7/1/91-01711

DRAFT FINAL
WORK PLAN FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
AND ENVIRONMENTAL RISK ASSESSMENT
Naval Supply Center
Cheatham Annex
Williamsburg, Virginia

Prepared for:

Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia
Contract No: N62470-90-B-7661

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ESE Project No. 4901165

July 1991

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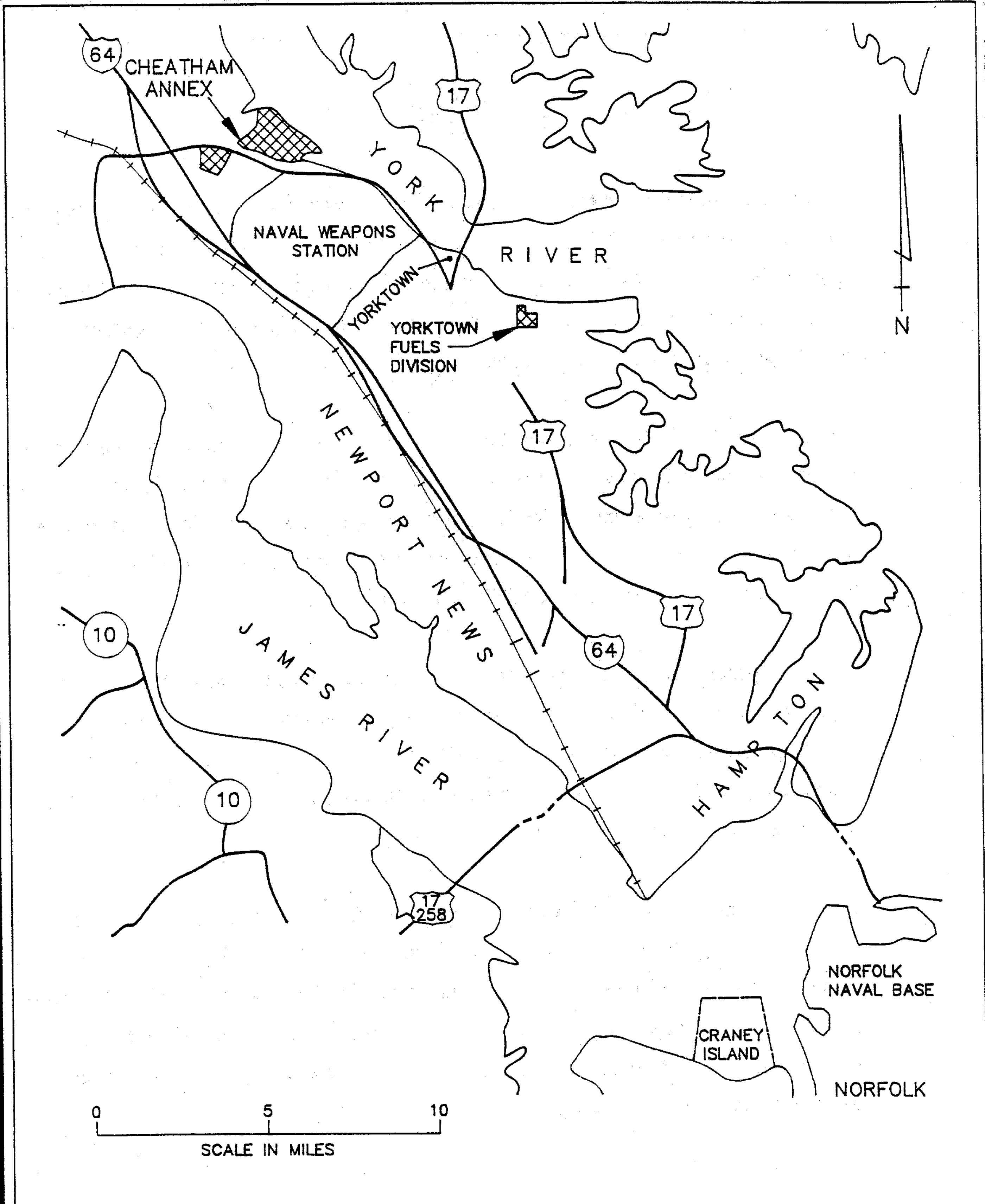
1.0 INTRODUCTION

This remedial investigation/feasibility study (RI/FS) work plan was prepared pursuant to a request for proposal (RFP) from the US Department of the Navy under Contract Number N62470-90-B-7661, Indefinite Quantity Contract for Environmental Services for Installation Restoration at various activities under the cognizance of the Atlantic Division, Naval Facilities Engineering Command.

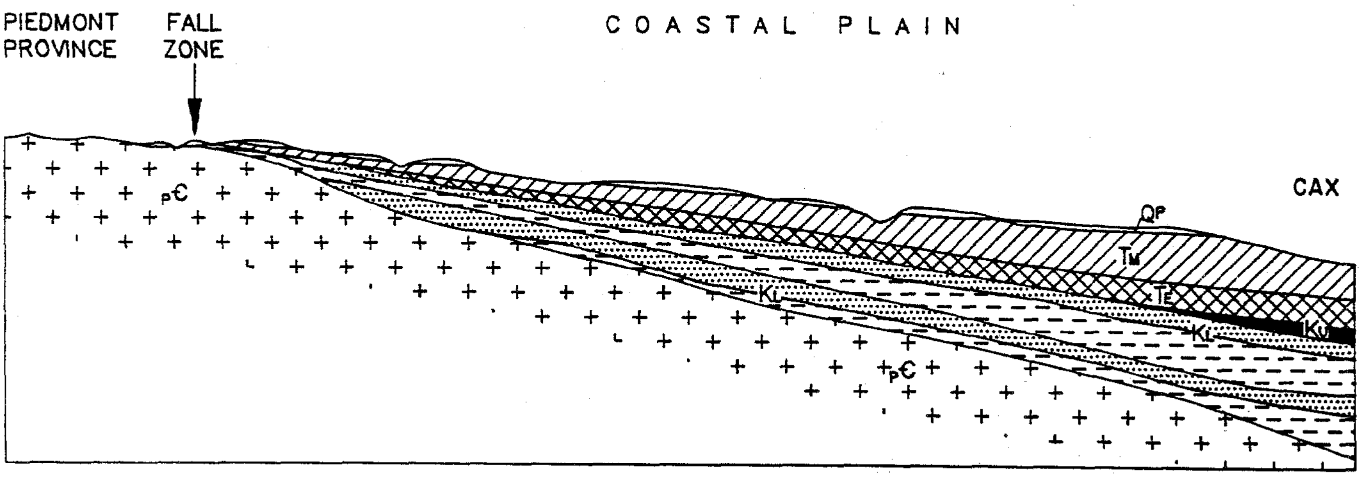
This RI/FS work plan and its supporting documents, the site-specific sampling plan (SSP) and site-specific health and safety plan (HASP), set forth the field procedures, sampling parameters, quality assurance objectives, organization and responsibility, project schedule, and health and safety requirements necessary to enact an RI/FS at the Naval Supply Center, Cheatham Annex (CAX), Williamsburg, Virginia.

The RI/FS process represents a series of tasks and procedures designed to characterize the nature and extent of risks posed by uncontrolled hazardous waste releases and to evaluate potential remedial actions. The RI/FS is a fully flexible and interactive process engineered to gather sufficient information to support an informed risk management decision regarding remedy selection.

The content and format of this work plan and its supporting documents (SSP and HASP) are based on that presented in OSWER directive 9355.3-01, October 1988, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," Interim Final. Quality assurance requirements are referenced from the Navy Quality Assurance Program Document, NEESA 20.2-047B, Sampling and Chemical Analysis Quality Assurance Requirements, June 1988.



ESE Environmental Science & Engineering	DATE 5-15-91	SCALE SHOWN	TITLE VICINITY MAP CHEATHAM ANNEX	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. VM65 / -	CLIENT NSC CHEATHAM	FIGURE 2-1



QP = PLEISTOCENE TERRACE FORMATION

TM = MIOCENE MARL

TE = EOCENE GLAUCONITIC SAND AND MARL

KU = UPPER CRETACEOUS SANDS AND CLAYS

KL = LOWER CRETACEOUS SANDS AND CLAYS

pЄ = CRYSTALLINE BASEMENT ROCK, CHIEFLY PRE-CAMBRIAN

ESE Environmental Science & Engineering	DATE 7-18-91	SCALE N.T.S.	TITLE Generalized Geologic Cross-Section of the Atlantic Coastal Plain in Virginia
	DRAWN BY LAF	APPROVED BY	
	JOB NO. 4901165	DWG. NO./ REV. NO. XSEC65 / 2	CLIENT NSC CHEATHAM — FIGURE 2-2

System	Series	Age	Formation	Approximate Thickness	Lithologic Character	Hydrologic Comments
Cretaceous	Lower Cretaceous	F G H	Mattaponi (Lower) Potomac Group	0 - 1500	Interbedded sands, silts and clays of fluvial and deltaic origin; some thin marginal marine beds; unit F dominantly silts and clays of interdelta region in extreme eastern part of the area	Capable of high yield with proper development in most areas of York-James Peninsula; mostly undeveloped at present time
Triassic					Predominantly soft red and brown shales; some thin beds of hard red shale and sandstone	Supplies groundwater to a few low-yield water table wells in Ashland Area
Pre-Triassic Crystalline Rock					Highly variable rock types	Supplies moderate quantities of groundwater to deep wells near Fall Zone

Source: VWCB, 1973.

Cretaceous deposits of the Mattaponi (Lower) and Potomac Group formations underlie the Paleocene deposits and constitute the lowermost unconsolidated sediments of the area. The Cretaceous deposits are characterized by discontinuous sand bodies interbedded with silts and clays. In the York-James Peninsula, these deposits are characteristic of a fluvial-deltaic depositional environment. The fluvial deposits are characteristically channel sand bodies that are coarse-grained at the base and become finer grained upward. The deltaic deposits are medium-grained, moderately sorted sands. The Cretaceous deposits in the vicinity of CAX are approximately 1,450 feet thick (VWCB, 1973, cited in NEESA, 1984).

2.5 Hydrology and Hydrogeology

2.5.1 Surface Water

As discussed in the IAS for CAX (NEESA, 1984), the site lies within the York River Basin near the mouth of the river. This basin, in the central and eastern sections of Virginia, is located between the Rappahannock River Basin to the north and the James River Basin to the south. The headwaters rise in Orange County and flow approximately 120 miles in a southeasterly direction to the Chesapeake Bay. The basin is approximately 5 miles wide at CAX.

The main tributaries of the York River at the portion of CAX currently under investigation are King Creek along the southern boundary of the Annex, Cheatham Lake along the western boundary, and Jones Pond in the southwest. Cheatham Lake is the main drainage feature of the activity. Penniman Lake is located in the northwestern portion of the annex and drains to King Creek. Surface runoff from the sites addressed in this report enter stormwater systems, open surface ditches, and drains that discharge to Penniman Lake, King Creek, and York River.

Extensive wetlands are found along all the major creeks that drain the Annex, in addition to some shoreline areas of the York River. The tidal reaches of the York River extend throughout CAX, upstream through the entire 30-mile length of the river, and another 30 miles up both tributaries (the Mattaponi and Pamunky rivers). The tributary creeks that

The principal artesian aquifer is the deepest of the three aquifers and consists of deposits of the Mattaponi and Potomac Group formations of the Lower Cretaceous Series. This aquifer consists of several discontinuous sand bodies interbedded with silt and clay. The top of the aquifer is approximately 450 feet below msl in the vicinity of CAX. Recharge to the aquifer occurs through the outcrop in Henrico, Hanover, and western King William counties. However, substantial recharge also occurs east of these areas from vertical leakage between the adjacent aquifers through the confining layers; vertical leakage has been estimated at 30,500 gallons per day per square mile (gpd/mi^2) of area.

Transmissibilities in the central and eastern part of the aquifer (including CAX) vary from 15,000 to 50,000 gpd/ft. Flow direction is generally eastward toward the Chesapeake Bay. The most extensive aquifer development has occurred in the Richmond metropolitan area. Dissolved solids in the water increase with depth in an easterly direction and result in limited aquifer use east of Williamsburg, where total dissolved solids range from 1,500 to 9,000 parts per million (ppm) and chlorides may exceed 1,000 ppm (VWCB, 1973, cited in NEESA, 1984). The aquifer is unusable as a potable water source at CAX because of its naturally poor quality.

2.6 Biology

2.6.1 Terrestrial Biology

Terrestrial flora on CAX is predominantly woodland species. Three types of tree stands are present: pine stands composed primarily of loblolly and Virginia pines, mixed pine and hardwood stands, and hardwood stands. Elevated level areas are the predominant location of pine stands, and hardwood stands are found on slopes and ravines. These wooded areas are important in reducing soil erosion and providing wildlife habitat. Native tree species found at CAX include beech, black cherry, red maple, sweet gum, white ash, and white oak.

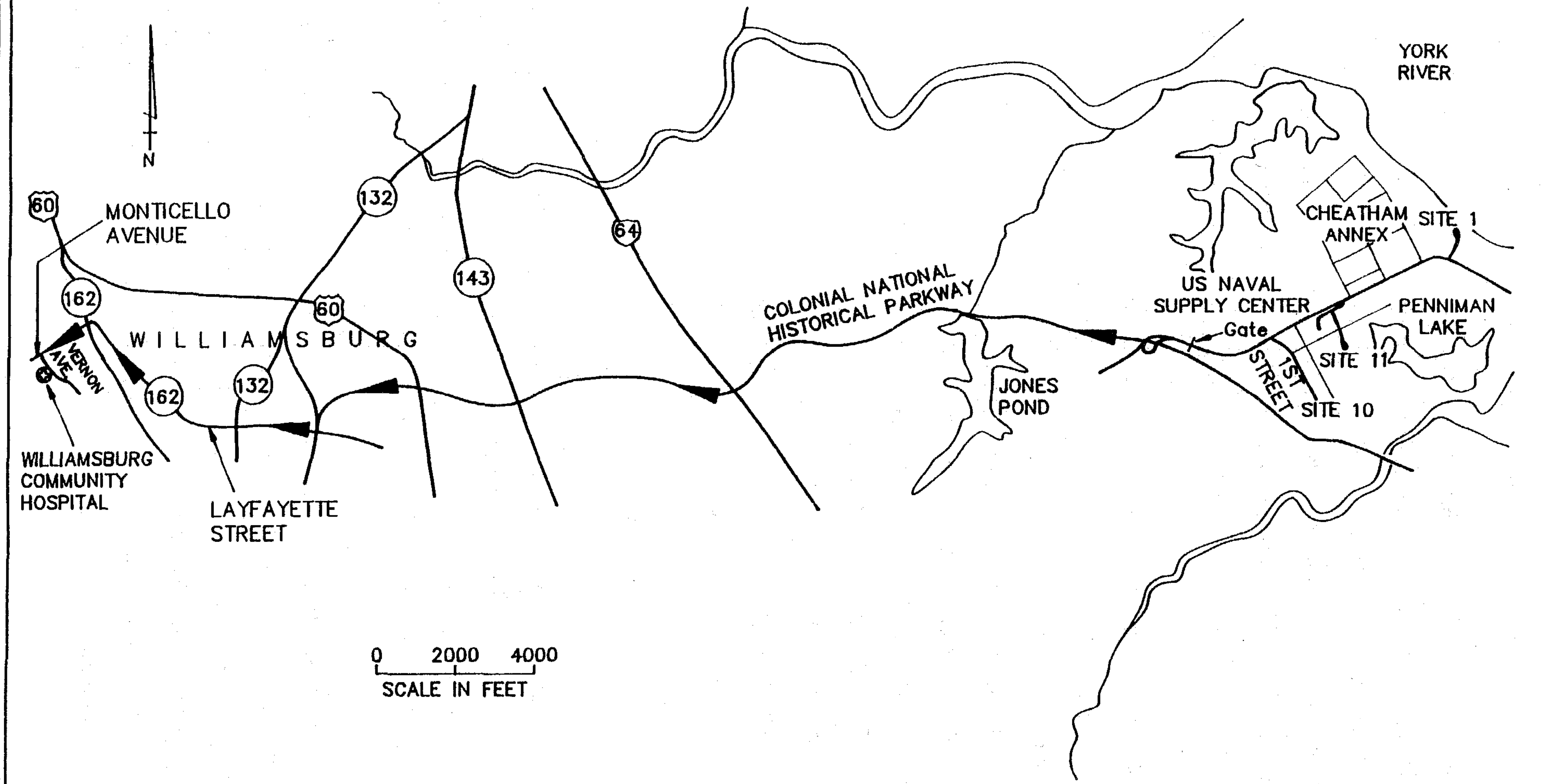
the majority of wetlands on CAX are this type. Type V and Type VI marshes are in Group Two and are only slightly less important than the Group One marshes. Because these marshes are found on higher elevations, less opportunity exists for detritus to be washed into nearby waterways by the tides. This group of marshes is also valuable as flood buffers. The CAX wetlands and adjacent creeks provide nursery areas for striped bass, white perch, and other species, and are prime habitats for migrating waterfowl.

The habitat of aquatic floral species is generally determined by water salinity and bottom types. In this area of the York River, the following species are associated with certain salinity ranges:

- Hornwort: freshwater only
- Water-celery: freshwater only
- Pondweed: fresh to 5 parts per thousand (ppt)
- Horned pondweed: fresh to 5 ppt
- Waterweed: fresh to 10 ppt
- Watermilfoil: fresh to 10 ppt
- Pondweed: 5 to 25 ppt
- Eelgrass: 10 to 35 ppt
- Widgeon grass: 5 to 40 ppt

These species are commonly found growing at depths of 3 to 9 feet in soft bottom muds. Waterweed and watermilfoil have been plant pests at times due to increased nutrient loading. Eelgrass is most often found growing in soft mud. Widgeon grass is sensitive to both increased water temperature and turbidity.

Oysters, blue crabs, and hard and soft-shell clams are found in the York River offshore of CAX; this area of the York River is designated as a crab pot fishery. Additionally, the river south of Queens Creek (immediately north of CAX) is a spawning and nursery ground for blue crabs. Fish species commonly found in the York River include hogchoker, white perch, white catfish, channel catfish, bay anchovy, oyster toadfish, striped bass, Atlantic croaker, weakfish, spotted hake, spot, and silver perch. It was



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DATE	SCALE	TITLE
5-21-91	SHOWN	SITE LOCATION MAP
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FIGURE 2-3

Table 2-3
Summary Table of Ranges of Concentration Observed in 1991 Interim RI Report

Site 11

Analytical Parameter VOCs	Groundwater Concentration Range (ug/l)	Surface Water Concentration Range (ug/l)	Soil Concentration Range (ug/l)	Sediment Concentration Range (ug/l)
Toluene	BDL-0.9	BDL-103	BDL	BDL-3
1,1,1-Trichlorethene	BDL	BDL-9	BDL-12	BDL-9
Methyl ethylketone	BDL-10	BDL-15	BDL-68	BDL-15
Methyl chloride	3-22	BDL-861	16-266	16-86
Acetone	BDL	BDL-52	36-122	NA
BNAs				
Bis(2-ethylhexy) phthalate	BDL-49	BDL-103	BDL-233	BDL-510
Di-n-octyl phthalate	BDL-15	BDL-16	BDL	BDL-289
Diethyl phthalate	BDL	BDL-11	BDL	BDL
Di-n-butyl phthalate	BDL	BDL	BDL	BDL-119
Fluorene	BDL	BDL	BDL	BDL-327
Fluoranthene	BDL	BDL	BDL	BDL-1937
Chrysene	BDL	BDL	BDL	BDL-1395
Pyrene	BDL	BDL	BDL	BDL-1681
Phenanthrene	BDL	BDL	BDL	BDL-2108
Anthracene	BDL	BDL	BDL	BDL-642
Benzo(a)anthracene	BDL	BDL	BDL	BDL-851
Benzo(b)anthracene	BDL	BDL	BDL	BDL-550
Benzo(k)anthracene	BDL	BDL	BDL	BDL-528
Benzo(a)pyrene	BDL	BDL	BDL	BDL-729
Indeno (1,2,3-c,d)pyrene	BDL	BDL	BDL	BDL-429
Benzo(g,h,i)perylene	BDL	BDL	BDL	BDL-295
Acenaphthylene	BDL	BDL	BDL	BDL-4967
Acenaphthene	BDL	BDL	BDL	BDL-173
Total Phenols	BDL-90	BDL-4000	BDL-4000	BDL
Lead	BDL-1.8	BDL-8.2	BDL-51500	BDL-195000
Oil & Grease	BDL	BDL	BDL-1316000	BDL-797200
pH	6.4-6.9	7.2-8.4	NA	NA

BDL = Below detection limit
NA = Not applicable

3.0 INITIAL EVALUATION

This section sets forth inferences drawn from currently available information on the site and the surrounding area, and provides a preliminary evaluation of the type and volume of waste present, the potential contaminant migration and exposure pathways, public or environmental health risks, and preliminary response objectives.

3.1 Types of Contaminants

Information regarding the type and volume of contaminants is limited solely to US Department of the Navy information regarding the current and former uses of CAX, and analytical data generated from previous investigations in the area. CAX is separated into three identified sites which require further study: the landfill near the incinerator (Site 1), decontamination agent disposal near First Street (Site 10), and the bone yard (Site 11).

3.1.1 Site 1, Landfill Near Incinerator

Site 1 is approximately 2 acres in size and located along the York River behind the old incinerator (Building CAD 129, Figure 3-1). It was used between 1942 to 1951 as a disposal area for burning residues, and from 1951 to 1972 as a general landfill. A variety of wastes, including empty paint and paint thinner cans, cartons of ether and other unspecified drugs, railroad ties, tar paper sawdust, rags, concrete, and lumber were burned and disposed in the landfill until its closure in 1981. Approximately 34,500 tons of solid waste was buried at the landfill.

Two groundwater sampling rounds were taken in the fall of 1986 and the winter of 1987. Both rounds tested positive for BNAs, oil and grease, and metals. (The zinc results appear inconclusive due to the use of galvanized steel monitor well casing.) The Virginia groundwater standards (VGS) for total phenols were exceeded, and occasional oil and grease concentrations suggest some degradation of groundwater quality. Collecting additional data is warranted to further evaluate the extent and occurrence of site-related contamination.

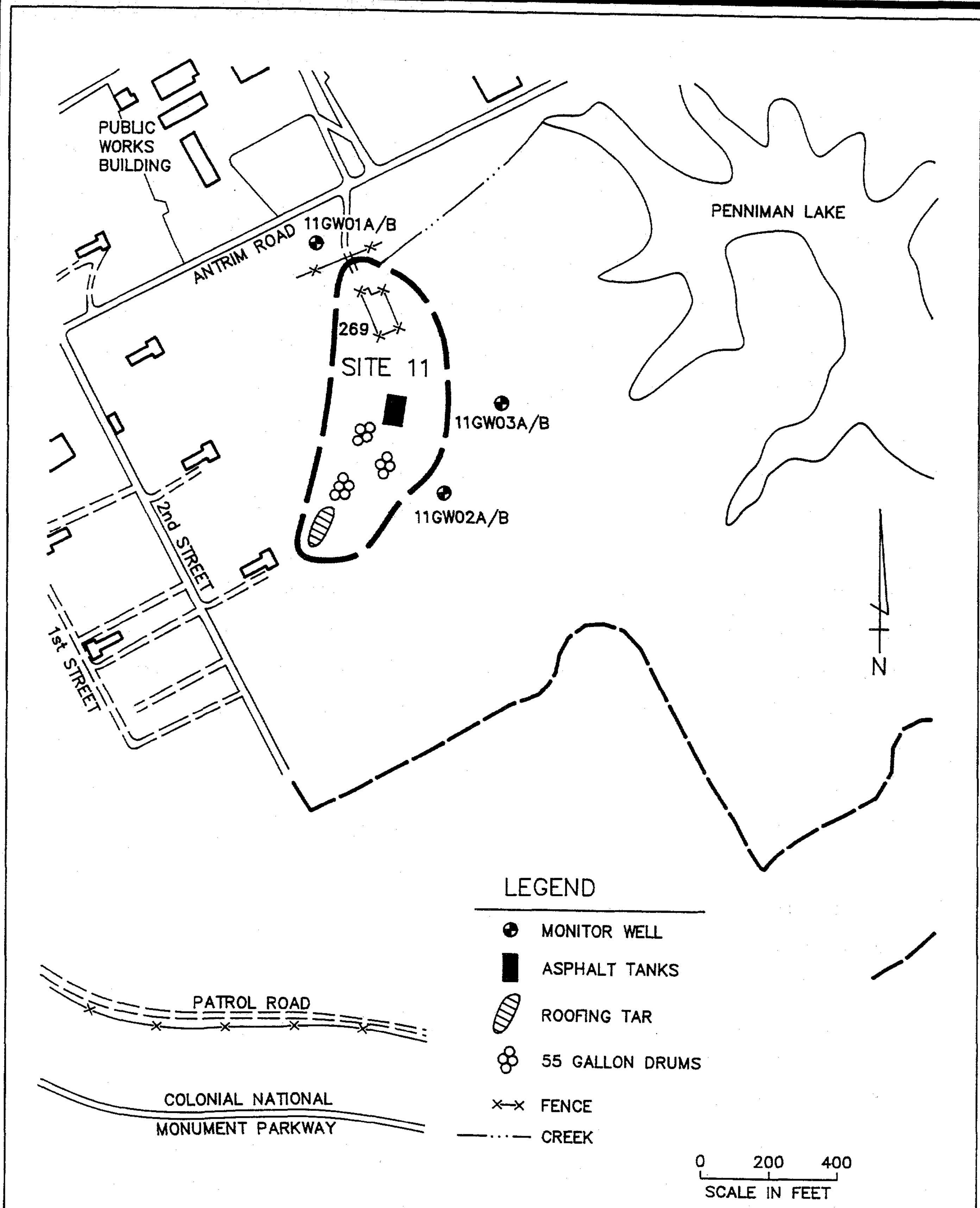
3.1.2 Site 10, Decontamination Agent Disposal Area Near First Street

Site 10 is an estimated 1-acre site located south of First Street in the southernmost part of the old Dupont munitions plant area (Figure 3-2). No information is available concerning when the wastes were buried, but according to the IAS (NEESA, 1984), the general appearance of the site indicated that burial probably occurred prior to 1982. Available information indicates that an estimated 75 to 100 gallons of DS-2 decontamination agent were buried at the site. DS-2 chemical composition is 70 percent diethylene triamine, 28 percent ethylene glycol monomethyl ether, and 2 percent sodium hydroxide.

A geophysical survey was conducted in an attempt to identify subsurface magnetic anomalies, suggestive of DS-2 burial; four anomalies indicative of metal burial were identified. Collecting additional data, by installing monitor wells and sampling the groundwater, is warranted to further evaluate the extent and occurrence of site-related contamination.

3.1.3 Site 11, Bone Yard

Site 11 encompasses an estimated 8-acre area located approximately 250 feet south of Antrim Road, behind the public works facility (Figure 3-3). During the IAS in February 1984, metal debris, old containers, fence posts, and abandoned cars were found inside the gate. Various discarded clamshell buckets and other surplus objects used in heavy construction were also scattered in the area. Additional debris included numerous drums containing petroleum products, several 500-gallon square tanks containing asphalt or oil used in making asphalt, and numerous tar cylinders used for roofing.



Environmental Science & Engineering	DATE 7-3-91	SCALE SHOWN	TITLE SITE 11 — BONE YARD	
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Two groundwater sampling rounds were taken in both the fall of 1986 and the winter of 1987. Both rounds tested positive for BNAs and oil and grease. A 6.4 pH was measured in well 11GW01, below the suggested 6.5 pH secondary maximum contaminant level (SMCL) lower limit. Surface water and sediments tested positive for VOCs, BNAs, and lead. Soil analyses revealed VOCs, although they were not detected in the groundwater. BNAs and metals were also detected in soil samples. The Virginia Groundwater Standards (VGS) for total phenols and pH were exceeded, suggesting some degradation of groundwater quality. Virginia State Ambient Water Quality Criteria (VAWQC) and Federal Ambient Water Quality Criteria (FAWQC) were exceeded in surface water for BNAs, total phenols, and lead. Collecting additional data is warranted to further evaluate the extent and occurrence of site-related contamination.

3.2 Potential Contaminant Migration and Exposure Pathways

The major route of contaminant migration would be by groundwater transport: suspected organic solvents are readily soluble and transportable in water. Other potential pathways, such as dust emissions or by releases into the air, will be evaluated at a later stage in the investigation.

Potential receptors and methods of exposure include humans (through ingesting contaminated groundwater or soil, contact with soil, and inhaling dusts or contaminated air) and various types of wildlife, including birds and fish. A more detailed evaluation will be made during the risk assessment.

3.3 Potential Response Objectives and Preliminary Remedial Alternatives

3.3.1 Surface Soils

Depending on the investigation findings, the following remedial technologies could be considered: in-situ vapor extraction (ISVE), microbial degradation, removal, solvent extraction (Site 10), or no action.

3.3.2 Groundwater

Depending on the investigation findings, the following remedial technologies could be considered: groundwater monitoring, containment (by slurry walls, etc.), groundwater extraction and treatment (by granular activated carbon, air stripping, or spray evaporation), or in-situ treatment by microbial degradation.

3.3.3 Sediment and Marsh Sediment

Depending on the investigation findings, the following remedial technologies could be considered: sediment and marsh sediment monitoring, dredging and replacing sediment, or no action.

4.0 WORK PLAN OBJECTIVES, APPROACH, AND RATIONALE

This section presents the objectives and scope of work to be carried out and specifies the approach and rationale to achieve the desired goals.

4.1 Work Plan Objectives

The objectives of the RI/FS are:

- To determine the nature, extent, and degree of contamination.
- To identify potential contaminant migration and exposure pathways and receptors, and to develop a report assessing the environmental risk associated with the contaminant problems.
- To develop an RI/FS report presenting the findings of the study and evaluating potential remedial alternatives.

To meet these objectives, a specific scope of work has been developed to produce data of sufficient quality (Section 4.2).

4.2 Data Quality Objectives (DQOs)

The primary objective is to provide data of sufficient quality and quantity to ensure that the project objectives (Section 4.1) are met. To meet the required DQOs, careful planning, evaluation, and development of the work plan approach must be undertaken (Section 4.3). Additionally, quality assurance (QA) procedures for the sampling and analysis of the various media have to be established. QA procedures, including precision and accuracy, are documented in the SSP, ESE Master QA Plan 1 1989, and/or Navy Quality Assurance Plan, NEESA 20.2-047B, June 1988. Project completeness goals (Field and Laboratory) will be set at 90 percent. If 90 percent completeness is not met or if sample points considered particularly important do not have adequate data collection, the Navy EIC shall be consulted for direction.

4.3 Work Plan Approach and Rationale (RI/FS Tasks)

4.3.1 Presite Activities (RI/FS Tasks 1 and 2)

1. Develop Work Plan: Review existing data and discuss the project with the Engineer in Charge (EIC). Prepare draft plan and submit it to the EIC and the Navy Project Manager.
2. Develop Site-Specific Sampling Plan (SSP): Prepare a sampling and analytical plan including field operations, personnel activity schedule, sampling locations and rationale, laboratory identification, analytical requirements, and sample handling. Copies of the draft sampling plan will be provided to the EIC and Navy Project Manager.

3. Develop a Site-Specific Health and Safety Plan (HASP): Assess the potential risks associated with field investigations and laboratory analyses, and coordinate with Navy personnel to establish a Site-Specific HASP. The Plan will address activity-specific precautions and will govern all aspects of the project, both in the field and in the laboratory, so that all contractor and subcontractor personnel are adequately trained and protected at all times. Copies of the draft HASP will be provided to the EIC and the Navy Project Manager.

4. Develop a Laboratory QA/QC Plan: Before field sampling begins, the laboratory must fulfill the requirements of the Navy's Quality Assurance Program (QAP). The Laboratory QA/QC Plan must be in accordance with the requirements of NEESA 20.2-047B, Sampling and Chemical Analysis Quality Assurance Requirements, June 1988. These requirements include approval of a laboratory work plan, proficiency testing, submitting to a laboratory inspection, and approval of a laboratory QA/QC plan the Martin Marietta Energy Systems, Inc. (MMESI). Copies of the draft Laboratory QA/QC Plan will be provided to MMESI and the EIC.

4.3.2 Onsite Investigation (RI/FS Task 3) Site 1

1. Verify Sampling Locations: Specific locations for soil samples, marsh sediment samples, monitor wells, and biota samples will be established and verified by the EIC and ESE personnel and marked with stakes. A summary of proposed sampling and surveys are shown in Table 4-1 (Round 1) and Table 4-2 (Round 2).

2. Background Sampling: Background soil, groundwater, and marsh sediments samples will be collected for analysis to better define the variability of concentrations of naturally occurring parameters of interest. Background data will be used to further evaluate whether constituents detected are site related, especially where criteria have been exceeded for upgradient sampling locations at a given site. Specific rationale for background sampling is found in the SSP, Section 3.1.

3. Soil Sampling: Borings will be advanced using hollow-stem augers; the samples will be collected with split-spoon samplers. The soil samples will be analyzed at ESE's Gainesville, Florida laboratory. QA samples will be submitted as required by the Navy QAP. Specific rationale for soil sampling is found in the SSP, Section 3.1.1.

Table 4-1

Summary of Proposed Additional RI Efforts
Naval Supply Center, Cheatham Annex, Williamsburg, Virginia
Round 1

Site No.	Well Installed	Sampling (a)								Analytes (b)
		GW	SW	SD	SO*	MS	BI	SG	GS	
1	2	8	--	--	3	6	--	--	--	BNAs & TPH
10	4	4	--	--	4	--	--	--	X	VOCs, BNAs, TPH, & TAL Metals
11	2	5	5	10	2	6	--	X	--	GW--BNAs, SW, SD, SO, & MS--VOC, BNAs, Pb, & TPH
Total	8	17	5	10	9	12	--	X	X	

(a) GW = Groundwater; SW = Surface Water; SD = Sediment; SO = Soil; MS = Marsh Sediment; BI = Biota; SG = Soil Gas Survey, and GS = Geophysical Survey.

(b) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acids; Pb = Lead; TPH = Total Petroleum Hydrocarbons, and TAL = Total Analyte List.

* Additional soil sample locations will be determined by the soil gas results.

Table 4-2

Summary of Proposed Additional RI Efforts
Naval Supply Center, Cheatham Annex, Williamsburg, Virginia
Round 2

Site No.	Well Installed	Sampling (a)								Analytes (b)
		GW	SW	SD	SO	MS	BI*	SG	GS	
1	--	8	--	--	--	6	3	--	--	BNAs & TPH
10	--	4	--	--	--	--	--	--	--	VOCs, BNAs, TPH & TAL Metals
11	--	5	5	10	--	6	2	--	--	GW--BNAs, SW, SD, & MS--VOC, BNAs, Pb, & TPH
Total	--	17	5	10	--	12	5	--	--	

(a) GW = Groundwater; SW = Surface Water; SD = Sediment; SO = Soil; MS = Marsh Sediment; BI = Biota; SG = Soil Gas Survey, and GS = Geophysical Survey.

(b) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acids; TAL = Total Analyte List; Pb = Lead, and TPH = Total Petroleum Hydrocarbons.

* Biota sampling will be performed if marsh sampling indicates contamination.

6. Marsh Sediment: Two rounds of marsh sediment sampling will be undertaken. QA samples will be prepared and submitted as required by the Navy QAP; all samples will be sent to ESE's Gainesville, Florida laboratory. Specific rationale for marsh sediment sampling is found in the SSP Section 3.1.3. Marsh sediment samples will be collected from 0 to 2 feet and 2 to 4 feet at each location.

   One marsh sediment sample will be collected at the creek downgradient from the landfill and another marsh sediment sample will be collected at the beach of the York River downgradient from the landfill (Figure 4-1). Marsh sediment samples will be analyzed for BNAs and TPH.

7. Biological Sampling: If Round 1 marsh sediment samples are found to be contaminated, biota samples will be collected during the second sampling round. The nature and extent of contamination in biota will be evaluated by collecting samples of aquatic life at each of the areas of concern at the site and analyzing for the presence of site-related contamination in tissue. Biological samples will be collected at the same time and from the same location as any second round marsh sediment samples (Figure 4-1). Water quality parameters will be evaluated during each round of sampling to complement marsh sediment and biotic data. Integrated abiotic and biotic sampling will be conducted during Round 2 sampling. Water quality parameters will be collected during each sampling effort.

8. Off-Base Inventory: An inventory of water wells (potential receptors) in the vicinity of CA will be performed. Based on hydrogeologic conditions in the site vicinity, it is unlikely that any supply wells in areas surrounding the installation would be impacted by site contamination problems: known wells are located upgradient of the sites of concern. Shallow groundwater flow is toward the York River, and the site is located adjacent to the York River. All supply wells in the vicinity of CA will be identified; data collected (if available) will

include owner, location, usage, depth, daily pumpage rate, well diameter, and installation date. Well data will be obtained through water supply company records, local well drillers, and the local health department.

4.3.3 Onsite Investigation (RI/FS Task 3) Site 10

1. Verify Sampling Locations: Specific locations for soil samples, monitor wells, and geophysical surveys will be established and verified by the EIC and ESE personnel and marked with stakes. A summary of proposed sampling and surveys are shown in Table 4-1 (Round 1) and Table 4-2 (Round 2).

2. Geophysical Survey: Two geophysical surveys (magnetic and electromagnetic) will be conducted at Site 10 to locate buried material before drilling activities. Magnetic and electromagnetic readings will be taken at 15-foot centers.

   A geophysical survey located buried iron material with a magnetometer during a previous study. Because the exact location of the magnetic survey is unknown and the field data were not included in the report, another magnetometer survey will be conducted. Also, the mounds that might indicate burial appear beyond the limits of the previous survey. An electromagnetic survey will also be conducted to locate buried material that the magnetic survey cannot detect (i.e., pits, trenches, and other non-iron material).

3. Background Sampling: Background soil and groundwater samples will be collected to better define the naturally occurring concentrations of parameters of interest. Background data will be used to further evaluate whether constituents detected are site related, especially where criteria have been exceeded for upgradient sampling locations at a given site.

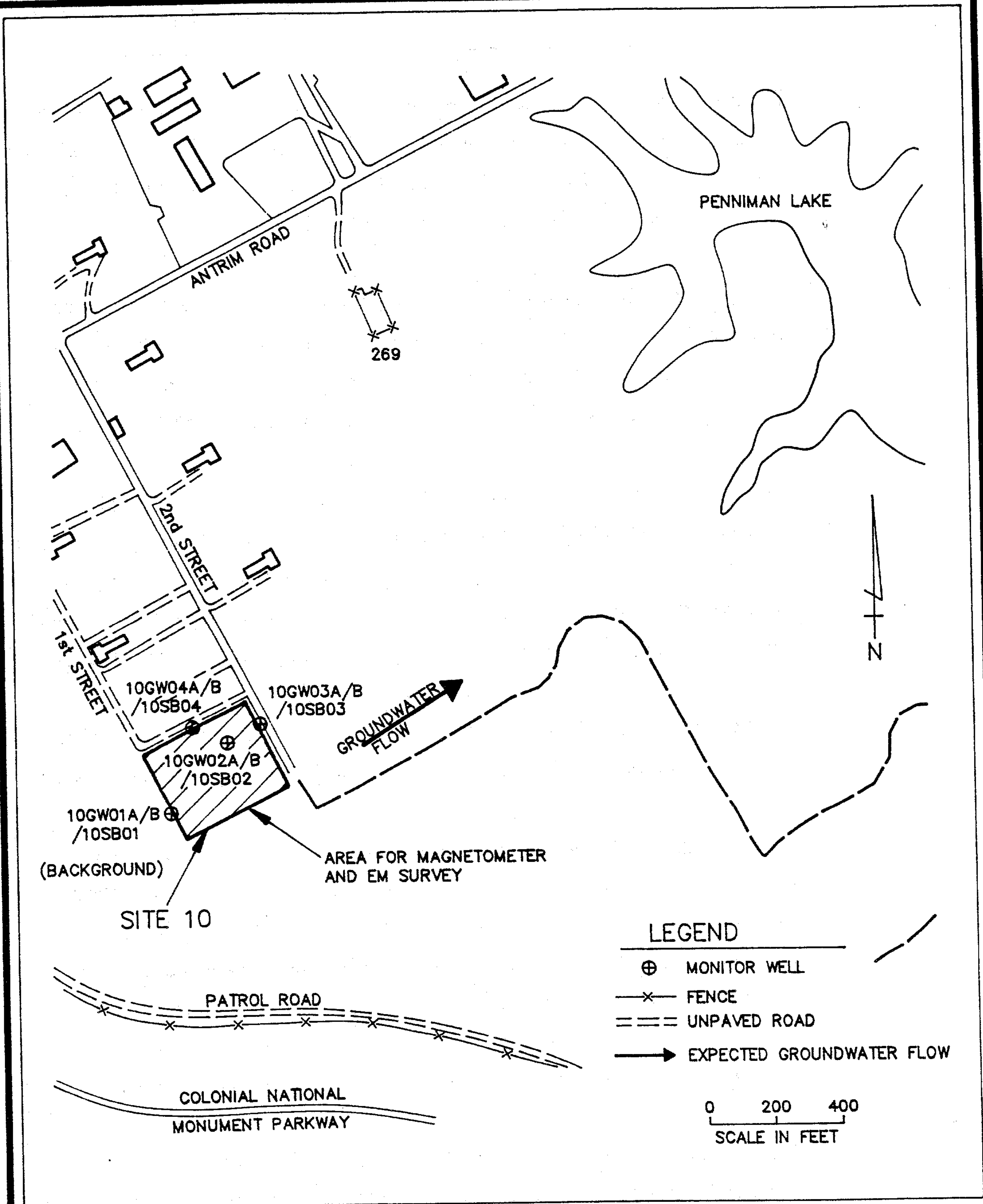
The background soil sample will be collected from the same location that the background monitor well total analyte list will be installed. Soil sample will be analyzed for VOCs, BNAs, TPH, and (TAL) metals. The groundwater samples will be analyzed for VOCs, BNAs, TPH, and TAL metals.

4. Soil Sampling: Borings will be advanced using hollow-stem augers; the samples will be collected with split-spoon samplers. The soil samples will be analyzed at ESE's Gainesville, Florida laboratory. QA samples will be submitted as required. Specific rationale for soil sampling is found in the SSP, Section 3.2.1.

   Three soil samples will be collected from Site 10. The soil borings will be placed downgradient of the magnetometer survey performed during the interim RI (Figure 4-2). One soil boring location will be downgradient of the largest magnetic anomaly as determined in the interim RI (adjacent to the tree line), and other two will be collected downgradient in the north and east site corners (at the boundary of the Decontaminated Agent Burial Ground). The soil samples will help establish the extent of soil contamination toward Penniman Lake. Soil samples will be analyzed for VOCs, BNAs, TPH, and TAL metals.

5. Monitor Well Installation. One background and three new monitor wells will be installed at the same locations from which the soil samples were collected. The borings will be advanced using a hollow-stem auger to approximately 7 feet below the water table. Split-spoon samples will be collected at 5-foot intervals. Rationale for the monitor well locations is detailed in the SSP Section 3.2.1. The monitor wells will be surveyed to determine plane coordinates and elevations of ground and top of casing relative to msl.

   Ten-foot screens will be used in all the monitor wells at Site 10; all well construction materials (screen, riser, pipe, etc.) will be 2-inch ID stainless steel. Stainless steel will be used because the solvents that comprise DS-2 may disintegrate PVC. The slot size will be 0.01-inch. The well locations are



ESE Environmental Science & Engineering	DATE 5-21-91	SCALE SHOWN	TITLE SITE 10 – PROPOSED SAMPLE LOCATIONS
	DRAWN BY LAF	APPROVED BY	
	JOB NO. 4901165	DWG. NO./ REV. NO. DCPSL / –	CLIENT NSC CHEATHAM — FIGURE 4–2

designed to establish the extent and direction of contaminant migration in the groundwater. Groundwater flow is expected to reflect surface topography, with a gradient to the northeast toward Penniman Lake.

6. Monitor Well Sampling: Two rounds of groundwater samples will be collected. QA samples will be prepared and submitted as required by the Navy QAP; all samples will be sent to ESE's Gainesville, Florida laboratory. Rationale for monitor well sampling is detailed in the SSP Section 3.2.1.

   Groundwater samples from the new monitor wells at Site 10 will be analyzed for VOCs, BNAs, TPH, and TAL metals. The groundwater samples will establish the direction and extent of contamination toward Penniman Lake.

7. Aerial Photographic Interpretation: If contamination is found at Site 10, aerial photographs will be collected and reviewed to identify sizes, shapes, and boundaries of the three sites. The history of each landfill or burial site will be confirmed through the photographic analyses of sites prior to, throughout, and after their periods of use. Boundary changes, site clearing, and revegetation history will be delineated. Stressed vegetation and any unusual or unexpected occurrences will be recorded. The US Navy will supply the historical aerial photography coverage. Rationale for aerial photographic interpretation is detailed in the SSP Section 3.0.

4.3.4 Onsite Investigation (RI/FS Task 3) Site 11

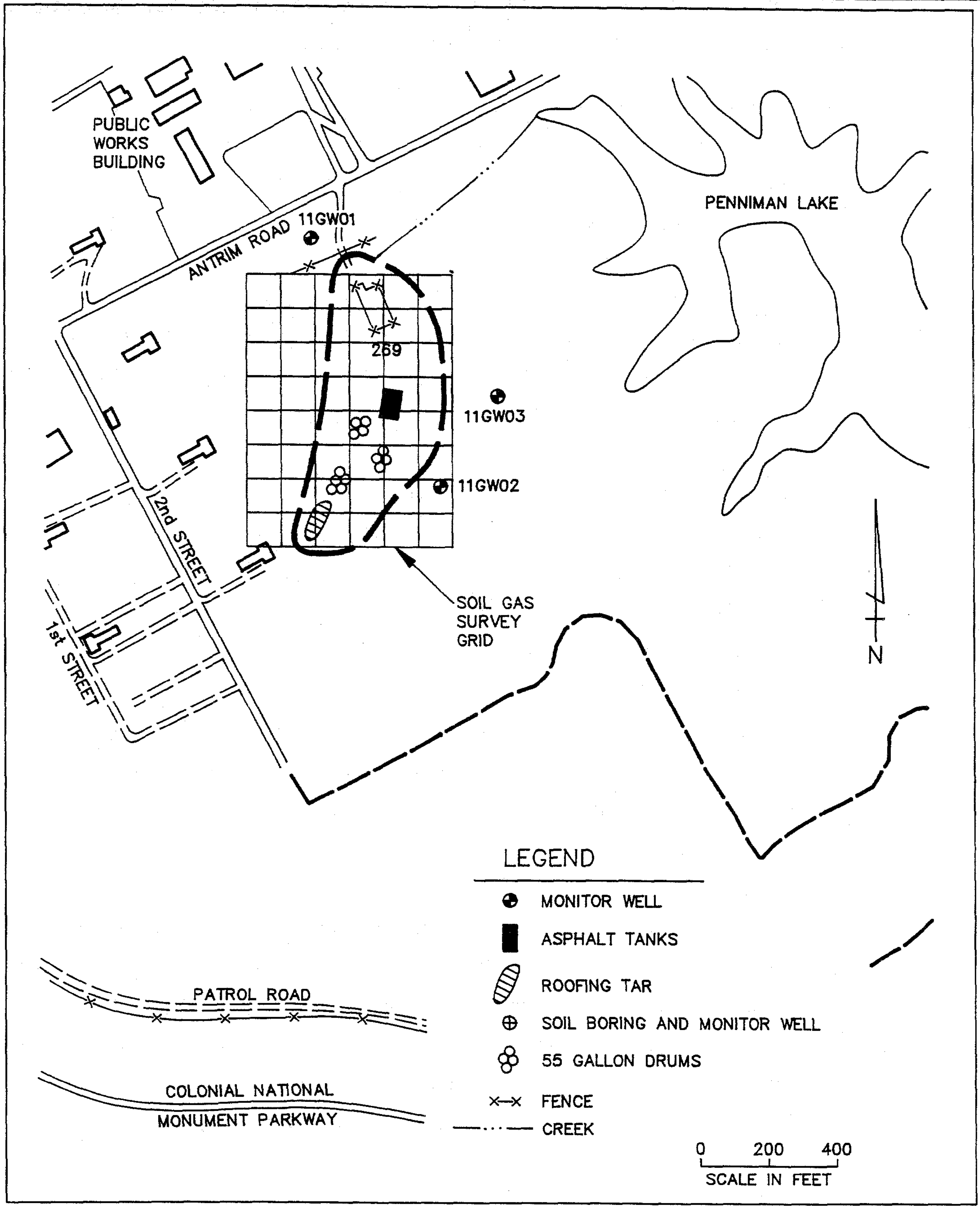
1. Verify Sampling Locations: Specific locations for soil gas surveys, soil samples, sediment and marsh sediment samples, surface water samples, monitor wells, and biota samples will be established and verified by the EIC and ESE personnel and marked with stakes. A summary of proposed sampling and surveys are shown in Table 4-1.

2. Background Sampling: Background soil, groundwater, surface water, and sediment and marsh sediments samples will be collected for analysis to better define the variability of naturally occurring concentrations of target compounds. Background data will be used to further evaluate whether contaminants are site related, especially where criteria have been exceeded for upgradient sampling locations at a given site.

   The background soil sample at Site 11 will be collected from the same location that the background monitor well will be installed (Figure 4-3). Soil and groundwater samples will be analyzed for VOCs, BNAs, TPH, and lead. Background surface water and sediment sample locations will be collected at an undeveloped corner of Penniman Lake and will be analyzed for the same parameters as the soil samples (Figure 4-4). A background marsh sediment location that would be representative of naturally occurring conditions at Site 11 is not available.

3. Soil Gas Survey: A soil gas survey will be conducted at Site 11 and used as a screening procedure to optimize the number of soil samples to be collected by hand auger. The survey will be conducted in a 600- by 800-foot area (Figure 4-5).

   The soil gas sampling locations will be chosen on a grid system at 100-foot centers; the grid will be adjusted in the field as data is acquired, plotted, and evaluated. To define the extent of contaminant distribution, soil gas samples will be collected using the 100-foot center spacing by tracing the area of positive readings away from areas of elevated readings until the concentration of the analyte is either less than 0.01 micrograms per liter (ug/l) or the compound detection limit. Samples then will be collected at 50-foot centers within the defined areas of contamination to refine the source area(s).



Environmental Science & Engineering	DATE 7-3-91	SCALE SHOWN	TITLE SITE 11 – BONE YARD PROPOSED SOIL GAS SURVEY	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. PSBY65 / 1	CLIENT NSC CHEATHAM	FIGURE 4–5

The soil gas samples will be analyzed for benzene, toluene, ethylbenzene, and total xylenes (BTEX) and methyl ethyl ketone (MEK). A full set of standards will be run at the beginning of each day, and at least one standard will be run after each sample that shows detectable concentrations of target analytes.

4. Soil Sampling: Borings will be advanced using hollow-stem augers; the samples will be collected with split-spoon samplers. The soil samples will be analyzed at ESE's Gainesville, Florida laboratory. QA samples will be submitted as required. Specific rationale for soil sampling is found in the SSP, Section 3.2.2.

   Sampling and analysis will be conducted for one soil sample (Figure 4-3). The boring will fill the data gap between samples 11GW01 and 11GW03. The soil sample will establish the extent of soil contamination toward Penniman Lake. Soil samples will be analyzed for VOCs, BNAs, TPH, and lead.

   Shallow soil sample locations will be conducted determined by the soil gas survey results. The shallow soil samples will be collected by hand auger. Rationale for the placement of shallow soil samples is detailed in the SSP, Section 3.2.2.

5. Monitor Well Installation. One background and one new monitor well will be installed at the same locations from which the soil samples were collected. The borings will be advanced using a hollow-stem auger to approximately 7 feet below the water table. Split-spoon samples will be collected at 5-foot intervals. Rationale for the monitor well locations is detailed in the SSP Section 3.3.2. The monitor wells will be surveyed to determine plane coordinates and elevations of ground and top of casing relative to msl.

Ten-foot screens will be used in all the monitor wells at Site 11 to provide consistency with existing wells at the site. All well construction materials (screen, riser, pipe, etc.) will be 4-inch ID PVC. The screens slot size will be 0.01 inch.

6. Monitor Well Sampling: Two rounds of groundwater sampling will be undertaken. QA samples will be prepared and submitted as required by the Navy QAP; all samples will be sent to ESE's Gainesville, Florida laboratory. Rationale for monitor well sampling is detailed in the SSP Section 3.3.2.

   Groundwater samples from the new and existing monitor wells at Site 11 will be analyzed for BNAs only. During previous studies, the existing monitor wells tested positive only for phenols; their inclusion in this study will help characterize the extent of any contaminant plume.

7. Surface Water, Sediment, and Marsh Sediment: Two rounds of surface water, sediment, and marsh sediment sampling will be undertaken. QA samples will be prepared and submitted as required by the Navy QAP; all samples will be sent to ESE's Gainesville, Florida laboratory. Specific rationale for surface water, sediment, and marsh sediment sampling is found in the SSP Section 3.3.4. Sediment and marsh sediment samples will be collected from 0 to 2 feet and 2 to 4 feet at each location.

   Four surface water, four sediment, and three marsh sediment samples will be collected at Site 11 and analyzed for VOCs, BNAs, TPH, and lead (Figure 4-3). The existing monitor wells tested positive for VOCs, BNAs, TPH, and lead during previous studies, and their inclusion in this study will help characterize the extent of any contaminant plume.

8. Biological Sampling: Biota samples will be collected during the second sampling event if marsh sediment samples are contaminated. The nature and extent of contamination in biota will be evaluated by collecting samples of aquatic life at each of the areas of concern on the site and analyzing for the presence of site-related contaminants in tissue. Biological samples will be collected at the same time and from the same location as any second round marsh sediment samples. Water quality parameters will be evaluated at the time of sampling for marsh sediment and biotic media. Integrated abiotic and biotic sampling will be conducted during the second round, and water quality parameters will be collected during each sampling effort.

   The background biota sample at Site 11 will be located at the western section of Penniman Lake. The background sample will be collected at the same location as the background sample for surface water/sediment samples.

4.3.5 Sample Analysis and Data Evaluation (Tasks 4 and 5)

The RI sample analysis and data evaluation will consider the types and quantities of contaminants at and around each of the three sites and the transport mechanisms that are allowing or may allow migration of contaminants from the site. Such information that has been developed to date for each site will be used to identify the presence, approximate extent, and migration potential of contaminated materials in these areas. Estimates of the extent of contamination and migration potential will be based on field data collected for this study. Physical characteristics of soils will be evaluated and summarized from existing data, as appropriate.

The location and level of suspected contaminant plumes will be described and mapped, where possible. Such mapping will use data from soil and groundwater sampling, as well as other data collected for this study. The site hydrogeology will be summarized using the field data generated by this study.

Analytical data from the current effort will be presented and evaluated. Contaminants identified in this effort will be listed and their known toxicity will be described. These values will be compared to any available standards or criteria of acceptable levels, and all exceedances will be noted. All sampling locations will be plotted on a site map.

Additional gaps or anomalies in the data will be identified, along with any circumstances that arise during the investigation that may affect the accuracy or validity of the data. Recommendations will be made regarding what, if any, additional study effort may be appropriate to remedy such problems.

4.3.6 Risk Assessment (Task 6)

The Risk Assessment will provide input for estimating the levels of risk to offsite receptors and for evaluating remedial alternatives for the sites in question. Analysis of all data generated/collected by this study will be directed toward fulfilling the stated objectives of the study and supporting the technical basis for recommending remedial alternatives. Upon completion, this assessment will be incorporated into the RI.

A Level II Semiquantitative Risk Assessment will also be performed as part of the RI; it will provide input to the Remedial Actions Assessment portion of the FS, and will be based on data developed during previous and current contamination assessments. The objective of this assessment will be to evaluate how chemicals migrate from each site and reach points of contact with local populations, and to define the potentially exposed populations and their levels of exposure in general terms.

The process of Risk Assessment involves analyzing existing or potential future harm to public health or the environment due to the release of contaminants from a site. The major components of a Risk Assessment are exposure assessment, toxicity assessment, and risk characterization. In the exposure assessment, transport mechanisms for the contaminants of concern and potential human or environmental receptors are identified and evaluated. The toxicity assessment determines the nature and extent of the hazards of exposure to contaminants from the site. Risk characterization integrates the information developed during the exposure and toxicity assessments to estimate the risk to public health or the environment under the various conditions of exposure.

As the initial step in the exposure assessment, potential transport mechanisms for the contaminants of concern will be evaluated based on the hydrogeologic and chemical monitoring data developed for the contamination assessment. Emphasis is expected to be placed on transport via groundwater or surface water, but consideration shall also be given to other possible transport mechanisms such as wind. The assessment of risk to onsite and offsite receptors shall consider concentration levels of the contaminants at their source, manner of placement (e.g., buried in drums, spilled on ground surface), rate of transport from the source, dilution and attenuation mechanisms, and mobility and stability of the various types of contaminants.

Following the identification of contaminant sources and the potential for migration through various media, an exposed population analysis will be conducted to determine which populations are likely to be exposed through contact with these media. Integrated exposure analysis shall combine various medium-specific exposures (e.g., through water, food, inhalation) to assess overall exposure to contaminants migrating from each site. Other data, including descriptions of populations served by surface reservoirs of drinking water, flora, and fauna present on the installation, and accessibility of each site to human and animal populations, will be obtained primarily from previous studies and from discussions with plant personnel.

The toxicity assessment will include a toxicological evaluation and a dose response assessment. The toxicological evaluation is a qualitative assessment of published data on human health effects and environmental toxicity for the contaminants of concern. A toxicity profile will be prepared for each contaminant, summarizing documented adverse effects, doses employed, routes of exposure, reliability of available data, etc. Toxicity profiles developed by EPA for some contaminants shall be used where appropriate. The dose response assessment involves identifying available quantitative indices of toxicity (e.g., NOEL, LC_{50}) based on the toxicity profiles, to determine acceptable daily intake

(ADI) levels and excess cancer risk for humans or levels of environmental concern for aquatic and terrestrial organisms.

The risk characterization will address all types of actual or potential risks at the site, including carcinogenic, noncarcinogenic, environmental, and public welfare risks. For carcinogens with available data, the unit cancer risk estimate will be used to calculate site-specific risk values that are then compared to acceptable risk levels defined in regulatory standards or criteria. For noncarcinogens, expected exposure levels will be compared to ADI values identified during the toxicity assessment. Environmental risks will be evaluated by comparing expected exposure levels to available criteria for toxic effects to fish or wildlife and vegetation. Risks to public welfare will qualitatively consider adverse effects on property values, intended future land uses, public opinion and perception, and recreational activities.

The preliminary Risk Assessment will be based on the "no action" alternative and will be factored into the preliminary FS screening of remedial action alternatives. In the course of the detailed remedial alternatives analysis in the FS, refined qualitative Risk Assessments will be developed reflecting changes in the environmental settings at each site and the resulting cessation of (or modification of the rates of) contaminant releases. Results of this effort will be presented in a format that permits comparisons of the environmental impacts and potential benefits based on implementing each of the remediation alternatives evaluated.

Efforts will be undertaken to fill data gaps identified as a result of the previous phases of field study and remediation alternative evaluations. This will include additional field sampling, well construction, literature searches, interviews, or other efforts that might be required. These actions will be undertaken in coordination with LANTDIVNAVFACENGCOM and will focus on significant and specific data requirements.

4.3.7 Remedial Investigation Report (Task 8)

The RI report document(s) will be prepared in accordance with EPA guidance Documents and shall consist of the following major elements:

- Executive summary
- Introduction -- purpose of report, site description, site history, previous investigations, report organization
- Study Area Investigation -- description of field activities and investigations
- Physical Characteristics of the Study Area -- discussion and results of field activities that define the physical conditions of the site such as geology, soils, and hydrogeology
- Nature and Extent of Contamination -- discussion and results of site characterization related to contamination sources and the media impacted
- Contaminant Fate and Transport -- potential routes of transport, contaminant persistence, and migration characteristics
- Baseline Risk Assessment -- discussion of public health and environmental impact evaluations
- Summary and Conclusions

Sampling data, chemical analysis results, and other supporting data and analyses will be included in the appendices, as appropriate.

4.3.8 Development of Remedial Alternatives (Task 9A)

Four major activities will be performed during the first phase of the FS. The first activity will be to review available site data collected during previous environmental surveys and/or generated during the RI to characterize existing and potential site problems. Once an understanding of the problems at the site is obtained, general response objectives for the site contamination remediation can be formulated. For each response objective, the potential technologies that could be used to achieve the response objective will be identified. Any waste containment or disposal requirements associated with these technologies will also be identified at this time. The list of potential technologies will be as extensive as possible to ensure that all known technologies, including innovative technologies, receive consideration. This task will begin concurrently with the RI if a general understanding of the site problem can be gained from previous survey data (and/or if it is believed at this early stage that a given site will require remediation).

The second Phase I activity will be to prescreen the technologies that were previously identified to remedy the problem at this site. During this evaluation process, potential technologies will be screened against effectiveness and implementability criteria. Effectiveness at this stage in the evaluation process will be a determination of the ability of the technology to reduce the toxicity, mobility, or volume of the waste. Implementability will be a determination of the compatibility of the potential technology with site characteristics. Potential technologies that have not been demonstrated on similar sites will be considered innovative. Innovative technologies will be carried through this screening process to the next step and phase of the FS, because sufficient operating data to eliminate these technologies from consideration will, by definition, be unavailable.

The third Phase I activity will be to identify technology-specific applicable or relevant and appropriate requirements (ARARs) associated with the prescreened technologies. Technology-specific ARARs will generally consist of contaminant discharge and disposal limitations resulting from treatment processes, monitoring requirements, and site closure requirements. Regulations that may be applicable to specific operations include the

Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and the Clean Air Act (CAA). State and local regulations may also place restrictions on specific activities. The ability of operations to be in compliance with ARARs will be an important consideration in the evaluation process.

The final Phase I activity will be to assemble the prescreened technologies into remedial alternatives. The remedial alternatives will consist of combinations of remedial technologies selected from the menu of prescreened technologies. For example, a treatment alternative may consist of technologies covering all or part of the following operational steps: containment, collection, transportation, treatment, disposal, closure, and monitoring. The Superfund Amendments and Reauthorization Act (SARA) also requires that a no-action alternative and a containment with little or no treatment alternative be developed as baseline alternatives for comparison in the next FS phase.

4.3.9 Initial Screening of Remedial Alternatives (Task 9B)

The purpose of this phase will be to reduce the number of alternatives that were developed during Phase I, while still preserving a range of options. Assembled alternatives will be screened against the criteria of effectiveness, implementability, and order-of-magnitude cost. Alternatives that employ source control; offer permanent solutions; result in the reduction of contaminant mobility, toxicity, or volume; or use innovative treatment or resource recovery technology have statutory preference under SARA. Innovative technologies that pass the screening will offer the potential of better treatment performance, easier implementability, fewer or lesser adverse impacts, or lower costs than demonstrated technologies. The cost factor will be used to screen technologies to a limited extent. Cost will only be used to discriminate among alternatives that offer similar results and are similar in statutory preference. Cost will not be used as a factor in comparing treatment and nontreatment alternatives. Any alternative screened out during this evaluation will be accompanied by an explanation of the rationale used for its removal.

The RI/FS process has become more interactive under SARA. As alternatives are screened, additional data requirements may become apparent. Data requirements may include additional waste characterization data, bench and pilot-scale treatability test results, and site characterization data such as pump test results or waste compatibility with construction materials. Any required additional data-gathering activities will be considered as Phase II of the RI, which is driven by the needs of the FS. The Phase II RI may necessitate modifying the contract if the required additional data collection effort is beyond the original scope of work.

Consultations will be conducted with EPA and appropriate state agencies during the alternative screening phase. SARA mandates that the state have "substantial and meaningful involvement in the initiation, development, and selection of remedial alternatives." State involvement will be actively solicited during this phase of the FS, and the state will be allowed to review and comment on the FS methods and findings.

4.3.10 Detailed Analysis of Remedial Alternatives (Task 10)

Following the screening process of Phase II, a reduced number of alternatives will receive a detailed evaluation. The alternatives will again be evaluated by the criteria of effectiveness, implementability, and cost, and will also be compared against one another. The criteria of effectiveness will be evaluated by: (1) the ability of the alternative to reduce risk by reducing the contaminant toxicity, mobility, or volume and the permanency of the solution; (2) the ability to meet ARARs; (3) the degree of protection to human health and the environment afforded both during construction and long term; and (4) the reliability of the alternative based on field experience, process complexity, and failure potential.

The criteria of implementability will be evaluated by: (1) the technical feasibility of constructing, maintaining, and monitoring the alternative; (2) the administrative feasibility of obtaining permits or waivers, obtaining LANTNAVFACENGCOM, state, and EPA approvals, and implementing the alternative in a reasonable time frame; and (3) the availability of equipment, supplies, operators, offsite treatment and/or disposal capacity, and long-term funding.

The cost criteria will include: (1) capital cost of construction, equipment, land, buildings, engineering services, and project administration; (2) operation and maintenance costs of labor, spare parts, materials, and administration; (3) replacement cost and estimated frequency of replacement; and (4) contingency cost of replacing failed technology and upgrading performance standards following the mandatory 5-year review. This detailed analysis will allow a final determination to be made as to the best available alternative.

The selected remedy will be the alternative that represents the best balance of effectiveness, implementability, and cost and is protective of human health and the environment. When making this decision, the statutory preferences for remedies that use source control; offer permanent solutions; result in the reduction of contaminant mobility, toxicity, or volume; or use innovative treatment or resource recovery technologies will be duly considered. The concurrence of regulatory agencies is quite important to the ultimate success of the remediation process. The state, EPA, and community will be given an opportunity to review and comment on the detailed analysis of alternatives and will be consulted prior to making the final selection.

4.3.11 Feasibility Study Report (Task 11)

The FS report document(s) will be prepared in accordance with CERCLA Guidance Documents and will consist of the following major elements:

- Executive summary

- Introduction -- purpose and organization of report, site description, site history, nature and extent of contamination, contaminant fate and transport, and Baseline Risk Assessment

- Identification and Screening of Technologies -- discusses remedial action objectives for each matrix relative to contaminants of interest, and allowable exposures based on risk and ARARs

- General Response Actions -- describes estimated magnitude for each impacted matrix requiring remediation

- Identification and Screening of Technology Types and Process Options -- describes and identifies remediation technologies and their screening; evaluates technologies and selects representatives for consideration for each matrix

- Development and Screening of Alternatives -- discusses alternative combinations under consideration and the procedures used to screen them

- Detailed Analysis of Alternatives -- describes and evaluates each remediation alternative against a specific array of suitability factors and presents a comparative assessment to select the most feasible for implementation

- Summary of detailed analysis

Supporting documentation of screening and detailed analyses relevant to cost, technical/engineering feasibility, public health and environmental assessments, legal/regulatory analysis, and other items will also be included in the appendices, as appropriate.

4.3.12 Organization, Responsibility, and Project Schedule

ESE will be responsible for providing all personnel, subcontractors, materials, and equipment necessary to complete the study. Persons in responsible project staff positions have extensive experience and expertise in their area(s) of involvement, including hydrogeologic investigations, contamination assessments, remedial engineering, and site safety for hazardous waste disposal sites. ESE's responsibilities include developing and adhering to an appropriate HASP to protect contractor, subcontractor, and Naval personnel. Key ESE project personnel are listed below, along with pertinent identification information:

Name	Title	Medical Examination* (within the last year)	OSHA-Approved Safety Training
A.M. Forrest	Project Manager Geophysicist	Yes	Yes
M.E. Skrobacz	Geologist/Site Safety Officer	Yes	Yes
R.G. Martin	Ecologist/Safety Manager	Yes	Yes
C.W. Stafford	Field Technician	Yes	Yes
J.D. Shamis	Laboratory Coordinator/ Quality Assurance	Yes	Yes

* Verification of medical records is on file with: ESE, Human Resources Office, PO Box 1703, Gainesville, FL 32602-1703, (904) 332-3318.

NAVAL PERSONNEL

A list of primary contacts at LANTNAVFACENGCOM involved in this project is as follows:

Name	Project Function	Telephone
Dan Boucher	Project Manager	(804) 444-9700
Brenda Norton	Engineer-in-Charge	(804) 445-4801
Chick Salyer	Site Engineer	(804) 887-7373

PROJECT SCHEDULE

The anticipated project schedule is presented below:

Milestone	Days	Approximate Date
Contract Award	0	September 28, 1990
Site Visit	160	March 8, 1991
Submit Final RI Interim Report	220	May 6, 1991
Submit Draft WP, SSP, HASP	236	May 22, 1991
Receive Government Comments	266	June 21, 1991
Submit Draft Final WP, SSP, HASP	296	July 21, 1991
TRC Meeting	316	August 10, 1991
Submit Final WP, SSP, HASP	346	September 9, 1991

Throughout the course of the project, the ESE Project Manager will routinely contact the EIC to report on project status, problems, and adjustments to the proposed schedule.

RI/FS SCHEDULE

The anticipated schedule to complete the RI/FS is as follows:

RI	Day
Contract Award	0
Mob/Demob	30
Task 3	
Round 1	50
Chemical Analysis and Data Reduction	80
Round 2	110
Chemical Analysis (Task 4) Data Review (Task 5) Risk Assessment (Task 6)	140
Draft RI Report	200
Review (Task 8)	230
Final Review (Task 8)	275
FS	
Development and Screening of Alternatives (Task 9)	305
Detailed Analysis of Remedial Alternatives (Task 10)	425
Draft FS Report	515
Review (Task 11)	545
Final FS Report	590

5.0 BIBLIOGRAPHY

NAVFACENGCOM, 1991. Final Remedial Investigation Interim Report, Naval Supply Center, Cheatham Annex, Williamsburg, Virginia.

Naval Energy and Environmental Support Activity (NEESA), 1984. Initial Assessment Study of Naval Supply Center (Norfolk) Cheatham Annex and Yorktown Fuels Division.

VWCB, 1973. Groundwater of the York-James Peninsula, Virginia State Water Control Board, Basic Data Bulletin 39.

DRAFT FINAL
SITE SAMPLING PLAN FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
Cheatham Annex
Naval Supply Center
Williamsburg, Virginia

Prepared for:

Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

Contract No. N62470-90-B-7661

Prepared by:

Environmental Science & Engineering, Inc. (ESE)
250-A Exchange Place
Herndon, Virginia 22070

ESE Project No. 4901165

July 1991

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1.0 INTRODUCTION AND SITE BACKGROUND

The site sampling plan (SSP) details the objectives, field operations, sampling methods, locations, rationale, laboratory identification, and analytical requirements to complete the scope of work presented in the work plan for the Remedial Investigation/Feasibility Study (RI/FS) at Cheatham Annex.

Additional background information regarding the setting, history, and previous investigations at the site can be found in Sections 2 and 3 of the Work Plan and in the 1991 RI Interim Report, Cheatham Annex.

2.0 SAMPLING OBJECTIVES AND RESPONSIBILITY

This section sets forth the objectives of the sampling plan and lists the intended use for the data collected from the various media to be sampled during the investigation. The responsibilities of the various personnel required to carry out the investigation are also specified.

2.1 Sampling Plan Objectives

The underlying objectives of the sampling plan are to perform an RI/FS that will more specifically identify the nature, extent, and degree of contamination at Cheatham Annex (CAX) at the Naval Weapons Station, Williamsburg, Virginia (Figure 2-1).

The field investigation will provide the information necessary to compile an RI/FS report, including an environmental risk assessment that will set forth whether contaminants are likely to affect or are currently affecting human health and the environment, and if required, potential remedial alternatives.

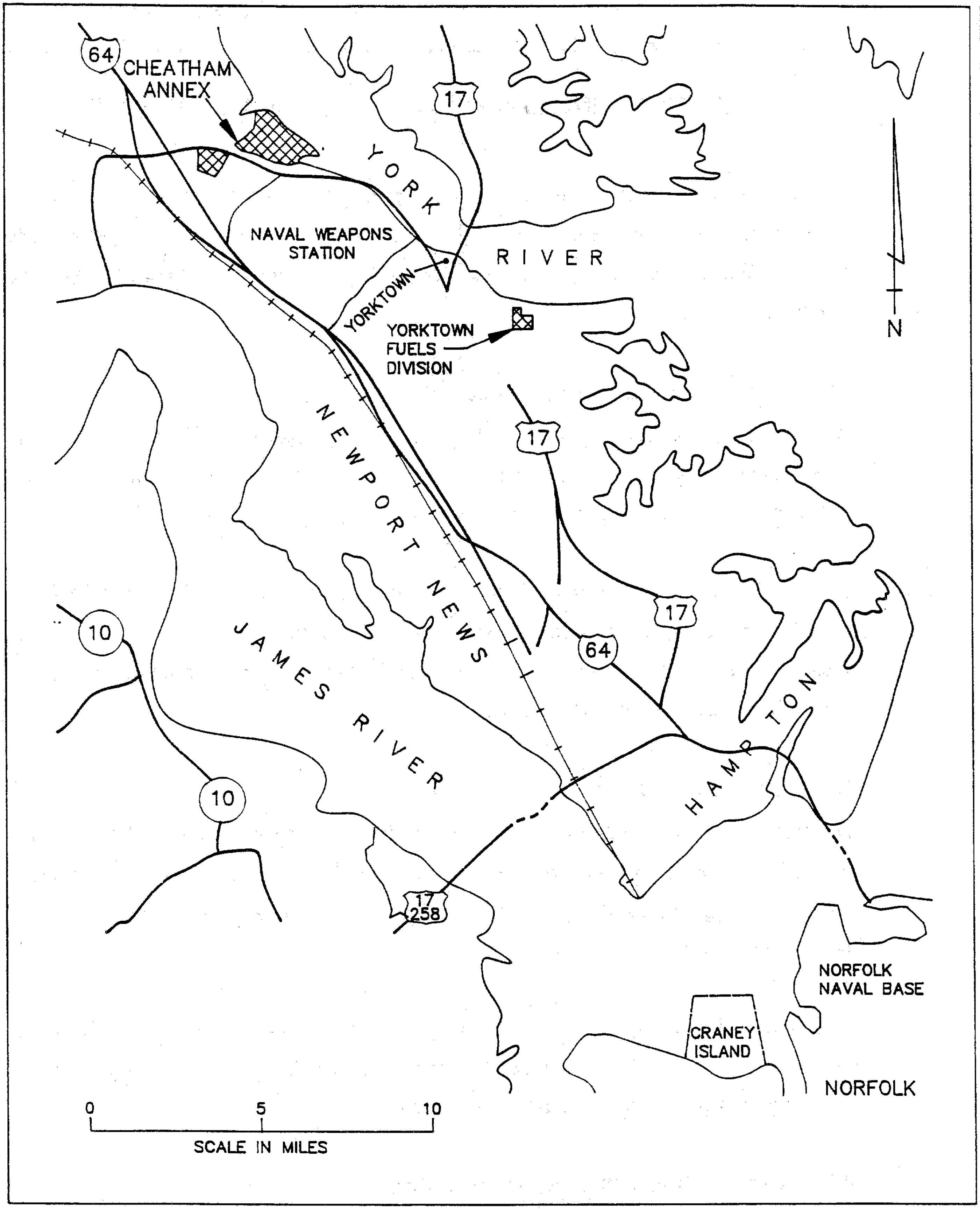
2.2 Intended Data Use

The information and analytical data generated from the investigation will be used to establish whether or not the site is releasing hazardous substances into the environment and what, if any, remedial actions may be required to abate any future release or rectify any current pollution problems.

To achieve this objective, the data will be reduced and evaluated, and an RI/FS report will be compiled with an environmental risk assessment that will address potential environmental problems associated with the site.

2.3 Organization and Responsibility

The field investigation team members, organization, and specific functions during the sampling and analytical effort are provided in the following listing:



Environmental Science & Engineering	DATE 5-15-91	SCALE SHOWN	TITLE VICINITY MAP CHEATHAM ANNEX	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. VM65 / –	CLIENT NSC CHEATHAM	FIGURE 2–1

ESE Personnel

- Andrew M. Forrest
    - Project Manager
    - Conduct geophysical survey
    - Field Team Leader (FTL) and Site Safety Officer (SSO)
    - Collect samples from soil borings and monitor wells
    - Maintain field notebook, including field observations
    - Classify subsoils

- R. G. Martin
    - Collect surface water, sediment, marsh sediment, and biota samples
    - Soil gas survey
    - Project Safety Manager

- C. W. Stafford
    - Assist in soil and water sample collection
    - Develop monitor wells prior to sampling
    - Monitor air quality at the site during drilling
    - Decontaminate sampling equipment

Additionally, a senior ESE project manager will make an unannounced visit to the field during sampling to audit field sampling activities. The senior project manager will ensure that sampling activities are being conducted in a manner consistent with the QA procedures established for this investigation.

Subcontractors

- Drilling Subcontractor: Under subcontract to ESE, a drilling subcontractor will provide all drilling, split-spoon sampling, and monitor well installation equipment for the investigation.

- ESE Analytical Laboratory, Gainesville, Florida: Will provide all the analytical laboratory services for the project. The project coordinator will be Jeff Shamis at (800) 874-7872, ext. 1449.

Charles Manos from the ESE Gainesville office will review and validate 10-20 percent of the CLP data packages. Routne procedures to be used for data assessment are presented in "Laboratory Data Validation - Functional Guidelines for Evaluating Organic Analyses," USEPA, February 1988 and "Laboratory Data Validation - Functional Guidelines for Evaluating Inorganic Analyses," USEAP draft, 13 June 1988.

Additional data assessment procedures are found in the CLP SOW 2/88 for organics and SOW 7/88 for inorganics.

3.0 SAMPLE LOCATIONS AND RATIONALE

This section of the plan identifies the location for each sample matrix to be collected and specifies the analytical parameters for each individual sample. (A brief description of the importance and rationale behind the selection of the sampling locations and analytical parameters is also included.) A summary of the RI efforts is presented in Table 3-1 for Round 1 and Table 3-2 for Round 2. A sampling summary is presented in Table 3-3 for Round 1 and Table 3-4 for Round 2, including quality assurance/quality control (QA/QC) requirements for NEESA Level C protocol. An explanation of the sample numbering system is presented in Table 3-5.

3.1 Site 1 - Landfill Near Incinerator

3.1.1 Soil Samples

Soil samples will be collected from each of two boreholes to be drilled at the proposed monitor well locations. Borings will be advanced to 7 feet below the water table or until an impermeable layer is encountered using hollow stem augers. The advantage of the auger method is that water introduction is avoided, and water-bearing strata identification is facilitated by observing changes in soil moisture in samples and/or cuttings. The background shallow soil sample will be collected using a hand auger; additional information on the collection method and sampling equipment is specified in Section 4.2.2 and Section 4.2.3.

Existing data and knowledge of the disposal of various wastes at Site 1 have aided in the selection of analytical parameters for the soil samples. Previously, two rounds of water samples from existing monitor wells detected base/neutral/acid compounds (BNAs), metals, and oil and grease. The source of the high metal concentrations appears inconclusive because the monitor wells were constructed with galvanized steel casing. Soil samples will be collected east and north of the landfill (Figure 3-1) and analyzed for BNAs and total petroleum hydrocarbons (TPH) (Table 3-6). Soil sample 1SB08 will

Table 3-1

Summary of Proposed Additional RI Efforts
Naval Supply Center, Cheatham Annex, Williamsburg, Virginia
Round 1

Site No.	Wells Installed	Sampling [a]								Analytes [b]
		GW	SW	SD	SO	MS	BI*	SG	GS	
1	2	7	--	--	2**	4	--	--	--	BNAs & TPH
10	3	3	--	--	3	--	--	--	X	VOCs, BNAs, TPH, TAL Metals
11	1	4	4	8	1	6	--	X	--	GW -- BNAs SW, SD, SO, & MS -- VOCs, BNAs, Pb, & TPH
Subtotal	6	14	4	8	6	10	--	X	X	
Site No.	Wells Installed	Background Sampling [a]								Analytes [b]
		GW	SW	SD	SO	MS	BI	SG	GS	
1	--	1	--	--	1	2	--	--	--	BNAs & TPH
10	1	1	--	--	1	--	--	--	--	VOCs, BNAs, TPH, & TAL Metals
11	1	1	1	2	1	--	--	--	--	GW--BNAs, SW, SD, SO, & MS -- VOCs, BNAs, Pb, & TPH
Subtotal	2	3	1	2	3	2	--	--	--	
Total	8	17	5	10	9	12	--	X	X	

(a) GW = Groundwater; SW = Surface Water; SD = Sediment; SO = Soil; MS = Marsh Sediment; BI = Biota; SG = Soil Gas Survey; GS = Geophysical Survey

(b) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acids Extractables; Pb = Lead; TPH = Total Petroleum Hydrocarbons, and TAL = Target Analyte List

* Biota sampling will be performed if marsh samples are found to be impacted

** Additional soil sample locations will be determined by evaluation of soil gas survey data

Table 3-2

Summary of Proposed Additional RI Efforts
Naval Supply Center, Cheatham Annex, Williamsburg, Virginia
Round 2

Site No.	Wells Installed	Sampling [a]								Analytes [b]
		GW	SW	SD	SO	MS	BI*	SG	GS	
1	--	7	--	--	--	4	2	--	--	BNAs & TPH
10	--	3	--	--	--	--	--	--	--	VOCs, BNAs, TPH, TAL Metals
11	--	4	4	8	--	6	1	--	--	GW -- BNAs SW, SD, & MS -- VOCs, BNAs, Pb, & TPH
Subtotal	--	14	4	8	--	10	3	--	--	
Site No.	**Wells Installed**	**Background Sampling [a]**								**Analytes [b]**
		GW	**SW**	**SD**	**SO**	**MS**	**BI**	**SG**	**GS**	
1	--	1	--	--	--	2	1	--	--	BNAs & TPH
10	--	1	--	--	--	--	--	--	--	VOCs, BNAs, TPH, TAL Metals
11	--	1	1	2	--	--	1	--	--	GW--BNAs, SW, SD, & MS -- VOCs, BNAs, Pb, & TPH
Subtotal	--	3	1	2	--	4	2	--	--	
Total	**--**	**17**	**5**	**10**	**--**	**12**	**5**	**--**	**--**	

(a) GW = Groundwater; SW = Surface Water; SD = Sediment; SO = Soil; MS = Marsh Sediment; BI = Biota; SG = Soil Gas Survey; GS = Geophysical Survey

(b) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acids Extractables; Pb = Lead; TPH = Total Petroleum Hydrocarbons, and TAL = Target Analyte List

* Biota sampling will be performed if marsh samples are found to be impacted

Table 3-3

Sampling Summary Table, Cheatham Annex RI/FS**
Round 1

	Total Days To Sample	Analysis (a)	# Samples	Back-ground	Field Dupes	EQPT Blanks	MS/MSD (5%)	Trip Blanks (1/Cooler)*	Field Blanks (1/Event)*	Soil Totals	Water Totals
1. Soil*** 8 borings 1 samples/boring	3	VOCs	4	2	2	2	4	2	4	12	8
		BNAs	7	3	3	3	6	0	6	19	9
		TPH	7	3	3	3	6	0	6	19	9
		Metals	3	1	1	1	2	0	2	7	3
		Lead	1	1	1	1	2	0	2	5	3
2. Groundwater Monitoring Wells	3	VOCs	3	1	1	1	2	1	1	0	10
		BNA	14	3	3	3	6	0	3	0	32
		TPH	10	2	2	2	4	0	2	0	22
		Metals	3	1	1	1	2	0	1	0	9
3. Surface Water	1	VOCs	4	1	1	0	2	1	0	0	8
		BNA	4	1	1	0	2	0	0	0	7
		TPH	4	1	1	0	2	0	0	0	7
		Lead	4	1	1	0	2	0	0	0	7
4. Sediment	1	VOCs	8	2	1	1	2	1	1	13	3
		BNA	8	2	1	1	2	0	1	13	2
		TPH	8	2	1	1	2	0	1	13	2
		Lead	8	2	1	1	2	0	1	13	2
5. Marsh Sediment	1	VOCs	8	2	1	1	2	1	1	15	3
		BNA	8	2	1	1	2	0	1	15	2
		TPH	8	2	1	1	2	0	1	15	2
		Lead	8	2	1	1	2	0	1	15	2

(a) VOCs = Volatile Organic Compounds; BNAs = Base/Neutral/Acid Compounds; and TPH = Total Petroleum Hydrocarbons.

* Equipment blanks, trip blanks, and field blanks for soil, sediment, and marsh sediment samples are actually water samples.
** QA/QC samples, according to Neesa Level C protocol.
***Hand auger soil samples are not included, which will be determined by the soil gas survey.

Table 3-4

Sampling Summary Table, Cheatham Annex RI/FS**
Round 2

	Total Days To Sample	Analysis (a)	# Samples	Back-ground	Field Dupes	EQPT Blanks	MS/MSD (5%)	Trip Blanks (1/Cooler)*	Field Blanks (1/Event)*	Soil Totals	Water Totals
1. Groundwater Monitoring Wells	3	VOCs	3	1	1	1	2	1	1	0	10
		BNA	14	3	3	3	6	0	3	0	32
		TPH	10	2	2	2	4	0	2	0	22
		Metals	3	1	1	1	2	0	1	0	9
2. Surface Water	1	VOCs	4	1	1	0	2	1	1	0	9
		BNA	4	1	1	0	2	0	1	0	8
		TPH	4	1	1	0	2	0	1	0	8
		Lead	4	1	1	0	2	0	1	0	8
3. Sediment	1	VOCs	8	2	1	1	2	1	1	13	3
		BNA	8	2	1	1	2	0	1	13	2
		TPH	8	2	1	1	2	0	1	13	2
		Lead	8	2	1	1	2	0	1	13	2
4. Marsh Sediment	1	VOCs	10	2	1	1	2	1	1	15	3
		BNA	10	2	1	1	2	0	1	15	2
		TPH	10	2	1	1	2	0	1	15	2
		Lead	10	2	1	1	2	0	1	15	2

(a) VOCs = Volatile Organic Compounds; BNAs = Base/Neutral/Acid Compounds; and TPH = Total Petroleum Hydrocarbons.

* Equipment blanks, trip blanks, and field blanks for sediment and marsh sediment samples are actually water samples.
** QA/QC samples, according to Neesa Level C protocol.

Table 3-5

Explanation of Numbering System

First two digits	Site Number
Third and fourth letters	Sample Type
SB	Soil Boring
SS	Shallow Soil Sample
GW	Groundwater Sample
SW	Surface Water Sample
SD	Sediment Sample
MS	Marsh Sediment Sample
BS	Biota Sample
Fifth and sixth digit	Sample Number
Seventh Letter A - Round 1 B - Round 2	Round Number
Example: 01SB01A	Site 1, Soil Boring, Sample Number 1, Round 1

Table 3-6

Site 1
Sample Matrix and Analytical Parameters
Naval Supply Center, Cheatham Annex
Williamsburg, Virginia
Round 1

Soil Sample	Chemical Analysis [a]	Physical Parameters
1SS01A	BNAs, TPH	TOV**
1SB07A	BNAs, TPH	TOV
1SB08A	BNAs, TPH	TOV
Field Blank*	BNAs, TPH	
Equipment Blank*	BNAs, TPH	

Groundwater Sample	Chemical Analysis	Physical Parameters [b]
1EW01A	BNAs, TPH	pH, TEMP, SP. COND
1EW02A	BNAs, TPH	pH, TEMP, SP. COND
1EW03A	BNAs, TPH	pH, TEMP, SP. COND
1EW04A	BNAs, TPH	pH, TEMP, SP. COND
1GW05A	BNAs, TPH	pH, TEMP, SP. COND
1GW06A	BNAs, TPH	pH, TEMP, SP. COND
1GW07A	BNAs, TPH	pH, TEMP, SP. COND
1GW08A	BNAs, TPH	pH, TEMP, SP. COND
Duplicate	BNAs, TPH	pH, TEMP, SP. COND
Field Blank	BNAs, TPH	
Equipment Blank	BNAs, TPH	

Table 3-6 (continued)

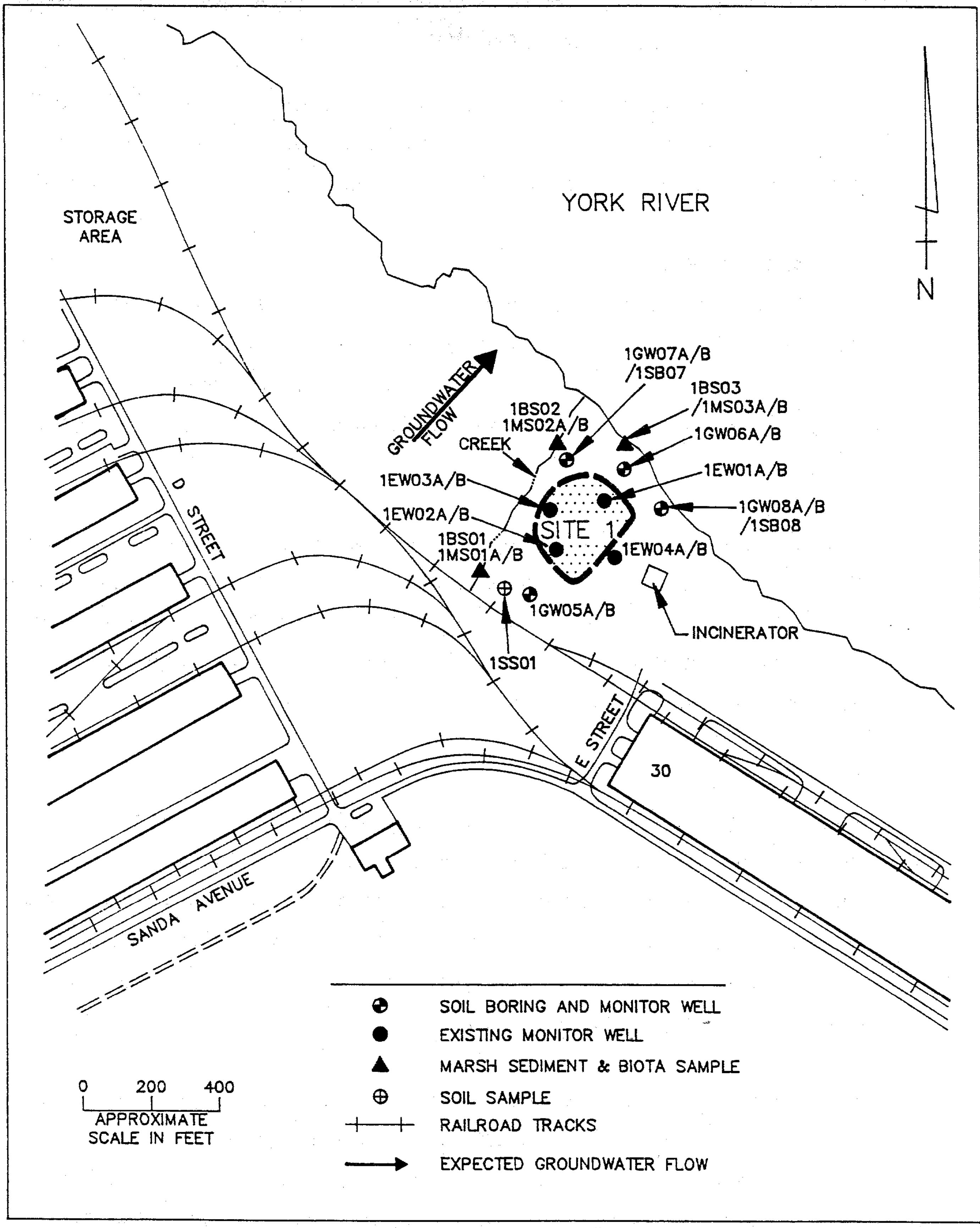
Marsh Sediment Sample	Chemical Analysis	Physical Parameters
1MS01SA	BNAs, TPH	TOV
1MS01DA	BNAs, TPH	TOV
1MS02SA	BNAs, TPH	TOV
1MS02DA	BNAs, TPH	TOV
1MS03SA	BNAs, TPH	TOV
1MS03DA	BNAs, TPH	TOV
Duplicate	BNAs, TPH	TOV
Field Blank*	BNAs, TPH	
Equipment Blank*	BNAs, TPH	

(a) BNAs = Base Neutral Acid Compounds; TPH = Total Petroleum Hydrocarbons

(b) TEMP = Temperature; SP. COND = Specific Conductivity for aqueous samples only

* The soil and marsh sediment field blanks and equipment blanks will be aqueous samples

** TOV = Total Organic Vapor measured with an organic vapor analyzer (OVA)



ESE Environmental Science & Engineering	DATE 7-18-91	SCALE SHOWN	TITLE SITE 1 PROPOSED SAMPLE LOCATIONS	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. PSL65 / 1	CLIENT NSC CHEATHAM	FIGURE 3-1

establish the extent of soil contamination toward York River, and the 1SB07 sampling point will establish if contamination is also migrating toward the creek. Background soil sample 1SS01 will be collected upgradient of the landfill located adjacent to 1GW05.

3.1.2 Groundwater Samples

Two rounds of groundwater samples will be collected and analyzed to allow data consistency to be evaluated and to increase the overall confidence level of the analytical data (Table 3-6 for Round 1 and Table 3-7 for Round 2). Sample collection techniques are specified in Section 4.2.6. Rationale for sampling locations is detailed in Section 3.1.1.

Groundwater samples will be collected from the two new monitor wells (1GW07 and 1GW08) and six existing monitor wells (1EW01 through 1EW04, 1GW05, and 1GW06) (Figure 3-1). The samples will be analyzed for BNAs and TPH. Existing groundwater analytical data (NAVFACENGCOM, 1991) aided in the selection of analytical parameters for the groundwater samples.

3.1.3 Marsh Sediment

Two rounds of marsh sediment samples (Table 3-6 for Round 1 and Table 3-7 for Round 2) will be collected to allow data consistency to be evaluated and to increase the overall confidence level of the analytical data (Figure 3-1). Marsh sediment samples will be collected at two depth intervals: 0 to 2 feet and 2 to 4 feet. The two depth sampling intervals will define vertical extent and concentration of contaminants. Marsh sediment sampling methods are specified in Section 4.2.10.

Three marsh sediment samples will be collected (Figure 3-1); a background sample will be collected upgradient from the landfill at the creek, the second will be collected downgradient of the landfill at the creek (before the creek enters the York River), and the third will be collected on the beach of the York River downgradient of the landfill. The samples will be analyzed for BNAs and TPH.

Table 3-7

Site 1
Sample Matrix and Analytical Parameters
Naval Supply Center, Cheatham Annex
Williamsburg, Virginia
Round 2

Groundwater Sample	Chemical Analysis	Physical Parameters [b]
1EW01B	BNAs, TPH	pH, TEMP, SP. COND
1EW02B	BNAs, TPH	pH, TEMP, SP. COND
1EW03B	BNAs, TPH	pH, TEMP, SP. COND
1EW04B	BNAs, TPH	pH, TEMP, SP. COND
1GW05B	BNAs, TPH	pH, TEMP, SP. COND
1GW06B	BNAs, TPH	pH, TEMP, SP. COND
1GW07B	BNAs, TPH	pH, TEMP, SP. COND
1GW08B	BNAs, TPH	pH, TEMP, SP. COND
Duplicate	BNAs, TPH	pH, TEMP, SP. COND
Field Blank*	BNAs, TPH	
Equipment Blank*	BNAs, TPH	

Table 3-7 (Continued)

Marsh Sediment Sample	Chemical Analysis	Physical Parameters
1MS01SB	BNAs, TPH	TOV**
1MS01DB	BNAs, TPH	TOV
1MS02SB	BNAs, TPH	TOV
1MS02DB	BNAs, TPH	TOV
1MS03SB	BNAs, TPH	TOV
1MS03DB	BNAs, TPH	TOV
Field Blank*	BNAs, TPH	
Equipment Blank*	BNAs, TPH	

(a) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acid Compounds; TPH = Total Petroleum Hydrocarbons

(b) TEMP = Temperature; SP. COND = Specific Conductivity for aqueous samples only

* The marsh sediment field blanks and equipment blanks will be aqueous samples

** TOV = Total Organic Vapor measured with an organic vapor analyzer (OVA)

3.1.4 Biota Sampling

If the first round marsh samples are found to be impacted, biota sampling will be performed during the second round to assess potential impacts of site contamination on the surrounding environment. The goal of this program is to evaluate the status of the indigenous aquatic and benthic populations by examining the presence of site-related contaminants within existing biota, and by assessing species diversity and distribution. The biota sampling methods are specified in Section 4.2.11. The biota sample locations will be the same as those for marsh sediment samples at Site 1 (Figure 3-1).

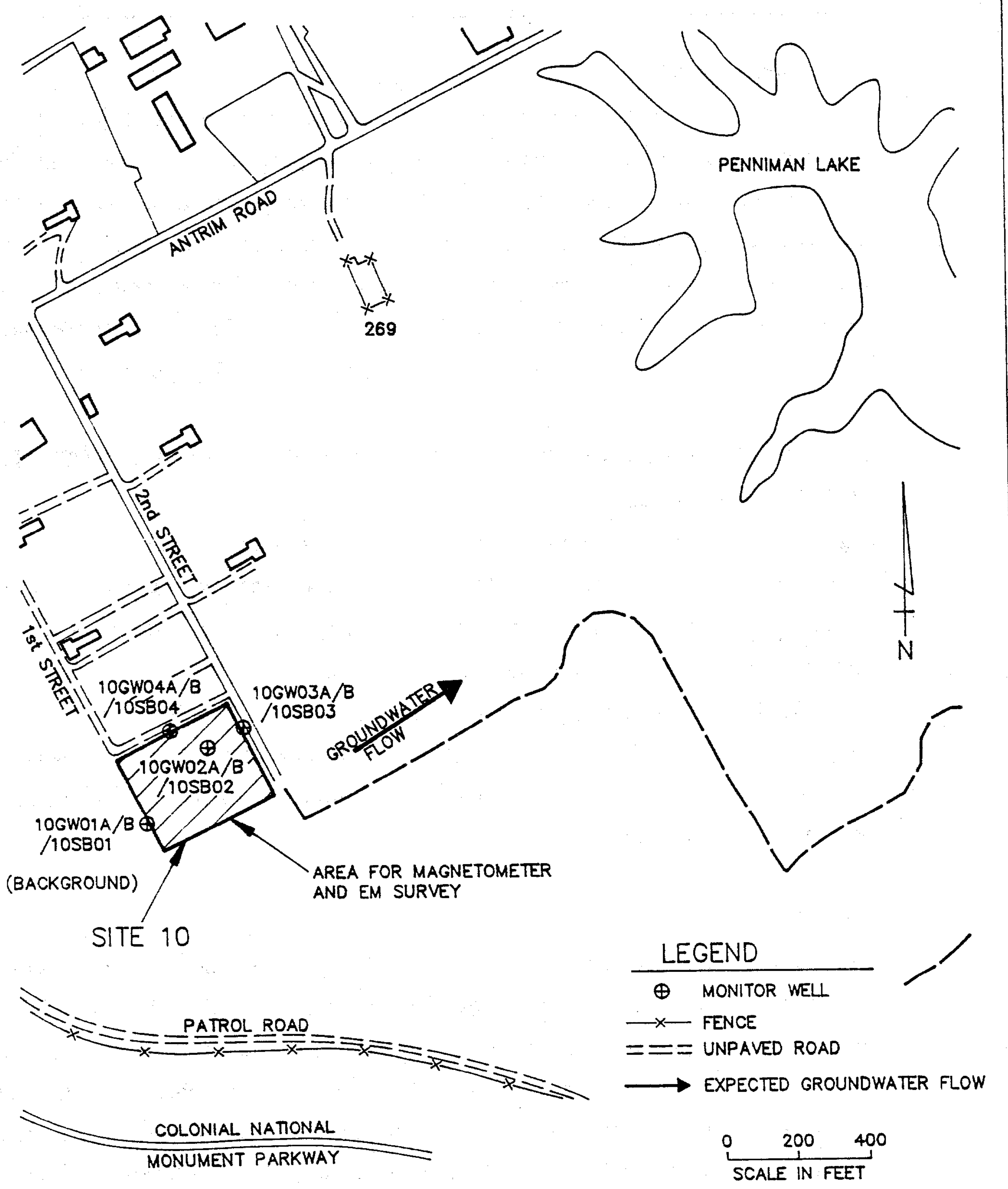
3.2 Site 10 - Decontamination Agent Disposal Area Near First Street

3.2.1 Geophysical Survey

A geophysical survey will be performed (Figure 3-2) before drilling activities. The survey will consist of an electromagnetic (EM) conductivity, and magnetic survey to locate and/or confirm potential burial areas. The geophysical survey procedure is specified in Section 4.2.12. The survey will include the area from the interim RI (NAVFACENGCOM, 1991) geophysical survey because no site control existed. The survey will extend south to include all of the Site 10 "mounds" that appear beyond the limits of the previous survey. The mounds may indicate burial, and the survey will determine limits of buried material.

3.2.2 Soil Samples

Soil samples will be collected from each of the four proposed monitor well locations. Borings will be advanced to 7 feet below the water table or until an impermeable layer is encountered using hollow stem augers. The advantage of the auger method is that water introduction is avoided, and water-bearing strata identification is facilitated by observing changes in soil moisture in samples and/or cuttings. The collection method and sampling equipment is specified in Section 4.2.2. A monitor well will be installed in each of the borings.



Environmental Science & Engineering	DATE 5-21-91	SCALE SHOWN	TITLE SITE 10 – PROPOSED SAMPLE LOCATIONS
	DRAWN BY LAF	APPROVED BY	
	JOB NO. 4901165	DWG. NO./ REV. NO. DCPSL / –	CLIENT NSC CHEATHAM — FIGURE 3-2

The background sample (10SB01) will be collected upgradient of the decontamination agent disposal area at the southern boundary (Figure 3-2). One soil sample location (10SB02) will be downgradient of the largest magnetic anomaly (adjacent to the tree line) determined during the interim RI field effort, and the other two will be collected downgradient in the north (10SB04) and east (10SB03) site corners (at the boundary of the Decontamination Agent Disposal Area). The soil samples will establish the extent of soil contamination toward Penniman Lake. Because no analytical data exists for Site 10, soil samples will be analyzed for volatile organic compounds (VOCs), BNAs, TPH, and target analyte list (TAL) metals (Table 3-8).

3.2.3 Groundwater Samples

Two rounds of groundwater samples will be collected (Table 3-8 for Round 1 and Table 3-9 for Round 2) to allow data consistency to be evaluated and to increase the overall confidence level of the analytical data. Sample collection techniques are specified in Section 4.2.6. Rationale for sampling locations is detailed in Section 3.2.1.

Groundwater samples will be collected from the four new monitor wells (10GW01 through 10GW04) as shown in Figure 3-2. Because conditions are unknown, groundwater samples will be analyzed for VOCs, BNAs, TPH, and TAL metals.

3.2.4 Aerial Photographic Interpretation

Interpretation of aerial photographs will be undertaken if contamination is observed. The previous geophysical survey does not appear to include all the mounds found at the site. Aerial photographs will be collected and reviewed to identify sizes, shapes, and boundaries of possible burial areas and will be used to develop a more detailed site map. This review is specified in Section 4.2.13.

Table 3-8

Site 10
Sample Matrix and Analytical Parameters
Naval Supply Center, Cheatham Annex
Williamsburg, Virginia
Round 1

Soil Sample	Chemical Analysis [(a)]	Physical Parameters
10SB01A	VOCs, BNAs, TPH, TAL METALS	TOV**
10SB02A	VOCs, BNAs, TPH, TAL METALS	TOV
10SB03A	VOCs, BNAs, TPH, TAL METALS	TOV
10SB04A	VOCs, BNAs, TPH, TAL METALS	TOV
Duplicate	VOCs, BNAs, TPH, TAL METALS	TOV
Field Blank*	VOCs, BNAs, TPH, TAL METALS	
Equipment Blank*	VOCs, BNAs, TPH, TAL METALS	
Trip Blank*	VOCs	

Groundwater Sample	Chemical Analysis	Physical Parameters [(b)]
10GW01A	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
10GW02A	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
10GW03A	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
10GW04A	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
Duplicate	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
Field Blank	VOCs, BNAs, TPH, TAL METALS	
Equipment Blank	VOCs, BNAs, TPH, TAL METALS	

(a) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acid Extractables; TPH = Total Petroleum Hydrocarbons, and TAL = Target Analyte List

(b) TEMP = Temperature; SP. COND = Specific Conductivity for aqueous samples only

* The soil trip blanks, field blanks, and equipment blanks will be aqueous samples

** TOV = Total Organic Vapor measured with an organic vapor analyzer (OVA)

Table 3-9

Site 10
Sample Matrix and Analytical Parameters
Naval Supply Center, Cheatham Annex
Williamsburg, Virginia
Round 2

Groundwater Sample	Chemical Analysis	Physical Parameters (b)
10GW01B	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
10GW02B	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
10GW03B	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
10GW04B	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
Duplicate	VOCs, BNAs, TPH, TAL METALS	pH, TEMP, SP. COND
Field Blank	VOCs, BNAs, TPH, TAL METALS	
Equipment Blank	VOCs, BNAs, TPH, TAL METALS	
Trip Blank	VOCs	

(a) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acid Extractables; TPH = Total Petroleum Hydrocarbons, and TAL = Target Analyte List

(b) TEMP = Temperature; SP. COND = Specific Conductivity for aqueous samples only

3.3 Site 11 - Bone Yard

3.3.1 Soil Gas Survey

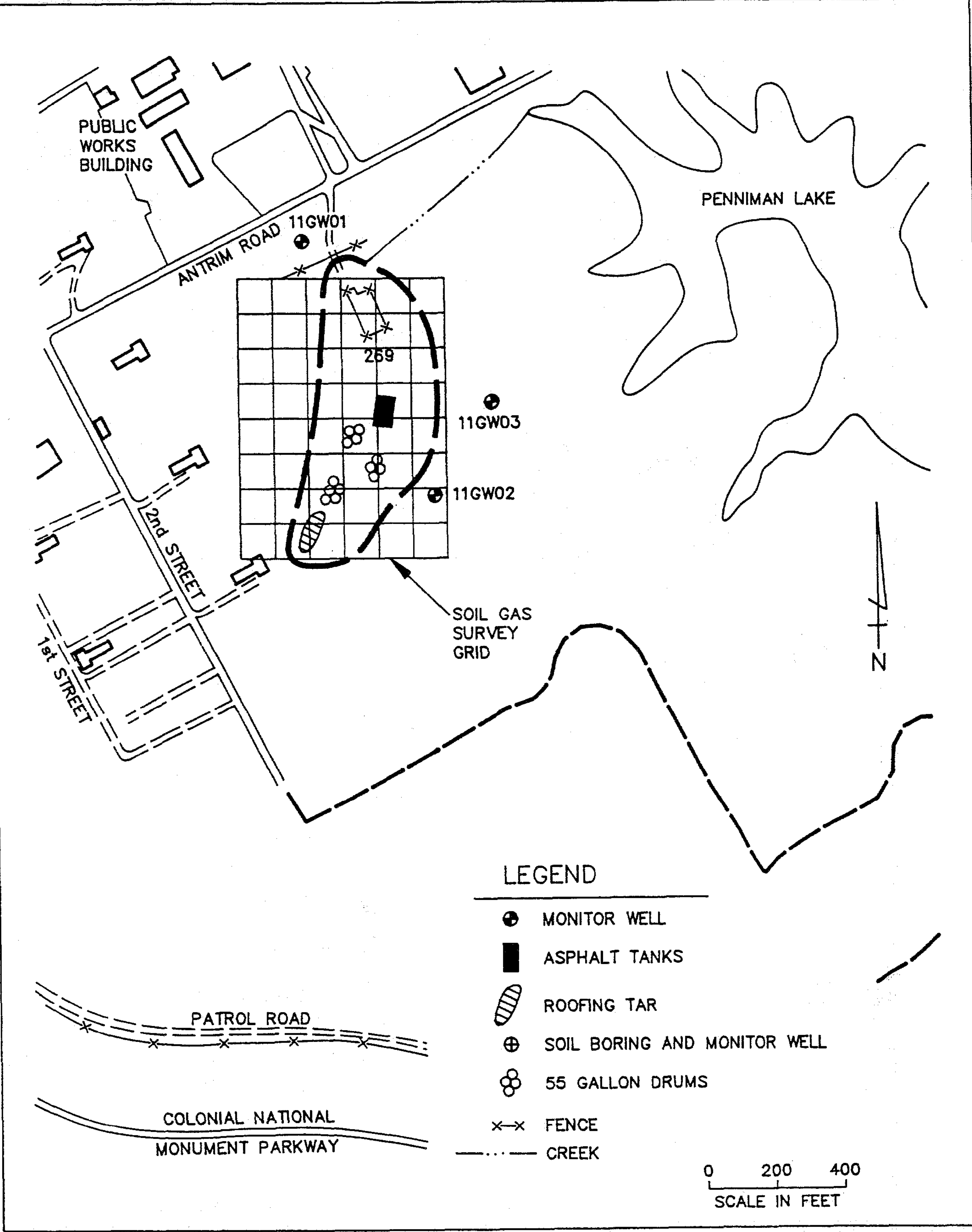
A soil gas survey will be conducted at Site 11 (Figure 3-3) and used as a screening procedure to optimize the number of soil samples to be collected by hand auger. The survey will be conducted in an approximately 600- by 800-foot area. The soil gas samples will be analyzed for benzene, toluene, ethylbenzene, and total xylenes (BTEX), and methyl ethyl ketone (MEK). The soil gas survey method is specified in Section 4.2.1.

3.3.2 Soil Samples

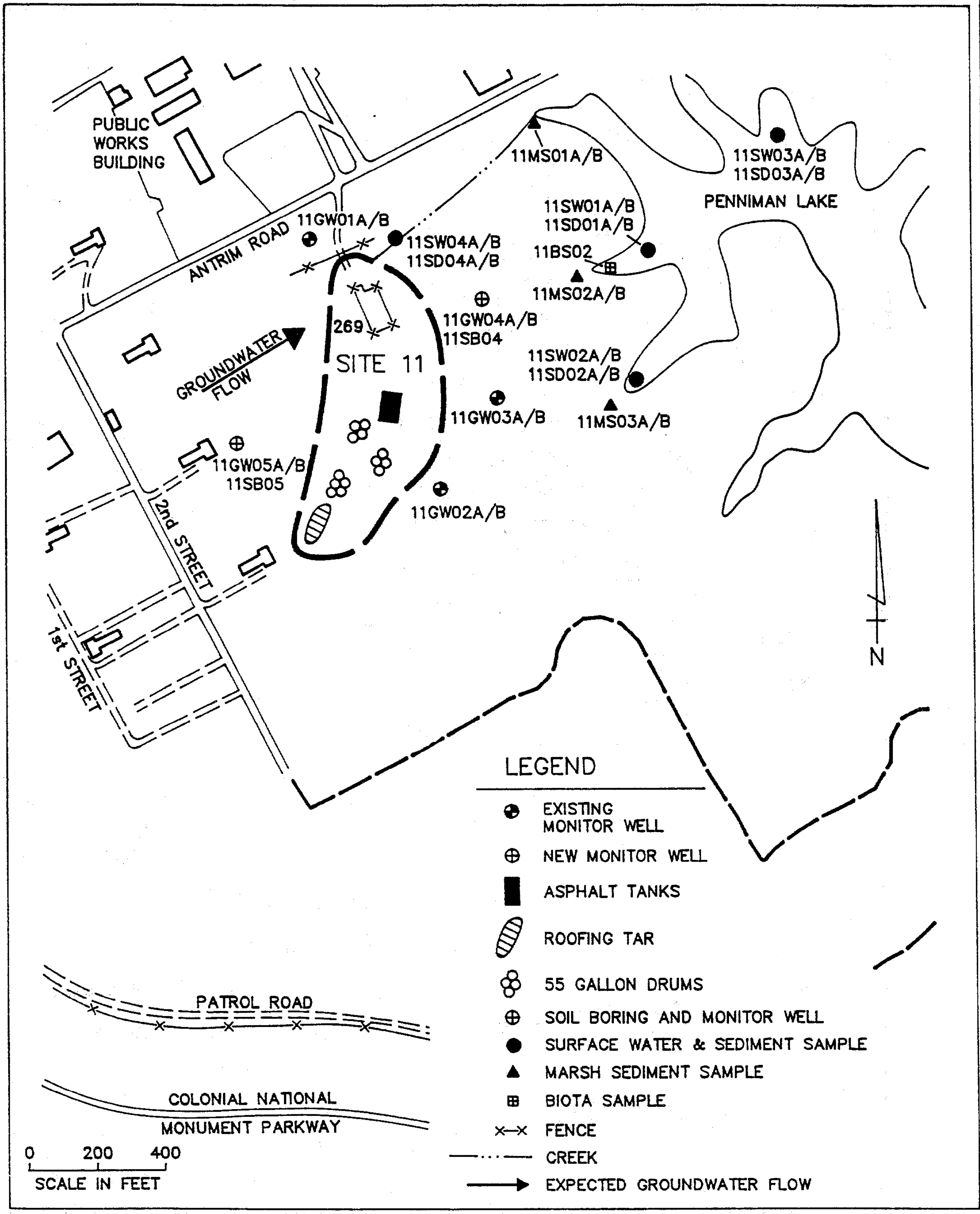
Soil samples will be collected from each of two boreholes to be drilled at the proposed monitor well locations. Borings will be advanced by hollow stem augers to 7 feet below the water table or until an impermeable layer is encountered. The advantage of the auger method is that water introduction is avoided, and water-bearing strata identification is facilitated by observing changes in soil moisture in samples and/or cuttings. Sample collection techniques are specified in Section 4.2.2. A monitor well will be installed in each of the borings.

Existing data and knowledge of the disposal of various wastes have aided in the selection of the soil sample analytical parameters. Previous samples tested positive for VOCs, BNAs, metals, and oil and grease; however, only BNAs were detected in the most recent groundwater samples. A background soil sample will be collected from west of the Bone Yard. A soil sample will be collected from 11GW04, east of the Bone Yard between existing well locations 11GW01 and 11GW03 (Figure 3-4). The soil samples will be analyzed for VOCs, BNAs, TPH, and lead (Table 3-10).

The location and number of shallow soil samples to be collected in Site 11 will be determined after evaluation of the soil gas survey results. The shallow soil samples will be collected from 0-3 feet using a hand auger, and will be analyzed for VOCs, BNAs, TPH, and lead. Additional information on the collection method and sampling equipment is specified in Section 4.2.3.



Environmental Science & Engineering	DATE 7-3-91	SCALE SHOWN	TITLE SITE 11 – BONE YARD PROPOSED SOIL GAS SURVEY	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. PSBY65 / 1	CLIENT NSC CHEATHAM	FIGURE 3–3



Environmental Science & Engineering	DATE 7-19-91	SCALE SHOWN	TITLE SITE 11 – BONE YARD PROPOSED SAMPLE LOCATIONS	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. PSBONE / 2	CLIENT NSC CHEATHAM	FIGURE 3-4

Table 3-10

Site 11
Sample Matrix and Analytical Parameters
Naval Supply Center, Cheatham Annex
Williamsburg, Virginia
Round 1

Soil Sample	Chemical Analysis [(a)]	Physical Parameters
11SB07A	VOCs, BNAs, TPH, Pb	TOV**
11SB08A	VOCs, BNAs, TPH, Pb	TOV
Field Blank*	VOCs, BNAs, TPH, Pb	
Equipment Blank*	VOCs, BNAs, TPH, Pb	
Trip Blank*	VOCs	

Groundwater Sample	Chemical Analysis	Physical Parameters [(b)]
11GW01A	BNAs	pH, TEMP, SP. COND
11GW02A	BNAs	pH, TEMP, SP. COND
11GW03A	BNAs	pH, TEMP, SP. COND
11GW04A	BNAs	pH, TEMP, SP. COND
11GW05A	BNAs	pH, TEMP, SP. COND
Duplicate	BNAs	pH, TEMP, SP. COND
Field Blank	BNAs	
Equipment Blank	BNAs	

Table 3-10 (continued)

Surface Water Sample	Chemical Analysis	Physical Parameters
11SW01A	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW02A	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW03A	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW04A	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW05A	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
Duplicate	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
Trip Blank	VOCs	

Sediment Sample	Chemical Analysis	Physical Parameters
11SD01SA	VOCs, BNAs, TPH, Pb	TOV
11SD01DA	VOCs, BNAs, TPH, Pb	TOV
11SD02SA	VOCs, BNAs, TPH, Pb	TOV
11SD02DA	VOCs, BNAs, TPH, Pb	TOV
11SD03SA	VOCs, BNAs, TPH, Pb	TOV
11SD04SA	VOCs, BNAs, TPH, Pb	TOV
11SD04DA	VOCs, BNAs, TPH, Pb	TOV
11SD05SA	VOCs, BNAs, TPH, Pb	TOV
11SD05DA	VOCs, BNAs, TPH, Pb	TOV
Duplicate	VOCs, BNAs, TPH, Pb	TOV
Field Blank*	VOCs, BNAs, TPH, Pb	
Equipment Blank*	VOCs, BNAs, TPH, Pb	
Trip Blank*	VOCs	

Table 3-10 (continued)

Marsh Sediment Sample	Chemical Analysis	Physical Parameters
11MS01SA	VOCs, BNAs, TPH, Pb	TOV
11MS01DA	VOCs, BNAs, TPH, Pb	TOV
11MS02SA	VOCs, BNAs, TPH, Pb	TOV
11MS02DA	VOCs, BNAs, TPH, Pb	TOV
11MS03SA	VOCs, BNAs, TPH, Pb	TOV
11MS03DA	VOCs, BNAs, TPH, Pb	TOV
Duplicate	VOCs, BNAs, TPH, Pb	TOV
Field Blank*	VOCs, BNAs, TPH, Pb	
Equipment Blank*	VOCs, BNAs, TPH, Pb	
Trip Blank*	VOCs, BNAs, TPH, Pb	

(a) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acid Extractables; TPH = Total Petroleum Hydrocarbons; Pb = Lead

(b) TEMP = Temperature; SP. COND = Specific Conductivity for aqueous samples only

* The soil, sediment, and marsh sediment trip blanks, field blanks, and equipment blanks will be aqueous samples

** TOV = Total Organic Vapor measured with an organic vapor analyzer (OVA)

3.3.3 Groundwater Samples

Groundwater will be sampled twice to allow data consistency to be evaluated and to increase the overall confidence level of the analytical data (Table 3-10 for Round 1 and Table 3-11 for Round 2). Sample collection techniques are specified in Section 4.2.6. Rationale for sampling locations is detailed in Section 3.3.2.

Groundwater samples will be collected from the two new monitor wells (11GW04 and 11GW05) and three existing monitor wells (11GW01 through 11GW03) as shown in Figure 3-4. The samples will be analyzed for BNAs. Previous data collected in the Interim RI report (NAVFACENGCOM, 1991) aided in the selection of analytical parameters for the groundwater samples.

3.3.4 Surface Water, Sediment, and Marsh Sediment

Two rounds of surface water, sediment, and marsh sediment samples will be collected to allow data consistency to be evaluated and to increase the overall confidence level of the analytical data (Table 3-10 for Round 1 and Table 3-11 for Round 2). Sediment and marsh sediment will be collected at two depth intervals: 0 to 2 feet and 2 to 4 feet. The two depth sampling intervals will define vertical extent and concentration of contaminants. Surface water sample collection methods are specified in Section 4.2.9; sediment and marsh sediment sampling methods are specified in Section 4.2.10.

Five surface water and sediment locations will be sampled at Site 11 (Figures 3-4 and 3-5). One surface water and sediment sample will be collected in the creek between monitor wells 11GW01 and 11GW04 to establish if the creek is being impacted directly from Site 11. A background surface water and sediment sample will be collected at the northeast corner of Penniman Lake; the adjacent area does not appear to be developed or used. Three surface water and sediment samples will be resampled where contamination was observed (NAVFACENGCOM, 1991). The samples will be analyzed for VOCs, BNAs, TPH, and lead. Existing data aided in the selection of analytical parameters.

Table 3-11

Site 11
Sample Matrix and Analytical Parameters
Naval Supply Center, Cheatham Annex
Williamsburg, Virginia
Round 2

Groundwater Sample	Chemical Analysis	Physical Parameters [(b)]
11GW01B	BNAs	pH, TEMP, SP. COND
11GW02B	BNAs	pH, TEMP, SP. COND
11GW03B	BNAs	pH, TEMP, SP. COND
11GW04B	BNAs	pH, TEMP, SP. COND
11GW05B	BNAs	pH, TEMP, SP. COND
Duplicate	BNAs	pH, TEMP, SP. COND
Field Blank*	BNAs	
Equipment Blank*	BNAs	

Surface Water Sample	Chemical Analysis	Physical Parameters
11SW01B	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW02B	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW03B	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW04B	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
11SW05B	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
Duplicate	VOCs, BNAs, TPH, Pb	pH, TEMP, SP. COND
Trip Blank	VOCs	

Table 3-11 (continued)

Sediment Sample	Chemical Analysis	Physical Parameters
11SD01SB	VOCs, BNAs, TPH, Pb	TOV**
11SD01DB	VOCs, BNAs, TPH, Pb	TOV
11SD02SB	VOCs, BNAs, TPH, Pb	TOV
11SD02DB	VOCs, BNAs, TPH, Pb	TOV
11SD03SB	VOCs, BNAs, TPH, Pb	TOV
11SD04SB	VOCs, BNAs, TPH, Pb	TOV
11SD04DB	VOCs, BNAs, TPH, Pb	TOV
11SD05SB	VOCs, BNAs, TPH, Pb	TOV
11SD05DB	VOCs, BNAs, TPH, Pb	TOV
Duplicate	VOCs, BNAs, TPH, Pb	TOV
Field Blank*	VOCs, BNAs, TPH, Pb	
Equipment Blank*	VOCs, BNAs, TPH, Pb	
Trip Blank*	VOCs	

Table 3-11 (continued)

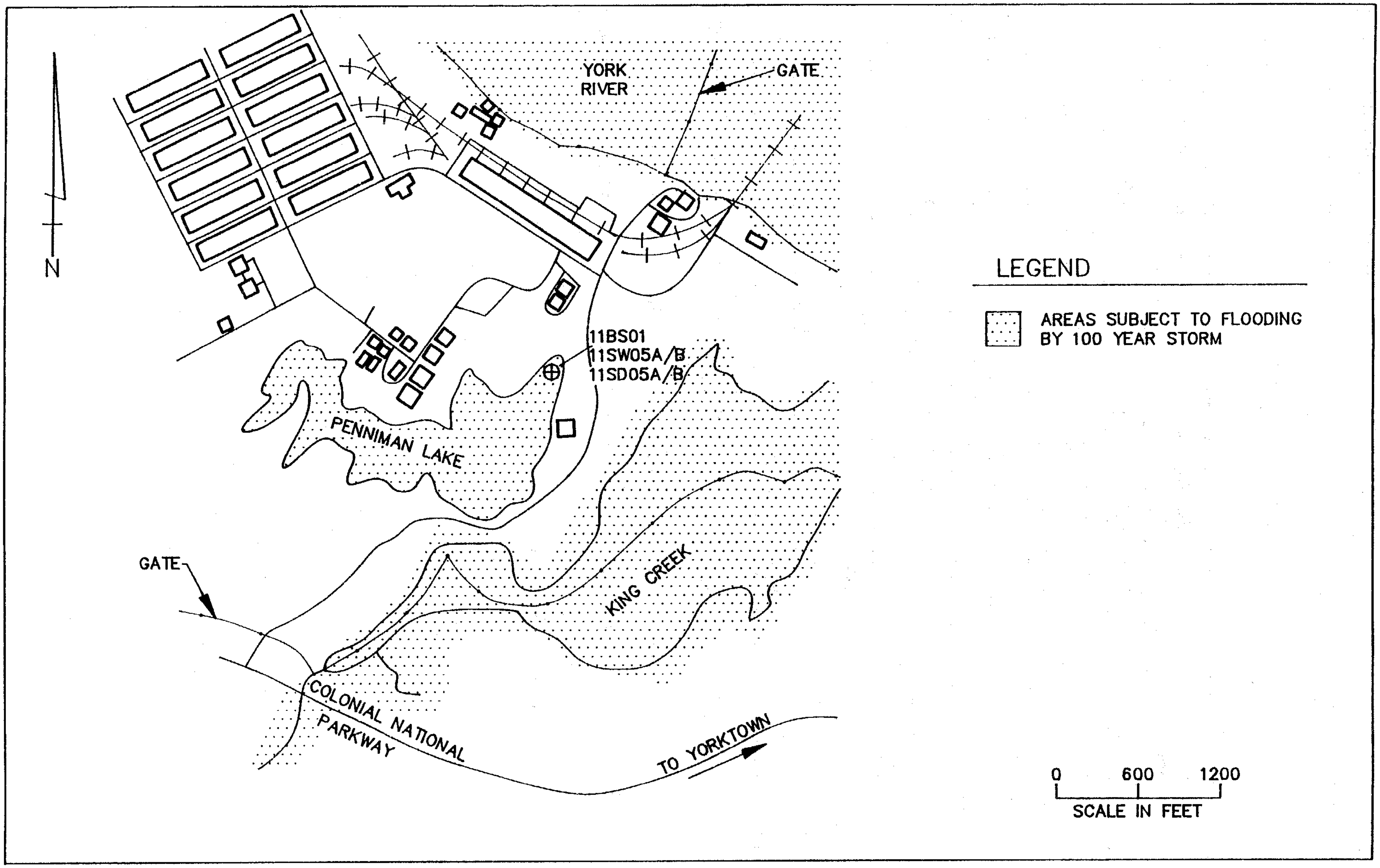
Marsh Sediment Sample	Chemical Analysis	Physical Parameters
11MS01SB	VOCs, BNAs, TPH, Pb	TOV
11MS01DB	VOCs, BNAs, TPH, Pb	TOV
11MS02SB	VOCs, BNAs, TPH, Pb	TOV
11MS02DB	VOCs, BNAs, TPH, Pb	TOV
11MS03SB	VOCs, BNAs, TPH, Pb	TOV
11MS03DB	VOCs, BNAs, TPH, Pb	TOV
Duplicate	VOCs, BNAs, TPH, Pb	TOV
Field Blank*	VOCs, BNAs, TPH, Pb	
Equipment Blank*	VOCs, BNAs, TPH, Pb	
Trip Blank*	VOCs, BNAs, TPH, Pb	

(a) VOCs = Volatile Organic Compounds; BNAs = Base Neutral Acid Extractables; TPH = Total Petroleum Hydrocarbons; Pb = Lead

(b) TEMP = Temperature; SP. COND = Specific Conductivity for aqueous samples only

* The sediment and marsh sediment trip blanks, field blanks, and equipment blanks will be aqueous samples

** TOV = Total Organic Vapor measured with an organic vapor analyzer (OVA)



Environmental Science & Engineering

DATE 5-15-91	SCALE SHOWN	TITLE PROPOSED BACKGROUND SURFACE WATER, SEDIMENT, AND BIOTA SAMPLES	
DRAWN BY LAF	APPROVED BY		
JOB NO. 4901165	DWG. NO./ REV. NO. FLOOD / -	CLIENT NSC CHEATHAM	FIGURE 3-5

3.3.5 Biota Sampling

If the marsh samples are found to be impacted, biota sampling will be performed to assess the potential impacts of site contamination on the aquatic environment. The goal of this program is to evaluate the status of the indigenous aquatic and benthic populations by examining the presence of site-related contaminants within existing biota, and by assessing species diversity and distribution.

The background sample (11BS01) will be located at the northeast corner of Penniman Lake (Figure 3-5), and the biota sample (11BS02) will be located adjacent to 11SW05 in the western section of Penniman Lake (Figure 3-4). The biota sampling method is specified in Section 4.2.11.

3.4 Off-Base Well Inventory

A well inventory of the potential groundwater contamination receptors in the vicinity of CAX will be developed. Based on hydrogeologic conditions in the vicinity, it is unlikely that any supply wells in areas surrounding CAX will be impacted by site contamination problems; currently, all known wells are located upgradient of the sites of concern. Shallow groundwater flow is toward the York River.

3.5 Quality Assurance Samples/Laboratory Analytical Protocols

Quality assurance samples to complement the soil and groundwater sample sets will be collected per the Navy Quality Assurance Program document NEESA 20.2-047B, Sampling and Chemical Analysis Quality Assurance Requirements, June 1988. A sampling summary with the total number of samples is presented in Table 3-2 for Round 1 and Table 3-3 for Round 2. A summary of specific analytes of interest for VOCs, BNAs, TPH, and TAL metals are presented in Table 3-12. The Contract Laboratory Program (CLP) protocols for the organics are referenced from EPA CLP statement of work (SOW) 2/88. The CLP protocols for inorganics are referenced in EPA CLP SOW 7/88.

Table 3-12. Target Compound List (TCL) and Contract Required Quantitiation Limits (CROL)*

	Quantitiation Limits**	
Volatile Organics (EPA Method 624)	Water (ug/l)	Low Soil/Sediment* (ug/kg)
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloriethene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichlormethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
trans-1,3-Dichloropropene	5	5
Bromoform	5	5
4-Methyl-2-Pentanone	10	10
2-Hexanone	10	10
Tetrachloroethene	5	5
Toluene	5	5
1,1,2,2-Tetracloroethane	5	5
Chlorobenzene	5	5
Ethylbenzene	5	5
Styrene	5	5
Xylenes (total)	5	5

* Medium soil/sediment contract required quantitation limits (CRQL) for volatile TCL compounds are 125 times the individual low soil/sediment CRQL.

** Quantitation limits listed for soil/sediment are based on wet weight. The quanitiation limits calculated by the laboratory for soil/sediment, calculated on a dry weight basis as required by the contract, will be higher.

Table 3-12. (continued)

BNAs (EPA Method 8270)	Quantitiation Limits**	
	Water (ug/l)	Low Soil/Sediment* (ug/kg)
Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-dipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic Acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopendtadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1600
Acenaphthene	10	330

* Medium soil/sediment contract required quantitation limits (CRQL) for volatile TCL compounds are 60 times the individual low soil/sediment CRQL.

** Quantitation limits listed for soil/sediment are based on wet weight. The quanitiation limits calculated by the laboratory for soil/sediment, calculated on a dry weight basis as required by the contract, will be higher.

Table 3-12. (continued)

BNAs (EPA Method 8270)	Quantitiation Limits**	
	Water (ug/l)	Low Soil/Sediment* (ug/kg)
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphtalate	10	330
4-Chlorophenyl-phenyl-ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-nitrosodiphenylamine	10	330
4-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-buthylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Buthylbenzylphthalate	10	330
3,3-Dicholorbenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo-(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

* Medium soil/sediment contract required quantitation limits (CRQL) for volatile TCL compounds are 60 times the individual low soil/sediment CRQL.

** Quantitation limits listed for soil/sediment are based on wet weight. The quanitiation limits calculated by the laboratory for soil/sediment, calculated on a dry weight basis as required by the contract, will be higher.

Table 3-12. (continued)

	Detection Limits**	
TAL Metals	Aqueous (ug/l)*	Solid (mg/kg)***
Aluminum Aluminum	73 5.0**	7.3 0.5**
Antimony Antimony	46 5.0**	4.6 0.5**
Arsenic Arsenic	70 2.3	7.0 0.23
Barium	1.4	0.14
Beryllium	1.8	0.18
Cadmium Cadmium	2.5 0.5**	0.25 0.05**
Calcium	48	4.8
Chromium Chromium	5.5 2.3	0.55 0.23
Cobalt	13	1.3
Copper	11	1.1
Iron	28	2.8
Lead Lead	37 1.4	3.7 0.14
Magnesium	36	3.6
Manganese	1.6	0.16
Mercury	0.2	0.02
Molybdenum Molybdenum	40 5.0**	4.0 0.5**

* Based on ESE's instrument detection limit (IDL) studies. The EPA Contract Laboratory Program (CLP) SOW 7/85 requirements were followed when the IDL studies were conducted.

** Based on the lowest standard that ESE routinely uses. For solid, the detection limits are adjusted for sample weight and final volume.

*** Based on auqeous IDL studies times a factor of 0.1 to take into account sample weight and final volume of digestate contract, will be higher.

Table 3-12. (continued)

TAL Metals	Detection Limits**	
	Aqueous (ug/l)*	Solid (mg/kg)***
Nickel Nickel	13 5.0**	1.3 0.5**
Potassium Potassium	367 5.0**	36.7 0.5**
Selenium Selenium	101 1.8	10.1 0.18
Silver Silver	5.8 0.16	0.58 0.016
Sodium Sodium	231 100**	23.1 10.0
Strontium	7.0	0.7
Thallium Thallium	189 5.0	18.9 0.5
Vanadium Vanadium	7.4 5.0**	0.74 0.5**
Zinc	5.6	0.56

* Based on ESE's instrument detection limit (IDL) studies. The EPA Contract Laboratory Program (CLP) SOW 7/85 requirements were followed when the IDL studies were conducted.

** Based on the lowest standard that ESE routinely uses. For solid, the detection limits are adjusted for sample weight and final volume.

*** Based on auqeous IDL studies times a factor of 0.1 to take into account sample weight and final volume of digestate contract, will be higher.

Table 3-12. (continued)

	Detection Limits	
Total Petroleum Hydrocarbons*	Aqueous (mg/l)	Solid (ug/g)
Diesel	0.5	10
Gasoline	0.5	10
Aviation Fuel	0.5	100

* EPA Method 8015, Modified

4.0 SAMPLING AND FIELD PROCEDURES

This section specifies the type of equipment required to carry out all field activities listed in the sampling and work plans. This section also details the exact step-by-step procedures that will be adopted by field personnel to ensure data of sufficient quality to fulfill the required data quality objectives. Deviations or variances from the approved WP, SSP, and HASP will be recorded in the bound field book. Deviations, variances, and out-of-control events will be reported and discussed with ESE's project manager and the Navy EIC within 24 hours.

4.1 Sequence of Activities

4.1.1 Site 1

This section provides an overview of the proposed sequence of activities at Site 1 that will be undertaken during the field investigation. Locations and rationale for each round of groundwater, soil, marsh sediment, and biota sampling are described in Section 3.1.

1. ESE personnel will meet with Naval personnel to discuss the project's safety requirements and to verify sample locations in relation to utilities or other previously unrecognized hindrances to sampling/well installation.

2. Each of the two proposed soil boring/monitor well installation locations will be cleared (if required) and marked with stakes.

3. Prior to and during boring advancement, the air in the breathing zone and from the borehole will be monitored for volatile organic vapors using an organic vapor analyzer (OVA). Readings will be recorded and will form the basis of selection for personal protective equipment (see Health and Safety Plan, Appendix A).

4. Two boreholes will be advanced, and soil samples will be collected in accordance with Section 4.2.4 of this plan using a split-spoon sampler (ASTM

Method D-1586-87). The soil sample with the highest OVA reading will be collected from each boring (or the sample closest to water if no readings are detected), placed in pre-labeled containers, and placed on ice pending shipment.

5. The background soil sample will be collected from 0 to 2 feet using a hand auger.

6. Drill cuttings will be stored onsite in DOT-approved 55-gallon storage drums. Drill cutting disposal will be the responsibility of the contractor.

7. Two groundwater monitor wells will be installed in accordance with Section 4.2.4 of this plan.

8. Both new monitor wells will be developed, following installation. Developed water will be contained in 55-gallon drums. Development water disposal is the responsibility of the Navy.

9. Following development, all new and existing wells will be purged. Groundwater samples will be collected from each of the two new wells and six existing wells using the method described in Section 4.2.6.

10. Three marsh sediment sample locations will be collected in accordance with Section 4.2.10.

11. Decontamination procedures will be carried out as detailed in Section 4.2.8.

12. Chain-of-custody (COC) records will be maintained for all samples. The top copy of the COC form will be placed in a watertight container, sealed inside the cooler, and will accompany the samples to the laboratory. The laboratory will return the completed form to document receipt of the undisturbed samples.

13. Biota sampling will be performed if marsh sediment samples are found to be impacted, as detailed in Section 4.2.11.

14. All monitor wells will be surveyed for vertical and horizontal control. Readings will include ground elevations and top of monitor well casings as detailed in Section 4.2.4. The creeks will be surveyed and the data plotted on the monitor well location maps.

15. An offsite well inventory study will be carried out as described in Section 4.2.14.

4.1.2 Site 10

This section provides an overview of the proposed sequence of activities at Site 10 that will be undertaken during the field investigation. Locations and rationale for each round of groundwater and soil sampling are described in Section 3.2.

1. ESE personnel will meet with Naval personnel to discuss the project's safety requirements and to verify sample locations in relation to utilities or other previously unrecognized hindrances to sampling/well installation.

2. A geophysical survey will be conducted if contamination is found as described in Section 4.2.12.

3. Each of the four proposed soil boring/monitor well installation locations will be cleared (if required) and marked with stakes.

4. Prior to and during boring advancement, the air in the breathing zone and from the borehole will be monitored for volatile organic vapors using an organic vapor analyzer (OVA). Readings will be recorded and will form the basis of selection for personal protective equipment (see Health and Safety Plan, Appendix A).

5. Four boreholes will be advanced, and soil samples will be collected in accordance with Section 4.2.4 of this plan using a split-spoon sampler (ASTM Method D-1586-87). The soil sample with the highest OVA reading will be collected from each boring (or the sample closest to water if no readings are detected), placed in pre-labeled containers, and placed on ice pending shipment.

6. Drill cuttings will be stored onsite in DOT-approved 55-gallon storage drums. Drill cutting disposal will be the responsibility of the contractor.

7. Four groundwater monitor wells will be installed in accordance with Section 4.2.4 of this plan.

8. All wells will be developed, following installation. Developed water will be contained in 55-gallon drums. Development water disposal is the responsibility of the Navy.

9. Following development, the wells will be purged. Groundwater samples will be collected from each of the four new wells using the method described in Section 4.2.6.

10. Decontamination procedures will be carried out as detailed in Section 4.2.8.

11. Chain-of-custody (COC) records will be maintained for all samples. The top copy of the COC form will be placed in a watertight container, sealed inside the cooler, and will accompany the samples to the laboratory. The laboratory will return the completed form to document receipt of the undisturbed samples.

12. All monitor wells will be surveyed for vertical and horizontal control (state planar coordinates and mean sea level (msl)). Readings will include ground elevations and top of monitor well casings as detailed in Section 4.2.4. The creeks will be surveyed and the data plotted on the monitor well location maps.

13. If contamination is found, aerial photographic interpretation will be performed as described in Section 4.2.13.

14. An offsite well inventory study will be carried out as described in Section 4.2.14.

4.1.3 Site 11

This section provides an overview of the proposed sequence of activities that will be undertaken at Site 11 during the field investigation. Locations and rationale for the collection of soil gas samples, as well as each round of groundwater, soil, surface water, sediment, marsh sediment, and biota sampling are described in Section 3.0.

1. ESE personnel will meet with Naval personnel to discuss the project's safety requirements and to verify sample locations in relation to utilities or other previously unrecognized hindrances to sampling/well installation.

2. A soil gas survey will be conducted as specified in Section 4.2.1 of this plan.

3. Each of the two proposed soil boring/monitor well installation locations will be cleared (if required) and marked with stakes.

4. Prior to and during boring advancement, the air in the breathing zone and from the borehole will be monitored for volatile organic vapors using an organic vapor analyzer (OVA). Readings will be recorded and will form the basis of selection for personal protective equipment (see Health and Safety Plan, Appendix A).

5. Two boreholes will be advanced, and soil samples will be collected in accordance with Section 4.2.4 of this plan using a split-spoon sampler (ASTM Method D-1586-87). The soil sample with the highest OVA reading will be collected from each boring (or the sample closest to water if no readings are detected), placed in pre-labeled containers, and placed on ice pending shipment.

6. Drill cuttings will be stored onsite in DOT-approved 55-gallon storage drums. Drill cutting disposal will be the responsibility of the contractor.

7. Two groundwater monitor wells will be installed in accordance with Section 4.2.4 of this plan.

8. Both wells will be developed, following installation. Developed water will be contained in 55-gallon drums. Development water disposal is the responsibility of the Navy.

9. Following development, the wells will be purged. Groundwater samples will be collected from each of the two new wells and three existing wells using the method described in Section 4.2.6.

10. Soil samples will be collected from 2 to 4 feet using a hand auger. The location and number of soil samples will be determined by the soil gas survey.

11. Five surface water, ten sediment, and eight marsh sediment samples will be collected in accordance with Section 3.3 of this plan; the method is described in Section 4.2.9 and Section 4.2.10.

12. Decontamination procedures will be carried out as detailed in Section 4.2.8.

13. Chain-of-custody (COC) records will be maintained for all samples. The top copy of the COC form will be placed in a watertight container, sealed inside the cooler, and will accompany the samples to the laboratory. The laboratory will return the completed form to document receipt of the undisturbed samples.

14. If marsh sediment samples are found to be impacted, biota sampling will be performed as detailed in Section 4.2.11.

15. All monitor wells will be surveyed for vertical and horizontal control. Readings will include ground elevations and top of monitor well casings as detailed in Section 4.2.4. The creeks will be surveyed and the data plotted on the monitor well location maps.

4.2 Field Sampling and Equipment Procedures

This section provides clear, step-by-step methodologies for each individual field sampling technique.

4.2.1 Soil Gas Survey

A soil gas survey will be conducted at Site 11; sample locations may be modified if onsite analyses indicate elevated contamination levels. The procedure used will be based on best professional judgment to ensure that an adequate number of samples are allocated to investigate small source areas, and that larger source areas will not necessarily contain the majority of sampling locations. Soil gas survey data will be used as a screening procedure to optimize soil sample collection.

To provide the required coverage over the entire site area, soil gas sampling locations will be chosen on an equidimensional grid with 100-foot spacing. Grid spacings will initially be at 100-foot centers; 50-foot centers will be reserved for suspected source areas. Selected locations will be chosen for additional quality control sampling at a rate of one in ten samples, or one per set of samples.

Prior to placing the soil gas sampling probes, each grid point will be located using a compass and tape. Once a sampling location is located and flagged, a 1-inch diameter pilot hole will be driven to approximately 12 inches using a compressed air-powered jackhammer and bit assembly.

When the pilot hole is complete, a soil gas probe will be placed in the hole and driven to a depth of 5 feet or refusal, using a jackhammer equipped with a "pin driver." Soil gas probes consist of 5-foot lengths of galvanized steel electrical conduit, crimped at the bottom, with a small diameter gas inlet hole drilled near the bottom. Once the probe has reached the desired depth, the deformed top end will be cut smooth with a pipe cutter, if necessary, and sealed with aluminum foil.

Sampling will generally be performed within 24 hours of the time of probe installation. The aluminum foil cap will be replaced with a Teflon® tube equipped with a silicon stopper of appropriate diameter. The soil gas sampling apparatus consists of a Teflon® tube equipped with a silicon stopper, a desiccator containing a Tedlar® sampling bag, and a battery-powered vacuum pump. To collect a sample, the silicon stopper is inserted in the end of the soil gas probe, and a Tedlar® bag is connected to the opposite end of the Teflon® tube within the desiccator. The vacuum pump creates a vacuum in the desiccator that draws soil gas into the Tedlar® bag. The soil gas probe is purged of two probe volumes (1.5 liters of vapor for a 5-foot length probe) before a clean Tedlar® bag sample is obtained, and the valve on the sample bag is closed and delivered to the onsite chemist for analysis. At that time, sampling information will be recorded and will include sampling location number, sampler, date of probe installation, date and time of sampling, weather conditions, and general comments. Date and time of analysis will also be recorded.

Prior to analyzing the sample, it is screened with a portable OVA for gross contamination to avoid damaging the gas chromograph (GC) column. If gross contamination is detected during screening, the sample is diluted with ultra-zero air before analysis. The GC is also operated using ultra-zero air as the carrier gas for all analyses and to establish baseline response levels for the instrument.

Appropriate standards of the target compounds (BTEX) and MEK are prepared at several concentration ranges in Tedlar® bags from liquid concentrate and ultra-zero air. Gaseous aliquots of the standards are used to determine the retention times and responses of the target compounds in the columns.

A full set of standards are run at the beginning of each day, and at least one standard is run after each sample that shows detectable concentrations of target compounds.
A 99.5 percent correlation to the standard check calibration will be the acceptance criteria for the calibration curve. Check standards are run, at a minimum of every fifth sample, to check retention time and responses during the run to within ±20 percent from the standard calibration.

Checks for instrument carryover and contamination are performed periodically by running a sample of ultra-zero air in a Tedlar® bag, especially after "hot" samples are run.

4.2.2 Soil Sampling

Soil samples from borings will be collected using a 2-inch split-spoon sampler in accordance with ASTM Method D1586-87. Split-spoon samples will be collected at

5-foot centers beginning at the surface. Drive shoes will be replaced if they become dented or distorted, and an interchangeable sample retainer will be used. To avoid delay due to decontamination procedures, the drilling subcontractor will have at least four complete split-spoon samplers ready at the start of each work period. One duplicate soil sample will be collected and analyzed for quality control purposes.

The soil samples will be screened at 1-foot intervals with an OVA to provide a preliminary indication of the vertical and horizontal extent of VOC contamination; readings will be noted in the field note book. The geologist will classify and record the soil types on preprinted boring log records. If no readings are obtained, the VOC sample will be taken from the 1-foot interval closest to the water table.

4.2.3 Shallow Soil Samples

The background sample at Site 1 and the samples determined by the soil gas survey will be collected at 0 to 3 feet using a hand auger as described in Section 4.2.10. All samples will be placed into the correct number of prelabeled clean glass jars. Sample handling and shipment procedures are discussed in Section 5.0.

4.2.4 Monitor Well Installation

A drill rig mounted on a mobile unit will be used to perform all soil borings and monitor well installations. Each rig will use necessary tools, supplies, and equipment supplied by the subcontractor to drill each location. Drilling crews on each rig will consist of an experienced driller and a driller's assistant. An ESE geologist experienced in hazardous waste site investigations will be onsite to monitor the driller's efforts, maintain air monitoring/safety controls, and log the borehole. Additional subcontractor personnel may be required to transport water to the rigs, decontaminate tools, and construct the concrete aprons/collars around wells.

Four monitor wells will be constructed of 4-inch ID, threaded PVC well screen, riser, and casing for Sites 1 and 11. Four monitor wells at Site 10 will be constructed of 2-inch ID, threaded, stainless steel well screen, riser, and casing. All well screen and riser will be decontaminated before installation.

Figure 4-1 illustrates a typical monitor well construction detail. A sand pack (#2 Morie sand or equivalent) will be placed around the well screen and will extend from 2 to 5 feet above the top of the screen. A 0.01-inch slotted well screen will be used in each well. A bentonite seal (minimum 1-foot thickness) will be placed on top of the sand pack. Finally, a grout mixture of two parts sand and one part cement, thoroughly mixed with the specified amount of potable water, will be placed in the borehole and rodded to ensure a proper seal.

Immediately after grouting, a 5-foot length of protective, clean steel casing with a locking cap will be installed over the well pipe to a depth of approximately 2.5 feet below ground surface. An internal drainage hole will be drilled through the steel casing just above the mortar collar. After the grout has thoroughly set, the protective steel casing will be painted orange and identified by number in white.

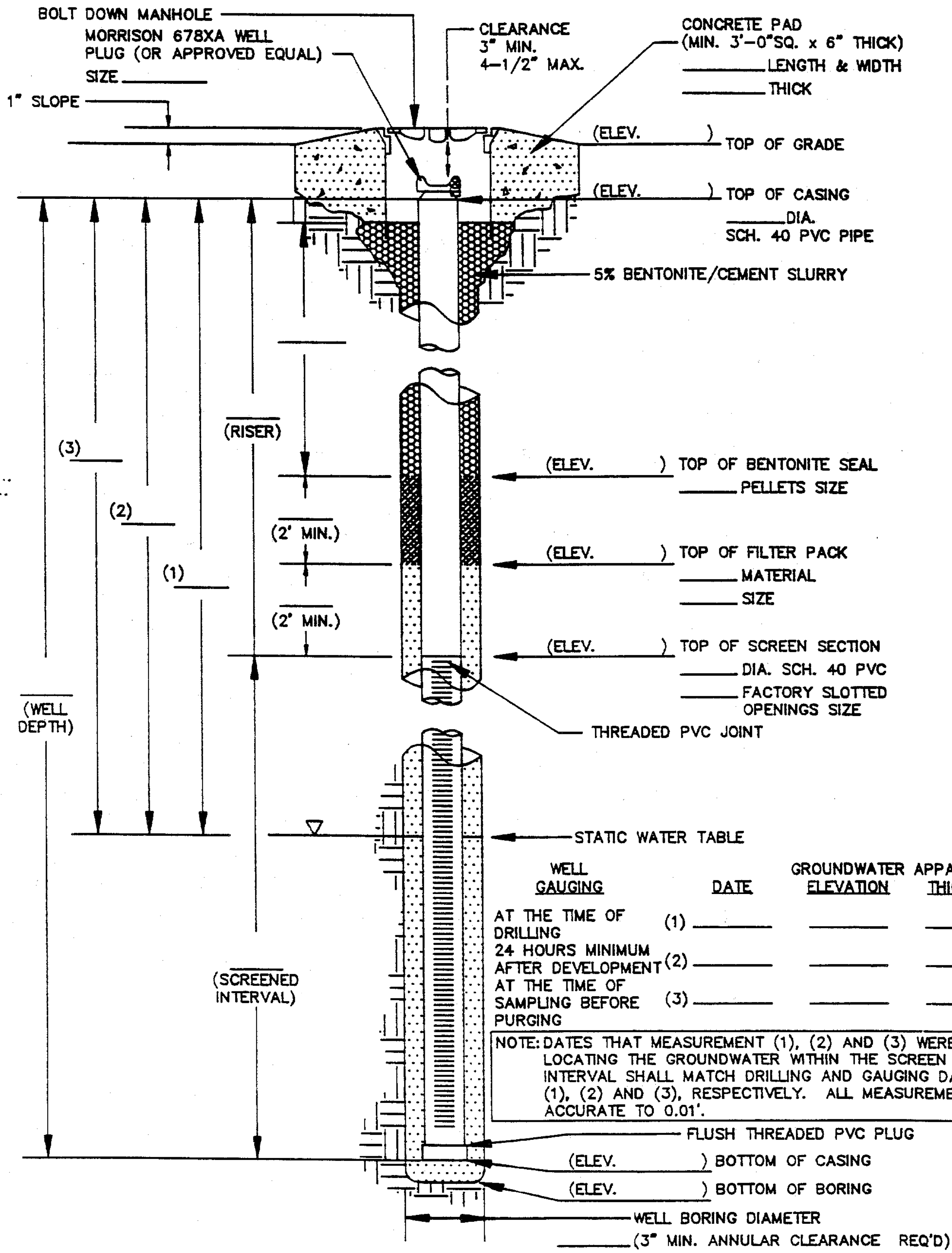
A 3-foot square, 9-inch thick concrete collar will be constructed around each well. This apron/collar will be constructed of 3000-psi, ready-mixed concrete. The concrete will slope downward from the protective casing. The concrete pads will be constructed within five days after all the wells are installed. Additional protection will be provided by three 6-foot metal posts set radially around the monitor well. The posts will be placed 3 feet from the protective casing, set in grout 3 feet below ground surface, and painted orange.

Monitor wells will be surveyed to state planar coordinates. Ground elevations will be surveyed within ±0.1 foot, tops of monitor well casings will be surveyed within ±0.03 foot, and horizontal control will be surveyed to ±1 foot.

Environmental Science & Engineering

MONITOR WELL INSTALLATION DETAIL

LOCATION:	FACILITY NUMBER:	INSTALLATION DATE:	MONITOR WELL NUMBER:
TYPE RIG:	INSTALLED BY:	REMARKS:	



WELL GAUGING		DATE	GROUNDWATER ELEVATION	APPARENT HC THICKNESS
AT THE TIME OF DRILLING	(1)	______	______	______
24 HOURS MINIMUM AFTER DEVELOPMENT	(2)	______	______	______
AT THE TIME OF SAMPLING BEFORE PURGING	(3)	______	______	______

NOTE: DATES THAT MEASUREMENT (1), (2) AND (3) WERE TAKEN LOCATING THE GROUNDWATER WITHIN THE SCREEN INTERVAL SHALL MATCH DRILLING AND GAUGING DATES (1), (2) AND (3), RESPECTIVELY. ALL MEASUREMENTS ACCURATE TO 0.01'.

FIGURE 4-

4.2.5 Well Development

All wells will be developed following installation to remove particulate materials that may have entered during construction. Development will be accomplished by removing three to five times the well volume by either bailing or continuous low yield pumping. All fluid generated from well development will be contained in DOT-approved 55-gallon drums, pending disposal.

4.2.6 Groundwater Sampling

Sampling procedures will generally follow protocol described in the US EPA Technical Enforcement Guidance Document. Monitor wells will be sampled beginning with those suspected of being least contaminated and progressing to those assumed most contaminated, based on OVA readings from soil samples and existing data. One duplicate groundwater sample will be collected and analyzed at each site for quality control purposes. Aqueous metal samples will not be filtered upon collection.

The following procedures will be used to collect groundwater samples:

1. Groundwater samples will not be collected until at least five days have elapsed since the monitor wells were developed (wells must be allowed to reach equilibrium).

2. Monitor well samples will be collected from the least likely contaminated locations, followed by monitor wells with increasing levels of contamination.

3. To ensure that cross-contamination between wells does not occur, all reusable equipment used to measure and sample groundwater (e.g., pumps, tapes) will be cleaned prior to use in each well. All nondedicated sampling equipment will be decontaminated as described in Section 4.2.7.

4. Static water depth and total depth will be measured to within 0.01 foot using a decontaminated electric interface probe with attached permanent depth-marked tape. The static and total depth will be used to calculate the volume

of standing water. One bailer of groundwater from the top of the water column and one from the bottom of the well will be collected to detect immiscible layers before purging the well.

5. Prior to collecting a sample, the volume of water in the screen and well casing will be purged three to five times. If well yield is sufficient, additional well volumes may be removed until well temperature, specific conductance, and pH have stabilized to 1°C, 100 μmhos, and 0.2 respectively. Wells that recharge extremely slowly will be purged dry, allowed to recharge, and purged again. If excessive time is required to purge three volumes, the EIC will be notified, and it may be agreed to purge a lesser volume. The amount of fluid purged will be measured and recorded.

6. Water samples will be collected using dedicated, precleaned Teflon® or high density polyethylene bailers.

7. All sampling equipment will be kept off contaminated soil to prevent sample cross-contamination (equipment will be placed on disposable polyethylene plastic sheeting or wrapped in aluminum foil for storage).

8. The bailer will be rinsed once with well water (first bail is discarded) prior to collecting a sample. The first sample withdrawn from the well will be checked for temperature, pH, and specific conductance. Subsequent samples collected from within the screened interval will be used to fill sample bottles. Bottles intended for VOC analysis will be filled first, followed by the extractable organic fraction, and finally the inorganic fraction. Care will be taken not to leave any headspace or air bubbles in bottles intended for volatile analysis. If the bottles are found to have headspace or bubbles, they will be reopened and topped until the bottle is full.

4.2.7 Investigation-Derived Waste

Drill cuttings and well development fluids will be collected and stored in labeled 55-gallon drums; disposal will be the contractor's responsibility.

4.2.8 Decontamination Procedures

A thorough decontamination procedure will be used to decontaminate the hand augers, split-spoons, and other reusable sampling equipment (e.g., pump) used in the investigation. The decontamination procedure is as follows: 1) detergent wash and scrub, 2) tap water rinse, 3) 10 percent nitric acid rinse (HNO_3), 4) deionized/distilled water rinse, 5) isopropyl alcohol rinse, and 6) air dry. Sampling equipment will be wrapped in aluminum foil (shiny side out) during transport.

All potentially contaminated drilling equipment (e.g., augers, rods, etc.) will be steam cleaned with potable water before borings to prevent cross-contamination. After the last boring, drilling equipment will be steam cleaned to prevent contamination from leaving the site.

4.2.9 Surface Water Sampling

Five surface water samples will be collected. A grab sample will be collected at approximately one-half to two-thirds the depth of the water. Samples will be taken with a disposable 500 ml or larger glass, Teflon®, or stainless steel jar inverted and the mouth of the jar oriented upstream; the jar will be filled while moving it upstream. Samples will be collected by immersing a separate sample container that is not preserved and then transferring the sample to the proper pre-preserved container and securely sealing it. After sampling is completed at one location, the sampling equipment will be decontaminated before collecting the next sample. Surface water samples will not be filtered. Finally, the container will be labeled, placed in an ice chest (4°C), and delivered overnight to ESE's laboratory in Gainesville, Florida. A water sample will also be collected at each location for temperature, pH, and specific conductivity measurements; the results will be recorded in a field notebook along with sample collection time and observations on flow rate and cause of flow (e.g., recent rainfall).

4.2.10 Sediment/Marsh Sediment Sampling

In general, ESE will observe the following procedures when collecting sediment and soil samples:

1. All sample points will be marked with a painted wooden stake that displays a sample point code number. The approximate location will be recorded on a suitable installation map for future reference.

2. Prior to sampling, all surface vegetation, rocks, and debris will be removed to allow collection of a clean and representative sample.

3. Sediment grab samples will be taken immediately adjacent to the stream bank or from the bottom of the stream (0-3 inches in depth) by scooping with either a jar, trowel, or spatula and placing into a collector container. The standing liquid on top of the container will be removed. Additional sediment will be collected until the jar is full, and the lid will be sècurely tightened.

4. Marsh sediment samples will be collected from 2 to 4 feet using 1-7/8-inch OD, 1-3/4-inch ID clear lexan tubing. The tubing will be pushed or driven into the substrate to the required depth. A rubber plug will then be placed into the top of the tubing, and air will be withdrawn from inside the tube to create a partial vacuum to help hold the sediment inside. (This is especially important if the sediment is poorly consolidated.) The lexan will then be quickly withdrawn, and a plastic cap will be placed over the lower end of the tube to prevent loss of the sample. A description of the sediment as viewed through the clear tubing will be recorded on preprinted logs. Sediment from the required interval will be removed from the tube using a 1-3/4-inch brass plunger and placed into the required sample containers.

5. Reusable sampling equipment (spatulas, trowels, brass plunger, etc.) will be decontaminated prior to sampling and between sampling locations to prevent cross-contamination. The procedure will follow that specified in Section 4.2.8.

6. Samples for chemical analysis (see Table 2-1) will be placed in appropriate sample containers and shipped in coolers at 4°C via Federal Express's priority overnight service.

7. Samples will be marked with identifying information and logged in the field notebook.

4.2.11 Biological Sampling

Biota samples will be collected during the second round of sampling if Round 1 marsh sediment samples are found to be contaminated. The nature and extent of contamination in biota will be evaluated by collecting samples of aquatic life at each of the areas of concern on the site and analyzing for the presence of site-related

contamination in tissue. Biological samples will be collected at the same time and from the same location that second round marsh sediment and/or surface water samples are collected. Water quality parameters will be evaluated at the time of sampling for abiotic and biotic media.

Data will be collected for samples from the contaminated areas and the control(s) for the following parameters:

- Dissolved oxygen (DO)
- pH
- Turbidity
- Temperature
- Hardness
- Flow rate
- Stream depth and width
- Substrate

Fish Tissue

Fish will be collected at each area of concern; methodology will depend on the size and depth of the water body. A fish seine will be used in small shallow streams. Investigators on each end of the seine will drag the stream for a distance not to exceed 10 feet. The ends of the seine will be closed, and it will be brought to the water's edge to remove fish from the net. Different methods may be used for larger bodies of water: electroshocking from a boat, trawling with a net, or a fish trap depending on local fishery regulations and species composition.

Collected fish will be examined for species, sex, age, length, weight, and morphological changes. Small fish will be composited to provide enough weight for analysis. Fish will be separated according to species if several species are collected; species commonly consumed by humans and high trophic level species will be selected for analysis. Large fish will be dissected, and the liver and fillet will be frozen separately for analysis. The fillet is critical to determine effects to human health because the remainder is rarely consumed by humans. The liver is important for ecological health because predatory birds (e.g., pelicans and ospreys) consume this portion of the fish, and many contaminants bioaccumulute in the liver.

Benthic Invertebrates

Benthic invertebrates will be collected at each area of concern, depending on availability. Organisms sampled will include invertebrates commonly consumed by humans (clams or crabs, depending on availability), as well as common invertebrates important in the community that provide contaminant pathways to higher trophic level organisms such as predatory fish or birds. Methodology for collecting benthic invertebrates will depend on the type of habitat being investigated. Stream-net sampling devices (e.g., Hess, Hess streambottom, Surber, portable invertebrate box) are used in a wide range of shallow habitat types, including shallow areas of rivers to small shallow flowing streams (ASTM, 1990). These are hand-operated unit area samplers that permit qualitative and quantitative estimates of biomass, number of individuals, and number of taxa. Drift nets are another device useful for qualitatively collecting benthic invertebrates dislodged from their habitats and floating in the water column. Ponar grab samplers can be used in deeper habitats such as rivers, reservoirs, lakes, estuaries, and oceans. The Ekman grab sampler is usually used in small lakes or reservoirs, and is inefficient in deep water or where moderate to strong currents or wave action occur. The substrate type also influences selection of the sampling device. Surver samplers, for example, are used when the bottom is mud, sand, gravel, or rubble. The Ponar grab sampler can be used in mud, coarse sand, or fine gravel.

Invertebrate samplers will be rinsed onsite to remove sediments. The final rinse will be with deionized water. Prepared samples will be frozen and shipped on ice to the laboratory for contaminant analysis.

Statistics

Two or more sites will be considered in each of the areas of concern to account for variability. At least three replicate samples will be collected from each of the sites in the areas of concern and the control to enable statistical analysis of the data. Descriptive statistics (mean, standard error) will be calculated for abiotic and biotic samples. If the data appear to be lognormal, a geometric mean will be used to report central tendency. Depending on the sample size and the homogeneity of the data, either parametric or nonparametric tests of significance will be used to compare the contaminated to the control areas.

Population Studies

Population studies will be conducted with fish, benthic invertebrates, zooplankton, and phytoplankton at the contaminated and control sites to determine potential ecological effects.

- Phytoplankton/zooplankton: Zooplankton and phytoplankton samples may be collected qualitatively or quantitatively. Plankton can be sampled qualitatively with conical tow nets; not all taxa are retained, and density cannot be defined unless a flow meter is used. Phytoplankton can be sampled quantitatively with a Van Dorn water sampling bottle, which closes when activated by a messenger (ASTM, 1990). These may not be totally satisfactory for quantitatively collecting zooplankton, which are active and may be able to avoid the sampling device. If the water depth is sufficient, conical tow nets or a Clarke-Bumpus Plankton Sampler are preferable for quantitative collection of zooplankton.

Samples will be collected and preserved with 10 percent buffered formalin or Lugols iodine solution. The samples will be analyzed for diversity and density.

- Fish: A random subsample of fish collected according to the methods given above for contaminant analysis will be preserved for population studies. Species identification will be performed to analyze species composition and relative abundance.

- Invertebrates: A random sample of invertebrates collected according to the methods given above for contaminant analysis will be preserved for population studies. Samples will be preserved in 10 percent buffered formalin, and sent to the laboratory for identification of taxa and analysis of diversity and density.

4.2.12 Geophysical Survey

The geophysical survey will be conducted before drilling activities. The investigation will consist of both magnetic and electromagnetic (EM) conductivity surveys to confirm and locate areas of possible drums or metallic object burials and other conductive materials. This will aid in the placement of soil borings. Details of the geophysical survey are described below.

Equipment and Procedures

A magnetometer survey to identify ferrous metals (iron and steel) will be conducted using a magnetic gradiometer. The gradiometer is a microprocessor-based, proton precession magnetometer consisting of a sensor, staff, and control unit. In the configuration used in this survey, the sensor contains two sensing units spaced at a

1-meter vertical separation. The lower sensor is supported by staff at a height of approximately 2.4 meters above the ground surface.

Operated in the gradiometer mode, the magnetic gradiometer will obtain measurements of the total magnetic field intensity from the upper and lower sensors at each survey station. The difference between the lower and upper sensor will be automatically calculated to yield the vertical magnetic gradient. Temporal changes in the earth's normal magnetic field will be corrected using a base station and tie points.

The EM survey will be conducted using an electromagnetic (EM) induction meter, which measures the apparent conductivity of the subsurface by using the principles of electromagnetic induction. The EM induction meter consists of two horizontal coplanar loops, one acting as a transmitter and the other as a receiver. The transmitter induces eddy currents in the earth, which in turn produce a secondary field. The receiver intercepts the secondary field in which the EM induction meter measures the terrain conductivity by comparing the strength of the secondary field to that of the primary.

The depth of investigation by EM is a function of the intercoil spacing and the orientation of the antenna dipoles. The EM induction meter has an intercoil spacing of 12 feet, and used in the horizontal mode, has an effective depth of analysis of approximately 20 feet. This depth is considered sufficient to locate landfill boundaries, trenches, and buried objects at CAX.

Site-Specific Scope of Work

A magnetic and electromagnetic survey will be conducted at Site 10 to locate buried material. Magnetic and electromagnetic readings will be obtained at 15-foot intervals along each survey line, with lines spaced 15 feet apart.

Four readings will be obtained with the EM induction meter at each measurement station. Readings will be obtained with the antenna boom oriented in two compass directions: north-south and east-west. The EM induction meter will be connected to a data logger that simultaneously records both the quadrature-phase component and the in-phase component. The quadrature-phase component measures the terrain conductivity of the subsurface and will detect metallic and nonmetallic objects or features with conductivities that vary from their surroundings. The in-phase component gives measurements that are proportional to an effective, average magnetic susceptibility of the surrounding earth; this mode is sensitive to large metallic objects. The readings do not indicate true magnetic susceptibility because there is an unknown additive constant and multiplying factor that would be required to convert the measured values to magnetic susceptibility.

4.2.13 Aerial Photographic Interpretation

If contamination is detected at Site 10, aerial photographs will be collected and reviewed to identify sizes, shapes, and boundaries of the three sites. The history of each landfill or burial site will be confirmed through the photographic analyses of sites prior to, throughout, and after their periods of use. Boundary changes and site clearing and revegetation history will be delineated. Stressed vegetation and any unusual or unexpected occurrences will be recorded. The US Navy/National Archives Cartographic Branch is a source for historical aerial photography coverage. Any additional information found with current aerial photography will also be used to update existing site maps.

4.2.14 Off-Base Well Inventory

A well inventory of the potential groundwater contamination receptors in the vicinity of CAX will be performed. It is proposed that all supply wells in the site vicinity be identified. Data to be collected (if available) will include owner, location, usage, depth, daily pumpage rate, well diameter, and installation date. Well data will be obtained from the Navy through the HRS document.

4.3 Equipment and Calibration Requirements

4.3.1 Instrument Calibration and Maintenance

To ensure that measurements made in the field have been performed with properly calibrated instruments, field personnel will follow the procedures described in the Equipment Calibration and Maintenance Owners Manual. All field equipment will be calibrated (at a minimum) daily, prior to and after use, and will be maintained and repaired in accordance with manufacturer's specifications. In addition, prior to and after use, each major piece of equipment will be cleaned, decontaminated, checked for damage, and repaired as necessary. These activities will be noted in the field log book.

Despite even the most rigorous maintenance program, equipment failures do occur. When equipment cannot be repaired, it will be returned to the manufacturer for repairs. Calibration procedures for each instrument that will be used in the field for data acquisition are provided in Table 4-1.

4.3.2 Equipment List for the Field Investigation

The following list provides a comprehensive list of equipment required for the execution of the field investigation.

ESE EQUIPMENT/RESOURCES

- Sampling Equipment:

Lexan Tubing	Field Notebooks
Stainless Steel Bucket Auger	Stainless Steel Bowls
Duct Tape	Trash Bags
Waterproof Markers	Deionized/Distilled Water
Stainless Steel or Teflon® Spatulas/Spoons	Organic Vapor Analyzer
Sample Containers	Marking Tape and Stakes
Topographic Map	Aluminum Foil
Stainless Steel or Teflon® Bailer	Pump (Develop and Purge)

Table 4-1

Equipment Maintenance and Calibration Protocols
Cheatham Annex Investigation

Equipment	Maintenance/Calibration	Frequency
FID flame ionization detector (OVA)	Calibrate with methane and/or benzene gas	Start and end of each day
Explosimeter	Calibrate with methane and carbon monoxide Zero instrument in air	One per month Start of each day in clean area (e.g., support zone)
pH	Calibrate with three pH buffer solutions	Before and after use, and after every 20 samples
Temperature	Check against a mercury thermometer	Every 10 samples
Specific conductance	Calibrate with one calibration solution	Before each use
Rechargeable equipment batteries	Charge	After use/as required

Drums (Development Water)
Shipping Coolers
Detergent
Isopropanol
Survey Equipment
Measuring Tape
Nitric Acid (10 percent)
Spray Bottles

- Safety Equipment:

Steel-toed Boots
Decontamination Buckets/Brushes
Respirator Cartridges
Safety Glasses
Tyvek Suits
Rubber Gloves
Respirators
Hard Hats

NAVY EQUIPMENT/RESOURCES

- Approved potable wash and rinse water for decontamination
- Utility maps and/or previously* cleared/marked utility lines
- Site access agreements

* A thorough knowledge of the locations of all underground lines is imperative during this investigation, given the location of certain sampling points.

5.0 SAMPLE HANDLING AND ANALYSIS

This section provides information on the sample handling, containers, preservation, shipping, and maximum allowable holding time requirements for the samples to be collected at CAX.

5.1 Sample Containers Preservation, Shipment, and Holding Times

The field team leader is responsible for the proper sampling labeling, preservation, documentation, and shipment of samples to the laboratory to meet holding times. Table 5-1 (Round 1) and Table 5-2 (Round 2) lists the number of samples, their holding times, correct volumes and containers, and preservation requirements. All bottles used for the project will be traceable by lot number. Certificates of analysis will be available for each lot upon request. The laboratory will verify preserved status of all chemically preserved samples. The pH for metal samples will be checked upon receipt, while the pH for water samples submitted for VOC will be verified after analysis.

All soil and water samples will be shipped in plastic-lined coolers and padded with vermiculite or bubble wrap to prevent breakage. The coolers will have a minimum of two 1-gallon bags (double bagged) of ice placed in them during shipment to maintain the samples at 4°C. The coolers will be sealed using strapping tape and will have custody seals taped over lid and body of the cooler, rendering the samples irretrievable during shipment without breaking the custody seals.

5.2 Sample Documentation

Field records will be completed at the time a sample is collected and will be signed or initialed, including the date and time, by the sample collector(s). Field records, to be maintained in a bound notebook, will contain the following information:

- Names and affiliations of sample collector(s)
- General description of the day's field activities
- Documentation of weather conditions during the previous 48 hours

Table 5-1

Sample Volumes, Number, Preservation, and Allowable Holding Times (Established by EPA, ref CFR 40, pt. 136) Round 1

(Includes all samples for Sites 1, 10, 11)

Parameter[a]	Number (includes QA)	Volume/Container*	Preservation	Holding Time (b)
Soils**				
VOCs	20	60 ml/glass	4°C	14 days
BNAs	28	500 ml/glass	4°C	14 days/40 days
TPH	28	60 ml/glass	4°C	14 days/40 days
Metals	10	500 ml/glass	4°C	180 days***
Pb	8	500 ml/glass	4°C	180 days
Groundwater				
VOCs	10	3x60 ml/glass	4°C, HCL (pH<2)	14 days
BNAs	32	1 l/glass	4°C	7 days/40 days
TPH	22	3x60 ml/glass	4°C	7 days/40 days
Metals	9	1 l/plastic	4°C, $HN0_3$ (pH<2)	180 days***
Surface Water				
VOCs				
BNAs	9	3x60 ml/glass	4°C, HCL (pH<2)	14 days
TPH	8	1 l/glass	4°C	7 days/40 days
Pb	8	3x60 ml/glass	4°C	7 days/40 days
	8	1 l/glass	4°C, $HN0_3$ (pH<2)	180 days
Sediment**				
VOCs	16	60 ml/glass	4°C	14 days
BNAs	15	500 ml/glass	4°C	14 days/40 days
TPH	15	60 ml/glass	4°C	14 days/40 days
Pb	15	500 ml/glass	4°C	180 days
Marsh Sediment**				
VOCs	18	60 ml/glass	4°C	14 days
BNAs	17	500 ml/glass	4°C	14 days/40 days
TPH	17	60 ml/glass	4°C	14 days/40 days
Pb	17	500 ml/glass	4°C	180 days

(a) VOCs = Volatile Organic Compounds; BNAs = Base/Neutral/Acids; TPH = Total Petroleum Hydrocarbons; and Pb = Lead

(b) Sample collection to extraction/extraction to analysis.

* All containers have Teflon®-lined lids

** Includes soil, sediment, and marsh sediment blanks, which are actually aqueous samples. Each fraction of the aqueous blank samples will be preserved as required by the protocols

*** Mercury has a holding time of 28 days

Table 5-2
Sample Volumes, Number, Preservation, and Allowable Holding Times (Established by EPA, ref CFR 40, pt. 136)
Round 2

(Includes all samples for Sites 1, 10, and 11)

Parameter[a]	Number (includes QA)	Volume/Container*	Preservation	Holding Time
Groundwater				
VOCs	10	3x60 ml/glass	4°C, HCL (pH<2)	14 days
BNAs	32	1 /glass	4°C	7 days/40 days
TPH	22	3x60 ml/glass	4°C	7 days/40 days
Metals	9	1 l/glass	4°C, $HN0_3$ (pH<2)	180 days***
Surface Water				
VOCs				
BNAs	9	3x60 ml/glass	4°C, HCL (pH<2)	14 days
TPH	8	1 l/glass	4°C	7 days/40 days
Pb	8	3x60 ml/glass	4°C	7 days/40 days
	8	1 l/glass	4°C, $HN0_3$ (pH<2)	180 days
Sediment**				
VOCs	16	60 ml/glass	4°C	14 days
BNAs	15	500 ml/glass	4°C	14 days/40 days
TPH	15	60 ml/glass	4°C	14 days/40 days
Pb	15	500 ml/glass	4°C	180 days
Marsh Sediment**				
VOCs	18	500 ml/glass	4°C	14 days
BNAs	17	60 ml/glass	4°C	14 days/40 days
TPH	17	500 ml/glass	4°C	14 days/40 days
Pb	17	60 ml/glass	4°C	180 days

(a) VOCs = Volatile Organic Compounds; BNAs = Base/Neutral/Acids; TPH = Total Petroleum Hydrocarbons; and Pb = Lead

(b) Sampling collection to extraction/extraction to analysis.

* All containers have Teflon®-lined lids

** Includes sediment and marsh sediment blanks, which are actually aqueous samples; Each fraction of the aqueous blank samples will be preserved as required by the protocols.

*** Mercury has a holding time of 28 days.

- Field equipment calibration data
- Unique sample number
- Project/installation name or identification
- Purpose of sample/analysis
- Field measurements of temperature, pH, and conductivity
- Date and time of sampling
- Source/location of sample
- Sample matrix
- Method of sample collection
- Volumes of groundwater removed before sampling, where applicable
- Water level measurements (where applicable)
- Preservative used
- Analyses required
- Serial number(s) on seal(s) and transportation case(s), if any.

COC forms will also be completed for each sample or groups of samples as appropriate. An example of the COC record is provided in Figure 5-1.

The sample container is then placed in a transportation case (i.e., ice chest) along with the custody record form and pertinent field records. The transportation case is then sealed and labeled.

When transferring sample possession, the transferee will sign and record the date and time on the custody record. Custody transfers will account for each individual sample, although samples may be transferred as a group. Every person who takes custody will fill in the appropriate section of a COC record. To prevent undue proliferation of custody records, the number of persons involved in the chain of possession will be as few as possible.

*** FIELD LOGSHEET *** FIELD GROUP: XXXXXX

PROJECT NUMBER — PROJECT NAME: XXXXXX — LAB COORD. JEFF SHAMIS

XXXXXX

ESE #	SITE/STA	HAZ?	FRACTIONS(CIRCLE)	DATE	TIME	PARAMETER LIST
*1			C EC N			XXXXXX
*2			C EC N			XXXXXX
*3			C EC N			XXXXXX
*4			C EC N			XXXXXX
*5			C EC N			XXXXXX
*6	F.DUPE		C EC N			XXXXXX
*7	EQPBLK		C EC N			XXXXXX

NOTE -CHANGE OR ENTER SITE ID AS NECESSARY; UP TO 9 ALPHANUMERIC CHARACTERS MAY BE USED
-CIRCLE FRACTIONS COLLECTED. ENTER DATE,TIME,FIELD DATA (IF REQUIRED), HAZARD CODE AND NOTES
-HAZARD CODES: I-IGNITABLE C-CORROSIVE R-REACTIVE T-TOXIC WASTE H-OTHER ACUTE HAZARD; IDENTIFY SPECIFICS IF KNOWN
-PLEASE RETURN LOGSHEETS WITH SAMPLES TO Hunter/ESE, Inc.

RELINQUISHED BY: (NAME/COMPANY/DATE/TIME)	VIA:	REC'D BY (NAME/COMPANY/DATE/TIME)
1		
2		
3		

SAMPLER: MORE SAMPLES TO BE SHIPPED? __ IF YES, ANTICIPATED # __ TO SHIP ON __/__/__
SAMPLE CUSTODIAN: Custody Seals Intact? __ Samples Iced? __ Preservations Audited? __ Problems?

Figure 5-1
SAMPLE CHAIN-OF-CUSTODY LOG SHEET

SOURCE: ESE, 1991

Environmental Science & Engineering, Inc.
A CILCORP Company

The sampling crew chief is responsible for seeing that samples are properly preserved, labeled, packaged, and dispatched to the laboratory for analysis. This responsibility includes filling out, dating, and signing the appropriate portion of the COC record.

All packages sent to the laboratory will be accompanied by the COC record and other pertinent forms. A copy of these forms will be retained by the sample collectors and transferred to the project files upon completion of sampling at the installation.

Samples will be shipped daily via overnight courier to the laboratory by the sampling crew. Samples will be packed in coolers to avoid breakage, and all samples will be iced. All containers and coolers will be sealed by a tape that shows signs of or can be easily torn if tampered with. The sampling crew chief will provide airbill numbers to the laboratory sample custodian when samples are shipped. Delivery from the airport directly to the laboratory will be made by the overnight courier service. Overnight couriers do not need to sign the individual COC forms. Airbill receipts will be considered valid addendums to the COC forms.

To ensure that the laboratory performs the correct analyses and that the sample integrity is guaranteed from the time of collection until analysis, correct labeling of both sample containers and accompanying documentation (e.g., COC report) must be performed. ESE laboratory will submit monthly progress reports. The reports will detail the activities associated with the analysis of those samples for that month.

Also, at the time of sample collection, each sample will be identified by affixing a pressure-sensitive gummed label on the container. Notations on the label will be made in waterproof, indelible ink. Information on the sample label will include:

- Unique sample number
- Project number or identification
- Source of sample (including identification number, name, location, and sample type)
- Preservative used
- Analyses required

- Name of collector(s)
- Date and time of collection

The COC report serves as physical evidence of sample custody; provides proof of sample collection; the sample location, date, time, type of sample, and analytical parameters; number of containers shipped; and the name of the sample custodians up until the time of shipment.

The COC report is a duplicate form. One copy accompanies the samples to the laboratory where receipt is acknowledged by the laboratory sample custodian. The other copy is retained by the field team leader and incorporated into the project files. An example COC report is presented as Figure 5-1.

6.0 BIBLIOGRAPHY

ASTM. 1990. Annual Book of ASTM Standards. Water and Environmental Technology. Vol. II.04.

NAVFACENGCOM, 1991. Final Remedial Investigation Interim Report, Naval Supply Center (Norfolk), Cheatham Annex, Williamsburg, Virginia.

APPENDIX A

BORING LOG SHEET

PAGE 1 OF 1

PROJECT NO: ____ FILE NO: ________ BORING NO: ________ PROJECT NAME: ________

DATE BEGAN: ____ DATE FINISHED: ________ FIELD GEOLOGIST: ________

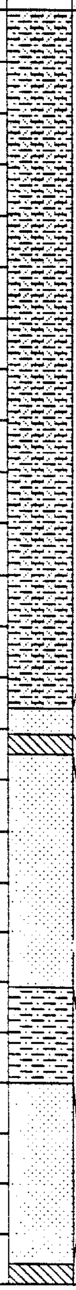
DRILLER: ________ NORTH: ________ EAST: N/A

GROUND SURFACE ELEV: ________ GWL DATE/TIME: ________ GWL DEPTH: ________

DRILLING METHOD: ________ DRILL EQUIP: ________ GWL EQUIP: ________

CONTRACTOR: ________ CHECKED BY: ________

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (0.5')	REC (FT)	PROFILE	DESCRIPTION	USCS	VOLATILE ORGANIC VAPORS (ppm) FID	PID	REMARKS
	0.00									
10.0										
	-5.00									
5.0										
	-10.00									
0.0										
	-15.00									
5.0										
	-20.00									
10.0										
	-25.00									



WELL SAMPLING DATA FORM

Well Number: ______________ Date: ____________ Time: ____________

Boring Diameter: ______________ Well Casing Diameter: ______________

Annular Space Length: __________________ Stickup: __________________

WATER LEVEL

Held: ____

Cut: ____

DTW: ____________________ Top of Casing

COLUMN OF WATER IN WELL

Casing Length: ______________________

DTW Top of Casing: ______________________

Column of Water in Well: ______________________

VOLUME TO BE REMOVED

Gallons per foot of A.S. (from chart) = __________

Column of Water or Length of A.S. (whichever is less) X __________

Volume of Annular Space = __________

Gallons per foot of Casing = __________

Column of Water X __________

Volume of Casing = __________

Total Volume (Volume of A.S. + Volume of Casing) = __________

Number of Volumes to be Evacuated X __________

Total Volume to be Evacuated = __________

Method of Purging (pump, bailer, etc.): ______________________________

FIELD ANALYSES	Start	Mid	End
Time			
pH			
Conductivity			
Temperature			

Total Volume Purged: __________ gallons

Sample Date/Time: ________________ Sample Number: ________________

FRACTIONS

VP	V	N	NF	C	O	S	UP	Z	B
CF	F	H	CL	M	P	R	RP	T	RS

Signed/Sampler: ________________________________ Date: __________

Signed/Reviewer: ________________________________ Date: __________

DRAFT FINAL
SITE-SPECIFIC HEALTH AND SAFETY PLAN FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY NAVAL SUPPLY CENTER
Cheatham Annex
Williamsburg, Virginia

Prepared for:

Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia
Contract No: N62470-90-B-7661

Prepared by:

Environmental Science & Engineering, Inc. (ESE)
250-A Exchange Place
Herndon, Virginia 22070

July 1991

APPROVALS

This plan has been prepared to provide site-specific safety and health information related to activities to be performed during field investigation activities at the Naval Supply Center, Cheatham Annex, Williamsburg, Virginia. Personnel associated with this project will sign the Declaration of Understanding to document that they have read and understand this Site-Specific Health and Safety Plan (HASP). Changes to this HASP shall be documented in writing. Any additional safety information developed during field activities shall be noted and used to revise the plan prior to subsequent activities. This plan has been reviewed and approved for this project.

Andrew M. Forrest Project Manager	Date
Ronald G. Martin Project Safety Manager	Date

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APPENDICES

LIST OF TABLES

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1.0 INTRODUCTION

WASTE TYPE(S):				
Liquid: X	Solid: ___	Sludge: ___	Gas: ___	Other: ___
CHARACTERISTICS:				
Corrosive: ___	Ignitable: ___	Radioactive: ___	Volatile: X	Toxic: X
Reactive: ___	Unknown: ___	Other: ___		

1.1 Plan Purpose

This Health and Safety Plan (HASP) describes the procedures that will be followed during field investigation activities at the Naval Supply Center, Cheatham Annex (CAX), Williamsburg, Virginia. This HASP is designed to protect the health and safety of personnel involved in the investigation of hazardous substances at the site and to develop a contingency plan for dealing with onsite emergencies, some of which may have the potential for offsite impact. Topics addressed in the health and safety program described by this HASP include:

- Site characteristics
- Waste characteristics
- Hazard evaluation
- Site control
- Personnel training
- Personal protection
- Monitoring equipment
- Work limitations
- Action levels
- Decontamination
- Medical monitoring
- Emergency contacts

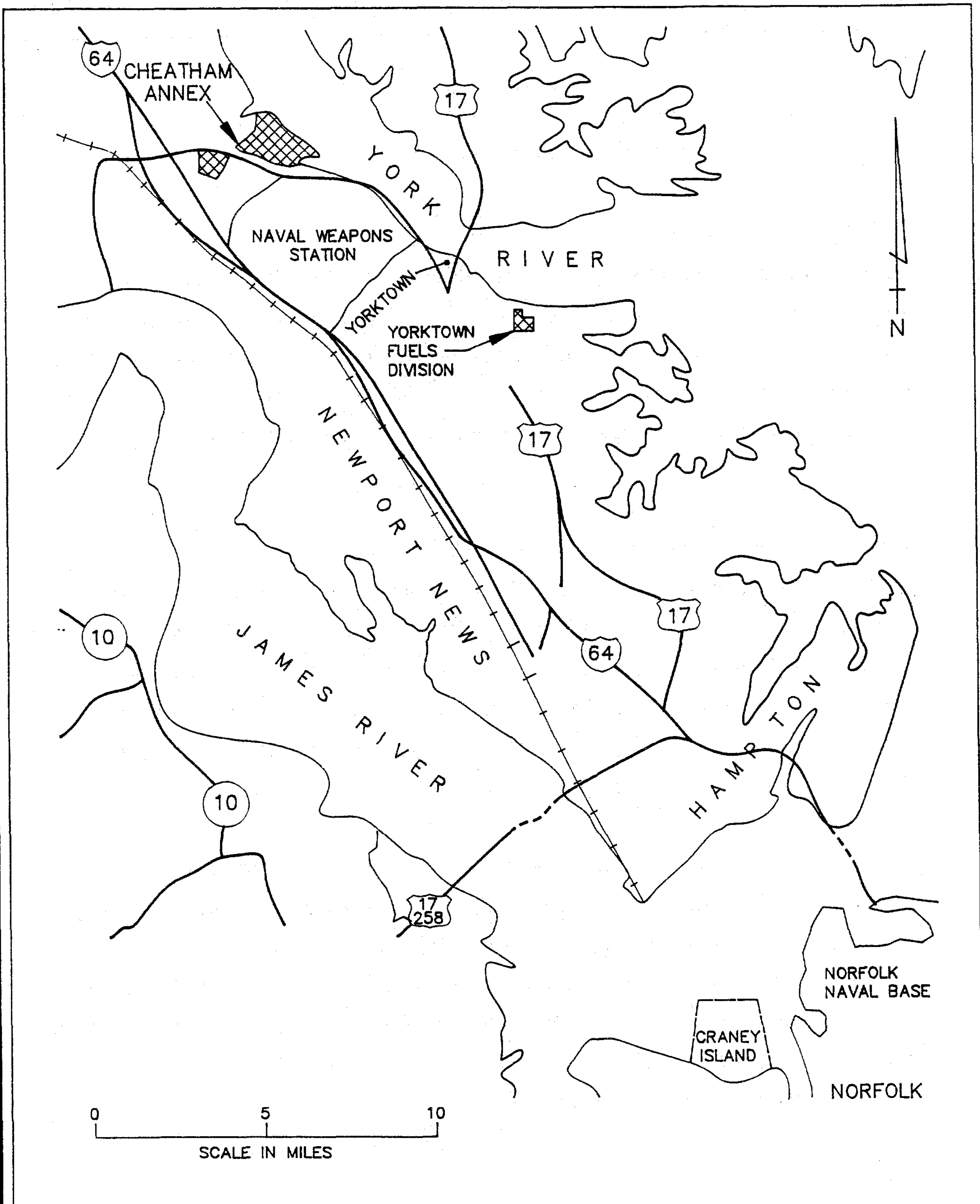
- Incident reporting
- Field documentation of health and safety procedures

1.2 Site Description

CAX is located in Williamsburg, Virginia in Central York County on the Virginia Peninsula (Figure 1-1). The 1,579-acre facility is bounded on the north by the York River, on the south by the Colonial Parkway, on the west by Department of Interior property, and on the east by the Yorktown Naval Weapons Station. CAX is surrounded by a patrolled fence with guards stationed at gates to restrict entry by unauthorized personnel.

CAX was initially commissioned as a satellite unit of the Naval Supply Depot in June 1943 to provide bulk storage facilities. During World War I and prior to establishing CAX, the site had been the location of a large powder and shell-loading facility operated by Dupont. Following closeout in 1918, the land was used for farming or left idle until CAX was established in 1943. CAX's mission has essentially remained the same since it was commissioned: receiving, storing, packaging, and shipping materials to Federal facilities on the east coast and major distribution centers in Europe.

CAX is located on the York-James Peninsula (see Figure 1-1) in the Coastal Plain Physiographic Province. This elongated peninsula occupies an area of approximately 1,752 square miles with a topography characterized as gently rolling terrain dissected by ravines and stream valleys that flow predominantly northeast toward the York River. Ground elevations at the site vary from sea level along the eastern boundary at the York River to a maximum elevation of approximately 90 feet above mean sea level (msl) on a few scattered hills in western site portions.



ESE Environmental Science & Engineering	DATE 5-15-91	SCALE SHOWN	TITLE VICINITY MAP CHEATHAM ANNEX	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. VM65 / –	CLIENT NSC CHEATHAM	FIGURE 1–1

The climate of the Virginia Peninsula is moderate continental, with mild winters and long, warm summers. Average monthly temperatures for the area range from approximately 41°F in January to 79°F in July. Precipitation is well distributed throughout the year, and the heaviest rains occur in July and August. Prevailing winds are usually from the southwest, although northeasterly winds are common in some months. The average wind speed is 10.6 miles per hour (mph), and average annual net precipitation is approximately 45 inches.

2.0 ORGANIZATION AND RESPONSIBILITIES

Responsibilities of the Project Manager, Project Safety Manager, Site Safety Officer (SSO), Field Team Leader (FTL), and field team members will be in accordance with ESE standard practices. Subcontractors for this project are considered field team members and subject to the same requirements and responsibilities.

2.1 Project Manager

The ultimate responsibility for health and safety on the project lies with the Project Manager. The Project Manager for the field work to be conducted at CAX is Mr. Andrew M. Forrest. The Project Manager's safety and health responsibilities include:

1. Directing the preparation of an effective and comprehensive HASP for the project
2. Ensuring that adequate and appropriate safety training and equipment are available for project personnel
3. Ensuring that project personnel are medically monitored and qualified for their involvement in the project

2.2 Project Safety Manager

The Project Safety Manager for the field work will be Mr. Ronald G. Martin, who will be responsible to the Project Manager for overall project safety. He will be responsible for implementing corrective actions for the safety program at CAX, including:

1. Preparing or reviewing the project HASP, making necessary changes, and providing final approval when the document is satisfactory
2. Categorizing and identifying the hazards and associated risks for the conditions and activities to be encountered onsite
3. Reviewing reports of incidents related to project activities
4. Ensuring proper documentation and maintenance of all health and safety records

2.3 Site Safety Officer

The Site Safety Officer (SSO) will also be Mr. Forrest, who will be responsible for personnel health and safety during site activities at CAX. Responsibilities include:

1. Conducting site safety meetings prior to field activities
2. Performing onsite documentation of all required records (e.g., medical surveillance, training, safety meetings)
3. Implementing all safety procedures and operations onsite
4. Updating equipment or procedures based on new information gathered during the site inspection
5. Upgrading or downgrading the levels of personal protection based on site observations
6. Determining and posting locations and routes to medical facilities (including poison control centers) and arranging emergency transportation to medical facilities, as required
7. Notifying, as required, local public emergency officers, including police and fire departments, of the nature of the team's operations and making emergency telephone numbers available to all team members
8. Ensuring that at least one member of the field team is available to stay behind and notify emergency services if the SSO must enter an area of maximum hazard, or entering this area only after notifying emergency services (police department)
9. Observing work party members for symptoms of onsite exposure or stress
10. Arranging for the availability of onsite emergency medical care and first aid, as necessary

The SSO has the ultimate responsibility to stop any operation that threatens the health or safety of the team or surrounding populace or causes significant adverse impact to the environment.

2.4 Field Team Leaders

The FTL will also be Mr. Forrest. He will be responsible for all operational activities onsite and all safety and health practices by site personnel. FTL responsibilities include:

1. Ensuring and enforcing compliance with the HASP
2. Controlling site entry of unauthorized personnel or coordinating with local law enforcement agencies or state authorities to limit site access
3. Coordinating site activities so they may be performed in an efficient and safe manner consistent with the HASP
4. Enforcing the buddy system onsite
5. Ensuring the ready access and availability of all safety equipment

2.5 Field Team Members

ESE field team members and subcontractors are responsible to the FTL and SSO for all activities onsite. The responsibilities of field team members include:

1. Complying with all aspects of the HASP, including strict adherence to the buddy system
2. Obeying the orders of the FTL and SSO
3. Notifying the FTL or SSO of hazardous or potentially hazardous incidents or working situations

2.6 Site Visitors

All visitors, including client and government agency representatives, are required to comply with all HASP provisions, and will be responsible to the FTL or SSO. Site visitors are responsible for:

1. Complying with all aspects of the HASP, including strict adherence to the buddy system
2. Obeying the orders of the FTL and SSO

2.7 Client Contact

The client contact will be Mrs. Brenda Norton. Mrs. Norton will serve as the primary liaison between LANTDIVFACENGCOM and the ESE Project Manager; her phone number is (804) 445-4801 during working hours. All ESE project personnel and subcontractors are directly or indirectly responsible to the client. The client contacts, however, must comply with all applicable portions of the HASP when in areas covered by its provisions.

3.0 REGULATORY REQUIREMENTS

Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910 and 1926 apply to work under this site-specific safety plan. Detailed OSHA requirements for hazardous waste operations are contained in 29 CFR 1910.120, "Final Rule for Hazardous Waste Site Operations and Emergency Response." Specific sections of 29 CFR 1910 and 1926 which apply include:

1. Section 1910.134: Respiratory Protection
2. Section 1910.1000: Air Contaminants
3. Section 1926.602: Material Handling Equipment

Additional guidance for hazardous waste operations may be found in the EPA publication "Standard Operating Safety Guides" (November 1984), National Institute of Occupational Safety and Health NIOSH/OSHA/US Coast Guard (USCG)/EPA publication "Occupa-tional Safety and Health Guidance manual for Hazardous Waste Site Activities" (October 1985), and US Army Corps of Engineers (USACE) publication "Safety and Health Requirements Manual" (revised October 1984).

Health and safety related air monitoring data generated during the project will become part of the written record. Both medical and air monitoring data will be retained as required by OSHA in various standards (29 Code of Federal Regulations (CFR) 1910.20, 1910.1018, 1910.1025). Training records are maintained in project files and on personal identification cards and will be available for inspection at all times. Subcontractors will be required to have similar documents available for inspection as required.

4.0 TRAINING

All ESE site personnel and subcontractors for the CAX field investigation will have completed an extensive 40-hour training course and will have worked at least three days at a hazardous waste site. An outline of the ESE training course is shown in Table 4-1. All subcontractors and site visitors will be required to provide proof of equivalent training prior to entering an exclusion zone. The FTL will have completed an additional 8 hours of waste site management training. At least one member of the field team will be trained to perform cardiopulmonary resuscitation (CPR) and first aid.

Table 4-1.

ESE Hazardous Waste/Materials Site Investigations Training Course

Safety Plans
Fundamentals of Industrial Hygiene
Properties of Hazardous Materials/Compatibility Testing, Shipping, and Handling of Samples/Chain of Custody
Levels of Personal Protection
Air Characterization (includes Hands-On Session)
Hotline Systems
Decontamination Operation
Emergency Response
Air-Purifying Respirators (APR) and Fit-Testing
Air-Supplying Respirators (ASR)
Field Exercises, Air-Purifying Respirators, and Self-Contained Breathing Apparatus (SCBA), Levels A, B, and C
Field Exercises (Site Zones and Sampling Operations)
Confined Space Entry
Review of Regulations
Engineering Controls

Source: ESE, 1991

5.0 MEDICAL EXAMINATIONS

All onsite ESE personnel for this project will be required to have the medical examination consistent with the parameters outlined in Table 5-1. This examination is given annually; more often if specified by the attending physician. All site visitors and subcontractors will be required to participate in an equivalent medical surveillance program, including monitoring for site contaminants prior to entering the exclusion zone. All medical examinations shall include certification by the physician of the employee's ability to wear a negative-pressure respirator and to perform strenuous work. If a person sustains an injury or contracts an illness related to work onsite that results in lost work time, he must obtain written approval from a physician to regain access to the site.

Table 5-1

Medical Monitoring Program

Basic physical exam
Heart status and functions (EKG)
Chest X-ray (Roentgenogram posterior-anterior)
Pulmonary function--forced vital capacity, forced expiratory volume at 1 second and reserve volume
Blood--full SMAC Series
Hemoglobin--cell counts, protein levels
Heavy metals
Liver function--full enzyme profile
Renal function--BUN, Creatinine, Creatine/Creatinine ratio, lipoprotein count and differential, uric acid
Urinalysis
Audiometry--audio spectrum response of ear
Eye--physical condition, visual acuity

Source: ESE, 1991

6.0 SITE HAZARD EVALUATION

6.1 Chemical Hazards

Site contaminants identified during previous investigations include volatile and semivolatile organics, heavy metals, and oil and grease. Principal exposure pathways for personnel engaged in field activities at the site include dermal contact, inhalation, and ingestion. Known contaminants of concern are discussed below:

- 1,1,1-trichloroethane (TCA), also known as methyl chloroform: Chemical abstract service (CAS) Number 71-55-6; OSHA permissible exposure limit (PEL) - 350 ppm; (8-hour time-weighted average (TWA)); immediately dangerous to life or health (IDLH) level - 1000 ppm. Routes of exposure are: inhalation, ingestion, and corneal contact. Symptoms of exposure include: headaches, weariness, central nervous system (CVS) depression, poor equilibrium, irritated eyes, dermatitis, and cardiac arrythmia. Target organs are the skin, CNS, cardiovascular system (SVS), and eyes.

- Phenol: CAS Number 108-95-2; OSHA PEL - 5 ppm; (8-hour TWA); IDLH level - 250 ppm. Routes of exposure are: inhalation, skin absorption, ingestion, and corneal contact. Symptoms of exposure include: irritation to the eyes, nose, and throat, anorexia, weakness, muscle aches, dark urine, cyanosis, liver and kidney damage, tremors and convulsions, and skin burns. Target organs are the liver, kidneys, and skin.

- Acetone: CAS Number 67-64-1; OSHA PEL - 1000 ppm; (8-hour TWA); IDLH level - 20,000 ppm. Routes of exposure are: inhalation, ingestion, and corneal contact. Symptoms of exposure include: irritation to the eyes, nose, and throat, dizziness, and dermatitis. Target organs the respiratory system and skin.

- Dimethylphthalate: CAS Number 131-11-3; OSHA PEL - 5 mg/m^3; (8-hour TWA); IDLH level - 9300 mg/m^3. Routes of exposure are: ingestion, inhalation, corneal contact. Symptoms of exposure include: irritation to nasal passages, upper respiratory system, stomach, and eye pain. Target organs are the respiratory system and gastrointestinal tract.

- Inorganic lead: CAS Number 7439-92-1; PEL - 0.05 mg/m^3; (8-hour TWA); IDLH level is not applicable. Routes of exposure are inhalation, ingestion, and corneal contact. Symptoms of exposure include: weariness, insomnia, constipation, abdominal pain, hypotension, anemia, and gingival lead line. Exposure and target organs are the gastrointestinal tract, CNS, kidneys, blood, and gums.

6.2 Physical and Mechanical Hazards

Activities onsite may include:

- Site Characterization
- Site Air Monitoring
- Installation and Sampling of Groundwater Monitor Wells
- Soil gas survey
- Site Topographic Surveying
- Collection of Surface and Subsurface Soil
- Geophysical Surveying

Physical hazards associated with these activities are varied and include: vehicle/pedestrian collisions, fire, handling heavy material, equipment operations resulting in contact and crushing type injuries, and use of air- and electrically-powered tools that may result in abrasions, contusions, lacerations, etc. The potential for such hazards necessitates the use by all onsite personnel of personal protective clothing to include coveralls, safety gloves or boots, and hard hats. Additionally, personnel engaged in physical labor are to wear sturdy work gloves.

6.2.1 Motor Vehicles and Motorized Equipment

All motor vehicles will be maintained in a safe operating condition and in accordance with local and state safety requirements. All vehicles and moving equipment will be operated onsite and enroute to and from sites in accordance with state and local motor vehicle regulations for speed, lights, warning signals, passenger capacity, and operation. If any equipment is left unattended at night adjacent to a highway or construction area, it will be provided with suitable barricading, light reflectors, or other visual warnings to identify its location.

Any equipment, including drill rigs, earth-moving equipment, and other mechanical equipment, will be operated in strict compliance with the manufacturer's instructions, specifications, and limitations, as well as any applicable regulations. The operator is responsible for inspecting the equipment daily to ensure that it is functioning properly and safely. This inspection will include all pins, pulleys connections subject to faster than normal wear, and all lubrication points.

Hand signals to equipment operators will be the commonly accepted industry standard signals for the type of equipment being used. Only one person will signal the equipment operator at any given time.

When equipment with moving booms, arms, or masts is operated in the vicinity of overhead hazards, the operator, with assistance from the designated signaling person, will ensure that moving equipment parts equipment maintain safe clearances to the hazards. Equipment will be kept away from energized electrical lines by at least 16 feet for lines rated at 50 kV and above.

Drill rigs and other equipment not specifically designed to move with an elevated boom, mast, or arm will be returned to traveling position and condition before being moved.

6.2.2 Portable Equipment and Tools

All equipment and tools will be inspected prior to each day's use and as often as necessary to ensure safe usage. Defective equipment and tools will be removed from service immediately. Examples of defective tools include: hooks and chains stretched beyond allowable deformations, cable and ropes with more than the allowable number of broken strands, missing grounding prongs on power tools, defective on/off switches, mushroomed heads of impact tools, sprung wrench jaws, missing or broken handles or guards, and wooden handles that are cracked, splintered, or loose. All equipment and tools will be used within their rated capacities and capabilities.

Pneumatic and hydraulic tools and equipment will be used in accordance with manufacturer's instructions and applicable OSHA standards, and will be inspected daily by trained operators. All pressure and vacuum connections will be secured with suitable means to minimize damage and potential for injury caused by failed connections. No safety device will be removed, modified, or otherwise compromised for any reason.

Electrical equipment, including pumps, sampling equipment, and meters, will be inspected to ensure that they are in good condition and properly working prior to onsite use. Only approved, listed equipment and components will be used. All connections will be made in accordance with National Electric Code practices. All equipment and devices will be properly grounded or bonded to an adequate grounding mechanism. Only equipment listed as explosion-proof will be used in areas with explosivity sustained at or above 10 percent of the lower explosive limit (LEL).

Whenever possible, equipment should not be driven into the ground, but placed into an augered hole. All onsite personnel will exercise due care when working with drilling equipment to eliminate becoming entangled, crushed, or otherwise injured. No loose clothing or unconfined long hair will be permitted in the immediate area of any operating drilling tools or equipment. Probes and other pieces of equipment that are driven into the ground will be placed using a slide hammer to minimize potential for crushing injury.

6.2.3 Excavation and Trenching

No excavation or trenching is necessary. However, while clearing the site for any drilling, employees will wear appropriate personal protective equipment for the hazards present as determined by the SSO.

6.2.4 Demolition and Tank Removal

No demolition or tank removal will be undertaken.

6.2.5 Confined Spaces

No confined space entry will be required during the remedial investigation.

7.0 AIR MONITORING

7.1 General

An air monitoring program is fundamental to the safety of onsite and offsite personnel. Total organic vapor (TOV) levels associated with onsite activities will be monitored with a flame ionization detection (FID) instrument (OVA). This instrument will be the primary source of information for upgrading personal protection. Monitoring equipment will be calibrated and maintained at least twice daily (before and after use) in accordance with manufacturer's recommendations.

ESE personnel will establish a daily background TOV level prior to initiating onsite activities. Under most circumstances, this level can be determined by taking multiple readings at representative locations along the perimeter of the site and averaging the results of sustained measurements. (A sustained measurement is defined as the arithmetic average of six readings taken at 10-second intervals.) If, due to site conditions, perimeter readings will not yield a truly representative background level, the SSO or ESE Corporate Health and Safety Officer will be consulted for guidance.

Decisions to upgrade or downgrade personal protection will be based on a sustained breathing zone TOV level that exceeds background (i.e., 0 ppm) levels. Breathing zone refers to the area from the top of the shoulders to the top of the head. Specific criteria for upgrading personal protection based on TOV levels is presented in Table 5-1. Appendix A contains a sample log sheet for recording TOV measurements. All field work will be carried out in a minimum of level D protection. TOV Air monitoring will be used to determine appropriate levels of personal protection.

Table 7-1

Organic Vapor Measurements and Personal Protection

Total Organic Vapor*	Level of Protection**
Up to (background + 2 ppm)	D
(Background + 3 ppm) to (background + 10 ppm)	C
(Background + 11 ppm) to 500 ppm	B
Greater than 500 ppm***	A

* Based on sustained breathing zone measurements with FID
** As described in Appendix B
*** Call Project Safety Officer for Confirmation

Source: ESE, 1991

7.2 Site-Specific Air Monitoring Procedures

Specific air monitoring procedures to be used during field activities of the design phase are listed below.

1. Prior to drilling or other soil intrusion activity, measure exposure levels in boring area with FID to compare with the background measurement.
2. Measure FID level within borings with probe. If FID levels exceed 10 ppm in boring, take measurement of drillers' and geologists' breathing zones and take measurements in the bore hole with explosive gas meter.
3. If sustained breathing zone levels exceed (background + 3 ppm) in any work areas, upgrade applicable worker(s) to Level C.
4. If sustained breathing zone levels exceed (background + 11 ppm), or if the explosive gas meter registers ≥ 20 percent LEL, consult with the SSO or a Corporate Health and Safety Officer before continuing operations.
5. Record measurements on the log sheet in Appendix A.

8.0 SITE SAFETY WORK PLAN

8.1 Perimeter Establishment

The work area perimeter will be established as a 25-foot radius from the sampling point, unless changed by the SSO.

8.2 Personal Protection

The following levels of protection will be used:

- Level D for surface investigations
- Modified D for subsurface investigations (foot and hand protection)
- Level C if sustained TOV readings in the breathing zone exceed background level + 3 ppm

Hard hats and eye protection will be worn by all personnel within 50 feet of active drilling and/or excavation operations, and whenever there is a potential for splashing or falling equipment parts. Sturdy work gloves are required for all personnel handling tools or performing manual labor.

8.3 Work Zones and Decontamination Procedures

Work zones and decontamination procedures will be established at the site by the SSO. These zones and procedures may be modified to fit applicable field conditions; however, proposed modifications must be approved by the ESE Project Manager and SSO prior to being implemented in the field.

All heavy equipment will be decontaminated with steam cleaners at a designated and marked location onsite. Water from the steam cleaner will be used to remove any visual contamination from drilling and excavation equipment.

8.4 Site Entry Procedures

The site can be entered through a gate located on Colonial National Historical Parkway (see Figure 8-1).

8.5 Team Members

The following individuals will require site access for the Landfill near the Incinerator (Site 1), Decontaminated Agent Disposal Area (Site 10), and Bone Yard (Site 11):

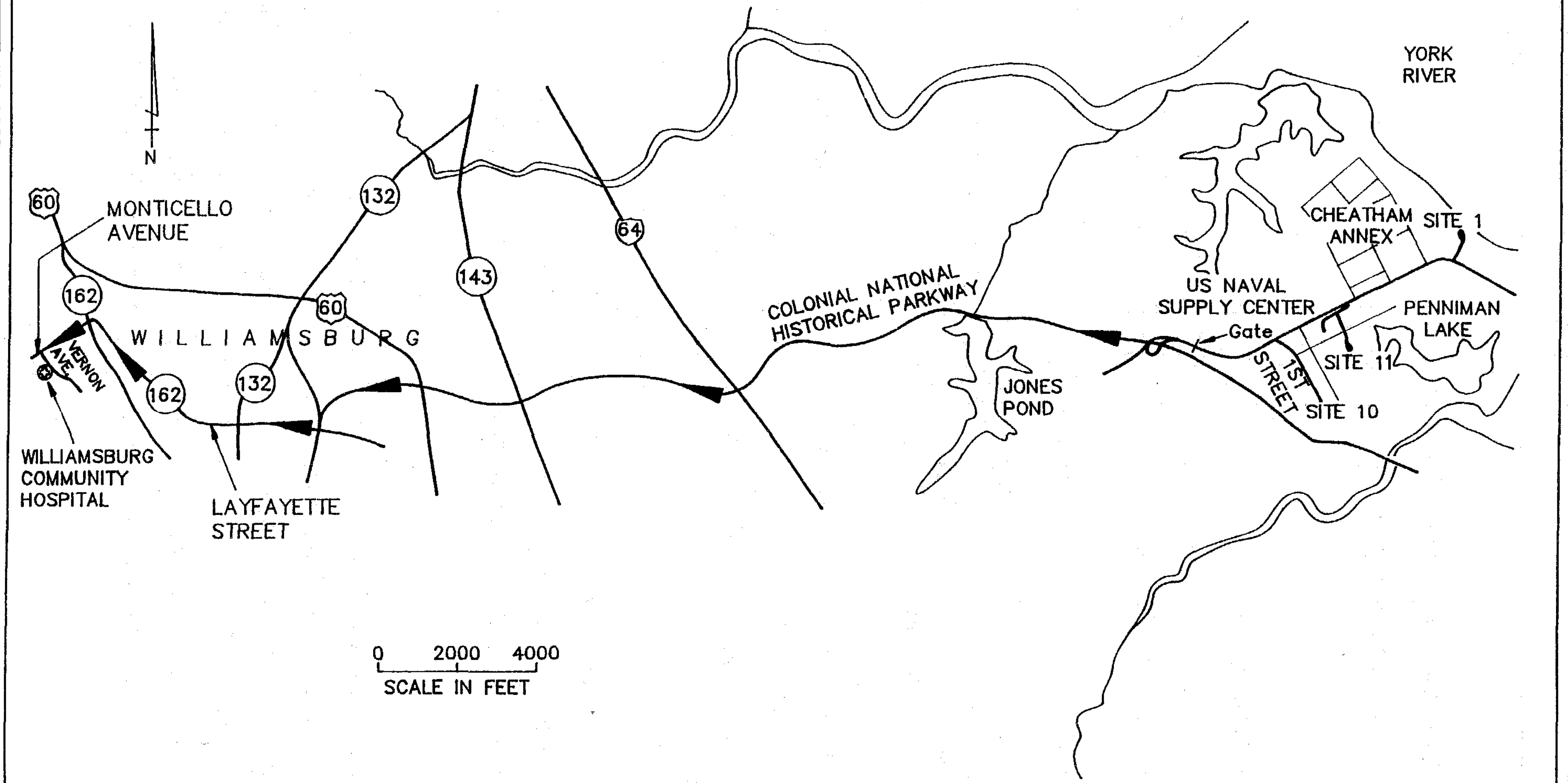
Team Member	Responsibility
Andrew Forrest*, **	Project Manager, FTL, SSO
Ron Martin*	Field Team Member, Project Safety Manager
Bill Stafford	Field Team Member
Drilling Subcontractors	Drilling Operations

All of these individuals are certified to wear respiratory protection in accordance with criteria from 29 CFR 1910.134 and have taken a 40-hour Hazardous Materials Training course. The following designations indicate additional certifications: (*) CPR certified, and (**) Emergency First Aid certified.

8.6 Work Limitations

Work shall be limited to daylight hours and during normal weather conditions. Extremes in temperature and weather conditions (e.g., wind and lightning) will restrict working hours.

The following technique will serve as a guide for monitoring the body's recuperative ability toward excess heat. Monitoring of personnel wearing protective equipment and clothing will commence when the ambient temperature is 70°F or above. When temperatures exceed 85°F, workers will be monitored after every work period. Monitoring will include visual observations for signs of heat stress, measuring oral temperature during employee rest period (if oral temperatures exceed 100°F, lengthen



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	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. ER65 / -	CLIENT NSC CHEATHAM	FIGURE 8-1

break period and shorten work period), and measurement of radial pulse at the beginning of each rest period. If the heart rate exceeds 110 beats per minute at the beginning of a rest period, the next work period will be shortened by 10 minutes and the rest period will remain the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle will be shortened another 10 minutes.

8.6.1 Characteristics of Heat Stroke

Heat stroke is a profound disturbance of the body's heat-regulating mechanism, associated with high fever and collapse. This condition can result in convulsion, unconsciousness, and even death unless responsive measures are undertaken immediately. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age are all contributing factors to heat stroke. Symptoms may include the following:

- Sudden onset
- Dry, hot, and flushed skin
- Dilated pupils
- Early loss of consciousness
- Full and fast pulse
- Uneven breathing rate
- Involuntary muscle twitching and convulsions
- Body temperature reaching 105°F and higher

Heat stroke constitutes a medical emergency and warrants immediate medical care. Remove the victim to a cool environment and remove as much clothing as possible. Reduce temperature by dousing the body with wet sponges, or preferably, wrap the victim in a wet towel and monitor breathing. If cold packs are available, apply to underarms, the neck, ankles, or any place where blood vessels close to the skin surface can be cooled. If the victim is conscious, have him/her drink Gatorade or comparable electrolyte-enhanced liquid.

Heat stroke prevention of heat stroke is strongly encouraged, especially under conditions of high ambient temperature and humidity. The following suggested work conditions are recommended:

1. Ensure that workers drink plenty of fluids during work breaks.
2. Ensure that frequent work breaks are scheduled, and that schedules are observed.
3. Revise work schedules to take advantage of cooler parts of the day (e.g., work in early morning hours or at night).
4. Observe the following general guidelines:

Ambient Temperature (°F)	Active Work Time (min/hr) using Level B Respiratory Protection
75 or less	50
80	40
85	30
90	20
100	0

Also, good hygienic standards must be maintained by frequent clothing changes and daily showering. Clothing must be permitted to dry during rest periods. If skin problems appear, consult medical personnel.

8.6.2 Characteristics of Frost-Bite

The human body "senses" cold as a result of two factors: air temperature and wind velocity. Cooling of the flesh increases rapidly as wind velocity increases. Frostbite can occur at relatively mild temperatures if wind is allowed to penetrate body insulation or attack exposed skin. For example, when the air temperature is 40°F and the wind velocity is 30 miles per hour, the exposed skin would be subject to an equivalent still air temperature of 13°F. Table 8-1 illustrates windchill indices and the associated hazards to exposed flesh. Protection will be taken to minimize exposed flesh, and layered clothing will be used, as appropriate.

Table 8-1

Windchill Index

Windspeed in mph	Actual Thermometer Reading (°F)									
	50	40	30	20	10	0	-10	-20	-30	-40
Calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116

Over 40 mph (little added effect)	**Little Danger** (for properly clothed person) 50°F to 20°F	**Increasing and Great Danger** (danger from freezing of exposed flesh) 10°F to -40°F

Source: National Safety Council, 1982.

9.0 STANDARD OPERATING PROCEDURES

9.1 General Safety Rules

In addition to the specific requirements of this site-specific HASP, common sense should prevail at all times. The following general safety rules and practices will be in effect at the site:

1. The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors, but will not hinder emergency services, if needed.
2. All open holes, trenches, and obstacles will be properly barricaded in accordance with local site needs. These needs will be determined by proximity to traffic (both pedestrian and vehicular) and the location of the hole, trench, or obstacle. If holes are required to be left open during non-working hours, they will be adequately decked over or barricaded and sufficiently lighted.
3. Prior to conducting any digging or boring operations, underground utility locations will be identified. The engineer-in-charge (EIC) and local utility authorities will be contacted to provide locations of underground utility lines and piping. All boring, excavation, and other site work will be planned and performed with consideration for underground lines.
4. Drilling, boring, movement, and use of cranes and drilling rigs; erection of towers; movement of vehicles and equipment; and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs, lights, buildings, other structures and construction, and natural features such as trees, boulders, bodies of water, and terrain.
5. When working in areas where flammable vapors may be present, particular care will be exercised with tools and equipment that may be sources of ignition. All tools and equipment so provided will be properly bonded and/or grounded.

6. Approved and appropriate safety equipment, as specified in this site-specific HASP (e.g., eye protection, hard hats, foot protection, respirators) will be worn in required areas. In addition, eye protection will be worn when handling contaminated soil and water.
7. Beards that interfere with respirator fit are not allowed unless certified within the site boundaries. This is necessary because all site personnel may be called upon to use respiratory protection.
8. No smoking, eating, or drinking will be allowed in the designated work zone.
9. Tools and hands will be kept away from the face.
10. Personnel will shower at the end of each shift, or as soon as possible after leaving the site.
11. Each sample will be treated and handled as through it were extremely toxic.
12. Persons with long hair and/or loose-fitting clothing that could become entangled in power equipment are not permitted in the work area.
13. Horseplay is prohibited in the work area.
14. Work while under the influence of intoxicants, narcotics, or controlled substances is prohibited.

9.2 Accident Prevention Plan/Accident Reporting

The purpose of the site-specific HASP is to prevent accidents and minimize the impact of an accident should one occur (i.e., the site-specific HASP is the accident prevention plan).

All accidents and potential exposures must be reported to the SSO immediately. Prompt reporting is essential to ameliorating the hazard and ensuring the well-being of the affected individual(s). The SSO will notify the ESE Project Manager of any serious accidents or exposures. The SSO or other designated field team members will have current CPR and first aid training, which will be administered to affected personnel under the SSO's direction. For serious accidents, the nearest ambulance service will be contacted to transport the injured personnel to the nearest medical facility (see Section

10.0). The SSO will have established contact with involved medical authorities to ensure that medical facility personnel are knowledgeable of the activities occurring at the site and the types of potential exposures or accidents that might occur.

A formal report of an OSHA-recordable accident or event will be filed on behalf of the employee by ESE. All reports must be received within two working days.

9.2.1 Worker Injury Response Plan

If an employee working in a contaminated area is physically injured, Red Cross first aid procedures will be followed. Depending on the severity of the injury, emergency medical response may be sought. Emergency phone numbers will be conspicuously posted at the command post. If the injured individual can be moved, he/she will be taken to the edge of the work area (on a stretcher, if needed) where contaminated clothing will be removed (if possible), emergency first aid will be administered, and transportation to local emergency medical facility will be arranged.

Minor Accidents: If the injury to the worker is chemical in nature (e.g., overexposure), the following first aid procedures are to be instituted as soon as possible:

a. Eye Exposure - If contaminated solid or liquid gets into the eyes, wash eyes immediately with large amount of water and lift the lower and upper lids occasionally. Obtain medical attention immediately. (For obvious reasons, contact lens are prohibited for individuals working in the contaminated area.)

b. Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solids or liquids penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately if symptoms warrant.

c. Breathing - If a person breathes in large amounts of organic vapor, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

d. Swallowing - If contaminated solid or liquid has been swallowed and the person is conscious, feed the individual large quantities of salt water immediately and induce vomiting if indicated by the appropriate MSDS list (unless the person is unconscious). Obtain medical attention immediately.

A list of chemical compounds and their MSDS's likely to be found on the site will be conspicuously posted in the command trailer. The SSO is responsible for making attending emergency medical response personnel aware of possible contaminants causing the medical emergency. An identical list of compounds shall also be maintained by the Corporate Health and Safety Officer. Any incident involving worker exposure or injury should be reported to the Project Manager and Corporate Health and Safety Officer immediately.

Major Accidents: Major accidents which pose a potential immediate threat to life, limb, or health shall be handled in the following manner:

a. The injured individuals will be administered to by the SSO or other member of the work party holding current certification in CPR and first aid.

b. The necessary emergency response services (ambulance, fire department, hospital, poison control center) will be notified immediately.

9.3 Contingency Plan

9.3.1 Fire Control

No smoking will be allowed in any control areas onsite at any time. Fire extinguishers will be available at sampling sites for use on small fires. All samples shall be handled as though extremely toxic, flammable, and reactive. The SSO will post, in a conspicuous place, the telephone number of the nearest fire station and local emergency personnel to be contacted in case of a fire emergency.

9.3.2 Spill Control

In the event of a spill, the SSO will be notified immediately. The important factors are that no personnel are exposed to vapors, gases, or mists and the liquid does not ignite. Waste spillage must not be allowed to contaminate any adjacent surface water and must be contained onsite, if possible, while avoiding worker exposure. Small dikes may be erected to contain spillage, if appropriate, until proper spill response can be executed. Subsequent to cleanup activities, the SSO will conduct a survey of the area to ensure that no residual toxic or explosive vapors are present.

10.0 EMERGENCY INFORMATION

All emergency information, including phone numbers and routes to emergency medical care, will be posted onsite and/or carried by each field team member.

10.1 Local Emergency Contacts

Ambulance (804) 887-7333/7222

Fire Department (804) 887-7333

Hospital - First Aid - Naval Weapons Station (804) 887-4911

Hospital - Emergency - Williamsburg Community Hospital (804) 253-6005

Police (804) 887-7222

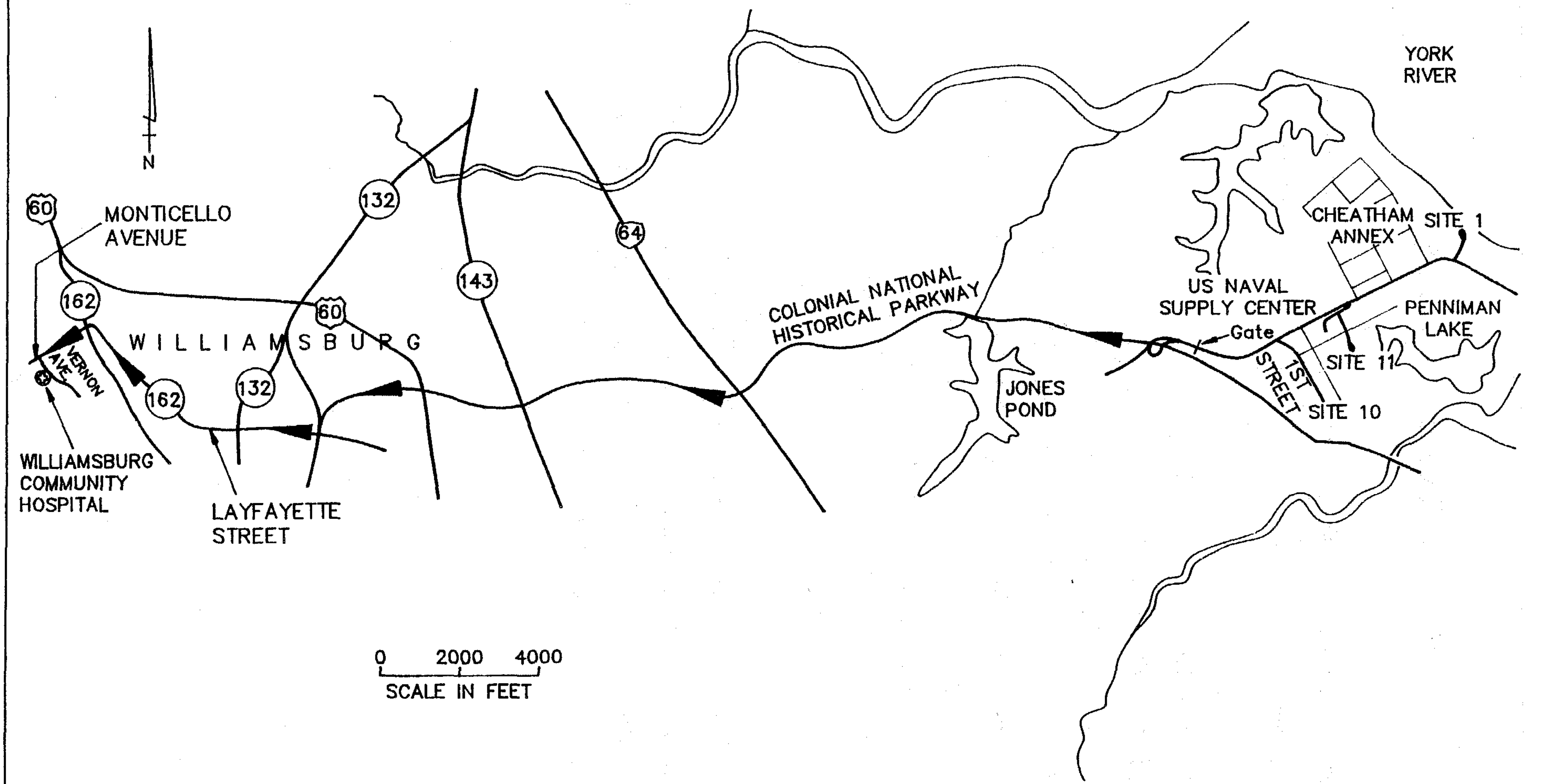
Client Contract, Work Number: Chick Salyer (804) 887-7373

Agency Contact, Work Number: Brenda Norton (804) 445-4801

ESE Project Director (703) 318-8900

10.2 Route to Nearest Medical Care Facility

The route to the hospital from the site is as follows: Take (west) right onto Colonial National Historical Parkway out of gate; turn right (west) onto Lafayette Street (Route 162) and right onto Montesello Avenue (Figure 10-1).



Environmental Science & Engineering	DATE 5-21-91	SCALE SHOWN	TITLE ROUTE TO WILLIAMSBURG COMMUNITY HOSPITAL	
	DRAWN BY LAF	APPROVED BY		
	JOB NO. 4901165	DWG. NO./ REV. NO. ER65 / -	CLIENT NSC CHEATHAM	FIGURE 10-1

APPENDIX A

Forms

DPSC 5/31LB

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
PROJECT SPECIFIC SAFETY AND HEALTH PLAN

PROJECT NAME: ______________________________

PROJECT NUMBER: ______________________________

PROJECT MANAGER: ______________________________

CORPORATE SAFETY OFFICER: ______________________________

Check if Designee ☐

DECLARATION OF UNDERSTANDING

I have read and understand this Site-Specific Safety and Health Plan (SSHP) prepared for the Defense Personnel Support Center in Philadelphia, Pennsylvania, and agree to abide by the procedures and limitations specified. I also certify that all medical monitoring and health and safety training requirements which may be applicable to my employment at this site are current and will not expire during onsite activities.

NAME	EMPLOYEE NO.	SS NO.	DATE

NOTE: All subcontractors to ESE must abide by the specifications and limitations contained in this SSHP.

D12/PPG 6/89h

DECLARATION OF UNDERSTANDING FORM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

This brief Medical Data Sheet will be completed by all onsite personnel and will be kept onsite during the conduct of site operations. Completion is required in addition to compliance with the Medical Surveillance Program requirements described in this HASP. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project ______________________________

Name ______________________ Home Telephone __________

Address ______________________________

Age __________ Height __________ Weight __________

Name of Next of Kin ______________________________

Drug or other Allergies ______________________________

Particular Sensitivities ______________________________

Do You Wear Contacts? ______________________________

Provide a Checklist of Previous Illnesses or Exposures to Hazardous Chemicals ______________________________

____

____

What medications are you presently using? ______________________________

____

____

Do you have any medical restrictions? ______________________________

____

Name, Address, and phone number of personal physician:

____

____

____

____

ESE Environmental Science & Engineering, Inc.

MONITORING DATA LOG

Page ____ of ____

Instrument (Name/Model No./Serial No.): ____________________

____

Manufacturer: ____________________

Sampled By: ____________________ Date of Sample: ____________________

Project Name: ____________________ Project Number: ____________________

Site Location: ____________________

Barometric Pressure* ____________________ Temperature* ____________________ Relative Humidity* ____________________

Sample Location (Breathing Zone, Bore Hole, etc.)	Time of Sample	Concentration Measured	Activity Monitored

*Record if available

Environmental Science & Engineering, Inc.
A CILCORP Company

EQUIPMENT MAINTENANCE/ SERVICE LOG

Instrument (Name/Model No./Serial No.) ______________________

Manufacturer ______________________

Date Purchased ______________________

Date In	Date Out	Service Requested By	Reason for Service/Maintenance	Service Performed (Brief Description)	Servicing Company	Name (Print) / Signature

REVISION 1.0 03/03/88

ESE REPORT OF ACCIDENT, INJURY OR ILLNESS

REPORT NUMBER:

IDENTIFICATION

Division/Operating Unit/Contractor:________ Employee Name:________

Social Security No.:________ Supervisor:________

Employee Number:________ Sex: M ▯ F ▯ Age:____ Project (or N/A):________

Grade / Job Title:________ Years of Experience:________

Date of Occurrence:________ Time:________ Date Reported:________ Time:________

Emp. Home Address:________ Home Telephone No.:________

INCIDENT

Outcome:	Type:		Recordability:	
1 ▯ Damage	6 ▯ Fire	11 ▯ Equipment Failure	16 ▯ First-Aid	NOTE: Complete the information on the reverse side of this form if boxes 2,3 or 16 through 20 were checked.
2 ▯ Injury or Illness	7 ▯ Explosion	12 ▯ Loss of Time	17 ▯ Medical Treatment	
3 ▯ Fatality	8 ▯ Gas or Vapor Release	13 ▯ Theft,Burglary	18 ▯ Restricted Work	
4 ▯ Close Call (Near Miss)	9 ▯ Spillage	14 ▯ Vehicular	19 ▯ Lost Time	
5 ▯ Potential for Loss	10 ▯ Contamination	15 ▯ Other	20 ▯ Off Job	

Describe What Happened:

What:________

Who :________

Where:________ Street Address:________

City:________ State:________ Zip Code:________

How:________

ANALYSIS

Describe Hazard(s) - Unsafe Conditions and/or Acts - causing the Incident:

____

Describe the Underlying Cause(s) and/or Failure(s):

____

CONTROLS

Recommended Action and System Changes:

____

Investigator:________ (PRINT) ________ (SIGNATURE) Title:________ Date:________

ATTACH ADDITIONAL SHEETS IF NECESSARY

Figure 7-2 (Page 1 of 2)
ACCIDENT, INJURY, OR ILLNESS REPORT FORM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

ESE INJURY/ILLNESS REPORT

MEDICAL TREATMENT

Was medical treatment received: [] YES [] NO   Did injury/illness result in a lost work day: [] YES [] NO

If YES, what was the last date worked: ________________

Name and address of medical facility:

____

____

Name, address and telephone number of examining physician:

____

____

INJURY/ILLNESS DESCRIPTION

Describe nature of injury or illness:

____

____

____

____

____

Part of body injured: ____

Describe diagnosis and/or treatment:

____

____

____

____

____

Supervisor's Signature: ______________________________ Date: ________________

FOR HUMAN RESOURCES DIVISION USE ONLY

Workers Compensation report filed: [] YES [] NO   Date: ________________

OSHA Recordable injury or illness: [] YES [] NO   Log Number: ____________

______________________________ ____________

Director of Human Resources   Date

______________________________ ____________

ESE Corporate Safety Manager   Date

Figure 7-2 (Page 2 of 2)
ACCIDENT, INJURY, OR ILLNESS REPORT FORM

SOURCE: ESE.

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.

APPENDIX B
Personal Protective Equipment Levels

APPENDIX B

PERSONAL PROTECTIVE EQUIPMENT LEVELS

PERSONAL PROTECTIVE EQUIPMENT--LEVEL A

1. Open-circuit, pressure-demand, self-contained breathing apparatus (SCBA)
2. Totally encapsulated suit
3. Gloves, inner (surgical type)
4. Gloves, outer (chemical protective)
5. Boots, chemical protective, steel toe and shank
6. Booties, chemical protective

CRITERIA

1. Sites known to contain hazards which:
   a. Require the highest level of respiratory protection (as stated above)
   b. Will cause illness as a result of personal exposure
   c. Permit a reasonable determination that personal exposure could occur to any part of the body
2. Sites for which the Project Manager and/or Site Safety Manager make a reasonable determination that, based on the lack of information to the contrary, the site may be described as stated directly above.

PERSONAL PROTECTIVE EQUIPMENT--LEVEL B

1. Open-circuit, pressure-demand SCBA or airline
2. Chemical protective Saranex® suits
3. Gloves, inner (surgical type)
4. Gloves, outer (chemical protective)
5. Boots, chemical protective, steel toe and shank
6. Booties, chemical protective

CRITERIA

1. Sites known to contain hazards which require the highest level of respiratory protection as stated previously and which:
   a. Will cause illness as a result of personal exposure
   b. Permit a reasonable determination that personal exposure to areas of the body not covered by Level B protective clothing is unlikely
2. Sites for which the Project Manager and/or Site Safety Manager make a reasonable determination that, based on the lack of information to the contrary, the site may be described as stated above.

PERSONAL PROTECTIVE EQUIPMENT--LEVEL C

1. Full face-piece, air-purifying respirator
2. Emergency escape oxygen pack (carried)
3. Chemical protective suits
4. Gloves, inner (surgical type)
5. Gloves, outer (chemical protective)
6. Boots, chemical protective, steel toe and shank
7. Booties, chemical protective

CRITERIA

1. Sites known to contain hazards which:
   a. Do not require a level of respiratory protection greater than the level afforded by air-purifying respirators (nominal protection of 10), as stated above
   b. Will cause illness as a result of personal exposure
   c. Permit a reasonable determination that personal exposure to areas of the body not covered by Level C protective clothing is unlikely
2. Sites for which the Project Manager and/or site Safety and Health Officer make a reasonable determination that, based on the lack of information to the contrary, the site may be described as stated previously.

PERSONAL PROTECTIVE EQUIPMENT--MODIFIED LEVEL D

1. Coveralls, cotton
2. Boots/chemical protective, steel toe and shank
3. Safety glasses
4. Hardhat with optional face shield (where overhead hazards exist)
5. Nitrile gloves (to be used when handling samples)
6. Tyvek® coveralls used at discretion of SSO
7. Air-purifying respirator (readily available)

PERSONAL PROTECTIVE EQUIPMENT--LEVEL D

1. Coveralls, cotton
2. Boots/shoes, safety
3. Safety glasses
4. Hardhat (where overhead hazards exist)

CRITERIA

Sites where the Project Manager and/or Site Safety and Health Officer make a reasonable determination that hazards due to exposure to hazardous materials are unlikely.

ADDITIONAL PERSONAL PROTECTION

In addition to personal protective equipment, field personnel having duties on or near the hazard site should have ready access to:

1. An fully stocked industrial-size first-aid kit
2. An eyewash kit
3. At least 6 gallons of potable water in a pressurized container to permit decontamination in event of accidental skin or eye contact with chemicals
4. Field instrumentation: pH meters, photoionization meters, etc.
5. Litmus paper

APPENDIX C

Work Zones and Decontamination Procedures

Appendix C
Work Zones and Decontamination Procedures

Level C Decontamination Procedures

Equipment Worn

The full decontamination procedure is for workers wearing Level C protection (with tapes joints between gloves, boots and suit). Such protection consists of:

1. One-piece, hooded, chemical resistant splash suit
2. Canister-equipped full-face mask
3. Hard hat
4. Chemical-resistant boots with steel toe and shank
5. Boot covers
6. Inner and outer gloves

Procedure for Full Decontamination

Station 1: Segregated Equipment Drop

Deposit equipment used on the site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the possibility of cross contamination.

Necessary equipment includes:

1. Containers of various sizes
2. Plastic liners
3. Plastic drop cloths

Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decon solution or detergent/water solution.

Necessary equipment includes:

1. Container (20 to 30 gallon)
2. Decon Solution
3. Detergent/water solution
4. Two or three long-handle, soft bristle scrub brushes

Station 3: Boot Cover and Glove Rinse

Rinse off decon solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Necessary equipment includes:

1. Container (20 to 30 gallon)
2. High pressure spray unit
3. Water
4. Two or three long-handle, soft-bristle scrub brushes

Station 4: Tape Removal

Remove tape around boots and gloves and deposit in container with plastic liner.

Necessary equipment includes:

1. Container (20 to 30 gallon)
2. Plastic liners

Station 5: Boot Cover Removal

Remove boot covers and deposit in container with plastic liner.

Necessary equipment includes:

1. Container (20 to 30 gallon)
2. Plastic liner
3. Bench or stool

Station 6: Outer-Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Necessary equipment includes:

1. Container (20 to 30 gallon)
2. Plastic liner

Station 7: Suit/Safety Boot Wash

Thoroughly wash splash suit and safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of decon solution or detergent/water solution. Repeat as many times as necessary.

Necessary equipment includes:

1. Container (30 to 50 gallon)
2. Decon solution
3. Detergent/water solution
4. Two or three long-handle, soft-bristle scrub brushes

Station 8: Suit/Safety Boot Rinse

Rinse off decon solution or detergent/water solution using copious amounts of water. Repeat as many times as necessary.

Necessary equipment includes:

1. Container (30 to 50 gallon capacity)
2. High-pressure spray unit
3. Water
4. Two or three long-handle, soft-bristle scrub brushes

Station 9: Canister or Mask Change

If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer glove and boot covers donned, and joints taped. Worker returns to duty.

Necessary equipment includes:

1. Canister (or mask)
2. Tape
3. Boot covers
4. Gloves

Station 10: Safety Boot Removal

Remove safety boot and deposit in container with plastic liner.

Necessary equipment includes:

1. Container (30 to 50 gallons)
2. Plastic liners
3. Bench or stool
4. Bootjack

Station 11: Splash Suit Removal

With assistance of helper, remove splash suit. Deposit in container with plastic liner.

Necessary equipment includes:

1. Container (30 to 50 gallon)
2. Bench or stool
3. Plastic liner

Station 12: Inner-Glove Wash

Wash inner gloves with decon solution or detergent/water solution that will not harm skin. Repeat as many times as necessary.

Necessary equipment includes:

1. Decon solution
2. Detergent/water solution
3. Basin or bucket

Station 13: Inner-Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary.

Necessary equipment includes:

1. Water
2. Basin or bucket
3. Small table

Station 14: Facepiece Removal

Remove facepiece. Avoid touching face with gloves. Deposit facepiece in container with plastic liner.

Necessary equipment includes:

1. Container (30 to 50 gallon)
2. Plastic liners

Station 15: Inner-Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Necessary equipment includes:

1. Container (20 to 30 gallon)
2. Plastic liner.

Station 16: Inner-Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing off the site since there is a possibility small amounts of contaminants have been transferring removing contaminated outer clothing.

Necessary equipment includes:

1. Container (30 to 50 gallon)
2. Plastic liner.

Station 17: Field Wash

Shower promptly upon exiting site. Wash hands and face repeatedly. Redress with clean clothes.

<u>Modified Level C Decontamination Procedures</u>

The preceding description outlines each station that is included in a complete worst-case decontamination protocol. Individual sites may not require as elaborate a decontamination reduction corridor and procedures. The following protocol may be used judiciously in situations representing lesser hazards:

Task 1: Set up decontamination reduction corridor.

A. Select an area on level ground upwind of the work zone. Layout an area approximately 30 feet in length and 10 feet in width. Drive perimeter stakes in corners and attach visible marking flags. Attach survey tape to perimeter stakes. The survey tape should be as close to the ground surface as possible, so as not to pose a tripping hazard to workers exiting the contaminated zone.

B. Procure the following equipment
   1. Four 55-gallon steel drums
   2. Large size hefty trash bags
   3. Two 32-gallon plastic trash cans
   4. Four standard cement cinder blocks
   5. One 10-foot length 2x12 oak timber
   6. One 8x4 laminated plywood board
   7. One set sawhorse clamps
   8. Eight 54" lengths of 2x4 lumber
   9. One roll polyethylene plastic sheeting
   10. Two metal folding chairs
   11. Eight 10-quart plastic buckets
   12. Four 20-gallon galvanized wash basins
   13. Six long-handled wooden scrub brushes
   14. Two gallons detergent dish washing liquid
   15. Eight soft-bristled plastic brushes
   16. Paper towels

C. Set up the decontamination reduction corridor in conformance with Figure __. At the entrance of the decontamination corridor, set an oak timber on top of cinder blocks to serve as a bench for workers exiting the work area. Workers shall utilize the splash suit and boot cover wash prior to removing tape from glove and boot joints. Workers should enter the decontamination line progressing from least contaminated individual to most contaminated individual, if possible, on the basis of evident soiled outer clothing. Each worker shall continue to wear the full-face respirator until the designated mask removal station.

D. Equipment returned from the contaminated zone should be handed across the line and temporarily stored in a drop area until personnel have completed the personnel decontamination process. Equipment which appears obviously soiled should be placed within the contaminated area and not handed across the hot line. Level C protective equipment will be needed to clean this equipment.

E. After removing and discarding tape from gloves and boots, step across the entry bench into the splashsuit rinse. Use long-handled brush to rinse splashsuit and inner boots.

F. Proceed to chair and remove and discard splashsuit (saranex) in 55 gallon drum lined with a hefty trash bag.

G. Proceed to outer glove rinse and drop station. This station will consist of a board at waist level supported by two auxiliary 55 gallon steel drums. The board will be wrapped in plastic. A 10-qt. plastic bucket half-filled with water and dishwashing liquid will serve as the outer glove rinse station. Rinse and remove outer gloves.

H. At next station, remove full-face respirator mask. Loosen top strap first, exercising care to prevent hair from becoming entwined in strap. Remove mask and discard used cartridges in lined plastic garbage pail to left.

I. At next station, sit in chair and remove inner neoprene boots, if desired, and change to work boots. Store inner boots to left of garbage pail.

J. The final station on the decontamination line is a plywood work table at waist level. The table should be lined with plastic. Two buckets half-filled with water and dishwashing detergent will serve as handwash and hand rinse. The remaining portion of the table will be used to clean and package air monitoring equipment.

K. Personnel exiting the contaminated area should be assisted by support personnel who themselves have already completed the decontamination procedure. Personnel rendering assistance should exercise care to prevent contact with contaminated equipment and clothing from personnel still in the decontamination process.

L. Once decontamination is complete, lined drums containing used soiled splashsuits should be sealed until the next days use. Water from wash basins may have to be collected and disposed of as manifested hazardous waste, depending upon site requirements. Galvanized steel wash basins should be emptied and rinsed in preparation of the following days use.

M. Secure decontamination area and return to command trailer.

APPENDIX D

Site Worksheet

Appendix D

Site Worksheet

ESE Site-Specific Health and Safety Plan WorkSheet	Project Name:
Check if Designee:	Project #:
	Project Manager:
	Corporate Safety Officer:

Declaration of Understanding

I have read and understand this Health and Safety Plan (HASP), and agree to abide by the procedures and limitations specified. (**Note:** all personnel signing must be listed in part G. All subcontractors must abide by the procedures and limitations specified in this HASP.)

Name	Employee #	SS #	Date

<table>
<tr><th colspan="2">A. General Project Information</th></tr>
<tr><td>Site:</td><td>Date Prepared:</td></tr>
<tr><td>Location:</td><td>Prepared by:</td></tr>
<tr><td rowspan="2">Project Objective:
☐ Preliminary Contamination Assessment
☐ Contaminant Assessment
☐ Remedial Action</td><td>Proposed Date of Activity:</td></tr>
<tr><td>Background Review:</td></tr>
<tr><td colspan="2">Prefield Briefing Date: ☐ Complete ☐ Partial</td></tr>
<tr><td>Level of Protection:
☐ A ☐ B
☐ C ☐ D
☐ Modified D</td><td>Overall Hazard Estimate:
☐ High ☐ Moderate
☐ Low ☐ Unknown</td></tr>
</table>

B. Site/Material Characteristics

Material Type:
☐ Contaminated Soil ☐ Saturated Soil ☐ Contaminated Water ☐ Free Product

Facility Type: ☐ Active ☐ Inactive

Facility Size:

Topography:

Significant Features:

Site History:

C. Hazard Evaluation

Planned Activities:
☐ Site Visit/Walkover Only

Sampling:
☐ Sediment ☐ Soil ☐ Air ☐ Surface Water ☐ Ground Water

Installation:
☐ Monitoring Wells ☐ Recovery Wells ☐ Treatment System ☐ Other

Removal:
☐ Tanks, Piping ☐ Contaminated Soil

D. Work Plan Instructions

Attach Map/Sketch and Identify:
☐ Work Zones ☐ Perimeter ☐ Structures ☐ Contaminated Areas
☐ Location of First Aid Equipment ☐ Location of Safety Equipment

Personal Protection Levels Required:
☐ A ☐ B ☐ C ☐ D ☐ Modified D

Additional Personal Protective Equipment:

Monitoring Equipment:
☐ PID ☐ FID ☐ Oxygen ☐ Explosimeter ☐ Other

E. Site Operations/Decontamination	
Command Post Phone Number	Personal Decontamination Procedures: ☐ Designated Hot-line ☐ Contaminant Reduction Corridor
Equipment Decontamination Procedures: ☐ Decontamination Pad ☐ Steam Cleaning	
Equipment and Materials: ☐ Drilling Rig ☐ Backhoe ☐ Crane ☐ Other	
Site Entry Procedures:	
Team Size:	Pre-field Briefing Date:
Work Schedule:	
Limitations:	

F. Emergency Precautions
Emergency Actions:
Fire and Explosions:
Injury:
Spill Control:
Weather/Other:
Potential Chemical Exposure: ☐ Inhalation ☐ Ingestion ☐ Absorption ☐ Other
Emergency Contacts: Police: CHEMTREC: 800/424-9300
Hospital/Emergency Medical Care Unit: Name: Address: Telephone:
Route to Hospital (attach map):

G. Team Organization and Responsibilities				
Name	Position/Title	On-site Duties/Responsibilities	Date of Physical	Date of Fit Testing

H. Contaminant Characteristics						
Compound	TLV/PEL	Contaminant Source Estimated Quantities	Route of Exposure	Symptoms of Acute Exposure	Response Factors	
					PID	FID