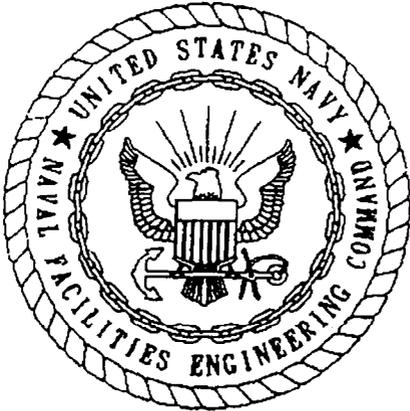


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TECHNICAL WORK PLAN INTERIM CORRECTIVE MEASURE SCREENING INVESTIGATION
- SITE 11 RCRA FACILITY INVESTIGATION NSB KINGS BAY GA
3/1/1993
ABB ENVIRONMENTAL

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**TECHNICAL WORK PLAN
INTERIM CORRECTIVE MEASURE
SCREENING INVESTIGATION - SITE 11
RCRA FACILITY INVESTIGATION
NSB KINGS BAY, GEORGIA**

**CONTRACT TASK ORDER NO. 041
MODIFICATION NO. 3
NAVY CLEAN - DISTRICT I
CONTRACT NO. N62467-89-D-0317**

MARCH 1993



**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA
29411-0068**

RELEASE OF THIS DOCUMENT REQUIRES THE PRIOR
NOTIFICATION OF THE COMMANDING OFFICER OF
NSB KINGS BAY

Technical Work Plan
 Interim Corrective Measure Screening Investigation - Site 11
 RCRA Facility Investigation
 NSB Kings Bay, Georgia

Record of Document Changes

DATE	SECTION	PAGE	SUMMARY OF CHANGES
3/1/93	4	4-8	Added third paragraph concerning procedures to use if difficulties were encountered during direct push technology
3/1/93	4	4-9	Corrected Figure (i.e., number of lots, number and location of samples to be collected)
3/1/93	4	4-10	Corrected number of samples in table
3/1/93	4	4-11	Last Paragraph - changed vapor cone sample number within the landfill from 15 to 18
3/1/93	4	4-12	Third Paragraph - changed the pond to Porcupine Lake
3/1/93	4	4-13	Last Paragraph - changed private wells to private irrigation wells (PIWs), continuing on next page changed number of PIWs to 94
3/1/93	4	4-15	Corrected Figure (i.e., number and location of PIWs)
3/1/93	4	4-17	Corrected number of samples in Table 4-2
3/1/93	4	4-27	Corrected ARARs Table
3/1/93	4	4-28	Second Paragraph - added Georgia ARARs to list of ARARs considered
3/1/93	5	5-2	5.3.1 Changed personnel at NSB Kings Bay to reflect changes at the activity
3/1/93	5	5-3	Changed the organization chart to reflect personnel changes at the activity

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**TECHNICAL WORK PLAN
INTERIM CORRECTIVE MEASURE SCREENING INVESTIGATION
SITE 11
CONTRACT TASK ORDER NO. 041
MODIFICATION NO. 3
NAVY CLEAN - DISTRICT 1
CONTRACT NO. N62467-89-D-0317**

**NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

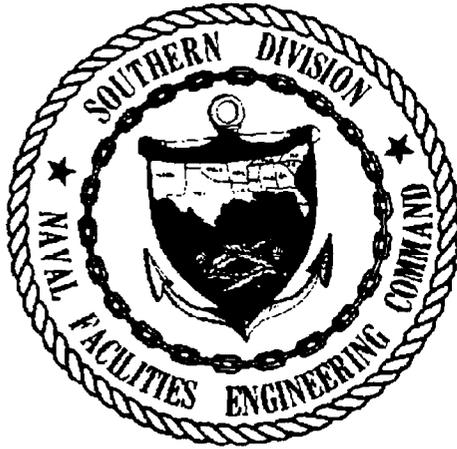
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Naval Facilities Engineering Command
Charleston, South Carolina 29411-0068**

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**ABB Environmental Services, Inc.
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March 1993



FOREWORD

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), the 1976 Resource Conservation and Recovery Act (RCRA), as augmented by the 1984 Hazardous and Solid Waste Amendments (HSWA), and as directed in Executive Order 12580 of January 1987, the Department of Defense (DOD) conducts an Installation Restoration Program (IRP) for evaluating and remediating problems related to releases and disposals of toxic and hazardous materials at DOD facilities.

The Naval Assessment and Control of Installation Pollutants (NACIP) program was developed by the Navy to implement the IRP for all naval and Marine Corps facilities. The NACIP program was originally conducted in three phases: (1) Phase I, Initial Assessment Study, (2) Phase II, Confirmation Study (including a Verification Step and a Characterization Step), and (3) Phase III, Planning and Implementation of Remedial Measures. The three-phase IRP was modified and updated to be congruent with CERCLA/SARA and RCRA/HSWA-driven DOD IRP.

The updated nomenclature for the IRP process is as follows:

- Preliminary Assessment/Site Inspection (PA/SI)
- Remedial Investigation/Feasibility Study (RI/FS)
- Remedial Design/Remedial Action (RD/RA)
- Site Closeout (SC)

Four sites at the Naval Submarine Base (NSB), in Kings Bay, Georgia, were identified for investigation under the IRP. A work plan for conducting a RCRA Facility Investigation/Site Inspection (RFI/SI) at three of four sites has been completed and implemented. No sampling or analyses will be conducted at the fourth site. The Public Works Department at the NSB will gather information for the fourth site to include in the RFI Report.

Because of the detection of volatile organic compounds in groundwater samples downgradient and off site, an Interim Corrective Measure Screening Investigation will be implemented at Site 11, the Old Camden County Landfill. This technical work plan outlines the Interim Corrective Measure Screening Investigation to be conducted.

The Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) has the responsibility for implementing of the Navy and Marine Corps IRP in the southeastern and midwestern United States. Questions regarding this report should be addressed to the SOUTHNAVFACENGCOM Engineer-in-Charge, Mr. Ed Lohr, at (803) 743-0355.

EXECUTIVE SUMMARY

In August 1992, as part of the RFI/SI of the Old Camden County Landfill at NSB Kings Bay, ABB Environmental Services, Inc. (ABB-ES) confirmed that, potentially, two plumes of contaminated groundwater, assumed to be emanating from the landfill, have migrated off site west toward the Crooked River Plantation Subdivision. The plumes, found in the surficial groundwater aquifer 9 to 25 feet below ground surface, have been confirmed by off-site laboratory analysis to contain 18 volatile organic compounds (VOCs) including vinyl chloride, benzene, trichloroethene, tetrachloroethene, trans-1,2-dichloroethene, and methylene chloride.

Many residents of the Crooked River Plantation Subdivision have private water wells that possibly are supplied by the surficial aquifer. Although it is believed that none of these private water wells are used as potable water sources, the water from these wells is used for irrigation and other non-potable uses. Therefore, it is possible that the residents of this subdivision could be exposed to the contaminants in the plume during the use of groundwater from their private wells.

The objectives of the field sampling program described in this work plan are to provide sufficient information to evaluate the following:

- the horizontal and vertical extent of groundwater contamination
- contaminants of potential concern and their concentrations
- contaminants of potential concern, if any, in the private well water samples collected within the subdivision
- possible contamination of surface water and sediment in Porcupine Lake
- partitioning of potential contaminants into the soil
- potential eminent human health risks associated with the use of private well water or recreational use of Porcupine Lake

The data provided during this investigation will drive potential interim corrective measures and will also be used to develop the RFI Confirmatory Sampling Work Plan.

ACKNOWLEDGEMENTS

In preparing this report, the personnel at ABB-ES commend the support, assistance, and cooperation provided by the personnel at NSB Kings Bay, Georgia, and SOUTHNAVFACENGCOM. In particular, we acknowledge the outstanding effort, dedication, and professionalism provided by the following people in the preparation of this report.

Name	Title	Position	Location
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James More	Engineer	Environmental Coordinator	NSB Kings Bay, GA

INTERIM CORRECTIVE MEASURE SCREENING INVESTIGATION WORK PLAN
SITE 11, NSB KINGS BAY

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GLOSSARY OF ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
CMS	Corrective Measure Study
DOD	Department of Defense
DQOs	Data Quality Objectives
EIC	Engineer-in-Charge
ELCD	Electrolytic Conductivity Detector
ft/min	feet per minute
FS	Feasibility Study
GC	gas chromatograph
HASP	Health and Safety Plan
HRS	Hazard Ranking System
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
IRP	Installation Restoration Program
K	hydraulic conductivity
ML	milliliter
MLW	Mean Low Water
MS	mass spectrometry
NACIP	Naval Assessment and Control of Installation Pollutants
NEESA	Naval Energy and Environmental Support Activity
NIRP	Naval Installation Restoration Program
NPL	National Priorities List
NSB	Naval Submarine Base
PA	Preliminary Assessment
PARCC	precision, accuracy, reproducibility, completeness, and comparability
PID	photoionization detector
ppm	parts per million
QA	Quality Assurance

QC	Quality Control
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment
RfD	reference dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
SC	Site Closure
SI	Site Investigation
SOUTHNAVFACENGCOM	Southern Division Naval Facilities Engineering Command
SVOC	semivolatile organic compound
SWMUs	solid waste management units
TCL	target compound list
TDS	total dissolved solids
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
μg/L	micrograms per liter

1.0 INTRODUCTION

Under contract to the U.S. Department of the Navy (Navy) Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOCM), ABB Environmental Services, Inc. (ABB-ES) prepared this Corrective Measure Screening Investigation Work Plan for Site 11, the Old Camden County Landfill, located on the Naval Submarine Base (NSB), Kings Bay, Georgia. This work plan was prepared under the Navy's Comprehensive Long-term Environmental Action Navy (CLEAN) Contract No. N62467-89-D-0317, Contract Task Order No. 041. The following subsections describe the site and the scope of the investigation (including the regulatory setting).

1.1 SITE DESCRIPTION. The Old Camden County Landfill is located in the western part of NSB Kings Bay. The landfill occupies approximately 35 acres and was operated by Camden County from 1974 to October 1981. The final landfill cover consists of 2 feet of fill. The site is vegetated with grasses, weeds, and pine saplings.

The length and width of the landfill were evaluated using magnetometry during the Resource Conservation and Recovery Act (RCRA) Facility Investigation/Site Investigation (RFI/SI) fieldwork conducted in January and February of 1992. The landfill's width, oriented southeast to northwest, ranges from less than 525 feet to 775 feet. The long dimension of the landfill is oriented southwest to northeast and is approximately 1,400 feet.

1.2 SCOPE OF NSB KINGS BAY SITE 11 WORK PLAN FOR SCREENING INVESTIGATION AND REGULATORY SETTING. This investigation was initiated to establish whether the volatile organic compounds (VOCs) detected in groundwater downgradient of Site 11 during the RFI/SI field program at NSB Kings Bay have migrated into the Crooked River Plantation Subdivision. Previous investigations at the landfill confirmed that VOCs have migrated off site. An Interim Corrective Measure Screening Investigation is planned to establish whether there is an immediate threat to human health within the subdivision.

In 1976, Congress passed RCRA to govern facilities where current operational practices involve the generation, handling, or disposal of hazardous substances. RCRA was amended in 1984 with the passage of the Hazardous and Solid Waste Amendments (HSWA). Under these amendments, corrective action is required for the release of hazardous waste from solid waste management units (SWMUs) at hazardous waste treatment, storage, or disposal facilities. The RCRA Corrective Action Program uses a four-phase approach to evaluate the condition of SWMUs and direct corrective action, if necessary, at these sites.

Phase I, the RCRA Facility Assessment (RFA), is designed to identify SWMUs that are, or are suspected to be, the sources of current or past releases of hazardous substances to the environment. If SWMUs are identified during the RFA that are or are suspected to be sources of contaminant releases, the owner or operator of the facility will be directed to perform an RFI to verify the release of toxic or hazardous substances and obtain information on the nature and extent of the contamination. Information collected during the RFI will be used to determine whether there is a need for interim corrective measures and will also aid in the

development and implementation of appropriate corrective measures. A Corrective Measure Study (CMS) will be prescribed if the release is characterized in the RFI as either immediately or potentially threatening to human health or the environment.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, was passed in 1980 to deal with past environmental problems at facilities that are no longer in operation. In accordance with CERCLA the Superfund Amendments and Reauthorization Act (SARA), the Department of Defense (DOD) is required to conduct an Installation Reservation Program (IRP) for evaluation and remediation of problems related to the release and disposal of hazardous materials at DOD facilities. The Naval Assessment and Control of Installation Pollutants (NACIP) program was established to identify the presence of suspected contamination at Navy and Marine Corps facilities from past operations and, if needed, to institute corrective remedial measures. The NACIP is conducted in four phases: Phase I, Preliminary Assessment/Site Investigation (PA/SI); Phase II, Remedial Investigation/Feasibility Study (RI/FS); Phase III, Remedial Design/Remedial Action (RD/RA); and Phase IV, Site Closure (SC).

Under CERCLA, the Hazard Ranking System (HRS) is used to prioritize hazardous waste sites and list them for cleanup activities on the U.S. Environmental Protection Agency's (USEPA's) National Priorities List (NPL). The Navy is required to evaluate formerly used defense sites as well as currently operating facilities. Under SARA, Congress established the Federal Agency Hazardous Waste Compliance Docket, also known as the Federal Facility Docket. The purpose of the docket is to identify federal facilities that potentially could be included on the NPL and compile and maintain information on the cleanup status of these sites. The Navy has used the latest HRS (II) to rank NSB Kings Bay. The overall facility score was 47.59, as calculated by ABB-ES. This score is a composite of the three sites under study at NSB Kings Bay, and indicates that NSB Kings Bay could be listed on the NPL in the future. USEPA has not confirmed this score.

Because NSB Kings Bay is operating under a current RCRA permit, the facility is obligated to follow RCRA regulations. Future remediation at Site 11 might be carried out under CERCLA because of the HRS ranking the facility received. Thus, an attempt was made in this Interim Corrective Measure Screening Investigation to follow both RCRA and CERCLA regulations because of the potential for the facility to be added to the NPL.

2.0 ENVIRONMENTAL SETTING, DISPOSAL HISTORY, AND HISTORICAL RESPONSE

2.1 ENVIRONMENTAL SETTING. The following subsections summarize information regarding climate, topography, surface water hydrology and quality, regional and site-specific hydrogeology, and water supply. These areas are discussed in detail in the RFI/SI Work plan (ABB-ES, 1991). Additional information was obtained during the RFI/SI field investigation and the Phase I Interim Investigation of Site 11 conducted in February 1992 and August 1992, respectively (ABB-ES, 1992a, 1992c).

2.1.1 Climate NSB Kings Bay is located in an area characterized by a humid subtropical climate. The mean annual temperature is approximately 68° Fahrenheit. Mean annual precipitation is estimated to be 54 inches. Relative humidity varies widely throughout the year, with an annual average of 87 percent in the morning and 55 percent in the afternoon. Prevailing winds are westerly, with strong northerly components in winter and southerly components in summer.

2.1.2 Topography Elevations at NSB Kings Bay are measured relative to mean low water (MLW), rather than mean sea level. The elevations at NSB Kings Bay range from zero feet MLW at the shoreline to 35 feet MLW in the western part of the base. The area around the base is generally flat and marshy, and traversed by slow meandering streams.

Elevations at the Old Camden County Landfill are higher than most surrounding areas, being approximately 35 feet MLW. Drainage features provide topographic relief and, in the vicinity of the landfill, variations in elevations are approximately 10 feet.

2.1.3 Surface Water Hydrology and Quality NSB Kings Bay is drained by four drainage networks: Marianna Creek, the North River, the Crooked River, and Cumberland Sound Basins. Drainage from the creeks and rivers ultimately leads to Cumberland Sound.

Within the base, artificial drainage patterns are formed by roads and drainage ditches. Surface water runoff at NSB Kings Bay is to intermittent creeks and rivers via storm drainage ditches. Infiltration of precipitation to groundwater is promoted by the flat topography. Salt marshes cover approximately 30 percent of the 11,000-acre drainage network. The remainder is upland swamps and marshes.

Water quality in the freshwater bodies at the base is typical of the region. Concentrations of mercury could reflect the use of mercury-based fungicides. Dissolved oxygen concentrations are generally low. The freshwater bodies around the base are generally used for non-contact recreation such as boating, navigation, and fishing.

2.1.4 Regional Hydrogeology There are three groundwater aquifers in the Kings Bay and surrounding areas. The uppermost aquifer is the unconfined water table (surficial) aquifer, ranging in thickness from approximately

6 feet below ground surface (bgs) to 90 feet bgs. This is the aquifer generally used for irrigation in the community. It is made up of interbedded sands and silts, with sparse thin layers of clayey sand or clay. Limestone lenses that yield large amounts of water are reported within the water table aquifer.

The secondary aquifer is composed of isolated limestone lenses within a confining unit that ranges from 380 feet to 530 feet thick. This confining unit separates the water table aquifer from the primary artesian aquifer. The confining unit is a regional formation, the Hawthorn Formation, present from north Florida to South Carolina. Groundwater yields in the secondary aquifer are highly variable, and it is not considered a principal source of water.

The primary artesian aquifer, or Floridian aquifer, is the primary source of drinking water for the NSB and surrounding communities. This aquifer is made up of two water bearing zones separated from one another by a confining layer that ranges from 100 to 150 feet thick.

2.1.5 Site-Specific Hydrogeology Appendix A contains the Phase I Interim Investigation Memorandum (ABB-ES, 1992c) describing the results of work conducted at the Old Camden County Landfill, Site 11, during August 1992. This investigation included collection of stratigraphic and hydrogeologic information and groundwater sampling and analysis. The memorandum contains a geologic cross-section and groundwater potentiometric surface map. The following paragraphs summarize hydrogeologic information in the memorandum.

Site stratigraphy is primarily interbedded sand and silty sand. Thin layers of sandy clay or clay are present within the upper water table aquifer. Hydraulic pressures were recorded at several intervals during piezocone penetration and the data do not suggest that confining layers are present within 70 feet of the ground surface.

Groundwater flow is generally west-northwest, based on water level measurements obtained from the nine on-site groundwater monitoring wells. Flow directions are consistent for water levels measured in February, May, July, and August of 1992.

Hydraulic conductivity (K) estimates were obtained during groundwater sampling in August 1992. Estimated K values range from 2.6×10^{-5} feet per minute (ft/min) to 9.3×10^{-3} ft/min. Groundwater flow velocities calculated from the K estimates range from 2.6×10^{-7} to 9.3×10^{-5} ft/min, based on a porosity of 0.33 and an average hydraulic gradient of 0.003 feet per foot.

The landfill opened 18 years ago and closed 11 years ago. Over a period of 18 years, the estimated distance of contaminant migration, based on the maximum seepage velocity, is 880 feet. Over 11 years, the estimated maximum distance of contaminant migration is 540 feet. Plume delineation data obtained to date indicate that contaminants have migrated at least 200 feet from the western landfill edge.

2.2 DISPOSAL HISTORY. The disposal history of the Old Camden County Landfill was investigated through records searches and interviews during the Initial

Assessment Study (IAS) by C.C. Johnson and Associates in 1985. The following paragraphs summarize the disposal history of the site based on information obtained during the IAS. A more detailed description of the disposal history can be found in the RFI/SI Work Plan (ABB-ES, 1991).

The Old Camden County Landfill was operated from 1974 to October 1981. Wastes reportedly disposed at the landfill include general household and office waste, scrap paper, wood, and sewage treatment plant sludge and grit from the NSB sewage treatment plants. Approximately 500,000 cubic yards of wastes were disposed of. Hazardous wastes were not accepted at the landfill. Relative amounts of wastes accepted from four sources are as follows:

<u>Source</u>	<u>Volume of Waste</u>
Camden County	60 percent
NSB Kings Bay	20 to 30 percent
Blue Star Shipping Co.	5 to 10 percent
Gilman Paper Co.	5 to 10 percent

Initially, wastes were burned before burial in the landfill, but this practice was discontinued in 1975.

Wastes were placed in trenches oriented southeast to northwest. These trenches extended the width of the landfill, which ranged from less than 575 feet to 775 feet. The trenches reportedly extended approximately 8 feet bgs and were approximately 20 feet wide. Wastes placed in the trenches were covered daily with 6 inches of soil. Upon closure, the landfill was covered with 2 feet of fill.

2.3 INVESTIGATION HISTORY. Three investigations have been conducted under the IRP at NSB Kings Bay; all included the Old Camden County Landfill.

The first investigation was the IAS, conducted in 1985 by C.C. Johnson and Associates. This investigation included records searches and interviews to identify past waste disposal sites and evaluate the need for further investigation. The IAS identified 16 waste disposal sites, but none were recommended for further investigation. However, under the facility's HSWA permit, four sites, including the Old Camden County Landfill, were required to undergo further investigation.

ABB-ES prepared an RFI/SI Work Plan in 1991 as part of the U.S. Navy CLEAN Program. The work plan was implemented in January and February of 1992. The RFI/SI field effort included geophysical surveys, subsurface soil sampling, and the installation of nine groundwater monitoring wells at the Old Camden County Landfill site. Soil and groundwater samples were analyzed for Appendix IX constituents.

Bimonthly groundwater monitoring is conducted as part of the overall RFI. Based on the absence of other Appendix IX constituents such as semivolatile organic compounds (SVOCs), pesticides, herbicides, dioxins, and furans during the second groundwater sampling event, the list of analytes for groundwater monitoring was limited to only VOCs and inorganics.

The RFI/SI field program, data interpretations, and evaluations are presented in detail in the RFI/SI Technical Memorandum No. 1 (ABB-ES 1992a). Technical Memorandum No. 2 discusses the results of the second sampling event conducted in May 1992 (ABB-ES 1992b).

After two groundwater sampling events were conducted, the presence of vinyl chloride in groundwater samples from monitoring well KBA-11-2 at the Old Camden County Landfill was confirmed. The U.S. Navy elected to further investigate groundwater quality downgradient of the landfill.

ABB-ES conducted this Phase I Interim Investigation at Site 11 in August 1992. This investigation included collection of groundwater samples using direct push technology. Thirty-six groundwater samples, including three duplicate samples, were collected from 25 locations downgradient of the landfill. Samples were analyzed in an on-site laboratory for target VOCs, including chloroethane, vinyl chloride, trans-1,2-dichloroethene, trichloroethene, and tetrachloroethene. Duplicate water samples were also collected and confirmation analyses were conducted in an off-site laboratory approved to perform analyses associated with site characterizations conducted under the IRP by the Naval Energy and Environmental Support Activity (NEESA).

Results of the Phase I Interim Investigation of VOC contamination at Site 11 indicate that vinyl chloride is present along a 530-foot-long section of the western boundary of the landfill and on the western side of Spur 40. Concentrations of vinyl chloride ranging from 2.8 to 120 micrograms per liter ($\mu\text{g/L}$) were detected along the right-of-way to Spur 40. Concentrations of vinyl chloride detected near the western boundary of the landfill ranged from 2.2 to 1,400 $\mu\text{g/L}$ (the 1400 $\mu\text{g/L}$ is an estimated value). Preliminary data indicate that two relatively narrow, parallel, plumes of vinyl chloride have been detected flowing east to west out of the western side of the landfill. This indicates that the landfill could have two source areas where VOCs are being released to groundwater. VOC contaminants were detected at depths ranging from 9 to 25 feet bgs.

3.0 DATA REQUIREMENTS

3.1 DATA REQUIREMENTS FOR PRELIMINARY RISK EVALUATION. In addition to the identification and concentration of chemical contaminants in groundwater, additional data are required for the preliminary screening risk evaluation. These data requirements include the characteristics of the private water wells such as the types of pumps, and depths of the wells. Information on the irrigation systems is also required, including the water flow rates from the wells, number and types of sprinkler heads, pipe lengths and sizes, and the frequency and duration of use of the irrigation systems. Data on the site characteristics are necessary as is information on meteorological conditions at the site.

The risk evaluation will require identification of all possible human receptors, all uses of groundwater, and the frequency and duration of these uses. Possible uses identified thus far include irrigation, filling of swimming pools, and swimming and wading activity in the nearby pond.

3.2 DATA REQUIREMENTS FOR DEVELOPMENT OF AN RFI CONFIRMATORY SAMPLING WORK PLAN. The purpose of the RFI is to characterize the nature and extent of contamination at Site 11 for an informed risk management decision on the corrective measure to be implemented at the site. Data needs for the corrective measure can include: environmental factors such as topography, climate, site geology and hydrogeology; physical and chemical characteristics of the matrices and contaminants of concern; and site characteristics such as area for equipment setup, accessibility, and proximity of utilities, sewer systems, and water supplies. The Interim Corrective Measure Screening Investigation will provide information to complete a detailed work plan for the RFI Confirmatory Sampling.

4.0 SCREENING INVESTIGATION TASKS

4.1 PRELIMINARY ACTIVITIES. This section describes the activities that must be performed upon receipt of the notice to proceed before commencing of the field sampling program.

4.1.1 Subcontractor Coordination Upon receipt of the notice to proceed, ABB-ES will contact all appropriate subcontractors to finalize any remaining contractual matters and plan the mobilization and related activities associated with fieldwork. Coordination activities include: scheduling, staffing, and procurement of all personnel, materials, equipment, and supplies required to complete the proposed work. Subcontractors include the direct push contractor, land surveyors, engineering support, and analytical laboratories. A USEPA- and NEESA-approved laboratory will be selected.

4.1.2 Permitting, Authorization, and Site Access In conjunction with subcontractor scheduling, ABB-ES will ensure that the necessary authorization and approval is secured for all vehicles and personnel scheduled for field activities. The NSB Kings Bay Environmental Coordinator will be contacted to arrange authorization of the appropriate vehicle passes and contractor identification badges for both ABB-ES and subcontractor personnel and their vehicles. Such badges will permit authorized personnel to enter specified areas of the facility for the purpose of completing the approved fieldwork. ABB-ES will ensure that all necessary permits (e.g., excavation permits for direct push penetrations) have been obtained through the Environmental Coordinator and/or appropriate state agencies before mobilization for fieldwork.

Before mobilization for fieldwork, ABB-ES will coordinate with NSB Kings Bay to identify and locate all underground utilities and other underground structures, as well as overhead utilities that could obstruct field activities. Upon mobilization to the field, ABB-ES will work with base personnel to mark each utility for future reference. This action will minimize the health and safety risks of field personnel and help protect the integrity of the utility. Identification and location of utilities could include referring to blueprints and using electronic equipment in the field to locate utility lines. NSB Kings Bay will assume final responsibility for the location and identification of utilities or other subsurface structures during this investigation.

4.1.3 Mobilization/Demobilization Mobilization will begin on Monday, October 12, 1992, with the arrival of the ABB-ES Field Operations Lead and chemists. These personnel will set up the field laboratory and coordinate all permitting and access activities. The field sampling program will begin on Wednesday, October 14, 1992, with the arrival of other ABB-ES support staff and the direct push contractor. One day will be required to breakdown and demobilize at the end of the sampling program.

4.1.4 Well Owner Surveys and Permission to Sample on Private Property Additional information regarding uses of groundwater will be solicited from private well owners via a survey (Form 4-1). This survey will be distributed

PRIVATE WELL SURVEY

Thank you for participating in this brief survey. Your input will help identify potential problems associated with the use of groundwater in the area. Your responses will be held in confidence, only to be used by the project team working on the groundwater investigation. (See other side when complete)

1. How long have you lived in your current home?
Do you own the house or rent it?
If rented, who owns the house?
Their mailing address?
2. Do you have a private well?
(Any water source other than a metered, public water supply).
3. What kind of well is it?
Please describe it as best you can. (Location in yard, depth, type of pump).
4. Do you know who installed your well?
When?
5. Please use the chart below to indicate how you have used your well water, how often and when. Check the box if the activity applies to your home, then complete the line.

Activity	Times per Week	Time of Day
<input type="checkbox"/> Filling Swimming Pool		
<input type="checkbox"/> Garden Watering		
<input type="checkbox"/> Lawn Watering		
<input type="checkbox"/> Drinking Water for Adults, Children, Animals		
<input type="checkbox"/> Washing Cars and Yard Items		
<input type="checkbox"/> Other, please specify: _____ _____ _____		

6. Do you use a hose with your private well water?
For what kind of activities?
7. Do you have a sprinkler system? _____ How many sprinkler heads? _____
What type and number of spigots do you have on each system? _____
_____ are their positions in the yard?

WELL TEST CONSENT FORM

To gather information on the location and concentration of the plume, we are asking your permission to sample your private well. This sampling process will be conducted at no expense to you and the data will provide a better understanding of groundwater quality in your area. The process is as follows:

1. Upon receipt of this completed Consent Form, you will be contacted to establish a date and time for the sampling. (The sampling needs to take place by early November.)
2. An ABB Environmental Services, Inc. (ABB-ES) staff member will meet you at the agreed date and time to take 3-9 samples from your well. The sampling will require up to 2 hours time.
3. Results from your well test will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process can take several weeks.

With this understanding, I do allow the U.S. Navy, including its consultant, ABB-ES and their subcontractors, access my property and sample my well.

Signature

Address

Phone

Please return this form at the public meeting or mail it to Public Affairs Office, Subbase King's Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

to residents of Crooked River Plantation along with the notice of the public information session (Form 4-2). When completed, the surveys will provide a better understanding of groundwater uses and will help define possible human exposure pathways.

The second side of the survey form will be the consent form for private irrigation well sampling (see Form 4-2). The survey and consent form will be distributed with a cover letter that explains:

- the IRP
- the findings to date
- the process of the investigations
- the need for public involvement
- the time frame of sampling and analysis activities

The survey/consent form and cover letter will give full instructions as to when to respond, who to respond to, and a contact person for questions. Residents of Crooked River Plantation with surveys that are not returned will receive a follow-up telephone call.

Once groundwater sampling is underway in Subdivision roadways, the location of the plume will be better delineated. At this time, private properties will be selected as possible locations for further groundwater sampling.

The residents of the selected properties will be notified in writing. The sampling methods will be fully described, including the likely physical impact to resident's properties and plans for restoration. A permission form will be included with full instructions for its submission, time for the response; and a contact person for questions (Form 4-3). Residents with permission forms that are not returned will receive a follow-up telephone call.

4.2 FIELD INVESTIGATION. The objectives of the field program for this interim phase of work are: (1) evaluating the contaminant plume beneath the Crooked River Plantation Subdivision, (2) discerning any contribution to the plume from sources upgradient of the landfill, (3) sampling of private wells in the subdivision, and (4) assessing the presence or absence of contamination in surface water, sediment, soil gas, and air. The investigation will also collect data to perform a preliminary screening risk evaluation for possible exposure routes. The field sampling effort will follow the procedures outlined in the RFI work plan for NSB Kings Bay, including procedures for collection of groundwater and surface water samples, sediment samples, topographic surveying, documentation, field monitoring instrumentation, equipment decontamination procedures, control and disposal of investigation-derived wastes, and quality assurance (QA) and quality control (QC) procedures.

4.2.1 Direct Push Technology Stratigraphic data (piezocone), groundwater sampling (hydrocone), and soil gas sampling (vapor cone) will be conducted using direct push technology. Subsurface penetrations are made by hydraulically advancing small diameter steel rods into the soil at a constant rate.

NOTICE OF PUBLIC INFORMATION SESSION
CROOKED RIVER ELEMENTARY SCHOOL LIBRARY
THURSDAY, OCTOBER 15, 1992 - 7:00 PM

In an earlier notification and at the community meeting on September 3, you were given information about groundwater testing being done by the Navy. August, 1992 testing of the groundwater confirmed the existence of a "plume" of vinyl chloride near the Old Camden County Landfill. The Navy and their consultants, ABB Environmental Services, Inc., in cooperation with the City of St. Mary's and state regulatory agencies, will be continuing these investigations in the Crooked River Plantation subdivision beginning the week of October 12, 1992. This testing must be done to define the location and extent of the plume, and to eventually develop a cleanup plan.

Homeowners in Crooked River Plantation who are located from Plantation Drive to Spur 40 (Figure 1-1), as well as others in the subdivision who have private wells, are encouraged to attend this meeting. This is the area targeted for additional testing. Any other residents interested in our progress are also welcome to attend.

The discussions at this meeting will include:

- ***Sampling and Testing of Private Wells*** At the last meeting, residents who had private wells were asked to report them to the Navy and, as a precaution, to stop using them until they could be tested. Before these wells can be tested, permission forms like the one attached need to be signed. Residents in the area of Crooked River Plantation mentioned above are particularly encouraged to attend the information session on Thursday and to grant permission for testing of their wells. Additional information on how private well testing will be conducted will be shared at the meeting. Other residents may request testing of their wells by mailing in a permission form or by signing one at the meeting. Private wells outside the targeted area will be done as soon as possible, after testing of the wells within the targeted area.
- ***Hydrocone Sampling in Streets and Rights of Way*** Hydrocone testing will begin immediately in the targeted area to determine the location and extent of the "plume". Hydrocone technology consists of a large truck with a metal rod which pushes into the ground to retrieve groundwater samples. Samples will be initially taken in streets and rights of way to be the least disruptive to your neighborhood.
- ***Permission to Sample on Private Properties*** Private homeowners in the targeted area may also be asked permission to allow hydrocone sampling on their properties. The process will be the same as in the streets and on the rights of way. Homes in the targeted area have permission forms attached to this notice. Those residents are urged to review the form, sign it, and bring it to the meeting with any questions. If you cannot attend the meeting, please mail it in the enclosed envelope no later than October 15, 1992.

Your continued assistance in the investigation of area groundwater is appreciated and will help to more quickly and accurately determine the location and extent of the plume. When this is done, a plan of action for cleanup can be developed. If you have questions about this testing, we encourage you to attend the October 15, 1992 meeting. Other inquiries may be made to the Subbase Public Affairs Office, 673-4714.

PERMISSION TO CONDUCT SAMPLING ON PRIVATE PROPERTY

As you may know, an area of groundwater, called a "plume", contaminated with vinyl chloride has been detected in the vicinity of the Old Camden County Landfill. The plume was confirmed in August 1992 by a groundwater investigation being conducted by the U.S. Navy at Subase Kings Bay, where the landfill is located.

In cooperation with state and local regulatory officials, the U.S. Navy is conducting further investigations to better define the plume's location. Additional investigations will include conducting surveys, sampling of private water wells and groundwater testing along the right-of-ways in Crooked River Plantation.

More data is needed to develop a plan to address the plume. Your property is one of the few strategically located, which if tested, will provide the necessary data to define the location and extent of the plume. For these reasons, the U.S. Navy is requesting access to your property, to allow its consultants, ABB Environmental Services, Inc., to conduct these tests.

Utilizing a technique called "direct push", hydraulic jacks will be used to anchor and stabilize the truck while metal rods are pushed into the ground to collect groundwater samples. Due to the process of positioning the truck and collecting the samples, after effects on the property will be evident. These include tire tracks, two 1-foot diameter depressions in the ground created by the jacks, and one 3-inch hole created by the sampling rod.

ABB Environmental Services will work with you to select appropriate sampling location(s) on your property to minimize any inconvenience that this may cause you and your family. After the sampling has been completed, the Navy will ensure that all holes and tracks are filled, damaged grassed areas are seeded or re-sodded, and destroyed vegetation is replaced at no expense to you. Once the landscapers are done, you will be asked to sign a release form acknowledging that you are satisfied with the repairs made to your yard.

With this understanding in mind, your permission is requested to participate in the following process:

1. Upon receipt of this completed Permission Form, you will be contacted to set a date and time for the sampling. (The sampling needs to take place by early November).
2. An ABB Environmental Services, Inc. staff members will meet you at the agreed date and time. You will be asked to select and indicate the least disruptive point on the property to conduct the sampling. Please inform these representatives of any known underground structures or other unique features of the property not readily observable (e.g., sprinkler system, wells, septic tank, etc.)
3. The sampling will then take place and will require approximately 2 hours to complete.
4. If requested, results from the sampling will be made available to you, through the U.S. Navy, after laboratory analysis and validation. This process may take several weeks.

Form 4-3 (Cont.)

Under these terms, I do allow the U.S. Navy, including its consultant, ABB Environmental Services, Inc. and their subcontractors, to access my property and perform Direct Push, hydrocone sampling.

Signature

Address

Phone

Please return this form to the Public Affairs Office, Subbase Kings Bay, GA 31547-5015 on or by October 15, 1992. Please keep one copy of this completed form for your records.

Property Owner Advisement

Federal law gives you the right to obtain a portion of any water or soil sample that the Navy may draw from your property. This is what is normally referred to as a "split sample." Should you request a split sample, you will be responsible for providing a container(s) for the split sample(s) and will be responsible for all costs associated with analyzing your portion of the sample(s). The Navy will be responsible for its portion of the sample(s) and will bear all costs associated with analyzing its portion. Federal law also gives you the right to obtain a copy of the results of the Navy's analysis of any samples it draws from your property. Unless you indicate to us that you do not desire to receive a copy of the results, a copy will be provided to you without charge.

Statutory Authority Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code Sec. 9604(4)(B).

Stratigraphic data are interpreted from measurements of the resistance to penetration at the tip and outer surface of the sleeve of the piezocone. Subsurface pore pressure is monitored with a pressure transducer. Resistance to penetration and pore pressure are interpreted by computer to provide United Soil Classification System category, relative soil density, hydraulic pressures, and strata thicknesses.

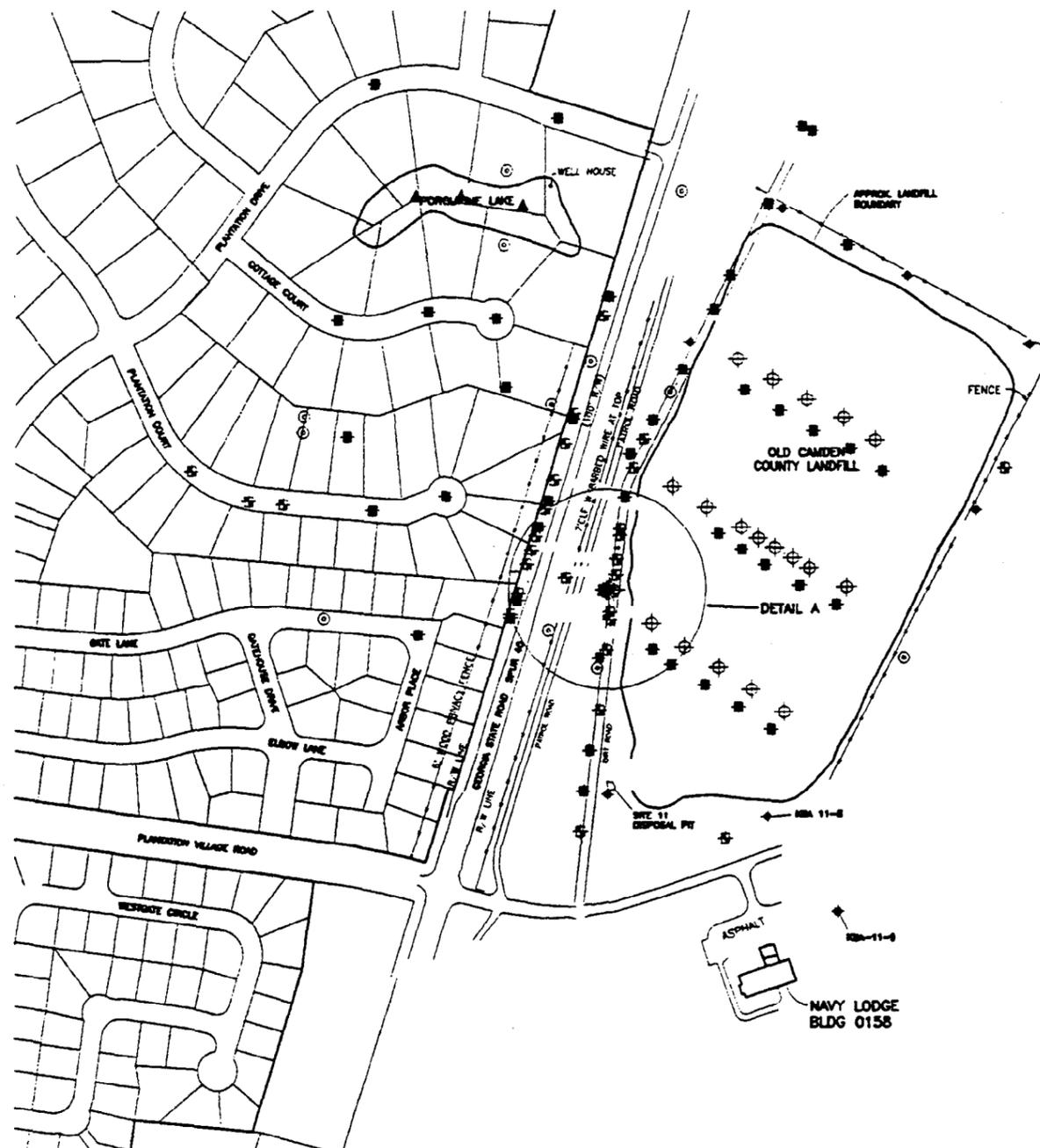
The hydrocone groundwater sampler consists of a telescoping assembly containing a 1-foot length of stainless steel well screen fitted with a cone tip. The assembly is sealed from infiltration during penetration by O-rings above and below the sample chamber. The screen is exposed once the desired sample depth has been achieved. Natural hydrostatic pressure forces groundwater to flow into the collection chamber. Sample volatilization is prevented by applying back pressure with argon gas. The rate of sample chamber filling is recorded and used to estimate aquifer permeability. The chamber and screen assemblages are lifted to the ground surface and the sample is recovered. To collect groundwater at multiple intervals, the hole is reentered with a clean sample collection chamber and screen assemblage.

If difficulties are encountered using the direct push technology, hollow-stem auger drilling will be used to set PVC casings in order to advance the direct push instruments through the obstructing layer. Multiple casings may be used at each location to collect from various depths.

Soil gas is collected by advancing the vapor cone to the desired depth and allowing soil gas to enter the sample ports. A pulse pump and flexible tubing are used to bring the soil gas to the surface where it is transferred to Tedlar bags for analysis.

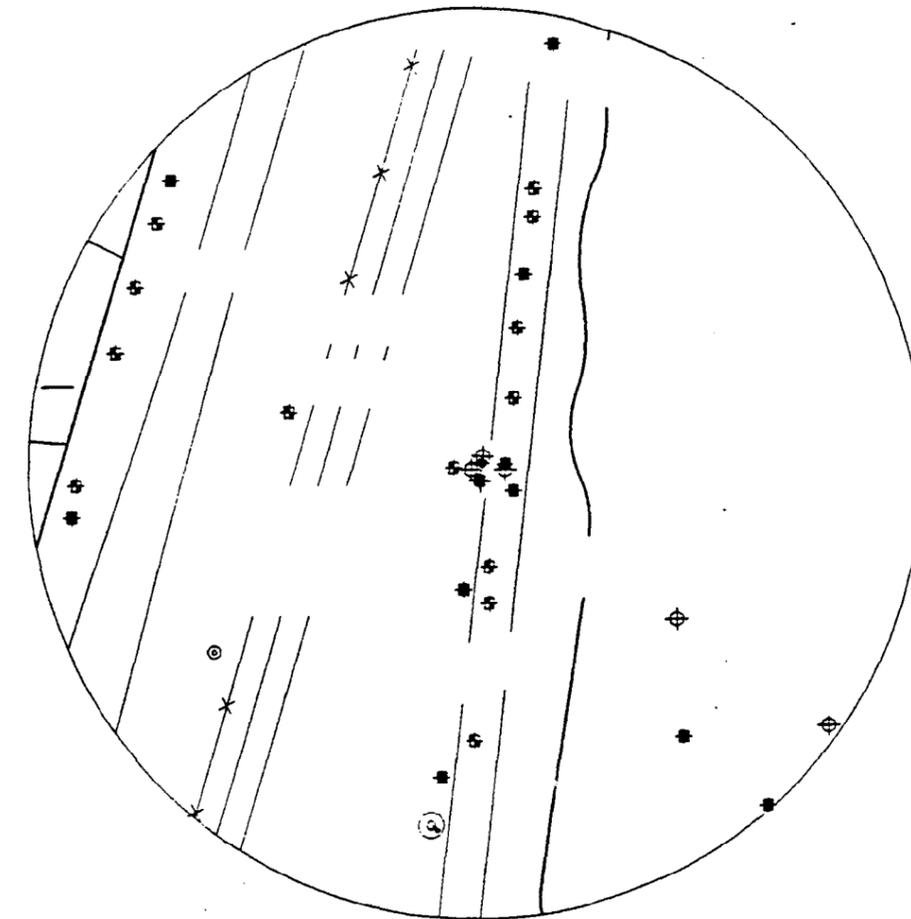
4.2.1.1 Hydrocone Sampling The first objective of the Corrective Measure Screening Investigation is to assess the areal extent of the VOC plume. Hydrocone samples will be collected around the perimeter of the landfill and in the Crooked River Plantation Subdivision. Assessment of the plume geometry will define the scope of the subsequent field activities and the preliminary risk evaluation. Hydrocone screening results will be used to determine the location for monitoring wells to be installed during the Phase I RFI. It is anticipated that monitoring well clusters will be required. Groundwater will be sampled using the hydrocone at three depths at each location, at approximately 2 feet, 12 feet, and 22 feet below the water table as permitted by geologic conditions. All hydrocone samples will be screened for VOCs in the field laboratory. Sample depths may be adjusted in the field based on results from the field laboratory. Ten percent of the samples will be submitted for laboratory confirmation by Contract Laboratory Program (CLP) methods. In addition, ten percent of the samples collected in and around the landfill will be submitted for SVOC analysis by an off site laboratory.

Initially, hydrocone samples will be collected on subdivision roadways. Initial sample locations are shown in Figure 4-1. Table 4-1 summarizes the field sampling plan. Spacing between the initial 11 locations in the subdivision is wide (300 to 500 feet between locations) in order to roughly define where the plume is located. Sample results from the field laboratory will generally be available on the day of sample collection. Once sample



LEGEND

- EXISTING MONITORING WELL LOCATIONS
- ▲ MARSH
- ⊕ PROPOSED VAPOR CONE LOCATIONS
- ⊕ H1-H25, P1,P2 PHASE I INTERIM INVESTIGATION SCREENING LOCATIONS (AUGUST 1992 SAMPLE LOCATIONS)
- PROPOSED GROUNDWATER SAMPLE LOCATIONS FOR THE INTERIM CORRECTIVE MEASURES SCREENING INVESTIGATION
- ⊙ PROPOSED PIEZOCONE LOCATIONS
- ▲ PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATIONS.



DETAIL A



FIGURE 4-1
SITE II SCREENING
EXPLORATION LOCATIONS



INTERIM CORRECTIVE
MEASURE SCREENING
INVESTIGATION WORK PLAN
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

TABLE 4-1 Field Sampling Plan, Interim Corrective Measure, Site 11 NSB Kings Bay

SAMPLE TYPE	MEDIA	NUMBER OF LOCATIONS	NUMBER OF SAMPLES	FIELD SCREENING	LABORATORY CONFIRMATION	LABORATORY ANALYSIS
HYDROCONE						
SUBDIVISION						
INITIAL	WATER	11	33	33		
FINAL*	WATER	22	90	90	14	VOC
LANDFILL PERIMETER	WATER	23	70	70	8	VOC (5 VOC, 3 SVOC)
LANDFILL	WATER	15	45	45	5	VOC
TEN % OF HYDROCONE	WATER					
PIEZOCONE	NA	15	0	NA	NA	
VAPOR CONE	AIR	22	22	22	0	
FLUX AIR CHAMBER	AIR					VOC
SURFACE WATER	WATER	3	5	5	3	VOC, SVOC
SEDIMENT	SEDIMENT	3	3	3	3	VOC, SVOC
PRIVATE IRRIGATION WELLS	WATER	51	51	51	24	VOC
TOTALS*		165	319	319	57	

* EXACT NUMBER MAY VARY BASED ON FINDINGS OF INITIAL SAMPLES AND PROERTY ACCESS.

QUALITY CONTROL SAMPLE ARE NOT INCLUDED ON THIS TABLE.

VOC = Volatile Organic Chemicals

SVOC = Semi-Volatile Organic Chemicals

NA = Not Applicable

Table 4-1 wk1

results for the initial locations are available, refinement of the plume boundaries will be made by collecting closely spaced samples. The strategy for defining the plume location is to bisect the initial locations, and then continue to bisect the adjacent detect and non-detect locations until the edge of the plume is known within approximately 50 feet. Defining the plume in the subdivision will add approximately 20 to 22 sample locations to the original 11. Sampling for plume definition might need to be partly or entirely conducted on private property. Once the rough boundary has been defined by the original 11 locations, house lots will be identified and permission sought to access private property for exploration (see Subsection 4.1.4). Gaining permission for work on private property, or lack of permission, could affect achieving project objectives.

Hydrocone sampling will be conducted around the perimeter of the landfill to evaluate for upgradient and crossgradient sources to the plume. A total of 23 locations will be sampled, at three depths each, along the south, east and north sides of the landfill (see Figure 4-1 and Table 4-1). Three locations along the eastern border of the landfill and five locations across Spur 40 will be sampled to delineate the plume as it leaves the landfill. Results of the initial screening will reveal whether additional sampling locations or additional sampling depths at initial locations are needed to refine plume geometry.

Fifteen hydrocone samples will be collected within the landfill boundary to correlate groundwater quality with the anomalies observed during the magnetometry survey [see Figure 4-5 of the Technical Memorandum No. 1, June 1992 (ABB-ES, 1992a)]. The hydrocone locations will be spaced 100 feet apart along linear topographic highs running parallel and adjacent to disposal trenches. The groundwater beneath three such ridges will be sampled, at five locations per ridge (see Figure 4-1 and Table 4-1). The area that has been selected for hydrocone sampling is the suspected source of chemical waste.

The low magnetic signal in the area indicates that typical municipal waste such as trash and demolition debris are not present. This is based on the pattern of the magnetic gradient contours observed over most of the landfill.

To complete the characterization of the groundwater plume, the off-site laboratory samples from the landfill perimeter and inside the landfill will also be analyzed for SVOCs.

4.2.1.2 Piezocone Sampling To characterize the geology and stratigraphy of the site, 15 piezocone locations have been proposed around the perimeter of the landfill and in the subdivision (see Figure 4-1 and Table 4-1). Piezocones will be driven to refusal, which occurred at depths ranging from 78 to 97 feet bgs at the 2 locations driven during the Phase I interim investigation. Piezocone data will be valuable in understanding the distribution of the contaminant plume, identifying any confining layers or preferential migration pathways, and predicting the fate of the plume.

4.2.1.3 Vapor Cone Sampling Vapor cone sampling will be conducted at four locations next to monitoring well KBA-11-2 and at the 18 hydrocone locations inside the landfill (see Figure 4-1 and Table 4-1). Vapor cone data will be

used to assess the partitioning of chemical wastes from the water table into soil gas and the potential exposure risks associated with this pathway. Samples will be analyzed by the field laboratory for target VOCs.

4.2.2 Surface Water Investigations Porcupine Lake is a 1.5-acre, shallow, man-made water body in the Crooked River Plantation Subdivision (see Figure 4-1). Porcupine Lake is used for recreational activities such as wading. Surface water and sediment will be sampled and a source evaluation will be conducted to determine the contribution of city water and groundwater to the lake.

4.2.2.1 Surface Water and Sediment Sampling Surface water and sediment samples will be collected from three locations in Porcupine Lake in the Crooked River Plantation Subdivision (see Figure 4-1 and Table 4-1). The sample locations are along the approximate center line of the lake at the anticipated maximum depth to minimize the effects of volatilization. Samples will be collected according to the procedures outlined in Subsection 2.2.3 of the RFI Work Plan (ABB-ES, 1991). Samples will be screened for VOCs at the field laboratory, and for VOCs and SVOCs at the off-site laboratory by CLP methods.

4.2.2.2 Porcupine Lake Source Evaluation During surface water and sediment sampling, water depth to the bottom of Porcupine Lake will be measured with a weighted tape or measuring stick. The water depth data will be used to evaluate whether the lake intersects the groundwater table. Lake water elevation will be recorded during the topographic survey and compared with the groundwater elevation to determine whether the lake is draining or feeding groundwater.

During dry periods, the lake maybe filled with city water via a non-metered water line and valve whose location and existence are unknown to the city. To learn more about the contribution of city water to the lake, interviews with local homeowners will be conducted as well as city water department officials to obtain pertinent system drawing and water usage records; a records search will be performed at city hall to locate and interview the contractor who installed the subdivision water system; and the lake will be traversed with water department personnel to physically verify the existence of any water line running to the pond using a probing rod, metal detector, or backhoe. Every effort will be made to ascertain the schedule and volume of lake fillings with city water.

4.2.3 Sample Requirements for Air Modeling and Screening Risk Evaluation An air sampling program at the Crooked River Plantation Subdivision will be conducted to support the air modeling and preliminary screening risk evaluation. This air sampling program will consist of two screening measurement techniques. One of those techniques will obtain data for inclusion into the air modeling. The other technique will provide data necessary for the preliminary screening risk evaluation.

Air modeling is part of the air pathway analysis that will provide the calculated contaminant concentrations, based on emission rates and meteorological data, used as input into the preliminary screening risk

assessment. To fulfill these data input needs, field screening air measurements will be conducted as soon as sufficient data are available from the groundwater screening program to design the air sampling program.

4.2.3.1 Air Emission Isolation Flux Chamber Sampling A direct measurement technique may be conducted based on the results of the surface water sampling conducted at Porcupine Lake (see Figure 4-1). If vinyl chloride is detected in the surface water, an emission flux will need to be assessed for input to the air modeling. Direct measurement of VOCs will be performed using the emission isolation flux chamber method with real-time analysis by direct reading instrumentation followed by subsequent gas chromatography/mass spectrometry (GC/MS) laboratory analysis. This technique will use a flux chamber to isolate a known area for emission flux (rate per area) measurements.

Three emission flux sample locations in the lake will be used during the program. Five total emission flux analytical samples will be collected and submitted to the laboratory; one sample per location will be collected as well as one analytical blank and one duplicate sample. In addition, the real-time analysis will contribute additional data provided that the vinyl chloride concentration is above the direct reading instrumentation's detection limit (0.2 to 0.8 parts per million [ppm]) for vinyl chloride. Meteorological parameters including barometric pressure, relative humidity, precipitation, and general weather conditions and the surface water temperature will be monitored and recorded during these sampling events.

4.2.3.2 Real-Time Instrument Survey Sampling After the initial field investigations have evaluated the extent of the contaminant plume beneath the Crooked River Plantation Subdivision, a real-time instrument survey screening technique will be conducted. This part of the air sampling program will be based upon the delineation of the plume and will cover the areas accessible to field personnel. The sampling locations for the survey will be designed to identify potential emission "hot spots" for VOCs in low-lying areas or depressions. The real-time instrument survey is a screening technique limited by the direct reading instrumentation's detection limits (0.2 to 0.8 ppm for vinyl chloride). The survey will use real-time direct reading instrumentation to assess the average concentration of specific VOCs in the air layer directly above the sites. Real-time instrument surveys will also include taking headspace concentration measurements in cracks, holes, drainage ditches, ground surface depressions, and utility meter boxes. Permission to enter these locations will be obtained during the preliminary activities (see Subsection 4.1).

This survey program will be carried out for approximately three days during quiescent wind conditions (i.e., average wind speed less than 5 miles per hour) or the period needed to get three replicate measurements at each sampling location. In addition, wind speed and direction, temperature, barometric pressure, relative humidity, precipitation, and general weather conditions will be monitored and recorded throughout the survey.

4.2.4 Private Irrigation Well Sampling Residents of the Crooked River Plantation Subdivision with private irrigation wells (PIWs) will be offered

the opportunity to have their wells sampled. To date, 94 PIWs have been identified in the subdivision. Figure 4-2 shows the location of known PIWs. Homeowners with PIWs will be contacted so that arrangements can be made to sample the well water. PIWs observed to date are equipped with pumps located above the ground surface outside buildings. Samples will be collected at the pump outlet spigot according to the procedures outlined in Subsection 2.2.5 of the RFI Work Plan (ABB-ES, 1991). All PIW samples will be screened for VOCs in the field laboratory. Ten percent of the samples will be submitted for laboratory confirmation by CLP methods. In addition, all samples collected within the suspected boundaries of the plume will be submitted to the off site laboratory for confirmation. During purging of the PIWs, a maximum flow rate will be measured by bucket and stop watch methods. Flow data will be used in the air modeling for different domestic-use scenarios. Homeowners with PIWs will be asked to supply information on the nature and frequency of their well uses. A summary of the field sampling plan is presented in Table 4-1.

4.2.5 Topographic Survey All hydrocone, piezocone, vapor cone, and surface water sample locations will be surveyed for location and elevation to 0.1-foot horizontal and 0.01-foot vertical. Locations will be tied into the State Plane Coordinate System and MLW datum according to the procedures outlined in Subsection 2.2.7 of the RFI Work Plan (ABB-ES, 1991). The number of survey locations can vary depending on the final number of hydrocone locations in the subdivision.

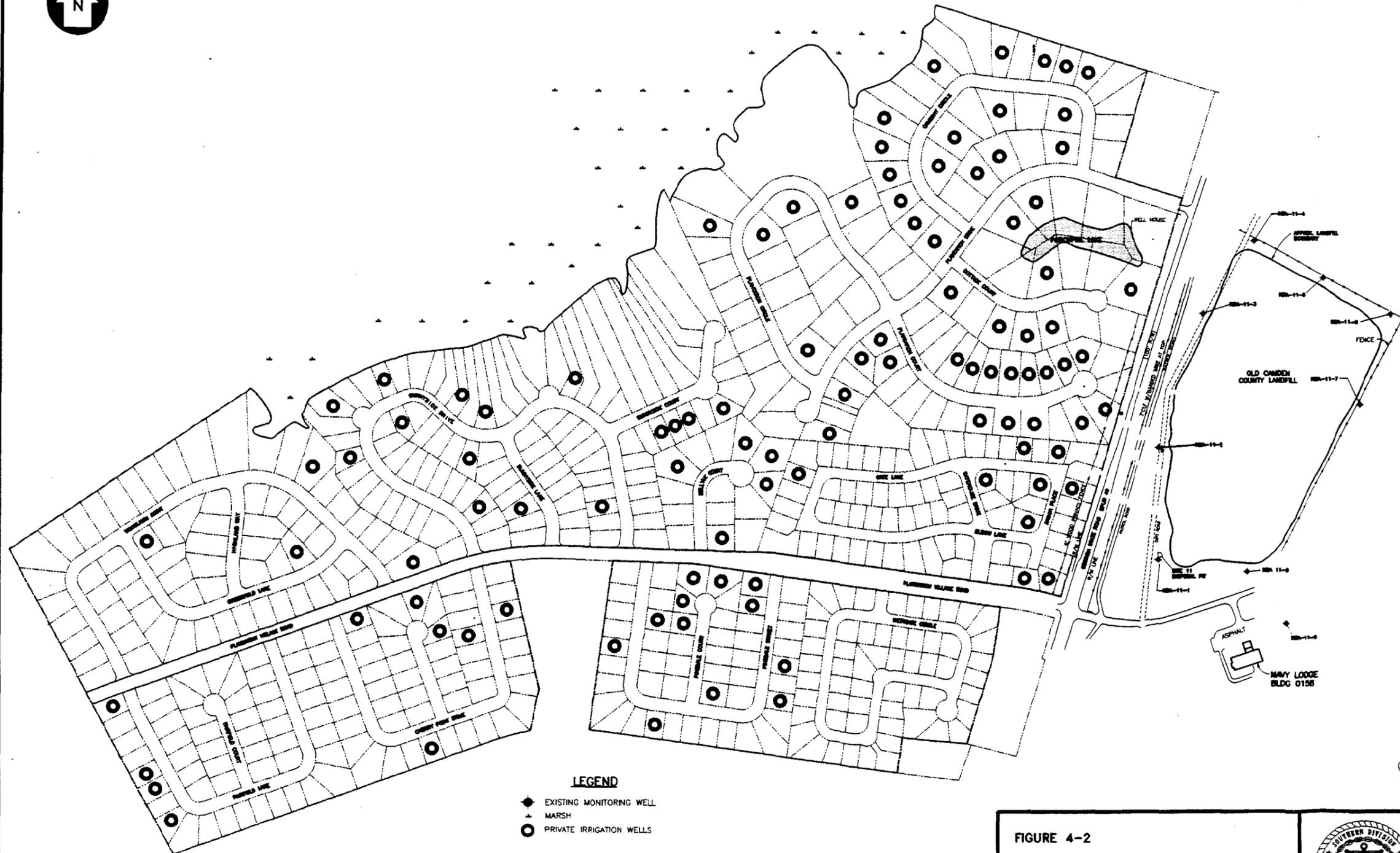
4.3 SAMPLE ANALYSES AND DATA MANAGEMENT. Sample analyses will be conducted according to the guidelines described in Subsection 4.6.3 of the RFI Work Plan (ABB-ES, 1991). Laboratory results as well as survey readings and stratigraphic data will be collected in an appropriate computer database for further statistical analysis.

4.3.1 Data Quality Objectives The intended use of data and the required data quality objectives (DQOs) are best defined during the planning stages to ensure that collection, containerization, shipping, and analytical methods are consistent with the degree of confidence required of the resultant data. Subsection 4.1.1 of NSB Kings Bay RFI/SI Work Plan (ABB-ES, 1991) describes the five levels of DQOs in detail. Examples of task-specific DQOs are as follows:

Sediment and Surface Water Sampling Screening, Level 1: All sediment and surface water samples collected by ABB-ES personnel will first be screened with either an organic vapor analyzer or photoionization detector (PID) for the presence or absence of volatile compounds.

Field Gas Chromatograph Screening, Level 2: All samples collected from private wells and using the hydrocone will be analyzed for VOCs of interest at the field GC trailer.

Confirmatory Sampling, Level 4: Ten percent of the VOC samples collected using the hydrocone will be sent off site for confirmatory laboratory testing. Samples will be analyzed for the Target Compound List (TCL) using the low concentration CLP method.



LEGEND

- ◆ EXISTING MONITORING WELL
- ▲ MARSH
- PRIVATE IRRIGATION WELLS



FIGURE 4-2

**CROOKED RIVER PLANTATION SUBDIVISION
LOCATIONS OF PRIVATE IRRIGATION WELLS**



**INTERIM CORRECTIVE
MEASURE SCREENING
INVESTIGATION WORK PLAN**

**NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

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5.0 PROJECT MANAGEMENT PLAN

The Project Management Plan for the Interim Corrective Measure Screening Investigation at NSB Kings Bay includes the technical and management approach, qualifications of key personnel, and schedules for conducting the project.

5.1 TECHNICAL APPROACH. This Interim Corrective Measure Screening Investigation at Site 11, NSB Kings Bay, is designed to establish the preliminary screening risk to human health posed by use of groundwater affected by contaminants from the old Camden County Landfill. The potential for risk was established during the initial site inspection and the Phase I Interim Investigation. Data from the Interim Corrective Measure Screening Investigation field sampling program will be used to conduct a preliminary screening risk evaluation, as well as to locate monitoring wells for the RFI confirmatory program.

Groundwater screening and sampling will be conducted in the Crooked River Plantation Subdivision on public right-of-ways using direct push technology to roughly delineate the plume. The plume boundary will be further defined by additional sampling that could require access to private property. Groundwater screening will be conducted west of the landfill to further delineate the plume exiting the landfill. Screening samples will also be collected around the south, east, and north perimeters of the landfill to evaluate for upgradient sources that might contribute to the plume. In addition locations will be screened inside the landfill to investigate the potential source area defined in the RFI/SI program geophysical survey. Ten percent of the samples will go to the contract laboratory for confirmation by CLP methods.

Soil gas samples will be collected around monitoring well KBA-11-2 and at any of the groundwater screening locations inside the landfill that contain VOCs. Soil gas samples will be used to evaluate the partitioning of contaminants from groundwater to the soils. Soil gas samples will be screened for VOCs at the field laboratory.

Surface water and sediment samples will be collected from the pond in the subdivision. Samples will be screened for VOCs at the field laboratory, and will be analyzed at the contract laboratory for TCL VOCs and SVOCs by CLP methods. Results will be used for the preliminary screening risk evaluation.

Air sampling will be conducted for input into air modeling and preliminary screening risk evaluation. If VOCs are detected in the pond water, flux chamber sampling of the pond will be conducted. In addition, real-time screening of ground surface depressions located above the plume, as defined by hydrocone groundwater samples, will be conducted.

All residents of the subdivision with private wells will be given the opportunity to have their wells sampled. Well water will be analyzed at the contract laboratory for TCL VOCs. Well flow rates will be measured, and well

use data will be collected for use in the preliminary screening risk evaluation.

Results of the preliminary screening risk evaluation will be used to establish health threats and design the appropriate corrective measure to reduce or remove health threats.

5.2 MANAGEMENT APPROACH. In undertaking the NSB Kings Bay Interim Corrective Measure Screening Investigation, ABB-ES will be responsible for overall program management with senior ABB-ES personnel filling the key roles of Corporate Officer, Program Manager, Quality Assurance Coordinator, Health and Safety Coordinator, Task Order Manager, and technical support staff. The proposed organization chart for this project is shown in Figure 5-1.

5.3 KEY PERSONNEL. Key individuals in the project structure are highlighted in this subsection.

5.3.1 NSB Kings Bay The activity is the lead contact with the local, state, and federal regulators. It is the responsibility of the activity to review and approve all technical deliverables. Captain M.W. O'Neil is the Commanding Officer for NSB Kings Bay. Captain Len Scullion is the Public Works Officer and Mr. John Garner is the base Environmental Coordinator who is the primary point of contact with the regulatory agencies.

5.3.2 SOUTHNAVFACENGCOCM Engineer-in-Charge (EIC) SOUTHNAVFACENGCOCM is responsible for establishing policy and guidance for the CLEAN Program. SOUTHNAVFACENGCOCM awards contracts, approves funding, and has primary control of report release and interagency communication. The SOUTHNAVFACENGCOCM Remedial Program Manager (RPM), Mr. Ed Lohr, is responsible for the technical and financial management of the RFI/SI and CMS activities at NSB Kings Bay. Mr. Lohr is the primary project contact. He prepares the project statement of work; develops the project Site Management Plan; manages project scope, schedule, and budget; and provides technical review and approval of all deliverables. Mr. Lohr will be responsible for changes in the scope of work, if any, determined during Project Managers' Meetings.

5.3.3 Corporate Officer The Corporate Officer and Vice-President of Southeastern Regional Operations is Mr. Tony Allen. Mr. Allen is responsible for committing the corporate resources necessary to conduct the program work activities, supplying corporate-level input for problem resolution, and assisting the Task Order Manager as needed in project implementation.

5.3.4 Program Manager The Program Manager, Mr. William Lawrence, is responsible for oversight and management of the overall multi-installation Navy CLEAN contract for District 1. In this position, Mr. Lawrence is able to identify overall program needs, promote technology and other information transfer between various Navy CLEAN projects, and direct resources, as appropriate, for effective and timely completion of program activities.

5.3.5 Task Order Manager The Task Order Manager for NSB Kings Bay will be Mr. Frank Cater, P.E. Mr. Cater is responsible for evaluating the appropriateness and adequacy of the technical or engineering services provided

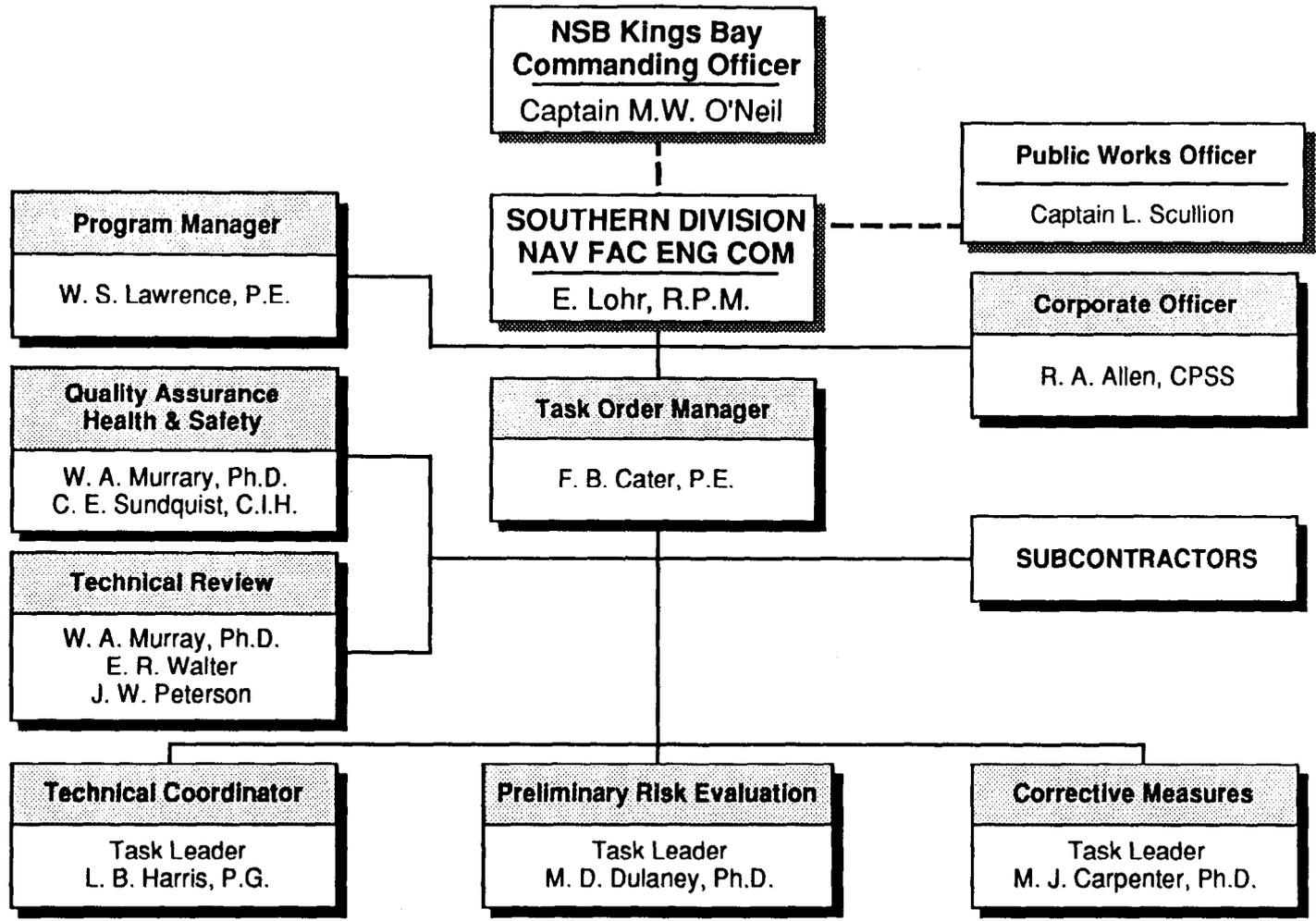


FIGURE 5-1
PROJECT ORGANIZATION



**INTERIM CORRECTIVE
MEASURE INVESTIGATION
WORKPLAN**

**NAVY SUBMARINE BASE
KINGS BAY, GEORGIA**

for NSB Kings Bay and for developing the technical approach and level of effort required to address each task of the Plan of Action. Mr. Cater is also responsible for the day-to-day conduct of the work, including the integration of the input of supporting disciplines and subcontractors. He will review the ongoing QC during the performance of the work, the technical integrity of conclusions and recommendations, and the clarity and usefulness of all project work products.

5.3.6 Technical Coordinator Ms. Laura Harris, P.G., will be the technical activity leader for the field studies and the development of the Interim Corrective Measure Screening Investigation Report. She will also be responsible for the quality and completeness of data gathered during the field program, including overall management and coordination of fieldwork, and supervision and scheduling of work.

Ms. Harris, will also be the primary Field Operations Leader, responsible for ensuring that field activities are performed consistent with the project work plan and supporting documents. This effort will include appropriate logging and documentation of standard and approved methods to ensure that pertinent information is obtained during the exploration program. Other responsibilities include oversight of sampling activities and site characterization studies.

5.3.7 Risk Evaluation Dr. Marland Dulaney will be responsible for the Preliminary Risk Evaluation. Dr. Dulaney will plan and perform the risk evaluation supported by Interim Corrective Measures Investigation data. Dr. Dulaney will identify chemicals of potential concern and possible exposure pathways. He will characterize the risk related to potential exposure to off-site migration of contaminants and determine if there is an immediate health risk associated with these exposures. Dr. Dulaney will recommend an immediate response action if required.

5.3.8 Corrective Measures Lead Dr. Marguerite Carpenter is responsible for the development and implementation of the CMS. Dr. Carpenter will provide guidance to the project team concerning regulations governing the corrective measures implemented at Site 11. She is well versed in the regulations under CERCLA and RCRA governing hazardous waste site remediation.

5.4 SUPPORT ROLES.

5.4.1 Quality Assurance Manager As the Quality Assurance Manager, Dr. Willard Murray will be responsible for ensuring that field and laboratory activities support DQOs and conform with the project work plan. Dr. Murray will perform periodic field and laboratory audits to monitor conformance with requirements.

5.4.2 Health and Safety Coordinator Ms. Cindy Sundquist is the Corporate Health and Safety Manager for ABB-ES and will act as Health and Safety Coordinator for the project. The Health and Safety Coordinator is responsible for ensuring that the project team complies with the Health and Safety Program. She is also responsible for assuring that a Health and Safety Plan is developed for each site activity.

5.4.3 Internal Technical Review Committee

Quality Review Board. A Quality Review Board made up of senior technical staff from the ABB-ES team will assist the Task Order Manager by providing review of the technical aspects of the project to assure they are produced in accordance with corporate policy, and meet the requirements of SOUTHNAVFACENGCOM. The Board for the project is comprised of Dr. Willard Murray, Ms. Elizabeth Walter, and Mr. John Peterson.

Dr. Willard Murray will be part of the ABB-ES technical quality review board and will be actively involved in assuring the technical quality and appropriateness of methodologies, conclusions, and recommendations of the Interim Corrective Measure Screening Investigation.

Ms. Elizabeth Walter, a Senior Toxicologist, will provide guidance on the approach and methodology used to characterize risk and establish target cleanup levels.

Mr. John Peterson, a Senior Geologist and Senior Project Manager, will provide guidance on selecting corrective measures which are appropriate for site conditions and client needs.

5.4.4 Other Key Technical Team Members Qualified technical staff and field personnel from ABB-ES or their subcontractors will accomplish specific tasks such as air modeling, sample collection, subcontractor oversight, data analysis, and report preparation. Oversight of staff activities will be accomplished by the management team described above.

The main technical staff members responsible for portions of this program include: Norma Gordon (Senior Air Modeler), John Planinsek (Chemist), Nora Weber (Chemist), and Bruce Henning (Scientist).

5.4.5 Project Schedule The schedule is presented in Table 5-1. The schedule will begin upon the approval of the work plan and the notice to proceed. Ready access to private property (i.e., permission from residents is easily obtained) is assumed. It was also assumed that there will be no delays because of securing required permits. The schedule might also be modified following review of the data collected during the Interim Corrective Measure Screening Investigation.

TABLE 5.1 SCHEDULE

**CTO 041 Modification #3 Interim Corrective Measure Screening Investigation
NSB Kings Bay, Georgia**

Task Name	Start Date	Duration (Days)	End Date	1992			1993				
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	
NOTICE TO PROCEED	12-Oct	1	12-Oct								
PRELIMINARY FIELD ACTIVITIES	13-Oct	16	28-Oct	█							
FIELD ACTIVITIES	15-Oct	38	21-Nov	██████████							
LABORATORY ANALYSIS OFF-SITE	16-Oct	50	4-Dec	██████████							
DATA EVALUATION	2-Nov	87	27-Jan		████████████████████						
REPORT	16-Nov	129	9-Apr				██				
Draft to Navy	27-Jan	0	27-Jan				▲				
Final Draft to Agencies	1-Mar	0	1-Mar						▲		
Final	9-Apr	0	9-Apr								▲
MEETING 1	14-Oct	1	14-Oct	█							
MEETING 2	22-Oct	1	22-Oct	█							
MEETING 3	17-Dec	2	18-Dec			█					

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APPENDIX A

PHASE I INTERIM INVESTIGATION MEMORANDUM, SITE 11



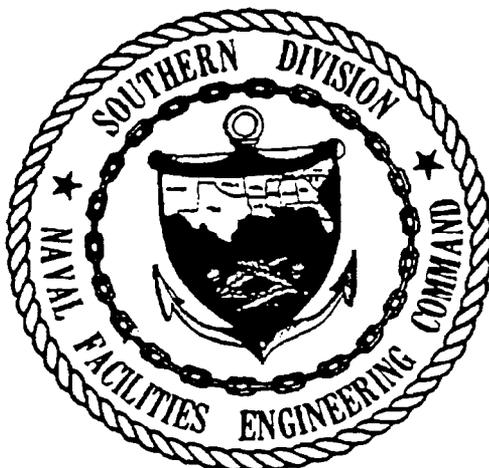
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**PHASE I INTERIM INVESTIGATION
MEMORANDUM, SITE 11**

**NAVAL INSTALLATION RESTORATION PROGRAM
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

CTO 041

SEPTEMBER 1992



**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA
29411-0068**

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**PHASE I INTERIM INVESTIGATION
MEMORANDUM, SITE 11**

**NAVAL INSTALLATION RESTORATION PROGRAM
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

CTO 041

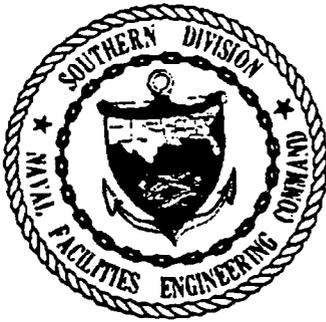
Prepared for:

**Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina 29411-0068**

Prepared by:

**ABB Environmental Services, Inc.
1400 Centerpoint Blvd., Suite 158
Knoxville, Tennessee 37932-1968**

September 1992



FOREWORD

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), the 1976 Resource Conservation and Recovery Act, as augmented by the 1984 Hazardous and Solid Waste Amendments (HSWA), and as directed in Executive Order 12580 of January 1987, the Department of Defense (DOD) conducts an Installation Restoration (IR) Program for evaluating and remediating problems related to releases and disposal of toxic and hazardous materials at DOD facilities.

The Naval Assessment and Control of Installation Pollutants (NACIP) program was developed by the Navy to implement the IR Program for all naval and Marine Corps facilities. The NACIP program was originally conducted in three phases: (1) Phase I, Initial Assessment Study, (2) Phase II, Confirmation Study (including a Verification Step and a Characterization Step), and (3) Phase III, Planning and Implementation of Remedial Measures. The three-phase IR Program was modified and updated to be congruent with CERCLA/SARA and RCRA/HSWA driven DOD IR Program.

The updated nomenclature for the RCRA/SARA process is as follows:

- Preliminary Assessment and Site Inspection
- Remedial Investigation
- Feasibility Study
- Planning and Implementation of Remedial Design

Four sites at Naval Submarine Base (NSB), Kings Bay, Georgia, were identified for investigation under the IR Program. A work plan for conducting a RCRA Facility Investigation/Site Inspection (RFI/SI) at three of four sites has been completed and implemented. No sampling or analyses will be conducted at the fourth site. The Public Works Department at the NSB will gather information for the fourth site to include in the RFI Report.

A Phase I Interim Investigation was conducted at one of the four sites, Site 11, in response to detection of VOC contaminants, primarily vinyl chloride, in a downgradient monitoring well. The investigation included collection and chemical analysis of groundwater samples and collection of stratigraphic information using direct push technology. This report summarizes findings and conclusions resulting from evaluation of data collected during the investigation.

Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) has the responsibility for implementation of the Navy and Marine Corps IR Program in the southeastern and midwestern United States. Questions regarding this report should be addressed to the SOUTHNAVFACENGCOM Engineer-in-Charge, Mr. Ed Lohr, at (803) 743-0355.

ACKNOWLEDGEMENTS

In preparing this report, the personnel at ABB Environmental Services, Inc., commend the support, assistance, and cooperation provided by the personnel at NSB Kings Bay, Georgia, and SOUTHNAVFACENGCOM. In particular, we acknowledge the outstanding effort, dedication, and professionalism provided by the following people in the preparation of this report.

Name	Title	Position	Location/Phone
Ed Lohr	Engineer	Engineer-in-Charge	SOUTHNAVFACENGCOM 803-743-0355
James More	Engineer	Environmental Coordinator	NSB Kings Bay, GA 912-673-4759

PHASE I INTERIM INVESTIGATION MEMORANDUM, SITE 11

NAVY INSTALLATION RESTORATION PROGRAM
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

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EXECUTIVE SUMMARY

ABB Environmental Services, Inc. (ABB-ES), under contract to Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), conducted site investigation activities at one of four former waste disposal sites at Naval Submarine Base (NSB), Kings Bay, Georgia. This investigation resulted from information obtained from groundwater monitoring activities associated with the RCRA Facility Investigation/Site Inspection that will continue into calendar year 1993. This Phase I Interim Investigation was completed under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (contract number N62467-89-D-0317, Contract Task Order [CTO] number 041) between SOUTHNAVFACENGCOM and ABB-ES.

This memorandum summarizes the scope, findings, and conclusions of the initial phase of an investigation to begin to delineate and characterize groundwater contamination detected downgradient of Site 11. Site 11 is the Old Camden County Landfill, which is on property now owned by the Navy. Vinyl chloride was the primary VOC of concern for this investigation. The investigation included collection of groundwater samples and analysis for target volatile organic compounds (VOCs) in a field laboratory. Two piezocone penetrations were conducted for collection of stratigraphic information. Groundwater sampling was conducted near the western boundary of the landfill, near the NSB property line west of the landfill, and on the western right-of-way to Georgia Spur 40.

Thirty-six groundwater samples, including three duplicate samples, were collected from 25 locations using a hydrocone groundwater sampler and direct push technology. One groundwater sample was collected from an on-site monitoring well, KBA-11-2, using a teflon bailer. Field analyses were performed according to SW-846 Method 8010 modified for field application. Target VOCs for field analyses included chloroethane, vinyl chloride, trans-1,2-dichloroethene, trichloroethene, and tetrachloroethene. Six samples, including a duplicate sample, were submitted for confirmatory analysis at a laboratory approved by the Naval Energy and Environmental Support Activity (NEESA). Confirmatory analyses included halogenated VOCs using SW-846 Method 8010. One of the confirmatory samples was also analyzed for aromatic VOCs using SW-846 Method 8020.

Confirmatory analytical data were compared to the field data for corresponding samples. The field and confirmatory data were in agreement, indicating that the field data was viable for use in site screening.

Stratigraphic information obtained from the piezocone penetrations indicate the subsurface is primarily comprised of interbedded sand and silty sand. No confining layers were identified in the stratigraphic units included in the surficial aquifer. Hydraulic pressures were evaluated at multiple depths during the piezocone penetrations. No downward flow components were identified based on the hydraulic pressures recorded during the piezocone penetrations.

Results of the Phase I Interim Investigation of VOC contamination at Site 11 indicate that two plumes may be present along the western boundary of the landfill and on the western side of Spur 40. Concentrations of vinyl chloride ranging from 2.8 ug/l to 120 ug/l were detected along the right-of-way to Spur

40. Concentrations of vinyl chloride detected near the western boundary of the landfill ranged from 2.2 ug/l to 1400 J ug/l. The two areas of highest concentrations are relatively narrow, however their overall area of influence is approximately 530 feet in the north to south direction. This indicates that the landfill may have two areas where VOCs are being released to groundwater. VOC contaminants were detected at depths ranging from 9 feet below land surface (BLS) to 25 feet BLS.

VOC contaminants detected in the confirmatory samples include halogenated solvents such as vinyl chloride, 1,1-dichloroethane, cis-1,2-dichloroethene, and tetrachloroethene. Fuel related VOCs were also detected, including toluene, benzene, ethylbenzene, and xylenes. Vinyl chloride and cis-1,2-dichloroethene are present in groundwater at concentrations that exceed their respective MCLs of 2 ug/l and 70 ug/l.

Samples collected from the western right-of-way to Spur 40 are located approximately 50 feet east of private property included in Crooked River Plantation subdivision. On September 3, 1992, the residents of Crooked River Plantation were informed of the groundwater contamination and invited to a public meeting held on September 7, 1992.

Navy has made required notifications in accordance with the National Contingency Plan. An interim measures study technical plan has been initiated. The plan will include a schedule for field work to begin in mid-October 1992. Presently, the interim measures study is expected to include, but may not be limited to, the use of direct push technology to further characterize the extent of contamination and stratigraphy. Data will be collected for use in air modeling to support preliminary risk evaluations. Groundwater samples will be collected from existing private irrigation wells potentially influenced by groundwater contaminants. Data collected during the interim measures study will be used to complete a preliminary screening risk evaluation.

The data collected during the interim measures study will be used in development of a RCRA Facility Investigation (RFI) Workplan. The RFI is expected to include installation of confirmatory monitoring wells and collection of data in support of risk assessment and Corrective Measures Study.

ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
ASTM	American Society for Testing Materials
BLS	below land surface
CERCLA	Comprehensive Environmental Restoration, Compensation and Liability Act
CPT	cone penetrometer testing
ELCD	electrolytic conductivity detector
GA DNR	Georgia Department of Natural Resources
GC	gas chromatograph
MLW	mean low water
NACIP	Naval Assessment and Control of Installation Pollutants
PID	photoionization detector
PSC	potential source of contamination
RCRA	Resource Conservation and Recovery Act
RFI/SI	RCRA Facility Investigation/Site Inspection
SWMU	solid waste management unit
SOUTHNAV- FACENGCOCM	Southern Division Facilities Naval Engineering Command
NSB	Naval Submarine Base
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
ug/l	micrograms per liter

1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) conducted site screening activities at Site 11, the Old Camden County Landfill, at Naval Submarine Base (NSB), Kings Bay, Georgia. Screening activities were initiated because analytical data from three groundwater sampling events conducted in association with an on-going RCRA Facility Investigation/Site Inspection (RFI/SI) indicated that volatile organic compounds (VOCs) were present in groundwater downgradient of the Old Camden County Landfill. The VOC of primary concern is vinyl chloride. The screening investigation was conducted pursuant to the approved RFI/SI work plan (ABB-ES, 1991) and as detailed in the Preliminary Plan of Action (ABB-ES, 1992).

Screening activities included collection of stratigraphic information and groundwater samples using cone penetrometer testing (CPT), a direct push technology. Groundwater samples were analyzed in the field to facilitate decisions associated with achieving the project objectives. Off-site, confirmatory laboratory analyses were performed on replicate samples. The confirmatory data was used in evaluating the reliability of field analytical data.

Project objectives included: (1) a determination of whether VOC contaminants had migrated off NSB property, (2) generally define the horizontal extent of contamination in the north and south direction near the western boundary of the landfill, (3) generally define the horizontal extent of contamination in the north and south directions on right-of-way property west of Spur 40, if contaminants were present there, or along the NSB property line if contaminants had not migrated to the western side of Spur 40 and (4) investigate the vertical extent of contamination.

Section 2.0 of this document describes the field program for the Phase I Interim Investigation at Site 11. Section 3.0 presents results of the investigation, and Section 4.0 discusses conclusions and follow-on activities. Figures and tables referenced in this report are included in Appendices A and B, respectively.

2.0 FIELD PROGRAM

The stratigraphy of the surficial sand aquifer was evaluated and groundwater samples were recovered using direct push methods provided under subcontract by Subsurface Technology, Incorporated of Maitland, Florida. Equipment consisted of a cone penetrometer truck, piezocone, hydrocone groundwater sampler, computer and associated software. One groundwater sample was obtained from existing groundwater monitoring well KBA-11-2 using a teflon bailer.

2.1 DIRECT PUSH TECHNOLOGY

Stratigraphic information was obtained from two piezocone penetrations, PC-1 and PC-2 (Figure 1), completed to refusal at 85 and 97 feet below land surface (BLS), respectively. PC-1 is located on Georgia State Route Spur 40 western right-of-way property, approximately 150 feet west of monitoring well KBA-11-2. The second penetration (PC-2) is located east of Spur 40 on NSB property, approximately 25 feet east of monitoring well KBA-11-2. Due to an error in saving the data for PC-2 on the on-board computer, all data beyond the 17-foot depth were lost.

Piezocone penetrations are made by hydraulically advancing a series of steel rods into the soil at a constant rate. Resistance to penetration at the cone tip and at the outer surface of the sleeve, located near the cone tip, is recorded. Subsurface pore pressure is monitored with a pressure transducer. These measurements are recorded by the on-board computer. Following demobilization, the data are compared to empirically derived measurements or parameters characteristic of different soil types. Thus, the piezocone is able to provide information regarding soil classifications consistent with the Unified Soil Classification System (USCS), relative soil density (split-spoon blow counts), water levels, and effective thickness of confining units, if any.

The hydrocone groundwater sampler provided by Subsurface Technology consists of a telescoping assembly containing a 1-foot length of stainless-steel well screen fitted with a cone tip. This assemblage is hydraulically advanced with a series of rods in the same manner as are the piezocone penetrations. When the screen is exposed by retracting the outer casing of the sample device, natural hydrostatic pressure forces groundwater to flow into the sample collection chamber. The amount of groundwater entering the collection chamber is monitored and controlled by pressuring the collection chamber with argon gas. Argon back pressure prevents volatilization of the sample during collection and retrieval. Rate of filling of the chamber is recorded and used to estimate horizontal permeability within the aquifer at the sample interval. The sample is contained in the chamber for retrieval by using argon gas back pressure to impinge a small ball into its check-valve at the bottom of the sample collection chamber. The sample collection chamber and screen assemblage are lifted to the surface to recover the sample. To collect water from multiple intervals, the hole is reentered with a clean sample collection chamber and screen assemblage and the hydrocone is advanced to the desired depth. Cross-contamination is prevented by using O-rings to form a water-tight seal above and below the sample chamber. The pressure transducer and computer allow the sample chamber to be monitored for infiltration of water.

Sample location and depth intervals were chosen based on analytical data provided by an on-site laboratory. Thus, the location and depth interval of successive samples was selected based on analytical information from preceding samples.

Sample locations are shown on Figure 1 in Appendix A. A total of 33 groundwater samples were collected, including duplicate samples, for analysis using the field gas chromatograph (GC). Six replicate groundwater samples, including a duplicate sample, were sent to CH2M HILL Laboratories for confirmatory analysis.

Groundwater sampling began near existing monitoring well KBA-11-2, and continued to the north and south to define the limits of horizontal contamination. Samples were recovered from multiple depths at many of these locations, especially near monitoring well KBA-11-2, because of the need to identify the depth of highest contaminant levels. In some cases, sample depths were restricted by a dense, but permeable, sand lens that could not be penetrated by the hydrocone.

After the horizontal extent of contamination was evaluated near the western landfill boundary, sampling was conducted to the west near the NSB property boundary. One hydrocone penetration, HC-15, was conducted near the property boundary to confirm the general direction that the plume was migrating and to evaluate the vertical extent of contamination. Four groundwater samples were collected at this location from depths ranging from 16 feet BLS to 78 feet BLS, where the hydrocone met refusal. Concentrations of vinyl chloride of 400 J ug/l (estimated) and 11 ug/l were detected at depths of 16 to 17 feet BLS and 24 to 25 feet BLS, respectively, at the location of HC-15. The presence of vinyl chloride near the NSB property line caused sampling to be conducted on right-of-way property west of Spur 40.

2.2 ANALYTICAL PROGRAM

ABB-ES established a mobile laboratory facility at NSB, Kings Bay. A 28-foot field trailer and portable purge and trap GC were mobilized to NSB, Kings Bay. The GC was operated by an ABB-ES chemist. Field analyses included the five target halogenated VOCs listed below. Corresponding detection limits are also listed below.

<u>Compound</u>	<u>Practical Quantitation Limit</u>
Chloroethane	10 ug/l
Vinyl Chloride	2 ug/l
trans-1,2-Dichloroethene	2 ug/l
Trichloroethene	5 ug/l
Tetrachloroethene	2 ug/l

Groundwater samples collected using the hydrocone were decanted into 40-milliliter (ml) vials having Teflon[®] septa. Hydrochloric acid preservative was added to the vials prior to filling with groundwater. After collection, vials were placed on ice in a cooler, chain-of-custody was completed, and the samples were transported to the field laboratory for analysis.

Samples were analyzed according to SW-846 Method 8010, adapted for field application, for purgeable halocarbons. Quantification of vinyl chloride was done using a photoionization detector (PID). The purge and trap connection to the GC was adapted for use of the PID for measurement of vinyl chloride concentrations. Analysis of performance standards and correlation to off site analytical data confirmed the accuracy of field measurements of low concentrations of vinyl chloride, trans-1,2-dichloroethene, and tetrachloroethene. The practical quantitation limits for chloroethane and

trichloroethene were elevated to 10 ug/l and 5 ug/l, respectively, from 2 ug/l because initial calibration criteria were not met for these compounds.

Groundwater samples HC-1 through HC-5 were collected on Friday, August 7, 1992, in anticipation of the field laboratory overcoming technical problems by noon that day. When noon passed and the field laboratory was still experiencing problems, a decision was made to terminate sampling for a period of two days, the weekend, to either have the field laboratory become functional and fulfill its intended use, or make alternate arrangements. The two day period that sampling was ceased was sufficient for the problems with the field laboratory to be corrected, confirmation of the viability of using the PID for vinyl chloride analysis, and analysis of the five groundwater samples previously collected. The samples were properly preserved with concentrated hydrochloric acid and stored on ice in an ice chest. Analysis of the samples was performed within 3 days of sample collection, which is well within holding time.

2.3 DECONTAMINATION PROCEDURES

All hydrocone sampling equipment in contact with the sample was cleaned as follows:

- 1) Washed with Alconox[®] and deionized water.
- 2) Rinsed with deionized water.
- 3) Rinsed with pesticide-grade propanol.
- 4) Rinsed with deionized, carbon-filtered water (ASTM Type II).
- 5) Air dried.
- 6) Wrapped in aluminum foil.

Decontamination fluids were collected in the decontamination area, which was lined with black plastic. The thin layer of decontamination water collected on the plastic was allowed to evaporate, during which time volatilization of VOCs would also occur. At the end of the field effort the remaining decontamination water and unused portions of groundwater samples were returned to the site and disposed within the area of contamination in accordance with the U.S. Environmental Protection Agency (USEPA) guidance for management of investigation-derived waste (USEPA, 1991).

2.4 LOCATION SURVEY

Piezocone and hydrocone sampling locations were surveyed by a Georgia licensed surveyor provided under subcontract by Privett and Associates Land Planners and Surveyors, of St. Mary's, Georgia. A closed loop horizontal and vertical location survey was done to determine each piezocone and hydrocone location with 0.1 feet of horizontal and 0.01 feet of vertical accuracy. Horizontal locations were tied to existing control points on the base and meet the requirements of a third order Class III Survey. Horizontal measurements are precise to 1 foot in 10,000 feet. Vertical elevations are relative to mean low water (MLW), consistent with other NSB, Kings Bay, survey data.

3.0 RESULTS

The following subsections discuss analytical results, evaluations, and interpretations for the Phase I Interim Investigation, Site 11, conducted August 4 through 13, 1992.

3.1 GEOLOGIC AND HYDROGEOLOGIC INVESTIGATION RESULTS

Geologic and hydrogeologic information was obtained from two piezocone penetrations conducted during the investigation. Estimates of hydraulic conductivity (K) were also obtained from information recorded during sampling using the hydrocone.

Figure 2 is a geologic cross-section (A - A') developed from stratigraphic information obtained from the piezocone penetrations. Sample locations and the location of the cross-section are shown in Figure 1. The stratigraphy of the site is primarily comprised of interbedded layers of sand and silty sand. Thin layers of clayey sand or clay are present over the interval penetrated. Data for piezocone penetration PC-2 beyond the 17-foot depth were lost due to operator error.

Table 1 summarizes K data obtained during collection of samples using the hydrocone. Estimated K values range from 2.6×10^{-3} feet per minute (ft/min) to 9.3×10^{-3} ft/min. The arithmetic mean and geometric mean were calculated to be 2.0×10^{-3} ft/min and 1.0×10^{-3} ft/min, respectively. Seepage velocities calculated from the K estimates range from 2.6×10^{-7} ft/min to 9.3×10^{-7} ft/min. Calculations of seepage velocities assumed Darcian flow, 30 percent effective porosity, and an average horizontal hydraulic gradient of 0.003 ft/ft. The hydraulic gradient was determined from potentiometric surface maps developed from water levels measured in February, May, July, and August 1992. Figure 3 in Appendix A is a potentiometric map developed from groundwater levels measured on August 7, 1992. Groundwater flow directions shown in Figure 3 are consistent with previous data collected during the RFI/SI.

The landfill opened 18 years ago and closed 11 years ago. Over a period of 18 years, the estimated distance of contaminant migration, based on the maximum seepage velocity stated in the above paragraph, is 880 feet. Over a period of 11 years, the estimated maximum distance of contaminant migration is 540 feet. Estimates of contaminant migration based on the arithmetic mean, geometric mean, and lowest seepage velocity range from 2.5 feet to 189 feet over an 18 year period. Data associated with this investigation indicate that contaminants have migrated at least 200 feet.

Vertical flow gradients were evaluated by pore pressures measured at four depths during penetration PC-1. Hydraulic pressures increased with depth, being 10.4 pounds per square inch (psi) at 31 feet BLS and 34.23 psi at 84 feet BLS. These data do not suggest downward groundwater flow components.

3.2 ON SITE GROUNDWATER CONTAMINATION

The initial objective of hydrocone sampling was to verify the viability of the technique by obtaining groundwater samples from an interval equivalent to the middle of the screened interval of monitoring well KBA-11-2, which is 8 feet BLS at the well location. A depth of 10 feet BLS was targeted based on differences in elevation at the well location and at the area where hydrocone penetrations

would be placed. The first attempt to collect a groundwater sample from 10 feet BLS was unsuccessful because the hydraulic head at 10 feet BLS was insufficient to provide adequate sample volumes.

Twenty-three groundwater samples, including two duplicate samples, were collected from 15 locations on NSB property using the hydrocone groundwater sampler (Figure 1 in Appendix A). Field analytical data are presented in Table 2 in Appendix B. Figure 4 in Appendix A is a cross-section (B - B') showing field GC data for samples collected near the western boundary of the landfill. This cross-section shows the relationship between sample depths and vinyl chloride concentrations in groundwater.

One groundwater sample was collected from monitoring well KBA-11-2 using a decontaminated teflon bailer. Five well volumes were purged prior to sample collection. During field analysis vinyl chloride was detected at a concentration of 93 ug/l in a groundwater sample from the monitoring well. Concentrations of vinyl chloride detected in five groundwater samples collected from monitoring well KBA-11-2 during three monitoring events in February, May, and July 1992 ranged from 18 ug/l to 150 ug/l.

Groundwater sample HC-1 was collected from a location approximately 25 feet upgradient (east) of monitoring well KBA-11-2. Field analysis of this sample indicated 4.2 ug/l of vinyl chloride, well below the 93 ug/l of vinyl chloride detected in a sample from the monitoring well. Samples HC-2 through HC-5 were collected from locations 75 feet and 150 feet to the north and to the south of monitoring well KBA-11-2. Field analytical data for groundwater samples HC-2 through HC-5 indicated that sample HC-2 contained 2.2 ug/l vinyl chloride and that the other three samples did not contain detectable levels of vinyl chloride.

Sample location HC-6 was placed directly beside the monitoring well. Four groundwater samples were collected from four depths at this location. Sample HC-6A was collected from 7 to 8 feet BLS, approximately 2 feet below the water table. No target VOCs were detected during field analysis of this sample. The second sample, HC-6B, was collected from 9.5 to 10.5 feet BLS and contained 40 ug/l of vinyl chloride. The third sample, HC-6C, was collected from 12.5 to 13.5 feet BLS and contained an estimated concentration of vinyl chloride of 700 J ug/l. The fourth sample, HC-6D, was collected from 15.5 to 16.5 feet BLS and contained an estimated concentration of vinyl chloride of 1400 J ug/l. The linear range of the GC was calculated to be 40 ug/l for vinyl chloride. All concentrations of vinyl chloride in excess of 40 ug/l are considered estimated, but are also considered to be valid for the intended use of the data (site screening). The data from the four groundwater samples collected from sample location HC-6 indicated that VOC contaminants are not present in the upper 2 feet of the water table, and that concentrations of vinyl chloride an order of magnitude greater than that detected in samples from monitoring well KBA-11-2 are present in groundwater 3.5 feet below the screened interval of KBA-11-2.

Based on field GC data for the groundwater samples from HC-6, it became clear that the sample depths for locations HC-1 through HC-5 were too shallow. Samples collected from depths corresponding to the middle of the screened interval of monitoring well KBA-11-2 would not result in concentrations of vinyl chloride similar to that detected in a sample from the monitoring well. A decision was made to sample at greater depths.

Groundwater samples HC-7 through HC-13 were collected from locations to the north and south of monitoring well KBA-11-2 to evaluate the horizontal extent of contamination near the western boundary of the landfill. The target sample depth for these samples was 16 to 17 feet BLS. A dense fine sand layer located approximately 14 feet BLS occasionally prevented penetrations from reaching the target depth. Sample depths were either 14 to 15 feet BLS or 16 to 17 feet BLS, as indicated on Table 2.

Sample locations HC-7, HC-9, and HC-11 are located 300 feet, 150 feet and 50 south of monitoring well KBA-11-2, respectively. No target VOCs were detected in groundwater sample HC-7. Groundwater samples HC-9 and HC-11 contained 2.5 ug/l and 9.0 ug/l of vinyl chloride, respectively.

Sample locations HC-10, HC-8, HC-13, and HC-12 are 380 feet, 300 feet, 135 feet, and 40 feet north of monitoring well KBA-11-2, respectively. Vinyl chloride was the only target VOC detected and was found in all four of these samples. The concentration of vinyl chloride in groundwater sample HC-8 was 40 ug/l. Concentrations of vinyl chloride in HC-12 and HC-13, to the south of sample location HC-8, were 3.2 ug/l and 5.7 ug/l, respectively. Groundwater sample HC-10, collected from a location to the north of sample location HC-8, contained 4.3 ug/l of vinyl chloride. These data suggest that releases may have occurred from two disposal trenches in the landfill, which would result in two slugs of contamination. These two slugs of contamination are referred to as two plumes, plume A and plume B, in Figure 4. Additional data are needed to verify that two plumes are present.

Sample location HC-14 is adjacent to monitoring well KBA-11-2 on the downgradient side of the well. This location was targeted for groundwater sampling at multiple depths, and was anticipated to provide information regarding the vertical extent of contamination. A dense fine sand layer caused refusal, so a sample was collected from 19 to 20 feet BLS, the depth of refusal. This sample, HC-14, contained an estimated concentration of 60 J ug/l of vinyl chloride. This may indicate that the highest concentrations of vinyl chloride in the VOC contaminant plume are approximately 16 feet BLS in the vicinity of monitoring well KBA-11-2. This is based on the estimated concentration of 1400 J ug/l of vinyl chloride detected in groundwater sample HC-6D.

Sampling activities moved to the west near the NSB property line and outside the perimeter fence. Sample location HC-15 is west-northwest of monitoring well KBA-11-2. The objective of sampling near the property line was to determine whether site-related VOCs were present in groundwater, which would provide an indication that contamination had moved off NSB property and indicate the general direction of contaminant migration. Sample HC-15A was collected from a depth of 16 to 17 feet BLS and contained an estimated concentration of vinyl chloride of 400 J ug/l. Three other intervals were sampled at this location. Sample HC-15B was collected from 24 to 25 feet BLS, HC-15C from 49 to 50 feet, and HC-15D from 77 to 78 feet BLS (at refusal). The only target VOC detected in these three samples was in sample HC-15B (24 to 25 feet BLS), which contained 11 ug/l of vinyl chloride.

In summary, field GC data for groundwater samples collected from locations along the western landfill boundary indicate that VOC contamination may be comprised of two plumes, as shown in Figure 4. The location of cross-section B - B' is shown in Figure 1. In the area of monitoring well KBA-11-2 vinyl chloride was detected at a concentration of 1400 ug/l. Approximately 300 feet north of

monitoring well KBA-11-2 at sample location HC-8 40 ug/l of vinyl chloride was detected. The concentrations of vinyl chloride between the two potential plumes range from 3.2 ug/l to 5.7 ug/l, based on concentrations detected in samples HC-12 and HC-13. Contamination is present near the NSB property line, where concentrations of vinyl chloride of 400 J ug/l and 11 ug/l were detected at 16 to 17 feet BLS and 24 to 25 feet BLS, respectively.

3.3 OFF SITE GROUNDWATER CONTAMINATION

Ten groundwater samples were collected from locations on the western right-of-way of Spur 40 on property owned by the Georgia Department of Transportation (GA DOT). These locations are hydraulically downgradient of the landfill. Results of field analyses indicate a similar scenario regarding distribution of groundwater contaminants as was found near the landfill boundary. Figure 5, cross-section C - C', shows the general location of what may be two plumes (A and B) based on field GC data for samples collected from the right-of-way property. Figure 6, cross-section D - D', shows field GC data for the VOC contamination detected at the location of monitoring well KBA-11-2 (designated as plume A). Cross-section D - D' extends from the landfill to the western right-of-way of Spur 40. Sample locations and the location of the cross-sections are shown in Figure 1.

Groundwater sample HC-16 was collected from 12 to 13 feet BLS, at refusal on a dense fine sand layer, and found to contain an estimated concentration of vinyl chloride of 120 J ug/l and 6.2 ug/l of tetrachloroethene. Tetrachloroethene was not detected in samples collected near the source of contamination on NSB property, but is a potential parent compound of vinyl chloride. Typically, parent compounds such as tetrachloroethene would not be expected near the leading edge of the plume if they were not detected near the source area.

Groundwater sample HC-25 was collected from a depth of 13 to 14 feet BLS and contained and estimated 54 J ug/l of vinyl chloride and 6.4 ug/l of tetrachloroethene. Sample location HC-25 is approximately 350 feet north of sample location HC-16.

Sample locations HC-17, HC-19, HC-21, HC-22, and HC-23 are located between locations HC-16 and HC-25. These samples were collected from depths ranging from 16 to 20 feet BLS. Sample depth intervals for the samples ranged from 12.5 to 13.5 feet BLS to 19 to 20 feet BLS (Table 2). Concentrations of vinyl chloride in these samples range from an estimated 45 J ug/l, near location HC-16, to 2.8 ug/l at sample location HC-22. Two of these samples, HC-17 and HC-19, contained detectable concentrations of tetrachloroethene of 4.6 ug/l and 3.2 ug/l, respectively.

Groundwater sample HC-20 was collected from a location approximately 250 feet to the north of sample location HC-25 to evaluate for contaminant migration to a pond located northwest of the sample point. Sample HC-20 was collected from a depth of 15 to 16 feet BLS and did not contain detectable concentrations of target VOCs.

Sample locations HC-18 and HC-24 are located south of sample location HC-16, where 120 J ug/l of vinyl chloride was detected. These samples contained 6.2 ug/l and 3.2 ug/l of vinyl chloride, respectively.

3.4 CONFIRMATION LABORATORY ANALYTICAL RESULTS

Six groundwater samples, including one duplicate sample, were sent to CH2M HILL Laboratories for analysis of halogenated VOCs according to SW-846 Method 8010 (USEPA, 1986). One of the six was also analyzed for aromatic VOCs according to SW-846 Method 8020. Table 3 summarizes analytical results for VOCs included in the field analyses and other VOCs detected in the six groundwater samples.

3.3.1 Correlation of Confirmatory and Field Analytical Data Groundwater samples HC-2, HC-3, HC-10, HC-15B, and HC-23 were replicated for analysis at CH2M HILL Laboratories. The field analytical data and corresponding confirmatory analytical data, in units of ug/l, are as follows:

<u>Sample</u>	<u>Compound</u>	<u>Field</u>	<u>Confirmatory</u>
HC-2	vinyl chloride	2.2	2.0
HC-3	(no target VOCs detected by either analysis)		
HC-10	vinyl chloride	4.3	1.4
HC-15B	vinyl chloride	11	11
HC-23	trichloroethene	5 U	4.9/4.7
	vinyl chloride	45 J	32 J/35 J

The field data and confirmatory data for vinyl chloride are generally in agreement, indicating the field GC data for the 33 groundwater samples is adequate for the intended use. The field laboratory experienced difficulty in quantification of trichloroethene due to poor integration for this compound. The detection limit for trichloroethene was elevated to 5 ug/l for the field analyses. The concentrations of 4.9 ug/l and 4.7 ug/l of trichloroethene reported for the confirmatory analyses are below the practical quantitation limit of the field GC.

3.3.2 Other VOCs Detected in Groundwater by Confirmatory Analysis Confirmatory analytical data for groundwater sample HC-15B (Table 3 in Appendix B) provide an initial characterization of the nature of the contaminant plume. Twelve VOCs, including vinyl chloride, were detected in groundwater sample HC-15B (24 to 25 feet BLS) as shown in Table 3. Three compounds, 1,1-dichloroethane, cis-1,2-dichloroethene, and toluene were detected at concentrations ranging from 100 ug/l to 230 ug/l. Cis-1,2-dichloroethene in this sample exceeds its Federal Primary Drinking Water Standard MCL of 70 ug/l. Federal Primary Drinking Water Standard MCLs are shown in Table 3 for those VOCs that are regulated under the Safe Drinking Water Act.

Chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene were detected at concentrations ranging from 2.3 ug/l to 4.6 ug/l in groundwater sample HC-10. These compounds have been detected in groundwater samples from monitoring well KBA-11-3 during previous sampling events associated with the RFI/SI. Concentrations detected in groundwater samples collected from the monitoring well and using the hydrocone are below corresponding Federal Primary Drinking Water Standard MCLs.

Three VOCs were detected in confirmatory groundwater samples at concentrations near their corresponding MCLs. Tetrachloroethene was detected in replicate groundwater samples from sampling location HC-23 at concentrations of 4.9 ug/l and 4.7 ug/l, which approximates the MCL for tetrachloroethene of 5 ug/l. Benzene and 1,1-dichloroethane were detected in sample HC-15B at concentrations

of 1.7 ug/l and 3.9 ug/l, respectively. The MCL for benzene is 5 ug/l and the MCL for 1,1-dichloroethane is 7 ug/l.

Confirmatory laboratory analysis of groundwater samples collected during the Phase I Interim Investigation at Site 11 indicate the nature of VOC contaminants in the plume. VOC contaminants include halogenated solvents such as vinyl chloride, 1,1-dichloroethane, cis-1,2-dichloroethene, and tetrachloroethene. Fuel related VOCs were also detected, including toluene, benzene, ethylbenzene, and xylenes.

4.0 CONCLUSIONS AND FOLLOW-ON ACTIVITIES

4.1 CONCLUSIONS

Results of the Phase I Interim Investigation of VOC contamination at Site 11 indicate that two plumes may be present along the western boundary of the landfill and on the western side of Spur 40. The two areas of highest concentrations are relatively narrow, however their overall area of influence is approximately 530 feet in the north to south direction. This indicates that the landfill may have two areas where VOCs are being released to groundwater. VOC contaminants were detected at depths ranging from 9 feet BLS to 25 feet BLS.

VOC contaminants include halogenated solvents such as vinyl chloride, 1,1-dichloroethane, cis-1,2-dichloroethene, and tetrachloroethene. Fuel related VOCs were also detected, including toluene, benzene, ethylbenzene, and xylenes. Vinyl chloride and cis-1,2-dichloroethene are present in groundwater at concentrations that exceed their respective MCLs of 2 ug/l and 70 ug/l.

Samples collected from the western right-of-way to Spur 40 are located approximately 50 feet east of private property included in Crooked River Plantation subdivision. Concentrations of vinyl chloride ranging from 2.8 ug/l to 120 ug/l were detected along the right-of-way.

4.2 FOLLOW-ON ACTIVITIES

Prior to and during completion of this report the Navy has notified the National Response Center, USEPA Region IV, and the Georgia Department of Natural Resources (GA DNR) regarding the release of hazardous substances from the site. On September 3, 1992, a public meeting was held for the purpose of informing residents of Crooked River Plantation subdivision of the results of this investigation, and plans to further investigate the problem and initiate remedial measures. On September 9, 1992, SOUTHNAVFACENGC.COM, NSB, and ABB-ES representatives met with representatives from GA DNR to discuss regulatory matters associated with continuing the investigation and planning of corrective measures.

Recommendations for follow-on work include development and implementation of interim measures. An interim measures study technical plan has been initiated. A draft technical plan for interim measures will be submitted to GA DNR in early October 1992. The plan will include a schedule for field work to begin in mid-October 1992. Presently, the interim measures study is expected to include, but may not be limited to; the use of direct push technology to further characterize the extent of contamination and stratigraphy; collection of data for use in air modeling to support preliminary risk evaluations; and collection and analysis of groundwater samples from existing private irrigation wells potentially influenced by groundwater contaminants. Completion of a preliminary screening risk evaluation based on data collected during the interim measures study.

The data collected during the interim measures study will be used in development of an RFI Workplan. The RFI is expected to include installation of confirmatory monitoring wells and collection of data in support of risk assessment and Corrective Measures Study.

Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC): A detailed definition and description of PARCC is found in the NSB Kings Bay RFI/SI Work Plan (ABB-ES, 1991) Subsections 4.1.3 and 4.6.2.1.

Quality Control Samples: A brief description of QC samples is found in the NSB Kings Bay RFI/SI Work Plan, Subsection 4.2.8. The quantity of QC samples, taken from the Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (NEESA, 1988), is as follows:

Trip Blanks: one per cooler (for VOCs only)

Equipment Rinsates: one per day for each analyte that was collected using a decontaminated piece of equipment that day.

Field Blanks: one per source per event

Field Duplicates: 10 percent level

Matrix Spikes/Matrix Spike Duplicates: 5 percent level

Table 4-2 has a breakdown of the total number of samples, including QC samples that will be sent off site for analyses.

4.3.2 Field Laboratory ABB-ES personnel will establish an on-site field laboratory for the detection of VOCs using two Hewlett Packard 5890 Electrolytic Conductivity Detector (ELCD)/PID GCs or the equivalent. These GCs will be used in conjunction with a LSC 2000 purge-and-trap to enable the GCs to reach the required detection limits. A DB-624 75M column will be used to separate compounds of interest. The ELCD detector will be calibrated to detect vinyl chloride, cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene. The PID detector will be calibrated to detect benzene, toluene, ethylbenzene, m-xylene, p-xylene, and o-xylene. A chemstation will be used to operate the GCs.

4.3.2.1 Calibration A three-point calibration will be constructed for each machine for the compounds of interest at the start of the field program. A mid-level standard calibration check will be run every 24 hours to check machine stability.

4.3.2.2 QA/QC Duplicate samples will be collected and analyzed at a frequency of 10 percent of the total samples for each matrix. Matrices to be analyzed in the field laboratory include groundwater, surface water, and sediments. A method blank will be run at the beginning of each day. Cleaning blanks (to check for carryover) will be run at the discretion of the site chemist. Matrix spike and matrix spike duplicate analyses will take place on 5 percent of the samples. A known amount of bromofluorobenzene surrogate will be added to each sample and the percentage recovery calculated.

4.3.2.3 Sample Preparation For water samples, a 5-milliliter (ml) aliquot or a portion of the sample diluted to 5 ml is removed from the sample vial with a Luer lock syringe. A surrogate is added to the sample, which is then transferred into the sparger vessel for purging and subsequent analysis.

TABLE 4-2 Off-Site Sample Analysis, Interim Corrective Measure, Site 11 NSB Kings Bay

Parameter/Method	Matrix	Samples	Duplicates	Trip Blanks	Field Blanks	Rinseates	MS	MSD	Total to Lab
TCL VOCs (1)	Groundwater	43	6	15	6	13	2	2	87
CLP-COP	Surface Water	3	1	-	-	-	1	1	6
(low level)	Sediments	3	1	-	-	1 (2)	1	1	7
	Flux Air Chamber	3	1	-	1	-	1	1	7
TCL SVOCs	Groundwater	3	1	-	-	-	1	1	6
CLP-COP	Surface Water	3	1	-	-	-	1	1	6
	Sediments	3	1	-	2	1 (2)	1	1	9

- (1) VOCs will be run for TCL list and dichlorodifluoromethane
- (2) All rinseate samples will be aqueous
- (3) One filter blank per 10 day shift
- (4) One blank per 10 day shift of water used to collect filter blanks
- TCL Target Compound List
- VOCs Volatile Organic Compounds
- CLP-COP Contract Laboratory Program/Caucus Organic Protocol
- SVOCs Semivolatile Organic Compounds
- MS Matrix Spike
- MSD Matrix Spike Duplicate

Table 4-2 wk1

For sediment samples, 5 grams \pm 0.1 grams is transferred from the sample vial to the sparger vessel. The sparger vessel is attached to the purge-and-trap device and 5 ml of reagent water, containing a known amount of surrogate, is added to the sparger vessel. Purging is then initiated.

Soil gas samples will be collected in a Tedlar bag by the field crew. A 100-microliter sample will be withdrawn with an airtight syringe and injected directly into the GC. A copy of the Standard Operating Procedure for purge-and-trap analysis of VOCs by field GC is in Appendix B.

4.3.3 Sample Analyses

4.3.3.1 Direct Push Samples All samples collected at NSB Kings Bay by the direct push method will first undergo field analysis for a select group of VOCs using an on-site GC. Ten percent of the samples collected in the field will then be selected for confirmatory laboratory analysis for low level TCL volatiles. In addition, we will attempt to collect a sufficient sample volume so that ten percent of the samples collected in the landfill can also be analyzed for SVOCs. These samples will be sent to an off-site NEESA approved laboratory on a daily basis. Tables 4-3 and 4-4 list VOCs and SVOCs, respectively, and their detection limits.

4.3.3.2 Surface Water/Sediments All surface water and sediment samples will be screened by the field GC for target VOCs. In addition, all these samples will be sent off site for VOC and SVOC analyses.

4.3.3.3 Domestic Wells All domestic well samples will be sent to an off-site laboratory for TCL VOC analysis using the low concentration CLP method (USEPA, 1991c).

4.3.3.4 Air Flux Chamber Sampling Flux chamber samples will be sent to the contract laboratory for TCL VOC analysis (see Table 4-2). A complete list of samples broken down by media, parameter, method, reference, level of validation, and DQO level is in Table 4-5.

4.3.4 Data Validation All confirmatory off-site laboratory data will be sent to Heartland Environmental Services, Inc., in St. Peters, Missouri, for Level D validation. Upon receipt, analytical data are systematically validated following guidance in USEPA's *Functional Guidelines for Evaluating Organic Analyses* (USEPA, 1988a) and *Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1988b). These guidelines provide a systematic procedure for evaluating laboratory QA/QC measures such as holding times, blank analyses, surrogate recoveries, matrix spike results, GC/MS tuning, instrument calibration, compound identification, and method performance. In addition, the air flux chamber samples will be validated using best professional judgment conforming to USEPA's reference methods. The validated data can then be used for site contaminant characterization and assessment.

4.3.5 Data Management Data management will be conducted according to the guidelines described in Subsection 4.6.3 of the NSB Kings Bay RFI/SI Work Plan (ABB-ES, 1991).

Table 4-3 Volatile Organic Compounds Target Compound List and Contract Required Quantitation Limits (CRQL), Interim Corrective Measure, Site 11, NSB Kings Bay

<u>VOLATILE ORGANIC COMPOUNDS</u>	<u>QUANTITATION LIMITS</u> ^(a)
	<u>WATER</u> <u>µg/L</u> ^(b)
Chloromethane	1
Bromomethane	1
Vinyl Chloride	1
Chloroethane	1
Methylene chloride	2
Acetone	5
Carbon Disulfide	1
1,1-Dichloroethene	1
1,1-Dichloroethane	1
cis-1,2-Dichloroethene	1
trans-1,2-Dichloroethene	1
Chloroform	1
1,2-Dichloroethane	1
2-Butanone	5
Bromochloromethane	1
1,1,1-Trichloroethane	1
Carbon Tetrachloride	1
Bromodichloromethane	1
1,2-Dichloropropane	1
cis-1,3-Dichloropropene	1
Trichloroethene	1
Dibromochloromethane	1
1,1,2-Trichloroethane	1
Benzene	1
trans-1,3-Dichloropropene	1
Bromoform	1

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Table 4-3 (continued) Volatile Organic Compounds Target Compound List and Contract Required Quantitation Limits (CRQL), Interim Corrective Measure, Site 11, NSB Kings Bay

<u>VOLATILE ORGANIC COMPOUNDS</u>	<u>QUANTITATION LIMITS^(a)</u>
	<u>WATER</u> <u>µg/L^(b)</u>
4-Methyl-2-pentanone	5
2-Hexanone	5
Tetrachloroethene	1
1,1,2,2-Tetrachloroethane	1
1,2-Dibromoethane	1
Toluene	1
Chlorobenzene	1
Ethylbenzene	1
Stryrene	1
Xylenes (total)	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzene	1
1,2-Dichlorobenzene	1
1,2-Dibromo-3-chloropropane	1

^(b) µg/L micrograms per Liter

Note: Except for Methylene chloride, the quantitation limits in this table are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.

In the case of Methylene chloride, the CRQL value in this table is based on the lowest level of detection in samples contaminated with this common laboratory solvent that can be achieved by reasonable means in a production laboratory.

^(a) USEPA, 1991b, Contract Laboratory Program - Statement of Work for Low Concentration Water for Organics Analysis. USEPA Document No. OLC01.0.

Table 4-4 Semi-Volatile Organic Compounds Target Compound List and Contract Required Quantitation Limits (CRQL), Interim Corrective Measure, Site 11, NSB Kings Bay

<u>SEMIVOLATILE ORGANIC COMPOUNDS</u>	<u>QUANTITATION LIMITS*</u>			
	<u>WATER</u> <u>µg/L^(a)</u>	<u>LOW</u> <u>SOIL</u> <u>µg/Kg^(b)</u>	<u>MED.</u> <u>SOIL</u> <u>µg/Kg^(b)</u>	<u>ON</u> <u>COLUMN</u> <u>(ng)^(c)</u>
Phenol	10	330	10000	20
bis(2-Chloroethyl) ether	10	330	10000	20
2-Chlorophenol	10	330	10000	20
1,3-Dichlorobenzene	10	330	10000	20
1,4-Dichlorobenzene	10	330	10000	20
1,2-Dichlorobenzene	10	330	10000	20
2-Methylphenol	10	330	10000	20
2,2'-oxybis (1-Chloropropane) ¹	10	330	10000	20
4-Methylphenol	10	330	10000	20
N-Nitroso-di-n-propylamine	10	330	10000	20
Hexachloroethane	10	330	10000	20
Nitrobenzene	10	330	10000	20
Isophorone	10	330	10000	20
2-Nitrophenol	10	330	10000	20
2,4-Dimethylphenol	10	330	10000	20
bis(2-Chloroethoxy) methane	10	330	10000	20
2,4-Dichlorophenol	10	330	10000	20
1,2,4-Trichlorobenzene	10	330	10000	20
Naphthalene	10	330	10000	20
4-Chloroaniline	10	330	10000	20

Table 4-4 (continued) Semi-Volatile Organic Compounds Target Compound List and Contract Required Quantitation Limits (CRQL), Interim Corrective Measure, Site 11, NSB Kings Bay

<u>SEMIVOLATILE ORGANIC COMPOUNDS</u>	<u>QUANTITATION LIMITS*</u>			
	<u>WATER</u> <u>µg/L^(a)</u>	<u>LOW</u> <u>SOIL</u> <u>µg/Kg^(b)</u>	<u>MED.</u> <u>SOIL</u> <u>µg/Kg^(b)</u>	<u>ON</u> <u>COLUMN</u> <u>(ng)^(c)</u>
Hexachlorobutadiene	10	330	10000	20
4-Chloro-3-methylphenol	10	330	10000	20
2-Methylnaphthalene	10	330	10000	20
Hexachlorocyclopentadiene	10	330	10000	20
2,4,6-Trichlorophenol	10	330	10000	20
2,4,5-Trichlorophenol	25	800	25000	50
2-Chloronaphthalene	10	330	10000	20
2-Nitroaniline	25	800	25000	50
Dimethylphthalate	10	330	10000	20
Acenaphthylene	10	330	10000	20
2,6-Dinitrotoluene	10	330	10000	20
3-Nitroaniline	25	800	25000	50
Acenaphthene	10	330	10000	20
2,4-Dinitrophenol	25	800	25000	50
4-Nitrophenol	25	800	25000	50
Dibenzofuran	10	330	10000	20
2,4-Dinitrotoluene	10	330	10000	20
Diethylphthalate	10	330	10000	20
4-Chlorophenyl-phenylether	10	330	10000	20
Fluorene	10	330	10000	20

Table 4-4 (continued) Semi-Volatile Organic Compounds Target Compound List and Contract Required Quantitation Limits (CROL), Interim Corrective Measure, Site 11, NSB Kings Bay

<u>SEMIVOLATILE ORGANIC COMPOUNDS</u>	<u>QUANTITATION LIMITS*</u>			
	<u>WATER</u>	<u>LOW SOIL</u>	<u>MED. SOIL</u>	<u>ON COLUMN</u>
	<u>µg/L^(a)</u>	<u>µg/Kg^(b)</u>	<u>µg/Kg^(b)</u>	<u>(ng)^(c)</u>
4-Nitroaniline	25	800	25000	50
4,6-Dinitro-2-methylphenol	25	800	25000	50
N-nitrosodiphenylamine	10	330	10000	20
4-Bromophenyl-phenylether	10	330	10000	20
Hexachlorobenzene	10	330	10000	20
Pentachlorophenol	25	800	25000	50
Phenanthrene	10	330	10000	20
Anthracene	10	330	10000	20
Carbazole	10	330	10000	20
Di-n-butylphthalate	10	330	10000	20
Fluoranthene	10	330	10000	20
Pyrene	10	330	10000	20
Butylbenzylphthalate	10	330	10000	20
3,3'-Dichlorobenzidine	10	330	10000	20
Benzo(a)anthracene	10	330	10000	20
Chrysene	10	330	10000	20
bis(2-Ethylhexyl)phthalate	10	330	10000	20
Di-n-octylphthalate	10	330	10000	20
Benzo(b)fluoranthene	10	330	10000	20
Benzo(k)fluoranthene	10	330	10000	20

Table 4-4 (continued) Semi-Volatile Organic Compounds Target Compound List and Contract Required Quantitation Limits (CROL), Interim Corrective Measure, Site 11, NSB Kings Bay

<u>SEMIVOLATILE ORGANIC COMPOUNDS</u>	<u>QUANTITATION LIMITS*</u>			
	<u>WATER</u> <u>µg/L^(a)</u>	<u>LOW</u> <u>SOIL</u> <u>µg/Kg^(b)</u>	<u>MED.</u> <u>SOIL</u> <u>µg/Kg^(b)</u>	<u>ON</u> <u>COLUMN</u> <u>(ng)^(c)</u>
Benzo(a)pyrene	10	330	10000	20
Indeno(1,2,3-ch)pyrene	10	330	10000	20
Dibenz(a,h)anthracene	10	330	10000	20
Benzo(g,h,i)perylene	10	330	10000	20

¹ Previously known by the name bis(2-Chloroisopropyl) ether

^(a) µg/L micrograms per Liter

^(b) µg/kg micrograms per kilogram

^(c) ng nanograms

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

USEPA, 1991a, Contract Laboratory Program - Statement of Work for Organics Analysis. USEPA Document No. OLM01.0.

TABLE 4-5 Laboratory Analytical Program, Interim Corrective Measure, Site 11, NSB Kings Bay

Media	Parameter	Method	Reference	Validation Level	DQO Level
Groundwater	TCL VOCs (low level)	GC/MS	CLP-COP	D	IV
	TCL SVOCs	GC/MS	CLP-COP	D	IV
Domestic Wells	TCL VOCs (low levels)	GC/MS	CLP-COP	D	IV
Surface Water	TCL VOCs (low level)	GC/MS	CLP-COP	D	IV
	TCL SVOCs	GC/MS	CLP-COP	D	IV
Sediments	TCL VOCs (low level)	GC/MS	CLP-COP	D	IV
	TCL SVOCs	GC/MS	CLP-COP	D	IV
Air Monitoring	TCL VOCs (low level)	GC/MS	CLP-COP	D	IV

TCL Target Compound List
 VOC Volatile Organic Compound
 SVOC Semivolatile Organic Compound
 GC/MS Gas Chromatograph/Mass Spectrometry
 CLP-COP Contract Laboratory Program/Caucus Organic Protocol
 DQO Data Quality Objective

4.4 DATA EVALUATION, INTERPRETATION, AND MODELING. Data for this project encompasses both field and laboratory analyses. Samples collected for laboratory analysis will be used to confirm the analytical data collected in the field. The data will be used to evaluate immediate risks to human health and to prepare the RFI confirmatory sampling work plan. The data will be collected and entered into a computer database for appropriate statistical analysis. Further description of data management can be found in Subsection 4.6.3 of the RFI Work Plan (ABB-ES, 1991).

4.4.1 Data Evaluation Chemical data collected during the Interim Corrective Measure Screening Investigation will be used to characterize the site and to evaluate the potential levels of risk posed to human health. Chemical data will be compared to Applicable or Relevant and Appropriate Requirements (ARARs) and contaminants of concern will be identified. Also, evaluation will follow guidelines provided in the USEPA *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A* (December 1989), *Guidance for Data Useability in Risk Assessment* (October 1990), and *Supplemental Region IV Risk Assessment Guidance* (March 1991). Table 4-6 lists federal and State of Georgia ARARs for the chemicals detected during the first phase of sampling at Kings Bay.

Air flux chamber samples will be validated in accordance with procedures described in Subsection 4.3.4 of this work plan. A data quality assessment consisting of an evaluation based on PARCC parameters (refer to Subsection 4.3.1 for DQOs) will be performed on the validated data set. This assessment will identify the overall usability of the air flux chamber sample data.

4.4.2 Data Interpretation The validated chemical data and the hydrogeologic data from this and previous investigations will be used to interpret the site's physical conditions. Interpretations will be included in a technical memorandum report.

The size and depth of the chemical plume(s) will be evaluated and represented graphically in plan and cross-section. Geologic data from the piezocone locations will be used to construct geologic cross-sections and map any confining layers and any pathways for preferential migration of groundwater and groundwater contamination. Soil gas data will be used to interpret the partitioning of contaminants into the vadose zone. Source evaluation of Porcupine Lake water will be used to determine the lake's relation to groundwater and the contaminant plume. Air monitoring data will be used to determine presence of VOCs in air. Ultimately, the data from this screening program will be used to determine the risks to human health and safety (see Subsection 4.5).

4.4.3 Description of Modeling Potential sources of air emissions include volatilization from contaminated surface water or from irrigation systems using contaminated groundwater. Screening techniques will be employed to estimate air concentrations for use in the preliminary risk evaluation. The types of models could include air dispersion models, such as the USEPA SCREEN model (Brode, 1988), to simulate movement of air contaminants after release. Air emissions modeling could be performed to estimate emission rates for input

TABLE 4-6 Chemical Specific Applicable or Relevant and Appropriate Requirements, Interim Corrective Measure, Site 11, NSB Kings Bay

CHEMICAL $\mu\text{g/L}$	MAXIMUM DETECTED CONCENTRATION $\mu\text{g/L}$	FEDERAL MCL $\mu\text{g/L}$	FEDERAL MCLG $\mu\text{g/L}$	FEDERAL AWQC WATER AND ORGANISMS $\mu\text{g/L}$	GEORGIA DRINKING WATER STANDARDS ¹ $\mu\text{g/L}$	GEORGIA SURFACE WATER CRITERIA ² $\mu\text{g/L}$
Ethylbenzene	10	700	700	1,400	700	28,718
Chlorobenzene	2.3	100	100	488	100	20
1,1-Dichloroethane	100	-	-	-	-	-
trans-1,2-Dichloroethene		100	100	-	100	136,319
Methylene Chloride	15	5	0	-	-	1,578
Tetrachloroethene	6.4	5	0	0.8	5	8.85
Trichloroethene	4.9	5	0	2.7	5	80.7
Vinyl Chloride	1400J	2	0	2.0	2	525
Toluene	230	1,000	1,000	14,300	1,000	301,941
Bromomethane (methyl bromide)	1.5	-	-	-	-	470.8
1,1-Dichloroethene	3.9	7	7	0.033	7	3.2
cis-1,2-Dichloroethene	200	70	70	-	70	-
Benzene	1.7	5	0	0.66	5	71.28
1,2-Dichlorobenzene	6.4	600	600	-	600	2,600
1,4-Dichlorobenzene	46	75	75	-	75	2,600
Dichlorodifluoromethane	5.3	-	-	-	-	-
m/o-xylene	31	*	*	-	-	-
o-xylene	17	*	*	-	-	-
xylenes (Total)	15	10,000	10,000	-	10,000	-

* See xylenes (total)
MCL Maximum Contaminant Level, USEPA Office of Water, December 1992.
MCLG Maximum Contaminant Level Goal, USEPA Office of Water, December 1992.
AWQC Ambient Water Quality Criteria
Federal AWQC IRIS, 1992; USEPA Office of Water Regulations and Standards Criteria and Standards Division, May 1987.
 $\mu\text{g/L}$ micrograms per liter
P Pending regulation in 1993'
- No available standard or criteria.
1) Georgia Department of Natural Resources, July 1992, Rules for Safe Drinking Water, Chapter 391-3-5, Environmental Protection Division.
2) Bureau of National Affairs, Inc., August 1991, Georgia Water Quality Control Regulations and Standards, Title 391, Chapter 3, Environmental Protection Rule 6.

to the dispersion models. Models could be selected from the National Technical Guidance Series (USEPA, 1989a), the *Superfund Exposure Assessment Manual* (USEPA, 1988c), the *Risk Assessment Guidance for Superfund* (USEPA, 1989b), or current literature. Air monitoring conducted on the site can provide a direct measurement of actual air emission rates for dispersion analyses. The dispersion modeling results will be analyzed and summarized in a written report.

4.5 PRELIMINARY RISK EVALUATION. The risks associated with exposure to the chemical contaminants identified in the groundwater will be examined. The risk evaluation will be performed according to appropriate federal and state guidelines, including *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual: Part A* (USEPA, 1989b), the *Supplemental USEPA Region IV Risk Assessment Guidance* (USEPA, 1991c), and the *RCRA Facility Investigations Guidance* (USEPA, 1989d). The ARARs for this investigation include the National Primary Drinking Water Regulations, which provide the Maximum Contaminant Levels (USEPA, 1989c), Federal Ambient Water Quality Criteria (USEPA, 1986), Georgia Drinking Water Standards (Georgia Department of Natural Resources, 1992) and Georgia Surface Water Criteria (Bureau of National Affairs, 1991).

The risk evaluation will consist of four parts: (1) identification of the chemicals of potential concern; (2) the human exposure assessment; (3) the toxicity assessment; and (4) the risk characterization. A preliminary risk evaluation report will be provided as part of the Interim Corrective Measures Screening Investigation.

4.5.1 Identification of Chemicals of Potential Concern The results from the groundwater samples will provide information regarding chemical contaminants and their concentrations. These data will be used to identify the chemicals of potential concern for the preliminary human health risk evaluation. The concentrations of chemicals identified in the groundwater will be compared with the above-mentioned ARARs and USEPA screening concentrations (USEPA, 1992). The screening concentrations are chemical concentrations in groundwater that, using standard USEPA exposure scenarios, are associated with either a carcinogenic risk of 1×10^{-6} or Hazard Index of 1.0. Chemicals detected in groundwater at concentrations above ARARs or screening concentrations will be considered chemicals of potential concern. Those chemicals detected at levels below these concentrations might also be considered chemicals of potential concern if, in the professional judgment of the risk assessor, they could significantly add to the total risk from exposure to groundwater.

4.5.2 Exposure Assessment Possible routes of human exposure to the identified chemicals of potential concern will be considered on a case-by-case basis. The potential exposure routes identified at the site include inhalation of VOCs released during irrigation of yards and gardens, or other recreational activity using the groundwater; dermal contact and incidental ingestion of the groundwater during irrigation or other recreational activities; dermal contact and incidental ingestion of groundwater or contaminated sediment during swimming or wading in Porcupine Lake; and dermal

contact and incidental ingestion of groundwater during swimming if the groundwater is used to fill swimming pools.

4.5.3 Toxicity Assessment The purpose of the toxicity assessment is to identify adverse toxic effects known to occur following exposure to the chemicals of concern by the identified exposure routes. Reference doses (RfDs) and cancer slope factors will be used in the toxicity assessment. The sources of this information will include the USEPA Integrated Risk Information System database, the USEPA Health Effects Assessment Summary Tables, and the Agency for Toxic Substances and Disease Registry Toxicology Profiles. If no toxicity values are available for chemicals of potential concern, then these values will be developed by a toxicologist using applicable USEPA Region IV guidance and best professional judgment.

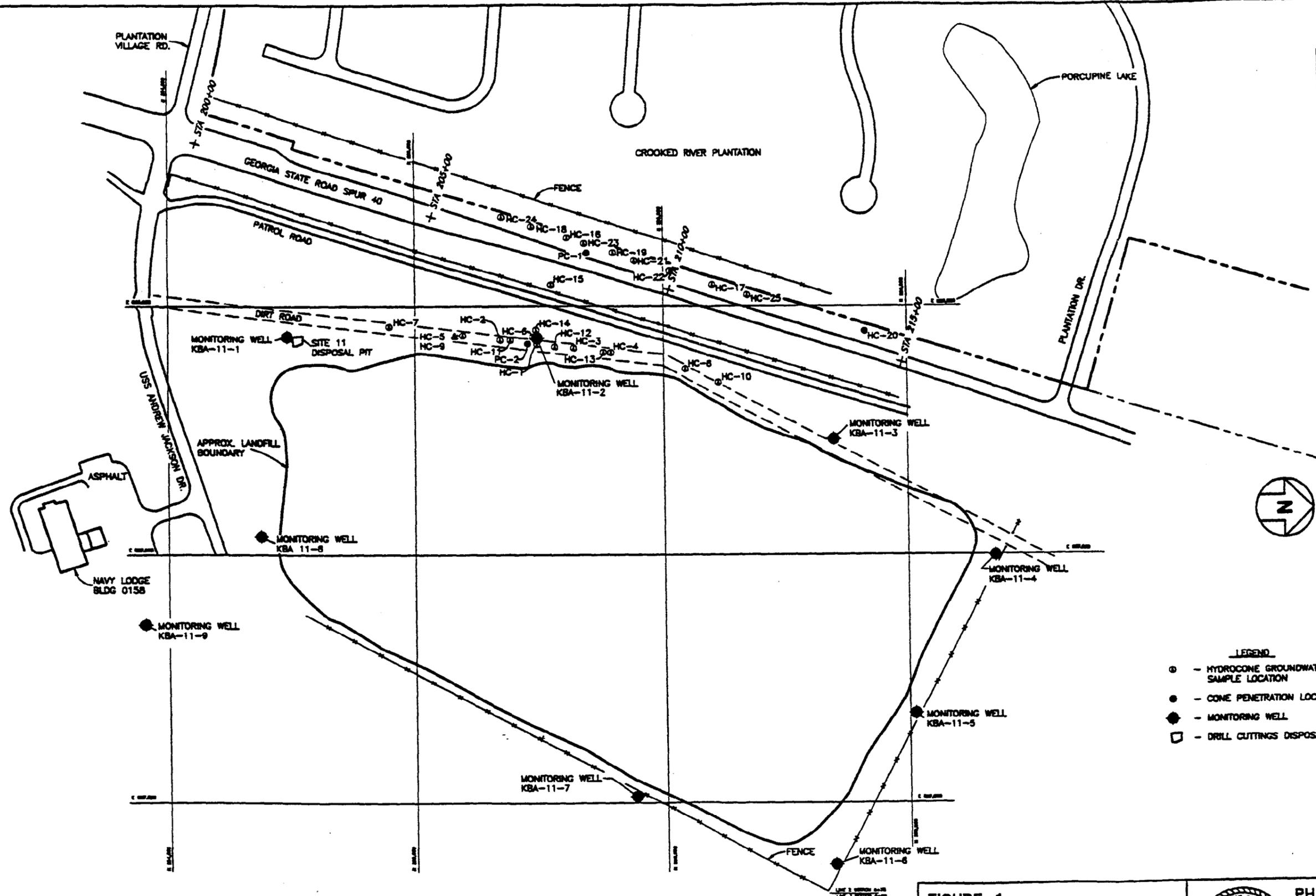
4.5.4 Risk Characterization A preliminary risk evaluation will be conducted using standard USEPA risk methodology (USEPA, 1989b). This risk evaluation will consider the chemicals of potential concern, the exposure route(s), and the known toxicity of each chemical of potential concern. The total carcinogenic risks will be evaluated for all carcinogens identified as chemicals of potential concern by all identified routes of exposure. Hazard Indices will also be estimated and will be grouped and summed by known toxic effect. The uncertainty of the carcinogenic and noncarcinogenic risk evaluation will also be addressed in this section.

4.5.5 Summary and Recommendations The results of the human health risk evaluation will be summarized in a report, which will identify the chemicals of potential concern in the groundwater, the exposure routes, the toxicity of each chemical of potential concern, and the results of the risk characterization. Based on the results of this analysis, recommendations concerning immediate risk to human health will be provided (i.e., an immediate response action may be required).

REFERENCES

- ABB Environmental Services, Inc. (ABB-ES), 1991. Naval Submarine Base, Kings Bay, Georgia, Potential Source of Contamination (PSC) Site Investigation/Solid Waste Management Unit (SI/SWMU), RCRA Facility Investigation (RFI) Work Plan; Prepared for Southern Division Naval Facilities Engineering Command; October 1991.
- U.S. Environmental Protection Agency (USEPA), 1991. Management of Investigation-Derived Waste During Site Inspections; Office of Research and Development; May 1991.

APPENDIX A
FIGURES



ELEVATIONS AT PIEZOCONE PENETRATION & HYDROCONE GROUNDWATER LOCATIONS	
HC-1	34.65
HC-2	34.37
HC-3	34.49
HC-4	34.45
HC-5	34.59
HC-6	32.98
HC-7	34.87
HC-8	34.53
HC-9	34.59
HC-10	34.04
HC-11	34.12
HC-12	34.74
HC-13	34.38
HC-14	32.24
HC-15	31.56
HC-16	30.17
HC-17	28.79
HC-18	30.16
HC-19	29.81
HC-20	27.82
HC-21	29.76
HC-22	29.38
HC-23	30.17
HC-24	-
HC-25	28.53
PC-1	34.51
PC-2	31.87

- LEGEND**
- - HYDROCONE GROUNDWATER SAMPLE LOCATION
 - - CONE PENETRATION LOCATION
 - ◆ - MONITORING WELL
 - - DRILL CUTTINGS DISPOSAL PIT

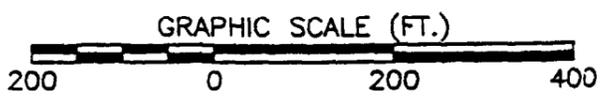
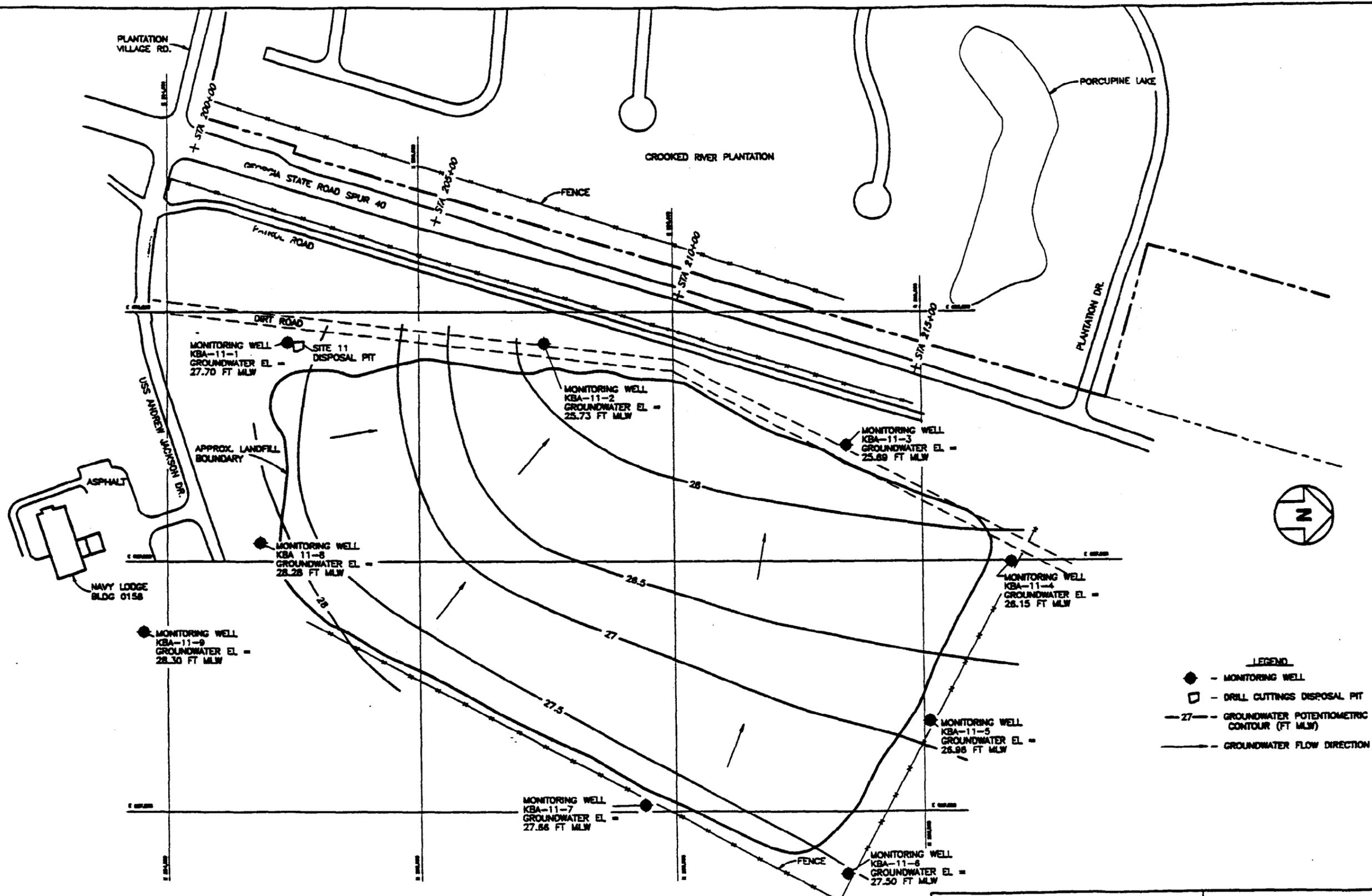


FIGURE 1
SITE 11
CONE PENETROMETER
LOCATIONS



PHASE I
INTERIM INVESTIGATION
SITE 11
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

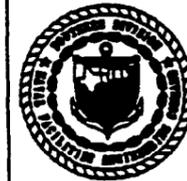
0509AB32



- LEGEND**
- - MONITORING WELL
 - - DRILL CUTTINGS DISPOSAL PIT
 - 27- - GROUNDWATER POTENTIOMETRIC CONTOUR (FT MLW)
 - - GROUNDWATER FLOW DIRECTION



FIGURE 3
SITE 11
GROUNDWATER POTENTIOMETRIC
SURFACE MAP



PHASE I
INTERIM INVESTIGATION
SITE 11
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

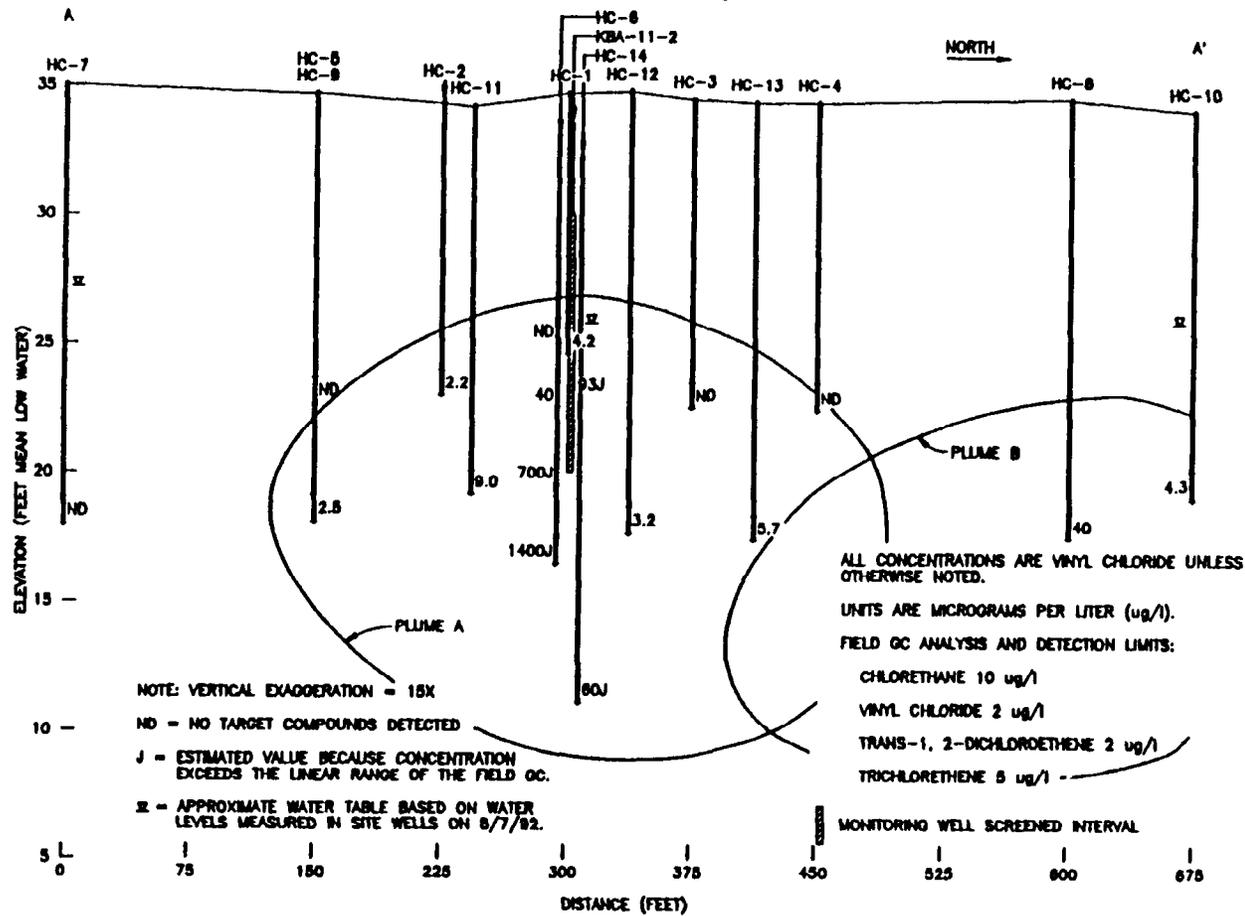
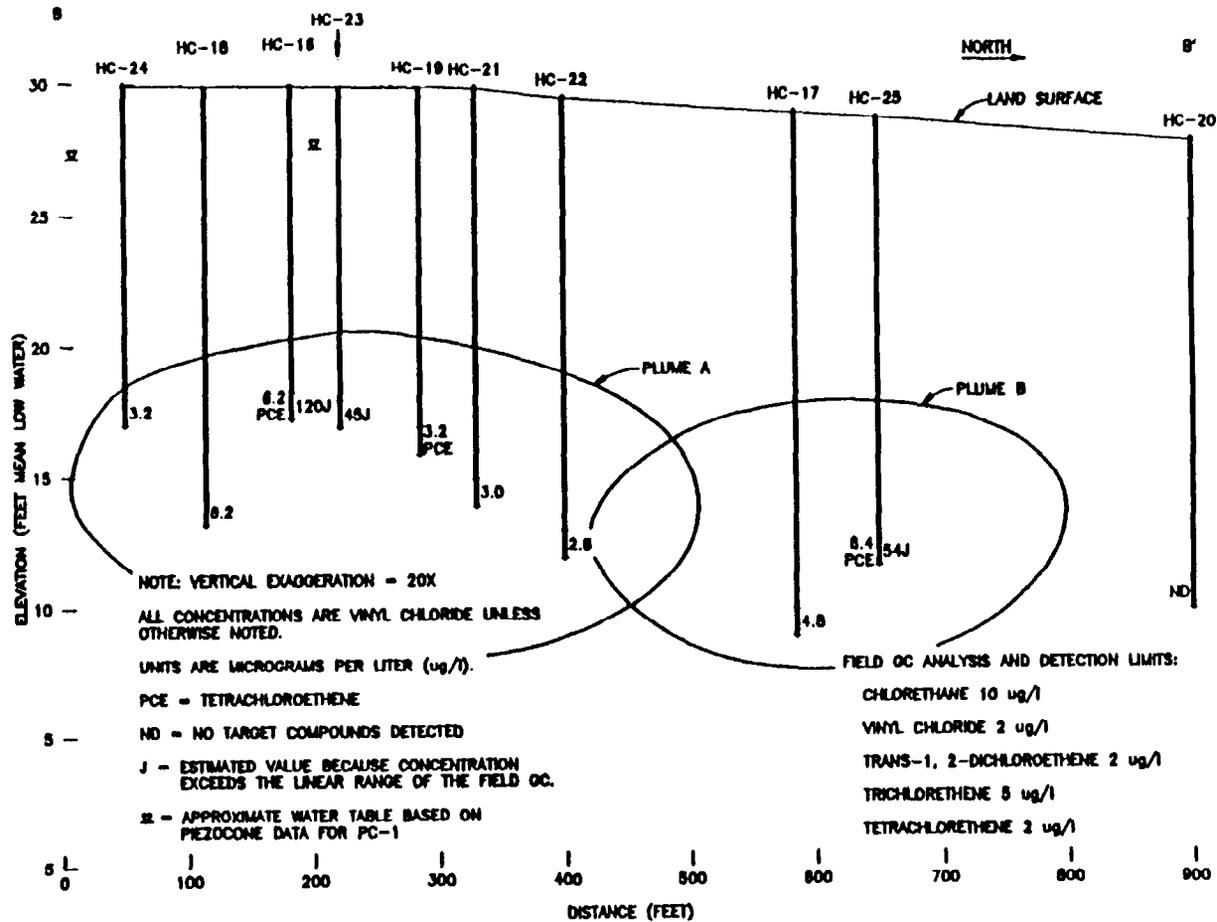


FIGURE 4
CROSS-SECTION B - B'
(HC-7 TO HC-10)
FIELD GC DATA



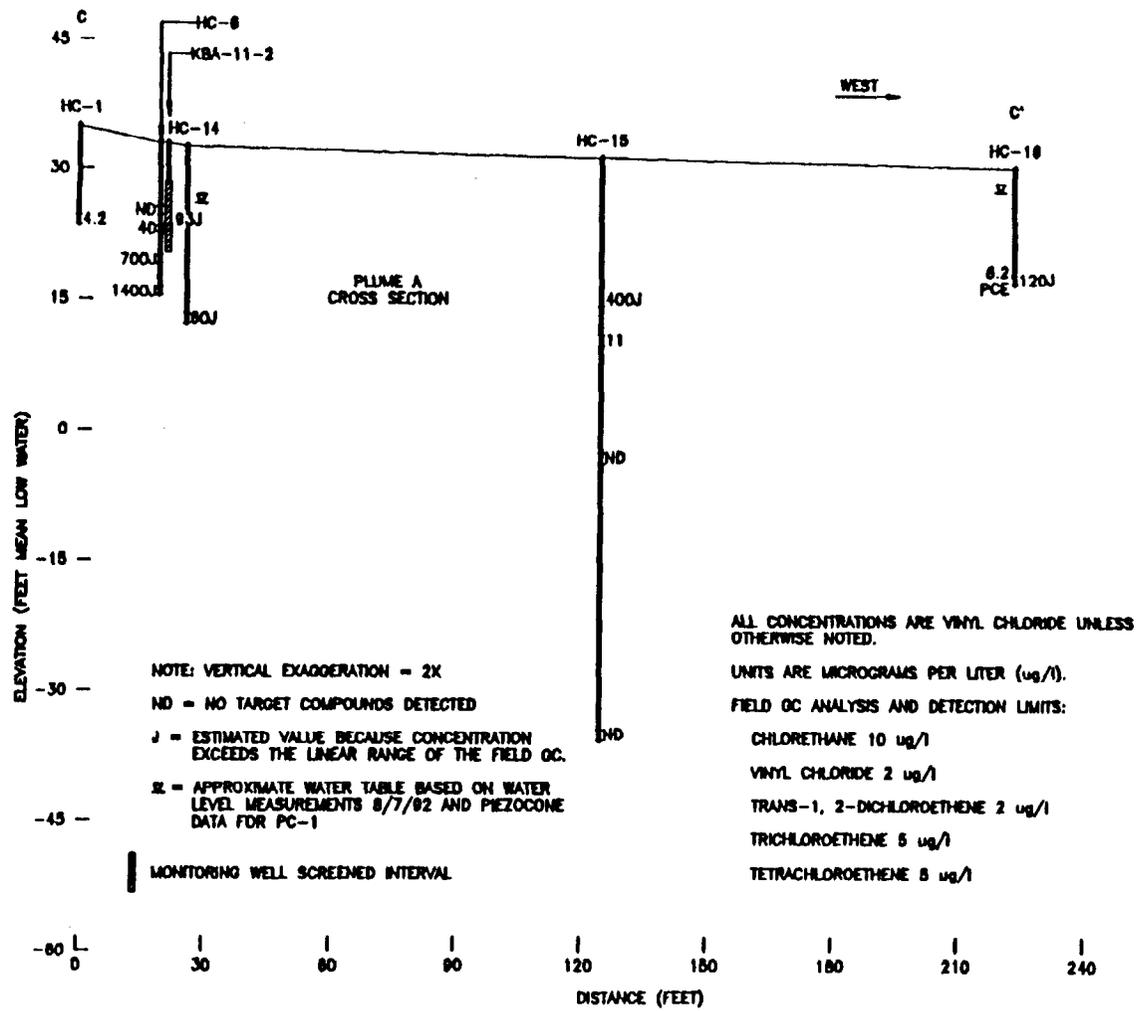
PHASE I
INTERIM INVESTIGATION
SITE 11
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA



**FIGURE 5
CROSS-SECTION C - C'
(HC-24 TO HC-20)
FIELD GC DATA**



**PHASE I
INTERIM INVESTIGATION
SITE 11
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**



**FIGURE 6
CROSS-SECTION D - D'
(HC-1 TO HC-10)
FIELD GC DATA**



**PHASE I
INTERIM INVESTIGATION
SITE 11
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

APPENDIX B

TABLES

Table 1 - Hydraulic Conductivity Estimates Based on Hydrocone Data

Sample ID	Depth		Estimated Hydraulic Conductivity		
	ft BLS	ft MLW	ft/min	ft/yr	gal/day/ft ²
HC-1	11 - 12	25.65 - 24.65	3.9E-03	2.0E+03	37
HC-2	10.5 - 11.5	23.87 - 22.87	2.2E-03	1.2E+03	21
HC-3	11 - 12	23.49 - 22.49	2.5E-03	1.3E+03	24
HC-4	11 - 12	23.45 - 22.45	3.5E-03	1.8E+03	34
HC-5	11 - 12	23.59 - 22.59	6.6E-03	3.5E+03	63
HC-6A	7 - 8	25.98 - 24.98	NR	NR	NR
HC-6B	9.5 - 10.5	23.48 - 22.48	9.3E-03	4.9E+03	89
HC-6C	12.5 - 13.5	20.48 - 19.48	3.1E-03	1.6E+03	30
HC-6D	15.5 - 16.5	17.48 - 16.48	1.4E-03	7.4E+02	13
HC-7	16 - 17	18.87 - 17.87	6.3E-04	3.3E+02	6.0
HC-8	16 - 17	18.53 - 17.53	6.3E-04	3.3E+02	6.0
HC-9	15.5 - 16.5	19.09 - 18.09	4.8E-05	2.5E+01	0.46
HC-10	14 - 15	20.04 - 19.04	3.9E-04	2.0E+02	3.7
HC-11	14 - 15	20.12 - 19.12	4.0E-04	2.1E+02	3.8
HC-12	16 - 17	18.74 - 17.74	3.7E-04	1.9E+02	3.5
HC-13	16 - 17	18.36 - 17.36	6.4E-04	3.4E+02	6.1
HC-14	19 - 20	13.24 - 12.24	8.0E-04	4.2E+02	7.7
HC-15A	16 - 17	15.56 - 14.56	NR	NR	NR
HC-15B	24 - 25	7.56 - 6.56	4.3E-04	2.3E+02	4.1
HC-15C	49 - 50	<17.44 - 16.44>	NR	NR	NR
HC-15D	77 - 78	<45.44 - 44.44>	2.6E-05	1.4E+01	0.25
HC-16	12 - 13	18.17 - 17.17	5.4E-04	2.8E+02	5.2
HC-17	19 - 20	9.79 - 8.79	NR	NR	NR
HC-18	16 - 17	14.16 - 13.16	2.5E-03	1.3E+03	24
HC-19	13 - 14	16.81 - 15.81	NR	NR	NR
HC-20	17 - 18	10.82 - 9.82	7.2E-04	3.8E+02	6.9
HC-21	15 - 16	14.76 - 13.76	NR	NR	NR
HC-22	16 - 17	13.38 - 12.38	3.2E-03	1.7E+03	31
HC-23	12.5 - 13.5	17.67 - 16.67	8.5E-04	4.5E+02	8.2
HC-24	13 - 14	17.00 - 16.00*	3.8E-03	2.0E+03	36
HC-25	13 - 14	15.53 - 14.53	5.6E-03	2.9E+03	54

Notes:

ft = feet

BLS = below land surface

MLW = mean low water

ft/min = feet per minute

ft/yr = feet per year

gal/day/ft² = gallons per day per square foot

NR = not reported because silt interfered with data collection

* elevation estimated based on topographic gradient because elevation was not reported with survey.

Table 2
Phase I Interim Investigation Site 11
Field Laboratory Results for Groundwater Samples ($\mu\text{g}/\ell$)

Parameter	Sample I.D. and Depth (ft BLS)						
	KBA-11-2 ¹ 3-13	HC-1 11-12	HC-2 10.5-11.5	HC-3 11-12	HC-3 ^{Dup} 11-12	HC-4 11-12	HC-5 11-12
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride ¹	93 J	4.2	2.2	2 U	2 U	2 U	2 U

Parameter	Sample I.D. and Depth (ft BLS)									
	HC-6A 7-8	HC-6B 9.5-10.5	HC-6C 12.5-13.5	HC-6D 15.5-16.5	HC-7 16-17	HC-8 16-17	HC-9 15.5-16.5	HC-10 14-15	HC-11 14-15	
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	
Vinyl Chloride	2 U	40	700 J	1400 J	2 U	40	2.5	4.3	9.0	

Explanation

- 1 Monitoring Well
- 2 Values flagged J as estimated because concentrations exceeded the linear range of the GC
- Dup Duplicate
- U Compound analyzed but not detected above or below the indicated practical quantitation limit.

Table continued)
Phase I Interim Investigation Site 11
Field Laboratory Results for Groundwater Samples ($\mu\text{g}/\ell$)

Parameter	Sample I.D. and Depth (ft BLS)								
	HC-12 16-17	HC-12 ^{Dup} 16-17	HC-13 16-17	HC-14 19-20	HC-15A 16-17	HC-15B 24-25	HC-15C 49-50	HC-15D 77-78	HC-16 12-13
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	6.2
Vinyl Chloride ²	3.2	2.7	5.7	60 J	400 J	11	2 U	2 U	120 J

Parameter	Sample I.D. and Depth (ft BLS)								
	HC-17 19-20	HC-18 16-17	HC-19 13-14	HC-20 15-16	HC-21 15-16	HC-22 16-17	HC-23 12.5-13.5	HC-24 13-14	HC-25 13-14
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	4.6	2 U	3.2	2 U	2 U	2 U	2 U	2 U	6.4
Vinyl Chloride ²	4.8	6.2	2 U	2 U	3.0	2.8	45 J	3.2	54 J

Explanation

- 1 Monitoring Well
- 2 Values flagged J as estimated because concentrations exceeded the linear range of the GC
- Dup Duplicate
- U Compound analyzed but not detected above or below the indicated practical quantitation limit.

Table 3
Phase I Interim Investigation Site 11
Confirmatory Laboratory Results for Groundwater Samples (ug/l)

Parameter	MCL	Sample I.D. and Depth (ft BLS)					
		HC-2 ^{Lab} 10.5-11.5	HC-3 ^{Lab} 11-12	HC-10 ^{Lab} 14-15	HC-15B ^{Lab} 24-25	HC-23 ^{Lab} 12.5-13.5	HC-23 ^{Dup} 12.5-13.5
Chloroethane		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5	1.0 U	1.0 U	1.0 U	1.0 U	4.9	4.7
Tetrachloroethene	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride ¹	2	2.0	1.0 U	1.4	11 J	32 J	35 J
Benzene	5	1.0 U	1.0 U	1.0 U	1.7	1.0 U	1.0 U
Bromomethane		1.0 U	1.0 U	1.0 U	1.0 U	1.5	1.1
Chlorobenzene		1.0 U	1.0 U	2.3	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	60	1.0 U	1.0 U	6.4	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	1.0 U	1.8	4.6	1.0 U	1.0 U	1.0 U
Dichlorodifluoromethane		1.0 U	1.0 U	1.0 U	5.3	1.0 U	1.0 U
1,1-Dichloroethane		1.0 U	1.0 U	1.0 U	100	1.0 U	1.0 U
1,1-Dichloroethene	7	1.0 U	1.0 U	1.0 U	3.9	1.0 U	1.0 U
Cis-1,2-Dichloroethene	70	1.0 U	1.0 U	1.0 U	200	29	28
Ethyl Benzene	700	1.0 U	1.0 U	1.0 U	10	1.0 U	1.0 U
Methylene Chloride	5	1.0 U	1.0 U	1.0 U	15	1.0 U	1.0 U
Toluene	1000	1.0 U	1.0 U	1.0 U	230	1.0 U	1.0 U
m- and p-Xylene	10,000	2.0 U	2.0 U	2.0 U	17	2.0 U	2.0 U
o-Xylene	10,000	1.0 U	1.0 U	1.0 U	15	1.0 U	1.0 U
Total Xylenes	10,000	1.0 U	1.0 U	1.0 U	31	1.0 U	1.0 U

Explanation

- 1 Values flagged J as estimated because the continuing calibration standard exceeded QC limits.
- Dup Duplicate
- Lab Off-site Laboratory Analysis
- U Compound analyzed but not detected

APPENDIX B
STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURES

Author: Field Chemistry and
Environmental Chemistry

Issuing Unit: ABB-ES
SOP: FGCP00101
DATE: 7-2-91
Page 1 of 17

Reviewed by:

Name and Functional Area

Approved by:

Name and Functional Area

TITLE: Purge and Trap Analysis of Volatile Organic Compounds
by Field Gas Chromatography

SCOPE: These procedures describe the preparation and analysis of soil and water samples for volatile organics by purge and trap procedure. Analytes to be analyzed using this technique are project specific and will be selected by the site chemist prior to field activities. The method is used when quantification of specific compounds at low part per billion detection limits is required.

REQUIREMENTS: APPARATUS AND MATERIALS

Syringes: An appropriate number of syringes of various volumes will be selected according to project requirements

Sample Containers: Pre-cleaned amber glass vials with screw-caps and Teflon liners

Vials: Various sizes chosen on a project specific basis for use with GC standards

Spatula: Stainless steel

Purge and trap device: The purge and trap device consists of: a sparge vessel; a trap; and a desorber. A Tekmar LSC 2000, or equivalent, will be used.

Sparge vessel: The purging chamber is designed to accept 5 mL water samples or 5 gram soil samples.

Trap: Traps are purchased from Tekmar, Supelco, or other commercial vendors, and meet EPA specifications outlined in EPA method 5030 (USEPA 1986).

Reagent water: Reagent water is defined as water in which target organic compounds are not observed at or above the method detection limit. Reagent water is used for blanks, soil analyses, and dilutions of aqueous samples.

Methanol: Purge and trap quality or equivalent. Store away from other solvents.

Gas Chromatograph: A Hewlett Packard 5890 gas chromatograph (temperature programmable), or equivalent, will be used. Instruments will be capable of meeting requirements and performance objectives outlined in EPA method 8000 (EPA 1986).

Columns: For most applications a capillary column (e.g., J&W scientific DB-624) will be employed. A packed column may be substituted to meet the analytical needs of some programs. Columns will be purchased from commercial vendors.

Detectors: The primary detectors used for most field analyses are the Photoionization detectors (PID) and the Electrolytic Conductivity Detector (ELCD). These detectors, connected in series, are capable of detecting an assortment of chlorinated and aromatic target compounds. A Flame ionization Detector (FID) and /or Electron Capture Detector (ECD) may be substituted to meet project specific needs. Choice of detector will be specified in the project work plan.

Integrator: A data processing unit will be used in conjunction with the GC detector to record data from the GC analyses. The integrator will be capable of producing chromatograms, and summarizing the response of detected

compounds. A Hewlett Packard HP-3396, or equivalent, will be used.

Direct data transfer to a PC unit may also be available for some projects. This system has the capability to produce customized tables for use with data evaluation and contamination assessments.

Surrogate standard: An appropriate surrogate may be used in conjunction with purge and trap analysis as determined on a project specific basis. The project chemist shall evaluate the need of a surrogate standard, according to the project data quality objectives (DQOs), prior to field activities.

CONVENTIONS: To aid in organization field screening activities will use established convention for coding standards, recording logbook entries, making calculations, and the analyzing quality control samples. Deviations from the convention outlined in this document will not be allowed without the issuance of a written field change request, a logbook entry detailing the reason(s) for any deviation(s), and a discussion with the project chemist.

Chemical Standards. Chemical standards will be purchased from Supleco, Inc., Chem Service, Inc., or an equivalent supplier. All chemical standard preparation records will be logged and coded in a project GC run logbook. Specific information and conventions for entering this data can be found in Appendix A. At a minimum, the chemist enters the following information in the logbook:

- vendor name supplying standards
- concentration of standards prepared
- dilution records and calculations performed in deriving standard's concentrations
- lot number of standards
- code assigned to standard

Standards Preparation. All standards are prepared from neat solutions or prepared mixes purchased through an approved

supplier. Stock standards will be made by diluting neat standards or prepared mixes with an appropriate solvent. For standards made from neat solutions, the compound density will be used to determine the quantity of neat compound to add to the solvent.

All calibration standards will be made by serial dilution from stock standards. The calibration standard concentrations will be determined by the expected range of contaminant concentrations.

- standards are selected with the guidance of the project chemist on a site-specific basis. Compounds will be chosen to meet the needs of specific projects.
- standards are stored in vials with Teflon caps with a code that identifies the exact working standard mix. Codes will follow the format FGCXXXXXXWWYYZZ where XXXXXX is the month, date, and year that the mix was made; WW is the page in the GC logbook where the standard can be found; YY is where the standard fell chronologically on that day; and ZZ is the logbook number where the standard can be found. The code and the standard concentration will be entered on the vial label. This code will be entered in the GC run log whenever the standard is analyzed so the use of all standards may be traced. All appropriate standards will be stored in a refrigerator or cooler.
- a summary of standard preparation steps will be entered into the project GC run logbook
- when preparing standards, all syringes will be rinsed in purge and trap grade methanol at least three times before use.

CALIBRATION: Prior to analyzing samples instrument operation conditions are established and recorded in the instrument logbook or on an operation conditions record sheet. Calibration will be conducted using standard calibration technique is used. A

detailed description of external standard calibration is found in EPA Method 8000 (EPA 1986).

Initial Calibration At the initiation of each field program, a minimum three-point initial calibration curve will be prepared covering the desired concentration range of VOC analyses for the site.

Quantitation of volatile organics should be calculated from a point to point calibration curve as described in USEPA method 8000 (EPA 1986), but is not required. If the relative standard deviation of response factors is less than 30 percent for a given target analyte, linear regression may be used for determining the concentration detected in samples.

Independent Check Standard Verification. After the first initial calibration conducted in each field event, an independent check standard may be analyzed in accordance with specific project DQOs. The check sample will be made from a different source than the stock solution and working standards. The check sample is used to verify the accuracy of the working standard. A percent difference (%D) of <30% is considered acceptable to confirm standard accuracy.

Continuing Calibration Prior to sample analysis, a continuing calibration check standard will be analyzed at or near the mid-level each day. The target analytes must have percent differences (%D) of <30% when compared to the initial calibration.

Samples may be run only if no more than one compound per detector, or a total of 10% of the target compounds, exceed the %D criteria of 30% . If the above criteria are not met, a second standard is analyzed. If the second standard is unacceptable, a new calibration curve will be prepared. Following analysis of an acceptable continuing calibration standard, samples can be analyzed for a period of 24 hours from the time of standard injection. Sample IDs for the continuing calibration standard will be entered into the instrument logbook.

A closing standard is analyzed as the last analytical run of the day. The sample ID for the closing standards will be entered into the logbook by the code ZZCLSYYYXXXXXX where

YYY is the standard concentration, and XXXXXX is the month, day, and year of analysis.

Retention Time Windows. Retention times will be set to 3% for target compounds.

Low Level Method Blanks. A method blank analyzed before samples are analyzed. A method blank consists of 5 mL of reagent water that may have a surrogate standard added. Blanks are analyzed under identical procedures as samples. Method blanks are acceptable if no target compounds are present above the detection limits established for the instrument. Samples are not analyzed until an acceptable method blank is run demonstrating that the instrument is free of contamination.

Medium Level Blanks. A medium level method blank will be analyzed prior to the analysis of extracts from medium-level extractions (Section 3.2.2). A medium level blank will consist of 100 uL of methanol added to 5 mL reagent water. The methanol will originate from the same source as the methanol used in the soil extraction procedure. Surrogate standard may be added to the reagent water which is then analyzed by the same procedure described for water samples in Section 4.1.

Cleaning Blank. Blanks will also be analyzed after any high-level sample to ensure that carryover is not occurring. A high level sample is defined as being five times higher than the highest calibration point. Blanks may be run more often based on the judgement of the field analyst.

Method Detection Limits. Method detection limits (Mils) will be determined on an annual basis and applied to all field purge and trap analyses during that year. Method detection limits are established by analyzing seven standards at a concentration equal to the low level calibration standard. The standard deviation is calculated for these seven runs and will be multiplied by 3.1 (student's t value for 95 percent confidence). This number is divided by the Ave RF to established the MDL for each analyte.

SAMPLE

PREPARATION:

Sample preparation techniques have been adapted from protocols outlined in EPA purge and trap methods 8010, 8020, and 8240 (EPA 1986). Methods have been modified for the purpose of field application where appropriate. After instrument calibration and method blank analysis has been completed as outlined in Section 2.0, samples can be analyzed.

Water Samples. Open the sample bottle and, with a 5 mL syringe, carefully draw the sample into the syringe barrel and discard 1 volume. Draw sample into syringe. Depress the syringe plunger, and vent any residual air while adjusting the volume to 5 mL. Care must be taken to prevent air bubbles from forming in the syringe. Using a syringe, add appropriate surrogate standard to the sample. Attach the 5 mL syringe to the syringe valve on the purging device. Open the purge valve and inject the sample into the purging chamber. Close the valve and purge the sample. Prior to the analysis of subsequent samples, wash the chamber with a minimum of two 5 mL flushes of reagent water.

Dilution of Water Samples. If field notes or historic information indicate that high concentrations of VOCs may be present, samples will be diluted to bring target compounds into the instrument calibration range. Dilutions will be made within a 5 mL syringe. If 1.0 mL or more of sample is used, the 5 mL syringe is used to measure the sample volume. Reagent water is then drawn into the syringe to make a final volume of 5.0 mL. If less than 1.0 mL of sample is used, than a syringe designed to measure the respective volume will be used to measure the sample. Sample will be added to 5.0 mL of reagent water in a 5.0 mL syringe and analyzed as a normal water sample.

For samples that are diluted a dilution factor is applied to the detection limits and target compound results. Dilution factors are calculated as follows:

$$\begin{array}{l} \text{X mL} \qquad \qquad \text{DF} \quad = \quad \underline{5 \text{ mL}} \\ \qquad \qquad \text{where x} \quad = \quad \text{volume of sample} \end{array}$$

4.2 Soil Samples. Soil samples include subsurface soils, surface soils, or sediment samples. VOC concentration in soil samples may be calculated based on the dry weight if project specifications require. Percent moisture adjustments will be made to the raw data results as described in Section 4.2. The percent moisture of each sample will be calculated based on modification of procedures outlined in Section 7.2 of the EPA SOW (EPA 1988) as described in the following subsections.

Percent Solid Determination. Weigh sample measuring pan. Add 10 g nominal of sample into pan and record weight (+0.1 g). Weigh dried sample and pan. Sample weight equals the difference between the pan weight and total weight. Calculate the percent moisture.

Alternatively, an automatic moisture balance may be used to determine percent solid as per the manufacturer's instruction.

grams of samples - grams of dry sample

$$\% \text{moisture} = \frac{\text{grams of sample}}{\text{grams of sample}} \times 100$$

$$\% \text{solid} = 100 - \% \text{moisture}$$

Low Level Preparation. Open the sample bottle. Using a spatula place 1 to 5 grams of samples into the soil sparging vessel. Weigh the soil using an analytical balance. Record the sample weight to the nearest 0.1 gram in the logbook. Attach the soil sparger to the purging device. Fill a 5 mL Luer lock syringe with 5 mL of reagent water. Depress the syringe plunger and vent any residual air while adjusting the volume to 5 mL. Add appropriate volume of surrogate standard to the reagent water. Attach the syringe to the syringe valve on the purging device. Open the purge valve and inject the water into the soil sparging chamber. Close the valve and purge the sample.

After sample purging is completed soil is removal from the sparger, and the chamber is rinsed with reagent water. If contamination is detected at concentration exceeding the limits defined in Section 2.3 fore carryover blanks, then the sparger is rinsed with methanol or suitable solvent to eliminate residual contamination.

Medium Level Preparation. If field notes or low level analyses indicate that samples contain high concentration of target compounds and/or other hydrocarbons, samples will be prepared using a medium level methanol extraction technique similar to the medium level method outlined in EPA method 8240 (EPA 1986).

It is necessary to analyze a medium level method blank each day medium level samples are analyzed. Medium level method blanks are described in Section 3.2.3.

Four grams of sample is measured into a test tube using an analytical balance. 10 mL of methanol is added to the test tube. The test tube is capped and shaken for one minute until the soil is thoroughly distributed in the methanol. The suspended soil is allowed to settle, and if necessary, a centrifuge is used. One hundred microliters of the methanol extract is removed from the test tube and added to 5 mL reagent water and surrogate (if required) in a 5 mL syringe. In no case will greater than 100 uL of methanol be used.

For highly contaminated soils the extract may require additional dilution. If less than 2 uL (a 10 uL syringe) of extract is required to bring VOCs into instrument calibration range, then the extract will be diluted and a volume of 2 uL, or greater, will be used to the reagent water. The reagent water and methanol extract is then analyzed according to procedures for water samples outlined in Section 3.1.

**TARGET COMPOUND
CONCENTRATIONS**

CALCULATIONS: The concentration of target compounds detected in samples will be calculated using either point to point comparison to the initial calibration curve, or by linear regression (if the RF is <30%).

**FIELD
DOCUMENTATION**

PROCEDURES: A log of all chromatography runs will be recorded in a bound notebook with sequential numbered pages. A separate logbook will be maintained for each gas chromatograph instrument used in the field. The logbook will record the

concentrations for all calibrations standards injected, sample run number, sample ID, date, standard preparation code, sample volume and /or weight, and any additional information particular to the injection. In addition, when sample data is to be transferred to a PC the integrator entry format outlined in Attachment B will be followed.

Individual sections in each instrument logbook will be designated for recording information on standard preparation, instrument maintenance, instrument operating conditions, and sample percent moisture results.

Raw data will be organized by instrument and date of analysis in files on site. After conclusion of the field effort, data will be transferred to storage at Jordan. Raw data includes chromatograms and calibrations records from all standard, blank, and sample analyses used in the field program.

QUALITY CONTROL

PROCEDURES:

The following procedure will be implemented by the field chemist to insure standardization of the operating procedures.

1. All appropriate standards will be preserved by storing them in a refrigerator or cooler.
2. Calibration: If a continuing calibration standard does not meet requirements outlined in Section 3.2, then a second standard will be analyzed. If the second standard does not meet requirements, a new initial calibration will be required.
3. The field chemist will review each sample analysis chromatogram before analyzing the next sample. If used, surrogate recoveries are calculated, surrogate and target compound retention times are compared to calibration standards and carryover potential is evaluated.
4. Surrogate Review (project specific): surrogate recoveries will be entered into the logbook after each analysis. The field chemist will evaluate surrogate

retention times. Samples with surrogate recovering <30% will be reanalyzed to confirm matrix interference.

5. Matrix Spikes Analyses: Matrix spike quality control samples may be required on a project specific basis. Matrix spikes are field samples to which target compounds at the mid-calibration range have been added. Target compound percent recoveries will be recorded.
6. Carryover target and non-target analytes: cleaning blanks will be analyzed after samples containing high concentrations of target of non-target compound until, in the judgement of the field analyst, carryover will not impact subsequent analytical runs.

QC

REQUIREMENTS: Table 1 gives a brief description of the DQOs generally associated with field GC screening and the quality control procedures required for each. Specific DQOs and QC procedures are presented in sampling and design plans and may possess subtle differences from those presented here.

DATA REVIEW AND

DELIVERABLES: Data from all samples analyses and relevant calibration and blank analyses will be documented in the project GC run logbook. A quality control summary may be generated at the completion of the project. The quality control summary will include an evaluation of the field screening data. The summary will include an evaluation of some or all of the following parameters: initial calibrations, continuing calibrations, closing calibrations, surrogate recoveries, matrix spikes, matrix spikes duplicates, method blanks, dilutions, reanalyses, retention times, and raw data.

REFERENCES

- Clay, P.F., and T.M. Spittler, Ph.D. "The Use of Portable Instruments in Hazardous Waste Site Characterizations"; Proceedings of the National Conference on Management of Uncontrolled Hazardous Waste Sites, Silver Springs, MD.
- U.S. Environmental Protection Agency. 1986. "Test Methods for Evaluation Solid Waste, Physical/Chemical Methods"; SW-846; Office of Solids Waste and Emergency Response; Washington, D.C.
- U.S. Environmental Protection Agency, 1987. "A Compendium of Superfund Field Operations Methods"; Office of Emergency and Remedial Response; Washington DC.
- U.S. Environmental Protection Agency, 1988. "Field Screening Methods Catalog User's Guide"; Office of Emergency and Remedial Response; Washington, DC.
- U.S.Environmental Protection Agency, 1988. USEPA Contract Laboratory Program Statement of Work for Organic Analyses.

ATTACHMENT A
FIELD CHEMISTRY
ISIS CODED FOR QUALITY CONTROL SAMPLES

ISIS CODES. Field Chemistry has developed ISIS codes for quality control samples (e.g., calibration standards, blanks, check standards, etc.). The standard format will facilitate the evaluation of field data. This will be essential when the data are either electronically stored in a data abase or compiled in a hare copy format. The use of ISIS codes applies to all aspects of Field Chemistry (i.e., gas chromatography, infrared spectroscopy, total solids, etc.)

ISISXXXXXXXXXX (fourteen digit code)

ISIS, 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Positions #1 and #2 contain the quality control standard identifier.

MB	-	Method Blank
CB	-	Cleaning Blank
1S	-	Initial standard, 1st calibration level
2S	-	Initial standard, 2nd calibration level
3S	-	Initial standard, 3rd calibration level
IC	-	Independent check standard
CC	-	Continuing check standard
CS	-	Closing check standard
OT	-	Other

Positions #3 and #4 contain the analysis identifier.

EL	-	Elements, analyzed by AA or X-RAY fluorescence
HD	-	Hydrocarbons, analyzed by GC_FID
HP	-	HPLC, undefined analysis
PA	-	PAHs, analyzed by UV spectroscopy
PB	-	PCBs, analyzed by GC
PH	-	PHCs, analyzed by IR spectroscopy
PT	-	Pesticides, analyzed by GC
SV	-	Semivolatiles, analyzed by GC
VA	-	Volatile aromatics, analyzed by GC
VC	-	Volatile chlorinated, analyzed by GC
VT	-	Total volatiles, analyzed by GC
OT	-	Other

Positions #5 through #10 contain the date (e.g., 050991)

Positions #11 and #12 contain the detector type.

AA	-	Atomic adsorption detector
ED	-	ECD, (Ni 63) detector
FD	-	FID, Flame ionization detector
IR	-	IR, detector
HD	-	ELCD, Hall Cell detector
NP	-	NPD, Nitrogen/Phosphorous detector
PD	-	PID, Photoionization detector
UV	-	UV, fluorescence detector
XR	-	X-RAY, Fluorescence detector
MS	-	Mass spectrometer

Positions #13 contains QC and miscellaneous information

M	-	Matrix spike
D	-	Matrix spike duplicate
V	-	Soil gas (vapor)
F	-	Field duplicate

Positions #14 contains the letter F to indicate field screening analysis.

ATTACHMENT B
FIELD CHEMISTRY
HP 3396 INTEGRATOR ENTRY STANDARDIZATION

INTEGRATOR ENTRY. The HP 3396 integrator allows the entry of 42 characters in the title format under OP #4 (option #4, replace title, Y). The following format has been devised to standardize the information included in the title. This format must be followed when data is to be electronically transferred to a separate data storage system (i.e., personal computer). It is recommended that this format be used either in part or in its entirety for all data that is acquired by the HP 3396 integrator.

Examples:

ISISXXXXXXXXXX S A:4.53 G:A I:A D:1

ISISXXXXXXXXXX W A:5.00 G:B I:B D:1

ISISXXXXXXXXXX M A:MEDL G:A I:A D:125

ISISXXXXXXXXXX O A:4.97 G:A I:C D:1

Positions #1 through #14 contain the appropriate ISIS code.

Position #15 is blank.

Position #16 contains the matrix identifier, only one may be entered.

S - Soil, W - Water, M - Medium level soil, O - organic phase

Position #17 is blank.

Position #18 and #19 contain the amount indicator, A:.

Positions #20 through #23 contain the amount of sample analyzed, (e.g., 4.97).

Soil and organic solvents amounts are always entered in grams (g); Water sample volumes are always entered in milliliters (mL), note: 200 μ L is entered as 0.020 mL.

Position #24 is blank.

Positions #25 and #26 contain the gas chromatograph (GC) indicator, G:

Position #27 contains the GC identifier (e.g, A, B, C, . . .).

Position #28 is blank.

Position #29 and #30 contain the integrator indicator, I:

Position #31 contains the integrator identifier (e.g., A, B, C, . . .).

Position #32 is blank.

Positions #33 and #34 contain the dilution factor indicator, D:

Positions #35 through #42 contains the dilution factor (i.e., 125)

The dilution factor does not include cases where less than 5 g of soil rate used (i.e., in volatile analysis). This dilution will be taken into account from the soil amount in positions #20 through #23. The same rule applies when less than 5 mL of water are used (i.e., if 2 mL of sample were added to 3 mL of water for a final volume of 5 mL the dilution factor is entered as 1 in position #35).

FD	-	FID, Flame ionization detector
IR	-	IR, detector
HD	-	ELCD, Hall Cell detector
NP	-	NPD, Nitrogen/Phosphorous detector
PD	-	PID, Photoionization detector
UV	-	UV, fluorescence detector
XR	-	X-RAY, Fluorescence detector
MS	-	Mass spectrometer

Positions #13 contains QC and miscellaneous information

M	-	Matrix spike
D	-	Matrix spike duplicate
V	-	Soil gas (vapor)
F	-	Field duplicate

Positions #14 contains the letter F to indicate field screening analysis.