02.05-08/18/93-00569

FINAL

ENGINEERING EVALUATION/ COST ANALYSIS

CAMP ALLEN LANDFILL - AREA B NAVAL BASE, NORFOLK, VIRGINIA

CONTRACT TASK ORDER 0176

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under the:

LANTDIV CLEAN Program
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AUGUST 18, 1993

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LIST OF ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
Baker	Baker Environmental, Inc.
bgs	below ground surface
BNA	Base/Neutral/Acid Organic Compounds
CAA	Clean Air Act
CERCLA	Comprehensive Long-Term Environmental Action Navy
CWA	Clean Water Act
DoD	Department of Defense
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
E&S	Erosion and Sedimentation
FS	Feasibility Study
gpm	gallons per minute
HRSD	Hampton Roads Sanitation District
IAS	Initial Assessment Study
ICR	Ignitability, Corrosivity, and Reactivity
IRP	Installation Restoration Program
LANTDIV	Atlantic Division
MCL	Maximum Contaminant Level
mL	milliliter
µmhos/m	micromhos per meter
NACIP	Naval Assessment and Control of Installation Pollutants
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Contingency Plan
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation

LIST OF ACRONYMS
(Continued)

SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Contaminant Level
SVOC	Semivolatile Organic Compound
SWMF	Virginia Solid Waste Management Facility
TAL	Target Analyte List
TBC	To Be Considered
TCE	Trichloroethylene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TRC	Technical Review Committee
TSCA	Toxic Substances Control Act
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
VDEQ	Virginia Department of Environmental Quality
VGS	Virginia Groundwater Standards
VOC	Volatile Organic Compound
VPDES	Virginia Pollutant Discharge Elimination system
VWQS	Virginia Water Quality Standards

1.0 INTRODUCTION

This report presents the Engineering Evaluation/Cost Analysis (EE/CA) of removal action options for "Area B" of the Camp Allen Landfill Site located at the Naval Base, Norfolk, Virginia. This EE/CA has been prepared by Baker Environmental, Inc. (Baker) under contract to the Atlantic Division (LANTDIV) Naval Facilities Engineering Command.

The EE/CA is a brief analysis of removal alternatives for a site where action may be delayed for six months or more before on-site cleanup is initiated. During this six month planning period, potential removal alternatives are evaluated for effectiveness in minimizing or stabilizing the threat to public health, consistency with anticipated final remedial action, consistency with applicable or relevant and appropriate requirements (ARARs), and cost effectiveness.

This EE/CA has been conducted following the removal program guidelines of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), the National Oil and Hazardous Substances Contingency Plan (NCP), and the draft EE/CA Guidance For Non-Time-Critical Removal Actions dated June 1987.

The Department of the Navy (DON) has broad authority under CERCLA Section 104 and Executive Order 12580 to carry out removal actions when the release is on, or the sole source of the release is from, the DON installation. The Navy/Marine Corps Installation Restoration (IR) Program was initiated to identify, assess, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps activities. This EE/CA also follows the guidelines published in the Navy/Marine Corps IR Manual dated February 1992.

This EE/CA study and report have been based on previous investigations, including an Initial Assessment Study, a Site Suitability Assessment Study, a Confirmation Study, and an Interim Remedial Investigation, as well as an ongoing Remedial Investigation conducted by Baker. These investigations have identified areas of contamination within Area B of the Camp Allen Landfill due to past disposal operations at the site.

A detailed description of the site, its background, the investigations to date and the nature and extent of contamination is presented in Section 2.0 of this report. Section 3.0 defines the scope

of the removal action and provides a description of potential removal alternatives for the site contaminants. Section 4.0 provides an individual evaluation of appropriate alternatives selected for the site. Section 5.0 provides a comparative analysis of the strengths and weaknesses of each alternative relative to the others, and Section 6.0 identifies the proposed removal action.

2.0 SITE CHARACTERIZATION

2.1 Site Description

The Camp Allen Landfill Site is located in the City of Norfolk, Virginia approximately one mile east of Hampton Boulevard and one mile south of Willoughby Bay. Figure 2-1 presents the Site Location Map. The Camp Allen Landfill is comprised of two primary areas (Areas A and B), operated by the United States Navy from the late 1930s until 1975. Figure 2-2 presents the Camp Allen Landfill Site Map. This Removal Action will focus on the Area B landfill, as it is reported to contain a significant amount of contaminated debris which can be readily removed. Figure 2-3 presents the Camp Allen Landfill, Area B Site Map.

2.1.1 Surface Drainage

Four major surface drainage systems surround the greater Norfolk area including the James and Elizabeth Rivers and Willoughby and Chesapeake Bays.

Surface water flows westward from a ponded area adjacent to Area B, through a culvert under the northern portion of the Camp Allen Salvage Yard (located between Areas A and B), and discharges into the drainage ditch along the northernmost boundary of Area A. From this point, surface water flows towards Willoughby Bay through a series of concrete drainage channels and underground culverts (replacing the former Bousch Creek).

Surface drainage at the Camp Allen Landfill Site is relatively poor in places. This is especially true at Area B. After a period of heavy rainfall, standing water can cover the entire site. In general, this can be attributed to the silty/clayey nature of site surficial soils. Patterns of surface drainage can be observed on Figure 2-4.

2.1.2 General Site Geology

Site geology consists of four to five separate strata, including:

- Fill/landfill materials (from 0 to 18 feet depth).
- Silts, clays and sands (from 0 to 27 inches or deeper).

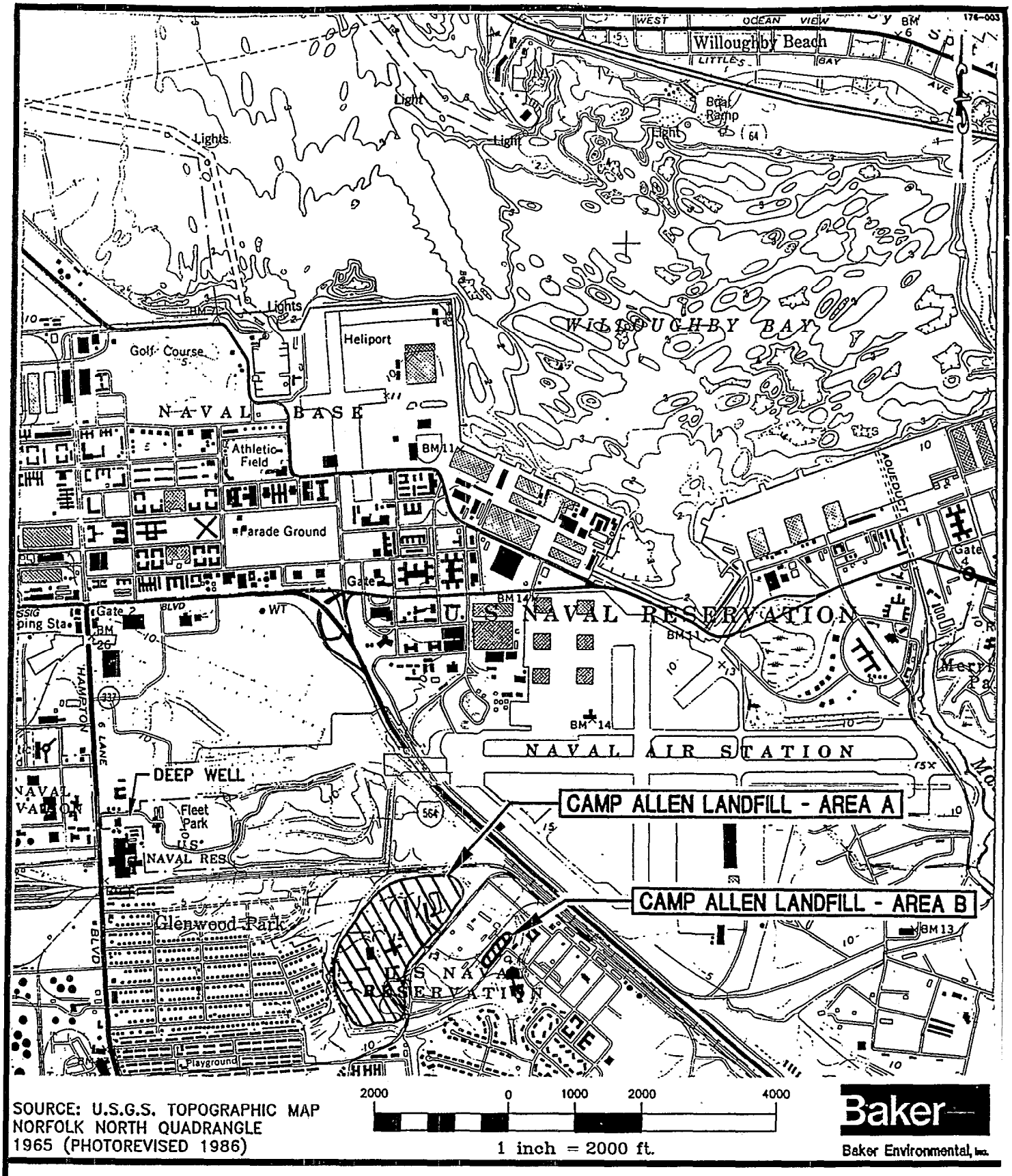


FIGURE 2-1
LOCATION MAP
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

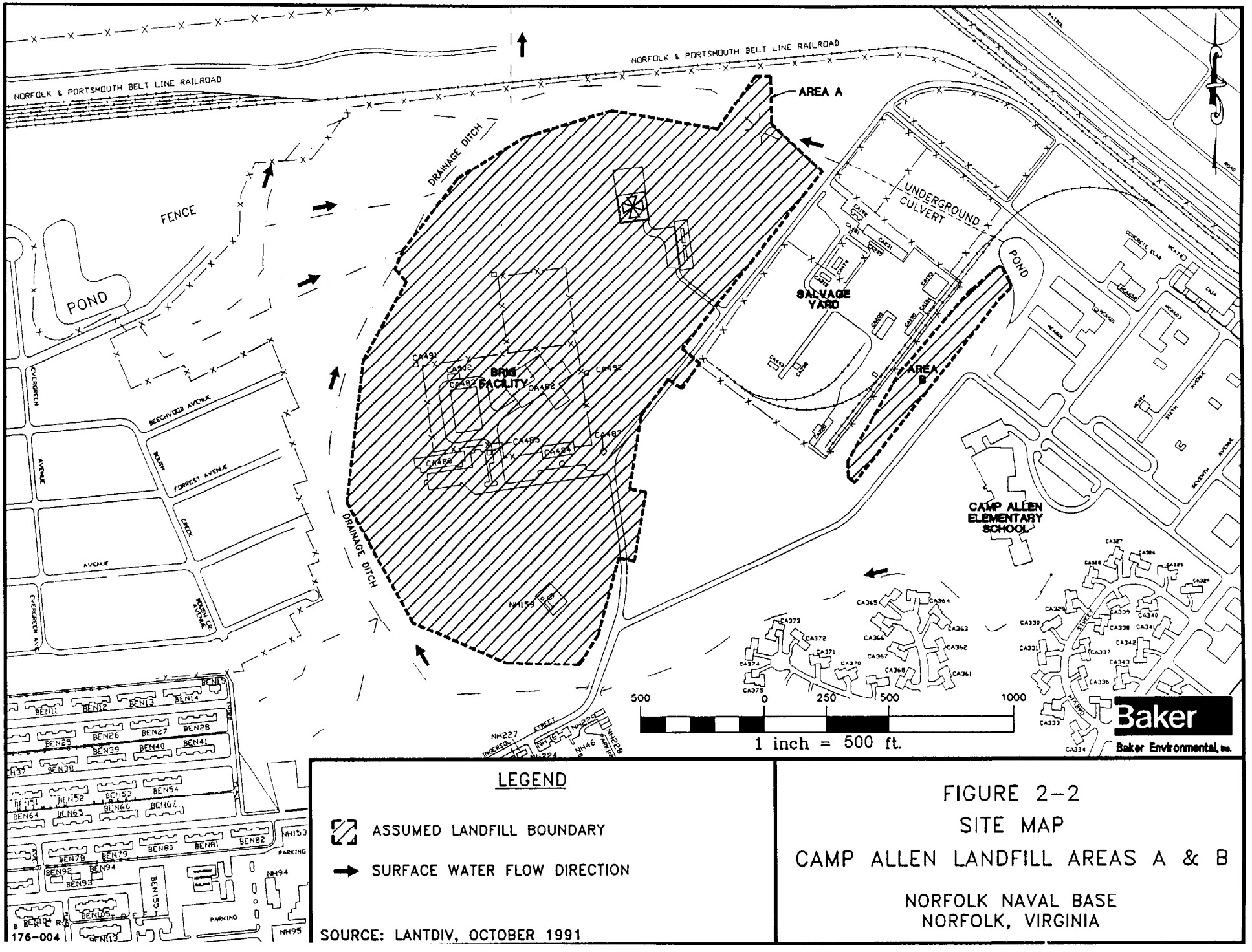


FIGURE 2-2
SITE MAP
CAMP ALLEN LANDFILL AREAS A & B
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

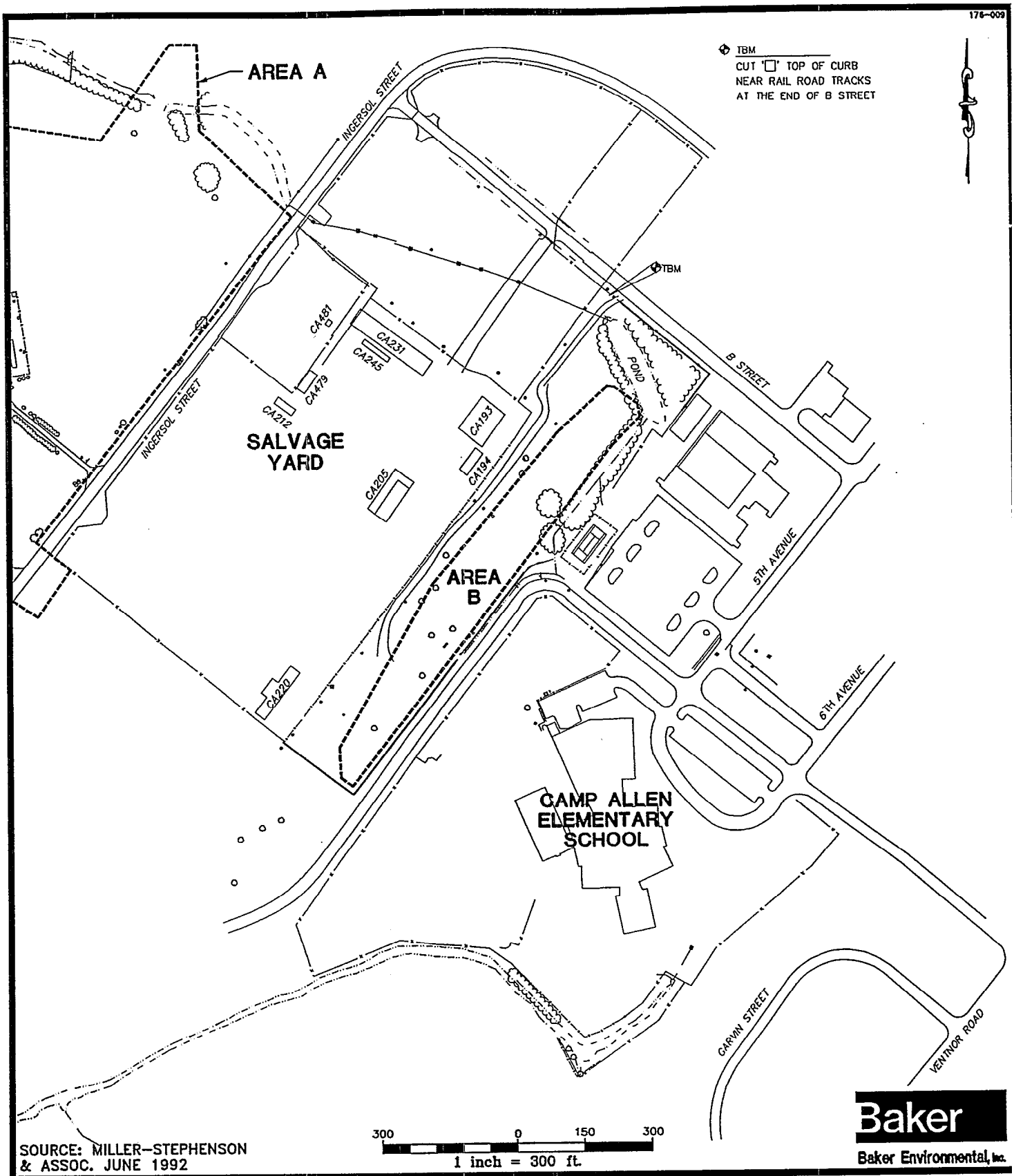
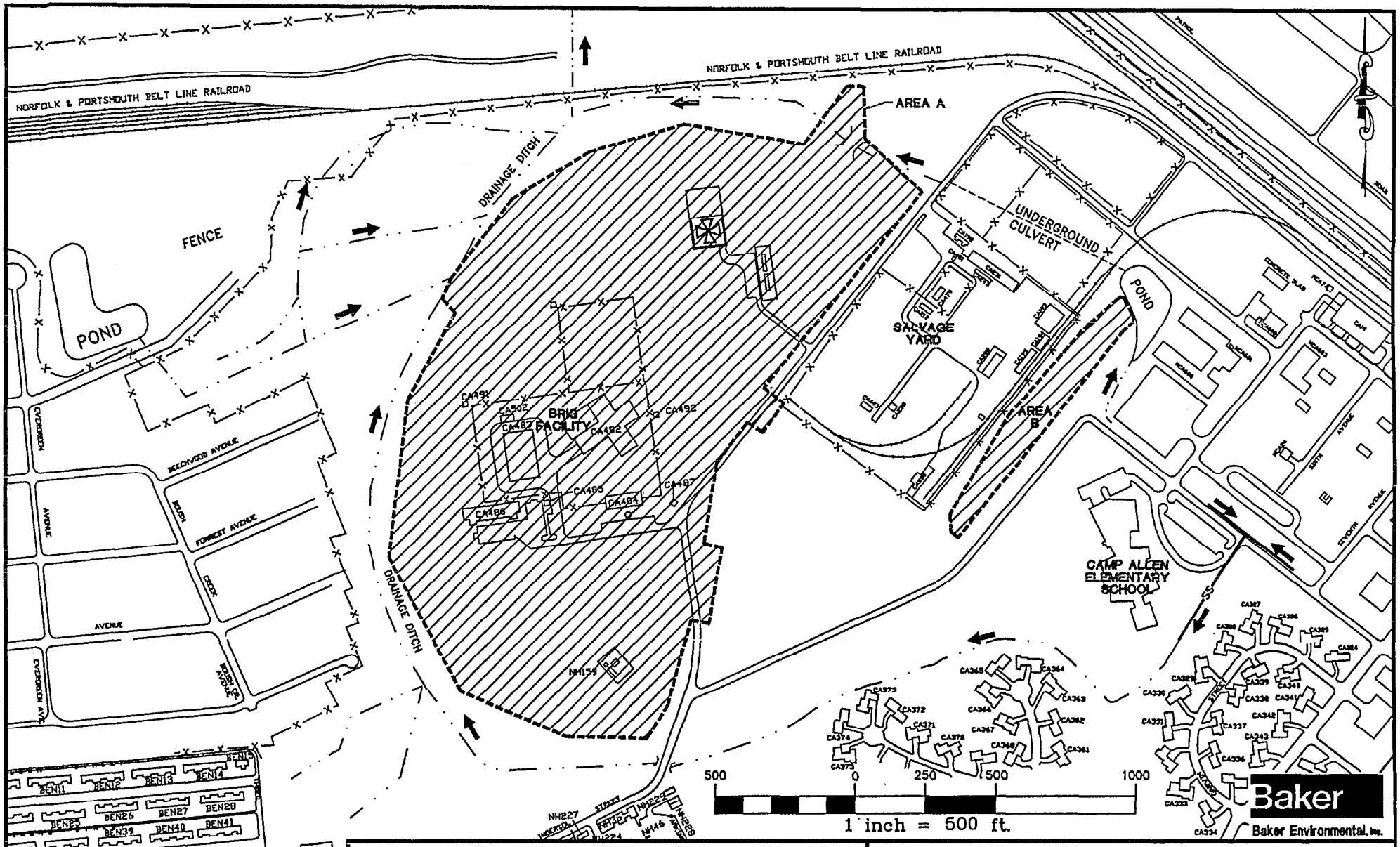


FIGURE 2-3
SITE MAP
CAMP ALLEN LANDFILL
AREA B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



LEGEND

ASSUMED LANDFILL BOUNDARY

SURFACE WATER FLOW DIRECTION

—SS— STORM SEWER

SOURCE: LANTDIV, OCTOBER 1991

FIGURE 2-4
SURFACE DRAINAGE MAP
CAMP ALLEN LANDFILL AREAS A & B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

- A confining clay layer (when present) ranging from 25 feet to approximately 40 feet in depth.

- A silt/sand/shell hash unit (Yorktown Aquifer) ranging from 40 feet to 130 feet in depth.

Breaching of the confining clay unit possibly was caused by scouring, a result of erosional forces associated with historic Bousch Creek. This could also be the result of the variable shallow marine depositional environment or a combination of both. Bousch Creek has been replaced by a network of drainage ditches and culverts during the development of the Base. Areas where major Bousch Creek channels were present are potentially areas where the clay unit is breached or poorly represented. Figure 2-5 presents a generalized geologic cross-section of subsurface lithologic conditions in the vicinity of the Camp Allen Landfill.

2.1.3 General Site Hydrogeology

The water table aquifer and the Yorktown Aquifer are the primary groundwater aquifer systems of concern at the Camp Allen Landfill Site. The surficial aquifer, consisting of primarily silts and fine sands, tends to flow eastward from Area B. Shallow groundwater in this area is typically encountered about 4 to 6 feet below ground surface.

Groundwater in the lower (Yorktown) aquifer consisting of silt, sand and shell material flows northward from Area B. This is a semi-confined aquifer system with a noncontinuous (intermittently breached) confining layer. The Yorktown Aquifer is approximately 90 to 100 feet thick in the site area. Figure 2-6 presents generalized groundwater flow directions at Areas A and B.

2.1.4 Natural Resources and Ecological Features

The Naval Base, Norfolk exhibits resources ranging from creeks and wetlands to varying types of forests. Tributaries such as Bousch Creek have been completely filled in over the course of time leaving only remnants, which exist as tidal drainage ways accommodating stormwater and surface runoff in the area. In part, Bousch Creek remnants and the surrounding area to the north and northwest are classified by the United States Fish and Wildlife Service (USFWS) as being wetlands.

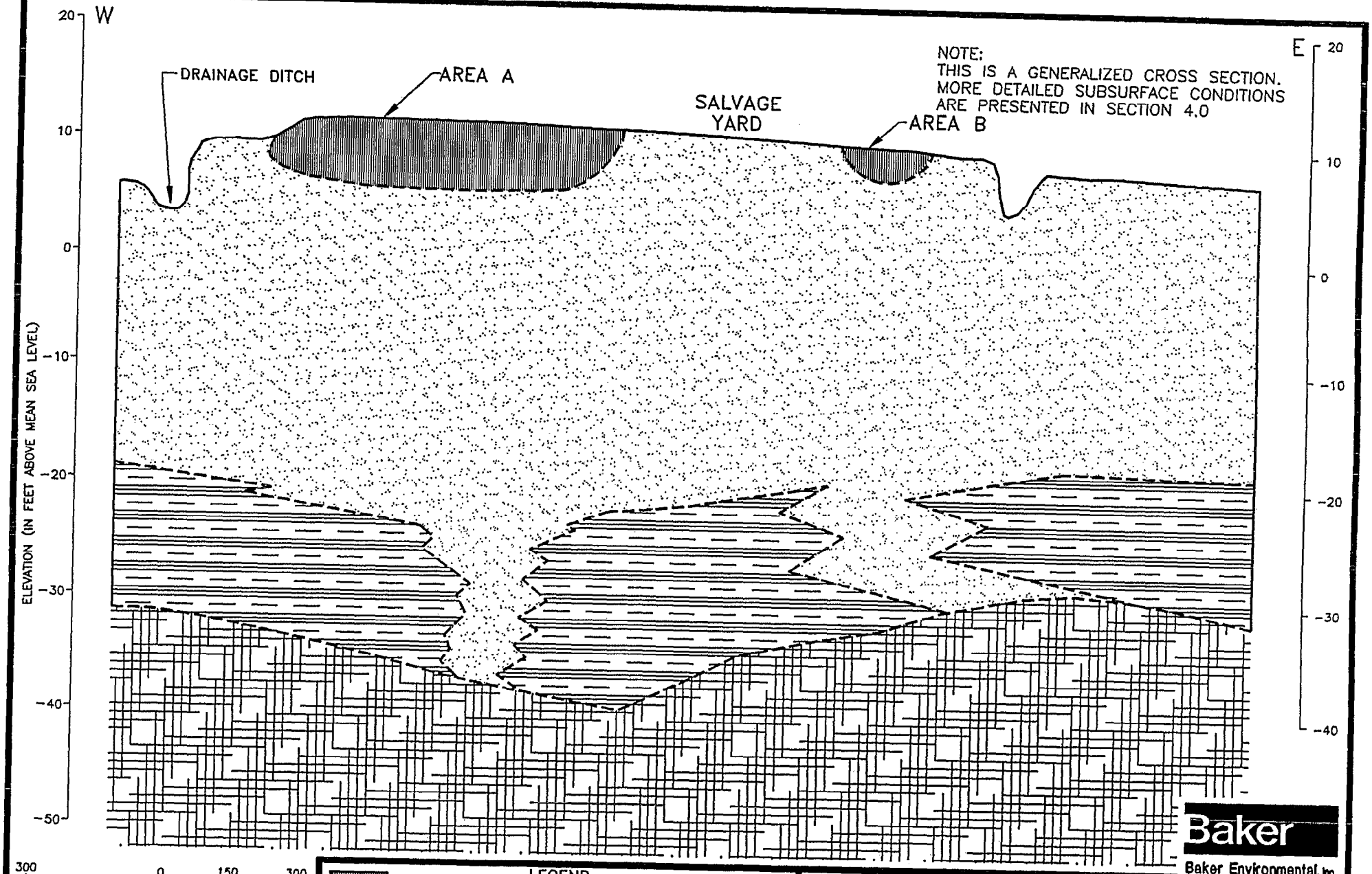


FIGURE 2-5
GENERALIZED GEOLOGIC CROSS-SECTION
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

176-006

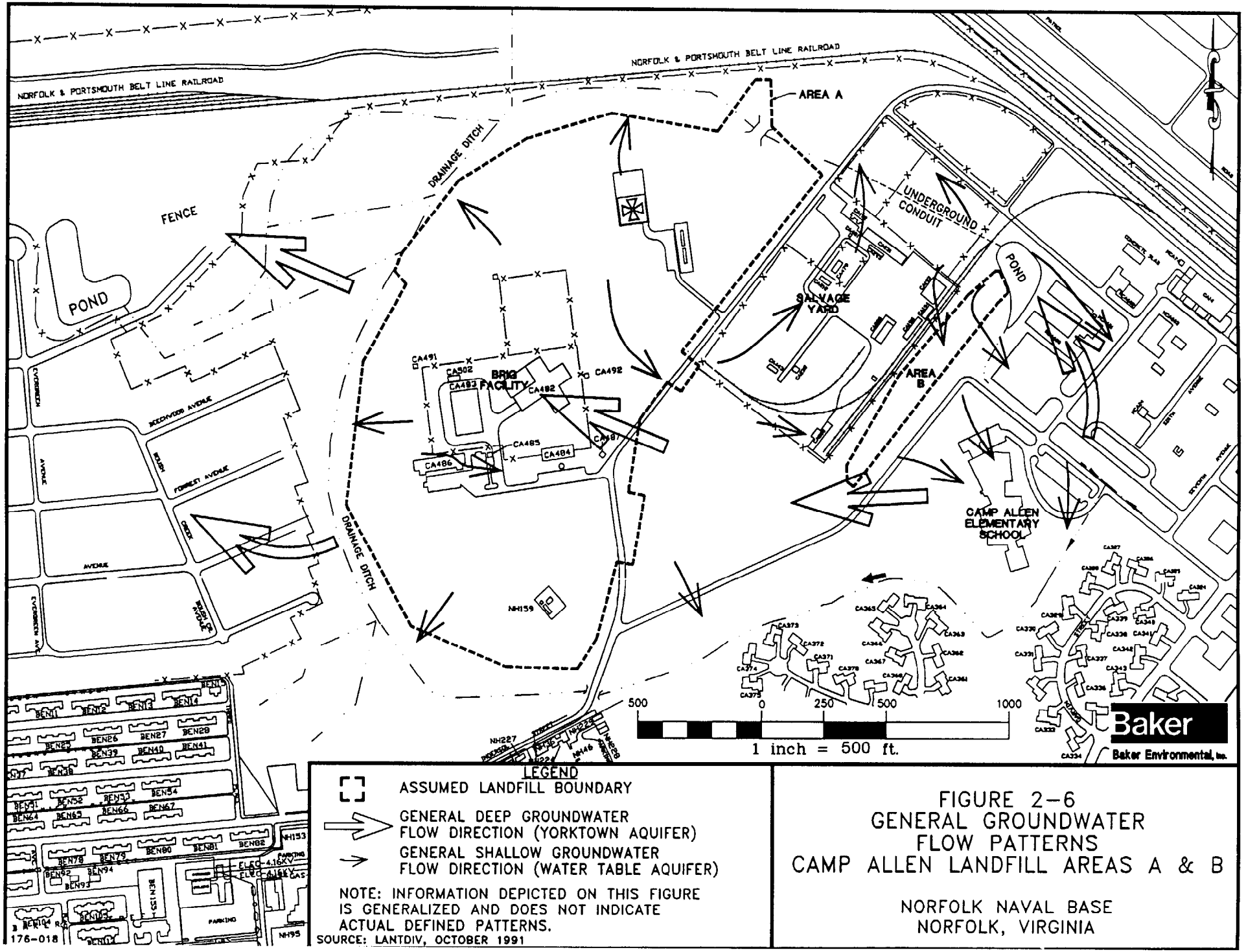


FIGURE 2-6
GENERAL GROUNDWATER FLOW PATTERNS
CAMP ALLEN LANDFILL AREAS A & B

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

2.1.5 Nature of Contamination

Based on previous studies and investigations, it has been confirmed that soils, sediment, surface water, and groundwater located in the vicinity of Area B of the Camp Allen Landfill Site have been impacted by past disposal practices. The primary contaminants are volatile organic compounds, with some areas exhibiting low levels of semivolatile organic compounds, pesticide/PCB compounds, and metals. As the findings related to the Camp Allen Landfill Area B are very complex, a simplified listing of primary areas of detected contamination is presented below:

- Subsurface Soil - Central portion of Area B
  - VOCs - Trichloroethene, toluene, ethylbenzene, xylenes
  - Pesticides/PCBs - 4,4'-DDE, 4,4'-DDD, Aroclor-1254
- Surface Soil: Nominal findings
- Sediment - Pond north of Area B
  - Metals - Mercury, zinc, cadmium, lead
  - VOCs - trichloroethene, 1,2-dichloroethene, vinyl chloride
- Surface Water
  - VOCs - Trichloroethene, 1,2-dichloroethene, vinyl chloride, benzene - in pond north of Area B
  - Metals - Arsenic, cadmium, chromium, lead, mercury, zinc - in pond north of Area B and in all drainage ditches
- Shallow Groundwater
  - VOCs - Trichloroethene, 1,2-dichloroethene, vinyl chloride, benzene - south/southeast of Area B
  - Metals - Arsenic, barium, cadmium, chromium, lead, zinc - both north and south of Area B
- Deep Groundwater
  - VOCs - Trichloroethene, 1,2-dichloroethene, vinyl chloride - central Area B
  - Metals - Arsenic, cadmium, chromium, lead, zinc - north of Area B

2.2 Site Background

Originally, the Camp Allen area was primarily occupied by surface water features related to Bousch Creek, which flows north into Willoughby Bay. Development of residential, commercial, and military related structures were limited to adjacent, topographically high areas during this time period. In the late 1930s, the Camp Allen area was reportedly used as a soils borrow area for Naval Base Norfolk related expansions. During the early 1940s landfilling operations commenced in the Camp Allen area (Camp Allen Landfill). Disposal activities continued until the mid-1970s.

The eastern portion of the Camp Allen Landfill (Area B) received wastes from a 1971 Salvage Yard fire. The Camp Allen Salvage Yard, presently an operating facility, is located between Camp Allen Landfill Areas A and B. The residue and debris resulting from this fire was buried in the eastern portion of the landfill (Area B). Although not documented, this debris may have included lubricating oil, organic solvents, paints, paint thinners, acids, caustics and pesticides which were stored at the Salvage Yard. Reportedly, residue from the fire and residual waste which was not burned were buried in trenches approximately 150 feet long, six to eight feet deep and ten feet wide. Many of the wastes were reportedly drummed or otherwise containerized. At present, Area B is covered with grass.

2.2.1 Previous Investigations

Previous investigations of the Camp Allen Landfill at the Naval Base, Norfolk, Virginia that have been conducted are an Initial Assessment Study (IAS), Site Suitability Assessment Study, Confirmation Study, and an ongoing Interim Remedial Investigation (RI). The following sections discusses these studies. Only the findings pertinent to the removal action at Area B have been included in this report.

In April 1982, an IAS was conducted at the Naval Base Norfolk, Norfolk, Virginia (then referred to as Sewell's Point Naval Complex). The Final IAS (dated February 1983) identified the Camp Allen Landfill (Site 1) Areas A and B as potential areas of concern. Based on IAS findings, investigations continued at the Camp Allen Landfill.

Previous investigation results preliminarily identified areas of significant contamination, as well as important geologic/hydrogeologic considerations within Area B of the Camp Allen Landfill. The composite information generated in these studies over the past 10 years has

been incorporated into this study's interpretations of the nature and extent of contamination, as appropriate. In general, findings indicate that primary site conditions are as follows:

- The primary source areas are near monitoring well GW-4 (See Figure 2-7). The nature of the source appears to be primarily volatile organic contaminants.

- The water table aquifer was found to contain elevated volatile organic concentrations in and downgradient from source areas.

- Surface water and sediment samples revealed elevated volatile organic concentrations.

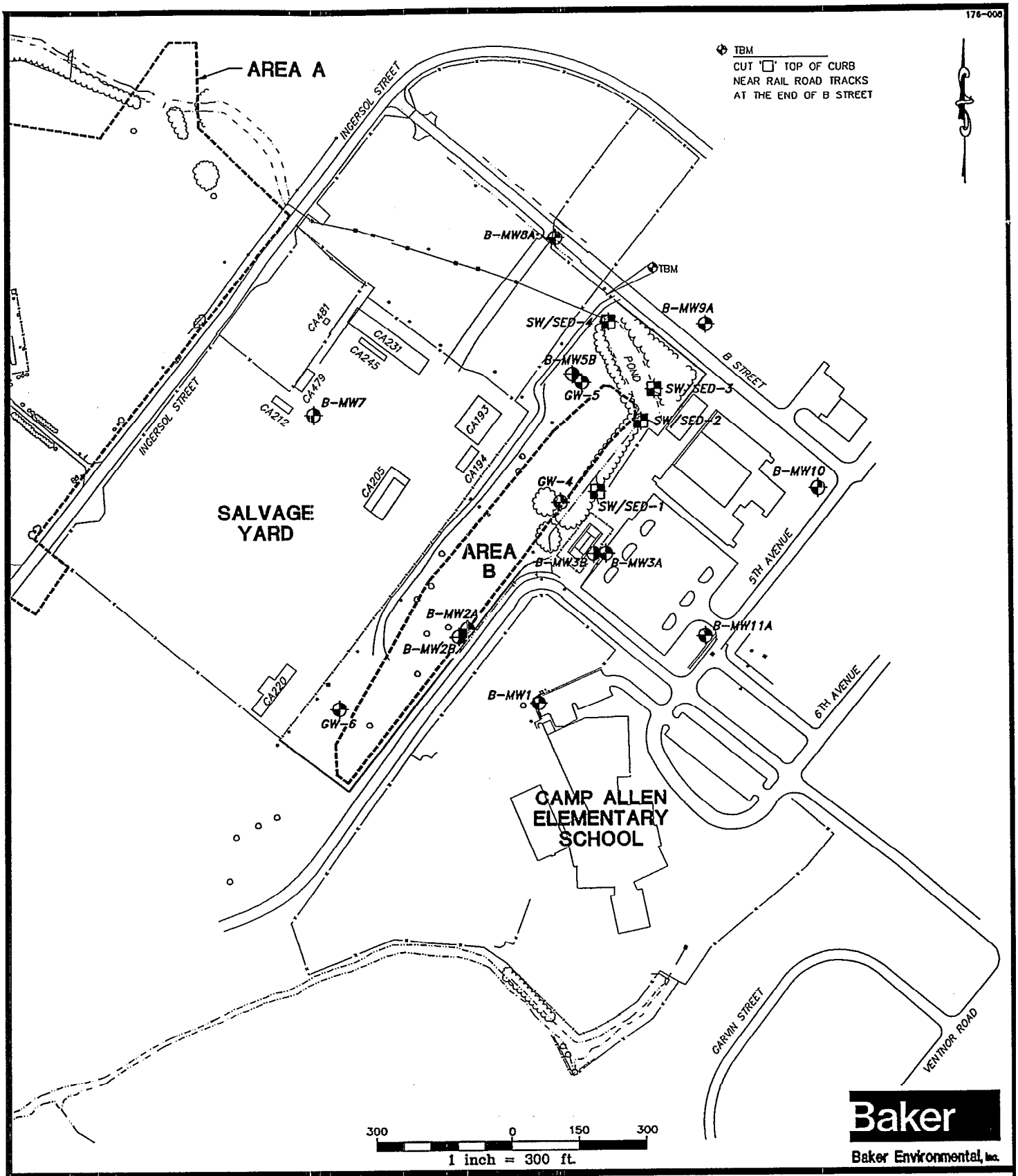
The following subsections summarize the investigation activities and the results pertinent to the removal action at Area B. Figure 2-7 presents the sampling point locations for the various studies.

2.2.1.1 Confirmation Study (April, 1987)

Three shallow (approximately 25-feet deep) and one deep (approximately 90-feet deep) groundwater monitoring wells were installed as part of this study. The three shallow wells were installed in the east/northeastern portion of Area B in 1983. The one deep well was installed approximately one mile northwest of the Camp Allen Landfill in the area north of the Naval Reserve offices and east of Hampton Boulevard (see Figure 2-1). This well was installed to determine if contaminant migration was being affected by two private deep wells which provide manufacturing process water. An existing non-potable deep well at the Marine Barracks was also sampled. Groundwater samples were collected during four separate sampling events conducted during the Confirmation Study (December 1983, August 1984, April 1986 and June 1986).

- Round 1 groundwater samples were analyzed for Priority Pollutant list compounds and xylenes.

- Round 2 groundwater samples were analyzed for Priority Pollutant list compounds and screened for dioxin.



LEGEND

A-MW6A — SHALLOW MONITORING WELL

A-MW6B — DEEP MONITORING WELL

SW/SED-1 — SURFACE WATER/SEDIMENT SAMPLE LOCATION

STUDY CONDUCTED BY CH2M HILL, INC.
MAP SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-7
CAMP ALLEN LANDFILL
INTERIM REMEDIAL INVESTIGATION: AREA B SAMPLING POINTS

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

- Round 3 groundwater samples were analyzed for Priority Pollutant list volatile organics, semivolatile organics, and inorganics. PCBs were not included during this sampling event. In addition, xylene, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), and ethylene dibromide (EDB) were also analyzed.

- Round 4 groundwater samples were analyzed for MEK, MIBK, and EDB.

The Confirmation Study indicated the following results pertinent to the removal action:

- Analysis of organic compounds in one groundwater sample location (GW-4) detected significant concentrations of several volatile organics. In general, detected concentrations were found to decrease with time.

- Analysis of inorganic compounds in groundwater indicated elevated concentrations (for total metals) of cadmium, chromium, lead, and zinc.

- Special analysis indicated elevated concentrations of MEK and MIBK at GW-4.

2.2.1.2 Interim Remedial Investigation Report (Malcolm Pirnie - March, 1988)

An Interim RI Report for IAS Sites 1 to 5 was prepared by Malcolm Pirnie in 1988. In summary, the report for Site 1 (Camp Allen Landfill Area B) identified: (1) localized contamination in the vicinity of GW-4 with significant concentrations of organics which have decreased with time, (2) organic constituents identified in GW-4 migrating to the drainage area located adjacent to the well, and (3) cadmium, chromium, lead and zinc concentrations in groundwater slightly exceeding water quality criteria.

2.2.1.3 Interim Remedial Investigation (CH_2M Hill - April, 1992)

In the fall and winter of 1990-1991, CH_2M Hill continued the original Interim Remedial Investigation activities at the Camp Allen Landfill.

A soil gas survey (68 Petrex sample locations) was performed in the vicinity of Area B. Eight (8) shallow and 3 deep monitoring wells were installed at Area B and each had in-situ hydraulic conductivity tests performed.

Surface water and sediment samples were collected and analyzed from adjacent drainage ditches at the Area B pond. Surface water samples were analyzed for volatile organics, semivolatile organics, and metals, (total and dissolved). Sediments were also analyzed for these parameters with the exception of dissolved metals. Investigation results relevant to the removal action include the following:

- Elevated volatile organics, including vinyl chloride, 1,2-dichloroethene, trichloroethene, and benzene, were present in shallow monitoring wells directly downgradient (southeast) of Area B.

- Volatile organics, including vinyl chloride, 1,2-dichloroethene, trichloroethene, and benzene, were detected in surface water and sediment samples collected from the drainage ditch and pond areas.

2.2.2 Current Investigations

Baker was contracted to perform Remedial Investigation, Baseline Risk Assessment, and Feasibility Study activities for Areas A and B of the Camp Allen Landfill Site under the Navy CLEAN Program. This work is presently in progress. A summary of the field activities is presented in the following paragraphs.

Field activities at Area B were conducted as three separate events (Rounds 1, 2, and 3). Field activities conducted at the Area B Landfill included:

- Geophysical Survey (Round 1)
- Geoprobe (In-situ Groundwater) Sampling (Round 1)
- Monitoring Well Installation (Rounds 1, 2, and 3)
- Surface Soil Sampling (Rounds 2 and 3)
- Surface Water/Sediment Sampling (Round 2)
- Source Characterization (Round 2)
- Groundwater Sampling (Rounds 1, 2, and 3)
- Slug Tests (Round 2)
- Land Surveying (Rounds 2 and 3)
- Air Quality Sampling

Round 1 field activities included a geophysical survey, a geoprobe investigation, and installation of deep groundwater monitoring wells with associated groundwater sampling. Round 1 activities were performed in late-April and early-May 1992.

Round 2 activities, performed from May to July 1992, included a surface water/sediment sampling program, collection of surface soil samples, source characterization borings, shallow monitoring well construction, groundwater sampling, aquifer (slug) tests, and a land survey.

Round 3 activities at Area B consisted of additional surface soil sampling, drilling and installation of additional monitoring wells, and a final site land survey. Round 3 activities were performed in December 1992.

Section 2.3 presents analytical data obtained throughout the three Rounds of sampling activity.

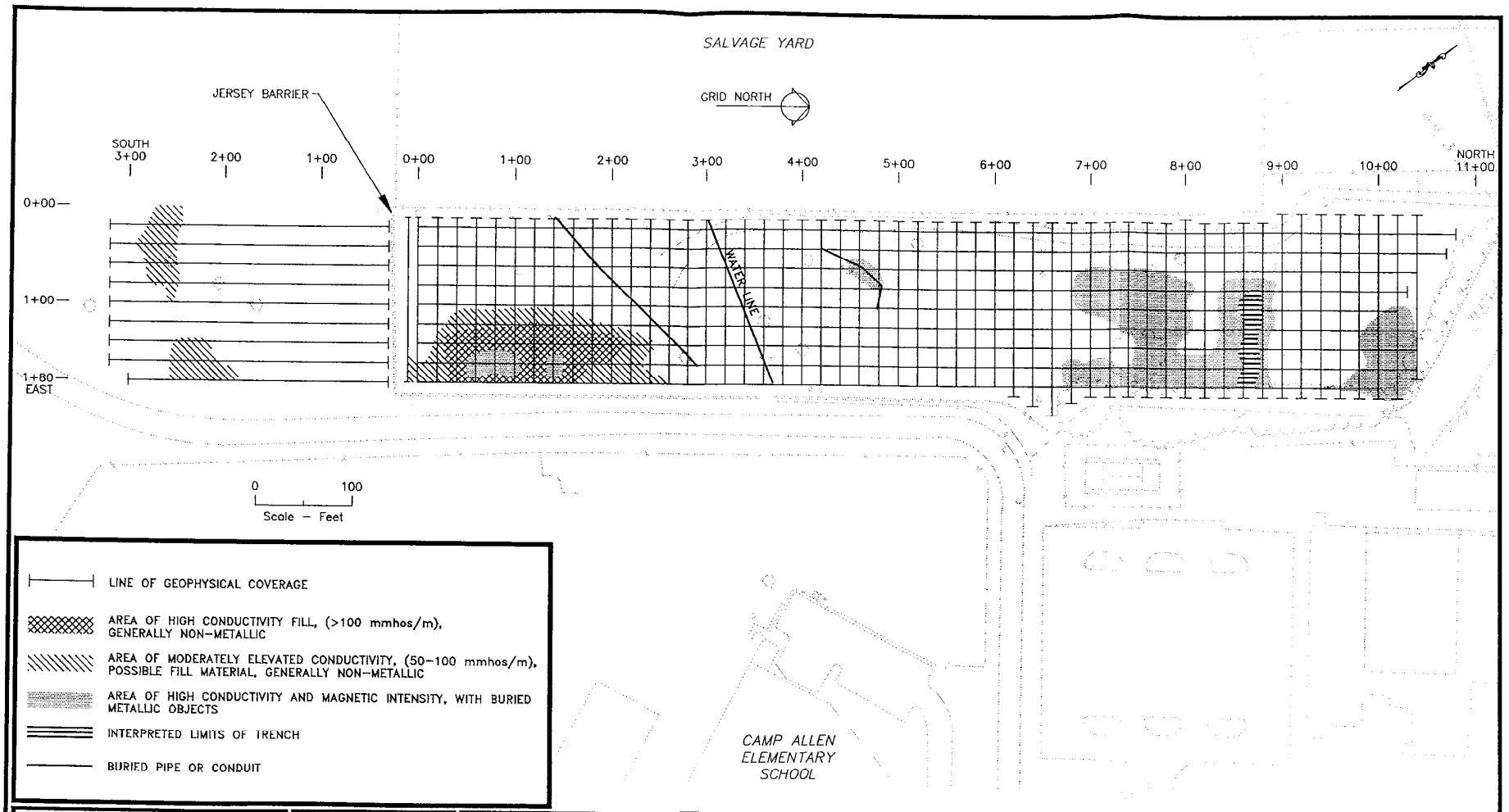
2.2.3 Site Summary

Source characterization activities at Area B, including a review of historical information and soil gas survey results (CH2M Hill, 1992), the geophysical survey conducted during the ongoing remedial investigation, and source characterization borings, indicate four areas of apparent disposal. These areas are best illustrated by the interpreted EM and magnetic results of the geophysical survey as shown on Figure 2-8.

The southeastern corner of Area B appears to be a concentrated pocket of high conductivity material, interpreted as fill, of a mostly nonmetallic nature. A soil sample collected from this location as part of the ongoing remedial investigation suggests that incinerator ash may have been disposed in this area. Within this portion of the site, however, are two smaller areas of high conductivity and magnetic intensity, with buried metallic objects. Soil taken from a disposal characterization boring placed near this area displayed low levels of tetrachloroethene and trichloroethene.

Toward the middle portion of Area B adjacent to the Salvage Yard, the geophysical survey detected an area of high conductivity and magnetic intensity, with buried metallic objects.

The third area of apparent disposal is the large area towards the northeastern end of Area B. This area is a zone of buried metallic objects which includes indications of trenching activities.



REVISIONS			
	DATE	4/93	GEOPHYSICAL INVESTIGATION CAMP ALLEN LANDFILL – AREA B NORFOLK, VIRGINIA PREPARED FOR BAKER ENVIRONMENTAL, INC
	SCALE	GRAPHIC	
	DRAWN	GLB	
	REVIEWED		WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania
	S.O.#	19084	
	CADD#	176-010	

Baker
Baker Environmental, Inc.
WESTON GEOPHYSICAL CORP. IS A WHOLLY OWNED SUBSIDIARY OF BAKER ENVIRONMENTAL, INC.

FIGURE 2-8
PRIMARY AREAS OF WASTE DISPOSAL
AREA B

SCALE GRAPHIC | DATE 4/93

FIGURE
2-8

Based on historical accounts of the Salvage Yard fire and subsequent trench and fill operations at Area B, fire wastes were apparently buried in trenches. The volatile and semivolatile organic compounds detected in this area during the ongoing remedial investigation were significant and may be associated with waste solvents or fuel oils. Pesticides and PCBs were also detected in Area B at levels which are below TSCA action levels but may indicate a potential source. Trenches were basically rectangular in shape and reportedly extended to a depth of approximately 8 feet below ground surface. On average, this is approximately 3 feet below the water table surface.

The fourth area of disposal is located at the northeast corner of Area B alongside the pond. This area has been identified as construction rubble, including concrete demolition debris.

Volatile organic compounds and metals have been detected in the shallow groundwater at Area B in excess of federal maximum contaminant levels (MCLs). Based on source characterization results, a strong correlation can be made to identified source areas of volatile contaminants and volatile constituents detected in the shallow groundwater.

2.3 Analytical Data

The following sections present the analytical results from Baker's ongoing Remedial Investigation. The results presented are limited to those pertinent to the removal action at Area B.

As anticipated from previous investigations, analytical results for volatiles, semivolatiles, pesticide/PCBs and metals confirmed that soils, sediment, surface water and groundwater located at and around the Area B landfill are impacted by past disposal operations. Many of the detected constituents associated with the aforementioned analyses have exceeded various Federal and/or State standards and guidelines. In general this contamination is largely attributed to past disposal practices and incineration activities in the Camp Allen Landfill area and off-site sources (i.e., Salvage Yard). This section will only address surface soils, subsurface soils and groundwater (water table), as these areas are of primary concern for the removal action.

2.3.1 Surface Soil

During the RI five surface soil samples were collected from the Area B landfill. Samples were analyzed for volatile organic compounds, semivolatile organic compounds, pesticide/PCB compounds and metals. Figures 2-9 and 2-10 present organic and inorganic constituents present in surficial soils, respectively. Tables 2-1 through 2-4 present a complete list of constituents detected and the corresponding concentration.

No volatile organic compounds other than common laboratory contaminants were detected.

Three surface soil samples contained semivolatile organic compounds at concentrations ranging from 17 µg/kg to 150 µg/kg. Total semivolatiles ranged in concentration from 256 µg/kg to 777 µg/kg.

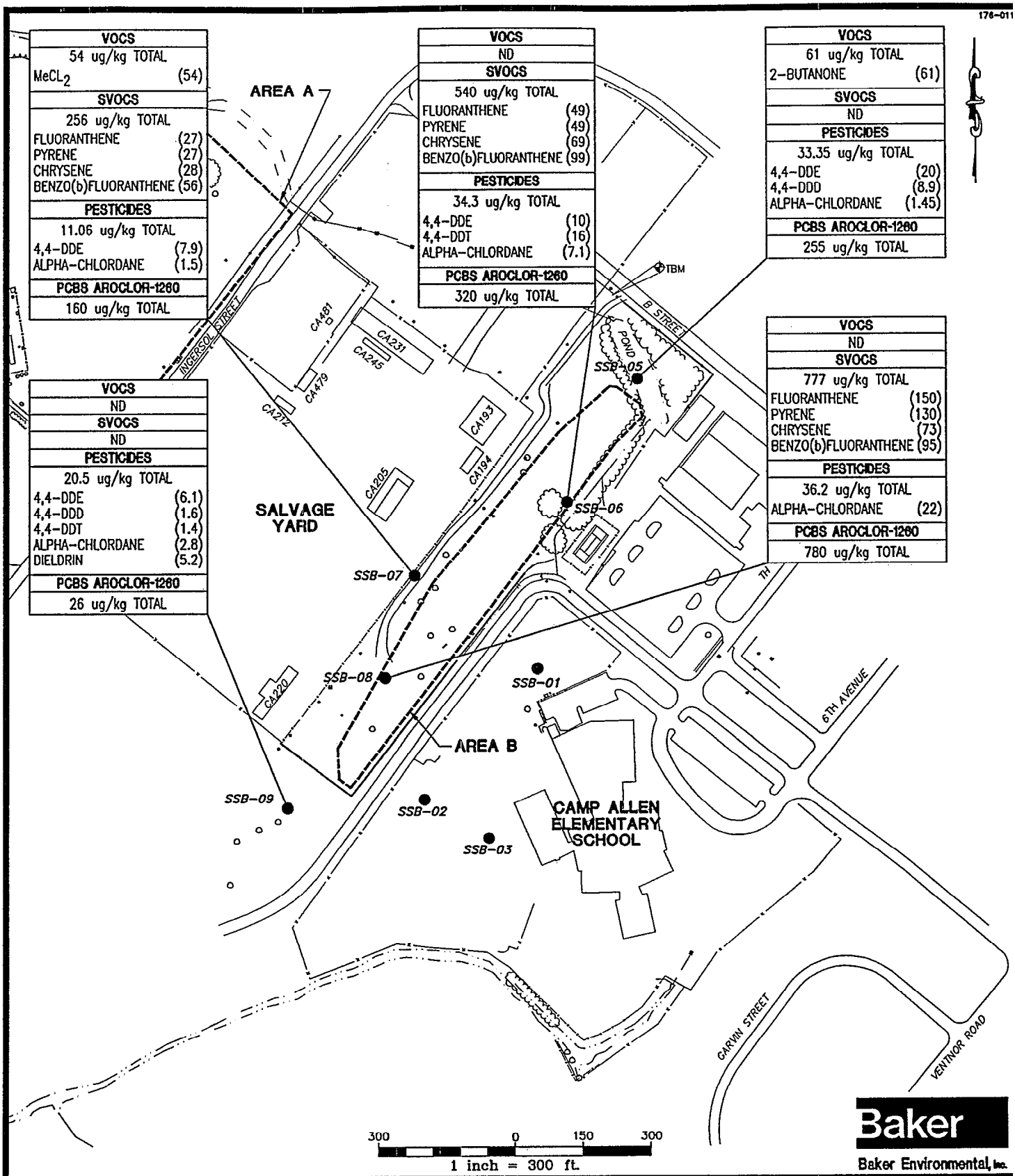
The pesticide/PCB compounds detected can be considered uniform throughout the surficial soils in Area B, as concentrations did not vary significantly. Pesticides were detected in all five surficial soil samples at concentrations ranging from 0.43 µg/kg to 22 µg/kg. Total pesticides ranged from 11.06 µg/kg to 36.2 µg/kg. In addition, all of the surficial soils in Area B contained pesticides, whereas only one subsurface soil sample (SBB-06) contained pesticide constituents which were significantly higher than other subsurface soil samples. The PCB Aroclor-1260 was detected in Area B surface soils.

Four samples collected in the immediate vicinity of Area B contained cadmium at concentrations ranging from 1.5 mg/kg to 20.5 mg/kg. Cadmium concentrations exceeded USGS background criteria in all four samples. No other metals exceeded background concentrations.

2.3.2 Source Characterization

Subsurface soil samples were collected from Area B and analyzed. A complete list of constituents detected and the corresponding concentrations are presented in Tables 2-5 through 2-8.

Source characterization sampling was performed in Area B as part of the ongoing RI efforts. Figure 2-11 presents soil boring locations at Area B. Source characterization analytical results for subsurface soil samples collected during the RI at Area B show:

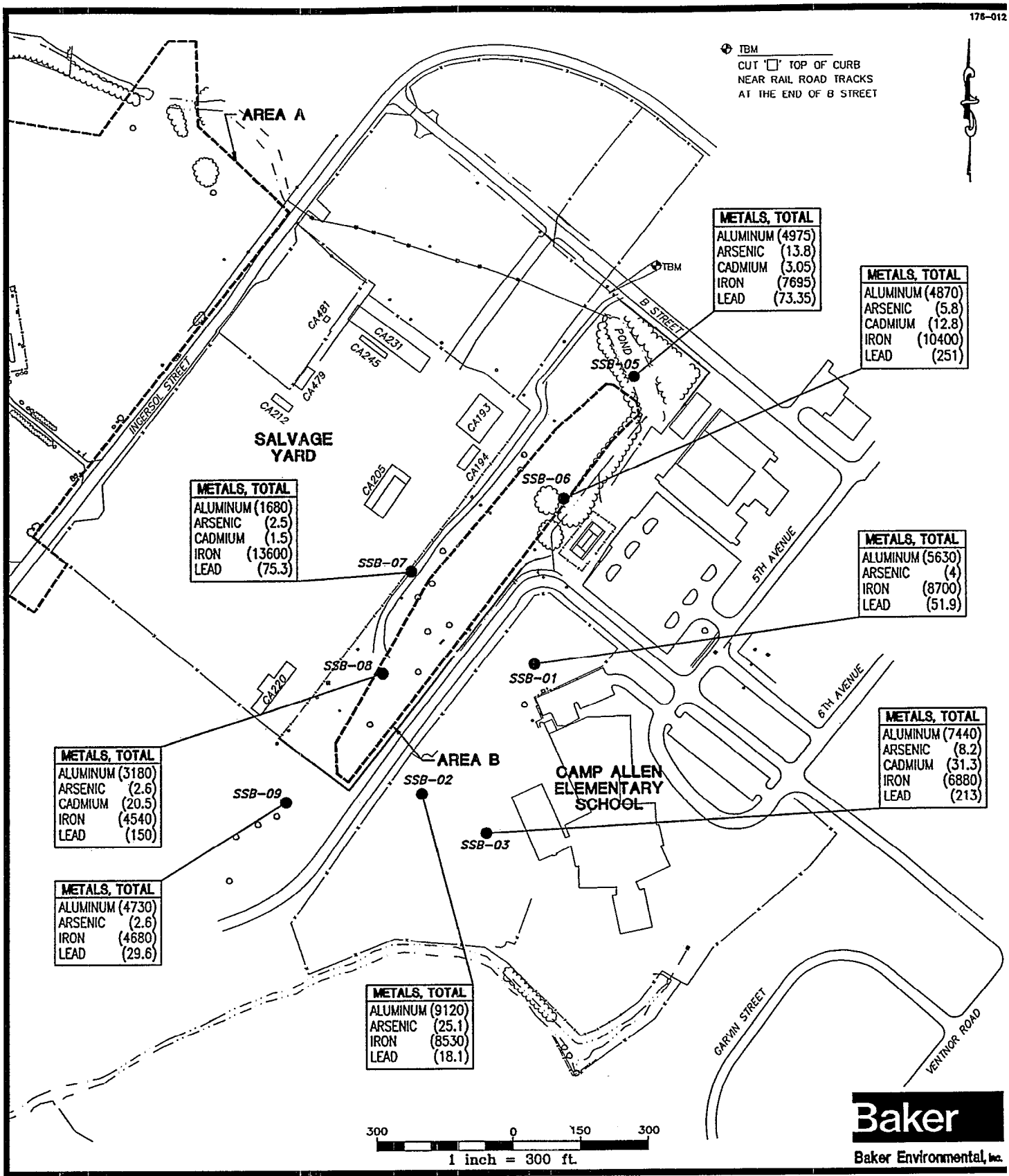


LEGEND

SSB-05 ●	SURFACE SOIL SAMPLE LOCATION
ug/kg	PARTS PER BILLION
PCB	POLYCHLORINATED BIPHENYLS
$MeCL_2$	METHYLENE CHLORIDE
SVOCS	SEMIVOLATILE ORGANIC COMPOUNDS
VOCS	VOLATILE ORGANIC COMPOUNDS
ND	NOT DETECTED

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-9
SURFACE SOIL SAMPLE RESULTS
(ORGANICS)
AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA



LEGEND

SSB-05 SURFACE SOIL SAMPLE LOCATION

NOTE: ALL RESULTS ARE PRESENTED IN mg/kg (ppm).

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-10
SURFACE SOIL SAMPLE RESULTS
(INORGANICS)
AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

TABLE 2-1
ROUND 3
SURFACE SOIL SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SSB-05DUP	SSB-06	SSB-07	SSB-08	SSB-09
Date collected	12/8/92	12/8/92	12/8/92	12/8/92	12/8/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Methylene chloride	17 U	11 U	54	14 U	11 U
2-butanone	61	11 U	11 U	14 U	11 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-2
ROUND 3
SURFACE SOIL SAMPLE RESULTS
SEMIVOLATILES, AREA B
CAMP ALLEN LANDFILL , NORFOLK, VIRGINIA

Sample No.	SSB-05 DUP	SSB-06	SSB-07	SSB-08	SSB-09
Date Collected	12/8/92	12/8/92	12/8/92	12/8/92	12/8/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Naphthalene	490 U	29 J	350 U	610 U	360 U
Phenanthrene	490 U	390 U	350 U	70 J	360 U
Fluoranthene	490 U	49 J	27 J	150 J	360 U
Pyrene	490 U	49 J	27 J	130 J	360 U
Butylbenzylphthalate	490 U	17 J	350 U	610 U	360 U
Benzo(a)anthracene	490 U	53 J	24 J	75 J	360 U
Chrysene	490 U	69 J	28 J	73 J	360 U
Benzo(b)fluoranthene	490 U	99 J	56 J	95 J	360 U
Benzo(k)fluoranthene	490 U	37 J	21 J	38 J	360 U
Benzo(a)pyrene	490 U	54 J	30 J	68 J	360 U
Indeno(1,2,3-cd)pyrene	490 UJ	45 J	24 J	38 J	360 UJ
Benzo(g,h,i)perylene	490 UJ	39 J	19 J	40 J	360 UJ

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-3
ROUND 3
SURFACE SOIL SAMPLE RESULTS
PESTICIDE/PCB, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample No.	SSB-05DUP	SSB-06	SSB-07	SSB-08	SSB-09
Date Collected	12/8/92	12/8/92	12/8/92	12/8/92	12/8/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Aldrin	2.45 UL	2 UL	0.79 J	5.8 L	1.8 U
Heptachlor epoxide	2.45 UL	2 UL	1.8 U	3 UL	1.5 J
Endosulfan I	1.9 J	1.2 J	0.44 J	8.4 L	1.8 U
Dieldrin	4.9 UL	3.9 UL	3.5 U	6.1 UL	5.2
4,4'-DDE	20 L	10 L	7.9	6.1 UL	6.1
4,4'-DDD	8.9 L	3.9 UL	3.5 U	6.1 UL	1.6 J
4,4'-DDT	4.9 UL	16 L	3.5 U	6.1 UL	1.4 J
Endrin ketone	1.62 UL	3.9 UL	3.5 U	6.1 UL	3.6 U
Alpha-Chlordane	1.45 J	7.1 L	1.5 J	22 L	2.8
Gamma-Chlordane	1.1 J	2 UL	0.43 J	3 UL	1.9
Aroclor-1260	255 L	320 L	160	780 L	26 J

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-4
ROUND 3
SURFACE SOIL SAMPLE RESULTS
METALS, TOTAL, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SSB-05DUP	SSB-06	SSB-07	SSB-08	SSB-09
Date collected	12/8/92	12/8/92	12/8/92	12/8/92	12/8/92
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	4975	4870	1680	3180	4730
Antimony	5.6 UL	3.7 UL	3.8 UL	4.8 UL	3.8 UL
Arsenic	13.8	5.8	2.5	2.6	2.6
Barium	17.65 J	33.2 J	1 U	44.4 J	1 U
Beryllium	0.33 U	0.22 U	0.22 U	0.28 U	0.22 U
Cadmium	3.05	12.8	1.5	20.5	0.9 U
Calcium	1600 J	31400 J	6580 J	1850 J	2950 J
Chromium	16.05	24.3	13.5	44.3	7.9
Cobalt	3.3 U	6.7	2.2 U	2.8 U	2.2 U
Copper	32.7	16.6	39.8	87.8	2 U
Iron	7695	10400	13600	4540	4680
Lead	73.35	251	75.3	150	29.6
Magnesium	14 U	14 U	14 U	14 U	14 U
Manganese	23.2	102	62	70.5	34
Mercury	0.355	0.17	0.16	0.77	0.12
Nickel	4.15	25.3	7.9	15.3	2.7 U
Potassium	192 U	192 U	192 U	192 U	192 U
Selenium	0.655 UL	0.43 UL	0.44 UL	0.55 UL	0.45 UL
Silver	0.84 U	0.84 U	0.84 U	0.84 U	0.67 U
Sodium	39 U	39 U	39 U	39 U	39 U
Thallium	0.33 U	0.23	0.22 U	0.28 U	0.22 U
Vanadium	18.6	18.6	11.3	19.8	10.2
Zinc	5	5	5	405	5

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-5
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-01RE	SBB-02	SBB-03	SBB-04	SBB-05
Date collected	5/19/92	5/19/92	5/19/92	5/19/92	5/19/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Vinyl chloride	18 UJ	11 U	12 U	40 U	16
Methylene chloride	18 UJ	11 U	12 U	40 U	12 U
Acetone	18 U	11 U	12 U	40 U	170 J
1,1-dichloroethane	18 UJ	11 U	12 U	40 U	12
1,2-dichloroethene	18 UJ	11 U	12 U	420	79
1,2-dichloroethane	18 UJ	11 U	12 U	25 J	12 U
2-butanone	18 UJ	11 U	12 U	40 U	12 U
1,1,1-trichloroethane	18 UJ	11 U	12 U	15 J	8 J
Trichloroethene	18 UJ	11 U	12 U	27 J	12 U
Benzene	18 UJ	11 U	12 U	250	26
T-1,3-dichloropropene	18 UJ	11 U	12 U	40 U	12 U
4-methyl-2-pentanone	18 UJ	11 U	12 U	250	120
Toluene	18 UJ	11 U	12 U	85	68
Ethylbenzene	18 UJ	11 U	12 U	40 U	12 U
Xylenes(total)	18 UJ	11 U	12 U	40 U	4 J

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-5
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-06	SBB-07	SBB-08	SBB-09	SBB-10 DUP
Date collected	5/18/92	5/18/92	5/18/92	5/18/92	5/18/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Vinyl chloride	15000 U	1500 U	12 U	11 U	12 U
Methylene chloride	15000 U	1500 U	200	11 U	12 U
Acetone	6000 J	1900	12 U	11 U	12 U
1,1-dichloroethane	15000 U	1500 U	12 U	11 U	12 U
1,2-dichloroethene	15000 U	4300	4 J	11 U	12 U
1,2-dichloroethane	15000 U	1500 U	12 U	11 U	12 U
2-butanone	10000 J	1500 U	12 U	11 U	12 U
1,1,1-trichloroethane	15000 U	1500 U	12 U	11 U	12 U
Trichloroethene	15000 U	3100	12 U	11 U	12 U
Benzene	15000 U	1500 U	12 U	11 U	12 U
T-1,3-dichloropropene	15000 U	1500 U	12 U	11 U	12 U
4-methyl-2-pentanone	15000 U	2200	61	11 U	12 U
Toluene	16000	1500 U	14	11 U	12 U
Ethylbenzene	30000	1500 U	12 U	11 U	12 U
Xylenes(total)	200000	1500 U	5 J	11 U	12 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-6
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
SEMIVOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-01	SBB-02	SBB-03	SBB-04	SBB-05
Date collected	5/19/92	5/19/92	5/19/92	5/19/92	5/19/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Bis(2-ethylhexyl)phthalate	580 U	380 U	410 U	400 U	390 U
Butylphthalate,di-n-	580 U	380 U	410 U	400 U	390 U
Dichlorobenzene,1,2-	580 U	380 U	410 U	400 U	390 U
Diethylphthalate	580 U	48 J	23 J	95 J	390 U
Methylnaphthalene,2-	580 U	380 U	410 U	400 U	390 U
Methylphenol,2-	580 U	380 U	410 U	400 U	390 U
Methylphenol,4-	580 U	380 U	410 U	400 U	390 U
Naphthalene	580 U	380 U	410 U	400 U	390 U
Phenanthrene	580 U	380 U	410 U	400 U	390 U
Phenol	580 U	380 U	410 U	25 J	390 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-6
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
SEMIVOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-06	SBB-07	SBB-08	SBB-09	SBB-10 DUP
Date collected	5/18/92	5/18/92	5/18/92	5/18/92	5/18/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Bis(2-ethylhexyl)phthalate	3900 UJ	2000 U	390 U	380 U	61 J
Butylphthalate,di-n-	830 J	2000 U	390 U	380 U	330 U
Dichlorobenzene,1,2-	6500	2000 U	390 U	380 U	390 U
Diethylphthalate	3900 U	2000 U	34 J	26 J	60 J
Methylnaphthalene,2-	3300 J	2000 U	390 U	380 U	390 U
Methylphenol,2-	3900 U	180 J	46 J	380 U	390 U
Methylphenol,4-	3900 U	650 J	390 U	380 U	390 U
Naphthalene	14000	2000 U	390 U	380 U	390 U
Phenanthrene	230 J	2000 U	390 U	380 U	390 U
Phenol	3900 U	13000	28 J	380 U	390 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-7
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
PESTICIDE/PCBS, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-01	SBB-02	SBB-03	SBB-04	SBB-05
Date collected	5/19/92	5/19/92	5/19/92	5/19/92	5/19/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Endosulfan I	2.9 U	1.9 U	2 U	2 U	2 U
Dieldrin	5.8 U	3.8 U	4.1 U	4 U	3.9 U
DDE,4,4'-	5.8 U	3.8 U	4.1 U	4 U	3.9 U
Endosulfan II	5.8 U	3.8 U	4.1 U	4 U	3.9 U
DDD,4,4'-	5.8 U	3.8 U	4.1 U	4 U	3.9 U
Endrin aldehyde	5.8 U	3.8 U	4.1 U	4 U	3.9 U
Aroclor-1254	58 U	38 U	41 U	40 U	39 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-7
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
PESTICIDE/PCBS, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-06	SBB-07	SBB-08	SBB-09	SBB-10 DUP
Date collected	5/18/92	5/18/92	5/18/92	5/18/92	5/18/92
Units	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Endosulfan I	78	2 U	2 U	1.9 U	1.95 U
Dieldrin	1500	3.9 U	3.9 U	3.8 U	4 U
DDE,4,4'-	14 J	3.9 U	3.9 U	3.8 U	4 U
Endosulfan II	17 J	3.9 U	3.9 U	3.8 U	4 U
DDD,4,4'-	3800	3.9 U	3.9 U	3.8 U	4 U
Endrin aldehyde	12 J	3.9 U	3.9 U	3.8 U	4 U
Aroclor-1254	9500	39 U	39 U	38 U	39 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
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L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-8
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
METALS, TOTAL, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-01	SBB-02	SBB-03	SBB-04	SBB-05
Date collected	5/19/92	5/19/92	5/19/92	5/19/92	5/19/92
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	14600	8200	3360	5050	6090
Antimony	8 L	4.1	4.4	4.5	4.3
Arsenic	60.5 J	2.2	5.7	0.98	1
Barium	1480	27	7	12.1	14.6
Beryllium	5.6	0.45	0.49	0.49	0.48
Cadmium	1.3	0.68	0.74	0.74	0.72
Calcium	9290	311	352	517	544
Chromium	24.9	8.6	6	7.5	6.4
Cobalt	16.2	1.8	2	2	1.9
Copper	63.6	3.8	2.1	2.8	3.1
Iron	22700	6530	3820	3340	3880
Lead	19.8 J	4.6	3.1	2.9	3.1
Magnesium	2180	487	399	438	358
Manganese	63.5 J	47.2	14.6	12.1	12.3
Mercury	0.68	0.1	0.12	0.13	0.13
Nickel	38.7	5.2	3.5	4.3	3.9
Potassium	2230	316	389	423	320
Selenium	5.7 J	0.47	0.5	0.48 UL	0.47
Silver	0.73 U	0.45	0.49	0.49	0.48
Sodium	1250	515	399	552	561
Thallium	2	0.47	0.45	0.65	0.64
Vanadium	149	12.8	10.2	9.5	9.3
Zinc	47.9 J	17.1	7.9	18.6	13.2

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
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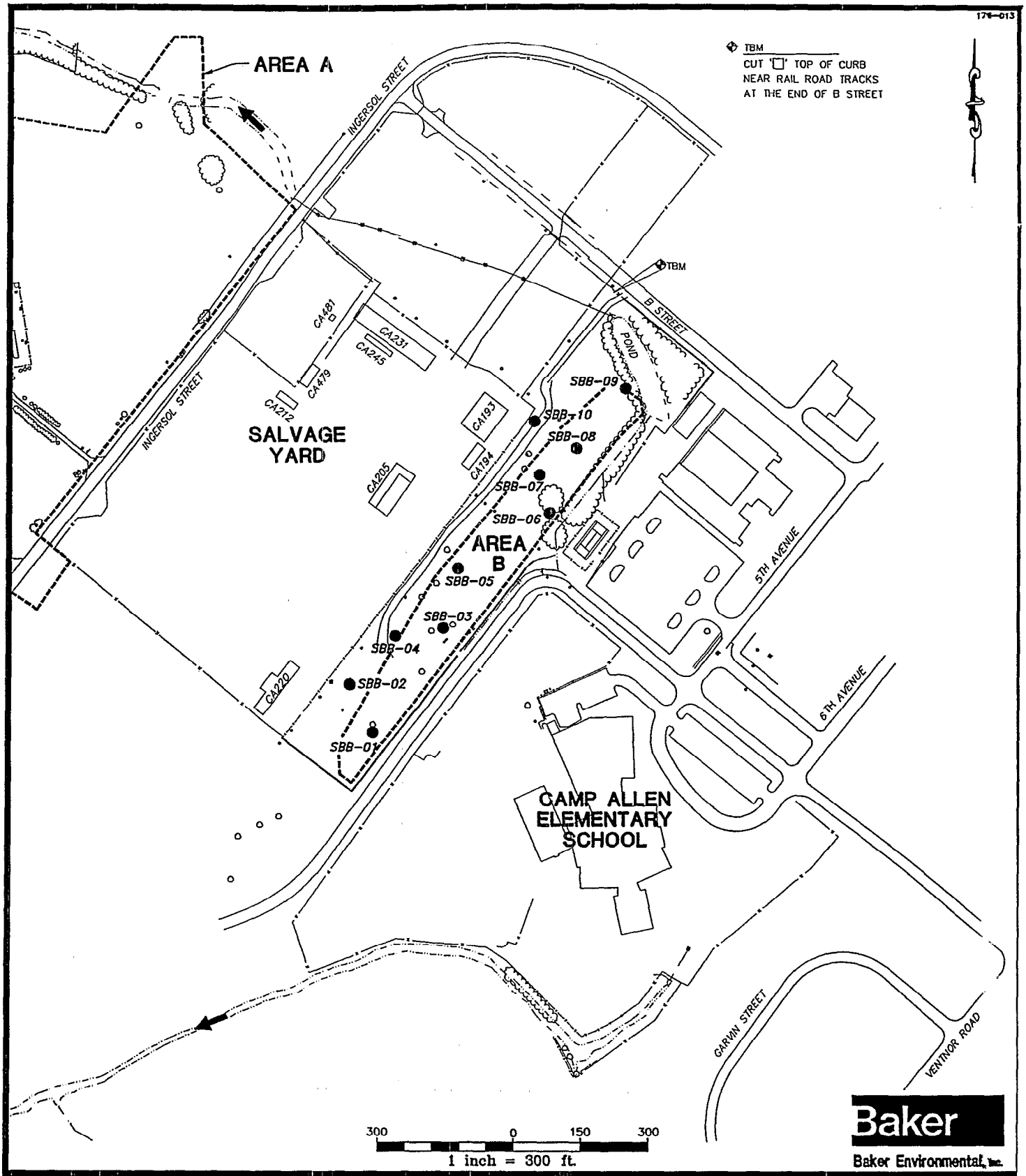
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-8
ROUND 2
SOURCE CHARACTERIZATION SUBSURFACE SOIL SAMPLE RESULTS
METALS, TOTAL, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Sample no.	SBB-06	SBB-07	SBB-08	SBB-09	SBB-10DUP
Date collected	5/18/92	5/18/92	5/18/92	5/18/92	5/18/92
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	10100	15500	3440	7140	9720
Antimony	4.2 UL	0.02	4.1	4	4.2 UL
Arsenic	0.78	2.5	0.66	1.1	1.4
Barium	32.9	41.9	9.5	19.2	30.45
Beryllium	0.47 U	0.49	0.46	0.44	0.47 U
Cadmium	0.7 U	0.73	0.69	0.67	0.705 U
Calcium	1240	782	361	302	499
Chromium	8 U	18.3	6.5	5.9	8 U
Cobalt	1.9 U	2	1.8	1.8	1.85 U
Copper	2 U	5.8	1.9	3.1	2 U
Iron	7150	13500	2010	3380	10145
Lead	6.2	8.6	2.1	5.5	6.55
Magnesium	432	938	314	477	577.5
Manganese	17.1	17.2	9.2 J	6.8	12.25
Mercury	0.12 U	0.11	0.1	0.1	0.115 U
Nickel	3.3	4.7	3.3	4.8	2.275
Potassium	451	682	276	329	355
Selenium	0.46 UL	0.48 UL	0.46	0.47	0.465 UL
Silver	0.47 U	0.49	0.46	0.44	0.47 U
Sodium	39 U	402	243	312	185.75
Thallium	1 U	0.5	0.59	0.56	1 U
Vanadium	4 U	26.6	6.2	10.4	4 U
Zinc	5.6	26	6	6.1	14.25

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.



LEGEND

SBB-01 ● SOURCE CHARACTERIZATION BORING LOCATION

← SURFACE WATER FLOW DIRECTION

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-11
SOURCE CHARACTERIZATION BORING LOCATIONS
AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

- Five of ten samples collected contained volatile organic compounds ranging in concentration from 4 µg/kg to 200,000 µg/kg. Total volatile concentrations ranged from 284 µg/kg to 262,000 µg/kg. The volatile organic compounds detected may be associated with waste solvents or fuel oils.

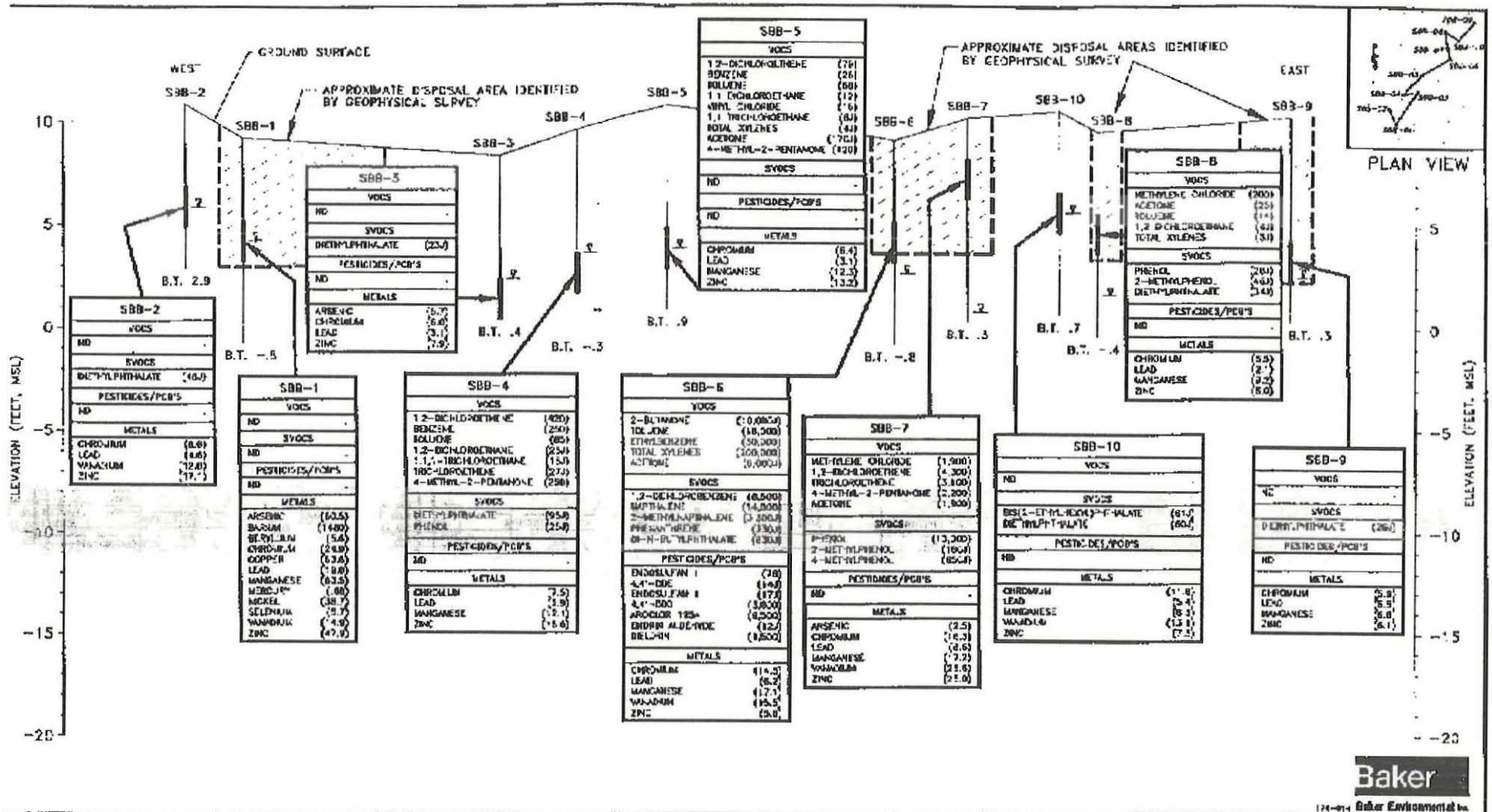
- Semivolatile organic compounds were detected in eight samples at concentrations ranging from 23 µg/kg to 120 µg/kg. Total semivolatiles ranged from 23 µg/kg to 14,000 µg/kg. The semivolatile organic compounds detected can be associated with plastics, heating or lubricating oil, products of combustion from organic material, and disinfectants.

- Pesticide compounds were detected in one sample (SBB-06) at concentrations ranging from 12 µg/kg to 3,800 µg/kg. This sample also contained 9,500 µg/kg of the PCB Aroclor-1254. Pesticide compounds were detected in this area at levels indicating a potential source. PCB compounds have been primarily used in transformers and capacitors as dielectric fluid. The occurrence and distribution of pesticide/PCB compounds suggests that SBB-06 is most likely one of the primary areas in which trench and fill operations occurred.

- Cadmium exceeded the USGS background criteria of 1.0 mg/kg in one sample (SBB-01, 1.3 mg/kg). The occurrence and distribution of cadmium can probably be attributed to wide dispersal at varying concentrations throughout the soils in the Camp Allen area. No other metals exceeded available USGS background criteria concentrations. Commonly detected metals included arsenic, chromium, lead and zinc.

In evaluating the aforementioned detections and considering the locations of the subsurface soil samples, one area (vicinity of SBB-06) is of particular concern as it contained significant concentrations of volatile and semivolatile organics and inorganics (metals).

Concentrations of volatiles, semivolatiles, pesticides/PCBs, and metals in subsurface soils at Area B are depicted on Figure 2-12. The distribution pattern of volatiles, semivolatiles, and pesticide/PCB compounds appears to be concentrated in two sections of Area B comprised of three sample locations (SBB-04 and SBB-06/SBB-07). Boring location SBB-04 is located adjacent to the Salvage Yard in an area where underground utilities cross Area B toward the southeast.



SBB-2	
VOCs	
ND	-
SVOCs	
DIETHYLPHTHALATE	(40J)
PESTICIDES/PCB'S	
ND	-
METALS	
CHROMIUM	(8.8)
LEAD	(4.6)
VANADIUM	(12.8)
ZINC	(19.4)

SBB-1	
VOCs	
ND	-
SVOCs	
ND	-
PESTICIDES/PCB'S	
ND	-
METALS	
ARSENIC	(63.5)
BARIUM	(1480)
BERYLLIUM	(5.6)
CHROMIUM	(248)
COPPER	(63.6)
LEAD	(198)
MANGANESE	(63.5)
MERCURY	(.68)
NICKEL	(38.7)
SELENIUM	(5.7)
VANADIUM	(74.9)
ZINC	(47.9)

SBB-3	
VOCs	
ND	-
SVOCs	
DIETHYLPHTHALATE	(23J)
PESTICIDES/PCB'S	
ND	-
METALS	
ARSENIC	(5.7)
CHROMIUM	(6.6)
LEAD	(3.1)
ZINC	(17.9)

SBB-4	
VOCs	
1,2-DICHLOROETHENE	(420)
BENZENE	(250)
TOLUENE	(85)
1,2-DICHLOROETHANE	(25J)
1,1,1-TRICHLOROETHANE	(15J)
TRICHLOROETHENE	(27J)
4-METHYL-2-PENTANONE	(250)
SVOCs	
DIETHYLPHTHALATE	(95J)
PHENOL	(25J)
PESTICIDES/PCB'S	
ND	-
METALS	
CHROMIUM	(7.5)
LEAD	(3.9)
MANGANESE	(12.1)
ZINC	(15.6)

SBB-5	
VOCs	
1,2-DICHLOROETHENE	(79)
BENZENE	(26)
TOLUENE	(68)
1,1 DICHLOROETHANE	(12)
VINYL CHLORIDE	(16)
1,1 TRICHLOROETHANE	(8J)
TOTAL XYLENES	(4J)
ACETONE	(170J)
4-METHYL-2-PENTANONE	(120)
SVOCs	
ND	-
PESTICIDES/PCB'S	
ND	-
METALS	
CHROMIUM	(6.4)
LEAD	(3.1)
MANGANESE	(12.3)
ZINC	(13.2)

SBB-6	
VOCs	
2-BUTANONE	(10,000J)
TOLUENE	(18,000)
ETHYLBENZENE	(50,000)
TOTAL XYLENES	(300,000)
ACETONE	(9,000J)
SVOCs	
1,2-DICHLOROBENZENE	(8,500)
NAPTHALENE	(14,000)
2-METHYLNAPHTHALENE	(3,200J)
PHENANTHRENE	(330J)
DI-N-BUTYLPHTHALATE	(230J)
PESTICIDES/PCB'S	
ENDOSULFAN I	(78)
4,4'-DDE	(140)
ENDOSULFAN II	(17J)
4,4'-DDD	(3,600)
AROCLOR 1254	(8,500)
ENDRIN ALDEHYDE	(12J)
DIELDRIN	(1,600)
METALS	
CHROMIUM	(14.5)
LEAD	(8.2)
MANGANESE	(17.1)
VANADIUM	(15.5)
ZINC	(58)

SBB-7	
VOCs	
METHYLENE CHLORIDE	(1,900)
1,2-DICHLOROETHENE	(4,300)
TRICHLOROETHENE	(3,100)
4-METHYL-2-PENTANONE	(2,200)
ACETONE	(1,900)
SVOCs	
PHENOL	(13,300)
2-METHYLPHENOL	(180J)
4-METHYLPHENOL	(850J)
PESTICIDES/PCB'S	
ND	-
METALS	
ARSENIC	(2.5)
CHROMIUM	(16.3)
LEAD	(6.6)
MANGANESE	(17.2)
VANADIUM	(25.6)
ZINC	(25.0)

SBB-8	
VOCs	
METHYLENE CHLORIDE	(300)
ACETONE	(25)
TOLUENE	(1)
1,2 DICHLOROETHANE	(4J)
TOTAL XYLENES	(3J)
SVOCs	
PHENOL	(20J)
2-METHYLPHENO..	(46J)
DIETHYLPHTHALATE	(34J)
PESTICIDES/PCB'S	
ND	-
METALS	
CHROMIUM	(5.5)
LEAD	(2.)
MANGANESE	(9.2)
ZINC	(5.0)

SBB-10	
VOCs	
ND	-
SVOCs	
BIS(2-ETHYLHEXYL)PHTHALATE	(61J)
DIETHYLPHTHALATE	(60J)
PESTICIDES/PCB'S	
ND	-
METALS	
CHROMIUM	(11.8)
LEAD	(3.4)
MANGANESE	(8.3)
VANADIUM	(13.8)
ZINC	(7.5)

SBB-9	
VOCs	
ND	-
SVOCs	
DIETHYLPHTHALATE	(26J)
PESTICIDES/PCB'S	
ND	-
METALS	
CHROMIUM	(5.9)
LEAD	(5.5)
MANGANESE	(5.8)
ZINC	(6.1)

LEGEND

- GROUNDWATER ENCOUNTERED DURING DRILLING
- B.T. X' — BORING TERMINATED, ELEVATION MSL
- SAMPLE LOCATION
- VOCs — VOLATILE ORGANIC COMPOUNDS
- SVOCs — SEMI VOLATILE ORGANIC COMPOUNDS
- ND — NOT DETECTED
- ALL UNITS IN ug/kg EXCEPT METALS (mg/kg)

Horizontal Scale: 1 inch = 90 ft.

Vertical Scale: 1 inch = 5 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 2-12
SOURCE CHARACTERIZATION SAMPLE RESULTS
AREA B
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

Borings SBB-06 and SBB-07 are located within the primary disposal area identified in the geophysical survey report. The significant detections of organic compounds further support that this location probably received the bulk of the wastes from the Salvage Yard fire.

Significant detections of inorganic compounds appear to be concentrated in the area of boring location SBB-01, in the southwestern corner of Area B. Based on the geophysical survey results, this was another suspected disposal area containing pockets of metallic fill material surrounded by high conductivity nonmetallic fill.

2.3.3 Groundwater (Shallow)

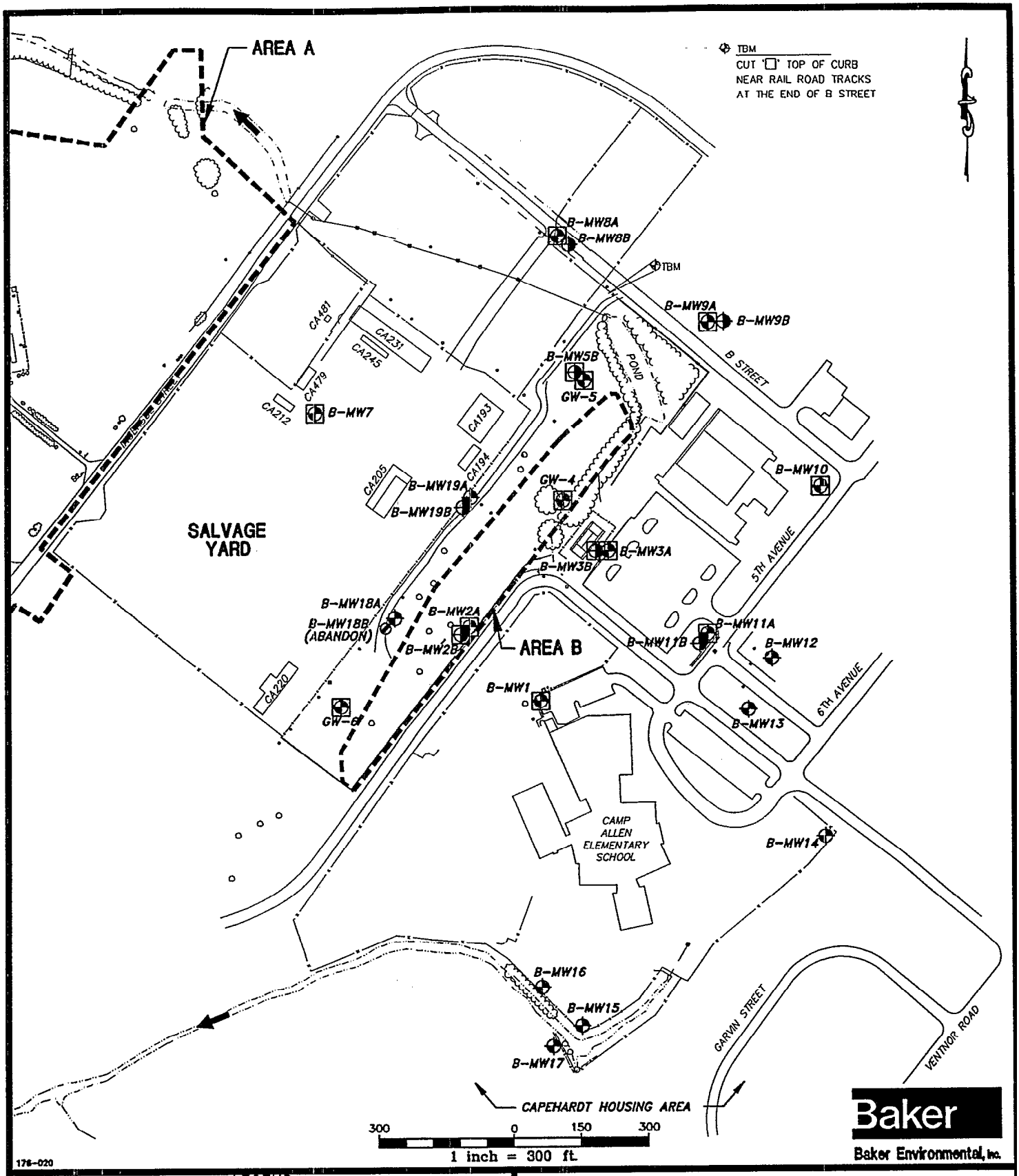
The locations of monitoring wells in the vicinity of Area B are shown on Figure 2-13. A complete list of constituents detected and the corresponding concentrations are presented in Tables 2-9 through 2-13. Distribution of volatile organic compounds at Area B show the highest concentrations at the northeastern portion of Area B and southeast of Area B, along (or adjacent to) utility conduits beneath C Street. Constituents include trichloroethene, vinyl chloride, BTEX, ketones, and chlorobenzene.

Semivolatile organic compounds at Area B in the shallow groundwater include phenols, phthalates, several different PAHs, ethers, and dichlorobenzene.

Pesticides at Area B were detected at several locations at concentrations exceeding MCLs (western portion of Area B and southeast of Area B). However, detected constituents and their respective concentrations suggest it is likely that these are related to regional land applications rather than site-specific causes.

Elevated total metal constituent concentrations, exceeding applicable water quality standards, were detected in three primary areas in the shallow groundwater at the Camp Allen Landfill Area B. Two of the areas appear to be related to the Salvage Yard. The third location appears to be originating from beneath the Capehardt housing area (see Figure 2-13). Based on historical information, Salvage Yard operations and soil borrow activities in the Capehardt housing areas are likely sources.

In summary, volatile and semivolatile organic contaminants and inorganic (metal) contaminants identified in the shallow groundwater are generally concentrated in suspected



LEGEND

- A-MW8B — EXISTING DEEP MONITORING WELL
- A-MW1C — NEWLY INSTALLED DEEP MONITORING WELL
- A-MW7 — EXISTING SHALLOW MONITORING WELL
- B-20WSS — NEWLY INSTALLED SHALLOW MONITORING WELL
- A-MW20B — ABANDONED BORING
- STREAM FLOW DIRECTION
- LIMITS OF AREA A AND AREA B LANDFILL

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-13
MONITORING WELL LOCATIONS
AREA B
CAMP ALLEN LANDFILL

NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

TABLE 2-9
ROUND 2
GROUNDWATER SHALLOW SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW13	B-MW12	B-MW11A	B-MW3A	B-MW7	B-MW10
Date collected	6/11/92	6/11/92	6/11/92	6/11/92	6/10/92	6/10/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Vinyl chloride	10 U	10 U	940 J	300	10 U	10 U
1,1-dichloroethene	10 U	10 U	120 U	37	10 U	10 U
1,1-dichloroethane	10 U	10 U	120 U	89	10 U	10 U
1,2-dichloroethene	10 U	10 U	1600	460	10 U	10 U
1,2-dichloroethane	10 U	10 U	58 J	180	10 U	10 U
1,1,1-trichloroethane	10 U	10 U	120 U	30 J	10 U	10 U
Trichloroethene	10 U	10 U	44 J	520	10 U	10 U
Benzene	10 U	10 U	29 J	410	10 U	10 U
Tetrachloroethene	10 U	10 U	120 U	8 J	10 U	10 U
Chlorobenzene	10 U	10 U	120 U	33 U	10 U	10 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-9
ROUND 2
GROUNDWATER SHALLOW SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW9A	B-MW8A	GW-5	GW-4	B-MW2A	GW-6
Date collected	6/10/92	6/10/92	6/13/92	6/13/92	6/12/92	6/12/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Vinyl chloride	10 U	10 U	10 U	420 U	10 U	10 U
1,1-dichloroethene	10 U	10 U	10 U	420 U	10 U	10 U
1,1-dichloroethane	10 U	10 U	3 J	420 U	10 U	10 U
1,2-dichloroethene	10 U	10 U	10 U	420 U	10 U	10 U
1,2-dichloroethane	10 U	10 U	10 U	420 U	6 J	10 U
1,1,1-trichloroethane	10 U	10 U	10 U	420 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U	420 U	3 J	10 U
Benzene	10 U	10 U	10 U	420 U	10 U	10 U
Tetrachloroethene	10 U	10 U	10 U	420 U	10 J	10 U
Chlorobenzene	10 U	10 U	10 U	420 U	10 UJ	10 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-9
ROUND 2
GROUNDWATER SHALLOW SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW1	B-MW14	B-MW15	B-MW16	B-MW17
Date collected	6/11/92	6/14/92	6/14/92	6/14/92	6/14/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L
Vinyl chloride	10 U	10 U	370	10 U	10 U
1,1-dichloroethene	10 U	10 U	51	10 U	10 U
1,1-dichloroethane	10 U	10 U	33 U	10 U	10 U
1,2-dichloroethene	10 U	10 U	418	10 U	10 U
1,2-dichloroethane	2 J	10 U	120	10 U	10 U
1,1,1-trichloroethane	10 U	10 U	33 U	10 U	10 U
Trichloroethene	10 U	10 U	510	10 U	10 U
Benzene	10 U	10 U	20 J	10 U	10 U
Tetrachloroethene	10 U	10 U	33 U	10 U	10 U
Chlorobenzene	48	10 U	33 U	10 U	10 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-9
ROUND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	GW-4	B-MW12	B-MW13	B-MW14	B-MW15
Date collected	12/14/92	12/14/92	12/14/92	12/14/92	12/14/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L
Vinyl chloride	100 U	2 U	2 U	2 U	315
Acetone	1250	10 U	10 U	10 U	57 J
1,1-dichloroethene	100 U	2 U	2 U	2 U	32.5
1,2-dichloroethene	100 U	2 U	2 U	2 U	230
1,2-dichloroethane	100 U	2 U	2 U	2 U	62
Trichloroethene	100 U	2 U	2 U	2 U	230
Benzene	100 U	2 U	2 U	2 U	11 J
4-methyl-2-pentanone	525 J	10 U	10 U	10 U	100 U
Tetrachloroethene	100 U	2 U	2 U	2 U	20 U
Ethylbenzene	100 U	2 U	2 U	2 U	20 U
Xylenes(total)	115 J	2 U	2 U	2 U	20 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-9
ROUND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
VOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW16	B-MW17	B-MW18A	B-MW19A
Date collected	12/14/92	12/16/92	12/16/92	12/16/92
Units	ug/L	ug/L	ug/L	ug/L
Vinyl chloride	2	2 U	2 U	4 U
Acetone	10 U	10 U	10 U	18 U
1,1-dichloroethene	2 U	2 U	2 U	4 U
1,2-dichloroethene	1 J	2 U	2 U	4 U
1,2-dichloroethane	2 U	2 U	2 U	4 U
Trichloroethene	2 U	2 U	2 U	4 U
Benzene	2 U	2 U	2 U	4 U
4-methyl-2-pentanone	10 U	10 U	10 U	18 U
Tetrachloroethene	2 U	2 U	4	4 U
Ethylbenzene	2 U	2 U	2 U	18
Xylenes(total)	2 U	2 U	2 U	140

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-10
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
SEMIVOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW13	B-MW12	B-MW11A	B-MW3A	B-MW7	B-MW10	B-MW9A
Date collected	6/11/92	6/11/92	6/11/92	6/11/92	6/10/92	6/10/92	6/10/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acenaphthene	10 U	10 U	2 J	10 U	76	10 U	10 U
Bis(2-chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	10 UJ	10 UJ	10 U	10 U	10 U	10 UJ	10 U
Dibenzofuran	10 U	10 U	10 U	10 U	7 J	10 U	10 U
Dichlorobenzene,1,2-	10 U	10 U	16	3 J	10 U	4 J	10 U
Dichlorobenzene,1,4-	10 U	10 U	3 J	2 J	10 U	10 U	10 U
Diethylphthalate	0.6 J	10 U	1 J	2 J	1 J	10 U	0.9 J
Dimethylphenol,2,4-	10 U	10 U	0.6 J	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	0.5 J	10 U	10 U
Methylnaphthalene,2-	10 U	10 U	10 U	2 J	10 U	10 U	10 U
Methylphenol,4-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	4 J	1 J	10 U	10 U
Nitrosodiphenylamine,N-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Oxybis(1-chloropropane),2,2'-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	0.7 J	6 J	10 U	10 U	10 U
Pyrene	10 UJ	10 UJ	10 U	10 U	0.8 J	10 UJ	10 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-10
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
SEMIVOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW8A	GW-5	GW-4	B-MW2A	GW-6	B-MW1	B-MW14
Date collected	6/10/92	6/13/92	6/13/92	6/12/92	6/12/92	6/11/92	6/14/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	10 U	2 J	2 J	10 UJ	10 UJ	10 U	2 J
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorobenzene,1,2-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dichlorobenzene,1,4-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	0.7 J	10 U	10 U	0.7 J	10 U	10 U	10 U
Dimethylphenol,2,4-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylnaphthalene,2-	10 U	10 U	0.6 J	10 U	10 U	10 U	10 U
Methylphenol,4-	10 U	10 U	13	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	3 J	10 U	10 U	10 U	10 U
Nitrosodiphenylamine,N-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Oxybis(1-chloropropane),2,2'-	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenanthrene	10 U	10 U	0.9 J	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	14	0.6 J	0.6 J	5.4 J	10 U
Pyrene	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
J = Analyte present. Reported value may not be accurate or precise.
L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.
K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-10
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
SEMIVOLATILES, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW15	B-MW16	B-MW17	B-MW18A	B-MW19A
Date collected	6/14/92	6/14/92	6/14/92	12/16/92	12/16/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L
Acenaphthene	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroethyl)ether	8 J	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	5 J	10 U	1.45 J	10 U	10 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U
Dichlorobenzene,1,2-	10 U	10 U	10 U	10 U	10 U
Dichlorobenzene,1,4-	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U
Dimethylphenol,2,4-	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U
Methylnaphthalene,2-	10 U	10 U	10 U	10 U	8 J
Methylphenol,4-	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	2 J
Nitrosodiphenylamine,N-	1 J	10 U	10 U	10 U	10 U
Oxybis(1-chloropropane),2,2'-	4 J	10 U	10 U	10 U	10 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	5.35 J	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected, quantitation may be inaccurate or imprecise.

UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

L = Analyte present. Reported value may be biased low. Actual value is expected to be higher.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-11
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
PESTICIDE/PCBS, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW18A	B-MW19A	B-MW13	B-MW12	B-MW11A	B-MW3A	B-MW7
Date collected	12/16/92	12/16/92	6/11/92	6/11/92	6/11/92	6/11/92	6/10/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
BHC,alpha-	0.05 UL	0.05 UL	0.05 U	0.05 U	0.05 U	0.005 J	0.05 U
BHC,delta-	0.05 UL	0.05 UL	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
BHC,gamma-	0.05 UL	0.05 UL	0.05 U	0.05 U	0.05 U	0.15	0.05 U
Heptachlor epoxide	0.05 UL	0.05 UL	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Dieldrin	0.022 J	0.1 UL	0.1 U	0.009 J	0.1 U	0.043 J	0.1 U
DDE,4,4'-	0.1 UL	0.1 UL	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Endrin	0.1 UL	0.1 UL	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
DDD,4,4'-	0.1 UL	0.1 UL	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
DDT,4,4'-	0.1 UL	0.1 UL	0.1 U	0.015 J	0.1 U	0.1 U	0.1 U
Endrin aldehyde	0.1 UL	0.1 UL	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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TABLE 2-11
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
PESTICIDE/PCBS, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW10	B-MW9A	B-MW8A	GW-5	GW-4	B-MW2A	GW-6
Date collected	6/10/92	6/10/92	6/10/92	6/13/92	6/13/92	6/12/92	6/12/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
BHC,alpha-	0.05 UL	0.05 U	0.05 U	0.05 UL	0.05 UL	0.05 U	0.05 U
BHC,delta-	0.05 U	0.05 U	0.05 U	0.05 UL	0.014 J	0.05 U	0.05 U
BHC,gamma-	0.05 U	0.05 U	0.05 U	0.05 UL	0.05 UL	0.05 U	0.05 U
Heptachlor epoxide	0.05 U	0.006 J	0.05 U	0.005 J	0.05 UL	0.05 U	0.05 U
Dieldrin	0.94 L	0.1 U	0.1 U	0.1 UL	0.1 U	0.007 J	0.1 U
DDE,4,4'-	0.1 UL	0.1 U	0.1 U	0.1 UL	0.047 J	0.1 U	0.1 U
Endrin	0.031 J	0.1 U	0.1 U	0.1 UL	0.1 UL	0.1 U	0.1 U
DDD,4,4'-	0.1 UL	0.1 U	0.1 U	0.1 UL	0.14	0.1 U	0.1 U
DDT,4,4'-	0.1 UL	0.1 U	0.1 U	0.1 UL	0.1 R	0.1 U	0.1 U
Endrin aldehyde	0.1 UL	0.1 U	0.1 U	0.1 UL	0.009 J	0.1 U	0.1 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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UL = Not detected, quantitation limit is probably higher.

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K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-11
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
PESTICIDE/PCBS, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW1	B-MW14	B-MW15	B-MW16	B-MW17
Date collected	6/10/92	6/14/92	6/14/92	6/14/92	6/14/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L
BHC,alpha-	0.05 UL	0.05 UL	0.05 UL	0.05 UL	0.05 UL
BHC,delta-	0.05 UL	0.05 UL	0.05 UL	0.05 UL	0.05 UL
BHC,gamma-	0.05 UL	0.05 UL	0.05 UL	0.05 UL	0.05 UL
Heptachlor epoxide	0.05 UL	0.05 UL	0.05 UL	0.05 UL	0.05 UL
Dieldrin	0.1 UL	0.1 UL	0.1 UL	0.1 UL	0.1 UL
DDE,4,4'-	0.1 UL	0.1 UL	0.1 UL	0.1 UL	0.0135 J
Endrin	0.1 UL	0.1 UL	0.1 UL	0.1 UL	0.1 UL
DDD,4,4'-	0.1 UL	0.1 UL	0.1 UL	0.1 UL	0.1 UL
DDT,4,4'-	0.1 UL	0.1 U	0.1 U	0.1 UL	0.075 UL
Endrin aldehyde	0.1 UL	0.1 UL	0.1 UL	0.1 UL	0.1 UL

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected, quantitation may be inaccurate or imprecise.
UL = Not detected, quantitation limit is probably higher.
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K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-12
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
METALS, TOTAL, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW13	B-MW12	B-MW11A	B-MW3A	B-MW2A	GW-6	B-MW14
Date collected	6/11/92	6/11/92	6/11/92	6/11/92	6/12/92	6/12/92	6/14/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	162000	51100	88800	8230	63900	37600	93000 J
Antimony	18 UL	18 UL	18 UL	18 UL	18 UL	18 UL	18 U
Arsenic	27.2 L	20 L	32 L	2 U	24.1 L	2 U	10.2
Barium	296	210	228	46.1	176	255	194
Beryllium	6.3	2.3	4.1	2 U	3.3	2 U	2 U
Cadmium	17.8	3 U	3 U	3 U	3 U	3 U	3 U
Calcium	44900	35900	12000	98800	18700	108000	53500
Chromium	244 K	8 U	141 K	8 U	8 U	8 U	166
Cobalt	37.1	15.2	14.6	8 U	25.8	8 U	8 U
Copper	110	50.6	59.2	2 U	38.1	37.7	51
Iron	249000	86700	183000	23200	64700	51500	108000
Lead	92.5	60.2	44.8	1 U	38.5	35	61.2
Magnesium	27600	19600	32500	19100	14900	16000	17200
Manganese	810 K	889 K	906 K	1270 K	865 K	805 K	381
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	68.2	23.9	27.6	11 U	37.5	17.5	11 U
Potassium	16400	8160	12200	8030	7960	8680	10600 J
Silver	2.4	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	12900	12500	62300	36100	19000	15500	7860
Vanadium	596 K	267 K	297 K	22.4 K	175 K	110 K	356
Zinc	393 K	355 K	231 K	168 K	331 K	206 K	193 J

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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TABLE 2-12
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
METALS, TOTAL, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW15	B-MW16	GW-5	GW-4	B-MW7	B-MW10	B-MW9A
Date collected	6/14/92	6/14/92	6/13/92	6/13/92	6/10/92	6/10/92	6/10/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	127000	24500 J	3040 J	6660 J	192000	22800	2650
Antimony	18 U	18 U	18 U	21.6 L	28.7	18 U	18 U
Arsenic	16.1 J	7.6	26.6	22.6 L	17	11.6	2 U
Barium	253	145	614	71.2 J	704	78.3	59.3
Beryllium	2 U	2 U	2 U	2 U	6.7	2 U	2 U
Cadmium	3 U	3 U	6.3	3 U	10.9	3 U	3 U
Calcium	60400	126000	161000	126000	192000	15400	26400
Chromium	213	32.6	96.2	82.1	264	8 U	8 U
Cobalt	8 U	8 U	8 U	8 U	8 U	8 U	8 U
Copper	65	17	14	13.6	339	14.7	11.7
Iron	147000	19900 J	178000	15600	119000	26200	7940
Lead	41.3	11.4	1 U	23.2	1020	6.1 K	1
Magnesium	53100	20800	6000	9400	45800	6920	7250
Manganese	1690	182	268	262	907	164	831
Mercury	0.27	0.34	0.2 UL	0.2 UL	1.6	0.2 U	0.2 U
Nickel	11 U	11 U	11 U	11 U	107	12.4	11 U
Potassium	15400 J	6970 J	5230	13700	39200	4280	3040
Silver	2 U	2	2 U	2 U	2 U	2 U	2 U
Sodium	222000	54500	33300	72400	56300	17600	23700
Vanadium	359	4 U	38	45.5	461	58.2	4 U
Zinc	266 J	96 J	5 U	100	1550 J	5 U	5 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-12
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
METALS, TOTAL, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW8A	B-MW1	B-MW17	B-MW18A	B-MW19A
Date collected	6/10/92	6/11/92	6/14/92	12/16/92	12/16/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	905	135500	610000	135000	83000
Antimony	18 U	18 UL	18 U	17 U	17 U
Arsenic	93.6	24.4 L	10 U	15	8.5
Barium	35.6	279	1740	389 J	230 J
Beryllium	2 U	6.5	18.5	1 U	1 U
Cadmium	3 U	2.25	10	4 U	4 U
Calcium	37800	105100	74100	31000	90500
Chromium	8 U	217.5 K	774.5	165	98
Cobalt	8 U	33.4	202.5	29.7	22.6
Copper	5.9	76.65	380	100	39.2
Iron	33500	162000	734500	106000	61900
Lead	1 U	54.4	312	70.8	26.2
Magnesium	8340	53550	126500	18200	15900
Manganese	152	1815 K	4880	591	573
Mercury	0.2 U	0.16	3	0.45	0.2 U
Nickel	11	59.15	433	12 U	47.1
Potassium	3200	15650	45900 J	13400	10000
Silver	2 U	2 U	2	3 U	3 U
Sodium	23200	15250	41800	7830	8600
Vanadium	4 U	412.5 K	1610	334	160
Zinc	5 U	403 JK	1355 J	248	3 U

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UL = Not detected, quantitation limit is probably higher.

J = Analyte present. Reported value may not be accurate or precise.

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K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

TABLE 2-13
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
METALS, DISSOLVED, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW13	B-MW12	B-MW11A	B-MW3A	B-MW2A	GW-6	B-MW16
Date collected	6/11/92	6/11/92	6/11/92	6/11/92	6/12/92	6/12/92	6/14/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	201	59 U	59 U	59 U	59 U	59 U	59 U
Antimony	18 U	18 U	18 U	18 U	18 U	18 U	18 U
Arsenic	2 U	16.4	2 U	2 U	2 U	2 U	3.4
Barium	13.4	49.9	53.3	26.4	21.7	64.2	14
Calcium	39400	33800	11300	97300	13600	108000	124000
Chromium	8 U	8 U	8 U	8 U	8 U	8 U	8 U
Cobalt	8 U	8 U	8 U	10.3	13.3	8 U	8 U
Copper	10.5	2 U	2 U	2 U	2 U	2 U	2 U
Iron	18100	27900	64600	5500	1740	536	10 U
Magnesium	10900	14300	24800	17900	7680	13100	18500
Manganese	275	704	715	1180	573	595	85
Potassium	3470	3930	3510	7240	2530	5870	5420
Sodium	10700	11000	64600	34000	15300	14300	54900
Vanadium	4	4	4	4	4	4	4 U
Zinc	5 U	5 U	5 U	5 U	5 U	5 U	22

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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TABLE 2-13
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
METALS, DISSOLVED, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	B-MW15	B-MW14	B-MW8A	B-MW9A	B-MW10	B-MW7
Date collected	6/14/92	6/14/92	6/10/92	6/10/92	6/10/92	6/10/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	59 U	59 U	59 U	59 U	59 U	59 U
Antimony	18 U	18 U	18 U	18 U	18 U	18 U
Arsenic	2 U	2 U	51.1	2 U	2 U	2 U
Barium	24	8	28	47	22.7	96.5
Calcium	54700	47800	35200	26500	15100	146000
Chromium	8 U	8 U	8 U	8 U	10.4	8 U
Cobalt	8 U	8 U	8 U	8 U	8 U	8 U
Copper	2 U	2 U	2.7	2.2	2 U	5.1
Iron	482	10 U	23500	3460	1080	542
Magnesium	38900	5820	7860	7090	5200	24900
Manganese	1130	47	132	825	107	247
Potassium	6120	1530	3050	2680	2080	20500
Sodium	227000	5990	21500	21200	16600	51400
Vanadium	4 U	4 U	4 U	4 U	4 U	4 U
Zinc	5 U	5 U	5 U	5 U	5 U	5 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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TABLE 2-13
ROUNDS 2 AND 3
GROUNDWATER SHALLOW SAMPLE RESULTS
METALS, DISSOLVED, AREA B
CAMP ALLEN LANDFILL, NORFOLK, VIRGINIA

Well ID no.	GW-4	GW-5	B-MW1	B-MW17	B-MW18A	B-MW19A
Date collected	6/13/92	6/13/92	6/11/92	6/14/92	12/16/92	12/16/92
Units	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	59 U	59 U	59 U	59 U	15 U	15 U
Antimony	32.9	18 U	18 U	18 U	17 U	17 U
Arsenic	14.1	2 U	2 U	2 U	8.8	7.8
Barium	3 U	3 U	15.8	21	1 U	23.5
Calcium	141000	98500	101900	41800	24900	88900
Chromium	22.2	8 U	8 U	8 U	9 U	9 U
Cobalt	8 U	8 U	13.55	8 U	10 U	10 U
Copper	2 U	2 U	3.95	2 U	2 U	2 U
Iron	164	176	2375	995.5	1200	1780
Magnesium	9300	5100	40150	31400	3440 J	7390 J
Manganese	221	36	1385	517.5	143	291
Potassium	14000	5040	4335	4880	2690	4030
Sodium	75500	35500	13550	41250	6470	7160
Vanadium	29.9	4 U	3	4 U	4 U	4 U
Zinc	5 U	5 U	5 U	16.75	3 U	3 U

Note: Data qualifier codes presented below are used to express laboratory confidence concerning the presence or absence and quantitation of compounds or analytes.

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source areas. Constituent migration appears to be limited to either shallow groundwater discharge zones along the drainage ditches encompassing the Camp Allen area and/or downward migration into the Yorktown Aquifer via the identified breached/ineffective portions of the confining clay unit separating the shallow groundwater aquifer and the deeper Yorktown Aquifers.

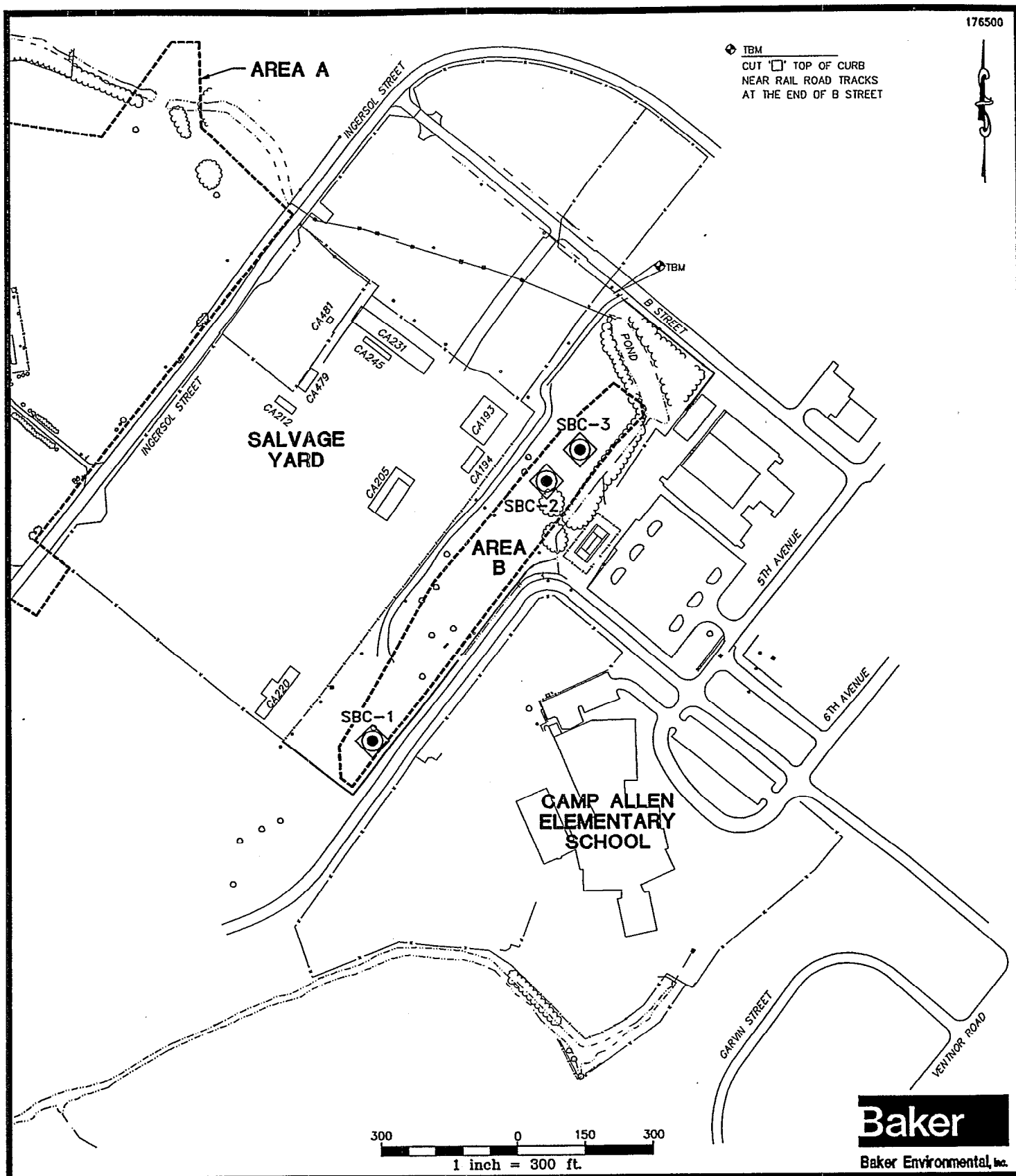
2.4 Disposal Characterization Borings

In April, 1993, Baker conducted a field program at Camp Allen Area B in support of the engineering evaluation of removal and disposal options. The field program consisted of sampling of soil at three discrete stations within the disposal areas of Area B, and analysis of each sample for full TCLP (toxicity characteristic leaching procedure) and RCRA characteristics ignitability, corrosivity and reactivity (ICR). Figure 2-14 shows the location of these borings.

At each data station, a single soil boring (SBC-2) or multiple borings (SBC-1 and SBC-3) were advanced to 10 feet of depth, about 5 feet into the water table. Drilling was by hollow-stem auger (HSA) and Standard Penetration Testing (SPT - ASTM Method 1586-D). The SPT sampler was advanced ahead of the auger bit, with 24-inch samples taken on 2-foot centers beginning at the surface and ending at the final depth of 10 feet. The SPT samples were visually described following the guidelines of the Uniform Soil Classification System (USCS), indicating soil type, color, moisture content, relative density and other relevant information; the boring logs appear in Appendix B. Part of each SPT sample was reserved for compositing into a single sample from each station for chemical analysis covering the interval of 0.5 feet of depth to 10 feet.

Each of the samples from the discrete intervals of SBC-2 and SBC-3 were sent to the laboratory for compositing. At SBC-1, however, the interval of 2 to 4 feet (immediately above the water table) indicated a non-specific release of volatile organic compounds registered by the Photo-Ionization Detector (PID) significantly higher than the releases from the other intervals; this interval was selected for laboratory analysis, with the remaining intervals discarded according to the provisions of the project plans.

A second boring at station SBC-1 was necessary to collect the requisite volume of sample for analysis from the interval of 2 to 4 feet. A second boring at SBC-3 was advanced after the



LEGEND

SBC-1 ◈ DISPOSAL CHARACTERIZATION BORING STATION

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-14
DISPOSAL CHARACTERIZATION BORINGS
AREA B
CAMP ALLEN LANDFILL
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

initial attempt at that station encountered a metal tank or drum about 3 or 4 feet below land surface.

The results of the discrete analyses of the soil samples from SBC-1, SBC-2 and SBC-3 appear on Table 2-14. The results of the analyses are compared to the maximum concentration for toxicity characteristic, as listed in 40 CFR, Part 261.24. Based on these analyses, the representative soil samples taken from the Area B disposal areas are not characteristically hazardous.

The results of the analysis of SBC-1, where low levels of trichloroethene and tetrachloroethene were detected in the sample extract, suggest that the area of buried magnetic objects located within the larger area of fill at the southeastern corner of Area B as shown on Figure 2-8 should be considered for removal as part of the scope of work for the removal action. The results of the analyses of SBC-2 and SBC-3 further support that this location probably received the bulk of the wastes from the Salvage Yard fire.

2.5 Site Conditions that Justify a Removal

Section 300.415 of the National Oil and Hazardous Substances Contingency Plan (NCP) lists the factors to be considered in determining the appropriateness of a Removal Action. Paragraph (b) (2) (ii) of 300.415 directly applies to the conditions at the Camp Allen Landfill Site. Based on the characteristics of the site as presented in the previous sections, there exist conditions at the site which necessitate a response. These conditions are outlined below:

"Actual or potential contamination of [drinking water supplies or] sensitive ecosystems".

Based on previous investigations, the primary source of these contaminants is the debris from the Salvage Yard fire buried in Area B. Several contaminants associated with the site have migrated into the groundwater (shallow and deep aquifer systems). These contaminants include vinyl chloride, 1,2-dichloroethene, 1,2-dichloroethane, and trichloroethene. In addition, other organic and inorganic contaminants were detected; however, volatile organic contaminants were the most significant.

Current property usage at the Camp Allen Landfill will remain unchanged in the foreseeable future. Future potential development of the property in the unlikely event of a base closure

TABLE 2 - 14
CAMP ALLEN AREA B
TCLP ANALYSES OF THREE SOIL BORINGS

PARAMETER	REPORTING LIMIT	UNIT	SAMPLE SBC-1	SAMPLE SBC-2	SAMPLE SBC-3	MAXIMUM CONCENTRATION FOR TOXICITY CHARACTERISTIC (1)
TCLP Toxicity Metals						
Silver	0.10	mg/L	ND	ND	ND	5.0
Arsenic	0.50	mg/L	ND	ND	ND	5.0
Barium	1.0	mg/L	1.7	ND	1.1	100.0
Cadmium	0.10	mg/L	ND	ND	ND	1.0
Chromium	0.10	mg/L	ND	ND	ND	5.0
Mercury	0.020	mg/L	ND	ND	ND	0.2
Lead	0.10	mg/L	ND	0.26	ND	5.0
Selenium	0.30	mg/L	ND	ND	ND	1.0
TCLP Herbicides						
2,4-D	0.50	mg/L	ND	ND	ND	10.0
2,4,5-TP (Silvex)	0.10	mg/L	ND	ND	ND	1.0
TCLP Pesticides						
Lindane	0.00010	mg/L	0.0011	ND	ND	0.4
Heptachlor	0.00010	mg/L	ND	ND	ND	0.008
Heptachlor epoxide	0.00010	mg/L	ND	ND	ND	0.008
Endrin	0.00050	mg/L	ND	ND	ND	0.02
Chlordane	0.00050	mg/L	ND	ND	ND	0.03
Methoxychlor	0.0010	mg/L	ND	ND	ND	10.0
Toxaphene	0.0050	mg/L	ND	ND	ND	0.5
TCLP Volatile Organics						
Benzene	0.025	mg/L	ND	ND	ND	0.5
Carbon Tetrachloride	0.025	mg/L	ND	ND	ND	0.5
Chlorobenzene	0.025	mg/L	ND	ND	ND	100.0
Chloroform	0.025	mg/L	ND	ND	ND	6.0
1,2-Dichloroethane	0.025	mg/L	ND	ND	ND	0.5
1,1-Dichloroethylene	0.025	mg/L	ND	ND	ND	0.7
Methyl ethyl ketone	0.25	mg/L	ND	ND	ND	200.0
Tetrachlorethylene	0.025	mg/L	0.18	ND	ND	0.7
Trichloroethylene	0.025	mg/L	0.061	0.067	ND	0.5
Vinyl Chloride	0.050	mg/L	ND	ND	ND	0.2
TCLP Semivolatile Organics						
Cresols, Total	0.040	mg/L	ND	ND	3.2	200.0
1,4-Dichlorobenzene	0.040	mg/L	ND	ND	ND	7.5
2,4-Dinitrotoluene	0.040	mg/L	ND	ND	ND	0.13
Hexachlorobenzene	0.040	mg/L	ND	ND	ND	0.13
Hexachlorobutadiene	0.040	mg/L	ND	ND	ND	0.5
Hexachloroethane	0.040	mg/L	ND	ND	ND	3.0
Nitrobenzene	0.040	mg/L	ND	ND	ND	2.0
Pentachlorophenol	0.20	mg/L	ND	ND	ND	100.0
Pyridine	0.040	mg/L	ND	ND	ND	5.0
2,4,5-Trichlorophenol	0.040	mg/L	ND	ND	ND	400.0
2,4,6-Trichlorophenol	0.040	mg/L	ND	ND	ND	2.0
Inorganic Analysis						
pH Non-Aqueous		su	7.6	7.6	7.6	NA
Cyanide, Reactive	10	mg/kg	ND	ND	ND	NA
Sulfide, Reactive	50	mg/kg	ND	ND	ND	NA
Flash Point - Pensky Martens		deg F	>180	>180	>180	NA
Solids, Total (TS)	0.50	%	60.3	84.0	84.7	NA

NOTES: (1) Reference 40 CFR 261.24
NA - Not Applicable
ND - Not Detected

would probably be commercial/industrial or recreational because of deed restriction concerning former landfills.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected under this Removal Action, may present an imminent and substantial endangerment to (public health or welfare, or) the environment. Therefore, this Removal Action will be based on the protection of sensitive ecosystems and non-potable groundwater from VOC contamination due to debris buried at Area B.

investigated at the Camp Allen Landfill did not result in total site Incremental Cancer Risk (ICR) value in excess of USEPA's target risk range (10^{-6} to 10^{-4}). Current potential human exposure did not result in Hazard Index (HI) value equal to, or exceeding, 1.0, indicating that noncarcinogenic adverse human health effects will not occur.

Current property usage at the Camp Allen Landfill will remain unchanged in the foreseeable future. Future potential development of the property in the unlikely event of a base closure would probably be commercial/industrial or recreational because of deed restriction concerning former landfills.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected under this Removal Action, may present an imminent and substantial endangerment to (public health or welfare, or) the environment. Therefore, this Removal Action will be based on the protection of sensitive ecosystems and non-potable groundwater from VOC contamination due to debris buried at Area B.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The investigations at Area B of the Camp Allen Landfill site and the analysis of the data has shown that past disposal practices have resulted in the contamination of soils, groundwater, surface water, and sediment. The objective of this removal action is to remove the source of contamination determined to be the residue and debris remaining after the 1971 Salvage Yard fire, which has been buried in Area B via trench and fill operations. These waste materials pose a potential threat to public health and the environment due to the potential for direct contact with contaminated surface runoff and groundwater seepage. The removal of these sources should reduce the potential threat to public health and the environment from the release of contaminants.

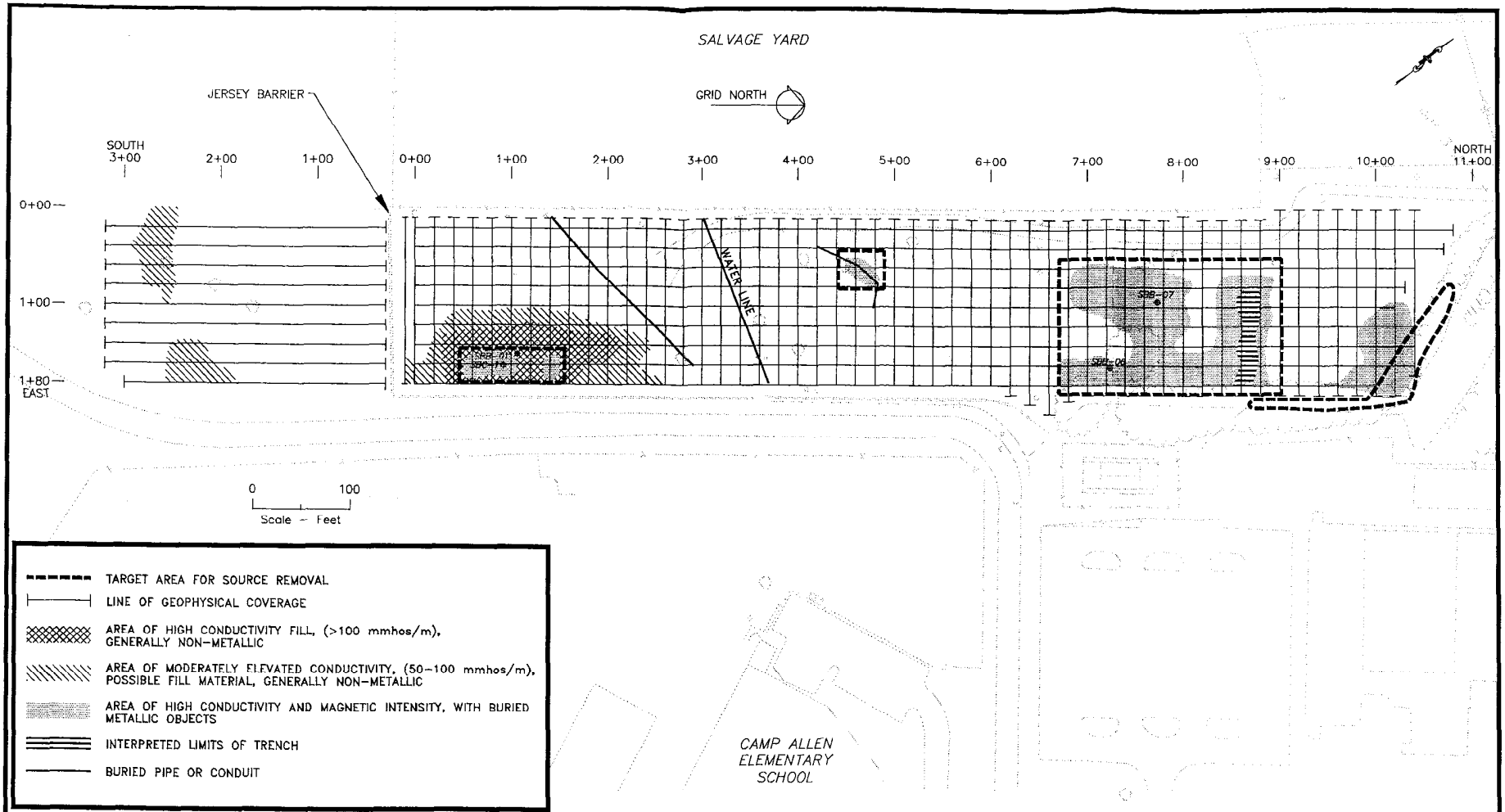
This removal is considered to be a partial site remediation. While complete remediation of all media will be considered further in the ongoing Camp Allen Landfill Study, the removal action should be consistent with the anticipated final remedial action. This EE/CA will develop a removal alternative which achieves the objective stated above while meeting the requirements of the NCP and the Navy/Marine Corps IR Program.

3.1 Statutory Limits on Removal Actions

The National Contingency Plan dictates statutory limits of $2 million and 12 months on EPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the remedial action to be taken. This removal action will not be EPA fund-financed. The Navy/Marine Corps IR Manual does not limit the cost or duration of the removal action; however, cost effectiveness is a recommended criterion for evaluation of removal action alternatives.

3.2 Removal Action Scope

Based on historical accounts of the Salvage Yard fire and subsequent trench and fill operations at Area B, as well as recent investigation activities, fire wastes were apparently buried in trenches toward the north of Area B as shown in Figure 3-1. The significant detections of organic compounds from Borings SBB-06 and SBB-07 further support that this location probably received the bulk of the wastes from the Salvage Yard fire. Therefore, the removal action scope will include the excavation and disposal of material backfilled into these trenches along with the associated contaminated soil.



REVISIONS			
	DATE	4/93	GEOPHYSICAL INVESTIGATION CAMP ALLEN LANDFILL - AREA B NORFOLK, VIRGINIA PREPARED FOR BAKER ENVIRONMENTAL, INC
	SCALE	GRAPHIC	
	DRAWN	GLB	
	REVIEWED	SJK	
	S.O.#	19084	WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania
	CADD#	176-015	

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Baker Environmental, Inc.
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TARGET AREA OF REMOVAL ACTION
AREA B

SCALE GRAPHIC | DATE 4/93

FIGURE
3-1

In addition, three other disposal areas will be included in the removal action scope. The first is located in the southeastern corner of Area B and includes two areas of fill and buried metallic objects within a larger area of non-metallic fill. The other two disposal areas included in the removal action scope include a small area of buried metallic objects located near the Salvage Yard fence, and an area of concrete rubble and demolition debris which borders the pond.

Included in the removal action scope are the following items of work:

- Temporary dewatering of the removal areas to lower the water table.
- Treatment of extracted groundwater and discharge to the sanitary sewer system of the Hampton Roads Sanitation District.
- Excavation of the soil and debris from the trenches plus over-excavation of visibly contaminated soil from the side walls and floor of the excavation.
- Confirmation soil sampling and analysis, and additional excavation of material contaminated in excess of removal action endpoints.
- Transportation to and disposal at a RCRA permitted hazardous waste landfill.
- Site restoration.

3.3 Removal Action Schedule

The schedule objective for the Removal Action is to have completed the action within 12 months from the time of approval of the Action Memorandum. Since this Removal Action has been designated non-time-critical, the start date will be determined by factors other than the urgency of the threat. Possible factors include weather conditions, the availability of resources, and normal procurement periods.

A preliminary breakdown of the construction schedule is provided below:

- Mobilization - 1 month
- Removal Action - 2 to 3 months
- Site Restoration - 1 month

3.4 Applicable or Relevant and Appropriate Requirements (ARARs)

The 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP), while not requiring that removal actions attain applicable or relevant and appropriate Federal and State requirements, recommends that to the extent practicable they be attained. These guidelines, which are known as ARARs for the site, may be specific to the conditions present on the site or may be meant to address similar situations and, therefore, are suitable for use at the site.

The Department of the Navy, which is the lead organization for this site, has determined the Federal ARARs for this removal action and has coordinated with the Virginia Department of Environmental Quality in establishing the State ARARs. USEPA plays a major role in reviewing the ARARs for the Removal Action, with Virginia Department of Environmental Quality providing the ultimate State ARARs. Feedback from all regulatory agencies will be considered.

Three factors are applied to determine whether the identification and attainment of ARARs is practicable in a particular removal situation: (1) the exigencies of the situation; (2) the effect of ARAR attainment on the statutory limits for removal action duration and cost; and (3) the criteria listed under SARA section 121(d)4 providing conditions under which ARARs may be waived. The first two factors do not apply to this action. This EE/CA by definition is for a non-time-critical removal action, and as such, urgent conditions do not constrain or preclude efforts to attain ARARs. Statutory limits on removal time and cost are not applicable for removal actions not funded by the EPA or State. Therefore the attainment of ARARs should not be affected by the exigencies of the situation or by the statutory limit in the scope of the removal action.

The criteria listed under SARA section 121(d)4 for which ARARs may be waived include the following:

- Interim remedy waiver
- Greater risk to health and the environment
- Technical impracticability
- Equivalent standard of performance
- Inconsistent application of State requirements

The analysis of removal alternatives will determine if all ARARs can be attained at a site and if the action qualifies for an exception under SARA. If all ARARs cannot be attained, the removal action will be evaluated against those ARARs which are most crucial to the proper stabilization of the site and to the proper protection of public health and the environment until remedial action can provide additional protection.

ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are particular to individual contaminants. Location-specific ARARs depend upon the location of the contamination and potential restrictions on activities conducted in these areas (i.e., wetlands, floodplains, etc.). Action-specific ARARs, as the name implies, govern the remedial actions. Action-specific ARARs are usually technology- or activity-based directions or limitations that control actions taken at CERCLA sites.

The following sections present the ARARs which must be attained or considered as part of the removal action scope at Area B. Included are the recommended clean up goals for contaminated soils.

3.4.1 Chemical-Specific ARARs

- Site Specific Cleanup Goals for Soil - The risk-based cleanup levels provided below have been developed to assure removal of all contaminated soil to levels which are protective of the non-potable groundwater at the site. The chemicals of concern for the shallow groundwater at the site are trichloroethene, 1,2-dichloroethene, and vinyl chloride. Confirmation samples taken after excavation of contaminated soil and debris must be lower than these levels for the removal to be considered complete.

Chemical of Concern	Cleanup Goal (mg/kg)
1,2-Dichloroethene	70
Vinyl Chloride	0.9
Trichloroethene	47

- Virginia Hazardous Waste Management Regulations (VR 672-10-1) - The criteria for identifying the characteristics of hazardous waste and for listed hazardous wastes are provided in Part III of these regulations. RCRA hazardous wastes are not anticipated based on the results of the disposal characterization samples provided in Section 2.4. Any wastes found to be RCRA hazardous wastes will be stored, treated and/or disposed according to the applicable regulations in these sections.

- Clean Water Act "Indirect Discharge Requirements" (40 CFR 403); the Commonwealth of Virginia Permit Regulations (VR-680-14-01, Section 7); and local HRSD Industrial Wastewater Discharge Regulations (Part III and Appendix D). The water treatment system effluent will be discharged to the sanitary sewer system of the Hampton Roads Sanitation District (HRSD). The effluent limits will comply with the requirements tentatively set by HRSD at:

Contaminant	Discharge Limit (mg/l)
BTEX	1.0
Arsenic	0.1
Barium	2.0
Lead	1.0
Chromium	2.0
Cadmium	0.1
Zinc	2.0
Acetone	1.0
Total Toxic Organics	2.13(1)

(1) With no single organic exceeding 1.0 mg/l per 40 CFR 433.11 (e).

- National Ambient Air Quality Standards - The Clean Air Act gives the criteria and requirements for ambient air quality monitoring and the requirements for reporting ambient air quality data and information. Based on these regulations air at and

around the Camp Allen Landfill site will be monitored to ensure compliance with these standards. The Virginia Department of Environmental Quality implements the National Ambient Air Quality Standards through the Virginia Air Pollution Control Regulations.

3.4.2 Location-Specific ARARs

- Fish and Wildlife Coordination Act (16 USC 661, et. seq.) - The Fish and Wildlife Coordination Act requires action to protect fish and wildlife from actions modifying streams or areas affecting streams. At this time, there are no plans to disturb or modify any streams in the area.

- Endangered Species Act (16 USC 153) - The Endangered Species Act requires action to avoid jeopardizing the continued existence of listed endangered or threatened species or modifications to their habitat. The USDI has been contacted and it has been determined that the Peregrine Falcon, a federally endangered species, has been observed regularly at the site. The appropriate state agencies will be contacted by the Virginia Department of Environmental Quality to determine if there are any other threatened or endangered species in the area and how this act will affect the remedial activity.

- Coastal Zone Management Act - The Coastal Zone Management Act requires activities affecting land or water uses in a coastal zone to certify noninterference with coastal zone management. It has been determined that the site lies within the Virginia coastal zone. The Virginia Coastal Zone Management Office will be contacted by the Virginia Department of Environmental Quality to determine what, if any, effect the remedial activities will have on the Virginia coastal zone, and what actions will have to be taken to be in compliance with this act.

- National Historic Preservation Act - It is believed that there are no buildings listed on the National Register of Historic Places at the Camp Allen Landfill site. The Virginia Office of Historic Places has been contacted to obtain a list of Historic Places to determine and identify any historic landmarks/places in the general area of the site.

3.4.3 Action-Specific ARARs

- RCRA Land Disposal Restrictions (40 CFR 268) - 40 CFR Part 268 identifies those RCRA hazardous wastes that are restricted from land disposal. RCRA hazardous wastes are not anticipated based on the results of the disposal characterization samples provided in Section 2.4. Waste that is land disposal restricted would be shipped off site for disposal with the proper labels, manifests, and notification forms indicating that the waste is land disposal restricted.

- OSHA (29 CFR 1910, 1926, 1940) - These regulations provide occupational safety and health requirements applicable to workers engaged in on site field activities. It is required that the regulations be followed for site workers during construction and operation of remedial activities. Therefore, all workers will be made aware of the regulations and they will be enforced by the Site Health and Safety Officer during all remedial activities.

- DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1 - 172.558) - The wastes from the remedial activities will be classified for transportation based on the chemicals present in the material. Shipping papers (including hazardous waste manifests) will be prepared that describe the hazardous material offered for transportation and will include contents, shipper's name, proper shipping name, hazard class, identification number, total quantity, and certification that the material is presented according to DOT regulations. All wastes will be packaged according to DOT regulations with the proper markings on each container.

- Virginia Solid Waste Regulations (VR-672-20-10) - The purpose of these regulations is to establish standards and procedures pertaining to the construction, operation, maintenance, closure and post-closure of solid waste management facilities in the Commonwealth of Virginia in order to protect the public health, public safety, the environment, and natural resources. All Virginia Solid Waste Regulations will be strictly adhered to during disposal of uncontaminated rubble from the Camp Allen Landfill site, and all applicable permits will be obtained.

- Virginia Hazardous Waste Management Regulations (VR 672-10-1) - Because Virginia administers an authorized State RCRA program, the Virginia Hazardous Waste Management Regulations (VHWMR) may serve as the governing ARAR in

place of the RCRA regulations contained in the 40 CFR Parts, except for the Land Disposal Restrictions of 40 CRF Part 268. Although disposal characterization borings determined that the soil samples from Area B source areas were not characteristic hazardous wastes, on-site activity will be conducted in accordance with VHWMR Part X in order to provide additional environmental and worker protection during the removal action. Transportation of contaminated soil and debris will be conducted in accordance with VHWMR Part V (Manifest Regulations for Hazardous Waste Management) and Part VII (Regulations Applicable to Transporters of Hazardous Waste), and VHWMR (VR 672-30-1) Regulations Governing the Transportation of Hazardous Materials.

Incineration of soils was retained as a removal alternative but is not the Navy's proposed disposal alternative. VHWMR (VR 672-10-1) Part X Section 10.13 is the state ARAR for incineration of soils/sediment.

- Virginia Stormwater Management Act, Section 10.1 - 603.1 et seq.; Virginia Stormwater Management Regulations (VR 215-02-00), the Virginia Erosion and Sediment Control Law, Code of Virginia Sections 10.1 - 560 et seq., the Virginia Erosion and Sediment Control Regulations (VR 625-02-00), and local stormwater management and sediment and erosion control programs administered by the County. Design plans concerning land disturbing activities will be submitted by the Virginia Department of Environmental Quality - Waste Division to the locality for review before any land disturbing activity.

3.5 Disposal Requirements

In order to identify appropriate technologies for the removal action alternatives, it is necessary to classify the material to be removed into one of three waste categories: (1) recyclable or recoverable materials; (2) wastes restricted from land disposal under RCRA Land Disposal Restrictions; and (3) all CERCLA wastes not otherwise restricted, and all RCRA wastes not included in Categories 1 and 2. Category 1 wastes will generally be required to be recycled or recovered. Category 2 wastes will require pretreatment prior to land disposal, an alternative to land disposal, or disposal at a specific type of facility (e.g. TSCA-permitted). Direct land disposal may be among the options considered for Category 3 wastes.

The soil and debris to be removed from the site is not anticipated to contain appreciable amounts of recyclable/recoverable materials (Category 1).

RCRA regulations governing the identification and listing of a hazardous waste are presented in 40 CFR, Part 261. Based on the lack of conclusive documentation of materials disposed in Area B, it can not be proved that materials were disposed of that would allow the contaminated soil and debris to be classified as a RCRA U-, L- or P-listed hazardous waste. The soil and debris could be considered a RCRA characteristic waste if the material does not meet toxicity characteristic waste standards (40 CFR 261.24) based on the Toxicity Characteristic Leaching Procedure (TCLP) test (Appendix II of 40 CFR 261). As reported in Section 2.4, however, disposal characterization borings analyzed for full TCLP and RCRA characteristics determined that the representative soil samples from the Area B source areas are not characteristic hazardous wastes. Therefore, the soil and debris to be removed will be classified under Category 3, and direct land disposal will be considered as an option.

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

The following section presents a discussion of potential removal action technologies for the Camp Allen Landfill Area B site. Appropriate removal actions and technologies are identified and, although current EE/CA guidance does not require initial screening of alternatives, a brief evaluation of potential technologies is provided in order to provide a cost-effective evaluation of a focused list of alternatives for removal action which are most suited to the type, quantity and location of contaminants.

Based on past experience and resources available for identifying removal technologies, Table 4-1 identifies the general response actions for the proposed removal action. The first response action, No Action, does not meet the objectives of the removal action for the Camp Allen site. Furthermore, the No Action alternative is not required for evaluation by the latest EE/CA guidelines, dated March 30, 1988. The remaining general response actions are discussed in the following sections.

4.1 Institutional Controls

Institutional controls, which are non-engineering solutions to prevent public access to the site or movement of contaminated media, may be considered when identifying removal action alternatives. These controls may include alternate residential water supplies, access restrictions and legal restrictions. They may also include periodic monitoring and analysis of surface water and groundwater to determine when or if an alternative response action may be implemented.

The objective of this removal action has been previously identified as the removal of the contaminant sources from Area B of the Camp Allen Landfill site to reduce the potential threat to public health and the environment. For the purposes of this removal action, institutional controls do not meet the stated objective and will not be retained for further evaluation as a removal action alternative.

4.2 Containment Actions

Under a containment response, the threat to public health is potentially removed through mechanisms such as capping, vertical barriers, or surface controls, which prevent direct exposure with or migration of the contamination without disturbing or removing the waste

TABLE 4-1

SUMMARY OF IDENTIFICATION AND SCREENING OF
GENERAL RESPONSE ACTIONS
CAMP ALLEN LANDFILL - AREA B, NAVAL BASE, NORFOLK, VIRGINIA

Response Action	Technology	Screening Comment
No Action	None	Not retained. Not required by NCP for evaluation.
Institutional Controls	Monitoring Access restrictions Legal restrictions	Not retained. Does not meet removal action objectives.
Containment Actions	Capping Vertical barriers	Not retained. Potentially incompatible with future remedial action.
Off-Site Disposal	Sanitary landfill RCRA facility	Retain for further consideration.
On-Site Treatment	Soil washing Chemical dechlorination Solidification Landfarming Incineration	Not retained. Difficult to implement at the Area B site.
On-Site Disposal	On-site landfill	Not retained.
Off-Site Treatment	Incineration	Retained.

from the site. Two types of containment responses are potentially applicable for the Camp Allen Site: a RCRA cap and a low permeability cover.

The primary purpose of a cap is to provide a vertical barrier to infiltrating precipitation, thus reducing the volume and migration of contaminated groundwater from the site.

A RCRA cap is the most conservative design for a capping alternative. A RCRA cap would involve the placement of a 2-foot thick compacted clay fill layer over the contaminated area, installation of a synthetic liner, covering the synthetic liner with a 1-foot drainage layer, a 2-foot layer of vegetative fill, seeding and mulching the area, and construction of drainage ditches to control run-on and runoff. This alternative would probably provide a slightly greater degree of protection than the low permeability cover.

The second containment alternative, a low permeability cover, is a single layered clay cap consisting of low permeability soil covered with a single layer of topsoil with a vegetative cover. For this alternative, a 2-foot layer of clay would be placed over the contaminated area and would be covered with a 1-foot layer of fill followed by seeding and mulching. A low permeability cover could also be a layer of asphalt installed to reduce infiltration to the zone of contamination.

Although capping would reduce the mobility of contaminants by reducing infiltration of surface waters through the zone of contamination, it would not meet the removal action objectives of removal of the source of contamination. Furthermore, the source material was reportedly buried in part below the water table, thus a cap would not prevent continued leaching into the groundwater. Therefore, capping and the containment response action will not be retained for further evaluation.

4.3 Off-Site Disposal

Excavation and removal of contaminated soil and debris for disposal in a secure landfill is a commonly employed removal alternative. Solid waste (RCRA Subtitle D) or hazardous waste (RCRA Subtitle C) landfills may be utilized depending on the characteristics of the waste. As reported in Section 2.4, representative soil samples taken from Area B source areas were analyzed for full TCLP and RCRA characteristics and determined not to be a characteristic hazardous waste. Since the wastes are not a RCRA hazardous waste, they could be potentially disposed directly into a solid waste landfill, such as a sanitary, industrial, or construction

debris landfill. However, the construction requirements (e.g., liners and caps), as well as record keeping and reporting requirements, are typically more stringent for hazardous waste landfills than for solid waste disposal facilities. Thus, hazardous waste landfills offer a higher degree of protection than that provided by nonhazardous facilities.

In order to be disposed in either a RCRA Subtitle C or Subtitle D landfill, the soil and debris must not contain any free liquids (i.e., must pass the paint filter test). In addition, solid waste landfills often place restrictions on the types and concentrations of constituents that they will accept in nonhazardous contaminated soil or sediment.

Contaminated soil and debris would be removed by hand or heavy equipment (e.g., backhoe), providing an immediate benefit to the public health. Confirmation sampling and analysis would assure that a complete removal has occurred. The excavated area would be regraded, backfilled with clean fill, compacted and revegetated. Based on the ability of this alternative to achieve the removal action objectives, this alternative will be retained for further evaluation.

4.4 On-Site Treatment

Certain physical/chemical, biological, and thermal treatment alternatives are available for on-site treatment of the Area B wastes. Physical/Chemical alternatives include soil washing or solvent extraction, chemical dechlorination, and solidification. Biological treatment on site may be applicable as a landfarming alternative. On-site thermal treatment via a mobile incinerator may be an applicable removal alternative.

Soil washing, or solvent extraction, is the extraction of contaminants from excavated soil by mixing with water, solvents, surfactants, or chelating agents. The extracted slurry of concentrated contaminants undergoes further treatment, including dewatering, carbon treatment, and incineration, for final removal of contaminants, while the treated soil is put back into the excavation or disposed at a sanitary landfill.

Chemical dechlorination processes use chemical reagents to destroy hazardous chlorinated molecules or to detoxify them to form other compounds that are considered less harmful. The process, originally developed for treatment of PCB-containing soils, involves mixing equal portions of contaminated soil and reactant in a heated reactor. Excess reagent is decanted and the soil is washed two to three times with water to remove excess reagent and the product of

the reaction. The volume of wastewater produced from this process must be treated, usually by chemical oxidation, carbon adsorption, or incineration.

Solidification is a stabilization process which locks the contaminants into a non-leaching matrix by the addition of and mixing with cement, lime, gypsum, silicate-based materials including fly ash, or other suitable setting agents. Solidification processes have been applied in-situ by mixing the soils in place, and also through excavation, treatment, and placement. Cement-based solidification is most suitable for immobilizing metals, while silicate-based processes have shown success in treating metals, waste oil, and solvents.

Landfarming is a biological process by which affected soils are excavated and spread over an area and tilled to enhance naturally occurring processes, including aeration, volatilization, biodegradation, and photolysis. Additional agents such as nitrogen, phosphorous, and organic nutrients may be applied to enhance the biological reaction. In landfarming, volatilization removes a large portion of the lighter hydrocarbons and degradation is responsible for the decomposition of the heavier fraction of hydrocarbons. Although successful aerobic biodegradation of some chlorinated compounds has been reported, the more complex, multi-chlorinated compounds have shown greater resistance to this method of treatment.

On-site thermal treatment would involve excavating the soil and processing in a mobile incinerator. Portable rotary kiln incinerators can process a large variety of solid and liquid wastes with minimal preprocessing, which may include screening and shredding to reduce solid particle size. Incineration is a proven technology at hazardous waste sites. A test burn would be necessary to prove the efficiency of this alternative for the waste to be destroyed. Air pollution control equipment would be required to avoid unnecessary impact to the surrounding area during the removal action.

Implementation of the on-site treatment alternatives discussed above presents several difficulties, some of which are common to all of the alternatives. First, on-site treatment equipment usually has a low capacity relative to the excavation rate. This is based on the necessity to keep equipment size to a minimum in order to transport it to the site with a minimum of set up time. The result is a much longer schedule for on-site treatment in comparison to off-site treatment or disposal and large stockpiles of contaminated soil stored on site. The longer time frame for removal can impact labor costs, and public approval may be more difficult to obtain due to the prolonged impact to the surrounding neighborhood. Larger capacity treatment systems for on site use are usually expensive to mobilize and may not be

cost effective on a price per cubic yard basis for relatively small volumes of waste. Possible objections to on-site treatment due to noise and aesthetics would most likely impact the implementability of these alternatives.

Although applicable in concept and possibly applicable for the future remedial action of the Camp Allen Landfill site, the on-site treatment alternatives will not be retained for further evaluation for the removal action, but will be further evaluated in the ongoing remedial investigation and feasibility study.

4.5 On-Site Disposal

Excavation of contaminated soil and on-site disposal is a possible alternative for the removal action. However, placement and consolidation of the contaminated soil and debris in an on-site area would require construction of an on-site disposal cell and long-term monitoring and maintenance of the burial cell. This alternative will not be evaluated further due to the added cost and complexity of implementation as compared to off-site disposal.

4.6 Off-Site Treatment

Based on the results of TCLP analysis of representative samples of the waste to be removed at Area B, treatment is not required prior to land disposal. However, the Hazardous and Solid Waste Amendments to RCRA show a strong preference for treatment, recycling or destruction as opposed to landfilling. Although not applicable to the Area B wastes, the recommended Best Demonstrated Available Technology (BDAT) for listed or characteristic hazardous wastes containing solvents is incineration. Therefore, this technology will be considered for evaluation.

Several technologies are utilized at commercial hazardous waste incineration facilities, including rotary kiln, fixed hearth, and cement industrial kiln. Incineration is a treatment process using high temperature oxidation to destroy organic constituents in the soil. Pollution control equipment is used to control emissions of sulfur dioxide, nitrogen oxides, hydrochloric acid and products of incomplete combustion. In accordance with 40 CFR 264.343, 99.99 percent destruction and removal efficiency of the organic hazardous constituents is required. RCRA regulations specify that the residuals be analyzed to determine what, if any, treatment is required prior to land disposal.

Because of the regulatory preference for alternatives to land disposal, incineration will be retained for further evaluation.

4.7 Summary

Based upon the evaluation conducted in this section, the following response actions are retained for further consideration:

- Off-Site Disposal
- Off-Site Incineration

5.0 ANALYSIS OF REMOVAL ALTERNATIVES

In this section, a detailed analysis of the retained response actions from Section 4.0 of this EE/CA is presented. This analysis is conducted to provide sufficient information to adequately compare the alternatives, select an appropriate removal action for the site, and demonstrate satisfaction of the CERCLA removal selection requirements in the Action Memorandum. Each alternative will be evaluated individually based on the criteria cited in the current EPA guidance and listed below:

- Effectiveness
- Implementability
- Cost

Paralleling the EPA guidance, the Navy/Marine Corps IR Manual recommends that criteria for evaluating removal alternatives include effectiveness to minimize the threat to public health, consistency with anticipated final remedial action, consistency with ARARs, and cost effectiveness. Together, these two guidance documents will form the basis for this evaluation.

5.1 Alternative 1 - Excavation and Off-Site Disposal

Alternative 1, Excavation and Off-Site Disposal, entails the removal of the sources of contamination from Area B and disposal at an approved RCRA Subtitle C hazardous waste landfill. These source areas, which were previously identified in the Site Summary, Section 2.2.3, include the following:

- Salvage Yard fire wastes (towards northeastern end of Area B)
- Area of buried metallic objects (middle of Area B)
- Area of buried metallic objects (southeastern corner of Area B)

Also included in this removal action alternative is the removal of the construction rubble adjacent to the pond. Because this material is not considered a source of contamination, the removal of the construction rubble will be limited to the surface materials for aesthetic purposes.

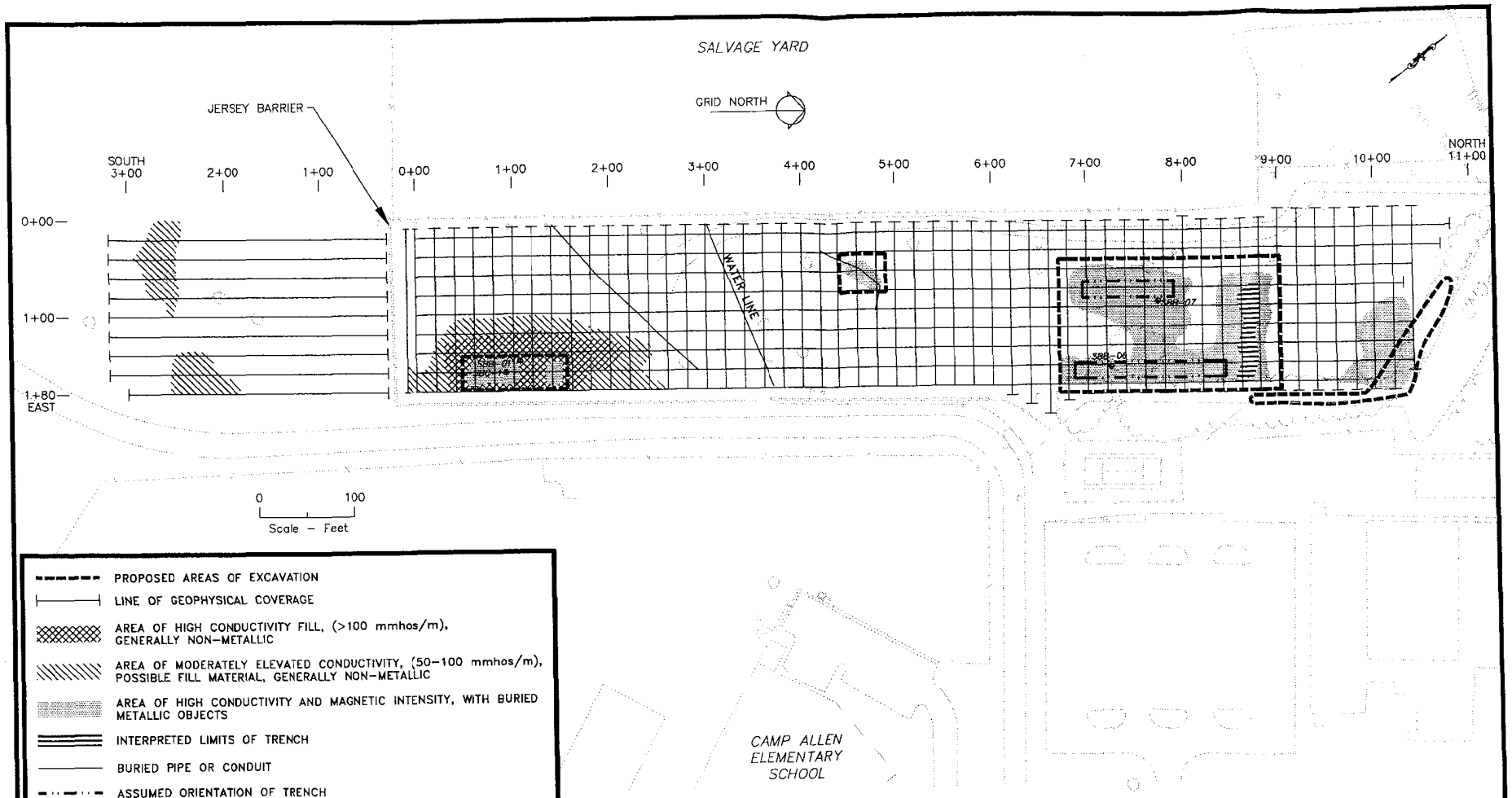
Based on historical accounts of the Salvage Yard fire, subsequent disposal operations at Area B, and recent investigation activities, fire wastes were apparently buried in rectangular

trenches of varying dimensions. Figure 5-1 shows the interpreted limits of one trench and a possible orientation for two others assumed for the purpose of estimating quantities for disposal. The initial activity for this removal action will be the excavation of test pits to determine the actual extent of the trenches. Once the trenches have been delineated, the removal operation will begin.

In order to excavate all the source material from the trenches (which reportedly has been buried as deep as 8 feet), a dewatering system will be installed to lower the water table, which is an average depth of 5 feet below ground surface. It is recommended that the dewatering system consist of a series of drive points which are installed in the shallow aquifer to a depth of 15 feet and connected to a vacuum system to extract groundwater. If the system is unsuccessful in lowering the water table, recovery wells will be installed and the area dewatered by conventional groundwater pumping. The extracted groundwater will be treated on site prior to discharge to the sanitary sewer system of the Hampton Roads Sanitation District (HRSD). Figure 5-2 provides a schematic diagram of the on-site groundwater treatment system. A pilot scale study of groundwater treatability will be conducted during the dewatering operation to provide information which may be useful to the future remedial action at the site. The treatment system will consist of a settling tank for removal of metal contaminated sediments followed by an air stripper and carbon adsorption filter to remove the remaining organics. The effluent limits will comply with the requirements tentatively set by HRSD as listed in Section 3.4.1.

Once the water table has been lowered, excavation will begin. Erosion and sedimentation controls will be installed to prevent inflow of runoff into the excavation and to prevent migration of contaminants from the removal area. Excavated soil and debris will be temporarily stockpiled in protected laydown areas and sampled prior to transportation to the disposal facility.

The preliminary volume of soil and debris estimated for disposal is 2,600 cubic yards. This volume is based on a trench orientation as shown of Figure 5-1, assuming a total trench length of 500 feet, with a trench width of 10 feet and a trench depth of 8 feet. This volume also assumes two feet of over-excavation from the sidewalls of the trench and one foot of over-excavation from the trench floor. Possible uncontaminated surface material has not been subtracted from this estimated volume. The quantity used for estimating the excavation (not disposal) has been increased by 20 percent to reflect the effort to delineate the trenches.



REVISIONS		
	DATE	4/93
	SCALE	GRAPHIC
	DRAWN	GLB
	REVIEWED	SJK
	S.O.#	19084
	CADD#	176-016

GEOPHYSICAL INVESTIGATION
CAMP ALLEN LANDFILL – AREA B
NORFOLK, VIRGINIA
PREPARED FOR BAKER ENVIRONMENTAL, INC

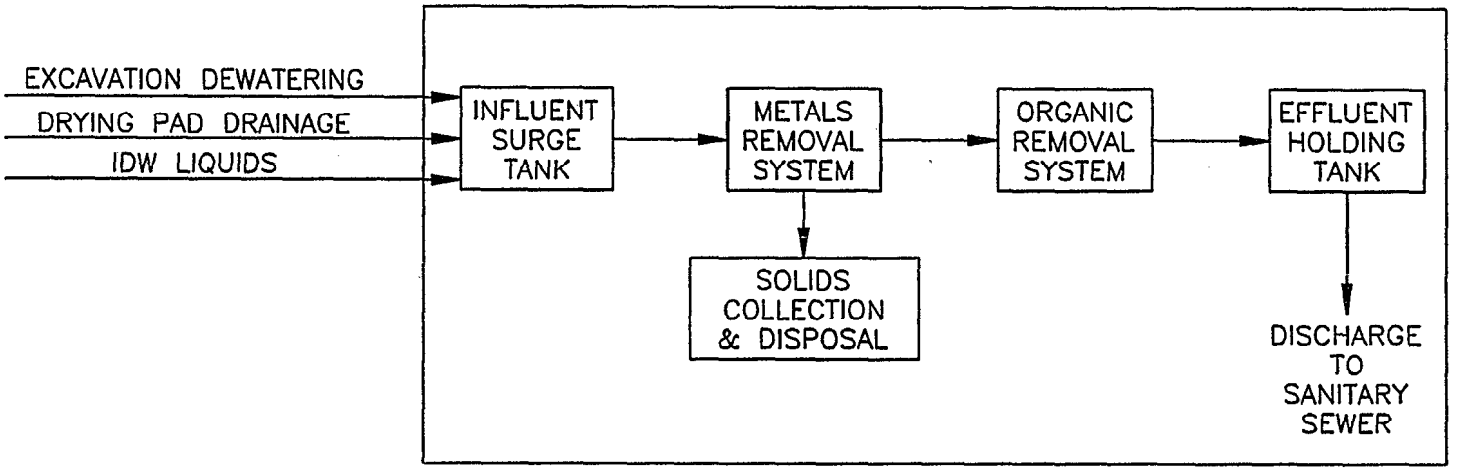
WESTON GEOPHYSICAL CORP.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.
WESTON GEOPHYSICAL CORP. IS A WHOLLY OWNED SUBSIDIARY OF BAKER ENVIRONMENTAL, INC.

PROPOSED AREAS OF EXCAVATION
AREA B

SCALE	GRAPHIC	DATE	4/93

FIGURE
5-1



Baker

Baker Environmental, Inc.

FIGURE 5-2
ON-SITE GROUNDWATER
TREATMENT SYSTEM
SCHEMATIC DIAGRAM
NORFOLK NAVAL BASE
NORFOLK, VIRGINIA

176-021

Excavated material will be further dewatered to eliminate any free liquids prior to disposal. The most economical method of dewatering would be by gravity drainage combined with evaporation. Emissions of VOCs from temporary storage of stockpiled soils are not regulated, but will be monitored to protect worker safety. Soil will be placed on an impermeable surface such as a polyethylene sheeting and spread in a 1 to 2-foot layer to dry. For the purposes of this evaluation and cost estimate, it is assumed a drying agent such as kiln dust will be added at a rate of 10 percent by weight to half of the excavated material (material from below the water table). The perimeter of the liner will be bermed to prevent runoff, and free liquids will be drained into a sump, where they will be collected and treated with the on-site treatment system discussed above, then discharged to the sanitary sewer system of the Hampton Roads Sanitation District.

The dewatered soil will be loaded onto trucks or roll-off containers. During excavation and loading, all trucks and equipment in contact with contaminated material will be decontaminated prior to leaving the contamination zone. The loaded waste will be manifested by a licensed hazardous waste hauler and transported to an approved RCRA Subtitle C hazardous waste landfill.

Surficial waste material from the construction rubble pile adjacent to the pond will be removed to a depth of 1 foot below ground surface. Excavation efforts will be undertaken in a manner that minimizes disturbance to the wetlands, and any disturbed wetlands will be restored to original site conditions to the maximum extent practicable. The excavated material will be loaded onto trucks or roll-off containers and transported to a solid waste or industrial waste landfill approved by the state. The estimated quantity of this material is 440 cubic yards. This is based on an area 60 feet by 100 feet and a rubble thickness of 2 feet (assuming the rubble is piled an average of one foot above grade).

Once excavation in the trench area has been completed, confirmation soil samples will be collected from the walls and floor of the excavation and analyzed in an off-site laboratory to ensure that the significantly contaminated soils have been removed to the action levels determined in Section 3.4. For the purposes of this evaluation, an over-excavation of two feet from the reported trench dimensions has been assumed. A 48-hour turnaround on laboratory analysis will be required in order to minimize the time that the excavation will remain open.

The excavated areas would be backfilled with new material brought from off site and regraded to the original contours. All excavated areas would be revegetated.

5.1.1 Effectiveness

Protectiveness

Excavation activities would pose a short-term exposure to site workers from inhalation of contaminated dust. These potential impacts can be reduced by implementation of a site-specific health and safety plan and the use of wetting agents during excavation activities. A licensed hazardous waste hauler will be employed to assure safe transport of the contaminated material to the landfill.

Excavation of the contaminant source from Area B and off-site disposal would reduce the potential threat to public health and the environment by reducing the potential for direct contact with contaminated surface runoff and groundwater seepage. An immediate reduction in the contaminant levels migrating from the source area would be anticipated. This alternative can be implemented within the proposed removal action schedule.

Chemical-specific ARARs for soils established in Section 3.4 will be met by taking confirmation samples from the excavation, and removing any remaining contaminated soil. During excavation, erosion and sedimentation controls and treatment and discharge to the sanitary sewer of water produced during dewatering activities would be used to ensure that removal activities do not cause further migration of contaminants to downstream surface waters. In addition, dust control measures would be employed to assure that the National Ambient Air Quality Standards are not exceeded at the site boundary. This alternative would be in compliance with all Federal and State location-specific ARARs. On-site actions and off-site transportation and disposal would comply with all action-specific ARARs.

The Navy/Marine Corps IR Program considers the following factors in determining the appropriateness of a removal action: (1) actual or potential exposure of nearby human populations or animals from hazardous substances, pollutants or contaminants; (2) high levels of hazardous substances, pollutants, or contaminants in soil largely at or near the surface that may migrate due to exposure or weather conditions; and (3) hazardous substances, pollutants, or contaminants in drums or other bulk storage containers that pose a threat of release. This alternative addresses these IR Program factors. Removal of the source of contamination significantly reduces the potential threat of exposure to base personnel, civilians, and animal populations, reduces the potential for waste material to migrate, and reduces the potential for

release of hazardous substances from drums or other containers potentially buried with the Salvage Yard debris.

Residuals remaining in the excavation area will be at levels which do not pose a risk from direct contact to human health. The long-term reliability for providing continued protection is excellent since the contaminant source will be permanently removed from the site.

Protection of human health and the environment at the RCRA hazardous waste disposal facility would be achieved through the use of a double liner system with a leachate collection layer.

Use of Alternatives to Land Disposal

The off-site disposal alternative would ignore the removal program's policy encouraging the use of alternatives to land disposal, such as treatment or recycling. Section 4.0, Identification of Removal Action Alternatives, presents a discussion of the on-site treatment alternatives and the reasons for not selecting them.

5.1.2 Implementability

Technical Feasibility and Availability

Implementation of Alternative 1 would involve the use of standard earth moving and hauling equipment. The technologies proposed for excavation, dewatering, material handling and off-site disposal are all demonstrated and commercially available. Conventional erosion and sedimentation controls will be maintained in all areas during removal activities. Site access would be obtained with little difficulty; no temporary roads would be required for access to the site. Labor and resources are readily available and could be obtained locally. Transportation loads would require manifests and transportation by licensed hazardous waste haulers.

The off-site hazardous waste landfill that receives the soil must have a RCRA Part A or Part B permit and must be in compliance with such permit. The availability of landfill capacity is not expected to be a concern.

For costing purposes, it is assumed that the the soil and debris would be transported to the GSX Landfill in Pinewood, South Carolina.

Administrative Feasibility

Because the source of contamination is removed from the site, it is likely that the public will accept this alternative.

CERCLA 121(e) exempts any response action conducted entirely on site from having to obtain a Federal, State or local permit. Obtaining the necessary approvals (i.e., landfill and state approvals) for disposal of the soil is not expected to be a problem. Approval time may vary, but it is estimated to be approximately six weeks.

5.1.3 Cost

The total estimated cost of implementation of this alternative is approximately $1.97 million. Table 5-1 presents a summary of this cost estimate.

5.2 Alternative 2 - Excavation and Off-Site Incineration

Alternative 2, Excavation and Off-Site Incineration, is similar in scope and on-site implementation to Alternative 1, but replaces disposal at a RCRA-permitted hazardous waste landfill with destruction of contaminated soil at a hazardous waste incinerator. This alternative entails the removal of the sources of contamination from Area B. These source areas, which were previously identified in the Site Summary, Section 2.2.3, include the following:

- Salvage Yard fire wastes (towards northeastern end of Area B)
- Area of buried metallic objects (towards middle of Area B)
- Area of buried metallic objects (southeastern corner of Area B)

Also included in this removal action alternative is the removal of the construction rubble adjacent to the pond. Because this material is not considered a source of contamination, the removal of the construction rubble will be limited to the surface materials for aesthetic purposes.

Based on historical accounts of the Salvage Yard fire and subsequent disposal operations at Area B and recent investigation activities, fire wastes were apparently buried in rectangular

PROJECT LOCATION: CAMP ALLEN AREA B NORFOLK, VIRGINIA — DESIGN STATUS:30%___60%___90%___Final__
PROJECT NAME: REMOVAL ACTION - ALTERNATE 1: OFF-SITE DISPOSAL — DATE: August 10, 1993
CONTRACT NUMBER: CTO-0176 — PREPARED BY: Baker Environmental

Account Number	DESCRIPTION OF ITEM	WBS UNITS	U/M	COST/WB UNIT ($)	TOTAL MU MATL COST($)	TOTAL MU/LABO COST($)	TOTAL MU/EQUI COST($)	TOTAL CONTRACT COST($)
33.01	MOBILIZATION AND PREPARATORY WORK							
33.01.01	Mobilize Equipment & Facilities	1	LS	4500	2500	2000		4500
33.01.03	Prework Submittals/Implementation Plan	1	LS	10000		6000	4000	10000
33.01.04	Setup/Construct Temporary Facilities	1	LS	4000	2000	2000		4000
33.01.05	Construct Temporary Ultilites	1	LS	7500	1500	2000	4000	7500
33.02	MONITORING,SAMPLING,TESTING,ANALYSIS							
33.02.03	Personnel Air Sampling/Analysis	100	EACH	140				14000
33.02.05	Sampling/Analysis of Surface Water/Groundwater	100	EACH	650				65000
33.02.06	Sampling/Analysis of Soil	70	EACH	750				52500
33.02.90	TCLP Analysis of Soil	25	EACH	1500				37500
33.03	SITE WORK							
33.03.02	Clearing and Grubbing	1.5	ACRE	3800		2700	3000	5700
33.03.13	6" Gravel Road	307	CY	20				6140
33.03.05	Fencing	480	LF	5				2400
33.05	SURFACE WATER COLLECTION AND CONTROL							
33.05.07	Sediment Barriers - Silt Fencing	500	LF	1.4	500	200		700
33.06	GROUNDWATER COLLECTION AND CONTROL							
33.06.90	Vacuum System Dewatering	6	WEEK	5000				30000
33.08	SOLIDS COLLECTION AND CONTAINMENT							
33.08.01	Excavation	3120	CY	10		19700	11500	31200
33.08.02	Waste Containment - Loading	3120	CY	5		6900	8700	15600
33.08.90	Drying Pad	10000	SF	1				10000

Table 5-1

PROJECT LOCATION: CAMP ALLEN AREA B NORFOLK, VIRGINIA
PROJECT NAME: REMOVAL ACTION - ALTERNATE 1: OFF-SITE DISPOSAL
CONTRACT NUMBER: CTO-0176

DESIGN STATUS:30%__60%__90%__Final__
DATE: August 10, 1993
PREPARED BY: Baker Environmental

Account Number	DESCRIPTION OF ITEM	WBS UNITS	U/M	COST/WB UNIT ($)	TOTAL MU MATL COST($)	TOTAL MU/LABO COST($)	TOTAL MU/EQUI COST($)	TOTAL CONTRACT COST($)
33.09	LIQUIDS/SEDIMENTS COLLECT & CONTAIN							
33.09.03	Waste Containment - Decon. Fluids	6200	GAL	1.4	1870	4570		8680
33.09.90	Decon Pad	1800	SF	5				9000
33.13	PHYSICAL TREATMENT							
33.13.90	Pilot Scale Treatment System	6	WEEK	10000				60000
33.15	STABILIZATION/FIXATION/ENCAPSULATION							
33.15.04	Pozzolan Processes (Drying Agent)	1950	TON	50	58500	19500	19500	97500
33.19	DISPOSAL							
33.19.02	Transport to TSDF - Soil and Debris	204	LOAD	1300				265200
33.19.03	Disposal Fees and Taxes - Rubble	720	TON	60				43200
33.19.03	Disposal Fees and Taxes - Soil and Debris	4095	TON	250				1023750
33.19.92	Disposal Fees and Taxes - Treatment Sludge	700	GAL	0.6				420
33.20	SITE RESTORATION							
33.20.01	Earthwork (backfill, spread, and compact)	2600	CY	24	15600	28700	18100	62400
33.20.04	Revegetation	1.5	ACRE	1800	1600	525	575	2700
33.21	DEMOBILIZATION							
33.21.01	Remove Temporary Facilities	1	LS	2500		1500	1000	2500
33.21.02	Remove Temporary Utilities	1	LS	1750		750	1000	1750
33.21.04	Demobilization Equipment,Facilities	1	LS	5000		2500	2500	5000
33.21.06	Post Construction Submittals	1	LS	5000		4000	1000	5000

Table 5-1

PROJECT LOCATION: CAMP ALLEN AREA B NORFOLK, VIRGINIA
PROJECT NAME: REMOVAL ACTION - ALTERNATE 1: OFF-SITE DISPOSAL
CONTRACT NUMBER: CTO-0176

DESIGN STATUS:30%___60%___90%___Final__
DATE: August 10, 1993
PREPARED BY: Baker Environmental

Account Number	DESCRIPTION OF ITEM	WBS UNITS	U/M	COST/WB UNIT ($)	TOTAL MU MATL COST($)	TOTAL MU/LABO COST($)	TOTAL MU/EQUI COST($)	TOTAL CONTRACT COST($)
33.22	FIELD SUPERVISION							
33.22.90	Field Supervision	1	LS	68000		58000	10000	68000
33.23	TECHNICAL OVERSIGHT							
33.23.90	Technical Oversight	1	LS	10000		8000	2000	10000
33.23.91	Data Validation	1	LS	6000		5000	1000	6000
	TOTAL COST							1967840

Table 5-1

trenches of varying dimensions. Figure 5-1 shows the interpreted limits of one trench and a possible orientation for two others assumed for the purpose of estimating quantities for disposal. The initial activity for this removal action will be the excavation of test pits to determine the actual extent of the trenches. Once the trenches have been delineated, the removal operation will begin.

In order to excavate all the source material from the trenches (which reportedly has been buried as deep as 8 feet), a dewatering system will be installed to lower the water table, which is an average 5 feet below ground surface. This will consist of a series of recovery wells installed in the shallow aquifer to extract groundwater. The extracted groundwater will be treated on site prior to discharge to the sanitary sewer system of the Hampton Roads Sanitation District (HRSD). A pilot scale study of groundwater treatability will be conducted during the dewatering operation to provide information which may be useful to the future remedial action at the site. Influent and effluent from the treatment system will be sampled daily to measure removal efficiencies. The treatment system will consist of a settling tank for removal of metal contaminated sediments followed by an air stripper and carbon adsorption filter to remove the remaining organics. The effluent limits will comply with the requirements tentatively set by HRSD as listed in Section 3.4.1.

Once the water table has been lowered, excavation will begin. Erosion and sedimentation controls will be installed to prevent inflow of runoff into the excavation and to prevent migration of contaminants from the removal area. Excavated soil and debris will be temporarily stockpiled in protected laydown areas and sampled prior to transportation to the disposal facility.

The preliminary volume of soil and debris estimated for disposal is 2,600 cubic yards. This volume has been based on a trench orientation as shown of Figure 5-1, assuming a total trench length of 500 feet, with a trench width of 10 feet and a trench depth of 8 feet. This volume also assumes two feet of over-excavation from the sidewalls of the trench and one foot of over-excavation from the trench floor. Possible uncontaminated surface material has not been subtracted from this estimated volume. The quantity used for estimating excavation (not disposal) has been increased by 20 percent to reflect the effort to delineate the trenches.

Excavated material will be further dewatered to eliminate any free liquids prior to disposal. The most economical method of dewatering would be by gravity drainage combined with evaporation. Emissions of VOCs from temporary storage of stockpiled soils are not regulated

but will be monitored to protect worker safety. Soil will be placed on an impermeable surface such as a polyethylene sheeting and spread in a 1 to 2-foot layer to dry. For the purposes of this evaluation and cost estimate, it is assumed a drying agent such as kiln dust will be added at a rate of 10 percent by weight to half of the excavated material (material from below the water table). The perimeter of the liner will be bermed to prevent runoff, and free liquids will be drained into a sump, where they will be collected and treated with the on-site treatment system discussed above, then discharged to the surface.

The dewatered soil will be loaded onto trucks or roll-off containers. During excavation and loading, all trucks and equipment in contact with contaminated material will be decontaminated prior to leaving the contamination zone. The loaded waste will be manifested by a licensed hazardous waste hauler and transported to an approved RCRA Subtitle C hazardous waste incinerator.

Surficial waste material from the construction rubble pile adjacent to the pond will be removed to a depth of 1 foot below ground surface. Excavation efforts will be undertaken in a manner that minimizes disturbance to the wetlands, and any disturbed wetlands will be restored to original site conditions to the maximum extent practicable. The excavated material will be loaded onto trucks or roll-off containers and transported to a solid waste or industrial waste landfill approved by the state. The estimated quantity of this material is 440 cubic yards. This is based on an area 60 feet by 100 feet and a rubble thickness of 2 feet (assuming the rubble is piled an average of one foot above grade).

Once excavation in the trench area has been completed, confirmation soil samples will be collected from the walls and floor of the excavation and analyzed in an off-site laboratory to ensure that the significantly contaminated soils have been removed to the action levels determined in Section 3.4. For the purposes of this evaluation, an over-excavation of two feet from the reported trench dimensions has been assumed. A 48 hour turnaround on laboratory analysis will be required in order to minimize the time that the excavation will remain open.

The excavated areas would be backfilled with new material brought from off site and regraded to the original contours. All excavated areas would be revegetated.

5.2.1 Effectiveness

Protectiveness

Excavation activities would pose a short-term exposure to site workers from inhalation of contaminated dust. These potential impacts can be reduced by implementation of a site-specific health and safety plan and the use of wetting agents during excavation activities. A licensed hazardous waste hauler will be employed to assure safe transport of the contaminated material to the incinerator.

Excavation of the contaminant source from Area B and off-site incineration would reduce the potential threat to public health and environment due to potential for direct contact with contaminated surface runoff and groundwater seepage. An immediate reduction in the contaminant levels migrating from the source area would be anticipated. This alternative can be implemented within the proposed removal action schedule.

Chemical-specific ARARs for soils established in Section 3.4 will be met by taking confirmation samples from the excavation, and removing any remaining contaminated soil. During excavation, erosion and sedimentation controls and treatment of water produced during dewatering activities would be used to ensure that removal activities do not cause further migration of contaminants to downstream surface waters. In addition, dust control measures would be employed to assure that the National Ambient Air Quality Standards are not exceeded at the site boundary. This alternative would be in compliance with all Federal and State location-specific ARARs. On-site actions and off-site transportation and disposal would comply with all action-specific ARARs.

The Navy/Marine Corps IR Program considers the following factors in determining the appropriateness of a removal action: (1) actual or potential exposure of nearby human populations or animals from hazardous substances, pollutants or contaminants; (2) high levels of hazardous substances, pollutants, or contaminants in soil largely at or near the surface that may migrate due to exposure or weather conditions; and (3) hazardous substances, pollutants, or contaminants in drums or other bulk storage containers that pose a threat of release. This alternative addresses these IR Program factors. Removal of the source of contamination significantly reduces the potential threat of exposure to base personnel, civilians, and animal populations, reduces the potential for waste material to migrate, and reduces the potential for

release of hazardous substances from drums or other containers potentially buried with the Salvage Yard debris.

Residuals remaining in the excavation area will be at levels which do not pose a risk from direct contact to human health. The long-term reliability for providing continued protection is excellent since the contaminant source will be permanently removed from the site.

Protection of human health and the environment at the RCRA hazardous waste incinerator will be achieved by the destruction efficiencies required by the RCRA permit for incineration of hazardous waste. Residual ash would be analyzed to determine what, if any, treatment (i.e., stabilization) is required prior to land disposal.

Use of Alternatives to Land Disposal

The off-site incineration alternative would comply with removal program's policy encouraging the use of alternatives to land disposal, such as treatment or recycling. Residue from the incineration of the soil (ash) would be landfilled at a RCRA-permitted facility.

5.2.2 Implementability

Technical Feasibility and Availability

Implementation of this alternative would involve the use of standard earth moving and hauling equipment. The technologies proposed for excavation, dewatering, material handling and off-site disposal are all demonstrated and commercially available. Conventional erosion and sedimentation controls will be maintained in all areas during removal activities. Site access would be obtained with little difficulty; no temporary roads would be required for on-site activities. Labor and resources are readily available and could be obtained locally. Transportation loads would require manifests and transportation by licensed hazardous waste haulers.

The off-site hazardous waste incinerator that receives the soil must have a RCRA Part A or Part B permit and must be in compliance with such permit. The availability of incineration capacity is not expected to be a concern.

For costing purposes, it is assumed that the the soil and debris would be transported to the ThermalKEM incinerator in Rock Hill, South Carolina.

Administrative Feasibility

Because the source of contamination is removed from the site, it is likely that the public will accept this alternative.

CERCLA 121(e) exempts any response action conducted entirely on site from having to obtain a Federal, State or local permit. Obtaining the necessary approvals (i.e., landfill and state approvals) for disposal of the soil is not expected to be a problem. Approval time may vary, but it is estimated to be approximately six weeks.

5.2.3 Cost

The total estimated cost of implementation of this alternative is approximately $5.04 million. Table 5-2 presents a summary of this cost estimate.

PROJECT LOCATION: CAMP ALLEN AREA B NORFOLK, VIRGINIA
PROJECT NAME: REMOVAL ACTION - ALTERNATE 2: OFF-SITE INCINERATION
CONTRACT NUMBER: CTO-0176

DESIGN STATUS:30%__60%__90%__Final__
DATE: August 10, 1993
PREPARED BY: Baker Environmental

Account Number	DESCRIPTION OF ITEM	WBS UNITS	U/M	COST/WB UNIT ($)	TOTAL MU MATL COST($)	TOTAL MU/LABO COST($)	TOTAL MU/EQUI COST($)	TOTAL CONTRACT COST($)
33.01	MOBILIZATION AND PREPARATORY WORK							
33.01.01	Mobilize Equipment & Facilities	1	LS	4500	2500	2000		4500
33.01.03	Prework Submittals/Implementation Plan	1	LS	10000		6000	4000	10000
33.01.04	Setup/Construct Temporary Facilities	1	LS	4000	2000	2000		4000
33.01.05	Construct Temporary Ultilites	1	LS	7500	1500	2000	4000	7500
33.02	MONITORING,SAMPLING,TESTING,ANALYSIS							
33.02.03	Personnel Air Sampling/Analysis	100	EACH	140				14000
33.02.05	Sampling/Analysis of Surface Water/Groundwater	100	EACH	650				65000
33.02.06	Sampling/Analysis of Soil	70	EACH	750				52500
33.02.90	TCLP Analysis of Soil	25	EACH	1500				37500
33.03	SITE WORK							
33.03.02	Clearing and Grubbing	1.5	ACRE	3800		2700	3000	5700
33.03.13	6" Gravel Road	307	CY	20				6140
33.03.05	Fencing	480	LF	5				2400
33.05	SURFACE WATER COLLECTION AND CONTROL							
33.05.07	Sediment Barriers - Silt Fencing	500	LF	1.4	500	200		700
33.06	GROUNDWATER COLLECTION AND CONTROL							
33.06.90	Vacuum System Dewatering	6	WEEK	5000				30000
33.08	SOLIDS COLLECTION AND CONTAINMENT							
33.08.01	Excavation	3120	CY	10		19700	11500	31200
33.08.02	Waste Containment - Loading	3120	CY	5		6900	8700	15600
33.08.90	Drying Pad	10000	SF	1				10000

Table 5-2

PROJECT LOCATION: CAMP ALLEN AREA B NORFOLK, VIRGINIA
PROJECT NAME: REMOVAL ACTION - ALTERNATE 2: OFF-SITE INCINERATION
CONTRACT NUMBER: CTO-0176

DESIGN STATUS:30%__60%__90%__Final__
DATE: August 10, 1993
PREPARED BY: Baker Environmental

Account Number	DESCRIPTION OF ITEM	WBS UNITS	U/M	COST/WB UNIT ($)	TOTAL MU MATL COST($)	TOTAL MU/LABO COST($)	TOTAL MU/EQUI COST($)	TOTAL CONTRACT COST($)
33.09	LIQUIDS/SEDIMENTS COLLECT & CONTAIN							
33.09.03	Waste Containment - Decon. Fluids	6200	GAL	1.4	1870	4570		8680
33.09.90	Decon Pad	1800	SF	5				9000
33.13	PHYSICAL TREATMENT							
33.13.90	Pilot Scale Treatment System	6	WEEK	10000				60000
33.15	STABILIZATION/FIXATION/ENCAPSULATION							
33.15.04	Pozzolan Processes (Drying Agent)	1950	TON	50	58500	19500	19500	97500
33.19	DISPOSAL							
33.19.02	Transport to TSDF - Soil and Debris	204	LOAD	1300				265200
33.19.03	Disposal Fees and Taxes - Rubble	720	TON	60				43200
33.19.03	Disposal Fees and Taxes - Soil and Debris	4095	TON	1000				4095000
33.19.92	Disposal Fees and Taxes - Treatment Sludge	700	GAL	0.6				420
33.20	SITE RESTORATION							
33.20.01	Earthwork (backfill, spread, and compact)	2600	CY	24	15600	28700	18100	62400
33.20.04	Revegetation	1.5	ACRE	1800	1600	525	575	2700
33.21	DEMOBILIZATION							
33.21.01	Remove Temporary Facilities	1	LS	2500		1500	1000	2500
33.21.02	Remove Temporary Utilities	1	LS	1750		750	1000	1750
33.21.04	Demobilization Equipment,Facilities	1	LS	5000		2500	2500	5000
33.21.06	Post Construction Submittals	1	LS	5000		4000	1000	5000

Table 5-2

PROJECT LOCATION: CAMP ALLEN AREA B NORFOLK, VIRGINIA
PROJECT NAME: REMOVAL ACTION - ALTERNATE 2: OFF-SITE INCINERATION
CONTRACT NUMBER: CTO-0176

DESIGN STATUS:30%___60%___90%___Final__
DATE: August 10, 1993
PREPARED BY: Baker Environmental

Account Number	DESCRIPTION OF ITEM	WBS UNITS	U/M	COST/WB UNIT ($)	TOTAL MU MATL COST($)	TOTAL MU/LABO COST($)	TOTAL MU/EQUI COST($)	TOTAL CONTRACT COST($)
33.22	FIELD SUPERVISION							
33.22.90	Field Supervision	1	LS	68000		58000	10000	68000
33.23	TECHNICAL OVERSIGHT							
33.23.90	Technical Oversight	1	LS	10000		8000	2000	10000
33.23.91	Data Validation	1	LS	6000		5000	1000	6000
	TOTAL COST							5039090

Table 5-2

6.0 COMPARATIVE ANALYSIS

The two alternatives were qualitatively assessed and compared to each other based on the same criteria used in Section 5.0: effectiveness, implementability, and cost. A summary of the comparative analysis is presented in Table 6-1.

6.1 Effectiveness

Protectiveness

With respect to the site and adjacent properties, Alternatives 1 and 2 would provide equal levels of protection of public health and the environment. Both alternatives would immediately remove the source of contamination at the site. Thus, the risk of contaminant migration to downstream surface waters and through groundwater seepage would be mitigated.

In addition, both alternatives can be implemented within the proposed removal action schedule.

With respect to protection of human health and the environment at the disposal facility, Alternative 2 would potentially achieve a higher level of protection than that offered by Alternative 1. Incineration provides the greatest degree of protectiveness, since permitted hazardous waste incinerators are required to achieve 99.99 percent destruction and removal efficiencies and handle residuals as hazardous waste if characterized as such. In contrast, waste disposed at a RCRA-permitted hazardous waste disposal facility is not destroyed, but treated or immobilized, if required, to meet treatment standards and deposited in a cell with a double liner system. Post-closure monitoring periods of at least 30 years are required.

Use of Alternatives to Land Disposal

Alternative 1 does not use an alternative to land disposal, whereas Alternative 2 meets the NCP bias for alternatives to land disposal by destruction of the waste through incineration.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES
CAMP ALLEN AREA B, NAVAL BASE, NORFOLK, VIRGINIA

Evaluation Criteria	Alternative 1: Off-Site Disposal in Hazardous Waste Landfill	Alternative 2: Off-Site Incineration
Effectiveness:		
• Protectiveness	• Removes remaining source of contamination. Reduces contaminant migration. Reduces risk of ingestion/inhalation of contaminants. Minimum double liner required. Minimum 30-year post closure period.	• Removes remaining source of contamination. Reduces contaminant migration. Reduces risk of ingestion/inhalation of contaminants. 99.99% destruction and removal efficiency required.
• Use of Land Disposal Alternatives	• Does not use an alternative to land disposal.	• Meets the NCP bias for alternatives to land disposal.
Implementability:		
• Technical Feasibility	• Removal and disposal technologies are all feasible.	• Removal and disposal technologies are all feasible.
• Availability	• Landfill capacity is adequate.	• Incinerator capacity is adequate.
• Administrative Feasibility	• Public opposition not anticipated, comments to be addressed following public comment period. Landfill and state approval required for disposal.	• Public opposition not anticipated, comments to be addressed following public comment period. Landfill and state approval required for disposal.
Cost:		
• Capital Cost	• $1.97 million	• $5.04 million
• Operation and Maintenance Cost	• None	• None
• Other Costs	• None	• None

6.2 Implementability

Technical Feasibility

The technical feasibility of implementing the removal action under each Alternative is very similar. The on-site activities are the same and utilize conventional technologies. The availability of both hazardous waste landfill space and incineration capacity is not expected to be a concern.

Administrative Feasibility

Since the proposed removal action will permanently remove the source of contamination from the site with minimal risk to the community or the environment, public opposition to either alternative is not anticipated. Obtaining the necessary approvals for disposal of the soil is not expected to be a problem for either facility (landfill or incinerator). Approval times for both facilities are similar (approximately six weeks).

Cost

The estimated capital cost of Alternative 1 is $1.97 Million compared to $5.04 Million for Alternative 2. There are no operation and maintenance costs associated with either alternative.

7.0 PROPOSED REMOVAL ACTION

Based on the preceding evaluation, it is proposed that the source of contamination at the Camp Allen Landfill Area B be excavated and transported to a RCRA-permitted landfill (Alternative 1). Documentation of the material disposed in Area B is not available to support listing the soil and debris as hazardous or restricting the waste from land disposal under the RCRA Land Disposal Restrictions.

Disposed material characterization borings at Area B were sampled and analyzed for full TCLP and RCRA characteristics determined that the representative soil samples from the Area B source areas are not characteristic hazardous wastes. Excavation and off-site disposal provides an immediate reduction of the potential threat to public health and the environment at the site. Disposal at a RCRA-permitted hazardous waste landfill provides a high degree of long-term protection.

8.0 REFERENCES

Baker Environmental, Inc. Camp Allen Remedial Investigation Report, Draft Final, August 1993.

Baker Environmental, Inc. Baseline Risk Assessment, Draft Final, August 1993.

Baker Environmental, Inc. Feasibility Study Report, Draft Final, August 1993.

CH_2M Hill. Remedial Investigation, Site Summary, Camp Allen Landfill, April 1992.

Malcolm Pirnie. Site Suitability Assessment, Proposed Brig Expansion (P-977) Naval Station, Norfolk, Virginia, June 1984.

Malcolm Pirnie. NACIP Program, Confirmation Study, Sewell's Point Naval Complex, Norfolk, Virginia, April 1987.

Malcolm Pirnie. Installation Restoration Program, Remedial Investigation, Interim Report, Norfolk Naval Base, Norfolk, Virginia, May 1988.

APPENDIX A
DEFINITION OF CHEMICAL TERMS

APPENDIX A

DEFINITION OF CHEMICAL TERMS

Acid	Substances can be either an acid, a base of a salt. Generally, acids have a sour taste and can dissolve certain metals. Common acids include vinegar, tomatoes, lemons, and stomach fluid.
Caustic	A caustic substance may burn skin by chemical action. Caustics are corrosive. Acids are caustic and burn skin (Drano is an example).
Inorganic	An inorganic compound is one without carbon and is derived from minerals. Metals, such as silver, gold, and tin, are examples of inorganics. Other examples include cyanide and arsenic.
Organic	Organic compounds all contain carbon and are obtained from vegetable or animal sources (living organisms) or are synthesized (combined) in a laboratory. Examples of organics include alcohol, glycerin (used in lotions and cosmetics) and acetone (used in solvents for lacquers, varnishes, and plastics).
PAHs	Polyaromatic Hydrocarbons (PAHs) are derived from the incomplete combustion of petroleum and coal (carbon-based substances). PAHs are also produced by the incomplete combustion of tobacco smoking, and also occur naturally.
PCBs	Polychlorinated biphenyls (PCBs) are synthetic chemicals once used in inks, plastics, and paper coatings. Because they withstand high temperature, PCBs are excellent fluids for use in electrical transformers and capacitors. These chemicals are no longer produced and are stringently regulated.
Solvent	A solvent is a substance which can dissolve another substance. For example in saltwater, the water is the solvent dissolving the salt. Likewise, chemical solvents, such as paint stripper, dissolve old paint.
SVOC	Semivolatile Organic Compounds (SVOCs) are those organic compounds which do not readily evaporate. Examples include PAHs and naphthalene (found in moth balls).
TAL	The Target Analyte List (TAL), developed by the USEPA, is a list of 23 inorganic compounds which are routinely assessed in the laboratory. An analyte is the chemical for which a sample is analyzed.
TCL	The Target Compound List (TCL), also developed by the USEPA, is a list of organic compounds which are routinely assessed in the laboratory.
TCLP	The Toxicity Characteristic Leaching Procedure (TCLP), developed by the USEPA, is a laboratory method to analyze contaminants. If the contaminants exceed the limit set by the USEPA for this procedure, they are then characterized as hazardous.
VOC	Volatile Organic Compounds (VOCs) are those organic compounds which evaporate quickly. Examples include chloroform (used as an anesthetic and solvent), acetone (used in nail polish), and benzene (found in gasoline).

APPENDIX B
DISPOSAL CHARACTERIZATION BORING LOGS

Baker Environmental, Inc.

FIELD TEST BORING RECORD

PROJECT: MCB Camp Allen, Landfill Area B
S.O. NO.: 19176 BORING NO.: SBC-1
COORDINATES: EAST: NORTH:
ELEVATION: SURFACE: TOP OF PVC CASING:

RIG: Mobile Drill - 53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
SIZE (DIAM.)	2"		4.25"		4/14/93	10.0'	Clear, 74°		1215
LENGTH	2'		5'			4.0'	@ station #2		
TYPE	STD		H.S.A.						
HAMMER WT.	140 lbs.								
FALL	2.5'								
STICK UP									

REMARKS: Top 6" discarded. Log was prepared from split spoon. A second drill station was used to collect the required amount of sample from 2-4'.

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL / ROCK	Sample ID — Type - No. (N = No Samp.)	Samp. Rec. (Ft. & %)	SPT Blows Per 0.5' / RQD (Ft. & %)	Lab. Class. / Pen. Rate	PID (ppm)	Classification (Grain Size, Principal Constituents, Etc.) / Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density / Hardness	Moisture Content, Organic Content, Plasticity, and Other Observations / Weathering, Bedding, Fracturing, and Other Observations	SOIL / ROCK	ELEVATION
1			1.6	2-2 3-3		0.5	Fine Sand and Silt, Trace Clay. Root Frgs. Moderately Friable	DK Grey		Dry - Damp		
2												
3			NR			10.0 PS	No Recovery			Water Table		
4												
5			1.7	4-2 2-1		0.5	Clayey, Silty Fine Sand. Wood Fragments Moderately Plastic	DK Grey/ Black		Wet		
6												
7			NR	3-1 3-2			No Recovery					
8												
9			2.0	1-2 1-3			Clayey, Silty Fine Sand	DK Grey/ Black		Wet		
10												

DRILLING CO.: Industrial Marine Service BAKER REP.:
DRILLER: B. Roper BORING NO.: SBC-1 SHEET 1 OF 1

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORD

PROJECT: MCB Camp Allen, Landfill Area B
S.O. NO.: 19176 BORING NO.: SBC-2
COORDINATES: EAST: NORTH:
ELEVATION: SURFACE: TOP OF PVC CASING:

RIG: Mobile Drill - 53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
SIZE (DIAM.)	2"		4.25"		4/14/93	10'	Clear, 74°		1450
LENGTH	2'		5'						
TYPE	STD		H.S.A.						
HAMMER WT.	140 lbs.								
FALL	2.5'								
STICK UP									

REMARKS: Top 6" discarded. Log was prepared from split spoon. All 2' interval samples were sent to laboratory for compositing.

DEPTH	SOIL / ROCK	Sample ID — Type-No. (N = No Samp.)	Samp. Rec. (Ft. & %)	SPT Blows Per 0.5' / RQD (Ft. & %)	Lab. Class. / Pen. Rate	PID (ppm)	Classification (Grain Size, Principal Constituents, Etc.) / Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density / Hardness	Moisture Content, Organic Content, Plasticity, and Other Observations / Weathering, Bedding, Fracturing, and Other Observations	SOIL / ROCK	ELEVATION
1			1.8	1 3 5 4		2-2.5	Clayey, Silty Fine Sand	MD-DK Brown	loose	Dry - Damp		
2												
3			2.0	2 3 2 1		5.0 / 8.0	2.0-2.8 Same above 2.8-4.0 Δ color, Δ clay DK Grey, ↑ clay	DK Grey/ Black	loose	Damp		
4												
5			1.6	2 0 1 1		1.5	Silty, Clayey Fine Sand. Slight Δ color	Lt-Md Grey Green Brown	loose	Wet		
6												
7			2.0	1 1 2 2		25 / 40	6.0-7.5 same above 7.5-8.0 Fine Sand, Some silt, some clay	DK Grey/ Black	loose	Wet		
8												
9			2.0	2 1 3 2		5.0	Fine Sand, Trace Silt, Trace Clay	Md-DK Grey		Wet		
10												

DRILLING CO.: Industrial Marine Service BAKER REP.:
DRILLER: B. Roper BORING NO.: SBC-2 SHEET 1 OF 1

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORD

PROJECT: MCB Camp Allen, Landfill Area B
S.O. NO.: 19176 BORING NO.: SBC-3
COORDINATES: EAST: NORTH:
ELEVATION: SURFACE: TOP OF PVC CASING:

RIG: Mobile Drill - 53	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
SIZE (DIAM.)	2"		4.25"		4/14/93	4'	Clear, 74°		1605
LENGTH	2'		5'			10'	@ station #2		
TYPE	STD		H.S.A.						
HAMMER WT.	140 lbs.								
FALL	2.5'								
STICK UP									

REMARKS: Top 6" discarded. Log was prepared from split spoon. Auger bound @ 4' due to hollow metallic chamber. Relocate 5'

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL / ROCK	Sample ID — Type-No. (N = No Samp.)	Samp. Rec. (Ft. & %)	SPT Blows Per 0.5' / RQD (Ft. & %)	Lab. Class. / Pen. Rate	PID (ppm)	Classification (Grain Size, Principal Constituents, Etc.) / *Classification (Name, Grain Size, Principal Constituents, Etc.)*	Color / *Color*	Consist. or Density / *Hardness*	Moisture Content, Organic Content, Plasticity, and Other Observations / *Weathering, Bedding, Fracturing, and Other Observations*	SOIL / ROCK	ELEVATION
1			1.6	3 4 3 6		30	Clayey, Silty Fine Sand. Roots Abundant	Md-Dk Brown	loose firm	Damp		
2												
3			1.9	2 3 2 3		8	Clayey, Silty Fine Sand.	Md-Dk Brown	loose-slight Plastic	Wet		
4												
5			2.0	2 2 4 3		15-34	Clayey, Silty Fine Sand.	Lt Grn. Grey to Md Grey	loose-slight plastic	Wet-Damp		
6												
7			2.0	2 7 7 2		1.5	Silty Fine Sand Some Clay	Dk Green	loose occais. slight plastic	Wet		
8												
9			0.5	3 3 2 2		1.3	Fine Sand, Some Silt Some Clay	Md-Dk Brown	Very loose	Wet		
10												

DRILLING CO.: Industrial Marine Service BAKER REP.:
DRILLER: B. Roper BORING NO.: SBC-3 SHEET 1 OF 1