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DRAFT WORK PLAN FIELD INVESTIGATION PLAN REMEDIAL INVESTIGATION FIREFIGHTER TRAINING AREA, LIGHTER AMPHIBIOUS RESUPPLY CARGO (LARC) 60 MAINTENANCE AREA, AND AUTO CRAFT AREA FORT STORY VA

10/1/1994

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Draft Work Plan

FIELD INVESTIGATION PLAN

Remedial Investigation For Fort Story, Virginia

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October 1994

US Army Corps
of Engineers
Baltimore District

0285-588

RECYCLED PAPER

DRAFT WORK PLAN:
FIELD INVESTIGATION PLAN

FIREFIGHTER TRAINING AREA (SITE 4)
LARC MAINTENANCE AREA (SITE 6)
AUTO CRAFT BUILDING AREA (SITE 7)

FORT STORY
VIRGINIA BEACH, VIRGINIA

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

CONTRACT DACA31-94-D-0017
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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

The Department of Defense (DOD) initiated investigations at its facilities to evaluate potential environmental impacts, if any, associated with prior suspected hazardous material releases. The Installation Restoration Program (IRP) was developed by DOD in response to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to implement this investigation and remedial process.

Fort Story is participating in the IRP in which DOD has been investigating hazardous waste sites by identifying, evaluating and controlling the migration of hazardous contaminants.

1.2 INTRODUCTION

The U.S. Army Corps of Engineers (ACE), Baltimore District, has developed Scopes of Services, all dated 17 August 1994, for Remedial Investigations (RI) at the Firefighter Training Area (Site 4), LARC Maintenance Area (Site 6) and the Auto Craft Building Area (Site 7). Malcolm Pirnie has prepared the Work Plan in accordance with the ACE Scope of Services for performance of the RIs.

Malcolm Pirnie is performing the RIs as a contractor to the ACE. The methodology and activities described herein will serve as the general operating procedures for field personnel performing the RIs.

The Work Plan is comprised of three components: a Field Investigation Plan (FIP), a Chemical Data Acquisition Plan (CDAP) and a Site Safety and Health Plan (SSHP). The FIP (this document) establishes the investigation objectives, provides the project approach and rationale and outlines the methods and activities which will be followed by the field personnel performing the field investigations. The CDAP presents the detailed standard operating procedures which will be utilized by project personnel to develop a site database of appropriate data quality to support a site and risk assessment. The SSHP details health and safety protocol, referencing OSHA regulations, which will be followed by field personnel during performance of the site work.

1.3 PROJECT PURPOSE

The purpose of the FIP is to define the tasks for identifying potential contamination, delineating the extent of contamination, identifying contamination migration and assessing risk from the sites at Fort Story. The results of the RIs will determine the need for further action based on the presence of contaminants in the soil, sediment, surface water and groundwater.

1.4 PROJECT SCOPE

This FIP addresses the necessary sampling and analytical tasks to provide information for the following:

- Delineation of the nature and extent of contamination at each site.
- Evaluation of potential migration of contaminants.
- Assessment of risks to human health and the environment posed by each site.
- Recommendations for future action at each site based on the findings.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 LOCATION AND DESCRIPTION

2.1.1 Facility Location and Description

Fort Story is located in southeastern Virginia within the city of Virginia Beach, Virginia. Fort Story occupies an area of approximately 1,450 acres and is situated on Cape Henry which roughly divides the waters of the Chesapeake Bay to the north and the Atlantic Ocean to the east. Figure 2-1 provides the location of Fort Story.

The chief potable water supply in the region is the surface water reservoir system operated by the City of Norfolk. To a minor extent, potable water is obtained from groundwater sources. Groundwater use at Fort Story is restricted to withdrawal from a single well located at the Lighter Amphibious Resupply Cargo (LARC) maintenance area. The unavailability of construction data for this well precludes a determination of which aquifer unit provides the groundwater withdrawn from this well. Water is obtained from the well for nonpotable uses only.

The Virginia Department of Environmental Quality (DEQ), Division of Water, Tidewater Region, regulates wells in the region. Information obtained by Montgomery-Watson during performance of the PA/SI indicated that groundwater use is discouraged because of poor quality and withdrawal restrictions. High dissolved iron and manganese and total solids characterize the groundwater in the upper aquifers.

2.1.2 Site Locations and Descriptions

Firefighter Training Area (Site 4)

The Firefighter Training Area (FTA) (Site 4) is located in a sandy flat area situated adjacent to the northern flank of the central sand ridge in the southwestern section of Fort Story along Hospital Road. Figure 2-2 provides the location of the site.

The site is underlain by Holocene Age sand deposits. The sand is typically subrounded to subangular, usually poorly graded and medium to coarse grained. The coarse grained facies is generally restricted to depths in excess of 4 feet. Silty sand is present to a depth of 2 to 4 feet in the eastern area of the site.

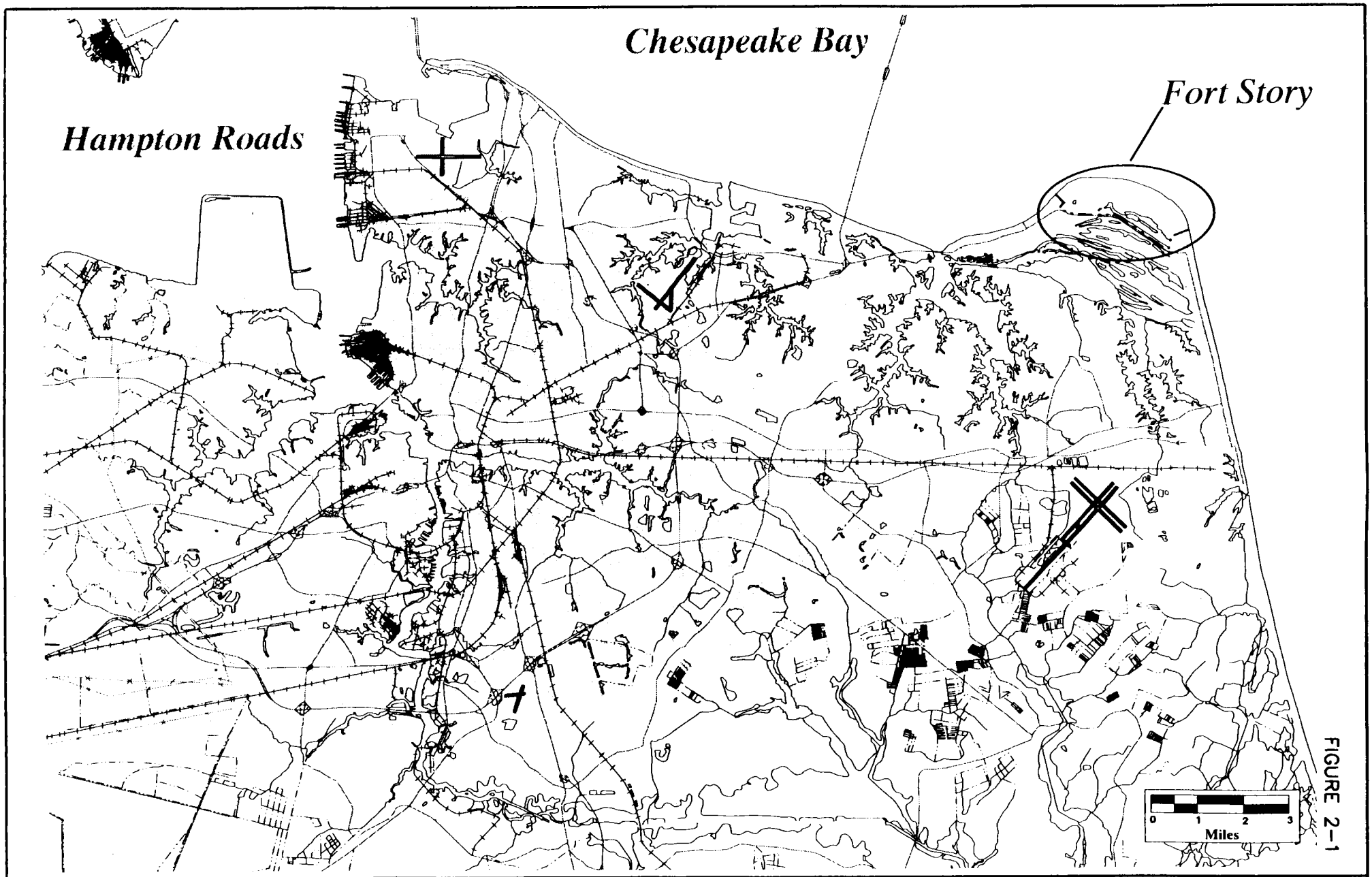

FIGURE 2-1

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FORT STORY, VIRGINIA
FIELD INVESTIGATION PLAN
FORT STORY LOCATION MAP

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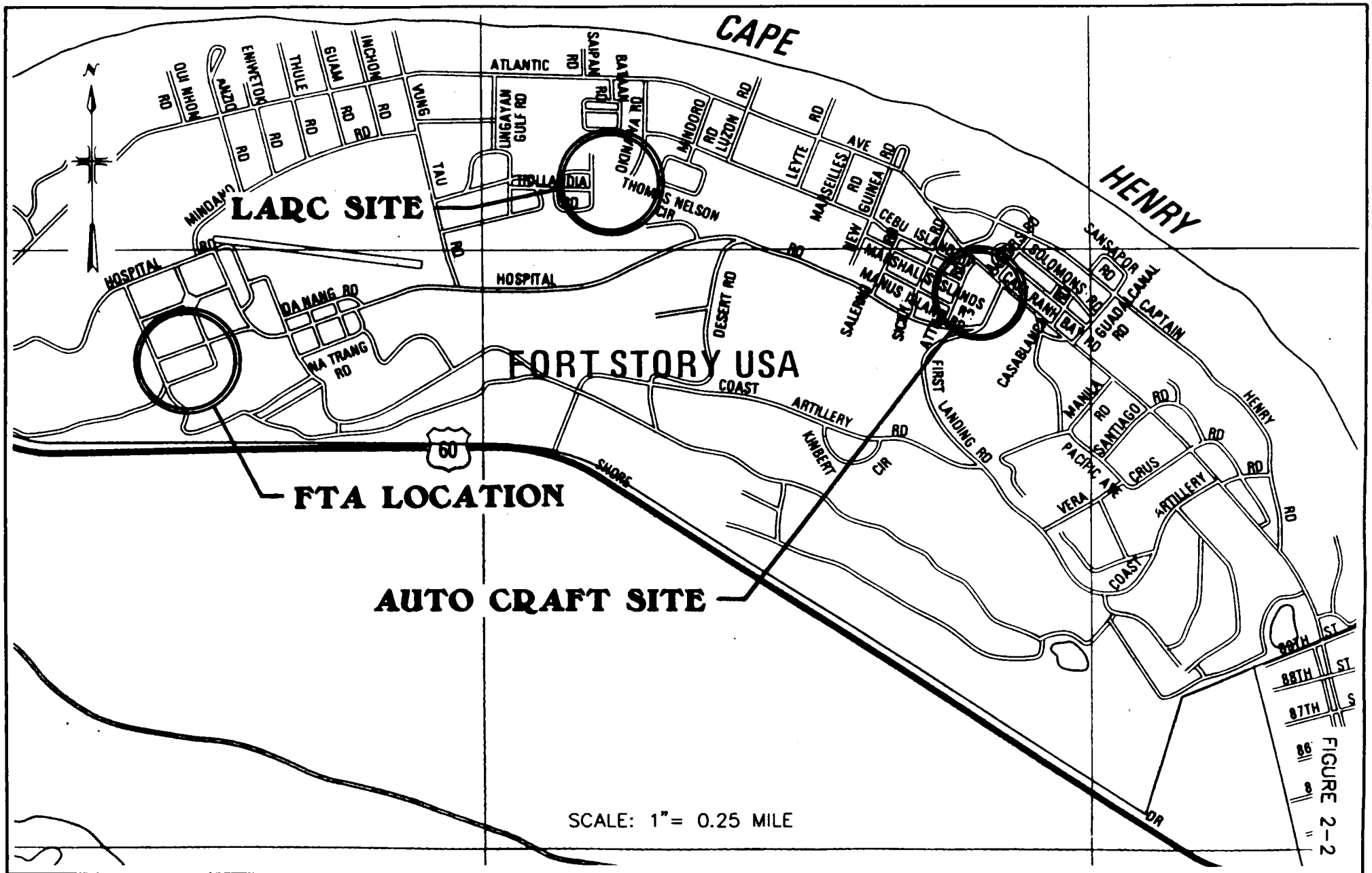

FIGURE 2-2

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FORT STORY, VIRGINIA
FIELD INVESTIGATION PLAN
SITE LOCATION MAP

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Water table elevations range from 8.5 feet National Geodetic Vertical Datum (NGVD) in the northern portion of the site to less than 8.3 feet NGVD in the southern portion. Groundwater flow is from the northwest across the site to the south and east. Hydraulic conductivity values calculated by James M. Montgomery, Inc. (JMM) at the site range from 1.17×10^{-2} to 1.37×10^{-2} centimeters per second (cm/sec) with an average value of 1.24×10^{-2} cm/sec.

LARC Maintenance Area (Site 6)

The Lighter Amphibious Resupply Carco (LARC) maintenance area, which is the maintenance and wash rack area for LARC vehicles is located in the sand flat area that lies between the coastal dune complex to the north and the central sand ridge to the south. The LARC area includes Buildings 1081, 1082, 1083 and 1084. The location of the site is provided on Figure 2-2.

The LARC area is underlain by Holocene Age sand deposits. The sand is typically described as fine to medium grained, poorly graded, subrounded and occasionally slightly silty. At one location within the site area, a peat lens less than 1 foot in thickness was encountered at a relatively shallow depth.

The measured depth to groundwater at the site ranged from 7.47 below ground surface to 5.07 feet below ground surface. Based on water level data from on-site and nearby off-site wells, the water table elevation ranges from approximately 8 feet NGVD in the southern portion of the site to less than 5 feet NGVD in the unpaved, wash rack area. Additionally, the water level data suggest the possible existence of a cone of depression in the vicinity of the wash rack supply well located at the southwestern corner of the wash rack area. The minimum groundwater level elevation within the cone of depression is approximately 4 feet NGVD. Though locally variable in magnitude and direction, the prevailing hydraulic gradient for the site is in a northward direction toward the coastline. Hydraulic conductivity values range from 1.99×10^{-3} to 1.84×10^{-2} centimeters per second (cm/sec) with an average value of 7.42×10^{-2} cm/sec.

Auto Craft Building Area (Site 7)

The Auto Craft Building is located in the sand flat area south of the coastal dune complex at the junction of Atlantic Avenue and Cebu Road. The location of the site is provided on Figure 2-2.

The site is underlain by Holocene Age sand deposits. The sand is typically characterized as fine to medium grained, subrounded and poorly graded. Discontinuous units of clay and silt are located in the north area of the site at depths of 5 feet and thicknesses of 2 feet.

Depths to groundwater at the site vary from 7.80 feet below ground surface to 10.25 feet below ground surface. Water table elevations at the site ranged from 5.3 feet NGVD near the building to 5.07 feet NGVD. The lateral hydraulic gradient at the site is directed to the northeast. Based upon a limited number of wells, hydraulic conductivity values range from 3.23×10^{-3} to 7.11×10^{-3} centimeters per second (cm/sec) with an average value of 5.17×10^{-3} cm/sec.

2.2 HISTORY

2.2.1 Facility History

Fort Story began as a military installation in 1914. On 10 March 1914, the Virginia General Assembly ceded 343.1 acres, located at Cape Henry in Princess Anne County, to the U.S. Government "to erect fortifications and for other military purposes." On 14 June 1914, the U.S. District Court acquired title for the land by condemnation proceedings against the Cape Henry Syndicate and other landowners in the Cape Henry subdivision. War Department General Order No. 31, dated 24 July 1916, named this newly acquired tract of land Fort Story in honor of Major General John Patton Story.

Construction of powder magazines and projectile rooms got underway during the latter part of 1916 and by February 1917, construction of the 16-inch howitzer fortifications had begun. Also, during February 1917, the 2nd and 5th Coast Artillery Companies established the military garrison at Fort Story. From 1917 through 1925, the installation continued to develop as a small coast artillery garrison consisting of little more than its armament. The only land expansion which occurred during the period was the acquisition of 9.38 acres from the Norfolk and Southern Railway Company in March 1917.

During World War I, Fort Story was integrated into the Coast Defenses of Chesapeake Bay which included Fort Monroe (Headquarters) and Fort Wool (located at the east entrance of the Hampton Roads Bridge Tunnel). On 9 June 1925, Fort Story was designated a Harbor Defense Command by War Department General Order No. 13, but the change in designation added little to the dwindling post-war activity of the garrison.

As World War II approached, Fort Story began an extensive development. Many of the facilities which exist at Fort Story today were constructed then, and the installation increased in size to 1,439 acres. An additional 11.82 acres were acquired in 1963 which increased its size to its present 1,451 acres. In the 1940s, the construction included temporary artillery batteries, theater, chapel, fire station, mess halls, barracks, Officer and NCO clubs, shops, additional powder magazines and projectile rooms, six underground storage bunkers and 19 seacoast searchlights.

In December 1941, the Headquarters of the Harbor Defense Command was moved from Fort Monroe to Fort Story. Two harbor defense installations were added to the network in 1941; Fort John Curtis and a mine base. On March 1, 1944, the Chesapeake Bay sector of the Harbor Defenses was inactivated, and control passed to Headquarters, Southeastern Sector, Eastern Defense Command, Raleigh, North Carolina.

By September 1944, Fort Story began a transition from a heavily fortified coast artillery garrison to a convalescent hospital. At the time of its closing on 15 March 1946, the hospital had accommodated over 13,472 patients.

At the closing of World War II, Fort Story again changed missions. This time it assumed the role which it still has today, to train units and individuals for amphibious operations. Fort Story was officially transferred to the Transportation Corps in July 1948 as a subpost of the Transportation Training Command, Fort Eustis, Virginia.

Fort Story trains army personnel in amphibious and Logistics Over-the-Shore (LOTS) operations. Fort Story is the only available facility which has the necessary natural terrain features and beaches, sand, surf, variable tide conditions (bay and ocean) and hinterlands, all of which are normally experienced by amphibious and LOTS operations. In addition, Fort Story contains beach training areas, tactical training areas and a series of trails throughout the installation. The deep water ship anchorage, off-road driving areas and soil of sufficient bearing strength for the heavy vehicles are indispensable in amphibious training, LOTS training and the testing of new equipment, doctrines and techniques.

2.2.2 Site History

Firefighter Training Area (Site 4)

A temporary hospital facility was located on the site until 1960 when it's operations were relocated and the structure demolished. From 1960 through 1978, the area adjacent to the southern boundary along U.S. Route 60 was used as a wildlife game preserve. The

site was cleared and used for fire training exercises in the latter part of 1978. Prior to 1980, these exercises consisted of extinguishing JP-4 aviation fuel, which was released and ignited directly to the surface soils of the site. The releases were reportedly extinguished by a mixture of firefighting foam and water.

A concrete pit was constructed in 1980 and used for firefighting training exercises. The 100 foot square by 2 foot deep pit was used on a monthly basis. Procedures included:

- Filling the pit with several inches of water and 75 to 400 gallons of fuel (i.e., JP-4, contaminated fuels and hydraulic fluid).
- Igniting the mixture and allowing it to burn.
- Extinguishing the fire with 50 to 150 gallons of firefighting foam.
- Allowing the residues of the fuel and extinguishing mixtures to evaporate naturally.

Additionally, during 1980 through 1986, many installation personnel reportedly used the area as an unauthorized dumping site. The site is currently free of any surface debris or evidence of buried debris. In June 1988, firefighting training activities were discontinued at this site.

LARC Maintenance Area (Site 6)

During the 1950s, the wash rack area was first used as the barge amphibious resupply cargo (BARC) motor pool and maintenance facility. In 1964, the BARC vehicle was phased out and the LARC vehicle was prototyped. Presently, this is the only facility on the East Coast available to the Army Transportation Corps for amphibious training.

In 1982, the LARC facility was modified with the construction of a concrete wash rack pad. In 1987, the U.S. Army Environmental Hygiene Agency (USAEHA) conducted a study at Site 6 and concluded that the soil north of the wash rack area was contaminated with grease, oil, lead and chromium but that this contaminated material did not pose a significant health hazard.

The underground storage tank (UST) area is located approximately 600 feet south of the wash rack area. A 10,000-gallon UST is located at the north gate of the LARC vehicle motor pool. This tank was installed in 1983. Although JMM's April 1990 field visits

to this area identified soil-stained zones around the UST, no reports of tank failing or leaking have been documented. These soil-stained areas may have been caused by overfilling or spillage during use. In 1987, the USAEHA sampled the UST and found it contained oil, water, 1,1,1-trichloroethane and chromium. This UST is not presently being used.

Auto Craft Building Area (Site 7)

Two solvent dip tanks were used for the storage of spent degreasing solvents and waste oils when the building was in use. Previously, waste oil generated at the site was piped out of the building and into the adjacent UST. The UST has subsequently been removed.

Prior to its use as the Auto Craft Building, the site was used as a motor pool for wheeled vehicles. During the winter of 1989 and 1990, a portion of the building was destroyed by fire. A portion of the building's concrete foundation and some debris remain in the area. A previous investigation indicated that waste solvents were poured directly on the ground to control weed growth along the fence surrounding the site. A visual inspection by JMM in 1990 verified the presence of an apparent petroleum-based product around the area and distinctive petroleum odor at the site.

2.3 PREVIOUS CONDITIONS

As a result of the numerous operations and activities carried out on the base, hazardous substances and hazardous wastes have been disposed of at various locations on the base resulting in environmental contamination.

2.4 PREVIOUS INVESTIGATIONS

2.4.1 JMM Preliminary Assessment/Site Investigation

Preliminary assessment/site investigation (PA/SI) activities were conducted in 1991 and 1992 by James M. Montgomery, Inc. (JMM). JMM conducted the PA/SI to determine the presence of significant contamination at eight sites including:

- Landfill 1 (Site 1)
- Landfill 2 (Site 2)
- Firefighter Training Area (Site 4)
- Underground Fuel Storage Tank Farm (Site 5)
- LARC Maintenance Area (Site 6)
- Auto Craft Building (Site 7)
- Drainage Outfall Line (Site 8)
- NIKE Facility (Site 9)

Executive Summary

For the eight sites investigated by JMM, three were recommended for no further action: Landfill 1, Drainage Outfall Line and the NIKE Facility. Further confirmatory investigation was recommended at Landfill 2. A remedial investigation/feasibility study (RI/FS) was recommended at the remaining four sites: FTA, Underground Fuel Storage Tanks, LARC area and Auto Craft Building.

Firefighter Training Area

Site Investigations

Groundwater and soil matrices were investigated at the site with the installation of three monitoring wells and nine soil borings. Figures 2-9 and 2-10 in Appendix A show sampling locations. The locations for the wells and borings were selected based on the results of the soil gas survey conducted the field investigation.

Soil Gas Survey

Soil gas samples were collected at the intersections of a 100-foot by 100-foot grid having seven rows and six columns. Results of the survey indicate that potentially contaminated areas of the site include the north central site location, as indicated by detectable levels of benzene, and the extreme southeastern corner of the site, as indicated by elevated levels of benzene, 1,1,1-trichloroethane (TCA) and total hydrocarbons. Figures 2-12, 2-13 and 2-14 in Appendix A present the soil gas contour plots for these contaminants.

Soil Analytical Results

Figure 2-9 in Appendix A provides the sampling locations along with the soil analytes detected above trigger levels that warrant further investigation. Several analytes were detected at levels above the trigger levels. The largest concentration was associated with areas adjacent to the fire training pit (FTP), as well as an area located in the southeast corner of the site. Total fuel hydrocarbons, copper, and lead were detected above trigger levels at the site. Numerous analytes without trigger levels were detected at the site including xylenes and numerous semivolatiles.

Groundwater Analytical Results

Figure 2-10 in Appendix A provides the sampling locations along with the groundwater analytes detected above trigger levels. As with soil samples, numerous analytes were detected above trigger levels with the major areas of contamination associated with the FTP and the southeast corner of the site. Benzene, total fuel hydrocarbons, phenol, 1,2-dichloroethane (1,2-DCA), TCA and 1,1-dichloroethene (1,1-DCE) were detected above trigger levels.

LARC Maintenance Area

Site Investigations

Groundwater and soil matrices were investigated at the site with the installation of four monitoring wells and twelve soil borings. Figures 2-20 and 2-21 in Appendix A show sampling locations. The locations for the wells and borings were selected based on consideration of current and previous site activities suspected to have potentially resulted in the contamination of the environmental media at the site.

Soil Analytical Results

Figure 2-20 in Appendix A provides the sampling locations along with the soil analytes detected above trigger levels that warrant further investigation. Several analytes were detected at levels above the trigger levels. The site has two main areas of possible environmental concern: the wash rack area where the LARCs are parked which has an oil/water separator and the existing underground storage tank (UST) located at the southern end of the site. Total fuel hydrocarbons, copper, zinc, and lead were detected above trigger levels at the site.

Groundwater Analytical Results

Figure 2-21 in Appendix A provides the sampling locations along with the groundwater analytes detected above trigger levels. As with soil samples, numerous analytes were detected above trigger levels at the wash rack and UST areas. Benzene, vinyl chloride, total fuel hydrocarbons, and 1,1-DCE were detected above trigger levels.

Auto Craft Building Area

Site Investigations

Groundwater and soil matrices were investigated at the site with the installation of two monitoring wells and eight soil borings. Figures 2-23 and 2-24 in Appendix A show sampling locations. The locations for the wells and borings were selected based on consideration of current and previous site activities suspected to have potentially resulted in the contamination of the environmental media at the site.

Soil Analytical Results

Figure 2-23 in Appendix A provides the sampling locations along with the soil analytes detected above trigger levels that warrant further investigation. Several analytes were detected at levels above the trigger levels. Total fuel hydrocarbons, zinc, and lead were detected above trigger levels at the site.

Groundwater Analytical Results

Figure 2-24 in Appendix A provides the sampling locations along with the groundwater analytes detected above trigger levels. Total fuel hydrocarbons was the only analyte detected above trigger levels in groundwater.

2.4.2 IT Removal Actions

IT Corporation conducted several rapid response removal actions at several sites at Fort Story in 1994. Their removal actions consisted of the following:

Firefighter Training Area:

- Removal and containerization of Fire Training Pit (FTP) materials including water, concrete and debris.

- Excavate the contaminated soil surrounding the concrete pad of the FTP until a Total Petroleum Hydrocarbon (TPH) action level of 50 parts per million (ppm) was met.
- Transport the excavated soils to the LARC area for treatment.
- Demolish the concrete-lined FTP.
- Remove the monitoring well at the edge of the FTP.
- Install a recovery trench in the base of the FTP excavation using gravel to backfill the excavated FTP area.
- Transport and dispose of concrete and liquid wastes from the FTP area.

LARC Area:

- Dispose off-site of two piles of soil previously stockpiled adjacent to the LARC area which were believed to contain F-listed solvents.
- Design and install an in-situ bioremediation system for the treatment of TPH-contaminated soils.
- Bioremediate the soil within the LARC "sandbox" and the soils from the FTP to a TPH level of less than 50 ppm.
- Return the treated "sandbox" soils to the sandbox area.

2.5 GEOGRAPHY AND CLIMATE

2.5.1 Geography

Land features encountered at Fort Story consist of linear sand ridges, sand flats and wetland areas. The topography is dominated by a series of prominent linear, well-drained sand ridges that roughly bisect the Fort Story area. The central ridges trend parallel to the coastline and are characterized by maximum elevations in excess of 85 feet, National Geodetic Vertical Datum (NGVD) of 1929. A second series of sand ridges located on Fort Story are comprised of an active dune complex located adjacent to the coastline. The coastal sand ridges attain maximum elevation in excess of 25 feet NGVD. Broad, poorly drained sand flats are located adjacent to the sand ridge areas. Land surface elevations in the sand flat areas typically range between 5 and 10 feet, NGVD. Wetland areas, which are common features of the sand flats, occur locally in closed depressions. South of the central

sand ridges, the Fort Story topography consists of an extensive wooded, wetland area, formerly a back-bay, lagoonal feature. Most of the installation's facilities and operations are confined to the sand ridge and sand flat areas.

2.5.2 Climate

Historical climatological data for the Fort Story area is recorded at the Norfolk-Virginia Beach Airport, and is available from the National Atmospheric and Oceanic Administration (NOAA) through the National Climatic Data Center. The Norfolk-Virginia Beach Airport is located approximately 8 miles west of Fort Story.

The following table summarizes average precipitation and temperature for the Fort Story area from 1941 to 1970.

Average Temperature and Precipitation Data
Fort Story Area (1941 - 1970) (NOAA, 1982)

Month	Temperature (°F)			Precipitation (inches)
	Daily Min	Daily Max	Daily Mean	
January	32.2	48.8	40.5	3.35
February	32.7	50.0	41.4	3.31
March	38.9	57.3	48.1	3.42
April	47.9	67.7	57.8	2.71
May	57.2	76.2	66.7	3.34
June	65.5	83.5	74.5	3.62
July	69.9	86.6	78.3	5.70
August	68.9	84.9	76.9	5.92
September	63.9	79.6	71.8	4.20
October	53.3	70.1	61.7	3.06
November	42.6	60.5	51.6	2.94
December	34.0	50.6	42.3	3.11
Annual	50.6	68.0	59.3	44.68

Fort Story climate is characterized by mild winters and hot summers. Temperatures are affected by air flowing through the area from the Atlantic Ocean. Average relative humidity is high in the area, with an afternoon average humidity of approximately 60 percent, which rises in the nighttime to 80 percent. In Winter, the average temperature is 41 degrees F, with the lowest temperature recorded of 5 degrees F for the period of record. The average Summer temperature is 76 degrees F with a highest recorded temperature of 104 degrees F.

The greatest percentage of precipitation occurs between April and September, which encompasses most of the growing season. The maximum amount of rainfall recorded in the area was 9.95 inches in a one day period.

2.6 GEOLOGIC SETTING

The Virginia Coastal Plan sediments consist of an eastward thickening wedge of generally unconsolidated, interbedded sands and clays with minor occurrences of gravel and shell fragments. Within the Fort Story area, the sediments are in excess of 3,500 feet thick and are underlain by crystalline basement rocks. Utilizing well data from the region, Meng and Harsh determined the distribution of the principal aquifer units within these sediments. Their analysis indicated that the hydrogeologic framework of the coastal plain sediments in the Fort Story vicinity consists of six aquifer units separated by intervening semi-confining units. In order of increasing depth from ground surface, these aquifers include:

- The Columbia Aquifer, which is the water table aquifer, comprised of undifferentiated Holocene age sediments.
- The Yorktown - Eastover Aquifer, which occurs within the Yorktown and Eastover formations of Pliocene and Miocene age, respectively.
- The Chickahominy - Piney Point Aquifer, which occurs within the Chickahominy and Piney Point formations of Eocene Age and the Old Church Formation of Oligocene Age, where present.
- The Upper, Middle, and Lower Potomac Aquifers, which occur within the Potomac Group of Cretaceous age.

The Columbia, Yorktown - Eastover, and Chickahominy - Piney Point aquifers and intervening semi-confining units comprise roughly the upper one-quarter of the total thickness of the coastal plain sediments in the Fort Story area. The remaining sediment thickness, in turn, consists of the Upper, Middle and Lower aquifers and intervening semi-confining units that comprise the Potomac Group.

Meng and Harsh indicate that the thickness of the Columbia Aquifer in the Fort Story area is approximately 120 feet and separated from the underlying Yorktown - Eastover Aquifer by the Yorktown semi-confining layer which has an approximate thickness of 40 feet. The lithology of the Columbia Aquifer is characterized primarily as Holocene beach sand and nearshore marine sand which commonly contains pebbles, shell fragments and blocks of coquinite. James Montgomery, Inc. has performed slug tests on 28 wells on the base. Hydraulic conductivities average 8.2 centimeters per second (cm/sec). The underlying Yorktown semi-confining unit is comprised of the upper portion of the Yorktown formation and described as marine silt with occasional interbeds of fine sand and coquina.

The Yorktown - Eastover Aquifer underlies the Yorktown confining unit and is encountered between the depths of 160 and 440 feet below ground surface.

Based on depth to water measurements obtained from the 28 monitoring wells that JMM installed for the PA/SI and three other studies, the water table occurs at an average depth of 10 feet in the Fort Story area. Generalized water table contours in the Fort Story area are characterized by the presence of a local groundwater divide in the vicinity of the central sand ridge complex. Groundwater elevations in excess of 10 feet are encountered in this area. Groundwater levels decline to approximately 3 feet in coastal sand ridges to the north. South of the central sand ridge complex, groundwater levels decline to approximately 8 feet in the vicinity of the wetland area. Based on these data, the general ambient groundwater flow directions are northward toward the coastline and southward toward the wooded wetland, from the central sand ridge area.

3.0 FIELD INVESTIGATION METHODOLOGIES

The purpose of the RI field investigations is to evaluate the presence or absence of contaminants in the environmental media at each site. The proposed investigation focuses on delineating the extent of contamination. The data will also be used to make recommendations as to future remedial investigation work to be conducted at each site, if necessary.

The following subsections give general methodologies for each field investigative technique to be used. More specific methodologies for certain activities are provided in Malcolm Pirnie's Chemical Data Acquisition Plan (CDAP). Potential health and safety concerns for each investigation activity are addressed in Malcolm Pirnie's Site Safety and Health Plan (SSHP).

3.1 FIP RATIONALE

The main objective of the RI is to determine the nature and extent of any contamination in soil, sediment, surface water and groundwater at each site. The data generated from the chemical and physical analysis will be of sufficient quality to represent site conditions for determining if additional remedial investigations or removal actions are warranted or to prepare decision documents for no further actions. To achieve these objectives, the RI program is following the USEPA's document entitled "Data Quality Objectives for Remedial Response Actions, USEPA/540/G-87/003, March 1987. These levels are described below:

- **Level V. Non-standard Methods.** Analyses which may require method modification and/or development.

- **Level IV. Contract Laboratory Program (CLP) Routine Analytical Services.** This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data.

- **Level III. Laboratory analysis using methods other than the CLP Routine Analytical Services.** This level is used primarily in support of engineering studies using standard EPA approved procedures. Some procedures may be equivalent to CLP Routine Analytical Services, without the CLP requirements for documentation.

- **Level II. Field Analysis.** This level is characterized by the use of portable analytical instruments which can be used on-site, or in mobile laboratories stationed near a site (close-support labs). Depending upon the type of contaminants, sample matrix, and personne skills, qualitative and quantitative data can be obtained.

- **Level I. Field Screening.** This level is characterized by the use of portable instruments which can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.

3.1.1 Site Data Quality Objectives

The DQO levels for samples collected at each site will be Level I for field screening (e.g., HNu readings), Level II for on-site portable GC analysis and Level III for chemical analysis. Chemical analysis will be for Target Compound List (TCL)/Target Analyte List (TAL) compounds, unless otherwise noted. CLP methodologies will be used but without CLP data package generation and documentation. Level III data, combined with QA monitoring by the U.S. Army Corps of Engineers (ACE) will result in the desired data quality and confidence to support decisions regarding each site.

The data quality levels for samples are attained through sound chemical quality management, achieved through the implementation of the CDAP. The CDAP is in accordance with ACE document ER-1110-1-263, particularly Appendix E, Sampling Handling Protocol for Low, Medium and High Concentration Samples of Hazardous Waste; and applicable EPA and DOT standards and regulations.

On-site Portable GC Analysis

A field portable GC will be mobilized to Fort Story for on-site screening of volatile and semivolatile organics by CLP SOW, July 1993 for both aqueous and soil media. The field GC will produce Level II analytical data. The on-site analysis will be used to direct field activities in determining the vertical and horizontal extent of contamination in soils and groundwater.

Off-site Laboratory Analysis

Analytical methods will follow the CLP Statement of Work OLM01.9 of 7/93 for organics and ILM03.0 of 7/93 for inorganics unless otherwise noted. All analytical methods,

volume requirements, holding times and preservation requirements are outlined in Section 6.0 of the base-wide CDAP.

Table 6-2 of the CDAP identifies the sampling and analytical summary for each site. The base-wide CDAP and site-specific attachments will identify the precision, accuracy, and completeness goals used to select sampling and analysis methods.

The approach to be taken in the project will be structured so that the initial tasks of the RI will be performed to characterize the physical conditions of each site and to define the nature and extent of contamination.

The scope of the activities to be performed for the RI will be continually reviewed throughout the project. Modifications will be made when necessary to redirect or refine the project focus as the data indicate. All modifications will receive the proper prior approvals.

3.1.2 Existing Data Assessment

To better define data gaps and establish a comprehensive field investigation approach, an assessment of the existing database as it relates to the nature and extent of contamination and support of the risk assessment is necessary.

The identification of data needs based on the uses and decisions we are to make is critical in establishing the field investigation approach for the project. These data needs focus on the following:

- Establishing background data.
- Determining the extent of surficial/subsurface soil contamination on-site.
- Evaluating the potential migration of contaminants from source soils to groundwater on-site and downgradient of the site.
- Evaluating the potential migration of contaminants from source soils to surface water and sediment to on-site and downgradient receptors.

Based on a review of existing data and the data quality objectives for the project, the data gaps identified for the field investigation are summarized as follows:

Firefighter Training Area (Site 4)

- The vertical and lateral extent of contamination in soils and groundwater at the Fire Training Pit, solvent plume area and northern area of the site has not been established.
- The vertical and lateral extent of contamination in groundwater downgradient of the site has not been established.
- Presence/absence of contamination in other media such as sediments and surface water has not been determined.
- Impacts to human health and the environment through exposure to contaminants has not been evaluated.

LARC Maintenance Area (Site 6)

- The vertical and lateral extent of contamination in soils and groundwater at the UST, oil/water separator and sand box areas has not been established.
- The vertical and lateral extent of contamination in groundwater downgradient of each area at the site has not been established.
- Presence/absence of contamination in other media such as sediments and surface water has not been determined.
- Impacts to human health and the environment through exposure to contaminants has not been evaluated.

Auto Craft Building Area (Site 7)

- The vertical and lateral extent of contamination in soils and groundwater at the site has not been established.
- The vertical and lateral extent of contamination in groundwater downgradient of the site has not been established.
- Impacts to human health and the environment through exposure to contaminants has not been evaluated.

Based on a review of the data gaps listed above, the data needs identified for the field investigation are summarized as follows:

- Vertical extent of soil contamination at each site will be addressed by the installation of soil borings with samples collected at three depths.

- Vertical and lateral extent of on-site and downgradient groundwater contamination at each site will be addressed by the collection of groundwater samples from DPT points, DPT temporary well points and permanent monitoring wells.

- Presence/absence of contamination in other media such as sediment and surface water at the FTA and LARC sites will be addressed with the collection of numerous samples for these media.

- Impacts to human health and the environment through exposure to contaminants will be evaluated through the performance of a baseline risk assessment at each site.

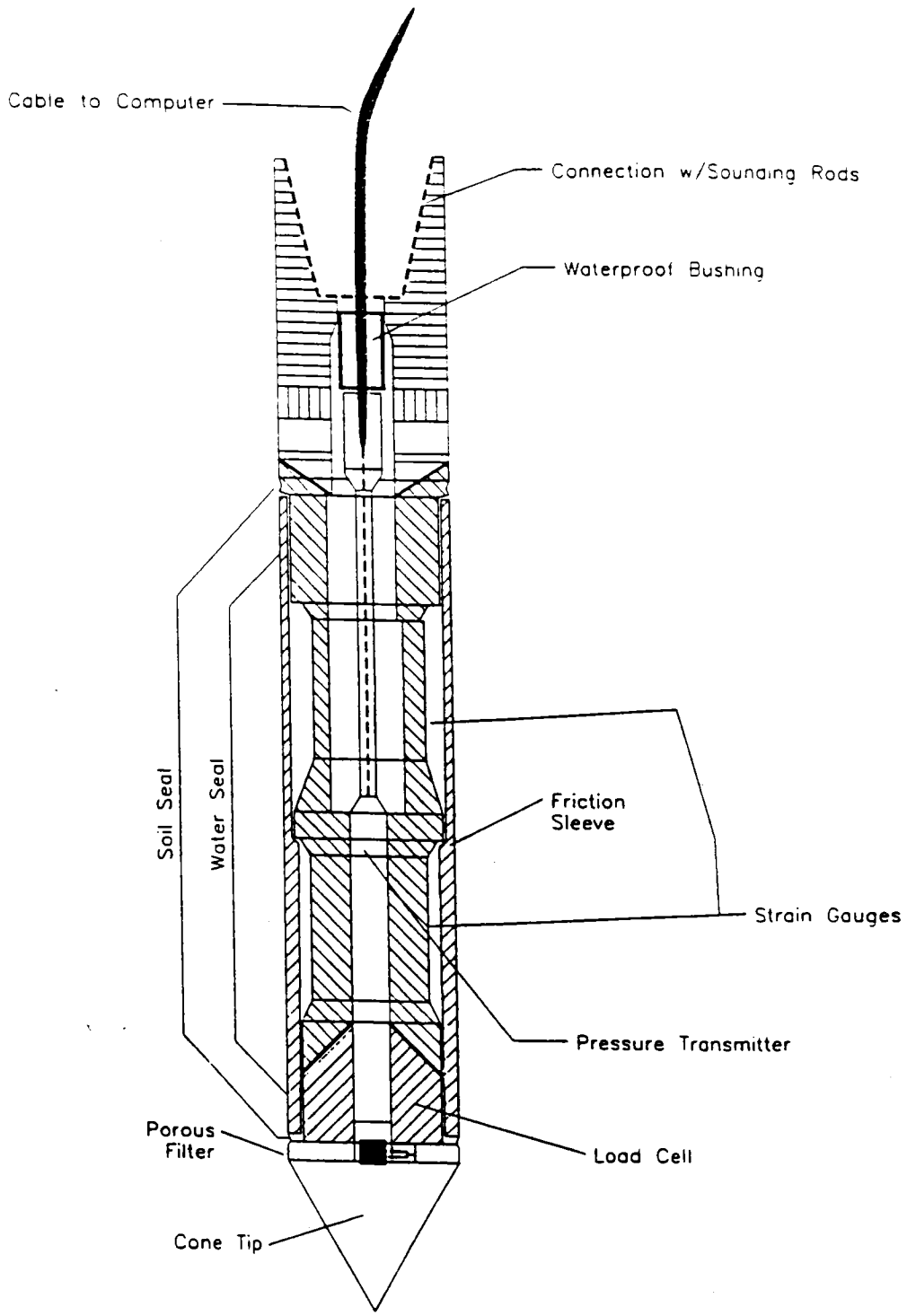
3.2 SOIL BORINGS

Hand augers will be used for near-surface soil borings (i.e., borings to a maximum depth of 12 inches whenever possible. Samples will be collected from depth intervals as noted in Section 4.0.

Where field conditions do not allow for hand augering of near-surface soil borings, and where deeper soil samples are required (i.e., overburden soil borings), a direct push technology (DPT) rig equipped with a piezocone (Figure 3-1) and soil sampler (Figure 3-2) will be used. DPT minimizes the need for conventional drilling techniques by using hydraulic pressure to push geotechnical tools and subsurface sampling devices into the formations to be investigated. No cuttings are generated and no foreign substances are permanently introduced into the sampling zone during the procedure. Therefore, the volume of investigation derived wastes is reduced. Use of the DPT and piezocone is governed by ASTM Standard 3441.

The piezocone provides real-time geotechnical data. The data from the piezocone is continuously fed into the on-board computer, and a standardized soil type is generated for the formation through which the piezocone is passing. This information may be viewed on the computer's monitor in real-time. The geotechnical information generated on site by the piezocone will be calibrated to provide stratigraphic information for each site. This will be done by collecting a continuous core sample adjacent to two of the piezocone soundings and adjusting the standardized soil type descriptions to match the log from the core sample.

FIGURE 3-1



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PIEZOCONE SCHEMATIC

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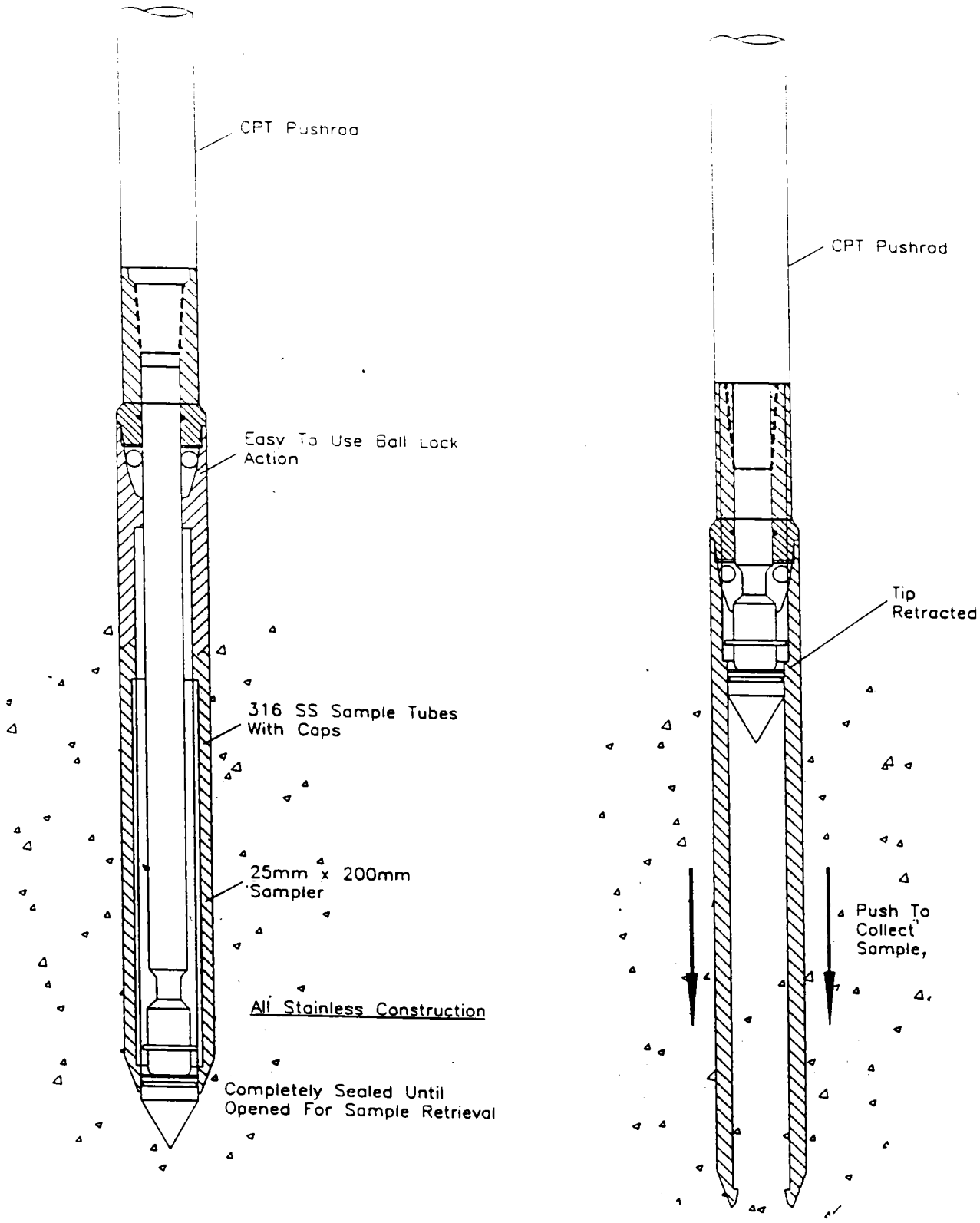
FIGURE 3-2



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Based on the information generated by the piezocone, pertinent sampling intervals will be identified while on site. Once a specific sampling interval is identified, the appropriate sampling tool will be used to collect discrete samples of soil.

For collecting discrete soil samples, the tip is advanced to the top of the interval to be sampled. The tip is retracted and the sampler (Figure 3-2) is pushed through the desired interval to collect the sample. The sample is contained inside a stainless steel sampling tube located in the sampling tip. The sampling interval will be increased at those locations where duplicates samples are to be collected.

The soils recovered from borings for calibration to piezocone logs will be logged in accordance with the Unified Soil Classification System (USCS) by a geologist in accordance with the USACE Borehole Logging Requirements. Information generated during the boring process will be recorded on field boring logs with additional information recorded in the field log book.

If subsurface conditions are encountered where the DPT method for soil borings is not appropriate (e.g., large cobbles or boulders which may impede drilling), other drilling techniques are as hollow stem auger or water rotary drilling will be used upon approval of the USACE. If these drilling techniques are necessary, potable water will be used.

Soil samples to be sent to a laboratory for chemical analysis will be removed from the center of each soil sampler using a stainless steel spatula or spoon and placed in the appropriate sample jars. A portion of the soil samples obtained from each split spoon will be jarred and screened with a photoionization detector (PID) to screen for volatile organic compounds. Aliquots for VOC analysis will be taken directly from the soil sampler, packed tightly into two 40 ml VOA vials and stored at 4°C. Prior to placement into the sample jars, all soil not requiring volatile organic analysis will be homogenized as described in Section 3.1.1 and the CDAP. Refer to Table 4-2 of the CDAP for sample volume requirements.

Upon completion of overburden soil borings, the borehole will be tremie grouted to the ground surface with a bentonite grout. Any excess soils generated during the boring process will be disposed of in accordance with Section 3.9.

Drilling Equipment Decontamination Procedures

To prevent the possibility of cross-contamination between boreholes, the DPT rig and all drilling accessories will be thoroughly decontaminated before arriving on-site and

between all drilling sites. A pressurized steam cleaner will be utilized for decontamination of the DPT rig and accessories. Decontaminant water and materials will be disposed of in accordance with Section 3.9.

3.3 TEMPORARY WELL INSTALLATIONS

Temporary direct push well points will be installed to provide for short-term continued monitoring of groundwater at each site. The location of these points will be based on on-site portable GC analysis of groundwater samples collected by DPT. Monitoring point depth and screened interval will also be based on observed geologic data collected by the DPT piezocone, soil borings correlated to the DPT data, existing groundwater data and distribution of suspected contaminants within the subsurface. The presence of saturated sediments may be confirmed, if required, by conducting pore water dissipation tests over the interval which will be penetrated by the monitoring point screen.

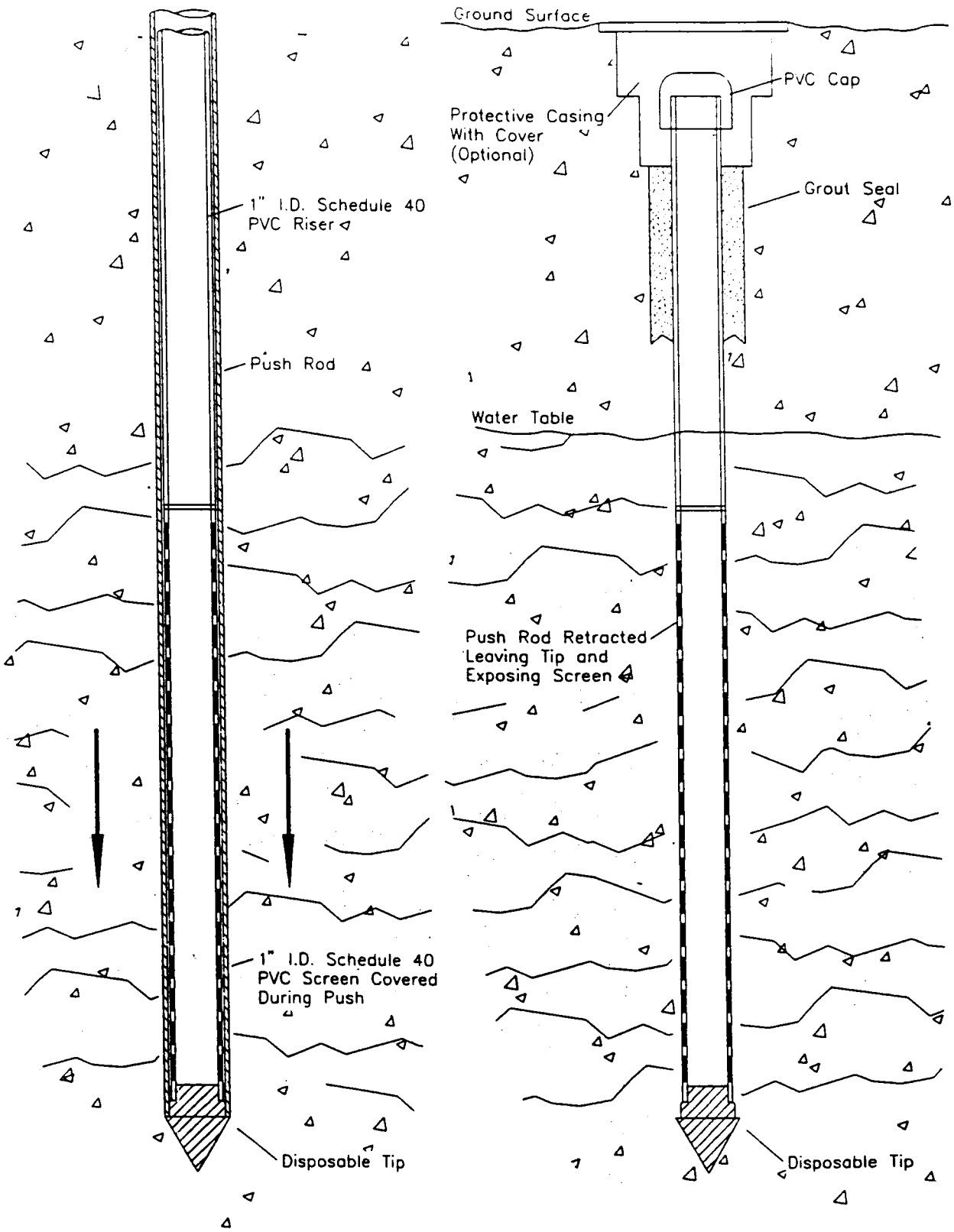
Temporary monitoring points will be installed using direct push technology. A disposable cone penetrometer tip will be attached to a 1-inch I.D. PVC screen which joined to a l-inch I.D. PVC riser pipe. The screen and riser is shielded during the pushing (drilling) activities by the push rod which abuts against the disposable tip. The assembly is pushed to the desired depth. Upon reaching the desired depth, the push rod is retracted which exposes the PVC screen to the sediments. A grout seal and well security casing, either flush-mount or standard 2.5-foot stick-up, is constructed. The well construction is illustrated in Figure 3-3.

3.4 MONITORING WELL INSTALLATIONS

Groundwater monitoring wells will be installed at each site after on-site analysis of groundwater samples collected by DPT. These wells will be placed to provide for long-term continued monitoring of groundwater at each site. Monitoring well depths and screened intervals will also be based upon observed data collected by the DPT piezocone, soil borings, existing geologic data, and suspected contaminant distribution in the subsurface media.

Monitoring wells will be installed using a minimum 6 1/4-inch inside diameter (I.D.) hollow stem augers (minimum 11-inch outside diameter). The augers will be advanced either by a truck-mounted or track-mounted drilling rig depending upon the ground surface

FIGURE 3-3



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conditions. Each monitoring well will be constructed in accordance with the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD).

The monitoring wells will be installed through the hollow stem augers and will be constructed of 2-inch I.D., flush-threaded PVC well screen and riser. The well screen will be constructed of an appropriate slot size (0.010 or 0.020 inch) to minimize the intrusion of finer materials. A sand material of suitable particle size distribution will be placed in the annulus around the well screen to provide a filter zone. The filter pack and screen size will be determined utilizing data from previous investigations. The sandpack will be placed two (2) feet above the top of the well screen. A minimum of one (1) foot of bentonite seal will then be placed above the sandpack while the remainder of the annular space will be cement grouted to the surface. Each well will be flush mounted and protected by a protective manhole. Figure 3-4 provides a typical flush mounted well design.

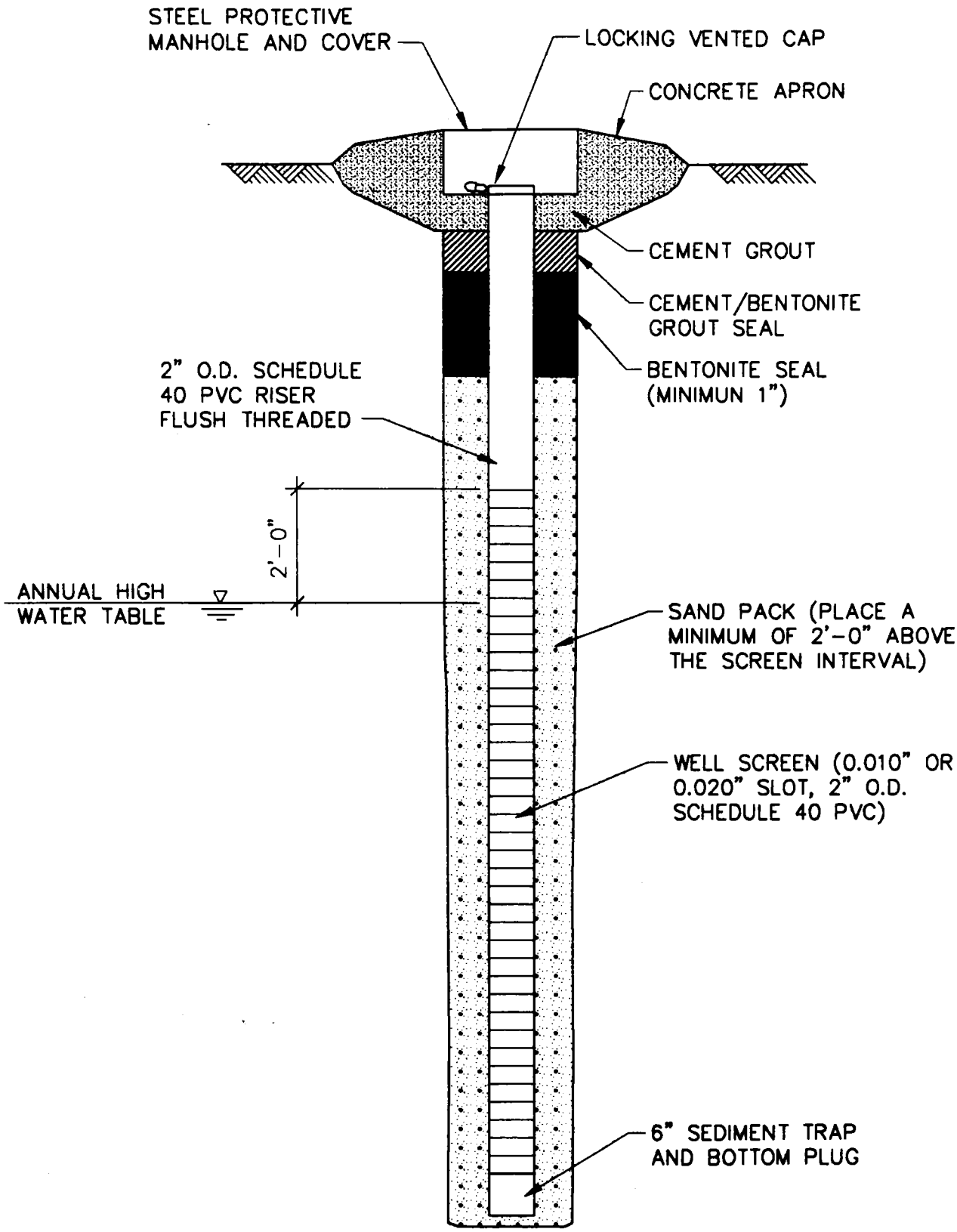
Each well will be developed by the drilling contractor until a turbidity-free groundwater (< 50 NTUs) is obtained and the water is stable with respect to specific conductance and temperature. Specific conductance and temperature readings will be measured before, during and after development and recorded in the field documents. Development water from the wells will be collected and disposed of in accordance with Section 3.9.

3.5 SURFACE SOIL SAMPLES

The surface soil sampling program will evaluate the nature and extent of any surface and near-surface soil contamination. The sample locations will generally be centered around areas of potential contamination due to accidental spills or historic industrial activities, areas of stressed vegetation and stained soils. The distances between sample points will be established based on historical information regarding the nature and source of contaminants, the shape and size of the contaminated area, and visual extent of contamination. Surface soil samples will be collected at locations described in Section 4.0.

Surface soil samples will be collected to a depth of twelve inches below ground surface. The semi-volatile and inorganic aliquots of the surface soil samples will be collected from the upper six inches of soil. The samples will be collected using a stainless steel scoop or stainless steel hand auger as deemed appropriate based on site conditions. VOC aliquots of the surface samples will be collected from the six to twelve inch depth interval as these

FIGURE 3-4



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constituents are not likely to be found closer to the surface. They will be collected as discrete samples using a stainless steel hand auger. Aliquots for VOC analysis will be placed directly from the hand auger, packed tightly into two 40-ml VOA vials, and immediately stored at 4°C in an ice chest. Prior to commencing and between each sample collection point, decontamination of sampling tools and equipment will be performed as described in Section 3.8.

Sample Homogenization

Samples will be homogenized (with exception of volatile organic samples which will be placed directly into two 40-ml vial sample containers) by first removing rocks, twigs, leaves and other debris if they are not considered part of the sample. The soil will then be removed from the sampling device, placed in a decontaminated stainless steel bowl, and thoroughly mixed using a stainless steel spoon. Refer to Table 4-2 of the CDAP for sample volume requirements.

After mixing, a portion of the sample will be placed in a sample container and the container will be closed securely. The sample containers will then be labelled, added to the chain-of-custody and stored at 4°C for shipping to the laboratory.

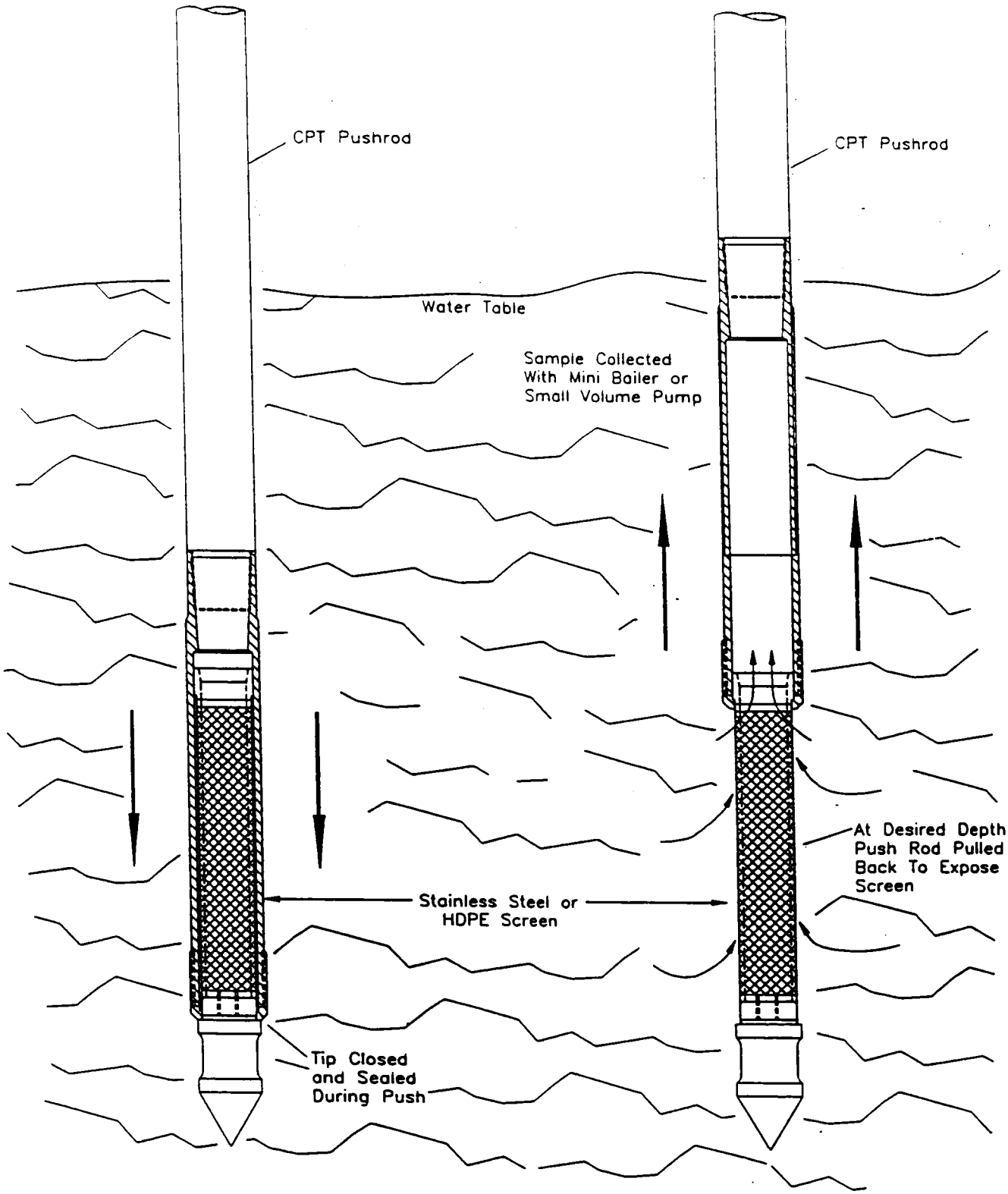
3.6 GROUNDWATER SAMPLING

DPT Procedures

Following completion of soil boring to the desired depth by DPT rig, groundwater samples will be collected for laboratory chemical analyses. Sampling of groundwater at each location will not require well development. For collecting discrete groundwater samples, the tip is advanced below the water table to the bottom of the interval to be sampled. The push rod is retracted (Figure 3-5) exposing a 0.005 inch slotted stainless steel screen. The sample is collected from the push rod using a 0.75 inch bailer or pump.

Groundwater samples will be collected by DPT water sampler for laboratory chemical analyses. Groundwater samples collected for volatile analyses will be collected first, followed by inorganic analytes. Volatile samples will be placed in two 40-ml vials. Refer to Table 4-2 of the CDAP for sample volume requirements. All samples will be placed in a cooler at 4°C and made ready for shipment to the laboratory. Field pH, conductivity, and temperature will be measured.

FIGURE 3-5



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CPT GROUNDWATER SAMPLER

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Monitoring Wells/Temporary DPT Wells

Water levels will be measured at least twice in the existing and newly constructed monitoring wells during field investigation activities. Water levels will be measured with an electronic water level indicator. The following procedures will be used:

- Equipment operation and accuracy will be checked and documented prior to taking measurements.
- All pertinent well data will be recorded.
- The water level will be recorded to nearest 0.01 foot.
- Weather at time and date of measurement will be recorded.

Following monitoring well installation and development, groundwater samples will be collected from monitoring wells for laboratory chemical analyses (refer to the CDAP for details on sample collection). Sampling of groundwater at each well location will begin no sooner than 3 days following well development. Each well will be purged of three to five well volumes (or more if required for stabilization of field parameters) prior to collecting groundwater samples. Stabilization of field parameters during purging is defined as less than 10 percent change in value over two successive measurements for turbidity, temperature, conductivity, pH, dissolved oxygen, and Eh. The volume of standing water in the borehole will be calculated using the pre-purge water level, total depth of the well and a known constant for the number of gallons of water per foot of well diameter. Water purged from the well before sampling will be disposed of in accordance with procedures outlined in Section 3.9.

After purging, groundwater samples will be collected when the water level in the well has sufficiently recovered to a minimum of 75 percent of the pre-purge level or after two hours, whichever comes first. Field pH, conductivity, temperature, Eh, and turbidity will be measured for each well volume during purging in order to obtain a representative sample (refer to CDAP) from the aquifer, where field parameters reach equilibrium as discussed above, samples will be collected. Purging of the monitoring wells will be conducted using a PVC or disposable teflon bailer of appropriate dimensions for the well to be purged. Following collection of the organics samples, the groundwater samples will be filtered through 45 micron filters. Water passing through the 45 micron filter will be analyzed for

the inorganics identified in Table 4-2 of the CDAP.

After collection and transfer to the appropriate sample container, the samples will be secured in a cooler at 4°C and made ready for shipment to the laboratory.

3.7 SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediment samples will be collected to assess the potential for contaminants to migrate by storm water runoff and sediment deposition. Field information (e.g., pH, conductivity, temperature) will be recorded for the surface water. Surface water samples will be collected by direct immersion of sample bottles, where applicable, or a dipper jar, which will be decontaminated prior to collecting each sample. In the event that the surface water is heavily contaminated, the exterior of the sample bottles will be washed with soapy water and rinsed with deionized water after the bottles have been tightly capped. Care will be taken to avoid stirring up sediments that would contaminate or alter the water sample.

Sediment samples will be collected using a decontaminated stainless steel shovel or scoop following surface water sampling. Sampling will be conducted in a downstream-to-upstream order to limit disturbance of sediments upstream of a sample location. If the sampling team member has to enter the water, he will stand down stream of the sample point to avoid cross-contamination.

The sediment sample for volatile organic analysis will be immediately deposited in two, 40 ml glass vials with no mixing and placed in a cooler at 4°C for shipping to the laboratory to assure that the volatile fraction is not lost. Volatile sample fractions will not be homogenized. All samples collected for fractions other than volatiles will be homogenized prior to being placed in the sample containers to minimize bias of sample representativeness. Refer to Table 4-2 of the CDAP for sample volume requirements. The procedure for sediment sample homogenization is described in Section 3.1.1.

Sampling equipment will be decontaminated as discussed in Section 3.8. Refer to the CDAP for more detailed sampling methods and specific sample volumes.

3.8 DECONTAMINATION PROCEDURES

Cross contamination of samples from any source is to be avoided. To achieve this, all equipment used in sampling must be clean and free from the residue of any previous samples. All non-dedicated sampling equipment and boring materials must be cleaned prior to being used and reused. All DPT equipment will be steam cleaned in a predesignated location prior to use and between locations. All other sampling equipment, including bailers (if needed), will be decontaminated using the following procedure:

- Wash and scrub with low phosphate, laboratory-grade detergent
- Rinse with tap water
- Rinse with methanol (use hexane, followed by a methanol rinse, for oil and grease contaminated equipment)
- Rinse with deionized demonstrated analyte free water
- Air dry
- Wrap in aluminum foil for transport

In the case of oil-contaminated soils, sampling equipment will be steam-cleaned prior to decontamination procedures outlined above or be dedicated and disposed of after use.

Field instrumentation should be cleaned as per manufacturer's instructions. Probes such as those used in pH and conductivity meters and thermometers must be rinsed prior to and after each use with deionized water.

3.9 CONTROL AND DISPOSAL OF CONTAMINATED MATERIALS

The DPT rig uses direct push technology which does not generate drill cuttings. Borings will then be topped off with a cement/bentonite grout cap.

Drill cuttings generated during monitoring well installation will be containerized in U.S. Department of Transportation (DOT) approved, 55-gallon steel drums with the contents identified on weather-resistant labels attached to drum exteriors.

Groundwater discharged from monitoring wells during purging, development and sampling activities will be collected in DOT 55-gallon steel drums.

Groundwater that may be pushed out of the ground during soil boring activities will be allowed to infiltrate into the ground at each site if the following conditions are met:

- There is no free product observed present such as LNAPLs and DNAPLs.
- The infiltrating groundwater is being returned to the same water-bearing zone from which it is being purged.

Depending on the levels of personal protection used during the field investigation, some disposable personal protective equipment (PPE) and decontamination fluids will be generated. Every attempt will be made to wash surface contamination off so that PPE (e.g., Tyveks, gloves, and other disposable items) may be disposed of as ordinary trash. If contamination is suspected, these materials will be collected and containerized in DOT-approved, 55-gallon steel drums (separately from contaminated soils and water); the contents will be identified with weather-resistant labels attached to drum exteriors. Decontamination fluids, except those containing solvents, will be disposed of with drilling fluids generated at each site. Decontamination fluids containing solvents will be drummed separately from drilling fluids. Drums will be provided by the drilling contractor.

Drummed materials will be transported to, and staged at, a Fort Story-designated location. Malcolm Pirnie will maintain a log of the drums and drum contents; the contents will be evaluated upon receipt of results of the analytical data obtained during field investigations. If any drum is suspected to contain hazardous material, the drum will be securely sealed (i.e., capped and banded) and stored within an area approved by Fort Story. Fort Story will be notified regarding the contents of each drum. Malcolm Pirnie will determine and arrange for ultimate disposal with Fort Story providing manifest authorization. Nonhazardous disposable items will be contained and disposed of in a dumpster or via a licensed waste hauler, as appropriate.

3.10 SITE SURVEYING

A site survey will be completed using horizontal and vertical control to accurately locate and document RI sampling points at each site. The Fort Story GIS will be used if available. Malcolm Pirnie will subcontract all surveying required for the project site to a professional land surveyor licensed in the State of Virginia. Tasks will include surveying the

locations and elevations of all groundwater monitoring points and wells installed for this field investigation. The horizontal location of all other sampling locations (i.e., soil boring, sediment and surface water) will be established. Locations will be surveyed to the nearest 0.50 foot, and elevations surveyed to the nearest 0.01 foot.

4.0 SITE-SPECIFIC FIELD INVESTIGATIONS

The following sections outline the specific remedial investigation (RI) field activities to be performed at the Firefighter Training Area, LARC Maintenance Area and Auto Craft Building Area at Fort Story. Specific activities are based on the Scopes of Services for the project dated 17 August 1994. Data from previous investigations performed by others were used to optimize the field program which is detailed here. Data collected during the RI will be used in conjunction with existing data to delineate the extent of contamination and recommend further actions if necessary.

4.1 SITE VISIT

On October 18, 1994, representatives of Malcolm Pirnie visited the sites to inspect potential sample locations and current site conditions.

4.2 FIELD INVESTIGATIONS AND ENVIRONMENTAL SAMPLING

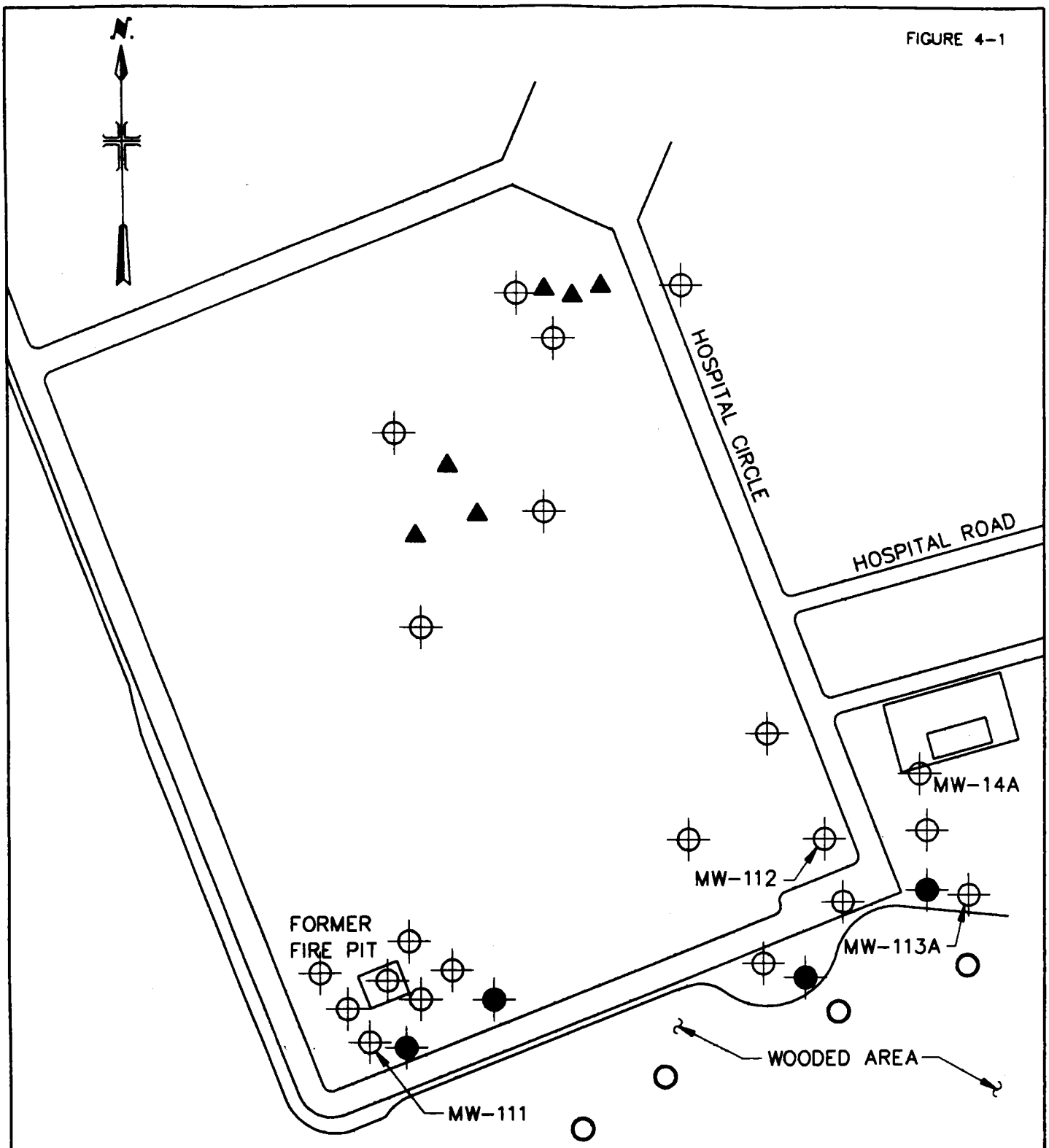
The sampling program has been developed to augment the existing database by:

- Defining the nature and extent of surface and subsurface soil and upgradient, site, and downgradient groundwater contamination at each site.
- Determining/assessing migration of contaminants in surface water and sediments at each site.

4.2.1 Firefighter Training Area (Site 4)

The sampling program will extend downgradient of the site to determine the extent of contamination that could be have migrated off-site. Figure 4-1 provides the sampling locations for this site. The following table summarizes our field investigations for this site:

FIGURE 4-1



SURFACE WATER SAMPLES / SEDIMENT SAMPLES

DPWS - DIRECT PUSH WATER SAMPLES / SOIL BORING LOCATIONS

SURFACE SOIL SAMPLES

SOIL BORING / WELL POINT LOCATIONS

SCALE: 1"=200'

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Summary of Field Investigation								
Location	Soil Borings/Samples	Surface Soil	Surface Water	Sediment	Ground Water	Well Points	Permanent Wells	DQO Level
Upgradient	5/15	0	0	0	5	0	0	III
Northern Area	4/12	6	0	0	4	0	0	III
Fire Pit	5/15	0	0	0	5	0	1	III
Solvent Plume	1/3	0	0	0	1	0	1	III
Downgradient	7/21	0	4	4	3	4	6	III
Total	22/66	6	4	4	18	4	8	

Table 4-1 provides a summary of the number of samples to be collected from each media, the number of QA/QC samples to be collected and the analytical requirements. All samples will be analyzed for TCL Volatiles and Semivolatiles, and TPH Heavy and Light fractions. TAL analysis will be conducted on all surface water and sediment samples and for 20 percent of soil and groundwater samples. For those groundwater samples which will be analyzed for TAL compounds, both total and dissolved fractions will be conducted.A summary of field activities by media is provided below.

Soil Samples

Twenty-two (22) soil boring locations have been established for the site to determine the vertical and horizontal extent of contamination in surface and subsurface soils. Eight (8) of these borings will be installed in the vicinity of the former fire training pit (FTP). Six (6) soil borings will be installed in the northern section of the site. The final eight (8) soil borings will be installed at the solvent plume area in the southeast corner of the site.

A hand augered sample will be collected from a depth of 0 to 12 inches as described in Section 3.3. The DPT rig will then be used to collect soil samples from two other depths at that location; 2 to 3 feet below ground surface and from immediately above the water table interface (estimated to be 5 to 6 feet below ground surface). One of the soil boring locations will be upgradient of the site to provide background data.

In addition, six (6) surface soil samples will be collected at the northern section of the site in areas of visible soil staining and from near SB-101.

TABLE 4-1
FIELD AND QA/QC SAMPLE SUMMARY

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
FIREFIGHTER TRAINING AREA (SITE 4)								
Groundwater Sampling by DPT:								
Field	Water	6	6	6	18	18	18	18
Duplicates(1)	Water	2	2	2	1	1	1	1
Rinsates(2)	Water	1	1	1	4	4	4	4
Trip Blanks(3)	Water	0	0	0	4	0	0	0
MS/MSD(4)	Water	1	1	1	1	1	1	1
CENED QA Samples(5)	Water	1	1	1	1	1	1	1
Groundwater Well Sampling:								
Field	Water	4	4	4	8	8	8	8
Duplicates	Water	0	0	0	1	1	1	1
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	2	0	0	0
MS/MSD	Water	0	0	0	1	1	1	1
CENED QA Samples	Water	0	0	0	1	1	1	1
Subsurface Soil Sampling by DPT:								
Field	Soil	9	9	9	44	44	44	44
Duplicates	Soil	1	1	1	4	4	4	4
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	2	2	2	2
CENED QA Samples	Soil	1	1	1	4	4	4	4
Surface Soil Samples:								
Field	Soil	5	5	5	28	28	28	28
Duplicates	Soil	0	0	0	3	3	3	3
Rinsates	Water	0	0	0	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	1	1	1	1
CENED QA Samples	Soil	1	1	1	3	3	3	3
Sediment Samples:								
Field	Soil	4	4	4	4	4	4	4
Duplicates	Soil	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	1	1	1	1
CENED QA Samples	Soil	1	1	1	1	1	1	1
Surface Water Samples:								
Field	Water	4	4	4	4	4	4	4
Duplicates	Water	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
CENED QA Samples	Water	1	1	1	1	1	1	1
Decontamination Water:								
Field Blanks – DI & Tap Water	Water	2	2	2	2	2	2	2

Notes:
(1) Duplicates collected at a rate of 10 percent of samples.
(2) Rinsates – One every other day for soil samples, one per day for water samples.
(3) Trip Blanks – One per cooler for water samples collected for VOC analysis.
(4) MS/MDS – Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
(5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

TABLE 4-1
FIELD AND QA/QC SAMPLE SUMMARY

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
LARC MAINTENANCE AREA (SITE 6)								
Groundwater Sampling by DPT:								
Field	Water	8	8	8	19	19	19	19
Duplicates(1)	Water	2	2	2	2	2	2	2
Rinsates(2)	Water	1	1	1	4	4	4	4
Trip Blanks(3)	Water	0	0	0	4	0	0	0
MS/MSD(4)	Water	1	1	1	1	1	1	1
CENED QA Samples(5)	Water	1	1	1	2	2	2	2
Groundwater Well Sampling:								
Field	Water	2	2	2	4	4	4	4
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	1	0	0	0
MS/MSD	Water	0	0	0	1	1	1	1
CENED QA Samples	Water	0	0	0	1	1	1	1
Subsurface Soil Sampling by DPT:								
Field	Soil	9	9	9	46	46	46	46
Duplicates	Soil	1	1	1	5	5	5	5
Rinsates	Water	1	1	1	2	2	2	2
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	2	2	2	2
CENED QA Samples	Soil	1	1	1	5	5	5	5
Surface Soil Samples:								
Field	Soil	5	5	5	23	23	23	23
Duplicates	Soil	0	0	0	2	2	2	2
Rinsates	Water	0	0	0	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	2	2	2	2
CENED QA Samples	Soil	1	1	1	2	2	2	2
Sediment Samples:								
Field	Soil	2	2	2	2	2	2	2
Duplicates	Soil	0	0	0	0	0	0	0
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	0	0	0	0
CENED QA Samples	Soil	0	0	0	0	0	0	0
Surface Water Samples:								
Field	Water	2	2	2	2	2	2	2
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
CENED QA Samples	Water	0	0	0	0	0	0	0

Notes:
(1) Duplicates collected at a rate of 10 percent of samples.
(2) Rinsates – One every other day for soil samples, one per day for water samples.
(3) Trip Blanks – One per cooler for water samples collected for VOC analysis.
(4) MS/MDS – Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
(5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

TABLE 4-1
FIELD AND QA/QC SAMPLE SUMMARY

Sampling Task	Media	Analysis Requirements						
		TAL Metals	TAL Hg	TAL Cyanide	TCL VOCs	TCL SOCs	TPH Heavy	TPH Light
AUTO CRAFT BUILDING AREA (SITE 7)								
Groundwater Sampling by DPT:								
Field	Water	6	6	6	6	6	6	6
Duplicates(1)	Water	2	2	2	1	1	1	1
Rinsates(2)	Water	1	1	1	1	1	1	1
Trip Blanks(3)	Water	0	0	0	1	0	0	0
MS/MSD(4)	Water	1	1	1	1	1	1	1
CENED QA Samples(5)	Water	1	1	1	1	1	1	1
Groundwater Well Sampling:								
Field	Water	2	2	2	1	1	1	1
Duplicates	Water	0	0	0	0	0	0	0
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	1	0	0	0
MS/MSD	Water	0	0	0	0	0	0	0
CENED QA Samples	Water	0	0	0	0	0	0	0
Subsurface Soil Sampling by DPT:								
Field	Soil	3	3	3	12	12	12	12
Duplicates	Soil	1	1	1	1	1	1	1
Rinsates	Water	1	1	1	1	1	1	1
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	1	1	1	1	1	1	1
CENED QA Samples	Soil	1	1	1	1	1	1	1
Surface Soil Samples:								
Field	Soil	1	1	1	6	6	6	6
Duplicates	Soil	0	0	0	1	1	1	1
Rinsates	Water	0	0	0	0	0	0	0
Trip Blanks	Water	0	0	0	0	0	0	0
MS/MSD	Soil	0	0	0	0	0	0	0
CENED QA Samples	Soil	0	0	0	1	1	1	1

Notes:
(1) Duplicates collected at a rate of 10 percent of samples.
(2) Rinsates – One every other day for soil samples, one per day for water samples.
(3) Trip Blanks – One per cooler for water samples collected for VOC analysis.
(4) MS/MDS – Matrix spike/matrix spike duplicates collected at a rate of 5 percent of samples.
(5) Split samples submitted to Army Corps of Engineers New England Division at a rate of 10 percent of samples.

Groundwater Samples

Groundwater samples will be collected by DPT from eighteen (18) locations to determine the nature and extent of contamination in groundwater. The depth to groundwater at the site is approximately 6 feet below ground surface. Samples will be collected from a depth of 5 feet below the water table. One (1) groundwater sample by DPT will be collected upgradient of the site to provide background data.

Groundwater samples will be collected from four (4) existing and four (4) new permanent groundwater monitoring wells. Existing wells will be redeveloped prior to sampling. The new wells will be installed to a depth of 5 feet below the water table elevation. Screened intervals will be established from two feet above the water table to five feet below the water table.

Four (4) temporary direct push well points will be installed but not sampled. Their location will be based on on-site GC analysis. The screens will be placed at a depth of 5 feet below the water table elevation. These well points may be used for short-term groundwater monitoring.

Sediment Samples

Four (4) sediment samples will be collected from within the wetlands area located to the south of the site.

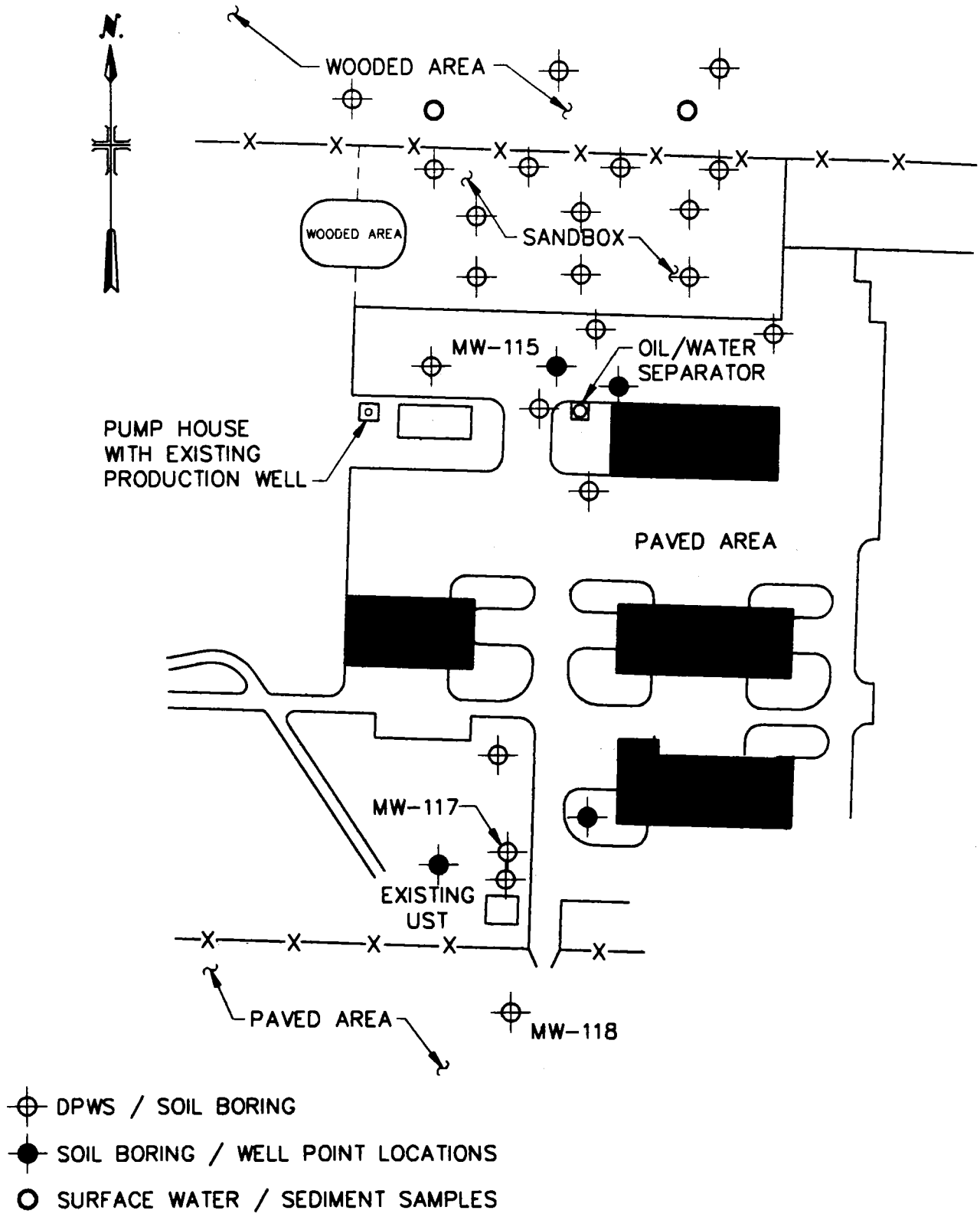
Surface Water Samples

Four (4) surface water samples will be collected at the same locations as the sediment samples from the wetlands area located to the south of the site.

4.2.2 LARC Maintenance Area (Site 6)

The sampling program will extend downgradient of the site to determine the extent of contamination that could be have migrated off-site. Figure 4-2 provides the sampling locations for this site. The following table summarizes our field investigations for this site:

FIGURE 4-2



SCALE: 1"=200'

MALCOLM PIRNIE	FORT STORY, VIRGINIA FIELD INVESTIGATION PLAN LARC SITE MAP	MALCOLM PIRNIE, INC. OCTOBER 1994

Summary of Field Investigation							
Location	Soil Borings/Samples	Surface Water	Sediment	Ground Water	Well Points	Permanent Wells	DQO Level
Upgradient	0/0	0	0	0	0	0	III
UST	4/12	0	0	2	2	2	III
Oil/Water Separator	4/12	0	0	2	2	2	III
Sandbox	12/36	0	0	12	0	1	III
Downgradient	3/9	2	2	3	0	2	III
Total	23/69	2	2	19	4	7	

Table 4-1 provides a summary of the number of samples to be collected from each media, the number of QA/QC samples to be collected and the analytical requirements. All samples will be analyzed for TCL Volatiles and Semivolatiles, and TPH Heavy and Light fractions. TAL analysis will be conducted on all surface water and sediment samples and for 20 percent of soil and groundwater samples. For those groundwater samples which will be analyzed for TAL compounds, both total and dissolved fractions will be conducted. A summary of field activities by media is provided below.

Soil Samples

Twenty-three (23) soil boring locations have been established for the site to determine the vertical and horizontal extent of contamination in surface and subsurface soils. Four (4) of these borings will be installed in the vicinity of the waste oil UST on the southern end of the site. Four (4) soil borings will be installed near the oil-water separator in the central section of the site. The final fifteen (15) soil borings will be installed near the "sandbox" area in the northern section of the site.

A hand augered sample will be collected from a depth of 0 to 12 inches as described in Section 3.3. The DPT rig will then be used to collect soil samples from two other depths at that location; 2 to 3 feet below ground surface and from immediately above the water table interface (estimated to be 5 to 6 feet below ground surface). One of the soil boring locations will be upgradient of the site to provide background data.

Groundwater Samples

Groundwater samples will be collected by DPT from nineteen (19) locations to determine the nature and extent of contamination in groundwater. The depth to groundwater at the site is approximately 5 to 8 feet below ground surface. Samples will be collected from a depth of 5 feet below the water table.

Groundwater samples will be collected from four (4) existing permanent groundwater monitoring wells. Existing wells will be redeveloped prior to sampling. Three (3) new wells will be installed to a depth of 5 feet below the water table elevation. Screened intervals will be established from two feet above the water table to 5 feet below the water table. These new wells will not be sampled as part of this field effort.

Four (4) temporary direct push well points will be installed but not sampled. These well points may be used for short-term groundwater monitoring. The screens will be placed at a depth of 5 feet below the water table elevation.

Sediment Samples

Two (2) sediment samples will be collected from the drainage ditch located between the sandbox and the wooded area.

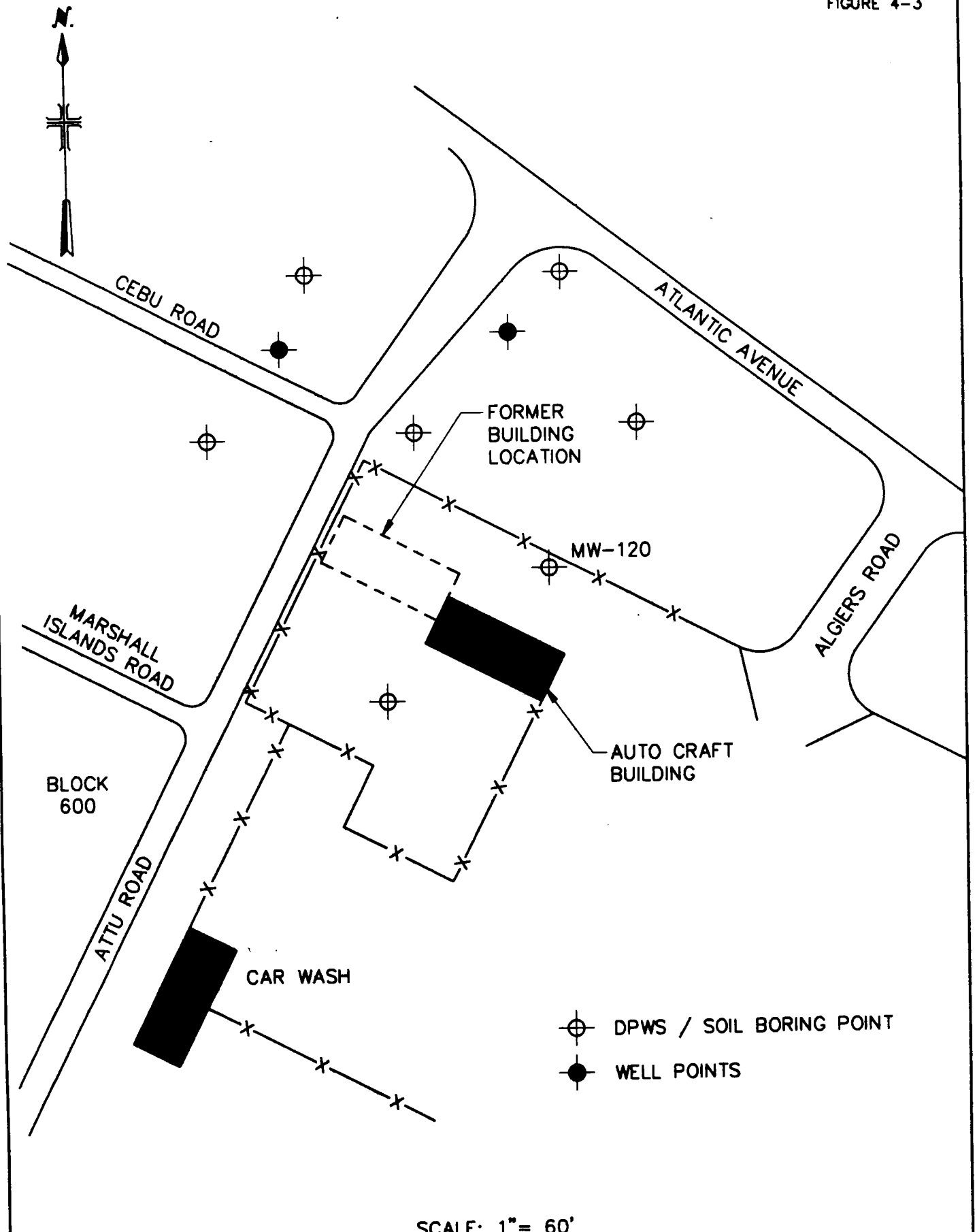
Surface Water Samples

Two (2) surface water samples will be collected from the drainage ditch located between the sandbox and the wooded area.

4.2.3 Auto Craft Building Area (Site 7)

The sampling program will extend downgradient of the site to determine the extent of contamination that could be have migrated off-site. Figure 4-3 provides the sampling locations for this site. The following table summarizes our field investigations for this site:

FIGURE 4-3



SCALE: 1"= 60'

MALCOLM PIRNIE	FORT STORY, VIRGINIA FIELD INVESTIGATION PLAN AUTO CRAFT SITE MAP	MALCOLM PIRNIE, INC. OCTOBER 1994

Summary of Field Investigation					
Location	Soil Borings/Samples	Ground Water	Well Points	Permanent Wells	DQO Level
Upgradient	1/3	1	0	0	III
Building Area	0/0	0	1	1	III
Downgradient	5/15	5	2	2	III
Total	6/18	6	3	3	

Table 4-1 provides a summary of the number of samples to be collected from each media, the number of QA/QC samples to be collected and the analytical requirements. All samples will be analyzed for TCL Volatiles and Semivolatiles, and TPH Heavy and Light fractions. TAL analysis will be conducted for 20 percent of soil and 50 percent of groundwater samples. For those groundwater samples which will be analyzed for TAL compounds, both total and dissolved fractions will be conducted. A summary of field activities by media is provided below.

Soil Samples

Six (6) soil boring locations have been established for the site to determine the vertical and horizontal extent of contamination in surface and subsurface soils.

A hand augered sample will be collected from a depth of 0 to 12 inches as described in Section 3.3. The DPT rig will then be used to collect soil samples from two other depths at that location; 2 to 3 feet below ground surface and from immediately above the water table (estimated to be 5 to 6 feet below ground surface). One of the soil boring locations will be upgradient of the site to provide background data.

Groundwater Samples

Groundwater samples will be collected by DPT from six (6) locations to determine the nature and extent of contamination in groundwater. The depth to groundwater at the site is approximately 8 to 10 feet below ground surface. Samples will be collected from a depth of 5 feet below the water table.

Groundwater samples will be collected from one (1) existing permanent groundwater monitoring well. This well will be redeveloped prior to sampling.

Three (3) temporary direct push well points will be installed but not sampled. These well points may be used for short-term groundwater monitoring. The screens will be placed at a depth of 5 feet below the water table elevation.

5.0 RI REPORTING

Malcolm Pirnie will provide detailed Remedial Investigation (RI) Reporting to the U.S. Army Corps of Engineers (ACE) upon completion of field activities. The report will be submitted in Draft, Final Draft and Final formats and will outline findings for each site. The RI Reports will address the following:

- Site Description and History
- Previous Investigations
- Data Quality Objectives
- Site Investigation Activities
- Physical Characteristics of the Site
- Field and Laboratory Data
- Nature and Extent of Contamination
- Contaminant Fate and Transport
- Baseline Risk Assessment
- Conclusions
- Recommendations

6.0 DATA MANAGEMENT PLAN

The Data Management Plan (DMP) describes the methodology to document and track the data and results generated during the remedial investigation (RI) field investigations. This plan identifies field and laboratory data documentation formats, procedures and file requirements.

6.1 DAILY SITE LOG BOOK

A log book of the site activities will be kept by the Field Manager documenting the following:

- Personnel on-site
- Time on-site and off-site
- Activities conducted
- Problems and resolutions
- Deviations from work plan
- Weather

The site log book should be bound, sturdy, of water repellant construction and kept in the possession of the Field Manager. The Site Log Book shall be identified by a site specific title, as necessary. All entries will be in indelible ink and all pages numbered. On a weekly basis, copies of the preceding weeks activities as recorded in the log book will be sent to the file custodian (Section 6.4).

6.2 STANDARD FIELD LOGS

A number of standard field forms will be used to document site activities. These include:

- Soil Boring Log
- Sample Collection Records
- Sample Chain-of-Custody Record
- Daily Field Reports

Copies of the standard field logs will be kept in files at the Newport News office. Copies of each field log are presented in the CDAP.

6.3 FIELD BOOKS

During field activities, it will be necessary for the project members to record site specific data from drilling activities, sampling activities, etc. This data will be recorded in field books dedicated to this project. The field books will be bound, sturdy, and of water repellent construction, with each page numbered. Each field book will be assigned by the Project Manager to a team member and identified by a site specific title. The assignment of the field book and its identifier will be recorded in the Daily Site Log Book. Field books will remain in the file at the Newport News office when not in use. Upon filling a field book or completion of the project, the book will be turned over to the file custodian and an entry made in the Site Log Book to that effect. On a weekly basis, copies of the previous week activities which were recorded in the Field Books will be sent to the file custodian.

6.4 PROJECT FILING

All sample documentation and field forms collected during this project will ultimately be stored in the project files at Malcolm Pirnie, Inc., Newport News, Virginia office. Franco Godoy will be the file custodian. All project files will be stored in an organized and accessible manner.

6.5 REPORTING

6.5.1 Progress Reports

Monthly progress reports will be submitted to the ACE. These progress reports will include progress on site activities during the reporting period, problems and resolutions, data collected, deliverables submitted. During field activities weekly progress reports of the field work will be provided to the ACE Project Manager.

6.5.2 Project Deliverables

The draft, final draft and final versions of the Remedial Investigation Report will be sent to the official list of project document recipients as listed in the ACE Scope of Work.

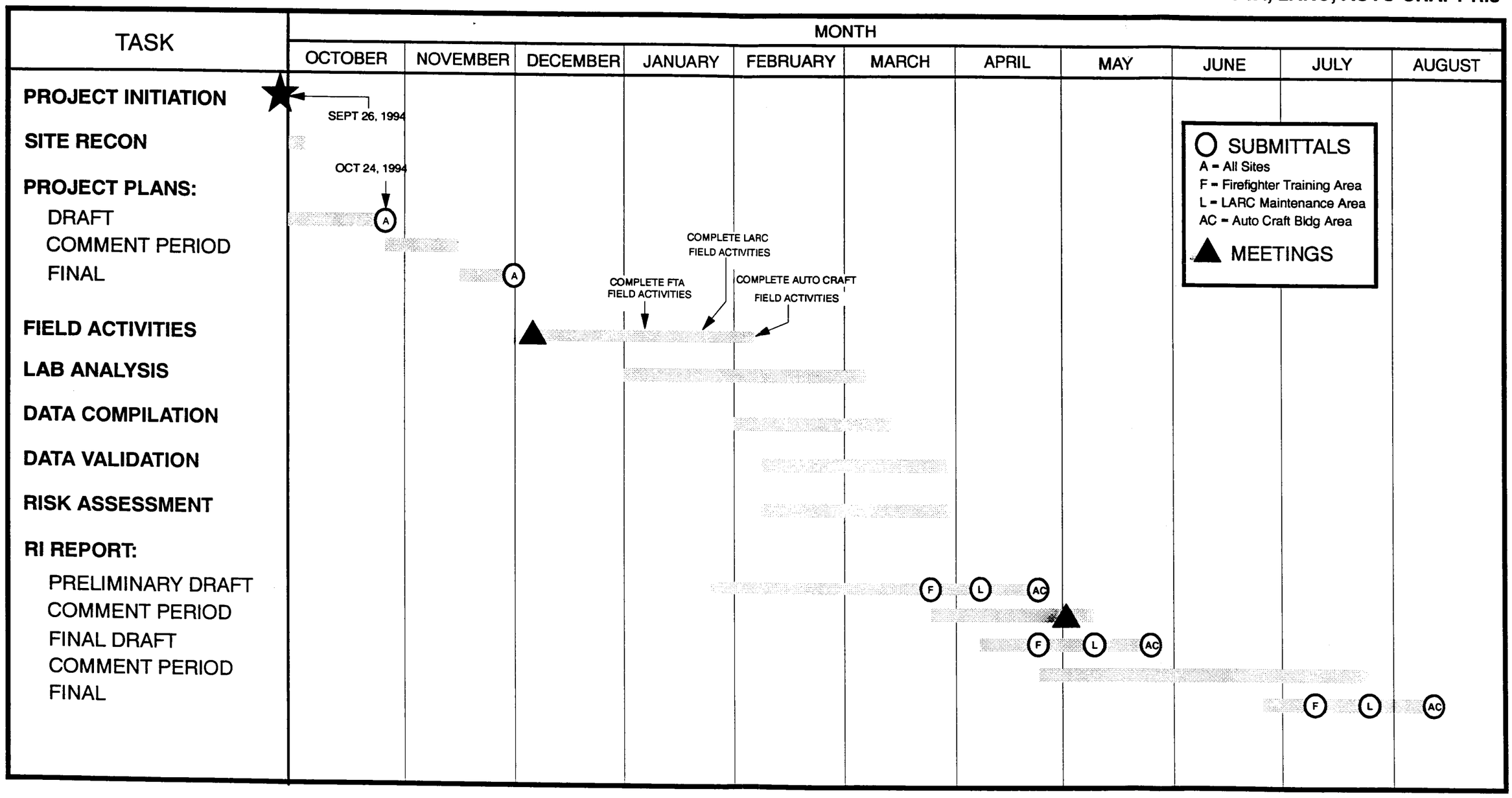
7.0 SCHEDULING

A Preliminary Project Schedule for the Remedial Investigation (RI) work is provided as Figure 7-1. A final schedule will be developed in conjunction with the U.S. Army Corps of Engineers upon acceptance of the Final Work Plan.

FIGURE 7-1

PROJECT SCHEDULE

FTA, LARC, AUTO CRAFT RIs



8.0 PROJECT ORGANIZATION

The Malcolm Pirnie organization structure for this project is shown on Figure 8-1. Steve Cho is the U.S. Army Corps of Engineers (ACE) Project Manager in charge of providing technical direction and monitoring the technical performance of Malcolm Pirnie.

For Malcolm Pirnie, Inc., Paul Busch, President, is the President and Phillip Feeney, Vice President in charge of the Newport News Regional Office, is the Officer providing overall project direction. Richard Brownell, Vice President in charge of Hazardous Waste Programs, is the Officer providing technical review.

The Project Manager for Malcolm Pirnie, Inc. is Franco Godoy, Associate, who specializes in hazardous waste investigation and remediation projects and who is the Hazardous Waste Group Manager for the Newport News Regional Office. The Field Manager is Mary Mullen. Health and safety and quality assurance will be the responsibility of Scott Bailey and Anthony Pace, respectively.

Malcolm Pirnie, Inc. has a matrix organization structure. Project personnel are drawn from throughout the company irrespective of group or locational assignment. The project personnel are selected on the basis of appropriate skills, experience and availability. For purposes of this project, tasks and subtasks will be assigned to Task Managers. Personnel working on specific tasks will report on a daily basis to their respective Task Managers. Task Managers, in turn, will work under the daily direction of the Project Manager.

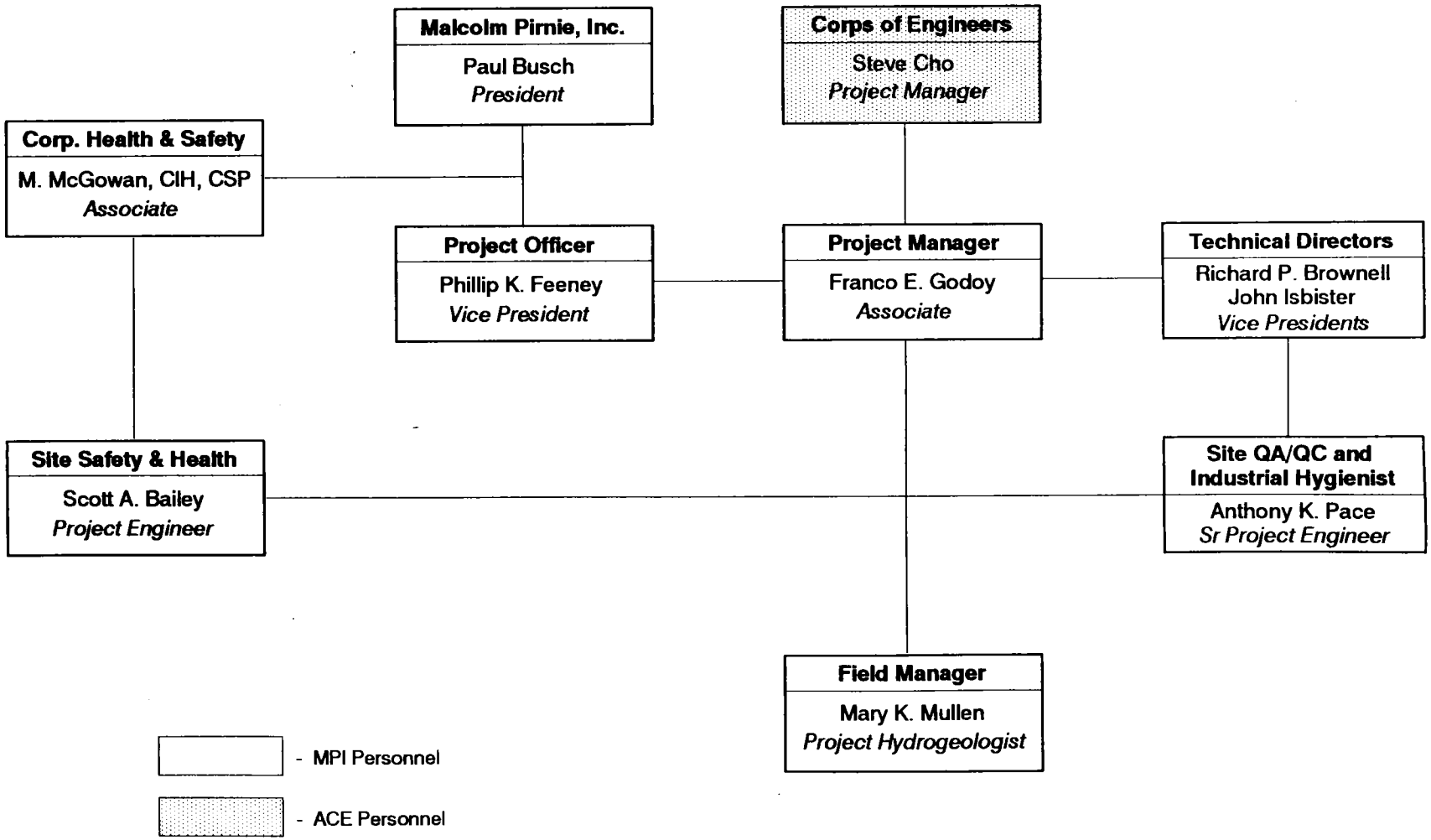
The project personnel responsibilities are summarized below.

Senior Company Officer: Paul L. Busch, Ph.D., President, is the Senior Company Officer at the top of the QA/QC chain of command. He interfaces with the Project Officer on QA/QC issues for the project.

Project Officer: The Project Officer, Phillip K. Feeney, P.E., is the representative of Malcolm Pirnie with contract authority. The Project Officer is responsible for the commitment of the resources required to fulfill Malcolm Pirnie's obligation to the ACE. The Project Officer is accountable to both the ACE and Malcolm Pirnie's President.

FIGURE 8-1

ORGANIZATIONAL CHART



Technical Review Director: The Technical Review Director, Richard Brownell, P.E., provides guidance on technical matters and reviews all technical documents relating to the project. The Technical Review Director may delegate technical guidance to specially trained individuals under his direction. John Isbister provides technical review assistance for hydrogeologic investigations.

Project Manager: The Project Manager, Franco Godoy, is accountable to the Project Officer throughout the duration of the project, and utilizes the Technical Review Officer for any technical assistance. The Manager may delegate authority to expedite and facilitate the implementation of the project plan. The Project Manager is responsible for:

- Review of engineering and interim reports
- Coordination with ACE
- Budget control
- Subcontractor performance
- Project coordination to implement Work Plan
- Allocation of resources and staffing to implement the QA/QC program
- Allocation of resources and staffing to implement Site Safety and Health Plan (SSHP)

Health and Safety Manager: The Health and Safety Manager, Mark A. McGowan, C.I.H., serves as the administrator of Malcolm Pirnie's Corporate Health and Safety program. He is accountable directly to Malcolm Pirnie's President for project health and safety concerns and is responsible for:

- Administering OSHA and DOT compliance training for Malcolm Pirnie field personnel.
- Administering the medical surveillance program.
- Ensuring field personnel having adequate experience with personal protective equipment.
- Providing guidance on data interpretation.

- Reviewing proposed levels of worker protection.

Site Field Manager: The Site Field Manager, Mary Mullen, will serve as the on-site contact person for Malcolm Pirnie for field investigations and tests. The coordinator will be responsible for the logistics of the field activities. The Field Coordinator will:

- Inspect and replace equipment
- Prepare daily and interim reports
- Prepare samples for shipment
- Coordinate field activities
- Schedule sampling and other field activities

Project Quality Control Officer: The Project QC Officer, Anthony Pace, is responsible for the project specific supervision and monitoring of the QC program and reports to the Project Manager. Additional responsibilities include:

- Ensuring that field personnel are familiar with and adhere to proper sampling procedures, field measurement techniques, and sample identification and chain-of-custody procedures.
- Coordinating with the analytical laboratory for the receipt of samples, the reporting of analytical results and recommending corrective actions to correct deficiencies in the analytical protocol or sampling.
- Ensuring that duplicate samples are provided to the ACE as necessary.

Task Managers: Various Task Managers will provide technical support to the Project Manager for implementation of the Work Plan relative to their respective task and have the following responsibilities:

- Preparing task reports and outlining field investigation requirements
- Reviewing daily reports and field notebooks
- Task scheduling

- Task budget management
- Task Work Plan coordination
- Data validation

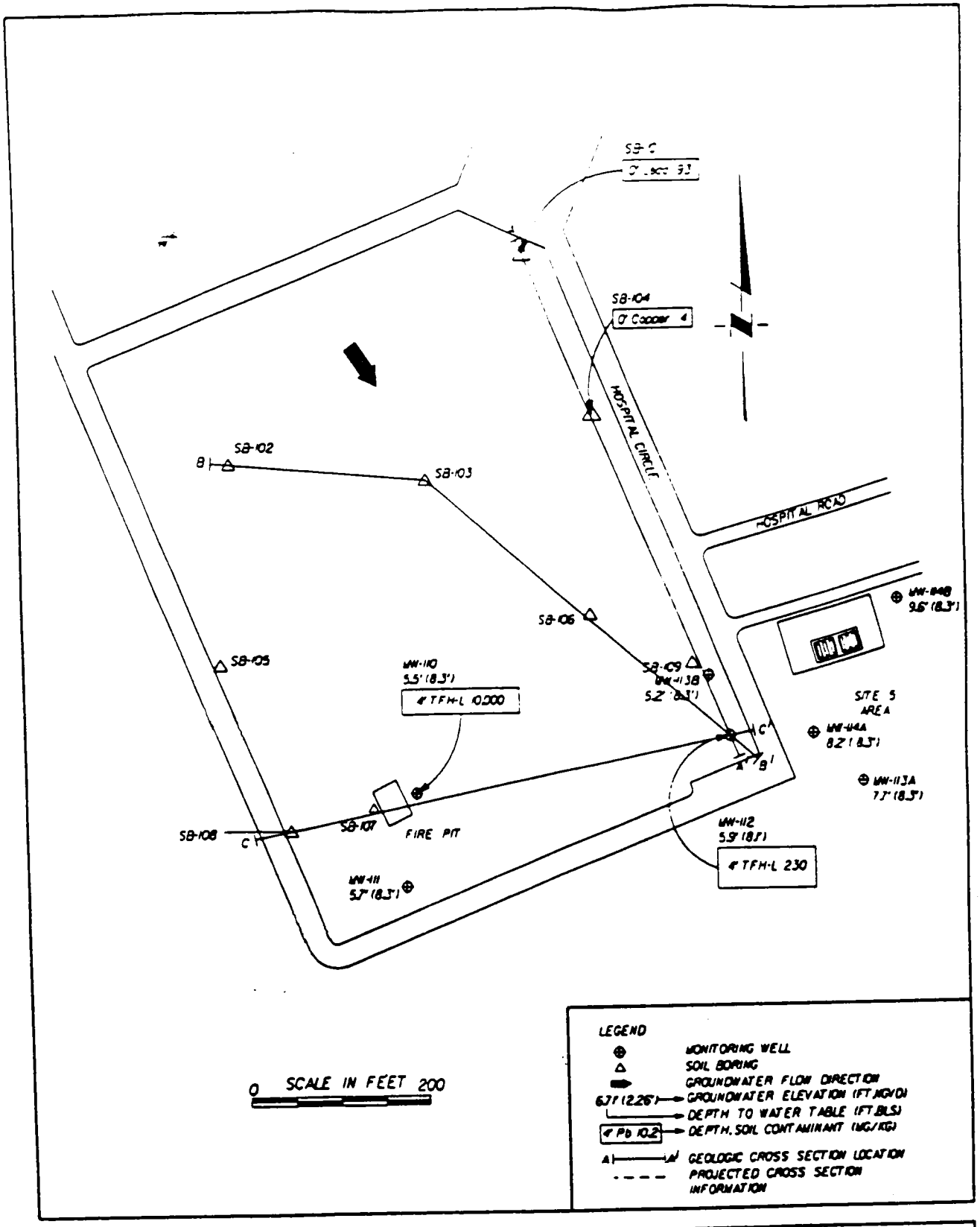
Site Safety and Health Officer: The Site Safety and Health Officer (SSHO), Anthony Pace, is responsible for ensuring that the field activities are carried out in accordance with the SSHP. The SSHO will provide technical assistance to the Project Manager and field personnel to assure site safety. In addition, the SSHO will:

- Monitor all field activities
- Monitor personal exposure to chemical toxicants
- Develop emergency response procedures
- Monitor for temperature stress
- Establish personnel and equipment decontamination procedures
- Stop work in the event unsafe work conditions are encountered

Field Sampling Team: Field sampling teams will be provided by Malcolm Pirnie, Inc. All personnel will follow the procedures described in this document and associated documents to assure consistency in sample collection.

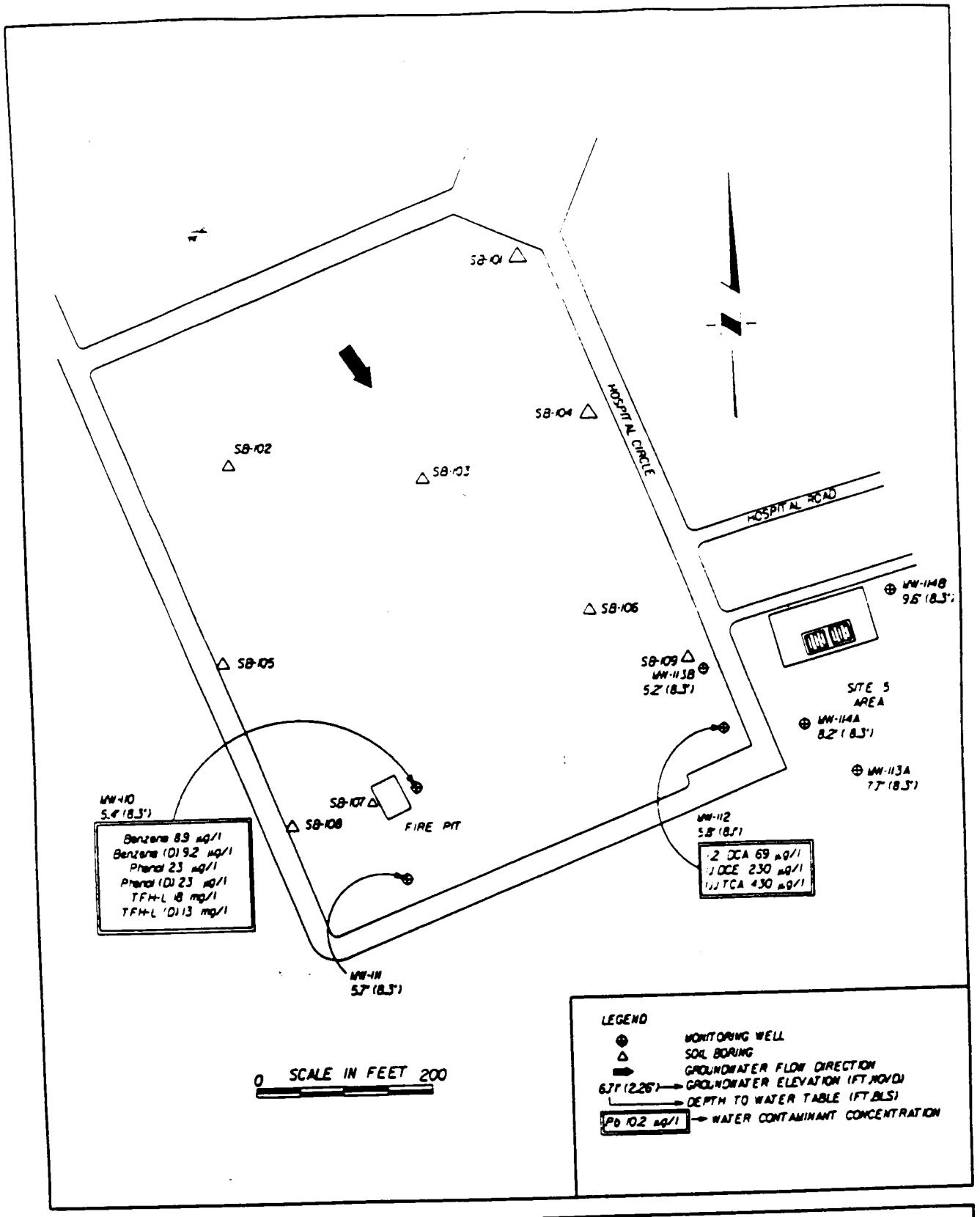
APPENDIX A

JAMES M. MONTGOMERY, INC.
PA/SI DATA



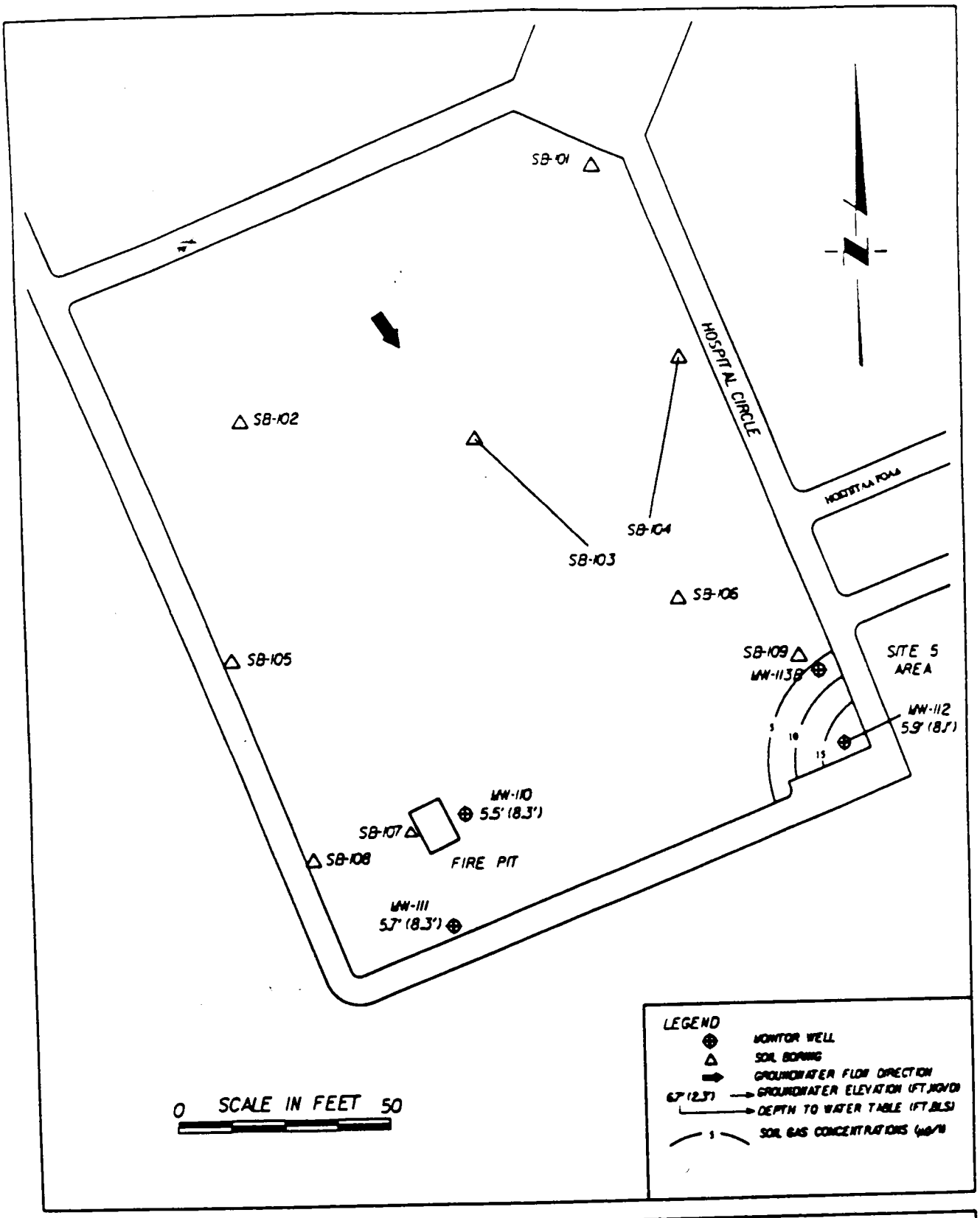
Soil Chemistry Concentrations and Geologic Cross Section Locations,
Site 4, Firefighter Training Area
Ft. Story, VA

Figure 2-9



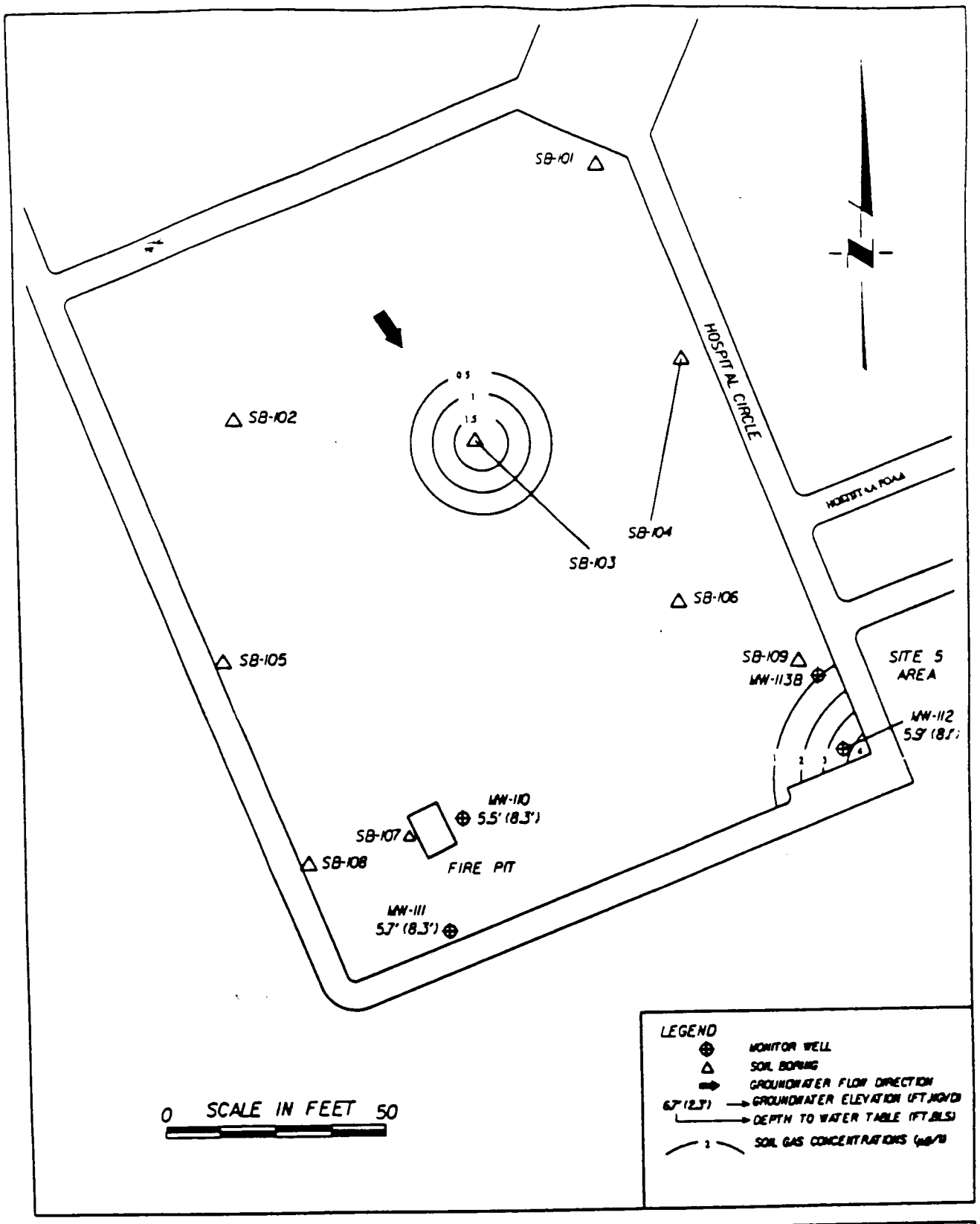
Groundwater Chemistry Concentrations,
Site 4, Firefighter Training Area
Ft. Story, VA

Figure 2-10



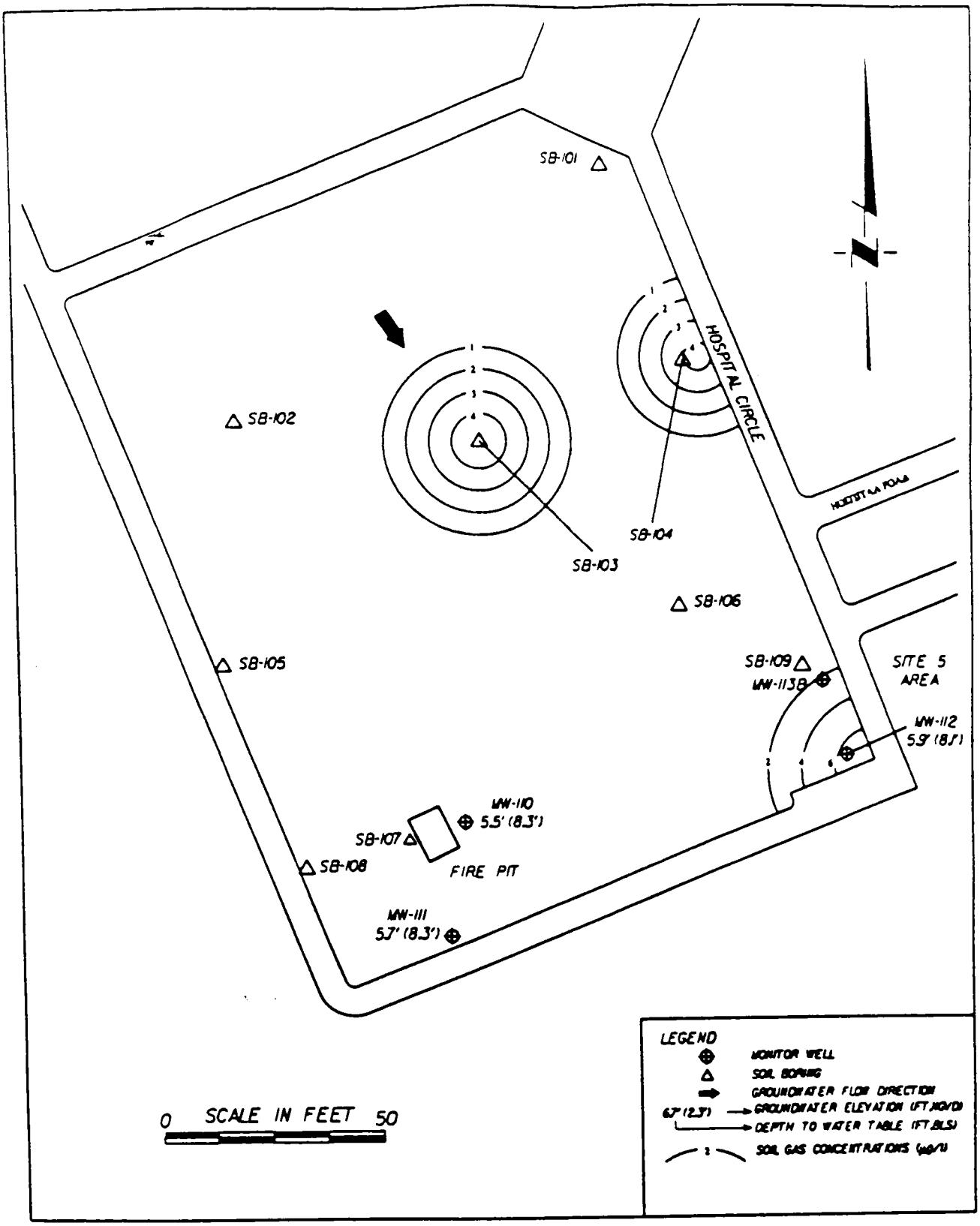
Benzene Concentrations in Soil Gas at Site 4, Firefighter Training Area
Ft. Story, VA

Figure 2-12



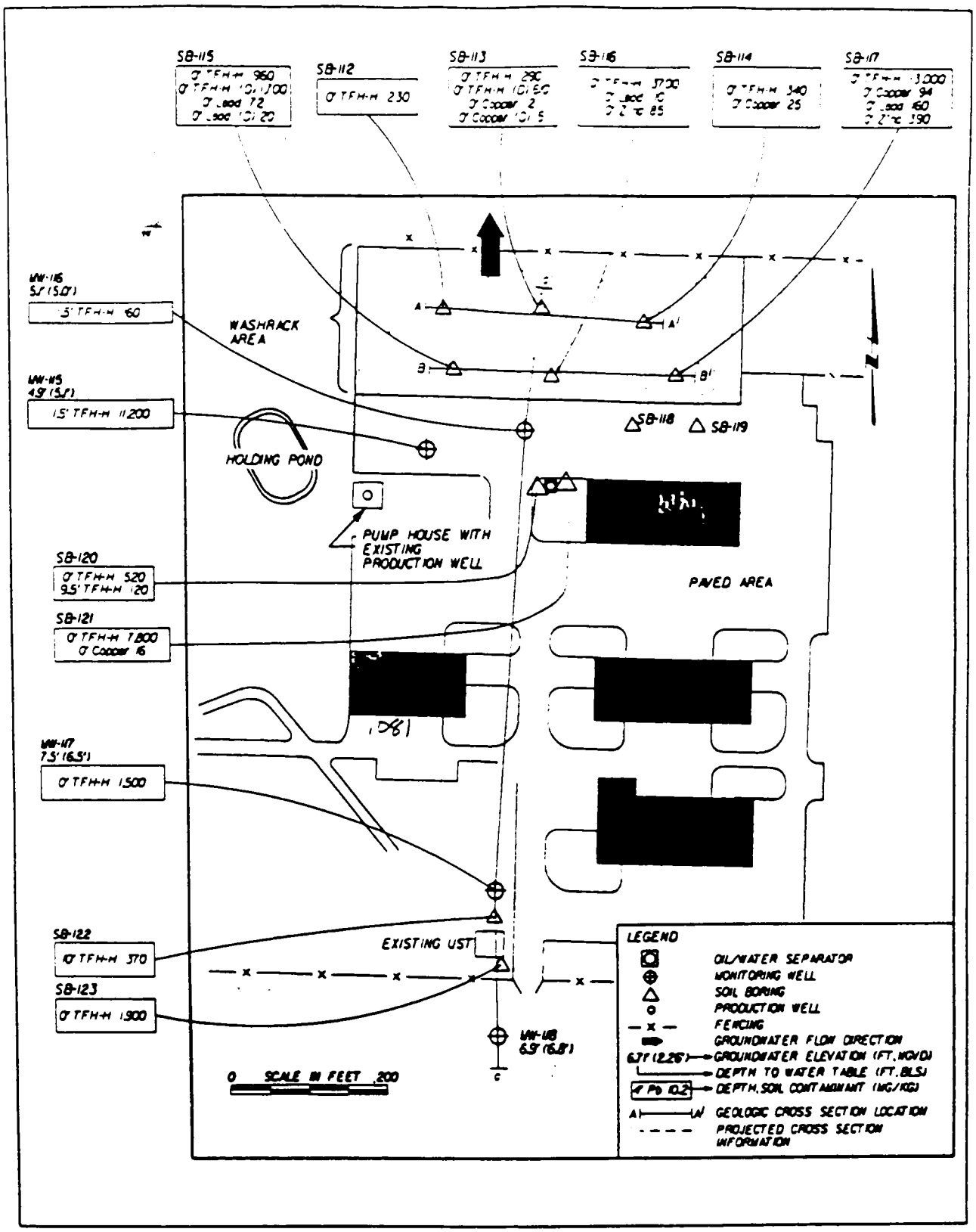
TCA Concentrations in Soil Gas at Site 4, Firefighter Training Area
Ft. Story, VA

Figure 2-13



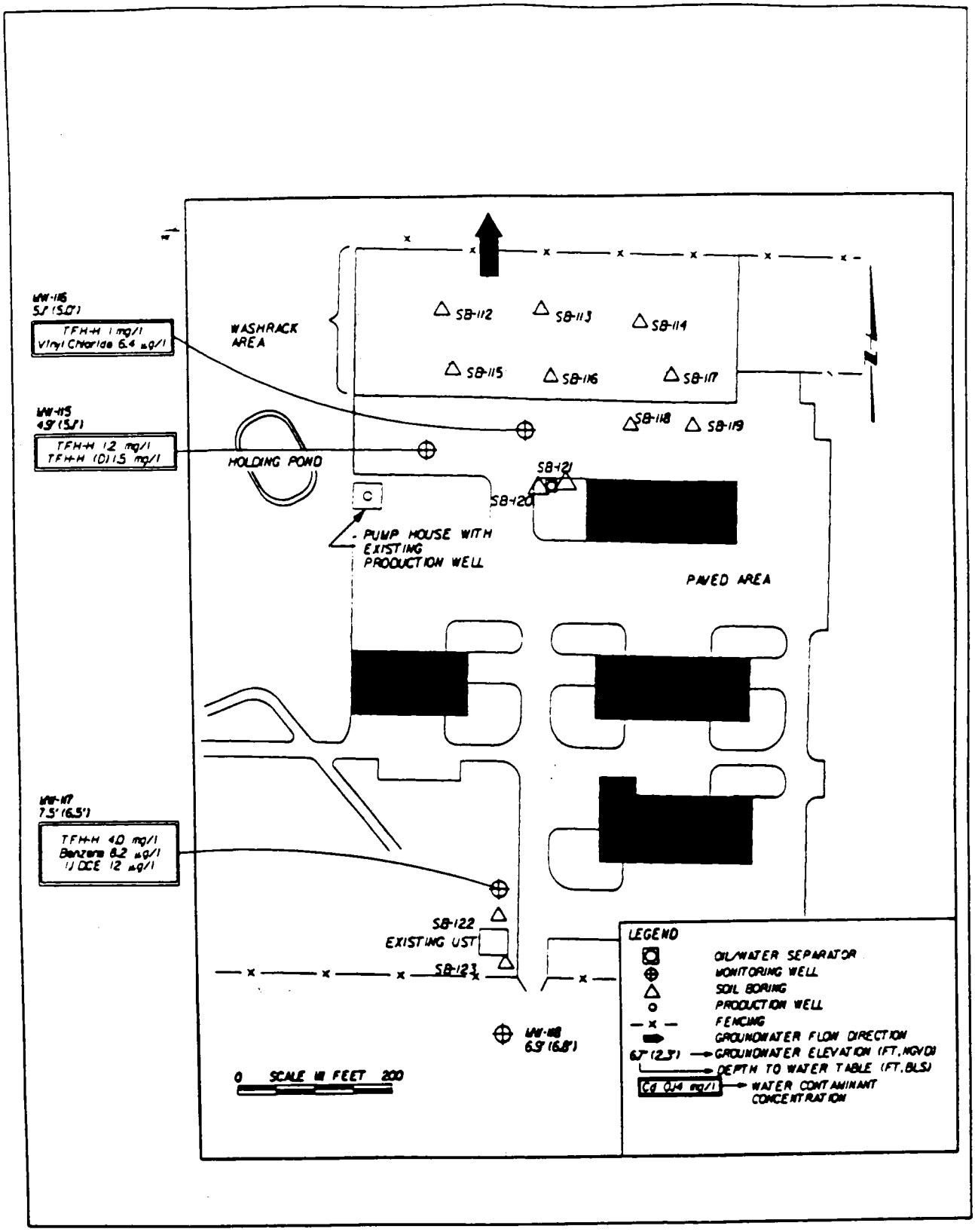
Total Hydrocarbon Concentrations in Soil Gas at Site 4, Firefighter Training Area
Ft. Story, VA

Figure 2-14



Soil Chemistry Concentration and Geologic Cross Section Locations,
Site 6, LARC Maintenance Area
Ft. Story, VA

Figure 2-20



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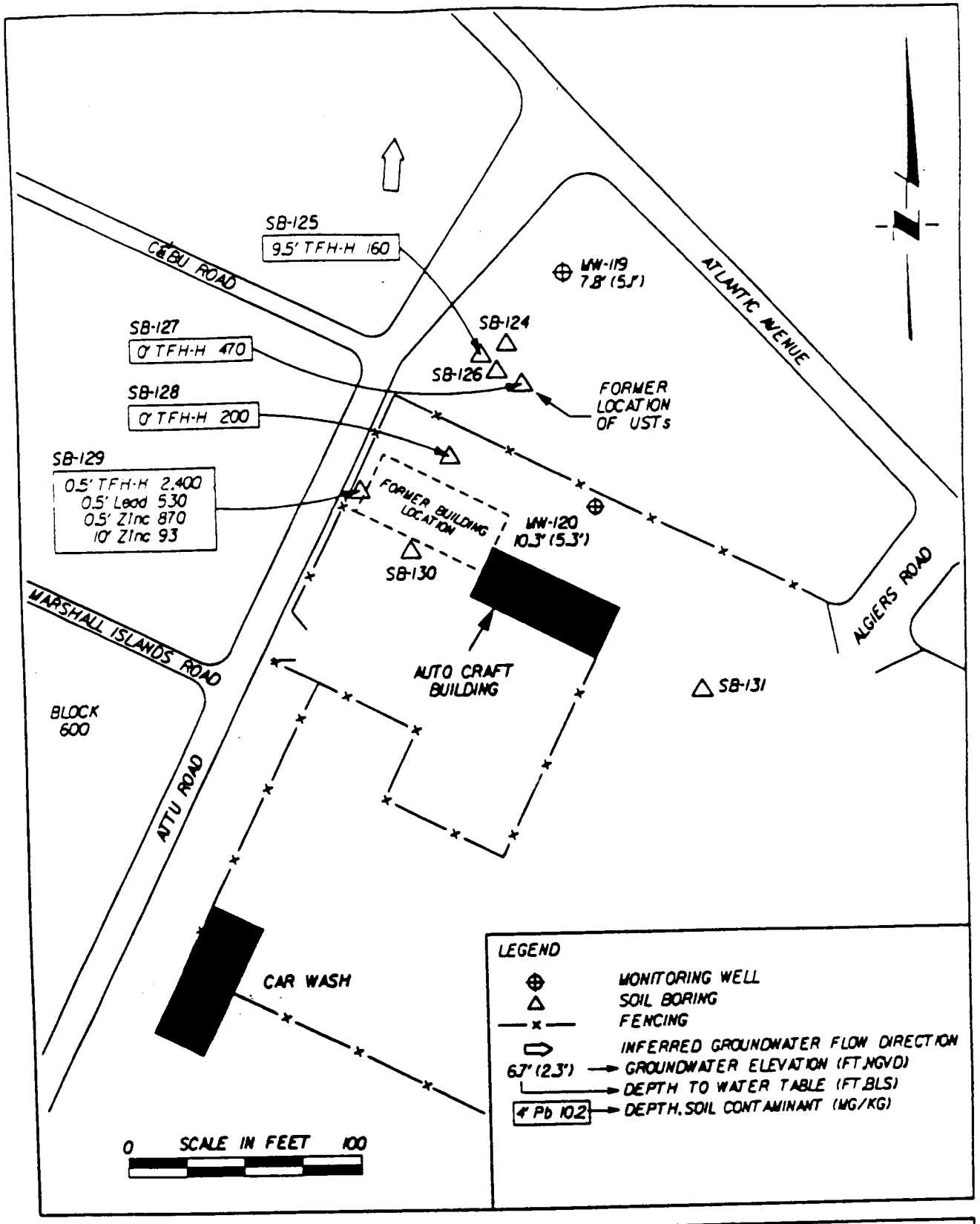
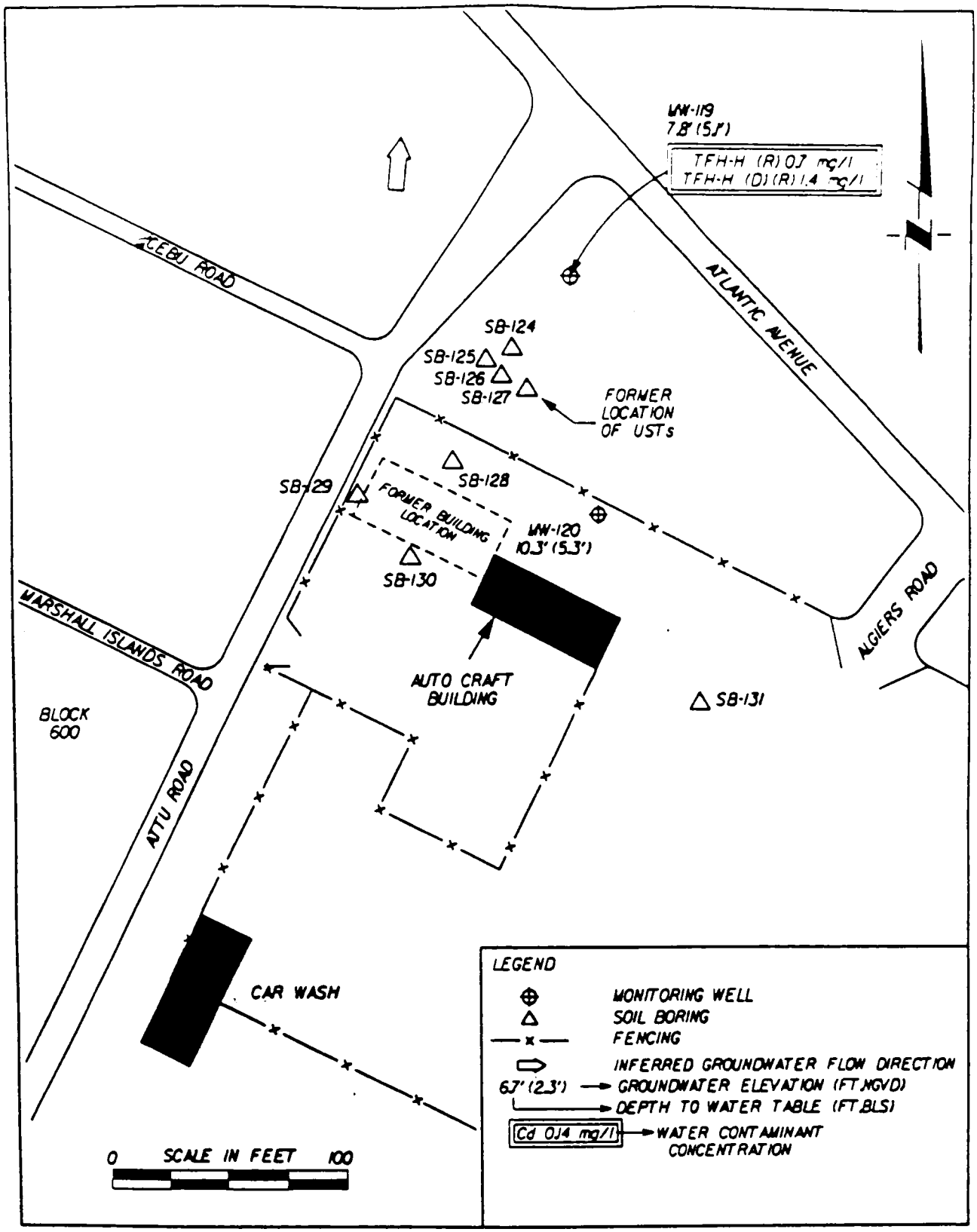
Groundwater Chemistry Concentrations,
Site 6, LARC Maintenance Area
Ft. Story, VA

Figure 2-21



Soil Chemistry Concentrations and Geologic Cross Section Locations,
Site 7, Auto Craft Building
Ft. Story, VA

Figure 2-23



Groundwater Chemistry Concentrations,
Site 7, Auto Craft Building
Ft. Story, VA

Figure 2-24