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FINAL

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY SAMPLING AND ANALYSIS PLAN FOR OPERABLE UNIT NO. 5 (SITE 2)

MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0106

Prepared For:

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

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

MARCH 11, 1993

PREFACE

This Sampling and Analysis Plan (SAP) consists of two sections: a Field Sampling and Analysis Plan (Section I) and a Quality Assurance Project Plan (Section II). These project plans have been prepared for field investigation activities associated with Operable Unit No. 5 (Site 2) at Marine Corps Base (MCB), Camp Lejeune, Jacksonville, North Carolina.

SECTION I

FINAL

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1.0 INTRODUCTION

Marine Corps Base (MCB) Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) effective November 4, 1989 (54 Federal Register 41015, October 4, 1989). Subsequent to this listing, the United States Environmental Protection Agency (EPA) Region IV, the North Carolina Department of Environment, Health and Natural Resources (DEHNR), and the United States Department of the Navy (DoN) entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune.

The scope of the FFA included the implementation of a remedial investigation/feasibility study (RI/FS) at 23 sites throughout MCB Camp Lejeune. An RI/FS Work Plan has been prepared for Site 2 (Former Nursery/Day Care Center).

This Field Sampling and Analysis Plan (FSAP) describes the proposed RI field activities that are to be conducted at Site 2 at Marine Corps Base, Camp Lejeune, North Carolina.

The primary purpose of the FSAP is to provide guidance for all field activities by describing in detail the sampling and data collection methods to be used to implement the various field tasks identified in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for Site 2 (Baker, 1992). The guidance also helps to ensure that sampling and data collection activities are carried out in accordance with EPA Region IV and Naval Energy and Environmental Support Activity (NEESA) practices so that data obtained during the field investigation are of sufficient quantity and quality to evaluate the nature and magnitude of contamination in various media, estimate human health and environmental risks, and to evaluate potential technologies for remediation of contaminated media.

The remaining portion of this section presents the background and setting of each of the sites. Section 2.0 (Data Quality Objectives) identifies the Data Quality Objectives (DQOs) for each of the field sampling programs described in the RI/FS Work Plan (Baker, 1992). The media, number and types of samples, and the frequency of sampling are discussed in Section 3.0 (Sampling Locations and Frequency). Section 4.0 (Sample Designation) describes the sample numbering scheme to be followed for identifying and tracking the samples. The investigative procedures (e.g., drilling, groundwater sampling, decontamination, etc.) are presented in Section 5.0 (Investigative Procedures). Sample handling and analysis is described in

Section 6.0 (Sample Handling and Analysis). Section 7.0 (Site Management) focuses on the organization and responsibilities of personnel associated with the field sampling events.

1.1 Site Description and Setting

This section briefly describes the description and setting of the sites. A more detailed description of each site is provided in Section 2.0 in the RI/FS Work Plan (Baker, 1992).

1.1.1 Marine Corps Base Camp Lejeune

This section provides an overview of the physical features associated with MCB Camp Lejeune.

1.1.1.1 Location and Setting

Marine Corps Base Camp Lejeune is located within the coastal plain in Onslow County, North Carolina. The facility covers approximately 170 square miles and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The eastern border of Camp Lejeune is the Atlantic shoreline. The western and northwestern boundaries are U.S. 17 and State Route 24, respectively. The City of Jacksonville, North Carolina, borders Camp Lejeune to the north. The MCB Camp Lejeune is depicted in Figure 1-1.

1.1.1.2 History

Construction of the base started in 1941 at Hadnot Point, where the major functions of the base are centered. Development at the Camp Lejeune complex is primarily in five geographical locations under the jurisdiction of the Base Command. These areas include Camp Geiger, Montford Point, Courthouse Bay, Mainside, and the Rifle Range Area. Site 2 is located in the Mainside (Water and Air Research, 1983).

1.1.1.3 Topography and Surface Drainage

The generally flat topography of MCB Camp Lejeune is typical of the seaward portions of the North Carolina coastal plain. Elevations on the base vary from sea level to 72 feet above mean

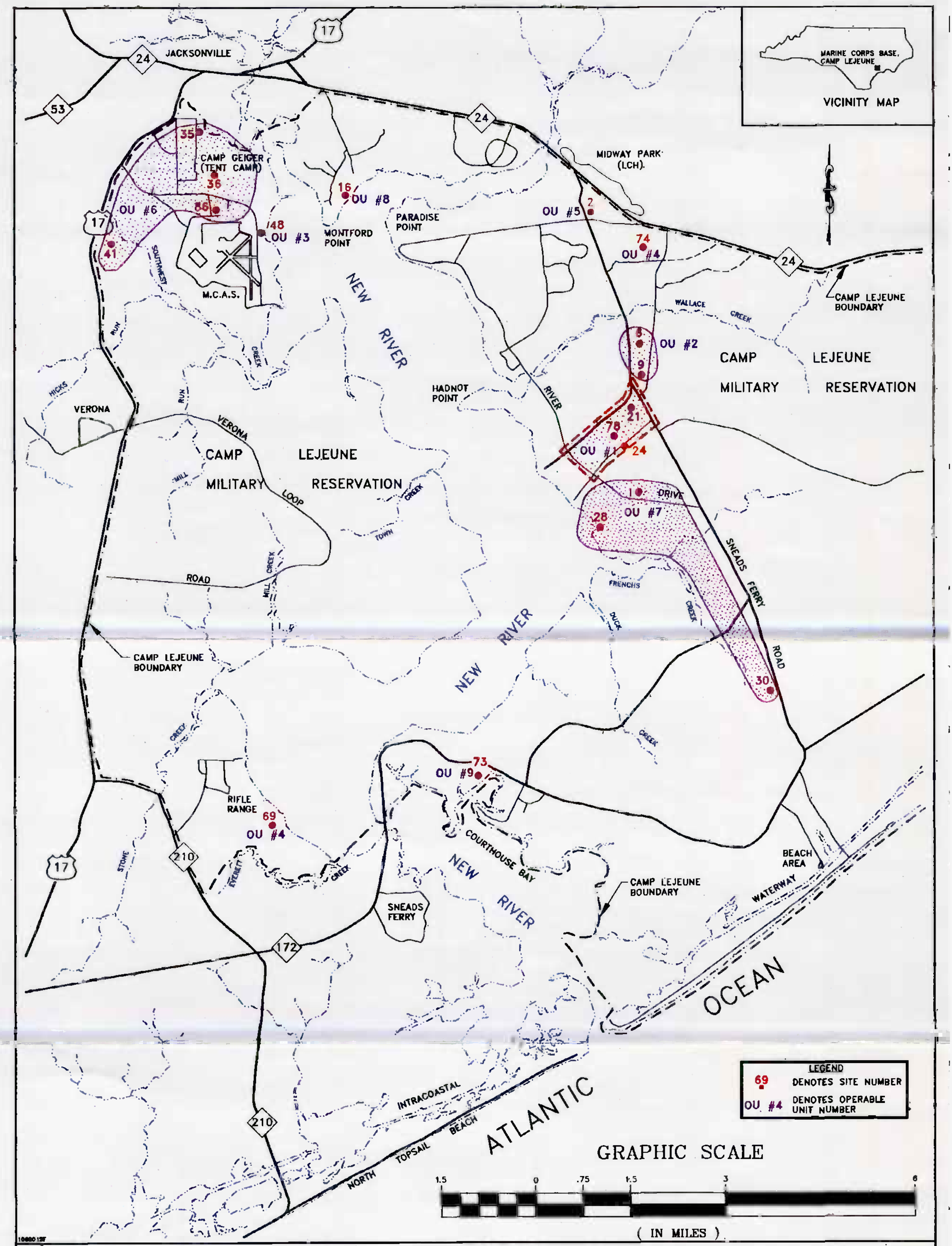

FIGURE 1-1
OPERABLE UNITS AND SITE LOCATIONS AT MARINE CORPS BASE CAMP LEJEUNE

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

SOURCE: U.S.G.S. WATER-RESOURCES INVESTIGATIONS REPORT 89-4096 sea level (msl); however, the elevation of most of Camp Lejeune is between 20 and 40 feet above msl.

Drainage at Camp Lejeune is generally toward the New River, except for areas near the coast, which drain into the Atlantic Ocean via the Intracoastal Waterway. In developed areas, natural drainage has been altered by asphalt, storm sewers, and drainage ditches.

The U.S. Army Corps of Engineers has mapped the limits of the 100-year floodplain at Camp Lejeune at 7.0 feet above msl in the upper reaches of the New River (Water and Air Research, 1983). The elevation of the 100-year floodplain increases downstream to 11 feet above msl near the coastal area (Water and Air Research, 1983).

1.1.1.4 Regional Geology

MCB Camp Lejeune is located in the Atlantic Coastal Plain physiographic province. The sediments of the Atlantic Coastal Plain consist of interbedded sands, clays, calcareous clays, shell beds, sandstone, and limestone. These sediments are layered in interfingering beds and lenses that gently dip and thicken to the southeast (ESE, 1991). Regionally, they comprise 10 aquifers and nine confining units which overlie igneous and metamorphic basement rocks of pre-Cretaceous age. These sediments were deposited in marine or near-marine environments and range in age from early Cretaceous to Quaternary time. Figure 1-2 presents a generalized stratigraphic column for this area (ESE, 1991).

United States Geological Survey (USGS) studies at MCB Camp Lejeune indicate that the Base is underlain by seven sand and limestone aquifers separated by confining units of silt and clay. These include the water table (surficial), Castle Hayne, Beaufort, Peedee, Black Creek, and upper and lower Cape Fear aquifers. The combined thickness of these sediments is approximately 1,500 feet. Less permeable clay and silt beds function as confining units or semiconfining units which separate the aquifers and impede the flow of groundwater between aquifers. A generalized hydrogeologic cross-section of this area is presented in Figure 1-3.

1.1.1.5 Regional Hydrogeology

The following summary of regional hydrogeology was originally presented in Harned et al. (1989).

FIGURE 1-2

GEOLOGIC AND HYDROGEOLOGIC UNITS IN THE COASTAL PLAIN OF NORTH CAROLINA

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
System	Series	Formation	Aquifer and Confining Unit
Quaternary	Holocene/Pleistocene	Undifferentiated	Surficial aquifer
Tertiary	Pliocene	Yorktown Formation(1)	Yorktown confining unit Yorktown aquifer
	Miocene	Eastover Formation(1)	
		Pungo River Formation(1)	Pungo River confining unit Pungo River aquifer
		Belgrade Formation(2)	Castle Hayne confining unit
	Oligocene	River Bend Formation	Castle Hayne aquifer
	Eocene	Castle Hayne Formation	Beaufort confining unit(3)
	Paleocene	Beaufort Formation	Beaufort aquifer
Cretaceous	Upper Cretaceous	Peedee Formation	Peedee confining unit Peedee aquifer
		Black Creek and Middendorf Formations	Black Creek confining unit Black Creek aquifer
		Cape Fear Formation	Upper Cape Fear confining unit Upper Cape Fear aquifer Lower Cape Fear confining unit Lower Cape Fear aquifer
	Lower Cretaceous(1)	Unnamed deposits(1)	Lower Cretaceous confining unit Lower Cretaceous aquifer(1)
Pre-Cretaceous basement rocks		--	--

(1) Geologic and hydrologic units probably not present beneath Camp Lejeune.
(2) Constitutes part of the surficial aquifer and Castle Hayne confining unit in the study area.
(3) Estimated to be confined to deposits of Paleocene age in the study area.

Source: Harned et al., 1989

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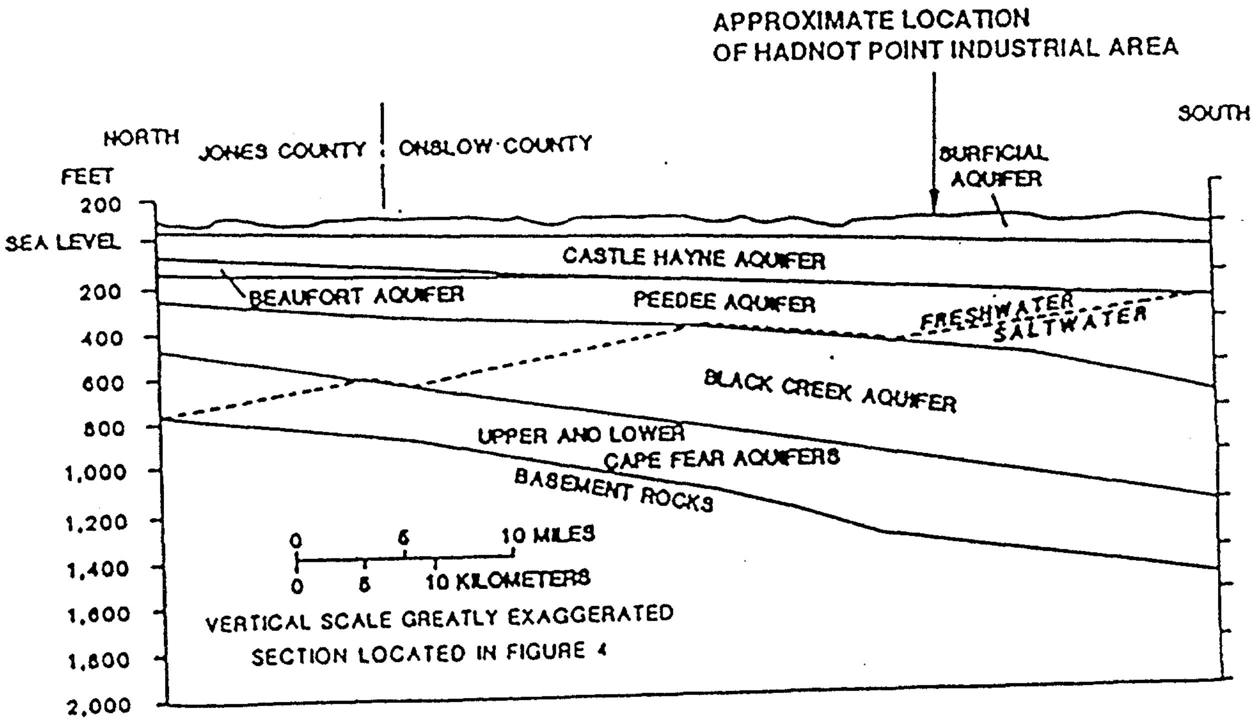

SOURCE: ESE, 1991

Baker

Baker Environmental, Inc.

FIGURE 1-3
GENERALIZED HYDROGEOLOGIC CROSS-SECTION
JONES AND ONSLOW COUNTIES, NORTH CAROLINA

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

The surficial aquifer is a series of sediments, primarily sand and clay,which commonly extend to depths of 50 to 100 feet. No laterally extensive clay confining units have been encountered in this interval during previous subsurface investigations in the area. This unit is not used for water supply in this part of the Base. The principal water-supply aquifer for the Base is the series of sand and limestone beds that occur between 50 and 300 feet below land surface. This series of sediments generally is known as the Castle Hayne aquifer. The Castle Hayne aquifer is about 150 to 350 feet thick in the area and is the most productive aquifer in North Carolina. Figure 1-4 is a geologic cross section of the subsurface near Site 2.

The aquifers that lie below the Castle Hayne consist of a thick sequence of sand and clay. Although some of these aquifers are used for water supply elsewhere in the Coastal Plain, they contain saltwater in the Camp Lejeune area.

Water levels in wells tapping the surficial aquifer vary seasonally. The surficial aquifer receives more recharge in the winter than in the summer when much of the water evaporates or is transpired by plants before it can reach the water table. Therefore, the water table generally is highest in the winter months and lowest in summer or early fall.

1.1.1.6 Surface Water Hydrology

The following summary of surface water hydrology was originally presented in the Initial Assessment Study (Water and Air Research, Inc., 1983).

The dominant surface water feature at MCB Camp Lejeune is the New River. It receives drainage from most of the base. The New River is short, with a course of approximately 50 miles on the central coastal plain of North Carolina. At MCB Camp Lejeune, the New River flows in a southerly direction and empties into the Atlantic Ocean through the New River Inlet. Several small coastal creeks drain the area of MCB Camp Lejeune that is not drained by the New River and its tributaries. These creeks flow into the Intracoastal Waterway, which is connected to the Atlantic Ocean by Bear Inlet, Brown's Inlet, and the New River Inlet. (Water and Air Research, 1983).

Water quality criteria for surface waters in North Carolina have been published under Title 15 of the North Carolina Administrative Code. At MCB Camp Lejeune, the New River falls into two classifications, SC (estuarine waters not suited for body contact sports or commercial shellfishing) and SA (estuarine waters suited for commercial shellfishing). The SC

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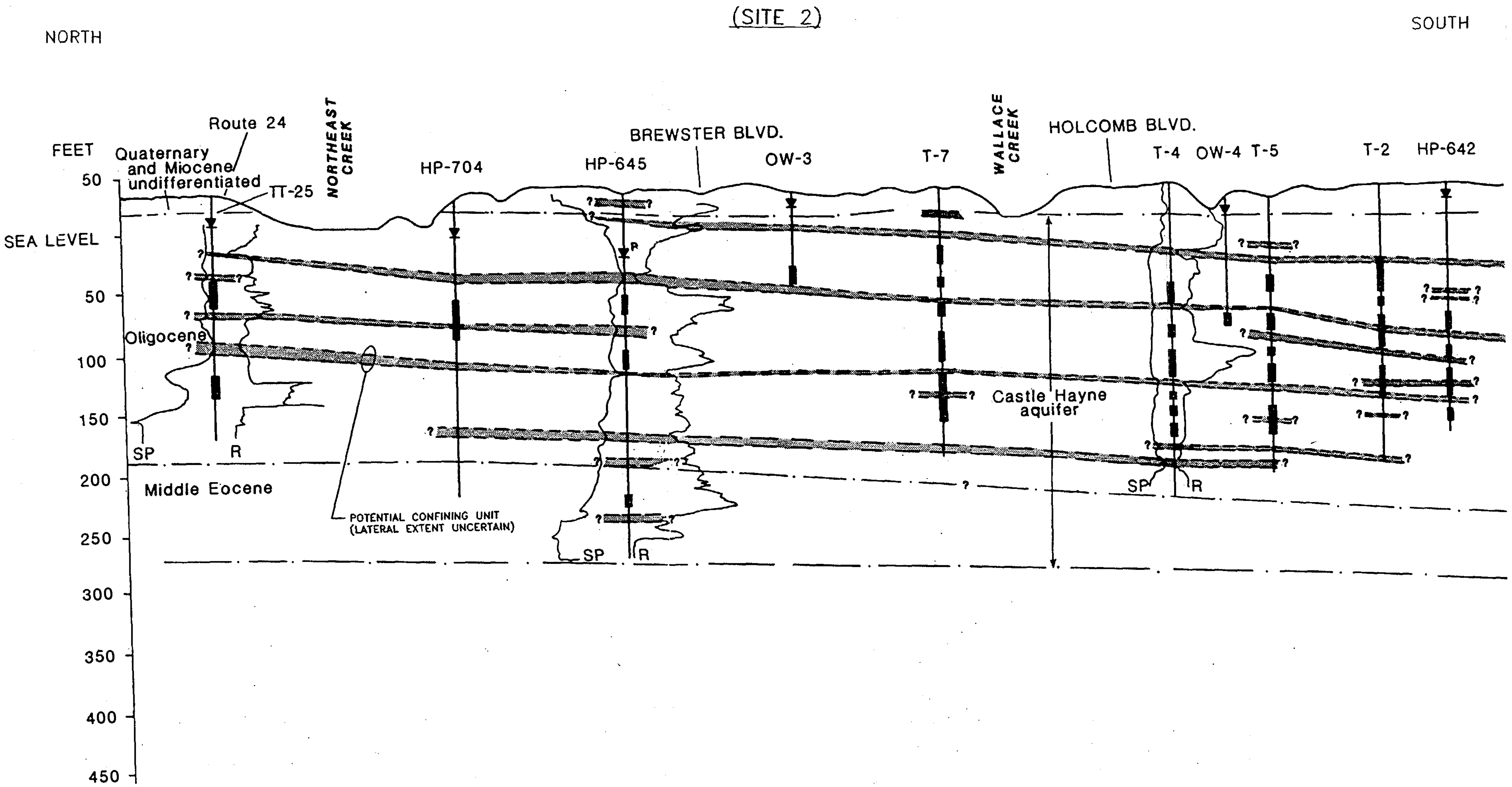
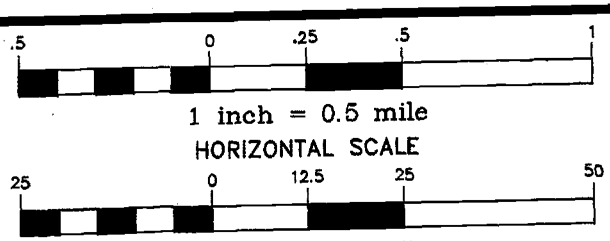


Baker
Baker Environmental, Inc.

SOURCE: HARNED, et al. (1989)



1 inch = 0.5 mile
HORIZONTAL SCALE

1 inch = 25 ft.
VERTICAL SCALE

FIGURE 1-4
HYDROGEOLOGIC CROSS SECTION
NEAR SITE 2

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

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classification applies to three areas of the New River at MCB Camp Lejeune including the Hadnot Point area. The rest of the New River at MCB Camp Lejeune falls into the SA classification (ESE, 1991).

1.1.1.7 Climatology

Marine Corps Base Camp Lejeune experiences mild winters and hot and humid summers. The average yearly rainfall is greater than 50 inches, and the potential evapotranspiration in the region varies from 34 inches to 36 inches of rainfall equivalent per year. The winter and summer seasons usually receive the most precipitation. Temperature ranges are reported to be 33°F to 53°F in the winter (i.e., January) and 71°F to 88°F in the summer (i.e., July). Winds are generally south-southwesterly in the summer and north-northwest in the winter (Water and Air Research, 1983).

1.1.1.8 Natural Resources and Ecological Features

The following summary of natural resources and ecological features was obtained from the IAS Report (Water and Air Research, 1983).

Approximately 60,000 of the 112,000 acres of Camp Lejeune are under forestry management. Forest management provides wood production, increased wildlife populations, enhancement of natural beauty, soil protection, prevention of stream pollution, and protection of endangered species. Upland game species including black bear, whitetail deer, gray squirrel, fox squirrel, quail, turkey, and migratory waterfowl are abundant and are considered in the wildlife management programs.

Aquatic ecosystems on MCB Camp Lejeune consist of small lakes, the New River estuary, numerous tributaries, creeks, and part of the Intracoastal Waterway. A wide variety of freshwater and saltwater fish species exist here. Freshwater ponds are under management to produce optimum yields and ensure continued harvest of desirable fish species (Water and Air Research, 1983).

Wetland ecosystems at MCB Camp Lejeune can be categorized into five habitat types: pond pine or pocosin; sweet gum/water oak/cypress and tupelo; sweet bay/swamp black gum and red maple; tidal marshes; and coastal beaches.

The Natural Resources and Environmental Affairs (NREA) Division of MCB Camp Lejeune, the U.S. Fish and Wildlife Service, and the North Carolina Wildlife Resource Commission have entered into an agreement for the protection of endangered and threatened species that might inhabit MCB Camp Lejeune. Habitats are maintained at MCB Camp Lejeune for the preservation and protection of rare and endangered species through the base's forest and wildlife management programs. Full protection is provided to such species and critical habitat is designated in management plans to prevent or mitigate adverse effects of base activities. Special emphasis is placed on habitat and sightings of alligators, osprey, bald eagles, cougars, dusky seaside sparrows, and red-cockaded woodpeckers (Water and Air Research, 1983).

Within 15 miles of Camp Lejeune are three publicly owned forests: Croatan National Forest; Hofmann Forest; and Camp Davis Forest. The remaining land surrounding Camp Lejeune is primarily used for agriculture. Typical crops include soybeans, small grains, and tobacco (Water and Air Research, 1983).

1.1.1.9 Land Use

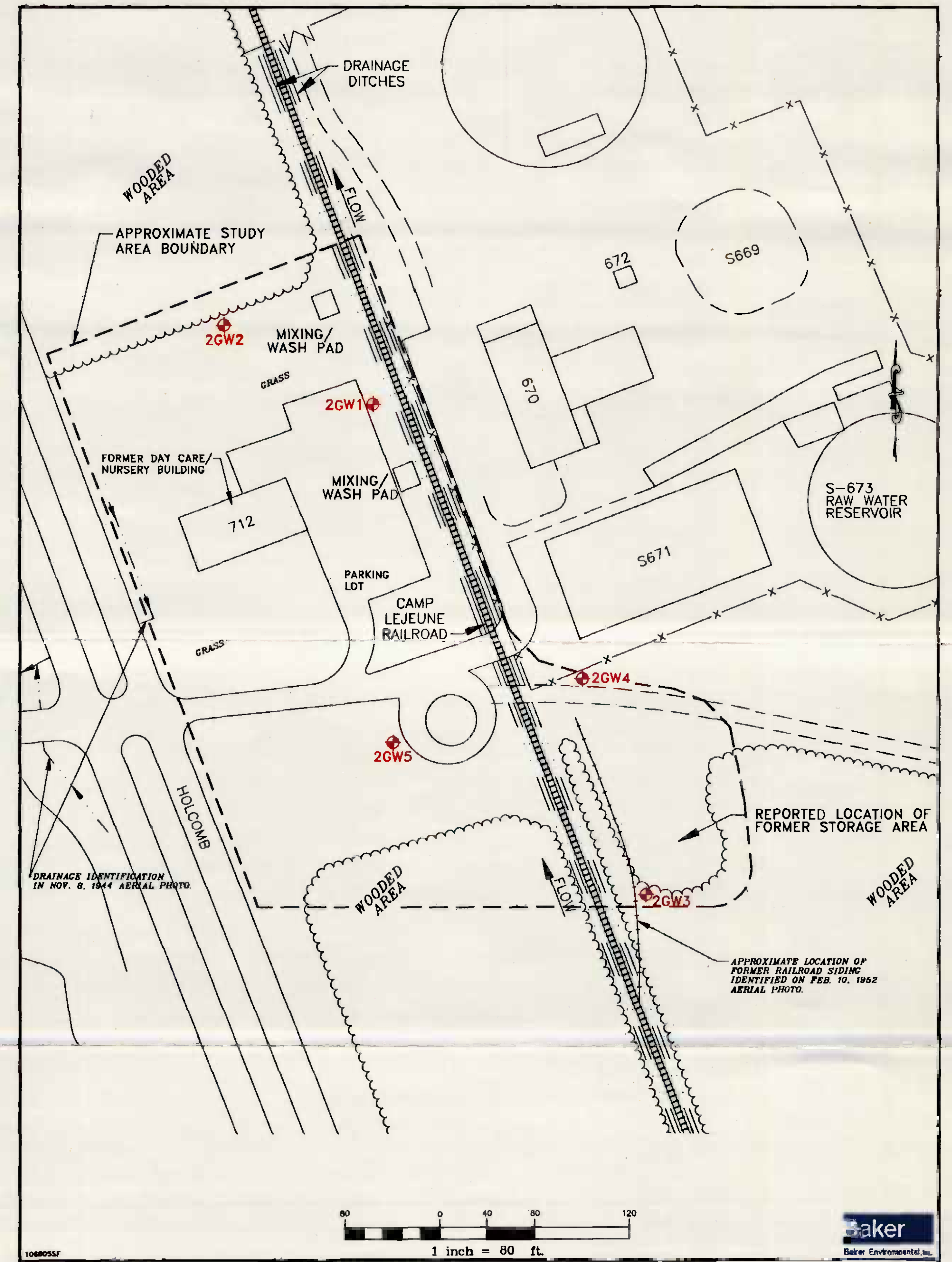
Camp Lejeune presently covers an area of approximately 170 square miles. Military and civilian population is approximately 60,000. During World War II, Camp Lejeune was used as a training area to prepare Marines for combat. This has been a continuing function of the facility during the Korean and Vietnam conflicts, and the recent Gulf War (i.e., Desert Storm). Toward the end of World War II, the camp was designated as a home base for the Second Marine Division. Since that time, Fleet Marine Force (FMF) units also have been stationed here as tenant commands.

1.1.2 Site 2 - Former Nursery/Day Care Center

This section addresses the background and setting of Site 2 (Former Nursery/Day Care Center). An environmental photographic interpretation center (EPIC) study was conducted for this site by the USEPA. Site specific results of this study are included in Appendix A of the RI/FS Work Plan (Baker, 1992).

1.1.2.1 Site Location and Setting

Site 2 is located approximately 3 miles east of the New River and 0.5 miles south of Route 24 (Figure 1-1). The site is depicted in Figure 1-5. The study area for this site includes two areas



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Baker

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FIGURE 1-5
STUDY AREA
SITE 2
MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

SOURCE: LANTDIV, OCT. 1991

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of concern: the Building 712 area and the Former Storage Area. The entire site is bounded by woodlands to the north and south, and by Holcomb Boulevard to the west. Railroad tracks, which trend northwest to southeast, run through the center of Site 2. The railroad tracks make up the eastern boundary of the Building 712 area and the western boundary of the Former Storage Area.

Building 712 was previously used as a pesticide storage, handling and mixing area. Two concrete mixing/washing pads are located behind (to the east of) Building 712. Site 2 encompasses approximately 2 acres.

1.1.2.2 Site Topography and Drainage

The topography of Site 2 is flat. There is a gravel parking lot to the east of the building. The remainder of the site is a grass lawn.

There are two drainage ditches which run parallel to both sides of the railroad tracks. Surface drainage, from the mixing/wash pad area of the site, is into the ditch which runs along the west side of the railroad tracks. Surface drainage from the Former Storage Area is into the ditch which runs along the east side of the railroad tracks. Water in the ditch appears to flow to the north, toward Overs Creek. A potential drainage pathway to the west was identified in aerial photos included in the EPIC study.

1.1.2.3 Site History

Building 712 is currently being used as a personnel office. From 1945 to 1958 this building was used for the storing, handling, and dispensing of pesticides. The building was later used as a children's day care center (ESE, 1990). On-site day care activities ceased in 1982.

The Former Storage Area was reportedly located in the southeastern portion of the site (ESE, 1990). This area is now vacant and the storage structure is no longer present. There is limited information available regarding the previous uses of this area.

1.1.2.4 Site Geology and Hydrogeology

Site-specific geologic/hydrogeologic information is limited. A sequence of clays, silts, and sands reportedly underlies the site. The water table was measured at 7 to 20 feet below ground surface (bgs). Well locations are shown on Figure 1-5. Groundwater flow is generally to the southeast (ESE, 1990).

1.2 Site Background - Site 2

This section summarizes the types and volume of known wastes at each site, probable transport and exposure pathways, and data limitations related to characterizing the sites, assessing human and ecological risks, and evaluating alternatives. This summary of information will be used to define the data quality objectives (DQOs) in Section 2.0.

1.2.1 Types and Volumes of Waste Present

Limited information is available regarding the volume of pesticide materials handled at this site. Organochlorine pesticides were detected in groundwater, surface water, sediment and soil samples collected on site. Fuel-related volatile organic compounds (VOCs) such as ethylbenzene, toluene, and xylene and semivolatile compounds such as naphthalene were detected in groundwater near the former storage area in the southwestern corner of the study area. In general, further evaluation is needed to determine the extent of soil, groundwater, sediment and surface water contamination at Site 2.

Based on the limited number of soil samples collected at Site 2, an estimation of the vertical and horizontal extent of soil contamination at this site cannot be made; therefore, the volume of waste present at the site cannot be estimated with the existing data.

1.2.2 Potential Transport and Exposure Pathways

Based on the evaluation of existing conditions at Site 2, the following potential contaminant transport and exposure pathways have been identified:

Transport Pathways

- Surface soil runoff from the Pesticide Mixing/Wash Pads to the drainage ditch.
- Surface soil runoff from the Former Storage Area to the drainage ditch.
- Sediment migration in drainage ditch to Overs Creek.

- Leaching of sediment contaminants to surface water.
- Migration/leaching of contaminants in the concrete mixing and washing pads to the soil.
- Migration/leaching of soil contaminants to groundwater.
- Groundwater infiltration from the shallow aquifer to the deep aquifer.

Exposure Pathways

- Wildlife exposure to contaminants due to incidental sediment and soil ingestion.
- Wildlife (e.g. burrowing animals) dermal exposure to contaminants in soil and sediment.
- Human exposure to contaminants due to incidental soil and sediment ingestion and dermal exposure.
- Human exposure to contaminants due to incidental dermal exposure to potentially contaminated concrete mixing and wash pads.
- Potential human exposure from future potential groundwater ingestion (the shallow aquifer is not used as a potable water supply).
- Potential human exposure to VOCs due to volatilization from groundwater.
- Human dermal exposure to contaminations due to future potential direct contact with groundwater.
- Potential human exposure due to ingestion of contaminated wildlife.

1.2.3 Present Database Limitations

The purpose of this section is to define data limitations with respect to either characterizing the site, assessing health and environmental risks, or evaluating potential feasible technologies. With the exception of recent groundwater sampling and analysis (Baker, 1992), the analytical methods and the level of QA/QC to which they were subjected for previous investigations at the site are not available or adequately documented. Consequently, much of the existing data is not reliable to fully characterize the site or to make an assessment of human health or ecological risks. A summary of media-specific data limitations is presented below.

Soil

The results of previous sampling efforts (August 1984 and November 1986) at Site 2 indicate the presence of pesticide contaminants in the soil. Sample collection was limited to the top three feet of soil. In addition, the specific sampling locations are unknown. Sample analysis was limited to organochlorine pesticide and herbicide parameters. The level of QA/QC and overall data quality are unknown.

Based on the review of existing information, data will be required to more fully characterize soil contamination, approximately delineate areas of concern, assess human health and ecological risks, evaluate the extent of soil runoff to the drainage ditch, and evaluate potential remedial technologies.

Groundwater

Five shallow monitoring wells were installed on site and sampled in July 1984. Groundwater samples were also collected in December 1986 and March 1982. Four water supply wells (Building 646, Building 616, Building 647 and Building 645) were also sampled in July 1984. The water supply well locations are not shown on Figure 1-4. They average approximately 1,000 feet north (Building 646), south (Building 616), east (Building 647), and west (Building 645) of the site. No detection of any contaminants of concern was reported for the water supply well samples (ESE, 1990). The monitoring and supply wells were analyzed for organochlorine pesticides, organochlorine herbicides, tetrachlorodioxin (1986 only) and volatile organics (1986 only).

During previous investigations, pesticides (DDD, DDE, DDT) were detected in monitoring wells 2GW1 and 2GW3. Volatile organic compounds (ethylbenzene, toluene) were detected in monitoring well 2GW3. The level of QA/QC protocols and overall data quality for samples collected during the previous investigations are unknown.

Because of the limited groundwater information to scope the RI, three of the monitoring wells (2GW2, 2GW3 and 2GW5) were sampled by Baker personnel in July , 1992. The samples were analyzed for Target Compound List (TCL) organic and Target Analyte List (TAL) inorganic parameters in accordance with CLP protocols and Level IV data quality.

Pesticides were not detected in the samples collected. Volatile organic compounds (ethylbenzene, toluene) and a semivolatile organic compound (naphthalene) were only detected in 2GW3. This well also exhibited volatile contamination during previous investigations.

Elevated levels of total metals concentrations were detected in monitoring well 2GW2. Arsenic, cadmium, and lead were detected in levels above the Federal Maximum Contaminant Level (MCL) and/or the North Carolina Water Quality Standard (NCWQS). During sampling, Baker personnel noted that this monitoring well contained a large amount of silt. A bailer from a previous investigation had been left in the monitoring well. The bailer also contained a large amount of silt. During purging (prior to sampling) the well recharged very slowly. Dissolved (filtered) metals concentrations were below Federal MCL and NCWQS.

Additional analytical data are required in order to more fully characterize groundwater contamination (particularly in the vicinity of 2GW3), approximately delineate potential plumes, assess human health and ecological risks, and evaluate remedial technologies.

Sediment

The results of previous sampling efforts (August 1984 and December 1986) at Site 2 indicate the presence of pesticide (DDD, DDE, DDT) and herbicide (2,4-D and 2,4,5-T) contaminants in the surface sediment. Sample analysis was limited to organochlorine pesticides and herbicides and tetrachlorodioxin (1986 only). The level of QA/QC protocols and overall data quality are unknown.

Based on the review of existing information, data will be required to more fully characterize the extent of sediment contamination in the ditch towards its outlet at Overs Creek, approximately delineate areas of concern, assess human health and ecological risks and evaluate remedial technologies. In addition, background pesticide levels need to be established since pest control activities have been documented throughout MCB Camp Lejeune.

Surface Water

The results of previous sampling efforts (December, 1986) at Site 2 indicate the presence of pesticide (DDD, DDT) in the surface water. Sample analysis was limited to organochlorine pesticides, organochlorine herbicides, tetrachlorodioxin and VOCs. The level of QA/QC protocols and overall data quality are unknown.

Based on the review of existing information, additional data will be required to assess surface water quality to evaluate potential human health and ecological risks.

Concrete Pesticide Mixing/Wash Pads

No samples have been collected from the concrete mixing and wash pads at Site 2. Data will be required to assess contaminant levels in the concrete to evaluate the hazardous or nonhazardous nature of the material for disposal purposes.

2.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that ensure that data of known and appropriate quality are obtained during the RI and FS and will support remedial decisions (EPA, 1987). Data Quality Objectives associated with each field collection program are discussed and presented in this Section. Data Quality Objectives were developed using the following three stage process:

- Stage 1 - Identify decision types
- Stage 2 - Identify data needs
- Stage 3 - Design data collection program

Stage 1 of the DQO process takes place during the scoping of the RI/FS. This stage involves the evaluation of existing information, development of a conceptual model for the site to identify contaminant transport and exposure pathways, and the development of objectives for further data collection efforts.

Stage 2 of the DQO process involves definition of the quality and quantity of data that will be required to meet the objectives established in Stage 1.

Stage 3 involves design of a data collection program to meet the requirements identified in Stage 2.

The remaining portions of this Section document the establishment of DQOs for the RI/FS at Site 2.

2.1 Stage 1 - Identification of Decision Types

As part of the Stage 1 DQO process, available information from previous site investigations and other sources (e.g., USGS) were reviewed in order to describe the current site conditions, evaluate existing data, and assess the adequacy of the data. This review has been documented in Section 2.0 of the RI/FS Work Plan and summarized in Section 1.1 and 1.2 of this FSAP. From this review and evaluation, a conceptual site model was developed for each site by identifying the potential sources of contamination, the contaminant migration pathways, and potential receptors. A conceptual site model for each site is presented in Table 2-1. Based on the conceptual contaminant transport/migration model for each site, specific RI/FS objectives

TABLE 2-1

CONCEPTUAL SITE MODEL AND RI/FS OBJECTIVES FOR SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Site	Area of Concern	Potential Migration and Exposure Pathways	Site-Specific RI/FS Objectives
2	Building 712	• Surface soil runoff from Site 2 to drainage ditch.	• Assess the horizontal extent of surface soil contamination in this portion of Site 2. • Determine nature and extent of contamination in surface water/sediments in the drainage ditch.
		• Leaching of sediment contaminants to surface water.	• Determine the nature and extent of contamination in surface water/sediments in the drainage ditch.
		• Migration/leaching of contaminants at the concrete mixing and washing pad areas to the soil.	• Determine the nature and extent of soil contamination under the concrete pads.
		• Migration/leaching of soil contaminants in the wash pad area to groundwater.	• Assess the vertical extent of soil contamination within this portion of Site 2. • Assess the nature and extent of contamination in the shallow aquifer near this portion of Site.
		• Direct contact with surface soil by humans and animals.	• Assess the level and nature of contamination in surface soils near this portion of Site 2.
		• Direct contact with surface water/sediment by humans and animals.	• Assess the level and nature of contamination in surface water/sediment near this portion of Site 2.
		• Direct contact with subsurface soils by burrowing animals.	• Assess the level and nature of contamination in subsurface soils near this portion of Site 2.
		• Direct contact with contaminated concrete at mixing and wash pads.	• Assess the level and nature of contamination in concrete at mixing and wash pads.
		• Human exposure from future potential groundwater ingestion or dermal contact.	• Assess the nature and extent of contamination in the shallow aquifer near this portion of Site 2.

TABLE 2-1 (Continued)

CONCEPTUAL SITE MODEL AND RI/FS OBJECTIVES FOR SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Site	Area of Concern	Potential Migration and Exposure Pathways	Site-Specific RI/FS Objectives
2 (Cont.)	Building 712	● Human exposure due to ingestion of contaminated wildlife.	● Qualify potential impacts/stresses to wildlife.
	Former Storage Area	● Surface soil runoff from the Former Storage Area to drainage ditch.	● Assess the horizontal extent of surface soil contamination in this portion of Site 2. ● Determine the nature and extent of contamination in surface water/sediments in the drainage ditch.
		● Leaching of sediment contaminants to surface water.	● Determine nature and extent of contamination in surface water/sediments in the drainage ditch.
		● Migration/leaching of soil contaminants to groundwater.	● Assess the vertical extent of soil contamination within this portion of Site 2. ● Assess the nature and extent of contamination in the shallow aquifer near this portion of Site 2.
		● Vertical groundwater migration to the deep aquifer.	● Evaluate groundwater quality in the deep aquifer (if contamination is detected in the shallow aquifer).
		● Direct contact with surface soil by humans and animals.	● Assess the level and nature of contamination in surface soils near this portion of Site 2.
		● Direct contact with surface water/sediment by humans and animals.	● Assess the level and nature of contamination in surface water/sediment near this portion of Site 2.
		● Direct contact with subsurface soils by burrowing animals.	● Assess the level and nature of contamination in subsurface soils near this portion of Site 2.
		● Human exposure from future potential groundwater ingestion or dermal contact.	● Assess the nature and extent of contamination in the shallow aquifer near this portion of Site 2.

TABLE 2-1 (Continued)

CONCEPTUAL SITE MODEL AND RI/FS OBJECTIVES FOR SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Site	Area of Concern	Potential Migration and Exposure Pathways	Site-Specific RI/FS Objectives
2 (Cont.)	Former Storage Area	● Human exposure to VOCs due to volatilization from groundwater.	● Assess the nature and extent of contamination in the shallow aquifer near this portion of Site 2.
		● Human exposure due to ingestion of contaminated wildlife.	● Evaluate potential impact/stresses to wildlife.

have been developed to (1) assess the nature and extent of the threat posed by the release or potential release of hazardous substances, (2) assess human health and environmental risks, and (3) identify and evaluate remedial alternatives. The identification of these objectives which are also presented in Table 2-1, is the first step toward the development of a program for collection of sufficient data for decision making.

The following section identifies the data requirements to meet the site-specific RI/FS objectives.

2.2 Stage 2 - Identification of Data Needs

In Stage 2 of the DQO process, the data quality and quantity required to support the RI/FS objectives developed during Stage 1 are identified. Data collected during the RI/FS for Site 2 will be used for: human and ecological risk assessment; site characterization; screening and evaluating alternatives; and remedial design. With respect to the RI/FS objectives identified in the previous section, data will be required to address the following:

Soil

- The extent of surface and subsurface soil contamination within reported disposal areas.
- The extent of surface soil contamination due to surface runoff.
- The physical properties of the soil to evaluate migration potentials and remedial technologies.
- The chemical properties of the soil to assess potential human health and environmental risks, and to evaluate remedial technologies.
- The chemical properties associated with disposal and treatment requirements.

Groundwater

- The extent and nature of on site and off-site groundwater contamination in shallow and/or deep aquifers.

- The flow direction and discharge patterns of the aquifers.

- The chemical properties needed to assess potential human health risks.

- The chemical properties needed to evaluate compliance with State or Federal drinking water standards.

- The chemical/physical properties that may affect the treatability of the groundwater.

Sediments

- The extent and nature of sediment contamination in surface water bodies potentially impacted by site runoff or groundwater discharge.

- The chemical properties to assess human health and environmental risks due to exposure.

Surface Water

- The extent and nature of surface water potentially impacted by site runoff or groundwater discharge.

- The chemical properties to assess human health and environmental risks.

Concrete Pesticide Mixing/Wash Pads

- The hazardous or nonhazardous nature of the former pesticide mixing pads to assess disposal and treatment requirements.

The type of data and the quality of data to meet the criteria listed above are summarized on Table 2-2. The data quality levels differ with respect to the end use of the data. Level IV data quality are generally required in risk assessments, characterizing the nature and extent of contamination, and to support the record of decision. Level III data quality is appropriate for evaluating treatment alternatives. Level II data quality is appropriate for field screening (i.e.,

TABLE 2-2

SUMMARY OF DATA TYPES AND DATA QUALITY LEVELS
SITE 2, MCB CAMP LEJEUNE

Media	Sampling Criteria/Purpose	Data Types	Data Quality Level
Soil	Determine extent of surface and subsurface soil contamination within reported disposal areas	TCL Organics TAL Inorganics Subsurface Features (Geophysical Methods)	IV IV II
	Determine extent of surface soil contamination due to surface runoff	TCL Organics TAL Inorganics	IV IV
	Determine physical properties of soil to evaluate migration potentials and remedial technologies	Grain Size Moisture Density Total Organic Carbon Chloride Total Fluoride Organic Nitrogen Alkalinity (total) Total TCLP	III III III III III III III III
	Determine chemical properties of soil to assess potential human health and environmental risks, and to evaluate remedial technologies	TCL Organics TAL Inorganics	IV IV
	Determine chemical properties associated with disposal and treatment requirements	Total TCLP Full RCRA Characterization	III III
Groundwater	Determine extent and nature of onsite and offsite groundwater contamination in shallow and/or deep aquifers	TCL Organics TAL Inorganics	IV IV
	Determine physical properties of the aquifers and their physical relationship between one another	Surface Features (lithologic samples) Water Level Elevations (static and pumping) Hydraulic Conductivity Transmissivity	II II II II

TABLE 2-2

SUMMARY OF DATA TYPES AND DATA QUALITY LEVELS
SITE 2, MCB CAMP LEJEUNE

Media	Sampling Criteria/Purpose	Data Types	Data Quality Level
Groundwater (Continued)	Determine flow direction and discharge patterns of the aquifers	Surface Features (lithologic samples)	II
		Water Level Elevations (static and pumping)	II
		Hydraulic Conductivity	II
		Transmissivity	II
	Determine chemical properties to assess potential human health risks	TCL Organics	IV
		TAL Inorganics	IV
	Determine chemical properties to evaluate compliance with State or Federal drinking water standards	TCL Organics	IV
		TAL Inorganics	IV
	Determine chemical/physical properties that may affect treatment	Total Suspended Solids	III
		Total Volatile Solids	III
		Biological Oxygen Demand	III
		Chemical Oxygen Demand	III
		Total Organic Carbon	III
		Total Dissolved Solids	I
		Temperature	I
		Specific Conductance	I
		pH	
Sediment	Determine extent and nature of sediment contamination in surface water bodies potentially impacted by site runoff, groundwater discharge, or tidal effects	TCL Organics	IV
		TAL Inorganics	IV
	Determine chemical properties to assess human health and environmental risks due to exposure	TCL Organics	IV
		TAL Inorganics	IV
		Total Organic Carbon	III
Surface Water	Determine extent and nature of surface water potentially impacted by site runoff, groundwater discharge, or tidal effects	TCL Organics	IV
		TAL Inorganics	IV
	Determine chemical properties to assess human health and environmental risks	TCL Organics	IV
		TAL Inorganics	IV
	Determine physical/chemical properties to assess potential impacts to aquatic life	Dissolved Oxygen	I
		Specific Conductance	I
		Temperature	I
		pH	I

geophysical investigations, soil gas). Level I data is appropriate for field measurements such as dissolved oxygen, temperature, specific conductance, and pH.

The analytical method also differs with respect to the end use of the data. For purposes of assessing health risks and to compare contaminant levels against Federal or State standards, it will be necessary to obtain lower detection levels for selected parameters such as volatile organics (e.g., EPA Method 8020). For this RI/FS, EPA Methods and CLP protocols will be used when applicable unless a method or protocol does not exist.

The quantity of samples collected is based on obtaining a representative measure to characterize the nature and extent of contamination, assess human health and environmental risks, and develop and evaluate remedial alternatives. For the various field investigations at the two sites, the number and location of samples was determined based on best engineering estimates, visual evaluation of the sites, and a review and evaluation of background information.

2.3 Stage 3 - Design Data Collection Program

The data collection program for Site 2 have been designed to meet the objectives identified in Table 2-1. Section 5.4 of the RI/FS Work Plan provides a general description of the various sampling programs for the four sites. Sections 3.0 through 5.0 of this FSAP provide the specific details of these sampling programs.

3.0 SAMPLING LOCATIONS AND FREQUENCY

This section of the FSAP identifies each sample matrix to be collected and the constituents to be analyzed.

3.1 Site 2 - Former Nursery Day Care Center

There are two areas of concern at Site 2: the Building 712 area (storing, handling and mixing of pesticides) and the Former Storage Area (VOC contaminants present in shallow groundwater). Samples will be collected from both areas of concern. The various sampling and investigation programs include: Geophysical Investigation; Soil Investigation; Concrete Pad Sampling; Groundwater Investigation; Surface Water/Sediment Investigation.

3.1.1 Geophysical Investigation

A geophysical investigation will be conducted at the Former Storage Area section of Site 2 to evaluate whether an underground storage tank was or is present in this area. Ground penetrating radar (GPR) or electromagnetic terrain profiling (EM) techniques will be used to define subsurface conditions (including the presence of an underground storage tank). The results of the geophysical investigation will be used to finalize soil boring and monitoring well locations.

3.1.2 Soil Investigation

The following subsections describe the soil sampling locations and analytical requirements at Building 712 and Former Storage Area at Site 2. Soil borings will be advanced (by a drilling rig) at each location to collect surface and subsurface soil samples. Soil boring locations and analytical parameters have been selected on the basis of the results of the EPIC study, other historical information and available information regarding soil quality on site. For risk assessment purposes, a minimum of 10 percent of all soil samples collected at each area of concern will be analyzed for full TCL organic and TAL inorganic parameters.

3.1.2.1 Building 712

Soil boring locations at Building 712 are presented on Figure 3-1. The number of samples, analytical requirements, data quality level and analytical turnaround time are included in Table 3-1.

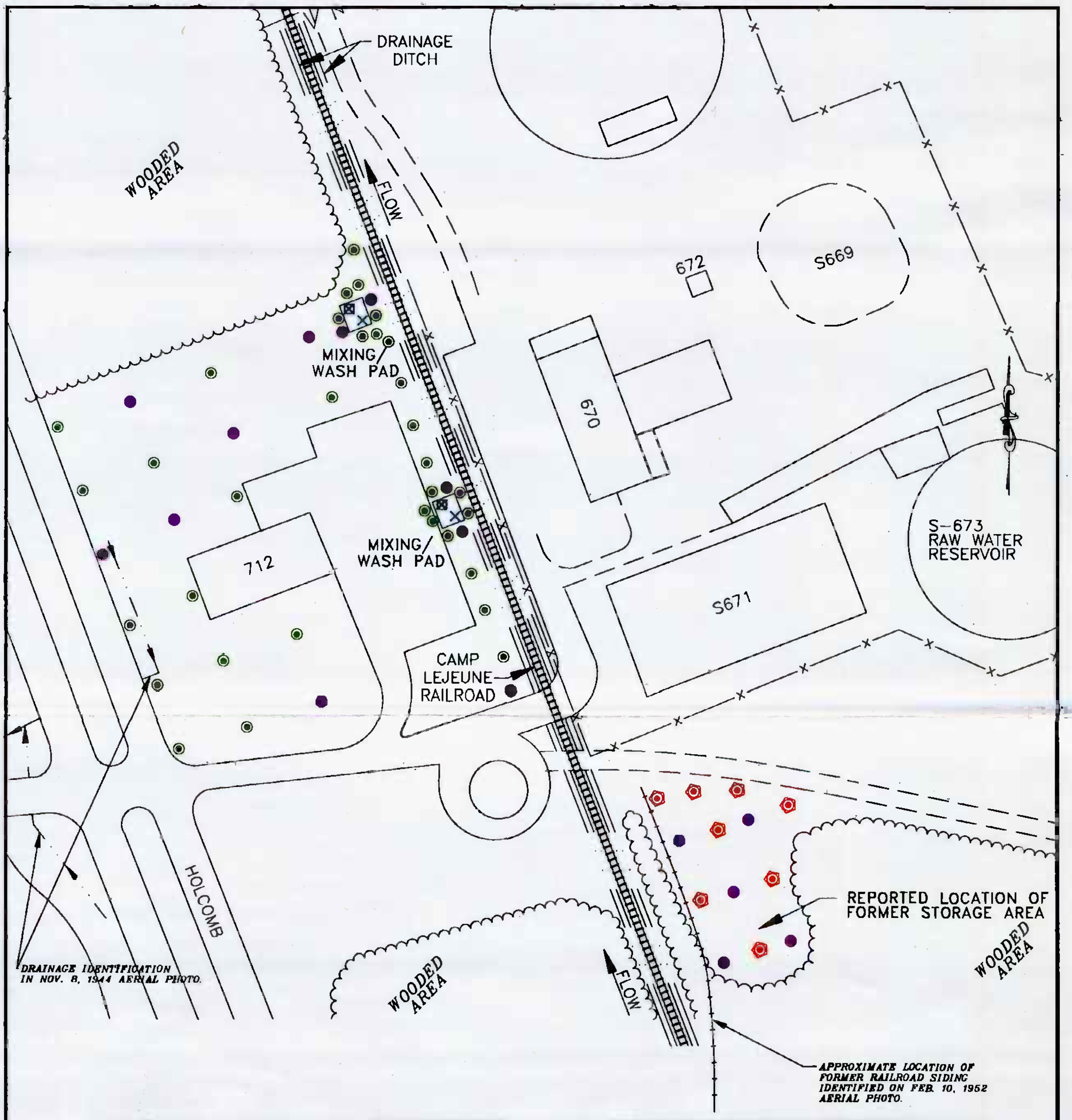
Nineteen soil borings will be advanced by a drilling rig using hollow stem augers at each location (Figure 3-1). Split-spoon soil samples will be collected using ASTM Method 1586 continuously from the surface to groundwater (estimated to be 7 to 20 feet bgs) Samples collected from the 0 to 6 inch interval will be submitted to the laboratory for analysis. Subsurface soil samples selected at 5 foot intervals (to the depth of groundwater) will also be submitted to the laboratory for analysis.

One representative composite soil sample, from a single borehole, will be analyzed for Engineering/FS parameters and waste disposal parameters (Table 3-1). These parameters include:

- Grain Size
- Moisture Density
- Chloride
- Total Fluorine
- Organic Nitrogen
- Alkalinity
- Total Organic Carbon (TOC)
- Toxicity Characteristic Leaching Procedure (pesticides and metals)
- Reactivity
- Corrosivity
- Ignitability

3.1.2.2 Former Storage Area

Soil sampling locations at the Old Storage Area are presented on Figure 3-1. The number of samples, analytical requirements, data quality level and analytical turnaround time are included in Table 3-1.



DESIGNATION	DESCRIPTION	No. OF LOCATIONS	Estimated No. OF SAMPLES	CHEMICAL ANALYSIS	TURNAROUND TIME
◉	SOIL BORING (0–6") (5' INTERVALS TO GROUNDWATER)	36	72–108	CHLORINATED HERBICIDES TCL PESTICIDES	ROUTINE (28–40 DAYS)
⬟	SOIL BORING (0–6") (5' INTERVALS TO GROUNDWATER)	8	16–24	BTEX	ROUTINE (28–40 DAYS)
×	CONCRETE CHIP	4	4	CHLORINATED HERBICIDES TCL PESTICIDES TAL METALS	ROUTINE (28–40 DAYS)
■	CONCRETE CHIP/SOIL BORING (0–6") (2'–4')	2	4	CHLORINATED HERBICIDES TCL PESTICIDES	QUICK TURN (14 DAYS) QUICK TURN (14 DAYS)
●	SOIL BORING	13	26–39	FULL TCL/TAL	QUICK TURN (14 DAYS)

80 0 40 80 120

1 inch = 80 ft.

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FIGURE 3-1
SOIL SAMPLING LOCATIONS
SITE 2

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

SOURCE: LANTDIV, OCT. 1991

01486P04Y

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 2 Bldg. 712 Area	Soil	19 Soil Borings				
		• 26-39 Samples (13 Borings)	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
		• 12-18 Samples (6 Borings)	TCL Organics	IV	1,2,3	Routine
			TAL Inorganics	IV	6	Routine
Site 2 Mixing Pads Area	Soil	25 Soil Borings				
		• 40-60 Samples (20 Borings)	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
		• 10-15 Samples (5 Borings)	TCL Organics	IV	1,2,3	Routine
			TAL Inorganics	IV	6	Routine
		• 1 Composite Sample	Engineering Parameters	III	7	Routine
Background Soil	Soil	2 Samples Total	TCL Organics	IV	1,2,3	Routine
			TAL Inorganics	IV	6	
Site 2 Bldg. 712	Concrete Pads	4 Concrete Chip Samples	TCLP Pesticides, Metals, and Herbicides	III	7	Routine
		4 Soil Samples from Beneath Concrete Pads	Chlorinated Herbicides	IV	4	14 days
			TCL Pesticides	IV	3	14 days
			TAL Inorganics	IV	7	14 days
Site 2 Bldg. 712 Drainage Ditches (RR Tracks)	Surface Water	10 Samples Total				
		• 6 Samples	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
		• 4 Samples	TCL Organics	IV	1,2,3	Routine
			TAL Inorganic	IV	7	Routine

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 2 Bldg. 712 Drainage Ditches (RR Tracks)	Sediment	10 Locations/20 Samples Total				
		• 12 Samples (includes 1 background)	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
			TOC	III	7	Routine
		• 8 Samples	TCL Organics	IV	1,2,3	Routine
			TAL Inorganics	IV	6	Routine
			TOC	III	7	Routine
Site 2 Holcomb Boulevard Drainage Ditch	Surface Water	2 Samples Total	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
Site 2 Holcomb Boulevard Drainage Ditch	Sediment	2 Locations/4 Samples Total	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
			TOC	III	7	Routine
Overs Creek	Surface Water	3 Samples Total				
		• 1 Sample	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
		• 2 Samples	TCL Organics	IV	1,2,3	Routine
			TAL Inorganics	IV	6	Routine

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Overs Creek	Sediment	3 Locations/6 Samples Total				
		• 2 Samples	Chlorinated Herbicides TCL Pesticides TOC	IV IV III	4 3 7	Routine Routine Routine
		• 4 Samples	TCL Organics TAL Inorganics TOC	IV IV III	1,2,3 6 7	Routine Routine Routine
Site 2 Former Storage Area	Soil	13 Borings				
		• 16-24 Samples (8 borings)	BTEX	III	5	14 days
		• 10-15 Samples (5 borings)	TCL Organics TAL Inorganics	IV IV	1,2,3 6	14 days 14 days
		• 1 Composite Sample	Engineering/FS Parameters	III	7	Routine
Site 2 Monitoring Well Boreholes	Soil	5 Monitoring Well Test Borings	TCL Organics	IV	1,2,3	Routine
		• 10 Samples (2/borehole)	TAL Inorganics	IV	6	Routine
Site 2 Former Storage Area Drainage Ditches	Surface Water	9 Samples Total (includes 1 background)				
		• 5 Samples	Chlorinated Herbicides TCL Pesticides	IV IV	4 3	Routine Routine
		• 4 Samples	TCL Organics TAL Inorganics	IV IV	1,2,3 6	14 days 14 days

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 2 Former Storage Area Drainage Ditch	Sediment	9 Locations/18 Samples Total				
		● 10 Samples	Chlorinated Herbicides	IV	4	Routine
			TCL Pesticides	IV	3	Routine
			TOC	III	8	Routine
		● 8 Samples	TCL Organics	IV	1,2,3	14 days
			TAL Inorganics	IV	6	14 days
			TOC	III	7	Routine
Site 2	Groundwater	5 Existing Wells and 5 New Wells	TCL Organics	IV	1,2,3	Routine
		11 Samples Total (2 Background)	TAL Inorganics	IV	6	Routine
			Engineering Parameters	III	I	Routine

TABLE 3-1
SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

1.	Purgeable Organic Compounds	EPA 8240/EPA 624	
2.	Base/Neutral and Acid Extractables	EPA 3510/3550	EPA 625
3.	Pesticides and PCBs	EPA 3510/3550	EPA 608
4.	Chlorinated Herbicides	EPA 8150	
5.	Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	EPA 8020	

6. TAL Inorganics

Aluminum	EPA 3010/EPA 200.7	Calcium	EPA 3010/EPA 200.7	Nickel	EPA 3010/EPA 200.7
Antimony	EPA 3010/EPA 200.7	Chromium	EPA 3010/EPA 200.7	Potassium	EPA 3010/EPA 200.7
Arsenic	EPA 3020/EPA 206	Cobalt	EPA 3010/EPA 200.7	Selenium	EPA 3020/EPA 270
Barium	EPA 3010/EPA 200.7	Copper	EPA 3010/EPA 200.7	Silver	EPA 3010/EPA 200.7
Beryllium	EPA 3010/EPA 200.7	Iron	EPA 3010/EPA 200.7	Thallium	EPA 3020/EPA 279
Cadmium	EPA 3010/EPA 200.7	Lead	EPA 3020/EPA 234	Vanadium	EPA 3010/EPA 200
Calcium	EPA 3010/EPA 200.7	Magnesium	EPA 3010/EPA 200.7	Zinc	EPA 3010/EPA 200.7
Chromium	EPA 3010/EPA 200.7	Manganese	EPA 3010/EPA 200.7	Cyanide	EPA 3010/EPA 335
		Mercury	EPA 3010/EPA 245.1		

7. Engineering/FS Parameters - Soil

Grain Size	ASTM D422	Reactivity	40 CFR 261
Moisture Density	ASTM D698	Corrosivity	40 CFR 261
Total TCLP	40 CFR 261	Ignitability	40 CFR 261
Chloride	SW 9251		
Total Fluoride	SM 4500-F		
Nitrogen (Organic)	EPA 350.2		
Alkalinity (Total)	SM 2320-B		
TOC	EPA 415.1		

8. Engineering/FS Parameters - Water

Biological Oxygen Demand	SM 5210
Chemical Oxygen Demand	EPA 410.1
Total Suspended Solids	EPA 160.2
Total Dissolved Solids	EPA 160.1
Total Volatile Solids	EPA 160.4
Total Organic Carbon	

Thirteen soil borings will be advanced (by a drilling rig using hollow-stem augers) in the vicinity of the Former Storage Area. Soil boring locations may be modified based on the results of the geophysical investigation. Samples will be collected from the 0 to 6 inch interval and at 5-foot intervals to groundwater in each boring. Samples collected from eight of the test borings will be analyzed for BTEX. Soil samples collected from the remaining five test borings will be analyzed for full TCL organics/TAL inorganics.

One representative composite soil sample, from a single borehole, will be analyzed for Engineering/FS parameters and waste disposal parameters (Table 3-1). These parameters include:

- Grain Size
- Moisture Density
- Chloride
- Total Fluorine
- Organic Nitrogen
- Alkalinity
- Total Organic Carbon (TOC)
- Toxicity Characteristic Leaching Procedure (pesticides and metals)
- Reactivity
- Corrosivity
- Ignitability

3.1.2.3 Monitoring Well Test Borings

Five monitoring wells will be installed at Site 2. Two soil samples will be collected for chemical analysis from each well borehole. The soil samples shall be collected from just above the soil/water table interface, and just below the water table in the saturated zone. All soil samples will be analyzed for full TCL organics and TAL inorganics (see Table 3-1).

3.1.2.4 Background Soil Quality

Two surface soil samples shall be collected from the lawn of a nearby administration building for purposes of establishing background levels. The soil samples shall be collected from 0 to 6 inches using a decontaminated stainless steel hand auger. Both samples shall be analyzed for full TCL organics and TAL inorganics.

3.1.3 Concrete Pad Sampling

Concrete pads, reportedly used for mixing pesticides and washing pesticide spraying equipment, are present in the Building 712 area of Site 2 (Figure 3-1). Two concrete chip samples will be collected from each pad to determine the leachability of contaminants which may be in the concrete. The number of samples , analytical requirements, data quality level and analytical turnaround time are included in Table 3-1.

The samples will be analyzed for TCLP pesticides and metals.

Additionally, a soil boring will be advanced beneath each pad (with a hand auger, after the concrete has been cut through). Soil samples will be collected from the 0 to 6 inch and 2 to 4 foot intervals below the pad. These soil samples will be analyzed for chlorinated herbicides and TCL pesticides.

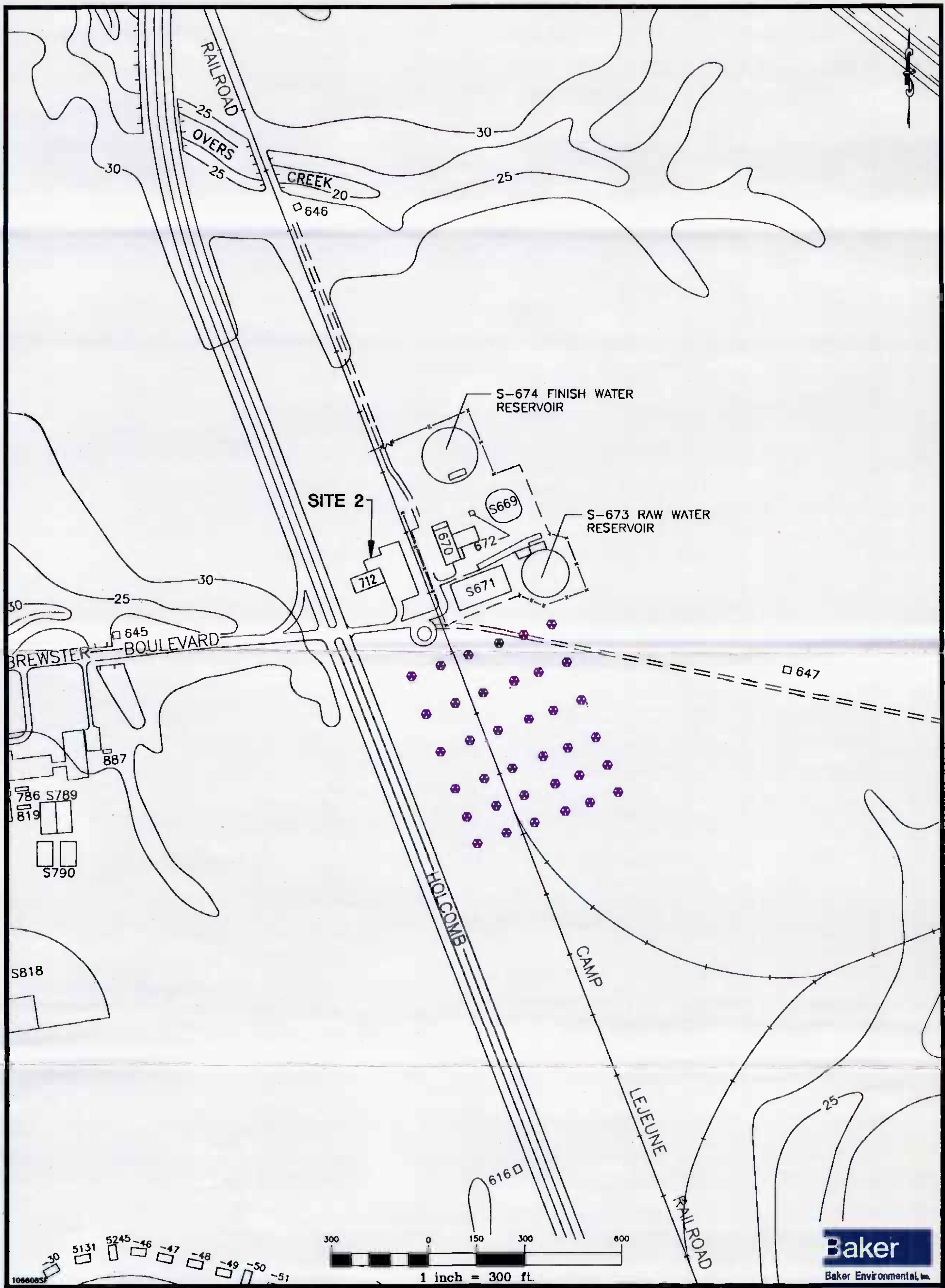
3.1.4 Groundwater Investigation

The following subsections describe the groundwater sampling locations and analytical requirements at Building 712 and the Former Storage Area at Site 2. Groundwater sampling locations and analytical parameters have been selected on the basis of available information regarding groundwater quality on site. A soil gas survey will also be conducted in the wooded area south of the former storage area. Results of the soil gas survey will also be used to select monitoring well locations. The proposed soil gas survey sampling grid is presented on Figure 3-2.

For risk assessment purposes, a minimum of 10 percent of all groundwater samples collected at each area of concern will be analyzed for full TCL organic and TAL inorganic parameters.

3.1.4.1 <u>Building 712</u>

Existing monitoring wells near Building 712 include: 2GW1, 2GW2, 2GW4 and 2GW5 (Figure 3-3). A background monitoring well will be installed north of Building 712. Groundwater samples will be collected from each of these monitoring wells. These samples will be analyzed for TCL organic and TAL Inorganic parameters (Table 3-1).



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LEGEND

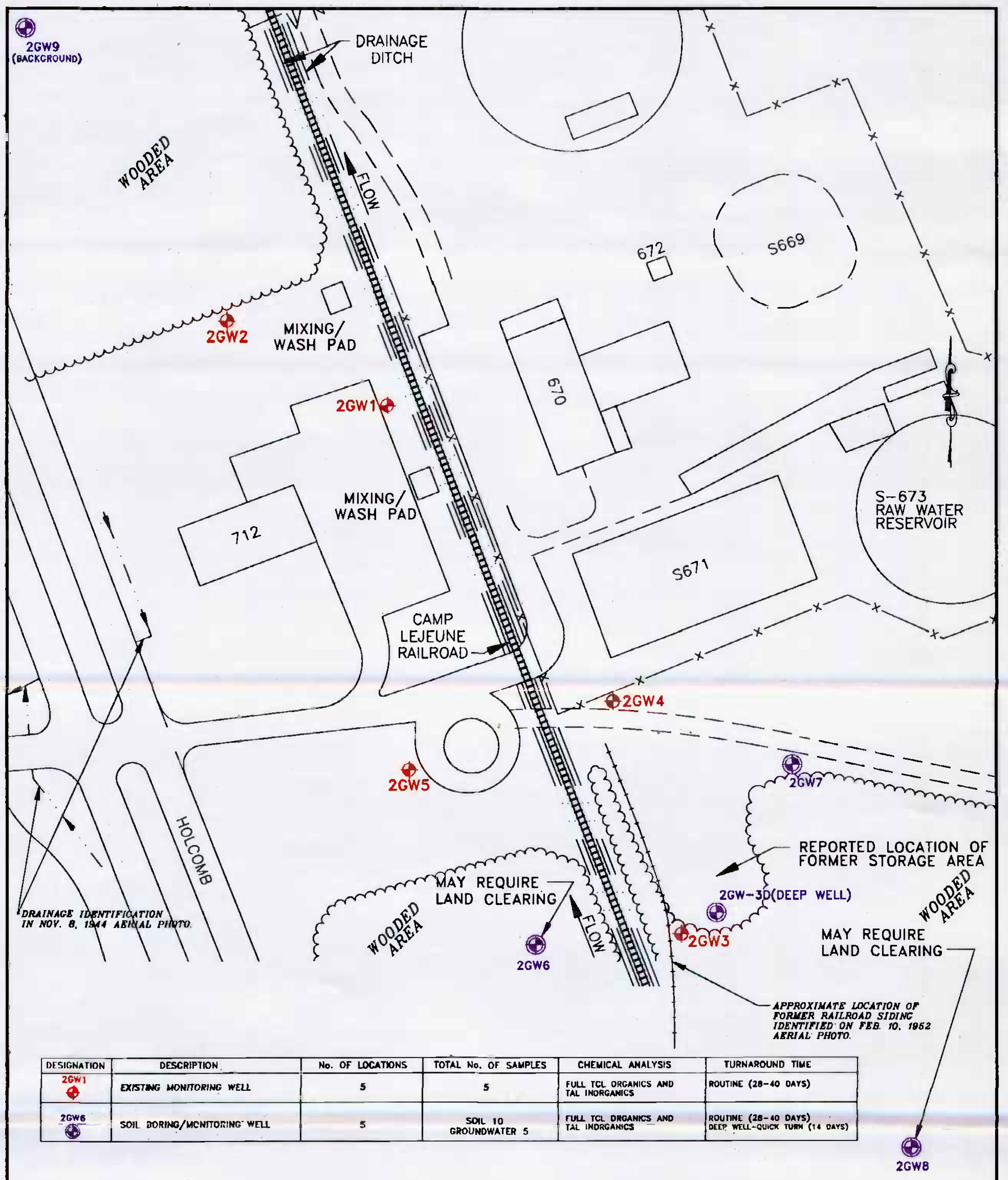
● SOIL GAS SURVEY SAMPLING LOCATION

SOURCE: LANTDIV, OCT. 1991

FIGURE 3-2
SOIL GAS SURVEY SAMPLING LOCATION MAP
SITE 2

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

01486P05Y



DESIGNATION	DESCRIPTION	No. OF LOCATIONS	TOTAL No. OF SAMPLES	CHEMICAL ANALYSIS	TURNAROUND TIME
2GW1 ⊕	EXISTING MONITORING WELL	5	5	FULL TCL ORGANICS AND TAL INORGANICS	ROUTINE (28-40 DAYS)
2GW6 ◉	SOIL BORING/MONITORING WELL	5	SOIL 10 GROUNDWATER 5	FULL TCL ORGANICS AND TAL INORGANICS	ROUTINE (28-40 DAYS) DEEP WELL-QUICK TURN (14 DAYS)

NOTE: NEW MONITORING WELL LOCATIONS WILL BE SELECTED BASED ON THE RESULTS OF THE SOIL GAS SURVEY.

80 0 40 80 120

1 inch = 80 ft.

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FIGURE 3-3
GROUNDWATER SAMPLING LOCATIONS
SITE 2

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

SOURCE: LANTDIV, OCT. 1991

01486P064

A groundwater sample from well 2GW1 will be analyzed for Engineering parameters (Table 3-1). The parameters include:

- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Total Volatile Solids (TVS)

Groundwater samples were collected from monitoring wells 2GW2 and 2GW5 during the Pre-Investigation Sampling (July 1992). These samples were analyzed for TCL organic and TAL inorganic parameters. No contaminants of concern were detected in these samples.

In addition to collection of groundwater samples, at least two rounds of static water elevations will be measured to delineate groundwater flow direction.

3.1.4.2 Former Storage Area

Monitoring well 2GW3 is the only existing monitoring well in the vicinity of the Former Storage Area (Figure 3-2). A groundwater sample was collected from this well during the Pre-Investigation Sampling (July 1992) and analyzed for TCL organic and TAL inorganic parameters in accordance with CLP protocols. Ethylbenzene and xylene (total) were the only contaminants of concern detected. In order to more fully delineate the extent of contaminants in shallow groundwater in this area, four additional monitoring wells (3 shallow, 1 deep) will be installed (Figure 3-3). Groundwater samples will be collected from the existing well (2GW3) and four additional monitoring wells. The samples will be analyzed for full TCL organic and TAL inorganic parameters. A groundwater sample from well 2GW3 will be analyzed for Engineering parameters (Table 3-1).

Three of the newly installed monitoring wells will be shallow (approximately 25 feet bgs). One deep (approximately 100 feet bgs) monitoring well will also be installed.

The deep monitoring well will be installed in the vicinity of the shallow well that exhibits the greatest degree of groundwater quality degradation. It is expected that this will be in the vicinity of 2GW3. VOC contaminants have been detected in the shallow groundwater in this area. Analytical results of groundwater samples collected from this well will be used to evaluate if groundwater contaminants have migrated from the shallow portion of the aquifer to the deeper portion of the aquifer

In addition to collection of groundwater samples, at least two rounds of static water elevations will be measured to delineate groundwater flow direction.

3.1.5 Surface Water/Sediment Investigation

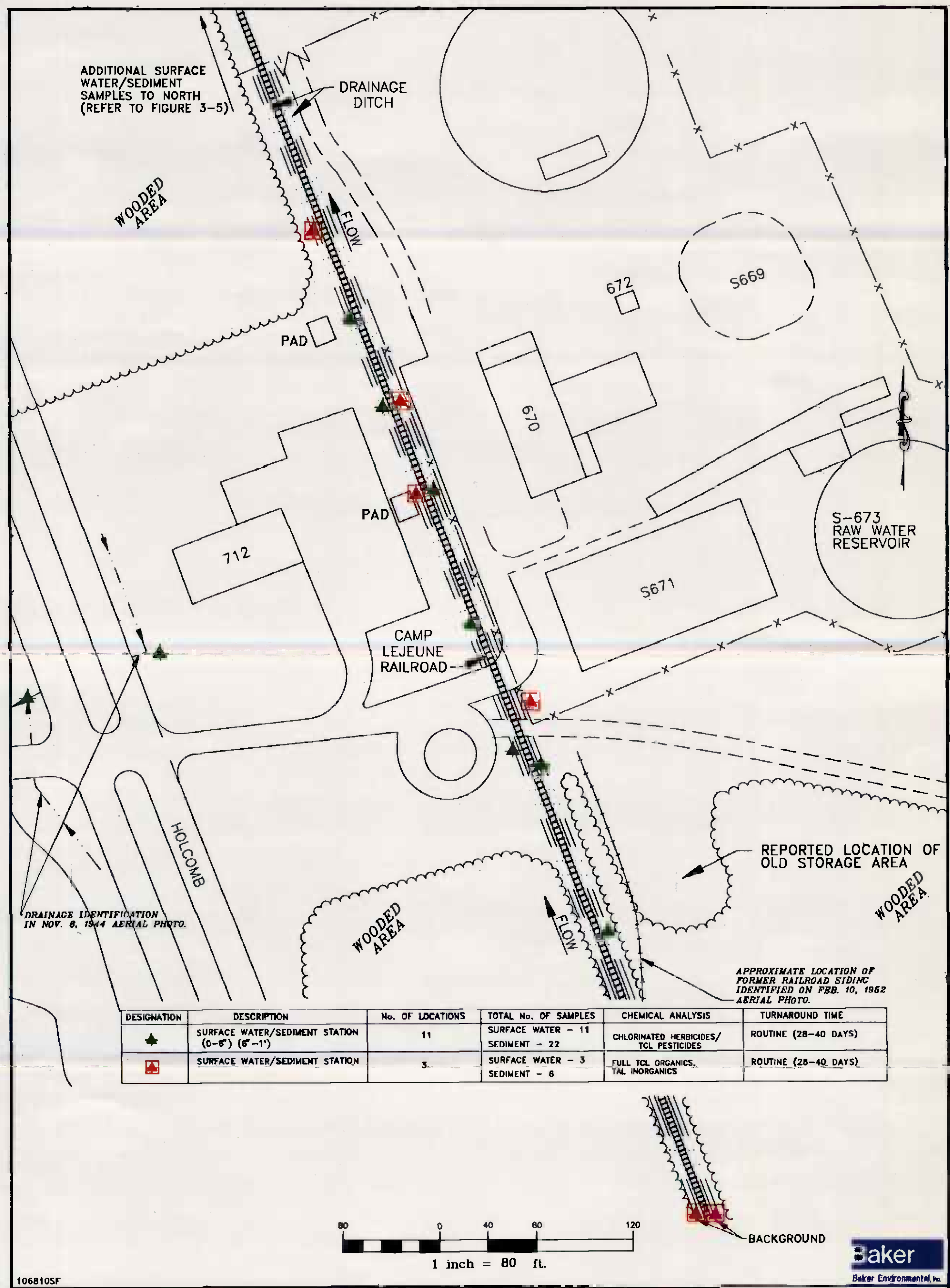
The following subsections describe the surface water/sediment sampling locations and analytical requirements at Building 712 and the Former Storage Area. Surface water/sediment sampling locations and analytical parameters have been selected on the basis of the results of the EPIC study, other historical information and available information regarding surface water/sediment quality on site. For risk assessment purposes, a minimum of 10 percent of all surface water/sediment samples collected at each area of concern will be analyzed for full TCL organic and TAL inorganic parameters.

A staff gauge will be installed in Overs Creek to measure surface water elevations. Elevations will be recorded when groundwater measurements are obtained at Site 2.

3.1.5.1 Drainage Ditch East of Building 712

Surface water/sediment samples will be collected from 10 locations within the drainage ditch which runs parallel to the railroad tracks east of Building 712 (Figure 3-4). This includes locations north of the site toward Overs Creek (Figure 3-5). The number of samples, analytical requirements, data quality level and analytical turnaround time are included in Table 3-1. Surface water samples collected from four locations will be analyzed for full TCL organics and TAL inorganics. Surface water samples collected from the remaining (six) locations will be analyzed for full TCL pesticides/herbicides. Figures 3-4 and 3-5 depict the sampling locations and location-specific analytical requirements.

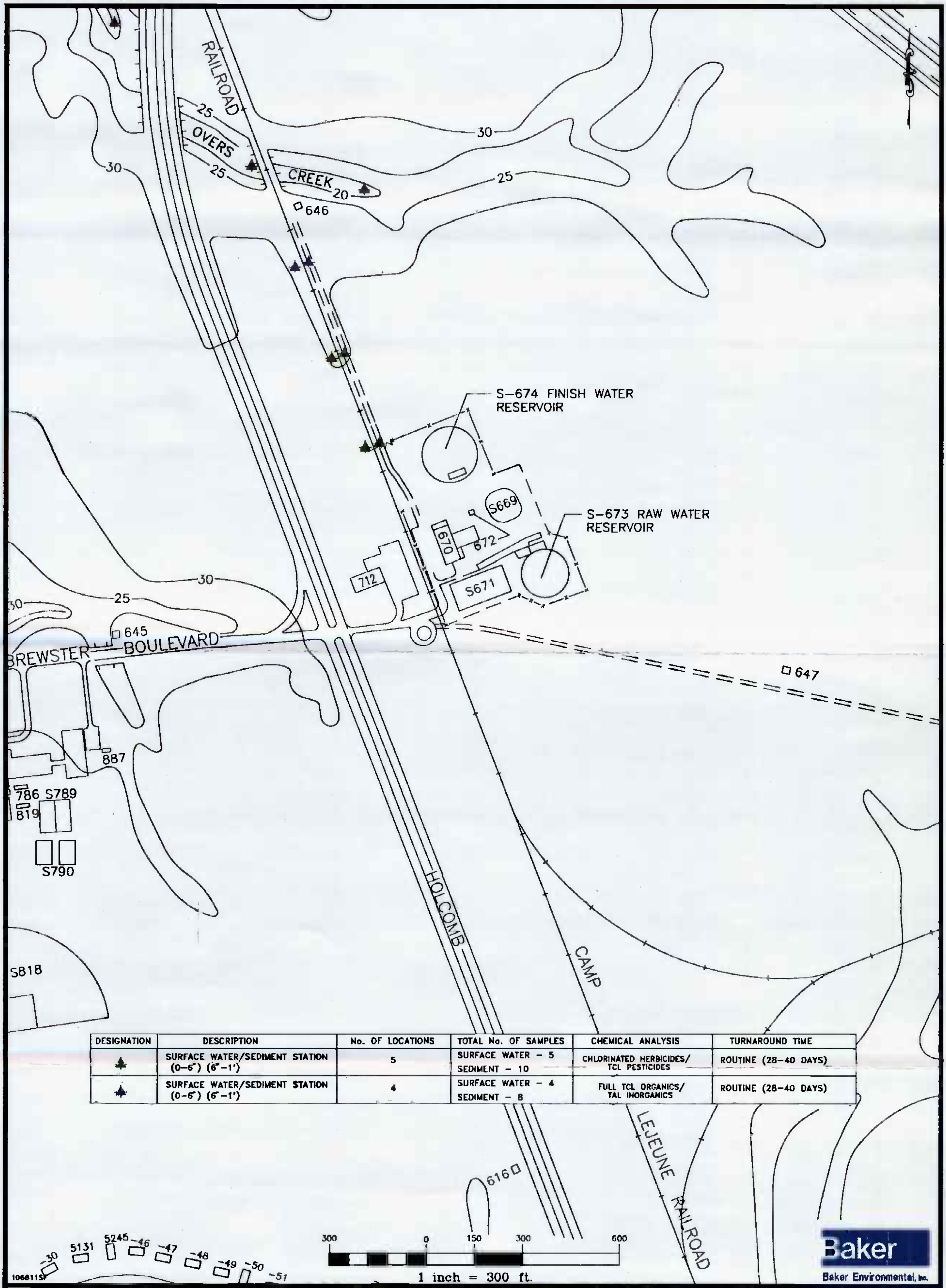
Two sediment samples will be collected from the same location as the surface water sample. The sediment samples will be collected from the 0 to 6 inches and from 6 to 12 inches in depth.



DESIGNATION	DESCRIPTION	No. OF LOCATIONS	TOTAL No. OF SAMPLES	CHEMICAL ANALYSIS	TURNAROUND TIME
▲	SURFACE WATER/SEDIMENT STATION (0-6") (6"-1')	11	SURFACE WATER - 11 SEDIMENT - 22	CHLORINATED HERBICIDES/ TCL PESTICIDES	ROUTINE (28-40 DAYS)
🟥	SURFACE WATER/SEDIMENT STATION	3	SURFACE WATER - 3 SEDIMENT - 6	FULL TCL ORGANICS, TAL INORGANICS	ROUTINE (28-40 DAYS)

FIGURE 3-4
SURFACE WATER/SEDIMENT SAMPLING LOCATIONS
SITE 2 AREA
MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

SOURCE: LANTDIV, OCT. 1991



DESIGNATION	DESCRIPTION	No. OF LOCATIONS	TOTAL No. OF SAMPLES	CHEMICAL ANALYSIS	TURNAROUND TIME
▲	SURFACE WATER/SEDIMENT STATION (0-6") (6"-1')	5	SURFACE WATER - 5 SEDIMENT - 10	CHLORINATED HERBICIDES/ TCL PESTICIDES	ROUTINE (28-40 DAYS)
▲	SURFACE WATER/SEDIMENT STATION (0-6") (6"-1')	4	SURFACE WATER - 4 SEDIMENT - 8	FULL TCL ORGANICS/ TAL INORGANICS	ROUTINE (28-40 DAYS)

FIGURE 3-5
SURFACE WATER/SEDIMENT SAMPLING
LOCATIONS NORTH OF SITE 2 AREA

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

SOURCE: LANTDIV. OCT. 1991

3.1.5.2 Drainage Ditch West of Former Storage Area

Surface water/sediment samples will be collected from nine locations within the drainage ditch which runs parallel to the railroad tracks, next to the Former Storage Area (Figure 3-4). The number of samples, analytical requirements, data quality level and analytical turnaround time are included in Table 3-1. Surface water samples collected from three locations (see Figures 3-4 and 3-5) shall be analyzed for full TCL organics and TAL inorganics. Surface water samples collected from the remaining (five) locations shall only be analyzed for full TCL pesticides/herbicides.

Two sediment samples will be collected from the same location as the surface water sample. The sediment samples will be collected from 0 to 6 inches and from 6 to 12 inches in depth.

3.1.5.3 Overs Creek

Three sampling locations have been identified in Overs Creek, as shown on Figure 3-5. One surface water sample will be collected at 4each location. Two of the three samples (see Figure 3-5 and Table 3-1) will be analyzed for full TCL organics and TAL inorganics. The third sample, collected just downstream of the Camp Lejeune railroad tracks, will only be analyzed for full TCL pesticides/herbicides.

Sediment samples will be collected at each location. Sediment samples shall be obtained from the surface (top six inches) and subsurface (six to twelve inches) for a total of six samples. Sediment samples shall be analyzed for the same parameters as the corresponding surface water sample (see Figure 3-5 and Table 3-1).

3.1.5.4 Holcomb Boulevard Drainage Ditch

As shown on Figure 3-4, a drainage ditch is present parallel to Holcomb Boulevard and the Building 712 property. Two surface water/sediment sampling locations have been identified in this ditch. One surface water and two sediment samples (top six inches and six to twelve inches) shall be collected at each location. All samples will be analyzed for full TCL pesticides/herbicides.

3.2 QA/QC Samples

QA/QC requirements for this investigation are presented in the Quality Assurance Project Plan (QAPP). The following QA/QC samples will be collected during field sampling activities:

- Trip Blanks

  Trip blanks are defined as samples which originate from organic-free deionized water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic (VOA) samples. One trip blank should accompany each cooler containing samples for volatile organic analysis. Trip blanks will only be analyzed for volatile organics.

- Equipment Rinsates

  Equipment rinsates are the final organic-free deionized water rinse from equipment decontamination procedures. Equipment rinsate blanks will be collected daily during each sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results from the blanks will be used to evaluate the decontamination methods. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

- Field Blanks

  Field blanks consist of the source water used in equipment decontamination procedures. At a minimum, one field blank form each event and each source of water must be collected and analyzed for the same parameters as the related samples.

  One field blank per source per event will be collected.

- Field Duplicates/Split Samples

  Field duplicates (or split samples) for soil samples are collected, homogenized, and split. All samples except VOCs are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the core and placed in 40-ml.

glass vials. The duplicates for water samples should be collected simultaneously. The water samples will not be composited.

Field duplicates will be collected at an appropriate frequency of 10 percent.

- Matrix Spike/Matrix Spike Duplicates (MS/MSD)

  MS/MSD samples are to evaluate the matrix effect of the sample upon the analytical methodology. A matrix spike and matrix spike duplicate must be performed for each group of samples of a similar matrix.

  MS/MSD samples will be collected at a frequency of 5 percent.

- Preservative Blanks

  Preservative blanks are prepared by putting organic-free deionized water in a container and preserving the sample with the appropriate preservative. This sample is submitted to the laboratory for full TCL/TAL analysis. One preservative blank will be collected at the beginning and end of this investigation.

4.0 SAMPLE DESIGNATION

All samples collected during this investigation, including QA/QC samples, will be designated with a unique number. The number will serve to identify the investigation, the site, the area within the site, the sample media, sampling location, the depth (soil) or round (groundwater) of sample, and QA/QC qualifiers.

The sample designation format is as follows:

Site # - Media - Location - Depth/Round (QA/QC)

An explanation of each of these identifiers is given below.

Site #	This investigation includes Site 2.
Media	SB = Soil Boring (soil sample from a boring) GW = Groundwater SW = Surface Water SD = Sediment CC = Concrete Chip WT = Waste
Location	The location numbers identify the sampling location. This would include station number for soil location or monitoring well number for groundwater. Each grid station will be identified with a unique identification number.
Depth/Round	Depth indicators will be used for soil samples. The number will refer to the depth of the top of the sampled interval. For example: 00 = top of sample at ground surface 01 = top of sample is 1 foot below surface 07= top of sample is 7 feet below surface Round indicator will be used for groundwater samples (round one and round two).
QA/QC	(FB) = Field Blank (D) = Duplicate Sample (TB) = Trip Blank (ER) = Equipment Rinsate (PB) = Preservative Blank

Under this sample designation format the sample number 2-GW-3-1D refers to:

2-GW-3-1D	Site 2
2--GW-3-1D	Groundwater sample
2-GW-3-1D	Monitoring well #3
2-GW-3-1D	Round 1
2-GW-3-1D	Duplicate (QA/QC) sample

This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented.

5.0 INVESTIGATIVE PROCEDURES

5.1 Soil Sample Collection

Soil samples will be collected throughout the site including both surface and subsurface samples. The majority of the soil samples will be collected from soil borings advanced by a hand auger. Soil samples will also be collected from boreholes advanced by a drilling rig and during the installation of monitoring wells. Some soil samples will be collected from test pits excavated by a backhoe.

Procedures for collecting the various types of soil samples are provided in the subsections which follow.

All hand auger or soil boring (including monitoring well borings) locations will be identified in the field by the Field Team Leader or Site Manager. Utility clearance shall be obtained from Activity personnel for all hand augers, soil boring and monitoring well borehole locations.

5.1.1 Soil Borings Advanced by Hand Auger

Hand augering is the most common manual method used to collect subsurface samples. Typically, 4-inch bucket augers with cutting heads are pushed and twisted into the ground and removed as the buckets are filled. The auger holes are advanced one bucket at a time. The practical depth of investigation using a hand auger is related to the material being sampled. In this investigation , hand augers will be used to collect discrete grab samples of soil from the 0 to 6 inches and 2 to 4 foot intervals.

When a vertical sampling interval has been established, one auger bucket is used to advance the auger hole to the first desired sampling depth. Since discrete grab samples are to be collected to characterize each depth, a new bucket will be placed on the end of the auger extension immediately prior to collecting the next sample. The top several inches of soil should be removed from the bucket to minimize the chances of cross-contamination of the sample from fall-in of material from the upper portions of the hole. The bucket auger will be decontaminated between samples and sampling locations as outlined in Section 5.7.

5.1.2 Soil Borings and Monitoring Well Boreholes

Soil samples from soil borings advanced by a drilling rig will be collected using a split-spoon sampler. A split-spoon sampler is a steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device can be driven into unconsolidated materials using a drive weight connected to the drilling rig. A standard split-spoon sampler (used for performing Standard Penetration Tests) is two inches outer diameter (OD) and 1-3/8-inches inner diameter (I.D.). This standard spoon is available in two common lengths providing either 20-inch or 26-inch internal longitudinal clearance for obtaining 18-inch or 24-inch long samples, respectively. Split spoons capable of obtaining 24-inch long samples will be utilized during this investigation.

Split-spoon samples will be collected continuously from the ground surface to the ground water table in each soil boring. Soil borings that will be converted into monitoring wells (monitoring well boreholes) will be advanced 10 feet below the water table. The physical characteristics of the samples will be described by the site geologist. The soil in the sampler will be classified according to the Unified Soil Classification System (USCS). Soil sample descriptions will be recorded in the field geologist's notebook.

Selected split-spoon samples will be submitted to the laboratory for analysis including samples collected at the surface and the interval immediately above the water table. If the water table is deeper than 10 feet, an additional split-spoon sample, selected by the geologist will be submitted for laboratory analysis. For human health risk assessment purposes, only the 0-6 in. interval of the first split-spoon sample (0 to 2 feet) will be submitted for analysis.

The following procedures for collecting soil samples in split-spoons will be used:

1. The surface sample will be collected by driving the split-spoon with blows from a 140-pound hammer falling 30 inches in accordance with ASTM D1586-84, Standard Penetration Test. Only the top 6 inches will be submitted to the laboratory for analyses.

2. Advance the borehole to the desired depth using hollow stem auger drilling techniques. The split-spoon will be lowered into the borehole inside the hollow stem auger (this will insure that undisturbed material will be sampled). Soil cuttings will not be containerized.

3. Drive the split-spoon using procedures outlined in 1 above.

4. Repeat this operation until the borehole has been advanced to the selected depth. Split-spoon samples will be collected continuously until groundwater is encountered.

5. Record in the field logbook the number of blows required to effect each six inches of penetration or fraction thereof. The first six inches is considered to be a seating drive. The sum of the number of blows required for the second and third six inches of penetration is termed the penetration resistance, N. If the sampler is driven less than 18 inches, the penetration resistance is that for the last one foot of penetration. (If less than one foot is penetrated, the logs shall state the number of blows and the fraction of one foot penetrated.) In cases where samples are driven 24 inches, the sum of second and third 6-inch increments will be used to calculate the penetration resistance. (Refusal of the SPT will be noted as 50 blows over an interval equal to or less than 6 inches; the interval driven will be noted with the blow count.)

6. Bring the sampler to the surface and remove both ends and one half of the split-spoon such that the soil recovered rests in the remaining half of the barrel. Describe the recovery (length), composition, structure, consistency, color, condition, etc., of the recovered soil; then put into sample jars.

7. Split-spoon samplers shall be decontaminated after each use and prior to the initial use at a site according to procedures outlined in Section 5.7.

The following procedures are to be used for soil samples submitted to the laboratory:

1. After sample collection, remove the soil from the split-spoon sampler. Prior to filling laboratory containers, the soil sample should be mixed thoroughly as possible to ensure that the sample is as representative as possible of the sample interval. Soil samples for volatile organic compounds should <u>not</u> be mixed. Further, sample containers for volatile organic compounds analyses should be filled completely without head space remaining in the container to minimize volatilization.

2. Record all pertinent sampling information such as soil description, sample depth,

sample number, sample location, and time of sample collection in the field logbook. In addition, label, tag, and number the sample bottle(s) as outlined in Section 6.0.

3. Pack the samples for shipping. Attach seal to the shipping package. Chain-of-Custody Forms and Sample Request Forms will be properly filled out and enclosed or attached (Section 6.0).

4. Decontaminate the split-spoon sample as described in Section 5.6. Replace disposable latex gloves between sample stations to prevent cross-contamination of samples.

5.2 Monitoring Well Installation

5.2.1 Shallow Monitoring Wells

Shallow monitoring wells will be installed at each site to monitor the shallow (water table) aquifer. It is estimated that these wells will be 25 feet bgs.

Procedures for the installation and construction of shallow monitoring wells are presented below:

- Activity personnel will approve all monitoring well locations. These locations will be free of underground or overhead utility lines.

- A borehole will be advanced by a drilling rig using hollow stem augers. The augers will be nominal 6 inch I.D.

- Soil (split spoon) samples will be collected continuously during borehole advancement. Samples will be collected according to the procedures outlined in Section 5.1.2. Sample submittal to the laboratory for analysis (Table 3-1) will follow the criteria outlined in Section 5.1.2.

- Upon completion of the borehole to the desired depth, monitoring well construction materials will be installed (inside the hollow stem augers).

- A six-inch layer of sand will be installed at the bottom of the borehole. This layer will serve to provide firm footing for the monitoring well screen and riser .

- PVC is the material selected for monitoring well construction. It was selected on the basis of its low cost, ease of use and flexibility. EPA Region IV requires justification of using PVC. Attachment A is a project-specific justification for use of PVC (based on existing groundwater quality information) presented in the EPA Region IV required format.

- Ten feet of 4-inch I.D., Schedule 40, #10 slot (0.010 inch) screen with bottom cap will be installed. The screen will be connected to threaded, flush-joint, PVC riser. The riser will extend to 3 feet above the surface. The screened interval will be selected to span the water table surface. A PVC slip-cap vented to the atmosphere, will be placed at the top of the riser.

- The annular space around the screen will be backfilled with a well-rounded medium to coarse-grained siliceous sand as the hollow-stem augers are being withdrawn from the borehole. Sand shall be placed from the bottom of the boring to approximately two feet above the top of the screened interval. A lesser distance above the top of the screened interval may be packed with sand if the well is very shallow to allow for placement of sealing materials.

- A sodium bentonite seal at least 2-foot thick will be placed above the sand pack. The bentonite shall be allowed to hydrate for at least 8 hours (or the manufacturer's recommended hydration time, whichever is longer) before further completion of the well.

- The annular space above the bentonite seal will be backfilled with a cement-bentonite grout consisting of five to ten percent bentonite powder (by dry weight) and seven gallons of potable water per 94 pound bag of portland cement.

- A deep monitoring well will be installed at Site 2 in the Former Storage Area. If a potential confining layer (e.g., clay layer) is encountered during drilling, the shallow portion of the aquifer will be cased off to prevent possible aquifer cross contamination.

- Fluid rotary drilling techniques may be utilized for deep well drilling.

- The depth intervals of all backfill materials are to be measured with a weighted measuring tape to the nearest 0.1 foot and recorded in the field logbook.

- The monitoring wells will be completed at the surface. The aboveground section of the PVC riser pipe will be protected by installation of a 6-inch diameter, 5-foot long steel casing (with locking cap and lock) seated into the cement grout. The bottom of the surface casing will be placed at a minimum of 2-1/2, but not more than 3-1/2 feet below the ground surface, as space permits, with an inverted taper to protect the casing from frost heaving. For very shallow wells, a steel casing of less than 5 feet in length may be used, as space permits. The protective steel casing must not in any event fully penetrate the bentonite seal.

- The top of each well will be protected with the installation of four, 3-inch diameter, 5-foot long steel pipes into a concrete apron. The steel pipes will be embedded to a minimum depth of 2.5 feet in 3,000 psi concrete. Each pipe will also be filled with concrete. A concrete apron approximately 5 feet by 5 feet by 0.5-feet thick will be placed at the same time the pipes are installed. The protective casing and steel pipes will be painted with day-glo yellow paint, or equivalent.

- If necessary, in high-traffic areas, the monitoring well will be completed at the surface using a "flush" man-hole type cover. If the well is installed through a paved or concrete surface, the annular space will be grouted to a depth of at least 2.5-feet and the well will be finished with a concrete collar. If the well has not been installed through a paved or concrete surface, the well will be completed by construction of a 5-foot by 5-foot by 0.5-foot thick apron made of 3,000 psi concrete. The concrete will be crowned to meet the finished grade of the surrounding pavement, as required. If appropriate, the vault around the buried wellhead will have a water drain to the surrounding soil and a watertight cover.

- All wells will have a locking cap connected to the protective casing.

Figure 5-1 is a typical shallow groundwater monitoring well construction diagram.

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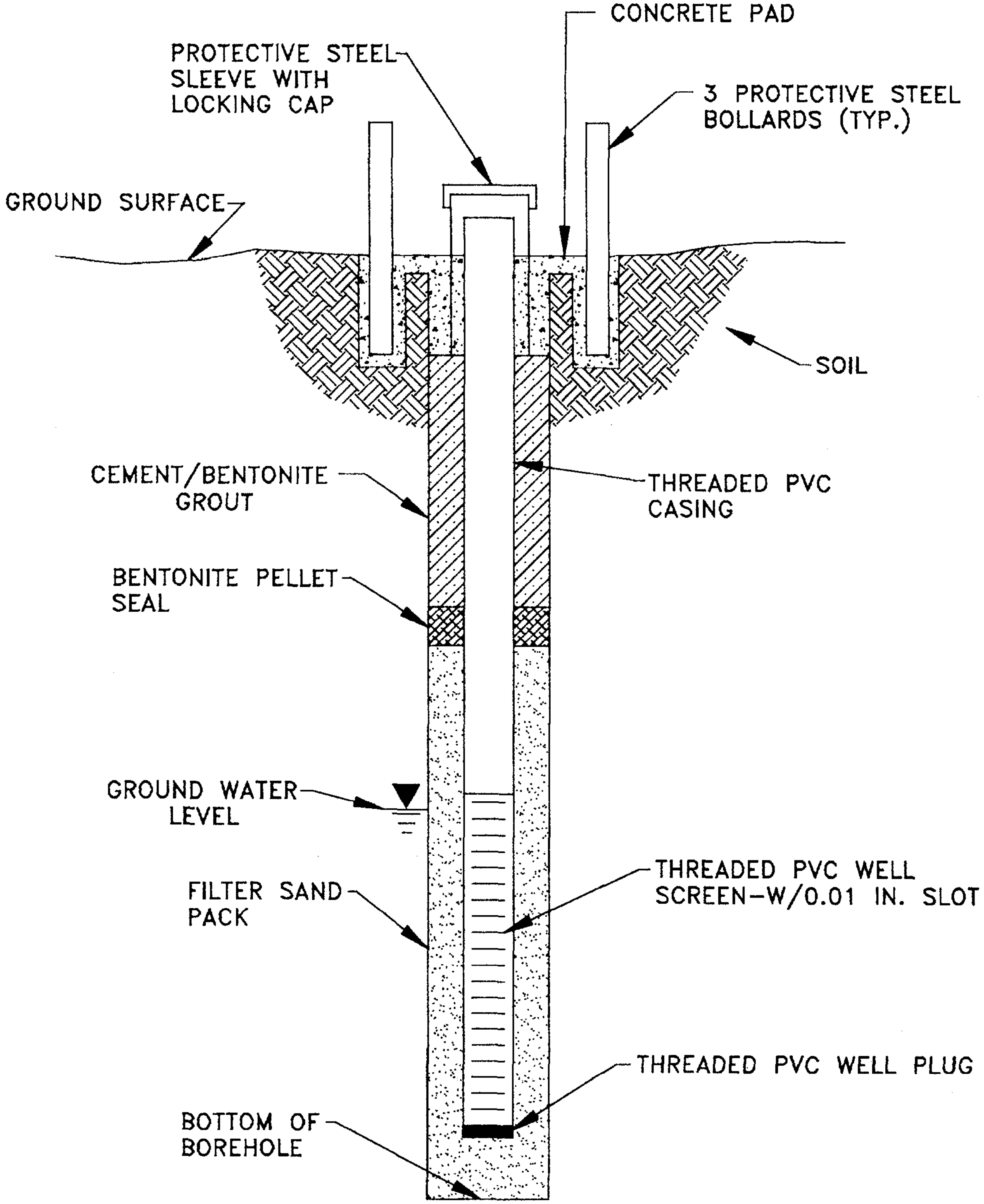

N.T.S.

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FIGURE 5-1
TYPICAL SHALLOW GROUNDWATER
MONITORING WELL CONSTRUCTION DIAGRAM

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

5.2.2 Deep Monitoring Wells

A deep monitoring well will be installed at Site 2 to monitor the deeper portion of the aquifer in this area. It is estimated that this well will be 50 feet bgs.

The procedures for installing or constructing the deep monitoring well are similar to those for the shallow wells (Section 5.2.1), with the following exceptions:

- Mud rotary drilling techniques may be utilized for drilling the deep monitoring well borehole.
- If a significant (greater than six inches thick) low hydraulic conductivity lithology (clay) is encountered during drilling, a six-inch casing will be installed into this lithology and will be grouted in place. This will prevent induced migration of potential contaminants from the shallow aquifer into the deeper portions of the aquifer.
- The grout will be permitted to set for 12 hours prior to resumption of drilling (through the casing).

Figure 5-2 is a typical deep groundwater monitoring well construction diagram.

5.2.3 Well Development

All monitoring wells will be developed 24 hours after the surface pad and protective casing have been installed. The purpose of well development is to stabilize and increase the permeability of the filter pack around the well screen, to restore the permeability of the formation which may have been reduced by the drilling operations, and to remove fine-grained materials that may have entered the well or filter pack during installation. The selection of the well development method typically is based on drilling methods, well construction and installation details, and the characteristics of the formation.

Well development will not be initiated until a minimum of 24 hours has elapsed subsequent to well completion. This time period will allow the cement grout to set. Wells typically are developed using bailers, low-yield pumping, or surging with a surge block or air. Selection of a development device will be dependent on conditions encountered during monitoring well installation. Well development water shall be containerized in either 55-gallon drums, steel holding tanks (with containment basins), or steel tankers (see Section 5.9).

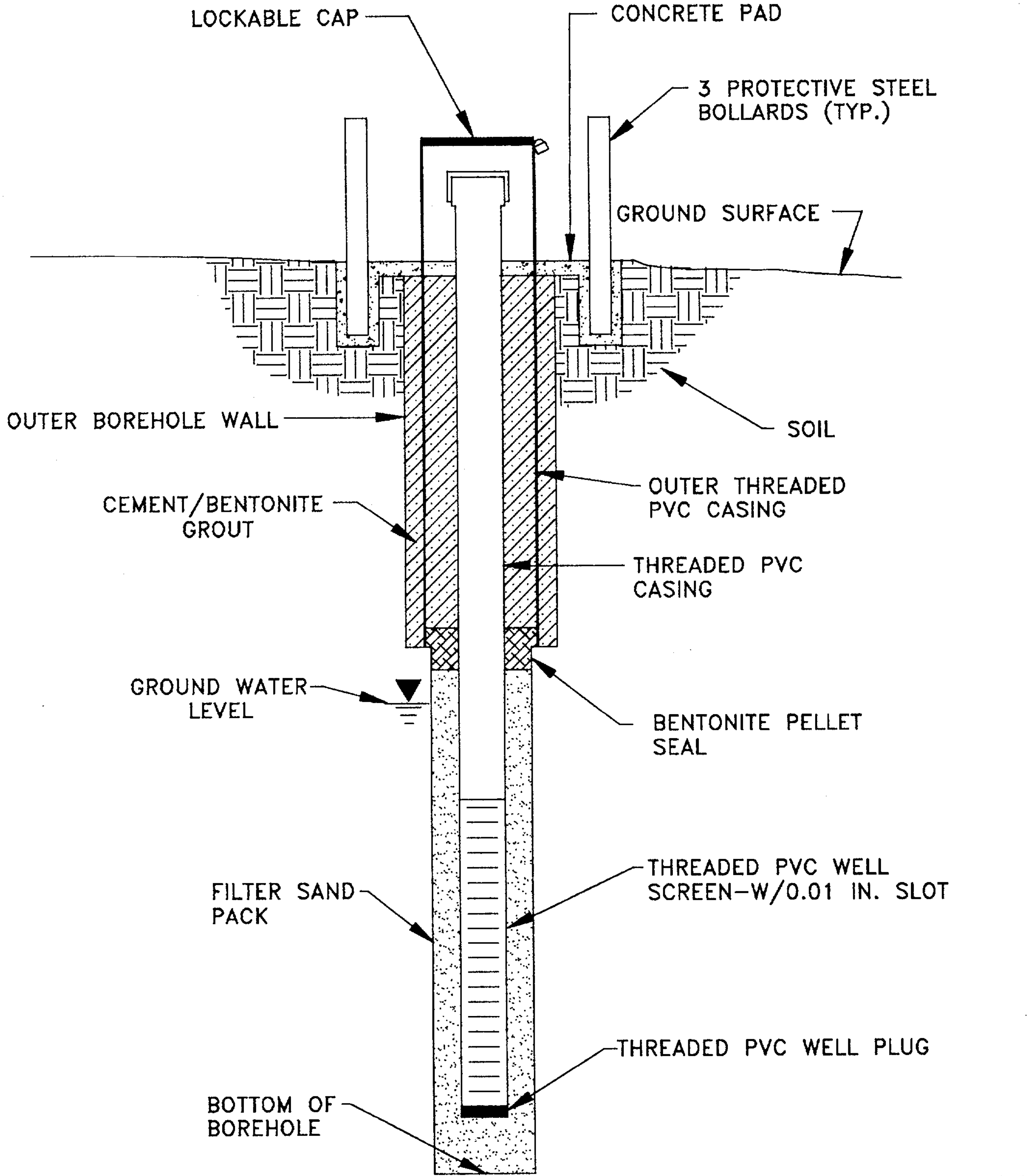

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FIGURE 5-2
TYPICAL DEEP GROUNDWATER
MONITORING WELL CONSTRUCTION DIAGRAM

MARINE CORPS BASE CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

All wells shall be developed until well water runs relatively clear of fine-grained materials. Note that the water in some wells does not clear with continued development. Typical limits placed on well development may include any one of the following:

- Clarity of water based on visual determination.
- A maximum time period (typically one hour for shallow wells).
- A maximum well volume (typically three to five well volumes).
- Stability of specific conductance and temperature measurements (typically less than 10 percent change between three successive measurements).
- Clarity based on turbidity measurements (typically less than 50 NTU).

A record of the well development shall be completed to document the development process.

Usually, a minimum period of one to two weeks should elapse between the end of initial development and the first sampling event for a well. This equilibration period allows groundwater unaffected by the installation of the well to occupy the vicinity of the screened interval.

5.3 Groundwater Sample Collection

Groundwater samples will be collected from existing and newly installed monitoring wells on site.

The collection of a groundwater sample includes the following steps:

1. First, open the well cap and use volatile organic detection equipment (HNu or OVA) on the escaping gases at the well head to determine the need for respiratory protection. This task is usually performed by the Field Team Leader, Health and Safety Officer, or other designee.

2. When proper respiratory protection has been donned, sound the well for total depth and water level (decontaminated equipment) and record these data in the field logbook. Calculate the fluid volume in the well.

3. Lower purging equipment (bailer or submersible pump) into the well to a short distance below the water level and begin water removal. If necessary, collect the purged water and dispose of it in an acceptable manner (e.g., DOT-approved 55-gallon drum).

4. Measure the rate of discharge.

5. Purge a minimum of three to five well volumes before sampling. In low permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Allow the well to recharge as necessary, but preferably to 70 percent of the static water level, and then sample.

6. Record measurements of specific conductance, temperature, and pH during purging to ensure the groundwater stabilizes. Generally, these measurements are made after three, four, and five well volumes.

7. Lower the bailer into the well, submerge into the groundwater, and retrieve. Pour groundwater from the bailer into the laboratory-supplied sample bottles.

8. Samples for VOC analysis will be collected first. Sample bottles will be filled in the same order for all monitoring wells.

Sample preservation handling procedures are outlined in Section 6.

5.4 Surface Water Sample Collection

The following procedures will be used for the collection of surface water samples at stations located at Site 2.

At each station, samples will be collected at the approximate mid-vertical point of the surface water body. Care will be taken to ensure that the sampler does not contact and/or stir up the sediments, while still being relatively close to the sediment-water interface.

The surface water samples will be collected by dipping the laboratory-supplied sample bottles directly into the water. Clean PVC gloves will be worn by sampling personnel at each sampling station. For those sample bottles that contain preservative (e.g., sulfuric acid), the water will be collected in a clean, decontaminated sampling container, and then slowly transferred into the appropriate laboratory-supplied sample bottle.

The water samples will be collected from near mid-stream at each station. Water samples at the furthest downstream station will be collected first, with subsequent samples taken at the next upstream station(s). Sediment samples will be collected after the water samples to minimize sediment disturbance and suspension.

All sample containers not containing preservative will be rinsed at least once with the sample water prior to final sample collection. In addition, the sampling container used to transfer the water into sample bottles containing preservatives will be rinsed once with sample water.

Care will be taken when collecting samples for analysis of volatile organics compounds (VOCs) to avoid excessive agitation that could result in loss of VOCs. VOC samples will be collected prior to the collection of the samples for analysis of the other parameters. Sample bottles will be filled in the same order at all sampling stations.

Temperature, pH, specific conductance, and dissolved oxygen of the surface water will be measured in the field at each sampling location (at each sampling depth), immediately following sample collection.

The sampling location will be marked by placing a wooden stake and bright colored flagging at the nearest bank or shore. The sampling location will be marked with indelible ink on the stake. In addition, the distance from the shore and the approximate location will be estimated using triangulation methods, and recorded and sketched in the field log book. If permission is granted, photographs will be taken to document the physical and biological characteristics of the sampling location.

The following information will be recorded in the field logbook:

- Project location, date and time
- Weather

- Sample location, number, and identification number
- Flow conditions (i.e., high, low, in flood, etc.)
- On site water quality measurements
- Visual description of water (i.e., clear, cloudy, muddy, etc.)
- Sketch of sampling location including boundaries of the water body, sample location (and depth), relative position with respect to the site, location of wood identifier stake
- Names of sampling personnel
- Sampling technique, procedure, and equipment used

Sample preservation and handling procedures are outlined in Section 6.

5.5 Sediment Sample Collection

The following procedures will be used for the collection of sediment samples at stations located at Site 2.

At each station, surface and near surface sediment samples will be collected at a depth of 0 to 6 inches and 6 to 12 inches. These intervals of sediment will be collected using a stainless steel hand-held coring instrument. A decontaminated stainless steel liner tube, fitted with an eggshell catcher to prevent sample loss, will be used at each station.

The coring device will be pushed into the sediments to a minimum depth of fifteen inches, or until refusal, whichever is encountered first. The sediments in the 0 to 6-inch interval and 6 to 12-inch interval will be extruded with a decontaminated extruder into the appropriate sample containers. If less than twelve inches of sediments are obtained, the first six inches will be placed in the 0 to 6-inch container, and the remaining sediment will be placed into the 6 to 12-inch container.

The sampling procedures for using the hand-held coring instrument are outlined below:

1. Inspect and prepare the corer:

    a. Inspect the core tube and, if one is being used, the core liner. Core tube and core liner must be firmly in place, free of obstruction throughout its length. Bottom edge of core tube, or of the nose piece, should be sharp and free of nicks or dents.

   b. Check the flutter valve for ease of movement.

   c. Check the flutter valve seat to make sure it is clear of any obstruction that could prevent a tight closure.

   d. Attach a line securely tot he core sampler. The line should be free of any frayed or worn sections, and sufficiently long to reach bottom.

2. Get in position for the sampling operation -- keeping in mind that, if the purpose is to obtain samples containing fauna or stratified sediments, disturbance of the bottom area to be sampled should be avoided.

3. Line up the sampler, aiming it vertically for the point where the sample is to be taken.

4. Push the core sampler, in a smooth and continuous movement, through the water and into the sediments -- increasing the thrust as necessary to obtain the penetration desired.

5. If the corer has not been completely submerged, close the flutter valve by hand and press it shut while the sample is retrieved. Warning: the flutter valve must be kept very wet if it is to seal properly.

6. Lift the core sampler clear of the water, keeping it as nearly vertical as possible, and handle the sample according to the type of core tube.

7. Secure and identify the new sample. Unscrew the nose cone. Pull the liner out. Push out any extra sediments (greater than 12 inches). Push out the sediments within the 6 to 12 inch interval and place it in a sample jar. Push out the 0 to 6 inch sediment interval into another sample jar.

8. Seal all sample jars tightly.

9. Label all samples.

5.6 Decontamination Procedures

Equipment and materials utilized during this investigation that will require decontamination fall into two broad categories:

- Field measurement and sampling equipment: water level meters, bailers, compositing bottles, hand corers, hydropunch tool, etc.
- Large machinery and equipment: drilling rigs and drilling equipment, backhoes, etc.

The following decontamination procedures are taken from USEPA IV Standard Operating Procedures (1991).

5.6.1 Field Measurement Sampling Equipment

5.6.1.1 Cleaning Procedures for Teflon® or Glass Field Sampling Equipment used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses

1. Equipment will be washed thoroughly with laboratory detergent and hot water using a brush to remove any particulate matter or surface film.
2. The equipment will be rinsed thoroughly with hot tap water.
3. Rinse equipment with at least a 10 percent nitric acid solution.
4. Rinse equipment thoroughly with deionized water.
6. Rinse equipment twice with solvent and allow to air dry for at least 24 hours.
7. Wrap equipment in one layer of aluminum foil. Roll edges of foil into a "tab" to allow for easy removal. Seal the foil wrapped equipment in plastic and date.
8. Rinse the Teflon® or glass sampling equipment thoroughly with tap water in the field as soon as possible after use.

When this sampling equipment is used to collect samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with Step 1. If the field equipment cannot be cleaned utilizing these procedures, it should be discarded.

Small and awkward equipment such as vacuum bottle inserts and well bailers may be soaked in the nitric acid solution instead of being rinsed with it. Fresh nitric acid solution should be prepared for each cleaning session.

5.6.1.2 Cleaning Procedures for Stainless Steel or Metal Sampling Equipment used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses

1. Wash equipment thoroughly with laboratory detergent and hot water using a brush to remove any particulate matter or surface film.
2. Rinse equipment thoroughly with hot tap water.
3. Rinse equipment thoroughly with deionized water.
4. Rinse equipment twice with solvent and allow to air dry for at least 24 hours.
5. Wrap equipment in one layer of aluminum foil. Roll edges of foil into a "tab" to allow for easy removal. Seal the foil wrapped equipment in plastic and date.
6. Rinse the stainless steel or metal sampling equipment thoroughly with tap water in the field as soon as possible after use.

When this sampling equipment is used to collect samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, when equipment is painted, badly rusted, or coated with materials that are difficult to remove, it may be necessary to steam clean, wire brush, or sandblast equipment before proceeding with Step 1. Any metal sampling equipment that cannot be cleaned using these procedures should be discarded.

5.6.1.3 Reusable Glass Composite Sample Containers

1. Wash containers thoroughly with hot tap water and laboratory detergent, using a bottle brush to remove particulate matter and surface film.
2. Rinse containers thoroughly with hot tap water.
3. Rinse containers with at least 10 percent nitric acid.
4. Rinse containers thoroughly with tap water.
5. Rinse containers thoroughly with deionized water.
6. Rinse twice with solvent and allow to air dry for at least 24 hours.
7. Cap with aluminum foil or Teflon® film.
8. After using, rinse with tap water in the field, seal with aluminum foil to keep the interior of the container wet, and return to the laboratory.

When these containers are used to collect samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the container several times with pesticide-grade acetone before proceeding with Step 1. If these materials cannot be removed with acetone, the container should be discarded. Glass reusable composite containers used to collect samples at pesticide, herbicide, or other chemical manufacturing facilities that produce toxic or noxious compounds shall be properly disposed of (preferably at the facility) at the conclusion of sampling activities and shall not be returned for cleaning. Also, glass composite containers used to collect in-process wastewater samples at industrial facilities shall be discarded after sampling. Any bottles that have a visible film, scale, or discoloration remaining after this cleaning procedure shall also be discarded.

5.6.1.4 Plastic Reusable Composite Sample Containers

1. Proceed with the cleaning procedures as outlined in Section 5.6.2 but omit the solvent rinse.

Plastic reusable sample containers used to collect samples from facilities that produce toxic or noxious compounds or are used to collect in-process waste stream samples at industrial facilities will be properly disposed (preferably at the facility) of at the conclusion of the sampling activities and will not be returned for cleaning. Any plastic composite sample containers that have a visible film, scale, or other discoloration remaining after this cleaning procedure will be discarded.

5.6.1.5 Well Sounders or Tapes Used to Measure Ground Water Levels

1. Wash with laboratory detergent and tap water.
2. Rinse with tap water.
3. Rinse with deionized water.
4. Allow to air dry overnight.
5. Wrap equipment in aluminum foil (with tab for easy removal), seal in plastic, and date.

5.6.1.6 Submersible Pumps and Hoses Used to Purge Ground Water Wells

1. Using a brush, scrub the exterior of the contaminated hose and pump with soapy water.
2. Rinse the soap from the outside of pump and hose with tap water.
3. Rinse the tap water residue from the outside of pump and hose with deionized water.
4. Equipment should be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

5.6.2 Large Machinery and Equipment

All drilling rigs, drilling and sampling equipment, backhoes, and all other associated equipment involved in the drilling and sampling activities shall be cleaned and decontaminated before entering the designated drill site. All equipment should be inspected before entering the site to ensure that there are no fluids leaking and that all gaskets and seals are intact. All drilling and associated equipment entering a site shall be clean of any contaminants that may have been transported from another hazardous waste site, thereby minimizing the potential for cross-contamination. Before site drilling activities are initiated, all drilling equipment shall be thoroughly cleaned and decontaminated at the designated cleaning/decontamination area. The following requirements and procedures are to be strictly adhered to on all drilling activities.

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) shall be steam cleaned before being brought on the site to remove all rust, soil and other material which may have come from other hazardous waste sites. The drill rig and/or other equipment associated with the drilling and sampling activities shall be inspected to insure that all oil, grease, hydraulic fluid, etc., have been removed, and all seals and gaskets are intact and there are no fluid leaks. No oils or grease shall be used to lubricate drill stem threads or any other drilling equipment being used over the borehole or in the borehole without EPA approval. If drill stems have a tendency to tighten during drilling, Teflon® string can be used on the drill stem threads. The drill rig(s) shall be steam cleaned prior to drilling each borehole. In addition, all downhole sampling equipment that will come into contact with the downhole equipment and sample medium shall be cleaned and decontaminated by the following procedures.

1. Clean with tap water and laboratory grade, phosphate-free detergent, using a brush, if necessary, to remove particulate matter and surface films. Steam cleaning and/or high pressure hot water washing may be necessary to remove matter that is difficult to remove with the brush. Hollow-stem augers, drill rods, shelby tubes, etc., that are hollow or have holes that transmit water or drilling fluids, shall be cleaned on the inside and outside. The steam cleaner and/or high pressure hot water washer shall be capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam (200°F plus).

2. Rinse thoroughly with tap water (potable).

NOTE: Tap water (potable) may be applied with a pump sprayer. All other decontamination liquids (D.I. water, organic-free water, and solvents), however, must be applied with non-interferring containers. These containers shall be made of glass, Teflon®, or stainless steel. This aspect of the decontamination procedures used by the driller will be inspected by the site geologist and/or other responsible person prior to beginning of operations.

3. Rinse thoroughly with deionized water.

4. Rinse twice with solvent (pesticide grade isopropanol).

5. Rinse thoroughly with organic-free water and allow to air dry. Do not rinse with deionized or distilled water.

   Organic-free water can be processed on site by purchasing or leasing a mobile deionization-organic filtration system.

   In some cases when no organic-free water is available, it is permissible (with approval) to leave off the organic-free water rinse and allow the equipment air dry before use.

6. Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported. Clean plastic can be used to wrap augers, drill stems, casings, etc., if they have been air dried.

7. All downhole augering, drilling and sampling equipment shall be sandblasted before Step #1 if painted, and/or if there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam and/or high pressure cleaning. All sandblasting shall be performed prior to arrival on site.

8. All well casing, tremie tubing, etc., that arrive on site with printing and/or writing on them shall be removed before Step #1. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can supply materials without the printing and/or writing if specified when materials are ordered.

9. Well casing, tremie tubing, etc., that are made of plastic (PVC) shall not be solvent rinsed during the cleaning and decontamination process. Used plastic materials that cannot be cleaned are not acceptable and shall be discarded.

Cleaning and decontamination of all equipment shall occur at a designated area on the site, downgradient, and downwind from the clean equipment drying and storage area. All cleaning of drill rods, auger flights, well screen and casing, etc., will be conducted above the plastic sheeting using saw horses or other appropriate means. At the completion of the drilling activities, the pit shall be backfilled with the appropriate material designated by the Site Manager, but only after the pit has been sampled, and the waste/rinse water has been pumped into 55-gallon drums. No solvent rinsates will be placed in the pit unless prior approval is granted. All solvent rinsates shall be collected in separate containers for proper disposal.

5.7 Geophysical Investigation

Geophysical techniques will be utilized during this investigation to provide subsurface information. Geophysical techniques that will be employed during this investigation are Electromagnetic terrain profiling (EM) and Ground Penetrating Radar (GPR). Procedures for collecting geophysical data in the field are presented below.

5.7.1 Electromagnetic Terrain Profiling

For an EM induction survey, a regular pattern of survey stations will provide coverage of the area in question. Typically, use of a grid spacing which is approximately equal to the size of the target sought by the survey, and a coil spacing with a maximum response for the depth of interest will produce satisfactory results. Specific needs for local detail, however, may require a refined coverage. The chosen spacing will be site and target specific.

The Geonics EM-31 will be used to conduct the EM survey. Two perpendicular measurement (e.g., operator facing north and facing east) will be collected at each station.

In conducting an EM survey, the field operator must avoid or note any potential sources of anomalous (noise) conductivity values such as power lines, buildings, fences, buried pipelines or any other large metal objects. Noise sources should be noted on the profiles or contour maps so that anomalies due to these known sources can be accounted for.

Important information that should be known for planning and before conducting an EM conductivity survey are: assumed hydrogeologic characteristics of the site, potential source locations and migration paths, characteristics of the hazardous substance of interest, and depths of interest. The level of detail necessary (size of object of interest and detail of resolution) determines the number of lines and station spacings of readings required.

EM data, if not recorded on a strip chart or digital recording instrument, should be recorded in the field logbook. At a minimum all data (strip chart, digital disks, or logbook) should have the following information listed:

- Project/site location identification
- Company
- Date and time
- Operators name
- Instrument make, model
- Coil spacings and configuration
- Line and station numbers
- Instrument reading scales
- Weather conditions/temperature

5.7.2 Ground Penetrating Radar

A GPR system consists of:

- AC/DC power supply
- Control unit (pulse transmitter)
- Antenna(s)
- Graphic recorder
- Digital recorder (optional)
- Magnetic tape recorder (optional)
- Coaxial cable which connects the control unit to the antenna

Typically, radar antennas contain both the transmitter and receiver within one fiberglass unit. Once a radar impulse is transmitted, the antenna switches to the receiver mode and records reflected radar impulses. The pulse receiver contains an amplifier which increase the amplitude of reflected signals. Bistatic antennas (transmitter-receiver are separate) allow the coverage of larger areas with one pass, and multi-receiver combinations allow the "stacking" of radar data which increases the signal to noise ratio.

Field data are generally printed by a graphic recorder and simultaneously can be stored on magnetic tape or diskette. The 8.7-5 6/10/88 graphic recorder produces a continuous time (vertical) versus distance (horizontal) profile of the subsurface for field quality control and qualitative interpretations. Radar impulses are synchronized with the swept-stylus type graphic recorder, producing a dark band proportional to the amplitude of reflected radar signal. Because the antenna is moving, each pass of the stylus represents a slightly different antenna position. Gradually, as the recorder paper advances under the moving stylus, a pattern of reflective interfaces emerges. Storage of data on diskette or magnetic tape allows opportunity of additional printing and/or computer processing for the refinement of data.

Radar systems are designed to use antennas of various electrical characteristics. Selection of the antenna is dictated by the requirements of the survey. If high resolution, near-surface data is desired, a small, high frequency antenna is used; if the survey requires deeper probing, a larger, lower frequency antenna is used (80, 120, 250, 300, 400, 500, 900, and 1,000 MHz antennas are commercially available). The drawback of using the lower frequency antennas is that resolution of data is sacrificed for penetration. Also, the low frequency antennas (less than 250 MHz) are generally not shielded, making them susceptible to overhead power line noise and spurious reflections from passing cars. The 900 and 1,000 MHz antennas are used almost exclusively for short penetration projects such as the detection of rebar in concrete, as their penetration is generally limited to 2 to 3 feet.

The majority of time involved with any GPR survey is spent establishing survey lines (Section 5.9) in the area of investigation so that detected anomalies can be easily located and excavated. Survey lines should be set to maximize coverage, while maintaining a grid spacing proportional to the presumed target dimensions.

At the onset of any GPR survey the radar control unit should be adjusted for the anticipated depth of penetration. Adjustments of the time window of exploration should be made by estimating the velocity of the medium and desired depth of penetration. Assuming 8.7-6 6/10/88 a soil velocity of 0.4 times the speed of light and a target that is buried 10 feet below ground surface, a minimum time window of 50 nanoseconds is needed.

Accurate determination of the depth to any layer requires calibration of the radar system. The easiest way of calibrating the GPR system to specific settings is by burying a plate at a measured depth, and moving the antenna slowly along the survey line. The plate will produce on the GPR record a thick, dark band, parabolic or flat in shape, with many multiple reflections beneath it. Once a certain confidence level is attained from depth calibration, the survey is conducted by slowly pulling the antenna along survey lines. A slow walking pace increases the horizontal resolution as radar signals are propagated in a 15 to 45 degree cone from the bottom of the antenna. A slow walking pace is recommended for hazardous waste investigations as targets are better defined and easier to resolve. The radar antenna can be towed from the back of a car or truck at speeds up to 10 miles an hour if the "target" is a continuous reflector, such as the water table.

5.8 Surveying

All surveying activities will be conducted by a qualified surveying subcontractor licensed in the State of North Carolina. Surveying activities will include the following:

- Surveying sampling grid for soil investigation.
- Surveying nongrid sampling points (monitoring wells, test pits, surface water/sediment locations).

All grid intersections will be marked with a wooden stake and will be numbered by the surveyor with a unique location number.

All monitoring wells will be surveyed. The vertical accuracy shall be surveyed to 0.01 feet and the horizontal accuracy within 0.1 foot. In addition, other sampling stations (surface water/sediment) will be surveyed for horizontal control within 1 foot accuracy. Control will be established by use of horizontal and vertical control points near the site that are tied into the North Carolina State Plane Coordinate System. If control points cannot be located, two benchmarks/monuments will be surveyed from the closest USGS (or equivalent) benchmarks. The 1929 msl datum will be used as a reference for the vertical elevation.

Surveying of surface water sampling stations may be difficult, especially in deep water. The field team will estimate all locations and mark them on a field map during sampling.

5.9 Handling of Site Investigation Generated Wastes

5.9.1 Responsibilities

LANTDIV - LANTDIV or the facility must ultimately be responsible for the final disposition of site wastes. As such, a LANTDIV representative will sign waste disposal manifests as the generator of the material, in the event off-site disposal is required. However, it may be the responsibility of Baker, depending on the contingency discussions during execution of the investigation to provide assistance to LANTDIV in arranging for final disposition and preparing the manifests.

Baker Project Manager - It is the responsibility of the Baker Project Manager to work with the LANTDIV-EIC in determining the final disposition of site investigation wastes. The Baker Project Manager will relay the results and implications of the chemical analysis of the waste or associated material, and advise on the regulatory requirements and prudent measures appropriate to the disposition of the material. The Baker Project Manager also is responsible for ensuring that field personnel involved in site investigation waste handling are familiar with the procedures to be implemented in the field, and that all required field documentation has been completed.

Baker Field Team Leader - The Field Team Leader is responsible for the on site supervision of the waste handling procedures during the site investigations. The Baker Field Team Leader also is responsible for ensuring that all other field personnel are familiar with these procedures.

5.9.2 Sources of Investigation Derived Wastes (IDW)

Field investigation activities often result in the generation and handling of potentially contaminated materials that must be properly managed to protect the public and the environment, as well as to meet legal requirements. These wastes may be either hazardous or nonhazardous in nature. The nature of the waste (hazardous or nonhazardous) will determine how the wastes will be handled during the field investigation.

The sources of waste material depend on the site activities planned for a project. The following types of activities (or sources), typical of site investigations, may result in the generation of waste material which must be properly handled:

- Drilling and monitoring well construction (drill cuttings)
- Monitoring well development (development water)
- Groundwater sampling (purge water)
- Aquifer pump tests (potentially contaminated groundwater)
- Heavy equipment decontamination (decontamination fluids)

- Sampling equipment decontamination (decontamination fluids)
- Personal protective equipment (health and safety disposables)
- Mud rotary drilling (contaminated mud)

5.9.3 Designation of Potentially Hazardous and Nonhazardous IDW

Wastes generated during the field investigation can be categorized as either potentially hazardous or nonhazardous in nature. The designation of such wastes will determine how the wastes will be handled. The criteria for determining the nature of the waste, and the subsequent handling of the waste is described below for each type of investigative waste.

5.9.3.1 Drill Cuttings

Drill cuttings will be generated during the augering of test borings and monitoring well boreholes. All drill cuttings will be containerized in 55-gallon drums or in lined roll-off boxes. As the borehole is augered, and soil samples collected, the Site Geologist will monitor the cuttings/samples with an HNu photoionization (PID) unit for organic vapors. In addition, the Site Geologist will describe the soils in a field log book. Upon completion, the soil borings will be backfilled with a cement-bentonite grout.

Cuttings which, by their appearance or organic vapor readings, appear to be contaminated should be kept separate from those cuttings which do not exhibit "contaminated" or "hazardous" characteristics for purposes of subsequent treatment and/or disposal.

5.9.3.2 Monitoring Well Development and Purge Water

All development and purge waters shall be containerized in tankers, or large (250-gallon) containers. Groundwater purge/development water that exhibits elevated HNu readings should be kept separate from purge/development water that does not exhibit elevated levels for purposes of subsequent treatment and/or disposal.

5.9.3.3 Decontamination Fluids

Equipment and personal decontamination fluids shall be containerized in 55-gallon drums. The fluids shall be collected from the decon/wash pads. If military vehicle wash racks are used to decon the heavy equipment, no collection of these wastewaters will be necessary since the decontamination waters will be treated at one of the Camp Lejeune treatment facilities (depending upon the location of the vehicle wash racks).

5.9.3.4 Investigation Derived Waste Sampling and Analysis

For each tanker or container of development/purge water, a sample shall be obtained for full TCL organic and TAL inorganic analysis. In addition, the sample shall be analyzed for RCRA hazardous waste characteristics including corrosivity, reactivity, and ignitability.

For each roll-off box of drill cuttings, a composite sample shall be collected and analyzed for full TCL organic and TAL inorganic analysis, full TCLP (organics and inorganics), and RCRA hazardous waste characteristics (corrosivity, reactivity, and ignitability).

Decontamination fluids collected during the investigation shall be sampled and analyzed for full TCL organics and TAL inorganics.

5.9.3.4 Personal Protective Equipment

All personal protective equipment (tyvek, gloves, and other health and safety disposables) shall be placed in the dump box, which will be provided by Camp Lejeune. Camp Lejeune will dispose of these materials when the box is full.

5.9.4 Labeling

If 55-gallon drums are used to containerize drill cuttings, the containers will be consequently numbered and labeled by the field team during the site investigation. Container labels shall be legible and of an indelible medium (waterproof marker, paint stick, or similar means). Information shall be recorded both on the container lid and its side. Container labels shall include, at a minimum:

- LANTDIV CTO (number)
- Project name
- Drum number
- Boring or well number
- Date

- Source
- Contents

If laboratory analysis reveals that containerized materials are hazardous or contain PCBs, additional labeling of containers may be required. The project management will assist LANTDIV in additional labeling procedures, if necessary, after departure of the field team from the facility. These additional labeling procedures will be based upon the identification of material present; EPA regulations applicable to labeling hazardous and PCB wastes are contained in 40 CFR Parts 261, 262 and 761.

5.9.5 Container Log

A container log shall be maintained in the site log book. The container log shall contain the same information as the container label plus any additional remarks or information. Such additional information may include the identification number of a representative laboratory sample.

5.9.6 Container Storage

Containers of site investigation wastes shall be stored in a specially designated, secure area that is managed by the Camp Lejeune Environmental Management Division until disposition is determined. An area within Lot 203 or Storage Lot 140 (HPIA) would be appropriate. All containers shall be covered with plastic sheeting to provide protection from weather.

If the laboratory analysis reveal that the containers hold hazardous or PCB waste, additionally required storage security may be implemented; in the absence of the investigation team, these will be the responsibility of LANTDIV or the facility, as confirmed by the contingency discussions.

Baker will assist LANTDIV in devising the storage requirements, which may include the drums being staged on wooden pallets or other structures to prevent contact with the ground and being staged to provide easy access. Weekly inspections by facility personnel of the temporary storage area may also be required. These inspections may assess the structural integrity of the containers and proper container labeling. Also, precipitation that may accumulate in the storage area may need to be removed. These weekly inspections and whatever precipitation removal is necessary shall be recorded in the site logbook.

5.9.7 Container Disposition

The disposition of containers of site investigation generated wastes shall be determined by LANTDIV, with the assistance of Baker, as necessary. Container disposition shall be based on quantity of materials, types of materials, and analytical results. If necessary, specific samples of contained materials may be collected identify further characteristics which may affect disposition. Typically, container disposition will not be addressed until after receipt of applicable analytical results; these results are usually not available until long after completion of the filed investigation at the facility.

5.9.8 Disposal of Contaminated Materials

Actual disposal methods for contaminated materials disturbed during a site investigation are the same as for other PCB or hazardous substances: incineration, landfilling, treatment, and so forth. The responsibility for disposal must be determined and agreed upon by all involved parties during negotiations addressing this contingency.

The usual course will be a contractor specialist retained to conduct the disposal. However, regardless of the mechanism used, all applicable Federal, state and local regulations shall be observed. EPA regulations applicable to generating, storing and transporting PCB or hazardous wastes are contained in 40 CFR Parts 262, 263 and 761.

Another consideration in selecting the method of disposal of contaminated materials is whether the disposal can be incorporated into subsequent site cleanup activities. For example, if construction of a suitable on-site disposal or treatment structure is expected, contaminated materials generated during the site investigation may be stored at the site for treatment/disposal with other site materials. In this case, the initial containment (drums or other containers) shall be evaluated for use as long-term storage. Also, other site conditions, such as drainage control, security and soil types must be considered in order to provide proper storage.

5.10 Water Level Measurements

Water level measurements will be collected from soil borings (during drilling), test pits and monitoring wells. Static water levels will be measured to the nearest 0.01 foot with a decontaminated electronic water level indicator (E-tape).

Water levels in monitoring wells will be measured from the top of the PVC casing riser. All other water level measurements will be taken from ground surface.

ATTACHMENT TO SECTION 5.0

JUSTIFICATION CRITERIA FOR USE OF PVC AS WELL CASING MATERIAL

The following is USEPA IV minimum seven point information requirements to justify the use of PVC as an alternate casing material for groundwater monitoring wells. If requested, justification of the use of PVC should be developed by addressing each of the following items:

1. **The DQOs for the groundwater samples to be collected.**

   Level IV DQOs will be used for analyses of groundwater samples collected during this project. Analytical parameters have been selected to characterize the presence or absence of contamination and to assess any associated risks to human health or the environment.

2. **The anticipated (organic) compounds and their concentration ranges.**

   <u>Site 2</u>

Ethylbenzene	190	µg/L
Xylene (total)	1,800	µg/L

<u>Site 74</u>

Groundwater sample analytical results (from existing monitoring wells) indicate that there are no contaminants of concern in groundwater at this site.

The concentrations listed above represent maximums at each site. These compounds are not necessarily present in all wells at a site. Overall concentrations are low.

There are two primary concerns regarding sample bias associated with use of PVC well casing under these conditions. One is that organic contaminants will leach from the PVC well casing. The other is that organic contaminants that may be present in the groundwater would adsorb onto the PVC. Either of these could result in biased analytical results.

It is important to note that all stagnant water from inside the well casing is purged immediately before sample collection. The time required to do this is expected to be much less than that required for groundwater sampling bias phenomena (adsorbing/leaching) to develop.

3. The anticipated residence time of the sample in the well and the aquifer's productivity.

Samples collected immediately after purging (i.e "fresh" from the aquifer).

Aquifer productivity: Subsurface soil samples are mostly fine sand. Hydraulic conductivity is estimated at 0.0001 to 0.01 cm/sec. The wells should recharge (enough to sample) before any sorbing/leaching of organics can occur. Aquifer tests conducted by O'Brien and Gere (1988) provided information of the following aquifer characteristics:

transmissivity:	500 gpd/ft.
well yield:	3 gpm
saturated thickness:	19-22 ft.
radius of influence:	300-400 ft.

4. The reasons for not using other casing materials.

Costs associated with use of stainless steel and teflon casing materials are prohibitive, particularly in 4-inch monitoring wells. PVC strength will be sufficient for this investigation. Existing groundwater quality data indicate that leaching/sorbing of organic materials from/onto the PVC will not be extensive enough to bias future groundwater analysis. PVC is lighter and more flexible than stainless steel.

5. Literature on the adsorption characteristics of the compounds and elements of interest.

The following was originally presented in National Water Well Association (NWWA, 1989):

Miller (1982) conducted a study to determine if PVC exhibited any tendency to sorb potential contaminants from solution. Trichloroethene and 1,1,2-Trichloroethane did not sorb to PVC. Reynolds and Gillham (1985) found that 1,1,2,2,Tetrachloroethane could sorb to PVC. The sorption was slow enough that groundwater sampling bias would not be significant if well development (purging the well of stagnant water) and sampling were to take place in the same day.

6. **Whether the wall thickness of the PVC casing would require a larger annular space when compared to other well construction materials.**

   It will not. Hollow stem augers used during drilling operations will be of sufficient diameter for installation of the PVC casing.

7. **The type of PVC to be used and, if available, the manufacturers specifications, and an assurance that the PVC to be used does not leach, mask, react or otherwise interfere with the contaminants being monitored within the limits of the DQOs.**

   Baker will request the appropriate manufacturers specifications and assurances regarding this requirement. This material will be supplied to Baker by the drilling subcontractor.

References for Attachment A:

National Water Well Association, 1989, Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells, Dublin, Ohio, 398 pp.

Miller, G.D., 1982, Uptake of lead, chromium and trace level volatile organics exposed to synthetic well casings, Proceedings of the Second National Symposium on Aquifer Restoration and Ground-Water Monitoring, National Water Well Association, Dublin, Ohio, pp. 236-245.

Reynolds, G.W. and Robert W. Gillham, 1985, Absorption of halogenated organic compounds by polymer materials commonly used in ground-water monitors, Proceedings of the Second Canadian/American Conference on Hydrogeology, National Water Well Association, Dublin, Ohio, pp. 125-132.

6.0 SAMPLE HANDLING AND ANALYSIS

6.1 Sample Program Operations

Field activities will be conducted according to the guidance of USEPA IV Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual (February 1, 1991).

The number of samples (including QA/QC samples), analytical method, data quality level and laboratory turnaround times are included in Table 6-1. Preservation requirements, bottle requirements and holding times are included in Table 6-1. Collection procedures for field QA/QC samples are outlined in Section 3.3.

6.2 Chain-of-Custody

Chain-of-custody procedures will be followed to ensure a documented, traceable link between measurement results and the sample/parameter that they represent. These procedures are intended to provide a legally acceptable record of sample preparation, storage and analysis.

To track sample custody transfers before ultimate disposition, sample custody will be documented using the chain-of-custody form shown in Figure 6-1. A chain-of-custody seal is shown in Figure 6-2. A sample label is shown in Figure 6-3. In addition, a master logbook will be used as a centralized mechanism for documenting project activities.

A chain-of-custody form will be completed for each container in which the samples are shipped. The shipping containers will usually be coolers. After the samples are properly packaged, the coolers will be sealed and prepared for shipment. Custody seals will be placed on the outside of the coolers to ensure that the samples are not disturbed prior to reaching the laboratory.

A field notebook, containing a master sample log, will be maintained for the site.

6.3 Logbooks and Field Forms

Field notebooks and a master sample log will be used to record sampling activities and information. Field notebooks will be bound, field survey books. Notebooks will be copied and

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time	Field QA/QC Samples(9)
							Field Duplicates
Site 2 Bldg. 712 Area	Soil	19 Soil Borings					
		• 26-39 Samples (13 Borings)	Chlorinated Herbicides	IV	4	Routine	3-4
			TCL Pesticides	IV	3	Routine	3-4
		• 12-18 Samples (6 Borings)	TCL Organics	IV	1,2,3	Routine	1
			TAL Inorganics	IV	6	Routine	1
Site 2 Mixing Pads Area	Soil	25 Soil Borings					
		• 40-60 Samples (20 Borings)	Chlorinated Herbicides	IV	4	Routine	4-6
			TCL Pesticides	IV	3	Routine	4-6
		• 10-15 Samples (5 Borings)	TCL Organics	IV	1,2,3	Routine	1-2
			TAL Inorganics	IV	6	Routine	1-2
		• 1 Composite Sample	Engineering Parameters	III	7	Routine	--
Background Soil	Soil	2 Samples Total	TCL Organics	IV	1,2,3	Routine	1
			TAL Inorganics	IV	6		1
Site 2 Bldg. 712	Concrete Pads	4 Concrete Chip Samples	TCLP Pesticides, Metals, and Herbicides	III	7	Routine	1
		4 Soil Samples from Beneath Concrete Pads	Chlorinated Herbicides	IV	4	14 days	1
			TCL Pesticides	IV	3	14 days	1
			TAL Inorganics	IV	7	14 days	1
Site 2 Bldg. 712 Drainage Ditches (RR Tracks)	Surface Water	10 Samples Total					
		• 6 Samples	Chlorinated Herbicides	IV	4	Routine	2
			TCL Pesticides	IV	3	Routine	2
		• 4 Samples	TCL Organics	IV	1,2,3	Routine	1
			TAL Inorganic	IV	7	Routine	1

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time	Field QA/QC Samples[9]
							Field Duplicates
Site 2 Bldg. 712 Drainage Ditches (RR Tracks)	Sediment	10 Locations/20 Samples Total • 12 Samples (includes 1 background)	Chlorinated Herbicides	IV	4	Routine	2
			TCL Pesticides	IV	3	Routine	2
			TOC	III	7	Routine	
		• 8 Samples	TCL Organics	IV	1,2,3	Routine	1
			TAL Inorganics	IV	6	Routine	1
			TOC	III	7	Routine	--
Site 2 Holcomb Boulevard Drainage Ditch	Surface Water	2 Samples Total	Chlorinated Herbicides	IV	4	Routine	1
			TCL Pesticides	IV	3	Routine	1
Site 2 Holcomb Boulevard Drainage Ditch	Sediment	2 Locations/4 Samples Total	Chlorinated Herbicides	IV	4	Routine	1
			TCL Pesticides	IV	3	Routine	1
			TOC	III	7	Routine	--
Overs Creek	Surface Water	3 Samples Total • 1 Sample	Chlorinated Herbicides	IV	4	Routine	1
			TCL Pesticides	IV	3	Routine	1
		• 2 Samples	TCL Organics	IV	1,2,3	Routine	
			TAL Inorganics	IV	6	Routine	

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time	Field QA/QC Samples(9)
							Field Duplicates
Overs Creek	Sediment	3 Locations/6 Samples Total					
			Chlorinated Herbicides	IV	4	Routine	1
			TCL Pesticides	IV	3	Routine	1
		• 2 Samples	TOC	III	7	Routine	--
		• 4 Samples	TCL Organics	IV	1,2,3	Routine	
			TAL Inorganics	IV	6	Routine	
			TOC	III	7	Routine	
Site 2 Former Storage Area	Soil	13 Borings					
		• 16-24 Samples (8 borings)	BTEX	III	5	14 days	1-2
		• 10-15 Samples (5 borings)	TCL Organics	IV	1,2,3	14 days	2-3
			TAL Inorganics	IV	6	14 days	2-3
		• 1 Composite Sample	Engineering/FS Parameters	III	7	Routine	--
Site 2 Monitoring Well Boreholes	Soil	5 Monitoring Well Test Borings	TCL Organics	IV	1,2,3	Routine	
		• 10 Samples (2/borehole)	TAL Inorganics	IV	6	Routine	

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time	Field QA/QC Samples(9)
							Field Duplicates
Site 2 Former Storage Area Drainage Ditches	Surface Water	9 Samples Total (includes 1 background)					
		• 5 Samples	Chlorinated Herbicides	IV	4	Routine	1
			TCL Pesticides	IV	3	Routine	1
		• 4 Samples	TCL Organics	IV	1,2,3	14 days	1
			TAL Inorganics	IV	6	14 days	1
Site 2 Former Storage Area Drainage Ditch	Sediment	9 Locations/18 Samples Total					
		• 10 Samples	Chlorinated Herbicides	IV	4	Routine	1
			TCL Pesticides	IV	3	Routine	1
			TOC	III	8	Routine	--
		• 8 Samples	TCL Organics	IV	1,2,3	14 days	1
			TAL Inorganics	IV	6	14 days	1
			TOC	III	7	Routine	--
Site 2	Groundwater	5 Existing Wells and 5 New Wells 11 Samples Total (2 Background)	TCL Organics	IV	1,2,3	Routine	2
			TAL Inorganics	IV	6	Routine	2
			Engineering Parameters	III	I	Routine	--

TABLE 6-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA

1.	Purgeable Organic Compounds	EPA 8240/EPA 624	
2.	Base/Neutral and Acid Extractables	EPA 3510/3550	EPA 625
3.	Pesticides and PCBs	EPA 3510/3550	EPA 608
4.	Chlorinated Herbicides	EPA 8150	
5.	Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	EPA 8020	

6. TAL Inorganics

Aluminum	EPA 3010/EPA 200.7	Calcium	EPA 3010/EPA 200.7	Nickel	EPA 3010/EPA 200.7
Antimony	EPA 3010/EPA 200.7	Chromium	EPA 3010/EPA 200.7	Potassium	EPA 3010/EPA 200.7
Arsenic	EPA 3020/EPA 206	Cobalt	EPA 3010/EPA 200.7	Selenium	EPA 3020/EPA 270
Barium	EPA 3010/EPA 200.7	Copper	EPA 3010/EPA 200.7	Silver	EPA 3010/EPA 200.7
Beryllium	EPA 3010/EPA 200.7	Iron	EPA 3010/EPA 200.7	Thallium	EPA 3020/EPA 279
Cadmium	EPA 3010/EPA 200.7	Lead	EPA 3020/EPA 234	Vanadium	EPA 3010/EPA 200
Calcium	EPA 3010/EPA 200.7	Magnesium	EPA 3010/EPA 200.7	Zinc	EPA 3010/EPA 200.7
Chromium	EPA 3010/EPA 200.7	Manganese	EPA 3010/EPA 200.7	Cyanide	EPA 3010/EPA 335
		Mercury	EPA 3010/EPA 245.1		

7. Engineering/FS Parameters - Soil

Grain Size	ASTM D422
Moisture Density	ASTM D698
Total TCLP	40 CFR 261
Chloride	SW 9251
Total Fluoride	SM 4500-F
Nitrogen (Organic)	EPA 350.2
Alkalinity (Total)	SM 2320-B
TOC	EPA 415.1

8. Engineering/FS Parameters - Water

Biological Oxygen Demand	SM 5210
Chemical Oxygen Demand	EPA 410.1
Total Suspended Solids	EPA 160.2
Total Dissolved Solids	EPA 160.1
Total Volatile Solids	EPA 160.4

9. Other Field QA/QC samples are:
Trip Blank - 1 per cooler (VOCs only)
Field Blank - 1 per source, per area, per event
Equipment Rinsate - 1 per day for each parameter sampled
Matrix Spike/Matrix Spike Duplicate - 1 per 20 samples

FIGURE 6-1

CHAIN-OF-CUSTODY RECORD

ct Name: ____________________
S. O. Number: ____________________

Sampler: ____________________
(Print)

Signature: ____________________

Sheet _____ of _____

BAKER ENVIRONMENTAL, INC.
Airport Office Park - Bldg No. 3
420 Rouser Road
Coraopolis, PA 15108
(412) 269-6000

Baker Sample I.D. No.	Sample Type	Sampled		Sample Storage and Preservation Details*									
				Cooling		HNO_3		H_2SO_4 Cooling		Other		Other	
		Date	Time	No. of Contnr.	Type/ Volume Contnr.	No. of Contnr.	Type/ Volume Contnr.	No. of Contnr.	Type/ Volume Contnr.	No. of Contnr.	Type/ Volume Contnr.	No. of Contnr.	Type/ Volume Contnr.

General Remarks:

*NOTES: Record type of container used with abbreviation P (plastic) or G (glass)
Record volume of containers in leters

Relinguished By (Sign): Date: Time: Remarks:	Received By (Sign): Date: Time: Remarks:
Shipment/Transportation Details:	
Relinguished By (Sign): Date: Time: Remarks:	Received By (Sign): Date: Time: Remarks:
Shipment/Transportation Details:	
Relinguished By (Sign): Date: Time: Remarks:	Received By (Sign): Date: Time: Remarks:
hipment/Transportation Details:	

Distribution:
Original - Sent with samples to lab (return with lab results to Project Manager for filing)
Copy - Retained by sampling personnel for filing

FIGURE 6-2

EXAMPLE CUSTODY SEAL

______/______/______ Date ______________________ Signature CUSTODY SEAL	______/______/______ Date ______________________ Signature CUSTODY SEAL

FIGURE 6-3

EXAMPLE SAMPLE LABEL

Baker Environmental Inc.
Airport Office Park, Bldg. 3
420 Rouser Road
Coraopolis, PA 15108

Project: ____________________ **CTO No.:** _____________

Sample Description: ________________________________

Date: ____/____/____ **Sampler:** ___________________

Time: ______________

Analysis: _______________ **Preservation:** ____________

Project Sample No.: _________________________________

submitted to the field sampling task leader, for filing upon completion of the assignment. The cover of each logbook will contain:

- The name of the person to whom the book is assigned
- The book number
- The project name
- Entry start date
- Entry completion date

Entries will include general sampling information so that site activities may be reconstructed. The beginning of each entry will include the date, sampling site, start time, weather conditions, field personnel present and level of personal protection. Other possible entries would be names and purpose of any visitors to the vicinity during sampling, unusual conditions which might impact the interpretation of the subsequent sampling data, or problems with the sampling equipment. All entries will be in ink with no erasures. Incorrect entries will be crossed out with a single strike and initialed.

A master sample log will be maintained on site for all samples taken. A full description of the sample, its origin and its condition will be included in the master log entry.

Field forms used in association with the logbooks include: Field Test Boring Record (Figure 6-4), and Test Boring and Well Construction Record (Figure 6-5).

6.4 Sample Logbook

The sample logbook is a three-ring binder which contains sample log sheets for each sample collected. A sample log sheet (Figure 6-6) is filled out for each and every sample collected. This form records vital information concerning the sample source, sampling methods, sample conditions and field measurements, and is used for sample validation and report preparation. The sample log sheets are numbered in order when placed in the sample logbook, and the sample number and log sheet page number are recorded on the sample logbook table of contents sheets (which is placed at the front of the sample logbook) for easy reference and access.

FIGURE 6-4

FIELD TEST BORING RECORD

Baker
Baker Environmental, Inc.

PROJECT: ______
CTO NO.: ______ BORING NO.: ______
COORDINATES: EAST: ______ NORTH: ______
ELEVATION: SURFACE: ______ TOP OF STEEL CASING: ______

RIG:									
	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)									
LENGTH									
TYPE									
HAMMER WT.									
FALL									
STICK UP									

REMARKS: ______

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class	Lab. M.C. %	Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type-No. (N = No Samp.)	(Ft. & %)	*RQD (Ft. & %)*	*Pen. Rate*		*Classification (Name, Grain Size, Principal Constituents, Etc.)*	*Color*	*Hardness*	*Weathering, Bedding, Fracturing, and Other Observations*	*ROCK*	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

DRILLING CO.: ______ BAKER REP.: ______
DRILLER: ______ BORING NO.: ______ SHEET ___ OF ___

Figure 6-5

Baker
Baker Environmental, Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Building P-64
S.O. NO.: 19010-51-SRN BORING NO.: MW-1
COORDINATES: EAST: NORTH:
ELEVATION: SURFACE: 13.94 TOP OF PVC CASING: 13.66

RIG: Mobile B-57	SPLIT SPOON	CASING	AUGERS	CORE BARREL	DATE	PROGRESS (FT)	WEATHER	WATER DEPTH (FT)	TIME
SIZE (DIAM.)	1-3/8" ID		6-1/4" ID		5/29/91	14.0	sunny, 70°-80° F	---	---
LENGTH	2.0'		5.0'		5/30/91	---	sunny, 80°-90° F	6.64	24 hrs.
TYPE	STD		HSA						
HAMMER WT.	140 lb.								
FALL	30"								
STICK UP									

REMARKS: Advanced boring to 14 ft. taking continuous 2-foot split-spoon samples; monitoring well installed at 14.35 ft.

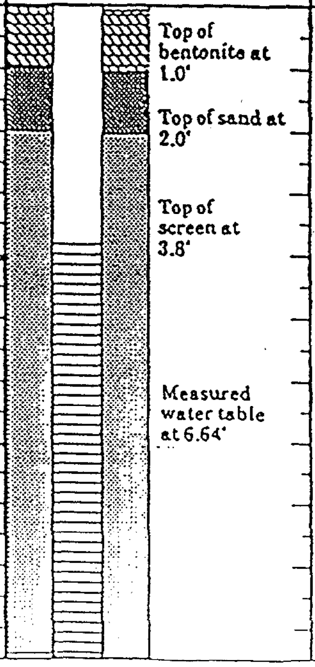
SAMPLE TYPE
= Split Spoon
= Shelby Tube
R = Air Rotary
D = Denison
A = Auger
W = Wash
C = Core
P = Piston
N = No Sample

WELL INFORMATION	DIAM	TYPE	TOP DEPTH (FT)	BOTTOM DEPTH (FT)
Well Casing	2"	Sch. 40 PVC, flush-jointed	0.28	3.8
Well Screen	2"	Sch. 40 PVC, flush-jointed	3.8	13.9

Depth (Ft.)		Sample Type and No.	Samp. Rec. Ft. & %	SPT or RQD	Lab. Class. or Pen. Rate	PID (ppm)	Visual Description	Elevation Ft. MSL
1 2	2.0	S-1	1.2/2.0 60%	16 12 6 5		0	SAND, fill material, trace gravel; brown-gray; medium dense; dry	
3 4	4.0	S-2	1.4/2.0 70%	4 4 4 3		0	SAND, fill material, trace carbon frags; brown-gray-black; loose; dry 3.0' SAND, fine-grained, trace gravel, trace silt; gray-brown; very loose; damp to moist 4.0'	10.94' 9.94'
5 6	6.0	S-3	1.8/2.0 90%	1 1 1 1		0	SAND, fine to medium-grained, trace silt, trace clay; gray-brown; very loose; damp to moist; water table at 5.5' - 6.0'	
7 8	8.0	S-4	2.0/2.0 100%	1 2 3 5		1-3	SAND, fine to medium-grained, trace silt; gray-white; loose; wet; petroleum odor noted in spoon sample 7.0'	7.30' 6.94'
9 10	10.0	S-5	.95/2.0 48%	3 1 1 1		0.5	SAND, medium to coarse-grained, trace silt; gray-white-brown; loose; wet; petroleum odor noted in spoon sample	

Match to Sheet 2

Well Installation Detail



DRILLING CO.: ATEC Associates
DRILLER: M. Miller
BAKER REP.: R. Bonelli
BORING NO.: MW-1
SHEET 1 OF 2

Figure 6-6

SAMPLE LOG SHEET

I. SAMPLE IDENTIFICATION

PROJECT SITE NAME: ______________________

SITE MANAGER: ________________

SAMPLE NAME/NUMBER: __________________ DATE ___/___/___ TIME: _______ HRS

SAMPLING LOCATION/DEPTH ____________________ TYPE: ___ GRAB ___ COMPOSITE

SAMPLE MATRIX: ___ SURFACE WATER ___ GROUNDWATER ___ SEDIMENT ___ SOIL

___ WASTE ___ OTHER (SPECIFY) ________________

☐ ENVIRONMENTAL SAMPLE ☐ HAZARDOUS SAMPLE

SAMPLED BY: (PRINT) _____________________ (SIGNATURE) ______________________

II. SAMPLE SOURCE

___ WELL ___ OUTFALL ___ LEACHATE ___ DRUM

___ BORING ___ RIVER/STREAM ___ BLDG/STRUCTURE ___ OTHER

___ TEST PIT/TRENCH ___ IMPOUNDMENT ___ TANK __________ (SPECIFY)

SOURCE DESCRIPTION ____

III. FIELD OBSERVATIONS/MEASUREMENTS

APPEARANCE/COLOR: ____

VOLATILE ORGANIC ANALYSIS (VOA): ____ HNU ____ OVA ____ OTHER

VOA READINGS: OFF SAMPLE _______________ RESIPRATORY ZONE ______________

LEL/O_2/H_2S READINGS: ______________________________________

RADIOACTIVITY (mR/hr): ____

pH: _____________ CONDUCTIVITY: ______________ TEMPERATURE: ____________

SALINITY: _____________ OTHER: ______________________________

OBSERVATIONS: ____

IV. SAMPLE DISPOSITION

PRESERVATION: ____

LABORATORY NAME: ____

LABORATORY LOCATION: ___ ON-SITE ___ OFF-SITE

FORWARDED TO LABORATORY: DATE ___/___/___ TIME: __________ HRS

V. ADDITIONAL REMARKS

7.0 SITE MANAGEMENT

This section outlines the responsibilities and reporting requirements of on site personnel.

7.1 Field Team Responsibilities

The field portion of this project will consist of one field team. All field activities will be coordinated by a Site Manager.

The Field Team will employ a drilling rig for soil boring and monitory well installation. The rig will be supervised by a Baker geologist. Two sampling technicians will be assigned to the field team.

A Site Manager (or Field Team Leader) will be assigned to manage all field activities. The Site Manager will ensure that all field activities are conducted in accordance with the project plans (the Work Plan, this Field Sampling and Analysis Plan, the Quality Assurance Project Plan, and the Health and Safety Plan).

7.2 Reporting Requirements

The Site Manager will report a summary of each day's field activities to the Project Manager or his/her designee. This may be done by telephone or telefax. The Site Manager will include, at a minimum, the following in his/her daily report:

- Baker personnel on site.
- Other personnel on site.
- Major activities of the day.
- Subcontractor quantities (e.g., drilling footages).
- Samples collected.
- Problems encountered.
- Planned activities.

The Site Manager will receive direction from the Project Manager regarding changes in scope of the investigation. This will be especially critical as the rapid-turnaround laboratory results become available since additional sample locations may be added to the program.

SECTION II

FINAL

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY QUALITY ASSURANCE PROJECT PLAN FOR OPERABLE UNIT NO. 5 (SITE 2) MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0106

Prepared For:

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

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

MARCH 11, 1993

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APPENDIX

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for the field investigation of the following site at Marine Corps Base Camp Lejeune, Jacksonville, North Carolina:

- Site 2 - Former Nursery/Day Care Center

The preparation of this QAPP, and other related project plans, is being performed under the Navy CLEAN Contract Task Order 0106. Baker Environmental, Inc., a wholly owned subsidiary of the Michael Baker Corporation, is the prime contractor for the implementation of this project.

This QAPP addresses the quality assurance and quality control steps and procedures that will be administered for the sample collection and analysis for this Remedial Investigation (RI). Detailed information regarding sample handling and analytical methods are provided in Sections 6.0 and 9.0, respectively. Sample collection procedures are provided in the Field Sampling and Analysis Plan (FSAP).

2.0 SCOPE OF QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) addresses sample collection and analysis to be conducted for the field investigation of Site 2 of Camp Lejeune, North Carolina. The QAPP has been developed for the Department of Navy (DoN) in accordance with U. S. Environmental Protection Agency (USEPA) guidelines. Contractors will follow QA/QC practices and procedures, including chain-of-custody procedures, while conducting all sample collection and analysis activities.

In order to provide adequate QA/QC, this investigation will require:

1. Use of a NEESA-certified analytical laboratory;

2. Use of accepted analytical methods for the samples outlined in the Field Sampling and Analysis Plan (FSAP). Analysis of samples for hazardous constituents parameters will be performed using the following documents:

    - "Statement of Work for Organic Analysis," USEPA, OLM01.6, June 1991;
    - "Statement of Work for Inorganic Analysis," USEPA, ILM02.0, March 1990;
    - "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983;
    - "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136;
    - "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition; and
    - "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886.

3. Field audit(s) during initial sampling activities to verify that sampling is being performed according to the Plan.

The structure of this QAPP and the QA elements addressed are:

- Title Page
- Table of Contents
- Introduction
- QAPP Scope
- Project Description
- Project Organization
- QA Objectives for Data Measurement
- Sampling Procedures
- Sample and Document Custody
- Calibration Procedures and Frequency
- Analytical Procedures
- Data Reduction, Validation, and Reporting
- Internal QC Checks
- Performance and System Audits
- Preventive Maintenance
- Data Measurement Assessment Procedures
- Corrective Action
- QA Reports to Management

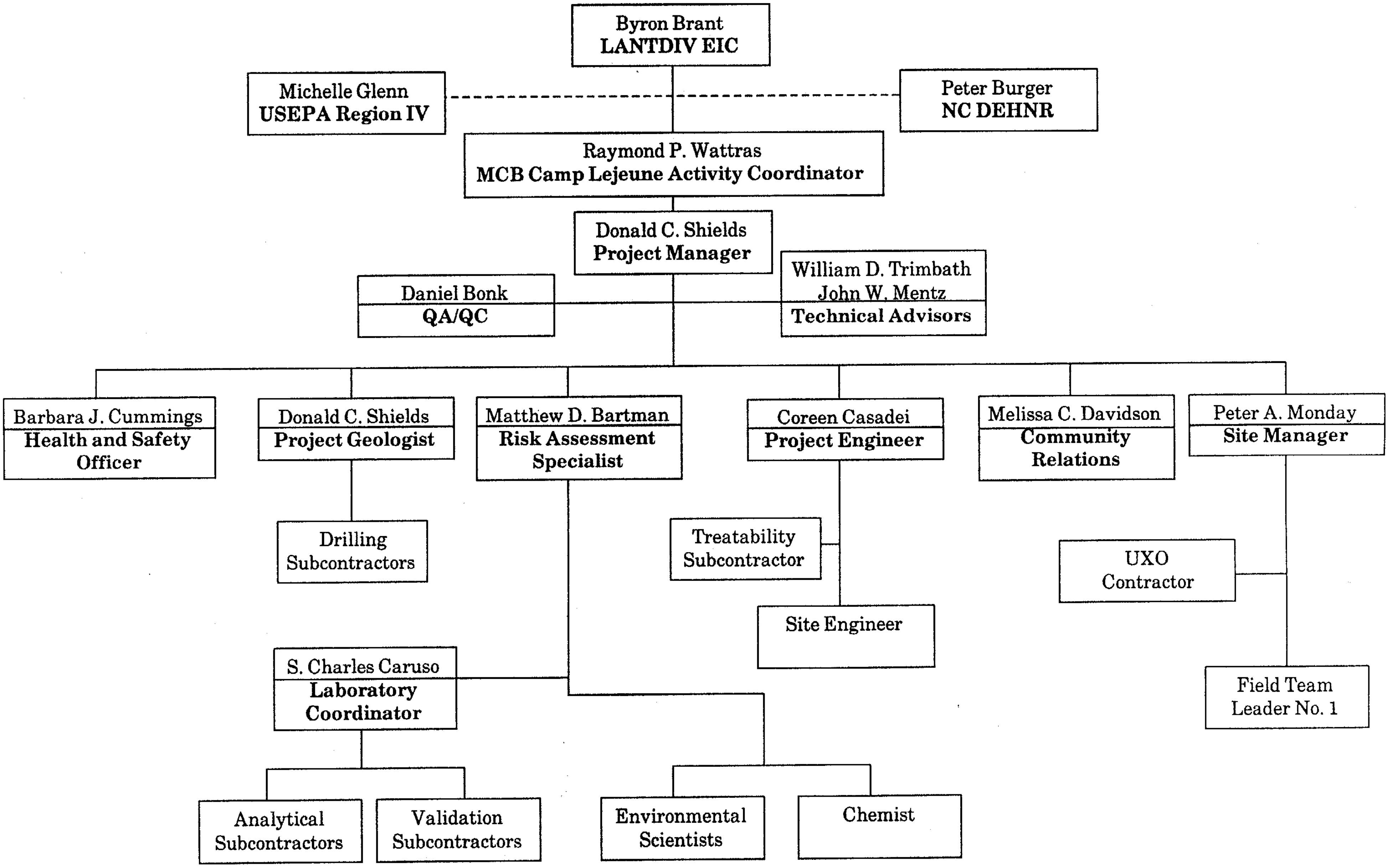
3.0 PROJECT DESCRIPTION

An introduction to the field investigation of Site 2 describing the project objectives and scope are given in Sections 4.0 and 5.0 of the RI/FS Work Plan. These sections discuss the objectives of the RI, and the various field sampling and analytical programs. A detailed description of the field investigations, including sample location and designation, sampling procedures and frequency, is presented in Sections 3.0, 4.0, and 5.0 of the FSAP.

4.0 PROJECT ORGANIZATION

Technical performance of the investigation of Site 2 at Camp Lejeune and key personnel responsible for quality assurance throughout its duration are described in Section 6.0 of the RI/FS Work Plan. The contractor will utilize subcontractors to perform laboratory analysis, data validation, drilling and monitoring well installation, ordnance clearance, and surveying. Specific subcontractors have not yet been identified. Figure 4-1 shows the project organization, lines of authority, and support personnel/organizations.

FIGURE 4-1
PROJECT ORGANIZATION
RI/FS AT SITE 2
MCB CAMP LEJEUNE, NORTH CAROLINA



5.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

The purpose of a QA Program is to establish policies for the implementation of regulatory requirements and to provide an internal means for control and review so that the work performed is of the highest professional standards.

5.1 Project Quality Assurance Objectives

Project QA objectives are:

- Scientific data will be of a quality sufficient to meet scientific and legal scrutiny;
- Data will be gathered/developed in accordance with procedures appropriate for the intended use of the data; and
- Data will be of acceptable precision, accuracy, completeness, representativeness, and comparability as required by the project.

The fundamental mechanisms that will be employed to achieve these quality goals can be categorized as prevention, assessment, and correction:

- Prevention of errors through planning, documented instructions and procedures, and careful selection and training of skilled, qualified personnel;
- Assessment of all quality assurance sampling reports furnished by the contract laboratory;
- Assessment of data through data validation, and of procedures through laboratory and field audits; and
- Correction for prevention of reoccurrence of conditions adverse to quality.

This QAPP, prepared in direct response to these goals, describes the QA Program to be implemented and the quality control (QC) procedures to be followed by the laboratory during the course of the project.

This QAPP presents the project organization and specifies or references technical procedures, documentation requirements, sample custody requirements, audit, and corrective action provisions to be applied to provide confidence that all activities meet the intent of the QA program. This QAPP has been prepared in accordance with U.S. EPA guidance as presented in "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80.

The procedures contained or referred to herein have been taken from:

- "Statement of Work for Organic Analysis," USEPA , OLM01.6, June 1991;
- "Statement of Work for Inorganic Analysis," USEPA , ILM02.0, March 1990;
- "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983;
- "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136;
- "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition;
- "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886; and
- "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," USEPA, (QAMS 005/80).

5.2 Data Quality Objectives

Data quality objectives (DQOs) are qualitative or quantitative statements developed by the data users to specify the quality of data needed from a particular data collection activity to support a specific decision. The DQOs are expressed in terms of precision, accuracy, representativeness, completeness, and comparability. Definitions for these terms, as well as for the more general term uncertainty, are given in Table 5-1.

TABLE 5-1

DEFINITIONS OF DATA QUALITY INDICATORS

PRECISION - A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed in terms of the standard deviation. Comparison of replicate values is best expressed as the relative percent difference (RPD). Various measures of precision exist depending upon the "prescribed similar conditions".

ACCURACY - The degree of agreement of a measurement (or an average of replicate measurements), X, with an accepted reference or true value, T, expressed as the difference between the two values, X-T. Accuracy is a measure of the bias in a system.

REPRESENTATIVENESS - Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental concern.

COMPLETENESS - A measure of the amount of the valid data obtained from the measurement system compared to the amount that was expected under “normal” conditions.

COMPARABILITY - Expresses the confidence with which one data set can be compared with another.

UNCERTAINTY - The likelihood of all types of errors associated with a particular decision.

The Project Manager, in conjunction with the Navy Engineer-in-Charge (EIC), is responsible for defining the DQOs. The intended use of the data, analytical measurements, and the availability of resources are integral in development of DQOs. DQOs define the level of uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both field sampling error and analytical instrument error. Ideally, zero uncertainty is the goal; however, the variables associated with sampling and analysis contribute to a degree of uncertainty in any data generated. It is an overall program objective to keep the total uncertainty within an acceptable range, so as not to hinder the intended use of the data. To achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness have been specified.

The data collected during the course of the site investigation will be used:

- To assess potential human health and environmental risks;
- To monitor health and safety conditions during field activities;
- To identify releases or suspected releases of hazardous waste and/or constituents;
- To characterize the wastes contained and/or managed; and,
- To screen from further investigation those areas which do not pose a threat to human health or environment.

All samples for characterizing the site, assessing human health and environmental risks, or selecting remedial alternatives will be analyzed and reported by the laboratory as Level IV data. Samples collected to evaluate process options (e.g., TOC, TSS, etc.) will be analyzed and reported by the laboratory as Level III data quality. Field parameters including temperature (aqueous only) and specific conductance will be Level I data quality. In the event treatability studies are conducted, sample analyses will be Level III or IV quality.

6.0 SAMPLING PROCEDURES

Descriptions of the procedures to be used for sampling the groundwater, surface water, sediment and soil at the site are provided in Section 5.0 of the FSAP. The number of samples, sampling locations, and sampling rationale by media also are presented in the FSAP.

7.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Sample custody procedures outlined in this section have been developed from "User's Guide to the Contract Laboratory Program," December 1988, OSWER Directive No. 9240.0-01. These procedures are in accordance with "EPA NEIC Policies and Procedure Manual," May 1978, revised November 1984, EPA 330-78-001-R and "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," December 1980, QAMS-005/80.

The purpose of this section is to outline the sample handling and sample documentation procedures to be used during implementation of the FSAP. The objective of the sample handling procedures is to deliver representative samples to the laboratories for analysis. The objectives of the sample documentation procedures are to: (1) ensure complete analysis of the requested parameters within the required turnaround times; and (2) document the sample from the point of collection to the final data report.

7.1 Sampling Handling

New polyethylene or glass bottles containing the proper preservatives will be provided by the laboratory for sample collection. In addition to the chemical preservatives, samples will be stored on ice at 4°C in a waterproof metal or sturdy plastic cooler, if required (see Tables 7-1 through 7-2 for summaries of containers, preservation, and holding times for water and soil/sediment respectively).

7.2 Chain-of-Custody Procedures

A sample is considered to be in an individual's possession if:

- It is in the sampler's possession or it is in the sampler's view after being in his or her possession;

- It was in the sampler's possession and then locked or sealed to prevent tampering; or

- It is in a secure area.

TABLE 7-1

SUMMARY OF CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR WATER SAMPLES

Parameter	Container	Preservation	Holding Time
TCL Volatiles	Two 40-ml vials with teflon septum caps	Cool, 4°C HCl pH <2	14 days (7 days if unpreserved)
TCL Semivolatiles	1-liter amber glass bottle with teflon caps	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
TCL Pesticides/PCBs	1-liter amber glass bottle with teflon caps	Cool, 4°C	7 days to extraction; 40 days after extraction for analysis
TAL Metals	1-500 ml polyethylene bottle	HNO_3 pH <2	6 months; Mercury 28 days
TAL Cyanide	1-liter polyethylene bottle	NaOH pH >12 Cool, 4°C	14 days
TOC	1-liter polyethylene bottle	Cool to 4°C HCl or H_2SO_4 to pH <2	28 days
TSS	1-liter polyethylene bottle	--	7 days
TVS	1-liter polyethylene bottle	--	7 days
TDS	1-liter polyethylene bottle	--	7 days
BOD	1-liter polyethylene bottle	Cool, 4°C	48 hours
COD	1-liter polyethylene bottle	Cool, 4°C H_2SO_4 pH <2	28 days

TCL - Target Contaminant List
TAL - Target Analyte List
TOC - Total Organic Carbon
TSS - Total Suspended Solids
TVS - Total Volatile Solids
TDS - Total Dissolved Solids
BOD - Biological Oxygen Demand
COD - Chemical Oxygen Demand

TABLE 7-2

SUMMARY OF CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SOIL, SEDIMENT, AND CONCRETE SAMPLES

Parameter	Container	Preservation	Holding Time
TCL Volatiles	Two 4-ounce wide-mouth glass jars	Cool, 4°C	10 days (7 days if unpreserved)
TCL Semivolatiles	One 8-ounce wide-mouth glass jar	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
TCL Pesticides/PCBs	One 8-ounce wide-mouth glass jar	Cool, 4°C	7 days to extraction; 40 days after extraction for analysis
TAL Metals	One 8-ounce wide-mouth glass jar	Cool, 4°C	6 months; Mercury, 28 days
TAL Cyanide	One 8-ounce wide-mouth glass jar	Cool, 4°C	14 days
Total TCLP	Two 8-ounce wide-mouth glass jar	Cool, 4°C	14 days
Chloride	One 8-ounce wide-mouth glass jar	--	Analyze immediately
Fluoride	One 8-ounce wide-mouth glass jar	None	28 days
Alkalinity	One 8-ounce wide-mouth glass jar	Cool, 4°C	14 days
TOC	One 8-ounce wide-mouth glass jar	Cool, 4°C	28 days
Corrosivity	One 4-ounce wide-mouth glass jar	Cool, 4°C	28 days
Ignitability	One 4-ounce wide-mouth glass jar	Cool, 4°C	28 days
Reactivity	One 4-ounce wide-mouth glass jar	Cool, 4°C	NA

NOTE: Samples to be tested for TCLP should undergo minimal disturbance prior to analysis.

TCL - Target Contaminant List
TAL - Target Analyte List
TCLP - Toxicity Characteristic Leaching Procedure
TOC -Total Organic Carbon

Five kinds of documentation will be used in tracking and shipping the analytical samples:

- Field log book;
- Sample labels;
- Chain-of-Custody (COC) records;
- Custody seals; and
- Commercial carrier airbills.

At a minimum, the label for each sample bottle will contain the following information:

- Site name;
- Sample number;
- Date and time of collection;
- Sample type (grab or composite);
- Matrix; and
- Sampler's initials.

The sample information, as well as the analysis to be performed on the sample, will be entered in the field log book for each sampling point. Additionally, the following items will be entered:

- Dates and times of entry;
- Names of field personnel on site;
- Names of visitors on site;
- Field conditions;
- Description of activities;
- Sampling remarks and observations;
- QA/QC samples collected;
- List of photographs taken; and
- Sketch of site conditions.

Custody of the samples will be maintained by field personnel from the time of sampling until the time they are forwarded to the analytical laboratory.

The sample custody is documented using Chain-of-Custody (COC) records. Field personnel will complete a COC record, in waterproof ink, to accompany each cooler forwarded from the site to the laboratory. Chemical reagents used to preserve the samples will be recorded on the

COC record. Any errors on the COC records will not be erased; instead, a line will be drawn through the error and initialed by the person completing the form. The original copy will be placed in a sealable plastic bag and put inside the appropriate cooler, secured to the cooler's lid.

If the sample cooler is to be shipped by commercial air carrier, the cooler must be secured with custody seals so that the seals would be broken if the cooler was opened. The commercial carrier is not required to sign the COC record as long as the custody seals remain intact and the COC record stays in the cooler. The only other documentation required is the completed airbill.

If the sample shipment is hand delivered to the laboratory by field personnel or retrieved by laboratory personnel at the site, then the custody seals are not necessary. The laboratory sample custodian, or his/her designee accepting the sample shipment, whether it is from the air carrier or the field personnel, signs and dates the COC record upon sample receipt. The original COC record will be returned along with the final data report. The laboratory will be responsible for maintaining internal log books and records that provide a custody record during sample preparation and analysis.

Laboratory Chain-of-Custody Procedures

Upon sample receipt the steps below are performed.

- Samples are received and unpacked in the laboratory where the staff checks for bottle integrity (loose caps, broken bottles, etc.).

- Samples are verified with incoming paperwork (packing slip, etc.) by type of bottle and stabilizer. The paperwork is either signed or initialed.

- Information concerning the sample (from the sampling record, Chain-of-Custody, and observation) is recorded along with parameters to be analyzed, date of sampling, and date the sample is received in the laboratory.

- Samples are placed in an appropriate secured storage area, e.g. refrigeration, until analysis.

- When analysis is complete, samples are stored for a 30-day period unless otherwise specified.

If collected samples arrive without Chain-of-Custody or incorrect Chain-of-Custody records, the following steps are taken:

- The laboratory prepares a nonconformance form stating the problem;
- The site supervisor and Project Manager are notified; and
- If the missing information cannot be reconstructed by the Project Manager or field staff, the samples affected are removed from the sampling program.

Primary considerations for sample storage are:

- Secured storage;
- Maintain prescribed temperature, if required, which is typically four degrees Celsius; and
- Extract and/or analyze samples within the prescribed holding time for the parameters of interest.

7.3 Document Custody Procedures

Project records are necessary to support the validity of the work, to allow it to be recreated if necessary, and to furnish documentary evidence of quality. The evidentiary value of data is dependent upon the proper maintenance and retrieval of quality assurance records. Therefore, procedures are established to assure that all documents attesting to the validity of work are accounted for when the work is completed.

Records are legible, filled out completely, and adequately identified as to the item or activity involved. Records are considered valid only if initialed, signed, or otherwise authenticated and dated by authorized personnel. These records may either be originals or reproduced copies. Records submitted to the files, with the exception of correspondence, are bound, placed in folders or binders, or otherwise secured for filing.

Following receipt of information from external sources, completion of analyses, and issuance of reports or other transmittals, associated records are submitted to the proper file. In addition, records transmitted are adequately protected from damage and loss during transfer (e.g, hand carrying or making copies prior to shipment).

The following documents will be transferred to the proper files during the course of this project: calculations and checkprints; reports and other data transmittals; copies of proposals, purchase orders for project services, and contracts; correspondence including incoming and outgoing letters, memoranda, and telephone records; and reference material.

All individuals on the project staff are responsible for reporting obsolete or superseded project-related information to the Project Manager. In turn, the Project Manager notifies the project and laboratory staffs of the resulting status change in project documents, such as drawings and project procedures.

In general, outdated drawings and other documents are marked "void." However, the Project Manager may request the copies be destroyed. One copy of void documents is maintained in the project files with the reasons for, and date of voiding clearly indicated.

Documents are marked "preliminary" to denote calculations and other material which have not been formally checked, or based on information which has not been checked, or do not contribute to final project information.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 Field Instruments

One field instrument will be used for health and safety monitoring: the HNu System portable photoionizer. These instruments will be calibrated on site daily according to the manufacturer's instructions in addition to the factory calibration it will receive prior to the start of site sampling. The calibration standards will be recorded in the field log book. Specific procedures for the calibration of water quality instruments are given in Appendix A of this document.

A pH meter and a conductivity meter will be used to analyze groundwater and surface water samples. Procedures from "Test Methods for Evaluating Solid Waste," USEPA, SW-846, November 1986, 3rd Edition will be used to calibrate these meters. Specific procedures for the calibration of water quality instruments are given in Appendix A of this document

8.2 Laboratory Instruments

The laboratory's procedures for calibration and related quality control measures are to be in accordance with the protocols presented in the following documents:

- "Statement of Work for Organic Analysis," USEPA, OLM01.6, June 1991;
- "Statement of Work for Inorganic Analysis," USEPA, ILM02.0, March 1990;
- "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," USEPA, July 1982;
- "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983;
- "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136;

- "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition; and

- "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886.

Formal calibration procedures are established to ensure that instrumentation and equipment used for sample analysis are accurately calibrated and properly functioning. These procedures apply to all instruments and equipment quantities. All calibrations are performed by laboratory personnel or external agencies using standard reference materials.

All calibrations are recorded on in-house calibration forms or instrument vendor forms or in dedicated bound notebooks. The following data are recorded for all calibrations: the date, target readings, actual readings, instrument identification number, and the analyst's initials. Other data may be recorded depending upon the calibration performed.

Only properly calibrated and operating equipment and instrumentation are used. Equipment and instrumentation not meeting the specified calibration criteria are to be segregated from active equipment whenever possible. Such equipment is repaired and recalibrated before reuse.

All equipment is uniquely identified, either by serial number or internal calibration number, to allow traceability between equipment and calibration records. Recognized procedures (ASTM, USEPA, or manufacturer's procedures) are used for calibration whenever available.

8.2.1 Method Calibration

Method calibration is performed as part of the laboratory analytical procedure (calibration curves, tuning). Calibration curves are prepared using five standards in graduated amounts across the appropriate range of analysis. New calibration curves are prepared whenever new reagents or standards are prepared or yearly, whichever is more frequent.

8.2.2 GC/MS System Calibration Procedure

This section outlines the requirements for the calibration of GC/MS systems for the determination of organic compounds. The following operations are performed in support of these requirements:

- Documentation of GC/MS mass calibration and abundance pattern;
- Documentation of GC/MS response factor stability; and
- Internal standard response and retention time monitoring.

Tuning and Mass Calibration

It is necessary to establish that a given GC/MS system meets the standard mass spectral abundance criteria prior to initiating data collection. This is accomplished through the analysis of p-bromofluorobenzene (BFB) for volatile compounds or decafluorotriphenylphosphine (DFTPP) for semivolatile compounds. The BFB or DFTPP criteria are met before any blanks, standards, or samples are analyzed.

A GC/MS system used for organic compound analysis is tuned to meet the criteria specified for BFB analysis (volatile compounds) or DFTPP (semivolatile compounds) for an injection of 50 nanograms (ng) of BFB or DFTPP. The analysis is performed separately from standard or blank analysis. These criteria are demonstrated every 12 hours of operation. Background subtraction, if required, is straight forward to eliminate column bleed or instrument background ions. Calibration documentation is in the form of a bar graph spectrum and a mass listing.

GC/MS System Calibration

After tuning criteria have been met and prior to sample analysis, the GC/MS system is initially calibrated at five concentrations utilizing the compounds to be analyzed to determine the linearity of response. Internal and surrogate standards are used with each calibration standard. Standards are analyzed under the same conditions as the samples.

- Relative Response Factor (RRF) Calculation - The USEPA specifies the internal standard to be used on a compound-by-compound basis for quantification. The relative response factor (RRF) is calculated for each compound at each concentration level.

- Continuing Calibration - A calibration check standard containing all semivolatile or volatile compounds and surrogates is run each 12 hours of analysis. A system performance check is performed. The criteria are the same as for the initial calibration system performance check. A calibration check is also performed. The percent difference is determined for each CCC.

The percent Difference for each CCC must be less than or equal to 25.0 percent. The system performance check and calibration check criteria must be met before sample analysis can be performed. The continuing calibration is recorded on the continuing calibration forms.

8.2.3 GC System Calibration Procedure

This section outlines the requirements for the calibration of GC systems for the determination of pesticides/PCBs. The following operations are performed in support of these requirements:

Three types of analyses are used to verify the calibration and evaluate instrument performance. The analyses of instrument blanks, Performance Evaluation mixtures (PEMs), and the mid-point concentration of the the individual standard mixtures A and B constitute the continuing calibration.

- It is necessary to establish resolution criteria by performing a Resolution Check Mixture where the depth of the valley of two adjacent peaks must be greater than or equal to 60.0 percent of the height of the shorter peak.

- The breakdown of DDT and Endrin in both of the PEMs must be less than 20.0 percent and the combined breakdown of DDT and Endrin must be less than 30.0 percent. All peaks in both the Performance Evaluation Mixtures must be 100 percent resolved on both columns.

- The absolute retention times of each of the single component pesticides and surrogates in both of the PEMs must be within the retention time windows determined from the three point initial calibration.

- The relative percent difference of the calculated amount and the true amount for each of the single component pesticides and surrogates in both of the PEMs must be less than or equivalent to 25.0 percent.

- At least one chromatogram between any two adjacent peaks in the midpoint concentrations of Individual Standard Mixtures A and B in the initial calibration must be greater than or equal to 90.0 percent.

8.2.4 System Calibration Procedure for GC Purgable Halocarbons and Aromatics

The system must be calibrated daily by external calibration. A minimum of three concentration levels, of each parameter, is used to prepare a calibration curve. The working calibration curve must be verified on each working day by the measurement of one or more calibration standards. If the response for any parameter varies from the predicted response by more than plus or minus ten percent, the test must be repeated using a fresh calibration standard.

The laboratory must spike and analyze a minimum of ten percent of all samples to monitor continuing laboratory performance.

Prior to analysis, the system must be demonstrated to be free from contamination, under the conditions of the analysis, by running a laboratory reagent blank.

The retention time window used to make the identification should be based upon measurements of actual retention time variations of standards over the course of the day.

If the response peak exceeds the working range of the system, prepare a dilution of the sample with reagent water and reanalyze.

8.2.5 System Calibration Procedure for Metals Analysis

This section outlines the requirements for the calibration of atomic absorption (AA) and Inductively Coupled Plasma (ICP) systems for the determination of metals. The following are performed in support of these requirements:

- Documentation of standard response; and

- Correlation coefficient monitoring.

The AA system utilized for direct aspiration technique analysis is initially calibrated with a calibration blank and five calibration standards. The standard concentrations are determined as follows. One standard is at a concentration near, but above, the MDL. The other concentrations correspond to the expected range of concentrations found in the actual samples. This five-point calibration is performed daily.

The AA system utilized for graphite furnace technique analysis is initially calibrated with a calibration blank and three calibration standards. The standard concentrations are determined as follows. One standard is at a concentration at the Contract Required Detection Limit (CRDL). The other concentrations correspond to the expected range of concentrations found in the actual samples. This three-point calibration is performed daily.

For AA systems, the calibration standards are prepared fresh each time an analysis is to be performed and discarded after use. The standards contain the same reagents at the same concentrations as will result in the samples following preparation.

The ICP system is calibrated initially with a calibration blank and one calibration standard. This calibration is performed daily. In addition, ICP systems must undergo quarterly linearity checks.

Correlation Coefficient Calculation

The data points of the blank and the five calibration standards are utilized to calculate the slope, the intercept, and the correlation coefficient of the best fit line. An acceptable correlation coefficient must be achieved before sample analysis may begin. An acceptable correlation coefficient is >0.995 for AA analyses and >0.995 for ICP analysis.

Calibration Verification

The initial calibration curve is verified on each working day by the measurement of one mid-range calibration standard. The calibration verification acceptance criterion is as follows:

- ICEP/GFAA - 90 to 110 percent of true value; and
- Cold Vapor AA - 80 to 120 percent of true value.

When measurements exceed the control limits, the analysis is terminated, the problem corrected, the instrument recalibrated, and the calibration reverified.

8.2.6 System Calibration Procedure for Inorganic Analyses

This section outlines the requirements that are used for calibration of colorimetric systems for analyses of inorganic parameters. The following are performed in support of these requirements:

- Documentation of standard response; and
- Correlation coefficient monitoring.

The system is initially calibrated with a blank and five calibration standards. Standard concentrations are one standard at a concentration near, but above, the MDL with additional concentrations corresponding to the expected range of concentrations found in actual samples. Standards contain the same reagents at the same concentrations as will be present in samples following preparation.

Correlation Coefficient Calculation

Data points of the blank and five calibration standards are utilized to calculate slope, intercept, and correlation coefficient of a best fit line. An acceptable correlation coefficient is achieved before sample analysis may begin. An acceptable correlation coefficient is >0.995 for all systems.

Calibration Verification

The initial calibration curve is verified on each working day by the measurement of two calibration standards. One standard is at a concentration near the low end of the calibration curve and one standard is at the high end of the curve. The acceptance criteria for recovery of verification standards is within 15 percent of the expected recovery for cyanide analyses and 10 percent of the expected recovery for other inorganic analyses. When measurements exceed control limits, analysis is terminated, the problem is corrected, the instrument is recalibrated, and calibration is reverified.

8.2.7 Periodic Calibration

Periodic calibration is performed on equipment required in analyses but not routinely calibrated as part of the analytical methodology. Equipment that falls within this category includes ovens, refrigerators, and balances. The calibration is recorded either on specified forms or in bound notebooks. Discussed below are the equipment, the calibration performed, and the frequency at which the calibration is performed.

- Balances are calibrated weekly with class S weights.

- The pH Meter meter is calibrated daily with pH 4 and 7 buffer solutions and checked with pH 10 buffer solution.

- The temperatures of the refrigerators are recorded daily.

- All liquid in glass thermometers are calibrated annually with the N.B.S. certified thermometer. Dial thermometers are calibrated quarterly.

- The N.B.S. Certified Thermometer is checked annually at the ice point.

The following equipment must maintain the following temperatures:

- Sample Storage and Refrigerators - within 2 degrees of 4 degrees Celsius; and
- Water Bath, Mercury - within 2 degrees of 95 degrees Celsius.

9.0 ANALYTICAL PROCEDURES

9.1 Field Analysis

An HNu PI-101 will be used to analyze ambient air for health and safety monitoring, as well as to screen soil during the soil sampling. The HNu PI-101 detects total organic vapor. This instruments will be operated in accordance with the manufacturer's instructions.

The pH, temperature, and specific conductivity of aqueous samples also will be measured in the field. These analyses will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater," September 1982, EPA/600/4-82-029.

9.2 Laboratory Analysis

The samples that will be collected during the investigation will be analyzed for constituents listed in Table 9-1. Parameters will be analyzed using EPA methods as noted in Table 9-1. Compounds and the corresponding method performance limits also are listed in Table 9-1

TABLE 9-1
METHOD PERFORMANCE LIMITS

Compound	Water CRQL(1) (μg/l)	Soil/Sediment CRQL(1) (μg/kg)	Method
Volatiles Chloromethane	10	10	CLP protocols (EPA Method 624)(2)
Bromomethane	10	10	
Vinyl Chloride	10	10	
Chloroethane	10	10	
Methylene Chloride	5	5	
Acetone	10	10	
Carbon Disulfide	5	5	
1,1-Dichloroethene	5	5	
1,1-Dichloroethane	5	5	
1,2-Dichloroethene (total)	5	5	
Chloroform	5	5	
1,2-Dichloroethane	5	5	
2-Butanone	10	10	
1,1,1-Trichloroethane	5	5	
Carbon Tetrachloride	5	5	
Bromodichloromethane	5	5	
1,2-Dichloropropane	5	5	
cis-1,3-Dichloropropene	5	5	
Trichloroethene	5	5	
Dibromochloromethane	5	5	
1,1,2-Trichloroethane	5	5	
Benzene	5	5	
trans-1,3-Dichloropropene	5	5	
Bromoform	5	5	
4-Methyl-2-pentanone	10	10	

(1) Contract Required Quantitation Limit, taken from "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM01.6, June 1991.

(2) Extraction method based on USEPA Method 8240, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Compound	Water CRQL(1) (μg/l)	Soil/Sediment CRQL(1) (μg/kg)	Method
2-Hexanone	10	10	CLP protocols (EPA Method 624)
Tetrachloroethene	5	5	
Toluene	5	5	
1,1,2,2-Tetrachloroethane	5	5	
Chlorobenzene	5	5	
Ethyl Benzene	5	5	
Styrene	5	5	
Xylenes (total)	5	5	
Semivolatiles Phenol	10	330	CLP protocols (EPA Method 625)(2)
bis(2-Chloroethyl) ether	10	330	
2-Chlorophenol	10	330	
1,3-Dichlorobenzene	10	330	
1,4-Dichlorobenzene	10	330	
Benzyl alcohol	10	330	
1,2-Dichlorobenzene	10	330	
2-Methylphenol	10	330	
bis(2-Chloroisopropyl)ether	10	330	
4-Methylphenol	10	330	
N-Nitroso-di-n-dipropylamine	10	330	
Hexachloroethane	10	330	
Nitrobenzene	10	330	
Isophorone	10	330	
2-Nitrophenol	10	330	
2,4-Dimethylphenol	10	330	
Benzoic acid	50	1600	
bis(2-Chloroethoxyl)methane	10	330	
2,4-Dichlorophenol	10	330	

(1) Contract Required Quantitation Limit, taken from "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM01.6, June 1991.

(2) Extraction method based on USEPA Method 8240, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Compound	Water CRQL(1) (µg/l)	Soil/Sediment CRQL(1) (µg/kg)	Method
1,2,4-Trichlorobenzene	10	330	CLP protocols (EPA Method 625)(2)
Naphthalene	10	330	
4-Chloroaniline	10	330	
Hexachlorobutadiene	10	330	
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330	
2-Methylnaphthalene	10	330	
Hexachlorocyclopentadiene	10	330	
2,4,6-Trichlorophenol	10	330	
2,4,5-Trichlorophenol	50	1600	
2-Chloronaphthalene	10	330	
2-Nitroaniline	50	1600	
Dimethylphthalate	10	330	
Acenaphthylene	10	330	
2,6-Dinitrotoluene	10	330	
3-Nitroaniline	50	1600	
Acenaphthene	10	330	
2,4-Dinitrophenol	50	1600	
4-Nitrophenol	50	1600	
Dibenzofuran	10	330	
2,4-Dinitrotoluene	10	330	
Diethylphthalate	10	330	
4-Chlorophenyl-phenyl ether	10	330	
Fluorene	10	330	
4-Nitroaniline	50	1600	
4,6-Dinitro-2-methylphenol	50	1600	
N-nitrosodiphenylamine	10	330	
4-Bromophenyl-phenylether	10	330	
Hexachlorobenzene	10	330	
Pentachlorophenol	50	1600	

(1) Contract Required Quantitation Limit, taken from "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM01.6, June 1991.

(2) Extraction method based on USEPA Method 8240, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Compound	Water CRQL(1) (µg/l)	Soil/Sediment CRQL(1) (µg/kg)	Method
Phenanthrene	10	330	CLP protocols (EPA Method 625)(2)
Anthracene	10	330	
Di-n-butylphthalate	10	330	
Fluoranthene	10	330	
Pyrene	10	330	
Butylbenzylphthalate	10	330	
3,3'-Dichlorobenzidine	20	660	
Benzo(a)anthracene	10	330	
Chrysene	10	330	
bis(2-Ethylhexyl)phthalate	10	330	
Di-n-octylphthalate	10	330	
Benzo(b)fluoranthene	10	330	
Benzo(k)fluoranthene	10	330	
Benzo(a)pyrene	10	330	
Indeno(1,2,3-cd)pyrene	10	330	
Dibenz(a,h)anthracene	10	330	
Benzo(g,h,i)perylene	10	330	
Pesticides/PCBs alpha-BHC	0.05	8.0	CLP protocols (EPA Method 608)(2)
beta-BHC	0.05	8.0	
delta-BHC	0.05	8.0	
gamma-BHC (Lindane)	0.05	8.0	
Heptachlor	0.05	8.0	
Aldrin	0.05	8.0	
Heptachlor epoxide	0.05	8.0	
Endosulfan I	0.05	8.0	
Dieldrin	0.10	16.0	
4,4'-DDE	0.10	16.0	
Endrin	0.10	16.0	
Endosulfan II	0.10	16.0	

(1) Contract Required Quantitation Limit, taken from "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM01.6, June 1991.

(2) Extraction method based on USEPA Method 8240, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Compound	Water CRQL(1) (μg/l)	Soil/Sediment CRQL(1) (μg/kg)	Method
4,4'-DDD	0.10	16.0	CLP protocols (EPA Method 608)(2)
Endosulfan sulfate	0.10	16.0	
4,4'-DDT	0.10	16.0	
Methoxychlor	0.5	80.0	
Endrin ketone	0.10	16.0	
alpha-Chlordane	0.5	80.0	
gamma-Chlordane	0.5	80.0	
Toxaphene	1.0	160.0	
Aroclor-1016	0.5	80.0	
Aroclor-1221	0.5	80.0	
Aroclor-1232	0.5	80.0	
Aroclor-1242	0.5	80.0	
Aroclor-1248	0.5	80.0	
Aroclor-1254	1.0	160.0	
Aroclor-1260	1.0	160.0	

(1) Contract Required Quantitation Limit, taken from "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM01.6, June 1991.

(2) Extraction method based on USEPA Method 8240, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Analyte	Method Number(1)	CRQL(2) (µg/l)	Method Description
Aluminum		200	
	200.7		Inductively Coupled Plasma
Antimony		60	
	200.7		Inductively Coupled Plasma
	204.2		Atomic Absorption, Furnace Technique
Arsenic		10	
	200.7		Inductively Coupled Plasma
	206.2		Atomic Absorption, Furnace Technique
Barium		200	
	200.7		Inductively Coupled Plasma
Beryllium		5	
	200.7		Inductively Coupled Plasma
	210.2		Atomic Absorption, Furnace Technique
Cadmium		5	
	200.7		Inductively Coupled Plasma
	213.2		Atomic Absorption, Furnace Technique
Calcium		5000	
	200.7		Inductively Coupled Plasma
	215.1		Atomic Absorption, Direct Aspiration
Chromium		10	
	200.7		Inductively Coupled Plasma
	218.2		Atomic Absorption, Furnace Technique
Cobalt		50	
	200.7		Inductively Coupled Plasma
Copper		25	
	200.7		Inductively Coupled Plasma
Iron		100	
	200.7		Inductively Coupled Plasma
Lead		3	
	200.7		Inductively Coupled Plasma
	239.2		Atomic Absorption, Furnace Technique

(1) Methods taken from "Statement of Work for Inorganic Analysis," USEPA Contract Laboratory Program, ILM02.0, March 1990.

(2) Contract Required Quantitation Limit.

(3) Extraction method for arsenic, lead, selenium, and thallium taken from USEPA Method 3020, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

(4) Extraction method for all other metals taken from USEPA Method 3010, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Analyte	Method Number(1)	CRQL(2) (µg/l)	Method Description
Magnesium		5000	
	200.7		Inductively Coupled Plasma
	242.1		Atomic Absorption, Direct Aspiration
Manganese		15	
	200.7		Inductively Coupled Plasma
Mercury		0.2	
	245.1		Water by manual cold vapor technique
	245.2		Water by automated cold vapor technique
	245.5		Soil/sediment by manual cold vapor technique
Nickel		40	
	200.7		Inductively Coupled Plasma
Potassium		5000	
	200.7		Inductively Coupled Plasma
	258.1		Atomic Absorption, Direct Aspiration
Selenium		5	
	200.7		Inductively Coupled Plasma
	270.2		Atomic Absorption, Furnace Technique
Silver		10	
	200.7		Inductively Coupled Plasma
	272.2		Atomic Absorption, Furnace Technique
Sodium		5000	
	200.7		Inductively Coupled Plasma
	273.1		Atomic Absorption, Direct Aspiration
Thallium		10	
	200.7		Inductively Coupled Plasma
	279.2		Atomic Absorption, Furnace Technique
Vanadium		50	
	200.7		Inductively Coupled Plasma
Zinc		20	
	200.7		Inductively Coupled Plasma
Cyanide		10	
	335.2		Titrimetric, Spectrophotometric

(1) Methods taken from "Statement of Work for Inorganic Analysis," USEPA Contract Laboratory Program, ILM02.0, March 1990.

(2) Contract Required Quantitation Limit.

(3) Extraction method for arsenic, lead, selenium, and thallium taken from USEPA Method 3020, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

(4) Extraction method for all other metals taken from USEPA Method 3010, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Parameter	Water Performance Limit	Soil Performance Limit	Method
Herbicides			
2,4-D	12 (µg/l)(1)	800 (µg/kg)(1)	EPA Method 8150
2,4,5-TP (Silvex)	1.7 (µg/l)(1)	110 (µg/kg)(1)	
BTEX			
Benzene	2.0 (µg/l)(1)	2.0 (mg/kg)(1)	EPA Method 8020
Toluene	2.0 (µg/l)(1)	2.0 (mg/kg)(1)	
Ethylbenzene	2.0 (µg/l)(1)	2.0 (mg/kg)(1)	
Xylene	2.0 (µg/l)(1)	2.0 (mg/kg)(1)	
Engineering/FS Parameters			
Nitrate	N/A (1)	N/A (1)	EPA 352.1
Sulfate	15mg/l(2)	15 (2)	EPA 375.1
Chemical Oxygen Demand (COD)	N/A	N/A	EPA 410.1
Biological Oxygen Demand (BOD)	N/A	N/A	EPA 405.1
Total Suspended Solids (TSS)	N/A	N/A	EPA 160.2
Total Dissolved Solids (TDS)	N/A	N/A	EPA 160.1
Total Volatile Solids (TVS)	N/A	N/A	EPA 160.4
Total Organic Carbon (TOC)	N/A	N/A	EPA 415.1
Chloride	N/A	N/A	SW 9251
Alkalinity (Total)	N/A	N/A	SM 2320-B
Nitrogen, Organic (as N)	N/A	N/A	EPA 351.4
Total Fluoride	N/A	N/A	SM 4500-F
Grain Size	N/A	N/A	ASTM D422
Moisture Density	N/A	N/A	ASTM D698

(1) Practical Quantitation Limit taken from "Test Methods for Evaluating Solid Waste," USEPA, November 1986.

(2) Method Detection Limit taken from "Methods for Chemical Analysis of Water and Wastes," USEPA, 1979, Revised March 1983.

N/A - Not Applicable

Note: These methods will be used to analyze the Toxicity Characteristic Leading Procedure (TCLP) extract. The extract will be prepared using Method 1311, described in "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52FR 26886.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Parameter	Water PQL(1) (µg/l)	Soil/ Sediment PQL(1) (mg/kg)	Method
Pesticides Chlordane	0.14	9.4	3550/ 8080
Endrin	0.06	4.0	3550/ 8080
Heptachor (and its hydroxide)	0.03	2.0)	3550/ 8080
Lindane	0.04	2.7	3550/ 8080
Methoxychlor	1.8	120	3550/ 8080
Toxaphene	2.4	160	3550/ 8080

(1) Practical Quantitation Limit taken from "Test Methods for Evaluating Solid Waste," USEPA, November 1986.

Note: These methods will be used to analyze the Toxicity Characteristic Leading Procedure (TCLP) extract. The extract will be prepared using Method 1311, described in "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52FR 26886.

TABLE 9-1 (Continued)
METHOD PERFORMANCE LIMITS

Analyte	Water PQL(1) (µg/l)	Soil/ Sediment PQL(1) (mg/kg)	Method	Method Description
Metals				
Arsenic	10	30	6010 7060	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Barium	20	1	6010	Inductively Coupled Plasma
Cadmium	1	2	6010 7131	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Chromium	20	4	6010 7191	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Lead	10	2	6010 7421	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Mercury	2	0.002	7470	Water by manual cold vapor technique Water by automated cold vapor technique
Selenium	20	40	6010 7740	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Silver	2	4	6010 7760	Inductively Coupled Plasma Atomic Absorption, Furnace Technique

(1) Practical Quantitation Limit, taken from "Test Methods for Evaluating Solid Waste," USEPA, November 1986.

Note: These methods will be used to analyze the Toxicity Characteristic Leading Procedure (TCLP) extract. The extract will be prepared using Method 1311, described in "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52FR 26886.

10.0 DATA REDUCTION, VALIDATION AND REPORTING

10.1 Field Data Procedures

Data validation practices as described by "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," USEPA, June 1988, and "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses - Draft," USEPA, June 1991 will be followed to insure that raw data are not altered and that an audit trail is developed for those data which require reduction. The documentation of sample collection will include the use of bound field log books in which all information on sample collection will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including: site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated).

A rigorous data control program will insure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, correspondence, chain-of-custody records, analytical reports, data packages, photographs, computer disks, and reports. The project manager is responsible for maintaining a project file in which all accountable documents will be inventoried. The project records will be retained for a period of three years after project close-out; then the files will be forwarded to the Navy.

All the field data, such as those generated during field measurements, observations and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and the Project Manager or his designee will proof at least ten percent of all data transfers.

10.2 Laboratory Data Procedures

The following procedures summarize the practices routinely used by laboratory staff for data reduction, validation, and reporting. Numerical analyses, including manual calculations, are documented and subjected to quality control review. Records of numerical analyses are legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

Laboratory Data Validation

Data validation begins with data reduction and continues through to the reporting of data.

Data processing is checked by an individual other than the analyst who performed the data processing. The checker reviews the data for the following:

- Utilization of the proper equations;
- Correctness of numerical input;
- Correctness of computations; and
- Correct interpretation of raw data (chromatographs, strip charts, etc.).

The checking process is thorough enough to verify the results.

All entries made in benchbooks, data sheets, computation sheets, input sheets, etc. are made in ink. No entry will be rendered unreadable.

Analytical Reports

The items listed below are required of analytical reports.

- Data is presented in a tabular format.

- Analytical reports are approved by appropriate laboratory personnel.

- The following information is included on the report: client name and address, report date, sample date, analysis dates, number of samples, purchase order number, project number, and project type. All pages are numbered.

- The sample numbers and corresponding laboratory numbers are identified.

- The parameters analyzed, report units, and values are identified.

- Method, trip, and field blank results are reported.

- Matrix spike, matrix spike duplicate, and replicate recoveries are reported.

- Calibration summaries are reported.

- Surrogate recoveries are reported.

- Holding times and sample analysis dates are reported.

- The detection limit of the procedure is identified.

- Consistent significant figures are used.

- Referenced footnotes are used when applicable.

- A letter of transmittal accompanies the report if any anomalies are associated with the data. The letter specifies these anomalies.

11.0 INTERNAL QUALITY CONTROL CHECKS

11.1 Field Internal Quality Control Checks

Field internal quality control checks to be used during this investigation include field duplicates, equipment rinsates, field blanks, preservation blanks, and trip blanks. The results from the field quality control samples will be used by the data validator to determine the overall quality of the data.

11.2 Types of QC Samples

Documentation of the analyses of the following types of QC samples is maintained in the laboratory bench notebooks and/or the specific client or project files.

Field Duplicates

Duplicates for soil samples are collected, homogenized, and split. All samples except VOCs are homogenized, and split. Volatiles are not mixed, but select segments of the soil are taken from the length of the core and placed in 40 ml glass vials. Cores may be sealed and shipped to the laboratory for subsampling if the project deems this appropriate. The duplicate for water samples should be collected simultaneously. Field duplicates should be collected at a frequency of 10% per sample matrix for levels D and C. All the duplicates should be sent to the primary laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory and used by the laboratory as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

Equipment Rinsates

Equipment rinsates are the final organic-free deionized water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results of the blanks will be used to flag or assess levels of analytes in the samples. This comparison is made during validation. The rinsates are analyzed for the same parameters as the related samples.

Field Blanks

Field blanks consist of the source water used in decontamination, steam cleaning, and drilling. At a minimum, one field blank from each vent and each source of water must be collected and analyzed for the same parameters as the related samples. Organic-free deionized water is taken to the field in sealed containers and poured into the appropriate sample containers at predesignated locations. This is done to determine if any contaminants present in the area may have an affect on the sample integrity.

Preservation Blank

To determine if the preservative used prior and during field operations was contaminated, preservative blanks are prepared. These samples are prepared by putting organic-free deionized water in the container and then preserving the sample with the appropriate preservative.

Trip Blank

Analysis of trip blanks is performed to monitor possible contamination during shipment and collection of samples. Trip blanks are initiated in the laboratory prior to the shipping of sample packs. A corresponding trip blank is prepared for each set of samples to be analyzed for volatile organic compounds.

Trip blank samples are prepared by adding four drops of concentrated hydrochloric acid and then filling the container with organic-free deionized water (ASTM Type II). The trip blanks accompany the samples through shipment to the sample site, sample collection, shipment to the laboratory, and storage of the samples.

If the analyses indicate contamination of the trip blank, the sample sources may be resampled. If the extent and nature of the contamination does not warrant such actions, the data will be accepted as valid.

Method Blank

Analysis of method blanks is performed to verify that method interferences caused by contamination in reagents, glassware, solvents, etc. are minimized and known.

Method blanks are initiated by the analyst prior to the preparation and/or analysis of the sample set. A method blank consists of a volume of organic-free deionized water equal to the sample volume which is carried through the entire analytical procedure. For solid samples to be analyzed by GC/MS, the method blank consists of a purified solid matrix approximately equal to the sample weight. A method blank is analyzed with each set of samples or at the very least, daily. If the analytical data of the method blank indicates excessive contamination, the source of contaminant will be determined. The samples may be re-analyzed or the data may be processed as is depending upon the nature and extent of the contamination.

Replicate Sample Analysis

Replicate sample analysis is performed to demonstrate the precision of an analysis. An interlaboratory replicate sample is initiated by the analyst prior to sample preparation and carried through the entire analytical procedure. The frequency of interlaboratory replicate analysis for each analyte is summarized in Table 11-1.

Spike Analysis

Spike analysis is performed to demonstrate the accuracy of an analysis. The analyst initiates the spike prior to sample preparation and analysis by adding a known amount of analyte(s) to a sample. The spike sample is carried through the entire analytical procedure. The frequency of spike analysis for each analyte(s) is summarized in Table 11-1.

Surrogate Standards

Surrogate standard analysis is performed to monitor the preparation and analyses of samples. All samples and blanks analyzed by GC/MS are fortified with a surrogate spiking solution prior to extraction or purging.

Internal Standards

Internal standard analyses are performed to monitor system stability. Prior to injection or purging, internal standards are added to all blanks and samples analyzed by GC/MS (refer to Section 5.1.1.).

TABLE 11-1

QC ANALYSIS FREQUENCY

Parameter	Replicate	Spike
Organic		
All analyses by GC/MS	5%	5%
All analyses by GC	5%	5%
Metals		
Liquids by flame AA or ICP	5%	5%
Solids by flame AA or ICP	5%	10%
All analyses by furnace AA	5%	10%
General Chemistry		
Cyanide	5%	5%
Nitrate	5%	5%
Sulfide	5%	5%

Matrix Spikes and Matrix Spike Duplicates

A matrix spike is an aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. A matrix spike duplicate is a second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method. A matrix spike and matrix spike duplicate will be performed at a frequency of 1 per 20 samples for organics.

11.3 Laboratory Control Limits

Control limits are established for QC checks (spikes, duplicates, blanks, etc.). CLP control limits for surrogate standards spikes, and duplicates associated with GC/MS analyses and Pesticide/PCB analyses are adopted. Control limits for spikes, duplicates, and reference samples are determined internally through statistical analysis.

Whenever an out-of-control situation occurs, the cause is determined. Any needed corrective actions are taken.

Method Blanks

For metals analyses, the criteria below are used for method blank analysis.

- If the concentration of the method blank is less than or equal to the detection level, no correction of sample results is performed.

- If the concentration of the blank is above the detection level for any group of samples associated with a particular blank, the concentration of the sample with the least concentrated analyte must be ten times the blank concentration. Otherwise, all samples associated with the blank and less than ten times the blank concentration must be redigested (reprepared) and reanalyzed, if possible. If the affected samples cannot be reprepared and reanalyzed within method holding times, the flagged sample result and the blank result are both to be reported. The sample value is not corrected for the blank value.

For GC/MS, GC analyses, the criteria below are used for method blank analysis.

- A method blank for volatiles analysis must contain no greater than five times the detection limit of common laboratory solvents (common laboratory solvents are: methylene chloride, acetone, toluene, 2-butanone, and chloroform).

- A method blank for semivolatiles analysis must contain no greater than five times the detection limit of common phthalate esters.

- For all other compounds not listed above, the method blank must contain less than the detection limit of any single compound. If a method blank exceeds the criteria, the analytical system is considered to be out of control. The source of the contamination is investigated and appropriate corrective measures are taken and documented before sample analysis proceeds. All samples processed with a method blank that is out of control (i.e., contaminated), are reextracted/repurged and reanalyzed, when possible. If the affected samples cannot be reextracted/repurged and reanalyzed within method holding times, the flagged sample result and the blank result are both to be reported. The sample value is not corrected for the blank value.

- No positive result for pesticides/PCBs should be reported unless the concentration of the compound exceeds five times the amount in the blank.

- A method blank for pesticides/PCBs must contain no greater than five times the detection limit for any pesticides/PCBs.

Surrogate Standards

For method blank surrogate standard analysis, corrective action is taken if any one of the conditions below exist.

- Recovery of any one surrogate compound in the volatile fraction is outside the required surrogate standard recovery limit.

- Recovery of any one surrogate compound in the semivolatile fraction is outside surrogate standard recovery limits.

Corrective action will include steps listed below.

- A check of: the calculations for errors; the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and instrument performance.

- Recalculation or reinjection/repurging of the blank or extract if the above corrective actions fail to solve the problem.

- Reextraction and reanalysis of the blank. For sample surrogate standard analysis, corrective action is taken if any one of the following conditions exist:

    - Recovery of any one surrogate compounds in the volatile fraction is outside the surrogate spike recovery limits;

    - Recovery of any one surrogate compound in either semivolatile fraction is below ten percent; or

- Recoveries of two or more surrogate compounds in either semivolatile fraction are outside surrogate spike recovery limits.

Corrective action will include the steps listed below.

- A check of: the calculations for errors; of the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and of instrument performance.

- Recalculating or reanalysis the sample or extract if the above corrective action fails to solve the problem.

- Reextraction and reanalysis of the sample if none of the above are a problem.

11.4 Quality Assurance Review of Reports, Plans, and Specifications

Prior to issuance of a final report, it is reviewed by senior-level program staff, the Project Manager, or a designated representative. This review addresses whether:

- The report satisfies the scope of work, client requirements, and pertinent regulatory requirements;

- Assumptions are clearly stated, justified, and documented;

- A reference is cited for any information utilized in report preparation that was originated outside the project;

- The report correctly and accurately presents the results obtained by the work;

- The tables and figures presented in the report are prepared, checked, and approved according to requirements;

- The report figures are signed and dated by the appropriate members of the project staff and project management; and

- The typed report has been proofread and punctuation, grammar, capitalization, and spelling are correct.

11.5 Laboratory Quality Assurance

Field Quality Assurance

Four types of field quality assurance/quality control samples will be submitted to the laboratory: trip blanks, equipment rinsates, field blanks, and field duplicates. A breakdown by type of sample with which the QA/QC samples will be submitted to the laboratories is given in Table 11-2. A summary of the number of environmental and QA/QC samples to be submitted for analysis is given in the FSAP.

TABLE 11-2

QA/QC SAMPLE FREQUENCY

Type of Sample	Metal	Organic
Trip Blank (for volatiles only)	NA[1]	One per cooler or one per shipping day
Equipment Rinsate[2]	One per day	One per day
Field Blank	One per source per event[3]	
Field Duplicate[4]	10%	10%
Preservation Blank	Two per event (prior to sampling and near the end of the sampling event)	

1 - Not Applicable

2 - Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

3 - Source water includes water used in decontamination, steam cleaning, and drilling.

4 - The duplicate must be taken from the same sample which will become the laboratory matrix spike/matrix spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

12.0 PERFORMANCE AND SYSTEM AUDITS

A field audit will be conducted during the field investigation to verify that sampling is being performed according to the plan. A report will be submitted within 30 calendar days of completion of the audit. Serious deficiencies will be reported within 24 hours of the time of discovery of the deficiency, including actions taken or to be taken to correct such deficiencies.

The following table (Table 12-1) is used for audits. At the appropriate time, the Project Manager or Program QA/QC designee will conduct field audits.

TABLE 12-1

SYSTEM AUDIT CHECKLIST - FIELD OPERATIONS

Project No. ______________________________

Date ______________________________

Project Name & Location ______________________________

Name & Signature of Auditor ______________________________

Team Members ______________________________

Name & Signature of Field Team ______________________________

Yes _____ No _____ 1. Is there a set of accountable field documents checked out to the Site Manager?
Comments: ______________________________
____
____

Yes _____ No _____ 2. Is the transfer of field operations from the Site Manager to field participants documented in a log book?
Comments: ______________________________
____
____

Yes _____ No _____ 3. Is there a written list of sampling locations and descriptions?
Comments: ______________________________
____
____

Yes _____ No _____ 4. Are samples collected as stated in the project plan or as directed by the Site Manager?
Comments: ______________________________
____
____

Yes _____ No _____ 5. Are samples collected in the type of container specified in the project plan or as directed by the Site Manager?
Comments: ______________________________
____
____

Yes _____ No _____ 6. Are samples preserved as specified in the project plan or as directed by the Site Manager?
Comments: ______________________________
____
____

TABLE 12-1
SYSTEM AUDIT CHECKLIST - FIELD OPERATIONS
PAGE TWO

Yes _____ No ______ 7. Are the number, frequency and type of samples collected as specified in the project plan or as directed by the Site Manager?

Comments: ______________________________________

____

____

Yes _____ No ______ 8. Are the number, frequency and type of measurements taken as specified in the project plan or as directed by the Site Manager?

Comments: ______________________________________

____

____

Yes _____ No ______ 9. Are samples identified with sample labels?

Comments: ______________________________________

____

____

Yes _____ No ______ 10. Are blank and duplicate samples properly identified?

Comments: ______________________________________

____

____

Yes _____ No ______ 11. Are sample and serial numbers for samples split with other organizations recorded in a log book or on a chain-of-custody record?

Comments: ______________________________________

____

____

Yes _____ No ______ 12. Are samples listed on a chain-of-custody record?

Comments: ______________________________________

____

____

Yes _____ No ______ 13. Is chain-of-custody documented and maintained?

Comments: ______________________________________

____

____

Yes _____ No ______ 14. Are quality assurance checks performed as directed?

Comments: ______________________________________

____

____

TABLE 12-1
SYSTEM AUDIT CHECKLIST - FIELD OPERATIONS
PAGE THREE

Yes _____ No _____ 15. Are photographs documented in logbooks as required?
Comments: ____
____
____

Yes _____ No _____ 16. Are all documents accounted for?
Comments: ____
____
____

Yes _____ No _____ 17. Have any documents been voided or destroyed?
Comments: ____
____
____

13.0 PREVENTIVE MAINTENANCE

13.1 Field Maintenance

The HNu PI-101 is to be used in site characterization and will be maintained as described by the manufacturer's instructions. The pH and specific conductance meters to be used during sampling will be maintained according to Appendix A, Field Water Quality Instruments.

13.2 Laboratory Maintenance

Preventive maintenance is an organized program of actions to prevent instruments and equipment from failing during use and to maintain proper performance of equipment and instruments. A comprehensive preventive maintenance program is implemented to increase the reliability of the measurement system. The preventive maintenance program addresses the following:

- Schedules of important preventive maintenance tasks that are carried out to minimize downtime; and

- Lists of critical spare parts that are available to minimize downtime.

The laboratory maintains histories, in instrument/equipment logs, of all major equipment. Trouble shooting, maintenance, and spare parts inventory are recorded in the logs. Instruments and equipment are maintained periodically in accordance with procedures described in individual analytical methods, manufacturer's recommendation, and/or service contracts.

The modern analytical laboratory depends heavily upon instrumentation and equipment; therefore, cleaning and preventive maintenance are primary considerations in the sustained production of satisfactory data. Specific requirements for proper care of laboratory instrumentation and equipment are contained in the manufacturer's instructions; however, some general guidelines are considered, and are listed below.

- Special precautions are taken to avoid spillage of corrosive chemicals on or around equipment and instrumentation not only to extend the life of the item, but also to eliminate contamination.

- Where available, covers are placed on instrumentation when not in use.
- Instrument parts are cleaned as required (i.e., mirrors, probes, detector cells).

14.0 DATA MEASUREMENT ASSESSMENT PROCEDURES

14.1 Overall Project Assessment

Overall data quality will be assessed by a thorough understanding of the data quality objectives which are stated during the design phase of the investigation. By maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing the analytical data as they are generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, data accuracy, precision, and completeness will be closely monitored.

14.2 Field Quality Assessment

To assure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The Project Manager will perform field audit(s) during the investigation to document that the appropriate procedures are being followed with respect to sample (and blank) collection. These audits will include a thorough review of the field books used by the project personnel to insure that all tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of field blanks, and other field QC samples will provide definitive indications of the data quality. If a problem that can be isolated arises, corrective actions can be instituted for future field efforts.

14.3 Laboratory Data Quality Assessment

As part of the analytical QA/QC program, the laboratory applies precision and accuracy criteria for each parameter that is analyzed. When analysis of a sample set is completed, QC data generated are reviewed and evaluated to ensure acceptance criteria are met. These criteria are method and matrix specific.

QA/QC data review is based on the following criteria:

- Method Blank Evaluation - The method blank results are evaluated for high readings characteristic of background contamination. If high blank values are observed, laboratory glassware and reagents are checked for contamination and the analysis of future samples halted until the system can be brought under control. A high background is defined as a background value sufficient to result in a difference in the sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid. A method blank must contain no greater than two times the parameter detection limit for most parameters.

- Trip Blank Evaluation - Trip blank results are evaluated for high readings similar to the method blanks described above. If high trip blank readings are encountered (i.e. a value sufficient to result in a difference in sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid), procedures for sample collection, shipment, and laboratory analysis are reviewed. If both the method and the trip blanks exhibit significant background contamination, the source of contamination is probably within the laboratory. Ambient air in the laboratory and reagents are checked as possible sources of contamination.

- Standard Calibration Curve Verification - The calibration curve or midpoint calibration standard (check standard) is evaluated daily to determine curve linearity through its full range and that sample values are within the range defined by the low and high standards. If the curve is not linear, sample values are corrected. If average response factors are used to calculate sample concentrations, these factors are verified on a daily basis. Verification of calibration curves and response factors is accomplished when the evaluated response for any parameter varies from the calibrated response by less than ranges specified in Section 7.0.

- Duplicate Sample Analyses - Duplicate sample analyses are used to determine the precision of the analytical method for the sample matrix. Two types of duplicate samples are analyzed for this project, field, and interlaboratory. Duplicate results are used to calculate precision as defined by the RPD. If interlaboratory duplicate values exceeds the control limit, the sample set are reanalyzed for the parameter in question. Precision limits are updated periodically following review of data.

- Reference Sample Analyses - The results of reference sample analysis are compared with true values, and the percent recovery of the reference sample is calculated. If correction is required (excessive or inadequate percent recovery), the reference sample is reanalyzed to demonstrate that the corrective action has been successful.

- Surrogate Standard Analyses - Surrogate standard determinations are performed on all samples and blanks for GC/MS analyses. All samples and blanks are fortified with surrogate spiking compounds before purging or extraction to monitor preparation and analysis of samples. Recoveries must meet specific criteria. If acceptance criteria are not met, corrective action is taken to correct the problem and the affected sample is reanalyzed.

- Matrix Spike Analyses - The observed recovery of spike versus theoretical spike recovery is used to calculate accuracy as defined by the percent recovery. If the accuracy value exceeds the control limit for the given parameter, the appropriate laboratory personnel notified and corrective action is taken before the sample set is reanalyzed for the parameter in question.

For completeness, it is expected that the methodology proposed for chemical characterization of the samples will meet QC acceptance criteria for at least 95 percent of all sample data. To ensure this completeness goal, sample data that does not meet the established criteria will be recollected, reextracted, or reanalyzed.

Data representativeness will be ensured through the use of appropriate analytical procedures, and analysis of samples performed within the allowed holding times.

Comparability is a qualitative characteristic of the data. By using standard methods for sampling and analyses, data generated in past or future investigations will be comparable with this investigation data.

14.4 Laboratory Data Validation

Review of analyses will be performed. A preliminary review will be performed by the project manager to verify all necessary paperwork (e.g., chain-of-custodies, traffic reports, analytical reports, and laboratory personnel signatures) and deliverables are present. A detailed quality assurance review will be performed by a data validation subcontractor to verify the qualitative and quantitative reliability of the data presented. This review will include a detailed review and interpretation of all data generated by the laboratory. The primary tools which will be used by experienced data validation personnel will be guidance documents, established criteria, and professional judgment.

A quality assurance report stating the qualitative and quantitative reliability of the analytical data will be prepared for NEESA. This report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to be best utilized. The report will reference NEESA 20.2-047B for applicable guidance, format, and standards.

During the data review, a data support documentation package will be prepared which will provide the back-up information that will accompany all qualifying statements present in the quality assurance review.

15.0 CORRECTIVE ACTION

Corrective action is taken whenever a nonconformance occurs. A nonconformance is defined as an event which is beyond the limits established for a particular operation by the plan. Nonconformances can occur in a number of activities. Such activities include sampling procedures, sample receipt, sample storage, sample analysis, data reporting, and computations.

The following personnel are responsible for detecting and reporting nonconformances:

- Project Staff - during testing and preparation and verification of numerical analyses; and

- Laboratory Staff - during the preparation for analyses, performance of analytical procedures, calibration of equipment, and quality control activities.

15.1 Corrective Action

Nonconformances are documented by the person originating or identifying it. Documentation includes the following:

- Identification of the individual(s) originating or identifying the nonconformance;
- Description of the nonconformance;
- Any required approval signatures (initials);
- Corrective action taken; and
- Corrective action completion date.

The NEESA contract representative (NCR), along with the contract project director. will be notified of a nonconformance and corrective action taken, if one of the following is true:

- A nonconformance causes a delay in work beyond the schedule completion date;
- A nonconformance affects information already reported; and
- A nonconformance affects the validity of the data.

15.2 Limits of Operation

The limits of operation that are used to identify nonconformances are established by the contents of the plan and by control limits produced by statistical analyses.

16.0 QUALITY ASSURANCE REPORTING PROCEDURES

The Project Manager will be responsible for assessing the performance of measurement systems and data quality related to the field investigation. A written record will be maintained of: the results of laboratory QC reports and other periodic assessments of measurement, data accuracy, precision, and completeness; performance and system audits; and any significant QA problems and recommended solutions. Each deliverable will contain a QA/QC assessment section. Also, a QA/QC assessment will be performed any time a significant problem is identified.

The Project Manager will keep in contact with the Navy Engineer-in-Charge through informal, verbal reports during the project as well as through monthly progress reports.

APPENDIX A

FIELD WATER QUALITY INSTRUMENTS

A. Calibration and Preventive Maintenance

Activity Before Site Visit

Field meters to be used during sampling, specifically the pH and specific conductance/thermistor meters will be checked against the contractor laboratory meters to insure proper calibration and precision response. Thermometers will be checked against a precision thermometer certified by the National Bureau of Standards. These activities will be performed by the contractor laboratory manager. In addition, buffer solutions and standard KCl solutions to be used to field calibrate the pH and conductivity meters will be laboratory tested to insure accuracy. The preparation date of standard solutions will be clearly marked on each of the containers to be taken into the field. A log which documents problems experienced with the instrument, corrective measures taken, battery replacement dates, when used and by whom for each meter and thermometer will be maintained by the contractor's laboratory manager. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement, when necessary in the field.

All equipment to be utilized during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manuals and the instructions with each instrument to ensure that all maintenance items are being observed. A spare electrode will be sent with each pH meter that is to be used for field measurements. Two thermometers will be sent to each field site where measurement of temperature is required, including those sites where a specific conductance/thermistor meter is required.

Activity at Site

The pH meter must be calibrated a minimum of twice each day using at least two different pH buffer solutions expected to bracket the pH range of field samples. Rinse the probe thoroughly between buffer measurements with distilled water and again after calibration is completed. Record in the field log book what buffer solutions were used. When the meter is moved, check pH reading by measuring the pH value of the buffer solution closest to the expected range of the sample. If the reading deviates from the known value by more than 0.1 standard units, recalibrate the instrument as described above. If unacceptable deviations still occur, consult the operating manual for remedial course of action.

The specific conductance/thermistor meter is less likely to exhibit random fluctuations and will only require daily checks against a known KCl solution, which should be chosen to be within the expected conductivity range. Note that specific conductance is temperature-dependent and, therefore, the meter readings must be adjusted to reflect the temperature of the standard solution. Thoroughly rinse the probe with distilled water after immersing in KCl standard solution. In addition to daily checks of the conductivity readings, the thermistor readings must also be checked daily. This is accomplished by taking a temperature reading of the KCl standard solution with both the conductivity probe and a mercury thermometer.

Before use, visually inspect the thermometer to assure there is no break in the mercury column. If there is a break, visually inspect the spare thermometer. If both thermometers have a break in the mercury, neither can be used until the break is corrected. This may be done by cooling the bulb until the mercury is all contained in the bulb.

B. Analytical Methods

All field measurements will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater," EPA-600/4-82-029, September 1982 or "Test Methods for Evaluating Solid Wastes," SW-846, November 1986. The quality assurance procedures for field analysis and equipment are detailed in these documents cited.