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DRAFT RESOURCE CONSERVATION AND RECOVERY ACT FACILITIES INVESTIGATION WORK PLAN FOR THE INVESTIGATION OF GROUNDWATER CONTAMINATION AT THE DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO) NORTH YARD SITE CNC CHARLESTON SC

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ENVIRONMENTAL SCIENCE AND ENGINEERING. INC.

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GROUND WATER CONTAMINATION
AT THE DEFENSE REUTILIZATION AND
MARKETING OFFICE (DRMO)
"NORTH YARD SITE"
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

Prepared for:

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION
Charleston, South Carolina

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LIST OF ACRONYMS

AAS	Atomic Absorption Spectrophotometry.
°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLASS	Chemical Laboratory Analysis and Scheduling System
cm^2	centimeters squared
cP	continental-polar
DOD	Department of Defense
DRMO	Defense Reutilization and Management Office
EIC	Engineer-In-Charge
EP	Extractive Procedure
EPA	Environtmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
°F	degrees Fahrenheit
g	grams
GC/MS	Gas Chromatography/Mass Spectrometry
ICP-AES	Inductively Coupled Plasma-Atomic Emmision Spectormetry
ID	Identification
IR	Infrared
KCl	potassium chloride
LQAC	Laboratory Quality Assurance Coordinator
MCL	Maximum Contaminant Level
mg	milligrams
MP	measuring point

LIST OF ACRONYMS
(Page 2 of 2)

MSL	mean sea level
mT	maritime-tropical
NACIP	Navy Assessment and Control of Installation Pollutants
NAVFACENGCOM	Naval Facilities Engineering Command
NEESA	Naval Energy and Environmental Support Activity
NWS	Charleston Naval Weapons Station
OSHA	Occupational Safety and Health Administration
Pb	Lead
PFE	Post Field Entry
PFS	Prefield Set Up
ppm	parts per million
PVC	Polyvinyl Chloride
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Audit
RFI	Resouce Facilities Investigation
SCDEHC	South Carolina Department of Health and Environmental Control
SCT	Salinity, Conductivity, and Temperature
TOH	Total Organic Halogens
ug	micrograms
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USSCS	United States Soil Conservation Service
UV	Ultraviolet
YSI®	Yellow Springs Instruments

1.0 INTRODUCTION AND BACKGROUND

1.1 OBJECTIVES

The Naval Facilities Engineering Command (NAVFACENGCOM), Southern Division, issued Contract No. N62467-85-C-0268 to Environmental Science and Engineering, Inc. (ESE) to conduct soil and/or ground water contamination investigations at various naval facilities. This document comprises the Resource Conservation and Recovery Act (RCRA) Facilities Investigation (RFI) work plan for the assessment of lead contamination in the ground water of the surficial aquifer at the Defense Reutilization and Management Office (DRMO), Charleston Naval Shipyard (NAVBASE Charleston), Charleston, South Carolina. This site is referred to as the "North Yard" site in the previous RCRA Facilities Audit (RFA). ESE recently completed an investigation of lead contamination in the soils at the site. The objective of this proposed investigation is to determine if lead contamination has occurred in the ground water of the surficial aquifer at the DRMO site.

1.2 LOCATION

NAVBASE Charleston is located on the banks of the Cooper River in Charleston County, South Carolina, approximately 5 miles north of the City of Charleston (Figure 1.2-1). The installation consists of two major areas: (1) an undeveloped spoil area on the east bank of the Cooper River on Daniel Island in Berkeley County, and (2) a developed area on the west bank of the Cooper River. The developed portion of NAVBASE Charleston lies on a peninsula, bounded on the west by the Ashley River and on the east by the Cooper River. The western boundary of the developed area adjoins the City of North Charleston, and the eastern boundary adjoins the Cooper River between river mile 10 and river mile 14.

The DRMO site is located at the extreme northern portion of NAVBASE Charleston. Figure 1.2-2 shows the general location of the DRMO area in relation to NAVBASE Charleston, and Figure 1.2-3 is a site map of the DRMO area.

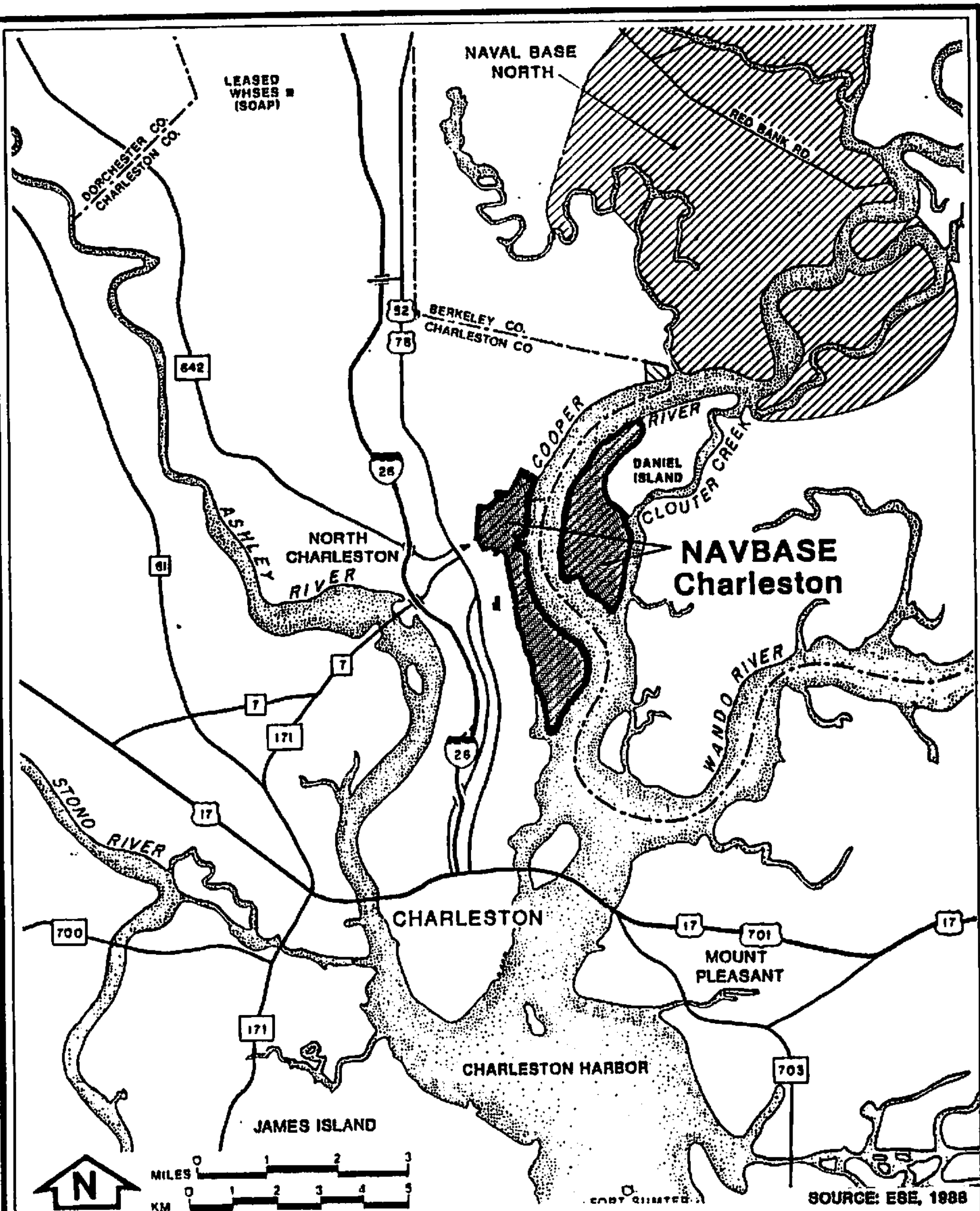


FIGURE 1.2-1

LOCATION MAP OF NAVBASE CHARLESTON

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

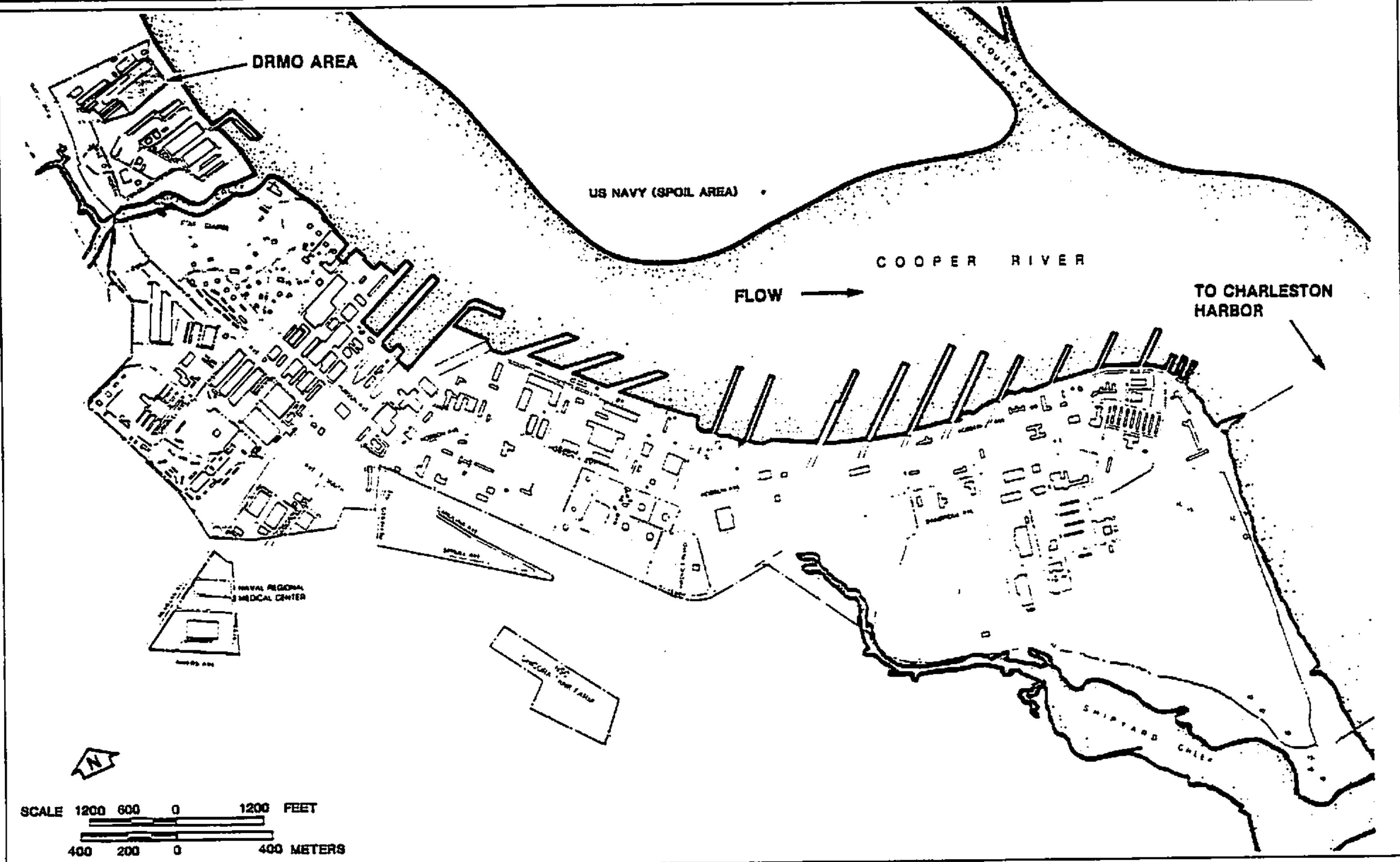


FIGURE 1.2-2

LOCATION OF DRMO AREA ON NAVBASE CHARLESTON

SOURCE: ESE, 1988

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

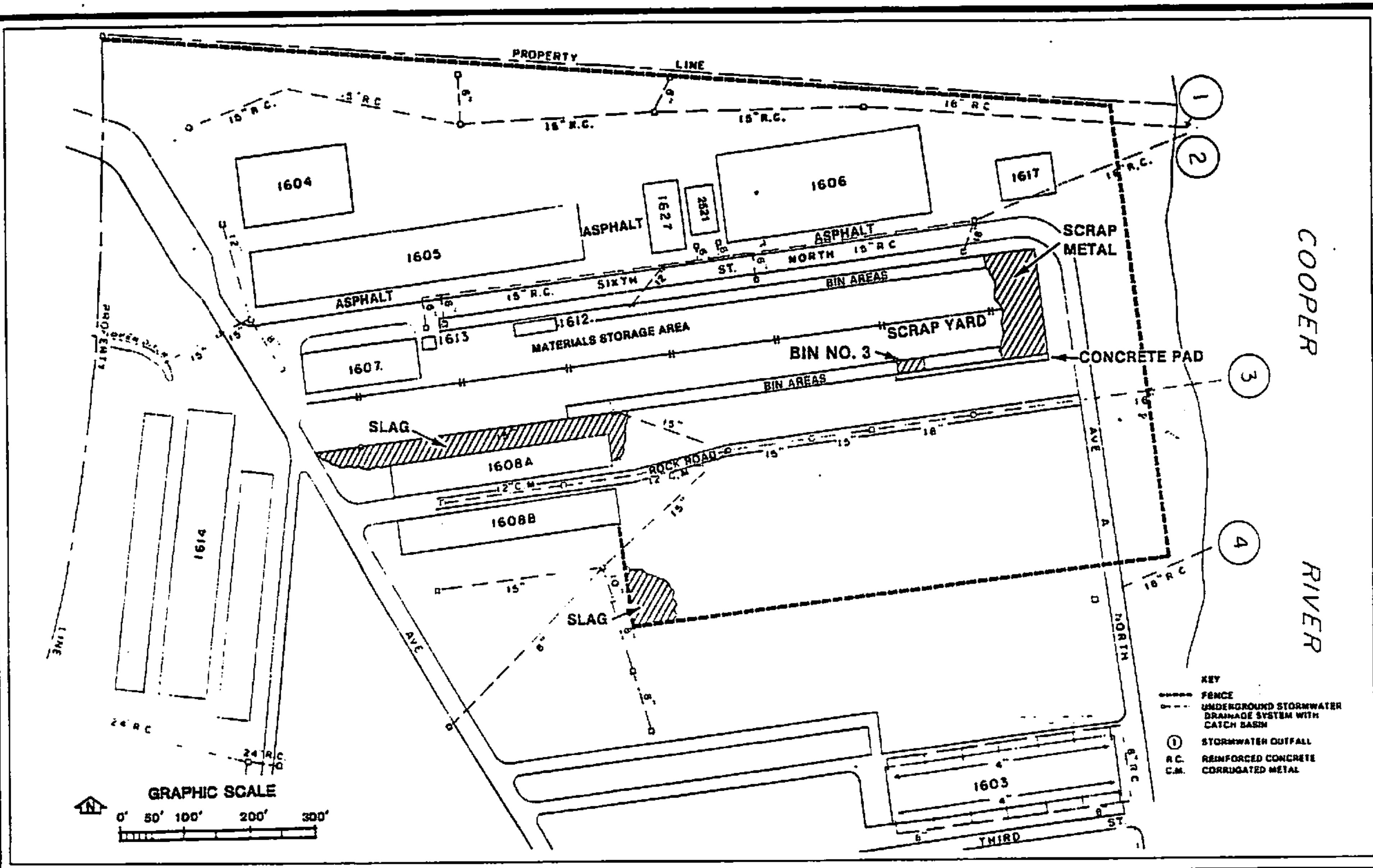


FIGURE 1.2-3

SITE MAP OF DRMO AREA

SOURCE: ESE, 1988

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

1.3 BACKGROUND

The DRMO at NAVBASE Charleston receives excess property from NAVBASE Charleston, as well as other Department of Defense (DOD) installations in the area. This material is then recycled within DOD, other federal or state agencies, or contract sold to the highest bidder.

Materials stored at the DRMO site are segregated according to type of metal (e.g., ferrous items, copper, brass, aluminum, etc.). Since the mid- to late-1960s, lead-acid batteries from submarines were stored in a materials salvage bin (Bin No. 03) in the DRMO area (see Figure 1.2-3) until picked up by a salvage contractor. The ground surface adjacent to Bin No. 03 is contaminated with a reddish-brown material. Soil samples collected by the Charleston Naval Hospital Industrial Hygiene personnel showed lead contamination in this area of up to 33 percent [330,000 micrograms (ug) of lead per gram (g) of soil]. The principal oxides of lead (PbO, Pb304, and Pb02) range in color from yellowish-red to brown (Weast, 1984).

The salvage bins are located on a concrete foundation, while the area in front of the bins consists of asphalt paving or concrete. An open drainage ditch is located immediately behind the bins and transmits surface runoff in a westerly direction to an underground catch basin and storm sewer system (Figure 1.2-3). The soils in the drainage ditch are visually contaminated by the reddish-brown material for a distance of 50 to 100 feet west of Bin No. 03.

Activity in the DRMO yard area generates fugitive dust, thus creating a potential for lead transport via atmospheric routes. In December 1985, ESE performed sampling and analysis of soils at the site and dust from several buildings. The conclusions of this investigation (ESE, 1986) are detailed below:

1. Soils in the DRMO area were found to be contaminated with lead. The lead contamination (1,000 mg/kg and higher) in the soils encompasses an area of approximately 6 acres. The highest concentrations (300,000 mg/kg) were in particulate samples collected from the paved area immediately adjacent to the former battery storage bin.

2. The lead contamination is migrating due to generation of lead-contaminated dust by activities in the DRMO area and by runoff of stormwater. The lead contamination is confined to the surficial soils (surface to 1 ft.) and does not appear to be migrating vertically.

3. Dust within several of the DRMO buildings is contamianted with lead at levels ranging up to 100,000 mg/kg.

4. Indoor and outdoor ambient air data collected during the site investigation did not indicate lead levels above occupational criteria. One sample of outdoor air did contain lead at a level slightly above the National Ambient Air Quality Standard.

5. The exposure and hazard assessment resulted in the determination of a residual lead level (3,000 mg/kg) that would not pose a risk to human health or environmental degradation. Soil lead levels in some areas of the DRMO site and lead levels in building dust are greater than 3,000 mg/kg; therefore, the potential currently exists for adverse risk to human health and/or environmental degradation.

6. Results of Extractive Procedure (EP) testing of two soil samples having the highest concentrations of lead indicate that the soils are classified as hazardous according to 40 CFR 261 and, therefore, would require disposal in a permitted hazardous waste disposal facility.

Based on the results of the soil and dust sampling, ESE performed a Feasibility Study (ESE, 1987) to address remediation of the lead-contaminated soils and dust. The Feasibility Study was completed in March, 1987 and the results presented to U.S. Environmental Protection Agency (EPA) and South Carolina Dept. of Health and Environmental Control (DHEC) personnel in June, 1987. At this meeting, EPA and DHEC representative requested additional information on the ground wter quality at the site. This RFI work plan was prepared to determine if lead in the contaminated soils has migrated to the ground water at the site.

2.0 SITE CHARACTERISTICS

This section describes the general environmental conditions at the site, including climatology, physiography, geology, and hydrological characteristics.

2.1 CLIMATOLOGY

Due to the proximity of the ocean, the climate of Charleston is mild and temperate. Daily weather is controlled largely by the movement of pressure systems across the country and by the diurnal effects of the land-sea breeze. Exchanges of air masses are relatively few in summer, when masses of warm, humid, maritime-tropical (mT) air persist for long periods under high pressure conditions associated with the western extension of the Atlantic Ridge. Winters are characterized by movements of frontal systems and by replacement of mT air with cool, dry, continental-polar (cP) air.

Average daily temperatures recorded during each month by the National Weather Service at the Charleston Municipal Airport are shown in Table 2.1-1. The coldest month is January, when daily temperatures typically range from approximately 37 to 60 degrees Fahrenheit (°F). In July, the warmest month, the average daily temperature extremes vary between approximately 72 and 90°F. The smaller diurnal temperature variation in summer is due to onshore flow from the relatively cooler water of the Atlantic Ocean. The record high and low temperatures measured at the airport are 102.9°F and 8.0°F, respectively. Normally, 60 days per year temperatures will be at 90°F or above, while 33 days of the year freezing temperatures will predominate. The average first occurrence of freezing temperatures is 10 October, while the average last occurrence is 19 February, (Army, 1976c; USSCS, 1971; NAVFAC, 1976).

The average annual rainfall in Charleston is 49.2 inches for the 30 year period from 1947-1976. The wettest month is July with a normal of more than 7.5 inches. Charleston has a bimodal precipitation pattern. The principal rainy season is in the summer with a secondary rainy season

Table 2.1-1 Annual and Monthly Climatological Data Recorded by the National Weather Service at Charleston Municipal Airport, Charleston, South Carolina

Time Year of Record	Normal Daily Average Temperature, °F Maximum 1947-76	Normal Daily Average Temperature, °F Minimum 1947-76	Normal Total Precipitation (inches) 1947-76	Prevailing Direction of Winds 1962-76
January	61.2	38.3	2.54	SW
February	62.5	40.4	3.29	NNE
March	68.0	45.4	3.93	SSW
April	76.9	52.7	2.88	SSW
May	83.9	61.8	3.61	S
June	89.2	69.1	4.98	S
July	89.2	72.0	7.71	SW
August	88.8	70.5	6.61	SW
September	84.9	66.2	5.83	NNE
October	77.2	55.1	2.84	NNE
November	67.9	43.9	2.09	N
December	61.3	38.6	2.85	NNE
Annual	75.9	54.5	49.16	NNE

Source: Army, 1976.

occurring in the late winter. The four summer months (June through September) experience more than 50 percent of the annual rainfall. Rain storms during the summer are due to strong convective atmospheric motions, which trigger 72 percent of the average 57 thunderstorm days per year. Rainfall during the winter is generally associated with the interface of cP frontal air masses replacing mT air. With the exception of the 7 inches dropped during the winter storm of 10-11 February 1973, only traces (less than 0.04 inch) of snow are usually experienced, mostly in January and February (Army, 1976; USSCS, 1971; NAVFAC, 1976). Dry seasons occur in the spring and fall.

The mean wind speed recorded at the Charleston Airport for the period from 1962 to 1976 was 9 miles per hour, with prevailing wind directions (Table 2.1-1) of north-northeast during the winter months and south-southwest during the summer months (Army, 1976c; USSCS, 1971; NAVFAC, 1976). Figure 2.1-1 represents a ten year average wind direction rose for Charleston Airport.

2.2 PHYSIOGRAPHY

NAVBASE Charleston is located on the eastern edge of a low, narrow finger of land separating the Ashley and Cooper Rivers . The topography of the area is typical of South Carolina's Lower Coastal Plain, with low relief plains broken only by the meandering courses of the many sluggish streams and rivers flowing toward the coast and by an occasional marine terrace escarpment. Topography at NAVBASE Charleston is essentially flat, with elevations ranging from just over 20 feet in the northwestern part of the base to sea level at the Cooper River. Much of the original topography of NAVBASE Charleston has been modified by man's activities. The southern end of the base originally was a tidal marsh drained by Shipyard Creek and its tributaries. Over the last 70 years, this area has been filled with both solid wastes and dredged spoil. Most of the base is within the 100-year flood zone, which is below +10 feet mean sea level (MSL) in elevation (ESE, 1981).

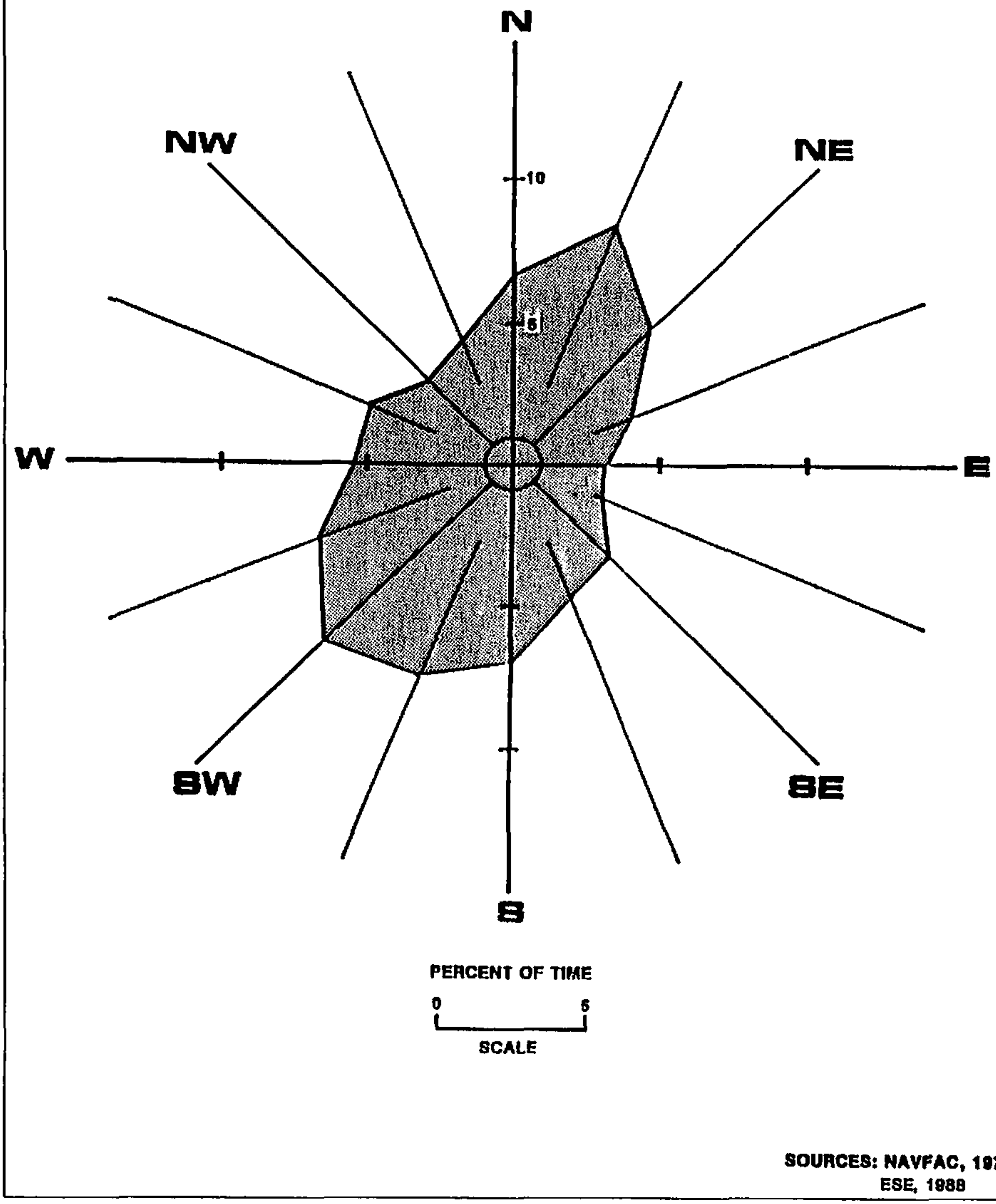


FIGURE 2.1-1

TEN-YEAR AVERAGE WIND DIRECTION FOR CHARLESTON AIRPORT, SOUTH CAROLINA

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

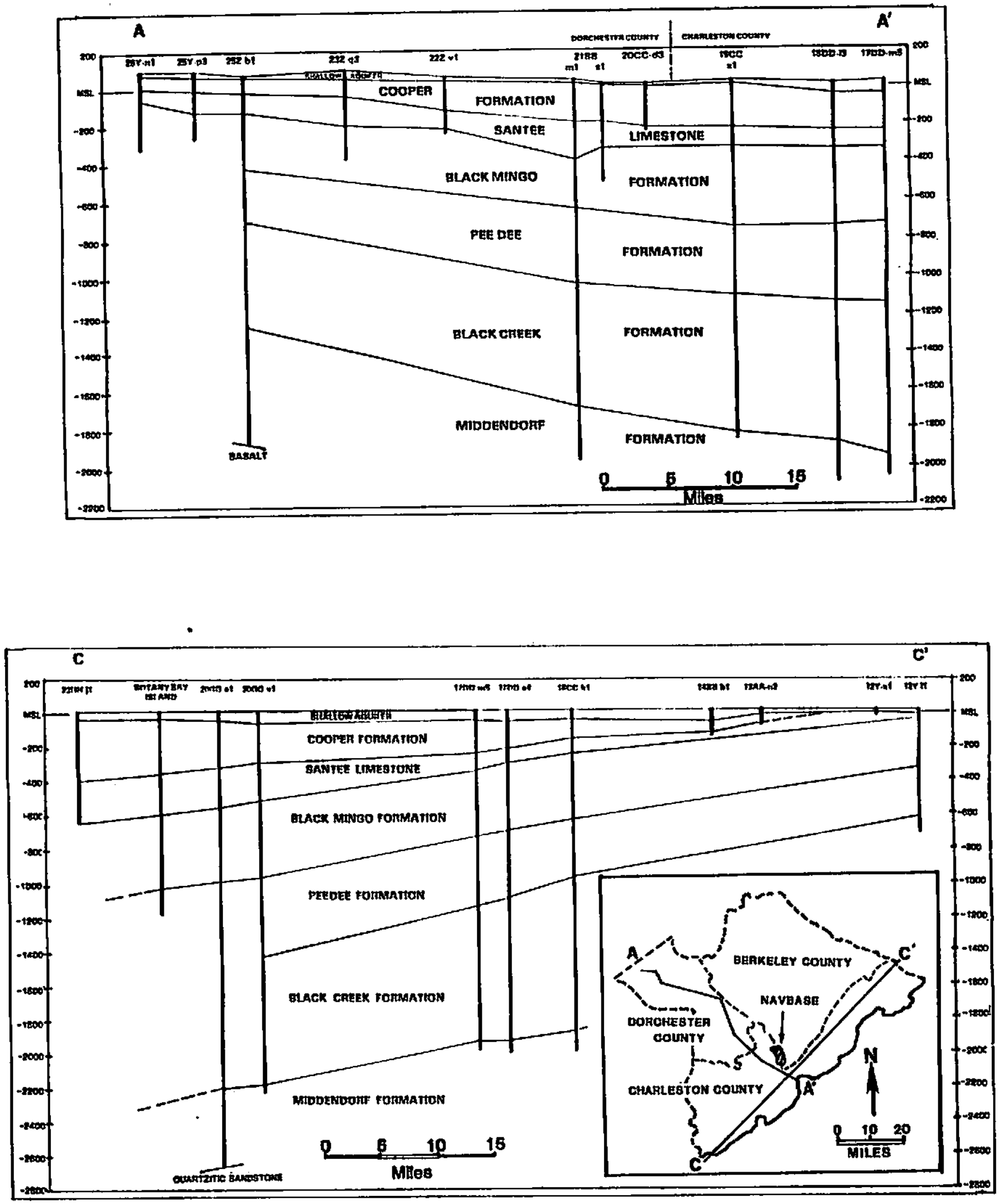
2.3 REGIONAL GEOLOGY

The geology of the Charleston area is characteristic of the southern part of the Atlantic Coastal Plain. A seaward-thickening wedge of Cretaceous and younger sediments is underlain by older igneous and metamorphic basement rock (see Figure 2.3-1). Also, the wedge thins to the south/southeast due to the intrusion of the Cape Fear Arch.

NAVBASE Charleston is underlain by unconsolidated to weakly consolidated Holocene to Miocene clastic sediments, composed of clays, organic-rich clays, silts, and sands (Figure 2.3-2). These materials generally comprise the Talbot Terrace as modified by the Cooper River. The thickness of this overburden is known in detail through the compilation of data from extensive drilling. Overburden thickness in the NAVBASE area varies, ranging from a maximum of greater than 82 feet in a north-northeast-trending depression in the surface of the underlying the Cooper Formation to the immediate west of the Cooper River, to less than 17 feet in isolated areas. Average overburden thickness is approximately 35 feet with thicker zones in the immediate vicinity of Cooper River (Park, 1985).

2.4 REGIONAL HYDROGEOLOGY

In Charleston County, less than 5% of domestic and municipal water used is from ground water. Over 95% of the water supply for domestic and municipal water consumption is from surface water (Park, 1985). The subsurface hydrogeology underneath NAVBASE Charleston (Figure 2.3-2) consists of the shallow aquifer comprised of surficial sands, silts, and clays of Pleistocene age, which is underlain by the Cooper Formation which acts as an effective regional confining zone. The surficial aquifer is not a source of potable water in the area for the most part; ground water in the shallow aquifer occurs under water table conditions with recharge supplied by local rainfall. The Cooper Formation has a thickness of approximately 200 feet. Underlying the Cooper Formation are



SOURCES: PARK, 1985; ESE, 1988

FIGURE 2.3-1

REGIONAL GEOLOGIC CROSS SECTIONS

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

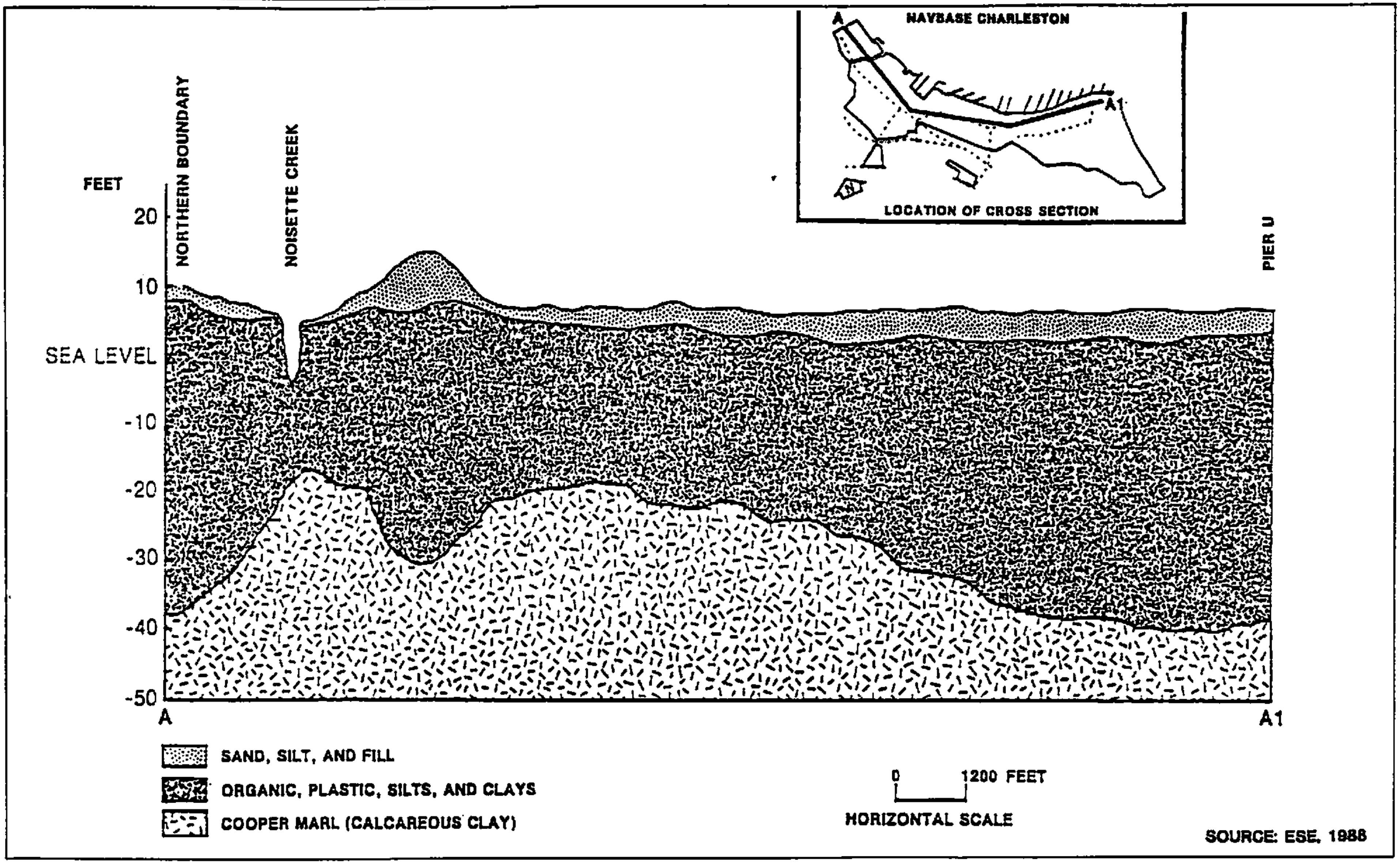


FIGURE 2.3-2

GENERALIZED GEOLOGIC CROSS SECTION THROUGH NAVBASE CHARLESTON

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

the middle aquifers which consist of the Santee Limestone (225-325 ft BLS) and the Black Mingo Formation (325-725 ft BLS). The Santee Limestone exhibits a brackish quality in the Charleston area (Park, 1985), and the aquifer is non-artesian in the Charleston area (Park, 1985). The Black Mingo formation contains an artesian aquifer which is more brackish than that of the Santee Limestone. Inter-aquifer transfer between the Santee Limestone and the Black Mingo formation aquifers in the open hole boreholes of the local domestic wells is common. Brackish water quality is accepted as the norm in these wells (Park, 1985). The Middendorf Formation (below 1,900 ft) contains the principal aquifer of the Carolina Piedmont. Its Brackish quality and deep depth makes it an unsuitable water source in the Charleston area. It is artesian in the Charleston area (Park, 1985).

2.5 SURFACE HYDROLOGY

The southern portion of NAVBASE Charleston is drained by Shipyard Creek and the northern portion by Noisette Creek (see Figure 1.2-2). Both creeks drain into the Cooper River. Surface drainage for most of NAVBASE Charleston is directly into the Cooper River, which empties into Charleston Harbor.

The storm drainage system for the DRMO area consists of open ditches, catch basins, and underground concrete and/or corrugated metal conduits (Figure 2.4-1). Storm water from this area drains into the Cooper River via four 18-inch diameter outfalls.

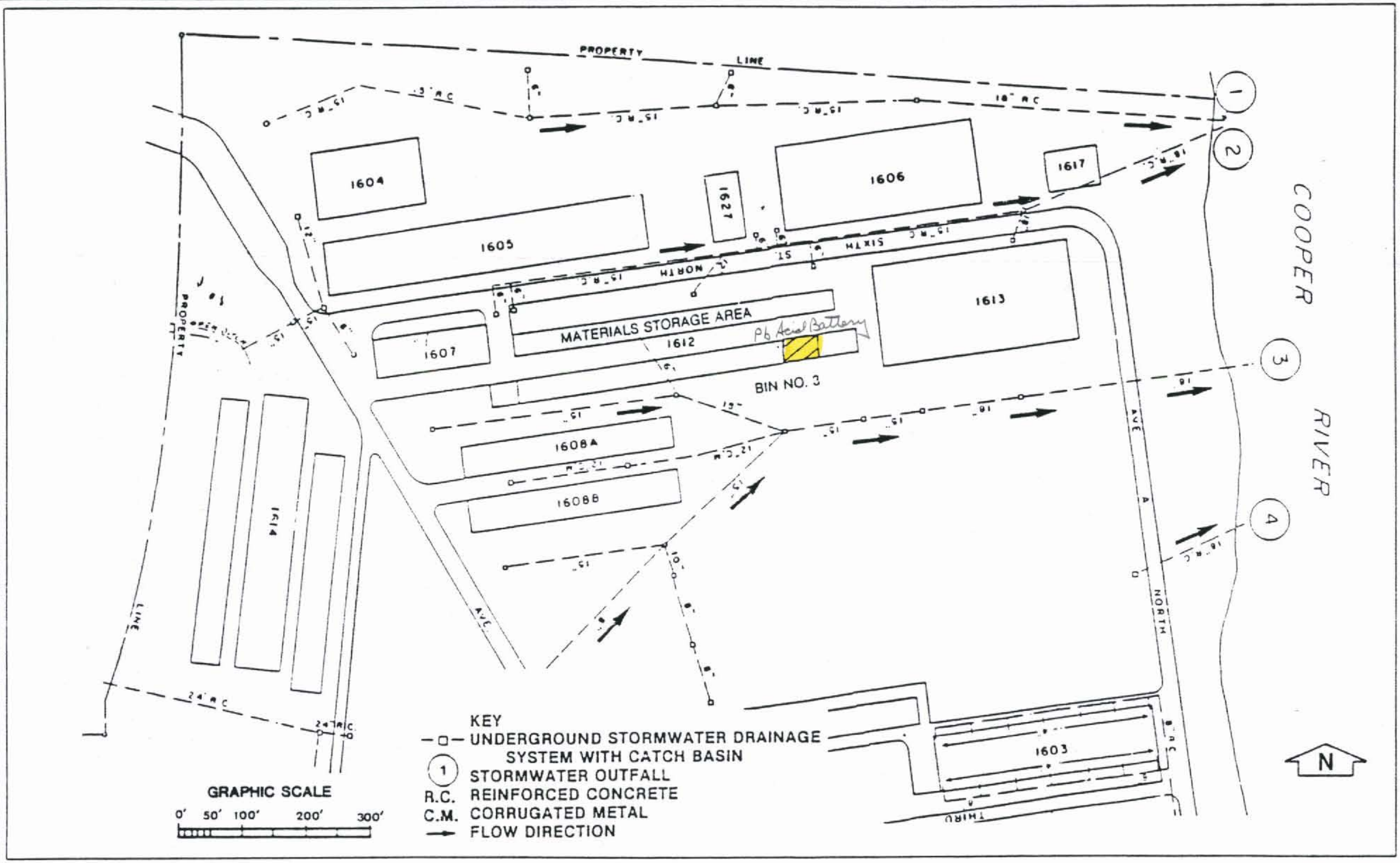


FIGURE 2.4-1

STORM DRAINAGE SYSTEM IN THE DRMO AREA

SOURCE: ESE, 1988

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

3.0 FIELD INVESTIGATION

3.1 FIELD PROCEDURES

3.1.1 Monitor Well Construction and Sampling Methodology

A total of four ground water monitor wells and two piezometers are proposed for this Characterization Study. The four proposed monitor wells will be approximately 15 feet deep the two piezometers will be installed to a depth of at least three feet below the existing water table and/or below the mean low seasonal water table. The locations of the proposed monitor wells and piezometers are shown in Figure 3.1-1.

The monitor wells and piezometers will be constructed utilizing the hollow stem auger method. Borehole cuttings will be drummed and set aside prior to completion of the analytical work. Each monitor well or piezometer will be constructed with 2-inch diameter, Schedule 40 PVC tri-loc or equivalent casing and 2-inch diameter, 0.018-slot size, Schedule 40 PVC tri-loc or equivalent, slotted screen. The casing and screen will have mill-threaded, flush joints. Glued or heat-welded joints will not be allowed. The annular space outside the well screen will be filled with a FX-99 or equivalent, gravel pack using a 98% pure SiO_2 to one foot above the well screen. A one-foot bentonite seal will be placed in the annulus above the sand pack. The remaining annular space will be grouted with a volclay bentonite grout or equivalent to the land surface. All gravel pack, seals and grout will be installed using a tremie pipe. Measurements to the top of the gravel pack and seals will be accurately made with a weighted steel tape. ESE will follow all state and local regulations concerning ground water monitoring well installation. Typical monitor well construction details are shown on Figure 3.1-2.

A 6-inch diameter, locking steel protective casing will be installed at land surface to prevent structural damage or unauthorized access to the monitor wells after the wells are developed. A concrete anti-percolation collar will be constructed to reinforce the protective casing and prevent downward vertical leakage of stormwater runoff. In high-traffic areas,

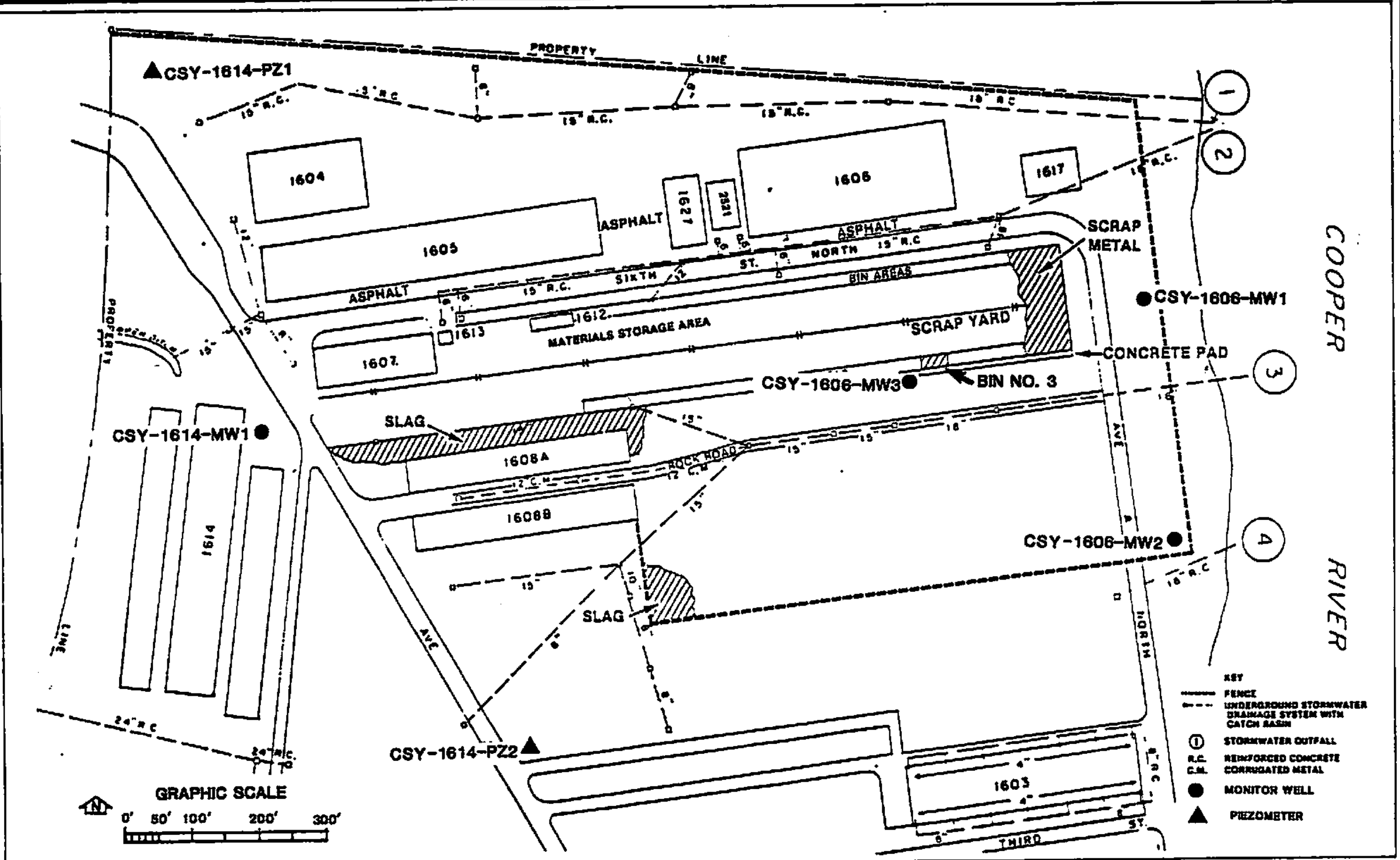


FIGURE 3.1-1

SITE MAP OF DRMO AREA. PROPOSED MONITOR WELL AND PIEZOMETER LOCATIONS

SOURCE: ESE, 1988

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

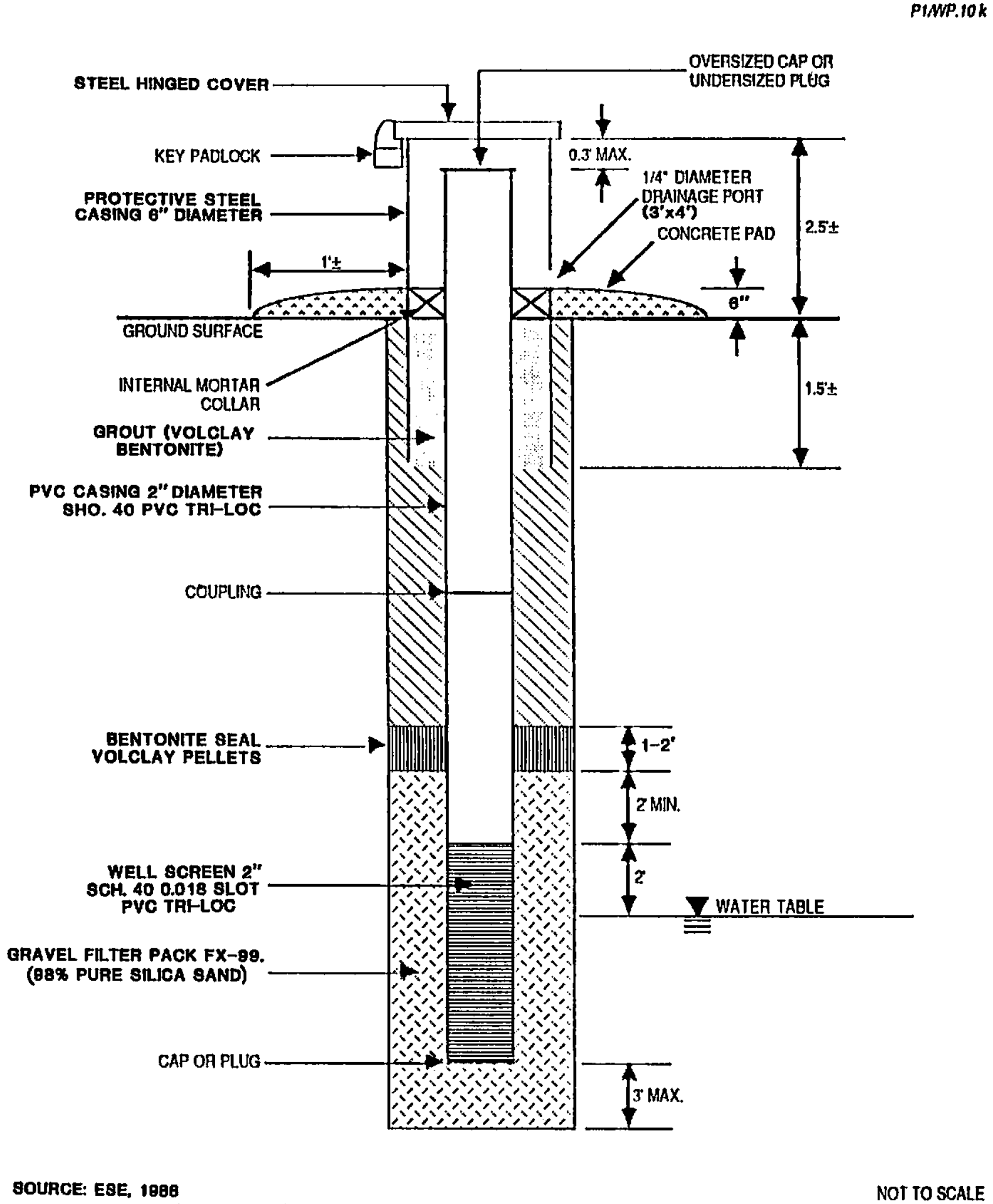


FIGURE 3.1-2

TYPICAL MONITOR WELL CONSTRUCTION

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

the monitor wells will be surrounded by a set of four, 4-inch diameter by 6' steel guard posts. The guard posts will be filled with concrete and painted orange to highlight visibility. A permanent sign will be attached to the well designating its location and number.

Portable tanks will be used to transport and hold drilling water. To eliminate the potential for cross-contamination, all drilling equipment and well construction materials will be steam cleaned using water from the drilling water source prior to drilling at each location. The drill rig will be placed on plastic sheeting to minimize hydraulic fluid or fuel spillage on the ground.

3.1.2 Well Drilling Logs and Documentation

Monitor well boreholes will be logged by a graduate geologist/hydrogeologist. Each well will be fully described on a well log as it is being drilled. The drilling log shall be composed and written in the field, without transcription from any other document, to include notebooks. Data to be included in the logs are as follows:

1. Depths, recorded in feet and fractions thereof (tenths of feet).
2. Soil descriptions, in accordance with the Unified Soil Classification System, prepared in the field by the ESE Site Geologists.
3. Depth to water, along with the method of determination, as first encountered during drilling. Any distinct water-bearing zones below the first zone also will be noted.
4. If drilling water is used, water losses, quantities lost, and the intervals over which they occur will be recorded.
5. The drilling equipment used will be described generally on each log, including such information as rod size, bit type, pump type, rig manufacturer, and model.
6. The drilling sequence will be recorded on each log.
7. All special problems will be recorded.
8. The dates for the start and completion of all borings will be recorded on the log.
9. Lithologic contacts will be noted on the boring log.

Well development will be performed after the grout is allowed to cure at least 24 hours after well installation. The following data will be recorded for development:

1. Well designation;
2. Date of well installation;
3. Date of development;
4. Static water level before and 24 consecutive hours after development;
5. Quantity of water lost during drilling and fluid purging, if water is used;
6. Quantity of standing water in well and annulus (30 percent porosity assumed for calculation) prior to development;
7. Specific conductivity, temperature, and pH measurements taken and recorded at the start, twice during, and at the conclusion of development. Calibration standards will be run prior to, during, and after each day's operation in the field;
8. Depth from top of well casing to bottom of well;
9. Screen length;
10. Depth from top of well casing to top of sediment inside well, before and after development;
11. Physical character of removed water, including changes during development in clarity, color, particulates, and odor;
12. Type and size/capacity of pump and/or bailer used;
13. Description of surge technique, if used;
14. Height of well casing above ground surface; and
15. Quantity of water removed and time of removal.

Development of wells will be accomplished with a centrifugal pump until the water is clear and the well sediment-free to the fullest extent practical. If well yields cannot sustain the flow rate of the pump, a bottom discharge bailer will be used. Water will not be added to the well to aid in development. The pump or bailer will be rinsed with the drilling water and allowed to air dry prior to use in the next well.

DI H_2O Need better field cleaning

Well development data recorded in the field will be tabulated. All development water will be drummed, labeled and stored on site prior to completion of the analytical work.

Development will proceed until the following conditions are met:

1. The well water is clear to the fullest extent possible to the unaided eye;
2. The sediment thickness remaining in the well is less than 5 percent of the screen length;
3. At least five well volumes (including the saturated filter material in the annulus) plus five times the volume of water lost during drilling have been removed from the well;
4. The temperature, specific conductivity, and pH of the well water have stabilized; and
5. The cap and all internal components of the well casing above the water table are rinsed with well water to remove all traces of soil/sediment/cuttings. This washing will be conducted before and/or during development.

The geologist/hydrogeologist will complete the Navy's Well Data Report. In addition, a manufacturer's list of well components will be included in the final report.

Ground water sampling will begin after the new monitor wells have been allowed to reach equilibrium. The following procedures will be followed on the day of sampling:

1. The depth to water will be measured from the top of casing.
2. The well depth will be sounded and recorded, and the depth of the water in the well will be calculated.
3. Samples will be taken after the fluid in the screen, well casing, and saturated annulus has been exchanged until pH, temperature and specific conductance stabilize over a 3 sample interval. No more than 10 volumes of water will be exchanged. In the event of low

well yields (e.g., in the presence of fine-grained sediments), some wells may have slow recovery rates. A decision to reduce the well purging to less than five volumes will be recommended by ESE, only if excessive time would be required to collect one or two samples from low-yielding wells. This decision will be subject to approval by the NAVFACENGCOM Engineer-In-Charge (EIC).

Water will be evacuated from the well until conductivity, pH, and temperature stabilize over a three sample interval. These data will become part of the project record. After the well is purged, the temperature, pH and specific conductance will be measured with properly calibrated instruments and recorded on a sampling log sheet.

Sampling will be accomplished by a bailer constructed of inert materials (PVC). No glue will be used in the construction of these bailers.

4. To protect the wells from contamination during sampling procedures, the following guidelines will be followed:

   a. A separate bailer will be supplied for each well. If the wells are resampled, new bailers will be supplied for each well to preclude contamination of the original bailer during storage. Separate disposable plastic gloves will be used each time a well is either purged or sampled;

   b. If a pump is used to purge the standing water from the well, the pump and the hoses will be thoroughly cleaned between samples, using the approved drilling water source. All sampling, however, will be performed utilizing the dedicated bailer;

   c. All sampling and well purging equipment will be protected from ground contact by placing the equipment on disposable polyethylene plastic sheeting to prevent soil contamination from tainting the ground water samples; and

d. Samples will be collected from background wells and wells suspected of being free from contamination before sampling wells which are suspected or known to contain contaminants.

5. Onsite measurements of water quality obtained during the ground water sampling episodes will consist of conductivity, temperature, and pH. These data will be presented in the final report. Measurements will be made using either a Hydrolab® 4000 or a pH meter and Yellow Springs Instruments (YSI®) Salinity, Conductivity, and Temperature (SCT) meter. The latter two instruments will be available onsite to serve as backup units for the Hydrolab® 4000. Calibration standards will be run and recorded prior to, during, and after each sampling day. Three saline [potassium chloride (KCl)] solutions of known conductivity (laboratory prepared) will be measured using the conductivity function and meter set at each calibration check. These standards will bracket the expected conductivity range (100 to 1,000 umhos/cm) of the ground water samples. If calibration indicates that the instrument is not responding correctly, use of a backup unit will begin. The pH calibration consists of testing two pH buffer standards (pH 4.0 and 7.0) and adjusting the Hydrolab® function to read specified pH units. Use of a backup pH meter will begin if the calibration procedure indicates improper meter response.

6. Inert threaded PVC well casings will be used in this program. Adsorption of certain compounds on the PVC surface may affect the apparent ground water concentration. To minimize adsorption of analytes by PVC each well will be purged and then sampled as soon as sufficient water returns. In this manner, the contact time between the water sample and the PVC will be kept to the shortest possible period.

During the sampling of each monitor well, information regarding the sampling will be kept in a notebook. The following data will be collected:

1. Well number;
2. Date;
3. Time;
4. Static water level;
5. Depth of well;
6. Number of bailer volumes removed, if applicable;
7. Pumping rate, if applicable;
8. Time of pumping, if applicable;
9. Water quality measurements of pH, specific conductance, and temperature;
10. Other pertinent observations of water samples (color, turbidity, odor, etc.);
11. Fractions sampled and preservatives;
12. Weather conditions and/or miscellaneous observations; and
13. Signature of sampler and date.

Table 3.1-1 lists the sample container type and cleaning procedures that will be utilized.

All disposable materials used during the field investigation will be placed in 55-gallon drums and sealed for disposal by NAVBASE personnel.

3.1.3 Surveying

All monitor wells and piezometers will be surveyed by a surveyor, licensed and registered in the State of South Carolina. Monitor well locations and elevations will be determined and identified on a base map. The measuring point (MP) elevation for each of the monitor wells will be surveyed and scribed onto the protective casing.

Table 3.1-1. Sample Container Matrices and Container Cleaning Procedure

Analysis/Parameter	Container Type	Matrix	Cleaning Procedure*
Lead - Should Additional heavy Metals (i.e Cd Cr Ni) be sampled?	1.0 Liter Polyethylene Cubitainer with Teflon® Lined Cap	Water	*

* Rinsed 2-3 mils .5% Ultrix Nitric Acid; drained; rinsed with laboratory distilled water; drained thoroughly.

Source: ESE, 1988.

3.1.4 Sample Quality Assurance/Quality Control

All samples will be collected in a careful manner. Laboratory grade nitric acid will be introduced to bring the sample to a pH of 2 or less immediately after collection. Each sample will be carefully labeled so that it can be identified by laboratory personnel. The sample label will include the project number, sample number, time and date, and sampler's initials. All samples will be identified with indelible ink on a standard preprinted and prenumbered label immediately after collection. Information concerning preservation methods, matrix, and sample location will be included on the label. Samples will be shipped in hard plastic, insulated ice chests and will be kept below 4°C from time of sample collection until analysis. Chain of custody will be maintained at all times. Data concerning the appropriate sample containers, volumes, and preservation techniques are presented in Section 5.0.

At the conclusion of each day in the field, the Site Manager will review each page of the field notebook for errors and omissions. He/she will then date and sign each reviewed page.

4.0 CHEMICAL ANALYSIS PROGRAM

4.1 INTRODUCTION

This section summarizes the chemical analysis program that will be utilized during the ground water investigation. A summary of the analytical requirements and environmental matrices for the site is presented in Table 4.1-1.

4.2 ANALYTICAL METHODS

The analytical methods and procedures that will be utilized during the investigation are given in Table 4.2-1. The following paragraphs briefly describe each method.

4.2.1 pH, Temperature, Specific Conductance

These parameters will be analyzed for in all ground water samples at the time of collection. Portable field units such as Hydrolab®, YSI®, and/or Beckman® instruments will be used following field calibration (EPA, 1983).

4.2.2 Lead

This method analyzes samples by inductively coupled plasma-atomic emission spectrometry (ICP-AES) [EPA Method 200.7] for the determination of total lead levels.

Table 4.1-1. Summary of Site Investigation for the DRMO Area, NAVBASE, Charleston

Sampling Location Monitor Well ID Number	Description	Environmental Matrix	Type of Chemical Analysis	
CSY-1614-MW1	Proposed Upgradient Monitor Well	Ground Water	A	B
CSY-1606-MW1	Proposed Downgradient Monitor Well	Ground Water	A	B
CSY-1606-MW2	Proposed Downgradient Monitor Well	Ground Water	A	B
CSY-1606-MW3	Proposed Downgradient Monitor Well	Ground Water	A	B

A = Field pH, temperature, specific conductance
B = Lead (EPA Method 200.7)

Table 4.2-1. Analytical Techniques, Method Numbers, and Procedural References

Parameter	Analytical Technique	Method Number	Method Reference
pH (Field)	Electrometric	150.1	EPA, 1983
Temperature (Field)	Thermometric	170.1	EPA, 1983
Specific Conductance (Field)	Electrometric	120.1	EPA, 1983
Lead	ICP-AES	200.7	EPA, 1984

Note: ICP-AES = Inductively coupled plasma-atomic emission spectrometry.

5.0 QUALITY ASSURANCE (QA)

5.1 INTRODUCTION

The laboratory will identify a Laboratory Quality Assurance Coordinator (LQAC), who will be responsible for overall QA/QC for the laboratory. The ESE LQAC for this project is Mr. J.D. Shamis (see Section 1.5).

The following paragraphs briefly summarize QA/QC procedures regarding organization, sample handling, analytical QC, and data management that are described in detail in the ESE QA/QC Manual (ESE, 1985). This manual, which has been reviewed and approved by Mitre Corporation, is incorporated herein by reference. Each member of the field team and all analysts will be supplied with a copy of this QA/QC Manual. The ESE QA/QC Manual will be employed to ensure the production of valid, properly formatted data defining the precision, accuracy, and sensitivity of each method used for NAVFACENGCOM sampling and analysis efforts.

5.2 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) ORGANIZATION

Within ESE's laboratory structure, QC activities are practiced and enforced by analysts, their immediate supervisors, laboratory coordinators, and division management. QC activities are the checks performed on a routine basis to assure and document the quality of generated data. QA is the responsibility of the Corporate QA Division and comprises those periodic audits and system/performance checks which ensure that appropriate QC is being practiced.

The ESE QA Division Manager reports to the ESE Chairman of the Board for overall supervision and the Executive Vice President for day-to-day management. The QA Manager is responsible for the effective operation of the QA program. The Officers-in-Charge (Vice President-Operations) are responsible to the QA Manager for assuring compliance with the requirements of the QA program within the divisions and regional offices for which they are administratively responsible. The QA staff consists of the QA Manager and several QA supervisors who perform laboratory QC auditing or serve as specific project QA supervisors (LQACs). The duties of LQACs include detailed and extensive QA auditing of project-specific sampling and analytical records and validation of analytical data according to project-specific precision, accuracy, and completeness criteria.

The Chemistry Division Manager directs the activities of several chemistry laboratory departments through Department Managers. Projects within the Chemistry Division are managed by Laboratory Coordinators who report to the Deputy Division Manager.

5.3 SAMPLE HANDLING PROCEDURES

5.3.1 Procedures Prior to Sample Collection

Prior to any field investigation involving the collection of laboratory samples, a Field Trip Plan Approval Form (Figure 5.3-1) and accompanying documents are filled out by the appropriate Field Team Leader. The following planning information is contained in the Field Trip Plan Approval Form:

1. Sampling schedules and projected sample arrival dates;
2. Samples, fractions, and quantities of each to be collected;
3. List of parameters to be measured in situ;
4. List of parameters required for analysis at each station, including method and/or detection limit requirements;
5. Laboratory and field contacts; and
6. Indication of a project specific QA plan.

Following approval of the Field Trip Plan Approval Packet by the Laboratory Coordinator, LQAC, and Project Manager, the necessary sampling containers, labels, and preservatives are prepared by the Laboratory Coordinator. This task requires analysis for lead in ground water samples.

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

Project No.__________

FIELD TRIP PLAN APPROVAL FORM

Project Name:__________

Field Trip Site:__________

Field Trip Responsibility(Subproj.or Proj.Mngr.)__________

Field Team Leader:__________

Laboratory Coordinator:__________

Field Team Members:

__________ __________

__________ __________

__________ __________

__________ __________

SCHEDULING INFORMATION:

Field Trip Briefing Mtg__________(Date)__________(Time)

Departure ESE__________(Date)__________(Time)

Site Arrival__________(Date)__________(Time)

Site Departure__________(Date)__________(Time)

Arrive ESE__________(Date)__________(Time)

PLANNING INFORMATION:

The following information must be attached (check to indicate):

__________Sampling and Shipping Schedule; Lab/Field Contacts Established

__________Sampling Location Layout

__________Samples to be Collected and Fraction

__________List of all Parameters to be Measured On-Site

__________List of Field Equipment Requested

APPROVALS:

Laboratory Coordinator (Date) Proj.or Subproj. Manager (Date)

Field Team Leader (Date) QA Manager (Date)

REMARKS:__________

cc:Project Director / Project Manager

Signature __________ Date __________

SOURCE: ESE, 1988

FIGURE 5.3-1

FIELD TRIP APPROVAL FORM

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

Each sample is identified by affixing the pressure-sensitive gummed label produced by the Chemical Laboratory Analysis and Scheduling System (CLASS) prefield set up (PFS) program. Each label has a unique combination of field group name and sequence number, a standardized sample preservation code (e.g., C for chilled, N for nitric acid), and station identification (ID). Each label also has spaces for the field team to write in the date and time of sample collection, sampler's initials, and a new station ID if different than the original station ID. New station ID may be necessary due to changes in field and/or sampling conditions which require substitution of sampling stations. All changes in station ID are clearly noted in permanent ink on the sample label and logsheet and must be approved by the Field Team Leader.

5.3.2 Procedures During Sample Collection

The Field Team Leader will be responsible for proper sampling, preservation, hazardous sample notations, and shipment of samples to the laboratory in a proper manner to meet required holding time.

Sample preservation for ground water samples consists of adding nitric acid to the samples to reduce the pH to less than 2.0 and cooling the samples to 4 degrees Celsius (°C).

At the conclusion of each field day, the Field Team Leader will review each page of the notebook for errors and omissions. The Field Team Leader will complete the logsheet for the samples collected that day and designate which fractions and samples are being sent to the laboratory (see Figure 5.3-2). The time and date of collection must be entered on the logsheet. Then the samples will be checked for conformance with specifications and shipped back to the laboratory. A copy of the logsheet will be included in each package shipped. Observations concerning sample conditions and other comments will be written on the logsheet. The Field Team Leader will alert the Laboratory Coordinator to pertinent shipping information at the end of each sampling day.

ENVIRONMENTAL SCIENCE & ENGINEERING 08-20-85 *** FIELD LOGSHEET *** FIELD GROUP: TEST

PROJECT NUMBER 84-936-900 PROJECT NAME: USA DATA MANAGEMENT LAB COORD. TOM GILLESPIE

ESE #	SITE/STA	HAZ?	FRACTIONS(CIRCLE)	DATE	TIME	PARAMETER LIST	DUE DATE	NOTES
1	WELL-A133	N	C CF N			TEST	09/19/85	
2	CREEK-S11	N	C CF N			TEST	09/19/85	
3	SWAN LAKE	N	C CF N			TEST	09/20/85	
4	BLANK-04		C CF N			TOM	09/20/85	

NOTE -CHANGE OR ENTER SITE ID AS NECESSARY: UP TO 6 ALPHANUMERIC CHARACTERS MAY BE USED
-CIRCLE FRACTIONS COLLECTED. ENTER DATE,TIME,FIELD DATA (IF REQUIRED). HAZARD CODE AND NOTES
-HAZARD CODES: I=IGNITABLE C=CORROSIVE R=REACTIVE T=TOXIC WASTE H=OTHER ACUTE HAZARD; IDENTIFY SPECIFICS IF KNOWN
-PLEASE RETURN LOGSHEETS WITH SAMPLES TO ESE

RELINQUISHED BY: (NAME/ORGANIZATION/DATE/TIME)	RECEIVED BY (NAME/ORGANIZATION/DATE/TIME)
1	
2	
3	

OTHER FIELD NOTES:

SOURCE: ESE, 1988

FIGURE 5.3-2

SAMPLE CHAIN-OF-CUSTODY LOGSHEET

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

5.3.3 Procedures for Sample Arrival at Laboratory

Upon arrival in the laboratory, samples will be checked in by the Laboratory Coordinator or his designate. All samples contained in the shipment will be compared to the logsheet(s) to ensure that all samples designated on the logsheet have been received. Any changes in station ID from the originally established station ID will be noted. The Laboratory Coordinator will note any special remarks concerning the shipment and indicate an analysis due date and any appropriate analytical subset lists for specific samples before delivering the logsheet to the Sample Control Center.

The information from the logsheet will be entered into the computer by the Laboratory Data Assistant; this activates the parameter list for the samples collected and received by the laboratory and is called a Post Field Entry (PFE). ESE's computerized CLASS is an integral part of the sample custody procedure for all sample analyses performed at the analytical laboratory.

The Laboratory Coordinator will notify the affected Department Managers of the samples' arrival and of those samples that have short holding time parameters. The Laboratory Coordinator also will work with the LQAC to distribute Project QA Plans to these Department Managers.

The samples will be audited for correct preservation by the Laboratory Coordinator. The Sample Control Coldroom Technician will assign a storage location in a secure storage area. Samples requiring refrigeration will be stored in a walk-in coldroom, and access will be limited to Chemistry personnel. Those samples not requiring refrigeration will be stored in a secure area. A sample check-in/check-out sheet will be maintained, and the laboratory analysts will sign and date it with a list of all sample fractions being checked out or returned.

5.4 ANALYTICAL QUALITY CONTROL

Analytical QC procedures are those steps taken by the laboratory in day-to-day activities to achieve the desired accuracy, precision, reliability, and comparability of analytical data. Each analytical Department Manager and analyst is responsible for performing the analysis in accordance with the defined QC practices outlined in the ESE QA/QC Manual (ESE, 1985).

For QC purposes, the number of water samples which are extracted for instrumental analysis as one group in one 24-hour period during several days in a 1-week period will constitute one lot. The number and type of QC samples specified in the following paragraphs will apply to this batch/lot of samples. For example, a group of samples which are extracted on the same day and (if required) undergo concentration and cleanup procedures on subsequent days would be considered one batch for QC purposes. Also a set of samples which are extracted over several days in a 1-week period may be considered one batch as long as the minimum number of QC samples specified in the following subsections are also extracted. In this case, QC samples will be spread over the several days.

Control spikes will be spiked into a "standard" matrix. For soil samples, an uncontaminated or known concentration soil matrix will be used as the standard matrix. In order to provide a matrix with similar soil properties, the soil sample will be obtained from an uncontaminated area of NAVBASE Charleston.

Spiking procedure and determination of replicates will be according to the Mitre-approved ESE QC/QC plan.

5.5 DATA REDUCTION, VALIDATION, AND REPORTING

5.5.1 Data Reduction and Reporting

Data transfer and reduction are essential functions in summarizing information to support conclusions. It is essential that these processes are performed accurately and, in the case of data reduction, accepted statistical techniques are used. ESE's Chemical Laboratory Analysis Scheduling System (CLASS) will be used for this project.

At a minimum, example calculations must be concluded with the summarized data to facilitate review. The entry of input data and calculations should be checked and the signature/initials of the Data Technician and Reviewer(s) accompany all data transfers with and without reduction.

The data flow scheme for CLASS is presented in Figure 5.5-1. An example data output form is shown in Figure 5.5-2. Reporting will include standard curves, QC data, and sample data.

For routine analyses performed at the ESE laboratory, sample response data information will be sent to the Laboratory Data Assistant for computer entry. The Laboratory Data Assistant will enter the information from the batch form into the computer which will calculate:

1. Quadratic regression line for standards,
2. Coefficients of variation for replicates,
3. Spiked recoveries,
4. Reference sample concentrations, and
5. Sample concentrations.

QC acceptance criteria for the relative percent difference of replicate spike recoveries and for the range of acceptable recoveries will be stored in the computer data management files for each STORET number/method code combination. If the samples in a sample lot do not pass all the QC checks, then the results reported in all samples processed in the same sample set should be considered as suspect and the analyses may need to be repeated.

Field Trip Preparation	--define parameters for analysis --assign temporary station codes --define sample fractions --produce labels and logsheets
Sample Login	--activate samples --set permanent station codes --store collection time and date --store field data
Schedule Analyses	--list of samples available for each parameter sorted by due date
Input Results	--reserve analysis --input calibration, quality control and sample data
Quality Control	--calculate calibration curve, spike, replicate and reference sample quality control
Calculate Results	--calculate and store final sample concentrations
Intersample QC	--check for data inconsistencies --perform interparameter calculations
Reports	--produce reports of sample data, quality control, and statistical analyses

SOURCE: ESE, 1988

FIGURE 5.5-1
FLOWCHART OF THE CLASS PROGRAM

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

REVISION 6.1 CLASS February 1,1983

ENVIRONMENTAL SCIENCE AND ENGINEERING 99999445 DATE : 02/01/83

PROJECT: EXAMPLE REPORT PRINTOUT FIELD LEADER: TOM GILLESPIE

FIELD GROUP: EXAM1 PARAMETERS: ALL SAMPLES: ALL STATUS: APPROVED

		SAMPLE NUMBERS	
		WELL-1	WELL-2
PARAMETERS	STORET #	212700	212702
DATE		11/12/82	11/15/82
TIME		1810	1450
WATER TEMP (C)	10	20.0	
PH	400	6.50	6.50
LAB PH(SU)	403	7.89	7.89
SP.CONDUCT.,FIELD (UMHOS/CM)	94	370	520
SP. COND. (UMHOS/CM)	95	400	650
TURBIDITY (NTU)	76	15.0	10.0
COLOR,TRUE(CLARIFIED)	80	80	80
ODOR	85	0.4	1
DISS. SOLIDS (MG/L)	70300	274	313
TOTAL SOLIDS (MG/L)	500	352	344
HARDNESS,CALC (MG/L AS CACO3)	99710	282	281
ALKALINITY (MG/L AS CACO3)	410	261	257
ALKALINITY,BICARB.(MG/L-CACO3)	425	261	257
ALKALINITY, CARB.(MG/L-CACO3)	430	<5	<5

SOURCE: ESE, 1988

FIGURE 5.5-2

FINAL RESULTS OUTPUT FROM THE DATA PROGRAM

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

Completed batch forms will be stored in files arranged numerically by batch number. Strip charts, copies of parameter notebooks, and QC charts will be stored for each parameter.

When the data set is complete for each sampling effort, the computer can be used to organize the information in the field group in a variety of formats. The final reports will be reviewed by the Laboratory Coordinator and the Project QA Supervisor.

During analysis, the analyst will indicate on the strip chart sample numbers, QC samples, blanks, and standards. After the data has been reduced and recorded in the analyst's notebook, the strip charts are filed in a central location by element.

The above information is entered for each sample analyzed into the ICAP computer. The raw data batches generated by ICAP computer will be evaluated, transmitted to PRIME, and filed in chronological order by date of analysis in the central filing location.

Laboratory Notebooks--Each analyst will maintain their own laboratory notebook. After each analysis, the analyst will record in the notebook the following information:

1. Problems encountered during the digestion/analysis,
2. Comments about the samples and/or analytical procedure,
3. Date of analysis,
4. Analyst(s),
5. Element,
6. Sample matrix,
7. Instrument conditions,
8. Sample numbers,
9. Quality Control data,
10. Raw data, and
11. Blank subtracted responses.

Standards--Stock standard solutions are purchased from vendors. These stock solutions are certified by the vendor for purity and concentration.

Volumetric dilutions are made from the stock solution in order to obtain working solutions. Serial dilutions are then made from the working solutions to obtain working standards to be used to generate standard curves. Working standard solution are stored in a volumetric flasks and properly labeled with the following information:

1. Preparer's name or initials,
2. Date of preparation,
3. Element(s), and
4. Concentration.

When necessary, outliers in the field laboratory and main laboratory generated data will be determined using the Dixon Criteria as described in the EPA-QAMS-005 document and in "Processing Data for Outliers," by W.J. Dixon, Biometrics, Vol. 9, No. 1, 1953.

5.5.2 Data Validation

The Project QA Supervisor will validate a portion of all preliminary data by field group. Tasks included in the validation review are listed in a data validation checklist (Figure 5.5-3). Preliminary data may be circulated and reviewed in-house, but all data reported to the client by the Project Manager must first be validated by the QA Supervisor.

Field Group ______________ Auditor ______________
Project ______________ Date ______________

QC Criteria	Batch Numbers			
1. Were holding times met for each sample?				
2. Were samples analyzed using the methods specified in the QA plan?				
3. Was a blank run for each batch and properly subtracted from sample?				
4. Were the required number of standards and spiked samples analyzed with each batch?				
5. Was the correlation coefficient of the calibration curve $\geq$0.995?				
6. Were spike recoveries within the acceptance criteria stated in the QA Plan?				
7. Randomly select one value/batch and trace back through the calculations to the raw data. Do the numbers agree?				

*If criteria were met, mark a √ under the batch number; if they were not met, mark "NO" and attach a separate sheet for explanations.

SOURCE: ESE, 1988

FIGURE 5.5-3

DATA VALIDATION CHECKLIST

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

6.0 CONTAMINATION ASSESSMENT

The objective of the contamination assessment is to identify the potential risk of adverse effects to human health or to the environment due to lead contamination potentially migrating from the site in the ground water of the surficial aquifer. The assessment will include the following analyses:

1. Hazard Identification--Identify the existence and concentration of lead in the surficial aquifer at the site. These concentrations will then be compared to applicable EPA and DHEC criteria for lead. The existing regulatory water quality criteria for lead will be the basis for determining the significance of ground water contamination. Based on 1 Sampling Rd !
2. Contamination Assessment--Evaluate the contaminant data from the field investigation to determine concentrations and distributions (where possible). 3 wells in Suspected Plume Area!
3. Contaminant Migration--Evaluate the potential for contaminant migration based on hydrogeologic data (water levels, gradients, etc.) obtained during the investigation. Again 3 wells

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DRAFT SAFETY PLAN
FOR THE RCRA FACILITIES INVESTIGATION
OF GROUND WATER CONTAMINATION AT THE
DRMO "NORTH YARD SITE"
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

Prepared for:

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION
Charleston, South Carolina

Prepared by:

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Tampa, Florida

April 1988

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LIST OF ACRONYMS

C.I.H.	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
DRMO	Defense Reutilization and Marketing Office
EPA	Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
MSHA	Mine Safety and Health Administration
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration

1.0 SAFETY PROGRAM

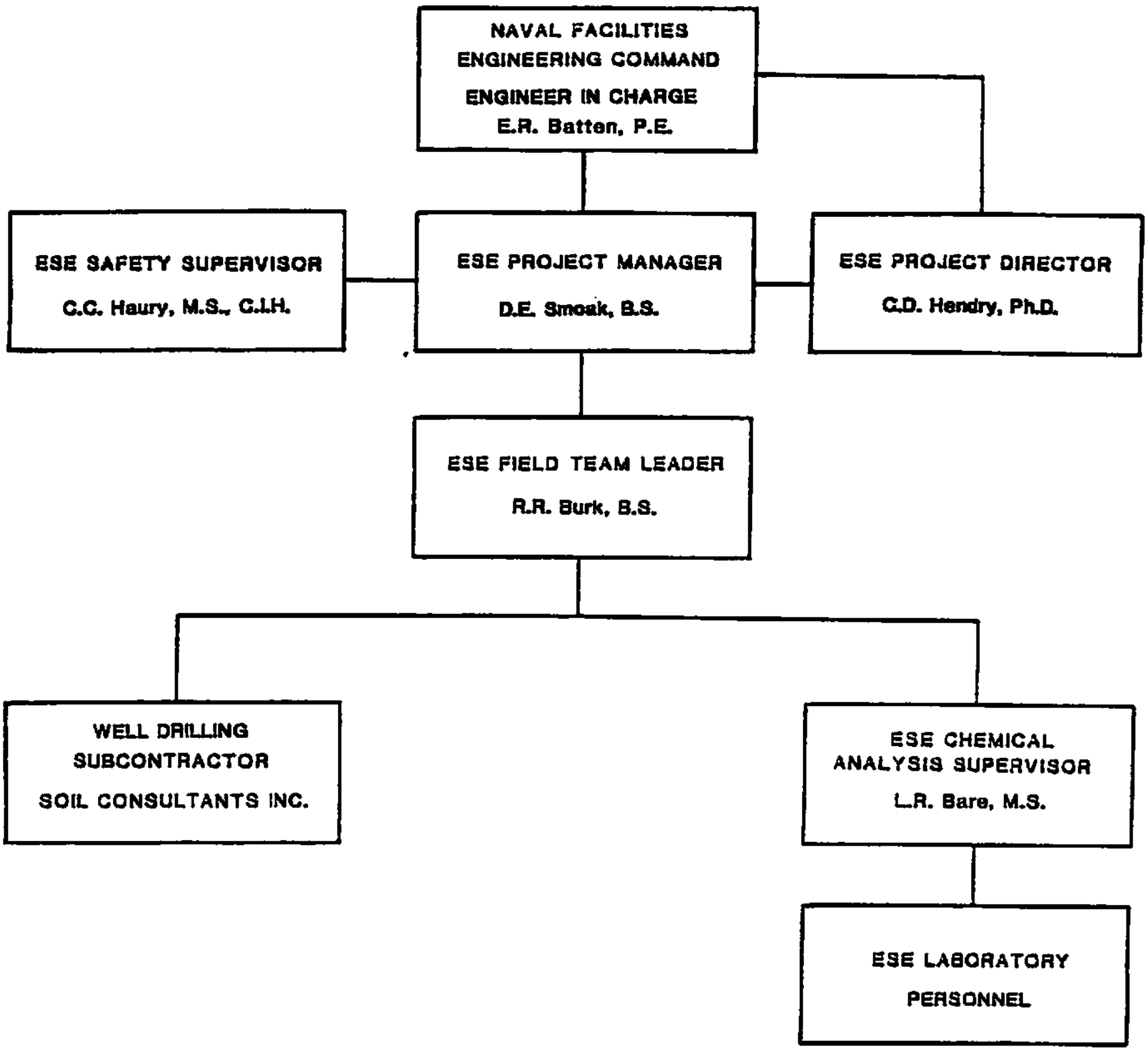
1.1 PURPOSE AND REFERENCES

The purpose of the safety program described in this plan is to describe the safety, accident, and fire protection standards and requirements, and to outline standard operating procedures to ensure the safety of all ESE personnel performing activities associated with the ground water investigation at the Defense Reutilization and Marketing Office (DRMO) "North Yard Site". It further provides for protection of U.S. Naval personnel, the general public, and the environment. This is done by indoctrination of all personnel in the requirements of the safety plan by ensuring that all personnel are adequately trained; provision of adequate safety equipment and medical surveillance for personnel exposed to potentially toxic chemicals; provision for safe, legal sample transport and handling; provision for the safe conduct of field inspections and sampling operations; and provision, as necessary, of exclusion areas and decontamination activities to prevent contamination migration impact to onsite personnel, the general public, or the environment. The program also provides emergency contingency plans for protection of ESE personnel and for any contingencies which might also affect Naval personnel. Responsibilities and authorities are designated, as well as reporting procedures.

The safety program complies with requirements of Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), state and local agencies, for all activities to be conducted. The program also complies with NAVBASE Charleston regulations relative to occupational safety and health, applicable NAVBASE Charleston security, safety, and fire prevention measures and the ESE Analytical Laboratory Safety Plan. The Field Team Leader will obtain NAVBASE Charleston Safety and Security Plans and indoctrinate field personnel.

1.2 SAFETY ORGANIZATION, ADMINISTRATION, AND RESPONSIBILITIES

Figure 1.2-1 is a diagram of the overall project safety organization. The Safety Supervisor has primary responsibility for: (1) briefing all field and laboratory personnel, (2) training the Project Manager and



SOURCE: ESE, 1988

FIGURE 1.2-1
SAFETY ORGANIZATION DETAIL-LINES OF AUTHORITY AND COMMUNICATION

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

Field Team Leader in conducting onsite safety supervision and coordination with NAVBASE Charleston personnel, (3) monitoring the ESE laboratory safety procedures, and (4) defining and monitoring sample handling and shipping requirements. The ESE Safety Supervisor (C.C. Haury) has designated the Field Team Leader (R.R. Burks) as the Site Safety Supervisor. Safe performance of the contamination assessment is the responsibility of all involved personnel.

Overall responsibility for safety during the site activities rests with the Field Team Leader (R.R. Burks) who is the designated Site Safety Supervisor. His responsibilities include:

1. Coordinating preparation of an effective, approved site and laboratory safety plan for the project;
2. Characterizing the potential specific chemical and physical hazards to be encountered in the conduct of the contamination assessment in conjunction with the Safety Supervisor;
3. Categorizing the project staff as to the levels of potential exposure to any dangerous levels of hazardous materials;
4. Assuring that adequate and appropriate safety training and equipment are available for project personnel;
5. Arranging for medical examinations for specified project personnel, if necessary; and
6. Determining and posting locations and routes to medical facilities and arranging emergency transportation to medical facilities (as required);
7. Notifying (as required) local public emergency officers (i.e., police and fire department) of the nature of the team's operations, and making emergency telephone numbers available to all team members;
8. Assuring that (a) at least one member of the field team is available to stay behind and notify Emergency Services if the Site Safety Supervisor must enter an area of maximum hazard, or (b) entering this area after he (Site Safety Supervisor) has notified Emergency Services (police department);

9. Observing work party members for symptoms of exposure or stress;
10. Arranging for the availability of onsite emergency medical care and first aid, as necessary; and
11. Designating a Site Safety Supervisor when the Field Team Leader has to leave the site.

The responsibilities of the Safety Supervisor (C.C. Haury, M.S. C.I.H.) include:

1. Indoctrinating the Project Manager and Field Team Leader in safety procedures so that they can assume on site safety responsibilities as the Safety Supervisor designates.
2. Approving all safety procedures and operations onsite;
3. Updating equipment or procedures based upon new information gathered during the site inspection; and
4. Upgrading or downgrading the levels of personnel protection based upon site characteristics (downgrading requires the approval of the Field Team Leader);

The Safety Supervisor's responsibilities will be delegated to the Field Team Leader (R.R. Burks) as Site Safety Supervisor after proper indoctrination by the Safety Supervisor. The Site Safety Supervisor or his designate has the ultimate responsibility to stop any operation that threatens the health or safety of the team or surrounding populace or causes significant adverse impact to the environment. The Field Team Leader has attended the U.S. Environmental Protection Agency (EPA)-accredited hazardous waste safety course and will assume the responsibility of Site Safety Supervisor during site operations.

The responsibilities of all personnel onsite include:

1. Complying with all aspects of the project safety plan, including strict adherence to the "buddy system";
2. Obeying the orders of the Site Safety Supervisor or his designate; and

3. Notifying the Site Safety Supervisor or his designate of hazardous or potentially hazardous incidents or working situations.

1.3 SITE HAZARD CHARACTERIZATION/ANALYSIS

Based on available environmental data for NAVBASE Charleston the potential hazards that may impact the health and safety of personnel conducting the environmental survey are described in the following sections.

1.3.1 Physical Hazards

The site is located within the DRMO materials storage yard. Potential physical hazards in the area include accidents resulting from using motorized vehicles to move materials and stepping on nails, broken glass, pieces of concrete, stone, etc., which might cause either a fall, cut, or puncture wound if personnel are not careful where and how they walk. In addition, there are numerous open storage bins in the area containing jagged or pointed pieces of scrap metal. Therefore, due care must be exercised when walking or working in this area to avoid possible injury.

1.3.2 Biological Hazards

Care must be taken to avoid stinging insects (wasps, spiders, scorpions, etc.) that may inhabit the materials storage areas. Due to activity in the area, no poisonous snakes are expected to be encountered, and no poisonous plants (e.g., poison ivy) are present.

1.3.3 Chemical Hazards

The well installation will be performed in an area suspected of being contaminated with lead. Lead levels of up to 330,000 µg/g (33 percent) have been measured in soils in the area. Potential exposure exists via inhalation of suspended particulate materials (i.e., soils, dust) containing lead or by smoking, eating, or drinking on the site. Symptoms of lead exposure include:

a. Anemia--elevated urinary metabolites of lead;
b. Colic--abdominal spasms, cramping; and

c. Palsy--loss of muscular control in wrists or ankles.

Lead exposure to sampling personnel and personnel working in the DRMO area will be minimized by the safety procedures described in Section 1.5.

Exposure of sampling personnel and personnel working in the DRMO area to contaminants will be minimized by the safety procedures described in Section 1.5, below.

1.4 SAFETY TRAINING

August, 1982, the Field Team Leader was certified by the American Red Cross as an instructor in cardiopulmonary resuscitation (CPR) and first aid. In addition, he received hazardous waste site investigation training in ESE's Hazardous Waste Training Program in December, 1987. The Safety Supervisor is a Certified Industrial Hygienist (C.I.H.) and has been certified in an EPA-approved training course in hazardous site investigation and management. See Table 1.4-1 for a list of those trained.

All ESE field personnel will be under the direct supervision of the Project Manager and Field Team Leader. The Project Manager will supervise the well installation. The Field Team Leader will supervise all sample collection activities. The Field Team Leader will indoctrinate field personnel in the safety operating procedures described in the next section and will instruct personnel in the use of safety equipment and protective gear prior to the commencement of field operations. The Project Manager will directly supervise safety operations during the well installation activities. The Project Manager will make contact with the NAVBASE Charleston personnel at the commencement and close of any potentially hazardous activity. Each team member will be instructed in relevant emergency procedures and will be provided emergency contact numbers.

Table 1.4-1 Safety Training

Name	Date Certified	Certification	Hours Trained
R.R. Burks	08/82	American Red Cross-CPR	24 hours
	08/82	American Red Cross-First Aid	24 hours
	12/87	ESE's Hazardous Materials Site Investigation	40 hours
C.H. Haury	04/87	ESE's Hazardous Material Site Investigation	40 hours

1.5 SAFETY OPERATING PROCEDURES

This section describes the safety operating procedures that will be employed during the course of the project, including personal protection equipment and safety procedures during sampling.

1.5.1 Categorization of Personnel

The Project Manager has categorized all project personnel with respect to the potential level of exposure and hazard that may be encountered in site activities at NAVBASE Charleston. The personnel categories are described in Table 1.5-1. The Project Manager will ensure that project personnel are informed of their category description, have been given appropriate training and instructions in use of personal protective equipment, and have received a copy of the Project Safety Plan.

In general, modified Level C protection will be worn for Category I personnel. Level D protection will be worn for Category II personnel.

1.5.2 Personnel Protection

Personal protective equipment (modified Level C) used for Category I personnel during well installation and ground water sampling, will include:

1. Saranex or Tyvek coveralls,
2. Steel-toe rubber or leather boots,
3. Disposable rubber boot covers,
4. Disposable inner-gloves,
5. Disposable outer-gloves (butyl rubber),
6. Hard hats (monitor well construction), and
7. Scott® full face air purifying respirators with Mine Safety and Health Administration (MSHA) and National Institute of Occupational Safety and Health (NIOSH) approved high efficiency cartridges on hand and ready for immediate use at the discretion of the Site Safety Officer.

Table 1.5-1. Categorization of Staff for Hazardous Projects

Category I	Modified Level C Protection
Any person (field or laboratory) involved in well installation, well development, or direct sampling, handling, and analysis of hazardous materials whose potential for exposure to dangerous levels of hazardous materials is high. Modified Level C protection is required.	1. Saranex or tyvek coveralls, 2. Steel-toe rubber or leather boots, 3. Disposable rubber boot covers, 4. Disposable inner-gloves, 5. Disposable outer-gloves (butyl rubber), 6. Hard hats (well installation), and 7. Full Face Scott® respirator equipped with Scott® high efficiency combination cartridge-filter pack will be worn at the discretion of the Site Safety Officer.
Category II	**Modified Level D Protection**
Any member of field or laboratory team not directly involved in well installation, well development, or sampling, handling, or analysis of hazardous materials whose potential for exposure to dangerous levels of hazardous materials is low. Level D protection is required.	1. Clothing suitable for ambient weather and terrain, 2. Sturdy leather or rubber boots (not street or jogging shoes), and 3. Hard hats (during well installation).

Source: ESE, 1988

For well installation, well development, and sampling, full-face air purifying respirators with high-efficiency MSHA and NIOSH approved particulate and organic vapor cartridges will be readily available and will be worn, when appropriate, based on onsite conditions (i.e., when either due to dry conditions and/or other environmental factors fugitive dust is likely to become airborne).

Category II personnel are involved in activities such as site reconnaissance, staking of sampling locations and transport of equipment and materials to individual sites. Level D protection is required for these types of activities. The use of sturdy leather or rubber boots is required (not street or jogging shoes) accompanied by boot covers. Clothing that is suitable for the ambient weather and terrain will be worn. Full face respirator conditions (as described above) apply to Category II personnel working directly at or adjacent to site during well installation.

1.5.3 Safety Procedures During Well Installation and Ground Water Sampling Activities

1. Air purifying respirators will be worn during monitor well installation and sampling activities if environmental conditions (i.e., dryness, wind, etc.) indicate a necessity.
2. To prevent dust from settling on clothes, boots and gloves will be taped to coveralls.
3. Full personnel decontamination will be conducted upon completion of sample collection. Decontamination will include systematic removal and disposal of protective clothing in plastic bags within the contaminated zone that has been staked off with fluorescent flags. Showering will occur at each individuals place of residence upon completion of work at NAVBASE Charleston to prevent inhalation/ingestion of dust/dirt containing contaminants. Special attention should be given to areas where fugitive dust may settle unnoticed (i.e., ears, hair, etc.).
4. No smoking, eating, or drinking will be allowed until decontamination is completed.

5. No smoking, welding, or activities involving open flames or sparks will be allowed at sampling sites.

1.5.4 Traffic

All field personnel will adhere to South Carolina/NAVBASE Charleston traffic regulations and exercise due caution.

1.5.5 Laboratory Safety Procedures

The ESE (1984) Laboratory Analytical Safety Program Manual will be followed for the ESE laboratory. The Safety Supervisor will audit analytical activities connected with the samples. All ESE Laboratory Analytical Safety Program requirements and procedures are incorporated by reference into this Safety Plan.

1.5.6 Medical Monitoring

All ESE personnel involved with contamination assessment projects undergo medical monitoring on an annual basis. Records are on file with the ESE Dept. of Human Resources at Gainesville, Florida

1.6 CONTINGENCY PLANS

1.6.1 Emergency Numbers/Services

Location of and access to a phone in case of emergency will be provided prior to mobilization and a map of the NAVBASE Charleston area will be issued to all site personnel.

Figure 1.6-1 shows the locations of fire, police, hospital and spill control facilities in relation to the DRMO site. The nearest telephone is located in Bldg. 1605 near the entrance to the site.

Also included are the emergency phone numbers for Charleston County, South Carolina, which is located just outside NAVBASE Charleston. These numbers should only be considered as a second choice.

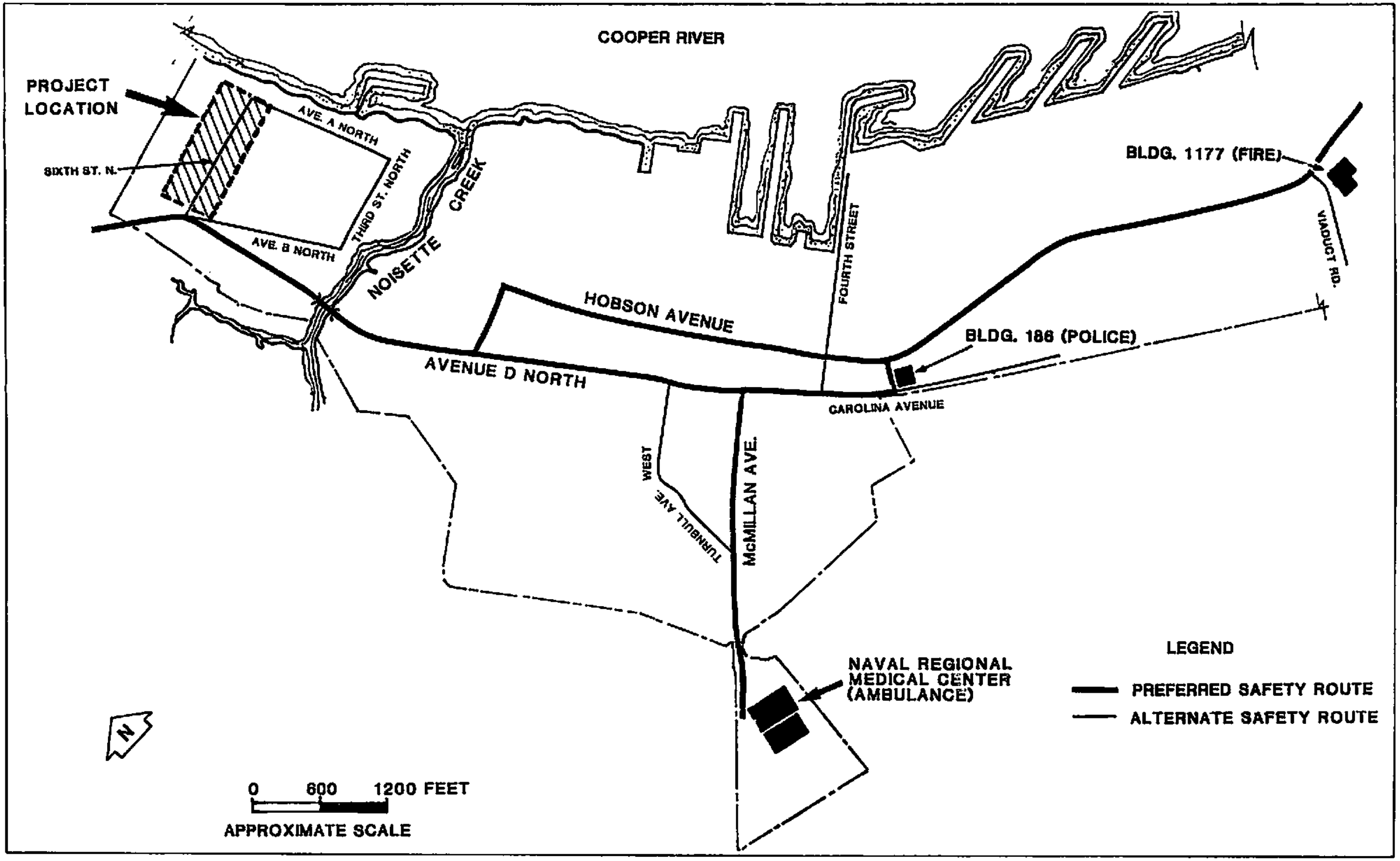


FIGURE 1.6-1

SAFETY ROUTES

SOURCE: ESE, 1988

GROUND WATER CHARACTERIZATION STUDY FOR DRMO AREA NAVBASE, CHARLESTON, S.C.

Emergency Numbers are as Follows:

NAVBASE, Charleston, South Carolina

Fire	(74) 3-5333
Police	(74) 3-5555*
Ambulance	(74) 3-5444

* Note: When on base, only the digit 3 is dialed followed by the four digits listed.

Charleston County, South Carolina

Fire	911
Police	911
Ambulance	911

1.6.2 Accident/Incident Reporting

The Accident/Incident Report is used to advise the Government of accidents/incidents that may affect work to be provided by this contract. The report requires immediate (within 1 hour) notification by telephone to the NAVBASE Charleston Safety Officer and Engineering Director by the Project Manager and follow-up written notification (within 24 hours) for the following incidents: fatalities, lost-time injuries, spill or exposure to hazardous materials, theft of hazardous material, fire, explosion, property damage in excess of $300, or loss of 1 day's scheduled activity.

The following format shall be used to transmit the report:

1. Name, organization, telephone number, and location of the contractor;
2. Name and title of the person(s) reporting;
3. Date and time of the accident/incident;
4. Location of the accident/incident (i.e., building number, facility name);

5. Brief summary of the accident/incident, giving pertinent details including type of operation ongoing at the time of the accident;
6. Cause of the accident/incident, if known;
7. Casualties (fatalities, disabling injuries);
8. Details of any existing chemical hazard or contamination;
9. Estimated property damage, if applicable;
10. Nature of the damage, effect on the contract schedule;
11. Action taken by the contractor to ensure safety and security;
12. Other damage or injuries sustained (public or private); and
13. Approval of the Contracting Officer prior to release of information.

1.6.3 Fire Control

Flammable chemicals in large quantities should not be encountered at this site. No smoking will be allowed in the sampling areas; however, fire extinguishers (#10 ABC), buckets, and shovels will be available. All fires will be reported immediately to the Fire Department

1.6.4 Spill Control

The chances of a chemical spill are minimal at these sites. However, in the event of a spill, the Project Manager or Field Team Leader will notify the Spill Control Department and Fire Department.

1.7 INSTALLATION RELATIONS/SECURITY REQUIREMENTS

Prior to field operations, the Project Manager is responsible for having the Site Safety Plan reviewed and approved by NAVBASE Charleston personnel and the Southern Division of the Naval Facilities Engineering Command.