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FINAL WORK PLAN REMEDIAL INVESTIGATION VERIFICATION STEP WITH TRANSMITTAL LETTER MCRD PARRIS ISLAND SC
3/7/1988
MCCLELLAND ENGINEERS

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FINAL WORK PLAN
REMEDIAL INVESTIGATION
VERIFICATION STEP
MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA
UIC: M00263

Report to:

NAVAL FACILITIES
ENGINEERING COMMAND
Charleston, South Carolina

McClelland

FINAL
WORK PLAN
REMEDIAL INVESTIGATION
VERIFICATION STEP
MARINE CORPS RECRUIT DEPOT,
PARRIS ISLAND, SOUTH CAROLINA
UIC: M00263

* * *

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McClelland engineers

Job No. 0187-3606
March 7, 1988

Southern Division
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Charleston, South Carolina 29411

Attention: Mr. Dick Byrd

McClelland Engineers is pleased to submit to you ten copies each of the Work Plan, Sample Handling and Analyses Plan, and the Health and Safety Plan for the verification activities associated with the Remedial Investigation, MCRD Parris Island. In accordance with the contract requirements, we are concurrently transmitting three copies of each plan to Mr. Cal Garnett, MCRD Parris Island for distribution at the activity.

We appreciate the opportunity to prepare these work plans for Southern Division, and we look forward to providing additional waste management consultation services in the future. Please call us if you have any questions.

Sincerely,

McCLELLAND ENGINEERS, INC.

Harry C. Day, Jr.
Project Supervisor

Susan T. Litherland, P.E.
Project Manager

HD/STL/pv(8:109:154)
Copies Submitted:
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CONTENTS

		Page
1.0	SUMMARY	1-1
2.0	INTRODUCTION	2-1
2.1	NIRP Program	2-1
2.2	Marine Corps Recruit Depot	2-2
2.3	Site Descriptions	2-2
2.3.1	Site 1 - Incinerator Landfill	2-2
2.3.2	Site 2 - Borrow Pit Landfill	2-3
2.3.3	Site 3 - Causeway Landfill	2-3
2.3.4	Site 4 - Dredge Spoils Area Fire Training Pit	2-4
2.3.5	Site 6 - Former Automotive Hobby Shop Spill Area	2-4
2.3.6	Site 16 - Pesticide Rinsate Disposal Area	2-4
2.3.7	Site 17 - Page Field Tanks (AS 16)	2-5
2.3.8	Site 18 - Page Field Tanks (AS 18)	2-5
2.3.9	Site 19 - MCX Service Station	2-5
3.0	PROPOSED FIELD INVESTIGATION	3-1
3.1	General Approach	3-1
3.2	Site 1 - Incinerator Landfill	3-3
3.3	Site 2 - Borrow Pit Landfill	3-4
3.4	Site 3 - Causeway Landfill	3-5
3.5	Site 4 - Dredge Spoils Area Fire Training Pit	3-5
3.6	Site 6 - Former Automotive Hobby Shop Spill Area	3-6
3.7	Site 16 - Pesticide Rinsate Disposal Area	3-6
3.8	Sites 17 and 18 - Page Field AVGAS Tanks	3-6
3.9	Site 19 - MCX Service Station	3-6
4.0	FIELD INVESTIGATION PROCEDURES	4-1
4.1	Drilling Techniques	4-1
4.2	Groundwater Monitoring Well and Wellpoint Installation	4-1
4.2.1	Well Drilling Procedures	4-2
4.2.2	Well Completion	4-3
4.2.3	Wellpoint Installation	4-4
4.2.4	Well Development	4-5
4.3	Borehole Grouting	4-5
5.0	RECOMMENDATIONS AND SCHEDULE	5-1
6.0	REFERENCES	6-1

1.0 SUMMARY

The Naval Installation Restoration Program (NIRP) uses a six-phase approach to manage past disposal sites at naval and marine facilities. Phase I, the Preliminary Assessment (PA), consists of the collection and review of all available information about the source and nature of hazardous substances at a site. Phase II, the Site Inspection (SI), involves a field inspection of a site. Phase III, the Additional Sampling Phase, may be conducted if a more comprehensive sampling effort is required than that achieved in the SI phase. Phase IV, Remedial Investigation (RI), is a field effort to collect sufficient information to characterize sites for development and evaluation of remedial responses. Phase V, the Feasibility Study (FS), involves the selection of remedial alternatives based on cost, environmental effects, and engineering feasibility. Phase VI, Remedial Acation, includes the design and implementation of remedial technologies selected in the FS state.

Phases I, II, and III have been completed for sixteen sites at the Marine Corps Recruit Depot (MCRD), Parris Island, South Carolina. This work corresponds to the Initial Assessment Study (IAS) undertaken as part of the Naval Assessment and Control of Installation Pollutants (NACIP) program. Of the sixteen sites identified in the IAS, six were identified for Remedial Investigation (confirmation). All six sites are located at MCRD Parris Island and include:

- Site 1, Incinerator Landfill,
- Site 2, Borrow Pit landfill,
- Site 3, Causeway Landfill,
- Site 4, Dredge Spoils Area Fire Training Pit,
- Site 6, Former Automotive Hobby Shop Spill Area, and
- Site 16, Pesticide Rinsate Disposal Area.

Three additional sites were subsequently identified by activity personnel and added to the list. These sites are:

- Site 17, Page Field AVGAS Tanks (AS-16),
- Site 18, Page Field AVGAS Tanks (AS-18), and
- Site 19, MCX Service Station.

This document presents the procedures which will be used in the remedial investigation phase of NIRP to evaluate whether specific toxic and hazardous materials are present at the nine sites in concentrations considered to be hazardous. Specifically, it describes those investigative procedures necessary to characterize the facility (environmental setting), define the source (source of characterization), degree and extent of hazardous constituent releases (contamination characterization), and identify actual or potential receptors. The collection of these data will further enable characterization of individual sites for development and evaluation of remedial responses.

According to the IAS study, three sites (Sites 1, 2, and 3) are landfill units that are mixtures of solid and hazardous wastes. All three sites contain nonhazardous wastes including domestic trash an garbage, as well as combustible an ignitable wastes including solvents, fuels, and oils. Site 1 contains incinerator ash in addition to the materials listed above.

Sites that reportedly received liquid wastes are Sites 1, 4, 6, 16, and probably Sites 2 and 3. Sites 17, 18, and 19 were not used to treat, store, or dispose of waste material. These sites were added to the investigation to evaluate the potential for leaks of fuel into the environment from leaking underground storage tanks or pipes. Site 16 received pesticide rinsate from the washing of pesticide equipment and containers. The rinsate may or may not have contained organic solvent as a carrier for the pesticides. Sites 17 and 18 were previously used to store fuels used for aviation (AVGAS) while Site 19 (MCX service station) was a vehicle refueling operation.

The Remedial Investigation field activities presented herein have been designed to provide data of adequate technical content and quality necessary to support the development and evaluation of recommendations for elimination of a site or corrective action under the NIRP program. The result of these activities will further enable a determination of any remedial actions and establish the public health implications of identified potential/actual off-site migration. Vadose or unsaturated zone gas sampling and testing are planned, where appropriate, to provide information concerning subsurface contamination with volatile organic compounds. In general, this technique is only used to reduce the required fieldwork and the results are usually

confirmed by completion of soil borings and the installation and sampling of monitoring wells. Wellpoints are also planned since they can be installed in areas where rig access is difficult. No cuttings are produced with the wellpoint installation technique. Sediment and surface water samples are planned at sites near marsh areas and those where there is a potential for surface migration from the site via runoff or where the potential exists for the presence of seeps from the site.

This Remedial Investigation Plan is presented in five sections. Section 2.0 gives background information concerning the NIRP Program, the Parris Island facility, and the nine sites which have been recommended for additional investigation. Section 3.0 presents our proposed program to investigate, define, and characterize the source, degree, and extent of releases at each of the nine sites. Details concerning drilling, sample handling, screening, and well installation are provided in Section 4.0. Our recommendations for the remedial investigation study are summarized in Section 5.0. References used during preparation of this document are provided in Section 6.0.

2.0 INTRODUCTION

2.1 NIRP Program

The purpose of the Naval Installation Restoration Program (NIRP) is to investigate and remediate uncontrolled hazardous waste disposal sites located on naval activities and related areas. It is designed to identify contamination resulting from past navy operations which may present a threat to human health or the environment and to institute remedial action as needed. The program consists of the following phases:

- Preliminary Assessment (PA),
- Site Inspection (SI),
- Additional Sampling (AS),
- Remedial Investigation (RI),
- Feasibility Study (FS), and
- Remedial Action.

The PA, SI and Additional Sampling phases of work correspond to the Initial Assessment Study (IAS) already completed under the Naval Assessment and Control of Installation Pollutants (NACIP) program. During this phase, record searches, personnel interviews, and on-site surveys are conducted to identify potential disposal sites and contaminated areas caused by past hazardous substance storage, handling, or disposal practices at naval activities. Each site is then evaluated to determine its potential threat to human health or the environment. The purpose of the RI is to gather data necessary to characterize the type and extent of contamination at sites of concern and to develop additional information regarding their migration pathways. As such, it corresponds closely with the NACIP confirmation phase objective of verifying and characterizing identified contamination, including hydrogeological, health, safety, and regulatory aspects. The objective of the Feasibility Study (FS) is to determine and make recommendations for the most cost effective remedial action available to protect the public health and environment. The FS involves a sequential process of identification, screening and evaluation of remedial technologies and alternatives which might be used to determine the most cost effective alternative. During the Remedial

Action phase, corrective measures designed to mitigate or eliminate confirmed problems are completed.

2.2 Marine Corps Recruit Depot

The Marine Corps Recruit Depot (MCRD) Parris Island is located approximately five miles south of the town of Beaufort, South Carolina (Figure 2-1). MCRD is located on an island north of the Port Royal Sound, between the Broad and the Beaufort Rivers.

According to the IAS, MCRD is located on 30 to 40 ft of unconsolidated sands, silts, and clays of Pleistocene age that are considered the shallow or surficial aquifer. This unit is hydraulically and physically separated from the underlying limestone aquifer of Tertiary age by the Hawthorn Formation. The IAS report states that the limestone aquifer, although used within the county as a local water source, is not used in the vicinity of MCRD because of local intrusion and contamination by salt water. The base geology and hydrogeology are described in more detail in the IAS report.

Based on preliminary site information provided in the IAS, potential migration pathways that should be assessed during the Remedial Investigation include:

- lateral movement of contaminants in high permeability surficial sands,
- discharge of shallow groundwater into adjacent marshland, with contaminant movement accelerated by flushing action produced by tidal fluctuations in the water table, and
- migration of contaminants from the surficial aquifer to the deep limestone aquifer, which would be enhanced by vertical hydraulic gradients in natural recharge zones or zones influenced by water supply pumping.

2.3 Site Descriptions

Locations of six sites recommended for contaminant verification, as well as the three sites subsequently added for investigation, are shown on Figure 2-2 and are briefly described below.

2.3.1 Site 1 - Incinerator Landfill. As stated in the IAS report, this site was used as the primary disposal area at MCRD Parris Island from 1921 to 1959 and continued to be used until 1965. Combustion residues, as well as

noncombustible wastes and some combustible wastes, were disposed of in the Incinerator Landfill. After the incinerator was closed, much of the combustible wastes were reportedly open-burned in the landfill without auxiliary fuel. The majority of wastes disposed of in this landfill were reportedly nonhazardous domestic wastes, ash residues, and construction debris. With the exception of the paint thinners and strippers which were burned in the landfill, the majority of hazardous wastes were burned in the incinerator during the period from 1921 to 1959.

According to the IAS, migration of contaminants into the marsh is likely, but vertical contaminant migration is reportedly limited due to surficial clays and confining beds above the Tertiary Limestone aquifer (Santee Limestone). Potential contaminant receptors would include the surrounding marsh areas, fish and shellfish within the marshes, and predatory species including humans which feed on fish species.

2.3.2 Site 2 - Borrow Pit Landfill. The IAS reports that this site was used as the primary disposal area for Depot wastes during the period from 1966 to 1968. Solid and hazardous wastes similar to those at Site 1 were reportedly disposed of in the Borrow Pit Landfill.

Horizontal migration of contaminants to the marsh is likely due to the underlying unconfined, highly permeable, sandy soil. Vertical contaminant migration is limited due to the low permeability confining layers above the Tertiary Limestone aquifer. Potential contaminant receptors would include the surrounding marsh areas, fish and shellfish within the marshes and predatory species including humans which feed on fish species.

2.3.3 Site 3 - Causeway Landfill. As stated in the IAS report, this site, which was constructed from solid waste and fill dirt across a tidal marsh of the Broad River, was the major Depot disposal area during most of the period between 1960 and 1972. The site was inactive between 1966 and 1968. Materials disposed of at this site reportedly include trash, solid, and hazardous waste. The causeway consists of an approximate 10 acre area which is about 10 ft high (above water line) and wide enough for vehicle traffic.

Contaminant migration into the marsh and nearby ponds is likely, according to the IAS report, due to tidal flushing of contaminants. Vertical migration is limited due to the low permeable soils and confining beds above

the Tertiary Limestone aquifer. Potential contaminant receptors would include the surrounding marsh areas, fish and shellfish within the marshes, and predatory species including humans which feed on fish species.

2.3.4 Site 4 - Dredge Spoils Area Fire Training Pit. Based on information in the IAS, this site was used for fire fighter training during an approximate 20 year period between the 1940s and mid-1960s. An estimated 12,000 gallons of waste fuels and oils, including waste motor oils and small quantities of petroleum based solvents, were introduced to the soils during training.

Contaminant migration within the surficial aquifer is likely, according to the IAS report. Vertical contaminant migration would be limited by the low permeable soils overlying the Tertiary Limestone aquifer. Potential contaminant receptors would include the surrounding marsh areas, fish and shellfish within the river and predatory species including humans which feed on fish species.

2.3.5 Site 6 - Former Automotive Hobby Shop Spill Area. As reported, this site was contaminated by surface spills of waste lube oil between the period of 1969 to 1982. It was estimated that more than 2,000 gallons of waste oil were spilled during this time.

Horizontal migration of contaminants is likely, due to the shallow water table and highly permeable soils near the ground surface. Vertical contaminant migration is limited due to the confining formation above the Tertiary Limestone aquifer. Potential contaminant receptors would include adjacent marsh areas, fish and shellfish, and predatory species including humans which feed on fish species.

2.3.6 Site 16 - Pesticide Rinsate Disposal Area. As stated in the IAS report, this site was used for the disposal of rinsewaters from pesticide spray containers. The site was used between 1950 and 1978, and covers an area of approximately 150 sq ft. Pesticides used at the activity during this period included Aldrin, Baygon, Chlordane, Dursban, Malathion, Naled, and DDT. Approximately 8,000 gallons of pesticide rinsate were disposed of at this site.

Tidal action, highly permeable sandy soil, and the shallow water table would allow contaminant migration from the site. Potential contaminant

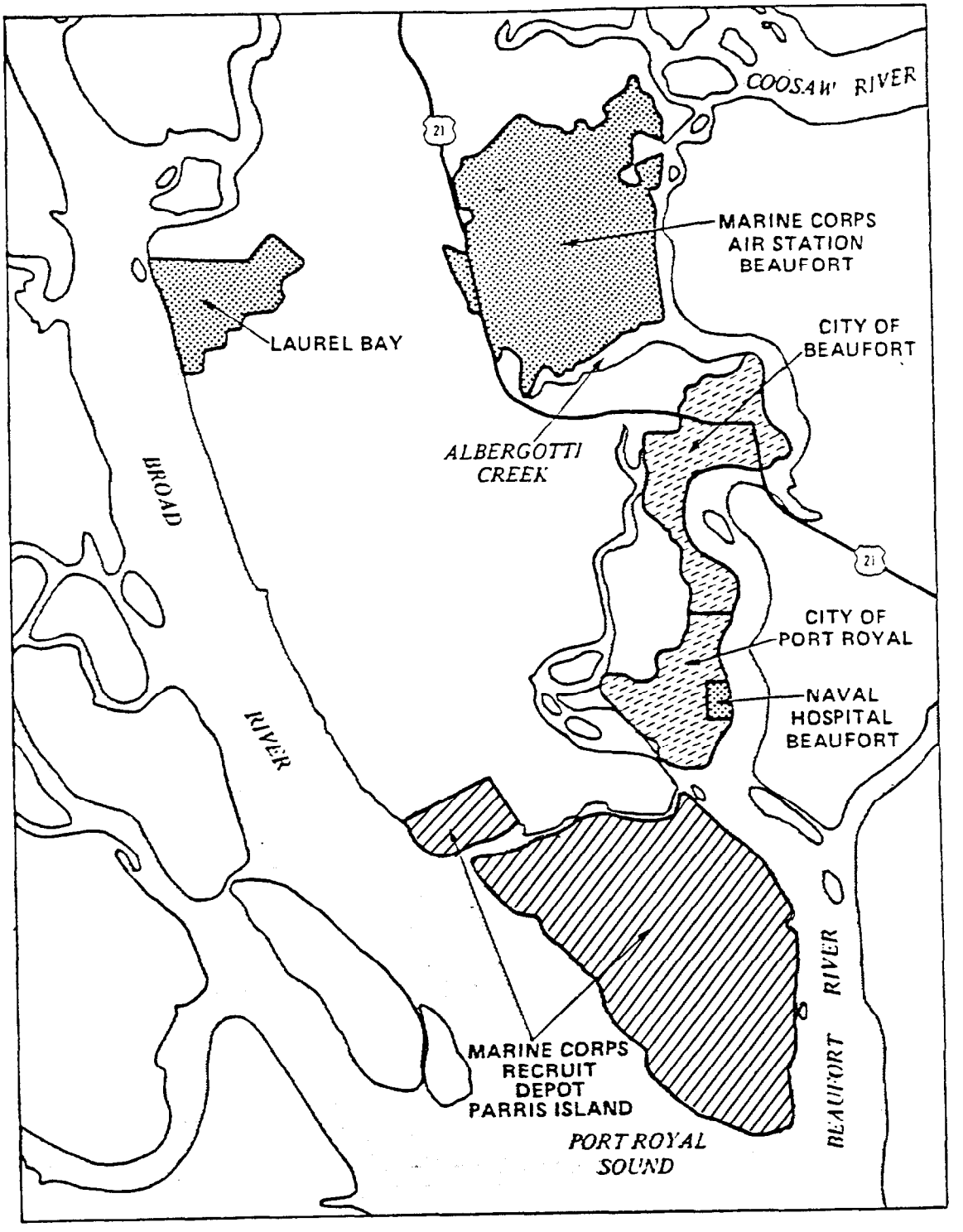
receptors would include the surrounding marsh areas, fish and shellfish within the marshes and predatory species including humans which feed on fish species.

2.3.7 Site 17 - Page Field Tanks (AS 16). Site 17 consists of four 25,000 gallon steel tanks which are approximately 10 ft in diameter and 40 ft long. They were installed at grade and then mounded with soil. According to Mr. Sharad Thakar (MCRD Parris Island, public works), four borings have been completed in the area (two to 15 ft and two to 25 ft) and one well installed. The well reportedly has not been sampled. The tanks, as of last summer, contained an unknown liquid (presumably water, as fuel use at this location was reportedly water driven). Under a separate contract for Southern Division NAVFAC, McClelland Engineers is sampling and analyzing materials in the AS 16 tanks.

2.3.8 Site 18 - Page Field Tanks (AS-18). The AS-18 tanks reportedly consist of four 50,000 gallon precast concrete tanks. They are cylindrical with a diameter of 35 ft and a height of 8.5 ft. The tanks were installed at grade and then mounded with soil. Reportedly, approximately 4.5 ft of soil is present over the top of the tanks. Eight borings have been completed in the area, four to 15 ft and four to 25 ft. One well has been installed but not sampled. These tanks are also thought to be full of an unknown liquid (presumably water, as fuel use at this location was reportedly water driven). Under a separate contract for Southern Division NAVFAC, McClelland Engineers is sampling and analyzing materials in the AS 18 tanks.

2.3.9 Site 19 - MCX Service Station. The MCX Service Station (Bldg. 850) is the location of an old Marine Corps exchange station that was taken out of service in approximately 1985. According to correspondence provided to McClelland Engineers from the activity, a project that was being undertaken to demolish underground storage tanks at this location identified environmental contamination at the site. Prior to 1985, automobile gasoline was stored in underground tanks (size and number not known) at this location. At present, the gasoline pumps have been removed from the pump islands and the building is vacant. Seven borings have been advanced at this site, all extending at least to 20 ft below ground. Three wells were installed, but

none have been sampled. In addition to four 5,000 gallon underground storage tanks, it is reported by activity personnel that a 500 gallon waste oil sludge tank is also present below ground at the site.



1 0 1 2 3 4 MILES
SCALE

FIGURE 2-1. VICINITY MAP

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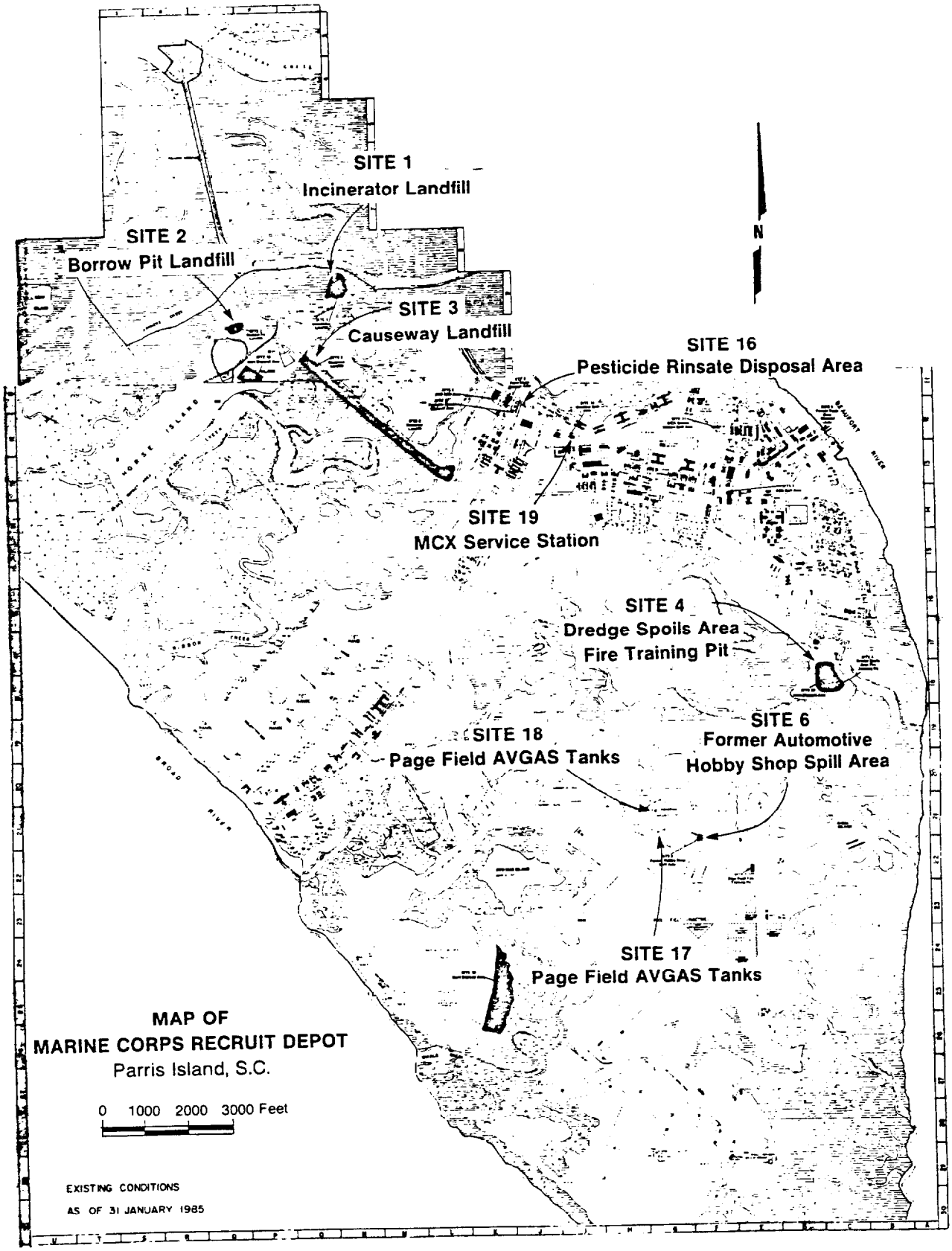

FIGURE 2-2. SITE LOCATIONS

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3.0 PROPOSED FIELD INVESTIGATION

This section provides information on site conditions and investigative approaches at the sites identified in the Initial Assessment Study, as well as those sites added later for confirmation.

3.1 General Approach

Field investigations will be conducted to evaluate the presence of hazardous wastes and potential migration of wastes from the sites. The presence of contamination will be evaluated in the surficial soils, shallow aquifer, and surface water, where appropriate.

Techniques planned for the field investigation include:

- soil borings, field screening and laboratory analysis of soil samples for chemical contamination;
- installation of monitoring wells and wellpoints, chemical analysis of groundwater samples to determine whether groundwater contamination is present, and measurement of water levels to determine groundwater flow directions;
- vadose zone vapor probe (VZV Probe®) work, to obtain data on soil gas contamination where borings and monitoring wells are not drilled; and
- chemical analysis of surface water and sediment samples collected from drainage ditches or marshy areas where appropriate (samples from tidally influenced areas will be collected during low tide when flushing of contaminants may occur) to evaluate migration of contaminants.

Wherever possible, wellpoint installation and the VZV Probe® will be used to obtain groundwater samples and soil contamination data. The wellpoints will be constructed of 1-1/4 in., inside diameter (ID), stainless steel pipe with a 5-ft section of stainless steel screen and a rolled stainless steel point. The points will be installed with a jackhammer and will be placed at locations which are generally not accessible to a drilling rig, for example, in marshy or wooded areas. Another advantage to installing wellpoints instead of monitoring wells is that no soil cuttings will be generated. Wellpoints installed in marshy or tidally affected areas will have water tight, removable stick ups that will eliminate the potential for surface water intrusion but will still allow access to the well for measurements and sampling. Also, because of the permeable materials expected in the shallow soils, appropriate

groundwater samples can be obtained from a wellpoint. Groundwater samples from wellpoints and monitoring wells in tidally-influenced areas will be collected at low tide when flushing of potential contaminants from the site toward the marsh may occur. In general, the combined sampling of wellpoints and monitoring wells will provide a cost-effective means of acquiring representative groundwater quality data.

Groundwater monitoring wells or wellpoints will be installed at sites where the potential exists for subsurface waste disposal (landfills). In general, monitoring wells or wellpoints will be installed far enough from each site to assure that the site is not penetrated during site activities, and close enough to identify possible contaminants migrating from the site.

Use of the vadose zone vapor probe (VZV Probe®) can reduce the number of soil samples which need to be collected and submitted for laboratory analysis. Soil vapor samples collected with the VZV Probe® can be screened in the field with the organic vapor analyzer/gas chromatograph (OVA/GC) and nonmethane peaks (those associated with fuel components for example) can be qualitatively identified. Soil borings will be used to collect a limited number of samples for confirmatory laboratory analyses and where contamination with nonvolatile compounds (which cannot be detected by the VZV Probe®) is a possibility.

The field investigations at each site are described in the following sections. Procedures used to collect the field data, such as sample collection and monitoring well installation, are described in greater detail in Section 4.0.

At many locations, oil and grease and total organic carbon (TOC) will be analyzed in addition to organic priority pollutants. These analyses are performed for two reasons. First, the parameter TOC is used as an indicator parameter for groundwater contamination. Second, TOC and/or total oil and grease analyses may be used as indicator parameters to evaluate the appropriateness of site remediation, if needed. These analyses are less expensive than any portion of the organic priority pollutant analytical suite, and determination of their potential value as a remediation indicator may save considerable costs and time as work progresses at the activity.

Any drill cuttings generated at the site during drilling operations will be collected and the cuttings placed in drums. Drums used for containment of

the cuttings will be provided by McClelland, and will be labeled with the site and boring number. Waters generated during the development of wells and wellpoints will be collected in a similar fashion. Cuttings and development waters will be disposed of as appropriate, during the remediation phase at this site.

Prior to beginning field activities, all boring and probe locations will be staked. Locations will be checked by activity personnel for underground utilities including electrical, gas, phone, storm sewer, water, or other lines. No subsurface work will be performed prior to location approval by activity personnel.

3.2 Site 1 - Incinerator Landfill

Work at Site 1 will include the installation of one monitoring well just south of the landfill, the installation of three wellpoints just outside the landfill boundary, and the collection of three sediment samples from the marsh surrounding the landfill. Assuming that potential contaminants from the landfill would tend to move radially from the site toward the marsh, the monitoring well located south of the landfill is anticipated to represent an upgradient sampling point, while the three wellpoints may represent downgradient sampling points. The locations are shown on Figure 3-1. Soil samples from the monitoring well borehole will be taken continuously from the surface to the depth of the boring (approximately 15 ft). The boring will terminate in a clay confining layer, if intercepted. Soil samples will be collected for visual inspection, classification, and headspace readings.

The monitoring well will be installed to collect groundwater samples for chemical analyses. The well will be completed such that the base of the screened section is just above the clay confining layer, if intercepted. The top of the screen will be set 2 ft above the water table, but no deeper than 5 ft below ground surface. Sediment samples will be collected by hand at three locations in the marsh around the landfill, one near each wellpoint location. The sediment samples will extend from a depth of 0 to 2 ft (if possible) taken during low tide. All three soil samples will be submitted for chemical analyses.

Soil samples will be tested for the presence of volatile organic compounds using a Foxboro Organic Vapor Analyzer (OVA) or other similar equipment. The screening procedure consists of sampling the headspace from a soil sample. The testing will be used to detect possible organic contamination in the subsurface. Gas chromatographs may be run on samples with the greatest OVA readings.

Water and soil samples collected at the site will be analyzed for the parameters listed in Table 3-1.

3.3 Site 2 - Borrow Pit Landfill

The work at Site 2 shall consist of advancing three soil borings and installing three monitoring wells around the landfill, and the collection of one surface water/sediment sample in the basin just west of the landfill. Figure 3-1 shows the sampling locations. Assuming a hydraulic gradient toward the northwest, Well PAI-2-1 is located upgradient of the site and Wells PAI-2-2 and PAI-2-3 are downgradient. The borings will be drilled to an approximate depth of 30 ft, but will not extend more than 4 ft beyond the top of a confining clay unit if encountered. During drilling, soil samples will be collected continuously for visual inspection, classification, and headspace readings. The wells will be completed such that the bottom of the well is just above the confining clay, if encountered, with the screen extending from the base of the well to about 2 ft above the water table, but no deeper than 5 ft below ground surface. The maximum screen length at this site will be 25 ft.

Soil samples from the borings will be tested for volatile organic compounds using the OVA. A field gas chromatograph may be run on the soil sample with the greatest headspace reading from each boring. Groundwater samples will be collected from the monitoring wells and will be submitted for analysis. The sediment sample shall consist of a sample taken from the surface to a depth of 2 ft. A surface water sample will be collected at the same location as the sediment sample. Table 3-2 lists the parameters for which the samples will be analyzed.

3.4 Site 3 - Causeway Landfill

The work at Site 3 shall consist of collecting a series of eight soil/sediment samples along the flanks of the causeway and eight surface water samples. Figure 3-2 shows the approximate sampling locations. The locations have been chosen off the edge of the landfill, since potential contaminants from the site are likely to move toward the marsh. Four soil/sediment samples will be collected on each side of the causeway. If possible, the samples will be taken in the marsh just below visual seepage points (if identifiable). At each location a surface water sample will be taken. If possible, these will be from seeps (if identifiable) on the side of the causeway. All of the Site 3 samples will be taken during low tide. The soil/sediment samples will consist of samples taken from the surface to a depth of about 2 ft. Table 3-3 lists the analyses for the various samples. Samples of soil/sediment will be screened with the OVA/GC. A GC may be run on samples with the highest OVA readings.

3.5 Site 4 - Dredge Spoils Area Fire Training Pit

At Site 4, five shallow soil borings will be drilled and continuously sampled at the locations shown in Figure 3-3. The borings have been planned at locations adjacent to the spoils area berm, near the reported location of the fire training pit. The borings will be drilled into, but not beyond, a clay confining unit, if encountered. The purpose of these borings will be to collect soil samples for headspace screening and chemical analyses. A field GC will be run on the soil samples with the highest headspace reading from each boring. If nonmethane-type peaks are identified, three wells will be installed. The wells will be installed in the boreholes with the highest headspace readings. If only methane-type peaks are identified, no wells will be installed. Soil samples (one from each borehole) will be analyzed for the parameters shown on Table 3-4.

The wells, if required, will be screened from about 2 ft above the water table to the top of the confining clay if identified, or from 5 ft to 20 ft below ground whichever is less. Water samples will be collected from all wells installed, and analyzed as shown in Table 3-4.

3.6 Site 6 - Former Automotive Hobby Shop Spill Area

The work at Site 6 will consist initially of drilling one soil boring near the buried tank to a depth of approximately 12 ft, but not extending beyond a clay confining unit, if encountered. Continuous soil samples will be collected and screened with the OVA/GC. If nonmethane peaks are identified within 2 ft of the water table, a well will be installed. This well will be screened from about 2 ft above the water table to 8 ft below the water table. A groundwater sample will be collected for the analyses listed in Table 3-5. The location of the boring/well is on Figure 3-4.

3.7 Site 16 - Pesticide Rinsate Disposal Area

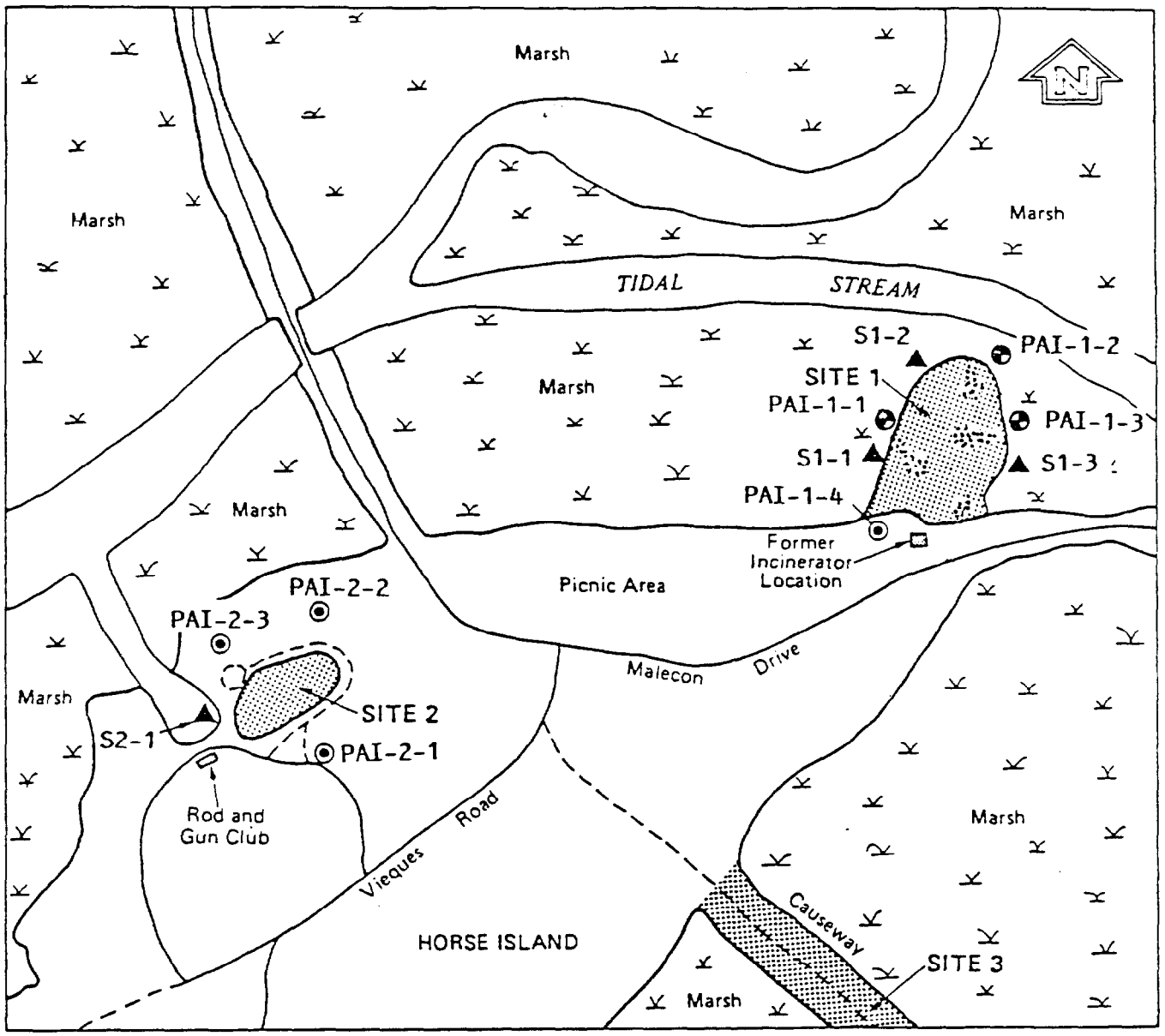
At Site 16, three soil borings will be drilled at the locations shown on Figure 3-5. The soil borings will be sampled continuously and will be drilled just into, but not beyond, the clay confining unit if encountered, or to 15 ft whichever is less. Two samples from each boring will be submitted for the analyses listed in Table 3-6.

3.8 Sites 17 and 18 - Page Field AVGAS Tanks

Initially, reports from the previous studies at these locations will be reviewed. Next, a VZV Probe® survey will be conducted to identify potential volatile organic subsurface contamination. Based on the results of the survey, two additional wells will be installed at each site. These wells, along with the previously installed wells, will be developed, sampled, and analyzed for the parameters shown on Table 3-7. Approximate locations are shown on Figure 3-6.

3.9 Site 19 - MCX Service Station

A VZV Probe® survey will be conducted around Site 19 to evaluate the extent of potential organic contamination. Site 19 and estimated VZV Probe® sampling locations are shown on Figure 3-7. Three wells have been installed previously and these wells will be sampled and analyzed for the parameters shown on Table 3-7.



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Note: These are approximate locations.

FIGURE 3-1. SITE 1-INCINERATOR LANDFILL AND SITE 2-BORROW PIT LANDFILL

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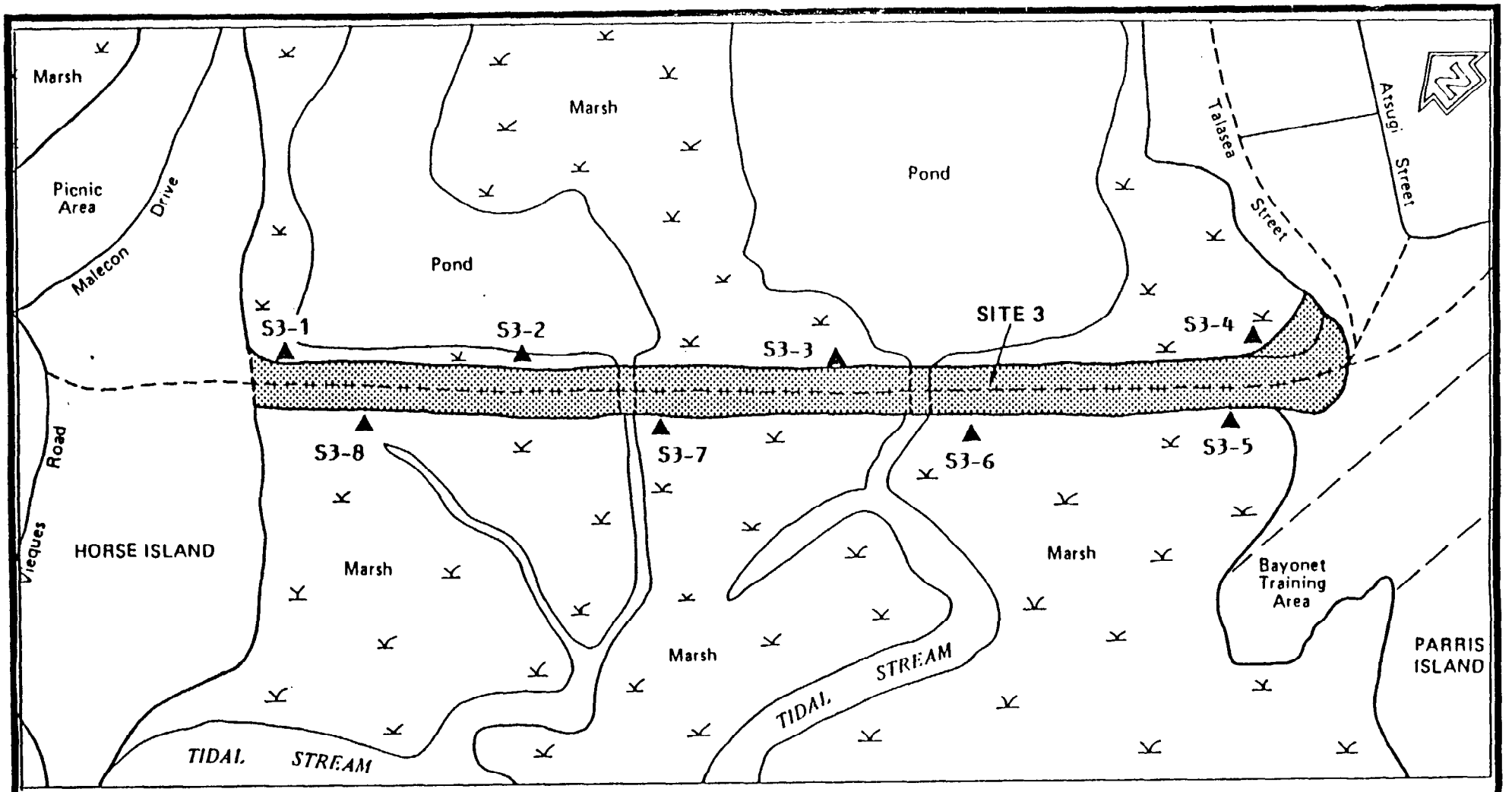


Note: These are approximate locations.

▲ Seep/surface water and causeway sediment sample

Site

--- Dirt Road

DRAFT

FIGURE 3-2. SITE 3-CAUSEWAY LANDFILL

McCLELLAND ENGINEERS

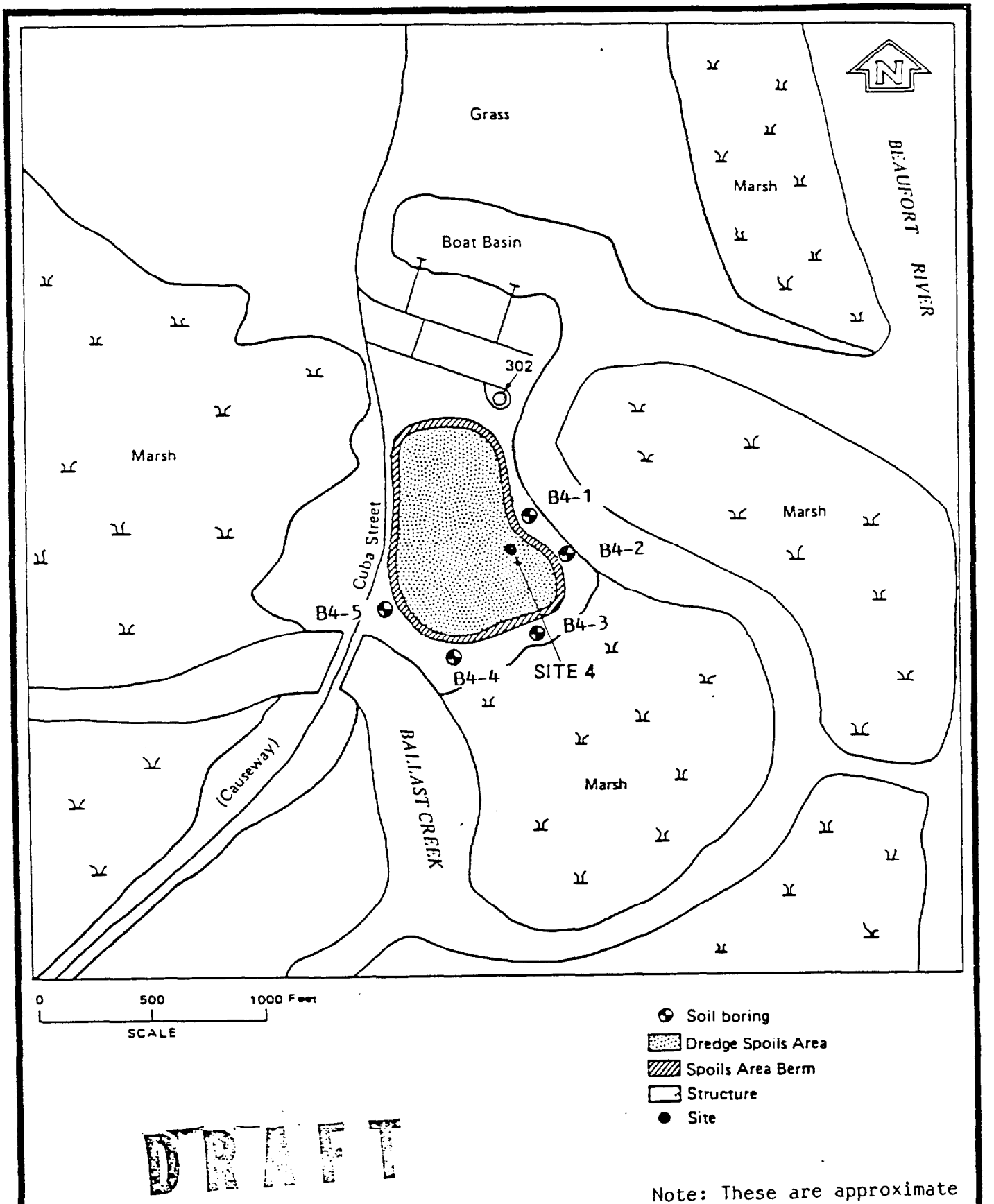
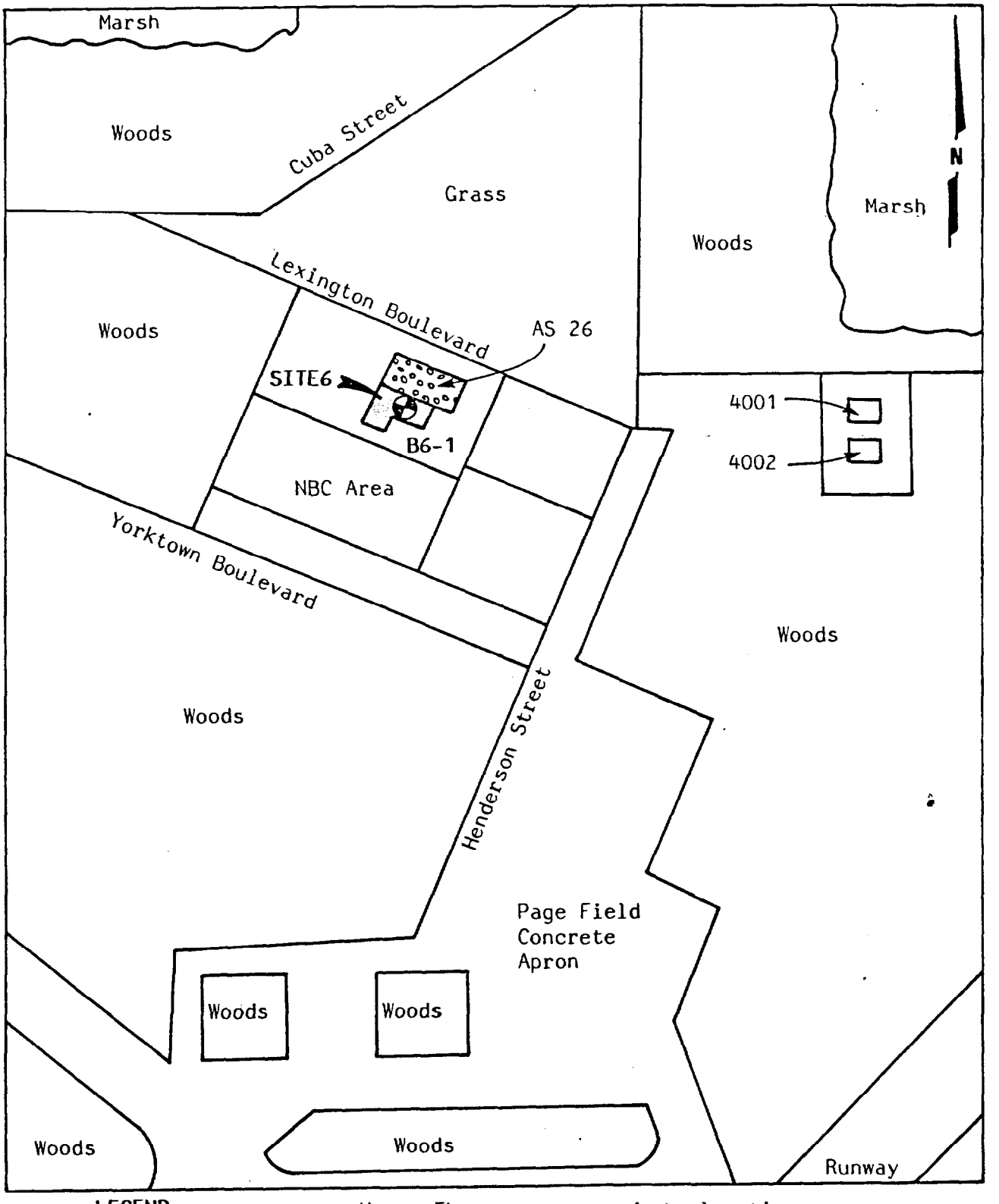


FIGURE 3-3. SITE 4-DREDGE SPOILS AREA FIRE TRAINING PIT

McCLELLAND ENGINEERS



LEGEND:

Site
Structure
Soil Boring

Note: These are approximate locations.

FIGURE 3-4. SITE 6-FORMER AUTOMOTIVE HOBBY SHOP SPILL AREA

0 250 500 Feet

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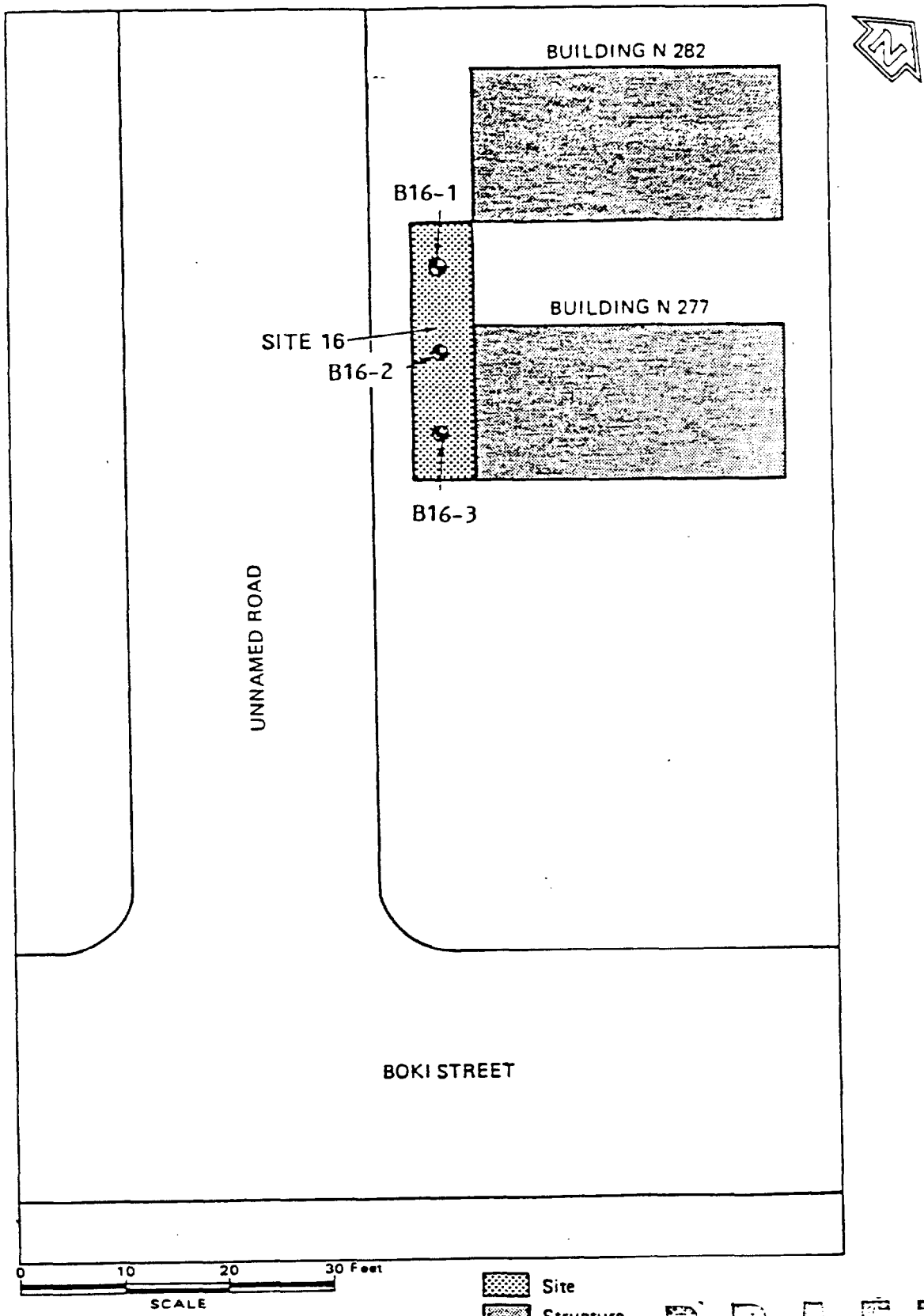
PLATE



Note: These are approximate locations.

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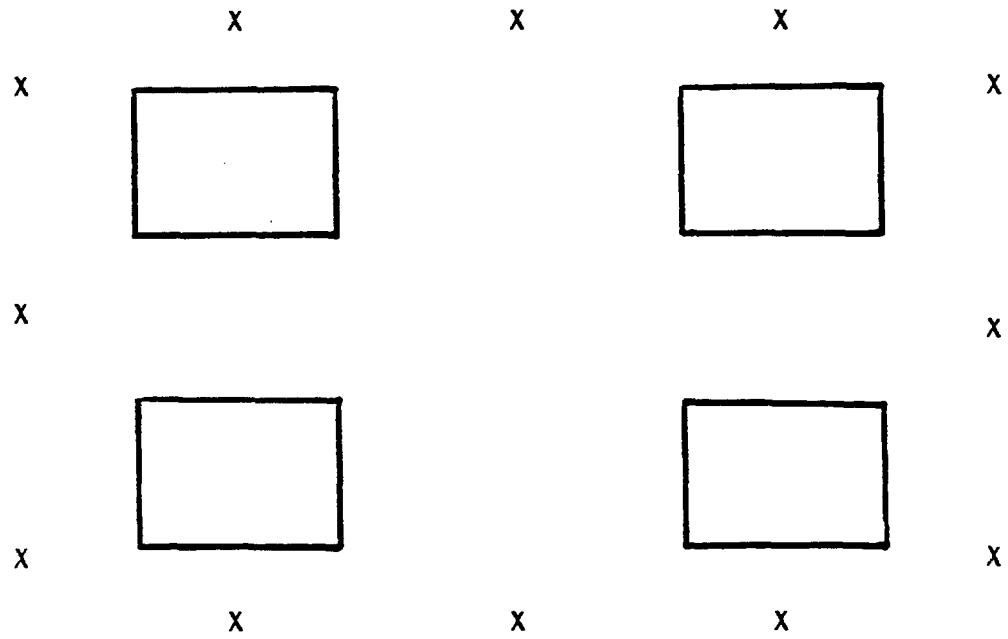
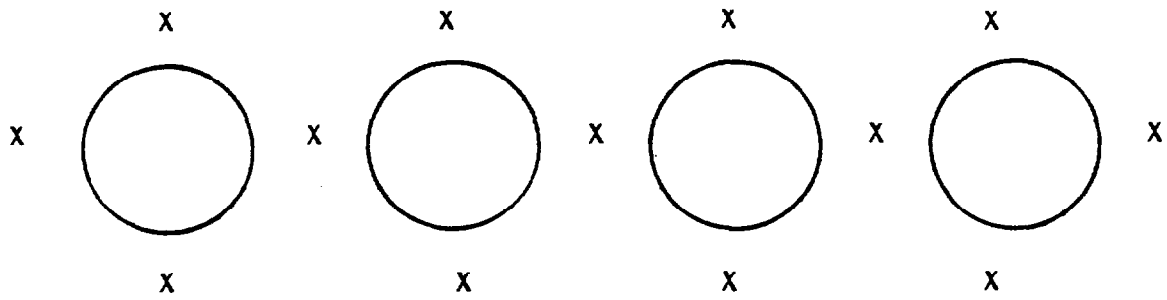
FIGURE 3-5. SITE 16-PESTICIDE RINSATE DISPOSAL AREA

McCLELLAND ENGINEERS



SITE 17



SITE 18

X Approximate VZV Probe Locations.

Note: Figure not drawn to scale.

DRAFT

FIGURE 3-6. SITES 17 AND 18-PAGE FIELD AVGAS TANKS

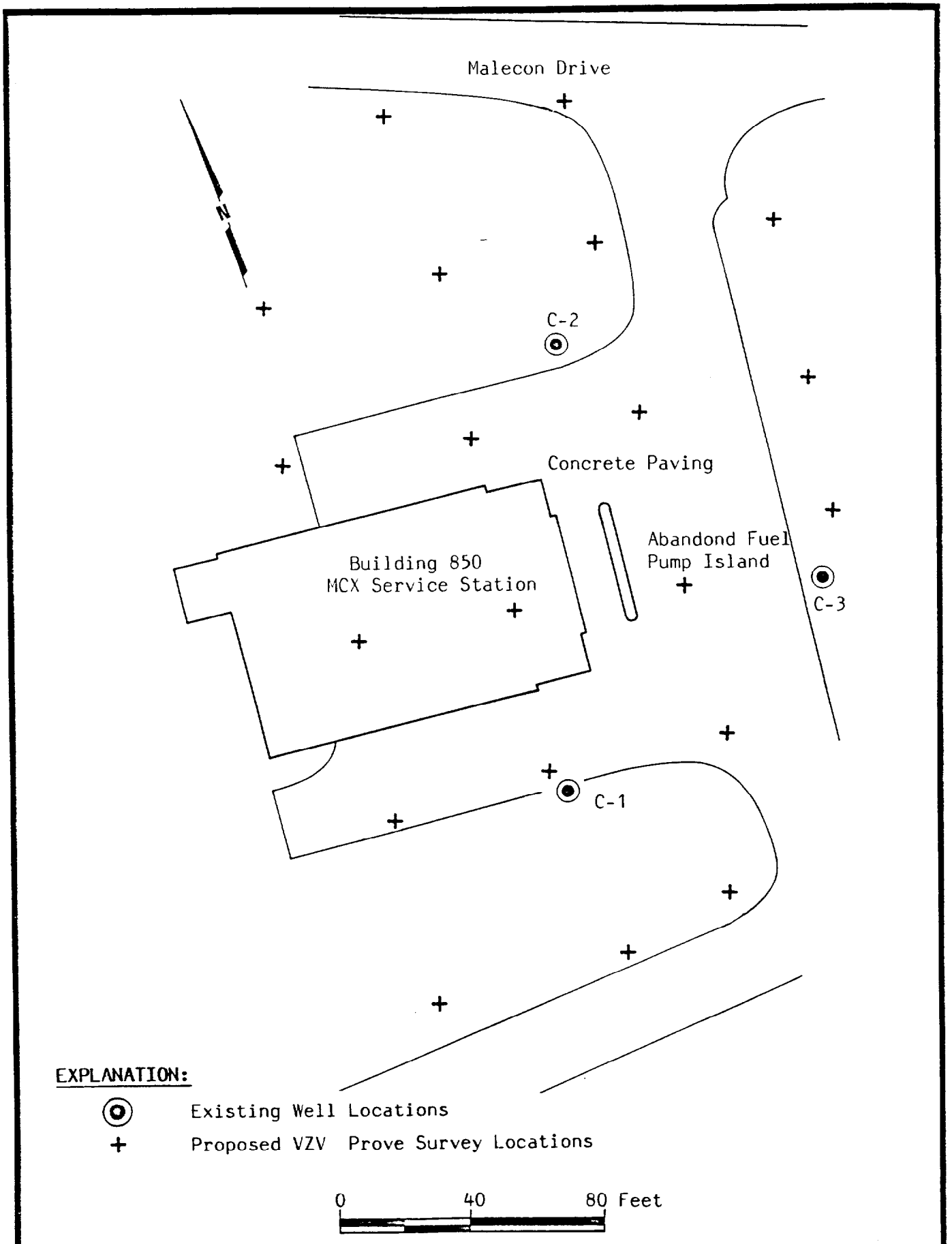


FIGURE 3-7. SITE 19-MCX SERVICE STATION

McCLELLAND ENGINEERS

PLATE

Table 3-1
Summary of Chemical Analyses for
Site 1 - Incinerator Landfill

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Sediment	Marsh	0' to 2'	3	A, B, D
Groundwater	PAI-1-4	NA[b]	1	A, B, C
Groundwater	Wellpoints	NA[b]	3	A, B, C

[a] Key to analyses
- A Priority Pollutants (volatiles, acid extractables, base/neutral extractables, pesticides, PCBs)
- B Dissolved (water) or total (sediment) metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag). Cr (VI) will be analyzed if Cr (total) is greater than detection limit.
- C Indicator Parameters (TOC, pH, specific conductance)
- D EP Toxicity (As, Cd, Cr, Pb, Hg)

[b] Not applicable

Table 3-2
Summary of Chemical Analyses for
Site 2 - Borrow Pit Landfill

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Sediment	Basin	0' to 2'	1	A, B, D
Surface Water	Basin	NA[b]	1	A, B, C
Groundwater	Monitoring Wells	NA[b]	3	A, B, C

[a] Key to analyses
- A Priority Pollutants (volatiles, acid extractables, base/neutral extractables, pesticides, PCBs)
- B Dissolved (water) or total (sediment) metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag). Cr (VI) will be analyzed if Cr (total) is greater than detection limit.
- C Indicator Parameters (TOC, pH, specific conductance)
- D EP Toxicity (As, Cd, Cr, Pb, Hg)

[b] Not applicable

Table 3-3
Summary of Chemical Analyses for
Site 3 - Causeway Landfill

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Soil/Sediment	Marsh	0' to 2' Screened[c]	8	A, B, D
Surface Water	Marsh	NA[b]	8	A, B, C

[a] Key to analyses
- A Priority Pollutants (volatiles, acid extractables, base/neutral extractables, pesticides, PCBs)
- B Dissolved (water) or total (sediment) metals (As, Ba, Be, Cd, Cr, Pb, Hg, Se, Ag). Cr (VI) will be analyzed if Cr (total) is greater than detection limit.
- C Indicator Parameters (TOC, pH, specific conductance)
- D EP Toxicity (As, Cd, Cr, Pb, Hg)

[b] Not applicable

[c] Screening performed with OVA/GC

Table 3-4
Summary of Chemical Analyses for
Site 4 - Dredge Spoils Area Fire Training Pit

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Soil	Soil Borings	Screened[c]	5	C, D
Groundwater	Wells	NA[b]	3 (max)	A, B, C

[a] Key to analyses
- A Priority Pollutants (volatiles, acid extractables, base/neutral extractables)
- B Indicator parameters (TOC, pH, specific conductance)
- C Dissolved (water) or total (soil) metals (Cd, Cr, Pb)
- D EP Toxicity (Cd, Cr, Pb)

[b] Not applicable

[c] Submitted samples based on results of field screening.

Table 3-5
Summary of Chemical Analyses for
Site 6 - Former Automotive Hobby Shop Spill Area

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Soil	B6-1	Screened[c]	2[d]	A, C, D
Groundwater	Monitoring Well	NA[b]	1	A, B, D

---

a Key to analyses
- A Priority Pollutants (volatiles, base/neutral extractables)
- B Indicator Parameters (TOC, pH, specific conductance)
- C Oil and grease
- D Dissolved (water) metals (Cd, Cr, Pb)

b Not applicable

c Submitted samples selected based on field screening.

d At least one sample from above the water table

Table 3-6
Summary of Chemical Analyses for
Site 16 - Pesticide Rinsate Disposal Area

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Soil	Borings	0' to 3'	6	A, B

[a] Key to analyses
A Priority Pollutants (pesticides)
B Total metals (As, Cd, Cr, Pb)

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Table 3-7
Summary of Chemical Analyses for
Sites 17 and 18 - Page Field AVGAS Tanks, and
Site 19 - MCX Service Station

Sample Type	Location	Depth	Number of Samples	Analyses[a]
Groundwater	New Wells Site 17	NA[b]	2	A, B, C
Groundwater	New Wells Site 18	NA	2	A, B, C
Groundwater	Existing Well Site 17	NA	1	A, B, C
Groundwater	Existing Well Site 18	NA	1	A, B, c
Groundwater	Existing Wells Site 19	NA	3	A, B, C

[a] Key to analyses
A Benzene, toluene, ethylbenzene, xylene
B Dissolved metals (Cd, Cr, Pb)
C Indicator Parameters (TOC, pH, specific conductance)

[b] Not applicable

4.0 FIELD INVESTIGATION PROCEDURES

The field investigation for the MCRD Parris Island sites was described in Section 3.0. - Proposed Field Investigation. This section describes procedures used to perform drilling and installation of monitoring wells, installation of wellpoints, the drilling techniques anticipated for advancement of borings, and subsurface sample collection. Procedures for evaluating the unsaturated zone soil gas with the vadose zone vapor probe (VZV Probe®) are included.

4.1 Drilling Techniques

Borehole advancement or drilling, whether for the collection of samples or for the installation of groundwater monitoring wells will follow the same procedure. All borings will be advanced using dry-auger methods (if possible). The borings will be advanced following collection of undisturbed sediments and soils by the use of either thin-walled tube samplers (for clays and more cohesive materials) and split spoon samplers (for sands and unconsolidated materials). The samplers will be hydraulically pushed or driven through the undisturbed sediments and soils by the drilling rig. If samples cannot be collected by this method because of resistance encountered (refusal), the samplers may be driven by hammering the sampler into the ground utilizing standard hammering techniques. If the samplers must be driven with the use of the hammer, blow counts will be recorded for the depth sampled.

Following collection of the samples, the borehole will be widened or reamed to a larger diameter. Dry auger techniques are preferred but wet rotary techniques will be used if drilling difficulties are encountered. This drilling method will be continued until the boring is advanced to its total depth, and drilling is terminated.

4.2 Groundwater Monitoring Well and Wellpoint Installation

Monitoring well and wellpoint locations and depths are identified in Section 3.0. Coordinates and elevations will be surveyed for each of the wells following installation. Coordinates will be measured to the closest foot and referenced to the State Plane Coordinate System or other local

coordinate system. Ground surface elevation to the closest tenth of a foot and elevation of the top of casing to the closest hundredth of a foot will be surveyed at each well. In addition, coordinates and elevations will be established for a minimum of two control monuments for each site, placed no closer than 500 ft apart. The coordinates and elevations of the wells and monuments will be plotted on a map and tabulated. This information will be included in the Remedial Investigation report.

4.2.1 Well Drilling Procedures. Monitoring well installation will be supervised by a driller registered in the State of South Carolina, and completed in accordance with state regulations. The monitoring wells will be installed using dry auger techniques when possible. When this is not possible, wet-rotary methods will be used. Drilling fluids will be restricted, if possible, to fresh, potable water obtained from an approved source (e.g., the activity water supply). Portable recirculation tanks will be used during the drilling operation. If drilling mud is necessary, additives will be restricted to Envirogel® or other pure bentonite mud. No organic drilling fluid additives will be used.

The drill rigs will be cleaned between the different sites to prevent tracking of contaminants between sites. All down-hole equipment will be decontaminated between holes (see Section SHA3.0 of Sample Handling and Analysis Plan). Drill rod joints will be free of grease or oil.

For installation of 2-in.-ID well casings, boreholes with a minimum diameter of 6 in. will be drilled. The drilling rig will be equipped with both 3-in.-diameter thin-walled tube samplers, and 2.5-in.-diameter split spoon samplers to permit sampling of cohesive and noncohesive soils, respectively.

During drilling, soil samples will be collected and labeled by the Team Leader who logs the borehole and performs typical field tests on the samples. The field tests may include pocket penetrometer or Torvane measurements and visual classification according to the Unified Soil Classification System. Boring logs constructed during drilling will record sample number and depth; soil type, color, and soil consistency; depths of the boring and the water table; method of sampling and drilling; dates of well completion and development; and any water losses, if applicable.

The borings will be completed to the depths specified in Section 3.0. Cuttings generated during drilling of the boreholes will be contained in drums and held onsite until chemical analyses of the soil have been completed. The wells will be installed as soon as possible, no later than 24 hours following borehole completion. If a borehole must be abandoned, abandonment will be conducted by sealing the boring with grout (Section 4.3).

4.2.2 Well Completion. All wells will be installed under supervision of a licensed water well driller for the State of South Carolina. All wells will be completed in accordance with the South Carolina regulations regarding monitoring well installation. A typical well construction diagram is presented in Figure 4-1. Well casings will be constructed of new, Schedule 40 PVC, 2-in.-inside diameter (ID), threaded, and flush jointed.

Well screens will be new, factory slotted, 2-in.-ID Schedule 40 PVC, threaded, flush jointed. Screen slot openings will be 0.010 inch. Screen lengths will vary depending on the site conditions from 5 to 15 ft in length.

If necessary, stainless steel centralizers will be installed immediately above the screen to center the casing in the borehole.

A sand pack will be installed in the annulus between the borehole and the screen. The pack will consist of clean, inert sand such as Clemtex No. 2 or equivalent, filled from the bottom of the borehole to at least 1 ft above the top of the screen. Commercial, granular bentonite or bentonite pellets will be used to form a seal, at least 1 ft thick, above the sand pack. After the bentonite seal has been allowed to swell, grout will be placed from the top of the bentonite seal to the ground surface. The well will be completed at the surface with a concrete pad in accordance with the state requirements. The grout mix is presented in Section 4.4.

A vented PVC cap will be provided for each well. In addition, a protective steel casing will be installed in the concrete pad. For above ground completion, the steel casing (at least 4-in.-diameter) will rise 2 to 3 ft above ground level and close with a cover and padlock.

Following completion of the borehole, but prior to completion of the well, flushing with clean, potable water may be necessary to remove any particulate-laden fluid (drilling mud), if wet-rotary methods were used, and to facilitate placement of the well and grout. After the well casing has been

centered in the open borehole, the annulus will be filled with sand from the bottom of the boring upward using a tremie pipe. The sand pack will be sealed from one foot above the top of the well screen with bentonite. Cement-bentonite or neat cement grout will be placed from the top of the bentonite seal to the ground surface, using a tremie pipe, if necessary, to insure that the grout forms a continuous collar around the well casing. After 24 hours, more grout will be added to account for settlement.

Completion details for each monitoring well will be recorded on the appropriate NAVFAC forms and diagrams. The well diagram will include the following:

- bottom of the borehole,
- screened interval and slot size,
- sand pack interval,
- thickness of bentonite seal,
- depth to base of grout backfill,
- height of riser,
- details of the protective casing,
- well location,
- ground surface and top of well casing elevations,
- design of joints and centralizers, and
- boring and well completion dates.

4.2.3 Wellpoint Installation. The 1-1/4-in.-ID, stainless steel wellpoints will be driven into the ground in 5-ft sections. The bottom section will consist of stainless steel, wire-wound well screen with a pointed tip. The point will be formed of rolled stainless steel and will be welded to the bottom end of the screen without lead or solder of any kind. The couplings used to attach the screen to the blank pipe and to attach each additional section of blank pipe will be threaded stainless steel and will also require no soldering.

The wellpoints will be installed with a jackhammer, powered by electricity or compressed air. At dry-land locations, surface completion will consist of a 2- to 3-ft stainless steel riser or stick up, vented cap and concrete pad. At marsh locations, the stainless steel riser will extend above the low-tide water level. At each of these wellpoints, a PVC extension pipe

will be attached to the stainless steel pipe, so that at high tides the top of the riser is above the water level and no leakage occurs through the vented cap. The connection between the stainless steel and PVC pipe will be water tight, but threaded so that the PVC riser can be removed during sampling.

The wellpoints will be developed and sampled in the same manner as the monitoring wells.

4.2.4 Well Development. Well development will begin at least 24 hours after installation of the well and placement of the grout in the borehole. Development will be performed using either a compressed air method, a manual bottom-filling bailer, or hand pump. The volume of water removed during development will equal a minimum of three times the volume of water standing in the well casing plus three times the volume of any water lost during well installation. For wells set in low permeable material, when it is not possible to remove these quantities of water, the well will be evacuated completely and allowed to recover before sampling. Development will entail the following procedures:

- measurement of water levels and total well depths before and after development;
- recording of changes in clarity, color, and odor noted in the water during development, as well as the total volume of water removed and rate of removal; and
- continuing development until the water appears clear, the sediment thickness in the well is less than 5% of the screen length, and the required volume has been removed.

4.3 Borehole Grouting

Each borehole will be grouted from the bottom up to minimize cross-contamination from the surface or from other strata penetrated during drilling. Because the grout mix is more dense than the drilling fluid, it will be used to displace the drilling fluids in the borehole. The drill pipe will be withdrawn while periodically filling the borehole with grout pumped through the drill pipe or through a tremie pipe.

The grout mix will consist of 5 to 10 gallons of water per sack (94 lb) of Portland Type I cement, up to but not greater than 7.5 lbs of bentonite.

Wellpoints will not require grout above the screen because: (1) wellpoint will be installed to very shallow depths, and (2) there is no annular

space between outside diameter of the casing and the formation. At these locations, the prevention of infiltration from the ground surface (surface water) will be accomplished with the use of the concrete pad placed around each wellpoint at ground surface.

Due to their small diameter (1/2 in.), holes made while pushing the vadose zone vapor probe and cone penetrometer will not be grouted. These holes will not penetrate through any layers which appear to contain the downward movement of contaminants. Additionally, the probe will be used only at shallow depths (e.g., less than 20 ft). The VZV Probe® will not be pushed below the water table.

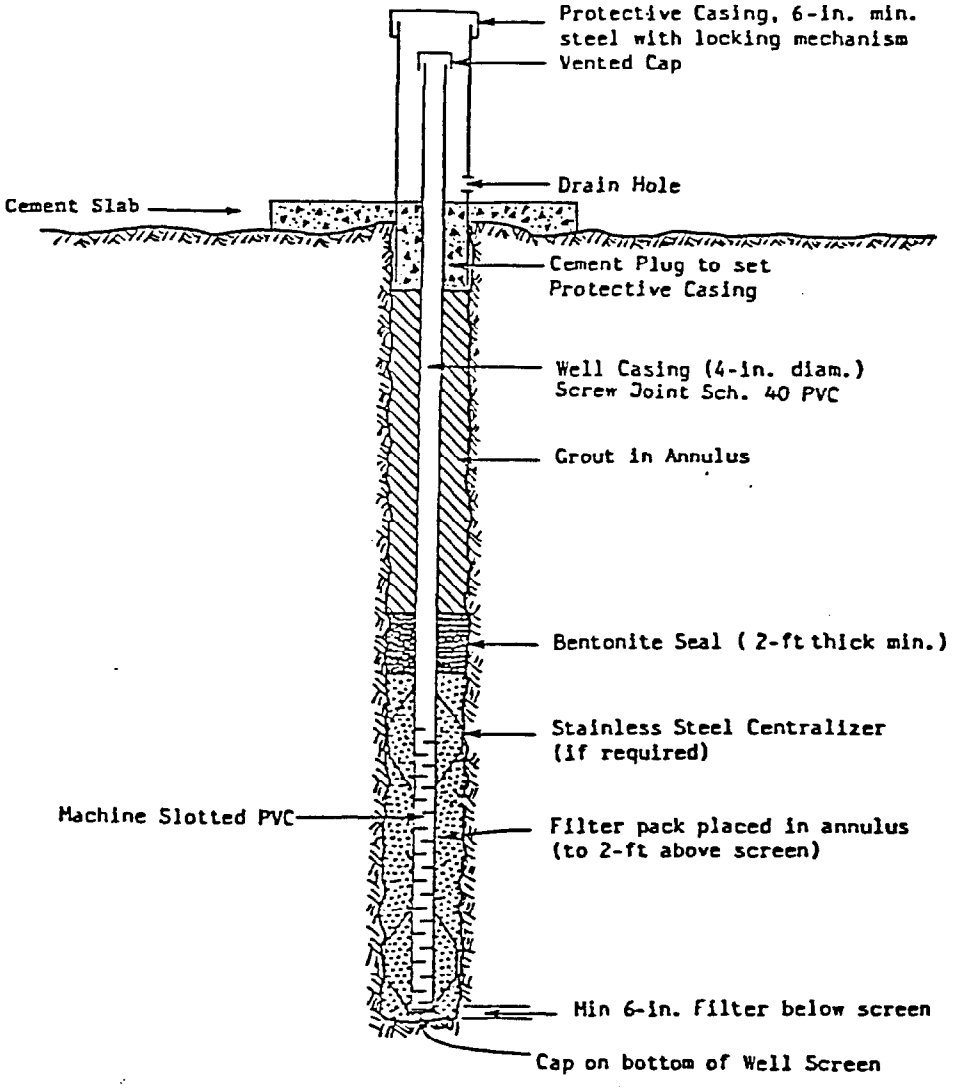


Figure 4-1.--Typical well construction diagram.

Table 4-1
Summary of Sampling, Preservation, and Analysis
Soil Samples

Parameter	Extraction Methods	Analytical Method	Sample Container	Preservation
Volatiles	5030[b]	8240[b]	Pint glass jar with foil-lined lid	Cool <4°C
Semivolatiles	3550[b]	8270[b]	(one sample jar for all analyses)	
Pesticides/PCBs	3540 or 3550[b]	8270[b]		
Metals (Sb, As, Ba, Cd, Cr, Pb, Hg, Ni, Se, Ag)	3050[b]	Section 7000[b]		
Chromium, hexavalent				
Cyanides		335.2 or 335[a]		
Total Organic Halogens (TOX)		9020[b]		
Oil and Grease		413.1[a]		

[a] From "Methods for Chemical Analysis of Water and Wastes," EPA, 1979.
[b] From "Test Methods for Evaluating Solid Waste," EPA SW-846, July 1982.

Table 4-2
Summary of Sampling, Preservation, and Analysis
Water Samples

Parameter	Analytical Methods	Sample Container	Preservation
Volatiles	601, 624[a]	Two 40 ml glass VOA vials with Teflon-lined septa. No headspace	No bubbles, pack in inverted position, Cool <4°C
Acid Extractables Base/Neutral Extractables Pesticides/PCBs Dioxins	625[a] 625[a] 608[a] 8250[d]	Half-gallon amber glass bottle with Teflon-lined lid	Cool <4°C
Metals (Sb, As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Hg, Mn, Ni, Se, Ag, Zn)	Section 200[b]	250 ml plastic bottle	Filter on site, HNO_3 to pH <2, Cool <4°C
Cyanide	335.2 or 335.3[b]	500 ml plastic bottle	NaOH to pH >12, Cool <4°C
Phenols, Total	420.1[b]	500 ml glass bottle	H_3PO_4 to pH <4, 0.5 g $CuSO_4$, Cool <4°C
Nitrates	352.1[b]	250 ml plastic bottle	H_2SO_4 to pH <2, Cool <4°C
Total Organic Carbon	415.1[b]	250 ml plastic bottle	HCl to pH <2, Cool <4°C
Chloride Chromium, hexavalent Salinity Sulfate Total Dissolved Solids	407A, 407B[c] 218.4[b] 210[c] 426C[b] 160.1[b]	One quart plastic bottle	Cool <4°C

Table 4-2 Continued

Parameter	Analytical Methods	Sample Container	Preservation
Total Organic Halogens	9020[d]	500 ml amber glass bottle No headspace	Cool <4°C
pH	150.1[b]	250 ml plastic	Determined on site
Temperature			
Specific Conductance	120.1[b]		
Gross Beta Activity	900[d]	Half-gallon plastic bottle with Teflon-lined lid	Cool <4°C
Gross Alpha Activity	900[d]		

a From "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA.
b From "Methods for Chemical Analysis of Water and Wastes," EPA, 1979.
c From "Standard Methods for the Examinataion of Water and Wastewater," American Public Health Association, 14th Edition.
d From "Test Methods for Evaluating Solid Waste," EPA SW-846, July 1982.
e From "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032 (1980 update), U.S. Environmental Protection Agency, August 1980.

5.0 RECOMMENDATIONS AND SCHEDULE

Our recommendations for the Verification Step site activities at MCRD Parris Island, South Carolina are presented in Tables 5-1 through 5-7. Each table summarizes the recommended activities at each of the twelve sites. A schedule for all the verification activities, including project milestones is shown in Figure 5-1.

Table 5-1

Recommended Verification Step Activities

Site 1 - Incinerator Landfill

Activity	Description
Wellpoint Installation	Install 3 15-ft wellpoints in surrounding marsh area.
Soil/Sediment Sampling	Collect 3 sediment samples from 0 to 2-ft depth at each of 3 locations at site.
Monitoring Well Installation	Install 1 monitoring well to an approximate total depth of 15 ft.
Groundwater Sampling	One set of groundwater samples will be taken. Water levels will be recorded prior to sampling activities.
Survey	Well and wellpoint locations will be surveyed.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	Analyses for Priority Pollutants (volatiles, acid and base/neutral extractables, pesticides, PCBs); dissolved (water) or total (sediment) metals; TOC, pH, SC, EP Toxicity metals (As, Cd, Cr, Pb, Hg).

Table 5-2
Recommended Verification Step Activities
Site 2 - Borrow Pit Landfill

Activity	Description
Soil/Sediment Sampling	Collect 1 sediment sample from 0 to 2-ft depth at each of 3 locations at site.
Surface Water Sampling	Collect 1 surface water sample at each sediment sampling location.
Monitoring Well Installation	Install 3 monitoring wells to an approximate total depth of 30 ft.
Groundwater Sampling	One set of groundwater samples will be taken. Water levels will be recorded prior to sampling activities.
Survey	Well locations will be surveyed.
Surface Water Runoff Sampling	1 sample will be collected of standing or ponded water at the site.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	Analyses for Priority Pollutants (volatiles, acid and base/neutral exractables, pesticides, PCBs); dissolved (water) or total (sediment) metals; TOC, pH, SC; EP Toxic metals (As, Cd, Cr, Pb, Hg).

Table 5-3
Recommended Verification Step Activities
Site 3 - Causeway Landfill

Activity	Description
Soil/Sediment Sampling	Collect 8 sediment samples from 0 to 2-ft depth at each of 8 locations at site.
Surface Water Sampling	Collect 8 surface water samples at each sediment sampling location.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	Analyses for Priority Pollutants (volatiles, acid and base/neutral extractables, pesticides, PCBs); dissolved (water) or total metals (sediment); TOC; pH, SC; EP Toxic metals (As, Cd, Cr, Pb, Hg).

Table 5-4
Recommended Verification Step Activities
Site 4 - Dredge Spoils Area Fire Training Pit

Activity	Description
Soil/Sediment Sampling	Collect 5 sediment samples from 0 to 20-ft depth at each of 5 locations at site.
Monitoring Well Installation	Install maximum 3 monitoring wells to an approximate total depth of 20 ft.
Groundwater Sampling	One set of groundwater samples will be taken if wells are installed. Water levels will be recorded prior to sampling activities.
Survey	Well locations will be surveyed if wells are installed.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	For water samples (if collected) analyses for Priority Pollutants (volatiles, acid and base/neutral extractables); TOX, pH, SC. If sediment samples only are collected, analyses for dissolved (water) or total (sediment) metals; EP Toxic metals (Cd, Cr, Pb).

Table 5-5
Recommended Verification Step Activities
Site 6 - Former Automotive Hobby Shop Spill Area

Activity	Description
Soil/Sediment Sampling	Collect 6 sediment samples from 0 to 12-ft depth at 1 location at site.
Monitoring Well Installation	Install maximum 1 monitoring well to an approximate total depth of 12 ft.
Groundwater Sampling	One set of groundwater samples will be taken. Water level will be recorded prior to sampling activities.
Survey	Well location will be surveyed.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	Analyses for Priority Pollutants (volatiles, base/neutral extractables); TOC, SC, pH, oil and grease, dissolved metals.

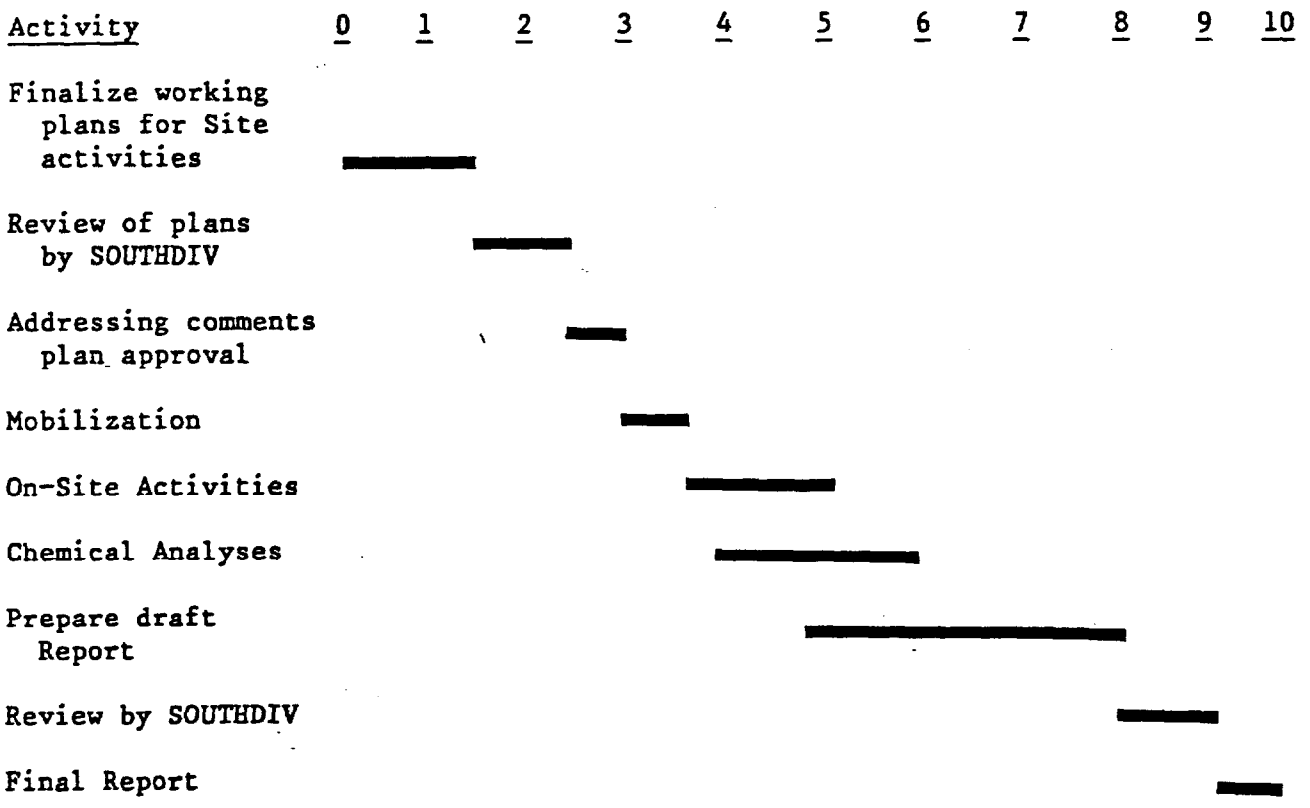
Table 5-6
Recommended Verification Step Activities
Site 16 - Pesticide Rinsate Disposal Area

Activity	Description
Soil/Sediment Sampling	Collect sediment samples from 0 to 15-ft depth at each of 3 locations at site.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	Analyses for Priority Pollutants (pesticides); total (sediment) metals.

Table 5-7
Recommended Verification Step Activities
Site 17 - Page Field AVGAS Tanks,
Site 18 - Page Field AVGAS Tanks,
Site 19 - MCX Service Station Exchange

Activity	Description
Monitoring Well Installation	Install 4 monitoring wells to an approximate total depth of 15 ft.
Groundwater Sampling	One set of groundwater samples will be taken. Water levels will be recorded prior to sampling activities.
Survey	Well locations will be surveyed.
Sample Screening	Headspace from sediment samples will be analyzed by OVA/GC.
Chemical Analyses	Analyses for Priority Pollutants (benzene, toluene, xylene); dissolved metals.
VZV Probe® Survey	Survey performed to identify areas containing organic vapors in the soil gas.

Figure 5-1
Work Schedule



6.0 REFERENCES

Dames & Moore, "Initial Assessment Study of Marine Corps Recruit Depot, Parris Island, South Carolina, UIC: M00263," prepared for Environmental Restoration Department, Naval Energy and Environmental Support Activity, Port Hueneme, California 93043, August 1986.