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INITIAL ASSESSMENT STUDY MCRD PARRIS ISLAND SC

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DAMES AND MOORE

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September 1986

INITIAL ASSESSMENT STUDY OF MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SOUTH CAROLINA

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NEESA 13-095

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY

Port Hueneme, California 93043

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INITIAL ASSESSMENT STUDY

OF

MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SOUTH CAROLINA

UIC: M00263

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EXECUTIVE SUMMARY

This report presents the results of the Initial Assessment Study (IAS) conducted at the Marine Corps Recruit Depot (MCRD), Parris Island, South Carolina. The purpose of an IAS is to identify and assess sites posing potential threats to human health or to the environment due to contamination from past handling of hazardous materials.

Based on information from historical records, aerial photographs, surface and aerial surveys, and personnel interviews, sixteen potentially contaminated sites were identified. Each site was evaluated for contamination characteristics, migration pathways, and pollutant receptors.

MCRD Parris Island is located on barrier-island sand, silt, and clay deposits that contain a surficial aquifer. While there is potential for contamination of this aquifer at MCRD Parris Island, its shallow depth and geographic isolation from other land masses would prevent contamination from migrating off-base to areas that use the surficial aquifer as a water source. At the Depot, the surficial aquifer is intercepted by the nearby marshes, creeks, and the Beaufort and Broad Rivers; any contamination reaching this aquifer would be discharged to these surface water bodies. These surface waters are important habitats for commercially harvested shellfish and finfish, as well as for migratory threatened and endangered species (the southern bald eagle, the wood stork, the eskimo curlew, and the short-nosed sturgeon) and their food sources. Therefore, contamination of these waters could result in adverse impact to human health and the environment.

The deeper Tertiary Limestone Aquifer, which is an important water supply source for Beaufort County and other areas to the south, is also present beneath the Depot. However, a confining layer separates the deep aquifer from the surficial aquifer and prevents vertical mixing and migration of contaminants to the deep aquifer. Below the entire Depot, salt water intrusion has contaminated the deeper aquifer, while the surficial aquifer has high contents of both saltwater and sulfur. These conditions prevent either aquifer from being used as a water supply source for the Depot.

Surface runoff from the developed part of the Depot enters a complex storm sewer system with approximately 60 outfalls, which empty into the marshes along the perimeter of the Depot. Undeveloped areas of the Depot have drainage ditches which empty into the adjacent marshes and creeks.

Though none of the sixteen sites poses an immediate threat to human health or the environment, this study concludes that six sites warrant further investigation under the NACIP Program to assess potential long-term impacts. A Confirmation Study involving sampling and testing is recommended to confirm or deny the existence of the suspected contamination and to quantify the extent of any problems that may exist.

The six sites recommended for confirmation are listed below in order of priority (i.e., confirmation study ranking scores):

(1) Site 3--Causeway Landfill
(2) Site 1--Incinerator Landfill
(3) Site 16--Pesticide Rinsate Disposal Area
(4) Site 4--Dredge Spoils Area Fire Training Pit
(5) Site 2--Borrow Pit Landfill
(6) Site 6--Former Automotive Hobby Shop Spill Area

The Confirmation Studies at these sites will determine whether a threat to human health or the environment exists, the extent of contamination, and the potential for contaminant migration. The necessity for conducting remedial measures or cleanup operations will then be determined by evaluation of the results of the Confirmation Studies.

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FOREWORD

The Department of the Navy developed the Navy Assessment and Control of Installation Pollutants (NACIP) program to identify and control environmental contamination resulting from past methods of storage, handling, and disposal of hazardous substances at Navy and Marine Corps facilities. The NACIP Program is part of the comprehensive Department of Defense Installation Restoration Program and resembles the Environmental Protection Agency's "Superfund" program, authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

In the first phase of the NACIP Program, a team of scientists and engineers conducts an Initial Assessment Study (IAS). The IAS team collects and evaluates evidence of contamination that pose a potential threat to human health or the environment. The IAS includes a review of archival and activity records, interviews with activity personnel, and an on-site survey of the activity. This report documents the findings of an IAS at the Marine Corps Recruit Depot (MCRD), Parris Island, South Carolina.

A total of 16 past disposal and potentially contaminated sites were identified. Further confirmation studies under the NACIP program are recommended for six of these sites. Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) will assist MCRD Parris Island in implementing the recommendations.

Questions regarding this report should be referred to the Naval Energy and Environmental Support Activity (NEESA) Code 112N, at AUTOVON 360-3351, FTS 799-3351, or commercial 805-982-3351. Questions concerning confirmation work or other follow-up efforts should be referred to SOUTHNAVFACENGCOM Code 114 at AUTOVON 563-5510, FTS 573-5510 or commercial 803-743-5510.

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- H. Calvin Garnett, Environmental Affairs Officer, MCRD Parris Island
- Gale Evans, Environmental Engineer, SOUTHNAVFACENGCOM
- Elizabeth Luecker, Engineer-in-Charge, NEESA
- Gerald A. Hels, Project Engineer, NEESA

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CHAPTER 1. INTRODUCTION

1.1 PROGRAM BACKGROUND. Past hazardous waste disposal methods, though acceptable at the time, have often caused unexpected long-term problems by releasing hazardous pollutants into the soil and ground water. In response to a growing recognition of these problems, the U.S. Congress directed the U.S. Environmental Protection Agency (EPA) to develop a comprehensive national program to manage past disposal sites. The program is outlined in the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of December 1980.

1.1.1 DOD Program. Department of Defense (DOD) efforts in this area preceded the nationwide CERCLA program. In 1975 the U.S. Army developed for DOD a pilot program to investigate past disposal sites at military installations. In 1980, DOD named this program as the Installation Restoration Program and instructed the services to comply with program guidelines.

1.1.2 Navy Program. The Navy manages its part of the program, the Navy Assessment and Control of Installation Pollutants (NACIP), in three phases. Phase one, the Initial Assessment Study (IAS), identifies potential disposal sites and contaminated areas caused by past hazardous substance storage, handling, or disposal practices at naval activities. These sites are then individually evaluated with respect to their potential threats to human health or to the environment. Phase two, the Confirmation Study, verifies and characterizes the extent of contamination present at sites of concern and develops additional information regarding their migration pathways. Phase three, the Remedial Measure, provides the required corrective measures to mitigate or eliminate confirmed problems.

1.2 AUTHORITY. The Chief of Naval Operations (CNO) and the Commandant of the Marine Corps (CMC) initiated the NACIP Program in OPNAVNOTE 6240 of 11 September 1980 and MCO 6280.1 of 30 January 1981. These were superseded by OPNAVINST 5090.1 of 26 May 1983 and MCO P11000.8B of 9 December 1983. The Naval Facilities Engineering Command (NAVFACENGCOM) manages the program within the existing structure of the Naval Environmental Protection Support Service (NEPSS), which is administered by the Naval Energy and Environmental Support Activity (NEESA). NEESA conducts the program's first phase, the IAS, in coordination with NAVFACENGCOM Engineering Field Divisions (EFDs). Activities are selected for an IAS by CNO based on recommendations by NAVFACENGCOM, the regional EFD, and NEESA. Specific approval of the Marine Corps Recruit Depot (MCRD) in Parris Island, South Carolina, for an IAS is contained in CNO letter ser 451/44383534 of 26 March 1984.

1.3 SCOPE.

1.3.1 Past Operations. The NACIP Program focuses on past hazardous substance storage, use, and disposal practices on Navy property. Current practices are regularly surveyed for conformity to state and federal regulations, and therefore are not included in the scope of the NACIP Program. The IAS report addresses operational nonhazardous disposal and storage areas only if they

were hazardous waste disposal or storage areas in the past. Current operations are investigated solely to infer what types and quantities of chemicals were used and what disposal methods were practiced in the past.

1.3.2 Results. If necessary, an IAS recommends remedial measures to be performed by the activity or EFD, or recommends Confirmation Studies to be administered by the EFD under the NACIP Program. Based on these recommendations, NAVFACENGCOM schedules Confirmation Studies for those sites determined by scientific and engineering judgment to be potential hazards to human health or to the environment.

1.4 INITIAL ASSESSMENT STUDY.

1.4.1 Records Search. The Initial Assessment Study begins with an investigation of activity records followed by a records search at various government agencies including EFD's, national and regional archives and records centers, and U.S. Geological Survey offices. In this initial step, study team members review records to assimilate information about the activity's past missions, industrial processes, waste disposal records, and known environmental contamination. Typical examples of records include activity master plans and histories, environmental impact statements, cadastral records, and aerial photographs. Appendix A lists the agencies contacted during this study.

1.4.2 On-Site Survey. After the records search, the study team conducts an on-site survey to complete documentation of past operations and disposal practices and to identify potentially contaminated areas. With the assistance of an activity point-of-contact, the team inspects the activity during ground and aerial tours, and interviews long-term employees and retirees. The on-site survey for MCRD Parris Island was conducted from 28 October through 1 November 1985; information in this report is current as of those dates.

Information obtained from interviews is verified by data from other sources before inclusion in the report. If information for certain sites is conflicting or inadequate, the team may collect samples for clarification.

1.4.3 Confirmation Study Ranking System. With information collected during the study, team members evaluate each site for its potential hazard to human health or to the environment. A two-step Confirmation Study Ranking System (CSRS) developed at NEESA is used to systematically evaluate the relative severity of potential problems. The first step, a flowchart based on types of waste, containment, and hydrogeology, eliminates innocuous sites from further consideration. If the flowchart indicates a site poses a potential threat to human health or to the environment, the second step, a numerical ranking model, is applied. This model assigns a numerical score from 0 to 100 to each site. The score reflects the characteristics of the wastes, the potential migration pathways from the site, and possible contaminant receptors on and off the activity.

1.4.4 Site Ranking. After a site is rated, engineering judgment determines the need for a confirmation study or an immediate mitigating action. At sites

recommended for further work, CSRS scores are used to develop a priority list for scheduling projects. For a more detailed description, refer to NEESA 20.2-042, Confirmation Study Ranking System.

1.4.5 Confirmation Study Criteria. A Confirmation Study is recommended for sites at which (1) sufficient evidence exists to indicate the presence of contamination, and (2) the contamination poses a potential threat to human health or to the environment.

1.5 CONFIRMATION STUDY. Generally, the EFD conducts the Confirmation Study in two phases--verification and characterization. In the verification phase short-term analytical testing and monitoring determine whether specific toxic and hazardous materials, identified in the Initial Assessment Study, are present in concentrations considered to be hazardous. Normally, the IAS recommends verification phase sampling and monitoring. If required, a characterization phase, involving longer-term testing and monitoring, provides more detailed information concerning the horizontal and vertical distribution of contamination migrating from sites, as well as site hydrogeology. The design of the characterization phase usually depends on results from the verification phase. If sites require remedial measures or additional monitoring programs, the Confirmation Study recommendations include the necessary planning information for the work, such as design parameters.

1.6 IAS REPORT CONTENTS. The significant findings and conclusions from the IAS are presented in Chapter 2 of this report. Confirmation study recommendations are presented in Chapter 3. Chapter 4 describes general activity information, history, biology and physical features. Chapters 5 through 8 trace the use of chemicals and hazardous materials from storage and transfer, through manufacturing and operations, to waste processing and disposal. The later chapters provide detailed documentation to support the findings and conclusions in Chapter 2.

Appendix A identifies government agencies contacted during the records search; Appendix B provides a list of acronyms and abbreviations used in this report. An activity layout geodetic map (GDM) showing the identified sites is included in the map pocket at the end of the report.

CHAPTER 2. SIGNIFICANT FINDINGS AND CONCLUSIONS

2.1 INTRODUCTION. This chapter summarizes the Initial Assessment Study (IAS) team's significant findings and conclusions on potential contamination migration pathways, potential contaminant receptors, and characteristics of the past disposal and spill sites identified at the Marine Corps Recruit Depot (MCRD) at Parris Island. Regional and vicinity maps presented in Figures 2-1 and 2-2 show the location of MCRD Parris Island. Sixteen sites were identified during the IAS. Six of the sites identified are recommended for confirmation studies. An activity layout map (with geodetic coordinates) showing the location of the sixteen sites is included in the map pocket (insert 1). Summary information concerning the identified sites is provided in Table 2-1.

2.1.1 Hydrogeology and Migration Potential. MCRD Parris Island is located upon 30 to 40 feet of Pleistocene sand, silt, and clay containing a surficial aquifer. Salt water intrusion and high sulfur content from decaying vegetation have made this aquifer unusable as a potable water source. Some 20 to 30 feet of the low permeability Hawthorn Formation lies below the surficial aquifer. This formation acts as a confining layer that effectively separates the surficial aquifer from the Tertiary Limestone Aquifer that lies below the Hawthorn. The Tertiary Limestone Aquifer is the primary potable water source for the Beaufort County area and areas to the south but, because of local saltwater contamination, this aquifer is not used as a water source at MCRD Parris Island.

The surficial aquifer is composed mostly of sand beneath the dry areas of the base. Clay underlies the wet areas between the many islands. Contamination of this aquifer would quickly migrate laterally through the sandy zones, and the water would discharge into the nearby marshes and rivers. Ground water contamination would not move to land areas off the base, because the tidally influenced rivers surrounding the base would intercept the surficial aquifer water.

The surficial aquifer water table experiences fluctuations due to tidal changes for a distance of at least 1,800 feet from the marsh edge. Water table depths range from 0 to 10 feet and seasonal changes can be as great as 6.5 feet. Hydraulic conductivity is approximately 1 foot per day (4×10^{-4} centimeters per second) and hydraulic gradients are always less than 1 percent unless deep drainage channels are present. The low permeability Hawthorn Formation and the artesian pressure of the Tertiary Limestone Aquifer physically and hydrologically separate the two aquifers and prevent any surficial aquifer contamination from moving vertically to the lower aquifer.

2.1.2 Potential Contaminant Receptors. Potential contaminant receptors would be limited to those receptors that utilize surficial aquifer water or surface water draining from the contaminated sites. Discharge of the aquifer and surface water would be into the marshes, tidal streams, and rivers that encircle the Depot. Surface water contaminants would discharge into the

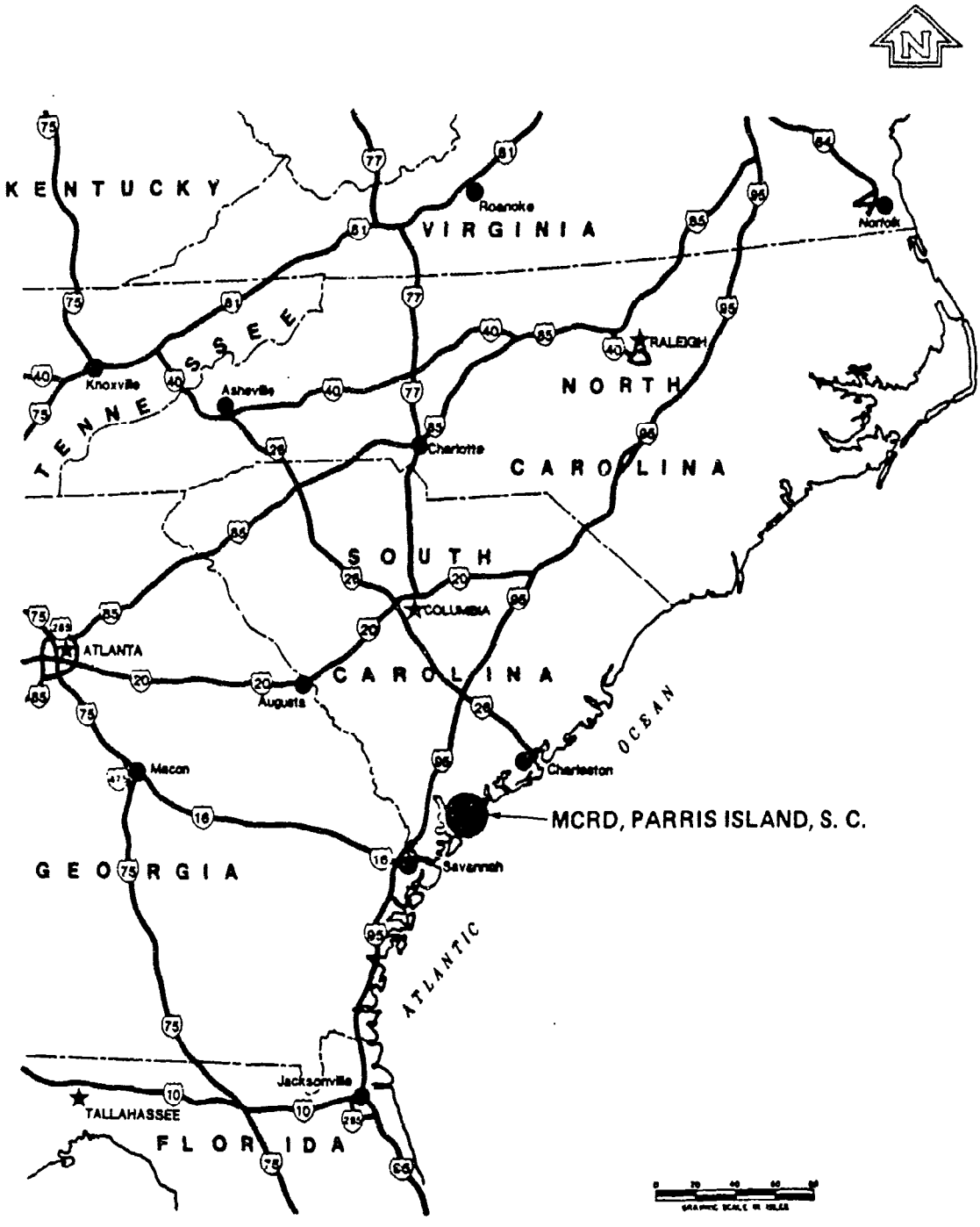

FIGURE 2-1
REGIONAL MAP

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

Dames & Moore

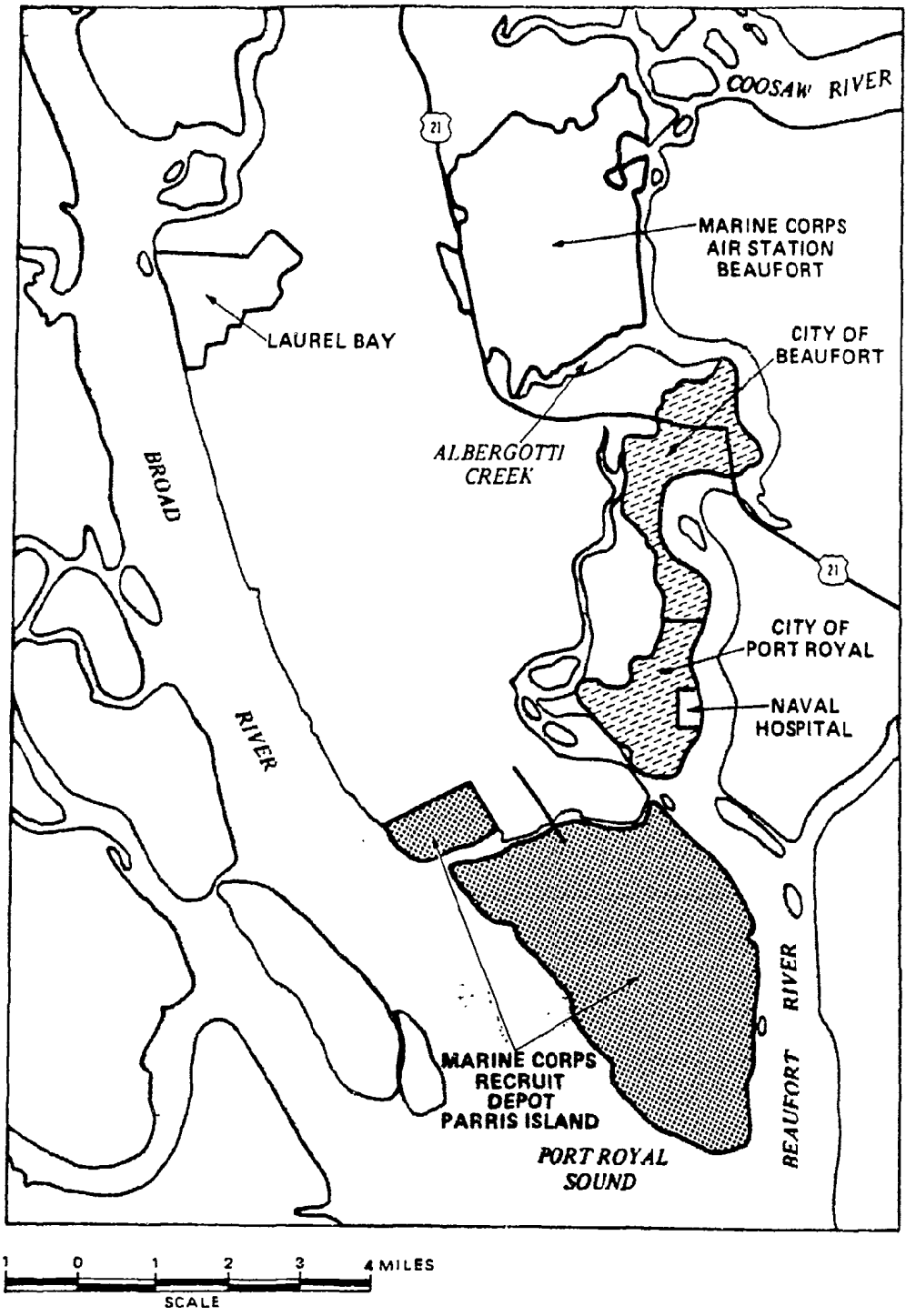

FIGURE 2-2
VICINITY MAP

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

Dames & Moore

TABLE 2-1

Summary of Site Information at MCRD Parris Island

Site Number	Site Name	Site Location	Period of Disposal	Waste Types	Estimated Total Quantity	Primary Sources
1	Incinerator Landfill	NE tip of Horse Island; N of Malecon Drive (GDM N-9)	1921 to 1965 (~45 yrs)	domestic trash and	24,000 ton	Entire Depot
				incinerator ash;		Incinerator
				construction debris;	unknown	Entire Depot
				solid paint wastes (1)	95 ton	Paint Shop: Former Naval Hospital
				paint thinners (2);	40,000 gal	Paint Shop
				paint strippers (3);	300 gal	Paint Shop
				empty pesticide containers;	58,000	Pest Control Shop
				cleaning rags (4);	6 ton	Garages and Shops
				spent absorbent;	500 lb	Automotive Hobby Shop
				solvent sludge (5);	4 lb	Automotive Hobby Shop
				perchlorethylene still bottoms;	2,600 gal	Dry Cleaning Plant
				solvent filters;	unknown	Dry Cleaning Plant
				mercury amalgam;	4 ton	Dental Clinic
				beryllium waste;	2 lb	Dental Clinic
				metal shavings;	2 ton	Mechanical Trades Shops
				PCB-contaminated oil;	43 lb	Electrical Shop
				paint stripping residues (6)	700 gal	Furniture/Upholstery Shop
				wood preserving residues (7)	400 gal	Furniture/Upholstery Shop
2	Borrow Pit Landfill	N-central Horse Island W of Malecon Drive; NE Rod and Gun Club (GDM Q-10)	1966 to 1968 (3 yrs)	domestic trash;	33,000 tons	Entire Depot
				construction debris;	unknown	Entire Depot
				solid paint wastes (1);	16 ton	Paint Shop
				paint thinners (2);	8,400 gal	Paint Shop
				Paint strippers (3);	60 gal	Paint Shop
				cleaning rags (4)	2 ton	Garages and Shops
				spent absorbent;	3,600 lb	Automotive Hobby Shop
				solvent sludge (5);	24 lbs	Automotive Hobby Shop
				perchlorethylene still bottoms;	3,300 gal	Dry Cleaning Plant
				metal shavings;	1 ton	Mechanical Trades Shops
				PCB-contaminated oil;	6 lb	Electrical Shop
				mercury amalgam;	1 ton	Dental Clinic
				beryllium waste.	2 lb	Dental Clinic
3	Causeway Landfill	Causeway between Horse Island and Parris Island; W of Malecon Drive (GDM L-13, M-12, N-11)	1960 to 1972 (~10 yrs)	domestic trash;	50,000 ton	Entire Depot
				construction debris;	unknown	
				solid paint wastes (1);	28.2 ton	Paint Shop
				empty pesticide containers;	20,000	Pest Control Shop
				cleaning rags (4);	3 ton	Garages and Shops
				spent absorbent;	2 ton	Automotive Hobby Shop
				solvent sludge (5);	32 lb	Automotive Hobby Shop
				perchloroethylene still bottoms;	5,600 gal	Dry Cleaning Plant
				mercury amalgam;	2 ton	Dental Clinic
				beryllium waste;	3 lb	Dental Clinic
				PCB-contaminated oil.	15 lb	Electrical Shop

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TABLE 2-1 (cont'd)

Summary of Site Information at MCRD Parris Island

Site Number	Site Name	Site Location	Period of Disposal	Waste Types	Estimated Total Quantity	Primary Sources
4	Dredge Spoils Area Fire Training Pit	600' NE of Cuba Street and Ballast Creek junction; near (beneath) SE corner of Dredge Spoils Area. (GDM C-18)	1940's to mid-1960's (~20 yrs)	contaminated fuels, waste oils, spent solvents, (kerosene, gasoline, mineral spirits, Varsol), hydraulic fluids.	12,000 gal (8)	Garages and other Shops
5	Former Paint Shop Disposal Area	Adjacent to Structure 160A; Edge of Beaufort River; 50' NNE of NE corner of Structure 95. (GDM C-12)	1930's to 1960 (~30 yrs)	paint scrapings from mixing tank.	17 ton	Paint Shop
6	Former Automotive Hobby Shop Spill Area	Adjacent to S wall of Building AS26; 150' S of Lexington Blvd. (GDM F-22)	1969 to 1982 (~18 yrs)	waste lube oil.	2,000 gal (8)	Automotive Hobby Shop (privately owned vehicles)
7	Page Field Fire Training Pit	170' SSW of S end of Henderson Street; on concrete apron along W edge of former Structure. (GDM F-23)	Mid-1960's to 1976 (~11 yrs)	contaminated fuels, waste oil, spent solvents, (kerosene, gasoline, mineral spirits, diesel fuel, Varsol), hydraulic fluids.	< 50 gal (8)	Garage and other Shops
8	PCB Spill Area (two locations)	Adjacent to Building 111 (GDM E/F-14)	1984	PCB-contaminated oil.	unknown (9)	PCB transformer
		Adjacent to Building 450 (GDM K-11).	1983	PCB-contaminated oil.	unknown (9)	PCB transformer storage
9	Paint Waste Storage Area	Between Quonset Hut N277 and Building 895 (GDM J-11)	1969-1984	Paint thinners and strippers (2),(3).	unknown (10)	Paint Shop
10	Gasoline Spill Area	Gasoline Station Adjacent to Building 850 (GDM I-12).	1983	Unleaded gasoline.	97 gal	Gasoline Station
11	MCX Service Station Spill Area	MCX Service Station; Adjacent to Building 170 (GDM F 12)	1969-1983	Waste motor oil.	50 55-gallon drums contaminated soil	MCX Service Station

TABLE 2-1 (cont'd)

Summary of Site Information at MCRD Parris Island

Site Number	Site Name	Site Location	Period of Disposal	Waste Types	Estimated Total Quantity	Primary Sources
12	Jericho Island Disposal Area	Southern tip of Jericho Island	1955-1968	Domestic trash.	Unknown	Local Residents
13	Inert Disposal Areas (three locations)	Southeastern tip of Area TA-3 GDM K-24/25/26);	1976-1979	Construction debris and yard wastes.	Unknown	Entire Depot
		Southern side of Horse Island (GDM P-11)	1979-Present			
		Dredge Spoils Area (GDM C-18)	1981-1985	Dredge spoils.	100,000 cu. yd	Ballast Creek and Marina
14	Storm Sewer Outfall	60 surface water locations	1918-1985	waste oil	4,500 gal	Garages and other Shops
				anti freeze	2,700 gal	Garages
				battery acid	2,700 gal	Garages
				x-ray fixer	1,000 gal	Dispensary/Dental Clinic
				photo fixer	4,200 gal	Photo Lab
				developer	4,200 gal	Photo Lab
				carbon tetrachloride	2,600 gal	Entire Depot
				boiler blowdown	150 mil gal	Steam Plant
				demineralizer regenerant	0.4 mil gal	Steam Plant
				cooling tower blowdown	330 mil gal	Cooling Towers
15	Dirt Roads (two roads)	Depot Dirt Roads	1918-1940	Waste lube oil, cutting oils, petroleum based solvents, hydraulic fluids.	11,000 gal	Garage and other Shops
		Road to Elliot's Beach (GDM M-25);	1941-1966		13,000 gal	
		Road to Borrow Pit Landfill (GDM R-12).	1941-1966		3,200 gal	
16	Pesticide Rinsate Disposal Area	Adjacent to Quonset Hut N 282 (GDM J-12)	1950-1978	Pesticide rinsate.	8,000 gal	Pest Control Shop

(1) Solid paint wastes consist of used brushes, rollers, rags, cans, and spray booth scrapings and skimmings.
(2) Paint thinners consist of diesel fuel, kerosene, and mineral spirits.
(3) Paint stripper consists of methylene chloride.
(4) Cleaning rags contaminated with oil, mineral spirits, and kerosene.
(5) Solvent consisted of equal amounts of aliphatic petroleum and chlorinated solvent compounds.
(6) Paint stripping residues estimated to contain about 640 lb of methylene chloride.
(7) Wood preserving residues estimated to contain about 420 lb of pentachlorophenol (PCP).
(8) Estimated quantity that spilled or leaked onto surface soils and available for migration.
(9) Approximately 14 55-gallon drums of contaminated soil and cleaning materials were disposed of off base from cleanup of Building 111 spill area; contaminated soils and cleaning materials were also drummed up and disposed of off base during cleanup of Building 450 spill area.
(10) During cleanup, the top 6 inches of soil was removed and disposed of off base; the area has since been paved with concrete.

marshlands and tributaries of the Beaufort and Broad Rivers. These marshes are the habitats of a great many species of plant and animal life. Shellfish and fish are important resources for the economy of the area and are very susceptible to water pollution. Potential contaminant receptors would include any part of the biological community which could come into contact with contaminants released at MCRD Parris Island. These include animals which ingest contaminants directly (e.g., shellfish and fish), animals which feed on other animals that might be contaminated (e.g., wading birds, ospreys, brown pelicans, bald eagles, man), and animals which have surface contact with contaminants without ingestion occurring (e.g., gulls, pelicans and ducks). Those species which are predatory on other contaminated species tend to ingest the largest quantities of contaminants and run the greatest risks of exhibiting negative effects.

Many of the endangered species in the MCRD Parris Island area are particularly susceptable to the bioamplification or synergistic effects due to their predatory natures. These species include the southern bald eagle (Haliaeetus l. leucocephalus) which preys on fish in the marshes near MCRD Parris Island, the wood stork (Mycteria americana) and eskimo curlew (Numenius borealis) which feed on shellfish in the marshes around MCRD Parris Island, the short-nosed sturgeon (Acipenser brevirostrum) which feeds upon shellfish in the marshes and rivers near MCRD Parris Island, and the American alligator (Alligator Mississippiensis) which inhabits the fresh water creeks and ditches around MCRD Parris Island and feeds largely on fish. In addition to these and other wildlife species which are susceptible to consuming contaminated species, man also consumes the fish and shellfish from the MCRD Parris Island area and is therefore susceptible to ingestion of contaminated species.

2.2 SITES RECOMMENDED FOR CONFIRMATION STUDIES. Significant findings and conclusions concerning the six sites identified by the IAS Team and recommended for confirmation studies are presented below. Detailed discussions of each site are included in Chapter 8.

2.2.1 Site 1--Incinerator Landfill. This site, located on the northeastern tip of Horse Island (GDM Coordinates N-9), was used as the primary disposal site at MCRD Parris Island from 1921 to 1959. Although the adjacent incinerator, which was used as the main method of waste treatment and disposal at MCRD Parris Island, was shut down around 1959, the Incinerator Landfill continued to be used until 1965. The majority of the solid wastes generated at the Depot between 1960 and 1965, however, were disposed of in the Causeway Landfill (Site 3), which was also in operation during that period. The Incinerator Landfill was used for disposal of combustion residues from the incinerator, as well as for non-combustible wastes. Some combustible wastes were also placed and burned in the landfill. After the incinerator was closed, much of the combustible wastes were open-burned in the landfill without auxiliary fuel. At the completion of this landfill operation, the site extended about 670 feet into the marsh and occupied an area of about 4 acres. The majority of wastes disposed of in this landfill were non-hazardous domestic wastes, ash residues and construction debris. The types and estimated total quantities of solid and hazardous wastes that were burned in the incinerator and/or were placed in the Incinerator Landfill directly for burial or open-burning are given in Table 2-1. With the exception of the

paint thinners and strippers, the majority of hazardous wastes were burned in the incinerator during the period from 1921-1959. The paint thinners (kerosene, diesel fuel, mineral spirits) and strippers (methylene chloride) were poured on the ground and burned in the landfill.

Migration of contaminants into the marsh is likely due to the flushing tidal action. The surficial clays and confining beds above the Tertiary Limestone Aquifer would limit vertical contaminant migration. Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (Haliaeetus l. leucocephalus), the wood stork (Mycteria americana), the eskimo curlew (Numenius borealis), and the short-nosed sturgeon (Acipenser brevirostrum . Because of the potential for contaminant migration and for adverse impacts on human health and the environment, Site 1 is recommended for a confirmation study.

2.2.2 Site 2--Borrow Pit Landfill. This site, which consisted of a former borrow pit located in the north central portion of Horse Island (GDM Coordinates Q-10), was used as the primary disposal area for Depot wastes for approximately 3 years, from 1966 to 1968. Similar to Site 1, solid wastes and construction debris composed the majority of wastes disposed of at this site. In addition to the solid and hazardous waste that were placed in Depot dumpsters and then disposed of in the Borrow Pit Landfill, solid paint wastes (used brushes, rollers, rags, cans, and spray booth scrapings), paint thinners (mineral spirits, kerosene and diesel fuel), and paint strippers (methylene chloride) were separately placed in the landfill by Paint Shop personnel. The types of wastes and total quantities placed in this landfill during its operation are presented in Table 2-1.

The wastes placed in this landfill were disposed of in unconfined, highly permeable, sandy soils less than 100 feet from a tidal inlet. Therefore, horizontal migration of contaminants to the marsh is likely. Low permeability confining layers above the Tertiary Limestone Aquifer would prohibit vertical contaminant migration. Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (Haliaeetus l. leucocephalus), the wood stork (Mycteria americana), the eskimo curlew (Numenius borealis), and the short-nosed sturgeon (Acipenser brevirostrum). Because of the potential for contaminant migration and for adverse impacts on human health and the environment, Site 2 is recommended for a confirmation study.

2.2.3 Site 3--Causeway Landfill. This site, consisting of a causeway that connects Horse Island and Parris Island (GDM Coordinates L-13, M-12, N-11), was constructed from solid waste and fill dirt across a tidal marsh of the Broad River. The site was the major Depot disposal area during most of the period between 1960 and 1972. Between 1960 and 1965, this landfill received approximately 75 percent of the solid waste generated by the Depot. The remainder was disposed of at Site 1, Incinerator Landfill, which was also in operation during that period. The site was inactive between 1966 and 1968.

Between 1969 and 1972, the site received all of the Depot's solid waste. In addition to trash, other solid and hazardous waste placed in the Depot's Dumpsters and trash cans were disposed of in the landfill. At its completion, the causeway consisted of a 10 acre area, about 10 feet high, with a dirt road surface and rip-rap sides. The type and total quantities of wastes placed in the Causeway Landfill are given in Table 2-1.

Leaching of contaminants from the site into the marsh and adjacent ponds is likely due to the tidal flushing of the filled materials. Vertical migration is unlikely due to the low permeability marsh soils and the confining beds above the Tertiary Limestone Aquifer. Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (Haliaeetus l. leucocephalus), the wood stork (Mycteria americana), the eskimo curlew (Numenius borealis), and the short-nosed sturgeon (Acipenser brevirostrum). Because of the potential for contaminant migration and for adverse impacts on human health and the environment, Site 3 is recommended for a confirmation study.

2.2.4 Site 4--Dredge Spoils Area Fire Training Pit. An area near the southeast corner of the Depot's current Dredge Spoils Area was used for fire fighting training. The Inert Disposal Area (Site 13; Section 2.3.8) which contains dredge materials from the Marina and Ballast Creek, was constructed on top of the former fire training pit in 1981. The Dredge Spoils Area (GDM Coordinates C-18) is situated between Cuba Street and Ballast Creek, south of Structure 302. It was reported that this fire training pit was used during an approximately 20-year period from the 1940's until the mid-1960's, when a pit was constructed at Page Field (Site 7; Section 2.3.2). A shallow pit approximately 30 to 40 feet in diameter was dug in the sandy soils. Contaminated fuels, waste motor oils, and small quantities of spent petroleum-based solvents (mineral spirits, kerosene, diesel fuel, and Varsol) that had been mixed with the waste oils were reportedly burned in the pit during training exercises. Since this pit was reportedly active during the operation of Page Field as an air station, it is likely that some AVGAS would also have been burned in this pit. It is estimated that as much as 12,000 gallons of waste fuels and oils contaminated area soils during the period of operation. It was reported that the area in the vicinity of the pit was significantly blackened and devoid of vegetation.

It is likely that at least some of the contaminated soils were disturbed and distributed during construction of the existing 12-foot earthen berm and the Dredge Spoils Area. Due to the location of the burn area near the edge of the berm, it is likely that disturbed contaminated soils would be contained within the embankment in that area.

Contaminant migration within the surficial aquifer is likely. Contaminants would likely migrate toward Ballast Creek less than 200 feet to the east. Vertical migration of contaminants would be limited by the low permeability soils overlying the Tertiary Limestone Aquifer. Potential contaminant receptors would include fish and shellfish within the river and predatory species (including humans) which feed on fish species. Endangered species that could

be impacted by contaminant migration into surface waters include the southern bald eagle (Haliaeetus l. leucocephalus), the eskimo curlew (Numenius borealis), the wood stork (Mycteria americana), and the short-nosed sturgeon (Acipenser brevirostrum). Because of the potential for contaminant migration and the potential impact on receptors, Site 4 is recommended for a confirmation study.

2.2.5 Site 6--Former Automotive Hobby Shop Spill Area. This site is located next to the Former Automotive Hobby Shop in Building AS26 (GDM Coordinates F-22). The area was contaminated by surface spills of waste lube oil during the period from 1969 to 1982. Spillage occurred during transfers of waste oil from small containers and 55-gallon drums into a 500-gallon underground waste oil storage tank, installed adjacent to the shop in 1969. In addition, unauthorized draining of vehicle crankcase oil directly onto the ground surface in the vicinity of the storage tank has also occurred. It was estimated that more than 2,000 gallons of waste oil were spilled in the area between 1969 and 1982, when the tank was abandoned.

Horizontal migration of contaminants to nearby tidal stream and marsh is likely due to the shallow water table and high permeability soils near the ground surface. The tidal streams and marsh are 900 feet northwest and northeast of this site. Vertical migration is limited due to the confining formation above the Tertiary Limestone Aquifer. Because of the potential for contaminant migration and the potential inpact on receptors, Site 6 is recommended for a confirmation study.

2.2.6 Site 16--Pesticide Rinsate Disposal Area. Between 1950 and 1978, rinsewaters from pesticide spray application containers and equipment was disposed of on a dirt area located between Quonset Huts N282 and N277 (GDM Coordinates J-12). This area, used for disposal of rinsate wastes, covered approximately 150 square feet. Pesticides used at the Depot during this period by the Pest Control Shop included: aldrin, baygon, chlordane, dursban, malathion, naled, and DDT. An estimated 8,000 gallons of rinsate were disposed of at Site 16.

Migration of contaminants from this site is likely. Soils beneath the site are mostly sand, with the high ground water table being at a depth of approximately 6 feet. The marsh is only 700 feet to the northeast. The site is therefore within the zone of tidal influence which causes groundwater level fluctuations. The tidal action, high permeability sandy soil, and shallow water table would allow for contamination migration from this site. Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into tidal and marsh waters include the southern bald eagle (Haliaeetus l. leucocephalus), the wood stork (Mycteria americana), the eskimo curlew (Numenius borealis), and short-nosed sturgeon (Acipenser brevirostrum). Because of the potential for contaminant migration and the potential adverse impact on receptors, Site 16 is recommended for a confirmation study.

2.3 SITES NOT RECOMMENDED FOR CONFIRMATION STUDIES. Ten sites were identified by the IAS team that were not recommended for confirmation studies. These sites are discussed below. Additional detail is provided in Chapter 8.

2.3.1 Site 5--Former Paint Shop Disposal Area. This site, situated on the bank of the Beaufort River (GDM Coordinates C-12), received paint scrapings from mixing tanks when the Paint Shop was located in Structure 177 and nearby Quonset huts. During the period of disposal, from at least the 1930's through 1960, hardened paint (consisting of a mixture of white lead, zinc, and linseed oil) was scraped from the mixing tank after soaking with a paint remover such as diesel fuel, or kerosene. An estimated 17 tons of hardened paint wastes were disposed of on the embankment at the edge of the river.

Because of the age and location of the site and the method of disposal, the wastes would have been washed from this site into the river and carried away. Much of the soil embankment was also eroded away by river currents and storms prior to the area being filled with construction debris in 1972. Therefore, no wastes are likely to remain at the site, and further migration of contaminants from this site is very unlikely. A confirmation study is therefore not recommended for Site 5.

2.3.2 Site 7--Page Field Fire Training Pit. A concrete pit (GDM Coordinates F-23) located at Page Field was used for fire fighting training from the mid-1960's until 1976. This site, approximately 25 feet in diameter, was constructed on a former runway apron and consisted of a concrete base, asphalt cover, and cinder block berm. Contaminated fuels, waste lube oil, and petroleum-based solvents (including mineral spirits, kerosene, and diesel fuel) were burned in the pit, which was abandoned in 1976 when it began to leak. Contaminant releases from this pit occurred for approximately 2 to 4 months during the time the pit was cracking and leaking before operations were terminated. An estimated 50 gallons or less of waste flammables are estimated to have leaked to the surrounding soils during this period. Any surface contaminants would have been dispersed by rainfall runoff. It is unlikely that the small quantities that might have penetrated nearby soils would migrate laterally more than 1,600 feet to the nearest surface water. Vertical migration of contaminants is unlikely due to the concrete barrier and the confining layers above the Tertiary Limestone Aquifer. Therefore, Site 7 is not recommended for a confirmation study.

2.3.3 Site 8--PCB Spill Areas. A PCB spill incident at a grassy area adjacent to Building 111 (GDM Coordinates E/F-14) occurred in 1984 when a contractor was removing three PCB transformers from Building 111. These transformers each contained 35 gallons of PCB transformer oil. The volume of spilled material was unknown; however, analysis of six soil samples collected in 1984 at this location showed concentrations of PCB ranging from 57 to 62,000 ppm. Remedial action was undertaken in November 1985, and the contaminated soils and concrete curbing were removed and the area cleaned up by depot maintenance under the direction of the Natural Resources Environmental Affairs Officer (NREAO). A total of 14 drums of 55-gallon and 35-gallon capacity were used for collection of the contaminated soil. The drums and concrete curbing were transferred to DRMO for disposal off base as a hazardous waste, via an EPA-certified contractor.

During transformer removal in 1983, a cleared area on an asphalt-paved equipment pad adjacent to Building 450 (GDM Coordinates K-11) was used by maintenance for temporary storage of transformers. Leakage from the transformers was

noticed prior to removal of these transformers; the volume is unknown. The transformers were moved to a different location on the pad and the area was covered with plastic and bermed to prevent movement of contaminants. Samples collected from a grassy area adjacent to the pad and the nearest storm drain were tested and no PCB's were detected. The contaminated plastic, sand, and asphalt were put into drums and transferred to DRMO for disposal off base as a hazardous waste.

Because both of the above contaminated areas were adequately cleaned up, Site 8 poses no threat to human health or the environment and is therefore not recommended for a confirmation study.

2.3.4 Site 9--Paint Waste Storage Area. An unpaved area adjacent to Building 864 (GDM Coordinates J-11) was used by the Paint Shop as a temporary storage area for paint wastes from 1969 until 1984. The storage area, situated between Quonset Hut N277 and Building 895, was approximately 20 feet by 60 feet and was used for storage of 30-gallon cans and 55-gallon drums. Paint Shop personnel brought liquid paint wastes including thinners (kerosene, diesel fuel, mineral spirits) and strippers (methylene chloride) in 30-gallon containers from the job site to this storage area. Until 1978, wastes brought to this storage area were then placed in the underground waste oil storge tank located at the Diesel Shop and mixed with the waste oil. A contractor collected the paint waste and waste oil from the tank for disposal off the base. After 1978, liquid paint wastes were no longer poured into the underground storage tank but were stored in 55-gallon drums at the Paint Waste Storage Area. Up to 40 drums were stored in this area at any given time. The use of this area for storage of paint wastes ended in 1983, when a contractor removed all remaining wastes for disposal at an incineration facility in Spartansburg, South Carolina.

Spillage occurred during the period of use from 1969 to 1984; the amount of waste spilled is unknown. In 1984, the storage area was cleaned up. Approximately 6 inches of surface soil were removed, the contaminated soil was disposed of by DRMO, and the area was covered with concrete pavement. After 1984, both liquid and solid paint wastes were stored in two Quonset huts (Structures N281 and N282), located about 200 feet east of Building 864.

Because the contaminated area was adequately cleaned up and the area paved over, Site 9 poses no threat to human health or the environment and, therefore, is not recommended for a confirmation study.

2.3.5 Site 10--Gasoline Spill Area. In December 1983, a 97-gallon spill of unleaded gasoline occurred at the fuel storage area adjacent to Building 170 (GDM Coordinates F-12). The spill occurred when an underground day tank was being filled from an aboveground storage tank. The spilled gasoline overflowed and escaped from the day tank through a vent at the surface. The gasoline spilled onto asphalt, but flowed down a road to a grassy area and formed pools of liquid. The resulting contaminated area was thoroughly cleaned up by excavating the gasoline-stained soil at the shoulder of the road. Approximately 50 55-gallon drums of contaminated soil were removed and shipped off the base by DRMO for disposal as a hazardous waste. Because the contaminated area was adequately cleaned up, Site 10 poses no threat to human health or the

environment, and therefore this site is not recommended for a confirmation study.

2.3.6 Site 11--MCX Service Station Spill Area. Spillage occurred around a 500-gallon underground waste oil storage tank at the Marine Corps Exchange (MCX) Service Station (GDM Coordinates I-12). From approximately 1969 until 1983, garage personnel poured used crankcase oil from small containers into the tank via a fill pipe that extended to the surface. Spillage occurred while carrying and transferring the used oil to the tank. In 1983, the contaminated soil which surrounded the fill pipe opening was excavated, placed in 50 55-gallon drums, and shipped off the Depot for disposal as a hazardous waste. At the conclusion of the cleanup, a concrete pad was placed around the tank's fill pipe and was sloped towards the center to contain any spilled oil. Waste oil has not been generated at this station since the garage was closed in 1984. Because the contaminated area was adequately cleaned up, Site 11 poses no threat to human health or the environment, and therefore this site is not recommended for a confirmation study.

2.3.7 Site 12--Jericho Island Disposal Area. This site covers an area approximately 100-feet by 250-feet along the central part of the southern edge of Jericho Island. Disposal of waste at this site occurred from about 1955 to 1968 when MCRD Parris Island purchased the property to extend the impact zone safety area needed down-range of the Depot's small arms firing ranges. The area has an irregular, undulating surface due to the random scattering of waste piles, ranging up to approximately 30 feet in diameter and 5 feet in height. The site extends from the island's edge southward onto the marsh. The wastes disposed of at this site were routine domestic trash (including small rusted cans, beer and soda bottles, hubcaps, tires, buckets, cinder blocks, childrens toys, rusted 5-gallon cans, sheet metal, paper, plastic, and wood). It was reported that these wastes were brought to the island by local residents (not from Parris Island) and no organized landfill operations occurred. The observed non-hazardous character of the waste indicates that there is no potential for contaminant migration from this site. Therefore, Site 12 poses no threat to human health or the environment and is not recommended for a confirmation study.

2.3.8 Site 13--Inert Disposal Areas. Construction debris and yard wastes have been disposed of in a borrow pit (Area TA-3) near Elliott's Beach (GDM Coordinates K-25) and in an inert landfill located on the southern portion of Horse Island (GDM Coordinates P-11) adjacent to Edding Creek. In addition, dredge spoils have been disposed of in an area adjacent to Ballast Creek. These three areas constitute Site 13. The borrow pit disposal area covers approximately 2 acres on the southeastern tip of area TA-3 adjacent to the marsh, and was used for disposal of construction debris and yard waste from 1976 until 1979. After 1979, construction debris and yard wastes from the Depot were taken to the inert landfill on Horse Island. This landfill, which was opened in 1979 and is still in use, covers approximately 50 acres. The Dredge Spoils Area, a land disposal area with an earthen containment berm, is situated approximately 60 feet south of Structure 302 between Cuba Street and Ballast Creek (GDM Coordinates C-18). The irregular-shaped area covers approximately 11 acres and has been used for disposal of dredge spoils from the Marina Basin and Ballast Creek since 1981. An estimated 200,000 cubic

yards of material were removed from the waterways and placed in this disposal area. The disposal area was constructed on top of a former fire fighting training pit (Site 4; Section 2.2.4) which was located in the southeastern portion of the containment area near the embankment.

Because only inert material was placed in the borrow pit area and inert landfill, and only river bottom sediments were disposed of in the dredge spoils area, these disposal areas do not pose a threat to human health or the environment and are therefore not recommended for confirmation studies.

2.3.9 Site 14--Storm Sewer Outfalls. Surface drainage from the developed area of the Depot flows to a storm sewer system. The system includes more than 60 outfall points to the adjacent marshes and rivers at MCRD Parris Island. These outfalls constitute Site 14. Various wastes generated by Depot shops were disposed of in the storm sewers from at least 1918 to 1985, as indicated in Table 2-1.

Migration of contaminants from this site would most likely have occurred at the time of discharge and present migration of contaminants is unlikely. The large number of outfall points, which are located throughout and around Parris Island, minimize the potential for accumulation of contaminants at any one point. Accumulation of contaminants would also be inhibited by the twice daily tidal actions and the several severe storms which occur annually. Therefore, Site 14 is not recommended for a confirmation study.

2.3.10 Site 15--Dirt Roads Disposal Area. From about 1918 until 1966, waste lube oil, cutting oil, petroleum-based solvents (kerosene, gasoline, mineral spirits), hydraulic fluids, and water-based coolants were transported by roads and Grounds personnel from various depot shops and sprayed on Depot roads for dust supression. From 1918-1940 an estimated 11,000 gallons was sprayed on all Depot roads with the majority of this quantity applied during the 1930's. The majority of the Depot's roads were paved in the 1940's. However, waste oils and hydraulic fluids continued to be applied to two dirt roads from the early 1940's to 1966, when this practice was discontinued. Approximately 1.5 miles of dirt road accessing Elliott's Beach (GDM Coordinates M-25) and 0.5 miles of road (GDM Coordinates R-12) accessing the Borrow Pit Landfill (Site 2; Section 2.2.2) received an estimated 13,000 gallons and 3,200 gallons of waste liquids, respectively during this period.

Because all dirt roads throughout the Depot received the waste oil and other fluids from 1918-1940, no single area has been identified as having received a large quantity of liquid waste. Although two roads received a total of 16,200 gallons of waste oils and other liquids after 1940, the area of distribution was large, and the practice was discontinued in 1966. Evaporation and biodegredation would also have been responsible for reducing the volume of contaminants migrating through the surface soils.

The depth to high water table beneath the site is one to four feet. This greatly exceeds the estimated required depth of less than 4 inches for contaminant immobilization, and percolation to the ground water is therefore unlikely. Therefore, the migration potential of any remaining contaminants is very small and Site 15 is not recommended for a confirmation study.

CHAPTER 3. RECOMMENDATIONS

3.1 INTRODUCTION. Recommended courses of action are provided for the potentially contaminated sites identified at MCRD Parris Island. Six sites pose a potential threat to human health or to the environment. Therefore, Confirmation Studies, Phase II of the NACIP program, are recommended for these sites. The Confirmation Study Ranking System (CSRS) is used to systematically evaluate the severity of potential problems at these sites. The remaining ten sites are not recommended for confirmation studies.

The resultant CSRS Scores and a summary of the recommended actions for the sites recommended for confirmation studies are listed in Table 3-1. These sampling recommendations are designed to first verify the presence of contamination in a period of one year or less. Depending on results of the first year verification, a characterization of the extent of the contamination at the sites may be required. The design of the characterization phase will also depend on results from the verification phase.

3.2 CONFIRMATION STUDY RECOMMENDATIONS. Sections 3.2.1 through 3.2.6 include sampling and analytical testing recommendations for confirmation studies. The testing parameters indicated in this chapter refer to the EPA listing of 129 priority pollutants (40CFR, Part 122, Appendix D, 1985). As used in this report, the testing parameter categories for purgeable organic compounds, acid-extractable organic compounds, pesticides, and metals specifically refer to the EPA priority pollutant list.

3.2.1 Site 1--Incinerator Landfill (Figure 3-1).

Monitoring Wells:	One monitoring well and four piezometers.
Types of Samples:	Ground water; soil taken at 5-foot intervals (starting at the surface), formation changes, and at the water table in the monitoring well. Soil samples from the well will be collected for classification and visual inspection only. Temporary piezometers will be driven without soil samples being collected. Surface water and sediment.
Number of Samples:	Twenty groundwater, four from the well and four from each piezometer; four surface water and sediment.
Frequency:	Groundwater: four times, at quarterly intervals from the monitoring well and from piezometers (taken at the end of high tide). Surface water and sediment: once (taken at the end of low tide).
Testing Parameters:	All samples: priority pollutants. Water samples: ground water levels (in wells), pH, specific conductance.

Remarks: One well is recommended for Site 1. Well W-1 is assumed to be significantly influenced by tidal fluctuations and therefore likely to exhibit the influence of the landfill on groundwater quality. Well depth will be approximately 15 feet, which is believed to be above the top of the confining clay layer. The piezometers will be well points hand driven to approximately 3 to 4 feet depth in order to allow for collection of a groundwater sample within the landfill.

TABLE 3-1
SUMMARY OF CONFIRMATION STUDY RECOMMENDATIONS
MCRD, Parris Island, South Carolina--Study Number 95

Name	CSRS Score	No. of Wells	No. of Groundwater Samples	No. of Borings	No. of Soil Samples[a]	No. of Surface Water Samples	No. of Sediment Samples	Testing Parameters
Site 95-1, Incinerator Landfill	22	5[b]	20	--	--	4	4	Water levels[c], pH, specific conductance, priority pollutants.
Site 95-2, Borrow Pit Landfill	9	3	12	--	--	1	1	Water levels[c], pH, specific conductance, priority pollutants.
Site 95-3, Causeway Landfill	30	--	8[d]	--	8[d]	--[d]	--[d]	Water levels[c], pH, specific conductance, priority pollutants.
Site 95-4, Dredge Spoils Area Fire Training Pit	12	3	12	--	--	--	--	Water levels[c], pH, specific conductance, oil and grease, AVGAS, priority pollutant metals, purgeable organics.
Site 95-6, Former Automotive Hobby Shop Spill Area	6	1[e]	4	--	4	--	--	Water levels[c], pH, specific conductance, oil and grease.
Site 95-16, Pesticide Rinsate Disposal Area	17	1	4	2	3	--	--	Water levels[c], pH, specific conductance, pesticides.

[a] Samples for chemical analysis; some soil samples are collected for classification and visual observation only.
[b] Four of the wells will be hand driven piezometers.
[c] During groundwater samples of all wells at all sites; pH and specific conductance for water samples only.
[d] Groundwater and soil samples to be collected at seep locations along causeway embankment. If less than eight seeps are identified, the number of surface water and sediment samples will equal the difference between 8 and the number of identified seeps.
[e] Three additional monitoring wells are proposed if free product is detected at the soil/ground water table interface.

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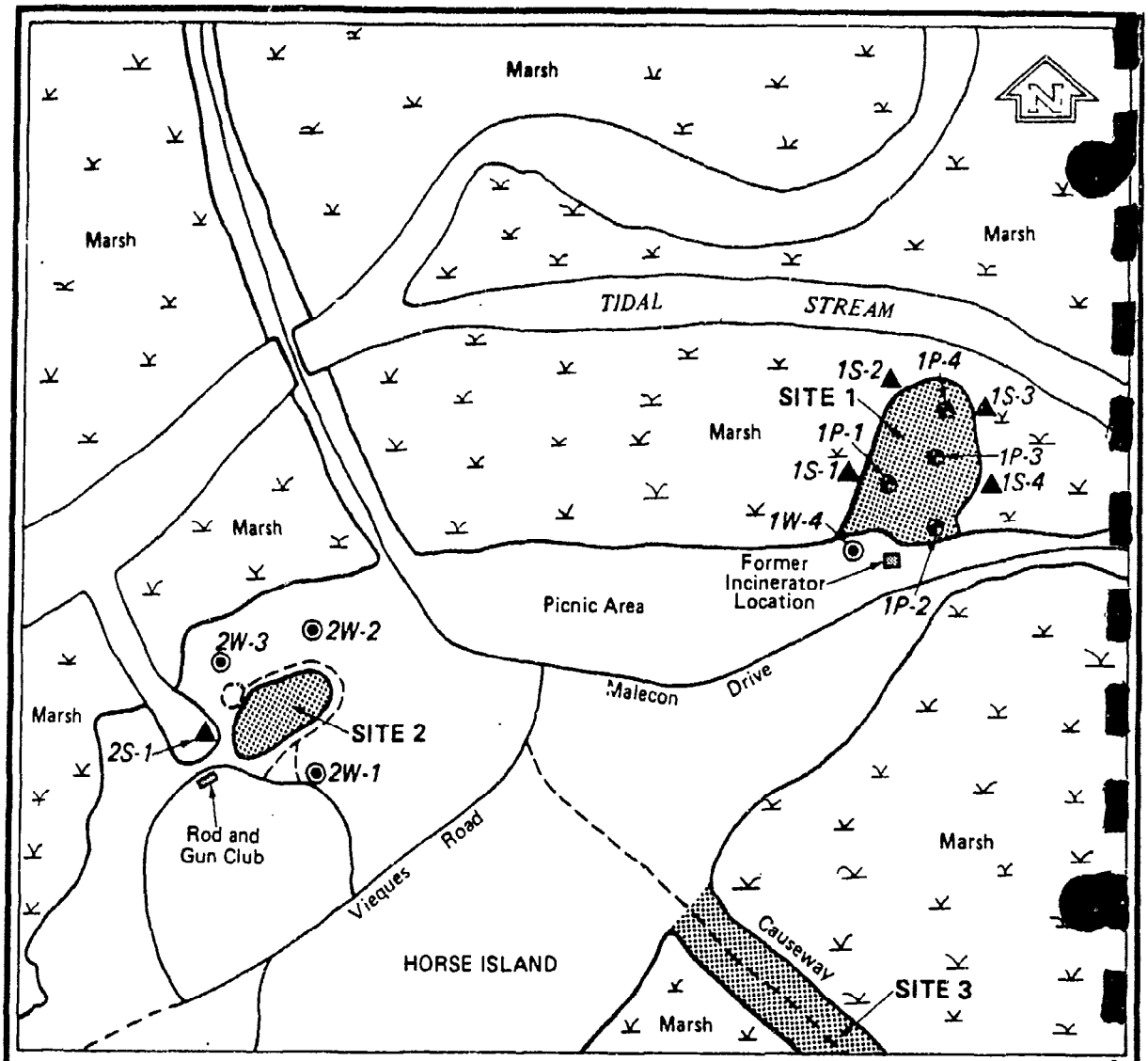


0 500 1000 FEET
SCALE

Monitoring well/groundwater sample
Temporary piezometer/groundwater sample
Surface water and sediment samples
Site
Structure
Dirt Road

FIGURE 3-1
SITE 1, INCINERATOR LANDFILL AND SITE 2, BORROW PIT LANDFILL CONFIRMATION STUDIES

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEP
Parris Island, South Carolina
Dames & Mo

3.2.2 Site 2--Borrow Pit Landfill (Figure 3-1).

Monitoring Wells: Three.

Types of Samples: Ground water; soil taken at 5-foot intervals (starting at the surface), formation changes, and at the water table in monitoring wells. Soil samples will be collected for classification and visual inspection only.
Surface water and sediment.

Number of Samples: Twelve ground water, four from each well; one surface water and sediment.

Frequency: All samples: Priority pollutants.
Groundwater: four times, at quarterly intervals (taken at the end of high tide).
Surface water and sediment: once (taken at low tide).

Testing Parameters: All samples: priority pollutants.
Water samples: water levels, (in wells), pH, specific conductance.

Remarks: Approximate well depth will be 30 feet; bottom of well is to be placed above top of confining layer. Well W-1 is the likely upgradient well for this site although it may be influenced by tidal fluctuations. Wells W-2 and W-3 are the downgradient wells. The surface water and sediment sample collected from the tidal stream will aid in determining whether contaminants are migrating from the site.

3.2.3 Site 3--Causeway Landfill (Figure 3-2).

Types of Samples: Ground water seepage, surface water, and soil/sediment samples.

Number of Samples: Eight ground water/surface water; and eight soil/sediment samples.

Frequency: Ground water, surface water, and soil/sediment: once.

Testing parameters: All samples: priority pollutants.
Water samples: pH, specific conductance.

Remarks: The eight water samples should be collected from seepage points along the causeway (if possible). Sampling during low tide will be necessary to identify potential seepage locations. Soil/sediment samples at these locations should be collected from the causeway at the point of seepage.

3.2.4 Site 4--Dredge Spoils Area Fire Training Pit (Figure 3-3).

Monitoring Wells: Three

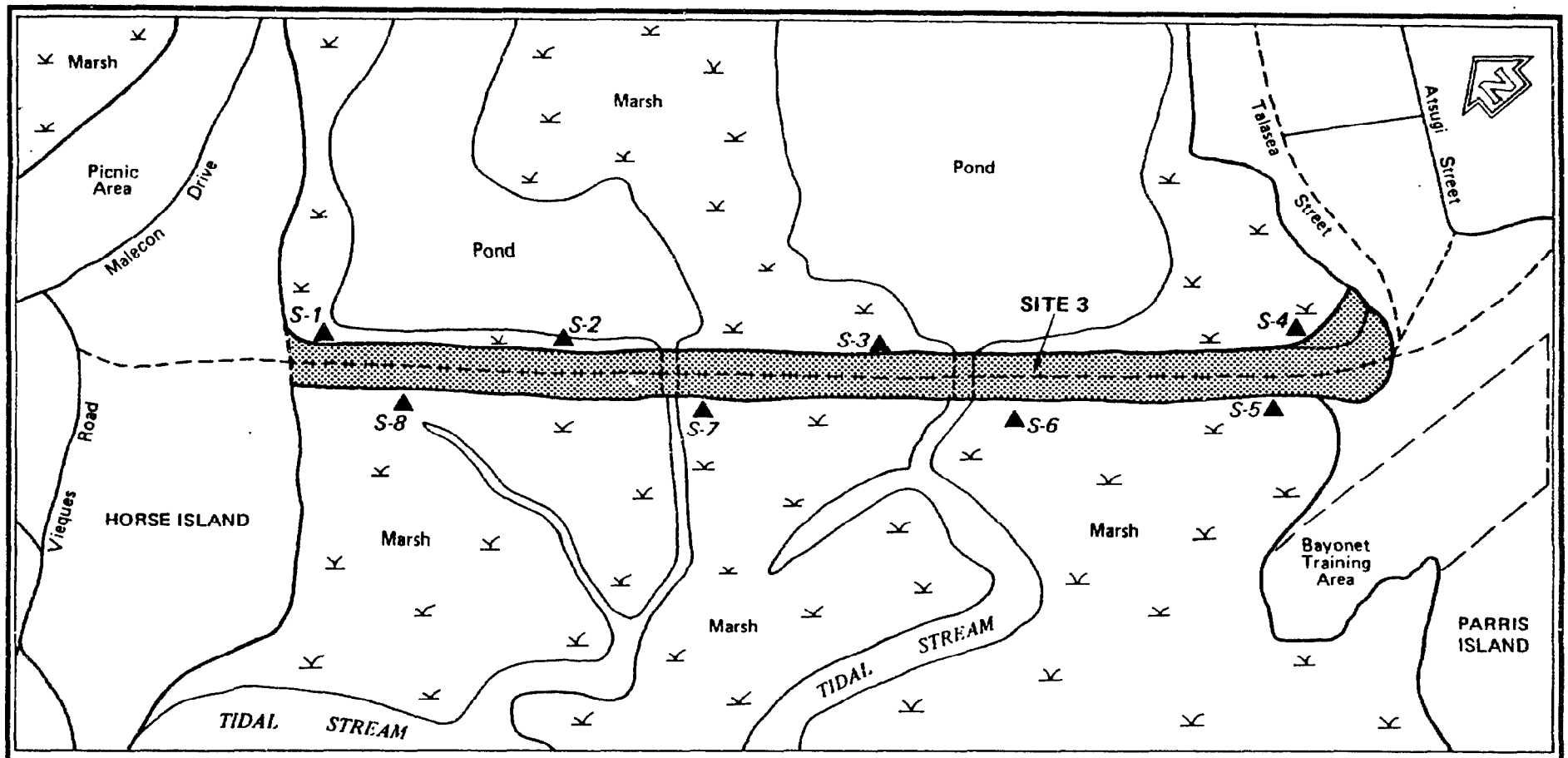
Types of Samples: Ground water; soil samples taken at 5-foot intervals, formation changes, and at the water table in monitoring wells. Soil samples in monitoring wells to be collected for classification and visual inspection only.

Number of Samples: Twelve ground water, four from each well.

Frequency: Ground water: four times, at quarterly intervals.

Testing Parameters: Water levels, pH, specific conductance, oil and grease, AVGAS, purgeable organics, Cr, Cd, and Pb.

Remarks: Wells will be approximately 15 feet deep and should be screened from 5 to 15 feet. Groundwater samples should be collected during the change from high to low tide.



▲ Seep/surface water and causeway sediment sample
Site
Dirt Road

FIGURE 3-2
SITE 3, CAUSEWAY LANDFILL
CONFIRMATION STUDY

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

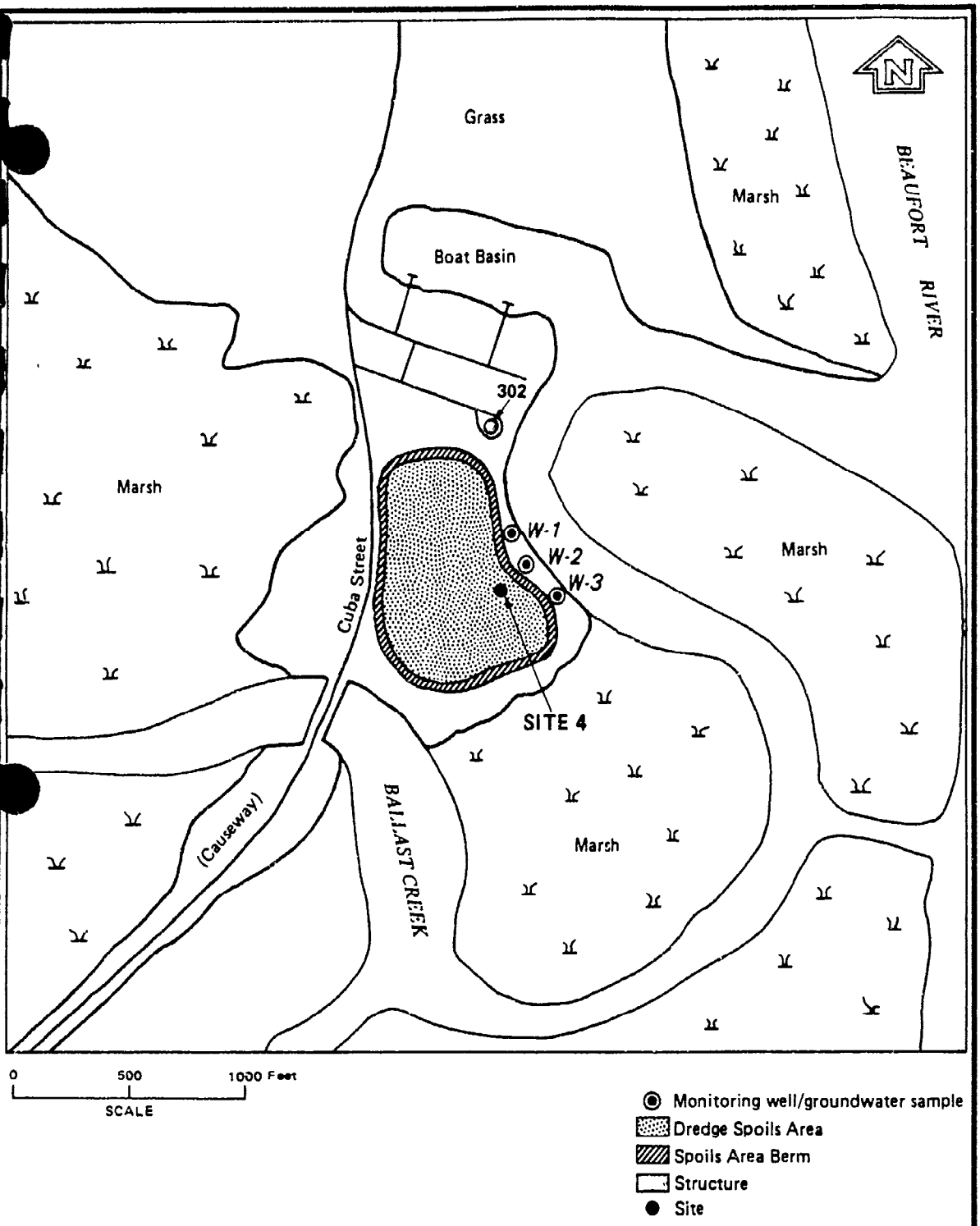


FIGURE 3-3
SITE 4, DREDGE SPOILS AREA FIRE TRAINING PIT
CONFIRMATION STUDY

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

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3.2.5 Site 6--Former Automotive Hobby Shop Spill Area (Figure 3-4).

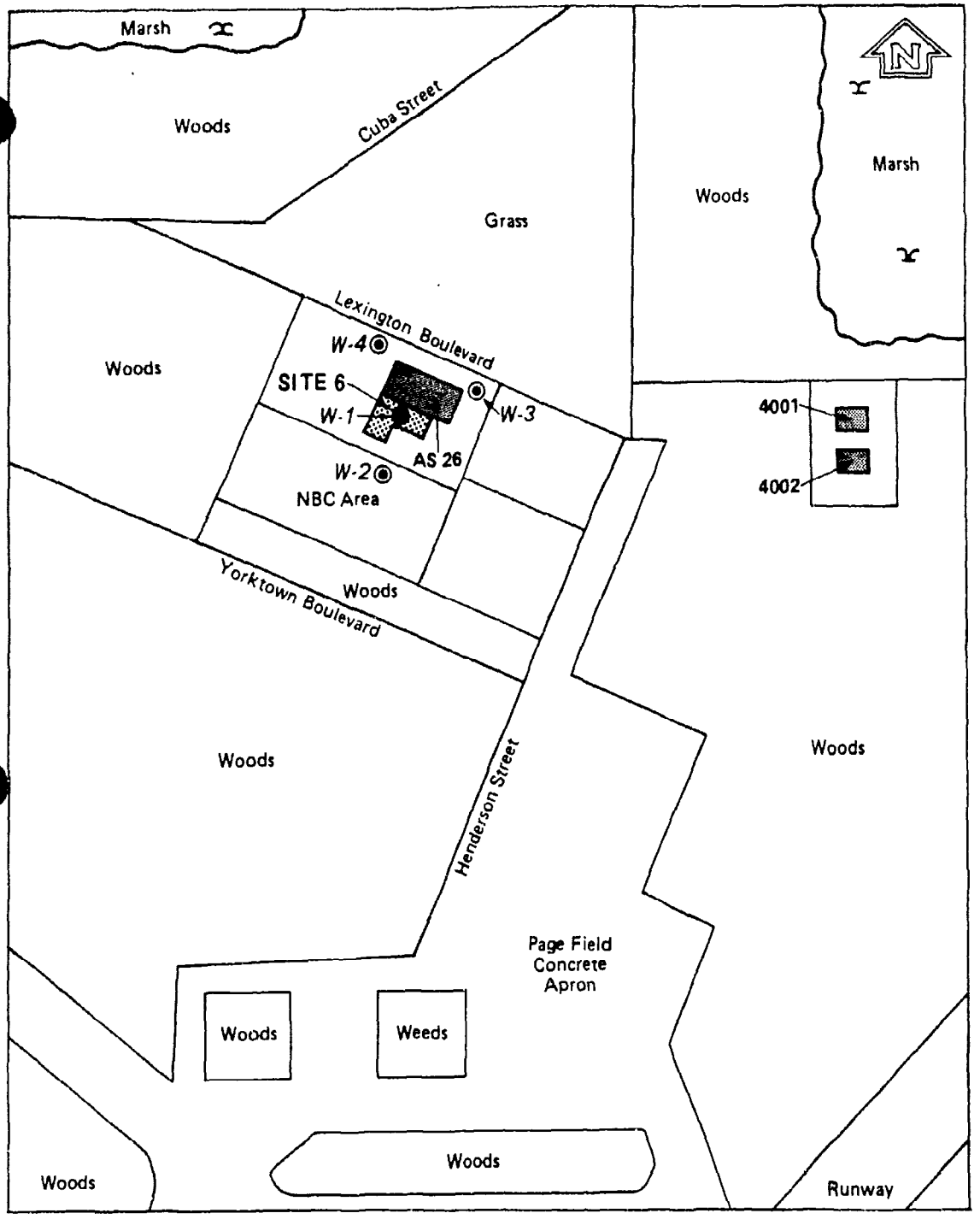
Monitoring Wells:	One (Stage 1).
Types of Samples:	Ground water; soil samples taken continuously from 0 to 12 feet in well W-1.
Number of Samples:	Four ground water from well W-1; four 3-foot composite soil samples from 1 to 12 feet in W-1.
Frequency:	Ground water: four times, at quarterly intervals. Soil: once.
Testing Parameters:	All samples: oil and grease. Ground water samples: Water levels, pH, specific conductance.

Remarks: Well W-1 will be installed to a depth of approximately 15 feet to determine the vertical migration of contaminants through the soils. If there is free product detected at the soil/ground water table interface, additional wells W-2, W-3, and W-4 should be installed to determine the extent of migration. If no free product is detected, the underground storage tank and surrounding contaminated surface soils should be removed.

3.2.6 Site 16--Pesticide Rinsate Disposal Area (Figure 3-5)

Monitoring Wells:	One.
Soil Borings:	Two.
Types of Samples:	Ground water; soil samples (in well) taken at 5-foot intervals, formation changes, and the water table. These samples will be collected for classification and visual inspection only.
Number of Samples:	Four ground water, from the well; three composite soil samples from 0 to 3 feet in well W-1 and soil borings B-1 and B-2. Soil samples from borings.
Frequency:	Ground water: four times at quarterly intervals. Soil: Once.
Testing Parameters:	All samples: pesticides. Water samples: Water levels (in well), pH, specific conductance.

Remarks: Well W-1 will be installed to a depth of approximately 15 feet to determine the vertical migration of contaminants through the soils to the ground water.



Site

Structure

0 250 500 Feet

SCALE

Monitoring well/groundwater sample (Stage 1)

Monitoring well/groundwater sample (Stage 2)

FIGURE 3-4
SITE 6,
FORMER AUTOMOTIVE HOBBY SHOP SPILL AREA
CONFIRMATION STUDY

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

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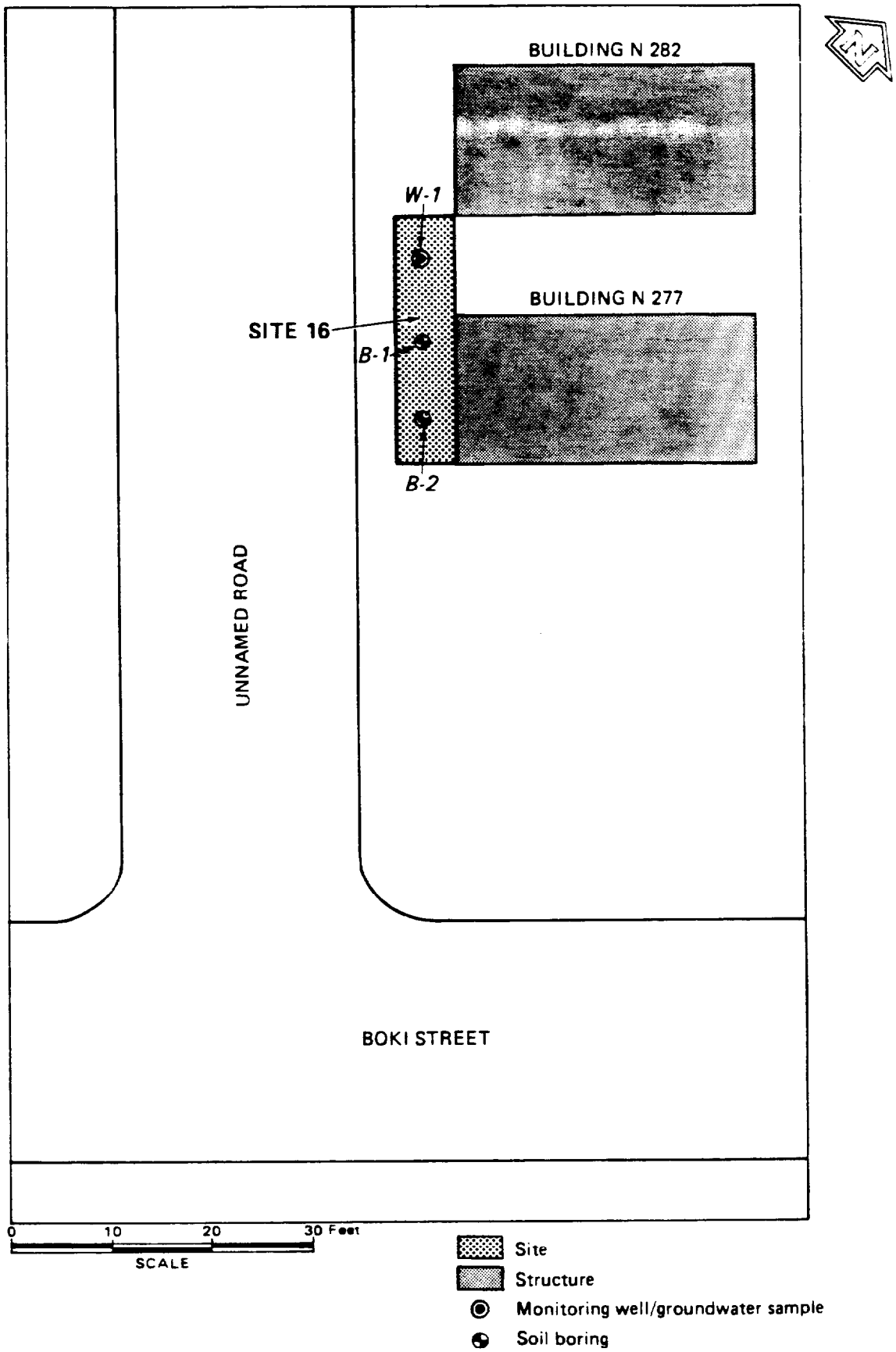


FIGURE 3-5
SITE 16, PESTICIDE RINSATE DISPOSAL AREA CONFIRMATION STUDY

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPO
Parris Island, South Carolina
Dames & Moor

CHAPTER 4. BACKGROUND

4.1 INTRODUCTION. The Marine Corps Recruit Depot (MCRD) Parris Island is part of a military complex that also includes the Marine Corps Air Station and Naval Hospital in Beaufort County, South Carolina. MCRD Parris Island is the subject of this report, while the Marine Corps Air Station and Naval Hospital are the subjects of a separate IAS report (NEESA 13-094).

As shown on the location maps (Figures 2-1 and 2-2), MCRD Parris Island is located approximately one mile south of the city limits of Port Royal and about 3 miles south of the city of Beaufort, in the southeastern corner of South Carolina. The activity is approximately 80 miles southwest of Charleston, South Carolina, and 35 miles northeast of Savannah, Georgia. The Depot consists of 8,047 acres, of which 3,274 acres are dry land, 4,344 acres are salt marsh, and 429 acres are saltwater creeks and ponds. The dry land consists of several islands, the largest being Parris Island, which houses most of the Depot's training, administrative, housing, and resource management facilities. Other islands have been used for training, recreation, and as sources of fill material, and include Horse Island, Doggie Island, Jericho Island, Goat Island, Gibbs Island, and Red Bug Island. There are several smaller islands within the Depot, but these have not been used due to access and size limitations.

The mission of MCRD Parris Island is to provide for the reception and recruit training of enlisted personnel upon their first entry into the Marine Corps; to provide field and combat skills training for recruits; to provide schools to train enlisted Marines as drill instructors and field staff; to conduct rifle marksmanship training for Marine officers and enlisted personnel in the southeastern United States area and for personnel of other services as requested; and to conduct training for Marine reserves. All males who enlist in the Marine Corps from states east of the Mississippi River are trained at MCRD Parris Island. All females who enlist throughout the United States are also trained at the Depot.

Because MCRD Parris Island is primarily a recruit training base, most of the available land space is utilized to provide or support the training facilities. Other land uses at the depot inlcude areas for administration, housing, maintenance facilities, community facilities, and recreation. The Depot is isolated from the mainland, except for the Pollock Memorial Causeway which crosses the marsh and Archer's Creek on the north. The Depot is bounded on the east by the Beaufort River and on the west by the Broad River. The two rivers converge south of the island and form Port Royal Sound, which connects to the Atlantic Ocean.

The Depot is situated on relatively flat land, with elevations varying between 0 and 22 feet above mean sea level (msl), and averaging 4 feet above msl. Low-lying areas are covered by saltwater during extremely high tides.

4.2 HISTORY. Colonization of Parris Island was initiated by the French in the sixteenth century. Subsequent settlements were established by the British and Spanish colonial powers. Indigo and rice plantations were situated on the

island in colonial times. The Port Royal area including Parris Island was seized by Federal forces during the Civil War and used as a naval base for the blockade of the South Atlantic coast of the Confederacy (Champie, 1959).

A permanent U.S. Naval Station was established at Parris Island in 1893, and a Navy yard operated until 1911. A wooden drydock completed in 1893 was used periodically for ship maintenance for about 30 years. Between 1911 and 1915, the station was used primarily as a U.S. Naval Disciplinary Barracks. In 1915, the entire island was transferred to the Marine Corps for use as a recruit depot, and recruit training began.

During World War I, facilities and training at MCRD Parris Island were greatly expanded. By the end of World War I, more than 41,000 recruits had been trained at the Depot. During World War I, approximately 400 wood-frame buildings were constructed, with sufficient capacity to house up to 9,000 recruits. In general, facilities and recruit training did not change significantly until World War II. Prior to 1929, Parris Island was not directly connected to the mainland and all transportation to and from it was by boat from Port Royal. In 1929, the Pollock Memorial Causeway over Archer's Creek and adjoining marsh land was completed, connecting the island to the mainland. In addition, a small airfield (Page Field) was established in 1932 for use in training Marine Corps and Navy pilots (U.S. Dept. of Navy, undated).

The next major expansion of MCRD Parris Island occurred just prior to and at the beginning of World War II. New housing was constructed and the training facilities were enlarged. During World War II, 205,000 recruits were trained at MCRD Parris Island. By the end of the war in 1945, over 20,000 recruits were stationed at the Depot. The small airfield constructed in 1932 was also expanded for use in the war effort. Army and Marine Corps pilots trained at Page Field, which was deactivated in 1946.

After World War II, recruit training diminished until the beginning of the Korean War. In 1949, a separate battalion was established for the purpose of training female recruits; this remains the only such command in existence. A total of 138,000 marines were trained at the Depot during the Korean War. Afterwards, recruit training operations again diminished until the beginning of U.S. involvement in the Vietnam War. During the years 1965-1971, approximately 250,000 marines were trained at the Depot. A major construction program was undertaken to replace many of the wooden buildings with brick buildings during the mid to late 1960's. Since the end of the Vietnam War, training levels have generally remained steady, with the number of recruits stationed at MCRD Parris Island typically ranging between 9,000 and 11,000 (U.S. Department of Navy, undated).

4.3. HISTORICAL RESOURCES

The MCRD Parris Island has several historical sites of significance that are recognized as national historic sites and included in the National Register of Historic Places. Ribaut Monument is located on the southeastern shore of Parris Island, approximately 3,000 feet from the Beaufort River. The monument was erected in 1925 by the U.S. Government in honor and memory of Jean Ribaut, who was then believed to have established a colony on the island in 1562.

Known as Charlesfort, the site was included in the National Register of Historic Places in August of 1974 (SOUTHDIV, 1984). Recent archeological work has cast doubt that Charlesfort was actually on Parris Island; artifacts uncovered may be remnants of Spanish colonization.

The Commanding General's quarters, the gazebo, and the Parris Island drydock area, covering approximately 3 acres, are parts of the first development of the present military base on Parris Island. These three structures have been designated a National Historic District. Their inclusion in the National Register precludes excavation of a destructive nature in the area.

An area that is not on the National Register, but which is of historical significance, is the site believed to be the old Spanish colonial fort predating Charlesfort, San Felipe II established in 1566. The site is located on the southeastern point of Parris Island, adjacent to the golf course and in the vicinity of Ribaut Monument. Artifacts believed to be associated with the site of San Felipe II were uncovered in 1979.

An additional site of historic significance as a World War I memorial is the location of "Iron Mike." This statue, located on Boulevard de France, was completed in 1924. It commemorates the Marines who trained at Parris Island and later lost their lives in Europe during World War I.

4.4 ADJACENT LAND USE

By nature of being an island, Parris Island has no development in close proximity. The surrounding area is estuary, however, and supports considerable commercial and recreational fishing, boating, and water recreation. The mainland closest to the island is developed as a residential area. Hilton Head Island, a major recreational area, is located approximately 3 miles southwest from MCRD Parris Island (Figure 4-1) across Port Royal Sound. Land use in the vicinity of MCRD Parris Island is shown in Figure 4-1.

4.5 LEGAL ACTION. There have been no legal actions concerning pollution incidents at the MCRD Parris Island.

4.6 BIOLOGICAL FEATURES.

4.6.1 Ecosystems. MCRD Parris Island is located in the outer coastal plain forest province ecoregion, as described in Bailey (1982). The plant communities of MCRD Parris Island (other than areas maintained as mown grass) are made up of temperate evergreen forest, pine forest, maritime forest, and salt marsh. Nearly all the upland portions of the island (all land above the high water mark) comprises temperate evergreen forest or managed pine forest. Areas of the island that have never been filled or excavated tend to support the temperate evergreen forest, while areas that have been disturbed or altered are typically managed pine forest. The extreme southern tip of the island (south of the golf course) is maritime forest with many large live oaks well over 100 years old. All of the area around Parris Island with elevations between high and low water is salt marsh, and there are substantial areas of estuary creeks and ponds. Jericho and Doggie Islands are temperate evergreen forest, surrounded by salt marsh. Horse Island is covered with both pine

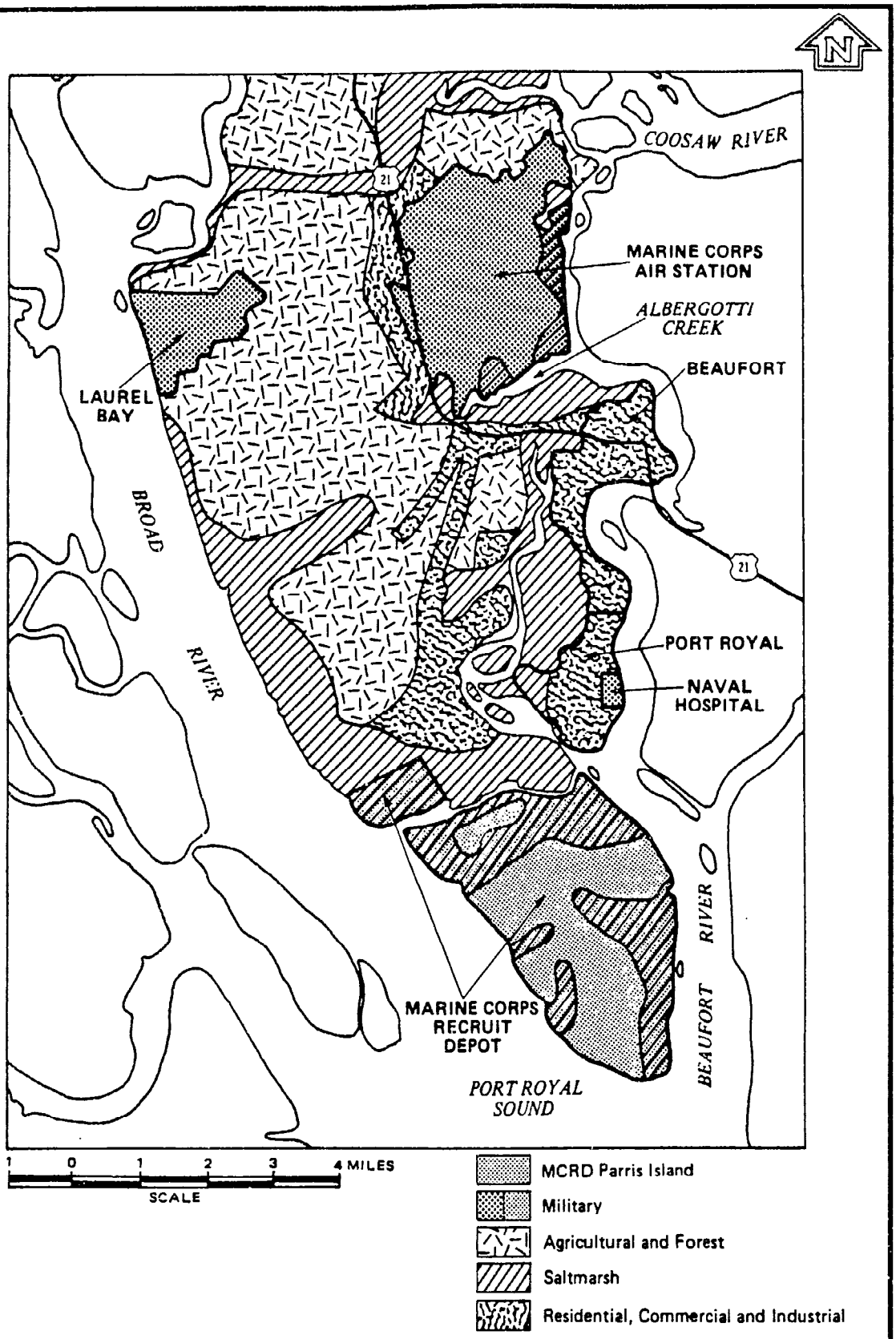


FIGURE 4-1
LAND USE MAP

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

Dames & Moore

forest (in the fill and borrow areas) and temperate evergreen forest (in relatively undisturbed areas), and is surrounded by salt marsh.

The temperate evergreen forest is the climax vegetation community through most of the area. This type of forest is characterized by evergreen oaks, such as the live oak (Quercus virginiana) and laurel oak (Quercus laurifolia), and other evergreen trees and scrubs such as the bull bay or southern magnolia (Magnolia grandiflora), red bay (Persea borbonia), sweet bay (Magnolia virginiana), and yaupon (Ilex vomitoria). The understory includes many runner or vine species such as poison ivy (Rhus radicans), Virginia creeper (Parthenocissus quinquefolia), muscadine grape (Vitis rotundifolia), and greenbriar (Smilax rotundifolia).

The maritime forest is a temperate evergreen forest that has been modified by salt spray and constant sea breezes. As a result, salt-tolerant species are dominant. These species include trees and shrubs such as the live oak (Quercus virginiana), yaupon (Ilex vomitoria), wax myrtle (Myrica cerifera), and cabbage palmetto (Sabal palmetto). Typically these species are stratified in bands along the ocean-facing beaches of islands. The band of vegetation nearest the ocean is composed of the most salt-tolerant species, wax myrtle, followed by the yaupon, and then a live oak-cabbage palmetto association. Undergrowth is typically sparse in maritime forest, although greenbriar (Smilax rotundifolia) vines are common in areas that do not support significant populations of large herbivores such as whitetailed deer and wild hogs.

The pine forest is dominated by loblolly (Pinus taeda) or slash pine (Pinus elliottii) with an understory of occasional small oaks (Quercus spp.), dogwoods (Cornus florida), and sweetgums (Liquidambar styraciflua). Pine forests are typically managed for lumber or pulpwood production and methods such as controlled burning and poisoning are often used to reduce competition from other tree species. Despite the lack of species diversity these control measures produce, pine forests may support large numbers of certain wildlife species, including whitetailed deer (Odocoileus virginianus), wild turkey (Meleagris gallopavo), and bobwhite (Colinus virginianus).

The salt marshes that surround Parris Island are typically found near the mouths of creeks and rivers, where silt, fine sand, and organic matter have settled out of the water forming shallow "mud flats." This creates conditions favorable for thick, lush growth of salt-tolerant marsh grasses. These tidally influenced areas support a tidal marsh estuary community vegetated predominantly by cordgrasses (Spartina spp.), black needlerush (Juncus roemerianus), saltgrass (Distichlis spicata), and glassworts (Salicornia spp.). The marshes support a very large assemblage of fauna, particularly fish and crustaceans. Shellfish and crustaceans such as blue crabs (Callinectes sapidus), stone crabs (Menippe sp.), shrimps (Penaeus and Palaemonetes spp.), American oysters (Crassostrea virginica), common blue mussels (Mytilus edulis), and the Atlantic ribbed mussel (Geukensis demissus) live in the marshes in large numbers and provide important food sources for fish and wildlife and for man. In addition to the habitat provided for adult fishes and crustaceans, the marshes provide critical spawning and nursery areas for a large percentage of salt water species. The protected shallows and high nutrient levels inherent to marshes provide ideal conditions for the

young of most coastal species for fish to develop. Marshes also support large numbers of animals that prey upon the fish and crustaceans. These predators include mammals such as raccoons (Procyon lotor), mink (Mustela vison), and river otter (Lutra canadensis); birds such as herons and egrets (Order Ciconiiformes), various shorebirds and gulls (Order Charadriiformes), brown pelicans (Pelecanus occidentalis), and large numbers of migratory ducks during the winter; and fish such as red drum (Sciaenops ocellata , spotted seatrout (Cynoscian nebulosus), and the southern flounder (Paralichthys lethostigma)). No amphibians are found within the saltmarsh, due to their inability to withstand highly saline conditions. Due to the complex nature of saltmarsh and the high utilization of estuarine species of fish and shellfish by man, it has long been the policy of both state and federal governments to provide protection against destruction and toxic contamination of salt marsh/estuary areas (Bailey, 1982).

The common mammalian herbivores of the area include the whitetailed deer (Odocoileus virginianus), the eastern cottontail (Sylvilagus floridanus), the marsh rabbit (Sylvilagus palustris), gray squirrels (Sciurus carolinensis), fox squirrels (Sciurus niger), cotton rats (Sigmodon hispidus) and the cotton mouse (Peromyscus gossypinus). Carnivores include the gray fox (Urocyon cinereoargenteus), minks (Mustela vison), striped skunks (Mephitus mephitus), river otter (Lutra canadensis), and occasional bobcats (Lynx rufus). The common bird species include the bobwhite (Colinus virginianus), the barred owl (Strix varia), chuck-wills-widow (Caprimulgus carolinensis), blue jay (Cyanocitta cristata), common crow (Corvus brachyrhynchos), fish crow (Corvus ossifragus), mockingbird (Mimus polyglottos), Osprey (Pandion haliaetus) red-tailed hawk (Buteo jamaicensis), herons and egrets (Order Ciconiiformes), white ibis (Eudocimus albus), mourning dove (Zenaida macroura), and assorted shorebirds and gulls (Order Charadriiformes) (Burt and Grossenheiden, 1976).

Common herptile species include the yellow rat snake (Elaphe obsoleta quadrivittata), black racer (Coluber constrictor), red-bellied water snake (Nerodia erythrogaster), eastern cottonmouth (Agkistrodon piscivorus), narrow-mouthed toad (Gastrophryne carolinensis), southern toad (Bufo terrestris), squirrel treefrog (Hyla squirella), bullfrog (Rana catesbeiana), diamondback terrapin (Malaclemys terrapin), eastern glass lizard (Ophisaurus ventralis) and the broad-headed skink (Eumeces laticeps). The American alligator (Alligator mississippiensis), which is federally listed as threatened in the Beaufort area, may be found in ponds, ditches, and occasionally in marshes. At least one large individual of this species is known to inhabit the ponds and ditches of the MCRD Parris Island golf course.

Freshwater fishes include sunfishes (Lepomis spp.), the brown bullhead (Ictalurus nebulosus), mosquitofish (Gambusia affinis), and killifish (Fundulus spp). An extremely large variety of saltwater fish depend upon the marshes and estuaries for at least a portion of their life. Some, like the striped mullet (Mugil cephalus), spotted seatrout (Cynoscion nebulosus), and southern flounder (Paralichthys lethostigma) may spend their entire life cycle in the estuaries. Some species that spawn in freshwater, such as striped bass (Morone saxatilis) and sturgeons (Acipenser spp.), utilize the estuaries as food sources. Other species like the jack crevalle (Caranx hippos) and the Cobia (Rachycentron canadum) usually frequent open waters but rely upon the

estuaries for spawning areas. Shellfish such as shrimps (Panaeus spp.), blue crabs (Callinectes sapidus), and oysters (Crassostrea virginica) occur in great numbers in the estuaries and salt marshes and provide important food sources for wildlife and man alike.

4.6.2 Rare, Threatened or Endangered Species. The Federal Government and the South Carolina Department of Wildlife and Marine Resources maintain lists of rare, threatened, and/or endangered species. The federally listed species (Table 4-1) are protected by federal statute (50 CFR 17). The State of South Carolina does not presently offer any legal protection to species it considers to be rare, threatened, or endangered (S.C. Rule 123-150) (Table 4-2).

Of the mammals on both the South Carolina and federal lists, none are likely to occur in close proximity to MCRD Parris Island. While the Florida panther (Felis concolor coryi) is suspected of occurring in the region there have been no recent confirmed sightings or other evidence of its presence. The Florida panther requires vast areas of very remote and undisturbed land for habitat none of which exist near the study area (U.S. FWS, 1985).

The whales listed include the finback (Balaenoptera physalus), humpback (Megaptera novaeangliae), right (Eubalaena glacialis), sei (Balaenoptera borealis), sperm (Physeter catodon), blue (Balaenoptera musculus), and bowhead (Balaena mysticetus). While these species may be occasionally seen along the coastline, it is rare for any of them to venture into the shallower, restricted waters of Port Royal Sound or the adjacent rivers. Strandings of right whales near Beaufort and Port Royal have been reported; sperm whales have stranded on Daws Island (directly west of the Depot across the Broad River) and on Hunting Island to the east of the Beaufort River (Schmidly, 1981). The Florida manatee (Trichechus manatus) may rarely visit the lower South Carolina coastline during the warm months. Because Beaufort is at the northern limits of the manatee's range, its occurrence in the study area would be unlikely (USFWS, 1985).

There are a number of bird species listed that may occur in the area near Parris Island. These include the southern bald eagle (Haliaeetus l. leucocephalus), (Pelecanus occidentalis carolinensis) eskimo curlew (Numenius borealis), ivory-billed woodpecker (Campephilus principalis), woodstork (Mycteria americana), red-cockaded woodpecker (Picoides borealis), the swallow-tailed kit (Elanoides forticatus), arctic peregrine falcon (Falco peregrinus tundrius), Ipswich (savannah) sparrow (Passerculus sandwichensis princeps), Bachman's warbler (Vermivora bachmanii), and Kirtland's warbler (Dendroica kirtlandii) (USFWS, 1985).

The southern bald eagle has been known to nest on Hunting Island and recently two eaglets were seen on Pritchards Island (Dr. Richard McCollum, 1985). While no eagles or eagle nesting have been noted at MCRD Parris Island, they are likely to utilize the neighboring marsh to collect food. Eagles prey heavily on fish and are known to have had serious population declines due to contamination of habitat and prey by toxic chemicals such as DDT, dieldrin, heavy metals, and PCB's. These contaminants have had markedly adverse affects on breeding success and have sometimes been directly responsible for mortality (King, 1981). Disturbance of nests and destruction or deterioration of

TABLE 4-1
FEDERALLY LISTED SPECIES OCCURING IN SOUTH CAROLINA
MCRD PARRIS ISLAND, SOUTH CAROLINA

(E=Endangered; T=Threatened; CH=Critical Habitat determined)

Mammals	General Distribution
Cougar, Eastern (Felis concolor cougar) - E	North, East
Manatee, Florida (Trichechus manatus) - E	Coastal waters
Panther, Florida (Felis concolor coryi) - E	South, West
Whale, finback (Balaenoptera physalus) - E	Coastal waters
Whale, humpback (Megaptera novaeangliae) - E	Coastal waters
Whale, right (Eubalaena glacialis) - E	Coastal waters
Whale, sei (Balaenoptera borealis) - E	Coastal waters
Whale, sperm (Physeter catodon) - E	Coastal waters
Birds	
Eagle, bald (Haliaeetus leucocephalus) - E	Entire state
Falcon, American peregrine (Falco peregrinus anatum) - E	Northwestern mountains
Falcon, Arctic peregrine (Falco peregrinus tundrius) - T	Coast, western mountains
Stork, wood (Mycteria americana) - E	Coastal swamps
Warbler, Bachman's (Vermivora bachmanii) - E	East, South
Warbler, Kirtland's (Dendroica kirtlandii) - E	East, North
Woodpecker, ivory-billed (Campephilus principalis) - E	East
Woodpecker, red-cockaded (Picoides (=Dendrocopos) borealis) E	Entire state
Reptiles:	
Alligator, American (Alligator mississippiensis) - T	Coastal areas
Alligator, American (Alligator mississippiensis) - E	Inland coastal plain
Snake, eastern indigo (Drymarchon corais couperi) T	Extreme Southeast
Turtle, Kemp's (Atlantic) ridley (Lepidochelys kempii) - E	Coastal waters
Turtle, green (Chelonia mydas) - T	Coastal waters
Turtle, hawksbill (Eretmochelys imbricata) - E	Coastal waters
Turtle, leatherback (Dermochelys coriacea) - E	Coastal waters
Turtle, loggerhead (Caretta caretta) - T	Coastal waters
Fishes:	
Sturgeon, shortnose (Acipenser brevirostrum) - E	Coastal rivers
Plants:	
Bunched arrowhead (Sagittaria fasciculata) - E	Greenville County
Miccosukee gooseberry (Ribes echinellum) - E	McCormick County
Persistent trillium (Trillium persistens) - E	Tallulah-Tugaloo River System, Oconee County
Small whorled pogonia (Isotria medeoloides) - E	Oconee County

Source: US Fish and Wildlife Service (1985)

TABLE 4-2
SOUTH CAROLINA STATE LISTED ENDANGERED SPECIES
MCRD PARRIS ISLAND, SOUTH CAROLINA

I. Birds

1. American Peregrine Falcon
   Falco peregrinus anatum
2. Arctic Peregrine Falcon
   Falco peregrinus tundrius
3. Bachman's Warbler
   Vermivora bachmanii
4. Eastern Brown Pelican
   Pelecanus occidentalis carolinensis
5. Eskimo Curlew
   Numenius borealis
6. Golden Eagle
   Aquila chrysaetos
7. Ipswich (Savannah) Sparrow
   Passerculus sandwichensis princeps
8. Ivory-billed Woodpecker
   Campephilus principalis
9. Kirtland's Warbler
   Dendroica kirtlandii
10. Southern Bald Eagle
    Haliaeetus l. leucocephalus
11. Swallow-tailed Kite
    Elanoides forticatus
12. Red-cockaded Woodpecker
    Picoides borealis

II. Fish

1. Shortnose Sturgeon
   Acipenser brevirostrum

III. Mammals

1. Atlantic Right Whale
   Eubalaena glacialis
2. Blue Whale
   Balaenoptera musculus
3. Bowhead Whale
   Balaena mysticetus
4. Finback Whale
   Balaenoptera physalus
5. Humpback Whale
   Megaptera novaengliae
6. Sei Whale
   Balaenoptera borealis
7. Sperm Whale
   Physeter catodon
8. Eastern Cougar
   Felis concolor cougar
9. Florida Manatee
   Trichechus manatus
10. Indiana Bat
    Myotis sodalis

IV. Reptiles

1. Atlantic Hawksbill Turtle
   Eretmochelys imbricata
2. Atlantic Leatherback Turtle
   Dermochelys c. coriacea
3. Atlantic Ridley Turtle
   Lepiodchelys kempii
4. Eastern Indigo Snake
   Drymarchon corais couperi
5. Gopher Tortoise
   Gopherus polyphemus

IV. Amphibians

1. Pine barrens Treefrog
   Hyla andersonii
2. Zig Zag Salamander
   Plethodon websteri

V. Mollusks

1. Atlantic Pigtoe Mussel
   Fusconaia masoni
2. Brother Spike Mussel
   Elliptio fraterna

Source: South Carolina Department of Wildlife and Marine Resources (1976)

Dames & Moore

feeding habitats are other significant factors in the eagle's decline (King, 1981). Therefore, any waste products that could contaminate the surface waters should be considered as a potentially serious threat to any bald eagles occurring in the Port Royal Sound area.

The eastern brown pelican lives and nests commonly in the study area. It, like the eagle, feeds heavily on fish in the estuaries and is therefore exposed to pollutants occurring in the surface waters. The occurrence of contamination should be considered a serious threat to the adult and young of this large fish-eating bird.

The eskimo curlew is a very rare medium-sized wading bird which feeds on crustaceans and other invertebrates in the marshes and mudflats. Due to its eating habits, it would be potentially jeopardized by contamination in the surface waters of the Port Royal Sound area.

While the ivory-billed woodpecker may potentially occur in the region of the lower South Carolina coast, it is associated with large undisturbed bottomland hardwood or cypress swamps. There is no habitat of this description near the Beaufort area.

The wood stork or wood ibis may, on rare occasions, utilize the marshes in the Port Royal Sound area. This large wading bird can be described as white with a bald head and black primary and secondary wing feathers. While no nesting occurs in the Port Royal Sound area, the potential for them to ingest contaminated prey in the marshes could be a threat to these birds.

There is no habitat for the red-cockaded woodpecker in the study area; this bird requires very old pine trees infected with red-heart fungus to provide nesting trees. Due to the pine forest management techniques being used, this condition does not occur in the study area.

The swallow-tailed kite may rarely visit the marshes around Parris Island but it is not likely to be using the Port Royal Sound area on a regular basis (Cely, 1985).

The arctic peregrine falcon, Ipswich sparrow, Bachman's warbler, and Kirtland's warbler may visit the area during migrations, but it is unlikely they would be significantly jeopardized by surface water contamination.

Of the listed reptiles and amphibians only the American alligator (Alligator mississippiensis) is known to occur at MCRD Parris Island. This large crocodilian is federally listed as being threatened in the Beaufort area. Within the study area it would be restricted to the marshes, ditches, tidal creeks, and any bodies of freshwater. Contaminants that might occur in these areas could render some threat to alligators, although research into specific effects of contaminants is lacking. One large individual of this species is known to inhabit the ponds and ditches of the MCRD Parris Island golf course.

The listed sea turtles--including the loggerhead turtle (Caretta caretta), green turtle (Chelonia mydas), hawksbill turtle (Eretmochelys imbricata), leatherback turtle (Dermochelys coriacea), and the kemp's (Atlantic) ridley

turtle (Lepidochelys kempi)--utilize the barrier islands as nesting locations. However, they apparently do not enter Port Royal Sound (McCollum, 1985).

The eastern indigo snake (Drymarchon corais couperi) has been documented in South Carolina on only one occasion, immediately north of the Savannah River and the City of Savannah. It is highly unlikely to ever occur in the study area.

The only listed fish species that might be found in the study area is the federally endangered short-nosed sturgeon (Acipenser brevirostrum). A large fish similar in appearance to the Atlantic sturgeon, it is found in coastal rivers where it feeds on bottom dwelling organisms, mostly crustaceans and other invertebrates. Due to its habitat and feeding characteristics, toxic contamination of the estuaries should be considered as detrimental to this species in the immediate area.

It is believed that the two listed mollusks, the Atlantic pigtoe mussel (Fusconaia masoni) and the brother spike mussel (Elliptio fraterna) do not occur in the Port Royal Sound area.

There are no listed plant species in the study area, and there is no designated critical habitat for endangered species near Parris Island.

4.7 PHYSICAL FEATURES.

4.7.1 Climatology. The MCRD Parris Island is in the southernmost region of South Carolina, where the climate is milder than else where in the state. This low-lying coastal area has numerous islands, inlets, streams, and marshes and a temperature regime that clearly reflects the influences of its maritime and southerly location. The climate is subtropical, with long and hot summers followed by short and mild winters. Precipitation is abundant, averaging about 49 inches per year and remaining within the range of 40 to 58 inches during most years. Precipitation in the amount of one-tenth inch or more falls on an average of about 77 days per year. The annual distribution shows a major monthly maximum of about 7 inches in July and a major monthly minimum of about 2 inches in November. The period of April through October, which includes the growing season for most crops in this area, receives an average of about 34 inches of rain; about 70 percent of the annual total.

Spring is a season of transition between a rather uniform winter and a rather uniform summer. March is typically a month of heavy rains and warming temperatures. April tends to be dry, but scattered thunderstorm activity begins as summer begins. April and May are the months of greatest tornado hazard, during the March through October tornado season.

Summers are warm and humid. Maximum daily temperatures are near or above 90 degrees F, and minimum daily temperatures are 65 to 70 degrees F range. Temperatures in excess of 100 degrees F are usually recorded two to five days each year. Maritime tropical air persists in the area for extended periods during summer. The abundant supply of warm, moist, relatively unstable air produces frequent scattered showers and thunderstorms. About 54 thunderstorms occur in an average year, 16 in July. Hailstorms are infrequent, occurring

one to five times per year and are usually of little consequence. The tropical storm season is generally considered to be the period from July through October. Hurricanes are rare to the area, but tropical storms occur on an average of about once every 2 or 3 years. The last hurricane occurred in 1979, and caused flooding at MCRD Parris Island.

Autumn begins warm, humid, and showery, but changes to a warm, relatively dry, and pleasant Indian summer, which tends to take place in October and continue into November. The first freezing temperatures in the area can be expected in the middle of November, but the onset of frost tends to be quite variable from year to year and from place to place. Tropical storms or hurricanes occasionally bring heavy rains and strong winds to the area during this season.

The winter season is short and mild. It is also relatively dry, accounting for only about 20 percent of the average annual precipitation. Average daily maximum and minimum temperatures are about 63 degrees F and 38 degrees F, respectively. The average winter temperature is about 50 degrees F. Freezing temperatures occur about 27 days of each year. Winter precipitation normally comes in the form of rain associated with fronts and traveling cyclones. Measurable snowfall seldom occurs. Freezing rain (glaze) occurs some winters, but damaging ice storms are rare (Stuck, 1980).

4.7.2 Topography. MCRD Parris Island lies in the Lower Coastal Plain physiographic province. Elevations range from sea level to 22 feet above msl. The Depot consists of Parris Island (the largest and most developed island), seven smaller named islands, many small unnamed islands, salt marshes, and related tidal creeks (Figure 4-2). Because of the low elevation, most of the depot is within the 100-year flood level. The majority of the area of Parris Island north of Ballast Creek, the east central area of Page Field, and the central part of Horse Island are the only surfaces to be above the 100-year flood level.

The Depot covers 8,047 acres with 1,502 acres devoted to forest management; 744 acres of grass and facilities; 4,344 acres of saltwater marsh; and the remainder consisting of creeks, ponds, and causeways. Dry land makes up 3,274 acres.

Drainage off the land surface is to the nearest surface water body. Three generally east-west creeks drain much of the Depot. Archers Creek is at the northern boundary of the Depot and connects Battery Creek to the north with the Broad River to the west of Parris Island. Ribbon Creek drains the area between Horse and Parris Islands and flows westward into the Broad River. Ballast Creek enters the Beaufort River and drains central Parris Island. Smaller unnamed creeks drain the areas west and east of Page Field.

The Beaufort and Broad Rivers meet at the south end of Parris Island to form Port Royal Sound, which extends about 4 miles southeastward to the Atlantic Ocean.

4.7.3 Geology.

4.7.3.1 Structural Geology. A generalized geologic section of the Beaufort County area is shown in Figure 4-3. Geologic structure has an important influence on the hydrogeology of the Tertiary Limestone Aquifer in the Beaufort-Jasper County area, widely referred to as the Low Country. A geologic cross section through Parris Island--showing the surficial sands, the low permeability Hawthorn Formation, and the Santee Limestone making up the Tertiary Limestone Aquifer--is presented in Figure 4-4.

The regional structural setting of the Tertiary Limestone Aquifer influences the: 1) occurrence and extent of saltwater encroachment in the aquifer, 2) the thickness--or absence--of confining beds over the aquifer and; 3) the permeability distribution, particularly in the upper part of the aquifer. Thus, the position of the top of the Tertiary Limestone Aquifer with respect to sea level has been important in the past geologic history of this aquifer and is also important at the present time. The upper surface of the aquifer has a regional dip (or slope) generally toward the southeast, but this surface is highly irregular with structural highs (arches) and lows (troughs) interrupting the regional dip (Figure 4-5).

The most conspicuous and hydrogeologically important structural feature in the Low Country is the Beaufort Arch, a structural high with a northeast-trending axis in central Beaufort County. Over the axis of the Beaufort Arch, the top of the Tertiary Limestone Aquifer ranges from about 40 to 20 feet below msl and is occasionally less than 20 feet below msl. Due to this shallow depth, tidal rivers and estuaries that are more than 20 feet deep actually penetrate the upper surface of the Tertiary Limestone Aquifer in the Beaufort area. During Pleistocene time when sea level was much lower than it is at present, the top of the Tertiary Limestone Aquifer in the Beaufort area was 'scoured' by rivers flowing into the sea. Miocene confining beds that were deposited originally over the Eocene limestone composing the aquifer were removed in some areas by this scouring. Mining of river phosphate and channel dredging may have also been responsible for removing confining beds in the Beaufort River.

A structural low, the Ridgeland Trough, has a northeast-trending axis extending from just northwest of Hardeeville in Jasper County to the vicinity of Highway 21 in northern Beaufort County. Along the axis of this structural basin, the top of the Tertiary Limestone Aquifer occurs at an elevation of greater than 100 feet below msl, and in southwestern Jasper County the top of the aquifer occurs at an elevation of more than 200 feet below msl.

In reference to ground water hydrology, these geologic structures are important with respect to the depth of the Tertiary Limestone Aquifer below salty surface water bodies. They are also important because confining beds overlying the aquifer are thick in structural basins or troughs, but are thin over structural highs.

4.7.3.2 Descriptive Geology.

The rocks beneath MCRD Parris Island that are described in the following sections are those containing the Tertiary Limestone Aquifer and overlying

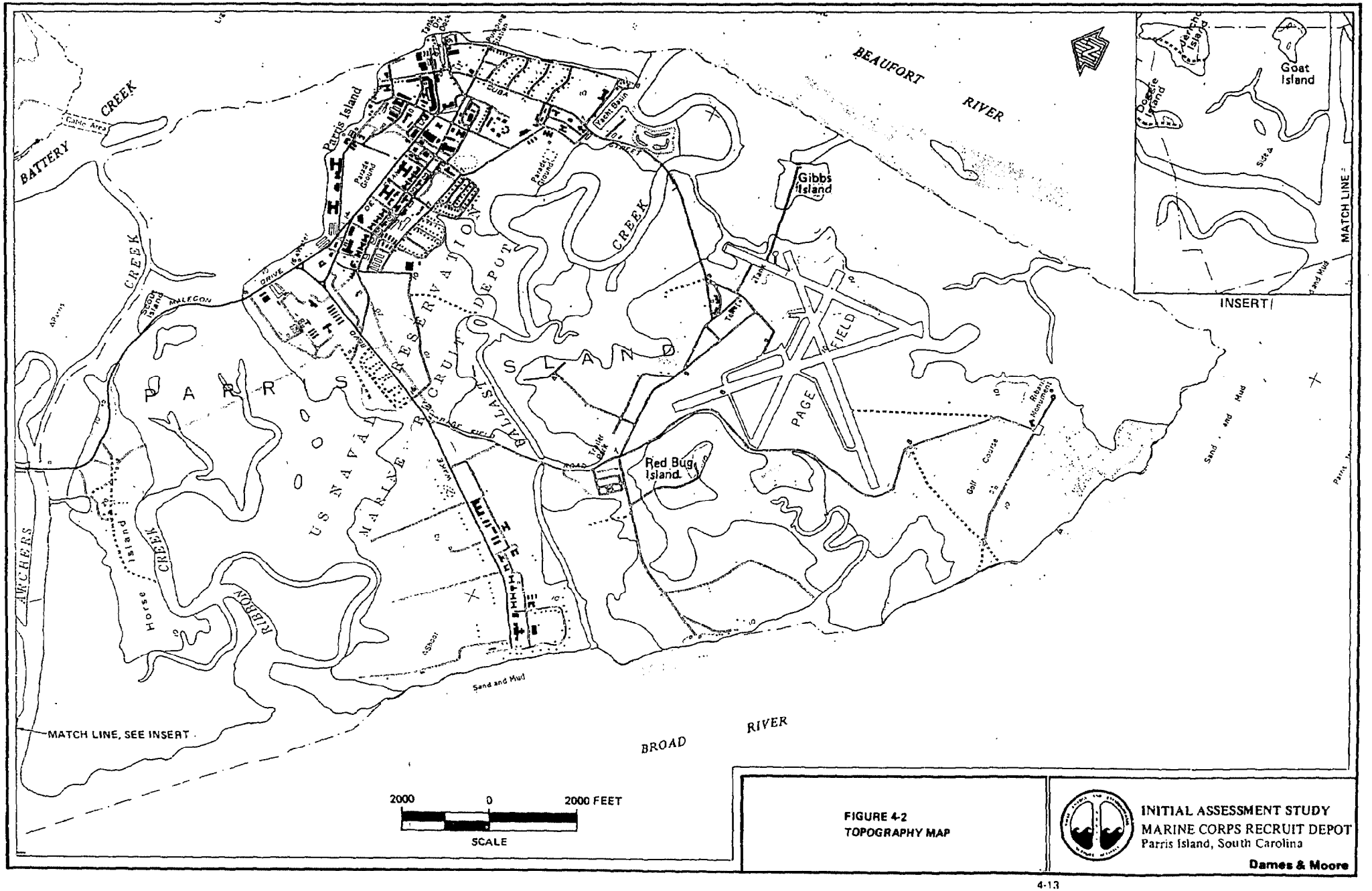
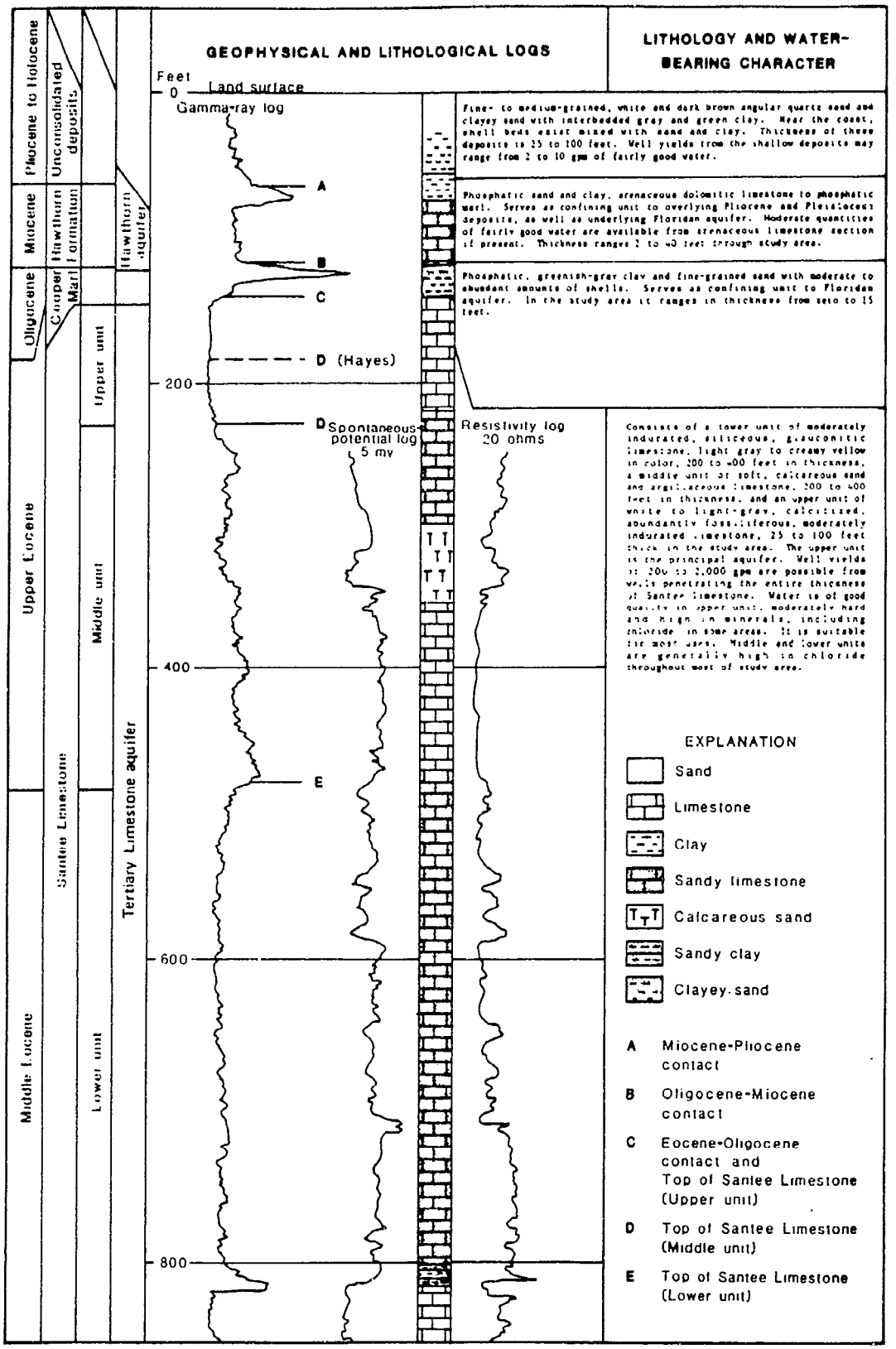


FIGURE 4-2
TOPOGRAPHY MAP

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

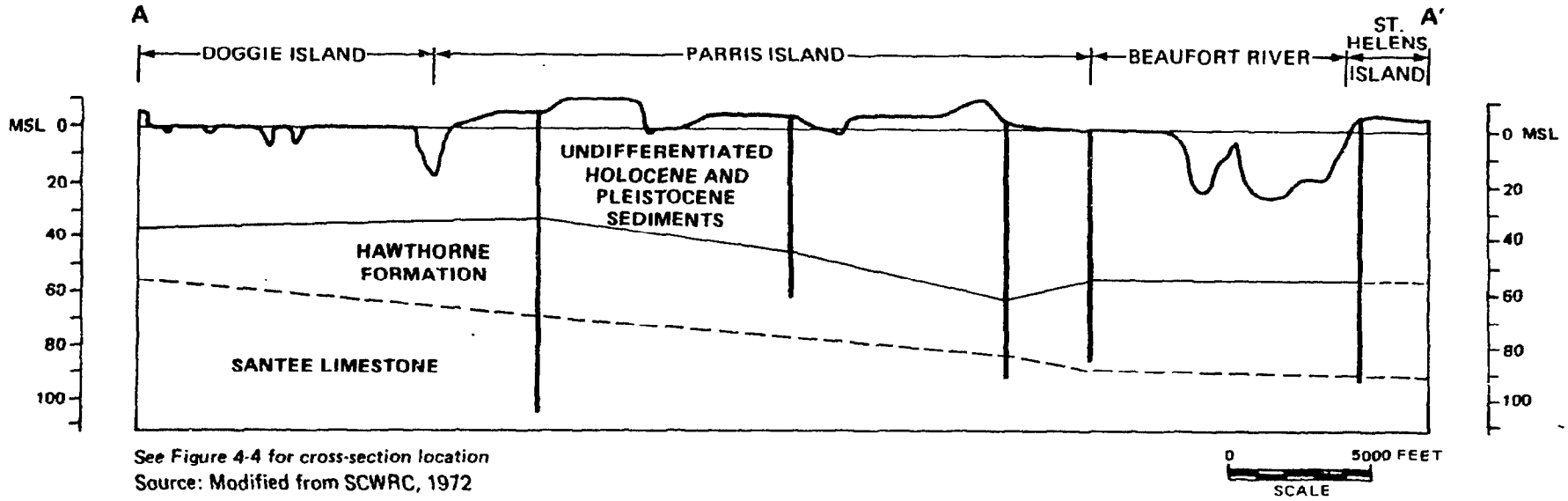
Dames & Moore



SOURCE. Hassen, 1985

FIGURE 4-3
GENERALIZED GEOLOGIC SECTION

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina
Dames & Moore

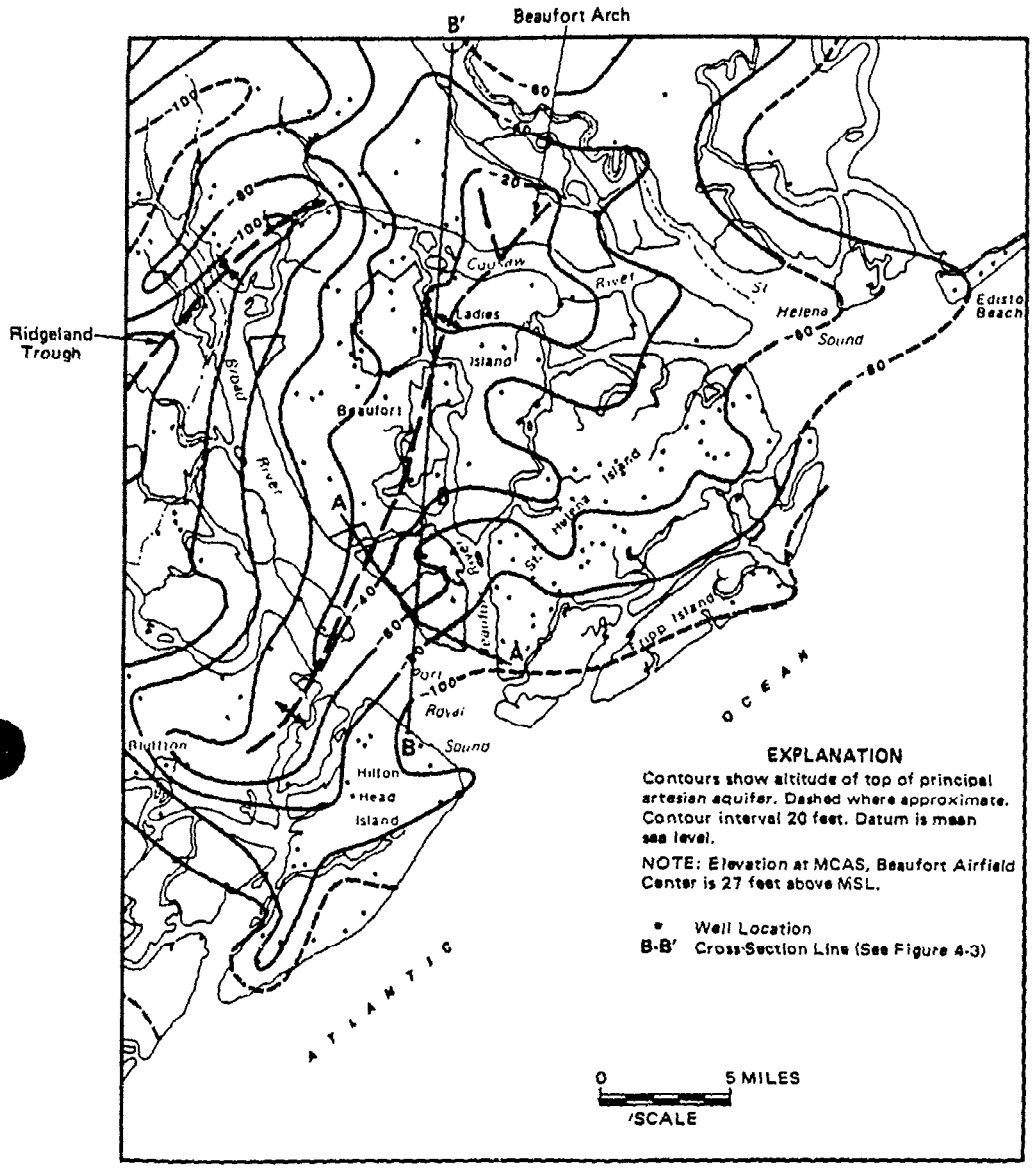


See Figure 4-4 for cross-section location

Source: Modified from SCWRC, 1972

FIGURE 4-4
GEOLOGIC CROSS-SECTION THROUGH PARRIS ISLAND

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina



Source: Modified from Hassen, 1985

FIGURE 4-5
STRUCTURE-CONTOUR MAP OF THE TOP OF THE SANTEE LIMESTONE. (TERTIARY LIMESTONE AQUIFER)

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

Dames & Moore

units extending to the surface. The rocks are described from oldest to youngest, encompassing: 1) Eocene limestones; 2) Oligocene limestones and marls; 3) Miocene limestones, sands and clays; and 4) Pleistocence sands and clays. The Tertiary Limestone Aquifer corresponds with the Eocene limestones and the surficial aquifer with the Pleistocene sands.

4.7.3.2.1 Eocene. Various geologic formations, or parts of formations, comprise the Tertiary Limestone Aquifer in the South Carolina Coastal Plain. About 55 miles north of MCRD Parris Island, the Tertiary Limestone Aquifer is composed almost entirely of the Santee Limestone, although locally some beds immediately below the Santee Limestone could logically be considered part of the aquifer. In the Low Country area, the Tertiary Limestone Aquifer is mainly composed of the Santee Limestone of Middle Eocene and Late Eocene age. In some areas it is composed of a limestone of Oligocene age, and in southwestern Beaufort County it is composed of a thin limestone of Miocene age. The Santee Limestone is primarily composed of limestones, that vary from relatively pure, to impure limestone containing clay or shale, to relatively thick marls. In the Low Country area, Hayes (1979) divided the Santee Limestone into three main lithologic units that are summarized as follows. The uppermost unit consists of white, cream-colored, or light-gray fossiliferous limestone and, in places, is composed almost entirely of fossil remains; this unit ranges in thickness from essentially zero to more than 200 feet. The middle unit consists of sandy or clayey limestone and ranges from 200 to 600 feet thick. The lower unit is indurated, siliceous, glauconitic, light-gray to creamy-yellow limestone that averages about 30 feet in thickness. The structural contour of the top of the Santee Limestone is shown in Figure 4-4.

4.7.3.2.2 Oligocene. Oligocene limestone overlies the Santee Limestone in southwestern Beaufort County and when water-bearing, it is considered to be part of the Tertiary Limestone Aquifer. In other areas, rocks of Oligocene age may be non-water-bearing and thus part of the overlying confining beds. These rocks of Oligocene age have either been referred to as the Cooper Marl or considered part of the Santee Limestone (Hayes, 1979). The Cooper Marl has been assigned to the early Oligocene. In the area near MCRD Parris Island, the Cooper Marl consists of phosphatic, greenish-gray clay and fine-grained sand with a moderate to very abundant amount of shells. In several areas of South Carolina the Cooper Marl contains sections of argillaceous to clean limestone, which may yield large amounts of good water. The Cooper Marl in the Parris Island area serves as a confining unit to the underlying Tertiary Limestone Aquifer, retarding the movement of contaminants into the aquifer. The thickness of the Cooper Marl ranges from zero to 15 feet, reflecting the amount of erosion prior to deposition of the Hawthorn Formation. The top of the deposit is 20 to 120 feet below land surface (Hassen, 1985).

4.7.3.2.3 Miocene. A thin (5- to 15-feet-thick) Lower Miocene limestone, called the Tampa Limestone and the 'Tampa Limestone equivalent,' overlies Oligocene rocks in southwestern Beaufort County and southern Jasper County. Depending on location, this thin limestone has been considered either part of the Tertiary Limestone Aquifer or part of the overlying confining beds. This thin limestone is hydrogeologically important for several reasons. Wells that are open to the Tampa Limestone have a noticeably high content of hydrogen

sulfide, which imparts a rotten-egg odor to the water. This unit is composed of phosphatic sand, sandy marl, or sandy clay in eastern Chatham County and southwestern Beaufort County. It occurs just above the Oligocene-Miocene boundary. This thin stratigraphic unit in southwestern Beaufort County is included in the Hawthorn Formation, which consists of Miocene deposits that appear to be locally discontinuous and varying in lithologic features across most of coastal South Carolina. The Hawthorn Formation consists of sandy, clayey materials that are frequently eroded in coastal Beaufort County. When present in the study area, it serves as a confining unit to the overlying Pleistocene deposits, as well as to the underlying Tertiary Limestone Aquifer.

Potential of the Hawthorn Formation as an aquifer in the study area is doubtful, owing to its thinness and general lithology; little is known about its water-bearing characteristics. In areas of Jasper, Hampton, and Colleton Counties, (Hayes, 1979) reported yields of 50 to 200 gallons per minute of fairly good water from this formation (Hassen, 1985).

4.7.3.2.4 Quaternary. The Pleistocene Epoch was marked by sea level fluctuations that are recorded in the sediment depositional record as land emergence and submergence cycles. As a result of the sea level fluctuations, the Pleistocene sediments are in many cases reworked, deposited as barrier islands, cut by erosional channels, and interbedded with alluvium. Geomorphologically, the "cycles" are reflected as four terrace-formations, which are from oldest to youngest: Pamlico, Princess Anne, Silver Bluff, and Recent (Glowacz, and others, 1980), of which the Princess Anne, Silver Bluff, and Recent deposits are present on Parris Island.

The Princess Anne and Silver Bluff Formations occur near the surface in the area as highly permeable beach-ridge deposits and low permeability clays (marsh deposits) located between the beach-ridge deposits. The permeable beach-ridges of these formations are generally vegetated with hardwoods and have erosional scarp faces that tend to trend somewhat parallel to the Atlantic Ocean. Approximate elevations for the terrace formations are: Princess Anne, 16 to 8 feet above msl, and Silver Bluff, 8 to 0 feet above msl.

Water tables tend to be very shallow in the swampy, topographically lower elevations, and range from surface grade to approximately 3 feet deep. In the topographically higher portion of the formations, consisting of older beach-ridges and bar deposits, the water table is found from surface grade to a maximum of about 10 feet deep. Ironstone deposits are commonly found in this barrier island deposit and are low in permeability and range from reddish brown to black in color (depending on the iron and manganese content). The iron-manganese cemented sands range in thickness from 10 feet to sand-size concretions. These ironstone features are thought to represent past and present geochemical change-of-state of iron and manganese due to seasonal fluctuations of the near-surface water table. In typical vertical soil profiles, the near-surface mottled zone(s) caused by iron-manganese staining can be considered an indicator of the local seasonal high water table elevation. The more massive concretions may represent a biogenic precipitate in Pleistocene marsh (backbarrier) environments. The sandy dune and beach facies of the barrier islands have deeper water than the marshy backbarrier deposits (Glowacz, and others, 1980).

Recent deposits occur as thin surficial veneers near the present coastline. Examples of these deposits are Fripp Island and the seaward side of Hilton Head Island. The Recent deposits consist of beaches, sand dunes, and alluvium. Most of the Recent alluvium consists of silt and clays of very low permeability (Glowacz, and others, 1980).

4.7.4 Soils.

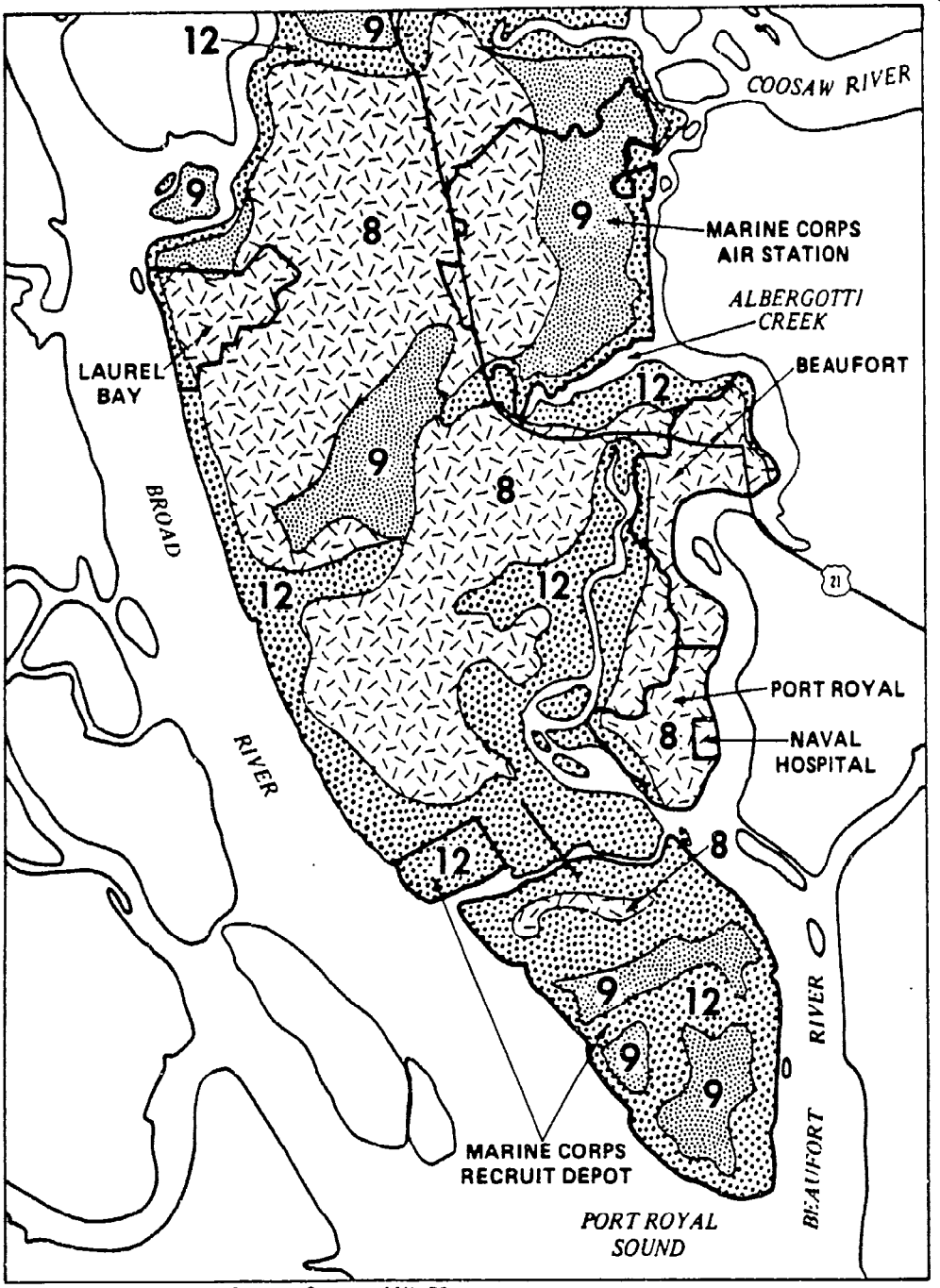
4.7.4.1 Soil Units. Soils at MCRD Parris Island have been mapped by the Soil Conservation Service as both individual soils and groupings of soils (units). The Depot has been mapped as having 15 individual soil types, but only eight types are present beneath the identified sites. Three soil units have been mapped for the Depot (Figure 4-6); these will be described below and the eight individual soil types will be explained in detail. The physical properties of the individual soil types are tabulated in Table 4-3.

4.7.4.1.1 Unit 8--Wando-Seabrook-Seewee. Excessively drained, moderately well drained, and somewhat poorly drained soils that are sandy throughout make up this association. Horse Island is made of this soil association. Site 2, Borrow Pit Landfill is located on these soils. This map unit makes up about 31 percent of Beaufort County. It is about 24 percent Wando soils, 18 percent Seabrook soils, 11 percent Seewee soils, and 47 percent minor soils.

Wando soils are in the higher areas and are excessively drained. Seabrook soils are in intermediate areas and are moderately well drained. Seewee soils are commonly in slightly lower areas than Seabrook soils and are somewhat poorly drained. All of these soils are sandy throughout and differ primarily in drainage. The minor soils in this map unit are the somewhat poorly drained Ridgeland soils, the poorly drained Baratari soils, and the very poorly drained Polawana and Rosedhu soils. In Jasper and Beaufort counties, about 60 percent of this unit is woodland, 20 percent has been developed for urban and recreational uses, and 20 percent is cultivated crops, truck crops, or pasture. With the exception of the soils in the higher areas, wetness is the main limitation to use of these soils. Droughtiness is a limitation to the excessively drained soils in the higher areas. There is rapid leaching in all of these soils. All soils in this unit, except the excessively drained Wando soils, have a seasonally high water table.

4.7.4.1.2 Unit 9--Coosaw-Williman-Ridgeland. Somewhat poorly drained and poorly drained soils that have a thick sandy surface layer and a loamy subsoil, and somewhat poorly drained soils that are sandy throughout, make up this association. Sites 4, Dredge Spoil Area Fire Training Pit; 6, Former Automotive Hobby Shop Spill Area; 7, Page Field Fire Training Pit; 8, PCB Spill Areas; 9, Paint Waste Storage Area; 10, Gasoline Spill Area; 11, MCX Service Station Spill Area; 16, Pesticide Rinsate Disposal Area; and parts of 13, Inert Disposal Area are located upon this unit. This map unit makes up about 13 percent of Beaufort County. It is about 21 percent Coosaw soils, 20 percent Williman soils, 13 percent Ridgeland soils, and 46 percent minor soils.

Coosaw soils are predominant in the higher areas and are somewhat poorly drained. Williman soils are in low areas and are poorly drained. Both of



1 0 1 2 3 4 MILES
SCALE

8 Wando–Seabrook–Seewee Soils

9 Coosaw–Williman–Ridgeland Soils

12 Bohicket–Capers–Handsboro Soils

Source: Adapted from Stuck, 1980

FIGURE 4-6
SOIL UNIT MAP OF BEAUFORT, SOUTH CAROLINA AND VICINITY

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

Dames & Moore

TABLE 4-3

Soil Properties of Beaufort, South Carolina and Vicinity

Soil Symbol-Soil Name	Depth (In.)	USDA Texture	Unified Soil Classification	Percent Clay and Silt	Liquid Limit (percent)	Plasticity Index	Risk of Corrosion Steel/Concrete	Sites Affected
Bk--Bohicket (Unit 12)	0-10	Silty clay loam	CH, MH	90-100	60-100	30-60	High/High	1,5,12,14
	10-40	Silty clay, clay	CH, MH	70-95	50-100	19-60	High/High	
	49-80	Variable	--	--	--	--	--	
CE-Capers Association (Unit 12)	0-22	Silty clay loam	MH	70-100	50-80	15-40	High/High	3
	22-68	Clay, silty clay	MH	75-100	60-80	18-40	High/High	
Cs--Coosaw (Unit 9)	0-27	Loamy fine sand.	SM	15-30	--	NP	Moderate/High	4,6,11,13 (part), 15 (part)
	27-31	Sandy loam, fine sandy loam	SM, -SM-SC	20-40	30	NP-7	Moderate/High	
	31-77	Sandy clay loam, fine sandy loam, sand loam.	SM,SC,SM-SC	25-50	15-35	2-15	Moderate/High	
Mu--Murad (Unit 9)	0-49	Fine sand	SM,SP-SM	10-25	--	NP	Moderate/High	7,8 (part), 15 (part)
	49-60	Sandy loam, fine sandy loam, sandy clay loam.	SM,SM-SC,SC	25-50	40	NP-15	Moderate/High	
	60-80	Fine sandy loam, sandy clay loam, sandy clay.	SM,SC,CL,SM-SC	36-65	25-50	5-25	Moderate/High	
Sw-Seewee (Unit 9)	0-25	Fine sand	SP-SP, SM	5-20	--	NP	Low/high	15 (part),
	25-45	Fine sand, sand	SP, SP-SM, SM	2-15	--	NP	Low/High	
	45-80	Fine sand, sand	SP, SP-SM, SM	1-15	--	NP	Low/High	
Wa-Wahee (Unit 9)	0-13	Fine sandy loam	SM, SM-SC	30-50	30	NP-7	Moderate/High	13 (part)
	13-40	Clay, clay loam, silty clay	CL, CH	70-90	41-60	18-32	High/High	
	40-62	Sandy clay loam, clay loam, silty clay loam	CL	36-65	30-50	11-25	High/High	
Wd-Wando (Units 8 and 9)	0-52	Fine sand	SP-SM, SM	5-25	--	NP	Low/Moderate	2,8 (part), 9,10,13 (part), 15 (part), 16
	52-85	Sand, fine sand	SP, SP-SM, SM	2-20	--	NP	Low/Moderate	
Wn-Williman (Unit 9)	0-26	Loamy fine sand	SM	15-35	25	NP-3	High/High	13 (part), 15 (part)
	26-80	Sandy loam, fine sandy loam, sandy clay loam	SM-SC, CL-ML SC, CL	30-65	15-35	3-15	High/High	

Source: [illegible]tuck, 1980

TABLE 4-3

Soil Properties of Beaufort, South Carolina and Vicinity (cont'd)

Soil Symbol-Soil Name	Depth (In)	Permeability (In/Hr)	Available Water Capacity (In/In)	Shrink-Swell Potential	Erosion Hazard	Hydrologic Group	High Water Table Depth (ft)/Kind	Sites Affected
Bk--Bohicket (Unit 12)	0-10	0.6-0.2	0.14-0.18	High	--	D	+3-0/Apparent	1,5,12,14
	10-49	0.06	0.12-0.16	High				
	49-80	--	--	--				
CE-Capers Association (Unit 12)	0-22	0.06-0.2	0.01-0.03	Very High	--	D	+1-1.0/Marsh	3
	22-68	0.06	0.01-0.03	Very High				
Cs--Coosaw (Unit 9)	0-27	6.0-20	0.06-0.11	Low	Slight	D	1.0-2.0/Apparent	4,6,11,13 (part), 15 (part)
	27-31	2.0-6.0	0.08-0.13	Low				
	31-77	0.6-2.0	0.08-0.16	Low				
Mu--Murad (Unit 9)	0-49	6.0-20	0.05-0.11	Very Low	Slight	C	1.5-3.0/Apparent	7,8 (part), 15 (part)
	49-60	0.6-2.0	0.10-0.17	Very Low				
	60-80	0.6-2.0	0.11-0.18	Very Low				
Sw-Seewee (Unit 9)	0-25	6.0-2.0	0.05-0.08	Very Low	Slight	B	1.0-2.0/Apparent	15 (part)
	25-45	0.6-6.0	0.04-0.07	Very Low				
	45-80	6.0-2.0	0.04-0.07	Very Low				
Wa-Wahee (Unit 9)	0-13	0.6-2.0	0.10-0.15	Low	Slight	D	0-1.0/Apparent	13 (part)
	13-40	0.06-0.2	0.12-0.20	Moderate				
	40-62	0.2-0.6	0.12-0.20	Moderate				
Wd-Wando (Units 8 and 9)	0-52	6.0-20	0.05-0.08	Very Low	Slight	A	6.0/--	2,8 (part), 9,10,13 (part), 15 (part), 16
	52-85	6.0-20	0.03-0.07	Very Low				
Wn-Williman (Unit 9)	0-26	2.0-6.0	0.05-0.11	Very Low	Slight	D	0-1.0/Apparent	13 (part), 15 (part)
	26-80	0.6-2.0	0.10-0.16	Low				

Source: Stuck, 1980

these soils have a sandy surface layer 20 to 40 inches thick and a loamy subsoil. Ridgeland soils commonly occupy intermediate areas, are sandy throughout, and are somewhat poorly drained. All of these soils have a seasonal high water table (Table 4-3). Among the minor soils in this map unit are the excessively drained Wando soils, the moderately well drained Seabrook soils, the somewhat poorly drained Murad soils, and the very poorly drained Deloss and Polawana soils. About 50 percent of this unit is woodland, 15 percent has been developed for urban and recreational uses, and 35 percent is used for truck crops, other crops, and pasture. Wetness is the main limitation to use of these soils.

4.7.4.1.3 Unit 12--Bohicket-Capers-Handsboro. Very poorly drained mineral and organic soils that are flooded daily or occasionally by saltwater, and adjacent upstream areas that are flooded occasionally by freshwater, make up this association. Sites 1, Incinerator Landfill; 3, Causeway Landfill; 5, Former Paint Shop Disposal Area; 12, Jericho Island Landfill; and 14, Storm Sewer Outfall.

This map unit consists of about 53 percent Bohicket soils, 17 percent Capers soils, 7 percent Handsboro soils, and 23 percent minor soils. Bohicket soils are commonly found in slightly lower areas than Capers and Handsboro soils. Frequently adjacent to tidal streams, they are flooded by saltwater to a depth of 6 to 36 inches twice daily. Capers soils are commonly in areas a few inches higher than Bohicket soils and are not as highly dissected with small tidal streams. Both Capers and Bohicket soils have a silty clay loam surface layer and are underlain by clay and clay loam. Handsboro soils are very poorly drained, organic soils that are flooded daily or occasionally by saltwater. Among the minor soils in this map unit are small islands of the excessively drained Wando soils, the moderately well drained Seabrook soils, the poorly drained Argent soils, and the very poorly drained Santee soils. Most of the soils in this map unit are in marsh grasses. The hazard of flooding, excessive salt and sulfur, and low bearing strength are some of the limitations to use of these soils.

4.7.4.2 Individual Soil Types.

4.7.4.2.1 BK--Bohicket association. This association is made up of very poorly drained, nearly level soils that are flooded twice daily by tidal saltwater. These soils are on broad tidal flats bordering the Atlantic Ocean and extending several miles inland along some of the larger rivers. They formed in silty and clayey marine sediment.

Typically, the surface layer is dark gray silty clay loam about 10 inches thick. The underlying material from 10 inches to a depth of 80 inches is about 39 inches of dark gray silty clay, 6 inches of dark gray silty clay and very dark grayish brown fine sandy loam, 13 inches of greenish gray clay, and 12 inches of dark greenish gray clay.

The Bohicket soils have very low permeability and high available water capacity. When continuously saturated by water, this soil ranges from slightly acid through moderately alkaline throughout. After air drying for 30 days, it is extremely acid.

Most of this soil supports marsh vegetation consisting of smooth cordgrass, needlegrass, and big cordgrass; the remainder is bare. Because of the high content of salt and sulfur, the very low bearing strength, and the difficulty of water control, these soils are not suited for row crops, pasture, trees, or urban uses. They provide a natural habitat for marine life and wildlife. Sites 1, Incinerator Landfill; 5, Former Paint Shop Disposal Area; 12, Jericho Island Landfill; 14, Storm Sewer Outfall; and part of 3, Causeway Landfill are located upon this soil Association.

4.7.4.2.2 CE--Capers Association. This association consists of very poorly drained, nearly level soils that are on tidal flats. The landscape is one of marsh areas dissected by an occasional saltwater stream. These areas have a dense cover of marsh grass. The Capers soils generally occupy intermediate positions between the uplands and the soils that are flooded by seawater for longer periods and to greater depths. These soils formed in silty and clayey marine sediment. Capers soils make up about 70 percent of the association. Typically, the surface layer is about 22 inches thick. It is very dark gray silty clay loam in the upper part and dark gray clay loam in the lower part. From 22 to 84 inches, a typical section has about 11 inches of gray clay loam, 12 inches of greenish gray clay, 23 inches of greenish gray sandy clay, and 16 inches of gray sandy clay loam that has pockets of fine sandy loam.

The Capers soils have very low permeability. The soil ranges from neutral through moderately alkaline throughout. The remaining 30 percent of the association consists of soils found below tidal streams and on marsh sandbars or small islands.

All of these soils are in marsh areas. Because of their salt and sulfur content, Capers soils are not suitable for row crops, improved pasture, woodland, or urban uses. They can be used for range pasture and as a natural habitat for wildlife. Most of Site 3, Causeway Landfill was constructed upon these marsh soils between Horse and Parris Islands.

4.7.4.2.3 Cs--Coosaw loamy fine sand. This deep, somewhat poorly drained, nearly level soil is on low ridges of the Lower Coastal Plain. Typically, the surface layer is dark grayish brown loamy fine sand about 7 inches thick. The subsurface layer is light brownish gray loamy fine sand about 20 inches thick. From 27 to 85 inches, a typical selection has about 4 inches of brownish yellow fine sandy loam that has brown and gray mottles, 7 inches of yellowish brown sandy clay loam that has gray, brown, and red mottles, 16 inches of gray sandy clay loam that has brown and red mottles, 23 inches of light brownish gray sandy clay loam that has reddish yellow and brownish yellow mottles, and 8 inches of light brownish gray fine sandy loam that has light gray, yellowish brown, and greenish gray mottles.

This soil is low in natural fertility and organic matter content, and is generally strongly acidic. The soil has medium to high potential for growing row crops and small grains. Its potential is slightly limited because of its depth to the subsoil and lack of drainage. This soil has medium potential for most urban uses. The soil has moderate limitations for most recreational uses because of its sandy surface texture and lack of drainage. Sites 4, Dredge Spoil Area Fire Training Pit; 6, Former Automotive Hobby Shop Spill Area; 11,

MCX Service Station Spill Area; and part of 13, Inert Disposal Areas are located upon this soil type.

4.7.4.2.4 Mu--Murad fine sand. This deep, moderately well drained, nearly level soil is on intermediate ridges on the uplands of the Lower Coastal Plain. Typically, the surface layer is dark grayish brown fine sand about 8 inches thick. The subsurface layer is fine sand about 41 inches thick, consisting of 13 inches of light yellowish brown that has light gray mottles and 28 inches of light gray that has brown mottles. The subsoil, from 49 inches to 80 inches depth, containing 11 inches of mottled, very pale brown fine sand loam, 7 inches of mottled, yellowish brown sandy clay loam, and 13 inches of mottled, light gray sandy clay loam. The underlying soil to a depth of 85 inches is mottled, brownish yellow loamy fine sand.

This soil is low in natural fertility and low in organic matter content. It is very strongly acid through slightly acid throughout. Permeability is moderate and available water capacity is low. This soil has medium potential for most urban uses. Because of its wetness and seasonal high water table, this soil has a moderate limitation for most recreational uses. Site 7, Page Field Fire Training Pit and parts of Site 8, PCB Spill Areas, and Site 15, Dirt Roads Disposal Area are located upon this soil.

4.7.4.2.5 Sw-Seewee fine sand. This somewhat poorly drained, nearly level, sandy soil is on low ridges.

Typically, the surface layer is fine sand about 14 inches thick. It is very dark brown in the upper part and dark grayish brown in the lower part. The subsurface layer is pale brown fine sand about 11 inches thick. The subsoil extends to a depth of 45 inches. It is 5 inches of dark brown fine sand, 5 inches of dark reddish brown and dark brown fine sand, and 10 inches of dark reddish brown fine sand. The underlying material, to a depth of 80 inches, is brown fine sand.

This soil is low in natural fertility and content of organic matter. It is very strongly acid through strongly acid to a depth of about 25 inches, and is strongly acid through medium acid below this depth. Permeability is moderate to moderately rapid, and available water capacity is low.

The soil has low potential for most urban uses. Because the water table is within 1 to 2 feet of the surface for about 5 months during most years, this soil has a severe limitation for dwellings, and some recreational uses. The water table in most areas can be lowered by a drainage system that is well designed, installed, and maintained. Part of Site 15, Dirt Roads Disposal Area, is over the soil.

4.7.4.2.6 Wa--Wahee fine sandy loam. This deep gray fine sandy loam is about 6 inches thick. The subsurface layer is pale olive fine sandy loam about 7 inches thick. The subsoil to a depth of 62 inches is 3 inches of mottled, yellowish brown clay loam, 5 inches of mottled, yellowish brown gray clay, 19 inches of mottled, gray sandy clay, and 22 inches of mottled, gray sandy clay loam.

This soil is medium in natural fertility and low in content of organic matter. It is very strongly acid or strongly acid throughout. Permeability is slow, and available water capacity is high.

This soil has low potential for most urban uses because it has a clayey subsoil that percs slowly and because the water table is at or near the surface for about 4 months during most years. Because of its wetness, this soil has severe limitations for dwellings and recreational uses. Part of Site 13, Inert Disposal Areas, is located upon this soil.

Site 7, Page Field Fire Training Pit is located above this unit, but because of a concrete apron and an asphalt oil retention platform, there is no direct pathway to this soil.

4.7.4.2.7 Wd--Wando fine sand, 0 to 6 percent slopes. This excessively drained, nearly level or gently sloping soil is found on the higher ridges of the lower marine terraces. Typically, the surface layer is dark brown fine sand about 9 inches thick. The underlying material is fine sand to a depth of 85 inches. Included with this soil are a few areas of soils that have a loamy fine sand or loamy sand surface layer, a few areas of soils that have a slight accumulation of organic stains at a depth below 50 inches, and a few small areas of soils that are strongly acidic. Also included are narrow areas of soils adjacent to drainageways that have slopes of more than 6 percent.

This soil is low in natural fertility and organic matter. It is medium acid through neutral throughout. Permeability is high and available water capacity is low. The soil has low potential for growing row crops and small grains and medium potential for pasture grasses. Its potential is limited because of high permeability, low inherent fertility, and low water holding and plant nutrient holding capacity. Sites 2, Borrow Pit Landfill; 9, Paint Waste Storage Area; 10, Gasoline Spill Area; 16, Pesticide Rinsate Disposal Area; and parts of Sites 8, PCB Spill Areas; 13, Inert Disposal Areas; and 15, Dirt Roads Disposal Area are located on this soil.

4.7.4.2.8 Wn--Williman loamy fine sand. This deep, poorly drained, nearly level soil is located on flat areas, in slight depressions, and along drainageways on the lower marine terraces. Typically, the surface layer is very dark gray loamy fine sand about 5 inches thick. The subsurface layer is loamy fine sand about 21 inches thick. It is mottled, dark grayish brown in the upper part and mottled, light brownish gray in the lower part. The subsoil to a depth of 80 inches consists of 4 inches of mottled, light brownish gray fine sandy loam, 17 inches of mottled, gray sandy clay, and 33 inches of mottled, light brownish gray sandy clay loam. The underlying material to a depth of about 90 inches is mottled, light brownish gray fine sandy loam.

Williman loamy fine sand is medium in natural fertility and low in organic matter. It is extremely acid through strongly acid in the surface layer, subsurface layer, and subsoil. The underlying material ranges from very strongly acid through neutral. Permeability is moderate and available water capacity is low to medium. The soil has low potential for urban uses. Because the water table is at or near the surface for about 5 months during

most years, this soil has severe limitations for septic tank absorption fields, dwellings, and recreational uses.

Parts of Sites 13, Inert Disposal Areas, and 15, Dirt Roads Disposal Area, are on this soil.

4.7.5 Hydrology.

4.7.5.1 Shallow Aquifer. In the MCRD Parris Island area the shallow unconfined aquifer is generally of permeable, fine to medium, Pleistocene age sands. These sands are primarily subangular and quartzitic containing carbonate shell fragments, heavy minerals, glauconite, and finely disseminated organics. Holocene age sediments generally consist of coarser, more angular, and less indurated sands than the Pleistocene age soils. River alluvium consists of silty, micaceous, fine to medium sand. Lenticular bodies of iron-cemented sand occur throughout the Pleistocene sediments.

Surface relief is relatively low. The area is drained by fresh and brackish water streams inland and by tidal streams along the coast. The water table in the MCRD Parris Island area usually ranges from 0 to 10 feet and is most commonly found at a depth of 3 feet. Water table fluctuations are a function of recharge, evaporation, and transpiration and have been observed to be as great as 6.5 feet at some locations (Glowacz, and others, 1980). Ground water table fluctuations due to tidal action have been measured to occur as far as 1,800 feet inland from the marsh edge (SCWRC, unpublished field data). The water table drops near drainage ditches to reflect discharge into the ditches.

Hydraulic conductivity was calculated to be 0.8 ft/day (3×10^{-4} cm/s). The hydraulic conductivity of clean fine Holocene sands of the surficial aquifer at the southwestern end of Hilton Head Island was estimated as 13 ft/day (5×10^{-3} cm/s) Pleistocene sands on Hilton Head Island had a hydraulic conductivity of 0.1 to 1.0 ft/day (4×10^{-5} cm/s to 4×10^{-4} cm/s) (Glowacz and others, 1980).

The direction of groundwater flow in the upper portion of the shallow surficial aquifer is generally toward the nearest surface water body such as a pond, river, tidal creek, or the ocean (Figure 4-7). The hydraulic gradients are usually low and are nearly flat; they are always less than 1 percent except near ditches which dewater small areas. The rate of groundwater flow in the shallow aquifer is generally less than 2 feet per day, typically in the range of 0.2 to 1.2 ft/day (SCDHEC, 1982).

4.7.5.2 Tertiary Limestone Aquifer. The Tertiary Limestone Aquifer, as it is referred to in South Carolina, extends continuously from South Carolina into Florida. Depending on the locality, this aquifer system has been referred to as the principal artesian aquifer, Floridan Aquifer, Ocala Aquifer, principal limestone aquifer, Santee Aquifer, and more recently as the southeastern limestone aquifer, even though it is not everywhere the principal aquifer, nor is it necessarily artesian.

The Tertiary Limestone Aquifer occupies a large geographical area (60 mile radius) from MCRD Parris Island in the South Carolina Coastal Plain (Figure 4-8) and supplies ground water to hundreds of wells. In the Central Coastal

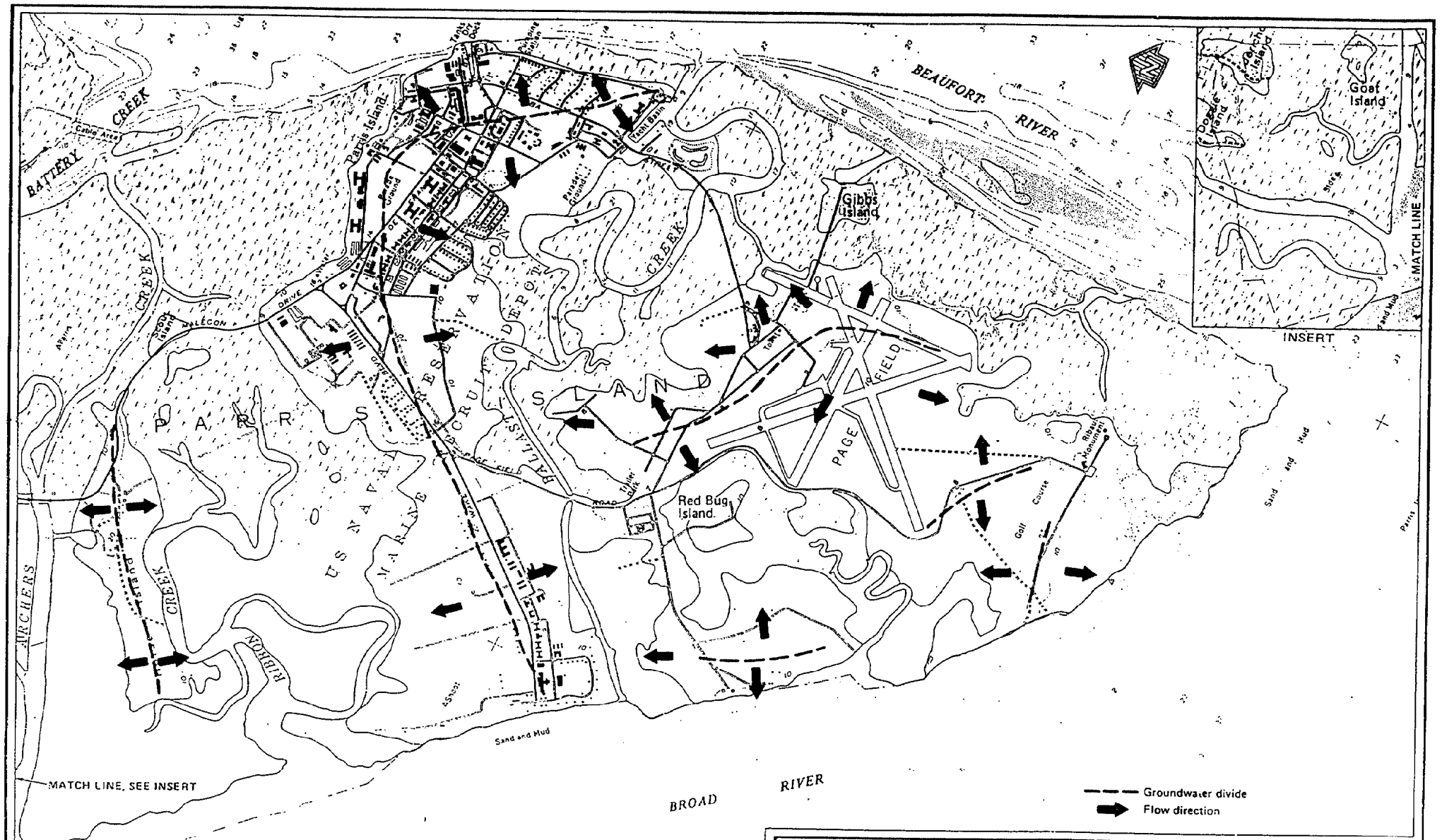


FIGURE 4-7
GROUNDWATER FLOW MAP

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

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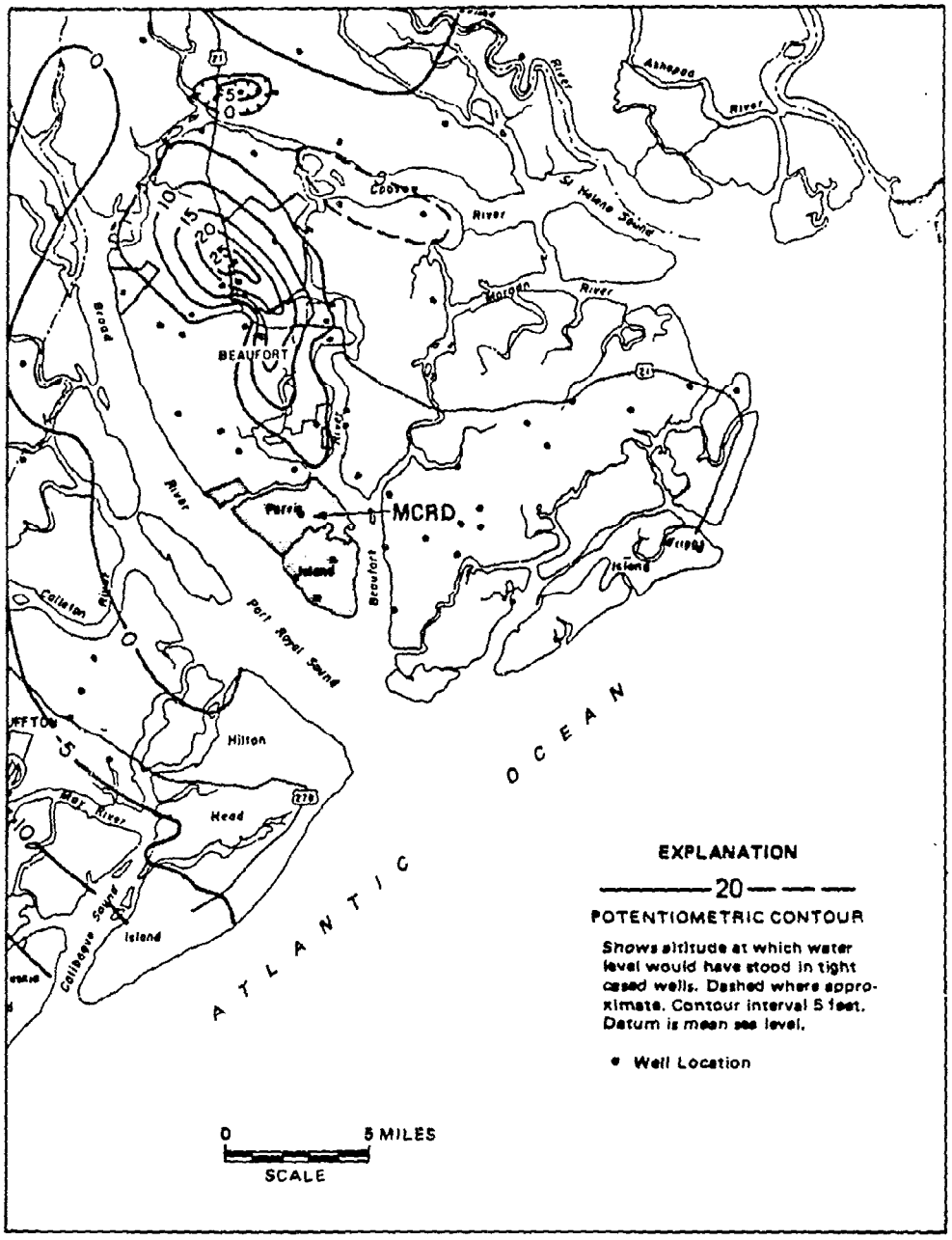


Source: Modified from Hayes, 1979

FIGURE 4-8
POTENTIOMETRIC SURFACE OF TERTIARY LIMESTONE AQUIFER, DECEMBER 1976.

INITIAL ASSESSMENT STUDY
MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

Dames & Moore

Plain, this aquifer occurs at or near land surface and is tapped by many small-diameter wells less than 100 feet deep. In many locations throughout the Central Coastal Plain, ground water in the aquifer occurs largely under unconfined conditions, although artesian (confined) conditions are common. Toward the south and southeast, the aquifer is capped by confining beds of the Cooper Marl and artesian conditions predominate. In the Low Country (including the Beaufort area north of MCRD Parris Island), the aquifer system again occurs near land surface and confining beds vary from essentially zero to more than 150 feet in thickness. Ground water of this aquifer occurs mainly under artesian conditions at MCRD Parris Island.

The Tertiary Limestone Aquifer is the most important source of ground water in the Low Country area and wells generally less than 250 feet deep tap this aquifer system. The aquifer is the only source of potable ground water west, north, and east of MCRD Parris Island. It is conservatively estimated that over 4,000 wells tap this aquifer in the Low Country, and that this aquifer system probably supplies over 80 percent of the ground water used in this area.

Ground water in the Tertiary Limestone Aquifer occurs in solutionally-enlarged openings or cavities in the limestone. In general, ground water occurs in a series of broadly-defined water-bearing (permeable) zones that serve as aquifers and are separated by less permeable rocks. Two zones lie beneath the MCRD Parris Island area. They dip toward Savannah, Georgia and are parallel to the geologic unit (or formation) boundaries. These two hydrogeologic units consist of (1) a 200-foot thick Upper Hydrogeologic Unit that contains an upper permeable zone, and (2) an 800-foot thick Lower Hydrogeologic Unit that has relatively low permeability compared to the Upper Unit except for a lower permeable zone.

The Upper Hydrogeologic Unit is composed primarily of the upper part of the Santee Limestone and has a greater overall permeability and yields much greater quantities of ground water to wells than the Lower Unit.

4.7.5.2.1 Upper Hydrogeologic Unit. The Upper Hydrogeologic Unit below MCRD Parris Island consists of the uppermost permeable zone of the Tertiary Limestone Aquifer. This upper permeable zone occurs throughout most of Beaufort County. However, it thins over the Beaufort Arch and has been completely eroded approximately 20 miles north of MCRD Parris Island.

Recharge of the Upper Hydrologic Unit in South Carolina occurs over most of Beaufort County east of the Broad River and over a 30-mile-wide zone trending northwest of the city of Beaufort along the South Carolina-Georgia border. Areas west of the activity are not recharge zones because of the thick low permeability formations within the Ridgeland Trough. A 30-mile-wide, eastwest trending recharge zone is also present from 60 to 90 miles north of MCRD Parris Island. These zones delineate potential effective porosity at the ground surface; actual recharge is affected by the thickness and permeability of any overlying rock formations and soils.

The Upper Hydrogeologic Unit supplies most of the ground water used from the Tertiary Limestone Aquifer in the Low Country. In some areas of the coastal

parts of the Low Country including Parris Island, water-bearing zones contain salt water.

The average transmissivity of the upper permeable zone of the Tertiary Limestone Aquifer in western Beaufort County (i.e., all of Beaufort County west of the Broad River) and southern Jasper County is about 370,000 gallons per day per foot gpd/ft and in eastern Beaufort County is notably less than 75,000 gpd/ft. The transmissivity of the upper permeable zone in northern Jasper County and southwestern and southeastern Hampton County is estimated to range from 75,000 gpd/ft to 220,000 gpd/ft, with transmissivities in the western and southwestern parts of the area due to increased thickness of the upper permeable zone (Hayes, 1979).

The average hydraulic conductivity of the upper permeable zone of the Tertiary Limestone Aquifer (determined by dividing the average transmissivity by average thickness) is estimated to be 400 feet per day (ft/d) (1.4×1^{-1} centimeters per second (cm/s)) in western Beaufort County, Jasper County, and southeastern and southwestern Hampton County. The upper permeability zone in eastern Beaufort County is estimated to have an average hydraulic conductivity of 175 ft/d (6.2×10^{-2} cm/s) (Hayes, 1979).

4.7.5.2.2 Lower Hydrogeologic Unit. The hydrogeologic (water-bearing) properties of the Lower Hydrogeologic Unit are not well known in much of the Low Country. Wells that are drilled into the Lower Unit are also usually open to the Upper Unit.

The Lower Hydrogeologic Unit is not a single unit but is a thick complex unit that is composed of both aquifers and confining beds. Prolific aquifers do not occur in the Lower Unit because these rocks are primarily impure limestone or marl. Aquifers in the Lower Unit contain saline formation water in the coastal parts of the Low Country such as below MCRD Parris Island. Chloride and dissolved solids generally increase with depth in these zones.

The transmissivity of the lower permeable zone of the Tertiary Limestone Aquifer in northern Colleton County and northeastern Hampton County is estimated to range from 37,000 gpd/ft to as low as 3,700 gpd/ft, with transmissivity decreasing to the north and northeast. The average transmissivity of the lower permeable zone of the Tertiary Limestone Aquifer in southern Colleton County is estimated to be 30,000 gpd/ft. The hydraulic conductivity of the lower permeable zone of this aquifer is estimated to vary between 75 and 100 ft/d (10^{-2} cm/sec) in eastern Beaufort County, Colleton County, and northeastern Hampton County (Hayes, 1979).

4.8 MIGRATION POTENTIAL.

4.8.1 Groundwater. There is little or no risk of surficial aquifer contamination penetrating into the water of the Tertiary Limestone Aquifer at MCRD Parris Island. Figure 4-6 shows the potentiometric surface of this aquifer to be above mean sea level at MCRD Parris Island. This indicates that the aquifer is artesian and hydrologically separate from the overlying surficial aquifer. Figure 4-5 shows the surface of the aquifer to lie from 40 to 90 feet below msl at MCRD Parris Island, with Figure 4-4 showing more than 20

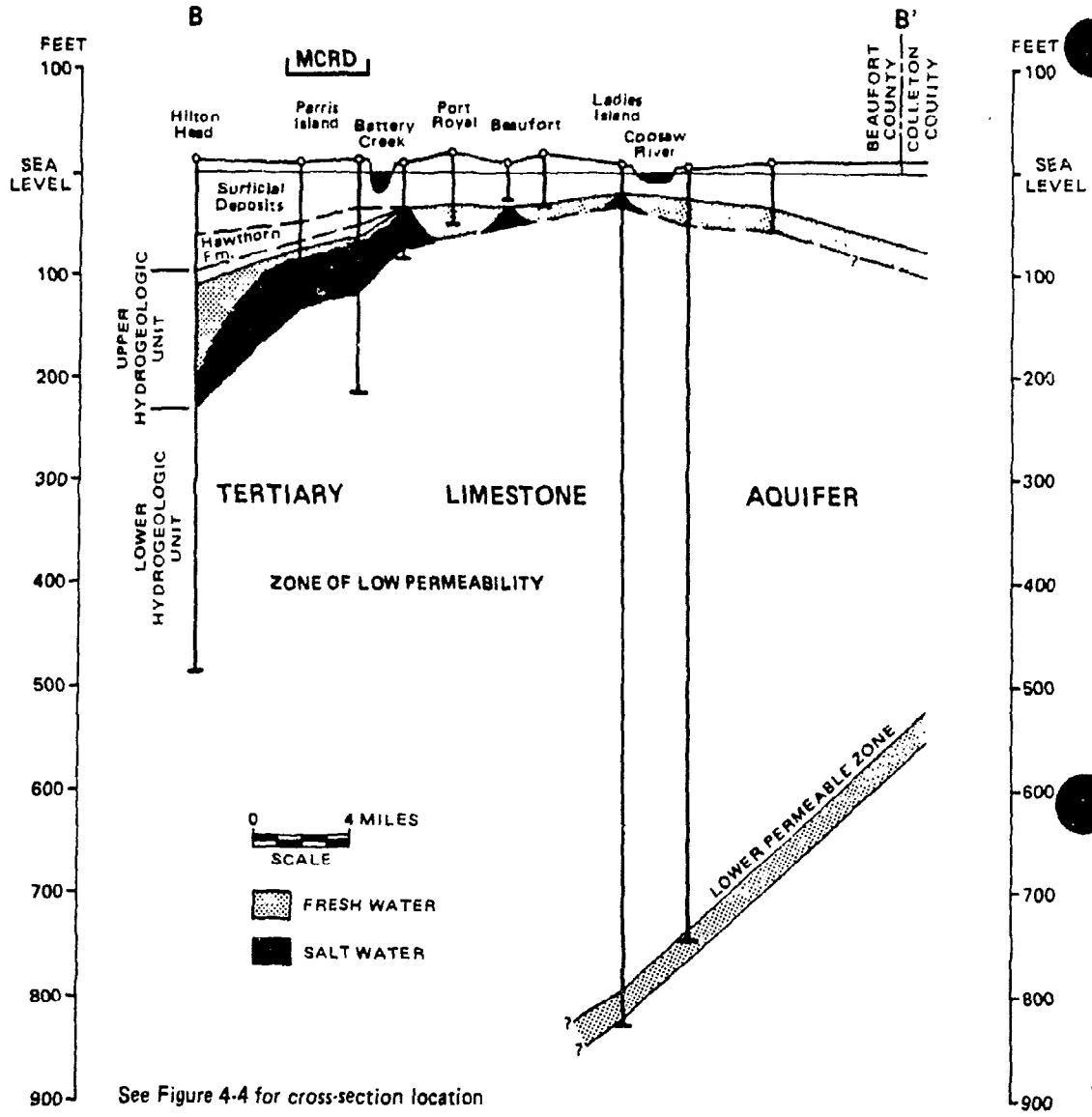
feet of the low permeability Hawthorn Formation present above the limestone for the entire length of Parris Island. Boring logs of Parris Island (SCWRC, 1972; SCWRC, unpublished) also show that the Quaternary soils beneath the marshes are mostly clay. These layers physically separate the surficial aquifer and surface waters from the Tertiary Limestone Aquifer, to further prevent vertical contaminant migration.

The surficial aquifer present beneath the island is not used for any purpose due to the poor quality of this aquifer's waters. Various studies (Hayes, 1979; Spigner and Ransom, 1979; SCDHEC, 1982; Hassen, 1985) have indicated that the surficial aquifer is a poor potable water source near the coastline due to salt water intrusion and high sulfur content resulting from decomposition of organic matter. The high sand percentage and shallow water table of this aquifer beneath the islands makes contamination of this aquifer very likely. Because MCRD Parris Island is bordered by major rivers, there is no chance of surficial aquifer contamination migrating to areas that use this aquifer as a water source.

Use of the water of the Tertiary Limestone Aquifer as a water source on and near Parris Island is limited due to the high amount of saltwater contamination. Figure 4-9 illustrates the infiltration of the saltwater beneath the base. Salt water would enter the aquifer along the contact zones of the aquifer with the saline water of Port Royal Sound and the continental shelf. Normal groundwater flow exceeds rates needed to keep the ocean water from flowing into the aquifer but the heavy pumping of base wells created a net discharge within the local area allowing the salt water intrusion. The history of Tertiary Limestone Aquifer use at the base was one of over-pumping, which caused the saltwater contamination of this aquifer. A well would be drilled and used until the saltwater content forced closure of the well. A new well would then be drilled and pumped until it, too, would need to be abandoned due to salt contamination. The wells present at the base are used by SCWRC and USGS for monitoring purposes but are not used for supplying water for potable or other uses.

4.8.2 Surface Water. Surface runoff from most of the working areas of the depot flows into storm sewers that discharge into the marshes surrounding Parris Island. Figure 4-10 shows surface runoff directions and surface water divides. Within the main areas of the activity, the surface water divides have been altered by the installation of the storm sewers and do not necessarily follow topography. Surface water flow off MCRD Parris Island discharges into the marshes located throughout the activity and into the Broad and Beaufort rivers. The very low elevation of the land surface and the shallow water table of the surficial aquifer at the base would cause surficial aquifer water to discharge into nearby surface waters. The migration of any contaminants in the surficial aquifer would be facilitated by the water table fluctuations due to the tidal changes. This would induce a flushing action that would quicken both the dispersal of surficial aquifer contamination and the discharge into the surface waters.

The marshes and rivers around MCRD Parris Island are important habitats for a variety of wildlife including some commercially important fish and shellfish (shrimp, crab and oysters) as well as two threatened or endangered vertebrate



Source: Modified from Spigner and Ransom, 1979

FIGURE 4-9
HYDROGEOLOGIC CROSS-SECTION OF THE TERTIARY LIMESTONE AQUIFER IN BEAUFORT COUNTY

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MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina
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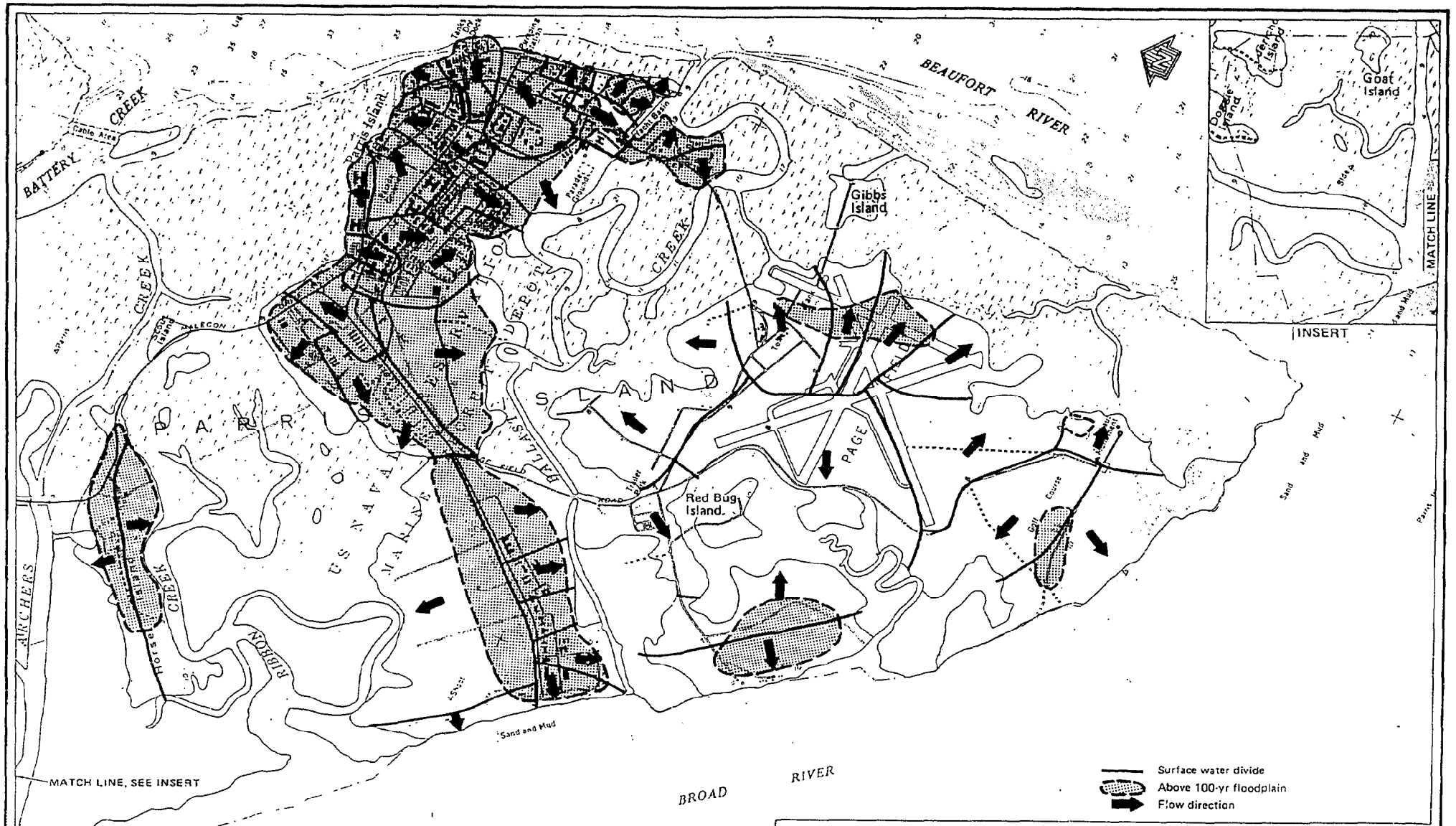

FIGURE 4-10
SURFACE DRAINAGE MAP

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MARINE CORPS RECRUIT DEPOT
Parris Island, South Carolina

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species (the southern Bald Eagle and the Eastern Brown Pelican). Most of the wildlife species, especially the shellfish, are very sensitive to water pollution. People consuming fish and shellfish from these waters may also be affected by contaminants accumulated within the seafood.

CHAPTER 5. WASTE GENERATION

5.1 INTRODUCTION. Painting operations and maintenance of automobiles and other ground vehicles and heavy equipment have been the largest sources of hazardous wastes generated at MCRD Parris Island over the years. The principal types of hazardous waste generated at the Depot have included both liquid and solid paint wastes and waste lube oils and hydraulic fluids. In addition, smaller amounts of heavy metal wastes, solvent wastes, and several other types of wastes have been generated at the Dental Clinic, Dry Cleaning Shop, and other shops operated in support of the recruit training operations at the Depot.

This chapter presents estimates of wastes generated by the individual shops at MCRD Parris Island (Section 5.2). Past operations are described as completely as possible, while current operations are discussed to enhance an understanding of past waste generation practices.

5.2 INDUSTRIAL OPERATIONS. Waste generation rates are summarized in Table 5-1 for all shops producing hazardous wastes at MCRD Parris Island. Storage and processing facilities and disposal areas employed for each waste are also summarized in Table 5-1.

For most of the shops listed in Table 5-1, accurate and reliable waste generation data were available for recent years (1970's and 1980's), but only limited information was available for the earlier years of operation, especially before the 1950's. To estimate the waste quantities for the earlier years of operation, the recent waste generation data for most of the shops were scaled in proportion to the number of recruits being trained at the Depot. Except for peak levels during the Vietnam era, Korean conflict, and World War II, the recruit population at the Depot has generally ranged between 9,000 and 11,000 since 1941. During the peak war years (1941-1945, 1951-1953, and 1965-1970), the number of recruits approximately doubled to about 20,000. Thus, for the period since 1941, the recent waste generation rates for most shops would also apply to most of the previous years, except for the peak war years, when the rates would have been approximately doubled. For the years between 1918 and 1941, recruit populations and industrial operations were at much lower levels than after 1941. The waste generation rates for these years were therefore estimated to be about 25 percent of the non-peak rates after 1941. In the case of the Paint Shop (Section 5.2.1.1), the waste generation rates for the earlier years of operation were based on the types of buildings and facilities present at the Depot and the types of paints employed during different time periods. Waste generation rates prior to 1918 were assumed to be negligible for most shops.

5.2.1 Facilities Maintenance

5.2.1.1 Paint Shops. The Paint Shop has been located in several different buildings and structures at the Depot. Over the years, most painting at MCRD Parris Island has been carried out in the field. The predominant type of painting has consisted of brush and roller painting of buildings located throughout the Depot. A much smaller amount of spray painting has also been

TABLE 5-1

WASTE GENERATION RATES FROM SHOPS AT MCRD PARRIS ISLAND, SOUTH CAROLINA

SHOP/GENERATOR	WASTE TYPE	WASTE QUANTITY (1)	TIME PERIOD	STORAGE/PROCESSING FACILITIES (2) (3)	DISPOSAL AREAS (4)
Automotive Hobby Shop (17)	lubricating oil, transmission fluid	1,250-2,500 gals/yr	1963-present	Waste oil tanks (1969-present) (18)	Site 6; off-station
	oily rags	90-180 lbs/yr	1963-present	Transfer station (1972-1976)	Station landfills; off-station
	oily absorbent (clay)	600-1,200 lbs/yr	1963-present	Transfer station (1972-1976)	Station landfills; off-station
	solvent (Stoddard) sludge	4-8 lbs/yr	1963-present	Transfer station (1972-1976)	Station landfills; off-station
Dry Cleaning Plant (17)	perchloroethylene still bottoms	550-1,100 gals/yr	1957-present	Incinerator (1957-1959); Transfer station (1972-1976)	Station landfills, off-station
	filters (19)	Unknown	1918-1957	Incinerator (1921-1957)	Site 1
Exchange Service Station (13)	lubricating oil	2,000-4,000 gals/yr	1942-1984	Waste oil tank (1968-present)	Site 4; Site 15; off-station
Dispensary/Dental Clinics	mecury amalgam	30 lbs/yr	1975-present	Salvage yard	Off-station
		300-600 lbs/yr	1942-1975	Incinerator (1942-1959); transfer station (1972-1976)	Station landfills; off-station
	beryllium	0.25-0.5 lb/yr	1955-present	Incinerator (1955-1959); transfer station (1972-1976)	Station landfills; off-station
	lead strips	150-300 lbs/yr	1930-present	Salvage yard	Off-station
	X-ray fixer solution	75-150 gals/yr	1930-present	STP (1948-present); silver recovery (1978-present) (20)	Site 14 (1930-1948)
Photographic Laboratory	fixer solution	420-840 gals/yr	1942-present	STP (1948-present); Silver recovery (1978-present)	Site 14 (1942-1949)
	developer solution	420-840 gals/yr	1942-present	STP (1948-present)	Site 14 (1942-1949)
Armory	cleaning rags (21)	200-400 lbs/yr	1941-present	Incinerator (1941-1959); transfer station (1972-1976)	Station landfills, off-station
		50 lbs/yr	1918-1940	Incinerator (1921-1940)	Site 1
Marksmanship training	small arms ammunition (lead, copper)	10 mil-20 mil rounds/yr	1941-present	--	Marshland (draining to Ribbon Creek)
		2 5 mil rounds/yr	1918-1940	--	Marshland (draining to Ribbon Creek)
	cleaning rags (21)	200-400 lbs/yr	1941-present	Incinerator (1941-1959); transfer station (1972-1976)	Station landfills; off-station
		50 lbs/yr	1918-1940	Incinerator (1921-1940)	Site 1
Hand Grenade Training	exploded hand grenades	25,000-50,000/yr	1941-present	Salvage yard (22)	Off-station
		7,000/yr	1918-1940	Salvage yard (22)	Off-station
Infiltration Course	exploded (1/4-lb) TNT Demolition Blocks	6,400/yr	1975-present	--	--(23)
Power/Steam Plants	ash (from coal burning)	600 tons/yr	1918-1942	--	Road Construction (24)
		60 tons/yr	1942-1957	--	Road Construction (24)
	boiler blowdown (25)	5,000-20,000 gals/day	1918-present	STP (1976-present)	Site 14 (1918-1976)
	demineralizer regenerant wastes (26)	9,000-18,000 gals/yr	1942-present	STP (1976-present)	Site 14 (1942-1976)
Dry dock	used paint brushes, cleaning rags, and paint cans	Unknown	1893-1922	--	Unknown
	pitch/tar	Unknown	1893-1922	--	Unknown
	turpentine	Unknown	1893-1922	--	Unknown
Former Naval Hospital	used paint brushes, cleaning rags, and paint cans	500-1,400 lbs/yr	1918-1949	Incinerator (1921-1949)	Site 1
	lubricating oil	100-300 gals/yr (27)	1918-1949	--	Site 15, off-station
	petroleum solvent	3-10 gals/yr (27)	1918-1949	--	--

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TABLE 5-1

WASTE GENERATION RATES FROM SHOPS AT MCRD PARRIS ISLAND, SOUTH CAROLINA

SHOP/GENERATOR	WASTE TYPE	WASTE QUANTITY (1)	TIME PERIOD	STORAGE/PROCESSING FACILITIES (2) (3)	DISPOSAL AREAS (4)
Paint Shop	hardened paint sludge (6)	1,000-2,000 lbs/yr (7)	1918-1960		Site 5
	used paint brushes, rollers, rags, cans, and spray booth scrappings and skimmings	5,500-11,000 lbs/yr (8)	1916-present	Incinerator (1921-1959), transfer station (1972-1976)	Station landfills; off-station
	paint thinner (diesel fuel, kerosene, mineral spirits)	700-2,800 gals/yr (8)	1918-present	Site 9 (1969-1984); Building 864 shed (1984-present)	Site 1; Site 2; off-station
	paint stripper (methylene chloride)	5-20 gals/yr (8)	1918-present	Site 9 (1969-1984); Building 846 (1984-present)	Site 1; Site 2; off-station
Electrical Shop (5)	cleaning rags (9)	40-80 lbs/yr	1952-present	Incinerator (1952-1959); transfer station (1972-1976)	Station landfills; off-station
	carbon tetrachloride	120 gals/yr	1930-1951	--	Site 14 (10)
	PCB - contaminated oil	2 lbs/yr	1940-present	Incinerator (1940-1959); transfer station (1972-1976)	Station landfills; off-station
Mechanical Trades Shops (5)	oily cleaning rags	60-120 lbs/yr	1960-present	Transfer station (1972-1976)	Station landfills; off-station
	cutting oil	180-360 gals/yr	1960-present	Waste oil tanks (1969-present) (11)	Site 4; Site 15; off-station
	water-based coolant	120-240 gals/yr	1960-present	Waste oil tanks (1969-present) (11)	Site 4; Site 15; off-station
	metal shavings	300-600 lbs/yr	1941-present	Salvage yard (1950-present)	Site 1; off-station
		75 lbs/yr	1918-1940	--	Site 1
Furniture/Upholstering Shop (5)	paint stripping residues (containing methylene chloride)	40 gals/yr (12)	1947-1963	Incinerator (1947-1959)	Site 1
	wood preserving residues (containing pentachlorophenol)	25 gals/yr (13)	1947-1967	Incinerator (1947-1959)	Site 1
Air Conditioning/ Refrigeration Shop (5)	Cooling tower blowdown (14)	20,000-40,000 gals/day	1950-present	--	Site 14
Diesel Shop (5)	lubricating oil	600-1,200 gals/yr	1941-present	Waste oil tanks (1969-present)	Site 4; Site 15; off-station
		150 gals/yr	1918-1940	--	Site 15; off-station
	hydraulic fluid	55-110 gals/yr	1941-present	Waste oil tanks (1969-present)	Site 4; Site 15; off-station
		15 gals/yr	1918-1940	--	Site 15, off-station
	solvent (kerosene, gasoline)	55-110 gals/yr	1941-present	Waste oil tanks (1969-present)	Site 4; Site 15; off-station
		15 gals/yr	1918-1940	--	Site 15; off-station
	oil in washrack effluent (15)	50-100 gals/yr	1942-present	Oil/water seperator (1974-present)	Site 14 (1942-1973)
	neutralized battery acid	50-100 gals/yr	1941-present	STP (1974-present)	Site 14 (1941-present)
		15 gals/yr	1918-1940		Site 14
Pest Control Shops (5)	empty containers	2,000-4,000/yr	1941-present	Incinerator (1941-1959); transfer station (1972-1974); triple rinsing (1979-present)	Station landfills; off-station
	rinse water (16)	500-1,000 gals/yr	1941-present	STP (1978-present)	Site 16 (1950-1977)
Motor Transport Garage (5)	lubricating oil, transmission fluid	700-1,400 gals/yr	1942-present	Waste oil tanks (1969-present)	Site 4, Site 15, off-station
		200 gals/yr	1918-1941		Site 15, off-station
	solvent (kerosene, gasoline, Varsol)	55-110 gals/yr	1942-present	Waste oil tanks (1969-present)	Site 4, Site 15; off-station
		15 gals/yr	1918-1941	--	Site 15, off station
	antifreeze	60-120 gals/yr	1942-present	STP (1974-present)	Site 14 (1942-1974)
		15 gals/yr	1918-1941		Site 14
	neutralized battery acid	60-120 gals/yr	1942-present	STP (1974-present)	Site 14 (1942-1974)
		15 gals/yr	[illegible]941		Site 14
	oil in washrack effluent (15)	50-100 gals/yr	[illegible]sent	Oil/water separator (1974-present)	Site 14 (1942-1973)

TABLE 5-1

WASTE GENERATION RATES FROM SHOPS AT MCRD PARRIS ISLAND, SOUTH CAROLINA

SHOP/GENERATOR	WASTE TYPE	WASTE QUANTITY (1)	TIME PERIOD	STORAGE/PROCESSING FACILITIES (2) (3)	DISPOSAL AREAS (4)
Page Field	contaminated AVGAS, engine oil,	9,000 gals/yr (27)	1942-1936	--	Off-station
	and hydraulic fluid	450 gals/yr (27)	1933-1941	--	Site 15; off-station
	carbon tetrachloride	100 gals/yr (27)	1942	--	Off-station
	diesel fuel	100 gals/yr (27)	1943-1946	--	Off-station

(1) For waste quantity ranges between 1941-1985, the maximum quantity applies to the war years (1943-1945, 1951-1953, and 1965-1970), and the minimum quantity applies to all other years except where otherwise noted. Waste quantities from 1918-1940 are assumed to be 25 percent of the minimum values for 1941-1985, except where otherwise noted. Prior to 1917, waste quantities are assumed to be negligible (except for the dry dock)

(2) Legend (and Corresponding Report Sections)

Waste Oil Tanks - 500-gallon underground storage tanks (Section 6.3 2.2)
Site 9 (Paint Waste Storage Area; Section 6.3.2.1)
Building 884 Shed (Section 6 3 2.1)
SIP - Sanitary Wastewater Treatment Plant (Section 7.2)
Incinerator - Large incinerator on Horse Island (Section 7.3)
Oil/Water Separators (Section 7.4)
Transfer Station (Section 7 5)
Salvage Yard (Section 6 3.1; Section 7.6)
Silver Recovery (Section 7 6)

(3) Where dates are not indicated, the storage or processing facilities operated for the entire period shown in Column 4 of this table.
(4) The station landfills (which received hazardous wastes) and their periods of operation are:

Incinerator Landfill (Site 1; Section 8.2; 1921-1965); Borrow Pit Landfill (Site 2; Section 8 3; 1966-1968); Causeway Landfill (Site 3; Section 8.4; 1960-1972). Other Inert Disposal Areas (Site 13; Section 8.14) did not receive any industrial waste.

(5) Facilities Maintenance Shops
(6) Hardened paint sludge consisting of lead, zinc, and paint remover (kerosene or diesel fuel) The sludge was scraped from paint mixing tanks.
(7) Based on an estimated 60 gal/yr from 1941-1960, and 30 gal/yr from 1918-1940.
(8) See Table 5-2 for more detailed data on paint wastes.
(9) cleaning rags contaminated with mineral spirits
(10) Storm sewer outfall associated with Building 20 drains.
(11) Waste oil and coolant from the machine shop is fed to the 500-gallon waste oil tank at the Diesel Shop (Section 5.3 1 6)
(12) Estimated to contain about 40 lbs/yr of methylene chloride.
(13) Estimated to contain about 20 lbs/yr of pentachlorophenol (PCP).
(14) Contained chromate corrosion inhibitors from 1960-1965, and non-chromate inhibitors from 1966 to present
(15) Since 1974, oil has been removed from washrack effluent by an oil/water separator, and then added to the 500-gallon waste oil tank
(16) Rinse water for pesticide containers and spray application equipment.
(17) Special Services Shops.
(18) The waste oil tank at Building AS-26 was used until 1983. The waste oil tank at the Motor Transport Garage has been used since 1983
(19) Filters contaminated with petroleum dry cleaning solvent
(20) The Fixer solution is sent to the silver recovery unit at the Photographic Laboratory
(21) Contaminated with dirt, carbon, unburned propellant, fine metal (copper, lead, brass, and steel) particles, and cleaning solvent (CLP since 1980 and kerosene before 1980)
(22) Recoverable metal fragments from exploded hand grenades are collected and shipped off-station to metal recyclers.
(23) Residues from the exploded TNT demolition blocks remain at the Infiltration Course
(24) Ash from coal-fired boiler was used as a cover for dirt roads throughout the Depot.
(25) Contains disodium phosphate and trisodium sulfite
(26) About one-third of the total volume consists of acid wastes, and two-thirds of alkaline wastes.
(27) Quantities are estimated from data for similar shops at the Marine Corps Air Station and the Naval Hospital Beaufort, South Carolina (IAS report number NEESA 13 094) Data were not available for MCRD Parris Island.

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performed at a spray booth in the Paint Shop. Both solid and liquid paint wastes have been generated by the Paint Shop. Solid paint wastes have included used brushes, rollers, rags, cans, and scrapings and skimmings from spray booths and mixing tanks. Liquid wastes have included paint strippers (mainly methylene chloride) and thinners (diesel fuel, kerosene, and mineral spirits) used to clean the paint brushes and other equipment. The annual generation rates for these wastes are summarized in Table 5-1 and presented in detail in Table 5-2.

Several Quonset huts in the northeast corner of the Depot were used to house the Paint Shop until 1960. These Quonset huts were located close to Building 20 and the existing powerplant (Building 160). In 1949, Structure 177 was constructed and used as the Paint Shop until 1960. While located in this Quonset hut and other nearby facilities that were used before 1949, the Paint Shop produced most of its own paint by stirring white lead, zinc, and linseed oil together in a large mixing tank. Hardened paint was periodically removed from the mixing tank by soaking with a paint remover (usually diesel fuel or kerosene) and scraping the materials from the sides of the tank. About 60 gallons per year of hardened paint waste scraped from the tank was then hand-carried to the Former Paint Shop Disposal Area (Site 5; Section 8.6).

Until 1960, while the Paint Shop was located in the quonset huts, the solid paint wastes--including used brushes, rollers, cleaning rags, and empty cans--were taken to the Incinerator Landfill (Site 1; Section 8.2) for disposal. In addition, the previously discussed spent strippers and thinners were also poured on the ground at the Incinerator Landfill. Painters would bring 30-gallon cans to the job sites to collect the liquid paint wastes. Other Paint Shop personnel would then pick up the containers from the job sites and bring them to the Incinerator Landfill. Separate containers were usually used for the solid paint wastes, although some of these wastes were sometimes placed in dumpsters, which would later be taken to the Incinerator (Section 7.3) to be burned. A small amount of liquid paint wastes was also reportedly poured down storm drains or on the ground at individual job sites; this practice was not routine and was reported to be infrequent.

In 1960, the Paint Shop moved from Structure 177 to Building 450, where it is still located. Most paints used since 1960 have been ready-mixed, and very little mixing of paints has been performed in Building 450. Between 1960 and 1965, both solid and liquid paint wastes continued to be brought to the Incinerator Landfill, as discussed for the period before 1960. The Incinerator Landfill was closed down in 1965. Between 1966 and 1968, the solid paint wastes were taken to the Borrow Pit Landfill (Site 2; Section 8.3) for disposal; between 1969 and 1972, they were taken to the Causeway Landfill (Site 3; Section 8.4). These solid paint wastes included about 30 gal/yr of scrapings and skimmings removed from a spray booth used in the Paint Shop. The solid waste would either be taken directly to the landfills by Paint Shop personnel, or placed in dumpsters that were later emptied at the landfills. Between 1966 and 1968, the previously discussed spent strippers and thinners were also brought to the Borrow Pit Landfill (Site 2; Section 8.3), where they were poured on the ground and burned.

TABLE 5-2

Paint Wastes Generated at MCRD Parris Island[a]

Time Period	Ratio of Solvent Wastes[b]	% Solids/% Liquids (by weight)	Annual Generation Rate, lb/yr			Processing/Disposal Methods[f]	
			Solids[c]	Liquids[d]	Total	Solids	Liquids
1980-1985	1	60/40	8,400	5,600	14,000	Off-station	Off-station
1976-1979	1.25	57.5/42.5	9,470	7,000	16,470	Off-station	Off-station
1972-1975	1.5	55/45	10,260	8,400	18,660	Off-station	Off-station
1968-1971	1.75	52.5/47.5	10,830	9,800	20,630	Site 2; Site 3	Site 2; Off-station
1966-1967	2	50/50	11,200	11,200	22,400	Site 2	Site 2
1941-1965	4	33/67	11,030	22,400	33,430	Incinerator; Site 1; Site 3; Site 5	Site 1
1918-1940	2[e]	33/67	5,510	11,200	16,710	Incinerator; Site 1; Site 5	Site 1
Before 1918	--	--	very low	very low	very low	Unknown	Unknown

(a) Most of the paint wastes have been generated base-wide in the painting of buildings at the Depot.

(b) Defined as the ratio of paint cleaning and thinner wastes for the time period under consideration to the period 1980-1985.

(c) Paint solids include used brushes, rollers, rags, cans, and scrapings and skimmings from spray booths and mixing tanks.

(d) Paint liquids include paint strippers (methylene chloride) and thinners (diesel fuel, kerosene, and mineral spirits). The thinners constitute about 99.3 percent of the total quantity of paint liquids.

(e) Assumes that the level of painting operations approximately doubled as a result of the expansion in facilities that occurred during the World War II period.

(f) The incinerator (on Horse Island), is described in Section 7.3. Site 1, Site 2, and Site 3, the Depot's hazardous waste landfills, are described in Sections 8.2, and 8.4.

After the Borrow Pit Landfill was closed in 1968, the Paint Shop started to use an unpaved area between Quonset hut N277 and Building 895 as a temporary storage area for liquid paint wastes. Between 1969 and 1978, painters would bring their liquid wastes in 30-gallon cans from the job sites to this storage area. The liquid wastes were then poured into the 500-gallon waste oil tank at the Diesel Shop (Section 5.2.1.6; Table 6-1) before being taken off-station for disposal. After 1978, the contents of the 30-gallon cans would be transferred to 55-gallon drums at the unpaved storage area. After about 40 drums of the liquid wastes accumulated in this area, a contractor picked up the drums in 1981 for disposal off-station. Another contractor pickup occurred in 1983. This Paint Waste Storage Area (Site 9; Sections 6.3.2 and 8.10) was used until 1984, when it was cleaned up and covered with concrete pavement. Since 1984, all paint wastes have been stored in drums in an enclosed shed adjacent to Building 864, until they are picked up and removed from the Depot by a contractor.

Since 1965, the quantity of paint wastes have decreased substantially, due to the replacement of many wooden buildings with brick buildings and the substitution of latex paints for some of the oil-based paints that had been predominant at the Depot. The steady decrease in waste quantities (see Table 5-2) up to the present time is due to the continual replacement of oil-based paints by latex paints. Brushes and other materials with latex paint residues could be cleaned by rinsing with warm water either in the field or the Paint Shop, with the cleaning water then being discharged to the sanitary sewer system. In 1972, the Causeway Landfill was closed and the solid paint wastes were then placed in dumpsters that were taken to the Transfer Station (Section 7.5) on Horse Island, before being taken off the Depot for disposal.

5.2.1.2 Electrical Shop. The Electrical Shop has been located in Building 450 since 1960. Prior to 1960 (since at least 1940, and possibly earlier), it was located in Building 20. The Electrical Shop has been responsible for maintaining power lines and distribution systems inside and outside buildings, rewinding motors, and maintaining transformers. Carbon tetrachloride was used as a cleaning solvent until the early 1950's. The spent carbon tetrachloride was poured down storm drains (Site 14; Section 8.15). Since the early 1950's, mineral spirits have been used as the cleaning solvent. The only wastes generated from parts cleaning since the early 1950's have been cleaning rags contaminated with mineral spirits. These cleaning rags have been placed in trash dumpsters for disposal at the station landfills (Table 5-1) or off-station. During inventory and inspection of Depot transformers in 1982, approximately 511 transformers were identified at MCRD Parris Island. Of these, 430 transformers were in service, with the remainder in storage (Section 6.2.5) for later use or disposal (Moore, 1983). In 1982, a program to phase out the use of PCB and PCB-contaminated transformers was initiated. Approximately 12 PCB and PCB-contaminated transformers are currently in use. Prior to 1982, about 32 of the transformers in use contained PCB's. PCB transformers have been used at MCRD Parris Island since about 1940.

Due to their fire resistance, most of the PCB transformers that have been used at the base were located inside buildings. Most transformers located outside buildings contained mineral or other non-PCB oils; a total of 9 transformers containing PCB's were located outdoors. Minor transformer maintenance such as

changing taps and adjusting voltage has been routinely performed in-place by maintenance personnel. If major work was needed on a transformer, it was usually shipped off the base for maintenance. Transformer oil was typically not changed at the base. In addition, transformer oils were never filtered at MCRD Parris Island.

Spills and leaks of transformer oils were reported to be minor. Most of the reported leaks that have occurred since the 1940's were reported to have occurred on indoor transformers and/or non-PCB-filled transformers. Leakage from transformers usually occurred at rubber gaskets or washers around the high and low-voltage taps. In most cases, the leaks could be eliminated by tightening the gaskets or washers. Any leaked or spilled transformer oil was reported to have been adequately cleaned up by use of kerosene-soaked rags to clean the transformer casings and floors and absorbent clay if any free liquid was present on the floor. Prior to 1980, contaminated clean-up materials from minor leaks were disposed in the Depot dumpsters prior to disposal in the Incinerator (Section 7.3), Incinerator Landfill (Site 1; Section 8.2), Borrow Pit Landfill (Site 2; Section 8.3), Causeway Landfill (Site 3; Section 8.4), or off-base. The amount of PCB oil contained in clean-up material is estimated to have been about 2 pounds per year. Since 1980, all PCB-contaminated material has been collected in drums and shipped off base as a hazardous waste through DRMO (Sections 6.3.1 and 7.6).

A major spill incident at a grassy area (Site 8; Section 8.9) adjacent to Building 111 occurred in 1984 when a contractor was removing three PCB transformers from the vault within Building 111. These transformers each contained 35 gallons of PCB transformer oil. The volume of spilled material was unknown; however, analysis of six soil samples collected in 1984 at this location showed concentrations of PCB ranging from 57 to 62,000 ppm. Remedial action was undertaken in November 1985, and the contaminated soils and concrete curbing were removed. A total of 14 drums of 55-gallon and 35-gallon capacity were used for collection of the contaminated soil. The drums and concrete curbing were transferred to DRMO for disposal. Another outdoor spill occurred during transformer removal from a storage pad adjacent to Building 450 (Section 6.2.5). As described in Section 8.9, this area (Site 8) was also adequately cleaned up.

5.2.1.3 Plumbing Shop. The Plumbing Shop has been located in Building 450 since 1960. Prior to 1960, it was located in Building 20. The Plumbing Shop has been responsible for maintaining all indoor and outdoor water lines, including sanitary and storm sewer lines. No hazardous waste has been produced by this shop.

5.2.1.4 Mechanical Trades Shops. The Mechanical Trades Shops have been located in Building 450 since 1960. Prior to 1960 (since at least 1940 and possibly earlier), they were located in Building 20. The Mechanical Trades Shops have performed machining, metal shaping, and welding operations. The machine shop has contained lathes, mills, grinders, and power back saws. Since 1960, the machine shop has generated oily cleaning rags, which have been placed in trash dumpsters, and liquid wastes consisting of cutting oil and water-based coolant. Since 1969, the wastes were placed in drums prior to disposal off-base or at the Dredge Spoils Area Fire Training Pit (Site 4;

Section 8.5) and the Dirt Roads Disposal Area (Site 15; Section 8.16). Prior to 1960, liquid wastes were not produced by the Mechanical Trades Shops. Metal shavings and scraps generated by the machine shop and sheet metal shop have been collected in 55-gallon drums and sent to metal recyclers via the Salvage Yard (Section 6.3.1) since about 1950. Prior to about 1950, the scrap metal was disposed of at the Incinerator Landfill (Site 1; Section 8.2).

5.2.1.5 Furniture/Upholstering Shop. A shop for repairing furniture and upholstering was constructed in 1947 and operated until the early 1960's, when the Depot started to use mainly new furniture. Two large covered vats in the shop, located in Building 22 near the marina, were used to strip varnish and paint from used furniture and doors. These rectangular tanks were about 11 feet long, 4 feet wide, and 3 feet deep. The vats were routinely used until 1963, but were rarely used thereafter. The stripping fluid (mainly methylene chloride) was recirculated through a strainer and never had to be replaced. The vats were located on a cement floor. The stripping fluid was allowed to drip back into the tanks before removal of the furniture. Stripping fluid consumed by evaporation and use was made up with fresh liquid. Waste accumulated on the strainers consisted primarily of paint residues and varnish.

Until the late 1950's, the wastes removed from the strainers in Building 22 were taken to the incinerator on Horse Island (Section 7.3) to be burned. After the incinerator was shut down in the late 1950's, the wastes were brought to the Incinerator Landfill (Site 1; Section 8.2). From 1947 to 1963, the quantity of waste generated was about 40 gal/yr. It is conservatively estimated that this waste contained about 40 pounds per year of methylene chloride. After 1963, waste removed by the strainers was minimal due to the very infrequent use of the vats. In 1985, the contents of the vats were removed, placed in three 55-gallon drums, and shipped off the Depot for disposal as a hazardous waste.

Wood preserving with pentachlorophenol (PCP) was performed in a vat near the physical training field in the First Battalion area (near Buildings 603 and 604) from the late 1940's to the mid-1960's. Lumber was soaked in the covered vat for about 24 hours. The operation of this vat was generally similar to the previously described paint stripping vats. Liquid was allowed to drip back into the vat before the treated wood was removed. No liquid waste was generated since the PCP was recirculated through a strainer. About 25 gal/yr of gummy material was removed by the strainer and brought to the incinerator (Section 7.3) or to the Incinerator Landfill (Site 1; Section 8.2). It is conservatively estimated that this waste contained about 20 pounds per year of PCP. When wood preserving operations were being phased out in the mid-1960's, the remaining PCP was used up, with no liquid waste requiring disposal.

No spills or leaks were reported to have occurred from either the paint stripping or wood preserving vats.

5.2.1.6 Diesel Shop. The Diesel Shop has been located in back of Building 864 since 1931. A variety of vehicles and other equipment operated by the Maintenance and the Roads and Grounds Departments have been, and continue to be repaired and maintained by the Diesel Shop. These vehicles and equipment

include tractors, lawn mowers, pumps, cranes, bulldozers, garbage trucks, road graders, and other large equipment. The principal waste generated at the Diesel Shop consists of lube oil, which has been collected in a 500-gallon underground tank (Section 6.3.3.2) since 1969. Prior to 1969, the waste oil was collected in drums. Other wastes generated by the Diesel Shop have included hydraulic fluid drained from dozers, cranes, garbage trucks, and tractors during maintenance operations, and spent solvents (kerosene and gasoline) from a parts cleaning tank. The hydraulic fluid and spent solvents have always been mixed with the waste lube oil prior to disposal. Since about 1966, the waste oil, hydraulic fluids, and solvents have been shipped off-station for disposal. Prior to about 1966, these wastes were either disposed of at the Dredge Spoils Area Fire Training Pit (Site 4; Section 8.5), the Page Field Fire Training Pit (Site 7; Section 8.8) the Dirt Roads Disposal Area (Site 15; Section 8.16), or shipped off-base for disposal.

A vehicle washrack has been used to wash the exterior of garbage trucks and other vehicles maintained by the Diesel Shop since about 1942. The drain water from the washrack has always been conveyed to a trap for grit removal before being routed to the Sewage Treatment Plant (Section 7.2). At the end of each week, the grit has been pumped into a tanker truck and the contents have been taken to a sanitary landfill in Beaufort County.

A stainless steel tank has been used to neutralize spent battery acid since at least the 1960's. The neutralized acids have been discharged to a drain connected to the sanitary sewer system since 1974. Prior to 1974, the neutralized acids were discharged to a storm sewer (Site 14; Section 8.15). No significant spills or leaks are reported to have occurred at this shop.

5.2.1.7 Pest Control Shop. The Pest Control Shop has been located in Building 401 since 1978. Between about 1950 and 1978, pesticide operations were performed in a Quonset hut (Structure N282) located about 100 feet north of the current Pest Control Shop. Between 1968 and 1978, pesticide operations were also conducted in Building 864.

Pesticides have most often been applied both inside buildings and outside on grass and open brush. Hand sprayers connected to holding tanks by a hose and pump system have been used for applications. The principal pesticides used since the 1970's have included Aldrin, Baygon, Chlordane, Dursban, Malathion, and Naled. Prior to the 1970's, other pesticides such as DDT were also used. In addition, herbicides such as Dalapon and Diuron have also been used. Typical pesticide and herbicide usage has been about 60,000-120,000 lb/yr and 35,000-70,000 lb/yr respectively.

Most pesticides have been packaged in 1-gallon or 5-gallon containers. Since 1978, these containers have been triple-rinsed with caustic solution before being discarded with other solid wastes (Section 7.5) in a dumpster. The washwater from Building 401 enters a drain connected to the sanitary sewer system. The building is equipped with an outside drain with a valve shutoff, to safeguard against slugs of concentrated pesticides from reaching the Sewage Treatment Plant (Section 7.2) in case of a pesticide spill. Malathion has been handled in 55-gallon drums, which have also been triple-rinsed on a concrete pad, with the washwater entering the same outside drain. The drums

have then been sent to DRMO for salvage. Prior to 1978, rinsing of pesticide containers would not have been as thorough as present regulations require, so that larger amounts of pesticide residues would have been discarded to dumpsters and ultimately been disposed of at the Depot's landfills (Table 5-1).

Mixing of pesticides and washing of equipment in Building 864 was carried out in a sink with a drain connected to the Sewage Treatment Plant. Mixing and washing operations in Quonset hut N282, however, were performed in a sink that drained to a dirt area (Site 16; Section 8.17) in back of the hut. Approximately 5 to 10 gallons per week of pesticide rinsate were drained to this area between about 1950 and 1978.

5.2.1.8 Air Conditioning and Refrigeration Shop. This shop has performed maintenance on air conditioning and refrigeration systems since about 1950. All maintenance functions such as loading equipment with freon have been performed in the field, and not at a central shop.

Both electric and absorption air conditioning units have been employed at the Depot. Many of these units have employed cooling towers. The number of towers employed has decreased from about 40 in 1960 to 20 in 1985, as unit sizes have steadily increased. Between 1960 and 1965, the cooling water was treated with a chlorinated corrosion inhibitor. Since 1965, non-chlorinated inhibitors have been used. Blowdown from the cooling towers (Table 5-1) has always been discharged directly to the storm sewer system (Site 14; Section 8.15).

5.2.2 Motor Transport Garage. The Motor Transport Garage has been located in Building 155 since 1942. Motor Transport has provided transportation services in support of recruit training, and has performed maintenance on approximately 250 vehicles, including 1.5-ton trucks, tractor trailers, trailers, forklifts, buses, passenger cars, and vans since the 1940's. In the 1930's and 1940's, about 50 to 75 vehicles were reportedly operated by Motor Transport. The principal wastes (Table 5-1) produced by the Motor Transport Garage have included waste lube oil and transmission fluid, which have been collected in a 500-gallon underground tank since 1969. Prior to 1969, these wastes were collected in drums. Other wastes generated by this shop have included spent cleaning solvents, including kerosene, gasoline, and Varsol, which have always been mixed with the waste lube oil and transmission fluid prior to disposal. Since about 1966, these wastes have been shipped off-base for disposal. Prior to about 1966, they were either disposed of on-base at the Dredge Spoils Area Fire Training Pit (Site 4; Section 8.5), the Page Field Fire Training Pit (Site 7; Section 8.8), at the Dirt Roads Disposal Area (Site 15, Section 8.16), or shipped off-station for disposal.

A vehicle washrack in back of Building 155 has been used to wash the Motor Transport vehicles since about 1942. The washrack effluent has always entered a drain surrounded by asphalt pavement. In 1974, the drain line was connected to the sanitary sewer system via an oil/water separator (Section 7.4). Prior to 1974, this drain was connected to a storm sewer (Site 14; Section 8.15). In addition to the washrack effluent, neutralized battery acids and waste antifreeze have also been discharged to this drain since 1942. The used

batteries have been neutralized with baking soda, flushed, and sent to DRMO (Section 7.6) for salvage. Each battery contains about 0.5 gallon of spent acid that is neutralized before being discharged.

No significant spills or leaks are reported to have occurred at this shop.

5.2.3 Special Services. Special Services, located on the second floor of Building 111, administers most organized recreational facilities provided by the Depot. Four facilities have potential for producing hazardous wastes. These facilities include the Marina, the Automotive Hobby Shop, the Woodworking Hobby Shop, and the Ceramics Hobby Shop, which are described below.

5.2.3.1 Marina. Several docks and small wood frame structures on the south bank of the Boat Basin have been used for berthing and some maintenance of craft privately owned by Depot personnel. The 6-acre inlet off the mouth of Ballast Creek was formerly a small wetland on the fringes of a short tributary; it was dredged to form the Boat Basin in the 1930's.

The engine shop for the marina has been located in Building 76 since about 1950. No waste oil has been generated here, since virtually all work has been done on outboard (two-stroke) engines, in which the lubricating oil is consumed with the fuel. Two heating oil tanks (Table 6-1) stand outside the engine shop, one disconnected. A 1,000-gallon gasoline tank (Table 6-1) is also located in the Marina area. This tank is surrounded by a concrete containment structure, within a 5-foot-high berm.

There have been no reported spills or environmentally significant incidents connected with the Marina.

5.2.3.2 Automotive Hobby Shop. Since February 1983, the Automotive Hobby Shop has been located in Building 12. This brick masonry structure, built in 1899, is one of the original buildings at the Depot. Between 1963 and 1982, the Automotive Hobby Shop was located in Building AS26. The Automotive Hobby Shop has been used exclusively by Depot personnel for owner maintenance of POV's.

Since 1983, waste crankcase oil and transmission fluid have been collected in 25-gallon drums kept on a wheeled cart in the shop; approximately one full drum a week has been taken to Depot Motor Transport for sale to a recycling facility (see Section 5.3.3). Small amounts of other wastes have also been produced by the Automotive Hobby Shop. Oily rags have been sent to the base laundry; a small number (Table 5-1) are disposed of in the dumpster when worn out. Oil absorbent used on the shop floor has also been disposed of in the dumpster when it became saturated. Disposal of batteries removed from vehicles has been the responsibility of the owner. The shop has not handled battery electrolyte and has never permitted painting. A parts cleaning bin contains approximately 20 gallons of solvent, which is strained and reused; small amounts (Table 5-1) of sludge removed from this bin have been disposed of in the dumpster. This solvent reportedly contains equal amounts of aliphatic petroleum and chlorinated solvent compounds.

The former Automotive Hobby Shop located in Building AS26 operated much as the current shop, except that waste oil was collected in an underground storage tank outside the building (since 1969) or in 55-gallon drums (before 1969). Due to spillage in the area of the underground tank, the area was identified as Site 6 (see Section 8.7).

5.2.3.3 Woodworking Hobby Shop. The Woodworking Hobby Shop has been located in Building 20 since 1982. This shop occupies the west end of the building, adjacent to the Automotive Hobby Shop in Building 12. Between 1963 and 1982, the shop was located in Building 922.

The Woodworking Hobby Shop has never used wood preservatives or solvents, and has used very small amounts of paints, lacquers, and stains. Wood glues have been used extensively, but do not become wastes. The shop produces only sawdust and woodchip wastes, which have always been disposed of as routine trash.

5.2.3.4 Ceramics Hobby Shop. The Ceramics Hobby Shop has been located at the east end of Building 20 since 1982. It was located in Building 922 from 1963 to 1982. The shop uses no lead-based clays, and very few lead-based glazing compounds. No clay or glaze normally becomes waste. Virtually no paints or thinners have been used in the Ceramics Hobby Shop; users have generally painted their projects at home. The only wastes that have normally been produced by the shop are small amounts of ceramic shards in projects that break during the firing process.

5.2.3.5 Marine Corps Exchange. A number of facilities at the Depot have been operated by the Marine Corps Exchange (MCX). The majority of these facilities have offered services that do not handle hazardous materials or generate hazardous wastes. The exchange dry cleaning plant and the exchange service station are exceptions.

5.2.3.5.1 Dry Cleaning Shop. The Dry Cleaning Shop has been located in Building 193 since 1957. While in this building, the shop has used perchloroethylene dry cleaning solvent and a still for solvent recycle. Still bottoms (Table 5-1) have been shipped off-base for disposal since 1972. Prior to 1972, the still bottoms were collected daily in one-gallon containers, which were placed in a trash dumpster located outside the Dry Cleaning Shop. Between 1957 and 1959, the perchloroethylene still bottoms would have been burned in the incinerator on Horse Island (Section 7.3). Between 1959 and 1972, the still bottoms were disposed of at the Incinertor Landfill (Site 1; Section 8.2), the Borrow Pit Landfill (Site 2; Section 8.3), and the Causeway Landfill (Site 3; Section 8.4).

Prior to 1957, the Dry Cleaning Shop was located in a small wooden building that no longer exists. This building was located between Buildings 155 and 615. While in this dry cleaning building, the shop used petroleum dry cleaning solvent that was recirculated through solvent filters. The only waste produced by this process consisted of the filters, which were placed in trash dumpsters and subsequently taken to the incinerator on Horse Island (Section 7.3).

5.2.3.5.2 Exchange Service Station. The MCX has also operated a service station for POV's of military personnel in Building 850 since 1942. Until 1984, the station provided vehicle maintenance and minor repair servicing. Since 1969, waste lube oil has been collected in an underground storage tank that has periodically been pumped out by a private contractor (Section 6.3.3). Prior to 1969, waste oil was collected in drums prior to being shipped off-base or being disposed of on-base at the fire training pits (Site 4; Section 8.5 and Site 7, Section 8.8) or the Dirt Roads Disposal Area (Site 15; Section 8.16). Spent batteries were also collected for recycle (Section 7.6). Since 1984, vehicle service work has not been available to MCX customers.

5.2.4 Dispensary/Dental Clinic. The Medical Dispensary has been located in Building 669 since 1970, and at several other locations including Buildings 195, 286, 684, and 910 since the 1940's. Prior to 1948, medical care was also provided at the Former Naval Hospital (Section 5.2.13). The Dental Clinic has been located in Building 674 since 1973. Between 1942 and 1973, dental services were provided in Building 171. A dental office was located in Building 143 before 1941. The Medical Dispensary and Dental Clinic have provided medical and dental services to recruits and other Marine Corps personnel at MCRD Parris Island.

The Medical Dispensary has used small amounts of X-ray developer and fixer in its radiology laboratory. The Dental Clinic has also generated spent fixer and developer waste from processing X-rays. Since 1978, fixer for the Medical Dispensary and Dental Clinic has been taken to the Photographic Laboratory (Section 5.2.5) for silver recovery (Table 5-1).

The principal wastes produced by the Dental Clinic have included mercury amalgam used for fillings, beryllium alloy produced by the grinding of metal plates in the prosthetics laboratory, and lead packets or wrappers used to cover x-rays. Since about 1975, mercury amalgam has been processed and mixed in plastic capsules. About 48 percent of the mercury amalgam consists of elemental mercury, with the balance consisting of silver, tin, copper, and zinc. Prior to 1975, the amount of mercury amalgam waste generated by manually mixing the amalgam is estimated to have been about 10 times as high as that generated since 1975, when the capsules were introduced. The beryllium plates consist mainly of nickel, and contain only about 0.5 percent beryllium, so that the amount of elemental beryllium in the waste is small (Table 5-1). In addition, about 270 lb/yr of empty capsules used to contain the mercury amalgam have also been generated since 1975. A minimal amount of mercury residue remains in the capsules after the amalgam is removed. The mercury and lead waste materials have been taken to the Salvage Yard (Section 6.3) and sold for recycle by DRMO (Section 7.6). The lead strips have always been sent off-base for recycle. The mercury wastes have been recycled since 1975. Prior to 1975, the mercury amalgam waste was placed in the trash, which was placed in the station landfills discussed in Sections 8.2, 8.3, and 8.4, or shipped off the Depot (since 1972). Beryllium wastes have been shipped off base for disposal as a hazardous waste since 1980. Prior to 1980, the beryllium wastes were placed in the trash prior to disposal in the station landfills or disposal off the Depot (since 1972).

5.2.5 Photographic Laboratory. The MCRD Parris Island Photographic Laboratory has been located on the second floor of Building 283, north of Boulevard de France in the central area of the Depot since about the mid-1970's. A photographic laboratory was also located in Building 853 since 1942. The laboratory typically uses about 35 to 70 gal/mo of both developer and fixer. Silver recovery has been performed in the laboratory since the late 1970's (see Section 7.6) and the silver flake has been sent to DRMO. The waste developer and residual fixer have been poured down the drain into the sanitary sewer system since 1948. Prior to 1948, the developer and fixer wastes would have been discharged directly to the storm sewer system (Site 14; Section 8.15). The Photographic Laboratory has also performed silver recovery on fixer used in radiology by the Branch Dental Clinic (see Section 5.3.8) over the same time period.

5.2.6 Target Factory. The Target Factory has been located in two 4,000 square foot buildings (Structures 798 and 799) since 1952. These buildings are located south of Palmyra Street in the Weapons Battalion area. The factory has never used paints, dyes, wood preservatives, or hazardous chemicals. The only wastes it has produced have been minor quantities of ink-marked target cloth and paper, which have been discarded with the routine trash.

5.2.7 Armory. The existing Depot armory (Building 6001), located between Panama and Kyushu Streets, is a one-story brick structure covering slightly less than 12,000 square feet. Completed in 1983, it stores small arms, primarily M-16 rifles, for permanent Depot personnel. Small numbers of pistols, shotguns, and privately-owned weapons are also stored there. The Depot armory was located in Building 615 between 1948 and 1983, and in Building 11 for about 1940 to 1948.

The only waste-producing activities conducted in the armory have been cleaning and minor repair of weapons. Considerably more rifle cleaning has occured in the Recruit Battalion and Weapons Battalion areas (Section 5.3.11).

The procedure for cleaning weapons has always been to soak and scrub metal parts in hot water. Since about 1981, the partially disassembled weapon has then been brushed and wiped with CLP (Cleaner, Lubricant, Protectant), a mixture of petroleum distillates and silicone. After the parts have been cleaned, metal surfaces have been brushed with a layer of the liquid to protect them from rust and corrosion. Prior to about 1981, kerosene and gasoline were used to clean and coat weapons. The main wastes produced by the armory have been the cotton towels used as cleaning rags. Most of the rags enter the Depot laundry, though some 50 to 100 wornout towels per month have been disposed of in the dumpster (Table 5-1). Paint brushes, toothbrushes, and copper bore and chamber brushes have also been used to clean weapons, and small numbers of these are regularly discarded as trash. Occasional worn out or broken weapons parts--primarily of steel, fiberglass, aluminum, and plastic--have also been discarded in the dumpsters.

Several 35-gallon covered bins in the armory contain petroleum dry cleaning solvents, which have been used to clean exceptionally dirty weapons. None has been disposed of; as it evaporates, fresh solvent is added periodically.

5.2.8 Recruit Training Areas. All activities involving ordnance are directly related to recruit training. Ordnance is utilized in three types of training -marksmanship training, hand-grenade training, and the infiltration courses. Most ordnance used at the Depot has consisted of small arms ammunition. Defective rounds discovered during operations at the firing ranges and training areas have been disposed of at MCAS Beaufort by the explosive ordnance disposal (EOD) unit. Defective grenades have been detonated in place.

In addition to training using ordnance, other recruit training activities involving the handling of hazardous materials have included Nuclear, biological, and Chemical (NBC) training and Geiger Counter training using cobalt discs.

5.2.8.1 Marksmanship Training--There are five firing ranges at the Depot, including rifle and pistol ranges for recruits and permanent personnel, and a field firing range using machine gun fire and pop-up targets. Four of these ranges have been located in the western portion of the Depot, next to Ribbon Creek and Broad River, since at least the 1930's. The fifth range (E) was added in the late 1950's. The majority of the ammunition used has consisted of 5.56mm ball for M-16 rifles, although ammunition for the .38 and .45 caliber pistols has also been used. An estimated 10 million to 20 million rounds of ammunition per year have been discharged on these ranges. The designated impact area behind the ranges is marshland drained by Ribbon Creek. Due to concerns of potential contamination resulting from small arms projectiles entering the marsh, a water sample was collected from Ribbon Creek and tested for copper and lead in 1977. Analytical results indicated negligible contamination, with a copper concentration of 0.04 ppm and lead below the detection limit of 0.01 ppm (Dadohara, 1977).

Weapons used during training have been cleaned by recruits in grassy areas behind the battalion mess halls. Disassembled rifle parts have been cleaned with rags, toothbrushes, and copper wire bore and chamber brushes using CLP, a mixture of petroleum distillates and silicone, since about 1981. Prior to the use of CLP, kerosene and gasoline were used. Water used in rifle cleaning enters the storm drains. Rags too worn to launder and worn-out brushes are disposed of in the dumpsters. These wastes contain small quantities of cleaning solvent, dirt, carbon, unburned propellant, and fine particles of copper, lead, brass, and steel.

5.2.8.2 Hand Grenade Training--There are two practice ranges for hand grenades at the Depot--one for live fuze training and one for live hand grenades. The live grenade range (Structure 4020), located in the easternmost portion of Page Field, has been active since the late 1950's. Prior to the late 1950's, the grenade range was located where Marksmanship Training Range E is currently located. An estimated 25,000 to 50,000 grenades per year have been exploded on the grenade range. Recoverable metal parts from the live grenade range have been collected periodically for disposal through DRMO (Section 7.6). Surface soil samples collected from the grenade range in 1977 showed low concentrations of TNT and RDX of 0.05 and 0.35 ppm (or less), respectively (Dadshara, 1977).

5.2.8.3 Infiltration Courses--The infiltration course for daylight training (Structure 4024) and the night movement course (Structure 4023) were constructed in 1975. These courses were not present at MCRD Parris Island before 1975. Recruits are trained in manuevering in combat situations and must scale a wall and crawl through a series of obstacles and around sandbagged bunkers. Instructors detonate ¼-pound TNT demolition blocks inside the bunkers and simulate gunfire with an oxygen-propane machine gun simulator. There are 32 unlined demolition pits in the course, in which demolition blocks are detonated to simulate artillery fire. An estimated 6,400 ¼-pound blocks per year have been detonated in these pits since their construction. The area surrounding the pits is flat with no clear drainage pattern. Surface soil samples were collected around the course in 1977. Analysis of the samples showed TNT content as high as 81 ppm and RDX concentrations as high as 890 ppm (Dodohara, 1977).

5.2.8.4 NBC Training--Nuclear, Biological, and Chemical (NBC) recruit training has been provided in and near Building AS26. No actual NBC materials have been used at MCRD Parris Island, with the exception of tear gas. The NBC training consists primarily of classroom instruction. The gas chamber has been operated in the western portion of AS26 since 1984. The gas chamber was previously located in a quonset hut at Elliot's Beach (Structure EB-11, which has since been demolished) since about 1948. This quonset hut was located in GDM M-25, directly north of Structure EB-11. A portable smoke generator, chemical canisters, and smoke grenades have been used in gas chamber training. Empty chemical canisters and expended smoke grenades have always been disposed of in the Depot dumpsters.

5.2.8.5 Geiger Counter Training--Prior to the mid-1970's, small radioactive cobalt discs, about 1-inch in diameter, were routinely placed in an open field in the vicinity of Building 923 for Geiger Counter training. During training, all discs placed in the field were collected and accounted for. When not in use, the discs were stored in lead canisters within a concrete vault in the floor of Building 923. This type of training was discontinued in the mid-1970's, and these discs were sent to Barnwell Laboratories for disposal in 1980.

5.2.9 Power/Steam Plants. The main power plant for MCRD Parris Island is located in Building 160, a two-story brick structure built in 1942. Building 160 occupies a location adjacent to and north of the old drydock, in the oldest part of the base. The original coal-burning power plant and its coal shed, built near the turn of the century, were adjacent to the existing location and the drydock, which was also used as a coal dock. Coal was barged from Port Royal to Parris Island and unloaded at the drydock. During the build-up during World War II, the present structure, with three Babcock & Wilcox boilers firing No. 6 fuel oil and three steam-driven 1,000 kW generators, was constructed in 1942. It is estimated that about 600 tons per year of boiler ash were generated between 1918 and 1942. This ash was employed in construction of roads throughout the Depot.

The old power plant was retained on a standby basis until early in the Korean War, when Building 160 was enlarged. The 172-foot-by-68-foot structure was lengthened by 52 feet and a Riley Stoker boiler was installed. The

configuration of the plant has not changed significantly since 1957, when the boilers began firing natural gas as their primary fuel. Electricity generation is secondary to steam production, since the plant cannot meet all the electric power demands of MCRD Parris Island. The depot is connected to the South Carolina Electric & Gas Company (SCE&G) grid, and the utility normally provides 75 percent of the electricity used on Parris Island. The plant has been operated to produce an average of 100,000 lb/hr of extraction steam, which has been used throughout the main part of the Depot for building heating, hot water, steam absorption, laundry, steam cleaners, and cooking.

Until 1976, discharges of boiler blowdown, demineralizer backwash and regeneration water, and rinse waters flowed to a manhole southeast of Building 160, and then less than 100 feet to the marsh draining into the Beaufort River. An estimated 6,500 gallons per day (gal/d) of acid wastes (pH 2.5 to 6.7), 11,000 gal/d of alkaline wastes (pH 8.5 to 11.1) and 11,000 gal/d of boiler blowdown (pH 10.8 to 11.5) were discharged to the river. Since at least the 1960's, the boiler blowdown has contained disodium phosphate and trisodium sulfite. The discharges were routed to the sewage treatment plant in 1976.

Associated with the main power plant are three No. 6 fuel oil storage tanks (Structures 94, 95, and 97), each with a capacity of 210,000 gallons. These tanks (Table 6-1) are located north and northeast of the plant, and have containment berms surrounding them. Two 5,000-gallon tanks for sulfuric acid and caustic are also located at the plant. The sodium hydroxide tank is situated inside the building. The acid tank is located on a gravel parking lot.

The major user of cooling water at MCRD Parris Island has been the powerplant in Building 160, which has used approximately 3 million gallons per day of water from the Beaufort River in a once-through cooling system since 1942. The cooling water has been discharged back into the Beaufort River after being heated in the condenser. The once-through cooling system has not changed substantially since 1942, when the existing power plant was constructed.

5.2.9.1 Weapons Area Steam Plant. In addition, to the main power/steam plant, the Depot operates a steam plant located in Building 1012, which consists of three Keeler water tube package units, each rated at 17,500 lb/hr for a total capacity of 52,500 lb/hr. Constructed in 1957, this plant has provided steam for building heating, hot water, and the mess halls in the Weapons Battalion (rifle range) area. As in the main steam plant, natural gas has been the primary fuel burned (since 1957). Structure 1013 (Table 6-1) is a 40,000-gallon tank containing standby fuel oil for the plant.

5.2.9.2 Other Steam Plants. Building AS-15 housed a 17,500 MBtu/hr Cleaver Brooks boiler manufactured in 1941 which burned No. 2 fuel oil. This boiler was originally part of the physical plant for Page Field. This boiler discharged 400 gal/d of blowdown containing disodium phosphate and trisodium sulfite to a storm sewer flowing directly into Ballast Creek. The boiler was removed when the building was demolished in 1982. Individual building boilers for heat and hot water have also been located in Buildings 4, 180, 228, 229, 299, 500, and 703. These boilers have burned No. 2 fuel oil. A small coal-

fired steam plant in the Weapons Battalion area was demolished in 1957 when the present natural gas burning plant was built in that area. Boiler houses containing hand-stoked boilers existed in Structures 767, 792, and 908. Coal combustion ash from these facilities, as well as from the former main power/steam plant, was used for road construction at the Depot.

5.2.10 Drydock. A wooden drydock was constructed in 1893, and was operated until the early 1920's for performing maintenance on Navy ships. The drydock is located in the northeastern portion of the Depot, about 50 feet south of the existing power plant in Building 160. The inlet of the drydock faces the Beaufort River. The drydock at MCRD Parris Island, which is 450 feet long, 104 feet wide, and 26 feet deep, is believed to be the largest wooden dry dock ever constructed in the United States. In constructing the drydock, wooden pilings were driven down to bedrock by steam pile drivers, and the drydock basin was excavated with a steam dredge.

When in use, the drydock was closed off from the river by means of a floating caisson-type gate, which was floated into place, filled with water, and allowed to sink. The gate thus sealed off the drydock from the river. To remove the gate, water was pumped out until the gate could be floated again and towed away. The drydock remained in service until the early 1920's, when ships simply outgrew the facility. Because the drydock was operated nearly a century ago, no information is available on waste generation or disposal related to the ship maintenance operations. Wastes generated at that time would likely have included paint wastes (used brushes, cleaning rags, and paint cans), pitch or tar, and turpentine.

After its use as a dry dock came to an end, the slip continued to be used for the unloading of coal barges until 1942; when the power plant (Section 5.3.14) converted from coal to fuel oil.

5.2.11 Asphalt Mixing Plant. A plant to process asphalt for use in paving roads and the runways at Page Airfield (Section 5.3.20) was installed on Horse Island in 1942. This plant was located at the same area that was later used in the 1970's as a solid waste transfer station (Structure 318; Section 7.5). The Asphalt Plant operated until the mid-1960's, when it was disassembled and shipped to Turkey.

The plant consisted of several hoppers and tanks for storing, heating, and mixing sand, aggregate, stones, and asphalt. Sand was taken from pits on Horse Island, while all the other raw materials, including asphalt, were transported to the Depot by truck. Two 500-gallon steam-heated tanks were used for storing the unprocessed asphalt.

Nearly all the asphalt and other raw materials brought to the Asphalt Plant were contained in the sand asphalt product, which was applied to the roads and runways by asphalt spreaders. The only waste generated by the Asphalt Plant consisted of a small amount of asphalt leakage that would harden on the ground and later be removed and handled as a solid waste (Section 7.5). No waste was generated by the deactivation of the plant, since the disassembled equipment was transported off the Depot for reuse in Turkey.

5.2.12 Former Naval Hospital. A relatively small Naval Hospital located in the northeast corner of Parris Island was commissioned in 1899 and operated until the late 1940's, when it was replaced by the Naval Hospital established in 1949 in nearby Beaufort, South Carolina. During the World War II period, the former Naval Hospital expanded considerably. As of 1946, facilities at the hospital included 48 buildings, 349 beds, barracks for 200 enlisted men and 20 civilians, two ambulances, and 12 trucks and other vehicles. The Former Naval Hospital occupied about 15 acres of land located about 500 feet northwest of the existing powerplant (Building 160).

The former Naval Hospital had its own motor transport and maintenance personnel, who collected wastes generated at the hospital and brought them to the large brick incinerator on Horse Island (Section 7.3). Wastes would have included used paint brushes cleaning rags, and paint cans; lube oil; and petroleum-based solvents (see Table 5-1). Wastewaters were discharged to a combined sanitary/storm sewer system that emptied into the Beaufort River.

5.2.13 Page Airfield. A very small airfield with grass runways was operated at the Depot between 1932 and the start of World War II. In the early 1940's, the airfield was considerably expanded into the southeastern portion of Parris Island. The runways were lengthened and paved with material from the Asphalt Plant (Section 5.3.18) on Horse Island. In 1937, Page Airfield occupied only 9 acres of land and contained only two structures. By 1946, Page Airfield occupied about 1,400 acres of land and included four asphalt runways between 4,000 and 6,000 feet long and 61 buildings and structures.

Operations at Page Airfield were minor before and after World War II. During the war years, the airfield received its heaviest use as a training base for Marine Corps and Army pilots. The airfield was relegated to caretaker status in 1946, and was thereafter operated only for transport of marines to and from the Depot. All aircraft operations at Page Airfield were terminated in the early 1950's. After 1946, fueling and maintenance operations performed at Page Airfield were minimal. Since the late 1940's, the airfield and surrounding areas have been used primarily for recruit training facilities such as the grenade ranges and infiltration courses (Section 5.3.13). In addition, a fire training pit (Section 8.8) at the airfield was used from the mid-1960's to 1976.

During World War II, maintenance on aircraft was performed in one main hangar. Maintenance operations were limited to light maintenance including changing of engine oil and hydraulic fluids and minor airplane repairs. Preassembled new engines were sometimes installed in place to replace old engines. Overhauling of engines was not performed at Page Airfield. Two smaller hangars were also used for relatively small planes. A ground support group operated at the airfield during the war years in support of the aircraft operations. The hangars contained fuel, storage tanks, and refueling facilities for squadrons of B-24, B-25, C-47, and F-4U aircraft. All aviation fuel was transported to the airfield by truck. Four 50,000-gallon underground fuel tanks (Structure AS18) were installed at the northern edge of Page Airfield (adjacent to Chapultepec Street) in 1942 for storage of AVGAS. Four other 25,000-gallon underground AVGAS tanks (structure AS16) were also installed in the same vicinity in 1942. While aircraft operations were being phased out after World

War II, the AVGAS continued to be pumped from these tanks until they were nearly empty. These eight tanks are still in place. Since these tanks were not reused, the tank bottoms have reportedly not been cleaned out. No leaks or spills are reported to have occurred from the AVGAS tanks.

The main wastes generated at Page Airfield consisted of fuel removed during defueling of aircraft, and waste oils and hydraulic fluids resulting from both aircraft and ground support operations. Cosmoline coating on new engines and other spare parts was removed with carbon tetrachloride (for one year only) or diesel fuel. The waste solvent was reportedly placed in drums and shipped off-station. Because of the scarcity and value of fuels during the war years, the defueled material was drained into drums that were sent to Navy Supply for reuse as ground vehicle fuel. The waste oils and hydraulic fluids were similarly placed in drums and sent to Navy Supply for reuse. Some waste fuel and oils that spilled on the runways and aprons were washed down drains that emptied into the marshes and Beaufort River via the storm sewer system (Site 14; Section 8.15).

CHAPTER 6. MATERIAL HANDLING: STORAGE AND TRANSPORTATION

6.1 INTRODUCTION. This chapter describes the storage and transportation and handling of hazardous materials and hazardous wastes at MCRD Parris Island.

6.2 MATERIALS, HANDLING/TRANSPORTATION AND STORAGE. The Supply Department has always been responsible for all incoming materials with the exception of Depot ordnance. Supplies have been received and issued directly for use, issued to the central warehouse for storage, or dispersed throughout the Depot in smaller supply/storage facilities. Hazardous materials received by Supply primarily have included pesticides, chlorine, paints, thinners, small quantities of solvents, and fuels. Fuels and other bulk shipments have always been delivered directly to storage facilities for utilization. There has never been a central flammable storage warehouse at the Depot. Supply has been responsible for direct delivery to the shops or points of use. Supply maintains a shelf life program for quality control of stored materials. Damaged materials and expired shelf life items have been tranferred to the DRMO Salvage Yard (Section 6.3.1) or the Reclamation and Salvage Area (Section 6.3.2) for off-Depot reuse or disposal.

6.2.1 Chemicals and Hazardous Materials Storage Facilities. Hazardous materials received by Supply have always been stored at the central warehouse (Building 867) or in smaller temporary storage areas near the point of use. There has never been a separate structure solely for central storage of raw hazardous materials prior to requisition by individual shops or units.

6.2.2 POL Storage. Petroleum, oils, and lubricants (POL's) have been stored primarily in aboveground tanks due to the high ground water table at MCRD Parris Island. An inventory of POL tanks at the depot is presented in Table 6-1. The installation dates, locations, contents, capacities and other pertinent information are presented. There are approximately 21 storage tanks for POL's at the depot, with six of these having been abandoned and left in place, as discussed below.

The five aboveground storage tanks in the bulk fuels storage area were installed in 1985. These tanks rest on concrete saddles approximately 7 feet above ground and are collectively surrounded by a containment berm. Two 1,000-gallon underground storage tanks were removed from this area prior to installation of these tanks. Removal of the underground tanks (which were installed in 1942) was part of a preventive maintenance program, and no leaks were reported to have occurred from these tanks. Two 10,000-gallon underground storage tanks near Building 625 were temporarily taken out of service in order to consolidate storage at the bulk fuels area storage tanks installed in 1985. These tanks were returned to service by the end of 1985, however. No leaks, spills or other incidents have been reported.

Eight underground storage tanks (Stuctures AS18 and AS16), located at the northern edge of Page Field, were used for AVGAS storage during the 1940's when the air station operated at Parris Island. The tanks were installed in 1942 and used until after World War II. The tanks were pumped empty as operations were phased out at Page Field. These tanks have been inactive since

TABLE 6-1

POL Storage Tank Inventory at MCRD Parris Island

Structure/Location	Contents	Above/Under Ground	Capacity (gal)	Date of Installation	Comments(1), (2)
POL Storage					
96	MOGAS	AG	4 @ 10,000	1985	Bulk Motor Fuel
	Diesel	AG	12,500	1985	Storage
94	No. 6 Fuel Oil	AG	210,000	1942	Main Steam Generating
95	No. 6 Fuel Oil	AG	210,000	1942	Plant
97	No. 6 Fuel Oil	AG	210,000	1942	
302	No. 2 Fuel Oil	AG	100,000		Standby Fuel Storage
1013	No. 6 Fuel Oil	AG	40,000	1957	Weapons Area Htg. Plant
850	MOGAS	UG	2 @ 4,000	1942	Exchange Service Station
			2 @ 2,000	1942	
895A	MOGAS	UG	20,000		Maintenance Division
	Diesel	UG	20,000		
AS27	Heating Fuel	AG	500	1965	Fuels
76	MOGAS	UG	1,000	1950	Marina Fuel Storage
625	MOGAS	UG	2 @ 10,000	1940's	
AS18	AVGAS	UG	4 @ 50,000	1942	Abandoned
AS16	AVGAS	UG	4 @ 25,000	1942	Abandoned
79B	No. 2 Fuel Oil	AG	100	1944	
193	No. 2 Fuel Oil	AG	2 @ 100	1957	
	Petroleum Naptha	UG	2 @ 500	1957	
	Petroleum Naptha	UG	1,000	1957	
405	No. 2 Fuel Oil	AG	100	1960	
500	No. 2 Fuel Oil	AG	1,000	1955	
500A	No. 2 Fuel Oil	AG	200	1955	
559	No. 2 Fuel Oil	AG	200	1955	
651	No. 2 Fuel Oil	AG	100	1941	
652	No. 2 Fuel Oil	AG	100	1941	
604	No. 2 Fuel Oil	AG	100	1953	
	No. 2 Fuel Oil	AG	200	1953	
695	No. 2 Fuel Oil	AG	100	1952	
703	No. 2 Fuel Oil	AG	500	1942	
764	No. 2 Fuel Oil	AG	100	1941	
777	No. 2 Fuel Oil	AG	100	1926	
783	No. 2 Fuel Oil	AG	100	1942	
786	No. 2 Fuel Oil	AG	100	1942	
864	No. 2 Fuel Oil	AG	250	1952	
865	No. 2 Fuel Oil	AG	250	1952	
866	No. 2 Fuel Oil	AG	250	1961	
869	No. 2 Fuel Oil	AG	250	1961	
875	No. 2 Fuel Oil	AG	200	1941	
Waste Oil Storage					
864	Waste Motor Oil	UG	500	1969	Diesel Shop
155	Waste Motor Oil	UG	500	1969	Motor Transport Garage
AS26	Waste Motor Oil	UG	500	1969	Former Auto Hobby Shop(3)
850	Waste Motor Oil	UG	500	1969	MCX Service Station (3)

(1) All tanks are of welded steel construction.

(2) Underground POL tanks in service are cathodically protected; waste oil storage tanks are not.

(3) Tanks no longer in service.

that time. These tanks were emptied, but were reportedly not cleaned out prior to being abandoned since they were never reused. No leaks or spills are reported to have occurred from the AVGAS tanks.

Tanks 94, 95, and 97 have provided fuel oil storage capacity for the main power/steam plant since 1942. These tanks have been surrounded by a concrete berm that drains to an oil/water separator since 1978 (Section 7.4). The Weapons Area Heating Plant (Structure 1012) has been fueled from an aboveground, 40,000-gallon tank since plant construction in 1957. No leaks or spills have been reported from any of the power plant fuel storage tanks.

In December 1983, a 97-gallon spill of unleaded gasoline (Site 10; Section 8.11) occurred at the fuel storage area at the gas station (Building 170). The spill occurred when an underground day tank was being filled from an aboveground storage tank. The spilled gasoline overflowed and escaped from the day tank through a vent at the surface. The resulting contaminated area was thoroughly cleaned up by excavation. Contaminated soils were removed and shipped off the base by DRMO for disposal as a hazardous waste.

6.2.3 Ordnance Storage. Ordnance materials have been stored at the Ammunition Supply Point (ASP), a 120-acre fenced site containing eight magazines (Structures A1 through A8) and two guard and administration buildings (A9 and A10), since these structures were built in 1942. Safe storage and security for the inventory of ammunition required by MCRD Parris Island are the ASP's only missions. Located for security and safety, the ASP covers a peninsula in the marshes southeast of the dredge cut and northeast of Page Field, north of Yorktown Boulevard. More than a mile of roads (Lexington Boulevard and Cienfugos Street) connect the dispersed magazines.

All ordnance used at the Depot has always been for recruit training with the exception of ammunition used by security personnel and small quantities used for structure demolition. Types of ordnance at the Depot have included firearms amunition, grenades, pyrotechnics, and demolitions. Table 6-2 lists a representative inventory of ordnance items stored at the ASP. The predominant inventory items in recent years have included 5.56mm ball and blank rounds, ¼-pound demolition blocks (used on the infiltration courses), practice grenade fuzes (used on the grenade range), and simulated booby traps and trip flares (used in tactical training). No mortar or artillery ammunition, or any heavy ordnance, has been stored at the MCRD Parris Island ASP.

Though undoubtedly the largest concentration of hazardous items at the Depot, the ASP has produced no ordnance wastes. Small numbers of ordnance items have occassionally been identified as defective, but have always been sent to MCAS Beaufort for disposal.

6.2.4 Bulk Chemical Storage. Two 5,000-gallon aboveground storage tanks for sulfuric acid and caustic are located at the main power/steam plant (Building 160). These tanks were installed in 1975 for pretreatment of acid and alkaline waste prior to discharge to the sanitary sewer. The tank containing sodium hydroxide is situated on concrete inside Building 160. The sulfuric acid tank is located outside the building in a gravel parking lot. No

TABLE 6-2

Ordnance Inventory

(Typical "On Hand" Quantities, 1977)

Type Ordnance	Quantity Stored	Turnover (% used per year)
Firearms Ammunition		
5.56mm Ball (M-16)	3,533,200	241
.45 Caliber	840,000	97
.22 Caliber Long Rifle	280,000	52
7.62mm	50,000	99
.38 Caliber	27,000	86
12 Gauge	3,000	88
Blank Firearms Ammunition	221,000	570
Grenades		
Practice Grenade		
Body	500	40
Fuze	30,000	155
Fragmentation	20,000	74
Smoke	4,350	86
Hand Illumination	200	74
CS Capsule	150	72
Pyrotechnics		
Simulated Booby Trap	6,000	155
Trip Flare	1,000	116
Other Pyrotechnic	1,000	95
Demolitions		
Explosive Black (¼lb)	2,000	208
Electric Blasting Cap	4,000	101
Time Fuze	2,080	23

Source: Dodohara, 1977

incidents or spills are reported to have occurred in this area. Prior to 1975, these chemicals were stored inside Building 160 in 55-gallon drums. No leaks or spills were reported to have occurred from storage of these chemicals.

6.2.5 Transformer Storage. During the 1940's, both PCB and non-PCB filled transformers were stored in a metal shed located west of Building 11 and adjacent to Building 145. Between 5 and 10 transformers were stored in this shed at any given time. This area is now paved and is a parking lot. From 1950 to 1970, about 5 to 10 transformers were stored in a metal shed located between Building 155 and the First Battalion Area. The transformers filled with oil were stored on the dirt floor within the shed. The area surrounding the shed was a lumber yard. No maintenance was performed on the transformers in these storage areas. No spills or leaks were reported to have occurred at either of these storage areas.

In 1983, temporary transformer storage occurred on an equipment pad adjacent to Building 450. Although leakage occurred during storage (Site 8; Section 8.9), the area was adequately cleaned up and the contaminated materials were drummed up and shipped off the base as a hazardous waste.

6.3 WASTE HANDLING/TRANSPORTATION AND STORAGE. The majority of hazardous wastes that have been generated by the Depot have resulted from painting operations and maintenance on automobiles and other ground vehicles and heavy equipment. Hazardous wastes generated by these operations at MCRD Parris Island have either been stored in central storage facilities prior to disposal or reuse, or temporarily held near the point of generation within or adjacent to Depot buildings. Some hazardous wastes that have resale value have been transported to the DRMO Salvage Yard (Section 6.3.1), which has operated since 1964. Prior to 1964, items with resale value were stored in the Reclamation and Salvage Area (Section 6.3.2) prior to shipment off the Depot.

6.3.1 DRMO Salvage Yard. The Defense Reutilization and Marketing Office (DRMO) of Charleston operates an offsite base (OSB) at MCRD Parris Island. This office was a separate unit and operated independently from 1964 until 1982, when it was placed under the control of the Charleston Naval Facilities as an OSB. During that period it operated under the name of the Defense Property Disposal Office (DPDO). DRMO, located in Buildings 629 and 630 at MCRD Parris Island, has operated a Salvage Yard and accepted materials from MCRD Parris Island, MCAS Beaufort, and NAVHOSP Beaufort since 1964. For a short period during 1984 and 1985, it also handled materials from Fort Stewart, Georgia.

Recyclable materials accepted by DRMO at MCRD Parris Island have included cardboard, wood, metals, canvas, rubber, bone and meat trimmings, batteries, and paper. None of these items, with the possible exception of batteries, are considered hazardous. DRMO has also accepted in its Salvage Yard hazardous materials or wastes that are still potentially useful or salvagable, including expired shelf-life, damaged, and off-specification paints, glazing compounds, dry cleaning solvents, cleaning compounds, spent batteries, mercury amalgam, and recovered silver. The quantities of expired shelf-life, damaged and off-spec items handled by DRMO are unknown. The volume of spent batteries,

mercury amalgam, and silver generated by the Depot and handled by DRMO is provided in Table 5-1.

Buildings 629 and 630 and the surrounding yard have been used for material transfers, temporary storage of smaller items, weather protected storage, and storage of operating equipment and vehicles. The Salvage Yard, which is located on Horse Island, has also accepted empty hazardous waste drums since 1964. Since the late 1970's, these containers have been accepted only if they have been properly triple-rinsed prior to transfer to the yard. All drums at the Salvage Yard have been stored on wooden pallets.

DRMO has been responsible for contracting for the off-base removal of hazardous wastes. DRMO also has had responsibility for contracting for the removal of hazardous wastes from the MCAS Beaufort and NAVHOSP Beaufort activities. Since 1983, salvageable hazardous wastes at MCRD Parris Island have been collected on a monthly basis directly from point of generation by the private contractor.

Prior to 1980, hazardous materials and wastes were accepted by DRMO (at that time called Defense Property Disposal Office (DPDO)) and stored in drums in the Salvage Yard. If there was no resale or recycle within 42 days, a private contractor would handle removal.

No spills or other incidents were reported to have occurred at the DRMO Salvage Yards.

6.3.2 Reclamation and Salvage Area. Prior to the existence of the DRMO Salvage Yard, which has been operated since 1964 (Section 6.3.1), a Reclamation and Salvage Area was operated by the Depot. This area, operated since at least the 1940's, was a 2-acre grassy area located near the Marina between Building 22 and Building 303. The area was rectangular with approximate dimensions of 200 feet by 400 feet. All depot wastes and excess materials with resale value were handled by Reclamation and Salvage personnel. The majority of recycled materials were non-hazardous wastes and excess materials similar to those handled by DRMO (see Section 6.3.1). Reportedly, the area was kept clean and no spills or other incidents occurred there.

6.3.3 Hazardous Waste Storage. MCRD Parris Island does not have a RCRA-Conforming storage facility for drums and containers of hazardous wastes. For most wastes, temporary drum storage has been provided at the point of generation of the wastes and at the DRMO Salvage Yard (Section 6.3.1) or Reclamation and Salvage Area (Section 6.3.2) prior to off-base recycle or disposal. Since 1969, temporary storage for paint wastes and waste oils has been provided by the Paint Waste Storage Area (Section 6.3.3.1) and by four 500-gallon underground storage tanks, respectively.

6.3.3.1 Paint Waste Storage Area. After the Borrow Pit Landfill (Site 2; Section 8.3) closed in 1968, the Paint Shop (Section 5.2.11) began to use an unpaved dirt area in back of the Roads and Grounds Department for temporary storage of liquid paint wastes. This area, designated as Site 9 (Section 8.10), is located adjacent to Building 864. Spent thinners (mineral spirits, kerosene, and diesel fuel) and paint strippers (methylene chloride) were

placed in 30-gallon "garbage" cans at the painting job sites, and then taken to the storage area adjacent to Building 864. Until 1978, wastes brought to this storage area were then placed in the underground waste oil storage tank (Section 6.3.3.2) located at the Diesel Shop and mixed with the waste oil. A contractor collected the paint wastes with the waste oil for disposal off the base. After 1978, liquid paint wastes were no longer poured into the underground storage tank at the Diesel Shop. They were stored in 55-gallon drums at the Paint Waste Storage Area from 1979 to 1984. Wastes were picked up from this area by a contractor for off-base disposal in 1981 and 1983, after about 40 drums of liquid paint wastes had accumulated in the storage area. The use of this area for storage of paint wastes ended in 1983, when a contractor removed all the remaining wastes for disposal at an incineration facility in Spartanburg, South Carolina. All the soil that had been contaminated by spillage of paint wastes was excavated and shipped off the base for disposal. The 1,200-square-foot area that had been used for storage of paint wastes was then covered with concrete pavement.

Since 1984, all paint wastes have been stored in 55-gallon drums in an enclosed shed adjacent to Building 864, until they have been picked up and removed from the Depot by a contractor. No spills or other incidents were reported to have occurred at the enclosed storage facility.

6.3.3.2 Waste Oil Storage. Four underground waste oil storage tanks are located at Building 864 (Diesel Shop--Section 5.3.1.6), Building 155 (Motor Transport Garage--Section 5.3.2), Building AS26 (Former Automotive Hobby Shop--Section 5.3.3.2), and Building 850 (MCX Service Station--Section 5.3.3.5). These tanks, listed on Table 6-1, are of welded steel construction and each have a capacity of 500 gallons. They were installed by Roads and Grounds personnel around 1969, and are not cathodically protected. The tanks at Buildings 864 and 155 are still active, while the use of the tanks at Buildings AS26 and 850 ended in 1982 and 1984, respectively.

Spillage of waste oil occurred around the tanks at the Automotive Hobby Shop (Site 11; Section 8.12) and the MCX Service Station. (Site 11; Section 8.12) Shop users at the Former Automotive Hobby Shop and garage personnel at the MCX Service Station carried used crankcase oil to the underground tanks. Spillage occurred while carrying and transferring the used oil to the tanks. All contaminated soil surrounding the MCX Service Station tank was excavated in 1983, placed in 50 55-gallon drums, and shipped off the Depot for disposal as a hazardous waste. At the conclusion of the cleanup, a concrete pad was placed around the tank's fill pipe. The pad was sloped towards the center to contain any spilled oil. The MCX Service Station continued to provide vehicle maintenance services for about a year after the completion of the cleanup. Waste oil has not been generated since the garage was closed in 1984.

Since about 1969, waste oil stored in the four underground storage tanks has been pumped out by a contractor and taken to a waste oil refiner in Savannah, Georgia. Prior to 1969, most of the waste oil generated at MCRD Parris Island was reportedly burned in the fire training pits (Site 4; Section 8.5 and Site 7; Section 8.8) and/or used for dust control on dirt roads (Site 15; Section 8.16); some of the waste oil was also shipped off the Depot to refiners or discharged to storm drains (Site 14; Section 8.15).

CHAPTER 7. WASTE PROCESSING

7.1. INTRODUCTION. This chapter describes the various methods of waste processing that have been used at MCRD Parris Island, including wastewater treatment, incineration, and recycle.

7.2 SANITARY WASTEWATER TREATMENT. Since 1948, MCRD Parris Island has operated its own secondary wastewater treatment plant which discharges effluent to the Beaufort River. The treatment plant is a standard rate trickling filter system consisting of a primary clarifer, two trickling filters, a secondary clarifer, separate anaerobic sludge digestion, and post chlorination. Sludge drying beds are used for dewatering digested sludge. The sewage treatment plant (STP) was constructed in 1946. Prior to 1948, all wastewaters were discharged untreated via the storm sewer system to the Beaufort and Broad Rivers. The STP was designed to treat up to 3 million gallons per day (mgd), but since about 1975 has operated at a level of about 1.2 mgd. When the Depot population was at peak levels during the Korean and Vietnam Wars (1951-1953, 1975-1970), the STP operated at about two-thirds capacity.

Mostly domestic sewage has been treated at the STP since 1948. Much smaller volumes of boiler blowdown, laundry effluents, battery wastes, vehicle washrack effluents, and pesticide container rinsate have also been fed to the STP. Since 1974, neutralized battery acids from the Motor Transport Garage and the Diesel Shop have been discharged to the sanitary sewer system. Laundry wastewater was routed to the STP in 1979. Boiler blowdown was routed to the STP in 1976, and vehicle washrack effluents were routed to the STP via oil/water separators in 1974. These effluents were discharged to the Depot's storm sewer system before they were rerouted to the sanitary sewer.

The 3.0 mgd plant was upgraded in 1979 with construction of a stacked trickling filter tower and a recirculation pump station. The plant modifications were designed such that the old trickling filter and the stacked tricking filter tower could be operated in series or in parallel. Current practice is to operate the filters in series. Since 1979, wastewater has been processed through the plastic media filter and then through the stone media filter. Effluent from both filters is pumped to two final clarifiers, from which it flows by gravity to a Parshall flume, chlorine contact chamber, and through an outfall sewer that discharges away from the shoreline. In 1981, a new chlorine building was constructed and equipped to meter chlorine dosage based on actual effluent flow. Sludge from the primary clarifers has been pumped to anaerobic digesters, after which it has been dried in nine adjacent drying beds. Until mid-1985, dried sludge was recycled as a soil amendment used by Roads and Grounds personnel at various locations around the Depot. Since October 1985, the dried sludge has been privately contracted to be hauled off Depot property.

Since 1972, a separate treatment system has been provided for the training facilities (Section 5.2.8) at the Page Field area. The treatment plant for this area is a 0.15 mgd, fully automatic, extended aeration package plant that was constructed in 1972 to replace a septic system that had been servicing

barracks located in the vicinity of Page Field since the 1940's. Although the barracks were demolished in 1982, it was reported that the package plant is still on line and operating. The treated effluent has been discharged to Ballast Creek since the plant was installed in 1972.

7.3 INCINERATION. A large incinerator, located at the northeastern tip of Horse Island, and an associated landfill (Site 1; Section 8.2) adjacent to the incinerator constituted the main waste treatment/disposal method at the Depot for nearly 40 years. The incinerator was constructed in 1921, and continued to operate until 1959. The Incinerator Landfill continued to be used for about six additional years after the incinerator was shut down.

The incinerator consisted of a large brick chamber about 43 feet long, 34 feet wide, and 20 feet high. Trucks carrying wastes would drive up a ramp and drop the wastes into the combustion chamber through a hole at the top. Coal was used as an auxiliary fuel to fire the incinerator.

Most combustible wastes such as trash and garbage were burned inside the incinerator. The quantities of wastes fed to the incinerator generally ranged between 10 and 20 tons per day. Non-combustible waste such as bottles, cans, and construction wastes were generally placed in the adjacent landfill, together with the incinerator ash residues. All paint wastes (Section 5.3.1) were also brought to the incinerator. Solid paint wastes such as empty cans, brushes, rags, and spray booth and mixing tank scrapings were generally placed in the Incinerator Landfill, although they were sometimes included with the other solid wastes fed to the incinerator. Spent paint thinners and strippers were (Section 5.2.1.1) poured on the ground at the landfill (see Section 8.2). Burning inside the incinerator was continuous. Periodic open burning also occurred in the landfill adjacent to the incinerator. No auxilary fuels were used in the burning areas.

A second, smaller incinerator was operated at the Commissary (Building 10) from the 1950's until 1981. The incinerator had a capacity of 2,000 pounds per day and was used for burning corrugated boxes and classified wastes. Auxiliary fuel was not used in operating this incinerator. During operation of the incinerator, the Commissary generated approximately 1,000 pounds per day more cardboard waste than the incinerator could handle. This excess was hauled to the larger incinerator on Horse Island or the landfill operating at the time (Sections 8.2, 8.3, and 8.4) and open-burned. Ash residue from the incinerator was also disposed of in the Depot landfill in operation at the time. From 1972 until 1981, the ash was disposed of off base. An estimated 0.5 ton of incinerator ash was generated annually during operation of this incinerator. Therefore, a total of approximately 15 tons of ash were generated by this incinerator. Since the incinerator was shut down in 1981, the majority of waste corrugated cardboard has been transferred to DRMO (Section 7.6) for recycle.

7.4 OIL/WATER SEPARATORS. A total of five oil/water separators are used at MCRD Parris Island. One of these, which was installed in 1974, is located at the vehicle washrack area at the Motor Transport Garage (Section 5.3.3). Since 1974, the water effluent from this separator has been discharged to the Sewage Treatment Plant (Section 7.2) via the sanitary sewer system, and the

oil removed from the water has been collected in an underground holding tank before being pumped out and shipped to a waste oil refiner. Before 1974, the vehicle washrack effluent was discharged to the storm sewers. An estimated 30-50 gallons per year of waste oil has been removed by this separator and collected in the holding tanks.

Four other oil/water separators were installed in 1978 at the following locations: (1) a bermed area around a fuel oil tank at the Weapons Area steam plant (Section 5.3.12); (2) three separate bermed areas around three fuel oil storage tanks at the central power plant (Building 160; Section 5.3.12); (3) a storage tank for residential heating oil, located near the dredge spoils area (Site 4; Section 8.5); and (4) a single bermed area around five storage tanks (Structure 170) at the bulk motor fuel area. Oil removed by the separators would be collected in underground holding tanks. Since installation of the separator at Structure 170, the holding tank has been pumped only once when a 50-gallon spill was contained within the concrete bermed area and collected by the separator. Prior to installation of this separator, discharge was to the storm sewer system. Prior to installation of the separators at the remaining locations, there were no drains surrounding these tanks. Drains and lines connected to the STP were installed during installation of these oil/water separators. The holding tanks associated with these other separators have not been pumped out, since oil spills have not occurred since their installation.

7.5 SOLID WASTE DISPOSAL. Until 1972, solid wastes generated at MCRD Parris Island were disposed of by incineration (Section 7.3) or in landfills (Sections 8.2, 8.3, and 8.4) on the Depot property. Before construction of the Causeway Landfill (Section 8.4) was completed in 1972, a solid waste transfer station containing a compactor (Structure 318) was installed at an area on Horse Island that had previously been used for the Asphalt Plant (Section 5.3.15). Trash and other solid waste placed in dumpsters at the base were thereafter taken to the transfer station, from which the wastes were later picked up and transported to a sanitary landfill in Beaufort County. The compactor was closed and operations at the transfer station ceased in 1976.

After 1976, solid waste dumpsters around the Depot were replaced with larger (8-cubic-yard) dumpsters, and collection trucks with compartment compactors were utilized. Domestic wastes placed in the dumpsters were then transported directly to the Beaufort County landfill. Since the early 1970's, solid waste generation rates have remained fairly constant, and approximately 5,500 tons of refuse have been transported annually to the county landfill.

The solid waste generation rate has fluctuated in proportion to the number of recruits at the Depot. During the war periods (1941-1945, 1951-1953, 1965-1970), the number of recruits and consequently refuse generation rates would have been approximately double the current production level of about 5,500 tons/year.

During operation of the incinerator (Section 7.3), the majority of refuse was burned and, therefore, the annual volume disposed of in the associated landfill (Site 1) was substantially less than the volume generated. An estimated 24,000 tons of solid waste and incinerator ash were disposed of in

the Incinerator Landfill (Site 1; Section 8.2) during its period of operation. Based on the current generation rates, estimated numbers of recruits, and periods of operation, an estimated 33,000 tons of solid waste refuse were disposed of in the Borrow Pit Landfill (Site 2; Section 8.3) and 60,000 tons in the Causeway Landfill (Site 3; Section 8.4). Although the Causeway Landfill was operated for a much longer period than the Borrow Pit Landfill, the Incinerator Landfill (Site 1) was still operating during part of that period (1960-1965), and waste generation rates were at non-peak levels for most of the period of operation.

Construction debris and yard wastes have been disposed of at several areas on the Depot, including a borrow pit near Elliott's Beach, and an inert landfill located in the north-central portion of Horse Island (Site 13; Section 8.14). The latter area has been used for disposal of construction debris, lawn clippings, tree limbs, and other yard wastes since the late 1970's. No liquid wastes or any type of industrial wastes were reported to have been disposed of at either of these areas. In addition to these inert debris disposal areas, dredge spoils from Ballast Creek and the Marina Basin have been disposed of in the Dredge Spoils Area since 1981 (Site 13; Section 8.14).

Until 1973, wet garbage from the mess halls was given to local hog farmers for use as swine feed. Since this practice was terminated in accordance with South Carolina law in 1973, wet garbage has been placed in dumpsters behind each mess hall for disposal off the Depot property. The dumpsters are located on concrete pads with curbing. Liquids draining from these dumpsters have been collected and routed to the sanitary sewer. Grease from the mess hall grease traps has been collected and transported off base to the county landfill since the early 1970's. Prior to that time, the grease was placed in 55-gallon drums and transported to the Depot Landfill in operation at the time.

Asbestos wastes resulting from maintenance operations on insulated equipment and steam lines have been generated at the Depot since at least the 1930's. Since 1979, the asbestos wastes have been placed in 80-gallon drums and shipped off base for disposal in a sanitary landfill. About 50 drums of waste have been generated annually. Prior to 1979, the asbestos wastes were placed in dumpsters and disposed of in the station landfills or shipped off the Depot for disposal in a sanitary landfill.

7.6 WASTE RECYCLING. A variety of wastes have been recycled at MCRD Parris Island since at least the 1940's. Waste recycling has primarily been handled by DRMO (Section 6.3.1) since 1964, and by Reclamation and Salvage (Section 6.3.2) prior to operation of the DRMO Salvage Yard. Some items have been recycled on a routine basis using a term contract, whereby wastes have been collected by a private contractor from the point of generation. Other items have been stored at the DRMO office or salvage yard until a sufficient quantity has accumulated. Recycled materials have included cardboard, paper, bone and meat trimmings, canvas, rags, rubber, batteries, and metals. The following quantities were recycled during fiscal year 1976 (SOUTHDIV, 1981):

Cardbord	570.9 tons
Paper	19.6 tons
bone and meat trimmings	57.4 tons
Canvas	14.1 tons

Rags	5.9 tons
Rubber (tires)	18.5 tons
Batteries	13.6 tons
Metals	435.5 tons

The volumes of these wastes have remained fairly constant, although quantities recycled would have fluctuated with recruit training levels. Hazardous wastes recycled have included empty hazardous waste storage drums, spent batteries, silver flake, mercury capsules and amalgam waste, and other hazardous materials no longer directly usuable by the naval activities, such as expired shelf-life, off-specification, damaged, or discontinued-use items.

Approximately 4,000 grams/month of silver is reclaimed (Section 5.2.5) and sold through DRMO. This silver has been reclaimed since the recovery units were installed at MCRD Parris Island, MCAS Beaufort and NAVHOSP Beaufort in the late 1970's. Since about 1975, approximately 300 pounds of spent mercury capsules and amalgam waste have been reclaimed annually through DRMO. MCAS Beaufort produces some of this waste. The dental facilities at MCAS Beaufort and MCRD Parris Island have produced this waste. The volumes of silver, Mercury-capsule and amalgam wastes have remained fairly constant since they have been recycled. Prior to recycle, these wastes were disposed of down sink drains or in trash dumpsters.

Waste oil have also been collected for reclamation by a private contractor (Section 6.3.3.1).

CHAPTER 8. DISPOSAL SITES AND POTENTIALLY CONTAMINATED AREAS

8.1 INTRODUCTION. Past waste disposal sites, spill locations and contaminated areas are identified and discussed in this chapter. Sixteen sites were identified at MCRD Parris Island. A summary of site information collected by the IAS team is presented in Table 2-1 of Chapter 2.

8.2 SITE 1--INCINERATOR LANDFILL. An incinerator was used as the main method of waste treatment and disposal at MCRD Parris Island from 1921 to 1959 (Section 7.3). During this time period, incinerator ash residues and non-combustible solid wastes such as cans, bottles, and construction debris were placed in a landfill adjacent to the incinerator. This Incinerator Landfill, designated as Site 1 in Figure 8-1, continued to be used for disposal of some combustible trash and non-combustible waste until the mid-1960's, several years after the incinerator was closed. For most of these years after the incinerator was shut down, the Causeway Landfill (Site 3; Section 8.4) was also operational. Between 1960 and 1965, the solid wastes generated at the depot were disposed of in both the Incinerator Landfill and the Causeway Landfill.

The Incinerator Landfill is located at the northeastern tip of Horse Island (GDM Coordinates N-9). When the incinerator started operating in 1921, a small piece of land behind the incinerator jutted out into the marsh to the north of Malecon Drive. Wastes were initially piled on the land or placed in trenches between the incinerator and the marsh. As the land became filled, solid wastes were pushed into the marsh, and the edge of the landfill was thereby extended further into the marsh. Fill dirt was also used to build up the land at the edge of the marsh. Aerial photos taken between 1945 and 1965 confirm that the landfill was gradually extended further and further into the marsh, and that the landfill was still active in 1965. At the completion of this landfill operation, the landfill extended about 670 feet into the marsh and occupied an area of about 4 acres. This area is currently covered by planted pine trees.

While most of the wastes piled on the land or placed in trenches was non-combustible, some combustible trash and other wastes were also placed in the landfill. Open burning of wastes in the landfill was periodically carried out. No auxilary fuel was used for burning. It was estimated that approximately 24,000 tons of solid waste refuse and incinerator ash were disposed of in the landfill during the period of operation.

Most of the wastes placed in the Incinerator Landfill were not hazardous. However, a considerable amount of paint wastes were also disposed of in the landfill. Most of the solid paint wastes generated at the depot were placed in the landfill. These wastes included used paint brushes, cleaning rags, and empty cans, as well as some paint scrapings from spray booths and mixing tanks. Prior to about 1960, when the Paint Shop (Section 5.2.1.1) was located in Structure 177 and other nearby quonset huts in the northeast corner of the base, most of the paint scrapings were disposed of at the Former Paint Shop Disposal Area (Site 5; Section 8.6). Between 1960, when the paint shop moved to Building 450, and the close of the Incinerator Landfill in the mid-1960's,

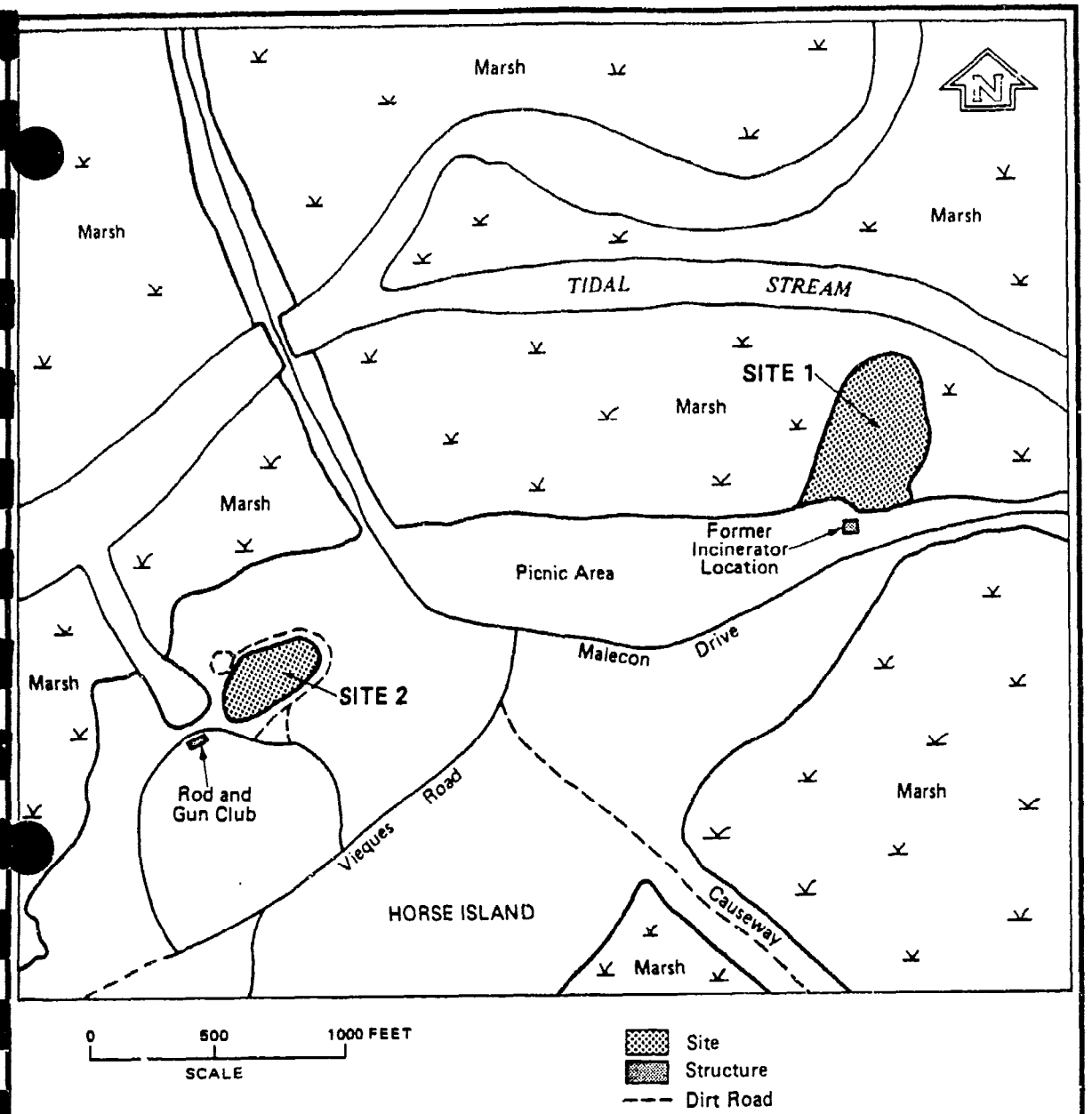

FIGURE 8-1
SITE 1, INCINERATOR LANDFILL AND
SITE 2, BORROW PIT LANDFILL

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paint scrapings were disposed of in the Incinerator Landfill. In addition to these solid paint wastes, liquid paint waste thinners (mineral spirits, kerosene, and diesel fuel) and strippers (methylene chloride) were poured on the ground at the landfill. In addition to paint wastes, hazardous waste disposed of in this landfill included: empty pesticide containers from the Pest Control Shop; oily rags, spent absorbent, and petroleum and chlorinated solvent sludge from the Automotive Hobby Shop; perchlorethylene still bottoms and filters used for processing petroleum dry cleaning solvent for reuse at the Dry Cleaning Plant; mercury amalgam and beryllium from the Dental Clinic; cleaning rags contaminated with mineral spirits and PCB-contaminated oil from the Electrical Shop; oily rags and metal shavings from the Mechanical Trade Shop; paint stripping residues (containing methylene chloride) and wood preserving residues (containing pentachloroephenol) from the Furniture/Upholstery Shop; and cleaning rags from the Armory and Marksmanship Training. The majority of these wastes were placed in Depot dumpsters and were burned in the incinerator during its operation. After 1959 some of the wastes were open burned in the landfill. The period of disposal and annual quantities of these wastes placed in the incinerator and/or associated landfill (with the exception of the period from 1960-1965 as discussed below) are as follows:

• used paint brushes, rollers, rags, cans, and spray booth scrapings (1921-1965)	5,500 - 11,000 lb/yr
• paint thinners (1921-1965)	700 - 2,800 gal/yr
• paint stripper (1921-1965)	5-20 gal/yr
• used paint brushes, rollers, rags, cans (1921-1949)	500 - 1,400 lb/yr
• empty pesticide containers (1941-1965)	2,000-4,000/yr
• oily rags (1963-1965)	90-180 lb/yr
• spent absorbent (1963-1965)	600-1,200/yr
• Petroleum and chlorinated solvent sludge (1963-1965)	4-8 lb/yr
• perchloroethylene still bottoms (1957-1965)	550-1,100 gal/yr
• used filters (1921-1957)	unknown
• mercury amalgam (1942-1965)	300-600 lb/yr
• berryllium waste (1955-1955)	0.25-0.5 lb/yr
• oily rags (1960-1965)	60-120 lb/yr
• metal shavings (1941-1950)	300-600 lb/yr
• PCB-contaminated oil (1940-1965)	2 lb/yr
• paint stripping residues (1947-1963)	40 gal/yr
• wood preserving residues (1947-1963)	25 gal/yr
• cleaning rags (1941-1965)	400-800 lb/yr

The above quantities are prior to any burning either in the incinerator or in the landfill. The range reflects the fluctuation in annual generation rates. From 1921 to 1940, the annual quantities generated and disposed of at Site 1 were approximately 25 percent of the minimum values reported. The maximum values apply to the periods 1941-1945 and 1951 to 1953. The minimum values reported apply to all other years. It is assumed that between 1960 and 1965, only 25 percent of the solid-type wastes listed above were disposed of at this site, with the remainder disposed of in the Causeway Landfill (Site 3; Section 8.4), also in operation during this period. These assumptions were used to develop the estimates for total quantities disposed of in the incinerator (from 1921-1959) and/or the associated landfill (1921-1965) during the period of operation, as provided in Table 2-1.

Migration of contaminants from this site is likely. The landfill was built upon low permeability clays and within the tidally influenced elevations of the marsh. The twice daily tidal ebb and flood over the marsh would flush water through porous zones of the landfill and then drain the zones, carrying contaminants with the water. The flushing action may also cause dispersion of contamination inland, into the permeable sands of Horse Island. Vertical migration through the surficial clays and confining beds into the Tertiary Limestone Aquifer is not likely.

Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (Haliaeetus l. leucocephalus), the wood stork (Mycteria americana), and the short-nosed sturgeon (Acipenser brevirostrum).

8.3 SITE 2--BORROW PIT LANDFILL. The Borrow Pit Landfill, which is designated as Site 2 in Figure 8-1, was used as the principal disposal area for wastes generated at the Depot over an approximately 3-year period from 1966 to 1968. The Borrow Pit Landfill was used after operations at the Incinerator Landfill (Site 1; Section 8.2) had been terminated and while operations at the Causeway Landfill (Site 3; Section 8.4) had been temporarily suspended. The landfill was located in the north central portion of Horse Island, to the west of Malecon Drive (GDM coordinates Q-10), and occupied a total area of about 1.9 acres.

The Borrow Pit Landfill consisted of a pit that had been dug to provide fill dirt for the base in the 1960's. All trash and other solid wastes discarded in dumpsters situated around the base were placed in the pit during the period of the landfill's operation. As estimated 33,000 tons of solid waste refuse were disposed of in this landfill during the period of operation. In addition to the wastes placed in the dumpsters, Paint Shop (Section 5.2.1.1) personnel brought solid paint wastes to the landfill. These wastes included empty paint cans, cleaning rags, used brushes, rollers, and spray booth scrapings. An estimated 16 tons of solid paint wastes were disposed of at this landfill during the period of operation. Annual paint waste quantities generated and disposed of in this landfill are provided in Table 5-2.

Liquid paint wastes including thinners (mineral spirits, kerosene, and diesel fuel) and stripper (methylene chloride) were also brought to this landfill by paint shop personnel and burned. During the three year period approximately 2,800 gallons of liquid paint wastes were burned annually in this landfill.

In addition to paint wastes, hazardous wastes disposed of in this landfill included: empty pesticide containers from the Pest Control Shop; oily rags, spent absorbent, and petroleum and chlorinated solvent sludge from the Automotive Hobby Shop; perchloroethylene still bottoms from the Dry Cleaning Plant; mercury amalgam and beryllium waste from the Dental Clinic; cleaning rags and PCB-contaminated oil from the Electrical Shop; cleaning rags and metal shavings from the Mechanical Trades Shop; and cleaning rags from the Armory and Marksmanship Training. These wastes were routinely discarded in the Depot Dumpsters. The period of disposal and annual quantities disposed of in the Borrow Pit Landfill are as follows:

• used paint brushes, rollers, rags, cans, and spray booth scrapings (1966-1968)	1,100 lb/yr
• paint thinners (1966-1968)	2,800 gal/yr
• paint strippers (1966-1968)	20 gal/yr
• cleaning rags (1966-1968)	1,200 lb/yr
• spent absorbent (1966-1968)	600-1,200 lb/yr
• petroleum and chlorinated solvent sludge (1966-1968)	4-8 lb/yr
• perchlorethylene still bottoms (1966-1968)	550-1,100 gal/yr
• mercury amalgam (1966-1968)	300-600 lb/yr
• beryllium waste (1966-1968)	0.25-0.5 lb/yr
• metal shavings (1966-1968)	600 lb/yr
• PCB-contaminated oil (1966-1968)	2 lb/yr

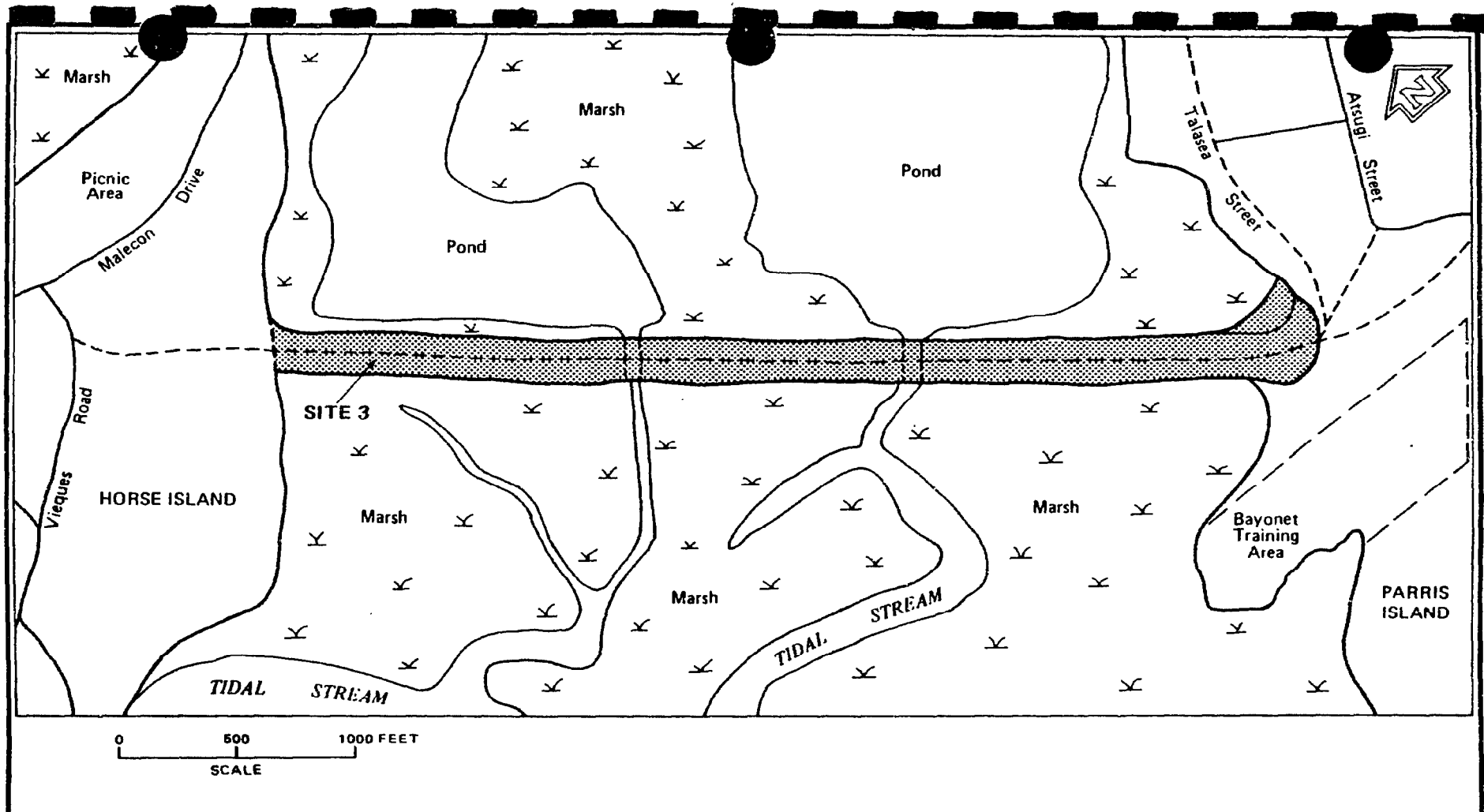
The annual generation and disposal rates remained constant over the 3-year period from 1966 to 1968. The total quantities of wastes disposed of at Site 2 during its operation are provided in Table 2-1.

When waste disposal at the Borrow Pit Landfill was initiated, the pit consisted of a hole about 10 feet deep. When the landfill operations were terminated, the pit was about half filled with wastes, and was about 6 feet deep. The landfill area was subsequently covered with secondary pine tree growth. Examination of aerial photos taken during the 1960's and 1970's indicated that waste disposal in the Borrow Pit Landfill did not begin until after 1965, and ended before the early 1970's. Reportedly it was operated between 1966 and 1968. In addition, most of the wastes placed in the borrow pit appeared to be located in the central and eastern portions of the site.

Migration of contaminants from this site is likely. The wastes were placed unconfined in highly permeable sandy soils which are located less than 100 feet from a tidal inlet. Horizontal migration of contaminants to the marsh is the likely pathway. The ebb and flood action of the tidal water would flush and remove contamination in the surficial aquifer and bring it into the marsh water. Leaching of contaminants through infiltration of rainfall would also result in discharge of contaminants into the marsh. Vertical migration into the Tertiary Limestone Aquifer is unlikely due to the low permeability confining beds above the aquifer.

Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (*Haliaeetus l. leucocephalus*), the wood stork (*Mycteria americana*), and the short-nosed sturgeon (*Acipenser brevirostrum*).

8.4 SITE 3--CAUSEWAY LANDFILL. The Causeway Landfill, designated as Site 3 in Figure 8-2, was used as the major waste disposal area at the Depot during most of the period between 1960 and 1972. Disposal operations at the Causeway Landfill were temporarily suspended for a 3-year period from 1966 to 1968, when construction of the causeway was suspended. The Depot wastes were taken to the Borrow Pit Landfill (Site 2; Section 8.3) during this period when the Causeway Landfill was inactive. Some Depot wastes were also taken to the



Site
Dirt Road

FIGURE B-2
SITE 3, CAUSEWAY LANDFILL

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Incinerator Landfill (Site 1; Section 8.2) between 1960 and 1965, although the majority of wastes generated at the Depot were disposed of in the Causeway Landfill during that period.

The Causeway Landfill (GDM Coordinates L-13, M-12, N-11) is located along the length of the causeway connecting Horse Island and Parris Island (see Figure 8-2). The causeway was constructed in two separate sections across a tidal marsh of the Broad River. One section began from the northeast edge of Horse Island, and was built up primarily with fill dirt taken from borrow pits on Horse Island. Some solid wastes were also reported to have been placed in this section of the causeway. The other section started near the southern end of Talasea Street on Parris Island, and was built up with both solid waste and fill dirt. Examination of aerial photos taken between 1959 and 1972 showed that the two sections of causeway gradually extended into the marsh until they met in 1972. At its completion, the causeway consisted of a 10 acre area, about 10 feet high, with a dirt road surface and rip rap sides.

Wastes placed in the Causeway Landfill included mainly trash and other materials discarded in dumpsters situated around the Depot and construction debris. An estimated 50,000 tons of solid waste refuse were disposed of in the Causeway Landfill. This estimate is based on a generation and disposal rate of approximately 7.5 to 15 tons per day for 10 years. No liquid wastes were reported to have ever been disposed of in the Causeway Landfill. Between 1965 and 1972, solid paint wastes including empty cans, used brushes, cleaning rags, and spray booth scrapings were either placed in the landfill directly by Paint Shop (Section 5.2.1.1) personnel or discarded into the dumpsters, which were then taken to the landfill. In construction of the causeway, alternate layers of compacted wastes and fill dirt were used until the desired height was reached. Any wastes that were left uncovered at the end of each day were open-burned during the night. No auxilary fuel was used for burning. The wastes burned at the landfill consisted primarily of about 1,000 pounds per day of corrugated cardboard boxes that could not be incinerated due to the limited capacity of the Depot's only incinerator at that time, which was located at the Commissary (see Section 7.3).

In addition to solid paint wastes, other hazardous wastes that were disposed of in the Causeway Landfill via Depot dumpsters included: empty pesticide containers from the Pest Control Shop; oily rags, spent absorbent, and petroleum and chlorinated solvent sludge from the Automotive Hobby Shop; perchloroethylene still bottoms from the Dry Cleaning Plant; mercury amalgam and beryllium waste from the Dental Clinic; cleaning rags and PCB-contaminated oil from the Electrical Shop; oily cleaning rags and metal shavings from the Mechanical Trades Shop; and cleaning rags from the Armory and Marksmanship Training. These wastes were routinely discarded in the Depot dumpsters prior to disposal in the Causeway Landfill. The period of disposal and annual quantities disposed of in the Causeway Landfill (with the exception of the periods between 1960-1965 and 1966-1968, as discussed below) are as follows:

• used paint brushes, rollers, rags, cans and spray booth scrapings (1921-1965; 1969-1971)	5,500-11,000 lb/yr
• empty pesticide containers (1960-1965; 1969-1971)	2,000-4,000/yr
• oily rags (1963-1965; 1969-1971)	90-180 lb/yr
• spent absorbent (1963-1965; 1969-1971)	600-1,200 lb/yr
• petroleum and chlorinated solvent sludge (1963-1965; 1969-1971)	4-8 lb/yr
• perchlorethylene still bottoms (1960-1965; 1969-1971)	550-1,100 gal/yr
• mercury amalgam (1960-1965; 1969-1971)	300-600 lb/yr
• beryllium waste (1960-1965; 1969-1971)	0.25-0.5 lb/yr
• cleaning rags (1960-1965; 1969-1971)	500-1,000 lb/yr
• PCB-contaminated oil (1960-1965; 1969-1971)	2 lb/yr

The range reflects the fluctuations in annual generation and disposal rates during the period of operation of Site 3. From 1960-1964 the annual disposal rates at Site 3 were assumed to be approximtely 75 percent of the minimum value reported. In 1965 the annual disposal rates at Site 3 were assumed to be approximately 75 percent of the maximum value. The remainder (from 1960-1965) was assumed to have been disposed of in the Incinerator Landfill (Site 1; Section 8.2). The maximum value reported applies to the period 1969-1970. Between 1966 - 1968 wastes were disposed of in the Borrow Pit Landfill (Site 2; Section 8.3). The minimum value reported applies to 1971.

Upon completion of the causeway, the area between the causeway and Scout Island became a salt water impoundment. To improve drainage and control of water height and flow from the lake to the Broad River, culverts and locks were installed through the sides of the causeway in 1975. Reportedly, at the time of excavaton and culvert installation, only typical domestic trash was encountered.

Migration of contaminants from this site is likely. The landfill was built upon clay marsh soils and within the tidal elevations. Ebb and flood actions of the twice daily tides would cause water to flush and drain porous zones of the Causeway Landfill. This would allow contamination to leach out of the Causeway Landfill and discharge into the marsh to the southwest and the ponds between this site and the Malecon Drive causeway to the northeast. Vertical migration of contamination into the Tertiary Limestone Aquifer is not likely due to the clay content of the marsh soils and the confining beds above the deep aquifer.

Potential contaminant receptors would include fish and shellfish within the marshes and ponds and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh and pond waters include the southern bald eagle (*Haliaeetus l. leucocephalus*), the wood stork (*Mycteria americana*), and the short-nosed sturgeon (*Acipenser brevirostrum*).

8.5 SITE 4--DREDGE SPOILS AREA FIRE TRAINING PIT. Prior to fire fighting training at the Page Field Fire Training Pit (Site 7; Section 8.8), an area near the southeast corner of the Depot's current Dredge Spoils Area was used for fire fighting training. The Dredge Spoils Area (Site 13; Section 8.14) was constructed on top of the fire training pit in 1981. The Dredge Spoils Area is situated between Cuba Street and Ballast Creek, south of Structure 302 (GDM Coordinates C-18). It was reported that this site (Figure 8-3) was used for training during an approximately 20-year period from the 1940's until the mid-1960's when a pit was constructed at Page Field. A shallow pit approximately 30 to 40 feet in diameter was dug in the sandy soils. Contaminated fuels, waste motor oils, and small quantities of spent petroleum-based solvents (mineral spirits, kerosene, diesel fuel, and Varsol) mixed with the waste oils were reportedly burned in the pit during training exercises. There was no storage tank at this location for waste fuels and oils prior to burning. Flammable liquids were transported to the site in drums and/or portable tanks. Training sessions were held approximately once per month and it was reported that approximately 300 to 400 gallons of waste flammable liquids were burned per training session. It was also reported that additional quantities of waste oils and fuels were burned in the pit as a means of disposal rather than for training. Based on generation rates reported in Table 5-1, an additional estimated 10,000 gallons may have been burned in this pit. Fire station personnel were responsible for fire control during these burnings. Since this pit was reportedly active during the operation of Page Field (Section 5.2.14) as an air station, it is likely that some AVGAS would also have been burned in this pit.

The amount of waste fuels and oils that would saturate the surface soils and vertically migrate through the soil strata without being burned is dependent upon operating practices, level of activities, and soil permeabilities. Using a conservative estimate that 10 percent of the liquids brought to the area were either spilled during handling, overflowed the pit, or saturated the pit soils prior to or after burning, it is estimated that as much as 12,000 gallons of waste fuels and oils contaminated area soils during the period of operation. It was reported that the area in the vicinity of the pit was significantly blackened and devoid of vegetation.

The fire fighting training pit area was accessed via roads that were partially constructed of coal ash cinders from the Depot's power plants (Section 5.2.9). These roads and the pit area were covered over when the Dredge Spoils Area (Site 13; Section 8.14) was constructed in 1976. The bermed area has been used for disposal of dredge spoils from the Marina Basin and Ballast Creek. Evidence of coal ash cinders is visible along the berm embankments. It is likely that at least some of the contaminated soils were disturbed and distributed during construction of the existing 12-foot earthen berm. Due to the location of the burn area near the edge of the berm, it is likely that disturbed contaminated soils would be contained within the embankment in that area.

Migration of contamination from this site is likely. The soil beneath the site is very permeable sands near the surface and sandy clay loam at depth. Depth to the surficial aquifer water table would be near 5 feet for most of the year. Ballast Creek is less than 200 feet to the east and contamination

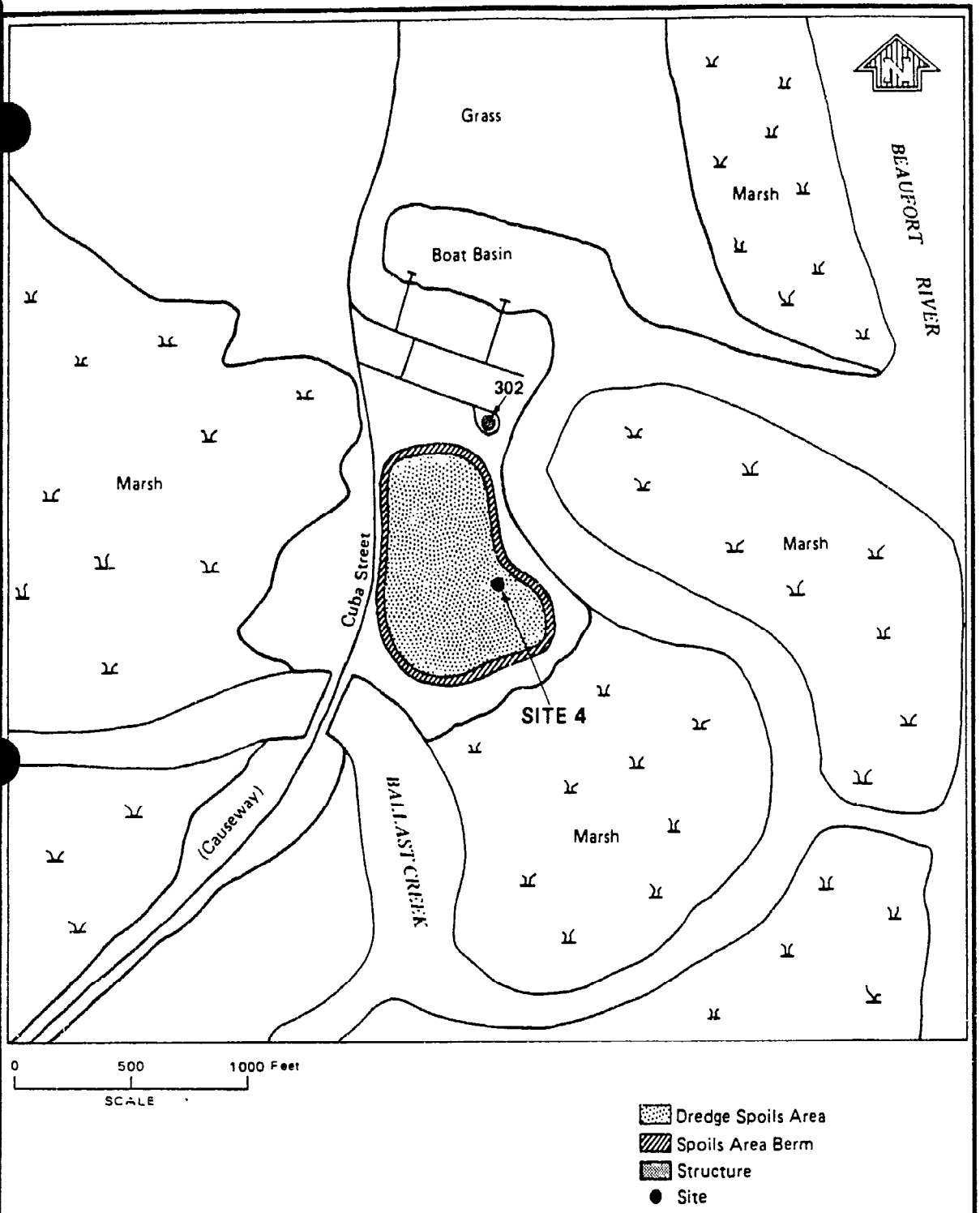

FIGURE 8-3
SITE 4, DREDGE SPOILS AREA FIRE TRAINING PIT

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would flow within the surficial aquifer and discharge into the creek. Vertical migration of contamination into the Tertiary Limestone Aquifer is not likely due to the low permeability Hawthorn Formation overlying the limestone between 40 and 80 feet in depth (-30 to -70 feet msl).

Potential contaminant receptors would include fish and shellfish within Ballast Creek and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into Ballast Creek include the southern bald eagle (*Haliaeetus l. leucocephalus*), the wood stork (*Mycteria americana*), and the short-nosed sturgeon (*Acipenser brevirostrum*).

8.6 SITE 5--FORMER PAINT SHOP DISPOSAL AREA. Before the Paint Shop (Section 5.2.1.1) was moved to its present location in Building 450, paint scrapings from mixing tanks were disposed of at the Former Paint Shop Disposal Area (GDM coordinates C-12), designated as Site 5 in Figure 8-4. Between 1949 and 1960, the Paint Shop was located in Structure 177, which is a Quonset hut situated close to the bank of the Beaufort River in the northeast corner of the Depot. Prior to 1949, the Paint Shop was located in several other Quonset huts, all of which were very close to the location of Structure 177.

While the Paint Shop was located in Structure 177 and the other nearby Quonset huts prior to 1960, most paints used at MCRD Parris Island were mixed in tanks at the Paint Shop. The mixtures consisted of white lead, zinc, and linseed oil. A paint remover consisting of diesel fuel oil or kerosene was used to remove the hardened paint waste from the mixing tanks. The hardened paint scraped from the tanks was carried to the edge of the river bank and poured down the embankment. The disposal site consisted of a small area approximately 30 feet long and 5 feet wide along the embankment. The Former Paint Shop Disposal Area was located adjacent to Structure 160A (a small pump house) and about 25 feet northwest of Tank 95 (see Figure 8-4). The disposal site was reportedly used from at least the 1930's until 1960. The amount of hardened paint sludge that was poured down the embankment was estimated to be about 1,000-2,000 lb/yr. The estimated total volume of paint wastes disposed of at this site was approximately 17 tons.

While the site was active, the disposal area consisted of bare river embankment adjacent to a dock or wharf. After 1972, nearby marsh land was filled in and the site was covered with construction debris. Due to the location of the site, the method of disposal, and the amount of precipitation and frequency of storms in the site area, the paint wastes disposed of on the embankment would have been readily washed into the river and carried away from the site.

Further migration of contaminants from this site is not likely due to the method of disposal. Disposal of wastes onto the bank next to the Beaufort River was used so that the river would remove the wastes and carry them away. Because of the river, tidal and storm action occurring at this site, the wastes would have been readily carried away by the river, and no wastes are likely to be there at the present time.

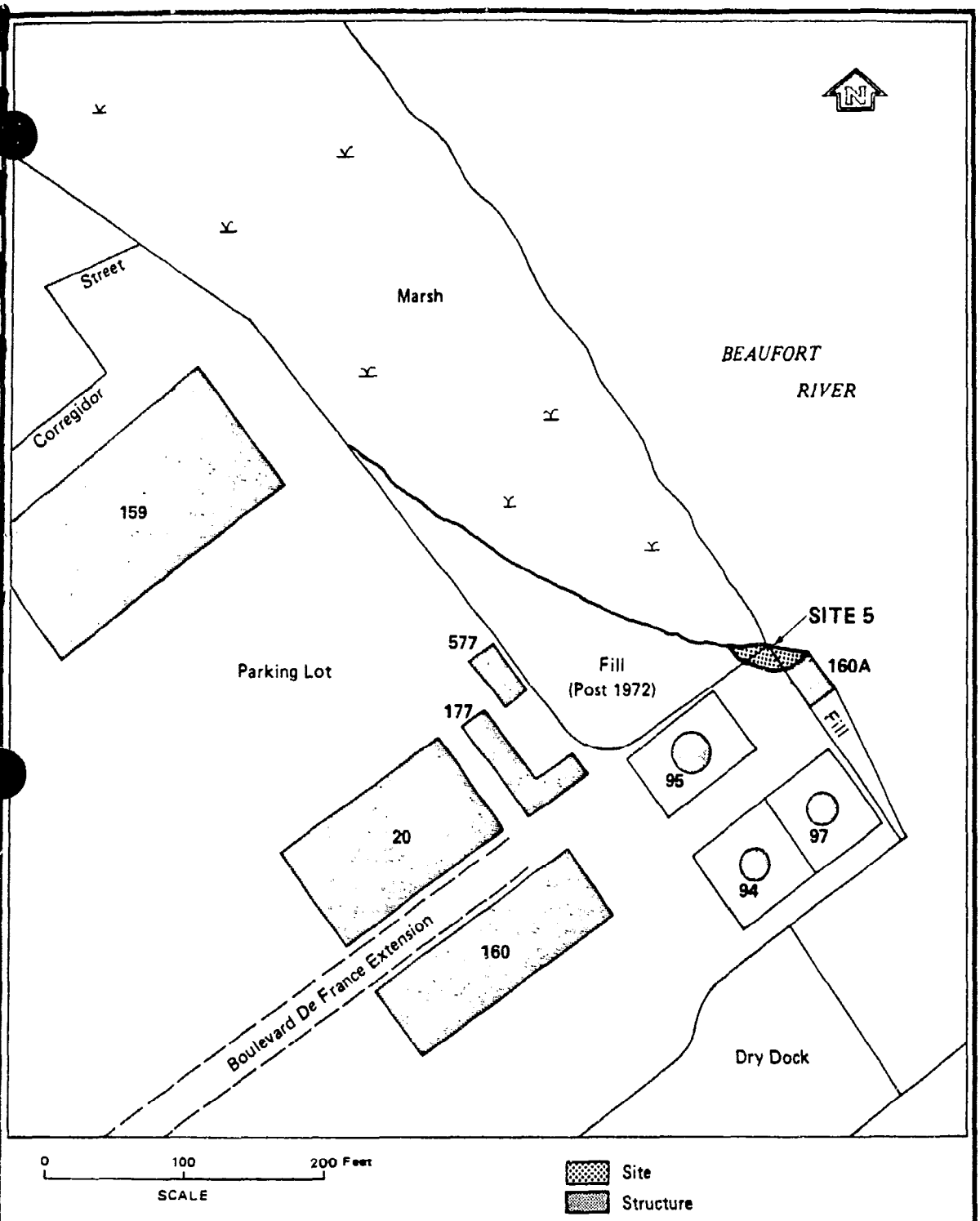

FIGURE 8-4
SITE 5, FORMER PAINT SHOP DISPOSAL AREA

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8.7 SITE 6--FORMER AUTOMOTIVE HOBBY SHOP SPILL AREA. This site (Figure 8-5) is located on the north side of the Former Automotive Hobby Shop which was located in the eastern portion of Structure AS26 (GDM Coordinates F-22). The area surrounds an underground waste oil storage tank that was previously used by the Hobby Shop. The area is flat, sandy, and mostly devoid of vegetation due to the addition of sandy fill in the area. The fill was reportedly hauled in for the purpose of acting as an oil absorbent. The Hobby Shop was operated at Building AS26 from the mid-1960's to 1982. In 1982, the shop was closed and reopened at its present location in Building 12 (Section 5.2.3.2) in 1983. It was reported that the Depot had no automotive hobby shop for approximately 1 year between 1982 and 1983.

A 500-gallon underground tank (Section 6.3.3.2) was installed in 1969 for use by the Hobby Shop for collection of waste lube oil. During the period of use, waste oil was collected in small containers and in 55-gallon drums. Contents were poured from these containers into the underground tank via a pipe that was approximately 3 inches in diameter and extended approximately 12 inches above ground surface. A funnel was typically used to pour waste oil into the tank. Significant spillage occurred during transfers and there is visual evidence of spilled waste oil surrounding the opening to the tank. The tank was abandoned in 1982 when the Hobby Shop was closed. Unauthorized use of the tank has occurred since 1982, primarily during the one-year period that this shop was closed, and prior to the opening of the existing shop. Site visits to this area by the IAS team on consecutive days during the Onsite Survey confirmed continued unauthorized use of this tank and continued spillage around the tank.

It was reported that during the period of operation of the Hobby Shop, unauthorized draining of vehicle crankcase oil directly onto the ground surface in the vicinity of the storage tank occurred during hours when the Hobby Shop was closed. Reportedly, this practice continued to occur during the period when no Hobby Shop was operated (in 1982 and 1983). Contamination of the soils in this area has resulted from spillage during transfers to the underground tank, poor housekeeping practices in the area, and unauthorized draining of waste lube oils directly onto the surface.

It was reported that during operation of the Hobby Shop, approximately 100-200 gallons of waste oil was collected in the tank per month and the tank was pumped out monthly by a private contractor. Assuming 5 percent spillage over a 14-year period, it was estimated that approximately 1,700 gallons could have been spilled during transfers to the tank. The unauthorized dumping or accidental spillage during vehicle maintenance would allow for additional contamination of the surface soils over the 20-year period of shop operation. It was estimated that more than 2,000 gallons of waste lube oil may have been spilled onto the ground in this area since 1969.

Evaporation and biodegredation would have been responsible for reducing the volume of contaminants. The volume of soil required to immobilize the spilled material was calculated by the following equation to estimate the maximum potential vertical extent of contaminants:

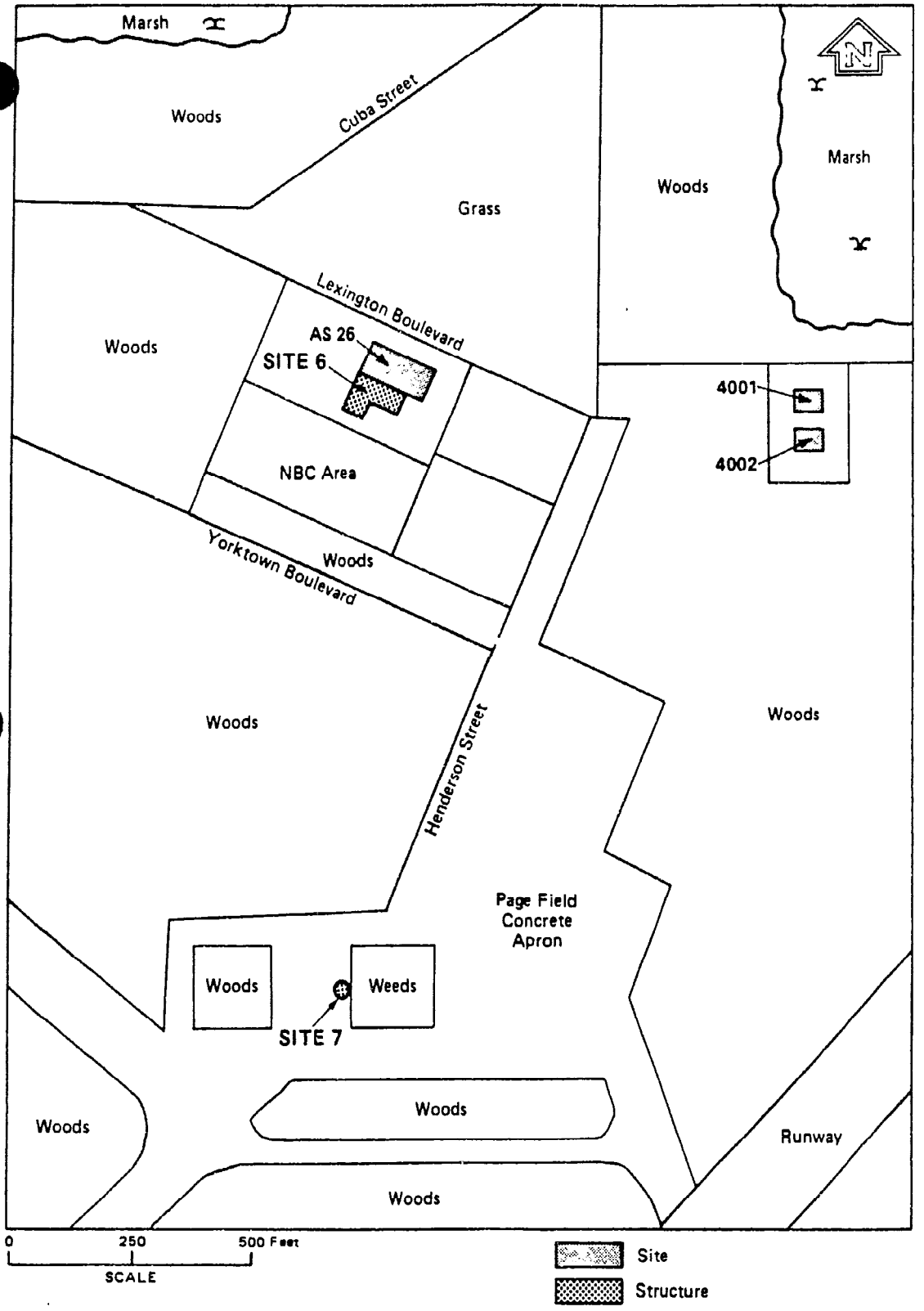

FIGURE 8-5
SITE 6,
FORMER AUTOMOTIVE HOBBY SHOP SPILL AREA,
SITE 7,
PAGE FIELD FIRE TRAINING PIT

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$$\frac{0.20 * V}{P * SR}$$ = Cubic Yards of soil required to attain immobile saturation where:

V = volume of oil in barrels,
P = porosity of soil, and
SR = residual saturation (API, 1972).

An estimated 167 cubic yards or 4,500 cubic feet of soil would be required for immobilization of 2,000 gallons of waste lube oil. Assuming a spill area of 15 feet by 20 feet, vertical immobilization would have required 15 feet of soil.

Since the surficial aquifer has a seasonal high water table depth of 1 to 2 feet, migration of contamination from this site is likely. Tidal streams and marsh are 900 feet northwest and northeast of this site. The soil is mostly high permeability sand near the surface and sandy clay loam at depth. Approximately 30 feet of the low permeability Hawthorn Formation is present below a depth of 50 feet. Vertical migration into the Tertiary Limestone Aquifer is not likely due to this confining formation. Horizontal migration of contaminants towards the marsh and streams is likely due to the shallow water table and sandy nature of the soils.

Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (*Haliaeetus l. leucocephalus*), the wood stork (*Mycteria americana*), and the short-nosed sturgeon (*Acipenser brevirostrum*).

8.8 SITE 7--PAGE FIELD FIRE TRAINING PIT. Fire training occurred at Page Field (GDM Coordinates F-23) during an 11-year period from the mid-1960's to 1976. A fire training pit was constructed on a former air station runway apron (Figure 8-5) with a concrete bottom, asphalt cover and a cinderblock berm. Reportedly the pit was abandoned in 1976 when it began to leak. The abandoned training pit is approximately 25 feet in diameter and sits on the edge of the concrete apron. It is bounded on the east by high weeds and shrubs. The pit was constructed adjacent to the western edge of a former Page Field Structure. This structure has since been demolished and weeds have covered the area. An abandoned 500-gallon waste oil/fuel tank sits approximately 60 feet from the pit and underground piping exists connecting the tank to the pit. Valves were used to control flow into the pit during training exercises. It was reported that training practice was held one to two times per month during the period of operation of this pit. Typically 300 to 400 gallons of contaminated fuels and/or waste motor oil were burned per training session. Since use of this pit ceased in 1976, only smoke house training with breathing apparatus has occurred at the Depot. Flammable fire fighting training for Depot personnel occurs periodically at the MCAS Beaufort fire/crash crew training burn pit.

Because the pit was constructed with asphalt cover on a concrete apron and with cinder block walls, migration of contaminants to the soil underlying the concrete apron is unlikely. Release of leaked wastes occurred for only 2 to 4

months during the period when the pit began to crack and leak until operations ceased in 1976. Assuming two percent of the flammable wastes burned in this pit during the period of leakage was lost to the surrounding area less, than 50 gallons of waste fuel or oil would have been released. The nearest surface water is 1,600 feet to the northeast, and horizontal migration of the small volume of oil which may have penetrated to the soil is unlikely. Vertical migration of any contamination into the Tertiary Limestone Aquifer is unlikely due to the overlying confining beds of the Hawthorn Formation.

8.9 SITE 8--PCB SPILL AREAS. A PCB spill incident at a grassy area adjacent to Building 111 (GDM Coordinates E/F-14; activity layout map) occurred in 1984 when a contractor was removing three PCB transformers from the vault within Building 111. These transformers each contained 35 gallons of PCB transformer oil. The volume of spilled material was unknown; however, analysis of six soil samples collected in 1984 at this location showed concentrations of PCB ranging from 57 to 62,000 ppm. Remedial action was undertaken in November 1985, and the contaminated soils and concrete curbing were removed and the area cleaned up by Depot maintenance personnel. A total of 14 drums of 55-gallon and 35-gallon capacity were used for collection of the contaminated soil. The drums and concrete curbing were transferred to DRMO for disposal off base as a hazardous waste.

During transformer removal in 1983, a cleared area on an asphalt-paved equipment pad adjacent to Building 450 (GDM Coordinates K-11; activity layout map) was used by the contractor for temporary storage of transformers. Leakage from the transformers was noticed prior to removal of these transformers; the volume is unknown. The transformers were moved to a different location on the pad and the area was covered with plastic and bermed to prevent movement of contaminants. Samples collected from a grassy area adjacent to the pad and the nearest storm drain were tested and no PCB's were detected. The contaminated plastic, sand, and asphalt were put into drums and transferred to DRMO for disposal off base as a hazardous waste.

Because both of the above contaminated areas were adequately cleaned up, this site poses no threat to human health or the environment.

8.10 SITE 9--PAINT WASTE STORAGE AREA. An unpaved area adjacent to Building 864 (GDM Coordinates J-11; activity layout map) was used by the Paint Shop (Section 5.2.1.1) as a temporary storage area for paint wastes from 1969 until 1984. The storage area situated between Quonset Hut N277 and Building 895, was approximately 20 feet by 60 feet and was used for storage of 30-gallon cans and 55-gallon drums. After the Borrow Pit Landfill (Site 2; Section 8.3) was closed in 1968, Paint Shop (Building 450) personnel brought liquid paint wastes including thinners (kerosene, diesel fuel, mineral spirits) and strippers (methylene chloride) in 30-gallon containers from the job site to this storage area. The annual paint waste generation rates have been provided in Table 5-2. Based on this information, an estimated 91,000 pounds of liquid paint wastes were stored in this area during its period of use. Until 1978, wastes brought to this storage area were then placed in the underground waste oil storge tank (Section 6.3.3.2) located at the Diesel Shop and mixed with the waste oil. A contractor collected the paint waste and waste oil from the tank for disposal off the base. After 1978, liquid paint wastes were no longer

poured into the underground storage tank. They were stored in 55-gallon drums at the Paint Waste Storage Area from 1979 to 1984. Wastes were picked up from this area by a contractor for off base disposal in 1981 and 1983, after 40 drums of liquid paint wastes had accumulated in the storage area. The use of this area for storage of paint wastes ended in 1983, when a contractor removed all remaining drums for disposal at an incineration facility in Spartansburg, South Carolina.

Spillage occurred during the period of use from 1969 to 1984; the amount of waste spilled is unknown. In 1984, the storage area was cleaned up based on visual inspection. Approximately 6 inches of surface soil was removed, the contaminated soil was disposed of off the Depot, and the area was covered with concrete pavement (Section 6.3.3.1). After 1984, both liquid and solid paint wastes were stored in two quonset huts (Structures N281 and N282), located about 200 feet east of Building 864. The paved area is still used as a back-up temporary paint waste storage area if the current storage area in quonset huts N281 and N282 are full. The area is used for storage approximately 10 days per year for storage of less than 5 drums on each occasion.

Because the contaminated area was adequately cleaned up and the area paved over, this site poses no threat to human health or the environment.

8.11 SITE 10--GASOLINE SPILL AREA. In December 1983, a 97-gallon spill of unleaded gasoline occurred at the fuel storage area adjacent to Building 170 (GDM Coordinates F-12; activity layout map). The spill occurred when an underground day tank was being filled from an aboveground storage tank. The spilled gasoline overflowed and escaped from the day tank through a vent at the surface. The gasoline spilled onto asphalt, but flowed down a road to a grassy area and formed pools of liquid. The resulting contaminated area was thoroughly cleaned up by excavating the gasoline-stained soil at the shoulder of the road. Approximately 50 55-gallon drums of contaminated soil were removed and shipped off the base by DRMO for disposal as a hazardous waste. Because the contaminated area was adequately cleaned up, this site poses no threat to human health or the environment.

8.12 SITE 11--MCX SERVICE STATION SPILL AREA. Spillage occurred around a 500-gallon underground waste oil storage tank at the Marine Corps Exchange (MCX) Service Station (GDM Coordinates I-12); activity layout map). From approximately 1969 until 1983, garage personnel carried used crankcase oil to the tank. Spillage occurred while carrying and transferring the used oil to the tank. Contents were poured from small containers into the underground tank via a fill pipe that extended to the surface. Soil surrounded the fill pipe opening. In 1983, the contaminated soil was excavated, placed in 50 55-gallon drums, and shipped off the Depot for disposal as a hazardous waste. At the conclusion of the cleanup, a concrete pad was placed around the tank's fill pipe and was sloped towards the center to contain any spilled oil. Waste oil has not been generated at this station since the garage was closed in 1984. Because the contaminated area was adequately cleaned up, this site poses no threat to human health or the environment.

8.13 SITE 12--JERICHO ISLAND DISPOSAL AREA. This site covers an area approximately 100 feet by 250 feet along the central part of the southern edge

of Jericho Island (Figure 4-2). Examination of aerial photographs indicated that disposal of waste at this site began between 1955 and 1964 and probably continued until 1968, when MCRD Parris Island purchased the property to extend the impact zone safety area needed down-range of the small arms firing ranges.

In October 1985, the IAS team observed that the area has an irregular, undulating surface due to the random scattering of waste piles. The waste piles are of various sizes, ranging up to approximately 30 feet in diameter and 5 feet in height. The aerial photographs show the site extending from the island's edge southward and built upon the marsh. During the site survey, the IAS team observed small, scattered areas of debris along the marsh edge and upon the island but the vast majority of waste was disposed of upon the marsh. The wastes appeared to be routine domestic (household) trash, with the following items identified: small rusted cans, beer and soda bottles, hubcaps, tires, buckets, cinder blocks, childrens toys, a few very rusted 5-gallon cans, sheet metal, paper, plastic, and wood. It was reported that these wastes were brought to the island by local residents and no organized landfill operations occurred. No wastes from Parris Island were reportedly ever disposed of at this site. The observed non-hazardous character of the waste indicates that there is no potential for contaminant migration from this site and therefore this site poses no threat to human health or the environment.

8.14 SITE 13--INERT DISPOSAL AREAS. Construction debris and yard wastes have been disposed of in a borrow pit (Area TA-3) near Elliott's Beach (GDM Coordinates K-25; activity layout map) and in an inert landfill located on the southern portion of Horse Island (GDM Coordinates P-11, activity layout map) adjacent to Edding Creek. In addition, dredge spoils have been disposed of in an area adjacent to Ballast Creek. These three areas constitute Site 13.

The borrow pit disposal area is a 300-foot by 300-foot area covering approximately 2 acres on the southeastern tip of area TA-3, adjacent to the marsh. The area was permitted by the state of South Carolina for disposal of construction debris and yard waste and was used from 1976 until it was closed in 1979. After 1979, construction debris and yard wastes from the Depot were taken to the permitted inert landfill on Horse Island. This landfill which was open in 1979 and is still in use, is a rectangular, 1,000-foot by 2,000-foot area which covers approximately 50 acres. Access to this area has been limited since it was opened. No liquid wastes or any type of industrial wastes have been disposed of at either of these areas.

The Dredge Spoils Area, a land disposal area with an earthen containment berm, is situated approximately 60 feet south of Structure 302 between Cuba Street and Ballast Creek (GDM Coordinates C-18). The irregular-shaped area covers approximately 11 acres and has been used for disposal of dredge spoils from the Marina Basin and Ballast Creek since 1976. Dredge spoils were placed in this area in 1976, 1981 and again in 1984/85. During each dredging operation approximately 100,000 cubic yards of material was removed from the waterways and placed in the disposal area. The disposal area was constructed on top of a former fire fighting training pit (Site 4; Section 8.5) which was located in the southeastern portion of the containment area near the embankment. Some of the contaminated soils from this site may have been disturbed and distributed

during construction of the berm. Due to the location of the burn area near the edge of the berm, it is likely that disturbed contaminated soils would be contained within the embankment in that area.

Because only inert material was placed in the borrow pit area and inert landfill, and only river bottom sediments were disposed of in the dredge spoils area, these disposal areas do not pose a threat to human health or the environment.

8.15 SITE 14--STORM SEWER OUTFALLS. The Depot's surface drainage is shown in Figure 4-10. Drainage from the developed area flows to a storm sewer system. In this area natural drainage has been altered. The drainage divides are shown in Figure 4-10. The system includes more than 60 outfall points to the adjacent marshes and rivers of MCRD Parris Island. These outfalls constitute Site 14. Various wastes generated by Depot shops were disposed of in the storm sewers from 1918 to 1975. The wastes received by the storm sewer system and adjacent surface waters, the period of disposal, and annual quantities disposed of in the storm sewers are as follows:

• waste oil from washracks (1942-1973)	100-200 gal/yr
• antifreeze (1942-1973)	60-120 gal/yr
• neutralized battery acid (1942-1973)	60-120 gal/yr
• x-ray fixer (1930-1948)	75-150 gal/yr
• photographic fixer (1942-1947)	420-840 gal/yr
• developer solution (1942-1947)	420-840 gal/yr
• carbon tetrachloride (1930-1951)	120 gal/yr
• boiler blowdown (1918-1975)	5,000-20,000 gal/day
• demineralizer regenerant (1942-1975)	9,000-18,000 gal/yr
• cooling tower blowdown (1950-1985)	20,000-40,000 gal/day

The boiler blowdown contained disodium phosphate and trisodium sulfite. About one-third of the total volume of demineralizer regenerant consisted of acid wastes, and two-thirds consisted of alkaline wastes. The maximum reported value applies to the periods 1941-1945, 1951-1953, and 1965-1970. The minimum value applies to other periods between 1941 and 1985. Quantities from 1918-1940 are assumed to be 25 percent of the minimum value. Estimated total quantities of the above wastes disposed of in the storm sewers are provided in Table 2-1.

Migration of contaminants from this site would most likely have occurred at the time of discharge and present migration of contaminants is unlikely. The large number of outfall points, which are located throughout and around Parris Island, minimize the potential for accumulation of contaminants at any one point. Accumulation of contaminants would also be inhibited by the twice daily tidal actions and the several severe storms which occur annually.

8.16 SITE 15--DIRT ROADS DISPOSAL AREA. From about 1918 until 1966, waste oils and hydraulic fluids were used by the Depot for dust supression on dirt roads. From 1918-1940 an estimated 11,000 gallons was sprayed on all Depot roads with the majority of this quantity applied during the 1930's. The majority of the Depot's roads were paved in the 1940's. However, waste oils and hydraulic fluids were reportedly routinely applied to two dirt roads, from the early 1940's to 1966. This practice was discontinued in 1966. Waste lube

oil, cutting oil, petroleum-based solvents (kerosene, gasoline), hydraulic fluids, and water-based coolants were transported by Roads and Grounds personnel from Depot shops and sprayed on 1.5 miles of dirt road accessing Elliott's Beach (GDM Coordinates M-25; activity layout map) and 0.5 miles of road accessing the Borrow Pit Landfill (Site 15; Section 8.16) (GDM Coordinates R-12; activity layout map).

Between 1941 and 1966 an estimated 600 gallons per year was applied to these two roads with approximately 20 percent of the total volume applied to the Borrow Pit Road and the remainder to Elliott's Beach Road. Therefore, an estimated 3,200 gallons of waste oil and other fluids were applied to the Borrow Pit Road and 13,000 gallons applied to Ellcott's Beach Road during the period from 1941-1966.

Because all dirt roads throughout the Depot received the waste oil and other fluids from 1918-1940, no single area has been identified as having received a large quantity of liquid waste. Although two roads have been identified as having received a total of 16,200 gallons of waste oils and other liquids after 1940, the area of distribution was large, and the practice was discontinued approximately 20 years ago in 1966. Therefore, the migration potential of any remaining contaminants is very small. Evaporation and biodegredation would have been responsible for reducing the volume of contaminants. The volume of soil required to immobilize the spilled material was calculated by the following equation to estimate the maximum potential vertical extent of contaminants:

$$\frac{0.20 * V}{P * SR} = \text{Cubic yards of soil required to attain immobilized saturation}$$

where:

V = volume of oil in barrels,
P = porosity of soil, and
SR = residual saturation (API, 1972).

Assuming no evaporation or biodegredation, an estimated 300 cubic yards and 1,100 cubic yards of soil would be required for immobilization of the waste oil on the Borrow Pit Road and Elliott's Beach Road, respectively. Assuming uniform application and a road application width of 12 feet, immobilization would have occurred within 4 inches along both roadways.

Migration of contaminants from this site is unlikely. The depth to high water table beneath the site is one to four feet. This greatly exceeds the required depth for contaminant immobilization, and percolation to the ground water is therefore unlikely.

8.17 SITE 16--PESTICIDE RINSATE DISPOSAL AREA. Between about 1950 and 1977, rinsewaters from pest control spray application containers and equipment were disposed of on a grassy area located between Quonset Huts N282 and N277 (Figure 8-6). This area for disposal of rinsate wastes (GDM Coordinates J-12) was approximately 6 feet by 25 feet and covered an area of approximately 150 square feet. The site received an estimated 5-10 gallons per week of pesticide rinsate from 1950-1977. Pesticides used at the Depot during this

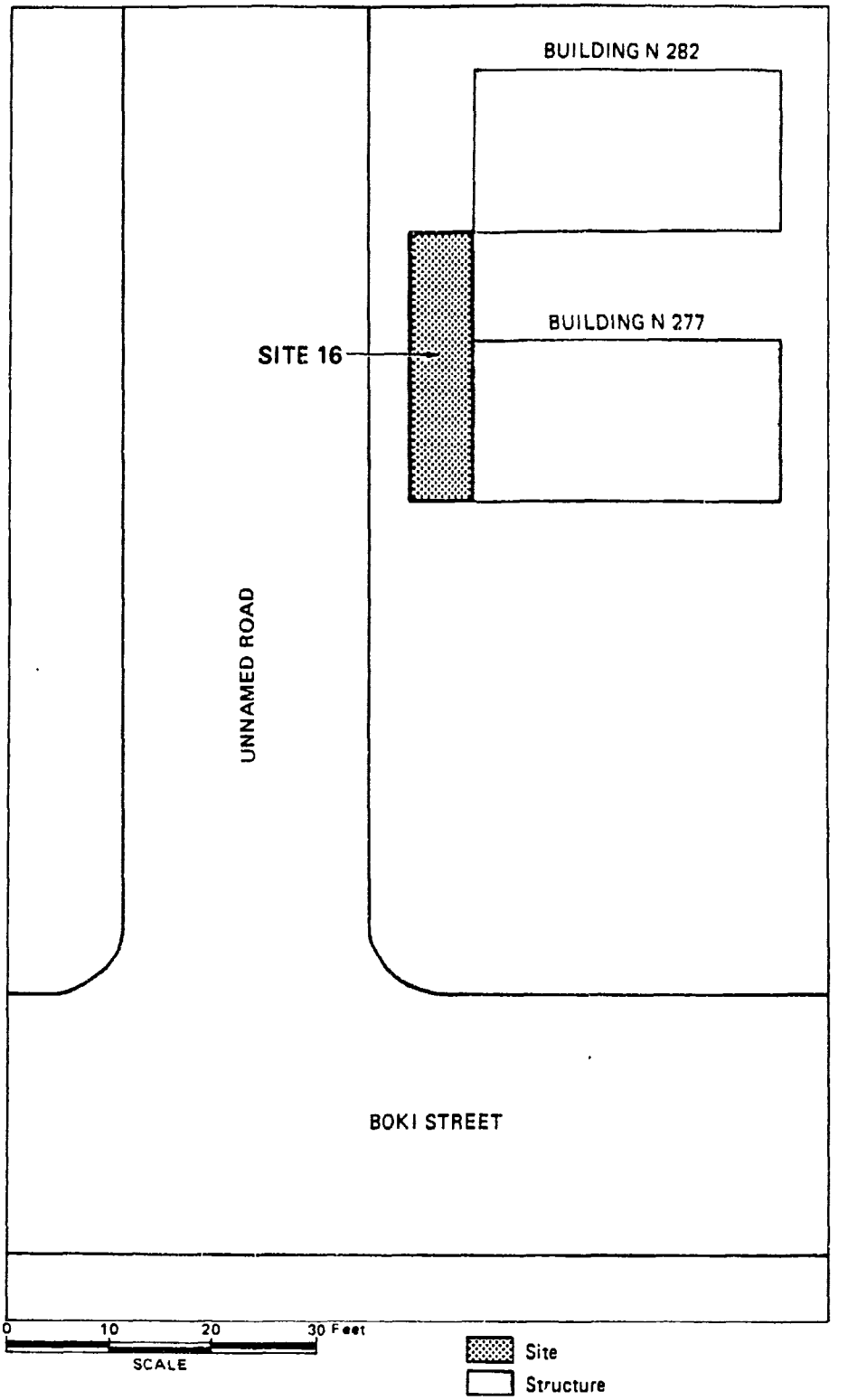

FIGURE 8-6
SITE 16, PESTICIDE RINSATE DISPOSAL AREA

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period by the Pest Control Shop (Section 5.2.1.7) included: Aldrin, Baygon, Chlordane, Dursban, Malathion, Naled, and DDT. Assuming a disposal rate of 250-500 gal per year from 1950 to 1977, an estimated 8,000 gallons of rinsate were disposed of at Site 16.

Migration of contaminants from this site is likely. Soils beneath the site are mostly sand with the high ground water table at a depth of approximately 6 feet. The marsh is only 700 feet to the northeast. This puts the site within the zone of tidal influence which causes groundwater level fluctuations. The tidal action, high permeability sandy soil, and shallow water table would allow for contamination migration from this site.

Potential contaminant receptors would include fish and shellfish within the marshes and predatory species (including humans) which feed on fish species. Endangered species that could be impacted by contaminant migration into marsh waters include the southern bald eagle (*Haliaeetus l. leucocephalus*), the wood stork (*Mycteria americana*), and the short-nosed sturgeon (*Acipenser brevirostrum*).

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APPENDIX A

Agencies Contacted During Records Search and Station Survey

Records Search. Various government agencies were contacted for documents pertinent to the MCRD Parris Island IAS effort. Agencies contacted included:

a. Naval Energy and Environmental Support Activity, Port Hueneme, California.
b. Naval Facilities Engineering Command Historian, Naval Construction Battalion Center (CBC), Port Hueneme, California.
c. Southern Division, Naval Facilities Engineering Command, Charleston Facilities Planning and Real Estate Department, Environmental Branch, Utilities Division, Applied Biology Natural Resources Branches.
d. Federal Archives and Records Center, East Point, Georgia.
e. Naval History Office, Washington Navy Yard, Washington, D.C., Command Histories 1949-1973.
f. Washington Federal Archives, Suitland, Maryland.
g. DOD Explosives Safety Board, Alexandria, VA.
h. Ordnance Environmental Support Office, Indian Head, Maryland.
i. Naval Facilities Engineering Command Headquarters, Washington, D.C.
j. National Archives, Navy and Old Army Branch, Washington, D.C.
k. United States Geological Survey, Washington, D.C.
l. National Archives, Cartographic Branch, Alexandria, Virginia.
m. U.S. Department of Agriculture, Soil Conservation Service, Beaufort, South Carolina.
n. Beaufort County Health Department and Planning Office, Beaufort, South Carolina.
o. U.S. Geological Survey, Water Resources Division, Beaufort, South Carolina.
p. University of South Carolina, Beaufort, South Carolina.
q. South Carolina Department of Health and Environmental Control, Columbia, South Carolina.
r. South Carolina Water Resources Commission, Columbia, South Carolina.
s. Depot Historian, Marine Corps Recruit Depot, Parris Island, South Carolina.

APPENDIX B
Acronyms/Abbreviations

ASP	Ammunition Supply Point
AUTOVON	Automatic Voice Network (telephone system)
AVGAS	Aviation Gasoline
BEQ	Bachelor Enlisted Quarters
BN	Battalion
BOQ	Bachelor Officers Quarters
CBC	Construction Battalion Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Cleaner, lubricant, protectant
CMC	Commandant of the Marine Corps
CNO	Chief of Naval Operations
COM	Commander
CSRS	Confirmation Study Ranking System
DOD	Department of Defense
DRMO	Defense Reutilization and Marketing Office (formerly DPDO)
EIC	Engineer-In-Charge
EFD	Engineering Field Division
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
gpd	Gallons per day
gpm	Gallons per month
IAS	Initial Assessment Study
lb/h	Pounds per hour
MBtu/hr	Thousand Bristish terhmal units per hour
MCAS	Marine Corps Air Station
MCRD	Marine Corps Recruit Depot
MCX	Marine Corps Exchange
mgd	Million gallons per day
MOGAS	Mobility (motor vehicle) Gasoline
msl	Mean sea level
NACIP	Navy Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NAVENENVSA	Naval Energy and Environmental Support Activity (also NEESA)
NAVFAC	Naval Facilities Engineering Command
NAVFACENGCOM	Naval Facilities Engineering Command
NAVHOSP	Naval Hospital
NEESA	Naval Energy and Environmental Support Activity (also NAVENENVSA)
NEPSS	Naval Environmental Protection Support Service
OSB	Off Site Base
PCP	Pentachlorophenol
pH	Unit of measure for hydrogen ion concentration
POL	Petroleum, Oil, and Lubricants
POV	Privately (or personally) owned vehicle(s)
pp	Priority pollutants (EPA)
ppb	Parts per billion

ppm	Parts per million
psig	Pounds per square inch gauge
RCRA	Resource Conservation and Recovery Act
SC	Clayey Sand
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric & Gas Company
SCWRC	South Carolina Water Resources Commission
SM	Silty Sand
SP	Sand
SHPO	State Historic Preservation Officer
SECNAV	Secretary of the Navy
SOUTHNAVFACENGCOM	Southern Division (SOUTHDIV), Naval Facilities Engineering Command
STP	Sewage Treatment Plant
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant