0158

DO NOT TAKE FROM OFFICE

APRIL 1983

INITIAL ASSESSMENT STUDY OF MARINE CORPS BASE CAMP LEJEUNE NORTH CAROLINA

NEESA 13–011

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY
Port Hueneme, California 93043

INITIAL ASSESSMENT STUDY

OF MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

UIC-M67001

Prepared for:

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY

Prepared by:

WATER AND AIR RESEARCH, INC.
Gainesville, Florida

Dr. Hugh Putnam, Team Leader, Report Author, Biologist
Mr. James Nichols, P.E., Environmental Engineer
Mr. Michael Hein, Environmental Scientist
Mr. William Adams, Hydrogeologist
Mr. Charles Fellows, Environmental Chemist
Dr. Jerry Steinberg, P.E. Environmental Engineer

April, 1983

EXECUTIVE SUMMARY

This report presents the results of an Initial Assessment Study (IAS) conducted at Marine Corps Base (MCB) Camp Lejeune and outlying fields. The purpose of an IAS is to identify and assess sites posing a potential threat to human health or the environment due to contamination from past hazardous materials operations.

Based on information from historical records, aerial photographs, field inspections, and personnel interviews, a total of 76 potentially contaminated sites were identified. Each of the sites was evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors.

The study concludes that, while none of the sites pose an immediate threat to human health or the environment, 22 warrant further investigation under the Navy Assessment and Control of Installation Pollutants (NACIP) Program, to assess potential long-term impacts. A confirmation study, involving actual sampling and monitoring of the 22 sites, is recommended to confirm or deny the existence of the suspected contamination and to quantify the extent of any problems which may exist. Since the on-site survey, MCB Camp Lejeune has taken action to evaluate or mitigate Site No. 2, the Former Nursery/Day-Care Center, and Site No. 16, the Montford Point Burn Dump. The 22 sites recommended for confirmation are listed below in order of priority.

1. Rifle Range Chemical Dump, Site No. 69;
2. Storage Lots 201 and 203, Site No. 6;
3. MCAS Mercury Dumpsite, Site No. 48;
4. Former Nursery/Day-Care Center, Site No. 2;
5. Transformer Storage Lot 140, Site No. 21;
6. Camp Geiger Dump, Site No. 41;
7. Mess Hall Grease Disposal Area, Site No. 74;
8. MCAS Basketball Court Site, Site No. 75;
9. MCAS Curtis Road Site, Site No. 76;
10. Courthouse Bay Liquids Disposal Area, Site No. 73;
11. Fire Fighting Training Pit, Site No. 9;
12. Industrial Area Fly Ash Dump, Site No. 24;
13. Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm at Air Station, Site No. 45;
14. Hadnot Point Burn Dump, Site No. 28;
15. French Creek Liquids Disposal Area, Site No. 1;
16. Rifle Range Dump, Site No. 68;
17. Montford Point Burn Dump, Site No. 16 (Mitigation undertaken);
18. Industrial Area Tank Farm, Site No. 22;
19. Crash Crew Fire Training Burn Pit; Site No. 54;
20. Sneads Ferry Road--Fuel Tank Sludge Area, Site No. 30;
21. Camp Geiger Area Dump, Site No. 36;
22. Camp Geiger Area Fuel Farm, Site No. 35.

The results of the Confirmation Study will be used to evaluate the necessity of conducting mitigating actions or clean-up operations.

CLW

Naval
Environmental
Protection
Support
Service

FOREWORD

The Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program in OPNAVNOTE 6240 ser 45/733503 of 11 September 1980 and Marine Corps Order 6280.1 of 30 January 1981. The purpose of the program is to systematically identify, assess, and control contamination of the environment resulting from past hazardous materials management operations.

An Initial Assessment Study (IAS) was performed at Marine Corps Base (MCB) Camp Lejeune, Jacksonville, North Carolina, by a team of specialists under the direction of the Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, California. Further confirmation studies under the NACIP program were recommended at several areas at the activity. Sections dealing with significant findings, conclusions, and recommendations are presented in the report. Technical sections provide more in-depth discussion on important aspects of the study.

Questions regarding the NACIP program should be referred to the NACIP Program Director, NEESA (Code 112N), Port Hueneme, CA 93043, AUTOVON 360-3351, FTS 799-3351, or commercial (805) 982-3351. Further information regarding this study may be obtained from NACIP Program Director at the above numbers.

Daniel L. Spiegelberg, LCDR, CEC, USN
Environmental Officer
Naval Energy and Environmental Support Activity

INITIAL ASSESSMENT STUDY
OF MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTENTS

Section			Page
EXECUTIVE SUMMARY			i
FOREWORD			ii
CONTENTS			iii
LIST OF FIGURES			vi
LIST OF TABLES			viii
SECTION 1.		INTRODUCTION	1-1
	1.1	PURPOSE OF INITIAL ASSESSMENT STUDY	1-1
	1.2	SEQUENCE OF EVENTS	1-1
	1.3	SUBSEQUENT NACIP STUDIES	1-3
SECTION 2.		SIGNIFICANT FINDINGS	2-1
	2.1	INTRODUCTION	2-1
	2.2	GENERAL FINDINGS	2-1
	2.3	DISCUSSION	2-2
	2.4	SITES REQUIRING CONFIRMATION INVESTIGATION	2-4
SECTION 3.		CONCLUSIONS	3-1
	3.1	INTRODUCTION	3-1
	3.2	GENERAL	3-1
	3.3	SITES NOT REQUIRING FURTHER ASSESSMENT	3-1
	3.4	SITES REQUIRING FURTHER ASSESSMENT	3-2
SECTION 4.		RECOMMENDATIONS	4-1
	4.1	INTRODUCTION	4-1
	4.2	OVERVIEW OF THE RECOMMENDATIONS PROCESS	4-1
	4.3	SUMMARY OF RECOMMENDATIONS	4-2
	4.4	SPECIFIC RECOMMENDATIONS BY SITE	4-2
SECTION 5.		BACKGROUND	5-1
	5.1	GENERAL	5-1
	5.2	HISTORY	5-2
	5.3	PHYSICAL FEATURES	5-3
	5.4	BIOLOGICAL FEATURES	5-15

CLW

0000000713

CONTENTS
(Continued, Page 2 of 2)

SECTION 6. ACTIVITY FINDINGS 6-1

6.1 INTRODUCTION. 6-1
6.2 OPERATIONS, ORDNANCE. 6-1
6.3 OPERATIONS, NONORDNANCE 6-2
6.4 OPERATIONS, RADIOLOGICAL. 6-18
6.5 MATERIAL STORAGE. 6-18
6.6 WASTE DISPOSAL OPERATIONS 6-20
6.7 SITES 6-25

SECTION 7. REFERENCES. 7-1

APPENDIXES

APPENDIX A--MONITORING-WELL CONSTRUCTION A-1
APPENDIX B--ABBREVIATIONS LIST B-1
APPENDIX C--LOGS OF WELL NOS. HP-613 AND HP-616. . . . . C-1

CLW

0000000714

LIST OF FIGURES

Figure	Title	Page
2-1	Site Locations at MCB Camp Lejeune	2-3
5-1	Regional Climatic Conditions in the Vicinity of MCB Camp Lejeune	5-4
5-2	Surface Water Drainage Sub-Basins at Hadnot Point, MCB Camp Lejeune.	5-5
5-3	Surface Water Drainage Sub-Basin at MCAS New River, MCB Camp Lejeune.	5-6
5-4	Geologic Cross Section From Wayne County, N.C. to Carteret County, N.C.	5-8
5-5	Geologic Cross Section From Cumberland County, N.C. to Onslow County, N.C.	5-9
5-6	New River Area Geology	5-10
5-7	Water Quality Classifications for the New River at MCB Camp Lejeune.	5-12
5-8	Wildlife Units at MCB Camp Lejeune	5-17
5-9	Red-Cockaded Woodpecker Colony Areas at MCB Camp Lejeune	5-25
6-1	Chronology of Solid Waste Disposal Sites and Waste Routing at Camp Lejeune, N.C.	6-21
6-2	Detail of Site No. 1, French Creek Liquids Disposal Area.	6-33
6-3	Site Locations at Hadnot Point	6-34
6-4	Detail of Site No. 2, Former Nursery/Day-Care Center	6-36
6-5	Site Locations at Midway Park Housing Area	6-37
6-6	Site No. 2--Former Nursery/Day-Care Center at Building 712. Water Treatment Plant in Foreground	6-38
6-7	Site Locations at Open Storage Area.	6-41
6-8a	Site No. 6--Storage Lots 201-203	6-[illegible]

CLW

LIST OF FIGURES
(Continued, Page 2 of 3)

Figure	Title	Page
6-8b	Site No. 9--Fire Fighting Training Pit Near Piney Green Road. Oil Water Separation Pit in Foreground	6-42
6-9	Detail of Site No. 16, Montford Point Burn Dump	6-45
6-10	Site Locations at Montford Point and Vicinity.	6-46
6-11	Site No. 16--Montford Point Burn Dump Showing Asbestos Pipe Insulation	6-47
6-12	Details of Sites 21 and 22, Storage Lot 140, and Industrial Area Tank Farm, Respectively.	6-50
6-13a	Site No. 22--Industrial Area Tank Farm	6-52
6-13b	Site No. 24--Industrial Area Fly Ash Dump.	6-52
6-14	Detail of Site No. 24, Industrial Area Fly Ash Dump	6-55
6-15	Detail of Site No. 28, Hadnot Point Burn Dump.	6-57
6-16a	Site No. 28--Hadnot Point Burn Dump.	6-58
6-16b	Site No. 35--Camp Geiger Area Fuel Farm.	6-58
6-17	Location of Site No. 30 at Combat Town Training Area.	6-60
6-18	Detail of Site No. 35, Camp Geiger Area Fuel Farm	6-62
6-19	Site Locations at Camp Geiger Area A	6-63
6-20	Detail of Site No. 36, Camp Geiger Area Dump (near STP)	6-65
6-21	Detail of Site No. 41, Camp Geiger Dump (near former trailer park)	6-67
6-22	Site Locations at Camp Geiger Area B	6-68
6-23a	Site No. 41--Camp Geiger Dump Near the Trailer Park	6-69

CLW

LIST OF FIGURES
(Continued, Page 3 of 3)

Figure	Title	Page
6-23b	Site No. 45--Campbell Street Underground Fuel Storage Area	6-69
6-24	Detail of Site No. 45, Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm . .	6-71
6-25	Site Locations at MCAS New River	6-72
6-26	Detail of Site No. 48, MCAS New River Mercury Dump Site.	6-74
6-27	Detail of Site No. 54, Crash Crew Fire Training Burn Pit.	6-76
6-28	Site No. 54--Crash Crew Fire Training Burn Pit. .	6-77
6-29	Detail of Site No. 68, Rifle Range Dump	6-79
6-30	Site Locations at Rifle Range Area.	6-80
6-31	Site No. 68--Rifle Range Dump	6-81
6-32	Physical Features and Locator Map for Site No. 69.	6-85
6-33	Site No. 69--Rifle Range Chemical Dump Showing Discarded Gas Detection Kits.	6-86
6-34	Detail of Site No. 73, Courthouse Bay Liquid Disposal Area	6-88
6-35	Site Locations at Engineer and Amphibious Training Area	6-89
6-36	Detail of Site Nos. 75 and 76, MCAS Basketball Court Site and MCAS Curtis Road Site, Respectively	6-93
6-37	Site Locations at HOLF Oak Grove.	6-122
A-1	Recommended Monitoring-Well Construction.	A-2

CLW

0000000717

LIST OF TABLES

Table	Title	Page
2-1	Pesticide Levels in Soil at Camp Lejeune Day-Care Center (in ppm, mg/kg), 1982	2-6
2-2	Volatile Organic Contaminant Levels in Potable Wells and WTP at Rifle Range	2-10
2-3	Volatile Organic Contaminant Levels in Test Well Nos. 15 and 16 and Surface Waters Near the Rifle Range Chemical Dump	2-12
4-1	Summary of Recommended Field Work	4-3
5-1	State and Federal Status of Sensitive Species for North Carolina.	5-22
5-2	Proposed Protected Plant List for North Carolina Listing Only Those Taxa Known to Occur in Carteret, Craven, Jones, or Onslow Counties . . .	5-23
5-3	Comments on Sensitive Species Regarding Occurrence Within Study Area (Camp Lejeune Complex). .	5-24
6-1	Water Treatment at MCB Camp Lejeune	6-8
6-2	Total Trihalomethane Values in Treated Water at Rifle Range, MCB Camp Lejeune, 1981 and 1982 . .	6-9
6-3	Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in mg/l).	6-10
6-4	Constituents in Waste Oil, MCB Camp Lejeune, 1981	6-23
6-5	Disposal Sites at Camp Lejeune Complex.	6-27

SECTION 1. INTRODUCTION

1.1 PURPOSE OF INITIAL ASSESSMENT STUDY. The Naval Energy and Environmental Support Activity (NEESA) conducts Initial Assessment Studies (IASs) as directed by the Chief of Naval Operations (CNO). NEESA works in conjunction with the Ordnance Environmental Support Office (OESO) during IASs. The purpose of an IAS is to collect and evaluate evidence which indicates existance of pollutants that may have contaminated a site or that pose a potential health hazard for people located on or off an installation. The IAS is the first phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program. The objective of the NACIP program is to identify, assess, and control environmental contamination from past hazardous materials storage, transfer, processing, and disposal operations. The NACIP program was initiated by OPNAVNOTE 6240 ser 45/733503 of 11 September 1980 and Marine Corps Order 6280.1 of 30 January 1981.

1.2 SEQUENCE OF EVENTS.

1.2.1 Marine Corps Base (MCB) Camp Lejeune was designated for an IAS by CNO letter ser 451/397464 of August 1981. Included in this IAS is Helicopter Outer Landing Field (HOLF) Oak Grove. The environmental consulting firm of Water and Air Research, Inc. (WAR) was selected to conduct the IAS in October 1981.

1.2.2 The Commanding Officer of MCB Camp Lejeune was notified via Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM) and by NEESA of the selection of MCB Camp Lejeune for an IAS. The NACIP Program Management Plan (Appendix A to NEESA 20.2-035) and Activity Support Requirements for IAS were forwarded to the installation to outline assessment scope, provide guidelines to personnel, and request advance information for review by the IAS team.

1.2.3 The LANTNAVFACENGCOM staff was briefed on the NACIP program and IAS on 25 January 1982 by Mr. Wallace Eakes, NEESA Contract Coordinator; Dr. Jerry Steinberg, WAR Project Coordinator; and Dr. Hugh Putnam, WAR Team Leader.

1.2.4 MCB Camp Lejeune Chief of Staff and other staff personnel were briefed by the same team on 28 January 1982.

1.2.5 Various government agencies were contacted during 8-25 February 1982 for documents pertinent to the IAS effort. Agencies contacted included:

1. NAVFACENGCOM Historian, Naval Construction Battalion Center (NCBC), Port Hueneme, California;
2. NEESA Information Management Department, NCBC, Port Hueneme, California;
3. NEESA Information Services Department, NCBC, Port Hueneme, California;

CLW

00000007 19

4. Installations Planning Division and Real Estate Division of the LANTNAVFACENGCOM Facilities Planning and Real Estate Department;
5. Utilities, Energy, and Environmental Division of the LANTNAVFACENGCOM Facilities Management Department;
6. Federal Records Service Center, Southeast Regional Branch, East Point, Georgia;
7. National Archives, Washington, D.C.;
8. National Archives Annex, Suitland, Maryland;
9. Federal Records Service Center, Suitland, Maryland;
10. Operational Archives, Naval History Office, Washington Navy Yard, Washington, D.C.;
11. Aviation History Office, Washington Navy Yard, Washington, D.C.;
12. Naval History Division, Curator's Branch, Photographic Collection, Washington Navy Yard, Washington, D.C.;
13. Department of Defense Explosive Safety Board, Alexandria, Virginia;
14. Navy Bureau of Medicine and Surgery, Washington, D.C.;
15. Marine Corps History Office, Washington Navy Yard, Washington, D.C.;
16. Naval Sea Systems Command, Safety Ordnance File (SAFEORD), Naval Surface Weapons Center (NSWC), Dahlgren, Virginia;
17. Accident Incident Data Bank (AID), NSWC, Dahlgren, Virginia;
18. EPA Environmental Photo Interpretative Center, Vint Hill Farm, Virginia (aerial photos);
19. NAVFACENGCOM Real Estate Office, Alexandria, Virginia;
20. United States Geological Survey (USGS) Public Information Office, Reston, Virginia; and
21. National Cartographic Information Center (NCIC), Reston, Virginia.

1.2.6 On-site investigations were conducted during the periods of 15-24 March 1982 and 1 January-3 February 1983. The field team interviewed current and past employees, examined records, and visited potential disposal sites. Mr. Wallace Eakes of NEESA and the following WAR personnel participated in on-site work:

1. Dr. Hugh Putnam, Team Leader, Report Author, Biologist;
2. Mr. James Nichols, P.E., Environmental Engineer;
3. Mr. Michael Hein, Environmental Scientist;
4. Mr. William Adams, Hydrogeologist;
5. Mr. Charles Fellows, Environmental Chemist; and
6. Dr. Jerry Steinberg, P.E., Environmental Engineer.

Ground and aerial tours were made of MCB Camp Lejeune and HOLF Oak Grove. Efforts were made to corroborate specific information discovered during interviews. Verification sources included present and past employees with direct knowledge, aerial photographs, and documents. Substantiation has been obtained for most interview information affecting significant findings and recommendations.

CLW

0000000720

1.2.7 From 1 April 1982 through 7 March 1983, information, conclusions, and recommendations were developed into this final report document. This included review and comment by NEESA, LANTNAVFACENGCOM, Marine Corps Air Station (MCAS) New River, NAVFACENGCOM Headquarters, and Commandant Marine Corps (CMC) staff.

1.3 SUBSEQUENT NACIP STUDIES. Recommendations for a Confirmation Study phase of the NACIP program is based on the findings of an IAS. A Confirmation Study is recommended only if the following circumstances exist:

1. Sufficient evidence exists to suspect that the activity is contaminated; and
2. The potential contamination may present a danger to:
   a. The health of civilians in nearby communities or personnel within the activity fenceline, or
   b. The environment within or outside the installation.

No further studies are conducted under the NACIP program if these criteria are not met.

CLW

0000000721

SECTION 2. SIGNIFICANT FINDINGS

2.1 INTRODUCTION. Substantial information has been collected during this Initial Assessment Study (IAS). This chapter summarizes the information collected and it includes three sections:

1. Brief statements of significant facts;
2. Narrative discussion elaborating on the statements, and
3. Abbreviated descriptions of all sites judged to require further assessment (i.e., confirmation).

Information and data are presented in Section 6. Conclusions based on study findings are presented in Section 3.

2.2 GENERAL FINDINGS.

2.2.1 Potentially hazardous chemical wastes have been generated by military activities at Marine Corps Base (MCB) Camp Lejeune.

2.2.2 Seventy-six waste disposal sites have been identified; however, most (54) do not contain hazardous waste or do not pose a significant threat to human health or the environment.

2.2.3 Although sites were identified throughout the base, the air station and Hadnot Point areas had the largest number. Helicopter Outlying Landing Field (HOLF) Oak Grove does not contain any significant sites.

2.2.4 No industrial or municipal wastes were found to be migrating onto base property.

2.2.5 Past use of aircraft and tracked and wheeled vehicles has caused Petroleum, Oil, Lubricants (POL) contamination. These substances were involved in 10 of the 22 sites judged to require confirmation.

2.2.6 Contaminants from the chemical landfill (Site No. 69) are expected to move downgradient and away from the potable wells at the Rifle Range. (Defining movement of pollutants is addressed in more detail in Section 5.) On the basis of this preliminary study, these wells are not at risk from the chemical landfill wastes. The Rifle Range Dump (Site No. 68) west of Well Nos. RR-45 and RR-97, requires further investigation. Solvents buried at this site may have moved upgradient toward Well Nos. RR-45 and RR-97 during heavy groundwater withdrawal.

2.2.7 Ordnance operations are, in general, carefully controlled. However, there is evidence to indicate that limited disposal of some ordnance has occurred at one disposal site (Site No. 41). Potential adverse public health or environmental impacts can be minimized by carefully controlling any future digging or construction activities at the disposal area.

2.2.8 Confining beds separating the water table aquifer and the semiconfined aquifer are discontinuous at Camp Lejeune. This condition

CLW

0000000722

increases the chance of leachate from old disposal sites migrating into the semiconfined aquifer, the source of potable water.

2.2.9 Groundwater near the surface is not used for drinking water but is highly susceptible to contamination from hazardous waste disposal practices.

2.2.10 Surface water contamination is also possible because flow in the shallow unconfined aquifer generally follows land contours and discharges to the New River or its tributaries.

2.3 DISCUSSION. The Camp Lejeune complex covers approximately 170 square miles. Wastes have been disposed of in many areas during the existence of the base. Because it is so large, Camp Lejeune has used localized sites for waste disposal. However, all waste was not disposed of at authorized areas. Waste disposal occurred in many parts of the installation and included disposal on the ground surface; the use of borrow pits; and spreading of waste oils, solvents, and other POL compounds on roads for dust control.

Located on the Camp Lejeune complex (including Marine Corps Air Station (MCAS) New River and HOLF Oak Grove) are 76 sites at which some form of waste disposal took place. These sites were documented through past records and interviews with former employees. Sites at MCB Camp Lejeune and HOLF Oak Grove are indicated in Figures 2-1 and 6-37, respectively. Knowledge regarding the exact location of all base disposal sites is incomplete. Some sites may never be found and much information now known lacks detail.

Assessments of human health or environmental risk have been made by considering factors such as the type of material involved and the potential for contaminant migration. Fifty-four sites were judged to present no significant risk and do not need to be further evaluated. Twenty-two sites have potentially hazardous materials and reasonable potential for material migration. These 22 sites warrant more analysis, i.e., confirmation analysis.

Overall, most old disposal sites and areas which received wastes are in Hadnot Point area (location of much of the base industrial activity), and at MCAS New River. Many of the sites judged as needing confirmation contain buried POL compounds (e.g., contaminated fuels, waste oils, solvents, and hydraulic fluids). There have been unavoidable POL spills and leaks throughout the base. At Hadnot Point, the Air Station, and Camp Geiger fuel farms, there have been releases of either Avgas, Mogas, JP-4, or JP-5 in significant quantities to generate concern about the groundwater aquifer.

Training functions on the base require use of large numbers of tracked and wheeled vehicles. In the past, waste oils from maintenance operations were either poured on the ground or put into storm drains. This practice has been stopped and a pollution abatement program usi

CLW

0000000723

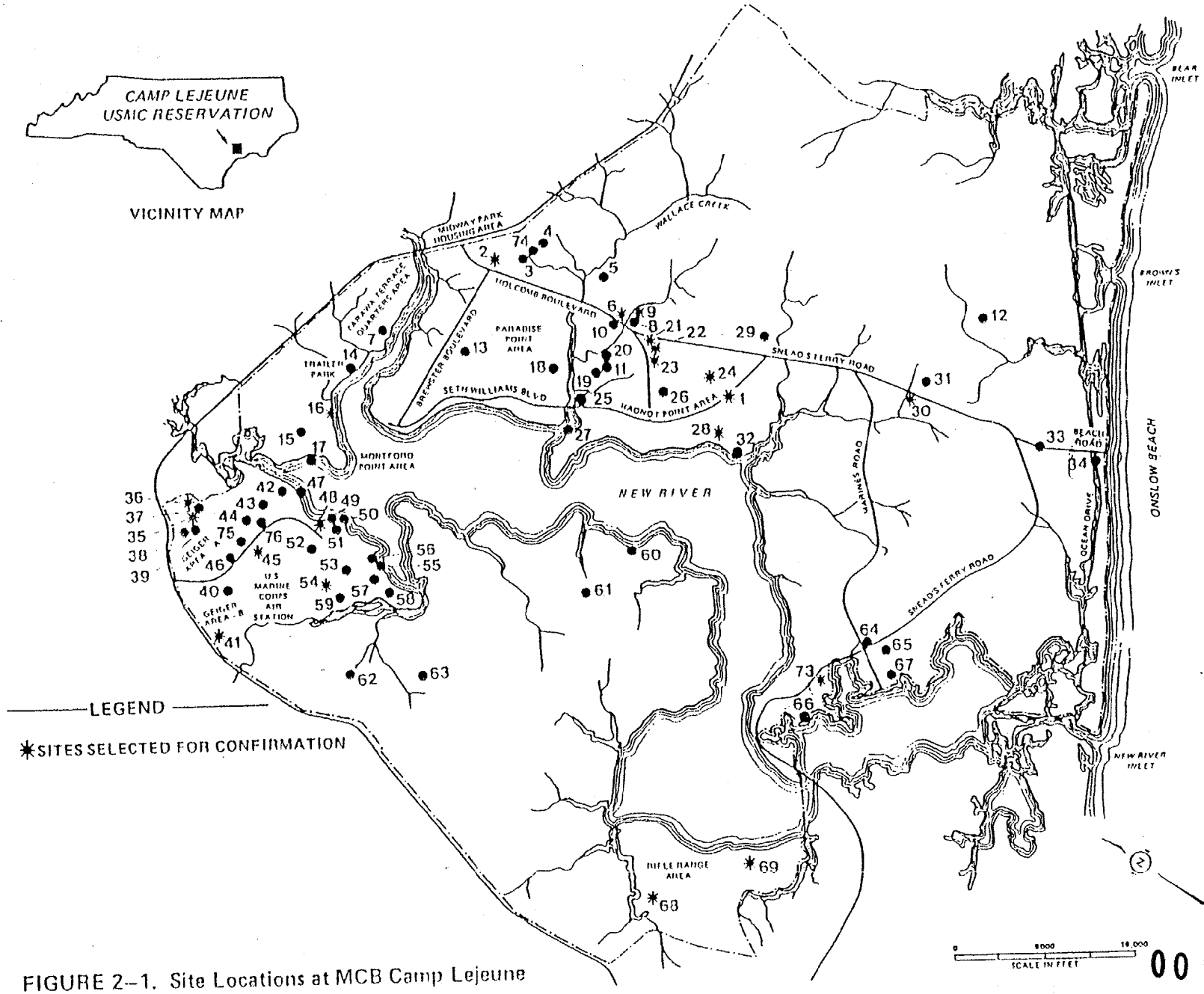


FIGURE 2–1. Site Locations at MCB Camp Lejeune

CLW

0000000724

oil-water separators has been instituted. At MCAS New River, waste oils, solvents and other compounds were often released to storm drains that entered the New River. Another practice was to store waste fuel, oils, and solvents and use them to control dust on unimproved roads. About 1,000 gallons per week of contaminated JP fuel, crankcase fluids, paint thinners, and other assorted POL compounds were used. Fuels and solvents were used during crash crew and firefighting training.

Since the base was constructed in the 1940s, large amounts of chemicals have been stored, used, and disposed of. One principal disposal site is the chemical landfill. The area is now closed, but all types of hazardous materials were buried here in the past. Although some of the chemicals are known, records identifying other chemicals have been lost. It is not known exactly how much material is involved, although it is recognized to involve hundreds of pounds of wastes. Because groundwater contamination is a concern, test wells have been installed and a sampling program instituted.

The mission of the base requires training using live ordnance. For this purpose, year-round impact areas have been set aside. Explosions have a local blast effect on the environment, but they are not thought to threaten the ground water. Skilled Explosive Ordnance Disposal (EOD) personnel have typically handled unexploded rounds in contained areas where ordnance is either burned or electrically exploded. However, some relatively small amounts of unexploded ordnance may have been disposed of in dumpsters and then buried in at least one landfill.

Potential for contamination of the aquifer varies at Camp Lejeune because of the discontinuous nature of confining layers. Therefore knowledge of nearby geological conditions is needed to completely evaluate a specific site. Geohydrology of the Camp Lejeune complex is such that groundwater generally moves toward the New River and its tributaries. Potable wells at the base are usually deep, but, due to voids in the confining layer, some wells may not be completely isolated from shallow groundwater. Also, heavy demands for water may at times produce an overall decline of pressure in the semiconfined aquifer. Therefore, contaminants can migrate laterally and vertically through gaps in the confining layer. Another factor possibly affecting groundwater quality is the unknown status of abandoned wells. Wells improperly sealed when abandoned may become pathways for contaminant migration.

2.4 SITES REQUIRING CONFIRMATION INVESTIGATION. The following sites warrant confirmation based on consideration of the type of material and the migration potential. Information in this section is extracted from one or more later sections in this report. As a minimum, reference should be made to detailed site information forms included in Section 6.7 for:

1. Cautions regarding estimate limitations of some quantities;
2. Supporting information regarding activities and dates of use;

CLW

0000000725

3. Locations according to streets or other known landmarks; and
4. References to figures which show site location and/or details.

Site locations are referenced to the 1979 edition of the Public Works Development Map (PWDM) which is a set of 24 sheets. Each sheet contains a locator system using a letter and a number to identify a specific grid. Throughout this report, locations are given using the following format: PWDM "sheet number", "grid letter and number." For example, a site situated in grid A17 on sheet 11 of 24 is rererenced as PWDM coordinates 11, A17.

2.4.1 Site No. 1: French Creek Liquids Disposal Area. This site (PWDM coordinates 11, C7/D7) has been used intermittently from the late 1940s to the mid-1970s. Liquid wastes from vehicle maintenance were poured on the ground as part of routine operations. Dead batteries were emptied of acid before disposal. Batteries and used battery acid usually were hand carried from maintenance buildings to a disposal point. Sometimes, holes were dug for waste acid disposal; these were immediately refilled with dirt. During oil changes, vehicles were driven to a disposal point before the used oil (or other fluid) was drained and replaced with new oil. Acid and oil disposal areas were not necessarily congruent. Suspected quantities involved are 5,000 to 20,000 gallons of waste POL and 1,000 to 10,000 gallons of battery acid. Comparing these quantities to better documented quantities for a similar site (i.e., Site No. 73) indicates that POL quantity estimates may be low at Site No. 1.

2.4.2 Site No. 2: Former Nursery/Day-Care Center (Building 712). This site is at PWDM coordinates 5, K10. This area had been recently operated as a day care center. From 1945 to 1958, pesticides of various kinds were stored, handled, and dispensed here. Residuals are present but reliable data from which to quantify residuals or spill volumes have not been found. Chemicals used in significant amounts include Chlordane, DDT, Diazinon, and 2,4-D. Stored only or used to a minor extent were Dieldrin, Lindane, Malathion, Silvex, and 2,4,5-T. Contaminated areas are the fenced playground, approximately 6,300 square feet; the mixing pad covering approximately 100 square feet; and the wash pad, approximately 225 square feet. An adjacent drainage ditch possibly received washout and spills. Table 2-1 presents results of a preliminary sampling program in April 1982. Based on test data, the day care activities were ceased in April 1982.

2.4.3 Site No. 6: Storage Lots 201 and 203. This site is at PWDM coordinates 6, F3-4/G3-4/H2-4/I2-4/J3. In the 1940s, the area occupied by Lot 203 was a waste disposal site. In the northeast corner, a site is marked where an unknown quantity of DDT was buried. Attempts to estimate the amount have been unsuccessful. The area where DDT was discharged is assumed to be within an 80- to 100-foot radius of the dump marker. The size of Storage Lots 201 and 203 is approximately 25 and 46 acres, respectively. DDT and transformers containing PCBs were stored her

CLW

Table 2-1. Pesticide Levels in Soil at Camp Lejeune Day-Care Center (in ppm, mg/kg), 1982

Station No.	Location*	DDE	DDD	DDT	Chlordane
1	Front play area	0.022	0.240	6.30	0.170
2	Rear play area	0.805	0.850	6.70	0.105
3	Wash pad	27.36	83.10	518.7	36.42
4	Mixing area	68.68	643.60	7,500	45.68
5	Storage area	0.021	0.100	0.061	0.060

* See Figure 6-4.

NOTE 1: Data reported as received without regard for significant digits.

NOTE 2: Since these analyses were made, more testing has been performed.

Source: Jacobs Environmental Laboratories, 1982.

No information referring specifically to PCB leaks has been found. Reports of white powder on the ground indicate DDT spills have occurred.

2.4.4 Site No. 9: Fire Fighting Training Pit at Piney Green Road. This site (PWDM coordinates 6, K3/L3) has been in operation from the 1960s to the present. Pollution abatement devices, including an oil-water separator and an impermeable liner in the training pit (approximately 800 square feet), have been installed. About 30,000 gallons per year of used oil, solvents, and contaminated fuels are burned during training exercises. Until the mid- to late 1960s, the pit was unlined. The entire site is about 1 to 2 acres in size. The soils are sandy and without ground cover.

2.4.5 Site No. 16: Montford Point Burn Dump--The dump (PWDM coordinates 2, N11-12) was opened around 1958 and was closed in 1972, although unauthorized dumping has subsequently occurred. The site contains building debris, garbage, tires, and waste oils. The quantity of these wastes is unknown, but the amount of oil buried here is considered insignificant. Materials have been dumped on the surface and include asbestos insulating material (estimated at less than 1 cubic yard) for pipes. (Note: Mitigation has been undertaken.) The site covers about 4 acres.

2.4.6 Site No. 21: Transformer Storage Lot 140. This site is at PWDM coordinates 10, I15. In 1958, the Pest Control Shop moved from Building 712 to Building 1105 as a storage and administration area and to Lot 140 as a mixing and equipment cleanup area. This shop probably used similar pesticide handling and mixing practices as those used at Building 712. This suggests the possibility for pesticide contamination at this site. Additional information documents overland discharge of waste water generated by rinsing pesticide application equipment on a routine basis. Wastewater discharge was estimated at 350 gallons per week in 1977. Chemicals stored in Building 1105 were identified as Diazinon; Chlordane (dust); Lindane; DDT (dust); Malathion (46-percent solution); Mirex; 2,4-D; Silvex; Dalpon; and Dursban.

In the early 1950s, transformer oil was drained into a pit located at Lot 140. The quantity of oil drained into this pit, over about a 1-year period, is unknown.

Also, surface discharge of transformer oils has been reported. In response to this, the upper 4 inches of soil at Lot 140 was sampled for PCBs in 1980. One part per million PCB or less was found in this topsoil layer.

2.4.7 Site No. 22: Industrial Area Tank Farm. The tank farm (PWDM coordinates 10, J15) is currently in operation. In 1979, a fuel leak estimated at 20,000 to 50,000 gallons occurred. The leak was in an underground line slightly behind the tank truck loading facility, between the building and the large above-ground fuel tank. The site covers about 4 acres.

CLW

0000000728

2.4.8 Site No. 24: Industrial Area Fly Ash Dump. This site (PWDM coordinates 10, L16-17, M16-17) was first disturbed in the 1940s. The disposal area was used until approximately 1980, when transporting ash to the present sanitary landfill began. The site (estimated to be 20 to 25 acres) is adjacent to upstream portions of Cogdels Creek. Materials disposed of include fly ash, solvents, used paint stripping compounds, sewage sludge, and water treatment spiractor sludge. The amount of fly ash is estimated at 31,500 tons. The estimate of stripping compounds disposed of here is about 45,000 gallons over 7 years.

2.4 9 Site No. 28: Hadnot Point Burn Dump. This disposal site (PWDM coordinates 10, Q13-14) was used for industrial area waste from 1946 to 1971. A variety of industrial waste (estimated between 185,000 to 370,000 cubic yards) was burned and covered. The area has been graded, seeded with grass, and now supports a good ground cover. Its proximity to Cogdels Creek and the New River poses health and environmental risks. Leachate and seepage to Cogdels Creek have been observed.

2.4.10 Site No. 30: Sneads Ferry Road--Fuel Tank Sludge Area. This site (PWDM cooridnates 18, G12) contains sludge and/or washout from storage tanks at the industrial area fuel farm. When the contents of two 12,000-gallon tanks were changed from leaded to unleaded fuel in 1970, sludge and/or washout was drained from the tanks by a private contractor and disposed of along a tank trail which intersects Sneads Ferry Road. Based on knowledge of tank capacity below tank outflow ports, about 600 gallons of sludge and washout were disposed of. It is possible that the site has been used for similar wastes from other tanks. Therefore, the 600-gallon amount must be considered a minimum quantity estimate. Composition of sludge and/or washout is unknown and may vary from substantial amounts of tetraethyl lead to mostly cleaning compounds. Soils in the area are sandy and conducive to migration toward French Creek, about 1,500 feet away.

2.4.11 Site No. 35: Camp Geiger Area Fuel Farm. The site is at PWDM coordinates 12, C11. A leak in an underground fuel line occurred in the late 1950s (probably 1958) near the pad supporting the overhead tanks. Amount of fuel is estimated to be in the thousands of gallons and the fuel moved east toward Brinson Creek. Holes were dug to the water table. Where fuel was floating on the groundwater surface, it was ignited and burned. Fuel contaminating Brinson Creek also was ignited and burned. Distance from the fuel farm to Brinson Creek is approximately 400 feet.

2.4.12 Site No. 36: Camp Geiger Area Dump Near Sewage Treatment Plant. The site (PWDM coordinates 12, D13/E13) received mixed industrial and municipal wastes from 1950 and 1959. These were burned and later covered; however, some materials may have been deposited on the ground surface and covered unburned. The site is about 200 feet from Brinson Creek and a small roadside drainage ditch, located on the opposite side of the landfill, is less than 100 feet away. The site covers 25,000 square feet and rises 10 to 12 feet above grade. Estimated volume is 14,000 cubic yards. Wastes of concern are hydrocarbons (solvents, waste oils, and hydraulic fluids) that were generated at Camp Geiger

CLW

MCAS New River. As many as 10,000 to 15,000 gallons may have been disposed of over 9 years. Most were probably burned.

2.4.13 Site No. 41: Camp Geiger Dump Near Former Trailer Park. This dump (at PWDM coordinates 13, E2-3) was active from 1953 to 1970. According to interviews with MCAS New River and Camp Lejeune Base personnel, it received POL compounds, solvents, old batteries, other assorted municipal waste, some ordnance and, in 1964, bags of Mirex. The site is estimated to cover 15 acres and to contain 110,000 cubic yards of waste. The amount of solvents and oils disposed of is estimated to be about 10,000 to 15,000 gallons; the amount of Mirex is estimated to be several tons. The amount of ordnance is not known.

2.4.14 Site No. 45: Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm. This site is at PWDM coordinates 23, O13-14/P13-14. The two facilities are on each side of White Street and on the north side of Campbell Street. In 1978, 200 to 300 gallons of Avgas were spilled or leaked from this facility. It is estimated that during 1981-1982 more than 100,000 gallons of fuel leaked into the surrounding soil due to corrosion of underground lines at the JP Fuel Farm. These lines have been replaced with an aboveground system. Although the volume of Avgas loss is low, the estimate may be conservative.

2.4.15 Site No. 48: MCAS New River Mercury Dump Site. This area is at PWDM coordinates 23, D17/E17. From 1956 to 1966, metallic mercury from the delay lines of the radar units was reported to have been buried around the photo lab, Building 804. One gallon per year was disposed of in this area. More than 1000 pounds may be dispersed over approximately 20,000 square feet adjacent to the New River.

2.4.16 Site No. 54: Crash Crew Fire Training Burn Pit. This site (PWDM coordinates 23, O24-25/P24-25) is an area off Runway 5-23 that has been used since the 1950s for crash crew training with various POL compounds. Originally, training was on the ground surface with the area surrounded by a berm. Later, a pit was used, which was eventually lined. The area is about 1.5 acres. Based on present annual POL usage of 15,000 gallons, nearly one-half million gallons of these compounds have been used at this site. Most of the POL was burned, but as many as 3,000 to 4,000 gallons may have soaked into the soil.

2.4.17 Site No. 68: Rifle Range Dump. This site (PWDM coordinates 16, H6-8/I6-7) was active from 1942 to 1972. Fill capacity of the dump is estiimated at 100,000 cubic yards. Types of wastes buried here include garbage, building debris, Waste Treatment Plant (WTP) sludge, and solvents. Solvents are used extensively for weapons cleaning. However, the amount disposed of at this site is relatively small and estimated to be approximately 1,000 to 2,000 gallons. Solvents are of concern because nearby Well Nos. RR-45 and RR-97 have been found to contain organic contaminants. The distance between the wells and the site is approximately 1,500 feet. Although the wells are upgradient, pumping could draw contaminants toward these wells. Table 2-2 contains results of volatile organic analyses run on samples from active Well Nos. RR-45, RR-47, CLW

Table 2-2. Volatile Organic Contaminant Levels in Potable Wells and WTP at the Rifle Range

Sampling Site	Date Sampled	Contaminant	Levels (in ppb)	
Well No. RR-45--Drinking Water Well	April 10, 1981	Methylene Chloride	4.0	
Well No. RR-47--Drinking Water Well	April 10, 1981	Clean		
Well No. RR-97--Drinking Water Well	April 10, 1981	Chloroform	16.6	
		Methylene Chloride	5.8	
		Trichloroethylene	1.8	
Bldg. No. RR-85--Water Treatment Plant--Treated Water	April 10, 1982	Chloroform	17.0	
		Methylene Chloride	3.0	
			Raw	Treated
RR Water Plant	May 20, 1981	1,1-Dichloroethane	5.40	3.40
		Chloroform	53.40	94.40
		Methylene Chloride	14.60	4.0

Note: Data reported as received without regard for significant digits.

Source: Jennings Laboratories, Inc., 1981.
Reports Dated: April 16, 1981
May 29, 1981

RR-97, and the WTP Bldg. No. RR85. Results are discussed in Section 2.4.18.

2.4.18 Site No. 69: Rifle Range Chemical Dump. This site (PWDM coordinate 16, L14-15/M14-15) was once designated for disposal of all hazardous chemicals. It has received much attention and is discussed in detail here. Although past records have been lost, it is known that pesticides, PCBs, pentachlorophenol, trichloroethylene (TCE), and many other compounds were buried here. This landfill was active from the early to mid-1950s to approximately 1976.

Tributaries to the New River (including Everett Creek and unnamed creeks and guts), the Rifle Range wells, and surface seeps are nearby. Test wells already exist and intermittent sampling has been done. Also, samples have been collected from a small tributary to Everett Creek and from pools on or near the site. Results of analyses for the presence of volatile organics are in Table 2-3.

Data on Table 2-3 show that water from Test Well Nos. 15 and 16 contains elevated levels of organic contaminants. Samples of surface water from a nearby pool also indicated a high concentration of volatile organic compounds. The pool is a pit 10 to 15 feet deep. It collects groundwater through its sides and bottom.

Because there is a risk of contaminating the potable water supply at the Rifle Range, samples were collected at three operating wells (RR-45, RR-47 and RR-97). The latter well is about 6,000 feet from the dump site. Analyses were run for organic contaminants in both raw and finished water. The results, shown in Table 2-2, indicate that Well No. RR-97 had three organic contaminants. No contaminants were detected in Well No. RR-47, but Well No. RR-45 had 4 parts per billion (ppb) of methylene chloride. Finished water (Well No. RR-85) showed levels of 17 ppb of chloroform and 3 ppb of methylene chloride. Possible sources of contamination are discussed in Secton 6.

Samples from the Rifle Range wells of raw and treated water have been analyzed for trihalomethane compounds. Results show that treated water in August of 1981 contained total trihalomethane (THM) in excess of 100 ppb. Further sampling in 1981 and 1982 indicates levels (except in December 1981) approximately half those observed in August. Reduction of trihalomethanes may be possible through changes in the water treatment process. Elimination or reduction of prechlorination has been successful in reducing trihalomethanes in other plants.

2.4.19 Site No. 73: Courthouse Bay Liquids Disposal Area. This site (PWDM coordinates 17, I11-12) was used from 1946 to 1977. The site is located about 200 feet from Courthouse Bay and 200 feet downgradient from the nearest well. About 13 acres have been identified as a possible POL disposal area, of which about 1 acre also has been used for waste acid disposal. Motor oil from vehicles was drained onto the ground during oil changes (potentially up to 400,000 gal of oil over 32 years). Dead batteries were drained of acid daily or weekly. The acid was poured [illegible]

CLW

Table 2-3. Volatile Organic Contaminant Levels in Test Well Nos. 15 and 16 and Potable Wells at Rifle Range (in ppb), April 10, 1981 (Page 1 of 2)

Sampling Site	Contaminant	Levels (in ppb)
Test Well No. 15	Methylene chloride	2
Test Well No. 16	1,1-Dichloroethane	38
	Methylene chloride	13
	1,2-Dichloroethane	52
	1,1-Dichloroethylene	73.6
	Toluene	51.8
Pool Below Test Well No. 16	Methylene chloride	3.4
Rad Pool	1,1-Dichloroethane	2.0
	Methylene chloride	2.4
Pool with Barrel	Benzene	1.0
	Toluene	181
	1,1-Dichloroethane	176
	1,1,1-Trichloroethane	103
	1,2-Dichloroethane	101
	1,1-Dichloroethylene	258
	1,1,2-Trichloroethane	252
	Chloroform	34.6
	Methylene chloride	37
	Trichloroethylene	141
Stream Bed Below, Behind Dump about 100 yds SSE of Test Well No. 17	Methylene chloride	14
	Tetrachloroethylene	5.8
Tidal Marsh at End of Road	Clean	
Mouth of Stream at Everett Creek	Clean	
Well No. RR-45-- Drinking Water Well	Methylene chloride	4.0
Well No. RR-47-- Drinking Water Well	Clean	

Table 2-3. Volatile Organic Contaminant Levels in Test Well Nos. 15 and 16 and Potable Wells at Rifle Range (in ppb), April 10, 1982 (Continued, Page 2 of 2)

Sampling Site	Contaminant	Levels (in ppb)
Well No. RR-97-- Drinking Water Well	Chloroform	16.6
	Methylene chloride	5.8
	Trichloroethylene	1.8
Bldg. No. RR-85-- Water Treatment Plant--Treated Water	Chloroform	17
	Methylene chloride	3.0

Source: U.S. Navy, 1982.

CLW

0000000734

shallow, hand-shoveled holes in the disposal area. The holes were then refilled. It is estimated that 10,000 to 20,000 gallons of waste battery liquid were disposed of.

2.4.20 Site No. 74: Mess Hall Grease Pit Area. This site of 2 to 3 acres is at PWDM coordinates 5, N12/014 and was used from about 1950 to the early 1960s. A large pit at this site received waste grease from mess halls; however, this activity is not considered to pose a hazard to the environment or human health. Burial of pesticides and PCB-containing oil probably occurred near the grease pit. A nearby area (about 400 feet southeast) was the site of a pest control activity where bags of sawdust were soaked in DDT solution before being placed in swamp waters. Spillage, wastage, and rinse-out may have resulted in pesticide contamination of soil and groundwater. Estimates of quantities involved include: 1,100 gallons of PCB oil, 50 to 500 gallons of DDT solution, and 2,200 gallons of drummed pesticides. Both areas of this site are within 100 yards of an inactive potable water well.

2.4.21 Site No. 75: MCAS Basketball Court Site. This site is at PWDM coordinates 23, 08-9/P8-9 and was used at least once in the early 1950s for burial disposal of drums. Up to one hundred 55-gallon drums of chloroacetophenone (CN) training agent(s) (a tear-causing compound) are believed to be buried at this site. In addition to CN, chloropicrin (PS), chloroform, carbon tetrachloride, and benzene may also be present. This site is located within 100 yards of on-base housing and within 500 feet of two potable water wells. Another potable water well is located about 800 feet from this site.

2.4.22 Site No. 76: MCAS Curtin Road Site. This site is at PWDM coordinates 23, L10/M10/N10. Drums were buried at this site on two separate occasions in 1949. The drums are believed to have contained some type of chloroacetophenone training agent (CN, CNC, CNB, CNS). Depending upon training agent type, other chemicals may be present including chloroform, benzene, carbon tetrachloride, and chloropicrin. Up to seventy-five 55-gallon drums may be present at this site located next to a residential area and within 1,000 feet of two potable water wells.

CLW

0000000735

SECTION 3. CONCLUSIONS

3.1 INTRODUCTION. Based on findings of the Initial Assessment Study (IAS), general and site-specific conclusions can be drawn regarding potential for contamination from past disposal of hazardous wastes.

3.2 GENERAL. At 54 of the 76 sites identified, there is little or no potential for harm to public health or the environment. This is because:

1. Most sites contain no significant amount of hazardous substances;
2. Potential for migration of wastes is small, or
3. Waste movement is not reasonably expected to cause exposure to humans or biological resources.

Potential for adverse impact exists at 22 sites (Nos. 1, 2, 6, 9, 16, 21, 22, 24, 28, 30, 35, 36, 41, 45, 48, 54, 68, 69, 73, 74, 75, and 76). Documentation of pollutant movement does not exist at most of these sites. At least some limited field investigation is needed to confirm or deny pollutant migration from suspected past disposal sites of hazardous wastes.

3.3 SITES NOT REQUIRING FURTHER ASSESSMENT. Sites judged not to need additional work are discussed below.

3.3.1 Inert Wastes. Twenty-five sites contain wastes which are inert, such as scrap wood, metal, and construction debris. These sites are Nos. 3, 4, 13, 14, 15, 17, 20, 25, 27, 32, 37, 38, 39, 40, 42, 46, 47, 50, 55, 57, 58, 59, 61, 62, and 63.

3.3.2 Nonverification of Sites. Five sites (Nos. 8, 11, 23, 26, and 72) were reported as possible hazardous wastes sites prior to or during the IAS. However, further investigation has revealed that, while hazardous materials may have been stored there, no spills or disposal of materials occurred.

3.3.3 Petroleum, Oil, Lubricant (POL) Spills with Insigificant Migration Potential. Although spills of POL have occurred at 9 sites (Nos. 5, 31, 33, 34, 52, 53, 56, 64, and 66), significant contamination is not expected because of the small quantities involved or the considerable distance to receiving streams, or both.

3.3.4 Landfilled or Open Dumped Waste in Small Quantities. At 14 sites, quantities of wastes, whether hazardous or not, were judged to be insignificant. These sites are Nos. 7, 10, 12, 18, 19, 43, 44, 49, 51, 60, 65, 67, 70, and 71.

3.3.5 Permitted Sites. The existing base sanitary landfill (Site No. 29) is a permitted site and therefore requires no further NACIP action.

3.4 SITES REQUIRING FURTHER ASSESSMENT.

3.4.1 Site No. 1: French Creek Liquids Disposal Area. Waste POL and used battery acid may threaten a potable water well at Building 636. Potential also exists for pollutant migration off-site into Cogdels Creek and then into the New River. Hence, adverse public health and/or environmental impacts are possible.

3.4.2 Site No. 2: Former Nursery/Day-Care Center. Residual pesticides may exist in soils and drainage conveyance sediments. Potential exists for movement to potable groundwater and Overs Creek. Therefore, adverse public health and/or environmental impacts are possible.

3.4.3 Site No. 6: Storage Lots 201 and 203. Residual from past disposal and spills of DDT may be present in great enough amounts to move off-site to surface waters (Wallace and Bearhead Creeks) and impact the aquatic environment.

3.4.4 Site No. 9: Fire Fighting Training Pit at Piney Green Road. Residual POL from fire fighting training potentially threatens surface waters (Bearhead Creek) with possible adverse health and/or environmental impacts.

3.4.5 Site No. 16: Montford Point Burn Dump, Site A. Asbestos on the ground poses a public health threat to persons being exposed to it. (Note: Mitigation has been undertaken.)

3.4.6. Site No. 21: Transformer Storage Lot 140. Transformer oil, possibly containing PCBs, may have seeped into the groundwater table and may be migrating toward potable water wells. Residual pesticides in the soil and in the drainage ditch sediment may threaten human health by direct contact. Migration potential to Bearhead Creek exists, hence, adverse public health and/or environmental impacts are possible.

3.4.7 Site No. 22: Industrial Area Tank Farm. Fuel leakage may have produced residual contamination of soils with potential for movement to potable groundwater (e.g., Well No. 602).

3.4.8 Site No. 24: Industrial Area Fly Ash Dump. Past disposal of fly ash and solvents may result in migration of harmful substances to Cogdels Creek with adverse public health and/or environmental impacts.

3.4.9 Site No. 28: Hadnot Point Burn Dump. Residuals from past industrial waste disposal potentially threatens Cogdels Creek, the New River, and a recreation pond with adverse health and environmental impacts.

3.4.10 Site No. 30: Sneads Ferry Road--Fuel Tank Sludge Area. Sludge deposits from fuel storage may leach hazardous fuel additives. Subsequent migration to French Creek could result in environmental degradation.

CLW

0000000737

3.4.11 Site No. 35: Camp Geiger Area Fuel Farm. Hazardous chemicals in residuals from past fuel spills may presently exist in soils. Migration of these chemicals to nearby Brinson Creek could adversely impact the aquatic environment.

3.4.12 Site No. 36: Camp Geiger Area Dump Near Sewage Treatment Plant. Solvents, waste oils, and hydraulic fluids in the landfill may move through the soil to contaminate nearby Brinson Creek or roadside drainage ditches flowing to Brinson Creek. Adverse effects on stream biota could then occur.

3.4.13 Site No. 41: Camp Geiger Dump Near Former Trailer Park. POL, solvents, Mirex, and lead from batteries are among hazardous substances which were disposed of at this site. These substances may migrate to tributaries of Southwest Creek, thereby causing environmental harm. Some ordnance was disposed of at this site and may pose a health hazard during on-site investigations or construction.

3.4.14 Site No. 45: Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm at MCAC New River. As a result of fuel spillage/leakage, tetraethyl lead and hydrocarbons may move through the soils to nearby drainage ditches and eventually to Southwest Creek or potable water wells.

3.4.15 Site No. 48: MCAS New River Mercury Dump Site. Mercury dumped on or in the ground near the New River may be migrating to the river causing toxic effects to stream biota and persons consuming fish.

3.4.16 Site No. 54: Crash Crew Fire Training Burn Pit at MCAC New River. Harmful substances (e.g., lead) in waste fuels, oils, and solvents may still remain in the soils near the pit. Potentially, they could migrate toward and into drainage ditches flowing to Southwest Creek and cause adverse impacts on aquatic systems.

3.4.17 Site No. 68: Rifle Range Dump. Solvents may have been disposed of in large enough quantities to be migrating downgradient to Stone Creek or moving upgradient into potable wells (e.g., Well Nos. RR-45 and RR-97).

3.4.18 Site No. 69: Rifle Range Chemical Dump. Toxic substances (including pesticides, PCBs, pentachlorophenol, and TCE) may be moving toward and into waters of Everette Creek or other unnamed tributaries of the New River. This poses threats to human health, via fish consumption or direct contact, and the environment. Troop training in the area occurs and risks of direct exposure to persons exist.

3.4.19 Site No. 73: Courthouse Bay Liquids Disposal Area. Waste motor oil and battery acid potentially could migrate into Courthouse Bay. Phenolics and heavy metals (e.g., lead and antimony) may be associated with these materials. A small potential exists for contamination of a potable water well (i.e., near Building A-5). Therefore, adverse public health and/or environmental impacts are possible.

CLW

0000000738

3.4.20 Site No. 74: Mess Hall Grease Pit Area. Spilled DDT solution and buried drums of PCB oil, pesticides, and other wastes may cause groundwater contamination and pose a threat to human health via potable water well contamination.

3.4.21 Site No. 75: MCAS Basketball Court Site. Buried drums of waste, probably training agent(s), may threaten potable water wells and a water treatment plant pond with contamination by training agent and associated solvents.

3.4.22 Site No. 76: MCAS Curtis Road Site. Buried drums, possibly containing either dry or dissolved training agent(s), may contaminate groundwater and migrate to existing potable water wells.

SECTION 4. RECOMMENDATIONS

4.1 INTRODUCTION. No further work is recommended at 54 of the 76 sites identified during the Initial Assessment Study (IAS). In this section, specific suggestions are made for further study at the remaining 22 sites judged to require confirmation investigation. Recommendations for confirmation studies are made only for sites located on military property or adjacent surface waters where comingling of on and off property waters typically occurs. Specifically excluded are any recommendations regarding interim measures at prospective confirmation study siter and sites not located on military property.

Recommendations typically involve field work which varies in effort according to perceived magnitude and extent of contamination potential. Important information at sites may remain to be gathered during confirmation. This is because the purpose of the IAS study has been to determine contamination potential, and at many sites, this has been satisfactorily assessed without processing all information which may be relevent to a confirmation investigation. For example, at some sites, precise location of site boundaries remain inexact, and an important aspect of confirmation will be to better define them.

Hazardous waste sites identified by the IAS team were evaluated using a Confirmation Study Ranking System (CSRS) developed by Naval Energy and Environmental Support Activity (NEESA) for the Navy Assessment and Control of Installation Pollutants (NACIP) program. The system is a two-step procedure for systematically evaluating a site's potential hazard to human health and the environment, based on evidence collected during the IAS.

Step one of the system is a flowchart which eliminates innocuous sites from further consideration. Step two is a ranking model which assigns a numerical score within a range of 0 to 100, to indicate the potential severity of a site. Scores are a reflection of the characteristics of the wastes disposed of at a site, contaminant migration pathways, and potential contaminant receptors on and off the installation. CSRS scores and engineering judgment are then used to evaluate the need for a confirmation study based on the criteria stipulated in Section 1.3. CSRS scores assigned to sites recommended for confirmation studies also assist Navy managers to establish priorities for accomplishing the recommended actions.

A more detailed description of the Confirmation Study Ranking System is contained in NEESA Report 20.2-042.

4.2 OVERVIEW OF THE RECOMMENDATIONS PROCESS. Recommendations are presented in the following section for additional investigation at each site requiring confirmation. A confirmation study may require multiple sampling efforts before concluding that a problem does not exist. Movement of pollutants in groundwater may be very slow and/or nonuniform, so that sample wells may not draw from affected parts of the aquifers.

CLW

Therefore, in addition to sampling results, recommendations and conclusions should be based on all facts known about a site, including the types and quantities of waste, hydrogeology, and potential routes of pollutants back into the environment. Detection of pollutants in groundwater samples is generally conclusive evidence, but negative results for a limited number of samples does not prove that pollutants are not and/or will not be present.

Recommendations (intended to be used as general guidance for subsequent investigation) are presented on a site-by-site basis using the following format:

Problem: A short statement indicating types of materials involved. Information regarding type of potential environmental contamination may also be given.

Goal: A concise statement addressing specific confirmation objectives.

Approach: An overview of general strategy applied.

Wells: General instructions for siting wells, if used.

Samples: General directions giving types and numbers of soil, sediment, groundwater, or surface water samples specified. General location for samples, other than wells, is often included.

Frequency: A brief specification of when, and over what period, to collect the various types of samples.

Analyses: Specification of information to be collected for each different type of sample. Generally, laboratory analyses are specified, but relevant supporting information may also be noted.

Frequency and analyses specifications are omitted if no samples are recommended.

4.3 SUMMARY OF RECOMMENDATIONS. Recommended principal activities are summarized in Table 4-1. For each site, the suggested number of well installations is shown. Total number of analyses required in well water, surface water, surface water sediments, and soils is shown for a 1-year period. Constituents recommended for analysis and frequency (where repetitive sampling is recommended) are also indicated.

Table 4-1 should be used with the detailed recommendations given for each site in Section 4.4.

4.4 SPECIFIC RECOMMENDATIONS BY SITE. Recommendations for confirmation work at specific sites are outlined below. Details for monitoring-well construction are given in Appendix A.

CLW

Table 4-1. Summary of Recommended Field Work

Site No.	CSRS Score and Study Type*	Wells to be Installed	Samples				Frequency†	Constituents**
			Wells	Surface Water	Sediments - S or Tissues - T	Soil Cores		
1	17C	7	16	-	-	-	2	SC, pH, o & g, Antimony, Chromium, Lead, Zinc Phenolics
2	27C	0	8	-	-	-	2	Cl pest, P pest, herb.
			-	-	4S	8	1	Cl pest, P pest, herb.
6	37V	0	0	-	-	20	1	DDT-R
9	19C	3	8	-	-	-	2	Aromat, TOX, phenolics
16	17	0	-	-	-	-	-	-
21	27C	3	12	-	-	-	2	Cl pest, PCBs
			-	-	2S	8	1	Cl pest, P pest, herb.
22	15C	2	6	-	-	-	2	Aromat/Pb
24	19C		-	-	5S	-	1	Metals A
			-	2	-	-	1	Metals A, F, SC, pH
		6	12	-	-	-	2	Metals A, F, SC, pH, TOX
28	17C		-	-	3S	-	1	o & g, Metals C, PCBs, Cl pest,
					2T		1	Cl pest
		5	10	6	-	-	2	o & g, Metals C, GWCI
30	11C	3††	6	-	-	-	2	SC, o & g, Pb
			-	-	-	5	1	o & g, Pb
35	6V	0	-	-	-	24	1	o & g, Pb
36	9C	5	10	-	-	-	2	GWCI
41	26C	4	8	-	-	-	2	GWCI, Cl pest
45	18C	0	-	-	3S	30	1	o & g, Pb
			2	-	-	-	2	Pb, Aromat

CLW

Table 4-1. Summary of Recommended Field Work (Continued, Page 2 of 2)

Site No.	CSRS Score and Study Type*	Wells to be Installed	Samples				Frequency†	Constituents**
			Wells	Surface Water	Sediments - S or Tissues - T	Soil Cores		
48	30C	6††	12	-	-	-	2	Total Hg
54	11V	0	-	-	-	24	1	o & g, Pb
68	17C	6	12	-	-	-	2	PHH, o & g
			8	-	-	-	4	PHH, o & g
69	47C	12††	36	3	-	-	3	GWCI, o & g, Cl pest, PCBs, Hg, Residual Chlorine, TCE, PCP
		6	18	-	-	-	3	GWCI, o & g, Cl pest, PCBs, Hg, Residual Chlorine, TCE, PCP
73	23C	4††	10	-	-	-	2	SC, pH, o & g, Antimony Chromium, Lead, Zinc Phenolics
74	24C	4	10	-	-	-	2	GWCI, Cl pest, PCBs
75	23C	4	14	2	-	-	2	GWCI, benzene
76	23C	3	10	-	-	-	2	GWCI, benzene

* Confirmation Study Ranking System Score is the numerical value; "C" indicates Characterization Study and "V" indicates Verification Study.

† Number of samplings during initial year of program. Additional sampling may be required.

** Key to constituent abbreviations:

Cl pest. - Organochlorine pesticides including DDT-R
P pest. - Organophosphorous pesticides
DDT-R - DDT and residues
o & g - Oil and grease
PHH - Purgeable halogenated hydrocarbons
TOC - Total organic carbon
SC - Specific conductance
Metals A - Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, and Zinc.
Metals B - Antimony, Chromium, Lead, and Zinc.
Metals C - Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, and Zinc.
GWCI - Groundwater contamination indicators, i.e., SC, pH, TOC, TOX (total organic halogen)
TOX - Total organic halogen
TCE - Trichloroethylene
Herb. - Phenoxyalkanoic acid herbicides
PCP - Pentachorophenol
Aromat - Aromatics commonly found in fuels, e.g., benzene, toluene, xylene

†† Hand-augered wells.

Source: WAR, 1982.

4.4.1 Core sampling is generally specified as at 1- to 2-foot intervals down into the water table. This spacing is based on an assumed depth to groundwater of 5 to 10 feet (i.e., 4 or 5 total samples). If depth to groundwater is greater, intervals should be selected to yield 4 or 5 samples between the surface and 1 foot below the water table. Core holes should be filled with cement grout following samplings.

4.4.2 Lead analysis has been specified in certain instances of potential gasoline contamination. Other hazardous substances may also be present in fuels, e.g., benzene. However, lead is considered a useful indicator and is a toxicant in some fuels.

4.4.3 Upgradient wells to document background groundwater quality are specified at many sites. Where several sites are relatively close, one or two background wells may serve more than one site.

4.4.4 Static and dynamic (if appropriate) water levels should be measured whenever wells are sampled. Provisions should be made to permit referencing levels to appropriate data [e.g., mean sea level (msl)].

4.4.5 Whenever DDT-R is recommended for analyses, this refers to analyzing o,p' and p,p' isomers of each of the following: DDT, DDD, and DDE (i.e., a total of six individual compounds).

4.4.6 Analyses denoted as RCRA groundwater contamination indicators refer to specific conductance, pH, total organic carbon (TOC), and total organic halogen (TOX).

Site No. 1: French Creek Liquids Disposal Area

Problem: Uncontained disposal of POL and used battery acid has occurred. Radiator flushing containing dichromate probably occurred. There is potential for migration to groundwater and less potential for surface water contamination. A potable water well is located in the vicinity.

Goal: Determine magnitude of disposal area and assess potential for migration.

Approach: Conduct an inspection of the site to determine boundaries. Install wells and sample shallow groundwater.

Wells: Use existing well (Building 636). Install a total of seven shallow wells--three at downgradient edge of each disposal area and one background, shallow well east of Daly Road and south of Main Service Road.

Samples: Sample each well.

Frequency: Wells: Sample twice, separated by 2 to 3 months

Analyses: Test for specific conductance, pH, oil and grease, phenolics, antimony, chromium, lead, and zinc.

Site No. 2: Former Nursery/Day-Care Center at Building 712 (Formerly the Pest Control Shop)

Problem: This building (presently closed to use) and an adjacent area across the railroad tracks was formerly the pesticide storage and handling facility. Residual pesticides in the soil and the building may pose health risks to supervisory personnel and small children. Preliminary sampling results are shown in Table 2-1. An adjacent drainage creek (ditch) probably received washout and spills. A playground, an old wash pad, an old mixing area, and an old storage area are involved.

Goal: Determine types and amounts of pesticides in the building and playground area, remainder of the area, and in the creek sediments. Determine if pesticides have migrated to nearby wells.

Approach: Collect cores from three sites in the playground. Conduct a thorough inspection of other outdoor areas (both inside and outside the fence) where mixing and handling occurred and obtain three additional soil samples. Collect two soil samples from storage area east of railroad tracks. Examine the building thoroughly and sample for pesticide residue or volatile Chlordane. Sample creek sediments. Collect samples from water supply wells nearby.

Wells: Use existing Well Nos. 645, 646, 647, 616.

Samples: In playground, take 18-inch-deep cores of soil from three separate locations. In other outdoor areas (washing, mixing, and storing), take one 18-inch-deep core from each area (See Section 4.4.1). From building, sample air for volatiles plus, from most used rooms, the residue samples from places likely to harbor fugitive substances, e.g., behind moldings. In creek, take sediment samples at four places: immediately downstream of site, about 1,400 feet downstream near Well No. 646, about 4,000 feet downstream above confluence with Overs Creek, and in Overs Creek upstream of creek widening at Northeast Creek. In wells, sample each well.

Frequency: Sample sediments and soils once. In wells, sample twice, separated by three months. If residuals are present, then further intensive sampling is needed to determine extent and distribution of contamination.

Analyses: For soils, sediments, well, and residues, test for organochlorine pesticides, including DDT-R, phenoxy alkanoic acid herbicides (including 2,4,5-T), malathion, diazinon. For air in the building, test for volatile Chlordane and Dieldrin.

CLW

0000000746

Site No. 6: Transformer Storage Lots 201 and 203

Problem: DDT contamination of soils due to burial in northeast section of Lot 203 and spills.

Goal: Determine presence of DDT in soils.

Approach: Sample soils in vicinity of suspected dumping and spilling of DDT. Emphasize areas radially from the four DDT-related locations.

Samples: At each of the four spill locations, select five places to obtain cores (i.e., 20 samples total). Unless there are on-site indications to concentrate sampling places, encircle locations. At each of the five sampling places, within an approximately 3-foot-diameter circle, take approximately four shallow cores 12 inches deep to produce a single composite sample totaling about 3 kilograms (kg) of soil. At the DDT dump, deeper cores may be necessary (see Section 4.4.1).

Frequency: Sample once.

Analyses: Analyze for DDT-R.

Site No. 9: Fire Fighting Training Pit at Piney Green Road

Problem: Contaminated fuels and smaller amounts of solvents and other Petroleum, Oil, Lubricants (POL) compounds have been used at this site with potential contamination of soil and water table.

Goal: Determine if POL and solvent compounds are present and if migration has occurred.

Approach: Sample groundwater and determine contamination from fuel or solvents. Even though pit is now lined, a plume of material may have moved downgradient during approximately 20 years before lining. Therefore, collect samples adjacent to and downgradient of pit. Well HP-635 is approximately 500 feet away. Although not downgradient, it is pumping and should be sampled.

Wells: Use Well No. 635 and install two downgradient wells and one well adjacent to pit.

Samples: Sample each well. Static and dynamic water levels should be recorded referenced to datum (see Section 4.4.1).

Frequency: Sample each well twice, 3 months apart.

Analyses: Analyze for aromatics commonly found in fuels (e.g., benzene, toluene, xylene) TOX and phenolics. Measure thickness of any POL layer encountered.

Site No. 16: Montford Point Burn Dump

Problem: Unauthorized dumping of asbestos here.

Goal: Confirm quantity of asbestos on land surface in order to estimate cleanup effort. Alternately, proceed directly to clean up and remove friable asbestos to an appropriately operated landfill.

Approach: Conduct a careful inspection of the site. Alternately, collect asbestos material on ground surface and dispose in an approved manner.

Samples: None

NOTE: Corrective action has been initiated.

Site No. 21: Transformer Storage Lot 140

Problem: Pesticide handling and mixing, and cleaning of pesticide contaminated equipment occurred at this site and soil contamination is probable. Storm water runoff may carry pesticides into Bearhead Creek via a railroad track drainage ditch adjacent to Storage Lot 140. Potential PCB disposal in pit may have contaminated groundwater with subsequent movement to potable wells (Pump Houses 602, 634, and 637).

Goal: Determine types and amounts of pesticides at Storage Lot 140 (to include the rinse pad, mixing area, and adjacent areas), and in drainage ditch sediment. Determine PCB content in groundwater between pit site and wells. Sample existing wells.

Approach: Collect soil and ditch sediment samples and install monitoring wells. Inspect site to determine if the 1958 to 1977 surface material has been covered by new material. Emphasize areas adjacent to wash pad and in mixing area.

Wells: Install three monitoring wells approximately 100 feet from pit site in directions of potable wells. Also use existing wells.

Samples: Collect soil samples at two depths from each of four places (i.e., eight samples total). Locate four places as follows: two in lot near the southeast corner, plus two outside lot in areas apparently within surface drainage route. Sample two depths: upper 6 inches and 12 to 18 inches below the surface. Insure that sampled soil is not fill material.

Collect ditch sediment samples at two locations: downstream end of Storage Lot 140 and immediately upstream of Sneads Ferry Road.

Frequency: Sample each well. Soil and sediment: sample once. Wells: sample twice.

Analysis: For soils and sediments, test for organochlorine pesticides including DDT-R, organophosphorus pesticides, phenoxy alkanoic acid herbicides (including 2,4,5-T). For wells: test for organochlorine pesticide scans (including PCBs).

CLW

0000000750

Site No. 22: Industrial Area Tank Farm

Problem: Fuels amounting to 20,000 to 50,000 gallons leaked into soils around tank farm. There is potential for migration to a potable well, i.e., Well No. 602.

Goal: Determine whether fuel components are present in groundwater at Well No. 602 or between site and Well No. 602.

Approach: Sample groundwater from two new wells and from Well No. 602, which is 1,100 feet downgradient and pumping.

Wells: Use existing Well No. 602. Install two new wells at approximately third points between site and Well No. 602.

Samples: Sample all wells.

Frequency: Sample well water twice, separated by 2 to 3 months.

Analyses: Analyze for aromatics commonly found in fuels (e.g., benzene, toluene, xylene) and lead. Measure thickness of any POL layer present.

CLW

0000000751

Site No. 24: Industrial Area Fly Ash Dump

Problem: Disposal of fly ash, sludges from water and wastewater treatment plants, and solvents has occurred. There is potential for migration to groundwater and/or surface water.

Goal: Determine whether hazardous wastes are present and assess potential for migration.

Approach: Conduct an inspection of the site to determine boundaries. Install wells and sample groundwater. Sample sediments and water in adjacent creek.

Wells: Install five wells at the downgradient edge of the site and one upgradient to establish background.

Samples: Sample each well. For creek sediments, take samples from four places near site plus one place about 1,000 feet downstream. Sample creek water at two locations below site (approximately east of Building 1775 and about 1,000 feet further downstream).

Frequency: For wells, sample twice in wet season, separated by 2 months. For sediments and water, sample once.

Analyses: For surface water, analyze for specific conductance, pH, fluoride and heavy metals (see list below). For groundwater, analyze for TOX (as an indicator of paint stripping solvents) plus surface water constituents with static water levels in wells referenced to msl. For sediments, test for metals only.

Note: Metals: Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, and Zinc.

CLW

0000000752

Site No. 28: Hadnot Point Burn Dump

Problem: Domestic and industrial wastes were disposed of at this site.

Goal: Determine whether hazardous wastes are present in groundwater near creek and assess potential for migration. Check on potential impacts on recreational pond fishes.

Approach: Conduct a careful inspection of the site to better define boundaries to insure proper well siting. Install wells and sample surface water and sediment in Cogdels Creek. Sample fish from the pond for chlorinated organic compounds.

Wells: Install one well upgradient for background, one well downgradient of the dump on the east side of Cogdels Creek, and three wells between dump and either Cogdels Creek or the New River.

Samples: Sample each well. Sample water column and sediment from three creek locations: (1) upstream of dump, (2) adjacent to dump area, and (3) downstream at the mouth of Cogdels Creek. Sample one composite each for two edible fish species from recreation pond.

Frequency: For wells and water column, sample twice during the wet season, separated by 2 months. Sample sediments once.

Analyses: Analyze well and surface water for specific conductance, oil and grease, pH, metals, TOX and TOC. Analyze sediment for oil and grease, metals, PCBs, and pesticides. Static water level in wells should be referenced to common datum. Analyze fish composites for chlorinated pesticides.

Note: Metals--Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, and Zinc.

CLW

Site No. 30: Sneads Ferry Road Fuel Tank Sludge Area

Problem: Sludge or bottom deposits from a large fuel tank were disposed of on the ground.

Goal: Determine whether hazardous waste is present and migrating toward groundwater

Approach: Define location of dumping. Sample soil for substantial residuals. Sample groundwater toward French Creek using simple wells.

Wells: Use three hand-augered wells downgradient toward French Creek.

Samples: Sample each well. Take surface cores at 5 places near dumping sites (see Section 4.4.1).

Frequency: Sample each well twice separated by 2 to 3 months. Sample sediments once.

Analyses: Analyze for specific conductance, oil and grease, and lead.

Site No. 35: Camp Geiger Area Fuel Farm

Problem: Fuel spills have contaminated soils. There is a possibility of groundwater contamination.

Goal: Determine if soils and groundwater remain contaminated with Mogas containing tetraethyl lead.

Approach: Sample soil between leak and Brinson Creek to assess extent and location of residual contamination, and to assess potential for movement into Brinson Creek. Surface gradient to creek is near due east; however, exact path of spill migration is not documented. Therefore, sample soil at points along the topographic gradient, but at locations on each side of the gradient line passing directly through the leak.

Samples: Collect a total of 24 soil cores down to 1 foot below the water table at 1- to 2-foot increments. At each of six points, collect cores at 4 depths. Determine the six points as follows: Establish a line parallel to the gradient passing through the leak. Establish three perpendicular crosslines along the line: near leak, near creek, and intermediate. Along each crossline, core at two points, 50 to 100 feet on each side of original line (see Section 4.4.1).

Frequency: Sample once.

Analyses: Analyze for oil and grease and lead.

CLW

0000000755

Site No. 36: Camp Geiger Area Dump near Sewage Treatment Plant

Problem: Industrial wastes have been disposed of at this site.

Goal: Determine whether hazardous wastes are present and if migration has occurred.

Approach: Establish monitoring wells to document groundwater quality

Wells: Install a total of five wells: one background plus four downgradient, close to boundary, surrounding mound clockwise from north to south.

Samples: Sample each well.

Frequency: Sample twice, separated by 2 to 3 months.

Analyses: Analyze for RCRA groundwater contamination indicators (GWCI) with static water level referenced to msl.

Site No. 41: Camp Geiger Dump near former Trailer Park

Problem: Industrial wastes and pesticides have been disposed of here, resulting in potential contamination of groundwater and two small tributaries to Southwest Creek.

Goal: Determine whether groundwater is contaminated and whether migration has occurred toward nearby surface water.

Approach: Install four monitor wells, one upgradient and three downgradient. Suitability of existing Test Well Nos. 18, 19, 20, and 21 will be determined by Phase II geologists (see Appendix A). If any existing wells are found unsuitable, then casings should be removed and holes plugged. Downgradient wells should address potential movement to each small tributary and wetland.

Wells: See above.

Samples: Sample each well.

Frequency: Sample twice in a 3-month period during wet season.

Analyses: Analyze for RCRA groundwater contamination indicators and organochlorine pesticides with static water levels referenced to msl.

Site No. 45: Campbell Street Underground Avgas Storage and Adjacent JP Fuel Farm at Air Station

Problem: There is potential migration and groundwater contamination from fuels containing tetraethyl lead. A potable water well is located near drainage canal.

Goals: Determine if JP fuel has contaminated soils outside of the fuel farm or the groundwater or surface drainage. Determine extent of contamination of soil and surface drainage due to Avgas leak.

Approach: Sample soils near both sites to define extent of impact. Sample surface drainage canal which parallels roadway south (downgradient) of fuel farm. This ditch should intercept most southward surface and subsurface flow. Sample Well No. 4140, which is about 700 to 800 feet downgradient of sites and lies near the drainage ditch/canal.

Wells: Use existing Well No. 4140.

Samples: Sample Well No. 4140. In the drainage ditch/canal, sample bottom sediments at three places, i.e., near sites on Campbell Street, near Well No. 4140, and south of Schmidt Street (i.e., about 3,000 feet from site). For soil cores, select 10 coring locations--five locations around perimeter of both sites. At each location, collect cores at three depths from surface down to 1 foot below water table (see Section 4.4.1).

Frequency: Sample soils and sediments once. Sample Well No. 4140 twice, separated by 2 to 3 months.

Analyses: Analyze every soil sample for lead and oil and grease. For well water, analyze for aromatics commonly found in fuels (e.g., benzene, toluene, xylene) and for lead. Static and dynamic water levels should be referenced to common datum.

CLW

00000007 58

Site No. 48: MCAS New River Mercury Dumpsite

Problem: Metallic mercury may have been dumped over a 10-year period behind Building 804. No evidence has been found to indicate a central disposal place. It is surmised that disposal occurred at random places with each place containing relatively small amounts of mercury.

Goal: Determine whether mercury is in groundwater near river.

Approach: Install wells in line parallel to river. About 100 feet of shoreline is involved. Well spacing should be relatively close due to potential for several pockets of mercury to exist. Elaborate wells are not needed because mercury is only consitutent of interest.

Wells: Install six simple (hand-augered) monitoring wells.

Samples: Sample each well.

Frequency: Take initial samples, sample 6 months later, then sample annually.

Analyses: Analyze for total mercury.

Site No. 54: Crash Crew Fire Training Burn Pit at the Air Station

Problem: Contaminated fuels, including leaded fuel, and various POL compounds are used for training purposes. Spills may have contaminated the surrounding soil.

Goal: Determine whether soils in immediate area of site are contaminated and whether there is potential for POL to enter groundwater.

Approach: Sample the soil in immediate area.

Wells: None

Samples: Collect a total of 24 cores. Cores should be deep enough to extend 1 foot into groundwater table. Take samples at 1- to 2-foot intervals (i.e., four depths at each place). Locate cores six places around pit counter clockwise from northwest to southeast of the pit (i.e., between pit and drainage ditches). Core at places equidistant from pit and nearest ditch (see Section 4.4.1).

Frequency: Sample once.

Analyses: Analyze for oil and grease and lead.

Site No. 68: Rifle Range Dump

Problem: Solvents disposed of at this site may be affecting nearby potable wells.

Goal: Determine whether solvents are present and have moved upgradient to threatened potable wells.

Approach: Establish test wells upgradient and downgradient of dump site to be sampled in conjunction with nearby water supply wells. Upgradient wells used to assess possible migration toward potable water wells rather than to document background.

Wells: Install three wells downgradient of dump site to determine whether pollutants have moved toward Stone Creek. Install three wells upgradient between dump site and Well Nos. RR-45 and RR-97.

Sampling: Sample each well.

Frequency: Test wells are to be sampled twice, separated by 2 or 3 months. Well Nos. RR-45 and RR-97 are to be sampled quarterly.

Analyses: Analyze for volatile organic compounds and oil and grease with static and dynamic water levels referenced to msl datum.

Site No. 69: Rifle Range Chemical Dump

Problem: Hazardous wastes of various types were buried here over a period of years and may migrate to surface water or groundwater.

Goal: Determine whether wastes are migrating to groundwater or surface water in sufficient quantities to cause risk to health.

Approach: Remove old monitoring wells, plug holes, and put in properly installed wells. Because of multidirectional drainage, use a two-phase approach to help place final wells.

Surround site with simple observation wells (i.e., hand-augered, PVC) located about 100 feet outside site boundary. Use 12 wells about 250 feet apart. Collect soil strata data when installing bores. Soil data will be used to estimate hydraulic conductivities and potential groundwater movement patterns. Collect specific conductivity and pH data to provide general indicators of contaminant plume location. Obtain static water levels referenced to common datum to define potentiometric gradient. Use hydraulic conductivity, gradient, and quality data to locate areas (directions) of highest potential contaminant movement.

Based on this initial evaluation of three samplings (at 4 month intervals during 1 year), install approximately six monitoring wells to rigorously define contaminant migration, if any.

Document background from off-site wells. Sample some nearby surface seeps.

Wells: Install twelve initial observation wells down to 2 feet into water table, three in Everett Creek basin, three in basin to southeast plus six in basin to north, and six formal monitoring wells.

Samples: Sample each well and three seeps northward.

Frequency: Sample both wells and seeps every 4 months.

Analyses: Analyze for GWCI, oil and grease, organochlorine pesticides (including DDT-R), PCBs, TCE, pentachlorophenol, residual chlorine, mercury. Water levels are to be taken referenced to common datum.

Site No. 73: Courthouse Bay Liquids Disposal Area

Problem: Used vehicle battery acid and motor oil were disposed of at this site and may migrate to Courthouse Bay or a potable water well.

Goal: Determine presence and levels of metals, phenolics and oil in groundwater and determine if migration has occurred. Evaluate potential for corrosion damage to present or future structures (including underground pipes and cables) from acidic waste.

Approach: Sample groundwater between site and Courthouse Bay and at closest potable well.

Wells: Use existing Well Building A-5. Install four simple, hand-augered wells: one well up gradient of disposal area, three wells down gradient near the Courthouse Bay shoreline.

Samples: Sample each well.

Frequency: Sample twice, separated by 3 months.

Analyses: Test for antimony, chromium, lead, zinc, oil and grease, phenolics, specific conductance, and pH.

Site No. 75: MCAS Basketball Court Site

Problem: Disposal of drums, possibly containing training agents dissolved in solvents, may contaminate groundwater in the vicinity of the site. Three potable water wells (Pump House Nos. S-TC-1251, 106, and 203) and/or a pond containing water treatment plant filter backwash water may be affected.

Goal: Determine specific location of buried drums and whether groundwater is contaminated and if contamination has migrated toward wells or pond.

Approach: Survey site using geophysical techniques to identify specific location of drums. Install monitoring wells surrounding drums, approximately 100-200 feet from drum locations to identify plume movement and quantify contaminant concentrations. Sample backwash pond and existing wells.

Wells: Install 4 monitoring wells in shallow aquifer.

Samples: Sample each well and backwash pond.

Frequency: Sample twice, separated by at least 3 months.

Analyses: Analyze for RCRA groundwater contamination indicators (GWCI) and benzene.

Site No. 74: Mess Hall Grease Pit Area

Problem: Disposal of drummed wastes including pesticides and PCBs and possibly other wastes may contaminate groundwater near potable water well (Pump House No. 654).

Goal: Determine whether groundwater contamination has occurred and if migration of contaminants toward well has occurred.

Approach: Install three monitoring wells between grease pit/drum burial area and existing well. Install one monitoring well between pest control area and existing well. Sample potable well and verify screened depth.

Wells: Install 4 wells and screen to sample both the upper and lower portions of the unconfined aquifer.

Samples: Sample all five wells.

Frequency: Sample twice, separated by 2-3 months.

Analyses: Analyze for RCRA groundwater contamination indicators (GWCI) and organochlorine pesticides, to include PCBs.

Site No. 76: MCAS Curtis Road Site

Problem: Buried drums, possibly containing training agents, may contaminate groundwater in the vicinity of two potable water wells (Pump House Nos. 106 and 203).

Goal: Determine specific location of buried drums and if groundwater is contaminated and whether migration toward wells has occurred.

Approach: Survey site using geophysical techniques to identify specific location of drums. Install monitoring wells surrounding drums, approximately 100-200 feet from drum locations to identify plume movement and quantify contaminant concentrations. Sample existing wells.

Wells: Install 3 monitoring wells in shallow aquifer.

Samples: Sample each well.

Frequency: Sample twice, separated by at least 3 months.

Analyses: Analyze for RCRA groundwater contamination indicators (GWCI) and benzene.

CLW

0000000767

SECTION 5. BACKGROUND

5.1 GENERAL. Marine Corps Base (MCB) Camp Lejeune is on the coastal plain in Onslow County, North Carolina. The facility covers approximately 170 square miles and is bisected by the New River, which flows in a generally southeasterly direction. This system forms a large estuary before entering the Atlantic Ocean.

Eleven miles of Atlantic shoreline form the eastern boundary of Camp Lejeune. The western and northeastern boundaries are U.S. 17 and State Road 24, respectively. Jacksonville, North Carolina, acts as the northern boundary. The complex has a roughly triangular outline.

Development at the Camp Lejeune complex is primarily in five geographical locations under the jurisdiction of the Base Command. They include Camp Geiger, Montford Point, Mainside, Courthouse Bay, and the Rifle Range area. Marine Corps Air Station (MCAS) New River, a helicopter base, is a separate command on the west side of the New River. There are also two Outlying Landing Fields (OLFs) under control of MCAS New River. These are Helicopter Outlying Landing Field (HOLF) Oak Grove, approximately 25 miles to the north, and OLF Camp Davis, 10 miles to the southwest (NAVFACENGCOM, 1975).

North of the base, 2,672 acres have been used for the air station. In the past, training for fixed-wing aircraft was carried out. Presently, only helicopter training occurs here.

North of Camp Lejeune is HOLF Oak Grove. The field is no longer active and is under caretaker status. The property has some camping facilities and occasionally is used for recreation by scouting groups. Infrequent use is also made for ground troop exercises and helicopter landings. HOLF Oak Grove is on 976 acres in eastern Jones County.

Within 15 miles of Camp Lejeune are three large, publicly owned tracts of land--Croatan National Forest, Hofmann Forest, and Camp Davis Forest. Because of the low elevations in the coastal plain, wetlands form significant acreage. These areas, to some extent, have been exploited by agricultural and silvicultural interests. There is a growing concern on a state and national level that these ecosystems, unique to the coastal plain, require a protected status to survive.

For the most part, remaining land use is agricultural. Typical crops are soybeans, small grains, and tobacco.

Productive estuaries along the coast support commercial finfish and shellfish industries. Increased leisure time has boosted tourism and enlarged resort residential areas. This, in turn, has stimulated the regional economy.

According to the most recent master plan (NAVFACENGCOM, 1975), there are two major corridors of developable land in the area. These extend south from New Bern along U.S. 17 and U.S. 58, and from Swansboro northwest to Jacksonville and Richlands along Routes 24 and 258. The principal economic base is MCB Camp Lejeune and associated military activities. More than 46,000 military personnel are stationed at the base, and more than 110,000 people are either employed or are eligible for support (NAVFACENGCOM, 1975).

5.2 HISTORY. Site selection for "The World's Most Complete Amphibious Training Base" was made in the 1940s. Construction of the camp began in 1941 after extensive land acquisition and was named in honor of Lieutenant General John A. Lejeune, USMC (Odell, 1970).

During construction, 9 million board feet of timber were harvested from the reservation. In 1944, a sawmill with a daily capacity of 10,000 board feet was being operated by base maintenance personnel. The sawmill closed in 1954, when lumber needs were filled by contract.

Construction of the base started on Hadnot Point, where the major functions were centered. As the facility grew and developed, Hadnot Point became crowded with maintenance and industrial activities. The problem led to the creation of a master plan that addressed these and other present and potential problems.

During World War II, Camp Lejeune was used as a training area to prepare Marines for combat. This has been a continuing function of the facility during the Korean and Vietnam conflicts. Toward the end of World War II, the camp was designated as a home base for the Second Marine Division. Since that time, Fleet Marine Force (FMF) units also have been stationed here as tenant commands.

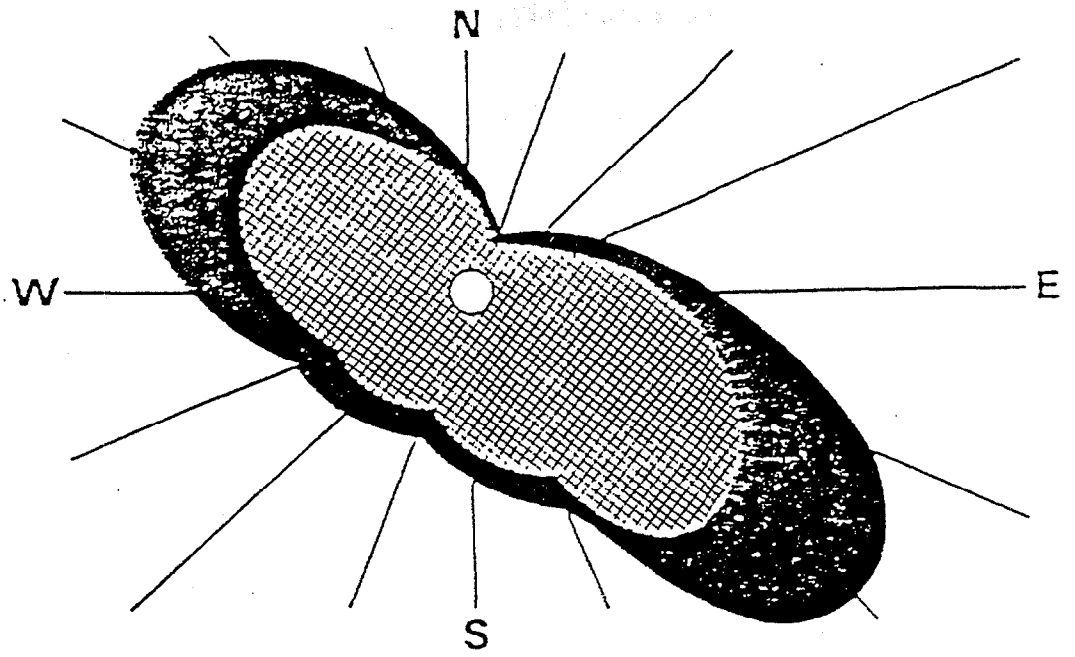
By 1945, construction in the Montford Point, Camp Geiger, and Courthouse Bay areas was complete. Montford Point, originally designated for training of troops, now is used for Marine Corps Service Support Schools. In the 1940s, recent recruits from Parris Island received tactical training at Camp Geiger. This practice has been discontinued, however. Courthouse Bay hosts amphibious training, while Paradise Point is still the site of housing commissioned personnel. Noncommissioned housing is provided in Tarawa Terrace I and II, Midway Park, and other designated areas.

The U.S. Naval Hospital opened in 1943 and has served military personnel during World War II and the Korean War. In addition, the hospital provides medical services for all assigned military personnel and their dependents. It once operated as a 500-bed unit, but has become obsolete, and a new medical center is under construction along Brewster Boulevard (NAVFACENGCOM, 1975).

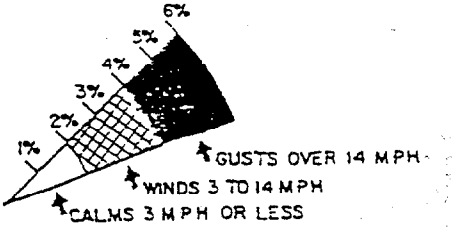
MCAS New River was set up as a separate command in 1951. At that time, it was called Peterfield Point, but the name was changed to

GLW

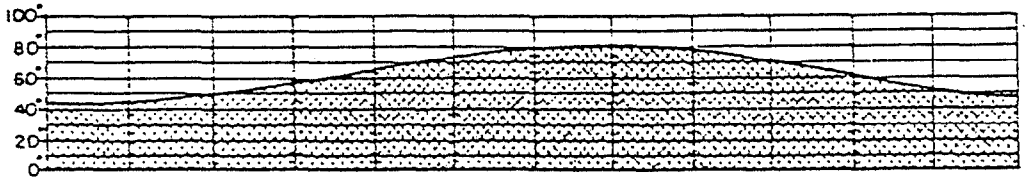
0000000769



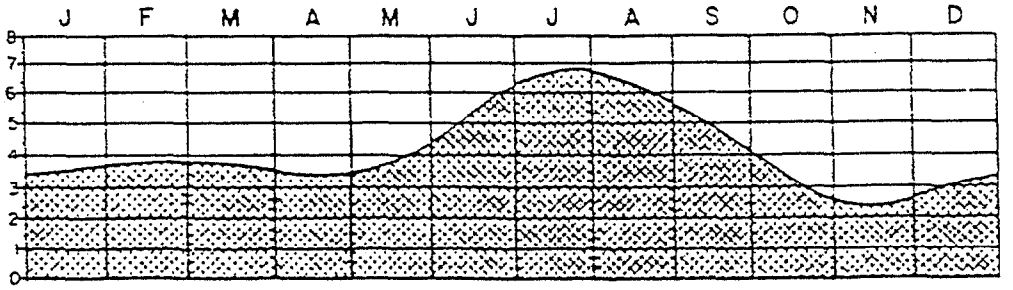
TYPICAL WIND PATTERN



% OF WIND COMING FROM INDICATED DIRECTION



AVERAGE MONTHLY TEMPERATURE



AVERAGE MONTHLY RAINFALL

CLW

0000000770

FIGURE 5–1

Regional Climatic Conditions in the Vicinity of MCB Camp Lejeune

SOURCE: NAVFACENGCOM, 1975

New River in 1968. In 1942, three new runways were added and the station came under the jurisdiction of MCAS Cherry Point. During this time, a PBJ squadron was based here and the facility was also used for glider training (NAVFACENGCOM, 1975). During the Korean War, it was used as a helicopter training base and for touch-and-go training for jet fighters (Natural Resource Management Plan, 1975).

In 1968, Marine Corps Outlying Landing Field (MCOLF) Oak Grove was placed under the jurisdiction of MCAS New River. The field was used as a helicopter base and renamed HOLF Oak Grove. During World War II, the field was under the command of MCAS Cherry Point. At the end of that war, all structures were destroyed with the exception of the runways.

5.3 PHYSICAL FEATURES.

5.3.1 Climatology. The North Carolina coastal plain area in which MCB Camp Lejeune is located is influenced by mild winters. Summers are humid with typically elevated temperatures. Rainfall usually averages more than 50 inches per year. Potential evapotranspiration in the region varies from 34 to 36 inches of rainfall equivalent per year (Narkunas, 1980). Winter and summer are the usual wet seasons. Temperature ranges are reported to be 33°F to 53°F during January and 71°F to 88°F in July (Odell, 1970).

Winds during the warm seasons are generally south-southwesterly while north-northwest winds predominate in winter. There is a relatively long growing season of 230 days. A summary of regional climatic conditions is shown in Figure 5-1.

5.3.2 Topography and Surface Drainage. The generally flat topography of the Camp Lejeune complex is typical of the seaward portions of the North Carolina coastal plain. Elevations on the base vary from sea level to 72 feet above msl; however, the elevation of most of Camp Lejeune is between 20 and 40 feet above msl. The coast is guarded by a 200- to 500-foot-wide barrier island complex. Elevations of the dune field on the barrier islands range from 10 to 40 feet above msl. Drainage at Camp Lejeune is predominately toward the New River, although areas near the coast drain directly toward the Atlantic Ocean through the Intracoastal Waterway. In developed areas, natural drainage has been changed by drainage ditches, storm sewers, and extensive concrete and asphalt areas. Drainage sub-basins for Hadnot Point area and MCAS New River are shown in Figures 5-2 and 5-3, respectively. Most sites evaluated in this study are in these two areas.

Approximately 70 percent of Camp Lejeune is in the broad, flat interstream areas (Atlantic Division, Bureau of Yards and Docks, 1965). Drainage here is poor, and the soils are often wet.

Flooding is a potential problem for base areas within the 100-year floodplain. The U.S. Army Corps of Engineers has mapped the limits of 100-year floodplain at Camp Lejeune at 7.0 feet above msl in the upper reaches of the New River (Natural Resource Management Plan,

CLW

0000000771

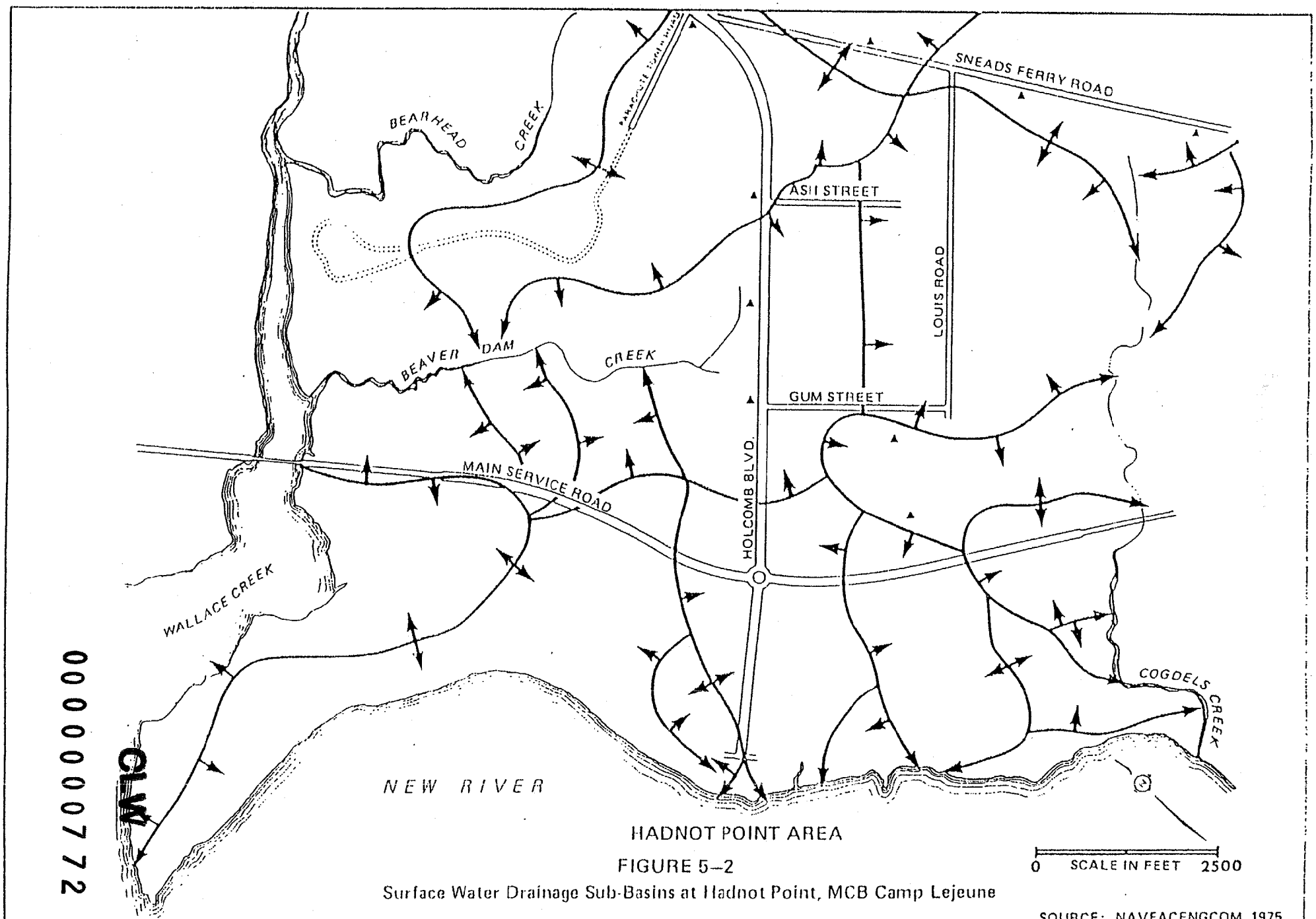


FIGURE 5–2

Surface Water Drainage Sub-Basins at Hadnot Point, MCB Camp Lejeune

SOURCE: NAVFACENGCOM, 1975

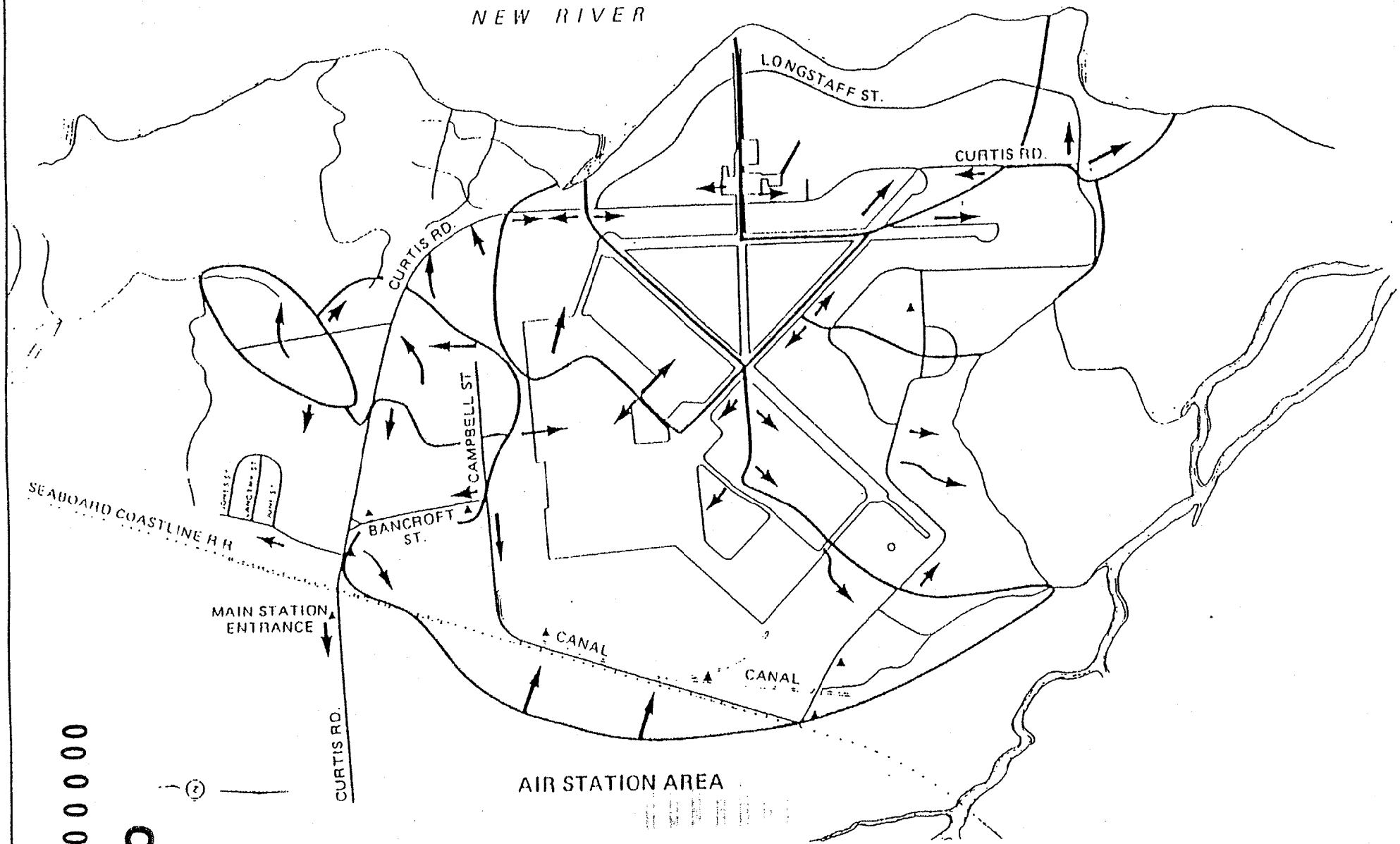


FIGURE 5–3
Surface Water Drainage Sub-Basin at MCAS New River, MCB Camp Lejeune

SOURCE I, 1982

Consulting Environmental Engineers and Scientists

CLW

0000007 3

1975). The elevation of the 100-year floodplain increases downstream and is 11.0 feet above msl on the open coast.

5.3.3 Geology. The geology of the Atlantic Coastal Plain physiographic province is typically a seaward-thickening wedge of sediments (Figures 5-4 and 5-5) on a basement complex of igneous and metamorphic rock similar to that at the surface in the Piedmont physiographic province. Sediments of the coastal plain vary in age from Cretaceous to Recent and consist of layers of sand, silt, clay, marl, limestone, and dolostone.

A mantle of Pleistocene and Recent sands and clays commonly covers the older sediments of the area. Beneath this mantle is a belted subcrop pattern with Cretaceous sediments nearest the surface in the west and progressively younger sediments nearest land surface toward the coast (Figure 5-6).

Although the sedimentary sequence is approximately 1,400 to 1,700 feet thick beneath MCB Camp Lejeune, only the uppermost 300 feet are pertinent to the purpose of this report because these strata contain the important water-bearing rocks at MCB Camp Lejeune.

The Eocene Castle Hayne Limestone consists of shell limestone, marl, calcareous sand, and clay. In Onslow County, the Castle Hayne varies in thickness from approximately 100 feet to more than 200 feet. Rocks of Oligocene age unconformably overlie the Castle Hayne. These sediments consist of fossiliferous limestone, calcareous sand, and clay and are equivalent to the Trent Formation according to recent correlation charts (Baum et al., 1979). In the subsurface of Onslow County, rocks of Oligocene age vary from approximately 40 feet to more than 200 feet thick (Brown et al., 1972).

The Yorktown Formation overlies the Oligocene and outcrops in a band east and south of Jacksonville. This unit consists of lenses of sand, clay, marl, and limestone. The Yorktown Formation has long been considered Late Miocene, but the latest correlation charts (Baum et al., 1979) date it in the Pliocene.

Pleistocene and Recent sands and clays mantle the older stratigraphic units in most of the study area and form the most seaward band of sediments. These sediments were deposited in Pleistocene and Recent time, when the retreat of continental glaciers raised sea levels.

5.3.4 Hydrology.

5.3.4.1 Surface Water. The dominant surface water feature at MCB Camp Lejeune is the New River. It receives drainage from most of the base. The New River is short, with a course of approximately 50 miles on the central coastal plain of North Carolina. Over most of its course, the New River is confined to a relatively narrow channel entrenched in the Eocene and Oligocene limestones. South of Jacksonville, the river widens dramatically as it flows across less resistant sands, clays, and marls

CLW

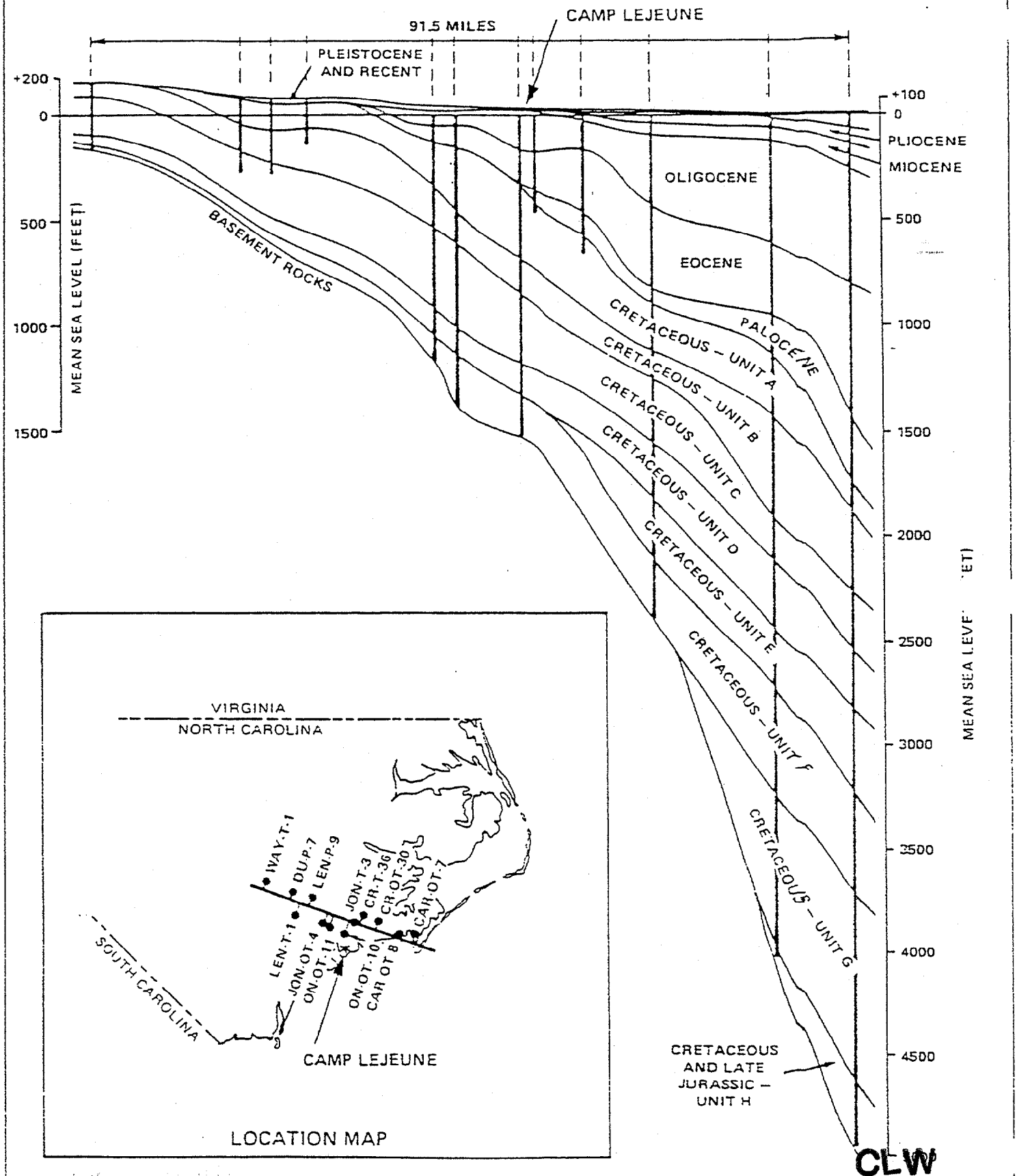


FIGURE 5–4

Geologic Cross Section From Wayne County, N.C. to Carteret County, N.C.

SOURCE: BROWN, ET AL., 1972

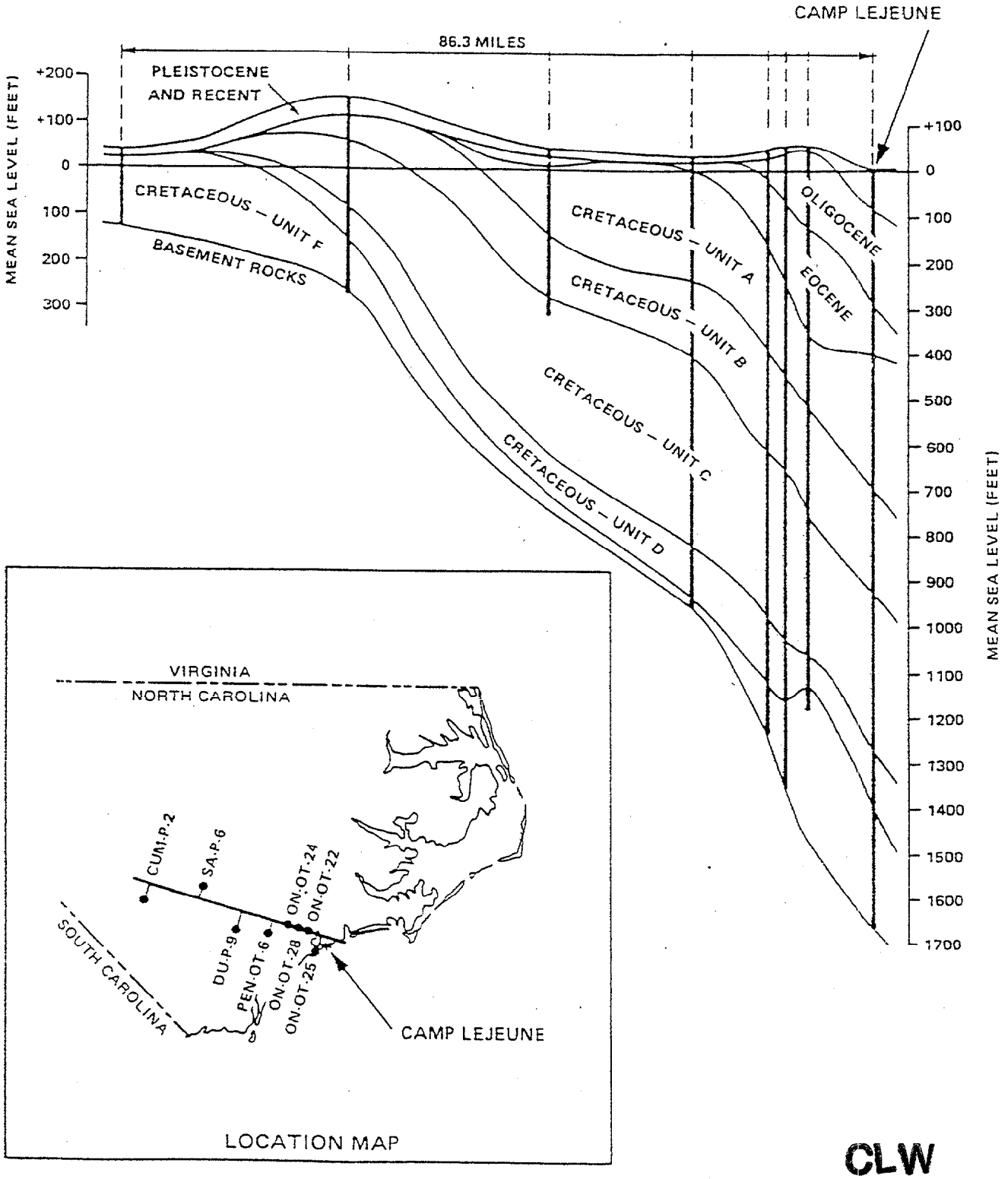


FIGURE 5–5

Geologic Cross Section From Cumberland County, N.C. to Onslow County, N.C.

CLW

00 00 00 07 76

SOURCE: BROWN, ET AL., 1972

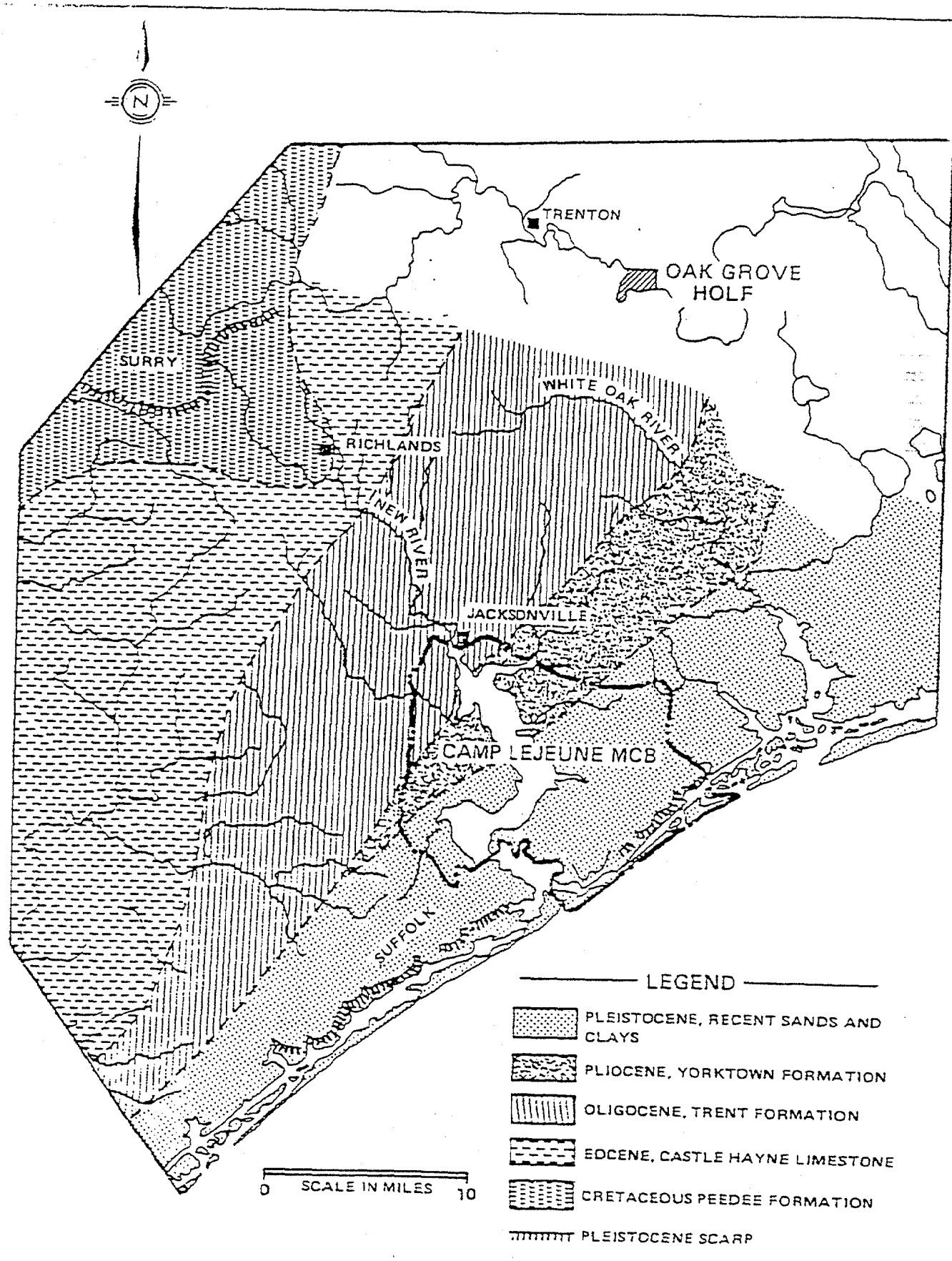


FIGURE 5–6

New River Area Geology

SOURCE: AFTER BURNETTE, 1967

CLW

0000000777

(Burnette, 1977). At MCB Camp Lejeune, the New River flows in a southerly direction and empties into the Atlantic Ocean through the New River Inlet. Several small coastal creeks drain the area of MCB Camp Lejeune that is not drained by the New River and its tributaries. These creeks flow into the Intracoastal Waterway, which is connected to the Atlantic Ocean by Bear Inlet, Brown's Inlet, and the New River Inlet.

Wilder et al. (1978) state the standard streamflow measurements employed by the U.S. Geological Survey are not applicable in low-gradient, tidal conditions. This is probably why streamflow in the New River below Jacksonville has not been determined. The tides at New River Inlet have a normal range of 3.0 feet and a spring range of 3.6 feet (U.S. Department of Commerce, 1979). The tidal range diminishes upstream to approximately 1 foot at Jacksonville (Howard, 1982). The flood tidal prism entering the New River Inlet in one tidal cycle was determined to be approximately 2.35×10^5 ft^3 (Burnette, 1977).

The average annual runoff of the MCB Camp Lejeune area has not been determined; however, Craven and Carteret Counties, to the northeast, have an average annual runoff of approximately 18 inches. The groundwater contribution to runoff in the same area northeast of MCB Camp Lejeune is estimated as 65 percent of total runoff (Wilder et al., 1978).

The water in the New River at MCB Camp Lejeune is brackish, shallow, and warm. Salinity is largely a function of distance from the ocean and rainfall. At Jacksonville, the New River may reach salinities of 10 parts per thousand (ppt) during extended periods of low rainfall. However, near the New River Inlet, salinity in the river is usually equivalent to that of sea water (35 ppt). Salinities near the inlet become significantly lower only during heavy rains (Burnette, 1977).

Water quality criteria for surface waters in North Carolina have been published under Title 15 of the North Carolina Administrative Code. The New River at MCB Camp Lejeune falls into two classifications (Figure 5-7). Classification SC applies to three areas of the New River at MCB Camp Lejeune. The best usage of Class SC waters is "fishing, secondary recreation, and any other usage except primary recreation or shellfishing for market purposes." The rest of the New River at MCB Camp Lejeune is Class SA, the highest estuarine classification. The best usage of Class SA waters is "shellfishing for market purposes and any other usage specified by the SB or SC classification."

5.3.4.2 Groundwater. The uppermost 300 feet of sediments at MCB Camp Lejeune is the source of fresh water for the base. Brackish water is usually found deeper than 300 feet below msl (Shiver, 1982). In general, the aquifer system consists of a water table aquifer and one or more semi-confined aquifers. Confining beds lie between the two aquifer systems and between the layers of the semi-confined aquifers. Variations in the local hydrogeology result from the complex depositional history of the area.

CLW

00000078

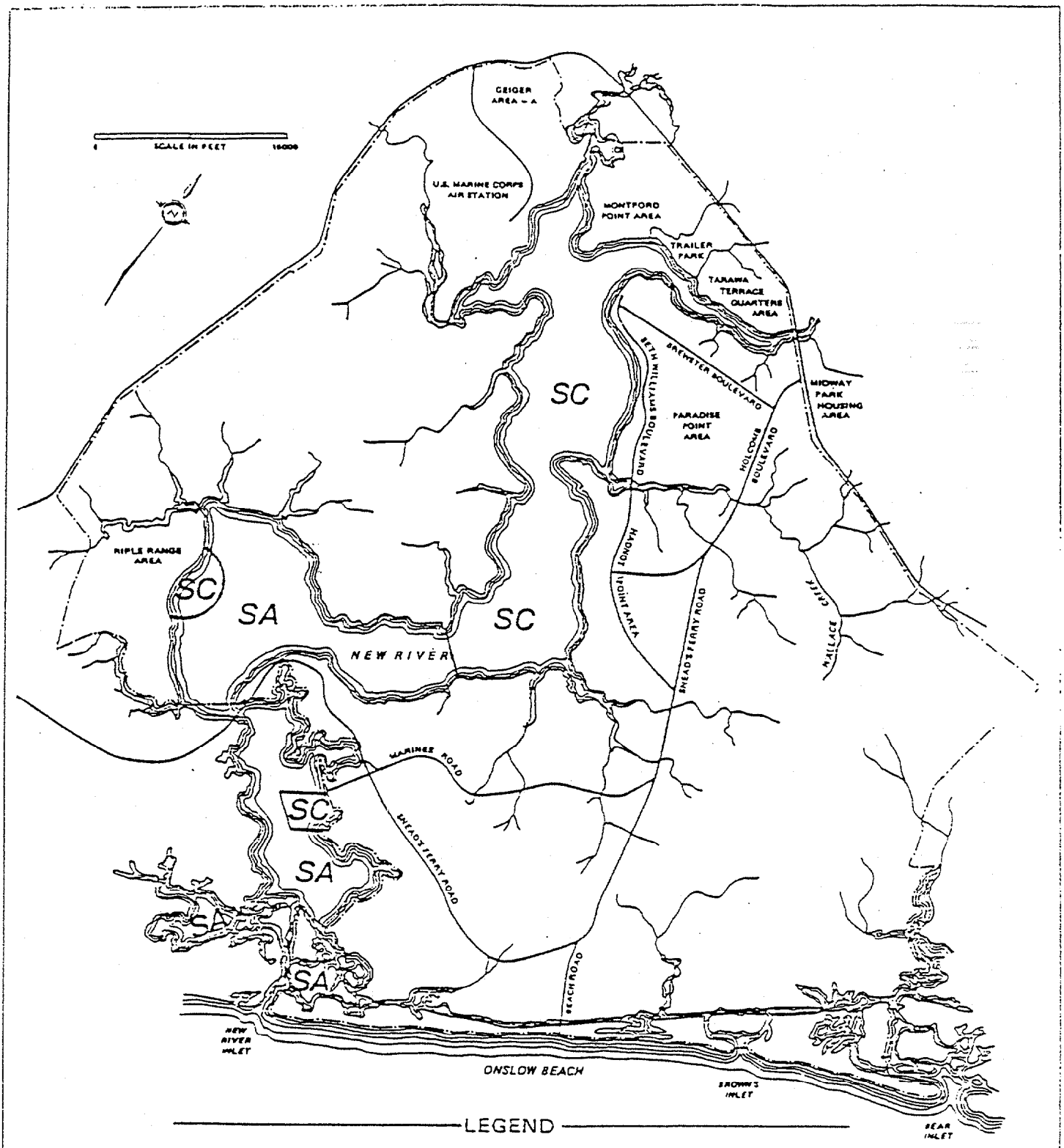


FIGURE 5–7
Water Quality Classifications for the New River at MCB Camp Lejeune

CLW

0000000779

SOURCE: NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES, 1977

The uppermost hydrogeologic unit, the water table aquifer, extends from land surface to the first confining bed. This aquifer consists of sand, silt, limestone, and small amounts of clay. These sediments are usually Pliocene and younger.

The water table aquifer is recharged when rainfall seeps into the ground and percolates into the zone of saturation. Depth to the zone of saturation is 10 feet or less at MCB Camp Lejeune (Atlantic Division, Bureau of Yards and Docks, 1965). Groundwater in the water table aquifer generally flows from upland areas toward stream valleys where it discharges to surface water. In interstream areas, some groundwater will flow from the water table aquifer to the first semiconfined aquifer as recharge, given favorable hydraulic gradient and geology. Recharge of the semiconfined aquifer may be expressed using Darcy's Law (Freeze and Cherry, 1979) as:

$$Q = \frac{h_1 - h_2}{m} \; k \; A$$

where: Q = Quantity of recharge per unit time,
h_1 = Hydraulic head in the water table aquifer,
h_2 = Hydraulic head in the semiconfined aquifer,
m = Thickness of the confining bed,
k = Hydraulic conductivity of the confining bed, and
A = Area for which recharge is calculated.

From this, it may be seen that groundwater will flow from the upper aquifer to the lower aquifer only if the hydraulic head in the water table aquifer is greater than the hydraulic head in the semiconfined aquifer. The thickness and lower hydraulic conductivity of the confining bed retard the flow of water between the two aquifers.

The semiconfined aquifer is composed of limestone and calcarous sands of the Eocene Castle Hayne Limestone, the Oligocene Trent Formation, and in some places, sand and limestone of the Pliocene Yorktown Formation. Regional groundwater flow in the semiconfined aquifer is toward the southeast. The regional flow is altered locally by pumping wells that penetrate this aquifer.

Narkunas (1980) reported that transmissivity of the limestone aquifer in the central coastal plain of North Carolina varied from 6,100 feet^2/day to 12,100 feet^2/day. Storage varied from 2.6×10^{-3} to 7.4×10^{-5}. Specific capacity of wells at MCB Camp Lejeune was reported as 5 to 10 gallons per minute per foot of drawdown (gpm/ft) in 1960 (LeGrand, 1960). Recent data indicate that the specific capacity of the wells tapping the semiconfined aquifer at MCB Camp Lejeune varies from less than 3 gpm/ft to approximately 20 gpm/ft.

The confining units, where present, consist of clay, sandy clay, silty clay, and occasionally dense limestone. These units occur as discontinuous lenses and may be present at any depth. A comparison of the logs for Well Nos. HP-613 and HP-616 (Appendix C) shows a reduction

CLW

0000000780

in the thickness of the confining bed from 27 feet to 6 feet in less than 2,000 feet. Many of the well logs for the base indicate that the confining units are either thin or absent. Wells in these areas withdraw at least some water from the water table aquifer.

5.3.4.3 Migration Potential. Pollutant migration potential is a function of both water movement potential and chemical and/or physical interactions of specific contaminants with specific environments. Regarding the latter, various contaminants can move greater or lesser distances depending upon such factors as: chemical reactions between contaminants and soils or strata; physical trapping of contaminants in strata voids; stratification caused by differences between contaminant densities and surface water or groundwater densities; and, solubility characteristics of specific contaminants among other factors.

Because these factors are site-specific, they cannot be discussed in detail in this background section. However, general characteristics of possible water movement and its effect on contaminant transport are discussed.

There are three potential migration pathways at MCB Camp Lejeune. In the first case, contaminants may be carried off-base by surface water drainage to the New River and its tributaries. The other two pathways are in groundwater. Contaminants entering the water table aquifer may then migrate to surface water, or they may migrate down into the semiconfined aquifer.

Surface water drainage is most rapid in the developed areas of the base where natural drainage has been modifed by ditches, storm sewers, and extensive areas of asphalt and concrete. Contaminants are most likely to be transported directly to surface drainage during periods of heavy rainfall. At other times, transport is likely to be to and through groundwater, except in areas adjacent to surface streams.

The water table aquifer is highly susceptible to contamination because it is composed predominantly of permeable materials at the earth surface. If a site is near a surface water feature, contaminants in the water table aquifer can be expected to move horizontally and toward the zone of discharge at the groundwater/surface water interface.

In the interstream areas (i.e., relatively distant from surface drainage), the horizontal component of flow will still tend to follow the topography, but under some circumstances a vertical flow may develop from the water table aquifer to the semiconfined limestone aquifer. These conditions depend on: (1) a hydraulic gradient from the water table aquifer toward the semiconfined aquifer, and (2) on the thickness and hydraulic conductivity of confining units. These factors are not well known at MCB Camp Lejeune. What is known is that conditions vary with locations.

In some areas, contamination of lower aquifers is very unlikely. For example, at Georgetown, near the Camp Geiger area, the hydrogeology tends to prevent migration of water from the water table

CLW

aquifer to the deeper aquifer (Division of Environmental Management, 1979). This is because the confining zone is approximately 50 feet thick and the hydraulic gradient is from the limestone aquifer toward the water table aquifer. These same conditions may be present in parts, but not all, of MCB Camp Lejeune.

Variability of the confining units decreases assurance of protection of the semiconfined limestone aquifer. Furthermore, although the hydraulic gradient between the water table and semiconfined aquifers is unknown at MCB Camp Lejeune, large-scale withdrawals of groundwater necessary to supply the base with water may have produced an overall decline of pressure in the semiconfined aquifer. This would tend to increase the potential for contaminant movement to the deeper aquifer.

Another possible factor affecting groundwater quality at MCB Camp Lejeune is the condition of abandoned wells. If a well is not properly sealed when abandoned, it may become a pathway for contaminants. Conversations with personnel at base maintenance and the water treatment plant have indicated that there is no inventory of abandoned wells nor are closure details available.

5.4 BIOLOGICAL FEATURES. The three forest areas surrounding Camp Lejeune--Croatan, Hofmann, and Camp Davis--provide extensive wildlife habitat. Animal life includes deer, black bear, turkey, squirrel, quail, rabbits, raccoons, muskrat, mink, and otter. The creeks, bays, swamps, marshes, and pocosins provide habitat for many types of birds, including egrets, fly catchers, woodpeckers, hawks, woodcocks, owls, bald eagles, peregrine falcons, and osprey. Reptiles include alligators, turtles, and snakes. Several species of the latter group are venemous. Freshwater fish in the streams and lakes of the forests include largemouth bass, redbreast sunfish, bluegill, chain pickerel, warmouth, yellow perch, and catfish. Trees found in the forests include loblolly, pond, longleaf, and shortleaf pines; sweet gum, tupelo gum, yellow-poplar, oak, red maple, sweet bay, and loblolly bay. In the pocosin wetlands, there is generally a shrub understory of evergreen and deciduous species. Several unusual plant species also can be found, including pitcher plants, sundews, and Venus flytraps (Richardson, 1981; Yong, 1982; Wilson, 1982).

The Camp Lejeune complex is predominantly tree covered, with large amounts of softwood (shortleaf, longleaf, pond, and primarily loblolly pines) and substantial stands of hardwood species. Timber-producing areas are under even-aged management with the exception of those along major streams and in swamps. These areas are managed to provide both wildlife habitat and erosion control. Smaller areas are managed for the benefit of endangered or threatened wildlife species such as the red-cockaded woodpecker.

Of Camp Lejeune's 112,000 acres, more than 60,000 are under forestry management. At the forests' borders are several species of shrubs, vines, and herbs. Acidic soils host carnivorous plants, including pitcher plants, sundews, and Venus flytraps. Forest manageme

CLW

0000000782

provides wood production, increased wildlife populations, enhancement of natural beauty, soil protection, prevention of stream pollution, and protection of endangered wildlife species (Natural Resource Management Plan, 1975).

Wildlife management at Camp Lejeune is based on guidelines in the United States Forest Service Wildlife Management Handbook. Upland game species (including deer, black bear, gray squirrel, fox squirrel, quail, turkey, and waterfowl) are abundant and are considered in the wildlife management program. There is an attempt to coordinate forest and wildlife management. Wildlife management is accomplished in part by providing a variety of habitats, including forests, perennial grass clearings, small-game strips, wildlife food plots, planted forest access roads, and plantings of shrub and fruit trees which produce edible seeds and fruits. Figure 5-8 presents the locations of wildlife food plots, fish ponds, wildlife openings, and small-game plots within the 14 wildlife units of the complex (Natural Resource Management Plan, 1975; NAVFACENGCOM, 1975).

Ecosystems discussed in this report will be broken into terrestrial (or upland), wetland, and aquatic communities.

5.4.1 Terrestrial Ecosystems. Camp Lejeune contains four upland habitat types (Natural Resource Management Plan, 1975). These are:

1. Longleaf pine,
2. Loblolly pine,
3. Loblolly pine/hardwood, and
4. Oak/hickory.

5.4.1.1 Longleaf Pine. Longleaf is the principal pine species and occurs on higher upland sites. Turkey, blackjack, post, and willow oaks, along with red bay, holly, and black gum, are the associated species. Gallberry, yaupon, low-bush huckleberry, titi, and chinquapin are also common in the understory. Herbaceous species include teaberry, ferns, and sawgrass. Quail and fox squirrel are common in this habitat and wild turkey find this forest type quite conducive for nesting and brooding range.

5.4.1.2 Loblolly Pine. Loblolly pine is the main timber stand of the area and many now grow on old farm homesteads. Persimmon, black cherry, red cedar, holly, dogwood, and scrub oak are common, while huckleberry, chinquapin, gallberry, beauty-berry, and wax myrtle make up the understory. Weeds and herbaceous plants include pokeweed, ragweed, smartweed, beggarweed, and partridge pea. Deer, turkey, gray squirrel, and quail are common in this forest type, especially if clearings are provided or prescribed burning is done to improve food and cover for the above species.

5.4.1.3 Loblolly Pine/Hardwood. This mixed forest occurs above the hardwoods and just below the pure stands of loblolly pine. Sweet gum, black cherry, red cedar, holly, sweet bay, and dogwood trees are common, while high bush huckleberry, gallberry, and wax myrtle comprise the

understory. Weeds and herbaceous plants include panic grass, broomsedge, pokeweed, partridge pea, and beggarweed. Gray squirrel, deer, and other small mammals are common here. The habitat is also conducive to wild turkey.

5.4.1.4 Oak/Hickory. This association is frequently found along streams and creeks below the loblolly/hardwood stands and above the bottomland hardwoods. White oak and southern red oak are the principal species. Black, post, chestnut, scrub oak; yellow poplar, sweet gum, black gum, persimmon, black cherry, maple, and dogwood also are common. Blueberry, chinquapin, and beauty-berry make up the understory. Herbaceous plants include ferns, teaberry, paspalums, and sedges. Wildlife frequently observed in this habitat include gray squirrel, wild turkey, deer, and wood duck. Black bears are also found here.

5.4.2 Wetland Ecosystems. Wetlands found in the coastal plain vary from those bordering freshwater streams and ponds to salt marshes along coastal estuaries. The most unusual wetland system is the pocosin, which has been referred to as a shrub bog by Christensen (1979). The term pocosin originates from an Algonquin Indian name meaning "swamp on a hill." Pocosins initially develop as wetlands formed in basins or depressions. The wetlands expand beyond the physical boundaries of the depression as the peat retains water. Eventually, the wetland expands above the groundwater, with peat acting as a reservoir, holding water by capillarity above the level of the main groundwater mass (Moore and Bellamy, 1974).

According to Richardson (1981), these evergreen shrub bogs comprise more than 50 percent of North Carolina's freshwater wetlands. Typically, these systems cover thousands of acres, are isolated from other water bodies, and periodically are subject to fire. Much of the pocosin habitat in North Carolina is gradually being lost to timber cutting or drainage with subsequent agricultural development. In 1962, for example, pocosins covered more than 2.2 million acres, but by 1979, only 695,000 acres remained undisturbed. Destruction of pocosins has resulted in changes of hydrologic regime, and nutrient export to other aquatic systems (Richardson, 1981).

A shrub understory with scattered emergent trees dominates pocosin vegetation. The most common species is pond pine. Other species include Atlantic white cedar, loblolly and longleaf pine, red maple, sweet bay, and loblolly bay (Christensen et al., 1981.)

The characteristics of pocosin fauna are less well understood than those of the plant community. Wilbur (1981) notes that pocosins serve wildlife species two ways: They are habitat for endemic species, but also are refuge for those species which once ranged widely, but now are confined because of habitat destruction. Endemics include two vertebrates, the pine barrens treefrog and the spotted turtle. Various small mammals and reptiles also are endemic to the pocosins. Such species as white-tailed deer and black bear also find refuge in the pocosins.

CLW

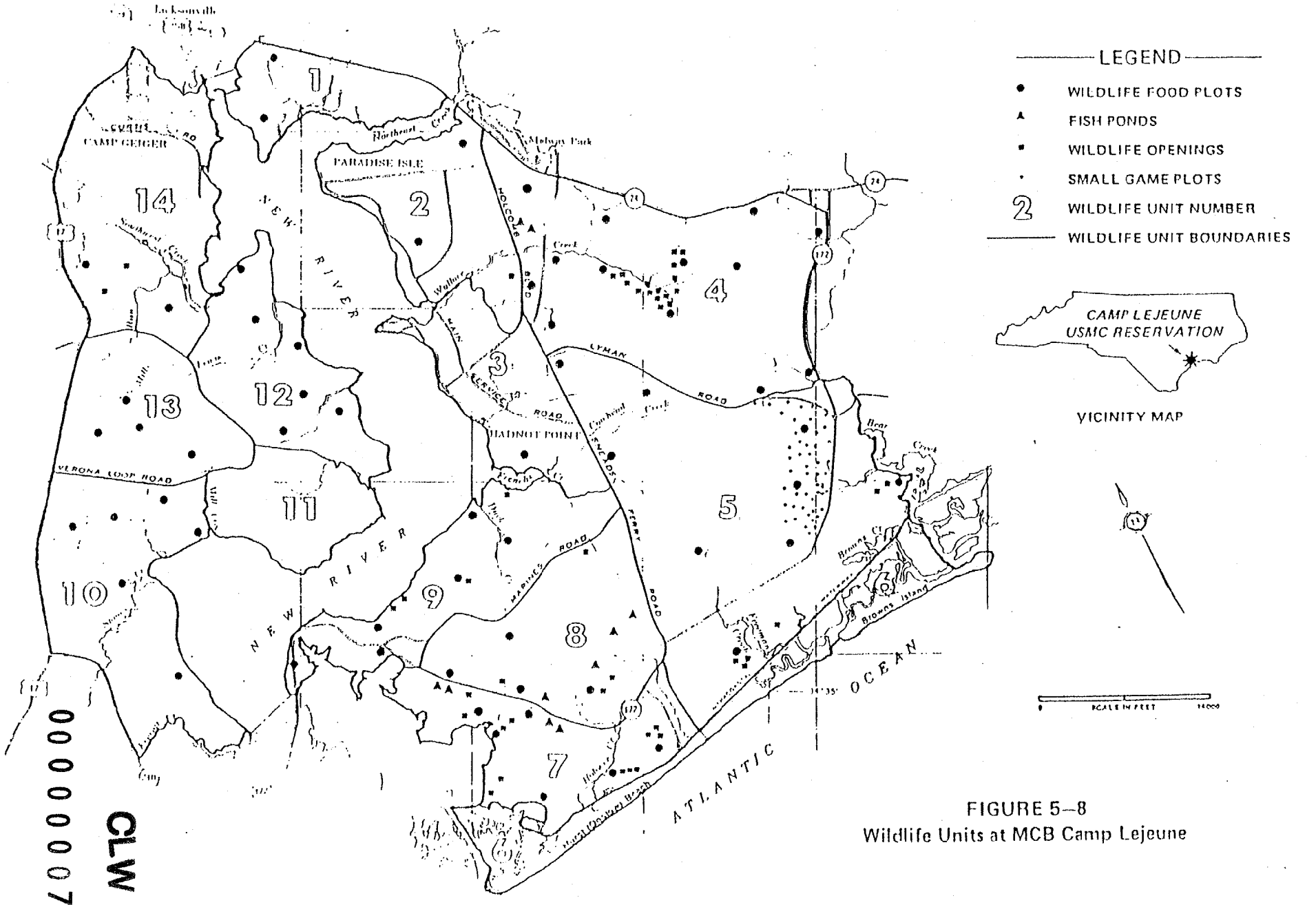


FIGURE 5–8
Wildlife Units at MCB Camp Lejeune

SOURCE: NATURAL RESOURCE MANAGEMENT PLAN CAMP LEJEUNE, NORTH CAROLINA, 1975

Wetland ecosystems on the Camp Lejeune complex can be separated into five habitat types (Natural Resource Management Plan, 1975).

1. Pond pine or pocosin,
2. Sweet gum/water oak/cypress and tupelo,
3. Sweet bay/swamp black gum and red maple,
4. Tidal marshes, and
5. Coastal beaches.

5.4.2.1 Pond Pine. This habitat (commonly known as pocosin or upland swamp) is dominated by pond pine with Atlantic white cedar, loblolly and longleaf pine, red maple, sweet bay, and loblolly bay also present as stated above. Understory plant species include greenbriar, cyrilla, fetter bush, and sheep laurel. Associated marsh and aquatic plants include mosses, ferns, pitcher plants, sundews, and Venus flytraps. Animals which can be frequently observed here include deer and black bear. Pocosins provide excellent escape cover for bear because pocosins are seldom disturbed by humans. The presence of pocosin-type habitat at Camp Lejeune is primarily responsible for the continued existence of black bear in the area. Many of the pocosins on the base are overgrown with brush and pine species that would be unprofitable to harvest.

5.4.2.2 Sweet Gum/Water Oak/Cypress and Tupelo. This habitat is found in the rich, moist bottomlands along streams and rivers and extends to the marine shoreline. Cypress dominate if water is present most of the year, while gums dominate if water availability is seasonal. Maple, black gum, hawthorn, sweet bay, red bay, and elm along with hornbeam, holly, and mulberry are also frequently present. Huckleberry, grape, and palmetto make up the understory. Deer, bear, turkey, and waterfowl (including woodcocks) are commonly found in this type of habitat.

5.4.2.3 Sweet Bay/Swamp Black Gum and Red Maple. As the name implies, sweet bay or swamp black gum and red maple are the dominant tree species in this floodplain habitat. Swamp tupelo, ash, and elm are also present. Greenbrier, rattan-vine, grape, and rose make up the understory. Fauna frequently found in this area include waterfowl, mink, otter, raccoon, deer, bear, and gray squirrel.

5.4.2.4 Tidal Marshes. The tidal marsh at the mouth of the New River on MCB Camp Lejeune is one of the few remaining North Carolina coastal areas relatively free from filling or other man-made changes. Vegetation consists of marsh and aquatic plants such as algae, cattails, saltgrass, cordgrass, bulrush, and spikerush. This habitat generously provides wildlife with food and cover. Migratory waterfowl, shorebirds, alligators, raccoons, and river otter are frequently seen within this habitat type.

5.4.2.5 Coastal Beaches. Coastal beaches along the Intracoastal Waterway and along the Outer Banks of MCB Camp Lejeune are used for recreation and to house a small military command unit on the beach. The Marines also conduct beach assault training maneuvers from company-size units to combined 2nd Division, Force Troops, and Marine Air Wing units.

CLW

These exercises involve the use of heavy equipment including Amphibious Tractors (AMTRACs). Training regulations presently restrict where heavy tracked vehicles are permitted to cross the dunes. These restrictions are intended to protect the ecologically sensitive coastal barrier dunes. The vegetation along the beaches includes trees (live oak and red cedar), woody plants (greenbrier, yaupon, holly, wax myrtle, and palmetto), and weeds and herbs (sea oats, beachgrass, butterfly pen, Virginia creeper, swamp mallow, and passion flower). Although in comparison to other types the coastal beaches are generally low in value to most game species, they serve as buffers to the mainland and provide habitat for many shorebirds.

5.4.3 Aquatic Ecosystems. Aquatic ecosystems on MCB Camp Lejeune consist of small lakes, the New River estuary, numerous tributary creeks, and part of the Intracoastal Waterway. A wide variety of freshwater and saltwater fish species live here. A number of freshwater ponds are under management to produce optimum yields and ensure continued harvest of desirable fish species (Natural Resource Management Plan, 1975).

Principal freshwater game fish species in the ponds, creeks, and the New River include largemouth bass, bluegill, redear sunfish, warmouth, pumpkinseed, yellow perch, redfin pickerel, jack pickerel, and channel catfish. The New River estuary is used extensively for shellfishing, especially in the bays and protected areas of the river such as Stone Bay, Traps Bay, and Ellis Cove.

The Intracoastal Waterway cuts the southeast edge of MCB Camp Lejeune. As it passes between the mainland and the barrier islands, the waterway carries a heavy flow of private pleasure boats during the summer and a steady flow of commercial barges year-round. A variety of saltwater fish is found in the Intracoastal Waterway and in the Atlantic Ocean adjacent to the base. These include flounder, weakfish, bluefish, spot, croaker, whiting, drum, mackeral, tarpon, marlin, and sailfish. Shellfish, represented by oysters, scallops, and clams, are also abundant (Natural Resource Management Plan, 1975; NAVFACENGCOM, 1975).

This part of the North Carolina coast is within the Atlantic flyway and many species of migrating birds pass through the region. Area habitats are used by migrating birds, and local species of shorebirds also employ the marsh areas as a nursery.

The long-range management plan for MCB Camp Lejeune calls for recreational improvements and increased access along the New River and Intracoastal Waterway for the wildlife observer and photographer as well as the game hunter and fisherman (NAVFACENGCOM, 1975).

Regionally, the area is important because of the marine fisheries resource. At nearby Beaufort, Duke University has a marine laboratory. The National Marine Fisheries Service Center for Menhaden Research is also near Beaufort. The University of North Carolina Institute of Marine Sciences and the State of North Carolina Department of Natural Resources Division of Marine Fisheries are in Morehead C

CLW

5.4.4 Rare, Threatened, or Endangered Species. The flora of North Carolina consists of approximately 3,400 taxa of vascular plants. The vertebrate fauna of over 865 species and subspecies includes 200 freshwater fish, 78 amphibians, 79 reptiles, 225 breeding and 175 winter and transient birds, 80 nonmarine mammals, and 28 pelagic or offshore mammals (Cooper, 1977). Of these organisms, 26 have been designated as endangered or threatened by the State of North Carolina and 25 are listed by the federal government as endangered or threatened for North Carolina (Table 5-1). The North Carolina Department of agriculture is currently (1982) reviewing additional plants for inclusion on the state endangered and threatened plant list. Table 5-2 presents 14 additional proposed taxa and taxa under review which are known to occur in Carteret, Craven, Jones, or Onslow Counties. The presence of North Carolina's sensitive species on the Camp Lejeune complex is described in Table 5-3.

The Natural Resources and Environmental Affairs (NREA) Division of MCB Camp Lejeune, the U.S. Fish and Wildlife Service, and the North Carolina Wildlife Resource Commission have entered into an agreement for the protection of endangered and threatened species that might inhabit MCB Camp Lejeune. Habitats are maintained at MCB Camp Lejeune for the preservation and protection of rare and endangered species through the base's forest and wildlife management programs. Full protection is provided to such species and critical habitat is designated in management plans to prevent or mitigate adverse effects of station activities.

As part of the rare and endangered species management program, special emphasis is placed on habitat and sightings of alligators, osprey, bald eagles, cougars, dusky seaside sparrows, and red-cockaded woodpeckers. The red-cockaded woodpecker is present in pine forests on MCB Camp Lejeune as noted in Table 5-3. This small woodpecker subsists on insects and is important in controlling insect pests which attack pine trees. Nesting cavities used by these birds are usually in overmature pine trees with red-heart disease. In some colonies, all the cavity trees are within 300 feet of each other, but in other colonies, they may be 0.5 mile apart (Hooper et al., 1980). Numerous red-cockaded woodpecker colonies on Camp Lejeune have been mapped and marked (Natural Resource Management Plan, 1975). These areas are shown in Figure 5-9.

Table 5-1. State and Federal Status of Sensitive Species for North Carolina

Scientific Name	Common Name	North Carolina*	Federal†
MAMMALS			
Felis concolor cougar	Eastern cougar	E	E
Trichechus manatus	Florida manatee	E	E
Myotis grisescens	Gray bat	E	E
Myotis sodalis	Indiana bat	E	E
Eubalaena glacialis	Atlantic right whale	E	E
Balaenoptera physalus	Finback whale	E	E
Megaptera novaeangliae	Humpback whale	E	E
Balaenoptera borealis	Sei whale	E	E
BIRDS			
Falco peregrinus anatum	American peregrine falcon	E	E
Falco peregrinus tundrius	Artic peregrine falcon	E	E
Haliaeetus leucocephalus	Bald eagle	E	E
Vermivora bachmanii	Bachman's warbler	E	E
Dendroica kirtlandii	Kirtland's warbler	E	E
Pelecanus occidentalis carolinensis	Eastern brown pelican	E	E
Picoides borealis	Red-cockaded woodpecker	E	E
FISH			
Acipenser brevirostrum	Shortnose sturgeon	E	E
Hybopsis monacha	Spotfin chub	T	T
REPTILES			
Alligator mississippiensis	American alligator	E	E
Chelonia mydos	Green turtle	T	T
Eretmochelys imbricata	Hawksbill turtle	E	E
Lepidochelys kempii	Kemp's ridley turtle	E	E
Dermochelys coriacea	Leatherback turtle	E	E
Caretta caretta	Loggerhead turtle	T	T
MOLLUSKS			
Mesodon clarki nantahala	Noonday land snail	T	T
PLANTS			
Sagittaria fasciculata	Bunched arrowhead	E	E
Hudsonia montana	Mountain golden heather	T	

E = Endangered and T = Threatened.

Sources: * Parker, W. and L. Dixon, 1980.
† U.S. Fish and Wildlife Service, 1980.

Table 5-2. Proposed Protected Plant List for North Carolina* Listing Only Those Taxa Known to Occur in Carteret, Craven, Jones, or Onslow Counties

Scientific Name	Common Name	Known Counties†	Habitat**	Proposed Status
Proposed Taxa				
Arenaria godfreyi	Godfrey's sandwort	Craven, Jones	Woodland seepage slopes of marl substrates	E
Asplenium heteroresiliens	Carolina spleenwort fern	Jones	Shaded marl outcrops	E
Calamovilfa brevipilis	Riverbank sandreed	Carteret, Craven Onslow	Long-leaf pine forests, bogs, and savannahs	T
Carex chapmanii	Chapman's sedge	Craven	Dry, sandy woods and roadsides	T
Cystopteris tennesseensis	Tennessee bladder fern	Craven, Jones	Marl outcrops	E
Lysimachia asperulaefolia	Rough-leaf loosestrife	Carteret, Craven, Jones, Onslow	Savannahs, pocosins, lowbay, upland bogs, and mesic environments. Acidic soils.	E
Myriophyllum laxum	Loose watermilfoil	Carteret, Craven	Lime sinks, pools, and ponds	T
Sarracenia rubra	Mountain sweet pitcher-plant	Carteret, Craven, Onslow	Shrub bogs and savannahs in the coastal plain	SC-E
Solidago verna	Spring-flowering goldenrod	Craven, Onslow	Savannahs, pocosins, pine barrens, pine flatwoods, and shrub bogs	E
Utricularia olivacea	Dwarf bladderwort	Carteret	Shallow, acid ponds with pH of 3 to 5	T
Taxa Under Review				
Aeschynomene virginica	Sensitive joint-vetch	Craven	Riverbanks, swamps, and tidal marshes in the coastal plain	I
Dionaea muscipula	Venus flytrap	Carteret, Craven Jones, Onslow	Wet, sandy ditches, pocosins, savannahs, and open bog margins	PP
Gentiana autumnalis	Pine barren gentian	Craven, Onslow	Pocosins, savannahs, and pine barrens	PP
Parnassia caroliniana	Carolina parnassia	Onslow	Savannahs	PP

E = Endangered, T = Threatened, SC-E = Special Concern--Endangered, I = Indeterminate, and PP = Primary Proposed Species.

Sources: * North Carolina Department of Agriculture, 1981a, 1981b.
† Radford, Ahles, and Bell, 1968; Justice and Bell, 1968; Beal, 1977; and Wilson, 1982.
** Radford, Ahles, and Bell, 1968; Cooper, 1977.

Table 5-3. Comments on Sensitive Species Regarding Occurrence Within Study Area (Camp Lejeune Complex)

Species	Comment
MAMMALS	
Eastern cougar	Possible transient but not seen since 1974
Florida manatee	Study area is northern extreme of summer range
Gray bat	Not in area
Indiana bat	Not in area
Atlantic right whale	Possible migrant offshore
Finback whale	Possible migrant offshore
Humpback whale	Possible migrant offshore
Sei whale	Possible migrant offshore
BIRDS	
American peregrine falcon	Possible but not common
Arctic peregrine falcon	Possible
Bald eagle	Not reported or seen
Bachman's warbler	Possible migrant but not observed
Kirtland's warbler	Possible migrant but not reported
Eastern brown pelican	Reported in area
Red-cockaded woodpecker	Frequent in area with known nesting areas
FISH	
Shortnose sturgeon	Not observed recently
Spotfin chub	Not in area
REPTILES	
American alligator	Routinely observed
Green turtle	Known nesting sites along coast
Hawksbill turtle	Possible migrant offshore
Kemp's ridley turtle	Possible migrant offshore
Leatherback turtle	Possible migrant offshore
Loggerhead turtle	Known nesting sites along coast
MOLLUSKS	
Noonday land snail	Not in area
PLANTS	
Bunched arrowhead	Not in area
Mountain golden heather	Not in area

Sources: Peterson, 1982.
Cooper, 1977.
Parker and Dixon, 1980.

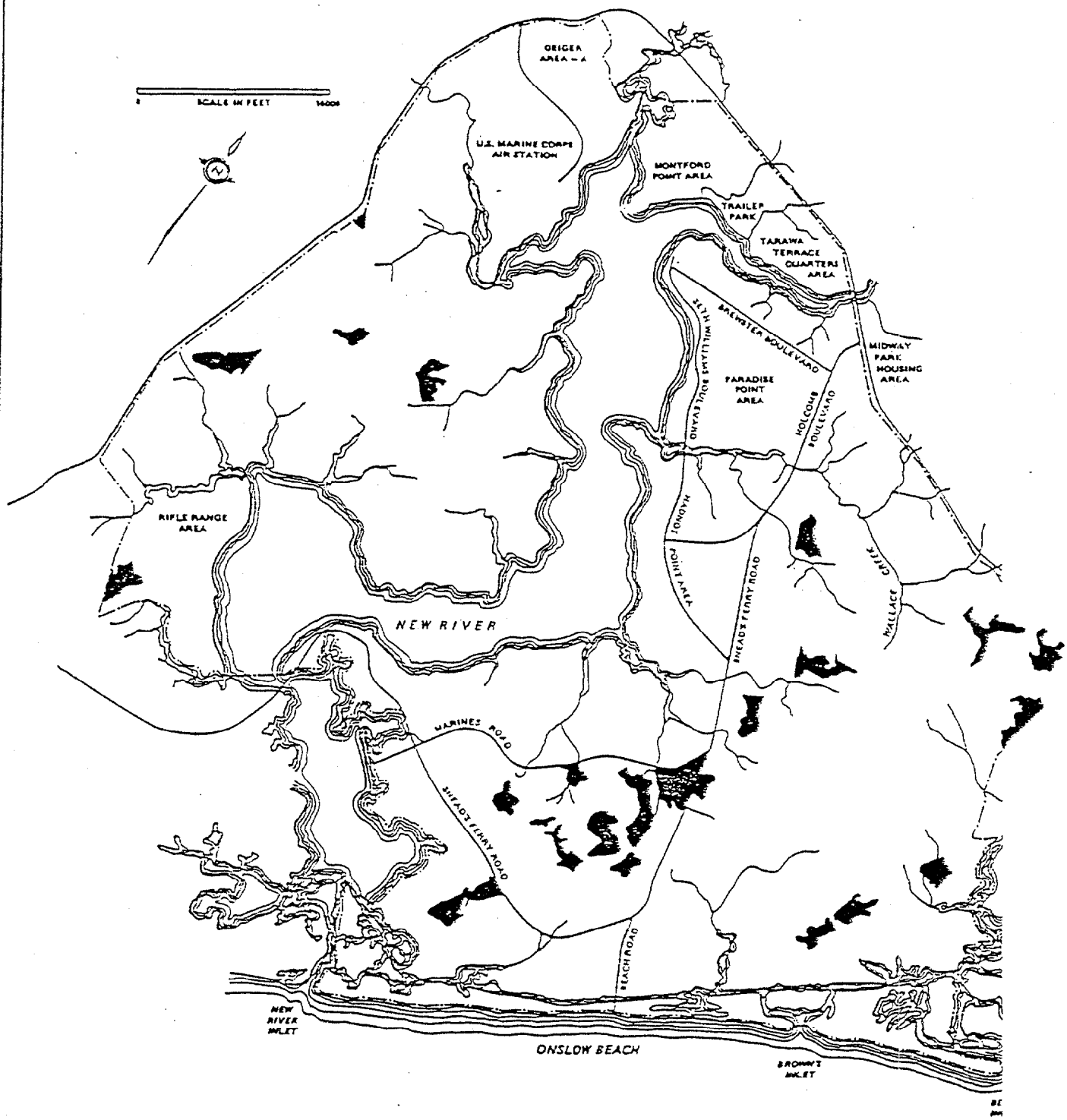


FIGURE 5–9
Red-Cockaded Woodpecker Colony Areas at MCB Camp Lejeune

CLW

0000000792

SOURCE: PETERSON, 1982

SECTION 6. ACTIVITY FINDINGS

6.1 INTRODUCTION. Section 6 summarizes base activities and operations which may involve potential environmental contamination. Emphasis is placed on past practices. At the end of the section is an inventory of all waste disposal sites which includes site descriptions. Information is more detailed for sites requiring confirmation.

Throughout the activities and operations summaries, the reader is referred to specific sites for more information. In these instances, site descriptions at the end of this section should be consulted.

6.2 OPERATIONS, ORDNANCE. Because ordnance operations at Marine Corps Base (MCB) Camp Lejeune are carefully controlled, there is little public health or environmental concern about past disposal practices. For that reason, only an overview of this function is presented. Camp Lejeune was established as a training center before World War II and has retained this characteristic feature. Numerous activities, from infantry and tank training to amphibious operations, require substantial amounts of ordnance each year. No manufacturing or load and pack operations occur on the base. All ordnance is shipped in and stored on the facility. Types of ordnance range from small arms ammunition to rockets, artillery, and mortar rounds. Principal magazine storage is in the Frenchs Creek area, while smaller storage areas exist in other designated places on the base. No reports of spills or accidents were discovered during this study.

There is evidence that, on a nonroutine, irregular basis, some ordnance was buried at the Camp Geiger landfill near the trailer park (Site No. 41). Reports indicate that some mortar shells were placed in dumpsters and ultimately taken to the landfill. A case of grenades was once found at that site and subsequently buried there. A 105mm cannon shell apparently blew up while being buried there. This suggests that care be taken when drilling or boring at Site No. 41.

Because of the training mission, a substantial amount of land has been designated as firing ranges and impact areas. There are three impact zones, called G-10, N-2, and K-2, for high explosives. Locations of these zones are as follows:

1. G-10 Impact Area--PWDM 1, D5-6.
2. N-2 Impact Area--Extends east from the junction of Gridline 94 and Onslow Beach along the beach line to Bear Creek Inlet, and then along Bear Creek to a point 400 yards north of the Intracoastal Waterway, and thence on a line 400 yards north of a parallel to the Intracoastal Waterway to Gridline 94. Ordnance from aircraft will impact on Brown's Island.
3. K-2 Impact Area--PWDM 1, D3/E3.

The New River bisects MCB Camp Lejeune and splits impact zones G-10 and K-2 into east and west sections. N-2 is southeast of G-10 and borders the Atlantic.

CLW

0000000793

A bombing range known as BT-3 has been established at Brown's Island. This property is 7 miles southwest of Swansboro, North Carolina. The island, referred to as the Brown's Island Target Complex, is used by aircraft for target runs with ordnance not to exceed an equivalent net explosive weight of 250 pounds TNT. The target complex also receives high trajectory artillery rounds.

There are two Explosive Ordnance Disposal (EOD) areas on the base near the impact zones. They are G-4 for the east and K-326 for the west side of the camp. They are used to dispose of inert, unserviceable, or dud ordnance. Ordnance is routinely collected by skilled EOD personnel and disposed of by burning or electrically exploding. There is no significant chemical waste generated by this activity. At times, residual propellant or incompletely burned munition compounds may remain, but amounts are typically less than 1 pound.

6.3 OPERATIONS; NONORDNANCE.

6.3.1 Introduction and Summary. Most waste material is generated by the support and maintenance functions of the base. Decentralization of utilities and other essential services is necessitated by the 170-square-mile land area. For instance, vehicle maintenance functions are carried out at several places. Past generation of hazardous waste is primarily a result of maintenance-type activities. Only light industrial activity has taken place.

In a facility the size of MCB Camp Lejeune, hazardous waste may be generated at many places. For instance, the 1979 Facility Development Map set indicates the following numbers of facilities:

1. Vehicle maintenance (except ramps and racks)--45 to 50 buildings,
2. Vehicle/aircraft racks/ramps--85 to 90 buildings,
3. Other maintenance--10 to 15 buildings,
4. Fuel related operations--approximately 50 buildings,
5. Maintenance shops--approximately 20 buildings, and
6. Other shops--approximately 10 buildings.

The actual number of shops is probably greater since individual shops within buildings are not distinguished in these numbers.

Because this investigation is conducted within finite military resources, priorities must be established. Priority criteria include types of substances potentially involved, intensity or size of activity or organization, and level of information available. More information is provided in this report on these activities assigned higher priorities.

Another important factor relating to information reported in this section is on-site judgment. Observed circumstances and information gathered during interviews indicate minimal contamination potential at many shops and activities. In these instances, priority was given to identifying and gathering information regarding other disposal sites, rather than gathering detailed information on activity, history, and productivity at what appeared to be lower priority activities.

6.3.3.4 Old 10th Regiment. This group occupied the "1800" area when only buildings with 500 designations were standing. Artillery was parked adjacent to the buildings. Maintenance activities took place in and around Buildings 571, 574, 576, 598, and 599. No information was obtained regarding wastes generated by this regiment. The area is now occupied by the 2nd Combat Engineers Battalion.

6.3.3.5 2nd Combat Engineers Battalion. This battalion is presently in the "1800" area. Routine maintenance of small combat vehicles takes place in Buildings 574, 576, and 598. No significant areas of contamination were observed.

6.3.3.6 2nd, 6th, and 10th Regiments. These regiments use several sections of the supply and industrial area. Buildings 1205, 1206, 1310, 1405, 1406, 1502, 1503, 1601, 1604, 1605, 1607, 1711, 1739, 1750, 1755, 1760, 1775, and 1780 are used for maintenance of small combat vehicles. Except for the 1700 area, many of these buildings were constructed in the early 1940s and early 1950s. The area is urban with most surfaces paved. Spills and other disposal activities may have occurred. However, no indications of significant contamination were found.

6.3.3.7 8th Marine Regiment. This regiment occupies a portion of Camp Geiger. Combat vehicles are maintained at Building TC-952. Large paved parking areas slope eastward to a tributary of Brinson Creek. This small creek has received runoff POL from the lots. There was evidence of dumping near the creek but no significant contamination was observed.

6.3.4 Fire Fighting Activities. Presently, there are two fire fighting training burn pits at MCB Camp Lejeune. One site used by the MCB Camp Lejeune Fire Department is located south of Bearhead Creek and between Holcomb Boulevard and Piney Green Road (see Site No. 9). The other is located near the end of Runway 5 at MCAS New River (see Site No. 54) and has been used for crash crew training. Both pits were initially unlined.

The fire department pit was first used in 1961 using water-contaminated JP-4 and JP-5. The fuel sat on top of a water layer in the bottom of the pit. The water layer was not treated after the training exercises were completed. This pit was lined in the late 1960s. From 1965 to 1971, approximately 30,000 gal/yr was burned at this pit. The current use is now about 5,000 gal/yr.

The Crash Crew Training Area at MCAS New River was used in the mid-1950s. Originally, training was on the ground and surrounded by a berm. Later, a pit was used which was lined in 1975. MCAS New River drainage ditches were reported to carry "Protien" fire fighting foam toward Southwest Creek during or after practice exercises. The affected area is about 1.5 acres. Based on a present annual usage of 15,000 gallons of POL, approximately 0.5 million gallons of these compounds have been used at this site. Most of these were burned, but as many as 3,000 to 4,000 gallons may have soaked into the soil.

CLW

6.3.5 Naval Field Research Laboratory. From 1947 to 1976, the Naval Research Laboratory was located in the area of the present Pest Control Shop (Building PT-37, see Site Nos. 19 and 20). Activities at the laboratory included using radionuclides (Iodine 131) for metabolic studies on small animals. These actions are not believed to have produced any lasting hazardous waste contamination (see Section 6.4).

6.3.6 Creosote Plant. During 1951 and 1952, a saw mill and creosote plant (Building 776; Site No. 3) manufactured railroad ties. This activity was located about 800 feet east of Building 613 (pump house and Well No. 13), on the opposite side of Holcomb Boulevard and the railroad tracks. Logs were cut into ties which were then placed in a chamber and pressure-treated with hot creosote. Creosote was used directly from a railroad tank car. Creosote remaining in the pressure chamber at the end of the treatment cycle was saved for later use. There were no reports of any creosote waste generation. Oil-burning boilers provided steam to heat the creosote.

The ties were used to build a railroad from Camp Lejeune to Cherry Point, North Carolina. Upon completion of the railroad, the mill and plant were sold and removed from Camp Lejeune. All that remained at the time of this IAS site visit were concrete pads and the boiler chimney. An inspection of the area did not reveal any indication of creosote or other wastes of concern.

6.3.7 Utility Operations. Utility operations have influenced environmental issues at the base. Power, steam, and water are discussed below. Waste disposal is discussed in Section 6.5

Power for the base is supplied by Carolina Power and Light Company with all lines above ground. Maintenance of the system is performed by the company, although transformer leakage within the systems is a concern of base environmental affairs personnel because of potential PCB contamination. Transformer storage is temporary and is now carried out with proper environmental controls. Presently, transformers are stored in Storage Lot 140, between Ash Street and Sneads Ferry Road on Center Road Extension. It is currently designated as a hazardous waste storage area. Historically, transformers were stored at Storage Lots 201 and 203. One incident of leaky 55-gallon drums of transformer oil near Building 1502 was reported. The problem was dealt with by disposing of the drums at Site No. 74 and the area near Building 1502 is believed to be cleaned up. (Refer to description of Site Nos. 6, 21, and 74 for additional information.)

The steam plant at Hadnot Point can produce 480,000 pounds of steam per hour and supplies the French Creek area as well as mainside. Steam is used for heating and cleaning of equipment. Substantial amounts of coal are stored near this facility. The area is identified as Site No. 26. This is a currently operating site and NACIP confirmation is not required. However, berms to prevent coal pile runoff were not noted and some alterations to runoff control may be warranted. The current CLW plan indicates that increased demand will be placed on the system in the

future. As many as 45,000 tons of coal are used per year. Fly ash has been disposed of on base for many years. (Refer to Site No. 24 for additional waste disposal information.)

Groundwater is the potable supply. This is significant, not as a potential source of contamination, but rather as a potential receptor. Strategically located wells provide water to eight treatment plants within the military complex. Generally, wells are deep enough to penetrate at least one impervious layer. The Hadnot Point plant serves French Creek, Tarawa Terrace, and Berkeley Manor. Storage is in elevated tanks with a total capacity of 1.4 million gallons. Table 6-1 presents characteristics of the water treatment plants.

The drinking water system at the Rifle Range area has been a concern because of elevated trihalomethane (THM) levels and proximity of wells to the chemical landfill (Site No. 69). This concern for impacts of Site No. 69 exists despite the fact that THM levels at other places are also somewhat high. For example, note Samples 14, 15, and 16 in Table 6-3. Test wells have been placed around the landfill to monitor groundwater characteristics. Table 6-2 shows THM levels in treated water at the Rifle Range. Strategies to reduce THM levels such as changes in chlorination procedures are being evaluated now (1982). Source of THM precursors is not known, but groundwater monitoring related to the chemical landfill is continuing. THM levels at 41 locations at Camp Lejeune are shown in Table 6-3. Three one-time samples (see Samples 14, 15, and 16) contained total THM at or greater than the 100 ppb EPA (annual average) drinking water limit. THM precursors obviously exist at various locations. However, sources of precursors may or may not be related to past hazardous material disposal. In fact, origins of precursors may not be related to any human activity (e.g., detrital matter or algae).

6.3.8 Radar Equipment Operations. At MCAS New River, metallic mercury was drained from delay lines at the radar site and buried without containment. The radar units were located near the Photo Lab, Building 804 (Site No. 48). This took place from the mid-1950s to the mid-1960s at a rate of about 1 gallon per year.

6.3.9 Pest Control Shop. The control of nuisance organisms at Camp Lejeune has been the mission of an activity called, at various times, Malaria Control, Insect Vector Control, and Pest Control Shop. Building 712 (Site No. 2) housed this activity from 1945 to 1958. Insecticides and herbicides were stored and mixed at this site until the activity moved to Building 1105. At Building 1105, the administrative and storage functions were accomplished while the mixing of chemicals was performed in the southeast portion of Lot 140 (Site No. 21). In 1977, this shop moved to Building PT-37 where it presently is located.

For a listing of the names and quantities of insecticides and herbicides used by this activity, see Site Nos. 2 and 21 in Section 6.7. Equipment washing without containment and treatment of the resulting wastewater was common practice at both Building 712 and Storage Lot 140.

CLW

Table 6-1. Water Treatment at MCB Camp Lejeune

Water Treatment Plant	Building	Capacity	Approx. Daily Flow	Treatment
Hadnot Point	HD-20	5 mgd	3.1 mgd	Lime
Holcomb Boulevard*	670	2 mgd	1.5 to 2 mgd	Lime
Tarawa Terrace†	TT-38	1 mgd	1 mpd	Lime
Air Station	AS-110	3.5 mgd	1 mgd	Lime
Camp Johnson†	M-168	0.75 mgd	0.25 mgd	Zeolite
Rifle Range	RR-85	0.6 mgd	0.25 mgd	Zeolite
Courthouse Bay**	BB-190	0.6 mgd	0.5 mgd	Zeolite
Onslow Beach	BA-138	0.25 mgd	0.15 to 0.2 mgd	Zeolite

* There are plans to expand the Holcomb Boulevard plant's capacity to 5 mgd.
† Scheduled for elimination.
** Scheduled for expansion to 1 mgd capacity.

Source: WAR, 1982.

Table 6-2. Total Trihalomethane Values in Treated Water at Rifle Range, MCB Camp Lejeune, 1981 and 1982

Date	Sample No.	Total THM (ppb)
1981		
8/20	467	100
8/20	468	100
8/20	469	98
8/20	470	98
9/24	542	42
9/24	543	43
9/24	544	40
9/24	545	44
10/28	552	49
10/28	553	53
10/28	554	51
10/28	555	55
12/30	567	105
12/30	568	99
12/30	569	104
12/30	570	103
1982		
1/28	572	63
1/28	573	57
1/28	574	71
1/28	575	63
3/18	577	32
3/18	578	47
3/18	579	--
3/18	580	58

Note: Data shown are to demonstrate levels and range of THM encountered.

Source: LANTNAVFACENGCOM, 1982.

Table 6-3. Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in ug/l)

Sample No.	General Area	Location	Chloroform	Bromodichloro-methane	Chlorodibromo-methane	Bromoform	Total THM*
1	Tarawa Terrace	Bldg. SST-39A, Water Plant @ first pump	1	4	3	2	10
2	Tarawa Terrace	Bldg. TT-60, TT Elementary School I, Main Hall Men's Room Sink	1	5	4	2	12
3	Tarawa Terrace	Bldg. TT-48, TT Elementary School II, Men's Room across Office	1	5	3	2	11
4	Tarawa Terrace	Bldg. TT-2453, TT Exchange Gas Station's Ladies Room	1	4	3	2	10
5	Tarawa Terrace	Bldg. TT-35, Sewage Plant's Office Sink	1	4	3	2	10
6	Knox Trailer Park	Bldg. E-23, Sewage Lift Station	3	3	1	<1	7

Table 6-3. Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in ug/l) (Continued, Page 2 of 6)

Sample No.	General Area	Location	Chloroform	Bromodichloro-methane	Chlorodibromo-methane	Bromoform	Total THM*
7	Montford Point	Bldg. M-178, Water Plant @ Sink Faucet	3	4	2	<1	9
8	Montford Point	Bldg. M-625, Steam Plant, Bathroom Sink	2	<1	<1	<1	2
9	Montford Point	Bldg. M-128, Branch Clinic, Men's Room	3	4	2	<1	9
10	Montford Point	Bldg. M-136, Sewage Plant Sink	3	4	2	<1	9
11	Montford Point	Bldg. M-231, BOQ, First Floor Men's Room	4	4	2	<1	10
12	New River	Bldg. AS-110 Water Plant @ Pump	11	15	20	5	51
13	New River	Bldg. G-520, Career Planner, Second Floor Men's Room	13	21	28	11	73

Table 6-3. Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in ug/l) (Continued, Page 3 of 6)

Sample No.	General Area	Location	Chloroform	Bromodichloro-methane	Chlorodibromo-methane	Bromoform	Total THM*
14	New River	Bldg. AS-4025, Barracks Rec. Room, Bathroom Sink	15	28	45	32	120
15	New River	Bldg. 710, Officer's Club Gally Sink	15	25	37	22	99
16	New River	Bldg. 2800, Boat Marina Men's Room	15	24	37	24	100
17	Holcomb Blvd.	Bldg. 670, Water Plant @ Pump	18	8	2	<1	28
18	Holcomb Blvd.	Bldg. 4022, Fire Station, Bathroom Sink	22	9	2	<1	33
19	Holcomb Blvd.	Bldg. 1915, Golf Course, Men's Locker Room	24	11	3	<1	38
20	Holcomb Blvd.	Bldg. 5400, Berkeley Manor Elementary School, Main Hall Bathroom	20	13	2	<1	35

Table 6-3. Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in ug/l) (Continued, Page 4 of 6)

Sample No.	General Area	Location	Chloroform	Bromodichloro-methane	Chlorodibromo-methane	Bromoform	Total THM*
21	Holcomb Blvd.	Bldg. 2615, PP Officer's Club, Gally Dishwashing Sink	23	21	3	<1	47
22	Rifle Range	Bldg. RR-85, Water Plant @ Finish Tap	29	15	4	<1	48
23	Rifle Range	Bldg. RR-6, Fire House Sink	29	14	4	<1	47
24	Rifle Range	Bldg. RR-10, Snack Bar Sink	29	15	4	<1	48
25	Rifle Range	Bldg. RR-200, Across from Target Shed	28	14	4	<1	46
26	Rifle Range	Bldg. RR-92, Sewage Plant Sink	29	15	5	<1	49
27	Court-house Bay	Bldg. BB-190, Water Plant @ Faucet	27	13	4	<1	44
28	Court-house Bay	Bldg. BB-7, Mess Hall Sink	27	13	4	<1	44

Table 6-3. Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in ug/l) (Continued, Page 5 of 6)

Sample No.	General Area	Location	Chloroform	Bromodichloro-methane	Chlorodibromo-methane	Bromoform	Total THM*
29	Court-house Bay	Bldg. BB-54, Service Club	29	13	4	<1	46
30	Court-house Bay	Bldg. SBB-204 Sewage Plant Sink	29	14	4	<1	47
31	Court-house Bay	Bldg. BB-46, Marina Bathroom Sink	38	18	6	<1	62
32	Onslow Beach	Bldg. BA-138, Water Plant	32	9	1	<1	42
33	Onslow Beach	Campsite #2, Spigot 10 (Mainland)	41	10	2	<1	53
34	Onslow Beach	Bldg. BA-103, Mess Hall	32	9	1	<1	42
35	Onslow Beach	Campsite #1, Spigot 2 (Beachside)	39	6	<1	<1	45
36	Onslow Beach	Bldg. SBA-142, Spigot at bottom of Pier	29	9	1	<1	39

Table 6-3. Trihalomethane (THM) Levels at MCB Camp Lejeune, 1982 (in ug/l) (Continued, Page 6 of 6)

Sample No.	General Area	Location	Chloroform	Bromodichloro-methane	Chlorodibromo-methane	Bromoform	Total THM*
37	Hadnot Point	Bldg. 20, Water Plant @ Pump	23	20†	2	<1	45**
38	Hadnot Point	Bldg. NH-1, Emergency Room Sink	28	20†	3	<1	51**
39	Hadnot Point	Bldg. 1202, Men's Room Sink	25	20†	2	<1	47**
40	Hadnot Point	Bldg. 65, Quality Control Lab, Room 220 Sink	25	20†	2	<1	47**
41	Hadnot Point	Bldg. FC-530, Laundry Room Sink, First Floor	28	20†	3	<1	51**

* Interim drinking water standard for TTHM is 100 ug/l (maximum) (annual average).
† This represents an upper limit on the possible bromodichloromethane level.
** This represents an upper limit on the possible total trihalomethane level.

Note: Data shown are to demonstrate levels and ranges of THM encountered.

Source: LANTNAVFACENGCOM, 1982.

wastewater at Storage Lot 140 was estimated to be about 350 gallons of overland discharge per week (NAVFACENGCOM, FY1977). Spillage during the mixing process occurred at Building 712 and possibly occurred at Storage Lot 140. Soil samples taken around Building 712 after this IAS team site visit have shown DDT residues at levels up to 0.75 percent, on a dry weight basis (see Table 2-1).

Building 712 most recently has been used as a day-care center (now relocated). Building 1105 now houses Roads and Grounds Department. Storage and handling procedures at Building 1105 were reported to be adequate to prevent any large spills and to insure a current safe working environment. Any pesticide solution not consumed during the day it was prepared was saved for later use.

6.3.10 Dry Cleaning Shop. Although there are many laundry distribution centers located within Camp Lejeune and MCAS New River, all dry cleaning is performed in Building 25. This laundry facility has been at the same location since 1943. The solvent used for dry cleaning was changed in 1970 from a petroleum based solvent to perchloroethylene (tetrachloroethene). Current consumption rate is approximately 34 tons per year. Solvent losses are reported to occur only as a result of evaporation during the dry cycle. Solvent is reclaimed by filtration and distillation. Therefore, little or no wastes have been generated. Spent filters are dried at high temperatures while any vapors are vented into the solvent storage tank. After drying, spent filters are bagged and sent to the landfill.

6.3.11 Preparation, Preservation, and Packaging Shops.

6.3.11.1 MCB Shop Stores Branch. The Preparation, Preservation, and Packaging (P, P, and P) Shop is responsible for rendering equipment and materials ready for storage and shipment or for rendering such stored items operational from storage. Located in Building 909 at Hadnot Point, this shop is presently accountable for packaging hazardous materials to be transported to the Defense Property Disposal Office (DPDO), or other storage locations. Prior to 1977, rinse water from this facility (300 gal/week in 1977) was discharged by storm sewer into Beaver Dam Creek. The shop last used the degreaser Trichloroethylene (TCE) in 1978.

6.3.11.2 2dFSSG, 2d Supply Battalion. The degreaser TCE was used in Buildings 901 and 1601 by the Marine 2nd Force Service Support Group (2dFSSG) to degrease engines at various times. Approximately 440 gallons of TCE were contained in a tank. In 1976 or 1977, this TCE tank was drained and the solvent sent to DPDO. No information was found regarding spills, leaks, or discharges from the tank.

6.3.12 Furniture Repair Shops. The Furniture Repair Shop operated by Base Maintenance is located in Building 1409. This shop used paint stripper (contained in an approximately 550 gallon vat) to remove [illegible] finishes (i.e., lacquer and varnish). The vat was emptied irregularly every 1 to 4 months. The paint stripper was placed in 55-gallon drums,

CLW

transported to the industrial area fly ash dump (Site No. 24), and poured onto the ground but not burned.

Special Services operates a furniture repair facility at Camp Geiger in Building TC-609. This facility has been in operation since at least 1968. Only small amounts of wastes are generated.

6.3.13 Paint Shops. Three paint shops are located in the Hadnot Point area. The Base Maintenance Paint Shop (Building 1202) used an estimated 9 tons of paint per year in 1980; similarly, the Central Paint Shop (Building 908) used 1 ton and the Hobby Paint Shop (Building 1103) used 2 tons. The Base Maintenance Paint Shop has been located in Building 1202 at least since pre-1951 and probably since the building was constructed in 1942.

As a matter of long standing shop policy, oil-based paint of all colors has been saved, combined, and the resulting gray paint then used. It has been reported that starting in 1964, about 20 to 40 gallons of oil-based paint were disposed of at the Hadnot Point Burn Dump (see Site No. 28) every other week. Some of this paint was burned. It is not known when this practice ceased. Thinning solvents are rarely used.

6.3.14 Photographic Laboratories. Six photographic facilities have been identified at Camp Lejeune. In 1968, Buildings 11 and 27 were used by the 2nd Marine Division, and Headquarters and Service Battalion, respectively, for photographic uses.

The Sanitary Engineering Survey for FY 1977 (NAVFACENGCONM, FY 1977) identified Building 54 (originally a mess hall built in 1943) as a photo lab generating 300 to 400 gallons per week of wastewater containing acetic acid, sodium sulfite, and ferric cyanide. It further described the Naval Regional Medical Center Hospital as generating 200 to 300 gallons per week of photographic wastes containing hydroquinone, alkali, and silver nitrate. The photo lab in Building 302, presently the Public Affairs Office, produced 15 gallons per day of wastes containing hydroquinone and methylaminophenol sulfate.

The Administration Office and Photographic Laboratory (Building 804 at MCAS New River) was built in 1955. This laboratory presently discharges about 50 gallons of developers and stop bath per month to a sanitary sewer. Fix bath solution is sent to DPDO for reclamation. Past waste disposal quantities are presumed similar to current ones. Discharge is expected to have been to sewers and not to landfills.

6.3.15 Other Industrial Trade Shops. Other general trade shops are associated with routine base maintenance functions. The Plaster and Masonry Shop is located in Building 1304 while Building 1202 houses the following shops: Electric, Metal Working, Plumbing and Heating, Refrigeration and Air Conditioning, and Carpenter. Generally, the materials used by these shops are consumed during the repair and construction functions that they perform. The metal refuse collection

CLW

system has been in use at Camp Lejeune for several decades and eliminated solid metal disposal problems. The Metal Working Shop is primarily a metal-forming facility without pickling or similar metal re-working operations. The Electric Shop sends any accumulated transformer oil to DPDO and rarely has disposed of any motor winding varnish. The Plumbing and Heating Shop used "Sizzle" to unclog indoor drain pipes but has since discontinued the use of this product which was probably a caustic cleaning agent. The Carpenter Shop was united with the Upholstery Shop in Building 1409 in 1951 before moving to its present location.

6.3.16 Fuel-Related Operations. Fuel storage, dispensing, and disposal are significant activities related to environmental contamination issues. One principal tank farm, for gasoline and diesel fuel, is located in the Hadnot Point area. Here, fuel is transferred into tank trucks and transported to smaller dispensing facilities on base. In the past, this operation has resulted in the release of POL compounds to the environment via leaks (see Section 6.5, Material Storage) or spills from tank trucks (e.g., refer to Site No. 64). Prompt action in the past has, by and large, prevented serious contamination from major spills.

6.4 OPERATIONS, RADIOLOGICAL. The Naval Research Laboratory site is near the present Pest Control Shop. Activities at the laboratory included using radionuclides for metabolic studies on small animals. Approximately 100 dogs were disposed of in a small area near the building. In November 1980, strontium 90 beta buttons were found while grading a parking lot near the building. The area was surveyed, and contaminated items were recovered. Soil samples were obtained and the site was cleaned of radioactive substances. Five 55-gallon drums of soil and animal residues were collected along with 499 beta buttons (400 microcuries per button).

Iodine 131 was used in metabolic studies at the Naval Research Laboratory. Because Iodine 131 has a half-life of only 8 days, potential for residual radiological contamination is nil.

6.5 MATERIAL STORAGE. Responsibility for support of the facility activities rests with the supply organizations of the various commands. Materials of interest include POL, pesticides, chemicals, and radiological substances.

Central stores located in the supply and industrial area of Hadnot Point receive all incoming supplies for the Camp Lejeune complex. The group gives support to the 2dFSSG as well as to other tenant commands on the base. The central stores group handles all commodities such as ammunition, fuels, shop stores, and food. In addition, the group inspects all materials that enter the base. There is also a materials stores traffic management unit which is responsible for waste storage and shipment from the base to proper receiving facilities. Following a DPDO declaration that a given material is waste, this group stores and transports it. The P,P, and P group certifies that the material is safe to move.

CLW

Storage of oils, fuels, and other lubricants is scattered throughout the base. The Environmental Engineering Survey FY80 Update, while addressing wastewater treatment needs, identified 69 waste oil systems, 46 grease racks, 50 POL storage areas, 144 fuel tanks, and 9 fueling areas. Under the present plan, POL are stored with adequate environmental safeguards; large fuel tanks or tank farms have earthen berms to contain spills. Other POL products in cans or drums are stored on fenced concrete pads. Historically, there was no awareness of the hazards associated with these compounds and containment measures were minor or did not exist. In the past, there have been leaks in fuel tanks or underground lines. When the break or leak is minor, there may be a considerable time before detection, sometimes resulting in a large amount entering surrounding soils. For example, tank farms at Hadnot Point, MCAS New River, and Camp Geiger have experienced losses through tank or line leakage. These events have prompted an awareness by base personnel of contamination problems associated with underground pipelines. Construction of aboveground lines has been one control measure at the JP Fuel Farm (Site No. 45). Refer to Site Nos. 22, 35, and 45 for detailed descriptions of various fuel storage problems.

Generally, POL contamination can be grouped as spillage of unused POL of a defined type or spillage/disposal of waste POL of an unknown type or types. When POL at a spill site can be identified as a single type of organic mixture, like Mogas or JP-4, the areas of concern may be limited to one or a few specific categories. These categories may be limited to such areas as: tainting of fish and shellfish flesh; taste and odor problems in potable water; migration of lead, lead compounds, and potential carcinogens (e.g., benzene) to human or environmental receptors; fire and/or explosion hazards; and problems at building construction sites.

Situations dealing with waste POL are potentially more complicated because many different types of wastes may have been combined, including toxic and hazardous organic substances. Additionally, waste motor oil alone has been known to contain some heavy metals and phenolics. Phenolic compounds are known to taint fish flesh and, when chlorinated in water treatment systems, to cause taste and odor problems at concentrations near 2 parts per billion. Consequently, waste POL sites may require more extensive analytical investigations to determine what wastes are present and thereby better define the specific areas of concern.

Hazardous chemicals are now segregated and stored in accordance with federal regulations to minimize risk to environment and to human health. Chemicals such as solvents are now stored on concrete pads which are fenced. There is adequate protection against runoff in case of a spill.

Pesticides currently are stored at the former Naval Research Laboratory (see Section 6.3.9). From 1943 to approximately 1958, pesticides were stored in Building 712; this building was used as a day-care center from the early 1960s until mid-1982. Subsequently,

CLW

pesticides were moved to Building 1105, where they remained until 1977. Stored in Building 1105 were chlorinated hydrocarbons such as DDT and Chlordane as well as Diazinon, Malathion, Lindane, Mirex, 2,4-D, Dalapon, and Dursban.

In the hazardous materials storage area (Building TP-452) HTH was being stored below antifreeze (ethylene glycol). The liquid either spilled or was released in some manner and contacted the HTH. Combustion resulted and the entire facility burned in 1977. This is an example of storage which was improperly planned or without knowledge of the hazard involved from putting these two substances in close proximity. Paint stored here was also consumed in the fire.

6.6 WASTE DISPOSAL OPERATIONS.

6.6.1 Sewage Treatment. Liquid sanitary wastes are conventionally treated throughout the complex. Because of the large surface area, sewage treatment plants (STPs) must be located in various areas. At Hadnot Point, gravity and force mains convey waste to a secondary trickling filter plant capable of treating 8 mgd. This plant, originally serving Hadnot Point, has been extended to Paradise Point, French Creek, and the Berkeley Manor housing area.

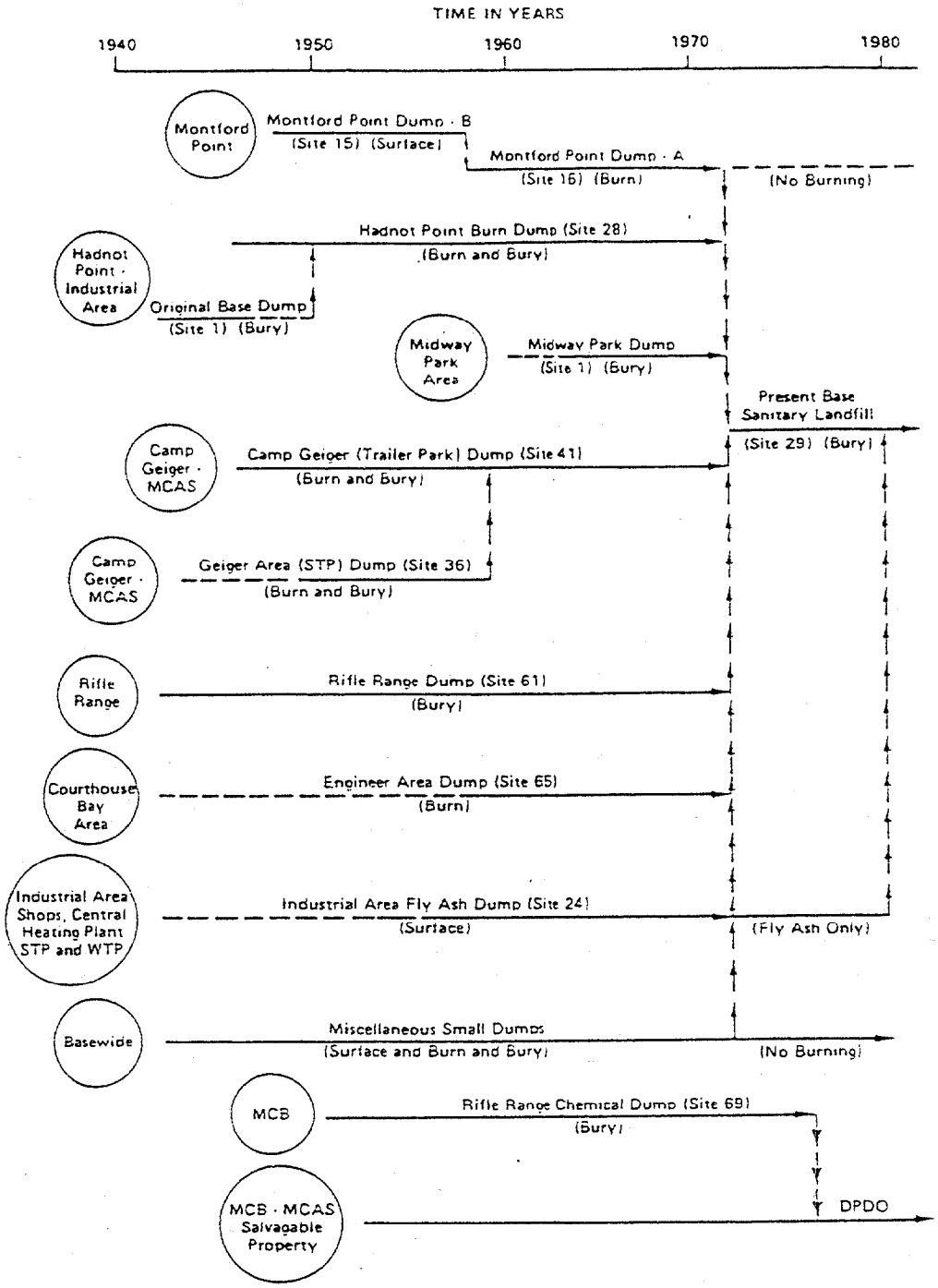
Courthouse Bay houses the Engineer's School and the Second Amphibious Tractor Battalion. Sewage treatment is at the secondary level using lime as a pH control. The design capacity of the plant is 0.5 mgd.

MCAS New River and nearby Camp Geiger at one time had separate treatment plants, each capable of providing secondary treatment. The Camp Geiger plant has been upgraded and now also serves the air station. Design capacity of this facility is 1.6 mgd.

6.6.2 Solid Wastes and POL Disposal. Solid waste disposal in the base complex has been on land in the past. Past practice has not been well regulated, and unauthorized disposal sites were used for many substances, some of which were hazardous. A chronology of principal waste disposal areas is given in Figure 6-1. The original base waste disposal site (prior to 1950) was off Holcomb Boulevard across from Storage Lot 203 (See Site No. 10). The site was a borrow pit used for disposal of construction debris. Following construction, which began in 1941, disposal areas were located near individual activities (see Site Nos. 1, 7, 10, 13, 15, 16, 19, 24, 25, 36, 37, 40, 42, 43, 44, 46, 55, 57, 61, 62, 63, 65, and 68). As a result, a number of sites were active simultaneously. In the early 1970s, a central landfill (Site No. 29) was established to receive wastes from the entire complex while other landfills were gradually phased out. One possible exception is the Chemical Dump in the Rifle Range area (Site No. 69) at which disposal continued.

A 1977 report by SCS Engineers shows that MCB Camp Lejeune generates 664 tons of solid waste per week, or approximately 95 tons per

CLW



CLW

0000000811

FIGURE 6–1

Chronology of Solid Waste Disposal Sites and Waste Routing at Camp Lejeune, N.C.

day. The composition is similar to municipal waste in other communities. The industrial waste contains nonhazardous materials and is typical of commercial industrial wastes from similar activities.

In addition to solid wastes, base personnel have estimated that prior to the early 1970s, about 5 percent of the waste oils (and other POL) was disposed of at landfills while the remainder was spread on roadways or poured down storm drains. Other liquid wastes disposed of at these scattered disposal sites include solvents and some paints that may have been burned or allowed to seep through the other wastes.

The Rifle Range Chemical Dump (Site No. 69) was set aside in about 1950 to receive toxic waste materials. A complete inventory was kept of types of wastes, amounts, and position of burial. These records have been lost, but according to a former base safety officer, an estimated 50 barrels of DDT, other pesticides, trichloroethylene sludge, wood preservative compounds, training agents (like "tear gas"), and PCBs (some in sealed cement septic tanks) were buried here. The surface area is about 6 acres and the volume of disposed materials may be as high as 93,000 cubic yards. This site was closed in 1978. Storage Lot 140 and Building TP-451 are currently designated as long-term hazardous waste storage areas.

Before a pollution control program was implemented in the early 1970s, it was common to spread waste oils and other POL materials on road surfaces for dust control. As many as 1,400 gallons per week were disposed of in this way. There are five sites (Nos. 5, 31, 33, 34, and 56) which are noted for this type of disposal. Wastes were collected from various maintenance shops on the station at intervals throughout the year. There was no regulated collection practice, and substantial quantities were flushed to drains that emptied into the New River.

Some characteristics of the waste oil currently generated are presented in Table 6-4. The data show significant levels of metals such as lead (376 mg/l) and zinc (475 mg/l). Cadmium, copper, chromium, and barium were also at elevated levels. Amounts of volatile organic compounds were found in the parts-per-billion (ppb) range with the exception of phenols (20 mg/l). These data emphasize the potential contamination which could result from improper disposal of waste oils. It is recognized that past practice in many vehicle maintenance shops allowed oil to seep into the soil on site and cause contamination. This generally has been stopped and current (1982) controls regulate collection and proper disposal of these materials.

6.6.3 Chemical and Training Agent Disposal. For the purpose of this report, a chemical agent is defined as a chemical that is capable of producing lethal or damaging effects on humans and which exists solely for that potential use. Chemical agents differ from training agents in that the latter are authorized for use in training people to function in a chemical environment. Training agents produce irritating/incapacitating

CLW

Table 6-4. Constituents in Waste Oil, MCB Camp Lejeune, 1981

Component	Concentration (mg/l)
Antimony	<0.02
Arsenic	<0.002
Barium	1.08
Beryllium	<0.005
Cadmium	1.88
Chromium	0.16
Copper	4.44
Lead	376.0
Mercury	<0.002
Nickel	0.36
Selenium	<0.002
Silver	0.16
Thallium	<0.1
Zinc	475.0
Toluene	0.012
1,1-Dichloroethane	0.004
Phenol	20

Source: LANTNAVFACENGCOM, 1981.

effects at low concentrations and are not lethal except at much higher concentrations. (Definitions adapted from Departments of Army and Air Force, 1975).

Information obtained from various sources indicates that some type of chemical warfare training has always been present at Camp Lejeune. Information has not been found to conclusively indicate whether or not chemical agents were present on-base. Information is also lacking which conclusively indicates whether, if present in large quantities, these agents were present in forms strictly usable as training aids or as stores for chemical warfare use.

Supporting the argument of chemical agent presence is the fact that, in the early 1950s, adequate storage facilities to maintain a supply of chemical agents did exist on-base. One unconfirmed report of phosgene vials being found on-base and other details of eyewitness observations tend to add credibility to this supposition. (These reports will be presented later in this section.)

The argument against chemical agent presence is supported by the fact that, historically, the development and storage of chemical agents has been assigned to the Army and Air Force with minimal Marine Corps involvement. Also, there is only a small probability that domestic or captured chemical agents were returned to Camp Lejeune from overseas war zones.

Most reported observations of "gas" disposal are consistent with training agent disposal. Training agents were sometimes spread as solids over areas used for training exercises. Disposal of large quantities of these training agents (e.g., drums of wet material that would not disperse properly) would be consistent with the Camp Lejeune training mission.

To summarize the "chemical agent presence question," there is little evidence supporting it. However, absence of information cannot be construed as evidence that large quantities of chemical agents were never present or disposed of on-base.

The remaining portions of this section will present a summary of the salient details and observations reported by former and current base employees regarding "gas" disposal operations. Data that might assist in the identification of the disposed material are presented.

Only one unconfirmed report of a chemical agent at Camp Lejeune was found. Recollections of an interviewed staff member were that in 1958 or 1959, during construction of Air Station housing north of Curtis Road, a bulldozer operator uncovered some glass ampules or vials. Both the operator and his supervisor smelled an odor of "new-mown hay." Subsequently, the area was cleared to a depth of 18 inches and a total of eight broken or intact vials were found. The staff member believed the vials had been "sent away" and were determined to contain phosgene. However, no written documentation or other verbal reports of this

CLW

incident were found. The reported odor is consistent with the odor of phosgene.

It is believed that if these vials did indeed contain phosgene, they were most likely training aids for troop education.

Three other incidences of "gas" burials have been identified (see Site Nos. 69, 75, and 76). These usually involved reports of Marines being present, sometimes with protective clothing. Care was usually exercised during unloading from trucks and placement in pits to ensure the integrity of 55-gallon drums and possibly 5-gallon cans. Some drums were rusty, while others were in good condition. Drums were painted various colors. Some drums were described as being much lighter than drums filled with oil.

At one of these incidents, some drums broke open, releasing a yellow or brown liquid that appeared like fuel oil but was not fuel oil. No distinctive odor was reported. No protective equipment or clothing was worn by the delivery and unloading personnel. The color and appearance are similar to various chemical agents, i.e., distilled mustard gas, nitrogen mustards, and lewisite. The lack of a distinctive odor may have been due to the fact that these agents have vapor densities 5 to 7 times greater than air and vapors may have been confined to the bottom of the pit. Despite these similarities, it is unlikely that such material would be handled by personnel without any protective equipment or clothing. However, this does not conclusively eliminate the possibility that these chemicals were present.

These three drum disposal incidences probably involved disposal of training agents, most probably chloroacetophenone (CN), as a solid or dissolved in one or more solvents. CN dissolved in chloroform, in chloropicrin and chloroform, or in carbon tetrachloride and benzene becomes the different training agents CNC, CNS, and CNB, respectively. The most probable liquid training agent would have been CNC. CN or another training agent, o-chlorobenzylidene malonitrile (CS), may have been present in the "much lighter than oil" drums. CS was developed around the time of the Korean War and replaced CN, which was developed in 1915. Both CS and CN have similar bulk densities (CS is about 0.25 g/cc), and both were stored and handled in 55-gallon drums.

6.7 SITES.

6.7.1 Introduction. A total of 76 waste disposal sites have been identified at MCB Camp Lejeune, MCAS New River, and HOLF Oak Grove. The sites are listed in Table 6-5, and are located on maps included with this section. For many sites, photographs have been included with the site reports. These show limited information regarding foliage, land use, and topography near sites.

The confirmation study ranking system (model) has been applied to these sites. A total of 54 sites were judged not to require further consideration. These sites include 12 at MCAS New River, 3 at HOLF Oak

CLW

Grove, and 39 at MCB Camp Lejeune. Five MCAS New River plus 17 MCB Camp Lejeune sites have been judged to require further assessment. These judgments were based on factors such as type of waste material and potential for migration.

Summaries of pertinent information concerning all sites are given in Table 6-5.

6.7.2 Sites Requiring Confirmation. The 22 sites requiring confirmation are described on individual forms in this section. The remaining 54 sites excluded from further consideration are described in Section 6.7.3 using similar, but abridged, forms.

Table 6-5. Disposal Sites at Camp Lejeune Complex*

Site No.	Site Description	Dates Used	Material Deposited	Public Works Development Map Sheet and Coordinates
1**	French Creek Liquids Disposal Area	Late 1940s to mid-1970s	Waste battery acid, POL	11 C7/D7
2**	Former Nursery/Day-Center (Bldg. 712)	1945-1958	Various pesticides	5, K10
3	Old Creosote Plant	1951-1952	Trash, general debris	5, N11-12/O11-12
4	Sawmill Road Construction Debris Dump	Unknown	Asphalt, old bricks, and cement	5, N14-15/O14-15
5	Piney Green Road	Unknown	Waste oil for dust control	6, G4/H4
6**	Storage Lots 201 & 203	1940s-Present	Metals, DDT, PCBs	6, F3-4/G3-4/H2-4/J2-4/
7	Tarawa Terrace Dump	1972	Construction debris, STP filter, sand, household trash	3, F4
8	Flammable Storage Warehouse Bldg. TP451 & TP452	Current	Flammables	6, K3
9**	Fire Fighting Training Pit	1960s-Present	JP-4, JP-5, solvents	6, K3/L3
10	Original Base Dump	Pre-1950	Construction debris	6, G2/H2
11	Pest Control Shop	1976-1982	Pesticide storage, beta buttons, animal carcasses with low-level radiation	10, F10
12	Explosive Ordnance Disposal	Early 1960s	Ordnance burned or exploded, colored smokes, white phosphorus	20, G9
13	Golf Course Construction Dump Site	1944	Clippings, branches, some asphalt	7, G12-13
14	Knox Area Rip-Rap	1973	Broken concrete and asphalt	2, L16-17/M16-17
15	Montford Point Dump, 1948-1954	1948-1958	Litter, asphalt, STP sand	2, M9-10
16**	Montford Point Burn Dump, 1958-1972	1958-1972	Garbage, waste oils, asbestos	2, N11-12
17	Montford Point Area Rip-Rap	1968-Unknown	Concrete rubble	2, N9/O9

Table 6-5. Disposal Sites at Camp Lejeune Complex* (Continued Page 2 of 5)

Site No.	Site Description	Dates Used	Material Deposited	Public Works Development Map Sheet and Coordinates
18	Watkins Village (E) Site	1976-1978	Construction materials and debris	7, L21
19	Naval Research Lab Dump	1956-1960	Radioactive contaminated animals, empty tanks, scrap metals	10, E10/F10
20	Naval Research Lab Incinerator	1956-1960	Some ash, debris	10, F10
21**	Transformer Storage Lot 140	1950-Present	PCB spill, DDT, transformer oil	10, I15
22**	Industrial Area Tank Farm	1979	Fuel (leaks)	10, J15
23	Roads and Grounds, Bldg. 1105	1957-1960	Pesticide, herbicide storage	10, J15
24**	Industrial Area Fly Ash Dump	1972-Approx. 1980	Fly ash and cinders, WTP sludge, STP sludge, construction debris	10, L16-17/M16-17
25	Base Incinerator	1940-1960	Burned trash, melted glass	10, G8
26	Coal Storage Area	Present	Coal storage runoff	10, L12
27	Naval Hospital Area Rip-Rap	1970-Unknown	Concrete, granite rip-rap erosion control	10, P5
28**	Hadnot Point Burn Dump	1946-1971	Solid wastes, industrial wastes, garbage, trash, oil-based paint	10, Q13-14/R13-14
29	Base Sanitary Landfill	1972-Present	Garbage, construction debris, general trash	11, A12/B12-13/C12-13/D13
30**	Sneads Ferry Road-Fuel Tank Sludge Area	1970	Sluge from fuel storage tank, tetraethyl lead and related compounds	18, G12
31	Engineering Stockage-G-4 Range Road	1950-early 1970s	Waste oils	20, G7-8/H3-8/I1-7/J1-5
32	French Creek	1973-1979	Rip-rap dumped	11, F3/G3-4/H4