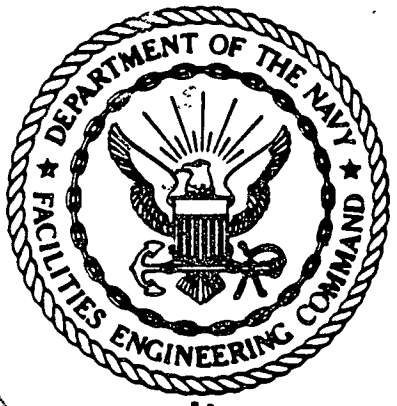
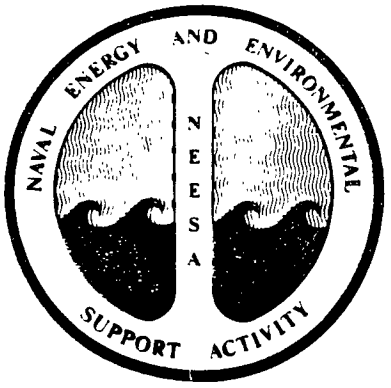


FEBRUARY 1983

INITIAL ASSESSMENT STUDY OF NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY

NEESA 13-020



NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY

Port Hueneme, California 93043

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INITIAL ASSESSMENT STUDY

NAVAL WEAPONS STATION EARLE, COLTS NECK, NEW JERSEY

UIC: N60478

Prepared By:

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Contract No. N62474-81-C-A526

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Prepared for:

NAVY ASSESSMENT AND CONTROL OF INSTALLATION POLLUTANTS (NACIP) DEPARTMENT

Naval Energy and Environmental Support Activity (NEESA)
Port Hueneme, California 93043

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Jeffery C. Heath, P.E.
John Accardi, Jr.

February, 1983

Naval
Environmental
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Service

FOREWORD

FOREWORD

The Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program in OPNAVNOTE 6240 ser 45/33503 of 11 September 1980. 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 the Naval Weapons Station Earle, Colts Neck, New Jersey by a team of specialists from the Fred C. Hart Associates, Inc., New York, New York. Further confirmation studies under the NACIP program were recommended at several areas at the activity. Discussions dealing with significant findings, conclusions, and recommendations are presented in the earlier sections of the report. The later 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.

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ACKNOWLEDGEMENTS

The Initial Assessment Study team commends the support, assistance and cooperation provided by personnel at Northern Division, Naval Facilities Engineering Command; Naval Energy and Environmental Support Activity; Ordnance Environmental Support Office and Earle Naval Weapons Station. In particular, the team gratefully acknowledges the outstanding effort provided by the following people, who participated in the successful completion of the study:

William Matthaey, Environmental Coordinator, NWS Earle
Michael Ring, Photographer, NWS Earle
John Accardi, Jr., Contract Coordinator, NEESA
David Smith, Environmental Engineer, Northern Division, Naval Facilities Engineering Command
George Wiese, Environmental Engineer, Northern Division, Naval Facilities Engineering Command
H.A. Dodohara, Chemical Engineer, Ordnance Environmental Support Office.

EXECUTIVE SUMMARY

This Initial Assessment Study (IAS) was performed for Naval Weapons Station Earle, Colts Neck, New Jersey as part of the Navy Assessment and Control of Installation Pollutants (NACIP) program, which has the objective of identifying, assessing and controlling environmental contamination resulting from past hazardous materials management.

The environmental setting of NWS Earle is characterized by geologic and hydrologic conditions favoring movement of pollutants within groundwater and, because of the amount of open land required by munitions operations, by significant wildlife resources. In the areas adjacent to the Main Base, groundwater is extensively used for both public and private water supply.

Operations at NWS Earle are primarily focused on handling, storage, renovation and transshipment of munitions. Operations generating wastes are typically small in scale and widely dispersed throughout the almost 16 square miles of the Main Base. In addition to ordnance operations, non-ordnance operations such as Public Works and the homeporting of Commander Service Squadron Two (COMSERVRON TWO) were also evaluated regarding past hazardous waste disposal practices.

The potential problems that were identified during the program are associated with the disposal of municipal wastes and small amounts of industrial wastes, and the production of nitrates during the open burning of ordnance materials. The principal conclusion to be drawn from the review of records, interviews, and site inspections by the NACIP Team is that the range of environmental problems at NWS Earle is not very significant.

A total of 29 waste disposal sites or spills were identified at NWS Earle. The study concludes that, while none of the sites pose an immediate threat to human health or the environment, four 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 four sites, is recommended to confirm or deny the existence of the suspected contamination and

to quantify the extent of any problems which may exist. These sites include an explosive ordnance demilitarization site and three landfills. The results of the Confirmation Study will be used to evaluate the necessity of conducting mitigating actions or clean-up operations.

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SECTION 1
INTRODUCTION

1.1 PURPOSE OF INITIAL ASSESSMENT STUDY

As directed by the Chief of Naval Operations (CNO), the Naval Energy and Environmental Support Activity (NEESA), in conjunction with the Ordnance Environmental Support Office (OESO), conducts Initial Assessment Studies (IASs) to collect and evaluate evidence which indicates the existence of pollutants which may pose a potential threat to human health or the environment either on or off the installation. The IAS is the first phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program, which has the objective of identifying, assessing, and controlling 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. Naval Weapons Station (NWS) Earle was designated for an IAS by CNO letter ser 451/397464 of 3 August 1981.

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

3. NWS Earle and NORTHNAVFAC personnel were briefed by NEESA Environmental Engineer Jeff Heath, P.E., and Wayne Tusa and James Shirk of Fred C. Hart Associates, Inc., on 6 May 1982.

4. Various government agencies were contacted for documents pertinent to the IAS effort. Agencies contacted included the following:

a. NEESA Information Management Department.

b. NEESA Information Services Department.

c. NAVFAC Historian, Naval Construction Battalion Center (NCBC), Port Hueneme, CA.

d. NORTHNAVFAC Facilities Management Department and Planning Department; Maintenance/Utilities Division and Real Estate Division, including the Environmental Engineering, Utilities Engineering and Natural Resources Branches.

e. National Archives Science and Technological Archives Division, Alexandria, VA.

f. National Archives, General Archives Division, Suitland, MD.

g. Washington National Records Center, Suitland, MD, Records Group 181, Records of the Naval Districts and Shore Establishments.

h. Naval Historical Center, including the Navy Library and the Operational Archives, Washington Navy Yard, District of Columbia, Command Histories.

i. U.S. Geological Survey, Reston, VA and Trenton, NJ.

j. U.S. Navy Ordnance Environmental Support Office, Indian Head, MD.

Prior to this study, NWS Earle and NORTHNAVFAC personnel conducted several surveys to identify sources of pollution and to plan corrective action. Recent reports date from the early 1970's and include air and water pollution surveys, Pollution Source and Environmental Reconnaissance Survey, Environmental Engineering Surveys, Hazardous Waste Management Plan and the Disposal Site Fact form. The NACIP Team used these reports to supplement extensive interviews and on-site investigations.

5. The on-site phase of the IAS was conducted on July 6-9 and July 19-20, 1982. The information presented in this report is current, as of the dates of the on-site investigation. The following personnel were assigned to the NACIP Team:

Mr. John Accardi, Jr. NEESA Contract Coordinator
Mr. Jeffery C. Heath, P.E., NEESA Contract Coordinator
Mr. David Smith, NORTHNAVFAC Representive (July 6-9)
Mr. George Wiese, NORTHNAVFAC Representative (July 19-20)
Mr. H.A. Dodohara, OESO Representative (July 6-9)
Mr. Wayne K. Tusa, Project Director, FCHA
Dr. Barry North, Project Reviewer, FCHA
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Mr. Paul H. Woods, Environmental Engineer, FCHA
Mr. Brian Gillen, Civil Engineer, FCHA
Ms. Mary Manto, Public Health Specialist, FCHA
Ms. Susan Chivvis, Biologist, FCHA
Dr. Donna Toeroek, Health Physicist, FCHA
Mr. Irving Forsten, Munitions Waste Management Consultant
Mr. William Matthaey, Environmental Coordinator, NWS Earle

In addition to on-site records reviews, interviews were conducted with present long-term employees and former employees. Ground and helicopter tours of the installation were made, and photographs were taken.

1.3 SUBSEQUENT NACIP STUDIES

The recommendations for the next phase of the NACIP program, the Confirmation Study, are based on the findings of the Initial Assessment Study.

During Confirmation Studies, extensive sampling and monitoring is conducted to confirm or refute the existence of migrating contamination at sites identified during an IAS. If significant impacts are found to be

present, the Confirmation Study recommends the types of remedial actions to be taken. A Confirmation Study is conducted only if the IAS concludes that:

1. Sufficient evidence exists to suspect that an installation is contaminated; and

2. The contamination presents a potential threat to:

   a. the health of civilians in adjoining communities or of personnel within the base fenceline, or

   b. the environment within or outside the installation.

If these criteria are not met, no further studies will be conducted under the NACIP program.

SECTION 2
SIGNIFICANT FINDINGS

2.1 GENERAL

Significant findings relevant to hazardous waste sites at NWS Earle have been grouped as follows: (1) background conditions; (2) past site operations; (3) waste sites; and (4) potential impacts.

2.2 BACKGROUND

The important background conditions with respect to hazardous waste management at NWS Earle are summarized below in discussions on the following: (1) soils and geology; (2) water resources; (3) ecology; and (4) population and land use. More detailed information can be found in Section 5 of this report.

2.2.1 Soils and Geology

Soils in the NWS Earle area are typically sandy (15 to 30 percent clay). For most soils, depth to seasonally high groundwater is greater than five feet, although soils adjacent to streams and marshes exhibit high seasonal groundwater. Soils are typically acid, with some lignite wetland soils being very acid. Soils also have high iron and sulfur contents. With respect to erosion, unprotected soils can be easily eroded if not properly graded, and due to the low natural fertility of the subsoils, re-establishment of vegetation is difficult.

Geologically, the Main Base is part of the New Jersey Atlantic Coastal Plain, a sequence of thick unconsolidated sand and clay deposits. The deposits thin to the northeast and thicken towards the Atlantic Coast. The Main Base contains outcrops of the Hornerstown Sand, the Vincentown Formation, the Kirkwood Formation and the Cohansey Sand. The Cohansey Sand forms a series of low hills along the center of the Main Base. The Waterfront and Chapel Hill Areas contain outcrops of the Wenonah Formation, Navesink Formation and Red Bank Sands.

2.2.2 Water Resources

The Main Base forms the headwaters for three major Coastal Plain rivers; the Swimming, Shark and Manasquan Rivers. Because the Main Base is at the headwaters, potential impacts to surface water quality can be severe. However, the potential of flooding and subsequent impacts are minimal. Water quality in the rivers draining the Main Base is within EPA standards. Of particular significance is the fact that two of the streams draining portions of the Main Base are tributaries to rivers used for surface water reservoirs. The northwest corner of the site drains into Mine Brook, which flows to the Swimming River Reservoir, and the southeast portion of the Main Base drains to the Shark River, the water source for the off-stream Glendola Reservoir. In addition, the Manasquan River, draining south from the Main Base, is being considered as the site for a proposed reservoir. Surface water drainage from the Waterfront Area enters Sandy Hook Bay directly and through Compton, Ware and Wagner Creeks. None of these are used for water supply.

Groundwater occurs in the thick sand and silty sand sequences that are part of the Coastal Plain deposits. In this area, the deeper aquifers are largely used for public water supply, while the near surface aquifers supply shallow domestic wells. The water supply for the Main Base is obtained from two deep wells (approximately 800 feet deep) that tap the Raritan-Magothy aquifer system; the outcrop and recharge area of this aquifer system is located several miles north and west of the Main Base and not subject to possible contamination from surface activities at the Main Base. The water supply at the Waterfront and Chapel Hill areas is obtained from adjacent municipal water systems.

The Main Base is a recharge area for the Vincentown and Kirkwood aquifers. Although these aquifers are not used for public water supply in the areas surrounding the Main Base, they are used for domestic supply in areas without public water systems. The direction of groundwater flow is from the recharge areas to the east and southeast, indicating that the areas most likely to be affected by groundwater migration of contaminants would be south and east of the Main Base. Communities surrounding the Waterfront and

Chapel Hill Areas obtain drinking water from the Monmouth Consolidated Water Company system using deep wells and surface reservoirs. Adjacent homes are part of this system and do not have domestic wells. Waste disposal activities at the Waterfront and Chapel Hill Area would not affect private or public wells.

The Vincentown and Kirkwood aquifers are used for both private and public water supply in the Jersey Coast area east of the Main Base. Groundwater quality in these aquifers is within standards, with the exception of high iron content. Off-site sources of potential groundwater contamination include the Shrewsbury Disposal Company site, located along the east side of the Main Base, the Monmouth County Regional Landfill, also east of the Main Base, and the Tedruth Plastics Company and Cities Service Chemicals Warehouse, both at the southeast corner of the Main Base.

2.2.3 Ecology

The Main Station consists of alternating cleared fields and oak-pine or mixed hardwoods forests. This is almost entirely low quality second growth timber, on land at one time cleared by natural fires or lumbering. Nineteen acres of Atlantic White Cedar Swamp are the only remainder of a unique wetland forest that once provided valuable timber. Southern parts of the Main Base are in part of the Pine Barren community, characterized by dry sandy soil which is vulnerable to erosion when cleared. The 9,000 acres of forest at NWS Earle support a diverse natural community that in some cases acts as a source of replenishment for nearby woodlands.

No species on the federal endangered species list have been seen on the Station, but some species on the New Jersey list may be present. An osprey has visited the Main Base, and may nest in the Chapel Hill area. The Mingamahone Brook supports Bog Turtles downstream of the Main Base, and provides an appropriate habitat for them at the Main Base.

The Waterfront area borders a tidal wetland, some of which has been filled in by the Navy and a neighboring (non-Navy) landfill. This marsh is a productive and environmentally useful resource which serves as a nursery for many marine and shore animals.

2.2.4 Population and Land Use

The total population of Monmouth County is greater than 500,000, but the areas of the county potentially affected by the Main Base have comparatively low population density. The area around the Main Base includes agricultural, vacant and low-density residential land. Three sites adjacent to the Main Base, Shrewsbury Disposal (also known as the Stavola Landfill), Cities Service Chemicals, and Tedruth Plastics, could result in encroachment of hazardous materials onto the Main Base.

At the Waterfront and Chapel Hill Area population density adjacent to the site is higher and largely single-family residential. An old municipal landfill is located on the opposite side of Ware Creek from the Waterfront Area.

2.3 SITE OPERATIONS

Past and present site operations generate materials classified as hazardous. The principal mission of NWS Earle has remained relatively unchanged since base construction in 1943, that is, the storage, maintenance, renovation and control of munitions. The scope of industrial operations needed to accomplish this mission is limited to repainting and repairing munitions. However, the disposal of unserviceable munitions and explosive ordnance requires special facilities and precautions.

Major tenant operations that may have generated potentially hazardous wastes include the Fleet Mobile Mine Assembly Group (MOMAG), Commander Service Squadron Two (COMSERVRON TWO), the Defense Property Disposal Office (DPDO), the Precious Metals Recovery Office (PMRO) and the Oil and Hazardous Materials Simulated Environment Test Tank (OHMSETT).

In addition to ordnance operations and non-ordnance related tenant operations, the base support functions (supply, fleet support and public works) have also been sources of hazardous materials.

More detailed information on site operations can be found in Sections 6.1 through 6.5.

2.4 WASTE TYPES AND DISPOSAL SITES

2.4.1 Waste Types

Wastes from ordnance operations have included waste solvents, blasting grit or shot, paints and metals and explosives from unserviceable munitions, as well as trash such as packing material, lumber and rags. Because most ordnance paint removal uses grit or shot blasting, solvents are present only as paint thinners or for equipment cleaning. Metals and explosives from unserviceable munitions are largely recoverable through the DPDO and military sales. Burning of nitrogen-containing munitions and explosives has the potential for generating nitrates, which are soluble and may pose a threat to groundwater use.

Wastes from nonordnance operations have included a broader range of waste types, including oils and small amounts of pesticides, oil and lead-based paints, solvents, degreasers, acids, metal scrap and dunnage.

2.4.2 Disposal Sites

In addition to the nine waste disposal sites previously indentified by NWS Earle personnel, the NACIP Team, based on an extensive records search, interviews and on-site inspections, has identified another 20 sites of potential concern. The histories of site use, the types of waste disposed, the magnitude of spill incidents, and other characteristics related to these 29 sites were investigated in detail. A description of waste disposal activities at each site and an analysis of potential human health or environmental effects from contaminant migration are presented in Section 6. Summaries of this information are presented in Section 3.

SECTION 3

CONCLUSIONS

3.1 GENERAL

Operations at NWS Earle are primarily focused on the handling, storage, renovation and transshipment of munitions. Operations generating wastes are typically small in scale and widely dispersed throughout the almost 16 square miles of the Main Base. In addition to ordnance operations, nonordnance operations such as Public Works and the homeporting of COMSERVRON TWO also generate wastes requiring the evaluation of disposal activities.

There are no records of the history of the use and disposition of sources of low-level ionizing radiation at NWS Earle. Interviews with appropriate personnel were conducted. These interviews indicated that there have never been, nor are there presently, nonordnance radiological materials on this base. There are microwave ovens on-site and an X-ray unit in the medical facility, but neither of these instruments have the potential for creating an adverse radiological impact on the environment. Thus, based on the information available during the initial assessment, further low level radiological characterization of this facility is not warranted.

The principal conclusion to be drawn from the review of records, interviews and site inspections by the NACIP Team is that the range of environmental problems at NWS Earle is not very significant. The potential problems that were identified during this program are associated with the disposal of municipal wastes and small amounts of industrial wastes, and the production of nitrates during the open burning of ordnance materials.

The locations of the 29 waste disposal sites identified during the IAS activities are shown in Figure 3-1. Of these 29 sites, 4 are recommended for further study and the remaining 25 are not. All 29 sites are discussed in Sections 3.3 and 3.4.

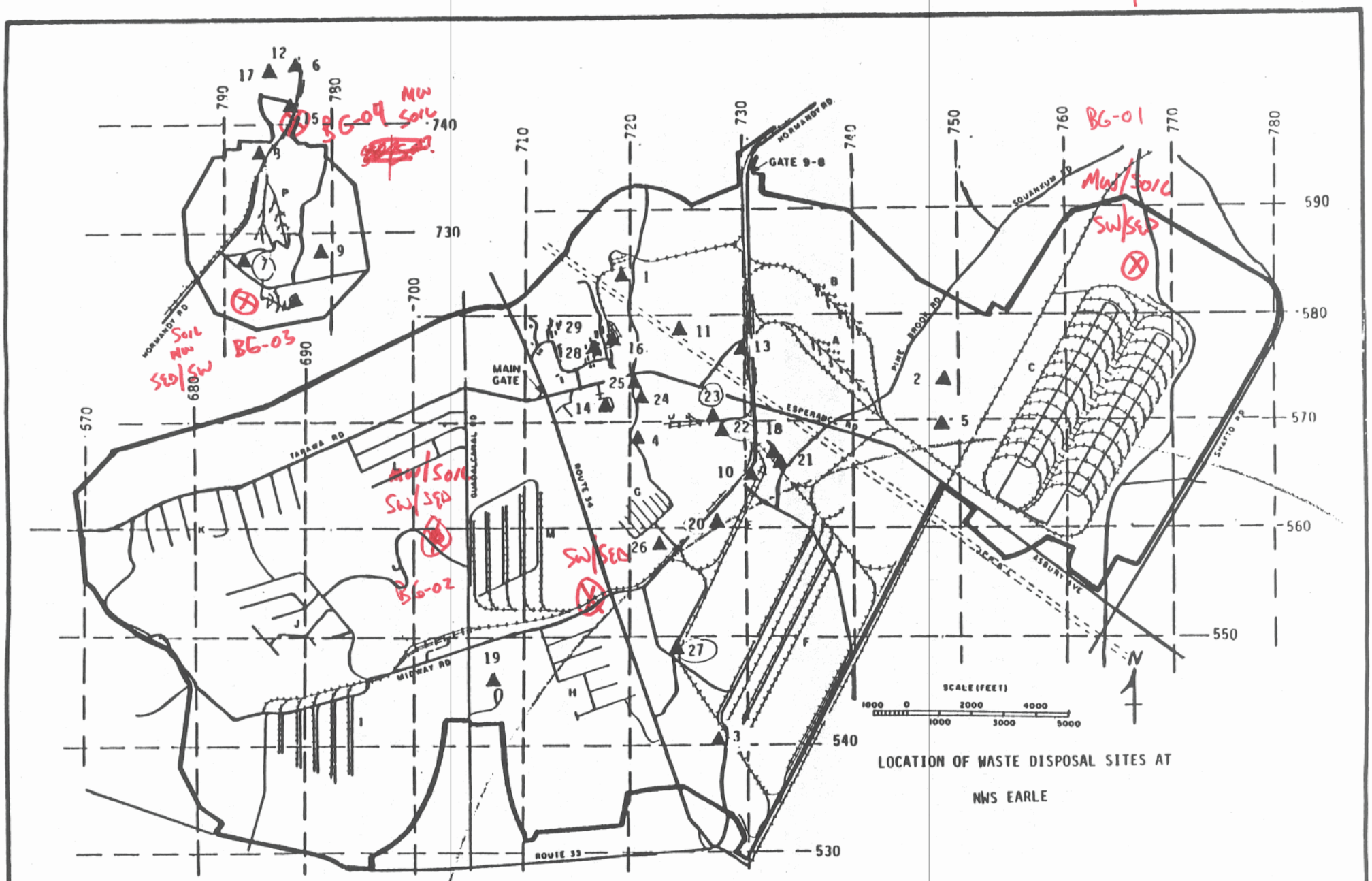

Figure 3-1. Location of Waste Disposal Sites at NWS Earle.

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INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Key to Location Map of Waste Disposal Sites at NWS Earle

Site Number	Site Title	Map Coordinates
1	Ordnance Demilitarization Site, Secured	719-584
2	Ordnance Demilitarization Site	748-574
3	Landfill Southwest of "F" Group	728-541
4	Landfill West of "D" Group	721-567
5	Landfill West of Army Barricades	749-570
6	Landfill West of Normandy Road	786-739
7	Landfill South of "P" Barricades	783-728
8	Landfill East of S-186	785-737
9	Landfill Southeast of "P" Barricades	790-727
10	Scrap Metal Landfill near Building 589	731-565
11	Contract Ordnance Disposal Area	725-579
12	Battery Acid Spill Site	786-739
13	Defense Property Disposal Office Yard	730-577
14	Defense Property Disposal Office Warehouse	718-571
15	Sludge Disposal Site Near Waterfront South Gate	787-741
16	Fuel Line Connecting Building C-19 and C-50	719-577
17	Disposal Site Behind Training Barge, Waterfront	786-745
18	Demilitarization Furnace	734-567
19	Paint Sludge Disposal Site Adjacent to Building S-34	707-546
20	Grit Blast Disposal Site Adjacent to	727-561
21	Baghouse and Cyclone Dust Storage Area	734-566
22	Paint Chip Disposal Site Near Building D-2	727-569
23	Paint Chip Disposal Site Near Building D-5	727-570
24	Closed Pistol Range	721-571
25	Closed Pistol Range	721-572
26	Explosive "D" Washout Area, Building G-B-1	723-559
27	Projectiles Refurbishing Area	725-549
28	Waste Oil Tank	714-577
29	PCB Spill Site, Building C-16	714-577
30		

3.2 INITIAL SITE SCREENING

Hazardous waste sites identified by the IAS team are evaluated using a Confirmation Study Ranking System (CSRS) developed by NEESA for the 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 flow chart 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 judgement are then used to evaluate the need for a confirmation study, based on the criteria stipulated in Section 1.4.

CSRS scores assigned to sites recommended for confirmation studies also assist Navy managers in establishing priorities for accomplishing the recommended actions. A more detailed description of the Confirmation Study Ranking System is contained in NEESA Report 20.2-042.

3.3 SITES CONCLUDED TO POSE A POTENTIAL THREAT TO HUMAN HEALTH OR THE ENVIRONMENT

Analyses have lead to the conclusion that the sites discussed in this section pose a potential threat to human health or the environment. These conclusions have been based on the review of records, interviews, site inspections and the NACIP Confirmation Study Ranking System (CSRS).

3.3.1 Site No. 2: Ordnance Demilitarization Site

This eleven-acre site, located at coordinates 748-574, has been used for the disposal of ordnance from on and off-base, including some disposal for the New Jersey Department of Environmental Protection. Use of the site commenced in 1974. The explosives and propellants which have been

disposed of at this site include ammonium picrate, trinitrotoluene (TNT), hexogen (cyclo - 1,3,5 - trimethylene - 2,4,6 trinitramine, or RDX), Composition 4 (C-4, which is a mixture of hexogen and plasticizer), black powder (75% KNO_3 (or $NaNO_3$), 15% charcoal, 10% sulfur), and double-base propellants (a mixture of nitrocellulose and nitroglycerine). It is estimated, based on current operations, that a total of approximately 80,000 pounds of explosives and propellents have been disposed of at this site.

Activities at this site could have resulted in the deposition of significant amounts of nitrate residues. These materials would readily dissolve in rainwater as it percolates through the site to the underlying groundwater. This site is located within the recharge zone of the Vincentown Aquifer, and the soils at the site are permeable, allowing for rapid migration to the underlying aquifer. Groundwater flow in this aquifer is to the southeast, and the nearest known downgradient well is approximately two miles away in that direction. However, several homes that may use the Vincentown Aquifer as a domestic water source are located less than one mile southeast of the site.

Because of the hydrogeology of the site, and the potential presence of nitrates in significant quantities, this site is recommended for a Confirmation Study.

3.3.2 Site No. 3: Landfill Southwest of "F" Group

This five-acre landfill, located at coordinates 728-541, was used for the disposal of Main Station refuse from 1960 to 1968. On-site interviews indicated that this landfill received both domestic and industrial wastes. Approximately 4,800 tons of wastes were disposed of over the lifetime of this site. This would have included material such as the following: paints and paint thinners; solvents, varnishes and shellacs; acids, alcohols and caustics; pesticide containers and rinsewaters; waste wood; small amounts of asbestos from pipe and boiler insultation and automotive brake linings; other industrial wastes; and domestic wastes (paper, glass, plastics, etc.).

Based on interviews and observation of activities at the Station, including the fact that housing has been supplied for military personnel since 1963, it appears that the industrial wastes listed above would have comprised a very small amount of the total waste deposited in this landfill. However, leachate from municipal wastes can pose a public health hazard if human consumption of contaminated waters does occur.

The major concern at this site is the risk posed by the highly permeable soils, which are conducive to off-base migration, and the potential for effects on groundwater users outside the Station. A study of the soils in the "F" Group area for foundation purposes indicates that the soils are sandy from the surface to the water table, which averages 15 feet below the ground in this area. In addition, the area is located in the recharge zone of the Kirkwood Aquifer. While this aquifer is not a source of supply for any formal public water systems in the vicinity of the Main Station, it is used for domestic purposes by private home dwellers in the area via shallow private wells. The groundwater flow is to the southeast and east; the nearest potential receptors are in a local community located less than one mile to the south of the Station.

3.3.3 Site No. 4: Landfill West of "D" Group

This five-acre landfill, located east of Macassar Road at coordinates 721-567, was used from 1943 to 1960 for the disposal of Main Station domestic and industrial wastes. Typical operation at this site included the burning of waste material in trenches prior to covering (burial). Roughly 10,200 tons of waste were disposed of over the lifetime of this site. This would have included material such as the following: domestic wastes; some demolition wastes; pesticide containers and rinsewaters; and industrial wastes in discarded containers such as paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and waste wood. In addition small amounts of and asbestos from automative brake linings would have been disposed of at this site.

Based on interviews and observation of activities at the Station, it appears that the industrial wastes listed above would have comprised a

very small amount of the total waste deposited in this landfill. However, leachate from municipal wastes can pose a public health hazard if human consumption of contaminated waters does occur.

This site is recommended for a Confirmation Study because of the potential disposal of potentially hazardous materials in an area where the hydrogeology is conducive to contaminant migration. This landfill is situated in the Cohansey Sand, a permeable sand formation which lies above the Kirkwood Aquifer. This aquifer is used for domestic purposes by private home dwellers in the vicinity via shallow private wells. The groundwater flow of the aquifer is southeasterly, and the nearest private users of this water are located 1.5 miles southeast of the site.

3.3.4 Site No. 5: Landfill West of Army Barricades

This thirteen-acre site, located at coordinates 749-570, was used for the disposal of Main Station refuse from 1968 to 1978. Approximately 6,600 tons of domestic and industrial wastes were disposed of over the lifetime of this landfill. This included material such as the following: domestic wastes, such as paper, glass and plastics; pesticide containers and rinsewaters; industrial wastes in discarded containers such as paint, paint thinners, solvents, varnishes, shellacs, acids, alcohols and caustics; and waste wood.

Based on interviews and observation of activities at the Station, including the fact the housing has been supplied for military personnel since 1963, it appears that the industrial wastes listed above would have comprised a very small amount of the total waste deposited in this landfill. However, leachate from municipal wastes can pose a public health hazard if human consumption of contaminated waters does occur.

This site is recommended for a Confirmation Study because of the potential disposal of hazardous materials in an area where the hydrogeology is conducive to contaminant migration. The soils underlying this site are sands and sandy loams with moderate permeabilities, and the site is located in the recharge area of the Kirkwood Aquifer. Thus, any percolation of

leachate-contaminated groundwater from the site will enter this aquifer, which serves as a source of domestic water for private homes in the area via shallow private wells. The groundwater flow direction of this aquifer is southeasterly, and the nearest of these downgradient receptors are located approximately one mile southeast of the site.

3.4 SITES NOT RECOMMENDED FOR A CONFIRMATION STUDY

Analyses have led to the conclusion that 25 of the sites identified during the Station visit do not pose a potential threat to human health or significant potential threat to the environment. These conclusions have been based on the review of records, interviews, site inspections and the NACIP Confirmation Study Ranking System.

3.4.1 Site No. 1: Ordnance Demilitarization Site, Secured

This six-acre site, located near Building S-465 at coordinates 719-584, was used for the burning of ordnance materials from 1943 to 1974. A site layout is shown in Figure 6-5. The site was demilitarized in 1975 by plowing the area, spreading a layer of oil-soaked hay, and setting the hay ablaze to burn the site's surface. The site is currently used by the U.S. Army as a communications facility.

No records or other hard data describing the operations of this ordnance disposal range were available. Based on interviews at the station, it was determined that at least 90% of the material burned during the lifetime of this site was smokeless powder, which is essentially nitrocellulose. Any unburned residue or combustion products left from this material would be relatively insoluble, and thus pose no hazard through percolation to the groundwater. Black powder (which is 75% KNO_3 (or $NaNO_3$), 15% charcoal, and 10% sulfur) may have been used to aid in ignition of the smokeless powder here. However, the amounts used would have been very small, so that no significant environmental or public health impacts would have resulted from combustion residues of that substance.

Given the nature of the propellants burned at this site and the fact that they do not pose a potential threat to public health or the environment, this site is not recommended for a Confirmation Study.

3.4.2 Site No. 6: Landfill West of Normandy Road

This four-acre landfill, located at coordinates 786-739, was used for the disposal of refuse from Waterfront Area operations from 1943 to 1965. Materials disposed of at this site were burned before covering; These wastes included dunnage lumber (typically untreated pine), glass, paper, packing material, and small amounts of paint and solvent wastes. Small amounts of preserved wood (e.g. pentachlorophenol-impregnated) may also have been disposed of here, but such activity could not be verified. On-site interviews indicated that the annual loading of this landfill was less than 2500 tons of refuse. Since the landfill was closed, the waterfront recreation building has been constructed on top of the filled land. The Station Public Works Department has no record of problems associated with the construction and use of this building on this site.

This site is adjacent to a tidal marsh and within close proximity to Sandy Hook Bay. Surface drainage from the site will flow into the marsh and eventually into the bay. In addition, the site is in an area of sandy soils that offer a conduit for migration of potential contaminants to the groundwater. However, area residents are supplied by a public water supply system, and there is no known use of the uppermost aquifer in the vicinity. Any contaminants that may migrate to groundwater will be discharged with base flow to either the marsh area or the bay.

The bulk of the wastes disposed of at this site were inert. Given this and the fact that groundwater in the area is not consumed, no health effects or significant environmental impacts are anticipated. Therefore, this site is not recommended for a Confirmation Study.

3.4.3 Site No. 7: Landfill South of "P" Barricades

This five-acre site, located at coordinates 783-728, was used from 1965 to 1977 for general station waste from the Waterfront Area. A discussion with personnel of the Public Works Department indicated that the annual loading of this landfill was less than 2500 tons of refuse. This included munitions shipping wastes (dunnage, packing materials, etc.), shop wastes from the Waterfront Public Works Shop and the Munitions Handling Laboratory (glass, wood and small quantities of waste paints, thinners and solvents), and domestic refuse. The site is now covered with two feet of soil and is being revegetated by weeds.

This site is located at the headwaters of Compton Creek, which drains through a tidal marsh area before emptying into Sandy Hook Bay. In addition, the site is in an area of permeable sandy soils that offer a conduit for downward migration of potential contaminants to the groundwater. However, area residents are part of a public water supply system and there is no known use of the uppermost aquifer in the vicinity.

The bulk of the wastes disposed of at this site were inert. Given this and the fact that groundwater in the area is not consumed, no health effects or significant environmental impacts are anticipated. Therefore, this site is not recommended for a Confirmation Study.

3.4.4 Site No. 8: Landfill East of S-186

This one-acre site, located at coordinates 785-737, was in use from 1943 to 1965 for dunnage disposal. Dunnage is typically made with untreated lumber. The quantity of wastes disposed of is not known exactly, but estimates of total dunnage quantities of 900 to 1,500 cubic yards per year would indicate that approximately 20,000 to 30,000 cubic yards of material were dumped at this site. This site was not selected for a Confirmation Study because only inert dunnage lumber was disposed of at the site.

3.4.5 Site No. 9: Landfill Southeast of "P" Barricades

This three-acre site, located at coordinates 790-727, was used for disposal of dunnage lumber from 1967 to 1972. Lumber was stacked and burned and then covered. No records exist of dunnage quantities disposed of at this site. However, estimates of total dunnage generation of 900 to 1,500 cubic yards per year would indicate that approximately 4,500 to 7,500 cubic yards of lumber were disposed of at this site. A Confirmation Study is not recommended for this site because of the presence of only waste lumber from dunnage disposal.

3.4.6 Site No. 10: Scrap Metal Landfill Near Building S-589

This two-acre site, located at coordinates 731-565, also known as the "Box Yard", was used from 1953 to 1965 for disposal of demilitarized munitions and spent munitions cases. Aluminum and steel containers and cases from 3"50, 5"38 and 40 mm ammunition were the principal items buried. This site was also used for the disposal of spent grit and paint chips from the ammunition rework operations located in Building D-5. Including cover material, approximately 65,000 cubic yards of material were disposed of at this site. Since the site was closed, erosion of cover material has uncovered significant quantities of 40 mm shell cases which are more than 50 percent rusted away.

The presence of the paint chips, which typically contain lead and zinc, was the primary concern in the analysis of this site. However, in the form of dried paint, these metals are probably bound into the paint in such a manner that they will not leach out under normal (not highly acidic or alkaline) environmental conditions. Thus the paint chips can be considered relatively inert. Considering this, and the fact that other known wastes at this site are inert, this site has not been selected for a Confirmation Study.

3.4.7 Site No. 11: Contract Ordnance Disposal Area

This fan-shaped, two-acre site, located at coordinates 725-579, was used by contractors for disposal of obsolete ordnance material for several years. However, the dates of this activity and the amounts of ordnance waste disposed of are not available. The site was also used from 1974 to 1977 for occassional fire-fighting training exercises. These exercises were conducted in and around two unlined pits which were dug at this site, each measuring roughly 30 ft. x 30 ft. x 2 ft. (depth). The typical practice involved placing a reject airplane or vehicle in the pit, soaking it and the pit with fuel oil (or possibly a mixture of fuel oil and waste oil), and setting the area ablaze. After the fire was extinguished, any remaining (unburned) oil was left in the pit and thus soaked into the soil. No data are available on the total quantities of oil remaining after buring; however, it is estimated that only small quantities (less than 50 gallons per year) of oil would have been lost in this manner.

This site was eliminated from consideration for a Confirmation Study because of the availability of only small quantities of waste material for migration to the groundwater.

3.4.8 Site No. 12: Battery Acid Spill Site, Waterfront

This area, located behind the new recreation building (Building R-14) at the Waterfront Area at coordinates 786-739, was used for disposal of an unknown amount of acid electrolyte from forklift batteries being sent offsite for reclamation. The period of disposal and total quantity disposed of are not known, but based on the number of forklifts in use in the area and frequency of battery changes, the amount of spilled electrolyte was probably less than 50 gallons per year.

The concerns associated with this site focus on the presence of battery acid in the waste. However, it was observed during visual inspection that this disposal site drains into a tidal marsh. It is therefore likely that any acidic liquids disposed of would have been neutralized by the buffering capacity of the sea water in the marsh. As a result, this site is not recommended for a Confirmation Study.

3.4.9 Site No. 13: Defense Property Disposal Office Yard

The Defense Property Disposal Office (DPDO) Storage Yard is located near the Rail Classification Yards at coordinates 730-577. Activities conducted at this site included the storage of scrap metals and the storage of forklift batteries. Minor spills of battery acid (on the order of 10 gallons per year or less) may have occured at the site during the handling of batteries (e.g. batteries may have tipped over). In addition, PCB-containing transformers were stored at this site in open rail cars before being transported to the controlled storage area (QH-8). Transformer cases were periodically inspected for damage, and larger transformers were stored in empty torpedo barrels. Interviews indicated that no leakage occurred. This site was not selected for a Confirmation Study because no significant amounts of hazardous waste seem to be present.

3.4.10 Site No. 14: Defense Property Disposal Office Warehouse

The Defense Property Disposal Office (DPDO) Warehouse, Building C-33, located at coordinates 718-571, is a 16,000 square foot storage building for items awaiting processing. On-site interviews indicated that a mercury spill of unknown quantity occurred in this building in 1970. Cleanup operations were conducted, but further information on the extent of the spill and subsequent cleanup was not available. This site was not selected for a Confirmation Study because site visits and interviews indicate that materials are stored in a protected manner, and thus the likelihood of environmental contamination is low.

3.4.11 Site No. 15: Sludge Disposal Site Near Waterfront South Gate

According to interviews conducted during the inspection of NWS Earle, a site along the railroad tracks at the main entrance to the Waterfront Area (coordinates 787-741) was used for disposal of an unknown quantity (possibly over 5,000 gallons) of oily bilge sludge, ranging from 1 to 25 percent oil, from ships homeported at the base during the early 1970's. However, the exact location of this disposal was not apparent from close inspection of the suspected area. Because the location and degree of oil

disposal at this site could not be determined during the inspection and subsequent discussions with Station personnel, this site was not recommended for a Confirmation Study.

3.4.12 Site No. 16: Fuel Line Connecting Buildings C-20 and C-50

This underground fuel line was used to transport diesel fuel from an underground fuel storage tank located adjacent to Building C-20 to a dispensing station (pump) located behind Building C-50, a distance of approximately 400 feet. A leak in the fuel line was discovered in June, 1977 when soil residues were discovered in the locomotive fuels, and use of the pipeline was discontinued. Subsequent excavation uncovered the location of the leak, and it was determined that the amount of diesel fuel lost was minimal (less than 50 gallons). Because the leak was discovered quickly, and the amount of fuel lost was estimated to be minimal, this site is not recommended for a Confirmation Study.

3.4.13 Site No. 17: Disposal Area Behind Training Barge, Waterfront Area

This site is currently used and has been used in the past as a disposal area by Waterfront Area personnel. The materials disposed of here have included forklift vehicles, empty paint cans, construction debris such as wood, concrete and asphalt, waste equipment such as old valves, and similar relatively inert materials. During physical inspection of the site an empty drum (55 gallons) was observed. However, no evidence of stressed vegetation was apparent. This site was not selected for a Confirmation Study because of the presence of largely inert and immobile materials.

3.4.14 Site No. 18: Demilitarization Furnace, Building 589

This furnace, located at coordinates 734-567, was placed in operation in 1978, and is used to demilitarize small caliber (up to 40 mm) ammunition by burning. Waste areas at the site include about 50 sq. ft. of soil contaminated by metal fragments dropping off the furnace discharge conveyor. In this fragment form (e.g. metal chips) the metals in question (typically iron and copper) are inert and as such do not pose a threat to

human health or the environment. Therefore, this site is not recommended for a Confirmation Study.

3.4.15 Site No. 19: Paint Chip and Sludge Disposal Area Adjacent to Building S-34

This site, located 1,000 feet south of Farmingdale Road at coordinates 708-543, was used for the disposal of paint chips and paint sludge from depth charge maintenance operations. Depth charge maintenance was conducted in Building S-34 from the early 1940's until the early 1960's. On-site interviews indicated that, from the outset of this operation, an estimated 1,000 depth charges per year (MK8, 14) were wire brushed, washed down, and repainted on an outdoor concrete platform. A five percent slurry of paint scrapings in wash water was discharged continuously at a 7,000 gallon per day flow rate into an open drainage swale. This operation continued until the late 1950's (circa 1959), when a solvent paint stripping procedure was started; this solvent stripping operation continued until about 1963. During the four years that the solvent stripping system was operative, approximately 100 gallons per year of a solvent/paint sludge mixture was disposed of on the site.

New barricade facilities were constructed on this former paint sludge disposal site in the early 1970's. It is assumed that any construction operations conducted at the site would have included excavating the site to a depth of 3 to 4 feet for the laying of a foundation, thus removing the bulk of any paint sludge residues remaining at the site. The presence of barricades on the site would also create a cap which would preclude further percolation of rainwater through the site to the groundwater. It is therefore reasoned that, because construction activity associated with the barricades built here would have removed much of the hazard associated with paint sludge disposal operations, this site does not represent a significant threat to the environment or to public health. Thus, a Confirmation Study is not recommended.

3.4.16 Site No. 20: Grit Blast Disposal Area, Building 544

Building 544 houses blasting operations for the removal of paint from mines. The paint removed from mines, along with spent grit, is disposed in a 15' x 100' area behind Building 544 at coordinates 727-561. Assuming a steady-state operation (i.e. paint applied this year will be removed over subsequent years), approximately three gallons of zinc chromate primer, 40 gallons of latex and lead based paints, and 10 gallons of copper based paints are stripped per year. Thus a volume of paint chips equivalent to roughly 53 gallons per year of wet paint was disposed of at this site. These paint chips typically contain lead and zinc. However, in this solid form (dried paint), these metals are probably bound into the paint in such a manner that they will not leach out under normal (not highly acidic or alkaline) environmental conditions. Thus the paint chips can be considered relatively inert.

This site is not recommended for a Confirmation Study because of the relative immobility of the lead and zinc contained in the paint chips.

3.4.17 Site No. 21: Baghouse and Cyclone Dust Storage Area Adjacent to Building S-589

This site, located at coordinates 734-566, is a storage area for dust recovered from the air pollution control systems on the demilitarization furnace. In the four years of operation (1978-1982), the air pollution control systems have recovered 25 drums per year of cylcone and baghouse dusts containing oxides of cadmium (0.60 to 4.07 percent by weight), lead 3.3 to 11.7 percent by weight), barium (0.31 to 4.62 percent by weight) and chromium (0.03 to 3.66 percent by weight).

During the period of use, some of the baghouse and cyclone dust was spilled onto the soil around the drums. However, the vast majority of the oxide forms of these metals range from slightly soluble to insoluble, indicating that the metal oxides present at this site will remain in the upper portion of soils, and will not migrate with percolating rainwater to the groundwater. In addition, the site was recently paved over, thus eli-

minating further rainfall infiltration. It is most likely that any metals entrained in the soils will remain there. Therefore, this site was not selected for a Confirmation Study.

3.4.18 Site No. 22: Paint Chip Disposal Area Adjacent to Building D-2

This site, located at coordinates 727-569, consists of approximately 50 square feet of stressed vegetation and discolored (black) soils behind Building D-2, probably resulting from past painting operations. It was reasoned that, based upon the appearance of the site, the amount of paint dumped in this area was not large enough to constitute a significant environmental or public health hazard. Therefore, this site was not selected for a Confirmation Study.

3.4.19 Site No. 23: Paint Chip Disposal Area Adjacent to Building D-5

Building D-5, located at coordinates 727-570, has been used at least since the early 1970's for reworking (i.e., repainting and stenciling) major items of ordnance such as torpedoes and aerial bombs. Approximately 200 square feet of bare area behind the building show evidence of paint spillage. It was reasoned that, based upon the appearance of the site, the amount of paint dumped in this area was not large enough to constitute a significant environmental or public health hazard. Therefore, this site was not selected for a Confirmation Study.

3.4.20 Site No. 24: Closed Pistol Range

This closed small arms practice range located at coordinates 721-571 is characterized by spent cartridge cases along the firing line and by lead and copper jacketed lead bullets in the impact berm. Estimating that approximately 200 rounds of 180 grain .45 caliber ammunition are required per person to maintain annual pistol qualification, and that no more than 50 personnel would maintain qualification per year, the annual loss of lead would be approximately 250 lb in the form of bullets. In that form and those amounts, lead does not pose a significant threat to the environment or to public health. Therefore, this site is not recommended for a Confirmation Study.

3.4.21 Site No. 25: Closed Pistol Range

This closed small arms range, located at coordinates 721-572, is similar in nature to Site No. 24. Estimating that approximately 200 rounds of 180 grain .45 caliber ammunition are required per person to maintain annual pistol qualification, and that no more than 50 personnel would maintain qualification per year, the annual loss of lead would be approximately 250 lb in the form of bullets. In that form and those amounts, lead does not pose a significant threat to the environment or to public health. Therefore, this site is not recommended for a Confirmation Study.

3.4.22 Site No. 26: Explosive "D" Washout Area, Building GB-1

This site, located behind Building GB-1 at coordinates 723-559, was used for the removal and recovery of Explosive "D", ammonium picrate, from 5" shells for one year in the late 1960's. The ammonium picrate was removed from the shells by washing out the shells with hot water. The explosive, which is highly soluble in hot water, was readily dissolved, and the resulting solution flowed into a settling tank where cooling of the water allowed precipitation and collection of the explosive crystals for reuse or disposal. Overflow from this settling tank flowed through an open 18-inch tile pipe to a 50 square foot unlined settling basin. There, cooling of the solution precipitated out most of the explosive. The precipitated crystals were then collected for reuse or disposal. However, onsite interviews indicated that as much as 20,000 pounds of ammonium picrate could have been lost to surface water during this recovery operation due to heavy rainfalls before cleanout of the settling basin.

This site was eliminated from the Confirmation Ranking Study process because any material lost would have been lost as a direct discharge to surface water, and would no longer be present. Hence, no migration to groundwater is anticipated.

3.4.23 Site No. 27: Projectile Refurbishing Area

At this location (coordinates 725-549), projectiles are refurbished by shot blasting, repainting and restenciling. Spent blasting shot and paint chips are disposed of behind the facility. Approximately 80 cubic feet of mixed blasting shot and paint chips are present at this site. These paint chips typically contain lead and zinc. However, in this solid form, (dried paint), these metals are probably bound into the paint in such a manner that they will not leach out under normal (not highly acidic or alkaline) environmental conditions. Thus the paint chips can be considered relatively inert; they do not pose a significant threat to the environment or public health. Therefore, this site is not recommended for a Confirmation Study.

3.4.24 Site No. 28: Waste Oil Tank

The underground waste oil storage tank located behind Building C-14 has overflowed within the last year, with one to several gallons of oil being spilled on the ground surface. Because of the extremely small quantity spilled (seemingly less than 10 gallons), the site was not selected for a Confirmation Study.

3.4.25 Site No. 29: PCB Spill Site, Building C-16

This site, in the storage yard north of Building C-16, was the location of a 1977 PCB spill from a vandalized transformer. Within five days of the occurence of the spill, over 120 cubic feet of contaminated soil was excavated and transported to off-site disposal. All visible evidence of the oil spill (e.g. discolored soil) was removed during this cleanup operation. Because of the rapid response accorded this problem, and because all oil-soaked soil was removed shortly after the incident, this site is not recommended for a Confirmation Study.

SECTION 4

RECOMMENDATIONS

Based on the preceding discussion of significant findings and conclusions, there are four sites at NWS Earle which are potentially contaminated, and pose a potential threat to human health or the environment on and off the station. However, additional information regarding the location or extent of contaminated areas and the potential for contaminant migration is needed to determine whether a threat exists before corrective action is initiated. Therefore, it is recommended that a Confirmation Study, Phase II of the NACIP Program, be performed for these four designated waste sites at NWS Earle, Colts Neck, New Jersey.

4.1 CONFIRMATION STUDY

The four sites have been ranked in descending order of priority based on the results of applying the Confirmation Study Ranking System (CSRS). These sites, in descending order, are:

Waste Site	Site No.	CRSM Score
.Landfill Southwest of "F" Group	3	10
.Landfill West of "D" Group	4	7
.Landfill West of the Army Barricades	5	6
.Ordnance Demilitarization Site	2	5

The recommendations presented in this section are intended to be used as a guide in the development and implementation of the Confirmation Study. Whenever possible, the recommendations include the approximate number of groundwater monitoring wells, type of samples to be taken, such as soil, water, or sediment, and the suspected contaminants for which a test should be made. In addition, follow-up programs based on the results of the initial sampling efforts are proposed.

It is recommended that the groundwater monitoring program, including monitoring well installation, be consistent with the guidance provided in the Groundwater Monitoring Guide, NEESA 20.2-031 of March 1981.

The number of recommended groundwater monitoring wells reflects the minimum number of wells that are considered to be required to determine the groundwater level and direction of groundwater flow and to provide groundwater samples for initial screening.

Table 4-1 summarizes the recommended environmental monitoring program for each of the four sites included in the CSRS. The detailed approach for each area is described in the sections below.

4.1.1 Site No. 2, Ordnance Demilitarization Site.

Type of Samples:	Groundwater and soil.
Number of Soil Samples:	One composite sample consisting of nine surface soil grabs.
Number of Monitoring Wells:	Three monitoring wells (one upgradient, two downgradient). Screens should be set according to data from test borings.
Frequency:	Quarterly for one year (12 samples). Groundwater elevation measurement before each sample.
Testing Parameters:	pH, nitrates, copper, lead, RDX, TNT, ammonium picrate.
Objective:	To determine if contaminants have migrated to the groundwater.
Remarks:	Nitrates in the soil at this site would be the source of any groundwater contamination. Because the site is active (demilitarization operations ongoing), it would be advantageous to evaluate nitrate concentrations in the soil. The recommended soil sampling method (a composite sample) is an inexpensive technique. The resulting information would be useful in estimating leaching rates and the potential for future contamination of the groundwater. If groundwater is determined to be contaminated, then additional monitoring wells may be required to establish the extent of that contamination.

Table 4-1

Summary of Recommended Confirmation Studies

Site	Site Number	Map Coordinates	CSRS Score	Type of Sample		Number of Samples		Number of Groundwater Monitoring Wells	Analytical Parameters
				Groundwater	Soil	Groundwater	Soil		
Ordnance Demilitarization Site	2	748-574	5	X	X	12	1 composite	3	pH, nitrates, lead, copper, RDX, TNT, ammonium picrate
Landfill Southwest of "F" Group	3	728-541	10	X	-	12	-	3	pH, specific conductance, total organic carbon, total organic halogen, chloride, phenols, nitrate, chromium III & VI, acetone and toluene
Landfill West of "D" Group	4	721-567	7	X	-	12	-	3	pH, specific conductance, total organic carbon, total organic halogen, chloride, phenols, nitrate, chromium III & VI, acetone and toluene
Landfill West of Army Barricades	5	749-570	6	X	-	12	-	3	pH, specific conductance, total organic carbon, total organic halogen, chloride, phenols, nitrate, chromium III & VI, acetone and toluene

4.1.2 Site No. 3, Landfill Southwest of "F" Group

Type of Samples:	Groundwater.
Number of Monitoring Wells:	Three (one upgradient, two downgradient). Estimated screen depth to be at least 16 feet below surface.
Frequency:	Quarterly for one year (12 samples) Groundwater elevation measurement before each sample.
Testing Parameters:	pH, specific conductance, total organic carbon, total organic halogen, chlorine, phenols, nitrate, chromium III & VI, zinc, lead, acetone, and toluene.
Objective:	To determine if contaminants are migrating from the landfill to the groundwater and if so, to what extent the groundwater has been contaminated.
Remarks:	If groundwater is determined to be contaminated then additional monitoring wells and testing parameters may be required.

4.1.3 Site No. 4, Landfill West of "D" Group

Type of Samples:	Groundwater.
Number of Monitoring Wells:	Three (one upgradient, two downgradient). Screens should be set according to data from test borings.
Frequency:	Quarterly for one year (12 samples) Groundwater elevation measurement before each sample.
Testing Parameters:	pH, specific conductance, total organic carbon, total organic halogen, chloride, phenols, nitrate, chromium III & VI, zinc, lead, acetone, and toluene.
Objective:	To determine if pollutants are migrating from the landfill into groundwater.
Remarks:	Based on results of the initial sampling program, additional wells and parameters may be recommended.

4.1.4 Site No. 5, Landfill West of Army Barricades

Type of Samples:	Groundwater.
Number of Monitoring Wells:	Three (one upgradient, two downgradient). Screens should be set according to data from test borings.
Frequency:	Quarterly for one year (12 samples) Groundwater elevation measurement before each sample.
Testing Parameters:	pH, specific conductance, total organic carbon, total organic halogen, phenols, nitrates, chromium III & IV, zinc, lead, acetone, and toluene.
Objective:	To determine if pollutants are migrating from the landfill into groundwater.
Remarks:	Based on results of the initial sampling program, additional wells and parameters may be recommended.

SECTION 5

BACKGROUND

5.1 GENERAL

Naval Weapons Station (NWS) Earle includes approximately 10,428 acres in the Main Base (inland) area and 706 acres in the Waterfront and Chapel Hill Areas. These two areas are linked by a 14-mile-long government-owned two lane road and two-track railway. The NWS is located in east-central Monmouth County between the town of Freehold and the Atlantic shore. The Main Base includes portions of Howell, Wall, and Colts Neck Townships and the Borough of Tinton Falls. The Waterfront and Chapel Hill Areas is located in Middletown Township. The NWS is approximately 47 miles southeast of New York City. (Figure 5-1).

The mission of the Naval Weapons Station is: to receive, renovate, maintain, store, and issue ammunition, explosives, and expendable ordance material; to provide logistic and administrative support to homeported ships; and to perform additional tasks as directed by the Naval Sea Systems Command.

The Main Base is primarily oriented towards munitions operations including storage, handling and renovation, with tenant organizations including the Defense Property Disposal Office (DPDO), the Defense Property Disposal precious Metals Recovery Office (PMRO) and the Mobile Mine Assembly Group (MOMAG). The Waterfront and Chapel Hill Area is oriented toward transshipment of munitions from the main base to the homeported ship of Service Squadron Two (COMSERVRON TWO), the major tenant at the waterfront. The other major tenant at the waterfront is the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) operated by the U.S. Environmental Protection Agency. These tenant organizations are described in more details in Section 6.

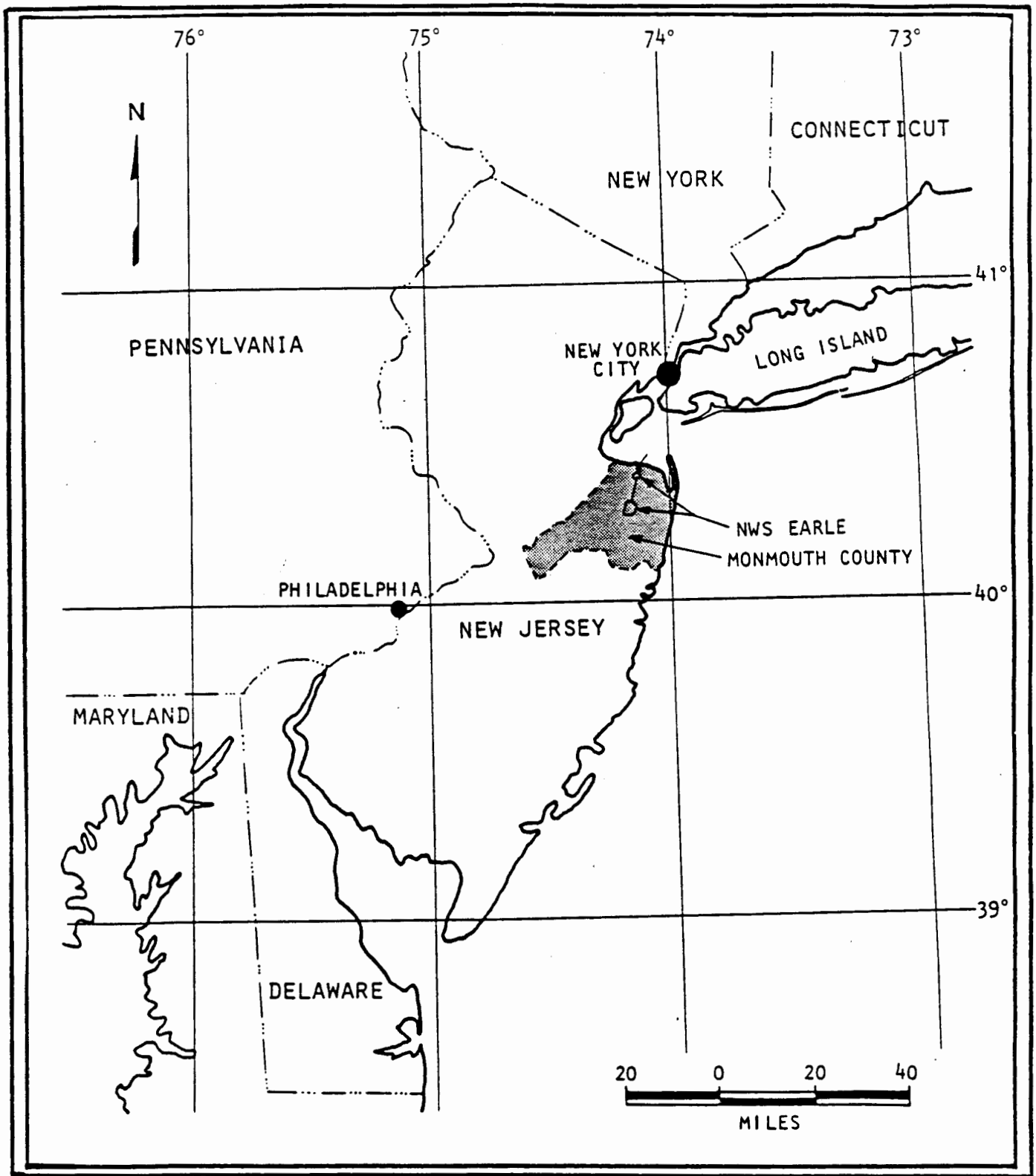


FIGURE 5-1. REGIONAL LOCATION MAP

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

The chain of command for NWS Earle begins with the Chief of Naval Operations (OPNAV), through the Chief of Naval Material (CHNAVMAT) and the Naval Sea Systems Command. The chain of command structure of the major tenant, COMSERVRON TWO, begins with OPNAV through the Commander-in-Chief of the Atlantic Fleet and the Commander, Naval Surface Force to the Commander, Service Group II.

Land use in the area immediately surrounding the Main Base is principally agriculture and vacant land, with strip development of commercial and residential land along highways. Other land uses such as chemical facilities or off-site civilian waste disposal operations can potentially affect environmental quality. Three such facilities are located near the southeast corner of the main base. These sites are: (1) the Shrewsbury Disposal Company landfill, adjacent to the main base south of Asbury Avenue (Gate 29), which is reputed to have received liquid industrial wastes of an unspecified nature, (2) the Monmouth County Regional Landfill, located east of the Shrewsbury Disposal Company landfill, which receives municipal refuse from all of eastern Monmouth County, (3) the Tedruth Plastics Company, located at the intersection of State Highways 33 and 34, at the southeast corner of the main base and four (4) Cities Service Chemicals warehouse in the same area.

5.2 HISTORY

Naval Weapons Station (NWS) Earle was established as as result of investigations conducted by a joint board comprised of individuals from the Bureau of Ordnance and the Bureau of Yards and Docks. Long before the outbreak of World War II, both services recognized the need for an explosives shipping facility somewhere in the Port of New York. The Army had established a board to survey the harbor area, but the site selected was considered uneconomical. The Navy board carried its search further abroad and located a large area of swamp and forest 12 miles from the coast. The board recommended that the shipping facilities be located on the shore, near Leonardo, with the magazines, industrial and administrative areas being located inland. The Secretary of the Navy approved the recommended location in June of 1943 and construction of the facility began immediately. The

depot was formally commissioned December 13, 1943 and was substantially completed by June 1944. The pier was constructed in the summer of 1944. Originally planned as a $25,000,000 facility, logistic considerations dictated expansion of the facility that pushed the final cost to $60,000,000.

NWS Earle was most active during World War II with a large portion of the ammunition and explosives used in the European Theatre of operations being shipped from this facility. Over 731,000 tons of ammunition were outloaded from the depot. During March and April of 1944, 225,000 tons were loaded to support the Normandy Operation. During March 1945, 128,000 tons of material was loaded for overseas shipment.

Following World War II, activities at the base decreased in response to lessening demands for munitions. For example, only 160,600 tons of explosives were shipped during most of 1960.

In 1963 the Bureau of Naval Weapons held a conference to determine alternative means for disposal of munitions at sea. As a result of this conference the Navy Sea Cargo Coordinator responsibilities at NWS Earle were expanded to include arranging and scheduling all deep water disposal of Navy material handled through East Coast ports. For example, in 1966 the S.S. Horace Greely was loaded with 6,030 tons of miscellaneous explosives and scuttled at sea. In 1967 the S.S. Eric C. Gibson was loaded with 9,000 tons of unservicable munitions and scuttled.

In 1969 the silver reclamation division was established at NWS Earle. They received at that time 1,500,000 pounds of film, 10,750 pounds of battery cells and 23,830 pounds of silver bearing missile batteries.

5.3 PHYSICAL FEATURES

5.3.1 General

Geographically the NWS Earle lies within the Outer Coastal Plain and is in an area of low relief. There are three major rivers draining the Main Base, the Shark River, the Manasquan River and the Swimming River.

5.3.2 Climatology

The NWS Earle is located on Monmouth County, approximately six miles inland from the Atlantic Ocean. The area is characterized by a predominantly continental climate with significant seasonal, daily and day to day temperature fluctuation. High humidity occurs frequently along the coast and less frequently inland. Freezing temperatures occur intermittently from October to April. The average first frost occurs on October 17 and the average last frost occurs on April 24, allowing for an average growing season of 198 days. The average annual precipitation is 44.67 inches at Long Branch and 41.82 inches at Newark. The mean annual temperature is 56.2°F at Long Branch and 53.8°F at Newark. The maximum and minimum average temperature are 62.4°F and 45.2°F respectively. (Table 5-1)

Because of its location near the coastline, Monmouth County is subject to easterly storms throughout late summer and early fall causing high tides and flooding and to tropical hurricanes that periodically sweep the coast. The winter is characterized by storms that move along the eastern seaboard. These storms from the north bring high winds and precipitation in the form of snow, ice pellets, or rain. However, the snow is seldom prolonged or heavy.

Spring is a period of contrasting weather, particularly during April. Spring and autumn are periods of frost. Summer is warm and humid with occasional showers and thunderstorms. Ground fog is a major weather problem in the summer, especially during the early morning hours. Autumn is a season of comfortable temperatures and generally pleasant weather.

Wind is highly variable in the area of NWS Earle. During the winter and early spring the dominant winds are from the northwest. During the spring and summer, onshore winds predominate.

While the climate of a large area in and around NWS Earle can be described generally, the microclimates, or climates in small sites or areas, may differ from the general climate of the area. For example, temperature, wind velocity, light, and humidity on the floors of cedar swamp forests are

TABLE 5-1

Monthly and Annual Air Temperature and Precepitation at Long Branch and Newark, New Jersey

Long Branch (1908-1930)

Month	Average Monthly Temperature (°F)	Average Monthly Precepitation (inches)	Average Monthly Snowfall (inches)	Lowest Temperature (°F)	Highest Temperature (°F)
January	31.5	3.73	7.0	-6	74
February	31.2	3.44	7.8	-9	76
March	39.4	3.58	5.6	6	83
April	48.2	4.18	1.2	12	92
May	58.0	3.21	0	30	97
June	67.1	3.56	0	42	99
July	72.1	4.39	0	48	102
August	70.8	4.44	0	47	98
September	65.9	2.62	0	36	96
October	55.4	2.82	T	27	91
November	44.2	2.82	0.2	13	81
December	34.2	3.53	5.2	-8	69
Average Annual	51.5	42.32	27.0		

Newark (1936-1975)

Month	Average Monthly Temperature (°F)	Average Monthly Precepitation (inches)	Average Monthly Snowfall (inches)	Lowest Average Temperature (°F)	Highest Average Temperature (°F)
January	32.0	3.10	6.8	24.9	39.0
February	32.4	2.90	8.0	24.8	40.0
March	40.6	3.88	5.0	32.4	48.7
April	51.1	3.40	0.5	41.7	60.5
May	61.9	3.53	T	52.1	71.6
June	71.2	3.35	0	61.6	80.7
July	76.3	3.89	0	67.0	85.5
August	74.6	4.29	0	65.6	83.6
September	67.6	3.83	0	58.4	76.7
October	57.0	2.94	T	47.6	66.3
November	46.0	3.39	0.4	38.1	53.9
December	35.1	3.32	6.9	28.0	42.1
Average Annual	53.8	41.82	27.6		

quite different from the conditions at the canopy. Therefore, plants and animals that may not seem suited for the general climate may indeed be present, but are restricted to the microclimate created by the unusual environmental conditions of a specific location.

For modeling purposes, the annual peak daily rainfall (1-year 24-hour) is greater than 2.5 inches (U.S. Department of Commerce, 1963).

5.3.3 Topography

The NWS Earle Main Base is located within the Outer Coastal Plain which is characterized by gently rolling lands and low hills. With regard to the site itself, for the most part the Main Base is relatively flat, except for the Hominy Hills, a low series of hills traversing the central portion of the facility. The hills have an average summit elevation of 200 feet above mean sea level (msl) and the highest point is 307 feet msl. The lowest elevation is slightly less than 100 feet msl.

The Main Base contains three main drainage basins and several smaller subbasins. The northern half of the Main Base drains to the Swimming River, either through Mine Brook, Hockhockson Brook, or Pine Brook. The southwestern portion of the Main Base drains to the Manasquan River via either Marsh Bog Brook or Mingamahone Brook. The southeast corner of the Main Base drains to the Shark River.

The Waterfront Area lies within the Inner Coastal Plain (locally referred to as the Bayshore Lowland). Sluggish streams drain northward into Raritan Bay and Sandy Hook Bay.

The Chapel Hill Area of NWS Earle (about 200 feet msl) is a portion of the Highland-Mt. Pleasant Hills, a series of prominent hills that form the drainage divide between the Inner and Outer Coastal Plain. As such, this area has the most variable relief of any portion of NWS Earle. Headwaters of Compton Creek, Ware Creek and Wagner Creek drain to Raritan Bay from the west, north and east parts of Chapel Hill, respectively.

5.3.4 Geology

5.3.4.1 General

NWS Earle lies in the Atlantic Coastal Plain which was formed over the last 170-200 million years as a result of depositional and erosional processes. In general, the plain is composed of a wedge-shaped series of unconsolidated layers of sands, clays, and marls on a gently southeastward dipping bedrock surface (80 to 100 ft. per mile) which is 1300 to 6000 ft. below the ground surface. These layers extend seaward to the submerged continental shelf. The dip of the unconsolidated beds decreases upward in the section to about 10 ft. per mile at the Kirkwood Formation-Cohansey Sand contact.

The oldest sediments of the Coastal Plain are Cretaceous Age and were deposited more than 200 million years ago. Subsequent to that deposition, multiple sea level transgressions and regressions deposited and shaped the younger sediments. The Cohansey Sand was laid down during the last major transgression and was exposed some five million years ago, at which time the present topography began to form. Minor transgressions during the Pleistocene glaciation resulted in some additional deposits at the lower elevations. Table 5-2 presents the sequence of Coastal Plain units. Figure 5-2 shows the surficial distribution of these units in Monmouth County. Figure 5-2 also shows the location of a northwest-southeast geologic section through Monmouth County presented Figure 5-3.

5.3.4.2 Main Base

At the Main Base, the oldest, deepest and thickest unconsolidated subsurface units are the Raritan and Magothy Formation. Those two units range in thickness from 600 to 2000 ft. and the Magothy Formation is characteristically a micaceous, fine-grained, lignitic sand interbedded with clays while the Raritan Formation is usually a lenticular, light-colored, medium to coarse-grained, subangular, and arkosic quartz sand interbedded with varicolored kaolinitic clays. In driller's logs these formations are usually described as a series of sand-silt-sand beds.

TABLE 5-2

Stratigraphic Units of the Northern Atlantic Coastal Plain of New Jersey

Era	System	Series	Formation		Maximum Thickness (ft)	Lithology
Cenozoic 0 to 55 million yrs. ago	Quaternary	Holocene Recent	Alluvium		50	Sand, silt, and black mud.
			Beach sand and gravel			Sand, quartz, light-colored, medium-grained, pebbly.
		Pleistocene	Cape May Formation		60	Sand, quartz, light-colored, heterogeneous, clayey, pebbly, glauconitic.
			Pensauken Formation[2]			
			Bridgeton Formation			
	Tertiary	Pliocene (?)	Beacon Hill Gravel		60	Gravel, quartz, light-colored, sandy.
		Pliocene (?) and Miocene(?)	Cohansey Sand		30	Sand, quartz, light-colored, medium- to coarse-grained, pebbly; local clay beds.
		Miocene	Kirkwood Formation		74	Sand, quartz, gray to tan, very fine to medium-grained micaceous, and dark-colored distomaceous clay.
		Eocene	Shark River Marl		100	Sand, quartz and glauconite, gray, brown, and green, fine- to coarse-grained, clayey, and green silty and sandy clay.
			Rancocas Group	Manasquan Formation		
				Vincentown Formation	130	Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.
				Hornerstown Sand	100	Sand, glauconite, green, medium- to coarse-grained, clayey.
Mesozoic 65-225 million yrs. ago	Cretaceous	Upper Cretaceous	Monmouth Group	Tinton Sand and Red Bank Sand undivided	135	Sand, quartz and glauconite, brown and gray, fine- to coarse-grained, clayey, micaceous.
				Navesink Formation	45	Sand, glauconite and quartz, green, black, and brown, medium- to coarse-grained, clayey.
				Mount Laurel Sand	85	Sand, quartz, brown and gray, fine- to coarse-grained, glauconitic.
			Matawan Group	Wenonah Formation	85	Sand, quartz, gran and brown, very fine to fine-grained, glauconitic, micaceous.
				Marshalltown Formation	50	Sand, quartz and glauconite, gray and black, very fine to medium-grained, very clayey.
				Englishtown Formation	150	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds.
				Woodbury Clay	60+	Clay, gray and black, micaceous.
				Merchantville Formation	60+	Clay, gray and black, micaceous glauconitic, silty; locally very fine-grained quartz and glauconite sand.
			Magothy Formation		175	Sand, quartz, light-gray, fine-grained, and dark-gray lignitic clay.
			Raritan Formation		400	Sand, quartz, light-colored, fine- to coarse-grained, pebbly, arkosic, and red, white, and variegated clay.
Pre-Cambrian 600 million - 4.5 billion yrs. ago		Pre-Cretaceous				Precambrian and early Paleozoic crystalline rocks - metamorphic schist and gneiss; locally Triassic basalt, sandstone, and shale.

Source: (1) Modified after Seaber, 1965, Table 3.
(2) Age of Pensauken Formation now considered late Miocene.

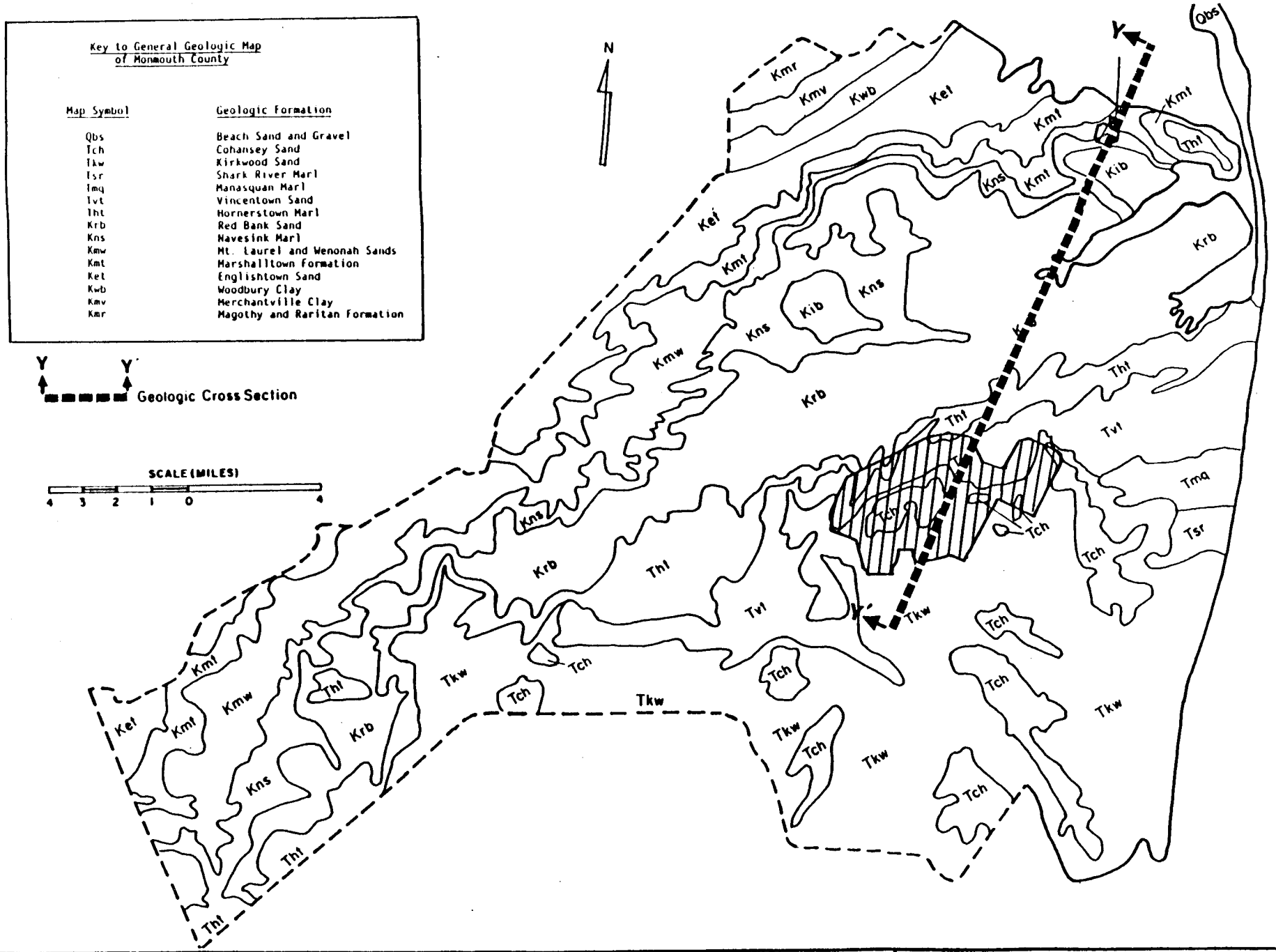
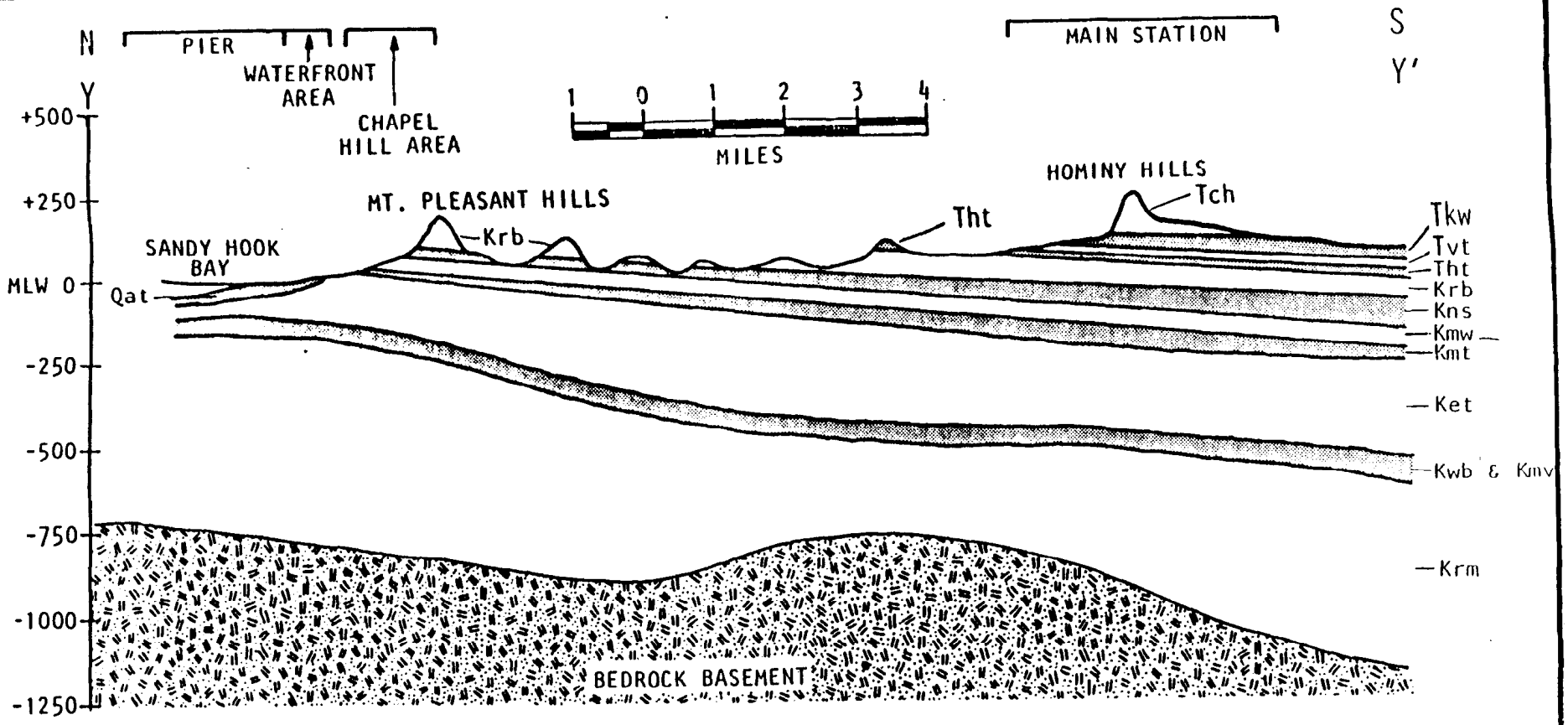


FIGURE 5-2. Generalized Geologic Map of Monmouth County, New Jersey.

INITIAL ASSESSMENT STUDY
FCHA NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY



LEGEND:

QUATERNARY
- Qat - COASTAL DEPOSITS

TERTIARY
- Tch - COHANSEY SAND
- Tkw - KIRKWOOD FORMATION
- Tvt - VINCENTOWN FORMATION
- Tht - HORNERSTOWN SAND

CRETACEOUS
- Krb - RED BANK SAND
- Kns - NAVESINK FORMATION
- Kmw - WENONAH FORMATION & MT LAUREL SAND
- Kmt - MARSHALLTOWN FORMATION
- Ket - ENGLISHTOWN FORMATION
- Kwb - WOODBURY CLAY
- Kwv - MERCHANTVILLE FORMATION
- Krm - RARITAN & MAGOTHY FORMATIONS

FIGURE 5-3. GENERALIZED GEOLOGIC CROSS SECTION Y-Y'

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The Merchantville Formation and Woodbury Clay unit ranges in thickness from 160 ft. at Lakehurst to 250 ft. along the coast. The Merchantville Formation is a black or dark green fossiliferous, glauconitic micaceous clay, silt, or sandy clay which is locally indurated and the Woodbury Clay is characteristically a 50 to 130 ft. thick dark-gray or black non-glauconitic, lignitic, fossiliferous blocky clay containing interbedded white sand lenses.

The Englishtown Formation is a gray micaceous quartz sand that weathers white, yellow, or brown which grades downdip into a clayey lithology resembling the overlying Marshalltown Formation and underlying Woodbury Formation.

The Marshalltown Formation is typically 30 ft. thick and varies in lithology from a black sandy micaceous glauconite clay to a clayey green sand. The formation dips southeast at 37 feet per mile and coarsens somewhat into clayey silts and sands similar to the overlying Wenonah Formation and Mount Laurel Sand.

The Wenonah Formation and Mount Laurel sand unit ranges from 60 to 100 ft. thick but thins downdip to about 15 ft. along the coast. The Wenonah Formation is typically a silt to medium-grained, yellow micaceous, and chloritic sand with local beds of thin black clays and indurated ferruginous sandstone. Lignite and traces of glauconite are present. The formation grades upwards into a lithology similar to the Mount Laurel sands; a glauconitic, fine to coarse-grained quartz sand having a salt-and-pepper appearance which is locally semi-indurated, dense, and compacted.

The Navesink Formation reaches a maximum thickness of 100 ft. and is a greenish-black, semi-consolidated, green sand marl consisting predominantly of fine to coarse-grained, rounded glauconite and some quartz grains with interstices filled with finely divided glauconite, calcium carbonate, and clay.

The Red Bank Sand, with thicknesses up to 140 ft. consists of an upper member of yellow or reddish-brown, medium to coarse-grained, micaceous

sand containing partly pyritized lignite and a lower dark gray clayey member composed of a clayey, micaceous, fossiliferous, glauconite sand or sandy clay.

The Hornerstown Sand, the basal Tertiary formation in Monmouth County, is a massive green semi-consolidated medium to coarse-grained, glauconite sand, silt, and clay containing interbedded shale layers. The sand thickness and lithology varies little downdip with the unit maintaining a thickness of 30 to 50 ft.

The Vincentown Formation ranges in thickness from a few feet at the eroded outcrop areas in Monmouth County to more than 190 ft. in the subsurface along the coast. There are two distinct members. The lower member is a glauconite and quartz sand facies overlain by the upper member which is a lime sand facies composed of sand-sized fragments of bryozoa, echinoids, and coral that are locally indurated into limestone lenses several inches thick.

The Manasquan Formation varies in thickness from several feet in the outcrop area to more than 200 ft. in the subsurface along the New Jersey Coast. A lower member ranges from glauconitic sand to clayey glauconitic quartz sand while the upper member ranges from a fine-grained sand or clay to a glauconitic quartz sand, silt, and clay.

The Kirkwood Formation ranges in thickness form 50 ft. in the outcrop area to 800 ft. along the coast. The formation is composed of a lower member of dark-brown, pebbly, lignitic, micaceous, ilmenitic, fine to very fine-grained quartz sand and silt containing some fine-grained glauconite overlain by an upper member of light-gray to yellow-brown micaceous ilmenitic, lignitic, very fine to fine-grained quartz sand. The formation grades from a predominance of silt and fine-grained sand facies updip to thick clays and shoestring-sand beds along the coast.

The Cohansey Sand is a widespread surficial deposit in southern Monmouth County. The formation is characteristically a yellowish-brown, unfossiliferous, cross-stratified, pebbly, ilmenitic fine to very coarse-grained quartz sand that is locally cemented with iron oxide. White, dark

gray, and red kaolinitic clays are interbedded with the sands but individual beds are difficult to trace because the sands and clays are lenticular and discontinous. Several sequences are usually found at any one site with the clay beds usually being 8 to 10 ft. thick but occasionally reaching thicknesses to 30 ft.

The Holocene Series at the Main Base consists largely of thick highly organic silt and clay in the swamps and recently deposited stream sands and gravels.

The nearest deep well to the Main Base is located approximtely 1.5 miles northwest of the facility. An interpretation of the drillers log is contained on Table 5-3. While this well does not intersect Tertiary deposits on the Main Base, it does give a fair representation of the depth to the various Cretaceous unconsolidated units.

In addition to the deep well data, shallow soil boring data is also available for a portion of the Main Base. The borings were installed during the late spring and early summer of 1978 in the vicinity of the "F" Group magazines. Borings ranged from a depth of 15 to 70 ft. The subsurface conditions to a depth of 70 ft. in the area of the "F" Group Magazines was divided into four units based on these borings. They are: 1) near surface zone of coarse to fine sand with trace fine gravel that averages about 7 feet thick; 2) an underlying zone of fine sand, with occasional clayey silt layers near the base; 3) below this is a zone of interbedded clayey silt and silty clay with trace fine sand; and 4) the deepest strata identified was encountered below elevation 97 feet and the materials usually consisted of silty fine sand to fine sand with trace silt. Surficial geology of the Main Base is shown on Figure 5-4.

5.3.4.3 Chapel Hill and Waterfront Area

This area is underlain by Cretaceous formations which are from oldest to youngest: Raritan/Magothy Formation; Merchantville Formation; Marshalltown Formation; Wenonah Formation; Mount Laurel Sand; Navesink Formation; and the Red Bank Sand.

TABLE 5-3

Log of Well 1.5 Miles Northwest of NWS Earle-Main Base

Formation	Thickness (feet)	Depth (feet)
Cretaceous:		
Sand, brown, clayey, glauconitic	10	10
Sand, brown, clayey, indurated, glauconitic	15	25
Red Bank Sand:		
Sand, reddish-brown, fine to coarse	35	60
Sand, greenish-gray, fine to medium	65	125
Navesink Formation:		
Clay (?), gray, sandy, glauconitic, very fossiliferous	35	160
Clay, greenish-gray, very glauconitic	5	165
Wenonah Formation and Mount Laurel Sand:		
Sand, fine, micaceous, clayey	35	200
Sand, and clay, gray, fine	10	210
Sand, gray, fine, clayey micaceous and glauconitic	30	240
Wenonah (?) Formation:		
Clay, gray, contains thin laminae of fine sand	5	245
Clay, gray, sandy	15	260
Clay, gray, sandy, micaceous	20	280
Marshalltown Formation:		
Clay, gray, contains thin laminae of fine sand	20	300
Clay, sandy, contains shell fragrments	10	310
Englishtown (?) Formation:		
Clay and sand. Sand is fine and micaceous	20	330
Englishtown Formation:		
Sand, gray, very fine to medium, slightly clayey	20	350
Englishtown (?) Formation:		
Clay, slightly sandy	50	400
Woodbury Clay:		
Clay, gray, micaceous, contains shell fragments	50	450
Clay, greenish-gray, micaceous	24	474
Merchantville Formation:		
Sand, gray, fine, contains pyrite and limonite	6	480
Clay, greenish-gray, sandy, micaceous, slightly fossiliferous	40	520
Clay, greenish-gray	30	550

TABLE 5-3 (cont.)

Log of Well 1.5 Miles Northwest of NWS Earle-Main Base

Formation	Thickness (feet)	Depth (feet)
Merchantville (?) Formation:		
Clay, greenish-gray, slightly sandy, glauconitic and fossiliferous	20	570
Magothy Formation:		
Clay, gray, sandy	40	610
Sand and clay in alternating layers; sand is fine, gray, and micaceous	20	630
Sand, light gray, very fine	20	650
Sand and clay, interbedded; sand is gray, very fine and micaceous	30	680

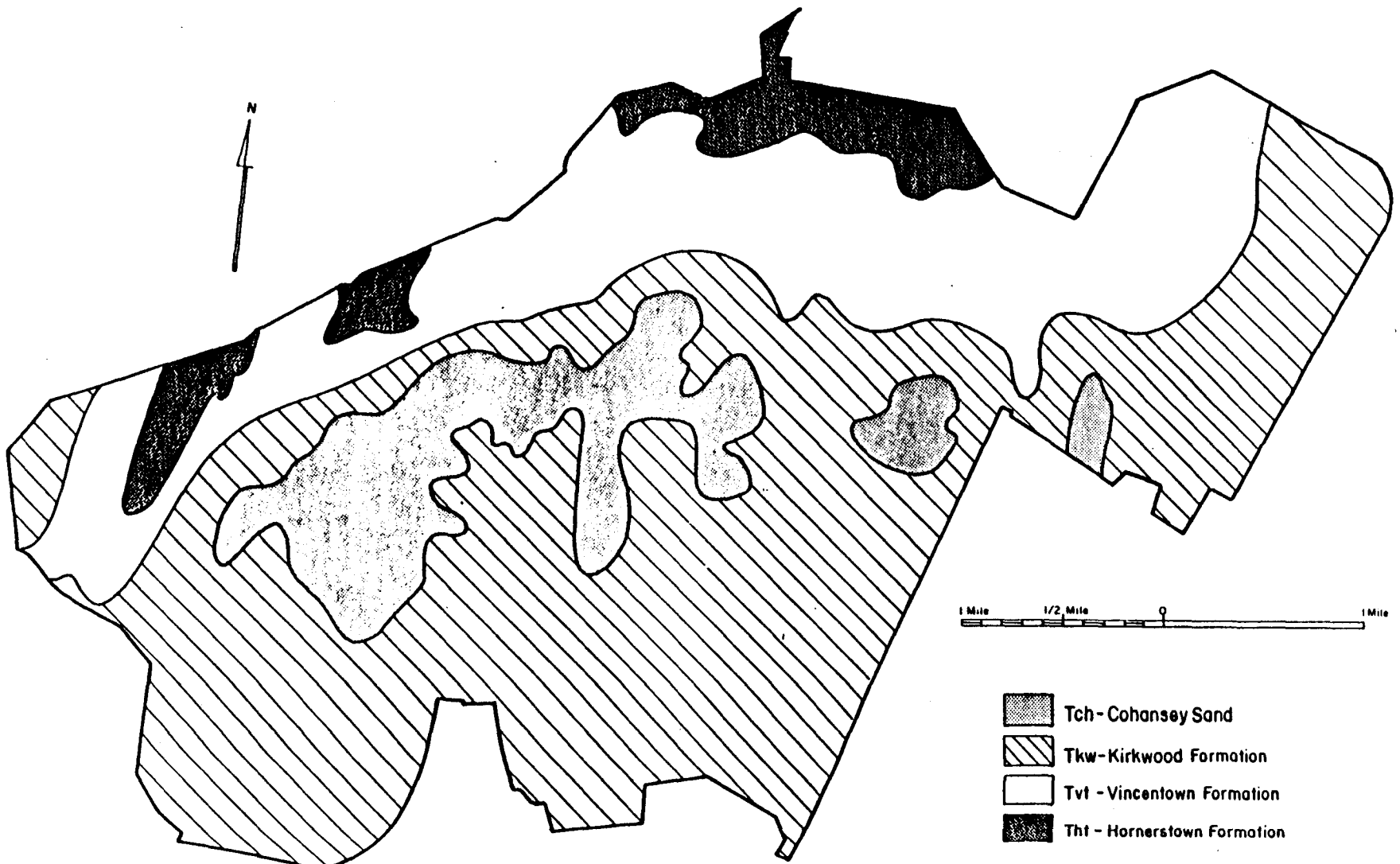

FIGURE 5-4. SURFICIAL GEOLOGIC DEPOSITS AT THE MAIN BASE

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NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

5.3.5 Soils

5.3.5.1 General

Soils in the vicinity of the NWS Earle facilities are numerous and extremely variable. The USDA Soil Conservation Service (SCS) recognizes 43 series of soil represented by 114 subtypes within Monmouth County. More than half of these occur within the boundaries of NWS Earle.

The different soil series are determined primarily by these factors: the geologic sediment or "parent material" from which the soil is derived, the location of the soil on the slope of the hill, and the level of the water table. In general, the soils are distributed in northeast-southwest trending belts related to the local physiographic features and underlying geologic formations.

Soils of particular interest at NWS Earle are the acid soils and the poorly-drained soils. The soil acidity is attributed to the pyrite or lignite derived from the parent materials. Through exposure to air and water, the pyrite/lignite-rich soils oxidize, producing sulfuric acid, which has corrosive qualities that can adversely affect fish and plant life. Black acid soils have been detected by the SCS within several feet of the surface at over 60 locations in Monmouth County. The acid soils seem to be common in, but not confined to, exposure areas of the Englishtown, Marshalltown, Kirkwood, Mount Laurel and Wenonah Formations, and the Red Bank Sands, Navesink Formation, Hornerstown Sand and Woodbury Clay. All of these units contain varying amounts of pyrite and lignite.

Poorly-drained soils are associated with stream and river flood plains and low-lying wetland areas, including freshwater swamps and salt water marshes. Soils in these areas are typically unconsolidated, organic-rich sands, silts and clays which are susceptible to both tidal or stream flooding and to settlement under loading.

5.3.5.2 Main Base

A generalized soil map for the Main Base is presented in Figure 5-5. As noted from this map, the most abundant soil series occuring at the Main Base are the Lakewood, Lakehurst, Leon and St. Johns soil series. Additional soil series occuring are the Keyport, Keansbury, Alluvial soils, Freehold, Johnson, Cranberry bogs, deep muck soils and the Evesboro series. Properties of these soils and others that only occur to a minor degree are listed in Table 5-4.

The Lakewood, Lakehurst, Leon and St. Johns Soil series vary significantly. The Lakewood series are typically well drained sandy soils. The Lakehurst series ranges from sand to fine sand, is nearly level to gently sloping, but drainage varies depending on topographic location. The Leon series contain more fine particles than the previous two series, are nearly level and are poorly drained. Typically they occur in depressional areas and broad flats. The St. Johns series is frequently flooded , nearly level and very poorly drained soil occuring on flood plains adjacent to large streams and swampy areas.

The remaining soils are restricted to deep marshy areas, disturbed areas, man-made land, and the flood plains directly adjacent to streams. Also, black highly acid soils have been exposed by construction activities at various depths on the Main Base. The acidity appears to be related to the Kirkwood lignitic clays underlying these areas.

5.3.5.3 Waterfront and Chapel Hill Area

The Waterfront area has been altered substantially by development and filling in of marsh areas. The building complex occupies original high ground while the trestle area near the shore was formerly a tidal marsh. Several closed sanitary landfills are also present.

The tidal marsh soils consist of soft organic rich silt, sand and clay. Beach sand occurs in patches along the bay shore and silt loam and loamy sand are present in areas south and east of the waterfront pier area.

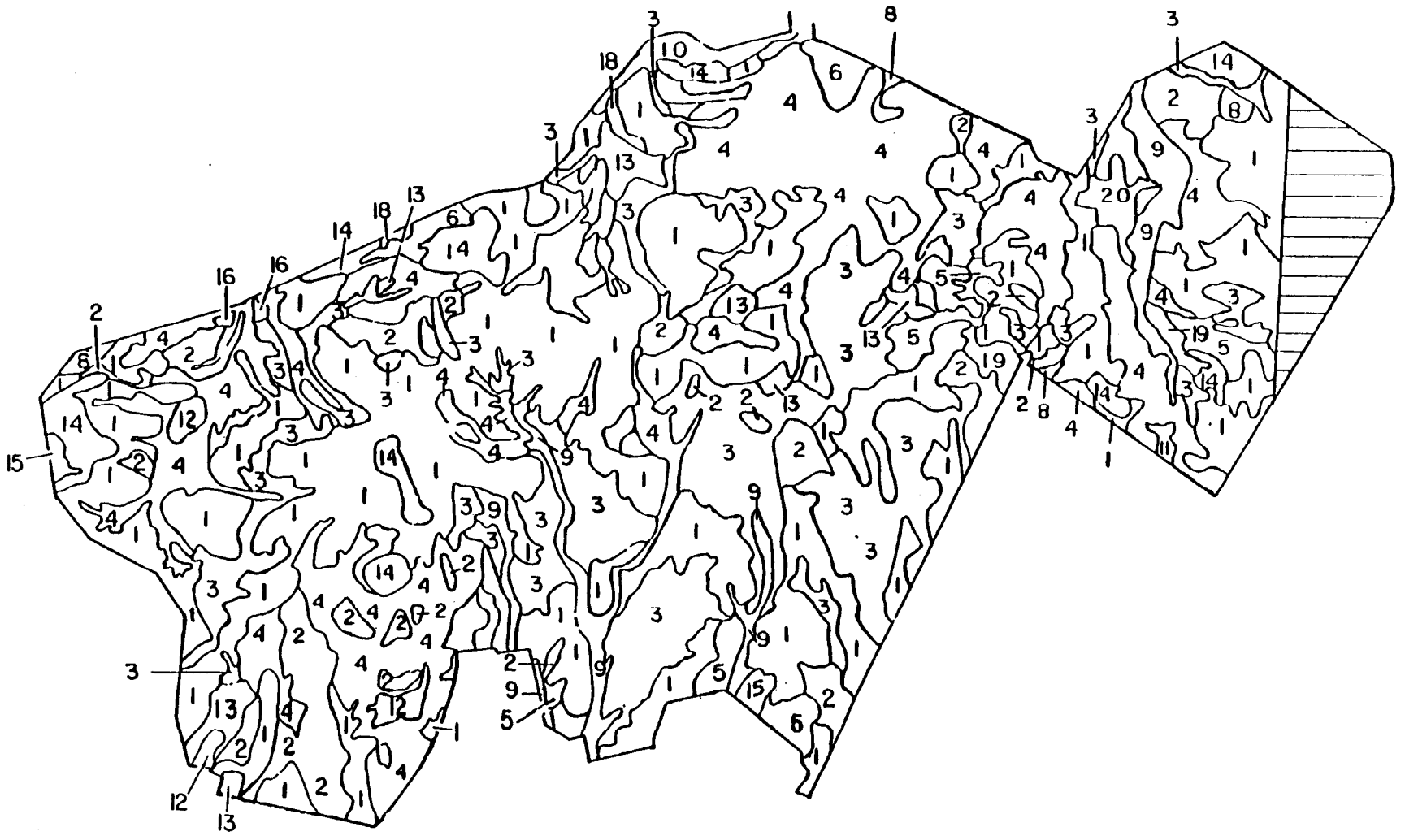

FIGURE 5-5. Generalized Soils Map of NWS Earle, Main Base.

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NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Figure 5-5
Generalized Soil Map

Map Number	Soil Series
1	Lakewood Sand or Fine Sand
2	Lakewood Sand or Fine Sand
3	Leon Loamy Sand or Loamy Fine Sand
4	St. Johns Silt Loam or Loamy Sand
5	Keyport Silt Loan; Fine and Loam or Sandy Loam
6	Keansburg Silt Loam
7	Alluvial Soils
8	Freehold Sand Loan or Loamy Sand
9	Johnson Sand, Silt and Clay (Flood Plains)
10	Manalapan Silt Loam
11	Made Land
12	Cranberry Bog
13	Deep Muck
14	Evesboro Sand; Sandy Loam or Loamy Sand
15	Sassafras Series
16	Monmouth Loam; Sandy Loam or Loamy Sand
17	Tuxedo Loamy Sand
18	Collinton Silt Loam or Loamy Sand
19	Elkton Series
20	Shallow Muck

TABLE 5-4

Selected Soil Properties - NWS Earle

Soil Series	Location[1]	Wetness (Natural Drainage)[2]	Permeability[3]	Seasonally High Water Table (ft)[4]	Stream/Tidal Flood Hazard[5]	Hydrologic Group[6]	Erodibility Factor[7]	Organic Content (%)	Soil Reaction (pH)[8]	Comments
Colemantown	MS	Poorly drained	Slow	0-1	Occasional (stream)	DD	0.43	2-3	3.5-5	
Collington	MS, CH	Well drained	Moderate to moderately slow	5+	None (stream)	B	0.28	0.5-3	4.5-5	
Keansburg	MS, CH	Very poorly drained	Moderate	At surface	None to common (stream)	D	NA	2-5	4.5-5	
Freehold	MS	Well drained	Moderate	5+	None	B	0.20-0.28	0.5-3	4.5-5	
Colts Neck	CH	Well drained	Moderate to moderately rapid	6	None	B	0.28	0.5-2	3.6-5	
Howell	MS	Well to moderately well drained	Slow	1½-5	None	D	0.43	2-4	4.5-5	Extremely acid (pH 1-3) when exposed to oxidation
Evesboro	MS, WF	Excessively drained	Rapid to moderate	5+	None	A	0.17	0-1	3.5-5	
Klej	MS, WF	Moderately well to well drained	Slow to rapid	1½-4	None	B	0.17	0-1	4-5	
Sassafras	MS, CH	Well drained	Moderate to moderately slow	3-5	None	B	0.28	0.5-2	4.5-5	
Lakewood	MS	Excessively drained	Rapid	5+	None	A	0.17	0-1	3.5-5	
Lakehurst	MS	Moderately well to somewhat poorly drained	Rapid	1½-4	None	B	0.17	0-1	3.5-5	
Atsion (Leon)	MS	Poorly drained	Rapid	0-1	Seldom (stream)	D	0.17	3-8	3.5-4.5	
Berryland (St. Johns)	MS	Very poorly drained	Moderately rapid	At surface	Seldom or occasionally (stream and tidal)	D	0.17	3-8	3.5-4.3	
Keyport	MS, WF	Moderately well drained	Slow	1½-2½	None	D	0.43	2-4	4-5	
Elkton	MS, WF	Poorly drained	Slow	0-1	None to slight (stream)	D	0.43	2-4	4-5	Severe frost heave
Matawan	MS	Moderately well drained	Slow	1½-3	None	C	0.28-0.32	0.5-2	4-5	
Alluvial land (Mumlapan)	MS	Poorly drained	Moderate	0-1	Frequent (stream)	D	NA	2-4	4.5-5	

TABLE 5-4 (cont.)

Selected Soil Properties - NWS Earle

Soil Series	Location[1]	Wetness (Natural Drainage)[2]	Permeability[3]	Seasonally High Water Table (ft)[4]	Stream/Tidal Flood Hazard[5]	Hydrologic Group[6]	Erodibility Factor[7]	Organic Content (%)	Soil Reaction (pH)[8]	Comments
Alluvial land (Johnson)	MS	Very poorly drained	Rapid	0-3	Frequent (stream)	D	NA	Variable	Variable	
Deep muck	MS	Very poorly drained	Rapid	At surface	Very frequent (stream)	D	NA	20-80	4.5-5.5	Severely acid, subject to shrinkage when drained and dried
Coastal Beach	WF	Excessively drained	Rapid	1-10	Very frequent (tidal)	NA	NA	0.5	6.6-7.3	Tidal/storm flooding hazard
Tidal Marsh	WF	Very poorly drained	Rapid	At surface	Vey frequent (tidal)	D	NA	5-20	6.6-7.3	
Fill land	WF	Excessively drained	Rapid	Variable	Variable	A	0.18	Low-variable	4-5	
Sanitary land Fill	WF	Variable	Variable	Variable	None	Variable	Variable	Variable	Variable	Subject to formation of gases and leachate, variable settling limits

Notes:

[1] Location: MS = Main Station Area, WF = Waterfront Area, CH = Chapel Hill Area.

[2] Wetness (natural drainage classes or water table height and duration) - This is an indication of the amount of the year that a soil is saturated or contains excess water. In some cases the soil is saturated by a water table that rises and falls seasonally; in others, water is perched over slowly permeable layers (clay or fragipans). Six natural drainage classes (before man's improvements efforts) are normally used; excessively drained; well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. Natural drainage classes are: excessive - no excess water in soil in any season; well drained - excess water for only short periods after abnormally heavy rainfall; moderately well drained - seasonally high water at 1½ to 4 feet from surface from January to April; somewhat poorly drained - seasonally high water at ½ to 1½ feet from surface from December to May; poorly drained - seasonally high water at 0 to 1 foot from surface from November to June; very poorly drained - seasonally high water at surface from October to June. Each class successively is wet for longer periods. There is not an absolute relation of wetness to permeability because wetness is merely an expression of whether the water can get away.

[3] Permeability - Permeability refers to the rate of vertical movement of water through a wet soil.

[4] Depth to seasonal high water is the normal range of minimum depth, in feet, to the water table (real or perched).

[5] Flood Hazard - This refers to the overflow of rivers, streams, tributaries, and tidal waters but is not intended to include shallow ponding associated with normal rainfall runoff. The hazard is given in terms of normal occurrence - none, seldom (less than 1 year in 5), occasional (1 overflow in 3 or 4 years), frequently (annually), and very frequent (several times a year).

[6] Hydrologic Soil Group are ratings of soils to indicate amount of runoff following prolonged wetting. A indicates the least runoff and D the most. Factors considered in rating were natural drainage or water table, permeability rate, depth to fragipan (dense slowly permeable layer) or bedrock. Conversely soils rated A can absorb the greatest rainfall and generally at the most rapid rates.

[7] Erodibility (K) factor are relative erosion factors indicating sheet erosion that might be expected from bare soil. Ratings are .17, .20, .24, .28, .32, .37, .43, and .49. Lowest erosion hazard is .17; highest is .49. Some soils that are nearly level are not rated.

[8] Soil reaction - presented as the natural range of pH for the soil.

SOURCE: Adapted from "Soil Properties and Soil Survey Interpretation Sheets for New Jersey" 1972-1976, Soil Conservation Service, USDA in cooperation with Rutgers University, College of Agriculture and Environmental Science.

Sandy areas are typically well-drained while tidal marshes are poorly drained and are flooded by daily tides and occasionally by storm tides. The boundaries of the raised landfill areas are subject to minor erosion. Soils in the Waterfront Area have not been associated with the acidity problem encountered on the Main Base.

The Chapel Hill area is covered by fertile, well-drained sand, sandy loam and loamy sand of the Collington, Sassafras and Colts Neck series. Due to the nature of the local soils, land forms and the general absence of streams, erosion and flooding have not been a problem. Although no black acid soils have been uncovered in the Chapel Hill Area, certain local geologic formations present in the Chapel Hill Area have been associated with this condition elsewhere in Monmouth County.

5.3.6 Hydrology

5.3.6.1 Surface Water

The Main Base portion of NWS Earle is located at the head waters of three major river sytems: the Manasquan, the Shark River and the Swimming River. Subdrainage basins for these streams are shown in Figure 5-6. Long term flow data for these streams are shown in Table 5-5, with gauging station locations also shown in Figure 5-6. As indicated in the table, flows in the Swimming River and the Shark River are significantly controlled by water supply withdrawals above each gauging station. The Monmouth Consolidated Water Company is permitted to withdraw up to 25 mgd (39 cfs) from the Swimming River and up to 8.5 mgd (13 cfs) from the Shark River. Hockhockson Brook, which drains approximately 40 percent of the Main Base, including the administration area and most of the waste sites, enters the Swimming River below the gauging station via Pine Brook.

Figure 5-7 locates minor surface water resources on the Main Base including wetlands, floodplains, and the following small ponds:

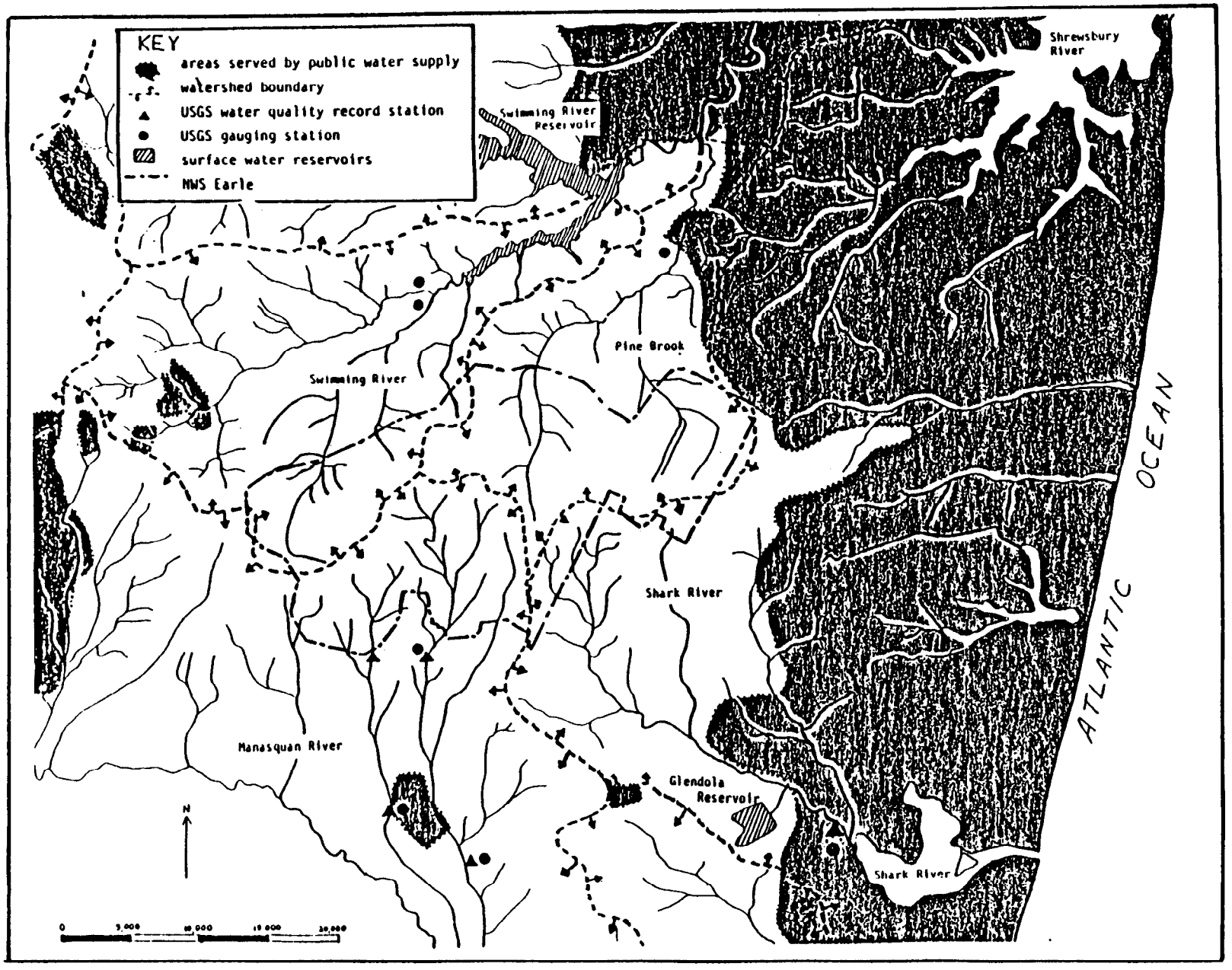

FIGURE 5-6. Regional Water Resources.

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NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

TABLE 5-5

Long-Term Stream Flow Data for Major Rivers

Draining Main Base

Stream	U.S.G.S. Gauge Number	Average Flow (cfs)	Low Flow (cfs)	Peak Flow (cfs)
Swimming River: Near Red Bank	01407500	80.6	0(1)	11,800
Shark River Near Neptune City	01407705	14.7	0(2)	580
Manasquan River	01408000	75.4	12.9	3940

Notes: (1) Flow controlled by water supply withdrawal from Swimming River Reservoir by Monmouth Consolidated Water Company

(2) Flow controlled by water supply withdrawal to Glendola Reservoir by Monmouth Consolidated Water Company.

Cfs = cubic feet per second

Source: USGS, 1981

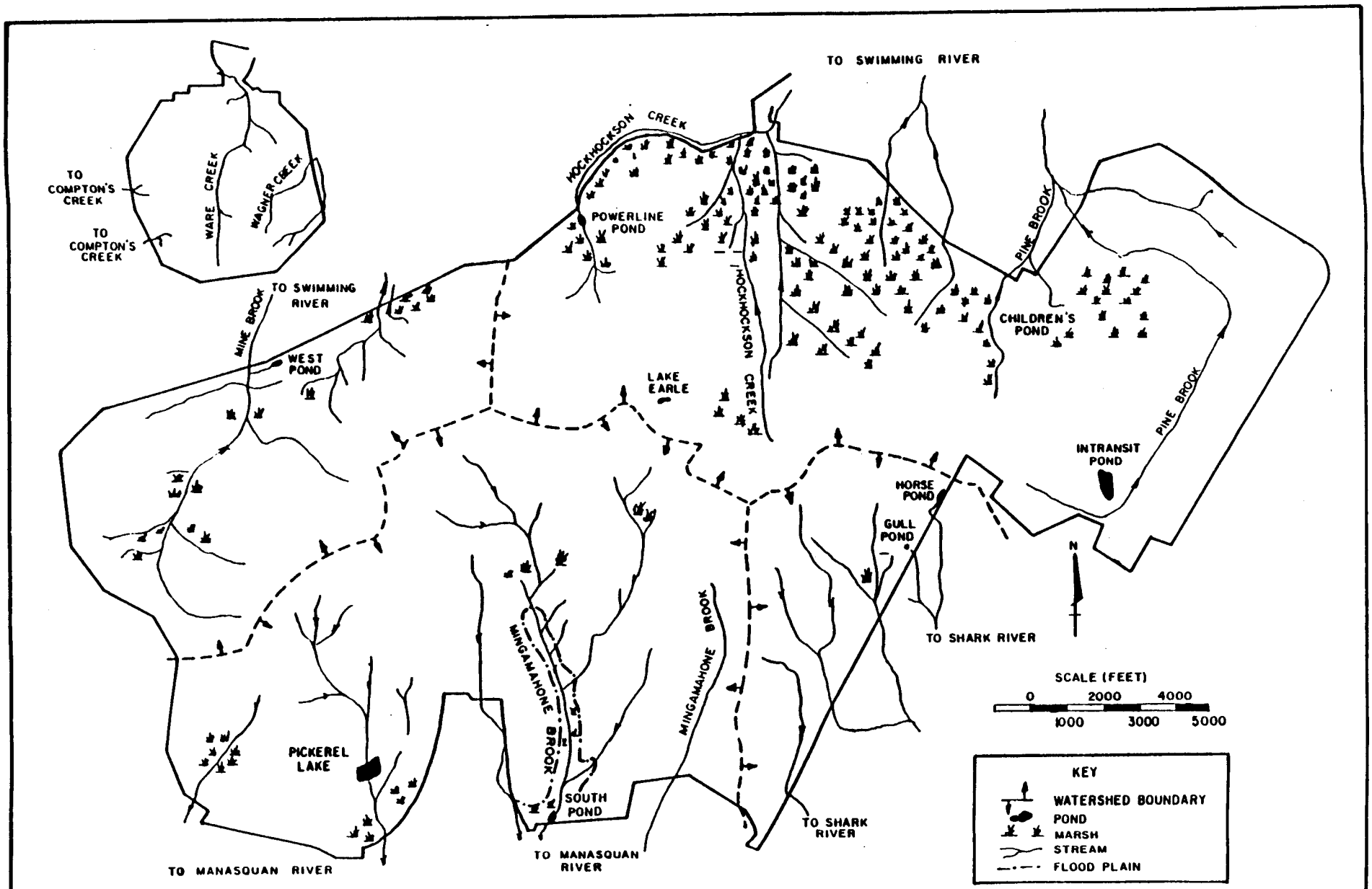

FIGURE 5-7. Minor Surface Water Resources.

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Children's Pond	0.1 ac
Earle Lake	1.5 ac
Gull Pond	0.2 ac
Intransit Pond	8.2 ac
Pickerel Pond	4.5 ac
Powerline Pond	0.1 ac
South Pond	0.5 ac
Horse Pond	1.9 ac
West Pond	1.7 ac
Total	19.0ac

Drainage from the Waterfront area enters three minor streams, Wagner Creek, Ware Creek, and Comptons Creek, all of which drain into Sandy Hook Bay.

Water quality data from the NJDEP and the USGS for the Swimming River, the Shark River and the Mansquan River Basins have been reviewed and significant information relative to the sites are summarized in Table 5-6. Data on both water quality and sediment quality (where available) indicate little stress on these streams. There are no indication of high levels of contamination from either point source or area source pollutant loads. No water quality data are available for the minor streams at the Waterfront and Chapel Hill Areas.

The major streams draining the main base are all classified FW-2 waters, with Pine Brook (downstream from Hockhockson Brook) being further classified for trout maintenance. Surface water standards for streams draining the Waterfront and Chapel Hill Areas are all TW-1, which permits shellfishing in tidal reaches of these streams, provided bacterial quality constraints are met.

5.3.6.2 Groundwater

5.3.6.2.1 General

The fresh groundwater in the unconsolidated formations underlying the NWS is derived solely from precipitation over the outcrop areas. Rainfall lost to evapotranspiration and overland flow results in approximately

TABLE 5-6

Summary of Water Quality Data for Major Rivers Draining Main Base

Pine Brook at Tinton Falls

. Dissolved Oxygen: 9.6 mgl (USGS. 1976)
. Fecal Coliform: 5,400 MPN, 70 MPN (USGS, 1976)
. Fecal Streptococci: 72,400 MPN, 350 MPN (USGS, 1976)
. Total Dissolved Solids: 6.6 mgl (USGS, 1976)

Shark River near Neptune City

. Dissolved Oxygen: 9.0 to 13.5 mgl (five measurements, USGS, 1981)
. Biochemical Oxygen Demand: 0.1 to 2.6 (USGS, 1981)
. Total Dissolved Solids: 1.9 mgl (USGS, 1981)
. Fecal Coliform: 125 MPN (log mean, USGS, 1981)
. Fecal Streptococci: 373 MPN (log mean, USGS, 1981)

Mingamahone Brook near Cranberry Bog Road

. Dissolved Oxygen: 7.8 mgl (NJDEP, 1977)
. pH: 6.6 (NJDEP, 1977)
. Fecal Coliform: 220 per 100 ml (NJDEP, 1977)

Mingamahone Brook near Hurley Pond Road

. Dissolved Oxygen: 8.6 mgl (NJDEP, 1977)
. pH: 7.1 (NJDEP, 1977)
. Fecal Coliform: 183 per 100 ml (NJDEP, 1977)

40 percent of the rainfall infiltrating as recharge to the groundwater reservoir. With an annual rainfall of approximately 45 inches per year, this recharge amounts to slightly less than 20 inches.

5.3.6.2.2 Main Base

The unconsolidated formations of the New Jersey Coastal Plain are a vertical sequence of beds of sands (in varying amounts) and clays. As such, underlying the Main Base there are several major and minor aquifers separated by partially confining aquicludes. The sandy aquifer zones yield water to varying degrees, with the deeper formations (Magothy-Raritan and Englishtown) yielding the largest amounts to public supply wells and the shallower aquifers being largely used by private domestic and agricultural wells. The water bearing properties of the geologic deposits underlying NWS Earle are described in Table 5-7 and the locations of water supply wells in and around the Main Base and the Waterfront and Chapel Hill areas are shown on Figure 5-8 and Table 5-8.

The Magothy-Raritan Formation is the deepest and most important aquifer in Monmouth County. Two wells located on the Main Base that pump from this formation (wells 30 and 31; Figure 5-8) are 810 and 836 feet deep. These two formations are regionally interconnected and as such are considered one aquifer. Permeability of the Raritan ranges from 210 to 3,500 gpd/sq ft and yields of public supply wells range from 100 to 1,4000 gpm. The Magothy has a permeability that ranges from 60 to 925 gpd; however because of the discontinous sands, yields average less than 250 gpm. The combination of those two formations contains the largest amount of ground water in storage in the Coastal Plain and is an important future source of groundwater for the county. Static water levels for two wells at the Main Base average 10 feet below sea level. Recharge to the aquifer takes place along the outcrop area, 12 to 15 miles northwest of the facility, and through downward leakage of water from overlying aquifers.

The Merchantville Formation and Woodbury Clay are relatively impermeable when compared to the underlying Raritan and Magothy Formations and overlying Englishtown Formation. Consequently, the Woodbury Clay and

TABLE 5-7

Water-Bearing Properties of Geologic Formations

ERA	SYSTEM	SERIES	SUBDIVISION	WATER BEARING PROPERTIES	Thickness Penetrated (feet)
Cenozoic	Quaternary	Recent	Alluvium and beach sand and gravel	A relatively poor aquifer. No drilled wells reported in this material.	0-30
		Pleistocene	Cape May, Pensauken, and Bridgeton Formations (undifferentiated)	Yields up to 6 gpm (gallons per minute) to domestic wells.	0-60
	Tertiary	Miocene (?) and Pliocene (?)	Cohansey Sand (series is debatable)	No wells reported in this formation.	0-30
		Miocene	Kirkwood Formation	Yields range from 15-1,200 gpm from wells, water usually contains iron, sulfide, and is acid.	60-100
		Eocene	Manasquan Formation and Shark River Marl	A poor aquifer; yields up to 12 gpm to domestic wells.	25-100
		Paleocene	Vincentown Formation	Numerous domestic wells tap this sand; yields range 10-50 gpm to domestic wells.	10-130
			Hornerstown Sand	A poor aquifer; yields up to 5 gpm to domestic wells.	30-100
Mesozoic	Cretaceous	Upper Cretaceous	Red Bank Sand (includes the Tinton Formation at the top)	Yields range from 3-30 gpm to domestic wells.	30-135
			Navesink Formation	Important to domestic consumers. Wells yield 10 gpm or less.	10-45
			Mount Laurel Sand Wenonah Formation	A single aquifer. Average yield 10 gpm. Maximum yield reported was 335 gpm.	15-85
			Marshalltown Formation	Not considered water-bearing in the county.	30-50
			Englishtown Formation	Average yield 25 gpm. Maximum yield reported 640 gpm. Average yield to large-capacity wells 410 gpm.	35-150
			Woodbury Clay Merchantville Formation	Both formations act as a single aquiclude. Not water-bearing.	50 50-60+
			Magothy Formation	Sands are discontinuous, and thickness variable. Maximum yield reported 250 gpm.	25-175
			Raritan Formation	Contains most important aquifers. Yields range 100-1,400 gpm to large-diameter wells.	140-400+
Precambrian	Late Precambrian(?)		Wissahickon Formation	No wells in this formation.	—

Source: Adapted from Minard & Owens, 1960, p. 7.

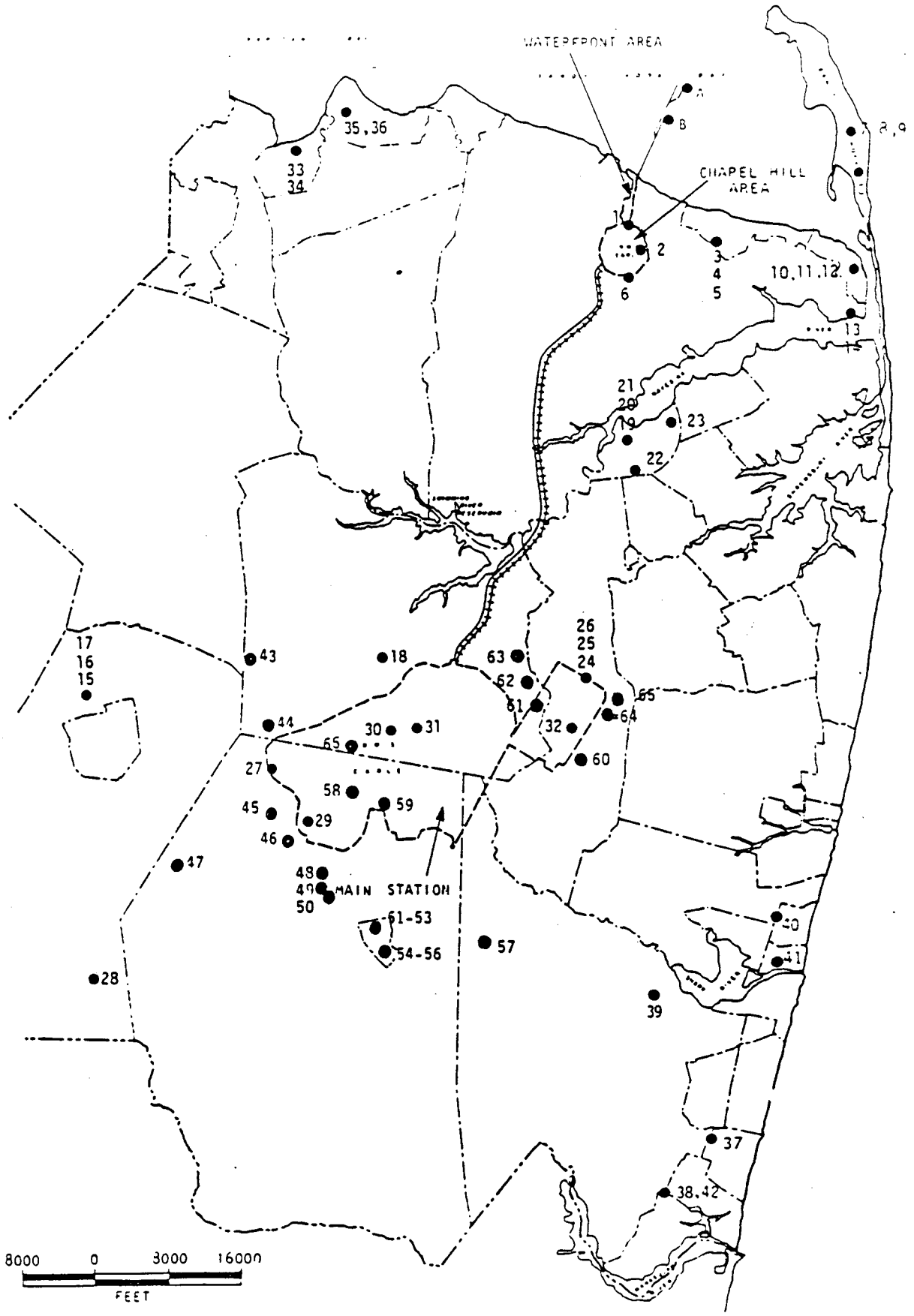

FIGURE 5-8. WELL LOCATIONS IN THE VICINITY OF NWS EARLE
(See next page for key to locations)

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NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

TABLE 5-8

Key to Well Location Map

Well Location	Owner/Location	Aquifer
1	NWS Earle	Englishtown
2	NWS Earle	Englishtown
3	Atlantic Highlands	Magothy and Raritan
4	Atlantic Highlands	Englishtown
5	Atlantic Highlands	Magothy and Raritan
6	NWS Earle	Englishtown
7	Fort Hancock	Mathothy and Raritan
8	Fort Hancock	Magothy and Raritan
9	Fort Hancock	Magothy and Raritan
10	Highlands	Magothy and Raritan
11	Highlands	Magothy and Raritan
12	Highlands	Hornerstown
13	Highlands Air Force Base	Englishtown
14	Highlands Air Force Base	Englishtown
15	Freehold	Magothy and Raritan
16	Freehold	Magothy and Raritan
17	Freehold	Magothy and Raritan
18	Colts Neck	Englishtown
19	Red Bank	Englishtown
20	Red Bank	Magothy and Raritan
21	Red Bank	Magothy and Raritan
22	Red Bank	Englishtown
23	Red Bank	Englishtown
24	NWS Earle	Red Bank
25	NWS Earle	Red Bank
26	NWS Earle	Red Bank
27	NWS Earle	Red Bank
28	NWS Earle	Red Bank
29	NWS Earle	Red Bank
30	NWS Earle	Magothy and Raritan
31	NWS Earle	Magothy and Raritan
32	NWS Earle	Red Bank
33	Keyport	Magothy and Raritan
34	Keyport	Old Bridge
35	Union Beach Boro	Magothy and Raritan
36	Union Beach Boro	Old Bridge
37	Sea Girt	Kirkwood
38	Manasquan	Kirkwood
39	Camp Evans	Mount Laurel & Wenonah
40	Ocean Grove	Mount Laurel & Wenonah
41	Avon by the Sea	Mount Laurel & Wenonah
42	Manasquan	Kirkwood
43	U.S. Army	Englishtown
44	U.S. Army	Englishtown
45	Seaside Investments	Englishtown
46	N.J. Latvain Club	Mt. Laurel and Wenonah
47	Abraham Hascup	Mt. Laurel and Wenonah
48	Emil Schroth	Magothy and Raritan

TABLE 5-8 (CONT)

Key to Well Location Map

Well Location	Owner/Location	Aquifer
49	N.J. Concrete Co.	Mt. Laurel & Wenonah
50	Howell Township	Englishtown
51	Farmingdale W.D.	Englishtown
52	Farmingdale, W.D.	Englishtown
53	Farmingdale, W.D.	Englishtown
54	Rokach & Sons	Vincentown
55	Rokach & Sons	Vincentown
56	Foster Canning	Vincentown
57	Duncan Checker	Vincentown
58	NWS Earle	Mt. Laurel and Wenonah
59	NWS Earle	Vincentown
60	NWS Earle	Vincentown
61	Southern Gulf	Englishtown
62	Dr. Red Bank.W. Muller	Englishtown
63	Ray Dittemer	Mt. Laurel and Wenonah
64	Mr. Scatuorehio	Englishtown
65	Homing Hills Gulf Co.	Englishtown
66	NWS Earle	Red Bank

Merchantville Formation perform as an aquitard or confining layer within the hydrologic sequence and no wells in Monmouth County are known to produce from these units.

The Englishtown Formation is the second most productive aquifer in the area surrounding the Main Base. Wells drilled into the Englishtown aquifer in and around the Main Base range between 240 and 480 feet deep. The average permeability is 200 gpd/sq ft and ranges from 50 to 300 spd/sq ft. The average yield to 20 large diameter public supply wells is 410 gpm. The aquifer is recharged at its outcrop area and from vertical leakage from overlying formations. Groundwater flow is downdip, towards the southeast.

The Marshalltown Formation is much less permeable than the adjacent beds and is considered a confining layer for the underling Englishtown Formation and the overlying Wenonah Formation-Mount Laurel Sand. While the Marshalltown Formation is not considered to be an aquifer, isolated areas have reported domestic well yields of 40 gallons per minute from the more sandy phases of the formation.

The Wenonah Formation and Mount Laurel Sand are porous sands which are hydraulically interconnected and as such form one aquifer. This aquifer is not heavily used in the area, providing less than 3% of the total groundwater used in Monmouth County in 1958. The average yield is 10 gpm and the maximum reported yield is 335 gpm. In the vicinity of the Main Base, wells using this aquifer range from 168 to 280 feet deep and the static water level averages 70 feet above sea level. The aquifer is recharged from precipitation in its outcrop area, approximately six miles to the northwest, and groundwater flow is downdip to the southweast.

The Navesink Formation is primarily a confining unit to the Vincentown, Wenonah and Mount Laurel formations. In the southern part of Monmouth County a 10 ft. thick basal shell bed yields small quantities of water to domestic wells (approximately 15 gpm).

The Red Bank Sand yields water to a few wells arround the Main Base, but is not considered a highly productive aquifer. The aquifer is

largely used for domestic wells and yields range from 3 to 30 gpm. The Red Bank Sand is recharged only a few miles northwest of the Main Base.

The Hornerstown Sand is relatively impermeable and serves as a confining bed. Occassional silty sand beds within the overall clayey deposit supply up to 5 gpm to domestic wells. A small portion of the aquifer recharge area is within the Main Base.

The Vincentown Formation is tapped by domestic wells and yields range from 10 to 50 gpm. Depths of wells screened in this formation in and around the Main Base range from 21 to 100 feet and the static water level averages about 65 feet above mean sea level. A substantial portion of the northern part of the Main Base lies within the outcrop area and hence is a recharge zone (Figure 5-4). Groundwater flow is east towards the Atlantic Coast (Figure 5-9).

The Manasquan Formation functions as an aquiclude between the underlying Vincentown Formation and the overlying Kirkwood Formation. However, in the area of the Main Base, this formation may be absent.

The Kirkwood Formation, though heavily used as a public water supply in other areas of the New Jersey Coastal Plain, is not used locally except for domestic supplies. The formation outcrops over the southern part of the Main Base, where it is less than 30 feet thick. (Figure 5-10).

The local general movement of water in this aquifer is chiefly from topographic highs toward the Manasquan River, the Shark River and Ocean County. As such it is a significant source of base flow for these rivers. Because of its extensive outcrop area within the Main Base, this aquifer would be the first to be affected by potential contaminant migration from waste disposal areas located with its recharge area. The monitoring of shallow water table wells in vicinity of the "F" Group Magazine storage area indicates that the groundwater level in that area averages 126 feet above sea level, or between 13 and 16 feet below ground surface.

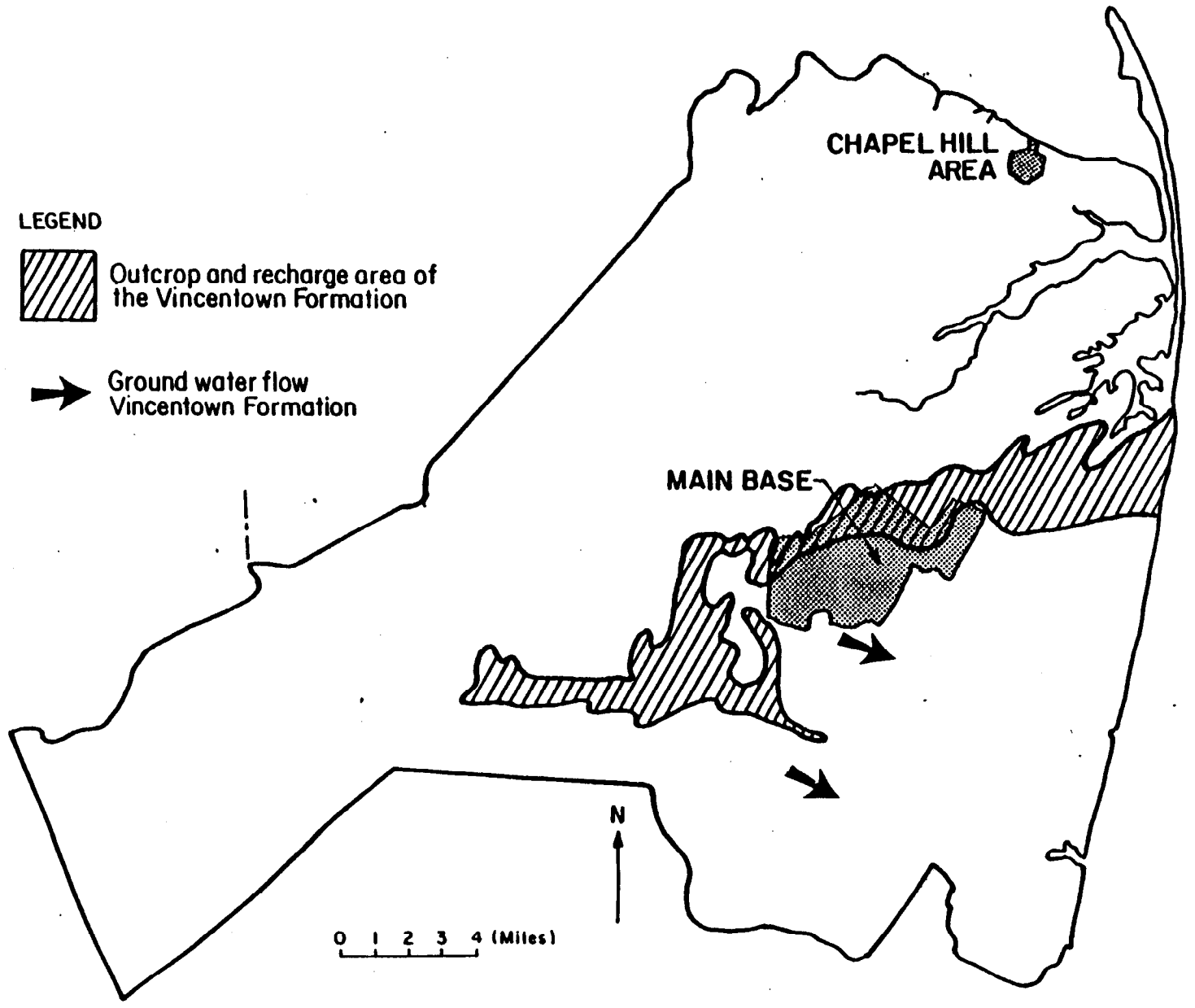

FIGURE 5-9. Groundwater Flow Direction in Vincentown Formation.

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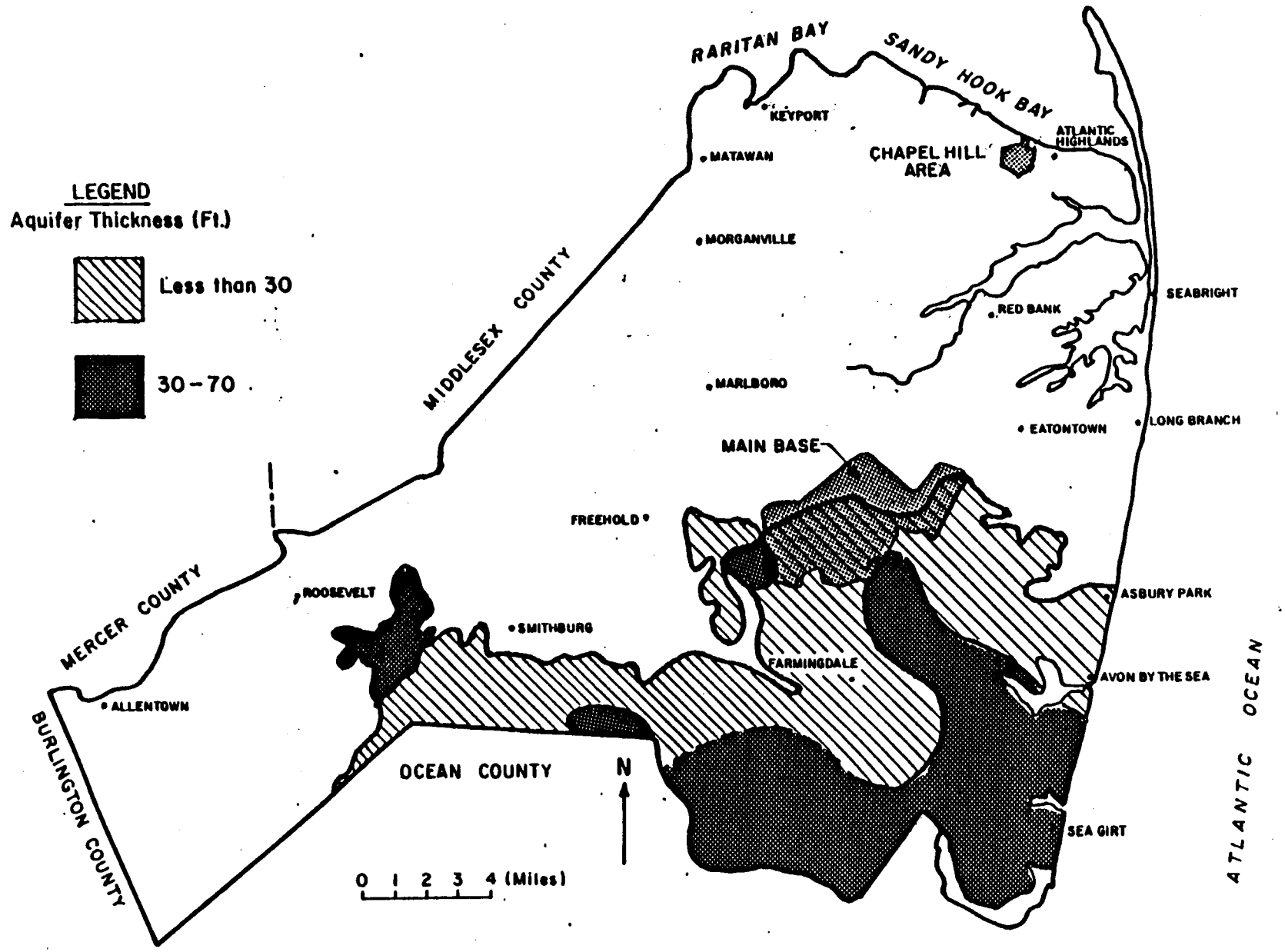

FIGURE 5-10. Thickness of Kirkwood Aquifer in Monmouth County, NJ.

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INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

No wells tap the Cohansey Sand at the Main Base. However, the outcrop areas of the Cohansey Sand are topographic highs and as such the aquifer recharges underlying aquifers, particularly the Kirkwood. Therefore, contaminant migration within this formation could potentially affect underlying aquifers. However, the interbedding of clays and sands within this unit will restrict vertical migration and favor lateral migration.

5.3.6.2.3 Waterfront and Chapel Hill Areas

The Waterfront and Chapel Hill areas overlie the older unconsolidated New Jersey Coastal Plain deposits. The Chapel Hill area contains outcrops of the Red Bank Sand, Navesink Formation, the Mt. Laurel and Wenonah Formation, and the Marshalltown Formation. Hydrogeologic properties of these formations are described in the previous section. Recharge occurs at the outcrop areas and groundwater flow is downdip to the southeast.

Local groundwater at the Waterfront Area is controlled by the proximity of Sandy Hook Bay, with local groundwater flow toward the bay.

5.3.6.2.4 Groundwater Quality

The groundwater quality from aquifers in the New Jersey Coastal Plain in the vicinity of NWS Earle is generally good. The total dissolved solids and other important water quality parameters all fall within acceptable federal and state potable water quality standards. These standards are given on Table 5-9 along with the general chemical quality of Monmouth County groundwater for various major aquifers. The most notable exception to the generally good quality of the groundwaters in the area is the excessive iron content known to occur locally in certain aquifers (Raritan Magothy Formations, Englishtown Formation and the Vincentown Formation).

Additional information on groundwater quality in the Kirkwood Formation is provided by the NJDEP Water Resources Data Survey for New Jersey, 1981. While no wells screened in the Kirkwood Formation in southern Monmouth County are included in this survey, several wells screened in the Kirkwood in northern Ocean County are included. The data indicates that for

TABLE 5-9

Water Quality of Ground-Water in Aquifers of Monmouth County
Parameters in (mg/l Unless Noted) (Range of Values Occurring)

Aquifer Formations	pH	Nitrate	Sulfate	Chloride	Specific Conductance (micromhos)	Total Dissolved Solids	Hardness	Total Iron
Raritan- Magothy	3.8-7.4	0.0	—	0.6-60.0 mostly < 3.0	64.0-290.0	34.0-117.0	13.0-103.0	< 6.0
Englishtown	7.0-8.4	0.05-.13	4.0-8.0	1.4-11.0	69.0-244.0	56.0-160.0	< 90.0	< 3.0
Wenonah & Mount Laurel Sands	6.5-8.1	0.04[b]	11.0[b]	0.2-6.0	160.0-290.0	112.0-145.0	56.0-110.0	< 0.3 (one sample = 10.0)
Red Bank Sands	6.9[b]	0.05[b]	4.0[b]	7.4-16.0		12.0[b]		
Kirkwood	4.8-6.6	0.12[b]	17.0[b]	9.6-17.0	52.0-189.0	18.0[b]		
Range for all Formations[a]	3.8-8.1	0.0-1.0	0.0-38.0	0.0-164.0			4.0-260.0	0.0-33.0
U.S. Public Health Service Potable Water Standards	None	10.0	250.0	250.0	None	500.0	None	0.3
N.J. Potable Water Standards	None	10.0	250.0	250.0	None	500.0	None	None

Notes: [a] After Jablonski (1970)
[b] Only one value given, blanks indicate no values are available.

Sources: N.J. State of, Dept. of Conservation & Economic Development, 1968. "Ground Water Resources of Monmouth Co., N.J.
N.J., State of, Dept. of Conservation & Economic Development, 1963. "Chloride Concentrations of Water from wells in the Atlantic Coastal Plain of N.J."
U.S. Environmental Protection Agency, 1976, Quality Criteria For Water

13 wells screened in the Kirkwood Aquifer inland from the Atlantic coast, the average specific conductance was 52 umhos/cm; the average pH was 6.0 and the average chloride concentration was 4.6 mg/l. Wells screened in the Kirkwood Formation along the Ocean County Atlantic Coast had higher specific conductance and chloride concentrations.

For several years the Shrewsbury Disposal Company has collected groundwater samples from two shallow monitoring wells located approximately 1500 feet south of the intersection of the Eastern New Jersey Power Company and the New Jersey Central Power and Light Company right-of-ways. Though these two wells are of unknown depth, it is assumed they monitor the quality of the shallow ground water system. The results of several monitoring periods is presented in Table 5-10 and compared to NJDEP Groundwater Standards and USEPA Drinking Water Standards. Except for iron, chlorides and total dissolved solids, the water quality is within groundwater standards.

5.3.7 Migration Potential

5.3.7.1 Surface Water

The potential for pollutant migration off-site via surface water depends largely on the proximity of the site to a stream channel and the amount of runoff generated per storm event. It has been estimated by the USGS that approximately 11 percent of the total yearly rainfall leaves NWS Earle as runoff. However, on a site specific basis, this number may increase or decrease depending on the local permeability of the soils, the type of vegetation and the extent of drainage control at the site. Also, the storm drainage system serving the Administration Area of the Main Base collects water from impermeable surfaces and conveys it directly to receiving streams. Pollutants on the impermeable surfaces would be readily transported to the adjoining streams. The storm drainage system is within the Hockhockson Brook (Pine Brook) subbasin of the Swimming River drainage basin.

Of the 22 waste sites identified on the Main Base, 18 are in the Swimming River drainage basin and four are within the Manasquan River drainage basin. All identified waste disposal sites at the Chapel Hill and

Table 5-10

Results of Chemical Sampling of Two Shallow Groundwater Monitoring Wells Located Adjacent to the Main Base, NWS Earle[1]

Parameters	Date Sampled Obtained																		USEPA Primary Drinking Water Standards	NJDEP Groundwater Standards
	2/6/79		7/9/79		9/19/79		12/27/79		3/14/80		6/30/82		12/17/82[2]		3/5/81		6/2/81			
	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2		
Total Coliform (colonies/100 ml)			neg.	neg.							40	10					neg.	neg.		
Turbidity (mg/l)			5	5							140	130					400	400		
Color			8	8							2,100	1,900					500	500		
Arsenic (mg/l)											0.005	0.005					0.005	0.005	0.05 mg/l	50 ug/l
Barium (mg/l)											0.5	3.4					0.25	0.65	1.0 mg/l	1.0 mg/l
Cadmium (mg/l)											0.02	0.02					0.014	0.002	0.01 mg/l	10 ug/l
Chromium (mg/l)											1.08	0.42					0.15	2.70	0.05 mg/l	50 ug/l
Cyanide (mg/l)											1.0	1.0					0.02	0.02		0.2 mg/l
Lead (mg/l)											0.1	0.1					0.17	0.50	0.05 mg/l	50 mg/l
Fluoride (mg/l)			0.7	0.65							0.3	1.0					0.05	0.05		2.0 mg/l
Selenium (mg/l)											0.005	10.005					0.005	0.005	0.01 mg/l	10 ug/l
Silver (mg/l)											0.1	0.1					0.01	0.03	0.05 mg/l	10 ug/l
M B A S (mg/l)											0.06	0.52					0	0		
Chloride (mg/l)	450	15	157	20	85	15.9	334	95	265	10	17.5	267	615	610	15		610	-		250 mg/l
Copper (mg/l)											0.2	0.1					0.08	0.61		1 mg/l
Hardness (mg/l)	171	45	143	40	90	32	1,420	89	990	39	38	1,228	990	1,220			360			
Iron (mg/l)	6.2	0.65	0.5	0.95	6.7	5.9	31	32	20.8	0.3	5.9	64	5,625	21	148		40	400		0.3 mg/l
Manganese (mg/l)											0.01	0.01					0.29	4.36		0.005 mg/l
Nitrate (mg/l)			6.4	2.4							6.2	3.0					5.0	10.6	10.0 mg/l	10 mg/l
Phenolic Compounds (mg/l)	0	0	0	0	0	0	0	0	0	0	2.0	7.5	0.08	0.04	0.12		0.12			1 ug/l
Sodium (mg/l)			655	40							4	500					257	113		50 mg/l
Sulfate (mg/l)			18.5	10.2							60	5					5	80		250 mg/l
Total Dissolved Solids (mg/l)	750	67	300	73	400	69	2,750	90	2,600	56	116	1,956	3,317	2,891	62		2,142			500 mg/l
Zinc (mg/l)														0.93	1.45		0.93	1.45		5 mg/l

Notes:

1) Sample analysis performed by J.R. Henderson Labs, Inc. Results reported in correspondence between Charles C. Widdis Professional Engineer and NWS.
2) Well No. 1 dry on this sampling date.
3) Blanks indicate data not available.

Waterfront Areas are within the Matawan River Basin and either drain to Compton, Wagner or Ware Creeks or directly into the tidal wetlands area. Storm drainage systems at the Waterfront Area discharge to Ware Creek, which drains to Sandy Hook Bay.

5.3.7.2 Groundwater

A large portion of the soils at the Main Base are sandy to sandy loams and as such are well drained to moderatly well drained. This indicates that unless the waste site is lined, rainwater will infiltrate fairly easily and percolate to the groundwater. Once the percolating water reaches the groundwater system, it will migrate in the direction of groundwater flow.

The two principal aquifers that could be affected by contaminant migration from the Main Base would be the Vincentown and the Kirkwood. Within five miles of the Main Base, neither of these aquifers are used for public water supply, but they are used for domestic supplies. Sites located within the Vincentown outcrop area (Figure 5-4) will percolate to the Vincentown, while sites located within the Kirkwood and Cohansey outcrop areas would leach into the Kirkwood aquifer. Groundwater flow is towards the southeast and east and contaminants would migrate in that direction. Of the 22 waste sites located at the Main Base nine are within the Vincentown recharge area and the remainer are within the Kirkwood recharge area.

Waste disposal sites located in the outcrop area of the Cohansey Sand have the potential of contaminating the Kirkwood Aquifer. However, because in the area of the Main Base the Cohansey Sand consists of interbedded sands and clays the potential for lateral migration is greater than for vertical migration . Lateral migration of contaminants from Site No. 4 to Earle Pond, for example, may have been responsible for catfish kills in the pond.

In addition to the potential for groundwater contamination from on base waste disposal sites, there is also the potential for migration of contaminated groundwater from the Shrewsbury Disposal site onto the NWS

Earle Main Base. While the average groundwater flow direction is towards the Atlantic Coast, local groundwater mounding from accelerated recharge at the disposal site, if present, could result in a minor component of flow northwest onto the Main Base.

5.4 BIOLOGICAL FEATURES

5.4.1 Terrestrial Ecosystems

5.4.1.1 Vegetation

The regional distribution of forest types is closely related to the inner and outer subdivisions of the Coastal Plain Physiographic Province (see section 5.3.3; Topography). On the outer Coastal Plain, the main station is characterized by Pine-Oak forests, while the Waterfront Area, on the inner Coastal Plain, is generally forested by the Oak-Chestnut type (Braun, 1950). The Chapel Hill area is in the boundary between the two Plains, and is dominated by hardwood forest like the inner Coastal Plain. Wetlands, abandoned cranberry bogs, and Pine Barrens areas are present locally.

5.4.1.1.1 Oak-Chestnut Forest

The Oak-Chestnut forest is dominated by various species of oak. The most common oaks of the overstory are usually white, black, red, chestnut, and scarlet. The drier upland areas also contain maples, locusts, wild cherry, mulberry and birch trees. In addition to these, Chapel Hill contains several stands of yellow poplar.

Lowland or floodplain associations of the Oak-Chestnut forest type may include black willow, blackgum, sweetgum and red maple. A shrub cover of heath plants such as laurel, blueberry, huckleberry and swamp azalea are typical of these forests (Robichaud and Buell, 1973).

5.4.1.1.2 Oak-Pine Forest

The upland Oak-Pine forest can be categorized in two ways: pine-dominated or oak-dominated. The pine-dominated forest is present in areas

of sandy, less fertile soil, and in New Jersey is commonly referred to as the Pine Barrens. Figure 5-11 shows the distribution of the Pine Barrens ecosystem in New Jersey and Figure 5-12 shows forest types at NWS Earle. Pine-dominated forests are present in the south-east of the Main Base. The most abundant tree in pine-dominated Oak-Pine forests is the pitch pine. Other common trees include shortleaf pine, black oak, white oak, post oak, scarlet oak and blackjack oak. The shrub layer is composed predominantly of heaths and may include black huckleberry, lowbush blueberry, sheep laurel, fetterbush and mountain laurel.

Oak-dominated Pine-Oak forests are generally considered a fringe area of the Pine-Oak forest (McCormick, 1970) and a transition between the Oak-Chestnut forest and pine-dominated Pine-Oak forests. Trees in this forest include black oak, scarlet oak, white oak, chestnut oak, post oak, pitch pine, and shortleaf pine. Common shrubs include black huckleberry, dangleberry and lowbush blueberry.

Upland forests which are composed of oaks and pines occupy areas in which the winter water-table remains at least 1.5 feet below the ground surface. Lowland groups of the Oak-Pine forest type are composed mainly of southern white cedar, red maple, black gum and pitch pine and usually occur on sites that are flooded or have a water-table that rises to within 1.5 feet of the surface for several weeks of the year (McCormick, 1973).

5.4.1.1.3 Forest Distribution at NWS Earle

With the exception of building areas, magazines, rail lines and roadways, much of the Main Base is forested. Figure 5-12 maps the eight dominant forest types, and Table 5-11 summarizes acreage by forest type. Annual growth, including ingrowth, is given in Table 5-12 by species and forest product.

The forests were a source of wood products for local use with lumber being an important industry until the mid 1800's. Wood was the universal fuel and large quantities were consumed locally or shipped to the nearby cities. Much of the timberland was cut over repeatedly to supply charcoal for local forges and iron foundries.

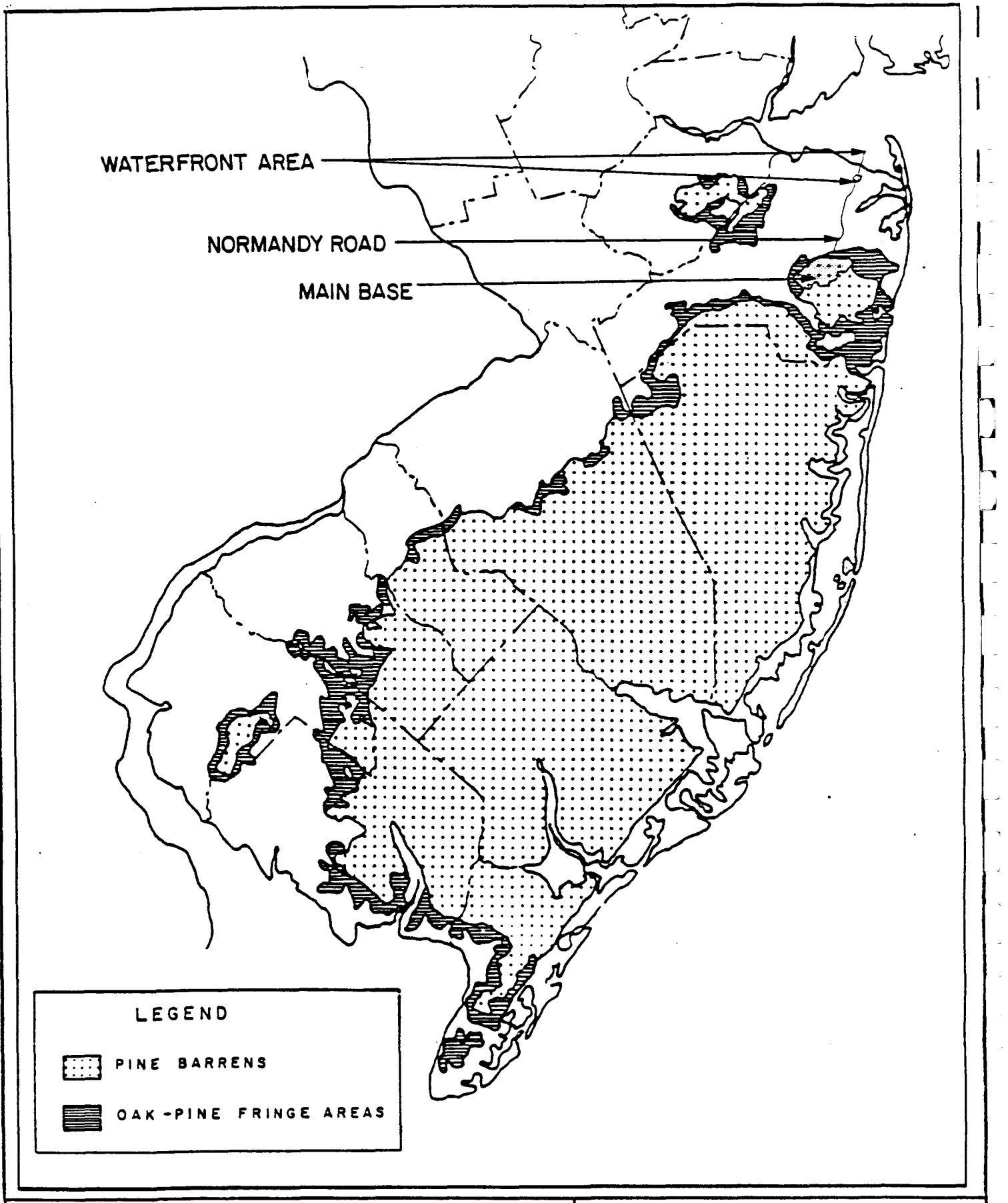


FIGURE 5-11. LIMITS OF THE PINE BARRENS REGION IN NEW JERSEY

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

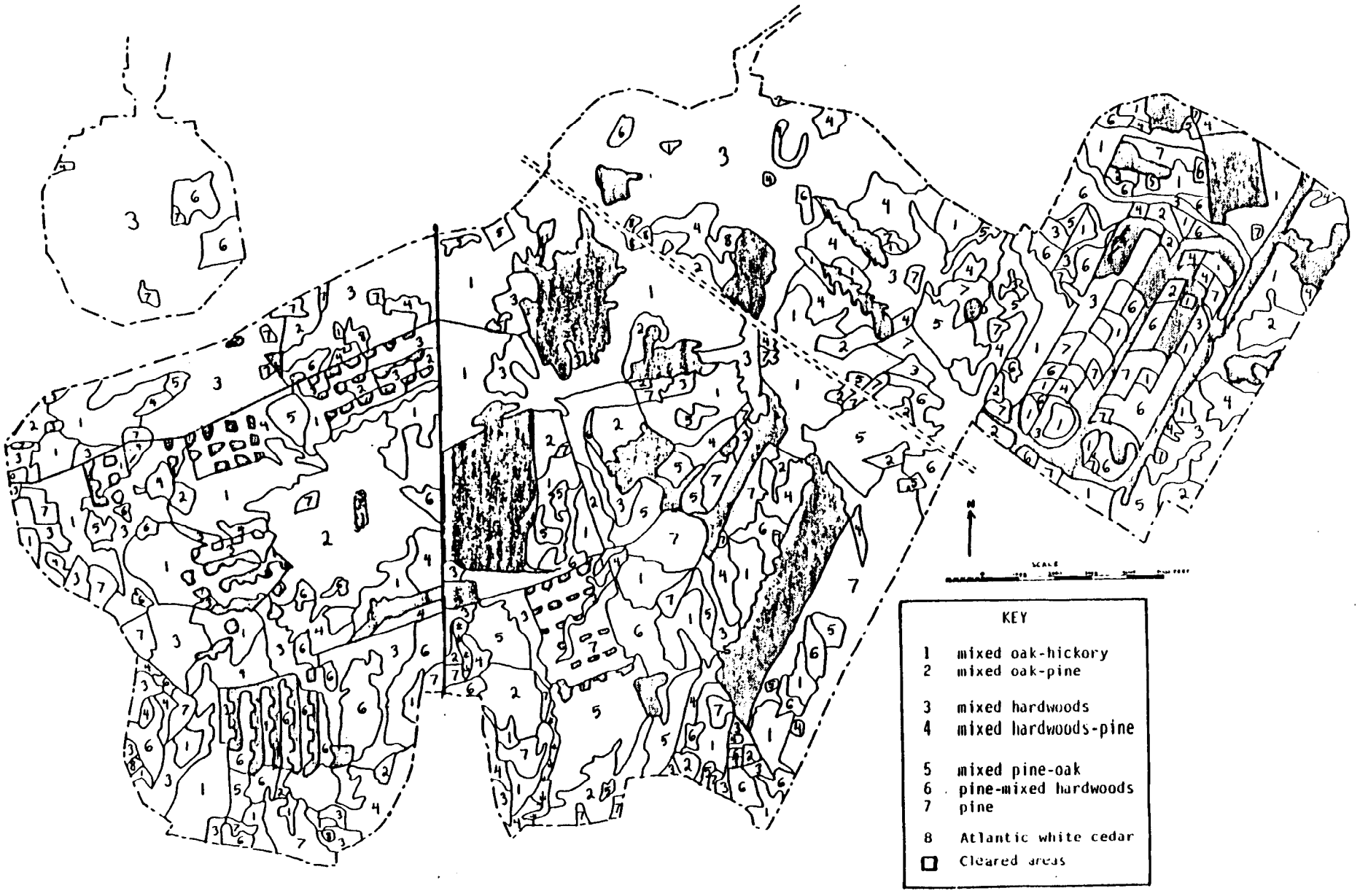


FIGURE 5-12. FOREST TYPES AT THE MAIN BASE

FCHA

INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

TABLE 5-11

Forest Types Summary at NWS Earle Main Base

FOREST TYPES	ACRES	Percent[a]
Mixed Oak	1,445	17.5
Poletimber[b]	1,183	
Sawtimber[b]	262	
Oak - Pine (Poletimber)	1,321	16.1
Mixed Hardwood	1,857	22.6
Poletimber	938	
Sawtimber	919	
Hardwood - Pine (Poletimber)	492	6.0
Pine - Oak (Poletimber)	676	8.2
Pine - Hardwood (Poletimber)	886	10.7
Pine (Poletimber)	378	4.6
Atlantic White Cedar (Poletimber)	17	0.2
Seedling - Sapling Types[b]	1,144	13.9
Total Managed Forest	8,216	99.8
Total Unmanaged Forest	824	
Total Forest	9,040	
Cleared or Developed	2,134	
Total	11,174	

Notes:

[a]Percent of managed forest

[b]Saplings: Seedlings - less than 4 inches diameter at breast height (dbh)
Poletimber - 4 inches - 11 inches dbh
Sawtimber - greater than 11 inches dbh

Sources: Gentile, 1977.

TABLE 5-12

Average Annual Forest Growth by Species and Product:

	Net Annual Growth	
	Per Acre	Total
Sawlog Material (FBM)		
White Oaks	3	29,280
Red Oaks	1	6,478
Good Hardwoods	21	178,000
Other Hardwoods	2	19,800
Total	27	233,558
Growing Stock (Cords)		
White Oaks	0.081	678
Red Oaks	0.113	946
Good Hardwoods	0.049	410
Other Hardwoods	0.198	1,657
Total Hardwood	0.441	3.691
Pine	0.141	1,180
Atlantic Cedar	0.002	16
Total Softwoods	0.143	1,196
Total All Species	0.584	4,887

Some open lands used for farming prior to establishment of the Station have since seeded into pure stands of sweetgum, or pitch pine, depending on moisture conditions. However, most former open areas now support poorly stocked stands of poor quality, open grown trees. Numerous fires have ravaged the forest for centuries, which, combined with past heavy cutting have reduced much of the area to poor quality sprout-origin stands of mixed oak-hickory and pitch pine. Results of a 1979 vegetation survey near three of the sites currently being evaluated are presented in Table 5-13. A survey of plants in the Waterfront Area is listed in Appendix A. This area is discussed more completely in Section 5.4.3 (Marine Wetlands.)

Cedar, recognized as valuable for centuries, was harvested with little regard for regeneration before the Navy acquired the site from private holders. As a result, only 19 acres of the original hundreds of acres of this valuable species remain on the Station. Former cedar sites now support poor quality stands consisting mostly of red maple and blackgum. Cedar is a preferred deer food, and the present deer population tends to prohibits cedar regeneration.

At the Main Base, there is a stand of Atlantic White Cedar southeast of Site No. 1, bisected by the JCP&L right-of-way. This forest represents a late stage of bog succession and, although of limited area, it is an example of a unique wetland association. The understory is dominated by red maple and blackgum. Common shrubs include sweet pepper-bush, mountain laurel and rhodondendron. Some of the common herbaceous plants of the forest floor were netted chain fern, skunk cabbage, sedges, and cinnamon fern. A second cedar swamp outside the south west corner of the station by Route 33 is designated as a wildlife habitat, floodplain and bog in the Monmouth County Unique Areas Study.

5.4.1.1.4 Forest Management

The Navy had no systematic forest management plan prior to 1962, but considerable soil conservation and reforestation work has been done since 1948 under the formal soil erosion program to correct severe erosion following construction of NWS Earle. Extensive programs have been developed

TABLE 5-13

Vegetation Surveyed Near Three Identified Waste Disposal Sites

Scientific Name	Common Name	Near Site No.1	Near Site No.5	Near Site No.3
	(TREES, SHRUBS AND VINES)			
Acer rubrum	Red Maple	X	X	X
Ailanthus altissima	Tree of Heaven			X
Ascyrum hyperioides	St. Andrew's Cross	X		
Betula sp.	Birch	X		
Betula lutea	Yellow Birch			X
Betual nigra	River Birch	X		
Betual populifolia	Gray Birch		X	X
Carya tomentosa	Mockernut		X	
Chamaecyparis thyoides	White Cedar			X
Clethra alnifolia	Sweet Pepper-bush	X	X	X
Diospyros virginiana	Persimmon		X	
Fagus grandifolia	Beech		X	X
Fraxinus sp.	Ash	X	X	X
Gaultheria procumbens	Wintergreen	X	X	
Gaylussacia frondosa	Tall Huckleberry	X	X	X
Ilex laevigata	Smooth Winterberry Holly	X	X	
Ilex opaca	American Holly	X	X	X
Juniperus virginiana	Red Cedar	X	X	
Kalmia angustifolia	Sheep-laurel	X	X	
Kalmia latifolia	Mountain Laurel		X	X
Liquidambar styraciflua	Sweet Gum		X	X
Lionicera japonica	Japanese Honeysuckle	X		
Magnolia virginiana	Sweetbay Magnolia	X		X
Myrica asplenifolia	Sweet Fern	X	X	
Myrica pensylvanica	Bayberry	X		
Nyssa sylvatica	Black Gum	X	X	X

TABLE 5-13 (Continued)

Vegetation Surveyed Near Three Identified Waste Disposal Sites

Scientific Name	Common Name	Near Site No. 1	Near Site No. 5	Near Site No. 3
Parthenocissus quinquefolia	Virginia Creeper	X	X	X
Pinus rigida	Pitch Pine	X	X	
Pinus strobus	White Pine		X	X
Prunus serotina	Black Cherry	X	X	X
Pyrus arbutifolia	Red Chokeberry	X		
Quercus alba	White Oak	X	X	X
Quercus borealis	Northern Red Oak	X	X	
Quercus coccinea	Scartlet Oak	X	X	X
Quercus falcata	Spanish Oak	X	X	
Quercus marilandica	Black-jack Oak	X	X	
Quercus prinus	Chestnut Oak	X		
Quercus stellata	Post Oak		X	
Quercus velutina	Black Oak	X	X	
Rhododendron sp.	Laurel	X		X
Rhus copallinum	Winged Sumac	X	X	X
Rhus radicans	Poison Ivy	X		
Robinia pseudoacacia	Black Locust	X	X	
Rosa sp.	Rose		X	X
Rubus sp.	Bramble	X	X	
Sassafras albidum	Sassafras	X	X	
Smilax bon-nox	Greenbrier		X	X
Smilax glauca	Greenbrier	X	X	X
Smilax rotundifolia	Common Greenbrier	X	X	X
Spiraea tomentosa	Hardhack	X		
Vaccinium sp.	Blueberry	X	X	X

TABLE 5-13 (Continued)

Vegetation Surveyed Near Three Identified Waste Disposal Sites

Scientific Name	Common Name	Near Site No.1	Near Site No.5	Near Site No.3
Viburnum dentatum	Southern Arrow-wood		X	
Vitus aestivalis	Summer Grape		X	
Vitus labrusca	Fox Grape	X		
	(HERBACEOUS PLANTS)			
Achillea millefolium	Common Yarrow	X		
Allium vineale	Field Garlic	X		
Andorpogon virginicus	Broomsedge	X	X	X
Antennaria plantaginifolia	Everlasting	X		
Asclerpia sp.	Milkweed	X	X	X
Athyrium filix-femina	Lady Fern	X		
Barbarea vulgaris	Winter cress	X		
Bromus sp.	Brome Grass	X		
Carex spp.	Sedges	X	X	X
Chimaphila maculata	Spotted Wintergreen		X	
Chrysanthemum leucanthemum	Ox-eye Daisy	X		
Cirsium sp.	Thistle	X		
Dactylis glomerata	Orchard Grass	X		
Galium aparine	Bedstraw	X		
Hieracium pratense	King Devil	X	X	
Hypochaeris radicata	Cat's-ear	X		
Juncus sp.	Rush			X
Lepidium campestre	Field Cress	X		

TABLE 5-13 (Continued)

Vegetation Surveyed Near Three Identified Waste Disposal Sites

Scientific Name	Common Name	Near Site No. 1	Near Site No. 5	Near Site No. 3
Lespedeza sp.	Bush Clover	X		
Linaria canadensis	Blue Toadflax	X		
Mitchella repens	Partridge-berry			X
Onoclea sensibilis	Sensitive Fern	X	X	X
Osmunda cinnamomea	Cinnamon Fern	X	X	X
Osmunda regalis	Royal Fern			X
Oxalis stricta	Yellow Wood-sorrel	X		
Panicum spp.	Panic Grass	X	X	
Penstemon digitalis	Beard-tongue	X		
Phragmites communis	Reed	X	X	
Plantago lanceolata	English Plantain	X		
Plantago virginica	Plantain	X		
Pteridium aquilinum	Bracken Fern	X	X	
Rumex acetosella	Red Sorrel	X		
Rumex crispus	Sour Dock	X		
Sisyrinchium albidum	Blue-eyed Grass	X		
Symplocarpus foetidus	Skunk Cabbage	X		X
Thelypteris simulata	Massachusetts Fern	X		X
Tragopogon pratense	Goat's Beard	X		
Trientalis borealis	Star Flower		X	
Trifolium dubium	Hop Clover	X		
Verbascum thapsus	Mullein	X		
Woodwardia areolata	Netted Chain Fern			X

for soil and water, forestry, fish and wildlife, and outdoor recreation at Earle. In 1968 the Secretary of the Navy awarded Earle the National Resources Conservation Award, and since then has given it several honorable Mentions.

5.4.1.1.5 Reforestation and Revegetation

Reforestation with pine has been prescribed for many sandy areas to aid in soil stabilization. On extremely poor sites, some of which have remained as exposed sand since the constructon of the station, special treatments have been prescribed to reestablish a forest and ground cover. Fertilizing and mulching are necessary in some cases to speed up the establishment of a vegetative cover. The seeding of special grass seed mixtures as a soil stabilizer has been helpful on certain reforested areas where wind erosion and "sandblasting" causes high mortality of seedlings. In highly acid areas, such as the Army Barricades area, slag has been spread to neutralize the soil so that plants can eventually survive.

In many cases where forest cover is not desired because location requires that the area remain open for reasons of safety, security, or fire regulations, various legumes and grasses have been chosen for vegetative cover. Crownvetch, a legume, has many advantages over previously used types of ground cover. It has a flower which gives six months of color to the area where it is established, and most important of all, it thrives under a variety of adverse site conditions. Also, it does not require mowing and grows densely, choking out weeds; and because it is a legume, it adds to the fertility of the soil. Crownvetch has been used as a ground cover for many newly established semi-improved areas.

Grasses which have been used in the reseeding of unimproved areas disturbed by construction include tall fescue, lovegrass and some of the improved ryegrasses. These grasses have proven themselves by their ability to survive poor and droughty soils. Trials, however, are in progress to evaluate new grasses and seed mixes capable of surviving extremely poor existing conditions while requiring a minimum of maintenance to sustain a turf capable of resisting invasion of woody weed vegetation.

Improvement of soil on some poor sandy areas has been done through the establishment of about 20 acres of wildlife food plots by the Conservation Club. These areas are fertilized and treated with manure obtained from local horse stables. Food plots have also been established under a power-line right-of-way on the Station, aiding in the prevention of erosion and making use of land on which forest growth is restricted.

5.4.1.2 Fires

Fires are frequent in the Pine Barrens, probably occuring more often in the historic and prehistoric past than they do today. The Pine Barrens vegetation has developed several fire resistance adaptations. Most plant species in the upland areas sprout vigorously from underground organs after the tops of the plants are burned.

The pitch pine, the most abundant tree in the region, is outstanding among eastern conifers in its ability to survive injury from fire. All pitch pine foliage may be killed by the heat of the fire, and still the crown will produce new needles. Dormant buds, capable of active growth when properly stimulated, are the key to the recovery of pitch pines. These dormant buds lie protected beneath the soil surface and along the trunks of the trees. Cones of some pitch pines are serotinous, i.e., they remain closed for an indefinite number of years after they mature, but open in response to high temperatures. The pitch pine is adapted to poor soils with a severe fire history, it is a common invader of cleared sites, and it is able to thrive on both droughty and wet sites.

Other tree species also exhibit adaptations. The shortleaf pine, like the pitch pine, has dormant buds along the trunk, but it does not retain it basal sprouting capability as long as the pitch pine. Oak trees generally do not sprout in the crown, but basal sprouts develop from stems after fires. The blackjack oak survives, perhaps even thrives, under conditions of very frequent fire. The post oak is less tolerant of frequent fire and the black oak even less. White chestnut and scarlet oaks are generally killed by recurrent fires.

Fire removes litter covering the forest floor. This provides a more suitable seedbed for pine which, unlike oaks, require mineral soil or a thin layer of litter and minimal shading for seedling establishment. Overall, fire favors pine over oak. In the absence of fire or other disturbance such as land clearing, pitch pine and shortleaf pine would eventually be replaced by oak and other hardwoods.

Periodic wildfires at possibly 40 year intervals have produced the oak-pine mixtures over extensive areas of upland, while more frequent fires have created mixtures of pitch pine and scrub oak. Different fire frequencies and intensities interrupt succession, thus accounting for most of the current variations in forest composition and largely obscuring the effects of soil differences. In swamps, fire may favor the reproduction of Atlantic white cedar or hardwoods. If fire consumes enough of the organic soil, quaking bogs, meadows, or leather-leaf areas may be favored.

5.4.1.2.1 Controlled Burning at NWS Earle

On the Main Base, controlled burning of about 2,000 acres occurs every two years. Prescribed burning is carried out on stands where pitch pine is the dominant species and where existing hardwoods are of no value. The purposes of the burning are as follows:

(1) Reduction of fire hazard by reducing the amount of flash fuels.

(2) Improvement of seedbed conditions for pine.

(3) Improvement of species composition by eliminating weed hardwoods in pine stands.

(4) Improvement of wildlife habitat.

Burning is carried out by the Station Fire Department, under the supervision of the Station Fire Chief. Areas which are burned for forest and wildlife

habitat improvement are selected by the Station Forester and must be approved by the Fire Chief and areas to be burned for fire hazard reduction are based on mutual agreement of both the Fire Chief and the Station Forester.

5.4.1.3 Insect and Disease Management

The great diversity and number of hardwood species provide natural deterrents to build-up of insect populations and disease infections, with the exception of one insect, the gypsy moth, Lymantria dispar, which has become a major problem.

5.4.1.3.1 Gypsy Moth Control Program at NWS Earle

Forest area in New Jersey, particularly in types where oak predominates, have suffered greatly due to defoliation by the gypsy moth. If uncontrolled, these defoliators build to extremely high populations, defoliating both hardwoods and conifers. The main objective of the Navy Gypsy Moth Control Program is to prevent the moth's spread into noninfested areas as required by USDA Quarantine Laws. Other objectives include the protection of forest stands and ornamental plantings within the administrative area. Both biological and chemical methods are utilized in the Control Program which is carried out in cooperation with the New Jersey Department of Agriculture (NJDA) and the US Department of Agriculture (USDA). A brief history of the gypsy moth supression program at NWS Earle is as follows:

(1) During the summer of 1964, the first egg masses were found in Monmouth County.

(2) In 1967, the Navy recognized the need for a control program, and made plans to aerial spray the Station in the spring of 1968.

(3) In 1968, the USDA, Agricultural Research Service, Plant Protection Division and the Navy cooperated in spraying 5,700 acres of infested land with Carbaryl (Sevin). At the time

Sevin had the lowest toxicity of any applicable material and also decomposed readily with no residual effects. Results were excellent. The New Jersey Department of Environmental Protection (NJDEP) provided the Navy with thousands of parasites in an attempt to prevent reinfestation of the Station.

(4) No buildup of the gypsy moth was experienced on the Station during 1969.

(5) In 1970, the Agricultural Research Service and the Navy again cooperated to spray 1,500 acres of infested land. Gardona, a chemical not toxic to bees, was used on an experimental basis. Results did not achieve expectations. The Station also experienced heavy population growth during 1970, resulting in gypsy moth infestations of varous degrees over much of the forest area.

(6) In 1971, the Agricultural Research Service and the Navy cooperated to spray 9,000 acres. The insecticide used was Sevin 80S, which gave excellent results.

(7) During 1972, control measures were carried out using a truck mounted mist blower in critical areas. An additional 350 acres were sprayed in cooperation with the New Jersey Department of Agriculture as part of an experimental procedure to test the effectivness of Bacillus thuringiensis in controlling gypsy moths. Results were only fair and reinfestation of most areas occurred through population buildup and invasion from outside areas.

(8) In agreement with the US Department of Agriculture, a biochemical approach was adopted for 1973. Under this approach, spraying was limited to selected areas so that gypsy moth parasites would have a greater opportunity to build up in areas where high moth populations would not be in danger of spreading. Other selected crucial areas were sprayed using

Sevin-4 in oil. Results on the 1,700 acres sprayed were excellent. In spite of a high degree of collapse in many areas, the level of gypsy moth infestation remained high due to population buildup in lightly infested areas and reinvasion from outside sources.

(9) In 1974, approximately 1,300 acres were aerial sprayed in cooperation with the United States Department of Agriculture, Animal Plant Health Service (USDA, APHS), using the insecticide Sevin-4 in oil. Results were excellent and this formulation of Sevin proved to be the most effective for gypsy moth control. Biological controls combined with the chemical control program resulting in the lowest level of defoliation sine 1969.

(10) During the spring of 1975, the aerial spraying of 420 acres was carried out in cooperation with the NJDA. Ground spraying with a truck mounted mist blower was carried out by the Station pest control section and by USDA, APHIS. Biological controls were not as effective during 1975, resulting in the defoliation of approximately 1,600 acres. Severe damage in many oak stands occurred, since trees had already been weakened by past defoliations. More important, the danger of transporting this pest to areas outside the quarantine region had also increased.

(11) During the spring of 1976, 4,700 acres of aerial spraying was done to prevent widespread defoliation and abide by Federal quarantine regulations. The insecticide used was Sevin-4 in oil and spraying was done in cooperation with the Animal Plant Health Service of the USDA. Spraying with a truck mounted mist blower was also done by both the Station Pest Control Section and by USDA, APHIS. Results within spray areas were excellent.

(12) In 1977, a total of 2,200 acres were aerial sprayed using Sevin-4 in oil, including 600 acres which had where high gypsy moth parasite population in previous years and had been left untreated.

(13) As a result of the effectiveness of the insecticide and the buildup of parasites, no aerial spraying was required during the spring of 1978 or the spring of 1979. Some truck mounted mist blower spraying was done around shipping areas for regulatory requirements.

(14) By 1980, the population of gypsy moths had again built up to the point where aerial spraying was necessary. An emergency action order was issued by the USDA requiring that all infested areas on NWS Earle be sprayed. Under a cooperative spray program paid for by the USDA, 8,000 acres were sprayed. Results were good. No defoliation was experienced in 1980, however a low level population was present in all areas during the spring of 1981 and approximately 400 acres were defoliated in a heavily infested area at the northeast perimeter of the Main Base.

(15) By the summer of 1981, the gypsy moth had again built up to the point where there were enough egg masses to provide for a spring of 1982 population that would completely defoliate all oak forest types on the Station with varying degrees of defoliation in other forest types. As a result of the experience with this insect over the past years, it is now evident that the gypsy moth problem is going to continue on a regular basis until silvicultural control techniques change the forest types at NWS Earle to a species composition that will resist epidemic build-up of the gypsy moth. Although the insecticides being used are very effective, the results are short lived due to the characteristics of the gypsy moth's spread by wind during its early instars and its extremely high build-up potential (500X). Biological agents help, but do not prevent the epidemic build-ups which have occurred.

5.4.1.3.2 Additional Insect Management

Another insect, the fall cankerworn, Alsophila pometaria, has built up to extremely high populations every five or six years, however it is brought under control by natural causes in a very short time. By itself, this insect is a minor problem, but combined with the gypsy moth it has contributed to destruction of oak stands. The reason for this is due to the early defoliation damage caused by the cankerworm, which is then followed by the gypsy moth just as the second set of leaves appear. The two defoliations during the same growing season are extremely damaging. Early timing for gypsy moth spraying, when cankerworm is present, has controlled this insect.

Other defoliating insects which sometimes build up to sigificant numbers, but still have caused only minor damage because of collapse from natural causes include: the red headed pine sawfly, Neodiprion leconte, the larch sawfly, Pristiphora erichsenii; sawflies of the genus Periclista; oak leaf rollers; Eastern tent caterpiller, Malacosoma americanum; the locust leafminer, Odontota dorsalis; and bagworm, Thyridopteryx ephemeraeformis. Insects damaging stems and buds include the European pine shoot moth, Rhyaciania buoliana, and Nantucket pine tip moth, Rhyocionia frustrana. These two insects have been extremely damaging to Austrian pine. Because there are only a few stands of Austrian pine , problems with these insects are not serious. White pine weevil, Pissodes strodbi, has caused some damage to terminal growth in sapling white pine plantations, but has been sucessfully controlled with insecticides.

5.4.1.3.3 Disease

There are no major disease problems with hardwood trees. One minor twig disease which becomes noticeable but does little damage is Dothiorella guercina which attacks chestnut oak.

A major disease, Pine tip blight, caused by the fungus Diplodia pinea, has caused much damage to pitch pine at the Main Base. Although pitch pine is not a valuable species, it is a major component of many of the

forested areas on the Main Base. There is no effective means to control this disease, but it is hoped that changes from the climatic extremes which have been experienced in recent years will bring the problem under control. Because of the extreme susceptiblity of Austrian pine to Diplodia, the planting of this species is no longer advisable.

5.4.2 Terrestrial Fauna

5.4.2.1 Mammals

The white tailed deer is the most conspicuous mammal of the Pine Barrens and the NWS Earle. These herbivores consume great quantities of plant material. They have no natural predators but hunters harvest significant numbers. Deer favor the forest edges and prefer thickets alternating with open areas. These vegetation types are common at NWS Earle.

Additional animals observed at NWS Earle are:

Very Abundant	Abundant	Common
White Tail Deer	Gray Fox	Ruffed Grouse
Cottontail Rabbit	Ringneck Pheasant	Red Fox
Bobwhite Quail	Raccoon	Opossum
	Gray Squirrel	Geese
		Ducks (many species).
		Red Squirrel

Historically, both the bobcat and the black bear occured in the region but both are now extirpated. The eastern coyote is increasing its range and may soon become abundant in the Pine Barrens to the south.

The tunnels and runs of moles, pine mice, and white-footed mice form intricate, criss-crossing patterns in most upland areas. The trails of various small rodents often are conspicuous in marshes, but the animals are rarely observed.

Animals observed during a survey near three of the numbered disposal areas are listed in Table 5-14. Wildlife common in the area and potentially occurring at Earle are presented in Appendix B.

5.4.2.2 Birds

The alternation of forest and cleared magazine areas on the Main Station, which favors a variety of insect species, also supports a diverse community of songbirds. Numerous hawks and owls prey on the abundant small birds and burrowing mammals. In addition to this, the Waterfront Area and adjacent marshes support an entirely different community of shore birds. The importance of this group of animals is apparent from Appendix B.

5.4.2.3 Amphibians and Reptiles

Some species, such as the box turtle, subsist primarily on plant foods. Reptiles and amphibians are most abundant in the lowland areas and it is there that they become important components of the ecosystem. The snakes and turtles of the uplands seldom are numerous enough to be considered of very great significance in the ecosystem.

5.4.2.4 Wildlife Management

Deer browse damage is severe in young tree plantation areas, despite culling of the herd through authorized hunting. Before 1966 hunting was not allowed because of risks to base security, safety and fire protection. Since 1966, fishing and hunting have been permitted for assigned station personnel and employees. An average of 4,000 hours per year is spent by about 200 hunters in the field after deer and small game. The average annual kill by species is:

46 deer	5 fox
72 rabbits	3 pheasants
52 squirrels	2 woodcock
34 quail	1 grouse
10 waterfowl	

TABLE 5-14

Animals Surveyed Near Three Identified Waste Disposal Sites

Scientific Name	Common Name	Near Site No.1	Near Site No.5	Near Site No.3
	AMPHIBIANS			
Bufo woodhouse fowleri	Fowler's Toad		X	
Rana catesbeiana	Bullfrog		X	
Rana claitans melanto	Greenfrog	X		
	REPTILES			
Chlycra s. serpentina	Common Snapping Turtle	X	X	
Clemmys guttata carolina	Spotted Turtle	X		
Terrapene carolina	Eastern Box Turtle			X
Coluber constrictor constrictor	Northern Black Racer			X
	BIRDS			
Coragyps artratus	Black Vulture	X		
Colinus virginanus	Bobwhite	X		
Colaptes auratus	Yellow-shafted Flicker		X	
Tyrannu tyrannus	Eastern Kingbird	X		
Cyanocitta cristata	Blue Jay	X	X	
Corvus brachyrhynchos	Common Crow	X	X	
Mimus polyglottos	Mockingbird	X		X
Dumetella carolinensis	Catbird		X	
Sturnus vulgaris	Starling	X		
Sturnella magna	Eastern Meadowlark	X		
Quiscalus quiscula	Common Grackle		X	
Molothrus ater	Brown Headed Cowbid		X	
Pipilo erythrophthalmus	Rufous-sided Towhee	X		

TABLE 5-14 (Continued)

Animals Surveyed Near Three Identified Waste Disposal Sites

Scientific Name	Common Name	Near Site No. 1	Near Site No. 5	Near Site No. 3
	MAMMALS			
Marmoto monax	Woodchuck		X	
Tamias striatus	Eastern Chipmunk		X	X
Peromyscus leucopus	White-footed Mouse		X	
Ondatra zibetha	Muskrat	X		
Sylvilagus floridanus	Eastern Cottontail	X	X	X
Odocoileus virginianus	White-tailed Deer	X	X	X

Harvest of all species generally has been much less than population and reproductive rates can support. Consequently, the depot serves as a wildlife producing area for natural restocking of surrounding lands. A serious wild dog problem, affecting both wildlife and man, arises on the station occasionally. This results from abandonment of pets by surrounding private owners.

5.4.3 Marine Wetlands

There are many areas of salt marshes in Monmouth County, including significant areas not included in the New Jersey 1970 Wetlands Act. These areas include marshes along Raritan and Sandy Hook Bays, Middletown; Silver; McClee's Creek in Middletown; marshes in the upper Shark River; and marshes east of the Garden State Parkway on the Manasquan River. In all, some 2000 acres of salt marsh remain in Monmouth County.

On the Raritan Bay, salt marshes occur along the Waterfront property and receive drainage from the Chapel Hill area. Some drainage from Chapel Hill flows into Comptons Creek, which has been designated a Wildlife Habitat, Tidal Marsh and Coastal floodplain in the Monmouth County Unique Areas Study. The Ware Creek marsh, adjacent to the Waterfront property is bordered on its other side by a sanitary landfill and airstrip (Figure 5-13). A 1979 field survey of four transects through this marsh and the adjacent field is included in Figure 5-14. Biomass productivity measured in that study of the Ware Creek marsh compares well to other marshes in the area, as summarized in Table 5-15. As can be seen from Figure 5-14, the Ware Creek marsh shows the typical saltmarsh pattern of single species vegetation bands: smooth cord grass is found closest to the water's edge in those areas regularly flooded by the tides; shoreward of this zone is an area of salt meadow, supporting salt grass and salt bog; landward of this zone, high tide bush and sea-myrtle are found; common reed is locally abundant along the upper marsh edge, especially where there has been soil disturbance. A list of animals common to the Waterfront marsh area is presented in Table 5-16.

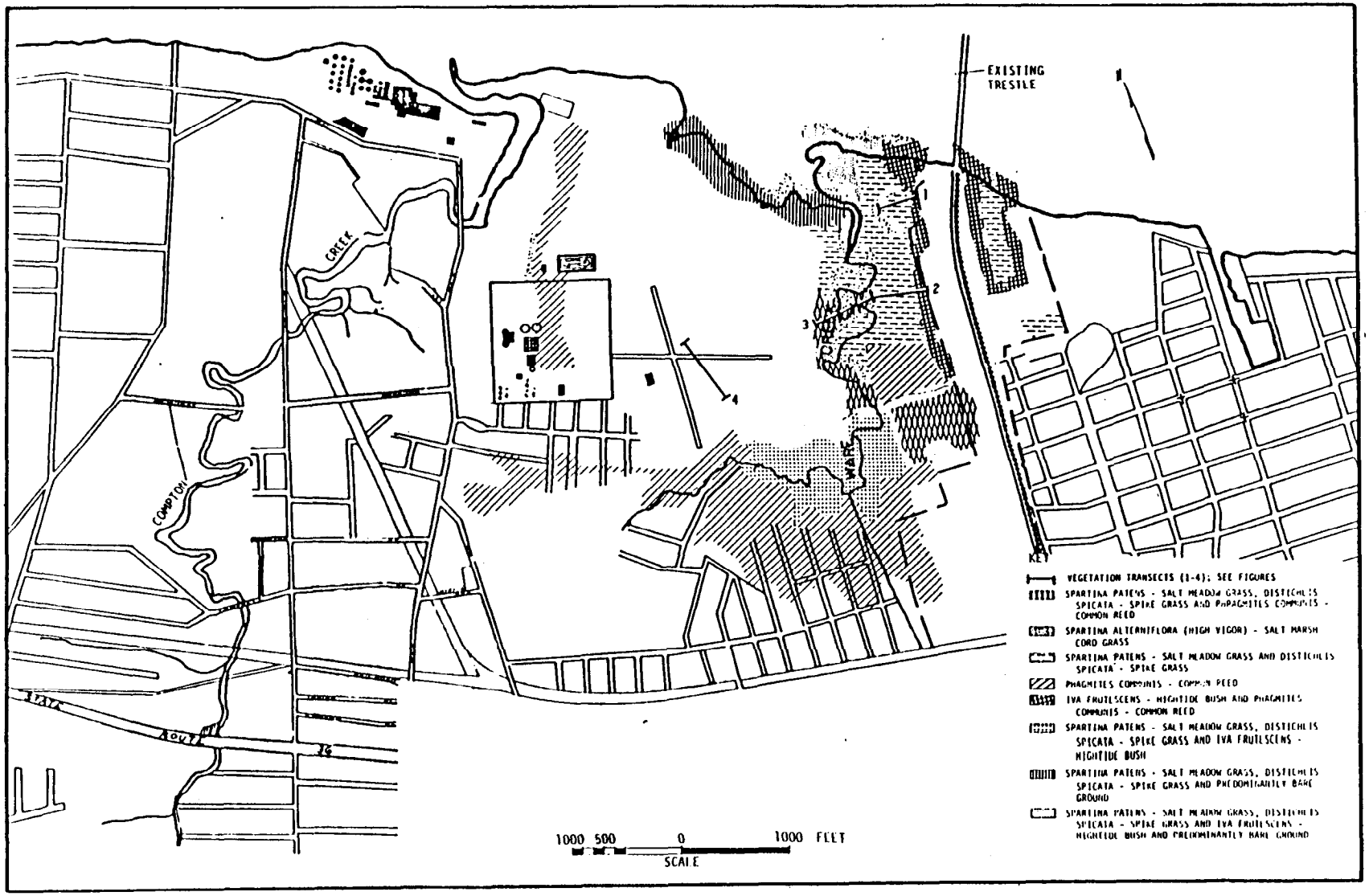
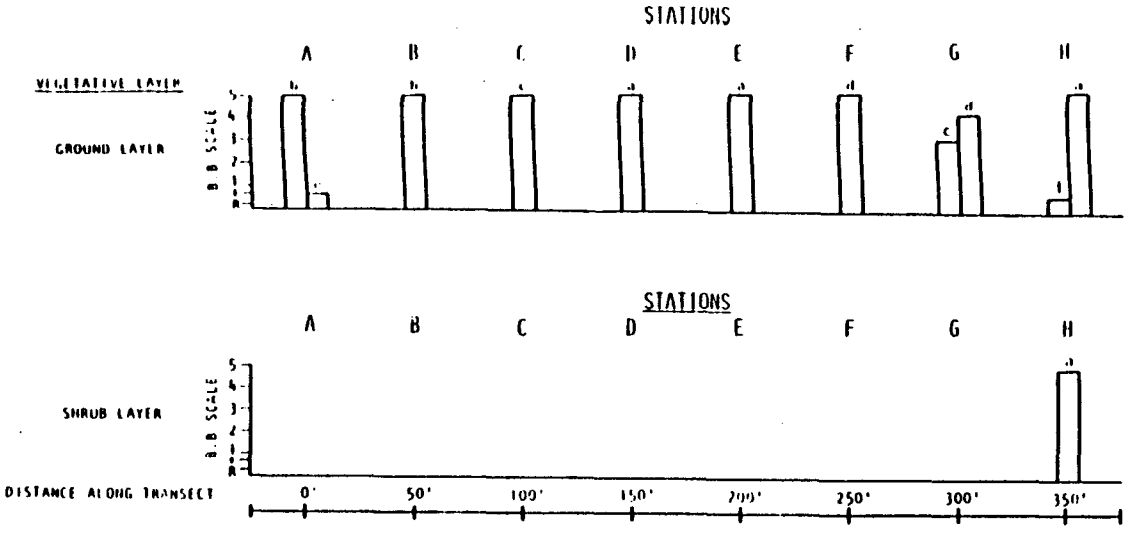


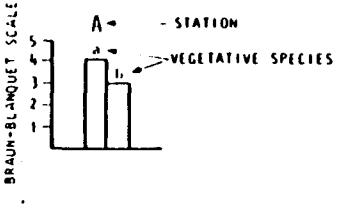
FIGURE 5-13. WETLANDS VEGETATION MAP: WATERFRONT AND ADJACENT AREAS

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY



VEGETATION TRANSECT NO. 1 - SALT MARSH

EXPLANATION



BRAUN-BLANQUET SCALE KEY:

5 = COVERAGE >75%

4 = COVERAGE 50-75%

3 = COVERAGE 25-50%

2 = COVERAGE 5-25%

1 = NUMEROUS, BUT LESS THAN 5% COVERAGE, OR SCATTERED AND UP TO 5% COVERAGE

+ = A FEW WITH SMALL COVERAGE

R = RARE OR SOLITARY WITH SMALL COVERAGE

SPECIES KEY.

GROUND LAYER

a) SALT GRASS

b) COMMON REED

c) SALT WATER CORD GRASS

d) SALT HAY

e) ORACH

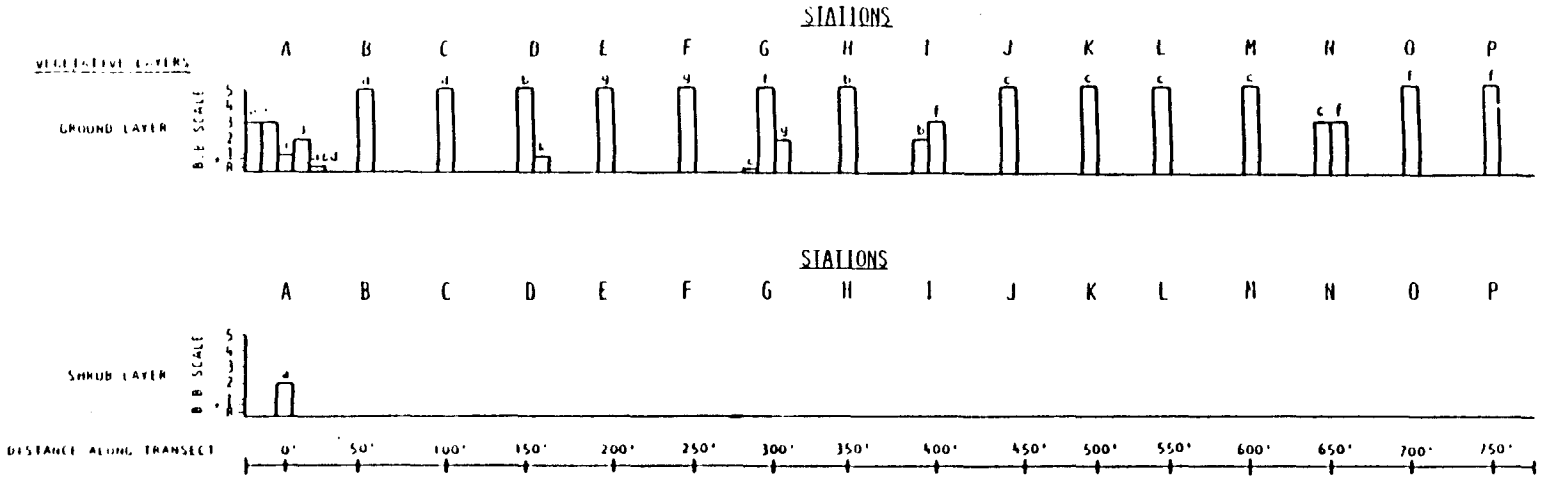
f) MARSH ELDER

SHRUB LAYER

a) MARSH ELDER

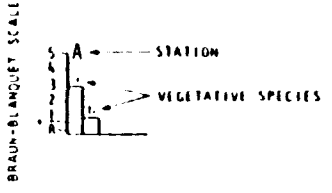
FIGURE 5-14.(a) VEGETATION TRANSECT NO. 1
(See Figure 5-13 for location)

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY



VEGETATION TRANSECT NO. 2 - SALT MARSH

EXPLANATION



BRAUN-BLANQUET SCALE KEY:

5 = COVERAGE >75%

4 = COVERAGE 50-75%

3 = COVERAGE 25-50%

2 = COVERAGE 5-25%

1 = NUMEROUS, BUT LESS THAN 5% COVERAGE, OR SCATTERED AND UP TO 5% COVERAGE

\+ = A FEW WITH SMALL COVERAGE

R = RARE OR SOLITARY WITH SMALL COVERAGE

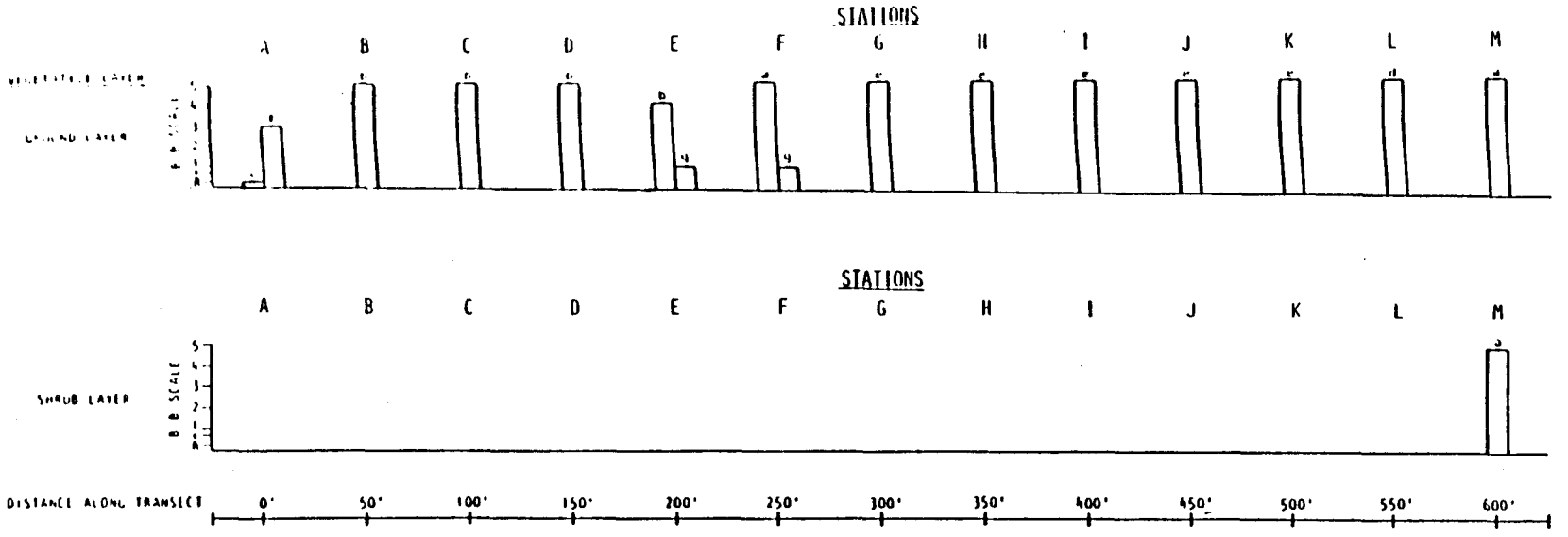
SPECIES KEY:

GROUND LAYER
a) CLIMBING FALSE BUCKWHEAT
b) SALT GRASS
c) SALT GRASS - SALT HAY
d) COMMON REED
e) WINGED RIB - SUMAC
f) SALT WATER CORD GRASS
g) SALT HAY
h) ORACH
i) BLACKBERRY
j) GOLDENROD
k) MARSH ELDER

SHRUB LAYER
a) BLACK LOCUST

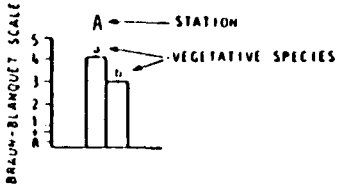
FIGURE 5-14.(b) VEGETATION TRANSECT NO. 2
(See Figure 5-13 for location)

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY



VEGETATION TRANSECT NO. 3 - SALT MARSH

EXPLANATION



BRAUN-BLANQUET SCALE KEY:

5 = COVERAGE >75%

4 = COVERAGE 50-75%

3 = COVERAGE 25-50%

2 = COVERAGE 5-25%

1 = NUMEROUS, BUT LESS THAN 5% COVERAGE, OR SCATTERED AND UP TO 5% COVERAGE

+ = A FEW WITH SMALL COVERAGE

R = RARE OR SOLITARY WITH SMALL COVERAGE

SPECIES KEY:

GROUND LAYER

a) SALT GRASS

b) COMMON REED

c) WINGED RIB- SUMAC

d) SALT WATER CORD GRASS

e) SALT HAY

f) BLUE STEM

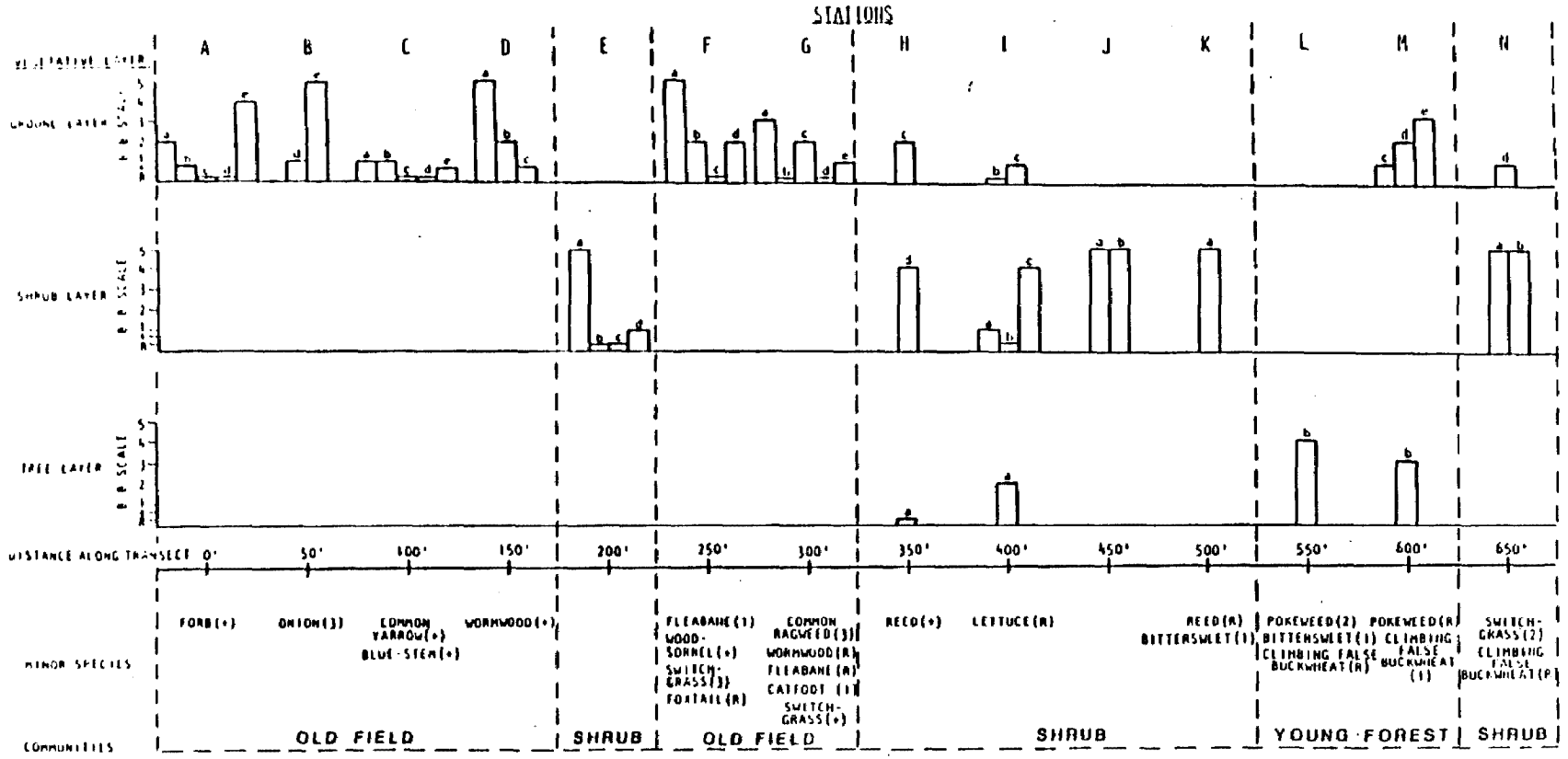
g) MARSH ELDER

SHRUB LAYER

a) MARSH ELDER

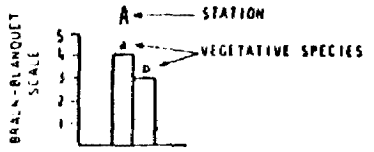
FIGURE 5-14.(c) VEGETATION TRANSECT NO. 3
(See Figure 5-13 for location)

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY



VEGETATION TRANSECT NO. 4 - OLD FIELD

EXPLANATION:



BRAUN-BLANQUET SCALE KEY:

5 = COVERAGE >75%
4 = COVERAGE 50-75%
3 = COVERAGE 25-50%
2 = COVERAGE 5-25%
1 = NUMEROUS, BUT LESS THAN 5% COVERAGE, OR SCATTERED AND UP TO 5% COVERAGE
+ = A FEW WITH SMALL COVERAGE
R = RARE OR SOLITARY WITH SMALL COVERAGE

SPECIES KEY:

GROUND LAYER
a) ASTER
b) FORB
c) GRASS
d) GRASS-LEAVED GOLDENROD
e) SWEET GOLDENROD

SHRUB LAYER
a) JAPANESE HONEYSUCKLE
b) RASPBERRY
c) WINGED SUMAC
d) STAGHORN SUMAC

TREE LAYER
a) COTTONWOOD
b) BLACK LOCUST

FIGURE 5-14.(d) VEGETATION TRANSECT NO. 4
(See Figure 5-13 for location)

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

TABLE 5-15

Marsh Biomass Estimates for Ware Creek Marsh Compared to Other Marshes

Species	Ware Creek Marsh[1] Middletown, N.J.	Conaskonk[2] Point, N.J.	Hempstead[3] Long Island, N.Y.	Raritan River[4] (near Crab Island), N.J.
Smooth cord grass (*Sparitan alterniflora*)	912	932	891 (ditched marshes) 1,495 (unditched marshes)	1,128
Salt Meadow *Distichtis spicata* *Spartina patens*	595	514	633	NA
Common reed	1,422	NA	NA	NA

Note: Biomass is given in grams per square meter; all biomass are mean values.

Sources:
[1]Dames & Moore, 1979.
[2]Environmental Concern, Inc., 1973
[3]Udell, et al., 1969
[4]Dames & Moore, 1977

TABLE 5-16

Potential Wildlife at the Waterfront Area

BIRDS

Green Heron[a]
Black-Crowned Night Heron[a]
Clapper Rail[a]
Long-billed Marsh Wren[a]
Redwinged Blackbird[a,b]
Marsh Hawk[a]
Fish Crow[a]
Catbird[a]
Brown Trasher[b]
Myrtle Warbler[b]
Savannah Sparrow[b]
White-Throated Sparrow[b]
Semipalmated Plover[a]
Killdeer[a]
Spotted Sandpiper[a]
Lesser Yellow Leg[a]
Gulls[a]
Mallard[a]
Canvasback[a]
Greater Scaup[a]
Bufflehead[a]
Great Heron[a]
Little Heron[a]
Blue Heron[a]

AQUATIC SPECIES

Ribbed Mussel[a]
Soft Clam[a]
Barnacle[a]
Common Mud Snail[a]
Fiddler Crab[a]
Square Back Crab[a]

TERRESTRIAL SPECIES

Reptiles & Amphibians

Northern Diamondback Terrapin[a]
American Toad[b]
Rat Snake[b]
Black Racer[b]

Mammals

Muskrat[a]
Raccoon[a,b]
Meadow Vole[a,b]
Meadow Jumping Mouse[a]
House Mouse[a,b]

TABLE 5-16 (Cont.)

Potential Wildlife at the Waterfront Area

Reptiles & Amphibians	Mammals
	Shorttail Shrew[a,b]
	Whitefooted Mouse[a,b]
	Norway Rat[b]
	Eastern Cottontail[b]
	Opossum[b]
	Skunk[b]

Notes: [a]Species normally associated with marsh or water-related habitats.
[b]Species normally associated with upland habitats.

Sources: Environmental Concern, Inc. 1975; Dames & Moore, 1976; N.J. Division of Fish, Games and Shellfisheries, 1973; Sandy Hook Marine Laboratory, 1971; Shure, 1970.

Other salt marshes in Monmouth County receive drainage from Normandy Road or the Main Base. McClee's Creek, passing under Normandy Road just south of Chapel Hill, supports a rich saltmarsh and fringe woodland where it enters the Navesink River. The two major drainage basins of the southern half of the Main Base feed the Shark River and Manasquan River, both of which have salt marshes mentioned as wildlife habitats in the Monmouth County Unique Areas Study.

5.4.4 Fresh Water Wetlands

The freshwater marsh, as the salt marsh, has great ecological value. Like the salt marsh, the fresh water marsh supports basic elements of the biological food chain which terminates in important predators such as fish, birds and mammals. The marshes also act as refuges for wintering and migratory populations of songbirds and waterfowl. However, unlike the saltmarsh, the fresh water marsh or pond can act a source of aquifer recharge. This happens most frequently when the marsh or pond is in hydrologic union with an aquifer and water can travel directly downward into the aquifer. Swamps and bogs may have a similar value in their ability to aid aquifer recharge and thus are extremely valuable resources not only for habitat and food supply but for protection against depletion of water supply.

Shadow Lake Marsh borders Normandy Road at the point where it crosses the Garden State Parkway. The marsh is a community of sedge, Phragmites and marsh grasses, with ferns, skunk cabbage, mosses, cattails, willow, water lilies and some Atlantic White Cedar also present. Maple, willow and beech border the marsh, which appears to be evolving towards a climax beech-maple community. Various species of frogs, toads, turtles, snakes, song birds, waterfowl and forest animals have been sighted.

The Main Base has areas of swampy, poorly drained soil in all its major drainage basins: the Hockhockson Brook and Pine Brook to the North, Mine Brook in the West, Manasquan River and Mingamahone Brook to the South, and Shark River to the East. None of these have been classified as Wetlands by the county, but their headwaters and floodplains are considered environmentally sensitive areas for purposes of land use planning. Undisturbed

vegetation in floodplains protects downstream water quality by filtering out sediment and some pollutants while stormwater is held in the spongy soil and plant network.

5.4.5 Aquatic Ecosystems

Phytoplankton and marine invertebrates potentially occurring in Sandy Hook Bay are presented in Appendix C. Freshwater ecosystems are discussed below.

5.4.5.1 Algae

The combination of high acidity and low nutrient levels in most Main Station waters favors diatoms and desmids and restricts blue-green algae. Desmids are particularly abundant in streams, where representatives from all genera can usually be found, and least abundant in lakes and ponds. In white cedar swamps and bogs, they are the dominant group. Bluegreen algae are more common in swamps and bogs than in streams. A list of Pine Barrens algae is included in Appendix D.

5.4.5.2 Macrophytes

Typical stream species of aquatic macrophytes include bur-reed (Sparganium spp.), water celery (Vallisneria americana), rushes (Eleocharis spp. and Scirpus spp.), golden club (Orontium aquatica), and waterwort (Elating minima).

Common aquatic macrophytes in ponds include the stream species plus fragrant water-lily (Nymphaea ordorata), spikerush (Eleocharisi robbinsii), swaying bulrush (Scirpus subterminalis), and floating heart (Nymphoides cordata).

Typical aquatic macrophytes found in open bogs incude pipeworts (Eriocauion spp.), water willow (Decodon verticulatus), water-milfoil (Myrcophyllum spp.), mermaidweed (Prosperpenoca spp.) and bladderworts (Utricularia spp.).

5.4.5.3 Macroinvertebrates

The macroinvertebrate communities in uncontaminated Pine Barrens streams are typically small but often diverse. Aquatic insects are usually dominant. In addition, aquatic earthworms, leeches, crustaceans, and molluscs may be present.

5.4.5.4 Fish

Pickerel Pond, West Pond and Lake Earle were dredged and sucessfully stocked with pickerel, but Channel Catfish introduced to Lake Earle died. With the exception of Gull Pond and the Intransit Pond, the ponds support rich eutrophic communities. The Intransit Pond dries up every few years, and Gull Pond receives no organic surface drainage, so aquatic life does not have an opportunity to take hold in these two ponds.

Marine fish and their probable abundance are given in Appendix E.

5.4.6 Endangered and Threatened Species

The State of New Jersey (New Jersey State Register, April 10, 1975) and the Federal Government (Federal Register, June 16, 1976; Federal Register, October 27, 1976) have identified several plant and animal species within New Jersey as being endangered or threatened. Table 5-17 summarizes endangered and threatened species that may be present at Earle and conditions for their occurrence. (Appendix F gives the complete New Jersey list.) Only species designated as endangered receive complete protection under state or federal law. Although there are no existing records of these plants or animals at NWS Earle, the potential for their occurrence does exist.

Concern over potential occurrence of endangered species primarily involves two species on the New Jersey list: small whorled pogonia and bog turtle. The pogonia has previously been found in Monmouth County (Fairbrothers, 1978) and its required habitat of acid soil on dry uplands is common on the Main Base.

Table 5-17

Endangered and Threatened Species of Potential Occurrence at NWS Earle

Endangered Species	Comments
Plants (Rare and Endangered)	
Knieskern's Beak-Rush[b]	Bogs containing iron
Small Whorled Pogonia[b]	Acid soil of dry woodlands
Hirst's Panic Grass[b]	Swamps
Amphibians	
Eastern Tiger Salamander[a]	Unstocked farm ponds
Reptiles	
Bog Turtle[a]	Sphagnum bogs, swamps, clear meadow streams - mud bottoms
Birds	
Bald Eagle[c]	Transient
Cooper's Hawk[a]	Breeds in alluvial woodlands
Osprey[a]	Nests in Sandy Hook - may feed in area
Peregrine Falcon[a,b]	Transient
Threatened Species	
Reptiles	
Eastern Earth Snake[a]	Abandoned fields, back roads near deciduous forest
Timber Rattlesnake[a]	Second growth hardwoods best
Birds	
Barred Owl[a]	Breeds lowlands - winters in conifers
Black Rail[a]	Rare coastal visitant - no breeding records in area
Bobolink[a]	Common fall migrant (abundant along coast) local breeder (grassy fields, ditched salt marsh)
Grasshopper Sparrow[a]	Rare migrant (outer coast) - local breeder (dry fields), no report
Henslow Sparrow[a]	Very local breeder - dry fields and damp meadows - no report

Table 5-17 (Continued)

Threatened Species	Comments
Birds (Continued)	
Ipswich Sparrow[a,b]	Rare migrant - no breeding reported in area
King Rail[a]	Seen in salt marshes in winter
Least Bittern[a]	Possible in marsh, but unlikely - prefers cattails
Marsh Hawk[a]	Breed in marshes but rare - fairly common fall migrant and winter visitant
Merlin[a]	Common migrant along coast
Piping Plover[a]	Migrant - unlikely breeder
Red-Headed Woodpecker[a]	Rare migrant - no breeding reported in area
Red-Shouldered Hawk[a]	Breeds in lowlands - rare on coastal plain
Roseate Tern[a]	Uncommon - rare migrant
Sharp-Shinned Hawk[a]	Breeds in conifers but rare - common migrant
Short-Billed Marsh Wren[a]	Very local breeder - S. alterniflora but no report
Short-Eared Owl[a]	Winter resident - very likely in marsh
Upland Sandpiper[a]	Uncommon - rare migrant
Vesper Sparrow[a]	Uncommon to common migrant - unlikely breeder - need agricultural area
Yellow-Crowned Night Heron[a]	Possibly breeds in Monmouth County
Mammals	
Keen's Myotis[a]	Caves, buildings, hollow trees, storm sewers
Small-footed Myotis[a]	Caves, crevices in rocks, buildings, forested areas
Southern Bog Lemming[a]	Low damp bogs and meadows

Sources: [a] N.J. State Register, April 10, 1976.
[b] Federal Register, June 16, 1976.
[c] Federal Register, October 27, 1976

The bog turtle is known to occur four miles south of the main base at Allaire State Park (Firer, 1978). This park is on the Mingamahone Brook, which is the major drainage basin for the Main Station. Much of the stream provides the bog turtle's preferred habitat -- a sedge and grass stream bank, and a soft muddy bottom. An exhaustive survey of the stream (June 6 and 7, 1978; Dames & Moore, 1979) for reptiles and amphibians revealed only common species, including the common snapping turtle, spotted turtle and green frog, but the endangered bog turtle's presence at NWS Earle cannot be ruled out.

The Federal Register lists the bald eagle and peregrine falcon as endangered species. These two bird species may pass through the NWS Earle. The bald eagle is usually found near open water. A small population is known to winter throughout New Jersey. The peregrine falcon is not known to have successfully reproduced in New Jersey since the 1950s. The falcon's presence is still possible in the Earle NWS regions during its migration along the coastline.

The New Jersey list contains species such as the porcupine which may be common elsewhere, though rare in New Jersey. Of New Jersey's endangered birds, an osprey was seen for three weeks visiting West Pond; it may live in the Chapel Hill area. Several species of endangered marine reptile have been caught off the Piers, but Sandy Hook Bay is not considered their critical habitat. Many of New Jersey's threatened or declining species have been seen at Earle--of note, a pair of great blue heron nest by West Pond.

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SECTION 6
ACTIVITY FINDINGS

6.1 GENERAL

This section provides a description of the activities at NWS Earle including ordnance and nonordnance operations, radiological operations, materials storage and waste disposal sites. Information provided in this section provides the background and documentation for Sections 2, 3 and 4 of this report.

Historical operations are documented as completely as possible based on: (1) a detailed records review; (2) interviews with current and retired station personnel; and (3) field visits to operations and disposal sites. Where gaps remained in the information obtained, best engineering judgment was applied to develop waste generation rates and total quantities disposed.

6.2 OPERATIONS, ORDNANCE

6.2.1 Ordnance Department (Code 20)

The functions of the Ordnance Department which are relevant to the initial assessment study are: (1) the preservation and maintenance of ammunition, missile components, explosives and technical ordnance items; (2) the disposal of unserviceable and/or dangerous ammunition and explosives; and (3) providing support to the Fleet Mine Facility.

The Operations Division (Code 210) provides production, handling, and disposal of ammunition, ammunition components, explosives, advanced weapons and technical ordnance through various branches. The ASW/Special Weapons Division (Code 230) directs assigned tasks of station-level maintenance of anti-submarine weapons such as torpedos, missiles, depth charges and bombs.

Unless specified otherwise, all ordnance operation map coordinates refer to the Universal Transverse Mercator grid system shown in Figure 6-1.

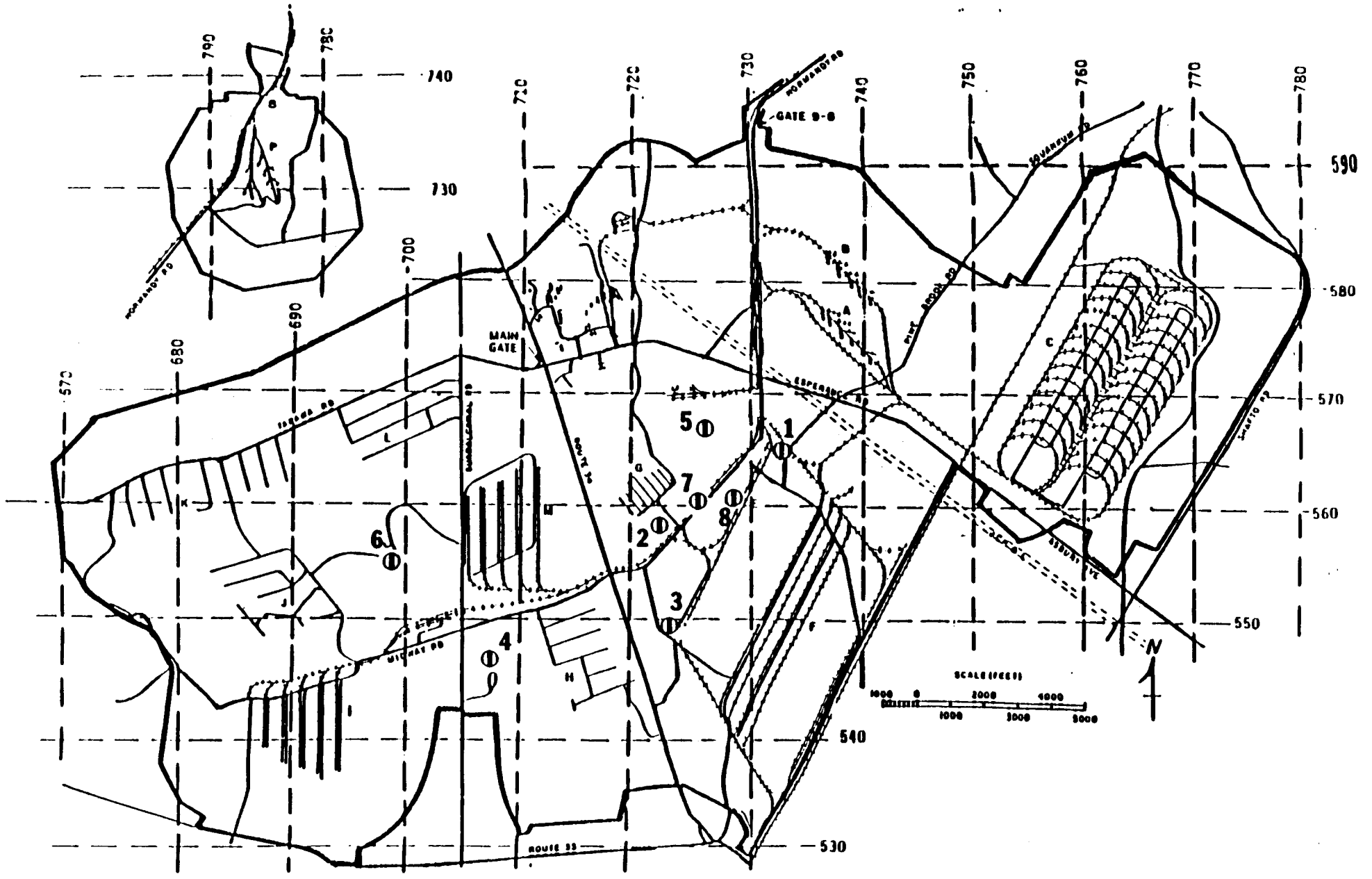

Figure 6-1. Location of Ordnance Operations at NWS Earle.

FCIIA

INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Key to Figure 6-1

Item	Description
1	Demilitarization Furnace
2	Explosive D Washout Area
3	Projectile Maintenance
4	Depth Charge Maintenance
5	Ammunition Rework Facility
6	Torpedo Refurbishing
7	Fleet Mobile Mine Facility
8	Mine Reconditioning Operations

6.2.1.1 Demilitarization

The current demilitarization (demil) facility was built during the mid-1970s and put into operation in 1978. The purpose of this facility was to eliminate the need for explosives storage on-site and disposal of explosives at sea. A further benefit derived was the recovery of useful metal from ammunition components. The ammunition processed ranges from small caliber (.22) to 20 mm size munitions.

The demil furnace is modelled after the U.S. Army's APE 1236 furnace, with modifications to meet Navy requirements. Ammunition is transferred by conveyor from the preparation room into a rotating incinerator. The incinerator can be fueled with either bottled gas or diesel fuel from an underground 5,000 gallon diesel oil tank. The incinerator chamber is divided into a series of four burning zones, with zone-to-zone heating increments of 400° F. Thus, a maximum temperature of 1600° F may be attained depending on the items being demilled. Small caliber ammunition and other explosive items explode within the furnace's steel chamber and burn off propellants and explosives, leaving only the metal components. The gases and particles leaving the furnace pass through a cyclone separator and a baghouse for particulate removal. The gases, augmented by blower action, exhaust through a 20" diameter stack, 34 feet in height.

The demil furnace and its feed room, Buildings S-589 and S-464, respectively, are located at map coordinates 733-565, approximately 1,500 feet south of the intersection of Normandy and Esperance Roads. Prior to its use as the demil furnace feed room, Building S-464 was used as a storage and preparation room for ammunition to be disposed of at sea.

The operation has produced 100 55-gallon drums of cyclone/baghouse residue over the past four years. This residue consists of the oxides of metallic elements such as zinc, magnesium, cadmium, copper, iron, lead, calcium, potassium, aluminum, barium, chromium, strontium, and antimony, as shown in the sample analyses performed over eight days in April and May, 1980 by personnel from the Naval Air Pollution Engineering Center, Crane, Indiana (shown in Table 6-1). The residue originates with various sizes

TABLE 6-1

CYCLONE AND BAGHOUSE DUST ANALYSIS

	29 APRIL 1980		1 MAY 1980		2 MAY 1980		3 MAY 1980	
	BAGHOUSE	CYCLONE	BAGHOUSE	CYCLONE	BAGHOUSE	CYCLONE	BAGHOUSE	CYCLONE
	7.2	6.5	7.1	6.6	8.1	10.3	7.6	7.3
sture	3.69	0.91	3.96	0.29	2.08	0.15	0.76	1.45
ific Gravity	0.59	1.54	0.70	1.74	0.16	1.17	0.24	1.99
bustibles	52.22	0.1	49.22	0.1	45.62	12.00	23.64	0.1
c	20.86	27.73	27.80	28.32	6.75	12.88	14.85	31.65
nesium	6.10	0.59	3.00	0.49	0.23	0.20	2.36	0.19
mium	1.58	0.79	1.25	1.08	2.27	2.44	4.07	1.12
per	0.61	2.13	0.38	3.42	0.42	3.59	0.58	1.46
n	2.13	10.39	1.35	6.00	0.90	12.42	1.45	11.10
d	11.71	5.45	4.91	11.24	5.55	6.06	7.06	10.23
cium	0.04	0.01	0.03	0.01	0.01	0.01	0.02	0.01
assium	2.54	1.48	4.58	3.17	7.57	9.89	9.71	1.85
minum	1.77	11.37	1.14	3.46	0.69	6.42	1.10	6.31
ium	0.86	0.43	0.65	2.83	0.31	0.61	0.60	2.53
omium	3.66	0.12	0.03	0.27	0.05	0.25	0.06	0.68
ontium	1.27	0.36	1.09	0.45	0.25	0.18	0.58	2.01
imony	1.63	0.69	1.31	1.03	0.40	0.32	1.16	0.54

	5 MAY 1980		6 MAY 1980		7 MAY 1980		8 MAY 1980	
	BAGHOUSE	CYCLONE	BAGHOUSE	CYCLONE	BAGHOUSE	CYCLONE	BAGHOUSE	CYCLONE
	8.0	7.1	7.0	6.8	6.6	6.9	6.1	6.7
sure	0.32	0.27	0.85	0.06	1.60	0.18	1.89	0.92
ific Gravity	0.32	0.80	0.26	1.51	0.39	1.44	0.35	1.56
bustibles	10.20	30.14	18.23	0.1	15.61	0.1	16.08	0.1
c	45.71	13.50	34.13	18.40	28.63	4.71	16.76	23.10
nesium	0.16	0.06	0.52	0.08	1.33	0.21	0.44	0.16
mium	2.95	0.96	3.22	1.73	3.89	0.76	3.85	0.60
per	0.32	0.76	0.36	2.27	0.74	0.99	2.12	12.05
n	1.32	4.09	1.65	13.74	2.80	3.81	3.00	0.10
d	6.19	7.92	6.64	4.87	8.86	3.30	8.39	4.53
cium	0.01	0.23	0.01	0.01	0.01	0.01	0.01	0.01
assium	3.04	0.34	3.98	2.21	3.24	1.60	5.67	2.58
minum	1.04	9.30	1.55	11.89	2.32	7.20	2.21	9.50
ium	0.45	0.33	0.44	0.92	0.55	4.62	0.81	0.67
omium	0.07	0.09	0.07	0.22	0.07	0.27	0.07	0.20
ontium	0.11	0.05	0.27	0.06	2.86	1.03	0.53	0.17
imony	1.24	0.19	0.38	0.33	1.03	0.42	0.49	0.32

of small caliber ammunition, detonators, fuses, primers from 40 mm rounds and initiators from signal flares. After demilling, the metal components leaving the furnace are separated and collected into 55 gallon drums for eventual sale by the Defense Property Disposal Office.

The bearings supporting the rotating incinerator are periodically maintained with a high temperature synthetic lubricant (HTAG - 3048, supplied by DuBois Chemicals) which is delivered in 35 lb cans. The empty cans are disposed in a 10 cu. yd. dumpster, together with trash, glass, boxes and fiberglass insulation.

Evidence of metal deposits was found in a 50 sq. ft. area under the discharge chute from the conveyor belt transferring metal out of the incinerator. The gravel surrounding the concrete base below the incinerator also has evidence of grease and metal dust particulate deposits. This area is described in Section 6.6 as Site No. 18.

6.2.1.2 Salvage Yard

The salvage yard, located roughly 100 yards southeast of the demil operation, is used primarily for storage of items for eventual commercial sale by the Property Disposal Officer. These items consist mainly of demilled military munition components separated by metal category (steel, aluminum or brass). In addition, the salvage yard contains the following: (1) expended torpedo battery containers; (2) 200 empty drums (55 gallon size) of unknown original content, stored on their sides, with small quantities of residuals leaking to the ground; and (3) the 100 drums of demil residue described in Section 6.2.1.1. This area is described in Section 6.6 as Site No. 21.

6.2.1.3 Box Yard

The "Box Yard" area was used in the period 1953-1965 for the disposal of various unserviceable (destroyed) munitions and containers from spent munitions. These were buried in 120-foot diameter holes over a two-acre site. Items buried included crushed aluminum or steel containers for

3"50 and 5"38 containers for smokeless powder. Steel 40 mm cartridge cases visible on the ground surface during the site visit were almost completely rusted away.

The Box Yard is located just off Munda Road about 1,000 feet south of the demil facility. The site has intermittent vegetation and secondary tree growth. This site is described in Section 6.6 as Site No. 10.

6.2.1.4 Smokeless Powder Disposal Operations

Smokeless powder, mostly of single base or nitro-cellulose composition, was removed from various sizes of ammunition (5"25, 5"38, 3"50, etc.) in Building E-13. This was done using a machine which clamped the ammunition horizontally in a fixture, removed the end cap and allowed the powder to be dropped into a receptacle. Primers containing tetryl were also removed in this building, placed in ammunition boxes and shipped to a separate disposal facility. Tetryl (chemical formula $(NO_2)_3C_6H_2CH_3N_2NO_2$) is a rapidly reacting explosive used as a booster or base charge (an initiating compound). The time period for the operation was approximately 1950-1965. No other chemicals were used in Building E-13, and on-site interviews indicated that there were no known accidents. Building E-13 is located on Oran Road at map coordinates 725-550.

Some of the powder recovered in Building E-13 was sent to NWS Crane in Indiana, and some was sent to military sales. The remainder was sent to the powder burn area located by map coordinates 720-583, about 2,500 feet south of the NWS Earle Property Line and 3,500 feet east of Route 34. This powder burn area is described in Section 6.6 as Site No. 1. Building S-465 in this location was used as the block house for controlling the powder burn. Powder was customarily placed in shallow trenches (18 inches by 3 inches deep by 40 feet long) from containers having 60-70 pounds capacity, and accumulated to amounts approximating 2,000 pounds. Ignition was accomplished from the block house using an electric squib and a narrow train of powder 22 feet long up to the trench. Black powder igniters were also burned here. In addition to powder, 5" double-base (primarily nitrocellulose, nitroglycerine composition) rockets were statically fired from test stands.

Investigation of the area in the proximity of the blockhouse, approximately 25 feet from Building S-465, revealed various pellets of extruded gun propellant on the ground surface. There was also a container top for an initiating fuse, a 12 gauge shot gun shell casing, a well corroded steel primer tube, and electrical squib leads (probably from the 5" rockets previously mentioned).

It was determined from on-site interviews that the powder burn area (Site No. 1) was in operation up until 1975. Part of the powder burn area is currently being used by the Ft. Monmouth Electronics Command. A number of antennas have been installed by that activity for various experiments.

It was mentioned during interviews that during the period 1950 to 1965, when powder was burned, it was not uncommon for a trenchload of powder to be covered without burning when the work day was ended. The environmental reports obtained from NORTHDIV indicated that the site was demilitarized by burning with diesel fuel-soaked hay and cross-plowing.

6.2.1.5 Explosive D Washout and Disposal

For approximately one year in the late 1960's, Explosive D (ammonium picrate) was removed from 5" shells (each shell contained about 5 pounds of explosive) in Building GB-1 by washing out the explosive with hot water. While Explosive D dissolves readily at elevated temperatures, the material is only slightly soluble at room temperature (1 gram/100 ml at 20°C). The Explosive D crystals were precipitated out of the water in a settling tank located within the building operating bay. The crystals were periodically collected and packed in boxes for disposal or reuse off base. Explosive D-contaminated wastewater which overflowed from this settling tank was discharged through an open 18-inch tile pipe to a 50 square foot unlined settling basin 30 feet east of the building. There, cooling of the solution precipitated most of the explosive out of solution. These precipitated crystals were also collected, packed in boxes and shipped off base for reuse or disposal.

When operations were in progress, overflow from the retaining basin went to an unlined pit. The remaining Explosive D was covered with diesel oil and burned. On occasion, heavy rains which occurred before burning washed the explosive away from the pit and into Mingamahone Brook. On-site interviews indicated that explosives from as many as 40,000 rounds, the equivalent of 200,000 pounds of explosive, could have been discharged into the unlined pit and 20,000 pounds could have been washed away prior to the open burning procedures previously described. Although some of the material may have been washed away into the Mingamahone Brook, the relative insolubility of the material suggests that most of the material settled out in surface soils in the immediate vicinity of the pit.

From the late 1960's until the early 1970's, munitions maintenance operations at this location also included grit blasting with steel shot and paint spraying. Thinners and solvents were also dumped outside the paint spray operation, possibly explaining the 200 square feet of bare soil and sparse vegetation growth discovered outside the building.

Building GB-1 is located at map coordinates 723-558, on Midway Road 2,000 feet east of Route 34. The washout area is identified as Site No. 26 in Section 6.6.

6.2.1.6 Projectile Maintenance

From the early 1940's until the present, Building E-14, located on Oran Road at map coordinates 724-549, has housed operations in which paint is stripped from projectiles using steel shot blast. After stripping the projectiles have been repainted and stencilled manually. Water has not been used in the operation. Dust from the operation has been controlled and sent through a hopper to a collection drum. About ten 20-gallon drums thus collected have been sold for scrap each year.

The facility is served by a two cubic yard dumpster which is emptied, under normal operations, once every three months. Aside from trash and bottles, it is estimated that 400 pounds of oil-contaminated rags, between one and two gallons of zinc chromate paint, and less than one half gallon of toluene (both generated as residues in discarded cans) were col-

lected annually with shop trash from Building E-14 since the facility began operating. These materials are presently hauled off station by a private contractor. Prior to 1978 these materials were dumped at the landfills at Site No. 3 (1960 to 1968), Site No. 4 (1943 to 1960) and Site No. 5 (1968 to 1978).

The back of the building has an area of about 500 square feet covered with grit blast (paint and steel shot) to a depth of about 2 inches. This area is described in Section 6.6 as Site No. 27.

6.2.1.7 Depth Charge Maintenance

Depth charge maintenance was conducted in Building S-34 from the early 1940's until the early 1960's. On-site interviews indicated that, since the early 1940's, an estimated 1,000 depth charge per year (MK8, 14) were wire brushed, washed down, and repainted on an outdoor concrete platform. A slurry consisting of a five percent mixture of paint scrapings in wash water was discharged continuously at a 7000 gallon per day flow rate into an open drainage swale. The stripped depth charges were then repainted with a zinc chromate primer and a lead-base top coat.

This procedure continued until the late 1950's when a solvent paint stripping procedure was started. Using this procedure, the depth charges were dipped into a 55-gallon tank containing "keolite," a solvent for lead-based paints. The depth charges were then lifted out of the tank and washed down with water as before. This procedure continued for about four years (circa 1959 to 1963).

The resultant discharges (including paint sludges) were dumped outside the building. Runoff from the site would travel via Mingamahone Creek to the Manasquan River. Approximately 100 gallons per year of a solvent/sludge mixture was disposed of on the site during the four years that the keolite stripping system was operative. This paint stripping operation was terminated in the early 1960's (circa 1963) due to the concerns of Station personnel regarding the potential environmental impacts of keolite on Mingamahone Creek aquatic life. Barricades were constructed on this disposal site in the early 1970's.

Building S-34 (now condemned) was probably built when the station initially opened (circa 1943). It is located about 1,000 feet south of Farmingdale Road at map coordinates 708-543, and described in Section 6.6 as Site No. 19.

6.2.1.8 Ammunition Rework Facility

The Ammunition Rework Facility has reconditioned larger ammunition items and components such as torpedo bodies and general purpose (low drag aerial) bombs of 500 pounds, 1,000 pounds and 2,000 pounds since the early 1940's. This is now done using a Wheelabrator steel shot blasting machine in Building D-5 to remove paint. Currently, grit and paint are collected from this operation at the rate of approximately 30 gallons/week and assigned to a contractor for disposal. Prior to 1977, the residue was dumped at various sites around the base, mostly in the "Box Yard" landfill described under section 6.2.1.3 and in Section 6.6 as Site No. 10.

Waterfall paint booths are used to spray paint the cleaned munitions using primarily zinc chromate primer. Dubois chemical "wite-gard" is used to clean out the booths. This is a corrosive alkaline material which, from the early 1940's until the mid-1970's, was drained out the back of the building together with the water and paint discharge from the paint booths. Now the discharges are collected in a tank at the bottom of the spray booth, recycled until saturated and eventually disposed of under contract.

Additional wastes generated include trash, lumber, scrap steel, and empty 16 ounce spray cans containing residues of paint thinner (primarily toluene, xylene and methyl chloride). These are disposed in a 1 cubic yard dumpster. The total waste generation rate over the life of the facility has averaged roughly 2 cubic yards per week. It is estimated that less than one half gallon each of toluene, xylene and methylene chloride generated as paint thinner residues in discarded cans were collected annually with shop trash from Building D-5. These materials are presently hauled off the station by a private contractor. Prior to 1978 these materials were disposed of in the landfills at Site No. 3 (1960 to 1968), Site No. 4 (1943 to 1960) and Site No. 5 (1968 to 1978).

Contaminated soil is evident behind the building, with approximately 200 square feet of bare spots showing evidence of paint spillage and hardened paint sludge. This site is described in Section 6.6 as Site No. 23.

Building D-2, located nearby, was formerly used for hand painting operations for various ammunition components. It is now used to re-palletize inert material. The facility is currently being refurbished as a modern painting facility, and will feature ventilation of paint fumes through dry filters to a discharge stack.

Approximately 50 square feet of stressed vegetation and black discolored soils exist behind Building D-2, probably resulting from past paint operations. A one cubic yard dumpster is used for disposal of wastes. The disposal site is described in Section 6.6 as Site No. 22.

Building D-5 is located 600 feet east of Lake Earle and about 1,000 feet south of Esperance Road and Building D-2 is 500 feet south of D-5. The buildings are located at map coordinates 725-567.

6.2.1.9 Torpedo Refurbishing

Torpedo assemblies (such as the MK 46) have been transported from various depot storage areas for reconditioning in the Anti-Submarine Warfare (ASW) area, Building ASW-557 since the early 1940's. This building is located on Lunga Road at Throckmorton Hill, one-half mile west of Guadalcanal Road at map coordinates 698-555. The refurbishing procedures and waste generation practices, at ASW-557 have remained relatively constant over the years, although final disposal sites for certain materials have changed. These practices are discussed in the following paragraphs. OESO has monitored both air and wastewater discharge emissions from AW-557 for the last several years.

At ASW-557, torpedo engines containing some residual fuel (Otto II, a torpedo propellant) are flushed out, first with "Agitene" (a hydrocarbon solvent) and then with water. (Otto Fuel II is estimated to contain 75

percent propylene glycol dinitrate (PGDN), 24 percent dibutyl sebacate (DBS) and 1-2 percent 2-nitro diphenylamine (2NDPA).) The discharge is transferred into 55-gallon drums and disposed off site. Torpedoes are fueled with Otto II, with 5 gallons of fuel used for exercise torpedoes and 8 gallons used for fleet operations. Grit blasting and painting are done in Building D-5 (see paragraph 6.2.1.8). Some stenciling is also done in ASW-557.

Small quantities of Otto fuel II have occasionally been spilled during engine disassembly. Spills were cleaned up with alcohol and rags which were then disposed of as discussed below.

Rags, paper suits and booties contaminated with Otto fuel are placed in plastic bags and then in 55-gallon drums for disposal under contract. About 5 drums were collected per month. During past busy periods, this waste quantity increased to ten drums per month.

Stores of Otto-contaminated wastes collected over a 4-5 month period include the following:

- 10 (55-gallon) drums of contaminated Agitene.
- 25 (55-gallon) drums of contaminated solid wastes.
- 6 (55-gallon) drums of contaminated Otto fuel.

Since 1978 the Otto fuel wastes have been handled under a contract administered by the Naval Underwater Systems Center, Newport, Rhode Island. Prior to that time, the wastes were destroyed at the Naval Ordnance Station, Indian Head, Maryland.

A 4 cubic yard dumpster, collected twice a week, contains trash, paint spray cans from stenciling work, etc. It is estimated that between one and five gallons of paint residues in discarded 13-fluid ounce cans were collected annually with shop trash since the facility began operating. These materials are presently hauled off station by a private contractor. Prior to 1977, these wastes were disposed of on the landfills at Site No. 3 (1960 to 1968), Site No. 4 (1943 to 1960) and Site No. 5 (1968 to 1978).

With the installation of the fuel loading area air pollution control system (circa 1978), agitene contaminated air filters also entered the waste stream as shop trash which is taken off site for disposal.

6.2.1.10 Explosive Ordnance Disposal (EOD) Operations

The Explosive Ordnance Disposal Operations activity has a training mission to indoctrinate naval personnel in explosive ordnance procedures and techniques. However, the primary function of the activity is to dispose of nonserviceable naval munitions and chemical explosives (mainly picric acid) from various sources.

Explosive Ordnance Disposal operations have been actively conducted since the early 1970's at NWS Earle, serving the Philadelphia Naval Base, and coordinating activities for the disposal of various types of explosive items as required. Assignments for explosive disposal have come from areas ranging from Maine to Michigan. Prior to the 1970's, disposal requirements for NWS Earle were taken care of by demilitarization at the "Box Yard" described in Section 6.2.1.3. The current facility, which is described as Site No. 2 in Section 6.6, is located at map coordinates 748-575, one-half mile northeast of Esperance Road. It covers approximately an 11-acre site.

Pyrotechnic (incendiary) compositions are destroyed in an unlined burn pit. Explosives are placed in a pit and set off by an initiating charge from a protected bunker at a safe distance. There is a 50 pound explosive limit per shot. On the average, 800 pounds per month of explosives are destroyed. Explosives detonated or burned include the following:

- Explosive D (ammonium picrate).
- TNT (2,4,6-trinitrotoluene).
- RDX (cyclotrimethylenetrinitramine, hexahydro, trinitratriazine).

- C-4 (plastic explosive: 91% RDX, plus polyisobutylene, motor oil and dibutyl-sebacate).
- Black Powder (74% potassium nitrate, 15.6% charcoal, and 10.4% sulfur).
- Double-base Propellant (more than 90% nitrocellulose and nitroglycerine).
- Single-base Propellant (primarily nitrocellulose).
- Picric Acid (2,4,6-trinitrophenol).

Some of the items containing the above, which in some cases are one-shot affairs, are nonserviceable 3"50, 76 mm, 5"48 rounds, "bangalore torpedoes" (used for general demolition work) and 2.75" rockets. The picric acid comes from laboratories which have arranged to dispose of the material at NWS Earle, such as the Edison National Storage Site of the Department of the Interior.

6.2.1.11 Waterfront Ordnance Operations

From the early 1940's until the present time, the Waterfront Operations Branch (Code 2901) has been responsible for loading and off-loading ordnance material onto or from ships, barges, vehicles and freight cars. The 2.9 mile pier with six deep water berths is connected to the Main Station by 14 miles of rail lines and paved roads (Normandy Road). Off-loading procedures, and waste generation practices at the waterfront have remained relatively constant over the years, although disposal sites for certain materials have changed. These practices are discussed in the following paragraphs.

Waste oils and ship bilge waters are handled through station operations and disposed of by contracted services. This branch only handles explosive ordnance items, including training rounds and expended shells. Any rounds of ammunition that are damaged are inspected by EOD and, if required, are routed to the EOD area for disposal (see Section 6.2.1.10). On occasion, the Waterfront Operations Branch has received the equivalent of 3-4 carloads of excessive shelf life ammunition requiring disposal. Such

rounds could go to other bases for disposal. If disposed of at NWS Earle, the remains would go to metal salvage (see Section 6.2.1.2).

The waste generated by this operation is essentially dunnage (produced in the uncrating and transfer of ordnance). No propellant or explosive wastes are generated, and no evidence or reports of accidents or spills were discovered. The facility serves 50 to 150 ships per year. The wastes are contained in a 30 cubic yard dumpster. Waste generation varies between 1,500 and 9,000 cubic yards per year. These materials are presently hauled offsite by a private contractor. Prior to 1977, these wastes were dumped in the landfills at Site No. 6 (1943 to 1965) and Site No. 7 (1965 to 1977).

6.2.1.12 Ordnance Carpenter Shop

The ordnance carpenter shop, Building S-35, has been a wood-working facility providing pallets, boxes, etc. in support of ordnance transfer and storage operations from the early 1940's until the present time. Aside from the generation of sawdust and trash waste, the shop produces empty cans which may contain hazardous wastes, e.g., lacquer, polyurethane, varnish, wood stain, toluene, plastic resin glue, rubber cement, acetone and synthetic thinner. However, the quantities used are small for all these items -- less than 1 gallon/month.

Wood preservatives were previously used here for three or four years in the 1970's. At present, wood products are constructed from pretreated wood. Comments made during on-site interviews indicate that at one time, 500 gallons of pentachlorophenol (PCP) was used as a wood preservative. The preservative was applied by hand and consumed by the wood being treated.

The waste generated from this shop consisted of solvents, varnishes and preservatives generated as residues in discarded cans. This waste would have been mixed with general shop trash (paper, glass, wood, etc.) in the shop dumpster. These materials are presently hauled offsite by a private contractor for disposal. Prior to 1978, these wastes would have been disposed of in the landfills at Site No. 3 (1960 to 1968), Site No. 4 (1943 to 1960) or Site No. 5 (1968 to 1978).

It should be noted that Building S-35 is supplied by potable water from an 80-foot deep well. Personnel in the building complained of a vinegar taste and foul smell from the water, which was also observed by the NACIP Team. However, analyses of the water by NWS Earle (test results were not available) were reported to have shown "harmless rust contamination."

Building S-35 is located on Tarawa Road west of Highway 34 at map coordinates 693-569.

6.2.2 Fleet Mobile Mine Facility

The Fleet Mobile Mine Facility (MOMAG) is a tenant organization at NWS Earle, located on the Station since 1975. Their mission is to recondition underwater mines (e.g., MK52, 55, 56, 57) every three to five years, store them in magazines and assign them to fleet operations, as required. The Mobile Mine Assembly Group mission is performed in two facilities. The mines are cleaned with solvent and restenciled at Building MA-3. Those requiring complete paint removal and repainting are sent to Building 544. Another operation conducted in Building MA-3 is the application of antifouling compound to mine cables and anchors to prevent seaweed accumulation. Both buildings are located at map coordinates 726-560 in the proximity of the ASW area. The reconditioning procedures, paint removal work and waste generation procedures at MOMAG have remained relatively constant since 1975.

6.2.2.1 Mine Reconditioning Operations

In the course of cleaning, touching up, painting and restenciling exterior surfaces of the mines, various empty cans containing residual wastes are generated from Buildings MA-3 (coordinates 698-555) and MA-544, (coordinates 728-561) as follows:

- 500 gallons per year of dope and lacquer thinner.
- 100 gallons per year of toluene thinner.
- 75 gallons per year dry cleaning solvent. In the past carbon tetrachloride and trichloroethylene were used. The operation currently uses carbo-chlor (composition unknown) which is supposedly nontoxic.

- 200 (1.8 ounce) cans per year of zinc chromate primer.
- 40 gallons per year of latex and lead paints in one and five gallon cans.
- 10 gallons per year of copper antifouling paint.
- 7 pints per year of acetone.
- 10 pounds per year of water repellent grease.

Two 2-cubic yard dumpsters are employed to take trash and empty cans from both buildings. About 8 cubic yards of these wastes are generated per week, depending upon workload, and are disposed of under contract.

In Building MA-3, a fungicide is applied to prevent fouling of the anchor and cable attachment to the mine. This fungicide, a mercurous chloride compound is practically insoluble in water, but breaks down to mercuric chloride and metallic mercury in sunlight. As described during interviews, a sticky brown exudate, also formed when the antifouling compound is exposed to the sun, is believed by workers to contain PCB. Because of the hazards associated with this operation, the gloves, disposable coveralls, and rags used in application of the anti-fouling compound are placed in a container and are disposed of under contract at the rate of about one 30-gallon drum per year. Interviews with plant personnel indicated that offsite disposal of this material via private contractor has been a continuing practice since the facility began operating.

Building MA-544 is used for removal of paint from mines and their protective crates and for spray painting with zinc chromate primer and finish painting. A small amount of stenciling is also done here. The wastes (trash) from this building are combined with those of Building MA-3 (put in same dumpster) for disposal.

Accumulated grit and paint from the paint removal operation is placed on the ground in a 1500 square foot area behind the building. As the material settles, new waste is shoveled into the trench. The silica grit is used once in the amount of three tons per quarter, provided in cardboard sacks. The material used is "Black Beauty" slag products from H.B. Reed &

Co., Highlands, Indiana. The spent grit shoveled into the trench also contains red lead paint from past paint operations as well as zinc chromate primer, lacquers, latex paints, etc. This grit disposal area is listed in Section 6.6 as Site No. 20.

It is estimated that between one and five gallons per year each of the following liquids were generated annually in discarded cans at Buildings MA-3 and MA-544 since the facilities began operating: latex paint, Copper Pac paint (a copper-based paint); lead-based paint; water repellant grease; and dry cleaning solvent. These materials are presently hauled offsite by a private contractor. Prior to 1978, these wastes were dumped in the landfills at Site No. 3 (1960 to 1968), Site No. 4 (1943 to 1960) and Site No. 5 (1968 to 1978).

6.2.3 Obsolete Pistol Firing Ranges

6.2.3.1 Pistol Range - Marine

An obsolete Pistol Firing Range previously used by the Marines from the 1940's until about 1978 is located at map coordinates 721-572 and is approximately one-half mile north of Lake Earle. The site is approximately 3 to 4 acres in size and the surface has ample evidence of past target practice such as .22, .30 and .45 caliber brass cartridge cases, lead and copper jacketed ball ammunition and 12 gauge shot gun cases. The lead bullets and lead shot discharged into the target area are presumably also in the area. The site is described in Section 6.6 as Site No. 24.

6.2.3.2 Pistol Range - Seabees

Just south of the Marine Range described in Section 6.2.3.1 is a second obsolete pistol firing range which was used by the Seabees. Similar ammunition remnants as described above were observed at this site. Some debris including creosoted rail road ties and bed springs were also found at this site. This site is described in Section 6.6 as Site No. 25.

6.3 OPERATIONS, NONORDNANCE

The bulk of the nonordnance activities of NWS Earle are located in the administrative areas of the Main Station and the Waterfront Area. Maps of these areas are shown in Figures 6-2 and 6-3, respectively.

6.3.1 Public Works Department (Code 09)

The NWS Earle Organization Manual describes the Station Public Works mission as follows:

> "Directs, coordinates and provides for the acquisition, design, construction and maintenance, repair and operation of public works and public utilities and for the installation, maintenance and repair of Ordnance production equipment. Provides in-house and contract support to homeported ships for the maintenance, repair and overhaul of propulsion and structural components. Operates, assigns, maintains and repairs construction, transportation and weight-handling and material-handling equipment. Administers the Forest Management Program. Directs the assignment, operation and maintenance of public quarters (housing). Provides for Station radio systems to include radio and TV installation and maintenance."

Construction, equipment maintenance, transportation, utilities and related support activities are implemented by the Maintenance and Utilities Division (Code 093) and the Transportation Division (Code 094). Various branches of these divisions perform specialized activities in shops and work areas located throughout the station. The relevant activities of these divisions and their branches are discussed in the following sections.

6.3.1.1 Maintenance and Utilities Division (Code 093)

The Maintenance and Utilities Divison consists of six principal branches: the Building Trades Branch (Code 0931), the Metal Trades Branch (Code 0932), the General Services Branch (Code 0933), the Electrical Trades Branch (Code 0935), the Pipefitting Branch (Code 0936), and the Waterfront Branch (Code 0937). With the exception of the pest control services and some electrical trade services, these maintenance and utility operations are housed in Building C-16 at the main station and Building R-10 at the waterfront area. Most of the heavy machinery used in carpentry and metals work

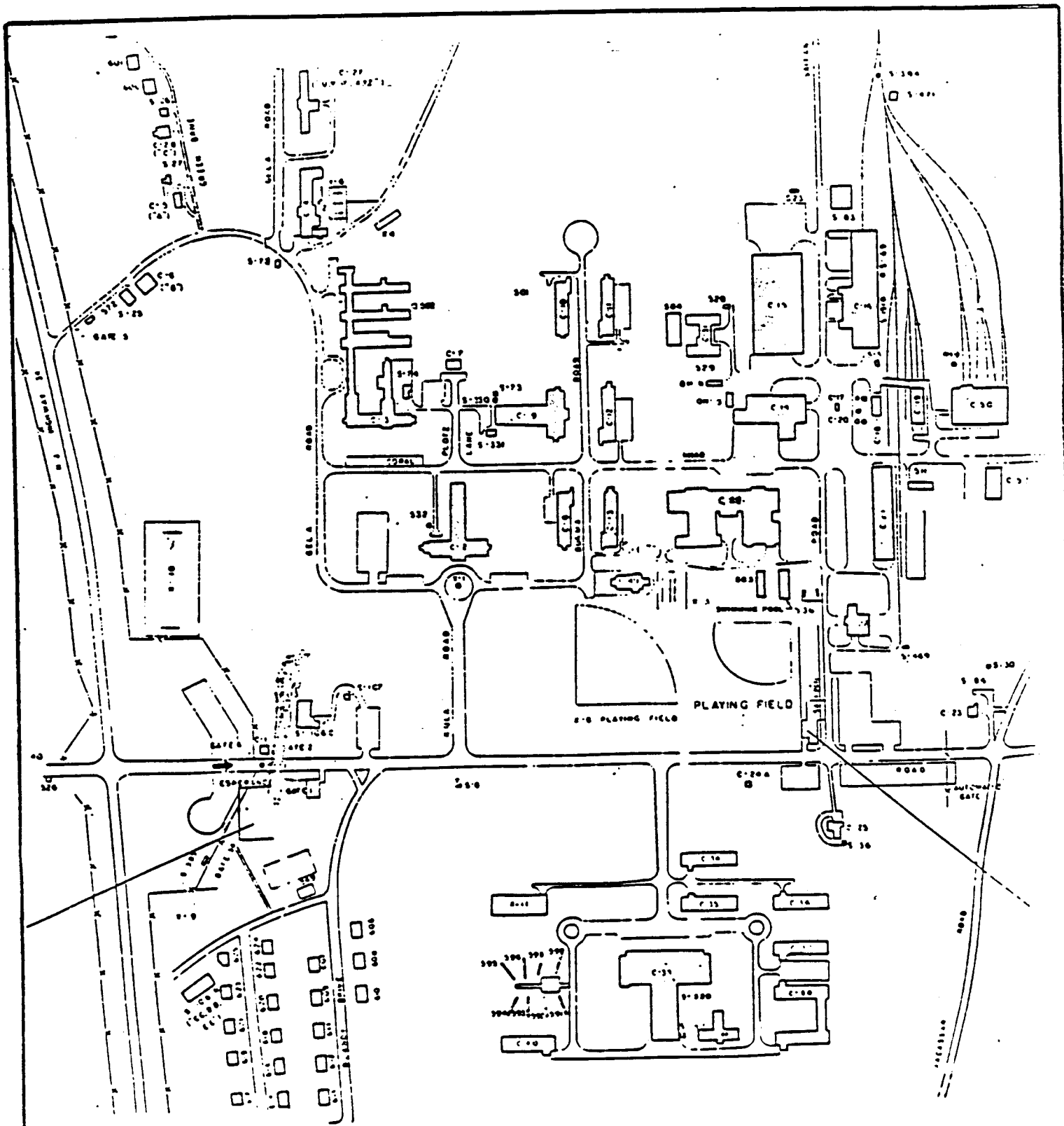

FIGURE 6-2. Map of NWS Earle Main Base.

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

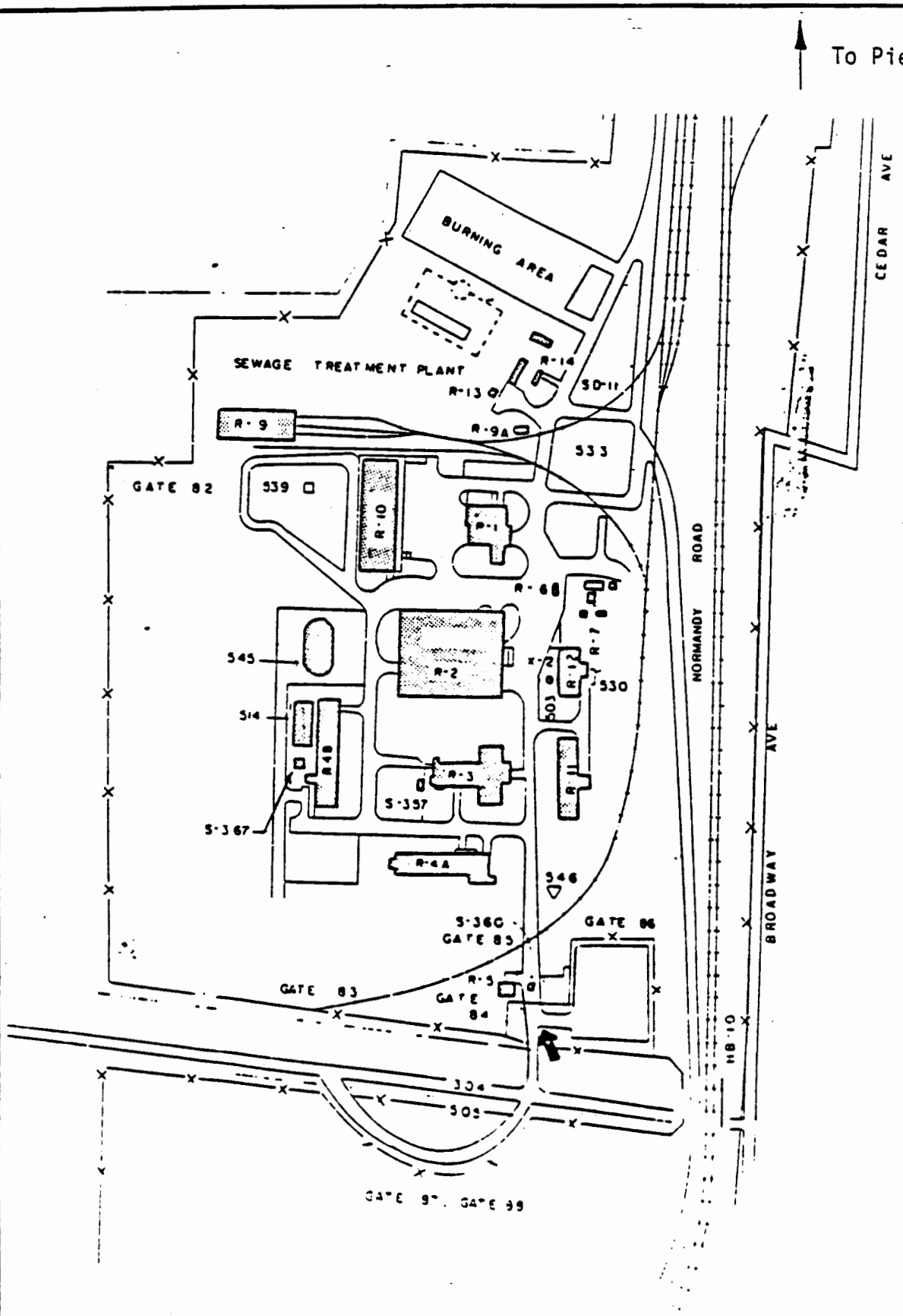

FIGURE 6-3. Map of NWS Earle Waterfront Area.

FCHA INITIAL ASSESSMENT STUDY NAVAL WEAPONS STATION EARLE

is housed in these buildings.

6.3.1.1.1 Building Trades Branch

The Building Trades Branch provides the following services for the Main Station: (1) performs carpentry, masonry and paint maintenance of buildings and structures; (2) performs building alterations and minor new construction; (3) performs carpentry repairs to automotive and railroad equipment; (4) prepares painted signs for general Station use; and (5) performs emergency repair services.

Waste products produced by carpentry activities include scrap lumber, sawdust and occasionally cans formerly containing wood stains and finishing products. These materials are currently mixed with shop trash and collected by a private contractor from a nearby dumpster for off-site disposal. Prior to 1978, these materials were disposed of in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-60) and Site No. 5 (1968-78).

The paints used by this trades branch include latex paints for interior work and oil-base paints for exterior work. This mixture of uses dates back to the 1950's, but the use of latex paints has increased substantially since the mid 1970's. Products used during painting operations include varnishes, shellacs, paint thinner, turpentine, and various types of oil-base and latex paints, including lead paints. All waste materials of these types are mixed with shop trash for collection and off-site disposal by a private contractor. It is estimated that approximately 10 gallons per month of paint is disposed of in this manner. In the past, these wastes were disposed of in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-60) and Site No. 5 (1968-78).

Hazardous (e.g., flammable) materials handled by this shop and other operations housed in Building C-16 are stored in Building S-3, a small storage shed located just south of Building C-16.

6.3.1.1.2 Metal Trades Branch

The Metal Trades Branch performs metal trades services for buildings, structures, machinery and equipment, and assists in the design,

development and manufacture of jigs, tools and special fixtures as required. Shop machinery, as listed in Table 6-1, includes drilling machines, lathes, grinders, welders and milling machines.

The primary wastes produced by metals shop operations include cutting oils and scrap metal. Since the installation of the waste oil tank behind Building C-14 in 1960, waste cutting oils have been routed to that tank from whence they are collected by a private contractor for offsite disposal. Prior to 1960, these cutting oils and other Station waste oils were used as follows:

- Spread on Station roadways for dust control purposes.
- Mixed with oil-based pesticides for land application.
- Used as boiler fuels to supplement virgin oil.

See Section 6.3.1.2 for more discussion of Station waste oils.

Scrap metals, including oily turnings resulting from machining operations, are routed to the Defense Property Disposal Office (DPDO) for recovery and sale offsite (see Section 6.3.4).

6.3.1.1.3 General Services Branch

The General Services Branch performs insect, weed, brush and pest control services for the Naval Weapons Station. Branch personnel share office space in Building S-83. Herbicides and insecticides are stored separately as per USEPA regulations in the following areas: (1) a storage area in Building S-83; and (2) a storage area in Building C-40. Another storage area in the basement of Building C-31 is used to store hoses and other branch equipment. Entry into the storage area in Building C-40 requires the use of respirators.

The General Services Branch began operating at NWS Earle in 1960. From 1960 to 1968, branch activities (pesticide storage and mixing, and container cleaning operations) were conducted in Building C-31. In 1968, the branch moved the bulk of its operations (office space, mixing, cleaning and some storage) to Building S-83; a chemical storage area was also provided at that time in Building C-40, and some equipment storage was retained in Building C-31.

Pest and weed control services at the Station have necessitated the use of a wide variety of herbicides and insecticides. Table 6-2 presents a listing obtained from the Station Pest Control Inventory of November 30, 1981 to demonstrate the types and amounts of insecticides and herbicides typically handled.

Large volume pesticide mixing operations have been conducted in the branch's tank trucks. Since 1968, small volume mixing operations (on the order of a few gallons) have been conducted in Building S-83. From 1960 to 1968, these operations were conducted in Building C-31.

The waste materials generated by this branch included off-spec insecticides and herbicides, and rinsewaters resulting from cleanup operations, and pesticide containers (pesticide containers were tripled-rinsed prior to disposal). In the past, these materials were typically buried in separate (from other wastes) holes in the landfills at Site No. 3 (1960-68) and Site No. 5 (1968-78). However, interviews at the Station indicate that some of these materials, particularly rinsewaters, may have been disposed of via sewer drains in the mixing buildings (Building C-31 and Building S-83). The quantities of materials disposed of via landfills or sewer drains are not shown. Currently, pesticide-contaminated rinsewaters are land applied, and off-spec materials are routed to the DPDO for offsite disposal.

6.3.1.1.4 Electrical Trades Branch

The Electrical Trades Branch of the Maintenance and Utilities Division provides the following Station services:

- Performs maintenance of electrical power systems, appliances, and alarm systems required in the station's mission.
- Performs electrical alterations and minor new installation.
- Maintains refrigeration and air conditioning units.
- Performs required installations, operations, maintenance and repair of radio communications equipment, radar and television.

TABLE 6-2

Station Pesticide Inventory (November, 1981)

Material	Concentration	Amount	Method of Storage
HERBICIDES BLDG. C-40			
Ammate-X	95%	355 lbs	Stored on Wooden Pallets
Dalapon	wp85%	200 lbs	Stored on Wooden Pallets
Tordon 101	10.2%	15 gals	Stored on Wooden Pallets
Weedone-170-155-2,4,5 T	31.4%	155 gals	Stored on Wooden Pallets
Ebon-2,4,5 T	30.5%	90 gals	Stored on Wooden Pallets
Amitrol-T	21%	2 gals	Stored on Wooden Pallets
Esteron-2,4,5 T	36%	95 gals	Stored on Metal Containers
Ded-Weed-2,4,5 T	83.5%	110 gals	Stored on Wooden Pallets
Vistik Spray Additive	100%	65 lbs	Stored on Wooden Pallets
Maintain-125	87.5%	6 gals	Stored on Wooden Pallets
Triton	-	-	-
Spreaded Sticker	77%	15 gals	Stored on Wooden Pallets
Sodium Arsenite	54%	60 gals	Stored on Wooden Pallets
24-DP-24-D	-	-	-
INSECTICIDES BLDGS. C-40 & S-86			
Malathion EC	57%	114 gals	Stored on Wooden Pallets
Diazinon Dust	2%	95 lbs	Stored on Wooden Pallets
Baygon EC	1.5%	4 gals	Stored on Wooden Pallets
Eaton's Bait Block	0.005%	50 lbs	Stored on Wooden Pallets
Eaton's Bait Bags	0.025%	68 lbs	Stored on Wooden Pallets
Warfarin	0.5%	20 lbs	Stored in Metal Locker
Sevin "Carbaryl"	wp 80%	445 lbs	Stored on Metal Pallets
Baygon Bait	2%	20 lbs	Stored on Metal Pallets
Gardona-75	wp 75.0%	36 lbs	Stored on Metal Pallets

Table 6-2 (Continued)

Material	Concentration	Amount	Method of Storage
Lindane Powder	1%	20 lbs	Stored on Wooden Pallets
Diazinon 4-E	47.5%	20 gals	Stored on Metal Pallets
Diazinon 4-S	48.7%	7 gals	Stored on Metal Pallets
Pyrethrum (Space Spray)	0.40%	8 gals	Stored on Metal Pallets
Pyrethrum (Spray Cans)	0.052%	700 lbs	Stored in Metal Locker
Pyrethrum (Spray Cans)	0.60%	186 12 oz cans	Stored on Wooden Pallets
Alpine Repellants-8215	100%	10 gals	Stored on Wooden Pallets
West Tox Space Spray	6%	3 gals	Stored on Wooden Pallets
Avinol Baits	1%	40 lbs	Stored in Metal Locker
4-The Birds Repellant	80%	1 doz	Stored in Metal Locker
Vaporite	23%	2½ gals	Stored in Metal Locker
Calcium Cyanide	42%	25 lbs	Stored in Metal Locker
Copper Sulfate	99%	80 lbs	Stored on Metal Pallets
Malathion GRN	6%	625 lbs	Stored on Wooden Pallets
Wasp Freeze Aero	0.05%	68 14oz cans	Stored in Metal Locker
Chlordane EC	72%	130 gals	Stored on Wooden Pallets
Naled-Dibrom-14	85%	75 gals	Stored on Wooden Pallets
Dursban-4-E	41.2%	9 gals	Stored on Metal Pallets
Rozel Tracking Powder	98.8%	18 gals	Stored on Metal Pallets
FICAM-W	76%	8	Stored on Metal Pallets
Resodex Fogging Compound	0.40%	19 gals	Stored on Metal Pallets
Vapona	0.5%	32 6 oz cans	Stored on Metal Pallets
Vapona	0.5%	38 12 oz cans	Stored on Metal Pallets
Ban-Bug Strips	-	5 doz	Stored in Metal Locker
Baygon E 1.5	13.9%	3 gals	Stored in Metal Locker
Sting-X	0.15%	36 11.5oz cans	Stored in Metal Locker
Rite-Off	0.5%	73 14oz cans	Stored in Metal Locker

Table 6-2 (Continued)

Material	Concentration	Amount	Method of Storage

INVENTORY OF OUT-OF-DATE PESTICIDES WITH DETERIORATING CONTAINERS

HERBICIDES

Ammate-X	95%	355 lbs	
Dalapon	wp85%	1050 lbs	
Hyvar-X	wp80%	100 lbs	
Tordon 101	10.2%	30 gals	
Weedone	31.4%	155 gals	
Erbon	30.5%	90 gals	
Amitrol-T	21%	10 gals	
Tandex	wp80%	150 lbs	
Amizine	15%	30 lbs	
Esteron	36%	95 lbs	
Ded-Weed	83.5%	110 gals	
Vistik Spray Additive	100%	65 lbs	
Maintain-125	87.5%	6 gals	
Triton	77%	15 gals	
Sodium Arsenate	54%	60 gals	
Arasan-425	42%	50 lbs	

INSECTICIDES

Malathion-E	57%	114 gals	
Malathion-GRAN	6%	625 lbs	
Dibrom-Naled-14	85%	75 gals	
Bayer (Experimental Insecticide Spray)		1 gal	
Lindane Power	1%	20 lbs	
Calium Cyanide (A-Dust)	42%	25 lbs	
Copper Sulfate	99%	80 lbs	
Diazinon Dust	2%	50 lbs	

Personnel of the branch are housed in various Station locations, including the Building C-31 Radio Shop (electronics mechanics responsible for Station radios and transmission systems), Building C-40 (alarm technicians), and Building C-16 (all other functions).

The air conditioning/refrigeration system maintenance operations process 3700 pounds per year of various types of refrigerants, including R-11 (trichloromonofluoromethane), R-12 (dichlorodifluoromethane), R-22 (monochlorodifluoromethane), R-500 (dichlorodifluoromethane and difluoroethane), and R-502 (monochlorodifluoromethane and monochloropentafluoroethane). These freons are purchased in disposable metal containers. When depleted, these containers are currently disposed of off-site via contractors (non-manifested disposal). Prior to 1978, these containers were disposed of in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-60) and Site No. 5 (1968-78).

Since 1960, all waste oils generated in electrical shop operations, with the exception of transformer oils, have been routed to the Station waste oil storage tank behind Building C-14 for ultimate collection and disposal offsite via contractor. Prior to 1960, these waste oils were mixed with other Station waste oils and either spread or roadways for dust control, mixed with oil-based pesticides for hard application, or used as boiler fuels to supplement virgin oil. (See Section 6.3.1.2). All other electrical shop wastes, such as cleaning solvents, are currently mixed with Station trash for offsite disposal via contractor. Prior to 1978 these wastes were disposed of in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-60) and Site No. 5 (1968-78).

As part of routine maintenance of the electrical distribution system, the Electrical Trades Branch drained, filtered and replaced oil in station transformers, which included the handling of PCB-contaminated transformer oils. Prior to 1978 the waste oils and contaminated filters generated were disposed of in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-1960) and Site No. 5 (1968-1978). Since 1978, all transformers taken off line and all transformer oils collected from leaks and spills are stored pending oil analysis and offsite disposal.

PCB-contaminated and potentially PCB-contaminated transformers, oils and other materials were stored in the designated PCB storage building, Quonset Hut-8 (QH-8), with the exception of some PCB transformers which were stored on wooden pallets in the storage yard north of Building C-16. Results of analyses of samples taken from some of the items stored in these areas indicate that materials with PCB concentrations above the regulated limit of 50 ppm are on hand.

Interviews indicated that a leak resulting from vandalism of three transformers occurred in the storage yard north of Building C-16 roughly 5 years ago (circa 1977). Cleanup measures were taken immediately to limit further soil contamination. Approximately 8 inches of soil in an area measuring 10 feet by 20 feet was removed and disposed of offsite (fate unknown). This site is discussed further in Section 6.6 as Site No. 29.

6.3.1.1.5 Pipefitting Branch

The Pipefitting Branch maintains the Station plumbing, heating, water and sewage systems, and operates the Station water purification and sewage disposal plants. This section focuses on shop operations of this branch. The sewage and water treatment systems are discussed in Sections 6.3.6 and 6.3.7, respectively.

Pipefitting shop operations are housed in Building C-16 along with the metals trades, carpentry and electrical shop operations. The rate at which waste cutting oils hae been generated by these combined operations throughout their lifetime has been estimated by shop personnel at 10 gallons per month. Since 1960, this oil has been routed to the waste oil storage tank behind Building C-14 for offsite disposal via contractor (see Section 6.3.1.2). Prior to 1960, these waste oils were mixed with other Station waste oils and either spread or roadways for dust control, mixed with oil-based pesticides for hard application, or used as boiler fuels to supplement virgin oil. All scrap metal generated was routed to the DPDO for resale or offsite disposal.

Asbestos pipe covering and boiler insulation was replaced routinely, as needed, during the 1960's and 70's, generating unknown amounts of waste asbestos. All of this waste material was disposed of in the landfills at Site No. 3 (1960-68) and Site No. 5 (1968-1978). No specific asbestos handling or disposal procedures were noted during interviews at the Station.

6.3.1.1.6 Waterfront Branch

The Waterfront Branch of the Maintenance and Utilities Division performs structural and utilities maintenance and emergency repair services for the Waterfront Area. The branch also maintains all operational homeporting facilities. This branch functions as a small maintenance and utilities division, providing limited electrical, carpentry, automotive maintenance, forklift maintenance, and metals trades services in Building R-10 at the Waterfront. The wastes generated by this branch were composed primarily of materials such as glass, paper, wood, packing material, and small amounts of paint wastes. These wastes are currently hauled offsite for disposal. Prior to 1977, these wastes were disposed of in the landfills at Site No. 6 (1943-1965) and Site No. 7 (1965 to 1977).

6.3.1.2 Transportation Division (Code 094)

The Transportation Division administers the assignment, operation, inspection, maintenance and repair of automotive, railroad, materials handling, weight handling and other transportation and contruction equipment. The division consists of three operations branches, the Vehicle, Equipment, and Railroad Operations Branches (Codes 0941, 0942 and 0943, respectively), and the Transportation Maintenance Branch (Code 0944). The operations branches provide vehicles, equipment and railroad operators for the Station as required to support the Station mission.

The Transportation Maintenance Branch performs maintenance, testing and repair of automotive, railroad, construction, material handling and weight handling equipment. Automotive maintenance, servicing and repair operations are conducted in Building C-14. The liquid wastes generated during these operations include crankcase, differential, transmission and

hydraulic oils. These wastes are collected in a 2000-gallon underground waste oil tank located behind the building to await removal by a private contractor.

This practice of handling waste oils from the Public Works Department has been in effect since the waste oil tank was installed in 1960. Interviews at the Station indicate that small amounts of waste oil may have been used for fire fighting training purposes (see Section 6.3.9), but the vast majority of waste oils were routed to the waste oil tank. Prior to 1960, these waste oils were mixed with other Station waste oils and either spread or roadways for dust control, mixed with oil-based pesticides for hard application, or used as boiler fuels to supplement virgin oil. During the inspection, there were indications that a spill had occurred near the waste oil tank. This was verified in interviews with site personnel. This site is discussed further in Section 6.6.28 as Site No. 28.

Other wastes from the automotive maintenance operations include rubbish, oil filters and paper boxes. These wastes are deposited in building dumpsters for removal by the Station trash hauling contractor. Prior to 1978 these wastes were disposed of in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-1960) and Site No. 5 (1968-1978).

Until 1977, the automotive maintenance shop also included a small spray painting operation. Paint and solvent wastes associated with that operation were discharged into the building dumpster for disposal in the landfills at Site No. 3 (1960-68), Site No. 4 (1943-1960) and Site No. 5 (1968-1977).

Building C-19 has housed forklift maintenance operations for some time. Forklift battery recharging operations have been conducted inside that building. Forklift batteries designated for disposal, both leaking and non-leaking, have been stored on wooden pallets in an area behind Building C-19 pending removal for offsite disposal by the DPDO. No evidence of recent leaks of forklift battery acid was observed during the inspection.

Waste oils generated during forklift maintenance operations are stored temporarily in a 500-gallon aboveground tank located between Buildings C-19 and C-50 before ultimately being collected by a contractor for off-site disposal. This practice has been in effect since 1960. Prior to 1960, these waste oils were mixed with other Station waste oils and either spread or roadways for dust control, mixed with oil-based pesticides for hard application, or used as boiler fuels to supplement virgin oil.

Locomotive maintenance operations are carried out in Building C-50. The waste oils generated from locomotives in this shop are retained in a storage tank located inside the building for recycling by a private contractor. This has been the practice since operations began at NWS Earle.

Steam cleaning operations are conducted in all three transportation maintenance shops through the use of portable equipment. Three such units are in use at NWS-Earle, one in each of the three maintenance shop buildings; they employ heated water and detergents. Wastes from these operations are discharged into the sewer drains of the respective buildings.

6.3.2 Fleet Support Department (Code 70)

The Fleet Support Department at NWS Earle has been in existence for 12 years (established circa 1970). It is responsible for directing mechanical, electronic and other capabilities for the fabrication, modernization, modification, overhaul and refurbishment of prototype weapons handling equipment, containers, components, auxiliary units, and other items. Fleet Support operations include the following:

- A metal trades operation housed in Building C-16. This branch performs metal working operations such as cutting and welding in support of other department activities.
- A small shop in Building C-31 in which electronic component packing operations are conducted.
- A large shop in Building C-15 in which mechanical and electrical overhaul, repair, renovation and modification operations are conducted.

The operations conducted in Building C-15 include engine degreasing and maintenance and spray painting of various types of weapons handling equipment, containers, components, etc. The liquids handled during these types of operations include oil-base paints, varnish, lacquer and degreasing/cleaning solvents such as sodium hydroxide. The spray painting area employs a two year old (installed circa 1980), dual filter electrostatic spraying system which minimizes the amount of paint wasted.

The wastes generated in these operations include: waste oils, which are stored in the waste oil tank behind Building C-14; waste paints, which are routed to the DPDO for resale or offsite disposal; spray paint filters, which are disposed of in the building trash dumpster; and water soluble waste degreasing solvents which are typically dumped into the building sewer drains. These waste disposal practices have been in effect since Fleet Support was established.

The metal trade operations conducted in Building C-16 generate small amounts of cutting oils and scrap metals as waste. Sine Fleet Support was established, the metals have been routed to the DPDO for recovery and resale, and the cutting oils have been routed to the waste oil tank behind Building C-14.

The electronic component packing operation in Building C-31 involves the use of polyurethane foam as a packing material. Waste foam from this operation is disposed of in the shop trash, which is collected by a private contractor for offsite disposal. From 1970 to 1978, this waste was disposed of in the Station landfill at Site No. 5.

6.3.3 Boiler Facilities

The listing of Table 6-3 presents information describing the type, location and horsepower rating of the 103 boilers currently in use at NWS Earle. All but two of these boilers are low temperature/low pressure boilers which provide heat and hot water for Station buildings.

TABLE 6-3

Station Boilers

Building No.	System-Type*	Type of Boiler	Year Built	Year Installed	Boiler Horsepower
		INDUSTRIAL - MAIN STATION			
C-1	L.T. Hot Water	Cast Iron - Sectional	1944	1944	-
C-2	L.T. Hot Water	Firebox Type - Fire Tube	1963	1963	25
C-3	L.P. Steam	H.R.T. Fire Tube	1944	1944	52
C-3	L.P. Steam	H.R.T. Fire Tube	1944	1944	52
C-3	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	80
C-4	L.T. Hot Water	Cast Iron - Sectional	1944	1944	17
C-4	Dom. Hot Water	Vertical, Glass Lined Tank	1979	1979	-
C-7	L.T. Hot Water	Cast Iron - Sectional	1973	1973	-
C-8	L.T. Hot Water	Cast Iron - Sectional	1974	1974	16
C-9	L.P. Steam	H.R.T. Fire Tube	1943	1943	60
C-9	L.P. Steam	H.R.T. Fire Tube	1943	1943	60
C-10	L.T. Hot Water	Modular - Cast Iron	1981	1981	11
C-11	L.T. Hot Water	Cast Iron - Sectional	1974	1974	16
C-12	L.T. Hot Water	Cast Iron - Sectional	1974	1974	16
C-13	L.T. Hot Water	Cast Iron - Sectional	1974	1974	16
C-15	L.P. Steam	Scotch Marine - Fire Tube	1956	1976	170
C-16	L.P. Steam	Scotch Marine - Fire Tube	1979	1979	125
C-17	L.P. Steam	Scotch Marine - Fire Tube	1979	1979	125
C-19	L.P. Steam	Scotch Marine - Fire Tube	1979	1979	40
C-21	L.P. Steam	Scotch Marine - Fire Tube	1979	1979	60
C-22	L.T. Hot Water	Cast Iron - Sectional	1944	1944	-
C-23	L.T. Hot Water	Cast Iron - Sectional	1944	1944	-
C-25	L.P. Steam	Cast Iron - Sectional	1944	1944	17
C-27	L.T. Hot Water	Cast Iron - Sectional	1944	1944	23
C-29	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	150
C-29	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	150
C-31	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	125
C-31	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	125
C-34	L.P. Steam	Cast Iron - Sectional	1944	1944	29
C-36	L.P. Steam	Cast Iron - Sectional	1944	1944	29

TABLE 6-3 (Continued)

Station Boilers

Building No.	System-Type*	Type of Boiler	Year Built	Year Installed	Boiler Horsepower
C-38	L.P. Steam	Cast Iron - Sectional	1944	1944	29
C-40	L.P. Steam	Cast Iron - Sectional	1944	1944	29
C-46	L.P. Steam	Vertical - Fire Tube	1952	1972	18
C-50	L.P. Steam	Scotch Marine - Fire Tube	1951	1952	150
C-50	L.P. Steam	Scotch Marine - Fire Tube	1951	1952	150
D-1A	L.T. Hot Water	Cast Iron - Sectional	1958	1958	-
D-2	L.P. Steam	Scotch Marine - Fire Tube	1957	1974	170
D-5	L.P. Steam	Cast Iron - Sectional	1964	1964	42
E-13	L.P. Steam	Cast Iron - Sectional	1944	1944	29
E-14	L.P. Steam	Scotch Marine - Fire Tube	1963	1963	40
FA-2	L.T. Hot Water	Cast Iron - Sectional	1952	1952	-
GB-1	L.P. Steam	Scotch Marine - Fire Tube	1980	1980	30
HA-1	L.T. Hot Water	-	-	-	-
MA-2	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	150
MA-2	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	150
S-35	L.P. Steam	Cast Iron - Sectional	-	-	-
S-53	L.T. Hot Water	-	-	-	-
S-179	L.P. Steam	L.U. Vertical - Fire Tube	1952	1973	18
S-464	L.T. Hot Water	Cast Iron - Sectional	1976	1976	14
500	L.T. Hot Water	Cast Iron - Sectional	1974	1974	25
552	L.P. Steam	Scotch Marine - Fire Tube	1979	1979	40
566	L.T. Hot Water	Scotch Marine - Fire Tube	1977	1978	100
567	L.T. Hot Water	Cast Iron - Sectional	1976	1976	
		INDUSTRIAL - WATERFRONT			
R-1	L.T. Hot Water	Cast Iron - Sectional	1944	1945	-
R-2	L.P. Steam	H.R.T - Fire Tube	1943	1943	51
R-3	L.P. Steam	H.R.T - Fire Tube	1944	1944	52
R-4A	L.T. Hot Water	Cast Iron - Sectional	1944	1944	28
R-4B	L.P. Steam	Cast Iron - Sectional	1943	1944	29

TABLE 6-3 (Continued)

Station Boilers

Building No.	System-Type*	Type of Boiler	Year Built	Year Installed	Boiler Horsepower
R-5	L.T. Hot Water	Cast Iron - Sectional	1944	1944	-
R-9	L.P. Steam	Scotch Marine - Fire Tube	1951	1952	150
R-10	L.P. Steam	Scotch Marine - Fire Tube	1981	1981	125
R-11	L.P. Steam	Cast Iron - Sectional	1943	1944	15
R-12	L.T. Hot Water	Cast Iron - Sectional	1944	1944	-
R-15	L.T. Hot Water	Cast Iron - Sectional	1977	1977	47
R-20	H.P. Steam	Scotch Marine - Fire Tube	1977	1977	350
R-20	H.P. Steam	Scotch Marine - Fire Tube	1977	1977	350
S-62	L.P. Steam	Cast Iron - Sectional	1944	1944	13
S-186	L.P. Steam	Cast Iron - Sectional	1944	1944	19
S-454	L.P. Steam	Cast Iron - Sectional	1944	1944	10
3-A	L.T. Hot Water	Cast Iron - Sectional	NA	NA	6
4-A	L.T. Hot Water	Cast Iron - Sectional	1978	1978	6
3-N	Dom. Hot Water	-	-	-	-
		RESIDENTIAL - MAIN STATION			
C-5	L.T. Hot Water	Cast Iron - Sectional	1974	1974	3.7
C-6	L.T. Hot Water	Cast Iron - Sectional	1974	1974	3.7
C-28	L.T. Hot Water	Cast Iron - Sectional	1981	1981	4.5
S-198	L.P. Steam	Cast Iron - Sectional	1981	1982	7.3
S-202	L.P. Steam	Cast Iron - Sectional	NA	NA	-
S-204	L.P. Steam	Cast Iron - Sectional	1981	1981	4.7
S-247	L.T. Hot Water	Cast Iron - Sectional	NA	NA	3.4
S-106B	L.T. Hot Water	Cast Iron - Sectional	1980	1980	8.3
601	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.4
602	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.4
603	L.T. Hot Water	Fire Tube - Vertical	1964	1964	5.6
604	L.T. Hot Water	Fire Tube - Vertical	1964	1964	5.6
605	L.T. Hot Water	Cast Iron - Sectional	1979	1979	4.6
606	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6

TABLE 6-3 (Continued)

Station Boilers

Building No.	System-Type*	Type of Boiler	Year Built	Year Installed	Boiler Horsepower
607	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
608	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
609	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
610	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
611	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
612	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
613	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
614	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
615	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
616	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
617	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
618	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
619	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
620	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
621	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
622	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
623	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
624	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
625	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.6
600	L.T. Hot Water	Fire Tube - Vertical	1964	1964	4.4

*L.T. = Low Temperature
L.P. = Low Pressure
H.P. = High Pressure
N.A. = Not Available

The remaining two boilers are identical 350 HP (12.1 million Btu/hr) high pressure boilers (pressure rating - 200 psi) located in Building R-20 on the pier at the waterfront area. These boilers supply high pressure steam to ships while in port. Steam condensate from these operations is pumped from the ships into the ocean.

Blowdown operations are conducted at these boilers every 4 to 8 hours depending upon load, with the discharge directed into the ocean. The volume of boiler blowdown amounts to roughly 1 to 2 percent of the boiler throughput per discharge event. The throughput of each boiler at full load is roughly 1,500 gallons per hour of water. The blowdown contents typically includes 150-300 ppm of caustic (sodium hydroxide) and 10-30 ppm of chelate, a chemical compound which retains calcium and magnesium ions in solution.

Fuel for these high pressure boilers is delivered via two 10,000 gallon railroad tank cars which are loaded from tank trucks on shore and transported to the pier. During normal operation these tank cars rest on tracks above spill pans, one on each side of Building R-20. These spill pans drain into a 1000-gallon separation tank located under the building. Oil collected from the separation tank is pumped to a 500 gallon tank located inside Building R-20 for recovery.

6.3.4 Defense Property Disposal Office

The Defense Property Disposal Office (DPDO), a tenant at NWS Earle, is responsible for distribution or sale of surplus government property and reclaimed waste from NWS Earle, Ft. Monmouth, New Jersey military reserves, National Guard units and active Coast Guard units. Disposal is accomplished through donation to local or state governments or by sale (after screening). The principal areas of interest with respect to the NACIP program are storage and sale of recovered scrap (i.e., demilitarized ammunition, other recoverable non-precious metals) and disposal of pesticides, PCB-containing transformers and other hazardous or toxic materials. DPDO operations are conducted at an open storage yard near the railroad classification yards (Coordinates 730-587) and at the central warehouse facility in the Administration Area (Building C-33). The normal inventory

of scrap metal (aluminum, metal shop turnings, inert ordnance, etc.) in the open storage area is 100 to 200 tons. In the warehouse area, storage has included up to 100 gallons of DDT in 5 gallon cans, battery acid, mercury, 550 drums of FS Smoke Agent and asbestos in containers.

Disposal of transformers with oil containing less than 49 ppm of PCBs is accomplished through local waste reclaimers including Shore Auto Wrecking, Naporano, and C&R Waste. Disposal of DDT has been done through Chemical Waste Management Inc. (Emelle, AL). Transformers containing PCBs in excess of 49 ppm were originally stored in rail cars in the storage yard. These are now held in the PCB storage building (QH-8).

6.3.5 Sanitation and Refuse Disposal.

Up until 1978, base refuse was collected by Public Works personnel and disposed of at one of several landfills on the base (Site Nos. 3, 4, and 5 at the Main Base and Site Nos. 6 ad 7 at the Waterfront). With the closure of the last landfills on 1978, refuse collection and disposal were converted to contractor functions, with off-base disposal of all wastes.

There are no records detailing the exact types and quantities of waste disposed of at these on-base landfills. However, based upon the types of operations conducted at NWS Earle, this refuse could have included the following:

- Paints and paint thinners.
- Solvents, varnishes and shellacs.
- Acids, alcohols and caustics.
- Pesticide containers and rinsewaters.
- Waste wood (construction debris and dunnage).
- Asbestos from pipe insulation and automotive brake linings.
- PCB-contaminated transformer filters and oil filters.

The study Recovery and Reuse of Refuse Resources [1], prepared by the Northern Division of NAVFACENCCOM, includes an estimate of daily refuse production of 1.7 tons per day (TPD) based on resident and non-resident base population in 1976. Using this estimate of the daily production of refuse, the loading to each Main Base landfill can be computed as approximately 600 tons per year (TPY). Given the operating periods for each of these landfills, the total amounts filled based on these figures are:

Site No. 4:	1943-1960	-	10,200 tons
Site No. 3:	1960-1968	-	4,800 tons
Site No. 5:	1968-1978	-	6,600 tons
		TOTAL	21,600 tons

The quantities of refuse landfilled at the Waterfront cannot be computed using this method. Data from the NWS Earle Activity Disposal Site Fact Forms [2] indicated a 25,000 TPY total loading for the Waterfront area. This estimate (equivalent to approximately 20 truckloads of refuse per day) appears to be an order of magnitude too high. Interviews of Public Works personnel at the Station indicate that not more than 2,500 TPY were landfilled at the Waterfront.

6.3.6 Water Treatment and Supply

Water supply and treatment at NWS Earle is performed by two separate systems, one for the Main Base and one for the Waterfront Area. Because the water supplied to the Waterfront Area is purchased from the Monmouth Consolidated Water Company, the principal interest for NACIP focuses on the Main Base treatment and supply system. The Main Base system is supplied by groundwater from an 800 ft deep well. At the treatment plant, located at the corner of Esperance and Saipan Roads, groundwater is aerated (to oxidize ferrous iron to ferric iron), with pH adjustment and filtration to remove the particulate ferric iron. The filtered water is chlorinated before storage and distribution. The total plant capacity is approximately 0.72 mgd, and the average daily flow is approximately 0.3 mgd. Weekly filter backwashing results in the discharge of about 32,000 gallons

of backwash to a leaching basin west of the plant. The backwash water contains principally insoluble ferric oxides. Future plans include the installation of piping to permit the direct discharge of backwash to the main base sewer system. Backwashing may then require a staggered backwash schedule to prevent hydraulic overloading of the wastewater treatment facility.

Shipboard water is supplied by 3 railroad tank cars each of 10,000 gallons capacity.

6.3.7 Wastewater Collection and Treatment

The NWS Earle Main Base and Waterfront wastewater collection systems are separate. Main Base wastes have been directed to that area's wastewater treatment plant since the Station was established in 1943. Waterfront area wastewater has been transported to the Middletown Sewer Authority for treatment and disposal since the mid 1970's.

The Main Base wastewater treatment plant, located at coordinates 713-590, consists of a bar screen, grit chamber and Imhoff tank followed by slow sand filtration, chlorination and discharge. In the Imhoff tank, solids are settled into a lower chamber where solids digestion occurs anaerobically (without oxygen), and discharged periodically to sand drying beds. After passing through the Imhoff tank, the settled sewage is distributed on slow sand filters, which mechanically remove particulate matter not removed in the prior process, and in which biological oxidation within the filter bed removes soluble organic pollutants. Underdrains below the sand filters collect the filtered wastewater for chlorination before discharge to Hockhockson Creek. The treatment plant design flow rate is 0.37 mgd, and average daily flow rate is approximately 0.1 mgd.

Digested sludge was disposed of in sanitary landfills on the base prior to 1978. However, test data detailing the constituents of this sludge is not available. Since closure of the Station landfills in 1978, this sludge has been transported off-site by contractors.

6.3.8 Fire Division (Code 104)

The Fire Division provides for fire fighting, fire prevention, inspections, investigations, fire prevention training, and the operation and maintenance of fire-fighting equipment. The division is housed in Building C-22 on the Main Base and in Building R-1 at the Waterfront Area. The Fire Division maintains a list, on note cards, of all hazardous materials currently located at NWS Earle in order to properly respond to fires or rescue situations in any area of the Station.

Past practices of the Fire Division which may have contributed to long-term environmental problems at the Station include former spill cleanup procedures and fire-fighting training practices. It was noted during the interviews at NWS Earle that occasional spills of materials such as fuel oil were known to have occurred. Typically, steps were taken by the Fire Division to clean up these spills, but the spills were generally not documented. In the past, the spill cleanup procedures used by the Fire Division typically entailed hosing down the spill until it was diluted and washed off any roadways, walkways or other pavement. Thus any spills would have been washed onto the ground. Current practice consists of containing the spilled material, cleaning it up with a sorbent, and disposing of the contaminated sorbent offsite, with all procedures approved by the Station Environmental Coordinator.

Fire-fighting training was conducted in the past in the Contract Ordnance Disposal Area, Site No. 11, which is described in Section 6.6. These exercises were conducted in and around two unlined pits which were dug in that area, each measuring roughly 30 ft x 30 ft x 2 ft (depth). The typical practice involved placing a reject airplane or vehicle in the pit, soaking it and the pit with fuel oil (or possibly a mixture of fuel oil and waste oil), and setting the area ablaze. After the fire was extinguished, any remaining (unburned) oil was left in the pit (to soak into soil). This practice was conducted occasionally from 1974 to 1977.

6.3.9 Photography Laboratory

The Photography Laboratory, located in Building R-48 at the Waterfront area, processes all photographic materials for the Naval Materials Handling Laboratory, the Earle Missile (the Station newspaper) and other film users on base. Until recently, silver-contaminated hypo was stored in drums for recovery by the Precious Metals Recovery Office (PMRO). Within the last few years, a silver-specific ion exchange system has been installed with the saturated resin columns being taken to the PMRO for recovery. Used film is also kept at the lab for silver recovery by the PMRO. Other chemicals (fixers, hardeners, etc.) are discharged to the Middletown Township Sanitary Sewerage Authority.

6.3.10 Precious Metals Recovery Office

The Precious Metals Recovery Office (PMRO) is a separate division of the Defense Property Disposal Office (DPDO) located in Building C-38. The function of the PMRO is to manage the removal and reclamation of precious metals (gold, silver, palladium, mercury, etc.) from used camera film and other sources such as missile batteries. According to interviews, film was burned for recovery until this operation was closed down under orders of the New Jersey Department of Environmental Protection. The wastes generated included potassium hydroxide solution (3,000 gallons per year) and mercury-contaminated water (100 gallons per year) from dental amalgam recovery. According to interviews, the total discharge of mercury to the wastewater treatment system during the period 1977-1982 was approximately 1.25 lb. On the average, with a typical wastewater treatment plant flow of 0.1 mgd, this results in mercury concentrations of less than one microgram per liter, which is much lower than the drinking water quality standard of 20 micrograms per liter. The potassium hydroxide (40 percent solution) was used as electrolyte in silver based batteries. This electrolyte was dumped on site from 1972 to 1978 at a rate of 3000 gallons per year. Given the low pH of the local soils and rainfall, this material is expected to be substantially neutralized.

At present, the PMRO acts as a clearing house for precious metals recovery, with all actual recovery operations being done by contractors off base.

6.3.11 Oil and Hazardous Materials Simulated Environmental Test Tank (EPA)

This tenant agency, the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) is located in the Waterfront Area. The central feature of this facility is a 667-foot long, 65 foot wide seawater-filled test tank which is used for simulating oil spills and testing spill recovery equipment such as booms and drogues. The tank is equipped with a wave generator, bubbler system, and filter system. A comparatively new facility (in operation since 1972), the system includes facilities for complete recovery of test oils to minimize cost to users. Users pay a premium for replacement of oil, so it is in their interest to maximize recovery. Because the seawater is continuously reused, high levels of treatment are necessary to preserve the test reliability. Approximately twelve 5000 gallon oil tank trailers are kept on site. No waste discharges are made on-site; unserviceable oils are disposed under contract .

6.4 RADIOLOGICAL OPERATIONS

There are no records of the history of uses and disposition of sources of low-level ionizing radiation at NWS Earle. Interviews with appropriate personnel were conducted. These interviews indicated that there have never been, nor are there presently nonordnance radiological materials on this base. There are microwave ovens on-site and an X-ray unit in the medical facility, but neither of these instruments have the potential for creating an adverse radiological impact on the environment.

Based on the information available during the initial assessment, further low level radiological characterization of this facility is not warranted.

6.5 MATERIALS STORAGE

The Supply Department (Code 11) orders and stores most of the materials awaiting usage at NWS Earle. There have been no fires or accidents due to ordnance storage or incompatible storage of ordnance materials noted over the past several years. There have been several minor incidents associated with oil and lubricant operations at Station facilities. Storage facilities, related practices and relevant spill events are discussed in the following sections.

6.5.1 Fuel Storage

The Station bulk fuel storage area consists of five underground storage tanks located adjacent to Building C-20, the fuel pump station at the main base, and three underground storage tanks located adjacent to Building R-7, the fuel pump station at the waterfront area. The sizes, locations, materials stored and construction materials of these storage tanks are summarized in Table 6-4.

An underground fuel line was once used to transport diesel fuel from the Building C-20 storage area to a fuel dispensing pump outside Building C-50. However, this fuel line was closed off when a leak in the line was discovered in June, 1977, and diesel fuel is now transported to Building C-50 via tank truck. This area is described further in Section 6.6.16 as Site No. 16.

6.5.2 Magazine Storage

A total of 249 magazines providing 838,552 square feet of storage space are located at the NWS Earle Main Base. Table 6-5 shows the number and types of magazines and their respective areas.

6.5.3 Hazardous Materials Storage

Hazardous materials other than fuel and munitions have been and are still stored at several locations in the Main Base Administration Area.

TABLE 6-4

NWS Earle Fuel Storage Tanks

Number	Location	Size (gal)	Material of Construction	Content
1	C-20	10,000	fiberglass	gasoline
2	C-20	12,500	concrete	gasoline
1	C-20	12,500	concrete	diesel fuel
1	C-20	12,500	concrete	fuel oil
1	R- 7	12,500	concrete	diesel fuel
1	R- 7	12,500	concrete	gasoline
1	R- 7	12,500	concrete	fuel oil
1	S-589	5,000	unknown	diesel oil

TABLE 6-5

Magazines at NWS Earle

Type	Number	Gross Area (sq. ft.)
Fuse and Detonator	26	15,496
High Explosive	128	267,336
Inert	15	139,152
Smoke Drum	1	3,834
Small Arms/Pyro	8	53,118
Smokeless Powder and Projectiles	46	302,436
M Group	25	57,180
Total	249	838,552

These storage areas include both supply and user-controlled areas. The major storage sites currently in use are as follows:

- Paints and solvents:		Bldg. C-18 (Supply)
		Shed S-3 (Public Works)
		Shed S-219 (Ordnance)
		Bldg. C-15 (Fleet Support)
- Herbicides and insecticides:		Bldg. S-86 (Public Works)
		Bldg. C-40 (Public Works)
		Bldg. C-31 (Public Works)
- PCB-containing transformers:		Bldg. C-40 (Public Works)
		Bldg. C-16 Storage Yard (Public Works)
		Quonset Hut Q-8
		DPDO Salvage Yard
- Other:	Demil Residues:	Shed S-457 (Ordnance)
		Bldg. C-38 (DPDO)
	Otto II Fuel:	Bldg. 538 (Ordnance)
	Precious Metals:	Blgd. C-38 (PMRO)
	Chlorine Gas:	Wastewater Treatment Plant
		Water Treatment Plant

6.6 WASTE DISPOSAL OPERATIONS

The IAS Team has identified 29 sites of potential contamination at Naval Weapons Station Earle, based on records at the site, records at the Northern Division of NAVFACENGCOM (Philadelphia, PA) and through site visits on July 6-9 and July 19-20, 1982. Sites 1 throught 9 had been previously identified as disposal sites by the Public Works office. The locations of all 29 sites are shown in Figure 6-4.

The principal conclusion to be drawn from the review of records, interviews, and site inspections by the NACIP Team is that the range of environmental problems at NWS Earle is not very significant. The potential

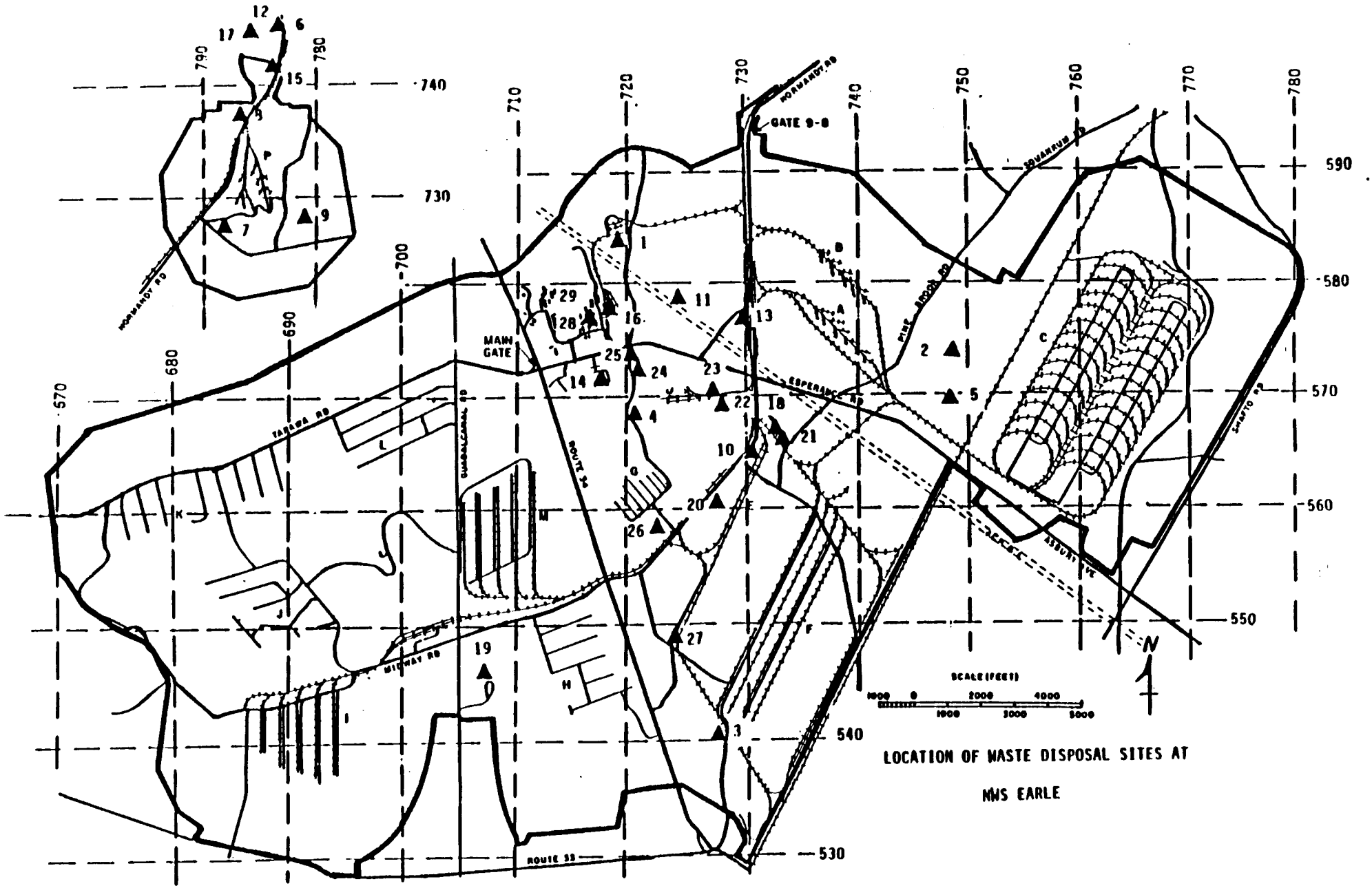

Figure 6-4. Location of Waste Disposal Sites at NWS Earle.

FCHA INITIAL ASSESSMENT STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Key to Location Map of Waste Disposal Sites at NWS Earle

Site Number	Site Title	Map Coordinates
1	Ordnance Demilitarization Site, Secured	719-584
2	Ordnance Demilitarization Site	748-574
3	Landfill Southwest of "F" Group	728-541
4	Landfill West of "D" Group	721-567
5	Landfill West of Army Barricades	749-570
6	Landfill West of Normandy Road	786-739
7	Landfill South of "P" Barricades	783-728
8	Landfill East of Building S-186	785-737
9	Landfill Southeast of "P" Barricades	790-727
10	Scrap Metal Landfill near Building 589	731-565
11	Contract Ordnance Disposal Area	725-579
12	Battery Acid Spill Site	786-739
13	Defense Property Disposal Office Yard	730-577
14	Defense Property Disposal Office Warehouse	718-571
15	Sludge Disposal Site Near Waterfront South Gate	787-741
16	Fuel Line Between Buildings C-20 and C-50	719-577
17	Disposal Site Behind Training Barge, Waterfront	786-745
18	Demilitarization Furnace	734-567
19	Paint Sludge Disposal Site Adjacent to Building S-34	707-546
20	Grit Blast Disposal Site Adjacent to Building 544	727-561
21	Baghouse and Cyclone Dust Storage Area Near Building 589	734-566
22	Paint Sludge Disposal Site Adjacent to Building D-2	727-569
23	Paint Sludge Disposal Site Adjacent to Building D-5	727-570
24	Closed Pistol Range	721-571
25	Closed Pistol Range	721-572
26	Explosive "D" Washout Area Near Building GB-1	723-559
27	Projectiles Refurbishing Area	725-549
28	Waste Oil Tank	714-577
29	PCB Spill Site in Storage Area North of Building C-16	714-577

problems that were identified during this program are associated with the disposal of municipal wastes and small amounts of industrial wastes, and the production of nitrates during the open burning of ordnance materials.

6.6.1 Site No. 1: Ordnance Demilitarization Site, Secured

This six-acre site, located near Building S-465 at coordinates 719-584, was used for the burning of ordnance materials from 1943 to 1974. A site layout is shown in Figure 6-5. The site was demiliterized in 1975, and is currently used by the U.S. Army as a communications facility. The demiliterization of the site involved plowing the area, spreading a layer of oil-soaked hay, and setting the hay ablaze to burn the site's surface. This operation was carried out three times.

No records or other hard data describing the operations of this ordnance disposal range were available. Based on interviews at the Station, it was determined that at least 90% of the material burned during the lifetime of this site was smokeless powder, which is essentially nitrocellulose. Any unburned residue or combustion products left from this material would be relatively insoluble, and thus pose no hazard through percolation to the groundwater. Black powder (which is 75% KNO_3 (or $NaNO_3$), 15% charcoal, and 10% sulfur) may have been used to aid in ignition of the smokeless powder here. However, the amounts used would have been very small, so that no significant environmental or public health impacts would have resulted from combustion residues of that substance.

Given the nature of the propellants burned at this site and the fact that they do not pose a potential threat to public health or the environment, this site is not recommended for a Confirmation Study.

6.6.2 Site No. 2: Ordnance Demilitarization Site

This eleven-acre site, located at coordinates 748-574, is currently being used for the burning of ordnance from on- and off-base operations, including some material received from the New Jersey Department of Environmental Protection. Operation of this site commenced in 1974. The

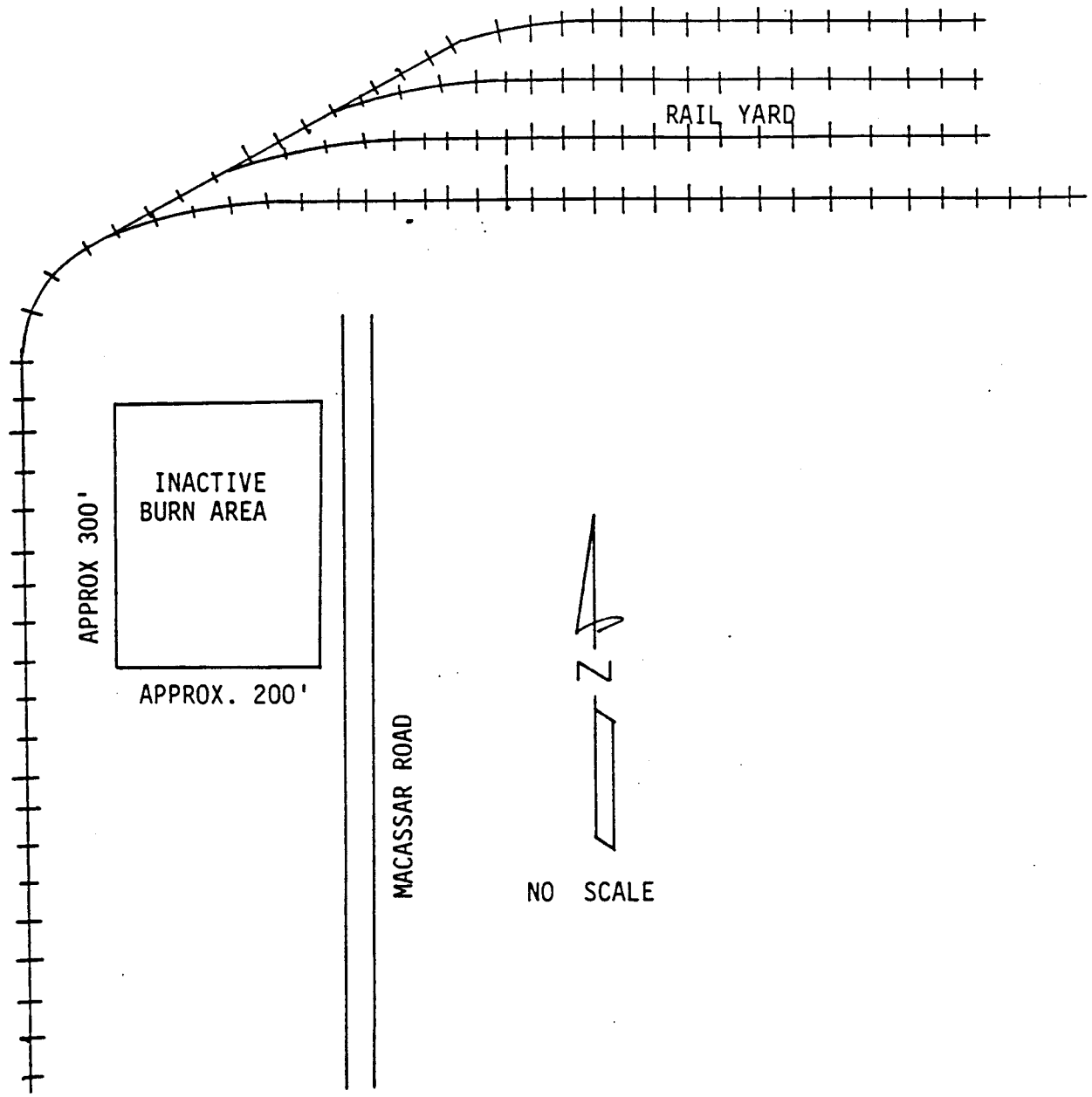

Figure 6-5 SITE NO. 1, ORDNANCE DEMILITARIZATION SITE, SECURED

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active burn pit and surrounding area are shown in Figures 6-6 and 6-7, respectively.

An average of roughly 800 pounds of explosive are burned at this site each month, for a total of approximately 80,000 pounds since ordnance demilitarization began at this location. The explosives and propellants which have been burned here include the following:

- Ammonium picrate (Explosive D- $(ONH_4)C_6H_2(NO_2)_3$).
- Trinitrotoluene (TNT - $CH_3C_6H_2(NO_2)_3$).
- Cyclonite (RDX - $C_3H_6N_6O_6$).
- C-4 (a plastic explosive compound - waxed RDX).
- Black powder (for example, 75% KNO_3 (or $NaNO_3$), 15% charcoal, and 10% sulfur).
- Double-base propellants, a mixture of nitrocellulose (60-80%) and nitroglycerine (20-40%) [4].

The combustion of ordnance material during demiliterization at this site would have produced gaseous products (e.g., nitrogen oxides, carbon monoxide and carbon dioxide), particulates, and other solid residues, but the exact amounts formed cannot be determined. The gaseous products would have been lost to the atmosphere, but some of the particulate products and all of the solid residues would have remained in the soil at this site. In addition small amounts of metal such as iron, copper and lead (these metals are components of double-base propellants) would have remained.

For the purpose of evaluating the potential impact of the residues at this site, it is estimated that five percent of the total ordnance material demilitarized remained as solid residue or unburned product, and that the vast majority of this residue was potassium nitrate and other nitrate compounds. According to the Handbook of Chemistry and Physics [6], nitrates are highly soluble in cold water. With monthly residues of 40 pounds, and given the average rates of rainfall and evapotranspiration in this area, it is estimated that the concentration of nitrates in the water percolating through this site to the groundwater is 9.7 mg/l. The U.S. Environmental Protection Agency National Primary Drinking Water Standard for nitrates is

Figure 6-6 SITE NO. 2, ORDNANCE DEMILITARIZATION SITE SHOWING SPENT MUNITIONS AND BURN RESIDUES

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Figure 6-7 SITE NO. 2, ORDNANCE DEMILITARIZATION SITE SHOWING LACK OF SITE DRAINAGE TO THE NORTH AND LACK OF VEGETATION

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10 mg/l. Based on the above analysis, the concentrations of nitrates in the water entering the groundwater table beneath this site are sufficiently close to the USEPA standard to pose a potential problem.

The potential for migration of metals from the site is minimal. Metals released during the burning of these ordnance materials would either remain in a metallic form or oxidize. In either form these metals are highly insoluble in natural rain waters and would most likely remain entrained in the soils. Therefore, metals at this site do not pose a significant environmental hazard.

This site is recommended for a Confirmation Study because of the potential release of nitrates to the groundwater. The site is located within the recharge zone of the Vincentown Aquifer. Groundwater flow in this aquifer is to the southest, and the nearest known downgradient well is approximately two miles away in that direction. However, several homes that may use the Vincentown Aquifer as a domestic water source are located less than one mile southeast of the site.

6.6.3 Site No. 3: Landfill Southwest of "F" Group

This five-acre site, located at coordinates 728-541, was used for the disposal of station refuse from 1960 to 1968. The approximate location of this site is shown in Figure 6-8. Station employees interviewed by the Public Works Department in 1980 indicated that an effort was made to dispose of only domestic refuse at this site. However, due to the absence of any other disposal sites at the Station during the lifetime of this landfill, it is likely that Station industrial wastes were disposed of here as well.

Based upon the estimates of Station solid waste production presented in Section 6.3.5 (1.7 tons of waste per day), the total wastes disposed of at this site would have been approximately 4,800 tons. This would have consisted primarily of municipal wastes such as paper, glass, plastics, trash, etc. However, the material disposed of at this site would have included other items such as the following:

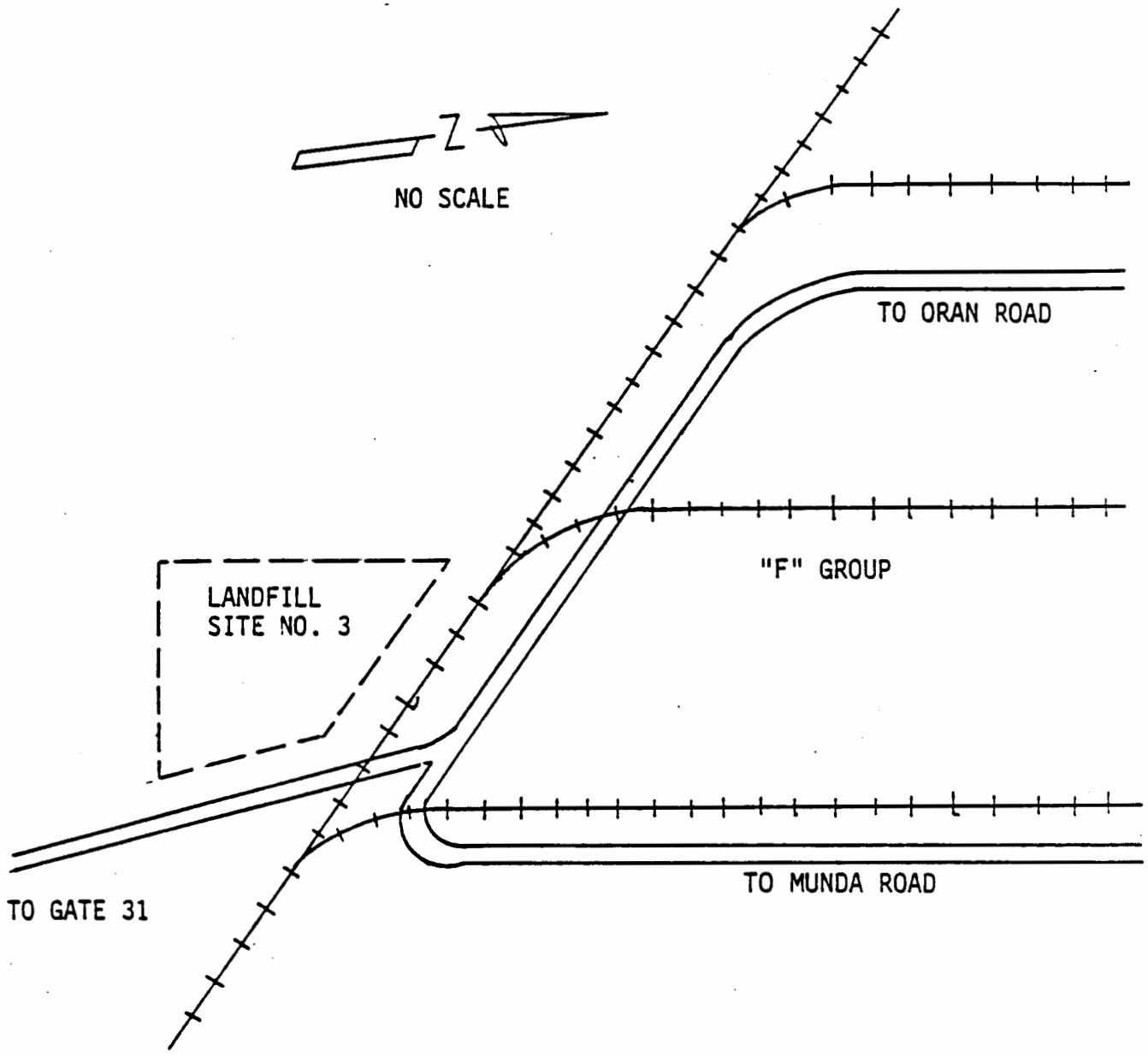

Figure 6-8 APPROXIMATE LOCATION OF SITE NO. 3, THE LANDFILL SOUTHWEST OF "F" GROUP

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- Paints and paint thinners.
- Solvents (e.g., toluene and acetone), varnishes and shellacs.
- Acids, alcohols and caustics.
- Pesticide containers and rinsewaters.
- Waste wood (construction debris and dunnage).
- Small amounts of asbestos from pipe and boiler insulation and automotive brake linings.
- Other industrial wastes.

The exact amounts of these various industrial wastes disposed of at this site are not known. However, gross estimates of the amounts of some of the more hazardous constituents can be made. Estimating the annual rate of paint usage at the Station at 300 gallons, and assuming that as much as 10% of all paint used becomes waste material, it is estimated that the following amounts of material were disposed of in this landfill in waste paint:

- Zinc: 450 pounds or less.
- Lead: 150 pounds or less.
- Titanium: 60 pounds or less.
- Chromium, iron, benzene, toluene, xylene, tetrachloroethane, ethyl acetate, acetate, acetone, ethyl alcohol and ethylene glycol: 30 pounds or less of each.*

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* These weight estimates are based on the following assumptions:

Weight of paint = 13 pounds per gallon

Composition of paint, by weight is zinc (15%), lead (5%), titanium (2%), chromium, iron, benzene, toluene, xylene, tetrachloroethane, ethyl acetate, acetone, ethyl alcohol, ethylene glycol (each 1%) [5].

This analysis supports the results of interviews and observation of Station activities, which indicate that industrial wastes comprise a very small amount of the total wastes deposited in this landfill. This is especially true in light of the fact that Station operations have included housing for military personnel since 1963. However, leachate from municipal wastes can pose a public health hazard if human consumption of contaminated wastes occurs.

No stressed vegetation was observed at this former landfill. However, this site is recommended for a Confirmation Study because of the potential that hazardous materials may have been disposed of there and because there is a high potential for migration. Soils underlying the site are sands and sand loams. A study of the soils in the "F" Group area for foundation purposes indicates that the soils are sandy from the surface to the water table, which averages 15 feet below the ground in this area. The data indicates that the soils are rapidly permeable and conducive to downward migration of contaminants. The site area is within the aquifer recharge zone of the Kirkwood Aquifer and as such poses a potential threat to groundwater quality in this aquifer. While not a formal source of public water in the vicinity of the Main Base, it is used for domestic purposes via shallow wells for homes nearby. Groundwater flow is to the southeast and east and the nearest potential receptors are in a local community which is less than one mile to the south.

6.6.4 Site No. 4: Landfill West of "D" Group

This five-acre landfill, located east of Macassar Road at coordinates 721-567, was used from 1943 to 1960 for the disposal of approximately 10,200 tons of general station waste (see Section 6.3.5). This included principally domestic wastes, with some demolition wastes and some industrial wastes such as empty solvent containers, paint, and insecticide or herbicide containers. Typical operations at this site included the burning of waste material in open trenches prior to covering (burial). However, interviews indicated that pesticide and herbicide materials (containers, rinsewaters, etc.) may have been buried unburned. Inspection of the site indicated inadequate or eroded cover along the east side of the fill, with some evi-

dence that construction debris was dumped since site closure. Because of the non-cohesive (sandy) soils at this site, erosion is suspected as the principal agent of cover removal. This is borne out by the presence of "outwash" areas down slope from the fill. No stressed vegetation was found downgradient, but trees planted on the landfill cover are not yet well established. The approximate site location and boundaries are shown in Figure 6-9.

As with Site No. 3, described above, this landfill may have received relatively small (as compared to total wastes deposited) amounts of industrial wastes which may have had hazardous constituents. Using the same waste generation factors as were used for Site No. 3, it can be estimated that the total quantity of hazardous wastes delivered to this landfill in paint residues alone was as follows:

- Zinc: 1,000 pounds or less.
- Lead: 350 pounds or less.
- Titanium: 170 pounds or less.
- Chromium, iron, benzene, toluene, xylene, tetrachlorethane, ethyl acetate, acetate acetone, ethyl alcohol, and ethylene glycol: 88 pounds or less of each.

Other wastes which probably found their way into this landfill include small amounts of: solvents (e.g., toluene and acetone); varnishes; shellacs, acids; alcohols; caustics; pesticide containers and rinsewaters; and asbestos residues from pipe and boiler insulation and automotive brake linings.

The numerical estimations above support the results of interviews and observations at the Station, which indicated that industrial wastes represent a very small percentage of the total wastes deposited in this landfill. However, leachate from municipal-type wastes can pose a public health hazard if human consumption of contaminated water occurs.

This landfill is within the area of Cranberry Hill, part of a series of low hills that traverse the Main Base. The hills consist of the

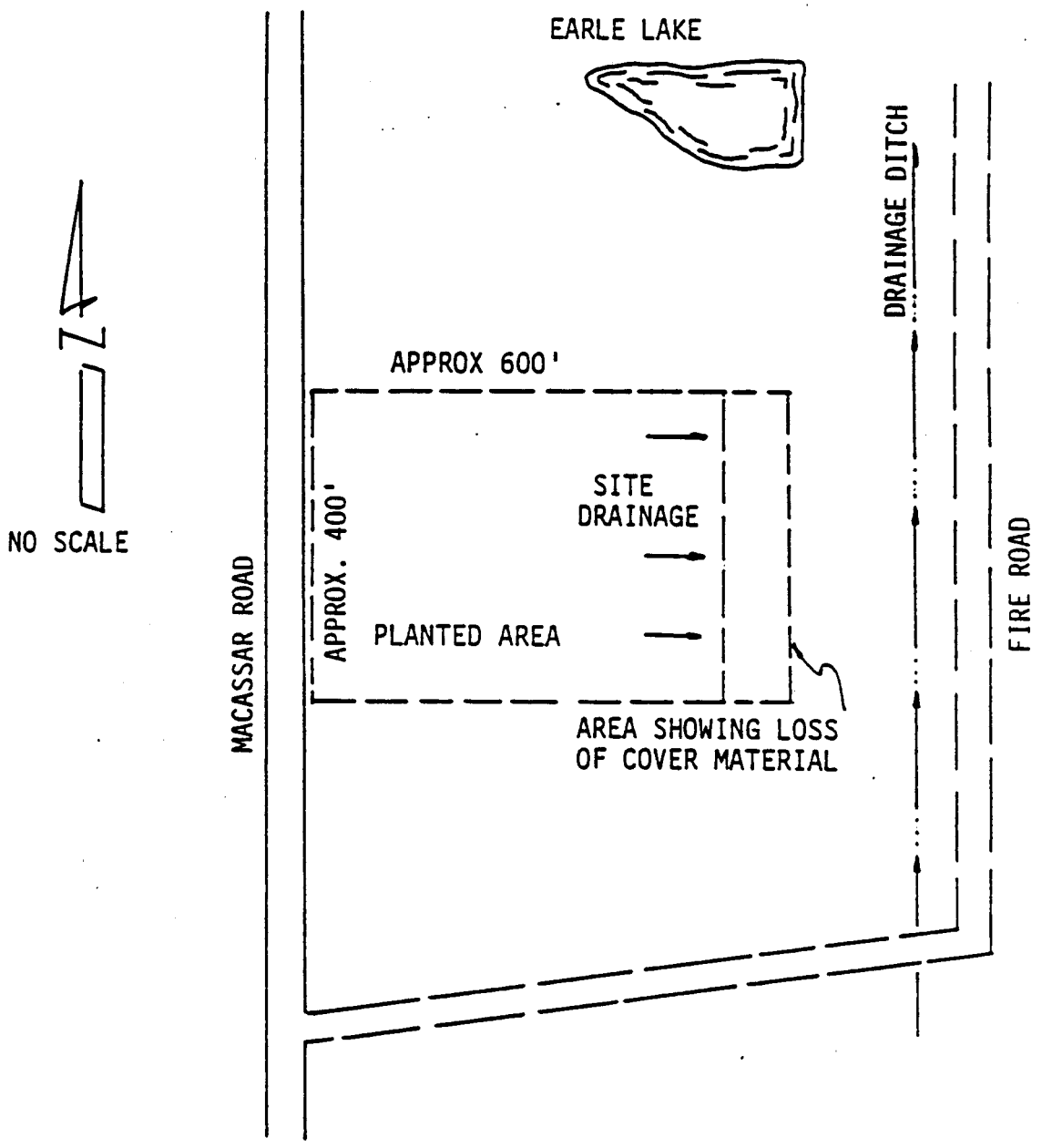

Figure 6-9 APPROXIMATE LOCATION OF SITE NO. 4, THE LANDFILL WEST OF "D" GROUP

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Cohansey Sand, a formation of interbedded sands and clays. The soil underlying the site is a rapidly permeable sand which will allow easy infiltration. However, the Cohansey Sand in this area contains white, dark, red and gray kaolinite clays interbedded with the sand; these clays would retard verticle migration and favor lateral migration. Several springs have been reported at the base of the hill, indicating that some groundwater in the Cohansey Sand may be perched.

In addition to lateral flow, a portion of the groundwater underlying the site may also move vertically downward through "windows" in the clay layers within the Cohansey Sand and recharge the Kirkwood Aquifer. Groundwater flow in the Kirkwood Aquifer is to the east and southeast of the site and the nearest potential groundwater users are 1.5 miles southeast of the site. This site is recommended for a Confirmation Study because of the potential disposal of hazardous materials and the hydrogeology that is highly conducive to contaminant migration.

6.6.5 Site No. 5: Landfill West of Army Barricades

This 13-acre site, located at coordinates 749-570, was used for the disposal of approximately 6,600 tons of station waste (both domestic and industrial) from 1968 to 1978. Inspection showed that closure was complete, but that because of cover soil characteristics, the vegetation at the site is poorly established. The site has a "closed" drainage pattern, indicating that no direct escape to surface water is occurring. At the same time the closed drainage and porous cover material allow high infiltration of materials to groundwater. Figures 6-10 and 6-11 show the vegetation and the nature of erosion at this site.

Using the waste paint generation figures and assumptions presented in the description of the landfill at Site No. 3, it can be estimated that the total quantity of hazardous wastes delivered to this landfill in paint residues alone was as follows:

- Zinc: 600 pounds or less.
- Lead: 200 pounds or less.

Figure 6-10 Site No. 5, Landfill West of Army Barricades showing typical vegetation

Figure 6-11 Site No. 5, Landfill West of Army Barricades showing typical erosion patterns adjacent to site

- Titanium: 80 pounds or less.
- Chromium, iron, benzene, toluene, xylene, tetrachlorethane, ethyl acetate, acetate, acetone, ethyl alcohol and ethylene glycol: 40 pounds or less of each.

Other wastes which probably found their way into this landfill include small amounts of: waste solvents (e.g., toluene and acetone), varnishes, shellacs, acids, alcohols, caustics, pesticide containers and rinsewaters, and small amounts of asbestos residues from pipe and boiler insulation and automotive brake linings.

The numerical estimations above support the results of interviews and observations at the Station, which indicated that industrial wastes represent a very small percentage of the total wastes deposited in this landfill. However, leachate from municipal-type wastes can pose a public health hazard if human consumption of contaminated water occurs.

The soils underlying this site are sands and sandy loams with moderate permeabilities. The site is located within the Kirkwood Aquifer recharge area and any downward migration of leachate-contaminated groundwater will enter this aquifer. The prevalent groundwater flow direction in this aquifer is to the southeast, and the nearest downgradient users of the aquifer are approximately one mile to the southeast. With site geology that is conducive to migration of leachate, and the potential that hazardous materials were disposed of at this site, the site is recommended for a Confirmation Study.

6.6.6 Site No. 6: Landfill West of Normandy Road

This four-acre landfill, located at coordinates 786-739, was used for the disposal of refuse from Waterfront Area operations from 1943 to 1965. Materials disposed of at this site were burned before covering. Given the nature of the activities in the Waterfront Area, it is expected that the wastes disposed of at this site included dunnage lumber (typically untreated pine), glass, paper, packing material, and small amounts of paint and solvent wastes. Small amounts of preserved wood (e.g. pentachlorophenol-impregnated) may also have been disposed of here, but such activity

could not be verified. Because no ships were homported at NWS Earle during the lifetime of this landfill, general shipboard refuse would have been limited. Figure 6-12 shows the approximate location of this site.

Data on the quantities of wasted disposed of at this site are not available. However, on-site interviews indicated that the annual loading of this landfill was less than 2500 tons of refuse.

This landfill site may have been a salt marsh before waste disposal began. Since the landfill was closed, the waterfront recreation building has been constructed on top of the filled land. The Station Public Works Department has no record of problems associated with the construction and use of this building on this site.

This site is adjacent to a tidal marsh and within close proximity to Sandy Hook Bay. Surface drainage from the site will flow into the marsh and eventually into the bay. In addition, the site is in an area of sandy soils that offer a conduit for migration of potential contaminants to the groundwater. However, area residents are supplied by the public water supply system, and there is no known use of the uppermost aquifer in the vicinity. Any contaminants that may migrate to groundwater will be discharged with base flow to either the marsh area or the bay.

The bulk of the wastes disposed of at this site were inert. Given this and the fact that groundwater in the area is not consumed, no health effects or significant environmental impacts are anticipated. Therefore, this site is not recommended for a Confirmation Study.

6.6.7 Site No. 7: Landfill South of "P" Barricades

This five-acre site, located at coordinates 783-728, was used from 1965 to 1977 for general station waste from the Waterfront Area. The average quantity disposed of was reported to be 25,000 tons per year [2]. However, a discussion with personnel of the Public Works Department indicated that the annual loading should have been less than 2500 tons of refuse. This included munitions shipping wastes (dunnage, packing materials, etc.), shop wastes from the Waterfront Public Works Shop and the

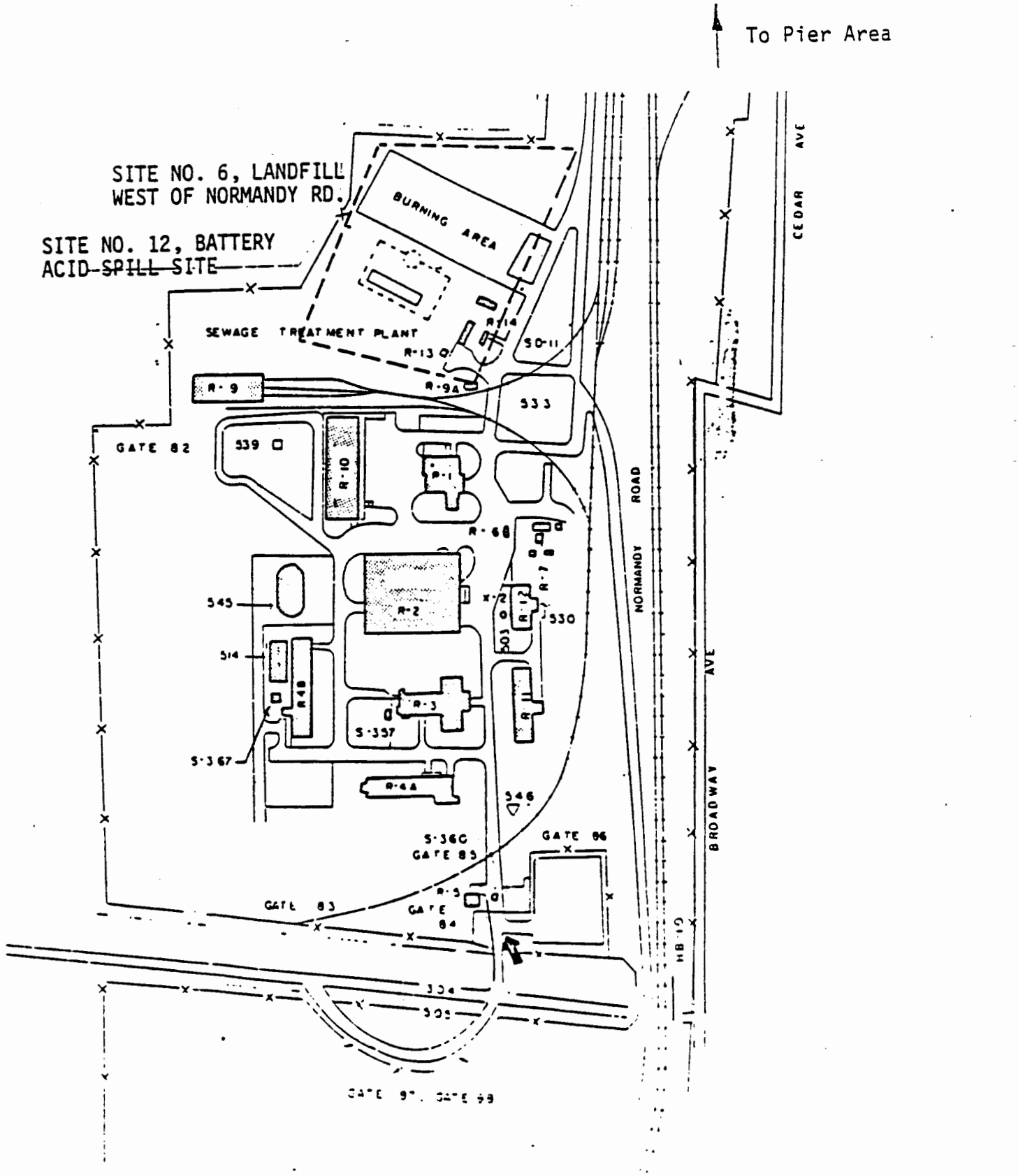

Figure 6-12 APPROXIMATE LOCATION OF SITE NO. 6, LANDFILL WEST OF NORMANDY ROAD, AND SITE NO. 12, BATTERY ACID SPILL SITE

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Munitions Handling Laboratory (glass, wood and small quantities of waste paints, thinners and solvents), and domestic refuse. The site is now covered with two feet of soil and is being revegetated by weeds, as shown in Figure 6-13.

This site is located at the headwaters of Compton Creek. This creek drains through a tidal marsh area before emptying into Sandy Hook Bay. In addition, the site is in an area of permeable sandy soils that offer a conduit for downward migration of potential contaminants to the groundwater. However, area residents are part of the public water supply system and there is no known use of the uppermost aquifer in the vicinity.

The bulk of the wastes disposed of at this site were inert. Given this and the fact that groundwater in the area is not consumed, no health effects or significant environmental impacts are anticipated. Therefore, this site is not recommended for a Confirmation Study.

6.6.8 Site No. 8: Landfill East of S-186

This one-acre site, located at coordinates 785-737, was in use from 1943 to 1965 for dunnage disposal. Dunnage is typically made with untreated lumber. The quantity of wastes disposed of is not known exactly, but estimates of total dunnage quantities of 900 to 1,500 cubic yards per year would indicate that approximately 20,000 to 30,000 cubic yards of material were dumped at this site. This site was not selected for a Confirmation Study because only inert dunnage lumber was disposed of at the site.

6.6.9 Site No. 9: Landfill Southeast of "P" Barricades

This three-acre site, located at coordinates 790-727, was used for disposal of dunnage lumber from 1967 to 1972. Lumber was stacked and burned and then covered. No records exist of dunnage quantities disposed of at this site. However, estimates of total dunnage generation of 900 to 1,500 cubic yards per year would indicate that approximately 4,500 to 7,500 cubic yards of lumber were disposed of at this site. A Confirmation Study is not recommended for this site because of the presence of only waste lumber from dunnage disposal.

Figure 6-13 Site No. 7, Landfill South of "P" Barricades, showing cover and revegetation

6.6.10 Site No. 10: Scrap Metal Landfill Near Building S-589

This two-acre site, located at coordinates 731-565, also known as the "Box Yard", was used from 1953 to 1965 for disposal of demilitarized munitions and spent munitions cases. Aluminum and steel containers and cases from 3"50, 5"38 and 40 mm ammunition were the principal items buried. Including cover material, approximately 65,000 cubic yards of material were disposed of at this site. Since the site was closed, erosion of cover material has uncovered significant quantities of 40 mm shell cases which are more than 50 percent rusted away.

This site was also used for the disposal of spent grit and paint chips from the ammunition rework operations located in Building D-5. These paint chips typically contain lead and zinc. However, in this solid (dried paint) form, these metals are probably bound into the paint in such a manner that they will not leach out under normal (not highly acidic or alkaline) environmental conditions. Thus the paint chips can be considered relatively inert.

This site has not been selected for a Confirmation Study because primarily inert wastes were disposed of at this location. Figure 6-14 shows the approximate location of the "Box Yard".

6.6.11 Site No. 11: Contract Ordnance Disposal Area

This fan-shaped, two-acre site, located at coordinates 725-579, was used by contractors for disposal of obsolete ordnance material for several years. However, the dates of this activity and the amounts of ordnance waste disposed of are not available.

This site was also used from 1974 to 1977 for occassional fire-fighting training exercises. These exercises were conducted in and around two unlined pits which were dug at this site, each measuring roughly 30 ft. x 30 ft. x 2 ft. (depth). The typical practice involved placing a reject airplane or vehicle in the pit, soaking it and the pit with fuel oil (or possibly a mixture of fuel oil and waste oil), and setting the area ablaze.

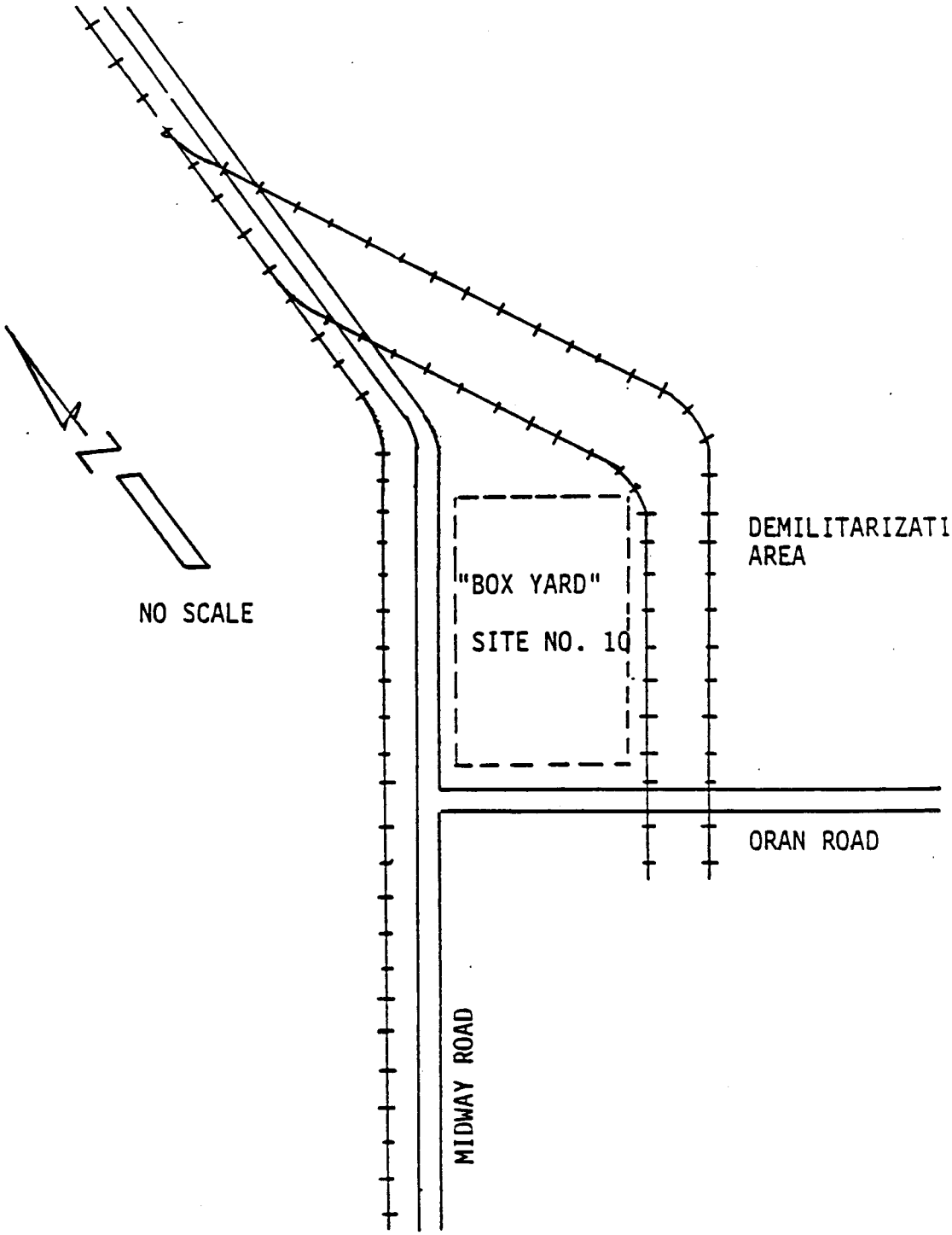

Figure 6-14 APPROXIMATE LOCATION OF SITE NO. 10, SCRAP METAL LANDFILL NEAR BUILDING S-589

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After the fire was extinguished, any remaining (unburned) oil was left in the pit and thus soaked into the soil. No data are available on the total quantities of oil remaining after buring; however, it is estimated that only small quantities (less than 50 gallons per year) of oil would have been lost in this manner.

There is some stressed vegetation in evidence at the site. However, this appears to result from the generally poor soil conditions here. This site was eliminated from consideration for a Confirmation Study because of the availability of only small quantities of waste material for migration to the groundwater. The approximate location of this site is shown in Figure 6-15.

6.6.12 Site No. 12: Battery Acid Spill Site, Waterfront

This area, located behind the new recreation building (Building R-14) at the Waterfront Area at coordinates 786-739, and also shown in Figure 6-12, was used for disposal of an unknown amount of acid electrolyte from forklift batteries being sent offsite for reclamation. The period of disposal and total quantity disposed of are not known, but based on the number of forklifts in use in the area and frequency of battery changes, the amount of spilled electrolyte was probably less than 50 gallons per year..

The concerns associated with this site focus on the presence of battery acid in the waste. However, it was observed during visual inspection that this disposal site drains into a tidal marsh. It is therefore likely that any acidic liquids disposed of would have been neutralized by the buffering capacity of the sea water in the marsh. As a result, this site is not recommended for a Confirmation Study.

6.6.13 Site No. 13: Defense Property Disposal Office Yard

The Defense Property Disposal Office (DPDO) Storage Yard is located near the Rail Classification Yards at coordinates 730-577. The approximate site location is shown in Figure 6-15. Activities conducted at this site included the storage of scrap metals and the storage of forklift

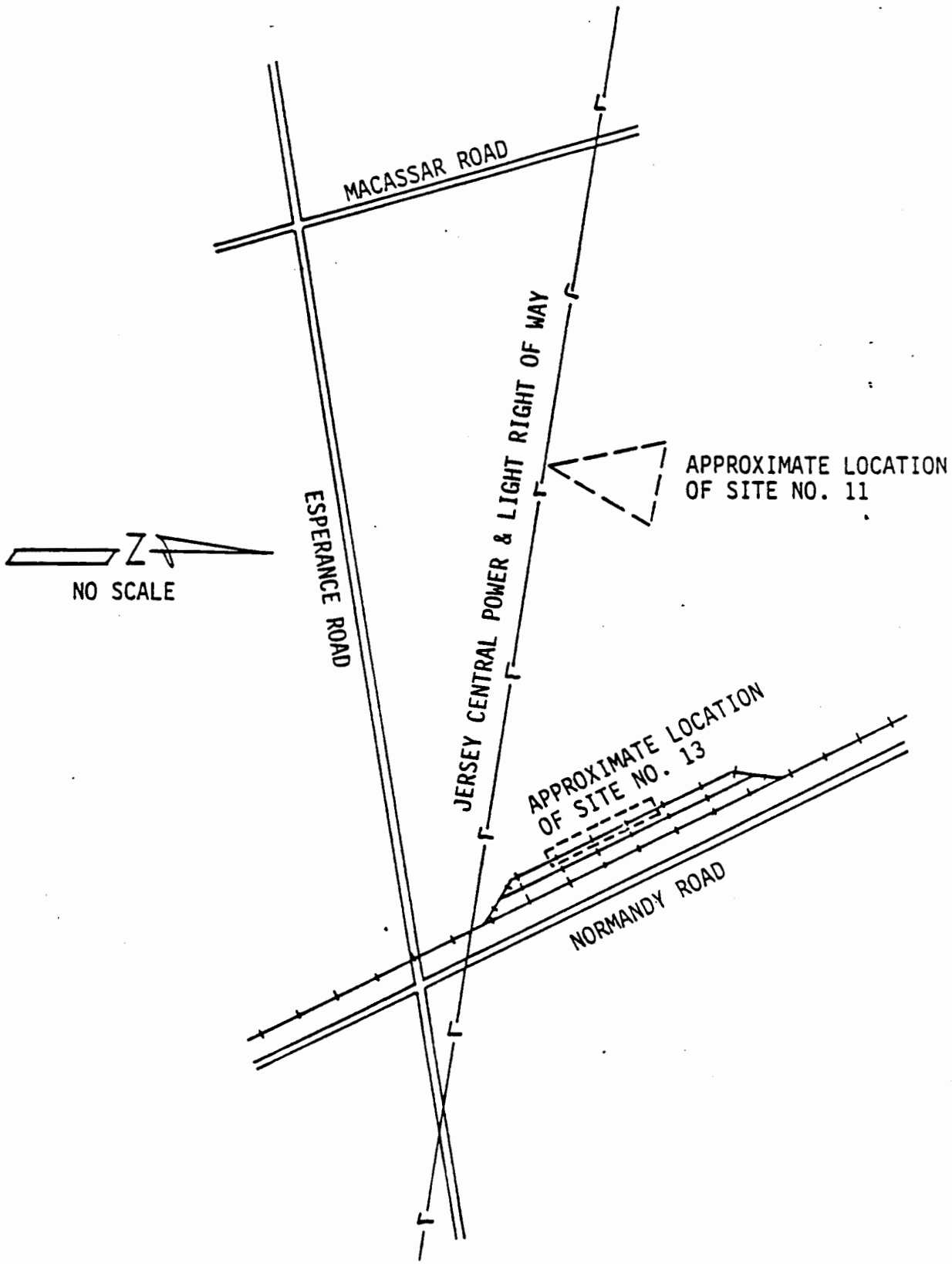

Figure 6-15 APPROXIMATE LOCATIONS OF SITE NO. 11, CONTRACT ORDNANCE DISPOSAL AREA, AND SITE NO. 13, DEFENSE PROPERTY DISPOSAL OFFICE YARD

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batteries. Minor spills of battery acid (on the order of 10 gallons per year or less) may have occured at the site during the handling of batteries (e.g. batteries may have tipped over). In addition, PCB-containing transformers were stored at this site in open rail cars before being transported to the controlled storage area (QH-8). Transformer cases were periodically inspected for damage, and larger transformers were stored in empty torpedo barrels. Interviews indicated that no leakage occurred. This site was not selected for a Confirmation Study because no significant amounts of hazardous waste seem to be present.

6.6.14 Site No. 14: Defense Property Disposal Office Warehouse

The Defense Property Disposal Office (DPDO) Warehouse, Building C-33, located at coordinates 718-571, is a 16,000 square foot storage building for items awaiting processing. On-site interviews indicated that a mercury spill of unknown quantity occurred in this building in 1970. Cleanup operations were conducted, but further information on the extent of the spill and subsequent cleanup was not available. This site was not selected for a Confirmation Study because site visits and interviews indicate that materials were stored in a protected manner, and thus the likelihood of environmental contamination was low. The approximate site location is shown in Figure 6-16.

6.6.15 Site No. 15: Sludge Disposal Site Near Waterfront South Gate

According to inverviews conducted during the inspection of NWS Earle, a site along the railroad tracks at the main entrance to the Waterfront Area (coordinates 787-741) was used for disposal of an unknown quantity (possibly over 5,000 gallons) of oily bilge sludge, ranging from 1 to 25 percent oil, from ships homeported at the base during the early 1970's [3]. However, the exact location of this disposal was not apparent from close inspection of the suspected area. Because the location and degree of oil disposal at this site could not be determined during the inspection and subsequent discussions with Station personnel, this site was not recommended for a Confirmation Study.

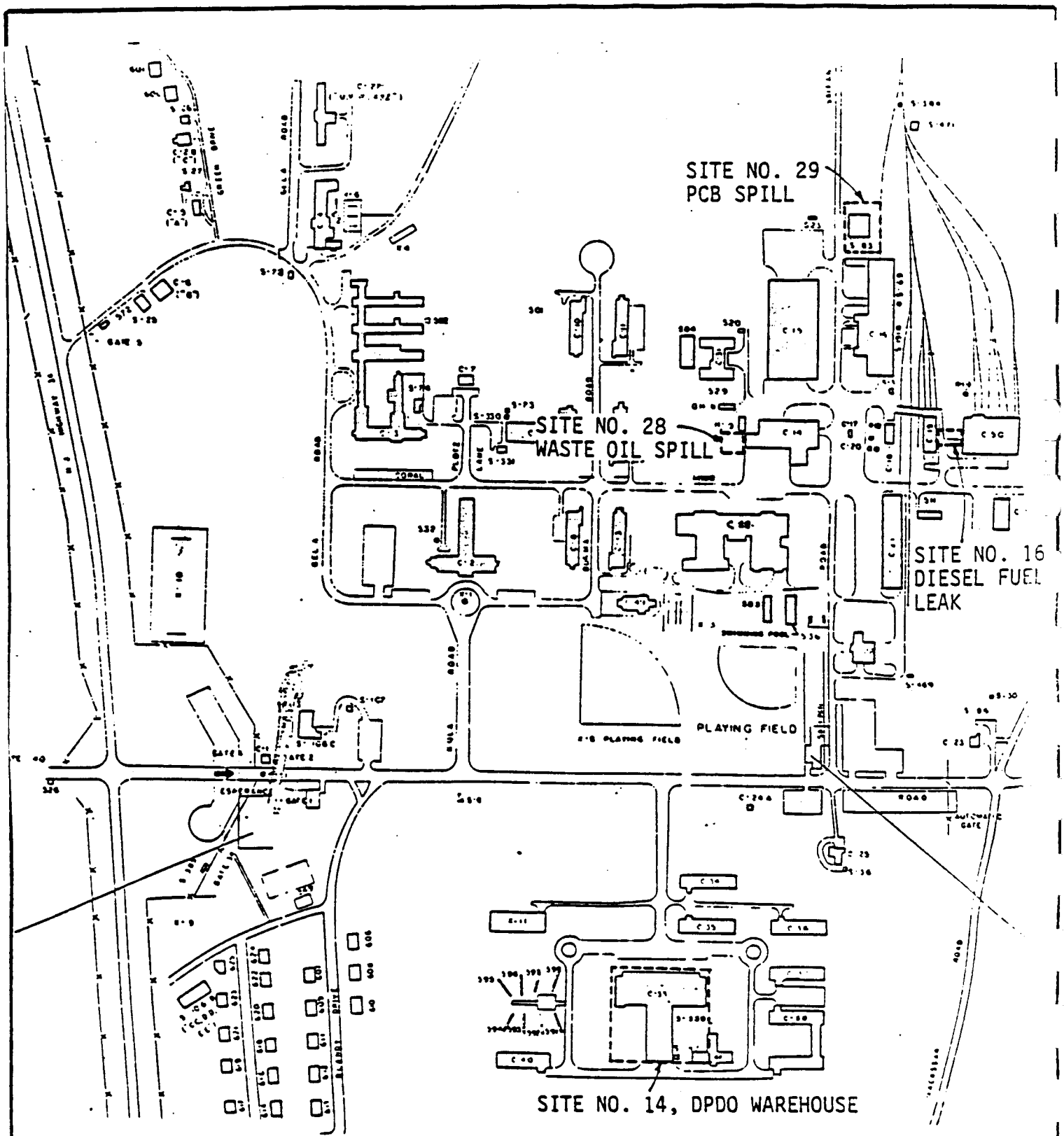

Figure 6-16 APPROXIMATE LOCATION OF WASTE DISPOSAL SITES IN THE MAIN BASE ADMINISTRATION AREAS: SITE NOS. 14, 16, 28 AND 29

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6.6.16 Site No. 16: Fuel Line Connecting Buildings C-20 and C-50

This underground fuel line was used to transport diesel fuel from an underground fuel storage tank located adjacent to Building C-20 to a dispensing station (pump) located behind Building C-50, a distance of approximately 400 feet. A leak in the fuel line was discovered in June, 1977 when soil residues were discovered in the locomotive fuels, and use of the pipeline was discontinued. Subsequent excavation uncovered the location of the leak, and it was determined that the amount of diesel fuel lost was minimal (less than 50 gallons). The location of this fuel line is shown in Figure 6-16. Because the leak was discovered quickly, and the amount of fuel lost was estimated to be minimal, this site is not recommended for a Confirmation Study.

6.6.17 Site No. 17: Disposal Area Behind Training Barge, Waterfront Area

This site is currently used and has been used in the past as a disposal area by Waterfront Area personnel. The materials disposed of here have included forklift vehicles, empty paint cans, construction debris such as wood, concrete and asphalt, waste equipment such as old valves, and similar relatively inert materials. During physical inspection of the site an empty drum (55 gallons) was observed. However, no evidence of stressed vegetation was apparent, as shown in Figure 6-17. This site was not selected for a Confirmation Study because of the presence of largely inert and immobile materials.

6.6.18 Site No. 18: Demilitarization Furnace, Building 589

This furnace, located at coordinates 734-567, and shown in Figure 6-18, was placed in operation in 1978, and is used to demilitarize small caliber (up to 40 mm) ammunition by burning. Waste areas at the site include about 50 sq. ft. of soil contaminated by metal fragments dropping off the furnace discharge conveyor. In this fragment form, (e.g. metal chips) the metals in question (typically iron and copper) are inert and as such do not pose a threat to human health or the environment. Therefore, this site is not recommended for a Confirmation Study.

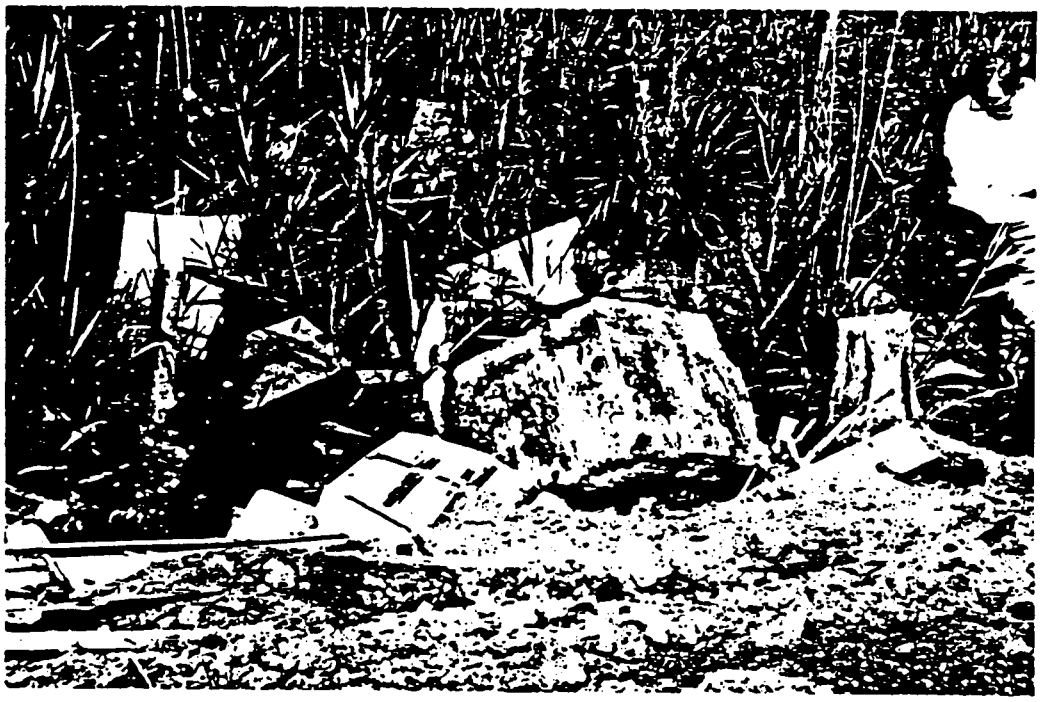

Figure 6-17 Site No. 17, Disposal Area Behind Training Barge, showing nature of material disposed and lack of vegetation stress

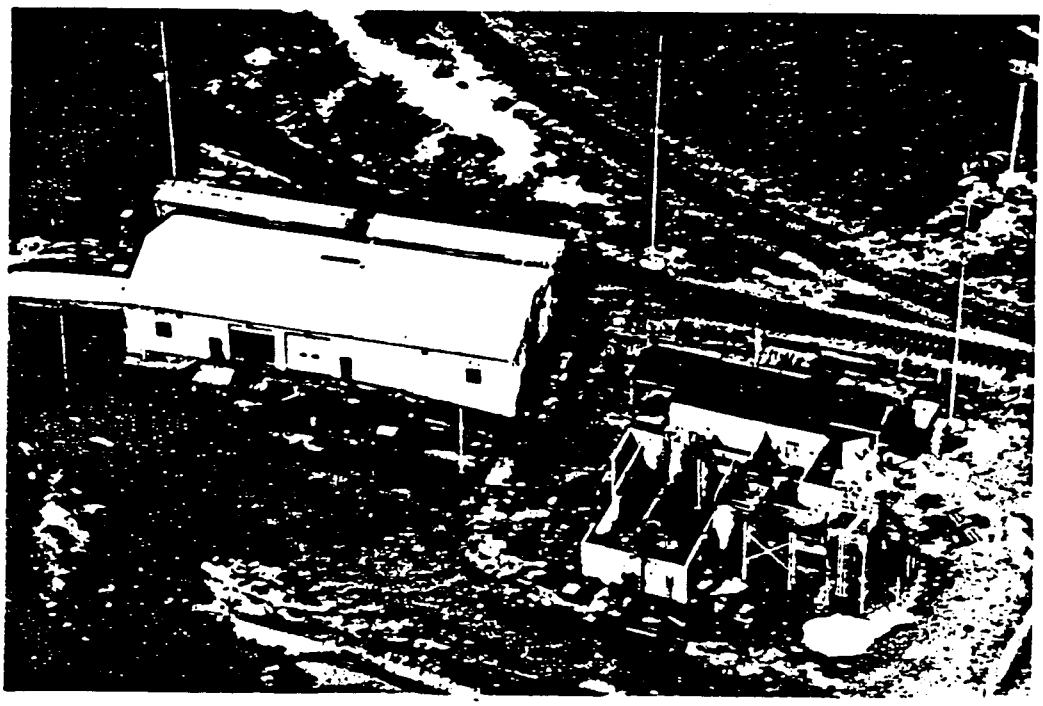

Figure 6-18 Site No. 18, Demilitarization Furnace, aerial view showing air pollution control devices

6.6.19 Site No. 19: Paint Chip and Sludge Disposal Area Adjacent to Building S-34

This site, located 1,000 feet south of Farmingdale Road at coordinates 708-543, was used for the disposal of paint chips and paint sludge from depth charge maintenance operations. Depth charge maintenance was conducted in Building S-34 from the early 1940's until the early 1960's. On-site interviews indicated that, since the early 1940's, an estimated 1,000 depth charges per year (MK8, 14) were wire brushed, washed down, and repainted on an outdoor concrete platform. A five percent solution of paint scrapings in wash waster was discharged continuously at a 7,000 gallon per day flow rate into an open drainage swale. The stripped depth charges were then repainted with a zinc chromate primer and a lead base top coat.

This procedure continued until the late 1950's when a solvent paint stripping procedure was started. Using this procedure, the depth charges were dipped into a 55-gallon tank containing "keolite," a solvent for lead-based paints. The depth charges were then lifted out of the tank and washed down with water as before. This procedure continued for about four years (circa 1959 to 1963).

The resultant discharges (including paint sludges) were dumped outside the building. Runoff from the site would travel via Mingamahone Creek to the Manasquan River. Approximately 100 gallons per year of a solvent/sludge mixture was disposed of on the site during the four years that the keolite stripping system was operative. This paint stripping operation was terminated in the early 1960's (circa 1963) due to the concerns of Station personnel regarding the potential environmental impacts of keolite on Mingamahone Creek aquatic life.

According to interviews at the Station, new barricade facilities were constructed on this former paint sludge disposal site in the early 1970's. It is assumed that any construction operations conducted at the site would have included excavating the site to a depth of 3 to 4 feet for the laying of a foundation. Such excavation would have removed the bulk of any paint sludge residues remaining at the site. In addition, the presence

of the barricades on the site would create a cap which would preclude percolation of rainwater through the site to the groundwater. It is therefore reasoned that, because construction activity associated with the barricades built here would have removed much of the hazard associated with paint sludge disposal operations, this site does not represent a significant threat to the environment or to public health. Thus, a Confirmation Study is not recommended.

6.6.20 Site No. 20: Grit Blast Disposal Area, Building 544

Building 544 houses blasting operations for the removal of paint from mines. The paint removed from mines, along with spent grit, is disposed in a 15' x 100' area behind Building 544 at coordinates 727-561. Assuming a steady-state operation (i.e. paint applied this year will be removed over subsequent years), approximately three gallons of zinc chromate primer, 40 gallons of latex and lead based paints, and 10 gallons of copper based paints are stripped per year. Thus a volume of paint chips equivalent to roughly 53 gallons per year of wet paint was disposed of at this site. These paint chips typically contain lead and zinc. However, in this solid form (dried paint), these metals are probably bound into the paint in such a manner that they will not leach out under normal (not highly acidic or alkaline) environmental conditions. Thus the paint chips can be considered relatively inert.

Figure 6-19 shows the appearance of this disposal site. This site is not recommended for a Confirmation Study because of the relative immobility (stability) of the lead and zinc contained in the paint chips.

6.6.21 Site No. 21: Baghouse and Cyclone Dust Storage Area Adjacent to Building S-589

After demilitarization of small arms ammunition by burning in the demil furnace, residual metals (principally brass cases), are recovered for sale as scrap through the DPDO. In the four years 1978-82, the air pollution control systems have recovered 25 drums per year (55 gallons per drum) of cyclone and baghouse dusts which contain oxides of metals. The most

Figure 6-19 Site No. 20, Grit Blast Disposal Area, Building 544, showing appearance of disposed material

significant pollutants are cadmium (0.60 to 4.07 percent by weight), lead (3.3 to 11.7 percent by weight), barium (0.31 to 4.62 percent by weight) and chromium (0.03 to 3.66 percent by weight). This material is described in detail in Section 6.2 of this report.

During the past four years, 1978-82, some of this baghouse and cyclone dust has been spilled onto the soil around the drums. As shown on Table 6.6, the vast majority of the oxide forms of these metals are very slightly soluble to insoluble, indicating that the metals will remain in the upper portion of the soils and not migrate with percolating rainwater. The only constituents that may migrate are the oxides of calcium, potassium and strontium. However, these constituents are minor components of the dust, and will not pose any significant environmental hazards. Furthermore, the site was recently paved over, eliminating any additional rainfall infiltration. It is most likely that these metals are entrained in the upper soils of the site and will remain at that position. Therefore, this site was not selected for a Confirmation Study. This site is shown in Figure 6-20.

6.6.22 Site No. 22: Paint Chip Disposal Area Adjacent to Building D-2

This site, located at coordinates 727-569, consists of approximately 50 square feet of stressed vegetation and discolored (black) soils behind Building D-2, probably resulting from past painting operations. It was reasoned that, based upon the appearance of the site, the amount of paint dumped in this area was not large enough to constitute a significant environmental or public health hazard. Therefore, this site was not selected for a Confirmation Study. A typical paint disposal area is shown in Figure 6-21.

6.6.23 Site No. 23: Paint Chip Disposal Area Adjacent to Building D-5

Building D-5, located at coordinates 727-570, has been used at least since the early 1970's for reworking (i.e., repainting and stenciling) major items of ordnance such as torpedoes and aerial bombs. Approximately 200 square feet of bare area behind the building show evidence of paint spillage. It was reasoned that, based upon the appearance of the site, the

Table 6.6

Solubility of Metals Identified in the Baghouse and Cyclone Dust Analysis

Constituent	Formula	Solubility in Grams/100cc of Cold Water
Zinc	ZnO	0.00016 gr
Magnesium	MgO	0.0086
	MgO_2	Insoluble
Cadmium	CdO	Insoluble
Copper	CuO_2	Insoluble
	Cu_4O	Insoluble
Iron	$Fe(OH_2)$	0.00015 gr
Lead	Pb_2O_3	Insoluble
Calcium	CaO	0.131
	CaO_2	Slightly Soluble
Potassium	K_2O	Very soluble
	KO_2	Very soluble
Aluminum	Al_2O_3	Insoluble
Barium	BaO_2	Very slightly soluble
Chromium	CrO_2	Insoluble
	CrO^2	Insoluble
Strontium	SrO	0.69
	SrO_2	0.018
Antimony	Sb_2O_5	Very slightly soluble

Source: Handbook of Chemistry and Physics, 1975, edited by Robert C. Weast [6]

Figure 6-20 Site No. 21, Baghouse and Cyclone Dust Storage Area, showing area affected by material spilling from drums, which were not covered until July 1982

Figure 6-21 Site No. 22, Paint Chip Disposal Area, Building D-2, showing nature of material, with 5 gallon can for scale

amount of paint dumped in this area was not large enough to constitute a significant environmental or public health hazard. Therefore, this site was not selected for a Confirmation Study.

6.6.24 Site No. 24: Closed Pistol Range

This closed small arms practice range located at coordinates 721-571 is characterized by spent cartridge cases along the firing line and by lead and copper jacketed lead bullets in the impact berm. Estimating that approximately 200 rounds of 180 grain .45 caliber ammunition are required per person to maintain annual pistol qualification, and that no more than 50 personnel would maintain qualification per year, the annual loss of lead would be approximately 250 lb in the form of bullets. In that form and those amounts, lead does not pose a significant threat to the environment or to public health. Therefore, this site is not recommended for a Confirmation Study.

6.6.25 Site No. 25: Closed Pistol Range

This closed small arms range, located near Site No. 24 (coordinates 721-572), is similar in nature to Site No. 24. Estimating that approximately 200 rounds of 180 grain .45 caliber ammunition are required per person to maintain annual pistol qualification, and that no more than 50 personnel would maintain qualification per year, the annual loss of lead would be approximately 250 lb in the form of bullets. In that form and those amounts, lead does not pose a significant threat to the environment or to public health. Therefore, this site is not recommended for a Confirmation Study.

6.6.26 Site No. 26: Explosive "D" Washout Area, Building GB-1

This site, located behind Building GB-1 at coordinates 723-559, was used for the removal and recovery of Explosive "D", ammonium picrate, from 5" shells for one year in the late 1960's. The ammonium picrate was removed from the shells by washing out the shells with hot water. The explosive, which is highly soluble in hot water, was readily dissolved, and

the resulting solution flowed into a settling tank where cooling of the water allowed precipitation and collection of Explosive D crystals for reuse or disposal. Overflow from this settling tank flowed through an open 18-inch tile pipe to a 50 square foot unlined settling basin. There, cooling of the solution precipitated out most of the explosive. These precipitated crystals were also collected for reuse or disposal. However, onsite interviews indicated that as much as 20,000 pounds of ammonium picrate could have been lost to surface water during this recovery operation due to heavy rainfalls before cleanout of the settling basin. The exposed discharge channel and settling basin are shown in Figures 6-22 and 6-23 respectively.

This site was eliminated from the Confirmation Ranking Study process because any material lost would have been lost as a direct discharge to surface water, and would no longer be present. Hence, no migration to groundwater is anticipated.

6.6.27 Site No. 27: Projectile Refurbishing Area

At this location (coordinates 725-549), projectiles are refurbished by shot blasting, repainting and restenciling. Spent blasting shot and paint chips are disposed of behind the facility. Approximately 80 cubic feet of mixed blasting shot and paint chips are present at this site. These paint chips typically contain lead and zinc. However, in this solid form, (dried paint), these metals are probably bound into the paint in such a manner that they will not leach out under normal (not highly acidic or alkaline) environmental conditions. Thus the paint chips can be considered relatively inert; they do not pose a significant threat to the environment or public health. Therefore, this site is not recommended for a Confirmation Study.

6.6.28 Site No. 28: Waste Oil Tank

The underground waste oil storage tank located behind Building C-14 has overflowed within the last year, with one to several gallons of oil being spilled on the ground surface. (See Figure 6-16 for site location).

Figure 6-22 Site No. 26, Explosive "D" Washout Area, showing open channel used to transport washed out material to precipitation lagoon

Figure 6-23 Site No. 26, Explosive "D" Washout Area, showing present revegetated appearance of precipitation lagoon

Because of the extremely small quantity spilled (seemingly less than 10 gallons), the site was not selected for a Confirmation Study.

6.6.29 Site No. 29: PCB Spill Site, Building C-16

This site, in the storage yard north of Building C-16, was the location of a 1977 PCB spill from a vandalized transformer. Within five days of the occurence of the spill, over 120 cubic feet of contaminated soil was excavated and transported to off-site disposal. All visible evidence of the oil spill (e.g. discolored soil) was removed during this cleanup operation. Because of the rapid response accorded this problem, and because all oil-soaked soil was removed shortly after the incident, this site is not recommended for a Confirmation Study.

SECTION 6 REFERENCES

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APPENDIX A

VEGETATION SURVEY AT WATERFRONT AREA

PLANTS RECORDED DURING SITE SURVEY OF WATERFRONT AREA

Common Name	Scientific Name
	Herbaceous Plants
Common Yarrow	Achillea millefolium
Onion	Allium sp.
Common Ragweed	Ambrosia artemisiifolia
Blue-stem	Andropogon scoparius
Broom-sedge	Andropogon virginicus
Wormwood	Artemisia sp.
Aster	Aster sp.
Orach	Atriplex sp.
Common Thistle	Cirsium sp.
Horseweed	Conyza canadensis
Salt-grass	Distichlis spicata
Fleabane	Erigeron sp.
Catfoot	Gnaphalium obtusifolium
Grass	Graminal sp.
Lettuce	Lactuca sp.
Pepper-grass	Lipidium virginicum
Wood-sorrel	Oxalis sp.
Switch-grass	Panicum virgatum
Common Reed	Phragmites communis
Poke-weed	Phytolacea americana
Climbing False Buckwheat	Polygonum scandens
Bramble	Rubus sp.
Foxtail	Setaria glauca
Bittersweet	Solanum dulcamara
Goldenrod	Solidago sp.
Grass-leaved Goldenrod	Solidago graminifolia
Sweet Goldenrod	Solidago odora
Seaside Goldenrod	Solidago sempervirens
Smooth Cord-grass	Spartina alterniflora
Salt Hay	Spartina patens
Common Cat-tail	Typha latifolia

Woody Plants	
Sea-myrtle	Baccharis halimifolia
Marsh-elder	Iva fructescens
Japanese Honeysuckle	Lonicera japonica
Bayberry	Myrica pensylvanica
Cottonwood	Populus deltoides
Wing-rib Sumac	Rhus copallina
Staghorn Sumac	Rhus typhina
Black Locust	Robinia pseudo-acacia
Willow	Salix sp.

Source: Dames & Moore, 1977. Field Plant Studies conducted in Waterfront Area of NWS Earle.

APPENDIX B

COMMON WILDLIFE AT NWS EARLE

WILDLIFE OF POTENTIAL OCCURRENCE AT NWS EARLE

BIRDS

Common Name	Scientific Name	Occurrence[a]
	Loons	
Common Loon	Gavia immer	CW
Arctic Loon	Gavia arctica	RW
Red-throated Loon	Gavia stellata	CW
	Grebes	
Red-necked Grebe	Podiceps grisegena	UW
Horned Grebe	Podiceps auritus	CW
Eared Grebe	Podiceps nigricollis	OW
Western Grebe	Aechmophorus occidentalis	RW
Pied-billed Grebe	Podilymbus podiceps	CW
	Shearwaters, Fulmars and Petrels	
Cory's Shearwater	Puffinus diomedea	PT
Greater Shearwater	Puffinus gravis	PT
Sooty Shearwater	Puffinus griseus	PT
Audubon's Shearwater	Puffinus lherminieri	PT
	Storm Petrels	
Leach's Storm-petrel	Oceanodroma leucorhoa	PT
Wilson's Storm-petrel	Oceanites oceanicus	PS
	Pelicans	
Brown Pelican	Pelecanus occidentalis	RT
	Boobies and Gannets	
Gannet	Morus bassanus	PW
	Cormorants	
Great Cormorant	Phalacrocorax carbo	CW
Double-crested Cormorant	Phalacrocorax auritus	CW

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Herons and Bitterns	
Great Blue Heron	Ardea herodias	CY
Green Heron	Butorides virescens	CS
Little Blue Heron	Florida caerulea	CT
Cattle Egret	Bubulcus ibis	UT
Great Egret	Casmerodius albus	CS
Snowy Egret	Egretta thula	CS
Louisiana Heron	Hydranassa tricolor	OT
Black-crowned Night Heron	Nycticorax nycticorax	CY
Yellow-crowned Night Heron	Nyctanassa violacea	US
Least Bittern	Ixobrychus exilis	RS
American Bittern	Botaurus lentiginosus	UY
	Ibises and Spoonbills	
Glossy Ibis	Plegadis falcinellus	UT
	Swans, Geese, and Ducks	
Mute Swan	Cygnus olor	CY
Whistling Swan	Olor columbianus	UW
Canada Goose	Branta canadensis	CW
Brant	Branta bernicia	CW
White-fronted Goose	Anser albifrons	RW
Blue Goose	Chen caerulescens	UW
Snow Goose	Chen hyperborea	UW
Mallard	Anas platyrhynchos	AY
Black Duck	Anas rubripes	AY
Gadwall	Anas strepera	CW
Pintail	Anas acuta	CW
Green-winged Teal	Anas crecca	CW
Blue-winged Teal	Anas discors	CS
European Wigeon	Anas penelope	UW
American Wigeon	Anas americana	AW
Northern Shoveler	Anas clypeata	UW
Wood Duck	Aix sponsa	CS
Redhead	Aythya americana	UW
Ring-necked Duck	Aythya collaris	CW
Canvasback	Aythya valisineria	AW
Greater Scaup	Aythya marila	AW
Lesser Scaup	Aythya affinis	AW
Common Goldeneye	Bucephala clangula	CW

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Swans, Geese and Ducks - Continued	
Barrow's Goldeneye	Bucephala islandica	RW
Bufflehead	Bucephala albeola	CW
Oldsquaw	Clangula hyemalis	CW
Harlequin Duck	Histrionicus histrionicus	OW
Common Eider	Somateria mollissima	OW
King Eider	Somateria spectabilis	OW
White-winged Scoter	Melanitta deglandi	CW
Surf Scoter	Melanitta perspicillata	CW
Common Scoter	Oidemia nigra	CW
Ruddy Duck	Oxyura jamaicensis	CW
Hooded Merganser	Lophodytes cucullatus	UW
Common Merganser	Mergus merganser	CW
Red-breasted Merganser	Mergus serrator	CW
	American Vultures	
Turkey Vulture	Cathartes aura	CS
Black Vulture	Coragyps atratus	RT
	Kites, Hawks, Eagles, and Harriers	
Goshawk	Accipiter gentilis	OW
Sharp-shinned Hawk	Accipiter striatus	UY
Cooper's Hawk	Accipiter cooperii	UY
Red-tailed Hawk	Buteo jamaicensis	CY
Red-shouldered Hawk	Buteo lineatus	UT
Broad-winged Hawk	Buteo platypterus	CS
Rough-legged Hawk	Buteo lagopus	OW
Bald Eagle	Haliaeetus leucocephalus	UT
Marsh Hawk	Circus cyaneus	CY
	Ospreys	
Osprey	Pandion haliaetus	CS
	Caracaras and Falcons	
Peregrine Falcon	Falco peregrinus	UT
Merlin	Falco columbarius	UT
American Kestrel	Falco sparverius	CY
	Grouse and Ptarmigan	
Ruffed Grouse	Bonasa umbellus	UY

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
Quail, Pheasants, and Partridge		
Bobwhite	Colinus virginianus	CY
Ring-necked Pheasant	Phasianus colchicus	CY
Rails, Gallinules, and Coots		
King Rail	Rallus elegans	UY
Clapper Rail	Rallus longirostris	CY
Sora	Porzana carolina	US
Black Rail	Laterallus jamaicensis	RS
Purple Gallinule	Porphyrula martinica	RT
Common Gallinule	Gallinula chloropus	CT
American Coot	Fulica americana	AW
Oystercatchers		
American Oystercatcher	Haematopus palliatus	RT
Plovers, Turnstones, and Surfbirds		
Semipalmated Plover	Charadrius semipalmatus	CT
Piping Plover	Charadrius melodus	US
Wilson's Plover	Charadrius wilsonia	RT
Killdeer	Charadrius vociferus	CY
American Golden Plover	Pluvialis dominica	VT
Black-bellied Plover	Pluvialis squatarola	CT
Woodcock, Snipe, and Sandpipers		
Ruddy Turnstone	Arenaria interpres	CT
American Woodcock	Philohela minor	CS
Common Snipe	Capella gallinago	CT
Whimbrel	Numenius phaeopus	UT
Upland Sandpiper	Bartramia longicauda	UT
Spotted Sandpiper	Actitis macularia	CS
Solitary Sandpiper	Tringa solitaria	CT
Greater Yellowlegs	Tringa melanoleuca	AT
Lesser Yellowlegs	Tringa flavipes	CT
Willet	Catoptrophorus semipalmatus	UT
Red Knot	Calidris canutus	CT
Purple Sandpiper	Calidris maritima	UW
Pectoral Sandpiper	Calidris melanotos	CT
White-rumped Sandpiper	Calidris fuscicollis	UT
Baird's Sandpiper	Calidris bairdii	OT
Least Sandpiper	Calidris minutilla	CT
Dunlin	Calidris alpina	CT
Semipalmated Sandpiper	Calidris pusilla	AT

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Woodcocks, Snipe and Sandpipers - Continued	
Western Sandpiper	Calidris mauri	UT
Sanderling	Calidris alba	AW
Short-billed Dowitcher	Limnodromus griseus	CT
Long-billed Dowitcher	Limnodromus scolopaceus	OT
Stilt Sandpiper	Micropalama himantopus	UT
Buff-breasted Sandpiper	Tryngites subruficollis	RT
Marbled Godwit	Limosa fedoa	OT
Hudsonian Godwit	Limosa haemastica	RT
Ruff	Philomachus pugnax	RT
	Avocets and Stilts	
American Avocet	Recurvirostra americana	RT
Black-necked Stilt	Himantopus mexicanus	RT
	Phalaropes	
Red Phalarope	Phalaropus fulicarius	PT
Northern Phalarope	Lobipes lobatus	PT
	Jaegers and Skuas	
Pomarine Jaeger	Stercorarius pomarinus	PT
Rarasitic Jaeger	Stercorarius parasiticus	PT
Long-tailed Jaeger	Stercorarius longicaudus	PT
	Gulls and Terns	
Glaucous Gull	Larus hyperboreus	UW
Iceland Gull	Larus glaucoides	UW
Great Black-backed Gull	Larus marinus	AY
Lesser Black-backed Gull	Larus fuscus	RT
Herring Gull	Larus argentatus	AY
Ring-billed Gull	Larus delawarensis	CW
Black-headed Gull	Larus ridibundus	UW
Laughing Gull	Larus atricilla	AS
Bonaparte's Gull	Larus philadelphia	AW
Little Gull	Larus minutus	OW
Ivory Gull	Pagophila eburnea	RW
Black-legged Kittiwake	Rissa tridactyia	UW
Sabine's Gull	Xema sabini	RT
Forster's Tern	Sterna forsteri	CT
Common Tern	Sterna hirundo	AS
Roseate Tern	Sterna dougallii	UT
Bridled Tern	Stern anaethetus	RT
Least Tern	Sterna albifrons	CS

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Gulls and Terns - Continued	
Royal Tern	Thalasseus maximus	CT
Caspian Tern	Hydroprogne caspia	UT
Black Tern	Chlidonias niger	CT
	Skimmers	
Black Skimmer	Rynchops niger	US
	Auks, Murres, and Puffins	
Razorbill	Alca otrda	OW
Common Murre	Uria aalge	RW
Thick-billed Murre	Uria lomvia	OW
Dovekie	Alle alle	UW
Black Guillemot	Cepphus grylle	RW
Common Puffin	Fratercula arctica	RW
	Pigeons and Doves	
Mourning Dove	Zenaida macroura	AY
	Cuckoos, Roadrunners, and Anis	
Yellow-billed Cuckoo	Coccyzus americanus	CS
Black-billed Cuckoo	Coccyzus erythropthalmus	CS
	Barn Owls	
Barn Owl	Tyto alba	UY
	Typical Owls	
Screech Owl	Otus asio	CY
Great Horned Owl	Bubo virginianus	CY
Snowy Owl	Nyctea scandiaca	OW
Barred Owl	Strix varia	UY
Long-eared Owl	Asio otus	UW
Short-eared Owl	Asio flammeus	UW
Saw-whet Owl	Aegolius acadicus	UW
	Goatsuckers	
Chuck-will's-widow	Caprimulgus carolinensis	RS
Whip-poor-will	Caprimulgus vociferus	CS
Common Nighthawk	Chordeiles minor	US

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Jays, Magpies, and Crows	
Blue Jay	Cyanocitta cristata	AY
Common Raven	Corvus corax	RW
Common Crow	Corvus brachyrhynchos	AY
Fish Crow	Corvus ossifragus	CS
	Chickadees, Titmice, Verdins, and Bushtits	
Black-capped Chickadee	Parus atricapillus	UW
Carolina Chickadee	Parus carolinensis	AY
Tufted Titmouse	Parus bicolor	CY
	Nuthatches	
White-breasted Nuthatch	Sitta carolinensis	CY
Red-breasted Nuthatch	Sitta canadensis	UW
	Creepers	
Brown Creeper	Certhia familiaris	CW
	Wrens	
House Wren	Troglodytes aedon	CS
Winter Wren	Troglodytes troglodytes	UW
Carolina Wren	Thryothorus ludovicianus	CY
Long-billed Marsh Wren	Telmatodytes palustris	CS
Short-billed Marsh Wren	Cistothorus platensis	RS
	Mockingbirds and Thrashers	
Mockingbird	Mimus polyglottos	CY
Gray Catbird	Dumetella carolinensis	AS
Brown Thrasher	Toxostoma rufum	CS
	Thrushes, Solitaires, and Bluebirds	
American Robin	Turdus migratorius	AY
Wood Thrush	Hylocichla mustelina	CS
Hermit Thrush	Catharus guttatus	CT
Swainson's Thrush	Catharus ustulatus	CT
Gray-cheeked Thrush	Catharus minimus	CT
Veery	Catharus fuscescens	CT
Eastern Bluebird	Sialia sialis	US

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Swifts	
Chimney Swift	Chaetura pelagica	AS
	Hummingbirds	
Ruby-throated Hummingbird	Archilochus colubris	CS
	Kingfishers	
Belted Kingfisher	Megaceryle alcyon	CY
	Woodpeckers, Flickers, and Sapsuckers	
Common Flicker	Colaptes auratus	CY
Pileated Woodpecker	Dryocopus pileatus	RT
Red-bellied Woodpecker	Centurus carolinus	UW
Red-headed Woodpecker	Melanerpes erythrocephalus	UT
Yellow-bellied Sapsucker	Sphyrapicus varius	CT
Hairy Woodpecker	Dendrocopos villosus	CY
Downy Woodpecker	Dendrocopos pubescens	CY
	Tyrant Flycatchers	
Eastern Kingbird	Tyrannus tyrannus	CS
Western Kingbird	Tyrannus verticalis	OT
Great Crested Flycatcher	Myiarchus crinitus	CS
Eastern Phoebe	Sayornis phoebe	CS
Yellow-bellied Flycatcher	Empidonax flaviventris	RT
Acadian Flycatcher	Empidonax virescens	US
Alder Flycatcher	Empidonax traillii	US
Least Flycatcher	Empidonax minimus	CS
Eastern Wood Pewee	Contopus virens	CS
Olive-sided Flycatcher	Nuttallornis borealis	UT
	Larks	
Horned Lark	Eremophila alpestris	CY
	Swallows	
Tree Swallow	Iridoprocne bicolor	AS
Bank Swallow	Riparia riparia	US
Rough-winged Swallow	Stelgidopteryx ruficollis	CS
Barn Swallow	Hirundo rustica	AS
Cliff Swallow	Petrochelidon pyrrhonota	UT
Purple Martin	Progne subis	CS

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Arctic Warblers, Kinglets, and Gnatcatchers	
Blue-gray Gnatcatcher	Polioptila caerulea	CS
Golden-crowned Kinglet	Regulus satrapa	AW
Ruby-crowned Kinglet	Regulus calendula	CT
	Wagtails and Pipits	
Water Pipit	Anthus spinoletta	UW
	Waxwings	
Cedar Waxwing	Bombycilla cedrorum	CY
	Shrikes	
Northern Shrike	Lanius excubitor	RW
Loggerhead Shrike	Lanius ludovicianus	OW
	Starlings	
Starling	Sturnus vulgaris	AY
	Vireos	
White-eyed Vireo	Vireo griseus	CS
Yellow-throated Vireo	Vireo flavifrons	CS
Solitary Vireo	Vireo solitarius	CT
Red-eyed Vireo	Vireo olivaceus	AS
Philadelphia Vireo	Vireo philadelphicus	OT
Warbling Vireo	Vireo gilvus	UT
	Wood Warblers	
Black-and-white Warbler	Mniotilta varia	CT
Prothonotary Warbler	Protonotaria citrea	UT
Worm-eating Warbler	Helmitheros vermivorus	UT
Golden-winged Warbler	Vermivora chrysoptera	OT
Blue-winged Warbler	Vermivora pinus	CS
Lawrence's Warbler	Vermivora lawrencei	RT
Tennessee Warbler	Vermivora peregrina	CT
Orange-crowned Warbler	Vermivora celata	UW
Nashville Warbler	Vermivora ruricapilla	CT
Northern Parula	Parula americana	CT
Yellow Warbler	Dendroica petechia	CS
Magnolia Warbler	Dendroica magnolia	CT
Cape May Warbler	Dendroica trigrina	CT

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
	Wood Warblers - Continued	
Black-throated Blue Warbler	Dendroica caerulescens	CT
Yellow-rumped Warbler	Dendroica coronata	AW
Black-throated Green Warbler	Dendroica virens	CT
Cerulean Warbler	Dendroica cerulea	OT
Blackburnian Warbler	Dendroica fusca	CT
Yellow-throated Warbler	Dendroica dominica	RT
Chestnut-sided Warbler	Dendroica pensylvanica	CT
Bay-breasted Warbler	Dendroica castanea	CT
Blackpoll Warbler	Dendroica striata	CT
Pine Warbler	Dendroica pinus	CS
Kirtland's Warbler	Dendroica kirtlandii	RT
Prairie Warbler	Dendroica discolor	CS
Palm Warbler	Dendroica palmarum	CT
Ovenbird	Seiurus aurocapillus	CS
Northern Waterthrush	Seiurus noveboracensis	CT
Louisiana Waterthrush	Seiurus motacilla	CT
Kentucky Warbler	Oporornis formosus	UT
Connecticut Warbler	Oporornis agilis	UT
Mourning Warbler	Oporornis philadelphia	UT
Common Yellowthroat	Geothlypis trichas	CS
Yellow-breasted Chat	Icteria virens	US
Hooded Warbler	Wilsonia citrina	US
Wilson's Warbler	Wilsonia pusilla	CT
Canada Warbler	Wilsonia canadensis	CT
American Redstart	Setophaga ruticilla	CS
	Weaver Finches	
House Sparrow	Passer domesticus	AY
	Meadowlarks, Blackbirds, and Orioles	
Bobolink	Dolichonyx oryzivorus	UT
Eastern Meadowlark	Sturnella magna	CY
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	RT
Red-winged Blackbird	Agelaius phoeniceus	AY
Orchard Oriole	Icterus spurius	US
Northern Oriole	Icterus galbula	CS
Rusty Blackbird	Euphagus carolinus	CW
Boat-tailed Grackle	Cassidix major	RT
Common Grackle	Quiscalus quiscula	AY
Brown-headed Cowbird	Molothrus ater	AY

BIRDS (Continued)

Common Name	Scientific Name	Occurrence[a]
Tanagers		
Western Tanager	Piranga ludoviciana	RT
Scarlet Tanager	Piranga olivacea	CS
Summer Tanager	Piranga rubra	RT
Grosbeaks, Sparrows, Finches, and Buntings		
Cardinal	Cardinalis cardinalis	AY
Rose-breasted Grosbeak	Pheucticus ludovicianus	CT
Black-headed Grosbeak	Pheucticus melanocephalus	RW
Blue Grosbeak	Guiraca caerulea	RT
Indigo Bunting	Passerina cyanea	CS
Dickcissel	Spiza americana	UW
Evening Grosbeak	Hesperiphona vespertina	CW
Purple Finch	Carpodacus purpureus	CW
House Finch	Carpodacus mexicanus	CY
Pine Grosbeak	Pinicola enculeator	RW
Common Redpoll	Acanthis flammea	OW
Pine Siskin	Spinus pinus	UW
American Goldfinch	Spinus tristis	AY
Red Crossbill	Loxia curvirostra	OW
White-winged Crossbill	Loxia elucoptera	OW
Rufous-sided Towhee	Pipilo erythrophthalmus	AS
Ipswich Sparrow	Passerculus princeps	UW
Savannah Sparrow	Passerculus sandwichensis	CW
Grasshopper Sparrow	Ammodramus savannarum	CS
Henslow's Sparrow	Ammodramus henslowii	US
Sharp-tailed Sparrow	Ammospiza caudacuta	CS
Seaside Sparrow	Ammospiza maritima	CS
Vesper Sparrow	Pooecetes gramineus	US
Lark Sparrow	Chondestes grammacus	OW
Dark-eyed Junco	Junco hyemalis	AW
Oregon Junco	Junco oreganus	OW
Tree Sparrow	Spizella arborea	CW
Chipping Sparrow	Spizella passerina	AS
Clay-colored Sparrow	Spizella pallida	OT
Field Sparrow	Spizella pusilla	CY
Harris's Sparrow	Zonotrichia querula	RT
White-crowned Sparrow	Zonotrichia leucophrys	UT
White-throated Sparrow	Zonotrichia albicollis	AW
Fox Sparrow	Passerella iliaca	CW
Lincoln's Sparrow	Melospiza lincolnii	UT
Swamp Sparrow	Melospiza georgiana	CY
Song Sparrow	Melospiza melodia	AY
Lapland Longspur	Calcarius lapponicus	OW
Snow Bunting	Plectrophenax nivalis	UW

SOURCE: Sandford, W.F., Feb. 20, 1969. Monmouth County's 331 Bird Species. The Daily Register.

Sandford, W.F., Feb. 27, 1969. Make it 332 Bird Species. The Daily Register.

[a]NOTE: A = Abundant; C = Common; U = Uncommon; O = Occasional; R = Rare; P = Pelagic; Y = Year-round; S = Summer; W = Winter; T = Transient.

MAMMALS

Common Name	Scientific Name
Pouched Mammals	
Opossum	*Didelphis marsupialus*
Insect Eaters	
Masked Shrew	*Sorex cinereus*
Smoky Shrew	*Sorex fumeus*
Least Shrew	*Cryptotis parva*
Eastern Mole	*Scalopus aquaticus*
Star-nosed Mole	*Condylura cristata*
Bats	
Keen Myotis	*Myotis keeni*
Little Brown Myotis	*Myotis lucifugus*
Small-footed Myotis	*Myotis subulatus*
Silver-haired Bat	*Lasionycteris noctwagans*
Eastern Pipistrel	*Pipistrellus subflavus*
Red Bat	*Lasiurus borealis*
Hoary Bat	*Lasiurus cinereus*
Big Brown Bat	*Eptesicus fuscus*
Hares and Rabbits	
Eastern Cottontail	*Sylvilagus floridanus*
New England Cottontail	*Sylvilagus transitionalis*
Rodents	
Eastern Chipmunk	*Tamias striatus*
Woodchuck	*Marmota monax*
Eastern Gray Squirrel	*Sciurus carolinensis*
Red Squirrel	*Tamiasciurus hudsonicus*
Southern Flying Squirrel	*Glaucomys volans*
Beaver	*Castor canadensis*
Rice Rat	*Oryzomys palustris*
White-footed Mouse	*Peromyscus leucopus*
Boreal Redback Vole	*Clethrionomys gapperi*
Meadow Vole	*Microtus pennsylvanicus*
Pine Vole	*Pitymys pinetorum*
Muskrat	*Ondatra zibethicus*
Southern Bog Lemming	*Synaptomys cooperi*
Norway Rat	*Rattus norvegicus*
House Mouse	*Mus musculus*
Meadow Jumping Mouse	*Zapus hudsonius*

MAMMALS

Common Name	Scientific Name
Flesh Eaters	
Red Fox	Vulpes fluva
Gray Fox	Urocyon cinereoargenteus
Raccoon	Procyon lotor
Long-tailed Weasel	Mustela frenata
Mink	Mustela vison
Striped Skunk	Mephitis mephitis
River Otter	Lutra canadensis
Even-Toed Hoofed Mammals	
White-tailed Deer	Odocoileus virginianus

SOURCE: Burt, W.H. and R.P. Grossenheider, 1964. A Field Guide to the Mammals. Houghton Mifflin Company: Boston. 284 p.

REPTILES

Common Name	Scientific Name
Turtles	
Common Snapping Turtle	Chelydra s. serpentina
Eastern Painted Turtle	Chrysemys p. picta
Spotted Turtle	Clemmys guttata
Wood Turtle	Clemmys insculpta
Bog Turtle	Clemmys muhlenbergi
Eastern Mud Turtle	Kinosternon s. subrubrum
Red-bellied Turtle	Pseudemys rubriventris
Stinkpot	Sternothaerus odoratus
Eastern Box Turtle	Terrapene c. carolina
Northern Diamondback Terrapin	Malaclemys terrapin terrapin
Lizards	
Five-lined Skink	Eumeces fasciatus
Ground Skink	Lygosoma laterale
Northern Fence Lizard	Sceloporus undulatus hyacinthus
Snakes	
Eastern Worm Snake	Carphophis a. amoenus
Scarlet Snake	Cemophora coccinea
Northern Black Racer	Coluber c. constrictor
Timber Rattlesnake	Crotalus h. horridus
Northern Ringneck Snake	Diadophis punctatus edwardsi
Corn Snake	Elaphe g. guttata
Black Rat Snake	Elaphe o. obsoleta
Eastern Earth Snake	Haldea v. valeriae
Eastern Hognose Snake	Heterodon platyrhinos
Eastern Milk Snake	Lampropeltis doliata triangulum
Eastern Kingsnake	Lampropeltis g. getulus
Northern Water Snake	Natrix s. sipedon
Rough Green Snake	Opheodrys aestivus
Northern Pine Snake	Pituophis m. melanoleucus
Northern Brown Snake	Storeria d. dekayi
Northern Red-bellied Snake	Storeria o. occipitomaculata
Eastern Ribbon Snake	Thamnophis s. sauritus
Eastern Garter Snake	Thamnophis s. sirtalis

SOURCE: Conant, R., 1958. A Field Guide to Reptiles and Amphibians. Houghton Mifflin Company: Boston. 366 p.

AMPHIBIANS

Common Name	Scientific Name
Salamanders	
Eastern Tiger Salamander	Ambystoma t. tigrinum
Spotted Salamander	Ambystoma maculatum
Marbled Salamander	Ambystoma opacum
Four-toed Salamander	Hemidactylium scutatum
Red-backed Salamander	Plethodon c. cinereus
Northern Two-lined Salamander	Eurycea b. bislineata
Northern Dusky Salamander	Desmognathus f. fuscus
Red-spotted Newt	Diemictylus v. viridescens
Northern Red Salamander	Pseudotriton r. rubra
Eastern Mud Salamander	Pseudotriton m. montanus
Frogs and Toads	
Northern Cricket Frog	Acris c. crepitans
Fowler's Toad	Bufo woodhousei fowleri
Pine Barrens Treefrog	Hyla andersoni
Northern Spring Peeper	Hyla c. crucifer
Eastern Gray Treefrog	Hyla v. versicolor
New Jersey Chorus Frog	Pseudacris triseriata kalmi
Bullfrog	Rana catesbeiana
Green Frog	Rana clamitans
Pickerel Frog	Rana palustris
Southern Leopard Frog	Rana pipiens sphenocephala
Carpenter Frog	Rana virgatipes
Wood Frog	Rana sylvatica
Eastern Spadefoot	Scaphiopus holbrooki

SOURCE: Conant, R., 1958. A Field Guide to Reptiles and Amphibians. Houghton Mifflin Company: Boston. 366 p.

APPENDIX C

PHYTOPLANKTON AND MARINE INVERTEBRATES

ESTUARINE SPECIES OF POTENTIAL OCCURRENCE IN SANDY HOOK BAY

PHYTOPLANKTON

Bacillariophyceae

Melosira varians Agarph[1]
M. borreri Greville[2]
Coscinodiscus excentricus Ehrenberg
Coscinodiscus radiatus Ehrenberg
Coscinodiscus concinnus W. Smith
Coscinodiscus centralis Ehrenberg
Coscinodiscus gigas Ehrenberg
Coscinodiscus sp.
Thalassiosira nordenskioldi Cleve
Thalassiosira gravida Cleve
Thalassiosira hyalina (Grun.)
Thalassiosira rotula Muenier
Thalassiosira sp.
Coscinosira polychorda Gran
Skeletonema costatum (Grev.) Cleve
Rhizosolenia alata Brightwell
Rhizosolenia fragilissima Bergon
Rhizosolenia setigera Brightwell
Rhizosolenia hebetata f. semispina (Hensen) Gran
Leptocylindrus danicus Cleve
Chaetoceros atlanticus Cleve
Chaetoceros danicus Cleve
Chaetoceros borealis Baily
Chaetoceros decipiens Cleve
Chaetoceros compressus Lauder
Chaetoceros didymus Ehrenberg

Bacillariophyceae (Continued)

Chaetoceros constrictus Gran
Chaetoceros affinis Lauder
Chaetoceros affinis v. Willei (Gran) Hustedt
Chaetoceros subsecundes (Gran) Hustedt
Chaetoceros holsaticus Schutt
Chaetoceros debilis Cleve
Chaetoceros sp.
Biddulphia granulata Roper
Triceratium favus Ehrenberg
Cerataulina bergonii Peragallo
Lithodesmium undulatum Ehrenberg
Eucampia zoodiacus Ehrenberg
Fragilaria crotonensis Kitton[1]
Fragilaria spp.
Asterionella japonica Cleve
Asterionella bleakerlevi Smith[2]
Synedra affinis v. faciculata (Kutzing) Gunow[2]
Thalassiothrix longissima Cleve and Grunow
Licomophora abbreviata Agardh
Achnanthes longpipes Agardh
Cocconeis scutellum Ehrenberg
Cocconeis spp.
Rhoicosphenia curvata (Kutzing) Grunow
Navicula cancellata Donk[2]
Navicula radiosa Kutzing
Navicula elegans W. Smith
Navicula spp.
Diploneis splendida (Greg.) Cleve
Pennularia spp.
Gyrosigma accuminatus (Kutzing) Rabenhorst[1/2]
Gyrosigma spp.

Bacillariophyceae (Continued)

Pleurosigma fasciola Ehrenberg
Pleurosigma spp.
Donkinia spp.
Amphora ovaris Kutzing[1]
Amphora lineolata Ehrenberg[1/2]
Cymbella spp.
Nitzschia seriata Cleve
Nitzschia lanceolata W. Smith[1/2]
Nitzschia closterium W. Smith
Nitzschia paradoxa (Gmelin) Grunow
Nitzschia spp.
Cymatopleura solea (Breb.) W. Smith[1]
Cymatopleura elliptica (Breb.) W. Smith[1]
Campylodiscus undulatus Greville

Cyanophyceae

Gomphosphaeria lucstris Chodat[1]
Agmenellum quadruplicatum (Menegh.) Brebsson[1]
Pandorina morum (O.F. Muller) Bory[1]
Scenedesmus armatus Chodat[1]
Ulothrix spp.[1]
Spirogyra spp.[1]
Closterium leileinni Kutzing[1]

Euglenophyta

Euglenoids[1/2]

Dinophyceae

Exuviella compressa (Stein) Ostenfeld
Exuviella spp.
Prorocentrum micans Ehrenberg
Amphidinium fusiforme Martin (?)
Gymnodinium rhombiodes Schutt
Nematodinium armatum (Dogiel) Kofoid and Swezy
Dinophysis acuta Ehrenberg
Dinophysis ovum Schutt
Glenodinium danicum Paulsen
Goniaulax spinifera (Clap. and Lachum.) Diessing
Goniaulax spp.
Peridiniopsis rotundata Lebour
Peridinium pellucidum (Bergh) Schutt
Peridinium cerasus Paulsen
Peridinium conicoides Paulsen
Peridinium trochoideum (Stein) Lemmermann
Peridinium elgans Cleve
Peridinium brevipes Paulsen
Ceratium bucephalum (Cleve) Cleve
Ceratium furca (Ehrenberg) Claparede and Lachmann
Ceratium fusus (Ehrenberg) Dujardin
Ceratium minutum Jorgensen
Ceratium tripos (O.F. Muller) Nitzsch
Ceratium macroseros (Ehrenberg) Van Heurck

NOTE:

[1]Freshwater species.

[2]Brackish-Water Species

SOURCE: Kawamura, T., 1966. Distribution of Phytoplankton Populations in Sandy Hook Bay and Adjacent Areas in Relation to Hydrographic Conditions in June 1962. Bureau of Sport Fisheries and Wildlife, Technical Paper 1, Washington, D.C.

ZOOPLANKTON

Protozoa

- Tintinnopsis aperta
- Tintinnopsis kofoidii
- Tintinnopsis lindeni
- Tintinnopsis musicola
- Tintinnopsis sp.
- Tintinnopsis tubulosa
- Helicostomella fusiformis
- Favella ehrenbergi
- Ptychocylis obtusa
- Rhabdonella sp.
- Tintinnus rectus
- Tintinnus turris
- Lionotus fasciola
- Loxophyllum rostratum
- Dipleptus sp.
- Acineta tuberosa

Coexentexata

- Diparena strangulata
- Phialacium longuida
- Obelia sp.
- Boceroides sp.

Aschelminuthes

- Synchaeta littoralis

Chaetognatha

- Sagitta elegans
- Sagitta minima

Arthropoda

- Euadne nordmanni
- Euadne tergestina
- . odon polyphenoides
- Podon lenckarti
- Calanus finmarchicus
- Calanus minor
- Paracalanus crassipostris

Arthropoda (Continued)

Pseudocalanus minutus
Pseudodiaptomus coronatus
Centropages bradyl
Centropages hamatus
Centropages typicus
Labidoceia activa
Acartia tonsa
Acartia clausi
Temora longicornis
Temora turbinata
Eurytemora americana
Eurytemora affinis
Tortanus discaudata
Oithona similis
Oithona simplex
Oithona plumifera
Microsetella norvegica
Microsetella rosea
Evansula incerta
Harpacticus spp.

Prochordata

Oikopleura disica
Oikopleura longicauda
Oikopleura sp.

SOURCE: Yamazi, I., 1966, Zooplankton Communities of the Navesink and Shrewsbury Rivers and Sandy Hook Bay, New Jersey, U.S. Bur. Sport Fish & Wildlife, Tech. Paper No. 2, pp 1-44.

BENTHOS

Porifera:

- *Cliona* sp.
- *Microciona prolifera*
- unidentified sp.

Cnidaria (Coelenterata):

Hydrozoa:
- *Hydractinia echinata*
- *Tubularia* sp.
- unidentified sp.

Anthozoa:
- *Certanthus* sp.
- *Haliplanella luciae*
- *Metridium senile*
- unidentified sp.

Platyhelminthes:

Tuberellaria:
- unidentified sp.

Nemertea (Rhynchocoela):
- Unidentified sp.

Annelida:

Oligochaeta:
- unidentified sp.

Polychaeta:

Polynoidae:
- *Harmothoe extenuata*
- *Harmothoe imbricata*
- *Lepidonotus squamatus*
- *Lepidonotus sublevis*

Phyllodociadae:
- *Eteone heteropoda*
- *Eteone lactea*
- *Eteone sanguinea*
- *Eulalia viridis*

Eumida sanguinea
Paranaitis speciosa
Phyllodoce groenlandica

Hesionidae:
Podarke obscura

Syllidae:
Exogone dispar
Antolytus cornutus

Nereidae:
Nereis arenaceodentata
Nereis succinea
Nereis virens
Nereis pelagica

Nephtyidae:
Nephtys bucera
Nephtys incisa
Nephtys picta

Glyceridae:
Glycera americana
Clycera dibranchiata

Onuphidae:
Diopatra cuprea

Lumbrineridae:
Lumbrineris tenuis

Arabellidae:
Drilonereis longa

Orbiniidae:
Scolopolos fragilis
Scoloplos armiger

Spionidae:
Polydora lingni
Spio setosa
Spio filicornis
Spiophanes bambyx
Streblospio benedicti
Scolelepis squamata
Scolelepides viridis

Chaetopteridae:
Spiochaetopterus oculatus

Cirratulidae:
Dodecaceria coralii
Tharyx sp.

Flabelligeridae:
Pherusa affinis

Capitellidae:
Heteromastus filiformis
Capitellid A
Capitellid B

Sabellariidae:
Sabellaria vulgaris

Pectinariidae:
Pectinaria gouldii
Pectinaria hyperborea
Pectinaria sp.

Ampharetidae:
Asabellides oculata

Terebellidae:
Polycirrus eximius

Sabellidae:
Sabella microphthalma

Serpulidae:
Hydroides dianthus
Protula tubularia
unidentified sp.

Mollusca:

Gastropoda:

Prosobrachia:
Littorina littorea
Crepidula fornicata
Crepidula plana
Lunatia heros
Polinices duplicatus
Urosalpinx cinerea
Eupleura caudata

Prosobranchia (Continued)

Busycon canaliculatum
Busycon carica
Nassarius obsoletus
Nassarius tribittatus
Retusa canaliculata
Retusa obtusa
Pyramidella fusca
Odostomia trifida
Odostomia sp.
Mitrella lunata

Opisthobranchia:
Adalaria proxima
Doridella obscura

Bivalvia:

Protobranchia:
Nucula proxima
Yoldia limatula

Lamellibranchis:
Modiolus demissus
Mytilus edulis
Anonia simplex
Crassostrea virginica
Mercenaria mercenaria
Gemma gemma
Petricola pholadiformis
Tellina agilis
Macoma balthica
Ensis directus
Spisula solidissima
Mulinia lateralis
Mya arenaria
Astarte borealis

Arthropoda:

Crustacea:

Cirripedia:
Balanus crenatus
Balanus eburneus
Balanus improvisus

Isopoda:
- Cyathura polita
- Edotea triloba
- Edotea montosa

Amphipoda:

Ampeliscidae:
- Ampelisca sp.

Haustoriidae:
- Haustorius sp.

Phoxocephalidae:
- Paraphoxus spinosus
- Paraphoxus epistomus

Stenothoidae:
- Stenothoe cypris
- Stenothoe minuta
- Stenothoe sp.

Gammaridae:
- Carinogammarus mucronatus
- Elasmopus laevis

Corophiidae:
- Corophium sp.
- Unciola serrata

Ischyroceridae:
- Jassa marmorata
- Jassa falceta

Aoridae:
- Microdentopus gryllotalpa

Unidentified sp.

Decapoda:

Carridea:
- Crangon septemspinosus

Brachyura:
- Callinectes sapidus
- Cancer irroratus
- Carcinus maenas
- Eurypanopeus depressus
- Hexapanopeus angustifrons

Brachyura (Continued)

Neopanope texana sayi
Panopeus herbsti
Rhithropanopeus harrissi
Libinia sp.
Ovalipis ocellatus

Anomura:
Pagurus longicarpus
Parurus pollicarus

Merostomata:
Limulus polyphemus

Ectoprocta:

Ctenostomata:
Alcyonidium polyoum
Amathia vidovici
Bowerbankia gracilis

Cheilostomata:
Bugula sp.
Canopeum reticulum
Electra hastingsae
Membranipora tenuis
Cryptosula pallasiana
Schizoporella unicornis

unidentified sp.

Echinodermata:

Asteroidea:
Asterias forbesi

Echinoidea:
Arbacia punctualata

Chordata:

Urochordata:
Molgula manhattensis

Tunicate:
Ascidiacea

Source: Dean, D. 1975, Raritan Bay Macrobenthos Survey, 1957-1960. NMFS Data Report 99.

McGrath, R.A., 1974. Benthic Macrofaunal Census of Raritan Bay: Preliminary results: Benthos of Raritan Bay. Paper NO24j Proceeding 3rd Symposium Hudson River Ecology, March 22-23, 1973.

U.S. Army Corps of Engineers, New York District, 1976a. Draft Environmental Statement: Staten Island, Fort Wadsworth to Arthur Kill Beach, Erosion Control and Hurricane Project, Richmond County, New York.

APPENDIX D

PINE BARRENS ALGAE

ALGAE KNOWN OR POSSIBLE FOR THE NEW JERSEY PINE BARRENS

Streams	
Red Algae	Batrrachospermum spp
Diatoms	Frustulia spp
	Fragilaria spp
	Eunotia spp
	Pinnularia spp
	Actinella punctata (a species found only in acid waters)
Green Algae	Mougeotia spp
	Zygogonium spp
	Zygnema spp
	Spirogyra spp
	Microspora spp
Desmids	almost all genera
Ponds and Lakes	Oedogonium spp
	Aphanochate repens
	Ulothrix zonata
	plus all stream algae species

APPENDIX E

MARINE FISH

Common Name	Scientific Name	Occurrence*
Sand tiger	Odontaspis taurus	C
Sandbar sharks	Carcharhinus milberti	C
Smooth dogfish	Mustelus canis	C
Smooth hammerhead	Sphyrna zygaena	R
Spiny dogfish	Squalus acanthias	C
Clearnose skate	Raja eglanteria	C
Little skate	Raja erinacea	C
Barndoor skate	Raja laevis	C
Roughtail stingray	Dasyatis centroura	C
Smooth butterfly ray	Gymnura micrura	R
Bullnose ray	Myliobatis freminvillei	R
Cownnose ray	Rhinoptera bonasus	C
Shortnose sturgeon	Acipenser brevirostrum	C
Atlantic sturgeon	Acipenser oxyrhynchus	C
Ladyfish	Elops saurus	R
Tarpon	Megalops atlantica	R
American eel	Anguilla rostrata	A
Hickory shad	Alosa mediocris	C
Blueback herring	Alosa aestivalis	C
Alewife	Alosa pseudoharengus	C
American shad	Alosa sapidissima	C
Atlantic menhaden	Brevortia tyrannus	A
Atlantic herring	Clupes harengus harengus	R
Gizzard shad	Dorosoma cepedianum	R
Atlantic round herring	Etrumeus teres	R
Atlantic thread herring	Opisthonema oglinum	R
Striped anchovy	Anchoa hepsetus	A
Bay anchovy	Anchoa mitchilli	C
Rainbow trout	Salmo gairdneri	R
Brown trout	Salmo trutta	R
Inshore lizardfish	Synodus foetens	R
Oyster toadfish	Opsanus tau	C
Goosefish	Lophius americanus	C
Atlantic cod	Gadus morhua	R
Silver hake	Merluccius bilinearis	R
Atlantic tomcod	Microgadus tomcod	R
Red hake	Urophycis chuss	C
Spotted hake	Urophycis regius	C
Striped cusk-eel	Rissola marginata	R
Halfbeak	Hyporhamphus unifasciatus	C
Atlantic needlefish	Strongylura marina	C
Sheepshead minnow	Cyprinodon variegatus	C

Common Name	Scientific Name	Occurrence*
Mumichog	Fundulus heteroclitus	A
Striped killifish	Fundulus majalis	C
Rainwater killifish	Lucania parva	C
Atlantic silverside	Menidia menidia	A
Rough silverside	Membras martinica	C
Threespine stickleback	Gasterosteus aculeatus	C
Fourspine stickleback	Apeltes quadracus	R
Lined seahorse	Hippocampus erectus	R
Northern pipefish	Syngnathus fuscus	C
White perch	Morone americanus	C
Striped bass	Morone saxatilis	C
Black sea bass	Centropristes striata	C
Bluefish	Pomatomus saltatrix	A
Cobia	Rachycentron canadum	R
Sharksucker	Echeneis naucrates	R
African pompano	Alectis crinitus	R
Blue runner	Caranx crysos	C
Crevalle jack	Caranx hippos	C
Atlantic bumper	Chloroscombrus chrysurus	R
Bigeye scad	Selar crumenophthalmus	R
Lookdown	Selene vomer	R
Banded rudderfish	Seriola zonata	R
Florida pompany	Trachinotus carolinus	R
Permit	Trachinotus falcatus	R
Atlantic moonfish	Vomer setapinnis	C
Gray snapper	Lutjanus griseus	R
Tripletail	Lobotes surinamensis	R
Pigfish	Orthopristis chrysopterus	R
Pinfish	Lagodon rhomboides	R
Scup	Stenotomus chrysops	A
Silver perch	Bairdiella chrysura	C
Weakfish	Cynoscion regalis	C
Spot	Leiostromus xanthurus	R
Northern kingfish	Menticirrhus saxatilis	C
Atlantic croaker	Micropogon undulatus	R
Black drum	Pogonias cromis	C
Red drum	Sciaenops ocellata	R
Red goatfish	Mullus auratus	R
Bermuda chub	Kyphosus sectatrix	R
Atlantic spadefish	Chaetodipterus faber	R
Spotfin butterflyfish	Chaetodon ocellatus	R
Tautog	Tautoga onitis	C
Cunner	Tautogolabrus adspersus	C
White mullet	Mugil curema	R
Striped mullet	Mugil cephalus	C
Northern sennet	Sphyraena borealis	R

Common Name	Scientific Name	Occurrence*
Northern stargazer	Astroscopus guttatus	R
American sand lance	Ammodytes americanus	R
Naked goby	Gobiosoma bosci	R
Atlantic cutlassfish	Trichiurus lepturus	R
Atlantic bonito	Sarda sarda	R
Chub mackerel	Scomber japonicus	R
Atlantic mackerel	Scomber scombrus	C
Spanish mackerel	Scomberomorus maculatus	R
Harvestfish	Peprilus adepidotus	R
Butterfish	Peprilus triacanthus	C
Northern searobin	Prionotus carolinus	A
Striped searobin	Prionotus evolans	A
Grubby	Myoxocephalus aneneus	R
Longhorn sculpin	Myoxocephalus octodecemspinosus	C
Gulfstream flounder	Citharichthys arctifrons	R
Smallmouth flounder	Etropus microstromus	R
Summer flounder	Paralichtys dentatus	C
Fourspot flounder	Paralichthys oblongus	R
Windowpane	Scophthalmus aquosus	A
Winter flounder	Pseudopleuronectes americanus	A
Hogchoker	Trinectes maculatus	C
Orange filefish	Aluterus schoepfi	R
Planehead filefish	Monacanthus hispidus	R
Gray triggerfish	Balistes capriscus	R
Smooth puffer	Lagocephalus laevigatus	R
Northern puffer	Sphoeroides maculatus	C
Striped burrfish	Chilomycterus schoepfi	R
Ocean sunfish	Mola mola	R

*A = abundant
C = common
R = rare

SOURCE: Sandy Hook Marine Laboratory, 1971. Review of aquatic resources and hydrographic characteristics of Raritan, Lower New York, and Sandy Hook Bays. National Marine Fisheries Service, NOAA, Battelle Institute 61 p.

APPENDIX F

NEW JERSEY ENDANGERED SPECIES

DEFINITIONS

ENDANGERED - An endangered species is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of or change in habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow.

THREATENED - May become endangered if conditions surrounding the species begin to or continue to deteriorate.

PERIPHERAL - A species whose occurence in New Jersey is at the extreme edge of its present natural range.

UNDETERMINED - A species about which there is not enough information available to determine the status.

DECLINING - A species which has exhibited a continued decline in population numbers over the years.

EXTIRPATED - A species that formerly occurred in New Jersey, but is not now known to exist within the state.

SPECIAL CASE - Species not known to nest regularly in New Jersey (marine reptiles) but that do occur off our shores - some occurring with regularity close to our shores or in our bays (marine reptiles and mammals).

ENDANGERED SPECIES IN NEW JERSEY

FISH

Shortnose Sturgeon	*Acipenser brevirostrum*

AMPHIBIANS

Tremblay's Salamander	*Ambystoma tremblayi*
Blue-spotted Salamander	*Ambystoma laterale*
Eastern Tiger Salamander	*Ambystoma tigrinum*
Pine Barrens Treefrog	*Hyla andersoni*
Southern Gray Treefrog	*Hyla chrysoscelis*

REPTILES

Bog Turtle	*Clemmys muhlenbergi*
Timber Rattlesnake	*Crotalus horridus horridus*

BIRDS

b Bald Eagle	*Haliaeetus leucocephalus*
Peregrine Falcon	*Falco peregrinus*
b Osprey	*Pandion haliaetus*
b Cooper's Hawk	*Accipter cooperii*
b Least Tern	*Sterna albifrons*
b Black Skimmer	*Rynchops niger*

MAMMALS

Indiana Bat	*Myotis sodalis*

SPECIAL CASE

MARINE REPTILES

Atlantic Hawksbill	*Eretmochelys imbricata*
Atlantic Loggernead	*Caretta caretta*
Atlantic Ridley	*Lepidochelys kempi*
Atlantic Leatherback	*Dermochelys coriacea*

MARINE MAMMALS

Sperm Whale	*Physeter macrocephalus*
Blue Whale	*Balaenoptera musculus*
Fin Whale	*Balaenoptera physalus*
Sei Whale	*Balaenoptera borealis*
Humpback Whale	*Megaptera novaeangliae*
Atlantic Right Whale	*Eubalaena glacialis*

b = breeds in New Jersey

THREATENED SPECIES IN NEW JERSEY

FISH

Atlantic Sturgeon	Acipenser oxyrhynchus
American Shad	Alosa sapidissima
Brook Trout (native)	Salvelinus fontinalis
Atlantic Tomcod	Microgadus tomcod

AMPHIBIANS

Long-tailed Salamander	Eurycea longicauda
Eastern Mud Salamander	Pseudotriton montanus

REPTILES

Wood Turtle	Clemmys insculpta
Corn Snake	Elaphe guttata
Northern Pine Snake	Pituophis melanoleucus melanoleucus

BIRDS

b Pied-billed Grebe	Podilymbus podiceps
b Great Blue Heron	Ardea herodias
b Red-shouldered Hawk	Buteo lineatus
b Marsh Hawk	Circus cyaneus [1]
Merlin	Falco columbarius
b Upland Sandpiper (Plover)	Bartramia longicauda
b Roseate Tern	Sterna dougallii
b Barred Owl	Strix varia
b Short-eared Owl	Asio flammeus [1]
b Red-headed Woodpecker	Melanerpes erythrocephalus
b Cliff Swallow	Petrochelidon pyrrhonota [1]
Short-billed Marsh Wren	Cistothorus platensis
b Bobolink	Dolichonyx oryzivorus [1]
b Savannah Sparrow	Passerculus sandwichensis [1]
b Ipswich Sparrow	Passerculus sandwichensis princeps
b Grasshopper Sparrow	Ammodramus savannarum [1]
Henslow's Sparrow	Ammodramus henslowii
b Vesper Sparrow	Pooecetes gramineus [1]

SPECIAL CASE

MARINE REPTILES

Atlantic Green Turtle	Chelonia mydas

b = breeds in New Jersey

1 Status designation applicable to breeding population only

PERIPHERAL SPECIES IN NEW JERSEY

FISH

White Shark	Carcharodon carcharias
Smooth Hammerhead	Sphyrna zygaena
Thorny Skate	Raja radiata
Spotted Eagle Ray	Aetobatus narinara
Ladyfish	Elops saurus
Tarpon	Megalops atlantica
Snakefish	Trachinocephalus myops
Haddock	Melanogrammus aeglefinus
White Hake	Urophycis tenuis
Halfbeak	Hyporhamphus unifasciatus
Houndfish	Tylosurus crocodilus
Bluespotted Cornetfish	Fistularia tabacaria
Longspine Snipefish	Macrorhamphosus scolopax
Gag	Mycteroperca microlepis
Snowy Grouper	Epinephelus niveatus
Warsaw Grouper	Epinephelus nigritus
Glasseye Snapper	Priacanthus cruentatus
Bigeye	Priacanthus arenatus
Short Bigeye	Pristigenys alta
Cobia	Rachycentron canadum
Bluerunner	Caranx crysos
Crevalle Jack	Caranx hippos
Horse-eye Jack	Caranx latus
Round Scad	Decapterus punctatus
Leatherjacket	Oligoplites saurus
Bigeye Scad	Selar crumenophthalmus
Lookdown	Selene vomer
Greater Amberjack	Seriola dumerili
Banded Rudderfish	Seriola zonata
Florida Pompano	Trachinotus carolinus
Permit	Trachinotus falcatus
Palometa	Trachinotus glaucus
Rough Scad	Trachurus lathami
Atlantic Moonfish	Vomer setapinnis
Dolphin	Coryphaena hippurus
Spotfin Mojarra	Eucinostomus argenteus
Gray Snapper	Lutjanus griseus
Spottail Pinfish	Diplodus holbrooki
Pinfish	Lagodon rhomboides
Spotted Seatrout	Cynoscion nebulosus
Banded Drum	Larimus fasciatus
Atlantic Croaker	Micropogon undulatus
Red Drum	Sciaenops ocellata
Red Goatfish	Mullus auratus

PERIPHERAL SPECIES IN NEW JERSEY

FISH

Spotted Goatfish	Pseudupeneus maculatus
Atlantic Spadefish	Chaetodipterus faber
Foureye Butterflyfish	Chaetodon capistratus
Spotfin Butterflyfish	Chaetodon ocellatus
Banded Butterflyfish	Chaetodon striatus
Sergeant Major	Abudefduf saxatilus
Atlantic Threadfin	Polydactylus octonemus
Rock Gunnel	Pholis gunnellus
Snake Blenny	Lumpenus lumpretaeformis
Fat Sleeper	Dormitator maculatus
Atlantic Cutlassfish	Trichiurus lepturus
Frigate Mackerel	Auxis thazard
King Mackeral	Scomberomorus cavalla
Spanish Mackerel	Scomberomorus maculatus
Barbfish	Scorpaena brasiliensis
Spotted Scorpionfish	Scorpaena plumieri
Scorpionfish	Scorpaena isthmensis
Flounder	Bothus robinsi
Flying Gurnard	Dactylopterus volitans
Orange Filefish	Aluterus schoepfi
Gray Triggerfish	Balistes capriscus
Planehead Filefish	Monacanthus hispidus
Trunkfish	Lactophrys trigonus
Smooth Trunkfish	Lactophrys triqueter
Scrawled Cowfish	Lactophrys quadricornis
Smooth Puffer	Lagocephalus laevigatus
Web Burrfish	Chilomycterus antillarum
Striped Burrfish	Chilomycterus schoepfi

BIRDS

Migratory birds are not listed, as many appear both spring and fall in New Jersey.

MAMMALS

Porcupine	Erethizon dorsatum

SPECIAL CASE

MARINE MAMMALS

Harp Seal	Pagophilus groenlandicus
Hooded Seal	Cystophora cristata
Gray Seal	Halichoerus grypus
Beluga Whale	Delphinapterus leucas

DECLINING SPECIES IN NEW JERSEY

FISH

Northern Kingfish	Menticirrhus saxatilis
Northern Puffer	Sphaeroides maculatus

AMPHIBIANS

Marbled Salamander	Ambystoma opacum
Spotted Salamander	Ambystoma maculatum
Four-toed Salamander	Hemidactylium scutatum
Northern Spring Salamander	Gyrinophilus porphyriticus porphyriticus
Northern Red Salamander	Pseudotriton ruber ruber
Eastern Spadefoot Toad	Scaphiopus holbrooki holbrooki

REPTILES

Eastern Hognose Snake	Heterodon platyrhinos

BIRDS

Red-necked Grebe	Podiceps grisegena
b Yellow-crowned Night Heron	Nyctanassa violacea
b American Bittern	Botaurus lentiginosus
b Least Bittern	Ixobrychus exilis
Baird's Sandpiper	Calidris bairdii
Marbled Godwit	Limosa fedoa
Hudsonian Godwit	Limosa haemastica
b Common Tern	Sterna hirundo
Razorbill	Alca torda
Dovekie	Alle alle
b Whip-poor-will	Caprimulgus vociferous
b Least Flycatcher	Empidonax minimus[1]
b Horned Lark	Eremophila alpestris[1]
b Purple Martin	Progne subis
b White-eyed Vireo	Vireo griseus
b Warbling Vireo	Vireo gilvus
b Yellow-breasted Chat	Icteria virens
b Hooded Warbler	Wilsonia citrina
b Eastern Meadowlark	Sturnella magna[1]

b = Breeds in New Jersey

[1] Status designation applicable to breeding population only.

UNDETERMINED SPECIES IN NEW JERSEY

FISH

Shortfin Mako	Isurus oxyrinchus
Bull Shark	Carcharninus leucas
Tiger Shark	Galeocerdo cuvieri
Clearnose Skate	Raja eglanteria
Roughtail Stingray	Dasyatis centroura
Atlantic Stingray	Dasyatis sabina
Bluntnose Stingray	Dasyatis sayi
Spiny Butterfly Ray	Gymnura altavela
Smooth Butterfly Ray	Gymnura micrura
Bullnose Ray	Myliobatis freminvillei
Round Herring	Etrumeus teres
Atlantic Thread Herring	Opisthonema oglinum
Silver Anchovy	Anchoviella eurystole
Rainbow Smelt	Osmerus mordax
Bridle Shiner	Notropis bifrenatus
Ironcolor Shiner	Notropis chalybaeus
Bluntnose Minnow	Pimephales notatus
Fourbeard Rockling	Enchelyopus cimbrius
Atlantic Cod	Gadus morhua
Ocean Pout	Macrozoarces americanus
Spotfin Killifish	Fundulus luciae
Rough Silverside	Membras martinica
Threespine Stickleback	Gasterosteus aculeatus
Ninespine Stickleback	Pungitius pungitius
Shield Darter	Percina peltata
Atlantic Pomfret	Brama brama
Striped Blenny	Chasmodes bosquianus
Crested Blenny	Hypleurochilus geminatus
Feather Blenny	Hypsoblennius hentzi
Darter Goby	Gobionellus boleosoma
Highfin Goby	Gobionellus oceanicus
Seaboard Goby	Gobiosoma ginsburgi
Sharksucker	Echeneis naucrates
Whitefin Sharksucker	Echeneis nuecratoides
Little Tuna	Euthynnus alletteratus
Chub Mackeral	Scomber colias
Harvestfish	Peprilus alepidotus
Sea Raven	Hemitripterus americanus
Grubby	Myoxocephalus aeneus
Bay Wniff	Citharichthys spilopterus
Fourspot Flounder	Paralichthys oblongus
Yellowtail Flounder	Limanda ferruginea

AMPHIBIANS

Jefferson Salamander	Ambystoma jeffersonianum
Silvery Salamander	Ambystoma platineum
Mountain Dusky Salamander	Desmognathus ochrophaeus
Upland Chorus Frog	Pseudacris triseriata feriarum
Carpenter Frog	Rana virgatipes
Northern Cricket Frog	Acris crepitans crepitans

REPTILES

Spotted Turtle	Clemmys guttata
Map Turtle	Graptemys geographica
Red-bellied Turtle	Chrysemys rubriventris
Midland Painted Turtle	Chrysemys picta marginata
Five-lined Skink	Eumeces fasciatus
Ground Skink	Leiolopisma laterale
Queen Snake	Natrix septemvittata
Eastern Smooth Earth Snake	Virginia valeriae
Northern Black Racer	Coluber constrictor constrictor
Eastern Smooth Green Snake	Opheodrys vernalis vernalis
Black Rat Snake	Elaphe obsoleta obsoleta
Eastern King Snake	Lampropeltis getulus getulus
Northern Scarlet Snake	Cemophora coccinea copei
Northern Copperhead	Agkistrodon contortrix mokasen
Eastern Worm Snake	Carphophis amoenus amoenus

BIRDS

b Black Duck	Anas rubripes
b Ruddy Duck	Oxyura jamaicensis
b Sharp-shinned Hawk	Accipter gentilis[1]
b King Rail	Rallus elegans
Yellow Rail	Coturnicops noveboracensis
b Black Rail	Laterallus jamaicensis
b American Coot	Fulica americana[1]
b Piping Plover	Charadrius melodus
b Common Snipe	Capella gallinago[1]
b Long-eared Owl	Asio otus
b Eastern Bluebird	Sialia sialis
Loggerhead Shrike	Lanius ludovicianus

MAMMALS

Water Shrew	Sorex palustris
Smokey Shrew	Sorex fumeus
Long-tailed Shrew	Sorex dispar
Least Shrew	Cryptotis parva
Hairy-tailed Mole	Parascalops breweri
Star-nosed Mole	Condylura cristata
Keen Myotis	Myotis keenii
Small-footed Myotis	Myotis subulatus
Silver-haired Bat	Lasionycteris noctivagans
Eastern Pipistrel	Pipistrellus subflavus
Hoary Bat	Lasiurus cinereus

b = Breeds in New Jersey

[1] Status designation applicable to breeding population only

UNDETERMINED SPECIES IN NEW JERSEY

Southern Flying Squirrel	Glaucomys volans
Marsh Rice Rat	Oryzomys palustris
Deer Mouse	Peromyscus maniculatus
Eastern Wood Rat	Neotoma floridana
Southern Bog Lemming	Synaptomys cooperi
Meadow Jumping Mouse	Zapus hudsonius
Woodland Jumping Mouse	Napaeozapus insignis
Bobcat	Lynx rufus

MARINE MAMMALS

Dense Beaked Whale	Mesoplodon densirostris
Gulfstream Beaked Whale	Mesoplodon gervaisi
Antillean Beaked Whale	Mesoplodon europaeus
True's Beaked Whale	Mesoplodon mirus
Cuvier's Beaked Whale	Ziphius cavirostris
Pygmy Sperm Whale	Kogia breviceps
Dwarf Sperm Whale	Kogia simus
Cuvier Dolphin	Stenella frontalis
Spotted Dolphin	Stenella plagiodon
Striped Dolphin	Stenella coeruleoalba
Common Dolphin	Delphinus delphis
Atlantic White-side Dolphin	Lagenorhynchus acutus
Atlantic Killer Whale	Orcinus orca
Risso's Dolphin	Grampus griseus
Long-finned Pilot Whale (Blackfish)	Globicephala melaena
Short-finned Pilot Whale	Globicephala macrorhyncus
Atlantic Harbor Porpoise	Phocoena phocoena
Minke Whale	Balaenoptera acutorostrata