June 1983

INITIAL ASSESSMENT STUDY OF NAVAL AIR STATION, PENSACOLA PENSACOLA, FLORIDA

NEESA 13-015

NAVAL ENERGY AND ENVIRONMENTAL
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From: Commanding Officer, Naval Energy and Environmental Support Activity
To: Distribution list

Subj: Errata for Initial Assessment Study Report for NAS Pensacola, NEESA 13-015 of Jun 83

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Encl: (1) Table 4-1, Summary of Sites Recommended for Confirmation Studies

1. Page 4-3 of the subject report forwarded by reference (a) is in error. Enclosure (1) *is* the corrected page 4-3 for reference (a).

2. Replace page 4-3 of reference (a) with enclosure (1). Point of contact on this matter is Kent Adams, AUTOVON 360-3351 or (805) 982-3351.

Gary S. Gasperino
GARY S. GASPERINO
By direction

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INITIAL ASSESSMENT STUDY

NAVAL AIR STATION, PENSACOLA

PENSACOLA, FLORIDA

UIC: N00204

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Prepared for:

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INSTALLATION POLLUTANTS (NACIP) DEPARTMENT
Naval Energy and Environmental Support Activity (NEESA)
Port Hueneme, California **93043**

June **1983**

TABLE 4-1

SUMMARY OF SITES RECOMMENDED FOR CONFIRMATION STUDIES

			Verification (One-Time Study) Sampling			Characterization (1st Year Effort) Sampling		
Site Number	Site Name	CSRS Score	# Soil Samples	# Water Samples	Lab Testing Parameters	# of Wells	# of Samples	Lab Testing Parameters
25-1	Sanitary Landfill	23				8-10	32-40	Groundwater contamination indicators, water level, water temperature
25-11	North Chevalier Field Disposal Site	22	6	28	Groundwater contamination indicators, silver, cadmium, chromium, mercury, nickel, lead, zinc			
25-17	Transformer Storage Area	26	12		Polychlorinated biphenyls			
25-21	Sludge Disposal at Fuel Tank Area	22	27		Lead, oil and grease			
25-22	Refueler Repair Shop Fuel Disposal Site	20	9		Lead, oil and grease			
25-27	Radium Dial Shop Sanitary				Contact RASO			
25-29	Soil South of Building 3460	13	5		pH, phenols cyanide, cadmium, chromium, copper, nickel			

4.4.1 Sanitary Landfill (Site 1).

Groundwater monitoring wells: Eight to ten new wells may be necessary to determine contamination migration characteristics.

Type of samples: groundwater

Number of samples: 32 to 40 per year

Sampling frequency: quarterly

Testing parameters: groundwater contamination indicators, water level, water temperature.

Remarks: The presence of contamination at this site has been verified by earlier work (Crawford and others, 1975; Boettcher, 1976). Therefore, the IAS team recommends installing a system of groundwater monitoring wells to determine contaminant migration characteristics. The monitoring system should include eight to ten new wells placed appropriately around the site. At least three, and as many as four or five groundwater investigation wells should be installed first to determine the direction of groundwater flow. The placement of these should be determined by groundwater experts during the confirmation study. Once the direction of groundwater flow is established, the most upgradient of these wells should be used as the upgradient well. The rest of the investigation wells can then be used as monitoring wells, along with other monitoring wells drilled as needed to characterize the contaminant plume.

4.4.2 North Chevalier Field Disposal Site (Site 11).

Groundwater monitoring wells: six

Type of samples: 24 groundwater samples, 4 surface water samples, 6 sediment samples

Number of samples: approximately.34 during the first year

Sampling frequency: sample each of 6 wells quarterly

Testing parameters: groundwater contamination indicators and the following metals: Cadmium, chromium, lead, mercury, nickel, silver, zinc.

Remarks: To verify the existence of groundwater contamination, place six wells around the perimeter of the disposal site. Sample each groundwater well quarterly for the first year. Sample surface water in runoff toward Bayou Grande quarterly for the first year. Sample sediments in runoff streams at the site. If significant contamination is found, it is recommended that groundwater monitoring be continued to determine contaminant migration characteristics. Additional wells might be necessary for the continued monitoring.

4.4.3 Transformer Storage Yard (Site 17).

Groundwater monitoring wells: none recommended at this time.

0000044

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4.4.3 Transformer Storage Yard (Site 17).

Groundwater monitoring wells: none recommended at this time.

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Executive Summary

This report presents the results of an Initial Assessment Study (IAS) conducted at Naval Air Station (NAS), Pensacola. The purpose of an IAS is to identify and assess sites posing a potential threat to human health or the environment due to contamination from past hazardous materials operations.

Based on information from historical records, aerial photographs, field inspections and personnel interviews, 29 potentially-contaminated sites were identified at NAS Pensacola. Each site was evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors.

The study concludes that, while none of the sites pose an immediate threat to human health or the environment, seven 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 seven sites, is recommended to confirm or deny the existence of the suspected contamination and to quantify the extent of any problems which may exist. The seven sites recommended for confirmation are

(1) Sanitary Landfill (Site 1)

(2) North Chevalier Field Disposal Site (Site 11)

(3) Transformer Storage Yard (Site 17)

(4) Sludge Disposal at Fuel Tank Area (Site 21)

(5) Refueler Repair Shop Fuel Disposal Site (Site 22)

(6) Radium Dial Shop Sanitary Sewer (Site 27)

(7) Soil South of Building 3460 (Site 29)

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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FOREWORD

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

In the first phase of the NACIP Program, a team of engineers and scientists conducts an Initial Assessment Study (IAS). The IAS team collects and evaluates evidence of contamination that may pose a potential threat to human health or the environment. The IAS includes a review of archival and activity records, interviews with activity personnel, and an on-site survey of the activity. This report documents the findings of an IAS at the Naval Air Station, Pensacola, Florida.

A confirmation study, phase II of the NACIP Program, is recommended for seven potentially contaminated sites identified during the IAS. Southern Division of the Naval Facilities Engineering Command (SOUTHDIV) will assist NAS Pensacola in implementing the recommendations.

Questions regarding this report should be referred to NEESA 112N at AUTOVON 360-3351, FTS 799-3351, or commercial 805-982-3351. Questions concerning confirmation work or other follow-on efforts should be referred to SOUTHDIV 114 at AUTOVON 794-5510, FTS 679-5510, or commercial 803-743-5510.

DANIEL L. SPIEGELBERG, LCDR, CEC, USN
Environmental Officer
Naval Energy and Environmental Support Activity

ACKNOWLEDGEMENT

The Initial Assessment Team acknowledges the excellent support and assistance provided by personnel of Naval Air Station (NAS), Pensacola, Navy Public Works Center (PWC) Pensacola, Naval Air Rework Facility (NAVAIREWORKFAC) Pensacola, and Southern Division, Naval Facilities Engineering Command (SOUTHDIV). In particular, the team gratefully acknowledges the effort provided by the following people:

Captain C. E. Christenson, Commanding Officer, PWC
Mr. Edward A. Pike, Environmental Engineer, PWC
Captain G. R. Fox, Commanding Officer, NAVAIREWORKFAC
Mr. Frank C. Stuart, Environmental Engineer, NAVAIREWORKFAC
Mr. Sam L. Lovelace, Facilities Management Office, NAS
Mr. Bruce L. Tanner, Environmental Engineer, NAS
Mr. Joseph L. McCauley, Environmental Engineer, SOUTHDIV
Mr. Kenneth A. Chacey, Environmental Engineer, SOUTHDIV

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TABLES

CHAPTER 1. INTRODUCTION

1.1 **PURPOSE.** As directed by the Chief of Naval Operations (CNO), the Naval Energy and Environmental Support Activity (NEESA) conducts Initial Assessment Studies (IASs) to collect and evaluate evidence indicating the existence of pollutants that may have contaminated a site and may pose potential threat to human health or to the environment. 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.

1.2 AUTHORITY. The NACIP Program was initiated by OPNAVNOTE 6240 Serial 45/733503 of 11 September 1980 and Marine Corps Order 6280.1 of 30 January 1981.

1.3 ON-SITE SURVEY. From 18-29 January 1982, the on-site survey portion of an Initial Assessment Study was performed at Naval Air Station (NAS) Pensacola by a team of specialists from NEESA and a hydrogeologist from the Army Corps of Engineers. Prior to performing the on-site survey, the team compiled and evaluated records from various offices, including Southern Division (SOUTHDIV), Naval Facilities Engineering Command, the Federal Archives and Records Center, the Navy History Office, the National Archives, and Public Works Center Pensacola, to obtain documented evidence of environmental contamination. During the on-site survey, the team reviewed activity records and maps, interviewed long-time employees and retirees of NAS Pensacola, and physically inspected the activity's facilities and environs. Recommended actions are summarized in Chapter 4 of this report.

1.4 SCOPE. This IAS covers the following Navy activities and their tenants.

(1) Naval Air Station (NAS) Pensacola

(2) Naval Air Rework Facility (NAVAIREWORKFAC) Pensacola

(3) Navy Public Works Center (PWC) Pensacola

Outlying landing fields are not covered in this IAS.

1.5 SUBSEQUENT NACIP STUDIES. The next phase of the NACIP Program is the Confirmation Study. During a confirmation study, extensive sampling and monitoring is conducted to confirm or refute the existence of suspected contamination at sites identified during an IAS. If significant contamination exists, the Confirmation Study recommends the types of remedial actions to be implemented. A confirmation study is conducted only if the IAS concludes that

(1) Sufficient evidence exists to suspect that the installation has contaminated areas, and

(2) The contamination presents danger to:

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

b. The environment within or outside the installation.

Further studies are not conducted under the NACIP program if these criteria are not met.

CHAPTER 2. SIGNIFICANT FINDINGS

2.1 INTRODUCTION. Twenty-nine disposal sites were identified and investigated during the NACIY Initial Assessment Study (IAS) at NAS Pensacola. Significant findings at some sites indicate the presence of contamination. Significant findings at other sites reveal that no contamination exists, or that contamination is insignificant. Only sites in which both significant contamination and migration potential are suspected are recommended for confirmation study. Details of the findings are presented in Section 6.6, Disposal Operations.

2.2 GENERAL FINDINGS.

2.2.1 Migration Potential. The hydrogeology of the NAS Pensacola area is conducive to migration of contaminants through the soil. If contaminants reach the soil, the high rainfall coupled with groundwater movement could cause migration to an off-base location.

2.2.2 Sensitive Marsh Areas. NAS Pensacola is surrounded by estuarine waters that are environmentally sensitive areas. In particular, Sherman Inlet, just south of Forrest Sherman Field, is considered an environmentally sensitive area of coastal marsh and seagrass plant communities. These communities could be affected by migrating chemicals.

2.2.3 Water Wells. Three water wells on the NAS Pensacola complex provide emergency backup potable water supply to the station. These wells can potentially be affected by migrating chemicals. The main source of water for the base, however, is a Navy-owned well field located at the Naval Technical Training Center, Corry Station. The water is pumped from the Sand and Gravel Aquifer.

2.2.4 Shellfishing Areas. Shellfishing areas in Pensacola Bay and Bayou Grande can be impacted by migration of chemicals to surface water and to sediments.

2.3 SITE-SPECIFIC FINDINGS. This section includes a summary description of each site investigated during the IAS. The IAS team selected a site for investigation if the team suspected that a hazardous material had been released to the environment at that site. The sites were numbered during the IAS field investigation in order of their discovery. During the investigation, some of the numbered sites were found not to have been hazardous material disposal sites, but were retained in the list of numbered sites. The Confirmation Study Ranking System (CSRS) was applied to all sites to determine which sites would continue to the confirmation phase of the NACIP Program.

2.3.1 Sanitary Landfill (Site 1). The sanitary landfill was used from the mid-1950s until 1976. In 1975, a groundwater investigation of the landfill indicated leachate contamination of the shallow aquifer underlying NAS Pensacola. Eleven groundwater investigation wells were installed for that purpose. The investigation reported elevated levels of TDS, ammonia, phenol, and cyanide in some of the wells. Some of the wells have since deteriorated and are no longer usable for leachate monitoring. Nearly all solid wastes generated on the naval complex were disposed of here. Evidence indicates that this site was also used for disposal of the following hazardous materials:

(1) Industrial waste from NARF, including paint and plating wastes

(2) Wastewaters containing pesticides from spraying operations

(3) PCB-contaminated rags and equipment

(4) Asbestos insulation materials

During the NACIP on-site survey, leachate was observed emerging from the landfill into a drainage system which flows into ponds at the golf course and, in turn, makes its way to the Bayou Grande. Analysis of leachate samples taken during the survey indicated the presence of industrial materials in the leachate.

2.3.2 Waterfront Sediments (Site 2). Between 1939 and 1973, sediments in Pensacola Bay, adjacent to the waterfront area of the NAS installation, received industrial wastes from storm drain outfalls. Materials disposed of in these drains include:

(1) Paint and paint strippers, ketones, and trichloroethylene (TCE)

(2) Metal plating solutions

(3) Wastewater containing radium paint waste

(4) Mercury from the gauge room of the power plant (Building 782)

Pensacola Bay is a commercial fishing and shellfishing area. Initial screening samples taken during the NACIP on-site survey indicate trace amounts of contaminants in the sediments along the waterfront. Radiological contamination was not found.

2.3.3 Crash Crew Training Area (Site 3). This site, on the southwest edge of Forrest Sherman Field, was used for fire-fighting practice by setting fires in unlined pits. The site has been used from the late fifties until the present (1982). Materials used and disposed of at the site were: (1) jet fuel (JP-4, JP-5); (2) aviation gasoline (AVGAS); (3) lube oil.

About 200 gallons per week of these flammable materials were poured directly on the soil, ignited, and then extinguished with water. Some of the material may have soaked into the soil.

2.3.4 Army Rubble Disposal Site (Site 4). This disposal site was used in the early 1950s to deposit rubble from demolished Army buildings. No evidence of hazardous materials disposal was discovered.

2.3.5 Borrow Pit (Site 5). In 1976, soil was removed from this area and used as a cap for the station landfill. There is no evidence of disposal at this site.

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2.3.6 Fort Redoubt Rubble Disposal Site (Site 6). Between **1973** and **1982,** this site was used for disposal of building rubble, which may have contained asbestos. Buried asbestos does not pose a threat to human health. No evidence of other hazardous materials disposal was discovered.

2.3.7 Firefighting School (Site 7). This facility, located in Building 1713, has been used to train firefighters since 1940. Flammable liquids were used to start fires in an open tank of water for firefighting practice. There is no evidence of hazardous materials use or disposal.

2.3.8 Rifle Range Disposal Site (Site 8). This site was reported to have been used for disposal and burning of solid waste from the naval complex between 1951 and 1955. No evidence of hazardous waste disposal was discovered. The new Public Works Center and its parking lot were built over this site.

2.3.9 Navy Yard Disposal Site (Site 9). This site was used as the station disposal site for the old Navy yard. The earliest existing records indicate that this disposal site was used from 1917, and that it was closed some time in the thirties. As far as can be determined, this site was used only for disposal of ordinary domestic trash and refuse. There is no indication of hazardous waste disposal here.

2.3.10 Commodore's Pond (Site 10). This pond was used in the mid-nineteenth century for underwater storage of wooden timbers for shipbuilding. There is no evidence of hazardous material use, storage, or disposal at this site.

2.3.11 North Chevalier Field Disposal Site (Site 11). This site was used from the late thirties until the early fifties for general disposal of industrial waste. It was reported that refuse from industrial activities was disposed of and burned here. Wastes disposed of here reportedly included waste oils. A grab sediment sample taken at this site during the IAS survey contained metals associated with plating operations. Areas of oily soil were noticed at this site during the survey. It was reported that a groundwater investigation well was drilled at this site in 1980 and that soil borings from the well were contaminated with oil.

2.3.12 Scrap Bins (Site 12). From the early thirties through the forties, wet garbage was deposited in receptacles in this area. Reportedly, two truckloads of garbage per day were hauled here. There is no evidence of any hazardous materials use, storage, or disposal.

2.3.13 Magazine Point Rubble Disposal Site (Site **13**). This site extends along the eastern waterfront of the base, including Magazine Point and the waterfront on the eastern side of Chevalier Field. This site was used for deposition of clean fill materials, including building rubble, bricks, metal, concrete, and wood. There is no evidence of hazardous materials disposal.

2.3.14 Dredge Spoil Fill (Site 14). This site was created between 1975 and 1977 by deposition of spoils from dredging operations in Pensacola Bay. During the on-site survey, the IAS team thought this site was Navy-owned. Through subsequent investigation, however, it was found not to be on Navy property. This site is discussed further in Section 5.6, Adjacent Land Use.

2.3.15 *Pesticide Rinseate Disposal Site (Site 15).* This site was used from 1963 to 1979 for disposal of rinse water from pesticide mixing and spray equipment cleaning. Materials reported to have been disposed of here include dilute solutions of pesticides.

2.3.16 *Brush Disposal Site (Site 16).* This area was used for disposal of brush from pruning and tree trimming, between the late sixties and 1973. Some metallic parts were also disposed of here. There is no indication of hazardous material use, storage, or disposal here.

2.3.17 *Transformer Storage Yard (Site 17).* This site was used by the Public Works Center Utilities Department for storage of transformers. Some of the transformers contained PCBs. The area is paved with asphalt. This operation was conducted from before 1964 until 1976, when all PCB transformers were removed from the storage area. Between 100 and 200 transformers, some of which had leaked, were stored here. The quantity of leakage is unknown. A sample of oily residue was taken from the surface of the pavement and analysis determined the oil contained PCB compounds.

2.3.18 *PCB Spill at Substation A (Site 18).* In 1966, Substation A near Building 47 was the site of a transformer oil spill. The area is paved, except for one gravel-covered area. A sample of oily residue from the gravel-covered area was tested and found to contain four parts per million of PCB, which is a nonhazardous concentration according to the Toxic Substances Control Act.

2.3.19 *Fuel Farm Pipeline Leak (Site 19).* In 1958, a leak occurred in the underground fuel pipeline which led from the fuel farm to the aircraft refueling facility at Forrest Sherman Field. This leak resulted in the direct discharge of about 860,000 gallons of fuel oil in this area. Trees and other vegetation were killed in a 200 feet by 400 feet area. Vegetative regrowth in the area is sparse, The soil in the area is permeable, and the hydrogeology of the area is conducive to migration. The water table is shallow in this area. An ecologically sensitive marsh area is located within one mile of the site, but no oil was observed in the marsh during the on-site visit.

2.3.20 *Berthing Pier Pipeline Leak (Site 20).* In 1981, an excavation crew discovered that a fuel oil pipeline leading to the berthing pier was leaking. The soil in the area appeared to be soaked with fuel oil. The type of oil spilled here was reported to be either Navy special fuel oil or marine diesel fuel. The oil on the water was cleaned up promptly, and some contaminated soil was removed from the site in a cleanup effort. Four monitoring wells are located at the berthing pier. The wells were checked during the IAS and did not contain oil.

2.3.21 *Sludge Disposal at Fuel Tank Area (Site 21).* During the 20 years between 1940 and 1960, nine fuel tanks in this area stored aviation gasoline. The tanks were cleaned yearly by removing tank-bottom sludge. An estimated 360 cubic yards of tank-bottom sludge was disposed around the perimeters of the tanks during the 20-year period. The sludge is suspected to have contained tetraethyl lead. The disposal site has unrestricted access. Although the sludge was reported to have been buried, it is not known how deep or how much soil covers the buried sludge.

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2.3.22 Refueler Repair Shop Fuel Disposal Site (Site 22). Between 1958 and 1977, the Public Works Transportation Department Refueler Shop used this area for disposing of residual fuel from refueler trucks before repair. About 19,000 gallons of aviation gasoline and jet fuel were disposed of here over a 19-year period. The aviation gasoline disposed of here contains tetraethyl lead. The site is located in an open area with unrestricted access.

2.3.23 Chevalier Field Pipeline Leaks (Site 23). This was the site of two separate underground fuel leaks. One leak, in 1965, consisted of Navy special fuel oil. The other leak, in 1968 or 1969, was diesel fuel, marine (DFM). These leaks saturated the soil at the site with oil. Oil slicks were reported on the water near the site. Grass and other vegetation was killed in the area directly over the leak. The water table in this area is shallow, and the soil in the area is conducive to migration. The leaks were repaired, but no attempt was made to remove contaminated soil.

2.3.24 DDT Mixing Area (Site 24). From the early 1950s to the early 1960s, this site was used for mixing DDT insecticide for mosquito control. DDT concentrate was mixed with fuel oil for spraying. An estimated total of 20 gallons of DDT solution containing about 3 pounds of DDT was spilled during the 10-year period.

2.3.25 Radium Spill Site (Site 25). In 1978, about 25 gallons of waste from radium removal operations was spilled from a containment drum on pavement. The spilled waste was cleaned up, placed in a secure container, and sent to a proper disposal site.

2.3.26 Supply Department Outside Storage (Site 26). Prior to 1956, and up until 1964, industrial chemicals were stored on this site. Reportedly, leaks were commonplace in the area during the eight-year period, allowing industrial chemicals including paint strippers and acids to enter the soil. The amounts of chemicals leaked are unknown.

2.3.27 Radium Dial Shop Sanitary Sewer (Site 27). From the 1940s to 1976, the Radium Dial Shop was located in Building 709. The sanitary sewer leading from Building 709 to manhole K7 was reportedly used for disposal of liquid wastes contaminated with radium. During a post-demolition survey conducted by the NEESA Radiological Affairs Support Office (RASO), low-Levels of radioactivity were detected in the sewer pipe at 18 inches below ground level. The pipe was plugged with concrete. In spite of RASO's recommendation to locate and sample the outfall and the manholes associated with this portion of the sewer system, there was no evidence that this had been done.

2.3.28 Transformer Accident (Site 28). In 1969 or 1970, a transformer fell off a truck, spilling transformer oil on the paved roadway. In the records search and in interviews during the on-site survey, no evidence was found to indicate whether the transformer contained PCB oil.

2.3.29 Soil South of Building 3460 (Site 29). In 1981, several evacuation workers received minor skin burns from contact with a liquid in the soil south of Building 3460. It is not known what chemical caused the burns. An industrial waste sewer line runs near this site, under the concrete apron south of Building 3460.

CHAPTER 3. CONCLUSIONS

3.1 INTRODUCTION. This chapter presents the conclusions of the Initial Assessment Study at NAS Pensacola. Significant findings from Chapter 2 were used to formulate these conclusions. The hydrogeology of the area was analyzed with regard to pathways of contaminant migration from disposal sites, and to environmental receptors which may be affected.

3.2 CONFIRMATION STUDY RANKING SYSTEM. Hazardous waste sites identified by the IAS team were 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 to the environment, based on evidence collected during the IAS. Step one of the system is a flowchart which eliminates innocuous sites from further consideration. Step two is a ranking model which assigns a numerical score within a range of 0 to 100 to indicate the potential severity of contamination. Scores reflect the characteristics of the wastes disposed of at a site, the contaminant migration pathways, and the 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 1.5. CSRS scores assigned to sites recommended for confirmation studies also assist Navy managers to establish priorities for accomplishing the recommended actions. A more detailed description of the Confirmation Study Ranking System is contained in NEESA Report 20.2-042.

3.2.1 Sanitary Landfill (Site 1). The landfill was used for disposal of all types of wastes on the NAS Pensacola complex, including industrial wastes from the NARF. A groundwater investigation indicated that leachate was contaminating the shallow aquifer. Leachate samples taken during the survey indicated the presence of industrial materials. Based on the above information, it is concluded that the landfill presents a potential threat to human health and to the environment. This site is recommended for further investigation under the NACIP program.

3.2.2 Waterfront Sediments (Site 2). Between 1939 and 1973, sediments in the portion of Pensacola Bay adjacent to the waterfront area received waste from industrial operations. Initial screening samples indicate the presence of trace amounts of chemical contaminants in waterfront sediments near former industrial waste discharge points. Because industrial wastes were discharged to the sediments in this area for about 34 years, and because trace amounts of substances occurring in those industrial wastes were fuund in sediment samples from the site during the on-site survey, it is concluded that some contamination of sediments in the ara did occur. However, because the discharges stopped years ago, and only because low levels of contaminants were found in the sediments, it is concluded that no threat to human health or to the environment exists at this site at the present time. Further study is not recommended at this site.

3.2.3 Crash Crew Training Area (Site 3). This site was used for firefighting practice between 1955 and 1982. Jet fuel and aviation gasoline were placed in unlined pits and set on fire. The IAS team concluded that these practices produced areas of localized contamination because the pits were unlined. This localized contamination does not present a significant threat to human health or to the environment because there is no direct contact with humans or wildlife, there are no nearby potable water wells, and there is a low potential for migration off-base due to the location of the site. Further study is not recommended at this site.

3.2.4 Army Rubble Disposal Site (Site 4). This site was used in the early **1950s** for deposition of building rubble. Materials reportedly disposed of here present-no threat to human-health or to the environment. Further study is not recommended at this site.

3.2.5 Borrow Pit (Site 5). Soil was removed from this site in 1976 for landfill cover. Since no evidence of disposal was found, this site presents no threat to human health or to the environment. Further study is not recommended at this site.

3.2.6 Fort Redoubt Rubble Disposal Site (Site 6). This site was used between 1973 and **1982** for disposal of building rubble, which may have contained asbestos. The asbestos, if present, has been buried and no longer poses a threat to human health. No evidence exists of the disposal of any other material at this site that would present a danger to human health or to the environment. Further study is not recommended at this site.

3.2.7 Firefighting School (Site 7). This facility was used for training firefighters. Since there is no evidence that hazardous materials were disposed of here, it is concluded that this site does not constitute public health or environmental threat. Further study is not recommended at this study.

3.2.8 Rifle Range Disposal Site (Site 8). This site was reportedly used for the disposal of solid waste from the naval complex between 1951 and 1955. Disposal was accomplished by burning and burial. Evidence of disposal of hazardous wastse was not discovered; therefore, this site does not constitute a hazard to public health or to the environment. Further study is not recommended at tnis site.

3.2.9 Navy Yard Disposal Site (Site 9). Early records indicate that this disposal site was used between 1917 and the early 1430s for disposal of trash and refuse. Because this site was used so long ago, and because hazardous materials were not disposed of here, no danger to human health or to the environment exists because of disposal at this site. Further study is not recommended at this site.

3.2.10 Commodore's Pond (Site 10). This pond was used for underwater storage of wooden timbers for use in shipbuilding in the nineteenth century. There is no evidence of hazardous materials use, storage, or disposal at tnis site. Danger to human health or to the environment did not result from operations at this site. Further study is not recommended at this site.

3.2.11 North Chevalier Field Disposal Site (Site 11). This site was used as a general disposal site for burning refuse from industrial activities. Because industrial waste was disposed of here, and because metal contamination was detected at tnis site, the IAS team concludes that this site may present a potential danger to human health or to the environment. This site is recommended for further investigation under the NACIP program.

3.2.12 Scrap Bins (Site 12). This site was used as a collection and transfer point for garbage. Because no hazardous waste is known to have been disposed of here, this site presents no danger to human health or to the environment. Further study is not recommended at this site.

3.2.13 Magazine Point Rubble Disposal Site (Site 13). Because this site was used for deposition of inert fill materials, and because no hazaradous materials were disposed here, no danger to human health or to the environment exists at this site. Further study is not recommended at this site.

3.2.14 Dredge Spoil Fill (Site 14). This site was created adjacent to Navy land by deposition of dredge spoils from Pensacola Bay. This was a permitted disposal operation performed by the Army Corps of Engineers. Because this site is not located on Navy land, it is discussed in Section 5.6, Adjacent Land Use.

3.2.15 Pesticide Rinseate Disposal Area (Site 15). This site was used for disposal of rinsewater from pesticide mixing and spray equipment cleaning. Although it has been documented that pesticide residues were disposed of here, there is no evidence of disposal of concentrated solutions. Only dilute reinseate solutions were disposed of here. In addition, there are no denuded areas of foliage. The pesticides disposed of here were not in sufficient concentrations to constitute a threat to the environment; therefore, the disposal site does not present a danger to human health or to the environment. Further study is not recommended at this site.

3.2.16 Brush Disposal Disposal Site (Site 16). This area was used for disposal of wood, other plant matter, and some metallic objects. Since evidence of hazardous materials use, storage, or disposal does not exist at this site, this site does not present a hazard to human health or to the environment. Further study is not recommended at this site.

3.2.17 Transformer Storage Yard (Site 17). This site was used for storage of transformers, some of which contained PCBs. The area is paved with asphalt, but high rainfall levels create the likelihood of PCBs being transported off the pavement and contaminating the ground at the edge of the pavement. A sample of a black, oily residue at this site was tested and found to contain high levels of a PCB-compound. Therefore, the potential for soil contamination at this site exists and presents a hazard to human health and to the environment. This site is recommended for further study under the NACIP Program.

3.2.18 PCB Spill at Substation A (site 18). In 1966, a transformer failed at Substation A, spilling PCB transformer fluid. The area is well-paved, except for one small gravel-covered area. A sample of oily residue was taken from the surface of this gravel area and analyzed. The results showed the presence of PCB in concentration less than that considered hazardous under the Toxic Substances Control Act. Because the area is mostly paved, and because the residue in the unpaved areas was tested and found non-hazardous, it is concluded that the area does not present a hazard to human health or to the environment. Therefore, further study is not recommended at this site.

3.2.19 Fuel Farm Pipeline Leaks (Site 19). A large quantity of fuel oil was spilled in this area, resulting in trees and other vegetation being killed. Because the soil in the area is permeable and the water table is shallow, it is likely that a layer of fuel oil is floating on the groundwater in this area. During the records search and the on-site survey, it was determined that there are not any potable groundwater wells located near this site. Although the findings on this site are not sufficient to warrant a confirmation study on the basis of danger to human health or to the environment, it is concluded that an effort should be made to determine whether oil is present on the groundwater and whether it is feasible to recover the oil. Further study under the NACIP Program is not rcommended at this site.

3.2.20 Berthing Pier Pipeline Leak (Site 20). Fuel leaks caused oil to be discharged into the soil at this site. Because the leaks were repaired and a cleanup at this site included removal of oil-contaminated soil, it is concluded that this site does not constitute a threat to human health or to the environment. Further study is not recommended at this site.

3.2.21 Sludge Disposal at Fuel Tank Area (Site 21). Sludge containing tetra ethyl lead was disposed of here. Soils of the area are highly permeable, and the level of rainfall in the area is high. There is unrestricted access to the site. Because of these facts, it is concluded that this site presents a potential danger to human health. This site is recommended for further study under the NACIP Program.

3.2.22 Refueler Repair Shop Fuel Disposal Site (Site 22). This site was used for disposal of residual aircraft fuel from refueler trucks prior to repairs. Because teraethyl lead was discharged into the soil in this area and because the possibility of contact with human beings is not excluded, it is concluded that this site presents a potential threat to human health. This site is recommended for further study under the NACIP Program.

3.2.23 Chevalier Field Pipeline Leaks (Site 23). Because oil leaks occurred at this site, vegetation was killed at this site, and oil slicks were reported near this site, it is concluded that the soil at this site is contaminated with oil. However, due to the lack of a receptor in the immediate environment, it is concluded that no hazard to human health or to the environment exists at this site. Further study is not recommended at this site.

3.2.24 DDT Mixing Area (Site 24). This site was used for the mixing of DDT for pest control. Evidence indicates that the quantities disposed of at this site were not large enough to be significant. It is concluded that this site does not present a threat to human health or to the environment. Further study is not recommended at this site.

3.2.25 Radium Spill Site (Site 25). Waste from radium removal operations was spilled in this area. Because the material was spilled on pavement and properly cleaned up, it is concluded that no potential hazard to human health or to the environment exists at this site. Further study is not recommended at this site.

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3.2.26 Supply Department Outside Storage (Site 26). Containers of industrial chemicals leaked at this site, causing hazardous materials to be discharged to the soil. It is concluded that, because of the leakage, there is some contamination of soil in this area. However, because the quantities leaked were estimated to be small, and because of the lack of an environmental receptor in the immediate area, it is concluded that this site does not pose a threat to human health or to the environment. Further study is not recommended at this site.

3.2.27 Radium Dial Shop Sanitary Sewer (Site 27). Because the sewer leading from the dial shop was used for disposal of liquid wastes containing radium, it is concluded that this portion of the sanitary sewer may be contaminated. This site is recommended for further study under the NACIP Program.

3.2.28 Transformer Accident (Site 28). This site sustained a spill of transformer oil. It is not known that the oil contained PCB compounds. The spill occurred on a paved roadway, effectively preventing direct discharge to the soil. The accident happened twelve years ago. Because of these facts it is concluded that, if PCB compounds were spilled here, they are no longer present at the site, but have been diluted and washed away by storm runoff. Therefore, it is concluded that no significant threat to human health or to the environment exists at this site. Further study is not recommended at this site.

3.2.29 Soil South of Building 3460 (Site 29). Because several workers received minor skin burns from a substance in the soil while excavating under the concrete apron south of Building 3460, it is concluded that this site constitutes a potential threat to human health. This site is recommended for further study under the NACIP Program.

CHAPTER 4. RECOMMENDATIONS

4.1 INTRODUCTION. Based on the foregoing discussion of significant findings and conclusions, seven sites at NAS Pensacola may be contaminated and may pose a potential threat to human health or to the environment on or off the activity. Figure 4-1 identifies the locations of these areas. However, before corrective action is initiated, additional information is needed regarding the locations or extent of the contaminated areas and the potential for contamination migration.

4.2 GENERAL RECOMMENDATIONS.

4.2.1 The IAS team recommends that sites 1, 3, 4, 6, 9, 11, 13, 15, 16, 17, 21, 22, 24, 27, and 29 be noted on the general development map and on real estate records.

4.2.2 The IAS team recommends that all groundwater monitoring wells be surveyed to mean sea level and noted on the general development map, and that central records of groundwater levels and chemical tests be retained.

4.3 MONITORING WELL INSTALLATION AND SAMPLING. 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; the types of samples to be taken, such as soil, water, or sediment; and the suspected contaminants for which tests should be made. Where appropriate, the IAS team recommends that the screening procedure include analysis for groundwater contamination indicators established by EPA. Groundwater contamination indicators include pH, specific conductance, total organic carbon, and total organic halogen. If a contamination indicator is positive, the specific contaminants should be identified and quantified. It is also recommended that groundwater monitoring and well installation be done using guidance in the Groundwater Monitoring Guide, NEESA 20.2-031 of March 1981. The number of groundwater monitoring wells recommended are necessary to determine the groundwater level and flow direction and will provide groundwater samples for initial contaminant screening. The final number and exact location of groundwater monitoring wells required to determine the extent and movement of contaminants from each site will be determined by a hydrogeologist as part of the confirmation study.

4.4 CONFIRMATION STUDY. The areas that warrant further investigation under a confirmation study include: the Sanitary Landfill (Site 1); North Chevalier Field Disposal Site (Site 11); the Transformer Storage Yard (Site 17); Sludge Disposal at Fuel Tank Area (Site 21); the Refueler Repair Shop Fuel Disposal Site (Site 22); the Radium Dial Shop Sanitary Sewer (Site 27); and the soil South of Building 3460 (Site 29). Figure 4-1 shows the locations of the seven sites identified for confirmation studies. Table 4-1 summarizes a recommended environmental monitoring program for the seven sites. Prior to the selection of sampling points, personnel from the Environmental Branch of the Public Works Center should be consulted regarding the location of contaminant sources.

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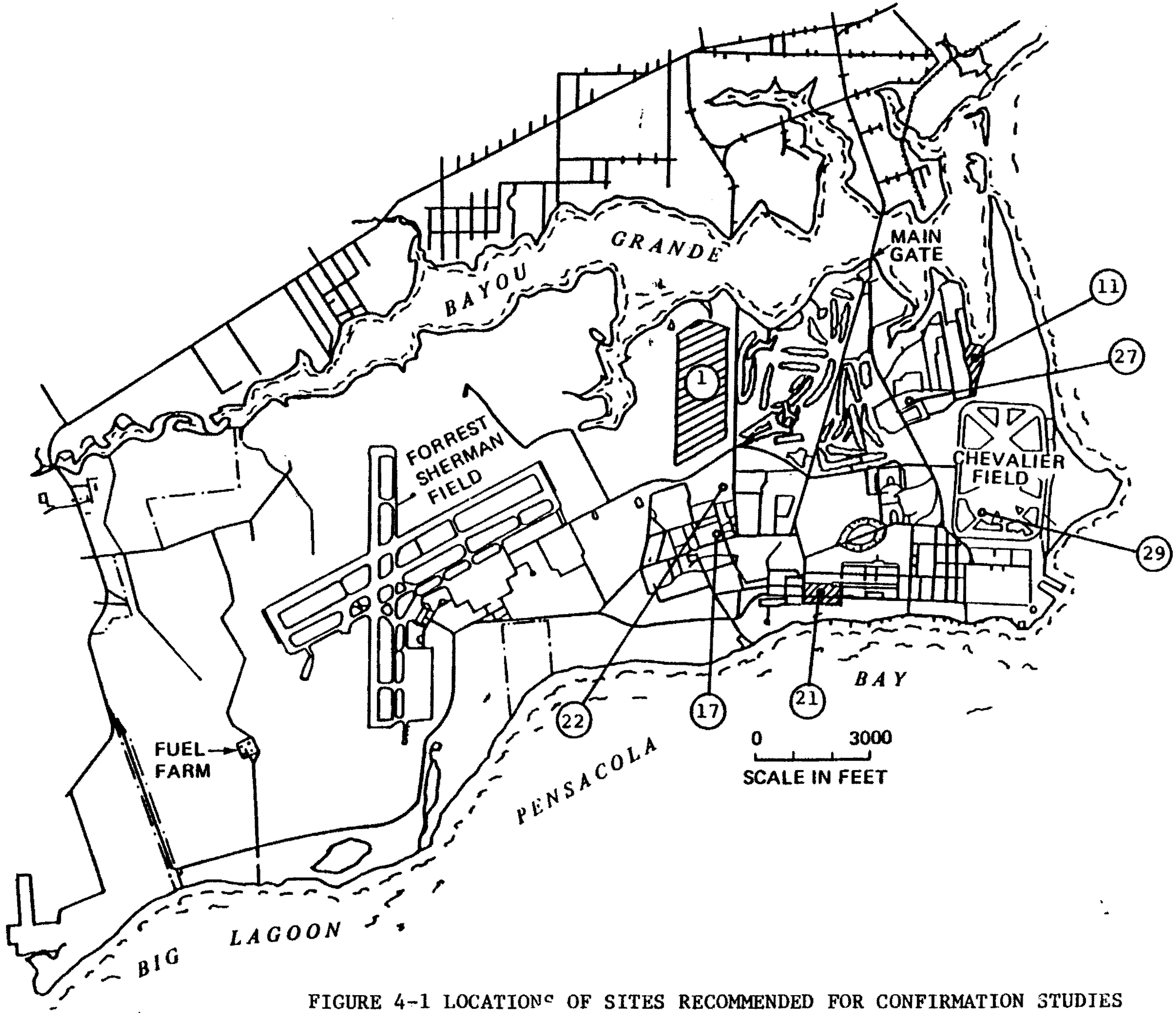

FIGURE 4-1 LOCATIONS OF SITES RECOMMENDED FOR CONFIRMATION STUDIES

TABLE 4-1

SUMMARY OF SITES RECOMMENDED **FOR** CONFIRMATION STUDIES

			Verification (One-Time Study) Sampling			Characterization (1st Year Effort) Sampling		
Site Number	Site Name	CSRS Score	# Soil Samples	# Water Samples	Lab Testing Parameters	# of Wells	# of Samples	Lab Testing Parameters
25-1	Sanitary Landfill	23				8-10	32-40	Groundwater contamination indicators, water level, water temyerature
25-11	North Chevalier Field Disposal Site	22		6	Groundwater contamination indicators, silver, cadmium, chromium, mercury, nickel, lead, zinc			
25-17	Transformer Storage Area	26		12	Polychlorinated biphenyls			
25-21	Sludge Disposal at Fuel Tank Area	22		27	Lead, oil and grease			
25-22	Refueler Repair Shop Fuel Disposal Site	20		9	Lead, oil and grease			
25-27	Radium Dial Shop Sanitary				Contact RASO			
25-25)	Soil South of Building 3460	13		5	pH, phenols cyanide, cadmium, chromium, copper, nickel			

4.4.1 Sanitary Landfill (Site 1).

Groundwater monitoring wells: Eight to ten new wells may be necessary to determine contamination migration characteristics.

Type of samples: groundwater

Number of samples: 32 to 40 per year

Sampling frequency: quarterly

Testing parameters: groundwater contamination indicators, water level, water temperature.

Remarks: The presence of contamination at this site has been verified by earlier work (Crawford and others, 1975; Boettcher, 1976). Therefore, the IAS team recommends installing a system of groundwater monitoring wells to determine contarninant migration characteristics. The monitoring system should include eight to ten new wells placed appropriately around the site. At least three, and as many as four or five groundwater investigation wells should be installed first to determine the direction of groundwater flow. The placement of these should be determined by groundwater experts during the confirmation study. Once the direction of groundwater flow is established, the most upgradient of these wells should be used as the upgradient well. The rest of the investigation wells can then be used as monitoring wells, along with other monitoring wells drilled as needed to characterize the contaminant plume.

4.4.2 North Chevalier Field Disposal Site (Site 11).

Groundwater monitoring wells: six

Type of samples: 24 groundwater samples, 4 surface water samples, 6 sediment samples

Number of samples: approximately 34 during the first year

Sampling frequency: sample each of 6 wells quarterly

Testing parameters: groundwater contamination indicators and the following metals: Cadmium, chromium, lead, mercury, nickel, silver, zinc.

Remarks: To verify the existence of groundwater contamination, place six wells around the perimeter of the disposal site. Sample each groundwater well quarterly for the first year. Sample surface water in runoff toward Bayou Grande quarterly for the first year. Sample sediments in runoff streams at the site. If significant contamination is found, it is recommended that groundwater monitoring be continued to determine contaminant migration characteristics. Additional wells might be necessary for the continued monitoring.

4.4.3 Transformer Storage Yard (Site 17).

Groundwater monitoring wells: none recommended at this time.

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Type of samples: soil

Number of samples: 12

Sampling frequency: once

Testing parameters: polychlorinated biphenyls

Remarks: To verify the presence of contamination, select twelve sampling points near the site, but off the pavement. Locate three sampling points on each of four sides of the site. Sample each location at the surface. If contamination is detected in the soil samples, the IAS team recommends cleanup of the area. As an interim measure, it is recommended that human access to the area be restricted by a physical barrier and that persons entering the area wear protective clothing. It is recommended that contaminated pavement and soil be removed and disposed of at a licensed disposal site.

4.4.4 Sludge Disposal at Fuel Tank Area (Site 21).

Groundwater monitoring wells: none recommended at this time.

Type of samples: soil, taken at surface and at subsurface depths of 12 inches and 24 inches

Number of samples: 27, one composite surface sample and two composite subsurface samples at each of nine fuel tank sites

Sampling frequency: once

Testing parameters: lead, oil and grease

Remarks: To verify the presence of contamination, locate eight sampling points equally spaced around the circumference of each tank site. Sample each point at the surface and at 12 inches and 24 inches depth. Combine the eight subsamples from each sampling level at each tank site. This will result in 27 discrete samples from nine tank sites, and from three different levels at each tank site. If significant contamination is detected, further confirmatory sampling will be needed, possibly including groundwater monitoring wells.

4.4.5 Refueler Repair Shop Fuel Disposal Site (Site 22).

Groundwater monitoring wells: none recommended at this time.

Type of samples: soil, taken at surface and at subsurface depths of 12 inches and 24 inches

Number of samples: nine; three surface samples, and six subsurface samples

Sampling frequency: once

Testing parameters: lead, oil and grease

Remarks: To verify the presence of contamination, select three sampling locations within the site boundary. Sample each location at the surface and at 12 inches and **24** inches aepth. This will result in nine separate samples, each to be analyzed separately. If significant contamination is found, it might be necessary to install groundwater monitoring wells to determine contaminant migration characteristics.

4.4.6 Radium Dial Shoo Sanrtarv Sewer (Site 27). It is recommended that the Radiological Affairs Support Office be contacted to conduct a survey of the sewer system associated with the demolished dial painting shop.

4.4.7 Soil South of Building ***3460*** (Site ***29***).

Groundwater monitoring wells: none recommended at this time.

Type of samples: soil

Number of samples: approximately ***5*** during the first year

Frequency: Once

Testing parameters: pH, phenols, cyanides, cadmium, chromium, nickel, copper, total organic carbon, total organic halogen, specific conductance, temperature, water level

Remarks: Verify the presence of contamination by using a core sampler to determine if contaminants are present in the soil. Select one location, and sample the soil at the surface and at depths of 12 inches, 24 inches, ***36*** inches, and *48* inches. If contaminants are found in tne soil sampling effort, groundwater monitoring wells should be installed. If monitoring wells are installed, analyze groundwater for only those contaminants found in the soil sampling program.

CHAPTER 5. BACKGROUND

5.1 GENERAL INFORMATION ON NAVAL AIR STATION PENSACOLA

5.1.1 Location. Naval Air Station Pensacola is located on a peninsula about five miles southwest of Pensacola, Florida. This peninsula is bounded on the north by Bayou Grande, on the east by Pensacola Bay, and on the south by the Gulf of Mexico.

The main industrial operations conducted at NAS Pensacola are located on the older, eastern end of the peninsula. The western end accommodates the main airfield, Forrest Sherman Field, and undeveloped wooded land.

Outlying airfields have been associated with NAS Pensacola in the past; four of these became independent naval air stations at one point in time. However, this report deals only with the mainside complex consisting of Naval Air Station (NAS) Pensacola, Naval Air Rework Facility (NAVAIREWORKFAC) Pensacola, Public Works Center (PWC) Pensacola, and other tenant activities.

5.1.2 Organization

5.1.2.1 NAS Pensacola. NAS Pensacola has approximately 5,589 acres of land in the complex, making it the largest activity on base. The mission of this command is "... to maintain and operate facilities and provide services and material to support operations of aviation activities and units of the Naval Air Training Command and other activities as designated by the Chief of Naval Operations (CNO)."

5.1.2.2 NAVAIREWORKFAC Pensacola. NAVAIREWORKFAC Pensacola, formerly the operations and repair department of NAS, is a tenant command located on NAS property. This command is responsible for maintaining and operating facilities for, and performing a complete range of depot-level rework operations on, designated weapons systems, accessories, and equipment; manufacturing parts and assemblies as required; providing engineering services in the development of changes of hardware design; furnishing technical services on aircraft maintenance and Logistic problems; and performing, upon specific request or assignment, other levels of aircraft maintenance. In 1980, NAVAIREWORKFAC occupied about 130 acres of land on the base.

5.1.2.3 Public Works Center (PWC) Pensacola. PWC maintains its own plant account, consisting of the housing and utility areas. These areas amount to approximately 250 acres. The mission of this command is to"... provide public works, public utilities, public housing, transportation support, engineering services, shore facilities planning support, and all other public works logistic support required by the operating forces, dependent activities, and other commands located in the vicinity of the Pensacola complex."

5.1.2.4 Other Tenants. Other tenant activities on base are the Naval Aerospace and Regional Medical Center (NAVAEROSPREGMEDCEN), the Naval Aerospace Medical Institute (NAVAEROSPMEDINST), the Naval Aerospace Medical Research Laboratory (NAVAEROMEDRSCHLAB), the Naval Air Maintenance Training Group Detachment (NAMTRAGRUDET), the Naval Aviation Engineering Service Unit Detachment (NAESU DET), the Naval Aviation Schools Command (NAVAVSCOLSCOM), the Defense Property Disposal Office (DPDO), the Naval Regional Dental Center (NAVREGDENCEN), Chief of Naval Education and Training (CNET), the Naval Flight Demonstration Squadron (Blue Angels) (NAVFLIGHTDEMORON), and the Naval Publications and Printing Support Office (NPPSO).

5.1.2.5 Other Holdings. Land is also held by the Department of the Interior and the National Park Service. This land includes historical areas such as the Lighthouse Reservation, Fort Barrancas, Fort Redoubt, Fort San Carlos, and the Barrancas National Cemetery. Figure 5-1 illustrates major land use at NAS Pensacola.

5.2 HISTORY. The history of the Pensacola naval complex can be traced through four centuries. Although construction of the current military bases in the complex began in 1914 for training of the Navy's air force, the military history of the sites dates back to the colonization of North America.

In 1528, Don Tristan De Luna entered Pensacola Bay and established the first European settlement in North America. From documents and logs of De Luna's expedition, historians believe he settled in the Fort Barrancas area on Naval Air Station Pensacola.

De Luna's settlement disbanded, but in 1698 the Spanish attempted a second fortified colony, Fort San Carlos De Austria, in Pensacola Bay. During the colony's early years, sickness, starvation, fires, and frequent Indian attacks plagued the settlers. From 1719 to 1722, with no relief from misfortune, the fort was captured by the French, recaptured by the Spanish, then lost again to the French. No remains of Fort San Carlos De Austria have been uncovered.

In 1771, the British constructed a small fortification on the present site of Fort Barrancas. But in 1803, the Spanish again re-occupied the territory and established Fort San Carlos de Barrancas. The present day Fort Barrancas was built between 1839-1844 in the same location.

Strategically, Fort Barrancas provided excellent coastal defense of the harbor entrance. Along with the nearby Fort Pickens, McRae and Bateria San Antonio, Barrancas' guard of the water enabled Pensacola to grow into an important naval base.

Another important asset in harbor defense, the Pensacola lighthouse, was built in 1824, 800 feet southwest of Fort Barrancas. This lighthouse, the first U.S. lighthouse in Florida, lasted until 1858. A second lighthouse, constructed in 1859, 2,000 feet west of the first site, still operates today as a navigational aid under U.S. Coast Guard supervision.

In 1825, Congress authorized the President to "select and purchase a site for a Navy yard and depot on the coast of Florida, in the Gulf of Mexico, to defend the commerce of the United States, and to clear the Gulf of Mexico and adjacent seas of pirates." A special board of commissioners, selected by the Secretary of the Navy, recommended the Pensacola site for a Navy yard. The Navy commenced building a Navy yard the next year on lands fronting the Pensacola Bay, from the mouth of the Big Bayou to a line below Tartar Point, and all the land on the bay for one mile back, as far as the Grand Lagoon.

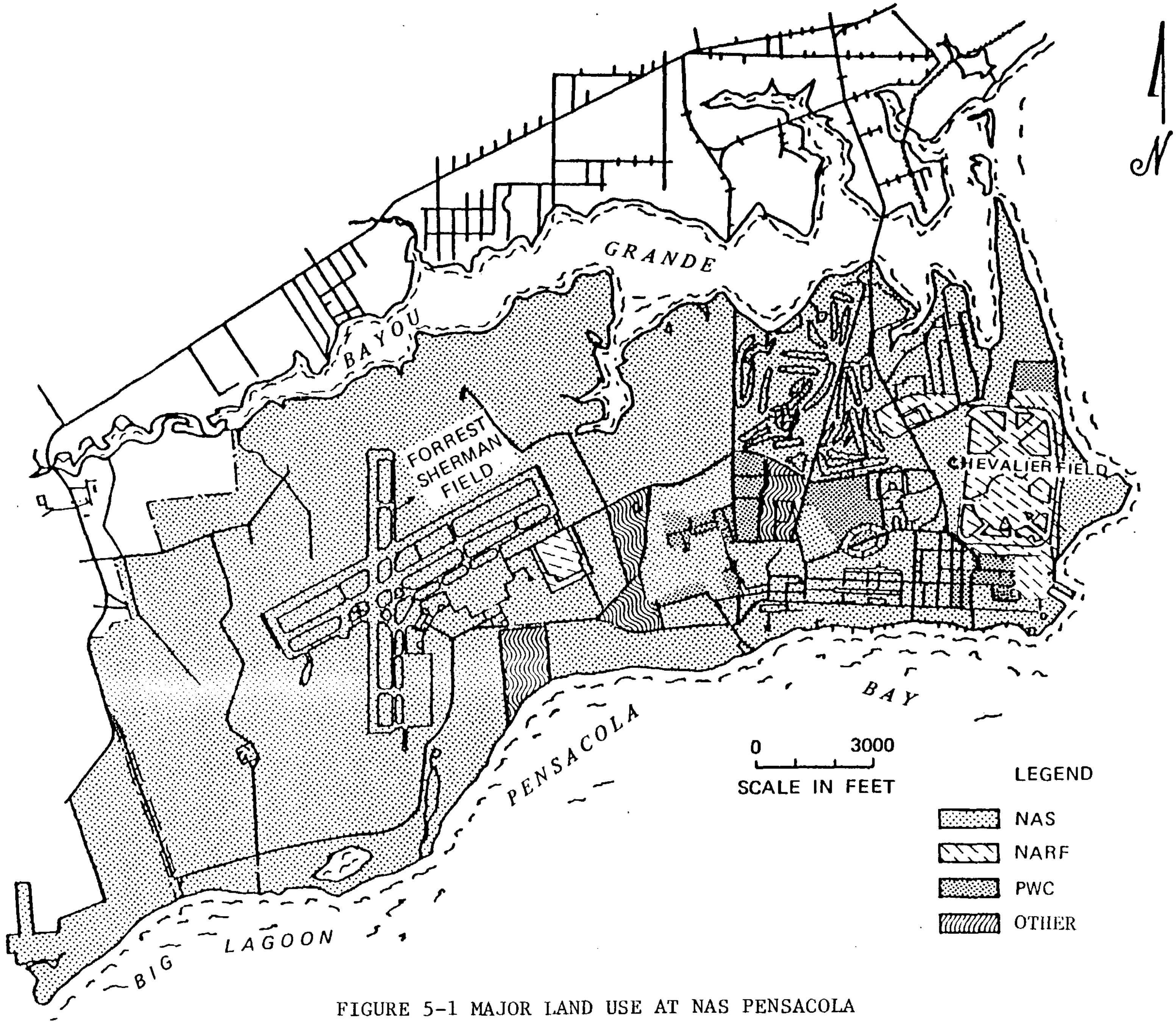

FIGURE 5-1 MAJOR LAND USE AT NAS PENSACOLA

Between 1828 and 1835, the Navy acquired approximately 2,300 acres of land. Fourteen hundred forty-six acres were purchased from Mr. and Mrs. Moreno, 850 acres of the Santa Rosa Sound, Barela, and Barrios lands were purchased from Mr. Joseph White, and 17.5 acres of a sand spit on the south side of the Grand Bayou were awarded from a quitclaim with Gulfpower Company.

Rapid growth of the base and the number of employees forced the Navy to build a brick wall around the Navy yard in 1837, to divide the yard from the residential communities of Warrington and Woolsey. Other important construction occurred in 1848 when work on a dry dock began. Setbacks plagued this project, which was still incomplete as late as 1854.

At the outbreak of the Civil War in 1861, the forts and the Navy yard fell to the Confederates. By the time they were driven out a year later, they had demolished the entire Navy yard. The local United States Garrison retired to Fort Pickens on Santa Rosa Island across the bay and successfully held the area for the rest of the war.

Of the general war ruins, only the quay walls and the tidal basin of the dry dock were salvable. Repairs progressed slowly. By 1883, the site of the yard was declared unuseable and indefensible in time of war. The Chief of the Bureau of Yards and Docks suggested to the Secretary of the Navy that the yard be closed and placed on inactive status.

The yard remained open, however and, in the next 20 years, several construction projects were initiated. In 1898, Congress provided funds for dredging the bar across the entrance to Pensacola Bay to provide ships entering the bay an easy access to the yard. On 28 September 1906, the Pensacola Electric Company received permission from the Secretary of the Navy to construct a railroad on the naval reservation and place the poles and string for the wires necessary to operate an electric railway. Improvement plans halted in late September of 1906, when a hurricane and an unprecedented rise in the tide flooded the yard. The whole reservation was submerged. A similar storm a year later badly damaged the central power house. Disaster struck again the next year when a large fire destroyed the steam engineering foundry, the smith boiler, the coppersmith shop, Building #2, and the yard's electric light and power plant. Restoration to an operational level again proved impossible, so the yard was officially closed acd placed on maintenance status in 1911.

Washington did not forget Pensacola. Three years later, in 1914, the Navy's first permanent air station was established on the site of the old Navy yard. The original aviation unit setting up the air station and flying school consisted of nine officers, 24 enlisted men, 7 flying boats and hydroplanes with canvas hangars for storage. An aviation radio laooratory, the first to conduct experiments with airborne radios, was established in 1916.

By 1922, the air training portion of the station increased in size until a reorganization of the command was necessary. A Superintendent of Aviation Training, directly responsible to the commanding officer of the station, supervised all schools and school activities, and acted as Operations Officer. That same year, the town of Woosley, north of the base, was razed to make room for an aircraft landing field called Station Field, now known as Chevalier Field.

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During World War I, 150 seaplanes were used for training, and station personnel reached a maximum of 5,000 men. Expansion projects in preparation for another war crisis began during the mid-1930s. Quarters were constructed for more officers and cadets. The dispensary, Marine barracks, new hospital and extended assembly and repair facilities were built. Utilities, such as power plants, roads, and walks accompanied the building. A new ground school, gymnasium, welfare building, and an aircraft store house were constructed. The naval air station field was enlarged to 180 acres to accommodate the aircraft squadron and it was renamed Chevalier Field.

Beginning in 1934, auxiliary fields were added to what later was to become the Naval Air Basic Training Complex. The first auxiliary field, Corry Field, was soon to be followed by four more--Saufley, Bronson, Barin, and Whiting. Chevalier Field and Corry Field were provided with paved runways and extensive permanent support facilities including land plane hangars, overhaul and repair shops, warehouses, barracks, and officer's quarters.

In 1939, a School of Aviation Medicine opened at Chevalier Field with a beginning class of nine reserve officers. The school's purpose was to familiarize Navy doctors with the special problems created by aviation.

Class A Service Schools for aviation mechanics opened in February 1940, to train aviation machinist's mates and aviation metal smiths.

Several important building projects were completed in 1941 including: Ellyson Field; a naval hospital; a permanent building for the engine overhaul division of the assembly and repair department; a building to house the School of Aviation Medicine; a chapel; a ship's service store; quarters for aviation cadets; a cadet recreation center; and an extension to one of the big storehouses.

Chevalier Field and its auxiliary field were grouped together in 1942 to form a command to be known as the U.S. Naval Air Training Center Pensacola, Florida, with headquarters on the main station. Under the new organization, the main station was known as Naval Air Station Pensacola and the auxiliary fields as Auxiliary Air Stations. The Commandant of the Naval Air Training Center Pensacola assumed additional duties as Chief of the Air Intermediate Training Command, which consisted of the local training center and its counterpart in Corpus Christi, Texas.

Four of the fields established to aid the training program at NAS Pensacola eventually became major elements of the Pensacola complex. Corry Field was commissioned in 1934, Saufley Field in 1940, Ellyson Field in 1941, and Whiting Field in 1943. All four fields were later designated naval air station.

The Naval Air Training Command was established in January 1944, with headquarters at NAS Pensacola. The number of pilots trained at NAS Pensacola reached a peak that year. During World War II, 12,000 men completed the extensive training and flew a combined total of almost two million hours with the fleet.

Aircraft technology was in a constant state of flux. In 1947, NAS Pensacola was designated an overhaul activity for aircraft, and in 1948 the Assembly ana Repair Department became known as Operations and Repair (O&R) Department.

The adaptability of the helicopter to military operations led to the formation of the Navy's Helicopter Training Unit One on 3 December 1950. Based at NAS Pensacola Ellyson Field, the basic advanced helicopter flight training program quickly matured and began to expand as the demand for graduate pilots increased. In March *1554,* the O&R Department successfully completed the first repair **job** of a Kaman PFK-1 Twin-Rotor Helicopter in Building 632.

Increasing usage of military jet aircraft and its adaptation to naval operations led to the construction of a new master jet airfield within the expanded boundaries of NAS Pensacola in 1953. Now known as Forrest Sherman Field, the new runway system was constructed in the western half of the station, and Chevalier Field was eventually abandoned as an operational facility for fixed-wing aircraft.

The Pensacola complex contributed to advancement in other scientific fields as well. In 1957, the Naval Aerospace Medical Center was commissioned. The new center combined the training and research facilities of the Naval Aerospace Medical Institute and the Research Laboratory with the clinical facilities of the naval hospital.

The importance of the historic resources of NAS Pensacola were recognized when Fort San Carlos was dedicated as a national landmark on 8 June 1963 and entered on the National Register of Historic Places.

The Bureau of Yards and Docks commissioned the Public Works Center located at NAS Pensacola in July 1965. The center's mission in cany ways is comparable to that of a public works organization serving a major metropolitan area with responsibility for utilities and transportation added to the workload.

On 1 August 1971, the Naval Training Command was established with headquarters at Pensacola for surface, sub-surface and aviation training. As the first Chief of Naval Training, Vice-Admiral Malcolm W. Cagle was charged with unifying the Navy's training readiness and managing the funds, the facilities, the cirricula and the support of all training except certain aspects of fleet training and training assigned to the Bureau of Medicine and Surgery.

Another action taken in the latter part of 1971 would rove to have an impact on **NAS** Pensacola's future development. The Secretary f the Navy signed an agreement with the Secretary of the Interior which added certain lands near the air station to the Gulf Island National Seashore. This agreement transferred management of approximately 64 acres surrounding Fort Redoubt, Fort Barrancas, and Fort San Carlos to the National Park Service.

In mid-February 1972, the Naval Support Command moved from the Bureau of Personnel under the Chief of Naval Training. Training axperts moved from Washington to Pensacola and to the staff of the Chief of Naval Technical Training in Memphis, Tennessee. By November **1972,** the command's name had been changed to the Naval Education and Training Command, and the staff was generating long-range planning studies.

5.3 PHYSICAL FEATURES

5.3.1 General. Naval Air Station (NAS) Pensacola, located in the extreme southeastern portion of Escambia County, Florida, lies within the Coastal Plain Province of the United States. This major physiographic division extends from New York southward and westward into Texas. It consists principally of unconsolidated sands, silts, and clays deposited before the shoreline of the continental mainland reached its present position. The province is subdivided, and NAS Pensacola is located within the Coastal Lowland: a series of broad, nearly level, marine terraces that extend several miles in from the coast and merge with the narrow terraces along the Escambia and Perdido Rivers. The highest terraces in the lowland have an elevation of about 100 feet, but nowhere does NAS Pensacola achieve this elevation. Because of the smooth topograhy and the fairly short time since it was under the sea, the Coastal Lowland has little dissection, and its drainage system is weakly developed (Carlisle, 1960). Figure 5-2 (Naval Facilities Engineering Command, Southern Division, 1980) shows the general setting of NAS Pensacola, and Figure 5-3 (U.S. Geological Survey, 1957) presents a broader view of the geographical setting.

5.3.2 Climatology. NAS Pensacola is situated in a humid, warm-temperature climate. The summers are long and warm, and winters are short and mild. The average summer temperature at Pensacola is slightly more than 80°F, but temperatures reach 90°F or more approximately 19 days in the period June through August. The average winter temperature is 55°F, and on the average, there are nine freezes. The cold spells are short, and temperatures rarely go as low as 15°F or 20°F (Carlisle, 1960, Marsh, 1966, and Flood and Associates, et al, 1978).

The annual rainfall is fairly high, nearly 62 inches on the average. Rainfall is well distributed, with a peak in July and August. Snow rarely falls, but snowfalls measuring two to three inches have been recorded. Hailstorms are infrequent and cover very restricted areas. Table 5-1 contains temperature and precipitation data for Pensacola, Florida (Carlisle, 1960). Average monthly rainfall statistics do not reflect a great variation in rainfall amounts. However, the character and duration of rainfall changes a great deal with the season. The broad maximum during the summer months results from scattered consecutive showers and thunderstorms which are present nearly every day, but which may not provide precipitation at a given measurement site. During the transitional spring and fall seasons, monthly rainfall amounts are both half of the summer maximum, but the number of days with rain and total time of rainfall stands in sharp contrast to the summer figures. Rainfall during these periods results from infrequent frontal passages which supply a general area of rainfall in moderate-to-heavy amounts. During the winter months, fronts pass through the area more frequently arid are associated with broader areas of light rain--in addition to the moderate to heavy rains which may occur with the actual frontal passage (Flood and Associates, et al, 1980).

Thunderstorms of high intensity are common, with as much as three or four inches of rainfall during an hour period (Marsh, 1966). Figure 5-4 shows the seasonal variation in rainfall (Hughes, Hampton, and Tucker, 1971).

The prevailing winds blow from the north and northwest during fall and winter and from the south and southwest in spring and summer. Summer days are often

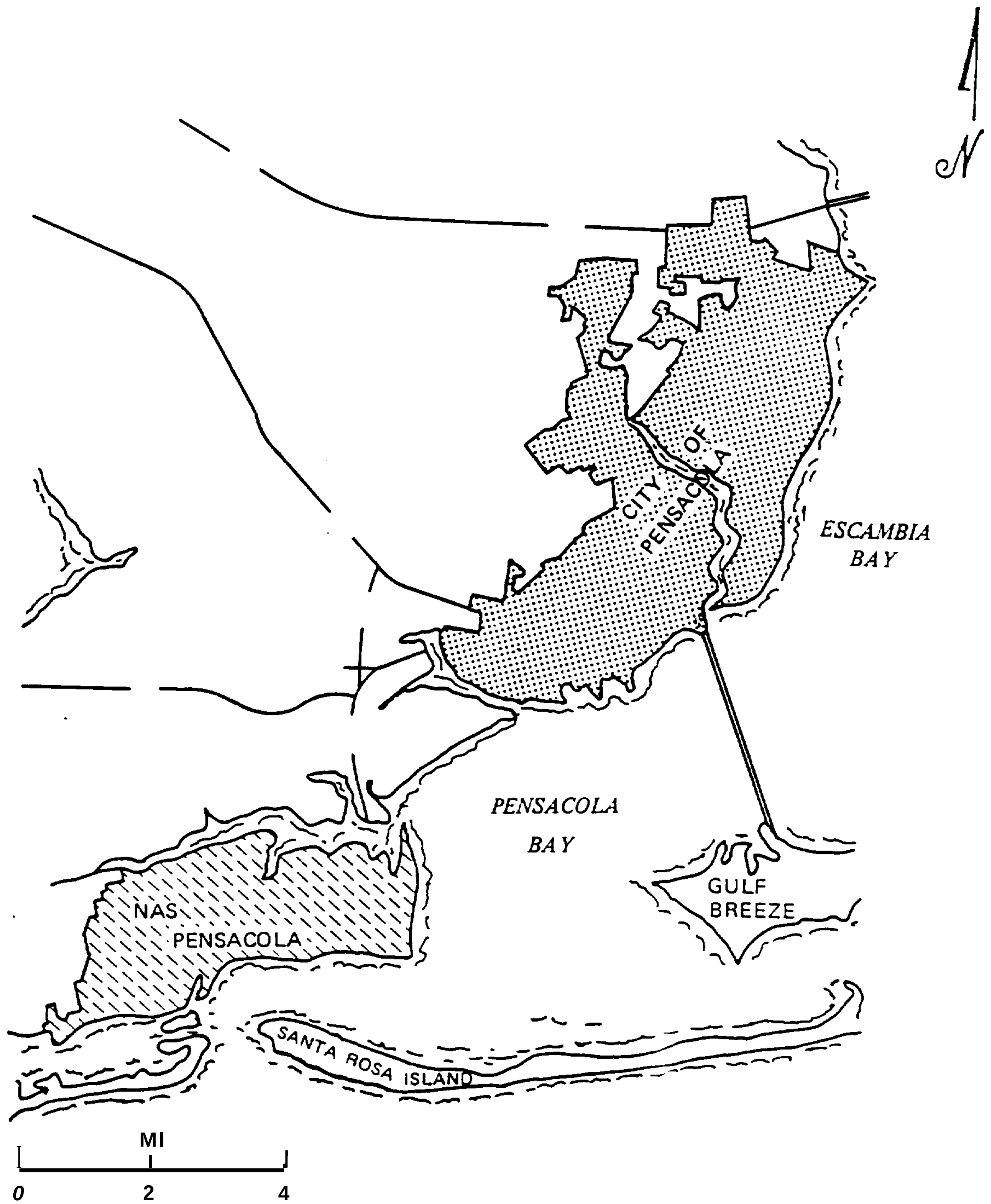

FIGURE 5-2 GENERAL SETTING OF NAS

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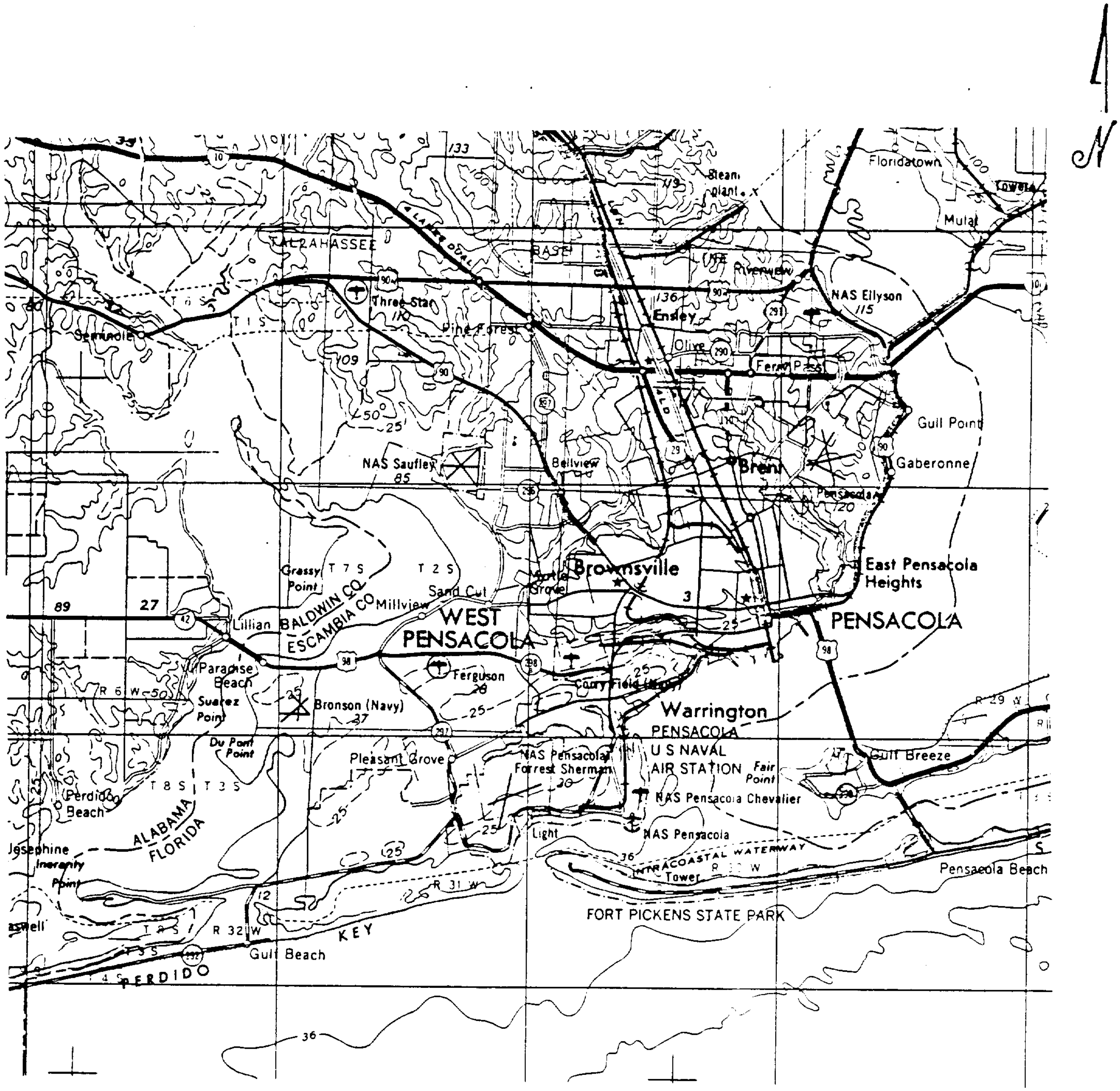

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5 0 5 10 15 23 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 50 FEET
WITH SUPPLEMENTARY CONTOURS AT 25 FOOT INTERVALS

FIGURE 5-3 NAS PENSACOLA **AND** VICINITY

TABLE 5-1
TEMPERATURE AND PRECIPITATION AT PENSACOLA
ESCAMBIA COUNTY, FLORIDA

Month	TEMPERATURE (1) Average (°F.)	Absolute Maximum (°F.)	Absolute Minimum (°F.)	PRECIPITATION (2) Average (Inches)	Driest Year (1954) (Inches)	Wettest Year (1953) (Inches)	Average Snowfall (Inches)
December	55.1	77	14	4.17	2.55	14.67	(3)
January	54.0	79	14	4.55	1.89	4.22	0
February	56.0	78	7	3.93	2.27	9.10	0
Winter	55.0	79	7	12.65	6.71	27.99	(3)
March	60.2	87	24	6.00	3.50	4.86	0
April	67.0	92	34	4.90	0.98	9.82	0
May	73.8	94	44	4.36	2.22	3.88	0
Spring	67.0	94	24	15.26	6.70	18.56	0
June	79.6	101	55	5.17	0.83	8.87	0
July	81.0	103	62	7.59	8.42	5.03	0
August	81.2	99	62	7.43	0.63	11.28	0
Summer	80.6	103	55	20.19	9.88	25.18	0
September	78.3	102	49	5.78	2.60	11.11	0
October	70.3	95	35	3.88	1.24	0.64	0
November	60.2	81	25	3.84	1.53	6.93	0.1
Fall	69.6	102	25	13.50	5.37	18.68	0.1
Year	68.0	103	7	61.60	28.66	90.41	0.1

(1) Average temperature based on a 76-year record, through 1955; highest and lowest temperature on a 51-year record, through 1930.

(2) Average precipitation based on a 76-year record, through 1955; wettest and driest years based on a 76-year record, in the period 1880-1955; snowfall based on a 51-year record, through 1930.

(3 rac

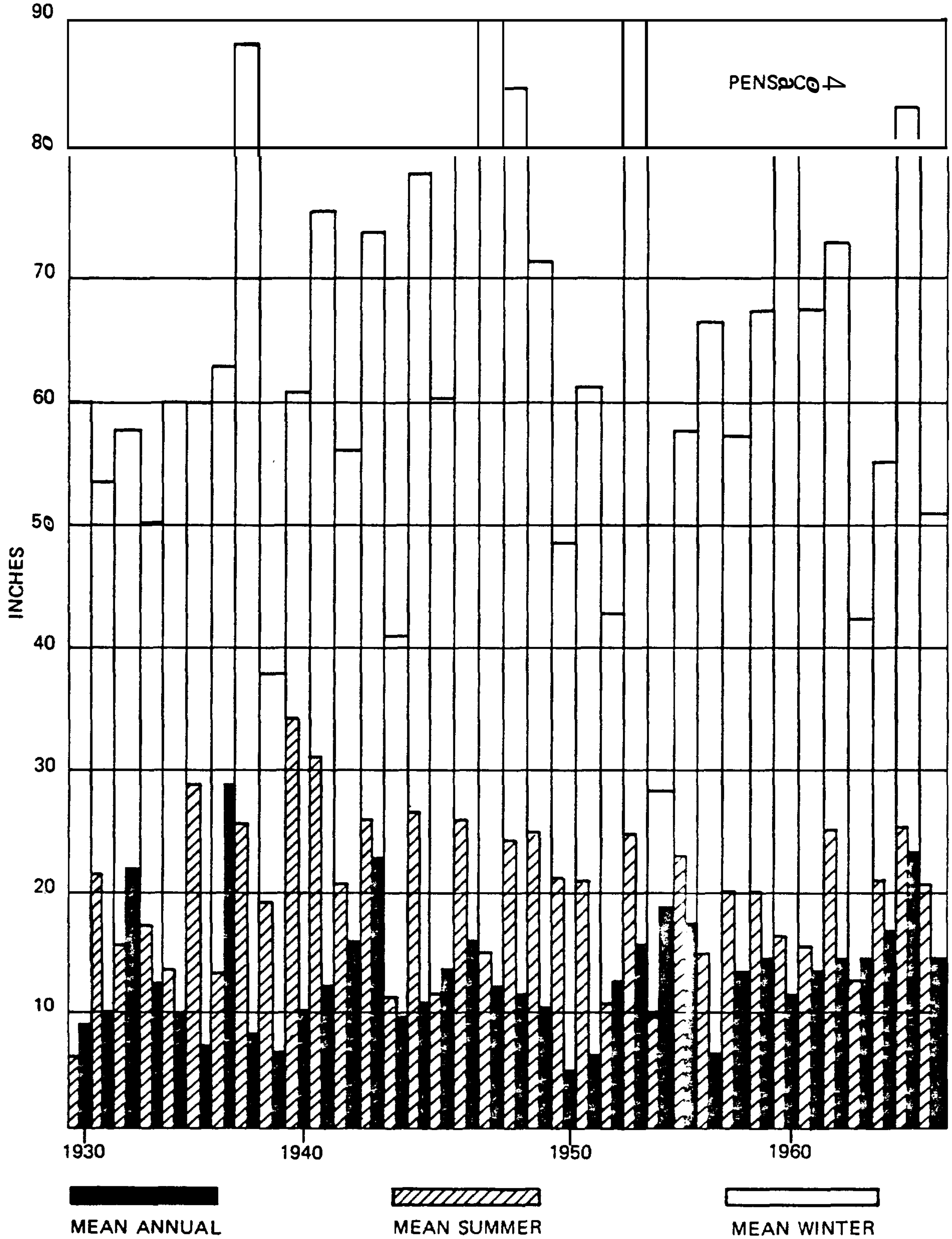

FIGURE 5-4 SEASONAL VARIATION OF RAINFALL

sultry, but most of the nights are cooled by breezes. Wind velocities are moderate except during thundersqualls (Carlisle, 1960). The winds are largely a function of the intensity of the Atlantic Burmuda High Pressure area and the local sea breeze circulation produced by the ocean-land heating differential. These effects are reflected by the prevailing southerly winds in the summer when the Bermuda High is most dominant and the land is warmer than the ocean. As the land becomes warmer on hot summer days, the sea breeze amplifies accordingly. At night when the land mass starts to cool, the sea breeze weakens and usually reverses into a land-breeze. This daily change in the local wind circulation tends to produce a complete clockwise rotation of the surface wind direction every 24 hours. In the winter time, when the influence of the Bermuda High is negligible and the land is cooler than the ocean, northerly winds prevail (Flood and Associates, et al, 1980). Table 5-2 reflects the wind-rose for NAS Pensacola.

Severe weather, which includes thunderstorms, tornadoes, tropical storms, and hurricanes occur so infrequently that precise statistics are often meaningless.

Records from 1885 to 1974 incidate a six year average between hurricanes, but the last 18 years of that period produced no hurricane damage at NAS Pensacola (Flood and Associates, et al, 1980). Hurricane Frederick reminded NAS Pensacola that the threat is very real. Tornadoes with wind speeds of 150 to 300 miles per hour can cause extensive damage, and winds of 60 miles per hour associated with thunderstorms moving 30 to 50 miles per hour are a threat to planes, boats, antennae, and construction in progress (Flood and Associates, et al, 1980).

5.3.3 Topography. The surface of NAS Pensacola is gently sloping terrain, ranging in elevation from sea level to approximately 40 feet above mean sea level. Moderately incised, 5- to 10-feet, natural and man-made drainages channel the surface water from NAS Pensacola to either Bayou Grande to the north, or Pensacola Bay to the south. Extensive grading and improvements in the vicinities of Forrest Sherman and Chevalier Field have resulted in large, nearly level planar areas. The western end of NAS Pensacola contains some marsh areas and several shallow pits which are the results of sand borrowing activities to obtain construction material. Several construction activities, target butts, Fort Redoubt, and Fort Barrancas have resulted in isolated areas of anomalous topographic highs. Figure 5-5 shows the topography of NAS Pensacola (U.S. Geological Survey, 1970) and Figure 5-6 shows this topography in a more generalized form (Naval Facilities Engineering Command, Southern Division, 1980).

5.3.4 Geology. The geological literature applicable to NAS Pensacola consisted of studies for the preparation of a report on Escambia and Santa Road Counties (Marsh, 1966). Primary sources examined by Marsh included Sellards and Gunter, 1912; Matson and Sandford 1913; Jacob and Cooper, 1940; Applin and Applin, 1944; Cooke, 1945; Calvern, 1949; MacNeil, 1949; Carlston, 1950; Heath and Clark, 1951; Puri and Vernon, 1959; Carlisle, 1960; Marsh, 1962; Musgrove, Barraclough, and Grantnam, 1965; and Barraclough and Marsh, 1965. Numerous other peripheral references were also used by Marsh in preparation of Marsh's 1966 report. This report is probably the most definitive work on Escambia and Santa Rosa Counties and, hence, NAS Pensacola. The following descriptions and figures, unless otherwise noted, are derived from these accounts.

TABLE 5-2
WIND DIRECTION AT NAS

WIND DIRECTION	PERCENTAGE OF TIME
North	16.0
Northeast	10.5
East	11.5
Southeast	11.5
South	13.0
Southwest	10.5
West	8.0
Northwest	9.0

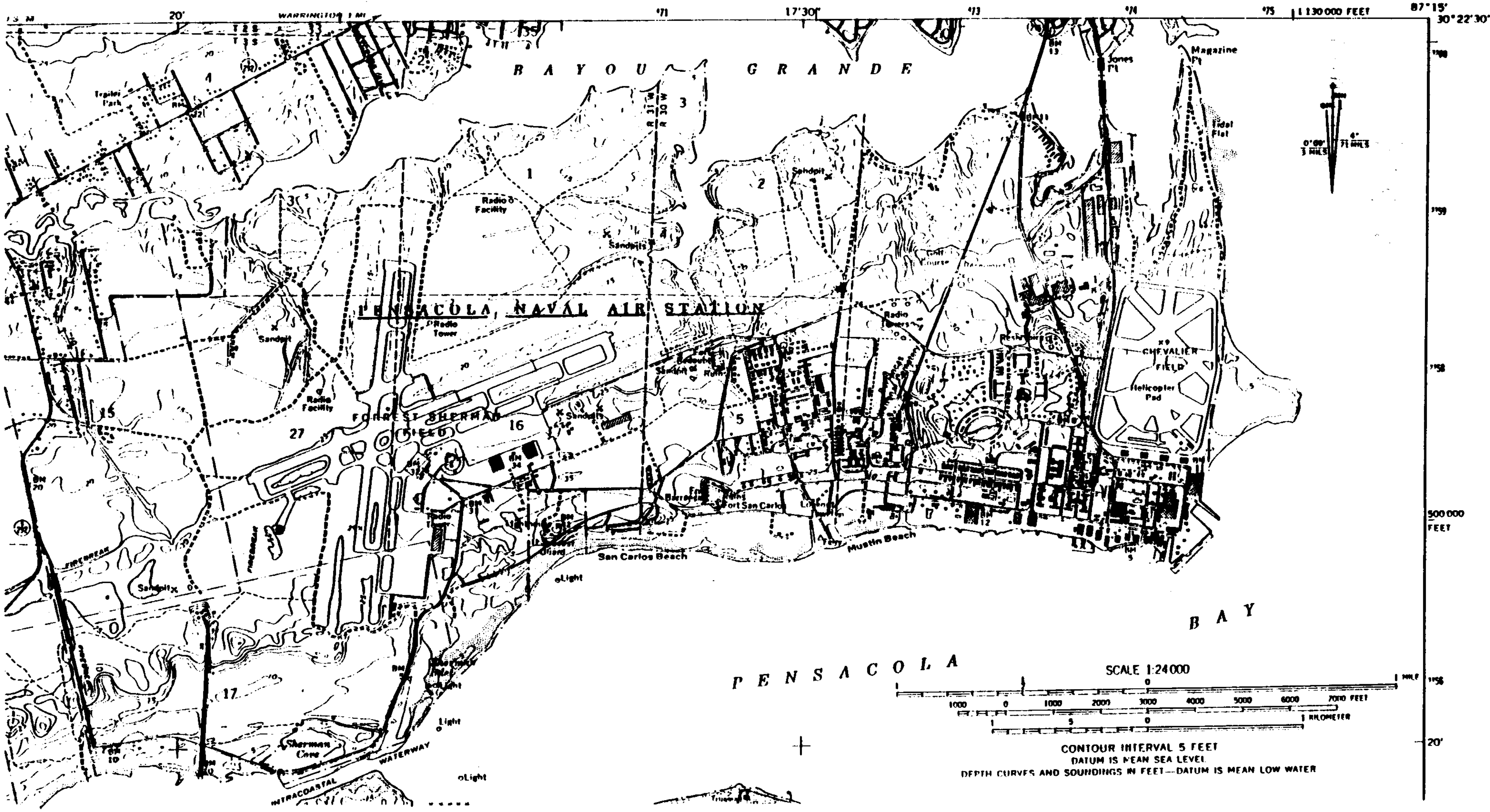

FIGURE 5 TOPOGRAPHY OF NAS

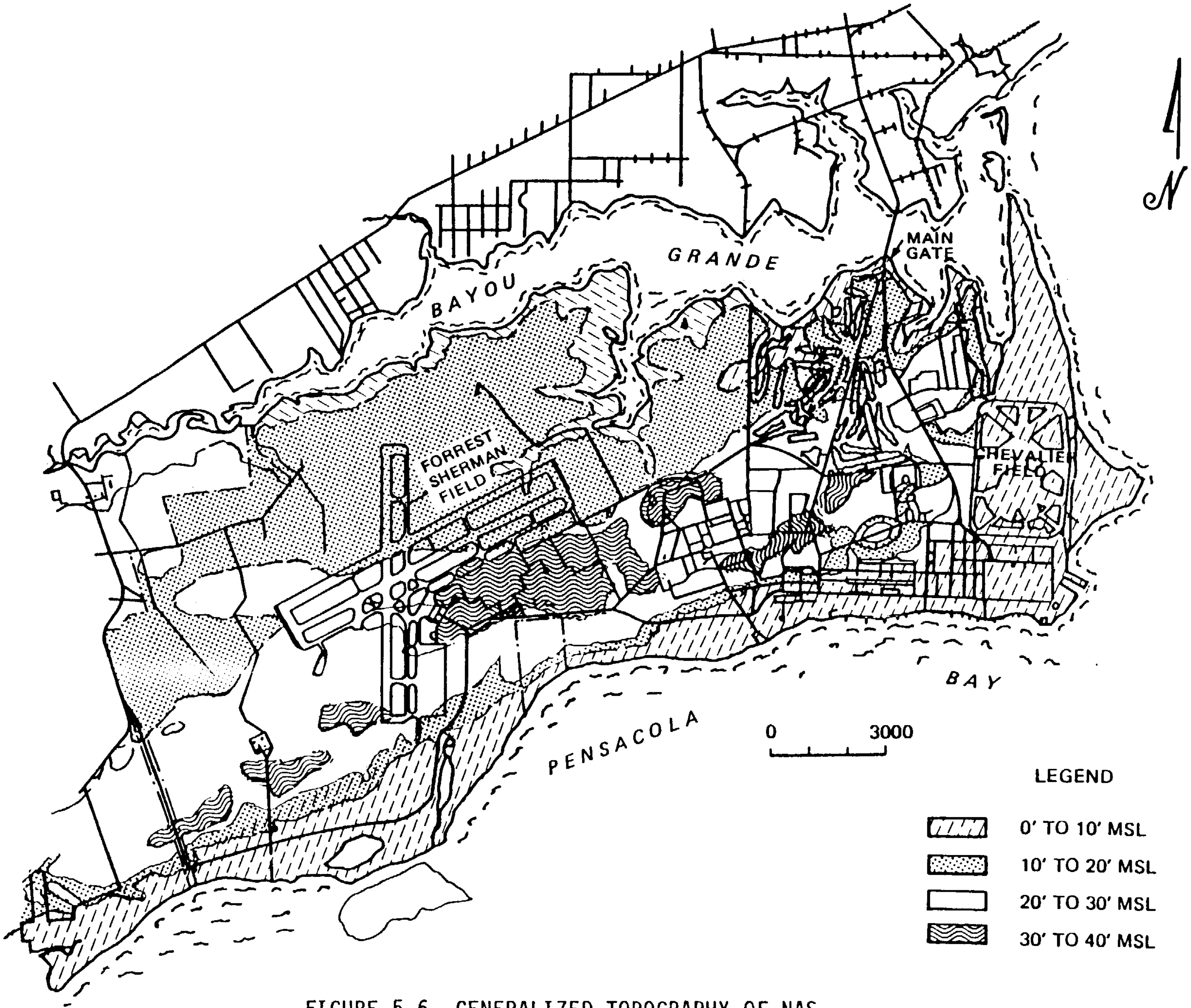

FIGURE 5-6 GENERALIZED TOPOGRAPHY OF NAS

The formations considered and described, from oldest to youngest, are Hatchetigbee Formation, Tallahatta Formation, Lisbon Equivalent, Ocala Group, Bucatunna Clay Member (Bryam Formation), Chickasawhay Limestone, Tampa Formation, Pensacola Clay, Miocene Coarse Clastics and Citronelle Formation. Figure 5-7 shows the generalized geologic column for the western Florida Panhandle.

The Hatchetigbee Formation underlies western-most Florida at depths ranging from 1,270 feet below sea level in northeast Santa Rosa County, to 2,730 feet below sea level in southern Escambia County and NAS Pensacola. The thickness of the formation ranges from 220 feet in northwestern Santa Rosa County to 420 feet just east of Pensacola. The Hatchetigbee Formation consists predominantly of gray to dark gray, silty micaceous clay. The clay is fossiliferous and calcareous and contains a little pyrite. Beds of gray to light-gray, nard glauconitic shale siltstone, and shaly limestone are present in lesser amounts.

The Tallahatta Formation lies at depths ranging from 1,040 feet below sea level in northeast Escambia County to 2,230 feet below sea level in southern Escambia County, and its minimum thickness of 170 feet is at Pensacola. The formation consists predominantly of hard, light-gray, calcareous shale and siltstone with numerous interbeds of gray Limestone and fine to very coarse, pebbly sand. A little gray or brown clay is present, and pyrite was noted in a few samples.

The Lisbon Equivalent underlies Santa Rosa and Escambia Counties at depths ranging from 510 feet below sea level in the northeast corner of the area to 2,090 feet in the southwest corner of the area. The formation ranges in thickness from 345 feet in northern Escambia County to 600 feet in east-central Santa Rosa County. The Lisbon Equivalent consists chiefly of shaley limestone whose color ranges from dark-gray to brownish-gray to very light-grayish cream. The rock is more massive and compact than the overlying Ocala Group and breaks into hard, blocky fragments speckled with glauconite. The Lisbon Equivalent contains a number of shale zones. The upper shale zone, present in the northern part of the area, lies 120 to 170 feet below the top of the Lisbon Equivalent, and the zone is quite variable. At some places it consists of from one to four thin beds occupying an interval of 10 to 80 feet; elsewhere only a single bed, locally as thick as 70 feet, is present. The lower zone, present in the southern part of the area which includes NAS Pensacola, occurs close to the base of the formation and consists of a single bed of shale 60 to 90 feet thick. The material making up the shaley zones ranges from a silty shale to shaley siltstone which is generally hard, light-grayish tan to light-gray, clacareous, and galuconitic. The Lisbon Equivalent also contains some gray clay, and, in soutnern Escambia County, a concentration of glauconite and/or phosphate occurs at the base of the unit.

The Ocala Group underlies the western Florida Panhandle at depths ranging from 290 feet below sea level in the northeast corner of Santa Rosa County to 1,940 feet below sea level at the southern end of Escambia County. The Ocala thickness ranges from 90 feet just east of Pensacola to 235 feet in northeastern Santa Rosa County. In western-most Florida, the Ocala is typically a light-gray or grayish-cream limestone near the upper contact, changing downward to chalky white limestone. Locally, all limestone in the

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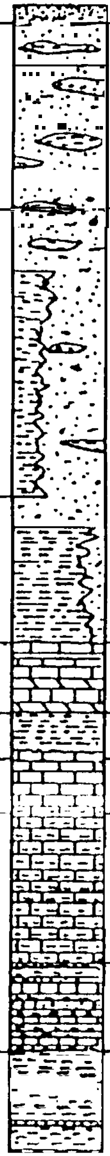
GENERALIZED GEOLOGIC COLUMN
OF FORMATIONS IN THE WESTERN FLORIDA PANHANDLE



SERIES	GRAPHIC SECTION	FORMATION
PLEISTOCENE		MARINE TERRACE DEPOSITS: SAND, LIGHT TAN. FINE TO COARSE
PLEISTOCENE (?)		CITRONELLE FORMATION: SAND WITH LENSES OF CLAY AND GRAVEL. SAND, LIGHT-YELLOWISH-BROWN TO REDDISH-BROWN. VERY FINE TO VERY COARSE AND POORLY SORTED. HARDPAN LAYERS IN UPPER PART. LOGS AND CARBONACEOUS ZONES PRESENT IN PLACES. FOSSILS EXTREMELY SCARCE EXCEPT NEAR THE COAST WHERE SHELL BEDS MAY BE THE MARINE EQUIVALENT OF THE FLUVIAL FACIES OF THE CITRONELLE.
UPPER MIOCENE UPPER MIDDLE TO LOWER UPPER MIOCENE		PENSACOLA CLAY: FORMATION CONSISTS OF AN UPPER MEMBER AND LOWER MEMBER OF DARK-TO-LIGHT-GRAY, TOUGH, SANDY CLAY; SEPARATED BY THE ESCAMBIA SAND MEMBER OF GRAY, FINE TO COARSE, QUARTZ SAND. CONTAINS CARBONIZED PLANT FRAGMENTS, AND ABUNDANT MOLLUSKS AND FORAMINIFERS, PENSACOLA CLAY IS PRESENT ONLY IN SOUTHERN HALF OF AREA. INTERFINGERING WITH THE MIOCENE COARSE CLASTICS IN THE CENTRAL PART.
LOWER MIOCENE AND UPPER OLIGOCENE		CHICKASAWHAY LIMESTONE AND TAMPA FORMATION, UNDIFFERENTIATED. TAMPA: LIMESTONE, LIGHT-GRAY TO GRAYISH-WHITE, HARD, WITH SEVERAL BEDS OF CLAY; CHICKASWHAY: DOLOMITIC LIMESTONE, GRAY, VESICULAR.
MIDDLE OLIGOCENE		BUCATUNNA CLAY MEMBER OF BYRAM FORMATION: CLAY, DARK-GRAY SOFT, SILTY TO SANDY, FORAMINIFERAL, CARBONACEOUS.
UPPER EOCENE		OCALA GROUP: LIMESTONE, LIGHT-GRAY TO CHALKY-WHITE FORAMINIFERS EXTREMELY ABUNDANT, ESP. LEPIDOCYCLINA; CORALS, ECHINOIDS, MOLLUSKS, BRYOZOANS.
MIDDLE EOCENE		LISBON EQUIVALENT: SHALY LIMESTONE, DARK-GRAY TO GRAYISH-CREAM; HARD, COMPACT; GLAUCONITIC; WITH THICK INTERVALS OF DENSE, LIGHT-GRAY SHALE-
		TALLAHATTA FORMATION: SHALE AND SILTSTONE, LIGHT-GRAY, HARD, WITH NUMEROUS INTERBEDS OF GRAY LIMESTONE AND VERY FINE TO VERY COARSE. PEBBLY SAND. FORAMINIFERS LOCALLY ABUNDANT.
LOWER EOCENE		HATCHETIGBEE FORMATION: CLAY, GRAY TO DARK-GRAY, MICACEOUS, SILTY, WITH BEDS OF GLAUCONITIC SHALE, SILTSTONE, AND SHALY LIMESTONE. MOLLUSKS, FORAMINIFERS, CORALS. ECHINOIDS. BASHI MARL MEMBER (ABOUT 10 FEET THICK) AT BASE.

FIGURE 5-7 GENERALIZED GEOLOGIC COLUMN OF FORMATIONS IN THE WESTERN FLORIDA PANHANDLE

Ocala may be white. The Ocala Group consists mostly of large foraminifers and other fossils. Commonly, the limestone is somewhat glauconitic, with local replacement of fossils by glauconite in a few places. At some localities, as much as five percent of some samples consisted of shiny, brownish-gold, rounded pellets that may be phosphate. A small amount of light-gray clay was noted in some samples, and some cuttings of Ocala from a water well in northern Santa Rosa County contained a few fragments of fossil wood.

The Bucatunna clay member of the Byram Formation underlies the entire western Panhandle of Florida and, in Santa Rosa and Escambia Counties occurs at depths below sea level ranging from about 200 feet in northeastern Santa Rosa County to about 1,760 feet in southern Escambia County. Its thickness ranges from 45 feet in northeastern Santa Rosa County to 215 feet in southwestern Santa Rosa County. The Bucatunna generally thickens toward the Gulf of Mexico. In western Florida the Bucatunna consists of fossiliferous, calcareous clay, dark lignitic clay, laminated fine sand and clay, and laminated argillaceous fine sand with some beds of coarser sand. Samples of the Bucatunna contained from five to 40 percent fine, quartz sand, but this clastic material probably does not occur as discrete interbeds but is disseminated throughout the clay as a gritty admixture. Most well samples of the Bucatunna from Escambia and Santa Rosa Counties consist of dark-gray, soft, calcareous, silty to sandy clay which contains occasional flecks of carbonized wood and a little pyrite.

The Chickasawhay Limestone underlies all of Escambia and Santa Rosa Counties, thickening gulfward from 30 to 40 feet along the northern border of the area to as much as 130 feet along the margin of the gulf. The formation consists of gray to Light-gray, hard, highly porous or vesicular limestone and dolomitic limestone; interbedded with light brown, hard, vesicular to compact dolomitic limestone; or dolomite that has a distinctive sugary texture. Fragments of the Chickasawhay Limestone have a knobby, rough surface that gives the impression of a microcoquina of obscure fossil fragments, although few can actually be distinguished as such.

The Tampa Formation, removed by erosion in the northern parts of Santa Rosa and Escambia Counties, reaches its maximum thickness of about 270 feet in southern Escambia County and is present beneath NAS Pensacola. The formation is hard, light-gray to grayish-white, although in places it contains several beds of clay, especially in the upper part, and it is hypothesized (Barraclough and Harsh, 1962) that the decreased effective porosity of the limestone resulting from the presence of so much clay has been an important factor in the drastic decline of water levels, amounting to more than 125 feet since 1936, in the Fort Walton Beach, Florida, area.

The Pensacola Clay underlies the area at depths ranging from 135 feet below sea level in central Santa Rosa County to 1,000 feet below sea level in the southwest corner of Escambia County. The total thickness of the formation ranges from 380 feet in the area four miles northwest of Pensacola to more than 1,000 feet at Mobile Bay. The upper member ranges in thickness from 240 feet about 10 miles east of Pensacola to 680 feet two miles southwest of Pensacola. The lower member ranges in thickness from 150 feet at the easterm edge of Santa Rosa County on Santa Rosa Island to 330 feet at Fort Walton Beach, Florida. The Escamoia Sand Member thickens southwestward from a minimum of 20 feet about six miles north of the mouth of the Escambia River to a maximum of 160 feet in the area 4.5 miles west of the mouth of the Perdido

River. Figure 5-8 is an isopachous map of the Pensacola Clay and Figure 5-9 shows the contours on tops of the Pensacola Clay. The upper and lower members of the Pensacola Clay consists of tough, dark to light-gray clay, but at a few localities it is brownish-gray. The clay is typically silty and contains variable amounts of very fine to very coarse quartz sand. Bits of carbonized wood and plant remains, such as leaves and reeds, are present throughout the formation. The clay is micaceous and slightly calcareous with some pyrite present. Locally, the formation grades into a clayey siltstone. Mollusk shells and foraminifers are abundant throughout the Pensacola Clay. The former are especially abundant in the upper part of the upper member in west-central and southern Escabmia County, where thick beds consisting almost entirely of shells are found near the top of the upper member. The Escambia Sand Member consists predominantly of light-gray to brownish-gray, fine-to-coarse sand and quartz granules in the lower part and peasize gravel in the upper part. In southern Santa Rosa County, the Escambia Sand Member contains some carbonaceous material and abundance of black grains, possibly phosphate, in the lower five feet.

The Miocene Coarse Clastics are present everywhere in the western Panhandle except in an area between central Escambia County and southwestern Santa Rosa County, where the Citronelle Formation lies unconformably upon the upper member of the Pensacola Clay, and in area east of Fort Walton Beach, Florida, where the Citronelle lies unconformably upon the lower member of the Pensacola Clay. The thickness of the Miocene Coarse Clastics is variable, generally ranging from about 70 feet in north-central Escambia County to as much as 500 feet in west-central Santa Rosa County. The Miocene Coarse Clastics consists chiefly of light-brown to light-gray, poorly sorted, fine to very coarse sand and granules and small pebbles of quartz. Muscovite is abundant throughout, and at several places in both the northern and southern parts of the area the sand contains abundant fragments of carbonized wood. Light to dark-gray, carbonaceous clay and siltstone that are somewhat calcareous occur throughout the unit as lenses up to 180 feet thick. In northeastern Santa Rosa County, about 60 feet of pea-sized gravel is present near the top of the coarse clastics. Locally, a few black phosphatic pebbles, fragments of limonite, and pieces of hardpan (sand cemented with iron oxides) were noted. The most distinctive feature of the Miocene Coarse Clastics is the numerous shell beds that occur throughout. These beds consist mostly of minute mollusks that commonly make up five to 50 percent of some well samples. In a well just north of Pensacola, the upper three-quarters of the Miocene Coarse Clastics contains so many shell beds that half of the rock mate.-ial from this interval (300 feet in thickness) consists of shells. Figure 5-3 shows the contours on top of the Miocene section in the west Florida Panhanc e.

The Citronelle Formation underlies all of Santa Rosa and Escambia Counties and is overlain in most places by Pleistocene terrace deposits. The thicknesses of the individual units are usually not apparent because it is virtually impossible to differentiate Pleistocene sand and gravel of the marine terrace from the Citronelle sand and gravel (Carlston, 1950). However, the terrace deposits are relatively thin, and therefore their inclusion would not greatly alter the general thickness figures. Together, the Citronelle and terrace deposits range in thickness from about 30 feet at the southern border of Santa Rosa County to about 790 feet in northwestern Escambia County. The combined thickness of these two units in Escambia and Santa Rosa Counties, is quite variable for two reasons; (1) the base of the Citronelle appears to be an

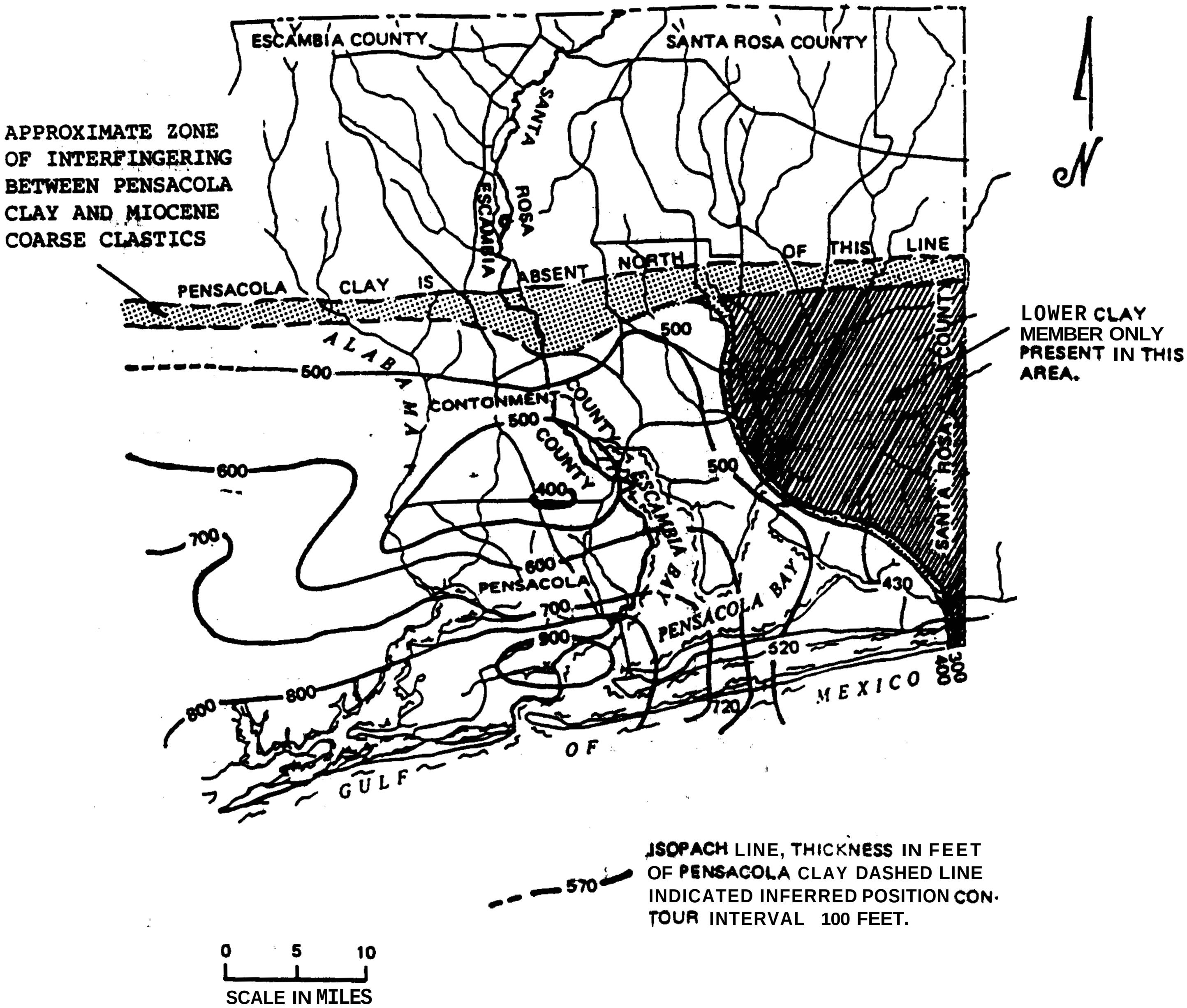


FIGURE 5-8 ISOPACHUOUS MAP OF THE PENSACOLA CLAY IN THE SOUTHERN HALF OF ESCAMBIA AND SANTA ROSA COUNTIES, FLORIDA.

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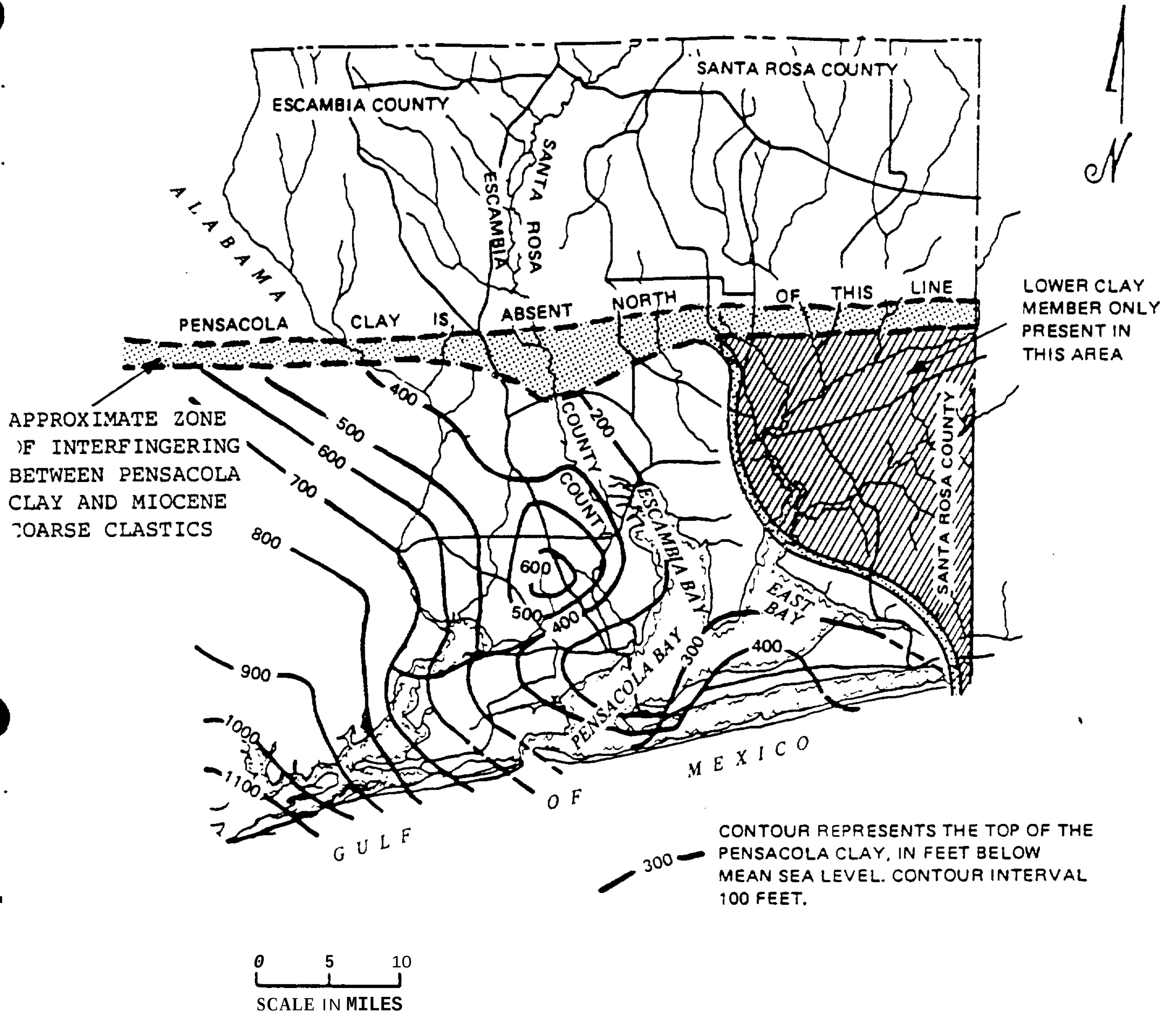
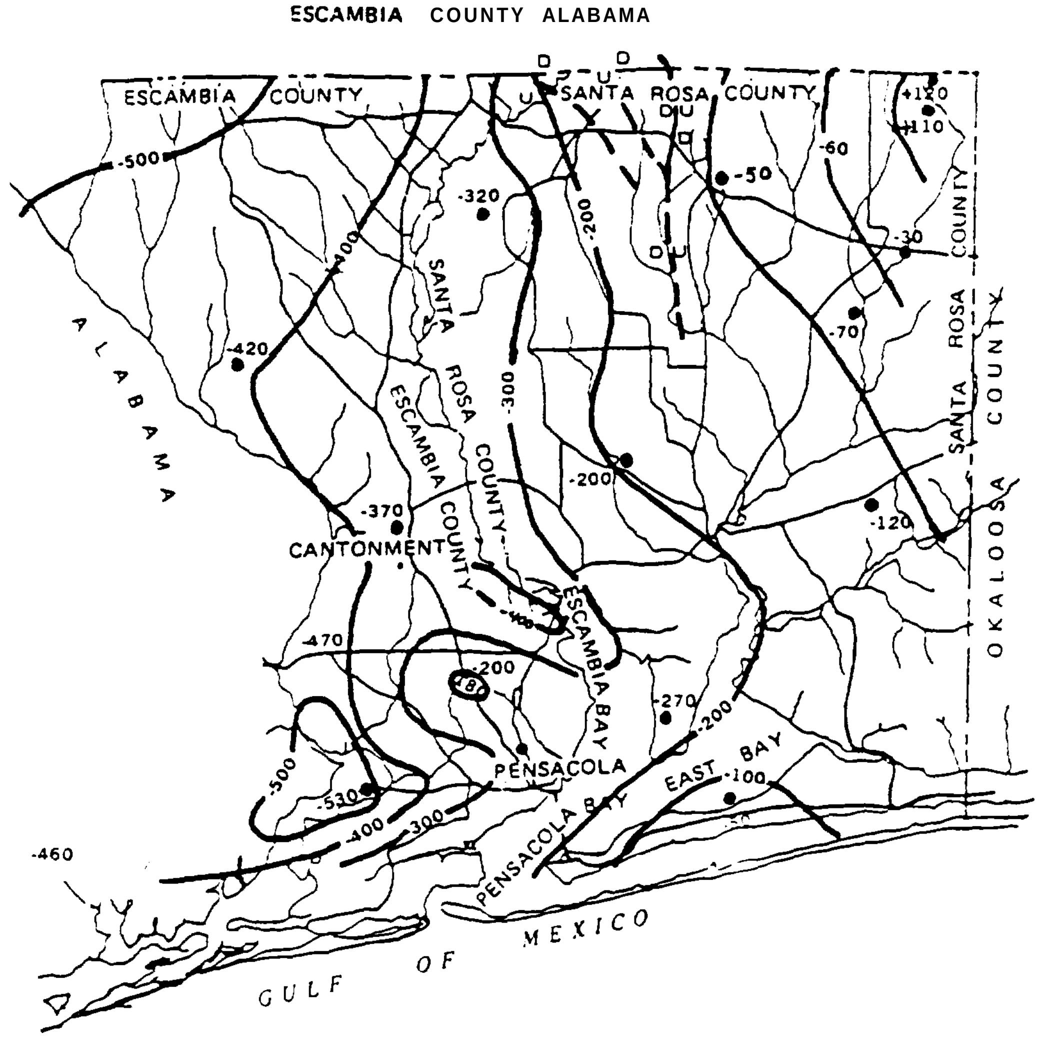


FIGURE 5-9. CONTOURS ON TOP OF THE PENSACOLA CLAY IN THE SOUTHERN HALF OF ESCAMBIA AND SANTA ROSA COUNTIES, FLORIDA.



0 5 10 SCALE IN MILES	
● -530 WELL	NUMBER INDICATES D TH TO THE TOP OF THE MIOCENE BEDS FEET BELOW MEAN SEA LEV
-500	CONTOUR REPRESENTS -E TOP OF THE MIOCENE BEDS. IN FEE' 30VE (+) OR BELOW (–) MEAN SEA L. EL CONTOUR INTERVAL 100 FEET.
U D	NORMAL FAULT U= UPTHROWN SIDE D= DOWNTHROWN SIDE DASHED WHERE LOCATION IS INFERRED.

FIGURE 5-10. CONTOURS ON TOP OF THE MIOCENE SECTION IN WESTERMOST FLORIDA. THIS IS A SURFACE OF UNCONFORMITY UNDERLAIN CHIEFLY BY UPPER MIOCENE COARSE CLASTIC SEDIMENTS.

irregular surface of unconformity, and (2) the top or the terrace deposits coincides with an irregular topography of considerable relief. The Citronelle consists principally of quartz sand which contains numerous lenses, beds, ana stringers of clay and gravel, and the lithology changes abruptly. The sana is typically light, yellowish-brown to reddish-brown, although some is white or lignt-gray. The grains are mostly angular to sub-angular and very poorly sorted, ranging from very fine to very coarse. Muscovite is abundant throughout. In places, the sand grades into gravel composed of quartz and chert pebbles up to an inch in diameter. A few pebbles of silicified, oolitic limestone were noted in samples from the northern part of the area. Elsewhere the sand grades into siltstone and clay. The siltstone is light-gray to light-yellow and in places contains abundant carbonized plant remains. The clay occurs in lenses as much as 60 feet thick and is chiefly white or gray, although some is lavender, yellow, or brown. Fragments of carbonized wood are common in the gray clay. Xlthougn it is difficult to ascertain the horizontai extent of the clay beds within the Citronelle, they probably range from a few reet to two or three miles in length. A distinctive rock type that occurs in the Citronelle Formation throughout western Florida is a limonite-cemented sandstone called "hardpan." This rock, formed by cementation of sand with iron oxides probably precipitated from groundwater, is dark, rusty-brown and is generally extremely hard, although some may be relatively soft. The "hardpan" most commonly occurs as layers that parallel the enclosing sediments. These layers range from a fraction of an inch to three to four feet in thickness. In places, the "hardpan" is filled with peculiar curving tubular structures of uncertain origin, from a fraction of an inch to several inches in diameter. These tubular structures parallel the bedding and are filled with the same loose sand that encloses the "hardpan" layers. Little is known concerning the lateral extent of these hardpan layers, but it is , unlikely that any given layer extends for more than a few thousand yards. Escambia and Santa Rosa Counties are dotted with hundreds of ponds, many of which probably owe their existence to hardpan layers at or near the surface. Table 5-3 presents a detailed section of the Citronelle Formation. Figure 5-11 shows the locations of two geologic sections through NAS Pensacola and Figures 5-12 and 5-13 present these cross-sections.

During the invasion of the sea upon the land in the Pleistocene Epoch, the Citronelle deposits were reworked and mixed with new deposits of similar materials. Several geologists have examined the evidence and established varying sequences and numbers of terraces. These interpretations are presented in Figure *5-14*. These authors agree unanimously on only two shorelines, the Pamlico and Wicomico. One of these surfaces, the Pamlico, may be represented on NAS Pensacola as indicated by Section V-V on Figure 5-15 and by tne extent of sea transgression represented by Figure 5-16. This surface, the Pamlico terrace, is the most recent and best preserved marine terrace in the area. It formed roughly *40,000* years ago during the brief interlude of warmer climate with the last glacial stage that is known as the mid-Wisconsin recession in Figure 5-14. Beaches and shoreline scarps with bases at an altitude of 30 feet are found along the valleys of all the major rivers, marking the position of the Pamlico Sea. The largest unbroken terrace area in western-most Florida is the peninsula that extends southward between the mouths of the Escambia and Yellow Rivers, separating Escambia Bay from East Bay (Figure 5-16). This is a very flat remnant of the Pamlico terrace, about *37* square miles in area, which rises from sea level to an altitude of 30 feet at the base of a scarp on the north. Early topographic maps (U.S. Geological

Table 5-3

Citronelle S-c-ion

Detailed section of the upper p· ·f the Citronelle F--mation in the cliffs along the west side Escambia Bay, ab 1½ miles north of East Pensacola He: ts, Escambia Cou : ¼ mile south of line between T. 1 S. and T. 2 S. in R. 29 W Pensacola, Fla., quadrangle. This is one of the largest and best outcrops in Florida. The section is representative of the sediments exposed all along these bluffs.

Unit	*Thickness (Feet)*
Pleistocene(?)	
Marine terrace(?) deposit	
6 Sand. light-tan, fine to coarse; contact with unit **3** is fairly sharp: unit 6 is softer than unit **5** and commonly weathers back, exposing a shelf-like surface at the top of unit 5	12
Citronelle Formation	
5 Sand. reddish-brown. : to **very** coarse, pebbly; very poorly sorted: pebbles angular to well rounded, quartz; 1 to 3 percent dark m nerals; units 5 and 4 are hard and form a vertical cliff	16
4 Sand, mostly rusty-reddish-browm, some white, irregular!.' intermingled snd as alternating strata: medium to medium coarse, pebbly sand whose grains are angular to subangular; 1 to 3 percent dark minerals; harder than underlying units: clay tubes and clay fragments (see unit 2) very scarce: grades upward into unit 5	*10*
3 Sand, white to gray with layers and irreg . ar patches of rust red; very fine to very coarse pebbly: abundant clay tubes as in unit 2 but more poorly preserved: clay layers and fragments much less numerous than in unit **2,** with fine muscovite flakes abun lant along bedding planes: forms relatively gentle sl e leading from base of unit 4	16
2 Sand, very white: soft, loose; grains suban r, poorly sorted, ranging from very fine to very co e, nearly all quartz: a few white quartz pebbles up a fourth inch in diameter; 1 to 2 percent black min als: sand is cross bedded on a small scale. The most istinctive feature is pure, white clay (kaolin) occur: g as: (1) angular chips and blocky fragments up : 4 inches long: (2) discontinuous beds 1 to 2 inches thick and as much as 20 feet long, some of which consist of tubular, irregularly shaped fragments, lik "islands" in the enclosing sand; and (3) abundant tubular fossil burrows of Callianassa(7) **sp.** ("ghost shrimp") which are ½ to 1 inch in diameter and as long as 1 foot, consisting of soft wh e kaolinite and sand; the tubes nre embedded vertically in the enclosing sand	13
Covered down *to* level of Escambia Bay	11
Total esposed section	67

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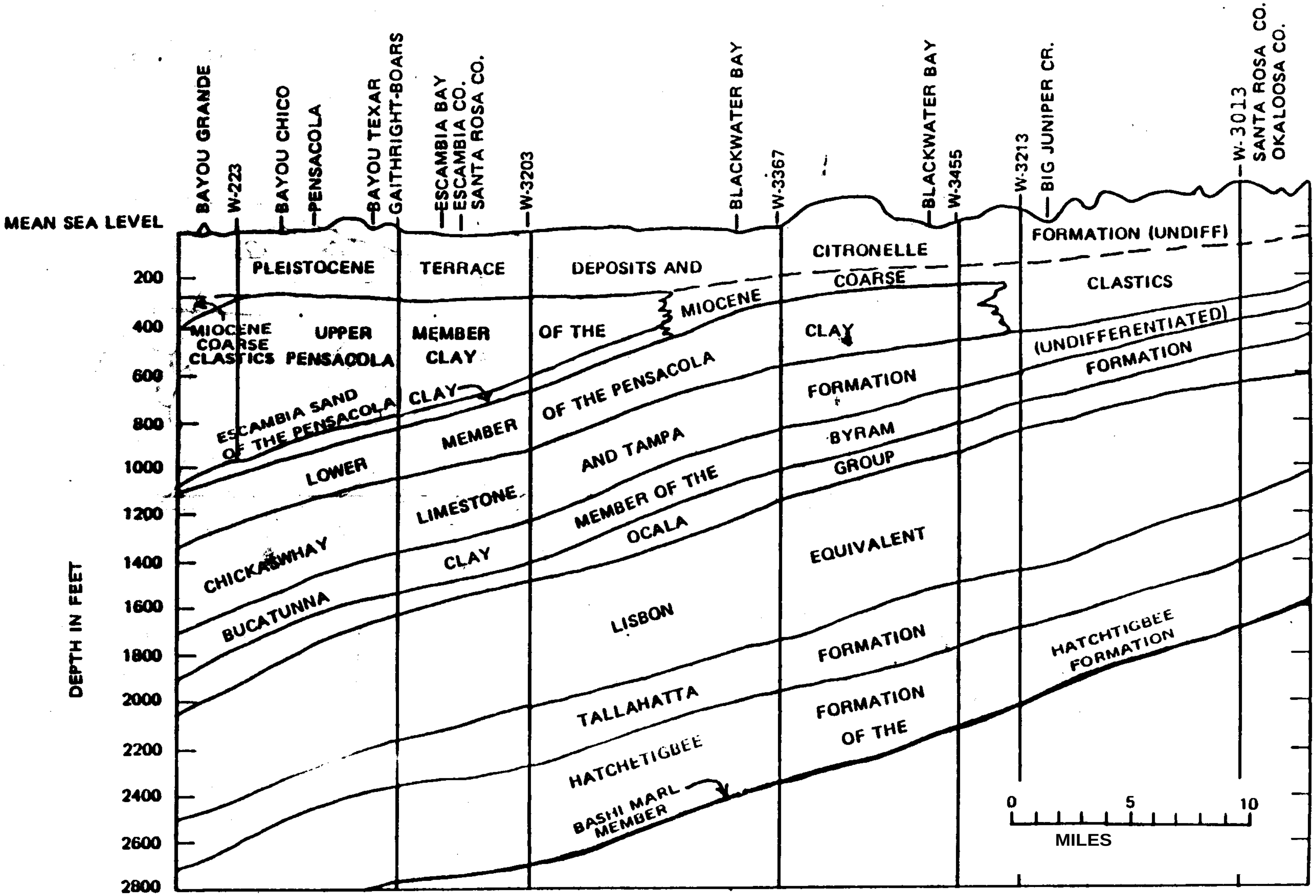


FIGURE 5-12 GEOLOGIC SECTION C-C ACROSS ESCAMBIA AND SANTA ROSA COUNTIES. SECTION PARALLELS THE REGIONAL DIP AND NAS IS LOCATED AT THE SOUTHWEST END OF THE PROFILE.

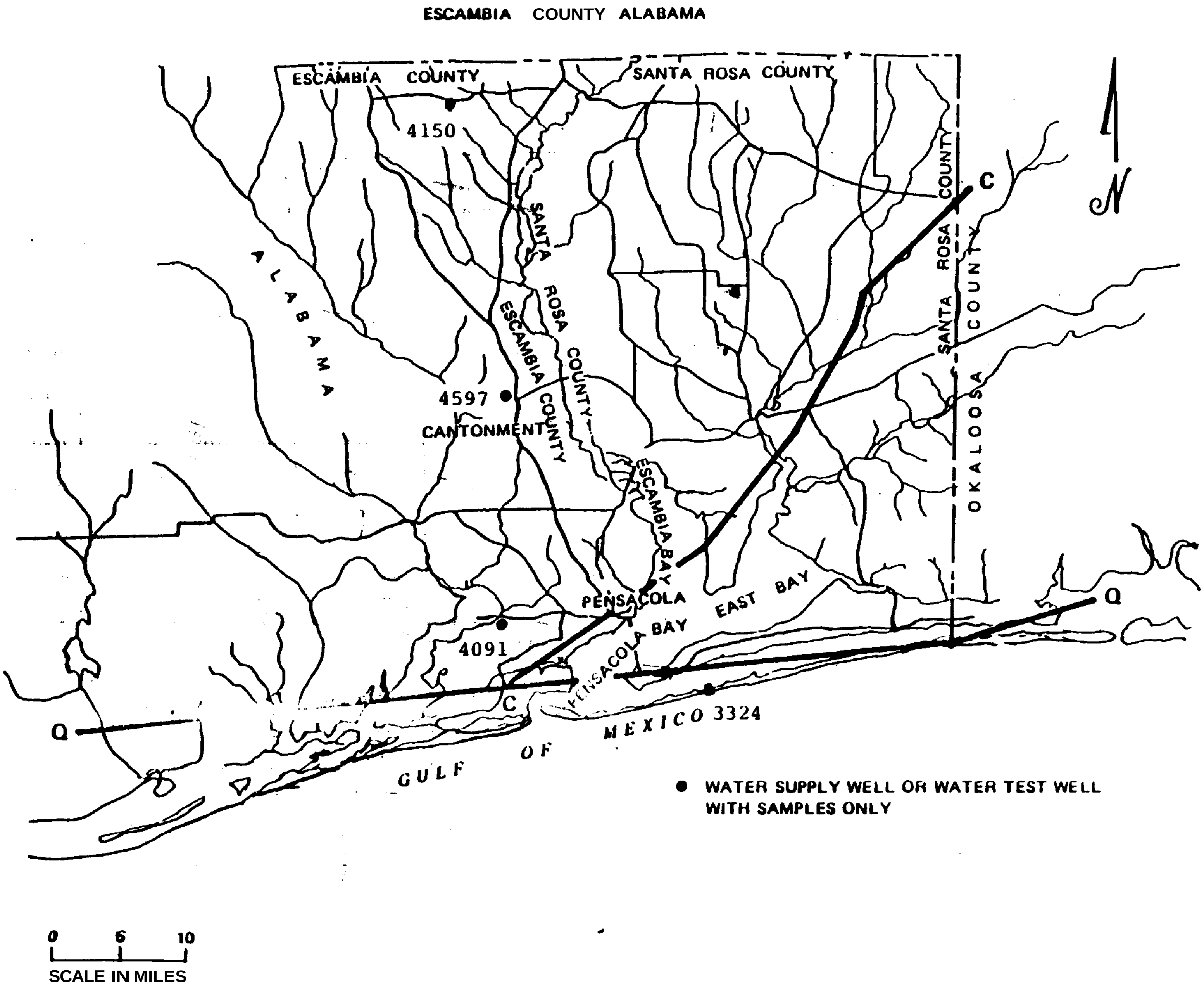
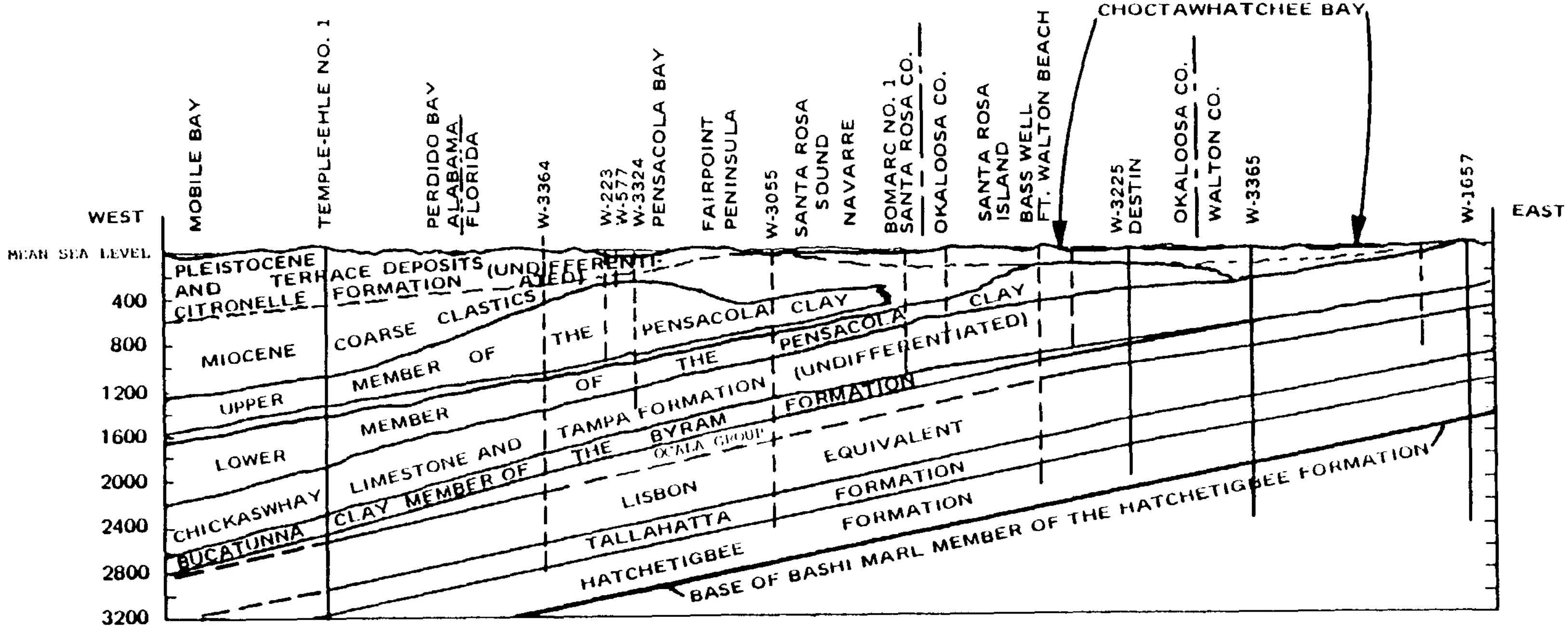


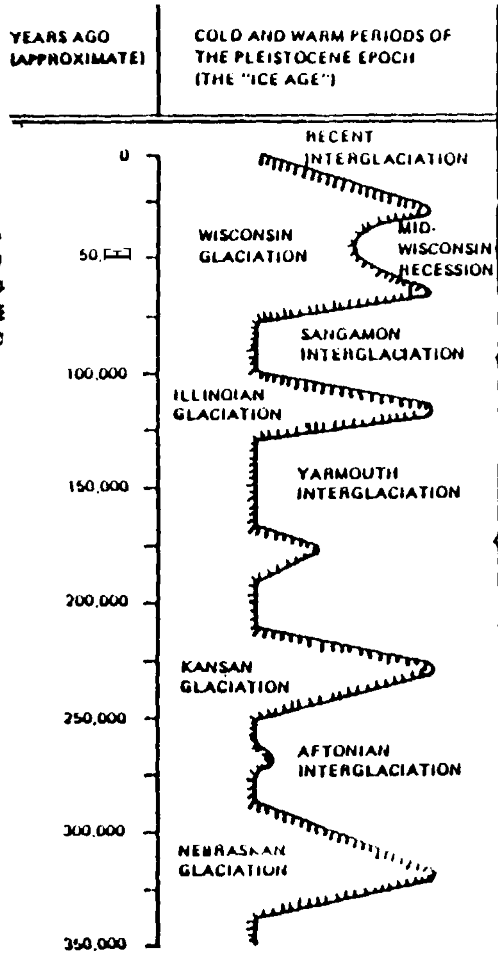
Figure 5-11. MAP OF WESTERNMOST FLORIDA AND SOUTHWESTERN ALABAMA SHOWING LOCATIONS OF WELLS AND CROSS SECTIONS.



NOTE: Wells shown by dashed lines have been projected along strike into plane of section.

0 5 10 15 20 MILES

FIGURE 5-13 GEOLOGIC SECTION Q-Q' FROM MOBILE BAY TC THE CHOCTAWHATCHEE RIVER (115 MILES) SHOWING FORMATIONS ALONG THE GULF COAST OF WESTERN FLORIDA. NAS IS LOCATED BETWEEN WELLS W-3364 AND W-223.



COOKE, 1931 AND 1946	VERNON, 1942	MACNEIL, 1949	CARLSTON, 1950	MARSH, 1961 ESCAMBIA AND SANTA ROSA COUNTIES, FLA.
		SILVER BLUFF SHORE-LINE - 8-10 FT.		
SILVER BLUFF SHORE-LINE - 5 FT.				
PAMLICO SHORELINE 25 FT.	COASTWISE 5-30 FOOT SURFACE	PAMLICO SHORELINE-25-35 FT.	PAMLICO TERRACE-20-30 FT.	PAMLICO TERRACE-SHORELINE AT 30 FT.
TALBOT SHORELINE-42 FT.				
PENHOLOWAY SHORE-LINE - 30 FT.			PENHOLOWAY TERRACE-60-70 FT.	PENHOLOWAY TERRACE-SHORELINE AT 70-80 FT.
WICOMICO SHORELINE 100 FT.	COASTWISE 60-105 FOOT SURFACE	WICOMICO SHORELINE-100 FT.	WICOMICO TERRACE-90-110 FT.	
SUNDERLAND SHORELINE - 170 FT.	COASTWISE 115-150 FOOT SURFACE	OKEFENOKEE SHORELINE-160 FT.	SUNDERLAND TERRACE-150-160 FT.	
COHARIE SHORELINE-215 FT.	COASTWISE 170-220 FOOT SURFACE		COHARIE TERRACE-180-210 FT.	
HAZLEHURST (FORMERLY BRANDYWINE) SHORE-LINE - 270 FT.	COASTWISE 250-320 FOOT SURFACE	HIGH TERRACE (RISES TO 280 FT. IN WESTERN FLORIDA. SUBAERIAL ORIGIN. NO SHORE-LINE SCARP.)		UPLAND SURFACE (EXTENDS AT LEAST FROM 80 TO 280 FT. ABOVE SEA LEVEL. NO SHORELINE SCARP IN ESCAMBIA AND SANTA ROSA COUNTIES, FLA.

NOT CORRELATED WITH SPECIFIC PLEISTOCENE SUBDIVISIONS (Vernon, 1942)

NOT CORRELATED WITH SPECIFIC PLEISTOCENE SUBDIVISIONS (MacNeil, 1949; Carlston, 1950)

FIGURE 5-14 PLEISTOCENE SHORELINES AND TERRACES IN THE FLORIDA PANHANDLE ACCORDING TO VARIOUS AUTHORS. ELEVATIONS ARE MEAN SEA LEVEL. PATTERN LEFT REPRESENTS WORLDWIDE ADVANCES AND RETREATS OF GLACIERS.

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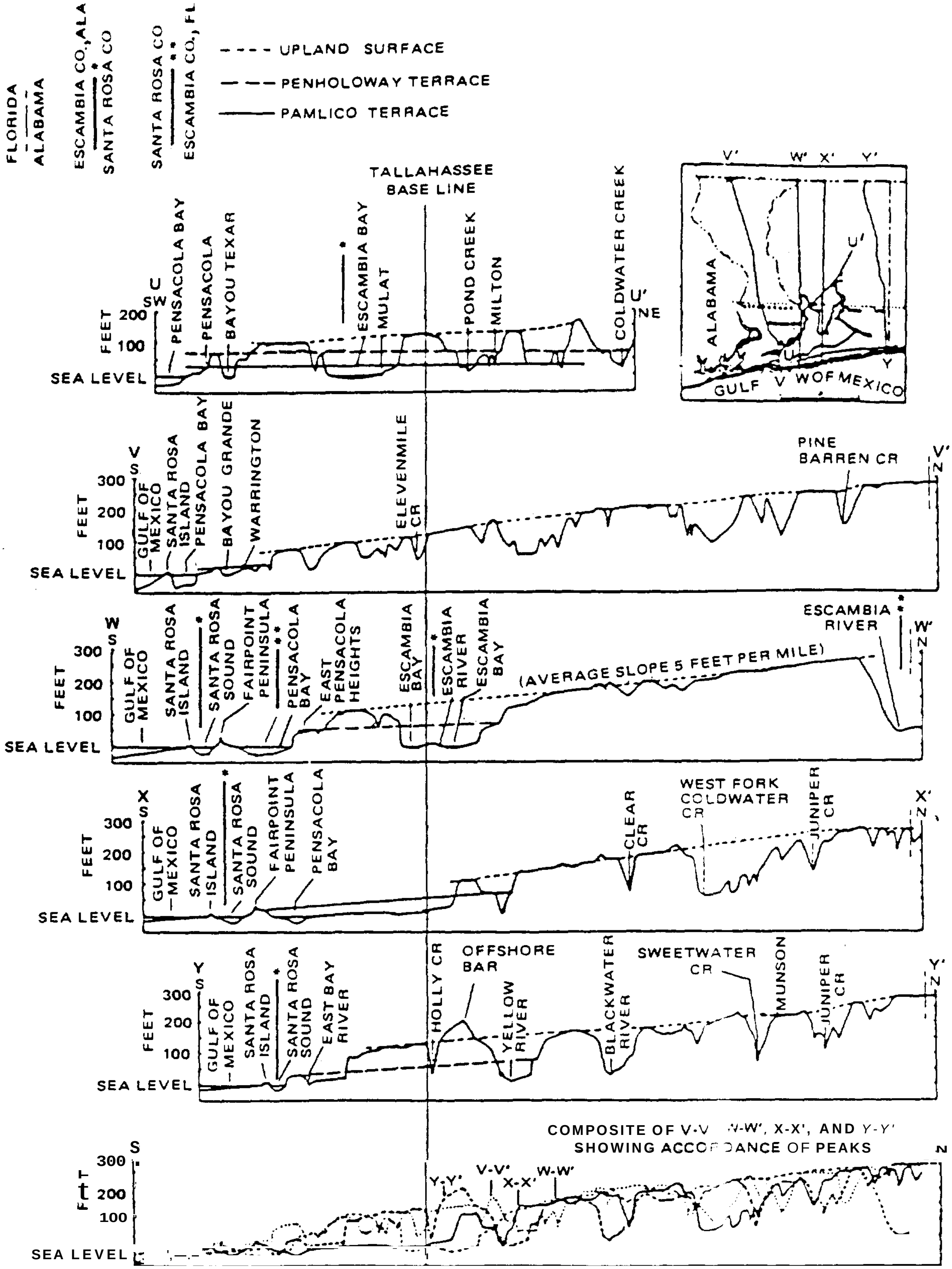


FIGURE 5-15 TOPOGRAPHIC PROFILES **ACROSS** THE WESTERN END OF THE FLORIDA PAN-HANDLE, SHOWING REMNANTS OF THREE PLEISTOCENE MARINE SURFACES. PROFILE Z-Z' IS A COMPOSITE OF PROFILES V-V', W-W', X-X', AND Y-Y' WHICH HAVE BEEN SUPERIMPOSED TO SHOW ALIGNMENT OF PEAKS AND FLAT UPLAND SURFACES. VERTICAL EXAGGERATION OF ALL PROFILES IS ABOUT 106 TIMES.

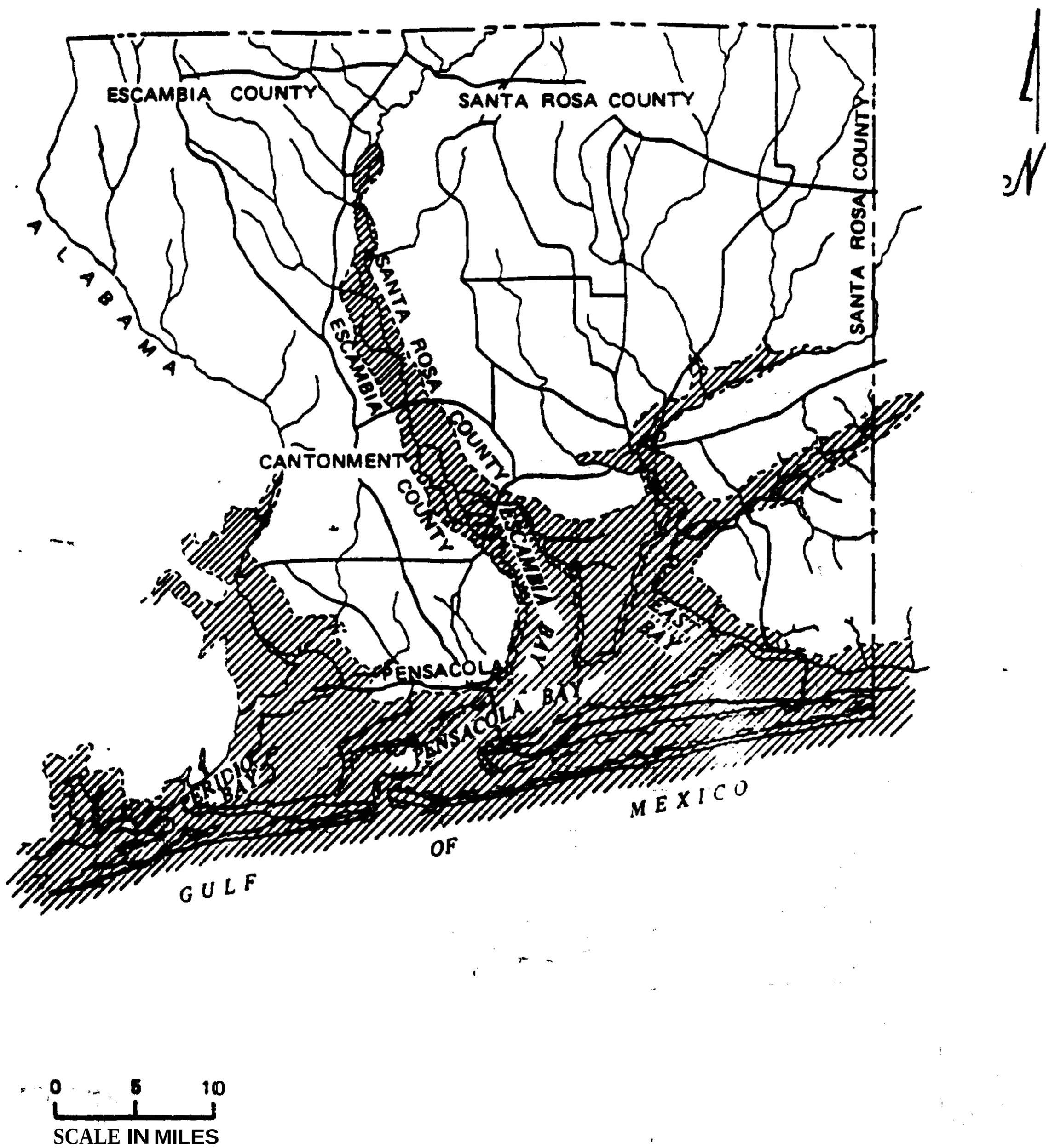


FIGURE 5-16, EXTENT OF THE PAMLICO SEA ALONG THE COAST OF WESTERNMOST FLORIDA DURING THE MID-WISCONSIN RECESSION OF THE WISCONSIN GLACIATION (ABOUT 40,000 YEARS AGO): SHORELINE ABOUT 30 FEET ABOVE PRESENT MEAN SEA LEVEL. SOLID PORTIONS OF SHORELINE ARE DRAWN ALONG TOES OF SEAWARD FACING SCARPS. WHERE DASHED, SHORELINE IS ONLY APPROXIMATELY LOCATED AND IN PART CONJECTURAL.

0000080

Survey, 1930) snow scarp traces along Bayou Grande which are at 8 to 10 feet above mean sea level ana seem to coincide with the Silver Bluff Shoreline or MacNeil (Figure 5-14). These prooably have been nearly obliterated by construction activities since then, ana it would require detailed field exploration to ascertain the validity of the Silver Bluff Shoreline hypothesis.

Appendix A contains the logs of deep borings (>100 feet) on and near NAS Pensacola. Boring Nos. W-3324, W-4091, W-4150, and W-4597 are from Yarsn, 1966; NAS 1, 2, and 3 are from Naval Facilities Engineering Command, Soutnern Division; Drawing Nos. 22081 ana 1304669, TH-11, and TH-23 are from Trapp, 1972; W-222-1/2 from Missimer and Associates, Inc., 1981b, and the Pensacola Development Well No. 1 is from the files of Mr. Joe Ladner, Public Works Center, NAS Pensacola, Florida. Figures 5-11, 5-17, and 5-18 show the locations of all wells except the Pensacola Development Well No. 1 which is unlocated.

5.3.5 Soils. The soils of Escambia County were described by Carlisle, 1966, and portions of that report applicable to NAS Pensacola were extracted ana are presented in the following paragraphs.

The parent material of the soils consists of marine and stream deposits. Sand and gravel formation of the Pleistocene Series cover most of the county, and under these are sand, gravel, and clay of the Citronelle Formation.

The climate of Escambia County gives rise to red-yellow podzolic and reddish-brown lateritic soils. Red-yellow podzolic soils are a group of well developed, well drained, acid soils that have thin organic and organic-mineral horizons over a light-colored, bleached horizon whicn, in turn, overlies a red, yellowish-rea, or yellow, more clayey horizon. The parent materials are all more or less siliceous. Coarse reticulate streaks or mottles of red, yellow, brown, and lignt gray are characteristic in deep horizons of the red-yellow poszolic soils where parent materials are thick (Thorp and Smith 1949). The reddish-brown lateritic soils are a zonal group of soils having a dark reddish-brown, granular surface soil; a red, friable clay horizon; and red *or* reticulately mottled lateritic parent material.

The general soil association map of Escambia County shows NAS Pensacola to be covered by five types; one belonging to a group of nearly level to gently sloping soils on uplands, and the remainder belonging to a group of nearly level soils on river terraces, depressions, and lowlands. The upland unit is composed of light-gray sands; sandy subsoils; excessively drained or somewhat excessively drained soils of the Lakewood-Lakeland series.

The Lakewood Series developed from thick beds or loose sand materials. These soils have a light gray surface soil that contains small amounts of organic matter, which gives it a salt and pepper appearance. They are associated with soils of the Leon and Lakeland Series. Between the surface soil and the brownish-yellow sub-layers, which began at 14 to 20 inches, is a layer of white sand. The Lakewood soils are acid throughout the profile, extremely low in fertility, contain little organic matter, and are excessively drained.

The soils of the Lakeland Series have formed from moderately tnick beds of unconsolidated acid sands and loamy sands, which are on sediments of finer

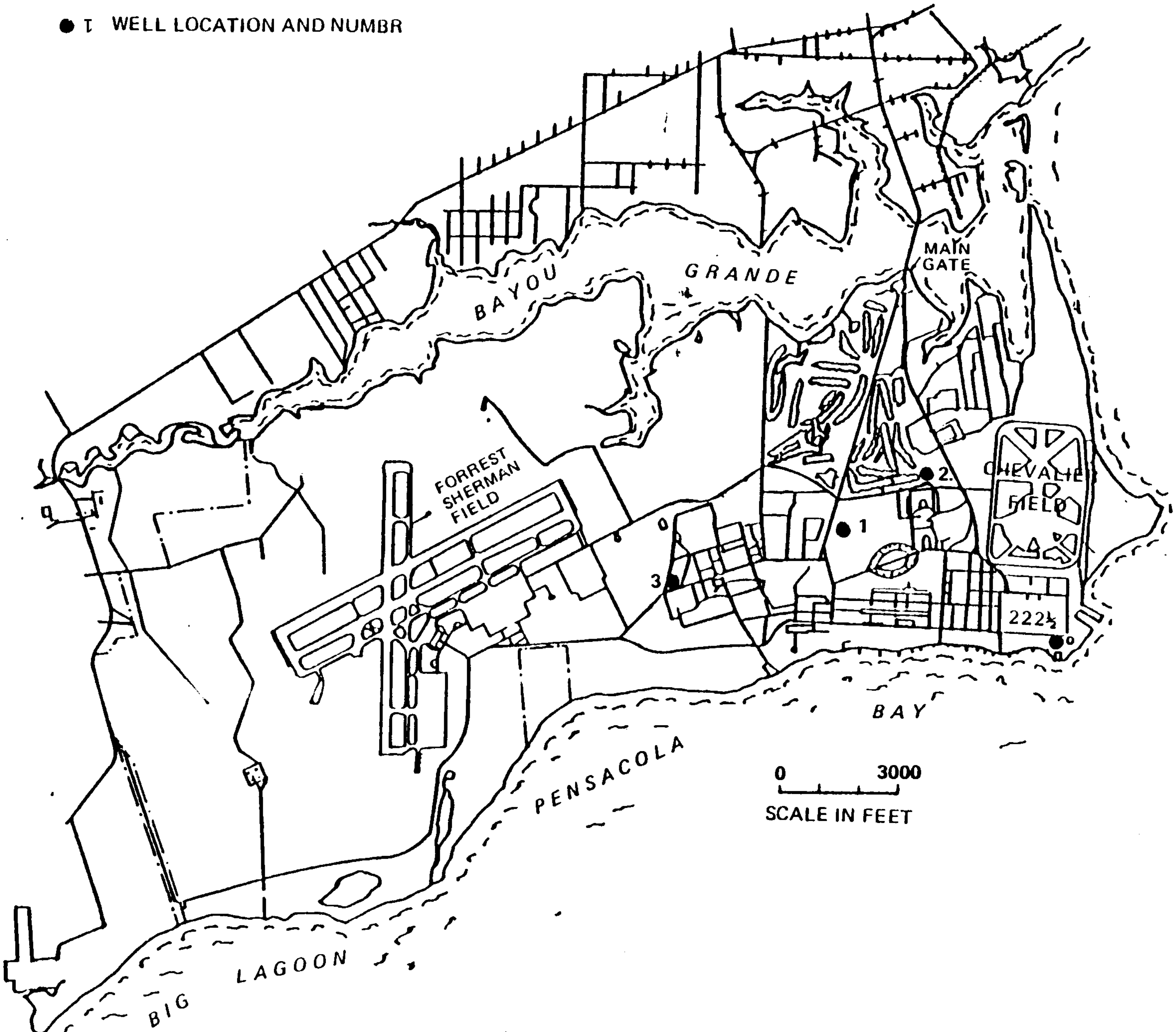


FIGURE 5-17 WEL' CATION AND NUMBER

Scale 1.250.000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 23 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 50 FEET
WITH SUPPLEMENTARY CONTOURS AT 25 FOOT INTERVALS

▲ TEST WELL LOCATIONS

FIGURE **5-18** USGS TEST WELLS NEAR NAS texture tnat begin at aeptns greater than 30 inches. The Lakeland soils are acid tnrougnout, low in fertility ana organic matter, and somewnat excessively drained.

The nearly level soils of river terraces, depressions, and lowlanas incluce the Klej-Leon series of gray sandy soils on lowlands which are somewnat poorly drained and have a moaerately high water table; the Plummer-Rutlege Series of gray or very-dark-gray fine sands which are poorly drained; the undifferential coastal soils (coastal dune land and beach-tiaal marsh) bordering salt water; and undifferentiated poorly drained flood plains and swamps of mixed alluvial land and fresh water swamp. The Klej Series have developed from thick beds of sands and loamy sands, under the influence of a high water table. These soils have a dark-gray to black surface soil and yellowish-orown to brownish-yellow subsoil. They are associated with the Rutlege, Plummer, and Leon Soils. Klej soils are acid throughout, low in natural fertility and organic matter, and somewhat poorly drained.

The Leon soils developed from thick beds of unconsolidated sands under cne influence of a high water table. These soils have a hardpan layer at depths of less than 30 inches. Leon soils are acid throughout the profile ana low in natural fertility. They are associated with the Plummer, Rutledge, and Klej soils.

The Plummer soils developed under conditions of poor drainange from thick beds or acid sand and loamy sand and are associated with the Rutlege, Leon, Klej, Portsmouth, and Lynchburg soils. The Plummer soils are acid throughout the profile, have little natural fertility, contain little organic matter, ana are poorly drained.

The Rutlege soils formed under poor drainage conditions in thick beds of acid, sandy materials. They are associated with the Plummer, Portsmouth, Leon, and Klej soils. The Rutlege surface soils contain much organic matter. The soils are acid in reaction throughout the profile and are poorly and very poorly drained, primarily because of a high water table.

The coastal dune land and beach is sand deposited by w..ve action along the coast. Some of it was reworked by winds that arifted : back sone distance from the shore and formed a range or' low sand dunes. :e coastal dune land and beach occurs as long, narrow strips along bays, la ions, and the Gulf of Mexico. Santa Rosa Island and similar larger areas cc tain many small depressions ana ponded areas where water covers the su face many months of the year. In contrast to the white sand that occurs throu iout the entire profile of the more typical areas, these depressions accumulat a very thin layer of organic matter. Many areas are barren. Those areas n t washed by waves nave a sparse growth of plants that are tolerant of salt an: a scattering of pine and scrub oak grown along the inner dunes.

Tidal marsh consists of areas along the coast that are often covered *by* sait water or brackish water at high tide. It lies adjacent to bays and Lagoons in the southwestern part of Escamoia County. These flat or nearly level areas are associated with coastal dune land and beach; they are only a tew feet above sea level. Included with this land are a few tidal flats that are almost barren because they are so salty.

0000082

The mixed alluvial land, poorly drained, represents a mixture of dissimilar materials that border the streams throughout the county and make up a very large total acreage. This land is a result of soil material accumulation rather than soil development. The materials vary so greatly in color, texture, and consistency that any attempt to map the soils separately would be impractical. The land is subject to frequent overflow; in many places it lies only a few inches above the water level of adjacent streams. The characteristics or' this miscellaneous land type change from time to time as new material is deposited or removed with each overflow. The texture of this land varies greatly, depending on the source of the material and the condition of the stream when the material was deposited. Locally, texture varies from silt loam to sand, The color ranges from gray to black according to the amount of organic matter in it. The land is mostly level to nearly level, internal drainage is variable, and surface runoff is very slow.

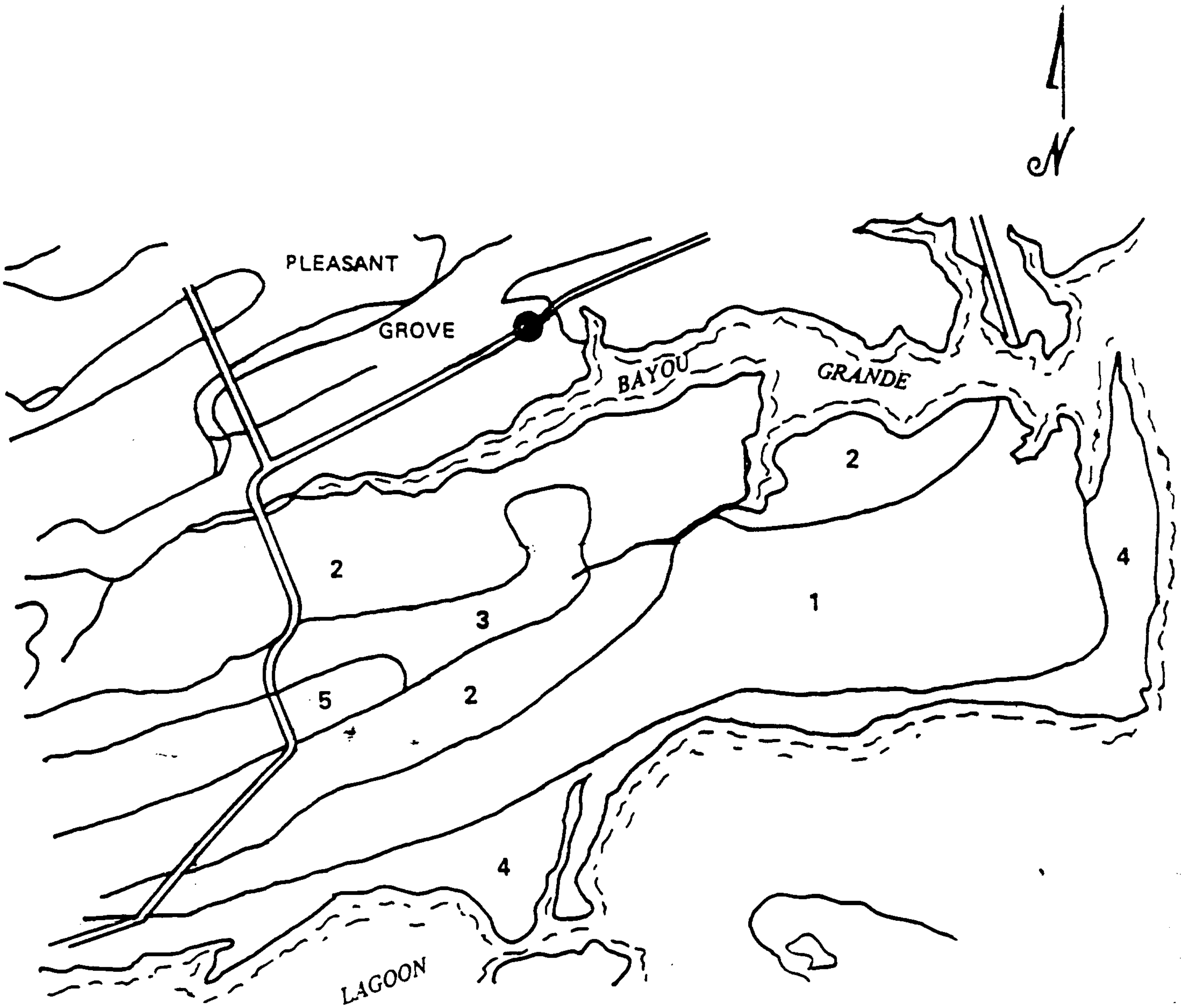
Fresh water swamp consists of naturally wooded areas, all or most of which are covered with water or are saturated throughout the year. The areas contain a mixture of soils and soil materials that vary in color, texture, composition, and thickness of layers. The soil material consist of stratified deposits recently washed from adjacent uplands and so intricately mixed that separation is not feasible. In some places the surface materials resemble those of Rutledge and Plummer sand. In many places organic matter of a varying thickness accumulates in the surface soil. The largest and most typical areas of fresh water swamps are in the southwestern part of the county and extend across the western edge of NAS Pensacola.

Figure 5-19 shows that portion of the general soil map of Escambia County which covers NAS Pensacola. A more detailed soil map for NAS Pensacola is presented in the Pensacola Naval Complex Master Plans (Naval Facililities Engineering Command, Southern Division, 1975 and 1980). Figure **3-20** is a correlation of that map with the USDA description (Carlisle, 1960). The Master Plan delimited 17 surface types at NAS Pensacola:

1. Alluvial
2. Tidal Marsh
3. Coastal Beach
4. Swamp
5. Lakeland (0-5% slope)
6. Lakeland (5-8% slope)
7. Leon (0-2% slope)
8. Klej (0-5% slope)
9. Rutlege (0-2% slope)
10. St. Lucie (0-5% slope)
11. Lakewood (0-5% slope)
12. Lakewood (5-12% slope)
13. Plummer (0-2% slope)
14. Sandy Fill
15. Mines, Pits, etc.
16. Stripped Land (0-5% slope)
17. Paved Areas

Direct correlations were not possible with all units, but the extrapolations discussed below are generally applicable and the discussions are valid for all general situations.

The USDA report (Carlisle, 1960) described a Lakeland loamy fine sand, loamy sand, and sand, each with slopes of 0-2, 2-5, 5-8, and 8-12 percent. The loamy fine sand has a grayish-brown surface soil that merges with the brownish-yellow fine sand of the subsoil. The surface soil varies from dark grayisn-brown to brown in color and from two to five inches in thickness. This soil is underlain by materials or finer texture below *42* inches and in **most** places within **72** inches. The loamy sand contains a greater amount of



LEGEND

NEARLY LEVEL TO GENTLY SLOPING ON UPLANDS

1. LIGHT-GRAY SANDS; SANDY SUBSOILS; EXCESSIVELY DRAINED OR SOMEWHAT EXCESSIVELY DRAINED: LAKEWOOD-LAKELAND.

NEARLY LEVEL SOILS OF RIVER TERRACES, DEPRESSIONS. AND LOWLANDS

2. GRAY SANDY SOILS ON LOWLANDS; SOMEWHAT POORLY DRAINED; MODERATELY HIGH WATER TABLE: KLEJ-LEON
3. GRAY OR VERY DARK GRAY FINE SANDS: POORLY DRAINED: PLUMMER-RUTLEGE
4. UNDIFFERENTIATED COASTAL SOILS BORDERING SALT WATER: COASTAL DUNE LAND AND BEACH-TIDAL MARSH
5. UNDIFFERENTIATED POORLY DRAINED FLOOD PLAINS AND SWAMPS: MIXED ALLUVIAL LAND-FRESH WATER SWAMP

FIGURE 5-19 NEARLY LEVEL SOILS OF NAS PENSACOLA

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medium and coarse sand grains throughout the profile than the loamy fine sand. The surrace soil varies from dark grayish-brown to brown in color and from two to five inches in thickness. The second layer may be yellowish brown or brownish yellow, and the rest of the profile is brownish-yellow. This soil contains materials of finer texture at depths between 42 and 72 inches. The Lakeland sand differs from the loamy fine sand and loamy sand primarily containing throughout its profile more medium and coarse sand and less material of fine texture. The surface soil ranges from dark grayish-brown to yellow-brown in color and from two to four inches in thickness. The second layer, a brownish-yellow or yellowish-brown sand, merges with the yellow or brownish-yellow subsoil. The close similarity of the three USDA Lakeland soils and the inability to precisely match the master plan units with any of the USDA units resulted in grouping all Lakeland soils on Figure 5-20.

Two phases (0-2 and 2-5 percent slopes) of Lakewood sand are described by Carlisle (1960); neither matching the 0-5 and 5-12 percent slopes delimited by the NAS Pensacola Master Plans (1975 and 1980). The level phase of the Lakewood sand occurs as long narrow strips parallel and adjacent to the coastline. The surface soil varies from light gray to light brownish-gray in color and from four to six inches in thickness. The lower sublayers vary from brownish-yellow in color and in most places are within 14 to 20 inches of the surface. The gentle sloping phase (2-5 percent slopes) has a thin, light gray surface soil and brownish-yellow sand in the subsoil beginning at a depth of approximately 16 inches. Some areas that have slopes in excss of five percent are included in this soil. Also included are a few areas that contain white sand throughout the profile but were too small to map separately. As with the Lakeland series, the two Lakeland soils are grouped together on Figure 5-20.

Two Leon soil phases, both with slopes of 0-2 percent are described by , Carlisle (1960) as opposed to the one unit shown on the NAS Pensacola Master Plans (1975 and 1980). The Leon sand is a level to nearly level somewhat poorly drained soil. Its typical profile consists or 0 to 4 inches of dark-gray to very dark gray sand, 4 to 18 inches of light-gray sand, 18 to 22 inchs of dark reddish-brown sand which forms a strongly cemented, organic-matter stained hardpan, 22 to 28 inches of yellow sand mottled with reddish-yellow, ana 28 to 42 inches of yellow, reddish-yellow, and very paie brown sand which becomes lighter colored as depth increases. The organic-matter stained hardpan varies greatly in thickness and degree of cementation within short distances. A thin layer of light-gray weakly cemented sandy loam commonly occurs immediately above the organic-matter stained hardpan. The sands vary considerably in thickness above the hardpan layer. The light colored surface phase of the Leon sand has a lighter-colored surface soil. The surface soil ranges from gray to light brownish-gray in color and from two to five inches in thickness. The organic-matter stained hardpan ranges from a dark-brown to dark grayish brown. Variations in the depths to the organic-matter stained hardpan are common; however, in most instances it occurs below 24 inches.

The NAS Pensacola Master Plans (1975 and 1980) Klej soil with slopes of 0-5 percent is matched with the USDA (Carlisle, 1960) Klej loamy sand and sand; both with slopes of 0-2 and 2-5 percent. The loamy sand has a surface soil which varies from dark gray to black in color and from three to six inches in thickness. The subsoil layers range from brownish-yellow to yellowish-brown loamy sands and contains various amounts of yellowish-red, strong-brown, and

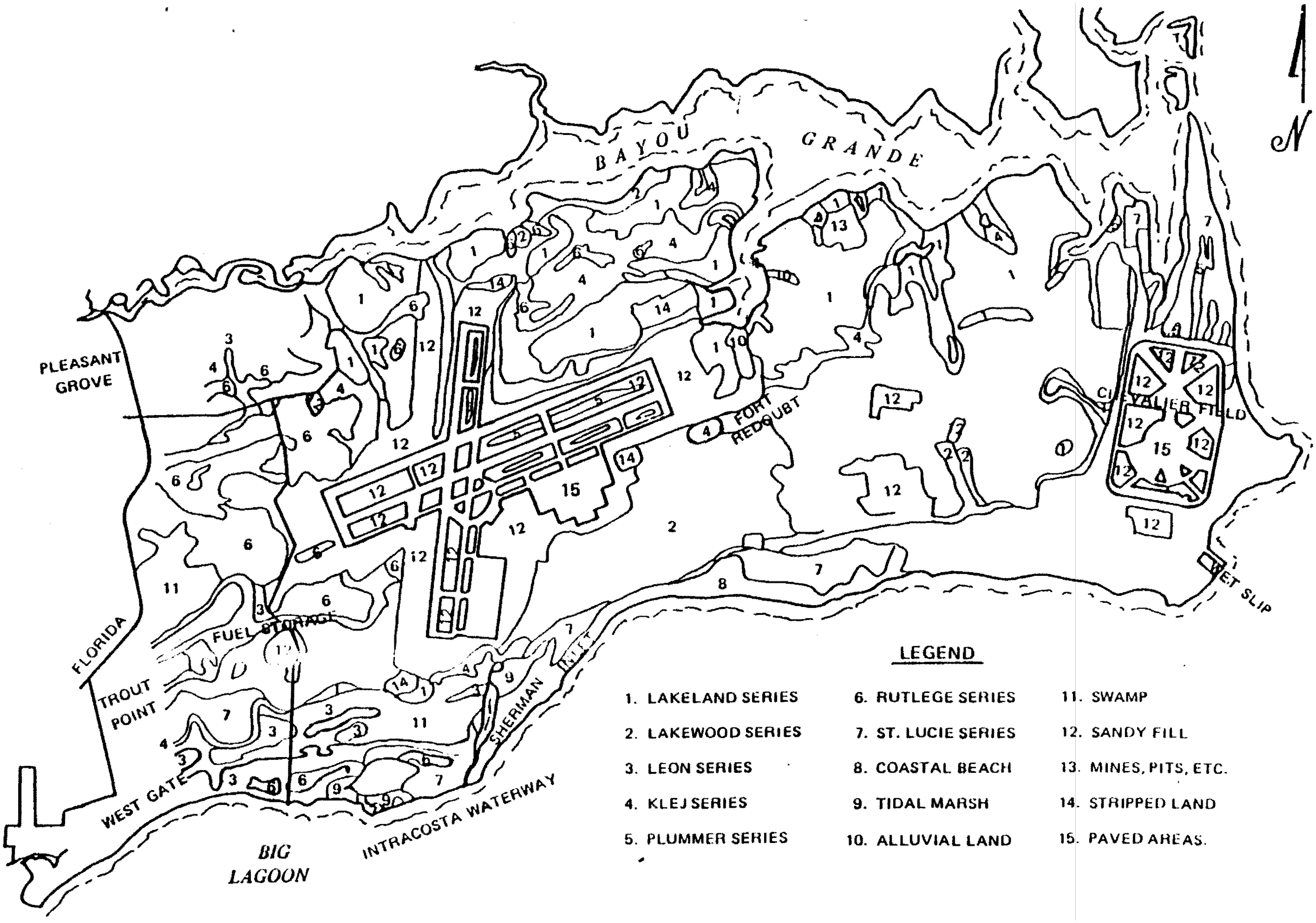

FIGURE 5-20 SOIL MAP OF NAS PENSACOLA

yellow mottling. A few small areas that have materials or finer texture at depths of 30 to 42 inches are included with this soil. The Klej sand Is distinguished from the Klej loamy sand primarily because it contains a slightly greater proportion of medium and coarse sand grains and less materials of finer texture throughout the profile. The surface soil varies from drak gray to very dark grayish-brown in color and from three to six inches in depth. The subsoil ranges from yellowish-brown to brownish-yellow and contains various quantities of yellowish-red, strong-brown, and yellowish mottles. in a few areas a layer of wnite sand occurs at a depth of about 40 inches.

The Plummer series consist of loamy sand with slopes of 0-2 and 2-5 percent and fine sand and sand with slopes of 0-2 percent according to the USDA (Carlisle, 1960) while the NAS Pensacola Master Plans (1975 and 1980) list only the Plummer unit with a slope of 0-2 percent. The Plummer loamy sand has a surface soil which varies from gray to very dark gray in color and from four to seven inches in thickness. The subsoil, ranging from a light gray to grayish-brown in color is a loamy sand that in many places contains strong-brown and brownish-yellow mottles. Variations are common. The texture of the surface soil generally ranges from loamy fine sand to loamy sand, but in places is a light sandy loam. In some places, materials of fine texture occur at shallow depths. The Plummer fine sand differs from the loamy sand primarily because it has more fine sand and less material or finer texture throughout the profile. The surface soil varies from gray to very dark gray in color and from two to seven inches in thickness. The subsurface horizons contain more brown color than those of other Plummer soils. The Plummer sand has less material of fine texture and more medium and coarse sand throughout the profile than the other two Plummer soils. The surface soil varies from gray to very dark gray in color and from two to rive inches in thickness. In places the subsoil contains brownish-gray sands.

Both Carlisle (1960) and the NAS Pensacola Master Plans (1975 and 1980) have one Rutlege soil with slopes of 0 to 2 percent. The Rutledge sand commonly occurs adjacent to fresh water swamp, and generally berween this miscellaneous land type and better drained soils. The surface soil is black and varies from 10 to 14 inches in thickness. The subsurface horizons range from gray to very aark gray and in many places contain much more brown c lor than the typical Rutlege soil.

The St. Lucie soil of the NAS Pensacola Master Plans (1975 ana 1980) are not included in the soil report of Escambia County (Carlisle, 1960) but they occupy a position generally between the beaches or swamps and the better drained soils. As such, they probably have characteristics similar to tne Lakeland, Lakewood, and Rutlege Series.

The coastal beach is sand deposited by wave action along the coast. It occurs as a long narrow strip along Pensacola Bay. In typical areas, wnite sands occur throughout the entire profile.

Tidal marsh consists of areas along the coast that are often covered by salt water or brackish water at high tide. It lies adjacent to bays and lagoons, and is only a few feet above sea level. Included with this land are a few tidal flats that are almost barren because they are so salty. Soil materials are mixed sand, silt, and clay, with various quantities of organic matter.

The Alluvial unit or tne NAS Pensacola Master Plans (1975 and 1980) appears to be a correlative of tne mixed alluvial land, poorly drained, described by Carlisle (1960). This unit represents a mixture of dissimilar materials that boraer the streams and is a result of soil material accumulation rather than soil development. The materials vary greatly in color, texture, ana consistency. In many places it lies only a few inches above the racer level or aajacent streams and is subject to frequent overflow. Texture of this land varies greatly with local ranges of silt loam to sand. The color ranges from gray to black according to the amount of organic matter in the material.

Fresh water swamp consists of naturally wooded areas, all or most of which are covered with water or are saturated throughout the year. The areas contain a mixture or soil and soil materials that vary in color, texture, composition, and thickness or' layers. The soil material consists of stratified deposits recently washed from adjacent uplands and so intricately mixed that separation is not feasible. The stratified materials range from sand to clay, and, in many places, organic matter of a varying thickness accumulates on the surface soil.

The sandy kill, mines, pits, etc., and stripped land units of the NAS Pensacola Master Plans (1975 and 1980) are synonymous with the pits, dumps, and made land unit of the USDA Report (Carlisle, 1960). This miscellaneous land type consists mostly of open excavations from which gravel has been removed, uceven areas of sand and waste materials that remain after the gravel is mined, and areas tnat man has filled in with several feet of materials. In some areas, and at NAS Pensacola, there are borrow pits or places where soil materials (sand) were excavated for use in builaing airports, roads, ana railroads. Extensive areas or fill are evident in the vicinity of the airfield at NAS Pensacola, and several borrow pits were too small to delineate on maps.

Delineations of paved areas are simply attempts to show the extensive surface areas of NAS Pensacola that have been surfaced with impermeable, sterile materials. Numerous smaller areas of paved surfaces exist.

Generally, all natural surface materials present on NAS Pensacola are coarse-grained sands or sandy materials that woula be classified as sand, poorly graded (SP) or silty sand (SM) according to the Unified Soil Classification Systsm (US Army Engineer Waterways Experiment Station, 1953). With increasing depth some soils would be classified a low plasticity silt (ML) and clayey sand (SC). Exceptions to these classifications could be found in the tidal marsh, alluvial land, and fresn water swamp units whose classifications could include sand, poorly graded (SP) silty sand (SM), low plasticity (ML), low plasticity clay (CL), or high plasticity clay (CH). Table 5-4 presents the general soil types occurring on NAS Pensacola ana the corresponding Unified Soil Classification System Units.

Numerous studies conducted for NAS Pensacola have required shallow (<100 feet deep) soil borings. The NAS Pensacola files were searched ana off-base sources queried to obtain any available soils information. The results of tnese efforts are summarized below, and supporting boring logs are presented in Appendix A.

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TABLE 5-4

USDA and Unified Soil Classification System Units of NAS Pensacola

USDA Soil Type	Depth, Inches	Unified Soil Classification System Unit
Lakeland	0-42	SM
	42+	ML or SC
Lakewood	0-42	SP
Leon	0-42	SP
Klej	0-12	SM
	12-42	SM or SC
Plummer	0-42	SM
Rutlege	0-12	SM
	12-42	SP
St. Lucie	---	SP
Coastal beach	0-42+	SP
Tidal marsh	---	SP, ML, CL
Alluvial land	---	SM to CL
Fresh water swamp	---	SM or SP to CH
Sandy fill	---	SP
Mines, pits, etc.	---	SP
Stripped land	---	SP
Paved areas	---	---

A series of borings with depths of less than 10 feet were reported by NFEC-SD (1974a, 1974b, 1975a, and 1975b) for the Entrance and Arterial Roads, increments 1, 2, and 3. These borings all penetrated sandy material throughout with a very limited number located in topographic lows passing through thin surface layers or organic material.

Meister and Associates performed a soils investigation (Dawkins and Associates, 1976) in connection with a wastewater disposal project at the two NAS Pensacola golf courses. They reported that the borings "generally confirmed that the predominant agricultural soil classification (for the upper 48 inches) within the two golf courses consists of Lakeland and Lakewood sands. Generally speaking, these sands are excessively to somewhat excessively drained, rapidly permeable sands with depths to the seasonably high ground water level in excess of 10 feet. Predominantly, the soils encountered in our borings were classified SP and consisted of clean sands in loose state." The location of the borings are shown on Figure 5-21, and the boring logs are presented in Appendix A.

Larry M. Jacobs and Associates, Inc. performed foundation investigations at NAS Pensacola and several of these report were examined (1976, 1978, 1979a, 1979b, 1980a, 1980b, and 1981). General descriptions of the soil characteristics follow, the boring group locations are shown on Figure 5-72 as boring groups 1 through 8, and the boring logs are presented in Appendix A.

Boring Group No. 1. These borings at the proposed Aircraft Refinishing Hangar, Chevalier Field, show "in general, the site was overlain with several inches to one foot of topsoil or red clay sand fill which was underlain by loose or medium dense slightly silty sand or sand to roughly elevation 0 feet, underlain by dense sand to roughly elevation -38 feet, where medium consistency marine clay was present to the bottom of the borings at 51 feet below existing grade."

Boring Group No. 2. These borings at the proposed disorientation building show "in general the site was underlain by loose or medium dense sand throughout. A slight organic stain was present in the sand from roughly 14 feet to the bottom of the borings. Roughly 8 inches of topsoil was present at the surface."

Boring Group No. 3. These borings at the proposed As[illegible]rs Facility "encountered loose sand near the surface which became medium dense at 5 feet and dense from 19 feet to the bottom of the borings."

Boring Group No. 4. These borings at the proposed Aircraft Support Facility show "in general, the sites were similar, with sand being present throughout the borings. The sand was medium dense throughout Boring #1."

Boring Group No. 5. These borings at the Pump Foundation in the pit at the Power Plant show "in general, both borings indicated that the site was underlain by basically a sand soil (SP) to the bottom of the borings where they were terminated just into the marine clay. Roughly a one foot layer of rubble and organic material was present from 2-3 feet below the bottom of the pit. The sand was generally loose to a depth of 6+ feet in Boring #1 and to a deeper elevation in Boring #2 of roughly 4 feet below the existing grade at

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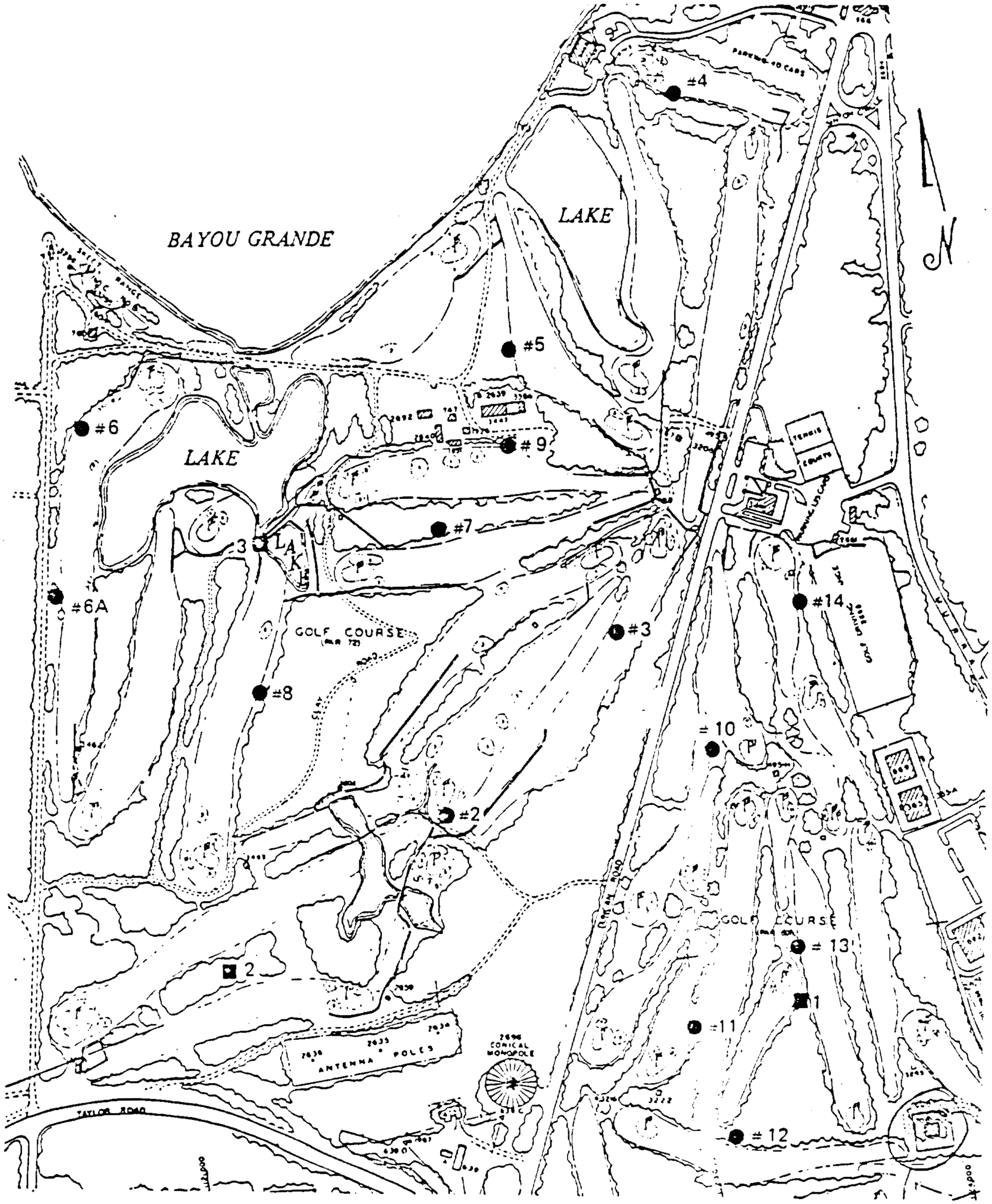

● #7 STANDARO PENETRATION TEST BORING

■ 4" DIAMETER OPEN PVC STANDPIPE

FIGURE 5-71 GOLF **COURSE** BORING LOCATIONS

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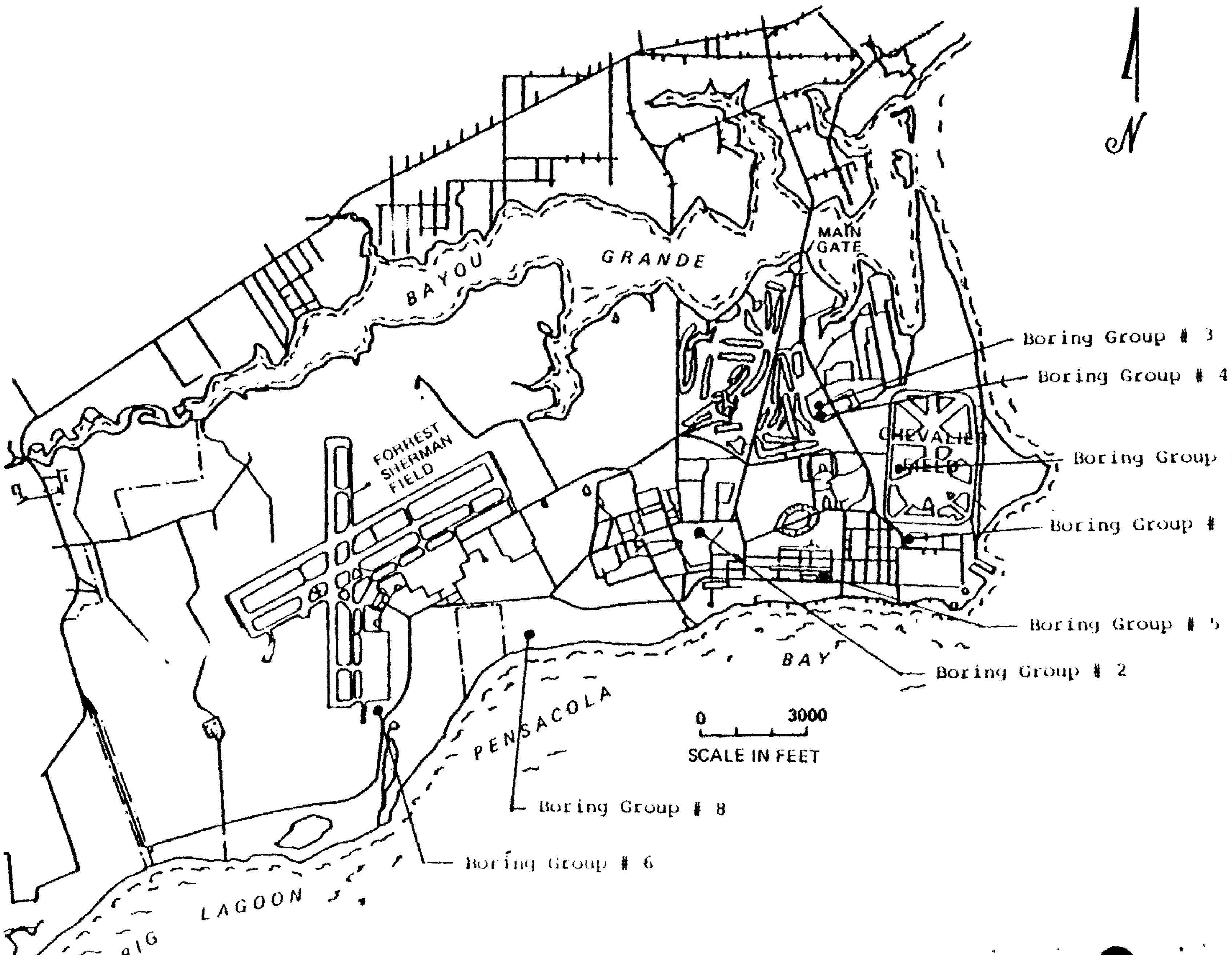


FIGURE 5-22 FOUNDAT[illegible]VESTIGATION BORINGS

the bottom of the pit. The soil then became medium dense to dense to just above the clay where it became very loose or soft in the clay or clayey sand mixture at the bottom of the boring."

Boring Group No. 6. These borings at the FRS Instructional Building showed "in general, the site was covered with roughly 3 inches of light topsoil which was underlain by tan to gray or white sand to a depth of 25 feet in Boring #1 and to 26 feet which was the bottom of the boring in Boring #2. A brown sand with organics was present from 25 to 26 feet in Boring #1. The soil was loose near the surface to a depth of roughly seven feet, where it became medium dense to the bottom of the borings."

Boring Group No. 7. A boring near Building 3557 "indicated 12 inches of concrete underlain by loose fine sand (SP) to a depth of 10 feet. From 10 feet to 17.5 feet sand was present with appreciable wood in the sand; from 17.5 to 50 feet below existing grade the soil was a clean sand (SP). The sand was medium dense to a depth of roughly 31-34 feet where it became dense to the bottom of the boring.".

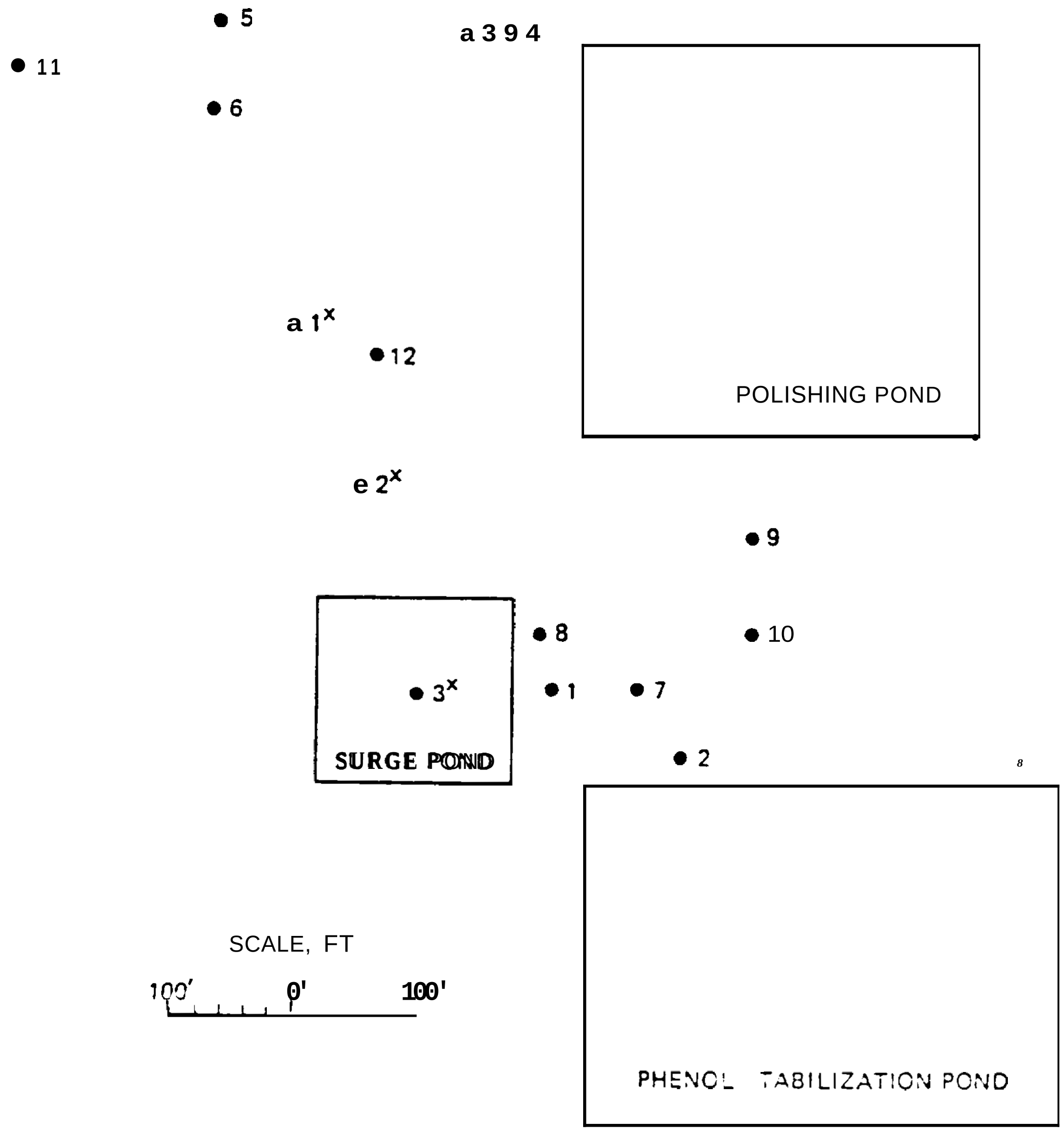
Boring Group No. 8. Four foundation borings were drilled at the Petty Officers Mess (NFEC-SD, 1975), and penetrated 17 to 24 feet of tan, white, or gray sand before entering a brown to dark brown sand with organic stains. Below this was gray to brown sand to the depth penetrated (41 feet).

The logs of 15 borings in the vicinity of the Industrial Wastewater Treatment Plant (IWTP), (NFEC-SD), 1972, 1978a, and 1978b) and one or these (Boring #7) is summarized in later work on the IWTP surge pond (Missimer and Associates, Inc., 1981a). These logs, generally show brown, loose to dense, fine to, medium sand the three deeper borings (No. 5, 6, and 7: show a soft to firm, sandy, blue-gray marine clay between 40 and 55 to 60 feet deep. The locations of these borings are shown on Figure 5-23, and the boring logs are presented in Appendix B.

The surficial soils at NAS Pensacola, as indicated by the borings which were examined, are sands and silty sands. These are underlain by fine to medium sand to the depth penetrated in most exploratory borings. At the IWTP and at the Aircraft Refinishing Hangar, Chevalier Field, a blue-gray sandy marine clay layer was encountered at a depth of 40-50 feet. This layer was underlain by fine to medium, white to gray sand to the maximum depth (66 feet) penetrated in the exploratory borings.

5.3.6 Hydrology.

5.3.6.1 Surface Water. NAS Pensacola is bordered on the south by Big Lagoon and Pensacola Bay, on the east by Pensacola Bay, and on the north by Bayou Grande. Only a very small portion of the western end of NAS is farther than a mile from one of these bodies of water. Swampy areas exist on or near the western portion of NAS Pensacola. Man-made drainage ways and storm drains feed into the short intermittent streams emptying into the bays and the



LEGEND

.1 BORING LOCATION AND NUMBER FROM NAVFAC DRAWING NO. 5055758

.1x BORING LOCATION AND NUMBER FROM NAVFAC DRAWING NO. 1281058

FIGURE 5-23 BORING LOCATIONS AT INDUSTRIAL WASTE TREATMENT PLANT bayou. No perennial streams enter or exit the air station, but the marshy areas and three small lakes retain water throughout the year. Figure 5-24 and 5-25 show the surface drainage and the storm and former wastewater outfalls, respectively, for NAS Pensacola (U.S. Geological Survey, 1970 and Naval Air Station, no date). Table 5-5 presents data for the outfalls (J. a. Converse & Co., Inc., 1976).

5.3.6.2 Groundwater. The groundwater of southwestern Florida has been the subject of numerous investigations (Barraclough, Jack T., 1967; Baraclough, Jack T. and Marsh, Owen T., 1962; Causey, L. V. and Leve, G. W., 1976; Cooper, H. H. and Stringfield, V. T., 1950; Dysart, J. E., et al, 1977; Feth J. ti., et al, 1965; Flood and Associates, Inc., et al, 1978; Healy, H G., 1974, 1975a, 1975b, 1377; Hyde, L. W., 1965 and 1975; Jacobs, C. E., Cooper, H. H., Jr., and Stubbs, S. A., 1940; Klein Howard, 1971 (revised 1975); Matson, G. C. and Sanford, S., 1913; Musgrove, Rufus H., Barraclougn, Jack T., and Grantham, Rodney G., 1965a, 1965b, and 1466; Musgrove, Rufus H., Barraclough, Jack T., and Marsh, Owen T., 1961; Rosenau, J. C. and Meadows, P. E., 1977; Shampine, W. J., 1975a and 1975b; Stewart, J. W., et al, 1971; Stringfield, V. T. 1964; Trapp, Henry, Jr., 1972, 1973, 1975, 1977, 1978, and 1979; and Vernon, Robert O., 1973). These investigations were concentrated on the shallow sand and gravel aquifer, but most all touched on the Floridan Aquifers as well. Figures 5-26 and 5-27 (Barraclough, Jack T., and Marsh, Owen T., 1962) show the statigraphic relationship of these aquifers and various aquitards.

The aquifers are described in several of the reports and no major differences in the descriptions were noted. The following aquifer descriptions were taken primarily from Musgrove, Barraclough, and Grantham, 1965.

Virtually all groundwater that is withdrawn in Escambia and Santa Rosa Counties comes from the sand and gravel aquifer. Although composed predominantly of sand, numerous lenses and layers of clay and gravel that are as much as 60 feet thick occur throughout the aquifer, and abrupt changes of facies are characteristic of the aquifer. The uppermost 5- to 20-foot section of the aquifer consists of light tan, fine to coarse sand that is soft and loose in contrast to the hard, reddish brown, pebbly sand that underlies it. The aquifer consists predominantly of quartz sand, ranging from white to light brown or reddish brown. Although some beds are moderately well sorted, the unit as a whole is generally rather poorly sorted. The associated stringers and lenses of gravel are made up chiefly of pea-sized pebbles. Small stringers of white to gray clay are scattered throughout the aquifer in addition to the large lenses of clay. In contrast to the rest of Florida, the groundwater conditions in Escambia and Santa Rosa Counties are complicated by the great lithologic variability of the aquifer. Groundwater is under artesian pressure where lenses and layers of clay, sandy clay, or hardpan overlie a saturated, permeable bed and under non-artesian conditions where such clays and hardpans are absent or where the permeable bed is not completely saturated. The recharge to this aquifer is derived almost entirely from rain falling in the immediate area of concern.

The Floridan aquifer in Escambia and Santa Rosa Counties is separated from the sand and gravel aquifer by a thick section of clay and is subdivided into two parts by an extensive clay bed. The upper limestone of the Floridan Aquifer is typically a brown to light-gray hard dolomitic limestone or dolomite with a distinctive spongy-looking texture and contains abundant shell fragments. The

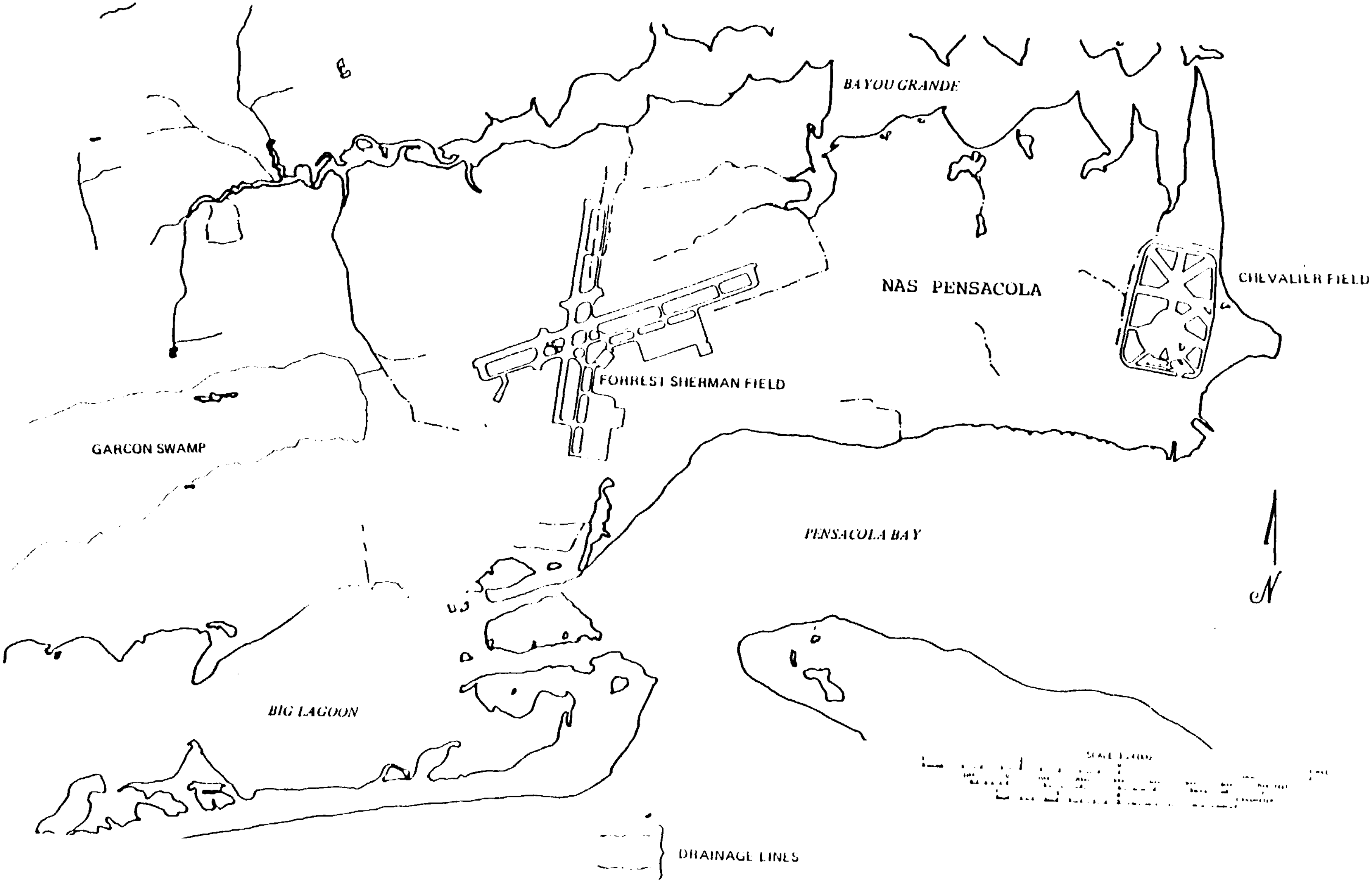


FIGURE 5-24 SURFACE DRAINAGE AT NAS PENSACOLA

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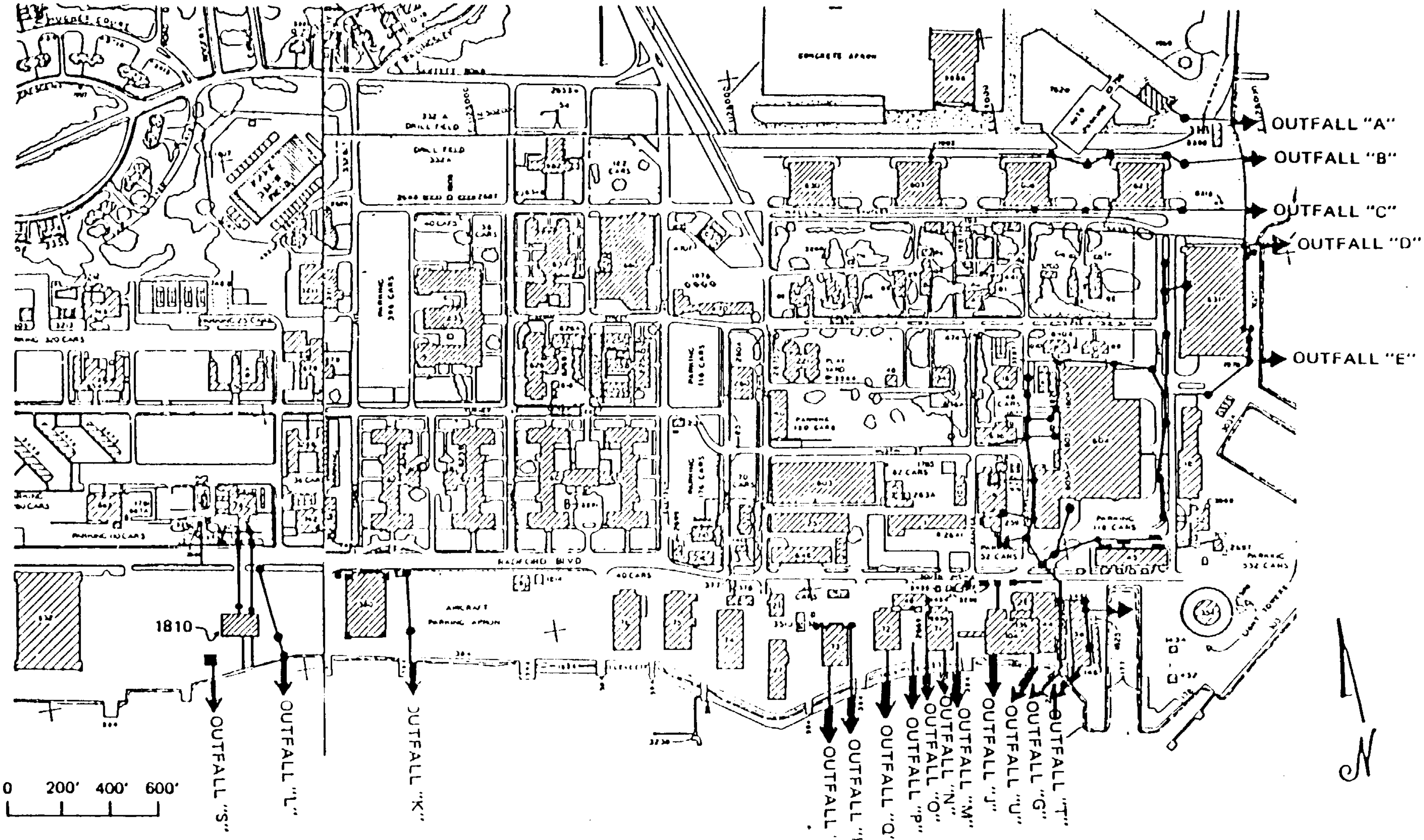

FIGURE 5-25 STORM SEWER OUTFALLS AT NAS PENSACOLA

TABLE 5-5

STORM WATER OUTFALL DATA FOR NAS

Outfall	Size, Inches
A	12
B	24
C	24
D	33
E	36
F	12
G	15
H	10
I	15
J	12
K	8
L	8 (2)
M	12
N	12
O	12
P	12
Q	12
R	12
S	12
T	-
U	6
V	

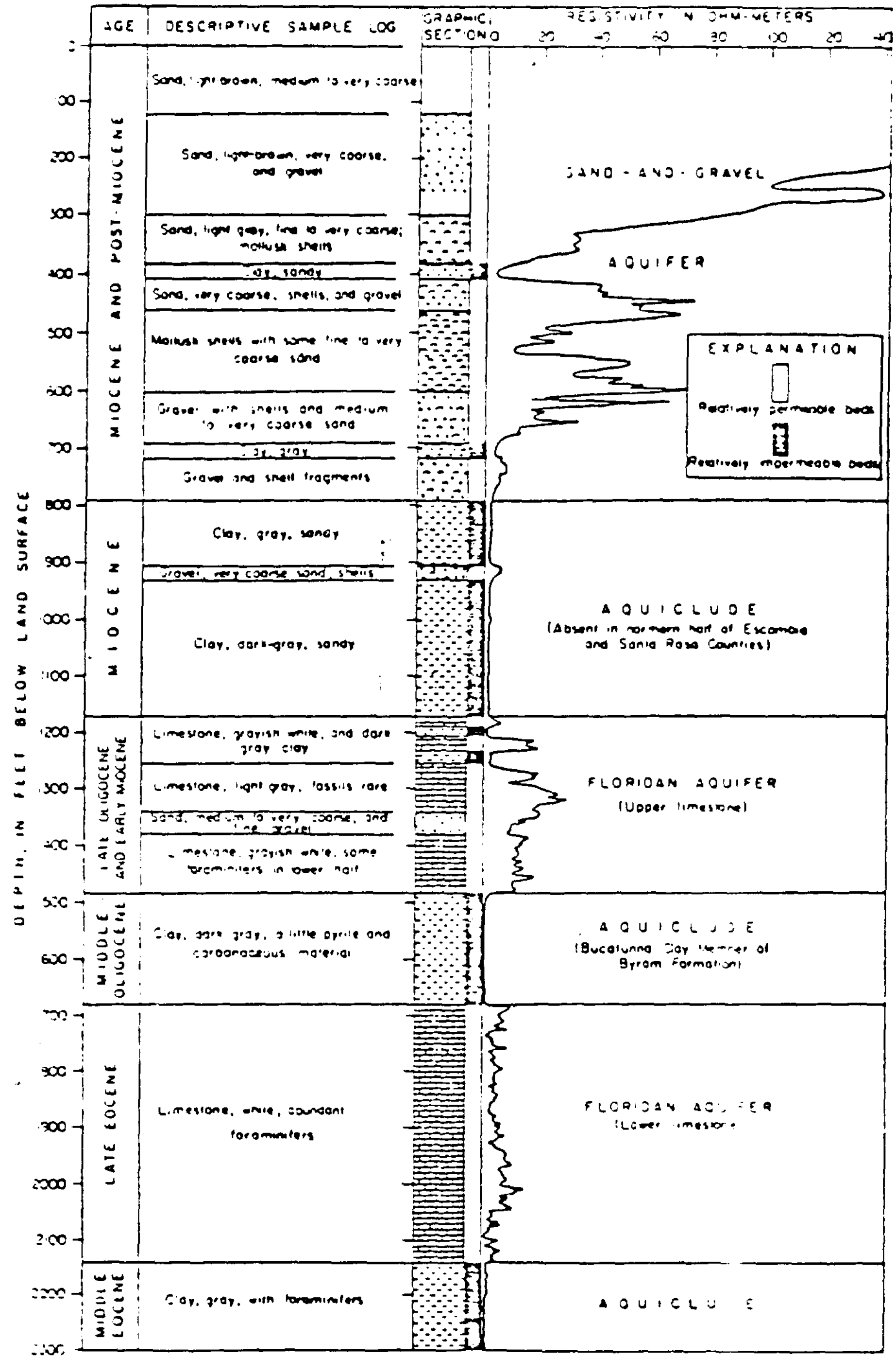

FIGURE 5-26 AQUIFERS AND AQUICLUDES ALONG THE GULF COAST OF WESTERN FLORIDA AS SHOWN IN A REPRESENTATIVE TEST WELL NEAR PENSACOLA

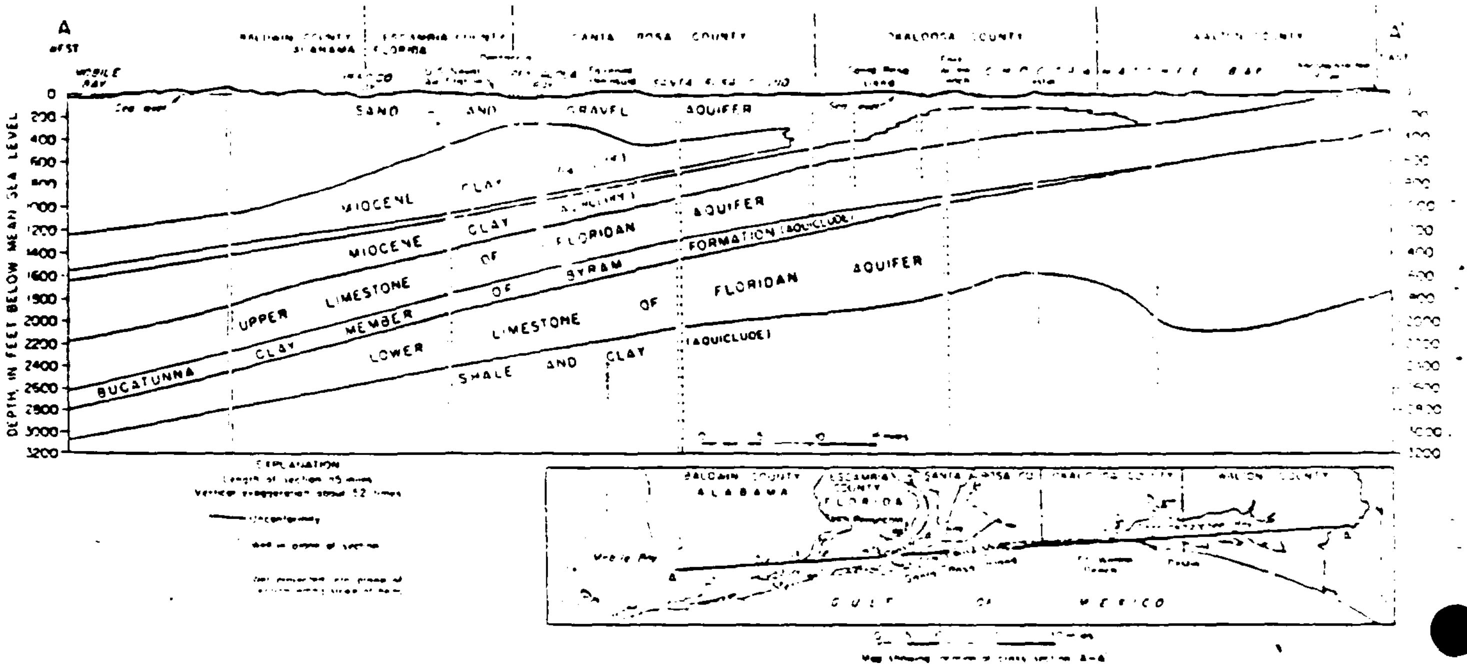

FIGURE 5-27 Aquifers and aquicludes along the gulf coast of Western Florida

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upper Floridan Aquifer is recharged mainly by water from the sand and gravel aquifer where the two are in contact in northern Escambia and Santa Rosa Counties.

The lower member of the Floridan Aquifer is white to grayish cream, rather soft and chalky limestone, but these appear to be randomly distributed and cannot be correlatea from well to well over any great distance. Recharge to the lower aquifer is derived from rain falling on the outcrop area some 10 to 35 miles to the north. The movement of groundwater in both sections or the Floridan Aquifer is generally to the south and southeast.

No comprehensive investigations of the groundwater underlying NAS Pensacola have been conducted, but several site-specific studies are available. These studies were initiated to support limited requirements and, while recommendations were usually made to follow up the work with groundwater movement definition, follow-up work was not always accomplished (or at least not located during this IAS). A large part of this data gap is due to the early concern of defining "pollution" and an unawareness on the part of samplers that water levels can be as important as water analysis.

Groundwater studies or investigations directly applicable to NAS Pensacola include general studies of the sand and gravel aquifer by Trapp, Naval Civil Engineering Laboratory (Crawford, Kent, and Youngberg, 1975 and Boettcher, 1976), sanitary landfill effluent investigations, Potable Water Supply Study by Black, Crow, Eidsness, Wastewater Treatment Studies by Dawkins and Associates, Inc., ana Missimer and Associates, Inc., investigation of grounawater contamination from the NAS IWTP.

Trapp, 1972, reported that nine paired (adjacent shallow and deep) observation wells were installed in the Pensacola area. In these wells the water levels in the shallow observation wells were consistently higher than the water levels in adjacent deeper observation wells. In these areas the vertical component of groundwater flow is downward, and at least that part of the groundwater body tapped by the deeper wells is receiving recharge. Thus, all this project's paired observation wells were drilled in areas of recharge and most of the Pensacola area, including NAS Pensacola, probably is a recharge area. One well, test hole No. 11, was located just northwest of NAS Pensacola (Figure 5-18 ana Appendix B).

Trapp, 1973, reported on an additional test hole (No. .3) southwest of NAS Pensacola (see Figure 5-18 and Appendix B) and the construction of a regional water table map. The water table map, Figure 5-28, was based on control points obtained from measured or reported water level.. in shallow wells, from neutron logs, from elevations along perennial streams, and from estimates derived from well depths and topography. The map is generalized because the control is widely spaced, mostly imprecise, and does not apply to a single point in time. The preparation of the map was also complicated by the problem of distinguishing perched water tables from the regional water table. Water levels in shallow wells and surface water bodies were assumed to represent the regional water table unless direct evidence of a perched water table was available. Perched groundwater bodies are usually of small areal extent, and they probably accounted for some of the irregularities in the configuration of the regional water-table countours, but not on the NAS Pensacola area. The

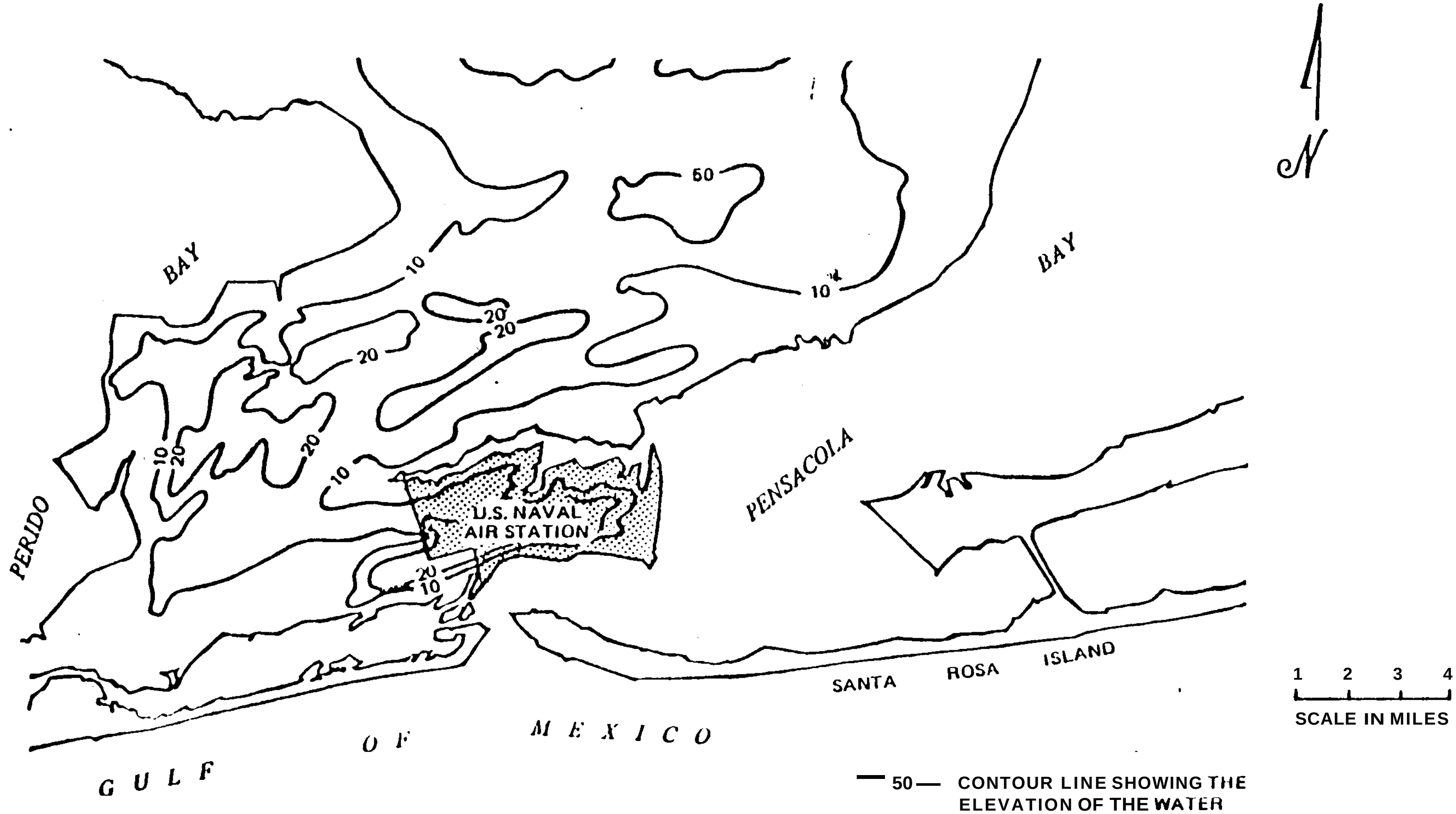

FIGURE 5-28 GROUND WATER CONTOURS FOR THE UPPER PORTION OF THE SAND-GRAVEL AQUIFER.

water-table elevations of 0 to less than 30 reet as snown on Figure 5-28 are probably valid for the historical conditions at NAS Pensacola.

Trapp, 1975, mapped the potentiometric surface for the sand ana gravel aquifer zone extending from 100 to 300 feet deep, the most commonly screened inverval. Historical data were used to prepare a preaevelopment nap, and the spring-summer 1973 data were used to prepare a post-development map. The predevelopment map showed that the potentiometric surface of the sand ana gravel aquifer in southern Escambia County was lenticular, paralleling the Escambia River to the east and the Perdido River to the west, and that the gradient was toward both rivers and Gulf of Mexico to the south. The post development map (Spring-Summer, 1973) retains the same general pattern, but numerous depression cones have developed around large production wells. The well field at NAS Pensacola (see Figure 5-18) had a depressed potentiometric surface to 20 feet below sea level as shown on Figure 5-29.

The Black, Crow, and Eidsness Study, 1969, was not based on any new data, and the data included are not precise. They reported on four test wells with data taken in 1953 and one boring in 1969 (see Figure 5-30 ana Table 5-6). No historical data were obtained which documented well installation or testing procedures, *so* the variations in water levels of the different strata in Well No. *3* cannot be explained. The water level in Well No. 1 and Well No. *2* approximate sea level and are probably good data, but Well No. 3 and Well No. *4* exhibit some levels well below sea level and are questionable. In addition, the one boring, at an elevation approximating the elevations of Well No. *3* and Well No. *4* ancountered groundwater at depths of six to seven feet which lessens the reliability of the water levels recorded for Well No. 3 and Well No. *4*.

The groundwater investigations at NAS Pensacola's sanitary landfill (Crawford, Kent, and Youngberg, 1975 and Boettcher, 1976) were prompted by tne leachate emission from the landfill and foreseeable capacity limits of the landfill operation. Crawford, Kent, and Youngberg reported on 11 groundwater monitoring wells in the vicinity of the landfill, ana four wells at potential landfill sites (see Figure 5-31). These wells exhibited groundwater elevations ranging from 1.87 feet **MSL** to 13.76 feet M[illegible] in the vicinity or the landfill with the lower elevations to the north towar[illegible] Bayou Grande. Potential landfill sites north of Forrest Sherman Fie[illegible] nad water table elevations of less than 10 feet MSL and the potential [illegible]ites south of the fuel farm had water table elevations of slightly less than [illegible] feet MSL. Figure 5-31 presents the general location of the observation [illegible]ills (NFECSD, 1975) and Table 5-7 presents their ground water elevation data. These observation wells were lined with 1-1/4" galvanized pipe and were const[illegible]cted by driving a five-feet pointed screen to a depth such that the poi[illegible] was four feet below the water table. A backhoe was **used** to remove **soil** cover prior to driving the well points. An eighteen-inch section of the pipe extended above ground level and was covered by a threaded cap.

Boettcher, 1976, reported that two additional monitoring wells were placed in the vicinity of monitoring Well No. 7 to provide samples representative of groundwater quality approximately 10 feet and 20 feet below the upper elevation of the groundwater, which is sampled by Well No. 7. This report states that during the period of August *1974* through March 1976 the

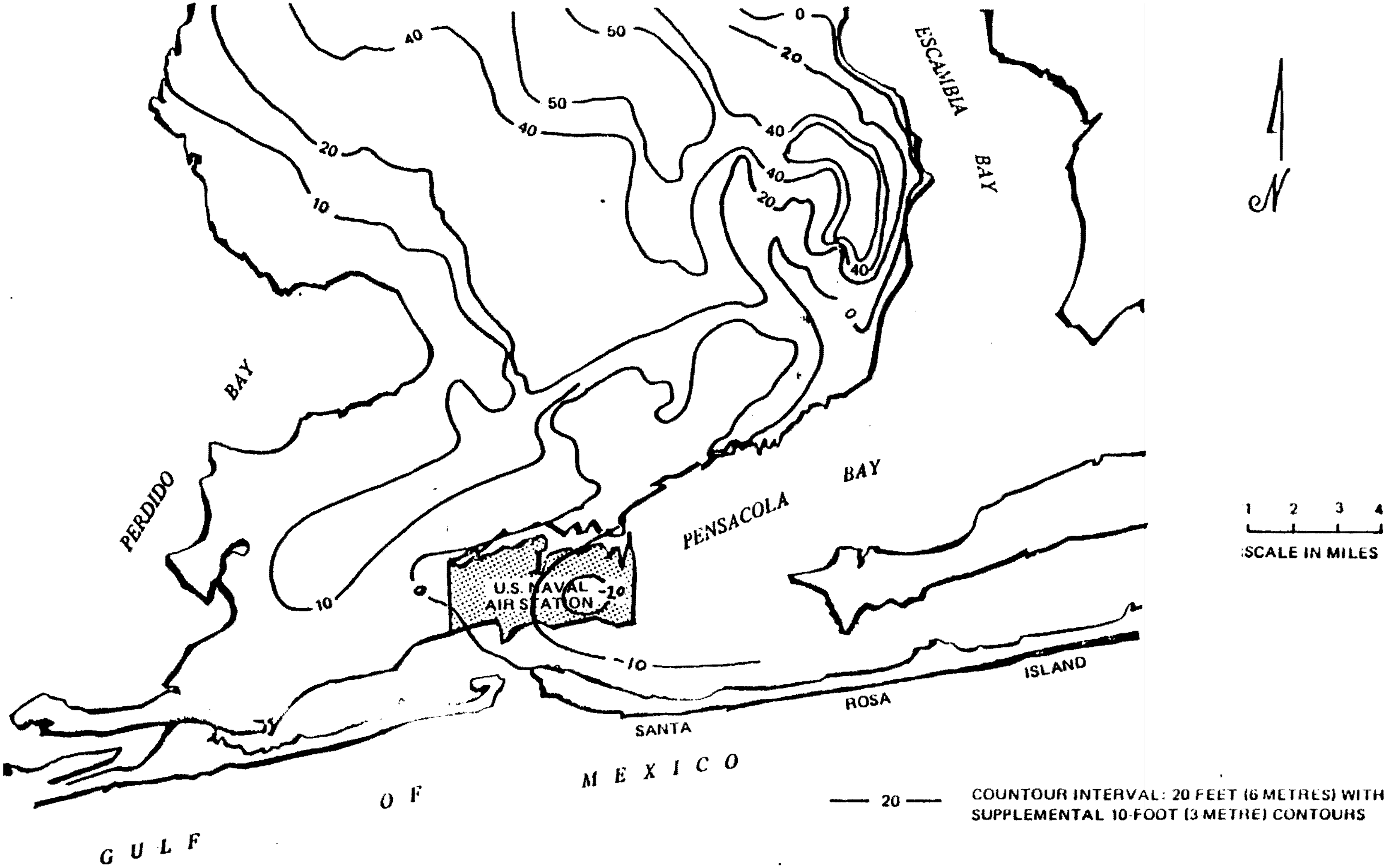

FIGURE 5-29 · POST DEVELOPMENT (1973) WATER LEVELS IN THE SAND AND GRAVEL AQUIFER

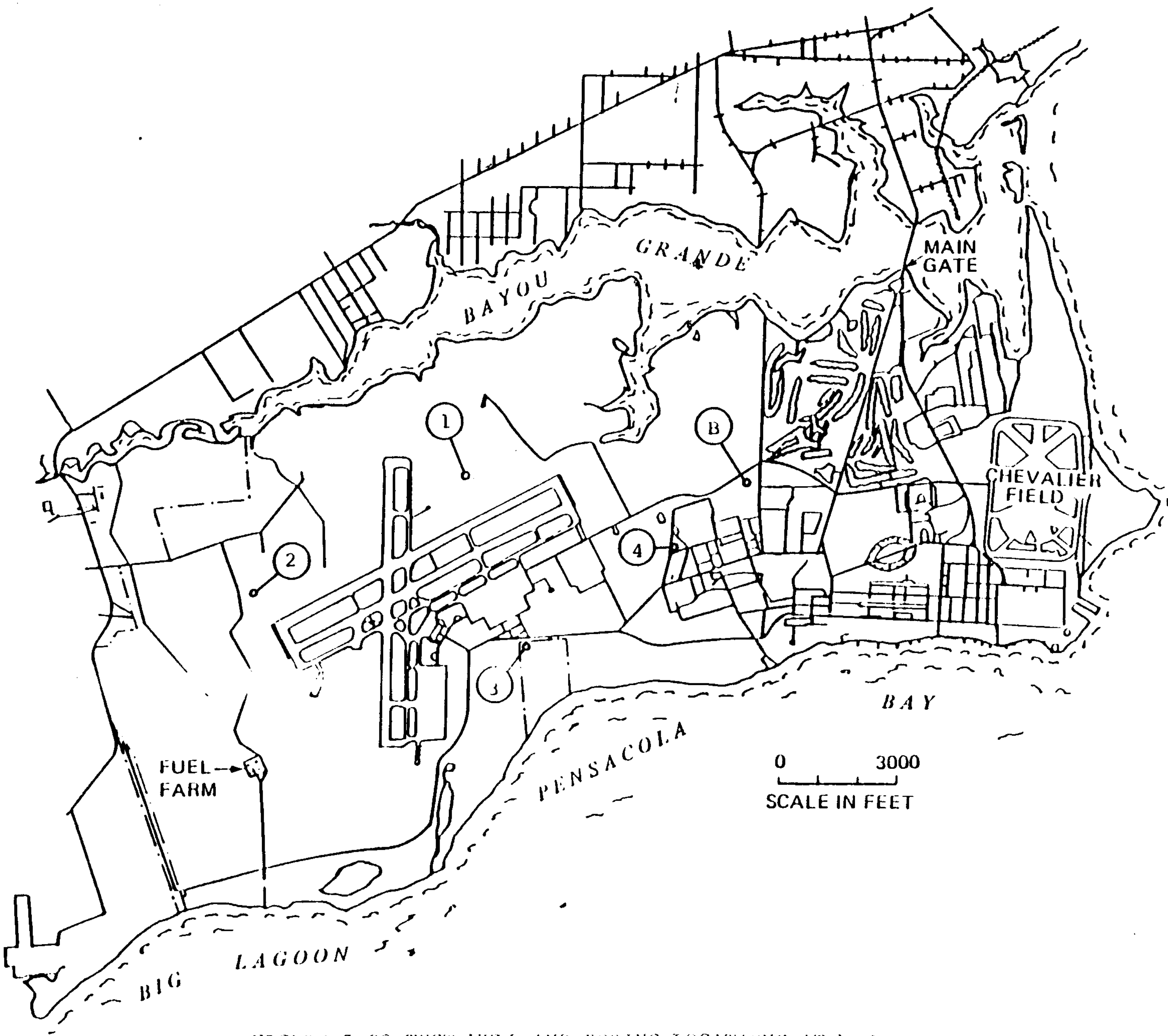

FIGURE 5-30 TEST WELL AND BORING LOCATIONS AT N@S SACOLA

TABLE 5-6

Water Levels of Test Wells at Forrest Sherman Field

Well Number	Stratum Number	Tested Interval, ft	Static Level	Date
1	1	100-160	13.08	4-04-53
1	2	210-270	13.00	4-09-53
2	1	147-188	13.00	4-21-53
3	1	115-155	43.00	5-08-53
3	2	200-240	24.00	5-01-53
3	3	250-290	30.00	5-05-53
4	1	200-223	50.50	5-20-53

Naval Air Basic Training Comman
Public Works Department
Sanitation Branch
Pensacola, Florida
by R.5. Blondhein, Chemist

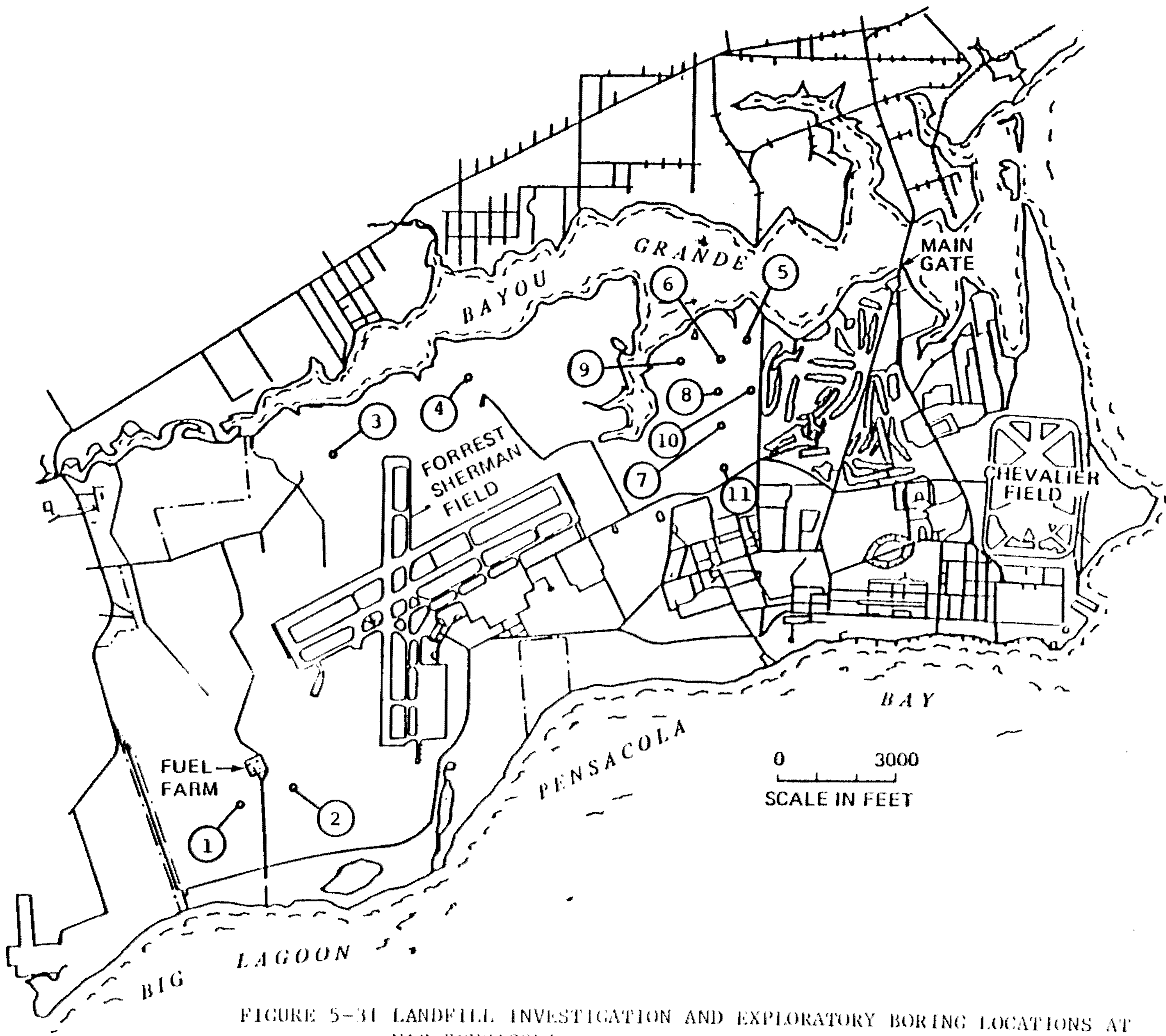

FIGURE 5-31 LANDFILL INVESTIGATION AND EXPLORATORY BORING LOCATIONS AT NAS PENSACOLA

TABLE 5-7

Sanitary Landfill Observation Well Data

Monitoring Well NO.	Ground Elev. ft	Distance to Groundwater ft	Groundwater Elev. ft (nbovc sea level)
GW01	36.8	17.85	18.95
GW02	27.0	8.04	18.96
GW03	15.6	7.50	8.10
GW04	15.2	6.79	8.41
GW05	16.0	14.13	1.87
GW06	14.0	6.54	7.46
GW07	20.3	9.58	10.45
GW08	19.2	9.06	10.14
GW09	14.6	7.83	6.77
GW10	8.8	3. a3	4.97
GW11	30.3	16.54	13.76

GW01 - About 500 ft SW of the Sherman Field Fuel Storage Area

GW02 - About 1000 ft SE of the Sherman Field Fuel Storage Area

GW03 - About 1000 ft NW of the beginning of Runway 18

GW04 - About 500 ft N of the FAA Radar Building

GW05 - About 1000 ft N of the Sanitary Landfill

GW06 - About 100 ft N of the Sanitary Landfill

GW07 - In the southern portion of the Sanitary Landfill

GW08 - In the northern portion of the Sanitary Landfill

GW09 - About 1000 ft NW of the Sanitary Landfill

GW10 - Adjacent to the seventh fairway of the west golf course about 700 feet from the Sanitary Landfill

GW11 - About 1000 ft S of the Sanitary Landfill

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groundwater levels in the vicinity of the landfill rose one to four feet, and attributes these rises to the plugging of a drain to control leachate emission and to a general increase in groundwater levels that might be attributed to increased infiltration in the vicinity of Well No. 7 and Well No. 8. These wells show an increase of over four reet, while the well farthest removed from the landfill (No. 11) shows an increase of less than 1/2 foot. The underdrain was unplugged, but no subsequent groundwater level measurements were located to verify or disclaim any of tnese possibilities.

Dawkins and Associates, Inc., looked into the feasibility of spreading waste water on the two NAS Pensacola golf courses. They reported that the depth to the groundwater level on the project site was definitely related to the surface topography and the elevation, in that the groundwater level approximates mean sea level in the investigated area and varied in depth below the surface from 1.3 feet to 24 feet. The majority of the groundwater movement from the site was lateral toward Bayou Grande, with some vertical movement. The locations of the borings for this investigation are shown on Figure 5-21, and Table 5-8 presents the water levels at the time of drilling. Three monitoring wells (4-inch diameter open PVC standpipe, with cap) were installed, but no subsequent measurements were made and the wells have since been destroyed.

Missimer and Associates, Inc. are evaluating groundwater contamination from the IWTP Surge Pond (1981a, 1981b, 1982). The available reports described the groundwater monitoring system to be installed, but no data are available which describe the system "as built." The initial report stated, "The downgradient wells are positioned to detect groundwater contamination from the surge pond. Well spacings were selected by using a simplified numerical analysis of flow induced by the positive head in the pond. The single upgradient well is located on the other side of the tidal inlet to Bayou Grande. This is a different surface water basin; one that is noc impacted by the treatment plant operation at shallow depths." The second report deals with the regional hydro-geologic framework and attempts to relate these aata to the IWTP Surge Pond location. Three very significant points are set forth in this report.

One, "apparently predictions of groundwater contamination cannot be quantified with regional information. Site specific testing is required to derive accurate hydraulic coefficients and to define the geologic framework to properly use the number. He (Trapp, 1973) interpreteu this (many shallow wells, 100 feet deep, had abnormally high water levels as indicative of perched conditions. These were the result of the numerous clay lenses that occur in the aquifer. Again, this clearly verifies the need for site specific data in assessing groundwater pollution problems."

This point should be the cornerstone for the development of any monitoring system, and data collected should become **a** part of the report detailing the "as-built" system.

The second point is that the IWTP is underlain by a confining clay layer from a depth of *40* to 60 feet. This conclusion was apparently based on a log of a test hole drilled at the IWTP. This log appears to be taken from earlier work at the IWTP (NFEC-SD, 1978) and generally agrees with the three deeper borings at the IWTP. These borings, nos. 5, 6, and 7, show **a** substantial clay layer, but additional borings may be rquired to ascertain its areal extent (see

TABLE 5-8

Water Levels at the NAS Golf Course

Boring No.	Depth to Water, Feet	Dace
1	10.5	1-20-76
2	24	1-20-76
3	6	1-20-76
4	9	1-20-76
5	13.5	1-20-76
6	9	1-21-76
6A	13.3	1-21-76
7	9	1-21-76
8	9	1-21-76
9	9	1-21-76
10	16.5	1-21-76
11	> 11	1-21-76
12	10.5	1-22-76
13	10.5	1-22-76
14	8	1-22-76
1SP	11	1-22-76
2SP	11	1-22-76
3SP	4	1-22-76

Figure 5-23 for the location of these borings, Appendix B for the boring logs, and Table 5-9 ana Figure 5-32 for the water table elevations associated with tnese borings).

The third point may be more misleading than critical. The report states "the closest water wells to the surge pond are aoout 4.7 miles." If NAS Pensacola's wells are connectea to the NAS Pensacola water supply, even though not used, this distance is shortened considerably and could affect decisions aoout the adequacy of the groundwater monitoring effort.

The last Missimer report (1982) was a finalization of the procedures set forth in the 1981a report. Two significant changes were noted. The upgradient well was moved to the north of the surge pond after it was discovered that the water table aquifer west of the tidal waterway to Bayou Grande was contaminated with petrochemicals. The final locations of the monitoring wells are shown on Figure 5-33. The second change was to alter the preferred technique of well installation from hollow-stem to solid-stem auger. Some other minor changes were accomplished, and the ground surface elevations at the monitoring wells were given.

Subsequent request for data concerning this IWTP surge pond monitoring effort resulted in obtaining groundwater elevations of 2.09, 1.99, 1.68, and 1.92 feet above MSL for DG-1, DG-2, DG-3, and UP-1, respectively, for the sampling effort of 24 November 1981.

Six monitoring wells were installed at two NAS Pensacola fuel tank farms. These wells were installed to verify future suspected leakage from the tanks. No plans for measuring the depth to, or the quality of, the water on a periodic basis exist and no record of an "as built" condition was obtained. Figure 5-34 shows the distribution of the wells around the tank farms, Figure 5-35 shows the specifications for installing the wells, and Table 5-10 contains groundwater levels at the time of installation. At least three other wells are located in the vicinity of these fuel farms, 3ut no data were availaole.

5.3.6.2.3 Migration Potential. Two requirements for pollution migration are a source and a pathway. Both'surface and subsurface pacnways exist at NAS Pensacola. The intermittent streams and drainageways of NAS Pensacola furnish short direct routes to the bays and marshes surrounding NAS Pensacola. The porosity and permeability of the surficial soils underlying the air station are such that infiltration of rainfall is rapid, runoff is minimized, and surface pollutants may be routed to the underlying water table. Table 5-11 presents the relationship between the surface soils and permeability on NAS Pensacola. Off-base subsurface migration of pollutants is enhanced by the soil permeability, the shallowness of the groundwater, and the short distance to the NAS Pensacola boundaries from any location within NAS Pensacola. The major or predominant pollutant pathway would be essentially horizontal after reacning the groundwater taole, but there is a vertical, downward component of groundwater flow (Dawkins and Associates, Inc., 1976 and Trapp, 1972). The proximity of NAS Pensacola boundaries and reported or suspected polluted groundwater areas on NAS Pensacola (Missimer and Associates, Inc., 1982; Crawrord, Kent, and Youngbert, 1975; Boettcher, 1976; and observations at the southwest tank farm during the IAS) and in Pensacola (Trapp, 1972) dictate that an acute awareness of possible subsurface pollution migration be

TABLE 5-9

Water Levels at the Industrial Waste Treatment Plant, NAS

Well No.	Ground Elevation, ft MSL	Depth to Water, ft	Ground Water Elevation, ft MSL	Date *
1*	10+	8.3 *	1.7	3 Dec 77
2	11	7.2	3.8	9 Dec 77
3	4	2.9	1.1	12 3ec 77
4	5	3.5	1.5	12 Dec 77
5	4	3.25	0.75	13 Dec 77
6	4	3.25	0.75	14 Dec 77
7	5	2.0	3.0	15 Dec 77
8	12	>16	<-4.0	16 Dec 77
9	5	3.4	1.6	13 Dec 77
10	5	3.7	1.3	13 Dec 77
11	5	3.25	1.75	19 Dec 77
12	5	2.5 **	2.5	16 Dec 77
1**	3++	1.5	1.5	17 Sep 68**
2	3	0.5	2.5	17 Sep 68
3	4	2.5	1.5	17 Sep 68

* NAVFAC Drawing No. 5055762

** NAVFAC Drawing No. 1281058

\+ Estimated from NAVFAC Drawing No. 5055758

++ Estimated from NAVFAC Drawing No. 1280158

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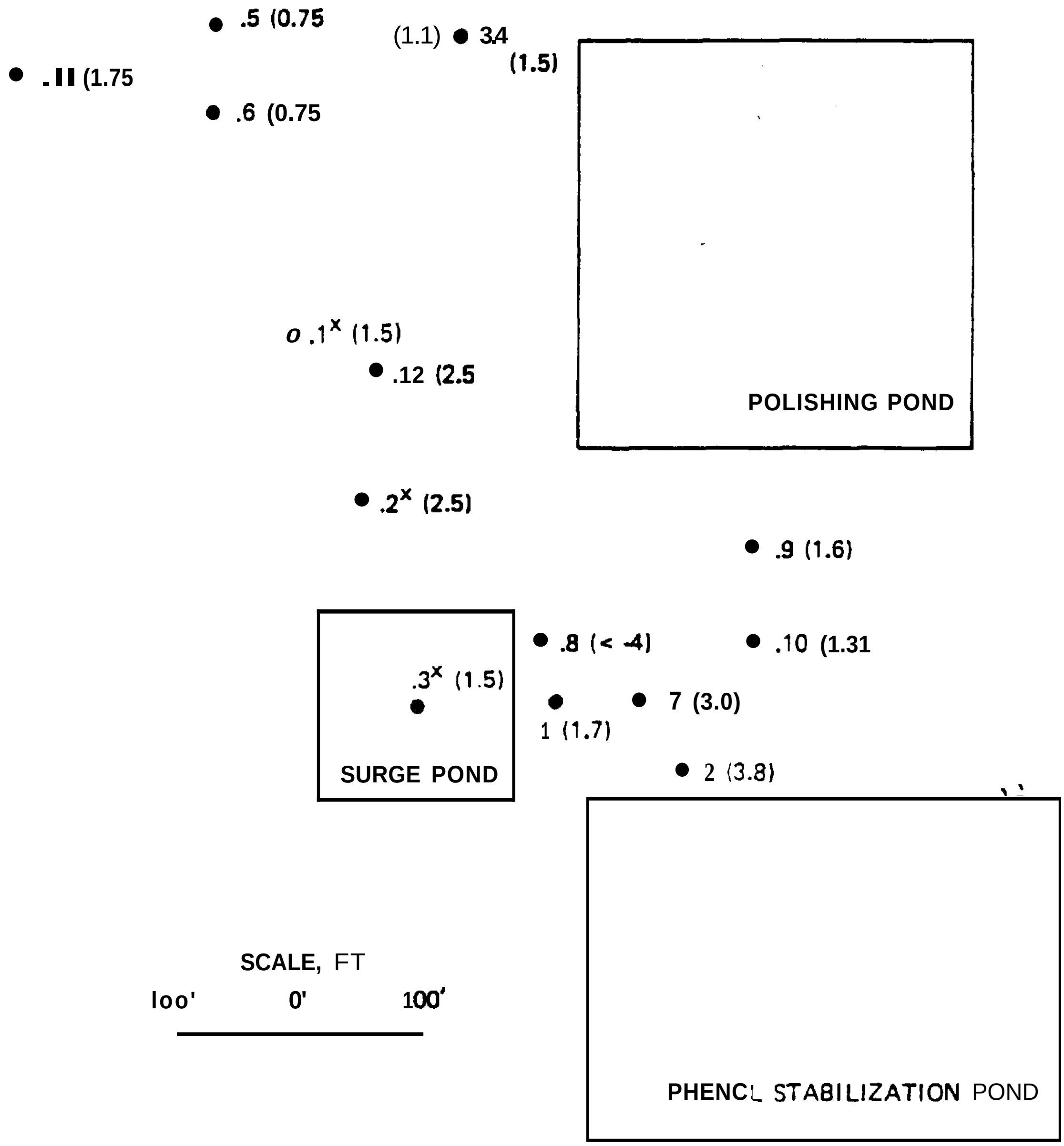

LEGEND

.1 (8.3) BORING LOCATION. NUMBER, AND GROUND WATER ELEVATION FROM NAVFAC DRAWING NOS. 5055758 AND 5055762

.1x (1.5) BORING LOCATION, NUMBER, AND GROUND WATER ELEVATION FROM NAVFAC DRAWING NO. 1281058

FIGURE 5-32 GROUND WATER ELEVATIONS AT THE INDUSTRIAL WASTE WATER TREATMENT PLANT

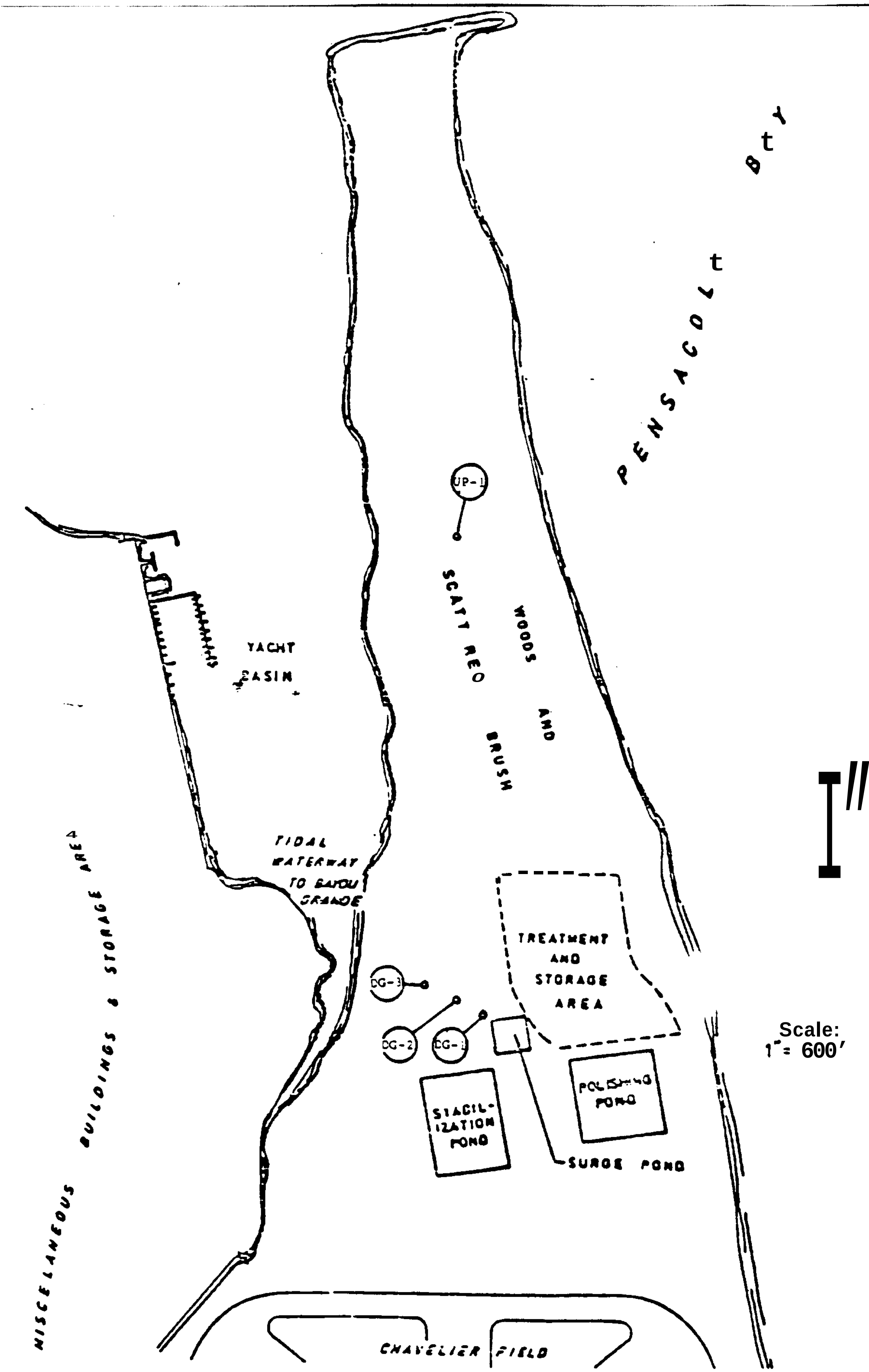

FIGURE 5-33 Monitoring wells at the IWTP surge pond

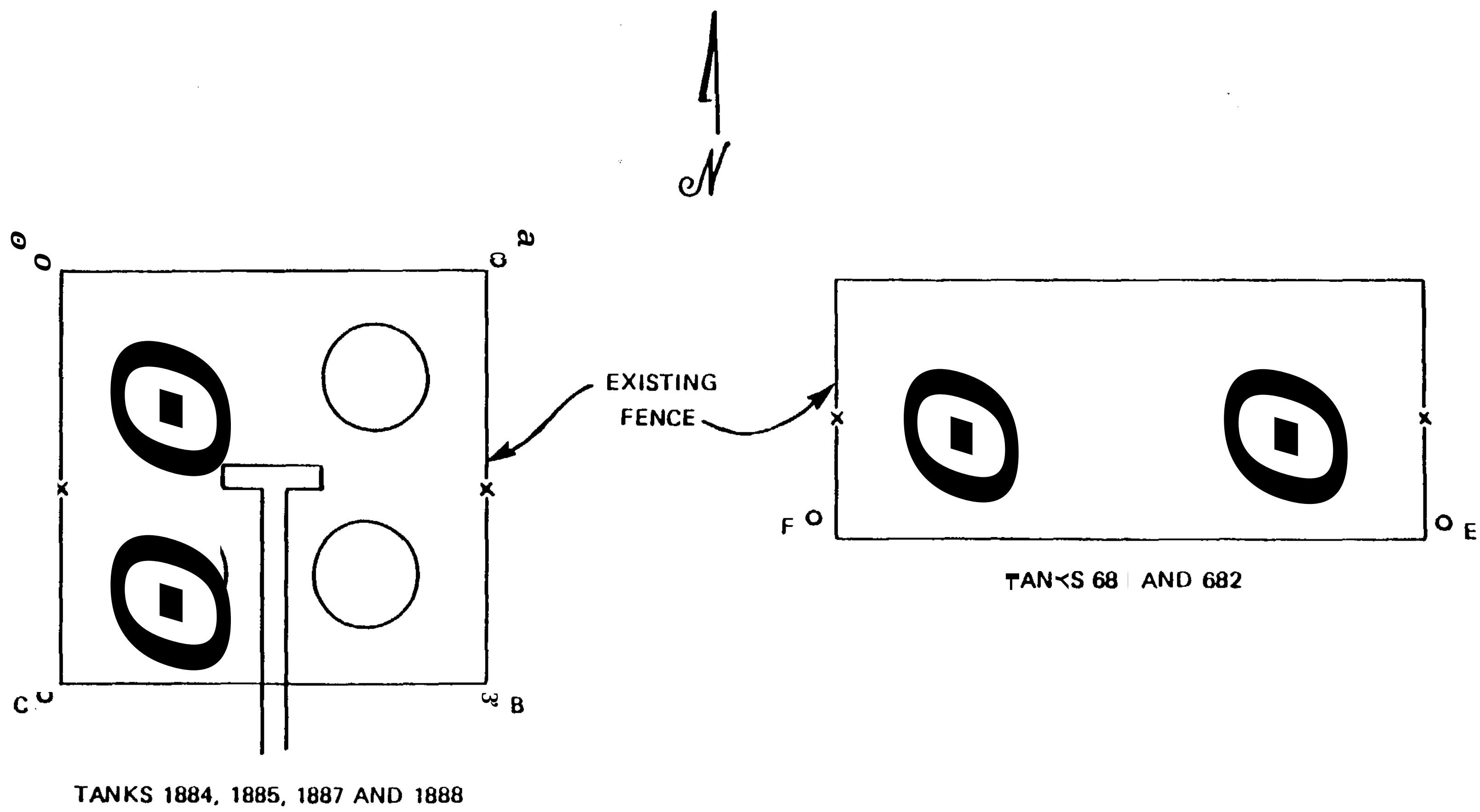

FIGURE 5-34 SCHEMATIC OF MONITORING WELL PREINVESTIGATION

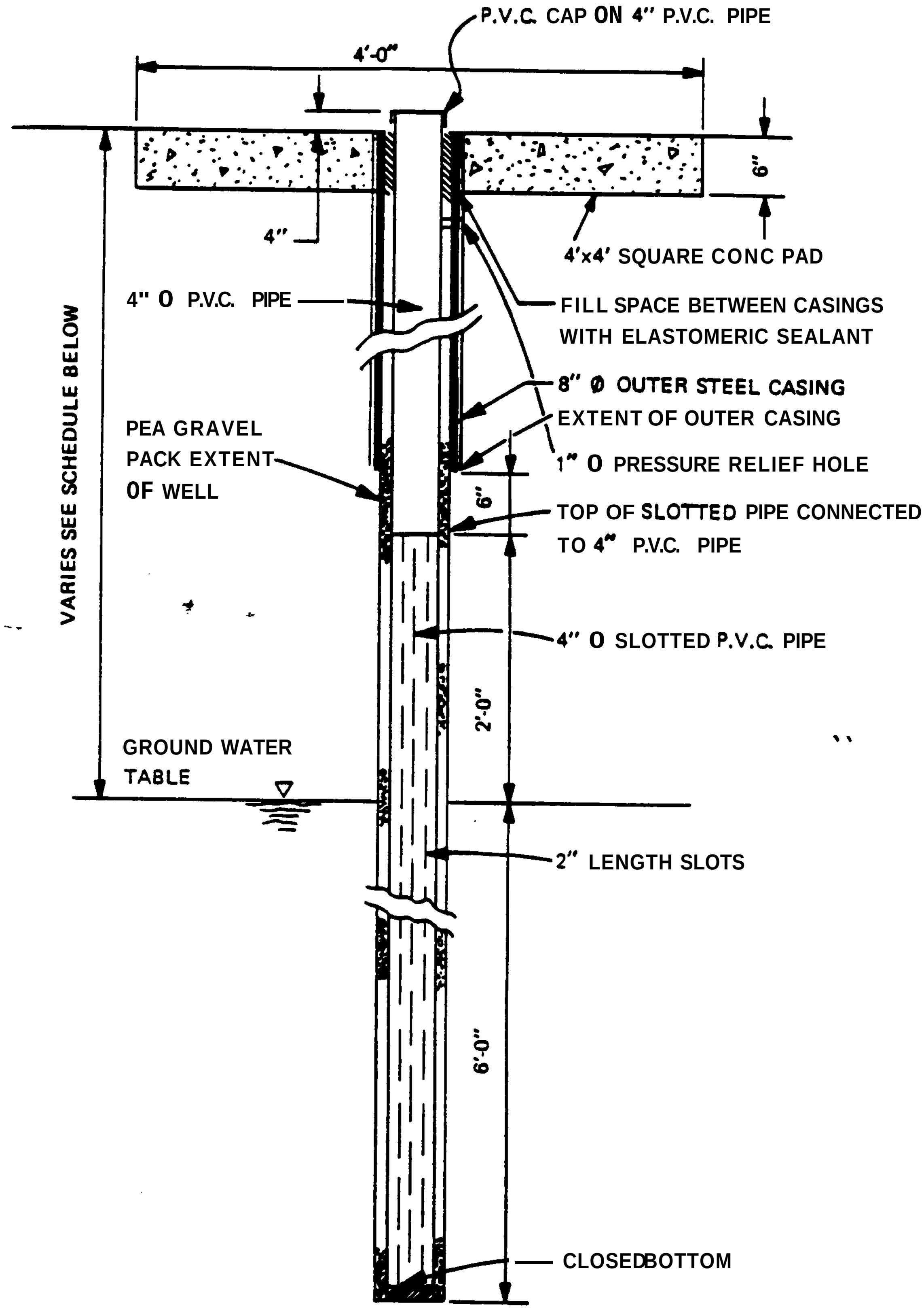

FIGURE 5-35 SCHEMATIC DIAGRAM OF MONITORING WELL

TABLE 5-10

Fuel Tank Monitoring Well Data

Well Designation	Surface Elevation, ft MSL	Depth to Water, ft	Water Elevation, ft MSL	Date
A	28.6*	3.83	24.77	June, 19
B	29.3*	5.75	23.55	June, 19
C	32.6*	5.75	26.85	June, 19
D	28.2*	3.83	24.37	June, 19
E	??	19.17	??	??
F	??	20.00	??	??

* Estimated from NAVFAC Drawing No, 5057986

TABLE 5-11

Permeability and Depth to Water of USDA Soil

Types on NAS

USDA Soil Type	Permeability, Inches of Water-perHour	Depth to Seasonally High Water Table, Feet
Lakeland	5- >10	10
Lakewood	>10	10
Leon	5- >10	1-2
Klej	5- >10	1-2
Plummer	5- >10	< 1
Rutlege	5- >10	< 1
St Lucie	--	--
Coastal Beach	>10	< 2
Tidal Marsh	Variable	0
Alluvial Land	Variable	< 1
Swamp	Variable	0
Sandy Fill	>10	Variable
Mines, Pits, Etc.	>10	Variable
Stripped Land	>10	Variable
Paved Areas	0	Variable

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maintained at NAS Pensacola. Note that no correlation between NAS Pensacola and the city of Pensacola contamination as reported by Trapp is suggested, in fact they are probably unrelated. These are simply facts that must be considered when planning NAS Pensacola activities.

5.4. BIOLOGICAL FEATURES

5.4.1 Life Zones and Ecology.

5.4.1.1 Marine and Estuarine Plant Communities. Two major marine and estuarine plant communities are found in the vicinity of NAS Pensacola--the seagrass communities and the coastal marsh. These are particularly important because of their high productivity and their role in the food chains of many marine organisms.

5.4.1.1.1 Seagrasses. Seagrasses are very important members of the marine subtidal flora. Despite the common name, seagrasses are not members of the grass family. They are vascular monocots with true roots, stems, leaves, flowers, fruits, and seeds. Characteristically, these seagrasses grow completely submerged in the saline waters with only the lowest of tides ever exposing them to air. They serve as protective nursery habitats for a number of economically important fish and shellfish species.

Turtle grass (Thallassia testudinum), shoal grass (Haladule beaudettei), and manatee grass (Cymodocea filiformis) are the most common seagrasses in the Pensacola area. Wideon-grass (Ruppia maritima), although not a true seagrass, invades brackish waters and is often mixed with seagrasses in the Pensacola area. Halophila baillonis and Halophila engelmanii have not been reported from the coastal waters of the area, but research indicates that they probably do occur there at depths of six to ten meters and more. These two species of Halophila are generally considered to be rare.

The three common seagrasses are found in sandy-bottom shallow waters of low-energy seashore sites. They occur in dense stands, called grassbeds, in very close-to-shore depths of usually not more than six feet; although Thalassia has been observed at a depth of 75 feet.

Seagrasses were formerly abundant in Escamoia Bay, Pensacola Bay, and East Bay, but have declined in these locations over the last 25 years to such an extent that now only a few scattered beds remain.

Seagrass beds are usually heterogeneous communities, with the three most common seagrasses variously intermixed. Frequently Ruppia maritima occurs with the seagrasses in places of lower salinity. The seagrass beds comprise an extremely important component of the local flora. They exhibit several significant environmental functions including:

(1) Primary production of biomass with resultant carbon fixation and oxygen production.

(2) Stabilization of bottom sediments by acting as sediment traps.

(3) Food supply for numerous animals both directly and through the detrital food webs.

(4) Haoitat for certain invertebrates which attach to or burrow inco their leaves.

(5) Refuge and protection for the immature stages of numerous seafood organisms including fishes, crabs, shrimps, ana bay scallops.

(a) Supply or an important substrate for the attachment of various species of oenthic algae.

5.4.1.1.2 Coastal Marsh. Coastal marshes are subject to the gentle daily fluctuations of the tides and are usually associated with the relatively protected bay and estuary habitats. These coastal marshes exhibit a distinct zonation of the most abundant plants in relation to inundation, salinity of the water, elevation of the substrate, and other tactors.

Three broadly discernible vegetation zones are found within coastal marshes. The outermost zone is dominated by the grass Spartina alterniflora and extends from aoout mean sea level up to level of the highest tide. Just landward of the Spartina zone and on slightly higher ground is a zone dominated by Juncus roemerianus, the black needle rush. This zone is the most extensive in the local marshes and is composed of an almost pure strand of Juncus. The third vegetational zone is characterized by the grasses Distichlis spicata and spartina patens. This zone is aoove the high tide lines and normally is inundated by sea water only during storm conditions.

Distriouted throughout the higher areas or the coastal marsh are a number of heroaceous dicots, such as sea lavender (Limonium carolinianum), marsh fleabane (Pluchea purpurascens), and salt-marsn aster (Aster tenuifolius).

Other grasses commonly found here are salt jointgrass (Paspalum veginatum) Virginia dropseed (Sporobolus virginicus), and reedgrass (Phragmites communis). Common in and around the salt barrens of tnese marsnes is glasswort (Salicornia perannis).

Just landward of the marsh is usually located a zone or shrubs that commonly include was myrtle (Myrica cerifera), ground-sei bush (Baccharis halomifolia), marsh elder (Iva frutescens), and yaupon holly (Ilex vomitoria).

5.4.1.2 Terrestrial Plant Communities. Four major terrestrial plant communities are found within southeastern Escambia County. The two forms prevalent at NAS Pensacola are the coastal strand and the scrub communities. In tne areas surrounding the NAS Pensacola installation, the flatwoods and sandhill plant communities dominate, although these two communities may occur within the installation boundaries where local environmental conditions favor their occurrence.

The basic vegetative cover at NAS Pensacola consists of grasses (Gramineae sp.) kudzu (Pueraria thunbergiana), a[illegible] pine (Pinus sp.). Some annual legumes are present throughout tne area such [illegible] Lespedeza sp. and vetch (Vicia sp.). The golf courses are extensive grassy [illegible]eas comprising about 135 acres of the 5,161 acres at NAS Pensacola.

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5.4.1.2.1 Coastal Strand. The coastal strand is characterized by extensive white-sand beaches and adjacent dune systems. The most noticeable feature of the vegetation is the distinct zonation which is observed as one travels inland from the seashore. Research has shown the primary causal factor for this zonation is the action of salt spray on the vegetation.

The soils here are composed of incoherent sand which make up the famous gleaming white sands of Pensacola beaches. The substrate is extremely infertile due to rapid leaching. Consequently, the plants which occur here have extensive outsized root systems.

The well-known sea oats (Uniuola paniculata) dominate the treeless, primary dunes area just inland from the beach strip, forming a characteristic zone. Associated witn sea oats in this zone are the sea rocket (Cakile edentula), beach pennywort (Hydrocotyle bonariensis), seaside evening primrose (Oenotnera humifusa), beach morning-glory (Ipomoea stolonifera), and dune mile pea (Calactia microphylla).

Another zone, characterized by shrubs, usually extends inland from the sea oats zone. Here the woody goldenrod (Chrysoma pauciflosculosa), conradina (Conradina canescens), and the unusual dune rosemary (Ceratiola erocoides) can be found. Outstanding in this shrub zone are low dense clumps of twin Live oak (Quercus geminata). Here, due to action of the salt spray, this plant, which is usually designated as a tree, is reduced in the form to that of a gnarled shrub. The dune golden aster (Chrysopsis anguina), the dune milkweed (Asclepias humistrata), and jointweeds (Polygonella spp.) are also common in this zone.

Inland from the shrub zone, and far enough from the tide line that spray in minimal, forests of slash pine (Pinus elliottii) and sand pine (Pinus clausa) occur.

In some areas, there may be a secondary dune ridge inland from the primary dune ridge separated from it by an interdunal zone. These are typically low, moist swales that support plants of hydric affinity. The plants typical of these areas are not found elsewhere in the dunes, where conditions are most xeric. Usually occurring in the swales are such plants as redwood (Lacnanthes caroliniana), bladderwort (Utricularia spp.), yelloweyed grasses (Xyris spp.), umbrella grass (Fuirena scripoidea), and bog buttons (Lacnacaulon englerii).

5.4.1.2.1.1 Ecology. Strand communities expend a considerable portion of their energy budget in adapting to the severe stresses of shifting sands, a highly saline environment, and high winds. In some instances, salt spray plays a role similar to fire in other ecosystems by retarding succession indefinitely at a grass or shrub state.

Because these plants are so highly specialized to withstand these natural stresses, they are highly sensitive to stresses not found in their natural environment. The effect of trampling or crusning is severe, and even light use of the vegetated areas may degrade them.

5.4.1.2.1.2 Value. Beaches, dunes, and their associated vegetation are important in absoroing and moderating the influence of waves and wind on coastal areas.

5.4.1.2.1.3 Vulnerability. The coastal strand is a dynamic system, advancing into the sea and receding from it according to the influences of winds, waves, currents, and changes in sea level (sea level has apparently been slowly rising over the last hundred years). These agents transport sand from offshore bar to beach to dune, and back again. They also move it up and down the coast (longshore drift), causing erosion of one beach and accretion or another.

Except for interference with the sand transport system, the sand beach itself is almost immune to man's activities. Foredune plants, however, are extremely sensitive to tne effects of four-wheel drive vehicles, motorcycles, and even foot traffic and must be protected from nearly all direct use. Backdunes are not quite so sensitive and will support light use.

5.4.1.2.1.4 Endangerment. The Florida Beach and Shore Preservation Act requires the Department of Natural Resources to establish coastal construction setback lines in all coastal counties, based upon natural processes. The act also requires the department to regulate construction undertaken for shore protection purposes.

5.4.1.2.2 Scrub. The scrub communities occur on sites which were coastal dune formations in former geologic ages. The habitat is xeric, and the soils are very infertile, being generally white sands of the Lakewood type. In general, the plants distinctive of the scrub community are also found on relatively recent coastal dunes. Here, the sand pine (Pinus clausa) is the dominant tree. Three oaks are also common. These are twin live oak (Quercus geminata), myrtle oak (Quercus myrtifolia), and chapman oak (Quercus chapmanii). Rosemary (Ceratiola ericoides) and saw-palmetto (Serenoa repens) are abundant shrubs in the understory.

5.4.1.2.2.1 Ecology. The sand pine scrub is essentially a firebased community. Ground cover is extremely sparse and leak fall is minimal, thus reducing the chance of tne frequent ground fires so importanc in the sandhill community.

Sucn fires allow for regeneration of the sand pine community, which would otnerwise pass into a xeric hammock. This type of fire regeneration usually results in even-aged stands of trees. The Ocala variety of sand pine (dominant in the peninsula) is so adapted to fire regeneration that heat (as from a fire) is needed to open its cones.

5.4.1.2.2.2 Value. This community, with its deep, loose sand, is typically a valuable aquifer recharge area. It is of considerable scientiric value because of its endemic species of wildlife, its unique ecology, ana the example it presents of ecosystem response to heat stress.

5.4.1.2.2.3 Vulnerability. The scrub is vulnerable to erosion and root damage caused by foot and mechanized traffic. The most importanc consideration, however, is proper management by maintenance of the fire schedule or other means such as clear cutting.

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5.4.1.2.2.4 Endangerment. Scrub communities are rapidly being lost to real estate development because of their ideal, well-drained upland situation. Scrub communities should be considered highly endangered.

5.4.1.2.3 Flatwoods. Flatwoods vegetation occupies areas whicn were ocean bottoms in past geologic ages. The terrain of the flatwoods is generally level with no appreciable contours of elevation. The appearance is that of a flat expanse of forested land, with the longleaf pine (Pinus palustis) being the dominant tree. Subdominant species in these forests are the slash pine (Pinus elliottii) and the saw-palmetto (Serenoa repens) which grows in prominent thickets in the understory. Such flatwoods comprise a major part or the southern pine forests of the United States.

The flatwoods soils contain little organic matter and are quite sandy in composition. The flatwoods are Characterized by a very shallow water taole and generally poor drainage. In places, the soil is almost continuously moist and there are frequently areas that have shallow standing water throughout tne year.

The low swampy depressions of the flatwoods are usually inhabited by strands of pond cypress (Taxodium ascendens), an interesting deciduous conifer closely related to the bald cypress. Usually associated there with the pond cypress are the buckwheat tree (Cliftonia monophylla), swamp cyrilla (Cyrilla recemiflora), and other hydric species. The latter two trees, together with ocher usually riparian species, are found also along the many small creeks and dainage courses whicn are typical of such flatwoods.

Open savannah-like areas also occur in the flatwoods nabitats. In these moist, acid sites, a number of interesting herbaceous plants occur. Of,, particular note among these are the following insectivorous plant: butterworts (Pinguicula spp.), pitcher-plants (Sarracenai spp), sundews (Drosera spp.), and bladderworts (Uticularia spp.). Also characteristic of these sites are the golden crest (Lophiola americana), the rush featherline (Pleea tenuifolia), false blazing star (Carphephorus pseudo-liatris), and various milkworts (Polygala spp.).

5.4.1.2.3.1 Ecology. Fire and water are the two main determinants in the ecology of flatwoods. Fire is instrumental in reducing competition trom hardwoods, but it generally does not occur often enough to kill the young, fire-sensitive slash pines.

The longleaf pine is particularly well adapted to fire and is immune to ground fires at almost all stages of growth. In fact, successful natural regeneration or longleaf pine is dependent on fire to provide a suitable seedbed for germination and to control brown spot disease, wnich causes heavy seedling mortality.

5.4.1.2.3.2 Value. The naturally high net productivity of flatwoods, particularly slash pine flatwoods, is conducive to lumber production and is a significant source! or wood for man's use.

5.4.1.2.3.3 Vulnerability. Flatwoods and fairly resilient ecosystems, but alternation of fire or water patterns can drastically change their species composition. Removal of fire results in succession to different types of hardwood communities, depending on the water stresses of a particular site.

5.4.1.2.3.4 Endangerment. Because of the vast area they cover (30 to 50 percent or the state), their natural resiliency, and their desirability as a renewable source of wood, their endangerment is not high when compared with other systems.

5.4.1.2.4 Sandhill. In general, the sandhill community is the most abundant vegetation type of South Escambia and Santa Rosa Counties. Soils are dry, slightly lower in fertility than the flatwoods soils, and contain a considerable amount of grayish sand.

Sandhill vegetation is 'dominated by the longleaf pine (Pinus palustris). Next in abundance is the turkey oak (Quercus laevis). This common tree displays the uncommon property of holaing its leaves in such a way that the blade surfaces are perpendicular to the ground, a characteristic which produces a distinctive ragged appearance. Bluejack oak (Quercus marilandica), post oak (Quercus stellata), and southern red oak (Quercus falcata) are also typical inhabitants or sandhill communities. Laurel oak (Quercus hemisphaerica) and live oak (Quercus virginiana) may also be found here. However, these two species do not acnieve their maximum stature nor fullest development in the sandhill environment.

The wild persimmon (Diospyros virginiana) and the Pensacola hawthorn (Crataegus lacrimata) are common on tne sandhill and are good indicators of this community. Low-growing clumps of saw-palmetto (Serenoa repens) are also common in the sandhill pine sorests.

Of the many heroaceous plants rouna in the sandhill community, two are particularly noteworthy. These are the bracken fern (Pteridium aquilinum) ana wire grass (Aristida stricta). The bracken fern is the most abundant fern in tne area and is particularly resistant to fire. It is one of the pioneer plants to reappear wnen a sandhill forest has been burned.

Wire grass is so named because of its long, narrow, wiry leaves. This perennial species is particularly abundant in the longleaf pine forests and is also remarkaoly resistant to fire. In fact, it is dependent upon periodic burning for optimum growth. This grass seldom produces seeds; it reproauces rarely and has a life span of several hundred years.

5.4.1.2.4.1 Ecology. Fire is the dominant factor in the ecology of this community. The interrelationships of the sandhill vegetation, particularly the longleaf pine–wiregrass relationship, are dependent on frequent (every two to five years) ground fires. Longleaf pine is very sensitive to hardwood competition. Wiregrass plays a role in preventing the germination of hardwood seeds and in ensuring that there is sufficient fuel buildup on the floor of the community to carry a fire over large areas.

After fire, heat ana drought are the dominant influences on the sandhill community, with many plants expending considerable portions of their energy budget to aoapt to these factors.

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The burrowing habits of many of the animals play a significant role in recycling the easily leached nutrients to the surface. Without these animals, additional nutrients would be lost from this system and added to others (ponds, for instance).

5.4.1.2.4.2 Value. Almost all rainfall in this community goes directly into the underlying aquifer, making it an important groundwater recharge area. There is little runoff to the sea and minimal evaporation, because of the rapid percolation of rainfall through the soil.

5.4.1.2.4.3 Vulnerability. Elimination of fire over a long period of time is a major means of changing this community by allowing succession to a xeric hammock.

A significant feature of the sandhill community, which greatly increases its sensitivity, is tne apparent inability of wiregrass, a key plant in sandhill ecology, to withstand disturbance. Once removed from an area, wiregrass will not return for at least one hundred years and may never return.

5.4.1.2.4.4 Endangerment. In all areas, developers take advantage of these high, well-drained sites for construction of housing developments. The agricultural and urban developments may result in greatly increased erosion and movement of nutrients into ponds, thereby increasing their rate of eutophycation.

5.4.1.3 Fishes. The most common fish species in the Pensacola area are reported as follows:

Black Mullet	Mugil cephalus
White Trout	Cynoscion arenarius
Speckled Trout	Cvnascion nebulosus
Atlantic Croaker	Micropogen unaciatus

Commercial fishing and shrimp harvesting are conducted regularly in Pensacola Bay.

5.4.1.4 Other Marine Organisms. Reportely, few species of clams (Bivalvia) occur in Pensacola Bay, Escambia Bay, and East Bay. Scallops (Filibranchia) are not found in the area; scallops are generally found in more brackish waters. Oysters (Eulamellibranchia) and shrimp (Natantia) are present in the bays. Oyster harvesting occurs in the winter in areas of East Bay and Escambia Bay approved by the Florida State Department of Natural Resources. Shrimp harvest occurs in the summer throughout the area.

5.4.2 Rare, Threatened, and Endangered Species. The U.S. Fish and Wildlife Service protects federally-listed animal and plant species under the Endangered Species Act of *1973* (Public Law *93-205*, as mended) and, under Section 4 or the Act, associated critical habitats. A list of federally-protected endangered and tnreatened species is updated and published annually in the Federal Register, most recently on 27 March 1981.

In classifying animals and plants, the Fish and Wildlife Service identifies endangered species as any species which is in danger of extinction throughout all or a significant portion of its ra: .. A species may be endangered because of the destruction, drastic moc .ication, or severe curtailment of its habitat, or because of over-exploitatioc, disease, or even unknown reasons. Species that occur in very limited areas, such as those known from tne type locality only, or those which grow in restricted fragile habitats, usually are considered endangered. A species threatened is one likely to become endangered within the foreseeable future throughout all or a significant portion or its range.

In addition to federally-listed, the Florida Environmentally Endangered Lands Plan designates a number of resident plant species as rare, threatened, or endangered. The Florida Environmentally Endangered Lands Plan was prepared by the Florida Department of Natural Resources in compliance with the directives of the Land Conservation Act of 1972 (Chapter 259, Florida Statutes).

A rare species, subspecies or local population, though not presently endangered or threatened, is potentially at risk because it is only found within a restricted geographic region or habitat or is thinly scattered over a more extensive range.

The Florida Game and Fresn Water Fish Commission designates a number of species as endangered, threatened, and species of special concern. Species of special concern are forms that do not clearly fit into the categories of rare, threatened, or endangered, yet which warrant special attention. Included are forms that, although presently relatively abundant, are particularly vulnerable to certain types of exploitation or environmental modifications and have experienced long-term population decline ana forms whose status in one area, in this case Florida, may have significant impact on endangered or threatened species elsewhere.

A species may also be designated as having undetermined status. Undetermined means that the species, subspecies, or local population is suspected of falling in the category of rare, threatened, or endangered but the available data does not provide an adequate basis for a decision.

5.4.2.1 Rare, Threatened, or Endangerea Plant Species. Appendix C lists Florida's endangered and threatened plant species. The list was compiled by the Florida Game and Fresh Water Fish Commission,

5.4.2.2 Rare, Threatened, or Endangered Species of Animals. On 30 May 1979, representatives of the Florida Game and Fresh Water Fisn Commission visited NAS Pensacola to review the area for possible endangered or threatened species critical habitat. As a result of the survey, it was concluded that "no potential critical habitat for currently listed endangered or threatened species occurs on the station" and that "it is very douotful that any portion of the station will ever be designated critical habitat for any species currently listed on the federal list."

Reportedly, an American alligator (Alligator mississippiensis) has been observed in one of the installation golf course ponds.

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Appendix D lists endangered and potentially-endangered animal species in Florida. The list was compiled by the Florida Game and Fresh Water Fish Commission.

The following are the federally listed species that are possible for the NAS Pensacola are:

Birds

Arctic peregrine (Falco peregrinus tundrius)--Endangered
Brown Pelican (Pelecanus occidentalis)--Endangered
Red-Cockaded Woodpecker (Picoides borealis)--Endangered

Reptiles

American Alligator (Alligator mississippiensis)--Threatened
Green Turtle (Chelonia mydas)--Endangered
Loggerhead Turtle (Caretta careteal--Threatened

Mamma1s

Perdido Bay Beach Mouse (Peromyscus palionotus trissyllepsis)

Appendix E describes these species. The descriptions were prepared by the United States Department of the Interior, Fish and Wildlife service, Jacksonville, Florida. Information on habitats, ranges, reasons for current status, and recovery plans is included.

5.4.3 Water Quality.

5.4.3.1 Surface Water Classification. According to tne State of Florida Department of Environmental Regulation's Gulf Breeze Office, the coastal waters surrounaing NAS Pensacola are classified as Class III waters.

The Rules of the Department of Environmental Regulation of the State of Florida defines Class III waters as "waters to be usea for recreational purposes, including such body contact activities as swimming and water skiing; ana for tne maintenance of a well-balanced fish and wildlife population." Criteria for classification of coastal waters are given in Appendix F.

Class II waters are areas which either actually or potentially have the capability of supporting recreational or commercial shellfish propagation and harvesting. Harvesting may occur in areas approved by the State of Florida. Chapter 350, Florida Statutes, defines the term shellfish as follows: "shellfish shall include oysters, clams, and whelks."

5.4.3.2 Fish Kills. Fish kills occasionally occurred along the waterfront industrial area of NAS Pensacola during the 1940s, 1950s, and 1960s. The quantity of fish killed or how often the fish kills occurred was not reported in detail. The cause of the fish kills was not reported. Wastes from the waterfront industrial activities may have contributed, but fish kills are known to have occurred near other industrialized areas near the city of Pensacola.

Reportedly, fish kills occurred along the waterfront areas near buildings 71, 72, 73, and 104. In the 1940s and 1950s, paint strippers and solvents emptied into the bay turned the water a cloudy yellow color. The discoloration of the water reportedly extended about 40 feet up and down the waterfront industrial area. Degreasers were reported to have been discharged into the bay; overflow from cyanide tanks in Building 604A reportedly drained into the bay in the Building 104 area.

Since plating wastes could upset operation at the sewage treatment plant, cyanide and chromate wastes that were emptied into the sewer system were routed to bypass the treatment plant so they would flow untreated into Pensacola Bay.

NAS Pensacola Instruction 5100.1A of 7 Nov 1968 states NAS Pensacola policy as "cyanides shall not be dumped into sanitary or storm sewers. When cyanide dumps are required, the chemical will be transferred to metal drums and carried out to sea where the drums shall be disposed of beyond the 12 mile limit." After that date, liquid wastes containing cyanide were disposed of according to that instruction.

In 1969, a fish kill incident received local public attention. The following information was stated in a 9 September 1969 memorandum from Head, Process Department, to Head, Production Department:

On 13 and 14 August 1969, approximately 30 gallons of cadmium plating solution spilled when the contents or a plating tank were transferred into drums. Since the solution had 10 ounces sodium cyanide per gallon of sollution, the spillage represenred 18 pounds of sodium cyanide. The spillage went into the storm drain and then into the bay near Building 104,

On 13 August 1969, about 146 gallons of chromic acid solution were emptied into the storm drain. Since the concentration of chromic acid is five ounces per gallon, tnis represents 46 pounds of waste.

The following information was stated in a 19 September 1969 memorandum from Code 60 to Code 41;

About 75 to 100 dead fish, mostly small needlefish, croakers, and one small speckled trout, were seen near tne storm sewer outfall in back of buildings 71 ana 104. The water was tinted a green color.

The following information was stated in a letter from the Executive Director of the State of Florida, Department of Air and Water Pollution Control, to the Commanding Officer of NAS Pensacola on 15 September 1969:

"Investigations or this incident by the Board of Conservation and Bureau of Sanitary Engineering revealed that approximately 1,000 fish were killed. They included speckled trout, mullet, pinfish and other species..."

"Cyanide and chromium were present in the waters surrounding the fish kill in amounts which grossly violated the water quality standards of the State of Florida."

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Quotations from the Executive Director's letter appeared in the "Pensacola News" newspaper.

Record search at NAS Pensacola revealed a draft letter apparently written in response to the Executive Director's letter. Whether the draft letter was finalized and sent was not determined during the IAS.

The draft letter included this information:

"Navy records of the results of chemical analysis immediately after the incident snow the following:

	Building 104	Building 72
pH	8.4	8.4
Temperature	28.0°C	28.0°(82.4°F)
Dissolved oxygen	6.3 ppm	6.6 pprn
Total chromates	.25	.10 ppm
Cyanates	0.0 ppm	2.4 ppm

Florida standards allow the following:

Cyanates	0.0 pprn
Total Chromium	1.0 ppm

"Navy investigation indicates the most probable cause for the increase in cyanate in the Building 72 area might have been the result of rinsing or spillage in the transfer of electroplating solution from tanks in the vicinity of Building 104."

"None of the quarterly reports sent to the State since 1965 have previously shown any presence of cyanates."

The industrial waste treatment plant became operational in the early 1970s; plating wastes are now diverted to this treatment facility.

5.5 **LEGAL, ACTIONS.** Until 1981, there had not been an:: environmentally related legal actions initiated against the Navy at NAS Pensacola. In August of 1981, the Navy was sued for property damage resulting from disposal of hazardous wastes on the property of a local private cocpany. The resulting federal tort claim concerned the alleged disposal of industrial waste sludge containing hazardous materials in a pit at a sand quarry in the city of Pensacola. Alleged disposal was claimed to have occurred in July of 1977. In that year, a local sand company was under contract to naul industrial wastes from NAVAIREWORKFAC Pensacola to a proper disposal site. An investigation by the Staff Judge Advocate's office resulted in the conclusion that no Navy wastes were disposed of at the sand quarry. An investigation of the chemical composition of wastes found at the sand quarry turned up evidence that NAVAIREWORKFAC Pensacola wastes were not disposed or there. Compounds in the pit were traced, however, to a local chemical company. Settlement of the case is still pending.

Records in the Judge Advocate General (JAG) files contain reports or NAVAIREWORKE'AC wastes disposed of at three other sites. One site, owned by a local sand company, is located behind the company's office at Saufley Field. The company had a permit to dispose of only domestic wastes at this dumpsite, but some of their drivers admitted hauling in NAVAIREWORKFAC wastes containing hazardous compounds. In another JAG investigation in May of 1981, two sites in Myrtle Grove were reported to be NAS Pensacola disposal sites. A local sewage pumping company had a two-year contract with NAS Pensacola for sewage disposal in 1975 and 1976. It was reported that wastes were deposited in a pit where a building is now situated. Also, it was reported tnat wastes were dumped along a street in Myrtle Grove.

The NAS Pensacola Legal Services Office has interviewed contractor truck drivers who admit hauling wastes to the above mentioned locations.

5.6 ADJACENT LAND USE. On the eastern side of NAS Pensacola, a new parcel or land was created as a result of dredging operations conducteu in Pensacola Bay between 1958 and 1959. This site is located at H-26 on the the NAS Pensacola General Development Map, and is illustrated on Figure 5-3e. This dredge spoil disposal area, approximately 63 acres, is not on NAS Pensacola property, but is owned by the State of Florida. The boundary Line between Florida property and U.S. Navy property is not marked, out the two properties have an adjacent boundary somewhere on the dredge spoil area.

The material disposed or at this site consisted exclusively of dredged sediments from Pensacola Bay amounting to about 10 million cubic yards. The sediments of Pensacola Bay are suspected to contain contaminants from industrial operations (see Section 6.6.2). Therefore, it is suspected that the dreaged material deposited here may contain similar concentrations of contaminant materials.

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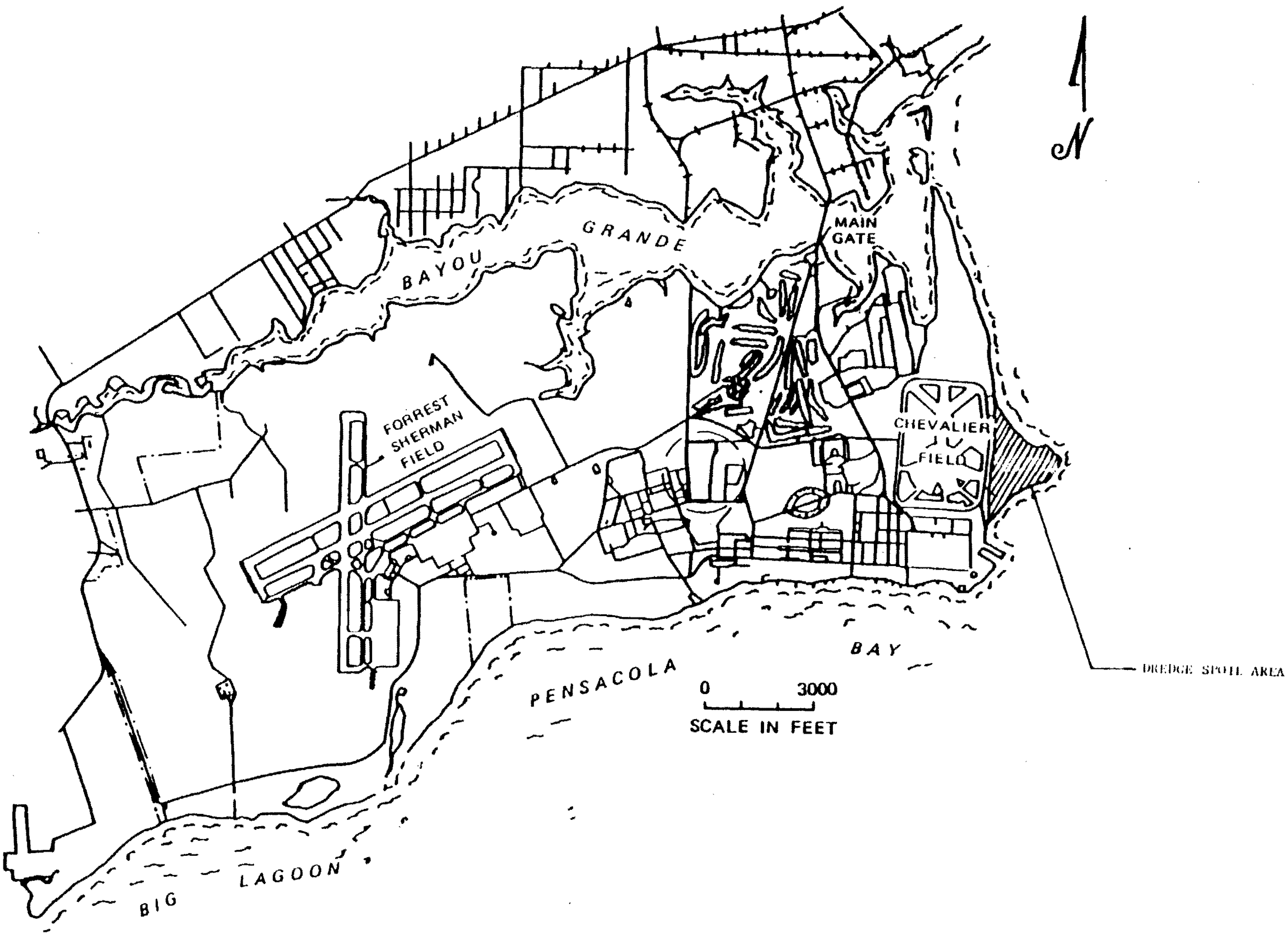


FIGURE 5-36 LOCATION OF THE DREDGE SPOIL FILL

6.1 GENERAL. This section describes the operations at NAS Pensacola that utilized hazardous materials, wastes generated by each operation, periods or operation, and quantities of materials disposed of. Where a lack of information on waste generation existed, engineering judgement was applied where necessary to estimate quantities of waste. Information included here provides tne documentation upon which sections 2, 3, and 4 are based.

b.2 OPERATIONS, ORDNANCE.

6.2.1 Ordnance at NAS Pensacola. Since 1922, the mission of NAS Pensacola has been primarily one or flight training, consequently, use of live ordnance has been limited.

Ordnance manufacturing, loading, or rework operations have never been conducted at NAS Pensacola. Replacement and rework of non-weapons, aircraft-related ordnance items has been done at NAVAIREWOWAC Pensacola.

Storage of certain kinds of ordnance items has taken place over the years. These were stored primarily for training purposes or for use in case of national emergency.

6.2.2 Ordnance Usage. From about 1920 to about 1942, a machine gun and rifle firing range existed at the present location of the Public Works Center, buildings 3560 and 3561. Figure 6-1 shows the location of this firing range at that time. Ordnance usage at this site was limited to small arms and .50 caliber ammunition. About 1942, the rifle range was converted to a pistol range. Only small-arms ammunition was used there after that date. In 1953, when Forrest Sherman Field was built, a firing range was built near one or the runways. This range was used for test-firing aircraft armaments. It was reported that .30 caliber, .50 caliber, and 20mm rounds were fired here. Figure 6-1 shows the location of this firing range. About 1965, this firing range was converted to a pistol range. The pistol range is now'closed. Only small arms ammunition was used there after that date.

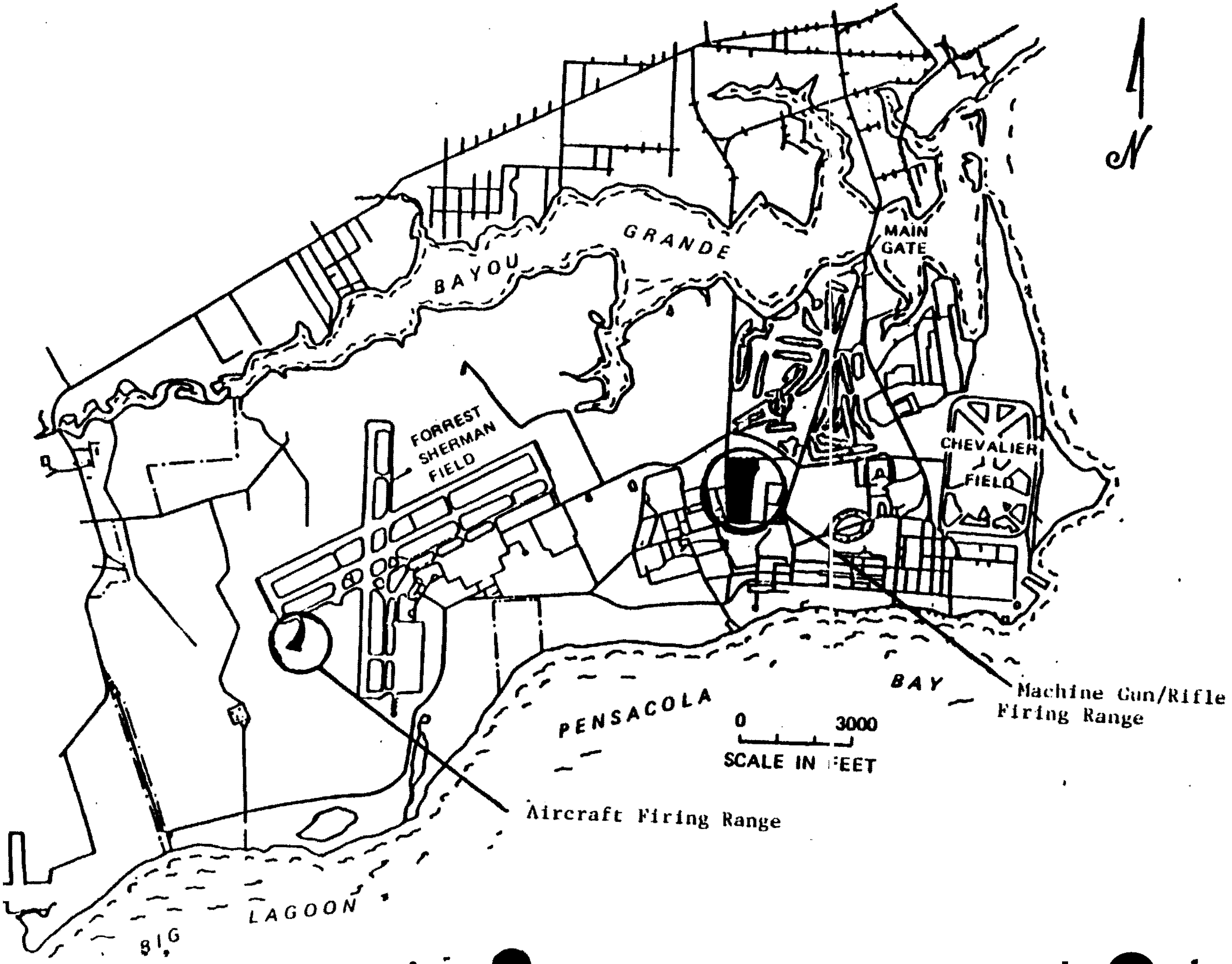
6.2.3 Ordnance Storage. Ordnance items have been stored on the grounds of the NAS Pensacoia complex in 17 magazines; the locations are shown in Figure 6-2. The contents of-each magazine during different time periods are listed in Table 6-1. The first three magazines were built on Magazine Point in 1937, seven more were built between 1940 and 1943. In 1956, shortly after the construction of Forrest Sherman Field, six more magazines were built adjacent to that field. One aaditional magazine was built at Forrest Sherman Field in 1969.

The types of ordnance stored at Pensacola Naval Complex are as follows:

(1) Bulk Smokeless Powaer--a propellant for projectiles fired from guns.

(2) Small Arms Ammunition--rifle and pistol ammunition in ready storage.

(3) Pyrotechnics--signal flares, illuminating flares, smoke generating devices, and dye markers.


BAYOU
GRANDE
MAIN GATE
FORREST SHERMAN FIELD
CHEVALIER FIELD
PENSACOLA
BAY
BIG LAGOON
0 3000
SCALE IN FEET
Machine Gun/Rifle Firing Range
Aircraft Firing Range

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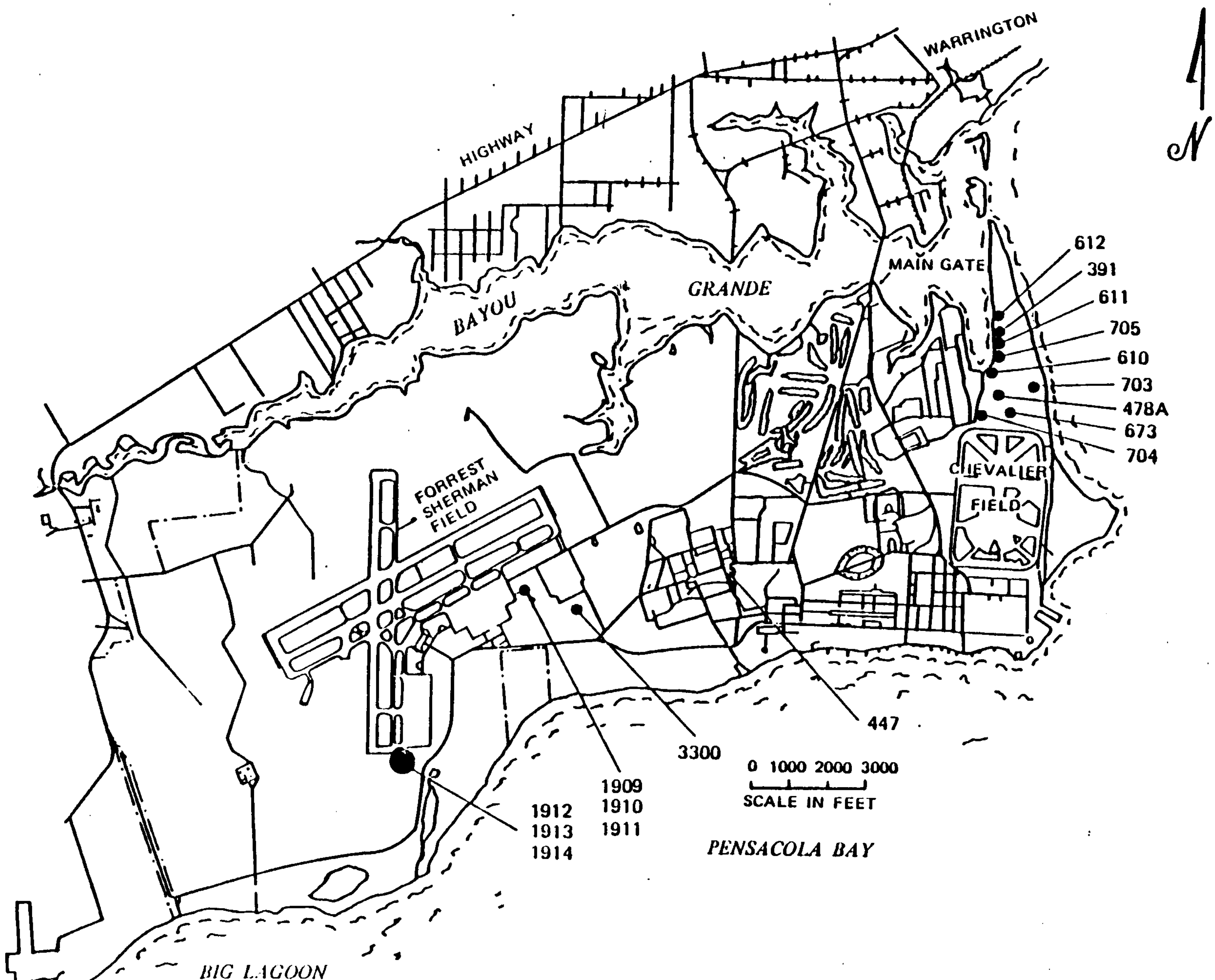

FIGURE 6-2 ORDNANCE STORAGE LOCATIONS

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BLDG. NO.	YEAR BUILT	DESIGN TYPE	CAPACITY/LB.	STORAGE ASSIGNMENT 1969-1971	STORAGE ASSIGNMENT 1971-1980	STORAGE ASSIGNMENT 1980-Present
391	1940	Black Powder	9,000	Bulk Smokeless Powder	Black Powder	Black Powder
1447	1941	Smokeless Powder 6 Projectile	Physical Capacity	Small Arms Ammunition	Small Arms Ammunition	Small Arms Ammunition
478A	1942	Inert Storage	N/A	Inert	Inert	Inert
610	1937	Smokeless Powder & Projectile	5,000	Small Arms Ammunition	Smokeless Powder	AEPS Kits 6 Overage Ordnance
611	1937	Smokeless Powder 6 Projectile	5,000	Pyrotechnics	Pyrotechnics	Pyrotechnics
612	1937	High Explosive	15,000	High Explosives, 20mm	Smokeless Powder	Rocket Motors
673	1941	Smokeless Powder 6 Projectile	20,000	High Explosives, 20mm	Smokeless Powder	CADS Kits
703	1941	Sinall Ariiis	Physical Capacity	Small Arms Ammunition	Small Arms Ammunition	Small Arms 6 50 Caliber
704	1943	Fuse 6 Detonator	5,000	Fuses & Detonators	Smokeless Powder	Fuses & Detonators
705	1943	Smokeless Powder & Projectile	5,000	Small Arms Ammunition	Pyroteclinics	CADS Kits
1909	1956	Smokeless Powder & Projectile	Physical Capacity	Small Arms Ammunition	Small Arms Ammunition	Small Arms Ammunition
[illegible]	1956	Smokeless Powder 6 Projectile	Physical Capacity	Small Arms Ammunition	Small Arms Ammunition	Small Ariiis Ammunition
1912	1956	Smokeless Powder 6 Projectile	20,000	Small Arms Ammunition	Small Ariiis Ammunition	Small Arms Ammunition
1913	1956	Smokeless Powder 6 Projectile	20,000	Small Arms Ammunition	Pyroteclinics	Small Arms Ammunition
1914	1956	Smokeless Powder & Projectile	Physical Capacity	Small Arms Ammunition	Fuses 6 Detonators	Wiot Control Ordnance
1300	1969	Smokeless Powder & Projectile	1,000	Small Ariiis Ammunition	Smokeless Powder	AEPS, CADS Kits

(4) High Explosive--20mm cannon ammunition having a high-explosive fragmentation warhead.

(5) Fuses and Detonators--various types of time fuses and initiating charges for various purposes.

(6) Cartridge Activated Devices (CAD)--small explosive charges used to separate parrs from aircraft during emergency procedures.

(7) Aircraft Escape Propulsion System (AEPS) Kits--rocket motors, fuses, and small explosive devices for ejection of the pilot from the aircraft during an emergency.

(8) Black Powder Salute Blanks--blank ammunition used for firing salutes.

(9) Riot Control Devices--tear-gas-generating devices.

6.2.4 Disposal of Ordnance Items. Overage ordnance, such as AEPS or CADS, kits were removed from aircraft after a certain design Lifetime, then stored in Building 610 while awaiting disposal by Explosive Ordnance Disposal (EOD) team. The team was called in periodically to remove the ordnance to a safe disposal area off the NAS Pensacola complex.

6.3 OPERATIONS, NON-ORDNANCE.

6.3.1 Early Industrial Operations. NAS Pensacola has been an industrial operations center since the 1800s.

Shipyard operations were conducted from about 1826 to about 1911, when the shipyard was permanently closed. Very little information was found during the records search on the type or quantity of wastes generated by the shipyard operation.

In 1914, the Navy's first permanent air station was established at the site of the abandoned Navy yard. Originally, only seaplanes were stationed at NAS Pensacola, and operations were centered along the southern waterfront areas near buildings 71, 72, and 382. In 1922, construction was initiated on a small Landing strip located where Chevalier Field now exists. From about 1922 to about 1939, ground-based aircraft, seaplanes, and airships were stationed at NAS Pensacola. Again, limited information exists concerning operations during this time period.

6.3.2 Industrial Operations at the Naval Air Rework Facility. About 1939, industrial operations were greatly expanded. Seaplane and airship operations were phased out and eliminated. Chevalier Field was expanded to its current size to accommodate ground-based aircraft and later, helicopters. The precursor to NAVAIREWORKFAC Pensacola, the Assembly and Repair Department, was formed.

Since about 1939, NAVAIREWORKFAC operations have remained essentially the same and have been the major generator of hazardous wastes at NAS Pensacola.

Table 6-2 is a list of hazardous materials used at NAVAIREWORKFAC Pensacola in 1981. The list gives a good indication of the type of hazardous materials used at the activity since about 1939.

The following sections are discussions Of past operations at NAS Pensacola. Where available from records and personnel interviews, types and quantities of waste generated are listed as well as disposal practices. Because of the lack of information, operations prior to 1939 are generally not discussed.

6.3.2.1 Foundry. The foundry, Building 26, was built in 1882. The foundry is still in operation, and no significant quantities of hazardous wastes have resulted from its operation.

6.3.2.2 Rubber Shop. Since 1961, the rubber shop has been located in Building 107. The shop was Located in Building 29 prior to moving to Building 107. The shop reworks and produces gaskets, plugs, and other plastic and rubber items used in naval aircraft. Small amounts of solvents were used, but they evaporated during the process. No significant amounts of hazardous waste were generated by this shop.

6.3.2.3 Machine Shop. Machining, cutting, grinding, and drilling of metal and fiberglass for aircraft has been performed in various buildings at NAS Pensacola since prior to 1940. Various cutting oils were used in some of these operations. Small amounts of oils cuttings, and other scrap were disposed of with the activity's garbage. Shops that generated larger quantities or waste oil had waste oil tanks adjacent to the buildings. See Section 6.5.2 for discussion of waste oil handling. Some scrap metal, especially larger pieces, was sent to DPDO for salvage. No significant quantity of hazardous waste was generated by machine shops at NAS Pensacola.

b.3.2.4 Aircraft Surface Treatment. From about 1962 until about 1978, Building 2662 housed operations to treat aircraft surfaces with Alodine just prior to painting. Approximately 10 to 15 aircraft a ueek were treated with Alodine. A batch of Alodine is made from 18.8 grams of chromic acid and 144 grams of calcium sulfate which was added to five gallons of water. About five gallons of Alodine was applied to the aircraft. The waste dripped to the Floor and ran to a drain in the northeast corner of the building. Prior to 1973 the waste flowed to Pensacola Bay; after 1973 it flowed to the industrial waste treatment plant. From 1962 to 1973, about 35,000 gallons of Alodine containing about 130 kilograms of chromic acid had flowed to Pensacola Bay. Other chemicals reportedly used at Building 2662 in 1966 include detergent, steam cleaner, paint remover (phenols), and dichloromethane; quantities used are unknown. Analysis or' a sample of the discharge from this facility taken in May 1966 is shown in Table 6-3.

In 1978, this operation was moved to Building 3557. Building 2662 is currently used for equipment and materials storage.

6.3.2.5 Paint Shops. Since about 1940, various buildings have had water-well paint booths for the painting f aircraft and their components.

Various paints have been used at NAS Pensacola since 1940. These paints include cellulose nitrate lacquer, zinc chromate, nitrate dope, acetate dope, "day glow," epoxy, and enamel. In general, waste paint cans and outdated

TABLE 6–2

HAZARDOUS MATERIALS AT NAVAIREWORKFAC PENSACOLA IN 1981

Macerial	Specificacion	Descrioción
Acetone	04–51	
Acetylene	BB–A–106	
Acid, acetic	0–A–76	
Acid, boric		
Acid, chromic	0-C-303	
Acid, Fluoboric		
Acid, hydrochloric	MIL-H-13528	
Acid, hydrofluoric	0-H-795	
Acid, nitric	0-N-350	
Acid, oxalic	0–0–690	
Acid, phosphoric		
Acid, sulfamic		
Acid, sulfuric	0-S-809B	
Alcohol, bucyl	TT-B-846B	
Alcohol, ethyl	MIL–A–6091	
Alcohol, isopropyl	TT-I-735	
Alodine	MIL-C-81706	Chromic Acid, ecc.
Ammonia	0-A-445	
Ammonium chloride	0–A491	
Ammonium nicrace	MIL–A–47240	
Ammonium chiosulface		
ARP–2		decergenc solution
Barrier Coating Solucion	MIL-B-81744	
Beryllium copper (Be less than 2%)		
Slack oxide solucion	MIL-C–13924	
Bucyl acecace	TT-8-840	
Cadmium mecal		
Cadmium oxide	YIL–C–6151	
Carbon dioxide	88-C-101B	
Carbon removing compound	P–C–111	
	MIL-C-19853	
Chem mill Enchanc 9H Alkccch 1NH		modified solium hydroxide alkaline aluminum salts
Chlorine gas	88-C-120	
Cleaning ccmpound, aluminum surface	MIL-C-5410	
Cleaning compound, aircraft surface	YIL–C–43516	
Cleaning compound	P–c–535	
Cleaning compound, solvenc emulsion	P–C–444	
Cleaning compound, solvent oil cooler	MIL–C–6864	
Cleaning compound, painc brush	*0-c-0042*	
Cl-2 Smoke abacemenc		Mechyl cyclopencadienyl manganese cricarbonyl
Coacing, polyurechane, rain erosion resiscanc	MIL-C-83231	

TABLE 6-2 (CONTINUED)

HAZARDOUS MATERIALS AT NAVAIREWORKFAC PENSACOLA IN 1931

Material	Specification	Description
Coating, rain erosion resistanc	MIL-C-7439	
Coating. epoxy	MIL-C-22750	
Coating, polyurethane	MIL-C-81773	
Coating, resin	MIL-R-3043	
Capper metal	QQ-C-521	
Copper sulfate	O-C-828	
Cuprous cyanide	YIL-C-51264	
Damping fluid (dimethvl polysiloxane)	NIL-D-1078	
Desealant	YIL-D-6093	Stripper, Methylene Chloride
Dichloromethane (methylene chloride)	MIL-D-6998	
Diverstrip D-95		Acidic organic paint stripper w/dicloromethane
Dope	MIL-D-5553	
Econochrome 40		Chromic acid salts
Ethyl acetate	TT-E-751	
Ethylene glycol	HIL-E-52171	
Ethylene glycol monoethyl ether acetate	MIL-E-7125	
Enamel	TT-E-489 TT-E-521	
Endox 116		Alkaline powder added to sodium cyanide for metal cleaning.
Enstrip S		Powdered additive used with Sodium Cyanide to strip nickel plate.
Enchox 980		Chromic acid and other salts.
Grease	MIL-G-3545 MIL-G-4363 MIL-G-6032 MIL-G-21164 MIL-G-23827 MIL-G-25013	
MIL-G-25537		
	MIL-G-81827 MIL-G-81322 MIL-G-81937	
Helium	BB-H-1168 MIL-H-83147	
Uycrauiic fluid	MIL-H-5606 NIL-;I-6083 MIL-H-83286	
Hydrogen	BB-H-886B	
Hydrogen peroxide	NIL-H-22868	
Iridite 15	MIL-M-3171 Type VIII	Chrom : Acid, etc.
Lacquer, acrylic	NIL-L-81352	
Lacquer, cellulose nitrate	TT-L-io TT-L-32	

TABLE 6–2 (CONTINUED)

HAZARDOUS MATERIALS AT NAVAIREWORKFAC PENSACOLA IN 1981

Material	Specification	Description
Lacquer	TT-L-54	
Lacquer	MIL-L-19537	
	MIL-L-19538	
Lead fluoborate		
Lubricant, dry film	MIL-L-8937	
	MIL-L-46147	
Mercury		
Methyl cchyl kecone	TT-M-261	
Methyl isobutyl ketone	TT-M-268	
Naphcha, aliphatic	TT-N-95	
Nickel acecace		
Nickel carbonate		
Nickel chloride	MIL-N-51301	
Oil, lubricacing	VV-L-800	
	MIL-L-2104	
	MIL-L-2105	
	MIL-L-6081	
	MIL-L-6085	
	MIL-L-6086	
	MIL-L-7808	
	MIL-L-7870	
	MIL-L-21260	
	HIL-L-22851	
	HIL-L-23699	
	MIL-L-15016	
	MIL-L-81087	
	MIL-L-81846	
Oxygen, gaseous	MIL-O-27210	
Oxygen, liquid	MIL-O-27210	
Painc	TT-P-28	
Parco lubrice	MIL-P-50002	
Phosphare coacing, Mn or Zn base (Parkerize)	HIL-P-16232	
Pocassium carbonace		
Pocassium cyanide		
Pocassium hydroxide	0-P-566	
Potassium nitrace	MIL-P-15613	
Pocassium sodium carcrace (Rochelle salc)	O-C-265	
Preservacive	MIL-C-16173	
Primer, epoxy	MIL-P-23377	
Primer, zinc chromace	TT-P-1757	
Remover, paint, acid accivaced	MIL-R-81903	
Remover, painc, acrylic	TT-R-248	
Remover. painc. epoxy	MIL-R-81294	
Remover, (Organic coacing, hoc.cank cype)	MIL-R-81835	
Remover, rusc, hoc alkaline	MIL-D-26549	

TABLE 6-" (CONTINUED)

HAZARDOUS MATERIALS AT NA. :REWORKFAC PENSACOLA IN 1981

Material	Specification	Description
Remover, resin. hoc alkaline (Clarkson NA 4)		
Sealanc	MIL-S-81733	
Sealanc, polyurechane	MIL-C-27725	
Sealing compound. polysulfide	MIL-S-8802	
Silver nitrate		
Silver cyanide	O-N-335	
SN		Nickel sulfamate plating solution
SNHA		Sulfamate nickel hardening ag
SNR		Double strength nickel sulfamate plating solution
Smut Go 2		Acidic material w/fluoride sa
Sodium acetate		
Sodium bicarbonate	P-S-641	
Sodium carbonate	O-S-571	
Sodium cyanide		
Sodium dichromate	O-S-395	
Sodium hydroxide	O-S-598	
Sodium nitrate	MIL-S-322	
Sodium stannate		
Sodium thiocyanate		
Solvent, dry cleaning (Stoddard)	P-D-680	
Scrip, resin B&B 27197 or Turco 3823		
Strip, AL resin RPI 706		
Tetrachloroethylene	O-T-2366	
Tetrapotassium pyrophosphate (Unichome 80)		
Thread compound, antisieze	MIL-T-5544	
Thinner, polyurethane	MIL-T-81772	
Thinner, cellulose acetate bucyrace dope	MIL-T-6096	
Thinner, acrylic lacquer	MIL-T-19544	
Thinner	MIL-T-19588	
Thinner	TT-T-266	
Thinner	MIL-T-6097	
Tin fluoborate		
Toluene	TT-T-548	
Treacmcnc. corrosion preventative, magnesium alloy	MIL-M-3171	
1,1,I, Trichloroethane	O-T-620 NIL-T-61533	
Trichloroechvlene	0-T-634	
Trichlorotrifluoroethane	MIL-C-81302	
Tricresyl phosohace	TT-T-656	
Turcoform Al cleaner		Alkaline aluminum cleaner
Turcosprayzall		Alkaline cleaner
Walkway compound, nonslip	MIL-W-5044	
Xylene	TT-X-916	
LE-3 emulsifier	MIL-I-25135	
ZL-22A penetrant	MIL-I-25135	
ZP-4 developing fluid	MIL-I-23135	
Zinc chloride		

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TXBLE 6-3

ELEMENT	CONCENTRATION
Aluminurn	5.0
Barium	Trace
Cadmium	0.1
Calcium	3.0
Chromium	0.4
Copper	0.04
Iron	0.7
Lead	0.4
Magnesium	3.0
Manganese	Trace
Nickel	0.1
Phosphorus	19.0
Potassium	N.D.
Silicon	5.0
Silver	N.D.
Sodium	11.0
Strontium	Trace
Tin	0.05
Titanium	0.9
Vanadium	Trace
Tin	0.05
Zinc	0.7
Zirconium	0.3
pH	7.0

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May 6, 1966, 12:30 p.m.

prints were disposed of with the activity's garbage. Sludges from water-wall paint booths were disposed in "wet dumpsters" located adjacent to paint shops, disposed into drains emptying in Pensacola Bay, and, at Building 648 complex, disposed of adjacent to the building.

Lacquer thinner, toluene, and M-T-6096 were the main paint thinners used at NAS Pensacola. Prior to 1973, waste thinners were poured into sewers leading to Pensacola Bay or poured directly into the bay.

Table 6-4 is a list of buildings with paint shops and a summary of past aisposal practices at the point shops.

Since about 1939, an estimated 170,000 gallons of paint sludges from water-wall paint booths have been generated at NAS Pensacola. In addition, an estimated 340,000 gallons of waste paint thinners and paints have been disposed in Pensacola Bay. Another estimated 20,000 gallons of waste paint thinners and paints was disposed of adjacent to the Building 648 complex.

Radium dial painting is discussed in Section 6.4 of this report.

6.3.2.6 Paint Stripping, Carbon Removal, Degreasing, and Surface Treatment. Paint stripping of aircraft and parts has been a major operation at NAS Pensacola since the formation of NAVAIREWORKFAC, about 1935.

The major paint stripping shop was located in Buildings 71, 72, and 49 from about 1935 to 1979. Acrylic stripper and epoxy stripper were purchased in five-gallon cans. The stripper was poured into a 100-gallon spray tank and the contents sprayed onto the plane. About 400 gallons per day of stripper was used at buildings 71 and 72. Empty five-gallon stripper cans were rinsed out and placed in a special dumpster provided by DPDO. Rinseate flowed to Pensacola Bay.

The stripper, when applied to the aircraft, dissolved the paint, dripped from the aircraft, ana flowed into drains that discharged into Pensacola Bay. Traps were provided in each drain to capture some of the paint chips. The paint chips were cleaned out of the traps about twice nonthly using a vacuum truck. The disposal site of the paint chips is uncertirn; but, most likely they were disposed of with the activity's garbage in the sanitary landfill.

After about 1973, the drains were connectea to the industrial waste collection system, and the waste was no longer discharged untreated into Pensacola Bay. In 1979, operations ceased at buildings 71 and 72 and were transferred to Building 3557.

After applying strippers to the aircraft, a ketone compound was used to clean the aircraft's surfaces. The ketone was applied with rags. Excess compound dripped from the aircraft and flowed into the drains discharging into Pensacola Bay. About 400 gallons per day of ketone was used at buildings 71 and 72. The used rags were placed in a special dumpster. The disposal site of the rags is uncertain; but, most likely they were disposed of with the activity's garbage in the sanitary landfill.

TABLE 6-4

SUMMARY OF PAINTING OPERATIONS AT NAS PENSACOLA

This table describes disposal practiced prior to connection of all facilities to the Industrial Waste Treatment Plant, in 1973.

Bldg.	Approximate dates of operations	Approximate Average Amount of Waste Per Year: Paint Sludges	Approximate Average Amount of Waste Per Year: Paints and Thinners	Comments
104	1940 to 1976	100 gallons	260 gallons	Waste went to bay
604	1937 to present	1600 gallons	2000 gallons	Waste went to wet dumpster and to sewer to bay.
606	1965 to Prtsent	0 gallons*	2600 gallons	Waste went to bay.
627	1939 to present	1600 gallons	2600 gallons	Prior to 1952, no paint sludge was generated. Wastes went to bay.
630	1968 to present	-	-	Helicopter blade painting, waste quantity is insignificant.
631	1940 to present	-	-	Small component painting, waste quantity is insignificant.
632	1950 to 1974	-	-	Small parts painting, waste quantity is insignificant.
648/649 756/2691	1949 to present	360 gallons	500 gallons	Waste dumped adjacent to building complex.
708	1941 to 1960	1600 gallons	5000 gallons	Waste paints and thinners to bay, disposition of paint sludges unknown.
709	1941 to 1973	-	-	Small operation.
3260	1968 to present	-	-	Small parts painting, waste quantity is insignificant.
3450	1973 to present	-	-	Quantity of waste generated is insignificant.
3460	1975 to present	-	-	Small parts painting, waste quantity is insignificant.
3588	1980 to present	-	-	Current operation, not covered in this report.

Total estimated paint sludges generated from 1939 to about 1973: 170,000 gallons

Total estimated waste paint thinners and paints from 1937 to about 1973 dumped into Pensacola Bay: 340,000 gallons

Total estimated waste paint thinners and paints from 1939 to about 1973 dumped adjacent to Bldg. 648 complex: 20,000 gallons

* Dry air filter type paint booth, used filter pads went to landfill.

In the southern portion of Building 71 and in Building 49, ten 500-gallon tanks were used for small parrs cleaning and stripping. Some tanks contained paint strippers, some contained ketones, and some contained trichloroethylene. The tanks were drained about once every six to eight weeks into the drains discharging into Penracola Bay.

Figure 6-3 showr the layout of buildings 71 and 72 and the location of the drains discharging into Pensacola Bay prior to connection to the industrial sewer system in 1573.

Paint stripping wastes usually contain about 15% to 25% phenols, waste paint, and traces of dissolved chromium and other metals from aircraft parts.

Paint stripping has also been performed at buildings 104, 603, 632, 708, and 1810. These operations are reported to have been similar to, but smaller in scale than, the operations in buildings 71 and 72. In Building 708, about 55 gallons per day of waste stripper was discharged into Pensacola Bay. No estimates of quantities were available for stripping waster discharged from buildings 104, b32, and 1810. Quantities were estimated from the descriptions of operations during personnel interviews to be less than 50 gallons per day. Waste from stripping operations in Building 630 is considered insignificant because of the small size of the operation. Only helicopter blades have been stripped in Building b30 since about 1968.

Table 6-5 lists the buildings where paint stripping was performed and the amount and disposition of wastes.

6.3.2.7 Metal Plating. Metal plating of aircraft parts has been a major operation at NAS Pensacola since about 1940. Major plating shops have been located in buildings 29/604A, 604, 649/755, and 709. Brush plating shops nave been located in buildings 630, 631, 3460, and 3557. No significant quantities of waste were generated at brush plating shops.

Building 29/604A, Old Plating Shop, was located where the current 604 plating shop is located. The plating operation was conducted from about 1960 until the shop was torn down in about 1970. The Building 29/604A plating operation was considered a small operation. Three cadmium plating lines were located in the shop along a magnesium treatment line. Chromium was also used in the magnesium treatment process. It was reported that 50-gallon tanks containing chromium solutions were drained once a month; larger tanks, less frequently. The tanks were drained to sewer lines discharging into Pensacola Bay.

Prior to about 1962, concentrated cyaniae solutions were drained into drums or into a tank truck, taken to Building 709 plating shop, and disposed into the sanitary sewer. See discussion of Building 709 below for further details.

From about 1962 until the shop closed down in 1970, concentrated cyanide solutions were drained into steel drums; the drums were stored near Building 3215, loaded onto a boat, and disposed of about 15 miles offshore in the Gulf of Mexico.

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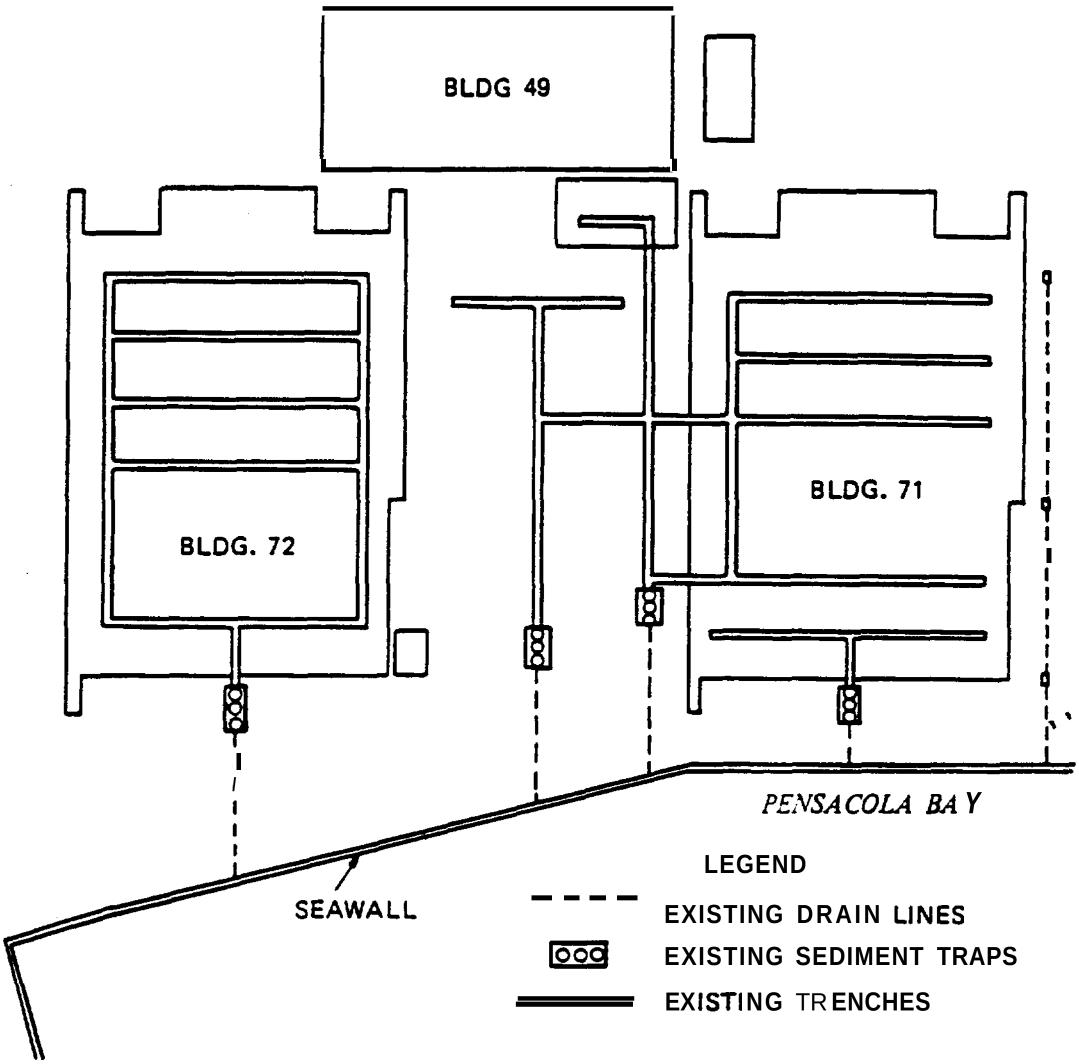

FIGURE 6-3 OUTFALL TRENCHES DISCHARGED WASTE FROM PAINT STRIPPING OPERATIONS INTO PENSACOLA BAY PRIOR TO 1973

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TABLE 6-5

SUMMARY OF PAINT STRIPPING OPERATIONS AT NAS PENSACOLA

Bldg.	Approximate Dates of Operation	Map Coords.	Average Amount of Waste Per Year			
			Strippers	Ketone	TCE[1]	Disposal Practices
71	1935-1979	K25	80,000	80,000	30,000	Waste went to bay until 1973.
72	1935-1979	K24	50,000	50,000	0	Waste went to bay until 1973.
104	1935-1970	K25	10,000[2]	10,000[2]	0[2]	Waste went to bay.
630	1968-present		-	-	-	Small operation, waste quantity considered insignificant.
632	1940-1976	K21	10,0002	10,0002	0[2]	Waste went to bay until 1973.
708	1948-1958	B32	14,300	14,300	0[2]	Waste went to bay.
1810	1940-1975	K22	10,0002	10,000[2]	0[2]	Waste went to bay until 1973.
3557	1970-present	H24	-	-	-	Current operation, not covered in this report.

Summary

Total estimated waste strippers generated from 1939 to 1973 and discharged to Pensacola Bay:	6,100,000 gallons
Total estimated waste ketone generated from 1939 to 1973 and discharged to Pensacola Bay	4,600,000 gallons
Total estimated waste TCE generated from 1939 to 1973 and discharged to Pensacola Bay.	1,100,000 gallons

[1]TCE: Trichloroethylene
[2]Exact data unavailable, number presented is best engineering estimate.

It was reported that "extremely small quantities" of cyanides were present in the discharge or' rinse tanks. The rinse tanks discharged to a storm sewer discharging into Pensacola Bay.

Table 6-6 is a partial list of chemicals used at Building 29/604A. Except for the cyanide compounds discussed earlier, these spent chemicals would have been discharged into sewers discharging into Pensacola Bay. A sample of Building 29/604A discharge taken on 6 May 1966 showed aluminum, chromium, copper, iron, magnesium, nickel, and sodium present in the one-to-ten ppm range; tin was also present at 0.4 ppm and titanium at 0.06 ppm. F-lowrate, at that time, was reported at 120 gallons per minute. The concentrations of these metals in the discharge would have been much higher during periods of tank draining.

Further discussion on the liquid wastes discharged into Pensacola Bay is presenred in Section 6.6.2.

In about 1968, Building 29/604A was torn down. In about 1972, the Building 604 plating shop was constructed on approximately the same site. This new plating shop is much larger and contains about thirty plating process tanks ranging in size from 40 to 2,000 gallons. The tanks were drained about once a month. The contents of the tanks flowed into the industrial waste sewer tnat discharges into the industrial waste treatment plant (IWTP). Prior to 1973, wastes from Building 604 went into Pensacola Bay. It was reported that several rinse tanks were not connected to the industrial waste sewer system until 1979 and unintentionally discharged untreated liquid waste into Pensacola Bay. Large tanks of cyanide solutions were pumped into tank trucks and disposed of by a contractor at a location not on NAS Pensacola property. Empty barrels were sent to DPDO for reclamation. In 1972, a cyanide pretreatment facility was installed which treated cyanide wastewaters from the plating shops and other areas prior to discharge to the industrial waste treatment plant.

Building 649/755 had two plating shops located in separate portions of the building.

The first shop located in the front of Building 649 was known as the Tin-Cadmium Plating Shop. This shop operated from about the mid-1940s to the early 1560s. The plating shop consisted of about 15 tanks of ZOO-gallon to 500-gallon capacity, containing various tin, cadmium, and cyanide solutions. Overflow from rinse tanks flowed into a ditch that flowed towards Chevalier Field and then north into a reach of Bayou Grande and into Pensacola Bay. Contents of the tanks would be emptied about once a month or once a quarter.

Prior to 1962, concentrated cyanide solutions were drained into drums or into a tank truck, taken to Building 709 plating shop, and disposed into the sanitary sewer. See discussion of Building 709 below for further details.

From 1962 until the shop closed down in 1970, concentrated cyanide solutions were drained into steel drums; the drums were stored by Building 3215, loaded onto a Navy boat, and disposed of about 15 miles offshore in the Gulf of Mexico. About ten drums of concentrated cyanide solution were disposed of each year. All other solutions would be poured into the ditch that flowed to Pensacola Bay. At the shop a 250-gallon tank containing trichloroethylene was

TABLE 6-6

PARTIAL LIST OF CHEMICALS USED AT BUILDING 29/604A IN 1966

Sodium Cyanide
Hydrofluoric Acid
Resin Stripper (Phenol)
Alodine (Chromium)
Sodium Carbonare
Nitric Acid
Sodium Hydroxide
Ammonium Nitrate
Hydrochloric A. d
Sodium Dichromate (Chromium)
Chromium Trioxide (Chromium)
Sulfuric Acid

also drained quarterly into the same ditch. In the early 1960s, after the tin-cadmium plating line was shut down, a magnesium treatment line was started and continued into the early 1970s. The 15 tanks at the shop contained nitric acid, phosphoric acid, caustics, potassium permanganate, various degreasers, and chromate solutions. The 200-gallon tanks on this line were drained monthly. Other tanks were drained less frequently. All tanks drained into the ditch leading towards Chevalier Field and eventually to Bayou Grande and Pensacola Bay. Empty drums were sent to DPDO for salvage.

Table 6-7 is a partial list of chemicals used in the magnesium treatment line in 1966.

Further discussion of the discharge of liquid waste into Pensacola Bay is presented in Section 6.6.2.

The second plating shop was located toward the back of the 649/755 complex, in Building 755. This quite extensive shop was used from the early 1960s until early 1970s. Fifty small tanks (50 to 200 gallons) were used for nickel, silver, lead, tin, chromium, and other metal plating. The chromium tanks were drained annually into the ditch leading eventually to Pensacola Bay. Other tanks in the shop were drained periodically, varying from once a month to once a year. A 1967 report stated that: "extremely small amounts of cyanide" would also be present in the overflow from the tanks and enter the ditch discharging into Pensacola Bay. Table 6-8 is a partial list of chemicals used at this shop in 1966.

Building 709 plating shop was used from about 1940 to about 1970. Approximately 50 tanks, varying from 50 to 3,865 gallons capacity, were used to provide full plating services. Building 709 had the activity's largest plating tank, 3,865 gallons, that contained 1,230 pounds of chromium. One half of the Volume of the tank was disposed of each year. Contents of other tanks were disposed of more frequently, the wastes flowing into the sanitary sewer system. These discharges into the sanitary sewer system may have caused operational problems ac the activity's primary sewage treatment plant.

Several 250-gallon degreaser tanks were located at Building 709. Some tanks contained trichloroethylene, others contained perchloroethylene. Waste solvent was drained quarterly to the sanitary sewer system. From 1962 to 1970, concentrated cyanide wastes were placed in 55-gallon drums and stored adjacent to Building 3215 to await disposal at sea (see Section 6.6). "Extremely small quantities" of cyanide were reported to have been in the overflow from rinse tanks and discharged into the sanitary sewer system. Prior to 1962, it was reported that 40 to 350 pounds of concentrated sodium cyanide was disposed of every two months to the sanitary sewer system. The sewage treatment plant would bypass this flow to protect the plant.

Table 6-9 is a partial list of chemicals used at Building 709 in 1966.

To estimate the amount of plating waste discharged into the Pensacola Bay over tne years, it is assumed that the largest plating tank at NAS Pensacola has discharged about 60,000 gallons containing about 18,000 pounds of chromium

TABLE 6-7

PARTIAL LIST OF CHEMICALS USED IN MAGNESIUM TREATMENT LINE, BUILDING 649, AS OF 1966

Ketosene
Inspection fluid
Detergent
Catbon Remover (Phenol)
Thinner-lacquer
Trichloroethylene
Perchloroethylene
Steam cleaner
Potassium Permanganate flow outfall
Sodium Hydroxide
Paint remover
Dichloromethanol
Nitric Acid
Phosphoric Acid
Chromate

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TABLE 6-8

PARTIAL LIST OF CHEMICAlS USED IN BUILDING 649/755, .PLATING SHOP IN 1966

Sodium Cyanide
Liquid Degreaser (oil)
Hydrofluoric Acid
Trichlorokane (oil)
Resin Stripper (Phenol)
Unichrome Strip Salts
Safety Solvent
Copper sulfate
Alodine (Chrome)
Boric Acid
Fluoboric Acid
Trichloroethylene
Steam Cleaner
Sodium Carbonate
Nitric Acid
Sodium Hydroxide
Ammonium Nitrate
Hydrochloric Acia
Ammonium Hydroxide
Sodium Dichromate
Chromium TDrioxide
Sulfuric Acid
Nickel solutions
Silver solutions
Lead solutions
Tin solutions

TABLE 6-9

PARTIAL LIST OF CHEMICALS USED AT BUILDING 709, AS OF 1966

Kerosene	Sodium Carbonate
Sodium Cyanide	Nitric Acid
Methyl Ethyl Ketone	Sodium Hydroxide
Trichlotoethane	Paint Remover
Calibrating Fluid	Ammonium Hydroxide
Stoddard Solvent	Sodium Dichromate
Unichrome Strip Salts	Potassium Cyanide
Carbon Remover	Oxalic Acid
Safety Solvent	Chromium Trioxide
Thinner-Lacquer	Sulfuric Acid
Alodine	Nickel Solutions
Boric Acid	Silver Solutions
Trichloroethylene	Tin Solutions
Steam Cleaner	

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into Pensacola Bay. Since about 1940, over 100 plating tanks of various sizes have existed at any one time at NAS Pensacola. It would be reasonable to assume that the amount of concentrated plating waste discharged into Pensacola Bay from about 1940 to about 1973 was well over one million gallons.

6.3.3 Maintenance Shops.

6.3.3.1 NAVAIREWORKFAC Maintenance. The NAVAIREWORKFAC Maintenance Shop, located in Building 44, is responsible for the maintenance, cleaning, and painting of facilities equipment. Wastes generated from this operation included paint sludge, waste oils, and radioactive material.

Since 1965, paint sludge has been stored in plastic–lined containers in Building 71 and disposed of by contract. Before 1965, paint sludges were discharged down drains that ran into the bay.

Waste oils have been stored in large underground tanks that are emptied weekly. This has been the standard practice since 1954.

Maintenance work on NAVAIREWORKFAC in–place machinery was done in buildings 225, 1821, and 3215. Paint skimmings were placed in sealed drums and taken to Building 73. Approximately 12 containers were filled every six months. Paint booth sludge was picked up by a contractor's tank truck. Waste oils, lacquer thinners, and residual paints were stored in 55–gallon drums and placed in a disposal area behind Building 225. The storage area was an uncovered concrete slab fenced in by wire, containing wire drum racks. Individual barrels were covered, marked, and stored behind Building 225 until six drums were collected, then the drums were moved to the designated storage area.

One storage building, Can E–1, is located behind the east corner of Building 225. Eighteen pallets of 50–gallon drums from the plating shop were reportedly stored there. Plating chemicals used included chromates, cyanides, and nitric acids. Several thousand gallons of these chemicals were used yearly by NAVAIREWORKFAC Pensacola. Until 1977, these plating chemicals were stored on the second deck of Building 604.

6.3.3.2 Aircraft Intermediate Maintenance Department (AIMD), Building 3260. AIMD Maintenance Shop serviced all aircraft machinery. Wastes from these shops, including oils, solvents, and hydraulic fluids, were stored in an unaerground tank north of Building 3260. This tank, or-ginally 50 feet west of the present location, was relocated in 1979. When the tank was uncovered, the surrounding earth contained no evidence of fuel leaks. Oils and solvents were stored west of Building 3260 in a fenced area.

6.3.3.3 Public Works Transportation Department. The PVC Transporration Department, located in Building 1771, maintains all base–owned vehicles; cars, vans, trucks, and forklifts. The crew is also responsible for hauling wastes from different shop sites to storage areas. Drivers disposed of waste canisters in the base landfill until it was closed in 1976.

Waste oils, stoddard solvent, and anti-freeze were stored in a 2,500-gallon underground tank north of Building 1771. The tank was used from 1958 until 1980. A contractor pumped out the tanks to dispose of the waste. Before the tank was in place, the solvents and anti-freeze were emptied into the storm drain.

At the south side of the building, one washrack, built in 1976, and two steam racks are located. One steam rack is operated by the tronrportation department, and one is used by the station refuse collector for dumpster sterilization. All equipment to be steamed was stored in a fenced area next to the racks. A large drain under the steam rack area is connected to the sanitary sewage collection system.

Until the base landfill was closed in 1976, PWC trucks picked up "wet boxes" from NAVAIREWORKFAC shops and buried them in the landfill. "Wet boxes" were old dumpsters filled with chemicals, paints, or any other wastes that could be put into the box.

Between 1979 and 1981, PWC Transportation Deportment stored paint chips and diluted used paint stripper in drums in an area southwest of Building 1771. Approximately 100 old and leaking 55-gallon drums were placed in this area. The area was sandy soil with a cement ground cover. No discoloration of the ground was apparent. The drums were finally overpacked and sent to the Sumter, Alabama, Hazardous Waste Disposal Facility.

From 1958-1975, the refueler repair shop drained the residual aviation fuels, AVGAS. Today, these fuels are drained into tanks. Because the soil was sandy, the fuels drained quickly through the ground, leaving no discoloration. Details of disposal of fuels at this site can be found in Section 6.6.22.

6.3.4 Battery Shops.

6.3.4.1 PWC Transportation Shop. Repair and disposal of batteries used in public works machinery, mainly transportation vehicles, was done in Building 3489. Small batteries from the 800 vehicles operated by PWC were returned intact to DPDO when they were no longer useful.

Large industrial batteries, used for forklifts, were drained in an area of trees north of the transportation buildings. Since the 1960s, about three gallons of battery acid was disposed of once every seven or eight months.

Before the battery shop vas located on the west side o: Building 1771, a concrete slab remains from that structure. An inspection of this area revealed no dead vegetation or discolored ground.

6.3.4.2 Golf Course Maintenance Battery Shop. A small battery shop is maintained at the golf course. Batteries for the golf carts were changed and filled here. In the past, a few spills have occurred, but not in one specific area. Old batteries were sent to DPDO for disposal.

6.3.4.3 NAVAIREWORKFAC Battery Shop. Since 1963, the NAVAIREWORKFAC Battery Shop, Building 606, has serviced all batteries used by NAVAIREWORKFAC. Since 1963, prior to that, Building 18 housed the battery shop.

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Two types of batteries were handled here--lead-acid and nickel-cadmium. Battery acids were neutralized with water and sodium bicarbonate. The acids were disposed of into a sink which drained into the industrial waste sewer system. The old batteries were stacked in the building and picked up by DPDO. Any silver-zinc batteries that came through NAVAIREWORKFAC were shipped to the Naval Ammunition Depot in Earle, New Jersey, for disposal.

6.3.4.4 AIMD Battery Shop. In Building 3260, batteries used in aircraft maintenance vehicles are repaired. This is one of the original AIMD shops and has been used since 1962. Two separate shops are maintained for the two types of batteries used--nickel-cadmium and lead-acid. In the nickel-based battery shop, 50-100 cells were worked on each month. Dead batteries were discharged and sent to DPDO. Twenty-two lead-acid batteries were serviced per month. The battery acid was discharged into a drain which connected to the industrial sewer system. The core was then neutralized with sodium bicarbonate and stored outside.

6.3.5 Pesticide Operations

6.3.5.1 General. According to the 1979 Pest Management Plan the major a pest management concerns at the installation are structural pests, disease vectors, household nuisance pests, ornamental and turf pests, stored product pests, and vertebrate pests.

Chlordane was used to control terminte infestations. Control of adult mosquitoes was accomplished with an ultra low volume aerosol generator using 95% Malathion concentrate. Application was done based on need rather than on a fixed schedule. Treatment of temporary standing water was performed by public works personnel using Altosid.

Flies were controlled with pyrethrum or pyrethroid aerosols. Propoxur (Baygon), applied in cracks and crevices, controlled household nuisance pests.

The chemical control of turf pests such as armyworm, sod webworm, nematodes, and turf disease was based solely on need and not based on a fixed schedule; this schedule was followed to avoid environmental and pest-resistance problems caused by pesticide overuse.

The imported fire ant was controlled with 10% chlordane granules. Mirex was used in place of chlordane when available.

Pests that invaded products in dry storage were treated using with phostoxin fumigants.

Pigeons and English sparrows sometimes entered hangars, causing operational problems. Seagulls on runways occasionally presented aircraft operations problems. Food treated with Avitrol was used to control the birds.

Reportedly, public works personnel performed pest control before each change of occupancy in the installation housing units. While the units were occupied, the residents performed pest control except for termite control. Termite control was always performed by public works personnel.

6.3.5.2 Pesticide Operations Areas. Building 263, in the waterfront industrial area, was reportedly used for pesticide storage and mixing. Operations started in this building in about 1953 and lasted until about 1970.

Building 1551 was then used after for pesticide operations, until about 1975 when it was dismantled.

Until the early 1960s, DDT, for mosquito control was applied by aerial spraying. In later years, a fogger machine was used for DDT application. The DDT mixing area was reportedly about 30 yards east of the oak tree located at the north end of Building 3561. Reportedly, spills occurred in the mixing area when DDT was transferred from drums to spray tanks. DDT application was performed for at least ten years to control mosquito outbreaks. On the average, two to three mosquito outbreaks occurred each year during the spring and summer. For each aerial application, 500 gallons of 20% DDT were mixed with 500 gallons of diesel oil. The foggcr machine used 300 gallons of each product. Two applications during a one-week period were performed for each mosquito outbreak. Details of disposal of DDT solutions can be found in Section 6.6.24.

In 1979, a new pesticide storage and mixing shop, Building 3506, was conrtructed in the golf course maintenance area.

6.3.5.3 Pesticide Storage. Buildings 263, 1551, and 3561 were used as pesticide storage and pesticide operations buildings.

Since 1979, golf course pesticides have been stored in the Pesticide Shop, Building 3586. Table 6-10 lists a normal inventory of pesticides stored, in Building 3586. Prior to construction of this facility, pesticides were storea in Building 2692 in the golf course maintenance area. Reportedly, spills of pesticides occurred in the building. The building was used for pesticide storage since about 1964 when the golf course maintenance facility was constructed. No information on quantities of pesticides spilled in the Duilding was found. Currently, fertilizer is stored in Building 2692.

6.3.5.4 Pesticide Disposal. Most recently, the Public Works Department pesticide rinseate disposal operations were performed in Building 3561. A tank washrack rinsing area was approved and constructea in March 1981. Rinseate from the washrack went into a collecting system and then into the sanitary sewer system. Inside the building, the sprayer washing facilities were connected to the sanitary sewer system.

Building 1551 was used for pesticide operations from aoout 1970 until about 1975. Prior to 1970, Building 263 was used for pesticide operations. Reportedly, when buildings 1551 and 263 were used for pesticide rinseate disposal, they were connected to the sanitary sewer system.

A tank sprayer was used for herbicide application beginning in 1957. Rinseate from the sprayer was disposed of at the installation landfill. A water hose was available at the landfill for use in rinsing out the tank. This rinseate disposal was continued until the landfill was closed in 1976.

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TABLE 6-10

Pesticides Normally Stored in the Golf Course Pesticide Shop Building 3586 (From 1979 Pest Management Plan)

1. **Insecticides**	
Carbaryl, 80% WP	10 Lbs.
Diazinon, 47.5% EC	2 Gals.
Dursban, 41% EC	10 Gals.
Dursban, .5% Mole Cricket Bait	900 Lbs.
Trichorfon, 80% SP (Dylox)	2 Lbs.
2. **Herbicides**	
CAMA, 10.301, EC (Calar)	3 Gals.
Copper, 7% SC	5 Gals.
Dalapon, 46.72 SP	100 Lbs.
Glyphosate, 41% EC	5 Gals.
Kerb, 50% WP	21 Lbs.
MSMA, 47.891, EC	16 Gals.
Simazine, 80% WP	20 Lbs.
2, 4-D, 49.8% Amine	4 Gals.
3. **Miscellaneous**	
Dexon, 35% WP	57 Lbs.
Maneb,- 80% WP	110 Lbs.
Methyl bromide, 98% LFU	30 Lbs.
Nemacur, 15% Granules	275 Lbs.

Since 1979, rinseate from sprayers used in golf course pesticide operations has been disposed of at Building 3586. Reportedly, the concrete pad in front of this pesticide shop had a drain that discharged into a holding tank. The sink on tne outside of the building also drained into the holding tank which war periodically pumped out by contractors. Sprayers were rinsed out on tne concrete pad area and rinseate was disposed of down the sink drain and into the drain on the concrete pad.

From about 1964 to 1979, rinseate from golf course pesticide operations was disposed of on the ground in an area between the equipment shed, Building 2640, and Building 2692 in the golf course maintenance area. Details on disposal of rinseate can be found in Section 6.6.15.

At the time of the NACIP on-site survey, January 1982, the condition of the vegetation in this rinseate disposal area was not noticeably different from vegetation in the adjacent area.

Reportedly, empty pesticide containers from pest control operations have always been triple rinsed and punched with holes to prevent reuse. The containers were disposed of in the installation landfill until the landfill was closed in 1976. After 1976, containers were placed in a designated Public Works Department dumpster. Contractors emptied dumpsters and removed the refuse from the installation.

6.3.6 Electrical Shop. The electrical shop is responsible for maintenance, minor repairs, and alterations to electrical and electronic equipment and systems on base. The shop has been moved many times during recent years. From 1964 to 1966 the shop was located in Building 105; from 1966 to 1975, in Building 739; from 1975 to 1976, in Building 458; in 1376, Building 3561; and from 1976 to the present, again in Building 458.

Transformer repairs performed by this shop included cleaning bushing gaskets with rags and replacing old bushing gaskets. In the past, this was done on both PCB and non-PCB oil-filled transformers. The rags and gaskets were thrown in the dumpsters which were hauled to the landfill. Approximately 260 cubic feet per year of PCB and oil-contaminated solid waste were disposed or' in this way.

Very little transformer fluid was disposed of during transformer maintenance at the electrical shop. The only known fluid discharge that went down the drain to the sanitary sewer was from rinsing tools at the end of a job, resulting in a minute discharge. When a transformer was repaired, enough fluid was removed to allow the work to be done. This fluid was then replaced in the transformer when the repair was completed. It was reported that oils contaminated with PCBs were used for weed control around the substations. Other excess transformer fluid was reported to have gone to disposal with waste oils.

In 1966 or 1967, substation "A," structure 1785, sustained a spill of transformer fluid from a PCB transformer. This spill was cleaned up, but some residue may remain in the soil. Details of the spill can be found in Section 6.6.18.

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In 1969, a truck was transporting a transformer to a new location, when the transformer slipped off the truck, hit the ground, and split open, spilling transformer fluid. The accident occurred on Radford Boulevard in front of Building 632. Details of the spill can be found in Section 6.6.28.

6.3.7 Print Shop. The Print Shop was established in 1940. Originally located in Building 45, it was moved to Building 461 in 1945. The shop had five working printing presses and used about 40 pounds of ink per month. Materials used were obtained through the Supply Department. A three-month supply was usually stored in the building. Used hypoclear was poured down the drain until approximately 1968, when DPDO obtained a silver recovery system. Empty ink cans containing material skimmed off the ink's surface were diposed of with the solid waste.

6.3.8 Photo Shops.

6.3.8.1 NAS Pensacola Photographic Laboratory. The Naval Air Station Photographic Laboratory is located in Building 633. Operations at the shop include both color and black and white developing. In 1980, the shop obtained its own silver recovery system for processing hypoclear. From 1978 to 1980, hypoclear was sent to DPDO for silver recovery. Used bleach fix solution was collected in barrels and then taken to DPDU for silver recovery. Liquid wastes not processed for silver recovery were disposed of in the sanitary sewer.

6.3.8.2 Naval Technical Training Center Photographic School. The photo school moved to Pensacola in 1923. The school was located in Building 52 until 1947 when it was moved to its present location in Building 1500. Operations at the school included both color and black and white developing. Table 6-11 lists chemicals used at the photo school's laboratory, Chemicals were stored in the basement of Building 1500 and in Building 1534. Until the early 1970s, sulfuric acid was reportedly kept in lead-lined containers in the basement of Building 1500. No spills were reported. In 1981, the photo school obtained a silver recovery system for processing used hypoclear. Between 1978 and 1981, used hypoclear was sent to DPDO for silver recovery. Prior to 1978, hypoclear was disposed of in the sanitary sewer. Waste film was sent to DPDO for packaging and then sent out for burning and disposal at a location not on NAS Pensacola property.

6.3.8.3 NAVAIREWORKFAC Photographic Laboratory. The SAVAIREWORKFAC Photo Lab was reportedly established prior to 1950. The lab has been in Building 121. Only black and white developing was done at this laboratory. A six-month supply of chemicals was stored at the laboratory. Hypoclear has been sent to DPDO for silver recovery since 1978; prior to that it was disposed of in the sanitary sewer system.

6.3.8.4 NAS Pensacola Institutional Media Development Office. The Institutional Media Development Office is located in Building 633. Only black and white photographic processing was done here, and very small amounts of chemicals were used. Used hypoclear was sent to the NAS Pensacola photo lab for silver recovery, Developer and other liquid wastes were disposed of in the sanitary sewer.

TABLE 6–11

CHEMICALS USED AT PHOTOGRAPHY SCHOOL

Chemicals	Quantity
B&W, DEV. D-76	10 GL
B&W, DEV. ETHOL, UFG	5 GL
B&W, DEVL. D-72	25 GL
B&W, DEV. KODALITH	2 GL
B&W, DEVL REP, VERSAFLO	15 GL
B&W, DEV. STARTER, VERSAFLO	1 QT
B&W FIX. STARFIX	20 GL
B&W, ROYALPRINT, ACTIV. & STOPBATH	
B&W, ROYALPRINT, F[illegible]X.	5 QT.
B&W, REV, MOPIC 1st DEV. STARTER	1 QT
B&W, REV. MOPIC 1st DEV. REP.	15 GL
B&W, REV. MOPIC BLEACH & REP.	15 GL
B&W, REV. CLEARING BATH & REP.	15 GL
B&W, REV. RE-DEV. & REP.	15 GL
ME4, PREHARDNER & REP.	50 LTR
ME4, NEUTRALIZER & REP.	100 LTR
ME4, 1st DEV.	100 LTR
ME4, 1st DEV. REP.	50 LTR
ME4, STOPBATH & REP.	
ME4, COLOR DEV.	100 LTR
ME4, COLOR DEV. REP.	100 LTR
ME4, FIX. & REP.	100 LTR
ME4, STAB. & REP.	100 LTR
ME4, PERSULFATE BLEACH "A"	100 LTR
ME4, PERSULFATE BLEACH "B"	100 LTR
ME4, PERSULFATE ACCELERATOR	100 LTR
C41, FLEXICOLOR DEV. REP.	5 GL
C41, FLEXICOLOR DEV. STARTER	1 QT
C41, FLEXICOLOR FIX. & REP.	1 GL
C41, FLEXICOLOR BLEACH REP.	5 GL
C41, FLEXICOLOR BEACH STARTER	1 QT
C41, FLEXICOLOR STAB. & REP.	1 GL.
C41, FLEXICOLOR STAB. & REP.	5 GL

(continued)

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TABLE 6-11

CHEMICALS USED AT PHOTOGRAPHY SCHOOL

Chemicals (continued)	Quantity
E6, 1st DEV. REP.	5 GL
E6, 1st DEV. STARTER	1 PT
E6, REV. BATH & REP.	5 GL
E6, COLOR DEV. REP.	5 GL
E6, COLOR DEV. STARTER	1 PT
E6, COND. & REP.	5 GL
E6, BLEACH STARTER	25 GL
E6, FIX. & REP.	5 GL
E6, STAB. & REP.	5 GL
EKTAPRINT, DEV. REP	5 GL
EKTAPRINT, BLEACH-FIX & REP.	3.5 GL
EKTRAPRINT, DEV. STARTER	25 GL
GLACIAL ACETIC ACID	
KIT CHEMISTRY FOR VERSARAC WASHER	
WETTING AGENT, PHOTO FLO	
BORIC ACID CRYSTALS	
GLOSS SOLUTION, FLEXO GLOSS	
SODIUM SULFITE	
DEV. REP. AD500	
DEV. STARTER AS500	
SODIUM SULFATE BI	
OXALIC ACID	
EKTAMATIC S30 STABILIZER	
EKTAMATIC A10 ACTIVATOR	
KODAK DEVELOPER SYSTEM CLEANER	

6.3.9 Power Plants, Boiler Plants.

6.3.9.1 Power Plants. Records show that two power plants have been in use since 1907. In 1907, Building 47 was built as the main power plant. Originally fired with coal, this power plant was converted to oil around 1930. Building 27, now the Commissary District Office, was used as coal storage for the power plant until around the turn of the century. The power plant in Building 2782 came on-line in 1955. In 1970, the power plant in Building 47 was declared excess; Building 47 was used from the mid-1970s until 1981 for storage of waste oils containing PCB compounds. During the IAS, no information relating to hazardous material disposal at the power plant was obtaihed.

6.3.9.2 Power Plant in Building 782. The plant was put into service in 1955. This plant is normally gas-fired, but it has oil-fired capability. Boiler water was treated with the usual chemicals, including sodium sulfite, sodium phosphate, and sodium hydroxide. The continuous blowdown from the main power plant boilers was routed to the industrial waste treatment plant (IWTP). Prior to construction of the IWTP in 1971, the blowdown was discharged directly into Pensacola Bay. In the past, chromic acid was used to treat water for all boilers on the installation. This practice was discontinued about 1972 when the chromic acid was replaced by sulfuric acid. When the sulfuric acid was recharged, the waste went co the IWTP. Before 1973, the waste went to the sewage treatment plant. The main instrument room in Building 782 is equipped with mercury-filled gauges. Prior to 1981, the gauge repair area in the instrument room did not have a continuous floor. Sometimes, leakage or routine maintenance caused mercury to be spilled through the floor in the gauge repair area to the first floor. This first-floor area was cleaned and hosed down twice a week. The wash water entered the storm sewer and was discharged into Pensacola Bay. It is estimated that approximately one half pint per year of mercury has been spilled in this manner. About 13 pints of mercury are estimated to have been accidentally disposed of in the storm sewer since Building 782 was built in 1955.

6.3.9.3 Disposal of Building Rubble Containing Asbestos. Many of the boilers on base were insulated with asbestos. When buildings with these boilers were torn down, the rubble was disposed of in various ways. The old Bachelor Enlisted Quarters (buildings 652, 653, 655, 657, 658, and 659) were demolished around 1974 by a contractor who disposed of the rubble off-base. Two of the Bachelor Officer's Quarters (buildings 660 and 661) were torn down around 1968; the rubble was taken to the sanitary landfill.

6.3.10 Sewage Treatment Plants. Until the early 1940s the only treatment for sanitary wastes was a cesspool between buildings 104 and 72. In 1941, with advent of World War II and the subsequent increase in operations ac NAS Pensacola, an Imhoff tank was installed just north of tne existing treatment facility. This tank treated only sewage from the magazine point area, which amounted to about 11% of the waste produced. Sewage from the Naval Hospital, Fort Barrancas, and from the south side of the station was pumped directly to Pensacola Bay on the south side of the base via sub-aqueous outfalls 1,200 feet and 1,600 feet long, respectively. The Imhoff tank was abandoned and the direct discharge of raw sanitary sewage on the south side of the base vas

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discontinued when the new sewage treatment plant was put into service in 1948. This plant provided only primary treatment. The plant consisted of a degritter, primary clarifiers, sludge digesters, and sludge drying beds. In 1971, Secondary treatment for domestic waste was added to the plant.

The original domestic sludge drying beds are still in use, and appear to be unlined. It is not known where the sludge was disposed of before the mid–1970s; the sludge is reported to have been disposed of in the sanitary landfill. From 1948, until 1971 when the IWTP was operational, this sludge was probably contaminated with cyanides and heavy metals due to the industrial operations contributing to the waste load. These wastes may have contaminated the soil under the present domestic drying beds. More recently, industrial waste has been treated separately from domestic waste.

Prior to 1971, when the existing plant was enlarged to include industrial waste treatment, the only major industrial area connected to the sanitary sewer was the complex at Building 709. This included paint shop, as well as the main plating shop. Periodically, the plating shop in Building 709 arranged to bypass the treatment plant and dispose of chromic acid through the sanitary sewer, straight to Pensacola Bay to avoid upsetting the plant. The other major industrial areas discharged directly into the bay or the storm sewers prior to 1971 when most were connected to the IWTP. The industrial areas on the southeast side of the base, including most NAVAIREWORKFAC Pensacola operations, were not connected until 1973.

In 1978, the domestic sludge was found to be hazardous by the Florida Department of Environmental Regulations (DER). As a result, this sludge had to be disposed of with the industrial sludge. Since that time, the chromate levels in the domestic sludge have returned to normal, allowing the sludge to be applied in the grassy areas next to Forrest Sherman Field.

6.3.11 Industrial Waste Treatment Plant. In 1971, the existing sewage treatment plant was upgraded. In 1973, NAVAIREWORKFAC Pensacola operations were connected to the plant. The plant now has secondary treatment for domestic waste and tertiary treatment for industrial wastes. The industrial sludge has been shown to be hazardous and is currently being disposed of by contract in Alabama, in accordance with current regulations. The sludge is reported to have been disposed of by contract since the start–up of the IWTP.

According to construction drawings, the industrial sludge drying beds were built without an impermeable liner beneath the underdrains. The surge pond was built with a soil cement and bentonite clay liner. The clay liner is further stabilized with an asphalt coating. In accordance wiht RCRA, groundwater monitoring wells were placed around the surge pond in the fall of 1981. The results of the first sampling are included in Table 6-12. Table 6-12 shows that contaminant levels in the three monitoring wells are not significantly different from those in the background well.

In 1975, approximately one–hundred 55–gallon drums of chromate sludge were sent by the Army from Fort Rucker, Alabama, to NAS Pensacola. This sludge was stored at the industrial waste treatment plant for approximately one year. During this time about 25 barrels were bled to the treatment system for

TABLE 6-12

ANALYTICAL RESULTS OF GROUNDWATER MONITORING AT THE INDUSTRIAL WASTE TREATMENT PLANT

Parameter	DG-1	Dc-2	DG-3	UP-1
Arsenic, ppm	0.001	0.001	0.001	0.001
Barium ppm	0.019	0.048	0.053	0.01
Cadmium, ppm	0.004	0.003	0.003	0.001
Chromium, ppm	0.023	0.017	0.018	0.018
Iron, ppm	0.11	0.36	0.01	0.08
Lead, ppo	0.003	0.004	0.005	0.003
Manganese, ppm	0.006	0.015	0.009	0.002
Mercury, ppm	0.0005	0.0005	0.0005	0.0005
Selenium, ppm	0.001	0.001	0.001	0.001
Silver, ppm	0.002	0.001	0.001	0.001
Endrin, ppb	0.33	0.033	0.033	0.033
Lindane, ppb	0.004	0.004	0.004	0.004
Methoxychlor, ppb	0.124	0.124	0.124	0.124
Toxaphene, ppb	0.6	0.6	0.6	0.6
2,4-D, ppb	0.1	0.1	0.1	0.1
2,4,5-TP Silvex, ppb	0.01	0.01	0.01	0.1
Radium	0.4	0.4	0.1	0.2
Gross Alpha	4.6	7.3	10.2	3.2
Gross Beta	18.2	17.5	9.7	8.6
Coliform Bacteria, cts/100 mls.	1600.	1600.	1600.	36.
Phenols, ppm	0.05	0.005	0.005	0.005

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disposal. This attempt to add sludge to the industrial influent was not operationally practical, and therefore was not successful. After about one year the sludge was hauled back to Alabama for disposal at a permitted site.

A temporary industrial sludge holding pond was used in 1979. The pond was built for emergency storage of sludge due to an overloading of the sludge drying beds. According to interviews, this pond was lined with plastic that was disposed of when the sludge was removed. This liner was reported to have had several tears at the time of disposal.

In 1979, a pump failed at the final industrial waste lift station, causing a spill of approximately 80,000 gallons of industrial waste from the IWTP. The spill was investigated by the Florida Department of Environmental Regulations (DER), which issued a warning notice to NAS Pensacola. The spill caused a minor fish kill and was considered a minor incident.

In the spring of 1981, several people received minor skin burns from a black, slimy material in the soil. This incident occurred while they were repairing a 16-inch water main south of Building 3460. A trench had been dug to repair the main. A black layer of an unknown substance was floating on the water in the trench; when the water was pumped out, the black filmy residue coated the sides of the trench and the pipe. It is reported that there was a noticeable odor "similar to paint remover" in the excavation. An industrial force main from the old paint strip area (buildings 71 and 72) lies approximately 100 feet away from the site of this incident. It is, therefore, suspected that industrial waste from the force main may have leaked into the surrounding soil, creating a possible health hazard to anyone working in a nearby open excavation.

6.3.12 Firefighting Operations.

6.3.12.1 NAS Pensacola Firefighting Division. The NAS Pensacola firefighting division, headquartered in Building 21, has the following duties: inspecting storage areas, fighting fires and chemical spills, and training.

6.3.12.2 Firefighting Training Operations. Training was conducted at the Firefighting School, Building 1713, and at the crash fire training area along Sherman Field. On the west side of Building 1713 are the remains of a raised open tank which was used in the past for surface fire training. Gasoline was used to sustain fires on the tank. Reportedly, a strip of land along Chevalier Field was also used for crash fire training during the war years and up until the 1960s. The location of this area could not be pinpointed, however. Crash fire training has been conducted along the edge of Sherman Field since the late 1950s. Training was conducted once a week during the whole year. Five fires per day were set, using 30 to 50 gallons of fuel for each fire. Fuel was obtained from the fuel division and usually consisted of "contaminated" JP-5, JP-4, or aviation gasoline mixed with lube oil. Details of the crash crew training area can be found in Section 6.6.3.

6.3.12.3 Fire Extinguisher Maintenance. Building 51, formerly the railroad roundhouse, has been used as a fire extinguisher maintenance facility. No waste hazardous materials were generated from this operation.

6.3.13 Disaster Preparednesr (DP) **Operations.** The purpose of the **DP** office is to prepare for disasters such as hurricanes, or nuclear, biological, or chemical **(NBC)** warfare. The **DP** office stored chemical kits to be used in the event **of** a **NBC** attack and will deliver the kits to shelters in the event of an attack. No hazardous materials were reported to have been used by this **office.**

6.3.14 Incinerators. Record8 taken from maps indicate that three incinerators have been in use at various times on base. The oldest, built around the turn **of** the century, was located between buildings 74 and **75.** Photographs snowed that the incinerator was badly damaged in the 1917 hurricane, but was later repaired and then torn **down** prior to 1936. The incinerator is reported to have been used for document and trash burning. It is not **known** where ash from operation **of** this incinerator was disposed of.

Another incinerator, Building 1948, located near DPDO and owned by NAS Pensacola was built in 1961. It was damaged during a storm in 1979 and has been shut down for repairs since then. This incinerator has been used exclusively for classified document disposal.

The old base hospital, now abandoned, also had an incinerator. Animal and pathological wastes were burned here prior to 1965. **In** 1965 this activity was moved to a new location off base. It is not knownm where the ash from this incinerator was disposed of.

6.4 RADIOLOGICAL OPERATIONS

6.4.1 Dial Painting. A dial painting shop was located in Building 709. According **to** installation personnel and records, **a** radioactive compound,, containing radium was purchased as a liquid and mixed with paint. The mixture was then used to paint dial faces. Dial painting began prior to 1940, employing two full-time painters by 1948. Records indicate that this operation was discontinued in 1950. Reportedly, dial painting was performed for a total of 10 to 14 years. After 1950, dials were painted using paint whicn did not contain radium.

Dials requiring repainting were soaked in benzene. Paint was removed from the dials in a liquid scraping bath containing either benzene or water. The liquid kept dust from forming when old paint was being scraped off. Painting and necessary dry scraping were performed under a ventilation hood.

The station's General Safety Rules specified that "at the end **of** the working period, the hands shall be carefully washed." Presumaoly, the sink in the dial painting shop was used for washing hands.

Solid waste, including brushes, dried paint, vials, wiping papers, and discarded dials, were placed in containers and temporarily stored in a shed near Building 709. Reportedly, the containers were disposed of at sea. The quantity aisposed of was estimated at three to four 55-gallon drums per year.

According to the General Safety Rules, the "liquid scraping bath must be emptied and the pan thorougnly cleaned with wiping papers daily. The liquid **of** the scraping bath should be emptied directly into the sewage system or

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deposited in a hole in the earth." Reportedly, water that was used as a scraping bath was disposed of down the sink drain in Building 709; however, some employees interviewed believed that the benzene was disposed of with the solid waste.

6.4.2 Radium Removal Operations. Until about 1965, dial painters stripped paint from dials prior to repainting. From 1965 until 1975, operations were performed in Building 709. In 1975, the operations moved to Building 780.

6.4.2.1 Most Recent Paint Stripping Procedures, 1965 to Present. Aircraft instruments were checked for the presence of radium using a model AN/PDR-27 radiac set. Aircraft instruments containing radium were removed from the aircraft and taken to Building 780 for disassembly.

Dials were stripped of paint using thick paint stripper. Usually, dials required further work; these dials were soaked in lye and nitric acid solutions. After exposure to these chemicals, some dials were not salvageable; these were disposed of as solid waste. Components that could not be decontaminated were also disposed of as solid waste. Contaminated instrument cases were soaked in "Turco" acid solution for two to three hours and then cleaned with a wire brush.

Reportedly, about 5,000 to 7,000 instruments per year entered Building 780 for removal of radium paint. During the 1960s through the middle 1970s, two persons were employed in paint removal operations. From the middle 1970s to date, one person has been assigned to this operation. About one drum of solid waste and two drums of liquid waste mixed with vermiculite were generated each year.

6.4.2.2 Waste Disposal. Radioactive waste from radium removal operations was packed into 55-gallon drums. During the 1960s, the drums were temporarily stored on the asphalt pad between Building 225 and Building 3215. During the 1960s, drums of radioactive waste from paint removal operations were taken to a disposal site not located on the NAS Pensacola complex.

During the 1970s a fenced storage area adjacent to Building 780 was built for waste storage. Most recently, six full drums of radioactive waste were stored in this fenced area. Two of the drums were in questionable condition due to corrosion. NAVAIREWORKFAC Pensacola was recently engaged in contract negotiations for disposal of the waste at a licensed site.

6.4.2.3 Spill Incident. About 1978, a spill of radium removal operations waste occurred in the storage area adjacent to Building 780, according to installation personnel. Drums had been stored in the area for several months and one drum corroded. The drum broke open and about half the contents spilled onto the concrete. The spill was cleaned up promptly and redrummed. The drums were shipped to an approved off-site radioactive waste disposal site. Details of the spill can be found in Section 6.6.25. No other spill incidents were recalled during interviews with installation personnel.

6.4.2.4 Dismantling of Building 709. Building 709 was dismantled in 1976. Prior to its demolition, Naval Energy and Environmental Support Activity (NEESA) Radiological Affairs Support Office (RASO) personnel surveyed the dial painting shop; associated ventilation ducts and drain pipes; adjacent areas;

and the grounds surrounding the building (Radiological Affairs Support Office, 1976). Drain pipe and portions of the linoleum floor covering, walls, and wood flooring within the dial painting shop were found to be contaminated. Adjacent area, surrounding grounds, and ventilation ducts were not contaminated. RASO personnel supervised removal of the contaminated materials. Waste was packaged and transferred to NAVAIREWORKFAC Pensacola for disposal. Records indicating the final dispostion of the waste were not available at the time of the NACIP IAS; however, RASO had recommended that the waste be shipped to a licensed disposal site. The contaminated drain pipe was excavated to a depth of 16 inches during the dismantling Operations. The remaining underground portion was capped and abandoned. "The dose rate from the pipe before refilling the hole with concrete was.l.2 mR/hr." (Radiological Affairs Support Office, 1976). Normal background is about .02 mR/hr. RASO had recommended that the contaminated pipe outfall be located and checked for contamination, but there was no evidence available at the time of the IAS that this bad been done. Records found during the IAS indicated that the sewer from Building 709 was connected to manhole K7.

6.4.3 Defense Property Disposal Office (DPDO) Operations. According to personnel, DPDO never disposed of radioactive waste on the NAS Pensacola installation.

6.4.4 Naval Aerospace Regional Medical Laboratory (NAVAEROMEDRSCHLAB) Operations. NAVAEROMEDRSCHLAB received Nuclear Regulatory Commission (NRC) license number 090697904 in 1977. The following isotopes were licensed for use by the laboratory:

Isotope	Quantity Used Each Year	Years of Use	How Used
Hydrogen-3	3 to 5 millicuries	Continuously since 1977	Radioimmunoassay, some injected in animals
Carbon-14	100 microcuries	"	Radioimmunoassay
Iodine-125	5 to 10 millicuries	1977-1980	"

Radioactive waste was stored in an underground storage room until the waste decayed to an acceptable level. Liquid waste war disposed of into the sanitary sewer system in accordance with Title 10, Code of Federal Regulations. Solid wastes such as test tubes and animal carcasses were incinerated at the NAS Pensacola veteraary clinic in accordance with the NRC license.

Reportedly, two non-licensable radioactive sources were stored in Building 183 since 1974. Building 183 is a small building located directly behind Building 3229. One source contained 15 millicuries of radium, the other 100 millicuries of either radium or a combination of radium and beryllium. The sources were used from about 1965 through 1974 in research for spacecraft.

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These two sources were the only items stored in the building. In a survey performed by a NAVAEROMEDRSCHLAB employee, the radiation levels measured next to the exterior of the storage building did not exceed background.

6.4.5 Aerospace and Regional Medical Center. The medical center at NAS Pensacola closed in 1976, and operations moved to new facilities off station. Reportedly, the old medical center did not use radioisotopes.

6.4.6 Other Operations Using Radioactive Materials. Departments of NAVAIREWORKFAC and NAS Pensacola that utilized or stored commodities containing radioactive materials such as ice detector probes, depleted uranium counterweights, helicopter "BIN" indicators, and electron tubes were contacted during the IAS on-site survey. There was no evidence to suggest that these operations have resulted in environmental contamination.

6.4.7 Sampling. Soil samples ware taken during the IAS on-site survey. Figure 6-4 is a map illustrating where samples were taken. Table 6-13 lists the radioactivity concentrations found in the samples. None of the samples showed unusual radioactivity levels.

6.5 MATERIAL STORAGE

6.5.1 Hazardous Materials.

6.5.1.1. Naval Air Keworr Facility (NAVAIREWORKFAC)

6.5.1.1.1 NAVAIREWORKFAC Plating Facility. Hazardous materials have been stored in Building 604, on the 2nd floor, since the early seventies. Types of materials stored are listed in Table 6-14. All chemicals designated for separate storage on the Consolidated Hazardous Item List (CHIL) have been consolidated into one segregated storage area. Reportedly, the storage area was reorganized and cleaned up in 1981. Before that time, spills and leaks frequently occurred.

In 1979, disposal of cyanide wastes from the plating shop to the IWTP was discontinued because the system was unable to cope with the high cyanide concentrations. Cyanide wastes generated were then stored in Building 604 until the cyanide pretreatment system was begun in 1972. Since the construction of the new plating shop in 1972, cyanide wastes have been destroyed by alkaline chlorination within Building 604. Cyanide drums were occasionally spilled but then were cleaned up immediately. During the on-site survey, a few drums of cyanide-containing materials were stored in a locked cage.

6.5.1.1.2 Building 3380. Paints and solvents have been stored in Building 3380 since 1972. No spills were reported, and the storage area was noted to be well organized. Located at the east side of the building is an asphalt yard which was used for storage of drums containing paint strippers and cleaning compounds since 1972. Storage usually consisted of several hundred drums at a time. According to NAVAIREWORKF'AC personnel, materials have been lost from open drums in this area by overflowing with rain water. Prior to 1981, runoff and spilled materials ran into an open ditch passing through the center of the storage yard. In 1981, the ditch was covered with asphalt, and runoff was diverted to two sumps, with discharge control valves, which were

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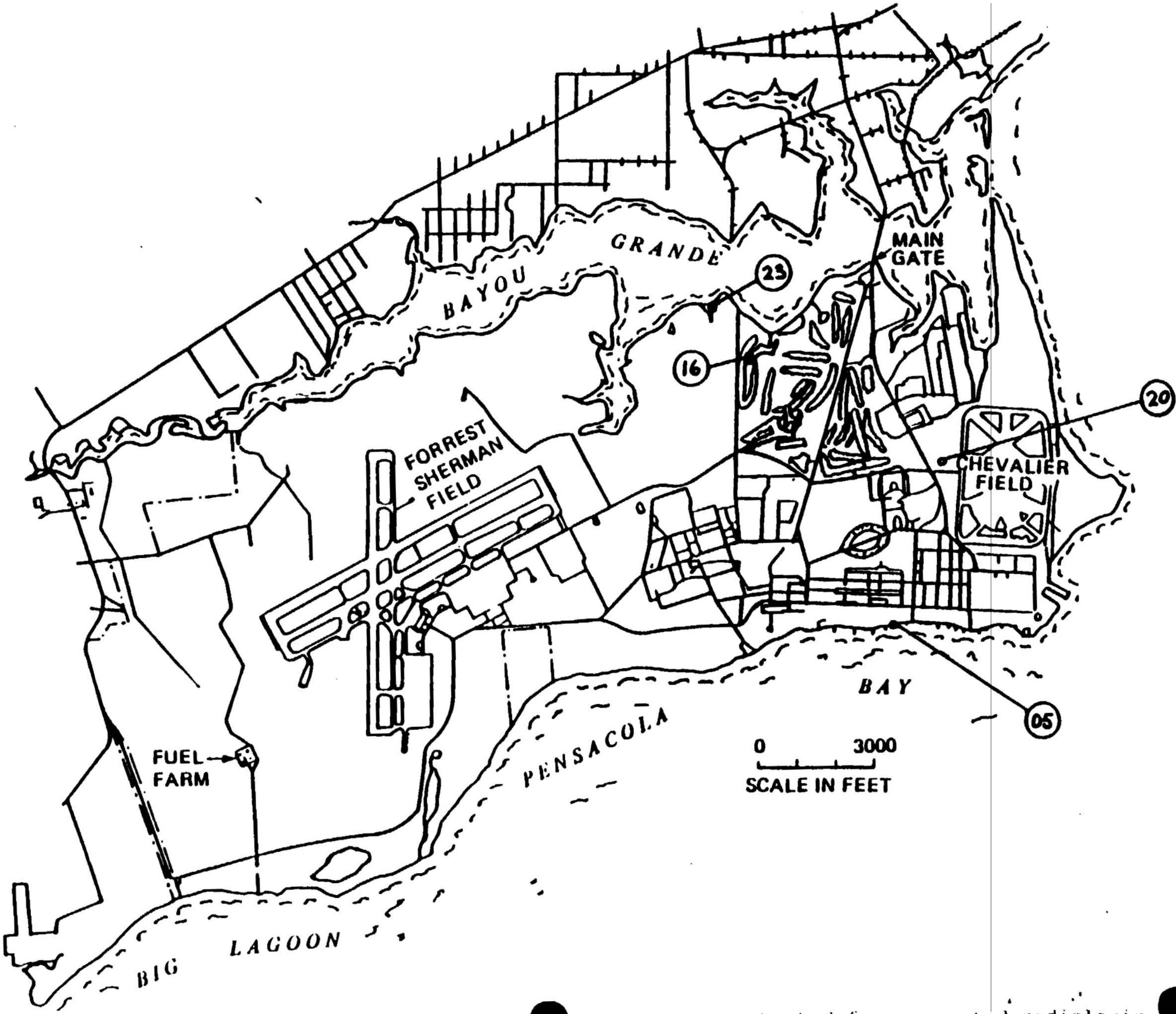

FIGURE 4. Locations checked for suspected radiological contamination. Contamination was not found.

TABLE 6-

NAS Pensacola Soil Samples

Radioactivity Concentrations

Samples Collected during NAS On-Site Survey

Sample Number	Sample Description	Radioactivity concentration Radionuclide, Picocuries per gram Uranium (Naturally Occurring)	Thorium (Naturally Occurring)	Cesium-137	Cobalt-60	Potassium-4(
05	Bottom sand, sediment Seawall at southwest corner building 382, South of Power Plant	0.2	≤0.8	≤ 0.04	< 0.04	≤0.7
16	Golf course pond sediment, near outfal from landfill	0.5	0.2	0.08	<0.04	≤0.7
20	Sediment from ditch by new Hazardous Waste Storage Facility (under construction)	≤0.8	0.1	≤0.04	≤0.04	≤0.7
23	Sediment from pond on Bayou Grande, due N of landfill	.8	≤ 1.0	≤0.1	≤0.1	<2

Comments:

Uranium and Thorium reported as naturally-occurring, with daughters such as Radium-226 and Actinium-228. Radioactivity concentrations are within normal background range.

Cesium-137 is within normal range found with fallout.

Cobalt-60 (man-made) was not detected above laboratory detector background.

TABLE 6–14

<u>AREA 1 CODE D CYANIDES</u>

POTASSIUM CYANIDE
CUPROUS CYANIDE
SODIUM CYANIDE
ENDOX 214
BARIUM CYANIDE
ALUMON
SILVER CYANIDE

<u>AREA 2 CODE C DRY STORAGE</u>

POTASSIUM HYDROXIDE
TURCO ETCHANT TFE -9H
SODIUM HYDROXIDE

<u>AREA 3 CODE B GENERAL SMRAGE (CAGE)</u>

NIPLEX NICKEL STRIPPER
NICKEL SULFATE
ALCOR 571 SEALER
POTASSIUM SODIUM TARTRATE
(ROCHELLE SALTS)
SODIUM CARBONATE
SODIUM THIOCYANATE
POTASSIUM CHROMATE
POTASSIUM IODINE
POTASSIUM CAKBONATE
AMMONIUM HYDROXIDE
SODIUM NITRATE
SODIUM CHLORIDE
AMMONIUM THIOSULFATE
RHOCO ZOXL CAD. ADD. PRENT
LIME
PARCO LUBRITE SOLUTION
PARKERIZE SOLUTION
UNICHROME 80 SALTS
SODIUM DICHROMATE
NICKEL CHLORIDE
COPPER SULFATE
SULFAMIC ACID
PLASTIC COATING COMPOUND (THERMOCOTE)
LEAD FLUOBORATE
TIN PLUOBRATE
CADIUM BRIGHTENER
CADMIUM OXIDE

<u>AREA # CODE B GENERAL STORAGE (CAGE)</u>

SODIUM THIOSULFATE
SODIUM STANNATE
IRON CHLORIDE (FERRIC) SOLUTION
MERCURY CHLORIDE
NICKEL CARBONATE
CUPRIC CARBONATE
CUPRIC SULFATE
AMMONIUM BIFLUORIDE
SULFAMIX WETTING AGENT
SULFONIC N-95
CALCIUM SULFATE
MAGNESIUM CARBONATE
SODIUM CHROMATE
SODIUM NITRITE
AMMONIUM THIOCYANATE
SULFAMIC ACID
SODIUM ACETATE
SODIUM DICHROMATE
ACETIC ACID
OXALIC ACID
AMMONIUM CHLORIDE
CALCIUM FLUORIDE
NICKEL CHLORIDE
BORIC ACID
SULFURIC INHIBITOR
HYDROCHLORIC INHIBITOR
AMMONIUM SULFIDE
FERROUS SULFATE
ZINC CHLORIDE
BARIUM CARBONATE
STANNOUS SULFATE
ANTIMONY OXIDE
UREA
AMMONIUM CITRATE
NICKEL ACETATE

(Continued)

TABLE 6-14 (CONTINUED)

AREA 10 CODE P SEPARATE STORAGE

SMUTGO #4
HYDROGEN PEROXIDE
ENDOX 114
ACTANE 821
ENSTRIP NP-1
ENSTBIP NP-2
SMUTGO -2
TURCO ALCLEAN
SODIUM STANNATE
ELECTROCLEANER

AREA 5 CODE A FLAMMABLES

HYDRAULIC FLUID, PRESERVATIVE
IRRIDITE -15

AREA 6 CODE M ACIDS

FLUOBORIC ACID
PHOSPHORIC ACID
HYDROFLUORIC ACID
HYDROCHLORIC ACID
NITRIC ACID
SULFURIC ACID
CORROSION REMOD COMP.

AREA 7 CODE N, U, V, W, COMPRESSED GAS

NITROGEN GAS, CYLINDERS

ARAEA 8 CODE G FLAMMABLES

TRICHLOROETHANE, DRUMS
LUBE OIL, VVL-800 GENERAL

AREA 9 CODE B GENERAL STORAGE

FUMETROL 101
ALODINE 1200
AMMONIUM NITRATE
UNICHROME -65
EXTHOX -980
EBONOL -C
CHROMIC ACID
ECONO CHROME -40

AREA 12 CODE G FLAMMABLES

THICHLORETHANE-AERO
SPRAYLAT MASKANT
ORGANOCERAM MASKANT
SOLVENT, CLEANING COMPOUND
TRICHLOROETHANE, GAL. CANS
UNICHROME RACKCOAT
STOPOFF LACQUER
LACQUER REDUCER
ETHYL ALCOHOL

SELECTRON CHEMICALS

NICKEL NEUTRAL
LHE CADMIUM
NICKEL SPECIAL
ACTIVATOR #1
ACTIVATOR #2
ACTIVATOR #3

installed on either side of the south end of the ditch. All runoff from Chevalier Field also runs through this ditch after passing through an oil-water separator located on the north side of the storage yard.

6.5.1.1.3 Building 225, Plant Services Building. A yard located behind Building 225 was used for storage of aircraft and aircraft parts. No hazardous materials were stored at this location.

6.5.1.1.4 Building 107, Rubber and Plastic Parts Manufacturing Repair. It was reported that metallic mercury was stored in the north end of the building. No evidence of disposal was discovered in this area.

6.5.1.2 Public Works Center.

6.5.1.2.1 Storage Area at Landfill. From 1979 to 1981, approximately 100 55-gallon drums of industrial waste were accumulated in storage on wooden pallets in a 20 by 50 foot area near the southeast corner of the landfill. The waste was reported to contain paint stripping waster. In 1981 the drums were taken to a hazardous waste disposal landfill in Sumter, Alabama. Soil in the area was stained black, indicating that leakage may have occurred.

6.5.1.2.2 Building 71. Building 71 has been used as an interim hazardous waste storage facility since 1980. Storage usually consisted of approximately eighty 55-gallon drums, but occasionally the number reached several hundred. The drums contained wastes from NAVAIREWORKFAC paint stripping operations. The building has floor drains which flow to the IWTP in the event of spillage.

6.5.1.2.3 Transformer Storage. Prior to 1976, approximately 200 transformers were stored in a fenced, asphalt yard behind Building 1554. These transformers were in all types of condition, ranging from usable and intact to non-working and leaking, including those awaiting disposal by DPDO. Transformer fluids remained in the transformers while they were stored at this yard. In 1976, these transformers were tested for PCB content. Those containing PCB were then moved to Building 47, the old power plant, for storage. A sample of oily residue was taken from the pavement in the storage yard during the NACIP on-site survey. A high level of PCB content was discovered in the residue. For details of this finding, see Section 6.6.17.

6.5.1.2.4 Building 47. PCB-contaminated transformers and materials were stored in Building 47 from 1976 to 1981. The transformers were stored in two separate areas for spill protection, but no spills were reported. In 1981, a hazardous waste disposal company removed the waste from Building 47 for disposal either at their Emelle, Alabama, landfill or by incineration at sea.

6.5.1.2.5 Building 29. In past years, Building 29 was used as a hazardous material storage area. The building was located at map coordinates H-18 but has since been torn down.

6.5.1.2.6 Building 3561. Hazardous materials for public works were most recently stored in Building 3561. Table 6-15 lists chemicals most recently in storage.

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TABLE 6-15
Hazardous Material Storage in Building 3561

Sodium Metaphosphate	1 Pallet
Clobber Sulfuric Acid	
Hydrochloric Acid	2 Pallets
Oil Chevor 32 & SAQ 50	1 Pallet
Floor Covering Adhesive	1 Pallet
Scale Dissolver Hydrochloric Acid	1 Pallet
Calclean Contains Sodium Melasticicate	1 Pallet
Caustic Soda	2 Pallets
Sodium Fluoride	1 Pallet
Aluminum Sulfate	1 Pallet
Acetic Acid Glacial	1 Pallet
Acid Hydrofluoro Silici H/2 SF 6	1 Pallet
Seal Kote Combustible	1 Pallet
Floor Stripper Contains Methanol and Methylene Chloride	1 Pallet
Acid Hydrofluora Silicic H/2	10 Pallets

*Does not include paint storage.

6.5.1.3 NAS Supply Department

6.5.1.3.1 Building 684. Building 684 has been the designated hazardous material storage building for the Supply Branch since 1942. Materials stored include paints, acids, paint removers, cleaners, hydraulic oil, motor oil, greases, glues, and some radioactive material. Small spills and leaks have occurred throughout the building's history, but no major spills have yet been reported. Details of the spills and leaks can be found in Section 6.6.26.

6.5.1.3.2 Building 226. Approximately five to six hundred 55-gallon drums containing hazardous materials were stored on the asphalt lot beside Building 226. Spills and leaks in this storage area were common, according to installation personnel.

Located on a separate area of the asphalt, around the corner of Building 226, was a storage area for empty compressed gas cylinders. There were several hundred cylinders which had contained chlorine gas, ammonia, acetylene, oxygen, and other gases.

6.5.1.3.3 Building 781A. Compressed gas cylinders have been stored in Building 781A since the 1950s. There have been several leaks reported from chlorine gas cylinders over the years. In such incidents the fire department was called in to dispose of the leaking cylinders. The usual method of disposal in the past was usually to drop the cylinder and release the contents into the water tank located beside the Firefighting School, Building 1713.

6.5.1.3.4 Building 740. The lot behind Building 740 and just north of Building 781 was reportedly used for storage of materials awaiting disposal up until the 1960s when storage was moved to Building 226.

6.5.1.4 Defense Property Disposal Office (DPDO).

6.5.1.4.1 Building 684. DPDO used a small caged area in Building 684 for storage of hazardous materials. Table 6-16 lists types of materials stored in that area. Until December of 1981, 3,600 pounds of 20% DDT solution were stored in 55-gallon drums next to the DPDO cage awaiting disposal. The drums had been damaged in shipment and then recontainerized in 1976 to avoid leakage. The DDT solutions were collected by a disposal contractor and incinerated at sea.

6.5.2 Fuel and Waste Oil Storage.

6.5.2.1 Fuel Storage. Location and other data on fuel storage tanks are summarized in Table 6-17.

6.5.2.1.1 Fuel Farm. Six monitoring wells are located around the perimeter of the fuel farm. According to personnel, however, the wells are not used. There has never been any reportd fuel loss from the farm tanks. The tanks were cleaned by a contractor in 1981. The sludge was pumped into drums and disposed of at a site not located on the NAS complex.

6.5.2.1.2 Aviation Gas (AVGAS) Tanks. From about 1951 until 1967, the AVGAS tanks off Radford Boulevard, structures numbered 638, 640, 641, 642, 643, 644, 356, and 357, were cleaned once a year. Installation personnel reported that

TABLE 6-16

Hazardous Material Storage at DPDO

MATERIAL	QUANTITY
Extinguisher, Fire	1
Duplixer	41
Battery, Storage	42
	3 drums
	1
	1 cn
	2 cn
	6 gallons
	770 lbs.
	56 Bt
	2 drums
	11 Bt
	1 drum
	2 drums
	10 kits
	2 drums
	48 pints
	2 gallons
	13 cn
	63 gallons
	84 gallons
	32 quarts
	20
	12 kits

TABLE 6-17

Fuel/Oil Storage Tanks at NAS Pensacola

LOCATION	#	TYPE	NOS.	MAP COORDINATES	YEARS IN USE	SIZE
				K-21	1941-present	12,000 GAL/EA
				K-20	1940-present	100,000 GAL/EA
Above Ground	2	AVGAS	356 357	K-21	1927-present	90,000 GAL/EA
LEX Pier Above Ground	1	Navy Special Fuel Oil Distillate DFM JP-5	354	K-26	1926-1969 1969-1972 1972-1974 1974-present	1,300,000 GAL
Fuel Farm Below Ground	4	JP-4	1884 1885 1887 1888	D-5	1955-present	567,000 GAL/EA
Fuel farm	1	Water Contaminated Fuel		0-5		
Below Ground	2	DFM	1681 682	F-23	1943-present	
Behind PW Above Ground	1	Diesel Fuel .		H-8	1930s-present	
Behind PW Below Ground	2	Gasoline		H-8		10.000 GAL/EA
Along N. Side of Redford Blvd.	5	AVGAS	640 641 642 638 402	J-20 J-21	1940-1960	90,000 GAL/EA
Above Ground	2	Fuel Oil	47B 47C	J-25	1932-present	8,778 GAL/EA
		Lube Oil Storage Facility	259	J-25	1918-present	
Under Ground	1	Ship Fuel Storage Tank	682	F-23	1943-present	127.000 BL
Above Ground	2	Oil Storage Tank	1782 1783	J-22	1953-present	24,000 GAL/EA
Above Ground	1	Fuel Oil Tank	1942	K-12	1954-present	81,396 GAL/EA

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sludge was removed from each tank and buried in an area between the tank and the surrounding concrete berm. Eventually, sludge was buried around the entire circumference of the tank. The details of this disposal practice can be found in Section 6.6.21.

6.5.2.2 Fuel Spills.

6.5.2.2.1 Chevalier Field. Fuel branch personnel inspected the pipelines every three months to monitor for leakage. After noticing dead grass along a ditch beside Chevalier Field in 1965, a leak was discovered in a pipeline carrying Navy Special Fuel Oil (NSFO). This fuel was pumped from the groundwater table, and contamined soil was removed. Some time between 1968 and 1970, another leak was discovered in the same area in a pipeline carrying Diesel Fuel Marine (DFM). Reportedly, a layer of fuel is present on the water table surface, and soil in the area appears contaminated with oil. Details of these spills can be found in Section 6.6.23.

6.5.2.2.2 Berthing Pier Pipeline Leak. In 1981, a contractor driving pilings at the berthing pier, structure number 303, discovered oil in the ground. Apparently, pipes that had originally carried fuel out to the pier had been blanked off years ago. Either the pipelines had broken during construction or the fuel had leaked out of the pipes over the years. The Port Services Division contained the spill and reportedly cleaned up the fuel. Details related to this spill can be found in Section 6.6.20.

6.5.2.2.3 JP-5 Spill. In 1976, according to fire department personnel, fuel was spilled over an area "the size of three city blocks" near Building 45. The fuel spill was cleaned up and salvaged, and resulted in minimal disposal. Very little fuel, if any, entered the bay.

6.5.2.2.4 Fuel Farm Pipeline Leak. Fuel farm personnel reported that in 1958, when operations at the fuel farm began, a leak developed in a section of pipeline leading from the tanks and running through a nearby swamp. The leak covered the swamp with a layer of fuel. Trees in the immediate area were killed. After the spill, the underground pipeline was replaced with an insulated, above-ground pipeline. Details related to this oil spill can be found in Section 6.6.19.

6.5.2.2.5 Harbor Spills. Port Services Division is reponsible for containment and cleanup of any fuel or oil spills in the harbor. Reportedly, most spills consisted of quantities in the range of 50-400 gallons.

In March 1979, diesel fuel, marine (DFM) was spilled while refueling the **USS LEXINGTON.** Port Services Department reported that approximately 2,600 gallons of fuel were recovered and 2,600 gallons remained in the water.

6.5.2.3 Waste Oil Tanks. Methods for disposal of waste oil included removal by contractor, disposal through the IWTP, and disposal to the crash crew fire training activity. Table 6-18 lists capacities and locations of all waste oil collection tanks. Figure 6-5 shows the locations of all collection tanks. It is not known how long the tanks have been used, but some were reportedly

TABLE 6-18
Waste Oil Collection Tanks at NAS Pensacola

a. Naval Air Sracion, Pensacola

Location	Storage container Capacity in Gallons	Number and Type Container
Bldg. 632(w)	500	1 each bowser (above ground)
Bldg. 1854	500	1 each bowser (above ground)
Bldg. 3260	500	1 each bowser (below ground)
Bldg. 1853(E)	500	1 each tank (below ground)
Bldg. 1853	165	3 each drums (above ground)
Bldg. 146	165	3 each drums (above ground)
Pier 302	N/A	Tugboat bilges and engine oil

b. Navy Public Works Center, Pensacola

Location	Storage Container Capacity in Gallons	Number and Type Container
Bldg. 782	500	1 each tank (above ground]
Bldg. 1771	220	4 each drums (above ground)
Bldg. 3297	2500	1 each tank (below ground)

c. Naval Air Rework Facility, Pensacola

Location	Storage Container Capacity in Gallons	Number and Type Container
Bldg. 225(NE)	220	4 each drums (above ground)
Bldg. 604(NE)	1500	1 each tank (below ground)
Bldg. 607(NE)	220	4 each drums (above ground)
Bldg. 631(W)	500	1 each rank (above ground)
Bldg. 631(N)	2000	1 each tank (below ground)
Bldg. 649(N)	500	1 each tank (below ground)
Bldg. 2691(E)	55	1 each drum (above ground)
Bldg. 3220(S)	500	1 each tank (below ground)
Bldg. 3221(E)	500	1 each tank (below ground)
Bldg. 3221(W)	500	1 each tank (below ground)
Bldg. 3460(E)	220	4 each drums (above ground)
Bldg. 3460(W)	220	4 each drums (above ground)
Bldg. 3460(NE)	220	4 each drums (above ground)
Bldg. 3556(E)	275	5 each drums (above ground)

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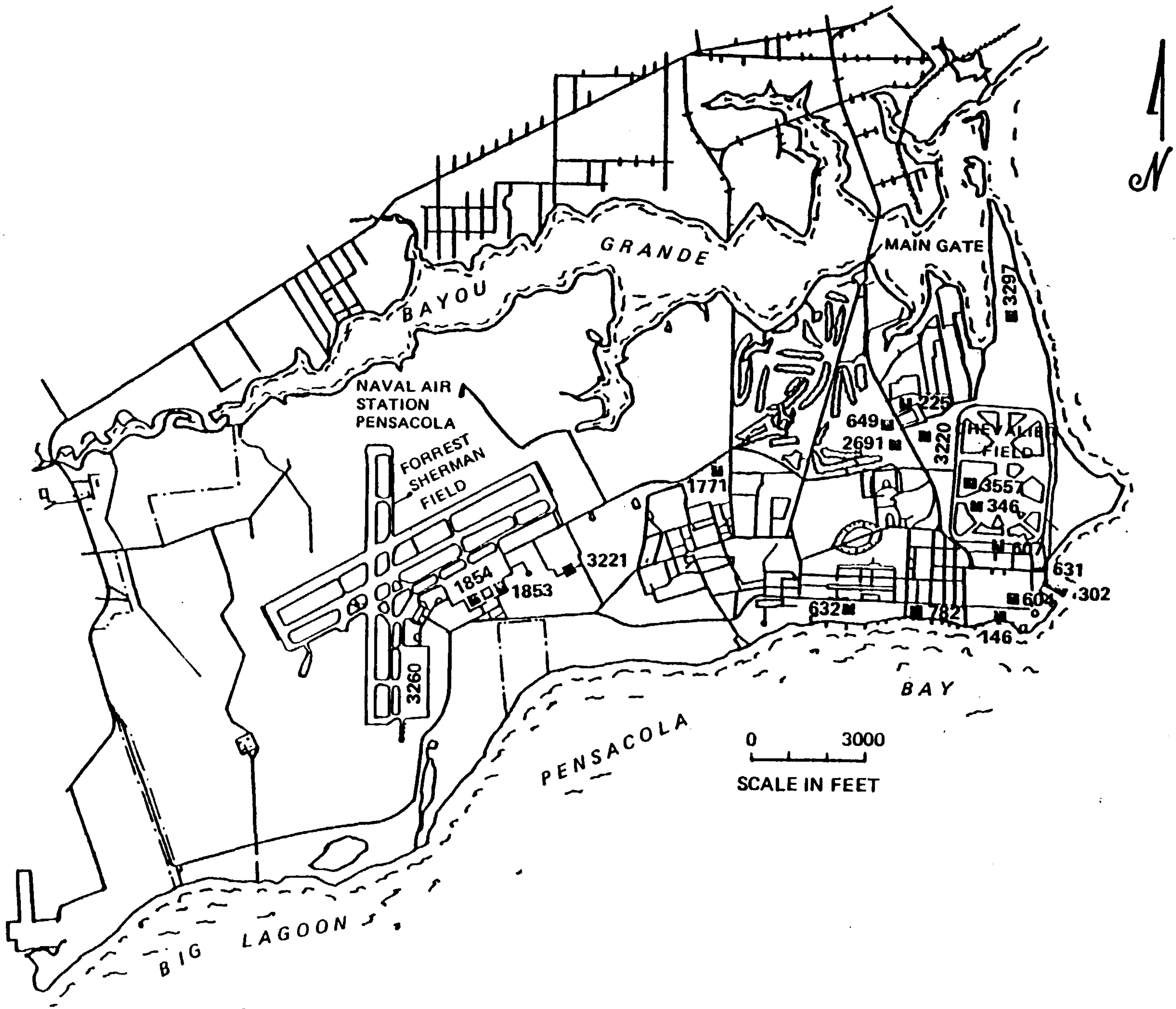

FIGURE 6-5 Location of Waste Oil Collection Points

installed prior to 1946. Approximately 85,000-100,000 gallons per year of waste oil is collected from the tanks by a contractor. Some of the oil is contaminated with hydraulic fluids, acids, and paint strippers, according to installation personnel. The contractor reprocesses the oil for recycling.

6.6 DISPOSAL OPERATIONS. This section includes a detailed description of each site selected for investigation during the IAS. All information in this section came from activity records, interviews with activity personnel, and physical inspection of sites.

6.6.1 Sanitary Landfill (Site 1). In the early 1950s, a new station disposal site vas started at NAS Pensacola. This disposal site was located northeast of Fort Redoubt, just west of Hole 15 of the golf course. An area approximately 2,000 feet north of this disposal site was used for open disposing of rubbish and rubble from demolition, construction, and grounds maintenance. The station disposal site was moved approximately 3,000 feet north, some time around 1960, to a position adjacent to the rubble disposal site. The rubble disposal site was used throughout this time. In the late 1960s the station disposal site was moved south to the area commonly known at NAS Pensacola as the landfill. The landfill was officially closed on 1 October 1976. Figure 6-6 gives the locations of these disposal sites, which, when combined, comprise Site 1. The first two station disposal sites mentioned above were used for burning refuse and other materials. Paint wastes, solvents, waste oils, and other flammable materials were burned and the resulting ashes were landfilled. In the 1970s, with the advent of citizen's concern over pollution, much less burning of flammable wastes was done in an area that was part of the 1960s section of the disposal site.

The landfill accepted waste from several outlying fields (OLFs) including Corry, Saufley, Ellison, Baron, and Whiting Fields, in addition to wastes generated by NAS Pensacola. A partial listing of wastes disposed of at Site 1 is found in Table 6-19. It should be noted that there is no indication that any radiological material was disposed of in Site 1.

In 1974, an abandoned drain field began discharging leachate from the landfill into a pond on the golf course. The drainfield outlet was temporarily plugged, causing the groundwater table to rise and eventually resulted in the closing of the landfill. At approximately this time, several groundwater investigation wells were installed and samples were taken from the wells. Crawford, 1975, on the results of the groundwater investigation, reported elevated levels of groundwater contaminants in wells near the landfill. Also reported was a groundwater flow in the direction of Bayou Grande. It was concluded that there was some contamination of the upper portion of the sand-and-gravel aquifer underlying NAS Pensacola.

During the on-site survey, the NACIP team obtained samples of leachate from Site 1. Sediment samples from the leachate point of entry into Bayou Grande were also taken. The samples were analyzed for several of the contaminants believed to Be in the landfill. The results of chemical analysis are shown in Table 6-20. The approximate locations of the sampling points are shown in Figure 6-6.

6.6.2 Waterfront Sediments (Site 2). Prior to connecting to the industrial waste collection and treatment system about 1973, industrial wastes from NAVAIREWORKFAC Pensacola operations were discharged untreated into Pensacola

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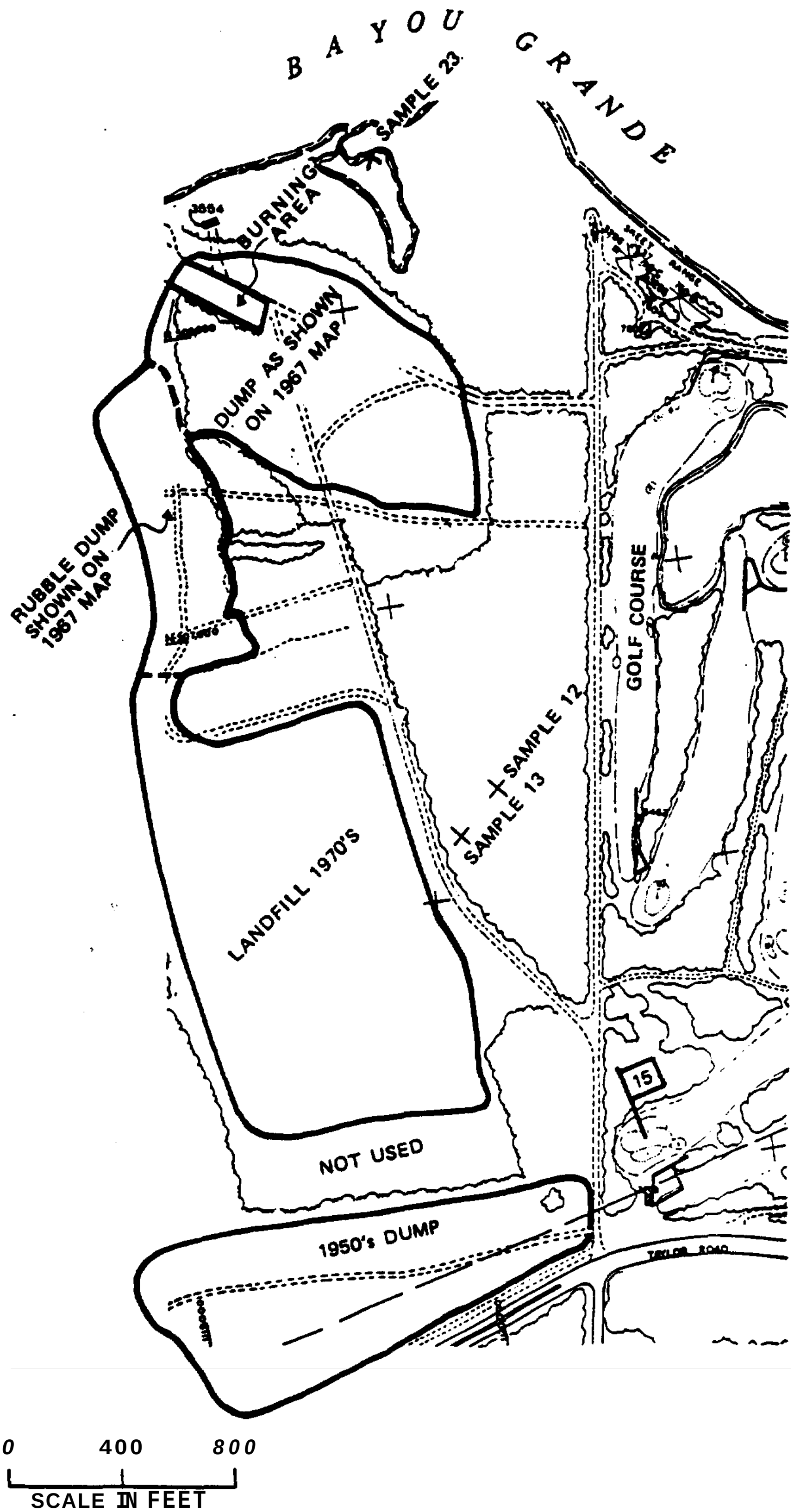

FIGURE 6-6 Historical landfill use. Several discrete areas of the landfill were used at different times.

TABLE 6-19

Partial List of Items

Disposed of In Sanitary Landfill

Approximate Date	Item	Total Amount Disposed	Comments
1950s-1976	Ketone soaked rags		
1950s-1976	PCB and Transformer Oil Soaked Rags	6,500 ft^3	
1950s-1976	Paint Chips		Contaminated with paint strippers
1[redacted]62-1976	Paint Sludge From Water Wall Paint Booth	170,000 lbs.	
[redacted]50s-1962	Paint Sludge	5,200 gals.	Burned at North end of site
1950s-1976	Dry Air Filter Pads from Paint Booths	11,963 ft^3	
1960-1964	Compressed Gas Cylinders	200	
1973	Asbestos From Building Demolition		
1967	Wood Soaked With Plating Solutions		Chrome, Nickel, Lead, Cadmium, Tin and Other In-organic Chemicals
1970-1976	Pesticide Rinseate		
1950s-1976	Garbage	64,800 Tons	
1950s-1976	Wastes From OLFs Corry, Ellison, Saufley, Baron, and Whiting		
1950s-1976	Containers From Paints, Pesticides, Oils, Strippers, Plating Chemicals, Solvents, Thinners, etc.		
1950s-1976	Mercury		

Table 6–20

Results of Chemical Analysis
of
Water and Sediment Samples at the Sanitary Landfill

SAMPLE NO.	DATE OF SAMPLING	TYPE OF SAMPLE	DESCHIPSION OF SAMPLING LOCATION	CADMIUM	CHROMIUM	MERCURY	NICKEL	LEAD
12	28 Jan 82	Water	Leachate, east side of landfill	0	0	0.2*	–	–
13	28 Jan 82	Water	Leachate, upstream, of 12 by 10, east side of landfill	0.7	0	N	–	–
18	28 Jan 82	Sediment	At bridge between Golf Course Pond and Bayou Grande	0.14	2.5	0.016	0.70	26
23	28 Jan 82	Sediment	Pond near Bayou Grande North of Sanitary Landfill	2.3	19	0.2	4.0	51

Bay. Notable wastes discharged into the bay included waste thinners, paints, paint strippers, paint chips, ketones, trichloroethylene, metal plating chemicals (primarily, chromium, cadmium, lead, and nickel' , mercury, and relatively small amounts of cyanides. In addition to the : chemicals, any chemical disposed of into a drain discharged into Pensaco.a Bay. A list of chemicals used at NAVAIREWORKFAC Pensacola is shown in Table 6-2. Table 6-21 is a partial list of chemicals reportedly discharged into Pensacola Bay.

Many of the chemicals discharged to the bay were biodegradable or would have been flushed out to the Gulf of Mexico from normal tidal fluctuations. Some chemicals, in particular inorganic compounds containing metals such as chromium, lead, mercury, and cadmium, may have been deposited in the sediments of the bay.

It is important to point out here that commercial sources of water pollution are located in the Pensacola Bay watershed. These industrial plants were not surveyed by the NACIP team; but, it is probable that these plants discharged wastes similar to the Navy's into the bay. Any waste discharged into the bay, by private industry or the Navy, potentially could be deposited in the sediments anywhere in Pensacola Bay.

Pensacola Bay is owned by the State of Florida. However, the intertidal zone of Pensacola Bay, the portion of land above the high-water line that adjoins NAS Pensacola, is owned by NAS Pensacola. The intertidal zone is of special interest due to the presence of shellfish beds along the shoreline. If the sediments are contaminated with a toxic metal such as chromium or mercury, then these metals can be taken up by the shellfish, concentrated, and stored in their tissues causing a potential threat to human health.

During the on-site survey, the NACIP team sampled the sediments of Pensacola Bay adjoining the base. The samples were analyzed for several of the known contaminants discharged by the Navy into Pensacola Bay. The results of the chemical analysis are shown in Table 6-22. The location of the sampling points are shown in Figure 6-7. No standard exists to define safe levels of a contaminant in a sediment. To get an idea of relative toxicity of the materials analyzed for, the EP toxicity limit is shown. The EP toxicity test involves the leaching of a contaminant from a solid sample and the limit shown is the level above which a material is considered hazardous. The results of sample analysis shown in Table 6-22 is the total amount of contaminant in the sample, not the amount that is leachable from the sample. If the EP toxicity test would have been performed on these samples, the results obtained would have been less than or equal to the rerults shown.

During the on-site survey, shellfish samples were not collected for analysis of tissue for metals concentrations. The concentrations of the contaminants in the shellfish may be higher than that of the surrounding sediments due to bioaccumulation. The potential for human health effects from eating contaminated shellfish from NAS Pensacola intertidal waters exists.

6.6.3 <u>Crash Crew Training Area (Site 3)</u>. From the late 1950s until the present, this site was used for traning firefighters to put out fires involving aircraft. Fuel was burned in open, unlined pits to simulate an aircraft crash fire situation. Aircraft fuel contaminated with water was collected and delivered to the site for use in the training. The aircraft

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TABLE 6-21

Partial List. of Chemicals
Discharged into Pensacola Bay

Approximate Date	Chemical	Total Amount Discharged	Comments
1962-1973	Waste Alodine	35,000 gallons	contains a total 130 kg. of chrome.
1939-1973	Waste Paint Thinners and Waste Paint	340,000 gallons	
1939-1973	Waste Paint Strippers	6,100,000 gallons	
1939-1973	Waste Ketone from Paint Stripping	4,600,000 gallons	
1939-1973	Waste TCE from Paint Stripping	1,100,000 gallons	
1939-1973	Concentrated Plating Wastes	71,000,000 gallons	chrome, nickel, lead, cadmium, tin, and ocher inorganic chemicals.

TABLE 6-22

RESULTS OF CHEMICAL ANALYSIS OF SEDIMENT SAMPLES OF PENSACOLA BAY AND BAYOU GRANDE

Sample Number	Date of Sampling	Description of Sampling Location	Sample Associated with Site Number	mg/kg Dry Weight				
				Cadimum	Chromium	Mercury	Nickel	Lead
02	28 Jan 82	East Side of Seaplane Ramp between bldgs. 73 and 73	2	0.37	3.1	0.0060	1.4	11
03	28 Jan 82	West Side of Seaplane Ramp between bldgs. 72 and 73	2	ND	8	0.022	-	-
04	28 Jan 82	East Side of Training Pier Building 3238	2	0.13	1.1	0.010	-	-
05	28 Jan 82	Adjacent to seawall by Power Plant Discharge	2	0.12	0.69	0.031	0.06	5.0
19	28 Jan 28	Swampy area of Bayou Grande about 100 yds north of bridge (Building 1875)	11	140	8900	2.0	27	650
EP Toxicity Limits				1.0	5.0	0.2	No Limit	5.0

ND: None detected.

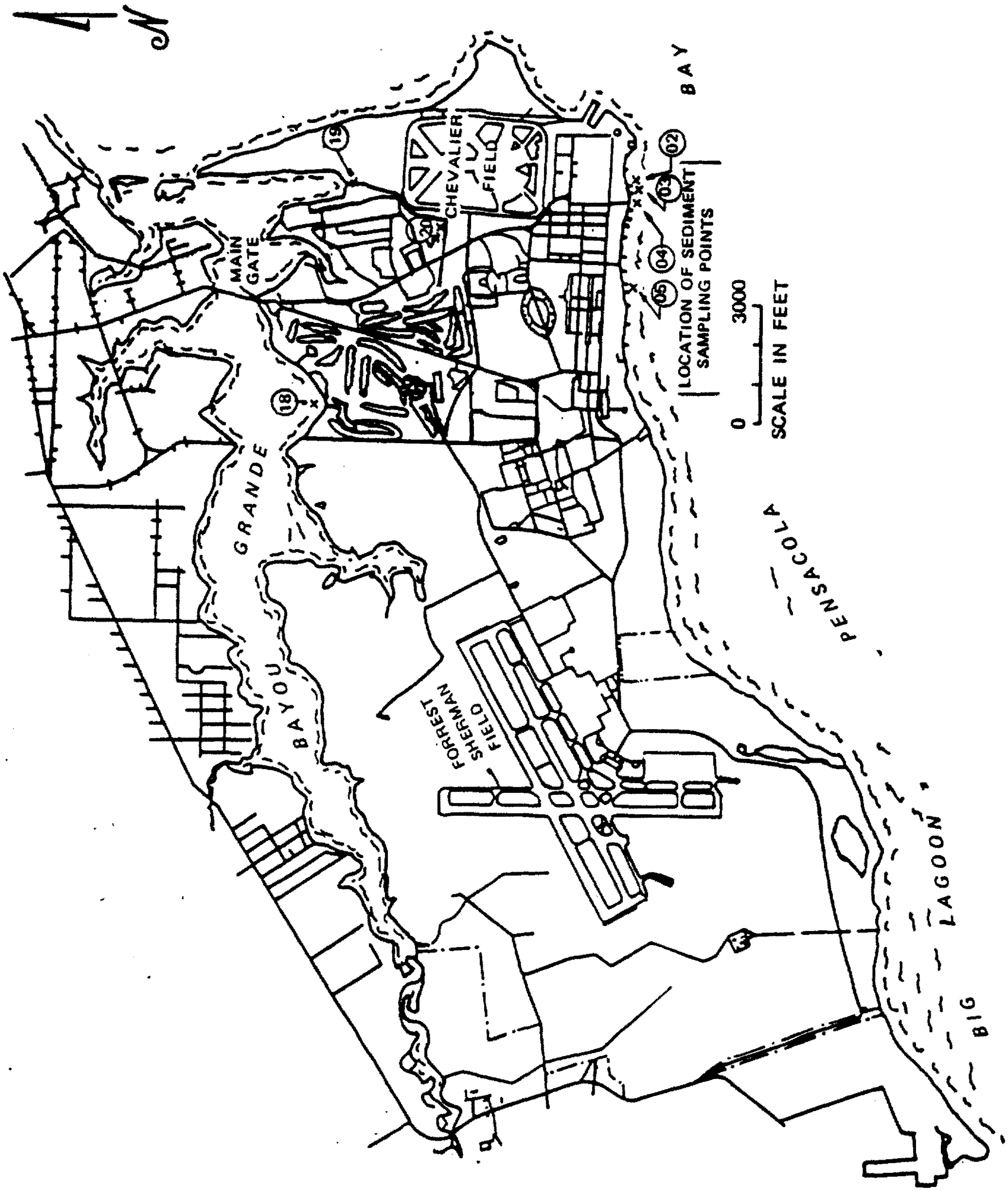

FIGURE 6-7 Locations of Sediment Sampling Points

fuel was burned in 30 to 50-gallon batches. About five fires per day were set using as much as 250 gallons of fuel per day. The major part of the fuel must have Been burned off, but it can be assumed that some of the fuel soaked into the soil under the unlined pits. It is estimated that about 200 gallons per week was disposed of here. This site is located near the southwestern portion of Forrest Sherman Field at coordinates L-8 through M-8 on the general development map. The dimensions of the site are approximately 1,300 feet by 2,600 feet. The materials disposed of here included JP-4, JP-5, AVGAS, and lube oil.

Various mixtures of the above materials were burned in the pits. The entire crash fire training area is covered with a layer of blackened sand. Some pits are still in use and others are abandoned. Figure 6-8 depicts the relationship of the pits to each other and to Sherman Field. The fire pits contained aircraft fuselage sections and steel cockpit simulators. Some or the pits contained standing water with oil slicks, indicating that not all the fuel was burned. The standing water on some pits was covered with a film of oil.

6.6.4 Army Rubble Disposal Site (Site 4). About 1951, the old Army barracks in Fort Barrancas were torn down. The rubble from this demolition was disposed of near what is now Building 3260 at Forrest Sherman Field. The rubble included timber, pipes, mattresses, and other demolition wastes. No burning was conducted at this site, and from all reports, no hazardous materials were disposed of here. The site is located at coordinates L-10 of the NAS Yensacola General Development Map. The site is rectangular shaped, measuring about 150 feet by 900 feet. Figure 6-9 shows the approximate boundaries of Site 4.

6.6.5 Borrow Pit (Site 5). About 1976, this site was cleared and soil was removed for cover material for the activity's sanitary landfill. The site, located to the east of Building 3221, is currently cleared with little or no vegetation growing on it. No reports of hazardous waste disposal were made during the survey. Visual inspection of the site by the NACIP team confirmed that no hazardous materials were disposed of at the site. The site is basically rectangular shaped, measuring about 650 by 800 feet. Figure 6-10 shows the approximate boundaries of Site 5.

6.6.6 Fort Redoubt Rubble Disposal Site (Site 6). From about 1973 to present, this site has been used for a rubble disposal. The site, adjacent to Site 5, has reportedly received rubble and demolition wastes from the removal of several buildings on base. During the visual inspection of the site by the NACIP team, concrete, wood, metal, and a few plastic items were observed at the site. No evidence of hazardous waste disposal was found relating to this site. The site is basically rectangular shaped, measuring about 450 by 1,650 feet. Figure 6-10 shows the approximate boundaries of Site 6.

6.6.7 Firefighting School (Site 7). Firefighter training has been located in Building 1713 since 1940. The IAS team determined that there is no evidence that hazardous materials were disposed of here.

6.6.8 Rifle Range Disposal Site (Site 8). It was reported that an abandoned disposal site exists at the location of the present Public Works Building, Building 3561. According to installation personnel, the disposal site was

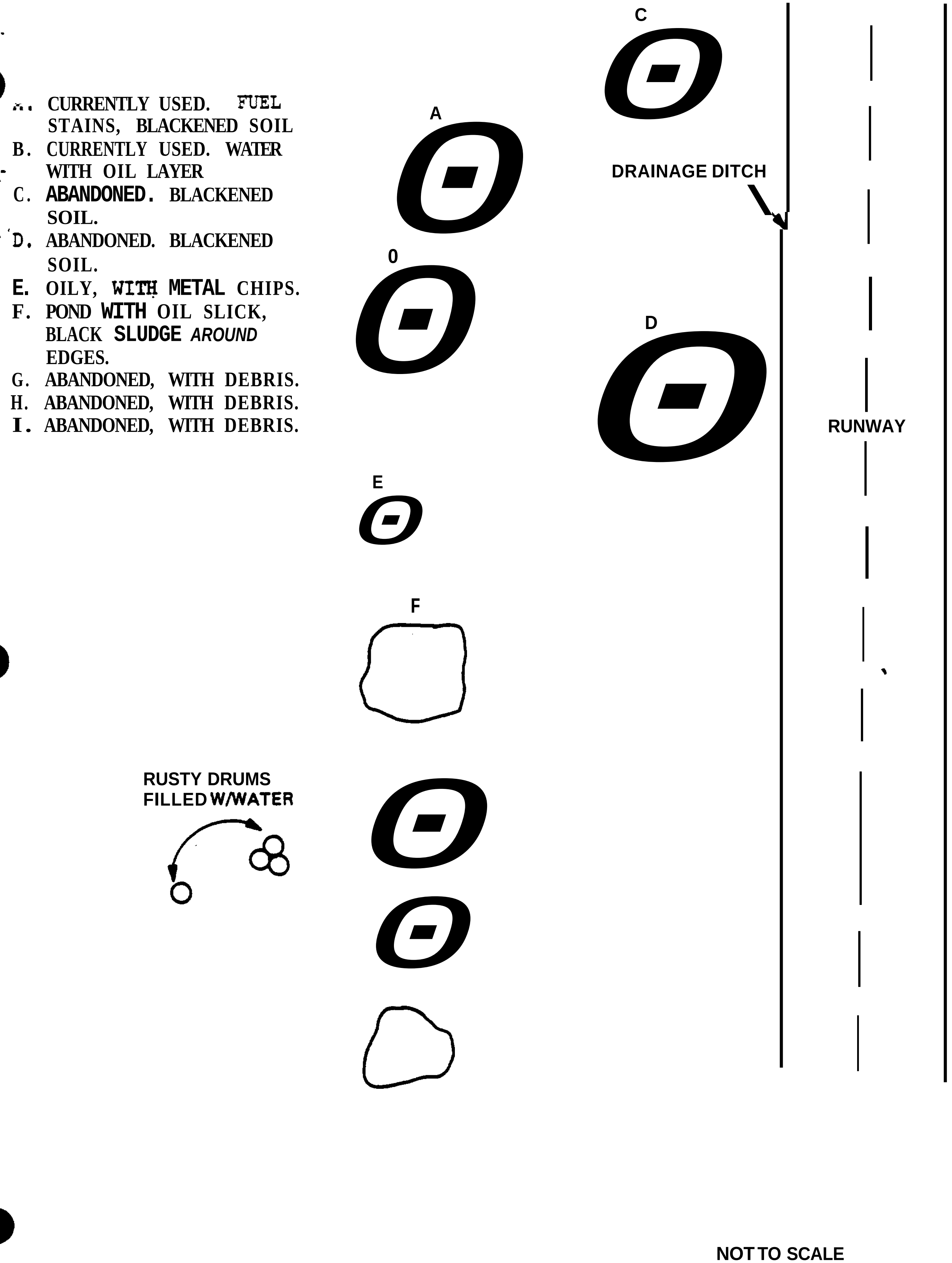

FIGURE 6–8 Locations of the crash crew training area fire pits.

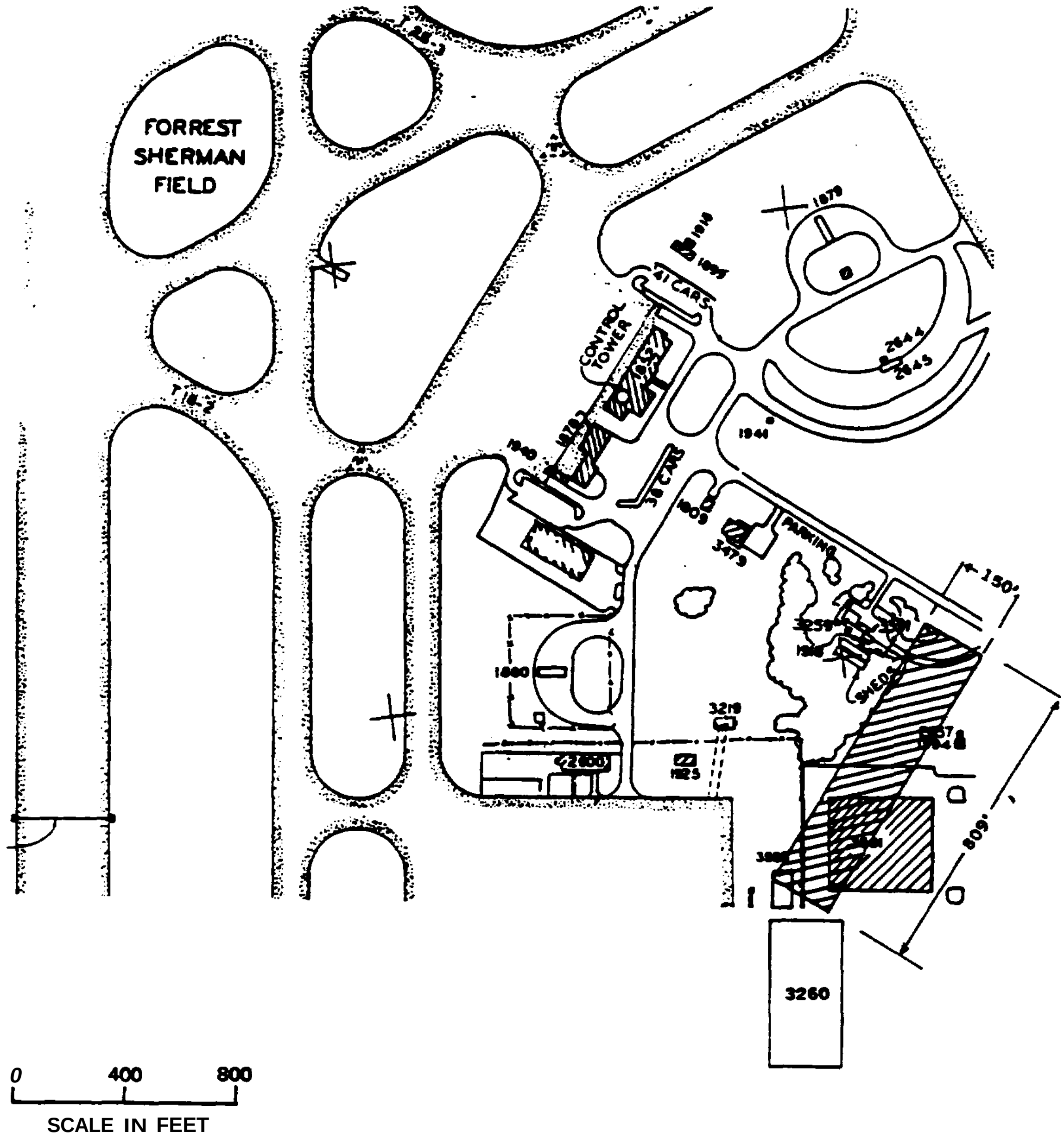

FIGURE *6-9* **Approximate boundaries of the Army rubble disposal site, Site 4.**

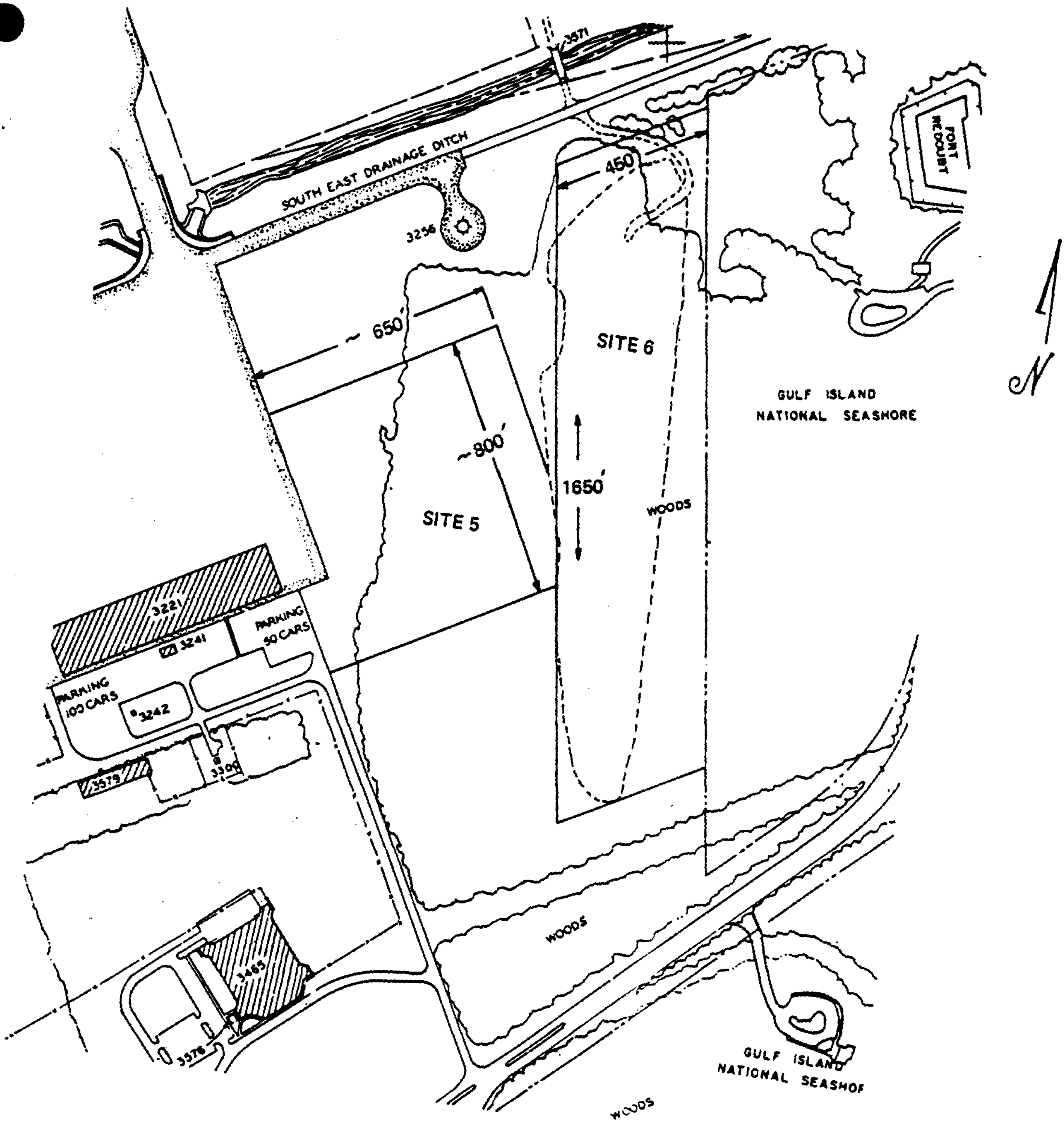

FIGURE 6-10 APPROXIMATE BOUNDARIES OF THE BORROW PIT (SITE 5) AND THE FORT REDOUBT RUBBLE DISPOSAL SITE (SITE 6)

operated from about 1955 to 1965. It was reported that the disposal site received solid wastes, primarily paper. The dry garbage was reported to have been placed in a trench about 12 feet wide by 7 feet deep by about 50 feet long and burned overnight. Aerial photos taken in 1951, 1958, and 1965 and maps of the 1950s and 1960s show that a rifle range was located there prior to the construction of Building 3561.

Aerial photos of January 1951 do show some sort of excavation being performed at the northern end of the rifle range (where Building 3561 is located); but no indications of dry garbage disposal are present. Aerial photos of January 1958 and January 1965 show the excavated area to be overgrown with vegetation. These photos contradict the report of dry garbage being disposed of at this site from 1955 to 1965.

Installation personnel reported that no garbage or residue were encountered during the construction of Building 3561. Also, no reports were found indicating any contamination of the site since the construction of Building 3561. Building 3561 and its parking lots currently cover the majority of the excavated area noted in the January 1951 photos. Visual inspection of the site by the NACIP team did not reveal any environmental contamination or any indication of the site being previously used for disposal. Even though it was reported to the NACIP team that the site was used for disposal, the aerial photographs, maps, and inspection of the site indicate that no environmental contamination exists at the site.

6.6.9 Navy Yard Disposal Site (Site 9). From the early 1900s until the early 1930s, a disposal site was located just northwest of the old yard wall. This disposal site is shown on several old maps and was known as the Navy Yard Dump or the Warrington Village Dump. The site is located at coordinates I23-24, H23-24 of the NAS Pensacola General Development Map. In the late 1960s, while trenching for the IWTP system, part of this disposal site was unearthed. Unearthed items included steel vehicle parts, broken glass, scrap metal, and debris. The bottom of this section of the disposal site was below the water table. No unusual odor was associated with the disposal site. Figure 6-11 gives the probable boundaries of the disposal site. Due to the age and accuracy of the maps used as references, Figure 6-11 represents the approximate location and boundaries of the disposal site.

6.6.10 Commodore's Pond (Site 10). At the same time Site 9 was unearthed, live oak timbers were dug up at the site of Commodore's Pond, located at coordinates H-23 of NAS Pensacola General Development Map. In the late 1800s the shaped oak timbers were placed in the pond to preserve the wood. There was no indication that other material had been disposed of there. The timbers were removed in the late 1960s and reburied on Magazine Point.

6.6.11 North Chevalier Field Disposal Site (Site 11). Located at the end of a branch of Bayou Grande, this disposal site was used from the early 1930s to the mid-1940s for burning refuse. Wastes from aircraft engine overhauls, other waste oils, lumber, and other burnables were disposed of at this site. Approximately 24 cubic yards per day of such items were disposed of there. An unknown number of 55-gallon drums were also found at this site during its operation. From the time of the site's operation until the early 1950s, oil slicks were noted in the Bayou branch during heavy rains. In 1981, a well was sunk into this old disposal site. The well showed that there was still oil

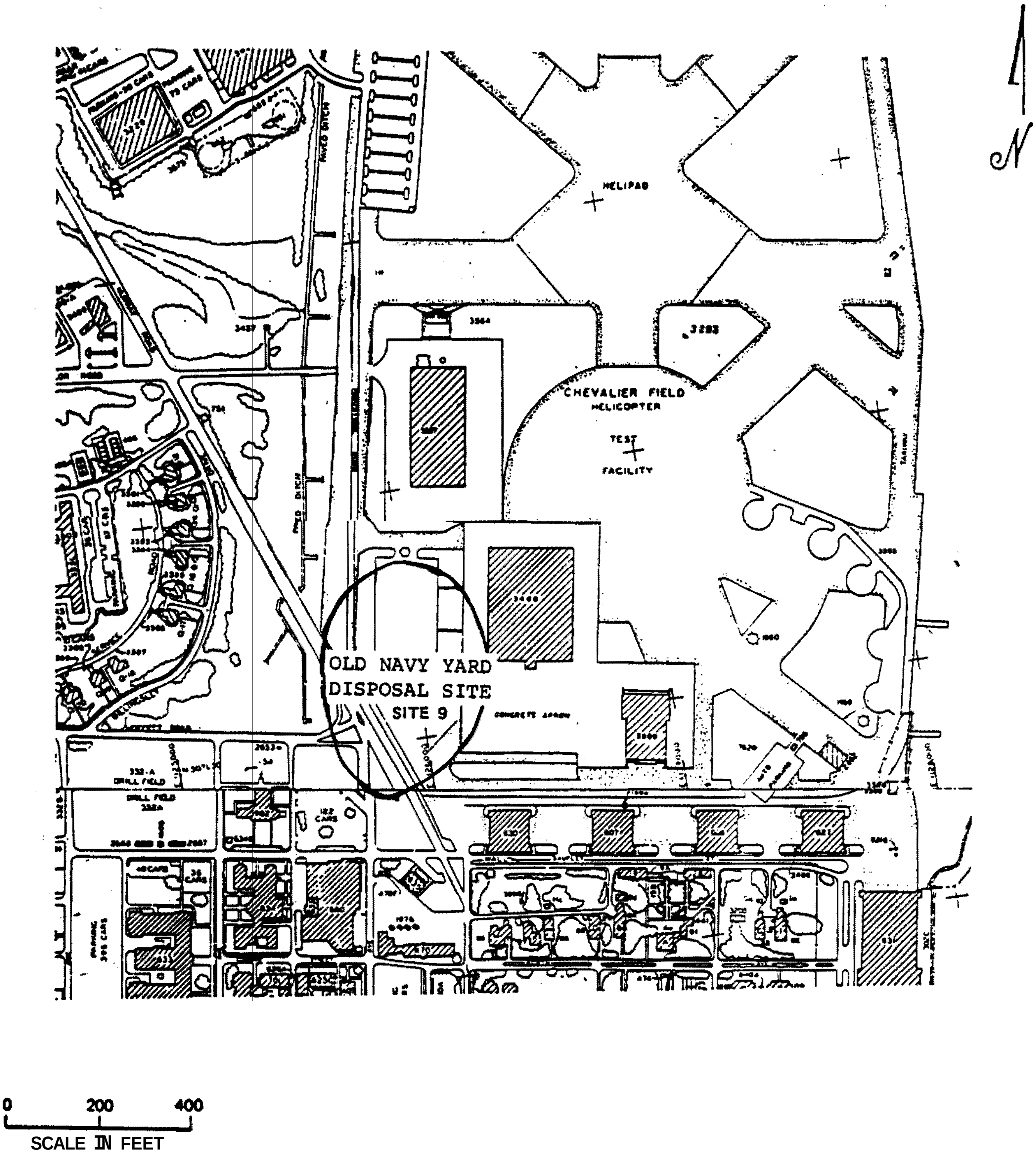

FIGURE **6-11** APPROXIMATE **LOCATION OF** THE **OLD** NAVY **YARD DISPOSAL SITE. (SITE** 9) contamination at this site. During the IAS, team members sampled sediment at the end of a branch of Bayou Grande chat adjoins this rite. The sample was analyzed for metals. The results are given in Table 6-22. Sample 19 shows levels of cadmium, chromium, mercury, and lead that exceed the EP toxicity levels by 10 to 1,000 times. Also, all samples tested for lead either equalled or exceeded the EP toxicity limit. These high'levels of contaminants cannot be attributed solely to NAS Pensacola's past discharges, but could be a result of non-Navy discharges into Pensacola Bay. These results indicate a high level of heavy metals contamination. Most recently, two piles of old tires were stored at the site. Figure 6-12 gives the probable extent of Site 11.

6.6.12 Scrap Bins (Site 12). From the early 1930s to the mid-1940s, garbage was sent to the Scrap Bins rather than to the Site 11 disposal site. These bins were located in "Pig Sty Hill" at Building 455. Approximately, 16 cubic yards per day of wet garbage was stored here awaiting disposal as livestock feed. The site is located at coordinates E-34 of the NAS Pensacola General Development Map. No evidence of hazardous material disposal was discovered here.

6.6.13 Magazine Point Rubble Disposal Site (Site 13). Since about 1965, the waterfront of NAS Pensacola from the dredge disposal area to Magazine Point has been used as a rubble disposal area. Visual inspection of the site revealed that it was a well-run rubble disposal site; only brick, concrete, wood, scrap metal, and other inert building wastes have been disposed of there. No environmental contamination exists from rubble disposal at this site.

6.6.14 Dredge Spoil Fill (Site 14). This site was created between 1975 and 1977 by deposition of spoils from dredging operations in Pensacola Bay. During the on-site survey, this site was thought by the IAS team to be Navy property. Further investigation, however, revealed that it was not on Navy land. This site is dicussed further in Section 5.6, Adjacent Land Use.

6.6.15 Pesticide Rinseate Disposal Area (Site 15). This site was used between 1963 and 1979 for disposal of pesticide rinseates. The site is located in an area between buildings 2640 and 2692 in the golf course maintenance area. Figure 6-13 illustrates the location of the disposal area. The area is located at coordinate D-19 on the general development map. Materials disposed of at this site consisted of organic phosphate, chlorinated hydrocarbons, Carbaryl, and carbamates.

These materials were disposed as rinseates, not as concentrated pesticides. This site was used to dispose of rinse water from cleaning spraying equipment. The rinseates were poured directly into the soil. The quantities of rinseates disposed of here are not known by installation personnel.

6.6.16 Brush Disposal Site (Site 16). Since the lace 1960s, this site has been used for the disposal of brush and tree limbs (see Figure 6-14). Aerial photographs indicate that, prior to about 1951, a portion of the brush disposal area may have been used for garbage burning and resultant ash disposal. The area was used by the Army during that time period. There is no evidence of any chemical usage by the Army at that base, and photographs indicate that all the waste was burned. Visual inspection of the site revealed that only brush, tree limbs, and several pieces of metal were present at the site. No evidence of disposal of hazardous waste was present.

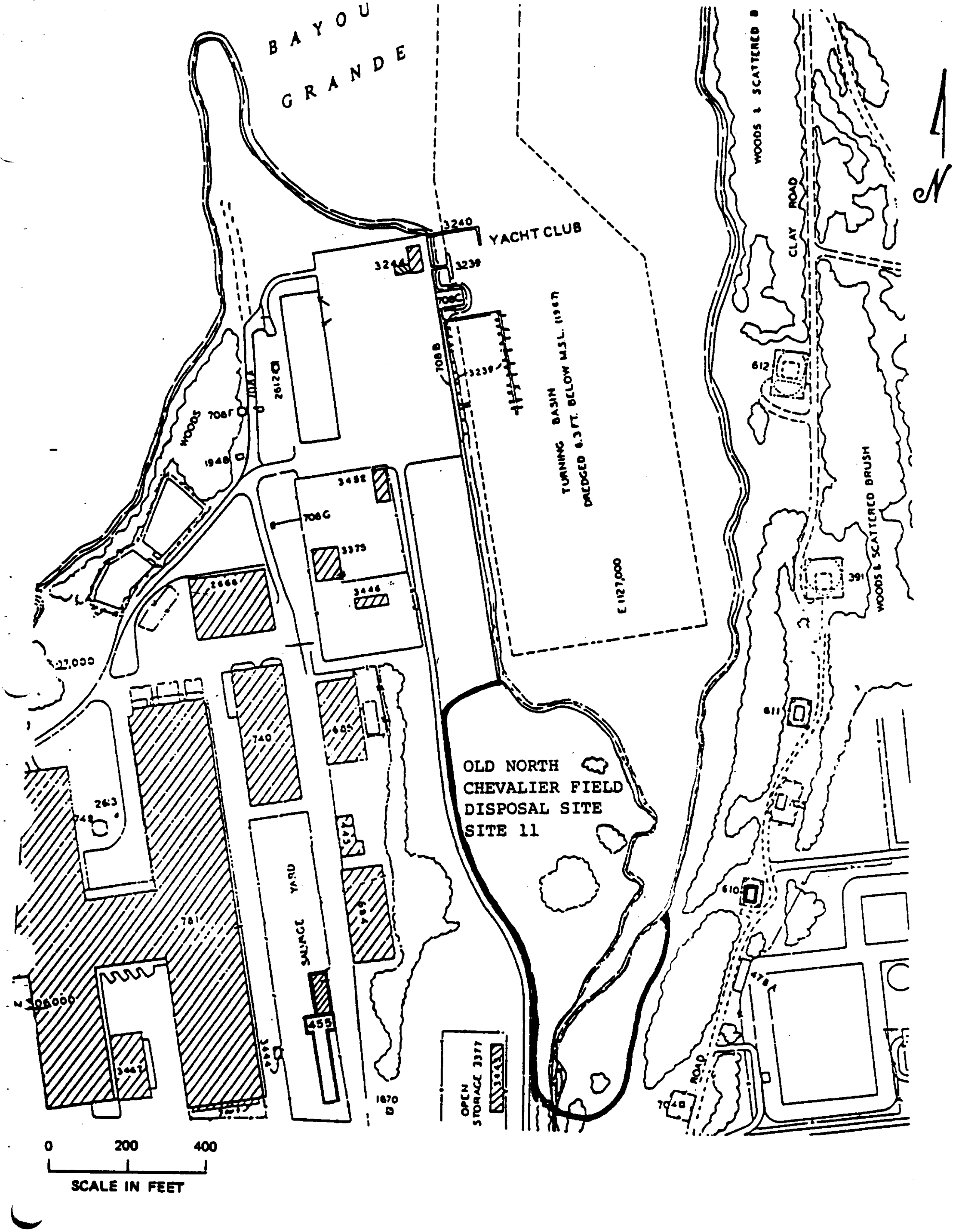

FIGURE 6-12 APPROXIMATE LOCATION OF OLD NORTH CHEVALIER FIELD DISPOSAL SITE

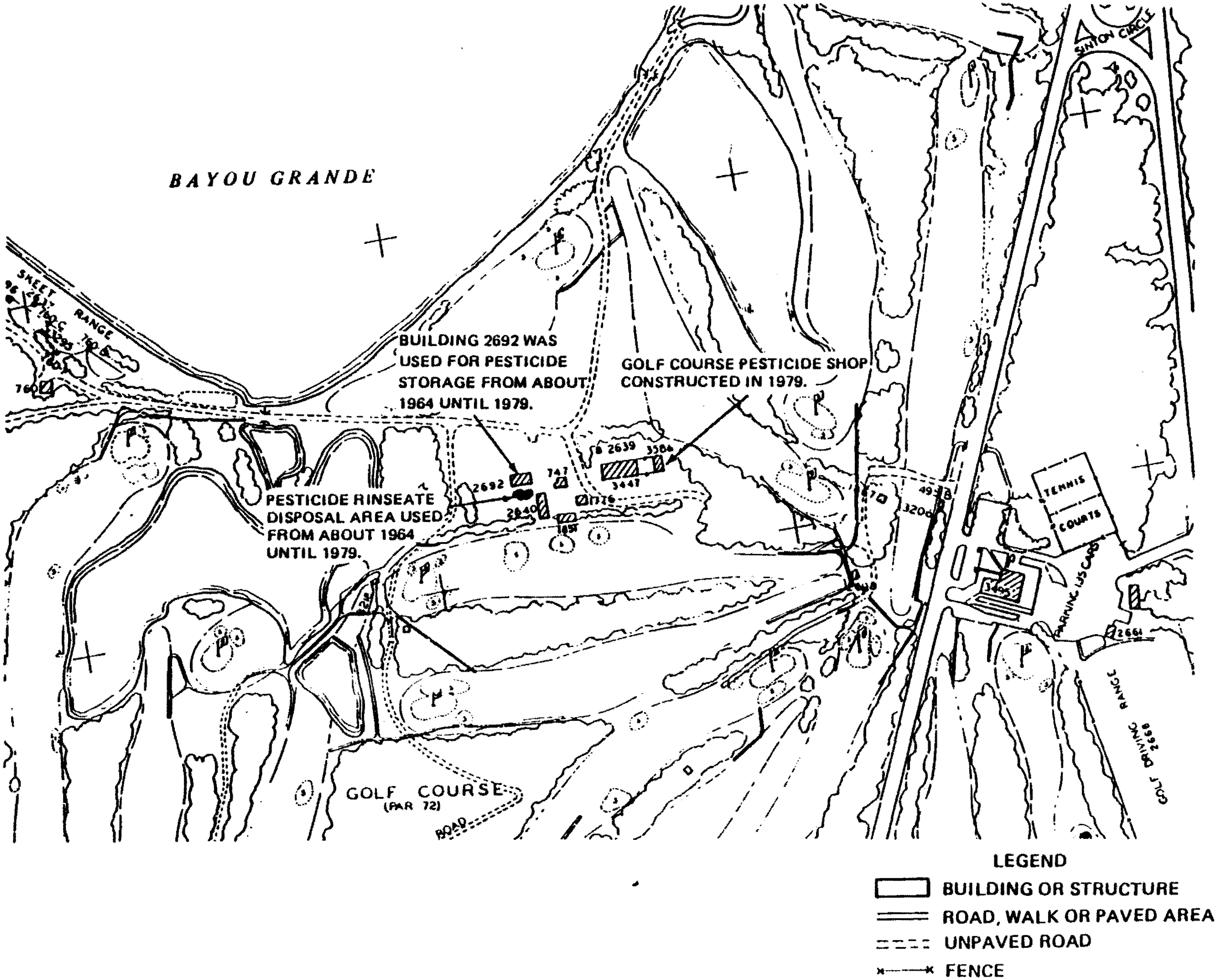

FIGURE 6-13 Approximate location of pesticide rinseate disposal area.

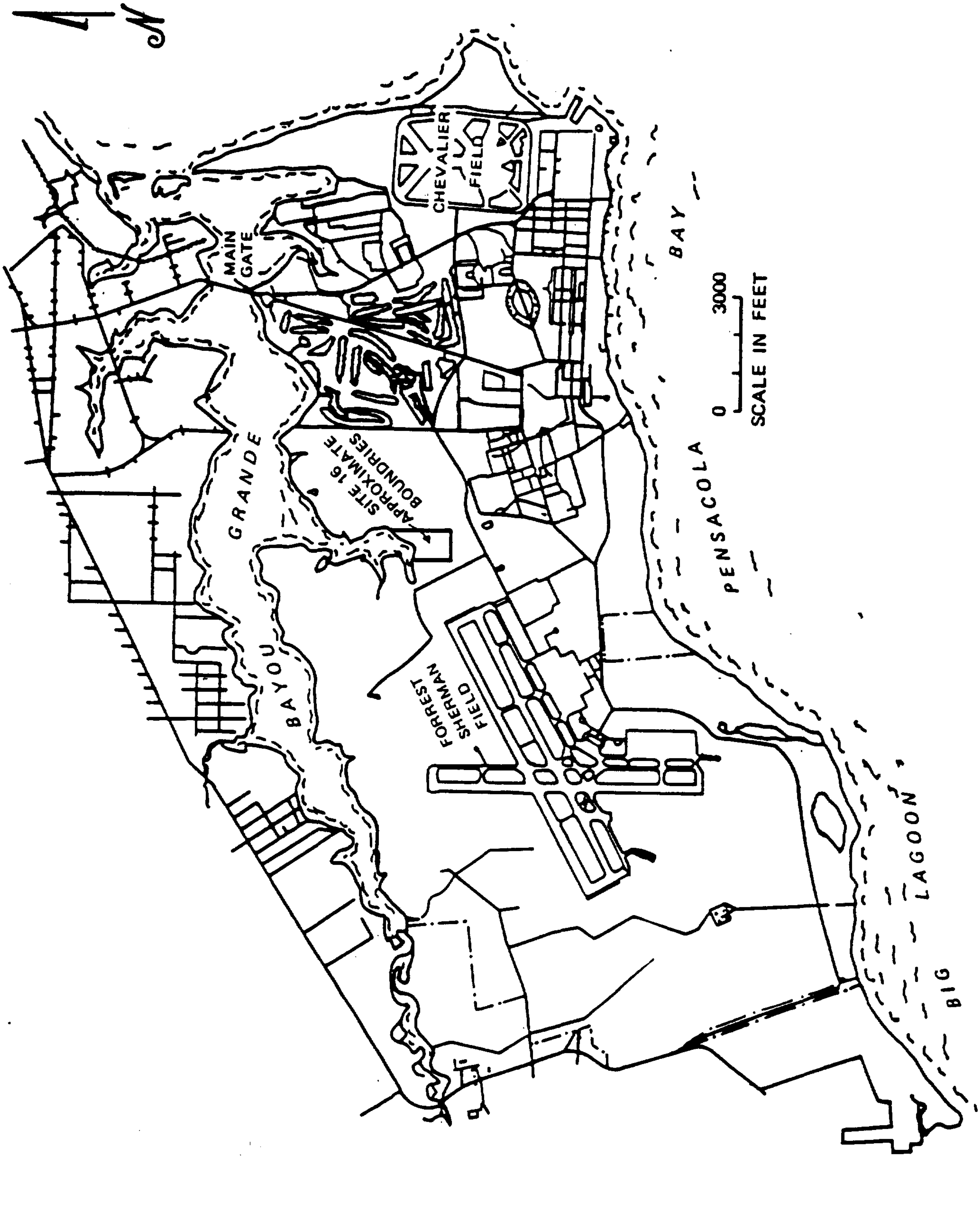

FIGURE 6-14 LOCATION OF SITE 16, THE BRUSH DISPOSAL SITE

6.6.17 Transformer Storage Yard (Site 17). Until 1976, this site was an open storage area for 200–300 transformers. The site is located north of Building 1554 at coordinates 1–18 of the NAS Pensacola General Development Map. The storage area, on the east side of a fenced yard, covered an area approximately 50 x 200 feet. Figure 6–15 illustrates the location of the storage yard. The area is paved with asphalt; adjacent sections of the yard are currently used for gravel and sand storage. No deliberate disposal occurred at this site; however, many of the transformers stored here had leaked. As a result both PCB and non-PCB transformer oils contaminated the site in unknown quantities, A black oily sludge was noted on the paved surface of the yard. A grab sample of these residues was taken and analyzed to determine if PCB compounds were present. Seventy thousand parts per million of PCB 1260 a8 well as other PCB types and other chlorinated hydrocarbons were found in the sample. These results indicate a high degree of contamination at this storage yard. The area outside the fence line next to the old transformer storage area is unpaved. These unpaved areas might have been contaminated by surface runoff from the site. This runoff could have caused migration of some components of the transformer oil, but probably not PCB because PCB migrates very little in water. PCBs form complexes with soil. If they have migrated to the edge of the pavement, they probably have not migrated further.

6.6.18 PCB Spill at Substation A (Site 18). About 50 gallons of PCB transformer fluid was spilled at Substation A in 1966 or 1967. This substation and adjoining areas are paved with concrete or asphalt. A small area (about 10 by 20 feet) adjacent to the east side of the transformer pad is not paved, but is covered with gravel, The gravel has an oily appearance. A sample of the oily soil was taken by the NACIP team and analyzed at the NEESA lab for PCB. Four parts per million of PCB was detected in the sample. This concentration is classified non–hazardous according to the Toxic Substances Control Act. Figure 6–16 shows the location of the substation and where the sample was obtained.

6.6.19 Fuel Farm Pipeline Leak (Site 19). In 1958, a leak occurred in the pipeline from the fuel farm tanks to the tank truck loading facility at Forrest Sherman Field. The spill was located at coordinates N-7 on the General Development Map. The type of fuel spilled was JP-4. The amount of fuel spilled was not measured, but the IAS team estimated the dimensions of the area containing dead trees to be 200 feet x 40 feet. Fuel Branch personnel estimated that spilled fuel on the ground was two inches deep. Using these estimates, the IAS team calculated that the fuel reaching the surface from the pipeline leak was approximately 360,000 gallons. The actual amount spilled is, in the judgement of the IAS team, probably much more than the calculated figure.

6.6.20 Berthing Pier Pipeline Leak (Site 20). In 1981, an excavation crew discovered that the soil under the pavement in the area of the Berthing Pier was saturated with oil. The Berthing Pier, structure number 303, is located at coordinates K-26 on the General Development Map. Station personnel reported that the oil was probably leaked from an old pipeline under the berthing pier. However, they could not estimate the amount leaked, or how long the leaking had continued. Four monitoring wells are located on the Berthing Pier and on the quay wall, structure number 303A. IAS team members checked the wells and found that the wells contained water, not oil. Station

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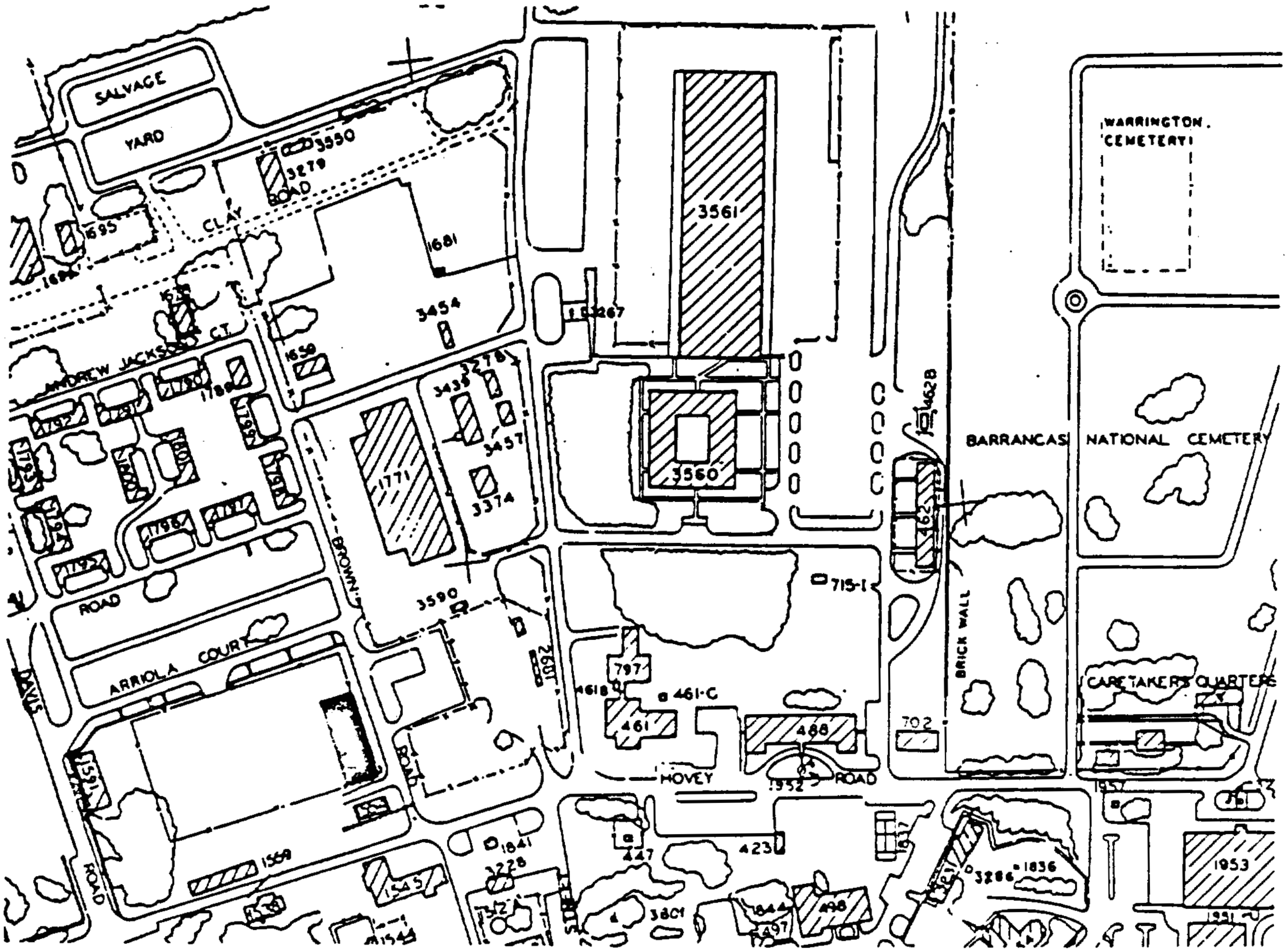
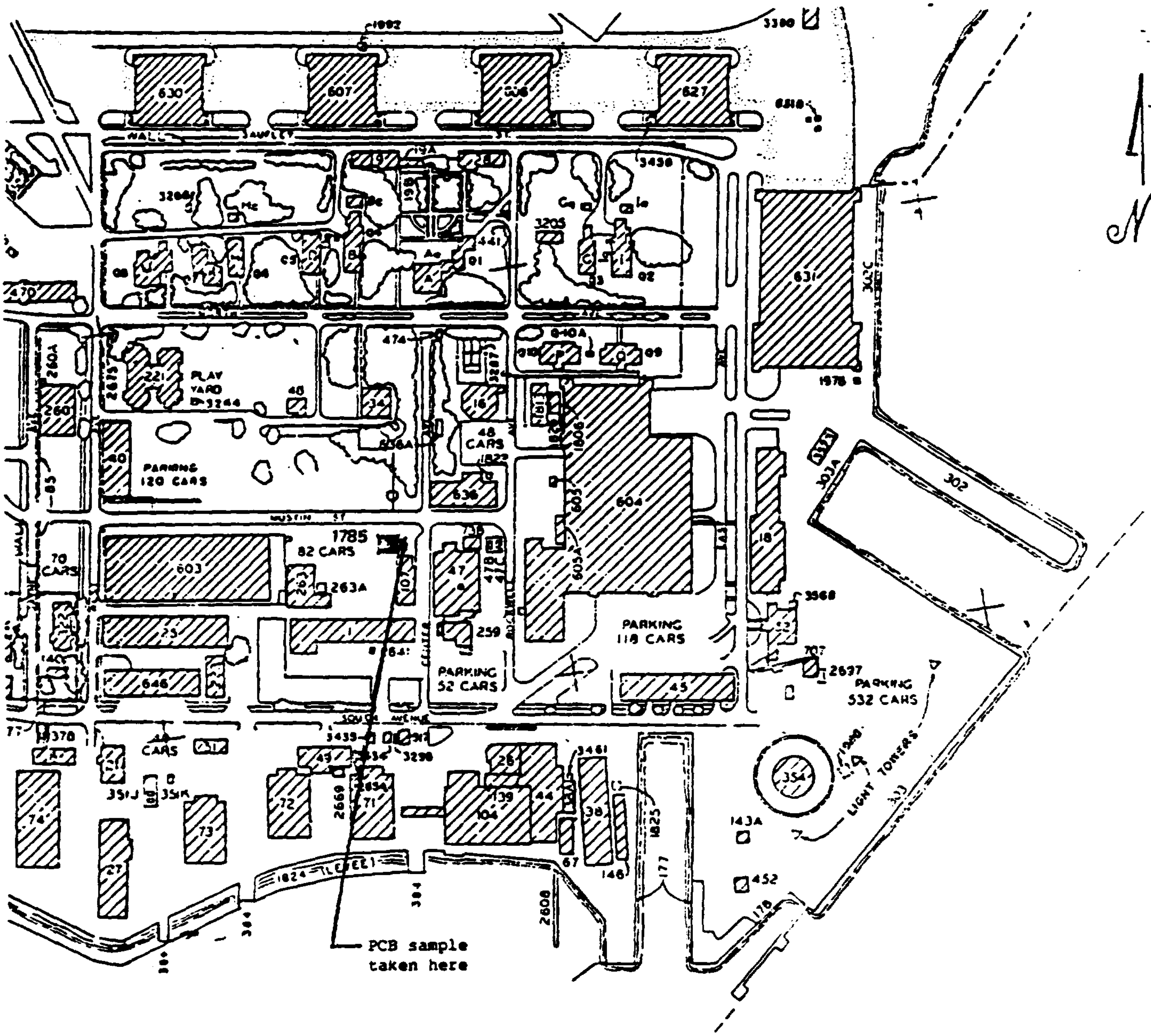


OLD
TRANSFORMER
STORAGE AREA

FIGURE 6-15 Transformer Storage Yard. Transformers were stored here when not in use, or when awaiting disposal.



SUBSTATION A
1966-1967 PCB
SPILL SITE

FIGURE 6-16 **Transformer Oil Spill Site at Substation A. About 50 gallons of oil containing PCB's was spilled in 1966 or 1967.**

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personnel reported that oil slicks have been commonplace near the Berthing Pier. An oil slick on Pensacola Bay caused by the excavation in 1981 was cleaned up by the Port Services Division.

6.6.21 Sludge Disposal at Fuel Tank Area (Site 21). Between 1940 and 1960, nine fuel tanks were used for storage of aviation gasoline and jet fuel. Each year, the sludge in these tanks was cleaned out and disposed of in the space between the tank and the wall surrounding each tank. This was done over the years, creating a doughnut-shaped disposal site around each fuel tank having an area of approximately 1650 square feet and an outside diameter of aproximately 50 feet. The sludge removed from these tanks is suspected to contain' high levels of lead or tetraethyl lead preceipitated from the fuel. The quantity removed from each tank is estimated to have been as much as 2 cubic yards per tank per year, which equals approximately 360 cubic yards of sludge buried over the 20-year period. Locations of the tanks are shown on Figure 6-17.

6.6.22 Refueler Repair Shop Fuel Disposal Site (Site 22). From 1958 to 1977, this site was used by the Transportation Department Refueler Repair Shop for disposal of fuel remaining in refueler trucks before repair operations began. This disposal site was located about 100 yards north of Building 1771 at coordinates H-18 on the NAS Pensacola General Development Map. The site occupies approximately 900 square feet. Materials disposed of at this site included aviation gasoline and jet fuel. It was estimated that this site received about 1,000 gallons of fuel per year over a 19-year period. Assuming, as a worst case, that the fuel was all high-octane aviation gasoline, which contains as much as 4.86 grams of tetraethyl lead per gallon, it can be calculated that as much as 203 pounds of pure tetraethyl lead was deposited here over the 19-year period. Figure 6-18 depicts the location of the site.

6.6.23 Chevalier Field Pipeline Leaks (Site 23). In 1965, a fuel oil pipeline leak was discovered near Chevalier Field when it was noticed that grass above the leak was killed by the oil coming to the surface. The location of this leak was at coordinates H-23 on the NAS Pensacola General Development Map. Figure 6-19 illustrates the location of the spill. The material disposed of by leakage at this site was Navy Special Fuel Oil, in unknown quantities. Some time between 1968 and 1970, another leak was discovered in the same area. The leaking substance this time, however, was Diesel Fuel Marine (DFM). The quantities of DFM leaked at this site are anknown.

6.6.24 DDT Mixing Area (Site 24). This site was used to mix DDT insecticide, and was subject to spillage of the mixed solution and concentrates. Disposal at this site was not intentional, but was the result of spillage. The site is located approximately 100 feet north of the northeast corner of Building 3561, at coordinates G-18 on the General Development Dap. Figure 6-20 illustrates the location of this disposal site. The IAS team estimated that the site was used for a 10-year period, ending in the early 1960s. The quantity of spilled DDT was estimated to be about 20 gallons of 20% DDT solution deposited over the 10-year period. This resulted in a total of about 3.3 pounds of DDT disposed of at this site during that time.

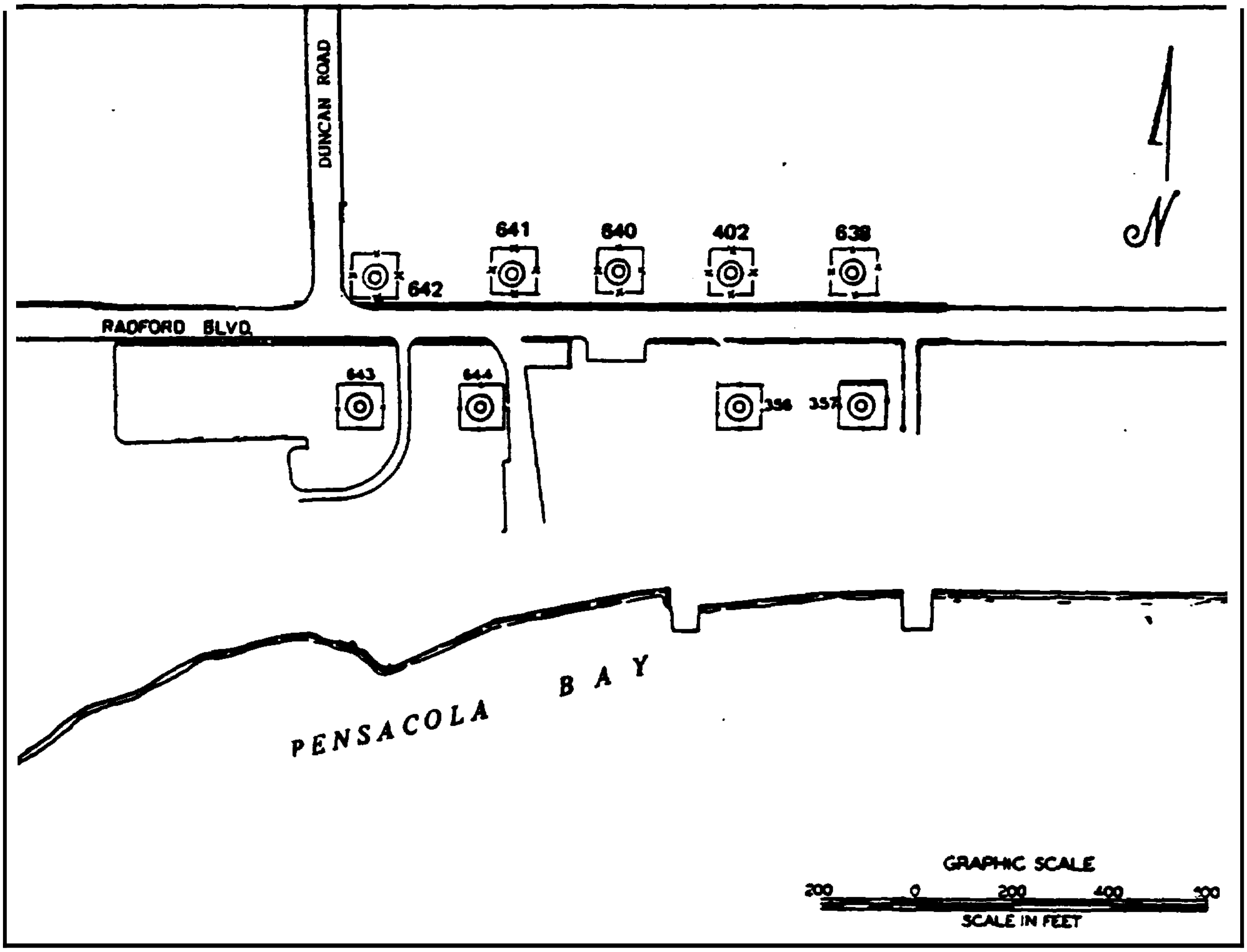

FIGURE 6-17 LOCATIONS OF NINE AVIATION GASOLINE STORAGE TANKS. SLUDGE WAS REMOVED FROM THE TANKS AND DISPOSED OF AROUND THE PERIMETER OF EACH TANK SITE. THE SLUDGE MAY CONTAIN LEAD CONTAMINATION. THE FIVE TANKS NORTH OF RADFORD BOULEVARD ARE NO LONGER STANDING. THESE NINE TANK SITES ARE CONSIDERED COLLECTIVELY AS SITE 21.

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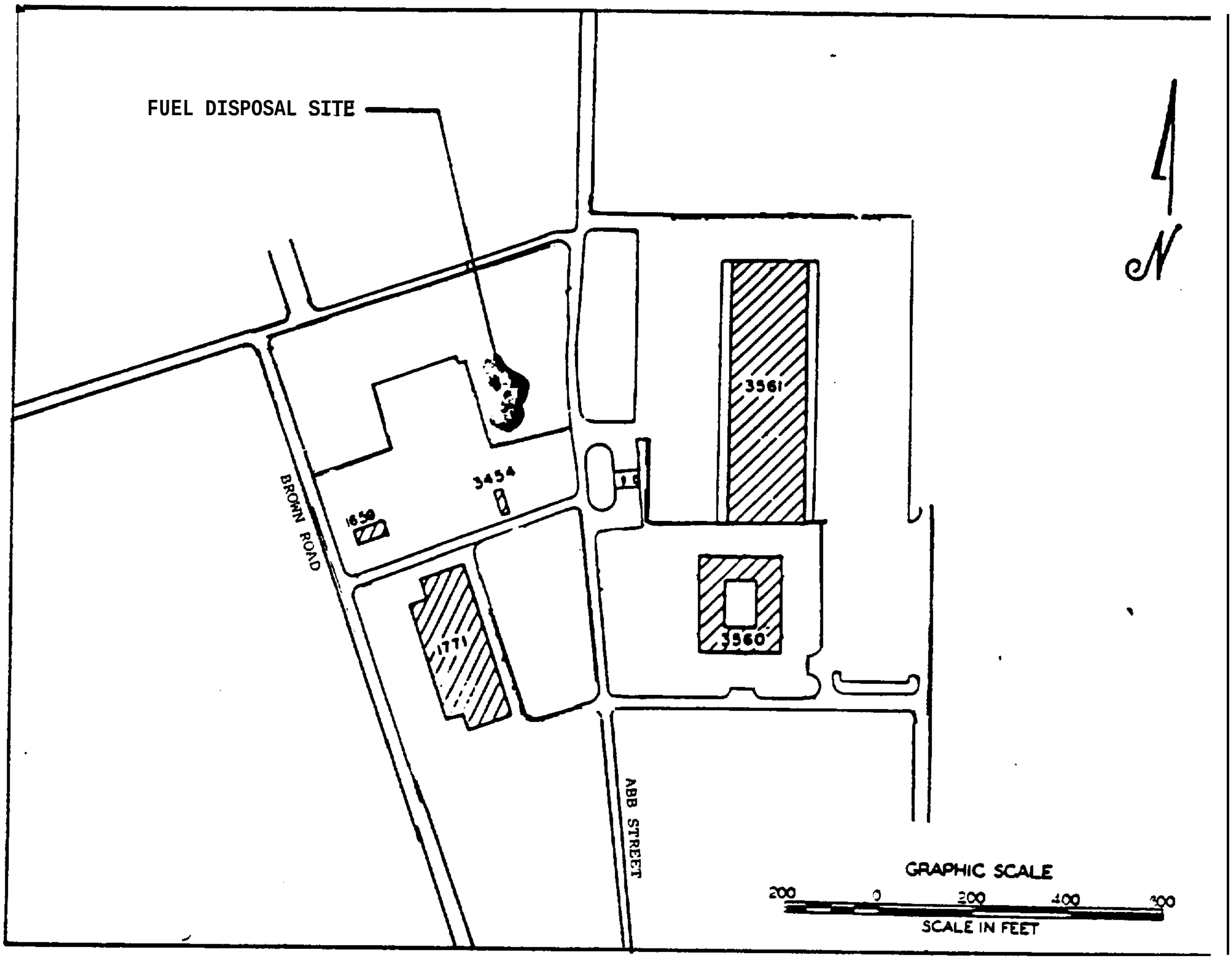

FIGURE 6-18 REFUELER REPAIR SHOP FUEL DISPOSAL SITE (SITE 21). RESIDUAL AVIATION GASOLINE WAS DISPOSED OF HERE. THE AVIATION GASOLINE CONTAINS A LEAD COMPOUND.

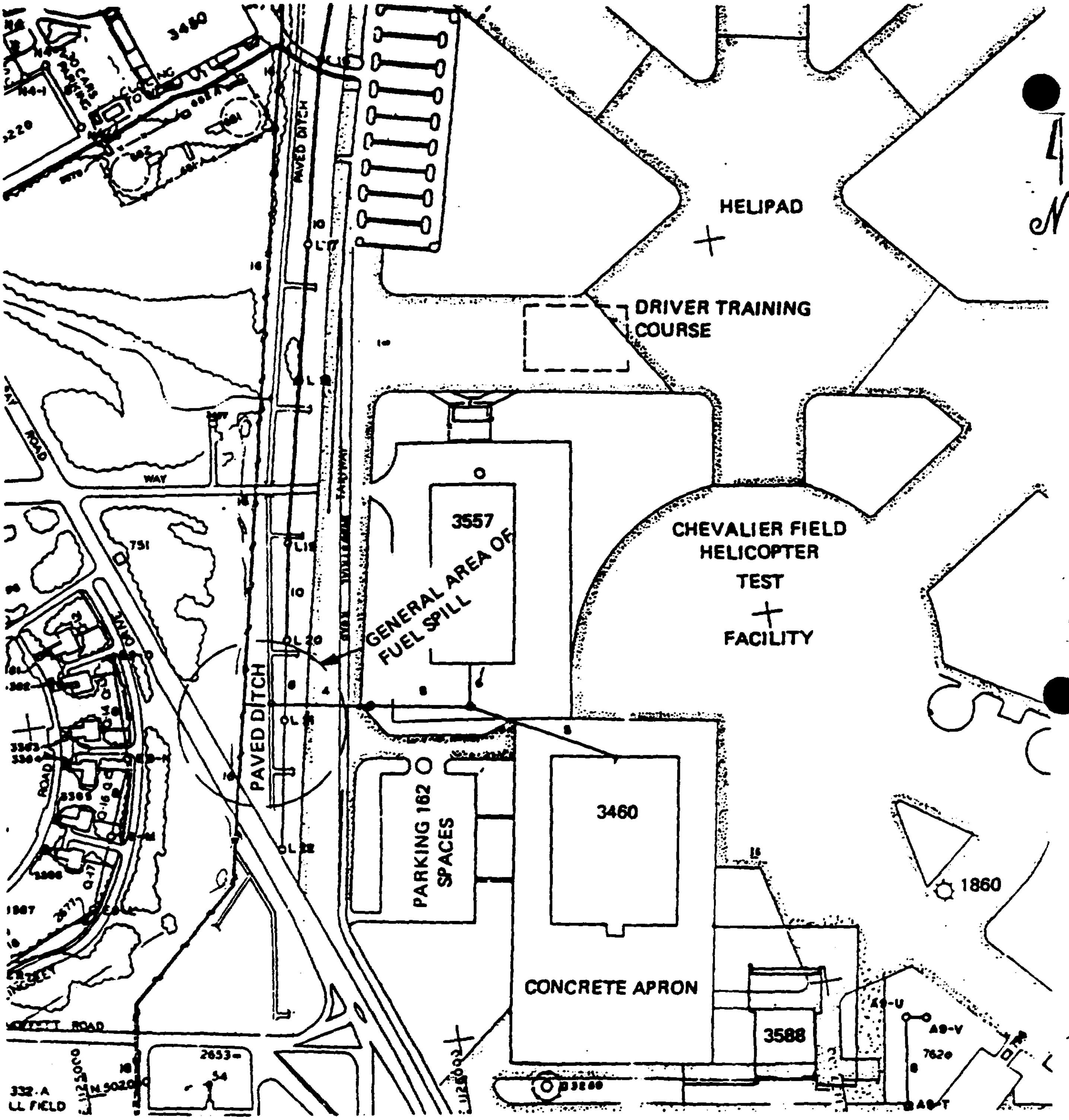

FIGURE 6-19 LOCATION OF CHEVALIER FIELD FUEL SPILL. (SITE 23)

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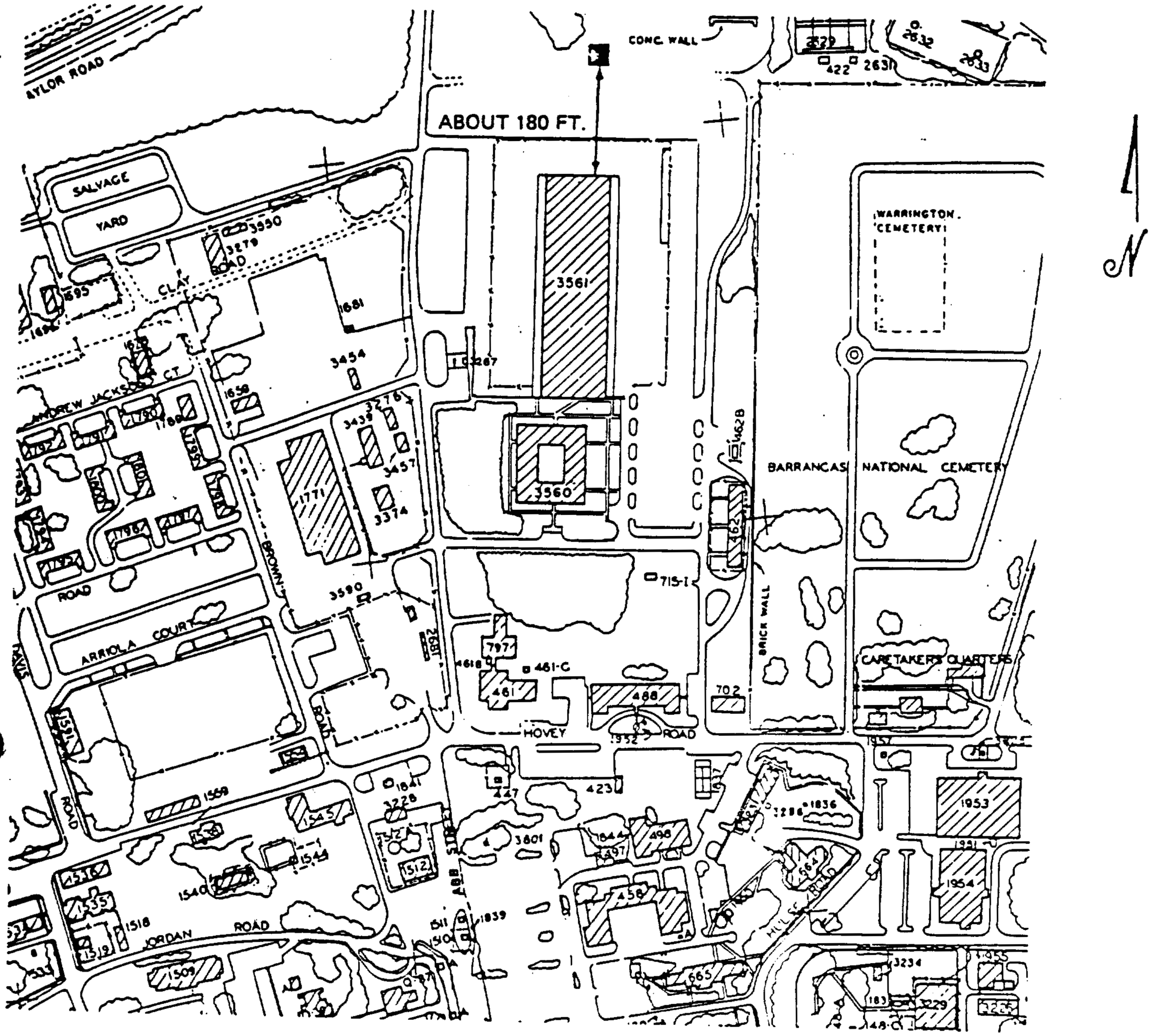

DDT MIXING AREA

LEGEND

BUILDING OR STRUCTURE

ROAD, WALK OR PAVED AREA

UNPAVED ROADS

FENCE

FIGURE 6-20 LOCATION OF DDT MIXING AREA (SITE 24)

6.2.25 Radium Spill Site (Site 25). A small spill of low-level radioactive waste containing radium occurred at this site in 1978. The waste, from radium removal operations, was stored in a drum at this site, awaiting disposal. The drum corroded and broke open, and approximately half the contents of the drum spilled on the concrete floor of the storage area located near Building 780, the Radium Decontamination Building, at coordinates F-23 on the general development map.

6.6.26 Supply Department Outside Storage (Site 26). Prior to 1956 and up until 1964, a 30 by 30 foot area on the south side of Building 684 was used by the Supply Department to store incoming paint strippers and acids. The site is located at map coordinates E-23 on the NAS Pensacola General Development Map. Incoming containers of materials were placed outside on steel matting, where leaks sometimes occurred, resulting in discharge of materials to the ground. Leaks seldom exceeded 10-20 gallons. The soil of the storage area is visibly stained and steel mats on the area have been corroded by chemical action.

6.6.27 Radium Dial Shop Sanitary Sewer. Building 709 was used from the 1940s to 1975 for reworking luminous instrument dials. A routine disposal operation in Building 709 was to wash spent cleaning solutions and luminous paint down the drains into the sanitary sewer.

The wastes disposed of were cleaning solutions containing benzine, white pigments, phosphors, and small amounts of radium. Sometimes acid or caustic solutions were used as well. The amounts of these liquids disposed of are not known, however, it is estimated that 5,000 to 7,000 instruments per year were processed. Assuming that about a quart of cleaning solution was used for each instrument, this would represent a total of about 1,500 gallons per year of cleaning solution disposed of down the drains.

After the demolition of Building 709, RASO surveyed the drain pipe and found it to be contaminated. The contaminated drain pipe was excavated to a depth of 18 inches during the dismantling operations. The remaining underground portion was capped and abandoned. The dose rate from tne pipe before refilling the hole with concrete was 1.2 mR/hr. Normal background is about .02 mR/hr. RASO had recommended that the contaminated pipe outfall be located and checked for contamination, but there was no evidence available at the time of the IAS that this had been done. Records found during the IAS indicated that the sewer from Building 709 was connected to manhole K7 of the sanitary sewer system.

6.6.28 Transformer Accident (Site 28). In 1969, a transformer was dropped from a truck, hit the ground, and was damaged. Approximately, 50 gallons of an unknown transformer fluid were spilled on the street. The accident occurred on Radford Boulevard in front of Building 632 as shown in Figure 6-21. The coordinates of this site are K-21 on the NAS Pensacola General Development Map. Station personnel recalled that the site was paved, and that the spilled fluid probably was washed into nearby storm drains.

6.6.29 Soil South of Building 3460 (Site 29). In 1971, the industrial waste treatment plant (IWTP) went into service. Since that time, the industrial waste sewer system has conveyed approximately 2.5 million gallons per year of mixed industrial waste to the IWTP. Some parts of this sewer system are

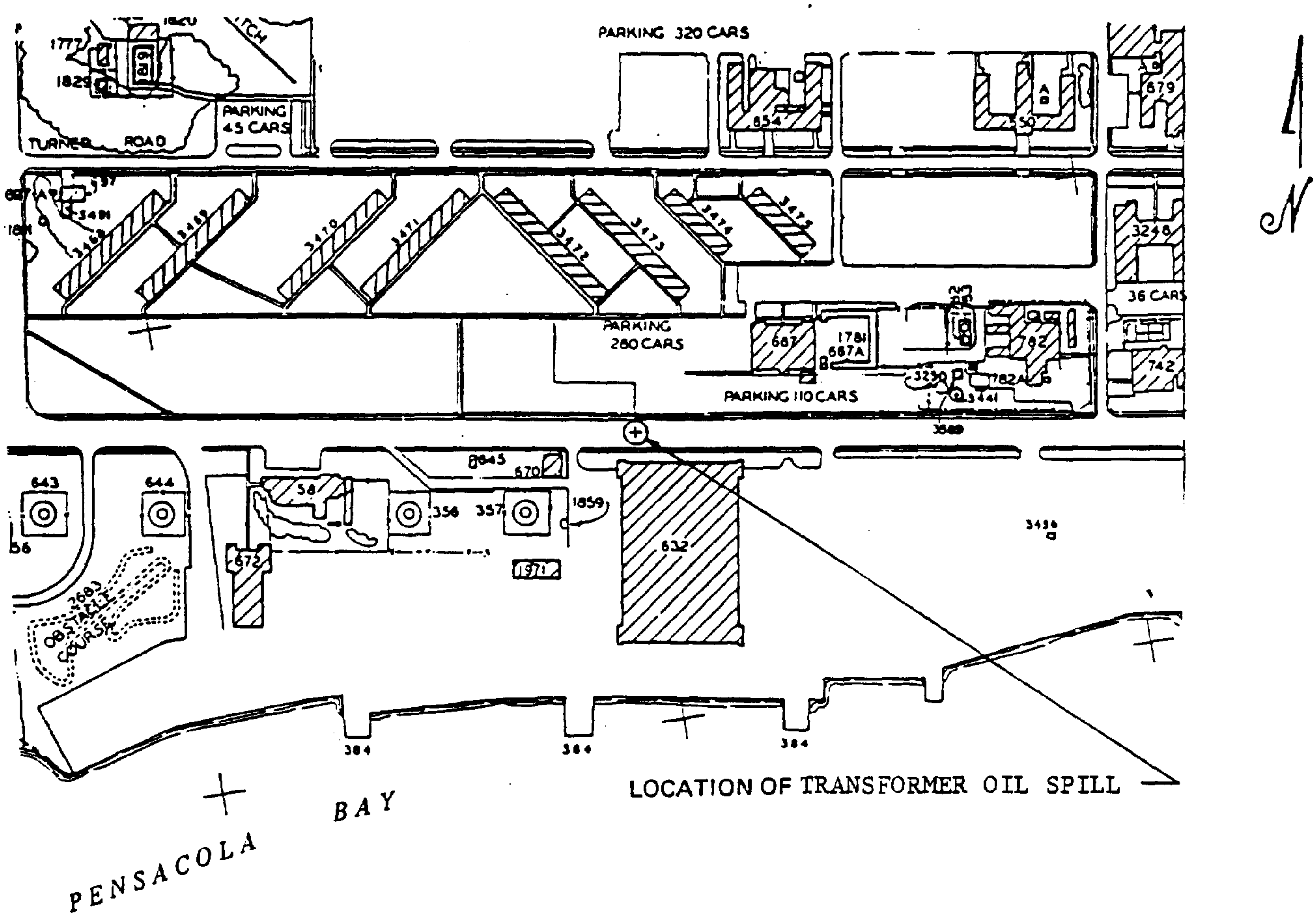

FIGURE 6-21 LOCATION **OF TRANSFORMER** OIL SPILL. (SITE 28). A TRANSFORMER FELL ONTO **THE ROADWAY,** AND **BROKE OPEN.** THE OIL SPILLED IS SUSPECTED TO CONTAIN PCB COMPOUNDS.

pressurized. The industrial waste disposed of in the sewer included paint stripper, thinners, chromic acid, phenolic compounds, cyanides, sulfuric acid, and other toxic compounds.

In the spring of 1981, while working in an ecavation under the concrete apron south of Building 3460, several people sustained chemical burns on their skin caused by a black slimy material in the soil in the excavation. Station personnel reported a noticeable odor of "paint stripper" in the excavation. An industrical waste sewer line runs under the concrete slab in this area. A leak in the industrial waste line is believed to have caused the contamination at this site. The extent of contamination is not known. The location of the suspected leak is shown in Figure 6-22, The coordinates of this site are 1-24 on the NAS Pensacola General Development Map.

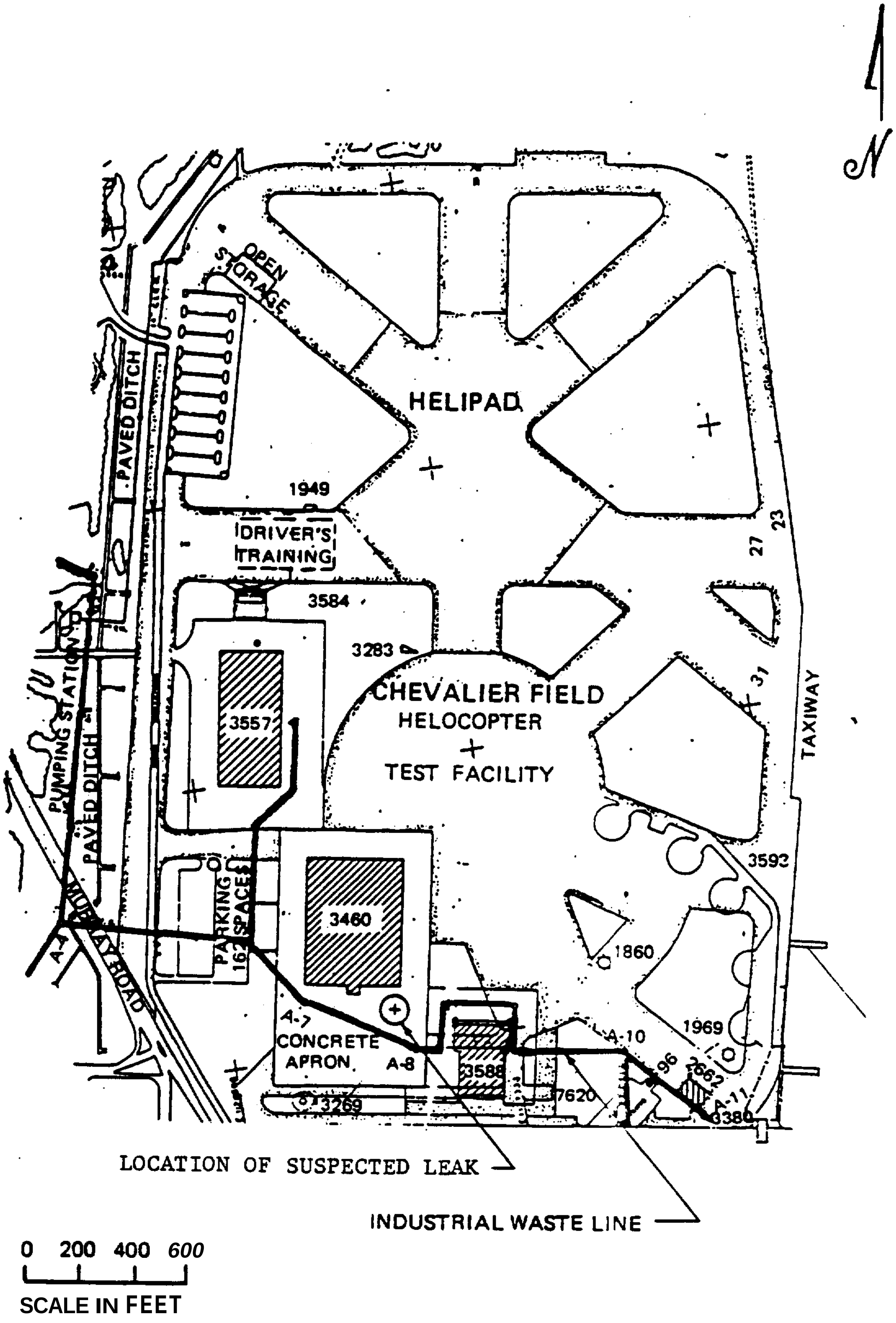

FIGURE 6-22 LOCATION OF SUSPECTED LEAK IN INDUSTRIAL WASTE SEWER SYSTEM (SITE 29)

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APPENDIX A

Logs of Deep Borings on and Near NAS Pensacola

WELL: Layne Central Co. test well for Santa Rosa Island Authority (an attempt to find fresh water on the island); abandoned and caved
LOCATION: Sec. 14, T. 3 S., R. 28 W., on Santa Rosa Island; 1.6 mi. east of Pensacola Beach Cantina; 180 ft. north and 438 ft. east of intersection of 17th Ave. and Via de Luna.
COUNTY: Escambia
FLORIDA GEOL. SURVEY NO.: W-3324
DEPTH: 1,370 feet
ELEVATION: 6 feet

	Depth below land surface (feet)
Pleistocene and Recent deposits; Citronelle Formation and Miocene coarse clastics undifferentiated	
Sand, white, quartz, medium to coarse, subangular; a few twigs and roots	0-25
Sand, as above; 2% fragments of tiny gastropods and pelecypods; one ostracod; *Arca* sp.	25-90
Gravel, granules to small pebbles of quartz, 45%; fine to very coarse sand, 20%; dark-gray clay, 30%; shell foraminifers including *Elphidium* sp.	90-92
Sand, white, medium to coarse; a few shell fragments and bits of carbonized wood . .	92-130
Sand and gravel, quartz, ranging from very coarse sand to pebbles 13 mm in diameter; 30% dark-gray clay containing wood fragments; 5% shells of large pelecypods	130-145
Sand, light-gray, fine to very coarse; shell fragments less than 1%; muscovite extremely abundant.	145-180
Sand, fine to very coarse and granules; 10-50% shells including pelecypods, gastropods, ostracods, and echinoid spines; iron-oxide hardpan at 195-196 feet . .	180-197
Gravel, granules to small pebbles; 20% very fine to coarse sand with much muscovite; 10% light-yellow siltstone containing many carbonized plant remains; 10% fragments of large pelecypods.	197-210
Gravel, quartz, pebbles up to 16 mm; dark-gray clay at 215-211 feet; iron-oxide hardpan at 218-222 feet.	210-222
Gravel, as above; 35% fine gray sand and siltstone; 15% shells of large pelecypods including heavy-ribbed pectens	222-227
Sand, light-gray, fine to very coarse; abundant muscovite; up to 10% gray clay; abundant shells and a few foraminifers.	227-365
Sand, very-light-gray, fine to coarse, and quartz granules; 30% gray clay; 5-15: shell fragments; abundant muscovite and carbonaceous fragments	365-434
Pensacola Clay (members not differentiated)	
Clay, gray; 40% fine to very coarse sand and granules; abundant muscovite; a few shell fragments	434-503
Sand, coarse to very coarse with small pebbles; a few shells, no mica	503-520
Clay, gray..	520-531
Hardpan, iron-oxide	531-532
Clay, gray; 40% fine to very coarse, pebbly sand; a few shell fragments; some muscovite.	532-595
Clay, dark-gray; silty and sandy.	595-757
Clay, as above; 2% flaky white calcite; pyrite.	757-825
Clay, as above; abundant shell fragments.	825-848
Clay, as above; wood fragments and leaves; only a few shells	848-871
Clay, as above, silty and sandy; fossils scarce	811-1032
Clay, as above; no shell fragments, but foraminifers abundant.	1032-1078
Clay, as above; 30% fine to very coarse sand; shell fragments and foraminifers; chert and pyrite	1078-1085
Clay, as above; foraminifers extremely abundant, especially very small ones, forming a "microconglomerate"	1085-1155
Chickasawhay Limestone and Tampa Formation undifferentiated	
Limestone, dolomitic, light-gray to cream, hard	1155-1159
Limestone, as above, somewhat softer; consists mostly of foraminifers	1158-1187
(This is the last of the samples; the following is from driller's and geologist's logs)	
Limestone, gray, hard, with black specks and fragments of shells.	1187-1290
Limestone, cream to tan, soft but tough; microfossiliferous (*Heterostegina* sp ?) . . .	1290-1325
Limestone, blue-gray, hard; fossiliferous	1325-1340?
Limestone, cream porous, hard; fossiliferous.	1340?-1370

WELL: Perdido Land Co. – Hugh Cary No. 1
LOCATION: NW¼ SE¼ sec. 16, T. 2 S., R. 31 W.
COUNTY: Escambia
FLORIDA GEOL. SURVEY NO: W-4091
DEPTH: 6,347 feet
ELEVATION: 20 feet (drilling floor)

	Depth below land surface (feet)
Terrace deposits and Citronelle Formation (undifferentiated)	
Sand, gray to tan, medium to coarse, carbonaceous	0-60
Clay, dark-gray, silty: abundant shell fragments of tiny pelecypods and gastropods; foraminifers common, including *Elphidium* sp	60-80
Sand, light-gray, fine to coarse: no fossils	80-150
Sand, as above with 10% gray clay containing a few shell fragments.	1%-I60
Sand, light-gray, very coarse to granules; shell fragments very scarce.	160-240
Sand, gray, fine to very coarse with granules: very scarce pelecypod fragments. . . .	240-520
Upper member of Pensacola Clay	
No sample.	520-530
Clay, gray, rather pure: a few shell fragments and pieces of carbonized wood	530-560
Shells of tiny gastropods and pelecypods making up 97% of sample and including *Crucibulum constrictum*, *Cypraeolina pyrenoids*, and *Placoides choctawhatcheensis*.	560-620
No sample.	620-630
Shells, as above, with 10-40% gray clay.	630-690
Clay, gray; abundant shells; some very coarse sand and fragments of cement	690-130
No sample.	730-740
Clay, as above.	740-760
No sample.	760-190
Clay, gray; 5-20% very coarse sand, a few to abundant shells	790-970
Clay, dark-gay: a few shells of small pelecypods.	910-1030
Escambia Sand Member of Pensacola Clay	
Sand, brownish-gray, medium to coarse: a few to abundant shell fragments: a little gray clay.	1030-1110
Lower member of Pensacola Clay	
Clay, gray; a few shells and pieces of carbonized wood.	1110-1390
Tampa Formation	
Limestone, light-gray: a few foraminifers	1390-1440
Clay, bark-gray: 20% limestone (cavings?); fossils very scarce	1440-1450
No samp.	1450-1460
Clay, dark-gray: 30% limestone (cavings?); fossils very scarce	1460-1470
Limestone, light-gray; numerous poorly preserved foraminifers	1470-1480
No sample.	1480-1490
Limestone, light-gray: abundant poorly preserved foraminifers; a little gray clay . .	1490-1560

Well No. 4091 (continued)

Chickasawhay Limestone

Limestone, very light-gray; 60% very light-tan, sugary, vesicular dolomitic limestone; foraminifers scarce	1560-1620
Limestone and dolomitic limestone as above, but the latter is not vesicular; foraminifers scarce to abundant; some pelecypod shells	1620-1680

Bucatunna Clay Member of Byram Formation

Clay, dark-gray, silty; some pyrite and carbonized wood; with *Robulus* cf. *R. alato-limbatus*, *Robulus* cf *R. limbosus* and *Amphistegina* sp	1680-1890

Ocala Group

Limestone, grayish-cream; very abundant foraminifers, including: *Nummulites floridensis*, *Sphaerogypsina globula*, *Lepidocyclina* cf. *L. ocalana*, *Lepidocyclina* cf *L. floridana*	1890-1920
Limestone, as above; foraminifers relatively few ad poorly preserved	1920-1950
Limestone, chalky-white, in large lumps coated with green clay; abundant cf. ——— sp	1950-1980
Limestone, grayish-cream ta chalky-white, in fine fragments; foraminifers few and poorly preserved, including *Nummulites floridensis* and *Nummulites vanderstoki*	1950-2040

Lisbon *equivalent*

Limestone, light-grayish-white; some bud, slightly calcareous shale; foraminifers abundant but poorly preserved	2040-2070
Shale, very-light-grayish cream, slightly calcareous; some limestone; foulls very scarce	2070-2100
Limestone, very-light-gray, shaly; fossils very scarce	2100-2120
Clay, very-light-gray with a faintly greenish cast; calcareous; no fossils	2120-2150
Shale, very-light-gray, calcareous; a few foraminifers	2150-2200

0000155

WELL: T. E. McMillan and A. R. Temple—Lee Daniell No. 1
LOCATION: SE¼SE¼ sec. 1, T. 5 N., R. 32 W.
COUNTY: Escambia
FLORIDA GEOL. SURVEY NO: W-4150
DEPTH: 6,867 feet
ELEVATION: 169 feet (drilling floor)

	Depth below land surface (feet)
Terrace deposits and Citronelle Formation	
Gravel and sand, very-light-yellowish-brown, quartz; rand medium to very coarse; pebbles up to 17 mm in diameter	0-300
Sand, as above; a few small pebbles	300-420
Clay, gray, very silty and sandy.	420-540
Sand. light-yellowish-brown, coarse; 40% dark-gray clay.	540-570
Clay, very-light-gray, in large chunks; some sand.	570-630
Miocene coarse clastics	
Shells; 30% palo-gray clay; 20% coarse sand; shells are mostly small pelecypods and gastropods; foraminifers common, including *Sorites* sp., *Archaias* sp., *Quinqueloculina costata*, *Quinqueloculina seminulum*.	630-690
Chickasawhay Limestone	
Limestone. pale-tan, dolomitic: knobby, rough texture: 5% dark-gray clay; pelecypod fragments, small gastropods, echinoid plates, and a few foraminifers	690-750
Bucatunna Clay Member of Byram Formation	
Clay, dark-gray: a few very small foraminifers	750-870
Ocala Group	
Limestone, dirty-pale-brownish-gray (discolored by admixture of clay): abundant foraminifers including *Sphaerogypsina globula*, *Heterostegina* sp., *Nummulites* sp.	870-900
Limestone, as above: 20-50% light-gray-clay; abundant glauconite; one small cup coral	900-1050
Lisbon equivalent	
Shale, very-llght-gray. calcareous; 20% very-light-gray limestone: a little gray clay; a few foraminifers	1050-1110
Limestone, very-light-gray; 10-40% shale; foraminifers scarce	1110-1260
Limestone, as above; 30-40% light-gray shale; foraminifers common. including *Pseudophragmina hannai* (most abundant). *Robulus inornatus*, *Robulus alato-limbatus*, *Nummulites gravelli*, *Nummulites sabinensis*	1260-1500
Tallahatta Formation	
Shale, very-light-gray, calcareous; foraminifers wry scarce	1500-1620
No sample.	1620-1680
Shale, as above: a few echinoid spines	1680-1800
Shale, as above: 302 gray clay; foraminifers moderately common	1800-1830
Hatchetigbee Formation	
Clay, dark-gray, silty; fossil fragments wry scarce	1830-2500

WELL: Clyde Creighton, Florida Oil Co.
LOCATION: Henry Floyd Farm, near Cottage Hill; NW¼NW¼ sec. 2, T. 1 N., R. 31 W.
COUNTY: Escambia
FLORIDA GEOL. SURVEY NO.: W-4507
DEPTH: 4,472 feet
ELEVATION: 110 feet
FOSSIL IDENTIFICATIONS BY: H. S. Puri

	Depth below land surface (feet)
Terrace deposits* and *Citronelle* Formation *(undifferentiated)	
Sand, yellowish-brown, medium to very coarse	0-20
Crawl. fine, and medium to very coarse sand, pale-yellowish-brown; 2% clay.	20-100
Gravel and sand, as above; 30% white-and-yellowish-brown clay	100-120
Sand, very-light-tan, medium to very coarse; 1% white clay	120-140
Silt and clay. light-yellowish-brown; 50% very fine to very coarse sand.	140-160
Clay and siltstone, gray, carbonaceous.	160-180
Gravel. pale-yellowish-brown, pieces granule-size to ½ inch; quartz and chert; a few fragments of iron-oxide hardpan.	180-300
Gravel and sand, very-light-tan; gravel fine, sand medium to very coarse; quartz and c	300-420
Gravel, fine; 5% gray clay.	420-480
Pensacola Clay* *(members not differentiated)	
clay, gray; 30% fine gravel (cavings).	480-520
Clay. gray, silty, micaceous; a few small gastropods and pelecypod fragments	520-560
Shells of gastropods and pelecypods; 101 gray. silty clay.	560-580
Shells, as above; 50% gray clay; *Globigerina* sp., *Haplocytheridea bassleri*	580-600
Clay. gray; a few shell fragments.	600-860
Clay. as above; shells including *Arca* sp..	860-1000
Tampa Formation	
Clay, gray, silty; 30X dirty-grayish-white limestone; shell fragments including small gastropods	1000-1020
Limestone, dirty-grayish-white, not dolomitic; 30% gray clay and shell fragments; *Sorites* sp.	1020-1060
Clay, gray, calcareous; shell fragments.	1060-1080
Chickasawhay Limestone	
Limestone, dolomitic, dirty-grayish-white; 30% gray clay; shell fragments and bryozoans	1080-1100
Limestone, dolomitic, light-gray, vesicular	1100-1180
Limestone, dolomitic, as above; looks like a microcoquina of foram casts; bryozoans and fragments of large pelecypods; *Nummulites* &..	1180-1220
Limestone, dolomitic, dirty-grayish-white, with *Nummulites dia* and *Lepidocyclina mantelli*	1220-1240
Limestone, dolomitic, as above; 5% gray clay; *Lepidocyclina undosa*	1240-1300
Bucatunna Clay* Member of *Byram Formation	
Clay, gray; 10% grayish-white dolomitic limestone (cavings?); *Nummulites dia*	1300-1320
Limestone, ——tic. gray m y cavings).	1320-1360
Clay, gray.	1360-1420

0000156

Well No. 4597 (continued)

Ocala Group

Clay, gray; 40% grayish limestone	1420-1440
[redacted] h, with *Lepidocyclina ocalana* and *Nummulites floridensis*	1440-1460
Clay, gray (probably cavings); 15% limestone	1460-1480
Limestone, dirty-gray; 5% gray clay; *Lepidocyclina* sp. and other foraminifers	1480-1500
Limestone, light-grayish-cream, fairly purr. very abundant poorly preserved foraminifers, mostly *Lepidocyclina* sp.	1500-1620
Limestone, grayish-cream, consisting almost entirely of foraminifers, including *Nummulites trinitatensis* and *Nummulites willcoxi*	1620-1680

Lisbon equivalent and Tallahatta Formation

Clay, gray; 402 foraminifers	1680-1700
Limestone, light-gray, consisting mostly of foraminifers, including *Nummulites willcoxi*	1700-1720
Clay, gray; 402 foraminifera	1720-1740
Limestone, as above; 40% gray clay	1740-1760
Shale, gray, calcareous; 10% limestone with foraminifers	1760-1800
Shale, light-gray	1800-1840
Shale, gray; 10-40% grayish-cream foraminiferal limestone; *Discocyclina* sp. (Claiborne type)	1840-1880
Shale, gray, with *Nummulites sabinensis*	1880-1940
Clay, light-gray, calcareous, with *Pseudophragmina* sp., *Lepidocyclina antillea*, and *Lepidocyclina pustulosa*	1940-1980
Shale, light-gray, calcareous, carbonaceous; foraminifers	1980-2320

Hatchetigbee(?) Formation

Clay, gray	2320-2340
Shale, light-gray, calcareous, clayey	2340-2360
Clay, gray; 10-30% light-gray limestone	2360-2400
Clay, gray	2400-2440
Clay, gray; 10-30% foraminiferal limestone; a fer gastropods	2440-2500
Clay, gray	2500-2600

Florida Bureau of Geology Well No. W-222 1/2
U.S. Navy Yard, Pensacola, Department of Docks and Yards
16 April 1907 - 21 June 1907
?? Samples beginning at surface and ending at 1000
feet. From USGS, their number 1541. See letter
W.C. Mendenhall 10-19-33.

Depth, Feet	Description
0-26	Cuttings of fine, angular, clear quartz sand, with and occasional fragment of macroscopic shell material.
?6-34	Moderately fine to moderately coarse grained, sub-angular, clear quartz sand. A few yellow grains present and a few fragments of macroscopic shell material.
?4-36	Sand as above, but no shell fragments, a few fragments of dark gray sandy clay.
?6-47	Sand as above. A few worn fragments of macroscopic shell material,
?7-65	Moderately fine, and moderately even grained, angular to sub-angular clear quartz sand, and a few fragments of dark gray sandy clay;
?3-84	Moderately fine grained, sub-angular, clear quartz sand.
?4-87	Fine to coarse grained clear quartz sand.
?7-102	Fine, sub-angular, clear quartz sand.
?02-134	Sample composed mainly of fine clear quartz sand, with some coarse grains also present.
?34-230	Cuttings of fine, angular clear quartz sand, and a few fragments of light tan colored clay. from which the sand was apparenfly washed.
?30-274	Very fine clear quartz sand with a small amount of coarse grained sand also present, and a considerable amount of colorless mica.
?74-294	Like the preceding with the averaging still finer grained.
?94-372	Cuttings of a fine grained angular sand apparently washed from a tan colored, highly sandy and micaceous clay.
?72-378	Like the preceding, with the addition of a few fragments of carbonaceous material and a few broken specimens of Textularia gramen. A few small fragments of nacreous macroscopic shell material also present.

0000157

Depth, Feet	Description
378-388	Very fine grained, somewhat micaceous sand, apparently washing from a tan colored sandy clay, No fossil material noted,
388-40.2	Sample of gray clay, Washed-Very small residue of small fragments of the clay and about 50% very fine grained clear quartz sand,. A few pyrite nodules, a few small fragments of macroscopic fossils, some Echinoid spines and a few specimens of Cibicides concentrica present.
402-586	Cuttings of gray clay, Washed-Moderately small residue composed of fine, uneven grained clear quartz sand, some fragments of macro-scopic fossils, Echinoid spines and a few foraminifera. Common foraminifera present were-Robulus americanus, Robulus vaughani, Textularia cf, gramen, Cibicides concentrica, Amphistegina lessoni.
586-592 1/2	Cuttings of very finely sandy and micaceous tannish gray clay which leaves a small washed residue of very fine grained light gray sand a trace of glauconite and a very few specimens of Uvigerina pygmea.
592 1/2-674	Fine conglomerate composed mainly of small quartz pebbles.
674-1000	A very uneven grained quartz sand, apparently washing from a gray clay, A very fed fragments of macroscopic fossils, a few Echinoid spines and-a few foraminifera species as listed under the sample from 420-586.

SUMMARY

The samples down to 372' contain no diagnostic fossils and probably represent Pliocene and Recent time.

Sample 372' to 1000' usually carry foraminifera which indicate that this portion of the section drilled was Upper Pliocene (Choctawhatchee] in age.

NAS No. 1

Depth, feet	Description
0– 30	red sandy clay
30– 37	sand
37– 70	soft sandy clay
70–109	hard sandy clay
109–117	good sand
117–124	red sandy clay
124–177	hard sand with clay streaks
177–208	hard pack sand
208–224	sand and clay
224–250	pack sand with red sandy clay

NAS No. 2

Depth, feet	Description
0– 35	red sandy clay
35– 54	brown sandy clay
54– 67	blue clay
67–118	sand with clay balls
118–150	pack sand
150–210	pack sand coarser than above
210–224	sand, gravel, and chalk, full of white chalk balls

0000158

NAS No. 3

Depth, feet	Description
0- 6	top sand
6- 11	white sand
11- 58	black muddy sand
58- 68	muddy sand
68- 72	sand
72- 78	blue clay and sand
78- 88	blue clay and shell
88-112	blue clay and shell, little sand
112-128	loose to medium packed sand
128-138	coarse sand, little blue clay
138-148	muddy sand and clay
148-158	loose sand
158-188	fine loose sand
188-198	loose to medium packed sand
198-228	medium packed sand
228-239	coarse sand, packed
239-241	hard blue clay
241-248	coarse sand, packed

Pensacola Development Well No. 1

About five miles west of Pensacola, on Big Bayou, three miles north of Navy Yard, in New Warrington, west of Barrancas Avenue and south of Gulf Beach Highway, near function.

Elevation - 20 ft, completed - 1901, Depth - 1702 ft,
Driller - Frank Sutter.

Driller's log, USGS Water Supply Paper 102, pp 257-258.
Driller's log by Frank Sutter from 0 to 1620 ft.

This log copied by Robert B. Campbell from a holographic memo in J. E. Dubuisson's (deceased) files.

Depth, feet	Description
0- 1	surface white sand
1- 7	reddish-yellow sand, coarse
7- 19	white sand (water)
19- 29	white sand, finer
29- 64	blue clay
64-124	whitish sand with drift
124-144	white coarse sand with small gravel
144-224	variegated clays and sands only a few inches thick
224-274	fine white sand with small gravel
274-294	gray sand, fine
294-314	soft bluish clay
314-329	harder clay, greenish in color
329-330	rock
33Q-332	fine greenish sand and clay mixed

0000159

Pensacola Development Well No. 1

(continued)

Depth, feet	Description
332- 333	rock
333- 349	clay with sand mixed, greenish
349- 527	greenish blue clay
527- 545	greenish sand (water sand, flow of 20 gallons per minute, good water)
545- 659	greenish blue clay
659- 680	greenish sand (water sand, flow of 25 gallons per minute, good water)
680- 939	greenish clay
939-1119	gray sand gradually becoming coarser toward bottom and bottom of strata interlaid with strata of blue clay a few inches thick, filled with finest shells (top of strata gave a fine artesian flow, possibly 100 gallons per minute)
1119-1331	hard greenish clay
1331-1336	fine sand, greenish (salt water, 10 gallons per 'minute)
1336-1602	very hard tough clay
1602-1620	very fine gray sand (small flow of water, sand very quick and would rush up in the casing several hundred feet

Total depth 1620 feet. Well was abandoned at this depth on account of quicksand.

Test Hole No. 11

Ground Elevation:	22 feet
Water Elevation:	9.13 feet, 5-27-71
Depth:	185 feet
Top of Screen:	182 feet

Depth, feet	Description
0- 43	clean sand
43- 98	silty material
98-124	fine sand
124-140	clay and silt
140-155	clean sand
155-187	silty sand and silt

Test Hole No. 23

Ground Elevation: 24 feet

Water Elevation: 5 feet, 3-29-72

Depth: 200 feet

Top of Screen: 172 feet

Depth, feet	Description
0- 50	sand, medium grained, with carbonaceous content increasing downward
50-118	sand, medium grained, with alternating clean, clayey, and peaty layers
118-138	sand; fine to medium grained, predominantly clayey, with shell fragments
138-161	silt, peaty, interbedded with fine sand, both containing shell fragments
161-181	sand, medium-grained, slightly clayey, with clay content increasing downward and abundant shell fragments
181-190	sand, poorly sorted, fairly clean, with shell fragments
190-200	sand, medium-grained, peaty, with abundant shell fragments

APPENDIX B

Log of *Soil* Borings

Log of Borings at IWTP

Boring No.	Depth, ft	Description
1	0- 3	Loose brown fine sand
	3- 5.5	Very loose tan fine sand
	5.5- 9	Very firm tan fine sand
	9-16	Dense white fine sand
2	0- 4.5	Very loose brown fine sand
	4.5- 6.5	Loose tan fine sand
	6.5-16	Very firm tan to white fine sand
3	0- 2	Very loose brown fine sand (SP)
	2- 7	Firm to very firm white sand (SP)
	7- 9.5	Dense white fine sand (SP)
	9.5-16	Very firm to firm white to light brown fine sand (SP)
4	0- 2.5	Loose brown fine sand (SP)
	2.5-13	Very firm to dense white sand (SP)
	13-16	Finn light brown sand
5	0- 3.5	Very loose to loose brown fine sand (SP)
	3.5-12	Very firm to dense white fine sand (SP)
	12-23	Very firm white to light grey fine sand (SP)
	23-33.5	Dense white fine sand (SP)
	33.5-39.5	Firm brown fine sand (SP)
	39.5-55.5	Firm blue-gray sandy marine clay with thin sand seams and pieces of shell throughout
	55.5-59	Firm to very firm gray fine sand (SP)
	59-66	Very dense white fine sand (SP)

0000162

Log of Borings at IWTP
(Continued)

Boring No.	Depth, ft	Description
6	0- 3	Brown slightly silty sand (SEI)
	3- 3.5	Loose tan fine sand (SP)
	3.5-17	Very firm light brown to white fine sand (SP)
	17-39	Dense white fine sand with occasional very fine sand seams (SP)
	39-43	Soft blue-gray sandy marine clay with shell fragments (CH)
	43-56	Firm blue-gray very sandy marine slay with thin clayey sand seams (CH)
	56-66	Very dense gray fine sand (SP)
7	0- 3	Loose and very loose brown slightly silty fine sand (SM)
	3-16	Very firm to dense white fine sand (SP)
	16-28	Firm to very firm white sand (S?)
	28-39.5	Very firm to dense light brown to white fine sand (SP)
	39.5-59	Soft to firm blue-gray slightly sandy marine clay with shell fragments (CH)
	59-62.5	Very dense grey medium to fine sand (SP)
	62.5-66	Very dense white fine sand
8	0- 2.5	Loose brown and tan slightly silty fine sand (fill) (SP/SM)
	2.5- 6	Loose tan sand (SP)
	6- 9.5	Very firm to dense brown and tan sand (SP)
	9.5-16	Dense white sand (SP)

Log of Borings at IWTP (Continued)

Boring No.	Depth, ft	Description
9	0- 2.5	Very loose to loose brown fine sand (SP)
	2.5- 9	Dense light brown to tan fine sand
	9-23	Very firm white fine sand with occasional dense seams
	23-26	Dense white sand
10	0- 2	Loose brown sand (SP)
	2- 9	Firm to dense tan to white fine sand (SP)
	9-26	Very firm white sand (SP)
11	0- 2.5	Very loose tan fine sand (SP)
	2.5-14	Very firm to firm white sand with occasional loose seams (SP)
	14-21.5	Very firm to dense light brown fine sand (SP)
	21.5-31	Dense white Sine sand (SP)
12	0- 0.5	Brown slightly silty sand (topsoil) (SP)
	0.5- 2.5	Very firm brown sand (SP)
	2.5-18	Very firm to dense white sand (SP)
	18-21	Very firm white sand (SP)
I (elev, 3 ft)	0- 2	Loose gray and white fine sand with few roots (SP)
	2-26	Firm, dense, and very dense white fine to medium sand (SP)
11 (elev, 3 ft)	0- 0.5	Gray topsoil and roots
	0.5-26	Loose, firm, dense, and very dense gray fine to medium sand (SP)
III (elev, 4 ft)	0- 9.5	Loose, firm, dense and very dense white fine to medium sand (SP)
	9.5-20	Very dense and dense gray and tan fine to medium sand (SP)
	20-25	Dense white fine to medium sand (SP)

0000163

Boring Group No. 1

Boring No.	Depth, ft	Description
1 (elev, 8.8)	0- 0.5	Red clayey sand fill, cohesionless and medium dense (SC)
	0.5- 3.0	Brown and tan slightly silty sand, cohesionless and medium dense (SM/SP)
	3.0-14.0	Light tan to white sand, cohesionless and medium dense to dense (SP)
	14.0-19.0	White sand, cohesionles and very dense
	19.0-28.0	Light gray sand, cohesionless and very dense (SP)
	28.0-35.0	Dark gray sand, cohesionless and very dense (SP)
	35.0-44.0	Brown sand with brown organic stain, cohesionless and dense (SP)
	44.0-47.0	Gray sand, cohesionless and dense (SP)
	47.0-51.0	Blue marine clay, cohesive and of medium consistency (OH)
2 (elev, 9.0)	0- 2.0	Brown to tan slightly silty sand; cohesionless and medium dense (SM/SP)
	2.0- 8.5	White sand with small pieces of brick at 3 ft, cohesionless and loose to medium dense (SP)
	8.5-19.0	White and light tan sand, cohesionless and dense (SP)
	19.0-29.0	Light gray sand, cohesionless and dense to very dense (SP)
	29.0-35.5	Dark gray sand, cohesionless and very dense (SP)
	35.5-40.0	Brown sand with brown organic stain, cohesionless and dense (SP)
	40.0-47.0	Gray sand, cohesionless and dense (SP)
	47.0-49.0	Blue marine clay, cohesive and of medium consistency (OH)

Boring Group No. 1
(Continued)

Boring No.	Depth, ft	Description
3 (elev, 8.5)	0– 0.5	Red clayey sand fill (SC)
	0.5– 2.5	White slightly silty sand, cohesionless and medium dense (SM/SP)
	2.5-13.0	Tan to white sand, cohesionless and medium dense to very dense (SP)
	13.0–23.0	White sand, cohesionless and'dense (SP)
	23.0-28.0	Light gray sand, cohesionless and very dense (SP)
	28.0–38.0	Dark gray sand, cohesionless and very dense (SP)
	38.0-47.0	Light gray sand, cohesionless and very dense to dense (SP)
	47.0–51.0	Blue marine clay, cohesive and of medium consistency (OH)
4 (elev, 8.2)	0– 0.25	Red clayey sand fill (SC)
	0.25– 2.5	Light tan to white slightly silty sand, cohesionless and medium dense (SM/SP)
	2.5-19.5	White sand, cohesionless and medium dense to dense (SP)
	19.5–27.0	Light gray sand, cohesionless and very dense to dense (SP)
	27.0–35.0	Dark gray sand, cohesionless and very dense (SP)
	35.0-38.0	Light brown sand with light brown organic stain, cohesionless and dense (SP)
	38.0-43.0	Light tan to gray sand, cohesionless and very dense (SP)
	43.0-46.5	Dark gray watery sand, cohesionless and medium dense (SM/SP)
	46.5–51.0	Blue marine clay, cohesive and of medium consistency (OH)

0000164

Boring Group No. 1
(Continued)

Boring No.	Depth, ft	Description
5 (elev, 8.8)	0– 1.0	Brown slightly silty topsoil (SM)
	1.0– 9.0	Light tan to white slightly silty sand, cohesionless and medium dense to loose (SM/SP)
	9.0–19.0	Light tan to white sand, cohesionless and dense (SP)
	19.0–28.0	Light gray sand, cohesionless and dense (SP)
	28.0–32.0	Dark gray sand, cohesionless and very dense to dense (SP)
	32.0–39.0	Light gray sand, cohesionless and very dense. (SP)
	39.0–44.0	Light tan sand, cohesionless and very dense (SP)
	44.0–48.5	Dark gray sand, cohesionless and dense (SP)
	48.5–51.0	Blue marine clay, cohesive and of medium consistency (OH)

Boring Group No. 2

Boring No.	Depth, ft	Description
	0– 0.75	Loose red sand with roots (topsoil) (SP)
	0.75–14.5	Loose tan to white sand (SP)
	14.5–21.0	Loose brown sand with organic stain (SP)
2	0– 0.67	Loose tan sand with roots (topsoil) (SP)
	0.67– 1.16	Loose red sand (SP)
	1.16–13.5	Loose tan to white sand (SP)
	13.5–21.0	Loose brown sand with organic stain (SP)

Boring Group No. 3

Boring No.	Depth, ft	Description
I	0– 0.5	Brown sand with roots (SP)
	0.5–34.5	Brown to tan fine sand (SP)
	34.5–41.0	Tan to brown fine sand with slight organic stain (SP)
2	0– 0.5	Brown sand with grass roots (SP)
	5–31.0	Brown to tan fine sand (SP)
3	0– 0.5	Brown sand with roots (SP)
	0.5–31.0	Brown to tan fine sand (SP)
4	0– 0.25	Asphalt
	0.25–25.0	Tan to white and tan sand (SP)
	25.0–31.0	White sand (SP)
5	0– 0.25	Asphalt
	0.25– 0.9	Sand shell
	0.9–21.0	Tan to white and tan sand (SP)
	21.0–31.0	White sand (SP)

Boring Group No. 4

Boring No.	Depth, ft	Description
1	0– 0.17	Asphalt
	0.17– 0.66	Red slightly clayey sand (SC)
	0.66–17.5	Tan sand (SP)
	17.5–21.0	Gray sand (SP)
2	0–17.0	Tan sand
	17.0–21.0	Gray sand (SP)

0000165

Boring Group No. 5

Boring No.	Depth, ft	Description
1	0-29.0	Brown to white to gray sand (SP)
	29.0-32.5	Gray marine clay and sand
2	0- 2.0	Gray and brown sand
	2.0- 3.0	Gray sand with wood, bricks, and organics
	3.0-17.5	White sand (SP)
	17.5-24.8	Gray sand (SP)
	24.8-26.9	Gray clay and sand (SC/OH)

Boring Group No, 6

Boring No.	Depth, ft	Description
1	0- 0.5	Gray sand with decaying leaves and roots–topsoil (SM)
	0.5- 9.0	Tan sand (SP)
	9.0-13.0	Gray sand (SP)
	13.0-25.0	Brown sand with organic stain (SM)
2	0- 0.5	Gray sand with decaying leaves and roots–topsoil (SM)
	0.5-26.0	Tan to white sand

Boring Group No. 7

Boring No.	Depth, ft	Description
1	0– 1.0	Concrete
	1.0–10.0	Tan to gray sand (SP)
	10.0–17.5	Gray sand with wood (SP)
	17.5-50.0	Gray sand (SP)

Boring Group No. 8

Boring No.	Depth, ft	Description
1 (elev, 30.5)	0–3	Tan sand (SP)
	3–9	White to tan sand (SP)
	9–18	White sand (SP)
	18–41	Brown sand with organic stain (SP)
2 (elev, 27.5)	0–6	Tan to light tan sand (SM/SP)
	6–14.5	Light tan and gray sand (SP)
	14.5–17.5	Gray sand (SP)
	17.5–33	Dark brown sand with brown organic stain (SM/SP)
	33–41	Dark gray sand (SP)
3 (elev, 6.9)	0–3	White to tan sand (SP)
	3–17	Tan sand (SP)
	17–22	Brown sand (SP)
	22–27	Brown sand with light organic stain (SP)
	27–41	Brown sand (SP)
4 (elev, 6.75)	0–3	White to tan sand
	3–24	Tan sand (SP)
	24–32	Brown sand with organic stain (SP)
	32–41	Brown sand (SP)

0000166

Golf Course Boring Logs

Boring No.	Depth, Feet	Description
1	0-0.5	Brown sandy topsoil (SP)
	0.5-8	Brown to tan sand, cohesionless and loose (SP)
	8-14	White sand, cohesionless and medium dense (SP)
	14-21	Light gray sand, cohesionless and dense (SP)
2	0-1.a	Brown sandy topsoil (SP)
	1.0-1.5	Orange slightly clayey silty sand, cohesionless and loose (SM)
	1.5-11.5	Brown to tan sand, cohesionless and loose (SP)
	11.5-22	Gray sand, cohesionless and dense (SP)
	22-26	Tan to white sand, cohesionless and dense (SP)
3	0-0.5	Black sandy topsoil (SP)
	0.5-9	Brown to tan sand, cohesionless and loose (SP)
	9-15.5	White sand, cohesionless and medium dense to dense (SP)
	15.5-16	Gray sand (with root seam 15.5 to 15.6) cohesionless and very dense
4	0-0.5	Black sandy topsoil (SP)
	0.5-6.5	Brown to light orange sand, cohesionless and loose (SP)
	6.5-11	Tan sand, cohesionless and loose (SP)
5	0-0.5	Black sandy topsoil (SP)
	0.5-1.5	Orange silty sand, cohesionless and looss (SM)
	1.5-16	Tan sand, cohesionless and loose (SP)
6	0-0.5	Black sandy topsoil (SM)
	0.5-9	Brown to tan sand, cohesionless and loose (SP)
	9-21	White to tan sand, cohesionless and medium dense (SP)
6A	0-0.5	Black slightly silty sand, top-soil (SP/SM)
	0.573.5	Tan sand, cohesionless and loose (SP)

Boring No.	Depth, Feet	Description
6A	3.5-4.5	Black slightly silty sand with traces of organics, cohesionless and medium dense (SP)
	4.5-6	Gray sand vith traces of organic cohesionless and medium dense (SP)
	6-9	Tan sand, cohesionless and medium dense (SP)
	9-11	White sand, cohesionless and loose (SP)
7	0-0.5	Black sandy topsoil (SP)
	0.5-11	Gray to tan sand, cohesionless and loose to medium dense (SP)
8	0-0.5	Black sandy topsoil (SP)
	0.5-9	Tan sand, cohesionless and loose (SP)
	9-16	Tan to white sand, cohesionless, medium dense to dense (SP)
9	0-0.5	Black sandy topsoil (SP)
	0.5-11	Gray to tan sand cohesionless and loose to medium dense (SP)
10	a-0.5	Gray sandy topsoil (SP)
	0.5-16	Brown to tan sand, cohesionless and loose to medium dense (SP)
11	0-0.5	Black sandy topsoil (SM)
	0.5-11	Tan sand, cohesionless and loose to medium dense (SP)
12	0-0.5	Black sandy topsoil (SP)
	0.5-11	Brown to tan sand, cohesionless and loose (SP)
13	0-0.5	Black sandy topsoil (SP)
	0.5-11	Brown to tan sand, cohesionless and loose (SP)
14	0-0.67	Black sandy topsoil (SP)
	0.67-8	Brown to tan sand, cohesionless and loose (SP)
	8-10.25	White sand, cohesionless and loose (SP)
	10.25-11	White and gray sand, cohesionless and medium dense (SP)
15P	a-0.5	Gray sandy topsoil (SP)
	0.5-16	Tan sand, cohesionless (SP)

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Boring No,	Depth, Feet	Description
2SP	0-0.5	Gray sandy topsoil,(SP)
	0.5-11	Brown to tan sand, cohesionless (SP)
	11-15	White sand, cohesionless (SP)
3SP	0-0.67	Gray sandy topsoil (SP)
	0.67-3	White sand, cohesionless (SP)
	3-5	Brown sand with traces of root, cohesionless (SP)
	5-15	Tan sand, cohesionless (SP)

APPENDIX C

Legal Status of Endangered and Potentially Endangered Plant Species in Florida

ENDANGERED AND POTENTIALLY ENDANGERED
PLANTS IN FLORIDA
24 **February** 1981

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1]						
		USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Acacia choriophylla	Tamarindillo						E	
Acoelorrhaphc sp.*	Palms					T		
Acrostichum aureum	Golden leather fern					T	R	
Acrostichum sp.**	Leather ferns					T		
Actaea pachypoda	Baneberry						R	
Adiantum capillus-veneris	Venus-hair fern					T	R	
Adiantum melanoleucum	Fragrant maidenhair fern					T	E	
Adiantum sp.**	Maidenhair ferns					T		
Agalinis purpurea vat. carteri	Carter's large purple false foxglove	UR		T				
Agalinis stenophylla	Narrow-leaved false foxglove	UR		X				
Agrimonia incisa	Incised groove bur	UR		T				
Andropogon arctatus	Pinewoods bluestem	UR		E				
Anemia sp.*	Pine ferns					T		
Anemone berlandieri	Texas anemone						R	
Anemonella thrlictroides	Rue anemone						E	
Aquilegia canadensis	Wild columbine	UR		E			R	
Arenaria godfreyi	Godfrey's sandwort			T				
Argythamaia blodgettii	Blodgett's wild-mercury	UR		T				
Aristida floridana	Florida three-awned grass	UR		E				
Aristida simpliciflora	Southern three-awned grass	UR		T				
Aristolochia tomentosa	Dutchman's pipe					T		
Asclepias connivens	Milkweed (unnamed)				U			
Asclepias curtissii	Curtis milkweed					T	T	
Asclepias tomcntosa	Velvet-leaf milkweed				R			
Asclepias viridula	Southern milkweed	UR		T				
Asimina pulchclla	Pawpaw (unnamed)			T				
Asimina pygmaea	Pink pawpaw					E		
Asimina rugclii	Pawpaw (unnamed)			T				V
Asimina tetramera	Four-petal pawpaw	UR		E		E	E	E
Asplenium auritum	Auricled spleenwort					E	E	

*All native species
**All native species except those otherwise listed

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SCIENTIFIC	COMMON NAME	DESIGNATED STATUS[1] USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN
Asplenium dentatum	Slender spleenwort					T	T	
Asplenium heterores .liens	Spleenwort (unnamed)	UR						
Asplenium plenum	Spleenwort (unnamed)	UR						
Asplenium pumilum	Dwarf spleenwort					T	E	
Asplenium serratum	Bird's nest spleenwort					T	E	
Asplenium sp.**	Spleenworts					T		
Aster brachypholis	Apalachicola River aster	UR		T				
Aster pinifolius	Pale violet aster	NT		E				
Astcr plumosus	Plumose aster	UR		T				
Aster spinulosus	Pinewoods aster	UR		T				
Athyrium sp.*	Southern lady ferns					T		
Avicennia germinans	Black mangrove						SC	
Azolla sp.*	Mosquito ferns					T		
Balduina atropurpurea	Purple balduina			E				
Baptisia .calycosa	Pineland wild indigo	UR		T				
Baptisia hirsuta	Hairy wild indigo	UR		T			T	
Baptisia megacarpa	Apalachicola wild indigo	UR		T			E:	
Baptisia riparia	Wild indigo (unnamed)	UR						
Baptisia simplicifolia	Coastal plain wild indigo	UR		T				
Basiphyllaea sp.*	Orchids		II			T		
Blechnum occidentale	Sinkhole fern					E	E	
Blechnum sp.* (except B. serrulatum, swamp fern)	Blechnum ferns'					T		
Bletia sp.*	Pine pinks		II			T		
Bonamia grandiflori	Florida bonamia	UR		T			T	
Botrychium lunarioides	Winter grapefern					T	R	
Botrychium sp.**	Grapeferns					T		
Brassia caudata	Spider. orchid (unnamed)	UR	II			T		
Brassia sp.**	Spider orchids		II			T		
Brickellia cordifolia	Flyr's nemesis	UR		T			R	
Brickellia eupatorioides var. floridana	Florida thoroughwort brickell-bush	UR		T				

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SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1]						
		USFWS[2]	CITES[3]	SI[4]	USFS[5]	EM6	FCREPA[7]	I.
Cereus gracilis	Prickly-apple	UR	II	E		E	T	
Cereus robinii	Tree cactus	UR	II	E		E	E	
Cereus sp.**	Cacti		II			T		
Chamaesyce cumulicola	Sand dune spurge	UR		T				
Chamaesyce deltoidea deltoidea	Wedge spurge	UR		T				
Chamaesyce deltoidea serpyllum	Wild thyme spurge	UR		E				
Chamaesyce garberi	Garber's spurge	UR		E				
Chamaesyce porteriana var. keyensis	Porter's hairy podded spurge	UR		E				
Chamaesyce porteriana var. porteriana	Porter's broad-leaved spurge			T				
Chamaesyce porteriana var. scoparia	Porter's broom spurge	UR		E				
Cheilanthes microphylla	Southern lip fern					T	R	
Chionanthus pygmaeus	Pigmy fringetree	UR		T		E	E	
Chrysophyllum olivaeforme	Satinleaf					T		
Chrysopsis cruiseana	Cruise's golden aster	UR					T	
Chrysopsis floridana	Florida golden aster	UR					E	
Cienfuegosia heterophylla	Yellow hibiscus					T		
Cleistes divaricata	Rosebud orchid		II		U	T		
Clematis micrantha	Old-man's beard virgin-bower	UR		E				
Clitoria fragrans	Pigeon-wing butterflypea	UR		T			T	
Clusia flava	Balsam-apple (unnamed)	UR						
Clusia rosea	Balsam-apple (unnamed)					E		
Coccothrinax argentata	Silver palm					E	T	
Coelorachis tuberculosa	Grass (unnamed)	UR						

*All native species
**All native species except those otherwise listed

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SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1] USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
ommelina gigas	Climbing dayflower	UR		T		T	T	
onradina eviflora	Short-leaved rosemary	UR		E				
Conradina glabra	Apalachicola rosemary	UR		E			T	
Conradina grandiflora	Large-flowered rosemary	UR		T				
orallorhiza sp.*	Coral-root orchids		II			T		
ordia sebestena	Geiger tree					T		
Coreopsis gladiata	Swamp coreopsis				U			
ornus alternifolia	Pagoda dogwood					T	E	
Cranichis sp.*	Orchids		II			T		
Croomia pauciflora	Few-flowered croomia	UR		T			E	
Croton elliottii	Elliott's. croton	UR		E				
Croton glandulosa var. simpsonii	Simpson's glandular croton	NT		E				
Cryptotaenia canadensis	Honewort						E	
tenitis sp.*	Comb ferns					T		
enium floridanum	Florida orange-grass	UR		T				
Cucurbita okeechobeensis	Okeechobee gourd	UR		T		E	T	
ipania glabta	Cupania					E	E	
uphea aspera	Tropical waxweed	UR		E				
Cynoglossum irginianum	Wild comfrey						R	
omium sp.*	Holly ferns					T		
yrtopodium punctatum	Cow-horn orchid					E	T	
eringothamnus pulchellus	Squirrel-banana (unnamed)	UR						
Dceringothamnus rugelii	Yellow squirrel-banana	UR					E	
ennstaedtia bipinnata	Cuplet fern					E	E	
Ccerandra frutescens	Scrub balm	UR		E			T	
Dicerandra immaculata	Spotless-petaled dicerandra	UR		E				
cerandra odoratissima	Rose dicerandra			T				
Dicranopteris sp.*	Net ferns					T		
gitaria floridana	Florida finger grass	UR						

*All native species
** l native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1]						
		USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN
Digitaria gracillima	Finger grass (unnamed)	UR						
Dirca palustris	Leatherwood						R	
Diritaria panciflora	Finger grass (unnamed)	UR						
Drosera intermedia	Water sundew						R	
Dryopteris sp.*	Shield ferns					T		
Elytraria carolinensis var. angurtifolia	Narrow-leaved Carolina scalystem	UR		T				
Encyclia boothiana	Dollar orchid	UR	II	T		E	E	
Encyclia pygmaea	Dwarf epidendrum		II			T	E	
Encyclia sp.*	Epidendrum orchids		II			T		
Epidendrum acunae	Acuna's epidendrum		II			T	E	
Epidendrum nocturnum	Night-scent orchid		II			T	T	
Epidendrum sp.**	Epidendrum orchids		II			T		
Epigaea repens	Trailing arbutus					E	R	
Equisetum sp.*	Horsetails					T		
Eragrostis tracyi	Sanibel lovegrass	UR		T			T	
Eriochloa michauxii var. simpsonii	Cup grass (unnamed)	UR		T				
Eriogonum floridanum	Scrub buckwheat						T	
Ernodea littoralis	Beach creeper						T	
Eryngium cuncifolium	Wedge-leaved button-snake roots	UR		T				
Erythrodes sp.*	Orchids		II			T		
Erythronium americanum	Dogtooth lily					T		
Erythronium umbilicatum	Dimpled dogtooth violet						T	
Eugenia confusa	Redberry eugenia					T		
Eugenia rhombea	Red stopper						E	
Euge .a simpsonii	Simpson cugenia					T		
Eulophia ecristata	Orchrid (unnamed)	UR	II			T		
Eulophia sp.**	Orchids		II			T		
Euphorbia austrina	Spurge (unnamed)	UR						
Euphorbia ditcoidalis	Spurge (unnamed)	UR						
Euphorbia exserta	Exserted fruited spurge	UR		T				

*All native species
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SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1] USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
'uphorbia telephioides	Telephus spurge	UR		T				
estiera segregata var. pinetorum	Pinewood privet	UR		E				
alactia pinetorum	Small's milkpea	UR		E				
Galeandra sp.*	Orchids		II			T		
Garberia fruticosa	Garberia					T		
'entiana pennelliana	Wiregrass gentian	UR		E	R		T	
Goniophlebium sp.*	Polypody ferns					T		
Gossypium hirsutum	Wild cotton						E	
Govenia sp.*	Orchids		II			T		
Guaiacum sanctum	Lignum-vitae		II			E	T	
Guzmania monostachia	Fuch's bromeliad					E	E	
Guzmania sp.**	Air plants					T		
ymnopogon floridanus	Florida beardgrass	UR		T				
Habenaria sp.*	Orchids		II			T		
'arperocallis flava	Harper's beauty	E		E	VR		E	
Aarrisella sp.*	Orchids		II			T		
Hartwrightia floridana	Florida hartwrightia	UR		T			R	
iedeoma graveolens	Mock pennyroyal	UR		E			T	
Hedyotis nigricans var. pulvinata	Diamondflowers	UR						
'elianthus carnosus	Lakeside sunflower	UR		T				
Helianthus debilis vestitus	Hairy cucumber-leaf sunflower	UR		T				
'iotropium polyphyllum var. horizontale	Prostrate many-leaved turnsole	UR		T				
Yepatica americana	Liverleaf						E	
ieterotheca flexuosa	Bent golden aster	UR		T				
Hexalectris sp.*	Coral-root orchids		II			T		
lexastylis arifolia	Heartleaf						R	
Hippomane mancinella	Manchineel					T	T	
Hydrangea arborescens	Wild hydrangea						R	
Hymenocallis coronaria	Stream-bank spider lily	UR		E				
Yymenocallis latifolia	Broad-leaved spider lily	UR		T				
Hymenocallis occidentalis	Spider lily (unnamed)				U			
lypelate trifoliata	Inkwood						T	
Hypericum cumulicola	Highlands scrub hypericum	UR		E			E	

*All native species

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SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1] USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN
Hypericum edisonianum	Edison's St. John's-wort	UR					T	
Hypericum lissophloeus	Smooth-barked St. John's-wort	UR					E	
Hypolepis sp.*	Flakelet ferns					T		
Ilex amelanchier	Holly (unnamed)	UR						
Ilex krugiana	Krug's holly					T	T	
Ilex opaca var. arenicola	Sand-loving American holly	UR		T				
Ilex sp.** (except I. cassine, cca, large gallberry; I. glabra, gallberry; I. myrtifolia, myrtle-leafed holly; I. vomitoria, yaupon)	Hollies					T		
Illicium floridanum	Anise (unnamed)					T		
Illicium parviflorum	Yellow anise	UR		T		T		
Ionopsis utricularioides	Delicate ionopsis orchid		II			E		
Ipomoea trichocarpa	Morning glory (unnamed)				R			
Isoetes sp.*	Quillworts					T		
Isopyrum biternatum	False rue anemone						R	
Isotria sp.*	Orchids		II			T		
Jacquemontia curtissii	Pineland clustervine	UR		T			T	
Jacquemontia reclinata	Beach clustervine	UR		T			E	
Juncus gymnocarpus	Coville's rush			T			R	
Justicia cooleyi	Cooley's water-willow	UR		E			T	
Justicia crassifolia	Thick-leaved water-willow	UR		E				
Kalmia latifolia	Mountain laurel						R	
Kosteletzkya smilacifolia	Southern seashore mallow	UR		T				
Lachnocaulon beyrichianum	Southern bog buttons			T				
Lechea cernua	Nodding pinweed	UR		T				
Lechea divaricata	Pine pinweed	UR		T				
Lechea lakelae	Lakela's pinweed	UR		T				
Leitneria floridana	Florida corkwood	UR		T			R	
Leochilus sp.*	Orchids		II			T		
Lepanthopsis melantha	Harris' tiny orchid	UR	II	T		T	R	

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SCIENTIFIC NAME	COMMON NAME	USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Liatris ohlingtrae	Florida gayfeather	UR		E				
Liatris provincialis	Godfrey's blazing star	UR					T	
aeopsis carolinensis	Parsley (unnamed)	UR						
Lilium iridollae	Panhandle lily	UR		E			E	
Limonium carolinianum var. angustatum	Narrow-leaved sea-lavendar	NT		E				
Lindera melissifolia	Swamp spicebush	UR		E				
Linum arenicola	Sand flax	UR		E				
Linum carteri var. carteri	Carter's small-flowered flax	UR		E				
Linum carteri var. smallii	Carter's large-flowered flax	UR		E				
Linum sulcatum var. harperi	Harper's grooved yellow flax	UR		T				
Linum westii	West's flax	UR		E			R	
Liparis sp.*	Orchids		II			T		
Listera sp.*	Orchids		II			T		
Litsea aestivalis	Pond spice			T			R	
Lomariopsis sp.*	Holly ferns					T		
Lupinus tracyi	Tracy's lupine	UR						
Lupinus westianus	Gulfcoast lupine	UR		T			T	
Lycopodium dichotomum	Hanging club moss						E	
Lycopodium sp.**	Club mosses					T		
Lygodium sp.*	Climbing ferns					T		
Lythrum curtissii	Lythrum (unnamed)	UR						
Lythrum flagellate	Lythrum (unnamed)	UR						
Macbridea alba	White birds-in-a-nest	UR					E	
Macradenia sp.*	Orchids		II			T		
Magnolia acuminata	Cucumber-tree						R	
Magnolia ashei	Ashe's magnolia	UR		T		E	T	
Magnolia pyramidata	Pyramidal magnolia					E		
Malaxis unifolia	Green adder's mouth		II			T	R	
Malaxis sp.**	Orchids		II			T		
Mallotonia gnaphalodes	Sea-lavender						T	
Manisuris tuberculosa	Piedmont jointgrass			T				

*All native species

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SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1] USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Harshallia mohrii	Barbara's buttons	UR						
Marsilea sp.*	Waterclovers					T		
Matela alabamcnsis	Anglepod (unnamed)	UR						
Matela floridana	Milkweed (unnamed)	UR						
Maxillaria crassifolia	Hidden orchid		II			T	E	
Maxonia sp.*	Ferns					T		
Melanthera parvifolia	Aster (unnamed)	UR						
Microgramma sp.*	Polypody ferns					T		
Minuartia godfrey	Pink (unnamed)	UR						
Honotropa brittonii	Indian-pipes	UR		T				
Honotropa hypopithys	Pinesap						R	
Monotropsis rcynoldsiae	Pigmy-pipes	UR		E			E	
Myrcianthes fragrans var. simpsonii	Simpson's stopper	UR		T				
Myriophyllum laxum	Piedmont water milfoil	UR		T				
Nemastylis floridana	Fall-flowering ixia	UR		T			T	
Nephrolepis sp.*	Boston ferns					T		
Nolina atopocarpa	Florida beargrass	UR		E	R		E	
Nolina brittoniana	Britton's beargrass	UR		E				
Nuphar luteum ulvaceum	West Florida cow lily	UR		T				
Okenia hypogaea	Burrowing four-o'clock						E	
Oncidium carthagenense	Coot Bay dancing lady	UR	II			T		
Oncidium variegatum	Dancing-lady orchid		II			T	T	
Oncidium sp.**	Orchids		II			T		
Onoclea sp.*	Sensitive ferns					T		
Ophioglossum palmatum	Hand fern			T		E	E	
Ophioglossum sp.**	Adder's tongues					T		
Opuntia spinosissima	Semaphore cactus	UR	II	T		T		
Opuntia triacantha	Three-spined prickly pear	UR	II	T		T		
Opuntia sp.**	Prickly pears		II					
Opuntia sp.** (except prostrate-growing ones)	Prickly pears					T		

*All native species
**All native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Oxypolis greenmanii	Giant water dropwort	UR		E			E	
Pachysandra procumbens	Allegheny spurge				VR		E	
Paltonium sp.*	Ribbon ferns					T		
Panicum nudicaule	Naked-stemmed panic grass	UR		T				
Panicum pinetorum	Pineland panic grass	UR		T				
Parnassia caroliniana	Coastal parnassia	UR			R			
Parnassia grandifolia	Grass-of-parnassus					E	E	
Paronychia chartacea	Paper-like nailwort	UR		E				
Paronychia rugelii var. interior	Rugel's interior nailwort	NT		E				
Pavonia spinifex	Yellow hibiscus					T		
Pellaea sp.*	Cliff brake ferns					T		
Peltandra sagittifolia	Spoon flower						R	
Peperomia floridana	Everglades peperomia	UR				T	E	
Peperomia sp.**	Peppers					T		
Pereskia sp.*	Cacti		II			T		
Persea borbonia var. humilis --	Dwarf red bay	UR		T				
Persicaria paludicola	Everglades knotweed	NT		T				
Phlebodium sp.*	Polypody ferns					T		
Phoradendron rubrum	Mahogany mistletoe						T	
Phyllanthus liebmannianus	Pinewood dainties	UR		T			R	
Phyllanthus pentaphyllus floridanus	Florida five-petaled leaf flower	UR		T				
Phymatodes sp.*	Polypody ferns					T		
Physalis viscosa var. elliotii	Elliot's sticky ground cherry	UR		T				
Physotegia leptophyllum	Slender-leaved false dragonhead	UR		T				
Pinckneya pubens	Hairy fevertree			T		T		
Pinguicula ionantha	Violet-flowered butterwort			T				
Pinguicula planifolia	Chapman's butterwort	UR						

*All native species
**All native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1] USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN
Pinguicula primulifolia	Butterwort (unnamed)				R			
Pisonia floridana	Four-o'clock (unnamed)	UR						
Pityrogramma sp.*	Bracken ferns					T		
Platanthera flava	Southern rein orchid		II	T		T		
Platanthera integra	Yellow fringeless orchid	UR	II	T		T		
Platanthera sp.**	Orchids		II			T		
Pleopaltis revoluta	Star-scale fern					T	E	
Pleurothallis sp.*	Orchids		II			T		
Podophyllum peltatum	May-apple						R	
Pogonia sp.*	Orchids		II			T		
Polygala boykinii var. sparsifolia	Boykin's few-leaved milkwort	UR		T				
Polygala lewtonii	Lewton's milkwort	UR		E				
Polygala smallii	Tiny milkwort	UR					E	
Polygonella ciliata var. basiramia	Hairy jointweed	UR		E				
Polygonella macrophylla	Large-leaved jointweed	UR		T			E	
Polygonella myriophylla	Small's jointweed	UR		E				
Polygonum meisnerianum	Mexican tear-thumb						R	
Polymnia laevigata	Aster (unnamed)	UR						
Polypodium sp.* (except P. aureum, serpent fern; P. polypodioides, resurrection fern)	Polypody ferns					T		
Polytrhiza lindenii	Ghost orchid		II			E		
Polystachya sp.*	Orchids		II			T		
Polystichum sp.*	Christmas ferns					T		
Ponthieva sp.*	Shadow witch orchids		11			T		
Potamogeton floridanus	Pondweed (unnamed)	UR						
Prescottia sp.*	Orchids		II			T		
Prunus geniculata	Scrub plum	UR		E			E	
Pseudophoenix sargentii	Buccaneer palm					T	E	
Psilotum sp.*	Whisk ferns					T		
Pteridium sp.*	Bracken ferns					T		

*All native species
**All native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Pteris sp.* (except P. aquilinum, common bracken fern)	Brake ferns					T		
Pycnanthemum floridanum	Florida mountain mint			T				
Remirea maritima	Beach-star	UR					E	
Restrepiella ophiocephala	Snake orchid		II			T	E	
Rhapidophyllum hystrix	Needle palm			T		T	T	V
Rhexia parviflora	Small-flowered meadowbeauty	UR		E				
Rhexia salicifolia	Panhandle meadowbeauty	UR		T			R	
Rhipsalis baccifera	Cactus (unnamed)	UR	II			T		
Rhipsalis sp.**	Cacti		II			T		
Rhizophora mangle	Red mangrove						SC	
Rhododendron austrinum	Orange azalea			T		E	T	
Rhododendron chapmanii	Chapman's rhododendron	E		E		E	E	
Rhododendron sp.**	Azaleas					T		
Rhynchosia cinerea	Brown-haired snoutbean	UR		T				
Rhynchospora culixa	Georgia beak rush	UR		T				
Rhynchospora punctata	Pineland beak rush	UR		T				
Ribes echinellum	Miccosukee gooseberry	UR		E		E	E	
Roystonea elata	Florida royal palm	UR		E		E	R	E
Rudbeckia mollis	Hairy coneflower				R			
Budbeckia nitida	St. Johns-Susan	UR					T	
Rudbeckia triloba var. pinnathiloba	Aster (unnamed)	UR						
Sabal sp.* (except S. palmetto, cabbage palm)	Cabbage palms					T		
Sachsia bahamensis	Bahama sachsia						E	
Sageretia minutiflora	Tiny-leaved buckthorn			T				
Salix floridana	Florida willow	UR					R	
Salvia blodgetti	Blodgett's sage	UR		T				
Salvinia sp.*	Water ferns					T		
Sarracenia leucophylla	White-top pitcherplant			E	U	E	T	

*All native species
**All native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	USFWS[2]	CITES[3]	ST[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Sarracenia purpurea	Fly-trap pitcherplant				U			
Sarracenia rubra	Red-flowered pitcherplant					E	R	
Scaevola plumieri	Scaevola					E		
Schisandra glabra	Schisandra			T			R	
Schizachyrium niveum	Riparium autumngrass	UR		T				
Schizachyrium rhizomatum	Florida autumngrass	NT		E				
Schizaea germanii	Tropical curly-grass fern	UR		E			R	
Schwalbea americana	American chaff-seed				R			
Scutellaria floridana	Florida skullcap	UR		T				
Selaginella sp.*	Spike mosses					T		
Sida rubromarginata	Red-margined mallow	UR		T				
Silene polypetala	Fringed campion	UR		E				
Sium floridanum	Florida water parsnip	UR		T				
Smilax smallii	Jackson-vine						T	
Solanum bahamense var. rugelii	Rugel's Bahama horse nettle	UR		X				
Solanum carolinense var. floridanum	Florida horse nettle	UR						
Sphenomeris sp.*	Parsley ferns					T		
Sphenostigma coelestinum	Bartram's ixia	UR		T		T	T	
Spigelia gentianoides	Gentian pinkroot	UR		E				
Spigelia loganioides	Florida pinkroot	UR		E			R	
Spiranthes lanceolata var. paludicola	Red-flowered ladies'-tresses	UR	II	E		T		
Spiranthes polyantha	Florida keys ladies'-tresses	UR	II	T		T		
Spiranthes sp.**	Ladies'-tresses		II			T		
Stachys lythroides	Tallahassee hedge nettle	UR		T				
Staphylea trifolia	Bladdernut						E	
Stenochlaena sp.*	Holly ferns					T		
Stewartia malacodendron	Silky camellia						T	

*All native species
**All native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1]						
		USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN[8]
Stillingia sylvatica tenuis	Slender queen's-delight spurge	UR		T				
umpfia martima	Pride-of-big-pine					E	E	
Suriana maritima	Bay cedar					E		
Swietenia mahogany	Mahogany					T		
Taxus floridana	Florida yew	UR		E		E	T	
Tectaria coriandrifolia	Hattie Bauer halberd fern					T	E	
Tectaria amesiana	Halberd fern (unnamed)	UR				T		
Tectaria sp.**	Halberd ferns					T		
Tephrosia angustissima	Hoary pea (unnamed)	UR						
Tephrosia mohrii	Pineland hoary pea	UR		T				
Tetramicra sp.*	Epidendrum orchids		II			T		
Tetrazygia bicolor	Tetrazygia					T		
Thalictrum cooleyi	Cooley's meadowrue	UR						
Thelypteris sp.* (except T. normalis, shield fern)	Aspidiums					T		
Thrinax floridana	Florida thatch palm					T	T	
Thrinax microcarpa	Brittle, thatch palm					T	T	
Thrinax sp.**	Thatch palms					T		
Tillandsia fasciculata	Wild pine bromeliad					E		
Tillandsia flexuosa	Twisted air plant					T	T	
Tillandsia pruinosa	Fuzzy-wuzzy air plant					T	T	
Tillandsia sp.** (except T. recurvata, ball moss; T. usneoides, Spanish moss)	Air plants					T		
Tipularia sp.*	Orchids		II			T		
Tithymalus austrinus	Florida jewbush			T				
Torreya taxifolia	Florida torreya	UR		E		E	E	
Tournefortia gnaphalodes	Sea-lavender					E		
Tragia saxicola	Florida keys noseburn	UR		T				
Trichomanes sp.*	Filmy ferns					T		
Trillium lanceolatum	Narrow-petaled trillium				U			

*All native species
**All native species except those otherwise listed

SCIENTIFIC NAME	COMMON NAME	USFWS[2]	CITES'	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IU
Trillium lancifolium	Lance-leaved wake-robin					E	T	
Triphora craigheadii	Craighead's nodding-caps	UR	II	E		T		
Triphora latifolia	Broad-leaved nodding-caps	UR	II	E		T		
Triphora sp.**	Nodding-caps		II			T		
Tripsacum floridanum	Florida gramagrass	UR		E				
Trismeria sp.*	Bracken fern					T		
Tropidia polystachya	Young-palm orchid		II			T	E	
Ulmus crassifolia	Cedar elm						R	
Uvularia floridana	Florida merrybells						R	
Vanilla barbellata	Worm-vine orchid		II			T	T	
Vanilla sp.**	Vanillas		II			T		
Veratrum woodii	Woods' false hellebore			T			E	
Verbena maritima	Coastal vervain	UR		T				
Verbena tampensis	Tampa vervain	UR		E				
Verbesina chapmanii	Chapman's crownbeard	UR		T			T	
Verbesina heterophylla	Variable-leaf crownbeard	UR		T				
Vicia ocalensis	Ocala vetch	UR		E			R	
Viola hastata	Halbepd-leaved yellow violet						E	
Vittaria sp.*	Shoestring ferns					T		
Warea amplexifolia	Clasping warea	UR		E				
Warea cartcri	Carter's warea	UR		E				
Warea sessifolia	Sessile-leaved warea			T				
Woodsia sp.*	Ferns					T		
Woodwardia sp.* (except W. virginica, Virginia chain fern)	Chain ferns					T		
Xyris drummondii	Yellow-eyed grass (unnamed)	UR						
Xyris isoetifolia	Quillwort yellow-eyed grass	UR		T				
Xyris longisepala	Karst pond yellow-eyed grass	UR		T			T	
Xyris scabrifolia	Harper's yellow-eyed grass	UR		T				
Zamia floridana	Florida coontie		II			T	T	

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SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS[1]						
		USFWS[2]	CITES[3]	SI[4]	USFS[5]	FDA[6]	FCREPA[7]	IUCN
Zamia integrifolia	Coontie		II	E		T		
Zamia umbrosa	East coast coontie		II			T	T	
Zamia sp.**	Coonties		II			T		
Zanthoxylum flavum	Yellowheart						E	
Zephyranthes simpsonii	Rain zephyr lily			T		E		
Zephyranthes treatiae	Easter zephyr lily			T		T		
Zephyranthes sp.** (except non-white species)	Rain lilies					T		
Zeuxine sp.*	Orchids		II			T		
Zizia latifolia	Bristol golden alexanders	UR		T				

[1]E=Endangered; NT=Non-valid Taxon (ineligible for federal listing); R=Rare; SC=of Special Concern; T=Threatened; U=Uncommon; UR=Under Review (for possible listing); V=Vulnerable; VR=Very Rare; X=Extinct; I=Included in Appendix I (of CITES); II=Included in Appendix II (of CITES).

[2]U. S. Fish and Wildlife Service: List of Endangered and Threatened Wildlife and Plants, 1979 (official United States list).

[3]Convention on International Trade in Endangered Species of Wiid Fauna and Flora.

[4]Smithsonian Institution: Endangered and Threatened Plants of the United States, E. S. Ayensu and R. A. DeFilipps, authors, 1978 (list of species proposed for inclusion on United States list).

[5]United States Forest Service: Endangered, Rare and Uncommon Wildflowers Found on the Southern National Forests, 1370.

[6]Florida Department of Agriculture and Consumer Services: Preservation of Native Flora of Florida Act, Florida Statutes Section 581.185, 1978 (official State of Florida list).

[7]Florida Committee on Rare and Endangered Plants and Animals: Rare and Endangered Biota of Florida Volume 5--Plants, D. B. Ward, editor, 1979.

[8]International Union for Conservation of Nature and Natural Resources: The IUCN Plant Red Data Book, G. L. Lucas and A. H. M. Synge, authors, 1978.

*All native species
**All native species except those otherwise listed

APPENDIX D

Legal Status of Endangered and Potentially Endangered Animal Species in Florida

Legal Status of Endangered and Potentially Endangered Animal Species in Florida--March 1981

Species	Legal Status[1] GFWFC[2]	USFWS[3]	CITES[4]
Fishes			
Shortnose sturgeon (Acipenser brevirostrum)	E -	E	I
Atlantic sturgeon (Acipenser oxprhynchus)	SSC		II
Key silverside (Menidia conchorum)	E		
Bluestripe shiner (Notropis callitaenia)	T	UR	
Blackmouth shiner (Notropis undescribed species)	T		
Lake Eustis Pupfish (Cyprinodon variegatus hubbsi)	SSC		
Saltmarsh topminnow (Fundulus jenkinsi)	SSC		
Rivulus (Rivulus marmoratus)	SSC		
Okaloosa darter (Etheostoma okaloosae)	E	E	
Harlequin darter (Etheostoma histrio)	SSC		
Southern tessellated darter (Ethcostoma olmstedi maculaticeps)	SSC		
Crystal darter (Ammocrypta asprella)	T	UR	
Key blenny (Starksia starcki)	SSC		
Shoal bass (Micropterus undescribed species)	SSC		
Suwannee bass (Micropterus notius)	SSC		
Amphibians and Reptiles			
Pine Barrens treefrog (Hyla andersonii)	SSC	E	
Gopher frog (Rana areolata)	SSC		
American crocodile (Crocodylus acutus)	E	E	
American alligator (Alligator mississippiensis)	SSC	T	II
Leatherback turtle (Dermochelys coriacea)	E	E	I
Atlantic green turtle (Chelonia mydas mydas)	E	E	I
Atlantic hawksbill turtle (Eretmochelys imbricata imbricata)	E	E	I
Atlantic ridley turtle (Lepidochclys kempi)	E	E	I
Atlantic loggerhead turtle (Caretta caretta caretta)	T	T	I
Key mud turtle (Kinosternon bauri bauri)	T		
Barbour's amp turtle (Graptemys barbouri)	SSC		
Suwannee cooter (Chrysemys concinna suwanniensis)	SSC	UR	
Gopher turtle (Gopherus polyphcmus)	SSC		II
Florida key mole skink (Eumeces egregius egregius)	SSC		

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Species	Legal Status[1] GFWFC[2]	USFWS[3]	CITES[4]
Blue-tailed mole skink (Eumeces egregius lividus)	T		
Sand skink (Neoseps reynoldsi)	T		
Atlantic salt marsh water snake (Nerodia fasciata taeniata)	E	T	
Short-tailed snake (Stilosoma extenuatum)	T	UR	
Big Pine Key ringneck snake (Diadophis punctatus acricus)	T		
Red rat snake (Elaphe guttata guttata)--lower Keys population only	SSC		
Florida brown snake (Storeria dekayi victa)--lower Keys population only	T		
Miami black-headed snake (Tantilla oolitica)	T	UR	
Eastern indigo snake (Drymarchon corais couperi)	T	T	
Florida ribbon snake (Thamnophis sauritus sackeni)--lower Keys population only	T		
Birds			
Eastern brown pelican (Pelecanus occidentalis carolinensis)	T	E	
Wood stork (Mycteria americana)	E		
Golden eagle (Aquila chrysaetos)			II
Bald eagle (Haliaeetus leucocephalus)	T	E	I
Osprey (Pandion haliaetus)			II
Everglade kite (Rostrhamus sociabilis plumbeus)	E	E	
Harsh hawk (Circus cyaneus)			II
Southeastern kestrel (Falco sparverius paulus)	T		II
Eastern kestrel (Falco sparverius sparverius)			II
Pigeon hawk (Falco columbarius)			II
Peregrine falcon (Falco peregrinus)	E	E	I
Audubon's caracara (Caracara cheriway auduboni)	T		
Burrowing owl (Athene cunicularia)	SSC		
Cuban snowy plover (Charadrius alexandrinus tenuirostris)	E		
Florida sandhill crane (Grus canadensis pratensis)	T		II
American oystercatcher (Haematopus palliatus)	SSC		
Little blue heron (Florida caerulea)	SSC		
Snowy egret (Egretta thula)	SSC		
Reddish egret (Dichromanassa rufescens)	SSC		
Louisiana heron (Hydranassa tricolor)	SSC		

Species	Legal status[1] GFWFC[2]	USFWS[3]	CITES[4]
Roseate spoonbill (Ajaia ajaja)	SSC		
Limpkin (Aramus guarauna)	SSC		
Roseate tern (Sterna dougallii)	T		
Least tern (Sterna albifrons)	T.		
White-crowned pigeon (Columba leucocephala)	T		
Ivory-billed woodpecker (Campephilus principalis)	E	E	
Red-cockaded woodpecker (Picoides borealis)	T	E	
Florida scrub jay (Aphelocoma coerulescens coerulescens)	T		
Marian's marsh wren (Cistothorus palustris marianae)	SSC		
Worthington's marsh wren (Cistothorus palustris griseus)	SSC		
Bachman's warbler (Vermivora bachmanii)	E	E	
Kirtland's warbler (Dendroica kirtlandii)	E	E	
Dusky seaside sparrow (Ammospiza maritima nigriscens)	E	E	
Cape Sable seaside sparrow (Ammospiza maritima mirabilis)	E	E	
Scott's seaside sparrow (Ammospiza maritima peninsulae)	SSC		
Wakulla seaside sparrow (Ammospiza maritima juncicola)	SSC		
Florida grasshopper sparrow (Ammodramus savannarum floridanus)	E		
Mammals			
Gray bat (Myotis griscsccns)	E	E	
Indiana bat (Myotis sodalis)	E	E	
Eastern chipmunk (Tamias striatus)	SSC		
Mangrove fox squirrel (Sciurus niger avicennia)	T		
Sherman's fox squirrel (Sciurus niger shermani)	SSC		
Goff's pocket gopher (Geomys pinetis goffi)	E		
Silver rice rat (Oryzomys argentatus)	E	UR	
Pallid beach mouse (Peromyscus polionotus decoloratus)	E		
Choctawhatchec beach mouse (Peronyscus polionotus allophrys)	T		
Perdido Bay beach mouse (Peromyscus polionotus trissyllepsis)	T		

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Species	Legal Status[1] GFWFC[2]	USFWS[3]	CITES[4]
Florida mouse '(*Peromyscus floridanus*)	T		
Key Largo cotton mouse (*Peromyscus possypinus allapaticola*)	E	UR	
Chadwick Beach cotton mouse (*Peromyscus gossypinus restrictus*)	SSC		
Key Largo woodrat (*Neotoma floridana smalli*)	E	UR	
Florida black bear (*Ursus americanus floridanus*)--except in Baker and Columbia counties and Apalachicola National Forest	T		
Key Vaca raccoon (*Procyon lotor auspicatus*)	T		
Everglades mink (*Mustela ~~vison~~ evergladensis*)	T		
River otter (*Lutra canadensis*)		UR	II
Florida panther (*Felis concolor coryi*)	E	E	I
Bobcat (*Lynx rufus*)		UR	II
Caribbean manatee (*Trichechus manatus latirostris*)	E	E	I
Key deer (*Odocoileus virginianus clavium*)	T	E	
Blue whale (*Balaenoptera musculus*)	E	E	I
Finback whale (*Balaenoptera physalus*)	E	E	II
Sei whale (*Balaenoptera borealis*)	E	E	I
Humpback whale (*Megaptera novaeangliae*)	E	E	I
Sperm whale (*Physeter catodon*)	E	E	
Invertebrates			
Stock Island tree snail (*Orthalicus reses*)	T	T	
Bahamas swallowtail butterfly (*Papilio andraemon bonhotei*)	T	T	
Schaus swallowtail butterfly (*Papilio aristodemus ponceanus*)	T	T	
Atala butterfly (*Eumaeus atala florida*)		UR	
Oklawaha sponge (*Dorsilia palmeri*)		UR	
Kissimmee sponge (*Ephydatia subtilis*)		UR	

[1]E=Endangered; T=Threatened; SSC=Species of Special Concern; UR=Under Review (for possible listing); I=included in Appendix I; II=included in Appendix 11.

[2]Game and Fresh Water Fish Commission.

[3]U. S. Fish and Wildlife Service.

[4]Convention on International Trade in Endangered Species of Wild Fauna and Flora.

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APPENDIX E

Endangered and Threatened Animal Species Descriptions

ARCTIC PEREGRINE FALCON

Falco peregrinus tundrius (White)

Order: Falconiformes

Family: Falconidae

Status: Endangered throughout its range (Federal Register 10/13/70; 12/2/70).

Range: Breeds in the treeless tundra area of Arctic Alaska, Canada, and western Greenland. Migrates south chiefly through eastern and middle North America to the Gulf Coast of the United States and then on to middle and South America as far south as Argentina and Chile. Southward migration along the Atlantic ccast may chiefly be from breeding areas in western Greenland. Some overwintaring apparently occurs along the Gulf coast and the southern tip of Florida.

Description: Medium-sized hawk with long wings and long tail. Adult is slate gray above; wing and tail feathers, and flanks barred with black. Black moustache marks on side of face. Throat white. Below coloring white and reddish buffy, extensively spotted and barred with black. Legs and feet yellow. Immature birds are brown above, streaked below. Like the American peregrine in general appearance, but smaller and paler in coloration, and with narrower moustache marks on the side of the face.

Reasons for Current Status: All field and laboratory evidence points to the cumulative effects of chlorinated pesticides and their breakdown products, especially DDT and its derivative DDE, which have been magnified up the food chain through the process of bioconcentration. These compounds have Increased adult mortality and reduced production of young by affecting reproductive mechanisms and causing eggs to become thin-shelled or otherwise nonviable.

Habitat: Nestlng habitat fs the Arctic tundra from northern Alaska to Greenland. Within this range the local terrain may vary from gently rolling tundra to precipitous clfff areas alcng rivers. The birds encounter almost all habltat types found in the eastern United States while on thefr migration routes, but prey species are usually hunted over open areas such as waterways, swamps, marshes, and fields. Coastal habitats are used extensively for temporary stopover during migration.

Critical Habftat: None designated.

Feeding Habits: Peregrines usually hunt their prey in the air, rather than on the ground. If the prey flies Into cover or manages to stay above the peregrine, it will usually escape. While flying high above its prey, the peregrine will dive or "stoop" and strike Its quarry In midair. The prey is either struck to the ground or killed outright by the blow from the falcon's talons. Host of the more common bird specfes cf medium to small size are likely to be potential prey.

Reproduction and Development: The birds begin thefr courtship behavior in may soon after arriving on the breeding grounds. A n st site' is selected which is relatively higher than the surrounding terra n. Depending on the geographic area, the site may vary all the way from a low hummock to a cliff ledge more than 300 feet hign. The nest itself usually consists of little more than a natural depression or scrape. Egg laying occurs mostly during the first half of June with the average clutch size being three eggs. Incubation lasts about 30 days with the female doing most of the incubating while the male hunts. From laying to independent existence of the young requires a minimum period of 95 days. Fledging success has been recently recorded in Arctic Alaska as 1.4 young per pair, and in western Greenland as 2.5 young per pair--the difference between the lccations being attrfbuted to higher pesticide levels in the Alaskan population.

A few peregrines may begin breeding at one year of age, but most do not begin until age two. It is uncertain if any wait until age three before breeding.

Population Level: In the Alaskan and Canadian Arctic most populations have declined to 50 percent or less of historic levels. There are possibly no more thar: 50 pairs remaining in Arctic Alaska, and a few thousand pairs in Arctic Canada. No estimate is available for Greenland.

Reccvery Team: Rene M. Oollcngfer, Team Leader
Wildlife Assistance
U.S. Fish and Wildlife Service
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Recovery Van: A draft recovery plan for the peregrine falcon, eastern population, has been completed and is under review. Although the plan covers both the Arctic and American peregrines, it deals almost exclusively with F. p. anatum, since F. p. tundrius does not nest in the United States. Recommendations for the—Arctic peregrine are therefore limited mostly to the protection of migration and winter habitat.

Other Management Activities/Recommendations: Needed or on going actions include intensified legal protecticn, increased public awareness of the peregrine's endangered status, and further reductions of persistent pesticides in the environment, especially in those South American countries where peregrines overwinter.

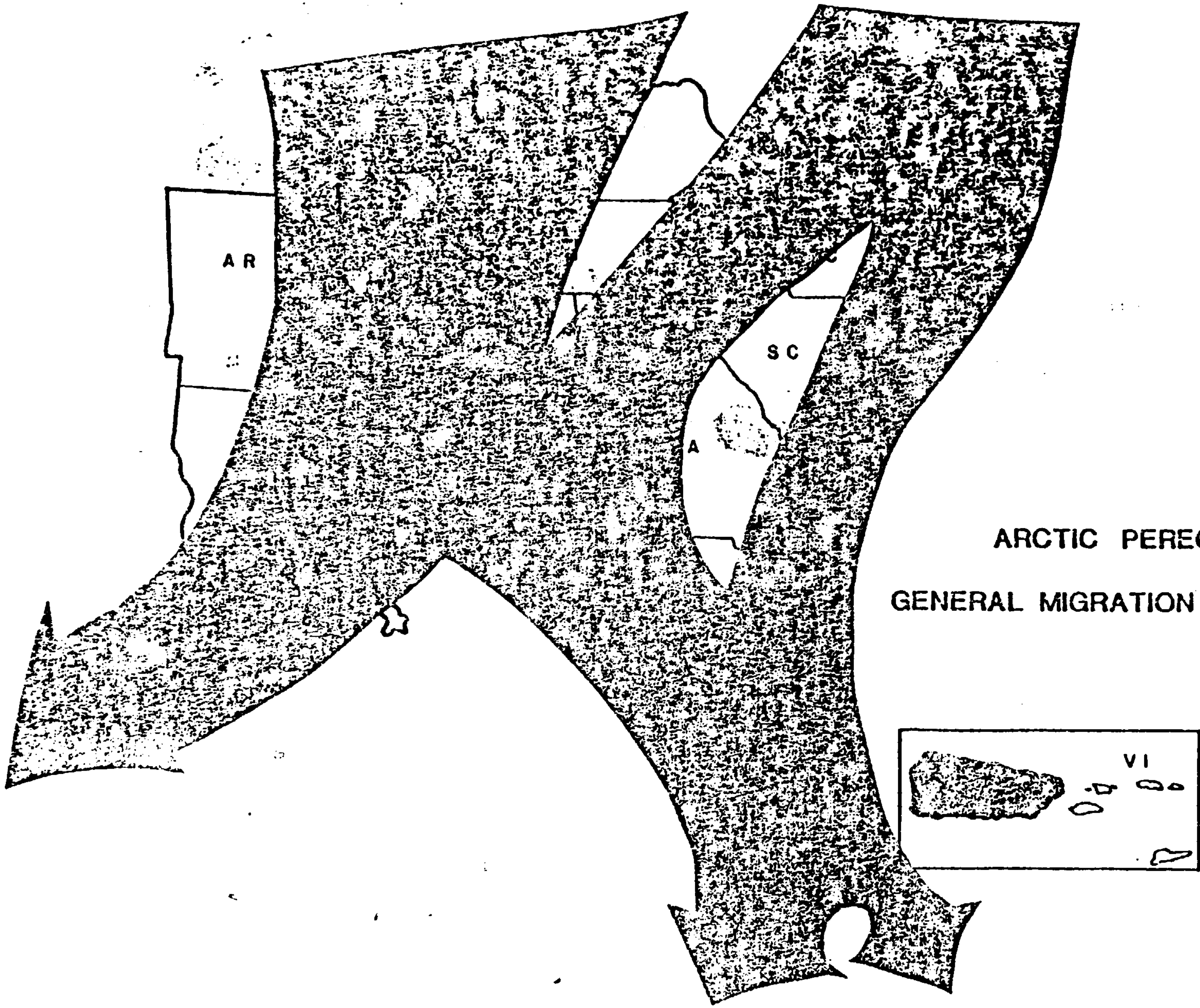
ARCTIC PEREGRINE FALCON - *F. p. tundrius*

References:

Bollengier, R.M., Jr., et al. 1976. Eastern peregrine falcon recovery plan (Draft). U.S. Department of Interior, Fish and Wildlife Service. Eoston, Massachusetts. 130 pp.

U.S. Department of Interior. 1973. Threatened wildlife of the United-States. U.S. Government Printing Office. Washington, D.C. 289 pp.

U.S. Department of Interfor. 1978. Species accounts for Sensitive Wildlife Information System (SWIS). Fish and Wildlife Service, National Fish and Wildlife Laboratory, Washington, D.C.



ARCTIC PEREGRINE

GENERAL MIGRATION CORRIDORS

BROWN PELICAN

· Pelecanus occidentalis (Gmelin)

Order: Pet ecani formes

Family: Pelecanldae

Status: Endangered throughout its range (Federal Register 10/13/70; 12/2/70).

Range: Found along the coast from North Carolina to Texas, Mexico, the West Indies and many Carlbbean Islands, and to Guyana and Venezuela In South America. Brown pelicans were extirpated from the Loulslana coast durlng the 1960's, but a small number have sfnce been reintroduced. The former and present distribution are the same.

Description: A large dark gray-brown water bird with white about the head and neck in the adults. Immatures are gray-brown above and on the neck, wlth white underparts. The brown pelican weighs up to 8 pounds and larger individuals have wing spreads of over 7 feet.

Reasons for Current Status: Reduced abundance has resulted primarily from the collapse of thin-shelled eggs or other impairment of reproductive success caused by ingestion of pesticide residues. in the food fishes. The principal residues are DDT compounds (Including DDE and DDD), polychlorinated bfphenyls (PCB's), dieldrin, and endrin. Along the Atlantic Coast egg shell thinnfng is more acute in the northern end of the range. Egg shells are somewhat thinner than normal in Florida, but the population has remained stable. Pesticides have drastically reduced the Texas population and completely eliminated the original Louisiana population.

Other detrimental factors include human disturbance of nesting colonies and mortalities that result from the birds being caught on fish hooks and subsequently entangled in monofilament line.

Habitat: Feeding occurs prlmarlly in shallow estuarine waters with the birds seldom venturing more than 20 miles out to sea except to take advantage of especially good fishing conditions, and even then it Is rare to ffnd one more than 40 miles out.

Sand spits and offshore sand bars are used extcnslvely as dally loafing and nocturnal roost areas. The preferred nesting sites are small coastal islands which provide protection from mammalian predators, especially racoons, and sufficient elevation to prevent widescale flooding of nests.

No data are avaflable on home ranga or terrltory size.

Critical Habltat: None designated.

Feeding Habits: The diet consists entirely of fish, especially menhaden, mullet, sardines, and pinfish which the birds capture by plunging downwind into the water. While under water the pelican reverses direction and emerges facing upwind, an upwind takeoff being essential for such a heavy bird.

Reproduction and Development: Brown pelicans nest in colonies mostly on small coastal islands. The nests are usually built in mangrove trees or similar size vegetation, but ground nesting may also occur. Ground nests vary from practically nothing to well built nests of sticks, reeds, straws, palmetto leaves, and grasses. Tree nests are made of similar materials, only they are more firmly constructed.

Nescing is mostly in early spring or summer, although fall and winter nesting have been recordsd in some localities. Normal clutch size is 3 eggs. All courtship behavior is confined to the nest site. Tha male carries nesting materials to the female and she builds the nest. Both share In fncubation and rearing duties.

The species is considered to be long-lived; one pelican captured in Edgewater, Florida, in November 1964, was found to have been banded in September 1933, over 31 years previously.

Population Level: There are 9,000 to 9,500 breeding pairs in the Southeast, mostly in Florida, but including about 3,200 pairs in South Carolina, and a small population of less than 100 birds on Castle Island, North Carolina. The South Carolina population was once estimated at 5,000 pairs. The former breeding population in Louisiana, possibly numbering more than 50,000 birds, has been extirpated. The State currently has about 400 pelicans that are the' result of transplants from Florida, but these birds have not become reestablished as a viable breeding population. Alabama had a non-breeding population of 400 pelicans in 1974, up from the low of 60 birds in 1971, but still well below the 1,800 recorded in 1956. Approximately 100 to 200 non-breeders are located along the Georgia coast.

Any measurement of population trends must consider normal movements cf the birds. It is known, for example, that first year pelicans in South Carolina and along both Florida coasts show a tendency for southward migration in the fall to the southern tip of Florida.

Recovery Team:

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BROWN PELICAN - P. occidentalis

Recovery Plan: Major objectives identified in the prelfmfnary Recovery Plan include:

1. Characterize suitable nesting habitat and identify all such places,
2. Develop methods to correct site deficiencies,
3. Select sites to be stocked,
4. Oevelop stocking methods,
5. Find and arrange sources of stock,
6. Carry out stocking program,
7. Monitor success of new colonfes,
8. Environmental measurement of limiting factors,
9. Initiate corrective measures for limiting factors, whet-e possible, and
10. Monitor population trends to evaluate effects of limiting factors.

Other Management Activities/Recommendations: Encourage strict regulation of use of persistent chemical pesticides, and educate fishermen in the correct method of releasing hooked pelicans. This latter problem is estimated to cause 500 or more mortalities per year.

References:

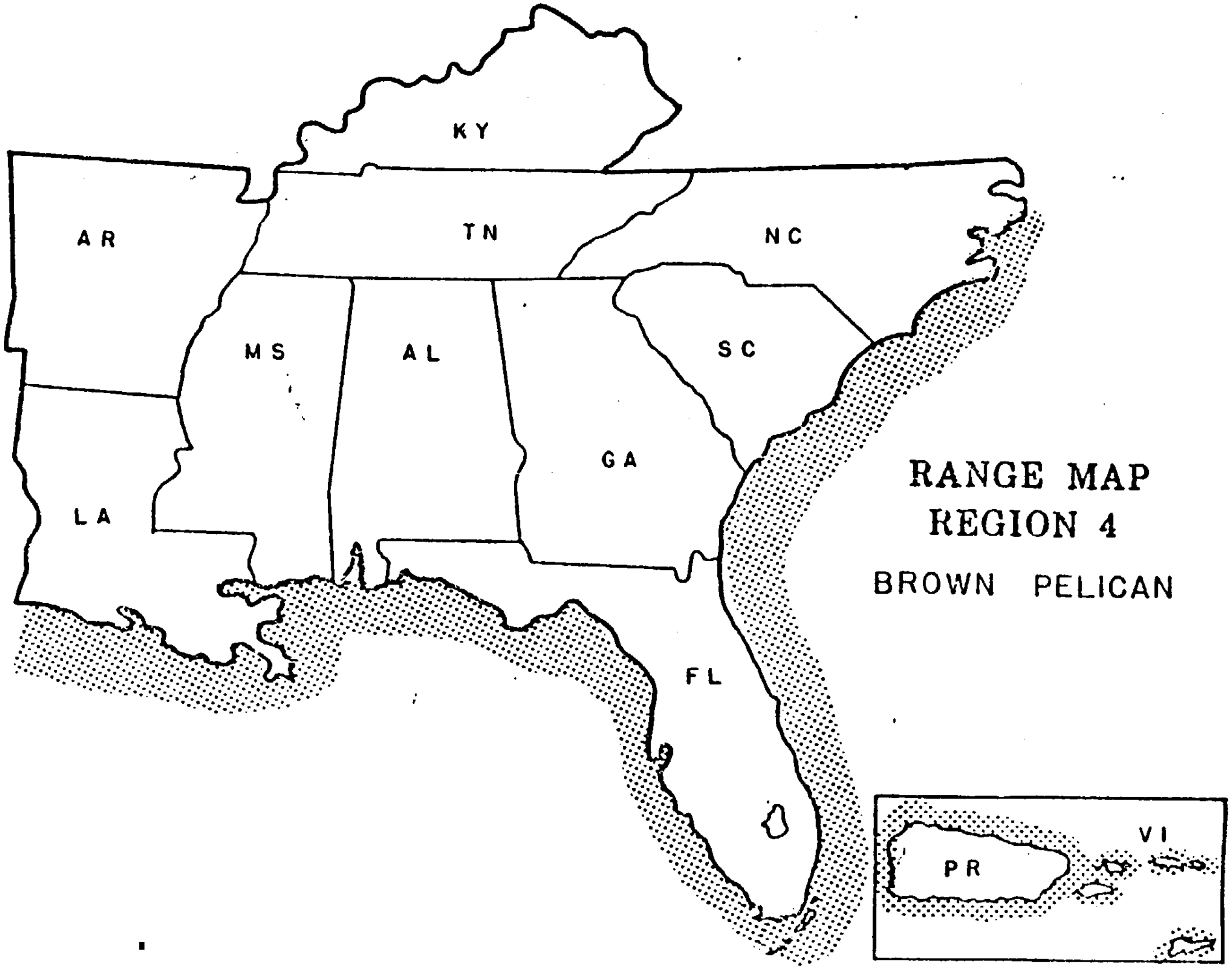
Keeler, James E. 1976. Birds. In: Endangered and threatened plants and animals of Alabama. Herbert Boschung, ed. Bull. Alabama Museum of Natural History 2:80-87.

Odum et al. 1977. Georgia's protected wildlife. Georgia Department of Natural Resources, Game and Fish Division. Social Circle, Georgia. 51 pp.

U.S. Department of Interior. 1976. Species accounts for Sensitive Wildlife Information System (SWIS). Ccmpiled by Fish and Wildlife Service, National Wildlife' Laboratory, Gainesville, Florida.

U.S. Department of Interior. 1973. Threatened Wildlife of the United States. U.S. Government Printing Office. Washington, D.C. 293 pp.

Williams, Lovett E. 1976. Recovery plan for the Eastern Brown Pelican (Preliminary Draft). U.S. Departiient of Interior, Fish and Wildlife Service. Atlanta, Georgia. 48 pp.



RANGE MAP
REGION 4
BROWN PELICAN

RED-COCKADED WOODPECKER

Picoides (=Dendrocopos) borealis (Vieillot)

Order: Piciformes

Family: Picidae

Status: Endangered throughout its range (Federal Reqirter 10/13/70).

Range: Presently found in scattered locations throughout the southeast; previous range slightly larger with more uniform distribution.

Description: Small woodpecker, 18 to 20 an. long, wing span 35 to 38 cm., black and white norizontal stripes on back, white cheeks and under parts, flanks black streaked. The cap and stripe on the side of the neck and the throat are black, The male has a small red spot on each side of the black cap.

Reasons for Current Status: The red-cockaded woodpecker was described by Audubon as being abundant in 1839, but it received little study until around 1970 when investigations began to indicate that the species could be headed for extinction. The decline is attributed primarily to the reduction of pine forest with trees sixty years old and older. Living pines in this age group infected with red-heart disease generally provide the specialized nesting sites which these woodpeckers require.

Habitat: The basic habitat requirement is for open stands of pines with a minimum age of 60 years. Longleaf pine (Pinus palustris) is most commonly used, but other species of southern pine are also acceptable. Dense stands, stands that are primarily hardwocd, or that have a dense understory are avoided.

Cavity excavation for roosting most always occurs in living pines, and usually in those which are infected with a fungus prrducing what is known as red-heart disease. A cavity tree area is referred to as a colony. There may be a number of cavities in the colony and up to seven or eight woodpeckers in the immediate area, but there will be only one breeding pair in the group. Completed cavities in active use usually have numerous small surrounding excavations which exude sap. The birds keep the sap flowing apparently as a cavity defense mechanism against rat snakes and possibly other predators. Depending on the quality of the habitat, the home range for a clan (a family unit) may vary from about one hundred or so acres, up to two hundred acres.

Critical Habitat: None designated.

Feeding Habits; The diet consists mainly of insects which include ants, beetles, grasshoppers, wood-boring insects, caterpillars, and corn ear worms if availabla; and to a lesser extent, seasonal wild fruits (about 16 to 19 percent of the diet).

Reproduction and Development: Egg laying occurs during April, May, and June with the female utilizing her mate's roosting cavity for a nest. Maximum clutch size is seven eggs with the average being three to five eggs. From egg laying to fledging requires about thirty-eight days, and then another several weeks are needed before the young become completely independent. Most often the parent birds and some of their offspring frcm previous years form a family unit called a clan, and rearing the new birds becomes a shared responsibility of the clan. However, single pairs may also breed successfully without the benefit of these "helpers".

Population Level: Estimated at 3,000 to 10,000. An accurate census is needed.

Recovery Team: Jerome A. Jackson, Team Leader
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Recovery Plan: A plan has been developed and provides recommendations as very briefly outlined below:

1. Identify extant populations and maintain a file of this information.

2. Protect extant populations when possible and encourage beneficial management on both private and public lands.

3. Attempt reestablishment of populations where the birds have been extirpated, but where suitable habitat still exists.

4. Link existing populations with habitat corridors to allow population expansion and reunion of fragmented segments of the gene pool.

References:

Jackson, Jerome A. 1976. Recovery plan for the red-cockaded woodpecker. U.S. Department of Interior, Fish and Wildlife Service, Atlanta, Georgia. 23 pp.

U.S. Department of Interior. 1977. Species accounts for Sensitive Wildlife Information System (SWIS). Fish and Wildlife Service, National Wildlife lsboratory, Gainesville, Florida.

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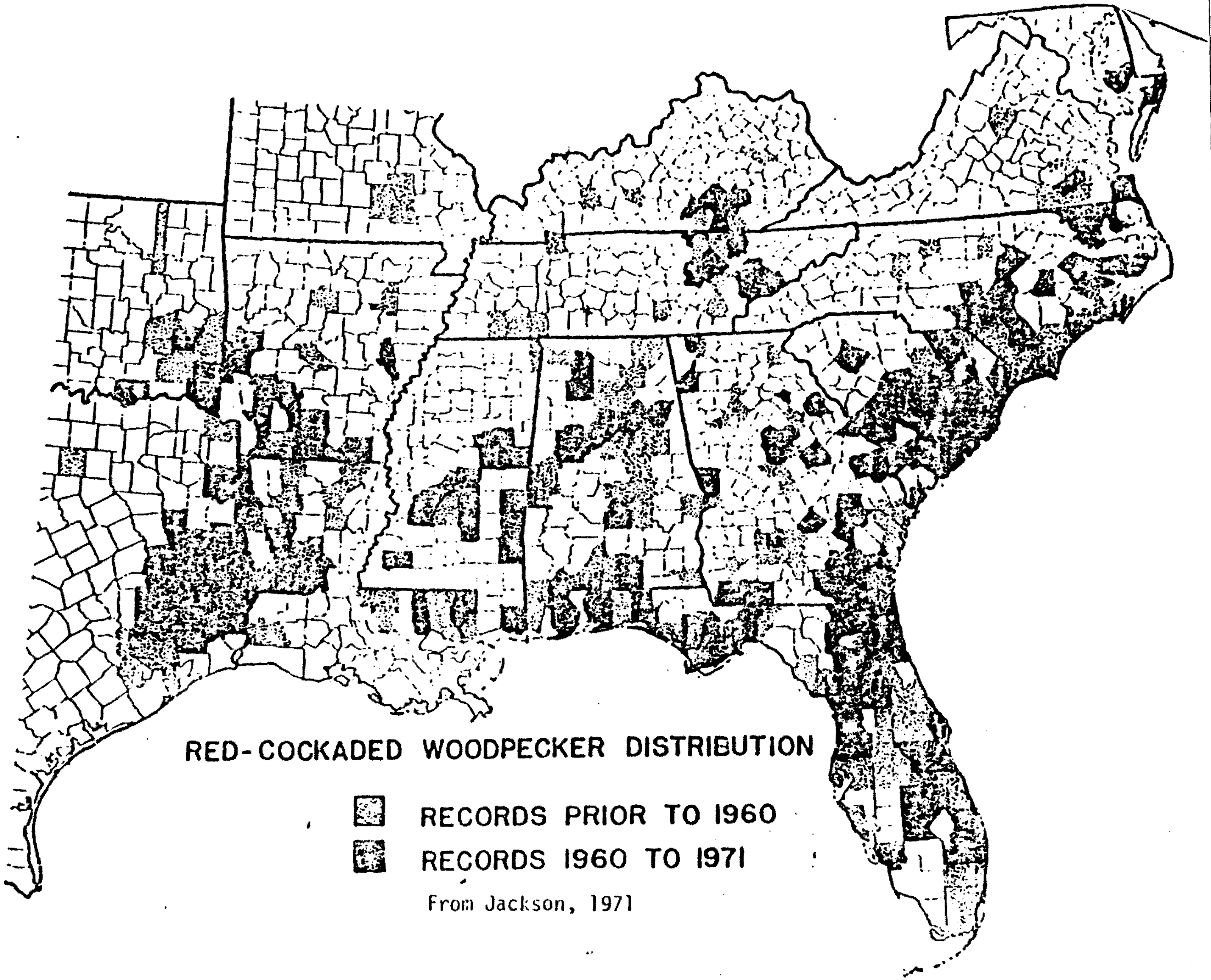
RED-COCKADED WOODPECKER DISTRIBUTION
RECORDS PRIOR TO 1960
RECORDS 1960 TO 1971
From Jackson, 1971

AMERICAN ALLIGATOR

Alligator mississippiensis (Daudin)

Order: Crocodilia

Family: Crocodylidae

Status: Endangered in the following areas: Arkansas, Mississippi, Alabama, North Carolina, inland coastal plain of Georgia and South Carolina, and inland Louisiana. Threatened in the following areas: all of Florida and the coastal areas of Georgia, South Carolina, and Louisiana. The alligator is not actually considered as endangered or threatened in Louisiana's Cameron, Vermilion, and Calcasieu Parishes, but it is listed as "threatened" under the Endangered Species Act's similarity of appearance provision. Alligator hunting is permitted in these three parishes in accordance with State laws; however, restrictions such as tagging of hides and licencing of buyers are imposed by Federal regulation to insure that alligators are not taken from biologically endangered or threatened populations and illegally entered into commercial trade. (Federal Register 9/26/75; 1/10/77).

Range: On Atlantic coastal plain from Tyrrel County, North Carolina, extending southward and around the U.S. coast line to Corpus Christi, Texas; and north in the Mississippi drainage to Arkansas and southeastern Oklahoma.

Description: Large roughbacked reptile with a broad rounded snout; fourth tooth on lower jaw fits into notch in upper jaw (in the American crocodile the fourth tooth is exposed when the jaws are closed). Although most adults range from 6 to 12 feet in length, a few may grow to more than 15 feet.

Reasons for Current Status: Alligator populations are estimated to have reached all time lows in the late 1950's and early 1960's. Records in Louisiana, for example, show that the alligator take dropped from 35,796 hides in 1948-49 to 1,091 in 1960-61. In 1967 the U.S. Department of the Interior determined the alligator to be an endangered species as a result of excessive exploitation and through habitat loss resulting from human encroachment. The first mentioned factor, which involves both over hunting and illegal poaching, is undoubtedly the most important. Experience has shown that determined hide hunters can easily wipe out the species over large areas in a relatively short time.

Habitat: River systems, canals, lakes, swamps, bayous, and coastal marshes. Studies conducted by the Louisiana Wildlife and Fisheries Commission indicate that alligators may move for considerable distance, and that males move farther than females. The minimum home range for males averaged 3,162 acres, and for females 21 acres. Minimum daily travel for males averaged 2,411 feet, and for females 79 feet. The studies also showed that males utilize large open bodies of water to a much greater extent than females.

The alligator's tolerance for salinity varfes wfth age and should be a management consideration for salt water marshes. Tolerance Is high for adults, but salinftfes much greater than ffve percent may be harmful for the newly hatched.

Critical Habitat: None designated.

Feeding Habits: Eats most anything of a suitable size including mamma s, reptiles, amphibians, birds, ff shes, and crustaceans.

Reproduction and Development: Allfgators are thought to become sexual y mature at about 6 or 7 years of age, or at approximately 6 feet fn-length. The time of nesting varies somewhat, but ft can be expected to occur sometime in late spring or early summer. Using grass or other vegetatfon, the female constructs a nest mound which may be better than 2 feet high and 6 feet across. The eggs are laid in a cavity area near the top center of the mound and then covered by 6 or 7 inches of vegetation. Maximum clutch size may be 60 or more eggs, but 35 or 40 is more near average. The female normally remains in the general vicfnity of the nest until the eggs hatch. Heat from the decaying vegetation incubates the eggs in about 9 week's time. As the young hatch out they begin calling the female who usually returns to aid their escape by uncovering the nest cavity.

Pcpulatfon Level: Estimated at 734,384 with about 75 percent of this number occurring within the area of Threatened status. Estlmates of total state populations are as follows (1974 data): South Carolina, 48,706; Georgia, 29,954; Florida, 407,585; Louisiana, 200,582; Texas, 26,784; Mississippi, 4,740; Alabama, '12,715; North Carolina, 1,314; Arkansas, 1,900; Oklahoma, 10.

In recent years the alligator has increased its numbers in many areas to the point that reclassification to a lower status appears needed. Reclassificaticn in southern Louisiana is currently in progress (Federal Resister 10/2/78), and other states are also likely to become involved as supporting data arc developed.

Reccvery Team: Ted Joanen (Team Leader)
Louisiana Wildlife and Ffsherfes Commission
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Grand Chenier, Louisiana 70643

Recovery Plan: Under development:

Other Management Actlvities/Recommendatfons: Allfgator populations previously extirpated from much of their historic Arkansas range have been restored to some extent through the efforts of the Arkansas Game and Fish Commission. From 1972-1977 the Commission obtained over 1700 surplus alligators from Louisiana and made releases over much of the southern and eastcentral portfons of the State.

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AMERICAN ALLIGATOR - A. mississippiensis

Until a Recovery Plan is completed and ready for implementation, or the species is otherwise secure, existing measures will be continued to control unnecessary habitat destruction and over exploitation.

References:

Joanen, T. 1969. Nesting ecology of alligators in Louisiana. Proc. S.E. Game and Fish Commission, 23:141-151.

______., and L. McNease. Louisiana's alligator research program (unpublished). Presented at the 68th National Audubon Convention, New Orleans, Louisiana, April 19, 1975.

U.S. Department of Interior. 1977. Reclassiffcation of American alligator to threatened status in certain parts of its range. Federal Register. January 10, 42(6):2071-2077.

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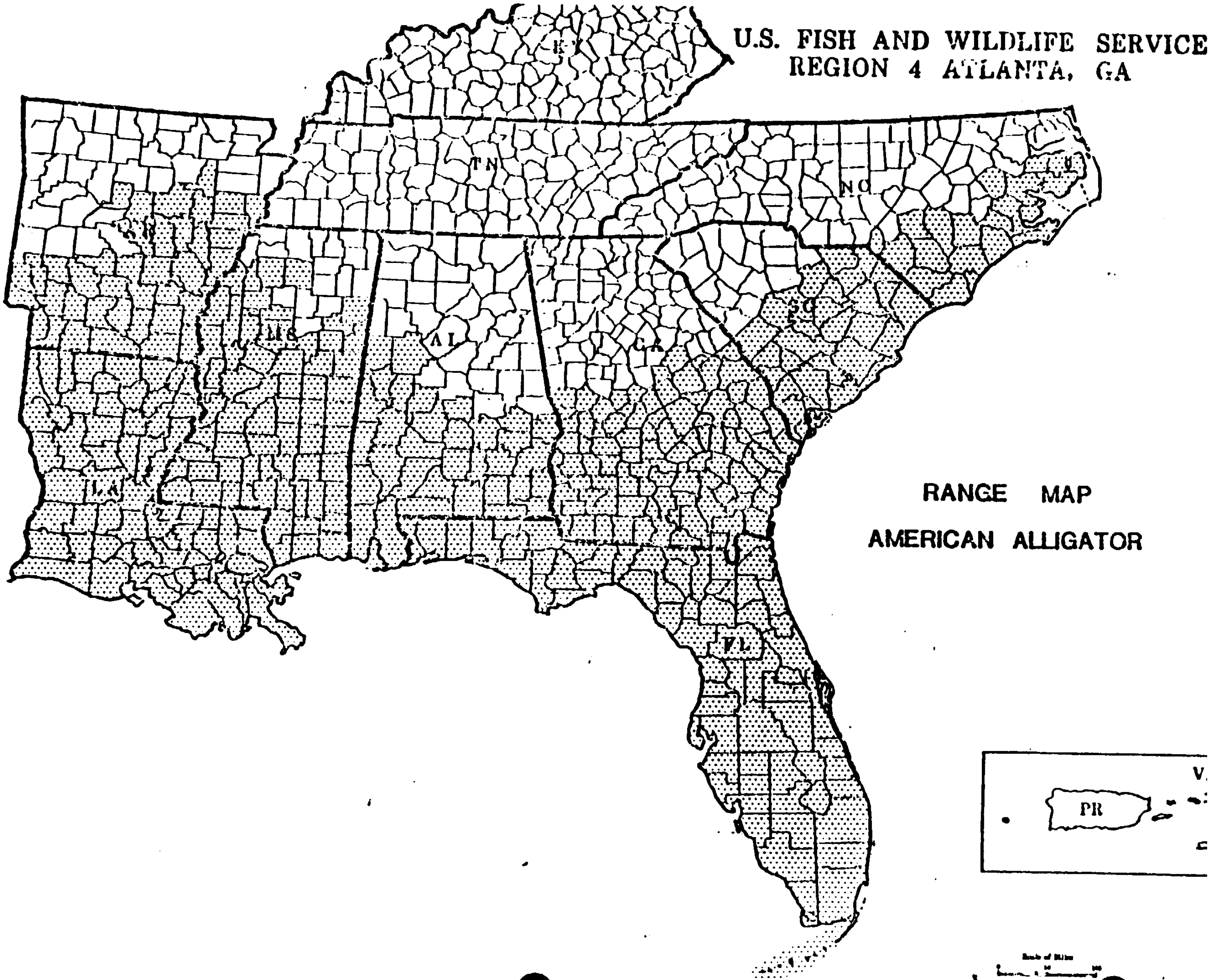
U.S. FISH AND WILDLIFE SERVICE
REGION 4 ATLANTA, GA



RANGE MAP
AMERICAN ALLIGATOR

GREEN SEA TURTLE

Chelonia mydas (Linnaeus)

Order: Testudinata

Family: Chelonlidae

Status: Endangered In Florida and the Pacific coast of Mexico; threatened elsewhere (Federal Reglster 7/28/78).

Range:. Found throughout the world in tropical and temperate seas and oceans.. The North American distribution Is from Massachusetts to Mexico, and froa British Columbia to Baja California. In Region 4, green turtles also occur in Puerto Rico and the Virgin Islands.

Continental U.S. nesting is limited to small populations on Florida's east coast from Brevard County to Broward County, and especially on Jupiter and Hutchinson Islands. Reglon 4 nestlng also includes Culebra Island, Puerto Klco.

Description: The green sea turtle grows to a maximum site of about four feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single clawed flippers. Color Is variable. Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace Is smooth, keelless, and light to dark brown wlth dark mottling; the plastron is whitish to light yellow. Adult heads are light brown wlth yellow markings.

Identifying characterlstlcs Include four costal plates, none of which borders the nuchal shield, no jagged marginats and only one pair of pre-frontals between the eyes.

Reasons for Current Status: Factors in the decline include overutilization as a food source by humans, excesslve natural predation in some areas, loss of ncstlng habitat to human encroachment (including dfsorientation of hatchlings due to excessive artffical light), Inadvertent drownings when the turtles become trapped in fishing and shrimplng trawls, and lack of adequate regulatory mechanisms.

Habitat: Green turtles are generally found In fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nestlng. Green turtles apparently have a strong nesting site fixation and often make long distance migrations between feeding grounds and nestlng beaches. Hatchlings have been observed to seek refuge and food in Sargassum clcmps.

GREEN SEA TURTLE - *C. mydas*

Critical Habitat: None designated; however, the Fish and Wildlife Service has a proposal in preparation.

Feeding Habits: Adults feed largaly on marine algae and grasses in shallow water areas. They may also consume small mollusks, sponges, crustaceans, and jellyfish.

Reproduction and Development: The nesting season varies with the locality. For Florida it is roughly April through August. Nesting occurs nocturnally at two, three, or four year intervals. A female may lay as many as seven clutches In a season at 9 to 13 day intervals. Clutch size varies from 75 to.200 eggs with incubation requiring 48 to 70 days, depending on beach and water conditions. Hatchlings generally emerge at night. Survival to naturity is very low. Age at maturity fs thought to be 4 to 6 years in tropical waters and 5 to 13 years in temperate waters.

Population Level: Estfnated to be no more than 600,000 adults world-wide. The Florida population is thought to be less than 100 adults.

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Recovery Plan: In preparation.

Other Management Activities/Recommendations: Ongoing conservation actions relevant to Region 4 include the development of an excluder trawl -by the National Marine Fisheries Service to prevent or reduce fncidental capture of sea turtles by shrimp fishermen; and efforts on certain National Wildlife Refuges in Florida to improve nesting success by raccoon control, and also by incubating the eggs and releasing the hatchlings under protected conditions. The Florida Department of Natural Resources at Its Hutchinson Island facility has gone a step further in improving the survival of hatchlings by rearing them to an age of 9-12 months before release.

References:

Howell, Ronald. 1978. Saving the green sea turtle. Florida Wildlife. March-April 31(6):33-35.

U.S. Department of the Interior. 1977. Species accounts for Sensitive Wildlife Information System (SWIS). Fish and Wildlife Service, National Wildlife Laboratory, Gainesville, Florida.

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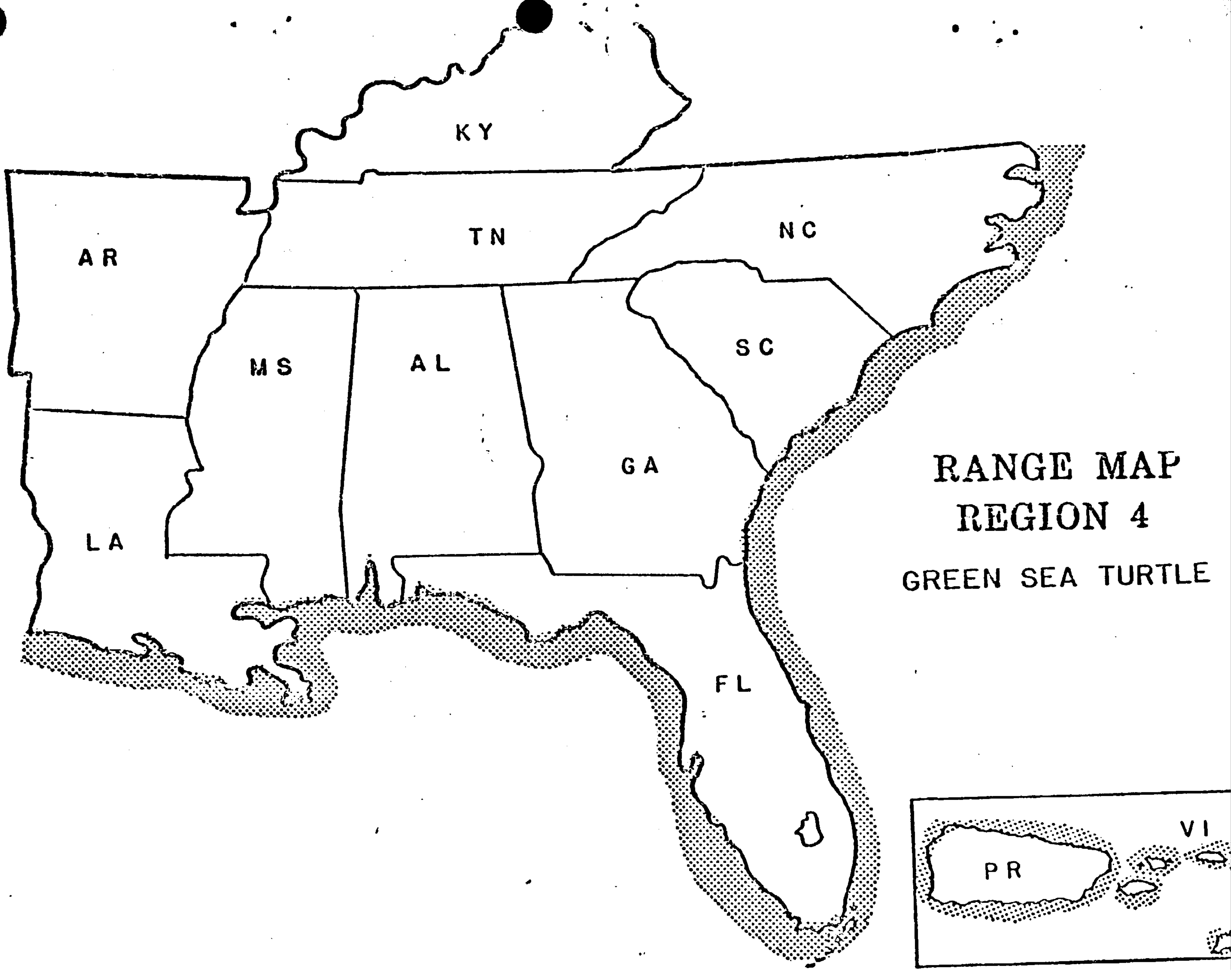

RANGE MAP
REGION 4
GREEN SEA TURTLE

LOGGERHEAD SEA TURTLE

Caretta caretta

Order: Testudinata

Family: Chelonfidae

Status: Threatened throughout Its range (Federal Resister July **28, 1978).**

Range: The loggerhead is found in temperate and subtropical waters worldwide, with major nesting beaches in eastern Australia, southeastern Africa, and the southeastern United States. U. S. nesting occurs on suitable beaches from North Carolina through Florida and to a lesser extent on islands off the Gulf states. The major U. S. nestfng beaches are on the east coast'of florida between Caps Canaveral and Palm Beach. Hutchinson Island and Jupiter Island are major rookeries within this area. Region 4 nesting is also reported for the Culebra Island area of Puerto Rico.

Description: The loggerhead is characterized by a large head with blunt jaws. The carapace and flippers are a reddish-brown color; the plastron is yellow. The carapace has five or more costals with the first touching the nuchal. There are three large rcutes on the brfdges between ths plastron and ccrapace. Adults grow to an'avarage weight of about 200 pounds, although some specimens may occasionally reach 1,000 pounds.

Reasons for Current Status: Factors in the decline fncluce loss of nesting beaches to various types of human encroachment (Including the problem of hatchling dfsorientatfon arfsing from excessive artificial light), overutilization of tho eggs as a food source by humans, excessive natural predation in some areas, inadvsrtent drownings when the turtles become trapped in fishing and shrimpfng trawls, and the lack of adequate regulatory mechanisms.

Habitat: The loggerhead is widely distributed within Its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Hatchlings have been found floatir; at sea in association with Sargassum rafts, but the exact extent of the association Is unknown. Nesting occurs mainly on open beaches or along narrow bays having suitable soil, and it is often in association with other species of sea turtles. Loggerheads apparently wander extensively. Tagged specimens have been recaptured 1,200 to 1,500 miles from the point of release.

Critical Habitat: No Critical Habitat has been designated, but some areas, including the Cape Canaveral shfp channel, are under consideration.

Feeding Habits: Although the loggerhead eats some plant material, the species is mainly carnivorous feeding on such things as mollusks, crustaceans, fish, and other marine animals.

Recrcduction and Development: The U. S. nesting season runs from about May to September. Nesting takes place nocturnally at two or three year intervals. Two or three clutches may be laid in a season at intervals of 12 to 55 day;. Clutch size averages around 120 eggs with incubation requiring 49-68 days, about 55 days being average. The hatchlings generally merge at night. Limited information indicates that in temperate waters it probably requires 10 or more years for the turtles to reach maturity.

Population Level: The U. S. population is estimated to number between 25,000 and 50,000.

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Recovery Plan: In preparation.

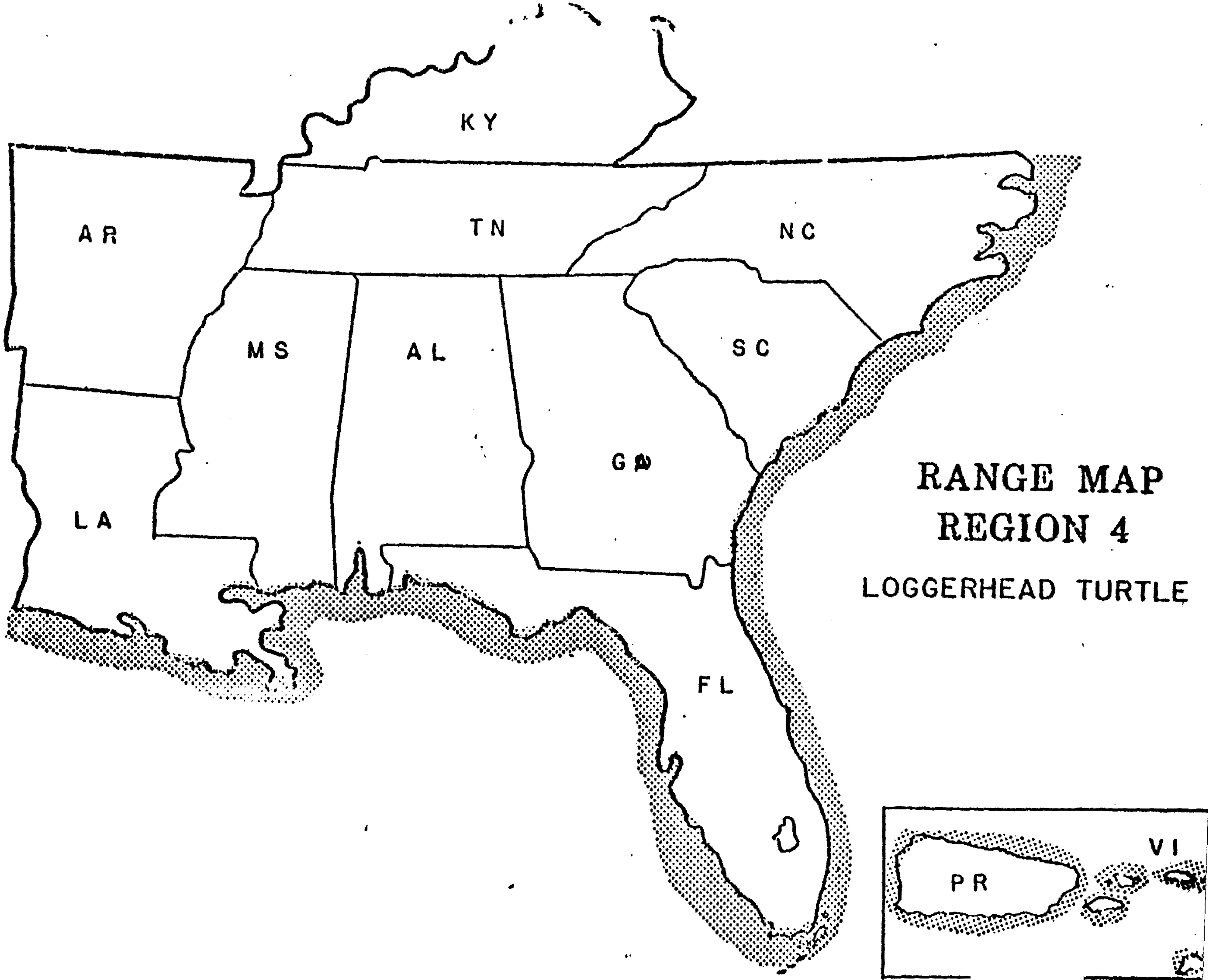
Other Management Activities/Recommendations: The National Marine Fishcries Service is presently working on the development of an excluder trawl to prevent or reduce incidental capture of sea turtles by shrimp fishermen. Coastally situated National Wildlife Refuges conduct programs to assure nest protecticn, and in some cases these efforts also include artificial incubation of the eggs and release of the hatchlings under controilcd conditions. Similar programs are also being conducted by State agencies. Scme authorities feel, however, that the main hope for assuring perpetuation of U. S. loggerheads lies in preserving sufficient nesting beaches in the form of parks and reserves.

References:

Ernst, Carl H., and R. W. Barbour. 1972. Turtles of the United States. Univ. Press Kentucky, Lexington. 347 pp.

Florida Audubon Society. 1976. Inventory of rare and endangered bicta of Florida, Maitland, Florida. pp. 549-550.

Gallagher, Robert M., M. L. Hollinger, R. M. Ingle, and C. R. Futch. 1972. Marine turtle nesting on Hutchinson Island, Florida in 1971. Florida Department of Natural Resources, St. Petersburg. Spec. Sci. Rept. No. 37. 11 pp.



RANGE MAP
REGION 4

LOGGERHEAD TURTLE

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APPENDIX F

Criteria For Surface Water Classification

All surface waters within and coastal waters contiguous to these basins, including off-shore waters, not otherwise classified shall be classified as Class III;. however, waters of the open ocean shall be maintained at a dissolved oxygen of not less than five (5.0) ml/l. Streams specifically listed in Section 17.3.21 by a separate listing designated as "Special Stream Classification" shall similarly be maintained at a minimum dissolved oxygen level of five (5.0) ml/l.

(1) Sewage, industrial wastes, or other wastes—any industrial waste or other wastes shall be effectively treated by the latest modern technological advancer as approved by the regulatory agency.

(2) pH – of receiving waters shall not be caused to vary more than one (1.0) unit above or below normal pH of the waters; and lower value shall be not less than (6.0), and upper value not more than eight and one-half (8.5). In cases where pH may be, due to natural background or causes, outside limits stated above, approval of the regulatory agency shall be secured prior to introducing such material in waters of the state.

(3) Dissolved Oxygen—the concentration in all surface waters shall not average less than 5 mg/l in a 24-hour period and never less than 4 mg/l. Normal daily and seasonal fluctuations above these levels shall be maintained. Dissolved oxygen concentrations in estuaries and tidal tributaries shall not be less than 4.0 mg/l except in naturally dystrophic waters. In those cases where background information indicates prior existence under unpolluted

conditions of lower values than required above, lower limits may be utilized after approval by the regulatory authority. Sampling shall be performed according to the methods approved by the Florida Pollution Control Board.

(4) Bacteriological – in those waters designated for body contact recreation, fecal coliform shall not exceed a monthly average of 200 per 100 ml of sample, nor exceed 400 fecal coliform per 100 ml of sample in 10 percent of the samples, nor exceed 800 fecal coliform on any one day, nor exceed a total coliform count of 1,000 per 100 ml as a monthly average, nor exceed 1,000 per 100 ml in more than 20 percent of the samples examined during any month; nor exceed 2,400 per 100 ml on any day. In those waters not normally used for body contact recreation, fecal coliform shall not exceed a monthly average of 500 per 100 ml of sample, nor exceed 750 fecal coliform per 100 ml of sample in 10 percent of the samples. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period. MPN of MF counts may be utilized.

(5) Toxic substances – free from substances attributable to municipal, industrial, agricultural or other discharges in concentrations or combinations which are toxic or harmful to humans, animal or aquatic life.

(6) Deleterious – free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor or other conditions in such degree as to create a nuisance.

(7) Turbidity – shall not exceed fifty (50) Jackson units as related to standard candle turbidimeter above background.