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September 1984

NORTHWESTERN FLORIDA ECOLOGICAL CHARACTERIZATION: AN ECOLOGICAL ATLAS

Map Narratives

Minerals Management Service
Fish and Wildlife Service

U.S. Department of the Interior

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MAP NARRATIVES

by

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PREFACE

The purpose of the Northwestern Florida Ecological Characterization study is to compile existing information about the biological, social, and physical sciences for the gulf coastal counties of Florida from Escambia County to Hernando County. The Ecological Atlas consists of composited overlay topic information, with 18 base maps to produce a total of 90 maps, and a volume of map narratives. Federal and State decisionmakers, among others, may use these maps and narratives for coastal planning and management, and in planning for Outer Continental Shelf oil and gas development. This study is one of a series of characterizations of coastal ecosystems being produced by the U.S. Fish and Wildlife Service. Additional studies include the Chenier Plain of Louisiana and Texas, the sea islands of Georgia and South Carolina, the rocky coast of Maine, the coast of northern and central California, the Pacific Northwest (Oregon and Washington), the Texas barrier islands, Mobile Bay (Alabama), and southwest Florida.

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SUMMARY

The study area is the northeast gulf coastal region of Florida from the western boundary of Escambia County and southeast to the Hernando-Pasco County line. The offshore area includes the region from the State-Federal demarcation to the shoreline, and the inland area includes the following counties:

Escambia	Franklin
Santa Rosa	Wakulla
Okaloosa	Jefferson
Walton	Taylor
Washington	Dixie
Bay	Levy
Calhoun	Citrus
Gulf	Hernando

These counties are included in the following 18 U.S. Geological Survey 1:100,000-scale topographic maps:

Pensacola	Carrabelle
Bay Minette	Valdosta
Crestview	Perry
Fort Walton Beach	Cross City
Marianna	Cedar Key
Panama City	Gainesville
Port St. Joe	Ocala
Bainbridge	Inverness
Tallahassee	Tarpon Springs

The data used in the production of this atlas meet all cartographic and narrative presentation standards and specifications outlined by the Minerals Management Service and U.S. Fish and Wildlife Service: thus, data presented are in a useful format for coastal decisionmakers. Previously or newly acquired map data and collateral information have been compiled to produce this atlas.

The topics included within this map narrative are biological resources; socioeconomic features; soils and landforms; oil, gas, and mineral resources; and hydrology and climatology.

CONTENTS

Page

Page

Page

FIGURES

Number		Page

TABLES

CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
kilometers (km)	0.6214	miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.470	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters (m^3)	2.000811	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (mt)	2205.0	pounds
metric tons (mt)	1.102	short tons
kilocalories (kcal)	3.968	BTU
Celsius degrees	1.8(C°) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.4	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
acres	0.4047	hectares
square miles (mi^2) kilometers	2.590	square
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
short tons (ton)	0.9072	metric tons
British Thermal Units(BTU)	0.2520	kilocalories
Fahrenheit degrees	0.5556 (F° -32)	Celsius degrees

ACKNOWLEDGMENTS

The production of this ecological atlas has benefited immensely from the contributions made by members of many Federal and State agencies, as well as numerous individuals, all of whom have played a major role in the successful completion of the maps and narratives. The data generated for the Florida Ecological Atlas contracts (Northeastern Gulf of Mexico and Southwestern Florida) comprise the most up-to-date resource mapping effort for the gulf coast of Florida. Throughout the entire project, from initial data search through final manuscript review, the product has been enhanced by the expertise and enthusiasm at all levels. We wish to thank, in particular, the Minerals Management Service, New Orleans OCS Office: Lawrence Handley, Villere Reggio, and Robert Rogers; U.S. Department of Agriculture, Soil Conservation Service, Gainesville, FL: Thomas Calhoun, Adam Hyde, Robert Johnson; U.S. Geological Survey, Water Resources Division, Tallahassee, FL: John Vechiole; U.S. Geological Survey Representative to National Wetlands Inventory, St. Petersburg, FL: Frederick Lavery; U.S. Fish and Wildlife Service, Panama City, FL: Jim Barkuloo, Mike Brim, and Lorna Sicarello; U.S. Fish and Wildlife Service, Endangered Species Office, Jacksonville, FL: Donald Palmer, Andy Robinson; National Weather Service, National Hurricane Center, National Oceanic and Atmospheric Administration, Miami, FL: Neil Frank, Harold Gerrish, and Robert Sheets; National Audubon Society, Tampa, FL: Richard Paul; National Audubon Society, Tavernier, FL: Barbara Patty.

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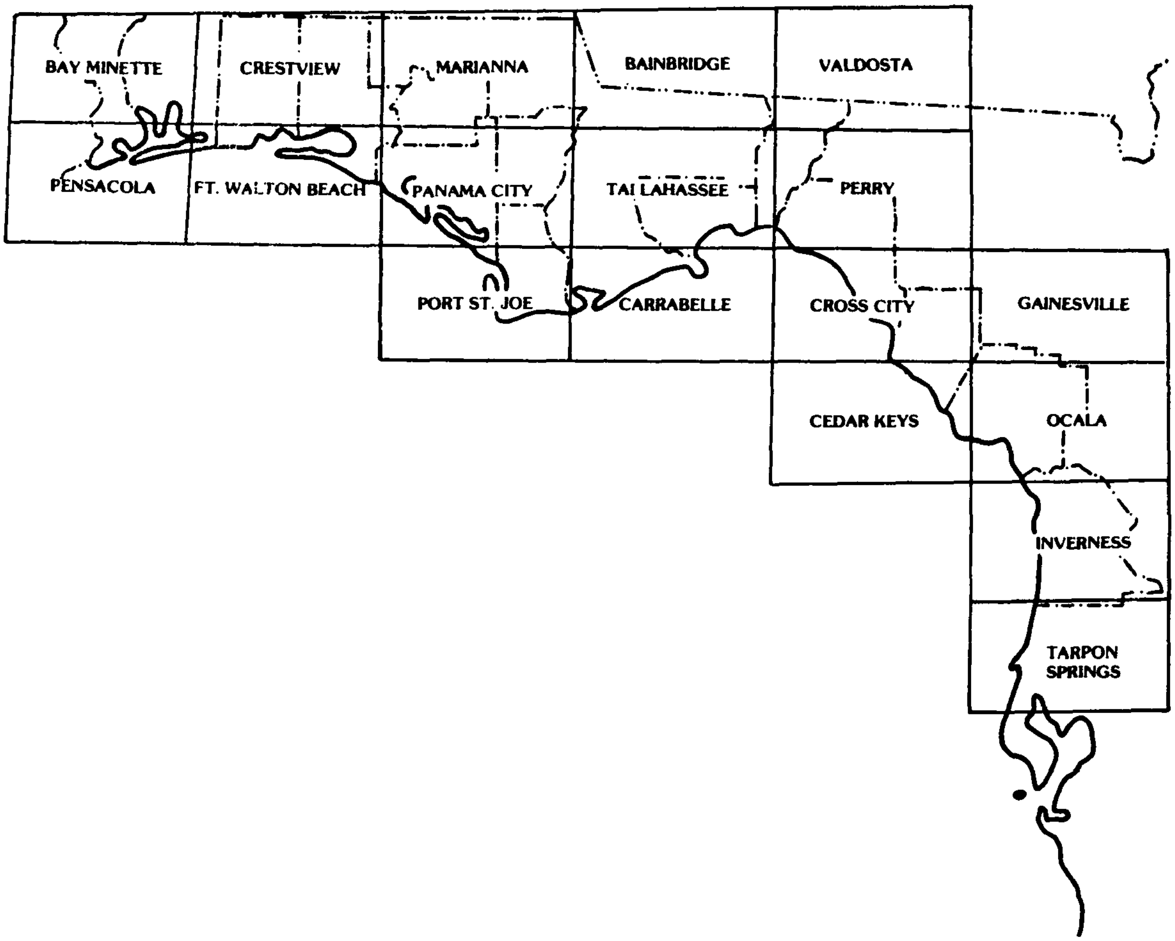
The cartographic design of the maps was carried out by Thomas Kunneke of Martel Laboratories, Inc. Technical production (map preparation, rendering, draft and final overlay reproduction) was performed by Joy DeMaesschalck, Bruce Florence, Lorie Godfrey, John Nolan, Aimee Robinson, and Jeanne Rooney. Thomas Palik was responsible for the collection of all mapped data, narrative writing, and manuscript review. Stephen Mortellaro assisted in writing and data collection for the biological resources section. Technical assistance for numerous tasks was provided by Michael Colby (photointerpretation, data collection) and Tony Leno (graphics). Veronika Oakes, of Martel Laboratories' word processing department, devoted many hours typing the drafts and final manuscript of the map narrative. In a publication of this magnitude, it is difficult not to neglect some individuals who may have contributed. For such inadvertent omissions, we sincerely apologize.



NORTHEAST GULF OF MEXICO ECOLOGICAL ATLAS PROJECT AREA

BIOLOGICAL RESOURCES

The northwestern Florida study area is located in the Outer Coastal Plain Forest Ecological Province according to Bailey (1980). The Outer Coastal Plain Ecological Province is an area of gentle slopes with numerous sluggish rivers and creeks. Swamps, marshes, and lakes are abundant and support a wide variety of animal life.

1. MAJOR HABITATS

Five habitat types are depicted on the Biological Resource maps of the northeast Gulf of Mexico. They are estuarine tidal marshes, estuarine scrub/shrub (mangrove forest), palustrine freshwater marshes, palustrine forest, and seagrass beds. In addition, phytoplankton and macroalgae aré primary producers in marine systems but are not shown on the maps. These are discussed below.

Phytoplankton: Steidinger (1972) indicated that the pelagic and benthic phytoplankton populations along the northeast gulf coast can be divided into four assemblages: (1) estuarine, (2) estuarine and coastal, (3) coastal, and (4) open gulf. Although there are seasonal changes in species dominance and abundance, the resident assemblages would include the diatoms *Skeletonema costatum*, *Chaetoceros* spp., *Rhizosolenia* spp., and *Thalassiosira* spp.; the dinoflagellates *Ceratium hircus*, *Gymnodinium splendens*, and *Ptychodiscus brevis*; and the blue-green algal species *Oscillatoria* (= *Trichodesmium*) *erythraea*.

In addition to their importance as food sources, some phytoplankton species can cause massive fish mortalities. These are commonly called red tides, due to the discoloration of the water. There are four toxic dinoflagellate species in the Gulf of Mexico: *Gonyaulax monilata*, *G. polyedra*, *Tamarensis* var. *excavata*, and *Ptychodiscus brevis* (formerly *Gymnodinium breve*) (Steidinger 1972). Only two of these are commonly associated with red tides along northwest Florida, *Gonyaulax monilata* and *Ptychodiscus brevis*. The latter species is associated with most of the widespread fish mortalities and toxicity among shellfish due to periodic population blooms.

These blooms have not been shown to be associated with any human-made pollutants or coastal modifications to date. They are believed to be of natural origin, and although detrimental to beach tourism, may have some beneficial effects in reducing populations of "trash" fish species, such as catfish, on a regular basis. The blooms do cause the temporary closure of shellfish harvesting areas; toxic concentrations of the neurotoxin in the dinoflagellates may be concentrated in the edible tissues of harvested shellfish. The toxins do not appear to be toxic to the shellfish.

Phytoplankton are important food sources for filter feeding organisms, such as zooplankton, and larger commercially and recreationally important species of mollusks such as the American oyster (Crassostrea virginica), the southern hardshell clam (Mercenaria campechiensis), the sunray venus clam (Macrocallista nimbosa), calico clam (M. maculata), bay scallop (Argopecten irradians) and calico scallop (A. gibbus).

Macroalgae: Earle (1972) listed 610 species of macroalgae for the entire Gulf of Mexico, 575 of which occur in the eastern Gulf of Mexico, and approximately 525 of which occur along the northeast gulf coast both within the estuaries and on the Continental Shelf (Humm 1973).

Excluding the blue-green algae (phylum Cyanophyta) for which the taxonomy is confused (see Humm and Wicks 1980), the approximate distribution of these species among the other three phyla is 51% red algae (Rhodophyta), 18% brown algae (Phaeophyta), and 31% green algae (Chlorophyta) (Humm 1973).

The ecology and physiology of the macroalgae of Florida's northwest coast are discussed by Dawes (1974). A wide variety of macroalgal communities exists in the study area, depending upon variations in substrate, salinity, light penetration, temperature, and nutrient concentrations. Examples of these communities are estuarine drift algal communities composed of species of Ulva, Gracilaria, Hypnea, and Enteromorpha; gulf stenohaline benthic communities consisting of species of Caulerpa, Udotea, Penicillus, Spyridia, Digenia, and Laurencia; and an epiphytic algal community attached to mangrove prop roots and pneumatophores consisting of species of Bostrichia, Caloglossa, Catanella, and Murrayella.

1.1 ESTUARINE (SALTWATER) TIDAL MARSH

Tidal marshes or emergent wetlands are one of the most valuable natural resources in the northeast gulf study area. They occur along the gulf coast and inland tidal rivers. Extensive expanses of marsh exist north of Tarpon Springs to St. Marks. The study area's 93,680 ha (231,391 acres) of tidal marsh represent 60% of the total 155,189 ha (383,317 acres) for the State and are itemized in Table 1.

Tidal marshes are dominated primarily by black needlerush (*Juncus roemerianus*), smooth cordgrass (*Spartina alterniflora*), or saltgrass (*Distichlis spicata*). These marshes provide nutrients, sediments, and detritus for a wide variety of animal life. Tidal marshes are an important food source for many species of commercial and sport fish and shellfish. They provide an excellent nursery habitat for numerous juvenile marine species such as the spotted trout (*Cynoscion nebulosus*) and red drum (*Sciaenops ocellatus*). Wildlife species using the marshes are deer, otter, raccoon, and many bird species. In addition, tidal marshes serve as an important factor in the stabilization and protection of the coastal shorelines.

Federally endangered and threatened plants and animals which may utilize the tidal marshes within the study area are:

Plants: none known

Animals:

American alligator	*Alligator mississippiensis*
Atlantic green turtle	*Chelonia mydas mydas*
Bald eagle	*Haliaeetus leucocephalus*

1.2 ESTUARINE SCRUB/SHRUB (MANGROVE)

Mangrove forests in the study area are composed of three dominant species. These are the red mangrove (*Rhizophora mangle*), the black mangrove (*Avicennia germinans*), and the white mangrove (*Laguncularia racemosa* Gaertn.).

Mangroves range no farther north in the study area than the Suwannee River due to their susceptibility to freeze damage. Red and white mangroves are most susceptible to freeze damage. Generally speaking, the species composition of mangroves consists of almost equal quantities of red, white, and black mangroves in Hernando County. The white and red mangroves become more scarce northward toward Cedar key. North of Cedar Key, the black mangrove is the only species present.

Table 1. Total number of acres of mangroves and tidal marshes by estuarine study area in northwest Florida (McNulty et al. 1972).

Estuary	County	Mangroves (acres)	Mangroves (ha)	Tidal marshes (acres)	Tidal marshes (ha)
Baileys Bluff to Saddle Key	Hernando, Citrus	1,301	526	16,683	6,754
Saddle Key to S. Mangrove Pt.	Citrus	7,915	3,204	32,587	13,193
Waccasassa Bay	Levy	448	181	30,752	12,450
Suwannee Sound	Levy	427	172	17,643	7,143
Suwannee Sound to Deadman Bay	Dixie	0		14,763	5,976
Deadman Bay	Dixie, Taylor	0		2,549	1,032
Deadman Bay to St. Marks River	Taylor, Jefferson	0		14,325	5,800
Apalachee Bay	Jefferson, Wakulla	0		55,669	22,538
St. George Sound	Franklin	0		3,605	1,459
Apalachicola Bay	Franklin	0		17,696	7,164
St. Joseph Bay	Gulf	0		853	345
St. Andrew Sound	Bay	0		576	233
East Bay (St. Andrew)	Bay	0		4,597	1,861
St. Andrew Bay	Bay	0		875	354
West Bay	Bay	0		3,349	1,355
North Bay	Bay	0		1,664	673
Choctawhatchee Bay	Okaloosa, Walton	0		2,816	1,140
Santa Rosa Sound	Santa Rosa, Escambia	0		309	129
East Bay (Pensacola)	Santa Rosa	0		3,307	1,338
Escambia Bay	Santa Rosa, Escambia	0		5,152	2,085
Pensacola Bay	Escambia	0		213	86
Perdido Bay	Escambia	0		1,408	570
Total		10,091	4,083	231,391	93,680

Within the study area there are 4,085 ha (10,091 acres) of mangrove forests, which represent 1.5% of the 272,972 ha (674,241 acres) of mangrove forests in the entire State (McNulty et al. 1972). The largest single area of mangroves in the study area is located from Saddle Key to S. Mangrove Point in Hernando County.

The mangrove community has received a lot of attention regarding its role in marine ecosystems (Odum et al. 1982). Mangroves provide both food and habitat. As a direct food source, it appears that direct herbivory of the plants is limited. Mangroves are an important contributor of litter used for energy in detrital-based food webs (Odum et al. 1982).

As habitat, mangroves also serve as nursery areas for pink shrimp, spiny lobster, snook, mullet, red drum, and numerous forage fish species such as the killifishes. In addition, many marine bird species depend on mangroves for nesting and feeding areas. Some federally endangered and threatened plants and animals which may use the mangrove forest within the study area are as follows:

Plants: none

Animals:

Eastern brown pelican	*Pelecanus occidentalis carolinensis*
Peregrine falcon	*Falco peregrinus*
Bald eagle	*Haliaeetus leucocephalus*
American alligator	*Alligator mississippiensis*

1.3 PALUSTRINE (FRESHWATER) MARSH

The palustrine marsh includes all nontidal wetlands dominated by persistent emergents and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt (Cowardin et al. 1979).

Freshwater marshes are generally located on low flat lands associated with drainage systems of rivers and creeks or inland depressions. Occasionally, they occur on hillside seeps. Dominant vegetation includes sawgrass (*Cladium jamaicense*), cattail (*Typha* spp.), bulltongue (*Sagittaria lancifolia*), spikerush (*Eleocharis* spp.), or maidencane (*Panicum hemitomon*). The plant composition of the marsh depends on the periodicity and depth of inundation. In general, freshwater marshes are dominated by a single species. These marshes provide essential feeding and rookery areas for a wide variety of wildlife, such as the otter, deer, heron, egret, limpkin, and ibis. In addition, freshwater marshes provide wintering areas for waterfowl such as the pintails, wigeons, redheads, and canvasback ducks.

Some federally endangered or threatened plants and animals which may utilize the freshwater marsh within the study area are:

Plants:

Harper's beauty	*Harperocallis flava*

Animals:

Florida sandhill crane	*Grus canadensis pratensis*
West Indian manatee	*Trichechus manatus latirostris*
Alligator	*Alligator mississippiensis*
Southeastern kestrel	*Falco sparverius paulus*

A partial type of freshwater marsh community which deserves special attention is the pitcher plant bogs. Pitcher plant bogs primarily occur in northern Florida and are most common in northwest Florida. This community occurs inland from the coast, generally on flat areas or hillside seeps. These bogs are characterized by such plants as the pitcher plant (*Sarracenia* spp.), sundew (*Drosera* spp.), Florida three awn (*Aristida rhizomophora*), wiregrass (*Aristida stricta*), and stunted slash pine (*Pinus elliottii*).

The federally endangered plant, Harper's beauty (*Harperocallis flava*), is found in this freshwater marsh community. The southeastern kestrel (*Falco sparverius paulus*) utilizes this community.

In addition, freshwater marshes may serve as water storage sites during floods, slowly releasing the water to downstream areas. These marshes prevent erosion and act as a filtering system for rivers and lakes by slowing flood waters, trapping sediments and nutrients that, if released, would greatly increase eutrophication.

1.4 PALUSTRINE FOREST

The palustrine forest includes all nontidal wetlands dominated by trees and all such tidal wetlands where salinity due to ocean-derived salts is below 0.5%. Palustrine forests encompass a wide range of forested wetland types. Some terms that are commonly used to describe palustrine forest are cypress domes or strands, bay swamps, and bottomland hardwoods (Cowardin et. al. 1979).

Cypress swamps occur along lake margins, rivers, and depressions within other communities, such as flatwoods throughout the study area. There are two species of cypress: Bald cypress (*Taxodium distichum*) and pond cypress (*T. ascendens*). Bald cypress is often dominant along lake and river margins. Pond cypress is generally found in depressions within flatwood communities and often has a dome shape. Therefore, they are frequently called cypress domes. The dome shape is due to the taller trees located in the center sloping down to the smaller trees on the periphery.

Bay swamps are similar to cypress swamps except that cypress is not the dominate species. In the panhandle portion of the study area, sweet bay (Magnolia virginiana) is the dominant species. In the peninsula portion of the study area, mixtures of red bay (Persea borbonia), loblolly bay (Gordonia lasianthus), and sweet bay (Magnolia virginiana) dominate.

Bottomland hardwoods occur within the floodplain of river systems. The forest of the Apalachicola River floodplain is an example of this type of wetland. Bottomland hardwoods have a highly diverse vegetation composition. Some plants which characterize this community are: American elm (Ulmus americana), black willow (Salix nigra), green ash (Fraxinus pennsylvanica), and many species of oaks (Quercus spp.).

River swamps are wetland forests that border streams and are quite diverse. River swamps are forested by complex mixtures of bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), red maple (Acer rubrum), and sweet bay (Magnolia virginiana). Ecological functions and values are similar to those for cypress strands. In addition, they may filter upland runoff that eventually enters coastal waters, removing sediment and nutrients detrimental to estuarine communities.

Palustrine forests provide valuable cover and food sources for numerous animals such as the black bear, bobcat, deer, gray squirrel, hawks, owls, turkey, snakes, frogs, and wading birds (e.g., egrets and herons, which often nest in the trees).

An important role of this community is to receive floodwater and slow the water flow which in turn improves the water quality and gradually releases the water into river systems.

Federally endangered and threatened plants and animals that may occur within or around palustrine forest within the study area are:

Plants:

Harper's beauty	Harperocallis flava
Florida torreya	Torreya taxifolia
Chapman's rhododendron	Rhododendron chapmanii
Miccosokee gooseberry	Ribes echinelluni

Animals:

American alligator	Alligator mississippiensis
Wood stork	Mycteria americana
Bald eagle	Haliaeetus leucocephalus
Ivory billed woodpecker	Campephilus principalis
Graybat	Myotis grisescens
Florida panther	Felis concolor coryi

1.5 SEAGRASS BEDS

Unlike macroalgal communities, seagrass beds have received much attention and are acknowledged as very important habitat and food sources in the study area.

Eiseman (1980) reported the occurrence of six species of seagrasses in northwest Florida:

1. *Thalassia testudinum* Banks *ex* Konig (turtle grass)
2. *Syringodium filiforme* Kutzing (manatee grass)
3. *Halodule wrightii* Ascherson (shoal grass)
4. *Ruppia maritima* L. (widgeon grass)
5. *Halophila engelmannii* Ascherson (gulf halophila)
6. *Halophila decipiens* Ostenfeld

Seagrass beds provide sediment stabilization, habitat diversity, nursery habitat for commercial and recreationally important species of fish and shellfish, and direct and indirect (detrital) food sources for many marine species.

McNulty et al. (1972) stated that there were 210,618 ha (520,431 acres) of submerged vegetation along the west coast of Florida, of which 67,107 ha (165,820 acres) are within the study area. The distribution of these major submerged vegetation areas in the northwest Florida study area according to McNulty et al. (1972) is shown in Table 2.

This publication acts to inform the user of the possible existence of seagrass beds, other than those already mapped, within and outside the study area boundary.

A general review of these areas by government and private entities has revealed that not only do seagrass beds exist near shore in both a continuous and patchy nature, but they also occur outside the study area boundary of this project. It is generally acknowledged that seagrass beds extend offshore, in varying density, in areas shown on the following base maps: Carrabelle (eastern portion), Perry, Cross City, Cedar Keys, Ocala, and Inverness. Source material (see Bibliography - Sources of mapped information) for this region did not show conclusive evidence that seagrasses existed beyond the study area boundary. At the time of mapping, no additional data were available to substantiate the existence of these outer seagrass beds. A large-scale, intensive mapping effort is required to detail the existence and the density of seagrass along the Big Bend and Panhandle coastline.

Table 2. Submerged vegetation areas in northwest Florida (McNulty et al. 1972).

Estuary	County	Submerged vegetation area (acres)	(ha)
Baileys Bluff to Saddle Key	Hernando, Citrus	4,084	1,653
Saddle Key to S. Mangrove Point	Citrus	62,730	25,396
Waccasassa Bay	Levy	24,223	9,806
Suwannee Sound	Levy	5,556	2,249
Suwannee Sound to Deadman Bay	Dixie	2,420	979
Deadman Bay	Dixie, Taylor	1,834	742
Deadman Bay to St. Marks River	Taylor, Jefferson	8,110	3,283
Apalachee Bay	Jefferson, Wakulla	23,521	9,522
St. George Sound	Franklin	8,641	3,498
Apalachicola Bay	Franklin	737	298
St. Joseph Bay	Gulf	6,325	2,560
St. Andrew Sound	Bay	373	151
East Bay (St. Andrew)	Bay	1,146	463
St. Andrew Bay	Bay	2,540	1,028
West Bay	Bay	1,542	624
North Bay	Bay	1,030	417
Choctawhatchee Bay	Okaloosa, Walton	3,092	1,251
Santa Rosa Sound	Santa Rosa, Escambia	4,683	1,895
East Bay (Pensacola)	Santa Rosa	310	125
Escambia Bay	Santa Rosa, Escambia	43	17
Pensacola Bay	Escambia	1,547	626
Perdido Bay	Escambia	1,333	539
Total		165,820	67,133

Seagrass beds are important to marine life for food and habitat. As a food source, direct herbivory of the leaves or rhizomes is limited to only a few species including sea urchins, some fish, and the West Indian manatee (Zieman 1982). The consumption of seagrass detritus and leaf epiphytes (microalgae and macroalgae) appears to be the major energy transfer pathways to gastropods, amphipods, isopods, caridean and penaeid shrimp, and crabs. These in turn support a food web through smaller fish, such as pinfish and grunts, up to the top carnivores including larger game fish (tarpon, spotted seatrout), wading birds, and humans (Zieman 1982).

Seagrass beds are particularly important as nursery grounds for juveniles of pink shrimp, several species of grunts and snappers, spotted seatrout, red drum, and sheepshead. The adult of some of these species may be more commonly associated with other habitats, but the seagrass nursery habitat is probably important in controlling the numbers of adults available to commercial and recreational fisheries.

2. ARTIFICIAL REEFS

The artificial reef program of the State of Florida is administered by the Bureau of Marine Science and Technology under Section 370.013 of the Florida Statutes. Approximately $110,000 in grants were awarded in 1979 and 1980, which were the first 2 years of the newly adopted program. The principal types of fish that inhabit the artificial reefs located in the northeast Gulf of Mexico study area coastal waters are grouper, snapper, Spanish mackerel, and amberjacks. A list of artificial reefs keyed by number on the atlas overlays is shown in Table 3.

Florida's coastal waters contain more artificial reefs than any other State (Seaman 1982). Scientific development and deployment of artificial reefs have been slow, with little research and scanty funding. Without considerable volunteer effort to secure materials and free labor, many of the present artificial reefs off northwest Florida would not exist.

Virtually all artificial reefs in Florida are composed of either ships, automobiles, tires, or concrete. New prefabricated artificial reefs are being introduced in Florida by the Japanese (off Fort Lauderdale, Panama City, and Jacksonville) under contract with the National Marine Fisheries Service.

Panama City's artificial reef program began officially in July 1978 and is run by the Panama City Marine Institute. Nine reefs are scheduled to be completed by the institute. The institute operates its own 100-ft barge and a 61-ft tugboat that was donated by the Belcher Oil Company of Miami (Panama City Marine Institute 1983).

Table 3. Northeast Gulf of Mexico artificial reefs (U.S. Army Corps of Engineers 1981; Florida Sea Grant College 1979).

Number on Map	Composition	Latitude	Longitude	Depth (ft)	Miles offshore
1	Polyproplyene plastic strips	30°16'54"	87°25'36"	20	0.9
2	USS Battleship Massachusetts	30°17'08"	87°18'07"	30	3.4
3	Unknown	30°17'46"	87°16'42"	72	3.4
4	Unknown	30°19'00"	87°13'40"	18	0.4
5	Polyproplyene plastic strips	30°19'56"	87°13'12"	20	0.3
6	3 barges, concrete rubble	30°16'54"	87°10'24"	45	1.0
7	Liberty Ship	30°16'03"	87°09'07"	70	4.4
8	Unknown	30°16'10"	87°09'40"	67	3.9
9	Unknown	30°17'20"	87°08'00"	57	3.5
10	Concrete rubble	30°18'08"	87°07'30"	60	0.4
11	P5M aircraft, tires	30°17'02"	87°07'06"	85	3.1
12	Liberty Ship	30°16'00"	86°49'24"	60	7.3
13	Liberty Ship	30°12'46"	86°48'20"	75	9.4
14	Liberty Ship	30°12'04"	86°48'03"	118	10.0
15	Barge	30°22'30"	86°35'54"	70	0.6
16	Concrete rubble, tires,barge	30°22'24"	86°35'00"	43	1.3
17	Concrete rubble, tires, appliances	30°22'20"	86°30'00"	43	1.3
18	Metal junk, autos, concrete	30°27'07"	86°30'00"	21	0.3
19	Bridge rubble	30°21'30"	86°29'48"	60	0.8
20	Barge	30°21'54"	86°29'30"	60	0.6
21	Concrete rubble, tires, tile, appliances	30°21'30"	86°25'00"	43	0.8
22	Tires, concrete rubble	30°24'36"	86°17'35"	7	0.7
23	Tires, concrete rubble	30°27'58"	86°14'34"	13	1.2
24	Tires, concrete rubble	30°25'56"	86°14'18"	13	0.4
25	Tires, concrete rubble	30°24'38"	86°08'48"	9	0.9
26	Unknown	30°07'00"	85°54'35"	64	3.8
27	Concrete rubble	30°09'32"	85°53'33"	72	4.0
28	Unknown	30°09'00"	85°53'00"	65	3.3
29	Barge, steel	30°07'05"	85°49'29"	75	5.0
30	Concrete rubble	30°04'16"	85°48'53"	77	5.0
31	Concrete rubble	29°58'07"	85°48'49"	85	10.0
32	Unknown	30°04'01"	85°46'07"	65	4.0
33	Unknown	30°00'00"	85°46'00"	76	6.7
34	Metal scraps, tires	30°04'51"	85°45'30"	71	3.4
35	Unknown	30°05'00"	85°44'07"	61	1.8
36	Tires, steel, concrete rubble	30°05'01"	85°44'02"	65	3.0
37	Liberty Ship	30°02'00"	85°43'20"	64	6.2
38	Steel, tires, concrete rubble	30°02'23"	85°43'18"	71	5.5
39	Unknown	29°59'00"	85°42'40"	77	7.0

(continued)

Table 3 (concluded).

Number on Map	Composition	Latitude	Longitude	Depth (ft)	Miles offshore
40	Liberty Ship	29°59'03"	85°42'20"	74	6.2
41	Autos	29°50'45"	85°33'50"	44	8.5
42	Autos	29°50'39"	85°33'50"	44	8.5
43	Autos	29°51'15"	85°32'56"	44	7.8
44	Autos	29°51'09"	85°32'38"	44	7.2
45	Autos	29°51'03"	85°32'06"	44	7.4
46	Autos	29°50'57"	85°32'14"	44	7.2
47	Autos	29°51'33"	85°31'32"	44	6.5
48	Autos	29°53'15"	85°32'00"	60	4.3
49	Autos	29°51'57"	85°31'20"	44	6.2
50	Autos	29°51'21"	85°31'08"	44	6.0
51	Unknown	29°50'24"	85°29'18"	34	4.0
52	Autos, concrete rubble	29°31'12"	85°07'30"	45	6.5
53	Tires, concrete rubble	30°00'06"	84°17'06"	13	4.0
54	Tires, concrete rubble	29°55'43"	84°13'06"	28	6.0
55	Unknown	29°54'55"	84°13'02"	29	6.0
56	Tires	30°00'00"	84°09'15"	20	4.8
57	Autos, tires, concrete rubble	30°00'00"	84°03'09"	20	6.5
58	Unknown	29°39'45"	83°39'00"	20	6.1
59	Liberty Ship	29°39'48"	83°37'49"	21	6.9
60	Autos, drums, tires	29°09'00"	83°16'00"	13	5.3
61	Autos, scrap metal	29°18'03"	83°15'06"	13	5.2
62	Autos, scrap metal	29°07'46"	83°06'25"	2	4.7
63	Autos, scrap metal	29°06'16"	83°06'14"	2	2.0
64	Autos, scrap metal	29°06'32"	83°03'22"	2	0.7
65[a]	Tires	29°04'04"	83°10'00"	20	5.9
66[a]	Autos, concrete rubble	28°53'00"	82°49'41"	22	6.5
67[a]	Fountainebleau site	30°10'50"	85°56'05"	71	3.8
68[a]	PCMI barge	30°07'30"	85°50'50"	78	4.3
69[a]	Warsaw site	30°04'00"	85°50'00"	78	6.8
70	Lost pontoon	30°04'40"	85°44'35"	68	2.7

[a]New sites.

3. SHELLFISH HARVEST AREAS

Shellfish harvest areas depicted in the atlas are defined by strict water quality standards and do not show actual extent of shellfish aggregations. Continual monitoring of fecal coliform bacteria levels is done by the Florida Department of Natural Resources (FDNR), Bureau of Marine Regulation and Development through the Department's Shellfish Environmental Assessment Section.

Shellfish harvest areas are classified as approved, conditionally approved, prohibited, or unclassified. Approved areas consistently fulfill water quality criteria. Conditionally approved areas also meet water quality standards, but are subject to more frequent localized changes, which may affect water quality by flooding and urban runoff. Prohibited areas, which consistently do not fulfill such requirements, are officially prohibited for the harvesting of shellfish. Unclassified areas are not subjected to continual water quality monitoring and are officially unapproved for shellfish harvesting.

The classification of all coastal and estuarine waters is subject to change due to water quality standards. Current shellfish harvest status of any particular area can be obtained from county health departments and the office of the FDNR, Shellfish Environmental Assessment Section located in Punta Gorda, Florida (telephone [813] 639-3443).

Shellfish is a broad term applied to many invertebrates. The water quality constraints imposed by shellfish harvest areas are directed at those species of shellfish which filter water to feed, specifically clams and oysters. These filter feeders, which are eaten, have potential to concentrate pathogens and toxins. Only the adductor muscle of scallops, another filter feeder, is commonly eaten and possesses less potential for concentrating pathogens and toxins. However, healthy populations of bay scallops are generally only associated with good water quality.

3.1 OYSTER BEDS

The American oyster, *Crassostrea virginica*, spawns during warm months, generally from April through October. Larvae are pelagic for 2-3 weeks, then settle and become permanently attached when suitable hard substrate is encountered. They then grow rapidly, provided water flow, temperature, and salinity are suitable. Good water flow not only aids in dispersal of the larvae, but also assures transport of nutrients and removal of wastes. Oysters can tolerate a wide salinity range (10-30 ppt) and temperatures of 25-26°C promote optimal growth. Salinities of 25-30 ppt encourage rapid growth and maturation. Unfortunately, predation, parasitism, and disease are also high at this salinity range. Where salinity is low (10-15 ppt), which includes most of Apalachicola Bay, pests are virtually eliminated (Galtsoff 1964).

Oysters in Florida attain marketable size in 2 to 3 years. Oysters are non-selective filter feeders, sorting food by size during ingestion. Phytoplankton, bacteria, and detritus are important nutrient sources (McNulty et al. 1972).

Because they are filter feeders, oysters can concentrate microorganisms as much as several thousandfold; this poses a potential health hazard since oysters are often found in shallow estuaries that may be contaminated with effluent containing pathogenic bacteria and viruses. For this reason, oyster harvesting is regulated according to strict water quality standards. But because estuarine water quality is subject to rapid change, oyster areas must be monitored frequently and may be only conditionally approved. With one exception, State law prohibits the taking of oysters between June 1 and August 31. The exception is East Bay in St. Andrew Sound, where harvest is allowed year round. The minimum allowable size is 3 inches, also determined by State law.

Oystering has been practiced in Florida since 1936. There are 5,604 ha (13,844 acres) of live oyster beds along Florida's entire gulf coast (McNulty et al. 1972). By far, the most important region for the harvesting of oysters in Florida is Apalachicola Bay and surrounding estuarine waters. Eighty-three percent of public oyster beds located along the Florida gulf coast are located in Apalachicola Bay. The major commercially important oysters are located in St. Vincent Sound, St. George Sound, and the East Bay-Apalachicola Bay Complex (Livingston 1980). The Cedar Keys region contains more than 1,000 acres of oyster bars that are exposed at low tide, but the oysters are small due to overcrowding.

In 1982, 4,153,182 lb of oysters worth $4,150,366 were taken in Apalachicola Bay. This figure represents 86% of the entire dollar value for the entire Florida gulf coast (Snell 1984).

In northwest Florida, the oyster grows on nearly any suitable substrate such as seawalls, reef mounds, and ridge-shaped reefs, particularly in the northern portions of the study area. Larger, naturally occurring, aggregations of oysters are depicted in the atlas as public oyster beds (Oys-1).

In certain areas, portions of submerged lands within estuaries have been leased by private interests in a maricultural effort to grow oysters. These areas appear in the atlas as private oyster beds (Oys-2). Interestingly, some areas acquired for oyster growing were subsequently closed to shellfish harvesting by the FDNR due to water quality degradation below approved criteria.

3.2 SCALLOP BEDS

Two species of scallops occur in the study area, bay scallops (Argopecten irradians) and calico scallops (A. gibbus). Bay scallops spawn offshore mainly in spring and early summer, though some spawn year round. Larvae of both species are planktonic for 1-2 weeks, then become sessile. Bay scallop larvae attach to inshore coastal seagrasses for several weeks prior to metamorphosis to the adult form. Calico scallop larvae require a hard substrate in water 5-20 m (16.4-65.6 ft) deep offshore for attachment prior to becoming mobile juveniles. Both species reach sexual maturity within their first year.

In 1982, 13,842 lb of scallops worth $37,487 were commercially caught on the Florida gulf coast (Snell 1984).

Bay scallops occupy the same general areas each year whereas calico scallop beds are variable, depending on where postlarvae are distributed by water currents. The maximum life span of scallops is about 2 years; most die at the age of 12-14 months, after one spawning season. Scallops are filter feeders, consuming phytoplankton. Bay scallops occur in most Florida estuaries, and large populations occur where seagrass meadows are extensive including off the Crystal River area. Where abundant, bay scallops support recreational fisheries. There is no closed season on bay scallops harvest for the public. Commercial fisherman cannot harvest scallops before August 1. Since bay scallops reach their maximum size in late July or early August, regulation by a January-July closed season would regulate minimum size as well. The calico scallop is the more important commercially harvestable species.

3.3 CLAMS

Three species of clams occur in significant abundance in northwest Florida: the northern quahog (Mercenaria mercenaria), southern quahog (Mercenaria campechiensis), and the sunray venus clam (Macrocallista nimbosa). All are found in estuaries and coastal waters from the mean high tide level to depths of 50 ft, and are most common on shallow flats. Only limited commercial and recreational harvesting of clams has been conducted within the study area (Godcharles and Jaap 1973). In 1982, only 860 lb of clams worth $1,581 were commercially caught on the Florida gulf coast (Snell 1984).

3.4 SHRIMP

In the study area, three shrimp species are predominant: pink shrimp (Penaeus duorarum), rock shrimp (Sicyonia brevirostris), and brown shrimp (Penaeus aztecus)(Joyce and Eldred 1966).

Pink shrimp are the most economically significant shrimp species in the State. Approximately 70% of the pink shrimp are caught off the Dry Tortugas. Spawning occurs in the open gulf, but only in the summer north of Tampa Bay. After several molts, postlarvae enter estuaries where they become bottom feeders. The estuarine phase of growth is the most critical in the life cycle of the pink shrimp. These areas provide postlarval, juvenile, and subadult shrimp with food and protection from predation.

Research indicates that the shrimp yield depends on the survival of the estuarine marshes, mangroves, and seagrass meadows in their natural state. Areas such as the marsh- or mangrove-water interface and seagrass meadows offer a rich food source for juvenile pink shrimp, which feed on detritus, algae, and microfauna.

As they become older, pink shrimp emigrate to the Gulf of Mexico and become predatory and omnivorous. Sexual maturity is reached in about 1 year. The majority of commercial pink shrimp are caught at depths of 20-27 m (66-90 ft). Shallow grass beds provide a source of smaller animals for the live-bait shrimp fishery. There are State and local size standards, but no catch limit for pink shrimp in Florida. The season varies according to area. The Florida catch accounts for approximately 97% of the total annual value of pink shrimp caught in the gulf.

Rock shrimp (*Sicyonia brevirostris*) are not dependent on estuaries during any part of their life cycle which is apparently passed entirely in offshore waters and primarily in depths of 18-82 m (60-270 ft). Spawning occurs year round; no information has been reported regarding larval development, feeding habits, or migration patterns. Sexual maturity is reached in approximately 1 year. Adult rock shrimp are apparently nocturnal, generalized carnivores. In Florida, rock shrimp are harvested mainly from sandy bottoms at depths of 18-40 m (60-132 ft). Rock shrimp are most frequently taken as incidental bycatch, especially with pink shrimp. However, a small scale directed fishery does exist and both catch and effort have been increasing steadily.

The brown shrimp (*Penaeus aztecus*) is the principal bait shrimp caught off the northwest Florida coast.

In 1982, the exvessel value of all shrimp landings for the Florida west coast exceeded $47 million (this amounted to a net economic impact of more than $200 million to the region). The exvessel value is the total paid to fisherman by dealers (it does not include sales directly to restaurants or other private concerns). As such, it indicates the direct economic contribution of the fishery (Snell 1984).

Shrimp distributions are not mapped.

3.5 BLUE CRAB

Blue crabs (Callinectes sapidus) are most abundant in bays and river mouths in Florida. They prefer muddy bottoms in waters up to about 35 m (114 ft) depth. Females migrate offshore to waters of higher salinity for spawning, which occurs year-round except in northern portions of the State. The planktonic larvae remain in higher salinity water for 30-50 days. The postlarvae and first few juvenile stages settle to the bottom and migrate (using tidal currents) back towards the estuaries. Juveniles occupy shallow areas in the estuary, such as seagrass meadows, while adults prefer deeper regions. Adults reach commercial size (5-inch carapace width) at 1-1.5 years, and may live as long as 3 to 4 years. Larvae eat both phyto- and zooplankton. Adult blue crabs are scavengers, but prefer live prey such as small fish, oysters, and clams. There is no closed season on blue crab in Florida. Crabs taken must measure 5 inches across the carapace, and egg-bearing females may not be sold. Since the late 1950's, the volume of blue crab landings of Florida's west coast has exceeded those of the east coast. The value per pound of blue crab is considerably less than that of stone crab, \$0.168 vs \$0.90 (1976 data).

The blue crab is common in all estuaries of the northeast gulf study area. Following mating, female blue crabs leave the mating estuary and move along the shore towards specific spawning areas. Apalachicola Bay is the major breeding grounds for the blue crab for the eastern Gulf of Mexico. It is hypothesized that larvae are carried by the loop current and redistributed to coastal estuaries (Oesterling and Eviak 1977).

In 1982, 8,870,850 lb of blue crabs worth \$2,209,055 were commercially caught on the Florida gulf coast (Snell 1984). Crab distributions are not mapped.

4. FINFISH SPAWNING, NURSERY, AND HARVEST AREAS

The extensive shoreline and sheltered embayments of the northeast gulf coastal region provide vital habitat for adult and nursery stocks necessary to the maintenance of the commercial and recreational fisheries of the region. Habitats such as mangrove forests, seagrass beds, and marshes provide refuge and forage areas for economically important species. Information on the following species was provided by the Florida Department of Natural Resources, the Gulf of Mexico and South Atlantic Fisheries Management Councils (Fisheries Management Plans), and the Saltwater Fisheries Study and Advisory Council (Final Report 1982).

Finfish areas are mapped on the biological resources maps in a matrix form on the map legend. The species data correlate to various habitats such as mangroves, seagrass beds, and marshes. Commercial fishery data for landings (in pounds) and exvessel value of selected species are listed by county in Appendix A.

4.1 ESTUARINE-DEPENDENT FISHES

4.1.1 Red Drum (*Sciaenops ocellatus*)

Red drum inhabit estuarine and nearshore gulf waters. Spawning occurs in coastal, nearshore areas beginning in September and continuing through February. Larvae are transported to estuarine nursery areas by currents, where they remain during the summer, developing into juveniles which leave the estuary with the onset of cold weather. As the fish mature they apparently prefer to spend more time in the shallow nearshore gulf. Red drum are primarily bottom feeders with a preference for crabs and shrimp. They exhibit secondary midwater and surface feeding. The State of Florida enforces a 12-inch minimum size limit on red drum.

4.1.2 Spotted Seatrout (*Cynoscion nebulosus*)

The spotted seatrout is very closely tied to the estuary. Spawning occurs within the estuary and possibly in those waters immediately adjacent to the mouth of the estuary. Florida stocks apparently spawn year round with a major peak in the spring and a minor peak in the fall. Essentially nonmigratory, seatrout exhibit a random residential range within the estuary. Tagging studies have shown that most fish move less than 30 mi.

Each estuary appears to have a unique breeding stock, each stock having slightly different morphological racial traits. Habitat preference appears to be seagrass beds. Spotted seatrout feed on fish, shrimp, and other crustaceans and become more piscivorous as they mature. A 12-inch minimum size limit is imposed throughout the State of Florida.

4.1.3 Snook (*Centropomus undecimalis*)

Snook are essentially tropical fishes and sensitive to cold-induced mortality. The northern limit of their range is located just north of Crystal River. Spawning, possibly lunar-induced, occurs at and near tidal passes from late May through July. Eggs and larvae are transported to estuarine and brackish nursery areas by currents. Juveniles live in the upper reaches of the estuary primarily in brackish streams, ditches, and tidal freshwater creeks. Snook are essentially nonmigratory, but do exhibit a residential range within the estuary and a net movement to the passes during the spawning season. Snook feed on fish and crustaceans. The State of Florida enforces a closed season on snook between January 1 and February 29, and between June 1 and July 31. A possession limit of two fish as well as a minimum size limit of 18 inches have also been imposed.

4.1.4 Atlantic Croaker (*Micropogonias undulatus*)

The Atlantic croaker is primarily a northern gulf species. Spawning occurs offshore and peaks about October. Larvae are transported into the estuary where they develop rapidly. In spring, the juveniles move into the coastal nearshore environment before moving farther offshore in the fall, possibly in response to declining water temperature. Croakers are harvested by the industrial fleet and processed into pet food, crab bait, and fish meal. Croakers are bottom feeders, preying on polychaetes, crustaceans, and fish, becoming more piscivorous as they mature.

4.1.5 Southern Flounder (*Paralichthys lethostigma*)

Spawning occurs offshore in fall and winter when adults migrate from estuarine and coastal nearshore waters. The buoyant eggs usually hatch within 2 days, and larvae move to inshore and estuarine nursery areas. During this time, the symmetric larvae undergo a metamorphosis in which the skull contorts and the right eye moves around to the left of the body. Juveniles typically inhabit shallow estuarine grass beds where they feed largely on marine worms, crustaceans, and fish. Adults are capable of protective coloration changes to blend with the surrounding bottom, and feed almost exclusively on fish and crustaceans. The State of Florida has imposed an 11-inch minimum size limit on flounders.

4.1.6 Florida Pompano (*Trachinotus carolinus*)

Although the exact spawning location is unknown, pompano are considered to spawn offshore, as evidenced by the appearance of very early larval forms in offshore gulf waters. The peak of an extended spawning season occurs from April through June. Rapidly growing juveniles prefer open beach areas where they forage for crustaceans and mollusks. Florida supplies nearly 90% of the U.S. population of pompano, which commands the highest price per pound of any fish in the southern United States. Florida law prohibits the harvest of pompano less than 9.5 inches long.

4.1.7 Striped Mullet (*Mugil cephalus*)

Spawning occurs between October and January in offshore waters. Floating eggs typically hatch within 2 days, and the developing planktonic larvae move into estuarine nursery areas as juveniles where they remain until sexually mature, approximately 2-3 years. Larvae and small juveniles feed on zooplankton, while juveniles and adults are herbivorous, feeding on diatoms, algae, and benthic detritus. With the exception of the seaward spawning migration in the fall, mullets remain in and are directly dependent on the estuary. This species is an economically important species in the region.

4.1.8 Gulf Menhaden (*Brevoortia patronus*)

The gulf menhaden is abundant in the northern Gulf of Mexico, and commercial harvesting efforts are concentrated in that region. Spawning probably occurs in coastal inshore areas. Planktonic larvae are selective carnivores, and migrate inshore and enter the estuarine nursery areas as juveniles. Juveniles develop a specialized gill raker: an alimentary tract complex with which it feeds by nonselective omnivorous filtering. Movement into and established residence in the estuary are an integral part of the menhaden life cycle.

4.1.9 Tarpon (*Megalops atlantica*)

Tarpon support an important recreational fishery in Florida. Spawning occurs from May through August in waters adjacent to offshore currents, along the Outer Continental Shelf. Larvae are transported or migrate inshore, developing into juveniles upon reaching estuarine nursery areas. Planktivorous juveniles inhabit isolated, often stagnant, pools which fringe the estuary. Adults feed on fish, crustaceans, and polychaete worms. Tarpon reach sexual maturity in about 7 years and have a body weight of about 60 pounds. Gulf coast stocks exhibit a faster growth rate than do east coast fish.

4.2 REEF FISHES

Groupers and snappers are important to both the recreational and commercial fisheries of the region. Generally, spawning occurs offshore over the Continental Shelf. Pelagic larvae are transported great distances by oceanic currents. Upon arrival at inshore, coastal, and estuarine nursery areas, juveniles seek cover and forage for fishes and crustaceans. Typically, as these fishes develop, they exhibit an offshore movement. These reef fishes, although inhabitants of other areas, generally seek out structures with some vertical relief, such as wrecks, artifical and coral reefs, rocky areas, holes, and ledges. Most groupers are protogynous hermaphrodites, beginning life as females and transforming into males at around age 5-7 years. The State of Florida imposes a 12-inch minimum size on grouper.

4.2.1 Red Grouper (*Epinephelus morio*)

The red grouper commonly occur offshore on the gulf coast, but occasionally can be found in more nearshore habitats. Spawning occurs in the spring over the Continental Shelf. Juveniles develop in coastal areas and tend to move offshore with age. This is an economically important species in northwest Florida.

4.2.2 Jewfish (*Epinephelus itajara*)

The jewfish is the largest of the groupers and can attain lengths in excess of 8 ft and weigh over 700 lb. Spawning occurs offshore during July and August. Juveniles and young adults inhabit coastal and estuarine seagrass beds and mangroves. Although occasionally occurring inshore, marine jewfish tend to frequent offshore habitats.

4.2.3 Gag Grouper (*Mycteroperca microlepis*)

The gag and the red are the major groupers contributing to the commercial and recreational fishery. The gag is the most frequently caught inshore grouper on the peninsular gulf coast. Spawning between January and March occurs in offshore waters of the Continental Shelf. Juveniles inhabit nearshore and estuarine nursery areas. Also found offshore, adult gag groupers do take residence in nearshore habitats.

4.2.4 Scamp (*Mycteroperca phenax*)

More common offshore, the adult scamp is not relatively abundant in coastal waters. Spawning occurs offshore during March and April. Adults are more common over hard broken bottoms such as rock and coral. The scamp is considered the best eating fish in the grouper family and is an important species in northwest Florida (Moe 1963).

4.2.5 Red Snapper (*Lutjanus campechanus*)

Although the specific spawning location is not known, red snapper probably spawn in offshore waters of the Continental Shelf from late June until October. Larvae are transported or move to coastal and estuarine waters. Juveniles exhibit a preference for inshore areas of mud or sand bottoms, and exercise an offshore movement as a function of size. Primarily found offshore, adult red snapper are not harvested in coastal and nearshore waters, but are an economically important species in the region.

4.2.6 Mangrove Snapper (*Lutjanus griseus*)

Although occurring in offshore habitats, the mangrove snapper is also found inshore in northwest Florida. Adults are commonly found around structures, grassbeds, and mangroves in the estuary. However, spawning takes place offshore from April through October. Larvae are transported inshore, and juveniles are common in estuarine seagrass beds and mangrove-fringed shorelines. This species is also referred to as the gray snapper.

4.3 COASTAL PELAGIC FISHES

The mackerels are fast-swimming, oceanic fishes and undergo extensive seasonal migrations.

4.3.1 King Mackerel (*Scomberomorus cavalla*)

The king mackerel is an economically important species in southwest Florida but is less important in northwest Florida. Spawning occurs in waters over the Outer Continental Shelf and in adjacent offshore currents between May and September. Little is known of juvenile forms; most inshore collections have been incidental in shrimp trawls. Adults undertake mass migrations. Evidently, there are several populations of kingfish in Florida, and some intermixing does occur. The gulf stock apparently comprises most fishes which winter between Cape Canaveral and Key West. These fishes move into the Gulf of Mexico in the spring, exhibiting a northward movement, and spend the summer in the northern gulf as far west as Texas. A return migration to southeast Florida occurs during the fall and winter. Another population of king mackerel, which is presently off the southeast coast in the spring, apparently moves down the Atlantic coast into the area to spawn. Adults feed on menhaden, shrimp, squid, small schooling jacks, and other schooling herring-like fishes.

4.3.2 Spanish Mackerel (*Scomberomorus maculatus*)

The Spanish mackerel also support a large recreational and commercial fishery in Florida. Whereas king mackerel are not commonly associated with nearshore areas, the Spanish mackerel frequently enters saline embayments during their migration runs. Spawning occurs over the inner Continental Shelf from May through September. The ecology of juveniles is poorly known, although they are captured inshore in shrimp trawls. Separate stocks are presumed for each coast of Florida. Fishes wintering in Florida Bay migrate into the northeastern gulf in the spring and return by the following winter. Spanish mackerel feed heavily on menhaden and commonly eat anchovies, small jacks, squid, and shrimp. There is a 12-inch minimum size limit imposed by the State of Florida on Spanish mackerel.

4.4 COMMERCIAL FISHERIES

Commercial landing and exvessel value for the coastal counties in the study area are depicted in Appendix A for the economically important finfish. These data were supplied by the NOAA, National Marine Fisheries Service (1981).

4.5 RECREATIONAL FISHERIES

Bell et al. (1982) assessed the annual value of the saltwater recreational fishery in Florida at about 5 billion dollars, in terms of directly and indirectly generated income.

The finfish habitat matrix displayed in the atlas legend was derived from currently available data supplied largely by the Florida Department of Natural Resources. Finfish species were assigned applicable movement migration status as described by Moe (1972).

5. SENSITIVE PLANT SPECIES

The floral assemblage of Florida comprises approximately 3,500 vascular plant species. Within this assemblage of largely native flora occur many species which have received special attention and status from numerous agencies. Florida ranks fourth behind Hawaii, California, and Texas in number of listed plant taxa, which exceeds 400 species with special designations. Of these, at least one-third and possibly as many as one-half occur in the northeast gulf study area.

For the purposes of mapping in the northeast gulf study area, the status categories of plants include:

(1) UR-1 (U.S. Fish and Wildlife Service) - Species considered as primary candidates for listing as threatened or endangered;

(2) Endangered (U.S. Fish and Wildlife Service) - Species defined as those in danger of extinction throughout all or a significant portion of their range;

(3) Threatened (U.S. Fish and Wildlife Service) - Species that are likely to become endangered within the foreseeable future;

(4) Endangered (Florida Committee on Rare and Endangered Plants and Animals) - Species in imminent danger of extinction or extirpation and whose survival is unlikely if the causal factors presently at work continue operating;

(5) Threatened (Florida Committee on Rare and Endangered Plants and Animals) - Species believed likely to move into the endangered category in the near future if the causal factors now at work continue operating.

The United States Fish and Wildlife Service (USFWS), in the 1980 Federal Register, listed only two species found in Florida as endangered. These are Chapman's rhododendron (Rhododendron chapmanii) and Harper's beauty (Harperocallis flava), both of which occur in the study area. However, the Federal Register does list 32 species which do occur in the study area and are currently under review status (category UR-1). These are considered as primary candidates for listing as threatened or endangered. Of these candidates, mappable information depicting locations of extant populations was obtained for 25 species. The mapped locations were drawn primarily from data collected by the Florida Natural Areas Inventory Program and the USFWS. Any field study pertaining to these plants which occurred prior to 1965 was not included, due to mapping requirements.

On 28 November 1983, a supplemental list to the 1980 Federal Register was published. Many species of status category UR-1 were changed to UR-2, the change in status meaning that more information regarding the species is needed to determine if a plant species is to be classified as endangered or threatened. Also, on 22 February 1984, the Florida torreya (*Torreya faxifolia*) was determined to be endangered. On 19 August 1985 the Miccosokee Gooseberry (Ribes echinellum) was determined to be threatened.

The locations for endangered and UR-1 status plants are plotted in the atlas for the following species.

Southern three-awned grass	*Aristida simpliciflora*
Plumose aster	*Aster plumosus*
Pine-wood aster	*Aster spinulosus*
Scare-weed	*Baptisia simplicifolia*
Cruise's golden-aster	*Chrysopsis cruiseana*
Tropical wax weed	*Cuphea aspera*
Telephus spurge	*Euphorbia telephioides*
Wiregrass gentian	*Gentiana pennelliana*
Harper's beauty	*Harperocallis flava*
Mock pennyroyal	*Hedeoma graveolens*
Bent golden-aster	*Heterotheca flexuosa*
Smooth-barked St. John's wort	*Hypericum lissophloeus*
Godfrey's blazing-star	*Liatris provincialis*
Panhandle lily	*Lilium iridollae*
West's flax	*Linum westii*
White birds-in-a-nest	*Macbridea alba*
Ashe's magnolia	*Magnolia ashei*
Godfrey's sandwort	*Minuartia godfreyi*
Pigmy-pipes	*Monotropsis reynoldsiae*
Florida beargrass	*Nolina atopocarpa*
Giant water-dropwort	*Oxypolis greenmanii*
Butterwort	*Pinguicula ionantha*
Large-leaved jointweed	*Polygonella macrophylla*
Chapman's rhododendron	*Rhododendron chapmanii*
Miccosukee gooseberry	*Ribes echinellum*
Florida skullcap	*Scutellaria floridana*
Tampa verbain	*Verbena tampensis*

In 1985, the Preservation of the Native Flora of Florida Act (section 581.185 of Florida statutes, 1985) was published and provided a list of plants considered endangered, threatened, or exploited by the State. The Florida Department of Agriculture and Consumer Service (FDACS) prepared a list that contains approximately 200 plant species which occur in Florida. A large number of these occur in northwest Florida. The northwest study area, due to its geologic history and temperate climate, contains many endemic species. Due to the lack of field studies, it is uncertain the number of species occurring in the coastal counties of northwest Florida. Cacti, bromeliads, orchid, and ferns make up nearly three-quarters of the endangered and threatened species listed by the State (FDACS).

Other organizations and agencies which apply special designations to components of Florida flora are the Florida Committee on Rare and Endangered Plants and Animals (FCREPA); the Convention on International Trade in Endangered Species of Wild Flora and Fauna; the Smithsonian Institution; and the United States Forest Service.

Despite the vast numbers of sensitive plants in northwest Florida, very little information on their natural history is available, and further study is warranted if this resource is to be preserved. Rarity of a species may be due to narrow habitat specificity, habitat destruction by urban or agricultural development, intense competitive pressure, or limited populations (as caused by pollution). Without proper information, such assessments are difficult to make.

Indiscriminant collection of rare plants for landscaping and horticulture has decimated populations and in some instances led to extirpation and extinction. In northwest Florida orchids are most severely affected by this type of activity. Florida statutes (Section 581.185, 1985) designed for the "Preservation of the Native Flora of Florida," offer minimal protection to sensitive plant species which are under collection pressure. An active, largely informal, trade in sensitive Florida flora, with some collection occurring within Federal and State parks, preserves, and refuges, and even the Everglades National Park, is not isolated from such illegal activities. Evidently, the inaccessibility of an area that contains sensitive plant species has provided more of a pragmatic protection from collection than has legislative action.

Urbanization and development for agricultural and mining activities contribute to alteration and direct loss of habitat necessary to support sensitive plant species. In addition, modification to hydrologic regimes can alter the hydroperiod on which habitats are critically dependent.

Sensitive plant species can be found in a variety of habitats in northwest Florida. Many of these species are endemic to Florida and occur mainly in regions that are relatively low and often coastal.

The federally endangered Chapman's rhododendron (Rhododendron chapmanii) is a Florida endemic species in the Heath family. It is an evergreen shrub which grows to a height of about 2 m (6.5 ft) and is the only native evergreen rhododendron in the Florida flora. This plant occurs in the Apalachicola River Basin and inhabits pine flatwoods and titiswamp borders. The primary reason for population decline is the conversion of native habitat into pine plantations for pulpwood production.

Harper's beauty (Harperocallis flava), a member of the lily family, is federally endangered. It was first discovered by S. McDaniel in 1965 in the Apalachicola National Forest in Franklin County. This plant genus is endemic only to Florida. It is a perennial herb with leaves 5-21 cm long and 2-3 mm wide. This plant inhabits open bogs such as the pitcher plant bogs.

The Florida torreya (Torreya taxifolia) occurs in three counties which are outside of the study area in Florida. A green tree in the Yew family, which may grow to a height of 12 m (40 ft), it inhabits rich, moist soils along bluffs and ravines in the Apalachicola River Basin. The primary reason for population decline was a disease in the late 1950's and early 1960's; the species was nearly eliminated.

The Miccosukee gooseberry (Ribes echinellum) occurs in one Florida county, outside of the study area. This small, spiny shrub inhabits upland hardwood forests along the northern shores of Lake Jackson in Jefferson County.

6. COLONIAL BIRD NESTING SITES

Habitat diversity, mild winter climate, and geographic location allow the northeast gulf study area to support one of the richest assemblages of avifauna in the continental United States. The vast expanses of coastal mudflats, saline marsh, and the mangrove-sheltered embayments as well as the marshes, wooded swamps, and cypress stands of the interior provide the forage areas and nesting substrate essential to the survival of vast populations of seabirds. shorebirds, wading birds, and waterfowl which predominate in the region. Nesting colonies are depicted on the atlas by numbered symbols. Species composition of each colony is listed by map base in Appendix B. The status categories of "endangered," "threatened," and "species of special concern," as listed by the Florida Game and Fresh Water Fish Commission (FGFWFC), apply to several bird species. Refer to Appendix C for special status definitions. Information pertaining to the following species was provided by the National Audubon Society, Florida Audubon Society, and Rare and Endangered Biota of Florida, Volume 2, Birds (Pritchard 1978).

6.1 SEABIRDS

Colonial nesting seabirds, considered regular inhabitants within the study area, include: the eastern brown pelican (*Pelecanus occidentalis carolinensis*) and double-crested cormorant (*Phalacrocorax auritus*).

6.1.1 Eastern Brown Pelican (*Pelecanus occidentalis carolinensis*)

The eastern brown pelican is listed by the USFWS as an endangered species, and is listed by FGFWFC as a threatened species. Aerial surveys estimate the Florida breeding population to be around 8,000 pairs. Nesting occurs usually on small coastal islands from early spring through summer. Two to three eggs are usually laid, and food availability determines fledgling success. The diet consists exclusively of fish, which are secured by plunge diving. Menhaden, mullet, sardines, and pinfish are the major prey items. The high incidence of first-year mortality (about 70%) from starvation may be due to the inefficiency of the young to secure prey. Because of its special status, the brown pelican is mapped in the endangered species portion of the atlas.

6.1.2 Double-crested Cormorant (*Phalacrocorax auritus*)

The double-crested cormorant usually lays three or four eggs with most nesting occurring in April through June. However, nesting has been reported throughout the year. Cormorants dive after and pursue prey underwater, returning to the surface to swallow the food, usually fish. Nesting often occurs with colonial wading birds and for this reason cormorant nesting sites are mapped under the heading of wading bird colonies in this atlas.

6.2 SHOREBIRDS

Shorebirds as defined for the atlas include gulls, terns, sandpipers, plovers, skimmers, and oystercatchers. Resident nesting species utilize coastal mudflats, saline and brackish marshes, sheltered embayments, and estuarine and coastal open water as forage areas. Nesting usually occurs on undisturbed beaches, islands, and sand spits where vegetation is sparse or absent. A brief discussion of all species mapped on the atlas is included below.

6.2.1 American Oystercatcher (*Hematopus palliatus*)

Resident populations in the study area are estimated at between 100 and 200 pairs. This local population is augmented by winter migrants from mid-Atlantic States each year. Noncolonial nesting occurs on islands in tidal bays on unvegetated sand or shell well above the high water mark. Two or three eggs are usually laid. Oyster beds and mudflats are the primary forage areas where oystercatchers secure their diet of mollusks and crustaceans. Concentrations are known to occur in northeast Taylor County for this bird species. The American Oystercatcher is listed as a species of special concern by the FGFWFC.

6.2.2 Snowy Plover (*Charadrius alexandrius tenuirostris*)

The Cuban snowy plover is listed as an endangered species by the FGFWFC. Conservation estimates place the gulf coast population at 100 pairs. Nesting habitat requirements are isolated expansive dry sandy beaches where breeding occurs from April to June. Eggs, usually three, are laid in a shallow depression which is sometimes lined with shell fragments. Snowy plovers forage in search of insects, worms, mollusks, and crustaceans on dry and tidally influenced sand flats. No other bird species in Florida relies solely on sandy beaches for nesting and foraging habitat.

In general, site specific nesting colony data are sparse for many species due to either the small numbers of individuals which constitute a colony or the transitory nature of the colony location. location.

6.2.3 Wilson's Plover (*Charadrius wilsonia*)

The Wilson's plover breeds sporadically from the southern portion of the study area southward through the Florida Keys. Nesting habitat diversity ranges from interior marshes to dredged spoil islands.

6.2.4 Laughing Gull (*Larus atricilla*)

The laughing gull is the most common breeding gull in the study area. Nesting occurs on both natural and dredged material islands where low vegetation covers sandy soil. Typically 1-3 eggs are laid in late April and early May, and young birds fledge by late August.

6.2.5 Least Tern (*Sterna albifrons*)

This easily disturbed species requires sandy, unvegetated nesting substrate such as sand spits, islands, dunes, and gravel-covered rooftops. Two eggs are usually laid in shallow scarpes in the sand. Nesting begins in late April. The FGFWFC lists the least tern as a threatened species.

6.2.6 Royal Tern (*Sterna maxima*)

This uncommon tern nests periodically in small numbers in the study area and occasionally within colonies of laughing gulls.

6.2.7 Common Tern (*Sterna hirundo*)

The common tern winters in northwest Florida in the coastal estuaries from Pensacola to Apalachicola and in the coastal marshes of Hernando County. The only known breeding area for this species is on St. Joseph Island where a few birds nested in the 1960's and early 1970's (Clapp et al. 1982b).

6.2.8 Sandwich tern (*Sterna sandvicensis*)

The sandwich tern bred regularly along the gulf coast of Florida in the 18th century, but no longer nested there by the early part of the 19th century. In 1970, they were found nesting on St. George Island and now breeding occurs along the gulf coast, commonly among flocks of royal terns. Recently, they have been reported nesting at Cape San Blas and on the spoil islands offshore of the Cross Florida Barge Canal (Kale 1978). Their noncolonial nesting occurs on sandy islands, natural or dredged. The sandwich tern is listed as a species of special concern by the FCREPA.

6.2.9 Black Skimmer (*Rynchops nigra*)

Nesting occurs from May through August on bare or sparsely vegetated beaches, dunes, spits, or dredged spoil islands throughout the study area.

6.3 WADING BIRDS

Vast expanses of coastal and interior wetland habitats support a great number of colonial nesting wading birds including herons, egrets, and ibises.

6.3.1 Great Blue Heron (Ardea herodias)

The great blue heron begins nesting in early January in small numbers with other colonial waders, or in small specific colonies. Major forage areas consist of interior marshes, shallow areas of sheltered saline embayments, and inland bodies of water. Major prey items are fish and crustaceans although the diet may be augmented by small reptiles and mammals. The great blue heron is a common breeding resident in the entire study area.

6.3.2 Little Blue Heron (Florida caerulea)

The little blue heron inhabits fresh or brackish marshes. The nesting season begins in February and lasts through August or September. The average clutch size consists of three eggs. The little blue heron prefers freshwater and brackish habitats in which to forage for fish, crustaceans, insects, and small reptiles and amphibians. This species is listed as a species of special concern by the FGFWFC.

6.3.3 Tricolor Heron (Hydranassa tricolor)

The tricolor heron, although found in wetlands throughout the study area, is more common in estuarine habitats, where it forages for small fish and crustaceans. Typically the breeding season extends from March to July during which time three or four eggs are laid in mixed or single species colonies. The tricolor heron is listed as a species of special concern by the FGFWFC.

6.3.4 Black-crowned Night Heron (Nycticorax nycticorax)

Feeding occurs in all shallow water habitats, but breeding concentrations appear to be associated with estuarine habitats. Breeding occurs from March to July and clutch size ranges from two to five eggs. A diet composed largely of fish may be supplemented by mollusks, crustaceans, small reptiles, amphibians, and mammals. This is the most nocturnal foraging heron, often preying on nestlings of the ibis and other herons.

6.3.5 Yellow-crowned Night Heron (Nyctanassa violacea)

More diurnal than the black-crowned night heron, the yellow-crowned night heron forages on coastal mudflats for fiddler crabs and other crustaceans, which constitute a major portion of its diet. Typically forming small colonies with other yellow-crowned night herons, this bird only occasionally nests with other waders. with other waders.

6.3.6 Cattle Egret (*Bubulcus ibis*)

Since its first appearance in 1952, the cattle egret, an Old World species, has become the most abundant bird in mixed species heronries in Florida. Although the cattle egret occupies coastal colonies, it rarely forages in marine and estuarine areas.

6.3.7 Great Egret (*Casmerodius albus*)

The great egret utilizes various forage habitats, from open pasture and interior impoundments to coastlines and saline marshes. The diet consists of fish, reptiles, amphibians, birds, small mammals, and invertebrates. The great egret exhibits a preference for more isolated heronries, where two to six eggs are laid per clutch from March through July.

6.3.8 Snowy Egret (*Egretta thula*)

Snowy egrets typically nest in mixed species colonies. Although colonies are widely distributed in coastal as well as interior wetlands, larger breeding colonies appear to establish near estuarine habitats. Eggs may be laid as early as December, although most nesting occurs between March and August. The snowy egret is an active predator, often running through shallow water or along the shoreline in pursuit of small fish. The diet also includes insects and crustaceans. The snowy egret is listed as a species of special concern by the FGFWFC.

6.3.9 White Ibis (*Eudocinus albus*)

This is an abundant species which flies and feeds in tight flocks. The diet consists largely of crawfish and other crustaceans, but insects, mollusks, and small fish, which are secured from shallow water areas are also eaten. The white ibis inhabits both freshwater and estuarine wetlands, where it nests on islands, marshes, or in mangroves.

6.3.10 Wood stork (*Mycteria americana*)

The wood stork, also called the wood ibis, is the only true stork (*Ciconiidae*) native to North America. This species is colonial in nesting, feeding, and roosting. The population was estimated to number around 100,000 birds, but it now numbers about 12,000 in Florida (Pritchard 1978).

The wood stork inhabits freshwater and brackish marshes, where it forms large rookeries, nesting primarily in cypress swamps and protected mangrove embayments. Breeding occurs from November through January with clutch sizes ranging from two to four eggs. Primary feeding areas are pools and depressions in marshes where small fish concentrate. Feeding is accomplished by tacto-location probing. This species is listed as endangered by both the FGFWFC and the USFWS.

6.3.11 Anhinga (*Anhinga anhinga*)

Although the anhinga does nest in some coastal wading bird colonies, it is chiefly a resident of interior and brackish wetlands. Fish constitute the bulk of the diet, and are pursued and captured underwater.

6.3.12 Florida Sandhill Crane (*Grus canadensis pratensia*)

Inhabiting wet prairies, cattle pastures, and marshy lake shorelines, the Florida sandhill crane occurs primarily in peninsular Florida. Within the northwest study area, this crane's habitat range is restricted to a few localized regions. Typically, two eggs are laid on a mound constructed of vegetation in shallow water during January. Both parents aid in guarding the nest, and hatching occurs in the early spring. The crane's diet is diverse, consisting of insects, frogs, small rodents, and vegetation. Habitat destruction and human disturbance are the major threats to this species. Total population is estimated at 4,000 individuals. The Florida sandhill crane is listed as threatened by FGFWFC.

6.3.13 Limpkin (*Aramus guarauna*)

The range of the limpkin includes nearly all of peninsular Florida and west of the Apalachicola River region. The limpkin is found in shoreline situations associated with slow-moving freshwater where it forages for aquatic snails, which constitute a major portion of the diet. Eggs are laid in the central depression of the nest, which is constructed of aquatic vegetation. Nesting may occur year round. The limpkin is listed as a species of special concern by the FGFWFC.

6.3.14 Migratory Waterfowl

The large coastal expanses of sheltered saline embayments, brackish sounds, tidal creeks and salt marshes support large numbers of wintering waterfowl. Peak populations occur from November through January with some members remaining through March. The most common species attracted to these coastal open water and saline environs include the following:

Lesser scaup (*Arythya affinis*)
Pintail (*Anas acuta*)
Blue-winged teal (*Anas acuta*)
Red-breasted merganser (*Mergus serrator*).
American wigeon (*Anas americana*)
Shoveler (*Anas clypeta*)
Common loon (*Gavia immer*)

The interior freshwater wetlands appear attractive to another assemblage of migratory waterfowl. Species commonly associated with inland habitats include the following:

Blue-winged teal (*Anas discors*)
Green-winged teal (*Anas crecca*)
American wigeon (*Anas americana*)
Wood duck (*Aix sponsa*)
Pintail (*Anas acuta*)
Shoveler (*Anas clypeata*)
American coot (*Fulica americana*)

The wood duck and American coot are breeding residents within the study area, with local populations being augmented by winter migrants.

Coastal waterfowl concentration areas include Chassahowitzka Bay, Homosassa Bay, Crystal Bay, Cedar Key, Apalachee Bay, St. George and St. Vincent Sounds, and St. Joseph Bay. Major waterfowl concentration areas which are managed to some degree include Chassahowitzka National Wildlife Refuge, Cedar Keys National Wildlife Refuge, St. Marks National Wildlife Refuge, and St. Vincent National Wildlife Refuge.

7. THREATENED AND ENDANGERED ANIMALS

The entire northwest study area is within the Outer Coastal Plain Forest Ecological Province. The climate in the Panhandle and west-central portions of the State is more temperate. There is a considerable variety of fauna inhabiting the coastal strands and inland areas, similar to the rich faunal assemblage in the more tropical southwest Florida region. Many of the threatened and endangered species inhabit small, isolated areas and their status is more a problem of population distribution than habitat loss, the converse being the case in southwest Florida.

The biotic assemblage of northwest Florida includes many species which warrant special status from Federal and State agencies. Defined below are the status categories as listed by the U.S. Fish and Wildlife Service (USFWS) and Florida Game and Fresh Water Fish Commission (FGFWFC).

USFWS

Endangered: Species in danger of extinction throughout all or a significant portion of their range.

Threatened: Species likely to become endangered within the foreseeable future.

Under Review Status 1: Species for which the USFWS presently has sufficient information on hand to support listing.

FGFWFC

Endangered: Species in danger of extinction if the deleterious factors affecting their populations continue to operate.

Threatened: Species that are likely to become endangered in the State within the foreseeable future if current trends continue.

Rare: Species which, although not presently endangered or threatened as defined above, are potentially at risk because they are found only within a restricted geographic area or habitat in the State or are sparsely distributed over a more extensive range.

Species of Special Concern: Species that do not clearly fit into one of the foregoing categories, yet warrant special attention.

The mapping of threatened and endangered species in this atlas was limited to the availability of mappable data. The Florida Natural Areas Inventory (FNAI) program is currently compiling and processing data on listed taxa for the State. Considerable assistance was supplied by FNAI in the species mapping effort of the atlas. Depending on data form, species were either mapped on township and range basis, site-specific basis, or by generalized range.

Nesting localities for the southern bald eagle (discussed under "Sensitive Habitat") and the eastern brown pelican were plotted by using information supplied by the USFWS and the FGFWFC. Nesting beaches of the loggerhead seaturtle were mapped from data supplied largely by the FDNR.

7.1 MAPPED SPECIES

7.1.1 West Indian Manatee (*Trichechus manatus latirostris*)

This large, passive mammal inhabits slow moving rivers, estuaries, and saline embayments where it feeds on aquatic and submerged vegetation. The total population of manatees in the United States is estimated at between 750 and 850 individuals, with approximately 350-400 inhabiting gulf coastal areas.

Manatees are weakly social animals which tend to congregate during cold weather at ground springs and warm water outfalls from power plants. The breeding season is not known. Calves are born after a 385-to 400-day gestation period and remain with the mother for an extended period. Major threats to this species include collision with powerboat propellers, vandalism, poaching, and habitat destruction. The USFWS has established designated critical habitats for the protection of this species, which are delineated in the atlas.

The State of Florida has also established manatee sanctuaries, which are shown in the atlas. Both the USFWS and the FGFWFC consider the West Indian manatee an endangered species.

7.1.2 Eastern Brown Pelican (*Pelicanus occidentalis carolinensis*)

The eastern brown pelican is listed by the USFWS as an endangered species, and is listed by the FGFWFC as a threatened species. Aerial surveys estimate the Florida breeding population to be around 8,000 pairs. Nesting occurs in mangroves (*Rhizophora mangle*, *Avicennia germinans*) usually on small coastal islands from early spring through summer. The eastern brown pelican is a permanent resident in the study area from Cedar Key south (Kale 1978).

7.1.3 Red-Cockaded Woodpecker (*Picoides borealis*)

The red-cockaded woodpecker inhabits mature stands of southern pine, typically with an open understory. Although rarer in the southern reaches of the area, several small colonies exist within the study area primarily in Wakulla County. Cavities used for nesting are excavated in live trees. Three to five white eggs are laid between April and June. Red-cockaded woodpeckers often occur together in units of two to eight birds known as clans. The unmated birds act as helpers during the nesting cycle. The continued emphasis of short-term rotation forest management severely cuts down the availability of pines old enough to meet the birds' specialized requirements and threatens the existence of this bird species. The red-cockaded woodpecker is listed as an endangered species by the USFWS and as a threatened species by the FGFWFC.

7.1.4 Atlantic Loggerhead Turtle (*Caretta caretta caretta*)

Loggerhead turtles inhabit temperate and subtropical seas worldwide. The central east coast of Florida harbors the major rookeries in the United States. Nesting on the peninsular gulf coast is confined to sandy beaches within the study area. Females emerge from the water at night, fan out depressions in the sand, deposit an average of 120 eggs, and backfill the nest. After an incubation time from 1 to 3 months, the hatchlings emerge from the nest en masse. The nesting season begins in May and lasts through September. In Florida, range and population size appear to be decreasing. Major threats appear to be human interference and development near nesting habitat, entrapment in shrimp trawls, and nest predation largely by raccoons.

7.1.5 Okaloosa Darter (*Etheostoma okaloosae*)

The Okaloosa darter is endemic to only a few creeks and their tributaries in Okaloosa and Walton Counties of Florida. The majority of the darter's habitat (90%) is contained within the Eglin Air Force Base. It is a small (2 inches) fish which inhabits clean, sandy bottom, small to medium-sized streams with a moderate to swift current. Spawning peaks in April and October. Clumps of green algae are used for egg-attachments. Due to its limited range and specific habitat requirements, the Okaloosa darter is extremely vulnerable. Population estimates range from 1,500 to 10,000 individuals. Both the USFWS and the FGFWFC list the Okaloosa darter as endangered.

7.2 OTHER THREATENED AND ENDANGERED ANIMALS

7.2.1 Florida Gopher Frog (*Rana areolata aesopus*)

The Florida gopher frog inhabits sandhill communities and sand pine scrub communities where it commonly shares the burrow of the Florida gopher tortoise (*Gopherus polyphemus*). Generally nocturnal, it forages at night for insects, which constitute the major portion of the diet. Gopher frogs congregate in shallow grassy pools to breed from early spring to late fall. The major threat is habitat destruction. The Florida gopher frog is listed as a species of special concern by the FGFWFC and is under review by the USFWS.

7.2.2 American Alligator (*Alligator mississippiensis*)

The American alligator occurs throughout Florida in interior wetland habitats, occasionally entering brackish and saline wetlands. Breeding season begins in mid-March. The female constructs a mound-shaped nest of vegetation in which 20-50 eggs are deposited. The female digs the hatchlings from the nest in approximately 9 weeks. Adults construct dens in the banks of rivers and lakes. Until the late 1960's, the hunting of alligators for hides dramatically reduced population size. The species was once listed as an endangered species by the USFWS, but its Federal status has been reduced to threatened, largely due to population increases. The American alligator is listed as a species of special concern by FGFWFC. Strictly controlled harvesting of alligators has recently been allowed in some locations within the State.

7.2.3 Marine Turtles

The Atlantic ridley turtle (*Lepidochelys kempi*), the Atlantic loggerhead (*Caretta caretta caretta*), the Atlantic leatherback (*Dermochely's coriacea*), and the Atlantic green turtle (*Chelonia mydas mydas*) occur in the gulf waters of northwest Florida. The Atlantic loggerhead commonly nests along the barrier islands in the study area. The Atlantic ridley turtle is listed as endangered by both the USFWS and the FGFWFC, and the Atlantic loggerhead turtle is listed as threatened by both agencies. The Atlantic leatherback turtle (*Dermochelys coriacea*) is the largest of all marine turtles and weighs an average of 1,000 lb. The species differs from other marine turtles in that the shell is covered with a layer of rubbery skin rather than the horny scutes found on other marine turtles. Nesting is rare in Florida and single nesting records exist for Walton and Okaloosa Counties. The Atlantic leatherback turtle is listed as an endangered animal by both the USFWS and the FGFWFC. The Atlantic green turtle has been reported along the gulf coast and is listed as endangered by both agencies.

7.2.4 Gopher Tortoise (Gopherus polyphemus)

The gopher tortoise inhabits drier areas such as beach scrub, live oak hammocks, and sandhill communities. In contrast to scattered populations in southwest Florida, those in the northwest study area are widespread, in suitable habitats. By excavating a long burrow, these turtles are host to many species.

The gopher tortoise lays up to 15 eggs in sand near the burrow. Incubation time is about 65 days, and the young construct their burrows in the same general vicinity of the nest shortly after hatching. The gopher tortoise is listed as a species of special concern by the FGFWFC and is under review by the USFWS.

7.2.5 Eastern Indigo Snake (Drymarchon corais couperi)

This snake inhabits dry, sandy areas, pine flatwoods, and moist tropical hammocks throughout peninsular Florida and the Florida Keys. In drier areas, it will utilize the burrows of the gopher tortoise (Gopherus polyphemus) as shelter. Five to twelve eggs are usually laid in May, hatching during August and September. The snake is attractive to collectors because of its large size and gentle nature. Over-collection and habitat loss have contributed to its listing as a threatened species by both the USFWS and the FGFWFC.

7.2.6 Southern Bald Eagle (Haliaeetus leucocephalus leucocephalus)

Historically, the southern bald eagle was nearly omnipresent in Florida. Breeding populations probably exceeded 1,000 breeding pairs. The current Florida breeding population is estimated at approximately 350 pairs.

The greatest concentration of eagle nests in the study area is found in the coastal swamps of Levy, Citrus, and Hernando Counties. Lesser numbers are found from north of Levy County to St. Joseph's Bay. Within the study area, west of St. Joseph's Bay, eagle nests are rare.

Typically a coastal species, the southern bald eagle is also associated with larger lakes and rivers. Coastal nests in the southern portion of the study area are usually built in mangroves, while those near interior watersheds are constructed in tall pine and cypress trees. Nests are constructed of sticks to which a veneer of finer material is applied. The bald eagle mates for life. Eggs, usually two, are laid between October and February; incubation takes about 35 days, and young remain in the nest for up to 3 months. The diet consists chiefly of fish, birds, turtles, and carrion. The status of the southern bald eagle is defined as endangered by the USFWS and as threatened by the FGFWFC.

7.2.7 Southeastern American Kestrel (*Falco sparverius paulus*)

This small falcon typically occurs in open habitats throughout the study area. This bird hunts by hovering and plunging or dropping onto prey from high perches. Three to five eggs are laid, usually in old woodpecker holes, between March and June. Incubation requires 30 days. The young remain in the nest for approximately 1 month before fledging. The Southeastern American kestrel is considered a threatened species by the FGFWFC and is under review by the USFWS.

7.2.8 Peregrine Falcon (*Falco peregrinus*)

Although no breeding records exist for this species in Florida, the study area provides optimum wintering habitat offering a dependable supply of waterfowl and shorebirds, which are major prey items. Wintering peregrine falcons arrive in Florida by September or October and usually depart by May. The peregrine falcon is listed as an endangered species by both the USFWS and the FGFWFC.

7.2.9 Florida Sandhill Crane (*Grus canadensis pratensis*)

A complete description of this bird species can be found in Section 6.3.12.

7.2.10 Limpkin (*Aramus guarauna*)

A complete description of this bird species can be found in Section 6.3.13.

7.2.11 Ivory-billed Woodpecker (*Campephilus principalis*)

The Florida population is probably extinct. This species requires vast expanses of virgin lowland hardwood forests isolated from timber harvesting operations. The ivory-billed woodpecker is listed as an endangered species by both the USFWS and the FGFWFC.

7.2.12 Florida Scrub Jay (*Aphelocoma coerulescens coerulescens*)

The Florida scrub jay inhabits both coastal and interior scrub oak areas of peninsular Florida. The relatively short breeding season extends from March to mid-June with two to five eggs being laid in the spring. Insects and acorns constitute the bulk of the diet, which is sometimes supplemented with small lizards and frogs. The only occurrence of this bird species in the study area is a small colony located in southwest Levy County. The Florida scrub jay is listed as a threatened species by the FGFWFC and is under review by the USFWS.

7.2.13 Marian's Marsh Wren (*Cistothorus palustris marianae*)

This species is an inhabitant of salt and brackish marshes along the Florida gulf coast north of Tarpon Springs. Habitat requirements include expansive areas of black rush (*Juncus roemerianus*) and cordgrass (*Spartina alterniflora*). Three to five eggs are laid in a nest constructed in these grasses or in the canopy of small black mangroves (*Avicennia germinans*). The breeding season extends from April through July. This species feeds on insects, crustaceans, and mollusks. Marian's marsh wren is listed as a species of special concern by the FGFWFC.

7.2.14 Bachman's Warbler (*Vermivora bachmanii*)

Possibly extirpated, this species is considered a migrant in Florida inhabiting wooded lowlands. Wintering occurs in Cuba and the Isle de Pines, and breeding ocurs in limited localities in several areas of south and central eastern United States. Bachman's warbler is listed as an endangered species by both the USFWS and the FGFWFC. It is doubtful that this bird has been sighted since 1965.

7.2.15 Wood Stork (*Mycteria americana*)

A complete description of this bird species can be found in Section 6.3.10.

7.2.16 Sherman's Fox Squirrel (*Sciurus niger shermani*)

This large tree squirrel inhabits longleaf pine - turkey oak vegetated sandhill communities. This species' range includes the northern two-thirds of peninsular Florida. Sherman's fox squirrel constructs nests of spanish moss (*Tillandsia usneoides*), leaves, and twigs. The litter ranges in size from one to four young, which remain in the brood nest for up to 2.5 months. Preferred food items are acorns and pine seeds. Sherman's fox squirrel is considered a species of special concern by the FGFWFC and is under review by the USFWS.

7.2.17 Florida Black Bear (*Ursus americanus floridanus*)

Occurring in widely scattered low density populations in Florida, the Florida black bear inhabits swamps and thickets characterized by very dense, almost impenetrable cover. It is smaller than other North American bear subspecies, weighing less than 400 lb. The range of this species is considerably less than its former range throughout the State. Within the study area, the Florida black bear inhabits Apalachicola National Forest (Franklin and Wakulla Counties). This species is generally nocturnal and may travel great distances.

Litters of two young are usually produced by temporarily formed breeding pairs. Essentially omnivorous, these bears eat acorns, berries, honey, and will occasionally prey on hogs and cattle, although they are considered a serious pest. The Florida black bear is considered a threatened species by the FGFWFC, except in Baker and Columbia Counties, and in the Apalachicola National Forest, where bear populations are higher.

7.2.18 Gray Bat (Myotis grisescens)

The gray bat is found only in the extreme northern portion of Washington County in the study area where populations prefer limestone karst topography. Gray bats are almost exclusively cave dwellers with only two colonies being reported from outside caves (one in a barn and the other in a storm sewer). The gray bat is listed as an endangered species by both the USFWS and the FGFWFC.

7.2.19 Florida Panther (Felis concolor coryi)

Possibly the only population of panthers in the eastern United States exist in Florida. Population size estimates range from 20 in south Florida to 30 in the entire State. Estimates are difficult because this animal is capable of traveling great distances; therefore, one panther could be responsible for many separate sightings. The last positive sighting in the northeast gulf study area was a panther shot by a sheriff's deputy near Inverness in Citrus County in March of 1968. Florida panthers probably do not breed until 3 years old, and most panther families observed contain two or three young. Dens are probably constructed in areas of dense thickets and fallen timber. Panthers require large expanses of undisturbed territory in which to hunt. Deer and other mammals support the diet. Federally designated critical habitat acquisition in the area of the Fakahatchee Strand and Big Cypress Swamp (Southwest Florida Ecological Atlas study area) is being investigated by the USFWS. Both the USFWS and the FGFWFC designate the Florida panther as an endangered species.

7.2.20 Choctawhatchee Beach Mouse (Peromyscus polionotus allophrys)

The Choctawhatchee beach mouse is in danger of extinction. Its original range included the Florida gulf coast from East Pass in Choctawhatchee Bay of Okaloosa County eastward to Shell Island in Bay County. An estimated 515 individuals remain today in two populations located between Morrison Lake in Walton County and St. Andrew Bay (including Shell Island in Bay County). The Choctawhatchee beach mouse is considered a threatened species by the FGFWFC (Bentzien 1983) and endangered by the USFWS as of 1985.

7.2.21 Perdido Key Beach Mouse (Peromyscus polionotus trissyllepsis)

The Perdido Key beach mouse may be extinct in Florida. A remnant population of 26 individuals remains in Gulf State Park, Alabama. The Perdido Key beach mouse is considered a threatened species by the FGFWFC (Bentzien 1983) and endangered by the USFWS.

7.3 WATERBIRDS WITH SPECIAL STATUS

Several seabirds, shorebirds, and wading birds with special status are discussed in a previous section (COLONIAL BIRD NESTING SITES).

Principal factors contributing to the listing of these species as endangered, threatened, and/or of special concern include hunting for sport or plumage; habitat loss and degradation; and reduced nesting success due to harmful pesticides. These species include: the eastern brown pelican (*Pelecanus occidentalis carolinensis*), wood stork (*Mycteria americana*), Cuban snowy plover (*Charadrius alexandrinus teniurostris*), American oystercatcher (*Haematopus palliatus*), little blue heron (*Florida caerulea*), snowy egret (*Egretta thula*), tricolor heron (*Hydranassa tricolor*), roseate tern (*Sterna dougallii*), least tern (*Sterna albifrons*), and limpkin (*Aramus guarauns*).

8. SENSITIVE HABITATS

The general region in which the southern bald eagle's active nesting site is located is denoted on the Biological Resources Maps as a sensitive habitat polygon. The map may not represent reality at the time of its publication since animals move from one location to another with time. The data on the maps are from a variety of survey efforts at different times; e.g., animal locations may have been missed; animals may have moved; new ones may have established themselves. Annual surveying is necessary for the State and Federal governments to keep their records up-to-date. This species is discussed in more detail in a previous section, 7.2.6 (OTHER THREATENED AND ENDANGERED ANIMALS, Southern Bald Eagle).

9. APPENDIXES

9.1 APPENDIX A - COMMERCIAL FISHERIES DATA

The catch of the commercial fishery industry for selected fish species in the northwest Florida study area is listed. Washington and Calhoun Counties are inland counties and are not included. Jefferson and Hernando Counties did not have any reported landings and are not included. The reported landings of each fish species are given in pounds as well as the exvessel value in dollars. The data are from Mr. Ernie Snell, National Marine Fisheries Service, Miami, Florida, for the last compiled year (1981).

Species	Landings (lb)	Study area rank	Value ($)	Study area rank	Mean price per lb
Red Drum	457,116	8	102,083	9	0.22
Spotted Seatrout	464,866	7	334,613	5	0.72
Atlantic Croaker	1,117,970	4	379,563	4	0.34
Flounder	175,385	9	103,196	8	0.59
Pompano	26,474	11	64,803	10	2.45
Striped Mullet	7,138,833	1	1,649,147	3	0.23
Menhaden	---	--	---	--	--
Sardines	1,037,598	6	120,585	7	0.12
Grouper & Scamp	2,926,069	2	3,069,725	2	1.05
Jewfish	1,855	13	910	13	0.49
Red Snapper	2,564,250	3	4,871,821	1	1.90
Mangrove Snapper	10,945	12	10,420	12	0.95
King Mackerel	57,376	10	36,879	11	0.64
Spanish Mackerel	1,113,671	5	330,277	6	0.30
Total	17,092,408	--	11,074,022	--	--

APPENDIX A

Species	Escambia County Weight (lb)	Escambia County Value ($)	Santa Rosa County Weight (lb)	Santa Rosa County Value ($)	Okaloosa County Weight (lb)	Okaloosa County Value ($)
Red Drum	9,798	3,646	8,348	3,704	18,427	7,224
Spotted Seatrout	59,656	45,647	37,187	28,341	14,484	11,825
Atlantic Croaker	578,315	194,380	192,037	68,363	206,162	82,045
Flounder	17,341	10,520	1,762	1,431	49,994	25,139
Pompano	1,070	2,442	144	359	4,656	9,884
Striped Mullet	1,541,751	417,961	309,840	84,032	174,360	47,730
Menhaden	*	*	*	*	*	*
Sardines	*	*	*	*	516,112	83,025
Grouper & Scamp	462,296	480,357	1,248	1,529	914,389	986,613
Jewfish	*	*	*	*	802	461
Red Snapper	333,774	627,142	10,577	21,439	145,946	278,920
Mangrove Snapper	294	304	71	104	281	307
King Mackerel	254	98	386	176	18,022	12,215
Spanish Mackerel	209,048	70,556	21,482	7,057	223,635	66,280
Total	3,213,597	1,853,053	583,082	216,535	2,287,280	1,611,668

Species	Walton County Weight (lb)	Walton County Value ($)	Bay County Weight (lb)	Bay County Value ($)	Gulf County Weight (lb)	Gulf County Value ($)
Red Drum	*	*	320,842	36,546	4,653	1,795
Spotted Seatrout	550	546	69,762	50,785	13,877	9,346
Atlantic Croaker	*	*	132,327	32,798	1,577	366
Flounder	325	260	20,665	18,854	7,382	4,367
Pompano	20	45	2,582	7,341	2,553	6,235
Striped Mullet	3,056	2,123	789,401	171,024	328,905	72,327
Menhaden	*	*	*	*	*	*
Sardines	*	*	179,681	13,635	341,650	23,915
Grouper & Scamp	*	*	807,596	823,888	56,412	65,493
Jewfish	*	*	98	49	*	*
Red Snapper	*	*	1,964,366	3,717,087	37,048	75,712
Mangrove Snapper	*	*	6,469	5,628	29	29
King Mackerel	*	*	38,073	24,073	88	44
Spanish Mackerel	22	8	434,183	122,875	219,373	61,613
Total	3,973	2,982	4,766,045	5,024,583	1,013,547	321,212

(continued)

APPENDIX A (Concluded)

Species	Franklin County Weight (lb)	Franklin County Value ($)	Wakulla County Weight (lb)	Wakulla County Value ($)	Taylor County Weight (lb)	Taylor County Value ($)
Red Drum	10,002	3,565	6,241	3,299	11,878	6,825
Spotted Seatrout	50,524	33,354	16,780	13,187	44,912	33,155
Atlantic Croaker	6,292	1,316	1,260	325	*	*
Flounder	68,186	36,929	1,805	1,083	2,242	1,973
Pompano	190	427	*	*	424	1,199
Striped Mullet	658,911	143,955	317,424	81,162	294,793	80,055
Menhaden	*	*	*	*	*	*
Sardines	145	10	*	*	*	*
Grouper & Scamp	593,058	615,656	500	540	*	*
Jewfish	955	400	*	*	*	*
Red Snapper	71,692	149,738	*	*	*	*
Mangrove Snapper	2,679	2,821	*	*	*	*
King Mackerel	506	260	*	*	*	*
Spanish Mackerel	775	228	1,300	325	*	*
Total	1,463,915	988,659	345,310	99,921	354,249	123,207

Species	Dixie County Weight (lb)	Dixie County Value ($)	Levy County Weight (lb)	Levy County Value ($)	Citrus County Weight (lb)	Citrus County Value ($)
Red Drum	25,795	14,127	15,026	6,277	26,106	15,075
Spotted Seatrout	99,129	71,266	18,049	10,706	39,956	26,455
Atlantic Croaker	*	*	*	*	*	*
Flounder	533	279	2,372	1,108	2,788	1,253
Pompano	243	608	8,249	20,618	6,343	15,645
Striped Mullet	504,513	95,505	659,982	114,476	1,555,897	338,797
Menhaden	*	*	*	*	*	*
Sardines	*	*	*	*	*	*
Grouper & Scamp	*	*	53,690	59,250	36,880	36,399
Jewfish	*	*	*	*	*	*
Red Snapper	*	*	847	1,783	*	*
Mangrove Snapper	*	*	582	698	540	529
King Mackerel	33	9	14	4	*	*
Spanish Mackerel	694	1,290	159	45	*	*
Total	630,940	183,084	758,970	214,965	1,668,510	434,153

*Denotes no landings reported.

9.2 APPENDIX B - COLONIAL BIRD NESTING SITE MATRIX

Key to Appendix B, Colonial Bird Nesting Site Matrix.

Colony Number - This is the colony number which appears next to the symbology in the atlas.

Colony Type - The colonies in the atlas are type-classed:

SB = Shorebird
WB = Wading Bird
BP = Brown Pelican

FWS Number - The corresponding colony numbers used by the United States Fish and Wildlife Service and the National Audubon Society for larger or less ephemeral colonies are shown in this column. Information concerning colonies without a corresponding FWS number was gathered largely through personal communication with the National Audubon Society and Florida Audubon Society members as well as other published data.

Species Composition

SB = Shorebirds
- AO - American Oystercatcher
- BS - Black Skimmer
- COT - Common Tern
- LG - Laughing Gull
- LT - Least Tern
- ROT - Royal Tern
- ST - Sandwich Tern
- SP - Snowy Plover
- WP - Wilson's Plover

WB = Wading Birds
- A - Anhinga
- BCNH - Black-crowned Night Heron
- CE - Cattle Egret
- DCC - Double-crested Cormorant
- FSC - Florida Sandhill Crane
- GI - Glossy Ibis
- GBH - Great Blue Heron
- GE - Great Egret
- LB - Least Bittern
- L - Limpkin
- LBH - Little Blue Heron
- LH - Louisiana Heron
- SE - Snowy Egret
- YCNH - Yellow-crowned Night Heron
- WI - White Ibis
- WS - Wood Stork

BP = Brown Pelican

Pensacola Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	SB	BS, LT, SP, WP	
2	SB	LT, SP	
3	SB	LT	
4	SB	LT	
5	SB	LT, SP, WP	
6	WB	GBH	
7	WB	GBH	
8	WB	GBH	
9	WB	GBH	

Bay Minette Base Map

None

Crestview Base Map

None

Fort Walton Beach Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	SB	SP	
2	SB	LT	
3	SB	LT	
4	SB	LT	

Panama City Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	SB, WB, BP	BP, BS, SE, LG, LH	
2	SB	BS	
3	WB	L	
4	SB	BS	
5	SB	BS	
6	SB	BS	

(continued)

APPENDIX B (continued)

Port St. Joe Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	SB, BP	BP, BS, LT, ROT, ST, WP	
2	WB	CE, GBH, GE, LGB, LH, SE	
3	SB	LT	
4	SB	SP	
5	BP	BP	

Bainbridge Base Map

None

Tallahassee Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	BCNH, CE, GBH, GE, LBH, SE	592004
2	SB, WB	LG, CE, GE, LBH, LH, SE	
3	SB, WB	AO, BCNH, CE, GE, LBH, LG, LH, SE	592005
4	WB	GBH, GE	
5	WB	CE, GH, GE	
7	WB	GBH, SE	
8	WB	GE	
9	WB	CE, GE, LBH	592006

Carrabelle Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	SB	BS	
2	SB	BS, LT	
3	WB	A, GBH, GE, LBH	
4	WB	GBH	
5	WB	GEH, GE, WI	
6	WB	GBH	
7	SB	SP	
8	SB	SP	
9	SB	SP	

(continued)

APPENDIX B (continued)

Valdosta Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, GBH, GE, LBH, WI	593004
2	WB	A, GBH	593005

Perry Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, GBH, GE	593010
2	WB	CE	593011
3	WB	FSC	

Cross City Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	A, CE, GE, WI	605014
2	WB	CE, GE	605016

Cedar Keys Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB, BP	BP, BCNH, CE, DCC, GBH, GE, LBH, LH, SE, WI, YCNH	605019
2	WB	WI	

Gainesville Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	CE, GE, LBH, LH, JWI	605015

(continued)

APPENDIX B (concluded)

Ocala Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	A, CE, GBH, GE	
2	WB	CE, GE, LBH	605021
3	WB	A, CE, GBH, GE	605020

Inverness Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB, BP	BCNH, BP, DCC, GBH, GE, LBH, LH, SE, WI, YCNH	611005
2	WB	BCNH, CE, DCC, GBH, GE, LBH, LH, SE, WI, YCNH	61108(2)
3	WB, BP	BP, BCNH, CE, GBH, GE, LBH, LH, SE, WI, WS	611001
4	WB	CE, DCC, GE	611011(2)
5	WB	BCHN, CE, DCC, GBH, GE, LBH, LH, SE, WI	611011(1)
6	SB	AO, BS, LG, LT, ROT, SP, ST	
7	WB	DCC, GBH, GE, SE, WI	61108(1)
8	WB	GBH, GE	611002
9	WB	CE, GE, LBH, LH, SE	611003
10	WB	A, CE, GBH, GE	611004
11	WB	CE, LH	611006
12	WB	CE	611007
13	WB	A, CE, GBH, GE, LBH, LH, SE, WI	611009
14	WB	CE, GE, CBH	611010
15	WB	CE, DCC, GBH, GE, LH, SE	611011(3)
16	WB	CE, GE, LBH, LH	611015
17	WB	CE, LH	611016
18	WB	WS	
19	WB	WS	
20	WB	WS	
21	WB	WS	
22	WB	WS	
23	WB	WS	
24	WB	WS	
25	SB	BS, LG, LT, ROT	
26	WB	BCNH, DCC	

Tarpon Springs Base Map

Colony Number	Colony Type	Species Composition	FWS #
1	WB	BCNH, CE, GBH, GE, LBH, LH, SE	6110k14

9.3 APPENDIX C - SPECIAL STATUS DEFINITIONS FOR PLANT AND ANIMAL SPECIES

9.3.1 U.S. Fish and Wildlife Service:

Endangered: Species in danger of extinction throughout all or a significant portion of their range.

Threatened: Species likely to become endangered within the foreseeable future.

Under Review: (1) species for which the service presently has sufficient information on hand to support listing, (2) species for which further research is necessary to support listing, (3) species no longer being considered for listing.

9.3.2 Florida Game and Fresh Water Fish Commission:

Endangered: Species, subspecies, or isolated population which is resident in Florida during a substantial portion of its life cycle and so few or depleted in number or so restricted in range or habitat due to any artificial or natural factors that it is in immediate danger of extinction or extirpation from the State, or which may attain such a status within the immediate future unless it or its habitat are fully protected and managed in such a way as to enhance its survival potential; or migratory or occasional in Florida and included as endangered on the United States Endangered and Threatened Species List.

Threatened: Species, subspecies, or isolated population which is resident in Florida during a substantial portion of its life cycle and which is acutely vulnerable to environmental alteration, declining in area at a rapid rate due to any artificial or natural factors and as a consequence is destined or very likely to become an endangered species within the foreseeable and predictable future unless appropriate protective measures or management techniques are initiated or maintained; or migratory or occasional in Florida and included as threatened on the United States Endangered and Threatened Species List.

Species of Special Concern: Species, subspecies, or isolated population which warrant special protection, recognition, or consideration because it occurs disjunctly or continuously in Florida and has a unique and significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable and predictable future, may result in its becoming a threatened species unless appropriate protective or management techniques are initiated or maintained; may already meet certain criteria for consideration as a threatened species, but for which conclusive data are limited or lacking; may occupy such an unusually vital and essential ecological niche that should it decline significantly in numbers or distribution other species would be adversely affected to a significant degree; or has not sufficiently recovered from past population depletion.

9.3.3 Florida Department of Agriculture and Consumer Services:

The official Florida list of threatened and endangered plants was prepared by the Division of Plant Industry (Dept. of Agriculture and Consumer Services) for the Florida State Legislature. No criteria are stated for these designations.

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12. GLOSSARY

amphipod - An order of freshwater and marine crustaceans having a laterally compressed body, elongated abdomen, and no carapace.

benthos - Organisms living on the sea or lake bottom.

crustacean - An aquatic arthropod of the class Crustacea characteristically having a segmented body, a chitinous exoskeleton, and paired, jointed limbs. Examples include lobsters, crabs, shrimp, and barnacles.

detritus - Any particulate matter derived from the process of decomposition.

dinoflagellate - Minute, chiefly marine, unicellular algae of the order Dinoflagellata, characteristically having two flagella and a cellulose outer envelope.

endangered species - A plant or animal species in danger of extinction because its habitat has been destroyed or it has been overexploited.

extirpation - Elimination.

gastropod - A mollusk of the class Gastropoda characteristically having a single, usually coiled shell and ventral muscular mass serving as an organ of locomotion. Examples include snails.

hammock - A mound of forested land elevated above the level of a surrounding marsh.

hermaphrodite - An organism having both male and female reproductive organs in the same individual, such as an earthworm.

Holocene - The current geological epoch extending from the end of the last ice age (10,000 years before the present) to the present.

invertebrate - An animal species having no backbone or spinal column.

isopod - An order of small crustaceans in which the body is flattened dorsoventrally and has seven pairs of legs typically alike in size and direction. Examples include sow bugs and gribbles.

metamorphosis - Marked change in the structure of an animal during development, usually in the larval to adult stages. Examples include caterpillars changing into butterflies and tadpoles changing into frogs.

palustrine - Pertaining to any freshwater wetland, such as a marsh, swamp, permanent or intermittent pond, that is nontidal and less than 0.5% saline.

pathogen - Any agent that causes disease. Examples include viruses, bacteria, and fungi.

pelagic - Pertaining to the water column of a sea or lake; refers to organisms living in open oceans or lakes.

phytoplankton - Microscopic plants that float or drift in fresh or salt water.

planktivorous - Feeding on plankton.

protogynous - Pertaining to a hermaphroditic organism which is a functional female first and which changes to a functional male.

rare species - Species found only within a restricted geographic area or habitat or sparsely distributed over a more extensive range.

silvicultural - Pertaining to the management and exploitation of forests.

species of special concern - Species which warrant special attention, because: It may, due to pending degradation or human disturbance, become threatened unless protective management strategies are employed; it cannot be classified as threatened until its status is more fully understood; it occupies such an essential ecological position that its decline might adversely affect associated species; or it has not sufficiently recovered from a past decline in abundance.

substrate - A surface on which a plant or animal grows or is attached.

threatened species - A species whose population is steadily declining and is very likely to become endangered in the near future unless the species or its habitat is fully protected and managed for its survival.

toxin - A poisonous substance, usually having a protein structure, secreted by certain organisms.

SOCIOECONOMIC FEATURES

The northwest Florida region encompasses an area of 11,764 mi^2 (Fernald 1981). Since 1970, Citrus and Hernando Counties have been a retirement mecca and have grown rapidly due to in-migration. The rest of the region has experienced a slow stable growth rate. A demographic profile of the 16 counties in the northwest Florida region is shown in Table 4.

The population of the region according to the 1980 census was 725,779, which is a 33.9% increase in the area's population of 542,033 in 1970 (Fernald 1981). Citrus and Hernando Counties experienced a rapid growth rate of 174.4%. The rest of the region experienced a more stable growth rate of 25.1%. The region has a low minority population and has a relatively low average per capita income. The population pattern in most of the study area is rural. The price level index is slightly below the national average. The principal sources of income in the region are from government income and transfer payments (social security and retirement pensions; Fernald 1981).

Table 4. Selected demographic statistics of northwest Florida counties (Fernald (1981).

Parameter	Escambia	Santa Rosa	Okaloosa	Walton	Washington	Bay	Calhoun	Gulf	Franklin
Land area (mi^2)	665.00	1,032.00	944.00	1,053.00	585.00	747.00	561.00	565.00	536.00
1980 Population	233,794.00	55,988.00	109,920.00	21,300.00	14,509.00	97,740.00	9,294.00	10,658.00	7,661.00
1970 Population	205,334.00	37,741.00	88,187.00	16,087.00	11,453.00	75,283.00	7,624.00	10,096.00	7,065.00
% Population change 1970-80	13.90	48.30	24.60	32.40	26.70	29.80	21.90	5.60	8.40
% In-migration 1970-80	21.50	71.70	36.80	97.50	82.50	62.60	73.50	-0-	53.50
% Black population	19.70	4.50	8.60	9.60	15.70	12.00	12.10	20.10	14.30
% Spanish origin	1.70	1.30	2.30	1.00	0.80	1.60	0.40	1.40	0.90
% ≥65 years old (1979)	8.00	5.90	4.80	3.60	6.00	9.60	14.40	10.80	16.00
Birth rate/1,000 (1980)	17.00	17.20	17.80	13.30	14.90	17.30	17.00	15.00	16.60
Death rate/1,000 (1980)	7.40	6.50	6.00	9.10	10.20	7.90	12.60	7.30	13.60
Population/M.D. (1980)	580.00	1,267.00	1,035.00	2,115.00	2,047.00	953.00	1,531.00	1,302.00	2,510.00
% W/some college (1970-80)	49.00	41.00	59.00	39.00	33.00	33.00	35.00	33.00	32.00
Crime rate/100,000 (1980)	8,696.00	4,325.00	3,203.00	2,435.00	1,842.00	6,414.00	1,285.00	2,976.00	3,240.00
% Mobile homes	5.40	3.90	5.00	3.90	5.50	10.50	4.80	3.90	5.70
Farm sales-1978, $(000)	10,545.00	14,734.00	7,818.00	18,256.00	7,050.00	1,252.00	7,519.00	2,348.00	ND
Bldg. permits-1980, $(000)	110,174.00	27,540.00	64,202.00	20,477.00	5,791.00	67,639.00	418.00	5,915.00	1,720.00
1977 Manufacturing, $(000,000)	1,006.60	167.20	260.00	69.10	4.90	286.80	27.90	139.10	56.60
1977 Wholesale trade, $(000,000)	553.00	51.60	89.80	32.70	18.50	263.90	19.60	5.70	19.00
1977 Retail trade, $(000,000)	772.00	102.00	315.00	35.00	23.00	334.00	21.00	19.00	16.00
Hotel & motel units (1980)	3,383.00	556.00	3,572.00	407.00	64.00	7,770.00	49.00	80.00	247.00
1980 Price level index	95.16	93.08	96.48	96.96	96.49	93.51	93.84	96.73	97.70
1979 Per capita income	6,973.00	6,362.00	6,570.00	5,141.00	5,321.00	6,487.00	4,890.00	6,768.00	3,974.00
% U.S. avg. per capita income	80.00	73.00	75.00	59.00	61.00	74.00	56.00	77.00	45.00
% Change-per capita income 1970-79	125.00	107.00	122.00	156.00	159.00	128.00	148.00	153.00	138.00
% Farm income	ND	0.40	1.10	2.70	7.70	0.10	6.00	1.70	0.00
% Construction income	6.40	3.30	3.90	3.00	4.80	4.60	4.20	19.20	2.40
% Manufacturing income	14.00	9.40	7.10	7.40	2.30	9.10	17.10	38.80	2.90
% Government income	28.70	20.00	43.20	13.80	22.60	25.10	14.60	10.90	21.80
% Dividend-interest income	8.40	8.50	8.80	11.30	9.40	9.90	9.00	7.10	13.40
% Transfer payments income	18.80	16.30	20.00	28.40	25.50	19.90	23.30	16.50	32.00

Table 4. (Concluded).

Parameter	Wakulla	Jefferson	Taylor	Dixie	Levy	Citrus	Hernando	NW Florida
Land area (mi^2)	601.00	605.00	1,051.00	692.00	1,083.00	560.00	484.00	11,764.00
1980 Population	10,887.00	10,703.00	16,532.00	7,751.00	19,870.00	54,703.00	44,469.00	725,779.00
1970 Population	6,308.00	8,778.00	13,641.00	5,480.00	12,756.00	19,196.00	17,004.00	542,033.00
% Population change 1970-80	72.60	21.90	21.20	41.40	55.80	185.00	161.50	48.20
% In-migration 1970-80	88.20	54.80	63.80	79.10	91.70	100.00	100.00	67.30
% Black population	16.40	47.70	21.30	11.60	16.00	3.20	6.20	13.80
% Spanish origin	0.90	0.70	0.80	0.90	1.30	1.40	1.90	1.20
% ≥65 years old (1979)	5.90	12.40	4.60	11.20	14.90	31.60	24.20	10.90
Birth rate/1,000 (1980)	16.10	17.30	15.80	15.60	14.60	9.70	10.50	15.90
Death rate/1,000 (1980)	7.30	7.80	10.00	11.20	10.10	14.60	13.60	9.70
Population/M.D. (1980)	2,674.00	2,618.00	1,208.00	ND	1,761.00	1,155.00	1,686.00	1,629.00
% W/some college (1970-80)	25.00	27.00	42.00	22.00	31.00	22.00	50.00	35.80
Crime rate/100,000 (1980)	1,112.00	1,184.00	3,176.00	2,227.00	4,357.00	4,415.00	4,744.00	3,477.00
% Mobile homes	12.60	4.50	6.70	4.10	10.10	12.20	22.70	7.60
Farm sales-1978, $(000)	1,221.00	18,130.00	2,384.00	1,867.00	12,350.00	5,344.00	24,535.00	127,350.00
Bldg. permits-1980, $(000)	4,810.00	3,758.00	6,383.00	1,091.00	10,609.00	897,784.00	77,434.00	1,305,744.00
1977 Manufacturing, $(000,000)	20.00	2.00	163.70	19.10	20.60	13.50	18.50	2,276.80
1977 Wholesale trade, $(000,000)	28.40	10.90	18.50	5.80	13.80	16.40	25.10	276.80
1977 Retail trade, $(000,000)	10.00	18.00	47.00	13.00	40.00	100.00	83.00	1,948.00
Hotel & motel units (1980)	174.00	130.00	514.00	139.00	373.00	690.00	500.00	18,648.00
1980 Price level index	96.65	95.10	92.66	93.07	94.82	95.62	95.72	95.23
1979 Per capita income	5,055.00	5,552.00	6,498.00	4,504.00	5,552.00	5,823.00	6,649.00	5,146.00
% U.S. avg. per capita income	58.00	63.00	74.00	51.00	63.00	66.00	76.00	65.70
% Change-per capita income 1970-79	138.00	157.00	134.00	117.00	117.00	133.00	140.00	135.80
% Farm income	1.40	19.00	1.50	2.70	9.10	1.00	7.90	4.20
% Construction income	2.70	3.90	7.30	5.90	5.70	6.80	3.30	5.50
% Manufacturing income	20.80	5.70	40.00	14.90	11.40	1.10	3.70	12.90
% Government income	12.70	10.50	11.00	23.80	11.30	6.60	10.30	17.90
% Dividend-interest income	9.90	9.40	8.10	8.40	12.90	24.10	16.70	11.00
% Transfer payments income	20.20	18.70	18.10	24.10	21.50	32.90	26.00	22.60

1. NATIONAL LANDS

1.1 NATIONAL WILDERNESS AREAS

Four national wilderness areas, comprising some 64,763 acres, are located in northwest Florida. The wilderness areas are managed by the U.S. Fish and Wildlife Service.

National wilderness areas have been created by Congress to set aside in permanent preserves, wilderness areas, which will be forever off-limits to incompatible human activities. Table 5 (Florida Department of Natural Resources, April 1981) describes the location, acreage, and year designated as a wilderness area for National wilderness areas located in northwest Florida.

1.2 NATIONAL WILDLIFE REFUGES

The U.S. Fish and Wildlife Service manages four wildlife refuges in northwest Florida consisting of over 90,000 acres (Florida Department of Transportation 1982). Most of the wildlife refuges are limited-purpose outdoor recreation areas designed for nature study, natural scenery appreciation, photography, hiking and picnicking. The location, acreage, endangered wildlife, and nesting bird colonies for the four wildlife refuges in northwest Florida are shown in Table 6.

1.3 NATIONAL MARINE AND ESTUARINE SANCTUARIES

The Apalachicola National Estuarine Sanctuary, established in November of 1980, is the only national estuarine sanctuary located in the study area. There are no national marine sanctuaries located in the study area.

The National Estuarine Sanctuary Program was created by Congress in 1972 as part of the 1972 Coastal Zone Management Act. The Apalachicola National Estuarine Sanctuary is the largest of 15 existing national estuarine sanctuaries. The sanctuary is located in Franklin and Gulf Counties and encompasses an area of 180,159 acres (135,680 acres are submerged lands). The sanctuary is composed of the Apalachicola River and its floodplains, fresh and saltwater marshes, open water, and barrier island habitats. Located within the sanctuary are 116 species of plants, over 250 bird species, over 100 fish species, and the highest species density of reptiles and amphibians in North America excluding Mexico (Florida Department of Natural Resources undated).

Table 5. National wilderness areas (Florida Department of Transportation 1982; Florida Department of Natural Resources 1981).

National Wilderness	Location	Acreage	Year designated
Bradwell Bay	Wakulla Co.	23,432	1974
Cedar Key	Levy Co.	375	1972
Chassahowitzka	Hernando Co. Citrus Co.	23,606	1976
St. Marks	Wakulla Co. Jefferson Co.	17,350	1974

Table 6. National wildlife refuges (Florida Department of Transportation 1982; Kale 1978; Layne 1978; McDiarmid 1978).

Name	County	Acreage	Endangered wildlife	Nesting bird colonies
Pig Island Unit, St. Vincent Island NWR	Gulf	50	Brown pelican Red-cockaded woodpecker	Brown pelican Laughing gull Royal tern Sandwich tern Black skimmer Common tern
St. Vincent Island	Franklin	12,000	W. Indian manatee Bald eagle Red-cockaded woodpecker American alligator Sea turtles	Great egret Snowy egret Tricolor heron Little blue heron Great blue heron Cattle egret
St. Marks	Wakulla Jefferson Taylor	64,012	W. Indian manatee Bald eagle Red-cockaded woodpecker American alligator	Great egret Little blue heron Snowy egret Cattle egret Black-crowned night heron Great blue heron
Lower Suwannee	Taylor Dixie	N/A	W. Indian manatee Bald eagle Red-cockaded woodpecker American alligator	Great egret Cattle egret Great blue heron Yellow-crowned night heron Little blue heron Black-crowned night heron

(continued)

Table 6 (concluded)

Name	County	Acreage	Endangered wildlife	Nesting bird colonies
Cedar Key	Levy	379	W. Indian manatee Bald eagle Brown pelican Red-cockaded woodpecker American alligator	Brown pelican Double-crested cormorant White ibis Great egret Great blue heron Cattle egret Tricolor heron Snowy egret
Crystal River	Citrus	N/A	W. Indian manatee Bald eagle Brown pelican Red-cockaded woodpecker American alligator	Wood stork Great egret Great blue heron Tricolor heron Little blue heron Snowy egret Black-crowned night heron White ibis
Chassahowitzka	Citrus Hernando	12,690	W. Indian manatee Bald eagle Brown pelican Red-cockaded woodpecker American alligator	Great egret Snowy egret Cattle egret Great blue heron Black-crowned night heron Double-crested cormorant Tricolor heron White ibis

1.4 MILITARY LANDS

Three large military bases are located in the northwest Florida study area: Tyndall Air Force Base, Eglin Air Force Base, and the Pensacola Naval Air Station. Tyndall Air Force Base is located on 28,000 acres of land in Bay County. Tyndall Air Force Base employs 4,000 military personnel and 1,200 civilian personnel. Eglin Air Force Base is located on 463,360 acres of land in the counties of Santa Rosa, Okaloosa, and Walton. Eglin Air Force Base employs 9,806 military personnel and 4,377 civilian personnel (personal communication with public affairs offices of Tyndall and Eglin Air Force Bases 1983). The Pensacola Naval Air Station operates four airfields in the greater Pensacola area employing 17,022 military and 12,954 civilian personnel (personal communication with public affairs office of Pensacola Naval Air Station 1984). In addition, the U.S. Navy operates a coastal systems laboratory at Panama City Beach.

1.5 NATIONAL SEASHORES

Gulf Islands National Seashore is the only National Seashore located in the study area. It covers 150 mi of barrier island beaches stretching from Destin, Florida, to Ship Island off Gulfport, Mississippi. The entire seashore encompasses an area of 135,000 acres. The Florida portion of the seashore includes a portion of the Perdido Key and all of Santa Rosa Island. The National Seashore is maintained by the U.S. Park Service. The National Seashore was created by Congress to preserve the unique natural coastal barrier island strip located in Escambia, Santa Rosa, and Okaloosa Counties of the Florida panhandle. The clean, white quartz sand beaches and coastal dunes form a unique natural barrier island strip in this region (American Automobile Association 1984).

2. STATE PARKS, RECREATION AREAS, WILDERNESS AREAS, AND WILDLIFE MANAGEMENT AREAS

2.1 STATE PARKS

Florida's State park system was created by the Florida Legislature to preserve and maintain a natural environment with a full program of compatible recreational activities. There are six State parks located within the northwest Florida region. These are listed in Table 7 (Florida Department of Natural Resources 1981).

2.2 STATE RECREATION AREAS

There are eight State recreation areas located in northwest Florida. State recreation areas provide more active recreation facilities than do State parks. They need not be of any special size or located in any special location. They need only be located convenient to population centers. The sizes and locations are shown in Table 8 (Florida Department of Natural Resources 1981).

2.3 STATE WILDERNESS AREAS

The Florida Wilderness System Act (Section 258.17, Florida Statutes, see Addendum 3) established two State wilderness areas in northwest Florida. Audubon Island is a small wilderness area located west of Panama City in St. Andrew Bay in Bay County and was approved on June 17, 1975. Halliman Island is a small wilderness area located west of Port St. Joe in Gulf County and was approved on June 17, 1975.

2.4 STATE WILDLIFE MANAGEMENT AREAS

The Florida Game and Fresh Water Fish Commission manages 15 state wildlife management areas in northwest Florida. An active habitat improvement program, including controlled burning, water fowl impoundments, and hardwood tree planting is maintained by the Florida Game and Fresh Water Fish Commission. Table 9 describes the location, acreage, endangered wildlife, and nesting bird colonies (Fernald 1981).

Table 7. Florida State parks (Florida Department of Natural Resources 1981; American Automobile Association 1984).

Parameter	Blackwater River State Park	T.H. Stone Memorial St. Joseph Peninsula State Park	Dr. Julian G. Bruce St. George Island State Park	Ochlockonee River State Park	Manatee Springs State Park	Fort Cooper State Park
County	Santa Rosa	Gulf	Franklin	Wakulla	Levy	Citrus
Size (acres)	360	2,516	1,963	392	2,075	549

Table 8. Florida State recreation areas (Florida Department of Natural Resources 1981; Florida Department of Transportation 1982; American Automobile Association 1984).

Parameter	Big Lagoon	Fred Gannon Rocky Bayou	Basin Bayou	Grayton Beach	Saint Andrews	Dead Lakes	Falling Waters	Lake Rousseau
County	Escambia	Okaloosa	Walton	Walton	Bay	Gulf	Washington	Citrus, Levy Marion
Size (acres)	699	357	287	350	1,063	66	156	3,624

Table 9. State wildlife management areas (Florida Department of Transportation 1982, Kale 1978; Layne 1978; McDiarmid 1978).

Wildlife management areas	County	Acreage	Endangered or threatened wildlife	Nesting bird colonies
La Floresta Perdida	Escambia	32,000		Least tern Snowy Plover
St. Regis	Escambia	21,000		Least tern Snowy plover
Blackwater	Santa Rosa Okaloosa	183,000		No data
Eglin	Santa Rosa Okaloosa Walton	463,360	Okaloosa darter	No data
Pt. Washington	Walton Bay	165,000		No data
Edward Ball	Gulf	65,000		No data
G.U. Parker	Gulf	22,160		No data
Apalachicola	Franklin Wakulla	558,000	Red-cockaded woodpecker	No data
Aucilla	Wakulla Taylor Jefferson	167,000	Bald eagle Red-cockaded woodpecker	Great blue heron Cattle egret Great egret

(continued)

Table 9 (concluded)

Wildlife management areas	County	Acreage	Endangered or threatened wildlife	Nesting bird colonies
Tide Swamp	Taylor	20,000		No data
Steinhatchee	Dixie	408,000		Cattle egret Great egret
Gulf Hammock	Levy	29,600	Bald eagle Brown pelican	Anhinga Great blue heron Cattle egret Great egret
Citrus	Citrus	41,000	Bald eagle Red-cockaded woodpecker	Cattle egret Tricolor heron Anhinga Great blue heron Great egret
Croom	Hernando	21,500	Bald eagle	Little blue heron Cattle egret Great egret
Richloam	Hernando	56,000	Bald eagle	Little blue heron Cattle egret Great egret

3. STATE AQUATIC PRESERVES

Thirty-one aquatic preserves were established by the Florida Aquatic Preserve Act of 1975 (Section 258.35 Florida Statutes) in the coastal waters of Florida (Florida Department of Natural Resources 1981). Four others were established under separate acts (Sections 258.16, 258.165, 258.391, and 258.392, Florida Statutes). Eight aquatic preserves are located within the northwest Florida study region (Allender 1982).

Florida's aquatic preserve system is regulated by the Florida Department of Natural Resources. Private submerged lands located within an aquatic preserve area are managed as part of the preserve, provided the private landowner contracts with the State of Florida for the donation or lease of his property to the State. Aquatic preserves have been established to preserve State-owned submerged lands in areas having exceptional biological, aesthetic, and scientific value (Florida Department of Natural Resources 1981).

4. CONSERVATION LANDS (STATE-OWNED)

In 1979, the Florida Legislature established the Conservation and Recreation Lands (CARL) Trust Fund (Section 253.023, Florida Statutes) to provide a means of acquiring and managing environmentally endangered lands and other lands for recreation, water management, and preservation of significant archaeological and historical sites. The fund combines $27 million remaining from the $240 million authorized by the Land Conservation Act of 1972 with a portion of the annual revenues obtained from severence taxes on solid minerals and liquid fuels. Since 1982, $20 million has been allocated each year for land acquisition. The areas to be purchased are selected by a committee. The Governor and Cabinet, acting as the Board of Trustees of The Internal Trust Fund, then selects specific parcels for actual purchase from this selection list. The program is administered by the Florida Department of Natural Rėsources. A list of lands purchased under the Land Conservation Act of 1972 and under the new CARL Program established in 1979 is given in Table 10 (Florida Department of Natural Resources 1981).

The "Save Our Coast" program was initiated by Florida Governor Bob Graham in September 1981. The program provides for $200 million in revenue bonds for purchase of selected coastal areas for preservation of which $75 million has been spent to date. The State supplies 80% of the moneys for purchase of coastal lands under this program with the counties supplying the other 20%. The program is administered by the Florida Department of Natural Resources (personal communication with Estes Whitfield 1984).

The "Save Our Rivers" program was adopted by the Florida Legislature on May 29, 1981. It provides for a 10-year $.05/100 increase in the documentary stamp tax. It is anticipated that this will create a $350 million dollar water management land acquisition trust fund which is managed by the Florida Department of Environmental Regulation. Moneys from this fund are allocated to the various State water management district offices for purchase of river front properties to preserve floodplain and watershed recharge areas. The trust fund supplies 80% of the purchase funds with the water management districts providing the other 20% (personal communication with Estes Whitfield 1984).

Table 10. Conservation lands (Florida Department of Natural Resources 1981).

Lands purchased under Land Conservation Act of 1972	Proposed lands to be purchased under 1979 CARL Program	County
Lower Apalachicola River Basin		Franklin, Gulf
Little St. George Island		Franklin
Cedar Key Scrub		Levy
Perdido Key		Escambia
Withlacoochee Tract		Citrus
	Escambia Bay Bluffs	Escambia
	Shell Island	Bay
	Williams Tract	Citrus

5. RECREATION LANDS

All recreation areas greater than or equal to 25 acres are plotted on the individual atlas overlays. The location and size of each recreation area are given in Table 11. Recreation areas are provided by the State of Florida, as well as the local county and municipal governments, to meet the recreational needs of their citizens. The State Division of Recreation and Parks has established criteria for evaluating the recreational needs of its citizens. Their recommendations are shown in Table 12.

Table 11. Northwest Florida recreation areas greater than or equal to 25 acres (Florida Department of Transportation 1982).

Name	County	Acreage
Big Lagoon State Recreation Area	Escambia	574.00
Ashton Brosnaham Recreation Center	Escambia	109.04
Osceola Golf Course	Escambia	139.00
Navy Point	Escambia	60.00
Scott Tennis Center	Escambia	40.00
Bayview Park	Escambia	28.00
Blackwater River St. Forest Area	Santa Rosa	122,083.00
Shoreline Park	Santa Rosa	153.33
Round Pin Recreation Site	Santa Rosa	26.00
Fred Gannon Rocky Bayou State Recreation Area	Okaloosa	632.27
Twin Hills Park	Okaloosa	28.40
Round Pin Recreation Site	Okaloosa	55.00
Newman Bracken Beach Park	Okaloosa	40.00
City Recreational Complex	Okaloosa	44.00
Municipal Golf Course	Okaloosa	80.00
Blackwater River St. Forest Area	Okaloosa	60,828.00
Chipley Park	Walton	40.00
Grayton Beach State Recreation Area	Walton	356.00
Falling Waters State Rec. Area	Washington	156.10
Pine Log State Forest Area	Bay	5,199.00
Oakland Terrace Park	Bay	28.00
Panama City Marina	Bay	25.00
St. Andrews State Recreation Area	Bay	1,062.70
S.B. Atkins Park	Calhoun	160.00

(continued)

Table 11 (concluded)

Name	County	Acreage
Sunland Recreational Park	Gulf	100.00
Dead Lakes State Recreation Area	Gulf	41.30
None	Franklin	
St. Marks	Wakulla	NA*
None	Jefferson	
None	Taylor	
None	Dixie	
Lake Rousseau State Recreation Area	Levy	1,243.00
Withlacoochee Park	Levy	47.00
Undeveloped County Area	Levy	477.00
Wekiva County Pier	Levy	100.00
Lake Rouathlikaha State Rec. Area	Citrus	707.83
Withlacoochee State Forest Area	Citrus	40,726.07
Lake Rousseau State Recreation Area	Citrus	3,623.80
Withlacoochee State Forest - Citrus Hunt Camp	Citrus	100.00
Withlacoochee State Forest - Mutual Mine Recreation Area	Citrus	100.00
Whispering Pines Park	Citrus	320.00
Withlacoochee St. Forest Area - Kennedy Park	Hernando	31,064.19
Eden Christian School	Hernando	26.00
Weeki Wachee Springs	Hernando	135.00
Heather Golf/Tennis Club	Hernando	400.00
Hernando Beach Club	Hernando	80.00
Chinsegut Hill	Hernando	NA*
Pine Log State Forest	Washington	1,711.88
Basin Bayou State Recreation Area	Walton	287.00

* NA - not available

Table 12. State of Florida - Division of Recreation and Parks user guidelines for resource-based outdoor recreation (Florida Department of Natural Resources 1981).

Activity	Resource/facility	Guidelines	Population served per resource/facility unit
Swimming (nonpool) freshwater or saltwater	Freshwater or saltwater beach	2.5 linear ft. of beach/ user/day	1 linear mi/25,000
Saltwater beach activities (sunbathing, snelling, etc.)	Saltwater beach area	100 sq. ft. of beach/user/ day	1 mi^2/50,000
Camping (RV/trailer and tent)	Designated camp site	4 users/site/ day	1 acre/25,000
Picnicking	Picnic tables	8 users/table/ day	1 acre/25,000
Fishing, power boating, water skiing, sailing freshwater or saltwater	Boat ramps	160 users/ single lane ramp/day	1 ramp/5,000
Fishing (nonboat) freshwater or saltwater	Piers, Catwalks and shoreline	6 linear feet of facility/ user/day	1 pier or catwalk/ 5,000
Visiting archaeological/ historical sites	Archaeological/ historical sites	384 users/site/ day	N/A
Hiking	Hiking trails	1 mile of trail/ 125 users/day	1 mi/10,000
Nature study	Nature trails	1 mile of trail/ 250 users/day	1 mi/10,000
Bicycling	Bicycle trails	1 mile of trail/ 261 users/day	1 mi/15,000
Horseback riding	Horseback riding trails	1 mile of trail/ 80 users/day	1 mi/20,000
Hunting	Hunting land	21 acres/user/ day	5,500 acres/ 10,000

6. ACCESS POINTS TO INTENSIVELY USED RECREATIONAL BEACHES

Florida's northwest coast contains 905,450 linear ft (171.5 mi) of intensively used recreational beaches. The recreational beaches are composed of white quartz sand and are located from Perdido Key through St. George Island. Access points to these recreational beaches are plotted on the atlas maps. The linear feet of recreational beach coastline by county is found in Table 13 (Henningsen and Salmon 1981).

Table 13. Recreational beach coastline by county (Henningsen and Salmon 1981).

County	Recreational beach coastline (linear ft)
Escambia	208,000
Santa Rosa	71,900
Okaloosa	74,200
Walton	125,700
Washington	-0-
Bay	158,650
Calhoun	-0-
Gulf	138,500
Franklin	128,500
Wakulla	-0-
Jefferson	-0-
Taylor	-0-
Dixie	-0-
Levy	-0-
Citrus	-0-
Hernando	-0-
Total	905,450

7. MARINAS

Northwest Florida is renowned for both its fresh and saltwater fishing. A summary of marinas by county is shown in Table 14. Individual marinas are numbered by county on the atlas maps and their names listed in Table 15.

Table 14. Marinas by county (Waterway Guide, Inc. 1982; Rao et al. 1980)

County	No. of marinas
Escambia	14
Santa Rosa	7
Okaloosa	16
Walton	5
Washington	2
Bay	28
Calhoun	3
Gulf	8
Franklin	12
Wakulla	8
Jefferson	0
Taylor	9
Dixie	6
Levy	8
Citrus	26
Hernando	8
Total	160

Table 15. Marinas in northwest Florida (Waterway Guide, Inc. 1982; Rao et al. 1980).

County	Number on map	Name	Number on map	Name
Escambia	1	Holiday Harbor Marina	8	Pensacola Bahia Mar, Inc.
	2	Shelter Cove Marina	9	Pensacola Yacht Club
	3	Southwind Marina	10	Smith's Fish Camp
	4	Rod and Reel Marina	11	Pensacola Municipal Docks
	5	Bell Marine Service	12	Rooks Marina
	6	Brown's Marina	13	The Marina
	7	Nautical Specialties Marina	14	The Marina and Restaurant
Santa Rosa	1	Chumuckla Springs Fishing Lodge	5	Brown's Fish Camp
	2	Jim's Fish Camp	6	Redbeard's Restaurant and Marina
	3	Pier One Marine, Inc.		
	4	Nichol's Seafood Restaurant and Marina	7	Garner's Landing
Okaloosa	1	Fort Walton Yacht Basin	9	Marina Point
	2	The Boat Marine Supply	10	Deckhands Marine
	3	The Boat	11	Shalimar Yacht Basin
	4	Herb's Exxon	12	Destin Marina
	5	Sound Marina	13	East Pass Marina
	6	Aquatic Enterprises	14	Marlborough Marina
	7	Hudson Marina	15	Robroy Lodge and Marina
	8	Mohl's Marina, Inc.	16	Bluewater Bay Marina
Walton	1	Juniper Lake Fish Camp	4	Smokehouse Lake Fishing
	2	Black Creek Lodge, Inc.	5	Dulls Marine-o-rama
	3	Old Cowford		
Washington	1	Hide-a-while	2	Miller's Ferry
Bay	1	Grand Lagoon Marine Services	6	Panama City Boatyard
	2	Holiday Lodge and Marina	7	Passport Marina
	3	Val's Bayside Marina, Inc.	8	Sun Harbor Lodge & Marina
	4	Port Lagoon Yacht Basin	9	Sun Harbor Lodge & Marina
	5	Treasure Island Marina	10	A-1 Marine, Inc.

(continued)

Table 15 (continued)

County	Number on map	Name	Number on map	Name
Bay	11	Bay Point Yacht and Country Club Resort	20	Gibb's Marine Services
			21	Harby Marina, Inc.
	12	Sea School	22	Gulf Marina
	13	Smith's Yacht Basin	23	Thomas' Deer Point Dam Bait and Tackle
	14	St. Andrews Marina		
	15	The Sailor's Supply Co.	24	Cedar Creed Bait Ranch
	16	Panama City Marina Services	25	Pier 98 Marina
	17	Panama City Marina	26	Tharp's Camp Cedar
	18	Etheridge Marina	27	Cherokee Landing
	19	Bay Marine and Propeller	28	Cox Fish Camp
Calhoun	1	Tucker's Bait and Grocery	3	Blountstown Marina
	2	Bailey's Fish Camp		
Gulf	1	Lake Side Lodge	6	Cypress Lodge
	2	Sign of the Shiner	7	The Little Motel and Camp Grounds
	3	Magnolia Fish Camp		
	4	Gate's Fish Camp	8	Lake Grove Lodge
	5	Hall's Fish Camp		
Franklin	1	Big Oaks Resort and Marina	7	Apalachicola Municipal Marina
	2	Breakaway Lodge, Inc.	8	Apalachi Marine Works
	3	Bay City Lodge	9	Sportsmen's Lodge
	4	Gulf Oil Dock	10	Carabelle Marina
	5	Rainbow Marina and Motel	11	Gulf Oil Dock
	6	Randolf Marine, Inc.	12	Alligator Point Marina
Wakulla	1	Jack Langston's Place	5	Shell Point Marina
	2	Ted Robert's and Son	6	Shell Island
	3	Bayside Marina	7	Shield's Marina, Inc.
	4	Bud's Marina and Fishcamp	8	Riverside Marina

(continued)

Table 15 (concluded)

County	Number on map	Name	Number on map	Name
Jefferson		None		
Taylor	1	Spring Warrior Fish Camp	6	Ideal Fish Camp
	2	Keaton Beach Marina	7	Misty Water's Marina
	3	West Wind Fish Camp	8	Sportsman's Marina
	4	Palm Grove Lodge	9	Pat Johnson's Fishcamp
	5	Pace's Fishing Camp		
Dixie	1	Horseshoe Marina	4	Moore's Suwannee Marina
	2	The Tackle Shop	5	Suwannee Shores
	3	Jon's Marina, Inc.	6	Bill Miller's Marine
Levy	1	Treasure Camp	5	Buddy's Fish Camp
	2	Waccasassa Marina & Fish Camp	6	Fin and Feather Camp
	3	Cedar Municipal Dock	7	Yankeetown Boat Co., Inc.
	4	Chevron Gas Dock	8	Cypress Marina and Campground
Citrus	1	Lake Rousseau Fish Camp	14	Cypress Lodge
	2	Turner Camp	15	Boat Basin Lodge
	3	Watson's Camp	16	Nature's Campground
	4	Idlewild Fish Camp	17	Harrison's Resort
	5	Brown's Blue Crab	18	Three Rivers Marina, Inc.
	6	Knox Bait house	19	Tradewinds Marina
	7	King's Bay Fishing Village	20	Riverside Villas and Motel
	8	Twin Rivers Marina	21	Riverhouse Marina
	9	Lewis Fish Marina	22	Macrae Bait House
	10	Pete's Pier	23	Moonrise Resort
	11	Port Paradise Resort	24	Trails End Camp
	12	Plantation Wharf	25	Chassahowitzka River Lodge
	13	Aloha Lodge	26	Lyke's Fish Camp
Hernando	1	Peterson's Fish Camp	6	Hernando Beach Marina
	2	Dick's Fish Camp	7	J.L. Welbourn Boat Livery
	3	Mary's Fish Camp		
	4	Weeki Wachee Marina	8	Mark Conner's Fish Camp
	5	Lindy's Marina		

8. CHARTER AND HEAD BOAT LOCATIONS

Charter boats are boats that can be rented (chartered) for a specified period. Head boats are large party boats that go fishing offshore in the Gulf of Mexico or Florida Straits for a specified period (usually 0.5 day, 1 day, or 2 days) and charge a dollar fee per person (head). Base locations of charter and head boats are mapped on the individual atlas overlays. A list of the principal ports of call for charter and head boats is shown in Table 16.

Table 16. Charter and head boat principal ports of call (Schmied 1982; Waterway Guide, Inc. 1982).

County	Port of call	Charter boats (no.)	Head boats (no.)
Escambia	Pensacola Beach	5	0
Santa Rosa	Gulf Breeze	5	0
Okaloosa	Destin Harbor	51	4
	Ft. Walton Beach Harbor	4	0
	Shalimar Harbor	3	0
	Santa Rosa Beach	2	0
Walton		0	0
Bay	Panama City	73	7
	Mexico Beach	6	0
Washington		0	0
Calhoun		0	0
Franklin		0	0
Wakulla	St. Marks	2	0
Jefferson		0	0
Taylor	Steinhatchee	1	0
Dixie		0	0
Levy		0	0
Citrus		4	0
Hernando		0	0
Total		156	11

9. PUBLIC BOAT RAMPS

The distribution of public boat ramps in northwest Florida is shown in Table 17. Most of the public boat ramps are centered in the high density urban areas.

Table 17. Total number of public boat ramps by county in northwest Florida (Florida Game and Fresh Water Fish Commission 1982a; Florida Game and Fresh Water Fish Commission 1982b; Schmied 1982; Florida Game and Fresh Water Fish Commission 1979).

County	No. boat ramps
Escambia	12
Santa Rosa	4
Okaloosa	8
Walton	10
Washington	17
Bay	14
Calhoun	11
Gulf	17
Franklin	17
Wakulla	14
Jefferson	4
Taylor	6
Dixie	13
Levy	5
Citrus	16
Hernando	8
Total	176

10. FLORIDA CANOE TRAIL SYSTEM

The National Wild and Scenic Rivers Act of 1968 (16 U.S. Code 1271) establishes a national system for the identification and preservation of wild and scenic rivers. In accordance with this act, the Bureau of Outdoor Recreation (precursor of the Heritage Conservation and Recreation Service) forwarded a detailed study to the President recommending the Suwannee River (in northern Florida) to be formally declared a National Wild and Scenic River. No formal action has been taken on this measure. In 1975, the Florida Bureau of Outdoor Recreation recommended that portions of the Waccassa and Withlacoochee Rivers in northwest Florida be placed on the list of possible rivers to be declared National Wild and Scenic Rivers.

The Florida Scenic and Wild Rivers Program was established by the Executive Board of the Department of Natural Resources in January of 1972 and revised in June of 1978. It is designed to preserve the aesthetic and wilderness qualities of exceptional rivers in Florida. Wild rivers are those which merit protection and preservation of their wilderness qualities (to prevent human development on their shorelines). Scenic rivers are rivers whose scenic or aesthetic characters merit their preservation and inclusion within the program.

The Florida Recreational Trails Act of 1979 (Chapter 260, Florida Statutes) establishes a system of canoe trails for recreational boating in Florida. Table 18 lists the canoe trails present in northwest Florida. The trails are mapped on the individual atlas overlays (Florida Department of Natural Resources 1981).

Table 18. Canoe trails in northwest Florida (Florida Department of Natural Resources 1981).

Canoe trail	County
Perdido River	Escambia
Coldwater Creek	Santa Rosa
Sweetwater/Juniper Creeks	Santa Rosa
Blackwater River	Santa Rosa
Yellow River	Santa Rosa
Blackwater River	Okaloosa
Yellow River	Okaloosa
Shoal River	Okaloosa
Shoal River	Walton
Chipola River	Calhoun
Econfina Creek	Bay
Ochlockonee River	Franklin
Ochlockonee River	Franklin
Ochlockonee River	Wakulla
Sopchoppy River	Wakulla
Wakulla River	Wakulla
Ochlockonee River	Wakulla
Lost Creek	Wakulla
Shoal River	Wakulla
Econfina Creek	Wakulla
Holmes Creek	Washington
Aucilla River	Jefferson
Aucilla River	Taylor
Withlacoochee River	Citrus
Withlacoochee River	Hernando
Wacissa River	Jefferson

11. MAJOR PUBLIC FISHING PIERS

There are 14 major public fishing piers located in northwest Florida (Aska 1983). These are described in Table 19.

Table 19. Major public piers (Aska 1983).

No. on map	Pier name	Pier address	County	Daily charge ($)	Operating hours	Length (ft)	Max. water depth	Construct. material	Year built	Capa-city
1	Pensacola Beach Fishing Pier	Ft. Pickens Road, Pensacola Beach	Escambia	3.00	5AM-6PM 24 hr (summer)	800	20	Wood	1979	600
2	Pensacola Bay Fishing Pier	17th Ave., Pensacola	Escambia	0.25	7AM-9PM	2,640	--	Concrete	1935	---
3	Municipal Auditorium	Palofax Street, Pensacola	Escambia	None	24 hr	100	30	Concrete	1982	500
4	Navarre Beach Fishing Pier	8525 Gulf Blvd., Gulf Breeze	Escambia	4.00	6AM-Sunset	1,200	30	Concrete	1969	---
5	Ft. Pickens Fishing Pier	Gulf Breeze	Escambia	None	24 hr	200	30	Wood	1980	100
6	Sound Fishing Pier	Cantonment	Santa Rosa	None	24 hr	1,452	--	Concrete	1953	---
7	Okaloosa Island Pier	U.S. Hwy 98 East, Ft. Walton Beach	Okaloosa	2.50	6-6 May-Oct 24 hr: May-Nov	1,261	20	Concrete	1972	500
8	Mexico Beach Pier	Mexico Beach	Bay	None	24 hr	385	10	Wood	1956	300
9	The Dan Russel Pier	110 S. Arnold Road, Panama City	Bay	2.00	6-6 Sep-May 24 hr: Jun-Aug	1,455	18	Wood, steel, concrete	1977	---
10	County Pier	12217 US Hwy 98, Panama City	Bay	None	6AM-11PM	600	20	Wood, concrete	1968	300
11	Bay County Public Pier	517 East 9th St., Panama City	Bay	None	24 hr	568	15	Wood	1960	50
12	Lafayette Park Pier	Apalachicola	Franklin	None	24 hr	1,000	20	Wood	1981	---
13	Battery Park Pier	Apalachicola	Franklin	None	24 hr	120	20	Wood	1980	---
14	Cedar Key Dock	Cedar Key	Levy	None	24 hr	100	15	Wood	---	150

12. ARTIFICIAL REEFS

The artificial reefs program of the State of Florida is administered by the Bureau of Marine Science and Technology under Section 370.013 of the Florida Statutes. Approximately $110,000 in grants were awarded in 1979 and 1980, which were the first two years of the newly adopted program. The principal types of fish that inhabit the artificial reefs located in the northwest Florida study area coastal waters are grouper, snapper, Spanish mackerel, and amberjacks. A list of artificial reefs keyed by number on the atlas overlays is shown in Table 20 (Florida Department of Natural Resources 1981).

Florida's coastal waters contain more artificial reefs than any other State (Seaman 1982). Scientific development and deployment of artificial reefs have been slow with little research and scanty funding. Without considerable volunteer effort to secure materials and free labor, many of the present artificial reefs off northwest Florida would not exist.

Virtually all artificial reefs in Florida are composed of either ships, automobiles, tires or concrete. New, prefabricated artificial reefs are being introduced in Florida by the Japanese (off Ft. Lauderdale, Panama City, and Jacksonville) under contract with the National Marine Fisheries Service.

Panama City's artificial reef program began officially in July of 1978 and is run by the Panama City Marine Institute. Nine reefs are scheduled to be completed by the institute. The Institute operates its own 100-ft barge and a 61-ft tugboat that was donated by the Belcher Oil Company of Miami (Panama City Marine Institute 1983).

Table 20. Artificial reefs (U.S. Army Corps of Engineers 1981; Florida Sea Grant College 1979)

Number on map	Composition	Latitude	Longitude	Depth (ft)	Miles offshore
1	Polypropylene Plastic Strips	30°16'54"	87°25'36"	20	0.9
2	USS Battleship Massachusetts	30°17'08"	87°18'07"	30	3.4
3	Unknown	30°17'46"	87°16'42"	72	3.4
4	Unknown	30°19'00"	87°13'40"	18	0.4
5	Polypropylene plastic strips	30°19'56"	87°13'12"	20	0.3
6	3 barges, concrete rubble	30°16'54"	87°10'24"	45	1.0
7	Liberty ship	30°16'03"	87°09'07"	70	4.4
8	Unknown	30°16'10"	87°09'40"	67	3.9
9	Unknown	30°17'20"	87°08'00"	57	3.5
10	Concrete rubble	30°18'08"	87°07'30"	60	0.4
11	P5M aircraft, tires	30°17'02"	87°07'06"	85	3.1
12	Liberty ship	30°16'00"	86°49'24"	60	7.3
13	Liberty ship	30°12'46"	86°48'20"	75	9.4
14	Liberty ship	30°12'04"	86°48'03"	118	10.0
15	Barge	30°22'30"	86°35'54"	70	0.6
16	Concrete rubble, tires, barge	30°22'24"	86°35'00"	43	1.3
17	Concrete rubble, tires, appliances	30°22'20"	86°30'00"	43	1.3
18	Metal junk, autos, concrete	30°27'07"	86°30'00"	21	0.3
19	Bridge rubble	30°21'30"	86°29'48"	60	0.8
20	Barge	30°21'54"	86°29'30"	60	0.6
21	Concrete rubble, tires, tile, appliances	30°21'30"	86°25'00"	43	0.8
22	Tires, concrete rubble	30°24'36"	86°17'35"	7	0.7
23	Tires, concrete rubble	30°27'58"	86°14'34"	13	1.2
24	Tires, concrete rubble	30°25'56"	86°14'18"	13	0.4
25	Tires, concrete rubble	30°24'38"	86°08'48"	9	0.9
26	Unknown	30°07'00"	85°54'35"	64	3.8
27	Concrete rubble	30°09'32"	85°53'33"	72	4.0
28	Unknown	30°09'00"	85°53'00"	65	3.3
29	Barge, steel	30°07'05"	85°49'29"	75	5.0
30	Concrete rubble	30°04'16"	85°48'53"	77	5.0
31	Concrete rubble	29°58'07"	85°48'49"	85	10.0
32	Unknown	30°04'01"	85°46'07"	65	4.0
33	Unknown	30°00'00"	85°46'00"	76	6.7
34	Metal scraps, tires	30°04'51"	85°45'30"	71	3.4
35	Unknown	30°05'00"	85°44'07"	61	1.8
36	Tires, steel, concrete rubble	30°05'01"	85°44'02"	65	3.0
37	Liberty ship	30°02'00"	85°43'20"	64	6.2
38	Steel, tires, concrete rubble	30°02'23"	85°43'18"	71	5.5
39	Unknown	29°59'00"	85°42'40"	77	7.0
40	Liberty ship	29°59'03"	85°42'20"	74	6.2

(continued)

Table 20 (concluded)

Number on map	Composition	Latitude	Longitude	Depth (ft)	Miles offshore
41	Autos	29°50'45"	85°33'50"	44	8.5
42	Autos	29°50'39"	85°33'50"	44	8.5
43	Autos	29°51'15"	85°32'56"	44	7.8
44	Autos	29°51'09"	85°32'38"	44	7.2
45	Autos	29°51'03"	85°32'06"	44	7.4
46	Autos	29°50'57"	85°32'14"	44	7.2
47	Autos	29°51'33"	85°31'33"	44	6.5
48	Autos	29°53'15"	85°33'00"	60	4.3
49	Autos	29°51'57"	85°31'20"	44	6.2
50	Autos	29°51'21"	85°31'08"	44	6.0
51	Unknown	29°50'24"	85°29'18"	34	4.0
52	Autos, concrete rubble	29°31'24"	85°07'36"	45	6.5
53	Tires, concrete rubble	30°00'06"	84°17'06"	13	4.0
54	Tires, concrete rubble	29°55'42"	84°13'06"	28	6.0
55	Unknown	29°54'55"	84°13'02"	29	6.0
56	Tires	30°00'00"	84°09'15"	20	4.8
57	Autos, tires, concrete rubble	30°00'00"	84°03'09"	20	6.5
58	Unknown	29°39'45"	83°39'00"	20	6.1
59	Liberty ship	29°09'48"	83°37'49"	21	6.9
60	Autos, drums, tires	29°19'00"	83°16'00"	13	5.3
61	Autos, scrap metal	29°18'03"	83°15'06"	13	5.2
62	Autos, scrap metal	29°07'46"	83°06'25"	2	4.7
63	Autos, scrap metal	29°06'16"	83°06'14"	2	2.0
64	Autos, scrap metal	29°06'32"	83°03'22"	2	0.7
65	Tires	29°04'09"	83°10'00"	20	5.9
66	Autos, concrete rubble	28°53'00"	82°49'41"	22	6.5
*67	(Fountainebleau site)	30°10'50"	83°56'05"	71	3.8
*68	(PCMI barge)	30°07'30"	85°50'50"	78	4.3
*69	(Warsaw site)	30°04'00"	85°50'00"	78	6.8
*70	(Lost pontoon)	30°04'40"	85°44'35"	68	2.7

* New sites

13. SHIPWRECKS

The National Ocean Survey (NOS) maintains an updated computer data base on all shipwrecks in the United States and its coastal waters. Individual shipwreck locations are plotted on NOS nautical charts. The data base gives an indepth description of each shipwreck site. Shipwrecks act as artificial fishing reefs providing artificial housing for many fish species. All shipwrecks are plotted on the individual atlas maps and are listed in Table 21.

Table 21. Shipwrecks in northwest Florida (National Oceanic and Atmospheric Administration 1981a).

Ship name	Latitude	Longitude	Depth (ft)
Unknown	30°15'00"	87°34'00"	
Unknown	30°14'45"	87°33'00"	
Eastern Light	30°18'54"	87°19'30"	
Unknown	30°18'50"	87°19'27"	
Anna Pepina	30°19'06"	87°18'48"	
Bride of Lorne	30°17'30"	87°18'42"	
Unknown	30°19'47"	87°18'48"	
Unknown	30°19'16"	87°18'00"	
Unknown	30°19'23"	87°15'20"	
Unknown	30°24'20"	87°15'30"	
Unknown	30°24'25"	87°15'20"	
Unknown	30°24'25"	87°15'15"	
Unknown	30°23'25"	87°14'50"	
Unknown	30°19'00"	87°12'00"	
Unknown	30°22'05"	87°11'35"	
Unknown	30°18'10"	87°10'15"	
Unknown	30°21'05"	87°04'45"	
Unknown	30°21'50"	87°03'25"	
Unknown	30°33'30"	87°00'25"	
Unknown	30°23'15"	86°46'42"	
Unknown	30°20'32"	86°42'39"	
Unknown	30°27'00"	86°32'10"	
Unknown	30°25'50"	86°30'00"	
Unknown	30°22'50"	86°30'25"	
Unknown	30°28'50"	86°28'25"	
Unknown	30°24'45"	86°27'50"	6
Unknown	30°25'30"	86°19'20"	7
Unknown	30°27'40"	86°18'15"	13
Unknown	30°29'25"	86°12'10"	7
Unknown	30°28'55"	86°12'05"	7
Unknown	30°27'50"	86°09'20"	2
Unknown	30°22'15"	86°06'00"	18
Unknown	30°15'00"	85°59'00"	1
Unknown	30°13'45"	85°49'40"	27
Unknown	30°17'35"	85°51'20"	55
Unknown	30°09'30"	85°47'50"	49
Unknown	30°07'30"	85°46'10"	2
Unknown	30°05'25"	85°46'00"	62
Unknown	30°11'45"	85°45'00"	9
Unknown	30°04'00"	85°45'00"	9
Unknown	30°06'40"	85°42'00"	8
Unknown	30°13'35"	85°41'50"	4
Unknown	30°06'30"	85°41'00"	24
Unknown	30°03'00"	85°37'30"	25

(continued)

Table 21 (concluded)

Ship name	Latitude	Longitude	Depth (ft)
Vamar	29°54'00"	85°27'54"	
Unknown	29°54'25"	85°24'50"	
Unknown	29°51'20"	85°23'50"	
Unknown	29°54'47"	85°23'26"	
Unknown	29°53'50"	85°22'00"	
Unknown	29°46'40"	85°22'40"	
Unknown	29°51'30"	85°20'35"	
Unknown	29°37'30"	85°09'30"	
Unknown	29°37'42"	85°05'51"	
Unknown	29°42'55"	84°59'10"	
Unknown	29°42'40"	84°59'45"	
Unknown	29°44'00"	84°43'30"	
Unknown	29°47'00"	84°39'00"	
Unknown	29°58'00"	84°20'00"	
Unknown	30°04'35"	84°11'15"	
Unknown	29°26'10"	83°17'30"	
Unknown	29°19'20"	83°11'35"	
Unknown	29°10'00"	83°11'30"	
Unknown	29°00'07"	83°11'30"	
Unknown	29°00'00"	83°11'25"	
Unknown	29°00'00"	82°45'30"	
	28°57'15"	82°50'45"	

14. MAJOR OFFSHORE STRUCTURES

Major offshore structures, as mapped on the atlas maps, represent fish havens for various pelagic and neritic fish. The major offshore structures that are mapped on the atlas overlays are either fixed steel towers greater than or equal to 30 ft above mean sea level in height or fishing platforms. There are no other large offshore structures (e.g., oil drilling platforms) within the study area.

15. LAND USE

The first settlements in northwest Florida occurred in the mid-1800's along coastal areas and streams that were navigable by boat. The earliest inland communities developed as offshoots of these coastal settlements. They were connected by trails and shallow streams. The railway system's expansion into northwest Florida provided the first stimulus to development by increasing the overall accessibility of the region. Communities connected by the railroad and provided with railroad terminals quickly became centers of trade and economic activity. Another major boost to the region's development came with the introduction of the automobile and the subsequent development of a highway system.

The U.S. Geological Survey (USGS) has developed a land use and land cover classification system which is described in USGS Circular 671. A Level I Land Use Classification using 1973 data has been mapped on the individual atlas overlays for all urban lands, agricultural lands, and rangeland (the data have been updated in urban areas with recent land use maps). The classification system is described in Table 22.

A percentage breakdown by U.S. Geological Survey Land Use Level I class is shown in Table 23. The northwest Florida study area is primarily rural; primary urban areas are Pensacola, Ft. Walton Beach, and Panama City.

Table 22. U.S. Geological Survey Level I and II land use classification systems (Kuyper et al. 1981).

Level I (mapped)	Level II (not mapped)
Urban or built-up land (mapped as urban land)	Residential
	Commercial and services
	Industrial
	Transportation, communications and utilities
	Industrial and commercial employees
	Mixed urban or built-up land
	Other urban or built-up land
Agricultural land (mapped as agricultural land)	Cropland and pasture
	Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
	Confined feeding operations
	Other agricultural land
Rangeland (mapped as rangeland)	Herbaceous rangeland
	Shrub-brushland rangeland
	Mixed rangeland
Forest land (not mapped)	Deciduous forest land
	Evergreen forest land
	Mixed forest land
Water (not mapped)	Streams and canals
	Lakes
	Reservoirs
	Bays and estuaries
Wetland (mapped on Overlay #1)	Forested wetland
	Nonforested wetland
Barren land (not mapped)	Dry salt flats
	Beaches
	Sandy areas other than beaches
	Bare exposed rock
	Strip mines, quarries, and gravel pits
	Transitional areas
	Mixed barren land

Table 23. U.S. Geological Survey Level I land use percentages by county (Florida State University 1980).

County	Urban	Agricultural	Rangeland	Forestland	Water	Wetland	Barren
Escambia	14.0%	14.2%	0.1%	50.1%	11.8%	7.8%	2.0%
Santa Rosa	4.2%	12.7%	0.0%	62.5%	10.5%	9.0%	1.1%
Okaloosa	8.2%	9.3%	0.0%	69.0%	6.1%	6.0%	1.4%
Walton	4.2%	14.7%	0.1%	64.4%	7.5%	8.0%	1.1%
Washington	1.7%	25.7%	0.0%	58.4%	1.0%	12.9%	0.3%
Bay	6.6%	2.2%	0.0%	70.5%	7.1%	11.7%	1.9%
Calhoun	1.3%	20.6%	0.0%	54.5%	3.0%	20.3%	0.3%
Gulf	1.5%	4.4%	0.0%	62.7%	2.3%	27.9%	1.2%
Franklin	2.0%	0.1%	0.0%	72.0%	1.8%	23.2%	0.9%
Wakulla	1.6%	10.1%	0.0%	71.1%	2.3%	14.4%	0.5%
Jefferson	1.3%	19.7%	0.0%	57.7%	0.6%	19.5%	1.2%
Taylor	2.1%	3.7%	0.0%	68.0%	0.2%	25.7%	0.3%
Dixie	0.8%	2.9%	0.1%	86.7%	2.3%	6.3%	0.9%
Levy	0.7%	18.7%	0.3%	47.8%	1.9%	29.0%	1.6%
Citrus	4.7%	16.3%	1.5%	35.9%	9.0%	25.8%	6.8%
Hernando	4.3%	23.5%	0.9%	36.0%	3.6%	24.0%	7.7%

16. LANDFILLS

The Florida Department of Environmental Regulation maintains an updated computer data base on all landfills and dumpsites in northwest Florida. Solid waste facilities are categorized by the computer data base as follows (Florida Dept. of Environmental Regulation 1982b):

<u>Code</u>:

100 Class I landfill (landfills handling $\geq$200 tons per month or $\geq$ 50 yd^3 per month refuse)

200 Class II landfill (landfills handling <200 tons per month or <50 yd^3 per month refuse)

300 Class III landfill (dumpsites)
- 310 Trash/yard trash
- 320 Trash composting

400 Sludge disposal facility

500 Other (transfer stations)

Class I and II landfills are numbered and plotted on the individual atlas overlays and described, in detail, in Tables 24 and 25. Class III landfills (dumpsites) as well as transfer stations are not mapped but are described in Tables 26 and 27.

Table 24. Class I landfills (Florida Department of Environmental Regulation 1982b).

Number on map	Name	County	Operator	Population served	Cubic yd/day	Cost/ ton	Life expect.
1	Perdido SLF	Escambia	County	255,000	3,220	---	1989
2	Klondike SLF	Escambia	County	185,000	3,770	$5.00	1982
3	Holley #3 SLF	Santa Rosa	County	10,000	730	---	---
4	Central Santa Rosa SLF	Santa Rosa	County	9,300	1,140	---	---
5	Baker SLF	Okaloosa	County	6,000	185	---	---
6	Laurel Hill SLF	Okaloosa	County	5,000	---	$0.90	---
7	Niceville-Valporoso SLF	Okaloosa	County	26,000	310	---	---
8	Wright SLF	Okaloosa	County	60,000	1,315	$3.60	---
9	Mud Hill SLF	Washington	County	14,068	35	$5.00	2026
10	Bay County SLF	Bay	County	100,000	978	$3.83	2001
11	Calhoun County SLF	Calhoun	County	8,000	90	---	1993
12	Port St. Joe SLF	Gulf	County	7,500	100	---	---
13	Franklin County SLF	Franklin	County	10,700	70	---	---
14	Medart Central SLF	Wakulla	County	9,300	25[a]	---	---
15	Jefferson County SLF	Jefferson	County	10,000	200	---	---
16	Taylor County Central SLF	Taylor	County	15,700	250	---	---
17	Central Central SLF	Citrus	County	50,000	262	$1.25	1991
18	Parson's Landfill	Citrus	Monier Resources	Industrial	200[a]	---	---
19	Majette Tower SLF	Bay	County	90,880	255[a]	$0.22	1987

[a]Tons/day.

Table 25. Class II landfills (Florida Department of Environmental Regulation 1982b).

Number on map	Name	County	Operator	Population served	Cubic yds/day	Cost/ ton	Life expect.
1	Oakgrove LF	Escambia	County	5,000	1	---	---
2	Camp Fire SLF	Escambia	County	3,500	1	$5.54	1987
3	Newport SLF	Escambia	Omni-vest, Inc.	Indus-trial	2	$1.00	1983
4	Northern Santa Rosa	Santa Rosa	County	10,000	190	---	---
5	Northwest Santa Rosa	Santa Rosa	County	6,000	60	---	---
6	Blue Mt. Dump	Walton	County	6,250	30	$0.70	---
7	New Harmony Dump	Walton	County	150	1[a]	$1.10[b]	---
8	Paxton Dump	Walton	County	1,000	2[a]	$1.10[b]	---
9	Walton County Central SFF	Walton	County	12,000	50[a]	---	---
10	North C-Z SLF	Walton	County	5,000	25	---	1987
11	Blountstown SLF	Calhoun	County	3,000	40	---	---
12	Honeyville Dump	Gulf	County	500	4	$1.28	---
13	Howard's Creek Dump	Gulf	County	500	2	$3.67	---
14	Oak Grove Dump	Gulf	County	1,000	4	---	---
15	Port St. Joe Dump	Gulf	County	6,600	12	$0.45	---
16	White City Dump	Gulf	County	500	58	$3.00	---
17	Buckhorn SLF	Gulf	County	4,500	40	$5.00	1995
18	Port St. Joe SLF	Gulf	County	6,600	100	---	---
19	Jefferson County SLF	Jefferson	County	10,000	50	---	---
20	Dixie County Central LF	Dixie	County	8,000	23	$5.60	---
21	Bronson SLF	Levy	County	2,500	23	---	---
22	Cedar key LF	Levy	County	1,000	10	$1.95	---
23	Chiefland LF	Levy	County	2,500	23	$0.20[b]	---
24	Williston SLF	Levy	County	4,000	65	$0.18[b]	---
25	Inglis and Yankeetown SLF	Levy	County	1,200	13	$0.20[b]	---
26	Croom SLF	Hernando	County	44,469	10	$9.80	1986
27	Ridge Manor Disposal LF	Hernando	Ridge Manor	600	15	---	---

[a]Tons/day.
[b]$/yd.

Table 26. Class III landfills (Florida Department of Environmental Regulation 1982b).

Name	County	Operator	Population served	Cubic yd/day
Pioneer Sand Company	Escambia	Pioneer Sand	Industrial	---
Gibson SLF	Okaloosa	City	22,000	100 yd

Table 27. Transfer stations (Florida Department of Environmental Regulation 1982b).

Name	County	Operator	Population served	Cubic ton	Cost/ ton
Pensacola TS	Escambia	City of Pensacola	65,000	110 yd	2.57
Southern Waste & Container Service	Escambia	SWCS	100,000	200 tons	9.00
Panama City Beach TS	Bay	County	14,000	100 yd	0.75
Panama City TS	Bay	County	40,000	160 tons	----

17. DREDGE SPOIL DISPOSAL SITES

The U.S. Army Corps of Engineers is responsible for all dredge and fill activities in the State. A permit must be obtained from the Corps before any dredge and fill activity will be allowed. The Florida Department of Environmental Regulation is responsible for permitting all dredge spoil sites in the State. They maintain location maps and site data on all dredge spoil disposal sites in northwest Florida. Individual dredge spoil sites have been plotted on the atlas overlays and represent all dredge spoil and disposal sites permitted by the Florida Department of Environmental Regulation in northwest Florida.

18. INDUSTRIAL AND MUNICIPAL POINT SOURCE DISCHARGES

The Florida Department of Environmental Regulation in Tallahassee keeps an updated computer data base on all industrial and municipal (sewage) point source discharges in northwest Florida. The individual industrial (sewage) point discharges are numbered and plotted on the individual atlas maps. A detailed matrix describing each industrial point source is found in Table 28. The individual municipal (sewage) point discharges are numbered and plotted on the individual atlas maps. A detailed matrix describing each municipal point source is found in Table 29 (Florida Dept. of Environmental Regulation 1982a).

Table 28. Industrial point source discharges (Florida Department of Environmental Regulation 1982a).

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
1	Naval Air Station	Activated sludge	0.4 TGD
2	EG&G Bionomics Marine Laboratory	Settling ponds, act. charcoal, evap/perc. ponds	30.0 TGD
3	Crist Steam Plant - Gulf Power Corp	Coal-fired steam plant	18.0 MGD
4	St. Regis Paper Company	Prim. settling basin, nutrient feed system & aeration ponds	28.0 MGD
5	Monsanto Co.	17-acre holding pond to deep injection wells	90.0 MGD
6	Hygeia Coca Cola Bottling Co.	Perc. ponds and spray irrigation	60.0 TGD
7	American Creosote Works, Inc.	----	----
8	Louisville & Nashville R.R.	----	----
9	O'Farrell Dairy	----	----
10	American Cyanamid Co., Inc.	Biol. oxidation, oxid/pol. pond, chlor, deep well	5.5 MGD
11	Air Products & Chemicals, Inc.	Ext. aer., neutral, anaerobic treatment, bio-oxide ponds	1.5 MGD
12	Exxon Corp.	Disposal well	----
13	Fairchild Republic Co.	Ind. wtp. to evap. pond	20.0 TGD
14	Metric Systems Corp	----	----
15	Showell Farms, Inc.	Ext. aer., lagoon, fat recovery and chlorination	1.2 MGD
16	Hiland Park Laundry	Screen chamber, prim. settle, trickling filter	----
17	Bay County WWPT (Regional)	Primary clarifier, aer., nutrient addition	32.0 MGD
18	Lansing Smith Plant, Gulf Power	Noncontact cooling water and ash	----
19	City of Port St. Joe	----	40.0 MGD
20	Basic Magnesia, Inc.	Untreated wastewater	15.0 MGD
21	S.O. Purdom Power Plant	Chlorinization, pH neutralization, and stabilization	198.4 MGD
22	Olin Corp.	Ext. aer., chlorination, polishing pond to ditch	0.5 MGD
23	Seminole Asphalt Refining Co.	API separ. to spray aer. lagoon	430.0 TGD
24	Idacon, Inc.	Retention, recirculation facility w/oil & water sep. & perc. pond	----

(continued)

Table 28 (concluded)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
25	Gulf States Chemical Company	Chem. neutralization to evap/ perc ponds	----
26	Tom's Foods	Aer. lagoon pretreat to Perry municipal treatment sys.	----
27	Martin Electronics, Inc.	ALK CLZ for cyanide waste chromium reduction to perc pond	20.0 TGD
28	Buckeye Cellulose Corp.	Prim. clarifier and aeriation lagoon to river	58.0 MGD
29	Suwannee Lumber Manufacturing	Recirculated no discharge	----
30	Continental Turp. & Rosin Corp.	Perc pond	50.0 TGD
31	Brown's Laundry	Screening, swamp & pump, sand filter to drainfield	----
32	Carrol Contracting	None - ponding	----
33	Dolime Materials	Settling pond to cross Florida barge canal	----
34	Florida Power Corp. Old Ash	Ponding to remove particulate	----
35	Florida Power Corp. Cooling Water	None	----
36	Florida Power Corp.	Evap/perc ponds	680.0 TGD
37	George L. Cunningham (laundry)	Septic tanks to drainfield	----
38	Jahna Industries	Settling basin	----
39	King and Roberts Asphalts	Settling and retention pond with recycling	432.0 TGD
40	Florida Power Corp. New Ash Ponds	Settling pond	----
41	E.M. Bass	----	----
42	Florida Crushed Stone	Settling pond	----
43	Hernando Egg Producers	Thermophilic digester and separation & sedimentation tank	----
44	West Coast Concrete	Retention pond	----
45	Bio-Chemical Energy	Ethanol plant	----
46	Florida Crushed Stone Limerock	Sedimentation and recycling	----
47	E.R. Jahna Industries	None	----
48	Camp Concrete Rock Company	----	----
49	Chemical Lime, Inc.	----	----
50	The Deltona Corp.	----	----
51	General Portland	----	----
52	General Portland	----	----
53	Triton Construction Company	----	----

Table 29. Municipal point source discharges (Florida Department of Environmental Regulation 1982a).

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
1	Vista Del Mar	Activated sludge w/filters to pond	50.0 TGD
2	Warrington STP	Contact stabilization w/filters to creek	2.0 MGD
3	McArthur Elementary School	Extended aeration to absorption bed	6.7 TGD
4	Tate High School	Extended aeration	30.0 TGD
5	Molino Elementary School	Extended aeration to perc. pond	12.5 TGD
6	Pine Meadow Elementary School	Extended aeration to perc. pond	12.5 TGD
7	Pen Haven	Trickling filter to polishing pond surface water discharge	0.3 MGD
8	Ernest Ward High School	Extended aeration	12.0 TGD
9	Avondale	Contact stabilization w/polishing pond to bay	1.0 MGD
10	Pine Forest Plant Work Center	Extended aeration	5.0 TGD
11	City of Century	Extended aeration to polishing pond to creek	25.0 TGD
12	Prison Camp	Extended aeration	16.0 TGD
13	Grande Lagoon SR 297	Aeration to polishing pond to perc. pond	50.0 TGD
14	Beulah Elementary School	Extended aeration to perc. ponds	15.0 TGD
15	Saufley Field	Trickling filter	210.0 MGD
16	Main STP	Activated sludge w/filters, phy-chem process	20.0 MGD
17	Scenic Hills STP	Reaerated act/sludge to spray irr.	988.0 TGD
18	Pensacola Greyhound Racing	Extended aeration	24.0 TGD
19	The Mariner	Extended aeration/cont. stab. to dual perc. ponds	60.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
20	Fountain Blue Map	Extended aeration	12.5 TGD
21	Moreno Courts	Extended aeration w/polishing pond and dual perc. ponds, act./ sludge	210.0 TGD
22	Perdido Bay Country Club	Cont. stab. to ponds to bayou	70.0 TGD
23	Sandy Acres Trailor Park	Extended aeration	4.0 TGD
24	Lakeview Mobile Estates	Extended aeration w/polishing pond	18.0 TGD
25	Bluff Springs Campground	Ext. aer. w/polishing pond to creek	15.0 TGD
26	Bayou Grande Villa STP	Extended aeration	41.0 TGD
27	Webb's Apts. STP	Extended aeration to perc. pond	7.5 TGD
28	Weekly Bayou	Drainfield	30.0 TGD
29	Grantwood Apartments	Ext. aer., pol. pond to perc. pond	18.0 TGD
30	The Windward	Cont. stabilization w/filter	60.0 TGD
31	Timberlake Mobile Home Park	Extended aeration to bayou	30.0 TGD
32	Innerarity Island STP	Extended aeration to bayou	50.0 TGD
33	Needle Rush Point STP	Ext. aer. w/filter to drain-field	25.0 TGD
34	Azalea Trace	Ext. aer. w/filter to perc. pond	60.0 TGD
35	Sundown Condo's	Ext. aer. w/filter to perc. pond	24.0 TGD
36	Shelter Cove Marina	Septic tanks to drainfield	5.0 TGD
37	Southwind Marina	Septic tanks to sand filter to drainfield	11.0 TGD
38	Perdido Key Yacht and Tennis	Extended aeration to drain-field	30.0 TGD
39	Shipwatch Surf and Yacht Club	Ext. aer. to perc. ponds w/filter	50.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
40	Sea Wind Condo	Cont. stab. to absorp. field	50.0 TGD
41	Sea Spray Condo	Ext. aer. to perc. pond w/filter	40.0 TGD
42	Sandy Key Condo	Cont. stabilization to drainfields	0.1 MGD
43	Laguna Dunes	Extended aeration	16.1 TGD
44	Boyington Swine Farm	----	----
45	Cary's Dairy	----	----
46	Key Farm	----	----
47	Oak Shade Farm	----	----
48	University of West Florida	Cont. stab. to pol. ponds to river	0.5 MGD
49	I-10 Welcome Station	Extended aeration to ditch	15.0 TGD
50	East Milton Elementary School	Extended aeration	5.0 TGD
51	Holly-Navarre Elementary School	Extended aeration	6.0 TGD
52	Pace Elementary School	Extended aeration	15.0 TGD
53	Pace High School	Extended aeration	24.0 TGD
54	Pea Ridge Elementary School	Extended aeration to absorption beds	12.0 MGD
55	Santa Rosa Industrial Park	Extended aeration to perc. ponds	30.0 TGD
56	Milton Vocational Technical School	Extended aeration to drain-fields	7,000.0 TGD
57	NAS Whiting Field	Trickling filter to creek	1,050.0 TGD
58	U.S. Naval Air Station	----	----
59	Town of Jay	Cont. stabilization	0.1 MGD
60	City of Milton	Trickling filter	1.8 MGD
61	City of Gulf Breeze	Cont. stabilization	0.5 MGD
62	Villa Venyce	Extended aeration to perc. ponds	0.1 MGD
63	Santa Rosa Shores STP	Ext. aer. to hold. pond to spray irr.	130.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
64	Colonial Pines MHP	Extended aeration to drainfield	20.0 TGD
65	Santa Villa S/D STP	Cont. stab. w/pol. ponds to perc. ponds	120.0 TGD
66	Barnett Mill	----	15.0 TGD
67	Anndora Villas	Extended aeration to absorption beds	12.0 TGD
68	Rowell Brothers, Inc.	----	----
69	Neal Kennington's Hog Farm	----	----
70	DOT I-10 Rest Area West	Extended aeration	10.0 TGD
71	DOT I-10 Rest Area East	Extended aeration	10.0 TGD
72	Berrydale Forestry Camp	Extended aeration	20.0 TGD
73	Santa Rosa Isl. Auth. & Demo	Activated sludge	1.2 MGD
74	Bob Sikes Airport Industrial Park	Trickling filter	50.0 TGD
75	Okaloosa Island STP	Cont. stabilization S.R. sound	680.0 TGD
76	Baker Elementary and High School	Extended aeration	24.0 TGD
77	Florosa Elementary School	Extended aeration to drainfield	24.0 TGD
78	Chateau Pres. Delamer	Extended aeration	84.0 TGD
79	Okaloosa Water and Sewer System	Cont. stabilization	3.0 MGD
80	Niceville-Valpo. Region	Cont. stabilization to spray irrigation	2.0 MGD
81	Aux. Field and Eglin AFB	Activated sludge to irrigation field	0.1 MGD
82	Hurlburt Field Hurlburt AFB	Trickling filter	726.0 TGD
83	Aux. Field #6, Eglin AFB	Ext. aer. to spray irr. and perc. ponds	72.0 TGD
84	Main base STP, Eglin AFB	Trickling filter to irr. field	0.5 MGD
85	Plew Eglin AFB	Cont. stabilization to spray field	1.5 MGD
86	Eglin Auxilary Field	----	----
87	Town of Mary Esther	Act. sludge to holding pond, spray	0.5 MGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
88	City of Crestview	Trickling filter	1.5 MGD
89	Ft. Walton Beach	Rotating bio, cont. to pond to spray irr.	4.5 MGD
90	Fllin Waterfront Rentals	Extended aeration to drainfield	7.5 TGD
91	Westwood Apartments	Cont. stabilization to perc. pond	40.0 TGD
92	Destin Water Users, Inc.	Cont. stabilization	2.0 MGD
93	Victoria Mobile Home Park	Extended aeration to perc. pond	15.0 TGD
94	Pippin Mobile Home Park	Extended aeration	3.0 TPD
95	Jacob Y. Youngblood Swine Farm	----	----
96	DOT I-10 Rest Area West	Extended aeration	10.0 TGD
97	East I-10 Rest Area	Ext. aer. to ditch to nat. perc. ponds	10.0 TGD
98	Okaloosa Correctional Institution	----	----
99	Okaloosa Correctional Institution	Est. aer. to spray irrigation	50.0 TGD
100	Freeport High School	Ext. aer. to perc. ponds	15.0 TGD
101	Walton High School	Extended aeration	15.0 TGD
102	Maude Saunders Elementary School	Ext. aer. to perc. ponds	15.0 TGD
103	Eglin AFB Site C-6	Ext. aer. to spray irrigation	20.0 TGD
104	Test Site C-6	----	----
105	Defuniak Springs	Cont. stab. to creek to river	75.0 TGD
106	South Walton Devl. Utility	Cont. stab. to perc. ponds	0.3 MGD
107	Sandcliffs STP	Cont. stabilization	60.0 TGD
108	Camp Creek Lake Subdivision	----	----
109	Sandestin Utility Company	Cont. stab. to spray irr.	0.4 MGD
110	Dune I Townhouses	Septic tank to drainfield	3.4 TGD
111	Blue Gulf Joint Ventures	Ext. aer. to perc. ponds	20.0 TGD
112	Sand Dollar Campground	Septic tank to drainfield	4.5 TGD

(continued)

Table 29 (continued)

Number on map		Process and/or treatment	Total capacity (thousand or million gal/day)
113	White Cliffs Condo	Septic tank to drainfield	4,200.0 TGD
114	Seaside I	Cont. stabilization to drainfields	30.0 TGD
115	Beachcrest Townhouse	Septic tank to drainfields	5.0 TGD
116	Emerald Hills Condo	Ext. aeration to perc. ponds	30.0 TGD
117	Cassine Gardens	Cont. stab. to perc. ponds	70.0 TGD
118	I-10 Properties Ltd.	----	----
119	Showell Poultry Farms, Inc.	----	----
120	City of Chipley	Activated sludge	0.5 MGD
121	City of Vernon	Extended aeration	0.1 MGD
122	Washington County Kennel Club	Extended aeration w/filters	25.0 TGD
123	Sunnyhills Utility	Cont. stab. to oxid. pond to spray irr.	70.0 TGD
124	David Solger	----	----
125	Massey Ward	----	----
126	S & S Greenwood Farms	----	----
127	Harry Shipes	----	----
128	Robert Hightower	----	----
129	Guy T. Easterling	----	----
130	Caryville Vocational Center	Extended aeration	10.0 TGD
131	Waller School	Septic tank to drainfield	5.1 TGD
132	Highland Park School	Extended aeration	7.5 TGD
133	Parker Elementary School	Extended aeration	7.5 TGD
134	Callaway Elementary School	Extended aeration	7.5 TGD
135	Southport Elementary School	Extended aeration	10.0 TGD
136	Bay County WWTP #2	Primary treatment only	3.0 MGD
137	Tom P. Haney School STP	----	----
138	Tyndall AFB	Trickling filter to spray field	1.2 MGD
139	Naval Coastal Systems Center	Trickling filter to bay	0.2 MGD
140	Tyndall AFB STP	----	----
141	Panama City	Cont. stabilization	2.0 MGD
142	Panama City Beach	Cont. stabilization	2.0 MGD
143	Lynn Haven	Trickling filter	0.7 MGD

(continued)

Table 29 (continued)

Number on map		Process and/or treatment	Total capacity (thousand or million gal/day)
144	Millville STP	Trickling filter to bayou and bay	3.0 MGD
145	The Shores STP	Ext. aer. to perc. ponds	55.0 TGD
146	Bay Point STP	Cont. stab. to spray irrigation	185.0 TGD
147	Crews Map	Cont. stabilization	40.0 TGD
148	Springfield #2	Extended aeration	15.0 TGD
149	Springfield #1	Extended aeration	15.0 TGD
150	Pinnacle Port Cond. STP	Extended aeration to perc ponds	65.0 TGD
151	Trailer City Estates	Ext. aer. to pol. ponds to bayou	12.0 TGD
152	Springfield #3	Extended aeration	15.0 TGD
153	Morris Manor Estates	Cont. stab. w/polishing pond	35.0 TGD
154	Southwood Shopping Center	Extended aeration	4.0 TGD
155	Woodlawn STP	Cont. stabilization	150.0 TGD
156	Latitude 29 Condo	Extended aeration	7.5 TGD
157	Parkway Garden Apartments	Ext. aer. polishing pond to bay	15.0 TGD
158	KOA Panama City Beach	Operable ASR 0.024 MGD in EA mode or 0.048 MGC in CS mode	48.0 TGD
159	Venture Out in America	Cont. stabilization and ext. aer.	135.0 TGD
160	Village MHP	Cont. stabilization	25.0 TGD
161	GKMZ Corp.	Ext. aer. w/polishing pond	20.0 TGD
162	Lannie Rowe Estates	Cont. stabilization perc pond	0.2 MGD
163	Bland Trailer Park	Extended aeration	12.0 TGD
164	Lane Mobile Homes	Extended aeration	24.0 TGD
165	Tanglewood Mobile Home Park	Extended aeration	6.0 TGD

(continued)

Table 29 (continued)

Number on map		Process and/or treatment	Total capacity (thousand or million gal/day)
166	Sunnyside Villas	Cont. stab. w/filter	50.0 TGD
167	Noah Legears Mobile Home Park STP	Ext. aer. to pol. pond to perc pond	10.0 TGD
168	Pines Mobile Home Park	Extended aeration	6.0 TGD
169	Abalone Apartments	Extended aeration	6.0 TGD
170	Gulf Coast Travel Park	Cont. stab. to spray irrigation	35.0 TGD
171	Bayside Mobile Home Park	Cont. stab. to perc pond	40.0 TGD
172	Town and Country Lake Estate	Cont. stabilization	0.1 MGD
173	Douglas Road Mobile Home Park	Ext. aer. to pol. pond to drainfield	8.0 TGD
174	Forest Shores	Cont. stabilization	50.0 MGD
175	Grimes-Callaway Bayou Estates	Ext. aer. w/filter to perc ponds	465.0 TGD
176	Derby Woods	Ext. aer./cont. stab. w/pol. pond	150.0 TGD
177	Pinehurst Garden Apartments STP	----	----
178	Springfield Housing Authority	Septic tank to absorp. bed	13.0 TGD
179	Windsong Condo	Septic tank/sand filter/ drainfield	4.5 TGD
180	Sandy Creek Ranch	Aerated Lagoon	75.0 TGD
181	Casey's Mobile Home Park	Cont. stabilization to bayou	14.0 TGD
182	Rountowner Motor Inn STP	----	----
183	Diamond Stock Farms, Inc.	----	----
184	City of Blountstown	Ext. aeration to surface waters	0.2 MGD
185	City of Wewahitchka	Cont. stabilization	0.2 MGD
186	Gulf Aire Subdivision STP	Cont. stab./pol. pond/perc ponds	40.0 TGD
187	Lanark Village Water & Sewage	Extended aeration	0.1 MGD
188	East Point Water & Sewer	Cont. stab. to hold. pond to spray site	150.0 TGD
189	City of Carrabelle	Primary STP to sound	0.1 MGD
190	City of Apalachicola	Trickling filter to Scipio Cr. to Apalachicola River	0.4 MGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
191	Alligator Point KOA	Extended aeration	15.0 TGD
192	Armistead Motel	Extended aeration	13.0 TGD
193	Villas of St. George	Extended aeration to drain-field	15.0 TGD
194	Camp Weed	Extended aeration w/filters	29.7 TGD
195	Wakulla County High School	Extended aeration	18.0 TGD
196	Wakulla Middle School	Ext. aer., surge tanks, tert. filter, dosing tanks, drainfield	18.0 TGD
197	Shell STP	Extended aeration	24.0 TGD
198	Paradise Village STP	Extended aeration to perc. pond	30.0 TGD
199	Oyster Ay Est. STP	Cont. stabilization	60.0 TGD
200	Wakulla Manor	Extended aeration to perc. pond	24.0 TGD
201	Bayside Villas	Extended aeration to absorption field	8.5 TGD
202	Edward C. Clark, M.D.	----	----
203	City of Monticello STP	Trickling filter/pol. pond to Bird Cr., Simpson Cr., Aucilla River	0.3 MGD
204	Tallahassee East KOA	Cont. stabilization	36.0 TGD
205	Tallahassee East KOA Campground	----	----
206	Mid Continent Truck Stop	Extended aeration	42.0 TGD
207	Isle of Rest Nursing Home	Extended aeration to spray irrigation	7.5 TGD
208	Floyd Armstrong	----	----
209	City of Perry Package STP	Extended aeration	0.5 MGD
210	City of Perry	Primary treatment w/oxid-ation pond	1.2 MGD
211	Taylor County Vocational Center	Extended aeration to perc pond	4.0 TGD
212	Cooey's Restaurant	Extended aeration to surface water	5.0 TGD
213	DOT Perry Rest Area	Extended aeration	10.0 TGD
214	Town of Cross City	Ext. aer. to swamp to gulf	150.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
215	Suwannee River KOA Campground	Extended aeration to perc. pond	24.0 TGD
216	Cross City Correctional Institute	Cont. stabilization to perc. pond	0.1 MGD
217	Northwest Florida Reg. Housing	----	----
218	City of Williston	Trickling filter	200.0 TGD
219	City of Chiefland	Ext. aer. w/chlorine to perc/evap pond	0.3 MGD
220	City of Cedar Key	Cont. stab. to tidal chan. to gulf	0.1 MGD
221	Chiefland Country Club	Septic tanks to sand filters	5.0 TGD
222	Hideaway Subdivision	Ext. aeration to evap/perc. ponds	15.0 TGD
223	Inglis Restaurant	Anaerobic system	4.0 TGD
224	Floral City Elementary School	Extended aeration	6.0 TGD
225	Lecanto School Complex	Extended aeration	100.0 TGD
226	Hernando County Elementary School	Extended aeration	5.0 TGD
227	Homosassa Springs Elementary School	Extended aeration	7.5 TGD
228	Key Pine Village	Extended aeration	5.0 TGD
229	City of Crystal River	Cont. stabilization	250.0 TGD
230	City of Inverness #1	Trickling filter and activated sludge	400.0 TGD
231	City of Inverness #2	Activated sludge	1.5 MGD
232	Crystal Acres Mobile Home Park	Extended aeration	10.0 TGD
233	Plantation Hotel	Cont. stabilization	35.0 TGD
234	Sunny Days Plaza	Extended aeration	6.0 TGD
235	Chassa River Lodge	Extended aeration	10.0 TGD
236	Fort Cooper Station Rest.	Extended aeration	35.0 TGD
237	Atlantis Arms	Extended aeration	6.0 TGD
238	Sandy Oaks Mobile Home Park	Extended aeration	10.0 TGD
239	Anchorage	Extended aeration	10.0 TGD
240	Turtle Creek Campground	Extended aeration	25.0 TGD
241	Spring Gardens	Extended aeration	5.0 TGD
242	Tradewinds Fishing Village	Extended aeration	26.0 TGD
243	Rooster's Rest/Adult MHP	Extended aeration	42.0 TGD
244	Seven Rurs Community Hospital	Extended aeration	50.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
245	Lake Rousseau Fish Camp	Extended aeration	10.0 TGD
246	Moonrise Resort	Extended aeration	15.0 TGD
247	Inverness Village Garden Condo	Extended aeration	42.0 TGD
248	Chassahowitzka Rur. Campground	Extended aeration	17.0 TGD
249	Riverview Mobile Estates	Extended aeration	15.0 TGD
250	Beverly Hills Rolling Oaks	Cont. stabilization	350.0 TGD
251	Seven Rivers Golf & Country Club	Extended stabilization	5.0 TGD
252	Apache Shore	Extended stabilization	7.0 TGD
253	Imperial Gardens Mobile Home Park	Extended stabilization	5.0 TGD
254	Homosassa Springs #1	Extended stabilization	60.0 TGD
255	Islands Condo Assoc. Inc.	Cont. stabilization	40.0 TGD
256	Holiday Inn	Extended aeration	30.0 TGD
257	Stonebrook Mobile Home Community	Extended aeration	15.0 TGD
258	Nature's Campground	Extended aeration	20.0 TGD
259	Fort Cooper Mobile Home Park	Extended aeration	15.0 TGD
260	Camp and Water	Extended aeration	30.0 TGD
261	Pyramid Restaurant	Extended aeration	6.0 TGD
262	Singing Forest Mobile Home Park	Extended aeration	25.0 TGD
263	Homosassa Springs Attract	Extended aeration	4.0 TGD
264	Crystal River Mobile Home Park	Extended aeration	5.0 TGD
265	Thunderbird Mobile Home Park	Extended aeration	5.0 TGD
266	Springs Village Mobile Home Park	Extended aeration	3.0 TGD
267	Westwind Village	Extended aeration	21.0 TGD
268	Harbor Lights Mobile Home Resort	Extended aeration	10.0 TGD
269	Cedars MHE	Extended aeration	14.0 TGD
270	Royal Oaks Manor	Extended aeration	71.0 TGD
271	Bell Villa Mobile Home Park	Extended aeration	7.0 TGD
272	Forest Hills Mobile Home Park	Extended aeration	20.0 TGD
273	Sugar Mill Woods Cypress Village	Oxidation ditch	500.0 TGD
274	Ensigns Oasis	Extended aeration	10.0 TGD
275	River Haven Village	Extended aeration	100.0 TGD
276	River Lodge Mobile Home Park	Cont. stabilization	40.0 TGD
277	Evanridge Mobile Home Park	Extended aeration	7.5 TGD
278	Crystal Lakes	Extended aeration	33.9 TGD
279	Homosassa Springs Shopping Center	Extended aeration	10.0 TGD
280	Casa Rio	Extended aeration	7.5 TGD
281	Carriage Hills Mobile Home Park	Extended aeration	12.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
282	Island Village Condo	Extended aeration	15.0 TGD
283	Homosassa Springs Shopping Center	Extended aeration	10.0 TGD
284	Dexter Park Villas	Extended aeration	35.0 TGD
285	Paradise Point Villas	Extended aeration	10.0 TGD
286	Otter Slide Subdivision	Extended aeration	10.0 TGD
287	Whispering Pines Mobile Home Park	Extended aeration	5.0 TGD
288	Blanton Mobile Home Park	Extended aeration	20.0 TGD
289	Crystal Isles Resort Campground	Extended aeration	16.0 TGD
290	Lecanto Hills Mobile Home Community	Extended aeration	12.0 TGD
291	West Hernando Water & Sewer	Cont. stabilization	250.0 TGD
292	High Point Mobile Home Subdivision	Extended aeration	300.0 TGD
293	Ridge Manor West	Cont. stabilization	85.0 TGD
294	Royal Highlands - The Heathers	Cont. stabilization	200.0 TGD
295	West Hernando Water & Sewer	Cont. stabilization	200.0 TGD
296	Pine Island State Park	Septic tank system to mound system	2.5 TGD
297	Timber Pines	Extended aeration	200.0 TGD
298	Fort Dade Mobile Home Park	Extended aeration	9.0 TGD
299	City of Brooksville	Cont. stabilization	375.0 TGD
300	City of Brooksville	Cont. stabilization	750.0 TGD
301	City of Brooksville	Extended aeration	50.0 TGD
302	Weeki Wachee North Mobile Home Park	Extended aeration	26.0 TGD
303	Camp E-How-Kee	Extended aeration	2.6 TGD
304	Oak Manor Mobile Home Park	Extended aeration	5.0 TGD
305	Evergreen Woods	Extended aeration	25.0 TGD
306	Spring Hill Lanes	Extended aeration	10.0 TGD
307	Hernando Hills Rur	Extended aeration	10.0 TGD
308	Camp Awyle	Extended aeration	30.0 TGD
309	Dames' Mobile Home Park	Extended aeration	5.0 TGD
310	Camper's Holiday	Extended aeration	30.0 TGD
311	Brooksville Golf & Country Club	Extended aeration	5.0 TGD
312	Weeki Wachee Springs	Extended aeration	1.5 TGD
313	41 Trailer Village	Extended aeration	7.5 TGD
314	Holiday Inn W.W.	Extended aeration	50.0 TGD
315	Lakewood Retreat	Extended aeration	12.0 TGD
316	Ridge Manor Campground	Extended aeration	12.0 TGD
317	McGist Mobile Home Park	Extended aeration	20.0 TGD

(continued)

Table 29 (continued)

Number on map	Name	Process and/or treatment	Total capacity (thousand or million gal/day)
318	Brookridge Inc.	Extended aeration	200.0 TGD
319	Hidden Valley Campground	Extended aeration	5.0 TGD
320	Weeki Wachee Campground	Extended aeration	60.0 TGD
321	The Meadows Mobile Home Park	Extended aeration	26.0 TGD
322	Imperial Estates Mobile Home Park	Extended aeration	20.0 TGD
323	Berkeley Manor Subdivision	Extended aeration	50.0 TGD
324	Foxmoor Health & Racquet Club	Extended aeration	20.0 TGD
325	Whispering Oaks	Extended aeration	25.0 TGD
326	Sunnybrook Adult Mobile Home Park	Extended aeration	20.0 TGD
327	Hill-N-Dale Subdivision	Cont. stabilization	100.0 TGD
328	Holiday Inn Trav-L-Park	Extended aeration	27.0 TGD
329	Wesleyan Bible Conf.	Extended aeration	30.0 TGD
330	S.W. Florida Water Mgmt. District	Extended aeration	10.0 TGD
331	Brooksville Road Prison	Extended aeration to sand filter	10.0 TGD
332	Hernando Co. Airport Industrial Park	Extended aeration	300.0 TGD
333	Braewood Utilities	Extended aeration	15.0 TGD
334	Spring Hill Utilities	Cont. stabilization	200.0 TGD
335	Brooks Industries, Inc.	Extended aeration	5.0 TGD
336	Sparton Electronics	Extended aeration	1.0 TGD
337	Georgia-Pacific Corp.	Ext. aer. to evap/perc ponds	6,000.0 MGD
338	Florida Power Corp. #4 & 5	Activated sludge	15.0 TGD
339	Florida Power Training Facility	Extended aeration	3.5 TGD
340	Florida Power Corp. #1, 2, 3	Extended aeration	30.0 TGD
341	Point-O-Woods	Extended aeration	17.0 TGD

19. NATIONAL NATURAL LANDMARKS

The Heritage Conservation and Recreation Service administers the National Natural Landmarks Program which was established by 16 U.S. Code 461. The objective of the program is to assist in the preservation of a variety of significant natural areas which, when considered together, will illustrate the diversity of the country's natural heritage.

Significant ecological and geological natural areas are identified, studied, and then recognized by a panel of scientists to accomplish this goal. A designated natural landmark is an ecological or geological feature that is identified and recognized by a panel of scientists as being qualified for this distinction. A registered natural landmark is a designated natural landmark where the owner has agreed to preserve the site in its natural state and is given a plaque to commemorate the occasion. There are three registered natural landmarks in northwest Florida. These natural landmarks are described in Table 30 (Schuler 1981).

Table 30. National natural landmarks (NL) (Schuler 1981).

Parameter	Waccasassa Bay State Preserve	Manatee Springs	Wakulla Springs
County	Levy	Levy	Wakulla
Class	Designated NL	Designated NL	Designated NL
Owner	State of Florida	State of Florida	Private
Size	30,829.02 acres	2,074.67 acres	± 4,000 acres
Description	Prime example of north Florida coastal ecosystem and serves as a habitat for at least three endangered species	Ranks sixth in size among the great artesian springs of Florida.	An independent freshwater ecosystem and one of the largest artesian springs in Florida. It is rich in aquatic vegetation and wildlife and is bordered by cypress trees. It also contains a well-developed hardwood habitat.

20. HISTORIC PLACES DESIGNATED ON THE NATIONAL REGISTER

The Historic Sites Act of 1935 states that the preservation of historic and prehistoric sites is national policy and the National Park Service should be the investigative agent for obtaining accurate facts concerning these sites. The Historic Preservation Act of 1966 provides for an expanded National Register of districts, sites, and objects significant in American history and archeology, and funds to help acquire and preserve sites. The program is administered in Florida by the Florida Department of State, Division of Archives, History and Records Management. A listing of all historic places designated on the National Register in northwest Florida as of February 1983 is shown in Table 31 (Texas Instruments, Inc. 1978).

Table 31. Historic sites appearing on the National Register (Florida Department of State 1983b).

County	Location	Site
Bay	(None)	
Calhoun	T1S-R8W, sec. 3	Cayson Mound and Village
	T1N-R8W, sec. 33	Old Calhoun County Courthouse
Citrus	T18S-R17E, sec. 18	Crystal River Indian Mounds
	T19S-R20E, sec. 28	Fort Cooper
	T19S-R17E, sec. 32	Yulee Sugar Mill
Dixie	(None)	
Escambia	T2S-R30W, sec. 46	American National Bank Bldg.
	T2S-R30W, sec. 46	Clara Barkley Dorr House
	T2S-R30W, sec. 23	Fort George
	T5S-R30W, sec. 5	Fort San Carlos de Barrancas
	T2S-R30W, sec. 46	Louisville and Nashville Passenger Station and Express Building
	T2S-R30W, sec. 25	Pensacola Athletic Club
	T2S-R30W, sec. 22	Pensacola Hospital
	T3S-R31W, sec. 16	Pensacola Naval Air Station Historic District
	T2S-R30W, sec. 46	Buccaneer
	T3S-R30W, sec. 5	Fort Barrancas Historical Dist.
	T3S-R30W	Fort Pickens
	T2S-R30W, sec. 25	Charles W. Jones House
	T2S-R30W, sec. 46	L&N Marine Terminal Building
	T2S-R30W, sec. 46	Old Christ Church
	T2S-R30W, sec. 46	Pensacola Historic District
	T2S-R31W, sec. 16	Pensacola Lighthouse and Keepers Quarters
	T3S-R31W, sec. 34	Perdido Key Historic District
	T2S-R30W, sec. 46	Plaza Ferdinand VII
	T2S-R30W, sec. 46	St. Michael's Creole Benevolent Assoc. Hall

(continued)

Table 31 (continued)

County	Location	Site
Escambia	T2S-R30W, sec. 46	San Carlos Hotel
	T2S-R30W, sec 44, 46	St. Joseph's Church Buildings
	T2S-R30W, sec. 46	Saenger Theater
	T2S-R30W, sec. 46	Thiesen Building
Franklin	T9S-R8W, sec. 1 & 12	Apalachicola Historic District
	T7S-R5W, sec. 36	Crooked River Lighthouse
	T8S-R8W, sec. 35	Pierce Site
	T9S-R7W, sec. 6	David G. Raney House
	T6S-R1W, sec. 31	Yent Mound
	T10S-R8W, sec. 21	Cape St. George Light
	T6S-R8W, sec. 23	Ft. Gadsen Historic Memorial
	T8S-R6W, sec. 28	Porter's Bar Site
	T9S-R7W, sec. 6	Trinity Episcopal Church
Gulf	(None)	
Hernando	(None)	
Jefferson	T2N-R4E, sec. 25	Denham-Lacy House
	T2N-R7E, sec. 8	Lyndhurst Plantation
	T2N-R4E, sec. 30	Monticello Historic District
	T2N-R4E, sec. 5	Palmer-Perkins House
	T1S-R3E, sec. 22	San Juan de Aspalaga site
	T2S-R5E, sec. 3 & 4	San Miguel de Asile Mission site
	T2N-R5E, sec. 30	Wirick-Simmons House
	T1N-R3E, sec. 22	Lloyd Railroad Depot
	T1S-R4E, sec. 10	Asa May House
	T2N-R5E, sec. 30	Palmer House
	T2N-R5E, sec. 30	Perkins Opera House
	T1S-R3E, sec. 8	San Joseph de Oeuya site
	T1N-R4E, sec. 23	Turnbull-Ritter House
Levy	(None)	

(continued)

Table 31 (concluded)

County	Location	Site
Okaloosa	T2S-R24W, sec. 13	Fort Walton Mound
	T1S-R22W, sec. 7	Valparaiso Inn
Santa Rosa	T1N-R28W, sec. 3	Louisville and Nashville Depot
	T1N-R28W, sec. 3	St. Mary's Episcopal Church and Rectory
Taylor	(None)	
Wakulla	T3S-R1E, sec. 15	Bird Hammock
	T5S-R1W, sec. 77	Old Wakulla County Courthouse
	T4S-R1E, sec. 11	Fort San Marcos de Apalache.
Walton	T3N-R19W, sec. 35	Chautauqua Auditorium
	T3N-R19W, sec. 35	"Sun Bright" House
Washington	(None)	

21. ARCHAEOLOGICAL AND HISTORICAL SITES

Prehistoric man has inhabited Florida for at least the past 10,000 years (radiocarbon dating of skeletal remains at Warm Springs in Sarasota County). A total of 3,556 archaeological sites are listed on the Florida Master Site File of the Florida Division of Archives, History and Records Management for the northeast Gulf of Mexico study area. The Florida Master Site File classes 16th and 17th century and later European colonial sites as being "historic" and all sites predating that period as "prehistoric." The total number of historic and prehistoric sites for both terrestrial and underwater locations for northwest Florida are mapped by township on the individual atlas overlays.

Archaeological resources in the study area are afforded varying degrees of protection by the following Federal, State, and local laws:

* The Antiquity Act of 1906 (PL 59-209, 34 Stat. 225; 16 USC 431-433) provides Federal control of all archaeological resources on lands owned or controlled by the United States Government.

* The Historic Sites Act of 1935 (PL 74-292, 49 Stat. 666; 16 USC 461-467) states that the preservation of historic and prehistoric sites is national policy and that the National Park Service should be the investigative agent for obtaining accurate facts concerning these sites.

* The Reservoir Salvage Act of 1960 (PL 86-523, 74 Stat. 220; 16 USC 469-469c) provides for a survey of the archaeological resources of any area to be affected by federally funded construction of a dam.

* The Historic Preservation Act of 1966 (PL 89-665, 80 Stat. 915; USC 470) provides for an expanded National Register of districts, sites, and objects significant in American history and archaeology and funds to help acquire and preserve sites. National Register sites must be given careful consideration when any project using Federal funds might adversely affect them. The head of the responsible Federal agency must allow the Advisory Council on Historic Preservation established under Title II of this act a reasonable opportunity to comment on the undertaking.

* The Archaeological and Historic Preservation Act of 1974 provides for preservation and recovery of archaeological remains and/or historical sites which are endangered by any federally funded project. Provisions of this act may be applied only after an agency has shown initial compliance with other appropriate Federal planning requirements.

* Executive Order 11593 (May 1971) states that heads of Federal agencies shall locate, inventory, and nominate to the National Register all sites, buildings, districts, and objects which are under their jurisdiction and are eligible for listing.

* The Florida Archives and History Act of 1969 (Chapter 267, Florida Statutes) created the Division of Archives and History and gave it responsibility for all Florida-owned historical sites and properties. In addition, this act establishes the Division's authority to issue permits for excavation or surfaced reconnaissance of historic and archaeological sites on State-owned and controlled lands.

On the local level, County Commissioners have the power to establish zoning ordinances that would affect archaeological sites under their jurisdiction (Texas Instruments, Inc. 1978).

The total number of archaeological sites by county for northwest Florida is shown in Table 32.

Table 32. Archaeological and historical sites per county (Florida Department of State 1983a).

County	Number of sites
Escambia	955
Santa Rosa	78
Okaloosa	130
Walton	129
Washington	43
Bay	178
Calhoun	20
Gulf	18
Franklin	731
Wakulla	197
Jefferson	556
Taylor	90
Dixie	72
Levy	137
Citrus	184
Hernando	38
Total	3,556

22. NATURE CONSERVANCY LANDS

The Nature Conservancy, established in 1951, is the largest private conservation organization specializing in the preservation of natural lands. The primary types of lands purchased by the conservancy for preservation include endangered species habitat, native ecosystems, environmentally critical areas, and primary sites for scientific research. The Nature Conservancy presently has Heritage programs in 30 states. The Nature Conservancy presently maintains a seven-member staff in Tallahassee which is responsible for Florida's Heritage Program.

In April 1981, the Conservancy entered into a 3-year contract with the Florida Department of Natural Resources establishing the eight-member staff to develop a "Florida Natural Areas Inventory." The Florida Natural Areas Inventory is funded by the Conservation and Recreation Lands Trust Fund (CARL). The Inventory has set up a filing and mapping system for three categories: natural communities (including terrestrial and aquatic habitats), special plants, and special animals (endangered and threatened). Sixty-seven natural communities, 342 plant species and 445 animal species are presently listed on this inventory. The data base for this listing is presently stored on both manual and computer files. Occurrences are plotted on U.S.G.S. 1:24,000 quadrangles. The data base can be searched by location, species or community name, and endangerment status. Information can be provided in a variety of formats and plays an important role in environmental permit reviews and planning for preserves or land development.

The Nature Conservancy has purchased the following seven sites for preservation in northwest Florida (TNC 1982):

1. Choctawhatchee (Walton County)
2. Dog Island (Franklin County)
3. Alligator Point (Franklin County)
4. Cummer Sanctuary (Levy County)
5. Brooks Preserve (Hernando County)
6. Robins Memorial Forest (Hernando County)
7. Escambia River Floodplain

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25. GLOSSARY

algae - A group of plants, one-celled, colonial, or many-celled, containing chlorophyll and having no true root, stem, or leaf. Algae are found in water or damp places.

coral reef - A ridge or mound of limestone, the upper surface of which lies, or lay at the time of its formation, near the level of the sea, and is predominantly composed of calcium carbonate secreted by organisms, the most important of which are corals.

demography - The study and description of population.

dredge spoil disposal site - A submerged spot where solid materials which have been dredged from the bottoms of waterways are dumped or disposed.

ecosystem - An interacting community of plants and animals, viewed within its physical environment or habitat.

estuary - Any semi-enclosed coastal water, open to the sea, having a freshwater input and with cyclical fluctuations in salinity.

neritic fish - Fish which swim in shallow ocean waters of less than 200 meters depth over the Continental Shelf.

oxidation - One of the processes of chemical weathering, involving the combination with oxygen.

pelagic fish - A fish inhabiting the open waters of an ocean or lake.

price level index - An index used for measuring the rate of inflation by comparing the present prices of various consumer items with the 1967 price of similar items.

Radiocarbon dating - The determination of the age of buried organic material by measuring the proportion of the isotope C^{14} (radioactive carbon) to the isotope C^{12} in the carbon it contains and comparing this to the atmospheric ratio. The method is suitable for the determination of ages up to a maximum of about 40,000 years.

sanctuary - A reservation or refuge where animals or birds may not be hunted or molested.

savannah - A tract of open grassland supporting grass and other low vegetation, with but a scattered growth of pine or other trees and bushes.

water table - The upper limit of the zone of saturation in permeable rocks; this level may vary seasonally with the amount of percolation.

SOILS AND LANDFORMS

1. SOILS

1.1 BACKGROUND

The soils mapped within the northeast Gulf of Mexico study area reflect a pattern of soil associations. Each soil association consists of one or more major soils for which it is named, and at least one minor soil. The soils in one association may occur in another association, however in a different pattern. The data used to produce the soil maps in this atlas were the most up-to-date information available from the U.S. Soil Conservation Service at the time material for these maps was collected. The attached 1:100,000 scale maps are most valuable as a source of information on the general nature of soils and the various soil types to be found in an area rather than as a precise location map for the soil types. A map at a smaller scale (1:1,000,000 scale) displaying the most recent soil survey data for Florida is available from the U.S. Soil Conservation Service.

1.2 GENESIS

The soils in the northeast Gulf of Mexico coastal region have been derived from recent beach deposits (wind- or wave-derived), river alluvium, marine terrace deposits or directly from a particular geologic formation. A large portion of the region is underlain by marine terrace deposits of the Holocene and Pleistocene epochs. A northern portion of the region is underlain by clastic material deposited by runoff from the Appalachian Mountains to the north.

1.3 SOIL CLASSIFICATION

The classification of soils follows the standard soil taxonomy key of the U.S. Soil Conservation Service (USSCS 1975).

1.3.1 Soil Association per Legend Unit. Those associations found in the atlas are given below.

1. Lakeland-Eustis-Lakewood Association. Nearly level to gently sloping, excessively drained soils, sandy throughout.

2. Lakeland, Ruston, and Norfolk-Sunsweet, Carnegie and Cuthbert Association. Sloping to steep, excessively drained soils, sandy throughout; well-drained, loamy soils with loamy or clayey subsoils, and moderately well-drained loamy soils with clayey subsoils.

3. Red Bay-Blakely Association. Nearly level to gently sloping, well-drained loamy soils with loamy subsoils.

4. Tifton-Carnegie-Faceville Association. Nearly level to gently sloping, well-drained, loamy soils with clayey or loamy subsoils.

5. Norfolk-Ruston-Savannah Association. Nearly level to gently sloping, well-drained or moderately well-drained, loamy soils with loamy subsoils.

6. Tifton-Irvington-Lynchburg Association. Nearly level to gently sloping, well-drained to somewhat poorly drained, loamy soils with clayey or loamy subsoils.

7. Klej-Leon Association. Nearly level, somewhat poorly drained sandy soils, sandy throughout or with weakly cemented sandy subsoil.

8. Huckabee-Kalmia-Izagota Association. Nearly level, well-drained soils, sandy throughout and moderately well-drained, loamy soils with loamy or clayey subsoils, on river terraces.

9. Coastal Dune Land and Beach Tidal Marsh Association. Nearly level, sandy soils and poorly drained soils subject to frequent flooding by tidal waters and gently sloping, sandy soils not subject to flooding by tidal waters.

10. Plummer-Rutlege-Alluvial Land-Fresh Water Swamp-Dorovan-Pamlico Association. Nearly level, poorly drained soils with a thick surface layer overlying a loamy subsoil and very poorly drained soils that are sandy throughout.

11. Lakeland-Paola-Kureb-St. Lucie-Rimini Association. Nearly level to steep, excessively drained soils, sandy throughout.

12. Lakeland-Troup Association. Nearly level to steep, excessively drained soils, sandy throughout, and well-drained soils with very thick sandy layers over loamy subsoil.

13. Troup-Orangeburg Association. Highly dissected nearly level to steep, well-drained, sandy soils with loamy subsoils.

14. Dothan-Orangeburg Association. Nearly level to sloping, well-drained, loamy and sandy soils with loamy subsoils.

15. Red Bay-Lucy Association. Nearly level to sloping, well-drained, loamy and sandy soils with loamy subsoils.

16. Chipley-Scranton Association. Nearly level to gently sloping, moderately well to somewhat poorly drained sandy soils.

17. Johns-Leaf Association. Nearly level, somewhat poorly to poorly drained, sandy soils with loamy subsoils on river terraces.

18. Salt Water Marsh-Bayvi-Dirego Association. Nearly level, very poorly drained soils subject to frequent flooding by tidal waters.

19. Fuquay-Lucy-Troup Association. Nearly level to sloping, well-drained soils with sandy layers over loamy subsoil.

20. Dothan-Orangeburg-Tifton Association: Nearly level to steep, well-drained sandy soils with loamy subsoil.

21. Lakeland-Faceville Association. Sloping to steep, excessively drained soils, sandy throughout, and well-drained, loamy soils with clayey subsoil.

22. Chipley-Albany-Leon Association. Nearly level to gently sloping, moderately well-drained soils, sandy throughout; somewhat poorly drained soils with very thick sandy layers over loamy subsoils, and poorly drained sandy soils with weakly cemented sandy subsoil.

23. Ardilla-Leefield-Stilson Association. Nearly level to gently sloping, somewhat poorly drained and moderately well-drained sandy soils with loamy subsoil.

24. Tifton-Faceville-Greenville Association. Nearly level to sloping, well-drained loamy soils with loamy subsoil.

25. Norfolk-Ruston-Goldsboro Association. Nearly level to sloping, well to moderately well-drained, sandy soils with loamy subsoil.

26. Tifton-Faceville-Marlboro Association. Nearly level to sloping, well to moderately well-drained sandy soils with loamy or clayey subsoil.

27. Lakeland-Cuthbert-Shubuta Association. Sloping to steep, excessively drained soils, sandy throughout, and moderately well-drained sandy soils with clayey subsoil.

28. Blanton-Klej-Plummer Association. Nearly level to gently sloping, moderately well-drained, somewhat poorly drained, and poorly drained sandy soils with loamy subsoil.

29. Goldsboro-Lynchburg-Rains Association. Nearly level to gently sloping, moderately well-drained, somewhat poorly drained and poorly drained sandy soils with loamy subsoil.

30. Kureb-Resota-Mandarin Association. Nearly level gently sloping, excessively drained and moderately well-drained soils, sandy to depths of 80 inches or more, some of which have organic stained sandy layers.

31. Lakeland-Foxworth-Centenary Association. Nearly level to sloping, excessively drained and moderately well-drained soils, sandy to depths of 80 inches or more, some of which have organic stained sandy layers.

32. Leefield-Albany-Stilson Association. Nearly level to gently sloping, somewhat poorly drained soils and moderately well-drained soils, some of which are sandy to a depth of 20 to 40 inches and loamy below, and some of which are sandy to more than 40 inches and loamy below.

33. Hurricane-Chipley-Albany Association. Nearly level to gently sloping, somewhat poorly drained soils, some sandy throughout and some sandy to depths of 40 inches or more and loamy below.

34. Pottsburg-Leon-Rutlege Association. Nearly level, poorly drained soils sandy to depths of 80 inches and some with organic stained sandy layers.

35. Plummer-Pelham Association. Nearly level, poorly drained sandy soils that have loamy subsoils at depths of 40 inches or more or within depths of 20 to 40 inches.

36. Rutlege-Allanton-Pickney Association. Nearly level or depressional, very poorly drained soils, sandy to depths of 80 inches or more, and some with organic stained sandy layers.

37. Chipley-Albany-Stilson Association. Nearly level, moderately well-drained soils that are sandy throughout, poorly drained soils with very thick sandy layers over loamy subsoil, and moderately well-drained sandy soils with loamy subsoils.

38. Leon-Albany-Plummer-Chipley-Osier Association. Nearly level, poorly drained sandy soils with weakly cemented sandy subsoil, and poorly drained soils with very thick sandy layers over loamy subsoil.

39. Dunbar-Bladen Association. Nearly level, poorly drained loamy soils with clayey subsoils.

40. Dothan-Stilson-Lucy Association. Nearly level and gently sloping, well and moderately well-drained sandy soils with loamy subsoils.

41. Ardilla-Leefield-Pansey Association. Nearly level, somewhat poorly and poorly drained sandy soils with weakly cemented sandy subsoil and very thick sandy layers over loamy subsoil.

42. Chipley-Albany-Blanton Association. Nearly level to gently sloping, moderately well-drained soils that are sandy throughout, and somewhat poorly drained soils with very thick sandy layers over loamy subsoil.

43. Leon-Felda-Matmon Association. Nearly level, poorly drained sandy soils with weakly cemented sandy subsoil, poorly drained sandy soils with loamy subsoil, and somewhat poorly drained sandy soils with clayey subsoils in close proximity to limestone rock.

44. Dothan-Orangeburg-Red Bay Association. Nearly level to sloping well-drained sandy or loamy soils with loamy subsoils.

45. Alpin-Blanton-Eustis Association. Nearly level to sloping excessively drained soils with very thick sandy layers over thin loamy sand or sandy loam lamella, and moderately well-drained soils with very thick sandy layers over loamy subsoils, and somewhat excessively drained soils sandy throughout.

46. Orangeburg-Lucy-Dothan Association. Nearly level to sloping well-drained sandy soils with loamy subsoils.

47. Chipley-Albany-Plummer Association. Nearly level to gently sloping moderately well-drained soils, sandy throughout, and somewhat poorly and poorly drained soils with very thick sandy layers over loamy subsoil.

48. Leon-Mascotte-Rutlege Association. Nearly level poorly drained sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil, and very poorly drained soils sandy throughout.

49. Broward, var.-Matmon-Osier Association. Nearly level somewhat poorly drained sandy soils, shallow to limestone and somewhat poorly drained sandy soils with clayey subsoils, shallow to limestone and poorly drained soils sandy throughout.

50. Manatee, var.-Felda, var.-Copeland, Var. Association. Nearly level very poorly and poorly drained sandy soils with loamy subsoils and very poorly drained sandy soils with loamy subsoils, shallow to limestone.

51. Fresh Water Swamp, Shallow to Limestone Association. Nearly level very poorly drained soils, shallow to limestone, subject to prolonged flooding.

52. Salt Water Marsh and Swamp-Coastal Dunes Association. Nearly level very poorly drained soils subject to frequent flooding by tidal waters and somewhat excessively drained sandy soils.

53. Alpin-Blanton Association. Nearly level to sloping excessively drained soils with very thick sandy layers over thin loamy sand or sandy loam lamella, and moderately well-drained soils with very thick sandy layers over loamy subsoil.

54. Chipley-Blanton-Swamp Association. Nearly level to gently sloping moderately well-drained soils, sandy throughout, and moderately well-drained soils with very thick sandy layers over loamy subsoils and very poorly drained soils.

55. Adamsville, var.-Chiefland-Blanton Association. Nearly level to gently sloping somewhat poorly drained soils, sandy throughout, and well-drained soils with thick sandy layers over loamy subsoils that are underlain by limestone, and moderately well drained soils with very thick sandy layers over loamy subsoils.

56. Candler-Apopka Association. Nearly level to sloping excessively drained soils with very thick sandy layers over thin loamy or sandy loam lamella, and well-drained soils with very thick sandy layers over loamy subsoil.

57. Jonesville-Chiefland-Archer Association. Nearly level to sloping excessively drained soils with very thick sandy layers over loamy subsoil, and moderately well-drained soils with loamy or clayey subsoils underlain by limestone.

58. Arredondo-Gainesville Association. Nearly level to sloping well-drained soils with very thick sandy layers over loamy subsoil, and well-drained soils, sandy throughout.

59. Hernando-Archer-Chiefland Association. Nearly level to gently sloping moderately well- to well-drained sandy soils with loamy or clayey subsoils underlain by limestone.

60. Sparr-Lochloosa-Tavares Association. Nearly level to sloping somewhat poorly drained soils with very thick or sandy layers over loamy subsoil, and moderately well-drained sandy soils.

61. Adamsville-Osier Association. Nearly level to gently sloping somewhat poorly drained sandy soils.

62. Bushnell-Wabasso-Felda Association. Nearly level somewhat poorly drained soils with thin sandy layers over a clayey subsoil layer underlain by limestone, and poorly drained sandy soils with a weakly cemented subsoil layer underlain by a loamy subsoil and poorly drained sandy soils with loamy subsoil.

63. Blichton-Flemington-Kanapaha Association. Nearly level to strongly sloping, poorly drained sandy soils with loamy or clayey subsoil, and poorly drained soils with very thick sandy layers over loamy subsoil.

64. Leon-Mascotte-Surrency Association. Nearly level poorly drained sandy soils with weakly cemented sandy subsoil, and poor drained sandy soils with a weak cemented sandy subsoil layer underlain by loamy subsoil and very poorly drained sandy soils with clayey subsoil.

65. Lynne-Pomona-Pompano Association. Nearly level poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy or clayey subsoil, and poorly drained sandy soils.

66. Candler-Paola-Tavares Association. Nearly level to sloping excessively drained soils with very thick sandy layers over thin loamy or sandy loam lamella and excessively and moderately well-drained soils sandy throughout.

67. Candler-Adamsville-Pompano Association. Nearly level to sloping excessively drained soils with very thick sandy layers over thin loamy or sandy loam lamella and somewhat poorly and poorly drained soils sandy throughout.

68. Arredondo-Kendrick Association. Nearly level to sloping well-drained soils with very thick sandy layers over loamy subsoil.

69. Broward-Boca Association. Nearly level somewhat poorly drained sandy soils underlain by limestone and poorly drained sandy soils with loamy subsoil underlain by limestone.

70. Panasoffkee-Bushnell Association. Nearly level somewhat poorly drained sandy soils with clayey subsoils underlain by limestone and somewhat poorly drained soils with thin sandy layers over clayey subsoil underlain by limestone.

71. Myakka-Basinger Association. Nearly level poorly drained sandy soils with weakly cemented sandy subsoil and poorly drained soils sandy throughout.

72. Meggett, var.-Pompano Association. Nearly level poorly drained soils with thin loamy layers over clayey subsoil and poorly drained soils sandy throughout.

73. Terra Ceia-Placid Association. Nearly level very poorly drained well-decomposed organic soils 50 to 80 inches thick or more and very poorly drained soils sandy throughout.

74. Arredondo-Sparr-Kendrick Association. Nearly level to sloping, well-drained and somewhat poorly drained sandy soils over loamy material.

75. Candler-Lake Association. Nearly level to sloping, excessively drained sandy soils with some lamallae of loamy sand and sandy loam present in the deeper horizons.

76. Masaryk Association. Nearly level to gently sloping, moderately well-drained sandy soils overlying loamy material.

77. Nobleton-Blichton-Flemington Association. Nearly level to strongly sloping poorly drained fine sands and sandy loams overlying loamy and clayey material.

78. EauGallie-Wabasso-Basinger Association. Nearly level, poorly drained sandy soils which are either sandy throughout or overlie loamy material.

79. Paisley-Floridana-Wabasso Association. Nearly level, poorly drained sandy soils overlying a clayey subsoil or loamy material.

80. Okeelanta-Aripeka-Terra Ceia Association. Nearly level, very poorly drained organic soils overlying sandy material or loamy soils overlying limestone.

81. Homosassa-Weekiwachee-Lacoochee Association. Nearly level, very poorly drained organic and mineral soils, and poorly drained, thin, sandy soils overlying limestone which are subject to frequent tidal flooding.

82. Floridana-Basinger Association. Nearly level, poorly drained sandy soils which are sandy throughout or overlie loamy material.

83. Salt Water Marsh and Swamp Association. Nearly level very poorly drained soils subject to frequent tidal flooding.

84. Fresh Water Swamp and Marsh Association. Nearly level very poorly drained soils subject to prolonged flooding.

85. Blichton-Lochloosa-Kendrick Association. Nearly level to sloping, poorly drained sandy soils with loamy subsoils, somewhat poorly drained soils with thick sandy layers over loamy subsoil, and well-drained soils with very thick sandy layers over loamy subsoil.

86. <u>Paisley-Bushnell Association</u>. Nearly level to gently sloping poorly and somewhat poorly drained soils with thin sandy layers over clayey subsoil.

87. <u>Myakka-Pomello-Basinger Association</u>. Nearly level, poorly drained and moderately well-drained sandy soils with weakly cemented sandy subsoil and poorly drained soils sandy throughout.

1.4 PHYSICAL SOIL PROPERTIES

Table 33 gives estimates of the physical properties of the soil of each association. The table is divided into the following components:

- Soil number on map (see map legend)

- Soil associations and components (see 1.3.1)

- Percentage of component soils

- Flood probability (yr)

- USDA Classification for soil texture

- Permeability (inches/hr)

  Permeability refers to the vertical rate at which water passes through uncompacted and undisturbed soil above the water table.

- Percent water capacity

  Water capacity is the percentage of empty space available in soil for water retention.

- pH

  The acidity or alkalinity of the soils is referred to as pH. A pH of less than 7.0 indicates an acid soil; a pH of more than 7.0 indicates an alkaline soil.

Table 33. Composite soil association physical properties (U.S. Department of Agriculture 1960-1982; Florida Department of Administration 1975).

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
1	Lakeland-Eustis-Lakewood						
	Lakeland	--	None	Fine sand	> 20.0	0.03-0.08	4.5-6.0
	Eustis	--	None	Loamy sand	5.0 - 10.0+	0.07-0.08	5.0-6.0
	Lakewood	--	None	Fine sand	10.0+	0.03-0.04	5.0-6.0
2	Lakeland, Ruston, & Norfolk Sunsweet, Carnegie & Cuthbert						
	Lakeland, Ruston, and Norfolk	65	None	Fine sand	> 20.0	0.03-0.08	4.5-6.0
	Sunsweet, Carnegie and Cuthbert	15	None	Fine sandy loam	5.0 - 10.0	0.09-0.12	4.5-5.0
3	Red Bay-Blakely						
	Red Bay	40	None	Sandy loam	0.6 - 6.0	0.07-0.17	4.5-6.0
	Blakely	40	None	Loam	2.5 - 10.0	0.12-0.13	4.5-6.0
4	Tifton-Carnegie-Faceville						
	Tifton	65	None	Sandy loam	0.6 - 20.0	0.06-0.15	4.5-5.5
	Carnegie	20	None	Fine sandy loam	5.0 - 10.0	0.09-0.11	4.5-5.0
	Faceville	10	None	Fine sandy loam	0.8 - 10.0	0.09-0.11	4.5-6.0
5	Norfolk-Ruston-Savannah						
	Norfolk	45	None	Fine sandy loam	2.5 - 10.0	0.09-0.12	4.5-5.5
	Ruston	30	None	Fine sandy loam	5.0 - 10.0	0.09-0.12	4.5-5.5
	Savannah	15	None	Fine sandy loam	2.5 - 10.0	0.09-0.12	4.5-5.5
6	Tifton-Irvington-Lynchburg						
	Tifton	70	None	Sandy loam	0.6 - 20.0	0.06-0.15	4.5-5.5
	Irvington	12	1:5	Sandy clay loam	0.8 - 10.0	0.09-0.11	4.5-5.5
	Lynchburg	8	None	Sandy loam	0.6 - 6.0	0.09-0.16	3.6-5.5

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
7	Klej-Leon						
	Klej	55	1:5	Loamy sand	5.0 - 10.0	0.07-0.08	4.5-5.5
	Leon	25	None	Fine sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
8	Huckabee-Kalmia-Izagota						
	Huckabee	45	1:25	Loamy fine sand		0.06-0.07	5.0-6.0
	Kalmia	25	1:10	Fine sandy loam	2.5 - 10.0	0.09-0.12	4.5-5.5
	Izagota	20	1:10	Fine sandy loam	0.05- 5.0	0.09-0.11	4.5-5.5
9	Coastal Dune Land and Beach Tidal Marsh						
	Coastal Dune Land and Beach	50	Annual	Marine sand with shells	10+	---	7.0+
	Tidal Marsh	20	Daily	Marine fine sand silt and organic water	---	---	---
10	Plummer-Rutlege-Alluvial Land-Fresh Water Swamp Dorovan-Pamlico						
	Plummer	--	Annual	Sandy loam	0.6 - 20.0	0.06-0.15	4.5-5.5
	Rutlege	--	Annual	Loamy fine sand	2.5 - 10.0	0.02-0.09	4.5-5.5
	Alluvial Land	--	Annual	Variable	---	---	---
	Fresh Water Swamp	--	Season	Muck	---	---	---
	Dorovan	--	Season	Muck	---	---	---
	Pamlico	--	Season	Muck	---	---	---
11	Lakeland-Paola-Kureb St. Lucie- Rimini						
	Lakeland	35	None	Fine sand	> 20.0	0.03-0.08	4.5-6.0
	Paola	--	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
	Kureb	--	---	Fine sand	---	---	---
	St. Lucie	--	None	Fine sand	> 20.0	< 0.05	5.1-6.0
	Rimini	--	---	Fine sand	---	---	---

(continued)

Table 33 (continued)

Number on map	Soil Association & component soil	Flood %	frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
12	Lakeland-Troup						
	Lakeland	45	None	Fine sand	> 20.0	0.03-0.08	4.5-6.0
	Troup	40	None	Loamy sand and clay loam	0.6 - 20.0	0.03-0.13	4.5-5.5
13	Troup-Orangeburg						
	Troup	40	None	Loamy sand and clay loam	0.6 - 20.0	0.06-0.15	4.5-5.5
	Orangeburg	30	None	Sandy loam	0.6 - 6.0	0.07-0.13	4.5-6.0
14	Dothan-Orangeburg						
	Dothan	45	None	Sandy clay loam	0.2 - 6.0	0.08-0.14	4.5-5.5
	Orangeburg	25	None	Sandy loam	0.6 - 6.0	0.07-0.13	4.5-6.0
15	Red Bay-Lucy						
	Red Bay	60	None	Sandy loam	0.6 - 6.0	0.07-0.17	4.5-6.0
	Lucy	25	None	Sandy clay loam	0.6 - 20.0	0.06-0.14	4.5-5.5
16	Chipley-Scranton						
	Chipley	55	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Scranton	20	1:2	Sandy	2.5 - 10.0	0.03-0.11	5.1-5.5
17	Johns-Leaf						
	Johns	45	1:25	Fine sandy loam	0.6 - 20.0	0.03-0.14	4.5-5.5
	Leaf	20	---	Fine sandy loam	---	---	---
18	Saltwater Marsh-Bayvi-Dirego						
	Saltwater Marsh	--	Tidal	Marine sand, silt and organic matter	---	---	---
	Bayvi	--	Tidal	Marine sand, silt and organic matter	---	---	---
	Dirego	--	Tidal	Marine sand, silt and organic matter	---	---	---

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	Flood frequency %	(yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
19	Fuquay-Lucy-Troup						
	Fuquay	40	None	Fine sand over sandy loam	0.06 - 6.0	0.04-0.15	4.5-5.5
	Lucy	25	None	Sandy clay loam	0.6 - 20.0	0.06-0.14	4.5-5.0
	Troup	20	None	Loamy sand and clay loam	0.6 - 20.0	0.03-0.13	4.5-5.5
20	Dothan-Orangeburg-Tifton						
	Dothan	35	None	Sandy clay loam	0.2 - 6.0	0.08-0.14	4.5-5.5
	Orangeburg	30	None	Sandy loam	0.6 - 6.0	0.07-0.13	4.5-6.0
	Tifton	15	None	Sandy loam	0.6 - 20.0	0.06-0.15	4.5-5.5
21	Lakeland-Faceville						
	Lakeland	40	None	Fine sand	> 20.0	0.03-0.08	4.5-6.0
	Faceville	35	None	Loamy sand	0.2 - 5.0	0.06-0.13	5.1-5.5
22	Chipley-Albany-Leon						
	Chipley	50	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Albany	25	None	Loamy sand	0.6 - 20.0	0.02-0.16	4.5-6.0
	Leon	10	None	Fine sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
23	Ardilla-Leefield-Stilson						
	Ardilla	40	---	Sandy loam	---	---	---
	Leefield	25	None	Sandy loam	0.2 - 20.0	0.04-0.13	4.5-6.5
	Stilson	10	---	Sandy loam	---	---	---
24	Tifton-Faceville-Greenville						
	Tifton	30	None	Sandy loam	0.6 - 20.0	0.06-0.15	4.5-5.5
	Faceville	25	None	Loamy sand	0.2 - 5.0	0.06-0.13	5.1-5.5
	Greenville	15	None	Fine sand loam over sandy clay loam	0.6 - 2.0	0.11-0.18	4.5-5.5

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
25	Norfolk-Ruston-Goldsboro						
	Norfolk	30	None	Fine sandy loam	2.5 - 10.0	0.09-0.12	4.5-5.5
	Ruston	25	none	Fine sandy loam	5.0 - 10.0	0.09-0.12	4.5-5.5
	Goldsboro	10	1:5	Coarse sand over sandy loam	0.8 - 10.0	0.03-0.11	5.1-5.5
26	Tifton-Faceville-Marlboro						
	Tifton	35	None	Sandy loam	0.6 - 20.0	0.06-0.15	4.5-5.5
	Faceville	30	None	Loamy sand	0.2 - 5.0	0.06-0.13	5.1-5.5
	Marlboro	10	None	Loamy sand	0.2 - 10.0	0.12-0.13	5.1-5.5
27	Lakeland-Cuthbert-Shubuta						
	Lakeland, Cuthbert, Shubuta	85	None	Fine sand	> 20	0.03-0.08	4.5-6.0
28	Blanton-Klej-Plummer						
	Blanton	45	1:5	Sand	0.05- 20.0	0.13-0.20	5.1-5.5
	Klej	25	1:5	Loamy sand	5.0 - 10.0	0.07-0.08	4.5-5.5
	Plummer	15	Season	Sand	10+	0.03-0.08	5.1-5.5
29	Goldsboro-Lynchburg-Rains						
	Goldsboro	35	1:5	Coarse sand over sandy loam	0.8 - 10.0	0.03-0.11	5.1-5.5
	Lynchburg	25	None	Sandy loam	0.6 - 6.0	0.09-0.16	3.6-5.5
	Rains	15	1:25	Sandy clay loam	0.6 - 6.0	0.08-0.15	4.5-6.5
30	Kureb-Resota-Mandarin						
	Kureb	--	None	Sand	6.0 - 20.0	< 0.05	4.5-7.3
	Resota	--	--	Sand	---	---	---
	Mandarin	--	--	Sand	---	---	---

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	Flood frequency %	(yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
31	Lakeland-Foxworth-Centenary						
	Lakeland	--	None	Fine sand	> 20	0.03-0.08	4.5-6.0
	Foxworth	--	None	Sand over fine sand	> 20	0.03-0.10	4.5-5.5
	Centenary	--	--	Fine sand	---	---	---
32	Leefield-Albany-Stilson						
	Leefield	--	None	Sandy loam	0.2 - 20.0	0.04-0.13	4.5-6.0
	Albany	--	None	Loamy sand	0.6 - 20.0	0.02-0.16	4.5-6.0
	Stilson	--	--	Loamy sand	---	---	---
33	Hurricane-Chipley-Albany						
	Hurricane	--	--	Fine sand	---	---	--
34	Pottsburg-Leon-Rutlege						
	Pottsburg	--	--	Fine sand	---	---	---
	Leon	--	None	Fine sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
	Rutlege	---	Annual	Loamy sand	6.0 - 20.0	0.04-0.10	3.6-5.0
35	Plummer-Pelham						
	Plummer	--	Season	Sand	10+	0.03-0.08	5.1-5.5
	Pelham	--	--	Fine sand over sandy loam	0.6 - 20.0	0.05-0.13	4.5-5.5
36	Rutlege-Allanton-Pickney						
	Rutlege	--	Annual	Loamy sand	6.0 - 20.0	0.04-0.10	3.6-5.0
	Allanton	--	--	Loamy sand	---	---	---
	Pickney	--	--	Loamy sand	---	---	---
37	Chipley-Albany-Stilson						
	Chipley	40	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Albany	30	None	Loamy sand	0.6 - 20.0	0.02-0.16	4.5-6.0
	Stilson	15	--	Fine sand	---	---	---

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
38	Leon-Albany-Plummer-Chipley Osier						
	Leon	--	None	Find sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
	Albany	--	None	Loamy sand	0.6 - 20.0	0.02-0.16	4.5-6.0
	Plummer	--	Season	Sand	10+	0.03-0.08	5.1-5.5
	Chipley	--	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Osier	--	--	Loamy sand	---	---	---
39	Dunbar-Bladen						
	Dunbar	50	1:5	Sandy loam and clay	0.05- 10.0	0.07-0.17	5.1-5.5
	Bladen	30	Annual	Sandy clay loam	0.05- 0.8	0.08-0.20	5.1-5.5
40	Dothan-Stilson-Lucy						
	Red Bay	60	None	Sandy loam	0.6 - 6.0	0.07-0.17	4.5-6.0
	Lucy	25	None	Sandy clay loam	0.6 - 20.0	0.06-0.14	4.5-5.5
	Lucy	10	None	Sandy clay loam	0.2 - 6.0	0.08-0.14	4.5-5.5
41	Ardilla-Leefield-Pansey						
	Ardilla	35	--	Sandy loam	---	---	---
	Leefield	25	None	Sandy loam	0.2 - 20.0	0.04-0.13	4.5-6.0
	Pansey	20	--	Sandy loam	---	---	---
42	Chipley-Albany-Blanton						
	Chipley	50	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Albany	15	None	Loamy sand	0.6 - 20.0	0.02-0.16	4.5-6.0
	Blanton	15	1:5	Sand	0.05- 20.0	0.13-0.20	5.1-5.5

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	Flood frequency %	(yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
43	Leon-Felda-Matmon						
	Leon	30	None	Fine sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
	Felda	25	1:12.5	Fine sand, slightly loamy, with some shells	0.63- 20.0	<0.05-0.15	5.1-7.8
	Matmon	20	--	Loamy fine sand	---	---	---
44	Dothan-Orangeburg-Red Bay						
	Dothan	35	None	Sandy clay loam	0.2 - 6.0	0.08-0.14	3.4-5.5
	Orangeburg	30	None	Sandy loam	0.6 - 6.0	0.07-0.13	4.5-6.0
	Red Bay	10	None	Sandy loam	0.6 - 6.0	0.07-0.17	4.5-6.0
45	Alpin-Blanton-Eustis						
	Alpin	60	None	Sand over fine sand	7.20	0.03-0.10	4.5-6.0
	Blanton	20	1:5	Sand	0.05- 20.0	0.13-0.20	5.1-5.5
	Eustis	10	None	Sand over sandy loam	0.2 - 10.0	0.04-0.12	4.1-5.5
46	Orangeburg-Lucy-Dothan						
	Orangeburg	60	None	Sandy loam	0.6 - 6.0	0.07-0.13	4.5-6.0
	Lucy	20	None	Sandy Clay loam	0.6 - 20.0	0.06-0.14	4.5-5.0
	Dothan	10	None	Sandy Clay loam	0.2 - 6.0	0.08-0.14	4.5-5.5
47	Chipley-Albany-Plummer						
	Chipley	50	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Albany	20	None	Loamy sand	0.6 - 20.0	0.02-0.16	4.5-6.0
	Plummer	15	Season	Sand	10.0+	0.03-0.08	5.1-5.5

(continued)

Table 33 (continued)

Number on map	Soil association % component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
48	Leon-Mascotte-Rutlege						
	Leon	30	None	Fine sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
	Mascotte	25	--	Loamy fine			
49	Broward,var.-Matmon-Osier						
	Broward,var.	42	--	Loamy fine sand over limestone	---	---	---
	Matmon	20	--	Loamy fine sand, over limestone	---	---	---
	Osier	20	--	Loamy fine sand	---	---	---
50	Manatee,var-Felda,var. Copeland,var.						
	Manatee,var.	50	--	Loamy fine sand	---	---	---
	Felda,var.	25	--	Fine sand over loam	---	---	---
	Copeland,var.	15	--	Fine sand over loam	---	---	---
51	Fresh Water Swamp, Shallow to Limestone						
	Fresh Water Swamp, Shallow to Limestone	75	Season	Fine sand, silt, & organics	---	---	---
52	Salt Water Marsh and Swamp Coastal Dunes						
	Salt Water Marsh & Swamp	70	Tidal	Marine fine sand & silt	---	---	---
	Coastal Dunes	10	None	Sand	6.0 - 20.0	0.03-0.05	4.5-6.0
53	Alpin-Blanton						
	Alpin	80	None	Sand over fine sand	7.20	0.03-0.10	4.5-6.0
	Blanton	10	1:5	Sand	0.05- 20.0	0.13-0.20	5.1-5.5

(continued)

Table 33 (continued)

Number on map	Soil associaton & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
54	Chipley-Blanton-Swamp						
	Chipley	35	None	Fine sand	6.0 - 20.0	0.03-0.10	4.5-6.5
	Blanton	35	1:5	Sand	0.05- 20.0	0.13-0.20	5.1-5.5
	Swamp	20	Season	Variable	---	---	---
55	Adamsville,var.-Chiefland						
	Adamsville,var.	30	None	Sand	6.0 - 20.0	0.05-0.10	4.5-6.0
	Chiefland	30					
	Blanton	30	1:5	Sand	0.05- 20.0	0.13-0.20	5.1-5.5
56	Candler-Apopka						
	Candler	55	None	Fine sand	6.0 - 20.0+	0.02-0.05	4.5-5.5
	Apopka	25	None	Sand	6.0 - 20.0	0.03-0.05	4.5-6.0
57	Jonesville-Chiefland-Archer						
	Jonesville	30	--	Sand over lime-stone	---	---	---
	Chiefland	25	--	Fine sand over limestone	---	---	---
	Archer	25	--	Fine sand over-lying limestone	---	---	---
58	Arredondo-Gainesville						
	Arredondo	40	None	Fine sand	6.3	0.05-0.10	
	Gainesville	30	None	Loamy sand	6.0 - 20.0	0.07-0.10	4.5-6.0

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	Flood %	frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
59	Hernando-Archer-Chiefland						
	Hernando	35	--	Fine sand over loamy fine sand	---	---	---
	Archer	25	--	Limestone	---	---	---
	Chiefland	20	--	Limestone	---	---	---
60	Sparr-Lochloosa-Tavares						
	Sparr	45	None	Fine sand	6.0 - 20.0	0.05-0.08	4.5-6.5
	Lochloosa	30	None	Fine sand over sandy clay	0.6 - 20.0	0.05-0.15	4.5-5.5
	Tavares	15	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
61	Adamsville-Osier						
	Bushnell	40	None	Fine sand	0.06- 2.0	---	---
	Wabasso	25	1:25	Fine sand	0.63- 20.0	0.05-2.00	4.5-7.8
	Felda	20	1:125	Fine sand, slightly loamy, with some shells	0.63- 20.0	<0.05-0.15	5.1-7.8
63	Blichton-Flemington-Kanapaha						
	Blichton	50	None	Sand over sandy clay loam	0.6 - 20.0	0.05-0.15	4.5-6.0
	Flemington	25	None	Loamy sand over clay	<0.06	0.12-0.18	3.6-5.5
	Kanapaha	20	None	Fine sand over clay	6.0 - 20.0	0.03-0.08	4.5-5.5
64	Leon-Mascotte-Surrency						
	Leon	35	None	Fine sand	0.6 - 20.0+	0.02-0.10	3.6-5.5
	Mascotte	30	--	Loamy fine sand	---	---	---
	Surrency	20	--	Loamy fine sand over sandy clay	---	---	---

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
65	Lynne-Pomona-Pompano						
	Lynne	35	None	Sand & fine sand	0.2 - 20.0	0.03-0.15	3.6-5.5
	Pomona	30	None	Sand	0.6 - 20.0	0.03-0.15	3.6-5.5
	Pompano	20	1:125	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
66	Candler-Paola-Tavares						
	Candler	85	None	Fine sand	6.0 - 20.0+	0.02-0.05	4.5-5.5
	Paola	4	None	Fine sand	> 20.0	<0.05	4.5-5.0
	Tavares	4	None	Fine sand	> 20.0	0.02-0.05	4.5-6.0
67	Candler-Adamsville-Pompano						
	Candler	20	None	Fine sand	6.0 - 20.0+	0.02-0.05	4.5-5.5
	Adamsville	15	--	Fine sand	---	---	---
	Pompano	15	1:125	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
68	Arredondo-Kendrick						
	Arrendondo	55	None	Fine sand	6.3	0.05-0.10	
	Kendrick	15	None	Loamy fine sand	0.6 - 20.0	0.05-0.17	4.5-5.5
69	Broward-Boca						
	Broward	35	--	Sand underlain by limestone	---	---	---
	Boca	35	--	Loamy sand underlain by limestone	---	---	---
70	Panasoffkee-Bushnell						
	Panasoffkee	--	--	Loamy sand over sandy clay	---	---	---
	Bushnell	--	Rare	Fine sand	0.06 - 2.0	---	---

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	Flood frequency %	(yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
71	Myakka-Basinger						
	Myakka	--	1:125	Fine sand	0.63- 20.0	<0.05-0.15	4.5-6.5
	Basinger	--	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
72	Meggett, var.-Pompano						
	Meggett, var.	35	--	Loamy sand over sandy clay	---	---	---
	Pompano	35	1:125	Fine sand	6.3 - 20.0	<0.05	5.6-7.8
73	Terra Ceia-Placid						
	Terra Ceia	40	Most of yr	Muck, peat	6.3 - 20.0	<0.20	6.6-7.8
	Placid	15	--	Loamy fine sand w/some organic matter	---	---	---
74	Arrendondo-Sparr-Kendrick						
	Arrendondo	--	None	Fine sand	6.3	0.05-0.10	
	Sparr	--	None	Fine sand	6.0 - 20.0	0.05-0.08	4.5-6.5
	Kendrick	--	None	Loamy fine sand	0.6 - 20.0	0.05-0.17	4.5-5.5
75	Candler-Lake						
	Candler	--	None	Fine sand	6.0 - 20.0+	0.02-0.05	4.5-5.5
	Lake	--	None	Fine sand	6.0 - 20.0+	0.03-0.06	4.5-6.5
76	Masaryk						
	Masaryk	--	None	Very fine sand	6.0 - 20.0+	0.05-0.10	4.5-6.0

(continued)

Table 33 (continued)

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
77	Nobleton-Blickton-Flemington						
	Nobleton	--	None	Fine sand over sandy clay loam	0.2 - 20.0	0.05-0.18	3.6-6.0
	Blickton	--	None	Loamy fine sand over sandy clay loam	0.6 - 20.0	0.05-0.15	4.5-6.0
	Flemington	--	None	Sandy clay	<0.06	0.12-0.18	4.5-5.5
78	EauGallie-Wabasso-Basinger						
	EauGallie	--	None	Fine sand	0.6 - 20.0	0.02-0.10	4.5-7.8
	Wabasso	--	1:125	Fine sand	0.63- 20.0	<0.05-20	4.5-7.8
	Basinger	--	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
79	Paisley-Floridana-Wabasso						
	Paisley	--	1:5	Fine sand over sandy clay	0.06- 20.0	0.05-0.18	4.5-8.4
	Floridana	--	None	Fine sand over sandy loam	0.6 - 20.0	0.05-0.15	6.1-8.4
	Wabasso	--	1:125	Fine sand	0.63- 20.0	<0.05-20	4.5-7.8
80	Okeelanta-Aripeka-Terra Ceia						
	Okeelanta	--	None	Muck over fine sand	6.0 - 20.0	0.05-0.30	4.5-7.8
	Aripeka	--	Season	Fine sand over weathered bed-rock	2.0 - 20.0	0.10-0.15	6.6-8.4
	Terra Ceia	--	Most of Yr.	Muck, peat	6.3 - 20.0	<0.20	6.6-7.8

(continued)

Table 33 (concluded)

Number on map	Soil association & component soil	%	Flood frequency (yr)	USDA classification	Permeability (inches/hr)	Available % water capacity	pH
81	Homosassa-Weeki Wachee Lacoochee						
	Homosassa	--	Season	Mucky fine sand over bedrock	2.0 - 20.0	0.07-0.25	6.1-7.8
	Weeki Wachee	--	Season	Muck	2.0 - 6.0	0.10-0.25	6.1-7.8
	Lacoochee	--	Season	Fine sandy loam over bedrock	0.6 - 6.0	0.10-0.20	6.6-8.4
82	Floridana-Basinger						
	Floridana	--	None	Fine sand over sandy loam	0.6 - 20.0	0.05-0.15	6.1-8.4
	Basinger	--	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5
83	Salt Water Marsh & Swamp						
	Salt Water Marsh & Swamp	75	Tidal	Variable	---	---	---
84	Fresh Water Marsh & Swamp						
	Fresh Water Marsh and Swamp	75	Tidal	Variable	---	---	---
85	Blichton-Lochloosa-Kendrick						
	Blichton	--	1:125	Fine sand	0.06- 6.3	0.05-0.20	
	Lochloosa	--	None	Fine sand over sandy clay	0.6 - 20.0	0.05-0.15	4.5-5.5
	Kendrick	--	None	Loamy fine sand	0.6 - 20.0	0.05-0.17	4.5-5.5
86	Paisley-Bushnell						
	Paisley	35	None	Fine sand	0.06- 20.0	0.05-0.18	4.5-8.4
	Bushnell	35	None	Fine sand	0.06 - 2.0	---	---
87	Myakka-Pomello-Basinger						
	Myakka	50	1:125	Fine sand	0.63- 20.0	<0.05-0.15	4.5-6.5
	Pomello	20	None	Fine sand	2.0 - 20.0	<0.05-0.15	4.5-5.5
	Basinger	15	None	Fine sand	> 20.0	0.03-0.07	3.6-5.5

2. LANDFORMS

2.1 MAJOR PHYSIOGRAPHIC REGIONS

The study area has been divided into two major physiographic zones, the central or mid-peninsular zone and the northern or proximal zone. The northern or proximal zone extends from Taylor County northwest through Escambia County. It is characterized by a broad upland which extends westward into the western Highlands of the panhandle region of the study area. The central or mid-peninsular zone extends southward from Dixie County through Hernando County. It is characterized by discontinuous highlands in the form of sub-parallel ridges separated by broad valleys. See Figure 1 (Scott et al. 1980).

2.2 MAJOR SURFACE LANDFORMS WITHIN THE NORTHERN REGION

The northern or proximal zone has been divided into two major physiographic regions, the Gulf Coastal Lowlands and the Northern Highlands (Puri and Vernon 1964). This northern zone is located mostly above the potentiometric surface and is characterized by many of the features of dry highland or "deadzone" karst such as dry, steep-walled sink holes, dry stream courses, intermittent lakes and prairies that were former shallow lakes (White 1970).

The physiographic provinces which fall within the northern zone of the study area are: the Western Highlands, Escambia Valley, Gulf Coastal Lowlands, Gulf Barrier Chain, Marianna Lowlands, New Hope Ridge, Greenhead Slope, Fountain Slope, Grand Ridge, and the Northern Highlands.

2.2.1 Western Highlands

The Western Highlands physiographic province forms the western extension of the Northern Highlands physiographic zone. This zone has been partitioned by erosion and solution into several smaller physiographic provinces, the largest of which is the Western Highlands. The Western Highlands consists of two gently southward sloping plateaus ranging from 150 ft to 250 ft in elevation.

The western plateau is bordered to the west by the Perdido River floodplain and on the east by the Choctawhatchee River Valley. It is bounded on the south by the Cody Scarp, which separates this plateau from the Gulf Coastal Lowlands to the south. The Cody Scarp is the most persistent topographic break in the State with topographic breaks of up to 100 ft (Scott et al. 1980).

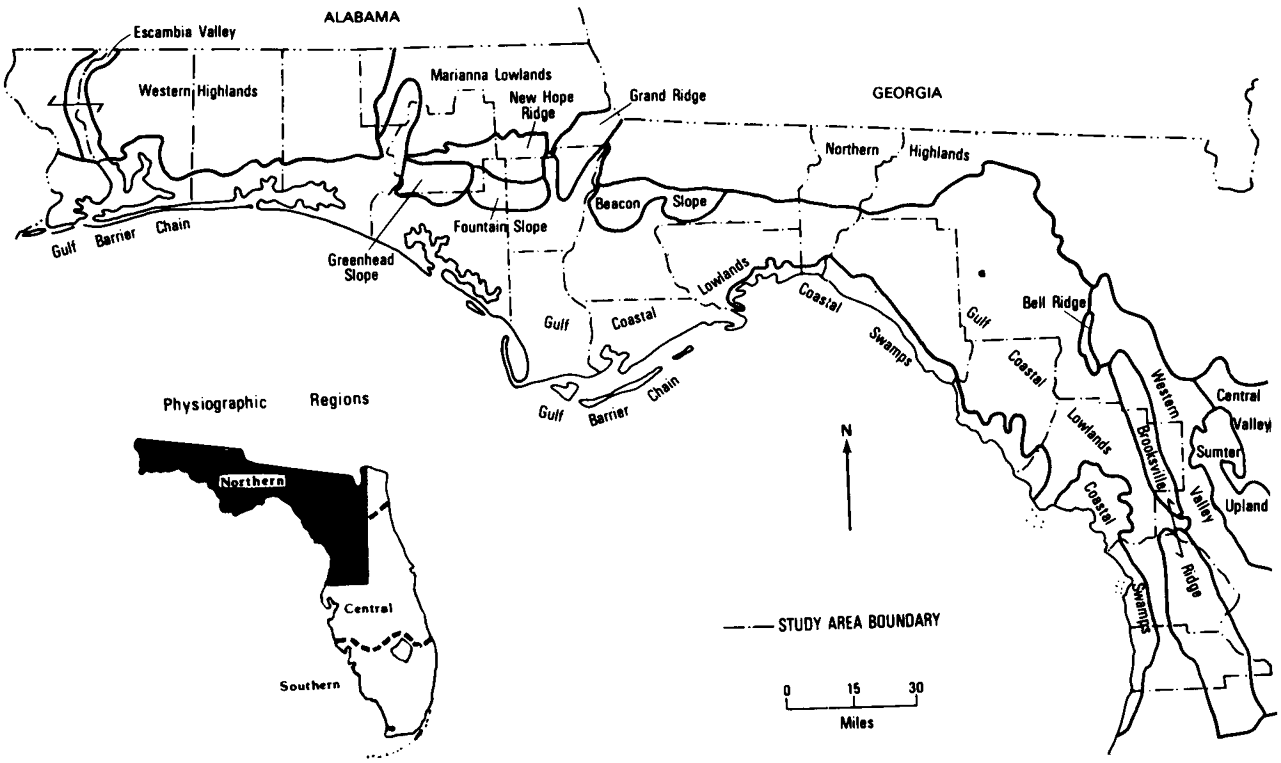

Figure 1. Physiographic provinces of northwest Florida (after Scott et al. 1980).

The western plateau is bounded on the east by the Marianna Lowlands and on the west by the Escambia Valley. It is bounded on the south by the Cody Scarp, which separates this plateau from the Gulf Coastal Lowlands. The Western Highlands is underlain predominantly by the Citronelle Formation of Pliocene-Pleistocene Age. The Citronelle Formation consists of fluvial deposits of coarse sand and gravel. It is older and consists of coarser sediments than are found in the Tallahassee Hills, which are composed of clayey sands of the Hawthorn and Miccosukee Formations (Puri and Vernon 1964; Scott et al. 1980).

2.2.2 Escambia Valley

The Escambia Valley physiographic province bisects the Western Highlands physiographic province. It merges on the south with the Gulf Coast Lowlands physiographic province. It is composed of low terrace deposits and alluvium from the Escambia River Floodplain. These deposits are generally less than 50-ft thick. The present floodplain is bounded by the toes of a scarp, which bounded the penholoway terrace at an elevation of 70 to 80 ft. Over 50 mi of these shoreline scarps carved by the Penholoway Sea some 80,000 years ago during the Sangamon Interglacial period are still preserved (Marsh 1966).

2.2.3 Gulf Coastal Lowlands

The Gulf Coast Lowlands physiographic province is a gently sloping southward feature with low relief extending across the panhandle and big bend portion of the study area. It is separated from the Northern Highland Region to the north by an escarpment of 20 to 100 ft of relief. The Gulf Coastal Lowlands are composed of a series of low level marine terraces formed during the Pleistocene epoch. The region is poorly drained. Relic barrier islands, lagoons, estuaries, coastal ridges, sand dune ridges, spits and bars, and coastal valleys are found in the province (Scott et al. 1980).

2.2.4 Gulf Barrier Chain

Barrier islands occur sporadically along the coast of the United States from Massachusetts to Texas. These dynamic features take the form of long, narrow, unconsolidated masses of sand which are either eroding, accreting, or migrating in response to oceanic and atmospheric processes. Many are periodically flooded, breached, and overwashed during hurricanes and winter storms. Barrier islands are a vulnerable and fragile resource that protects the mainland, bays, and estuaries from direct ocean waves and storm events.

There are approximately 300 barrier islands and spits in the United States, which total 1,658,700 acres. Of these, 80 are in Florida and have a total area of 467,700 acres (Sharma 1979). The barrier islands of Florida's northwest Gulf coast extend in a discontinuous zone from the Alabama-Florida line to Apalachicola and offshore of Cedar Key. There are six barrier islands within the atlas study area. These islands are associated with estuaries such as Pensacola Bay, East Bay, Choctawhatchee Bay, St. Andrew Bay, St. Josephs Bay, Apalachicola Bay, and Waccassassa Bay. Many owe their existence to changes in sea level that have occurred since the end of the Wisconsin glacial stage of the last Ice Age (120,000 to 11,000 years before the present; see Figure 2).

The barrier islands west of Apalachee Bay formed as offshore beach bars and spits from sand supplied bv coastal headlands, rivers, and formerly emergent areas of the Continental Shelf. As the rise in sea level slowed 4,000 to 5,000 years ago, this sand was worked by winds, currents, and waves to form features parallel to the ancient shoreline. The Cedar Keys area, however, is an example of a flooded paleo-dunefield.

2.2.5 Marianna Lowlands

The Marianna Lowlands cover a rectangular area of about 30 by 64 miles and are located in Holmes, Washington, and Jackson Counties. They are bounded on the west by the Western Highlands, on the southeast by the Grand Ridge, and on the south by the Holmes Valley Scarp of the New Hope Ridge. This steep north facing scarp extends nearly 200 ft above the level of the Marianna Lowlands.

It is believed that the lowlands were generally developed along the valleys of the Apalachicola, Chattahoochee, Chipola, and Choctawhatchee Rivers. It is further theorized that the Apalachicola River discharged through this region and formed the present lowlands region. The land surface of the region is well-drained and is covered by sinkholes, hills, and ridges (Puri and Vernon 1964).

2.2.6 New Hope Ridge

The New Hope Ridge forms a portion of the Northern Highlands physiographic province, which was partitioned by erosion and solution. Its triangular shape is bounded by the Marianna Lowlands to the north, the Greenhead Slope and Fountain Slope to the south and the Gulf Coastal Lowlands to the east.

The New Hope Ridge is underlain by high marine terrace clayey sands and forms a portion of the sand hills region (Musgrove et al 1965).

The New Hope Ridge is a gently southward sloping surface and is characterized by gently rolling forested land.

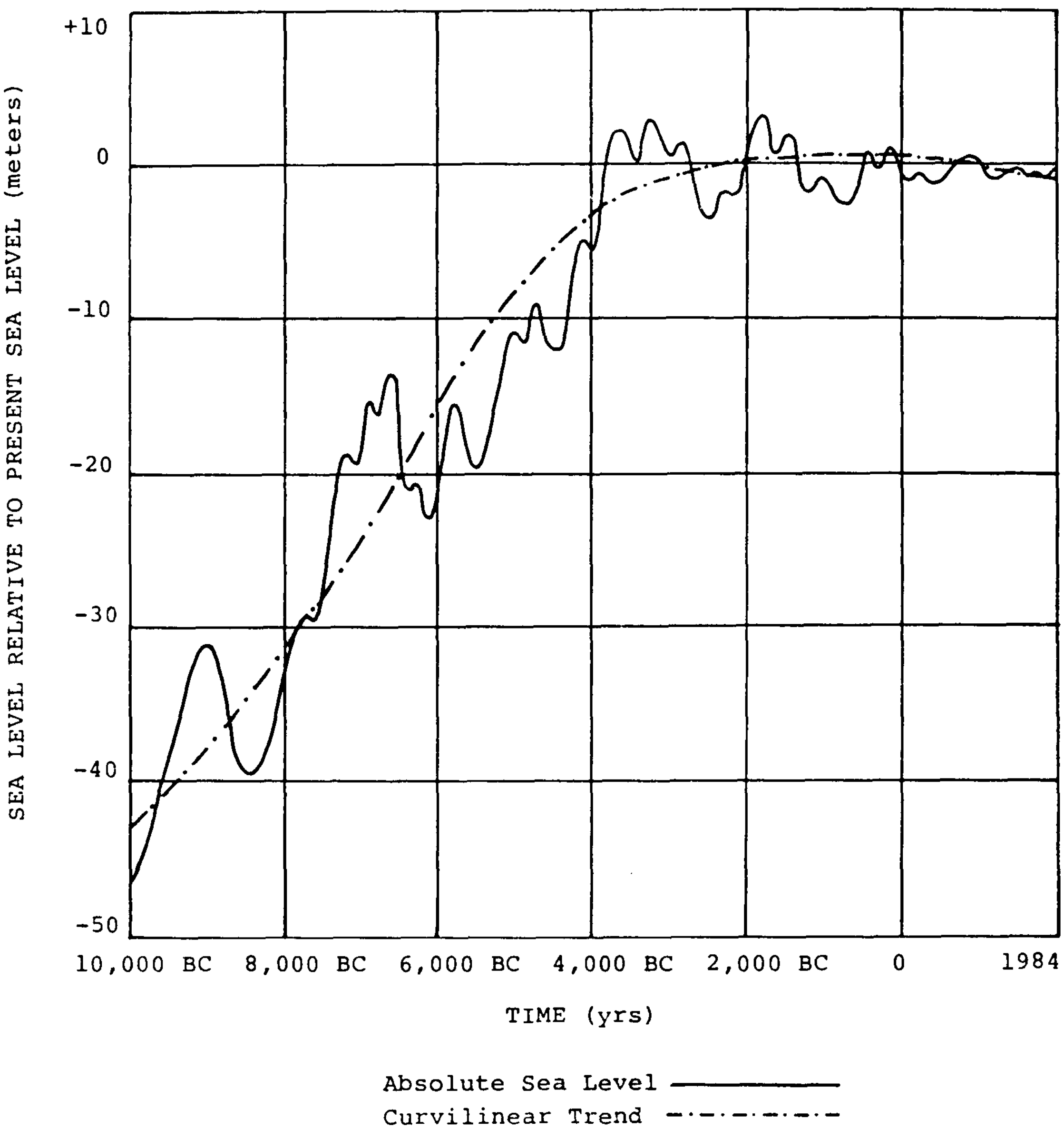

Figure 2. Sea level relative to present sea level for the past 12,000 years (Bruun 1962).

2.2.7 Greenhead Slope

The Greenhead Slope physiographic subprovince is bounded to the north by the Cody Scarp, to the south and west by the Gulf Coastal Lowlands and to the east by the Fountain Slope. The Greenhead Slope is the erosional remnant of higher marine terraces. This province comprises a portion of the sand hills region (Musgrove et al. 1965). The sand hills region is characterized by gently rolling forest lands exhibiting a dendritic drainage pattern (Schmidt and Clark 1980). The Greenhead, Fountain, and Beacon Slopes represent a discontinuous physiographic zone and are all partitoned erosional remnants of higher marine terraces.

2.2.8 Fountain Slope

The Fountain Slope physiographic province is bounded to the north by the Cody Scarp of the New Hope Ridge, to the west by the Greenhead Slope, and to the south and east by the Gulf Coastal Lowlands.

The Fountain Slope represents an erosional remnant of higher marine terraces. This province comprises a portion of the sand hills region (Musgrove et al. 1965). The sand hills region is characterized by gently rolling forest lands exhibiting a dendritic drainage pattern (Schmidt and Clark 1980).

2.2.9 Grand Ridge

The Grand Ridge physiographic subprovince is located in northeast Calhoun County within the study area. It is bounded to the north by the Marianna Lowlands and to the south by the Gulf Coastal Lowlands. It represents a partioned portion of the Northern Highlands physiographic zone. It can be described as a gently southward sloping plateau underlain by higher marine terrace clayey sands. It is characterized by gently rolling forested land (Puri and Vernon 1964).

2.2.10 Northern Highlands

The Northern Highlands physiographic province extends across the northern part of the State of Florida, but occurs only across the northern half of Jefferson County in the study area. It is bordered to the southwest and southeast by the Cody Scarp and the Gulf Coastal Lowlands. It is bordered to the south by the Cody Scarp and the Beacon Slope (White 1970). The Northern Highlands are underlain by clays of the Hawthorn Formation (Scott et al. 1980). The region is characterized by rolling forested hills rich in iron-red clays and clayey silts of the Miccosukee Formation.

2.3 MAJOR SURFACE LANDFORMS WITHIN THE CENTRAL REGION

The central or mid-peninsular zone is located above the potentiometric surface except where broad valley floors occur between the ridges. Broad shallow lakes occur along the valley floors throughout this zone and smaller deep lakes pock the ridges (White 1970).

The physiographic provinces which fall within the central zone of the study area are: the Coastal Swamps, Gulf Coastal Lowlands, Brooksville Ridge, and the Western Valley.

2.3.1 Coastal Swamps

This physiographic subprovince extends from the west side of Apalachee Bay southward to Tarpon Springs. The landward edge of the Coastal Swamp has been delineated as a line enclosing all continuous areas of swamp adjacent to the coast. A paucity of sand for beach building is largely responsible for the development of these swamps. The section of the coast where these swamps occur has a broad, shallow Continental Shelf with low wave energy for sand transport. No sand is carried in from the outside of the province and there is no local source of sand since the underlying rocks are carbonates. Therefore, a marshy coastline with no definite shoreline results (White 1970).

2.3.2 Gulf Coastal Lowlands

The Gulf Coastal Lowlands physiographic province is a gently sloping southward feature with low relief extending across the panhandle, big bend, and peninsula portions of the study area. It is separated from the Northern Highland Region to the north by a 20- to 100-foot escarpment, which, in the Jefferson County part of the study area, corresponds to the Cody Escarpment. The Gulf Coastal Lowlands are composed of a series of low level marine terraces formed during the Pleistocene epoch. The region is poorly drained. Relic barrier islands, lagoons, estuaries, coastal ridges, sand dune ridges, spits and bars, and coastal valleys are found in this physiographic region.

2.3.3 Brooksville Ridge

The Brooksville Ridge extends from eastern Gilchrist County in a south-southeasterly direction into Pasco County. It is the largest of several ridges that rise above the general level of the Central Highlands physiographic province. The Ridge is a linear feature 110 mi long that is divided into two parts by the Withlacoochee River at Dunnellon. Its southern section is 60 mi long and 10 to 15 mi wide and its northern section is 50 mi long and 4 to 6 mi wide.

The Ridge stands generally 100 ft above the lowland floors that surround it and reaches its maximum elevation at approximately 200 ft. The maximum elevation of the southern section is 75 ft higher than that of the northern section. The upper surface of the ridge is rough and dissected forming the most irregular land surface for any area of comparable size in peninsular Florida (White 1970).

The Ridge is capped by insoluble Miocene beds overlain by thin sand layers. These Miocene sediments are the red clastics of the Bone Valley and Alachua Formations. Thicker deposits of white sand occur near the western edge of the ridge and may be old stabilized dunes. The western edge of the ridge is probably a marine terrace scarp. The elevation of the toe of this scarp varies, possibly because segments of the scarp were shorelines at more than one sea level (White 1970).

All the major ridges of the Central Highlands owe their general orientation to relict coastal features. They are long, straight, narrow, and parallel to one another. They are elongated in the common orientation of relict beach ridges.

2.3.4 Western Valley

Differential erosion of a former highland created two large, irregular lowlands in unprotected areas of soluble substrate; notably the easily eroded Eocene formations. The longer, more westerly of these two lowlands is the Western Valley. It runs from the south corner of Gilchrist County in a south-southeasterly direction for 140 mi to the northeast corner of Hillsborough County. The elevation of this valley ranges from 50 to 100 ft.

The Western Valley includes the upper portions of the Withlacoochee and Hillsborough River Valleys, and the Tsala Apopka Plain area. The latter is approximately 50 mi long from north to south with a maximum width of about 14 mi in the center. It is flatter and lower than most of the other parts of these valleys, ranging from 50 to 75 ft in elevation with sections of higher, irregular topography.

The boundaries of the Western Valley are only vaguely defined, but correspond generally to the eastern edge of the Brooksville Ridge and the western edges of the Sumter and Lake Uplands.

3. BEACH EROSION

3.1 GENERAL

Beaches, like barrier islands, are constantly changing in response to fluctuations in sea level, wave conditions, longshore currents, atmospheric conditions, and human activities. In Florida, over 200 mi of ocean and gulf front property are in a critical state of erosion which poses a threat to both coastal and inland structures and property (U.S. Army Corps of Engineers 1971).

The causes of beach erosion are natural but can be artificially altered. One major natural cause of beach erosion is sea-level rise which is currently occurring at the rate of 0.005 ft/yr on the Atlantic and gulf coasts (Hicks et al. 1983). For Florida, this rate of sea-level rise amounts to a rate of shoreline retreat of about 1 to 3 ft/yr (Bruun 1962). Walton (1978) suggested, "This trend of shoreline erosion in response to rising sea level is not gradual, but rather takes place during more severe wave activity, such as occurs during hurricanes or extra-tropical storms." Another natural cause of shoreline erosion is barrier overwash, which occurs during periods of high tides when wave action transports sand into bays landward of the beach.

Dredging of the navigational channels through inlets that cut through the littoral zone is another major cause of beach erosion. Many of the 57 inlets in Florida have Federal maintenance programs with authorized channel depths of 10 to 20 ft. Minimum depths on the outer bars of unimproved inlets are naturally about 6 to 8 ft. As Walton (1978) explains it, "When a channel is either cut through a barrier island or dredged below the natural existing depths, the flow of water through the channel to the bay (or lagoon) on flood tide and to the ocean (or gulf) on ebb tide is increased leading to an increased capability of the channel to flush sand to its inner bay system or outer shoal system." The channel also acts as a barrier to sand carried along the coast by longshore drift. Therefore, drifting sands are carried through the inlet and deposited in bays behind the beaches. Once the sand has migrated into the bays, the wave energy there is insufficient to agitate it into suspension and allow it to be carried out again so that large amounts of former beach sand end up in bays behind dredged inlets or in the inlets themselves.

Structures, such as jetties at inlets, can cut off the natural movement of sand in the longshore current. Beaches "downstream" from these jetties are starved for sand to the extent that large stretches of Florida shoreline adjacent to the south side of inlets are undergoing beach recession at rates greater than 10 ft/yr (Walton 1978). There are presently no methods of dealing with beach erosion that have been consistently successful.

Nourishing beaches with sediment dredged from offshore is estimated to cost about $1 million/mile of restored beach, initially, and requires approximately $25,000/yr/mi to maintain (Sharma 1979). Other structures such as offshore breakwaters, groin fields, rock revetments, and seawalls have adverse effects on shorelines if not properly implemented.

The University of West Florida compiled a list of available studies of beach erosion in all Florida counties with significant stretches of sandy beach bordering the Gulf of Mexico or the Atlantic Ocean (Henningsen and Salmon 1981). Table 35 contains data for the coastal counties in the northwest Florida region. The list classifies areas according to the severity of the erosion problem. Table 34 lists acronyms used for Table 35.

Table 34. Acronyms used in Table 35.

COE	U.S. Army Corps of Engineers Jacksonville District
NSS	National Shoreline Study
DNR	Florida Department of Natural Resources, Bureau of Beaches and Shores
U of FL	University of Florida
Sea Grant	Sea Grant Program
NPS	U.S. Department of the Interior National Park Service
S	South or Southern
N	North or Northern

Below is a description of components of Table 35.

Historical Data Column

The historical data column provides data on State funds spent for beach erosion control projects from 1975 to 1981. The word "None" indicates that either no project studies have been undertaken or that information was not available at the time of this study. Monetary figures have been converted to the 1975 dollar value. A total of $30,555 was spent in the northeast gulf coastal region on erosional control projects from 1975 to 1981 (Henningsen and Salmon 1981).

Local Survey Column

This column gives information concerning an evaluation of the beach erosion problem as perceived by local officials and residents. Data were obtained from interviews and correspondence with local officials, news clippings, and government comprehensive plans. Erosion is not viewed as a problem in areas where human activities are not threatened.

Erosion Rates Column

This column itemizes erosion and/or accretion rates in the study area. Data represent one-dimensional, erosion-rate measurements indicating changes in beach width over a given period.

These figures indicate the regression of the mean-high-water line expressed in ft/yr. These rates are calculated by periodically reviewing shorelines by using aerial photography or U.S. Army Corps of Engineers high-water-shoreline-change charts. Except for Collier County where the most recent aerial photographs used were taken in 1979, the aerial photographs used were taken in 1973. These linear measurements are of limited use because they can show considerable regression while no net sand loss occurred. More accurate erosion rate information was not available at the time of the study. A "+" in front of a number in this column indicates accretion rather than erosion.

Professional Studies Column

This column lists the published professional studies and a description of their results in which beach erosion rates are recorded. In most cases, only the most recent studies are listed but where studies conflict or data conflict among columns, more than one study is noted.

Remarks Column

This last column contains notes and the significance of erosion problems and restoration projects. It also provides clarification where erosion data conflict.

The Coastal Hydrographic Section of the Florida Bureau of Beaches and Shores has developed a computer program to interpolate erosion rates between measured beach profiles. This program is a more reliable method of calculating erosion rates.

Table 35. Beach erosion in the coastal counties of northwestern Florida (modified after Henningsen and Salmon 1981).

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
ESCAMBIA/SANTA ROSA COUNTY		Interview 7/23/80	Aerial Photos 1973	Corps of Engineers Mobile District	
Perdido Key	None	No problem		Accretion (Chiu, U. of FL 1979)	Some isolated areas with minor erosion. East end of island is experiencing severe erosion.
Santa Rosa Island	None	No problem		Accretion (COE, 1979)	Walkovers - project ongoing.
OKALOOSA COUNTY		Interview 7/30/80	Aerial Photos 1973	Corps of Engineers Mobile District	
Santa Rosa Island	None	No problem		Accretion (COE, 1979)	East end of island experiences severe erosion (Federal property, no problem).
Destin to Walton County line	None	No problem		Accretion (Chiu, (U. of FL 1978).	
WALTON COUNTY	None	No reliable local information	No information	No studies done DNR/BBS study in progress	Erosion assessment in this county is not possible, due to lack of inform-

(continued)

Table 35 (continued)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
BAY COUNTY	Countywide studies and projects $30,555	Interview 5/28/81	Aerial Photos 1973	Corps of Engineers Mobile District	
Philips Inlet to Biltmore Beach	None	Moderate problem	1.5 ft/yr (1856-1971) (COE 1976)	Severe erosion (COE 1976)	New project proposed.
Biltmore Beach	None	Severe problem	7 ft/yr (1935-1971) (COE 1976)	Severe erosion (COE 1976)	New project proposed.
St. Andrews State Park to Shell Island	None	No problem	2 ft/yr = 3% yr (1934-1971) (NSS 1973)	Severe erosion (NSS 1973)	
Tyndall AFB	None				Federal property.
Mexico Beach area	None	Severe problem	3 ft/yr (1855-1934) (NSS 1973)	Critical erosion (NSS 1973)	Continuous deposit of dredge material on beach.
GULF COUNTY		Interview 8/21/80	Aerial Photos 1973	Corps of Engineers Mobile District	No erosion rates available.
Beacon Hill-Yon's Subdivision	None	Moderate problem		Moderate erosion (NSS 1973)	Critical erosion in portions of Beacon Hill (NSS 1973).

(continued)

Table 35 (concluded)

Location	Historical data (1975 dollars)	Local survey	Erosion rates	Professional studies	Remarks
GULF COUNTY (cont.)					
North part of St. Joseph Spit	None	No problem		Moderate erosion (NSS 1973)	Mostly state park and undeveloped.
South part of St. Joseph Spit	None	Moderate problem	3 ft/yr (1872-1935) (NSS 1973)	Severe erosion (NSS 1973)	
Cape San Blas Indian Peninsula	None	No problem		Accretion (NSS 1973)	Severe erosion immediately east of Cape San Blas.
FRANKLIN COUNTY		Interview 8/20/80	Aerial Photos 1973	Corps of Engineers Mobile District	
St. Vincent Island	None				Federal property.
Little St. George Island	None	No problem		Accretion (NSS 1973)	Partly eroding, partly accreting.
Sikes Cut East Cove	None	Severe problem	5 ft/yr (1855-1935) (NSS 1973)	Critical erosion (NSS 1973) Moderate erosion (Sea Grant 1980)	Erosion is worse at east end.
East St. George Island	None	No problem		Accretion (NSS 1973) (Sea Grant 1980)	

3.2 ACTIVE DUNES

Sand dunes are composed of mostly sand-size sediment, which has been transported by the wind. One of the prerequisites of dune formation is an adequate supply of sand for transport to sandflats. Also, these sandflats must exist at a sufficiently high level to allow the surface layer of sand to dry out between tides. The source of sediment can be relatively old marine deposits, more recent coastal headlands, or fluvial deposits. The second prerequisite is sufficient wind velocity to pick up and transport sand.

The beach can be divided into two zones of wind transport. In the foreshore zone sand is transported by water currents, waves, and occasionally the wind. Oceanic overwash of dunes is usually restricted to this area of the beach. In the backshore zone sand is transported primarily by wind, and breaking waves play only a minor role. The boundary between these zones is transitional. As Boorman (1977) pointed out, it is important to remember that the beach is the area of transport between submarine sand deposits and growing dunes, and that human activity on, and development of, the beach area affects the formation and growth of dunes.

The pattern of dune ridges that forms is a function of the sand supply. On a prograding coast with an abundant supply of sand, a series of ridges forms with the youngest to seaward. Eventually these dunes may become stabilized approximately where they formed. On the other hand, if the coast is an eroding one with a limited supply of sand, the seaward dune ridge grows to a maximum height and then migrates inland. The ridge usually moves landward, by a process of local erosion and deposition, as either a parabolic dune or as a complete dune ridge.

Vegetation plays two roles in dune development. It stabilizes existing sand surfaces, and it enhances further accretion by creating a barrier which reduces surface wind speed. Boorman (1977) discussed the differences between natural and human-made methods of dune stabilization. He pointed out that fixed barriers are effective for a time, but that dune accretion soon overwhelms them. Stabilization by vegetation is not subject to this limitation as dune grasses continue to grow with the developing dune. More than one species of vegetation, however, is required as dune development proceeds and conditions change.

Active dunes are located along the coastal barrier strip from Mobile Bay to Dog Island in the study area. These dunes extend to an elevation of more than 10 m in several locations. Paleodunes are located from Apalachicola Bay and the St. Marks Region to Offshore Cedar Key and Levy County and southward to north of Tampa Bay. These dunes occur both on and offshore. They represent aeolian features present at a time when local sources of sand were plentiful (late-Pleistocene).

4. FAULTS

The only faults in the study area are in northwest Santa Rosa and extreme northeast Escambia Counties. Several normal faults are located in this region. They represent the southward extension of the Pollard Graben which extends into the area from Alabama. Faults are not mapped in the atlas.

The Pollard oil field produces oil from structural traps found along these faults. The names of the normal faults found in this region are: Foshee Fault, North Pollard Fault, South Pollard Fault, and the Jay Fault. Structural oil traps are located all along the subsurface contacts of these faults. In all cases, beds located on the downthrown side of these faults are thicker than those on the upthrown side of the faults (Marsh 1966).

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7. GLOSSARY

accretion - The gradual addition of new land to old by the deposition of sediment carried by the water from a current.

aeolian - Soil deposits arranged by the wind. Also eolian.

differential - Of or constituting a degree of difference.

Eocene - The epoch of geologic time occurring between 40 and 60 million years before the present.

erosion - The removal of sediment by currents, wind, or ice.

escarpment - A steep face or ridge of land.

fluvial - Of or pertaining to rivers.

graben - A portion of the earth's crust that has been downthrown along faults relative to the rocks on either side.

karst - A type of topography that is formed over limestone, dolomite, or gypsum by dissolving or solution, and that is characterized by closed depressions or sinkholes, caves, and underground drainage.

littoral - The intertidal zone of the shore.

loam - A soil composed of a mixture of clay, silt, sand, and organic matter.

Miocene - The epoch of geologic time between 12 and 25 million years before the present.

normal fault - A fault at which the hanging wall has been moved down relative to the foot wall.

paleodune - Inactive ancient sand dune, concave toward the wind, formed when the wind blows out the center of a dune leaving behind the sides which are anchored by vegetation.

paucity - Scarcity.

permeability - The capacity of a soil horizon or formation to vertically transmit water.

physiographic province - Region of similar topographical structure and climate that has had a unified geomorphic history.

potentiometric surface - The level to which water will rise in a tightly cased well.

scarp - An escarpment, cliff, or steep slope of some extent formed by faulting.

water capacity - The percent of empty space available for water retention.

OIL, GAS, AND MINERAL RESOURCES

Although Florida is generally thought of as a vacation and retirement State, it is also the sixth largest, non-fuel mineral-producing State in the Nation (Fernald 1981). Mineral production in Florida (Table 36) ranks 14th as a source of income to the State (Sweeney and Hendry 1979). In terms of dollars, phosphate is the leading mineral resource, followed by petroleum, cement, and stone. The leading mineral resources of the northeast gulf study area are oil and gas, sand and gravel, gravel, clay, limestone, dolomite, peat, and shell bed deposits (see Figure 3). Figure 3 was compiled from the Florida Bureau of Geology Environmental geology map series and is a generalized representation of the surface mineral resources present in northwest Florida.

Table 37 lists the principal mineral resources produced in each of the 18 counties in the northeast gulf study area (Sweeney and Hendry 1979). The continued growth and diversification of the mineral industry in northwest Florida will be dependent upon the utilization of its non-metallic mineral resources (Calver 1957). Sources for the information included in this report are the most up-to-date available as of February 1982.

Table 36. 1979 mineral resource production in Florida (Modified after Sweeney and Hendry 1979 and Boyle and Hendry 1981).

Mineral resource	Value (million $)
Cement	139.7
Clays	31.3
Gem stones	0.004
Lime	11.4
Peat	2.2
Sand and gravel	39.5
Crushed stone	200.0[a]
Phosphate, uranium, kaolin, magnesium compounds, rare earth concentrate, staurolite, titanium, and zircon concentrate	1,045.5
Petroleum (crude)	659.0[a]
Natural gas	63.0[a]
Total	2,191.6

[a]Estimated by extrapolating 1977 and 1978 data and assuming a constant rate of increase.

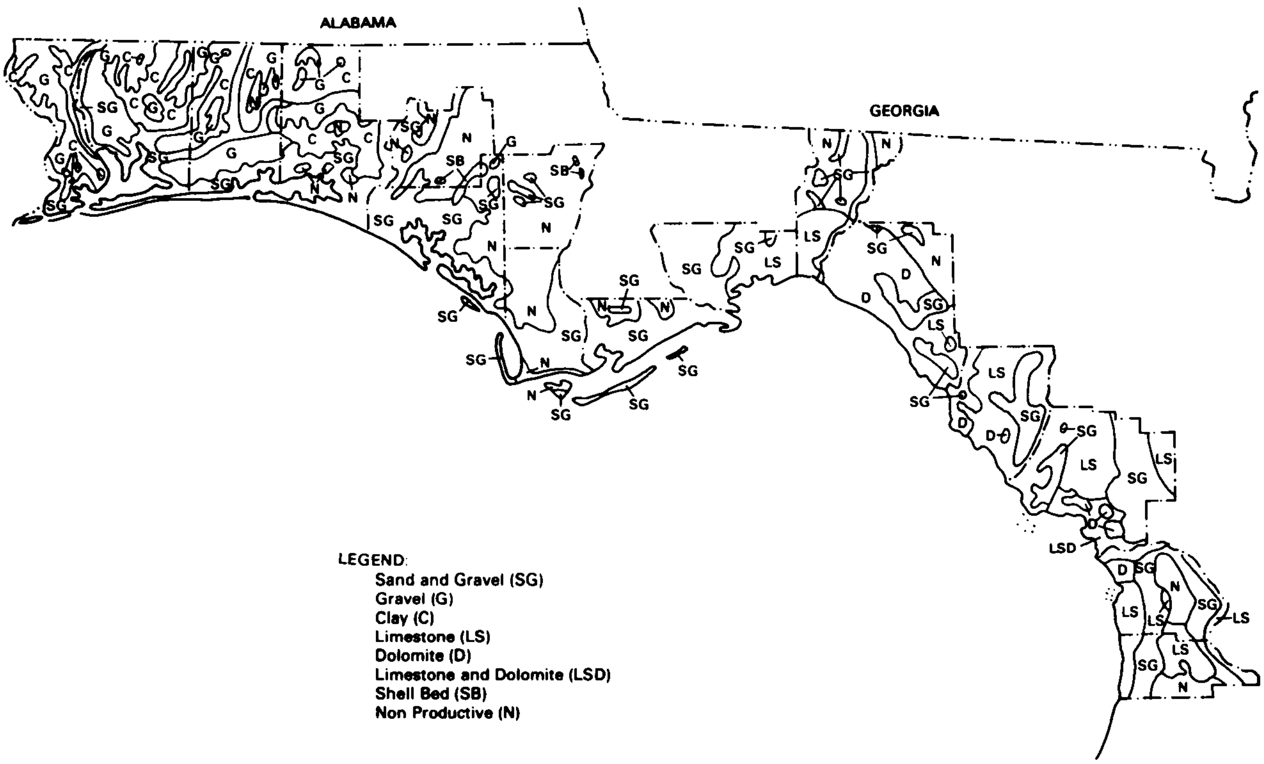

Figure 3. Surface mineral resources of northwest Florida (after Knapp 1978a, 1978b, 1980; Schmidt 1978a, 1978b, 1979; Deuerling 1981).

Table 37. Principal minerals produced, by county, in northwest Florida in 1978 (Sweeney and Hendry 1979; Boyle and Hendry 1981).

County	Principal mineral resources
Escambia	Sand and gravel
Santa Rosa	Oil and gas
Okaloosa	Sand and gravel
Walton	Sand and gravel
Washington	NA[a]
Bay	Sand and gravel
Calhoun	Sand and gravel
Gulf	Magnesium, lime
Franklin	None
Wakulla	None
Jefferson	None
Taylor	Dolomite
Dixie	NA[a]
Levy	Limestone
Citrus	Limestone
Hernando	Limestone

[a]Not available.

1. PIPELINES

1.1 GENERAL BACKGROUND

Only a limited number of oil and gas pipelines are located in the northwest Florida area. The pipelines are owned and maintained by the Florida Gas Transmission Company, the United Gas Company, the Five Flags Pipeline Company (gas), the South Georgia Natural Gas Company, and the Exxon Pipeline Company (crude oil). The general location of these pipelines is shown in Figure 4.

1.2 LEGEND EXPLANATION

The diameter (inches) and owner of each gas pipeline, as well as gas compressor stations, are shown on the atlas maps.

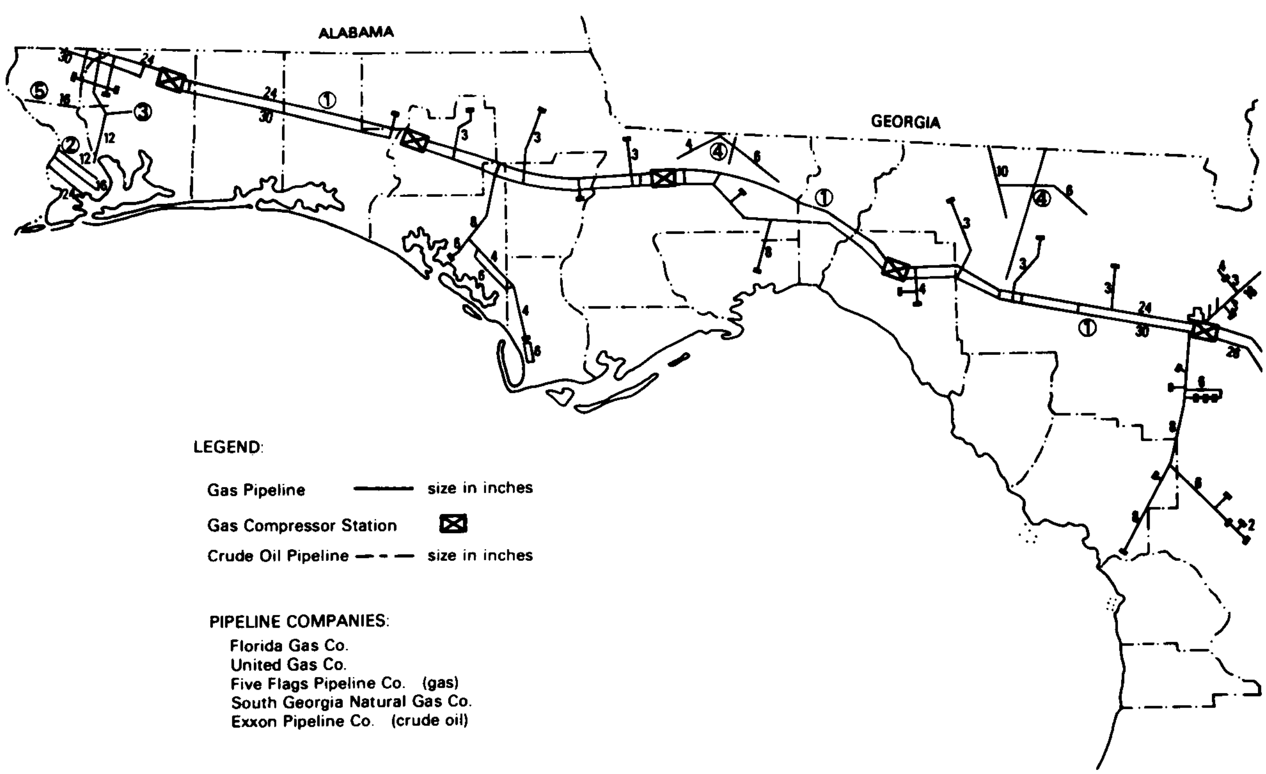

Figure 4. Pipelines in northwest Florida (after Tootle 1979).

2. DRILLING SITES

2.1 BACKGROUND

Oil was first discovered near the town of Jay in northern Santa Rosa County in 1970, when an exploration well tapped the Smackover Formation, a dolomitic limestone of Jurassic Age (150 million years old).

A total of 462 oil exploration wells have been drilled in the 16 county study region. Of these, a total of 118 wells have produced oil and gas. An inventory, by county, of exploration wells drilled, dry holes, and completed producers is shown in Table 38. All the producing wells are located in either extreme northeastern Escambia or northern Santa Rosa Counties. They are producing oil at a rate of 1.0 million barrels per month and natural gas at a rate of 1.25 million cubic feet per month (Schmidt 1978b). The Jay and Mt. Carmel well fields are located in extreme northeastern Santa rosa County. The Blackjack Creek wellfield is located in northern Santa Rosa County. The Sweetwater Creek wellfield is located in extreme northeastern Santa Rosa and extreme northwestern Okaloosa County (Curry 1984).

In 1981, it was established that 57 million barrels of crude oil and 67 billion cubic feet of natural gas remained in reserve in the Jay, Mt. Carmel, Blackjack Creek, and Sweetwater Creek well fields of northwest Florida (Fernald 1981).

2.2 LEGEND EXPLANATION

A brief description of the oil well drilling site symbology used on the Atlas overlays follows. "Location" indicates a drilling site where oil was not discovered. "Temporarily abandoned location" indicates a drilling site which is temporily abandoned without oil having been discovered. "Abandoned location" indicates a drilling site which has been abandoned. "Oil well" indicates a producing oil well. "Abandoned oil well" indicates a one-time producing oil well that has been abandoned. "Plugged and abandoned oil well" indicates a one-time producing oil well that has been plugged and abandoned.

Table 38. Oil well inventory of northeast gulf counties (Florida Department of Natural Resources 1981).

County	Number of dry holes	Number of producing wells	Total number of oil wells drilled
Escambia	37	20	57
Santa Rosa	160	98	258
Okaloosa	22	0	22
Walton	27	0	27
Washington	13	0	13
Bay	11	0	11
Calhoun	15	0	15
Gulf	7	0	7
Franklin	13	0	13
Wakulla	3	0	3
Jefferson	2	0	2
Taylor	12	0	12
Dixie	3	0	3
Levy	12	0	12
Citrus	3	0	3
Hernando	4	0	4
Totals	344	118	462

3. REFINERIES

Seminole Asphalt, Inc., located off U.S. 363 in southern Wakulla County, is the only refinery located in northwest Florida. It has been in operation since 1954 and is located on a 176-acre site near St. Marks. Its primary product is asphalt, but it also produces fuel oil by-products through simple crude distillation and vacuum distillation processes. It is currently producing 13,000 barrels a day of these products (Nichols 1982). This refinery is shown on the Atlas.

4. SURFACE MINERAL DEPOSITS

4.1 GEOLOGIC SETTING

The Florida Peninsula is underlain by more than 4,000 ft of sedimentary rocks that overlie much older sedimentary, metamorphic, and igneous basement rocks. This upper sequence of carbonate and clastic rocks forms the broad flat Floridan Plateau that encompasses all of Peninsular Florida and its continental shelves. In Late Oligocene to Early Miocene time (Table 39), the paleoclimate of Florida turned much colder and sea level fell more than 200 ft. As a result, the thick sequence of limestone and dolomite accumulating on the Floridan Plateau was flooded by clastic, deltaic, and riverine sediments originating from the Appalachian Mountains to the north (Scott et al. 1980).

The panhandle of Florida is underlain by a thick sequence of sedimentary rocks that cover much older sedimentary, metamorphic, and igneous basement rocks. Overlying this thick sequence of sedimentary rocks is a layer of clastics which originated from runoff from the Appalachian Mountains to the north and was deposited prior to the Pleistocene epoch (Scott et al. 1980).

Since that time, sea level has fluctuated several times and with each fluctuation, a marine terrace and ancient shoreline has developed with its associated depositional material.

The following surface mineral deposits in northwest Florida are discussed in this narrative: sand and gravel, clay, phosphate and uranium, limestone, limestone and dolomite, and peat.

4.2 SAND AND GRAVEL DEPOSITS

During the Pleistocene and Recent geologic epochs, sea level has fluctuated several times and with each fluctuation, a marine terrace and ancient shoreline have developed. The sand deposits covering these terraces vary considerably in thickness and lithology and are predominately composed of quartz sand containing varying proportions of silt, clay, and organic material (Scott et al. 1980). In general, the coarsest sand and gravel deposits are found in the higher terraces and the lower terrace deposits contain more clay and carbonate. In southern Florida, the terrace deposits are much thinner than those to the north and contain much more clay, silt, and organic material. The identification of terraces and shorelines is based primarily on elevation and the various terraces recognized by Cooke (1939, 1945), MacNeil (1949), and Healy (1975) with their approximate elevations are compared in Table 40.

Table 39. Geologic time scale for the Cenozoic Era (Zumberge 1965).

Era	Period	Epoch	Approximate dates (years before present)
Cenozoic	Quaternary	Recent	12,000
		Pleistocene	2,000,000
	Tertiary	Pliocene	12,000,000
		Miocene	25,000,000
		Oligocene	38,000,000
		Eocene	55,000,000
		Paleocene	65,000,000

Table 40. Correlation of terraces and shorelines in Florida. Numbers in parentheses after the terrace names are the elevations in feet above present mean sea level (after Scott et al. 1980).

Cooke (1939, 1945)	MacNeil (1949)	Healy (1975)
Hazlehurst, formerly Brandywine (215-270 ft)	High Pleistocene Terrace (150-280 ft)	Hazelhurst Terrace, Coastwise Delta Plain, High Pliocene Terrace (215-320 ft)
Coharie (170-215 ft)		Coharie (170-215 ft)
Sunderland (100-170 ft)	Okefenokee (150 ft)	Sunderland and Okefenokee (100-170 ft)
Wicomico (70-100 ft)	Wicomico (100 ft)	Wicomico (70-100 ft)
Penholoway (42-70 ft)		Penholoway (42-70 ft)
Talbot (25-42 ft)		Talbot (25-42 ft)
Pamlico (5-25 ft)	Pamlico (25-35 ft)	Pamlico (8-25 ft)
Silver Bluff (0-10 ft)	Silver Bluff (8-10 ft)	Silver Bluff (1-10 ft)

The mining of sand and gravel is the largest non-fuel mineral industry in the United States and the sixth leading mineral resource produced in Florida (Table 41). Approximately 95% of the sand and gravel produced in the United States is used for building and highway construction and the remaining 5% is used in industry as abrasives, foundry sands, filtering media, etc. (Scott et al. 1980).

Sand and gravel deposits, as mapped on the atlas overlays, refer to sand aggregate mixed with some gravel aggregate. Sand represents mostly quartz material between 0.0625 and 2 mm in size. Gravel aggregates range from 2 to 4.76 mm in size and vary in composition (Scott et al. 1980). Sand and gravel deposits in northwest Florida are composed primarily of quartz sand.

There are more producers of sand and gravel than of any other mineral commodity in northwest Florida (Scott et al. 1980). The names and locations of these producers are listed in Table 41. Most of Florida's gravel production is from the Panhandle with some potential for development in central Florida.

Sand and gravel are found in the floodplains of many rivers and streams in northwest Florida. They are also found in the Hawthorn, Miccosukee, and Citronelle formations making up the Northern Highlands in northwest Florida. Sand and gravel are actively mined in Bay, Escambia, Okaloosa, Santa Rosa, Wakulla, and Walton Counties of northwest Florida.

Sand and gravel mined in Florida are extracted from stream alluvium deposits, highland sands, terraces, and beach and dune deposits. The majority of deposits in northwest Florida are terrace deposits.

Surface mining is the only method used for mining sand and gravel in northwest Florida. There are three major types of surface mining employed: bank mining, pit mining, and subaqueous mining (Scott et al. 1980). The type of surface mining employed is dictated by the nature of the deposit. Bank and pit mining are the most common types. In bank mining, the elevation of the excavation floor is at or above the general land surface, whereas pit mining involves excavation below the land surface. Subaqueous mining involves excavation of sand and gravel below the surface of a natural body of water. Subaqueous mining is restricted to the coastal areas where erosion has created the need for beach replenishment programs.

Table 41. Active producers of sand and gravel in northwest Florida counties (Scott et al. 1980).

County	Company	Mine	Location Township	Range	Section
Bay	Calloway Sand Co. P.O. Box 343 Panama City, FL 32402	Calloway Pit	4S	13W	12
	Florida Asphalt Paving Co. P.O. Box 1310 Panama City, FL 32401	Hutchinson Pit	3S	14W	12
	Gulf Asphalt Corp. 6610 W. Highway 98 Panama City, FL 32401	Gulf Asphalt Pit	2S	13W	13,14
	Pitts Sand Co. Route R Panama City, FL 32401	Lynn Haven Mine	3S	14W	12
Calhoun	Panhandle Mining Dev. Route 1 Blountstown, FL 32424	Overholt Pit	1N	8W	27
Escambia	Campbell Sand & Gravel RFD 1, Box 242 Flomaton, FL 36441	Century Pit	5N	30W	22
	Clark Sand Co. P.O. Box 4267 Pensacola, FL 32507	Pensacola Mine	2S	30W	22
	E.M. Chadbourne, Inc. 4375 McCoy Drive Pensacola, FL 32503	Escambia Pit	1S	30W	35
	Escambia Materials, Inc. P.O. Box 12268 Pensacola, FL 32581	Bluff Springs Mine	5N	31W	25,26
	Green's Fill Dirt Route 5, Box 212 Pensacola, FL 32503	(No Name)	1S	31W	12
	J.W. McKay Sand Co. 263 Aquamarine Drive Pensacola, FL 32505	McKay Sand	1S	30W	26
	Pioneer Sand Co. P.O. Box 4599 Pensacola, FL 32507	Sauflay Pit	1S	31W	38

(continued)

Table 41 (concluded)

County	Company	Mine	Location		
			Township	Range	Section
Okaloosa	Morrell Sand Co. Route 2 Crestview, FL 32536	Dorcas Pit	4N	22W	21
	Twin City Sand Co. 168 Bayshore Drive Niceville, FL 32578	Niceville Mine	1S	22W	5
Santa Rosa	Santa Rosa Asphalt & Materials, Inc. Route 7, Box 284A Milton, FL 32570	Gault City Pit	1N	28W	21
Wakulla	Castoldi Hauling, Inc. P.O. Box 26 Panacea, FL 32346	Cass-Ora Pit Revell Pit Kornegay Pit	4S 4S 4S	1W 1W 1W	67 92 49
Walton	Adams Sand Co. General Delivery Mossy Head, FL 3243	Adams Mine	3N	21W	21

The mining of sand and gravel from a pit or bank can be quite difficult since extensive sorting is required. A hydraulic gun is employed to undermine the pit walls, allowing the sand to slump into the pit where it is then piped in a slurry to the screening area. In the larger operations, a suction dredge carries sand and gravel from the pit bottoms. In the screening area, the gravel portion of the sand is removed by screen shakers and the sand fraction is sorted by jets of water. The coarse sand is then taken by conveyor belt to a stockpile or truck and the fine sand portion is piped to a settling pond. Approximately 90% of Florida's sand and gravel is transported by truck, 8% by rail, and the remaining portion by water (U.S. Bureau of Mines 1965-79).

4.3 GRAVEL DEPOSITS

Stream deposits are the major source of gravel in northwest Florida (Scott et al. 1980). Gravel is actively mined in northeast Escambia County for use in concrete and industrial contruction (Schmidt 1978b).

4.4 CLAY DEPOSITS

Clays are hydrous aluminum silicates mixed with varying proportions of intrinsic impurities. Clays occur in several different mineral forms. The principal industrial clays are kaolin (china clay), ball clay, fire clay, fuller's earth, and common earth clays. Clays are located in lenticular beds found throughout the Western Highlands of northwest Florida. Brick manufacturing was conducted until 1975 near Barth in Escambia County. With the continued growth of the Pensacola and Ft. Walton Beach areas, it is anticipated that several new brick manufacturing companies will open in the near future (Schmidt 1978b).

Clays are mined by first removing the overburden by dragline, bulldozer, or pan scrapers, depending on the depth of the overburden and the distance it must be moved. The clay bed is then carefully cleaned and the clays are then loaded onto trucks from the dragline.

4.5 LIMESTONE DEPOSITS

Limestone of the Avon Park formation, Ocala group, Suwannee Limestone, and St. Marks formation are mined by open pit methods in the big bend region of northwest Florida.

Hard-rock and soft-rock limestone are the two principal types of limestone mined. Soft rock limestone is used primarily in the chemical industry, metal extraction processes, soil conditioning, and as a road base. Hard-rock limestone, which is no longer mined in Florida, is used as a building stone. The principal uses for limestone in Florida are as concrete aggregate and road base (approximately 87%), agricultural limestone (i.e., fertilizers, soil conditioning, and acidity control)(3.5%) and chemical-lime markets (approximately 10%). The companies operating limestone mines in northeast gulf study area are listed in Table 42 (Schmidt et al. 1979).

Limestone is mined by the open pit method. The overburden is first stripped off by a bulldozer or dragline and stacked near the excavation. Soft-rock limestone is mined by bulldozers or front-end loaders. Submerged soft-rock limestone is mined by draglines. Hard-rock limestone is first blasted by drilling slot-holes into the limestone and placing the detonating explosives. The hard-rock is then mined by bulldozer or front-end loader, or by dragline (submerged hard-rock limestone). In dry pits, the limestone is loaded onto trucks or conveyor belts and taken directly to the processing plant or it is crushed (hard-rock) and then hauled to the processing plant.

4.6 DOLOMITE DEPOSITS

Dolomite is defined as a sedimentary rock composed of calcium-magnesium carbonate. Dolomite is mined by open pit dragline methods in Citrus, Levy, and Taylor Counties. The dolomite is used for road base material, agricultural soil conditioners, and occasionally as aggregate in concrete (Knapp 1978a; Schmidt et al. 1979). A list of active dolomite-producing companies is shown in Table 43.

4.7 LIMESTONE AND DOLOMITE DEPOSITS

Dolomite is much less common than limestone. It can be defined as a sedimentary rock containing more than 50% dolomite and calcite with dolomite being the most abundant. Limestone and dolomite deposits in the study area are located in the big bend area from Jefferson County south through Citrus County (Schmidt et al. 1979). The uses of dolomite are generally the same as limestone although it is also a source of high-grade refractory materials. Limestone and dolomite deposits are mined by open-pit methods as described in Section 4.5.

Table 42. Active limestone-producing companies in the northwest Florida study area (Schmidt et al. 1979).

County	Company	Mine	Location Township	Location Range	Location Section
Citrus	Carroll Contracting & Ready Mix, Inc. P.O. Drawer 1398 Inverness, FL 32650	Carroll's Lecanto Pit	18S	18E	33
	Colite Mining Co. (Crystal River Quarries, Inc.) P.O. Box 216 Crystal River, FL 32629	Lecanto Rock Pit	19S	18E	15, 16
	E.R. Jahna Industries, Inc. Lecanto Rock Division P.O. Box 317 Lecanto, FL 32661	Lecanto Mine	18S	18E	15
	Lecanto Materials Co. (Crystal Construction Co.) Drawer 291 Lecanto, FL 32661	Lecanto Rock Mine	18S	18E	15
Dixie	Anderson Contracting Co., Inc. P.O. Box 38 Old Town, FL 32680	Tennille Pit	8S	10E	27
Hernando	Brooksville Rock Co., Inc. 605 W. Broad Street Brooksville, FL 33512	Broco Quarry	21S	18E	23
	W.L. Cobb Construction Co. 5002 E. Hillsborough Avenue Tampa, FL 33610	Aripeka Quarry	23S	17E	19
	Florida Crushed Stone Co. P.O. Box 668 Brooksville, FL 33512	Brooksville Gay Quarry	21S 22S 22S	19E 18E 19E	21,32 1,12 5-8,18
	Florida Rock Industries P.O. Box 457 Brooksville, FL 33512	Diamond Hill Mine	21S	19E	20
	E.R. Jahna Industries, Inc.	Mills Mine	23S	21E	1

(continued)

Table 42 (concluded)

County	Company	Mine	Location		
			Township	Range	Section
Levy	Connell & Schultz Box 97 Inverness, FL 32650	Williston Quarry	12S	19E	31
	Levy County Road Dept. P.O. Box 336 Bronson, FL 32621	Arrington Pit Williston Pit Grissin Pit	10S 13S 13S	15E 18E 14E	31 12 4
	V.E. Whitehurst & Sons, Inc. Route 1, Box 125 Williston, FL 32693	Raleigh Quarry	12S	19E	19,20
Pasco	Belcher Mine, Inc. P.O. Box 86 Aripeka, FL 33502	Belcher Mine	24S	16E	1,12
	Internatonal Minerals & Chemical Co. Box 867 Bartow, FL 33830	Morrell Limerock Mine	25S	22E	24,25
Taylor	Anderson Contracting Co. P.O. Box 38 Old Town, FL 32680	Cabbage Grove Pit	3S	4E	34
	Limerock Industries, Inc. P.O. Drawer 790 Chiefland, FL 32626	Cabbage Grove No. 2	3S	4E	34

Table 43. Active dolomite-producing companies in the northwest Florida study area (Schmidt et al. 1979).

County	Company	Mine	Location Township	Location Range	Location Section
Citrus	Colitz Mining Co. (Crystal River Quarries, Inc.) P.O. Box 216 Crystal River, FL 32629	Red Level Mine	17S	16E	36
	Dolime Minerals, Inc. (Florida Lime Works, Inc.) P.O. Drawer ARI Bartow, FL 33830	Crystal River Quarry	17S	16E	11,12
Levy	Florida Rock Industries P.O. Box 227 Gulf Hammock, FL 32639	Gulf Hammock Mine	14S	16E	21,28
Taylor	Dolime Minerals, Inc. P.O. Drawer ARI Bartow, FL 33830	(No Name)	4S	4E	13
	Limerock Industries, Inc. P.O. Drawer 790 Chiefland, FL 32626	Cabbage Grove No. 2	4S	4E	2,3

4.8 PEAT DEPOSITS

Peat is extremely varied in its composition and its chemical and physical properties. In commercial usage, three types of peat are recognized: moss peat consisting of poorly decomposed remains of sphagnum and other mosses; reed, or sedge peat, consisting of poorly decomposed plants of the sedge family (reeds, cattails, etc.); and humus consisting of peats decomposed to the extent that their biological identity is lost. Most of the peat found in Florida is classified as humus (Calver 1957).

Peat is used primarily as a soil conditioner. It is also used as a fertilizer filler, plant packing material, poultry litter, and infrequently as a low grade fuel. Nearly all the peat marketed in Florida is used for soil improvement (Calver 1957).

Florida ranked second in the United States in peat production in 1978 and 1979 (Boyle and Hendry 1981). Peat is not mapped on the atlas maps because the deposits are found in small localized beds near the surface at many random locations.

Peat is mined in open pits by bulldozers, front-end loaders, or draglines. The mined peat is transported to the processing plant by truck.

4.9 SHELL BED DEPOSITS

Shell beds are present in small areas of Calhoun, Washington, and Bay Counties. The shell beds are associated with a marl and range from 10 million years old. The shell is used as a road base and sub-base stabilizer (Schmidt 1979).

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7. GLOSSARY

calcareous - Containing calcium carbonate or calcium salts.

carbonate - A salt of carbonic acid; a compound containing the radical CO_3.

clastic - Consisting of fragments of rocks or of organic structures that have been moved individually from their places of origin.

Cretaceous - The third and latest period from 70 - 135 million years bp, included in the Mesozoic Era characterized by the development of flowering plants and the disappearance of dinosaurs.

dolomite - A common sedimentary mineral composed of calcium-magnesium carbonate.

formation - A bed, or assemblage of beds with well-marked upper and lower boundaries that can be traced and mapped over a considerable tract of country.

gravel - Rounded rock or mineral fragments between 2 and 4.76 mm in diameter (0.125 - 0.25).

gypsum - A mineral with the chemical formula $CaSO_4 \cdot 2H_2O$.

hydrous - Containing water.

igneous - Pertaining to rocks formed by solidification of hot mobile material termed magma.

isopach - A line on a geologic map connecting points of equal thickness of a geologic formation.

limestone - A sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$).

lithology - The study of rocks and rock forming processes.

metamorphic rock - Sedimentary or igneous rocks that have been altered by pressure, heat, or the introduction of new chemical substances.

paleoclimate - Ancient climate.

plateau - A relatively flat elevated area of land.

quarry - An open or surface mining pit.

sand - Rock fragments ranging in size from 0.0625 to 2 mm (0.004 - 0.125 inches).

sedimentary - Pertaining to rocks formed by the accumulation of sediment in water (aqueous deposits), or from wind deposition (aeolian deposits).

shoal - A shallow, submarine bank rising above the surrounding submarine topography.

silicate - A salt derived from SiO_2 or silicic acid.

sinkhole - A funnel-shaped depression in the ground surface formed by solution of limestone.

CLIMATOLOGY AND HYDROLOGY OF NORTHWEST FLORIDA

1. INTRODUCTION

1.1 CLIMATOLOGY OF NORTHWEST FLORIDA

The peninsula portion of the northeast gulf study area is renowned for its warm subtropical climate. Each year thousands of tourists flock to the region to bask in the Florida sun and swim in the warm waters of the Gulf of Mexico.

The peninsula portion of the northwest Florida study area receives more than 50% of its rainfall during the summer. The summer rainy season, as it is known, normally runs from approximately May 20 through September 20. The Panhandle of the northeast gulf study area has two rainy seasons: the winter rainy season and the summer rainy season.

Summer rainfall is associated with convective thunderstorms. Such thunderstorms form from intense daytime heating of warm subtropical air masses that prevail over the region during summer. Atmospheric moisture content and direct solar radiation are key ingredients in the formation of these thunderstorms. The sun reaches its highest point in the sky on 21 June (summer solstice). The optimum solar radiation period in the study area ranges from April through August. The optimum atmospheric moisture content period ranges from approximately 20 May through 20 September which coincides with the summer rainy season. Because the optimum solar radiation period occurs during the first 3 months of the rainy season, thunderstorms are most intense at this time.

During May and June, atmospheric steering currents are weak and thunderstorms tend to form along sea breeze convergence fronts in the interior of peninsula Florida. Sea breeze convergence fronts form where land breezes and sea breezes come together and winds are forced upwards. During July, August, and September, a southeasterly steering current usually prevails across the area.

The Atlantic Ridge, a semi-permanent high pressure system which prevails across the Atlantic from May through October, is located north of the region, at this time, allowing moist southeasterly trade winds to prevail across the region.

Showers and a few thunderstorms first form in the morning hours along the Florida east coast and Gulf Stream and then redevelop westward during the day steered by prevailing tradewinds (the average life expectancy of a thunderstorm cell is 1 hour; for this reason, precipitation totals tend to be quite erratic as thunderstorm cells continually form, develop, and die). By late afternoon, these cells are approaching the gulf coast of Florida. The thunderstorms mushroom rapidly as this moisture surge of shower activity reaches the sea breeze convergence zone just inland of the gulf coast. Because the atmosphere holds more moisture at high temperatures, the heaviest precipitation totals occur along the gulf coast during the late afternoon hours at the time of maximum solar heating. The gulf coast of Florida is the thunderstorm capital of the United States.

From time to time, frontal systems intrude into the Southeastern States, bringing westerly steering currents to the region and the precipitation cycle reverses. During these periods, showers develop during the morning on the gulf coast and redevelop eastward during the day, reaching the east coast during the late afternoon where they are most intense. During these periods of westerly steering current intrusions, the heaviest precipitation totals occur along the east coast.

During the fall, from late September through November, the fall dry season is characterized by atmospheric moisture drops and solar radiation decreases.

During winter, from December until mid-March, a secondary rainy season occurs almost exclusively along cold fronts, reaching a peak during February and March. During late March, frontal systems stall mostly north of the region, and the spring dry season ensues.

1.2 HYDROLOGY OF NORTHWEST FLORIDA

The hydrologic cycle is the circulation of water from where it falls as rain, flows overland and in streams as runoff to the ocean, and circulates back to the atmosphere through evapotranspiration. A small portion of the rainfall seeps into underground storage as recharge to ground water reservoirs (aquifers).

Surface waters in northwest Florida drain into the Gulf of Mexico. Stream discharges normally reach their peak during the latter part of the summer rainy season in the peninsula portion of the study area. However, in the Panhandle, maximum stream discharge could occur at the end of either the summer or winter rainy season.

2. FLORIDAN AQUIFER

2.1 BACKGROUND

Ground water is one of Florida's most valuable and abundant resources. Two principal aquifers are present in northwest Florida (Figure 5). The artesian Floridan aquifer contains water under sufficient pressure to rise above the top of the containing geological formations. It is also the principal source of ground water in most of Florida. The sand and gravel aquifer, which lies at depths of less than 750 ft, underlies most of the western portion of the study area.

The Floridan aquifer is included within the Lake City, Avon Park, and Ocala Limestones, all of Eocene Age; the Suwannee Limestone of Oligocene Age; and the Tampa Limestone and permeable portions of the Hawthorne Formation of Miocene Age. The Floridan aquifer is one of the world's largest. In some areas, the aquifer is exposed at the land surface, but over most of the State, it is beneath several hundred feet of sediments and confining formations. The thick non-porous rocks restrict the vertical flow of water upward and downward from the Floridan aquifer. In several places, there are large breaks in the confining formation, where large springs discharge. The depth to the base of water containing less than 10,000 mg/l of dissolved solids (freshwater-saltwater interface) in the Floridan aquifer across northwest Florida in 1980 is shown in Figure 6.

2.2 POTENTIOMETRIC CONTOUR MAP OF THE FLORIDAN AQUIFER

The altitude to which water will rise in artesian wells, generally ranges from a few feet to more than 130 ft and is known as the potentiometric surface. The potentiometric surface for the Floridan aquifer, as determined in May of 1980 and 1981, is shown in Figure 7 and is shown on the individual atlas maps. These were the latest data available at the time the maps were compiled and represent dry season potentiometric levels. A potentiometric map provides valuable data on the relative size and storage of subsurface waters and directions of ground water flow. Saltwater intrusion is a major problem in areas where the potentiometric surface approaches or falls below sea level. Generally speaking, the depth to the base of potable water can be estimated by multiplying the altitude of the potentiometric surface by 40.

The potentiometric contour map of the Floridan aquifer portrayed on the atlas maps represents dry season water levels present in tightly cased wells penetrating the Floridan aquifer in May 1981 in the area south of Cedar Key and in May 1980 north of Cedar Key. The contour interval is 5 to 10 above mean sea level. Contour lines on the atlas maps have been generalized to allow for nonsimultaneous water level measurements and variable well depth.

Figure 5. Aquifers of northwest Florida (after Franks 1982).

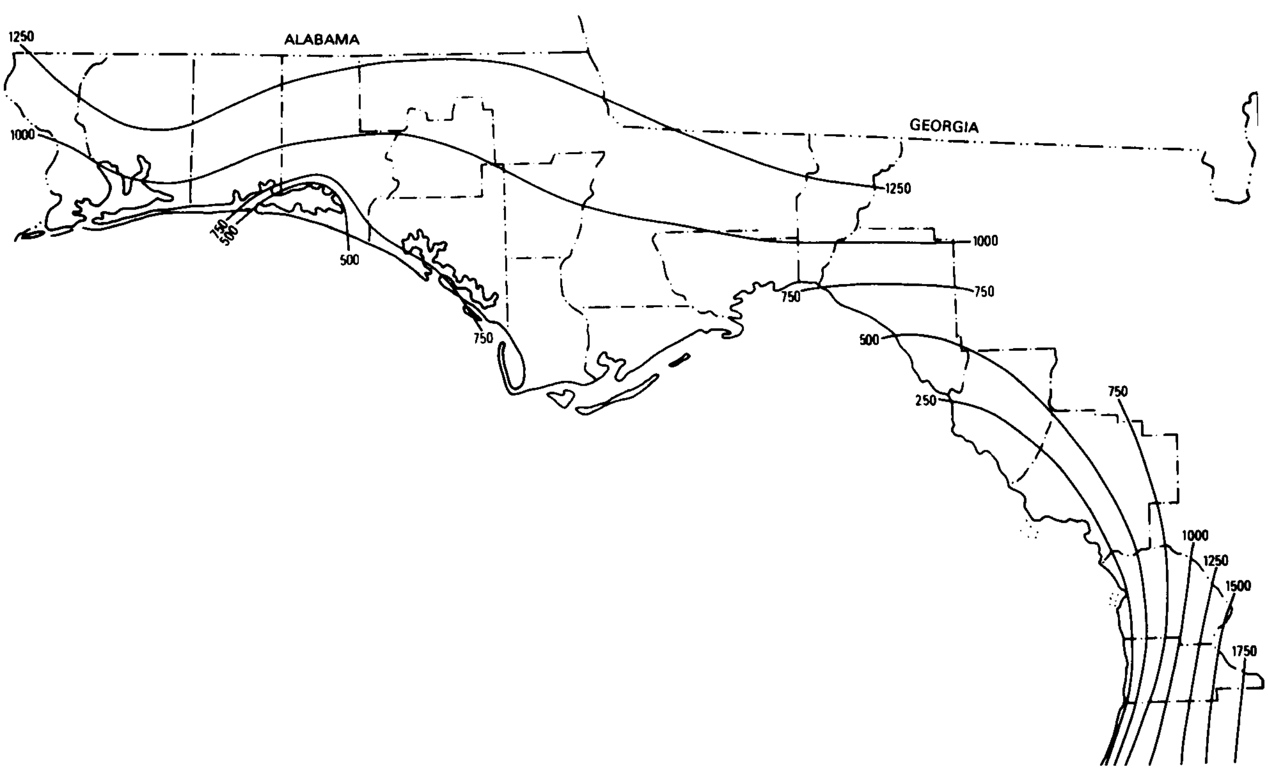

Figure 6. Depth to base of potable water in the Floridan aquifer; contours are in feet below mean sea level (adapted from Franks 1982).

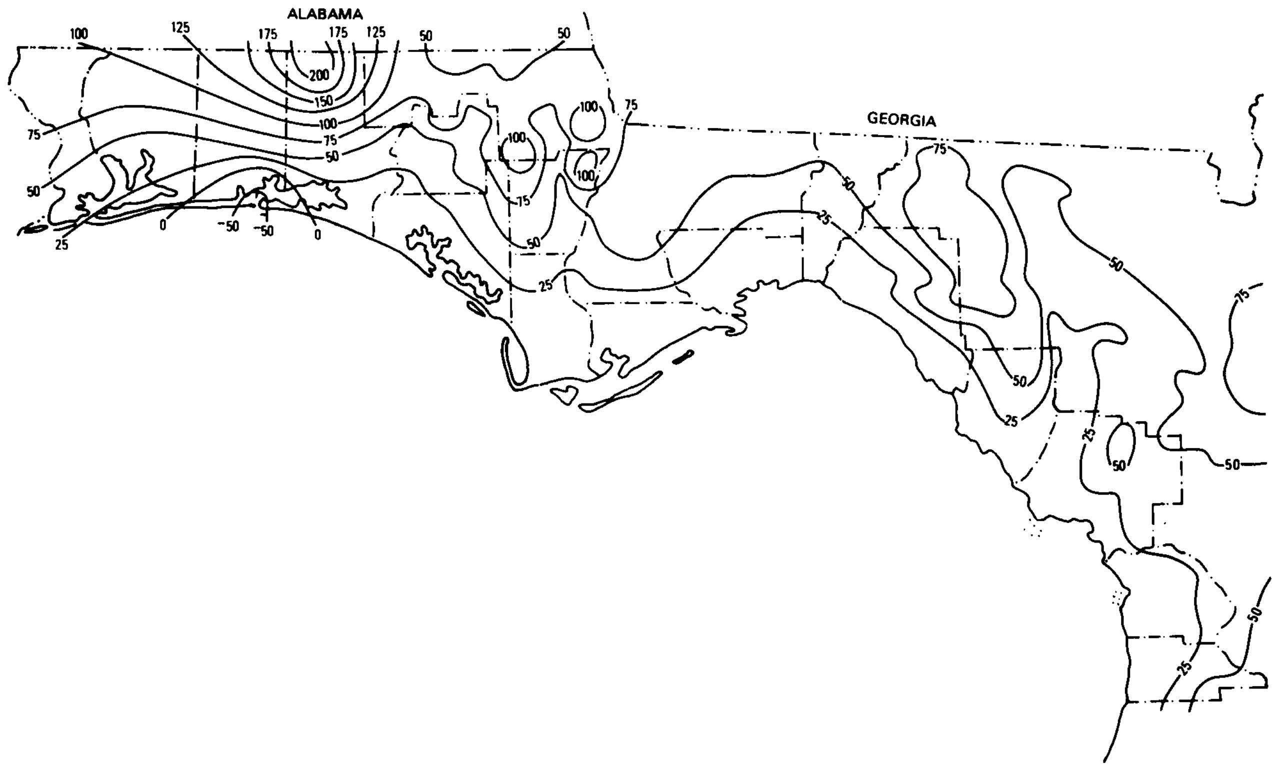

Figure 7. Generalized potentiometric surface of Floridan aquifer across northwest Florida during May 1980 and May 1981; contours are in feet above mean sea level (adapted from Franks 1982).

3. MONTHLY PRECIPITATION

3.1 BACKGROUND

The northeast gulf study area has a bi-modal annual monthly precipitation pattern which consists of the summer rainy season, a secondary late winter rainy season, and the fall and spring dry seasons. This bi-modal annual rainfall pattern is shown graphically in Figure 8.

3.2 MEAN MONTHLY PRECIPITATION

The summer rainy season normally starts during the latter portion of May. Atmospheric moisture increases and with high solar radiation levels present, convective thunderstorms build up during the afternoon hours over the Florida peninsula. During May and June, these thunderstorms form along land and sea breeze convergence zones in the interior of northwest Florida. Since atmospheric steering currents are weak at this time of year, the thunderstorms show little movement and the aerial distribution of these thunderstorms is limited (Figures 9 and 10). During July, August, and September, easterly tradewinds usually prevail across the area, and the aerial coverage of the thunderstorms increases. The thunderstorms are heaviest along the Florida gulf coast during the late afternoon and early evening hours (Figures 11, 12, and 13).

During the fall, from late September through November, the fall dry season is characterized by atmospheric moisture drops and solar radiation decreases (Figures 14 and 15).

During the winter, from December until mid-March, a secondary winter rainy season occurs. Precipitation occurs almost exclusively along cold fronts reaching a peak during the months of February and March (Figures 16, 17, 18, and 19). Monthly precipitation is much greater in the Panhandle of northwest Florida during these months.

During late spring, fronts stall mostly north of the region and the spring dry season ensues. With a scarcity of rainfall and solar radiation at its annual maximum, water tables reach their annual lowest level (see Figure 20).

The mean annual isohyetals (rainfall contours) shown on the atlas maps were compiled by the author from mean annual precipitation totals from 1951 to 1980 for all Florida National Weather Service climatological stations with a period of record dating back to at least 1951. The contour interval on the atlas maps is 1 inch. The 30-year period from 1951 to 1980 is the latest period of record for establishing climatological normal means. A small scale version of the mean annual isohyetals for Florida is shown in Figure 21. The contour interval on this figure is 2 inches.

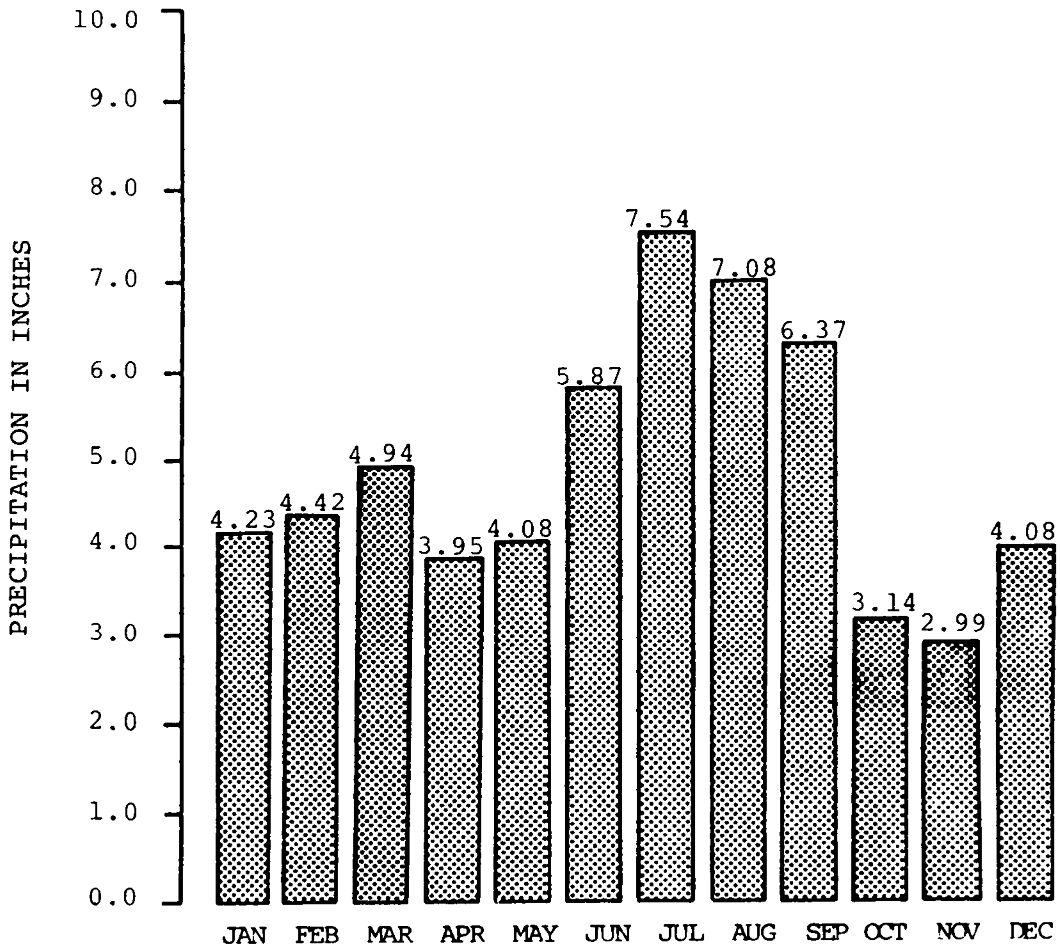

Figure 8. Normal mean monthly precipitation for northwest Florida, 1951-80; represents areal mean of monthly precipitation for study area (National Climatic Center 1982).

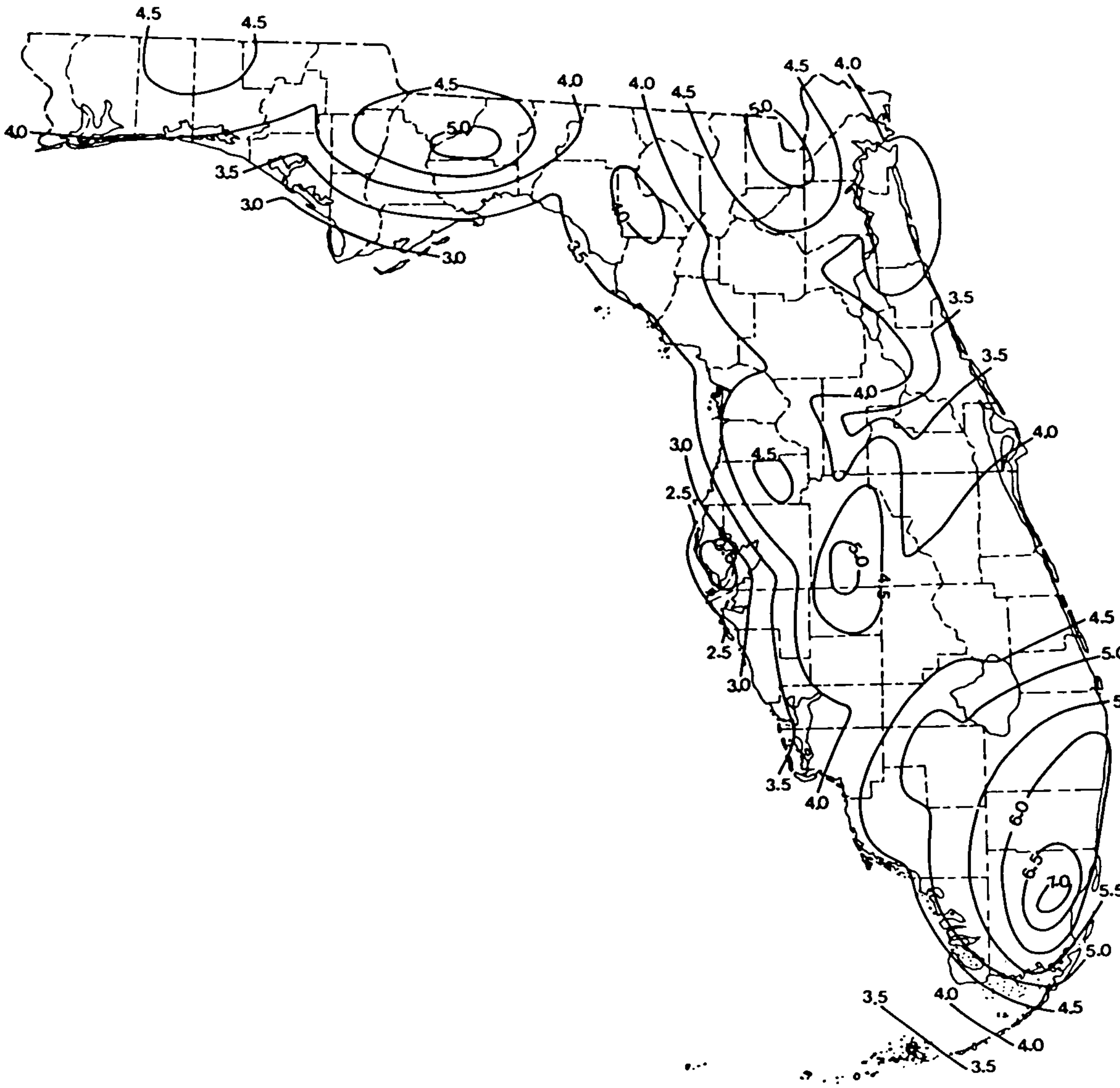

Figure 9. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, May 1951-80 (National Climatic Center 1982).

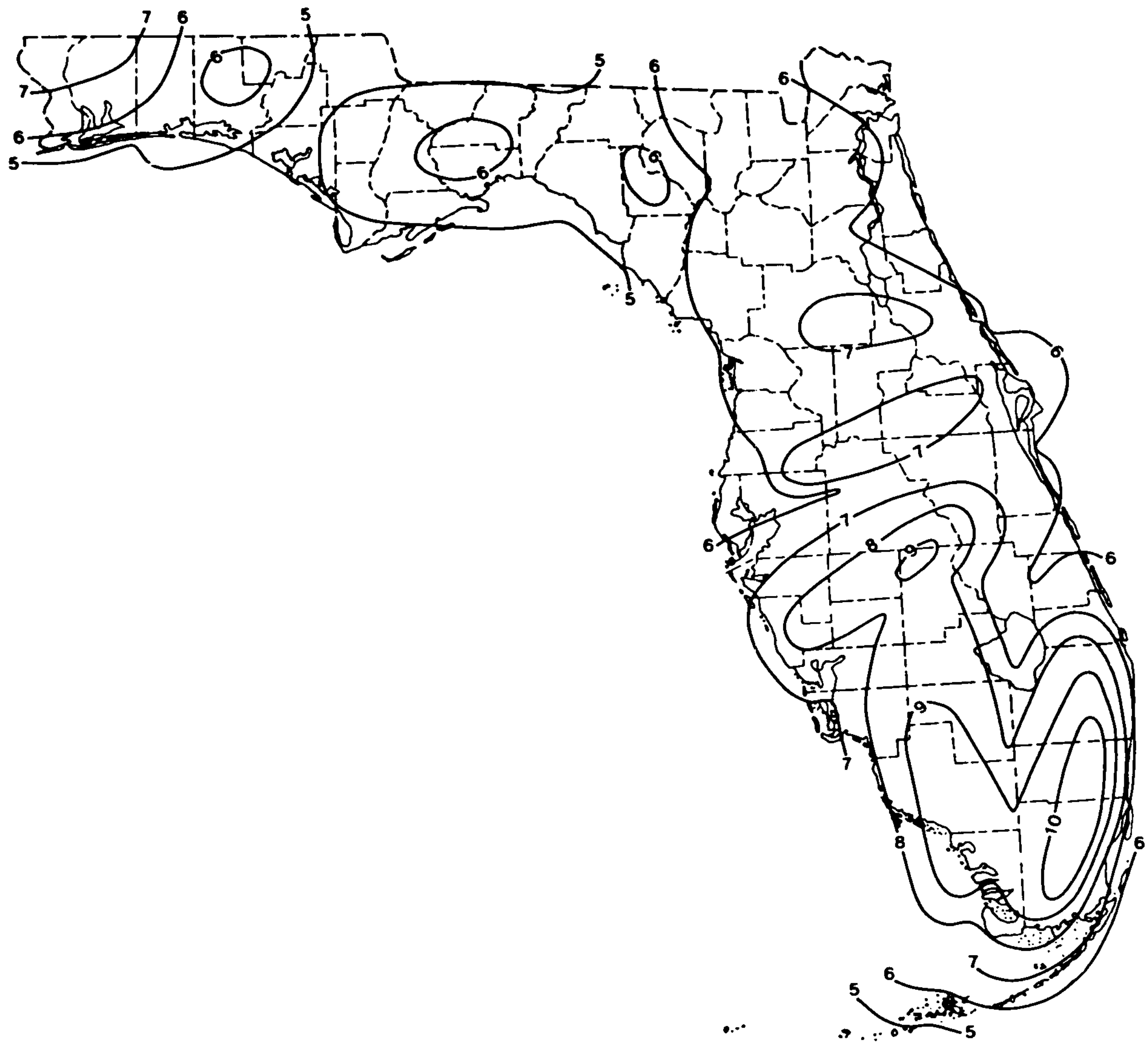

Figure 10. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, June 1951-80). (National Climatic Center 1982).

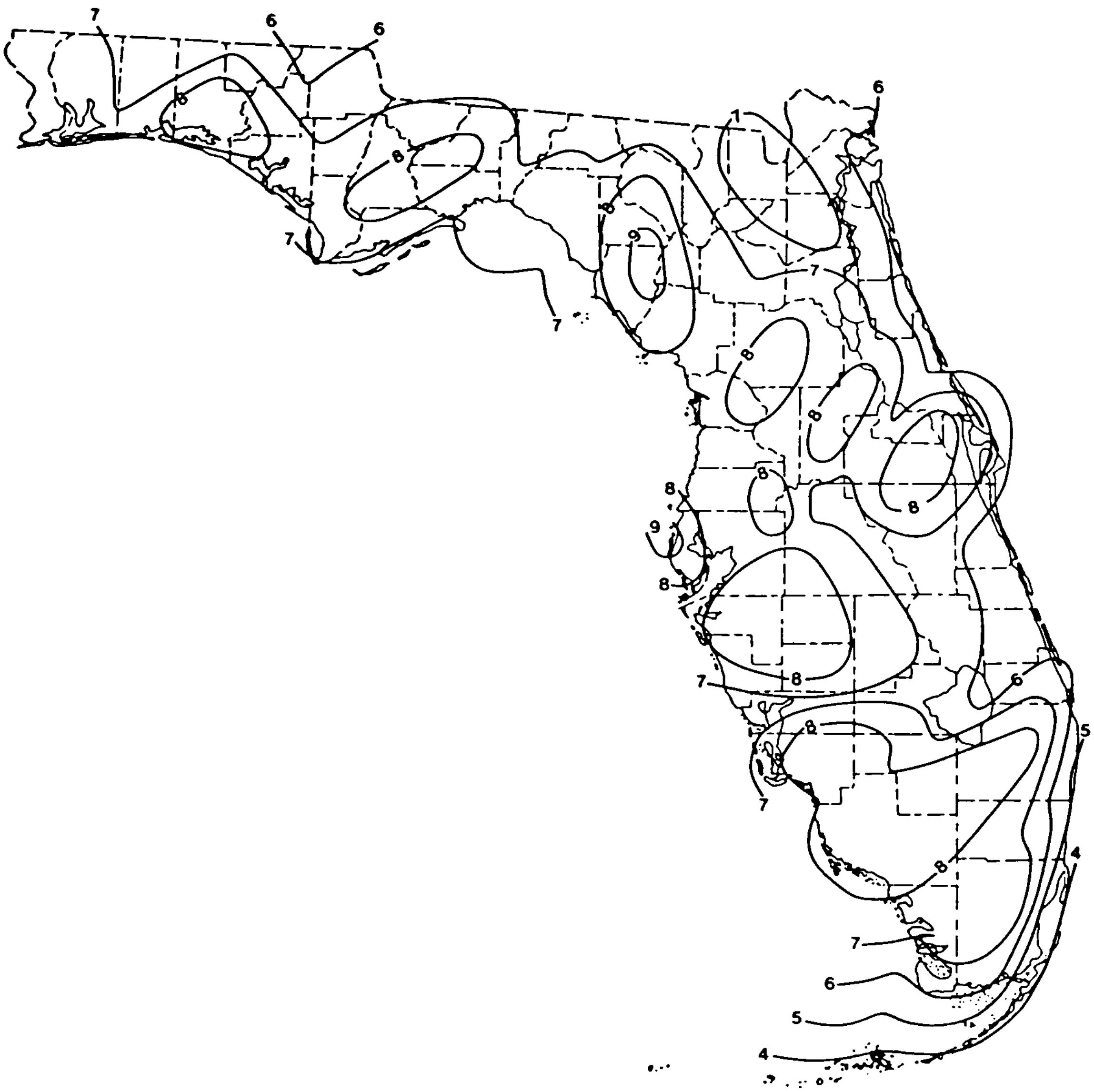

Figure 11. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, July 1951-80 (National Climatic Center 1982).

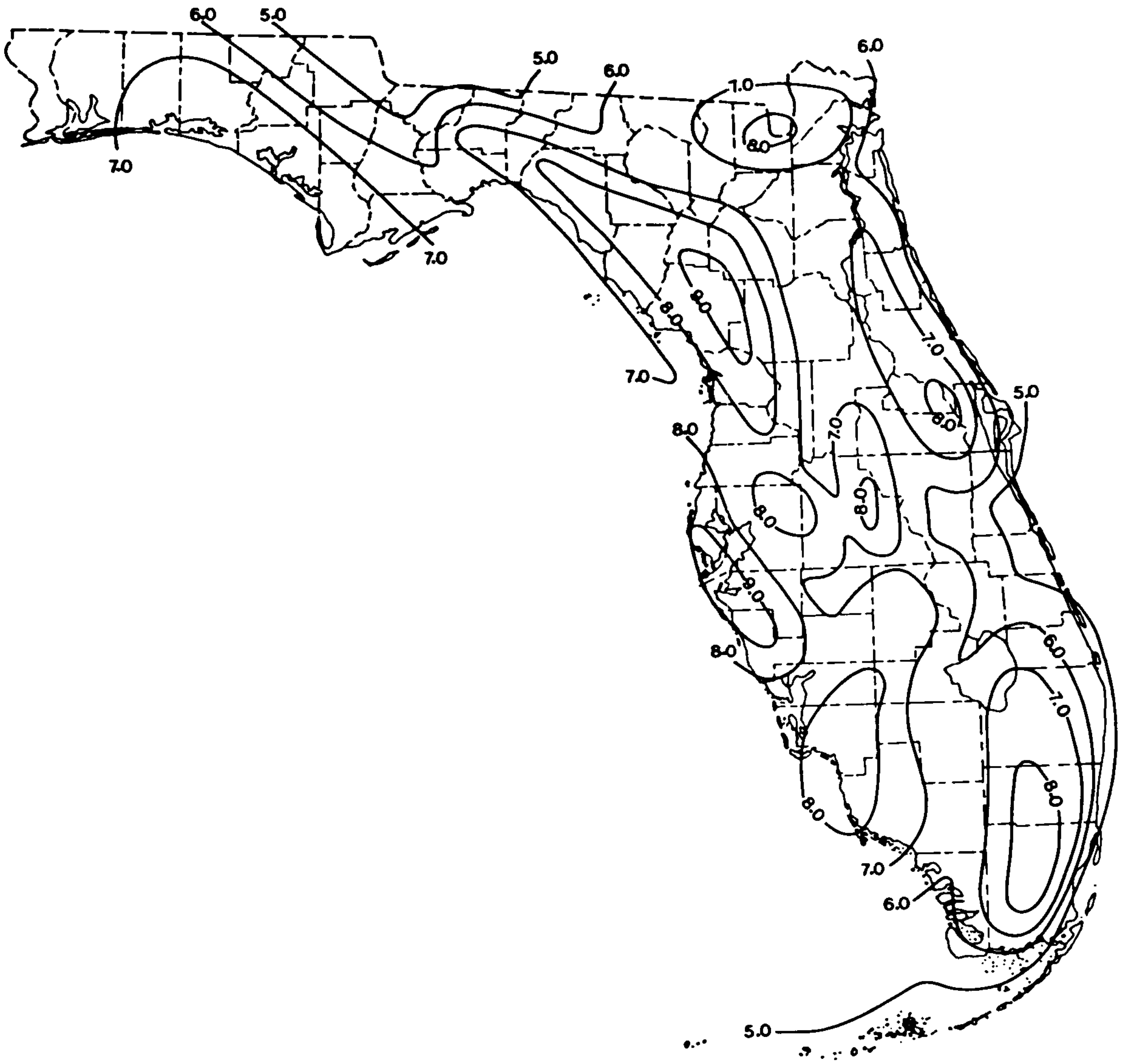

Figure 12. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, August 1951-80 (National Climatic Center 1982).

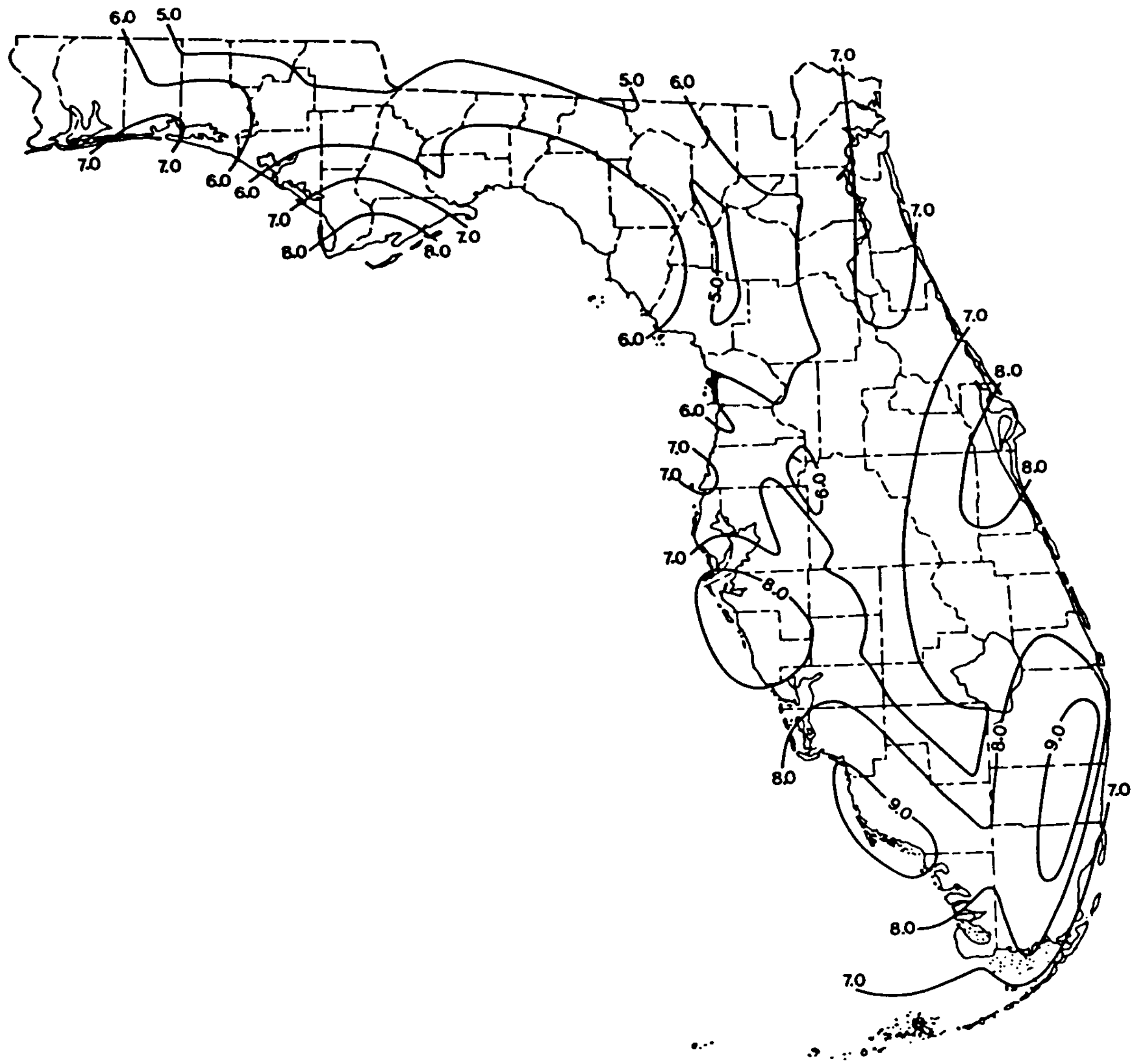

Figure 13. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, September 1951-80 (National Climatic Center 1982).

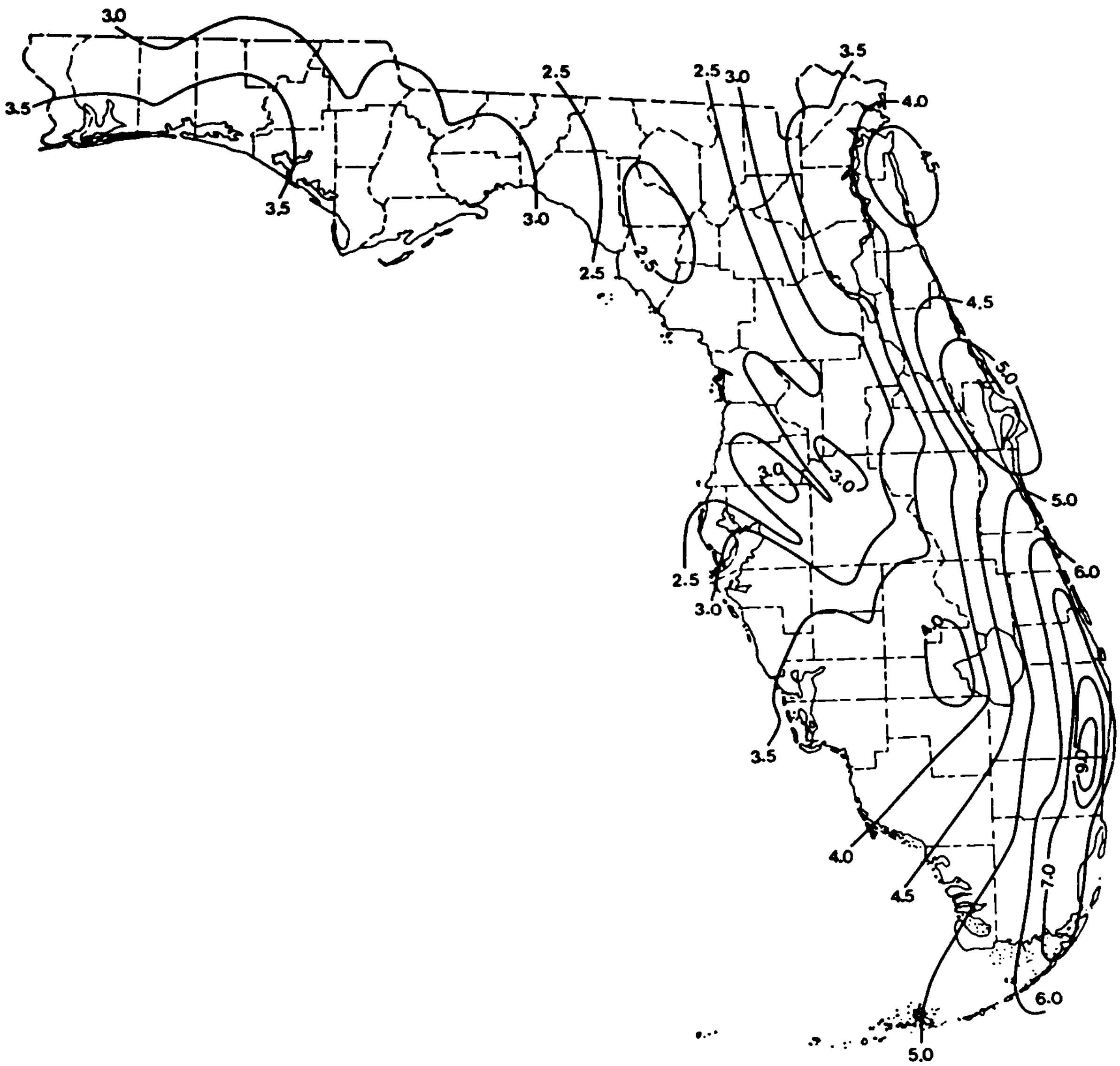

Figure 14. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, October 1951-80 (National Climatic Center 1982).

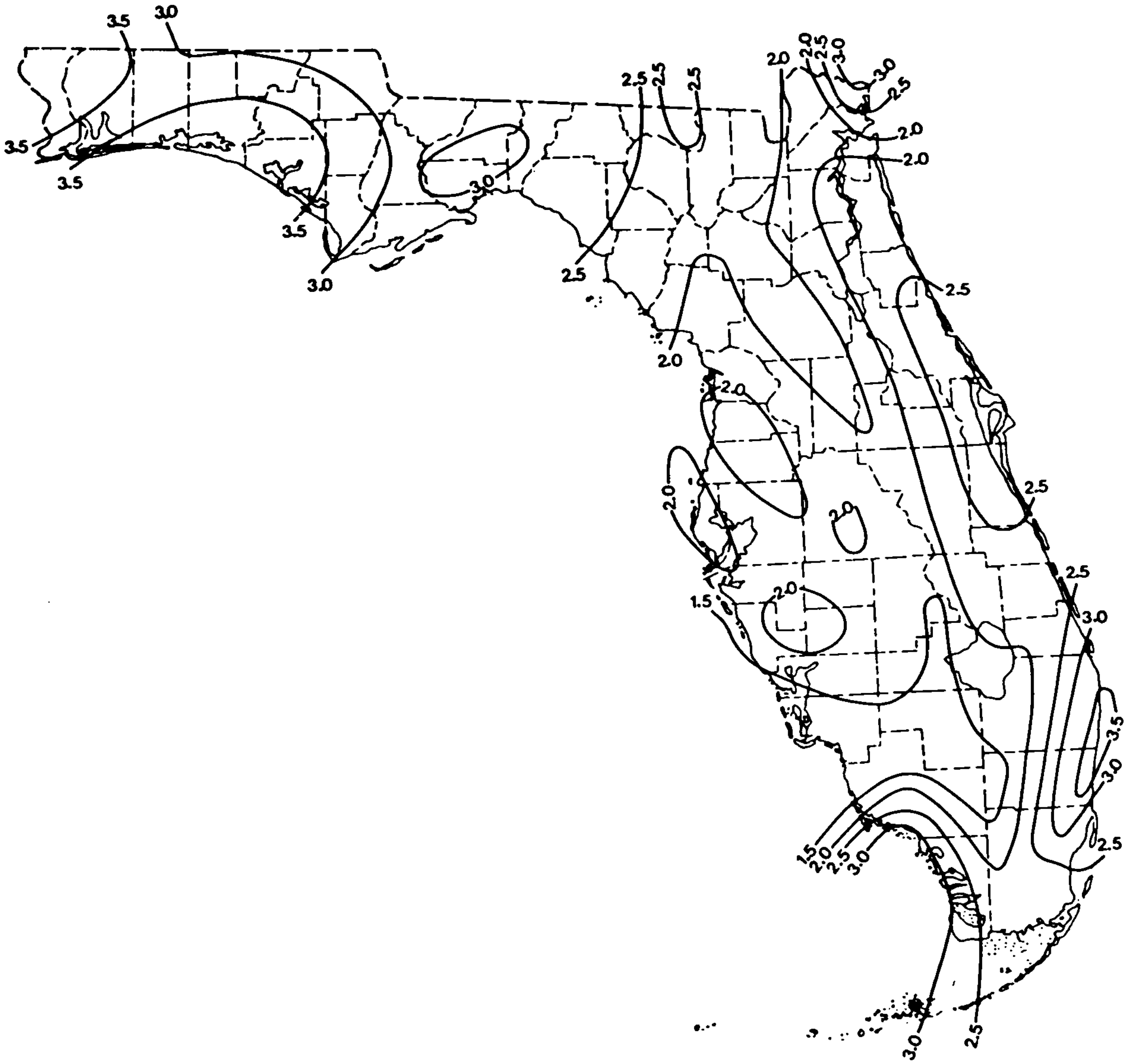

Figure 15. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, November 1951-80 (National Climatic Center 1982).

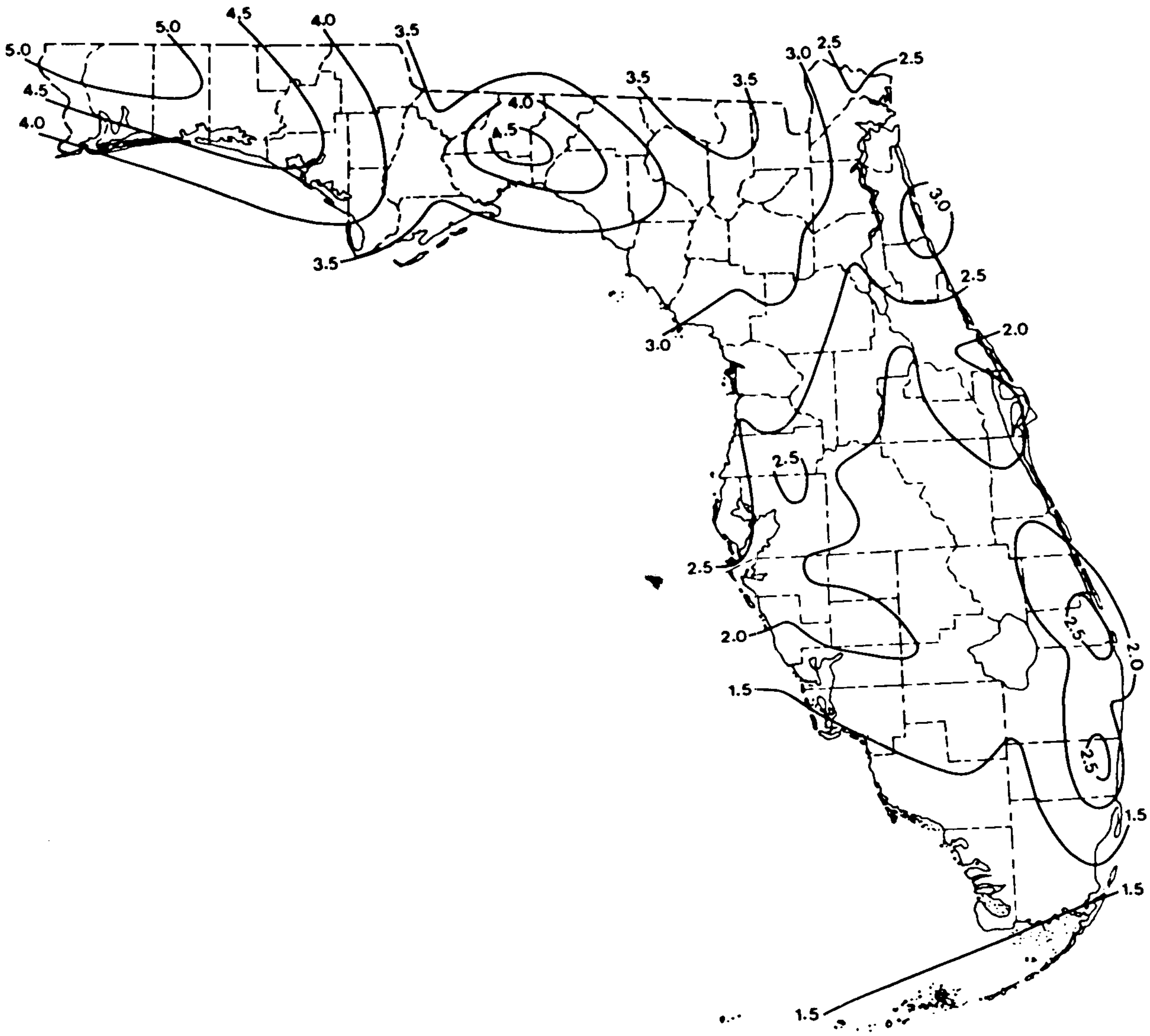

Figure 16. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, December 1951-80 (National Climatic Center 1982).

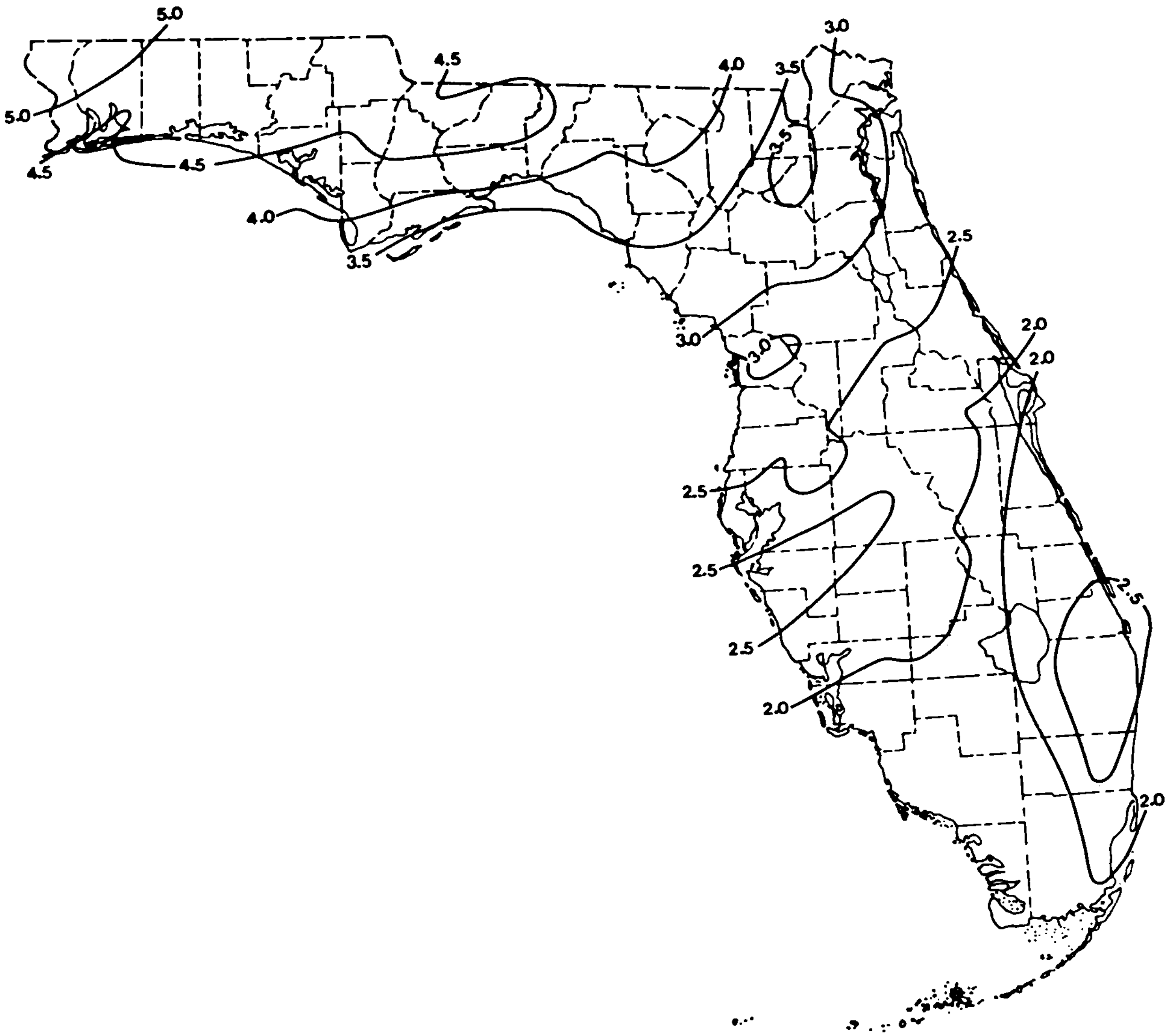

Figure 17. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, January 1951-80 (National Climatic Center 1982).

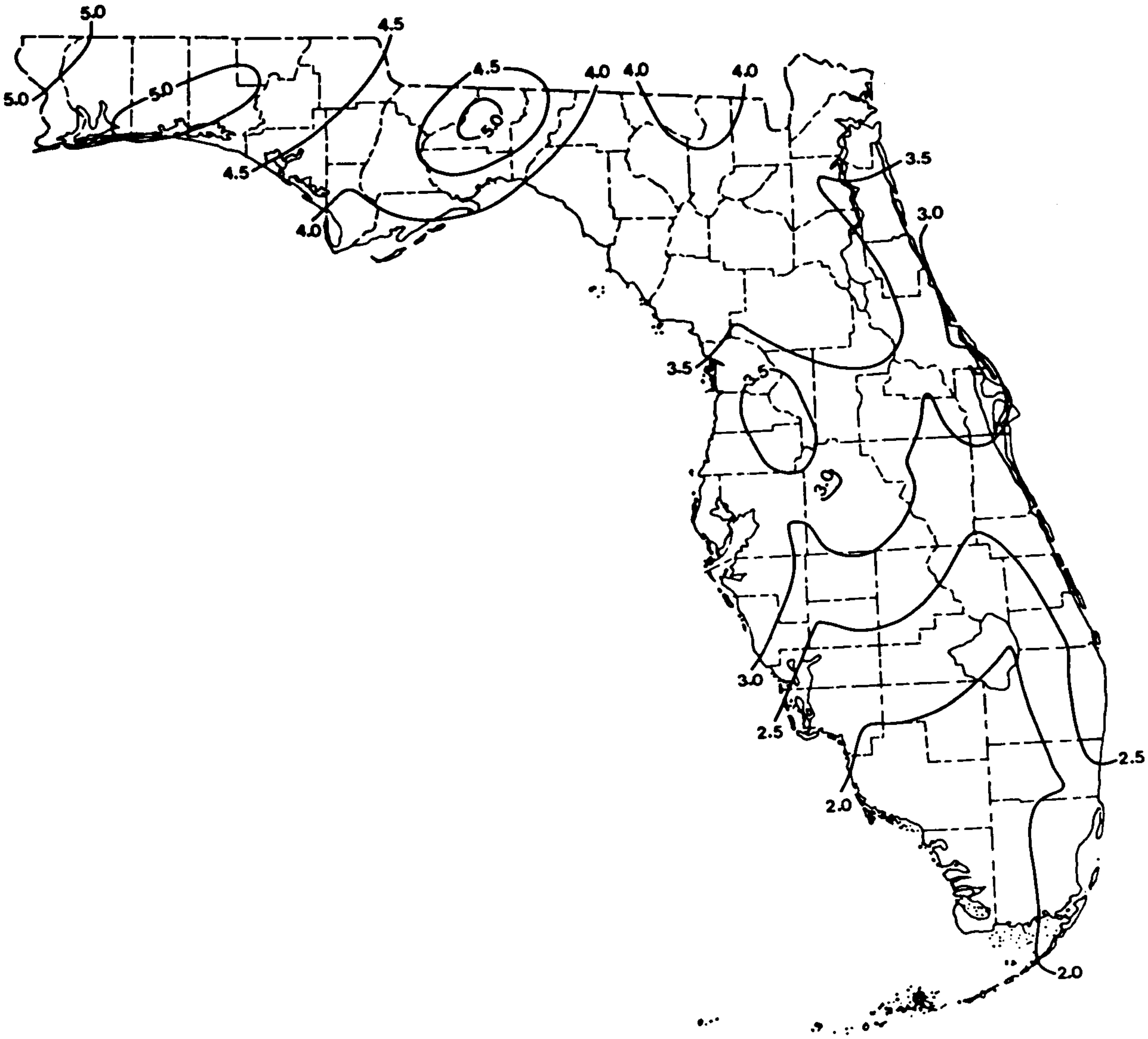

Figure 18. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, February 1951-80 (National Climatic Center 1982).

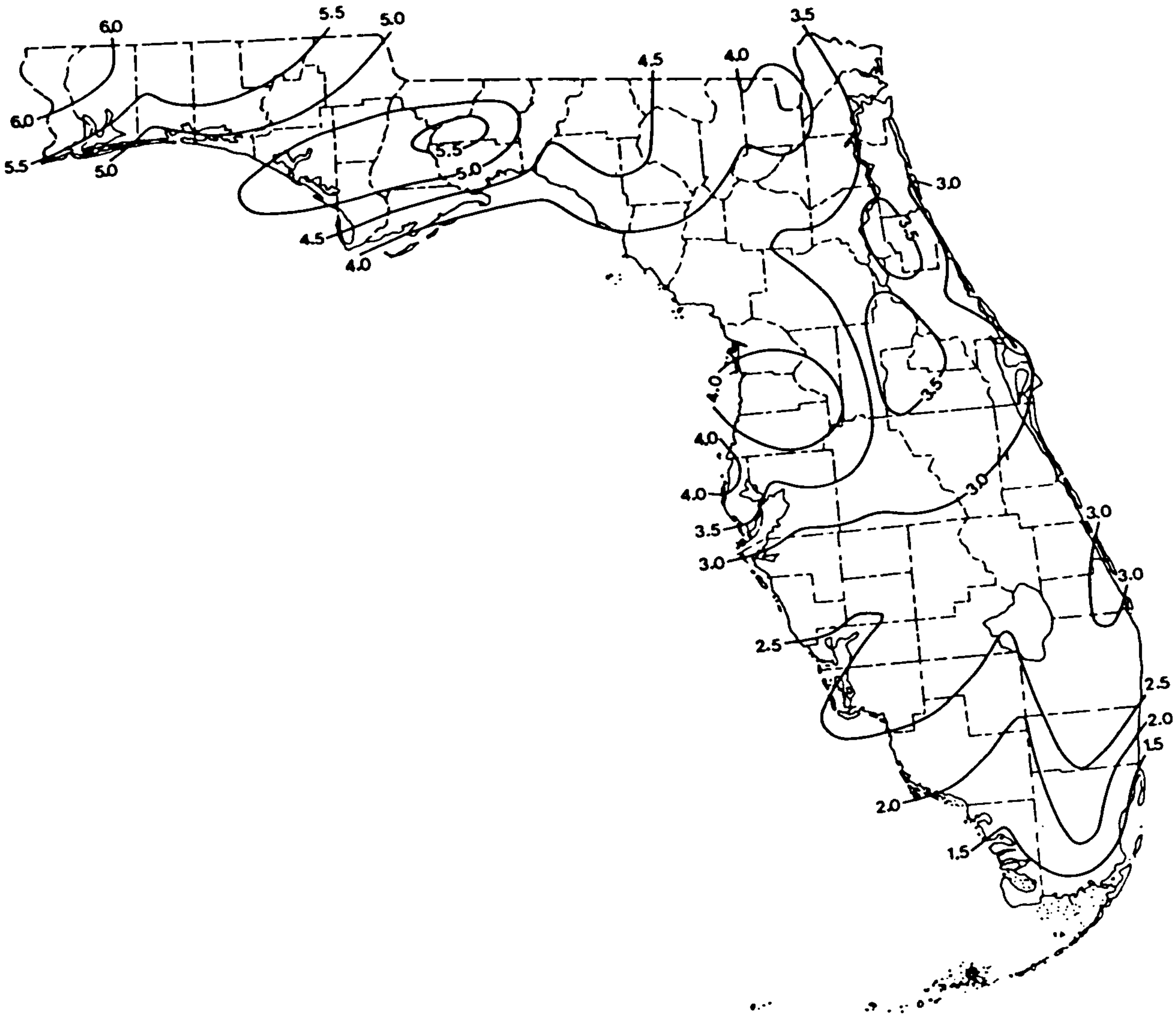

Figure 19. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, March 1951-80 (National Climatic Center 1982).

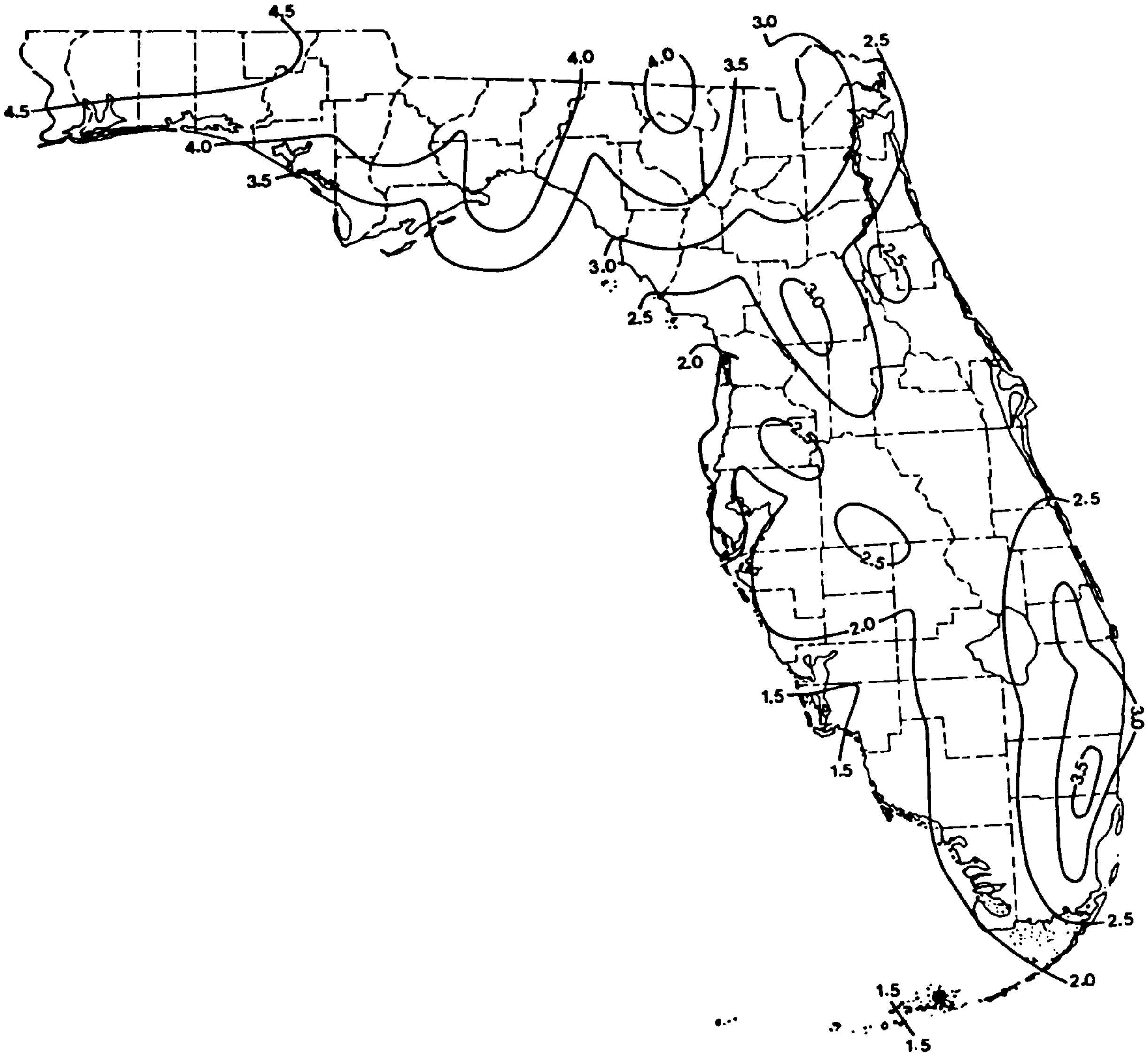

Figure 20. Florida map with isohyets (contour lines showing equal amounts of precipitation) for normal mean rainfall, April 1951-80 (National Climatic Center 1982).

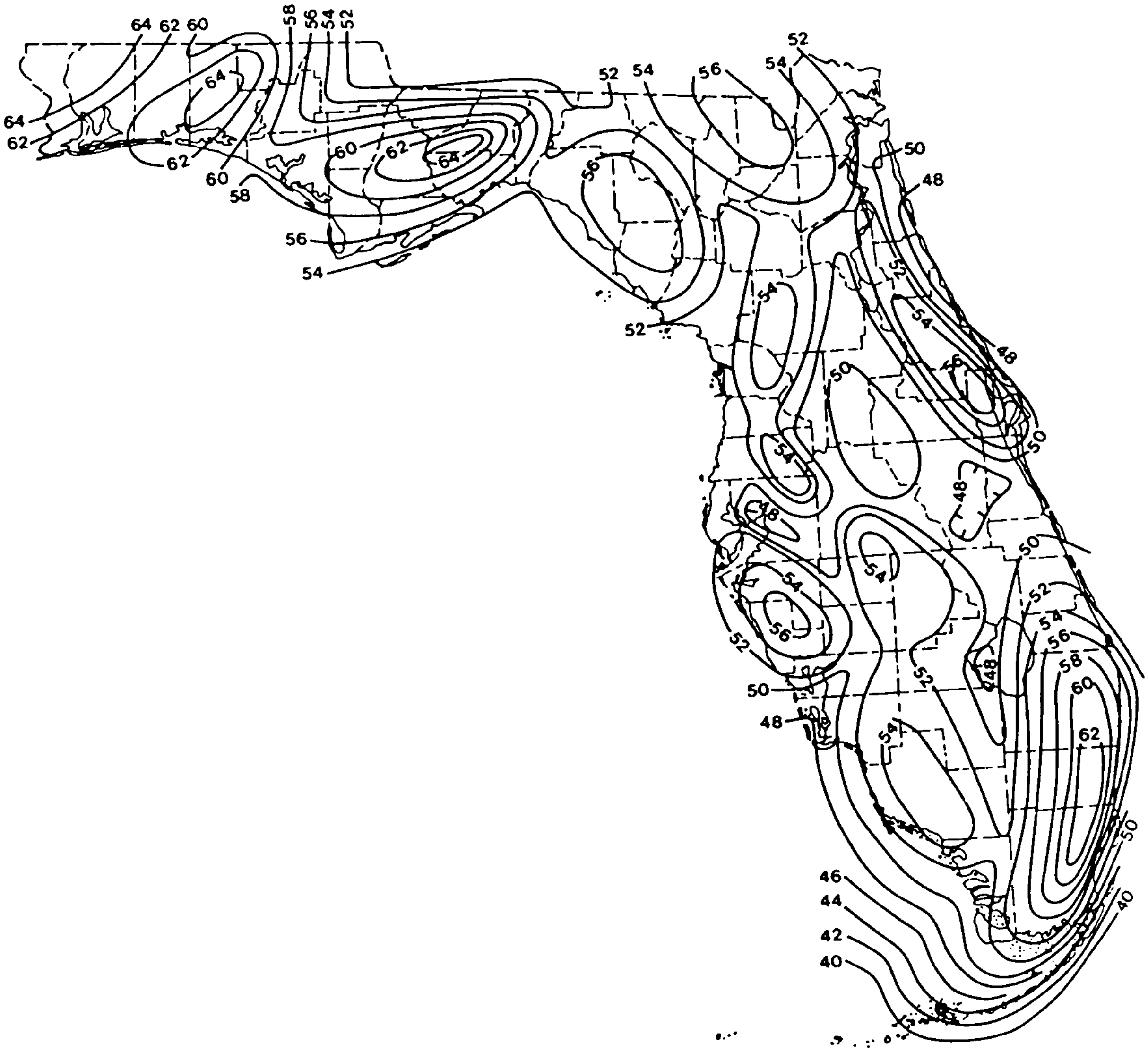

Figure 21. Florida map with isohyets (contour lines showing equal amounts of precipitation) for annual normal mean rainfall, 1951-80 (National Climatic Center 1982).

4. CLIMATOLOGICAL STATIONS

4.1 BACKGROUND

The National Weather Service, U.S. Geological Survey, Water Management Districts, U.S. Soil Conservation Survey, U.S. Air Force and various private corporations and individuals all operate climatological stations in the northeast gulf study region.

The National Weather Service climatological stations have the longest period of record and provide the only detailed climatological data for the last Weather Bureau normal period from 1951 to 1980.

4.2 NATIONAL WEATHER SERVICE 30-YEAR CLIMATOLOGICAL STATIONS

The National Weather Service climatological stations that have at least 30 years of continuous data are shown in Table 44 and are located on the atlas maps. The normal mean monthly precipitation for the period from 1951 to 1980 for these stations is shown in Table 45.

Table 44. National Weather Service climatological stations with 30 years or more data present in northwest Florida.

Number on Map	Station	County	Latitude	Longitude	Elev.	Temperature (1st year of record)	Precip. (1st year of record)	Evap. (1st year of record)[a]
1	Pensacola Airport	Escambia	30°28'	87°12'	112	1944	1944	-0-
2	Milton Exp. Station	Santa Rosa	30°47'	87°08'	217	1947	1947	1961
3	Crestview Airport	Okaloosa	30°47'	86°31'	185	1941	1941	-0-
4	Niceville	Okaloosa	30°31'	86°30'	60	1926	1926	-0-
5	De Funiak Springs	Walton	30°44'	86°07'	230	1898	1898	-0-
6	Chipley 3 E	Washington	30°47'	85°29'	130	1938	1938	-0-
7	Panama City NE	Bay	30°13'	85°36'	32	----	1899	-0-
8	Blountstown	Calhoun	30°27'	85°03'	60	1912	1912	-0-
9	Apalachicola	Franklin	29°44'	85°02'	19	1902	1902	-0-
10	St. Marks 5 SSE	Wakulla	30°06'	84°10'	10	1922	1922	-0-
11	Monticello 3 W	Jefferson	30°32'	83°55'	145	1903	1903	-0-
12	Cross City 2 WNW	Dixie	29°39'	83°10'	42	1951	1951	-0-
13	Inverness	Citrus	28°50'	82°20'	50	1899	1899	-0-
14	Brooksville Chin. Hill	Hernando	28°37'	82°22'	240	1892	1892	-0-

[a]Note: An evaporation station is also located at the Jim Woodruff Dam.

Table 45. Normal mean monthly precipitation for National Weather Service Climatological Stations in northwest Florida, 1951-80; precipitation in inches (National Climatic Center 1982).

Number on map	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	Pensacola Airport	4.59	4.93	5.59	4.43	4.07	6.06	7.38	6.56	6.85	3.54	3.26	4.28	61.54
2	Milton Exp. Station	5.05	4.97	6.09	4.84	4.34	7.09	7.18	6.44	6.78	3.44	3.87	5.37	65.46
3	Crestview Airport	4.63	4.75	5.67	4.74	4.61	5.99	6.50	7.13	5.52	3.28	3.19	5.05	61.06
4	Niceville	4.81	5.11	5.10	4.45	4.08	5.81	8.04	7.09	7.05	3.76	3.59	4.79	63.68
5	De Funiak Springs	4.87	5.14	5.82	4.66	4.51	6.36	8.41	7.24	6.36	3.62	3.46	4.77	65.22
6	Chipley 3 E	4.70	4.78	5.23	4.41	4.04	4.70	6.16	5.40	4.95	3.05	3.18	4.30	54.90
7	Panama City NE	3.34	4.36	5.21	3.68	3.28	4.99	7.72	7.92	6.33	3.43	3.65	4.49	59.40
8	Blountstown	4.66	4.26	5.02	4.34	4.86	5.77	7.15	6.54	5.74	3.34	3.03	3.37	58.08
9	Apalachicola	3.51	3.64	4.04	3.25	2.94	4.81	7.02	7.53	8.66	3.19	2.82	3.50	54.91
10	St. Marks 5 SSE	4.16	4.28	4.70	4.37	3.56	5.86	7.46	6.29	6.13	3.06	2.86	3.97	56.70
11	Monticello 3 W	4.52	4.55	4.63	4.40	4.43	5.46	6.88	5.52	5.92	2.67	2.77	4.09	55.84
12	Cross City 2 WNW	3.51	3.80	3.98	3.03	3.84	5.97	9.51	8.61	6.23	2.62	2.28	3.30	56.68
13	Inverness	3.00	3.49	3.98	2.44	4.27	6.77	8.53	8.92	5.97	2.69	1.98	2.73	54.77
14	Brooksville Chin. Hill	2.87	3.59	4.20	2.26	4.32	6.66	7.69	8.66	6.54	2.37	2.03	2.70	53.89

5. PREVAILING WINDS

Surface wind patterns in northwest Florida result from the interaction of diurnal winds (land and sea breezes) with large scale surface atmospheric pressure patterns. Surface winds across northwest Florida can be classified into three primary wind seasons: fall-winter, spring, and summer. During fall and winter, a generally moderate northeasterly flow prevails across the region. During the springtime, a moderate southerly wind flow prevails across the region and during the late spring and early summer, a light and variable southerly wind pattern is present over the region. The resultant seasonal surface winds for Florida are shown in Figure 22. Surface winds in late spring and early summer reflect local land and sea breeze patterns. During the middle and late summer, a southeasterly subtropical trade wind prevails across the northwest Florida area. The monthly prevailing wind directions and average wind speeds are shown in Table 46.

Annual wind roses located on the northwest Florida atlas maps are compiled from wind summaries for northwest Florida located at the National Climatic Center. The nine wind rose stations located on the atlas maps are shown in Figure 23.

Concentric circles on the wind roses on the atlas maps represent 5% frequency intervals. The averge wind speed (mph) is shown along the outer circumference for each direction.

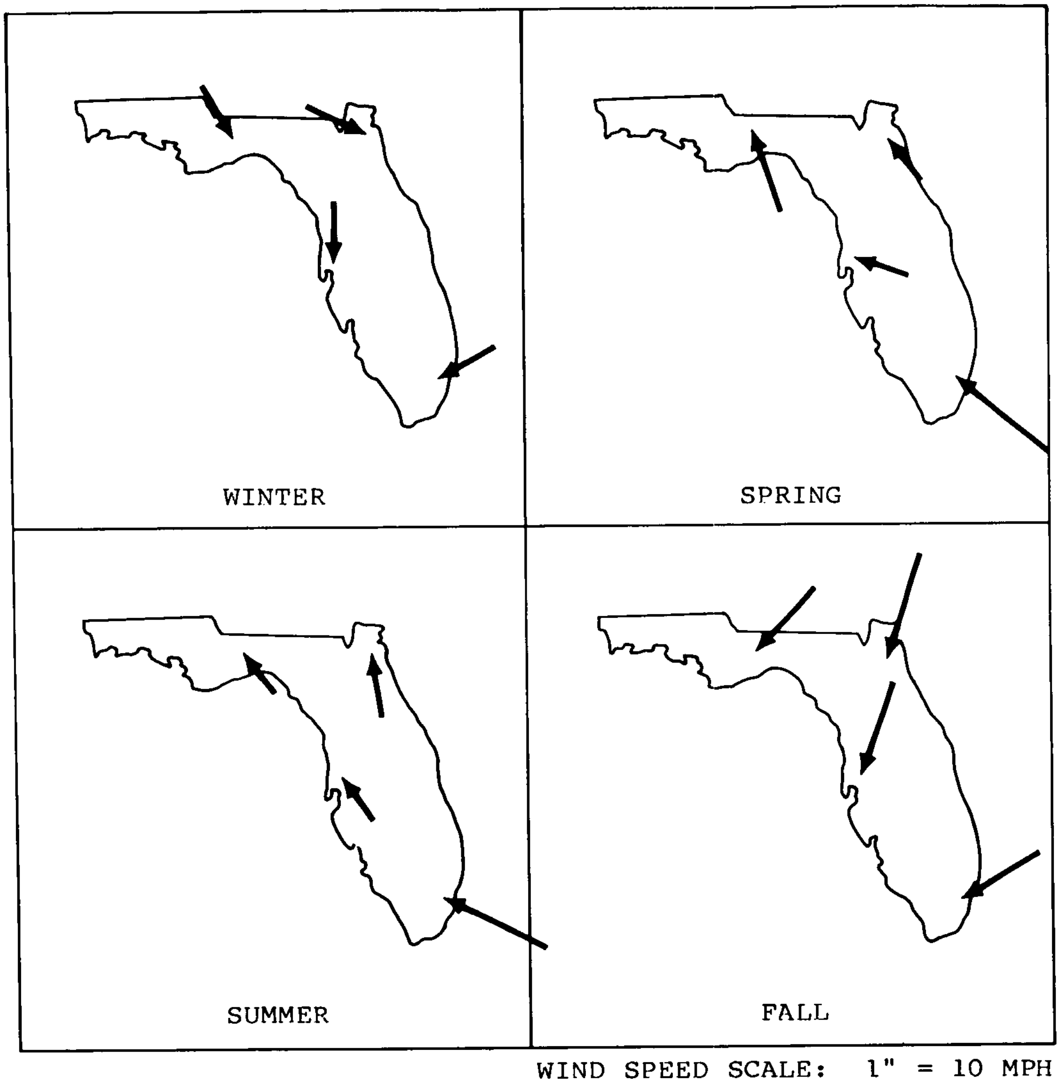

Figure 22. Resultant mid-season surface winds at four locations: Jacksonville, Miami, Tallahassee, Tampa (Gutfreund 1978). Period of record based on hourly observations, 1951-60.

Table 46. Prevailing wind directions and average wind speeds for Tampa, Tallahassee, and Pensacola, Florida, 1942-76 (National Climatic Center 1981b,c,d).

	Tampa		Tallahassee		Pensacola	
Month	Prevailing wind dir.	Avg. wind speed (mph)	Prevailing wind dir.	Avg. wind speed (mph)	Prevailing wind dir.	Avg. wind speed(mph)
January	N	8.9	N	7.1	N	8.9
February	E	9.4	N	7.7	N	9.2
March	S	9.7	S	7.8	N	9.3
April	ENE	9.6	S	7.0	SSE	8.7
May	E	9.0	S	6.4	SSE	7.6
June	E	8.3	S	6.3	SSW	6.6
July	E	7.5	E	5.3	SW	6.1
August	ENE	7.2	S	5.2	NE	6.1
September	ENE	8.1	S	5.9	NE	6.1
October	NNE	8.8	E	6.6	N	7.5
November	NNE	8.6	N	6.1	N	7.6
December	N	8.7	N	6.4	N	8.2
Annual	E	8.7	N	6.4	N	7.8

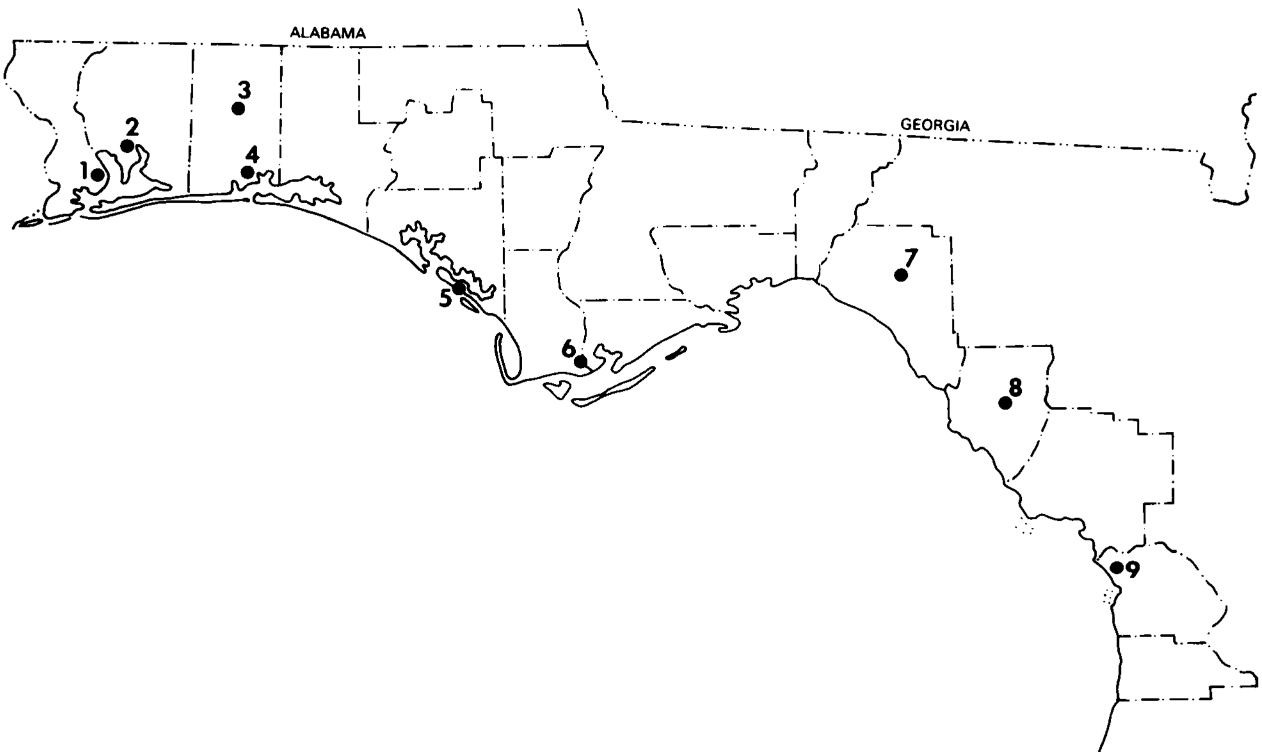

Figure 23. Northwest Florida wind rose stations.

6. CURRENTS

There is a noticeable lack of reliable current data available for the northeast gulf coastal waters. A summary of available current data study sites for the eastern Gulf of Mexico is shown in Figure 24.

The New England Coastal Engineers, Inc., under contract with the U.S. Bureau of Land Management, have developed a computer model named GAL which simulates geostrophic (wind induced) surface currents off the northwest coast of Florida. Individual current roses from this model are plotted on the atlas maps. The predicted currents for the three wind seasons off northwest Florida (spring, summer, fall-winter) are shown in Figures 25-27.

A moderate south-southeast current prevails in the spring, a light south-southeast current in summer, and a northeast current during the fall and winter in the northeast Gulf of Mexico.

The current roses show the resultant current direction and velocity for each of the three major wind seasons (spring, summer, and fall-winter). The length of each vector is proportional to the velocity. Concentric circles on most of the current roses represent a resultant current of 3 cm/s, unless otherwise noted.

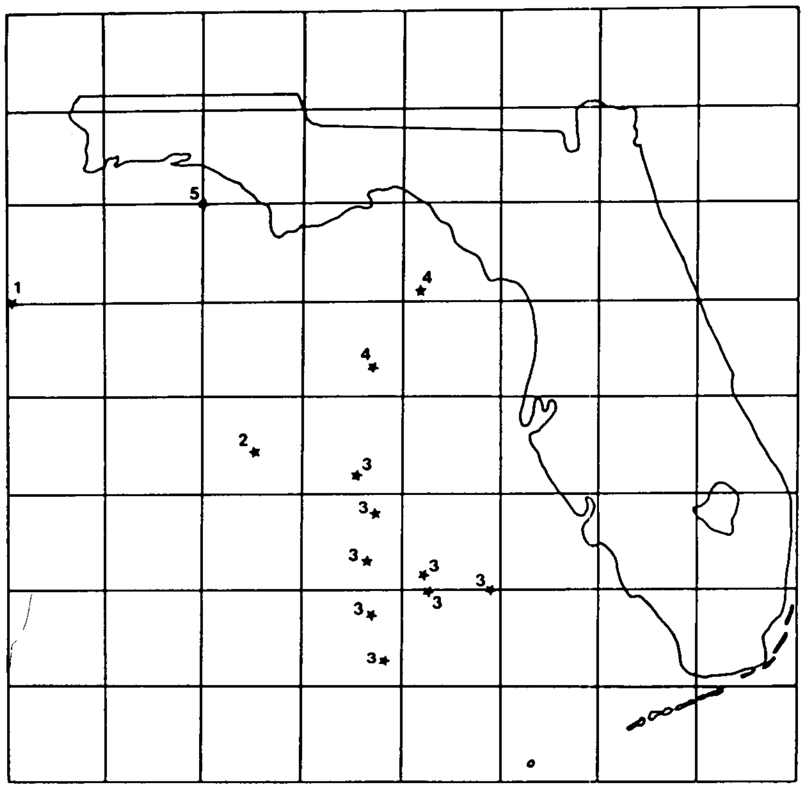

Figure 24. Location map of sites in the eastern Gulf of Mexico where data on currents have been collected. (New England Coastal Engineers 1981). Numbers refer to the following references:

1. Molinari, R.L., Mayer, D., and F. Chew. 1979. Physical oceanographic conditions at a potential OTEC site in the Gulf of Mexico near 29° N and 88° W. NOAA Tech. Mem. ERL AOML-41. Washington, D.C.

2. Molinari, R.L., and D. Mayer. 1980. Physical oceanographic conditions at a potential OTEC site in the Gulf of Mexico near 27.5° N and 85.5° W. NOAA Tech. Mem. ERL AOML-42. Washington, D.C.

3. Niiler, P.P., and C.J. Koblinsky. 1980. Direct measurement of circulation on west Florida continental shelf, January 1973 - May 1975. NOAA west Florida shelf dynamics project, reference 79-13. Washington, D.C.

4. Sturges, W., and C. Horton. 1979. Circulation in the Gulf of Mexico, a concise summary prepared as a working document for the conference on the role of organics in the marine environment. Florida State University, Dept. of Oceanography, Tallahassee, Fla.

5. Tolbert, W.H., and G.G. Salsman. 1980. Surface circulation of the eastern Gulf of Mexico as determined by drift bottle studies. Washington, D.C.

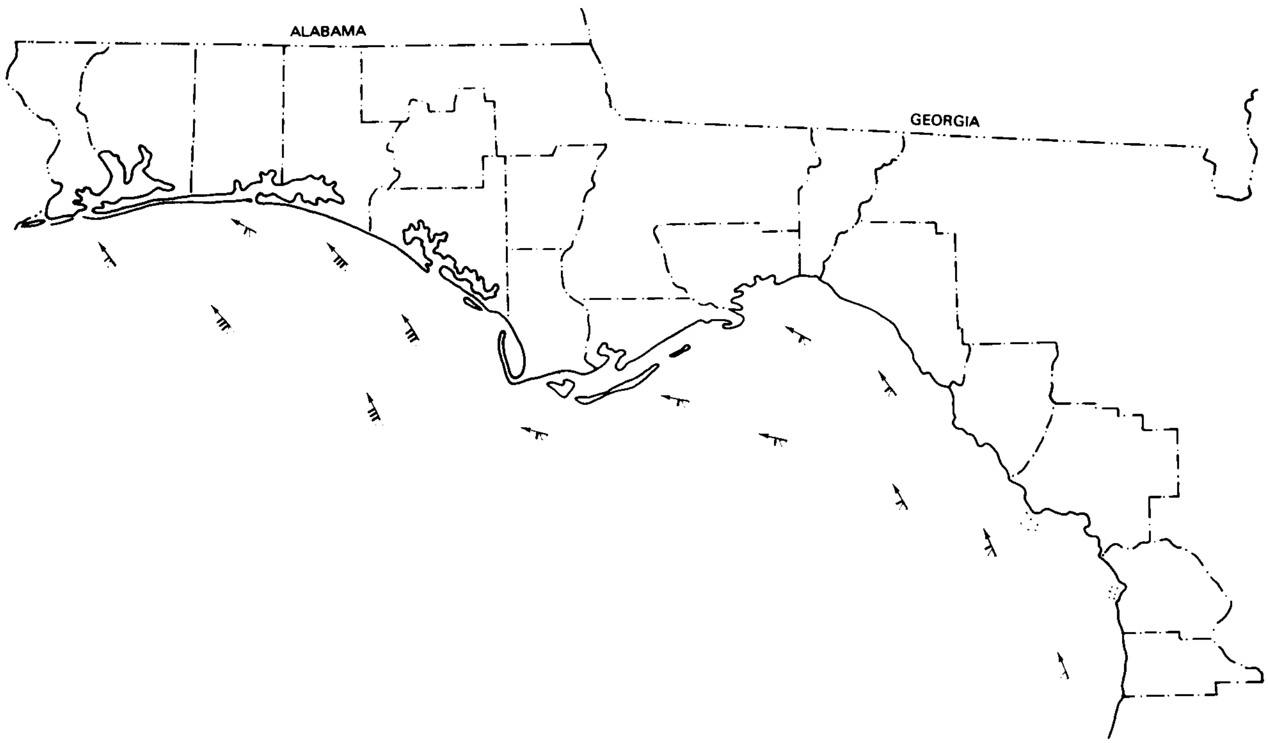

Figure 25. Mean spring surface currents off northwest Florida; number of feathers on current arrow equals velocity in cm/s; open triangle equals 50 cm/s (adapted from New England Coastal Engineers 1982).

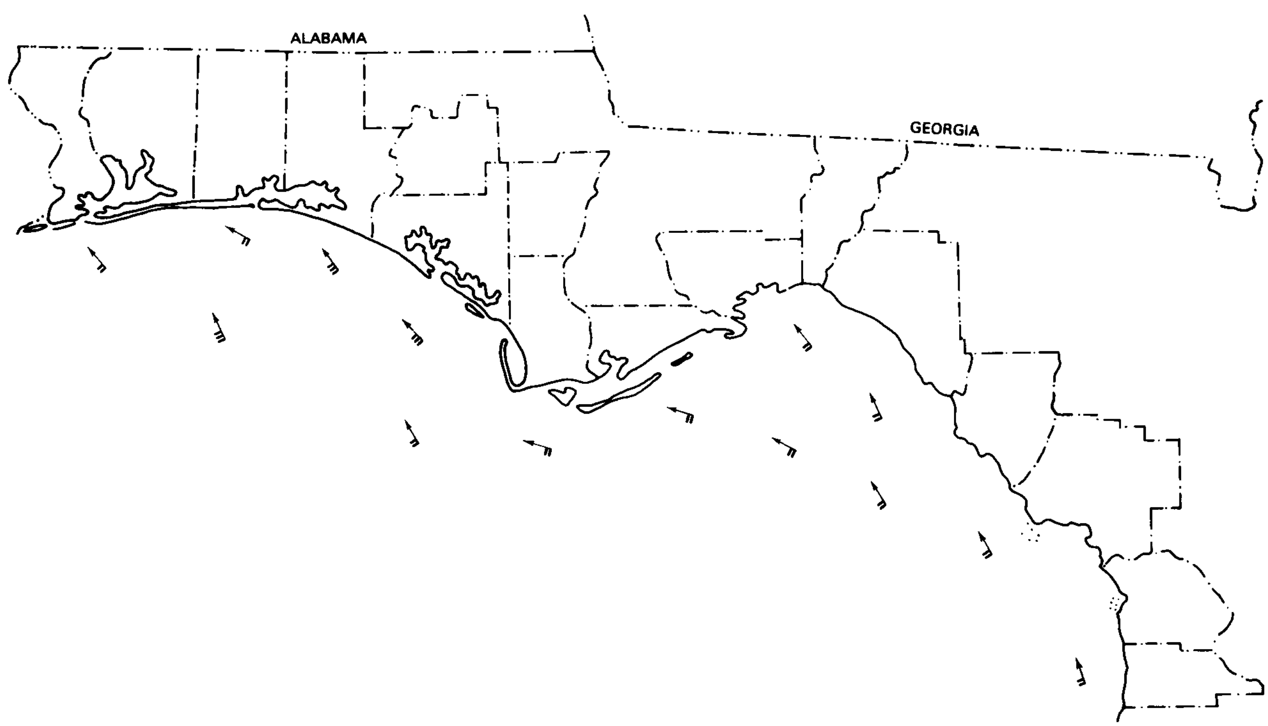

Figure 26. Mean summer surface currents off northwest Florida; number of feathers on current arrow equals velocity in cm/s; open triangle equals 50 cm/s (adapted from New England Coastal Engineers 1982).

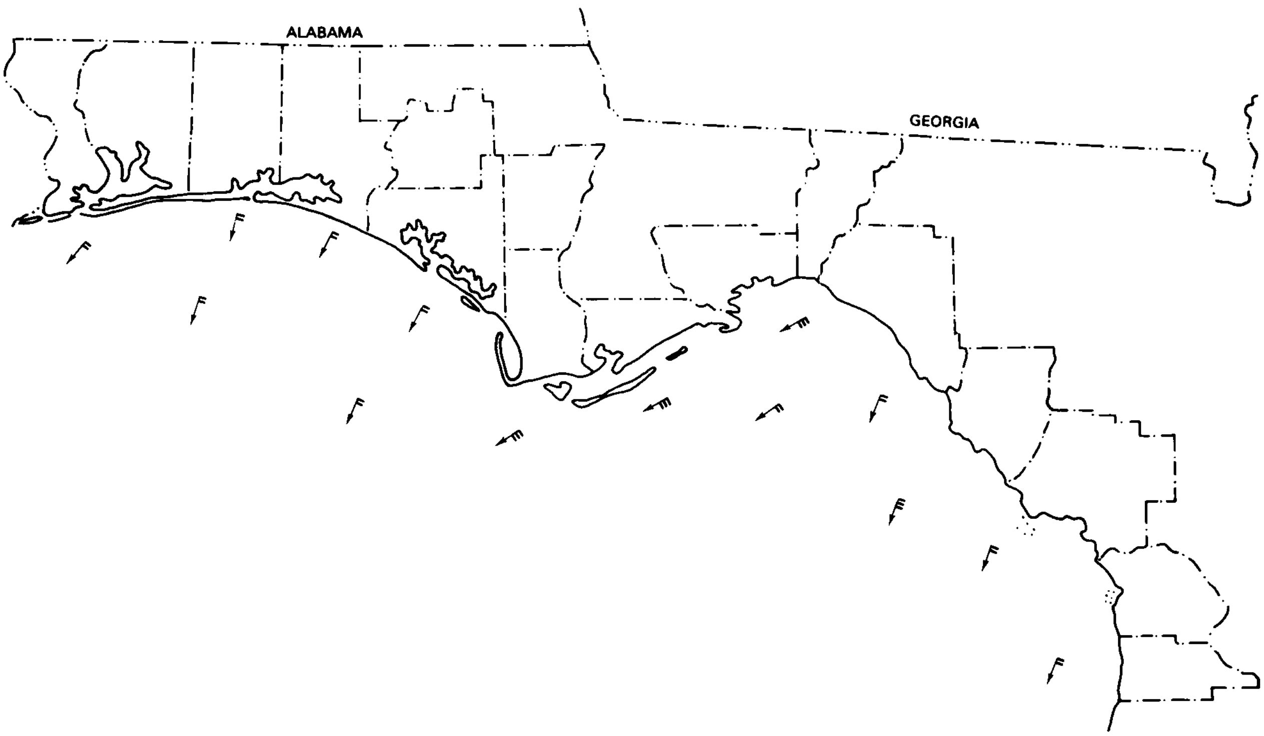

Figure 27. Mean fall and winter surface currents off northwest Florida; number of feathers on current arrow equals velocity in cm/s; open triangle equals 50 cm/s (adapted from New England Coastal Engineers 1982).

7. HURRICANES AND TROPICAL STORMS

7.1 BACKGROUND

Because of its geographic location in the subtropics, Florida is the most vulnerable State in the United States to hurricanes. With more and more development occurring in Florida's coastal region, the potential for catastrophic hurricane damage to artificial structures is increasing every year.

A cyclone is a surface weather system in which the barometric pressure diminishes progressively from the edges to the center of the storm. In the northern hemisphere, the winds around a cyclone flow counterclockwise into the center of the vortex. A tropical storm is a tropical cyclone with winds of 38 mph or higher, but less than 74 mph. A hurricane is a tropical cyclone accompanied by winds of 74 mph or higher. Hurricanes develop only over tropical oceans and occur in all tropical oceans except the South Atlantic.

The Atlantic hurricane season runs from June through November, although tropical storms have been recorded in all months of the year. The relative frequency of hurricane distribution, by time of year, in impacting northwest Florida is shown in Figure 28.

The study area is most susceptible to early and late season storms that originate in the northwest Caribbean Sea and Gulf of Mexico. Mid-hurricane season storms, which usually originate as disturbances moving off the African continent (Cape Verde type storms), are most likely to affect the Keys, sparing the gulf coast of Florida.

7.2 HURRICANE INUNDATION ZONES

The atlas maps depict the maximum areas subject to flooding for Saffir/Simpson category 1-5 hurricanes. The inundation zones represent a composite of the worst case of overland storm surges for each Saffir/Simpson category for storms approaching from all possible directions. The principal computer model for the compilation is the numerical storm surge prediction model SPLASH, which is short for special program to list amplitudes of surges from hurricanes. The SPLASH model predicts surge heights with selected pressure, size, forward speed, track, and wind information from hypothetical hurricanes. This model permits resultant tidal surge to be superimposed on a locale's shoreline configuration with its unique physical characteristics incorporated.

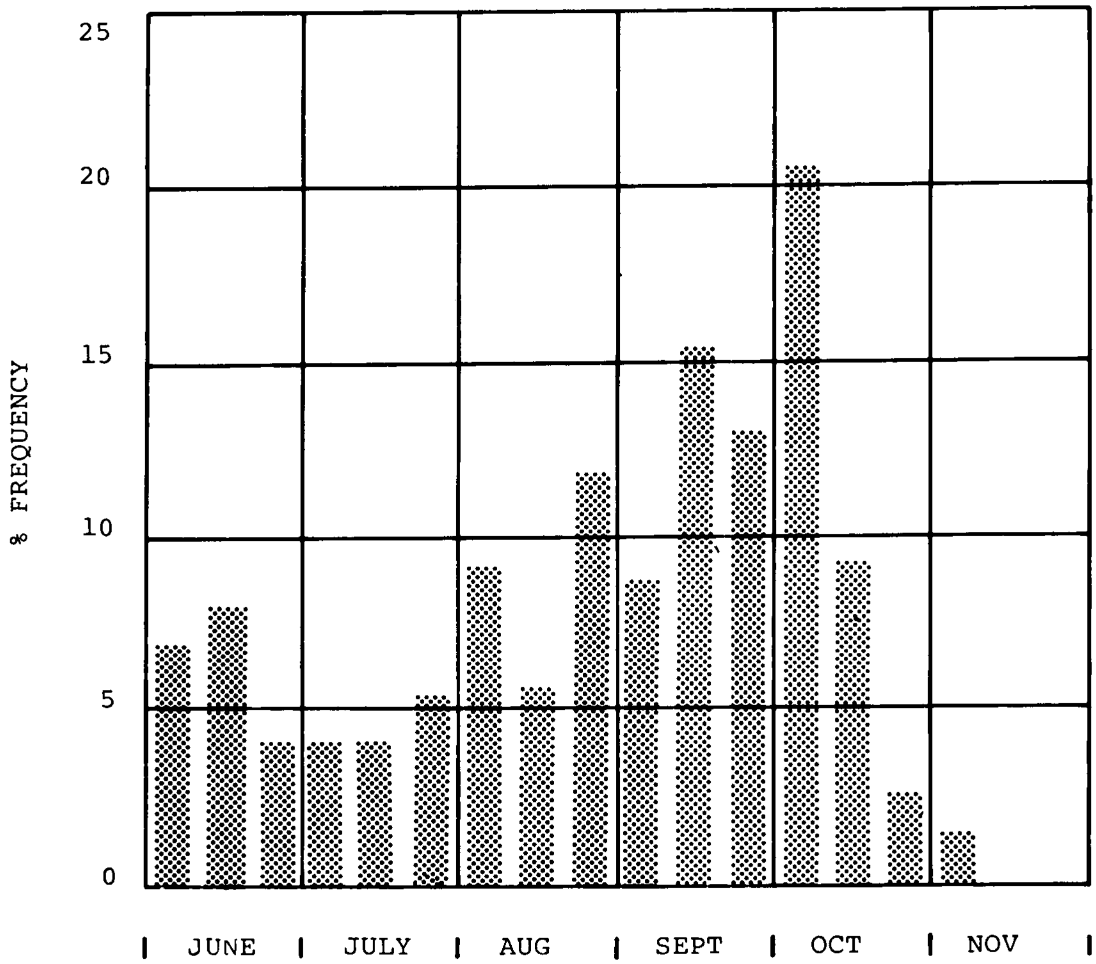

Figure 28. Frequency distribution of hurricanes by time of year in northwest Florida from 1871 to 1980 (Neumann et al. 1981).

The Saffir/Simpson hurricane intensity scale is used by the National Weather Service to classify hurricanes according to intensity. The scale was developed by Herbert Saffir, a consulting engineer, and Dr. Robert H. Simpson, former National Hurricane Center Director, and projects 1-5 scale assessment categories as follows:

<u>Category No. 1</u>

Winds of 74 to 95 mph. Damage primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. Storm surge 4 to 5 ft above normal. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.

<u>Category No. 2</u>

Winds of 96 to 110 mph. Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. Storm surge 6 to 8 ft above normal. Coastal roads and low-lying escape routes inland cut by rising water two to four hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying island areas required.

<u>Category No. 3</u>

Winds of 111 to 130 mph. Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. Storm surge 9 to 12 ft above normal.

Serious flooding at coast and many smaller structures near coast destroyed; large structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Flat terrain 5 ft or less above sea level flooded inland 8 mi or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.

Category No. 4

Winds of 131 to 155 mph. Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows, and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. Storm surge 13 to 18 ft above normal. Flat terrain 10 ft or less above sea level flooded inland as far as 6 mi. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hr before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yd of shore possibly required, and of single-story residences on low ground within 2 mi of shore.

Category No. 5

Winds greater than 155 mph. Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. Storm surge greater than 18 ft above normal. Major damage to lower floors of all structures less than 15 ft above sea level within 500 yd of shore. Lowlying escape routes inland cut by rising water 3 to 5 hr before hurricane center arrives. Massive evacuation of residential areas on low ground within 5-10 mi of shore possibly required.

Dr. Neil Frank, present National Hurricane Center Director, has adapted atmospheric pressure ranges to the Saffir/Simpson Scale. These pressure ranges, along with a numerical break-down of wind and storm surge ranges are shown in Table 47.

Table 47. Saffir/Simpson hurricane intensity scales (Southwest Florida Regional Planning Council 1981).

Scale number	Central pressures Millibars	Inches	Winds (mph)	Surge (ft)	Damage
1	$\geq$ 980	$\geq$ 28.94	74- 95	4 - 5	Minimal
2	965-979	28.50 - 28.91	96-110	6 - 8	Moderate
3	945-964	27.91 - 28.47	111-130	9 - 12	Extensive
4	920-944	27.17 - 27.88	131-155	13 - 18	Extreme
5	< 920	< 27.17	155+	18+	Catastrophic

7.3 HURRICANE AND TROPICAL STORM PROBABILITY

The probability of a hurricane impacting any portion of the coastline along northwest Florida can only be approximated due to the lack of a sufficient data base. In the 1800's and early 1900's, there were few climatological stations with barometers or anemometers to record the passage of such storms. Only during the last 15 years have geostationary meteorological satellites been available to track hurricanes accurately.

The National Hurricane Center has plotted the paths of hurricanes that have occurred annually since 1871 (Neumann et al. 1981). Prior to 1967 these plots represented a compromise in positions as reported in various references. The probability of hurricanes impacting northwest Florida has been estimated by Neumann et al. 1981 for Saffir/Simpson category 1-5 hurricanes passing within 50 mi of the northwest Florida coast. The cumulative probability of Saffir/Simpson category 1-5 hurricane force winds affecting each mapped area is shown on the individual atlas maps. It must be noted that hurricanes are rare events and their return periods vary considerably. In the Tampa Bay area, the last major hurricane to hit the region was in 1921. However, in 1848, two hurricanes hit the region within 3 weeks of each other.

8. HYDROLOGIC UNIT WATER BUDGETS

8.1 BACKGROUND

A hydrologic unit is a geographic area that forms a part of a national system for cataloging hydrologic and other information (Heath and Conover 1981). Hydrologic unit boundaries coincide with drainage basin boundaries but also include adjoining water bodies not associated with the drainage basins. The boundaries of the hydrologic units for Florida are shown in Figure 29. The hydrologic unit code is an eight-digit number representing the region, subregion, accounting, and cataloging units. The regions and subregions are used by the U.S. Water Resources Council for water and land resources planning. The accounting and cataloging units are used by the U.S. Geological Survey for managing the National Water Data Network.

8.2 HYDROLOGIC UNIT WATER BUDGET

The water budget is a convenient method for accounting for the inflow and outflow of water in a hydrologic system. To calculate a budget, one estimates the value of each component of the basic hydrologic cycle equation:

$$S = P - (R + ET)$$

Where:

S = change in storage (inches)
P = precipitation (inches)
R = runoff (inches)
ET = evapotranspiration (inches)

A water budget has been developed for each of the hydrologic units for northwest Florida and is shown in Table 48. The methodology of estimating the variables in this budget is described in the following sections.

Precipitation

The monthly precipitation for each hydrologic unit has been estimated by using the mean areal precipitation for the period from 1951 to 1980 (Figures 9-20).

Evapotranspiration

Evapotranspiration is defined as water that is evaporated back into the atmosphere from the land and water surfaces and is transpired back into the atmosphere by plants. Evapotranspiration was calculated for each hydrologic unit by using the following equation (Fractional Evaporation - Equivalent Formula), which was found by the U.S. Soil Conservation Survey to be most appropriate for Florida (Speir et al. 1969):

$$ET = (0.0082\ Ta - 0.1900) \times \frac{RS}{1500}$$

Where:

ET = evapotranspiration in inches/month
Ta = average monthly temperature (^{o}Fahrenheit)
RS = average monthly solar radiation (Langleys)

Runoff

Runoff is defined as that part of the precipitation that occurs in streams and includes water that flows over the ground surface to streams. Runoff was computed by distributing the total streamflow over the area of each hydrologic unit.

Storage

Water in storage was calculated by subtracting the monthly totals of runoff and evapotranspiration from that of precipitation.

Accumulated Storage

Accumulated storage is the change in storage for the year as reflected by changes in ground water levels (ground water inflow and outflow, which amounts to approximately 2% of a water budget, is difficult to estimate and has not been used in the calculation of this water budget).

Figure 29. Hydrologic unit map of Florida (after Heath and Conover 1981).

Table 48. Northwest Florida mean monthly hydrologic unit water budgets; figures represent inches (Palik 1984).

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03140106					
January	5.0	1.2	2.4	1.4	1.4
February	5.0	1.7	3.2	0.1	1.5
March	6.0	2.8	2.7	0.5	2.0
April	4.6	3.6	3.1	-2.1	-0.1
May	4.2	4.6	1.6	-2.0	-2.1
June	6.7	4.8	1.9	0.0	-2.1
July	7.5	4.8	2.1	0.6	-1.5
August	6.3	4.4	2.3	-0.4	-1.9
September	6.9	3.7	2.3	0.9	-1.0
October	3.4	2.7	1.6	-0.9	-1.9
November	3.7	1.6	1.4	0.7	-1.2
December	4.7	1.2	2.3	1.2	0.0
Annual totals	64.0	37.1	26.9	0.0	
Hydrologic Unit 03140107					
January	4.6	1.1	2.3	1.2	1.2
February	4.9	1.6	3.1	0.2	1.4
March	5.6	2.7	2.6	0.3	1.7
April	4.4	3.4	3.0	-2.0	-0.3
May	4.0	4.8	1.5	-2.3	-2.6
June	6.0	4.5	1.8	-0.3	-2.9
July	7.5	4.5	2.0	1.0	-1.9
August	6.4	4.3	2.2	-0.1	-2.0
September	6.8	3.6	2.2	1.0	-1.0
October	3.6	2.5	1.5	-0.4	-1.4
November	3.5	1.5	1.4	0.6	-0.8
December	4.1	1.1	2.2	0.8	0.0
Annual totals	61.4	35.6	25.8	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03140304					
January	5.1	1.2	2.4	1.5	1.5
February	5.0	1.8	3.2	0.0	1.5
March	6.1	3.0	2.7	0.4	1.9
April	4.9	3.8	3.1	-2.0	-0.1
May	4.4	4.8	1.5	-1.9	-2.0
June	7.2	5.1	1.8	0.3	-1.7
July	7.2	5.0	2.0	0.2	-1.5
August	6.3	4.7	2.2	-0.6	-2.1
September	6.7	3.9	2.2	0.6	-1.5
October	3.2	2.8	1.5	-1.1	-2.6
November	3.8	1.7	1.4	0.7	-1.9
December	5.3	1.2	2.2	1.9	0.0
Annual totals	65.2	39.0	26.2	0.0	
Hydrologic Unit 03140305					
January	5.0	1.3	2.1	1.6	1.6
February	5.0	1.9	2.9	0.2	1.8
March	6.1	3.2	2.3	0.6	2.4
April	4.8	4.1	2.7	-2.0	0.4
May	4.3	5.2	1.3	-2.2	-1.8
June	7.1	5.6	1.6	-0.1	-1.9
July	7.3	5.6	1.7	0.0	-1.9
August	6.3	5.1	1.9	-0.7	-2.6
September	6.8	4.2	1.9	0.7	-1.9
October	3.4	3.0	1.3	-0.9	-2.8
November	3.8	1.8	1.2	0.8	-2.0
December	5.2	1.3	1.9	2.0	0.0
Annual totals	65.1	42.3	22.8	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	runoff	Storage	Accum. storage
Hydrologic Unit 03140104					
January	4.9	1.1	2.3	1.5	1.5
February	4.8	1.6	3.1	0.1	1.6
March	5.8	2.7	2.8	0.3	1.9
April	4.8	3.4	3.3	-1.9	0.0
May	4.4	4.7	2.1	-2.4	-2.4
June	6.9	4.4	2.2	0.3	-2.1
July	7.0	4.4	2.1	0.5	-1.6
August	6.6	4.2	2.0	0.4	-1.2
September	6.5	3.6	2.4	0.5	-0.7
October	3.3	2.5	2.0	-1.2	-1.9
November	3.5	1.5	1.8	0.2	-1.7
December	5.2	1.1	2.4	1.7	0.0
Annual totals	63.7	35.2	28.5	0.0	
Hydrologic Unit 03140105					
January	4.6	1.0	2.3	1.3	1.3
February	5.0	1.5	2.7	0.8	2.1
March	5.1	2.5	2.5	0.1	2.2
April	4.3	3.2	3.0	-1.9	0.3
May	4.1	4.1	2.0	-2.0	-1.7
June	5.6	4.4	2.5	-1.3	-3.0
July	7.2	4.3	2.1	0.8	-2.2
August	6.9	4.0	2.2	0.7	-1.5
September	6.9	3.3	2.4	1.2	-0.3
October	3.6	2.4	2.2	-1.0	-1.3
November	3.5	1.4	1.9	0.2	-1.1
December	4.3	1.0	2.2	1.1	0.0
Annual totals	61.1	33.1	28.0	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03140103					
January	4.7	1.0	2.3	1.4	1.4
February	4.8	1.5	3.1	0.2	1.6
March	5.7	2.5	2.8	0.4	2.0
April	4.7	3.2	3.2	-1.7	0.3
May	4.5	4.2	2.1	-1.8	-1.5
June	5.9	4.5	2.2	-0.8	-2.3
July	7.0	4.4	2.1	0.5	-1.8
August	7.0	4.1	2.0	0.9	-0.9
September	6.0	3.3	2.4	0.3	-0.6
October	3.4	2.4	2.0	-1.0	-1.6
November	3.3	1.4	1.8	0.1	-1.5
December	4.9	1.0	2.4	1.5	0.0
Annual totals	61.9	33.5	28.4	0.0	
Hydrologic Unit 03140102					
January	4.8	1.1	2.7	1.0	1.0
February	5.0	1.6	2.9	0.5	1.5
March	5.2	2.6	3.0	-0.4	1.1
April	4.3	3.3	3.0	-2.0	-0.9
May	4.2	4.2	1.8	-1.8	-2.7
June	5.7	4.5	2.1	-0.9	-3.6
July	8.1	4.4	2.3	1.4	-2.2
August	7.4	4.1	2.5	0.8	-1.4
September	6.7	3.4	2.5	0.8	-0.6
October	3.7	2.5	2.2	-1.0	-1.6
November	3.6	1.5	1.7	0.4	-1.2
December	4.7	1.1	2.4	1.2	0.0
Annual totals	63.4	34.3	29.1	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03140202					
January	4.8	1.1	2.3	1.4	1.4
February	4.8	1.6	2.5	0.7	2.1
March	5.8	2.6	2.5	0.7	2.8
April	4.7	3.3	2.5	-1.1	1.7
May	4.5	4.3	1.6	-1.4	0.3
June	6.0	4.6	1.8	-0.4	-0.1
July	7.0	4.5	2.0	0.5	0.4
August	6.2	4.2	2.2	-0.2	0.2
September	5.0	3.4	2.2	-0.6	-0.4
October	3.3	2.5	1.9	-1.1	-1.5
November	3.1	1.5	1.5	0.1	-1.4
December	4.6	1.1	2.1	1.4	0.0
Annual totals	59.8	34.7	25.1	0.0	
Hydrologic Unit 03140203					
January	4.7	1.2	2.3	1.2	1.2
February	4.9	1.7	2.8	0.4	1.6
March	5.4	2.8	3.1	-0.5	1.1
April	4.4	3.5	3.3	-2.4	-1.3
May	4.2	4.5	1.7	-2.0	-3.3
June	5.4	4.7	1.2	-0.5	-3.8
July	7.2	4.7	1.3	1.2	-2.6
August	6.2	4.3	1.3	0.6	-2.0
September	5.4	3.6	1.1	0.7	-1.3
October	3.4	2.7	1.5	-0.8	-2.1
November	3.3	1.6	1.0	0.7	-1.4
December	4.5	1.2	1.9	1.4	0.0
Annual totals	59.0	36.5	22.5	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03140101					
January	4.3	1.0	2.7	0.6	0.6
February	4.3	1.5	3.3	-0.5	0.1
March	5.1	2.4	3.7	-1.0	-0.9
April	3.8	3.1	3.9	-3.2	-4.1
May	3.4	3.9	2.0	-2.5	-6.6
June	5.0	4.1	1.4	-0.5	-7.1
July	7.5	4.1	1.6	1.8	-5.3
August	7.5	3.8	1.6	2.1	-3.2
September	6.5	3.2	1.3	2.0	-1.2
October	3.4	2.3	1.8	-0.7	-1.9
November	3.5	1.4	1.2	0.9	-1.0
December	4.4	1.0	2.4	1.0	0.0
Annual totals	58.7	31.8	26.9	0.0	
Hydrologic Unit 03130012					
January	4.6	1.7	2.5	0.4	0.4
February	4.4	1.4	3.0	0.0	0.4
March	5.2	2.2	3.4	-0.4	0.0
April	4.2	2.8	3.3	-1.9	-1.9
May	4.3	3.6	2.2	-1.5	-3.4
June	5.1	3.8	1.8	-0.5	-3.9
July	6.8	3.8	1.7	1.3	-2.6
August	5.7	3.5	1.7	0.5	-2.1
September	5.7	2.9	1.6	1.2	-0.9
October	3.1	2.1	1.7	-0.7	-1.6
November	3.2	1.3	1.4	0.5	-1.1
December	4.0	0.9	2.0	1.0	0.0
Annual totals	56.3	30.0	26.3	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03130011					
January	4.3	1.2	1.8	1.3	1.3
February	4.2	1.8	2.5	-0.1	1.2
March	5.1	3.0	3.0	-0.9	0.3
April	4.2	3.8	2.7	-2.3	-2.0
May	4.5	4.8	1.6	-1.9	-3.9
June	5.5	5.2	1.3	-1.0	-4.9
July	7.5	5.0	1.2	1.3	-3.6
August	6.5	4.7	1.0	0.8	-2.8
September	6.5	3.9	0.8	1.8	-1.0
October	3.2	2.8	1.0	-0.6	-1.6
November	3.0	1.7	0.9	0.4	-1.2
December	3.7	1.2	1.3	1.2	0.0
Annual totals	58.2	39.1	19.1	0.0	
Hydrologic Unit 03130014					
January	3.5	1.7	2.4	-0.6	-0.6
February	3.8	1.4	3.3	-0.9	-1.5
March	4.1	2.2	4.1	-2.2	-3.7
April	3.5	2.8	3.6	-2.9	-6.6
May	3.2	3.6	2.1	-2.5	-9.1
June	5.0	3.8	1.7	-0.5	-9.6
July	7.0	3.8	1.6	1.6	-8.0
August	7.2	3.5	1.3	2.4	-5.6
September	8.6	2.9	1.1	4.6	-1.0
October	3.2	2.1	1.3	-0.2	-1.2
November	2.8	1.3	1.2	0.3	-0.9
December	3.5	0.9	1.7	0.9	0.0
Annual totals	55.4	30.0	25.4	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03130013					
January	4.0	11.0	12.3	0.7	0.7
February	4.2	1.4	3.1	-0.3	0.4
March	4.7	2.4	3.0	-0.7	-0.3
April	3.7	3.0	0.3	0.4	0.1
May	3.5	3.9	1.1	-1.5	-1.4
June	5.6	4.1	2.8	-1.3	-2.7
July	8.0	4.1	1.8	2.1	-2.7
August	6.6	3.8	2.8	0.0	-0.6
September	7.0	3.1	2.2	1.7	1.1
October	3.2	2.2	3.0	-2.0	-0.9
November	2.9	1.3	0.3	1.3	0.4
December	3.6	1.0	3.0	-0.4	0.0
Annual totals	57.0	41.3	35.7	0.0	
Hydrologic Unit 03120003					
January	4.3	1.0	2.3	1.0	1.0
February	4.5	1.4	3.6	-0.5	0.5
March	5.2	2.5	4.2	-1.5	-1.0
April	3.9	3.1	3.6	-2.8	-3.8
May	4.0	4.0	1.7	-1.7	-5.5
June	6.0	4.2	1.6	0.2	-5.3
July	8.0	4.2	1.7	2.1	-3.2
August	6.1	3.8	1.5	0.8	-2.4
September	6.1	3.1	1.5	1.5	-0.9
October	3.1	2.2	1.4	-0.5	-1.4
November	3.0	1.3	1.2	0.5	-0.9
December	3.8	1.0	1.9	0.9	0.0
Annual totals	58.0	31.8	26.2	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03120001					
January	4.4	1.3	1.2	1.9	1.9
February	4.6	1.9	1.3	1.4	3.3
March	5.0	3.1	1.9	0.0	3.3
April	4.3	4.0	1.6	-1.3	2.0
May	4.5	5.1	1.4	-2.0	0.0
June	5.8	5.5	1.4	-1.1	-1.1
July	7.5	5.5	1.5	0.5	-0.6
August	6.5	5.0	1.4	0.1	-0.5
September	6.1	4.2	1.6	0.3	-0.2
October	2.9	3.0	1.5	-1.6	-1.8
November	4.2	1.3	1.2	0.1	0.0
December	4.2	1.3	1.2	1.7	0.0
Annual totals	60.0	41.2	17.2	0.0	
Hydrologic Unit 03110103					
January	4.4	1.2	0.8	2.4	2.4
February	4.4	1.8	1.6	1.0	3.4
March	4.7	3.1	3.4	-1.8	1.6
April	4.2	3.9	2.5	-2.2	-0.6
May	4.2	4.9	1.5	-2.2	-2.8
June	5.3	5.3	1.1	-1.1	-3.9
July	6.8	5.1	0.9	0.8	-3.1
August	6.5	4.8	0.9	0.8	-2.3
September	5.8	4.0	1.2	0.6	-1.7
October	2.7	2.8	1.0	-1.1	-2.8
November	2.9	1.7	0.3	0.9	-1.9
December	4.2	1.2	1.1	1.9	0.0
Annual totals	56.1	39.8	16.3	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03110102					
January	3.8	1.4	0.7	1.7	1.7
February	3.7	2.0	1.2	0.5	2.2
March	4.2	3.3	1.8	-0.9	1.3
April	3.3	4.2	1.3	-2.2	-0.9
May	3.8	5.3	0.6	-2.1	-3.0
June	5.5	5.6	0.9	-1.0	-4.0
July	8.0	5.6	0.8	1.6	-2.4
August	8.0	5.2	1.1	1.7	-0.7
September	6.2	4.3	1.4	0.5	-0.2
October	2.6	3.1	1.1	-1.6	-1.8
November	2.5	1.9	0.5	0.1	-1.7
December	3.7	1.3	0.7	1.7	0.0
Annual totals	55.3	43.2	12.1	0.0	
Hydrologic Unit 03110205					
January	3.4	1.2	1.1	1.1	1.1
February	3.8	1.8	1.3	0.7	1.8
March	3.8	3.1	1.8	-1.1	0.7
April	2.8	3.9	1.8	-2.9	-2.2
May	3.8	5.0	1.4	-2.6	-4.8
June	6.0	5.4	1.2	-0.6	-5.4
July	8.9	5.1	1.1	2.7	-2.7
August	8.5	4.8	1.2	2.5	-0.2
September	6.1	4.0	1.1	1.0	0.8
October	2.5	2.8	1.1	-1.4	-0.6
November	2.1	1.7	0.9	-0.5	-1.1
December	3.2	1.2	0.9	1.1	0.0
Annual totals	54.9	40.0	14.9	0.0	

(continued)

Table 48 (continued)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03110101					
January	3.1	1.2	1.1	0.8	0.8
February	3.6	1.7	1.9	0.0	0.8
March	3.7	2.8	1.7	-0.8	0.0
April	2.4	3.6	0.5	-1.7	-1.7
May	3.8	4.6	0.6	-1.4	-3.1
June	6.3	4.9	0.7	0.7	-2.4
July	8.0	4.8	1.4	1.8	-0.6
August	8.8	4.4	2.7	1.7	1.1
September	5.5	3.7	2.4	-0.6	0.5
October	2.3	2.7	1.0	-1.4	-0.9
November	1.9	1.6	0.3	0.0	-0.9
December	2.9	1.2	0.8	0.9	0.0
Annual totals	52.3	37.2	15.1	0.0	
Hydrologic Unit 03080102					
January	3.1	1.6	0.7	0.8	0.8
February	3.7	1.8	0.5	1.4	2.2
March	3.6	2.9	1.1	-0.4	1.8
April	2.5	3.6	0.7	-1.8	0.0
May	4.1	4.5	0.7	-1.1	-1.1
June	6.7	4.4	1.2	1.1	0.0
July	7.5	4.4	1.6	1.5	1.5
August	9.0	3.9	1.6	3.5	5.0
September	5.0	3.5	3.5	-2.0	3.0
October	2.2	3.1	2.2	-3.1	-0.1
November	2.0	2.1	0.9	-1.0	-1.1
December	3.0	1.5	0.4	1.1	0.0
Annual totals	52.4	37.3	15.1	0.0	

(continued)

Table 48 (concluded)

Variable	Precip.	Evapotransp.	Runoff	Storage	Accum. storage
Hydrologic Unit 03100208					
January	2.9	2.0	0.5	0.4	0.4
February	3.5	2.2	0.6	0.7	1.1
March	4.0	3.5	0.7	-0.2	0.9
April	2.3	4.4	0.8	-2.9	-2.0
May	4.3	5.5	0.5	-1.7	-3.7
June	6.7	5.4	0.4	0.9	-2.8
July	8.0	5.3	0.5	2.2	-0.6
August	8.5	4.8	0.9	2.8	2.2
September	6.1	4.3	1.1	0.7	2.9
October	2.5	3.5	1.0	-2.0	0.9
November	2.0	2.5	0.7	-1.2	-0.3
December	2.7	1.9	0.5	0.3	0.0
Annual totals	53.5	45.3	8.2	0.0	
Hydrologic Unit 03100207					
January	2.9	1.8	0.5	0.6	0.6
February	3.4	2.0	0.4	1.0	1.6
March	4.0	3.1	0.8	0.1	1.7
April	2.2	3.9	0.5	-2.2	-0.5
May	4.2	5.0	0.5	-1.3	-1.8
June	6.5	4.9	0.9	0.7	-1.1
July	7.7	4.7	1.2	1.8	-1.1
August	7.7	4.7	1.2	2.5	0.7
September	6.0	3.8	2.7	-0.5	2.7
October	2.3	3.1	1.7	-2.5	0.2
November	2.0	2.2	0.7	-0.9	-0.7
December	2.7	1.7	0.3	0.7	0.0
Annual totals	47.5	40.9	11.4	0.0	

8.3 U.S. GEOLOGICAL SURVEY STREAM GAGING STATION LEGEND EXPLANATION

The U.S. Geological Survey maintains an active stream gaging network in northwest Florida. Data collected at each station consist of records of water elevation stage and measurements of discharge. Records of stage are obtained from a water-stage recorder that produces a continuous graphical output on chart paper or on a punched-tape recorder. Measurements of discharge are made with a current meter. Rating tables developed for each station give the discharge for any stage (water elevation). The daily mean discharge is determined from the mean daily stage as based on the station's rating table. Monthly and yearly mean discharges represent arithmetic means of daily discharges. The locations of the active U.S. Geological Survey stream gaging stations are shown on the atlas maps.

Monthly water quality samples are taken at a number of the U.S. Geological Survey stream gaging stations. The locations of these stations, as well as the mean specific conductivity (μmhos/cm) are shown on the individual atlas maps. The average specific conductivity of northwest Florida streams and canals is shown in Figure 30.

The U.S. Geological Survey maintains an active ground water observation well network where monthly water elevation levels are recorded. At selected ground water observation wells, monthly water quality samples are taken. The locations of these ground water observation wells where water quality samples are taken monthly, as well as their mean annual specific conductance (μmhos/cm) and chloride levels (mg/l), are shown on the individual atlas maps.

The units of specific conductivity on the maps are in μmhos/cm and not in mmhos as indicated in the legend under the headings "U.S. Geological Survey Stream Gage and Surface Water Quality Station" and "U.S. Geological Survey Ground Water Observation and Water Quality Well."

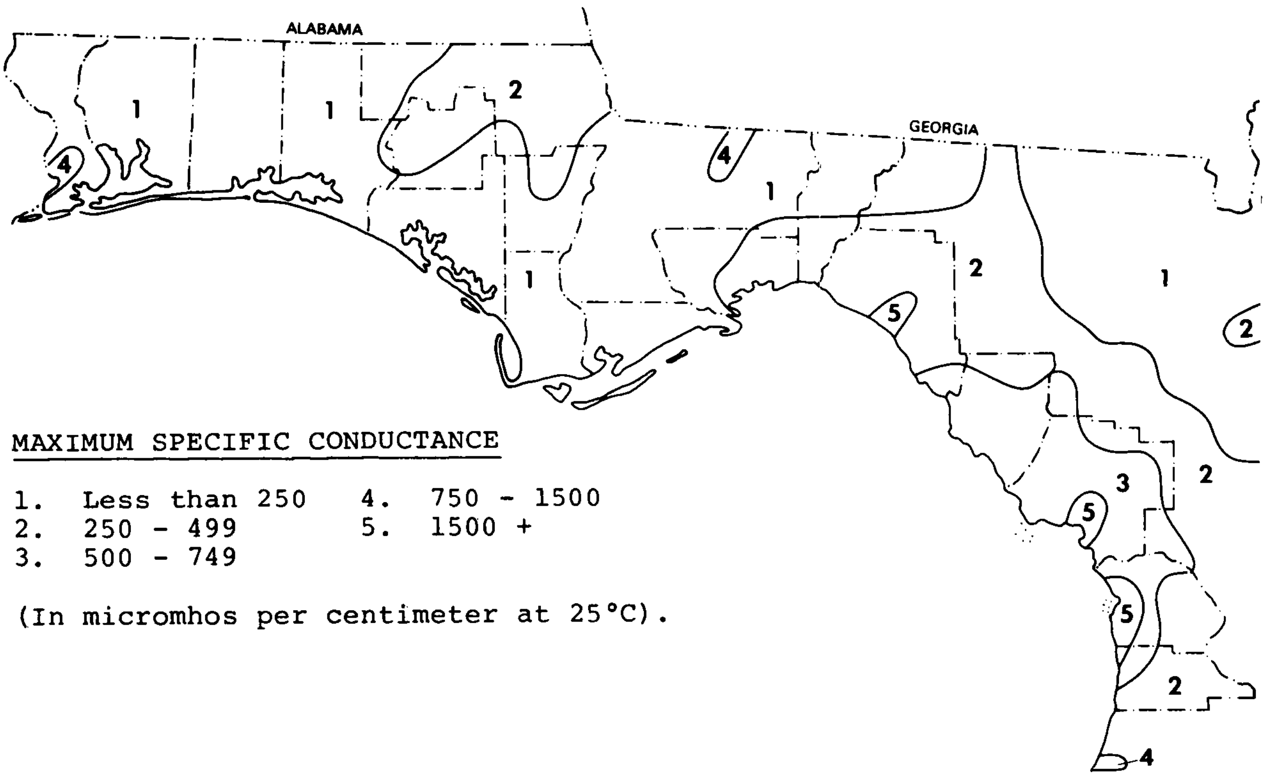

Figure 30. Specific conductance of water in northwest Florida streams and canals (Slack and Kaufman 1973).

The Florida Department of Environmental Regulation has established a permanent fixed surface water quality station network. Since the stations are relatively new, the period of record is insufficient to establish long-term means. A general water quality description of waters within U.S. Geological Survey hydrologic units as determined by the Florida Department of Environmental Regulation is shown in Table 49. The location of Florida Department of Environmental Regulation fixed surface water quality stations is shown on the individual atlas maps.

8.4 WATER USE

The estimated water use in northwest Florida by county is shown in Table 50. The primary water users in northwest Florida are: (1) agriculture (spray irrigation), (2) municipal water supply systems, and (3) industry.

Table 49. Northwest Florida water quality for June 1979 to December 1981 (Hand and Jackman 1982).

			Water quality parameter					
Hydrologic unit	Water body	Location	Dis-solved oxygen	Fecal coli-form	Chloro-phyll	Total phos-phorous	Total nitro-gen	Biolog-ical diver-sity index
03100207	Anclote - Pithlachasotee		Good	Good	-	Good	Fair	Good
03100208	Withlacoochee River	Central Florida	Good	Good	Good	Good	Fair	Good
03110101	Waccasassa River		Good	Good	Good	Fair	Fair	Good
03110102	Enconfina-Steinhatchee Rivers	Enconfina	Good	Fair	Good	Fair	Fair	Good
		Fenholloway	Poor	Good	Good	Poor	Fair	Poor
		Steinhatchee	Good	Good	Good	Good	Good	Good
03110103	Aucilla River		Good	Good	-	Good	Good	Good
		Wacissa Riv.	Good	Poor	-	Good	Good	Fair
03120001	St. Marks River		Good	Good	Good	Good	Good	Good
03120003	Ochlockonee River		Good	Fair	Good	Good	Fair	Good
03130011	Apalachicola River		Good	Good	-	Good	Fair	Good
03130014	Apalachicola Bay		Good	Good	Good	Good	Good	Good
03140101	St. Andrew Bay		Good	Good	Good	Good	Good	Good
03140203	Choctawatchee River		Good	Fair	Good	Good	Good	Fair
03140102	Choctawatchee Bay		Good	Good	Good	Good	Good	Good
03140103	Yellow River		Good	Fair	Good	Good	Good	Good
03140104	Blackwater River	Above Milton	Good	Good	Good	Good	Good	Good
		Below "	Fair	Fair	Good	Good	Good	Good
03140105	Escambia River		Good	Good	Good	Good	Good	Good
03140106	Perdido River		Good	Good	Good	Good	Good	Good
03140107	Perdido Bay		Good	Good	Good	Good	Good	-
		Eleven Mile Creek	Fair	Fair	Fair	Fair	Poor	-
03140305	Escambia River		Good	Good	Good	Good	Good	Good

		Screening levels		
Water quality parameter	Units	Good	Fair	Poor
Dissolved oxygen	mg/l	>5.0	3.5-5.5	<3.5
Fecal coliform	mpn/100 mi	<100	100-300	>500
Chlorophyll	µg/l	<15	15-30	>50
Total phosphorous	mg/l	<0.1	0.1-0.5	>0.5
Total nitrogen	mg/l	<0.7	0.7-3.5	>3.5
Diversity index	Shannon	>2	1.2	<1

Table 50. Estimated water use (mgd) in northwest Florida in 1980 (Leach 1982).

County	Public supply fresh	Fresh	Saline	Total
Escambia	30.46	427.49	0.24	427.73
Santa Rosa	5.83	26.04	---	26.04
Okaloosa	12.94	21.65	---	21.65
Walton	1.62	12.55	---	12.55
Washington	0.92	1.99	---	1.99
Bay	39.50	43.21	403.50	446.71
Calhoun	0.33	3.46	---	3.46
Gulf	0.97	35.48	13.00	48.48
Franklin	1.00	1.30	---	1.30
Wakulla	0.56	88.87	---	88.87
Jefferson	0.49	2.55	---	2.55
Taylor	1.49	53.66	---	53.66
Dixie	0.55	1.78	---	1.78
Levy	1.10	5.62	---	5.62
Citrus	0.91	12.04	1897.00	1909.04
Hernando	1.14	41.63	---	41.63
Total	99.81	779.32	2313.74	3093.06

9. MEAN ANNUAL COASTAL SALINITY

Mean annual coastal salinities located off the northwest Florida coast range from 17 to 33 parts per thousand. The data plotted on the atlas maps were collected by the National Marine Fisheries Service (it must be noted that coastal salinities vary considerably throughout the year).

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12. GLOSSARY

aquifer - A subsurface body of ground water.

Atlantic Ridge - A semi-permanent ridge of high pressure, which extends westward over the western Atlantic from the Azores high during summer.

barometer - An instrument which measures atmospheric pressure.

climatology - The science that studies long-term weather trends.

convective thunderstorm - A type of thunderstorm that develops as the result of differential heating of the earth's surface by the sun. These thunderstorms form over areas of intense local heating.

convergence - Process where airflow flowing into an area of low pressure converges and is forced upward since it cannot flow downward due to the earth's surface.

diurnal - Daily.

Eocene - A geologic epoch occurring some 40-60 million years before the present and characterized by the development of the modern types of mammals.

hydrology - The science dealing with the properties, distribution, and circulation of water.

Miocene - A geologic epoch occurring 12-25 million years before the present and characterized by the development of abundant grazing mammals.

Oligocene - A geologic epoch occuring 25-40 million years before the present and characterized by the development of large running mammals.

pH - The pH of a solution is a measure of the hydrogen ion activity and is expressed as the negative logarithm (base 10) of the effective hydrogen ion concentration. A pH of 0-6.9 indicates an acid, a pH of 7.0 a neutral solution, and a pH of 7.1-14.0 a base.

resultant - Net or average.

salinity - Salinity is a measure of dissolved salts in solution and is normally expressed in parts per thousand (0/00).

specific conductivity - Specific conductance or "electric conductance," as it is sometimes called, is a measure of the ability of water to conduct an electrical current. It is the reciprocal of the resistance in ohms measured between opposite faces of a centimeter cube of an aqueous solution and is usually expressed in micromhos per centimeter at 25 ^{o}C.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.