3. AFFECTED ENVIRONMENT

The Affected Environment section succinctly describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision to be made. It does not describe the entire existing environment, but only those environmental resources that would affect or that would be affected by the alternatives if they were implemented. This section, in conjunction with the description of the "status quo" alternative, forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

3.1 GENERAL ENVIRONMENTAL SETTING

The Southwest Florida Environmental Impact Statement study area is comprised of temperate and sub-tropical habitat in portions of Lee and Collier Counties. The major features include the Fakahatchee Strand State Preserve, the Florida Panther National Wildlife Refuge, the Ten Thousand Islands National Wildlife Refuge, the Big Cypress National Preserve, the Corkscrew Regional Ecosystem Watershed, the Rookery Bay and Estero Bay Aquatic Preserves, the Corkscrew Swamp Sanctuary, and the Picayune Strand State Forest. The interior parts of the study area show remnants of prehistoric shoreline, forming sand ridges, interspersed with large wetland strands. The coastal areas along the Gulf of Mexico are cut by islands, bays, and lagoons, and include portions of the largest mangrove ecosystem in the continental United States (**Figures 10a-e**, Map of Environmental Resources).

3.2 BIOLOGICAL RESOURCES

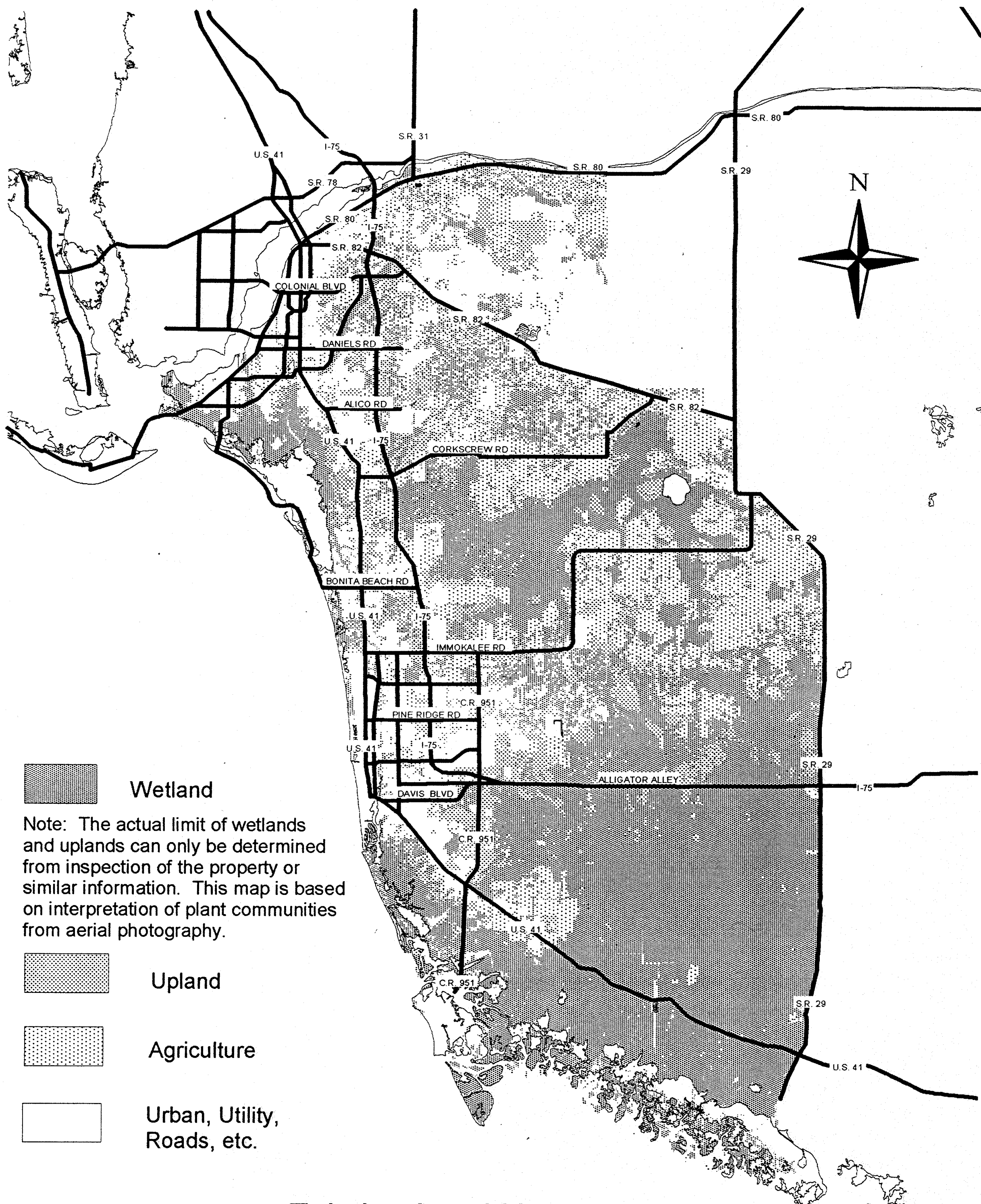
Southwest Florida features floral assemblages characteristic of both temperate and subtropical systems, as well as influences from the Caribbean. The coastal climatic influences, as well as the sheltered habitat afforded by the relatively remote sloughs and cypress strands of the region, provide suitable habitat for several tropical plant species that are rarely seen elsewhere in Florida (Ward 1979). In terms of supporting wide-ranging species (e.g., Florida panther, Florida black bear, and wood stork), the Southwest Florida area likely represents the most important region of Florida (Cox et al. 1994).

3.3 THREATENED AND ENDANGERED SPECIES

3.3.1 FAUNA

Twenty-three faunal species which are known to occur in Lee and Collier Counties are currently listed as threatened or endangered by the United States Fish and Wildlife Service (USFWS). Forty-five faunal species known to occur in these counties are currently listed as threatened, endangered, or as species of special concern by the Florida Game and Fresh Water Fish Commission (FGFWFC) (**Table 4**).

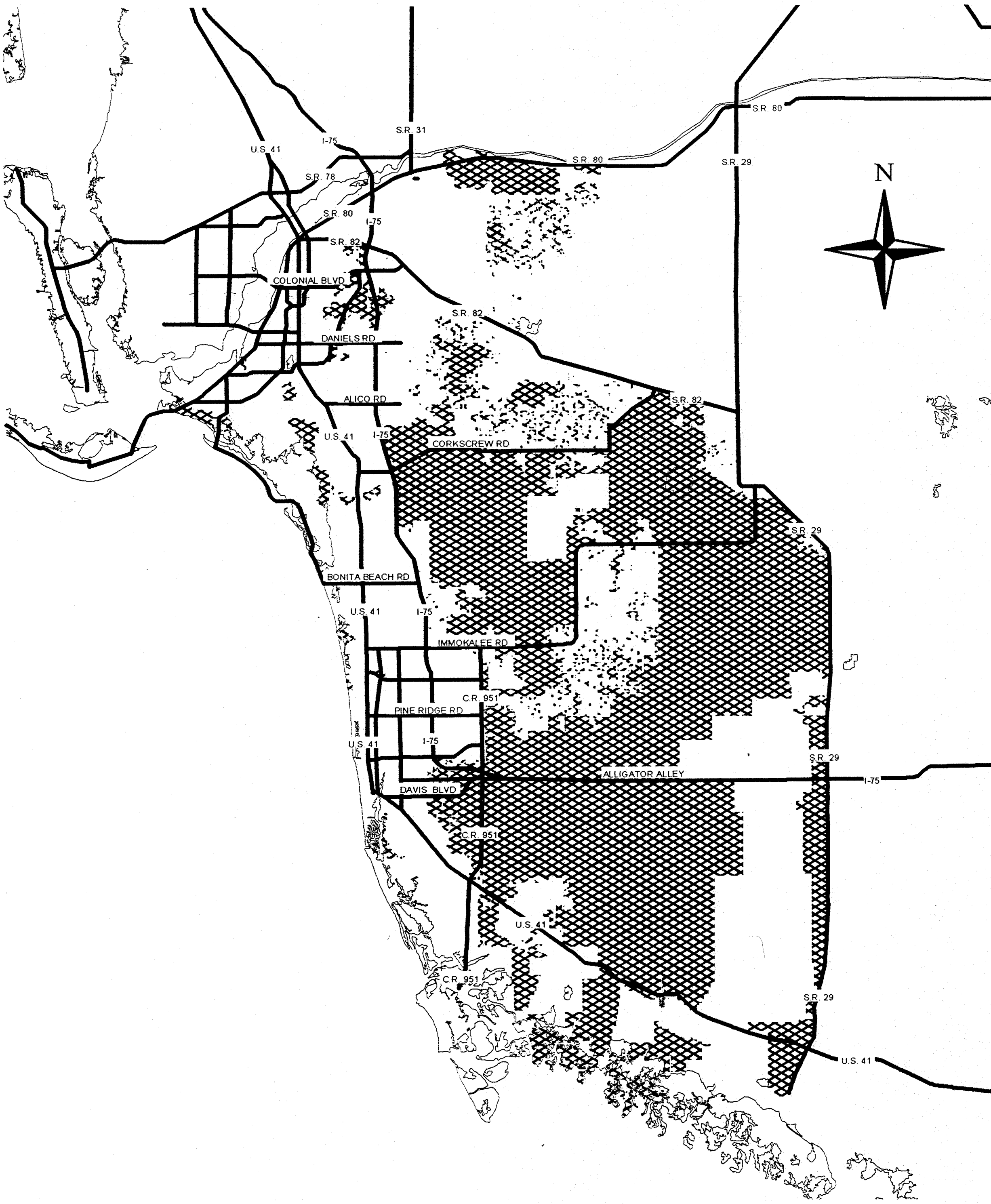
The Corps, through consultation with the USFWS, has determined that seventeen listed faunal species which occur in the study area could be affected by the proposed project. These species include the American crocodile, Eastern indigo snake, Florida scrub-jay, bald eagle, wood stork, red-cockaded woodpecker, piping plover, Audubon’s crested caracara, Everglades snail kite, Florida panther, mountain lion, West Indian manatee, and the Loggerhead, Hawksbill, Green, Leatherback, and Kemp's Ridley Sea Turtles.



Existing Land Use

Simplified based on 1995 Aerial Mapping

FIGURE 10a. MAP OF ENVIRONMENTAL RESOURCES - EXISTING LAND USE



Strategic Habitat Conservation Areas

from Florida Game and Fresh Water Fish Commission (1994)
Closing the Gaps in Florida's Wildlife Habitat Conservation System

FIGURE 10b. MAP OF ENVIRONMENTAL RESOURCES - STRATEGIC HABITAT CONSERVATION AREAS

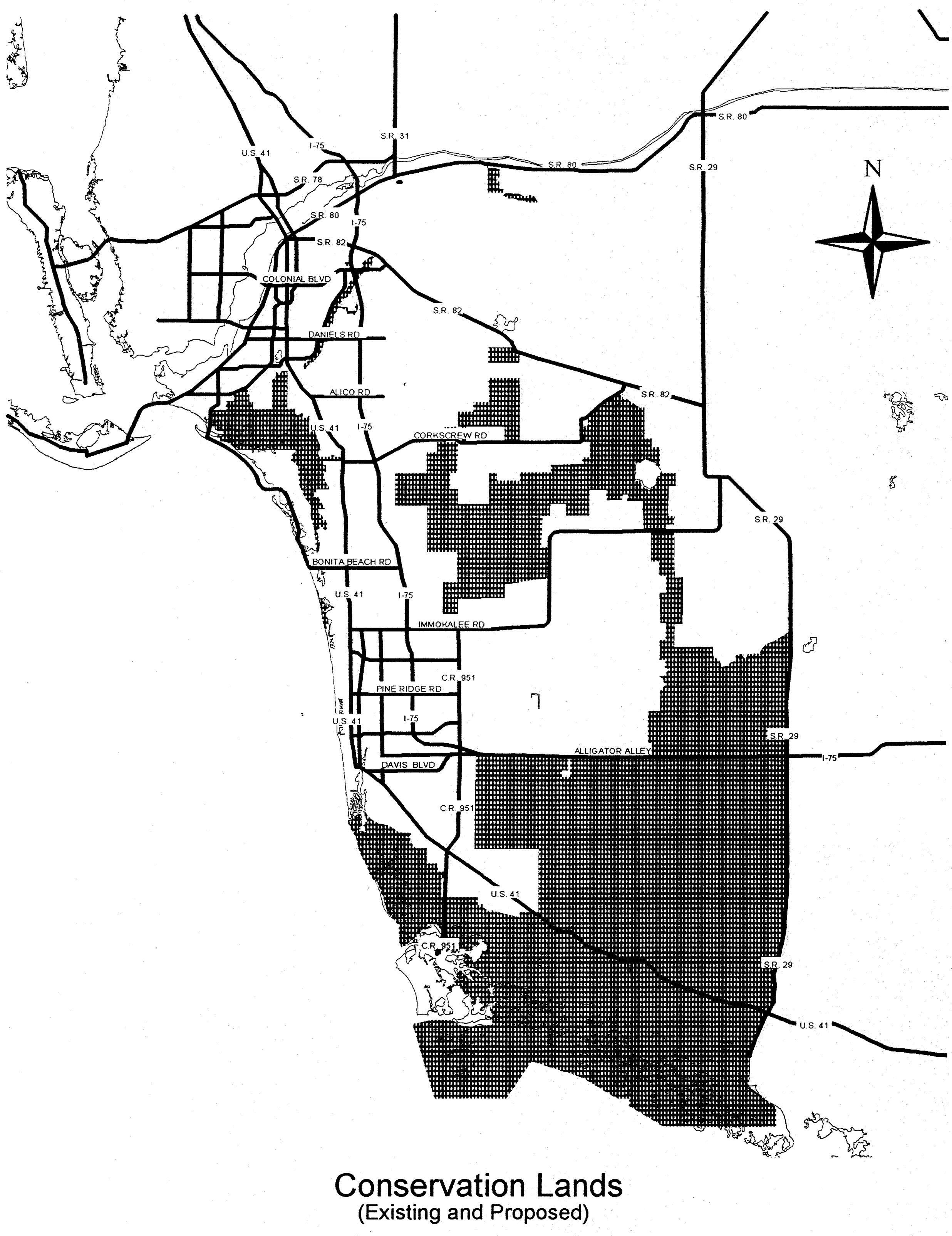
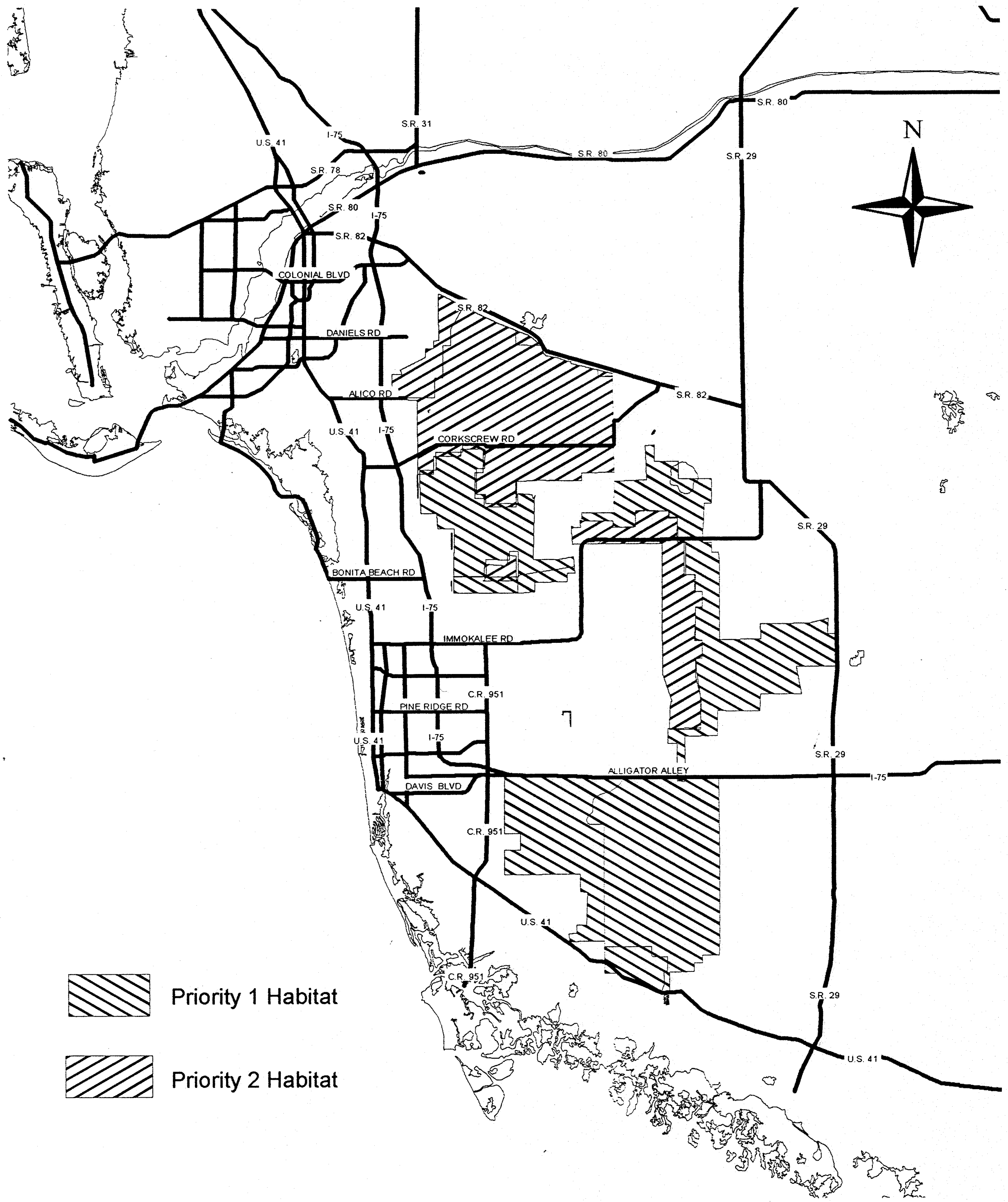


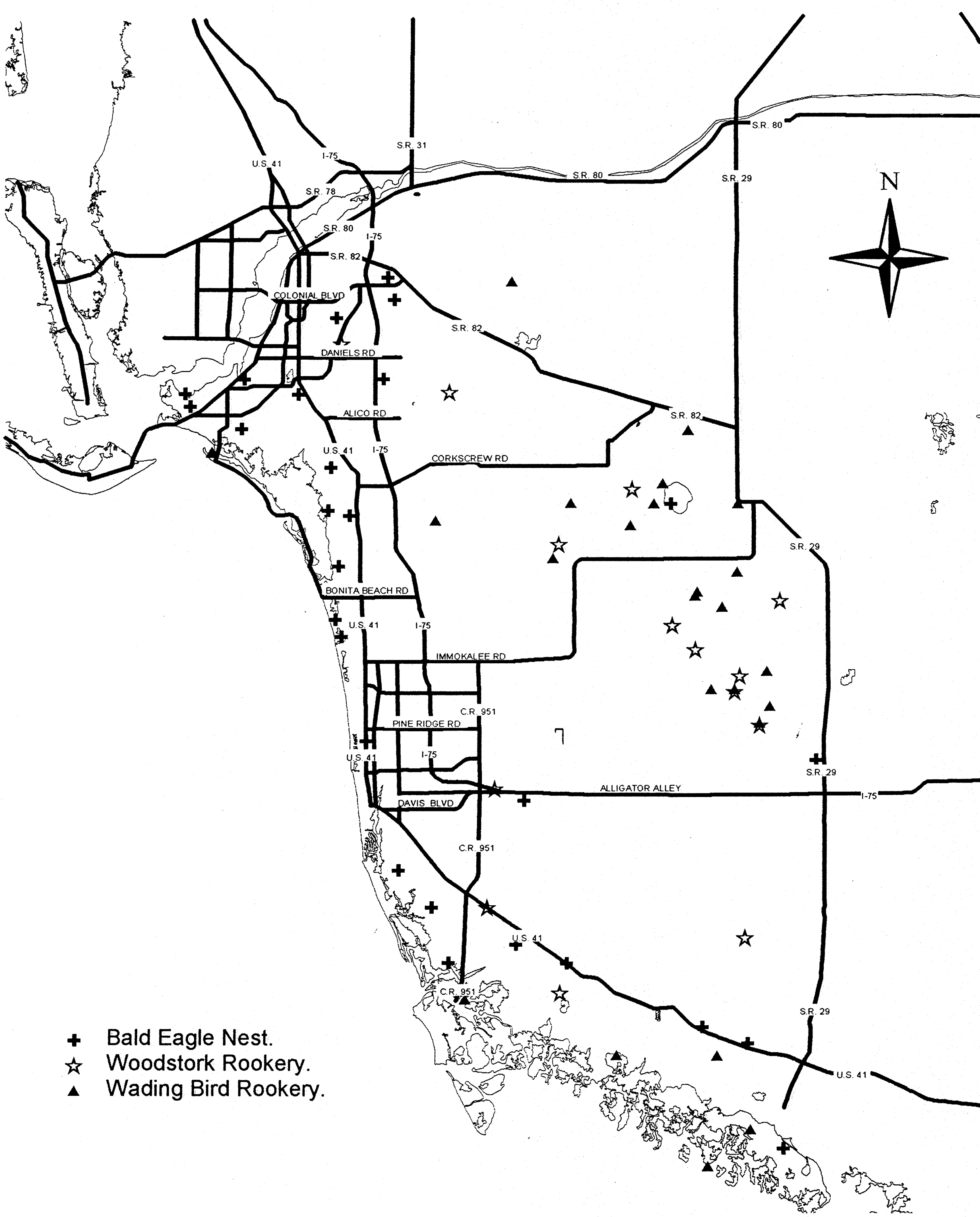
FIGURE 10c. MAP OF ENVIRONMENTAL RESOURCES - CONSERVATION LANDS



Florida Panther Priority 1 & 2 Habitat

from Florida Panther Interagency Committee (1983)
Panther Habitat Preservation Plan

FIGURE 10d. MAP OF ENVIRONMENTAL RESOURCES - PANTHER HABITAT PRESERVATION PLAN



ROOKERIES

FIGURE 10e. MAP OF ENVIRONMENTAL RESOURCES - ROOKERIES AND NEST SITES

Table 4. **Listed Faunal Species Occurring In Lee & Collier Counties, Florida**
(USFWS & FGFWFC, 1998)

Scientific Name	Common Name	Federal Status[1]	State Status[2]
AMPHIBIANS			
Rana capito	Gopher frog		SSC
REPTILES			
Alligator mississippiensis	American alligator	T (SA)	SSC
Caretta caretta	Loggerhead sea turtle	T	T
Chelonia mydas	Green sea turtle	E	E
Crocodylus acutus	American crocodile	E	E
Dermochelys coriacea	Leatherback sea turtle	E	E
Drymarchon corais couperi	Eastern indigo snake	T	T
Eretmochelys imbricata	Hawksbill sea turtle	E	E
Gopherus polyphemus	Gopher tortoise		SSC
Lepidochelys kempii	Kemp's ridley sea turtle	E	E
Pituophis melanoleucus mugitus	Florida pine snake		SSC
BIRDS			
Ajaia ajaja	Roseate spoonbill		SSC
Aphelocoma coerulescens	Florida scrub-jay	T	T
Aramus guarauna	Limpkin		SSC
Caracara plancus	Audubon's crested caracara	T	T
Charadrius alexandrinus tenuirostris	Southeastern snowy plover		T
Charadrius melodus	Piping plover	T	T
Egretta caerulea	Little blue heron		SSC
Egretta thula	Snowy egret		SSC
Egretta tricolor	Tricolored heron		SSC
Eudocimus albus	White ibis		SSC
Falco peregrinus tundrius	Arctic peregrine falcon		E
Falco sparverius paulus	Southeastern American kestrel		T
Grus canadensis pratensis	Florida sandhill crane		T
Haematopus palliatus	American oystercatcher		SSC
Haliaeetus leucocephalus	Bald eagle	T	T
Mycteria americana	Wood stork	E	E
Pelecanus occidentalis	Brown pelican		SSC
Picoides (= Dendrocopos) borealis	Red-cockaded woodpecker	E	T
Rhyncops niger	Black skimmer		SSC
Rostrhamus sociabilis plumbeus	Everglades snail kite	E	E
Speotyto cunicularia floridana	Florida burrowing owl		SSC
Sterna antillarum	Least tern		T
MAMMALS			
Balaena glacialis	Right whale	E	E
Balaenoptera borealis	Sei whale	E	E
Balaenoptera physalus	Finback whale	E	E
Blarina brevicauda shermanii	Sherman's short-tailed shrew		SSC
Felis concolor coryi	Florida panther	E	E
Felis concolor	Mountain lion	T (S/A)	E
Megaptera novaeangliae	Humpback whale	E	E
Mustela vison evergladensis	Everglades mink		T
Oryzomys palustris sanibelli	Sanibel Island rice rat		SSC
Physeter catodon	Sperm whale	E	E
Podomys floridanus	Florida mouse		SSC

Scientific Name	Common Name	Federal Status[1]	State Status[2]
Sciurus niger avicennia	Big Cypress fox squirrel		T
Trichechus manatus	West Indian manatee	E, CH	E
Ursus americanus floridanus	Florida black bear		T

[1]Federal Legal Status (US Fish and Wildlife Service)

E = Listed as an Endangered Species in the List of Endangered and Threatened Wildlife and Plants under the provisions of the Endangered Species Act. Defined as any species which is in danger of extinction throughout all or a significant portion of its range.

T = Listed as a Threatened Species. Defined as any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

T/SA = Threatened due to similarity of appearance.

CH = Critical Habitat has been designated for this species in both counties

[2]State Legal Status (Florida Game and Fresh Water Fish Commission)

E = Listed as an Endangered Species. Defined as a species, subspecies, or isolated population which is so rare or depleted in number or so restricted in range of habitat due to any man-made 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.

T = Listed as a Threatened Species. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.

SSC = Listed as a Species of Special Concern. Defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species.

A description of each species reported by the USFWS and the FGFWFC with the potential to be affected follows. For Federally listed species, the complete species account from the Draft Multi-Species Plan is attached at Appendix G.

Gopher frog *Rana capito*

This medium-sized frog is a commensal of the gopher tortoise (*Gopherus polyphemus*) and is typically found in and around gopher tortoise burrows (Ashton and Ashton 1988).

The typical habitat is native, upland, xeric communities, particularly xeric oak scrub, although they are also found in pine flatwoods, sand pine scrub, and xeric hammocks (Godley 1992). The only documented occurrence of the gopher frog in the study area is in coastal Lee. and Collier counties.

The gopher frog is currently listed as a species of special concern by the FGFWFC because of loss of upland habitat and wetland nesting habitat, typically ephemeral marshes located within a kilometer of the upland habitat.

American alligator *Alligator mississippiensis*

The American alligator's range extends across the southeastern states of Alabama, Arkansas, North and South Carolina, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas.

This reptile utilizes freshwater swamps and marshes as its primary habitat, but is also seen in rivers, lakes, and smaller bodies of water. Alligators have been shown to be an important part of the ecosystem, and are thus regarded by many as a "keystone" species. This role as a keystone species includes control of prey species and creation of peat through their nesting activities (University of Florida 1998).

Populations of the American alligator were severely affected in the early parts of this century due to hunting of the animal for its skin. In 1967, this species was listed as an endangered species which prohibited alligator hunting. As a result, the alligator has undergone a successful recovery. The alligator is hunted in Florida today under permit from the FGFWFC.

The American alligator is currently listed as threatened by the USFWS, due to its similarity to the American crocodile *(Crocodylus acutus)*. The American alligator is currently listed as a species of special concern by the FGFWFC.

Loggerhead Sea Turtle *Caretta caretta*

The loggerhead turtle is the most common sea turtle species in South Florida (USFWS 1998). The total number of loggerhead sea turtle nests surveyed in South Florida account for over 90 percent of all nests reported State-wide (USFWS 1998).

The nesting and hatching season for loggerhead sea turtles in South Florida extends from mid-March through November, with the female laying an average of 110-120 eggs per nest, with multiple nestings (commonly 2-6 nests) spaced at two-week intervals (Dodd 1992).

Little is known regarding their behavior beyond the nesting beaches, although hatchlings are known to ride offshore drift lines in the Atlantic, and small juveniles are closely associated with floating mats of *Sargassum* in open ocean habitat (Ashton and Ashton 1991; Dodd 1992).

The diet of the loggerhead varies, but is primarily composed of mollusks, crustaceans, and horseshoe crabs (Dodd 1992).

The loggerhead is listed due to pressures on several levels, ranging from habitat alteration due to urbanization of coastal beaches, to pollution of the ocean, and human predation.

The loggerhead is listed as a threatened species under the Endangered Species Act of 1973, and is also listed as threatened by the FGFWFC.

Green Sea Turtle *Chelonia mydas*

The only herbivorous sea turtle, the Green sea turtle is found throughout the tropic and subtropics, worldwide (Ehrhart and Witherington 1992). The green turtle, in Florida, nests primarily on the east coast, from Volusia County south to Dade County. The first recorded nesting in Southwest Florida occurred in 1994; prior to that there was only one recent nesting record on the west coast of Florida, occurring at Eglin Air Force Base in the Florida panhandle in 1987 (USFWS 1998; Ehrhart and Witherington 1992). However, the west coast of Florida does support important populations of immature green turtles (Ehrhart and Witherington 1992).

The green turtle is listed due to commercial exploitation (for meat, oil, and skins), habitat alteration due to urbanization of coastal beaches, and pollution of the ocean.

The green turtle is listed as a threatened species under the Endangered Species Act of 1973, except for the breeding populations in Florida and on the west coast of Mexico, which are listed as endangered. The green turtle is also listed as endangered by the FGFWFC.

American Crocodile *Crocodylus acutus*

The American crocodile's range extends across southernmost Florida, Mexico, Central America, the Caribbean Islands, and northern South America.

This reptile utilizes coastal saltwater swamps and marshes as its primary habitat, but is also seen in saline lakes. The crocodile has also been known to range a few miles inland.

Populations of the American crocodile in Florida were likely relatively small historically, and the severely limited present distribution in Florida makes the population susceptible to catastrophic crash due to disease, or loss of habitat and individuals in a severe storm event (i.e., hurricanes) (Moler 1992). The species has been depleted elsewhere in its range due to hunting of the animal for its skin, and through loss of habitat.

The American crocodile occurs in low numbers within the study area. Crocodiles have been sighted as far north as Pine and Sanibel Islands and occur in the Rookery Bay, McIlvane Bay and Imperial River areas. Although no successful reproduction has occurred on the Southwest coast, nesting has occurred.

The American crocodile is currently listed as an endangered species by both the USFWS and the FGFWFC.

Leatherback Sea Turtle *Dermochelys coriacea*

The largest extant turtle species, the leatherback turtle can reach 2.4 meters (8 feet) in length and weigh up to 725 kilograms (1600 pounds) (Ashton and Ashton 1991).

Leatherback turtles nest during the Spring and Summer months, laying 80 or more eggs, which hatch 60-70 days later. The adult leatherback turtle is considered omnivorous, feeding on jellyfish, drift algae, seaweed, sea urchins, and squid.

Serious threats to the leatherback turtle on its nesting beaches include artificial lighting, beach nourishment, increased human presence, and exotic beach and dune vegetation (USFWS 1998).

The leatherback turtle is listed as endangered by both the USFWS and the FGFWFC.

Eastern Indigo Snake *Drymarchon corais couperi*

The Eastern indigo snake is the largest non-venomous snake in North America. It is an isolated subspecies occurring in Southeastern Georgia and throughout peninsular Florida.

The Eastern indigo snake prefers drier habitats, but may be found in a variety of habitats from xeric sandhills, to cabbage palm hammocks, to hydric hardwood hammocks. Indigo snakes often forage adjacent to wetlands, particularly seasonal wetlands.

Indigo snakes need relatively large areas of undeveloped land to maintain population. The main reason for its decline is habitat loss due to development. Further, as habitats become fragmented by roads, indigo snakes become increasingly vulnerable to highway mortality as they move through their large territories (Schaefer and Junkin 1990).

The Eastern indigo snake occurs throughout the study area.

The Eastern indigo snake has been classified as a threatened species by the USFWS since 1978 and by the FGFWFC since 1971.

Hawksbill Sea Turtle *Eretmochelys imbricata*

The hawksbill sea turtle is found throughout the tropic and subtropics, worldwide. The hawksbill turtle rarely appears in historical records in Florida, but nests have been noted along the east coast (from Volusia County south to Monroe County) since the early 1980's (Meylan 1992). Stranding and museum records indicate the occurrence of the Hawksbill within the study area. The hawksbill is primarily associated with coral reefs, but also occupies other hard-bottom habitats (Meylan 1992).

The hawksbill turtle is listed due to commercial exploitation (for meat, oil, and skins), habitat alteration due to urbanization of coastal beaches, and pollution of the ocean, although exploitation for tortoiseshell is the principal cause for population decline worldwide (Meylan 1992).

The hawksbill turtle is listed as an endangered species under the Endangered Species Act of 1973. The hawksbill turtle is also listed as endangered by the FGFWFC.

Gopher tortoise *Gopherus polyphemus*

The gopher tortoise is found throughout peninsular Florida, with the bulk of the population in central and northern portions. The south Florida population is scattered due to habitat loss and fragmentation, as well as urbanization (Diemer 1992).

Typical habitat for the gopher tortoise includes sand pine scrub, coastal strand, oak hammocks, oak scrub, dry prairies, pine flatwoods, palmetto prairies, pasture, fallow cropland, and disturbed upland habitats (Diemer 1992).

The population is threatened by fragmentation of habitat and urbanization, as well by conversion of habitat to agricultural use, changes in land management practices (i.e., suppression of fire), and by susceptibility to upper respiratory infections. Coastal populations in Southwest Florida have been greatly reduced by urban development. Few tortoise populations (with the exception of the Immokalee area) exist outside coastal or riverine dune ridges in the study area.

The gopher tortoise is listed as a species of special concern by the FGFWFC.

Kemp's Ridley Sea Turtle *Lepidochelys kempii*

The Kemp's ridley sea turtle is found throughout the tropical and subtropical Atlantic, although adult ridleys are apparently limited to the Gulf of Mexico, worldwide (Ogren 1992). The majority of the turtle nest *en masse* at Rancho Nuevo, Tamaulipas, Mexico. A few nests have been noted recently in Texas, and one nest was documented in Pinellas County, Florida in 1989 (Ogren 1992).

The Kemp's ridley turtle is listed due to intensive egg collection, commercial exploitation (for meat, oil, and skins), and shrimp trawl mortality prior to the installation of Turtle Excluder Devices (TEDs).

The Kemp's ridley turtle is listed as an endangered species under the Endangered Species Act of 1973. The Kemp's ridley turtle is also listed as endangered by the FGFWFC.

Florida pine snake *Pituophis melanoleucus mugitus*

Florida pine snakes, which were once common throughout the southeast, are typically found in open, sandy, pine-turkey oak woodlands and abandoned fields, as well as in sandhill, scrub, and longleaf pine forests (Tennant and Krysko 1997). The pine snake is listed by the FGFWFC as a species of special concern, primarily due to loss and fragmentation of habitat, overcollecting, and road mortality (Franz 1992). The distribution of this species extends to Lee County only, and is not well-documented.

Limpkin *Aramus guarauna*

The limpkin is a heron-sized wading bird with a long neck, bill, and legs (Bryan 1996). They are typically found along the shallows of slow-moving freshwater rivers, marshes, and lakeshores. Nesting occurs in bulrush marshes, in the tops of cypress and cabbage palms, and amongst cypress knees (Bryan 1996).

The primary threat to the limpkin appears to be loss of its primary food source, the apple snail (*Pomacea paludosa*). The apple snail population is threatened by degradation of water quality, changes in hydroperiod and hydrology, pollution, and the proliferation of exotic plants, particularly water hyacinth (*Eichornia crassipes*), hydrilla (*Hydrilla verticillata*), and Brazilian elodea (*Egeria densa*).

The limpkin occurs throughout the study area, primarily in undeveloped areas.

The limpkin is listed as a species of special concern by the FGFWFC.

<u>Red-cockaded woodpecker</u> <u>*Picoides (=Dendrocopos) borealis*</u>

The red-cockaded woodpecker is a territorial, non-migratory, year-round resident of mature pine forests in the Southeastern United States (Hovis 1996).

The red-cockaded woodpecker uses open upland and hydric pine forests, as well as mixed pine/cypress forests in Southwest Florida. Like the Florida scrub-jay, red-cockaded woodpeckers exhibit cooperative breeding where immature birds aid in the rearing of the young (Ehrlich et al. 1992).

Red-cockaded woodpeckers in Southwest Florida require an average of 200 to 500 acres of old pine forest to support foraging and nesting habitat. Territory size is larger in Southwest Florida than in other parts of the species range due to available habitat.

The red-cockaded woodpecker appears to play a crucial role in the Southern pine forest ecosystem. A number of other birds use the nest cavities excavated by red-cockaded woodpeckers, such as bluebirds, and several other woodpecker species, including the downy, hairy, and red-bellied woodpecker (USFWS 1993). Larger woodpeckers may take over a red-cockaded woodpecker cavity, sometimes enlarging the hole enough to allow screech owls, wood ducks, and even raccoons to later move in. Flying squirrels, several species of reptiles and amphibians, and insects, primarily bees and wasps, also will use red-cockaded cavities (USFWS 1993).

In the study area, red-cockaded woodpeckers are documented in central Lee County east of Naples, Golden Gate Estates, Belle Meade (Picayune Strand State Forest).

The red-cockaded woodpecker rapidly declined as its pine habitat was altered for a variety of uses, primarily timber harvest and agriculture. The species was listed as endangered in March 1970 by the Department of the Interior. The red-cockaded woodpecker is listed as a threatened by the FGFWFC and endangered by the USFWS.

<u>Audubon's Crested Caracara</u>   <u>*Caracara plancus*</u>

The crested caracara is about the size of an osprey. The caracara is an opportunistic feeder; its diet includes both carrion and living prey. The living prey usually consist of small turtles, frogs, and lizards.

Adult caracara maintain large territories, usually with their mates. Pair bonds are strong, persisting until one of the mates dies. The nest is typically located in a cabbage palm. The breeding peak is from January to March, with the usual clutch being two or three eggs (Layne 1996).

The region of greatest abundance for this Florida population is a five-county area north and west of Lake Okeechobee (Layne 1996). Caracara occur in the following Florida counties: Glades, DeSoto, Highlands, Okeechobee, Osceola, Lee, Collier, Hendry, Charlotte, Hardee, and Polk Counties. Historically the Florida population was more widespread, but has diminished rapidly with expansion of development.

The crested caracara is a bird of open country. Dry prairies with wetter areas and scattered cabbage palm (*Sabal palmetto*) comprise their typical habitat. Caracara also occur in improved pasture lands and even in lightly wooded areas with more limited stretches of open grassland (Layne 1996). Adult caracara tend to spread thinly over a wide area, with each pair maintaining a large territory.

The primary cause for the decline of the crested caracara has been habitat loss. Real estate development, citrus groves, tree plantations, improved pastures, and other agricultural uses are all competing for the same habitat. Less significant factors may include illegal killing and trapping; increased numbers of road kills due to a rising volume of traffic; slow recovery from population losses because of the caracara's low reproductive rate; and possible loss of genetic variability (due to the relatively small population), thus making the caracara more vulnerable to stresses than would otherwise be the case (USFWS 1991).

Most caracara occur on privately-owned lands in Florida. The only Federal land on which the bird might permanently reside is the Air Force's Avon Park bombing range in Polk and Highlands County. Without any significant areas of habitat under State or Federal protection, long-term survival of the Florida population will depend largely upon finding innovative means of preserving the extensive tracts of prairie habitat in private ownership (USFWS 1991). Caracaras are documented in the eastern portions of the study area, primarily in association with agricultural lands. Historically, caracaras were documented as far west as Colonial and Summerlin Boulevards in Ft Myers.

The Audubon’s crested caracara is listed as threatened by both the USFWS and the FGFWFC.

Little blue heron *Egretta caerulea*
Snowy egret *Egretta thula*
Tricolored heron *Egretta tricolor*
White ibis *Eudocimus albus*

These wading birds forage in relatively shallow streams, lakes, ponds, rivers, cypress domes, mixed pine/cypress, hydric pine, and isolated wetlands in Southwest Florida. Wetlands within 15 km (9.3 miles) of rookeries are considered core foraging areas for wading birds (Cox et al. 1994). They also utilize estuaries, mangroves, and beaches in the study area. They feed on fish, frogs, crawfish, mice and insects.

Nesting occurs in flooded woodlands and on islands. Typical vegetation includes cypress, red maple, mangrove, willow, and buttonbush (Rodgers, Jr. 1996). Data collected in 1996 (FGFWFC) indicate that 25 wading bird rookeries occur within the EIS study area.

The primary threat to these wading birds is loss of foraging habitat, particularly seasonal and isolated wetlands, through habitat alteration, including filling and changes in hydrology. Exposure to pollution, pesticide residues, and disturbance of colony sites may also play a role (Rodgers, Jr. 1996).

These four wading bird species are listed as species of special concern by the FGFWFC.

Arctic peregrine falcon *Falco peregrinus tundrius*

The peregrine falcon is the largest of the falcons found in Florida. Florida serves as an important wintering area and migratory route for this subspecies. Migrants can be found in Florida after the first fall cold front with some individuals remaining all winter. Florida's coastline (including the Marco Island and Ten Thousand Island areas) and inland lakes and marshes, both abundant with shorebirds and waterfowl, attract these spectacular hunters. Dry prairies, wet prairies, and agricultural environments also serve as suitable feeding areas. Abundant bird prey and high perching areas are a must for this species. The peregrine falcon is listed as endangered by the FGFWFC and was recently delisted by the USFWS.

Southeastern American kestrel *Falco sparverius paulus*

The Southeastern American kestrel is the smallest of the falcons found in the United States. Florida also serves as an important wintering area for the similar American kestrel (*F. s. sparverius*). Both subspecies prefer open areas with scattered trees, as well as urban and cultivated habitats (Stys 1993). Typical food items consist of insects and small vertebrates, such as lizards and toads. Population decline appears to be due to man-induced changes including urbanization and changes in land use practices (e.g., suppression of fire). While clearing of timber and clearing for cattle has resulted in new foraging areas, it has also resulted in loss of suitable nest sites (Smallwood 1990 *in* Stys 1993). The Southeastern American kestrel is not well-documented in the study area but few comprehensive surveys have occurred. The Southeastern American kestrel is listed as threatened by the FGFWFC.

Florida sandhill crane *Grus canadensis pratensis*

The Florida sandhill crane is one of Florida's largest birds, and is one of six recognized subspecies of sandhill crane. The sandhill crane utilizes open prairies, active or fallow cropland, and improved pastures for foraging, and herbaceous wetlands as nest sites. The cranes are opportunistic feeders, feeding on invertebrates, plants, seeds, berries, birds, and small mammals (Stys 1997).

Concentrations of cranes have been noted in the area surrounding the Southwest Florida International Airport, as well as agricultural areas within the study area (Arnold Committee 1996). The crane is at risk due to loss of wetlands from filling or ditching, degradation or loss of prairie and range habitats, and fragmentation of remaining habitat into patches too small or remote to be considered suitable for crane use (Stys 1997). Low fecundity is also a concern for the long-term fitness and recovery of the species. The Florida sandhill crane has been listed as threatened by the FGFWFC since 1974.

Florida burrowing owl *Speotyto cunicularia floridana*

The Florida burrowing owl is listed as a species of special concern by the FGFWFC. The Florida burrowing owl is typically found in open, well-drained treeless areas where the herbaceous ground cover is low or close-cropped, such as pastures and athletic fields (Millsap 1996). The primary prey items include insects, brown anoles, Cuban treefrogs, roadkill animals, songbirds, and small rodents. The primary threats to the species are from development and intensive cultivation (Millsap 1996).

Although the status of the owl population in the study area is unclear, owls are known to occur on mining lands and improved pasture, and in the area surrounding the Southwest Florida International Airport, Marco Island, and some areas of Lehigh Acres (Arnold Committee 1996).

Florida Scrub-Jay *Aphelocoma coerulescens*

The Florida scrub-jay was listed by the USFWS as threatened under the Endangered Species Act in 1987, primarily due to habitat loss, fragmentation, and degradation. The scrub-jay is also listed as threatened by the FGFWFC. Scrub habitats associated with Florida's coastal islands, mainland coasts, and the Lake Wales Ridge are considered to be among the most threatened natural systems in the United States, with an estimated habitat loss of more than 80 percent relative to pre-settlement acreage (Fitzpatrick et al. 1991).

Florida scrub-jays are non-migratory and relatively sedentary, rarely traveling farther than 8-10 km (5-6 miles). Scrub-jays occupy territories on a continual (i.e., year-round) basis (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991; Fitzpatrick et al. 1994). Territory size averages 9-10 ha (22 to 25 ac), with a minimum size of about 5 ha (12 ac). The availability of territories is a limiting factor for scrub-jay populations.

There are relatively few predators of adult Florida scrub-jays, but the most frequent predators are raptors such as Cooper's hawk (*A. cooperii*), sharp-shinned hawk (*Accipiter striatus*), merlin (*Falco columbarius*), and the Northern harrier (*Circus cyaneus*). Snakes, raccoons (*Procyon lotor*), and feral cats (*Felis cattus*) are also known to prey on nestlings and adults (Fitzpatrick et al. 1994).

The Florida scrub-jay has very narrow habitat requirements, being endemic to Florida's relict dune ecosystems and scrubs, which occur on well-drained, nutrient-poor, sandy soils (Myers 1990; Fitzpatrick et al. 1994). This relict oak-dominated scrub, or xeric oak scrub, is crucial habitat for the Florida scrub-jay. The phenotypic oak scrub is predominantly four species of evergreen, low-growing oaks (Chapman oak (*Quercus chapmanii*), sand live oak (*Q. geminata*), myrtle oak (*Q*. *myrtifolia*), and scrub oak (*Q*. *inopina*)), with or without the presence of rosemary (*Ceratiola ericoides*) and/or sand pine (*Pinus clausa*) or slash pine (*P. elliottii* var. *densa*) (Myers 1990). In optimal scrub-jay habitat, these oaks are one to three meters (3 to 10 feet) tall, with a mosaic of sandy openings comprising 25 to 50 percent of the total cover, and a pine (sand pine or slash pine) canopy of less than 20 percent (Woolfenden and Fitzpatrick 1990).

The predominant communities providing suitable scrub-jay habitat in Southwest Florida are oak scrub and scrubby flatwoods, the latter of which differs from scrub in that it has a sparse cover of slash pine. Portions of the EIS study area (the western two-thirds of Lee County, the northern portion of Collier County, and the Immokalee area) are mapped as containing suitable habitat types (USFWS 1998). This habitat, in addition to similar habitat in Charlotte, Glades, and Hendry Counties, acts as a “connector” between the larger habitat areas designated as the “Southern Gulf Coast sub-region” and the “Lake Wales Ridge sub-region.” The Immokalee scrub-jay population has been designated by the USFWS and the FGFWFC for special protection measures (Arnold Committee 1996). Scrub jays have been reintroduced to oak scrubs at Rookery Bay National Estuarine Research Reserve.

The Southwest Florida area has experienced significant habitat fragmentation and loss due to development and urbanization (USFWS 1998). This loss of habitat, as well as degradation due to suppression of fire (necessary to maintain “optimal” habitat) has placed additional burdens on this region’s scrub-jay populations.

<u>Bald Eagle</u>   <u>*Haliaeetus leucocephalus*</u>

The bald eagle is the only eagle unique to North America. It ranges over most of the continent, from the northern reaches of Alaska and Canada down to northern Mexico.

The bald eagle occurs in various habitats near lakes, large rivers, and coastlines. In general, eagles need an environment of quiet isolation; tall, mature trees; clean waters; a source of prey; and prefer nesting within one-half mile (0.8 km) of water.

The bald eagle population was decimated in the 19th and early 20th centuries by habitat destruction, hunting, pesticide use and lead poisoning. In 1967, bald eagles were officially declared an endangered species. Due to this and other protective measures, the population has made a tremendous comeback, its populations greatly improving in numbers, productivity, and security in recent years. Its largest populations are currently found in Alaska and Florida (USFWS 1995).

Twenty-six active bald eagle nests are recorded within the study area, as of the 1996 winter census (FGFWFC 1996). In Lee ,and Collier counties, the nesting eagles are mainly concentrated along coastal areas. Nests typically occur in pines and cypress within the study area but occasionally eagles nest in Australian pines.

The bald eagle is currently listed as a threatened species by both the USFWS and FGFWFC.

<u>Wood Stork</u>   <u>*Mycteria americana*</u>

The wood stork is the only stork occurring in the United States. In the U.S., the wood stork's range includes Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas. The only states in which this bird is known to nest, however, are Florida, Georgia, and South Carolina.

Wood storks are wetland dwellers and use fresh, brackish, and saltwater habitats for feeding and nesting. Nesting occurs in cypress, hardwood and mangrove swamps. The extreme dependence of the wood stork on naturally functioning wetlands makes it an excellent indicator of the health of wetland ecosystems. Feeding takes place in shallow ponds, tidal pools, swamps, and marshes. Wetlands found within 30 km (18.6 miles) of rookeries are considered core foraging areas by the FGFWFC (Cox et al. 1994).

Until the last few decades, the wood stork was a common sight in Florida's wetlands. However, between the 1930's and 1960's, there was a serious decline in this species. One reason for the decline in population has been the changes in the hydrologic regime of the Everglades, which affected its foraging habitat and food production (Mazzotti 1990).

Four wood stork rookery sites were mapped within the EIS study area (all in Collier County) during the late 1980's (Runde et al. 1991). The largest wood stork rookery in the United States is located in the Audubon Society's Corkscrew Swamp Sanctuary (Arnold Committee 1996).

The wood stork is currently listed as an endangered species by both the USFWS and FGFWFC.

Everglade Snail Kite *Rostrhamus sociabilis plumbeus*

Although previously located in freshwater marshes over a considerable area of peninsular Florida, the range of the snail kite is currently more limited. This bird is now restricted to several impoundments on the headwaters of the St. John's River; the southwest side of Lake Okeechobee; the eastern and southern portions of Water Conservation Areas (WCA) 1, 2A and 3; the southern portion of WCA 2B; the western edge of WCA 3B; and the northern portion of Everglades National Park.

The snail kite inhabits relatively open freshwater marshes which support adequate populations of apple snail (*Pomacea paludosa*), upon which this bird feeds almost exclusively. Favorable areas consist of extensive shallow, open waters such as sloughs and flats, vegetated by sawgrass (*Cladium jamaicense*) and spikerushes (*Eleocharis spp.*). The areas are often interspersed with tree islands or small groups of scattered shrubs and trees which serve as perching and nesting sites. The water level must be sufficiently stable to prevent loss of the food supply through drying out of the surface.

In the study area, the snail kite has been noted in the area around the Southwest Florida International Airport mitigation lands, in canals and Harnes Marsh in Lehigh Acres (Arnold Committee 1996) and in agricultural retention areas in eastern Lee County.

The snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once snail kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth which inhibits the snail kite's ability to see its prey (USFWS, May 1996).

Three (3) snail kite roosting areas were identified within the EIS study area, based upon FGFWFC (1996) data - one each in Zooms B (the Hub), C, and D. An additional four (4) roosting areas are located just east of Zoom D. Snail kite use of habitat in Southwest Florida may be linked to drought conditions in other areas. Birds may also be dispersing juveniles (Toland USFWS pers. comm. 1996).

The snail kite is currently listed as an endangered species by both the USFWS and FGFWFC.

Sherman's short-tailed shrew *Blarina brevicauda shermanii*

The Sherman's short-tailed shrew is typically found in mesic forests and slash pine and palmetto flatwoods with dense herbaceous areas in Southwestern Florida. The primary threats to the shrew are habitat loss or disturbance, through changes in hydrology or land clearing activities, and predation by feral and domestic house cats (Layne 1992). Based upon current knowledge, Sherman's short-tailed shrew has one of the most restricted ranges of all Florida mammals (Layne 1992). The shrew has been collected along the Orange River and along Hickey Creek, located west and north of Lehigh Acres, respectively (Arnold Committee 1996).

The Sherman's short-tailed shrew is currently listed as a species of special concern by the FGFWFC.

<u>Florida panther</u> *<u>Felis concolor coryi</u>*

The Florida panther is one of the most endangered large mammals in the world and was designated as an endangered species by the Department of the Interior on 11 March 1967. The panther is also listed as endangered by the FGFWFC. A small population in South Florida, estimated to number between 30 and 50 adults (30 to 80 individuals), represents the only known remaining wild population of an animal that once ranged throughout most of the Southeastern United States from Arkansas and Louisiana eastward across Mississippi, Alabama, Georgia, Florida, and parts of South Carolina and Tennessee (USFWS 1998).

Geographic isolation, habitat loss, population decline, and associated inbreeding have resulted in a significant loss of genetic variability and health of the Florida panther. Population viability projections in 1989 and 1992 concluded that under the current demographic and genetic conditions, the Florida panther would probably become extinct within twenty to forty years (USFWS 1998).

The only known remaining panther population is centered in and around the Big Cypress Swamp and Everglades area of South Florida. Native landscapes within the Big Cypress Swamp region are dominated by pine, cypress, and freshwater marshes, interspersed with mixed-swamp forests, hammock forests, and prairies (Duever et al. 1979). Tracking data from radio-collared members of this population indicate that its epicenter is in Collier and Hendry Counties. Collared panthers have also been documented in Broward, Dade, Glades, Hardee, Highlands, Lee, Monroe, and Palm Beach Counties. There are still large areas of privately-owned land in Charlotte, Collier, Hendry, Lee, and Glades Counties where uncollared individuals may reside (Maehr 1992a). Lands under private ownership account for approximately 53% of the occupied panther range in South Florida (Logan et al. 1993). The greatest concentration of unprotected, occupied panther habitat is found on private land in eastern Collier County and southern Hendry County (Maehr 1992a). For the most part, privately owned lands are higher in elevation, better drained, have a higher percentage of hardwood hammocks and pine flatwoods, and are higher in natural productivity than public lands south of Interstate 75. Private lands contain some of the most productive panther habitat in South Florida, primarily due to habitat and general land management practices. However, better soils and drainage make this land more suitable for intensive agriculture and urban growth than public lands (Maehr 1992b).

Historically, the Florida panther population was tied to the population of its primary prey, the white-tailed deer (*Odocoileus virginianus*). As deer populations varied due to disease and to changes in land cover and land management practices, the panther took advantage of a human-introduced alternative to the deer - the feral hog (*Sus scrofa*) (Maehr 1992b). Food habit studies of panthers in Southwest Florida indicate that the feral hog was the most commonly taken prey followed by white-tailed deer, raccoon, and nine-banded armadillo (*Dasypus novemcinctus*). Although domestic cattle are readily available, they are rarely taken as prey items (Maehr 1990 *in* USFWS 1998).

The typical home range size for a female panther is 195 km^2 (75 square miles) (Logan et al. 1993). Female home range size has been positively correlated with higher percentages of dry prairie, shrub swamp, and shrub and brush, with the larger home ranges containing greater amounts of these cover types (Maehr 1992a). Similarly, female panther home range size is inversely related to habitat quality and may also influence reproductive success (Maehr 1992a). Male Florida panthers use more cover types and have larger home ranges than females. The average home range size for a male is approximately 518 km^2 (200 square miles) (Logan et al. 1993). The home range size of male panthers is influenced by the percentages of hardwood hammock, hardwood swamp, water, grass and agricultural land, barren land, and scrub and brush in the landscape. Smaller male home ranges have greater percentages of hardwood hammocks and hardwood swamp, while larger home ranges have greater percentages of water, grass and agricultural land, barren land, and shrub and brush. Dispersing males may wander widely through non-forested and disturbed areas (Maehr 1992b). Agricultural and other disturbed habitats, freshwater marsh, thicket swamp, and mixed swamp are not preferred, and are either used in proportion to their availability or are avoided (Maehr 1990). Habitats avoided by panthers include agricultural, barren land, shrub and brush, and dry prairie. The area of southeastern Lee County is typically used by young, dispersing cats prior to establishment of a permanent territory. These cats follow the forested areas along I-75 north from the CREW (Arnold Committee 1996).

Transportation infrastructure to accommodate for increased agricultural and urban growth and the associated increase in traffic volumes have resulted in significant threats to the panther. Although the relative significance of highway deaths to other sources of mortality is not entirely known, it has been the most often documented source of mortality (Maehr 1989; Maehr et al. 1991b *in* USFWS 1998). Roadways in Lee County have experienced the greatest level of panther mortality outside of the Fakahatchee Strand area (Arnold Committee 1996). Underpasses beneath Interstate 75, State Road 29, and Corkscrew Road have been constructed as a means to reduce risks along documented panther travel corridors. However, highways may also affect panthers (and other wide-ranging species) through habitat fragmentation. Rapidly increasing human populations and expanding agriculture in this portion of the State are compromising the ability of natural habitats to support a self-sustaining panther population. Increasing growth on the west coast of Florida, and the spread of agricultural development in the interior have placed increasing pressures on forested tracts in Collier, Glades, Highlands, and Hendry counties (Maehr 1992b).

Everglades mink *Mustela vison evergladensis*

The Everglades mink was first described as a subspecies in 1948 (Humphrey 1992). Its primary habitat is shallow wetlands of all types, although swamp forests are utilized more than most due to more stable hydroperiods. The diet of the mink consists of insects, crayfish, small mammals, and fish.

The primary threats to the species are from habitat degradation/alteration (draining of wetlands) and from conversion of habitat to citrus culture.

The Everglades mink is documented in the Big Cypress Preserve just east of the study area.

The Everglades mink is listed a threatened species by the FGFWFC.

Big Cypress fox squirrel *Sciurus niger avicennia*

The Big Cypress fox squirrel is a distinct subspecies of fox squirrel with a range restriction to Southwestern Florida. Habitat use by the Big Cypress fox squirrel is complex and poorly understood. They are found in a variety of forested communities, especially open pinelands, with the exception of dense mixed cypress-hardwood strands. This may be due to avoidance of gray squirrels (*Sciurus carolinensis*), which densely occupy the mixed cypress-hardwood community (Humphrey 1992).

The cones of the South Florida slash pine (*Pinus elliottii* var. *densa*) seem to be a favorite food item, although cypress (*Taxodium* spp.) cones, cabbage palm (*Sabal palmetto*) fruits, and acorns are also utilized. The Big Cypress fox squirrel nests in pines, constructing nests of grapevine and cabbage palm thatch, but also utilizes cypress, bromeliads and exotic trees such as melaleuca (*Melaleuca quinquenervia*).

The primary threat to the species is habitat destruction. Large-scale development west of the Big Cypress National Preserve, conversion of pinelands to agriculture, and road construction are considered serious threats.

The Big Cypress fox squirrel is documented in pinelands, mixed pine-cypress, open cypress heads and mixed forested areas in the study area.

The Big Cypress fox squirrel is listed as a threatened species by the FGFWFC, and is proposed as a candidate species for listing by the USFWS.

Florida black bear *Ursus americanus floridanus*

The Florida black bear is the largest extant land mammal in Florida (Maehr 1992c). Several fragmented sub-populations exist throughout the State, most notably around the Ocala National Forest, the Apalachicola National Forest, and in Southwest Florida. Large, undeveloped wooded tracts are the bear's preferred habitat. In Southwest Florida, the black bear also utilizes mangrove forests.

The black bear is omnivorous, feeding primarily on succulent vegetation (tubers, bulbs, berries, nuts, young shoots) and colonial insects. The berries of the saw palmetto (*Serenoa repens*), cabbage palm, swamp tupelo (*Nyssa biflora*), and acorns are preferred foods in the fall. The honey bee (*Apis mellifera*) is the most frequently consumed insect, and nine-banded armadillos the most commonly consumed vertebrate (Maehr 1992c).

The primary threat to the black bear is loss of habitat through clearing and fragmentation of forested land for agricultural uses, urbanization, and other development. Loss of individuals due to vehicular collisions is also of concern in areas where highways bisect remaining bear habitat. There have been forty-seven (47) recorded roadkills within the study area, primarily in the southern portion (Zooms C and D).

The black bear occurs throughout the undeveloped and rural areas within the study area.

The black bear has been listed as a threatened species by the FGFWFC since 1974.

West Indian Manatee *Trichechus manatus*

The West Indian manatee, is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers, and springs of Florida. Florida is essentially the northern extent of the West Indian manatee's range, although some manatees occasionally are reported from as far north as Virginia and the Carolinas.

The West Indian manatee lives in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. It can be found in both clear and muddy water. Water depths of at least 1 to 2 m (3 to 7 ft) are preferred, and flats and shallows are avoided unless they are adjacent to deeper water. During the summer months, manatees range throughout the coastal waters, estuaries, bays, and rivers of both coasts of Florida, and are usually found in small groups. During the winter, manatees tend to congregate in warm springs, and outfall canals associated with electric power generation facilities.

Over the past centuries, the principal sources of manatee mortality have been opportunistic hunting by man and deaths associated with unusually cold winters. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. The largest single mortality factor is collision with boats and barges. Manatees also are killed in flood gates and canal locks, by entanglement or ingestion of fishing gear, and through loss of habitat and pollution (FP&L 1989).

Lee and Collier counties have the second and third highest manatee mortality related to watercraft in the State. In 1996, 158 manatees died in Southwest Florida as a result of complications related to a red tide outbreak in Lee and Collier Counties.

The West Indian manatee is currently listed as an endangered species by both the USFWS and FGFWFC.

3.4 FISH AND WILDLIFE RESOURCES

Fish and wildlife species are still abundant and widespread throughout the study area, although the distribution and numbers of species has been changed as a result of development and general urbanization of the coastal areas. The southwest region of Florida has a rich diversity of native animal life, including species that are endemic to the region, and sub-tropical species found nowhere else in the United States, augmented seasonally by migratory patterns of many different birds and fish species. The species for which Southwest Florida is known include the alligator, the West Indian manatee, the wood stork, the Florida panther, the tarpon (*Megalops atlanticus*), and the pink shrimp (*Penaeus duorarum*) (SWFRPC 1995).

3.5 WATER QUALITY

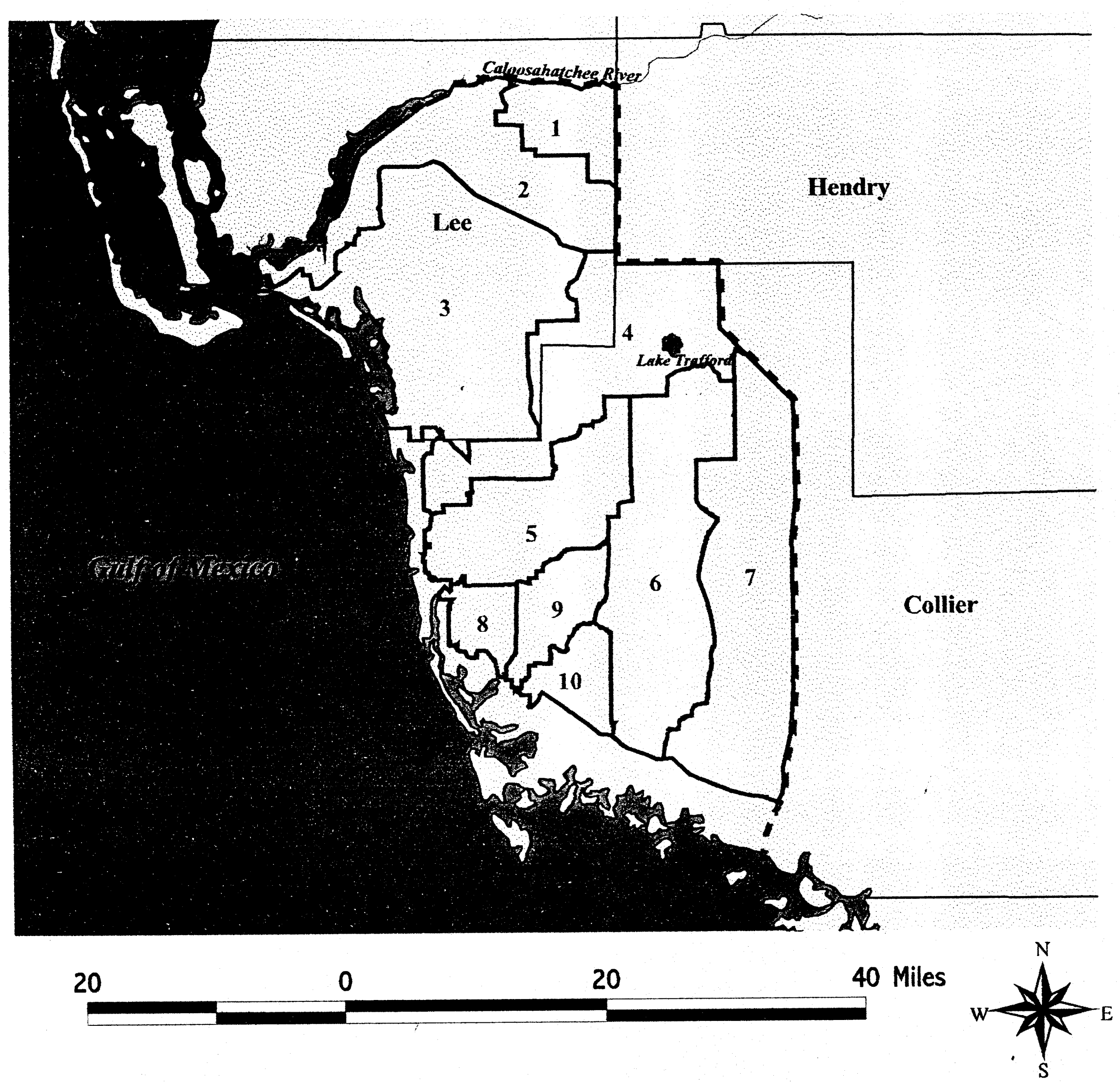
3.5.1. INTRODUCTION

This section provides descriptions of the methodology, terminology, and rationale used to characterize the affected environment of surface and ground water quality within the study area. The status of historical and current water quality conditions for the study area are described by means of water quality parameters, Florida State water classifications, water quality indices, and exceedences of Florida State water quality criteria. Water quality trends were based on available data for the study area, which for some watersheds, were not always complete.

3.5.2. SURFACE WATERS

This section describes surface water quality as defined by physical and biological parameters, flow characteristics, pollutants, nutrients and, if known, biological indicators. The descriptions of water quality are largely based on STORET data summaries for individual watersheds within the larger study area watersheds. STORET is an Environmental Protection Agency (EPA) database of water quality information collected by numerous agencies. Other water quality studies were consulted as well (CDM, Inc. 1995; Gibson 1997). Geography, topography, rainfall, evaporation, and man-made alterations within the watershed, such as hydrographic modifications (drainage canals, dams), development, and agriculture, affect the quality of water. The EPA and FDEP use STORET data to assess water quality trends in watersheds by condensing certain parameters into one of two indices, thereby facilitating year to year comparisons. Non-point source pollution, contaminant information, and exceedences of water quality standards are also evaluated for trend determination. In the following sections, water quality of rivers, creeks, bays, canals, and swamps will be discussed for the three watersheds of interest to this study.

For purposes of historical descriptions, the study area has been sectioned into four regions which include the Caloosahatchee, the Estero-Imperial Integrated, the Big Cypress/West Collier, and the Southern Big Cypress Swamp. More recent hydrologic descriptions of the study area, however, utilize smaller regions as described by the SFWMD watershed basins. These study area watershed basins are identified in **Figure 11** and **Table 5**. Introductory information on the physical setting, surrounding land use, natural habitats, and physical characteristics of the various watershed systems have been provided to better assess historic and current water quality within the study area.



Basin	Name
1	West Caloosahatchee
2	Tidal Caloosahatchee
3	Estero Bay
4	Cocohatchee-Corkscrew
5	Golden Gate
6	Faka Union Canal
7	Fakahatchee Strand
8	District VI
9	Henderson Creek
10	Collier-Seminole

Figure 11. **SFWMD Watersheds and Basins within the Study Area.**

Table 5. Watersheds And Receiving Waters Of The Study Area

WATERSHED	DRAINAGE BASIN	RECEIVING WATER BODY	ULTIMATE ENDPOINT
Caloosahatchee Watershed	Tidal Caloosahatchee Basin	Tidal Caloosahatchee River	San Carlos Bay
	West Caloosahatchee Basin	West Caloosahatchee River	West Caloosahatchee River
Estero-Imperial Watershed	Estero Bay Basin	Estero River, Spring Creek	Estero Bay
	Imperial River Basin	Imperial River	Estero Bay
Big Cypress/West Collier Watershed	Corkscrew-Cocohatchee River Basin	Cocohatchee River, Corkscrew Swamp	Wiggins Pass/Gulf of Mexico
	Golden Gate Canal Basin	Golden Gate Canal	Naples Bay
	District VI Basin	Lely Canal	Gulf of Mexico
	Faka-Union Canal Basin	Faka-Union Canal	Faka-Union Bay
	Henderson Creek Basin	Henderson Creek	Rookery Bay
	Collier-Seminole Basin	CR92 Canal	Gullivan Bay
Big Cypress Swamp	Fakahatchee Strand Basin	Fakahatchee Strand	Ten-Thousand Islands

The study area (**Figure 11**) incorporates portions of the Tidal Caloosahatchee and West Caloosahatchee watershed basins and sections of the Caloosahatchee River. The East Caloosahatchee River (although not shown in **Figure 11**) is also discussed since it drains into the study area, impacting the water quality of the western and tidal sections of the Caloosahatchee.

The East and West portions of the freshwater segment of Caloosahatchee River have been restructured into a canal known as C-43. Drinking and irrigation water is obtained from the eastern portion of the canal, while the western portion is designated for wildlife and recreational use. There are about 60 tributaries of varying water quality with respect to FDEP indices within the Caloosahatchee River watershed.

Physical Description

To accommodate navigation, flood control, and land reclamation needs, the Caloosahatchee River has been radically altered from its natural state. One of the most dramatic changes was the dredging that connected the Caloosahatchee to Lake Okeechobee in 1881 in order to lower the water level of Lake Okeechobee. In 1882, the channelization of the lower reaches of the river began.

Due to intensive canal construction by 1910, shallow draft navigation from the Gulf of Mexico to the Atlantic Ocean was possible. Canal locks at Moore Haven were completed in 1918, and the locks at Ortoona were completed in 1937. The W. P. Franklin Lock was completed in 1969, preventing saline water from flowing upstream of Olga (Kimes and Crocker 1998).

In addition to the alteration of the main channel, many canals have been constructed along the banks of the river. These canals were constructed for both water supply and land reclamation in order to support the many agricultural communities along the river.

Land use within the Caloosahatchee watershed is dominated by rangeland and agriculture, particularly in the upper part of the basin (FDEP 1996a). The major urban areas that occur along the tidal Caloosahatchee watershed basin are Ft. Myers and, across the river, the large residential areas of Cape Coral and North Ft. Myers.

Flow and stage height in the Caloosahatchee River is controlled by a series of locks. Agricultural practices and navigation channels have for many years dictated the patterns of surface water drainage. Canal, lock, and spillway construction and dredging have been occurring since the late 1800s, altering the natural watercourse of the Caloosahatchee River. Today, three primary locks function to regulate water level, usage, and saltwater intrusion. One, at Moore Haven, regulates Lake Okeechobee waters. The Ortoona Lock delineates the east river basin from the west and controls water on the adjoining land areas. The Franklin Lock at Ft. Myers prevents saltwater intrusion from the tidal Caloosahatchee River segment from proceeding eastward. The pattern and period of flow of the Caloosahatchee River is highly variable, based on demand. River flows are negative (from west to east) for a majority of the year, possibly resulting from heavy irrigation usage or losses to groundwater and/or evapotranspiration (Drew and Schomer 1984).

Historical Description

Camp, Dresser and McKee (CDM), Inc. (1995) compared monitoring results of a 1993-94 study on the freshwater Caloosahatchee River with data from 1973-1980. CDM concluded that historical water quality differed from current water quality only with respect to small differences in nutrient concentrations. The report stated dissolved oxygen was historically low, as were suspended solids. Total phosphorus was comparable to other Florida water bodies, but nitrogen and chlorophyll a were generally high. Decreasing trends in total nitrogen were observed westward from Lake Okeechobee. Measurements of DO, pH, conductivity, and total phosphorus generally increased westward from Lake Okeechobee.

Historical information on the tidal Caloosahatchee from 1975-76 was available from Drew and Schomer (1984). Previous surveys indicated some aspects of water quality, such as DO, improved as one moved downstream away from the urbanized areas. Seasonal water quality fluctuations have also been observed, with DO decreasing in October and December and stabilizing in February. Salinity decreased, temperature decreased, and chlorophyll a decreased in the winter. During the 1970s, pollution was attributed to the following major sources: downstream flow from the Franklin Lock; Orange River inflow; the wastewater treatment plant (WWTP) effluent from the cities of Cape Coral and Fort Myers; and the residential development, Water Way Estates (Drew and Schomer 1984).

Freshwater Systems

The freshwater systems of the Caloosahatchee River are discussed as the Eastern and Western Caloosahatchee (**Figure 11**). The Western Caloosahatchee begins at the point where Franklin Lock separates the tidally influenced waters from the upland waters. The Eastern Caloosahatchee begins at Ortoona Lock and extends to Lake Okeechobee. Before reaching Lake Okeechobee, the Eastern Caloosahatchee encounters Lake Hicpochee which is a small waterbody and historically (within the last twenty years) poor in water quality (FDEP 1996a).

Water quality parameters are expressed as annual averages and include physical and biological parameters, nutrients, and contaminants. Sediment quality data, if available, are also briefly discussed. Known impaired usage of the basins is presented last. The majority of the current data discussion represent data collected from 1990 to 1995.

Eastern Caloosahatchee Basin

Eastern Caloosahatchee waters are usually above neutral in pH (>7), but tend towards low DO (<4.8 mg/L). CDM (1995) recorded seasonal lows from May through October. Water clarity is characterized by low turbidity and mostly low TSS, although color is higher than average (>71 PCUs) for Florida waters. Conductivity is above average for Florida waters (>335 micromhos), usually measuring above 500 for most stations in the Eastern Caloosahatchee (FDEP 1996a). Ninemile Canal, which feeds into Lake Hicpochee, is of historically poor water quality having high color (120 PCUs), high conductivity (1195), and exceeding FDEP standards for DO (0.6 mg/L) (FDEP 1996a).

The chlorophyll a content was high (32 μg/L), which is above 90% for other typical Florida waters. Average BOD levels (2.8 mg/L) also exceeded Florida standards. Low diversity, pollution-tolerant species, and algal blooms have been reported from Ninemile Creek (FDEP 1996a). Coliform bacteria levels are low in the Eastern Caloosahatchee. However, Goodno Canal, a tributary with otherwise excellent water quality, exceeds FDEP standards for fecal coliform.

The average total nitrogen was high (>1.89 mg/L) in the river and in the tributaries while phosphorus measured 0.08 mg/L (FDEP 1996a). In 1993-94, total nitrogen values ranged from 1.1 to 2.2 mg/L and were highest from August through December. Total phosphorus was also highest during the summer with a range of 0.05 to 0.25 mg/L (CDM 1995). Lake Hicpochee exhibits "poor" water quality due to excessive nutrient concentrations. The lake rated a TSI value of 74 due to high nitrogen (2.6 mg/L) and low DO. Ninemile Canal near Lake Hicpochee also exceeds State standards for total nitrogen. Total nitrogen standards are set at >1.6 mg/L as an exceedence. Impaired use of the basin has been linked to agricultural runoff (CDM 1995).

West Caloosahatchee Basin
Reductions in pH and increased suspended solids are partially responsible for an observed degrading trend for areas north of Townsend Canal (FDEP 1996a). Chlorophyll a levels are improving and most other parameters are holding steady. Other areas of the basin rate "good" on the FDEP's WQI scale.

Physical water quality parameters throughout most of the basin are characterized by relatively neutral pH, DO readings mostly above 7.0 mg/L, good water clarity (i.e., low turbidity, low color, low TSS), and specific conductance between 500 and 700. No State standards for physical water quality are exceeded.

Biological oxygen demand is low (<2.3 mg/L) in the West Caloosahatchee and chlorophyll a ranges from 2-8 μg/L, an improvement over previous years. Nutrients generally do not exceed State standards, but at most basins are slightly higher than average for State waters. All waters in the West Caloosahatchee are rated "good" on the WQI scale.

Fecal and total coliform bacteria counts are low and do not exceed State standards. However, conventional pollutants (mercury) are present (FDEP 1996a).

Approximately 41% of the West Caloosahatchee Basin are agricultural lands. Wetlands and pine forests make up 12% and 16%, respectively. Impaired usage in this basin primarily results from agricultural runoff.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 41.4, 42.9, and 45.2; respectively.

Estuarine Systems

Tidal Caloosahatchee Basin
The tidal Caloosahatchee (**Figure 11**) extends 28 miles from Franklin Lock to San Carlos Bay, and is so named because its waters are subject to tidal forces (Drew and Schomer 1984). Tributaries of the tidal Caloosahatchee include Billy Creek, Whiskey Creek, Orange River, Hickey Creek, Roberts Canal, and Daughtrey Creek.

Physical water quality of the tidal Caloosahatchee is represented by pH, DO, conductivity, and water clarity. pH ranges slightly above neutral at 7.3 – 7.8. Except for Deep Lagoon and Manuel Branch, the average DO of the tidal Caloosahatchee and its tributaries ranges from 6.5 to 7.4. The overall DO trend is stable. Conductivity is usually above 10,000 micromhos, which is typical for estuarine waters. The freshwater tributaries are lower in conductivity. Orange River is the lowest at 508 micromhos. Water clarity varies along the river and tributaries. Deep Lagoon color was highest at 130 PCUs. A low of 33

PCUs occurs in the lower tidal basin. TSS are generally low at 1-10 mg/L. The highest TSS occurs in Manuel Branch. Turbidity is generally low, ranging between 1.3-6.3. The most turbid waters occur in Manuel Branch. Overall physical chemistry is stable (FDEP 1996a).

Measured values of key biological parameters indicate degraded water quality in parts of the tidal Caloosahatchee and tributaries. Biochemical oxygen demand (BOD), fecal coliform bacteria, and chlorophyll a levels exceeded State standards at several locations. Fecal coliform bacteria were high in 1992 at Manuel Branch (2195 MPN/100 ml) and Billy Creek (1839 MPN/100 ml). The State screening level for fecal coliform bacteria is >190 MPN/100 ml (FDEP 1996a). Chlorophyll a was high (27 µg/L) in Deep Lagoon and Billy Creek (57 µg/L). Due to the poor biological parameters, the tidal Caloosahatchee only partially meets its designated use as a Class II water, suitable for recreation and wildlife (FDEP 1996a).

Nutrient measurements for total nitrogen and total phosphorus in the tidal Caloosahatchee were highest at or east of Ft. Myers. Total nitrogen levels were exceeded in the Caloosahatchee at a station adjacent to Ft. Myers with an average measurement of 1.64 mg/L in 1991. Total nitrogen exceedences (>1.22 mg/L) were also observed east of Ft. Myers in the Caloosahatchee, and at Billy Creek and Deep Lagoon. Averages for total phosphorus exceeded State standards (i.e., were >0.07) in most cases, with the exception of Orange River. The nutrient status as indicated by the TSI is “poor” for Deep Lagoon, “poor” for Billy Creek, and “fair” but close to “poor” for the tidal Caloosahatchee. The WQI for freshwater streams and rivers rated Orange River water quality “good” (FDEP 1996a).

Impaired usage occurs from wastewater inputs from Ft. Myers WWTPs, high nutrient waters from upriver, inputs from tributaries, and stormwater runoff from cities. Algal blooms occur frequently because of excess nutrients (FDEP 1996a).

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 63.5, 46.0, and 58.7; respectively.

3.5.2.2. Estero-Imperial Integrated Watershed

Introduction

The Estero-Imperial Integrated Watershed is comprised of the Estero Bay Watershed and northern portions of the Big Cypress Watershed. The Caloosahatchee River Watershed to the north, the Golden Gate Canal Watershed to the south, and the Gulf of Mexico to the west border the area. Interstate 75 runs north to south through the westernmost portion of the Estero-Imperial Integrated Watershed and divides the more developed coastal areas from the less developed interior. Most of the watershed lies in Lee County with a small percentage located in Hendry County (**Figure 11**). The Estero and Imperial Rivers, and Spring Creek, though small, are the major tributaries within the Estero-Imperial Integrated Watershed that drain into Estero Bay. According to several reports, surface runoff and altered freshwater flows impact water quality greatest within this watershed. Warm, slow moving, estuarine water bodies such as the Estero and Imperial Rivers have some naturally low water quality characteristics such as low DO. Therefore, these may be more susceptible to water quality impacts resulting from changes in land use.

Physical Description

Population centers include the towns of Bonita Springs and Immokalee with 13,600 and 14,120 persons, respectively (U.S. Department of Commerce 1992). Bonita Springs is south of the Imperial River and above the Lee-Collier County border, and Immokalee is located along the eastern edge of the Estero-Imperial Integrated Watershed. Rapid growth is occurring in Bonita Springs where the population more than doubled from 1980 to 1990. Residential areas, cattle, and vegetable farms occupy the landscape and, except for the coastal areas, the population is low (FDEP 1996a).

The Estero and Imperial Rivers and Spring Creek provide minor freshwater flow into Estero Bay. The naturally low flow characteristics of these tributaries make Estero Bay notably susceptible to altered upland drainage water quality, volume, and seasonal inputs (Gissendanner 1983). The topography of the watershed is relatively level, thus accounting for the "sluggish" water movement in this part of the basin (FDEP 1996a).

The highest freshwater inflows into Estero Bay occur in September with great variation in volume observed over the course of the year (Kenner and Brown 1956; Drew and Schomer 1984). At one time, tidally induced flows in Estero Bay exceeded the amount of freshwater inflow (Jones 1980). Estero Bay tides are mixed and average about 0.54 m (1.75 ft) (Estevez et al. 1981), with velocities in the three major Bay-Gulf passes ranging from 0.64 m/s (ebb tide) to 1.52 m/s (flood tide). Flood tides can reach 1.07 m (3.5 ft) in height with volumes of 819 million cubic feet (measured for one pass in 1976) (Drew and Schomer 1984). The low freshwater inflow into Estero Bay allows for generally high saline conditions year-round (around 34 ppt in the dry season), yet is high enough to prevent hypersaline conditions. Salinity seldom falls below 10 ppt even in the wet season (Tabb et al. 1974). Saltwater intrusion into local aquifers has resulted from inadequate recharge of groundwater. This occurrence has been attributed to surface hydrology modifications such as drainage canal construction.

The construction of canals has increased surface water flow such that aquifers are not recharging, thereby allowing saltwater to infiltrate (Daltry and Burr 1998). The Ten Mile Canal was constructed about 1920 to drain a 70 square mile area for agricultural uses and directs this water into Mullock Creek, a tributary of Estero Bay. Generally, this watershed does not have the extensive drainage network of the surrounding areas, but the construction of roads and other berms has still significantly altered the hydrology of the area. These changes have resulted in extensive flooding along the Imperial River. In addition, where flows from the Imperial and Estero Rivers into Estero Bay were once approximately equal, the proportional flow from the Estero River is now much less than that of the Imperial River (Johnson Engineering, Inc. et al. 1998). Surface water from the more interior areas of Flint Pen Strand and Bird Rookery Swamp are drained into Estero Bay and the Wiggins Pass/Cocohatchee River Estuarine System through the Imperial River, Spring Creek, and the Cocohatchee Canal (SFWMD 1998a).

Historical Description

The Estero-Imperial Integrated Watershed was, and in many areas still is, typical of low, flat South Florida lands dominated by wetlands and characterized by slow, sheet-flow drainage patterns. In the past, the naturally dispersed water patterns served to distribute nutrients over broad areas of wetland vegetation. Thus, nutrient levels remained low in undrained areas of this watershed (Haag et al. 1996a). Seasonal fluctuations in flow due to rainfall created the necessary salinity regime in Estero Bay for good estuarine productivity. Estero Bay became the State's first aquatic preserve in 1966 (CHNEP 1997). In 1983, the Estero Bay Aquatic Preserve Management Plan was implemented with emphasis placed on "enhancing the existing wilderness condition" (Gissendanner 1983). Increasing development in the 1960s led to changes in the natural river systems around Estero Bay (CHNEP 1997). Changes in water quality and quantity have been observed. For example, the Imperial and Estero Rivers historically delivered less fresh water to Estero Bay. From 1940 to 1951, the maximum discharge from the Imperial River was 2,890 cubic feet. Low flows were common and no flows occurred on occasion. Periodic flooding has occurred (Kenner and Brown 1956).

Freshwater Systems

Currently, physical water quality in the coastal areas of the Estero and Imperial Basins is characterized by clear water with neutral pH (7.1 to 7.3) but relatively high conductivity values (>16,000 micromhos). DO is slightly lower in the Imperial Basin (4.9 mg/L compared to 5.7 mg/L) than in the Estero Basin. Estero and Imperial Basin water clarity is attributed to low turbidity at <5.0 NTU/NTUs, generally low suspended solids at <10 mg/L, above average Secchi disc depths of 0.9 m to 1.5 m, and low color at 43 to 55 PCUs. Chloride measurements are not available, but conductivity indicates high dissolved mineral content in the Estero and Imperial Rivers. Biological parameters of chlorophyll a and 5-day biochemical oxygen demand (BOD-5) are of slightly lower quality in the Imperial River than in the Estero River. To clarify, BOD in the Imperial River is higher (2.4 mg/L over 1.4 mg/L) than in the Estero River; chlorophyll a is higher in the Imperial (12 µg/L over 2 µg/L), but generally, the two systems are comparable with respect to water quality. Water from the Estero and Imperial Rivers has a "residency time in the Bay of at least several days during the wet season" (Clark 1987). The Estero and Imperial Rivers were evaluated by the FDEP as having "fair" water quality based on their nutrient status as determined by chlorophyll a, total nitrogen, and total phosphorus measurements.

Metals have been detected from limited sampling of the waters of the Estero-Imperial Integrated Watershed. In addition, elevated levels of cadmium, chromium, lead, mercury, and zinc have been found in the sediments of Estero Bay and River, Imperial River, and Spring Creek as recently as 1986 (Clark 1987). In general, analysis of metals, pesticides and PCBs is lacking for the Estero-Imperial Watershed, with metals having only been sampled six times (with the exception of iron) within the last 30 years.

The Imperial River is classified in terms of usage as a Class III water body, suitable for wildlife and recreation. Due to low DO, nonpoint pollution, and conventional pollutants, water quality only partially supports the Imperial River for this type of use (FDEP 1996a). Likewise, Estero River and Spring Creek are only in partial support of use; Spring Creek because of conventional pollutants and low DO, and Estero River for low DO and fecal coliform.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 52.9, 52.0, and 58; respectively.

Estuarine Systems

Estero Bay

Estero Bay waters are described as shallow, turbid, and of "fair" quality (FDEP 1996a). Nutrients at levels that exceed State standards tend to drive water-quality ratings down. Consequently, this water body only partially meets its Class III use designation (FDEP 1996a).

Water clarity, as indicated by turbidity, TSS, and color (8.5 NTU/NTUs, 28 mg/L, 25 PCUs, respectively) is low. Waters were well oxygenated with mean DO levels at 6.5 mg/L. Conductivity was 37800 micromhos (FDEP 1996a). Low chlorophyll a and low BOD were observed in the past. The mean for chlorophyll a was 8 mg/L, and the mean BOD was 1.6 mg/L.

Estero Bay phosphorus levels were above FDEP screening concentrations. Phosphorus screening levels are >0.07 mg/L and Estero Bay concentrations were 0.10 mg/L. Total nitrogen measured 0.81 mg/L, which is considered low for estuaries. Historical water quality has been described by FDEP as fair based on these parameters.

Estero Bay has not had a problem with high bacterial counts as indicated by the low total and fecal coliform analyses. Some contamination by cadmium, chromium, lead, mercury, and zinc in Estero Bay sediments has been observed. Concentrations of pesticides and PCBs were below minimum detection limits (Clark 1987).

Nutrient inputs from agricultural runoff (fertilizers) are cited as the source of high phosphorus. Habitat alteration through possible destruction of forests and wetlands, water flow changes, and pollution are listed as other impairments to use (CHNEP 1997).

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). TSIs were calculated by decade (1970-1979 and 1990-1998) and approximate 27.0 and 62.4, respectively, for the Estero/Imperial coastal area. Insufficient data for the period 1980-1989 precluded calculation of a TSI for that decade.

3.5.2.3 Big Cypress/West Collier Watershed

Physical Description

The Big Cypress/West Collier Watershed is a large basin encompassing several of the southern study area SFWMD watersheds, primarily including: Cocohatchee/Corkscrew Swamp; Golden Gate Canal; District VI; Henderson Creek; Faka-Union Canal; and Collier/Seminole basins (**Figure 11**). This region of the study area is situated in Big Cypress Preserve, an area of low flat lands of cypress trees, pine forests, and wet and dry prairies. Agriculture and urban are the main types of human land use; however, it should be noted that lands that are zoned as agricultural may in actuality be swamp. Major urban areas situated along the coastal area of the watershed are Naples, East Naples, North Naples, Naples Park, Marco Island, and Golden Gate. The single most conspicuous feature of the area is the expansive system of roads and canals constructed during the 1960s for the Golden Gate Estates (GGE) land development project. The Golden Gate Estate canals channel drainage from approximately 200,000 acres into the Gordon River, Naples Bay, and the Faka Union Bay (USACE 1980). Impacts from the Golden Gate Canal include overdrainage of surface waters, lowering of groundwater levels, altered traditional drainage patterns, reduction of habitats, and declines in agriculture potential (USACE 1980). Thus, the existing condition of water quality in the rivers and bays is undoubtedly linked to the major hydrological changes that have occurred in the past. Historically, the Big Cypress Basin was dominated by sheet flow, but several land reclamation projects starting at the beginning of the century have dramatically changed the hydrology. The majority of Collier County inside of the study area has been drained through the construction of canal networks. The construction of Golden Gate Estates (GGE) has dramatically lowered the groundwater table and changed salinity regimes of coastal areas of the Big Cypress/West Collier watershed.

Cocohatchee River, Naples Bay, Gordon River, Blackwater River, Faka Union Bay, Fakahatchee Bay, Marco Bay, and Rookery Bay are the major natural water bodies within the study area. Barron Canal, Golden Gate Canal, Cocohatchee River Canal, Faka-Union Canal, Gordon River Canal, and Henderson Creek Canal are the major artificial drainage systems within this watershed. Flow direction and areas drained by canals are dependent upon rainfall amount. For example, the Cocohatchee River Canal drains an area southwest of Lake Trafford during dry periods and may have no flow during very dry years. During the rainy season, the Cocohatchee River Canal along with Henderson Creek Canal serves to collect excess drainage from the Golden Gate Estates area (**Figure 11**).

Faka-Union Canal collects drainage from a series of smaller canals and discharges into the Ten Thousands Islands area. The Golden Gate Canal and Gordon River drain into Naples Bay, the periphery of which is lined with an extensive network of finger canals and residential developments. The Barron River Canal, built as a source of fill to make roads, drains strands and sloughs of the Big Cypress National Preserve (Drew and Schomer 1984).

Historical Description

No pre-canal water quality data exist to describe the original water quality within the Big Cypress/West Collier Watershed. However, there are some basic factors to consider related to the channelization of wetlands. Canal construction, which began in the 1920s, undoubtedly led to increased drainage of freshwater from wetlands into the estuaries and a subsequent increase in dissolved minerals. Possible changes in salinity, sedimentation, turbidity, and nutrients likely resulted. In lieu of more detailed pre-canal water quality descriptions, STORET data from the 1980s provides a historical description of post-canal water quality of the Golden Gate Watershed for comparison with the present day. Physical water quality was characterized by neutral pHs, DO levels that were on the average low (>5.0) at stations sampled in Naples Bay, Barron River Canal, Blackwater River, Gordon River, and Gordon River Canal, and conductivity above >1275 in some of the freshwater bodies (Cocohatchee River, Blackwater River). BOD and chlorophyll a were high in the Gordon River Canal and in the Blackwater River. Fecal coliform counts were high (>190 MPN/100 ml) in the Gordon River. Water quality in the Faka-Union canal was excellent, rating a very low 16 on the WQI scale. Naples Bay rated “fair” in terms of nutrient conditions according to the FDEP TSI with a 53. In general, the areas along the Blackwater River have the worst water quality.

Freshwater Systems

Corkscrew Swamp

Portions of Corkscrew Swamp are described as pristine due to its status as a National Audubon Society sanctuary. The Corkscrew Swamp Regional Ecosystem Watershed is a South Florida Water Management District (SFWMD) project that encompasses the sanctuary with goals to restore hydrologic conditions in impacted areas (Bird Rookery Swamp) and maintain flows and water quality in undisturbed areas of Corkscrew Swamp (SFWMD 1998a). Lake Trafford, north of Corkscrew Swamp is of historically good to fair water quality that fully supports use designation as a Class III water.

Cocohatchee River

Current physical water quality of the Cocohatchee River is characterized relative to typical State waters by low turbidity (2.9-3.5 NTU/NTUs), low TSS (2 –10 mg/L), higher than average color (85 –100 PCUs), neutral pH, variable DO (3.2 to 7.0 mg/L), and variable conductivity (675 – 2,650 micromhos (FDEP 1996a). The low DO results from excessive aquatic vegetation in the canals using up more oxygen than what is produced through photosynthesis (Kirby et al. 1988).

Chlorophyll a levels were well below State standards with a mean concentration of 5 µg/L. BOD was, at one location, higher than average for typical Florida waters, but just shy of exceeding State criteria. BOD averaged between 1.6 and 2.0 for two stations in the Cocohatchee River. Total coliform bacteria levels were higher than average for State waters, and fecal coliform counts exceeded State standards with 2,650 MPN/100 ml.

Nutrient levels are lower than average, with phosphorus and nitrogen levels below State screening levels. Low DO (5.1 mg/L) and high fecal coliform counts (381 MPN/100 ml), averaged from two locations, drive the WQI rating for the Cocohatchee River down. The Cocohatchee River is a Class II water, suitable for shellfish harvesting, which partially meets its designated use.

Cocohatchee River Canal

According to STORET data, the Cocohatchee River Canal has not been sampled since 1988; therefore, a current account of water quality is not possible. Historical data collected from 1980 to 1988 provide the basis of the following description. The Cocohatchee River Canal is about 13 miles long and less than 5 feet deep with better water quality than its natural counterpart. Compared to other State waters, physical water quality is better than average for most State waters.

Biological data for the Cocohatchee River Canal are absent from STORET for 1980-1988. Therefore, no BOD, coliform, or chlorophyll a information is presented.

Nutrients are present in amounts higher than average for most estuaries, but do not exceed State standards. Total nitrogen measured between 0.99 and 1.08 for two stations, and total phosphorus measured 0.03 for both stations.

No contaminants have been recently detected according to STORET data. However, the database compiled for this study indicates copper and zinc exceeded State standards in 23% and 14% of samples respectively from 1990-1998). Water quality is exhibiting a stable trend and fully supports designated use for a Class III water body (FDEP 1996a). Sediment quality information is not available for the Cocohatchee River Canal.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 46.5, 53.9, and 69.3 for the Corkscrew/Cocohatchee Basin. The data, though limited, indicate a degrading trend.

Golden Gate Canal

Current water-quality data were not available for the Golden Gate Canal from the STORET database. However, historical STORET water quality data from 1980-1989 are available. Physical water quality in the 1980s was characterized by relatively low turbidity (3.5-4.3 NTUs), low TSS (2-3 mg/L), higher color content than average (50-99 PCUs), neutral pH, and low to moderate levels of DO (4.8-6.0 mg/L). Conductivity was higher than average for typical State waters (572-650 micromhos).

BOD exceeded State standards with an average of 2.4 mg/L at one canal sample location. The State standard is 2.3 mg/L. One location was sampled for chlorophyll a and was higher than average for typical State waters with 19 µg/L. Fecal coliform bacteria were lower than average (55 MPN/100 ml).

Total nitrogen and total phosphorus met State standards and overall were lower than average for other State waters. Total nitrogen ranged from 0.81-1.07 and total phosphorus ranged from 0.02-0.03 for three locations along the Golden Gate Canal. The WQI for the Golden Gate Canal ranged from 36 to 40, an indication of "good" water quality (FDEP 1996a). Sediment quality information was not available.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 55.5, 59.4, and 54.1, respectively, for the Golden Gate Canal Basin. Although limited, the data indicate a stable trend.

Henderson Creek/Blackwater River

Henderson Creek appears to be of good water quality until it intersects Blackwater River, which is of historically fair to poor water quality, depending on which index is applied. The TSI rated Blackwater River a 61, which is "poor", while the WQI rated the river a 46, which is "fair", and close to "good". Low DO (3.5 mg/L) and high BOD (2.8) drive the index down. Because of these factors, the FDEP states that Blackwater River only partially meets its use designation. However, the overall status (derived from a combination of indices, contaminant information, nonpoint source assessments, and expert opinion) of the Blackwater River is represented as "poor" in the 1996 305b report (FDEP 1996a).

Fecal coliform bacteria counts from STORET data were 3 MPN/100 ml, averaged over five observations. The study area database compiled for this report indicates average fecal coliform levels from 1980 to 1990 was closer to 111 MPN/100 ml. No total coliform counts were available from STORET records for this period, but data summarized for **Table 13** (Appendix E) indicate high total coliform levels in Henderson Creek, averaging 1830 MPN/100 mls. Chlorophyll a levels measured 40 µg/L, which is higher than 90% of similar State waters; however, total nitrogen and total phosphorus levels remained low at 0.98 mg/L and 0.03 mg/L, respectively.

Sediment quality data was not available, and the literature provided very little historical or current water quality data for the District VI Basin.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979, 1980-1989, and 1990-1998) and approximate 67.3, 73.1, and 47.4 respectively for the Henderson Creek Basin. Data are insufficient, particularly from 1990-1998 to support any observations regarding improving or degrading trends in water quality.

Faka Union Canal

No current data were available for Faka Union Canal. Historical water-quality data from two stations from 1980 to 1989 indicate exceptional physical water quality. Turbidity measured less than 1 NTU, better than

90% of State waters, and color was low, between 10 and 30 PCUs. The DO was high (6.4 mg/L), and at one station it was above saturation (9.9). Conductivity was between 600 and 700, which is above average, but far from exceeding State standards.

Nutrient levels, bacterial contaminants, and BOD were all well within State standards. Total nitrogen ranged from 0.51-0.73 mg/L and total phosphorus measured 0.01 mg/L. The WQI rated Faka-Union Canal a 17, an indication of "good" water quality.

The WQIs for Faka-Union Canal Basin for 1970-1979, 1980-1989, and 1990-1998 were 60.6, 21.9, and 32.2, respectively. Though data are limited, particularly for 1990-1998, water quality appears to have improved from the 1970s to the 1980s, and remains relatively stable.

Collier-Seminole Basin

The Collier-Seminole Basin drains primarily cypress wetlands ultimately into Gullivan Bay. The basin exists within the boundaries of the Collier-Seminole State Park. The literature provided very little historical or current water quality data for the Collier-Seminole Basin. Sediment quality information was not available.

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). The WQI for 1990-1998 was 57.4 for the Collier-Seminole Basin. No data were available for the previous two decades.

Estuarine Systems

Naples Bay

Current water quality information is not available for Naples Bay. STORET data from 1989 are used to describe water quality. Water clarity is characterized by near average turbidity (3.6-4.5 NTU/NTUs), and slightly better than average color (40-80). No information on TSS was available from STORET for Naples Bay. Low DO was observed at two sample locations in the Bay. Average DO ranged from 4.5 to 6.0 mg/L. Chlorophyll a was low, measuring 6-7 μg/L, while total nitrogen levels exceeded State standards (1.31 mg/L), as did total phosphorus (0.10 mg/L). Sediment quality information was not available.

Historically, the major sources of freshwater to Naples Bay were the Gordon River, Haldeman Creek, Rock Creek, and direct run-off from the city of Naples, providing a combined discharge of approximately 100 cubic feet per second (cfs). The construction of Golden Gate Canal has considerably increased the flow of freshwater into the Bay in the wet season to as much as 1,500 cfs. In contrast, during the dry season in April, discharge to the Bay drops to near zero (Simpson et al. 1979).

Rookery Bay

Current water quality data are not available through STORET. Under the National Oceanic Atmospheric Association (NOAA) National Estuarine Reserve Research (NERR) National Monitoring Program, automated data collectors deployed throughout Rookery Bay will soon make continuously collected water quality data available on the Internet. In addition to being part of the NERR program, Rookery Bay is designated by the State of Florida as an aquatic preserve, and as a National Audubon Society Wildlife Sanctuary.

Rookery Bay has been described as a "transitional" estuary in terms of its location between the high-energy (erosional forces) coastline to the north and the lower energy. Physical water quality is characterized by large fluctuations in salinity and low flushing due to the small size of the adjacent upstream watershed. Freshwater arrives into Rookery Bay via Henderson Creek to the west and Stopper Creek to the northwest. Tidal exchange is low due to the presence of oyster bars and low flushing of the shallow creeks that feed into the Bay. Hypersaline conditions can result during periods of drought (Drew and Schomer 1984).

Based on recent nonpoint source assessments, Rookery Bay fully meets its designated use as a Class II water body for support of recreation and wildlife (FDEP 1996a).

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). However, insufficient data precluded calculation of TSIs.

Marco Bay

Neither current nor historic water quality data was available through STORET. However, Drew and Schomer (1984) presented some general information on the freshwater and tidal exchange, nutrients, and habitats of the estuary.

Freshwater flow into Marco Bay is through coastal wetlands, and from groundwater between the freshwater aquifer and the saline coastal aquifer. Inputs from the wetlands are approximately 100 to 200 times that of the groundwater input, with some of this large surface volume attributed to man-made drainage operations (Drew and Schomer 1984).

DO levels were frequently found to be lower in natural areas than in disturbed areas (i.e., canals). Accumulations of mangrove detritus and restricted backwater circulation were cited as the cause for the low DOs (Drew and Schomer 1984).

Nutrients are low in natural and artificial waterways of the Marco Bay/Estuary system. Locally, high nutrient conditions are theorized to result from certain wind conditions mixing the water column and causing releases from sediments (Drew and Schomer 1984). Chlorophyll a was highest in the canals. No data accompanied the descriptions.

Fakahatchee Bay

Current water-quality information on Fakahatchee Bay estuarine waters was not available from the STORET database. Relative comparisons between Fakahatchee Bay and adjacent Faka Union Bay were given in Drew and Schomer (1984) for freshwater input, salinity regimes, and nutrient loading. Salinity ranges from 0 to 40 ppt throughout the wet and dry seasons. Specific data on other water quality parameters are lacking. Heavy metal analysis from data collected in the 1970s did not indicate contamination of the waters, but some sediments did contain detectable amounts of lead, particularly those near areas receiving roadway runoff (Drew and Schomer 1984). Pesticides were also detected in some of the sediment samples; waters were described as uncontaminated.

Abbott and Nath (1996) cited increased freshwater from Faka Canal and abnormal salinity levels to blame for disappearance of seagrass meadows, displaced benthic habitats and fish communities, and declines in shellfish harvests.

3.5.2.4. Southern Big Cypress Swamp: West Collier County

The Southern Big Cypress Swamp is a large basin encompassing the southern and western portions of the study area, including the Fakahatchee Strand basin (**Figure 11**). The Southern Big Cypress Swamp is located in the southern half of the Big Cypress National Preserve and is part of the Big Cypress Swamp Watershed, USGS unit 03090204. The study area is situated in the western part of the Southern Big Cypress Swamp. Interest will focus on the Fakahatchee Strand, Okaloacoochee Slough, and the Barron and Turner River canals, two canals which hydrologically affect the western portion of the preserve. The Turner and Barron River canals were not originally designed for the specific purpose of draining land, but as a supply source for road construction materials (Drew and Schomer 1984).

Physical Description

Perhaps the most important drainage feature of the Big Cypress Swamp is the Fakahatchee Strand. A strand is an elongate area of large trees growing within drainage depression with no well-defined channel. The Fakahatchee Strand is a natural community of mixed hardwood swamp about five miles wide and twenty miles long. Along with Okaloacoochee Slough, it is a principal drainage slough of the western Big Cypress Swamp (McElroy and Alvarez 1975).

Land use within the Southern Big Cypress Swamp is primarily wetlands, with an estimated less than 5% of land under agricultural use and less than 5% in small towns. Census data record that in 1990, Everglades City, at which the Barron River Canal discharges, had a population of 317, and Chokoloskee, a small fishing town at which Turner River discharges, had a population of 240 (U.S. Department of Commerce 1992).

The Turner and Barron River canals drain freshwater from the strands and sloughs of the Big Cypress Swamp, and also receive additional freshwater input from the shallow water aquifer. Okaloacoochee Slough and Deep Lake Strand are two such features that contribute freshwater to the canals. The Barron River canal flow rate varies from 0 to 8.27 m^3/s (0 to 292 cfs) over the course of a year. During dry season, flows are low, from 1.42 to 2.84 m^3/s (50 to 100 cfs), but increase during the wet season to between 2.84 and 4.96 m^3/s (100 to 175 cfs). Over the long term (decades), flows average 2.89 m^3/s (102 cfs). Given the age of the canals, constructed over 50 years ago, water levels in the Barron and Turner River canal watersheds are assumed to have stabilized. A series of removable stop-log gates control flow along the Barron River canal, inserted during the dry season to conserve the aquifer and removed during the wet season to accommodate increased drainage (Drew and Schomer 1984).

Historical Description

Historical data from STORET indicate that water quality within much of the Big Cypress has been "fair" to "good" with respect to physical and biological parameters, and nutrient condition. However, metals were detected in previous sample data from Chokoloskee Bay at levels higher than in other local estuaries. Monitoring data from 1980-89 indicate that Barron River canal had good water conditions with a pH of 7.6, good water clarity as indicated by low turbidity (2.0 NTUs), low TSS (1 mg/L), and low color (55 PCUs). However, DO levels failed to meet State criteria with an average of 4.2 mg/L. Conductivity was normal at 536 micromhos. The Turner River canal exhibits freshwater conditions inland and estuarine conditions nearer the coast. Samples of the Turner River collected near the Tamiami indicate that physical water quality is good with an average DO of 7.3, low turbidity of 1.0 NTUs, and pH of 8.4. Conductivity, however, exceeded State standards with an average measurement of 1300 micromhos. Where Turner River flows into Oyster Bay, turbidity was higher at 4 NTUs, color was higher at 40, and conductivity was higher at 41250 micromhos due to higher salt content. DO was high at 8.5.

Biological parameters, BOD, chlorophyll a, and fecal coliform bacteria, were 1.3 mg/L, 7 μg/L, and 14 MPN/100 ml, respectively. None of these values exceeded (i.e., failed to meet) State standards. Nitrogen and phosphorus levels of Barron River canal runoff into the Gulf have been historically low. The annual average for total nitrogen was 0.98 mg/L, and for total phosphorus, concentrations were low at 0.02 mg/L. The TSI for Barron River canal runoff into the Gulf was 46 and for Turner Canal, 47.

Freshwater Systems

The literature provided very little historical or current water quality data for the Fakahatchee Strand Basin. A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). WQIs were calculated by decade (1970-1979 and 1990-1998) and approximate 62.0 and 55.4 for the Fakahatchee Strand Basin. Though data are missing for 1980-1989 and limited where present, a slight improvement in water quality was noted from the 1970s to the 1990s.

Estuarine Systems

Chokoloskee Bay

Recent water quality information was obtained from Gibson (1997) for 1990-1995. Historical data were obtained from the STORET database and from Drew and Schomer (1984).

The hydrology or rates of flushing and mixing of Chokoloskee Bay are not well known (Drew and Schomer 1984). Historically salinity has varied from 2.5 ppt to 20.2 ppt at the mouth of the bay. The water has been relatively clear as indicated by the average turbidity (3 NTUs), and color (30 PCUs). DO was high at 8.5 and the pH was normal for saline waters at 8.5. High conductivity (41,250 micromhos) is normal for waters with high salt content. No historical bacterial analyses or chlorophyll a measurements were available.

Historically nutrients increase with the rainy season from apparent increased flow from the Barron River Canal. Other sources of nutrients are possibly the oxidation of drained soils and runoff from agricultural and roadways (Drew and Schomer 1984). Total nitrogen has historically been lower than average at 0.64 mg/L compared to other Florida streams. Total phosphorus likewise has been lower than average at 0.03 mg/L. The TSI indicated that the overall nutrient status of Chokoloskee Bay was good, with a 46. Contaminants have been sampled in the Bay, but seasonal increases were theorized to result from “desorption by dissolved ions in seawater” as salinity varied (Drew and Schomer 1984). Manganese, copper, lead, and zinc were metals that increased with an increase in salinity. Concentrations of these metals were reported to be 1.5 to 3 times higher than metal concentrations from estuaries that received natural drainage (Drew and Schomer 1984).

The literature provided very little historical or current water quality data for many of the bays and estuaries of Southwest Florida. Limited data are available for the Ten Thousand Isles region, and the associated bays of Chokoloskee and Faka Union.

While the above descriptions summarize water quality from current literature, a recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). However, data were insufficient to calculate TSIs for Chokoloskee Bay, Faka Union Bay, and the Ten Thousand Isles region.

3.5.3 GROUNDWATER (AQUIFERS)

The Surficial, Intermediate, and Floridan Aquifer systems are the principal aquifers within the study area. The Floridan Aquifer system is widely used for ground water supply in other areas of the State but, within the study area, it is of naturally poor quality, having a high degree of mineralization. Thus, only the Surficial and Intermediate Aquifer Systems are used for groundwater supply (SFWMD 1995). The Floridan Aquifer is separated from the Surficial and Intermediate Aquifers by several layers of confining beds. Recharge areas for the Floridan Aquifer are outside the study area.

Within the study area, the Surficial Aquifer system contains the undifferentiated water table aquifer and the confined lower Tamiami Aquifer. The Biscayne Aquifer is another principal aquifer system within the Surficial Aquifer that occurs outside the study area (SFWMD 1995).

Florida Geological Survey: Water Quality
The primary data and discussion material for aquifer water quality was provided from Florida’s Ground Water Quality Monitoring Program. This program derives aquifer water quality data from three sources: Background Network wells, Very Intensive Study Area (VISA) Network wells, and Private Well Surveys. Only preliminary data from the Background Network were available from 1984 through 1988. A summary of these water quality data for the Surficial, Intermediate, and Floridan Aquifers is presented in Appendix E (**Table 27**).

Study Area: Water Quality
To evaluate more recent and geographically specific water quality data available within the study area, supplemental data (USGS) were gathered (including STORET) through June 1998 and water quality trends were revisited. To assess historical and current water quality trends for the study area aquifers, summary data statistics for various water quality parameters were recalculated for the following time periods: 1970-1980, 1980-1990, and 1990-1998.

3.5.3.1. Surficial Aquifer System

The Surficial Aquifer System is located beneath and adjacent to the land surface and is composed of Pliocene to Holocene quartz sands, shell beds, and carbonates. It consists of porous unconsolidated quartz sand deposits mixed with hardened carbonated rocks belonging to the Upper Miocene to Holocene Series (Florida Department of Natural Resources 1992). The carbonate rocks are the water-producing zones (SFWMD 1995).

Within the Surficial Aquifer system, the water table is mostly unconfined, but in deeper regions some partially confined or locally confined conditions may predominate from beds of low permeability. Underneath the Surficial Aquifer are broad thick beds that are more confining. In South Florida, sediment beds of the Surficial Aquifer are the Tamiami, Caloosahatchee, Fort Thompson, and Anastasia Formation, the Key Largo, and Miami Limestones, and the undifferentiated sediments (Florida Department of Natural Resources 1992). In general, Surficial Aquifer water levels slope downwards in a southwesterly direction towards the coast. Little seasonal fluctuation of the Surficial Aquifer water levels occurs (Dames and Moore 1997).

Median values for water quality measurements for the Surficial Aquifer are within State drinking water standards, with the exception of iron and lead. The MCL secondary standard for iron is 0.3 mg/L and the average for the Surficial Aquifer within the SFWMD was 0.88 mg/L. The high maximum values (>5mg/L) are likely the result of using unfiltered samples during analysis (Florida Department of Natural Resources 1992). Iron is high in the Surficial Aquifer system due to its proximity to iron minerals, organic rich soil horizons, and dissolved humic substances (Florida Department of Natural Resources 1992). Lead occurs in the surficial at "high" levels (Florida Department of Natural Resources 1992). Given the lack of natural sources of lead in Florida, the presence of lead is attributed to human sources, most often lead weights used in water level recorders (Florida Department of Natural Resources 1992).

Saltwater intrusion, incomplete flushing of seawater from the Everglades, and leftover irrigation water from the Floridan Aquifer system have created areas of increasing mineralization and high dissolved solids along the coast (SFWMD 1995). The Surficial Aquifer System is susceptible to anthropogenic contamination due to its closeness to the land surface. Lack of confinement, high recharge, and relatively high permeability and high water table all increase contamination potential. The increasing demands heighten the constant threat of saltwater intrusion, often resulting in water usage restrictions to users of the Surficial Aquifer (SFWMD 1995).

Physical and Geological Description

Water quality data in this section is derived from the FY95/96 Trend Ground Water Quality Monitoring Program for Collier County (Gibson 1997). Ground water samples from sixteen monitoring wells sampled quarterly were analyzed for "specific chemical analytes that are indicative of natural ground water geochemistry and potability" and compared to public water supply standards. In 1995-96, total dissolved solids, iron, chloride, and sulfate levels in the monitoring wells exceeded MCL standards established in F.A.C. 17-550 for treated community water supplies, but still compared favorably with historical data. The report concluded that these conditions "appear to represent the norm" for Surficial Aquifer waters in Collier County (Gibson 1997). The lower Tamiami Aquifer supplies Collier County with most of its potable water supplies (Dames and Moore 1997).

Withdrawals/Public Use

The principal source of urban water in Lee County is the Shallow Water Table Aquifer. The Shallow Water Table Aquifer is also used for agricultural irrigation. Transmissivities for the water table within Lee County range from 10,000 to 1,000,000 gpd/ft. Typical yields from public water supply wells are around 300 gpm (SFWMD 1995).

The Tamiami is a major potable resource for Collier County serving as the primary source of municipal, industrial, and agricultural water supply (SFWMD 1995). The water quality is similar to that of the water table aquifer, but often with lower iron concentrations, making it more suitable for potable supplies. Chloride concentrations may still be high in some coastal areas, with levels up to 10,000 mg/L. Aquifer thickness ranges from 150 feet to over 250 feet. Transmissivities range from 100,000 to 500,000 gpd/ft (Dames and Moore 1997). Water use of the Surficial and Intermediate Aquifers by Collier and Lee Counties in 1995 is presented in **Table 6**. More water is used in agricultural irrigation than any other category for both counties. In Collier County, agricultural irrigation accounted for approximately 68% of all water use in 1995.

Table 6. 1995 Water Use For Collier And Lee County*

County	Public Supply	Domestic Self-Supply (private well)	Industry/ Commercial Self-Supply	Agricultural Irrigation Self-Supply	Recreation Self-Supply	TOTAL
Collier	14,250	1,785	2,181	51,985	16,641	**86,842**
Lee	14,673	2,081	1,974	22,063	12,011	**52,802**
TOTAL	**28,923**	**3,866**	**4,155**	**74,048**	**28,652**	**139,644**
% of Total	***20.7%***	***2.8%***	***3.0%***	***53.0%***	***20.5%***	***1%***

Source: SFWMD, 1998b * Note: Millions of Gallons per Year

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). No data were available from 1970-1979 but slight increases in most minerals and an increase in pesticides was observed from the 1980s to the present decade.

3.5.3.2. Intermediate

The Intermediate Aquifer System is located in the Hawthorn group sediments and is comprised of two confined or in place semi-confined aquifers. The Sandstone Aquifer present in Lee County and Collier County north of Alligator Alley and the mid-Hawthorn aquifer underlie Collier County (Dames and Moore 1997).

Physical and Geological Description

The Sandstone Aquifer is composed of sandy limestone, dolomites, and sandstone up to 100 feet thick and is possibly part of the Peace River Formation. The aquifer slopes southeastward, gradually thinning out. The transmissivity is generally below 100,000 gpd/ft with hydraulic gradients ranging from 0.5 feet per mile to 5 feet per mile. A recharge zone exists northeast of Immokalee. The iron content is relatively low and the chloride concentrations are usually less than 600 mg/L. Increases in hardness and alkalinity occur as one moves toward the coast. Water quality is described overall as good. Within Collier County, the direction of water flow in most confined layers is southwestward (Dames and Moore 1997).

Limestone and dolomites from the Acadian Formation comprise the mid-Hawthorn Aquifer. Transmissivities are less than 50,000 gpd/ft. The mid-Hawthorn averages 100 feet in thickness with highly mineralized water. High levels of chlorides, calcium, magnesium, and sulfate are present within this aquifer. The mid-Hawthorn slopes toward the east-southeast and is under sufficient hydrostatic pressure to produce artesian conditions for wells drilling into this aquifer (Dames and Moore 1997).

Mean water quality parameters meet State drinking water standards with the exception of lead and total dissolved solids. Total dissolved solids in the Intermediate Aquifer range from 47 mg/L to 4188 mg/L within the SFWMD. Contact of water with carbonates and chemically unstable silicates (e.g. clays, opal), as well as saline intrusion are probable sources of high total dissolved solids (Florida Department of Natural Resources 1992).

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). No clear trends in water quality were evident for the Intermediate Aquifer. However, from 1980 to 1998, most mineral concentrations decreased, while iron and fluorides slightly increased. Pesticide concentrations increased notably.

3.5.3.3. Floridan Aquifer

The Floridan Aquifer within the study area is characterized by low hydraulic potential, low flushing, and saline intrusion from long contact/high dissolution of base strata of aquifer and coast (Florida Geological Survey 1992). It is composed of Tampa Formation sediments and is connected to the underlying Suwannee and Ocala Limestone, and Avon Park, Oldsmar, and Cedar Keys Formations. It is separated from the Intermediate Aquifer through confining sediments of the Hawthorn Group. The transmissivity ranges from 75,000 to 450,000 gpd/ft in the upper areas of the Floridan. Water quality has been described as brackish, degrading with depth and towards the coast (Dames and Moore 1997).

Mean chloride levels for Floridan Aquifer wells within the SFWMD exceed the States MCLs for drinking water. Median levels are 419.6 mg/L and the State standard is 250 mg/L. Median levels of total dissolved solids also exceed State standards (Florida Department of Natural Resources 1992).

A recent compilation of water quality data from all available organizations within the study area was conducted to support the impact analyses of this report (Appendix E). No distinct trends were observed, but slight increases in some minerals were noted along with a small decrease in chlorides.

3.6 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

The State of Florida contains some 20,000 waste generators and facilities, most associated with business and industry in populated areas. The exception to this is the use of pesticides and a variety of solvents associated with agri-business.

3.7 AIR QUALITY

Southwest Florida's air quality is among the best in the State. Based on existing data, the EIS study area is an attainment area for ozone and carbon monoxide pollution; however, particulate pollution and ozone have shown upward trends in recent years (SWFRPC 1995). Portions of this upward trend, specifically particulate pollution, is attributable to land clearing and other development activities.

3.8 NOISE

Much of the eastern study area is currently undeveloped, and as such, exhibit relatively low ambient noise levels. Heavy traffic roadways in and around the urbanized area may have noise levels on the order of 65 to 70 decibels (dB), measured 30 meters (100 feet) from the traffic artery. Around construction areas, or near the airports in Ft. Myers, Lehigh Acres and Naples, noise levels may exceed the EPA recommended upper level of 70dB by 25 to 30 decibels.

3.9 AESTHETIC RESOURCES

Consideration of aesthetic resources within the project study area is required by the National Environmental Policy Act of 1969 (NEPA) PL 91-190, as amended. Aesthetic Resources are defined in ER 1105-2-50 as " those natural and cultural features of the environment which elicit . . . a pleasurable response" in the observer, most notably from the predominant visual sense. Consequently, aesthetic resources are (commonly referred to as) visual resources, . . . features which can potentially be seen.

The EIS study area has a variety of natural systems that contribute to the aesthetic resources of the region. These range from aquatic (marine and freshwater) systems to upland forest systems. These natural communities provide a solid base of aesthetic values and functions that serve the permanent and seasonal residents of the region. Natural systems within the EIS study area include hundreds of kilometers of coastal shoreline, as well as a number of bays, sounds, and other shoreline water body features. The Region's economy is highly dependent on these areas providing natural attributes that are important to residents and tourists and providing food resources. Due to the attractiveness of coastal areas, there is an intense demand for land in these areas.

The EIS study area also contains a number of municipal, County, State, and Federal parks and preserves, including Rookery Bay National Estuarine Research Reserve, Estero Bay Aquatic Preserve, Collier-Seminole State Park, Wiggins Pass State Preserve, Koreshan State Park, Lover's Key State Park, Florida Panther National Wildlife Refuge, Ten Thousand Islands National Wildlife Refuge, Corkscrew Regional Ecosystem Watershed, Big Cypress Preserve, Picayune State Forest, and Fakahatchee Strand State Preserve. The study area also contains private preserves such as the Audubon Society's Corkscrew Swamp Sanctuary.

3.10 RECREATION RESOURCES

In the Southwest Florida EIS study area, there are hundreds of public parks and recreation areas, excluding beaches and boat access sites. These areas are administered by the Federal government, State government, Lee and Collier County governments, and various municipal governments, as well as by private agencies and private commercial interests.

Types and sizes of parks vary widely in the Region. Parks and recreation areas have been classified into two categories: user-oriented and resource-based. User-oriented recreation areas are defined as those containing facilities which can be provided almost anywhere for the convenience of the user. Among such facilities are ballfields, golf courses, and playgrounds. Resource-based outdoor recreation areas are dependent upon some particular element or combination of elements in the natural environment. These areas include beaches or hunting areas. Sizes of parks in Southwest Florida range from less than one acre to several thousand acres.

Within the urban setting, most of the regionally-significant parks and recreation areas are owned by the State of Florida or a local government. Outside the urban setting, nationally and internationally recognized preserves are managed for various active and passive recreational uses by the USFWS, the National Park Service, the Florida Department of Environmental Protection, the Florida Division of Forestry, and the South Florida Water Management District.

3.11 HISTORIC AND ARCHEOLOGICAL RESOURCES

The Southwest Florida region has a large number of historic and archaeological sites. According to the Division of Archives, Florida Department of State, there are 8,219 historic and archaeological sites in Southwest Florida recorded on the Florida Master Site File (1994). There are 689 sites in Collier County and 1,723 sites in Lee County. Only parts of the Region have been extensively surveyed; consequently, there may be considerably more sites to be discovered.

At present, few of Southwest Florida's historical or archaeological sites are listed on the National Register of Historic Places. Collier County has twelve sites listed, including the Seaboard Coast Line Railroad Depot, while Lee County has twelve sites, such as the Koreshan Unity Settlement Historic District.

Southwest Florida was the home of the Calusa people, whose unbroken history has been traced back to 500 BC by archeologists (Milanich 1995). The Calusa were the most important aboriginal group in Southern Florida in terms of influence, population size and density, and military power (Milanich 1995). Calusa towns were spread throughout Southwest Florida from Lake Okeechobee to the coast around Port Charlotte, and southward along the coast to the Ten Thousand Islands area. Major Calusa towns are thought to have been located on Horr and Marco Islands, on Mound Key in Estero Bay, and along the shores of Charlotte Harbor.

3.12 SOCIOECONOMIC RESOURCES

In Southwest Florida, the major economic contributors are retirement, tourism, construction, and agriculture. Each has an important part in the economy of the Region (SWFRPC 1995).

Southwest Florida has been a destination for retirees for years, especially since World War II. The effects of this influx of retirees are seen in the age of the population of the Region. Older people make up a larger proportion of the population of Southwest Florida than they do in the State as a whole. Based upon 1993 estimates, twenty-five percent of the EIS study area population is age 65 or older (SWFRPC 1995).

It is expected that retirement will continue to be important economically, even as the population grows more diverse. Retirees have time and money to spend on recreation and entertainment. They also tend to require more health and medical services. Households comprised of elderly or disabled residents represent a significant concern in Southwest Florida.

Tourism is a second major factor in economic development. It is becoming a year-round activity, with increasing numbers of summer tourists to balance the "snowbirds" and winter residents. Tourism is also a factor in population growth. Persons who visit as tourists may decide to move here during their working years or later as retirees.

The growing population within the study area results in the construction of more housing. From 1980 to 1993, housing unit growth in the Region averaged 5.8% per year (SWFRPC 1995). Collier County has had the greatest overall percentage of growth since 1980 (110.2%), although Lee County has had the greatest increase in the number of dwelling units (67,576) (SWFRPC 1995).

In addition to new housing, both tourism and retirement lead to other development of all kinds, although residential building forms the majority of the total permit activity noted above. Movie theaters, restaurants, shopping centers, grocery stores, and service stations are all needed for tourists, and new permanent and seasonal residents.

The importance of agriculture in Southwest Florida has changed to reflect the pattern of development in the Region. Increased development pressures in the coastal counties have caused agriculture to be less important there compared with other economic sectors. Farm acreage in the Region decreased 8.9% from 1982 to 1992 (SWFRPC 1995).

Citrus, long important in the Region, is increasing as production has shifted over the last few years from other areas of the State to Southwest Florida and its milder weather.