COASTAL MANAGEMENT ELEMENT

5.0 INTRODUCTION

5.0.0 Purpose

The purpose of this element is two fold. First, it is to plan for development activities in the coastal zone. Where it is determined the coastal resources would be damaged or destroyed by this development, appropriate measures will be suggested for limiting or removing these negative impacts. Secondly, this element is required to formulate guidelines which protect human life from storm events and limit public expenditures in areas subject to destruction by natural disasters.

5.0.1 Boundaries of the Coastal Area

The boundary of the study area for this element is shown in Figure 5.1. It can be described as follows: starting at the northern boundary of the City limits and the beach, proceed south along the beach to the southern boundary of the City, thence west and north along the City limits boundary to US 1, thence north along US 1 to its intersection with the Main Canal, thence proceed east and follow the boundary for the City limits to the point of beginning. The special purpose study area for hurricane evacuation and hazard mitigation encompasses the entire City. The special study area for estuarine water quality is the Indian River Lagoon and the north, main and south drainage canals.

5.1 NATURAL RESOURCES

5.1.0 Introduction

For the purposes of this report, the natural resources of Vero Beach have been divided into six vegetative communities and two wildlife habitats. Within each of these groupings there are subheadings. The vegetative communities are taken on a continuum from the Atlantic Ocean across the barrier island to the mainland. Each division is based on landform definition which maintains similar environmental conditions within the divisions. Wildlife habitats are grouped by type, either terrestrial or aquatic. Tables 5.1 and 5.2 present vegetation of the area; Tables 5.3-5.10 list the wildlife of the area.

The remaining natural resources are discussed in other sections of this report. The Lagoon system is discussed in Section 5.3, Estuarine Pollution. Beach and dune systems are in Section 5.4. There are no mineral resources and air quality and water resources are not within the scope of this element.

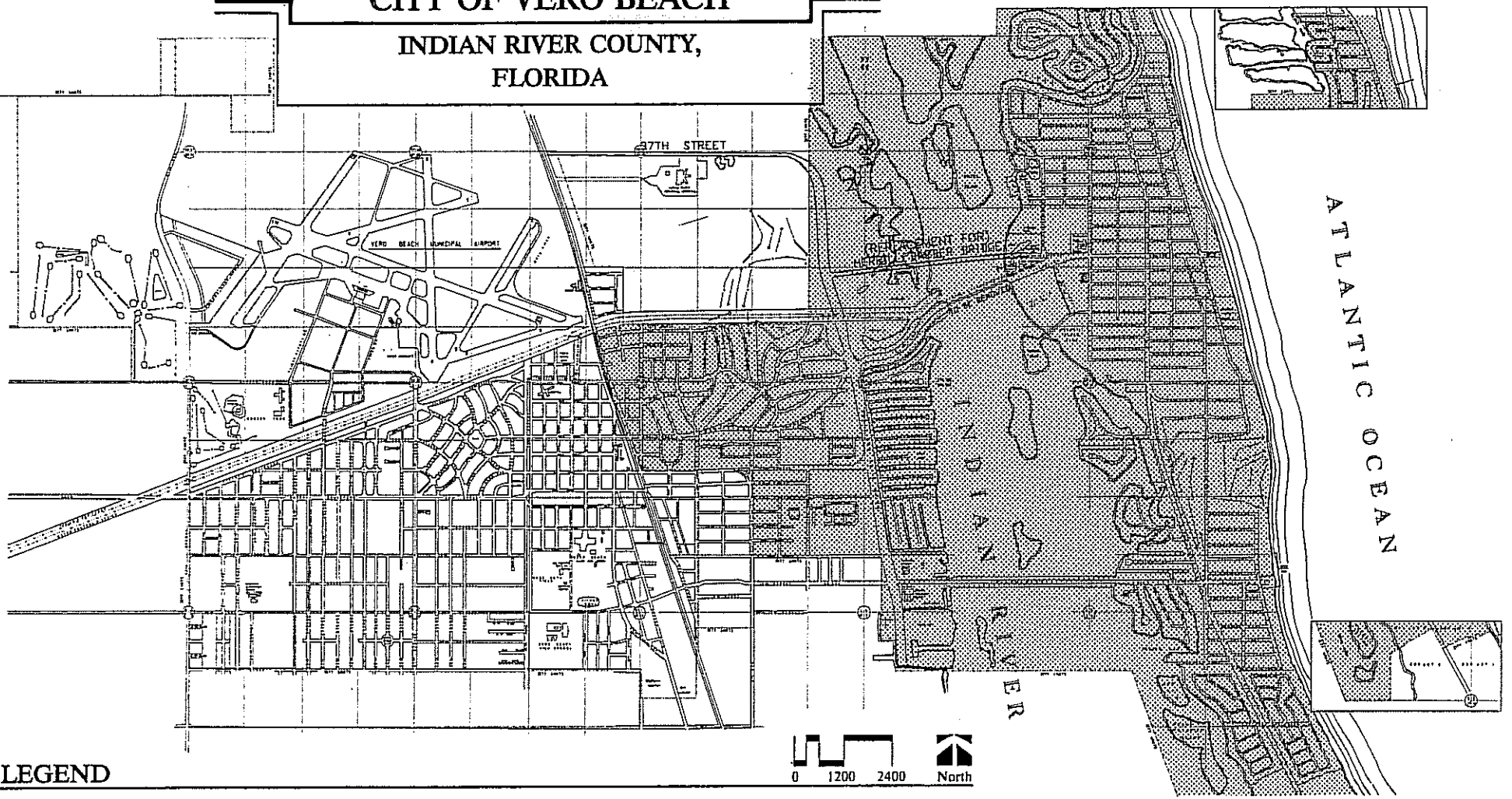
5.1.1 Vegetative Communities

5.1.1.0 Atlantic Ocean

The Vero Beach jurisdiction extends three miles offshore to the State's boundaries. This area is part of the nearshore Atlantic zone which includes the shallow subtidal and intertidal components of the continental shelf, extending from approximately 25-foot depths to mean low water. The nearshore Atlantic zone is a transition between terrestrial and oceanic regimes and is important to the stability of the barrier island. It provides spawning, nursery and feeding grounds for many estuarine and marine aquatic species (FGFWFC, 1982, p. 4).

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

Limits of Coastal Study Area

COASTAL STUDY AREA

Figure 5.1

Source: RS&H, 1987

RS&H / PLANTEC

SEPTEMBER 1989

Table 5.1. Common Herbs of the Study Area

Annual glasswort	*Salicornia bigelovii*
Ball moss	*Tillandsia recurvata*
Beach bean	*Canavalia maritima*
Beach elder	*Iva imbricata*
Beach grass	*Panicum amarulum*
Beach morning glory	*Ipomoea stolonifera*
Beach morning glory	*Ipomoea triloba*
Beach sunflower	*Helianthus debilis*
Beach-star	*Remirea maritima*
Blue curls	*Trichostema dichotomum*
Bracken fern	*Pteridium aquilinum*
Butterfly peas	*Centrosema virginianum*
Butterfly weed	*Asclepias tuberosa*
Chaff flower	*Alternanthera maritima*
Christmas berry	*Lycium carolinianum*
Climbing hempweed	*Mikania cordifolia*
Cock's comb	*Celosia nitida*
Cordgrass	*Spartina bakerii*
Corkey-stemmed passion flower	*Passiflora suberosa*
Cow peas	*Vigna luteola*
Croton	*Croton glandulosus*
Cypress rose pine	*Tillandsia fasciculata*
Dune groundcover	*Ernodea littoralis*
Eupatorium	*Eupatorium serotinum*
Eupatorium	*Eupatorium spp.*
Fish poison vine	*Dalbergia ecastophyllum*
Flattop goldenrod	*Solidago microcephala*
Fragrant cynanchum	*Cynanchum northropiae*
Frost grape	*Vitis vulpina*
Frostweed	*Verbesina virginica*
Golden aster	*Heterotheca floridana*
Golden aster	*Heterotheca scabrella*
Golden polypody	*Phlebodium aureum*
Gopher apple	*Licania michauxii*
Gray nicker	*Caesalpinia crista*
Green pine	*Tillandsia utriculata*
Greenbrier	*Smilax bona-nox*
Ground cherry	*Physalis viscosa*
Horse mint	*Monarda punctata*
Kitchen midden potato bush	*Solanum blodgettii*
Leafless cynanchum	*Cynanchum scoparium*
Leather fern	*Acrostichum aureum*
Manatee grass	*Syringodium filiforme*
Marsh elder	*Iva frutescens*
Melanthera	*Melanthera nivea*
Muscadine grape	*Vitis rotundifolia*
Orchid	*Encyclia tampensis*
Painted leaf	*Poinsettia heterophylla*

Table 5.1. Common Herbs of the Study Area (Continued)

Papaya	*Carica papaya*
Partridge pea	*Cassia brachiata*
Peperomia	*Peperomia humilis*
Pepper vine	*Ampelopsis arborea*
Perennial glasswort	*Salicornia virginica*
Pink purslane	*Portulaca pilosa*
Poison ivy	*Toxicodendron radicans*
Pokeweed	*Phytolacca americana*
Poor man's patch	*Mentzelia floridana*
Potato tree	*Solanum erianthum*
Puncture weeds	*Tribulus cistoides*
Railroad vine	*Ipomoea pes-caprae*
Rattlebox	*Crotalaria maritima*
Resurrection fern	*Polypodium polypodioides*
Rouge plant	*Rivina humilis*
Salt grass	*Distichilis spicata*
Salt jointgrass	*Paspalum vaginatum*
Salt marsh mallow	*Kosteletzkya virginica*
Saltwort	*Batis maritima*
Samphire	*Philoxerus vermicularis*
Sandbur	*Cenchrus spp.*
Sea blite	*Suaeda linearis*
Sea daisy	*Borrichia frutescens*
Sea lavender	*Limonium carolinianum*
Sea lavender	*Tournefortia gnaphalodes*
Sea oats	*Uniola paniculata*
Sea purslane	*Sesuvium maritimum*
Sea purslane	*Sesuvium portulacastrum*
Sea rocket	*Cakile fusiformis*
Seagrass	*Halophila johnsonii*
Seaside evening primrose	*Oenothera humifusa*
Seaside goldenrod	*Solidago sempervirens*
Seaside heliotrope	*Heliotropium curassavicum*
Sheep sorel	*Rumex spp.*
Shoal grass	*Halodule wrightii*
Shoestring fern	*Vittaria lineata*
Shrub verbena	*Lantana camara*
Silverleaf croton	*Croton punctatus*
Slender cordgrass	*Spartina patens*
Smooth cordgrass	*Spartina alterniflora*
Spanish bayonet	*Yucca gloriosa*
Spanish moss	*Tillandsia usneoides*
Spurge	*Chamaesyce mesembryanthemifolia*
String lily	*Crinum americanum*
Tread softly	*Cnidoscolus stimulosus*
Tuberous bean	*Phaseolus sp.*
Turtle grass	*Thalassia testudinum*
Twisted air plant	*Tillandsia flexuosa*

Table 5.1. Common Herbs of the Study Area (Continued)

Vervain	*Verbena maritima*
Vine milkweed	*Cynanchum blodgettii*
Virginia creeper	*Parthenocissus quinquefolia*
Water hemp	*Amaranthus cannabinus*
Water hyssop	*Bacopa monnieri*
White lantana	*Lantana involucrata*
Widgeon grass	*Ruppia maritima*
Wild poinsettia	*Poinsettia sp.*
Yellow top	*Flaveria floridana*

Sources: FGFWFC, 1982, pp. 47-48.
RS&H, 1987.

Table 5.2. Native Trees and Shrubs of the Study Area

Beauty-berry	*Callicarpa americana*
Black ironwood	*Krugiodendron ferreum*
Black mangrove	*Avicennia germinans*
Blolly	*Pisonia discolor*
Buttonwood	*Conocarpus erecta*
Cabbage palm	*Sabal palmetto*
Caesar weed	*Urena lobata*
Coastal-plain willow	*Salix caroliniana*
Coco plum	*Chrysobalanus icaco*
Coral bean	*Erythrina herbacea*
False willow	*Baccharis angustifolia*
Fiddlewood	*Citharexylum fruticosum*
Florida privet	*Forestiera segregata*
Goundsel	*Baccharis halimifolia*
Gumbo limbo	*Bursera simaruba*
Hercules club	*Zanthoxylum clava-herculis*
Hog plum	*Spondias purpurea*
Jamaica caper tree	*Capparis cynophallophora*
Lancewood	*Nectandra coriacea*
Live oak	*Quercus virginiana*
Marlberry	*Ardisia escallonioides*
Myrsine	*Myrsine guianensis*
Necklace pond	*Sophora tomentosa*
Paradise tree	*Simarouba glauca*
Pond apple	*Annona glabra*
Prickly pear	*Opuntia spp.*
Red mangrove	*Rhizophora mangle*
Saffron plum	*Bumelia celastrina*
Saw palmetto	*Serenoa repens*
Scaevola	*Scaevola plumieri*
Sea grape	*Coccoloba uvifera*
Shore bay	*Persea borbonia*
Snowberry	*Chiococca alba*
Southern soapberry	*Sapindus saponaria*
Southern sumac	*Rhus copallina*
Spanish stopper	*Eugenia myrtoides*
Strangler fig	*Ficus aurea*
Tallowwood	*Ximinia americana*
Tie tongue	*Coccoloba diversifolia*
Torchwood	*Amyris elemifera*
Tough buckthorn	*Bumelia tenax*
Twinberry	*Myrcianthes fragrans*
Varnish leaf	*Dodonaea viscosa*
Wax myrtle	*Myrica cerifera*
White indigo berry	*Randia aculeata*
White mangrove	*Laguncularia racemosa*
White stopper	*Eugenia axillaris*
Wild coffee	*Psychotria sulzneri*

Table 5.2. Native Trees and Shrubs of the Study Area (Continued)

Wild coffee	*Psychotria undata*
Wild lime	*Zanthoxylum fagara*
Wild mastic	*Mastichodendron foetidissimum*
Yellowwood	*Schaefferia frutescens*
Yellowwood, satinwood	*Zanthoxylum flavum*

Sources: FGFWFC, 1982, p. 46.
RS&H, 1987.

Table 5.3. Land Mammals of the Study Area

Black rat	*Rattus rattus*
Bobcat	*Lynx rufus floridanus*
Brazilian free-tailed bat	*Tadarida brasiliensis cynocephalus*
Cotton mouse	*Peromyscus gossypinus palmarius*
Domestic dog	*Canis familiaris*
Eastern cottontail	*Sylvilagus floridanus floridanus*
Eastern mole	*Scalopus aquaticus australis*
Eastern pipistrelle	*Pipistrellus subflavus floridanus*
Eastern wood rat	*Neotoma floridana floridana*
Evening bat	*Nycticeius humeralis humeralis*
Gray fox	*Urocyon cinereoargenteus floridanus*
Gray squirrel	*Sciurus carolinensis*
Hispid cotton rat	*Sigmodon hispidus littoralis*
Hoary bat	*Lasiurus cinereus*
House cat	*Felis domestica*
House mouse	*Mus musculus*
Least shrew	*Cryptotis parva floridana*
Marsh rabbit	*Sylvilagus palustris paludicola*
Nine-banded armadillo	*Dasypus novemcinctus mexicanus*
Norway rat	*Rattus norvegicus*
Old-field mouse	*Peromyscus polionotus niveiventris*
Oppossum	*Didelphis marsupialis pigra*
Raccoon	*Procyon lotor elucus*
Red bat	*Lasiurus borealis*
Rice rat	*Oryzomys palustris natator*
River otter	*Lutra canadensis vaga*
Seminole bat	*Lasiurus seminolus*
Short-tailed shrew	*Blarina brevicauda peninsulae*
Southern flying squirrel	*Glaucomys volans querceti*
Spotted skunk	*Spilogale putorius ambarvalis*
Striped skunk	*Mephitis mephitis elongata*
Yellow bat	*Lasiurus intermedius floridanus*

Formerly Occurred and/or Recent Unconfirmed Reports

Black bear	*Ursus americanus floridanus*
Feral pig	*Sus scrofa*
Florida red wolf (extinct)	*Canis rufus floridanus*
Jaguarundi	*Felis yagouaroundi*
Long-tailed weasel	*Mustela frenata peninsulae*
Mink	*Mustela vison lutensis*
Panther	*Felis concolor coryi*
White-tailed deer	*Odocoileus virginiana seminolus*

Sources: FGFWFC, 1982, p. 44.
RS&H, 1987.

Table 5.4. Reptiles of the Study Area

American alligator	*Alligator mississippiensis*
American crocodile	*Crocodylus acutus acutus*
Atlantic ridley	*Lepidochelys kempi*
Atlantic salt marsh snake	*Natrix fasciata taeniata*
Banded water snake	*Natrix fasciata pictiventris*
Black swamp snake	*Seminatrix pygaea cyclas*
Box turtle	*Terrapene carolina bauri*
Broad-headed skink	*Eumeces laticeps*
Brown anole	*Anolis sagrei*
Brown snake	*Storeria dekayi victa*
Brown water snake	*Natrix taxispilota*
Chicken turtle	*Deirochelys reticularia chrysea*
Coachwhip	*Masticophis flagellum flagellum*
Common garter snake	*Thamnophis sirtalis sirtalis*
Common mud turtle	*Kinosternon subrubrum steindachneri*
Common snapping turtle	*Chelydra serpentina osceola*
Corn snake	*Elaphe guttata guttata*
Cottonmouth	*Agkistrodon piscivorous conanti*
Crowned snake	*Tantilla coronata wagneri*
Diamondback terrapin	*Malaclemys terrapin tequesta*
Eastern coral snake	*Micrurus fulvius fulvius*
Eastern diamondback rattlesnake	*Crotalus adamanteus*
Eastern glass lizard	*Ophisaurus ventralis*
Eastern hog-nosed snake	*Heterodon platyrhinos*
Eastern kingsnake	*Lampropeltis getulus getulus*
Eastern ribbon snake	*Thamnophis sauritus sackeni*
Florida cooter	*Chrysemys floridana peninsularis*
Florida kingsnake	*Lampropeltis getulus floridana*
Florida red-bellied turtle	*Chrysemys nelsoni*
Florida softshell	*Trionyx ferox*
Gopher tortoise	*Gopherus polyphemus*
Green turtle	*Chelonia mydas mydas*
Green water snake	*Natrix cyclopion floridana*
Ground skink	*Scincella lateralis*
Hawksbill	*Eretmochelys imbricata imbricata*
Indigo snake	*Drymarchon corais couperi*
Indo-Pacific gecko	*Hemidactylus garnoti*
Island glass lizard	*Ophisaurus compressus*
Leatherback	*Dermochelys coriacea coriacea*
Loggerhead	*Caretta caretta caretta*
Loggerhead musk turtle	*Sternotherus minor*
Mud snake	*Farancia abacura abacura*
Pigmy rattlesnake	*Sistrurus miliarius barbouri*
Pine snake	*Pituophis melanoleucus mugitus*
Racer	*Coluber constrictor priapus*
Rat snake	*Elaphe obsoleta quadrivittata*
Red-tailed skink	*Eumeces egregius onocrepis*
Ring-necked snake	*Diadophis punctatus punctatus*

Table 5.4. Reptiles of the Study Area (Continued)

Rough green snake	*Opheodrys aestivus*
Scarlet kingsnake	*Lampropeltis triangulum triangulum*
Scarlet snake	*Cemophora coccinea coccinea*
Six-lined racerunner	*Cnemidophorus sexlineatus sexlineatus*
Slender glass lizard	*Ophisaurus attenuatus longicaudus*
Southeastern five-lined skink	*Eumeces inexpectatus*
Southern hog-nosed snake	*Heterodon simus*
Stinkpot	*Sternotherus odoratus*
Striped mud turtle	*Knosternon bauri palmarum*
Striped swamp snake	*Regina alleni*
Yellow-lipped snake	*Rhadinaea flavilata*

Sources: FGFWFC, 1982, pp. 35-36.
RS&H, 1987.

Table 5.5. Amphibians of the Study Area

Barking tree frog	*Hyla gratiosa*
Cuban tree frog	*Hyla septentrionalis*
Dwarf salamander	*Manculus guadridigitatus*
Dwarf siren	*Pseudobranchus striatus axanthus*
Eastern narrow-mouthed frog	*Gastrophryne carolinensis*
Eastern spadefoot	*Scaphiopus holbrooki*
Greater siren	*Siren lacertina*
Green tree frog	*Hyla cinerea*
Greenhouse frog	*Eleutherodactylus planirostris planirostris*
Leopard frog	*Rana pipiens sphenocephala*
Lesser siren	*Siren intermedia*
Little grass frog	*Limnaoedus ocularis*
Oak toad	*Bufo quercicus*
Ornate chorus frog	*Psedacris ornata*
Pig frog	*Rana grylio*
Pine-woods tree frog	*Hyla femoralis*
Southern chorus frog	*Pseudacris nigrita verrucosa*
Southern cricket frog	*Acris gryllus dorsalis*
Southern toad	*Bufo terrestris*
Spotted newt	*Notophthalmus viridescens piaropicola*
Squirrel tree frog	*Hyla squirella*
Two-toed amphiuma	*Amphiuma means*

Sources: FGFWFC, 1982, p. 34.
RS&H, 1987.

Table 5.6. Animal Life Commonly Associated with the Mangrove Community

Mammals

Bobcat
Marsh rabbit
Otter
Raccoon
Rice rat

Birds

American egret
Belted kingfisher
Black crowned night heron
Brown pelican
Cattle egret
Clapper rail
Fish crow
Great blue heron
Green-backed heron (formerly green heron)
Little blue heron
Northern parula warbler
Osprey
Red-winged blackbird
Roseate spoonbill
Snowy egret
White ibis
Yellow-crowned night heron
Yellow-rumped warbler
Yellow-throated warbler

Reptiles

Diamondback terrapin

Fishes

Bay anchovy
Gray snapper
Mosquitofish
Rainwater killifish
Sailfin molly
Sheepshead minnow
Tarpon
Tarpon snook

Invertebrates

Blue crab

Table 5.6. Animal Life Commonly Associated with the Mangrove Community (Continued)

Fiddler crab
Mangrove tree crab
Oysters
Shrimp
Snails

Sources: DNR, 1985, p. 33.
RS&H, 1987.

Table 5.7. Major Colonial Waterbird Rookeries

Colony	Location	Species	Average Number of Breeding Pairs
Riomar Island	T33S, R40E, S6 island just north of 17th St Bridge, Vero Beach	Cattle egret	1,800
		White ibis	1,300
		Louisiana heron	1,000
		Snowy egret	1,000
		Brown pelican	500
		Little blue heron	100
		Great egret	100
		Double-crested cormorant	50
		Anhinga	25
		Black-crowned night heron	20
		Yellow-crowned night heron	5
		Great blue heron	5
		Reddish egret	1

Sources: FGFWFC, 1982, p. 66.
RS&H, 1987.

Table 5.8. Birds of the Study Area

American avocet W	*Recurvirostra americana*
American coot W	*Fulica americana*
American goldfinch W	*Spinus tristis* (*Carduelis tristis*)
American kestrel R	*Falco sparverius*
American oystercatcher R*	*Haematopus palliatus*
American redstart M	*Setophaga ruticilla*
American robin W	*Turdus migratorius*
American wigeon W	*Anas americana*
Anhinga R*	*Anhinga anhinga*
Arctic tern M-A	*Sterna paradisaea*
Bald eagle R	*Haliaeetus leucocephalus*
Baltimore oriole W (Northern oriole)[2]	*Icterus galbula*
Bananaquit A	*Coereba flaveola*
Barn swallow M	*Hirundo rustica*
Barn-owl R* (Common barn-owl)	*Tyto alba*
Barred owl R*[1]	*Strix varia*
Belted kingfisher W	*Megaceryle alcyon (Ceryle alcyon)*[2]
Black scoter W	*Melanitta nigra*
Black skimmer R*	*Rynchops niger*
Black tern M	*Chlidonias niger*
Black vulture R	*Coragyps atratus*
Black-and-white warbler W	*Mniotilta varia*
Black-bellied plover W	*Pluvialis squatarola*
Black-crowned night-heron R*	*Nycticorax nycticorax*
Black-legged kittiwake W-A	*Rissa tridactyla*
Black-necked stilt W	*Himantopus mexicanus*
Black-throated blue warbler M	*Dendroica caerulescens*
Black-throated green warbler M	*Dendroicavirens*
Black-whiskered vireo S*	*Vireo altiloquus*
Blackburnian warbler M	*Dendroica fusca*
Blackpoll warbler M	*Dendroica striata*
Blue grosbeak M	*Guiraca caerulea*
Blue jay R*	*Cyanocitta cristata*
Blue-faced booby S-A (Masked booby)[2]	*Sula dactylatra*
Blue-gray gnatcatcher W	*Polioptila caerulea*
Blue-winged teal W	*Anas discors*
Blue-winged warbler M	*Vermivora pinus*
Boat-tailed grackle R	*Cassidix major (Quiscalus major)*
Bobolink M	*Dolichonyx oryzivorus*
Bobwhite R (Northern bobwhite)	*Colinus virginianus*
Bonaparte's gull W	*Larus philadelphia*
Bridled tern M	*Sterna anaethetus*

Table 5.8. Birds of the Study Area (Continued)

Broad-winged hawk M	*Buteo platypterus*
Brown booby W-A	*Sula leucogaster*
Brown noddy A	*Anous stolidus*
Brown pelican, R*	*Pelecanus occidentalis*
Brown thrasher R*	*Toxostoma rufum*
Burrowing owl M	*Speotyto cunicularia*
	(Athene cunicularia)
Canada goose W-A	*Branta canadensis*
Cape May warbler M	*Dendroica tigrina*
Cardinal R*	*Cardinalis cardinalis*
(Northern cardinal)	
Carolina wren R*	*Thryothorus ludovicianus*
Caspian tern W	*Hydroprogne caspia (Sterna caspia)*
Cattle egret R*	*Bubulcus ibis*
Cedar waxwing W	*Bombycilla cedrorum*
Chimney swift S*	*Chaetura pelagica*
Chuck-will's-widow S*	*Caprimulgus carolinensis*
Clapper rail R*	*Rallus longirostris*
Common flicker R*	*Colaptes auratus*
(Northern flicker)	
Common gallinule R*[1]	*Gallinula chloropus*
(Common moorhen)[2]	
Common grackle R	*Quiscalus quiscula*
Common loon W[1]	*Gavia immer*
Common nighthawk S*	*Chordeiles minor*
Common snipe W	*Capella gallinago*
	(Gallinago gallinago)
Common tern W	*Sterna hirundo*
Common yellowthroat W[1]	*Geothlypis trichas*
Cooper's hawk W	*Accipiter cooperii*
Double-crested cormorant R*	*Phalacrocorax auritus*
Downy woodpecker R*	*Dendrocopos pubescens*
	(Picoides pubescens)
Dunlin W	*Calidris alpina*
Eastern kingbird M	*Tyrannus tyrannus*
Eastern phoebe W	*Sayornis phoebe*
Eastern wood-pewee M	*Contopus virens*
Field sparrow W	*Spizella pusilla*
Fish crow R*	*Corvus ossifragus*
Forster's tern W	*Sterna forsteri*
Fulvous tree duck M[1]	*Dendrocygna bicolor*
(Fulvous whistling-duck)[2]	
Gadwall W	*Anas strepera*
Gannet W	*Morus bassanus*
(Northern gannet)	*(Sula bassanus)*
Glaucous gull W-A[1]	*Larus hyperboreus*
Glossy ibis R	*Plegadis falcinellus*
Grasshopper sparrow W	*Ammodramus savannarum*

Table 5.8. Birds of the Study Area (Continued)

Gray catbird W	*Dumetella carolinensis*
Gray kingbird S*	*Tyrannus dominicensis*
Great black-backed gull W	*Larus marinus*
Great blue heron R*	*Ardea herodias*
Great cormorant W-A	*Phalacrocorax carbo*
Great crested flycatcher S*	*Myiarchus crinitus*
Great egret R*	*Egretta alba*
	(casmerodias albus)
Great horned owl R*	*Bubo virginianus*
Great white heron S	*Ardea occidentalis*
(now considered a color phase of the Great blue heron)	*(Ardea herodias)*
Greater scaup W	*Aythya marila*
Greater yellowlegs W	*Tringa melanoleucus*
	(Tringa melanoleuca)
Green heron R*	*Butorides virescens*
(Green-backed heron)	*(Butorides striatus)*
Green-winged teal W	*Anas crecca*
Ground-dove R*	*Columbina passerina*
(Common ground-dove)	
Gull-billed tern A	*Gelochelidon nilotica*
	(Sterna nilotica)[2]
Hairy woodpecker R	*Dendrocopos villosus*
	(Picoides villosus)
Hermit thrush W	*Catharus guttatus*
Herring gull W	*Larus argentatus*
Hooded merganser W	*Lophodytes cucullatus*
Hooded warbler M	*Wilsonia citrina*
Horned grebe W-A	*Podiceps auritus*
Horned lark M	*Eremophila alpestris*
House sparrow R	*Passer domesticus*
House wren W	*Troglodytes aedon*
Iceland gull W-A	*Larus glaucoides*
Indigo bunting W	*Passerina cyanea*
Killdeer R*	*Charadrius vociferus*
Laughing gull W	*Larus atricilla*
Le Conte's sparrow W	*Ammospiza leconteii*
	(Ammodramus leconteii)
Leach's storm-petrel S-A	*Oceanodroma leucorhoa*
Least bittern W	*Ixobrychus exilis*
Least sandpiper W	*Calidris minutilla*
Least tern S*	*Sterna albifrons*
	(Sterna antillarum)
Lesser black-backed gull W-A	*Larus fuscus*
Lesser scaup W	*Aythya affinis*
Lesser yellowlegs W	*Tringa flavipes*
Little blue heron R*	*Egretta caerulea*
Loggerhead shrike R*	*Lanius ludovicianus*

Table 5.8. Birds of the Study Area (Continued)

Long-billed marsh wren W (Marsh wren)	*Telmatodytes palustris (Cistothorus palustris)*
Louisiana heron R* (Tricolored heron)	*Egretta tricolor*
Louisiana waterthrush M	*Seiurus motacilla*
Magnificent frigatebird R	*Fregata magnificens*
Magnolia warbler M	*Dendroica magnolia*
Mallard W	*Anas platyrhynchos*
Mangrove cuckoo A	*Coccyzus minor*
Marbled godwit W	*Limosa fedoa*
Marsh hawk R (Northern harrier)	*Circus cyaneus*
Merlin W	*Falco columbarius*
Mockingbird R*[1] (Northern mockingbird)[2]	*Mimus polyglottos*
Mottled duck R	*Anas fulvigula*
Mourning dove R*	*Zenaida macroura*
Northern parula W	*Parula americana*
Northern phalarope M-A (Red-necked phalarope)	*Lobipes lobatus (Phalaropus lobatus)*
Northern shoveler W	*Anas clypeata*
Northern waterthrush W	*Seiurus noveboracensis*
Oldsquaw A	*Clangula hyemalis*
Orange-crowned warbler W	*Vermivora celata*
Osprey R*	*Pandion haliaetus*
Ovenbird W	*Seiurus aurocapillus*
Painted bunting W	*Passerina ciris*
Palm warbler W	*Dendroica palmarum*
Pectoral sandpiper M	*Calidris meanotos*
Peregrine falcon W	*Falco peregrinus*
Pied-billed grebe R*	*Podilymbus podiceps*
Pileated woodpecker R*	*Dryocopus pileatus*
Pine siskin W-A	*Spinus pinus (Carduelis pinus)*
Pintail W (northern pintail)	*Anas acuta*
Piping plover W	*Charadrius melodus*
Pomarine jaeger W	*Stercorarius pomarinus*
Prairie warbler R*	*Dendroica discolor*
Prothonotary warbler M	*Protonotaria citrea*
Purple martin S*	*Progne subis*
Purple sandpiper W-A	*Calidris maritima*
Red knot W	*Calidris canutus*
Red phalarope M-A	*Phalaropus fulicarius (Phalaropus fulicaria)*
Red-bellied woodpecker R*	*Centurus carolinus (Melanerpes carolinus)*
Red-breasted merganser W	*Mergus serrator*
Red-eyed vireo M	*Vireo olivaceus*
Red-shouldered hawk R*	*Buteo lineatus*

Table 5.8. Birds of the Study Area (Continued)

Red-tailed hawk R	*Buteo jamaicensis*
Red-throated loon W-A	*Gavia stellata*
Red-winged blackbird R	*Agelaius phoeniceus*
Reddish egret R*	*Egretta rufescens*
Redhead W	*Aythya americana*
Ring-billed gull W	*Larus delawarensis*
Ring-necked duck W	*Aythya collaris*
Rock dove R*	*Columba livia*
Rose-breasted grosbeak M	*Pheucticus ludovicianus*
Roseate spoonbill S	*Ajaia ajaja*
Roseate tern M-A	*Sterna dougallii*
Rough-winged swallow M	*Stelgidopteryx ruficollis*
(Northern rough-winged swallow)	*(Stelgidopteryx serripennis)*
Royal tern W	*Thalasseus maximus*
	(Sterna maxima)
Ruby-crowned kinglet W	*Regulus calendula*
Ruby-throated hummingbird R*	*Archilochus colubris*
Ruddy duck W	*Oxyura jamaicensis*
Ruddy turnstone W	*Arenaria interpres*
Rufous-sided towhee R*	*Pipilo erythrophthalmus*
Sanderling W	*Calidris alba*
Sandwich tern W	*Thalasseus sandvicensis*
	(Sterna sandvicensis)
Savannah sparrow W	*Passerculus sandwichensis*
Scarlet tanager M	*Piranga olivacea*
Scissor-tailed flycatcher A	*Muscivora forficata*
	(Tyrannus forficatus)
Screech-owl R*	*Otus asio*
(Eastern screech-owl)	
Seaside sparrow W	*Ammospiza maritima*
	(Ammodramus maritimus)
Semipalmated plover W	*Charadrius semipalmatus*
Semipalmated sandpiper M	*Calidris pusilla*
Sharp-shinned hawk W	*Accipiter striatus*
Sharp-tailed sparrow W	*Ammospiza caudacuta*
	(Ammodramus caudacutus)
Shearwater S	*Puffinus spp.*
Short-billed dowitcher W	*Limnodromus griseus*
Short-billed marsh wren W	*Cistothorus platensis*
(Sedge wren)	
Smooth-billed ani R*	*Crotophaga ani*
Snowy egret R*	*Egretta thula*
Solitary sandpiper M	*Tringa solitaria*
Solitary vireo W	*Vireo solitarius*
Sooty tern A	*Sterna fuscata*
Spotted sandpiper W	*Actitis macularia*
Starling R*	*Sturnus vulgaris*
(European starling)	

Table 5.8. Birds of the Study Area (Continued)

Stilt sandpiper M	*Micropalama himantopus (Calidris himantopus)*
Summer tanager M	*Piranga rubra*
Surf scoter W	*Melanitta perspecillata*
Swainson's thrush M	*Catharus ustulatus*
Tennessee warbler M	*Vermivora peregrina*
Tree swallow W	*Iridoprocne bicolor (Tachycineta bicolor)*
Turkey vulture R	*Cathartes aura*
Veery M	*Catharus fuscescens*
Western kingbird A	*Tyrannus verticalis*
Western sandpiper W	*Calidris mauri*
Western tanager W	*Piranga ludoviciana*
Whimbrel W	*Numenius phaeopus*
Whip-poor-will W,M	*Caprimulgus vociferus*
White ibis R*	*Eudocimus albus*
White pelican W,S	*Pelecanus erythrorhynchos*
White-eyed vireo R*	*Vireo griseus*
White-rumped sandpiper M	*Calidris fuscicollis*
White-throated sparrow W	*Zonotrichia albicollis*
White-winged scoter W	*Melanitta deglandi (Melanitta fusca)*
Willet R*	*Catoptrophorus semipalmatus*
Wilson's phalarope M-A	*Steganopus tricolor (Phalaropus tricolor)*
Wilson's plover A	*Charadrius wilsonia*
Wilson's storm-petrel S-A	*Oceanites oceanicus*
Wilson's warbler M	*Wilsonia pusilla*
Wood duck R*	*Aix sponsa*
Wood stork R*	*Mycteria americana*
Wood thrush M	*Hylocichla mustelina*
Worm-eating warbler M	*Helmitheros vermivorus*
Yellow warbler M	*Dendroica petechia*
Yellow-bellied sapsucker W	*Sphyrapicus varius*
Yellow-billed cuckoo S	*Coccyzus americanus*
Yellow-breasted chat W	*Icteria virens*
Yellow-crowned night-heron R*	*Nyctanassa violacea (Nycticorax violaceus)*
Yellow-rumped warbler W	*Dendroica coronata*
Yellow-throated warbler W	*Dendroica dominica*

[1]Key to seasonal occurrence and breeding status: W - Primarily a winter resident; S - Primarily a summer resident; R - Occurs year-round in study area; M - Occurs during migration; A - Accidental or occasional visitor; * - nests in study area.

[2]Revised common or species names as proposed for the American Ornithologists' Union checklist of North American birds, 6th edition, are enclosed in parentheses.

Sources: FGFWFC, 1982, pp. 37-43.
RS&H, 1987.

Table 5.9. Animal Life Found in Marine Grassbed Areas or Generally Associated with this Community

Mammals

Atlantic bottle-nosed dolphin
Manatee

Birds

American coot
American widgeon
Belted kingfisher
Black skimmer
Blue-winged teal
Brown pelican
Caspian tern
Common loon
Double-crested cormorant
Forster's tern
Green-winged teal
Herring gull
Horned grebe
Least tern
Lesser scaup
Magnificent frigatebird
Northern shoveler
Osprey
Pintail
Red-breasted merganser
Royal tern
Ruddy duck

Reptiles

Diamondback terrapin

Fishes

Bullshark
Crevalle jack
Gafftopsail catfish
Gray snapper
Gulf killifish
Gulf pipefish
Ladyfish
Lined sole
Longnose killifish
Pigfish
Pinfish
Rainwater killifish

Table 5.9. Animal Life Found in Marine Grassbed Areas or Generally Associated with this Community (Continued)

Red drum
Sailfin molly
Scaled sardine
Sea catfish
Sheepshead
Sheepshead minnow
Silver jenny
Silver perch
Snook
Southern kingfish
Spot
Spotfin mojarra
Spotted seatrout
Striped anchovy
Striped mullet
Tarpon
Tidewater silverside
White mullet
Invertebrates
Northern quahog
Southern quahog

Sources: DNR, 1985, p. 35.
RS&H, 1987.

Table 5.10. Fishes of the Study Area

American eel L	*Anguilla rostrata*
Arrow stargazer O	*Gillellus greyae*
Atlantic bumper OIL	*Chloroscombrus chrysurus*
Atlantic cutlassfish IL	*Trichiurus lepturus*
Atlantic flyingfish O	*Cypselurus heterurus*
Atlantic midshipman O	*Porichthys plectrodon*
Atlantic moonfish OIL	*Selene setapinnis*
Atlantic sharpnose shark O	*Rhizoprionodon terraenovae*
Atlantic spadefish OIL	*Chaetodipterus faber*
Atlantic stingray OLF	*Dasyatis sabina*
Atlantic thread herring OIL	*Opisthonema oglinum*
Ballyhoo O	*Hemiramphus brasiliensis*
Bandtail puffer IL	*Sphoeroides spengleri*
Bank butterflyfish O	*Chaetodon aya*
Bank cusk-eel O	*Ophidion holbrooki*
Bank sea bass O	*Centropristis ocyurus*
Bar drum O	*Pareques sp. nov.*
Bar jack OI	*Caranx ruber*
Barbfish OIL	*Scorpaena brasiliensis*
Batfish O	*Ogcocephalus spp.*
Bay anchovy OIL	*Anchoa mitchilli*
Bay whiff L	*Citharichthys spilopterus*
Belted sandfish OL	*Serranus subligarius*
Bermuda chub OI	*Kyphosus sectatrix*
Bicolor damselfish O	*Pomacentrus partitus*
Bigeye O	*Priacanthus arenatus*
Bigeye stargazer O	*Dactyloscopus crossotus*
Bighead searobin OIL	*Prionotus tribulus*
Bigmouth sleeper L	*Gobiomorus dormitor*
Black drum IL	*Pogonias cromis*
Black grouper O	*Mycteroperca bonaci*
Black margate OI	*Anisotremus surinamensis*
Black sea bass OI	*Centropristis striata*
Blackcheek tonguefish OIL	*Symphurus plagiusa*
Blackear wrasse OI	*Pomacentrus poeyi*
Blackedge moray O	*Gymnothorax nigromarginatus*
Blackfin cardinalfish L*	*Astropogon puncticulatus*
Blackline tilefish O	*Caulolatilus cyanops*
Blacknose shark O	*Carcharhinus acronotus*
Blacktip shark OI	*Carcharhinus limbatus*
Blackwing searobin O	*Prionotus salmonicolor*
Blotched cusk-eel O	*Ophidion grayi*
Blue angelfish OI	*Holacanthus isabelita*
Blue runner OI	*Caranx crysos*
Blue tang I	*Acanthurus coeruleus*
Bluefin killifish F	*Lucania goodei*
Bluefish O	*Pomatomus saltator*
Bluegill F	*Lepomis macrochirus*

Bluegold goby O	*Lythrypnus spilus*
Bluehead O	*Thalassoma bifasciatum*
Bluespotted searobin O	*Prionotus roseus*
Bluespotted sunfish F	*Enneacanthus gloriosus*
Bluntnose stingray OL	*Dasyatis sayi*
Bob's halfbeak IL	*Hyporhamphus roberti*
Bonnethead OI	*Sphyrna tiburo*
Bowfin F	*Amia calva*
Bridled goby O	*Coryphopterus glaucofraenum*
Broad flounder OIL	*Paralichthys squamilentus*
Brook silverside F	*Labidesthes sicculus*
Brown bullhead F	*Ictalurus nebulosus*
Bull shark OILF	*Carcharhinus leucas*
Chain pipefish OILF	*Syngnathus louisianae*
Checkered blenny O	*Starksia ocellata*
Checkered puffer IL	*Sphoeroides testudineus*
Clearnose skate O	*Raja eglanteria*
Clown goby LF	*Microgobius gulosus*
Clown wrasse OI	*Pomacentrus maculipinna*
Cobia O	*Rachycentron canadum*
Cocoa damselfish OIL	*Pomacentrus variabilis*
Code goby L	*Gobiosoma robustum*
Conchfish L	*Astropogon stellatus*
Crested goby LF	*Lophogobius cyprinoides*
Crevalle jack OILF	*Caranx hippos*
Cuban anchovy OIL	*Anchoa cubana*
Cubbyu O	*Pareques umbrosus*
Cubera snapper OIL	*Lutjanus cyanopterus*
Darter goby L	*Gobionellus boleosoma*
Doctorfish OI	*Acanthurus chirurgus*
Dog snapper OIL	*Lutjanus jocu*
Dolphin O	*Corphaena hippurus*
Dusky anchovy OIL	*Anchoa lyolepis*
Dusky damselfish OI	*Pomacentrus dorsopunicans*
Dusky flounder O	*Syacium papillosum*
Dusky jawfish O	*Opistognathus whitehursti*
Dusky shark O	*Carcharhinus obscurus*
Dwarf seahorse L	*Hippocampus zosterae*
Emerald goby L	*Gobionellus smaragdus*
Emerald parrotfish L	*Nicholsina usta*
Eyed flounder O	*Bothus ocellatus*
Fat sleeper LF	*Dormitator maculatus*
Fawn cusk-eel O	*Lepophidium cervinum*
Flagfin mojarra I	*Eucinostomus melanopterus*
Flagfish F	*Jordanella floridae*
Flamefish OI	*Apogon maculatus*
Florida gar F	*Lepisosteus platyrhincus*
Florida pompano OI	*Trachinotus carolinus*

Freckled cardinalfish I	*Phaeoptyx conklini*
Freckled soapfish O	*Rypticus bistrispinus*
French angelfish OI	*Pomacanthus paru*
Frillfin goby IL	*Bathygobius soporator*
Fringed filefish OIL	*Monacanthus ciliatus*
Fringed flounder O	*Etropus crossotus*
Gafftopsail catfish OILF	*Bagre marinus*
Gag grouper OIL	*Mycteroperca microlepis*
Gizzard shad F	*Dorosoma cepedianum*
Golden shiner F	*Notemigonous crysoleucas*
Goldspotted killifish IL	*Floridichthys carpio*
Gray angelfish OI	*Pomacanthus arcautus*
Gray flounder O	*Etropus rimosus*
Gray snapper OILF	*Lutjanus griseus*
Gray triggerfish O	*Balistes capriscus*
Great barracuda OIL	*Sphyraena barracuda*
Great hammerhead O	*Sphyrna mokarran*
Greater amberjack O	*Seriola dumerili*
Green moray OI	*Lycodontis funebris*
Guaguanche O	*Sphyraena guachancho*
Gulf flounder OIL	*Paralichthys albigutta*
Gulf killifish IL	*Fundulus grandis*
Gulf kingfish O	*Menticirrhus littoralis*
Gulf pipefish ILF	*Syngnathus scovelli*
Hairy blenny OIL	*Labrisomus nuchipinnis*
Halfbeak OIL	*Hyporhamphus sp.*
Halfbeak OIL	*Hyporhamphus unifasciatus*
High hat OI	*Pareques acuminatus*
Highfin blenny	*Lupinoblennius nicholsi*
Highfin goby L	*Gobionellus oceanicus*
Hogchoker F	*Trinectes maculatus*
Hogfish O	*Lachnolaimus maximus*
Horned searobin O	*Bellatar militaris*
Horse-eye jack OI	*Caranx latus*
Houndfish OIL	*Tylosurus crocodilus*
Inshore lizardfish OIL	*Synodus foetens*
Irish pompano LF	*Diapterus auratus*
Island goby O	*Lythrypnus nesiotes*
Jack Dempsey F	*Cichlasoma octofasciatum*
Jewfish OIL	*Epinephelus itajara*
Jolthead porgy OI	*Calamus bajonado*
Key brotula OIL	*Ogilbia cayorum*
King mackerel O	*Scomberomorus cavalla*
Ladyfish L	*Elops saurus*
Lake chubsucker F*	*Erimyzon sucetta*
Lane snapper OIL	*Lutjanus synagris*
Largemouth bass F	*Micropterus salmoides*
Least killifish F	*Heterandria formosa*

Table 5.10. Fishes of the Study Area (Continued)

Leatherjacket OILF	*Oligoplites saurus*
Lemon shark O	*Negaprion brevirostris*
Leopard searobin OIL	*Prionotus scitulus*
Leopard toadfish O	*Opsanus pardus*
Lesser electric ray OI	*Narcine brasiliensis*
Lined seahorse OIL*	*Hippocampus erectus*
Lined sole L	*Achirus lineatus*
Little tunny OI*	*Euthynnus alletteratus*
Longfin scorpionfish O	*Scorpaena agassizi*
Longnose gar F	*Lepisosteus osseus*
Longnose killifish IL	*Fundulus similis*
Lookdown OIL	*Selene vomer*
Lyre goby F	*Evorthodus lyricus*
Man-of-war fish OI	*Nomeus gronovii*
Marbled puffer O	*Sphoeroides dorsalis*
Marginate cusk-eel O	*Ophidion marginatum*
Masked goby O	*Coryphopterus personatus*
Midnight parrotfish O*	*Scarus coelestinus*
Mohogany snapper OI	*Lutjanus mahogoni*
Molly miller OI	*Scartella cristata*
Mosquitofish LF	*Gambusia affinis*
Mottled cusk-eel O	*Lepophidium jeannae*
Mutton snapper OIL	*Lutjanus analis*
Naked goby LF	*Gobiosoma bosci*
Naked sole O	*Gymnachirus melas*
Nassau grouper O	*Epinephelus striatus*
Neon goby O	*Elacatinus oceanops*
Night sergeant OI	*Abudefduf taurus*
Northern kingfish O	*Menticirrhus saxatilis*
Northern sennet OIL	*Sphyraena borealis*
Nurse shark O*	*Ginglymostoma cirratum*
Ocean surgeon OI	*Acanthurus bahianus*
Oceanic whitetip shark O	*Carcharhinus maou*
Oyster toadfish L	*Opsanus tau*
Palespotted eel O	*Ophichthus ocellatus*
Palometa O	*Trachinotus goodei*
Pancake batfish O	*Halieutichthys aculeatus*
Pearly razorfish O	*Hemipteronotus novacula*
Penninsula silverside OIL	*Menidia peninsulae*
Permit OIL	*Trachinotus falcatus*
Pigfish OL*	*Orthopristis chrysoptera*
Pinfish ILF	*Lagodon rhomboides*
Planehead filefish OIL	*Stephanolepis hispidus*
Plumed scorpionfish OIL	*Scorpaena grandicornis*
Polka-dot batfish O	*Ogcocephalus radiatus*
Polka-dot cusk-eel O	*Otophidium omostigmum*
Porcupinefish O	*Diodon histrix*
Porkfish OIL	*Anisotremus virginicus*

Puddingwife OI	*Pomacentrus radiatus*
Purple reeffish O	*Chromis scotti*
Purplemouth moray O	*Lycodontis vicinus*
Queen angelfish OI	*Holacanthus ciliaris*
Rainbow parrotfish OI	*Scarus guacomaia*
Rainwater killifish IL	*Lucania parva*
Red barbier O	*Hemanthias vivanus*
Red drum OIL	*Sciaenops ocellata*
Red goatfish O	*Mullus auratus*
Red grouper OIL	*Epinephelus morio*
Red porgy O	*Pagrus pagrus*
Red snapper O	*Lutjanus campechanus*
Redear sunfish F	*Lepomis microlophus*
Redfin needlefish OILF	*Strongylura notata*
Redfin parrotfish OIL	*Sparisoma rubripinne*
Redtail parrotfish OIL	*Sparisoma chrysopterum*
Reef croaker O	*Odontoscion dentex*
Robin's flounder O	*Bothus robinsi*
Rock sea bass O	*Centropristis philadelphica*
Rosy blenny L	*Malacoctenus macropus*
Rough silverside IL	*Membras martinica*
Roughtail stingray O	*Dasyatis centroura*
Roughtongue bass O	*Holanthias martinicensis*
Round scad O	*Decapterus punctatus*
Saddle blenny O	*Malacoctenus triangulatus*
Saddle stargazer O	*Platygillellus rubrocinctus*
Sailfin flyingfish O	*Parexocoetus brachypterus*
Sailfin molly F	*Poecilia latipinna*
Sailfish O	*Istiophorus albicans*
Sailor's choice OIL	*Haemulon parrai*
Sand drum OI	*Umbrina coroides*
Sand perch O	*Diplectrum formosum*
Sand stargazer IL	*Dactyloscopus tridigitatus*
Sandbar shark O	*Carcharhinus plumbeus*
Sargassum pipefish O	*Syngnathus pelagicus*
Sargassumfish O	*Histrio histrio*
Scaled sardine OIL	*Harengula jaguana*
Scalloped hammerhead O	*Sphyrna lewini*
Scamp O	*Mycteroperca phenax*
Schoolmaster OIL	*Lutjanus apodus*
Sea catfish OILF	*Ariopsis felis*
Seaboard goby O	*Gobiosoma ginsburgi*
Sergeant major OIL	*Abudefduf saxatilis*
Sharksucker OI	*Echeneis naucrates*
Sheepshead OILF	*Archosargus probatocephalus*
Sheepshead minnow L	*Cyprinodon variegatus*
Shortnose batfish O	*Ogcocephalus nasutus*
Silky shark O	*Carcharhinus falciformis*

Silver anchovy O	*Anchoviella eurystole*
Silver jenny OILF	*Eucinostomus gula*
Silver perch L	*Bairdiella chrysoura*
Skilletfish OL	*Gobiesox strumosus*
Slashcheek goby F	*Gobionellus pseudofasciatus*
Slippery dick OIL	*Halichoeres bivittata*
Smallmouth grunt O	*Haemulon chrysargyreum*
Smooth trunkfish OIL	*Rhinesomus triqueter*
Smoothhead scorpionfish O	*Scorpaena calcarata*
Snakefish O	*Trachinocephalus myops*
Snook ILF	*Centropomus undecimalis*
Snowy grouper O	*Epinephelus niveatus*
Southern flounder OIL	*Paralichthys lethostigma*
Southern kingfish O	*Menticirrhus americanus*
Southern puffer IL	*Sphoeroides nephelus*
Spanish grunt O	*Haemulon macrostomum*
Spanish mackerel OIL	*Scomberomorus maculatus*
Spanish sardine OIL	*Sardinella aurita*
Speckled worm eel IL	*Myrophis punctatus*
Spinycheek sleeper L	*Eleotris pisonis*
Spot OIL	*Leiostomus xanthurus*
Spotfin goby L	*Gobionellus stigmaturus*
Spotfin jawfish O	*Opistognathus sp. nov.*
Spotfin mojarra OILF	*Eucinostomus argenteus*
Spottail pinfish OI	*Diplodus holbrooki*
Spotted eagle ray IL	*Aetobatus narinari*
Spotted goatfish O	*Pseudupeneus maculatus*
Spotted hake O	*Urophycis regius*
Spotted moray OI	*Lycodontis moringa*
Spotted scorpionfish OIL	*Scorpaena plumieri*
Spotted seatrout L	*Cynoscion nebulosus*
Spotted soapfish O	*Rypticus subbifrenatus*
Spotted sunfish F	*Lepomis punctatus*
Spotted whiff O	*Citharichthys macrops*
Spottedfin tonguefish O	*Symphurus diomedianus*
Stoplight parrotfish O	*Sparisoma viride*
Striped anchovy OIL	*Anchoa hepsetus*
Striped burrfish OIL	*Chilomycterus schoepfi*
Striped croaker O	*Bairdiella sanctaeluciae*
Striped mojarra ILF	*Eugerres plumieri*
Striped mullet OILF	*Mugil cephalus*
Summer flounder OIL	*Paralichthys dentatus*
Sunshine fish O	*Chromis insolatus*
Swamp darter F	*Etheastoma fusiforma*
Taillight shiner F	*Notropis maculatus*
Tarpon OLF	*Tarpon atlanticus*
Tarpon snook LF	*Centropomus pectinatus*
Tattler O	*Serranus phoebe*

Table 5.10. Fishes of the Study Area (Continued)

Tidewater silverside LF	*Menidia beryllina*
Tiger shark O	*Galeocerdo curvieri*
Tilefish O	*Lopholatilus chamaeleonticeps*
Timucu OIL	*Strongylura timucu*
Tomtate OIL	*Haemulon aurolineatum*
Twospot cardinalfish OI	*Apogon pseudomaculatus*
Vermilion snapper O	*Rhomboplites aurorubens*
Walking catfish F	*Clarias batrachus*
Warmouth F	*Lepomis gulosus*
Warsaw grouper O	*Epinephelus nigritus*
White grunt OIL	*Haemulon plumieri*
White hake O	*Urophycis tenius*
White mullet OILF	*Mugil curema*
Whitefin sharksucker OI	*Echeneis neucratoides*
Whitespotted soapfish O	*Rypticus maculatus*
Wrasse bass O	*Liopropoma eukrines*
Yellow chub OI	*Kyphosus incisor*
Yellow jack OI	*Caranx bartholomaei*
Yellowfin menhaden OIL	*Brevoortia smithi*
Yellowfin mojarra OIL	*Gerres cinereus*
Yellowhead jawfish O	*Opistognathus aurifrons*
Yellowtail reeffish O	*Chromis enchrysurus*
Yellowtail snapper OIL	*Ocyurus chrysurus*

*Systems where species are common, frequent, or abundant: O - Offshore waters; I - Inlets; L - Lagoonal system, including brackish impoundments; F - Freshwater tributaries and canals.

Sources: FGFWFC, 1982, pp. 27-33.
RS&H, 1987.

Nearshore Atlantic communities are sensitive to physical alteration and chemical contamination. Physical alteration may occur from natural disturbances such as major storms; from human endeavors including beach nourishment, inlet dredging, and construction of groins, piers, jetties, or bulkheads; or from imprudent recreational or commercial use of the resource. Resulting damages include outright habitat destruction, smothering of reef or benthic organisms with sand or silt, reduction of light penetration via excessive turbidity, overharvest of sport or commercial species, and scarring or breakage of reef structure. Thus far, the nearshore environment of the Vero Beach area has been spared most of the environmental degradation which is widespread along Florida's coast (FGFWFC, 1982, p. 4).

Algae is prolific in the waters adjacent to Vero Beach. Other vegetation consists of plankton, seaweed and sarragussum.

5.1.1.1 Beach and Dunes

Beaches define the coastline of the barrier island. Subject to winds, tides, waves, and currents, a beach is a constantly changing boundary. Its primary value to the barrier island is its capacity to absorb and dissipate wave energy, thus stabilizing the coastline. The beach is unvegetated and consists of sand and shell materials. It is subject to constant change due to the continual drift and movement of sand (FGFWFC, 1982, p. 8). Littoral drift is the sand which is moved by the process of being washed away by waves and redeposited downdrift of its origin. When this process is interrupted, for example by jetties and groins, the sand is deposited unevenly in one area and eroded in others.

Dunes are divided into two zones, the primary dune (foredune) and secondary dune (backdune). The primary dune extends landward of the backshore. It varies in height and may be only slightly higher than the backshore. The primary dunes in the study area reach a maximum height of approximately 15 feet. Secondary dunes are not well developed throughout the study area and in some sections are nonexistent.

Typical vegetation associated with a primary dune is sparse to moderately dense and is dominated by a few species tolerant of salt spray, desiccation, fluctuating salinities, and changing dune formation. Common primary dune species include sea rocket, railroad vine, sea oats, and a low trailing form of sea grape.

The dune community, while tolerant of environmental stresses such as desiccation and salt spray, is particularly sensitive to physical alteration. The dune flora is intolerant of trampling, requiring long periods of stabilization before complete recovery. Even more destructive to dune integrity is the historic practice of dune-line construction. This practice destroys the native dune flora and fauna, and ultimately the beach-dune structure itself. Attempts to stabilize dunes with such features as bulkheads often accelerate dune erosion because wave energy is no longer dissipated over a dune-fed beach, but concentrated at the wave-bulkhead interface. Because of the expense of beach nourishment or alternative shore stabilization techniques, it is imperative that beach-dune communities be preserved or redeveloped (FGFWFC, 1982, pp. 8-9).

5.1.1.2 Barrier Island Uplands

The uplands of a typical barrier island consist of the coastal strand and coastal hammock. However, in Vero Beach, development has altered both of these communities so that only remnants of these communities exist on the island.

Coastal strand vegetation is usually dominated by saw palmetto, with other important species including marlberry, myrsine, sea grape, tie tongue, wild coffee, white stopper, Spanish stopper, blolly, coco plum and shrub verbena. Remnants of this vegetative community are interspersed in developed areas because Vero Beach requires maintenance of indigenous species as part of its landscape ordinance.

Coastal strand associations succeed to a coastal hammock community, often via a transitional hammock or coastal scrub stage. The coastal hammock can vary from a mature canopy of live oaks and cabbage palms with a sparse understory of wild coffee and stoppers, and a dense ground cover of ferns and vines; to a jungle-like community of tropical hardwoods, vines, and shrubs, with a fairly open canopy of oaks and cabbage palms.

Mature coastal hammocks that would typically be found within the study area are dominated by large live oaks. Significantly, laurel oaks (Quercus laurifolia) and scrub oaks (Q. chapmanii) are rare although these species are abundant west of the Indian River, and north of the study area on barrier islands. This may be due to recent development of the study area's coastal hammocks, and relatively immature alkaline soils. Cabbage palms are codominant in many hammocks, and important canopy or understory plants include paradise tree, gumbo limbo, wild lime, Hercules club, wild mastic, myrsine, white stopper, Spanish stopper, twinberry, shore bay, tough buckthorn, shining sumac, wild coffee, snowberry, poison ivy, greenbrier, wild grapes, gopher apple, tread softly, ferns, and various grasses. Green pine, cypress rose pine, ball moss, golden polypody, shoestring fern, resurrection fern, and wild orchids are often found within the live oak - cabbage palm canopy. Brazilian pepper and Australian pine are commonly encountered in or adjacent to these hammocks, with Brazilian pepper often totally displacing the native understory (FGFWFC, 1982, p. 11).

In Vero Beach, both the coastal strand and coastal hammock communities have been severely modified and in many cases removed by urban development. The island is almost completely urbanized. Isolated remnants of coastal hammocks remain within developments on the south end of the barrier island. There is no accurate means of mapping these based on current data.

5.1.1.3 Lagoonal System

A typical barrier island will have a transition zone between the barrier island uplands and the river. Usually, these are wetland systems that provide vital habitat for diverse communities of fish and wildlife in addition to their other environmental contributions. However, in Vero Beach, development along the lagoonal shorelines has left only isolated vestiges of these ecosystems. Based on the U.S. Department of Interior National Wetlands Inventory (1984), one intertidal mangrove system remains is located on the mainland shoreline north of the Merrill Barber Bridge (see Figure 5.2). The quality and extent of the wetlands in this area have not been confirmed. The remaining wetland areas are associated with Fritz Island, Prang Island and the spoil islands in the river. The vegetation usually is dominated by red mangroves with occasional black or white mangroves. In some areas it consists of sea rocket, saltwort, perennial glasswort, seashore saltgrass and seashore pespalum. Patches of smooth cordgrass are sometimes found at the waterward edges (FGFWFC, 1982, p.20).

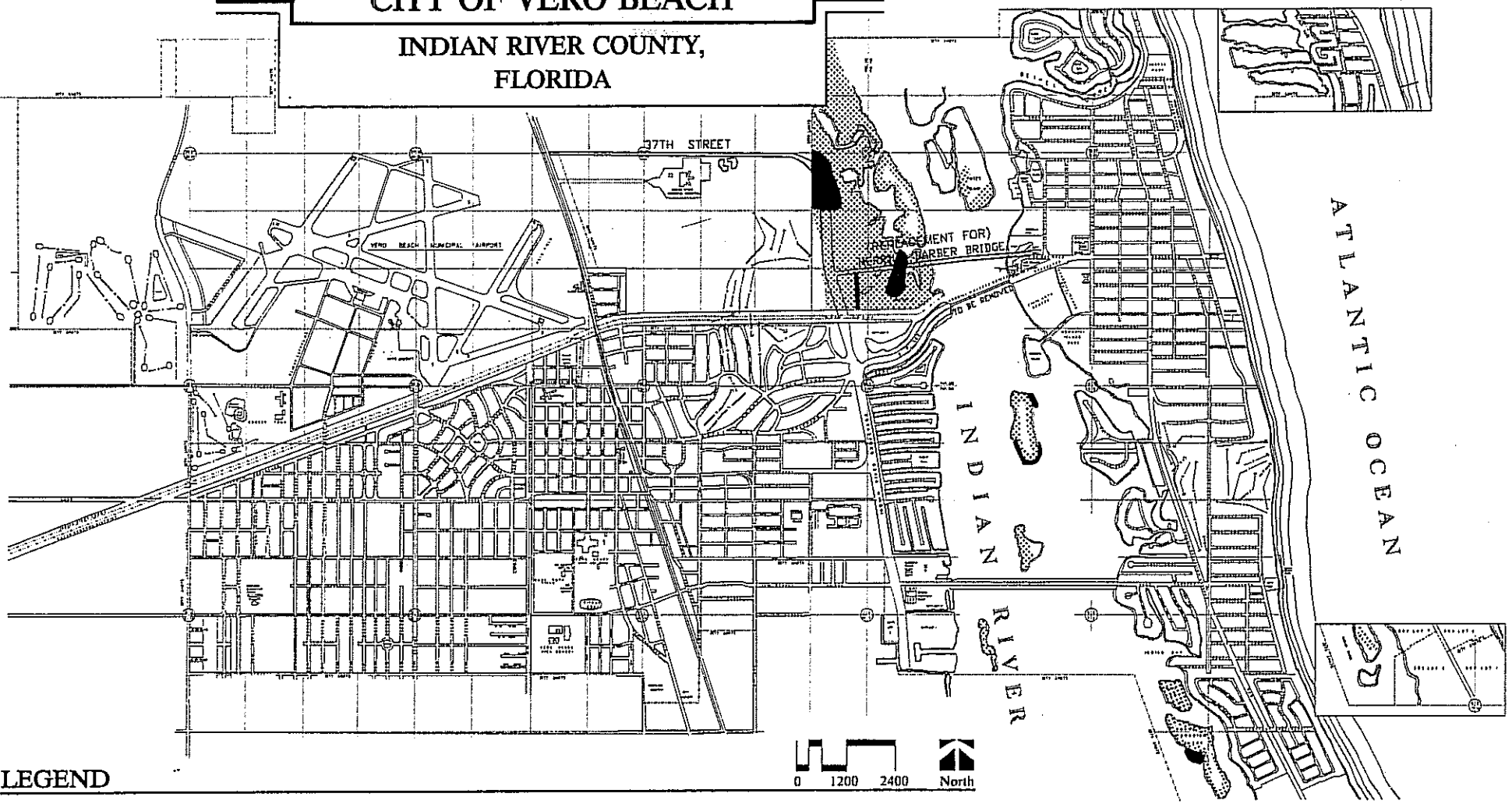
The USFWS Wetlands Inventory Map (1984) indicates that there are other estuarine subtidal areas along the river shoreline. However, existing conditions in Vero Beach indicate that these areas have little, if any, vegetative indicators. Therefore, they are not included on the wetlands map (Figure 5.2).

Within the lagoonal waters are two important vegetative communities, seagrass meadows and drift algae. Seagrass meadows form the most important lagoonal biotope. Seagrass Ecosystems Analysts mapped the seagrasses of the Indian River Lagoon from Sebastian Inlet to St. Lucie Inlet in 1986. Seven seagrass species were found; all species occur throughout the lagoon but not in a uniform pattern over all areas (Virnstein & Cairns, 1986, pp. 1, 4). The worst water quality and seagrass conditions were found near the Vero Beach area. Water there is almost always turbid, and only scattered patches of seagrass are found around the spoil islands (see Figure 5.3). In approximate order of decreasing abundance, the following

Figure 5.2

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

Estuarine intertidal scrub shrub of broad leaved evergreen (usually mangrove).

Estuarine subtidal; aquatic bed of rooted vascular vegetation.

WETLANDS

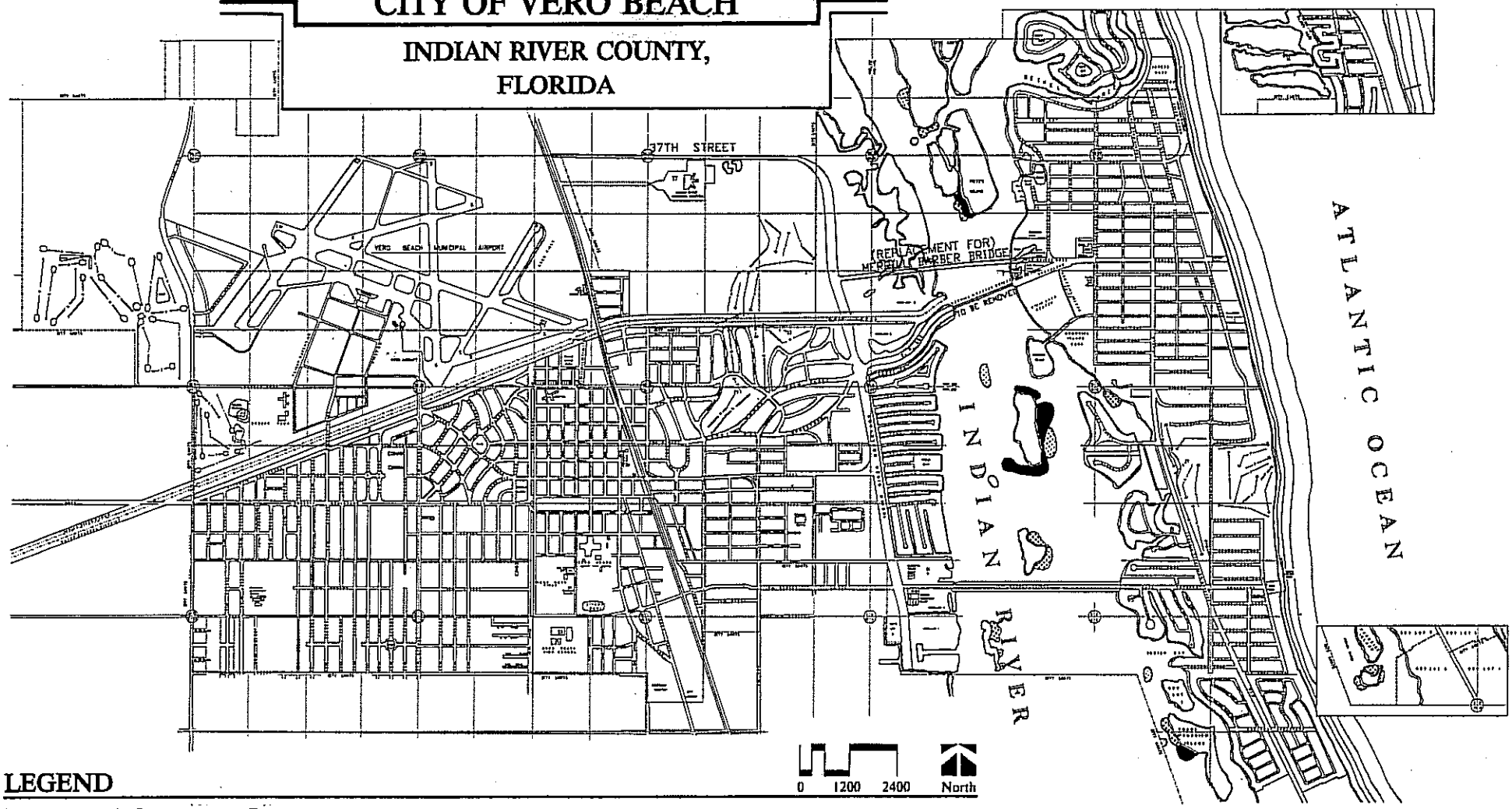
Figure 5.2

RS&H / PLANTEC

SEPTEMBER 1989

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

Percent of Seagrass Cover

- Less than 10%
- 10–40%
- 40–70%
- Greater than 70%

Source: Indian River County

SEPTEMBER 1989

SEAGRASS MEADOWS

Figure 5.3

RS&H / PLANTEC

7/92

species of seagrass were found: manatee grass, Syringodium filiforme; shoal grass, Halodule wrightii; Johnson's seagrass, Halophila johnsonii; turtle grass, Thalassia testudinum; paddle grass, Halophila decipiens; star grass, Halophila englemanni; and widgeon grass, Ruppia maritima.

Drift algae communities are intermediate between exposed bottoms and rooted seagrass meadows. These are formed of unattached, free drifting algae which aggregate in response to prevailing winds, water currents and bottom topography. Particularly large and persistent aggregations occur south of Sebastian Inlet and north of Vero Beach; the dominant genera include Gracilaria, Acanthophora, Hypnea, and Dictyota (FGFWFC, 1982, pp. 23-24). The importance of this community to the Lagoonal ecology has only recently been recognized. It is apparent that this biotope contributes to primary productivity and the overall diversity and stability of the Indian River (FGFWFC, 1982, p. 24).

5.1.1.4 Freshwater Wetlands

Some excavated freshwater mosquito impoundments remain in the coastal area. Although they contain some emergent vegetation, they are not considered freshwater wetlands.

5.1.2 Wildlife Habitats

5.1.2.0 Introduction

Information in this section is based on two separate studies. The first is The Sebastian Inlet-Ft. Pierce Inlet Barrier Island prepared by Florida Game & Fresh Water Fish Commission (1982). This report is a profile of natural communities, development trends and resource management guidelines that influence the barrier island which includes Vero Beach. The second study is The Indian River Lagoon Aquatic Preserves Management Plan prepared by the Department of Natural Resources (1985). No information was found which addressed wildlife for the City of Vero Beach only, therefore these studies were applied to the study area. Neither study specifically addresses the wildlife on the mainland. However, there is no evidence to suggest major differences in wildlife between the mainland coastal area and the barrier island. Tables 5.3 through 5.11 list the wildlife of the barrier island, lagoon and offshore waters; Table 5.12 lists species which are endangered, threatened or of special concern. These tables are located at the end of Section 5.1.

5.1.2.1 Terrestrial Habitats

The backshores and foredunes of the beach and dune community provide preferred nesting sites for sea turtles. The green turtle is particularly sensitive to changing beach-dune formations and avoids nesting where shoreline erosion or accretion is substantial. In the areas of Vero Beach where primary and secondary dunes occur, other species may forage along the primary dune but are most commonly found in the secondary dune: these include the gopher tortoise, old-field mouse, eastern cottontail, raccoon, skinks, anoles, coachwhip, and racer (FGFWFC, 1982, p. 10).

As previously discussed in Section 5.1.1.2, the natural conditions of the barrier island have been severely modified by urban development. As a result of habitat modification, it is likely that associated wildlife species will also have changed. No verification is available, therefore the following species are listed as typical to the barrier island and mainland and may still be found there: the eastern diamondback rattlesnake, crowned snake, hognose snakes, gopher tortoise, old-field mouse, hispid cotton rat, and eastern cottontail. Birds typically observed in this habitat include mockingbirds, ground doves, cardinals, and mourning doves. Other wildlife include raccoons, opossums, nine-banded armadillos, hispid cotton rats, least shrews, eastern moles, red-shouldered hawks, warblers, vireos, woodpeckers, southern toads, tree frogs, skinks, anoles, rat snakes, and hognose snakes (FGFWFC, 1982, pp. 10-11). Tables 5.3-5.5 list common land mammals, reptiles and amphibians.

The estuarine wetland communities on the spoil islands and mainland are also wildlife habitat for various species of fish, wading birds, mammals, reptiles, and amphibians. Cover, food and nesting areas are provided by the wetland habitat. Table 5.6 lists the animal life commonly associated with mangrove wetland communities.

A habitat associated with the Lagoon is the waterbird rookery on the spoil island north of the 17th Street bridge (see Figure 5.4). This is one of six major rookeries between the Sebastian Inlet and Ft. Pierce Inlet. As can be seen from Table 5.7, substantial numbers of birds with special designation nest in the rookery (FGFWFC, 1982, p. 66). Table 5.8 lists birds common to the study area.

Table 5.11. Marine Mammals of the Study Area

Antillean beaked whale	*Mesoplodon europaeus*
Atlantic bottle-nosed dolphin*	*Tursiops truncatus truncatus*
Atlantic right whale	*Eubalaena glacialis glacialis*
Bryde's whale	*Balaenoptera edeni*
Common dolphin	*Delphinus delphis*
Cuvier's dolphin	*Stenella frontalis*
Dense-beaked whale	*Mesoplodon densirostris*
Dwarf sperm whale	*Kogia simus*
False killer whale	*Pseudorca crassidens*
Finback whale	*Balaenoptera physalus*
Goose-beaked whale	*Ziphus cavirostris*
Gray's dolphin	*Stenella coeruleoalba*
Humpback	*Megaptera novaeagliae*
Killer whale	*Orcinus orca*
Little piked whale	*Balaenoptera acutorostrata*
Long-beaked dolphin	*Stenella longirostris*
Manatee*	*Trichechus manatus latirostris*
Pigmy killer whale	*Feresa attenuata*
Pygmy sperm whale	*Kogia breviceps*
Risso's dolphin	*Grampus griseus*
Rough-toothed dolphin	*Steno bredanensis*
Sei whale	*Balaenoptera borealis*
Short-finned pilot whale	*Globicephala macrorhyncha*
Sperm whale	*Physeter catodon*
Spotted dolphin	*Stenella plagiodon*
True's beaked whale	*Mesoplodon mirus*

*Frequently occurring in nearshore waters.

Sources: FGFWFC, 1982, p. 45.
RS&H, 1987.

Table 5.12. Species of the Indian River Lagoon Area which are Classified as Endangered, Threatened, or of Special Concern

ENDANGERED

Reptiles

Atlantic green turtle	*(Chelonia mydas mydas)*
Atlantic hawksbill turtle	*(Eretmochelys imbricata imbricata)*
Atlantic Ridley turtle	*(Lepidochelys kempii)*
Atlantic salt marsh snake	*(Nerodia fasciata taeniata)*
Leatherback turtle	*(Dermochelys coriacea)*

Birds

Peregrine falcon	*(Falco peregrinus)*
Wood stork	*(Mycteria americana)*

Mammals

West Indian manatee	*(Trichechus manatus)*

THREATENED

Reptiles

Atlantic loggerhead turtle	*(Caretta caretta caretta)*

Birds

American kestrel	*(Falco sparverius paulus)*
Bald eagle	*(Haliaeetus leucocephalus)*
Eastern brown pelican	*(Pelecanus occidentalis carolinensis)*
Least tern	*(Sterna albifrons)*
Roseate tern	*(Sterna dougallii)*

SPECIES OF SPECIAL CONCERN

Fishes

Common snook	*(Centropomus undecimalis)*
Rivulus	*(Rivulus marmoratus)*

Reptiles

American alligator	*(Alligator mississippiensis)*

Birds

American oystercatcher	*(Haematopus palliatus)*

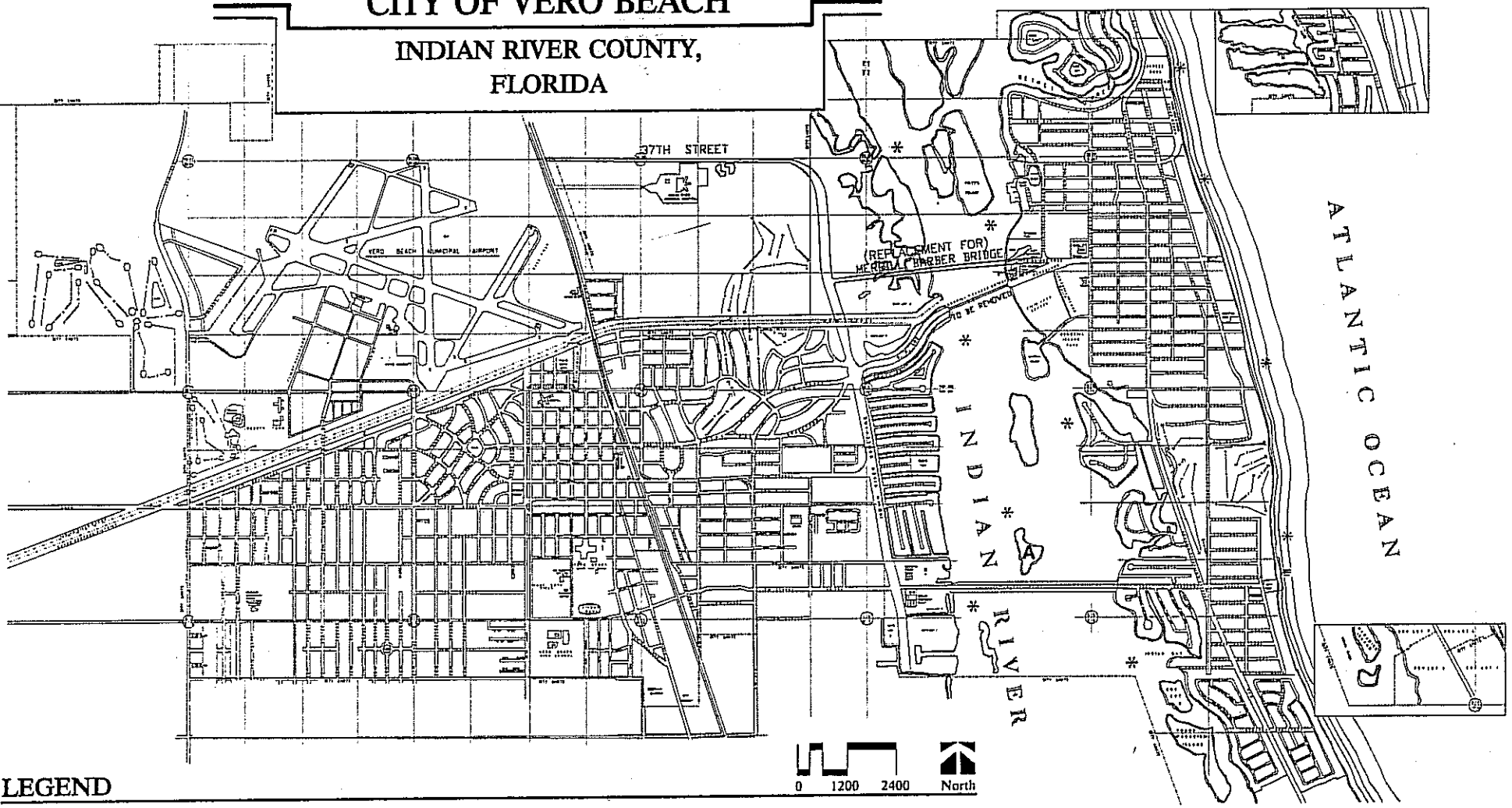
Table 5.12. Species of the Indian River Lagoon Area which are Classified as Endangered, Threatened, or of Special Concern (Continued)

Little blue heron	*(Florida caerulea)*
Louisiana heron *(Hydranassa tricolor)*	
Reddish egret	*(Dichromanassa rufescens)*
Roseate spoonbill	*(Ajaia ajaja)*
Snowy egret	*(Egretta thula)*

Sources: RS&H, 1987.

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

- * Manatee habitat throughout Indian River Lagoon
- * Sea turtle nesting area along beach
- A Riomar Island – major colonial waterbird rookery

SPECIAL WILDLIFE HABITAT AREAS

Figure 5.4

Sources: Vero Beach Planning Dept.; F.G.F.W.F.C. 1982

RS&H / PLANTEC

SEPTEMBER 1989

5.1.2.2 Aquatic Wildlife

The aquatic wildlife resources include those in the Indian River and the nearshore zone of the Atlantic Ocean. Numerous fish species are found in these waterbodies. In addition, the sea manatee (Trichechus manatus) inhabits the lagoonal area and feeds on the seagrass meadows. The seagrass beds are also habitat for juvenile species of fish, crabs, shrimp and lobster and other macroinvertebrates. Table 5.9 lists the species generally associated with marine grassbed communities. Tables 5.10 and 5.11 list the fishes and marine mammals known to inhabit the area and specifies which waterbody they inhabit.

In the Atlantic Ocean the nearshore reefs create habitat for a variety of organisms. Sabellariid worms, primarily Phragmatoma lapidosa colonize the reefs and provide a stable substrate for marine fauna such as algae, sponges, molluscs, crabs, lobster, bryozoans, sea anemones and a wide assortment of fish (FGFWFC, 1982, p. 5).

The open, sandy, ocean bottom is inhabited by burrowing animals such as scallops, clams, and sand dollars. Dominant taxa include flatfish, snake eels, searobins, stingrays and batfish (FGFWFC, 1982, p. 6).

5.1.2.3 Species That Are Endangered, Threatened and of Special Concern

Table 5.12 lists those animal species which are designated as endangered, threatened or of special concern. Efforts should be made to improve habitat conditions and reduce the negative impacts to the habitats of these species.

5.1.3 Coastal Flooding

The areas of Vero Beach which are subject to coastal flooding are shown in Section 5.5.0, Hurricane Evacuation Planning.

5.2 LAND USE INVENTORY AND ANALYSES

5.2.0 Existing Land Uses

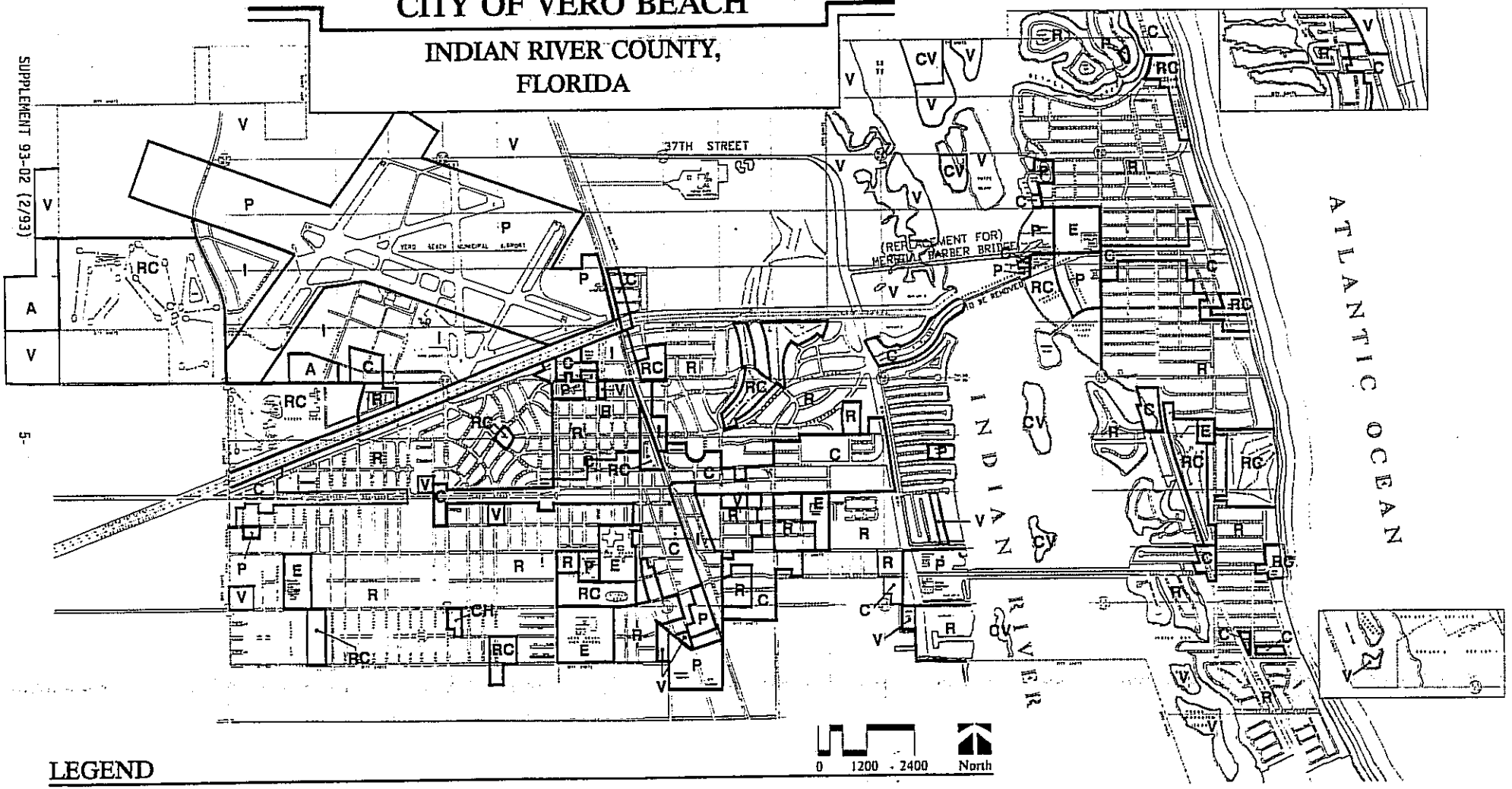
5.2.0.0 Introduction

The coastal area of Vero Beach is heavily developed and populated. Figure 5.5 shows the existing land uses. The barrier island consists of large tracts of low density residential with concentrations of higher density residential and commercial adjacent to the major roads, bridges and ocean front. Except for a few remaining areas of undeveloped land, the barrier island is urbanized from the Indian River to the ocean.

The mainland area included in the Coastal Zone is likewise almost completely developed. Residential land uses predominate. The business and commercial district of Vero Beach is included in the coastal area. Two municipal utility plants for power and sewage treatment are sited on the river.

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

R	Residential Use	CV	Conservation Use
C	Commercial Use	E	Educational Use
I	Industrial Use	P	Public buildings, grounds, and other public facilities
A	Agricultural Use		
RC	Recreational Use	V	Vacant or undeveloped land

EXISITING LAND USE (1987)

Figure 5.5

Source: Vero Beach Planning Department

RS&H / PLANTEC

SEPTEMBER 1989

7/92

5.2.0.1 Water-Dependent Uses

The Florida Department of Community Affairs (DCA) defines water-dependent uses as those "activities which can be carried out only on, in or adjacent to water areas because the use requires access to the water body for: waterborne transportation including ports or marinas; recreation; electrical generating facilities; or water supply" (DCA, 1986, p.16). Water-dependent uses (see Figure 5.10) occurring in Vero Beach include marinas on the eastern shoreline of the river, an electric generating facility, and wastewater treatment plant on the western shoreline, commercial fishing and recreation (beaches, fishing piers, boat ramps).

5.2.0.2 Water-Related Uses

These uses are defined by the DCA as "activities which are not directly dependent upon access to a water body but which provide goods and services that are directly associated with water-dependent or waterway uses" (DCA, 1986, p. 17). Land uses in Vero Beach which are considered water-related include the following: support facilities for marinas; commercial resorts associated with water-dependent recreation activities or marinas; upland areas and support facilities for fish camps, parks and recreation areas.

5.2.0.3 Estimate of Need for Water-Dependent and Water-Related Uses

The information required in order to estimate these needs is found in Section 5.6, Public Access, and Section 4.0, Sanitary Sewer, Solid Waste, Drainage, Potable Water and Natural Groundwater Aquifer Recharge Element. The information in the Public Access section documents the existing status of recreational facilities related to the beach or the Indian River. Based on this evaluation, Vero Beach shows a need for marina wet slips. Based on conversations with the Marina Director, a shortage of marina wet slips exists, although this need has not been accurately quantified. By 1995, it is estimated that between 267-279 marina wet slips will be needed and by 2000 there will be a need for between 290-310 slips. There will not be any additional demand for beach frontage or boat ramps in the planning timeframe. The electric and wastewater utilities in Vero Beach are not planning to expand the physical size of their facilities.

5.2.0.4 Shoreline Land Use Conflicts

The shorelines of the lagoon and ocean do not illustrate any significant conflicts in land use. The majority of the lagoon is bounded by low density uses which allow people access to the resource; the resource is not significantly threatened; and the uses themselves are not incompatible with each other. The potential areas of conflict are the marinas and utility plants. As they are, the marinas have a low impact on surrounding uses and are sited in appropriate locations. Expansion of the marinas should not cause conflicts with adjacent residential uses because sufficient expansion space exists. The marinas are adjacent to public open spaces which provide some buffer between the marinas and residential uses. The utility plants occupy a small area of the shoreline. No future expansion of the physical plants is proposed for the planning timeframe. There is little impact on surrounding uses. As shown on the Future Land Use Map, no additional lagoon shoreline is designated for utility.

The oceanfront is dominated by high density uses from the northern City limits to approximately Riomar Drive and between Sandpiper Lane and Seagull Drive. Hotels, condominiums and tourist commercial uses line these sections of the beachfront. Lower density residential uses are located on the ocean between these sections as well as westward of the higher density uses. The most obvious conflict the high intensity uses create is the restriction of beach access, both visually and physically. However, Vero Beach maintains sufficient numbers of walkways, access drives and parks to provide adequate physical access for beach users. Due to existing elevations, visual access to the beach is limited. The public access points used by pedestrians offer the best accessibility visually.

5.2.0.5 Recommendations for Minimizing Shoreline Land Use Conflicts

The projections for future needs for water-dependent and water-related shoreline uses indicate that there should be no additional shoreline conflicts resulting from siting new facilities. Marina expansion will occur in areas already designated for that use. No other major facilities are proposed for shoreline sites.

5.2.1 Economic Base Analysis

The economic base of the coastal area in Vero Beach is primarily related to the tourism and resort economic sectors and related support retail and service facilities. Current land uses in the coastal zone are predominantly low-density residential, with some concentrations of higher density residential and commercial uses located along the ocean front and major roadways. The higher density residential uses that occur are typically condominium developments, many of which are rented to seasonal visitors or used as winter homes by their owners. Commercial uses consist primarily of hotels/motels and tourist commercial uses, as well as retail and service establishments that serve the needs of both the permanent resident population as well as the seasonal visitors.

There are nearly 1,000 hotel/motel rooms in Vero Beach, and over 1,100 seasonal housing units. Most of these are located in the coastal zone area. The 3.9 miles of Atlantic Coast shoreline in Vero Beach are almost entirely dedicated to public recreational uses. Many establishments such as restaurants, hotels and condominiums have located on the ocean front in order to take advantage of the recreational opportunities provided by the beach. These are in addition to the hotels and motels, six marinas, three boat ramps, and four public parks, three of which include a boardwalk/pier facility, found in the coastal zone. All of these facilities cater to recreation-oriented demands, including those of the seasonal tourist population

The employment base of the coastal zone is rather mixed, but nevertheless dominated by, and dependent upon, the tourism/recreation industry. On the barrier island, the employment base is almost entirely related to retail and services. The predominant employment categories in the retail sector are General Merchandise Stores (SIC 53), Apparel and Accessory Stores (SIC 56), Eating and Drinking Places (SIC 58), Miscellaneous Retail (SIC 59), Hotels and Other Lodging Places (SIC 70) and Personal Services (SIC 72). Clearly, these employment categories represent an economic base that is dependent upon a continued tourism and recreation industry. Future land use plans for the coastal zone do not anticipate any departure from this tourism/recreation base. The existing economic base of the Vero Beach Coastal Zone should continue through the horizon of this Comprehensive Plan.

5.2.2 Areas Needing Redevelopment

There are no areas in the Vero Beach coastal area that need redevelopment.

5.2.3 Effects of Future Land Uses on Natural Resources

As noted earlier, the coastal area is essentially built out; remaining future growth will not be of the intensity which would negatively impact the remaining natural resources. The Future Land Use Map (see Figure 1.5) indicates changes to existing land uses which further restrict development of environmentally sensitive areas and lands adjacent to environmentally sensitive areas, either by type or density, which would create additional impacts that would negatively affect the remaining natural resources, except on the islands of Fritz, Prang and Government Lot 3 and the mainland area north of the main canal on the western edge of the Indian River.

The extent and quality of the wetlands in Vero Beach has not been determined. Mangrove systems along the edges of the islands will not be impacted by development due to existing controls.

Impacts to living marine resources from residential development on the islands will be minimized by not allowing runoff, the protection of mangrove fringes and restrictions on alteration of the circulation patterns of the Indian River as a result of a bridge.

5.2.4 Impacts of Development and Redevelopment on Historic Resources

5.2.4.0 Archaeological and Historic Resources of Vero Beach

The Florida Master Site File for Indian River County provides a listing of the archaeological sites and historic structures known in Vero Beach. However, this file is based only on sites reported to the Division of Historical Resources; a complete survey of the historic resources of Vero Beach has never been undertaken. Seven sites are listed for Vero Beach, six of these are in the coastal area (see Table 5.13). These sites are archaeological sites which have files and completed site forms on record with the Division of Historical Resources. These sites represent different cultural periods and types of remains. No historic structures are located in the coastal area.

5.2.4.1 Impact of Future Land Use on Archaeological and Historic Resources

The six archaeological sites in the coastal area are afforded little substantive legal protection. For sites on private property, the owner is only obligated to a review for permit if federal or state funds are used for work done to the site. Otherwise, the owner has no legal obligation to maintain the site. This status would most likely apply to sites 8IR9, 8IR16, 8IR25A and 8IR52. For sites that are on state property, Florida law (Ch. 267, F.S.) requires a review before any sites are changed or moved. Shipwrecks are considered state property and would therefore be subject to the review process before any salvage, dredging or other activities occurred which would negatively impact their existing conditions. This pertains to 8IR27 and 8IR29.

Except for the two shipwrecks, the sites are in developed areas and have, therefore, most likely been impacted by urban development. The City has no jurisdiction over privately owned sites or the shipwrecks in state waters. The City therefore has little ability to influence the conditions of any of the sites listed in Table 5.13. The City will cooperate with private owners and the state in efforts to preserve the integrity and historic value of the sites.

5.3 ESTUARINE POLLUTION

5.3.0 General Conditions

The City of Vero Beach is located on the Indian River, a long, wide, shallow estuarine lagoon bounded on the west by the Florida mainland and on the east by bar-built barrier islands. The river is part of the Lower East Coast Basin which extends from Ponce de Leon Inlet at New Smyrna Beach to the St. Lucie Inlet at Stuart and contains the Mosquito Lagoon and Banana River along with the Indian River (FDER, 1980, p III-1). The Indian River estuarine community is considered to be one of the richest in the United States in terms of productivity and the numbers of existing plant and animal species (FGFWFC, 1982, p.1). It derives its estuarine character from the mixing of fresh and salt waters. Freshwater sources are rainfall, groundwater from both the surficial and Floridan aquifers, small amounts of overland sheet flow, discharges from drainage canals and two rivers, the Sebastian and St. Lucie. Five inlets to the ocean allow for mixing of saline and fresh waters. These five connections are the Ponce Inlet, Port Canaveral Inlet, Sebastian Inlet, Ft. Pierce Inlet and the St. Lucie Inlet. The Sebastian and Ft. Pierce Inlets exert the greatest tidal influences over the lagoon. However, flushing currents which are strong near the inlets are greatly reduced by the narrow configuration of the lagoon and the constrictions created by the causeways which span the river.

Table 5.13. Known Archaeological and Historic Sites

Site #	Cat	Site Name	Culture	Type/Comments
81R9	A*	Vero Locality	---	Scattered Artifacts circa, 800 B.C. to 700 A.D.
81R16	A	Beach Land	St. Johns II	Prehistoric Midden(s) Prehistoric Mound(s)
81R25A	A	Nunn	---	Redeposited Material from Earlier Ship wreck
81R27	A	Riomar Wreck	Spanish	Historic Shipwreck, circa, 1715
81R29	A	Breckonshire	British	Historic Shipwreck, circa, 1800s
81R52	A	Castaways	Glades, Glades I Glades IIA, Glades IIB	Prehistoric Shell Midden House

*Archaeological site with full file and completed site form

Source: Division of Historical Resources, Florida Master, Site File, 10/21/87.

The Indian River is particularly vulnerable to degradation by surrounding development because of its shallow configuration, limited flushing characteristics and abundance of sensitive habitats. Water exits the system by only two means, flushing by ocean tides and evaporation/evapotranspiration. Circulation patterns, and thus mixing, are wind driven on the northern half and tidally driven on the southern half (FDER, 1980, p. III-1) and therefore highly variable. Environmental studies have identified nutrient eutrophication as the single greatest threat to the stability and long-term quality of the Indian River estuary (FGFWFC, 1982, p. 22).

5.3.0.0 Existing Conditions

The watershed of the Lower East Coast Basin is dominated by agriculture and range-land uses (FDER, 1980, p. III-3). However, the Vero Beach area is a densely populated urban center as are other cities such as Titusville, Cocoa, Merritt Island, Melbourne and Ft. Pierce. These urban areas are all situated along the lagoon and are a potential source of significant amounts of pollution from both point source and non-point sources.

Data are available which establish the existing conditions of waters in the Vero Beach area. Drainage canals that collect runoff are monitored by the U.S.G.S. (1985), which has a sampling station on the Main Canal. The Indian River Farms Water Control District (IRFWCD) collects data at two sampling areas in the City. The Florida Department of Environmental Regulation studied the 16th Street Canal watershed in Vero Beach (FDER, 1980) and completed a study which included a water quality assessment, non-point source assessment, and non-point source control needs. Water quality in the Indian River has been assessed and is documented in the State of Florida's 1986 305(b) Technical Report (FDER, 1986) and the Florida East Coast Basin Assessment Report (FDER, 1984).

The state has classified the waters of the Indian River that are within the City limits of Vero Beach as Class III (see Figure 5.6). The 305(b) report from FDER (1986) classifies the overall quality of the South Indian River Basin from Sebastian Inlet to Ft. Pierce as "Fair-partially meets use." In the Vero Beach area, the pollution problems are attributable to increased nutrient levels from urban runoff (see Table 5.14). Table 5.15 contains the trend analysis for reaches with fair and poor water quality and it notes where improvement trends have occurred. Two reaches near Vero Beach, #4.00 and #8.00, show better conditions (see Figure 5.6).

The Basin Assessment Survey (BAS) prepared by FDER (1984) subdivides the St. Johns River Basin into several segments and tests for chemical and biological parameters at sampling stations. The segment which includes Vero Beach extends from Sebastian Inlet, 22 miles south to the St. Lucie County line. The most developed portion of this segment is Vero Beach. Moderate development occurs north of Vero Beach at Johns Island, Wabasso and Sebastian. From Vero Beach to the end of the segment there is little development. The results from the eight sampling stations and one point source are shown in Table 5.16. In summary, Stations 7 and 8 which are downwind of Vero Beach have the worst water quality. Overall, the segment has fair to poor water quality (FDER, 1984, p.90).

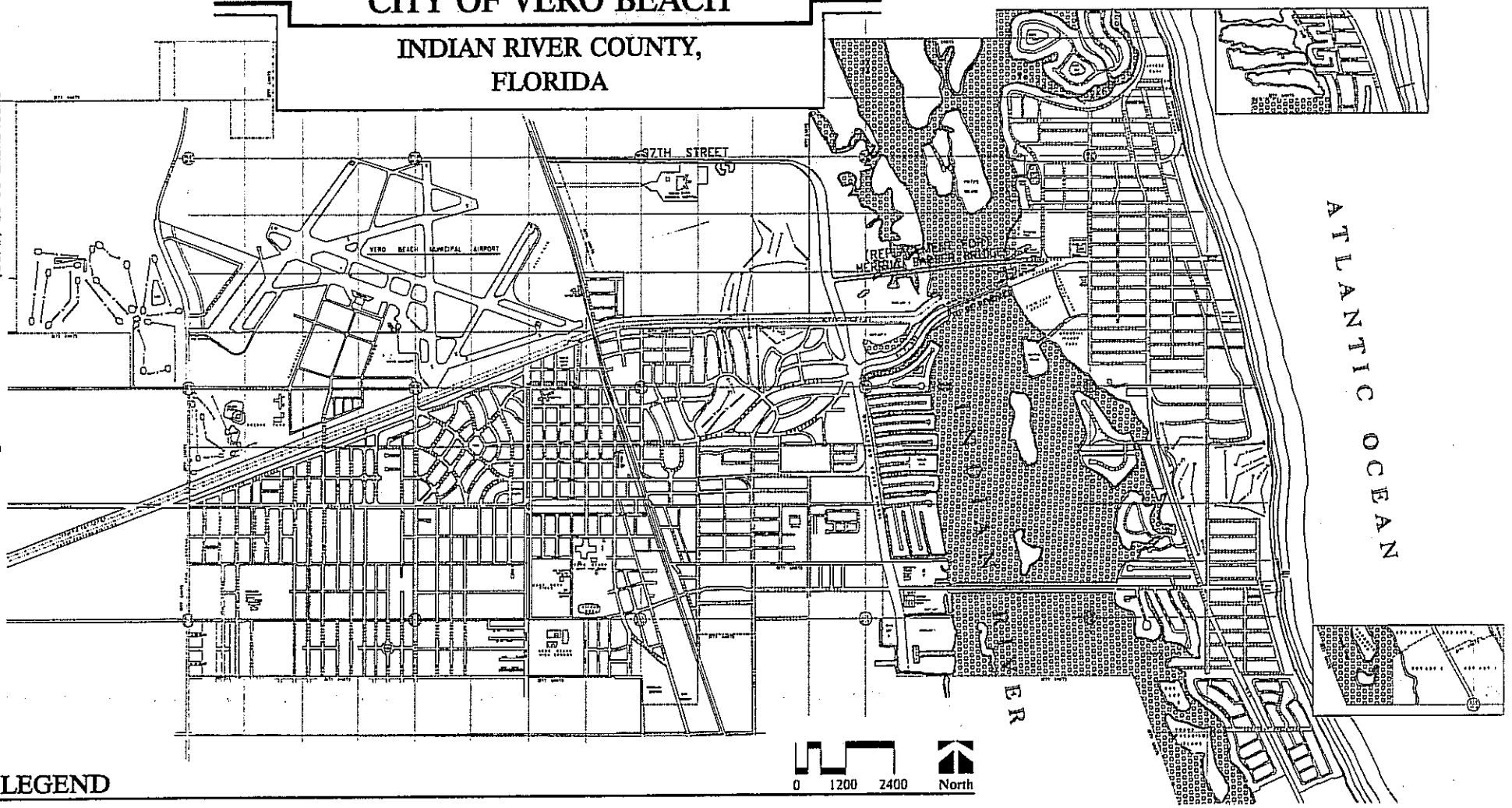
5.3.0.1 Existing Point Source and Non-Point Source Pollution

Point source discharges into the Lagoon from the City are limited to three sources. The Main and 16th Street Canals carry urban runoff from the Vero Beach watershed. The Municipal Sewage Treatment Plant (4.5 MGD) either discharges treated effluent into the Indian River or supplies cooling water to the electric generating plant (FDER, 1980, p. III-46).

The Main and 16th Street Canals are sources of point-source discharge to the Indian River Lagoon. However, they are fed by non-point sources in their respective watersheds. Evaluation and comparison of the conditions in these canals reflects conditions within their respective watersheds and can influence decisions concerning land use and drainage management. Limited water quality data exists for the 16th Street Canal. The most comprehensive data exists for the Main Canal (see Table 5.17). Table 5.18 summarizes the existing data for the Main Canal. Table 5.19 summarizes available data for the 16th Street Canal. The U.S.G.S. maintains a monitoring program for the Main Canal. The 16th Street Canal was studied by FDER as part of the State Water Quality Management Plan (FDER, 1980, p III-36). U.S. Environmental Protection Agency and FDER Water Quality Standards can be found in the Water Resources Atlas of Florida for comparison.

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

Class III Waters

SPECIAL WATER CLASSIFICATIONS
Figure 5.6

Sources: F.G.F.W.F.C., 1982; DNR, 1985

RS&H / PLANTEC

SEPTEMBER 1989

7/92

Table 5.14. Water Quality Index Results for Streams and Trophic State Index for Lakes and Estuaries

Catalog Unit: 3080203

RCH NAME	4.00 South Indian River	5.00 Main Canal	6.00 South Indian River	8.00 Prang Island
WQI	Good	Good	Good	Good
WQI #	13	29	11	11
pH	10	6	10	9
BACT	6	15	6	8
NUT	8	24	4	4
TURB	11	5	5	7
OTOX	0	65	0	0
ITOX	0	15	0	5
DO	14	23	14	15
BD	70	70	72	72
ED	85	85	85	85
NDO	122	110	769	655
NPH	121	107	738	612
NBAC	33	64	261	205
NNUT	73	125	335	301
NTUR	77	129	349	306
NOTX	0	4	0	0
NITX	0	46	0	1
NWQI	55	101	320	289
WATER BODY	Estuary	Stream	Estuary	Estuary
MILE	7.4	8.0	23.5	16.2
TSI	Fair	-	Fair	Fair
TSI #	54	0	50	52
SD	73	0	63	63
CHLA	74	0	10	35
NUT	52	0	43	47
TN	52	0	43	45
TP	67	0	63	60
NTSI	68	0	215	229
NSD	32	0	191	210
NCHLA	5	0	2	16
NTP	68	0	232	243
NTN	68	0	216	230

RCH Reach Number. Numbers with decimal values are new reaches identified by DER
NAME Name of reach
CATALOG UNIT USGS catalog unit

WATER QUALITY INDEX RESULTS

WQI Water quality index result: good, fair or poor
WQI # Water quality index number
pH pH
BACT Bacteria
NUT Nutrients (primarily inorganic nitrogen and phosphorus)
TURB Turbidity
OTOX Organic toxics
ITOX Inorganic toxics
DO Dissolved oxygen
BD Beginning date, first sample year from 1970 on
ED Ending date, last sample year up to 1985
NDO Number of dissolved oxygen samples
NPH Number of pH samples
NBAC Number of bacteria samples
NNUT Number of nutrient samples
NTUR Number of turbidity samples
NOTX Number of organic toxic samples
NITX Number of inorganic toxic samples
NWQI Number of WQI samples
WATER BODY Water body type
MILE Stream mile length of stream reach; square mile area of lake or estuary reach

TROPHIC STATE INDEX RESULTS

TSI Trophic state index result: good, fair or poor
TSI # Trophic state index number
SD Secchi disc transparency
CHLA Chlorophyll
NUT Nutrients based on TN, TP or TN+TP, depending on limiting nutrient
TN Total nitrogen
TP Total phosphorus
NTSI Number of TSI samples
NSD Number of Secchi disc samples
NCHLA Number of chlorophyll samples
NNUT Number of nutrient samples
NTP Number of total phosphorus samples
NTN Number of total nitrogen samples

For Streams: 0-29 is Good; 30-59 is Fair; and 60-100 is Poor.
For Estuaries: 0-49 is Good; 50-59 is Fair; and 60-100 is Poor.

Source: FDER, 1986, p.4.

Table 5.15. Fair and Poor Water Quality Reaches in the Basin: Sources of Pollution, Trends and DER Cleanup Actions

Catalog Unit: 3080203

	REACH NAME		
	4.00 South Indian River	6.00 South Indian River	8.00 Prang Island
Support Designated Use?	Partial	Partial	Partial
Lake-Estuary TSI	Fair	Fair	Fair
Stream WQI Good	Good	Good	
Pollution Sources	STP/NPS	STP/NPS	STP/NPS
Water Quality Trends	Better	Insuf	Better
Special Study Year	---	1985	---
Water Quality Problems and	Poorly flushed estuary around Vero Beach. Lower total nitrogen in 1982-1985.	Very close to good water quality. Ft. Pierce area has good quality due to flushing from inlet. Some STP and nonpoint source input. WLA and recent bioassay studies	East Side of Indian River at Vero Beach (Reach 4.00). Possible recent improvement.

Source: FDER, 1986, p. 87.

Table 5.16. Water Quality Data for Indian River

Station Number	Date	Depth	Temperature	DO	pH	Sal.	Cond.	Alk.	Colnr	Turb.	TSS	TP	TKN	NO2NO3	BOD5	CHL A
J-1	022984	3.00	16.5	6.3	8.1	39.0	42900	122	12	7.0	11	0.05	0.51	0.01	1.1	15.50
J-2	022984	4.00	16.0	6.5	8.0	37.0	43400	123	12	15.0	27	0.10	0.64	0.01	1.2	5.13
J-3	022984	4.50	17.0	6.4	8.0	30.0	38900	128	12	10.0	20	0.10	0.80	0.02	1.0	2.50
J-4	022984	3.50	17.0	6.5	7.9	29.0	37000	132	12	6.0	11	0.09	0.65	0.02	0.8	3.05
J-5	022984	3.00	17.0	6.5	7.9	28.0	36000	133	15	5.0	9	0.09	0.61	0.02	0.7	2.14
J-7	022984	2.50	17.0	6.6	8.1	28.0	34200	134	17	5.2	9	0.10	0.63	0.06	0.8	2.57
J-8	022984	6.50	17.0	6.6	8.0	22.0	32500	136	17	3.3	4	0.09	0.64	0.06	0.9	2.57
J-9	022984	3.00	17.0	6.7	8.1	22.5	34200	137	17	4.6	7	0.08	0.68	0.02	1.1	3.83
J-6	022984	1.00	23.0	7.2	7.2		1200		30	1.5	3	2.14	2.58	6.07	1.1	

Rain Data Vero Beach Sewage Treatment Plant
021984 0.01 Inches
022084 0.10 Inches
022284 0.88 Inches
022384 0.50 Inches
022784 1.07 Inches
022884 0.34 Inches

J-1	090584	3.0	29.5	4.5	8.0	29.0	44100	130	10	6.5	11	0.09	0.55	0.02	1.4	10.20
J-2	090584	3.0	29.5	5.0	8.0	27.0	42300	132	15	6.5	8	0.14	0.73	KO.01	2.2	15.30
J-3	090584	1.5	30.0	5.3	7.9	25.0	38700	131	20	5.2	10	0.12	0.68	KO.01	2.3	18.50
J-4	090584	2.5	29.5	5.0	7.9	23.5	37200	130	25	5.5	9	0.14	0.75	KO.01	2.4	15.90
J-5	090584	4.0	29.5	4.1	7.9	23.0	36300	128	25	7.1	16	0.16	0.83	0.03	2.3	14.10
J-7	090584	2.0	29.0	5.3	7.9	22.5	36200	123	25	6.1	10	0.14	0.79	0.02	2.3	13.40
J-8	090584	1.5	29.0	4.3	7.9	23.5	38000	123	17	5.6	4	0.12	0.79	0.02	2.0	5.56
J-9	090584	3.0	29.0	4.6	8.0	25.5	40800	123	17	5.2	5	0.09	0.61	0.01	1.1	1.44
J-6	090584	0.5	31.0	7.4	7.4		1430		17	2.6	6	3.97	1.47	10.90	0.7	

Rain Data Vero Beach Sewage Treatment Plant
082384 0.12 Inches
082484 0.02 Inches
082584 0.52 Inches
090584 1.27 Inches

Station Number	Storet Number	Description
J-1	27.02.0002	Indian River at ICWW Marker #70 just off Spratt Point south of Sebastian Inlet.
J-2	27.02.0003	Indian River at ICWW Marker #80 250 yards north of Wabasso Bridge on Highway 510.
J-3	27.02.0004	Indian River at ICWW Marker #110 between Pine Island and Barker Island.
J-4	27.02.0005	Indian River at ICWW Marker #123 just off Pople Point.
J-5	27.02.0006	Indian River at ICWW Marker #135 one half mile north of Highway 60 bridge.
J-6	27.02.1510	Vero Beach Sewage Treatment Plant effluent.
J-7	27.02.0007	Indian River at ICWW Marker #150 just off Prany Island south of Sewage Treatment Plant, and power plant effluent.
J-8	27.02.0008	Indian River at ICWW Marker #158 just off Porpoise Point.
J-9	27.02.0009	Indian River at ICWW Marker #168A just off Round Island at Indian River/St. Lucie County line.

Source: FDER, 1984, p.91.

Table 5.17. Coastal Area Sebastian Inlet to St. Lucie River
02253000 Main Canal at Vero Beach, Florida (National Stream-Quality Accounting Network Station) Water Year October 1984-September 1985

Date	Time	Stream Stage (Ft. Above Datum) (00065)	Stream-Flow, Instantaneous (CFS) (00061)	Specific Conductance (US/CM) (00095)	pH (Standard Units) (00400)	Temperature (Degree C) (00010)	Turbidity (NTU) (00076)	Oxygen Dissolved (MG/L) (00300)	Calcium Dissolved (MG/L as CA) (00915)	Magnesium Dissolved (MG/L as MG) (00925)	Sodium Dissolved (MG/L as NA) (00930)	Potassium Dissolved (MG/L as K) (00935)	Alkalinity Field (MG/L as CACO3) (00410)
Nov 29	0824	9.22	120	842	7.5	21.0	10.0	5.1	78	16	76	5.2	150
Jan 25	1849	8.92	74	990	7.6	15.0	1.5	9.1	100	48	210	9.2	164
Feb 28	0908	8.44	26	1920	7.6	22.5	1.5	5.7	110	44	230	8.1	*180
Apr 30	0917	8.53	26	1340	7.6	26.0	.70	5.3	100	29	150	5.4	204
Jul 02	1421	8.86	64	1480	7.4	30.0	1.0	10.6	99	32	150	5.6	175
Aug 14	0856	8.20	2	1120	7.6	29.0	2.3	5.7	86	22	99	7.4	177

Date	Time	Sulfate Dissolved (MG/L as SO4) (00945)	Chloride Dissolved (MG/L as CL) (00940)	Fluoride Dissolved (MG/L as F) (00950)	Silica Dissolved (MG/L as SIO2) (00955)	Solids, Residue at 180° C Dissolved (MG/L) (70300)	Nitrogen NO2+NO3 Dissolved (MG/L as N) (00631)	Nitrogen, Ammonia Dissolved (MG/L as N) (00608)	Nitrogen, Ammonia & Organic Total (MG/L as N) (00625)	Phosphorus, Total (MG/L as P) (00665)	Phosphorus, Dissolved MG/L as P) (00666)	Phosphorus, Ortho, Dissolved (MG/L as P) (00671)	Sediment Suspended (MG/L) (80154)
Nov 29	0824	70	160	.30	11	544	.69	.330	1.2	.210	.180	.160	13
Jan 25	1849	130	500	.50	11	1180	<.10	.090	.70	.050	.050	.030	<1
Feb 28	0908	120	460	.60	6.7	1150	-	-	1.1	.180	.130	-	1
Apr 30	0917	91	270	.40	1.7	845	<.10	.060	.80	.140	.070	.040	2
Jul 02	1421	92	380	.50	8.3	982	<.10	<.010	.70	.180	.160	.150	2
Aug 14	0856	73	230	.60	12	720	.63	.290	1.1	.270	.150	.170	6

Date	Time	Sed. Susp. Sieve Diam. % Finer Than .062 MM (70331)	Aluminum Dissolved (UG/L as AL) (01106)	Arsenic Dissolved (UG/L as AS) (01000)	Barium Dissolved (UG/L as BA) (01005)	Beryllium Dissolved (UG/L as BE) (01010)	Cadmium Dissolved (UG/L as CD) (01025)	Chromium Dissolved (UG/L as CR) (01030)	Cobalt Dissolved (UG/L as CO) (01035)	Copper Dissolved (UG/L as CU) (01040)	Iron Dissolved (UG/L as FE) (01046)	Lead Dissolved (UG/L as PB) (01049)	Lithium Dissolved (UG/L as LI) (01130)
Nov 29	0824	92	40	1	38	.0	<1	<1	<3	6	490	4	5
Jan 25	1849	<1											
Feb 28	0908	1	20	<1	53	<.5	<1	<1	<3	3	43	<1	14
Apr 30	0917	1	20	<1	50	<.5	2	3	<3	9	47	4	15
Jul 02	1421	50											
Aug 14	0856	67	30	2	40	<.5	<1	3	<3	9	430	<1	12

Date	Time	Manganese Dissolved (UG/L as MN) (01056)	Mercury Dissolved (UG/L as HG) (71890)	Molybdenum Dissolved (UG/L as MO) (01060)	Nickel Dissolved (UG/L as NI) (01065)	Selenium Dissolved (UG/L as SE) (01145)	Silver Dissolved (UG/L as AG) (01075)	Strontium Dissolved (UG/L as SR) (01080)	Vanadium Dissolved (UG/L as V) (01085)	Zinc Dissolved (UG/L as ZN) (01090)
Nov 29	0824	41	.1	<10	<1	<1	<1	2200	<6	20
Feb 28	0908	24	.3	<10	1	<1	1	7300	<6	10
Apr 30	0917	12	.3	<10	3	<1	<1	3600	<6	37
Aug 14	0856	60	.4	<10	5	<1	<1	5200	<6	13

Source: USGS, 1985, pp.191-192.

Table 5.18. Summary of USGS Water Quality Data Collected at Selected Stations Near Vero Beach

Parameter	Number of Samples	Units	Mean	Maximum	Minimum	Period of Record
Station #02253000 - Main Canal at Vero Beach						
Turbidity	69	JTU	7.67	40.0	1.00	70/05/02 - 78/04/19
Dissolved Oxygen	75	mg/L	5.76	11.2	0.99	67/05/04 - 79/09/11
Total Nitrogen	68	mg/L	1.31	3.44	0.49	73/02/27 - 79/09/11
Organic Nitrogen	87	mg/L	0.82	2.40	0.17	70/05/02 - 79/09/11
Total Ammonia	80	mg/L	0.12	0.43	0.00	71/08/31 - 79/09/11
Total Nitrate	78	mg/L	0.56	25.0	0.00	71/10/20 - 79/09/11
Total Kjeldahl Nitrogen	67	mg/L	1.01	2.83	0.46	73/02/27 - 79/09/11
Total Phosphorus (as P)	79	mg/L	0.16	0.61	0.04	73/02/27 - 79/09/11
Cadmium (Total)	21	ug/L	0.67	4.00	0.00	74/92/17 - 79/08/09

Source: FDER, 1980, p.111-138.

Table 5.19. Means of Water Quality Parameters in the 16th Street Canal from 3/15/79 - 6/22/79

Parameter	Station 1	2	3	4	5	6	7	8*
Water Temp °C	24.6	24.8	24.9	24.7	25.3	25.4	24.6	25.3
Diss. Oxygen mg/l	5.76	5.68	5.62	6.46	6.58	5.90	5.96	5.52
Ortho PO_4 mg/l	.18	1.11	2.29	2.57	2.64	2.72	2.53	2.50
BOD_5 mg/l	3.22	5.28	5.66	6.48	5.28	5.36	4.98	4.22
TKN mg/l	4.32		9.02			9.92		11.08
NO_3 mg/l	.36	1.09	1.14	2.30	3.01	2.73	2.99	3.62
NO_2 mg/l	.03	.49	1.02	1.10	1.47	1.11	1.23	1.26
Upstream		Net Flow	Wastewater Treatment Plant Discharge			Downstream		

* Concentration of effluent measured at chlorine contact chamber prior to discharge

Source: FDER, 1980, p. 111-43.

The FDER Vero Beach Study (1980) calculated the mean loading for nutrients typically found in agricultural and urban watersheds. These loadings indicate how different watershed characteristics affect water quality in the canals (see Table 5.20). It is apparent from this table that the drainage basins for the Main and South Canals produce the highest loadings per unit drainage area. The drainage basin for the North Canal contains only nine percent urban land use as compared to 16 percent and 20 percent in the Main and South Canal drainage basins (FDER, 1980, p. III-40). This suggests that the more intense the land uses become in the City, the higher the nutrient loadings will be in the Main Canal. This will create a negative impact on the water quality conditions in the canal.

The water quality data for the 16th Street Canal indicates it is highly enriched with phosphorus and nitrogen, especially towards the downstream locations. However, degradation has apparently occurred throughout the canal as evidenced by measurable nitrite concentrations, low dissolved oxygen and fish kills.

The Indian River Farms Water Control District maintains two sampling stations in Vero Beach. Station No. 1 is located at the 43rd Avenue Bridge across the Main Canal. Station No. 2 is located at the salinity control barrier on the Main Canal at Country Club Pointe subdivision. Table 5.21 compiles the data for the last year of sampling. Data from previous years are available from the Water Control District.

The Department of Environmental Regulation maintains monthly reports which provide information about point sources of pollution. The Groundwater Management System (GMS) reports identify point sources of pollution (GMS 18 report) and also provide water quality data on the different point sources (GMS 36 report). The GMS 18 report identifies two surface water outfalls in Vero Beach, the sewage treatment plant and the power plant. The GMS 36 report provides data only for the sewage treatment plant (see Table 5.22).

Average annual loadings were calculated for the Vero Beach municipal sewage treatment plant (FDER, 1980, p. III-45). These calculations were based upon mean effluent concentrations prior to discharge and a 4.5 MGD design flow. Table 5.23 presents the results of these calculations.

Table 5.20. Mean Loading From Canals in and Near Vero Beach (lb/day/mi2 of drainage area)

Canal	TP Load	TN Load	TKN Load	NO_3 Load
North	1.52	6.78	5.56	1.31
Main	1.62	13.27	10.22	5.67
South	2.42	11.83	10.11	0.71

Sources: FDER, 1980, p.111-40.
RS&H, 1987.

Table 5.21. Surface Water Data - Main Canal

Parameter	7-16-86		8-6-86		9-26-86		12-23-86 @ 1700		12-23-86 @ 1620	
	86-1527 #1	86-1528 #2	86-1793 #1	86-1794 #2	86-2418 #1	86-2419 #2	86-2987 #1	86-2988 #2	86-3367 #1	86-3368 #2
Chloride	335	295	300	510	240	450	220	330	345	795
Conductance, Specific, umhos/cm	1,400	1,500	1,000	1,800	700	1,300	1,100	1,000	1,200	2,700
Nitrogen Series:										
Ammonia, Unionized	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate	0.81	0.79	0.59	0.79	.41	.53	.56	.57	.16	.16
Nitrite	0.125	0.131	.034	.036	.040	.039	.057	.043	.010	.009
Total Kjeldahl Nitrogen	1.50	1.30	.98	.94	.86	.86	.72	.78	.76	.64
Oxygen Demand, Biochemical	2.3	1.3	1.8	1.3	<1	<1	2.3	4.5	<1	<1
Oxygen, Dissolved	5.8	5.3	6.4	5.3	5.2	5.1	4.1	6.7	6.1	7.4
pH, Field (Standard Units)	6.8	6.7	6.8	6.7	6.4	6.6	7.0	7.0	7.3	7.8
Phosphate, Ortho	0.34	0.30	.09	.20	.21	.28	.18	.20	.08	.12
Phosphate, Total	0.44	0.39	.17	.26	.30	.35	.25	.29	.10	.14
Total Suspended Solids	21	12	14	29	<1	11	2.	2.	8	14
Turbidity, NTU	31	30	4.6	39	3.6	4.9	2.7	4.1	1.4	4.2
Coliform Bacteria, Fecal counts/100mls	500	450	<100	TNTC	250	1,800	100	350	550	450
Temperature, Air °C	25.0	24.0	27.0	28.0	27.0	27.0	24.	24.7	20.0	20.8
Temperature, Water °C	25.0	27.0	28.0	29.0	28.0	28.0	25.2	24.9	20.2	21.7
Time Sampled	0600	0630	0600	0630	0855	0925	1005	1100	0830	0920

Parameter	10-22-86		1-21-87		3-19-87		6-12-87		6-17-87	
	86-2758 #1	86-2759 #2	87-115 #1	87-116 #2	87-721 #1	87-722 #2	87-1543 #1	87-1544 #2	87-1863 #1	87-1864 #2
Chloride	320	660	236	222	290	315	420	455	390	380
Conductance, Specific, umhos/cm	1,350	6,500	1,000	900	1,100	1,150	1,500	1,750	1,600	1,650
Nitrogen Series:										
Ammonia, Unionized	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate	.15	.24	.83	.72	.79	.83	.19	.18	.04	.04
Nitrite	.030	.022	.055	.039	.045	.049	.030	.028	.004	.004
Total Kjeldahl Nitrogen	.94	.70	.58	.54	1.10	1.00	.86	.74	.52	.46
Oxygen Demand, Biochemical	15.5	11.5	<1	<1	1.0	<1	<1	<1	5.5	6.3
Oxygen, Dissolved	2.3	5.8	5.6	8.7	7.9	8.1	4.5	8.0	10.2	8.1
pH, Field (Standard Units)	6.8	7.3	7.1	7.0	6.8	7.3	7.2	7.5	7.5	7.8
Phosphate, Ortho	.26	.22	.12	.13	.21	.17	.57	.24	.10	.16
Phosphate, Total	.38	.28	.28	.18	.26	.18	.57	.24	.14	.21
Total Suspended Solids	22	14	<1	16	13	8	8	8	13	5
Turbidity, NTU	3.1	5.4	3.1	6.7	14	6.7	2.3	2.1	1.6	3.2
Coliform Bacteria, Fecal counts/100mls	100	300	100	150	350	200	100	200	<100	800
Temperature, Air °C	26.2	26.9	14.1	14.1	18.0	18.5	29.0	29.3	30.7	31.0
Temperature, Water °C	26.2	28.2	17.6	17.6	19.2	19.0	26.5	27.0	29.2	28.7
Time Sampled	1005	1115	1230	1315	0835	0940	1200	1245	1230	1305

NOTE: All results in mg/l unless otherwise noted. Methods for the Examination of Water and Methods.

Source: Indian River Farms Water Control District, Water Year July 1986-June 1987.

Table 5.22. Water Quality at the Vero Beach Wastewater Treatment Plant

Facility No. 5131H03103

Site No. 5131X00013

Parameter		06/87	05/87	04/87	03/87	02/87	01/87	12/86	11/86	10/86	09/86
PH	STD UN	7.00	6.80	7.00	7.10	7.00	7.00	6.70	6.80	6.80	6.90
NITROGEN (N) TOT	MG/L	12.08	15.52	6.80	3.80	5.71	.10	5.50	8.60	13.10	11.80
NH3 N TOT	MG/L			0.200							
PHOSPHORUS TOT	MG/L	6.150	6.000	8.600	4.900	4.570	3.640	4.700	4.000	4.400	3.700
FECAL COLI MF	#/100	3	4	5	10	6	2	3	8	2	8
FLOW, MAX DAILY	MGD	3.1400	2.7300	3.1000	3.5100	3.2800	3.3900	3.1400	4.0900	5.3800	2.8000
FLOW, MONTH AVG	MGD	2.540	2.550	2.750	3.140	3.000	3.030	2.780	3.280	3.020	2.520
CHLORINE RESID	MG/L	0.80	0.60	0.80	0.70	0.80	0.60	0.60	0.60	0.50	0.60
BOD EFF	MG/L	4.0	5.0	4.0	4.0	5.0	5.0	5.0	4.0	4.0	3.0
RES SUSP EFF	MG/L	2	4	3	4	1	4	3	2	2	2

Parameter		08/86	07/86	06/86	04/86	03/86	02/86	01/86	12/85	11/85	10/85
PH	STD UN	7.00	6.80	6.90	6.80	6.90	7.00	7.10	7.00	7.10	7.20
NITROGEN (N) TOT	MG/L	8.90	10.80	11.70	15.90	15.70	15.30	15.90	16.60	16.30	17.40
PHOSPHORUS TOT	MG/L	5.000	6.800	5.500	5.300	5.300	4.200	4.200	5.300	4.800	5.000
FECAL COLI MF	#/100	3	4	2	6	4	2	3	2	3	6
FLOW, MAX DAILY	MGD	3.0000	2.7000	2.7900	3.0100	3.5200	2.9500	3.2000	2.8100	3.2000	3.5900
FLOW, MONTH AVG	MGD	2.680	2.450	2.540	2.670	2.870	2.770	2.820	2.550	2.690	2.950
CHLORINE RESID	MG/L	0.50	0.50	0.50	0.50	0.50	0.50	0.60	0.80	0.80	0.60
BOD EFF	MG/L	3.0	4.0	4.0	10.0	8.0	9.0	9.0	6.0	5.0	5.0
RES SUSP EFF	MG/L	2	3	2	5	8	9	4	4	8	4

Parameter		09/85	08/85	07/85	06/85	05/85	04/85	03/85	02/85	01/85	12/84
PH	STD UN	7.10	7.00	7.00	7.10	7.10	7.20	6.90	6.90	6.80	7.00
NITROGEN (N) TOT	MG/L	16.00	15.90	18.00	17.10	16.30			9.00	8.70	
PHOSPHORUS TOT	MG/L	4.600	4.100	5.700	5.700	5.800			4.800	5.400	
FECAL COLI MF	#/100	21	5	5	6	*	16	10	5	32	48
FLOW, MAX DAILY	MGD	4.5000	2.6600	3.3600	2.4800	2.5700	2.8900	2.8700	2.6700	2.8900	4.5500
FLOW, MONTH AVG	MGD	2.950	2.440	2.590	2.340	2.380	2.610	2.610	2.550	2.620	3.140
CHLORINE RESID	MG/L	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.70	0.60	0.60
BOD EFF	MG/L	4.0	6.0	6.0	7.0	10.0	4.0	7.0	5.0	9.0	8.0
RES SUSP EFF	MG/L	4	2	3	3	5	6	4	4	3	1

Parameter		11/84	10/84	09/84	08/84	07/84	06/84	05/84	04/84	03/84	02/84
PH	STD UN	7.00	7.00	7.00	6.90	6.90	6.80	6.80	6.80	6.90	6.90
FECAL COLI MF	#/100	9	1	3	4	6	5	4	9	12	2
FLOW, MAX DAILY	MGD	5.7900		3.6100	2.3800	2.5200	2.5200	3.0400	2.7500	3.3000	3.5100
FLOW, MONTH AVG	MGD	3.370	2.640	2.770	2.280	2.330	2.410	2.350	2.480	2.920	2.820
CHLORINE RESID	MG/L	0.60	0.80	0.60	0.60	0.60	0.70	0.70	0.65	0.70	0.70
BOD INFL	MG/L			169.0	185.0	193.0	208.0	234.0	209.0	134.0	135.0
BOD EFF	MG/L	13.0	8.0	5.0	2.0	4.0	7.0	10.0	9.0	7.0	6.0
RES SUSP INF	MG/L			83	110	96	89	117	97	85	96
RES SUSP EFF	MG/L	3	2	1	4	2	2	1	2	4	2

Parameter		01/84	12/83	11/83	10/83	09/83	08/83	07/83	06/83	10/81	07/81
PH	STD UN	7.00	6.90	6.80	6.90	6.90	7.00	7.00	6.90	7.20	7.20
FECAL COLI MF	#/100	2	2	3	2	3	4	4	1	1	1
FLOW, MAX DAILY	MGD	3.0800	3.1300	3.0800	4.5800	2.5700	3.0700	2.3800	3.0200	2.8500	2.3400
FLOW, MONTH AVG	MGD	2.820	2.990	2.730	3.060	2.410	2.460	2.250	2.450	2.390	2.100
CHLORINE RESID	MG/L	0.70	0.70	0.70	0.60	0.68	0.75	0.70	0.70	0.60	0.60
BOD INFL	MG/L	153.0	190.0	150.0	139.0	157.0	142.0	140.0	183.0	*	104.0
BOD EFF	MG/L	7.0	7.0	8.0	8.0	6.0	8.0	9.0	9.0	*	5.0
REM. BOD	PERCNT									97.0	97.0
REM. SUS SOL	PERCNT									98.0	97.0
RES SUSP INF	MG/L	88	85	88	69	84	92	98	103	*	125
RES SUSP EFF	MG/L	2	1	2	1	1	5	4	4	*	3

Parameter		05/81	04/81	03/81	02/81
PH LAB	STD UN	7.1	7.1	7.2	7.2
FECAL COLI MF	#/100	1	3	1	1
FLOW, MAX DAILY	MGD	0.0205	2.5900	2.5400	2.1700
FLOW, MONTH AVG	MGD	1.870	2.120	2.170	1.860
CHLORINE RESID	MG/L	0.50	0.50	0.60	0.60
BOD INFL	MG/L	203.0	201.0	199.0	194.0
BOD EFF	MG/L	9.0	7.0	8.0	5.0
REM. BOD	PERCNT	95.0	96.0	96.0	97.0
REM. SUS SOL	PERCNT	98.0	97.0	98.0	99.0
TEST-HSF ONLY	MG/L	4	4	4	4
RES SUSP INF	MG/L	159	172	153	164
RES SUSP EFF	MG/L	2	4	2	1

Source: FDER, 1987, pp. 36-38.

Table 5.23. Point Source Loading in the Vicinity of Vero Beach

Parameter		Avg. Concentration (mg/l)	Annual Load (lbs/yr)
Suspended Solids[1]		19.00	259,241
BOD_5[2]	4.22	57,579	
Total N[2]		16.96	231,406
Total PO_4[3]		7.00	95,510

Lbs/yr = mg/l * MGD * (8.307) * 365 da/yr

[1] Estimated assuming 90-percent design efficiency and 190 mg/l concentration of raw waste.

[2] Concentrations established from average concentrations observed in effluent.

[3] Concentrations estimated based on design efficiency assumed for waste load allocation established by FDER.

Sources: FDER, 1980, p.111-47.
RS&H, 1987.

5.3.0.2 Summary

The Indian River Lagoon adjacent to Vero Beach is more likely to be affected by the non-point source pollutants from urban runoff than from point source discharges. The runoff carried by the Main and 16th Street Canals typically originates from streets, parking lots, roofs, driveways, lawns and construction sites. As a result, significant amounts of organic materials; dissolved and suspended solids; heavy metals, pesticides; oils and grease; sediment; nutrients and pathenogenic organisms are carried to the Lagoon. The extensive seagrass meadows are considered to be the most important ecological community in the river. The biggest environmental threats to the stability of the seagrass beds are increased turbidity and eutrophication. Such increases could lead to shifts in the primary production base from sea grasses toward phytoplankton and a mud-sand bottom community (FDER, 1980, p. 111-52).

Sediment and organic loadings responsible for turbidity and eutrophication can be expected to increase with the continued urbanization of Vero Beach. Peak flows of runoff will also increase. The stormwater drainage system of Vero Beach facilitates the passage of stormwater downstream to the river. With no retention or detention, there is no opportunity to settle the sediments which cause turbidity and often transport organics, heavy metals, pesticides and pathogens. Over 50 percent of the heavy metals and phosphorus and nearly 75 percent of all pesticides have been found to be associated with the fine particulates of dust and dirt associated with streets and other paved surfaces (FDER, 1980 P. III-55). Due to the sandy nature of the soils, particulates associated with stormwater in Vero Beach should be removable by settling techniques. Further study should determine settling times and whether fine or large particulates should be removed.

5.3.1 Impact of Proposed Land Uses and Facilities on Estuaries

5.3.1.0 Point Sources

The General Sanitary Sewer, Solid Waste, Drainage, Potable Water and Natural Ground Water Aquifer Recharge Element proposes no new facilities using surface water discharge. There are no package plants within the City limits.

The number of marina slips will increase as noted in Section 5.6 Public Access Facilities. Historically, marinas are sources of pollutants which degrade water quality. The larger marina sizes will increase not only the amounts of pollutant sources but also the potential for accidental spills of harmful materials.

New stormwater treatment facilities will create additional sources of point source discharge into the Lagoon. New developments will be expected to have stormwater treatment facilities which will eventually discharge into surface waters. The intent of these facilities is to pretreat the runoff and improve water quality. Therefore, the pollutants that would normally have entered the Lagoon as non-point sources will be removed.

5.3.1.1 Non-Point Sources

There will be a negligible increase in non-point source pollution as a result of proposed land use changes. This is due to the nature of Vero Beach. As a small community, already at 80-percent buildout, there is little room for increased development. The City does intend to intensify some existing land uses (see p. 1-30). Significant increases in urban runoff are unlikely to occur as a result of this intensification and additional pollutant loadings to the Indian River will not be created. However, it can be assumed that as development occurs upstream, runoff to the drainage canals will increase and carry more pollutants.

5.3.1.2 Estuarine Circulation Patterns

No new facilities are proposed that will alter the circulation patterns of the Lagoon. It is assumed that new bridges to the islands of Fritz, Prang and Government Lot 3 will not be of a size or design which would alter circulation patterns in the estuary.

5.3.1.3 Sediment Contamination

The most likely source of new or additional contaminants to bottom sediments will be from the additional slips added to the existing marinas. Activities at marinas are sources of heavy metals, oils and greases, and other inorganic pollutants that can be trapped in bottom sediments.

5.3.2 Analysis of Needed Remedial Actions for Existing Pollution Problems

Existing pollution problems in Vero Beach consist of effluent discharge from the municipal treatment plant and collected stormwater runoff that is discharged from the Main and 16th Street Canals. The City has initiated a study to determine the feasibility of using the treatment plant effluent in a reuse system. This would remove all effluent discharge generated by Vero Beach from the Indian River (see Sanitary Sewer Subelement).

The most serious threat to Lagoon conditions from Vero Beach is the urban non-point sources. Control and management of these should center on reductions in suspended solids. Settling, filtering or other treatment to remove fine particulates will help prevent long-term accumulation of nutrients, heavy metals and other harmful materials. This is especially important in the vicinity of Vero Beach where the magnitude of tidal flushing is minimal (FDER, 1980, p. III-64).

The adoption of a stormwater management ordinance that promotes innovative management techniques is a primary necessity. The new Vero Beach guidelines address the issue of development impacts on runoff quality and quantity (FDER, 1980, p. III-65). Future treatment solutions will be constrained by reductions in available land area as remaining open areas are developed. Consideration should be given to using downstream land areas for pretreatment prior to discharge into the river. Larger single systems may be more desirable because they are more economical and manageable than numerous smaller systems. There are some undeveloped lands adjacent to the river. These should be studied as to their suitability for retention/detention areas. Where detention and retention areas are not appropriate, other methods should be evaluated.

5.3.3 State, Regional and Local Programs to Reduce Estuarine Pollution

State pollution regulation is largely vested in the Florida Department of Environmental Regulation (FDER). The FDER regulates dredge and fill of waters of the state and adjacent wetlands. Dredge and fill permitting is done in accordance with similar federal permitting. FDER also regulates discharges of pollutants into natural or artificial bodies of water. FDER establishes water quality standards, sets minimum treatment requirements, issues permits, licenses operations of wastewater treatment plants, administers construction grants for sewage treatment plants and regulates discharges of stormwater. FDER and the water management districts regulate the withdrawal, diversion, storage, and consumption of water, with the water management districts responsible for most of the permitting and operational aspects.

FDER certifies the siting of power plants and must consider the cooling water needs and environmental impacts of the proposed power plant.

The Department of Natural Resources (FDNR) is also involved in controlling estuarine pollution. The FDNR is responsible for selling or leasing state owned submerged lands if the sale or lease is "not contrary to the public interest." The proposed use of the conveyed or leased submerged land must not "interfere with the conservation of fish, marine or wildlife, or other natural resources." Deeds or leases may contain restrictions on dredging and filling.

The FDNR is also responsible for managing the aquatic preserves around the state. These preserves are state owned submerged lands which the state wishes to maintain in "an essentially natural condition." Special requirements pertain to the sale or lease of state owned submerged land within the aquatic preserves. A management plan for each preserve has or will be prepared. The lagoon south of Vero Beach is an aquatic preserve, as is the lagoon north of the City.

The FDNR also regulates exploration, drilling, and production of oil, gas, or other petroleum products, including drilling in estuaries.

The FDNR is responsible for the prevention and control of pollutants spilled into or upon coastal waters, estuaries, tidal flats, beaches, and lands adjoining the seacoasts of the state.

FDNR is the chief land purchasing agent and land manager for the State. The State, through several land acquisitions programs, often purchases environmentally sensitive lands which are vital for estuarine water quality.

The Department of Health and Rehabilitative Services administers an arthropod control program (mosquito control). This program sets limits on the types and amounts of oil and chemicals used to control mosquitoes. Special exceptions to State dredge and fill requirements are given to mosquito control projects. The program provides financial aid to counties or mosquito control districts.

The principal regional agency involved in controlling estuarine pollution is the water management district. The district is responsible for the flood control and drainage structures and therefore responsible for the quantity and timing of much of the fresh water delivered to the estuary. The district is also responsible for certain regulatory activities delegated from FDER. Chief among these is stormwater permitting. The districts were also assigned responsibility for regulating agricultural activities in wetlands under the Warren Henderson Act. The districts have a land acquisition program, the "Save Our Rivers Program," which allows the districts to purchase environmentally sensitive lands, and by preserving them, improve the quality of the fresh water entering the estuary.

The regional planning councils, along with the Department of Community Affairs, have some control over land use and development regulations through local comprehensive plan reviews and the development of regional impact (DRI) programs. Should the comprehensive regional policy plan call for stringent controls of pollution, then the consistency requirements between the regional and local plans would invoke strong local controls of pollution. The DRI process can require reviews of certain large developments' impacts on significant state and regional resources such as aquatic preserves or Outstanding Florida Waters. The impacts can be mitigated through conditions on the development order issued by the local government. The regional planning council has appeal rights if council feels that the development order does not adequately address the regional concerns.

Soil and water conservation districts are established pursuant to state law, but are usually countywide in area; and they have their own taxing authority. The districts' purpose is to control soil erosion. These erosion prevention efforts assist in maintaining estuarine water quality by reducing the sediment loads of waters flowing into the estuary.

The City, through its police power, regulates numerous activities which impact estuarine water quality. The City enforces septic tank regulations and utility hookups, enforces standards for package sewage treatment plants, regulates stormwater and drainage, controls the disposal of domestic solid waste including yard debris, controls removal and trimming of mangroves and other shoreline vegetation through the tree ordinance, controls land use through zoning and comprehensive planning, and enforces site planning and subdivision requirements.

5.4 BEACH AND DUNE SYSTEM

5.4.0 General Conditions

5.4.0.0 Beaches

Vero Beach has approximately 3.9 miles of beach. The amount of usable beach area north of Riomar Point (see Figure 5.7) is expected to decrease as a function of the erosion rate. From Riomar Point southward, the beach is accreting and is generally stable (USCOE, 1984, p. 172). Table 5.24 shows the projected beach area available in ten-year increments. The USCOE (1984) determined that the long-term erosion rate for the project area in Vero Beach was 2.62 cy/ft of beach per year. This number was increased in recent years to 4.7 cy/ft of beach per year (USCOE, 1986, p. 11).

Table 5.24. Daily Carrying Capacity* (Vero Beach)

Item	Year					
	1980	1990	2000	2010	2020	2030
Beach area (1,000 sq. ft.)	183	180	178	175	172	169
Daily Carrying Capacity (1,000 visitors)	3.7	3.6	3.6	3.5	3.4	3.4

*Based on SCORP criteria of 100 square feet per visitor and a turnover rate of two.

Sources: USCOE, 1984, p.172.
RS&H, 1987.

5.4.0.1 Dunes

Sandy dunes occur behind the beaches except for a 1.6-mile section of beach between the Village Spires Condominiums and Humiston Park. Seawalls are allowed only on this section of beach. The City owns 162 feet of seawall in front of Sexton Plaza. Private seawalls are interspersed along this beach section. North and south of this area there are vegetated dunes. The City generally renourishes the dunes in front of Jaycee Beach, Conn Beach and Humiston Park on an annual basis. The amount of sand varies at each location. Along Conn Beach, between five and ten thousand yards of sand are generally required each year.

5.4.1 Impacts of Coastal or Shore Protection Structures on Beach Conditions

Within the City of Vero Beach, there have been numerous attempts to protect upland property as the beach erodes. These efforts have involved construction of seawalls, placement of fill material, revegetating the dunes, and placement of riprap or sandbags. These isolated efforts have not uniformly reduced or halted the erosion process.

In March 1986, the City passed Chapter 75 of the Vero Beach Code which states that no coastal armoring will be allowed except where it already exists. Restoration programs for eroding City beaches north of Riomar Point are currently under review.

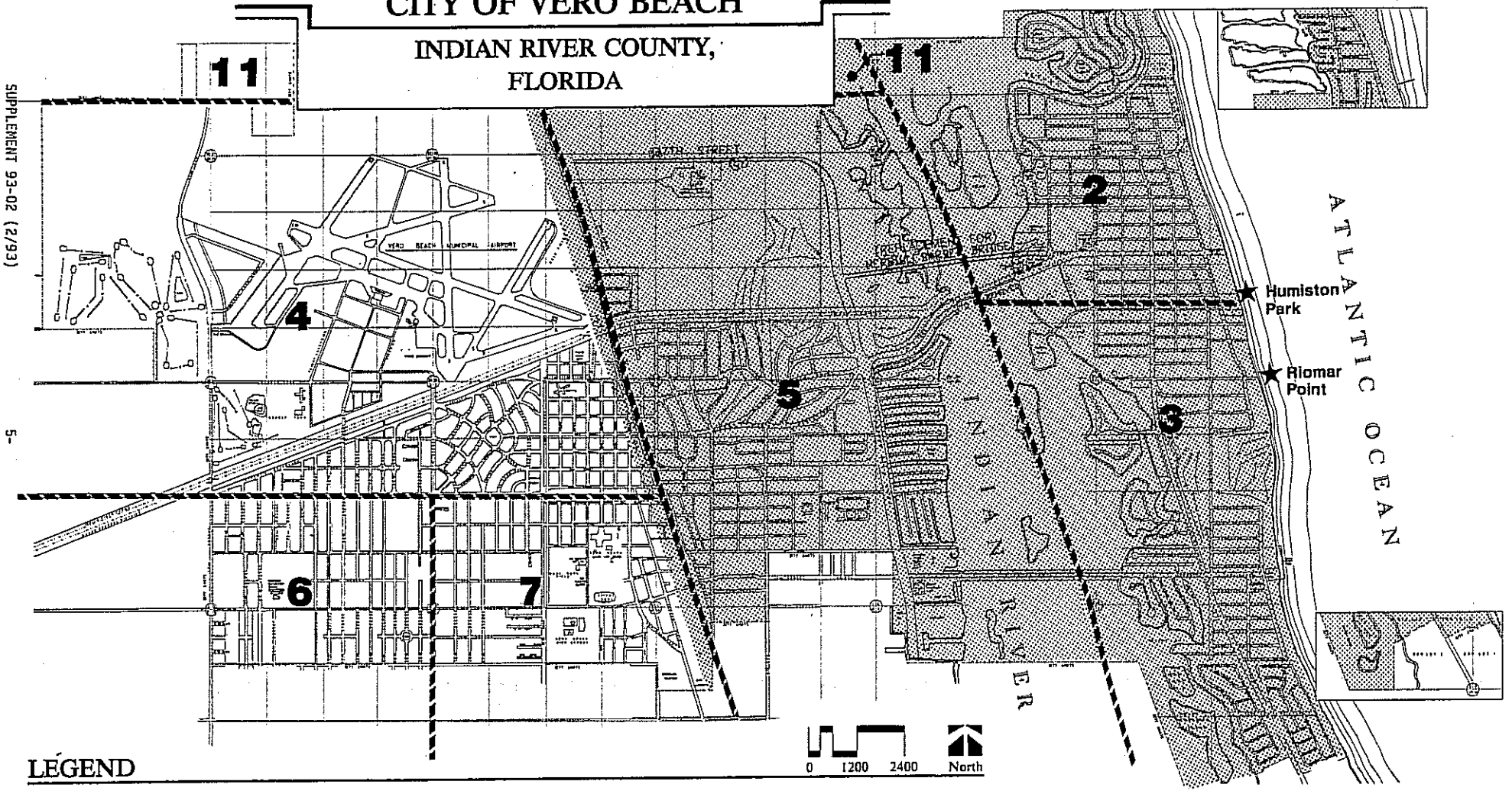
5.4.2 Existing and Potential Restoration Areas

Under existing programs, the City of Vero Beach renourishes the dunes around Conn Beach, Jaycee Beach and Humiston Park on an annual basis. The amount of sand varies at each location each year, depending on the amount of sand lost. Between five and ten thousand yards of sand are generally required along Conn Beach each year. Potential restoration areas are the sections of beach which continue to erode. These areas are being evaluated by the City for restoration and/or renourishment projects. Currently, no state or federally funded programs are being implemented in the City.

5.4.3 Measures to Protect or Restore Beaches and Dunes

The state administers the Coastal Construction Control Line (CCCL) program and 30-year erosion setback through the Department of Natural Resources, Division of Beaches and Shores. FDNR regulates all development seaward of the CCCL to ensure that the proposed development has minimal impact on the beach and dune system and can survive a major storm. As a part of the coastal construction permitting process, 30 years worth of erosion must be considered, and Florida law prohibits (with limited exceptions) construction of buildings that will be in the water in 30 years. FDNR's jurisdiction is limited to areas seaward of the CCCL. The control line for Vero Beach was set in 1979 and was reset in 1987. The new line moved landward of the old line by an average of 125 feet. In most cases it now runs through, or westward of, the majority of beachfront structures.

The City protects beaches and dunes in several ways. A City ordinance (87-39) provides for City and private participation in funding any state or federal beach restoration projects. In such circumstances, the City and the private landowners would be assessed as determined by resolution at a public hearing. Chapter 75 of the City Code is an ordinance for beach maintenance and preservation. The intent was to provide for the maintenance of the beaches within the City limits in order to provide for continued quality recreational opportunity and to protect upland properties to the extent that is compatible with beach maintenance and protection as established by the State of Florida. The ordinance prevents the construction of any new seawall, rock revetment or coastal armoring except in threatening situations. Ordinance 1560 was an emergency ordinance passed to permit construction of protective shoreline structures where upland property was endangered. This ordinance protects property rather than beach frontage. Chapter 75, as revised on August 16, 1988, allows oceanfront property owners to provide, at their own expense, for the maintenance and restoration of beaches and restoration of dunes on their property. The ordinance also states that construction east of the CCCL be approved by the State before action is taken by the City of Vero Beach. A separate ordinance (1552) prevents any vehicle, except those approved for cleaning, to be on the beaches.



Source: T.C.R.P.C., 1983

SEPTEMBER 1989

EVACUATION ZONES AND HURRICANE VULNERABILITY ZONE

Figure 5.7

RS&H / PLANTEC

5.5 NATURAL DISASTER PLANNING

5.5.0 Local Peacetime Emergency Plan

Vero Beach is included in the Indian River County Peacetime Emergency Plan (1986). The County plan presented information and data for the existing population in different storm events. Future projections will be made from these base numbers.

The Indian River County Plan divides the County into 16 evacuation zones of which seven are either all or partially within the Vero Beach City limits (see Figure 5.7). The extent of impact from a "category three" storm is also shown in Figure 5.7. Table 5.25 presents the different categories of storms and the number of evacuees for each storm type. Depending on its configuration, each evacuation zone may include population from both Vero Beach and the County. These are residents who are at-risk; the numbers do not include residents who are not at-risk but who may wish to evacuate their homes.

Table 5.25 Population Requiring Evacuation Vero Beach, Florida 1986.

Storm Type	Surge Height	Evacuees
Level A	3-5 Feet	6,948
Level B/Category 1	6-8 Feet	9,798
Level C/Category 2	9-11 Feetl	1,448
Level D/Category 3	12-14 Feet	14,198
Level E/Category 4	15+ Feet	17,893

Sources: Indian River County Peacetime Emergency Plan, 1986.
RS&H, 1987.

Persons leaving the area will seek a variety of shelters; with family or friends elsewhere in the County; inland hotels and motels; or some will leave the County altogether. However, there will be some evacuees who will need public shelters. There are 15 buildings designated as emergency evacuation shelters; seven are primary shelters and eight buildings are secondary shelters (see Table 5.26). The locations of these shelters in relation to Vero Beach are shown in Figure 5.8. At the present time, the total shelter capacity in the Vero Beach vicinity is approximately 2,362 spaces (Indian River County, 1987).

The principal evacuation routes are shown in Figure 5.8. These routes are critical to the evacuation of the hurricane vulnerability zone. The most critical linkages are the bridges and SR 60 to I-95. The evacuation time for Vero Beach is estimated to be ten hours, depending on the extent of early flooding and wind damage. The 17th Street bridge approaches could be potential hazards if early flooding precedes hurricane landfall. The majority of A1A is two-laned and tree lined; in the event of treefalls or flooding, it could become impassable. State Road 60, which provides access to I-95, is prone to flooding in heavy rains.

Table 5.26. Natural Disaster Shelters in Vero Beach

Name/Address	Location/ Evacuation District	Capacity/ Spaces Available
Primary Shelters		
1. St. Helen's Parrish Hall 2050 Vero Beach Avenue Vero Beach, Florida	4	44
2. Vero Beach Jr. High School 19th Street & 17th Avenue Vero Beach, Florida	7	803
3. Vero Beach Sr. High School 1707 16th Street Vero Beach, Florida	7	340
4. Vero Beach Elementary School 1770 12th Street Vero Beach, Florida	7	108
5. Dogertown Elementary School 4350 43rd Avenue Gifford, Florida	11	45
6. Middle 6 School 4695 28th Avenue Gifford, Florida	11	143
7. Indian River County Administration Building 1840 25th Street Vero Beach, Florida	4	300
Auxiliary Shelters		
A. First United Methodist Church 1750 20th Avenue Vero Beach, Florida	4	68
B. Glendale Baptist Church 27th Avenue & 8th Street Vero Beach, Florida	8	60
C. 20th Avenue Church of God 20th Avenue & 8th Street Vero Beach, Florida	8	91

Table 5.26. Natural Disaster Shelters in Vero Beach (Continued)

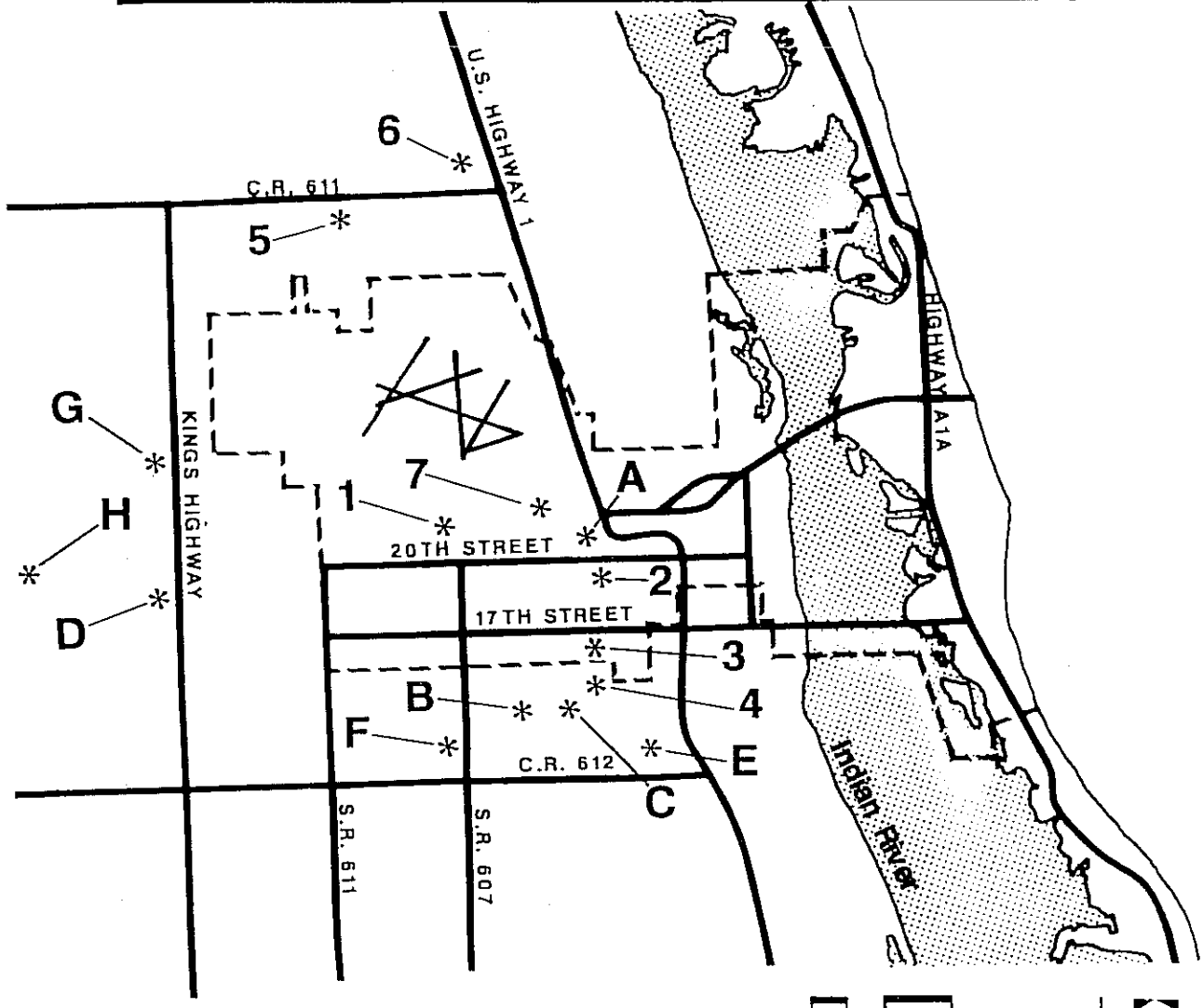
Name/Address	Location/ Evacuation District	Capacity/ Spaces Available
D. Mueller Center-IRCC Lundberg Road Vero Beach, Florida	15	120
E. Tabernacle Baptist Church 100 S.W. Old Dixie Highway Vero Beach, Florida	8	60
F. Truth Tabernacle Pentecostal Church Vero Beach, Florida	8	60
G. King's Baptist Church 3235 58th Avenue Vero Beach, Florida	15	60
H. Faith Baptist Church 7966 20th Street Vero Beach, Florida	15	60
TOTAL SPACES AVAILABLE		2,362

Sources: Indian River County Peacetime Emergency Management Plan, 1986.
RS&H, 1987.

Figure 5.8 Disaster Shelters and Evacuation Routes

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

1. St. Helens Parrish Hall
2. Vero Beach Junior High
3. Vero Beach Senior High
4. Vero Beach Elementary
5. Dodgertown Elementary
6. Indian River Middle Six
7. IRC Administration Building

A. First United Methodist Church
B. Glendale Baptist Church
C. 20th Avenue Church of God
D. Mueller Center
E. Tabernacle Baptist Church
F. Truth Tabernacle Pentecostal Church
G. Kings Baptist Church
H. Faith Baptist Church

Evacuation Routes

Source: Indian River County

RBP-H / PLANTEC

5.5.1 Projected Impacts and Special Needs for the Evacuation Plan

The evacuation plan must be feasible for all segments of the existing local population as well as for the anticipated future population. Two groups within the City with special needs are the elderly and the physically handicapped or disabled. After a brief discussion of these impacts, the requirements for the future population will be addressed.

At present, approximately 4,343 people in Vero Beach are 65 years of age or older. This number is projected to increase by 2000. The greatest need of the elderly in storm events is assistance in the evacuation process. Many no longer drive and therefore are unable to move to shelters. The physically handicapped are disabled and must also be given assistance if evacuation to shelters is required. Where necessary, shelters must be able to accommodate the special needs of these people. Patients in nursing homes vulnerable to storm surge must be transported to secure shelters and provided with appropriate care and facilities.

Population projections for Vero Beach indicate that in 1995 and 2000, the permanent population of Vero Beach will be 18,284 and 18,668, respectively. Based on the FLUE, these increases are expected to take place in evacuation district numbers 4, 5, 6 and 7. It was assumed that of the 1282 additional people for 1995 and 1882 people for 2000, 850 would be in storm surge levels "C" and "D" within the City limits. The remaining 432 people (1995) and 1032 people (2000) were divided so that 50% were within storm surge levels "C" and "D" but outside the City limits. The other 50% were also distributed outside the City limits but outside storm surge zones as well. Even though the growth will be outside the City limits, it will still impact sheltering demands within the Vero Beach vicinity. Therefore, these numbers were added to the total number of population requiring evacuation. It should be understood that the assumptions for the growth distribution are based on generalized knowledge of the planning area. A detailed study would be necessary in order to determine exactly where additional growth will occur and what actual percentage becomes "population at-risk". Table 5.27 gives the number of evacuees for each type of storm for 1995 and 2000.

Table 5.27 Projections for Population Requiring Evacuation, Vero Beach, Florida, 1995 and 2000

Storm Type	Surge Height	1995 Evacuees	2000 Evacuees
Level A	3-5 Feet	6,793	6,720
Level B/Category 1	6-8 Feet	9,580	9,477
Level C/Category 2	9-11 Feet	11,714	11,734
Level D/Category 3	12-14 Feet	14,403	14,394
Level E/Category 4	15+ Feet	17,494	17,307

Source: RS&H, 1987.

Not all residents who are at-risk will evacuate their homes and of those that do evacuate, not all will seek public shelter. However, it is necessary to maintain public shelters in Vero Beach to mitigate the potential loss of life that could result from a worst-case hurricane landfall.

To calculate the number of shelter users and available shelter space, several assumptions were made. First, only those shelters in proximity to the Vero Beach area were considered (see Figure 5.8). To calculate the estimated shelter demand, the estimated evacuees (see Table 5.25) calculated for Vero Beach were used. These figures were applied to the methodology used in the TCRPC, Hurricane Evacuation Study

Technical Data, (1983, p. 67) to calculate the potential shelter users shown in Table 5.28

Table 5.28 Estimated Shelter Users, Vero Beach

Storm Type	1987	1995	2000
Level A	937	937	937
Level B/Category 1	1,322	1,322	1,322
Level C/Category 2	1,545	1,616	1,637
Level D/Category 3	1,915	1,987	2,008
Level E/Category 4	2,414	2,414	2,414

Source: RS&H, 1987.

As stated earlier, these numbers include population from Indian River County as well as Vero Beach, wherever the evacuation district overlaps the County and City limits. Comparing Tables 5.26 and 5.28, it is apparent that for 1987, 1995 and 2000 there are sufficient shelter spaces for all storms except a Category 4, which would require an additional 52 spaces.

Measures that Vero Beach could implement to reduce or maintain hurricane evacuation times focus on traffic circulation improvements. The Traffic Circulation Element proposes improvements to the road network which should reduce hurricane evacuation times. The widening of A1A, the extension of Indian River Boulevard to the northern City limits, widening the Merrill Barber Bridge and widening of SR 60, 16th Street and 17th Street (see Section 2.4, p. 2-11), will reduce evacuation times. However, no estimates currently exist as to what the reduced time would be.

Additionally, the City can address flooding problems on surface streets. Further studies should be made by the City to ascertain the degree of flooding on evacuation routes and improvements to infrastructure should be made accordingly. As discussed in Section 5.5.0, p. 5-85, several roadways and bridges are known to be susceptible to flooding problems.

5.5.2 Post-Disaster Planning Issues

The purpose of this section is to examine the areas of Vero Beach where structures and facilities are most likely to be damaged by storms. Alternatives to current land uses and facility sites may then be offered so that rebuilding efforts after a storm concentrate on the activities which are the most feasible and beneficial to the community.

5.5.2.0Coastal High-Hazard Area

The coastal high-hazard area is defined by DCA as "...all areas within the local government's jurisdiction where public facilities have been damaged or undermined by coastal storms; Federal Emergency Management Agency designated 'V' zones; areas seaward of the CCCL established by FDNR; and inlets which are not structurally controlled" (1986, p. 6). Figure 5.9 shows the coastal high-hazard area for Vero Beach. The significance of this area is that it is most likely to experience the most severe damage from storms. For Vero Beach, this area is defined by combining areas seaward of the CCCL, the FEMA 'V' zones, and the areas damaged in the 1984 Thanksgiving Day storm.

5.5.2.1 Existing Conditions

The coastal high-hazard area contains commercial, residential and park uses. Hotels, motels, condominiums, offices and single-family residences are located on the shoreline along with four City parks and portions of the Riomar Country Club golf course. No roads are in the coastal high-hazard area except that part of Ocean Drive between Mango Drive and Gray Twig. Sections of privately and publicly owned seawall exist from Village Spires Condominiums to Flame Vine Road.

Only two storms in approximately the last 15 years have damaged the Vero Beach area; Hurricane David in September 1979 and the Thanksgiving Day storm in November 1984. Neither the State nor the Indian River County Department of Emergency Management have records which provide more than general information concerning damages from Hurricane David. Only a few damaged structures were noted: Memorial Island (docks were sunk), Beach Fire Station (damage not noted), City power plant (roof), the Seaburger Restaurant (which was destroyed), the J.C. Building (damage not noted) and residential damage. These damages resulted in approximately $170,257 in costs to repair or replace structures. Sand replacement for beach erosion was estimated at another $90,000.

The 1984 Thanksgiving Day storm caused extensive damage to property and eroded large sections of beach and dunes. Records are available which provide some documentation of damages and cost estimates for repair work (see Appendix II). However, because federal funds were not used, there are no extensive state files. The City of Vero Beach assessed the damage to public property at $367,500. Indian River County Emergency Management compiled a preliminary assessment of damages along the Vero Beach oceanfront from Oceangate Condominiums to Humiston Park. The County's total estimate of damages to property was $3,371,300.

5.5.2.2 Projected Future Conditions

The Future Land Use Element does not change the existing land uses in the coastal high-hazard area since they directly relate to the recreational/tourist/commercial uses of the beach. No new public facilities are proposed for this area except for beach access, parking and recreation. By virtue of their function, these facilities must be located within the coastal high-hazard area.

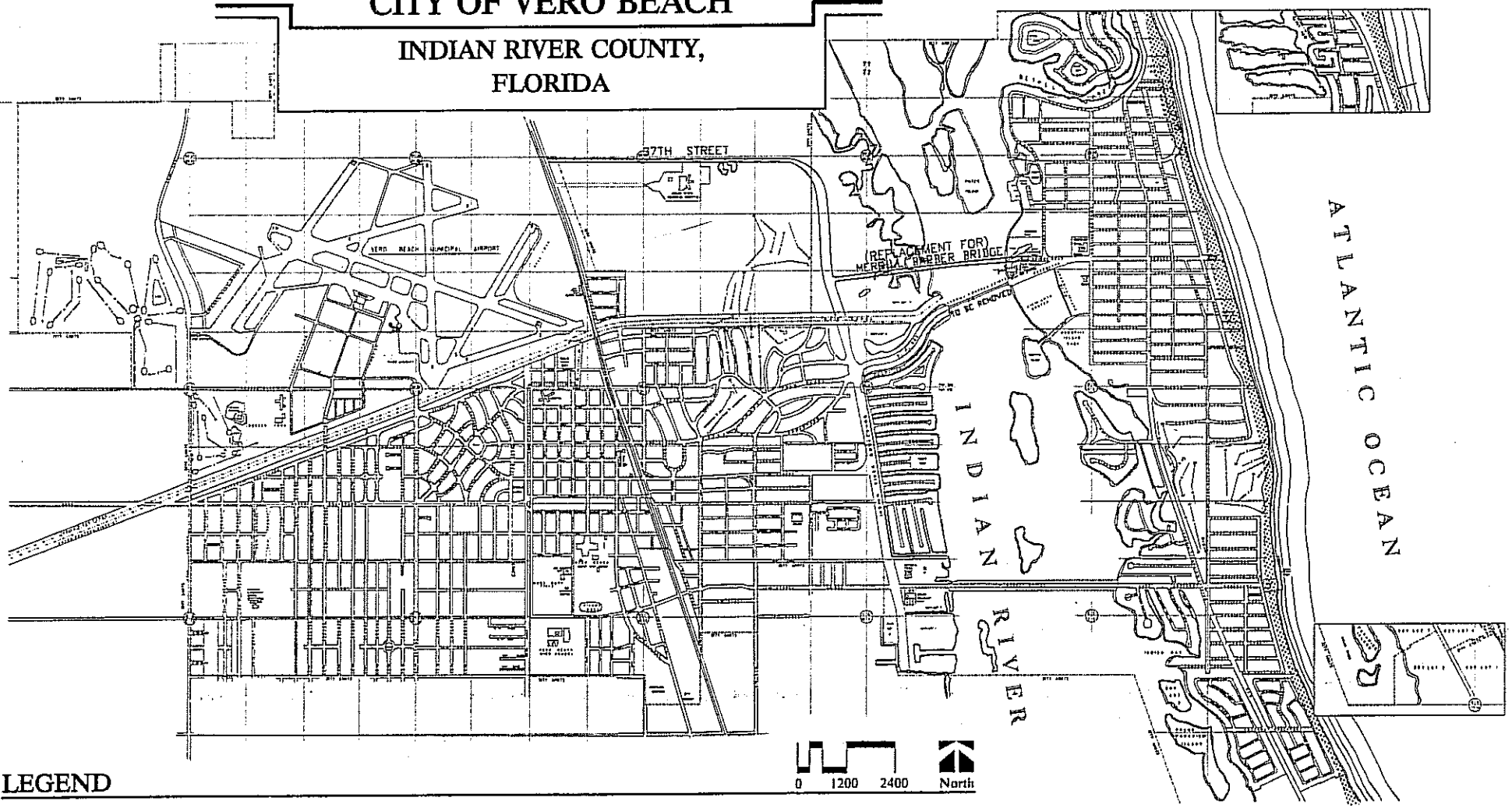
5.5.2.3 Post-Disaster Redevelopment Alternatives

Based on the damages from the last two storm events (see Appendix II), as well as an acknowledgment of the existing conditions in Vero, it is apparent that future storm events will damage some of the same structures. Eroding beaches and dunes north of Riomar Point threaten the stability of residential and commercial structures and increase their vulnerability to water damage from storms. Coastal protection structures are allowed only between Village Spires Condominium and Humiston Park. In some cases, during high storm tides, these structures are significantly impacted by wave action formerly buffered by a wider beach. Because this coastal armoring is not adequately solving the problem, additional coastal armoring is not allowed in the City. There is an immediate need to address the vulnerability of the eroding shoreline and dunes north of Riomar Point which will be affected by a storm event.

Water damage from storms also remains a threat to development south of Riomar Point but the probability is lessened because the beaches/dunes are accreting and provide greater buffer distance between storm tides and buildings.

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

Coastal High Hazard

COASTAL HIGH HAZARD ZONE

Figure 5.9

Source: RS&H

RS&H / PLANTEC

SEPTEMBER 1989

Storm surges remain a threat to all areas of the shoreline development as does the probability of wind damage. It is necessary for the City to determine what level of damage is tolerable before implementing changes to the land uses on the shoreline. The City must then determine what type of action to take. It seems inappropriate to suggest major changes to existing land uses on the shoreline since they are so intrinsically linked to the economy of the City.

Additional measures to reduce exposure to storm hazards include structural modifications, relocation and beach widening. All of these alternatives are expensive. Relocation is the least feasible option given that available land is scarce in Vero Beach.

5.6 PUBLIC ACCESS FACILITIES TO BEACH OR SHORELINE

5.6.0 Inventory of Existing Facilities

The resources of the coast and shoreline should be accessible to residents of Vero Beach. Facilities such as marinas, boardwalks, boat ramps, waterside parks and fishing piers allow residents to enjoy the advantages of coastal living. Table 5.29 lists the existing individual facilities in Vero Beach; it does not, however, include nearby facilities in Indian River County. Figure 5.10 locates the City facilities. A summary of the existing facilities is provided in Table 5.30.

The State of Florida (DNR, 1987) has established standards for resource-based outdoor recreation activities. These standards were used to evaluate the adequacy of existing public facilities and establish future demand (see Table 5.31). The existing conditions in Vero Beach are considered adequate by the City.

The parking demand for beach activities was calculated based on the daily visitor demand as calculated by Coastal Tech (1985, p. 29) and the turnover rate used by FDNR in "Outdoor Recreation in Florida," (1987). This demand establishes the peak use for residents and tourists and was used to project user demand for 1995 and 2000. Using the Coastal Tech projections, the required future parking spaces were calculated by dividing by six; this represents a turnover rate of two cars per day, with three people per car (see Table 5.32).

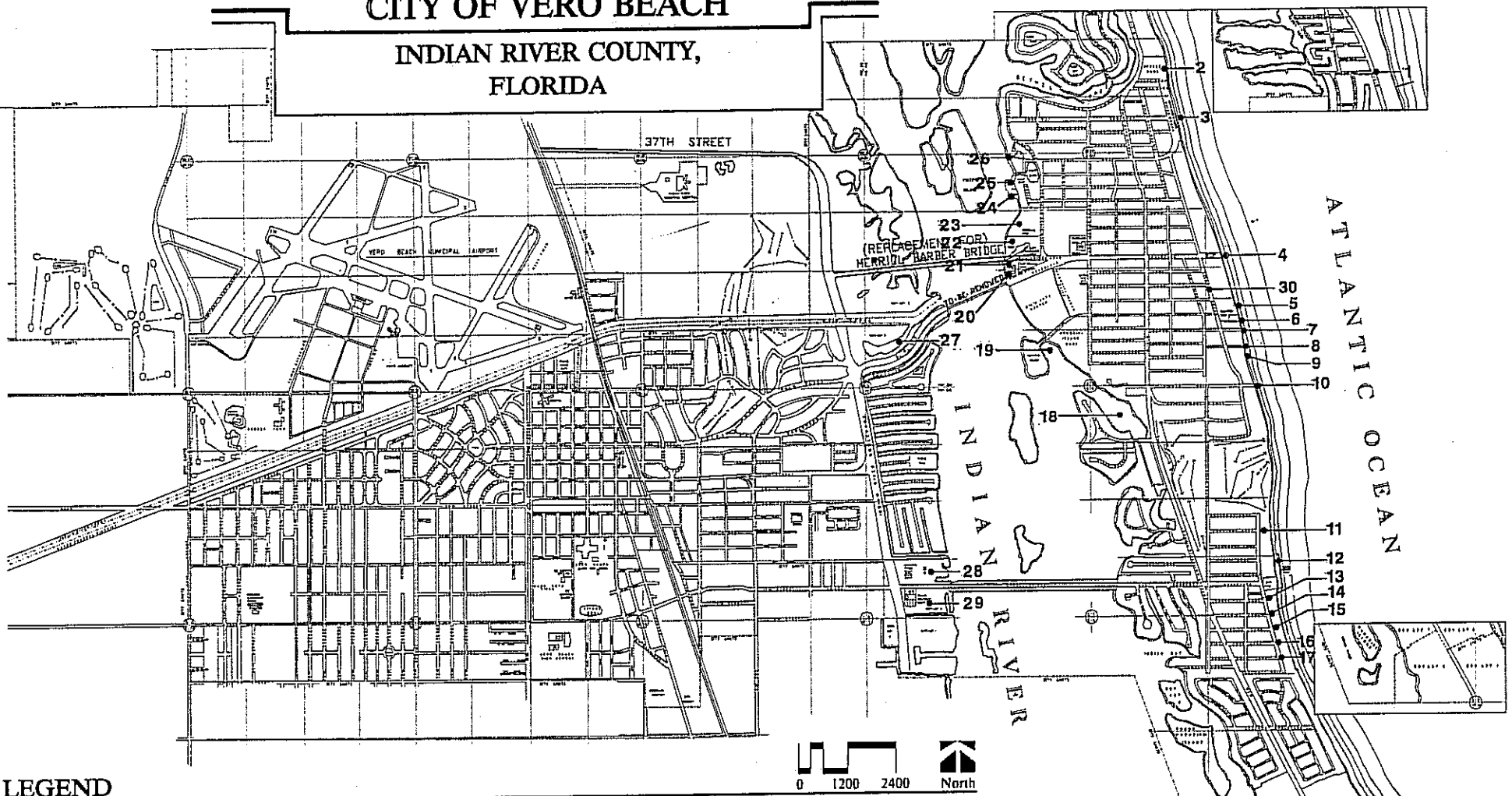
5.6.1 Future Needs

The DNR guidelines in Table 5.31 were used to project demand for 1995 and 2000. For the year 2000, there is a need for 61 to 81 additional marina slips. These facilities could be added to existing structures or incorporated into new facilities at different locations.

The Marina Director of Vero Beach indicated that the current wet slip supply does not meet demand. Although no quantification exists, he said that the waiting lists for all the public slips are filled. Expansion to meet demand is unlikely in the near future. The five-year plan requests funds for 36 more slips at the Municipal Marina to be contiguous with the existing marina. Table 5.33 suggests a low-high range of additional slips needed by 1995 and 2000. These numbers were generated based on the 48-63 percent growth in demand for wet slips from 1982 to 2005 for Indian River County as noted in the DNR Statewide Marina Siting Program (DNR, 1985, p. 30). The inventory of 229 slips used in the calculations came from the City Marina Director; it includes public and private wet slips.

CITY OF VERO BEACH

INDIAN RIVER COUNTY, FLORIDA



LEGEND

1. Bahia Mar Road — walkway
2. Jaysee Park — beachfront park & boardwalk
3. Conn Beach — beachfront park & boardwalk
4. Sexton Plaza — R.O.W.
5. Humiston Park — beachfront park & boardwalk
6. Easter Lily Lane — walkway & R.O.W.
7. Flamevine Lane — R.O.W.
8. Gayfeather Lane — R.O.W.
9. Hibiscus Lane — R.O.W.
10. Riomar Drive — R.O.W.
11. Lady Bug Lane — walkway
12. South Beach Park — beachfront park
13. Sandpiper Lane — walkway & R.O.W.
14. Jasmine Lane — walkway
15. Coquina Lane — walkway
16. Pirate Cove Lane — walkway
17. Turtle Cove Lane — walkway
18. Riomar Bay Yacht Club — marina
19. Memorial Island Park — river park & boat ramp
20. Mc William Park — river park & boat ramp
21. Jack's Marina
22. Boat Basin Park — river park & boat ramp
23. Bob Summer's Park — river park & boat ramp
24. Indian River Marina
25. Vero Beach Yacht Club — marina
26. Vero Beach Municipal Marina
27. Vero Marine Center
28. Municipal Power Plant
29. Sewage Treatment Plant
30. Ocean Drive

Source: Vero Beach Planning Dept.

PUBLIC ACCESS WATER DEPENDENT USES

Figure 5.10

SEPTEMBER 1989

RS&H / PLANTEC

Table 5.29. Existing Water-Dependent Uses

I. Marinas

Name	Map#	Public/ Private	#Slips Wet/Dry	Freshwater/ Saltwater
1. Vero Beach Municipal Marina	26	Public	72	Saltwater
2. Vero Beach Yacht Club	25	Private	24	Saltwater
3. Jack's Marina	21	Private	25	Saltwater
4. Indian River Marina	24	Private	18/70	Saltwater
5. Vero Marine Center	27	Private	50	Saltwater
6. Riomar Bay Yacht Club	18	Private	40	Saltwater

II. Boat Ramps

Name	Map#	#Ramp/Lanes	Freshwater/ Saltwater
1. Memorial Island Park	19	1 ramp, 3 lanes	Saltwater
2. McWilliams Park	20	1 ramp, 2 lanes	Saltwater
3. Boat Basin Park	22	6 lanes	Saltwater

III. Boardwalks/Piers

Name	Map#	Linear Feet	Freshwater/ Saltwater
1. Conn Beach	3	1,404'	Saltwater
2. Humiston Park	5	460'	Saltwater
3. Jaycee Park	2	478'	Saltwater

IV. Beach Access

Parks

Name	Map#	Size	Parking	Public/ Private
Humiston Park	5	522 lf front. 4 ac	282 sp	Public
Jaycee Park	2	550 lf front. 8 ac	181 sp	Public
Conn Beach	3	1,480 lf front. 1.25 ac	77 sp	Public
South Beach Park	12	580 lf front. 5.7 ac	258 sp	Public

Walkways

Name	Map#	Size	Public/ Private
Bahia Mar Road	1	15'	Public
Sandpiper Lane	13	10'	Public
Jasmine Lane	14	10'	Public
Coquina Lane	15	10'	Public
Pirate Cove Lane	16	10'	Public
Turtle Cove Lane	17	10'	Public
Lady Bug Lane	11	10'	Public

Table 5.29. Existing Water-Dependent Uses (Continued)

ROW'S

Name	Map#	Size	Parking	Public/ Private
Eastern Lily Lane	6	20'	--	Public
Sandpiper Lane	13	20'	--	Public
Hibiscus Lane	9	50'	--	Public
Sexton Plaza	4	150'	243	Public
Flamevine Lane	7	50'	74	Public
Gayfeather Lane	8	25'	20	Public
Riomar Drive	10	50'	5	Public
Ocean Drive	30	80'	100	Public

V. River Parks

Name	Map#	Size	Parking	Public/ Private
Memorial Island Complex	19	54 ac	--	Public
McWilliams	20	1 ac	--	Public
Bob Summers	23	12 ac	--	Public

VI. Public Utilities

Name	Map#	Size	Parking	Public/ Private
Vero Beach Municipal Power Plant	28	--	--	Public
Vero Beach Wastewater Treatment Plant	29	4.5 MGD	--	Public

Sources: DNR (July 7, 1987).
Vero Beach Planning.
RS&H, 1987.

Table 5.30. Summary of Existing Water-Dependent Uses

	Public	Private	Total
Marinas (slips)	72	157	229
Saltwater Beach (linear feet)	4,225	16,536	20,761
Boardwalks (linear feet)	2,342	--	2,342
Boat Ramps (lanes)	11	0	11
Dry Storage (slips)	0	70	70
Parks (acres)	96.45	0	96.45

Source: RS&H, 1987.

Table 5.31. Estimate of Facility Requirements By Year

Facility/ Resource	Population[1] Guideline	1987 Need	1995 Need	2000 Need	Existing Facility Resource
Swimming Beach	Min: 1 mi/25,000	0	0	0	3.9 miles[2]
	Med: 1 mi/100,000	0	0	0	
Boat Ramp Lanes	Min: 1 lane/4300	0	0	0	11 lanes
	Med: 1 lane/4700	0	0	0	
Marinas	---	--	38-50*	61-81*	229 wet slips[3]

*Indicates need for slips in addition to existing facility resource. Estimated need calculated in Table 5.33.

1. FDNR (1987), p. 98 (Population used: 17,400-1987; 1995; 18,650-2000. Source: RS&H, 1988.)
2. Source: Vero Beach Planning Department
3. Source: Vero Beach Marina Director; Calculations based on DCA Model Element. Includes Public and Private Slips

Table 5.32. Parking Demands

Year	Daily Maximum Demand	Parking Spaces Needed*	Existing Spaces**	Spaces Needed
1987	8,224	1,371	1,240	131
1995	9,320	1,553	1,240	313
2000	9,850	1,642	1,240	402

* Calculated at three people per car and two cars per day.
Daily demand is divided by six to determine number of parking spaces needed.
** From Vero Beach Planning Department.

Sources: Coastal Tech (1985, p. 29).
RS&H, 1990.

Table 5.33. Projected Increase in Demand for Wetslips

	*DNR Projections For 2005	Annual Increase in Demand	Projected 1987-1995	Projected 1987-2000
High	144 Slips	6.2 Slips	50	81
Medium	127 Slips	5.5 Slips	44	72
Low	100 Slips	4.7 Slips	38	61

* Demand Projections based on projections in DNR, 1985, p. 30.
Inventory from Vero Beach Marina Director.
Linear model for calculations based on DCA model element.

Source: RS&H, 1987.

5.7 INFRASTRUCTURE IN COASTAL HIGH-HAZARD AREA

5.7.0 Introduction

This section summarizes the existing conditions and future needs for infrastructure within the Coastal High-Hazard Area. The Coastal High-Hazard Area is defined on p. 88. This information is analyzed in more detail in the Traffic Circulation Element and the General Sanitary Sewer, Solid Waste, Drainage, Potable Water and Natural Groundwater Aquifer Recharge Element.

5.7.1 Existing Facilities

5.7.1.0 Roads, Bridges and Causeways

The network of arterial and collector roads serving the coastal area is shown in Figure 2.1. Table 5.34 presents the existing average daily traffic (ADT) for each of the coastal area roadway segments. Also shown in the table is the maximum daily service volume for the level of service appropriate to the roadway classification as defined in Policy 1.1 of the Transportation Element. As shown in Table 5.34, only the Merrill Barber Bridge segment currently exceeds the LOS standard.

5.7.1.1 Sanitary Sewer Facilities

There is one wastewater treatment plant which serves the City of Vero Beach. It is located at Indian River Boulevard and 17th Street, on the western shore of the Indian River. No package plants remain within the Vero Beach City limits. The sanitary sewer system is currently at 68-percent capacity. No other facilities are located in the coastal high-hazard area.

5.7.1.2 Potable Water Facilities

The City water system serves the entire City of Vero Beach as well as areas outside the City limits. City operated ground storage facilities in the coastal area are located at Riverside Park and in Indian River Shores at A1A and Fred Tuerk Drive, and on A1A north of the Moorings. Elevated storage facilities operated by the City are located at Riverside Park, the Moorings, which is south of the City limit, and A1A and Fred Tuerk Drive.

5.7.1.3 Drainage Facilities

There are two principle artificial drainage structures in the Vero Beach coastal high-hazard area. These are stormwater area outfalls at Sexton Plaza and Humiston Park. Both of these facilities discharge surface waters into the Atlantic Ocean. They are maintained by the City of Vero Beach.

5.7.1.4 Coastal or Shore Protection Structures and Beach Restoration Projects

Currently the only City-owned protection structure is the 162 feet of seawall in front of Sexton Plaza. Private seawalls are interspersed for approximately 2,900 feet along the beach at hotels and residences between the Village Spires Condominiums and Humiston Park.

The City maintains restoration programs for the dunes at Conn Beach, Jaycee Beach and Humiston Park on an annual basis.

Table 5.34. Existing Traffic Volumes for Arterial and Collectors in Coastal Area

	Roadway Segment	1987 ADT*	Level of Service
SR A1A	SCL to Cswy. Blvd. (SR 650)	9,200	A
SR A1A	Cswy. Blvd. (SR 656) to SR 60	13,200	A
SR A1A	SR 60 to NCL	14,000	A
Indian River Blvd.	SCL to 21 St.	9,500	A
Indian River Blvd.	21 St. to Royal Palm Blvd.	9,500	A
SR 60	US 1 to Indian River Blvd.	9,000	C
SR 60	Merrill Barber Bridge	16,900	E
SR 60	Indian River to A1A	12,000	A
US 1	21 St. to NCL	22,700	C
17th St.	Indian River Bridge	20,100	A
17th St.	Indian River Bridge to A1A	22,500	A

SCL: Southern City Limits
NCL: Northern City Limits

Sources: Traffic Circulation Element.
RS&H, 1987. (Revised 1990)

5.7.2 Future Needs

5.7.2.0 Roads, Bridges and Causeways

Table 5.35 shows the projected annual average daily trips for arterials and collectors for the study years 1995 and 2000. It is evident from this summary table that the ADT for several of the roadway segments will exceed the LOS standards.

Several improvements are scheduled for Vero Beach (see Table 5.36). The FDOT has included the Merrill Barber Bridge project in their Five-Year plan. Engineering design is scheduled for 1987 and right-of-way acquisition in 1990. Improvements will also be made to A1A. The following improvements are currently under design and will be implemented by 1991:

1. A continuous left turn from Beachland Boulevard (SR 60) to East Causeway Boulevard (SR 656) (approximately 1-1/2 miles).2. A five-lane section from East Causeway Boulevard (SR 656) to south of Seagull Drive with transitions to Castaway Boulevard (approximately three quarters of a mile).

Although these improvements will provide an interim measure of relief, additional improvements will be required in the corridor to provide for the increased traffic demand on A1A. It is expected that the FDOT will make the improvements in two phases, with final completion in 2000 at a total cost of $2.7 million. Indian River County has programmed an extension of Indian River Boulevard to the north by 1990; this improvement is included in the Capital Road Improvements Program.

5.7.2.1 Sanitary Sewer Facilities

Sewer facilities in the coastal area are not projected to change during the study time frame. As noted in the Sanitary Sewer Sub-element, several options exist for allocating the available capacity in the Vero Beach wastewater plant. The St. Johns River Water Management District (SJRWMD) has informally notified the City that they will be required to establish a reuse program for some of the treatment plant effluent when the plant permit comes up for renewal in 1990. The City is currently preparing plans for a reuse program.

5.7.2.2 Potable Water Facilities

No new potable water facilities are proposed for the coastal area.

5.7.2.3 Drainage Facilities

No major modifications are proposed for drainage facilities in the coastal area.

5.7.2.4 Coastal or Shore Protection Structures and Beach Restoration Projects

No plans currently have been approved for any shore protection or beach restoration projects.

Table 5.35. Projected Traffic Volumes, Arterials and Collectors in the Coastal Area, 1995 & 2000

	Roadway Segment	1995 ADT*	1995 Level of Service	2000 ADT*	2000 Level of Service
SR A1A	SCL to Cswy. Blvd. (SR 656)	12,144	A	14,352	B
SR A1A	Cswy. Blvd. to Beachland Blvd. (SR 60)	17,424	A	20,592	A
SR A1A	Beachland Blvd. (SR 60) to NCL	18,480	A	21,840	A
Indian River Blvd.	SCL to 21 St.	12,540	A	14,820	A
Indian River Blvd. (SR 60)	21 St. to Royal Palm Blvd.	12,540	A	14,820	A
SR 60 (21st. St.)	US 1 to Ind. Riv. Blvd.	11,880	B	26,364	A
SR 60	Merrill Barber Bridge	22,308	A	26,364	A
SR 60 (Beachland Blvd.)	Merrill Barber Bridge to A1A	15,840	A	18,720	A
US 1	21 St. to NCL	29,964	D	35,412	F
17 St.	Ind. Riv. Bridge	26,532	A	31,356	B
17 St.	Ind. Riv. Blvd. to A1A	29,700	B	35,100	E

SCL: Southern City Limits.
NCL: Northern City Limits.

Note: Reference Traffic Element, Tables 2.3 and 2.4 to establish volumes for Level of Service in 1995 and 2000.

Sources: Traffic Circulation Element.
RS&H, 1987. (Revised 1990.)

Table 5.36 Traffic Improvements Proposed for Coastal Areas

Project	Cost	Program Year
Replace Merrill Barber Bridge in new corridor depicted on all maps within the Comprehensive Plan	$30.0 million	1995
Widen A1A from Southern City Limits to Cswy. Blvd.	$1.0 million	2000
Widen A1A from Cswy. Blvd. to Northern City Limits	$1.7 million	1995
Extension of Indian River Blvd. from SR 60 to Northern City Limits	$0.9 million	1995

Sources: Traffic Circulation Element (Table 2-5).
RS&H, 1987.

5.8 GOALS, OBJECTIVES AND POLICIES

5.8.0 **Goal:** To establish growth management strategies that will allow growth in the coastal zone which does not damage or destroy the natural resources, protects human life and limits public expenditures in those areas subject to destruction by natural disaster.

5.8.0.0 Estuarine Quality

Objective 1:

The City shall cooperate with other governments in the basin to develop a surface water management program for the Indian River Lagoon which will maintain or improve the existing water quality levels. The management plan shall include recommendations to reduce or mitigate development impacts on water quality.

Policies:

1.1 No structures will be allowed in the Indian River which impair water circulation to an extent which would threaten the water quality.

1.2 The City shall establish a Water Quality Board by 1993 with representatives from other governments in the basin to modify their stormwater management ordinances to achieve a decrease in the nonpoint source pollutant loadings generated outside of Vero Beach which discharge to the Indian River Lagoon.

1.3 The City shall establish a program for the periodic inspection of Vero Beach stormwater control structures to ensure their proper functioning and maintenance in conjunction with the Land Development Regulations to be adopted by September 1, 1990.

1.4 By 1993, the City shall establish a review process for dredge and fill applications from the Florida Department of Natural Resources, Florida Department of Environmental Regulations, U.S. Army Corps of Engineers or other agency with jurisdiction in Vero Beach.

1.5 By 1991, the City shall participate on the Marine Resources Council to develop estuarine studies, as required by this plan, to be used for the surface water management program.

1.6 The City shall cooperate with other local governments to incorporate applicable portions of existing studies (such as The Sebastian Inlet-Fort Pierce Inlet Barrier Island: A Profile of Natural Communities, Development Trends, and Resource Management Guidelines; Water Quality and Urban Development: Vero Beach Study) into the surface water management plan by 1995. The plan shall provide regulatory or management techniques for addressing, at a minimum, the following issues: ensuring adequate sites for water dependent uses; preventing estuarine pollution; controlling surface water runoff; protecting living marine resources; reducing exposure to natural hazards and ensuring public access.

5.8.0.1 Water-Dependent Uses

Objective 2:

To develop and adopt guidelines which direct the location and management of water-enhanced, water-related and water-dependent facilities with the highest priority given to the water-dependent uses along the Indian River Lagoon.

Policies:

2.1 The Vero Beach Land Development Regulations, to be adopted by September 1, 1990, shall provide for the development and implementation of performance standards for marinas and marina-related facilities which address, but are not limited to, issues such as: setbacks, maintenance and containment of stormwater runoff and wash-down water for dry storage areas, and height limitations.

Criteria:

A. If existing marinas meet the City's operational standards, then they should be allowed to continue operations.

B. Expansion of existing facilities is preferred over development of new marinas. Where existing facilities fail to meet operational and environmental standards, new facilities offer a viable alternative.

C. New marina facilities shall retain all work-area runoff in a separate retention area. Stormwater runoff retention areas shall retain the runoff from a ten-year, 24-hour storm.

D. A fuel management/spill contingency plan will be developed and provided to the City of Vero Beach for review prior to operation of any new or expanded marina or within one year of comprehensive plan adoption for any existing marina. The plan shall describe methods for dispensing fuel and all procedures and materials to be used in the case of a fuel spill. The plan shall meet the Vero Beach Fire Prevention Codes and Rules of the State Fire Marshall's Office. The plan shall also reflect methods used by the Department of Natural Resources in containing and mitigating fuel spills to reduce environmental impacts.2.2 The City shall continue to implement regulations governing live-aboards. The regulations shall include, but not be limited to: definitions, mooring locations, pump-out/sewage requirements, fee assessments for community services.

2.3 When existing marina facilities seek a permit for expansion or modification, then they shall be required to retrofit or modify existing marina facilities to include, but not be limited to, consideration of: stormwater retention, work-area runoff retention, pump-out facilities and thresholds for their use, fuel management plans and spill contingency plans.

2.4 The Vero Beach Land Development Regulations, to be adopted by September 1, 1990, shall develop and adopt standards for new marina siting which shall address the following criteria.

Criteria:

A. Marina development is permissible within any area designated for a commercial use on the Future Land Use Map, if it is consistent with the performance standards developed by the City.

B. At the beginning of the zoning process, all marina development proposals must submit a conceptual plan to be reviewed by the Planning Department.

C. Commercial/industrial marina development shall be located within the C-1M Marina District. Residential/recreational and commercial/recreational marinas shall be a permitted use in these zoning categories.

D. Residential/recreational marinas will be considered with a Binding Site Plan.E. No fueling or repair facilities are permitted within residential zoning classifications.

E. When locating new marinas or expanding existing marinas, environmentally sensitive habitats as listed in the Conservation Element, Section 6.11.0.7, shall not be degraded.

F. Marina facilities shall be located where maximum physical advantage for flushing and circulation exists, where the least dredging and maintenance are required, and where marine and estuarine resources will not be degraded.

G. Marina basins shall be sited where there is an existing basin and access channel with an average water depth of three (3) feet below mean low water, except along the shoreline.

H. Marinas and docking facilities should be approved which require minimal or no dredging or filling to provide access by canal, channel or road. Preference shall be given to marina sites with existing channels. In the event that dredging is required, the mooring areas and the navigation access channels shall only be dredged to minimum depths required for access at mean low water. Any required dredging operations shall utilize appropriate construction techniques and materials to comply with state water quality standards, such as turbidity screens, hydraulic dredges, properly sized and isolated spoil deposition area to control spoil dewatering.

I. New marina or substantially expanded facilities shall be designed to take advantage of existing water circulation and shall not adversely affect existing circulation patterns. Improvement of circulation shall be a consideration when expanding or upgrading existing facilities. However, any buffer zone established by the Florida Department of Natural Resources-Shellfish Environmental Assessment Section (FDNR-SEAS) shall be maintained.

J. Marinas shall demonstrate that they have sufficient upland areas to accommodate all needed support facilities. These standards include, but are not limited to, adequate parking, work areas and retention areas for stormwater and work-area runoff.

K. Marina facilities shall not degrade water quality below existing Florida Department of Environmental Regulation water classification standards.

L. Commercial/recreational and commercial/industrial marinas shall not be located in Aquatic Preserves, or Outstanding Florida Waters, or other environmental areas designated by the City so as to adversely affect these waters.

M. Construction of multislip docking facilities and boat ramps shall be directed to locations where there is quick access to deep, open water, where the associated increase in boat traffic will be outside the areas of high manatee concentration, and where wetlands and seagrass beds supporting manatee habitat will not be degraded.

N. All applicants proposing marina development activities shall demonstrate compliance with all applicable federal, state and local laws which establish any type of additional protective status to adjacent waters beyond the existing Class III status.

O. All applicants will provide hurricane contingency plans that are in compliance with the City and County plans.

P. Applicants for marina development shall demonstrate whether the facility will be in public or private ownership. Facilities classified as public shall demonstrate this availability for public use, the economic need for the project and the feasibility of such a development within the local environmental, economic, social and recreational context.

2.5 The Vero Beach Marina Director, the Florida Marine Patrol and Indian River County Health Department shall inspect all marinas located in the City. Items to be inspected and reviewed may including the following.

Criteria:

A. Pump-out facilities/marine sanitation devices.

B. Compliance with power/sailboat mix, if required.

C. Spill prevention, control, containment and cleanup plans.

D. Waste collection and disposal methods.

E. Required fire fighting equipment.

2.6 The City shall review shoreline development in order to maximize opportunities for water dependent land uses. The following criteria, at a minimum, shall be utilized.

Criteria:

A. Water-related uses shall be built on uplands.

B. Development which is feasible only through creation of land by dredging and filling of areas below the mean high water line shall not be approved.

C. Water-dependent commercial and industrial uses which require siting adjacent to the Indian River Lagoon will be evaluated based on guidelines specified in the Vero Beach Land Development Regulations, to be adopted by September 1, 1990.

D. Water-related commercial and industrial uses may be considered for siting only adjacent to Class III waters of the Indian River Lagoon.

2.7 The Land Development Regulations which are to be adopted by September 1, 1990, shall develop policies for shoreline uses which adhere to the following priorities:

A. Primary priority: 1) nonstructural shoreline protection uses such as native shoreline revegetation and beach renourishment programs which restore degraded natural systems and provide recreational and storm protection benefits to the City; and 2) approved water-dependent estuarine shoreline uses such as: pervious accessways, small dock facilities and residential multislip dock facilities without commercial fuel tanks or other commercial facilities. These facilities shall demonstrate during site plan review compliance with the applicable performance standards stipulated in Policy 2.4 in order to prevent adverse impacts to natural features.

B. Second priority shall be directed toward water-related uses such as: 1) parking facilities for shoreline access; 2) residential structures which comply with the coastal construction code for structures within the coastal building zone; and 3) recreational facilities which comply with applicable codes.

C. Tertiary priority shall be directed toward: 1) commercial uses which comply with applicable codes.

5.8.0.2 Beaches and Dunes

Objective 3:

The City shall continue to implement a beach and dune management program which protects, enhances and restores the naturally functioning beach system.

Policies:

3.1 The Land Development Regulations to be adopted by September 1, 1990 shall include regulations governing the location, construction and maintenance of development adjacent to the Atlantic shoreline. New development seaward of the CCCL shall be governed by the following conditions, at a minimum.

Criteria:

A. To maintain the existing vegetation on the dune line or replace it with vegetation approved by the Vero Beach Planning Department.

B. No new shore hardening structures shall be permitted.

C. Setbacks or other non-structural methods of shoreline protection shall be given the highest priority.

D. "Soft" shoreline protection devices such as sand filled geotextile containers may be permitted, when it can be demonstrated, through competent engineering studies, that they will exert minimum adverse effects upon shoreline functions or dynamics, as well as adjacent properties. Further, these devices shall not impede public access to or along the shore.

E. All structures constructed seaward of the CCCL shall be constructed to meet existing state statutes.

F. Reconstruction of existing hard erosion control structures shall be permitted subject to meeting current standards.

G. Storage tanks shall be located as far westward of this dune line as possible but not less than 50 feet from the dune line.

H. Septic tanks shall be located landward of the most seaward portion of the habitable structure.

3.2 The City shall continue to implement programs for re-establishment and maintenance of the primary dune area. These standards shall include, at a minimum, the following provisions.

Criteria:

A. Excavations will be prohibited unless it is shown they are necessary to mitigate natural disaster occurrences or are FDNR permitted and monitored projects.

B. Native dune vegetation shall be maintained on site unless removal or alteration is permitted by both the City and the Florida Department of Natural Resources, or other appropriate regulatory agency.

C. New access shall be allowed only at designated cross-overs.

D. Control strategies will be utilized at non-designated cross-overs, until these can be acquired, improved or alternate access provided.

E. Dune cross-overs, boardwalks, walkways and other permittable structures seaward of the CCCL shall be elevated above dune vegetation and shall be designed to allow adequate light penetration.

F. Major parallel boardwalks shall be permitted seaward of the CCCL if they are constructed so as not to impact the dune line.

G. Publicly owned dunes which have been denuded shall be revegetated with approved native vegetation.

H. To encourage private property owners to re-establish dune vegetation which has been destroyed by undesignated access activities, the City shall permit the following:

- o Use of City property for equipment access to beach for dune restoration work.
- o Temporary use of nonhardening protection methods (such as geo-textile bags) to protect restored dunes.
- o Cooperative effort with State Department of Forestry to sponsor annual seedling sales of salt-tolerant dune restoration plant species for nominal cost to public.

I. Through the site plan review process, the City shall require dune restoration for new development or redevelopment.

3.3 The City may participate in beach stabilization and restoration programs, where necessary, that include local, state and/or federal agencies. The City shall encourage continued study of beach and shore to determine characteristics and causes of beach erosion and buildup.

3.4 The City shall prohibit vehicular traffic on or over the dune and on the beach except for beach cleaning, police vehicles, emergencies and the turtle patrol. Access will be at designated locations.

3.5 The City should attempt to provide, enhance and preserve scenic views of the water through such measures as site design reviews. Priority will be to minimize environmental impacts.

3.6 The City shall develop an interlocal agreement by September 1, 1992 with adjacent municipalities and the State of Florida for funding of beach maintenance and restoration programs.

5.8.0.3 Coastal High Hazard Area

Objective 4:

Limit future public expenditures for infrastructure and service facilities which subsidize growth within the coastal high hazard and high risk vulnerability zones areas of Vero Beach, except for expenditures for public land acquisition or enhancement of natural resources.

Policies:

4.1 In accordance with Rule 9J-5.003(17), F.A.C., the City designates the "Coastal High Hazard Area" (CHHA) as the evacuation zone for a Category 1 hurricane as established in the local government's regional hurricane evacuation study (Treasure Coast Regional Planning Council Hurricane Evacuation Study, 1994).

4.2 The City shall not fund public facilities built in the coastal high hazard area unless the facility is for public access, resource restoration or property protection.

4.3 The City shall not accept improved roadways for operation and maintenance responsibilities within the coastal high hazard zone.

4.4 If City utility lines are relocated for any purpose, they should be located outside of the coastal high hazard zone, except where there is no cost-feasible alternative.

Objective 5:

Limit densities within the coastal high hazard zone and direct future development outside of this area

Policies:

5.1 The City shall continue to limit future development on the barrier island through the use of, but not limited to, the following:

1. Building height limitations to 35 feet.
2. Density limitations.
3. Open space requirements.
4. Parking restrictions.

5.2 The City shall continue its program of land acquisition and management for recreation and preservation based on the expenditures designated in the Capital Improvements Element of this plan.

5.3 The City shall continue to regulate development and manage natural resources within the Coastal High Hazard Area (CHHA) by maintaining or reducing land use densities and intensities in accordance with the Land Use Element and Objective 8 of this element.

5.8.0.4 Hurricane Evacuation

Objective 6:

Maintain hurricane evacuation times for the Coastal High Hazard Area (CHHA) of seven hours or less for a Category I or above storm and for the entire City a maximum of 12 hours for a Category III or above storm.

Policies:

6.1 The City shall use public service announcements and the local cable-access station to promote awareness of the County Comprehensive Emergency Management Plan.

6.2 The City shall coordinate with other municipalities and appropriate agencies to develop Evacuation Zone Management Plans designed to maintain evacuation times. The following shall be considered at a minimum:

Criteria:

A. Roadway and other infrastructure improvements and funding mechanisms.
B. Programs designed to improve the behavioral response to hurricane evacuation orders.
C. Land use strategies.

6.3 The City shall utilize hurricane evacuation times, as well as volume to capacity ratios, in determining the timing and priority of roadway improvements as contained within the Traffic Circulation Element of this Plan.

6.4 The City shall support on-going public education efforts of Indian River County to educate public about hurricane evacuation procedures and to improve behavioral response to evacuation orders.

6.5 The City's Comprehensive Emergency Management Plan shall be consistent with the ~~local,~~ regional and state emergency management and evacuation plans.

6.6 The City shall coordinate with Florida East Coast Railroad, and other agencies as necessary, to stop train flow during hurricane evacuations.

5.8.0.5 Post-Disaster Recovery and Redevelopment

Objective 8:

Projected post-disaster recovery time in Vero Beach shall be reduced to eliminate or lessen the future risk to human life, and public and private property from natural hazards via recovery and redevelopment strategies.

Supplement 3; Adopted February 5, 2008; Ordinance #08-01.

Policies:

8.1 The City shall create a Recovery Task Force by 1992 to hear preliminary damage assessments and direct post-disaster recovery and redevelopment activities. The Recovery Task Force shall consist of the following:

Criteria:

A. City members of the Recovery Task Force may include the City Manager, Planning Director, City Engineer, Public Works Director, Utilities Director, City Attorney and other members as appointed by the City Council. Staff of the member departments may also serve on the Recovery Task Force as necessary.

8.2 Consistent with the City Comprehensive Emergency Management Plan, the City shall perform an initial damage assessment, immediately following a disaster event, in order to determine the extent of damage and prioritize allocation of recovery resources.

8.3 The Comprehensive Emergency Management Plan, Disaster Recovery Plan, shall specify procedures for implementing programs for immediate repair, replacement, and cleanup. Long-term rebuilding and redevelopment shall be addressed in a City mitigation plan as specified in the City Comprehensive Emergency Management Plan, Disaster Recovery Plan. Factors to be considered for short-term work include, but shall not be limited to:

A. Repairs to potable water, wastewater and power facilities;

B. Removal of debris;

C. Stabilization or removal of structures in a perilous condition;

D. Repairs required to make structures habitable; and

E. Roadway repairs required for vehicular access to emergency facilities or predesignated support facilities.

These considerations shall receive first priority in determining emergency building permits and distribution of City crews and equipment.

8.4 The City shall review all non-emergency and long-term redevelopment proposals utilizing the Land Development Regulations and the following criteria:

A. Structures seaward of the CCCL shall be permitted for reconstruction as long as current coastal zone construction requirements are met.

B. If utility lines, including but not limited to sewer, water, gas, electric and cable TV, must be relocated after a storm event, they should be permanently located landward (west) of the CCCL where the City Engineering Department determines that locational and engineering criteria are met.

C. Underground storage tanks located seaward of the CCCL which must be relocated after a storm event shall be relocated as far landward (west) of the dune line as possible but not less than 50 feet from the dune line.

D. Biohazardous incinerators or businesses which utilize or generate large quantities of hazardous materials (as defined within the Solid Waste and Hazardous Materials Element) shall be relocated landward (west) of the CCCL.

E. Water-dependent commercial uses seaward of the CCCL which are damaged by more than 50 percent of their assessed value shall be permitted for reconstruction seaward (east) of the CCCL only if consistent with the coastal zone construction requirements.

F. Water-related commercial uses seaward (east) of the CCCL which are damaged by more than 50 percent of their assessed value should be relocated landward (west) of the CCCL unless the project has no alternative location.

G. Water-enhanced commercial uses seaward (east) of the CCCL which are damaged by more than 50 percent of their assessed value should be relocated landward (west) of the CCCL if in compliance with existing building and zoning codes and adequate land is available.

H. If non-habitable minor structures, which are damaged by more than 50 percent of their assessed value, are reconstructed, they shall be relocated and constructed in compliance with the coastal zone construction requirements.

8.5 In the event of a disaster, all infrastructure and other City owned improvements, shall be analyzed to determine the cost effectiveness of relocation versus repair.

8.6 The City shall evaluate and identify areas susceptible to repeated damage by hurricane erosion and flooding.

8.7 The City shall request the Florida Department of Environmental Protection to forward information on the projected 30-year erosion line to determine erosion rates for Vero Beach, with special emphasis on areas with high erosion rates.

8.8 The City's post-disaster redevelopment and mitigation plan shall be coordinated with other local, regional and state entities. As additional interagency hazard mitigation reports are received, they shall be reviewed and incorporated into this plan, as appropriate.

8.9 Consistent with the Capital Improvements Element, the City shall only expend public funds for capital improvements in coastal high hazard areas that:

1. Maintain adopted level of service standards;

2. Replace existing capacity and upgrade the level of wastewater treatment required for reduction of pollutant loadings;

3. Do not support or encourage a net increase in the overall density and intensity of development beyond that indicated on the Future Land Use Map;

4. Support public beach and shoreline access, natural resources protection and enhancement, parks and recreation uses, or similar projects;

5. Provide for public safety or protection of public property including the relocation of vulnerable public facilities; and

6. Do not adversely impact hurricane evacuation times.

8.10 Capital improvements in the coastal high hazard areas shall not be planned or designed to create any capacity beyond that necessary to accommodate the existing overall intensity and density of development of these areas as indicated on the Future Land Use Map.

8.11 The City shall not approve or enter into any development or other similar contractual agreements with developers or property owners that would permit the construction of any infrastructure improvements supporting an increase in the overall intensity and density of development within coastal high hazard areas as indicated on the Future Land Use Map.

8.12 Consistent with the Land Use Element, the City's Comprehensive Emergency Management Plan, which addresses disaster preparedness and recovery, shall be periodically evaluated and used as a basis for notifying and evacuating residents, providing temporary shelter, and restoring services in the event of emergencies.

8.13 Siting standards and requirements shall be enforced to permit safe and insurable development and reconstruction in coastal high hazard areas consistent with applicable rules and regulations of state and federal governments.

8.14 The City shall review its Comprehensive Plan upon the issuance of any hazard mitigation reports to prepare and adopt appropriate amendments to the plan resulting from the report.

8.15 The City shall maintain, in cooperation with Indian River County and other local governments, a Local Mitigation Strategy to identify and prioritize disaster mitigation projects.

8.16 The City shall continue to enforce federal, state and local setback and elevation requirements to promote the protection and safety of life and property within the coastal high hazard area.

8.17 The City shall continue to regulate development and redevelopment and manage natural resources within the coastal high hazard area by continuing to develop and enforce Land Development Regulations which address vesting provisions, floodplain management, land use densities, beach and dune disturbance and emergency seawall permit applications.

5.8.0.6 Coastal Access

Objective 9:

The City shall maintain existing public access facilities to the beach, estuarine and river shorelines and by September 1, 1995, develop an alternative program for the acquisition of public access facilities consistent with the financing ability of the City.

Supplement 3; Adopted February 5, 2008; Ordinance #08-01.

Policies:

9.1 The City shall continue to acquire, improve or provide alternative access to beach. This plan shall include the following:

Criteria:

A. Cross-over structures.
B. Parking facilities.
C. Access shall be consistent with the standards included in the Recreation and Open Space Element.

9.2 The City shall continue to pursue funds for dune revegetation to be used when constructing dune cross-overs as replacement of unimproved dune access.

9.3 The City shall continue discussions with the Florida Department of Transportation to provide waterfront access on causeways and bridges.

9.4 The City shall ensure public access to beaches which are renourished with public funds through a site plan review procedure as outlined in the Land Development Regulations to be adopted by September 1, 1990. These regulations shall address the following criteria.

A. Require private property owners and single-family residential or commercial/retail to provide access to beaches.

B. Allow for the use of publicly owned access points on easements.

C. Allow the developer/owner to improve, consolidate or relocate public access provided it is consistent with this plan.

9.5 The City Land Development Regulations, to be adopted by September 1, 1990, shall provide for enforcement of the public access requirements of the 1985 Coastal Zone Protection Act.

5.8.0.7 Infrastructure

Objective 10:

Establish levels of service, service areas and phasing of improvements for the coastal zone consistent with the infrastructure elements of this plan, and the unique character of the coastal zone.

10.1 The levels of service, service areas and phasing of improvements for roadways within the coastal zone shall be those contained within the Traffic Circulation Element.

10.2 The levels of service, service areas and phasing of improvements for potable water within the coastal zone shall be those contained within the Potable Water Element for the Vero Beach water system.

10.3 The levels of service, service areas and phasing of improvements for sanitary sewer facilities within the coastal zone shall be those contained within the Sanitary Sewer Element for the City sanitary sewer system.

10.4 Public facilities shall be in place to meet the demand imposed by development or redevelopment as outlined within the Future Land Use Element, Traffic Circulation Element and Capital Improvements Element of this plan

5.8.0.8 Living Marine Resources and Habitat

Objective 11:

To protect, appropriately use and conserve marine habitat and living marine resources.

Policies:

11.1 The City shall maintain its program for sea turtle protection which includes relocation of eggs to an approved hatchery and assistance of hatchlings to the water.

11.2 The City shall not permit restoration, alteration or maintenance projects east of the existing dune vegetation line during sea turtle nesting season, from May 1 to October 31 of each year, except for projects necessary to mitigate natural disaster occurrences or FDNR permitted and monitored projects.12.3 The City shall continue to protect manatees and their habitat by implementing the policies in Section 6.11.0.4 of the Conservation Element.

11.4 The City shall protect the water quality of the Indian River Lagoon by implementing the objective and policies in Section 6.11.0.1 of the Conservation Element.

11.5 By 1993, the City shall establish a program between the Vero Beach Planning Department, Indian River County and DNR to monitor the condition of existing submerged aquatic vegetation (SAV) within the Indian River Lagoon and to determine if additional measures are required to protect and conserve the vegetation.

11.6 Beach renourishment projects for the City which require off-shore dredging shall be monitored by the City Planning Department and Indian River County to prevent damage to the nearshore reef.

11.7 The City shall protect and appropriately use the beaches and shoreline by implementing the objective and policies in Section 5.8.0.2 of the Coastal Element.

11.8 The publicly owned spoil islands in the Indian River Lagoon shall be maintained as conservation areas by the City as shown on the Future Land Use Map (Figure 1.5).

5.8.0.10 Coordination With Existing Resource Protection Plans

Objective 12:

To establish an intergovernmental coordination mechanism in order to coordinate with existing resource protection plans within the jurisdiction of more than one local government.

Supplement 3; Adopted February 5, 2008; Ordinance #08-01.

Policies:

12.1 The City shall implement the policies found in the Intergovernmental Coordination Element of this plan.

12.2 The City shall identify by 1993, those resource management plans which require intergovernmental coordination. The 1983 Hutchinson Island Resource Planning and Management plan shall be included.

5.9 REFERENCES CITED

Florida Department of Community Affairs. (September 30, 1986). Ch. 9J-5 FAC "Minimum Criteria for Review of Local Government Comprehensive Plans and Determination of Compliance." Tallahassee, FL: Author.

Florida Department of Environmental Regulation. (June, 1986). Water Quality Inventory for the State of Florida, 305(b) Technical Report. Tallahassee, FL: Author.

Florida Department of Environmental Regulation. (June 1980). "Water Quality and Urban Development: Vero Beach Study." Tallahassee, FL: Author.

Florida Department of Environmental Regulation. (1983-1984). Florida East Coast Basin Assessment Report. Orlando, FL: Technical Assistance Section St. Johns River District.

Florida Department of Environmental Regulation. (1987). Groundwater Management System Monthly Operating Reports, GMS 36, 08/03/87. Tallahassee, FL: Author.

Florida Game and Fresh Water Fish Commission. (November 1982). The Sebastian Inlet - Ft. Pierce Inlet Barrier Island: A Profile of Natural Communities, Development Trends, and Resource Management Guidelines. Vero Beach, FL: Office of Environmental Services.

Florida Department of Natural Resources. (1985). Toward A Proactive Statewide Marina Siting Program. Tallahassee, FL: Division of State Lands, Bureau of State Lands Management, Submerged Lands Section.

Florida Department of Natural Resources. (July 7, 1987). "Recreation and Parks Management Information System; Florida Recreation and Parks Facility Inventory, Indian River County." Tallahassee, FL: Author.

Florida Department of Natural Resources. (1987). Outdoor Recreation in Florida - 1987. Tallahassee, FL: Division of Recreation and Parks.

Indian River County. (1987). Draft Comprehensive Growth Management Policy Plan.

Indian River Farms Water Control District. (1987). Personal Communication of Unpublished Data.

U.S. Department of Interior. (January 1984). USFWS National Wetlands Inventory Map.

U.S. Geological Survey. (1986). Water Resources Data, Florida Water Year 1985 (Vol. 1A, Report FL-85-1A).

U.S. Army Corps of Engineers. (January 23, 1984). Indian River County, Florida, HD No. 98-154. Washington, DC: U.S. Government Printing Office. U.S. Army Corps of Engineers. (1986). Design Memorandum.

Virnstein, Robert W., Cairns, Kalam D. (1986). "Seagrass Maps of the Indian River Lagoon." Unpublished report.