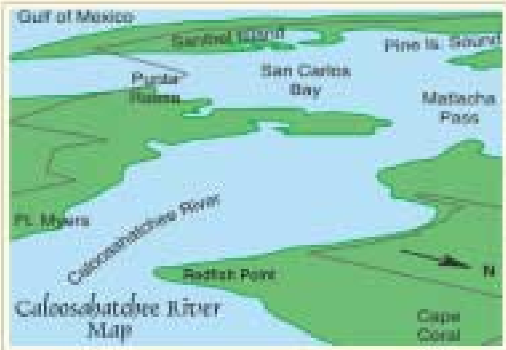
Caloosahatchee River 2002

Caloosahatchee River [illegible]



Caloosahatchee River Map

A Historical Geography of Southwest Florida Waterways

VOLUME TWO

Placida Harbor to Marco Island

Cover Credits:

1) Caloosahatchee River 2002, photo by Lee County Mosquito Control
2) Caloosahatchee River, Cape Coral Historical Society Museum
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A Historical Geography
of Southwest Florida Waterways

VOLUME TWO

Placida Harbor to Marco Island

2002

Gasparilla Pass, looking southeast past the causeway and abandoned railroad trestle to Gasparilla Sound with Charlotte Harbor in distance.

A Historical Geography
of Southwest Florida Waterways

VOLUME TWO

Placida Harbor to Marco Island

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Acknowledgments

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Chuck Listowski (Executive Director, West Coast Inland Navigation District, WCIND) inspired us to consider as our task, not only providing the public with a broader understanding of the historic roots of coastal development, but also establishing a scientific baseline needed by planners and elected officials to set policy and implement waterway resource management. The WCIND Board — elected commissioners from Manatee County (Joe McClash, Chair), Sarasota County (Nora Paterson and Shannon Staub, Alternate), Charlotte County (Mac Horton), and Lee County (Ray Judah) — provided encouragement throughout the project.

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Prior to 1988, he worked mostly in the Caribbean and Latin America on natural resource and watershed management issues. Since 1988, Gus has focused on Florida coastal management and marine recreation planning projects, dealing with boat live-aboards, derelict vessel removal, hurricane recovery, artificial reef monitoring, anchoring, waterway management and boat traffic evaluations.

Gus has boated in Florida for 30 years and has cruised the Caribbean, Bahamas and U.S. eastern seaboard aboard a Cheoy Lee Cruisaire 35, *La Vida*, which also serves as a self-contained field station for waterway research. Gus holds a Merchant Marine Master's Ticket (100 tons), and is a 28-year member of the U.S. Coast Guard Auxiliary.

When not boating or consulting on Southwest Florida waterways, Gus is training on his bike for ultra-marathon brevets or cycle-touring in some distant, exotic locale.

La Vida, the authors aboard, with sails and sheets eased off the wind, somewhere along the Southwest Florida coast.

David A. Fann is a geographer with the Florida Sea Grant College Program, University of Florida, Gainesville. He received a B.S. in Technical Journalism and a M.S. in Geography from the University of Florida. He performs Geographic Information System (GIS) analyses, creates map-based educational publications for recreational boaters, and participates in field data collection whenever possible. Along with *A Historical Geography of Southwest Florida Waterways, Volumes One and Two*, his primary focus in recent years has been the Regional Waterway Management System project in Manatee, Sarasota, and Lee Counties. This project gathers information on waterway conditions and boat populations, analyzes both kinds of data in a GIS, and provides the results to county policy makers, facilitating an efficient, region-wide approach to waterway management.

Before returning to the University of Florida in 1993, David did rocket science with Martin Marietta Aerospace at Kennedy Space Center and Cape Canaveral Air Force Station. He began his career as a technical writer/editor at Martin Marietta's Orlando Division.

For more than 30 years, David has sailed and fished Florida waters.

Paul Roat is a Florida native who has spent most of his life on the barrier islands of Manatee and Sarasota counties. Paul graduated from the University of South Florida with a degree in photojournalism and has spent 25 years writing or editing community newspapers, magazines and books. Paul works with Tom Cross Inc., a consulting firm specializing in environmental and marine writing and graphics. He is news editor for *The Islander*, a community newspaper based on Anna Maria Island.

1941 - The Changing Sea and Earth

*“. . . the sea, too, lay restless, awaiting the time when once more it should encroach upon the coastal plain, and creep up the sides of the foothills, and lap at the bases of the mountain ranges . . .
so the relation of sea and coast and mountain range
was that of a moment in geologic time.
For once more the mountains would be worn away
by the endless erosion of water and carried in silt to the sea,
and once more all the coast would be water again,
and the places of its cities and towns would belong to the sea.”*

— *In Under the Sea-Wind: A Naturalist's Picture of Ocean Life*
Rachel Carson
©1940
Published by Simon and Schuster,
New York. p. 271.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Sea Grant College Program
1315 East-West Highway
Silver Spring, Maryland 20910

Coastal Southwest Florida has undergone dramatic changes in the past 120 years. The vast mangrove forests, expansive seagrass meadows and serene sawgrass tracts have been changed into housing developments and waterfront condominiums. The once-quiet towns and fishing villages have been transformed into bustling communities. Unfortunately, the new residents to the coast are all too often unaware of the region's history.

The great naturalist and ecologist, Edward O. Wilson, in remarking on man's alteration of the environment, speaks of managing the human "footprint" on natural systems as society's greatest challenge in this the new century.

Yet, there are few such places where man's footprint is more starkly visible than the coast of Southwest Florida. In little more than three decades, a blink of an eye in human history, this coastline has gone from a mostly pristine region of small towns and coastal communities to one of immense development that has markedly changed the face of Southwest Florida.

Massive dredging and fill projects have reshaped the land and waterways. We have made land where nature did not, and dug waterways in areas nature picked to be seagrass beds. It is only through understanding these changes made throughout the years that we can fully appreciate the alterations to this once-pristine landscape.

As a society, we are intensely proud of our history and progress as a nation, tend not toward retrospection and focus intensely on the future. But to truly understand the immense changes that we have wrought on scale that is not readily observable or comprehensible, we need a point of reference and historical perspective if we are to derive necessary lessons from that history.

A Historical Geography of Southwest Florida Waterways, Volume Two, Placida Harbor to Marco Island offers readers a glimpse of the changes that have occurred in the region. Visual depiction of the manmade changes that have taken place are shown through maps and photographs.

As in Volume I, the authors chronicle magnificently the magnitude of cumulative impacts of thousands of smaller actions and among many jurisdictions over a relatively short time.

Only by learning of the past can we understand the needs of the future. Dr. Antonini and colleagues unveil the complex history and geography of this interesting and beautiful area. Southwest Florida with its rare ecosystems should be managed and nurtured in the coming years.

The authors have done us all an incalculable service yet again. They have provided us with invaluable information, insight and guidance we will surely need to address the difficult issues of environment and community that lie ahead.

Ronald C. Baird
Director
National Sea Grant College Program

NOAA

The Ship's Bell
Throughout each four-hour watch, hours and half-hours are struck by a ship's bell. The time is described as "one bell" for the first half hour, "two bells for the second half hour, and so on, up to eight bells.

INTRODUCTION

Perhaps nowhere else in Florida are manmade alterations to the natural landscape more visible than in the Southwest, along the coast between Placida Harbor and Marco Islands and east through the Caloosahatchee Valley to Lake Okeechobee. This 184-mile stretch of barrier island shore and riverine valley waterways, fishing villages, and small scattered agricultural communities in the pre–development, early 20th century era — is today a bustling chain of waterfront communities and thriving cities.

The coastline includes large estuaries, such as Charlotte Harbor, Pine Island Sound, and San Carlos Bay; smaller embayments; and hundreds of miles of manmade channels and canals linking the massive developments of Punta Gorda, Cape Coral, and Marco with the bays and, ultimately, the Gulf of Mexico. It also encompasses the Caloosahatchee, a riverine system that is part of the Okeechobee Waterway, the only water link across Florida, from the Gulf to the Atlantic Ocean.

Little Gasparilla Island, view north. Gasparilla Pass on lower left, abandoned railroad trestle and causeway to Placida on right, Placida Harbor and Cape Haze development in midground.

The peaceful communities and cities of today give little indication of recent conflicts in the region. In fact, few locations in the nation have received as much attention from federal, state, regional, and local managers and regulators of waterway and coastal development as has Southwest Florida.

Pressure from developers to dredge and fill vast tracts of land for home construction behind seawalls and embankments prompted statewide attention and federal action, which resulted in the curbing of permits that allowed growth and caused massive changes in the way Florida's leaders — and the developers — viewed and permitted development.

Some interests favored waterway construction to benefit navigation and riverine commerce. Meanwhile, land-oriented interests advocated waterways as great drainage ditches for quickly removing unwanted water from valuable agricultural acreage. The result was heated debate and dramatic changes in the ways rivers were viewed and used throughout Florida.

Lessons learned through these historical conflicts may bode well for future discussions of Southwest Florida development. National attention is currently focused on South Florida in the wake of a federal-state-regional program to preserve and protect the Everglades from development pressure and ensure water flow to sensitive areas far downstream in the "River of Grass."

This book, *A Historical Geography of Southwest Florida Waterways, Volume Two*, offers a glimpse of the changes that have occurred along this Southwest Florida coast since the late 19th Century. Undoubtedly, the biggest alterations to the natural landscape have occurred through manmade changes in the waterways, by the creation of the Gulf Intracoastal Waterway (ICW) and the Okeechobee Waterway and by development of waterfront communities upon submerged land.

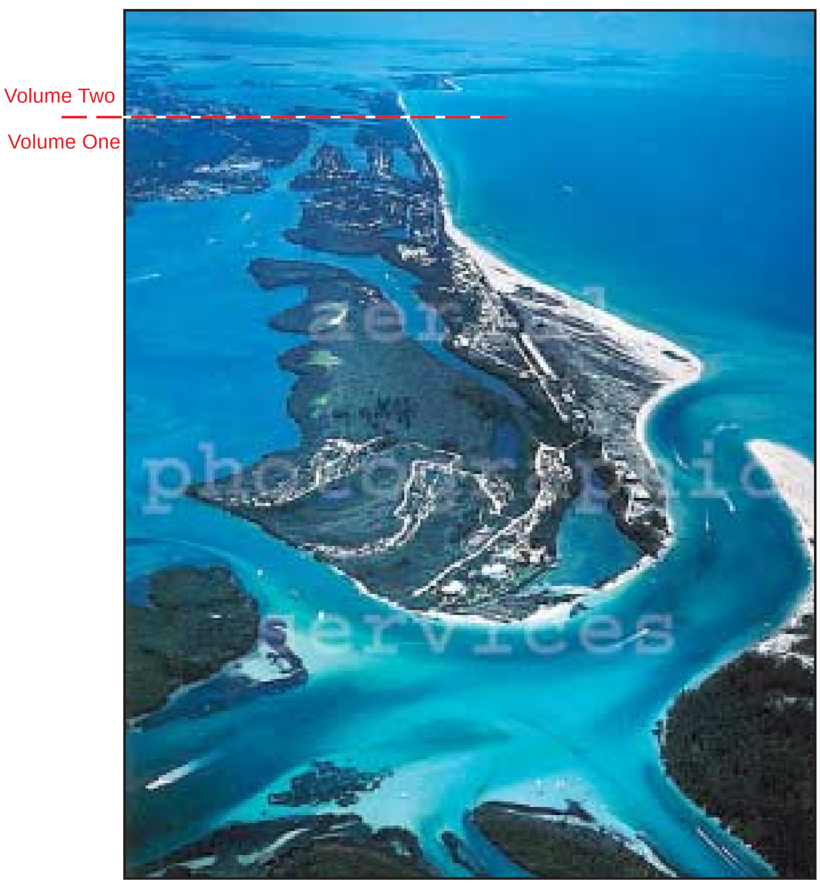
Before development, this stretch of coastline was an area of "wild" Florida, where natural barriers of shoals separated embayments and blocked passage of vessels. (See Boating Geography chapter.) As settlements began to flourish in the region in the late 1800s, the demands for transportation of goods grew, and dredging began in the region. In the 1880s, the lower course of the Caloosahatchee was the first waterway in the region to be "channelized." Dredging of passes in Charlotte Harbor, and Pine Island Sound followed. The early 1960s saw completion of the ICW from the mouth of the Caloosahatchee to Gasparilla Sound and points north. (See Dredging History chapter.)

With the region opened to the easy transport of goods and services, and with an immense demand for Florida housing after World War II, access channels and canals were deemed the easiest way to create homesites from "worthless swampland." The end of the development boom saw 1,136 miles of boat channels completed from Placida Harbor to Marco Island, totally changing the face of Southwest Florida. (See Access Channels chapter.)

An effective way to comprehend the changes in the region is through photographs and maps showing the pre- and post-development settings at selected locations, as depicted in the Photographic Record chapter. The Land Use Changes chapter highlights, community-by-community, the physical alterations in the area through housing development, railroad line creation, and dredging of the ICW.

Tidal inlets are a vital part of the landscape of Southwest Florida. The exchange of saltwater from the Gulf with freshwater of streams and rivers in the bays is facilitated through the passes between barrier islands. Inlets provide recreational opportunities for tens of thousands of boaters and fishers, and the Inlets chapter is devoted to their importance for navigation, recreation, and the environment.

The Caloosahatchee [Caloosa= indigenous Native Americans who inhabited Southwest Florida, Hatchee= Seminole for river] chapter chronicles the history of the Caloosahatchee Valley, which may serve as a harbinger for the future of at least several elements of the ongoing multi-billion dollar Everglades restoration effort. The river is an extreme case of altering land and water for coastal development and, in the process, irrevocably changing its form and function. The historic river, a valuable asset to pioneers as a commercial artery for transporting goods and providing services, had a meandering, shifting course sometimes drastically affected by floods and droughts. Today, it is the straight-channel, dredged, Okeechobee Waterway, used by resource managers for flood control and by boaters transiting between the Eastern Seaboard and the Gulf Coast. Questions on how to manage the historic river and its water in the future, constrained by its historical and ecological niche in South Florida, will provide a challenge in the years ahead.



Where Volume One and Volume Two meet, at the south end of Lemon Bay, with Stump Pass in the foreground, lower Lemon Bay in midground on left, The Cutoff (boundary) at dash line, Charlotte Harbor in background, looking south.

The Charting Waterway Changes chapter describes how Geographic Information System computer programs enable source material from different eras to contribute to the creation of the maps in this book. Cartographers place maps and charts in reference systems that evolve as knowledge of the Earth's true shape improves. A major problem is bringing them all into a common system, so that investigators can accurately measure and display historic changes in study area parameters of interest.

The future of Southwest Florida's vast system of bays, inlets, rivers, sleepy fishing communities, waterfront suburban tracts, and bustling urban cores is unknown. A growing awareness exists among residents that their paradise could easily be lost without widespread adoption of a stewardship ethic and continuing public efforts to restore and maintain the region's unique ecological and cultural treasures. The balance between people and nature will continue to be the challenge for Southwest Florida and its waterways.

This book is part of a series of publications on the boating geography of the region. *A Historical Geography of Southwest Florida Waterways, Volume One*, similarly treated the adjoining area to the north, from Lemon Bay to Anna Maria Sound (south of Tampa Bay).

While similar waterway conditions prevail in the northern (Volume One) region, several differences in the coastal development process between the northern and southern regions are noteworthy. First, the federally authorized ICW navigation channel was dredged much earlier in the north, reaching south from Tampa Bay to Sarasota in 1896 and from Sarasota to Venice in 1907. The ICW segment from Venice to Lemon Bay was dredged in the 1960s, coinciding with the ICW improvements covered in Volume Two.

Canal development occurred in the northern region much earlier as well, spurred on by entrepreneurs like John Ringling of Sarasota. Though canal development in the northern region was widespread, most canal systems there were smaller in scope and shorter in length. (A notable exception was Siesta Key's Grand Canal system.) The filling of bay water to create residential property was relatively more common; as a result, conversion of *water to land* predominated in the northern region. Thus, Volume One included the chapter "Land and Water Changes along the Waterway."

In contrast, the change from *land to water* along the pre–development shoreline largely defined coastal development in the southern region. Dredging vast networks of waterways landward of the shoreline created immense, canal-based communities like Punta Gorda Isles, Cape Coral, and Marco Island. Relatively much less conversion of water to land by filling of bay water took place in the southern region. Hence, this volume presents a chapter highlighting canal development case studies, rather than the regional land-water change analyses of Volume One.

Placida Harbor and Cape Haze canal development in foreground, looking north over Coral Creek towards Rotunda West.

Punta Gorda Isles in midground, looking north towards the Peace River, with Port Charlotte in background, Burnt Store Isles canal development in lower right.

A map-based approach is ideal for quantifying, displaying, and understanding the changes wrought by both man and nature along the southwest Florida coast. An analysis of the mapped features helps explain the present state of waterway conditions and the changing nature of the coastal environment. Where historic depth data are available as point soundings throughout areas of open waters — such as in Charlotte Harbor, Pine Island Sound, San Carlos Bay, and the Caloosahatchee (below Beautiful Island) — chloropleth maps show average depths interpreted from the soundings. However, historic charts of Estero Bay and the Naples–Marco region — where large areas of navigable bay waters are less abundant — provide only channel centerline depths. This precludes analyses of bathymetric change over much of the mapped region to the south.

Where region-wide maps are displayed, as in the Access Channels chapter and the Land Use Change chapter, the study area is segmented into five areal zones (Map 1).

1. Western Charlotte Harbor, including Pine Island Sound and western San Carlos Bay.

2. Eastern Charlotte Harbor, including Matlacha Pass and eastern San Carlos Bay (with the area 1 and 2 boundary following State Road 767 along Pine Island).

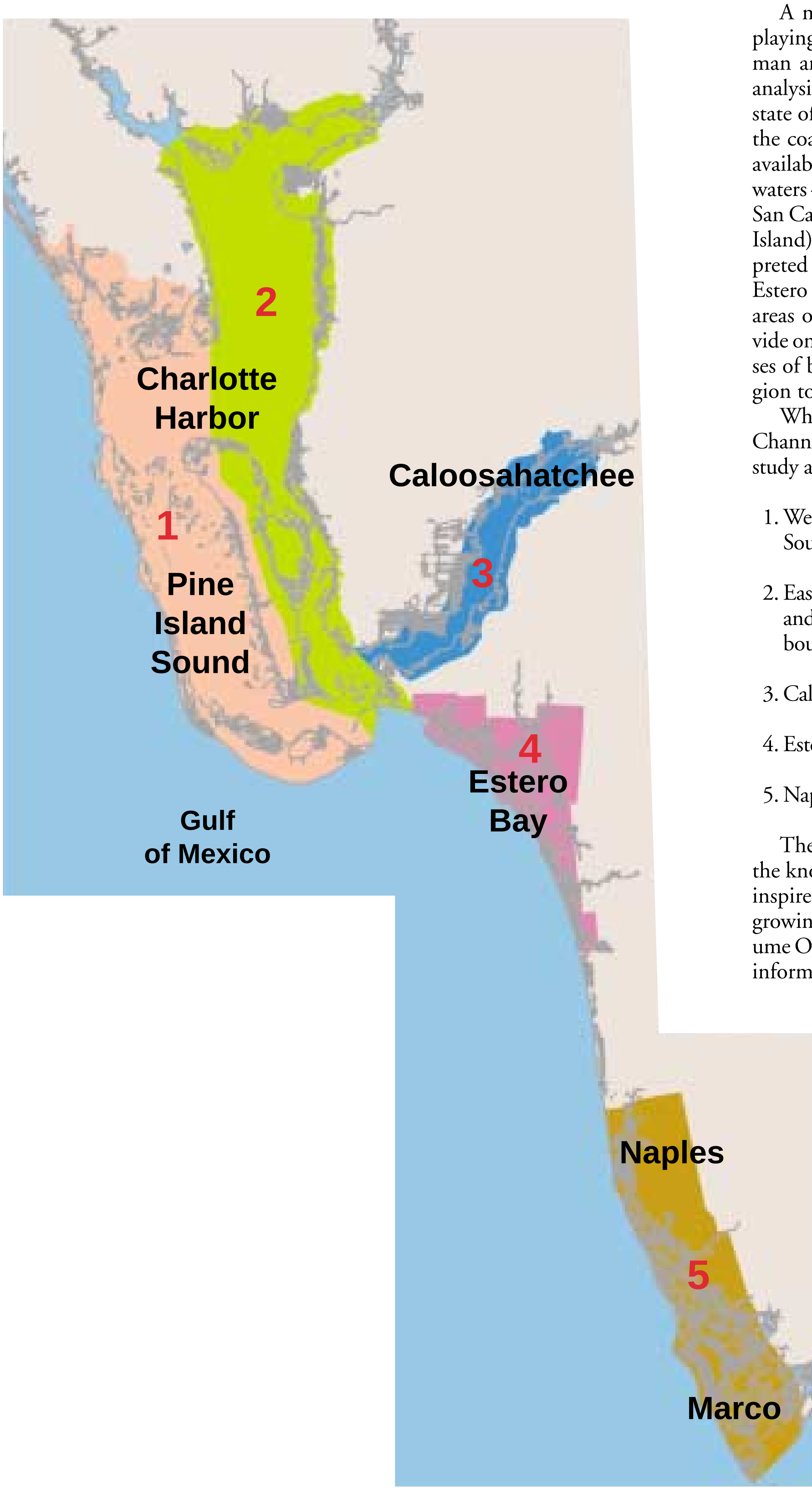
3. Caloosahatchee (upstream to Beautiful Island).

4. Estero Bay and Wiggins Bay.

5. Naples–Marco.

The intent of the volumes in this series is to increase the knowledge about coastal change in the region and to inspire public stewardship for a healthy environment in a growing community. Since the 1999 publication of Volume One, resource planners and elected officials have used information in the historical geography analysis to formulate prescriptive policies and actions to deal with waterway management needs. Habitat restoration of spoil islands, anchorage planning, and an innovative method of general permitting for maintenance dredging are some of the issues where an application of the principles and information contained in these books have been applied.

Digital map data contained in both volumes of this series will be incorporated into *A Coastal Data Server System for the Gulf Intracoastal Waterway and Adjoining Bay Waters of Southwest Florida,* to be hosted by the GeoPlan Center of the University of Florida. The NOAA Coastal Service Center, Charleston, SC, is supporting this effort through a grant to Florida Sea Grant.



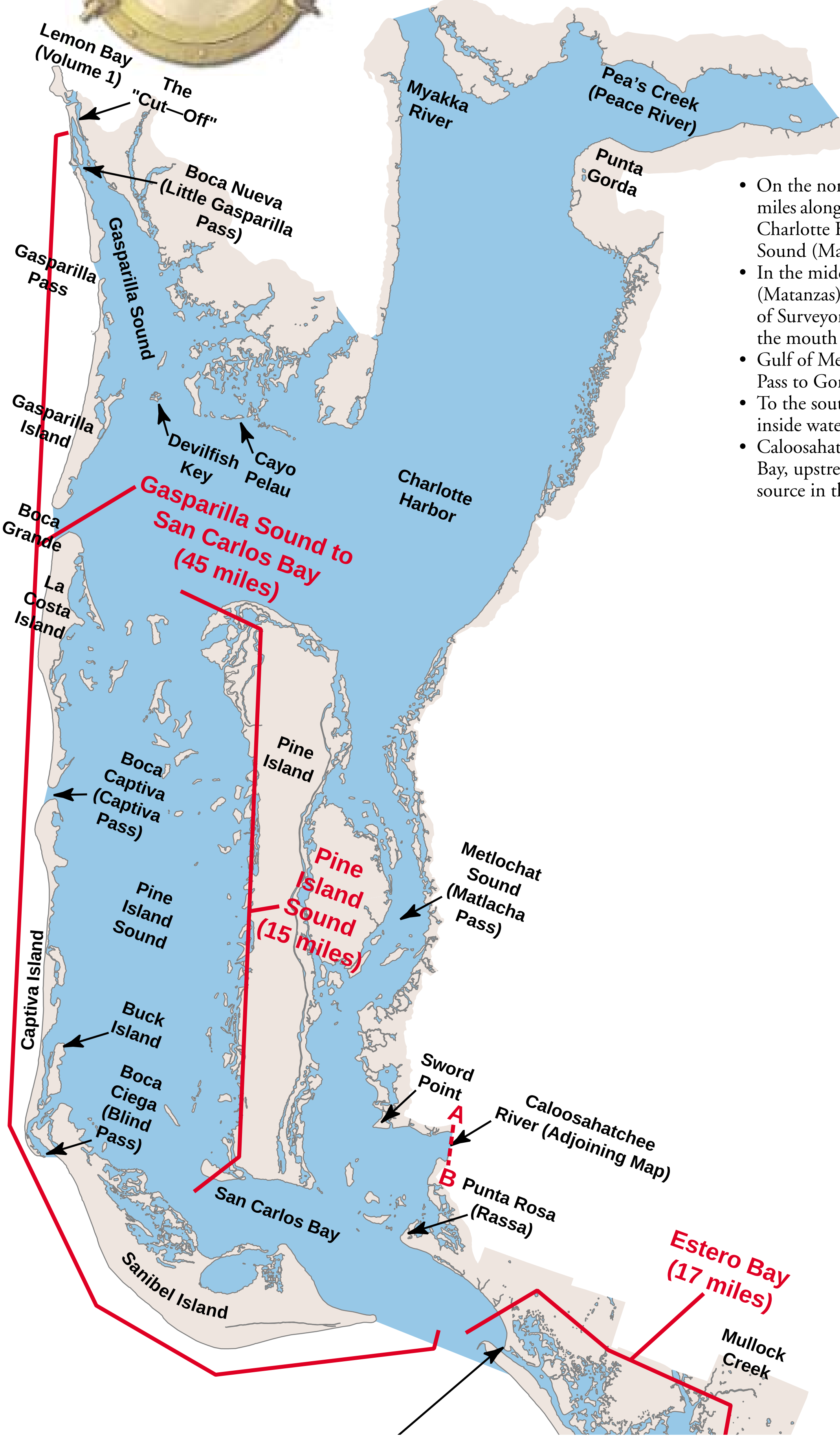
Map 1.
Regional map presentations in the
Access Channels and Land Use Changes chapters.

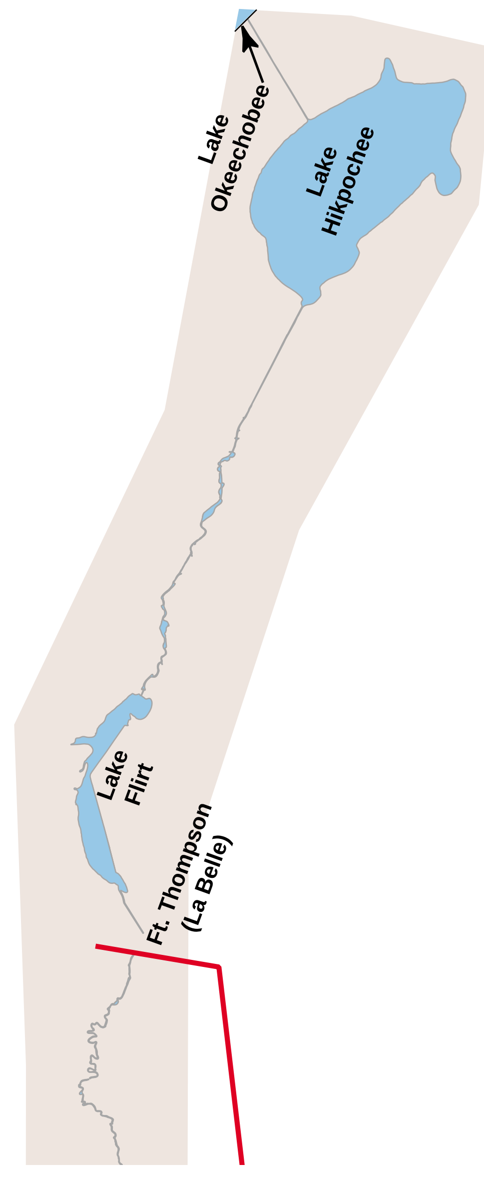
HISTORICAL DEVELOPMENT OF SOUTHWEST FLORIDA WATERWAYS

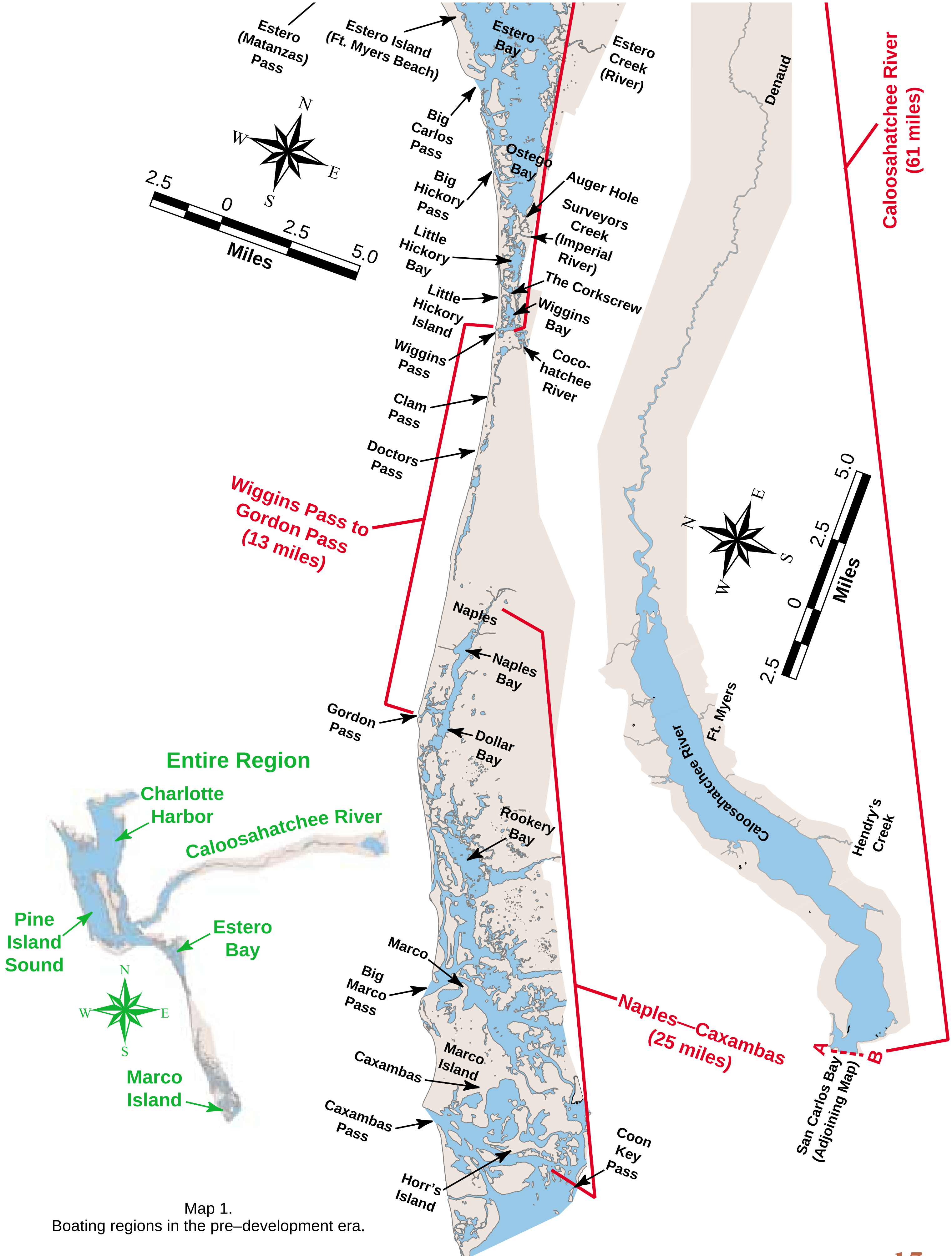
The Boating Geography of Southwest Florida Before Coastal Development

One must return to the late 19th century to visualize the pre–development condition of the waterways in Southwest Florida from Placida Harbor to Marco Island and the Caloosahatchee. This region included three separate inland bays, a reach along the Gulf of Mexico shore, and a river system (Map 1):

- On the north, Gasparilla Sound to San Carlos Bay, 45 miles along the Gulf shoreline, including elbow-shaped Charlotte Harbor, Pine Island Sound, and Metlochat Sound (Matlacha Pass);
- In the middle, Estero Bay, 17 miles long, from Estero (Matanzas) Pass (Ft. Myers Beach) through channels of Surveyors Creek (Imperial River) to Wiggins Bay, the mouth of the Cocohatchee and Wiggins Pass;
- Gulf of Mexico, a 13-mile reach south from Wiggins Pass to Gordon Pass;
- To the south, Naples Bay to Marco and Caxambas, an inside waterway stretching 25 miles long;
- Caloosahatchee, from the river's mouth in San Carlos Bay, upstream and eastward, for 84 miles to the river's source in the sawgrass region of Lake Okeechobee.







Map 1.
Boating regions in the pre–development era.

Natural barriers historically separated these waterways. The connections from Gasparilla Sound and San Carlos Bay were impeded: north to Lemon Bay by "The Cut-Off," east to the Caloosahatchee by the river's delta, and south from San Carlos Bay to the Gulf of Mexico by inlet shoals. Mariners entering and leaving Estero Bay had to run Estero (Matanzas) Pass and Wiggins Pass, as well as negotiate the tortuous, winding channel connecting Estero and Wiggins Bays. There were no harbors of refuge, such as present-day Clam Pass and Doctors Pass, along the Gulf Coast. Farther south, beyond the entrance at Gordon Pass, the inside passage from Naples Bay to Marco was strewn with oyster bars that made navigation risky even for shallow-draft vessels. On the Caloosahatchee, waterfalls set the head of navigation at Ft. Thompson (La Belle). Settlers along this coast could sail along the Gulf shore in good weather, but strong onshore winds would force them inside, where passage was especially impeded when seasonal "northers" reduced the water depths and made many shoals impassable.

From the north, mariners entered Gasparilla Sound through Gasparilla Pass (6.5–foot depth), though shallow-draft coasters sometimes used Little Gasparilla (Boca Nueva) Pass (3.5-foot depth) in settled weather. The sound, 9 miles long, varied in width from approximately a half mile in the north to 6 miles in the south (including Bull and Turtle Bays), where it connected with Charlotte Harbor. The principal channel south was between Devil Fish Key and Gasparilla Island (4.5 feet deep). Another shallower, crooked channel ran east between Devil Fish Key and Cayo Pelau. Charlotte Harbor, an extensive embayment with relatively uniform depths, opened to the south and stretched 10 miles east by 20 miles north. Vessels entered the harbor from the Gulf through Boca Grande Pass, which had a natural depth of 19 feet over the bar. East through the harbor, 9-foot depths could be carried to Punta Gorda. Pea's Creek (also called Pease Creek and, later, the Peace River) emptied into Charlotte Harbor just northeast of Punta Gorda.

Vessels heading south, either from Boca Grande or Charlotte Harbor, coasted down Pine Island Sound, the 15-mile-long by 3- to 4-mile-wide passage of water situated between Pine Island and the barrier island chain of La Costa, Captiva, and Sanibel Islands. Shoals existed opposite Boca Captiva (Captiva Pass) and Boca Ciega (Blind Pass). In fair weather, fishing schooners used either pass. Vessels touched at a fishing station on the northeast coast of Captiva Island. In 1880, Boca Ciega was not "blind" (closed), but had a 400-foot-wide channel. A side channel veered north between Buck and Captiva Islands, with depths from 3 to 6 feet all the way out to the sound. Along the inside passage heading south in Pine Island Sound, and after the shoals opposite Blind Pass, deep water opened into San Carlos Bay, and the channel skirted the east shore of Sanibel Island south to the Gulf of Mexico.

Numerous islands fringed Metlochat Sound (Matlacha Pass), separating Pine Island from the mainland to the east. The channel through Middle Metlochat was tortuous and impassable for vessels of more than 2–foot draft. Upper and Lower Metlochat Sound were relatively less obstructed by islands and afforded deeper water, accommodating vessels drawing 6 to 7 feet. Pine Island and Metlochat Sounds joined at the south in San Carlos Bay. An extensive tidal delta at the mouth of the Caloosahatchee shoaled the east portion of San Carlos Bay.

Estero River during the Koreshan settlement era, circa 1900.

Cuban fishing smacks sailing in Charlotte Harbor, 1922.

Imperial River, early 1900.

Coastal view of Marco Island, early 1900.

Estero Bay, which trends northwest/southeast and is approximately 7 miles long and 2 miles wide at its center, tapers at each end. Mariners entered at the north through Estero Pass (Matanzas Pass). The bay was bounded on the west by Estero, Big Hickory, and Little Hickory Islands. Though Big Carlos Pass retains its historic position and shape today, the other inlets situated south of it were very differently shaped in earlier eras. (The Inlet Dynamics chapter explains the effects of human intervention and natural processes on the history of these inlets.) Numerous islands of various sizes are scattered throughout the bay. A long sand bar covered with 6 to 12 inches of water at mean low water restricted vessels at the mouth of Estero Creek. Another sand bar was at the mouth of Surveyors Creek (Imperial River), with approximately 1 foot of water at mean low tide. Estero Bay ended at the Auger Hole, a tortuous distributary channel at the mouth of Surveyors Creek, a little south of Big Hickory Pass. Vessels transiting south had to negotiate this constriction and pass into Surveyors Creek, then down that creek through the Cork Screw, another sharply bending channel of shallow water, before entering Little Hickory Bay, a distance of 4 miles, in order to reach the Cocohatchee and Wiggins Pass.

The Gulf shore south of San Carlos Bay (Ft. Myers Beach) was sparsely populated in predevelopment times. This was especially true of the 13–mile stretch of coastline between Wiggins and Gordon Pass. Naples Bay could be approached through Gordon Pass, but there was only a fish camp at the inlet mouth in the early 1900s. An inside waterway connected this pass to Naples and extended south for 12 miles to Big Marco Pass. The passage was a few hundred feet to 1 mile distant from the Gulf beach, from 40 feet to one-half-mile wide, and from 3 to 10 feet deep. Many transverse oyster bars, covered by a dense growth of mangroves, obstructed the passage. About 3 miles south of Naples was Dollar Bay, a wider section of this waterway, and Rookery Bay, another enlarged section, lay another 4 miles south. Fishermen used tidal channels to run east of Marco Island and round Coon Key Pass, a distance of 13 miles, to reach Caxambas.

Orange River, early 1900.

The banks along the Caloosahatchee were lined with rickety docks, sewer outfall pipes and litter before the turn of the century. In 1888, the Ft. Myers Council ordered outhouses on the waterfront removed as they were "offensive to the best interest of the community."

The Caloosahatchee, early in the 19th century, was recognized as the key to settling the vast Okeechobee Basin. Unlike today, the river did not reach the big lake. An extensive shoal (5.5 foot depth), across the mouth where the river entered San Carlos Bay between Sword Point and Punta Rosa (Rassa), hampered navigation. Other obstacles included numerous oyster bars along the 17-mile reach up to Ft. Myers and a very crooked, shallow (4 feet deep), and long (44 mile) channel from Ft. Myers to the waterfalls at Ft. Thompson (La Belle). The river's source was 4 miles upstream of Ft. Thompson near Lake Flirt, which was 16 miles west of Lake Okeechobee. The Caloosahatchee above Ft. Myers was subject to overflow during the wet seasons. There are numerous recordings of 17-foot–high floods at Denaud; these recurring events prompted private ventures and government attempts to regulate river flow for land drainage and reclamation.

These were the general conditions that prevailed before changes were made, with navigation improvements and land drainage the principal goals behind the man-made alterations.

Caloosahatchee shoreline.

Bird's-eye view of Punta Gorda before seawall.

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Dredging History of Southwest Florida Inland Waterways

The region's dredging history is linked to the recognized advantages afforded by shipping local products to market on inland waterways, as well as by the desire to control flooding with upland drainage. Oftentimes, these two objectives pitted competing and conflicting interest: waterway navigation versus land reclamation. As coastal settlements were established in the late 1800s, local communities sought governmental assistance in creating inland navigation routes. Prior to the extension of railroads south of Tampa Bay, there was great interest in opening steamboat communication across Florida. Several navigable routes were investigated: from Jacksonville, via the St. John's River, then by way of Topokalija Lake (now called Lake Tohopekaliga) to Charlotte Harbor; and down the Kissimmee River and Caloosahatchee to Ft. Myers.

With a surge in interest following the Civil War to develop lands adjoining Lake Okeechobee, the great liquid heart of Florida, private investors, armed with land grants from the state to subsidize drainage projects, attempted several canal dredging projects to link the lake with the Gulf. (These improvements are discussed further in the Caloosahatchee chapter.) By and large, however, local settlers sought to improve sheltered water routes that could provide safe passage for light-draft vessels within Charlotte Harbor and the lower Caloosahatchee, in Estero Bay, and between Naples and Marco Island. The chronology of events is summarized in Table 1 and illustrated in Maps 1 and 2.

The hydrographic charts produced by the U.S. Coast and Geodetic Survey (Coast Survey), along with U.S. Army Corps of Engineers (Army Engineers) reports and maps to Congress, provide an invaluable baseline of information on waterway conditions in Southwest Florida during the pre- and early development period. Ship captains use Coast Survey charts to navigate and pilot within coastal waters. The reports and maps of the Army Engineers result from field studies to determine the engineering feasibility and economic justification for waterway improvements. Safety of vessels at sea and commercial concerns guided expenditures of federal funds for navigation improvements. The Army Engineers were responsible for surveying and improving waterways judged to have national importance through the General Survey Act of 1824 and the Rivers and Harbors Act of 1878. The earliest source charts and maps cover Charlotte Harbor and Pine Island Sound (1863-1879) and the Caloosahatchee (1887-1893). As few coastal settlements existed beyond San Carlos Bay prior to 1900, there was little justification in extending comprehensive charting to the south. The Army Engineers undertook a centerline survey of Estero Bay in 1908, but the Coast Survey charting dates from 1970. The earliest charts for the inside passage from Naples to Caxambas, based on centerline surveys, date from 1930.

Caloosahatchee and Okeechobee Waterway

The earliest dredging improvements in the region, which focused on the Caloosahatchee, were linked to the land drainage schemes of Hamilton Disston and the Gulf Coast Canal and Okeechobee Land Co. (1881-1888). These projects were designed to develop the rich, black muck-lands adjoining Lake Okeechobee by connecting the upper reach of the Caloosahatchee (from Lake Flirt) to Lake Okeechobee, and by removing a waterfall at Ft. Thompson. A federal navigation project, begun in 1883, improved the downstream reach of the river by creating a 7-feet-deep by 100-feet-wide channel over the Gulf bar at the river's mouth below Punta Rassa and through the oyster shoals to Ft. Myers. In 1910, this channel was enlarged to a depth of 12 feet and a width of 200 feet. The middle reach of the Caloosahatchee, from Ft. Myers to Ft. Thompson, became federalized in 1887, when the Army Engineers dredged a 4-feet-deep by 35-feet-wide channel and removed snags and overhanging trees. In 1902, the Army Engineers dredged (4-feet-deep by 50-feet-wide) the Orange River (formerly Twelve Mile Creek, 12 miles upstream from Ft. Myers), a Caloosahatchee tributary, from its mouth to Buckingham.

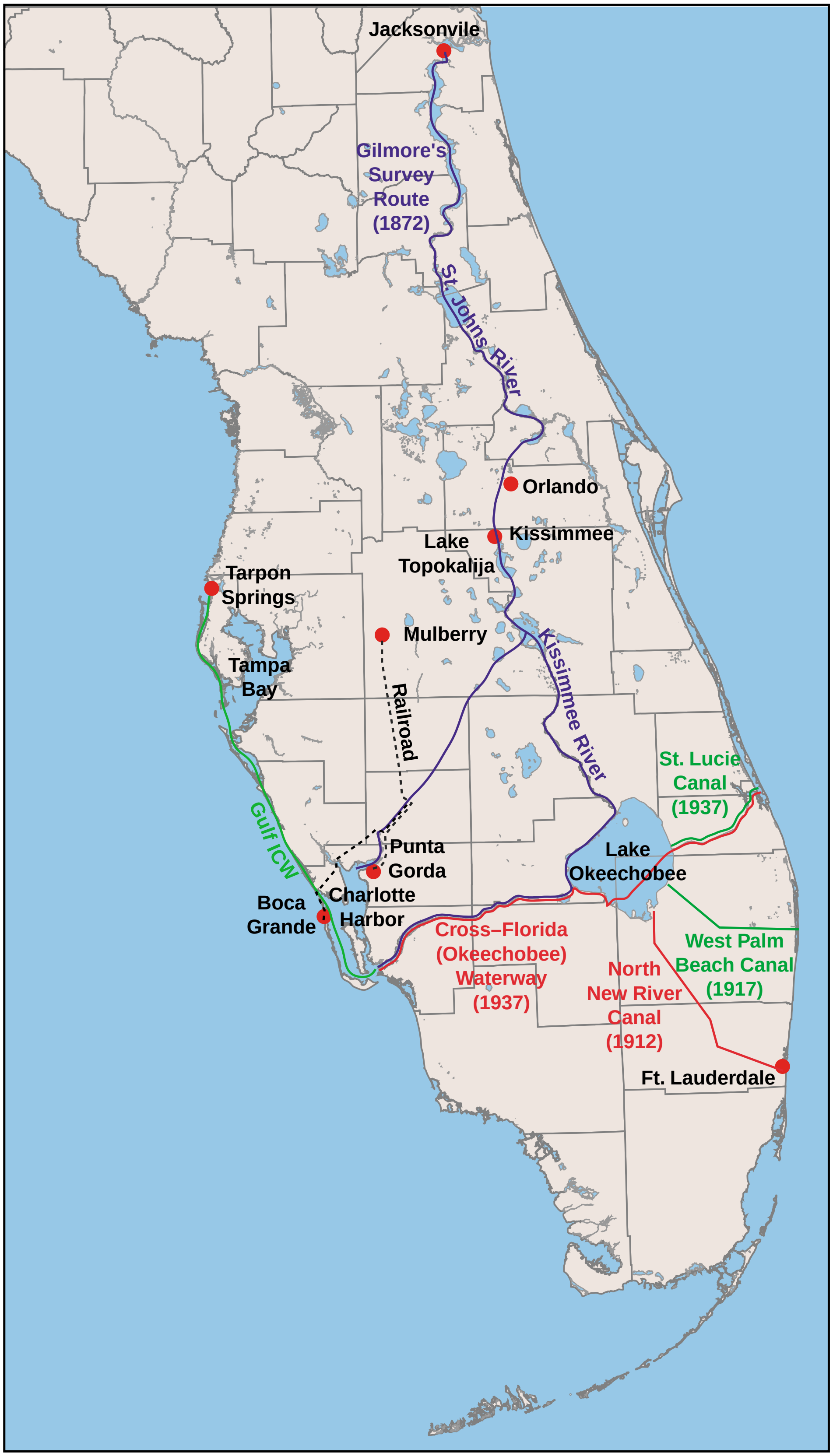
The development-era history of the Caloosahatchee is a record of competing demands for land drainage versus navigation. By 1883, a steamboat connection had been established between Ft. Myers and Kissimmee. In 1902, during tourist season (January-May), steamers ran daily between Ft. Myers and Punta Gorda. During the remainder of the year, the steamer service was three times per week. Another steamship line ran occasionally between Ft. Myers and Punta Gorda. Two schooners made semimonthly trips to Tampa. Other steamers made trips three times a week to upriver points as far as Ft. Thompson, a distance of 44 miles. Completion of the North New River (drainage) Canal, linking Lake Okeechobee to the Atlantic Ocean at Ft. Lauderdale, created a de facto Cross-Florida Waterway, but this easternmost route was closed to boat traffic in 1914 because of rock obstructions and hyacinths. The opening of the West Palm Beach (drainage) Canal in 1917 provided a temporary, alternative boat passage from the Gulf of Mexico to Florida's Eastern Seaboard.

In 1913, Florida Gov. Park Trammel advocated federal development of a navigable Cross-State Waterway in southern Florida, but this policy became law only on Aug. 30, 1935, through the Rivers and Harbors Act. And on March 22, 1937, the Cross-Florida Waterway, known today as the Okeechobee Waterway, was inaugurated; this passage included opening the St. Lucie Canal eastern segment and dredging a 7-feet-deep Caloosahatchee channel between Ft. Myers and Ft. Thompson.

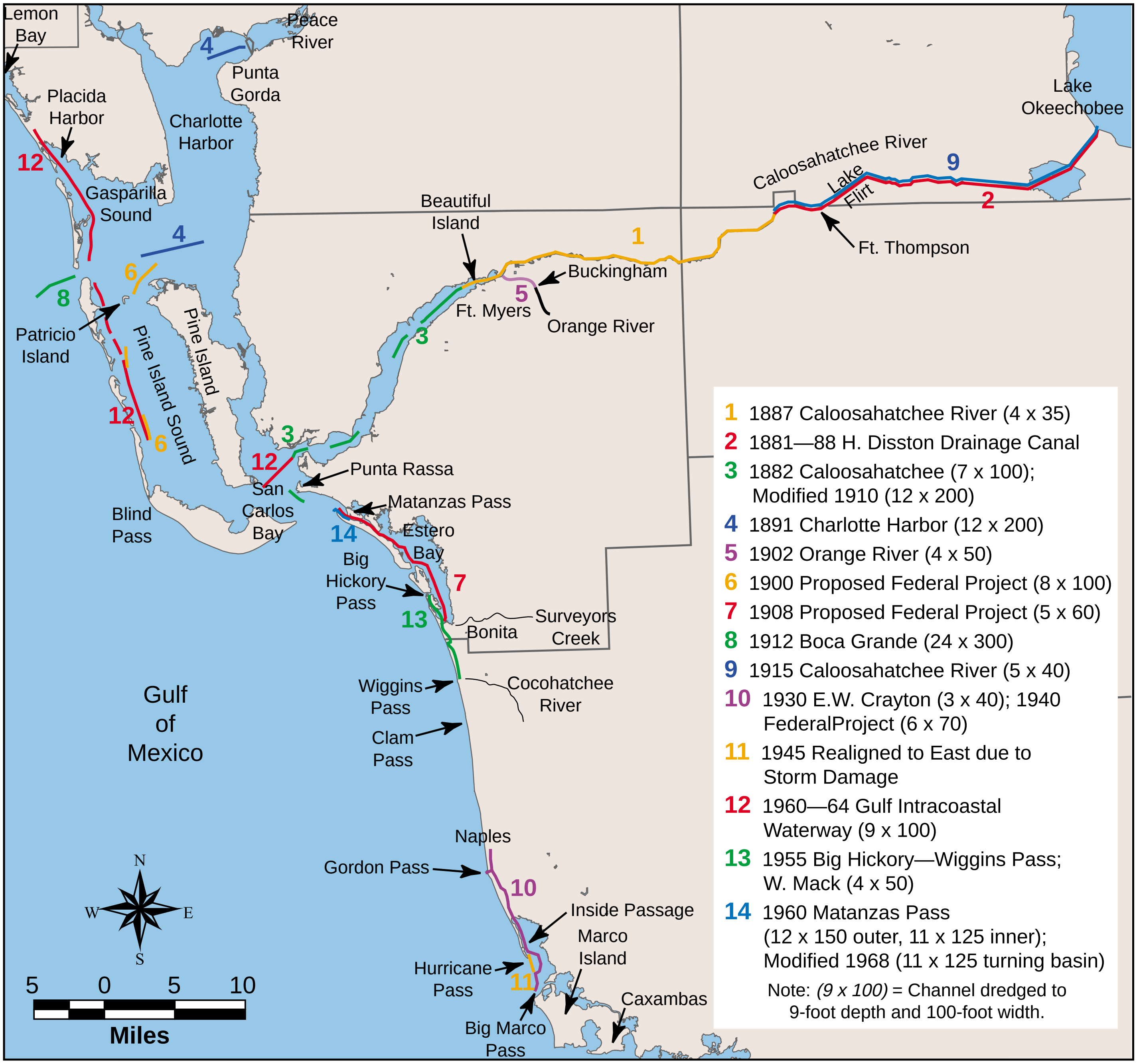
Historical Synopsis of Waterway Improvements in Southwest Florida (Volume Two).

1881-1888 Caloosahatchee (Upper)	Hamilton Disston (Atlantic and Gulf Coast Canal and Okeechobee Land Company): removed rock ledge waterfall at Ft. Thompson, straightened (removed bends) in river below Ft. Thompson; and dredged upper reach connecting river to Lake Okeechobee.
1882 Caloosahatchee (Lower)	Federal project: dredged channel from river mouth to Ft. Myers 100-feet-wide and 7-feet-deep.
1887 Caloosahatchee (Middle)	Federal project: dredged channel 4-feet-deep and 35-feet-wide, removed snags and overhanging trees from Ft. Myers to Ft. Thompson.
1891 Charlotte Harbor	Federal project established: channel 12-feet-deep and 200-feet-wide from inside Boca Grande Pass to Punta Gorda.
1900 Pine Island Sound	Army Engineers: recommended federal improvements for channel 8-feet-deep and 100-feet-wide through shoals northeast of Patricio Island and northeast of Blind Pass (not adopted).
1902 Orange River (Twelve Mile Creek)	Federal project established: channel 4-feet-deep and 50-feet-wide from mouth 6 miles upstream to head of navigation at Buckingham.
1908 Estero Bay	Army Engineers: recommended federal improvements for channel 5-feet-deep and 60-feet-wide from Matanzas Pass to mouth of Surveyors Creek (Imperial River) (not adopted).
1910 Caloosahatchee (Lower)	Federal project: modified to widen (200-feet) and deepen (12-feet) channel from bar below Punta Rassa to Ft. Myers.
1912 Cross - Florida Waterway	North New River Canal: connected Lake Okeechobee to Ft. Lauderdale. (Navigation usage terminated in 1914 due to rock obstructions and hyacinths.)
1912 Boca Grande	Federal project established: inlet channel through Boca Grande Pass to wharves at south end of Gasparilla Island, 24-feet-deep and 300-feet-wide.
1913 Cross - Florida Waterway	Gov. Trammel advocated federal government develop navigable Cross - State Waterway.
1915 Caloosahatchee (Upper)	State of Florida: dredged channel 5-feet-deep and 40-feet-wide from Lake Okeechobee to La Belle.
1917 Cross - Florida Waterway	West Palm Beach Canal to Lake Okeechobee: opened to boat traffic.
1930 Naples Bay - Marco (Inside Passage)	E.W. Crayton: dredged 3-feet-deep by 40-feet-wide inside passage, cut through oyster bars.
1935 Cross - Florida Waterway	Rivers and Harbors Act of Aug. 30, 1935: obligated federal government to build waterway; included St. Lucie Canal and dredging 7-feet-deep, Caloosahatchee channel between Ft. Myers and Ft. Thompson.
1937 Cross - Florida Waterway	Opened March 1937.
1939 Gulf Intracoastal Waterway	Board of Engineers for Rivers and Harbors: recommended federal intracoastal project, 9-feet-deep and 100-feet-wide, from Caloosahatchee (Ft. Myers) north to Anclote River (Tarpon Springs); World War II delayed funding until 1945.
1940 Naples Bay - Marco (Inside Passage)	Federal project: completed 6-feet-deep and 70-feet-wide channel from southern limit of Naples to landward side of Big Marco Pass, 10 miles.
1945 Naples Bay - Marco (Inside Passage)	Federal channel: relocated east of Hurricane Pass (due to storm damage).
1945 Gulf Intracoastal Waterway	Congress authorized and funded Gulf Intracoastal Waterway.
1948 Gulf Intracoastal Waterway	Modifying legislation revised cost-sharing arrangement between federal government and local interests.
1955 Big Hickory Pass - Wiggins Pass (Inside Passage)	Walter Mack: dredged 4-feet-deep by 50-feet-wide channel from south Estero Bay to the Cocohatchee (Wiggins Pass).
1960-64 Gulf Intracoastal Waterway	ICW: channel dredged 9-feet-deep by 100-feet-wide, began June 1960 at Punta Rassa and reached Placida in late 1964.
1960, 1968 Matanzas Pass Channel	Federal channel construction completed in 1961, 12-feet-deep and 150-feet-wide, from Gulf (San Carlos Bay) to Bowditch Point, and 11-feet-deep and 125-feet-wide (constricted to 85 feet by existing bridge) from Bowditch Point to Matanzas Pass; 1968 amendment added turning basin.

Table 1.



Map 1.
Surveyed routes and waterways across Florida.



MAP 2.
Surveyed routes and waterways on the Southwest coast and along the Caloosahatchee River.

Charlotte Harbor and Pine Island Sound

Navigation improvements for a 12-foot-deep by 200-foot-wide channel from inside Boca Grande entrance to the wharf at Punta Gorda were authorized by the federal government in 1891 and completed in 1897, justified principally to accommodate barge shipments of phosphate rock from mines in the Peace River Valley. Railroads brought phosphate to the wharf at Punta Gorda; it was then lightered to vessels lying in Boca Grande anchorage. Other cargo shipped to and from Charlotte Harbor included cattle, grain, fish, oysters, lumber, and general merchandise.

In 1911, the Charlotte Harbor & Northern Railway — locals called the railway the Cold, Hungry and Naked — completed construction of a rail line from the pebble phosphate mines at Mulberry, Fla., to Southwest Florida and across Placida Harbor to south Boca Grande. Storage facilities there could accommodate 23,000 tons of phosphate rock, and a system of belt conveyors moved the ore aboard ship at dockside. At that time, Boca Grande Pass had a natural depth of 19 feet over the bar. As phosphate shipments increased, larger vessels required deeper water when loaded. Initially, vessels were partially loaded at the South Boca Grande terminal and completed loading from barges towed out beyond the channel shoal. This system proved hazardous, and in 1912, the federal government adopted a project to dredge a 24-foot-deep by 300-foot-wide channel from the Gulf to the south Boca Grande terminal.

The inside passage west of Pine Island, between Charlotte Harbor and San Carlos Bay, was an important thoroughfare during the early development era of Southwest Florida. Steamers, like the Plant Steamship Company's *Saint Lucie* and the *Lawrence*, plied between Punta Gorda and Ft. Myers, shipping southbound grain, general merchandise, and crate material, while returning north mostly with oranges, grapefruit, and early vegetables. Two shoals, less than 5 feet deep and 600 feet long, were situated along this route: one off Patricio Island at the north end of Pine Island and the other near the southern end of Pine Island opposite Blind Pass. These obstructions were in constricted segments of the channel, which made passage difficult and hazardous for fully loaded cargo vessels during "northwester" storms. The Army Engineers, in 1900, recommended federal improvements for a channel 8-feet-deep and 100-feet-wide through these shoals, but the improvements were not adopted until 1960. No effective inside passage, north of Gasparilla Sound to Lemon Bay, existed in the pre–development era. Most vessels heading north from Charlotte Harbor transited Boca Grande to the Gulf of Mexico.

Estero Bay

The region south of San Carlos Bay was *"mare incognitum"* in the pre-development period. As coastal settlements were few and far between, there was no incentive for the federal government to conduct bathymetric surveys and compile charts. Eventually, when the Army Engineers surveyed Estero Bay in 1908, they could not locate an inland water route from Matanzas Pass to Naples, even though the Coast Survey chart seemed to indicate an interior waterway as far south as Clam Pass. At the time, there were three very small gasoline freight launches running between Ft. Myers and the Estero River, one twice weekly and two three-times weekly. Also, a mail steamer provided service from Ft. Myers to Carlos. As many as 36 fishing smacks were counted on the bay during the fishing season, when one carload of fish could be taken every two days to Punta Gorda for shipment by railroad. The Army Engineers recommended dredging a 5-foot-deep by 60-foot-wide channel from the mouth of Matanzas Pass to Surveyor's Creek (Imperial River) in 1908. While this proposed project was not implemented, federal authorization was received in 1960, and amended in 1968, for improving the Matanzas Pass Channel from the Gulf to a turning basin off San Carlos Island. In 1955, private developer Walter Mack, with contributions from the Bonita (town) Chamber of Commerce, dredged a channel, 4-feet-deep by 50-feet-wide, from Big Hickory Pass south to the Cocohatchee, thereby providing boat access between Estero Bay and Wiggins Pass.

"While the Pine Island Canal apparently was built by the Calusa or their ancestors, its construction could have involved the labor and knowledge of local as well as neighboring peoples…canoe canals were parts of a technology that was shared by many Florida Indians…the narrow, shallow channels of Florida Indian canoe canals reflect the character of Florida Indian watercraft…narrow, keel-less, shallow draft boats…their average width was approximately…16 inches…the draft of such canoes was apparently around 15 cm (6 inches) or less…The Pine Island Canal crossed the width of Pine Island and is believed to have facilitated canoe travel between Pine Island Sound and Matlacha Pass…Each end of the Pine Island Canal was at sea level. In between, the canal traversed land reaching a maximum elevation of 3.7–4.0 m (12–13 ft) above mean sea level near the center of the island…the evidence supports the interpretation that the Pine Island Canal functioned by using ground water in a controlled channel.

Dredge crew, circa 1900.

It is hypothesized the canal held a series of stepped impoundments by taking advantage of Pine Island's poorly drained soils and shallow fluctuating water table…the Pine Island Canal was not completely straight…stretches curved or angled from one side to another…in response to topographic features and allowed the canal to remain level or to have a very gentle slope, thus helping the canal to hold water."

—George M. Luer and Ryan J. Wheeler, "How the Pine Island Canal Worked: Topography, Hydraulics, and Engineering,"

—*The Florida Anthropologist*, Vol. 50, No. 3, September 1997.

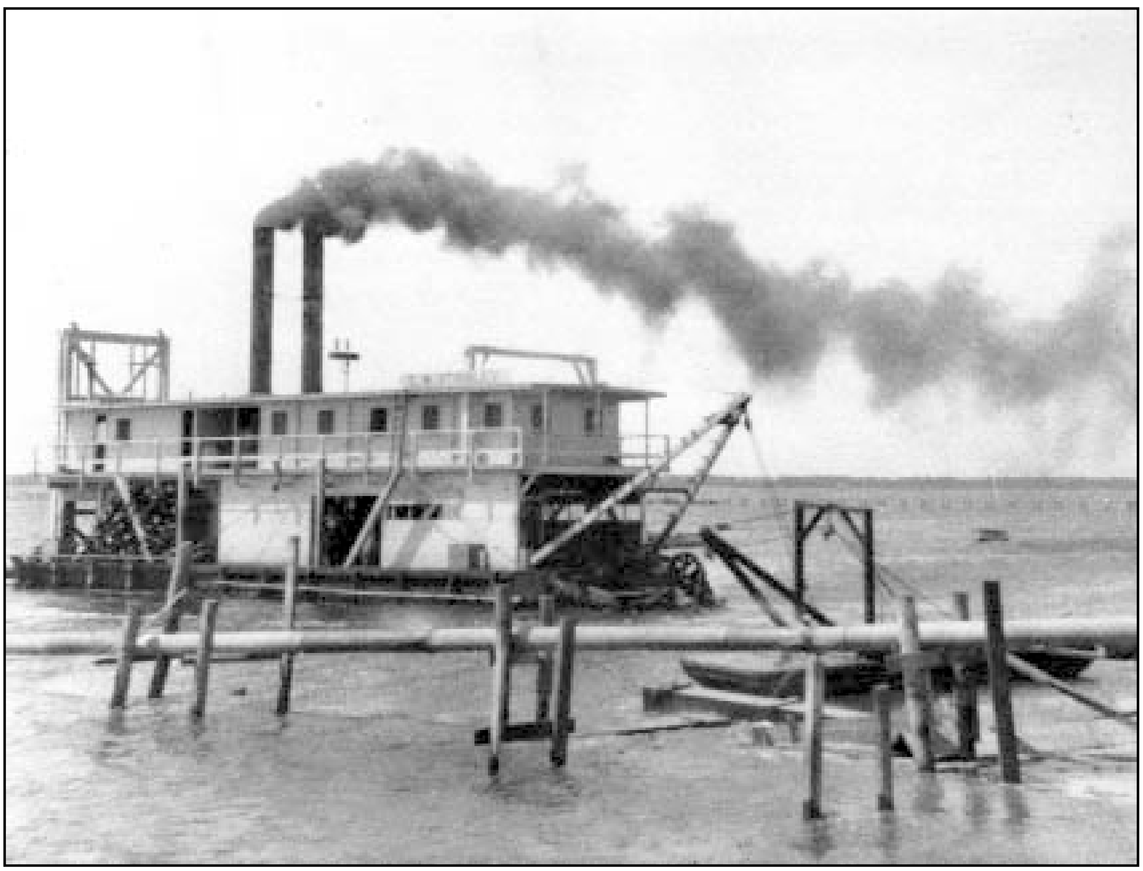
Naples and Marco Island

Naples constructed a pier in 1889 to accommodate steamship freight and passengers. Further improvements to waterway access to Naples were made in the 1930s by a local entrepreneur E. W. Crayton, who dredged and maintained cuts with depths from 3 to 8 feet and widths of 30 to 50 feet in the reach from Naples to Big Marco Pass. In 1940, the federal government assumed the project, which provides for an interior channel (6 feet deep and 70 feet wide) from the southern limit of the town of Naples to the landward side of Big Marco Pass. The waterway from Naples to Big Marco Pass is 14 miles long; local interests maintain the northerly four miles. The hurricane of October 1944 breached the barrier beach north of Big Marco Pass and severely shoaled the federal channel. The shoal was dredged in 1945 and the channel was relocated east of Hurricane Pass.

Gulf Intracoastal Waterway

The U.S. Board of Engineers for Rivers and Harbors recognized in 1939 the need to create a commercial water thoroughfare for passengers, goods, and services and recommended creation of the Gulf Intracoastal Waterway, a 9-foot-deep by 100-foot-wide channel stretching from the mouth of the Caloosahatchee to Lemon Bay and beyond (to Tarpon Springs). Federal funds, however, were not authorized until 1945. Dredging began from the south end in June 1960 and reached northern Gasparilla Sound by late 1964.

This federal project required a local sponsor to assist with funding channel maintenance, once the initial dredging had created the waterway. In 1947, the Florida Legislature created the West Coast Inland Navigation District (WCIND) as a special taxing authority for this purpose. The WCIND originally encompassed the counties of Lee, Charlotte, Sarasota, Manatee, and Pinellas, but Pinellas withdrew from the district in the 1970s. The district's mandate in time broadened to include other waterway management functions, such as dealing with anchorages, boat traffic, inlets, and beaches.



Dredge *Stribly,* 1926.

Contemporary Conditions

Today's system of arterial and secondary (access) channels provides boaters with unparalleled opportunities to transit the inland waterways of Southwest Florida. Key elements are: the Gulf Intracoastal Waterway, connecting Southwest Florida north to Tampa Bay and to coastal destinations in Alabama, Louisiana, and Texas; and the Okeechobee Waterway, providing a link across Florida to the U.S. Eastern Seaboard. These primary arteries interconnect at the mouth of the Caloosahatchee. A short four miles south is Matanzas Pass, the northern terminus of the route through Estero Bay to Wiggins Pass, utilized by shallow draft vessels en route to destinations south. Vessels must leave the inland waterway route at Wiggins Pass and transit along the Gulf shore 14 miles to Gordon Pass. At that point, boats enter the inside passage linking Naples with Marco Island. Such a boating infrastructure was unimaginable a century ago.

View west-northwest from Punta Rassa, Connie Mack Island at bottom of photo, with causeway leading to Sanibel Island in midground, Miserable Mile '1' of ICW appears as dredged cut with conical spoil islands on both sides of channel, leading to St. James City (Pine Island) and San Carlos Bay.

Gordon Pass jetties, looking north, Port Royal canal development in midground with the Naples downtown skyline on the horizon to the left.

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For Your Information...

Dredging Then and Now

The Army Engineers during the 1890s and early 1900s operated its own dredge, the U.S. Steam Snagboat and Dredge *Suwanee*, which made channel improvements and set day beacons in the inlets, inland waterways, and rivers in Southwest Florida. This vessel was a steam-driven, shallow-draft, square-bowed scow, 100 feet long, with a 24-foot beam and 4-foot draft. Although underpowered, she was suited to her task.

The *Suwanee* was put together inexpensively, as an experiment in creating a general-purpose vessel for work on small bays and rivers. Her suction dredge discharged the raised slurry upon the shore through pipes swung perpendicular to her sides, while her derrick provided the lifting power to raise rocks and snags from the bay bottom. It was difficult work, since much of the dredging had to be done from the bow of the boat, on bars too shallow to permit the *Suwanee*'s passage. Cuts were made by dragging the cutter — a hoof-shaped hood armed with teeth and a clear water valve above it — along the bottom using a hoisting tackle mounted on a guide pole. An auxiliary water jet from the boat's donkey pump was applied near and under the cutter.

The cut made at each move of the boat was 35 feet wide and 3 feet long. The average amount of solid material was about 25 percent of the discharge, but amounts as high as 85 percent were recorded. The total capacity of the pump — a 6-inch Edward's special cataract pump run by a belt from a flywheel on the hoisting engines — was 1400 gallons per minute or 800 gallons of water loaded with 25 percent of heavy material. The best day's work of the pump was 460 cubic yards. After discharge, the mud, which formed about 30 percent of the dredged material, floated for some distance, but the sand settled within 20 to 40 feet from the end of the pipe. The ship's complement included a 10-man crew to operate the snagboat, a launch, a float boat, and two rowboats.

Today, the Army Engineers contract private firms for maintenance dredging of federally-authorized inlets and the ICW. The West Coast Inland Navigation District directly hires contractors to dredge public secondary access channels. Most dredging operations — inlet operations aside — are designed to "surgically" remove accumulated silt and mud; the current general permit of the District allows it to dredge in Sarasota and Manatee counties up to 6,500 cubic yards at each authorized site over a 5-year period. Federal and state rules stringently regulate dredging to ensure that proper procedures are in place to protect bay and upland locales.

One type of hydraulic dredging system, designed for open water conditions, operates from a 30 by 100 foot barge outfitted with twin Detroit Diesel engines and 5-foot diameter propellers for improved maneuverability. Four hydraulic "spuds" lift the vessel out of the water for special work conditions. This system can remove 60 percent solids in sandy material with a production rate of 600 cubic yards per hour; the amount of clay material as solid is on the order of 15 percent, with the removal rate of about 100 cubic yards per hour.

Small, handheld systems, the least intrusive to the environment and shoreline residents, are used increasingly. These diver-operated systems require no tugboat and barge or other, large, unsightly support equipment stationed at the dredge site. A single diver operating a hand dredge can pump 600 gallons per minute of 45–65 percent solid materials by volume. This precision dredging approach minimizes environmental impacts by allowing the diver to direct the dredge head by hand in order to avoid disturbing sensitive bay bottom. Spoil material can be removed through a pipe up to 1,000 feet from the dredge and placed onto an upland dewatering containment site or into tractor trailers outfitted with watertight dump beds for offsite disposal.

Dredge operators must exercise care to avoid raising the turbidity level at the dredge site. Any water returned from the dried-out spoil must meet permitting standards, which may require manipulation of conditioning chemicals in a mixing tank and mechanical dewatering of the mixture in a recessed chamber filter press in order to remove suspended solids. The need for maintaining a quality coastal environment should be apparent, given the increasing population pressures from both waterfront and water-based recreational uses.

When the Army Engineers operated in the region during the pre–development period, procedures were simple and costs modest, even by standards of those days. Aside from removing the dredged material and placing it on an adjacent spoil site, some additional expense might be incurred for engineering designs and contingencies. Today, costs are higher and the duration of work appreciably longer. Table 2 compares the actual costs, adjusted to 1982-84 dollars, for two similar dredging operations in the region. The relative cost increases by an order of 2.5 times more for dredging and removing spoil material, in large measure due to the special equipment and handling required in order to maintain a clean and healthy environment. The non-construction cost is 7.5 times greater today, due largely to the need to acquire and comply with permit conditions, including water quality monitoring and reporting, which may continue long after the dredging event. Notwithstanding the overall increase in cost, however, the per unit of effort for removing a cubic yard of spoil is much less today than 100 years ago, making for a much more efficient operation, with the savings attributable to modern technology.

Steam tug towing phosphate-laden schooner out Boca Grande, circa 1890s.

Phosphate ore carrier at Port Boca Grande, 1978.

Cost comparisons of dredging 1,000 cubic yards in pre–development and contemporary periods.

Dredging Project	Actual Coast ($)	Actual Cost Adjusted to Comparable Values ($)
Pre–development (1900)*		
Removing Material	250	2,526
Engineering and Contingencies	37	376
Total	287	2,902
Contemporary (2001)**		
Removing Material	11,000	6,211
Engineering and Contingencies	5,000	2,823
Total	16,000	9,034
Relative Cost Increases		
Dredging	2.5 times more costly	
Non-Construction***	7.5 times more costly	

Costs normalized using Bureau of Labor Statistics Consumer Price Index (1982-84 base = 100):
Price indices are: 1913.....9.9; 1982-84.....100.0; 2001....177.1

* Army Corps of Engineers dredging "Horseshoe Shoal," northern Pine Island Sound, 1900 (assume cost comparable to 1913 figure), 7,399 cubic yard project, use 13.5 percent of cost to estimate 1,000 cubic yard volume,

** West Coast Inland Navigation District dredging Gottfried Creek, Lemon Bay, 2000-2001 10,000 cubic yard project, use 10 percent of cost to estimate 1,000 cubic yard volume,

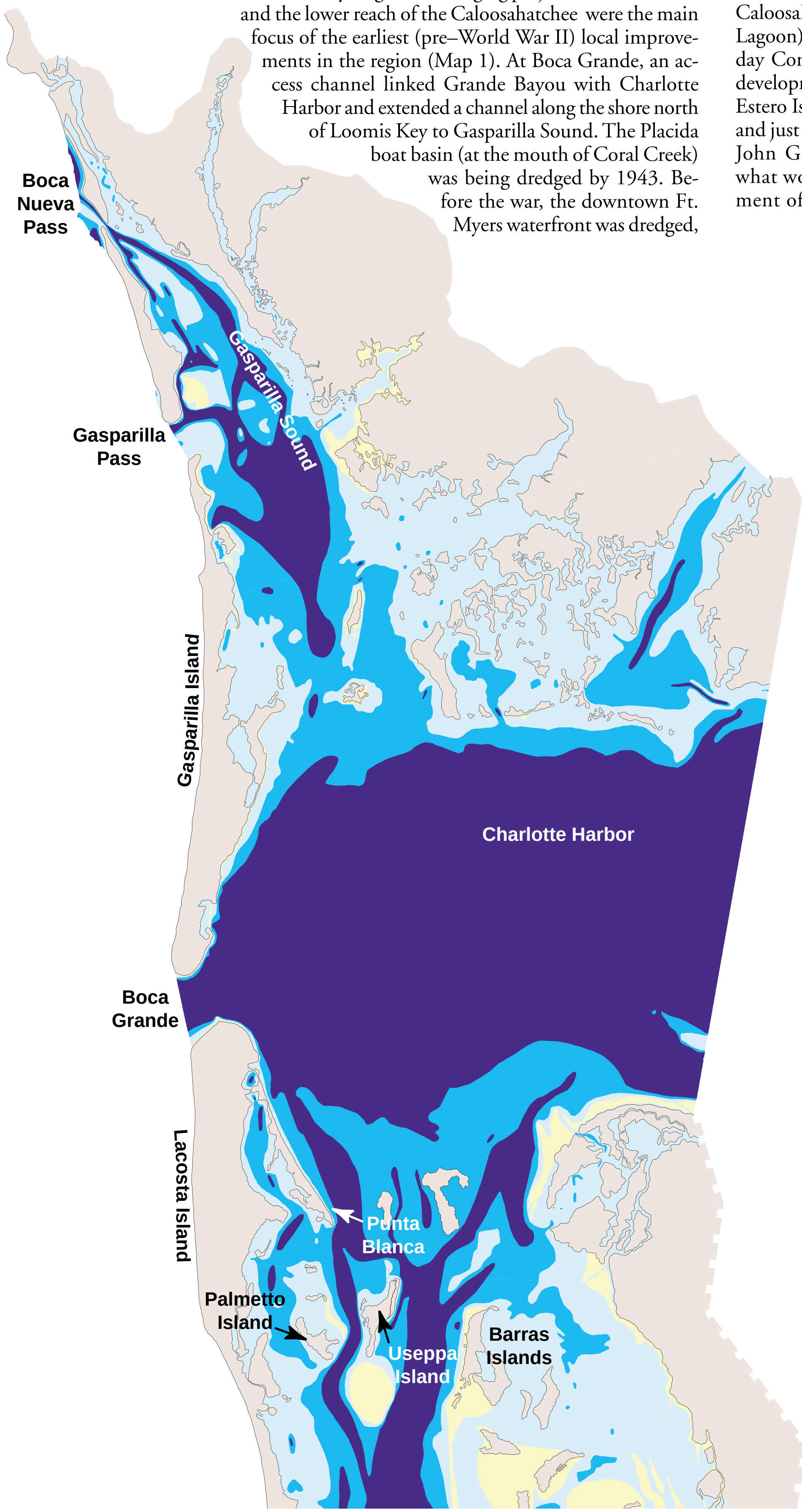
*** Permitting, engineering, monitoring, excluding legal expenses.

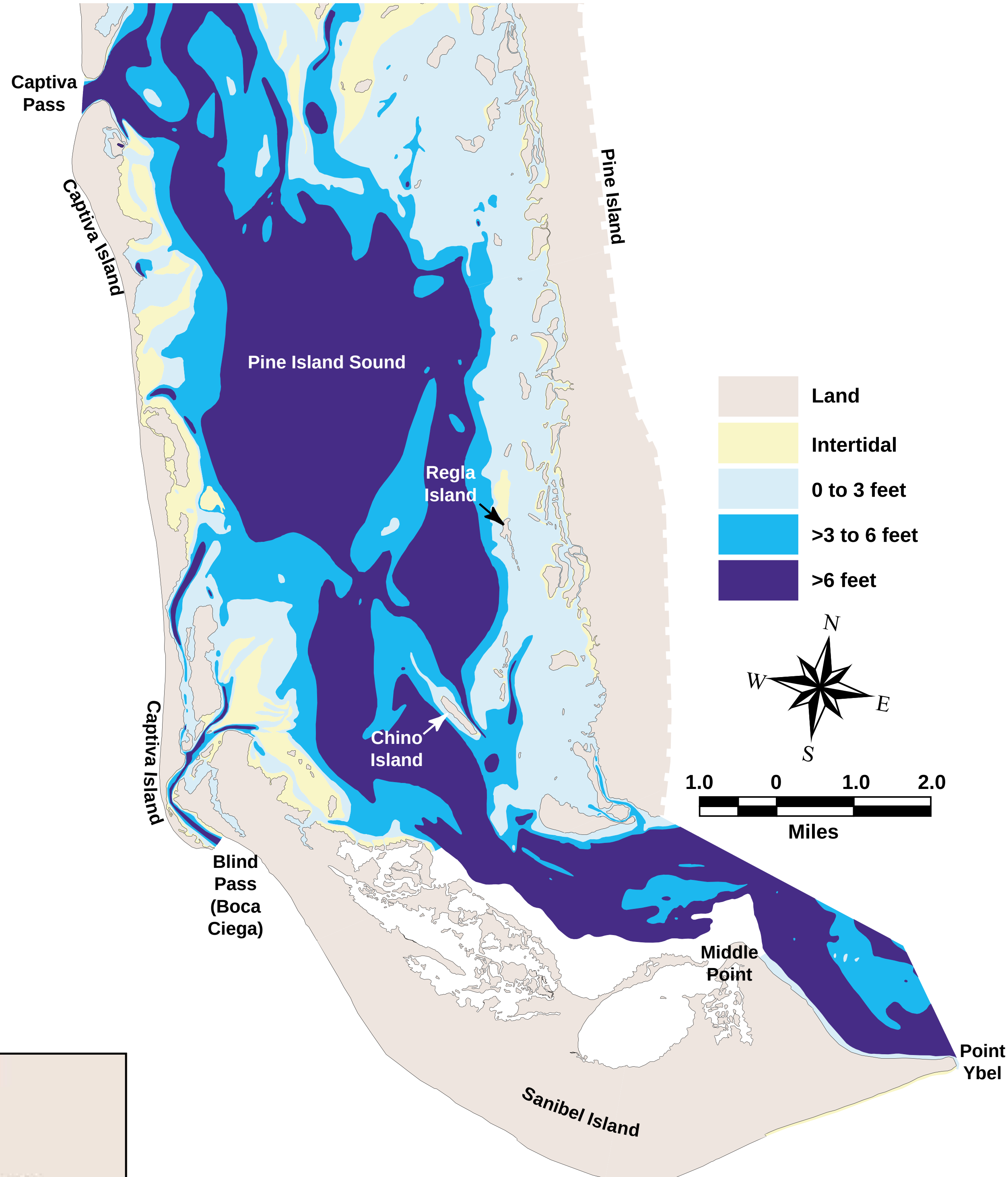
Table 2.

Dredging of Access Channels and Residential Canal Development

History

The Army Engineers' dredging projects at Boca Grande and the lower reach of the Caloosahatchee were the main focus of the earliest (pre–World War II) local improvements in the region (Map 1). At Boca Grande, an access channel linked Grande Bayou with Charlotte Harbor and extended a channel along the shore north of Loomis Key to Gasparilla Sound. The Placida boat basin (at the mouth of Coral Creek) was being dredged by 1943. Before the war, the downtown Ft. Myers waterfront was dredged, filled, and bulkheaded. Access channels along the Caloosahatchee were dredged into Hendry's Creek (Deep Lagoon), at Iona Cove, and at Punta Rassa Cove (present day Connie Mack Island). The earliest residential canal development in the region occurred on the north end of Estero Island (Ft. Myers Beach) facing San Carlos Island, and just north of Gordon Pass (Naples), where by 1940, John Glen Sample had begun canal construction of what would become Port Royal, an exclusive development of canals and beachfront estates.



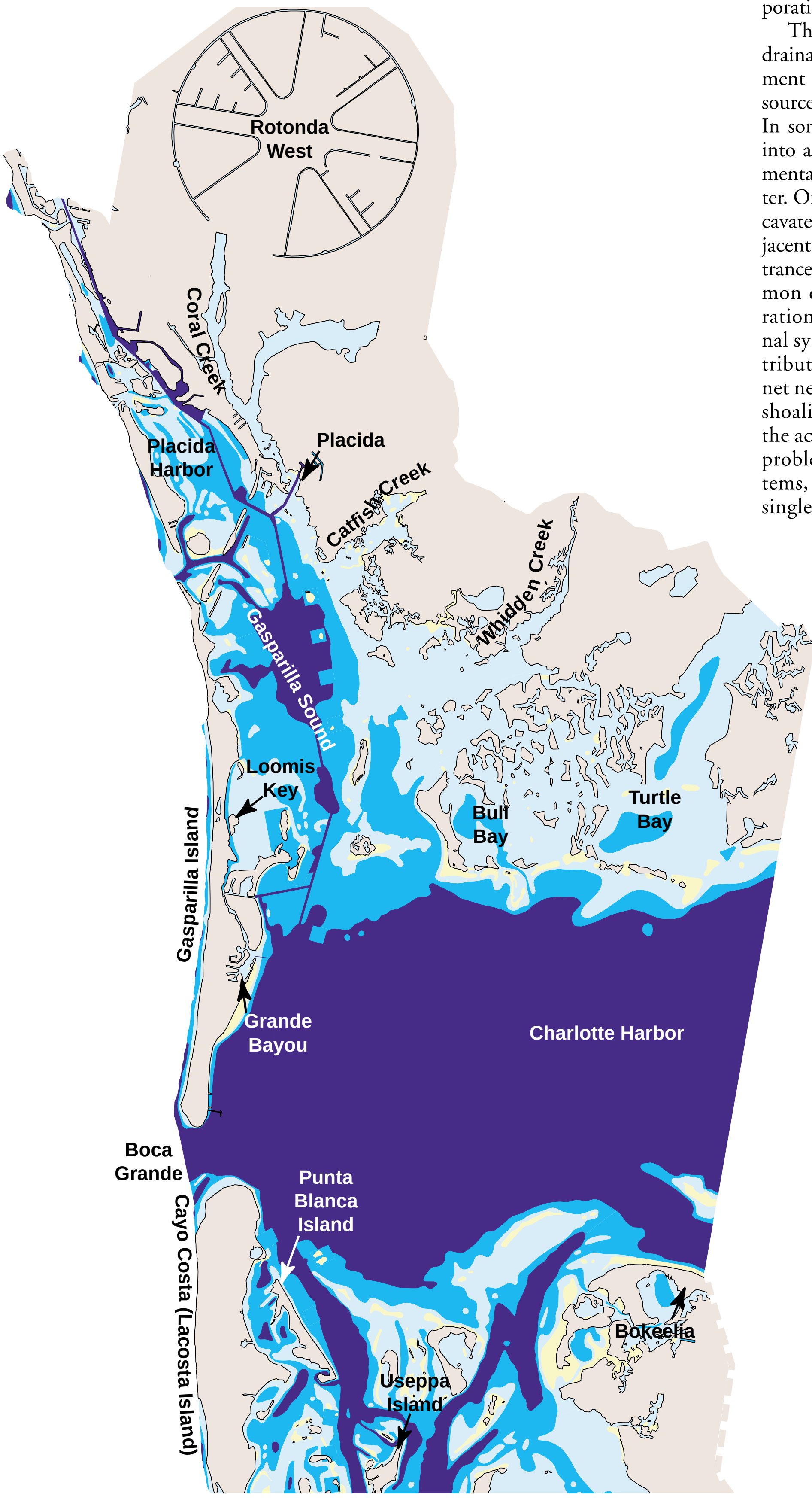


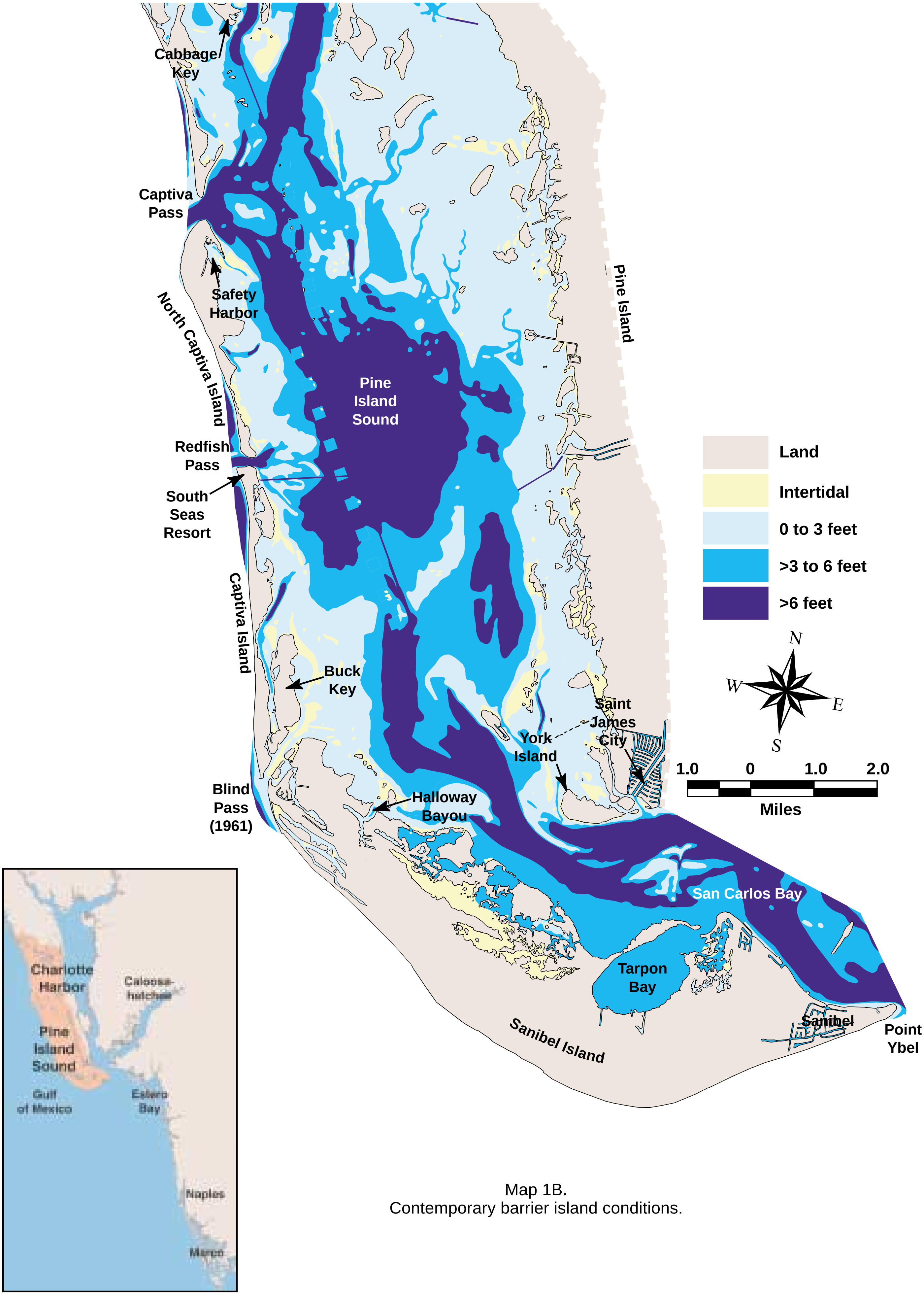
Map 1A.
Barrier island pre–development conditions

Pre–development era and contemporary channels and depths. Map 1 is divided into parts A-J, pre–development and modern periods. The first area is split into three parts: (1) barrier island (2) Peace River/Matlacha Pass (3) Caloosahatchee. For this region, widespread depths are available and presented. For the other two regions (4) Estero Bay and (5) Naples/Marco Island, only channel depths are available/and shown.

Dredge-and-fill became the established method to meet the growing post-war demand for waterfront housing. Beginning in the early 1950s, developers dug many "finger canals," with the fill deposited behind vertical cement seawalls. Sometimes, upland natural drainage features (swales) were used as templates to extend finger canals inland. A significant feature of this development era was the building of large-scale canal communities by a handful of individuals and corporations: Port Charlotte, 90,000 acres in 1956 by General Development Corp.; Cape Coral, 1,700 acres in 1959 by Gulf American Corp.; Marco Island, 25,000 acres in 1964 by Deltona Corp; and Rotunda West, 20,000 acres in 1969 by Cavanaugh Leasing Corp. One family, the Mackle brothers (Frank, Elliott, and Robert), owned or controlled major portions of General Development, Gulf American, and Deltona Corporations (see Case Studies).

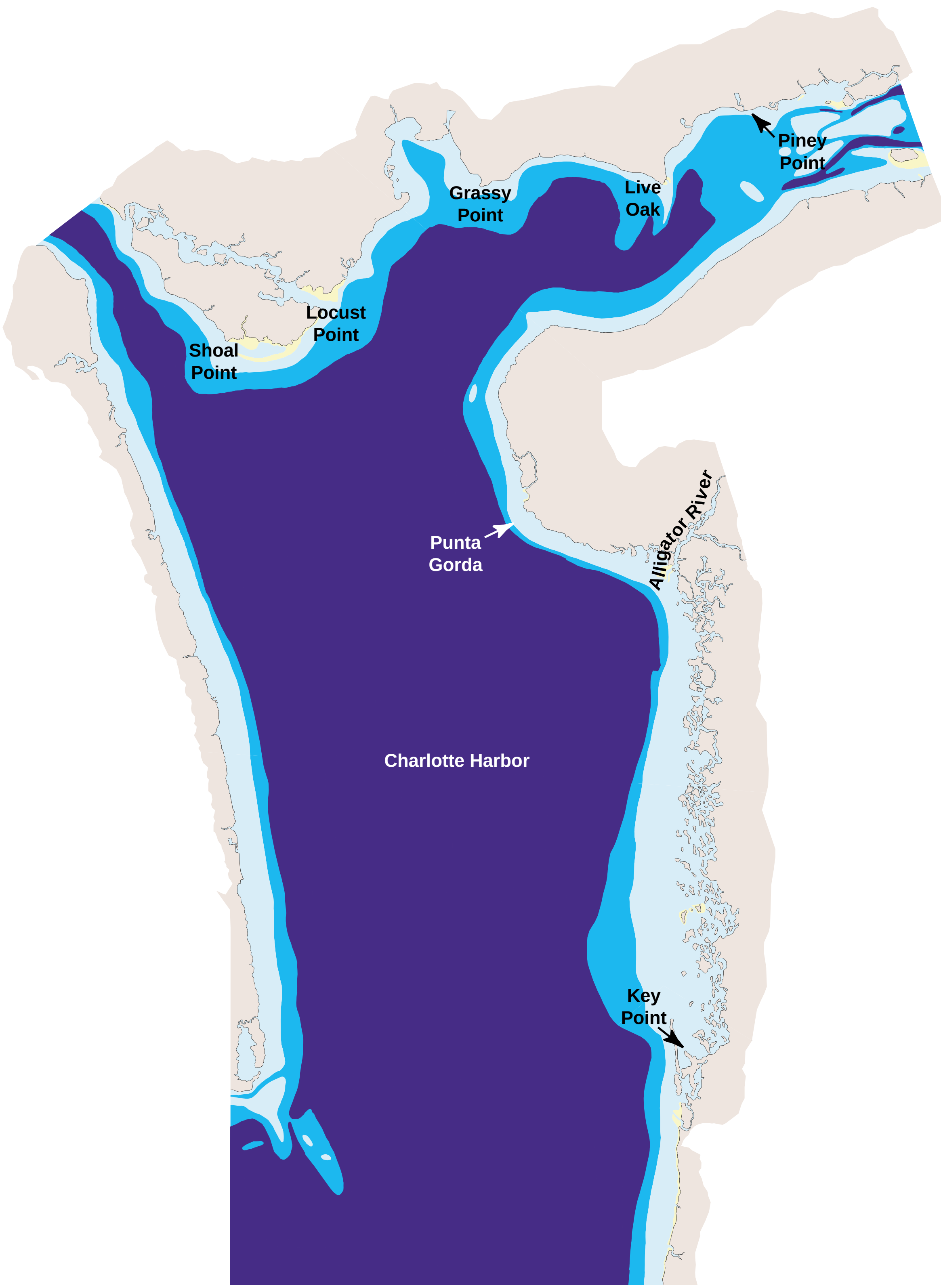
The canals served a number of purposes, including drainage, creation of waterfront property as an enhancement for sales, access to open water for boating, and a source of fill material for the creation of developable lots. In some cases, as in Port Charlotte, the canals drained into an interceptor lagoon constructed to provide rudimentary water treatment prior to discharge into open water. Oftentimes, though, the dead ends of canals were excavated to excessive depths in order to provide fill for adjacent upland development while the canal mouth or entrance to the main water body was left shallow. This common dredging practice led to environmental deterioration by decreasing the flushing efficiency of the canal system, aggravating salinity stratification and contributing to oxygen stress in benthic organisms. The net negative cost to the boater was — and is — chronic shoaling at the mouths of canals and restrictions in the access channels leading to deep, open water. These problems, though most severe, in the larger canal systems, are present almost everywhere, even in simple, single canals.

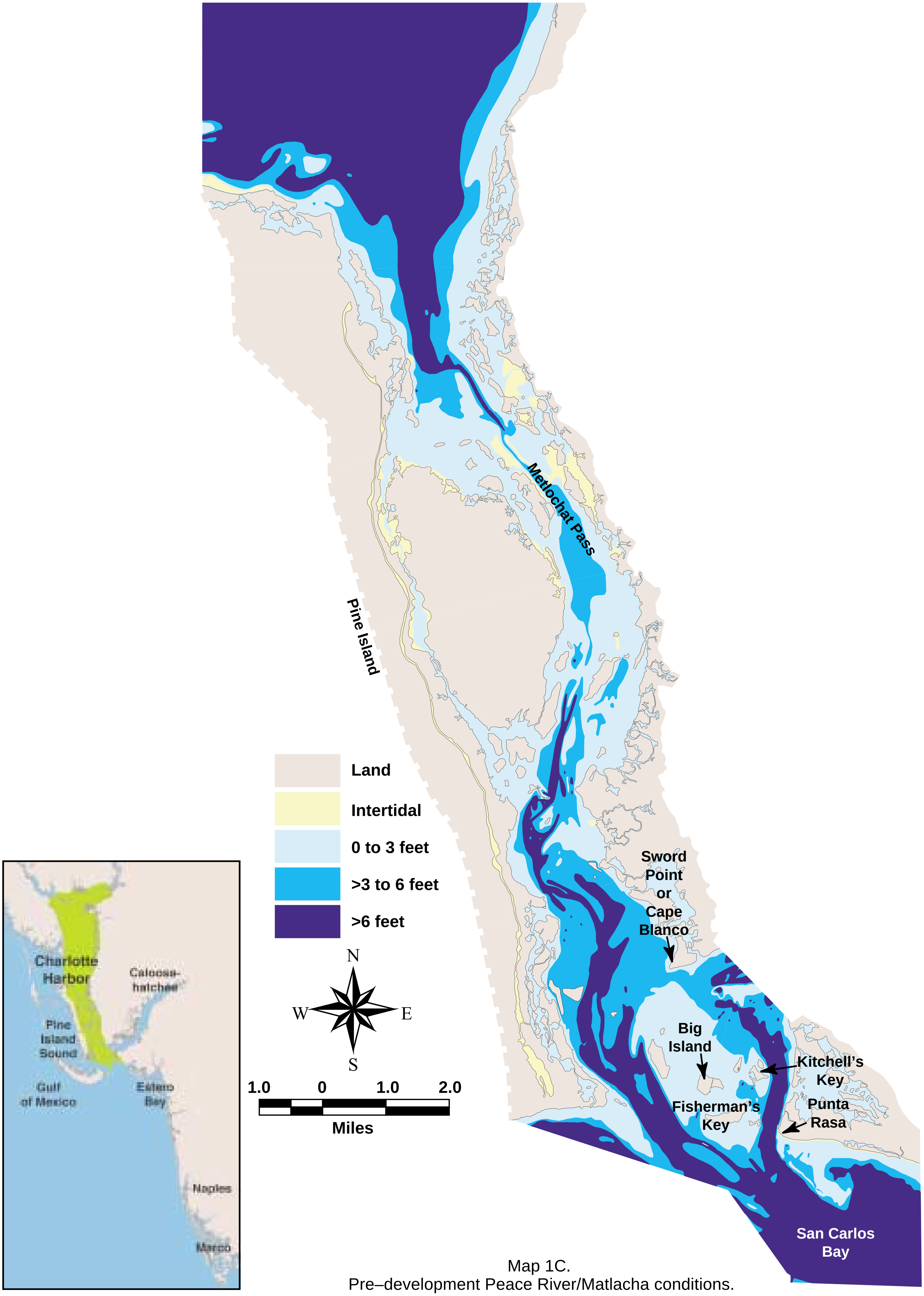




Map 1B.
Contemporary barrier island conditions.

An explosion of waterfront canal development began in the early 1950s at Aqualane Shores, just north of Port Royal (Naples), Goodland (east of Marco Island), and St. James City (south Pine Island). By the 1960s, residential subdivisions were developing on Naples Bay north from Gordon Pass to the City of Naples: Port Royal on the west shore, and Oyster Bay, Royal Harbor and Haldemen Creek on the east. In 1958, Collier County constructed a road that severed the natural drainage between Clam Bay and Doctors (Moorings) Bay. This was followed by the dredging of finger canals in south Clam Bay and by a major investment of Moorings Development Co., Canada, in Doctors Bay, including dredging, seawall construction, land fill, and inlet stabilization in the form of jetties and channel dredging at Doctors Pass. The Moorings development scheme spanned most of the 1960s (see Photographic Record of Waterway Changes). Naples Park, situated to the north of Clam Bay and south of Wiggins Pass, was part of this period's history, and included dredging both the residential canals and the feeder channel through Water Turkey Bay to the Cocohatchee.

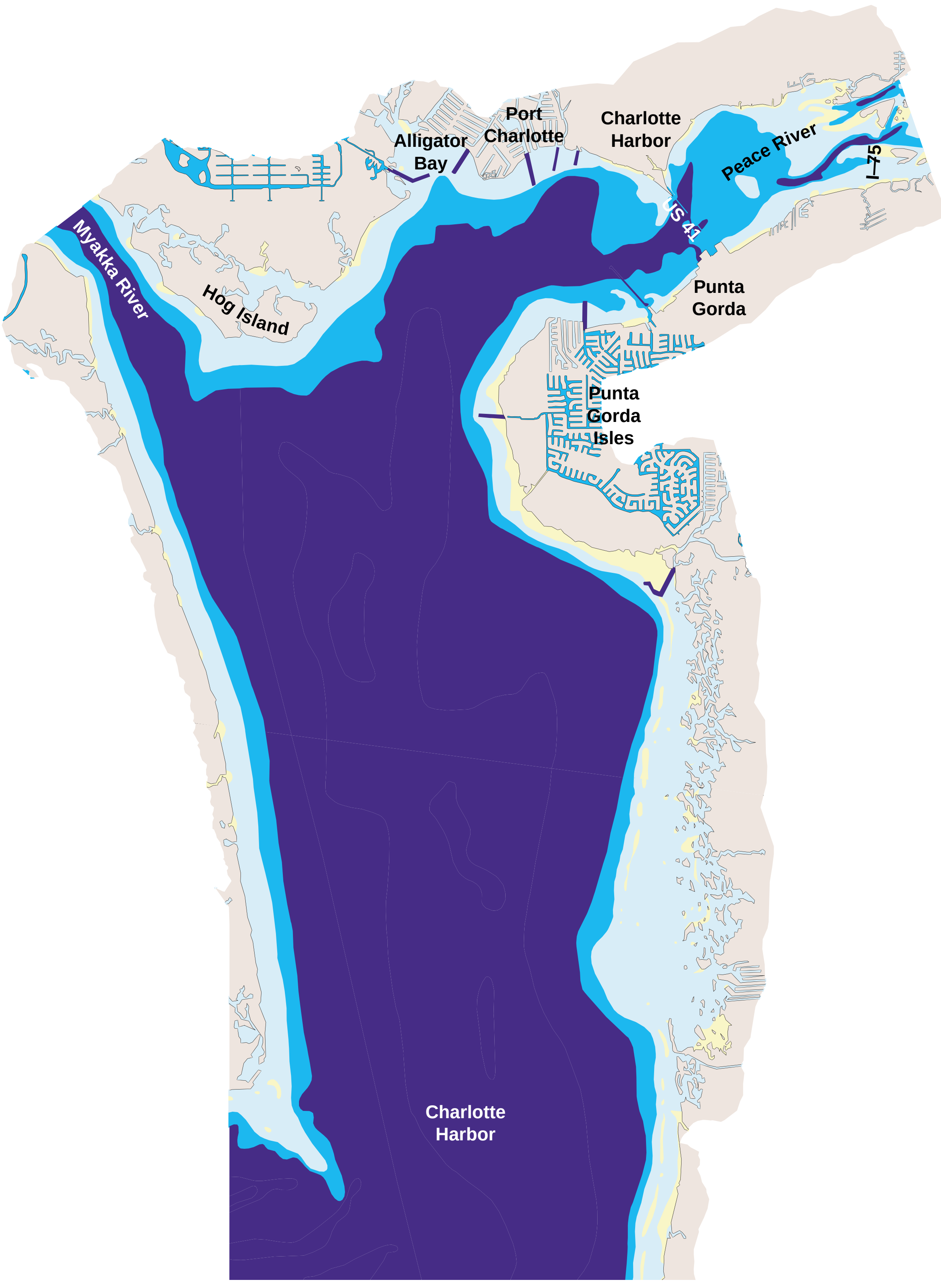


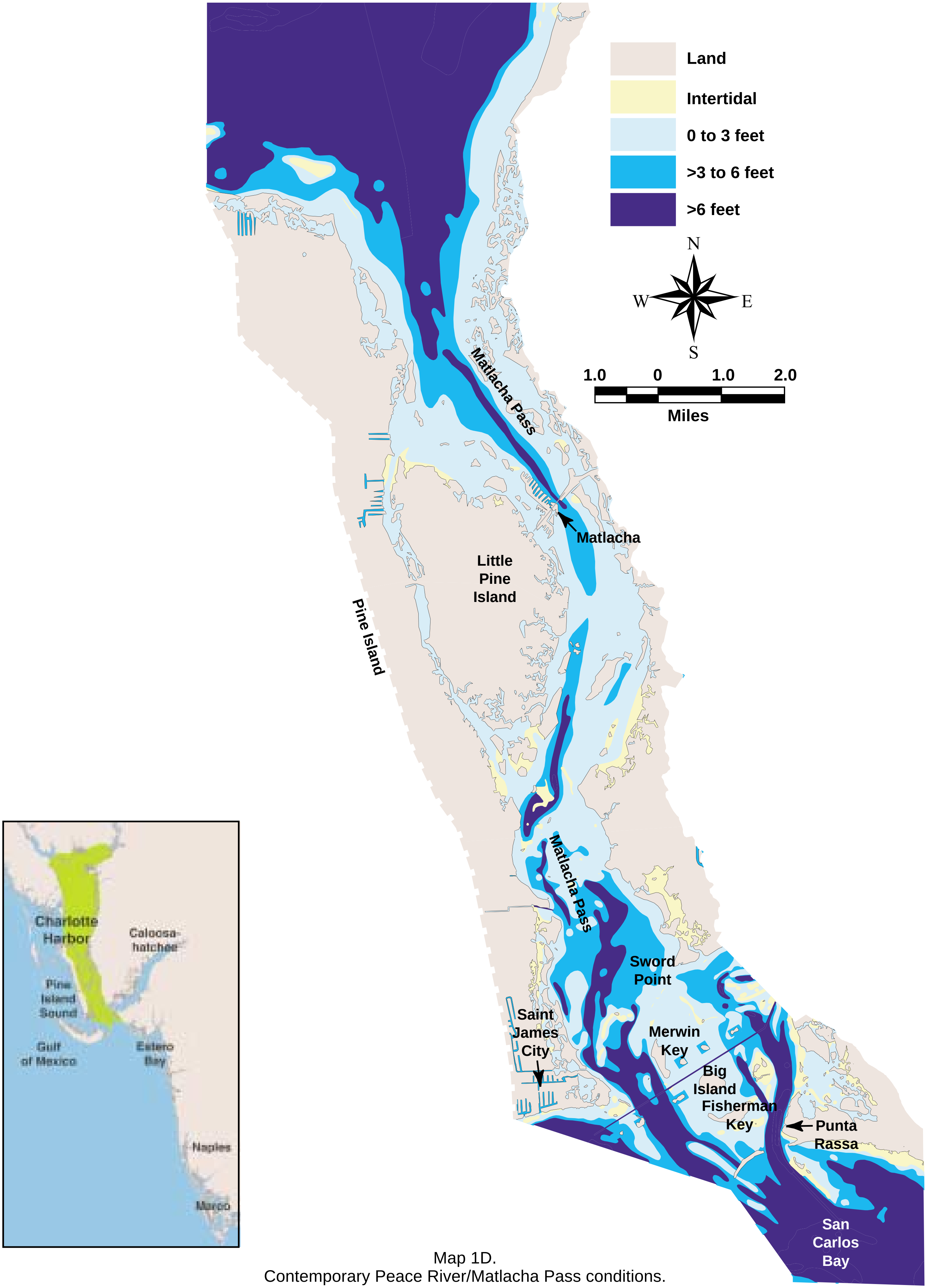


Map 1C.
Pre–development Peace River/Matlacha conditions.

Estero Bay, formerly a sleepy backwater locale, was stirring under the pressures of coastal residential development. By 1965, most finger canals on Estero Island (Ft. Myers Beach) were dredged. Land clearing for the canal subdivision at Hurricane Bay was complete, along with dredging of finger canals and an access channel. The Spring Creek subdivision canals were in place. Canal excavation was under way on the Imperial River's south shore, on the mainland side of Little Hickory Bay, and on the barrier island at Bonita Beach. By the mid-1970s, canals lined both banks of the Imperial River, and residents had moved into a waterfront subdivision on the upper Estero River.

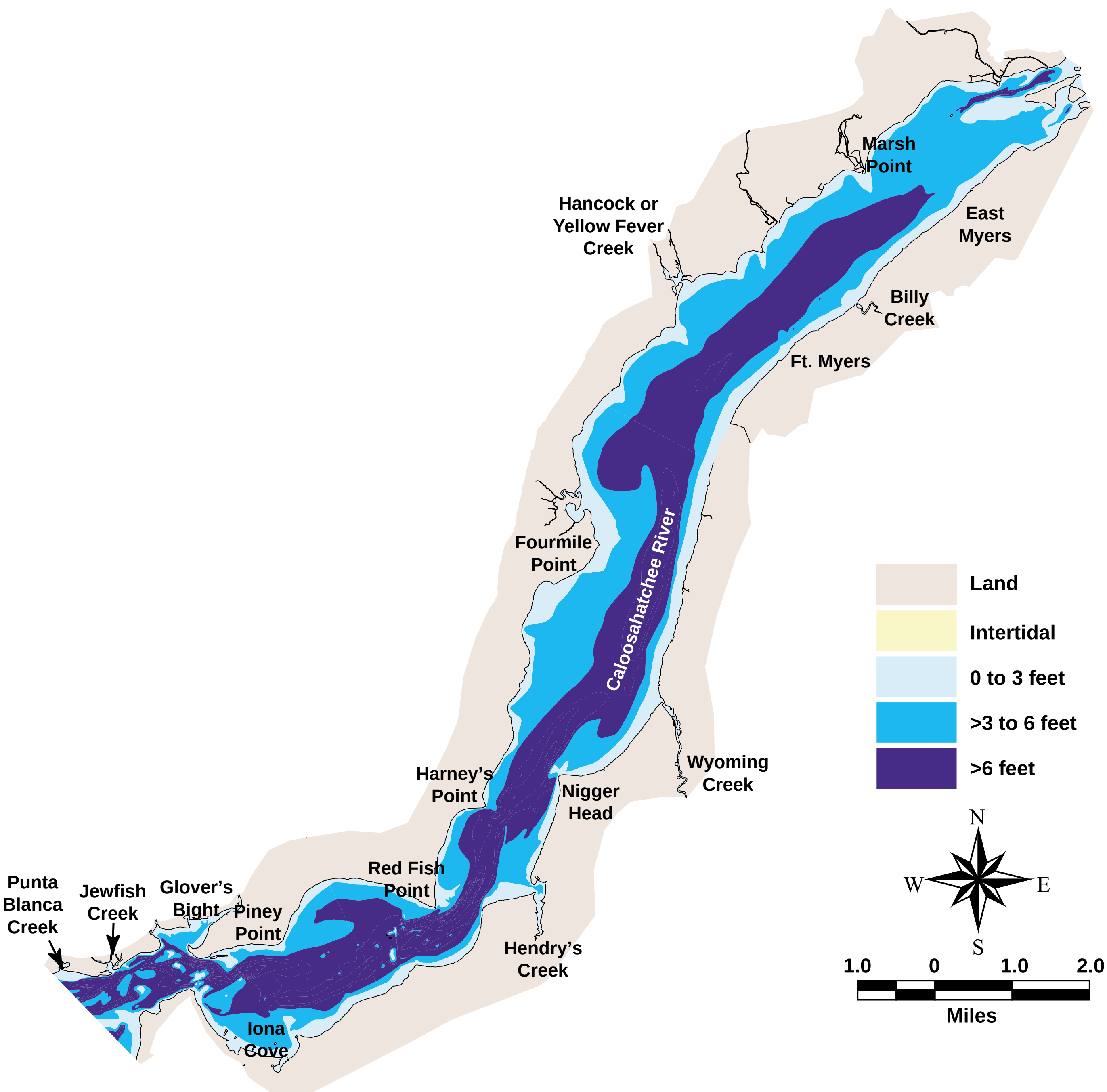
Barrier island canal development farther north, on Sanibel and Captiva Islands, began in the early 1960s, with dredging at Halloway Bayou and at South Seas Plantation (now South Seas Resort). However, the completion of the 3-mile-long causeway in May 1963, connecting Sanibel to the mainland at Punta Rassa, awakened the islands to a building boom. By 1973, most canals on the south tip of Sanibel had been dredged.



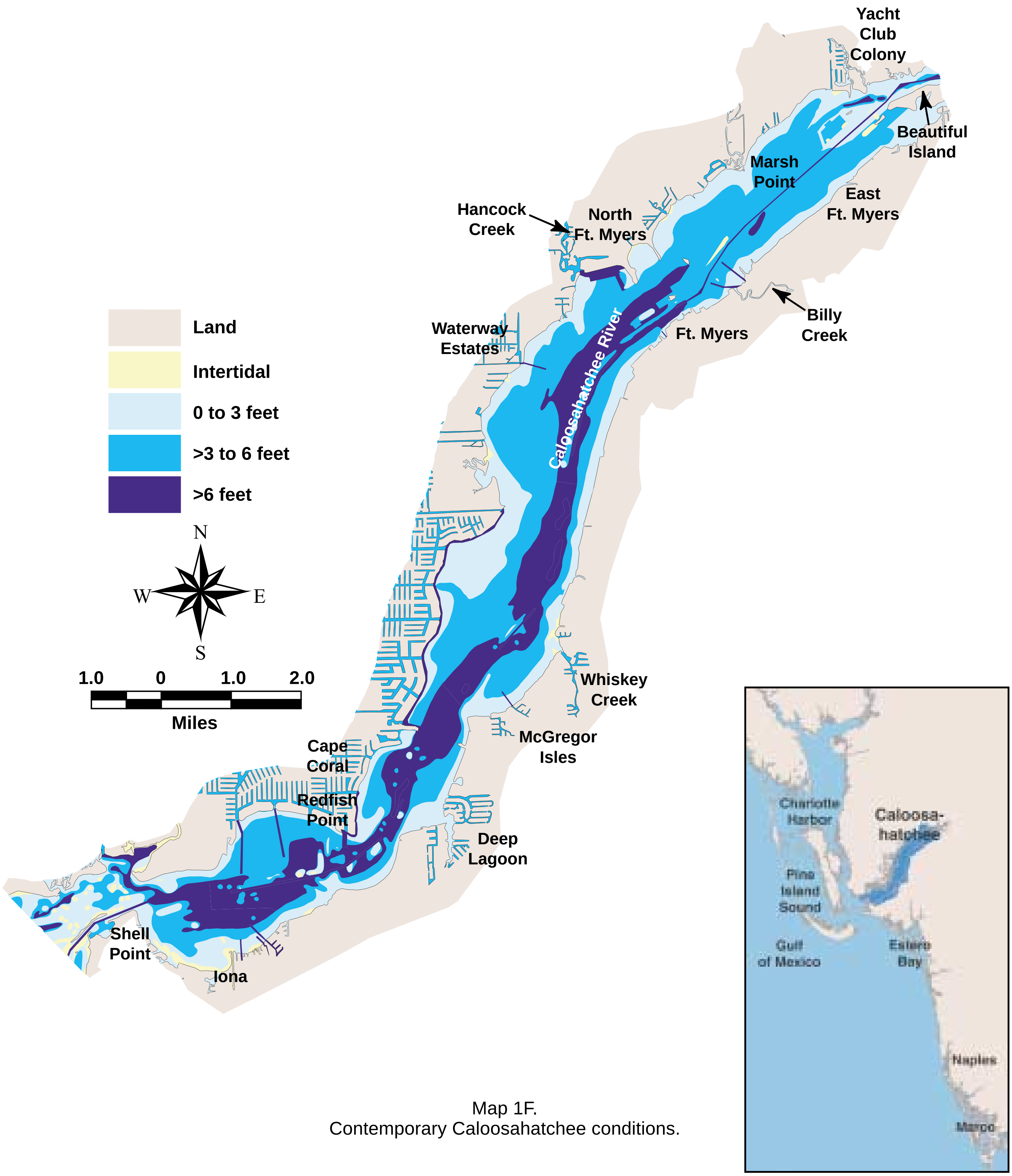


Map 1D.
Contemporary Peace River/Matlacha Pass conditions.

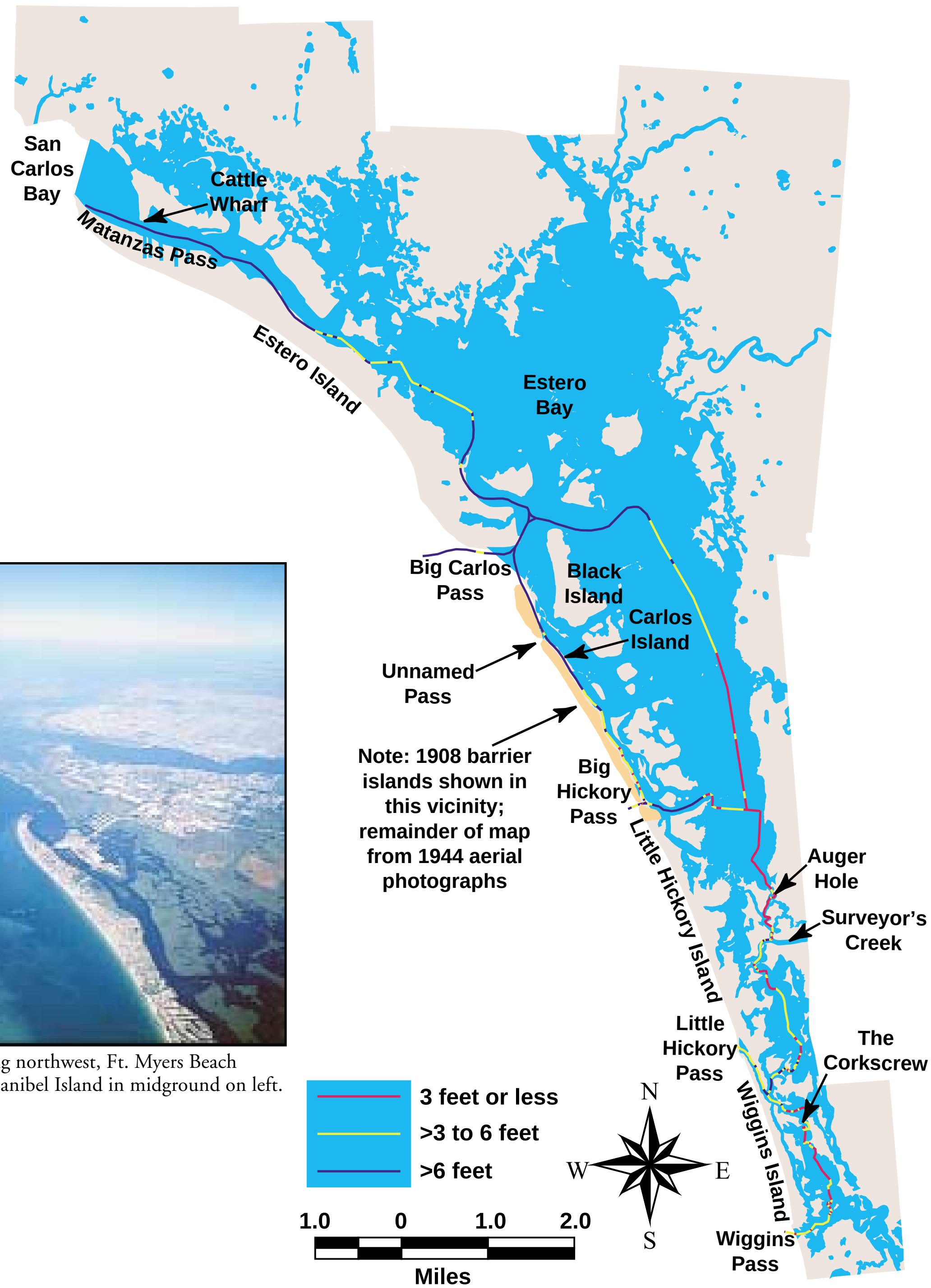
While the large-scale developments mentioned earlier, at Port Charlotte and Cape Coral, had their beginnings in the late 1950s and extended throughout the 1960s, similar projects were taking shape such as at Punta Gorda Isles and Alligator Creek in northeast Charlotte Harbor. Developments along the Caloosahatchee included Deep Lagoon (Hendry Creek), Hidden Harbour (Whiskey Creek, formerly Wyoming Creek), McGregor Isles (south shore), and Waterway Estates, Hancock Creek (Yellow Fever Creek), Marsh Point, and Yacht Club Colony (north shore). The Placida and Cape Haze area development began relatively late in this period, around 1969, and continued throughout the 1970s, with construction of canals along Coral Creek and Rotunda West. These canals, however, were never connected to the bay system because of growing public concern with potential environmental impacts.



Map 1E.
Pre–development Caloosahatchee conditions.

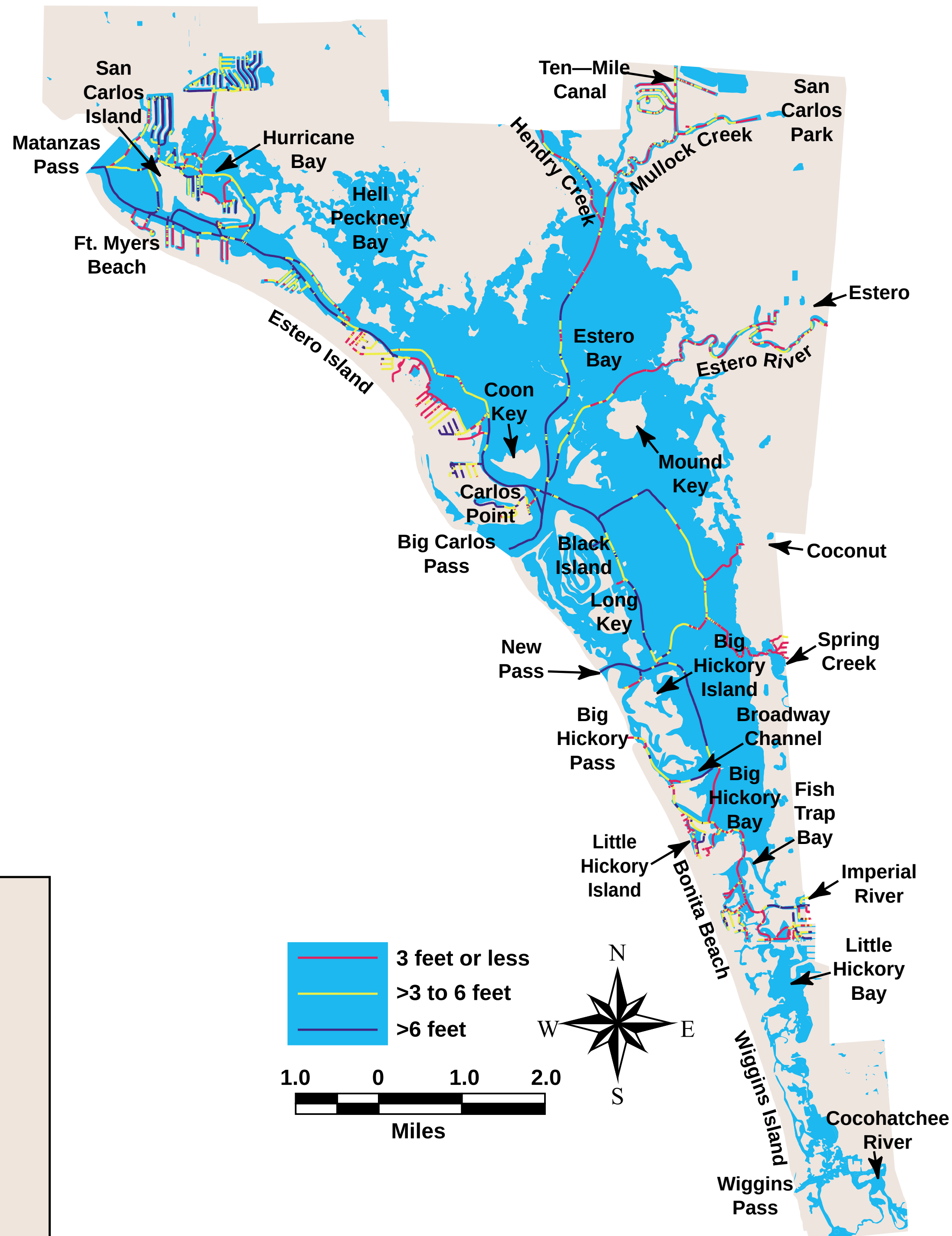


Map 1F.
Contemporary Caloosahatchee conditions.



Gulf approach to San Carlos Bay, looking northwest, Ft. Myers Beach (Estero Island) on right in foreground, Sanibel Island in midground on left.

Map 1G.
Pre–development Estero Bay conditions.



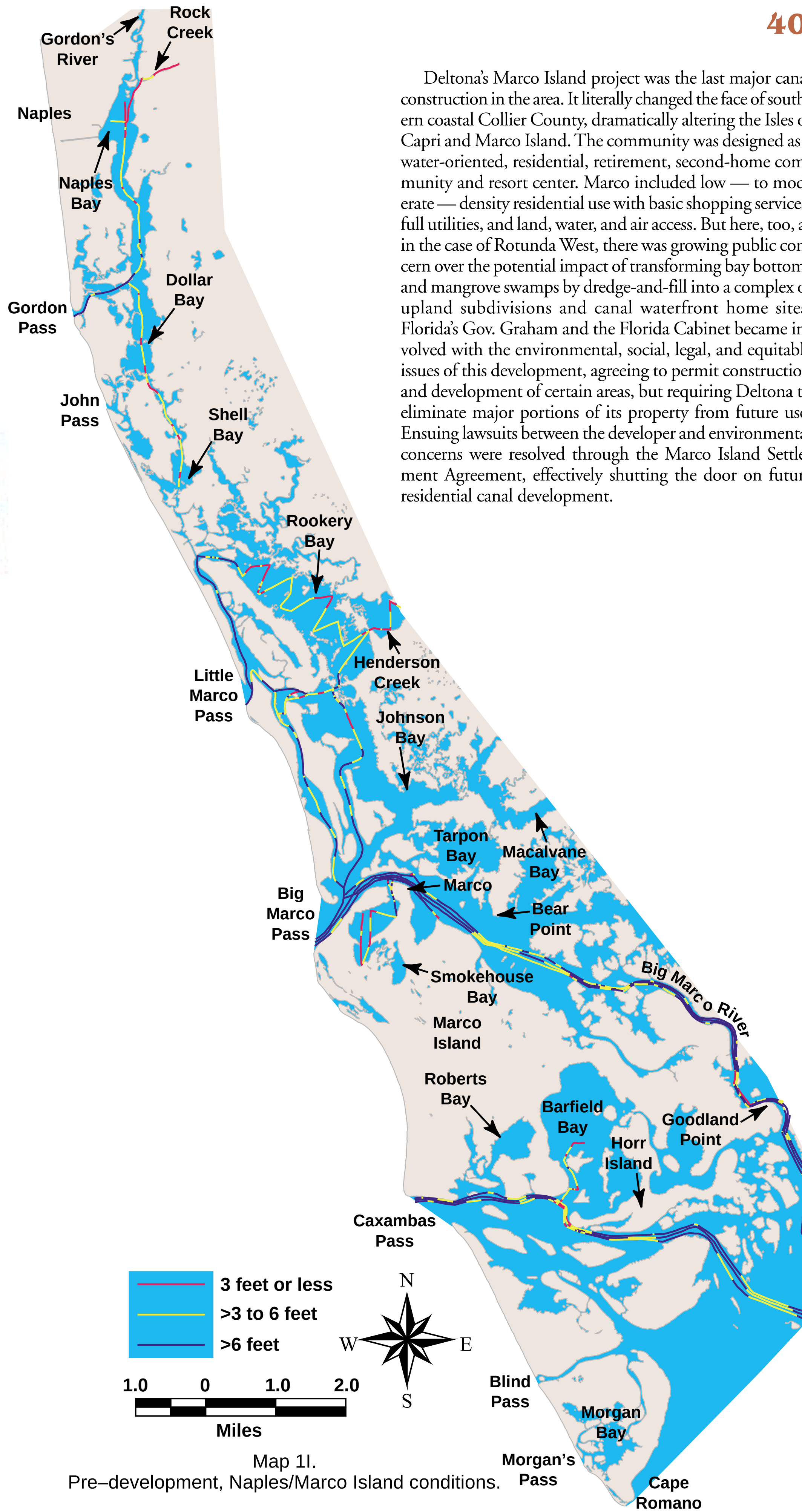
Map 1H.
Contemporary Estero Bay conditions.

Deltona's Marco Island project was the last major canal construction in the area. It literally changed the face of southern coastal Collier County, dramatically altering the Isles of Capri and Marco Island. The community was designed as a water-oriented, residential, retirement, second-home community and resort center. Marco included low — to moderate — density residential use with basic shopping services, full utilities, and land, water, and air access. But here, too, as in the case of Rotunda West, there was growing public concern over the potential impact of transforming bay bottoms and mangrove swamps by dredge-and-fill into a complex of upland subdivisions and canal waterfront home sites. Florida's Gov. Graham and the Florida Cabinet became involved with the environmental, social, legal, and equitable issues of this development, agreeing to permit construction and development of certain areas, but requiring Deltona to eliminate major portions of its property from future use. Ensuing lawsuits between the developer and environmental concerns were resolved through the Marco Island Settlement Agreement, effectively shutting the door on future residential canal development.

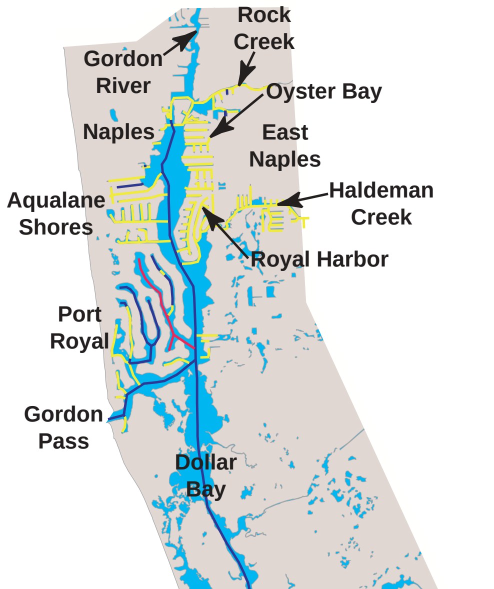
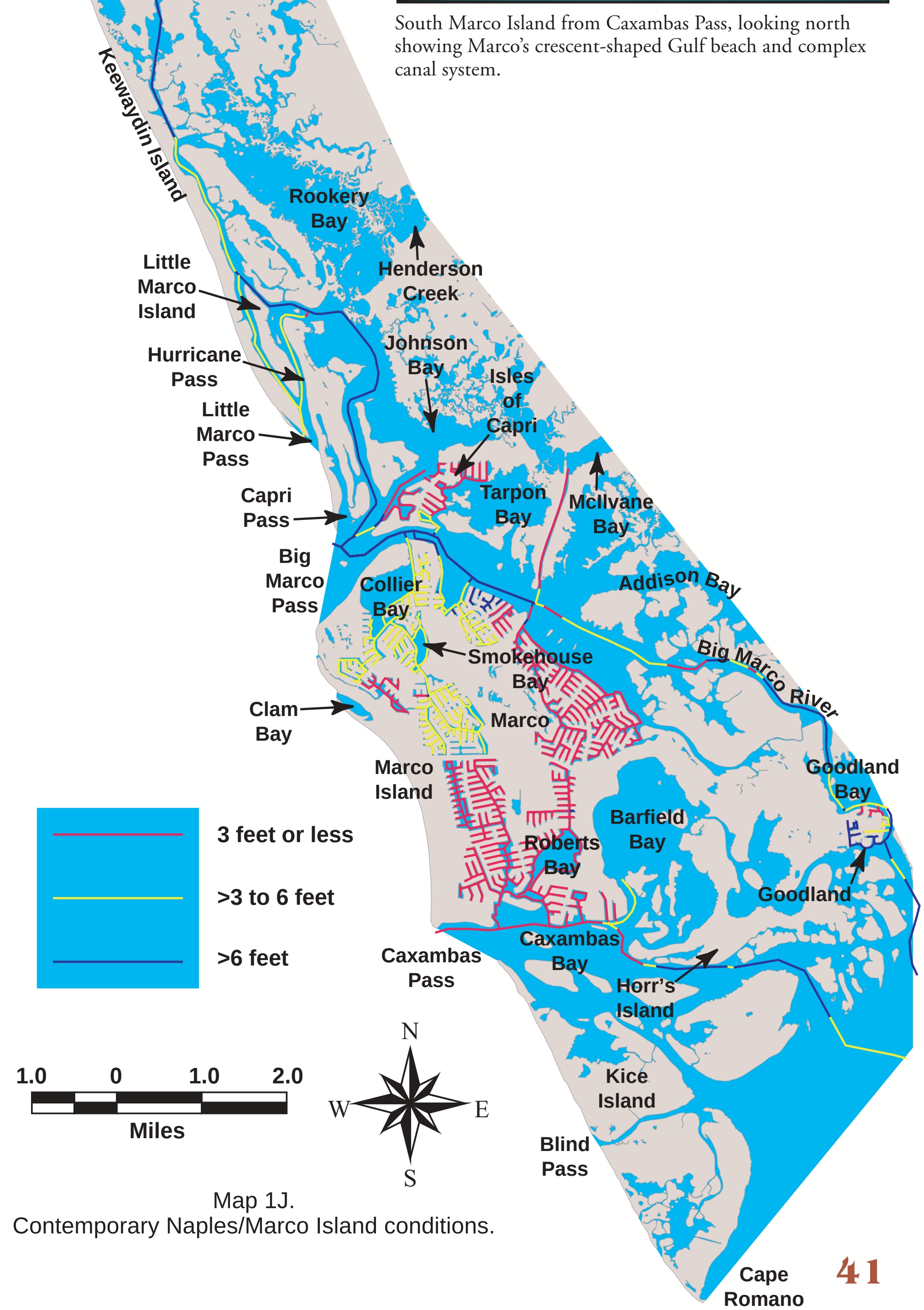
...Just as the sun was setting we arrived off the Great Marco Pass, the wind being so light that we were barely able to hold our own against the tide, which was setting out by the channel with a velocity of nearly three knots an hour; but at last we succeeded in passing the inner fairway buoy, and "brought up for the night." The settlement on Marco Island consists of two or three families, and here there is a post office.

—William Henn,
"Caught On A
Lee Shore,"
June 1893.

—*Tales of Old Florida*,
© 1987.



Map 1I.
Pre–development, Naples/Marco Island conditions.

South Marco Island from Caxambas Pass, looking north showing Marco's crescent-shaped Gulf beach and complex canal system.

Map 1J.
Contemporary Naples/Marco Island conditions.

Geography

This dredging history of access channels and residential canals has created 1,136 miles of boat channels from Placida Harbor to Marco Island in Southwest Florida (Table 1). These channels are concentrated in some areas more than others: most — 49 percent (549 miles) — are located in Charlotte Harbor (25 percent) and along the Caloosahatchee (24 percent). The next largest concentrations are along the Naples–Marco Waterway (13 percent), Pine Island Sound, San Carlos Bay (14 percent) and Estero Bay (11 percent). Matlacha Pass accounts for 8 percent, and the fewest channel miles are in Gasparilla Sound and Clam and Doctors Bays (5 percent).

Map 2 depicts the distribution of dredged (improved) and natural (unimproved) waterways in Southwest Florida. Seventy-four percent (843 miles) of the channels are improved (dredged) and 26 percent (293 miles) are unimproved (natural) channels. About 59 percent of the dredged waterways are in Charlotte Harbor (248 miles) and the Caloosahatchee (248 miles). Another 114 miles (13 percent) are in the Naples — Marco region. Most (33 percent) of the natural (unimproved) waterways are in Pine Island Sound and San Carlos Bay (96 miles); this is followed by Estero Bay, which has 56 miles (19 percent).

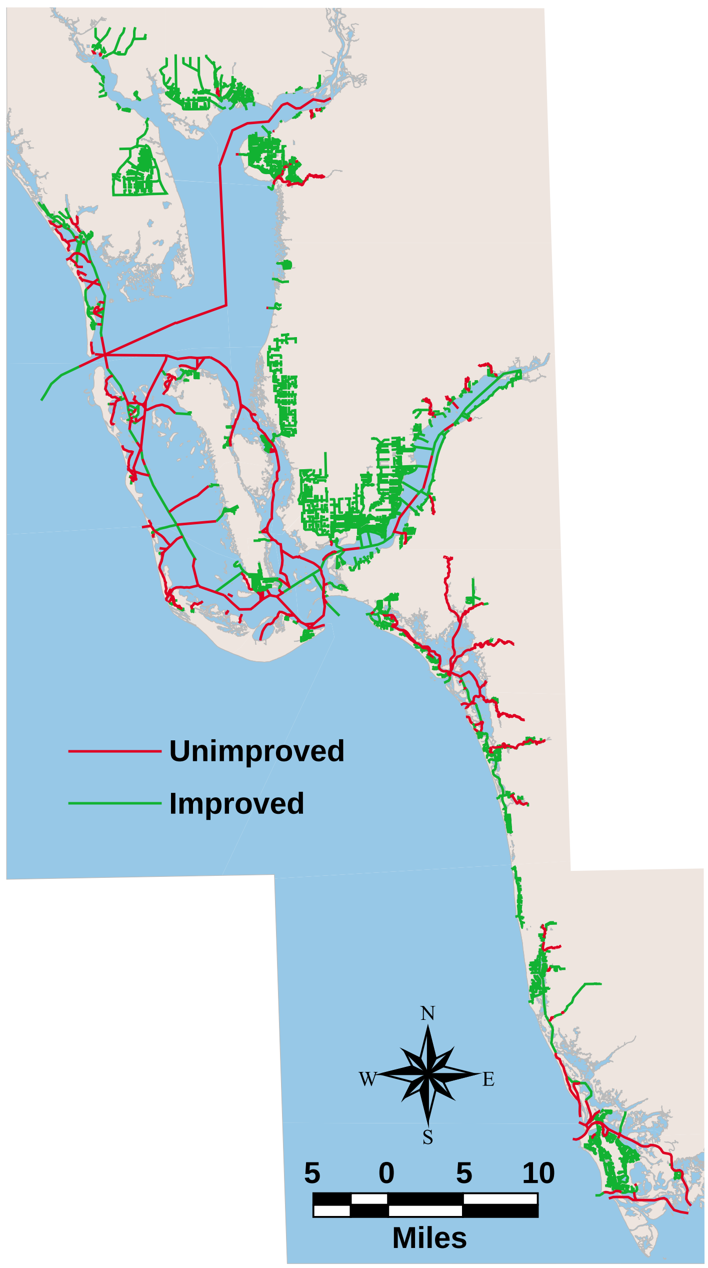
Improved (dredged) and unimproved (natural) waterways (miles).

Region	Improved	Unimproved	Total	Total (col.%)
Gasparilla Sound	23.1	24.4	47.5	4.2
Charlotte Harbor	247.7	32.4	280.1	24.7
Pine Island Sound/San Carlos Bay	66.0	96.2	162.2	14.2
Matlacha Pass	64.0	26.4	90.4	7.9
Caloosahatchee River	247.9	21.4	269.3	23.7
Estero Bay	69.7	56.1	125.8	11.1
Clam & Doctors Bays	10.9	0.0	10.9	1.0
Naples Marco Waterway	113.7	35.7	149.4	13.2
Total (miles)	843.0	292.6	1135.6	100.0
Total (row%)	74.2	25.8	100.0	

Table 1.

Aerial photograph of Marco Island under construction.

Another essential characteristic of boat channel geography is the form and spacing of channel segments.Some channels are simple, and others are complex. The channel systems include: finger canals or basins; multiple canal systems; individual shoreline channels; shoreline channels linked to finger canals; natural streams or tidal creeks; and access channels and major arteries. Figure 1 shows examples of channel forms, and the regional distributions are illustrated in Map 3 and Table 2. Fifty-six percent (630 miles) are multiple canal systems. Most are in Charlotte Harbor and the Caloosahatchee (215 miles each) and the Naples–Marco Waterway (81 miles). Another 23 percent (263 miles) is made up of access channels and major arterials, which are more evenly distributed within the region. Streams or tidal creeks represent 7 percent (74 miles); the largest



Map 2.
Distribution of improved and unimproved channels.

concentrations are in Estero Bay (29 miles) and Charlotte Harbor (24 miles). Shoreline channels linked to finger canals account for 7 percent (75 miles); 21 miles are in Pine Island Sound. Single finger canals and solitary basins total 5 percent (56 miles); Estero Bay has 14 miles of these waterways. Examples abound on Ft. Myers Beach. Channels that parallel the shoreline account for only 4 percent (39 miles) of all waterways, almost half of these (16 miles) are in Gasparilla Sound.

The varied form and distribution of these channel systems directly influences recreational boating in the region. Consider boating from a location in a multiple channel system, such as Punta Gorda Isles, where thousands of waterfront single-family homes line canals that stretch tens-of-miles inland and where a single channel provides access to open, deep water. This type of waterway system characterizes over half of the region's boating channels. An appreciation for the evolution of these waterway changes is intrinsic to understanding the need to boat in concert with nature in Southwest Florida.

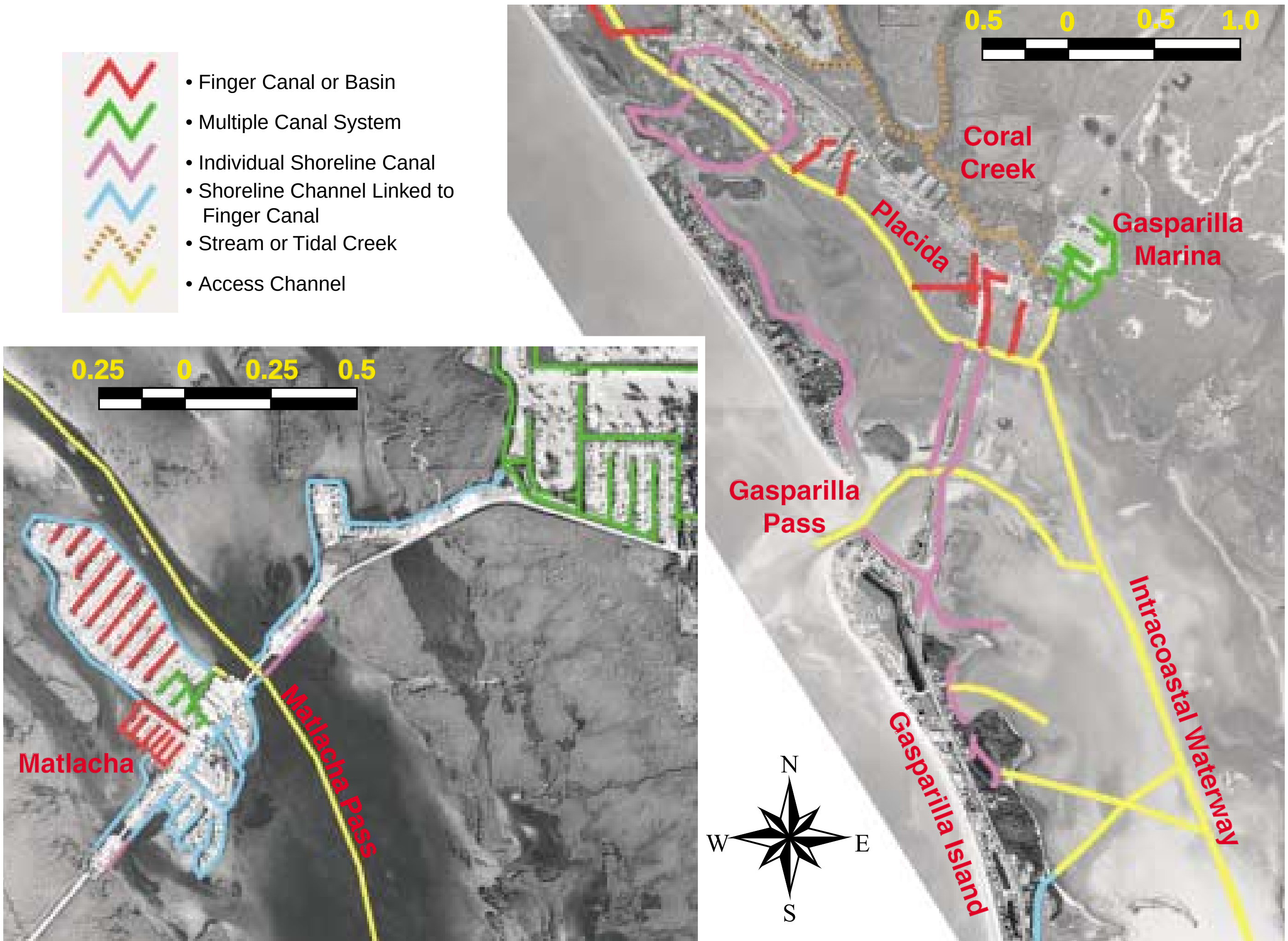


Figure 1. Examples of channel types.

Improved (dredged) and unimproved (natural) waterways

Region	Finger Canal or Basin	Multiple Canal System	Individual Shoreline Channel	Shoreline Channel Linked to Finger Canals	Stream or Tidal Creek	Access Channels and Arterials	Total (miles)	Total (row %)
Gasparilla Sound	3.5	2.1	15.9	1.4	5.5	19.1	47.5	4.2
Charlotte Harbor	11.3	215.1	1.4	7.2	24.1	21.0	280.1	24.7
Pine Island Sound/San Carlos Bay	2.7	32.4	13.7	21.1	0.0	92.3	162.2	14.2
Matlacha Pass	3.7	52.2	0.4	7.5	0.0	26.6	90.4	7.9
Caloosahatchee River	10.3	214.8	4.0	5.3	10.7	24.2	269.3	23.7
Estero Bay	14.4	30.2	3.1	16.0	29.0	33.1	125.8	11.1
Clam & Doctors Bays	0.0	1.5	0.0	7.5	0.0	1.9	10.9	1.0
Naples Marco Waterway	9.8	81.4	0.7	8.5	4.4	44.6	149.4	13.2
Total (miles)	55.7	629.7	39.2	74.5	73.7	262.8	1135.6	100.0
Total (col. %)	4.9	55.5	3.5	6.5	6.5	23.1	100.0	

Table 2.

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__________, 1879-80, Pine Island Sound, Charlotte Harbor, West of Pine Island, Florida, hydrographic (H) sheet, 1:20,000 scale, Register No. 1480a.

__________,1893, Caloosahatchee River, from Sword Point to Red Fish Point, Florida hydrographic (H) sheet, 1:10,000 scale, Register No. 2153.

__________, 1893, Caloosahatchee River, from Four Mile Point to Beautiful Id., Florida, hydrographic (H) sheet, 1:10,000 scale, Register No. 2155.

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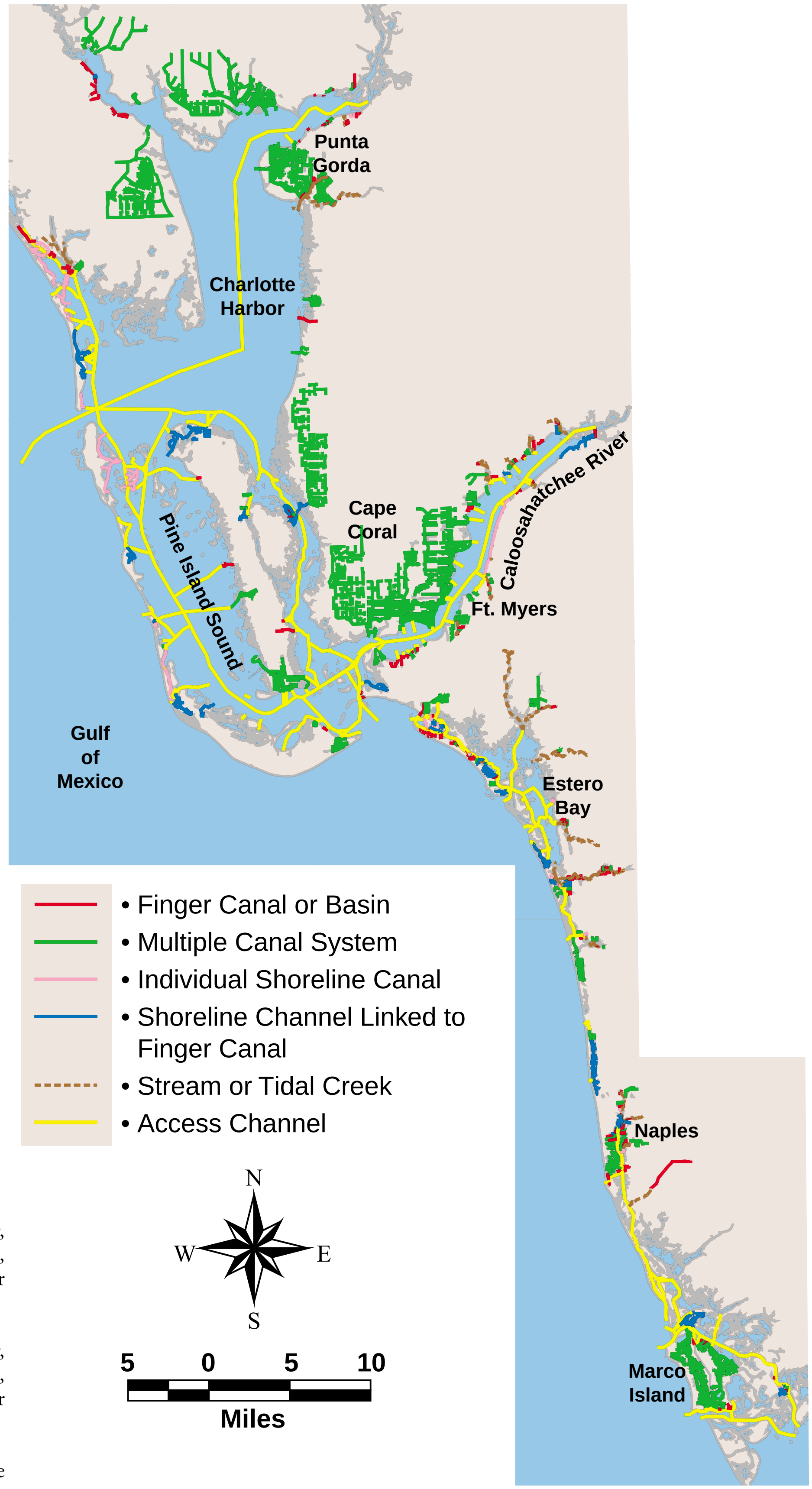
__________, 1930, Coon Key to Little Marco and Caxambas Passes, West Coast, Florida, hydrographic and topographic (H/T) sheet, 1:20,000 scale, Register No. 5072.

__________, 1930, Little Marco Pass to Naples Bay, West Coast, Florida, hydrographic and topographic (H/T) sheet, 1:20,000 scale, Register No. 5067.



Map 3.
Distribution of channels by type.

For Your Information...

Locked Waterways in Southwest Florida

Six freshwater canal systems, totaling 108 waterway miles (10 percent of all channels), are linked to Southwest Florida's boating infrastructure (Table 3 and Map 4), separated from the bays and rivers by either a lock or berm. Systems with larger boats have gated locks. Boat lifts hoist smaller vessels over a berm. These freshwater isolation systems date from the 1970s, when federal legislation began to curtail the impacts of upland development on sensitive marine habitats.

State permitting agencies saw in the lock and berm approach a compromise with developers to reduce the impacts of stormwater runoff as point source pollution. The larger canal system designs incorporate a stormwater trap, comprising a perimeter berm and a "spreader" canal to distribute runoff behind a fringe of mangroves. In such a system, stormwater builds up behind the lock and berm, and excess flow spills over the berm into the perimeter canal, filters through the mangroves, and seeps out into the bay. This strategy is considered better for the environment than concentrated runoff from a single point source. The three large multiple canal systems — Burnt Store Isles, Cape Coral North Spreader, and Cape Coral South Spreader — fit this design.

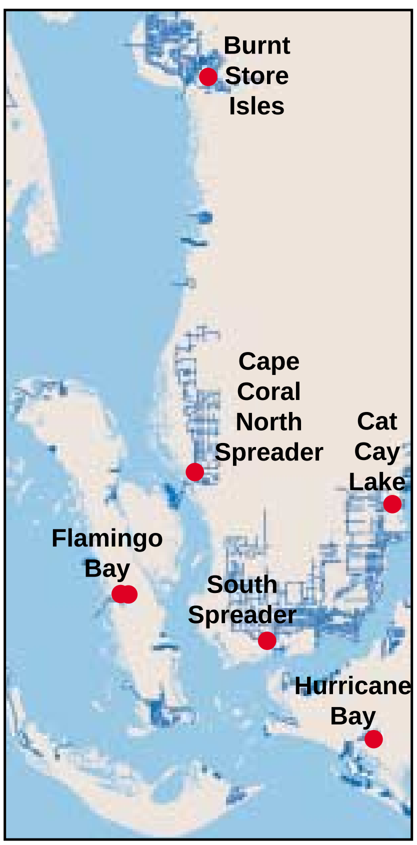
Locked waterways in Southwest Florida.

Waterway	Channel (miles)
Burnt Store Isles	11.3
Cape Coral North Spreader	47.2
Flamingo Bay	0.2
Cape Coral South Spreader	44.2
Cat Cay Lake	3.5
Hurricane Bay	1.9
Total	108.3

Table 3.

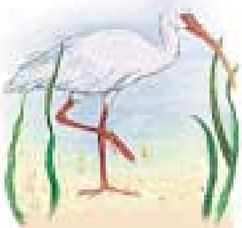
Lock at the entrance to the Cape Coral South Spreader Canal.

Boat lift at Cat Cay Lake.



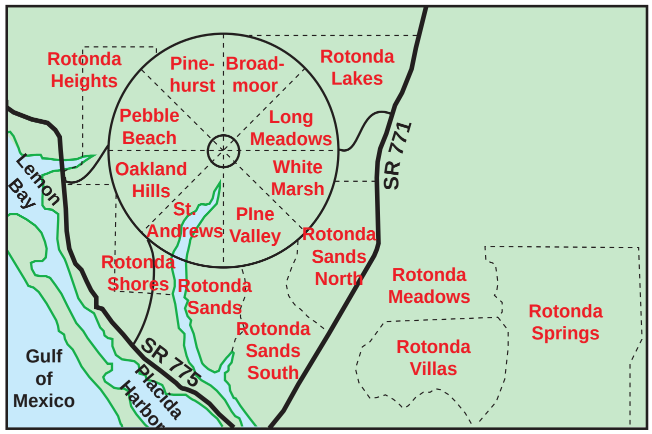
Map 4.
Locks and boat lifts.

Boat lift at Flamingo Bay.



Case Studies: Rotonda West, Cape Coral, Marco Island

One of the most notable features of Southwest Florida waterways is the growth and development of canalfront residential communities. As discussed in the preceding chapter, dredging during the two decades following World War II led to the creation of multiple canal systems where thousands of saltwater-accessible parcels were carved out of wetlands to satisfy a market for water-oriented single-family homes. More than half of the waterways in the region are of this form. The unparalleled construction frenzy during the 1950s and 1960s which led to the creation of these canal waterfront communities, prompted public concerns about a deteriorating coastal environment, shrinking public access to waterfront areas, and fears about the loss of sensitive habitats for wildlife. Landmark legislation, passed by Congress in the early 1970s to rein in wide-scale wetland destruction, brought an abrupt halt to this canal development process. The Environmental Protection Act (1970) created the U.S. Environmental Protection Agency, the Clean Water Act (1972), and the Endangered Species Act (1973), all have fundamentally changed waterfront development practices and curtailed waterway maintenance practices. Three cases – Rotonda West (Charlotte County), Cape Coral (Lee County), and Marco Island (Collier County) — help to explain how such widespread waterway construction evolved and demonstrate the effects of multiple canal systems on the local geographic setting.



Map 1.
Rotonda subdivisions.

Rotonda (circular shape on the left side of photo); view south with Stump Pass in the foreground; Gasparilla Pass upper right, Charlotte Harbor in background.


Cape Coral looking Southwest across Redfish Point and the Caloosahatchee with Punta Rassa on the extreme right.


South Marco Island and Roberts Bay in foreground, looking Southwest out Caxambas Pass.

The Vision of Rotonda West: A Self-Contained Circular Community of 50,000

Promoted as "one of the most exciting concepts in planning," Rotonda West has made an indelible imprint, both perceived and real, on the Southwest Florida landscape. Situated on Cape Haze peninsula between Buck and Coral Creeks in Charlotte County, it epitomizes the quest for building waterfront property that dominated much of this region's residential developments of the 1960s era. Imagine — "a brand new, community-in-the-round, a unique circle of eight pie-slice-shaped subdivisions, seven with their own golf courses and marinas, the eighth with a broad waterway (Coral Creek), the whole community surrounded by a circular waterway, offering, in all, 32 miles of navigable, blue-green waterways well-stocked with freshwater fish." That "vision" — of each homesite overlooking a canal, golf course, landscaped green belt or recreational waterway, and with each homeowner provided unlimited access to a private Gulf beach on Don Pedro Island — was offered to the public in 1969 by Cavanagh Leasing Corp. Map 1 shows Rotonda's subdivisions within and outside the "wheel".

Cavanagh purchased the property from the Vanderbilt family (descendants of Cornelius Vanderbilt) who had built the 35,000 acre 2-V Ranch for breeding Santa Gertrudis cattle. The land, only a few feet above mean sea level, had been covered years earlier with pine forest, but the timber had been cut down for lumber and naval stores by a succession of owners, including the Gainesville, Ocala and Charlotte Harbor Railroad (forerunner of the Florida Southern Railway Company).

Figure 1 shows pre–development conditions that prevailed in 1951. The Vanderbilts' improvements to the land for cattle grazing included building a dam on West Coral Creek to block salt water from infiltrating the fresh water runoff from the uplands. They also developed Cape Haze, an upscale residential community adjoining the Rotonda property between Coral Creek and Placida Harbor.

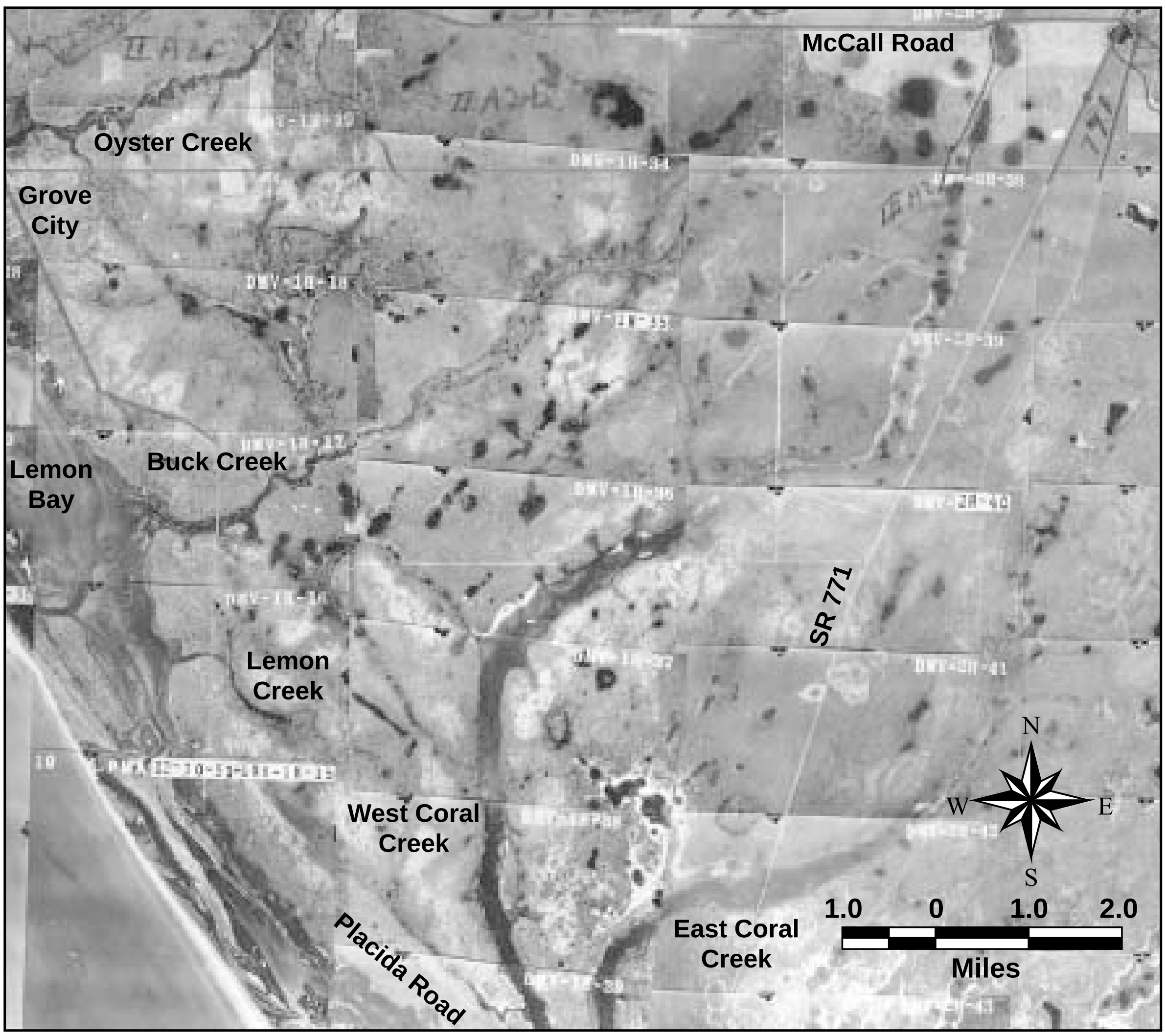


Figure 1. Rotonda aerial mosaic, 1951.

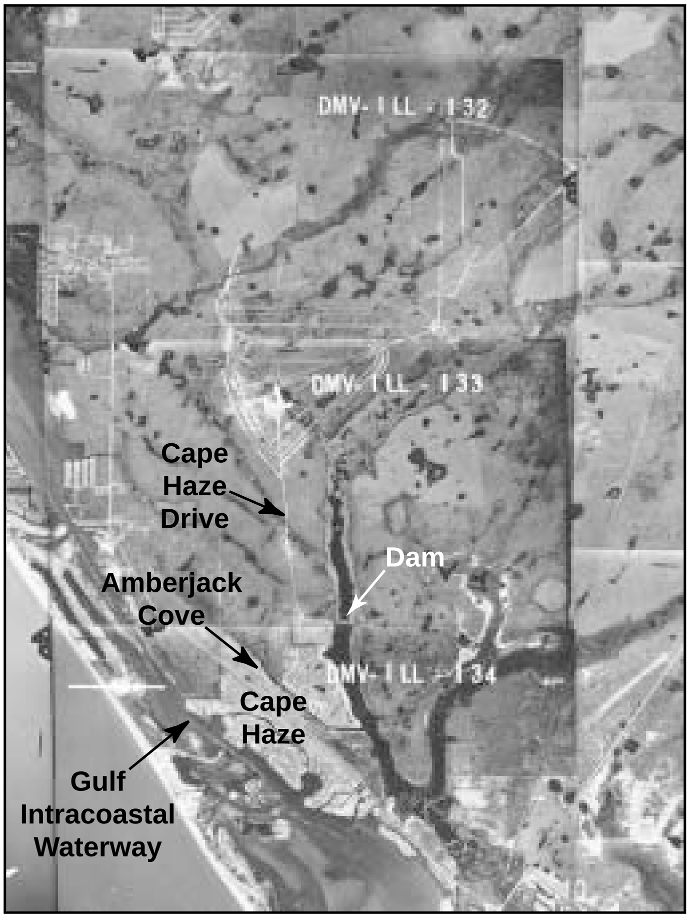


Figure 2. Rotonda aerial mosaic, 1970.

Figure 2 shows conditions in early 1970, the take-off year of Rotonda's development. The Vanderbilts' Cape Haze waterfront property had been cleared and bulkheaded, and finger canals had been dredged; the Gulf Intracoastal Waterway had established the inland waterway link between Placida Harbor and Lemon Bay; dredging was underway in Amberjack Cove (a natural slough); and the Vanderbilts' dam had been built across West Coral Creek. Parts of the Rotonda 'wheel' are visible, such as the west, north, and east sectors of Rotonda Circle, the hub, and construction within the Oakland Mills subdivision.


Figure 3. Rotonda aerial photograph, 1975.

Figure 3 shows the development in 1975. Eleven miles of canals, 6 feet deep and 60 feet wide, had been dredged in Oakland Hills, Pebble Beach and Pinehurst subdivisions. Deepwater canals crisscrossed the 2,600-acre Rotonda Sands area, between East and West Coral Creeks. About 600 homes were complete by 1976, mostly in Oakland Hills.

The Rotonda 'vision' promised an idyllic, Shangri-La lifestyle and implied access to Gulf waters. However, the developer was unable to forecast mounting public concerns about the health of the environment and passage of legislation, by 1975, that would halt unbridled destruction of wetlands. One consequence of the new laws was a decision never to dismantle the dam across West Coral Creek; Gulf access would not exist. Construction was halted on the environmentally sensitive wetlands areas, effectively blocking development of the St. Andrews and Rotonda Sands subdivisions. Figure 3 (1975) shows initial land clearance and canal construction within the subdivisions adjoining West and East Coral Creeks. In 1976, Deltona Corporation, the land development company headed by the Mackle family, assumed management of the Rotonda properties. The state eventually purchased the marginal lands in 1998 under the Environmentally Endangered Lands Act Cape Haze/Charlotte Harbor CARL (P2000) purchase.

Today's Rotonda is part of that pre-1975 "dream" and part post-legislation reality. Cavanagh's dream waterfront community, with Gulf access, is still perpetuated on some contemporary street maps. Modern (1995) aerial photography (Figure 4) shows a very different landscape: relict canals on the undevelopable St. Andrews and Rotonda Sands subdivisions outside the wheel; buildout of homesites within the wheel's western sectors of Oakland Mills and Pebble Beach; a moderate level of home-building in the northern Pinehurst and Broadmoor subdivisions; and negligible construction in the east and southeast White Marsh and Pine Valley areas. The Rotonda of today is a community shaped by a vision of outdoor living, Florida style, and attuned to pursuing that dream in an environmentally sustainable fashion.

Figure 4. Rotonda aerial photograph, 1999.

Creating a Waterfront Wonderland at Cape Coral

The Caloosahatchee Riverfront was a prime target for residential land development during the years following World War II. As service personnel returned to the United States and retirees began searching for affordable housing, the region's warm climate, laidback lifestyle, and cheap undeveloped land provided unparalleled incentives for economic growth and development. The Rosen brothers — Leonard and Jack — recognized an opportunity to profit by selling the American Dream, affordable housing on the installment plan. In 1957, they purchased for $125,000 a 1,724-acre parcel at Redfish Point on the north bank of the Caloosahatchee. The Rosens would turn that investment into a fortune of over $100 million by 1970 and create the largest land sales operation, Gulf American Corporation, in the United States. Their real estate business was a pioneer in using mail-order sales, television advertising, giveaways, and popular culture celebrities as company spokespersons.

Cape Coral looking northeast up the Caloosahatchee with Redfish Point on lower right.

Figure 5. Redfish Point, 1944.

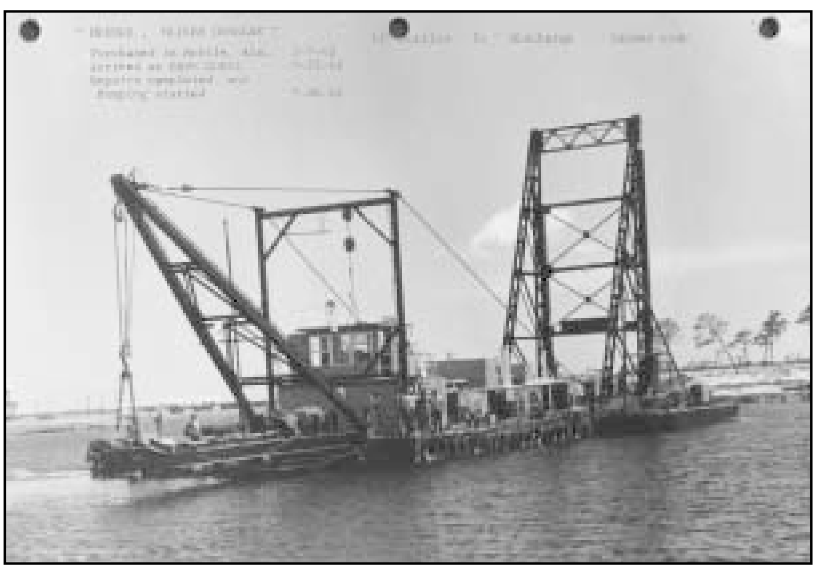


Figure 6. Dredge *Oliver Douglas,* 1962.

In the early 1940s, Redfish Point was uninhabited (Figure 5). Dense mangroves extended inland for 100 yards from the shoreline. The remainder of the property was only several feet above sea level and covered with grasslands, palmettos and second-growth pines. Since local land use regulations mandated homesite construction at a minimum 5.5 feet above sea level, the Rosens concluded that dredging would be needed to provide fill material. Gulf American refined the 'finger-islanding' dredge method of excavating canals so that most buildable lots fronted on waterways. A grid-patterned development produced the largest number of homesites. Though the main objective was to create land for home construction, the use of dredge-and-fill produced a suburban landscape of artificial canals, waterways and basins, the outlines of which were dictated by the amount of fill required at a given location. As a result, canal width and depth varies within Cape Coral: some waterways, such as in the Yacht Club area, are nearly 200 feet wide and over 30 feet deep; whereas canals located farther inland on higher elevation uplands are only 80 feet wide and 6- to 15-feet deep.

The dredge-and-fill method, which would later be criticized for its environmental impact, employed in the peak years of the early 1960s as many as four dredges and ten draglines, which at times operated around the clock. Hydraulic dredges, such as *Oliver Douglas* (Figure 6), were floating barges that pumped bay-bottom sediments in a liquid solution onto an emerging upland site. Draglines mechanically moved fill from canals to the uplands by dragging buckets across the ground (Figure 7). Building sites were bulldozed and leveled, and, in the process, nearly all vegetation was removed prior to construction (Figure 8).

By the early 1960s, over 50 million cubic yards of fill had been moved to create the Cape Coral development (Figure 9). This included dredging some 170 miles of saltwater accessible canals and three basins, as well as 14

Figure 7. Dragline at Cape Coral, 1962.

Figure 8. Cape Coral oblique aerial photograph, 1959.

Figure 9. Cape Coral at Redfish Point, oblique aerial photograph, 1961.

landlocked lakes.Waterway construction totaled about 250 miles by the mid-1970s. But Gulf American's days were numbered. Conflicts over dredging permits, due to emerging public concerns about potential environmental impacts, were costly. The company misjudged the regulatory climate. Large holdings became undevelopable, and in 1969, the Rosen brothers sold out. The City of Cape Coral, incorporated in 1970, was a community of over 20,000 residents. Its location on the north shore of the Caloosahatchee and its canalfront homesite development have retained the hallmark qualities of the American Dream through the years — waterfront living in a Florida setting (Figure10).

Figure 10. Redfish Point, 1999.

The natural waterway along the winding Caloosahatchee was widened, straightened and deepened after flood waters of the 1928 hurricane killed hundreds of people around Lake Okeechobee. Today, Ft. Myers is the largest city on Florida's "original cross-state canal," linking the east and west coasts of the state.

The Ultimate Waterfront Paradise in Southwest Florida: Marco Island

Marco Island was the single-largest undeveloped track of barrier island property in Southwest Florida in 1962 when the Mackle brothers — Elliott, Robert, and Frank — visited the site, lured by the prospect that the Colliers (descendents of Barron Collier, the advertising magnate) were interested in selling their 10,327-acre land holding, 6,700 on Marco and the rest on the mainland. The brothers purchased the Collier property for $7 million. They were experienced land developers, having created Miami's Key Biscayne, an upscale waterfront community, and through General Development Corp., developed the 118,000-acre Port Charlotte community on Charlotte Harbor's north shore. The Mackles sold General Development in 1961 and formed a new company, Deltona, which proceeded to develop homesites near Deland and Daytona Beach, Fla. The Deltona Corporation would be the corporate instrument to transform Marco into the ultimate waterfront paradise.

Figure 11, taken in December 1951, shows Marco Island in its pre–development state. Only two settlements existed: Marco Village on the north and Goodland on the east. Scrub vegetation covered most of Marco Island and an extensive mangrove shoreline fringed the river and bays in the pre–development period of time. Crescent Beach, the 5-mile sweep of Gulf shore between Big Marco and Caxambas Passes, was a vast, expanse of white sand. Mosquitoes were a constant menace of Marco Island because of the large intertidal areas on the bayside. There was a limited supply of freshwater and no sanitation infrastructure.

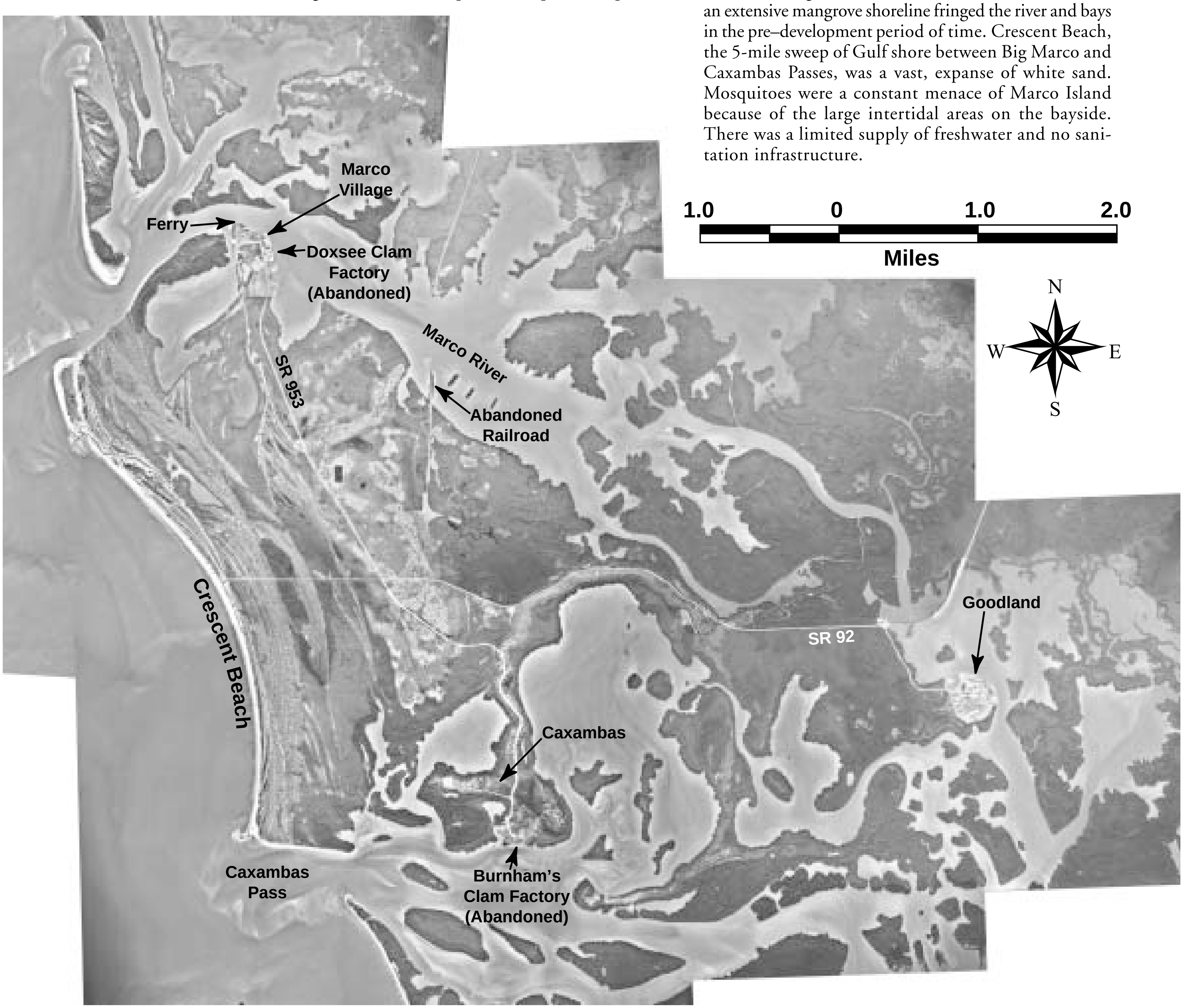


Figure 11. Marco Island aerial photomosaic, 1951.

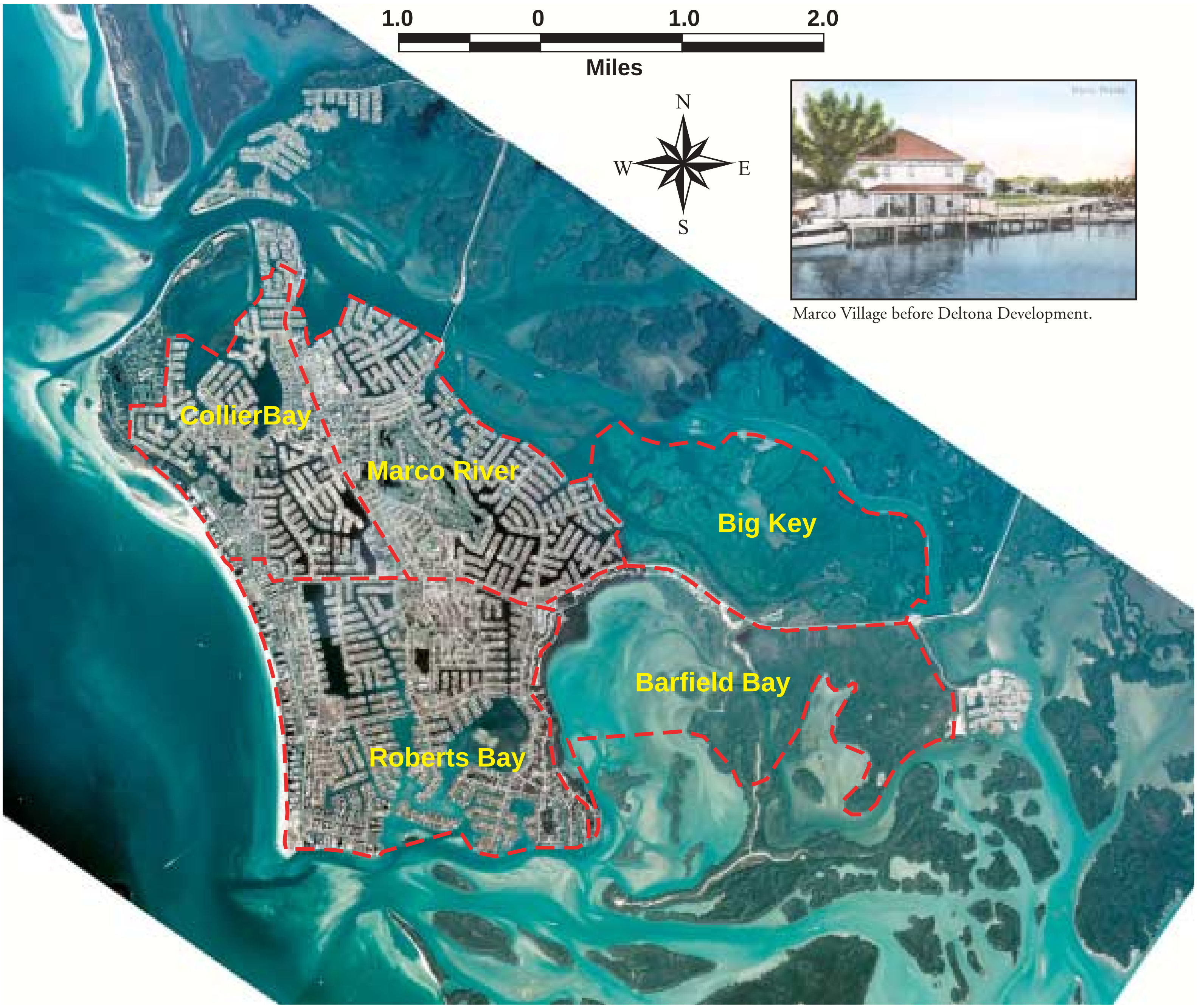
Clamming had been an economic mainstay of the island during the early 1900s, but the two major facilities — Doxsee's on Factory Bay and Burnham's at Caxambas Pass — closed when the clam beds were depleted.

The railroad, built in 1927, had been abandoned in the mid-1940s. A swing bridge over the Marco River connected Goodland with the mainland.

Villagers at Caxambas had been moved to Goodland in 1949 preceding the Colliers' attempt to develop the island. Nothing materialized from this Collier development plan. The U.S. Air Force had established a missile tracking station in the late 1950s on the southwest tip of Marco Island adjacent to Caxambas Pass.

The Mackles wanted to build a resort community from scratch and Marco Island, in 1962, presented them with such opportunity.

As land would have to be created from wetlands and bay bottom, the Mackles' 15-year development plan hinged on dredge-and-fill, a widely adopted and accepted 1960s land development method. The 6,700-acre site was subdivided into over 10,000 homesites, and other areas were set aside for commercial and public uses. Deltona's 1964 Plan (Map 2) shows the extent of the proposed development, which included 90 miles of canals with 8,000 waterfront parcels.



Marco Village before Deltona Development.

Figure 12. Marco Island permit areas (1992 aerial photograph).

The Army Engineers claimed jurisdiction and required its approval, in addition to county and state 'building' permits, since dredge-and-fill could potentially affect navigation on public waterways. Deltona subdivided the island into five areas, based on completing dredging and filling in each area within the Army Engineer three-year permit period (Figure 12). The company submitted its permit application for the Marco River area first, in 1964, and received Corps approval shortly thereafter. A Corps permit was requested for Roberts Bay in 1967, but the approval process took two years. The Collier Bay subdivision, submitted to the Corps in 1971, was not approved until 1976. The Barfield Bay and Big Key areas, which were scheduled to be developed in the late 1970s, never received Corps approval for dredging. The battle over Deltona's dredge-and-fill permit applications was an indication of a nationwide, emerging, environmental ethic that had prompted passage of landmark legislation to reign in widescale filling of wetlands, both freshwater and marine, and destruction of wildlife habitats.

The denial of permit applications by the Army Engineers made it impossible for Deltona to honor its sales contracts, since it began selling homesites in 1965 in all of the five areas based on the assumption of 'business-as-usual' in obtaining the federal permits to dredge and fill in order to create buildable waterfront properties. Though the company stopped land sales in 1973 within the unpermitted areas, it had already sold 75 percent of the sites in Collier Bay, 90 percent in Barfield Bay, and almost 100 percent in Big Key. Lawsuits and counter-suits, concerning the constitutionality of the Army Engineers decision and regarding just compensation were all decided against the company. In 1982, Deltona turned over almost all its remaining undeveloped holdings on Marco Island to the state for use as a nature preserve.

Figure 12 shows the extent of Marco's developed and undeveloped lands. The dream of an ultimate waterfront residential paradise, thus, came to an abrupt end, and under current federal, state, regional and local laws, finger-canal developments will never again be allowed in Southwest Florida.

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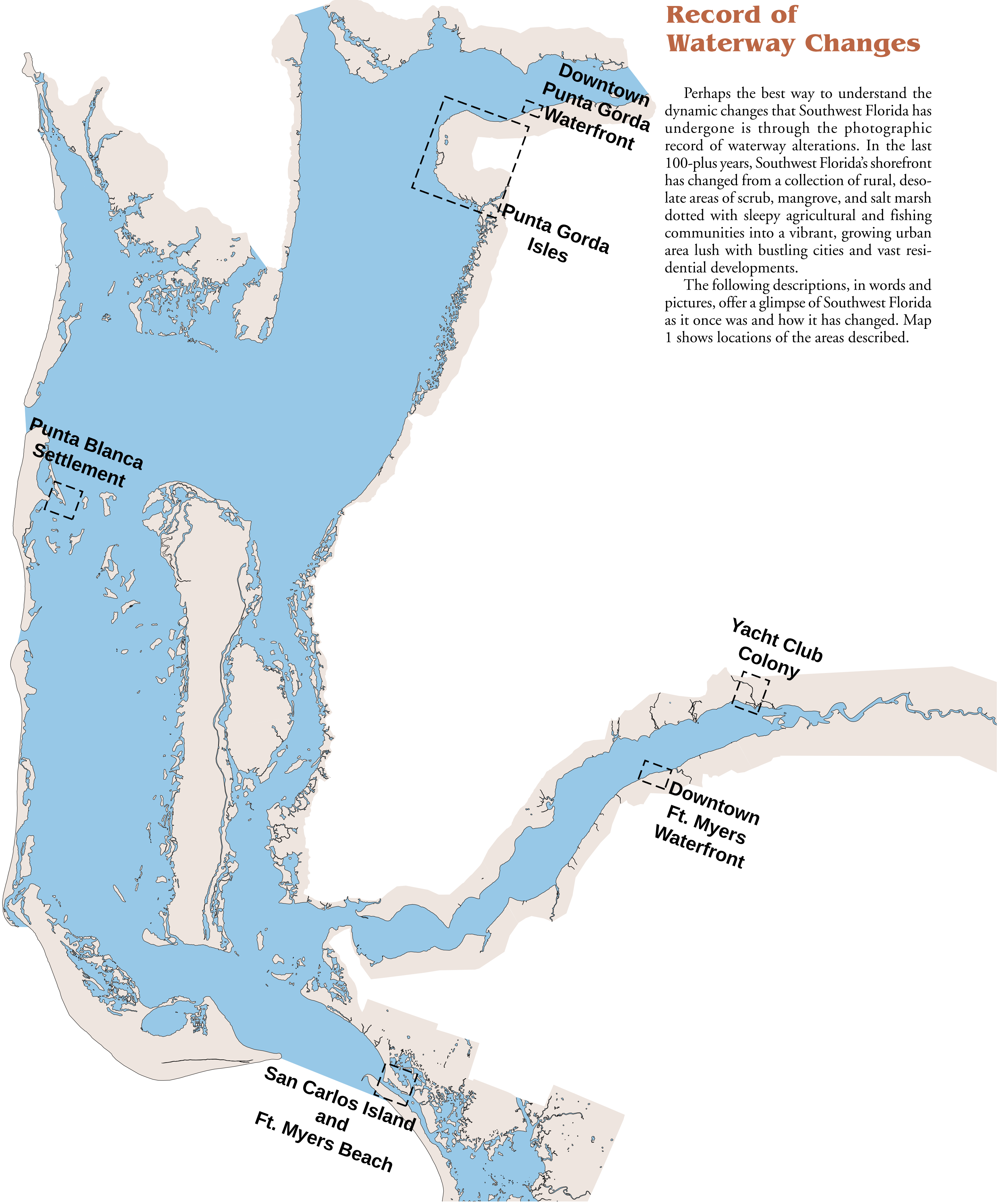
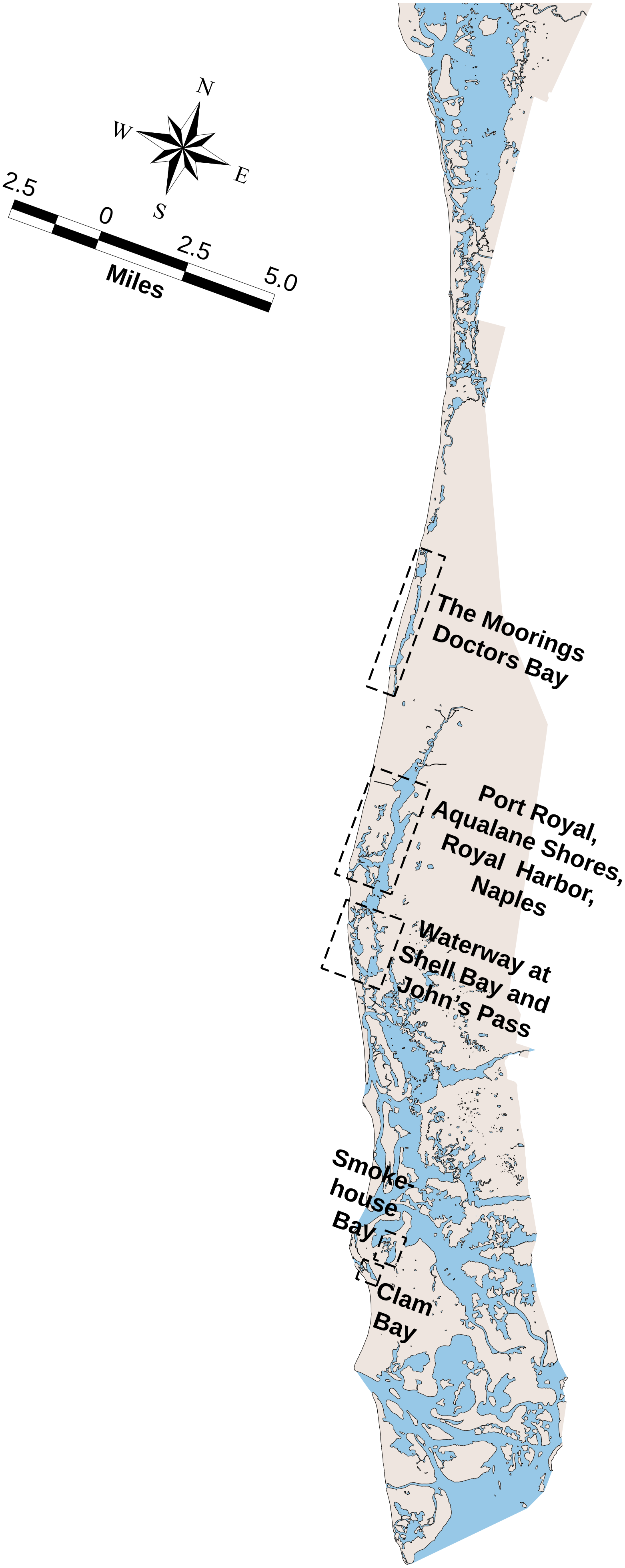
Map 2.
Marco Island development plan.

Photographic Record of Waterway Changes

Perhaps the best way to understand the dynamic changes that Southwest Florida has undergone is through the photographic record of waterway alterations. In the last 100-plus years, Southwest Florida's shorefront has changed from a collection of rural, desolate areas of scrub, mangrove, and salt marsh dotted with sleepy agricultural and fishing communities into a vibrant, growing urban area lush with bustling cities and vast residential developments.

The following descriptions, in words and pictures, offer a glimpse of Southwest Florida as it once was and how it has changed. Map 1 shows locations of the areas described.





Map 1.
Photo record case studies.

1. Downtown Punta Gorda Waterfront

Downtown Punta Gorda Waterfront changes are captured in maps and photographs from 1921 to present day. The Army Engineers 1921 maps (Figures 1A and 1B) shows existing waterfront conditions and those from an earlier time. In 1885-86, the railroad completed a spur to (a) Old Long Dock (Old Cattle Wharf on map), the first modern dock facility used by commercial fishermen to off-load fresh fish packed in ice and to ship their catch by rail to United States markets. In 1897, Long Dock was abandoned (later destroyed) for the Atlantic Coast Line railroad dock (b) at King Street. City Wharf (Figure 1A, c), at the foot of Sullivan Street (Figure 1C), was destroyed in 1921.

A fire in 1915 destroyed the fish houses on the King Street Dock, but some were rebuilt. Figure 1B shows fish houses and ship chandleries on the King Street Dock (b) and the Ice Wharf (d) at the foot of the alley to the east. The riverfront between King and Nesbit Streets was lined with small marine ways, boat repair facilities, and a blacksmith shop (e). Fishing boats, like the auxiliary-powered schooner *Roamer* (Figure 1D), operated from Punta Gorda during this era. The Nesbit Street Bridge (Figure 1B, f) was a county road that spanned the Peace River from Punta Gorda to Live Oak Point and Charlotte Harbor Town. The King Street Dock (Figure 1B, b) was removed in the late 1920s in order to build the modern bridge right of way. A residential district along Retta (Esplanade) Avenue had been laid out early in the city's history (Figure 1E).

The aerial photograph in Figure 1F shows early 1940s waterfront conditions; antecedent structures described above are outlined in red. Note the old bridge approach at the foot of Nesbit Street. The area to the west had been filled. An old landmark hotel (g) remained from bygone days, as did the abandoned railroad spur to the Old Cattle Wharf. By the early 1940s, a dredged boat basin and pier (h) occupied the present-day location of Fishermen's Village. The City's riverfront park (i) at Retta Esplanade was an open space.

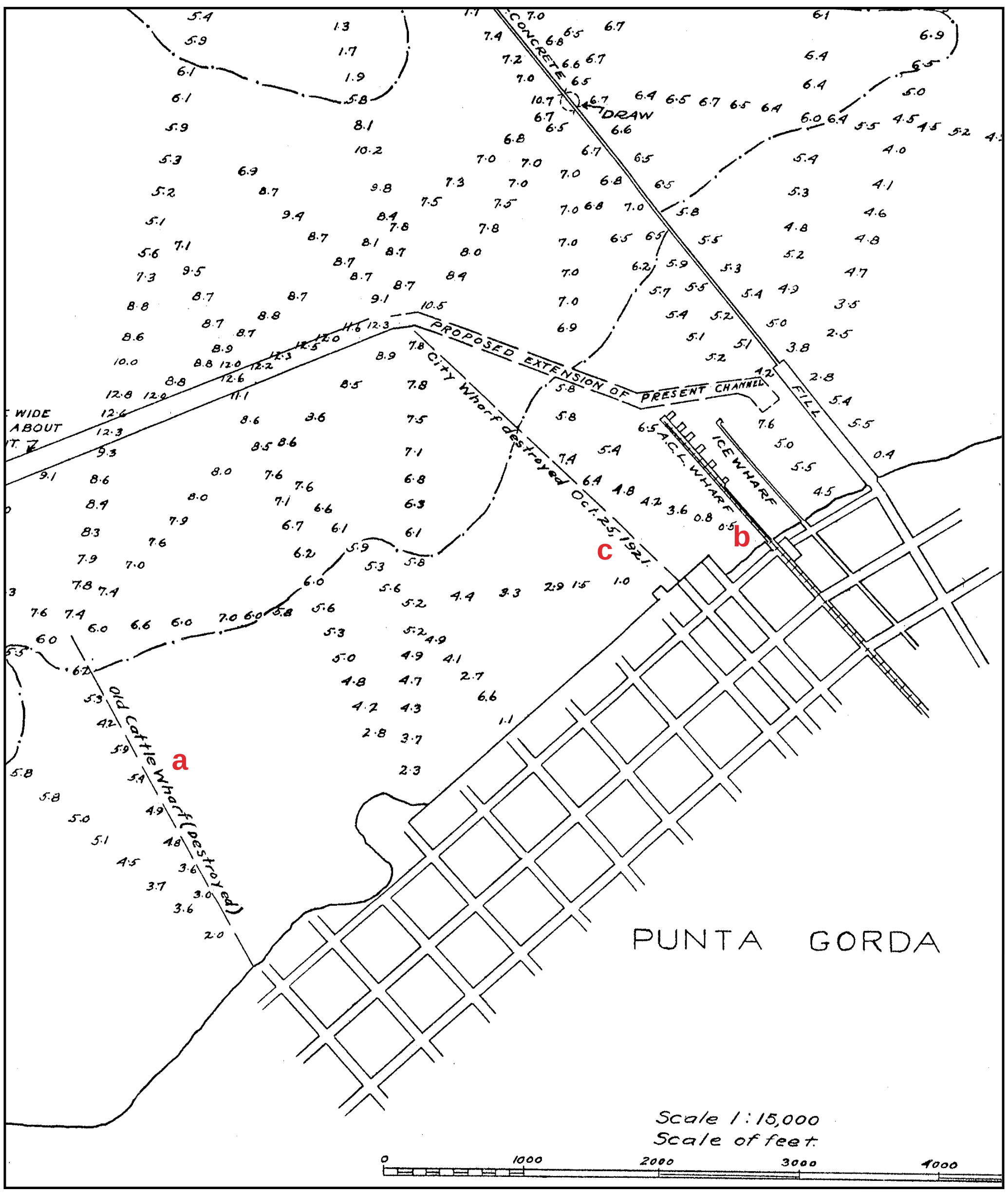


Figure 1A. Punta Gorda downtown, 1921.

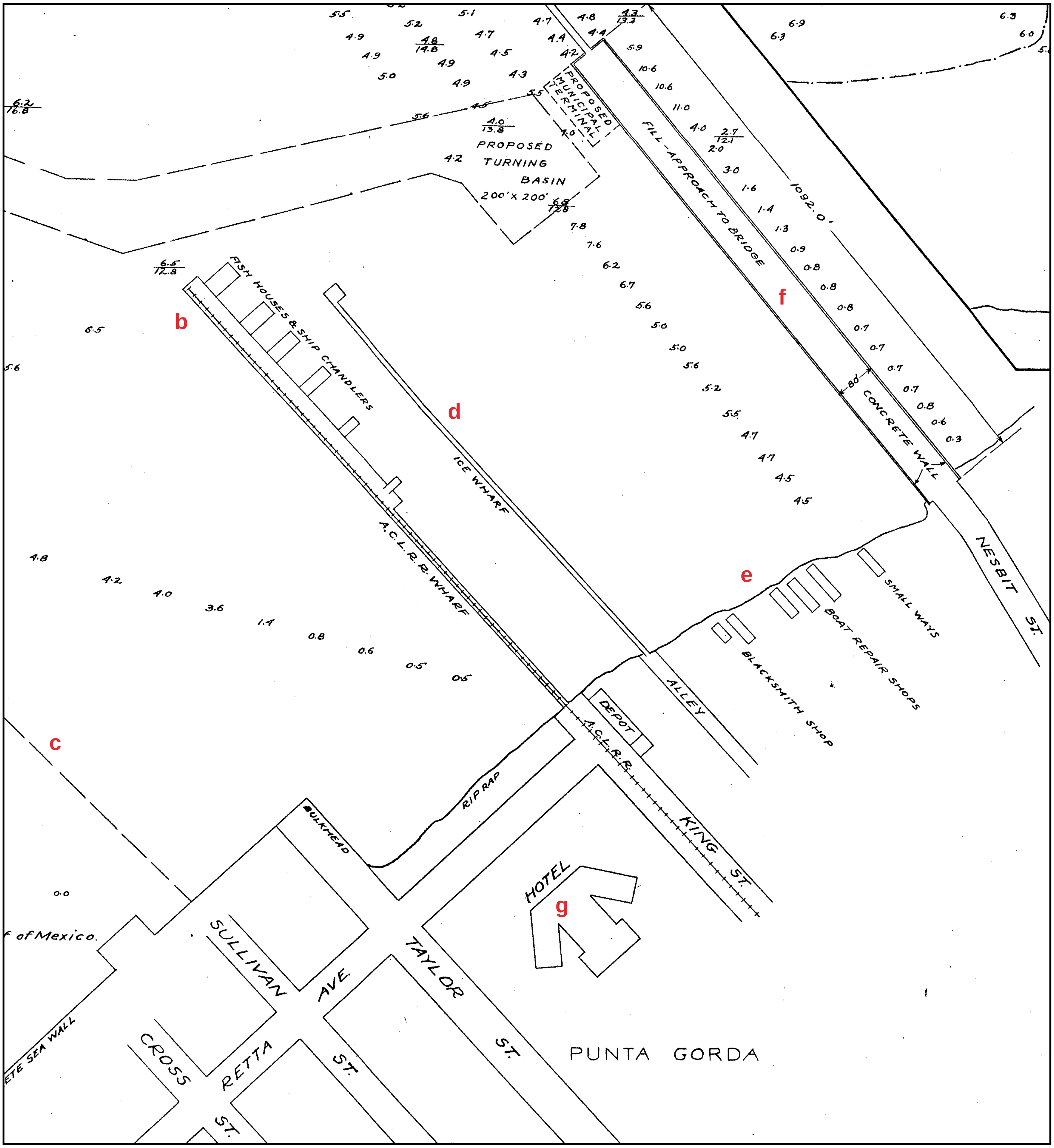


Figure 1B. Punta Gorda downtown (detailed plan), 1921.

The modern waterfront (Figure 1G) shows a completely transformed urban space. The old Nesbit Street County Bridge is replaced by two separate fixed spans — southbound traffic on Gilchrist Bridge and northbound on Collier Bridge. Commercial marine facilities have given way to service retail outlet stores and hotels. The open space along Retta Esplanade is Gilchrist Park. A time-share duplex with retail shopping, restaurants and modern marina — Fishermen's Village — occupies the commercial fish pier at the former location of the Old Cattle Dock. Land has been filled out into the river to provide buildable space for these expanding services. The old-town atmosphere and early 1900s buildings, especially old homes, are retained along Marion and Olympia and west of Nesbit.

Figure 1C. Punta Gorda city wharf.

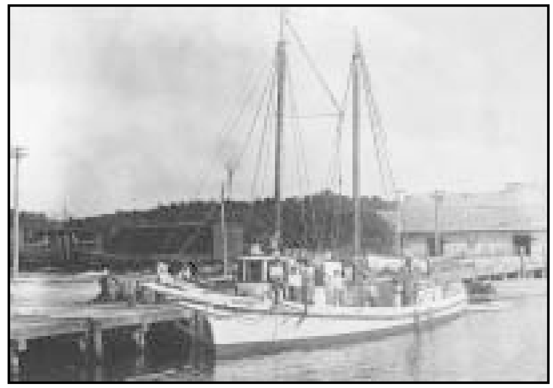


Figure 1D. Schooner *Roamer* at Punta Gorda.

Figure 1E. Punta Gorda Retta (Esplanade) Avenue.

Figure 1F. Punta Gorda downtown, 1940s.

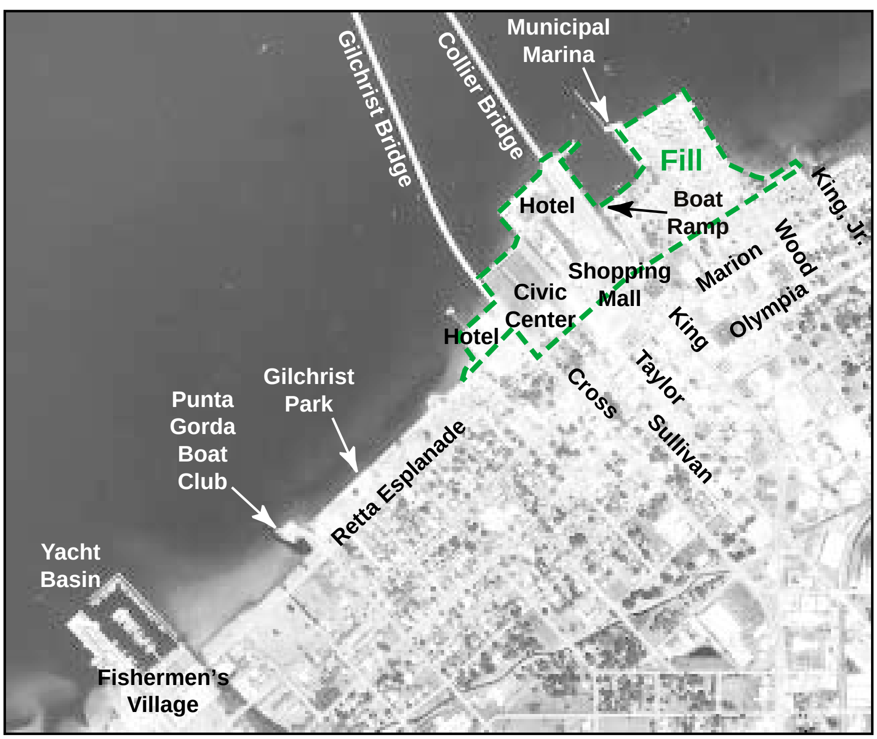


Figure 1G. Punta Gorda downtown,1992.

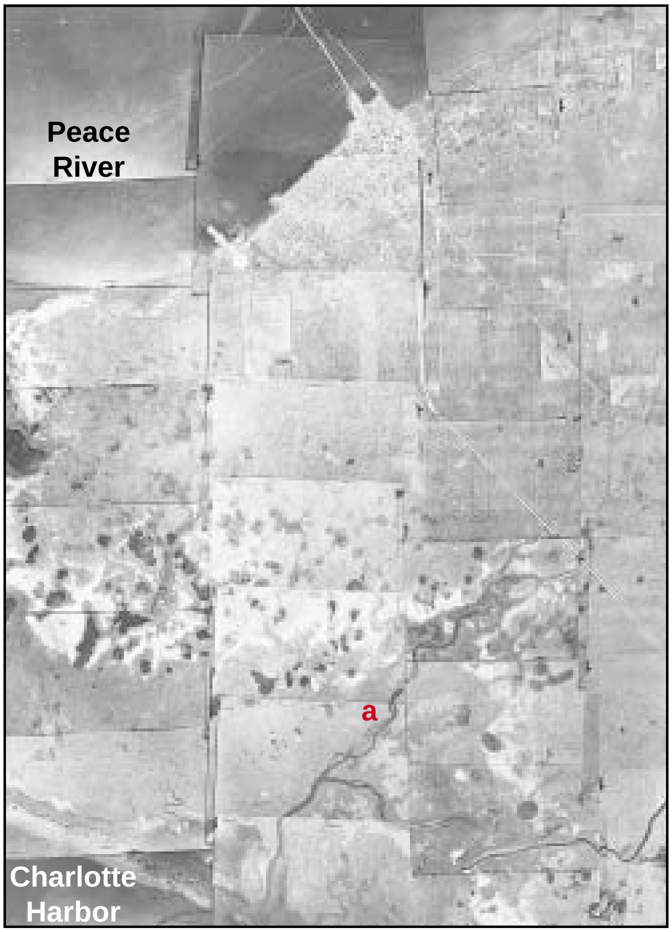


Figure 2A. Location of Punta Gorda Isles, 1944.

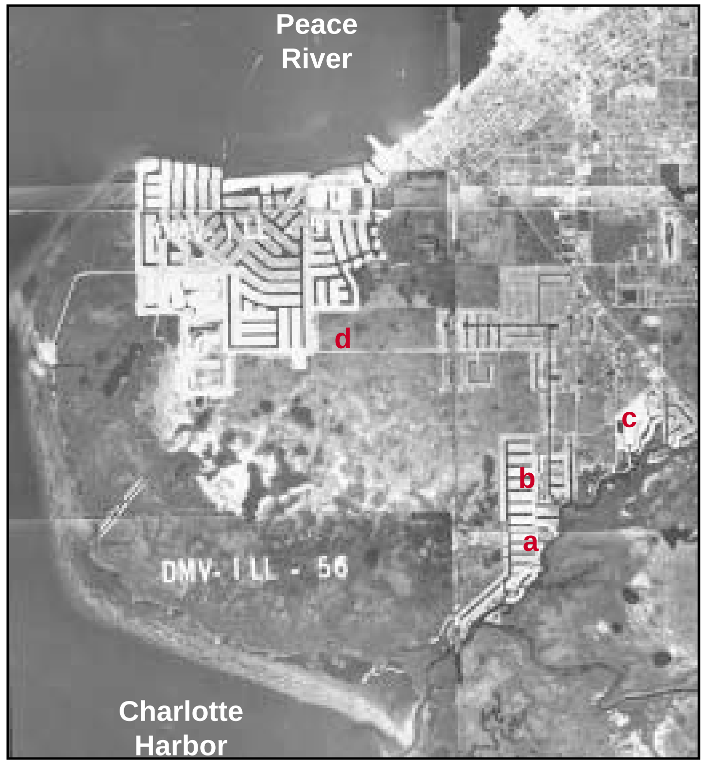


Figure 2B. Punta Gorda Isles, 1972.

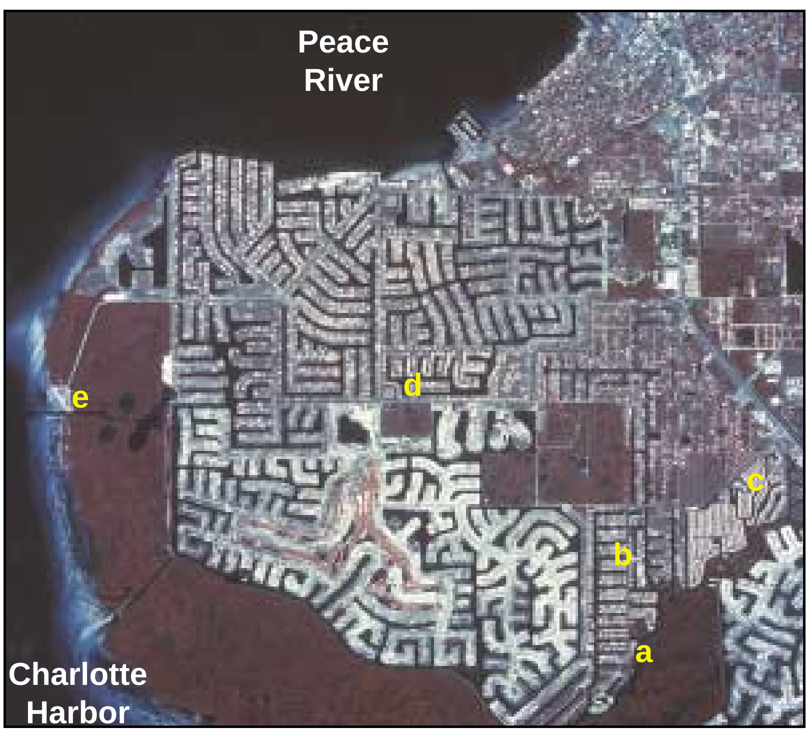


Figure 2C. Punta Gorda Isles, 1995. (False-color Infrared Image)

Punta Gorda Isles

Punta Gorda Isles is illustrative of the most dramatic changes in waterway development — namely, those directly tied to dredge-and-fill — which made land available for residential use. In 1944 (Figure 2A), much of the area was scrub, unimproved pasture, and wetland. By 1972 (Figure 2B), Alligator Creek (a) had artificial canals extending north into Charlotte Park (b) and Riviera (c), while most of the canals north of Aqui Esta Drive (d) in Punta Gorda Isles had been created. By 1995 (Figure 2C), the entire canal system, as its exists today, comprised over 2,000 salt-water parcels with access channels north to the Peace River, or through Ponce de Leon Channel (e) and Alligator Creek (a) to Charlotte Harbor.

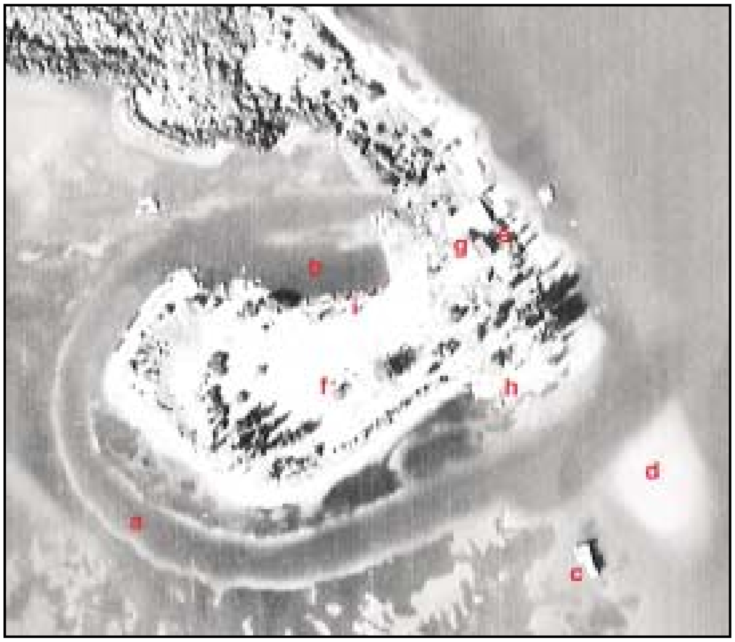


Figure 3A. Punta Blanca, 1944.

Figure 3C. Punta Blanca, 1999.

Punta Blanca Settlement

Punta Blanca's Settlement, which occupied the south tip of the island until the late 1950s, typifies the smaller, self-contained fishing communities that dotted the Charlotte Harbor shoreline in the early 20th century. Settled by some of the same fishing families that populated Cayo Costa, Boca Grande, and Pine Island, some 15 households lived there in the years preceding World War II. The village included a schoolhouse and general store. Small-boat repairs and fishing were the mainstays of the economy.

The aerial view taken in 1944 shows many features of the historic settlement (Figure 3A). The dredged approach channel (a) and boat basin (b) are prominent elements. Note the fish-house (c) south of the entrance to the approach channel, which was a favorite photo subject of boaters heading down Pine Island Sound channel until it burned in 1995 (Figure 3B). Prop-wash of the run-boats, as they came alongside and serviced the fish-house, created the shoal (d). The boat building shed at (e) had a marine ways used for launching. Other structures shown on the photo are the school (f), general store (g), community dock (h) and out-houses (i).

The settlement had one telephone, connected to Boca Grande by an underwater cable crossing the inlet and overhead wires strung on poles across Pelican Bay. School-age children from neighboring islands were shuttled to and from Punta Blanca until the school burned down in the late 1950s and Lee County terminated boat pickup service.

Today, little remains of this pioneer fishing community (Figure 3C). The site is overgrown with exotic vegetation, mostly Australian pine. The wellhead pipe of an artesian spring that once supplied drinking water rotted out years ago. The dredged entrance channel still accommodates deep-draft boats that venture into the basin and seek shelter from northers during the winter season.

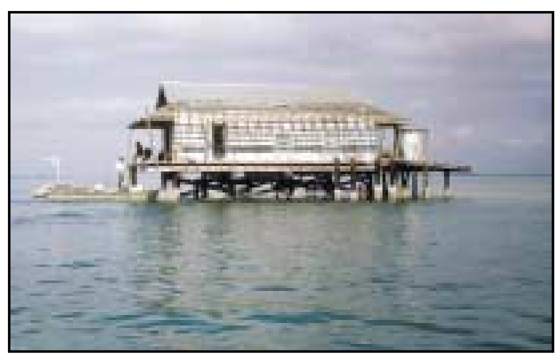


Figure 3B. Fish house at Punta Blanca, 1970.

Downtown Ft. Myers Waterfront

Downtown Ft. Myers waterfront today (Figure 4A) is a different world from how it appeared in 1887 (Figure 4B) when Capt. W. M. Black of the Army Engineers undertook the first hydrographic survey of the Caloosahatchee. Only one dock extended into the river from the southwest shore between the Edison home and Billy's Creek. In the 1880s, improvements by the federal government to the lower reach of the river, along with land drainage efforts by private interests in the upper Caloosahatchee valley that allowed growing citrus, provided the basis for downtown waterfront development. Ft. Myers evolved into a shipping hub for outbound produce and incoming agricultural supplies. Docks, such as the City Dock at the foot of Jackson Street and Ireland's Dock off Hendry Street, were elaborate structures extending far out to deep water in the river (Figure 4C). The

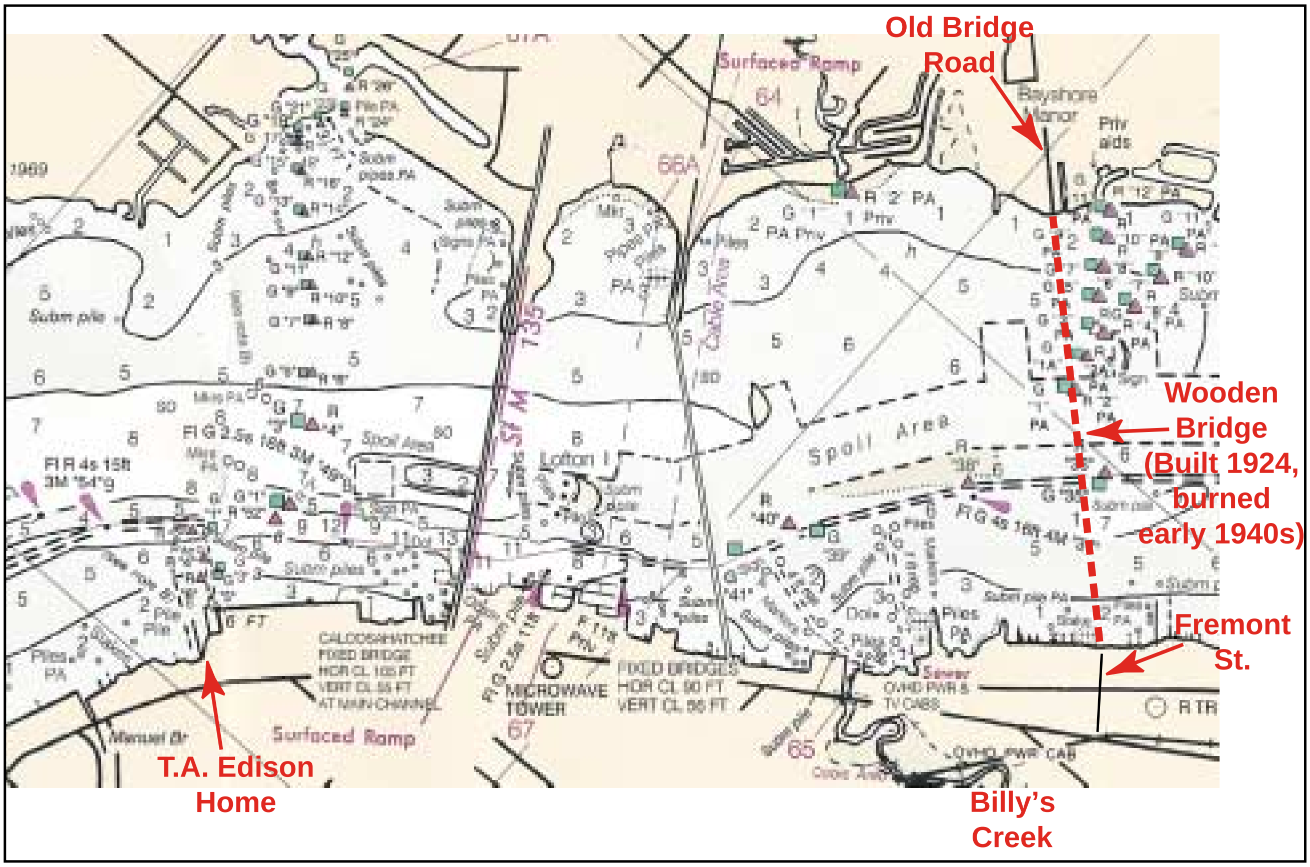


Figure 4A. Downtown Ft. Myers waterfront from nautical chart 11427, 1998.

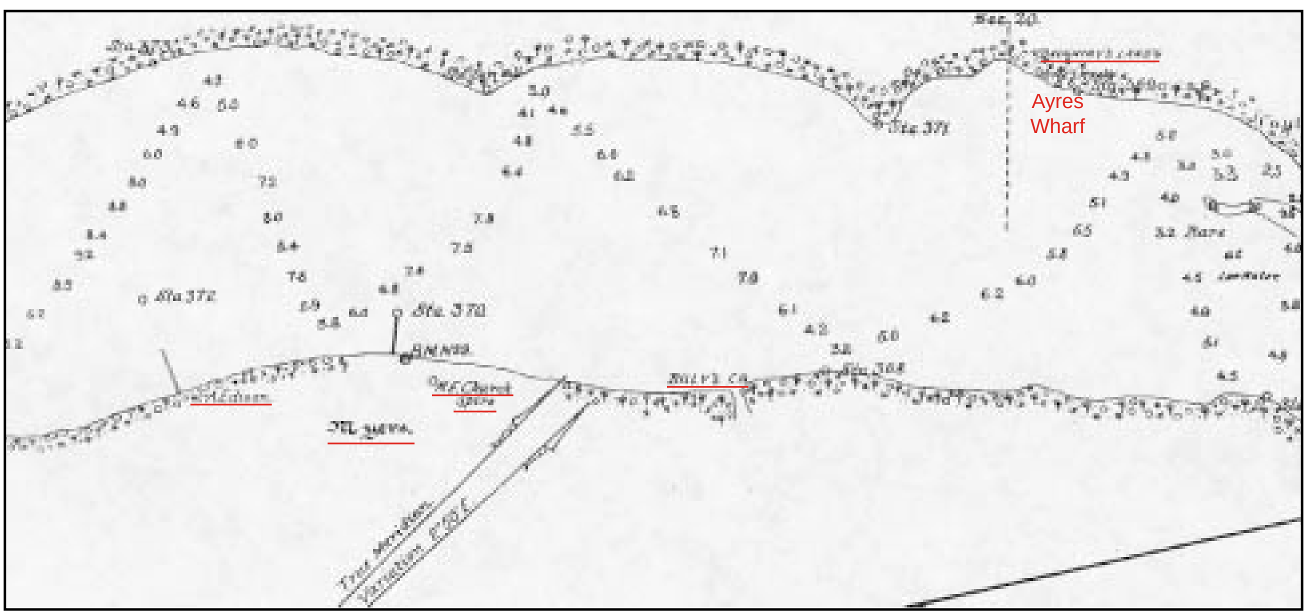


Figure 4B. Location of Ft. Myers (from U.S. Army Corps map of 1887).

Ice houses were located at strategic points around Charlotte Harbor, near the favorite fishing grounds and in water deep enough for the run boats from the fish companies. The run boat brought a load of ice and exchanged it for a load of fish. Fishers were able to quickly bring their catches to the ice house as soon as they were netted. The run boats also brought groceries and other supplies to the fishers and left them at the ice house to be picked up.

City Dock housed a variety of services, such as a fish market, Chinese laundry, machine shop and boatways. With the arrival of the railroad to Ft. Myers in 1904, rail spurs and packing houses on docks off Monroe Street accommodated produce shipped downriver (Figure 4D). A wooden bridge crossed the river in 1924, upstream from the modern bridges (Figure 4A); it was destroyed by fire in the 1940s.

The 1930s Works Progress Administration (WPA) Depression-era project built the $350,000 Yacht Basin, transforming the historic working waterfront, with its long docks and packing houses, into a recreational boating hub featuring a palm tree-lined park and promenade. A 1940s aerial photograph (Figure 4E) shows the early development of this new waterfront. Bay Street was the closest street parallel to the riverfront. Packing houses at the foot of Monroe Street still existed; a fire destroyed them in the early 1950s. The new Edison Bridge at Fowler Street is visible.

Wooded Lofton Island is in the upper left corner. J.F. Lofton dredged the earlier downtown boat basin (Figure 4F) and created a spoil bank (island), which he claimed by squatter's rights. A 1951 photo (Figure 4G) shows the home of J.L. Hunt on Lofton Island. (Lofton Island is now Pleasure Key.) Today's waterfront (Figure 4H), spanning the Caloosahatchee and Edison (southbound) bridges, includes Centennial Park and the Yacht Basin. More land was filled on the riverfront, and Edwards Drive was built to provide a scenic drive and access to the city's shoreline recreational facilities. The federally maintained Okeechobee Waterway flanks the waterfront and connects downtown Ft. Myers with the U.S. Eastern Seaboard and the Gulf of Mexico.

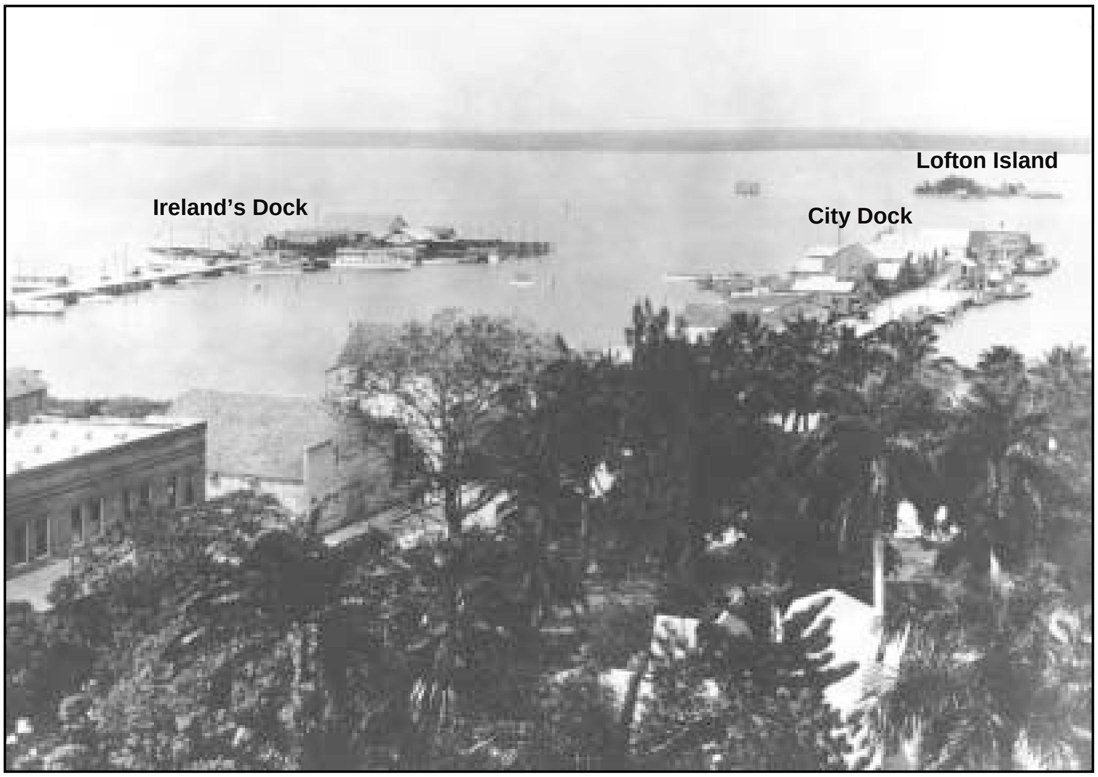


Figure 4C. Ireland's dock and city dock at Ft. Myers, 1914.

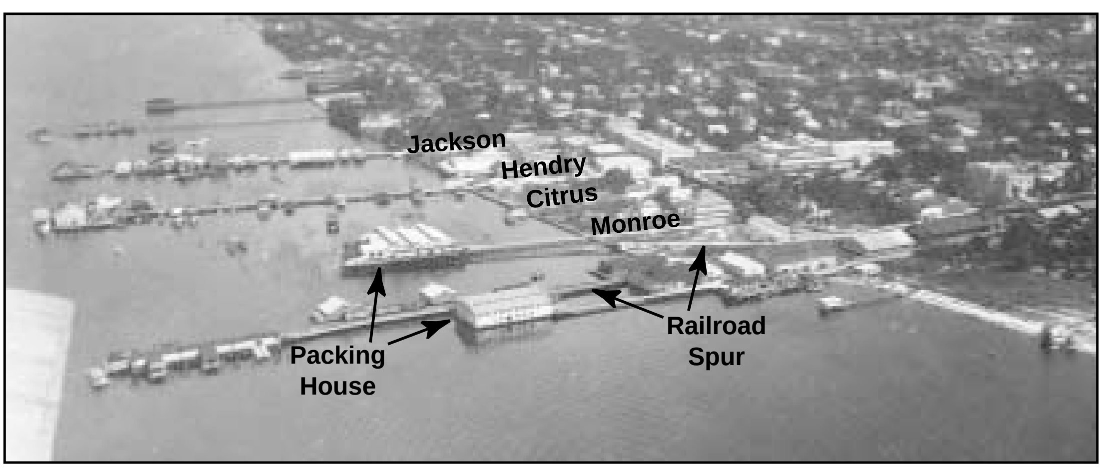


Figure 4D. Packing houses at Ft. Myers, 1929.

Figure 4E. Downtown Ft. Myers waterfront, 1940s.

Figure 4F. Downtown Ft. Myers waterfront, 1929.

Figure 4G. J. L. Hunt home on Lofton Island, 1951.

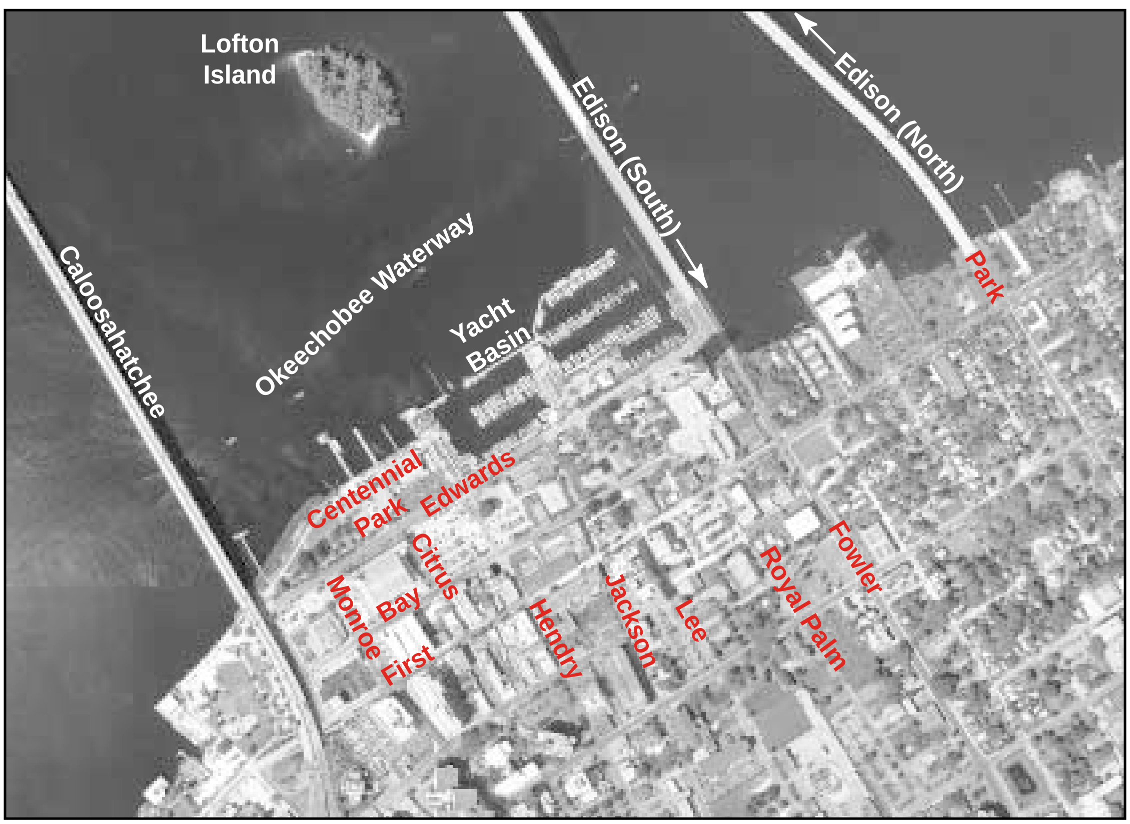


Figure 4H. Downtown Ft. Myers, 1998.

Yacht Club Colony

Aerial photographs show 1940s (Figure 5A) and 1998 (Figure 5B) conditions. Daughtrey Creek, a tributary of the Caloosahatchee, is a meandering stream with numerous distributary (interlocking) channels, which forms a delta as it approaches the river. The surrounding area in the 1940s was scrub and brushland vegetation used for extensive cattle grazing, with no visible habitation. The light-colored intersecting lines running north–south and east–west in Figure 5A are square-mile "sections" of townships (divisions of the U.S. Land Office Survey) and probably represent cleared, unpaved tracks. Figure 5B shows the multiple canal system, Yacht Club Colony, with some 200 residential parcels. The main entrance channel (a) has been dredged and linked to use Daughtrey Creek as the trunk artery (b) for a series of dredged finger canals (c). A second entrance channel (d) connects with a single finger canal (e) running north from the river. Most of the canals were dredged to 6 feet or less. However, those on either side of Cape Way (f) reach depths of 9 to 15 feet, likely to supply fill for building up the land surface to a higher elevation.

Figure 5A. Location of Yacht Club Colony, 1940s.

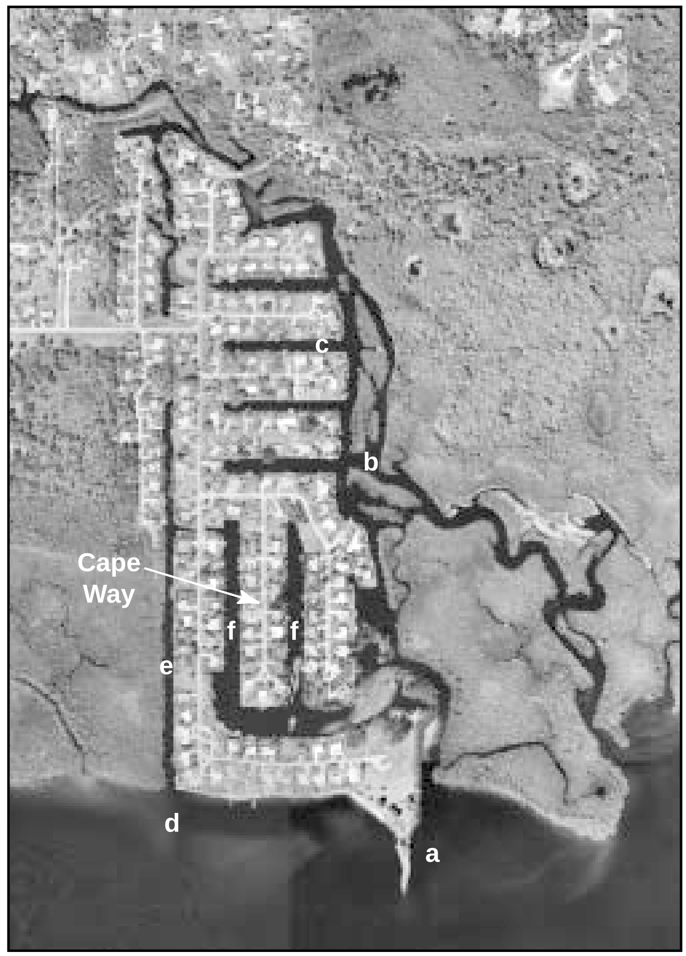


Figure 5B. Yacht Club Colony, 1998.

Figure 6A. San Carlos Island and Ft. Myers Beach, 1940s.

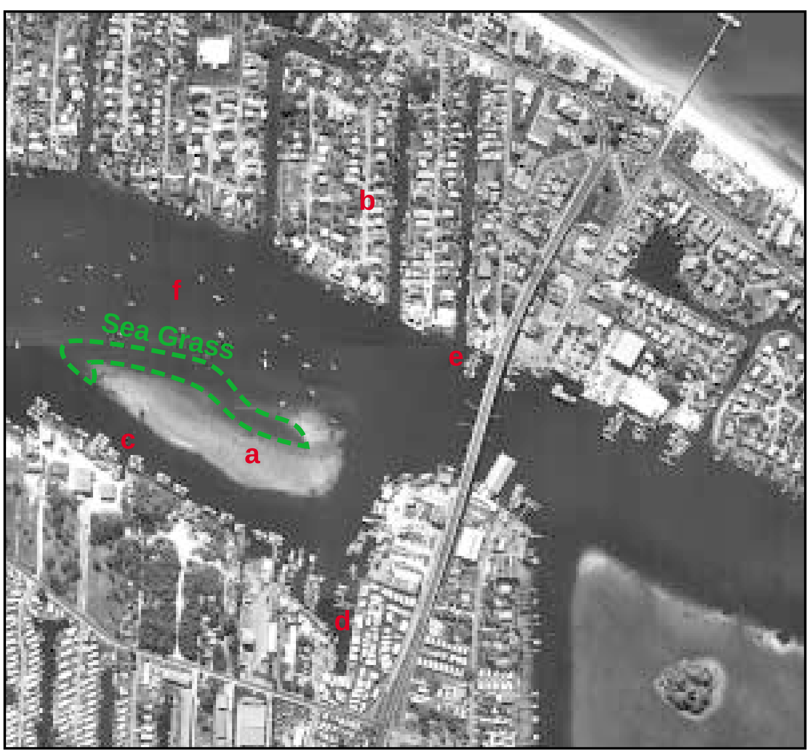


Figure 6B. Ft. Myers Beach, 1992.

San Carlos Island and Ft. Myers Beach

The low, oblique aerial photograph taken in 1940 (Figure 6A) shows Matanzas Harbor before arrival of the large-scale shrimp trawler fleet operations at San Carlos Island. Note the net spreads drying on platforms built on the mud flat (a). Much of the traditional bay fishing of this era was for mullet, with fishers using small skiffs either poled or powered with outboard engines. Also, note the many vacant lots lining the finger canals on Ft. Myers Beach (b). The 1992 photograph shows some remarkable changes (Figure 6B). There are many docks, two or more boats rafted alongside each other, lining the San Carlos shoreline (c). This is the shrimp trawler fleet. There is an absence of any structures on the mud flat (a). Most of the Ft. Myers Beach finger canal lots have homes (b). A number of full-service marinas (d) and waterfront restaurants with transient docks (e) cater to recreational boaters. The harbor also serves as an anchorage (f) for transiting boaters, accommodating upwards of 100 boats during the winter season. (The town of Ft. Myers Beach is in the process of developing an anchorage management plan).

The Moorings, Doctors Bay

Pre–development (1958) conditions included Doctors Pass, a small natural tidal inlet subject to migration and closure, which fed relatively open water back-bays fringed by mangroves and connected to Clam Bay to the north. Collier County, in 1958, constructed Seagate Drive (Figure 7A, a) and effectively severed tidal flow between Doctors and Clam Passes; culverts built in 1976 to reconnect the back-bays have done little to improve flushing. Beginning in 1959, Moorings Development Company of Canada began large-scale improvements, including removal of the mangrove fringe, deep dredging of the bay to create spoil for land fill, construction of seawalls along the entire perimeter of the bay, and straightening, jettying, and dredging Doctors Pass. Figure 7B shows the extent of this comprehensive development, which dramatically altered the natural system, in the 1970s.

The jetties (b) at Doctors Pass interrupt south-flowing longshore transport of beach sand, which contributes to deposition along the north jetty and creation of an offshore shoal, a hazard to navigation. Maintenance dredging periodically alleviates this problem. The beach south of the jetties is starved of beach sand, which has led to the placement of a groin field (c) to catch and retain drifting sand.

Single-family residences (d) line the east side of Doctors Bay, while the west side accommodates multi-family residences and high-rise residential condominiums. The population fluctuates seasonally.

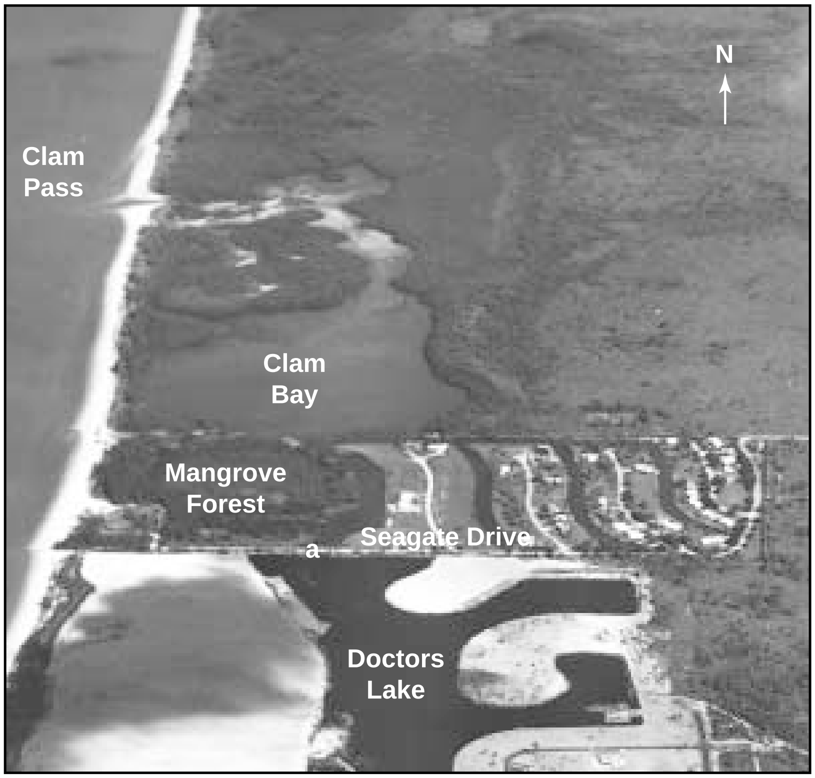


Figure 7A. Seagate Drive, Naples, 1958.

Figure 7B. Doctors Bay, Naples, 1970s.

Port Royal, Aqualane Shores, and Royal Harbor, Naples

The 1930 hydrographic chart (Figure 8A) shows mangrove and swamp covering much of today's exclusive finger-canal residential areas that border Naples Bay. But, even then, a canal (red-line) had been dredged in Aqualane Shores. Though some development occurred just before World War II in the Port Royal subdivision, the 1950s signaled massive finger-islanding in Aqualane Shores, Royal Harbor, and Port Royal (Figure 8B). Figure 8C shows dredging operations during 1950 at Aqualane Shores. Note the suction dredge (a) transferring slurry by pipeline (b) to upland sites (c). The pre-1930 canal, shown in Figure 8A, is at (d). By 1969, all of the canals had been dredged and seawalled, and much of the building was well under way in this region of exclusive, single-family residences (Figure 8D).

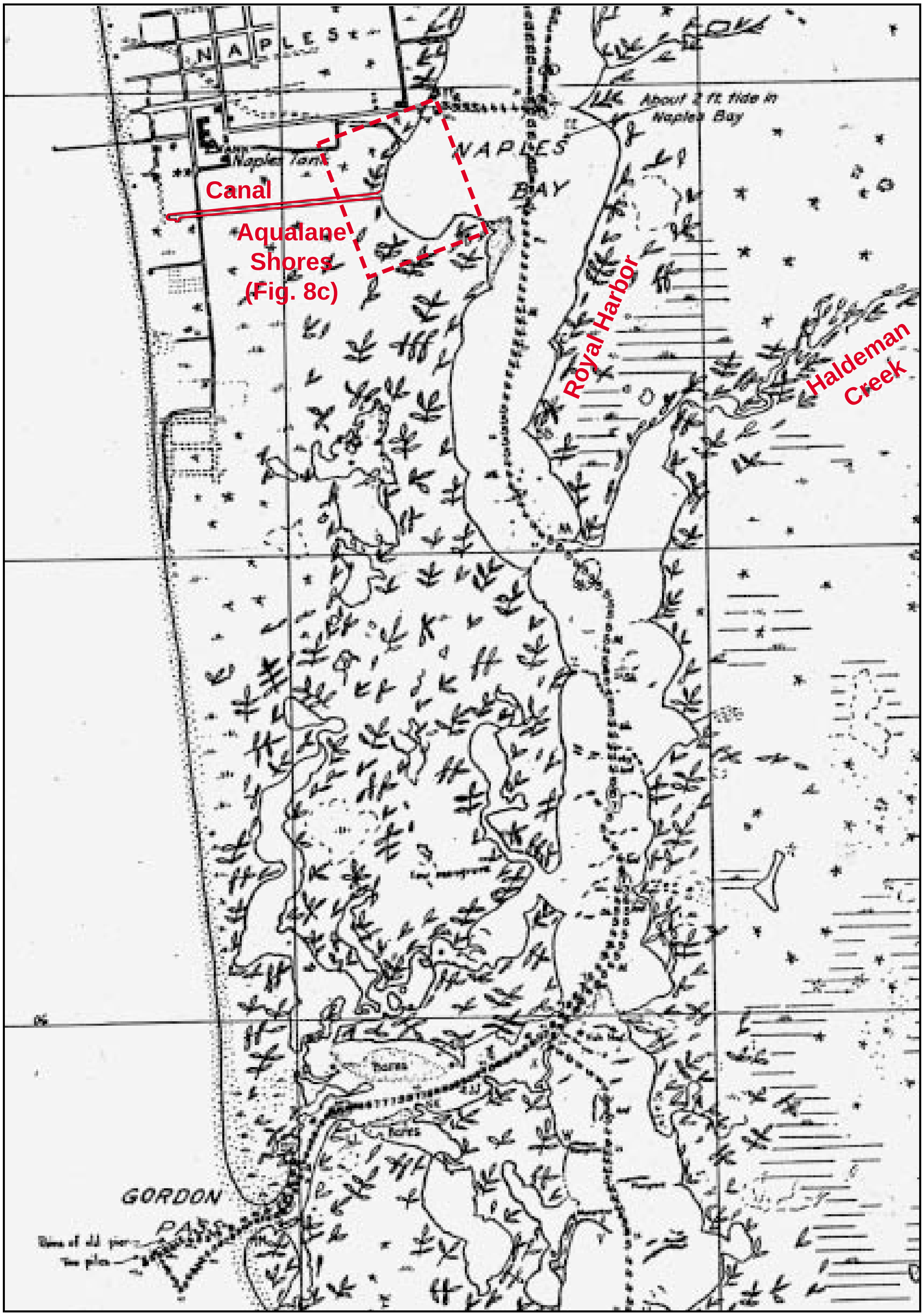


Figure 8A. Naples Bay, 1930, (from H-sheet 5067).

Figure 8B. Naples, 1959-60: Port Royal and Royal Harbor.

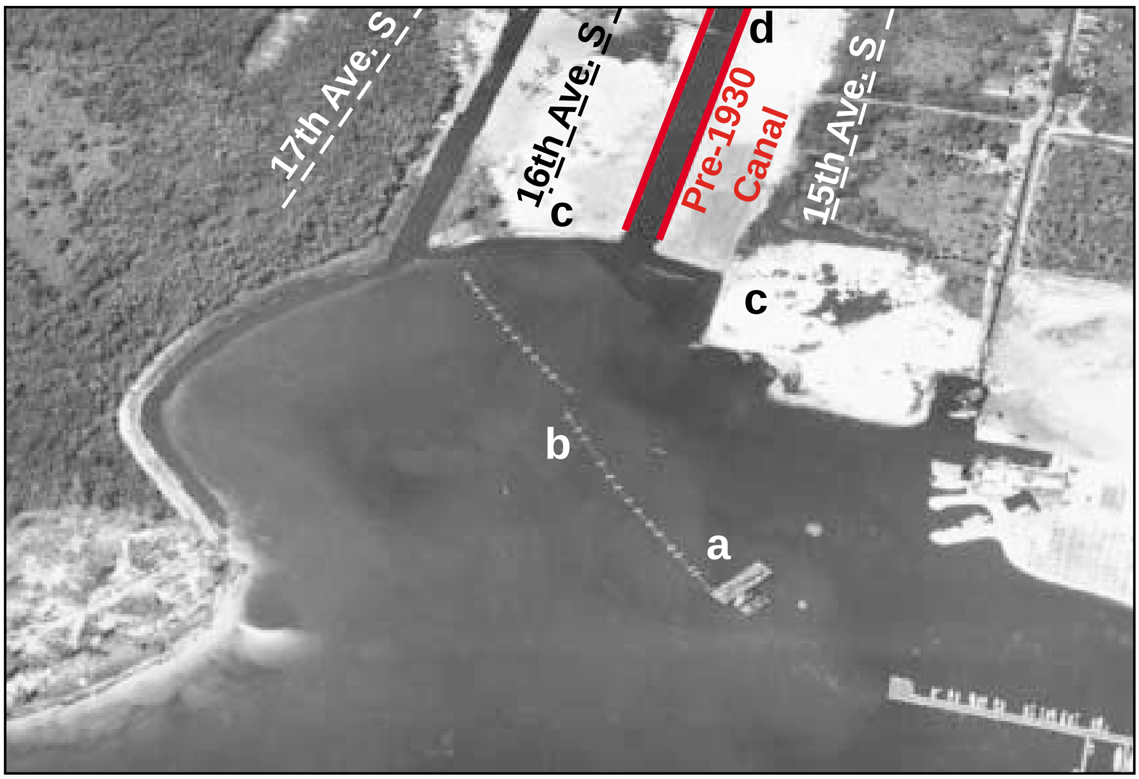


Figure 8C. Dredging at Aqualane Shores, 1950.

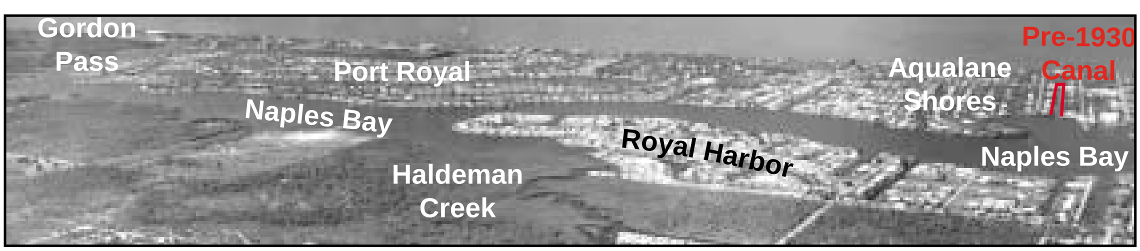


Figure 8D. Port Royal, Royal Harbor, and Aqualane Shores, 1969.

Waterway at Shell Bay and John's Pass

The hydrographic chart of 1930 (Figure 9A) and a 1952 aerial photograph (Figure 9B) show both naturally occurring and human-induced changes in waterway conditions. John's Pass (a), a "wild," wave-dominated inlet, shows a north-trending recurved spit with barely open channel conditions on the 1930 chart. This inlet had a history of openings and closures. By 1952, the inlet had closed; it is believed to have opened briefly with the passage of Hurricane Donna in 1960, but closed shortly thereafter.

The Naples–Marco waterway (Figure 9A, b) was in a natural condition when the Coast Survey mapped the area in 1930. Numerous oyster bars impeded boat traffic. Local interests made some improvements in the 1930s, but the federal government assumed responsibility in 1940 and systematically dredged the waterway. The dredged material, or spoil (Figure 9B, c), was placed side-cast and parallel to the channel, on the fringing mangroves, creating a linear northwest-southeast trending series of conical hillocks, where upland exotic vegetation is now the predominant cover.

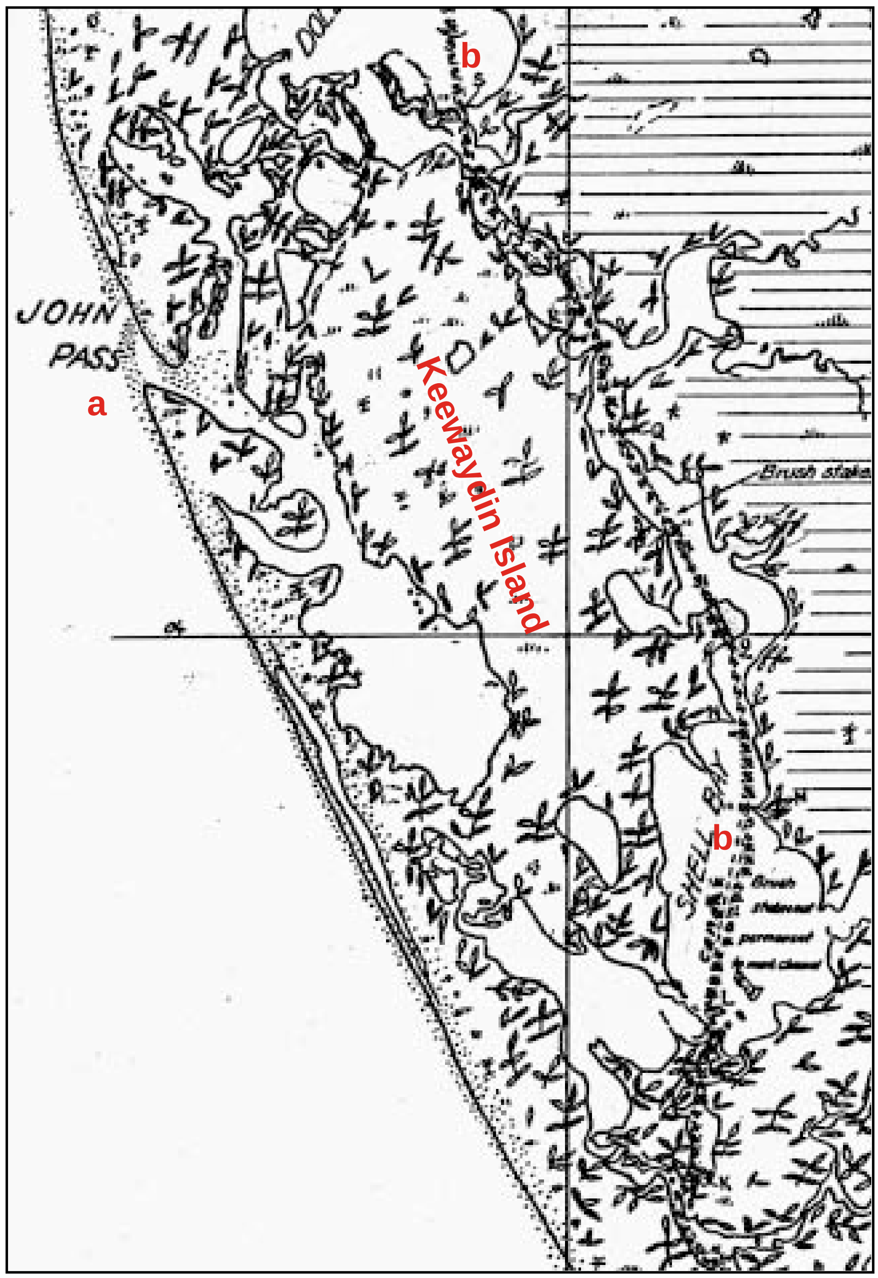


Figure 9A. Shell Bay and John's Pass, 1930, (from H-Sheet 5067).

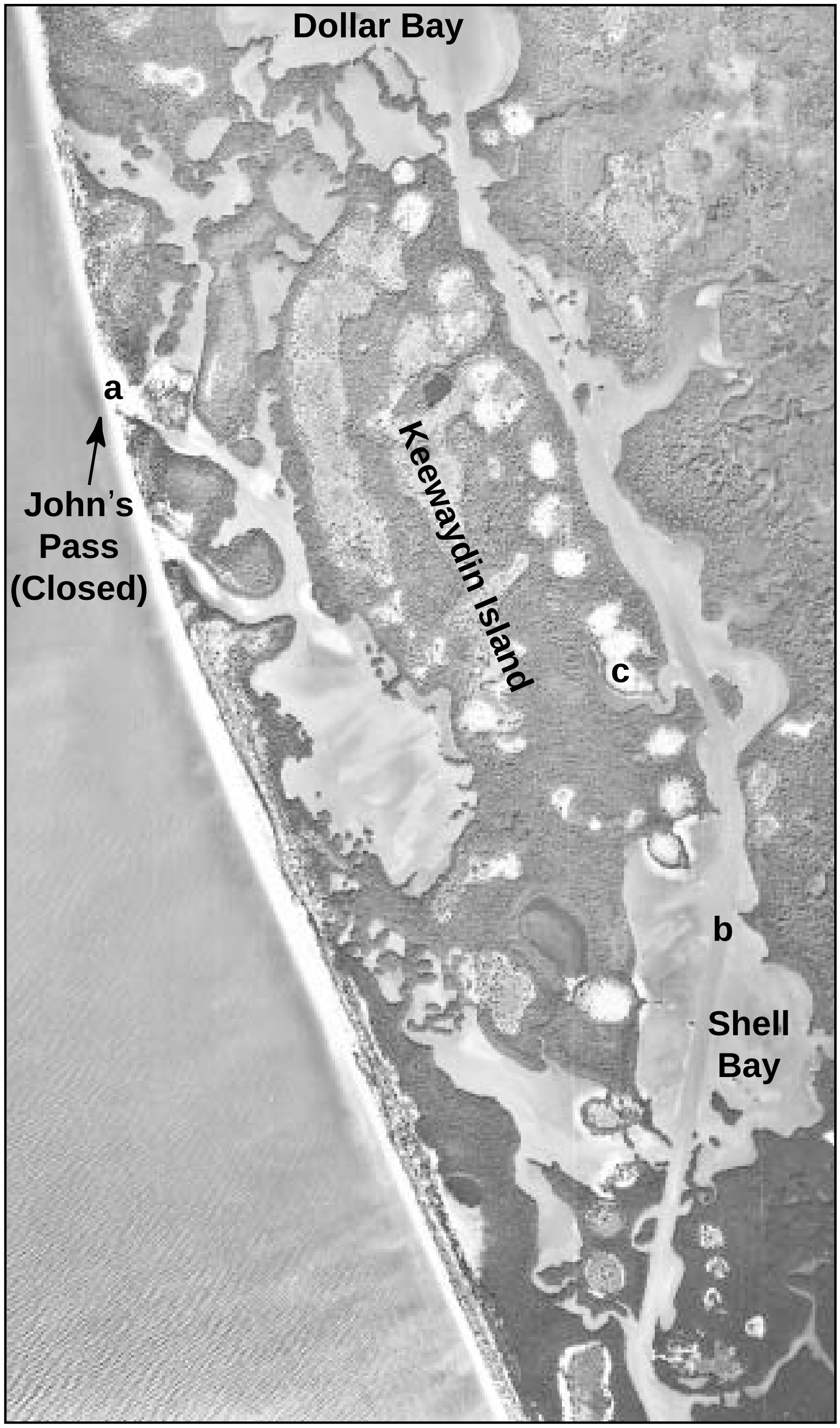


Figure 9B. Shell Bay and John's Pass, 1940s.

Smokehouse Bay

Smokehouse Bay is a back-bay of Collier Bay, which is located west of Marco Village and connects with the mouth of the Marco River at Big Marco Pass. Smokehouse Bay in the pre–development period encompassed an extensive intertidal area, which was a prime breeding ground for mosquitoes (Figure 10A). An initial step in dredge-and-fill operations was to build a dike around the construction site and seal it off from tidal fluctuations, thus eliminating a critical larval breeding requirement. An aerial photograph taken in October 1976 (Figure 10B) shows dikes at (a). A suction dredge is operating at (b). Figure 10C shows the dredge (b) and pipeline (c), which was operating near the intersection of North Collier Boulevard and Tigertail Court. Slurry, dredged from Smokehouse Bay, is being deposited at upland sites (Figure 10B, d). The final dredge-and-fill construction stage included filling a land-bridge at Giralda Court (e) and removing the dike at the distal end of Tigertail Court (Figure 10D, f). Figure 10D shows waterway conditions upon completion of dredging and home construction.

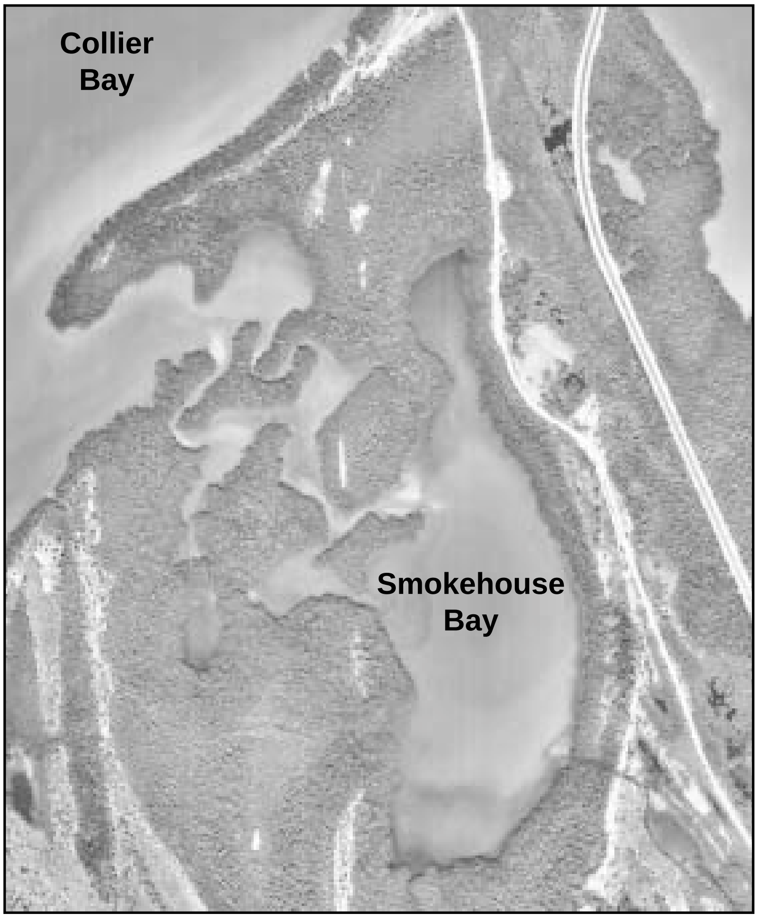


Figure 10A. Smokehouse Bay, 1952.

Figure 10B. Smokehouse Bay, 1976.

Figure 10C. Dredging in Smokehouse Bay, 1976.

Figure 10D. Smokehouse Bay, 1992.

Clam Bay

Prior to development, a tidal creek (Figure 11A, a), often not more than mid-thigh deep, connected Clam Bay to the Gulf of Mexico. Mangrove forest (b) surrounded Clam Bay. The natural drainage system to the Gulf, which periodically closed was augmented in the canal development process with two new water connections (Figure 11B), through Smokehouse Bay (c) and Collier Bay (d), both of which drain into the Marco River. The 1976 aerial photograph (Figure 11C) shows an intermediate stage in the development process, with Clam Bay sealed off from tidal exchange and seawalls (e) constructed around the perimeter. The upland behind the seawalls would be gradually filled in: Kendall south of Hernando is filled with recent spoil (white on photo), whereas Kendall north of Century still retains some of the mangrove fringe. In its final development stage (Figure 11D), Clam Bay is completely lined with sea walls and surrounded by single- and multi-family residences.

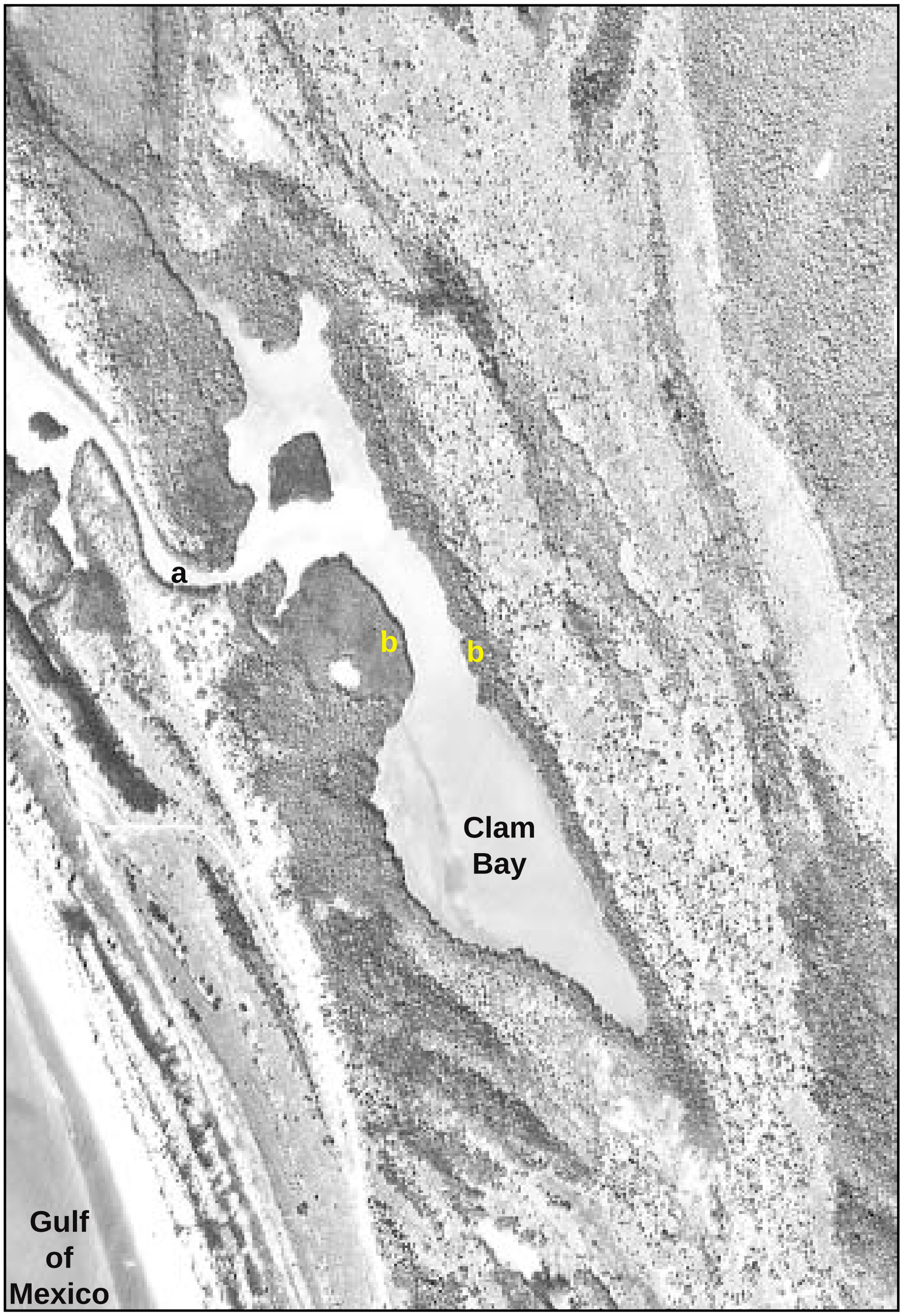


Figure 11A. Clam Bay, 1952.

Figure 11B. Clam Bay drainage, 1992.

Figure 11C. Clam Bay, 1976.

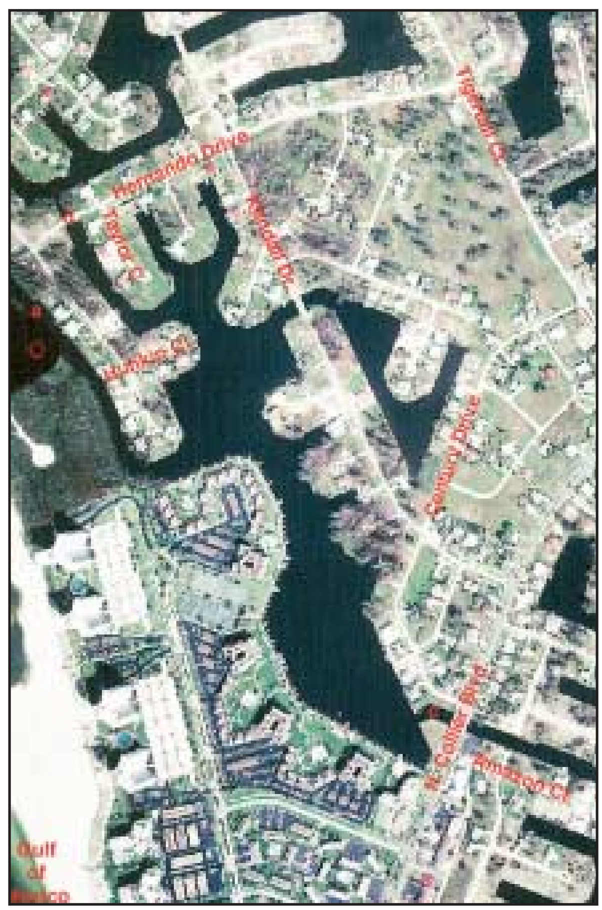


Figure 11D. Clam Bay, 1992.

Land Use and Land Cover Changes Along the Shoreline

Late 19th century mariners sailing along Southwest Florida's shore encountered few settlements. Population was sparse on the barrier islands, the eastern shore of Charlotte Harbor, Estero Bay, and Naples Bay and in the Caloosahatchee valley. Prior to the arrival of the railroad in Punta Gorda (1886) and the Big Freeze of 1892, only a few dozen persons lived on the islands and along the shore in this region.

Range cattle roamed freely over wide areas from the Myakka River south. During the Civil War, Southwest Florida was a prime source of beef for the Confederate army. Afterwards, and until about 1878, the primary market was Cuba. Cattle were shipped from Punta Gorda and Punta Rassa.

During the pre–development period, bay and Gulf fishing was in the hands of Cubans who often employed Native Americans as deckhands and established seasonal fish camps on islands all along this stretch of the Gulf coast: Lacosta, Mondongo, Pelau, Punta Blanca, Useppa, Captiva, Sanibel, Estero, Mound, Black, Little Hickory, and Marco. Cuban fishermen dried and salted mullet for the Cuban market, living in "ranchos" or palmetto-thatched houses. These fishing stations existed for more than three centuries, beginning in the late 1600s. The arrival of the railroad at Punta Gorda in 1886 and establishment of an ice factory there in 1893 opened up the domestic United States fresh fish market to local fishermen. More than 20 icehouses, from Charlotte Harbor to Estero Bay, were built to hold the day's fresh catch, which was collected by run boats and transported to Punta Gorda for shipment north. The local fisher-folk culture gradually changed as Cubans either assimilated into local Florida families or returned permanently to Cuba.

Production of naval stores and logging were other important local industries that followed the railroads into the region. Turpentine camps, or "stills," operated from remote locations, oftentimes using forced, convict laborers.

The 1890s witnessed the rapid introduction of the citrus industry as north Florida growers reestablished groves in the region below the frost-free line, producing citrus in the Caloosahatchee valley, along the shores of Estero Bay and Naples Bay, and on Marco Island. Before railroads, getting products to market and providing settlers with supplies meant reliance on inland water transport. Steamers and sailing schooners hauled fruit and vegetables north to Punta Gorda and returned south with grain and other supplies.

The arrival of the railroad in 1904 at Ft. Myers caused a boom in the local economy. Ft. Myers became the distribution and commercial center for Southwest Florida. The railroad offered northern tourists unrestricted access to winter vacation locales. Guest homes and hotels were established in the major towns. By the turn of the century, Punta Gorda and Ft. Myers each had between 1,200 and 1,500 inhabitants. The sparsely settled conditions and extensive land use during this pre–development period are reflected in Map 1–A, C, E, G, and I.

There is a striking difference between the pre–development waterfront use of the 1858-1944 period and that of the bayside and barrier islands in the 1990s (Map 1–B, D, F, H, and J). Table 1 summarizes the major changes in land use and land cover bordering this 253-square-mile shoreline area from pre–development to modern eras. The most dramatic change visible on Map 1A-J is the phenomenal urban development: the 1-square-mile aggregate urban area of the 1890s grew to 81 square miles by the 1990s, an 8,100-percent increase. Another discernible change during this period is the decline in vegetated uplands (forest, shrub, and brushland), a 76-percent decrease from 46 to 28 square miles.

Land use and land cover bordering the Southwest Florida shoreline: Pre–development era and 1990s.

Land Use and Land Cover	Pre-development+		Contemporary		Change
	(miles)*	(percent)	(miles)**	(percent)	(percent)
Wetland and Mangroves	129	51	135	53	+4
Vegetated Upland	117	46	28	11	-76
Agriculture	2	1	6	2	+200
Barren	4	2	3	1	-25
Urban	1	0	81	32	+8100
Total	253	100	253	99	

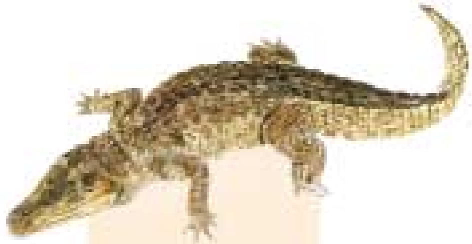
Table 1.

Sources:

* U.S. Coast and Geodetic Survey, T-Sheets No. 693, 738, 739, 853, 854, 855, 856, 1048, 1554a, 1554b, 2122, 2123, 2126, 4289, H/T-Sheets No. 5067, 5072, and 1944 aerial photography covering Estero Bay.

** South Florida Water Management District and Southwest Florida Water District, 1995.

\+ Pre–development Time Span: Charlotte Harbor (including Gasparilla Sound, Pine Island Sound, Matlacha Pass and San Carlos Bay):1858-1867, Caloosahatchee:1882-1883, Estero Bay: 1944, Naples-Marco: 1930.



Southwest Florida once shared a heritage of natural resources as bountiful and awe-inspiring as any region of America. Its heritage reflects the geological history, geographic location and biological evolution of the United States' only humid and sub-tropical peninsula. Coastal waters abounded with fish, rumored to impede the progress of sailing ships and rowboats. Birds were so numerous as to eclipse the sun when their flocks took wing. Naval stores of pine, cypress and oak seemed without limit. Not that the region was a benign Eden. Mosquitoes swarmed after sudden rains in numbers sufficient to kill livestock. Wild cats, venomous snakes, alligators, bears, sharks and other wildlife were elements of everyday life for explorers and settlers.

Clam factory of Marco Island, circa 1910.

Grande Bayou, Boca Grande in the early 1900s.

The Caloosahatchee before development.

1. **Placida** is the Spanish word for "placid," an apt term to describe Placida Harbor, located at the mouth of Coral Creek and at the north end of Gasparilla Sound, with access to the Gulf through Gasparilla Pass. The town originated with a bunkhouse of the Charlotte Harbor & Northern Railroad — locals called it the "Cold, Hungry and Naked" line — later supplemented by relocation of the Gasparilla fishing village. It has been a major commercial fishing center for decades. Today, with the impact of the commercial fishing gill net ban in 1995, most of the fishing activities in the area have been curtailed and many of the stores closed, although some shops and a restaurant are still in operation.

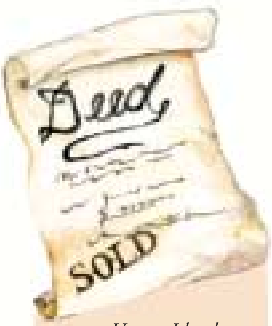
2. **Cayo Pelau** is a 140-acre island west of Bull Bay and fronting Charlotte Harbor. The island's settlement dates to the Calusa Indian period. It was occupied by Cuban fishermen during the 19th century. An 1832 expedition describes a Spanish-speaking (Cuban) settlement "…from 60 to 70 inhabitants who keep an abundance of hogs, dogs innumerable." The term "Pelau" is West Indian Spanish jargon for "bald spot," aptly describing the center of the island's wet–dry marsh, surrounded by gumbo limbo and mangrove trees.

3. **Gasparilla Island** is bounded on the north by Gasparilla Pass, on the east by Gasparilla Sound, on the south by Boca Grande (Pass) and on the west by the Gulf of Mexico. The island was sparsely settled by fishing families until the late 19th century. The federal government in 1848 established a military reservation at Boca Grande, including both the southern end of Gasparilla Island and the northern end of Lacosta Island. A lighthouse was built and placed in operation in 1890.

Construction began on a port facility and railroad spur to receive and ship phosphate ore mined in the Peace River Valley in 1905. The railroad provided access to the outside world. Fish houses were established along the rail line, which brought in ice from the mainland (Punta Gorda) and shipped out fresh fish. The fish house at the north end of the island developed into Gasparilla Village. The railroad also attracted land investors. The Gasparilla Inn opened in 1911 as a resort hotel, and Boca Grande was on its way to become an upscale community catering to affluent winter visitors and sports fishermen. Homes on Gilchrist and Park Avenues date back to this early development period. Storm-induced beach recession in the 1920s required the railroad to be shifted eastward. Fill dredged from the bay bottom along the east shore created Loomis Key. Boaters now use the dredged channel when transiting north from Grande Bayou to Gasparilla Sound. The Boca Grande Causeway, providing road connection to Placida, was built in 1958. In the late 1970s, the Port Boca Grande docks and storage facilities were found in need of extensive repairs and were abandoned in favor of shipping ore from the Peace River mines directly by rail to Tampa. The Boca Grande rail spur right of way became a bicycle path, and Port Boca Grande became an oil storage depot.

The lighthouse was retired from service in 1966 when automated channel navigation lights were installed. The old lighthouse became a site on the National Register of Historic Places in 1980. The U.S. Coast Guard recommissioned the light in 1986, and the Florida Department of Environmental Protection manages the park facilities. The lighthouse is now the location of a historical museum.

Map 1-A.
Pre–development conditions along the barrier islands.



Useppa Island was the first land purchased in Southwest Florida by New York advertising millionaire Barron Collier. Later, he was to purchase more Florida land than any other one person, including much of Lee County.

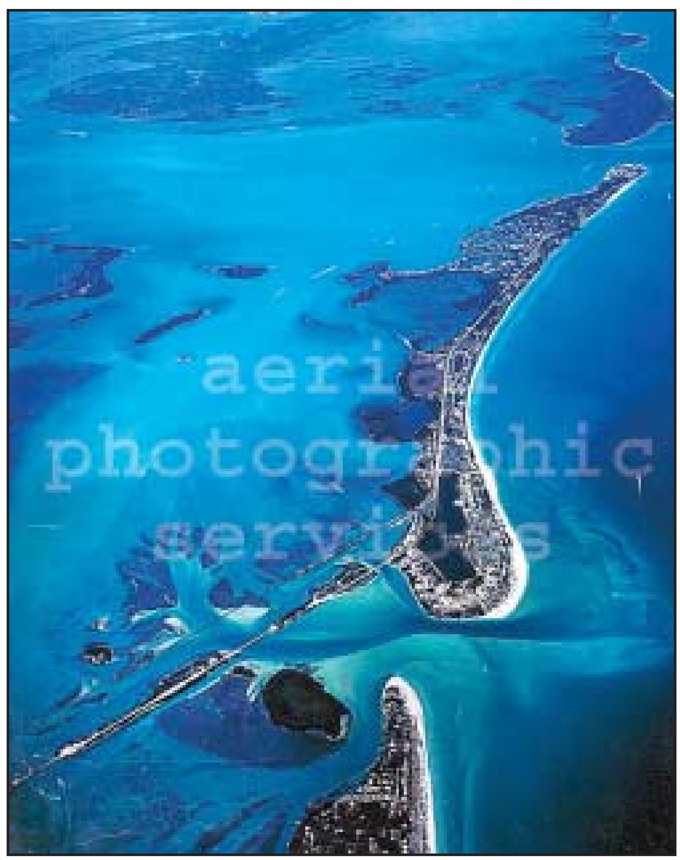
4. **Lacosta Island (Cayo Costa)** is a barrier island situated south of Boca Grande and north of Captiva Pass. The number of Indian shell mounds on the island indicate human habitation dates far back in the pre-Discovery period. The island was used periodically by Cubans during the 19th century as a base for fishing in Charlotte Harbor and nearby Gulf waters. In 1880, the original (1848) land parcel acquired as a military reservation by the federal government (see Gasparilla Island note above) was modified, and a limited area along the Boca Grande shore was set aside for military purposes, a pilot station, and a marine hospital. The federal government relinquished control of this property in 1938. Lacosta Island retained a quasi-clandestine reputation, even when ostensibly under federal control. It was a base for smuggling operations, especially rum from Cuba during the Prohibition, and is reported to have had a house of ill fame frequented by fishermen and sailors from the many Cuban fishing smacks that frequented the harbor at the turn of the century.

The feral hogs on the island were vestige of the island's past and accounted for the numerous trails through the impenetrable cabbage-palm forest. A number of residences remain on the island: some are in an abandoned state, others are maintained as fishing retreats. Lee County, in 1959, established a park on the northern 640 acre parcel. This park was turned over to the Florida Department of Environmental Protection in the early 1980s.

5. **Useppa Island** was settled by the ancestors of Calusa Indians thousands of years ago. Fort Casey was established here during the Seminole Wars, but was short-lived. A fishing community, called "Guiseppe," later developed on the island. During the Civil War, a Union naval station garrisoned here to protect refugees and curtail the smuggling of provisions to the Confederacy. Useppa's modern post-19th century history stems from its purchase by John Roach, president of the Chicago Street Railway Company, who built a home and small hotel, the Useppa Inn, where he entertained friends and business associates Henry Ford and Thomas Edison by fishing for tarpon during the winter months. Barron Collier bought the property in 1911 for his Florida residence. Today, the former Collier Mansion is the site of the Useppa Island Club and the island has been developed into an exclusive residential community.

6. **Cabbage Key** This island in Pine Island Sound, just west of Useppa, is 100 acres upon which is a resort, marina and restaurant. The resort is built atop a 38-foot-high Native American shell mound. The island is easy to locate because of the tall water tower, which provides visitors and guests a panoramic view of the bays and Gulf of Mexico. The resort was once the home of novelist Mary Roberts Rinehart. Contemporary novelist Randy Wayne White describes Cabbage Key as having "an oasis feel to it, sitting out there all by itself, like it could have been Abaco or Tangiers or Caicos, soaking up the sun through the decades while travelers tromped up the shell path to the old house on the mound."

Useppa Island, looking south towards the barrier islands.



Gasparilla Pass with causeway to Placida in foreground, looking south, down Gasparilla Island to Boca Grande, Lacosta Island (Cayo Costa) at upper right and Pine Island at upper left.

South Pine Island, looking northeast, St. James City in foreground.

Safety Harbor on North Captiva Island, looking south, towards Redfish Pass in midground.

Gaspar the Pirate: Fact or Fiction?

Legend and myth surround the name and a claim that a supposed pirate "Jose Gaspar" maintained a lair in these waters during the 18th and early 19th centuries. Some say the myths were invented about 1900 by a fishing guide, Juan Gomez, to entertain customers. Historians suspect the name refers to a 'Friar Gaspar.' Boca Gasparilla (Inlet) appears on a late 18th century chart of the region.

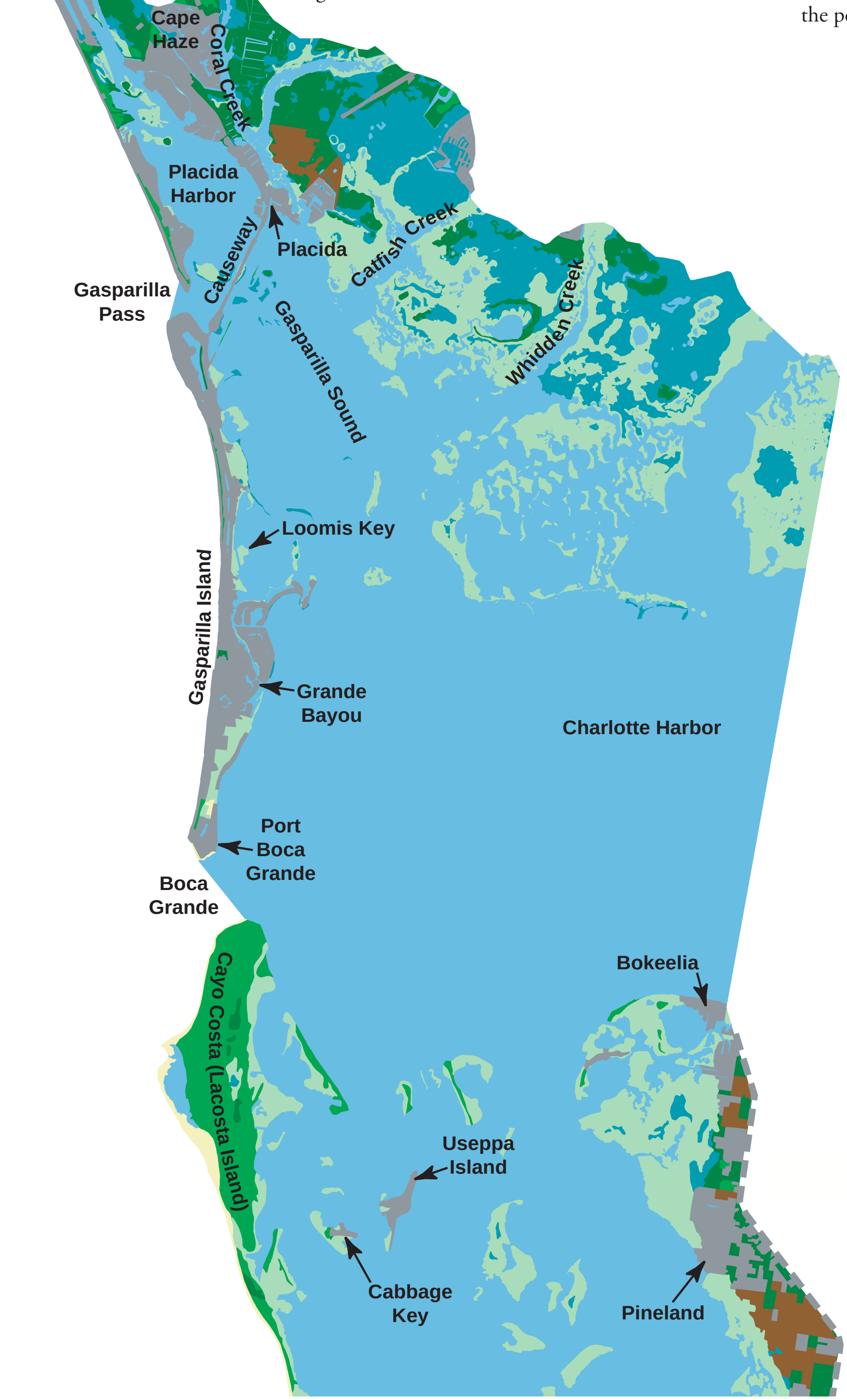
7. **Pine Island** consists of three settlements. At the north tip of the island is Bokeelia, on the south shore of Charlotte Harbor; Pineland is to the south on the east shore of Pine Island Sound; and St. James City at the southern tip of the island abuts San Carlos Bay. Pineland is home to the Randell Research Center — devoted to learning and teaching the archaeology, history, and ecology of Southwest Florida — owes this distinction in part to Calusa Indian shell mounds or middens (ancient Indian garbage dumps) located along the island's shore overlooking Pine Island Sound. There are remnants of an aboriginal canoe canal, dug by the Calusa or their ancestors, probably 500 to 1,000 years ago. The "haul-over" canal had its western terminus at Pineland and extended eastward to Matlacha Pass, ending at Indian Field. In 1912, when Army Engineers visited the region, Pineland town consisted of a post office and three or four houses, but no streets or roads. The early 20th century settlement developed from turpentine stills and sawmills on north Pine Island. Today, all three communities provide recreational, sport fishing, eco-tourism, agricultural, and residential services.

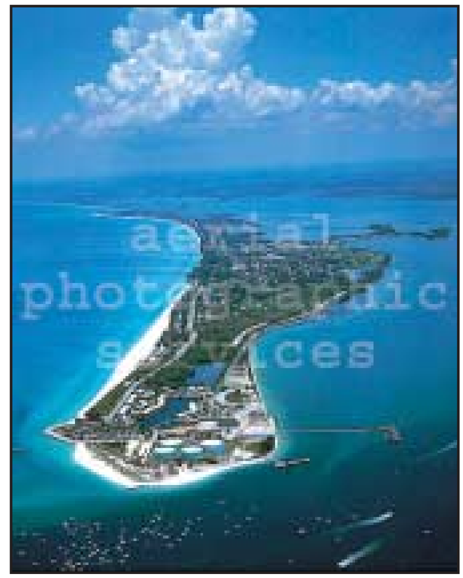
8. **North Captiva and Captiva Islands** were one island prior to the 1921 hurricane and the creation of Redfish Pass. Major storms in the 1920s, '30s, and '40s overtopped the low, narrow southern end of North Captiva. Safety Harbor, the small embayment inside Captiva Pass, was a fish camp during the pre–development period. A surge of vacation-home construction, beginning in the 1960s, along with finger-canal construction, has occurred on North Captiva Island. The State of Florida in 1975 acquired about half of the island, which has been designated a Barrier Island Preserve. South Seas, a destination marina and golfing resort, is at the north end of Captiva Island. The town of Captiva is at the center, adjacent to Roosevelt Channel, a present-day popular anchorage and relict inlet channel to Blind Pass. It is hard to imagine that the town claimed only 45 inhabitants just prior to World War II.

9. **Sanibel Island,** "…the piece of coast that trends E and W, is the beach of an island called Sanybel, this place is further remarkable for a great number of pine-trees without tops standing at the bottom of the bay (San Carlos Bay), there is no place like to it, in the whole extent of this coast" (from the sailing directions for the Dry Tortugas to Pensacola, Bernard Romans, 1775). An attempt at establishing an agricultural colony failed in the early 19th century. The first wave of settlement occurred in the late 1880s, when the federal government opened the island to homesteading. Sanibel's lighthouse at Point Ybel began operations in 1884. Much of Sanibel's early development era is linked to farming and fishing. Blind Pass was bridged in 1918.

The island's fame developed as a world-class paradise for shelling and wildlife observation during the early 20th century. Writers and artists came for the isolation and quiet beauty. In 1939, Sanibel's population was 100, and Wulfert had 10 residents. A concrete structure replaced the Blind Pass Bridge in 1954. (The pass closed in the early 1990s). But it was the Sanibel Causeway, built in 1963, that provided direct road access to the mainland and opened the island to a development boom. A substantial, 4,975-acre, undeveloped area, mainly along the northern Pine Island Sound side, has been retained as the J. N. "Ding" Darling National Wildlife Refuge.

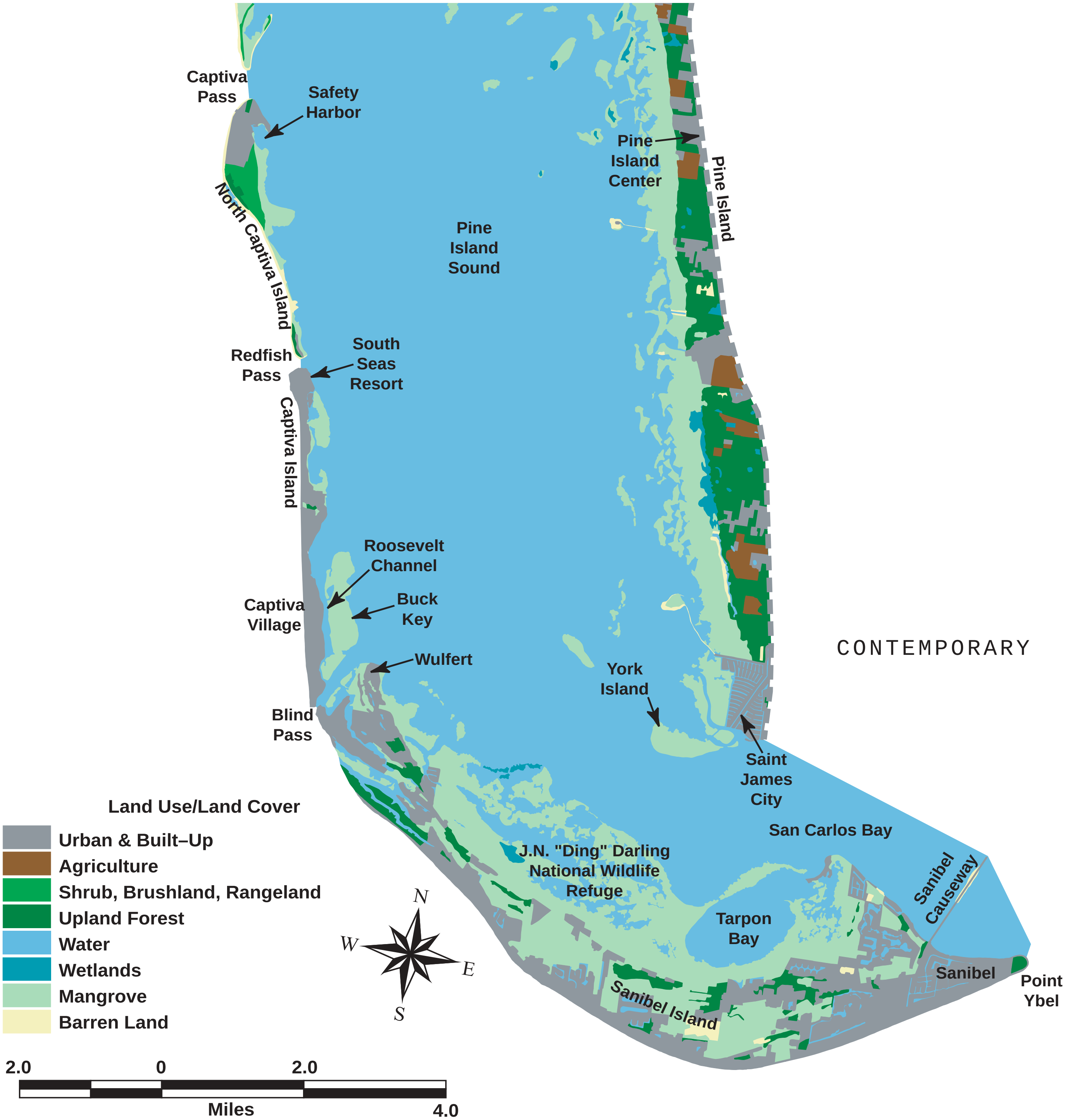
Today, Sanibel has an annual population of more than 5,800 people which swells to more than 20,000 during the peak tourism season.

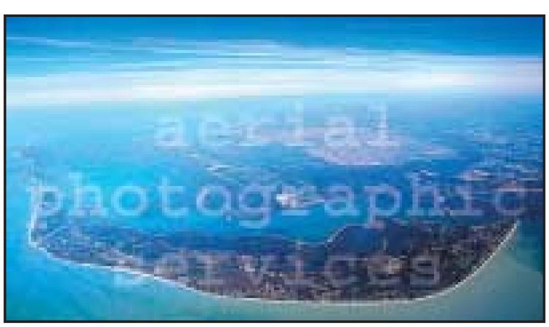




Boca Grande Pass during tarpon season with boats fishing along edge of channel with 50 foot depth range, view north with Gasparilla Sound on right.

North Captiva Island in foreground, Captiva and Sanibel Islands in distance, looking southeast, Pine Island Sound on left and Gulf of Mexico on right.





Sanibel Island in foreground, looking north across San Carlos Bay towards St. James City (south Pine Island) and Cape Coral.

Map 1-B.
Contemporary conditions along the barrier islands.

10. **El Jobean** was named after Joel Bean, a Boston lawyer, who in 1924 filed a town plan consisting of six wards, each with its own civic center bordering a circular plaza. Construction stopped with the stock market crash of 1929, and only a remnant of El Jobean remains today. Much of the subdivision is now within the Riverwood Development of Regional Impact.

11. **Charlotte Harbor (Town)**, settled in 1862, first called Live Oak Point and later Hickory Bluff, was the site of a cattle dock built to ship beef, first to the Confederacy, and later to Cuba. The bluff was leveled for building lots during the land boom period of the 1920s.

12. **Peace River**, or Peas Creek on pre–development maps, is named for black-eyed peas, which grew in the region.

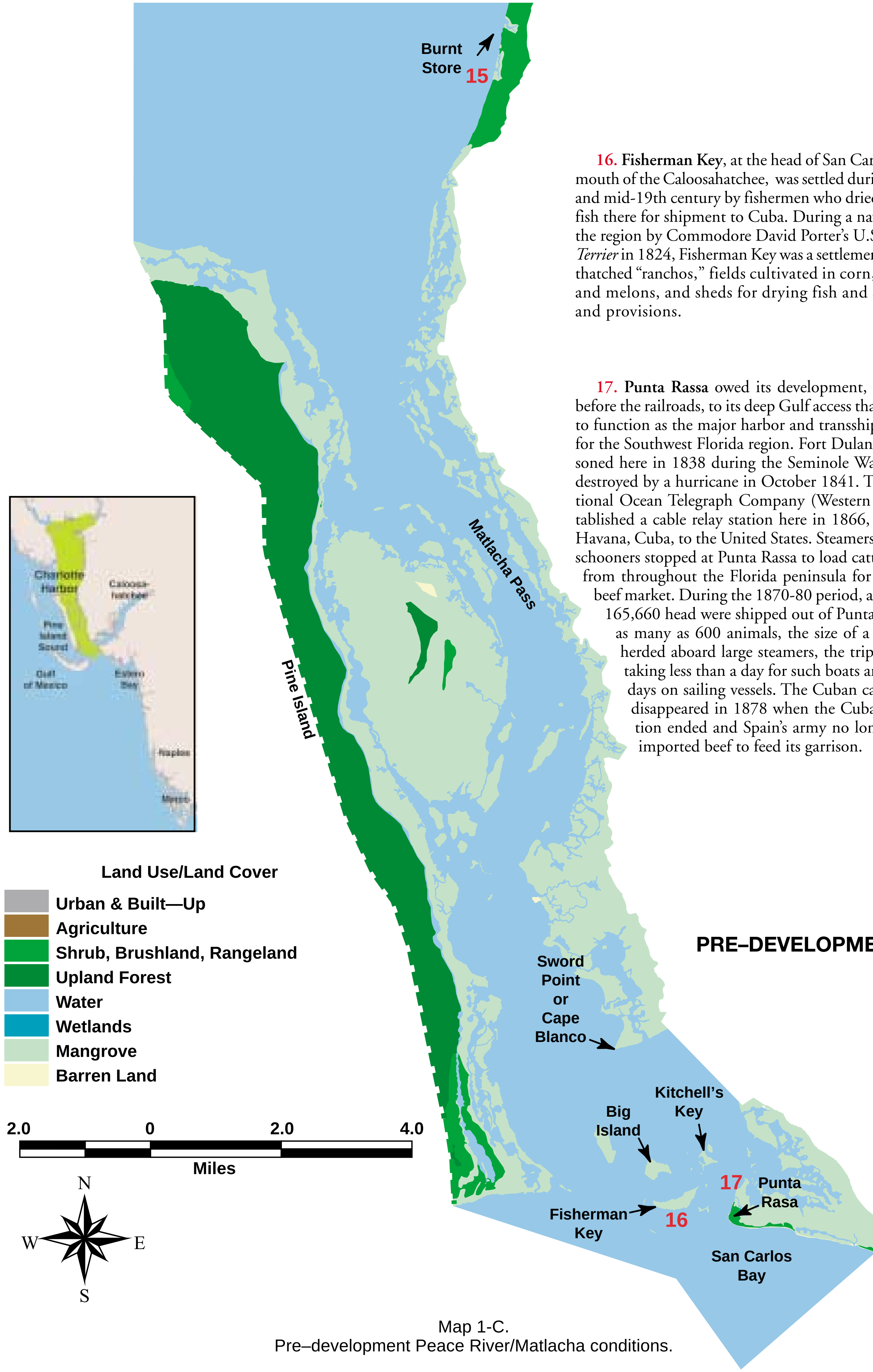
13. **Punta Gorda** became an important shipping hub in 1886 with the arrival of the Florida Southern Railroad and the telegraph. An ice factory built in 1893 transformed the fishing industry in the harbor by making the shipment of fresh fish possible. Small stilt fish houses and houseboats, called lighters, were set up throughout Charlotte Harbor, managed by fish companies which operated "run boats" that delivered ice and supplies to the outlying fishermen and picked up the catch for transport back to Punta Gorda. The salt fisheries that operated in the harbor throughout the early pre–development period were absorbed by this new enterprise.

14. **Punta Gorda Isles**, today an upscale residential waterfront community, was shrub, brushland, and rangeland in the pre–development period, where cattle roamed freely.

15. **Burnt Store** on the east shore of Charlotte Harbor, was a trading post that the Seminoles burned in 1845. Today, Burnt Store Marina and Country Club is a destination resort complex, featuring a 400-plus-slip (and dry-storage) marina, a golf course, and tennis courts, with condominium and upscale single-family homes.

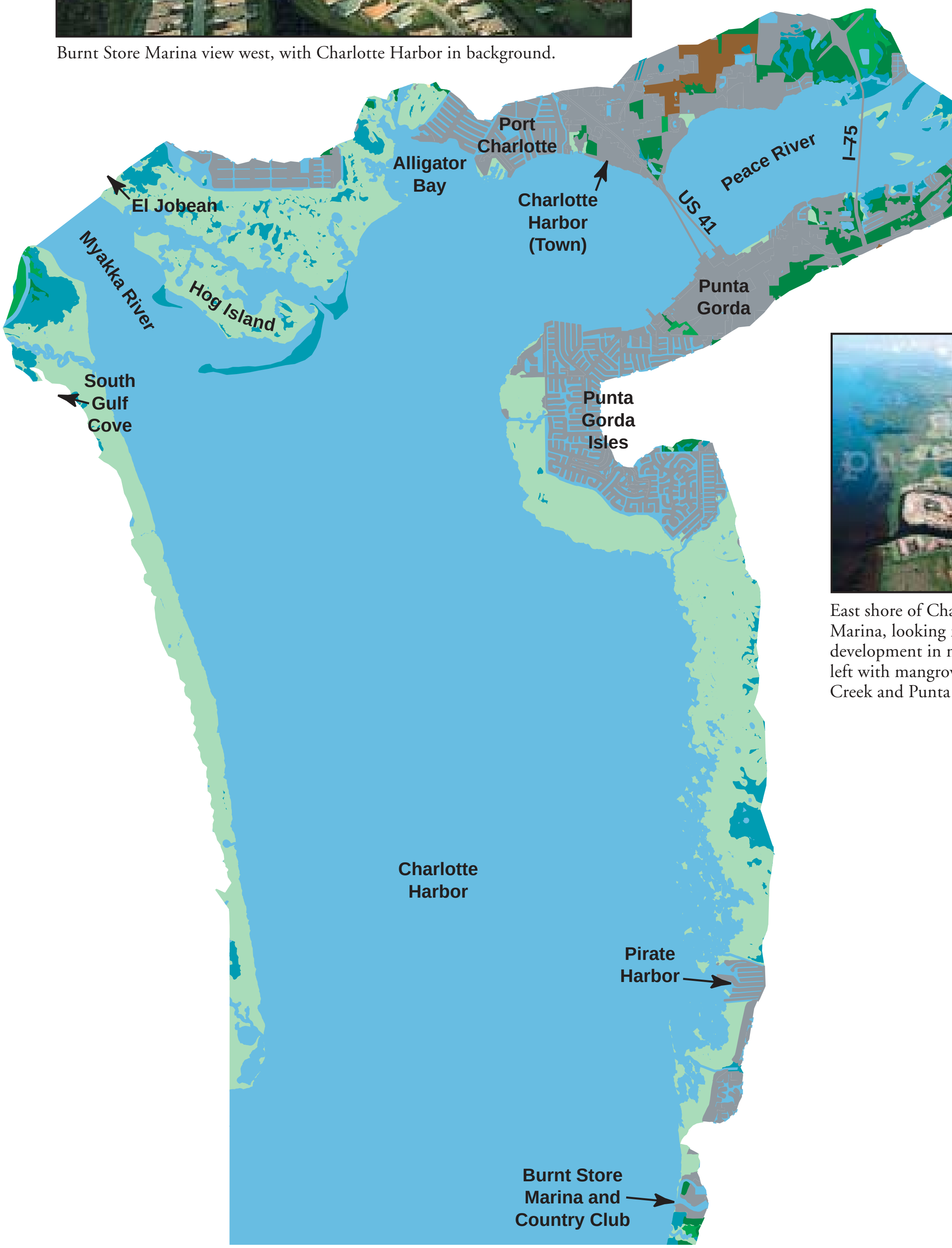
16. Fisherman Key, at the head of San Carlos Bay and mouth of the Caloosahatchee, was settled during the early and mid-19th century by fishermen who dried and salted fish there for shipment to Cuba. During a naval sortie in the region by Commodore David Porter's U.S. Schooner *Terrier* in 1824, Fisherman Key was a settlement with nine thatched "ranchos," fields cultivated in corn, pumpkins and melons, and sheds for drying fish and storing salt and provisions.

17. Punta Rassa owed its development, in the days before the railroads, to its deep Gulf access that enabled it to function as the major harbor and transshipping point for the Southwest Florida region. Fort Dulany was garrisoned here in 1838 during the Seminole Wars, but was destroyed by a hurricane in October 1841. The International Ocean Telegraph Company (Western Union) established a cable relay station here in 1866, connecting Havana, Cuba, to the United States. Steamers and sailing schooners stopped at Punta Rassa to load cattle, brought from throughout the Florida peninsula for the Cuban beef market. During the 1870-80 period, an estimated 165,660 head were shipped out of Punta Rassa, and as many as 600 animals, the size of a drive, were herded aboard large steamers, the trip to Havana taking less than a day for such boats and up to 10 days on sailing vessels. The Cuban cattle market disappeared in 1878 when the Cuban insurrection ended and Spain's army no longer needed imported beef to feed its garrison.



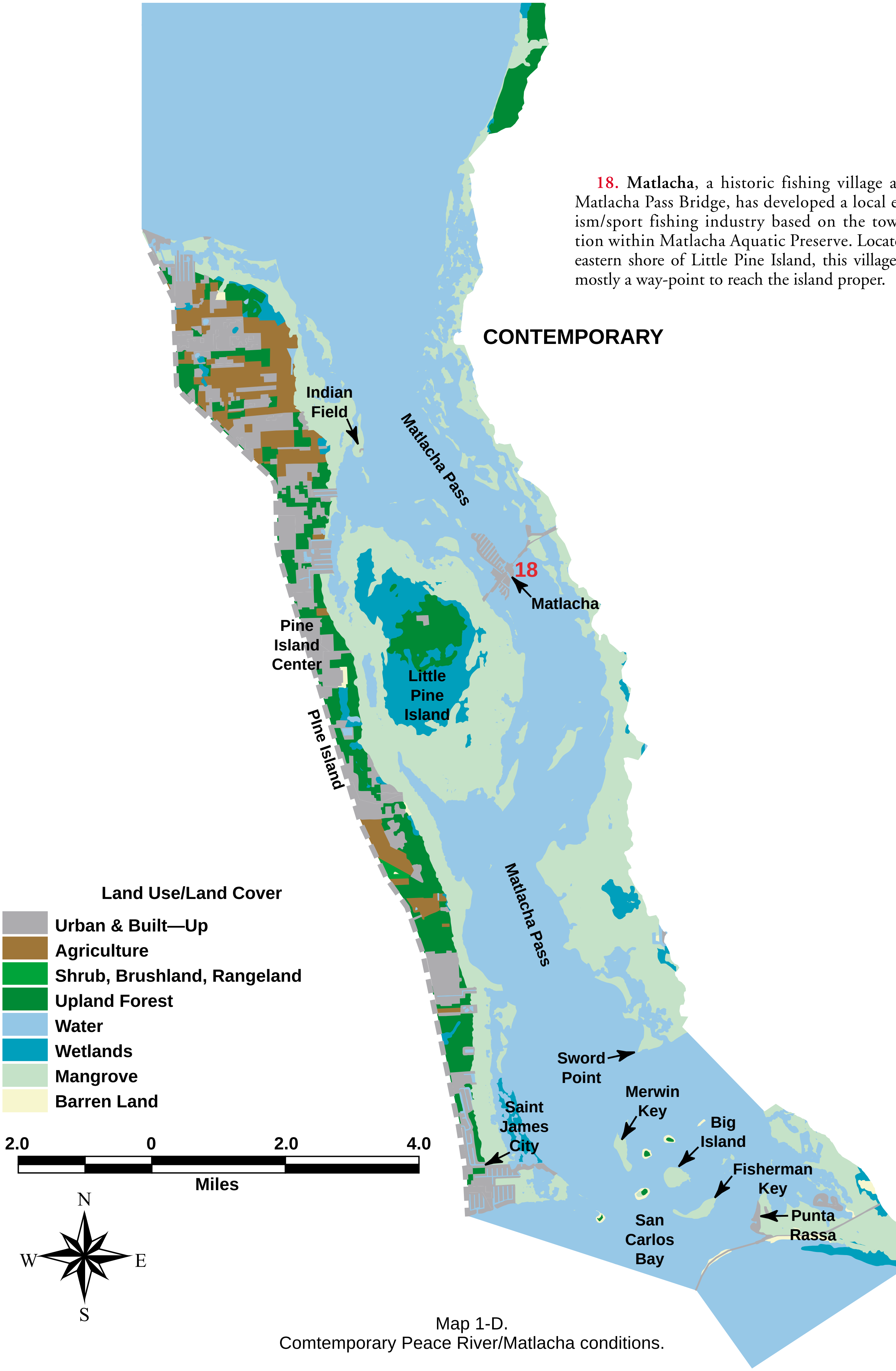
Map 1-C.
Pre–development Peace River/Matlacha conditions.

Burnt Store Marina view west, with Charlotte Harbor in background.



East shore of Charlotte Harbor from Burnt Store Marina, looking north, Burnt Store Lakes development in midground, Key Point on upper left with mangrove islands reaching to Alligator Creek and Punta Gorda Isles in distance.

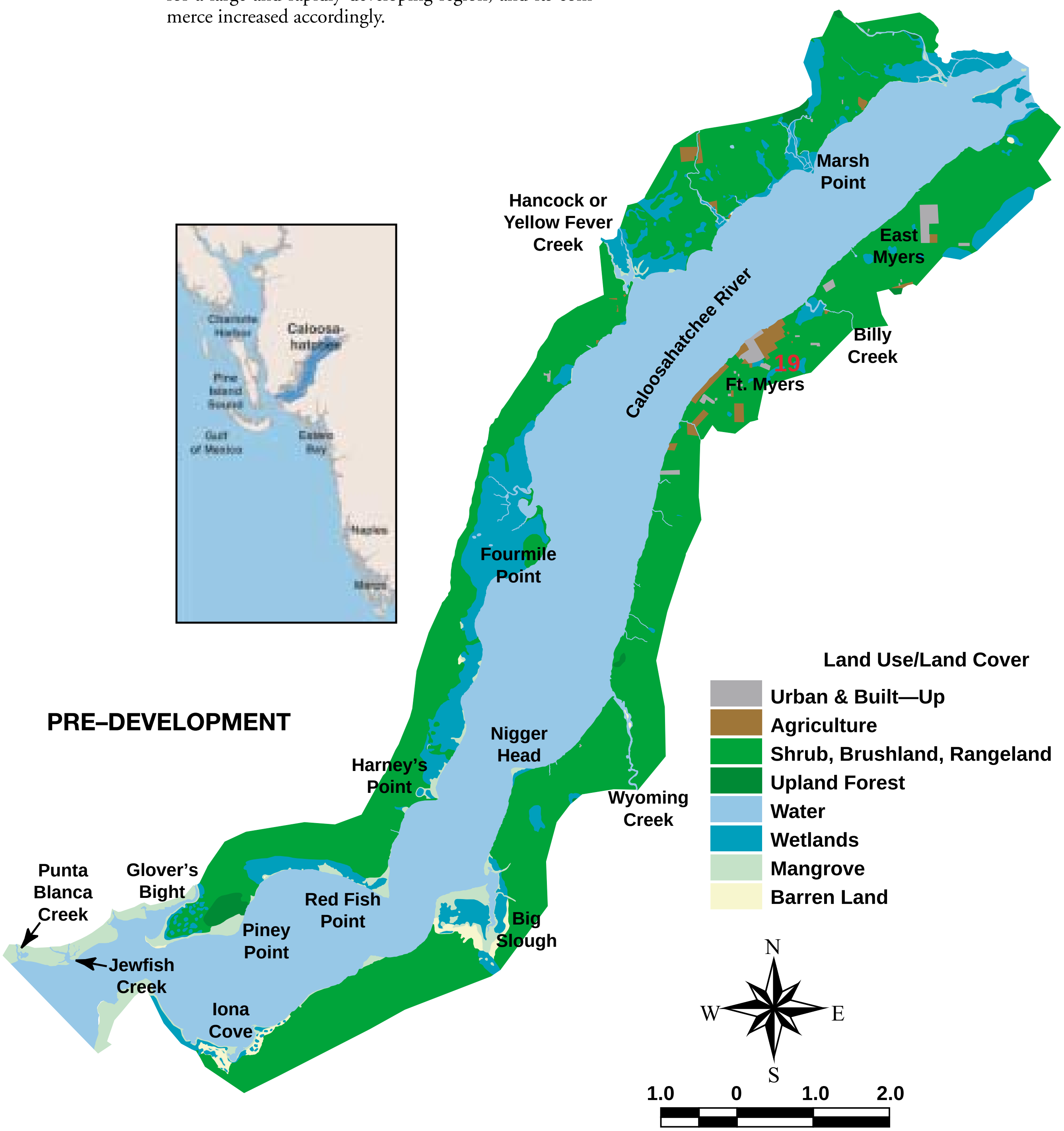
18. **Matlacha**, a historic fishing village adjoining Matlacha Pass Bridge, has developed a local eco-tourism/sport fishing industry based on the town's location within Matlacha Aquatic Preserve. Located on the eastern shore of Little Pine Island, this village is today mostly a way-point to reach the island proper.



Map 1-D.
Comtemporary Peace River/Matlacha conditions.

19. **Ft. Myers** served as an army supply depot during the Seminole and Civil Wars. By 1879, the town had a population of 150 and included four stores that supplied goods and medicines to the sparse population of the Caloosahatchee Valley. The town's population grew to 349 by 1885. The following year Ft. Myers became the seat of newly formed Lee County. The railroad arrived in 1904, and later a large tourist trade developed. The lower Caloosahatchee attracted hundreds of fishermen and sportsmen annually. Waterborne commerce — steamers and trading schooners — declined in the face of competition by the railroad. Ft. Myers, during the 20th century preceding World War II, became the distribution center for a large and rapidly developing region, and its commerce increased accordingly.

The Ft. Myers waterfront today is undergoing a resurgence of development. Hotels, condominiums and single-family homes line the riverfront east and west of downtown proper. The downtown waterfront is the focus of a redevelopment study that will blend the historic structures with new growth. There is thriving nightlife in the core of the city today that city officials hope to spread throughout the daytime hours. One element that should spur downtown redevelopment was the creation in the late 1990s of a terminal to allow daily high-speed boat trips from the city to Key West. Operation of a high-speed catamaran is expected to begin by 2003.



Map 1-F.
Pre–development Caloosahatchee conditions.

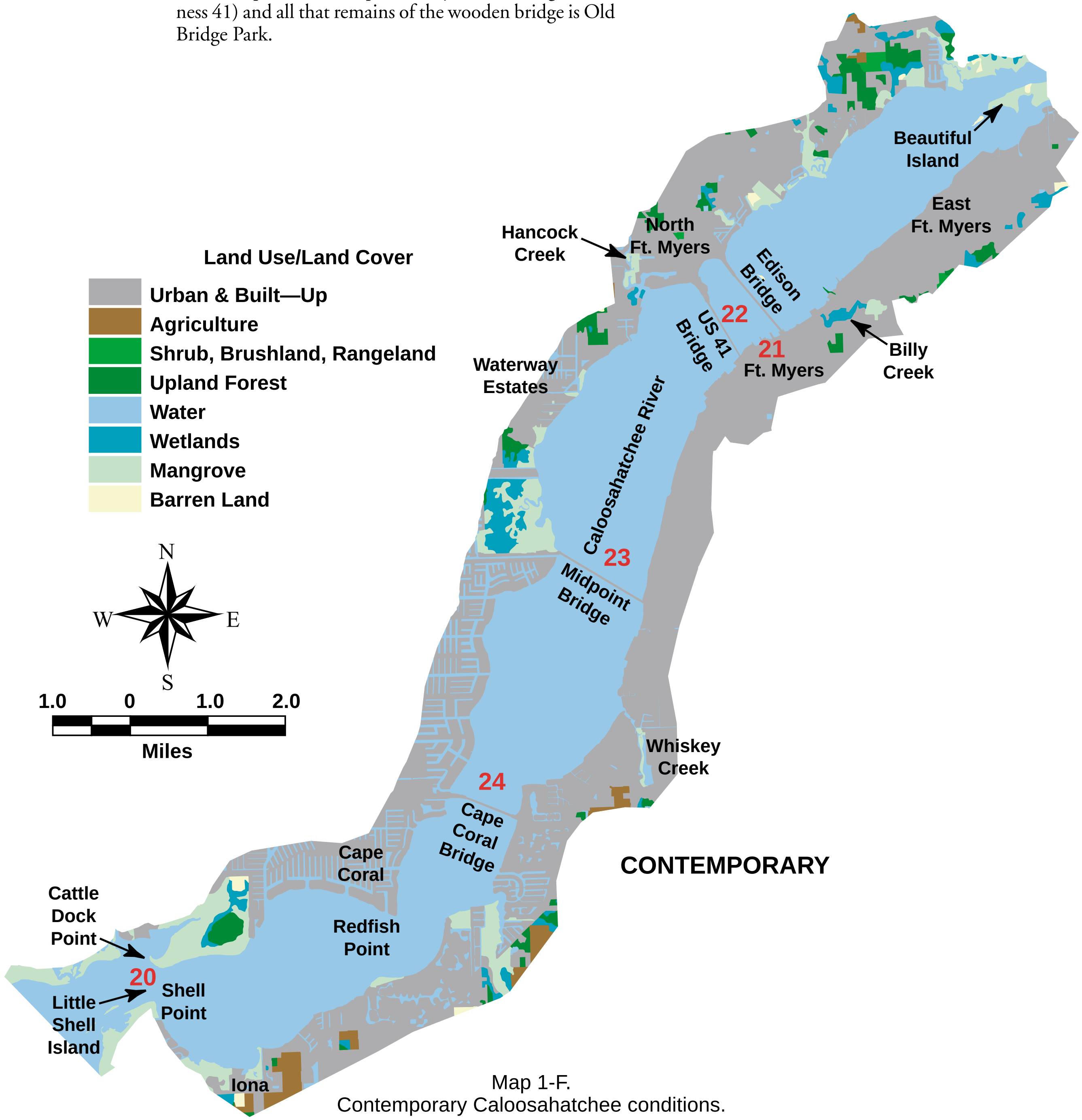
20. Little Shell Island, at the mouth of the Caloosahatchee, provided a place for boaters to go for great hamburgers during the 1950s. Today, the burgers are gone and the island is mostly deserted except for weekend boaters.

21. Ft. Myers Yacht Basin and Waterfront Park was built in 1937 as a WPA (Works Progress Administration) project, the New Deal relief and recovery program of the Depression that employed tens of thousands of people on public works projects, such as building roads, bridges, and parks.

22. Ft. Myers (downtown) Bridge The first bridge across the Caloosahatchee was a wooden structure built in 1924 that burned in the early 1940s. The bridge crossed the river upstream of the present day Edison Bridge (Business 41) and all that remains of the wooden bridge is Old Bridge Park.

23. Midpoint Bridge This span opened to vehicular traffic in October 1997. It is a four-lane facility with a 55-foot clearance for boats at the center of the channel. Construction of the bridge was first discussed in the 1960s; the issue came before the Lee County Board of County Commissioners in 1975 and was defeated by a 3-2 vote. It eventually was constructed.

24. Cape Coral Bridge A two-lane bridge first opened to vehicular traffic in 1964. A twin span was added in 1989, creating a total of four lanes of traffic. The bridge has a clearance for vessels of 55 feet at the center of the channel.

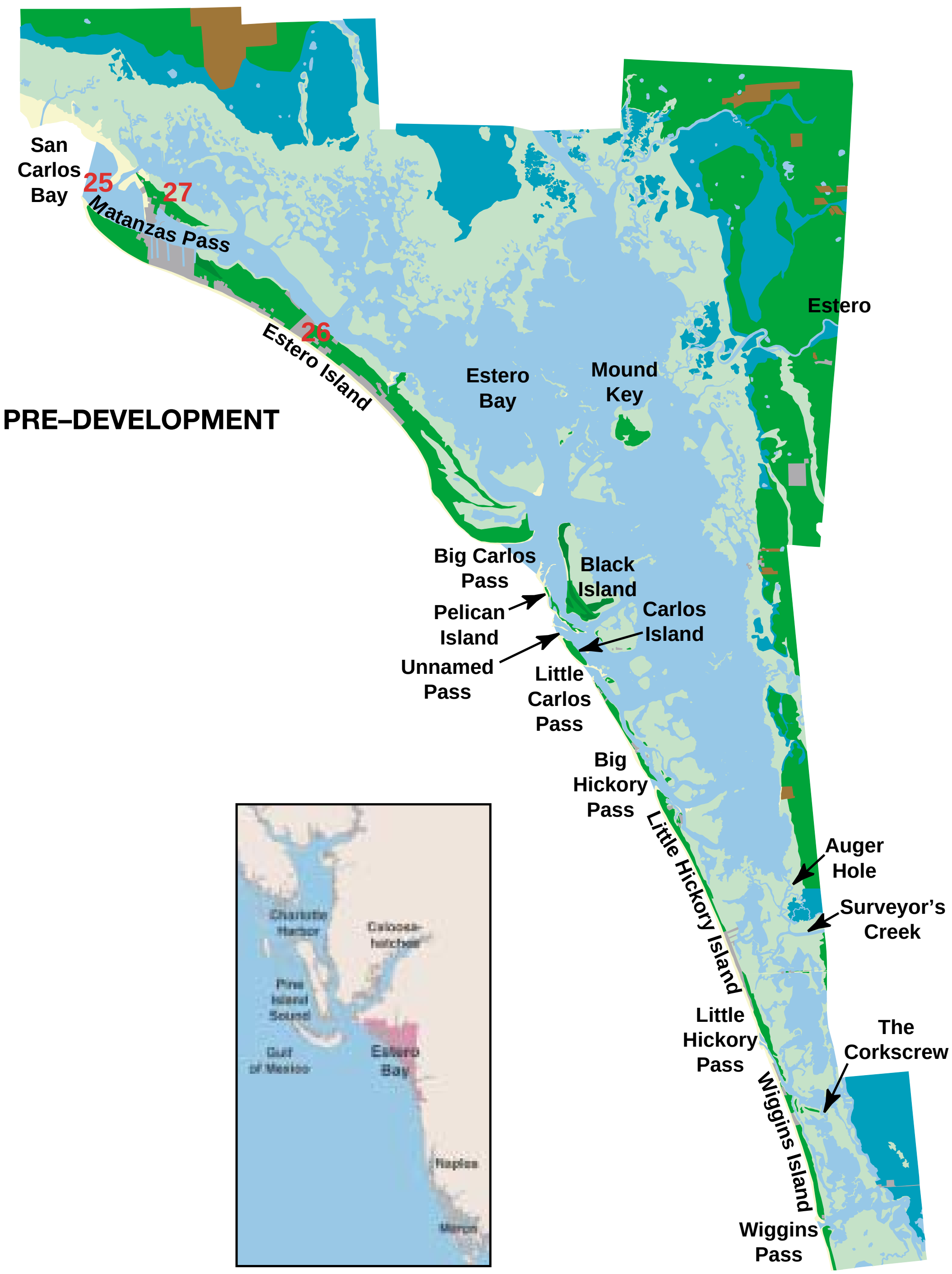


Map 1-F.
Contemporary Caloosahatchee conditions.

25. Matanzas (Pass), from the Spanish word for "slaughter," probably commemorates the 1566 death of Carlos, Chief of the Calusa Indians, at the hands of a Spanish expedition under Pedro Menendez. This Indian chief undoubtedly lent his name to Big and Little Carlos Passes and Carlos Island.

26. Ft. Myers Beach (Estero Island), called Crescent Beach in earlier times, was homesteaded in the 1890s. During those years, before road and bridge linked the island to the mainland, most supplies reached Estero Island by a boat operated by the Koreshan Unity (a communal pioneer society), which made regular trips from Ft. Myers to Estero. The hurricane of September 1926 destroyed a wooden bridge connecting Estero and San Carlos Islands. A swing bridge replaced it in 1928 and functioned until 1979, when the "Sky Bridge" was built. The first "finger-island" canals on Ft. Myers Beach were dredged in 1924, and by 1934, a large number of canal lots had been dredged and filled, facing Matanzas Pass, and sold for $35 each. By 1940, the island's population was 473. The pace of development accelerated after World War II, spurred by tourism and a growing demand for permanent waterfront living. There were more than 700 island residents in 1950, and the population jumped to 2,500 by 1960. A bridge spanning Big Carlos Pass and a causeway running from the south end of Estero Island to Bonita Beach were built in 1965. Today, Ft. Myers Beach is an incorporated town with an annual population of 14,000 which doubles during the winter tourist season.

27. San Carlos Island developed into one of the largest shrimp ports in the United States in 1950 with the discovery of "pink gold" in the Dry Tortugas, off Key West. As these beds became depleted, other shrimp grounds were discovered off Sanibel in the Gulf and as far away as Campeche, Mexico. During the peak production in 1996, 4.2 million pounds of heads-off shrimp were unloaded at San Carlos Island. Landings fell the next year to 2.7 million pounds, but still produced a dockside value of almost $14 million. It has been estimated that the shrimping industry on the island, on average, generates an economic base of more than $21 million and employs 600 people. However, the vagaries of the industry may cause those figures to change dramatically from year to year.



Map 1-G.
Pre–development Estero Bay conditions.

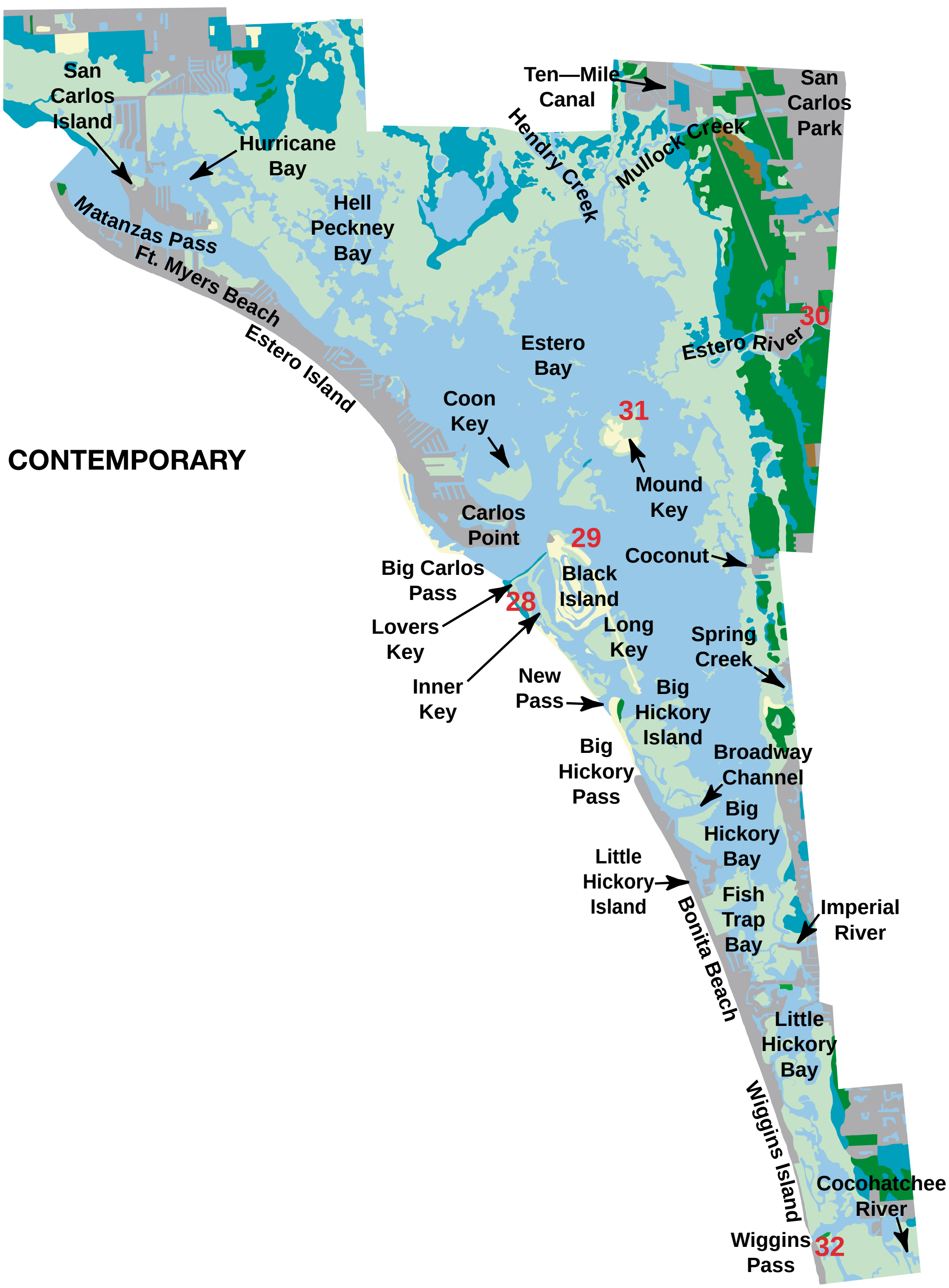
28. Lovers Key, once an offshore shoal, owes its emergence and growth to Hurricane Donna, the 1960 storm that devastated the Southwest Florida coast. Floyd Lucky, a local developer, laid claim to the newly formed island and began building and dredging. Wetland and bay bottom habitats were altered to uplands. The state purchased the island in 1983 and merged it with its acquisition of county-owned lands on Black Island, Long Key, and Inner Key in 1996 to create the Lovers Key State Park, a multi-use marine recreation area.

29. Black Island, a former Koreshan homesite and fish camp where fishermen and their families lived from the turn of the century until the 1950s, is now part of the Lovers Key State Park. Koreshan was a religious sect founded by Dr. Cyrus Teed. Koreshans believed the world was round, but concave rather than convex. The church followers also adhered to strict rules of celibacy and, by the end of World War II, the religion was mostly extinct.

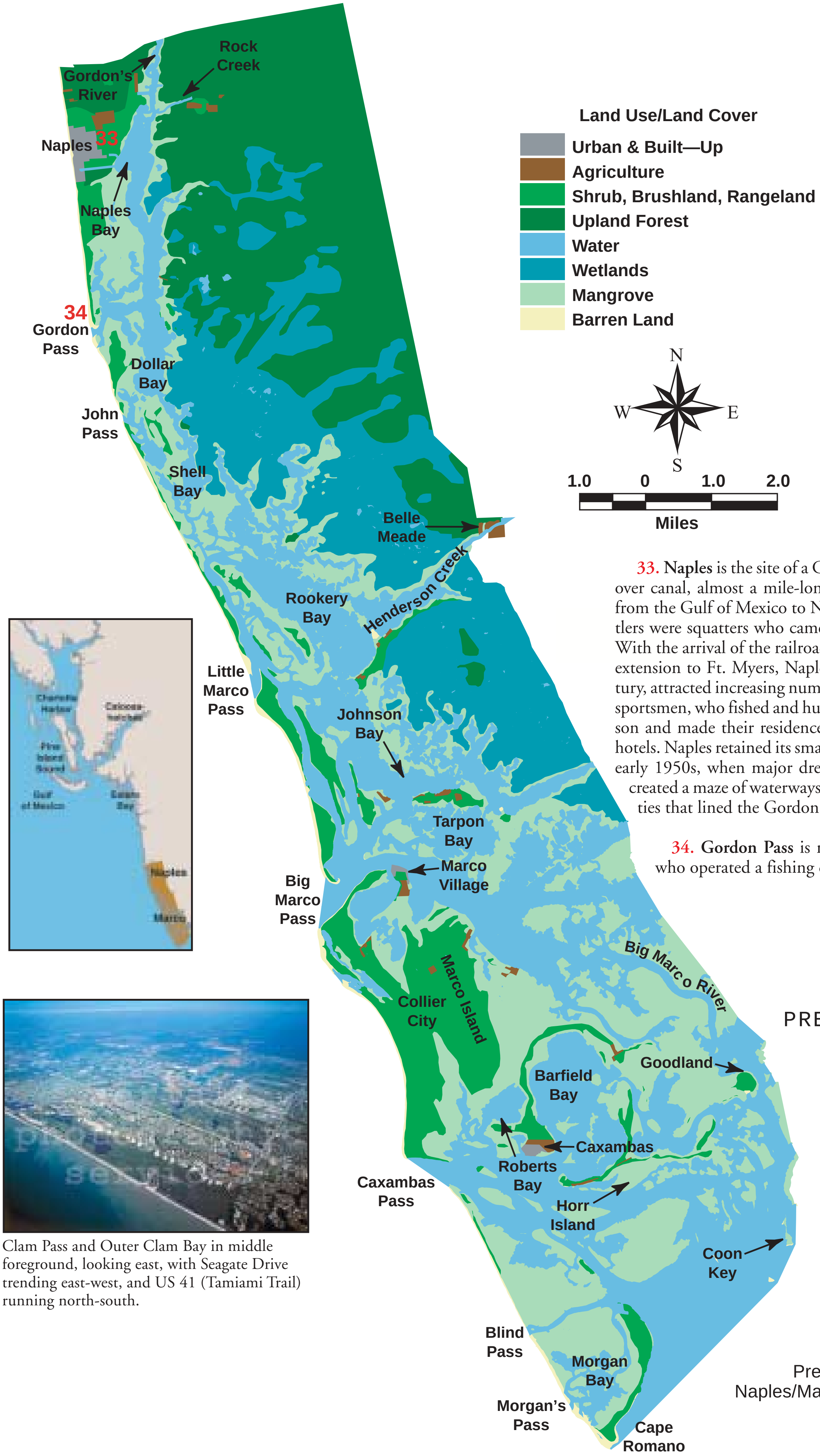
30. Estero, on the banks of the Estero River, was founded in 1894 by the Koreshan Unity. When the Army Engineers conducted a river survey in 1903, about 500 persons lived in the community and its vicinity. The Army Engineers reported that the town, incorporated by the Koreshans on a tract of 70,000 acres, included a post office, small store, machine shop and "…one of the largest printing establishments in Florida." The religion published its beliefs in "The Flaming Sword," a religious magazine, "The American Eagle," a newspaper, and in Koresh's private writings published through Guiding Star Publishing House. The Unity operated a large orange grove (185 acres) nine miles above the mouth of the river; they also colonized Mound Key and Black Island. Membership declined through the early 20th century and the land was deeded to the state in 1961. It is now the Koreshan State Historic Site.

31. Mound Key, almost 30 feet in height, owes its elevation to the thousands of years of shelling and building of middens by the Calusa and their predecessors. Mound Key is believed by researchers to be Carlos, the town where King Carlos of the Calusas met with Spanish Governor Pedro Menendez in 1566. Cuban fishermen settled on Mound Key in the 1800s, and by the early 1900s the island was home to members of the Koreshan Unity. The Koreshans deeded Mound Key to the state in 1961 to preserve the island's historic and archaeological character.

32. Wiggins Pass is named for Joe Wiggins, who homesteaded and operated a trading post in the area. Just south of the pass is the Delnor Wiggins Pass State Recreation Area.



Map 1-G.
Contemporary Estero Bay conditions.



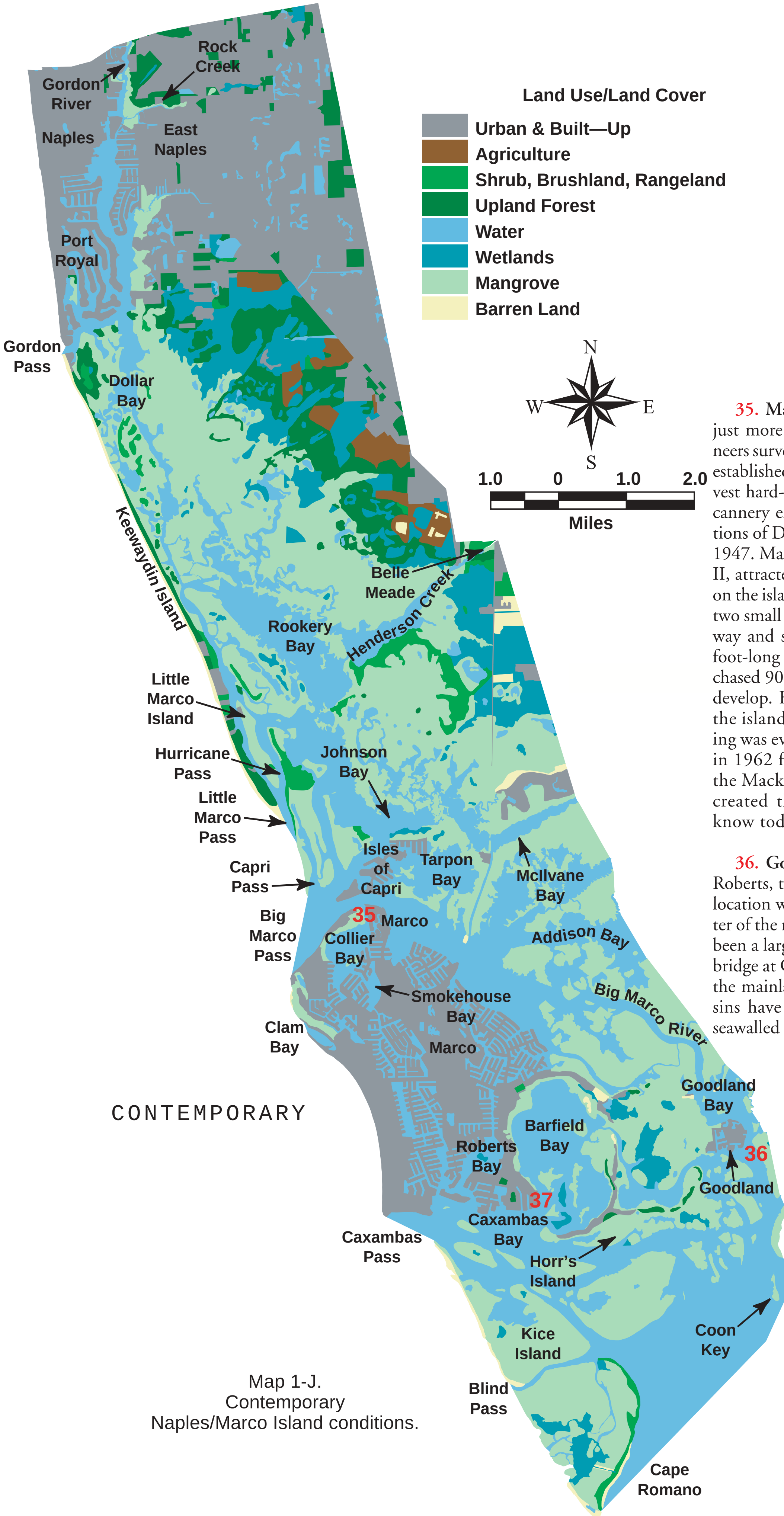
Clam Pass and Outer Clam Bay in middle foreground, looking east, with Seagate Drive trending east-west, and US 41 (Tamiami Trail) running north-south.

33. **Naples** is the site of a Calusa settlement and haul-over canal, almost a mile-long, deep canoe passageway from the Gulf of Mexico to Naples Bay. The earliest settlers were squatters who came to the area in the 1870s. With the arrival of the railroad at Punta Gorda and later extension to Ft. Myers, Naples, by the turn of the century, attracted increasing numbers of tourists, principally sportsmen, who fished and hunted during the winter season and made their residence aboard yachts or at local hotels. Naples retained its small-town ambiance until the early 1950s, when major dredge-and-fill developments created a maze of waterways and waterfront communities that lined the Gordon River and Naples Bay.

34. **Gordon Pass** is named for Roger Gordon, who operated a fishing camp there in the 1870s.

PRE–DEVELOPMENT

Map 1-I.
Pre–development
Naples/Marco Island conditions.



Map 1-J.
Contemporary
Naples/Marco Island conditions.

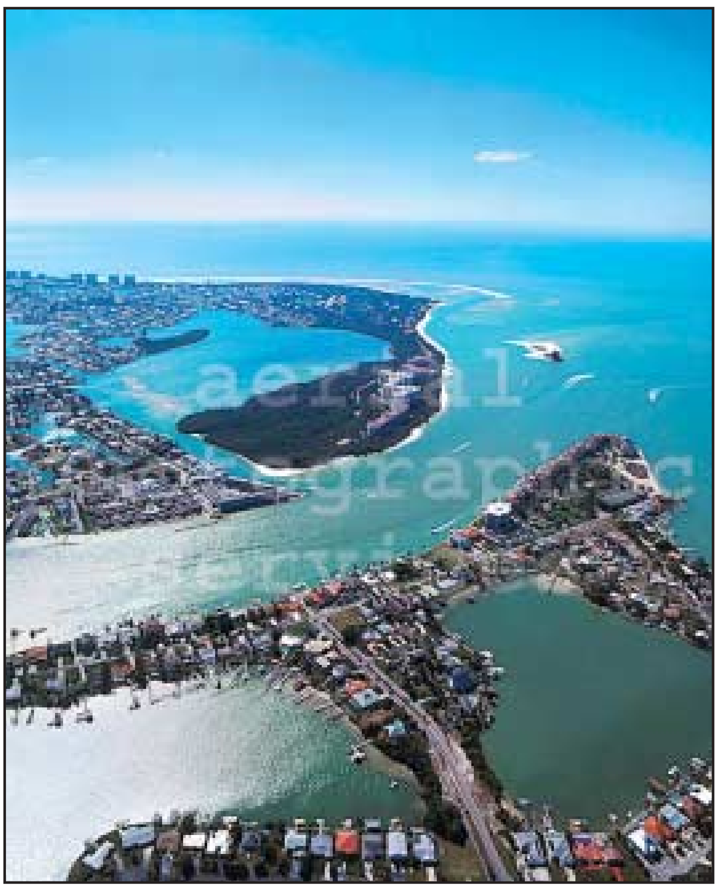
South Marco Island from Caxambas Pass, looking north, showing Marco's cresent-shaped Gulf beach and complex canal system.

35. **Marco** was a small fishing village in 1913, with just more than 100 inhabitants, when the Army Engineers surveyed the pass and inland waterway. J. H. Doxsee established a clam cannery at the village in 1910 to harvest hard-shell clams in the Ten Thousand Islands. The cannery employed as many as 150 people. Five generations of Doxsees operated the cannery before it closed in 1947. Marco Village, during the years before World War II, attracted sportsmen who fished for tarpon or hunted on the island and nearby mainland. They stayed at one or two small hotels on the island. At the time, a marine railway and shipyard were capable of accommodating 60-foot-long boats. In the early 1920s, Barron Collier purchased 90 percent of Marco Island, which he planned to develop. He even began to clear land in the middle of the island at a location named Collier City, but nothing was ever completed. Marco was totally transformed in 1962 from its sleepy, idyllic old Florida setting by the Mackle brothers when their Deltona Corporation created the residential canal resort community we know today.

36. **Goodland** was named by its first settler, Jonnie Roberts, to describe the fertile, well-drained soil and the location with abundant fishing available in the deep water of the nearby Marco River. Goodland had historically been a large Calusa settlement. The county built a swing bridge at Goodland in 1939, Marco's only connection to the mainland until 1969. Finger canals and borrow basins have transformed the mangrove shoreline into a seawalled waterfront residential community.

37. **Caxambas** (sometimes spelled "Caximbas"), one of the oldest place names on the Southwest Florida coast, is of West Indian (Arawak) origin, from the word "casimba" or "cacimba," which refers to a drinking hole or "well" which was probably a shallow freshwater depression in the beach used by explorers and fishermen in the pre–development period. Shell mounds attest to earlier Calusa settlement. There was a small agricultural and fishing settlement here during the 19th century. The E.S. Burnham Packing Company established a clam factory at Caxambas in 1904. The town was moved in 1949 to Goodland, preceding the Collier family's attempt to develop Marco Island.

South Marco Island and Roberts Bay in foreground, looking southwest out Caxambas Pass.



View south from the Isles of Capri, across the Big Marco River to Marco Island, Coconut Island separating Capri Pass from Big Marco Pass on right.

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South Pine Island, looking northeast, St. James City in foreground, road to Galt Island with McKeever Keys fronting on Pine Island Sound on the left midground and Matlacha Pass on right.

INLET DYNAMICS

Tidal inlets — Floridians often call them passes, especially on the west coast — are the most dynamic and visible features of Southwest Florida's boating geography. Inlets are points of entry and egress between the Gulf of Mexico and inland waterways. They are also a challenge to navigate, because of their shifting nature, strong ebb and flood currents, and changing wave action. Waves propagating into an opposing current in inlets increase in height and decrease in length. The result is steeper waves that are more difficult to navigate.

Offshore shoals continually shift because of the moving beach sand, so it is challenging to keep markers in the best water. Local watermen often leave the buoyed channel, guided by knowledge of local conditions that enables them to pick the best water and avoid uncharted obstructions. A basic understanding of how inlets come into being and evolve can aid all mariners to cope with the seeming vagaries of Florida's vital passes.

Rotonda West (circular shape on left side of photo), view south with Stump Pass in foreground, Gasparilla Pass in upper right, Charlotte Harbor in background.

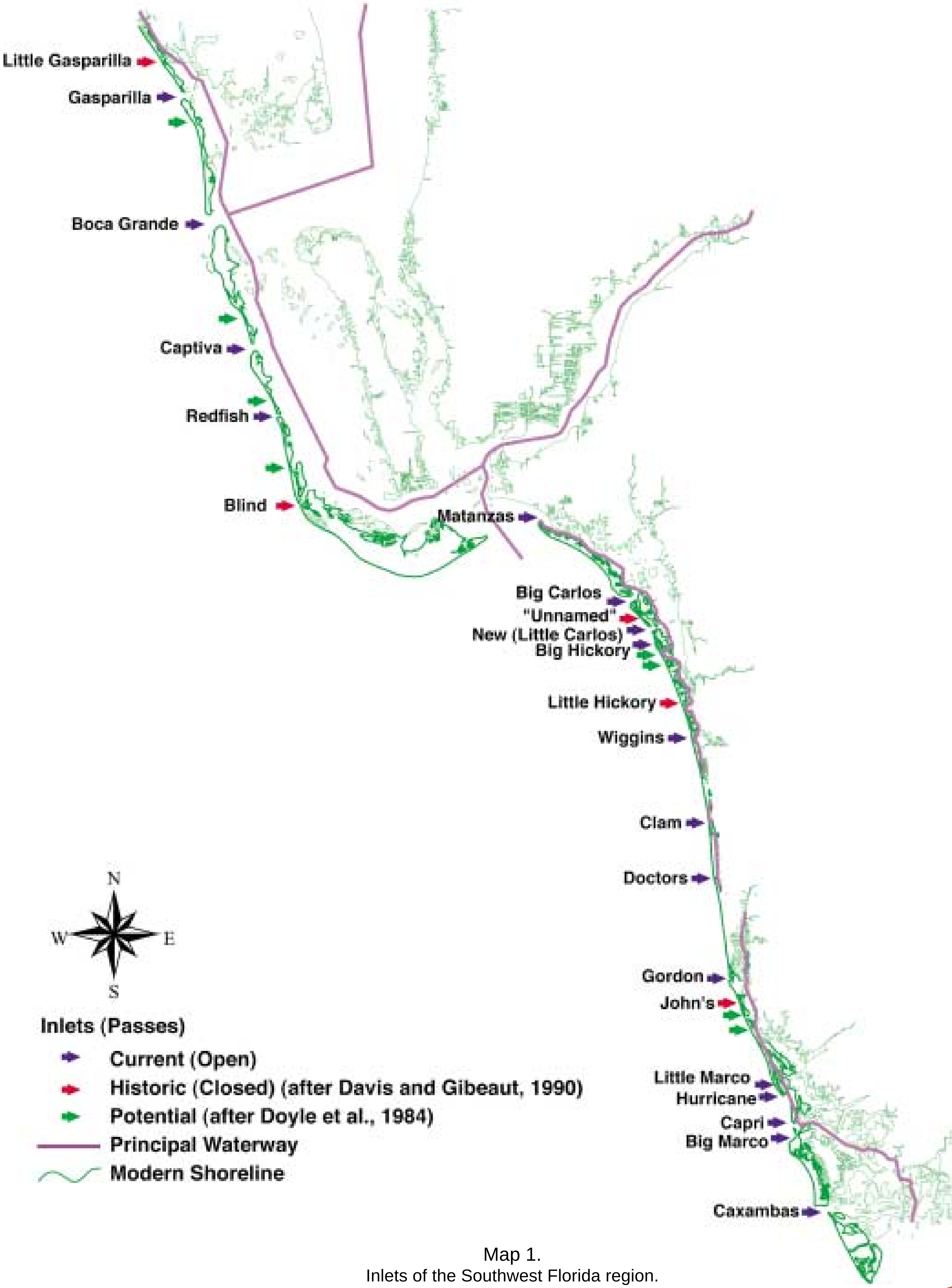
Inlet Locations and Status

Fifteen inlets are currently used by boaters to transit between Gulf and bay waters in this Southwest Florida region: Gasparilla, Boca Grande, Captiva, Redfish, Matanzas, Big Carlos, New, Big Hickory, Wiggins, Clam, Doctors, Gordon, Big Marco, Capri, and Caxambas Passes (Map 1). Table 1 lists distances for traversing the outside (Gulf of Mexico) and inside (Intracoastal and Inland Waterways) routes, as well as the intervening access channels. Outside route distances for mariners are longer, but travel time under favorable conditions is usually less, especially for high-performance cruisers. An exception to the distance rule is from Gordon Pass to Caxambas Pass, where the inside route is considerably longer due to running the Gordon River. Cruising sailboats often choose the outside route for better winds and to avoid bridges with restricted openings.

Boca Grande, Matanzas, Gordon, Capri, and Big Marco Passes are federally authorized navigation inlets, periodically surveyed and dredged by the Army Engineers, in cooperation with the West Coast Inland Navigation District (WCIND), Lee and Collier Counties, and the City of Naples. Though not generally navigable, Big Hickory Pass was dredged once, in the late 1970s, to increase tidal flushing. Wiggins, and Doctors Passes are maintenance dredged for navigation by Collier County and the City of Naples. Another four inlets–Redfish, Blind (currently closed), Clam, and Caxambas have been dredged either as a by product of beach renourishment or for water quality improvement. The remaining inlets — Gasparilla, Captiva, Big Carlos, New, Little Marco, and Hurricane — are natural, unimproved passes. Aids to navigation are maintained at all the inlets, except Gasparilla, Captiva, Big Hickory, Clam, Little Marco, Hurricane, and Big Marco. New and Big Hickory Passes have fixed–span bridges near their mouths, and Big Carlos has a lift bridge that opens on demand between 8 a.m. and 7 p.m., but is otherwise locked down.

Five inlets have closed during the past century on this reach of the Southwest Florida coast: Little Gasparilla, Blind, Un-named (south of Big Carlos), Little Hickory, and John's (Map 1). Current and historic inlets have formed, closed, and reopened, due to natural processes as well as human intervention. Such events directly affect the amount of water flowing through an inlet during a tidal cycle, referred to as a tidal prism. Dredging inlet "*A*" can rob some of the tidal prism from inlet "*B*", situated several miles down the coast. Similarly, the tidal prism of an inlet may be affected by changing the area of the bay adjacent to it; an inlet may close due to an abundance of sediment and strong longshore drift coupled with a small tidal prism.

Considerable debate continues regarding the effects on tidal prism and the related closing of inlets caused by the dredging and filling of mangrove and marsh environments along bay margins. Little disagreement exists, however, about the potential for storm overwash of the barrier islands and the creation of new inlets. Eight sites along this stretch of the coast are particularly vulnerable to storm overwash (the "potential" inlet sites on Map 1). They are prone to overwash because of the narrow width of the barrier island, low elevation, and orientation to storm-wave attack.



Map 1.
Inlets of the Southwest Florida region.

Route distances between inlets.

a. Gulf of Mexico (outside) route to inlet (sea buoy) entrance (distances in statute miles).

Pass/Inlet	Stump	Gasparilla	Boca Grande	Captiva	Redfish	Matanzas	Big Carlos	New (Little Carlos)	Big Hickory	Wiggins	Clam	Doctors	Gordon	Capri	Big Marco	Caxambas
Stump (Volume One)		7.0	16.1	24.7	27.3	51.8	59.4	60.7	62.4	67.3	72.1	75.3	81.0	89.9	92.2	95.7
Gasparilla	7.0		9.1	17.7	20.3	44.8	52.4	53.7	55.4	60.3	65.1	68.3	74.0	82.9	85.2	88.7
Boca Grande	16.1	9.1		8.6	11.2	35.7	45.3	44.6	46.3	51.2	56.0	59.2	64.9	73.8	76.1	79.6
Captiva	24.7	17.7	8.6		2.6	27.1	34.7	36.0	37.7	42.6	47.4	50.6	56.3	65.2	67.5	71.0
Redfish	27.3	20.3	11.2	2.6		24.5	32.1	33.4	35.1	40.0	44.8	48.0	53.7	62.6	64.9	68.4
Matanzas	51.8	44.8	35.7	27.1	24.5		7.6	8.9	10.6	15.5	20.3	23.5	29.2	38.1	40.4	43.9
Big Carlos	59.4	52.4	43.3	34.7	32.1	7.6		1.3	3.0	7.4	12.7	15.9	21.6	30.5	32.8	36.3
New (Little Carlos)	60.7	53.7	44.6	36.0	33.4	8.9	1.3		1.7	6.6	11.4	14.6	20.3	29.2	31.5	35.0
Big Hickory	62.4	55.4	46.3	37.7	35.1	10.6	3.0	1.7		4.9	9.7	12.9	18.6	27.5	29.8	33.3
Wiggins	67.3	60.3	51.2	42.6	40.0	15.5	7.9	6.6	4.9		4.8	8.0	13.7	22.6	24.9	28.4
Clam	72.1	65.1	56.0	47.4	44.8	20.3	12.7	11.4	9.7	4.8		3.2	8.9	17.8	20.1	23.6
Doctors	75.3	68.3	59.2	50.6	48.0	23.5	15.9	14.6	12.9	8.0	3.2		5.7	14.6	16.9	20.4
Gordon	81.0	74.0	64.9	56.3	53.7	29.2	21.6	20.3	18.6	13.7	8.9	5.7		8.9	11.2	14.7
Capri	89.9	82.9	73.8	65.2	62.6	38.1	30.5	29.2	27.5	22.6	17.8	14.6	8.9		2.3	5.8
Big Marco	92.2	85.2	76.1	67.5	64.9	40.4	32.8	31.5	29.8	24.9	20.1	16.9	11.2	2.3		3.5
Caxambas	95.7	88.7	79.6	71.0	68.4	43.9	36.3	35.0	33.3	28.4	23.6	20.4	14.7	5.8	3.5	

b. Intracoastal waterway (inside) route to inlet access channel (distances in statute miles).

Pass/Inlet	Stump	Gasparilla	Boca Grande	Captiva	Redfish	Matanzas	Big Carlos	New (Little Carlos)	Big Hickory	Wiggins
Stump (Volume One)		7.5	15.5	23.0	28.0	47.7	55.1	57.6	60.0	65.8
Gasparilla	7.5		8.0	15.5	20.5	40.2	47.6	50.1	52.5	58.3
Boca Grande	15.5	8.0		7.5	12.5	32.2	39.6	42.1	44.5	50.3
Captiva	23.0	15.5	7.5		5.0	24.7	32.1	34.6	37.0	42.8
Redfish	28.0	20.5	12.5	5.0		19.7	27.1	29.6	32.0	37.8
Matanzas	47.7	40.2	32.2	24.7	19.7		7.4	9.9	12.3	18.1
Big Carlos	55.1	47.6	39.6	32.1	27.1	7.4		2.5	4.9	10.7
New (Little Carlos)	57.6	50.1	42.1	34.6	29.6	9.9	2.5		2.4	8.2
Big Hickory	60.0	52.5	44.5	37.0	32.0	12.3	4.9	2.4		5.8
Wiggins	65.8	58.3	50.3	42.8	37.8	18.1	10.7	8.2	5.8	

c. Inland waterway (inside) to access channel (distances in statute miles).

Pass/Inlet	Gordon	Capri	Big Marco	Caxambas
Gordon		10.6	10.9	21.9
Capri	10.6		0.3	11.3
Big Carlos	10.9	0.3		11.0
Caxambas	21.9	11.3	11.0	

d. Inlet and access channels from Gulf to Intracoastal (distances in statute miles).

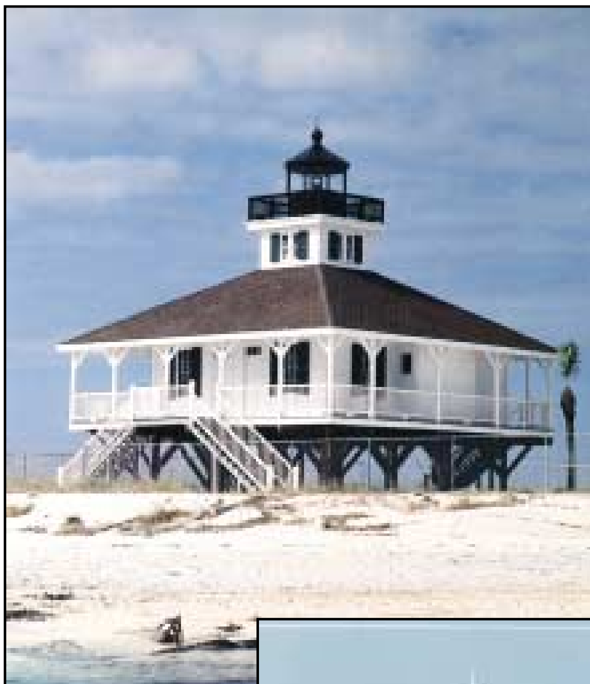
Pass/Inlet	Inlet Channel	ICW/IW Access	Total
Stump (Vol.1)	1.5	0.8	2.3
Gasparilla	0.9	1.2	2.1
Boca Grande	4.3	0.8	5.1
Captiva	2.5	1.2	3.7
Redfish	1.1	1.9	3.0
Matanzas	1.1	0.0	1.1
Big Carlos	1.8	0.0	1.8
New (Little Carlos)	0.9	0.4	1.3
Big Hickory	0.6	0.5	1.1
Wiggins	0.6	0.0	0.6
Clam	0.2		0.2
Doctors	0.3		0.3
Gordon	0.8	1.0	1.8
Capri	0.7	0.0	0.7
Big Marco	2.1	0.0	2.1
Caxambas	1.4	5.4	6.8

e. Outside route, including runs from and to the ICW/IW (distances in statute miles).															
Pass/Inlet	Stump	Gasparilla	Boca Grande	Captiva	Redfish	Matanzas	Big Carlos	New (Little Carlos)	Big Hickory	Wiggins	Clam	Doctors	Gordon	Capri	Big Marco	Caxambas
Stump (Volume One)		11.4	23.5	30.7	32.6	55.2	63.5	64.3	65.8	70.2	74.6	77.9	85.1	92.9	96.6	104.8
Gasparilla	11.4		16.3	23.5	25.4	48.0	56.3	57.1	58.6	63.0	67.4	70.7	77.9	85.7	89.4	97.6
Boca Grande	23.5	16.3		17.4	19.3	41.9	50.2	51.0	52.5	56.9	61.3	64.6	71.8	79.6	83.3	91.5
Captiva	30.7	23.5	17.4		9.3	31.9	40.2	41.0	42.5	46.9	51.3	54.6	61.8	69.6	73.3	81.5
Redfish	32.6	25.4	19.3	9.3		28.6	36.9	37.7	39.2	43.6	48.0	51.3	58.5	66.3	70.0	78.2
Matanzas	55.2	48.0	41.9	31.9	28.6		10.5	11.3	12.8	17.2	21.6	24.9	32.1	39.9	43.6	51.8
Big Carlos	63.5	56.3	50.2	40.2	36.9	10.5		4.4	5.9	10.3	14.7	18.0	25.2	33.0	36.7	44.9
New (Little Carlos)	64.3	57.1	51.0	41.0	37.7	11.3	4.4		4.1	8.5	12.9	16.2	23.4	31.2	34.9	43.1
Big Hickory	65.8	58.6	52.5	42.5	39.2	12.8	5.9	4.1		6.6	11.0	14.3	21.5	29.3	33.0	41.2
Wiggins	70.2	63.0	56.9	46.9	43.6	17.2	10.3	8.5	6.6		5.6	8.9	16.1	23.9	27.6	35.8
Clam	74.6	67.4	61.3	51.3	48.0	21.6	14.7	12.9	11.0	5.6		3.7	10.9	18.7	22.4	30.6
Doctors	77.9	70.7	64.6	54.6	51.3	24.9	18.0	16.2	14.3	8.9	3.7		7.8	15.6	19.3	27.5
Gordon	85.1	77.9	71.8	61.8	58.5	32.1	25.2	23.4	21.5	16.1	10.9	7.8		11.4	15.1	23.3
Capri	92.9	85.7	79.6	69.6	66.3	39.9	33.0	31.2	29.3	23.9	18.7	15.6	11.4		5.1	13.3
Big Marco	96.6	89.4	83.3	73.3	70.0	43.6	36.7	34.9	33.0	27.6	22.4	19.3	15.1	5.1		12.4
Caxambas	104.8	97.6	91.5	81.5	78.2	51.8	44.9	43.1	41.2	35.8	30.6	27.5	13.3	13.3	12.4	

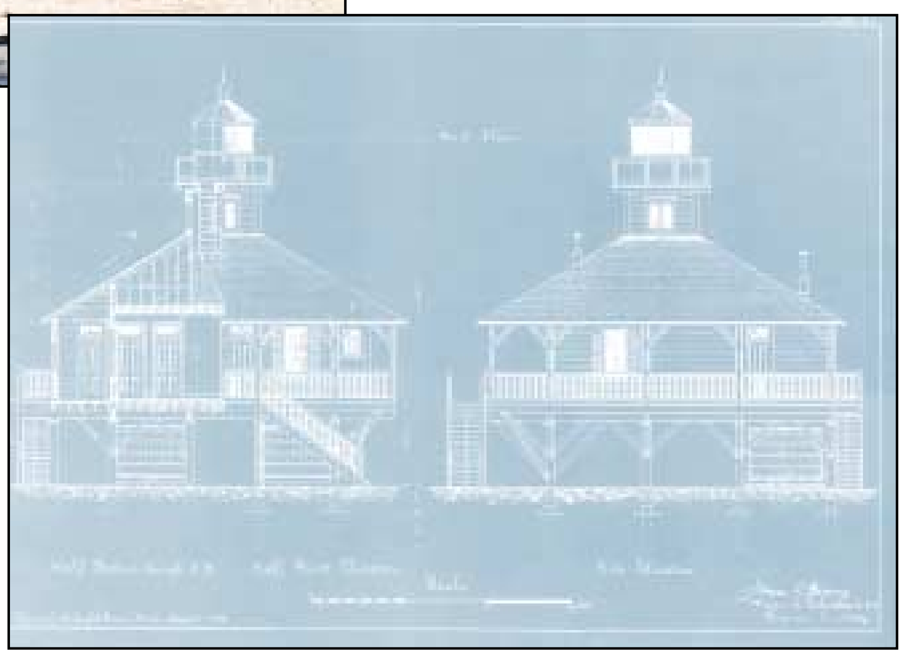
Table 1. (a-e)

In 1890, in order to illuminate the last dark spaces of the Florida coast, a lighthouse was lit on the southernmost tip of Gasparilla Island. Called Old Port Boca Grande Lighthouse, it served as a guidepost to Charlotte Harbor and was a square, house-type sentinel perched on steel stilts to protect it from the gnawing surf. In 1927, the iron pile Gasparilla Island Rear Range Lighthouse was constructed north of the old lighthouse to serve as an additional aid for harbor-bound traffic. Like its sister sentinel at Sanibel Island, its open framework design allowed wind and water to pass through unobstructed, and its lightweight piles were more easily anchored in the Gulf Coast's erosive shore than a masonry foundation.

—Elinor DeWire, *Guide to Florida Lighthouses* © 1987.



Old Port Boca Grande Lighthouse was abandoned in 1967 and fell victim to vandals and the elements. Local residents felt the elder sentinel should be preserved and had it transferred from federal to county ownership in 1972 for inclusion in a park. It was placed on the National Register of Historic Places in 1980. Late in 1985, the Gasparilla Island Conservation and Improvement Association assumed the responsibility of restoring the rapidly deteriorating structure. The project was successfully completed in November 1986. Through the assistance of the U.S. Coast Guard, the original imported French Fresnel lens was reinstalled. On November 21 of that year the beacon was ceremoniously relit and the Old Boca Grande Lighthouse is again an active federal aid to navigation.



Inlet Features

Inlets are natural or manmade channels connecting the coastal waters of the Gulf of Mexico to estuaries. A key feature of inlets is strong tide-induced currents that build up and modify supplies of sand, called shoals, adjacent to their channels. Inlets may migrate, stabilize, open, or close in response to changes in sediment supply, wave climate, tidal regime, back-bay filling or dredging. Changes in inlets occur on different time scales, ranging from hours during severe storm events to decades or even centuries.

For the mariner running an inlet, the most recognizable feature is the steep groundswell that builds across the inlet mouth, caused by waves interacting with the sea bottom where onshore swells encounter shoaling water. Figure 1 illustrates tide-generated and wave-generated features in a typical Southwest Florida inlet system. Sediment transport along the beach face, referred to as longshore or littoral drift, occurs on the Gulf side of barrier islands. It is generally north to south in Southwest Florida, although localized reversals are common. Figure 2 shows the elements of a typical inlet system; not all of the features illustrated may be present or well developed in all inlets.

Sand is deposited as shoals just inside and outside the inlet due to the reduction of current speed in these areas. Ebb-tidal deltas are created at the seaward margin-outside-of the inlet and retreat or bend in response to interaction with incoming waves and ebb tides. Large inlets, like Boca Grande and Big Marco, build extensive ebb-tidal deltas that may contain millions of cubic yards of sand. The sediment sources include material from the bay, material eroded from the main ebb channel, or longshore drift-deposited sand, that moves along the shore between the beach and the outer edge of the breaker zone due to waves approaching the shore at an angle.

Material brought out on the ebb tide is deposited on the swash platform. The breaking waves that the mariner experiences at the inlet entrance are a dominant feature on swash platforms and help create swash bars. Marginal channels may develop along the ends of barrier islands where incoming (flood) tidal flow is enhanced by wave-generated currents; the swash channel at Boca Grande is a good example of this feature. These channel features, at boat deck level, appear to have the smoothest water surface and absence of breakers and, under favorable weather, may offer the mariner a short route through an inlet.

Spits occur where there is a high rate of longshore sediment transport coupled with a small tidal prism in the estuary. Spit growth may restrict tidal flow in the main channel and cause downdrift migration or closure of the inlet. Migration of barrier island spits along this reach of the Florida coast is generally southward, in the direction of historic net longshore transport. The extension of Captiva Island, closure of Blind Pass, and migration of Little Marco Pass are illustrative of this process.

Flood (incoming) tidal currents transport sediment landward through the inlet via the main channel, producing a similar shallow water, delta-like feature on the bay (inner) side of the pass. The interplay of ebb and flood tides on this flood tidal delta creates spits and spill-over lobes where flood currents run strong. This dynamic process at Redfish Pass has caused shoaling within the dredged channel to South Seas Resort. Flood tidal deltas are less prone to change than ebb tidal deltas in Southwest Florida. They may become stabilized by seagrasses and mangroves over time, serving as nurseries for juvenile fish and important fishing grounds.

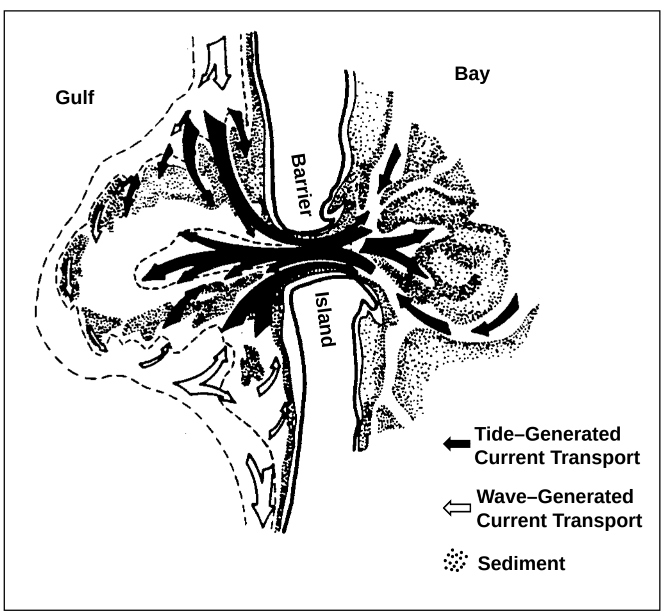


Figure 1.
Tide-generated and wave-generated transport features in a representative inlet system (from Smith, 1984).

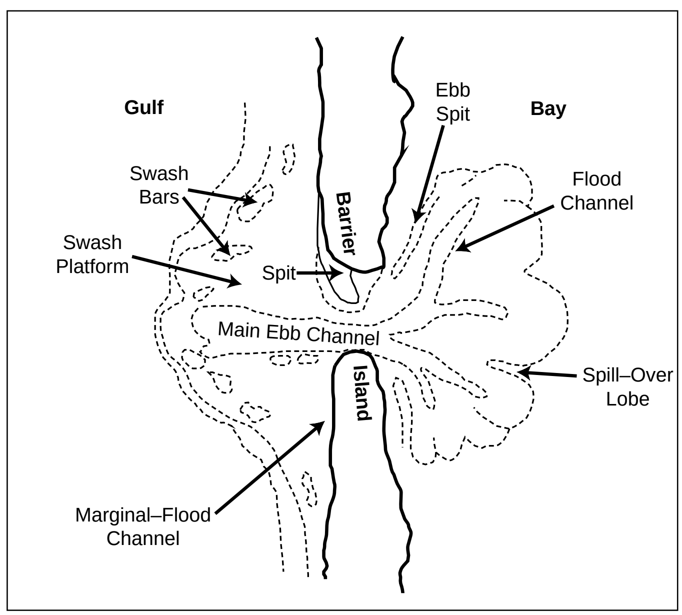


Figure 2.
Tidal inlet features (from Smith, 1984).

Types of Inlets

The form of seaward-flowing, ebb-tidal deltas is determined by tidal and wave energies. The mix of these two forces determines the movement and deposition of sediments. The character of an inlet — its shape, dynamics, and navigability — evolves over time as the inlet adjusts to changes caused by the interaction of tides and waves. Since Southwest Florida is a low wave energy coastline and the mean tidal range is relatively small (generally no more than 3 feet), a delicate balance exists between tide- and wave-dominated conditions. A slight decrease in tidal prism (e.g., due to bayside filling) may cause an inlet to change from tide-dominated to wave-dominated. Likewise, a change in wave energy reaching the inlet due to sediment accumulation and spit development along the beach face may offset the alignment of the ebb delta to the inlet.

In addition to these natural forces, shoreline engineering through construction of groins, jetties, and bulkheads — features designed to stabilize the shoreline by holding beach sand in one place — can dramatically alter the supply of sediment and the course of development and shape of an inlet. Another factor leading to inlet alteration is caused by beach renourishment, which can contribute to pass shoaling as added sand moves via longshore drift.

Figure 3 depicts four types of inlets found in Southwest Florida, based on the shape of ebb-tidal deltas: tide-dominated, wave-dominated, mixed-energy with straight shape, and mixed-energy with offset shape. The Gulf is to the left side of the diagram and the bay side is to the right, as in Figures 1 and 2.

The signature feature of tide-dominated inlets is a well-defined main ebb channel with deposits of beach sand on adjacent Gulf shores. Boca Grande and Redfish Pass are good examples. These inlets have relatively stable ebb tidal deltas. Mariners should exercise caution in approaching tide-dominated inlets from the Gulf during falling tides because maximum ebb current velocities can be high. A combination of strong on-shore winds and peak ebb tide can be especially hazardous due to the wave amplitude and steepness.

Wave-dominated inlets are very unstable and prone to migration along the coastline. As wave-dominated inlets migrate, the main channel lengthens and becomes hydraulically inefficient for tidal exchange. Big Hickory is an example of such a “wild” inlet. Wave-dominated inlets are susceptible to closure by the formation of new, more hydraulically efficient inlets when storms breach spits on the updrift side. Such an event occurred when a hurricane formed Redfish Pass in 1921 and, over subsequent years, captured the tidal prism of Blind Pass and closed it for extended periods.

Mixed-energy inlets have ebb-tidal (Gulf side) deltas shaped by a combination of tidal and wave forces. Maximum ebb and flood tidal current velocities tend to be equal and have a lower magnitude in mixed-energy inlets than other inlet types. The main ebb channel may shift its location due to drifting beach sediment. Where littoral drift is pronounced, a channel offset may occur.

Gordon Pass is an example of a mixed-energy inlet with a straight ebb-delta shape. Its main ebb channel is periodically dredged on an alignment perpendicular to the shore (east-west heading). Net littoral drift, from north to south, builds a shoal over the swash platform.

Big Marco, Captiva and Gasparilla inlets are mixed-energy systems with an offset alignment. The approach from the Gulf to the main ebb channel in these inlets is from the south, off the north end of the southern barrier islands. Once inshore of the swash bar shoals, the channel parallels the curved north shore.

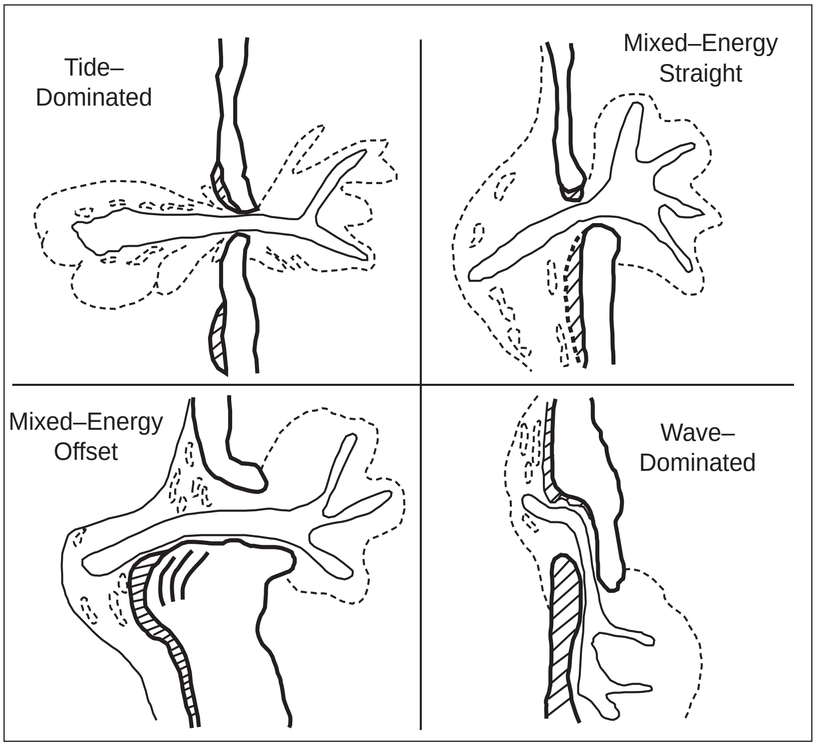
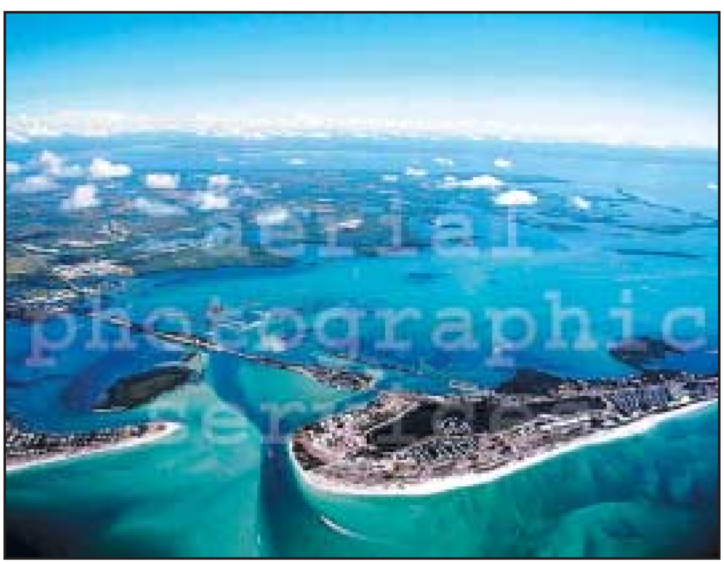


Figure 3.
Inlet types along the Southwest Florida Coast (from Davis Jr. and Gibeaut, 1990).



Gasparilla Pass, looking southeast past the causeway and abandoned railroad trestle to Gasparilla Sound with Charlotte Harbor in distance.

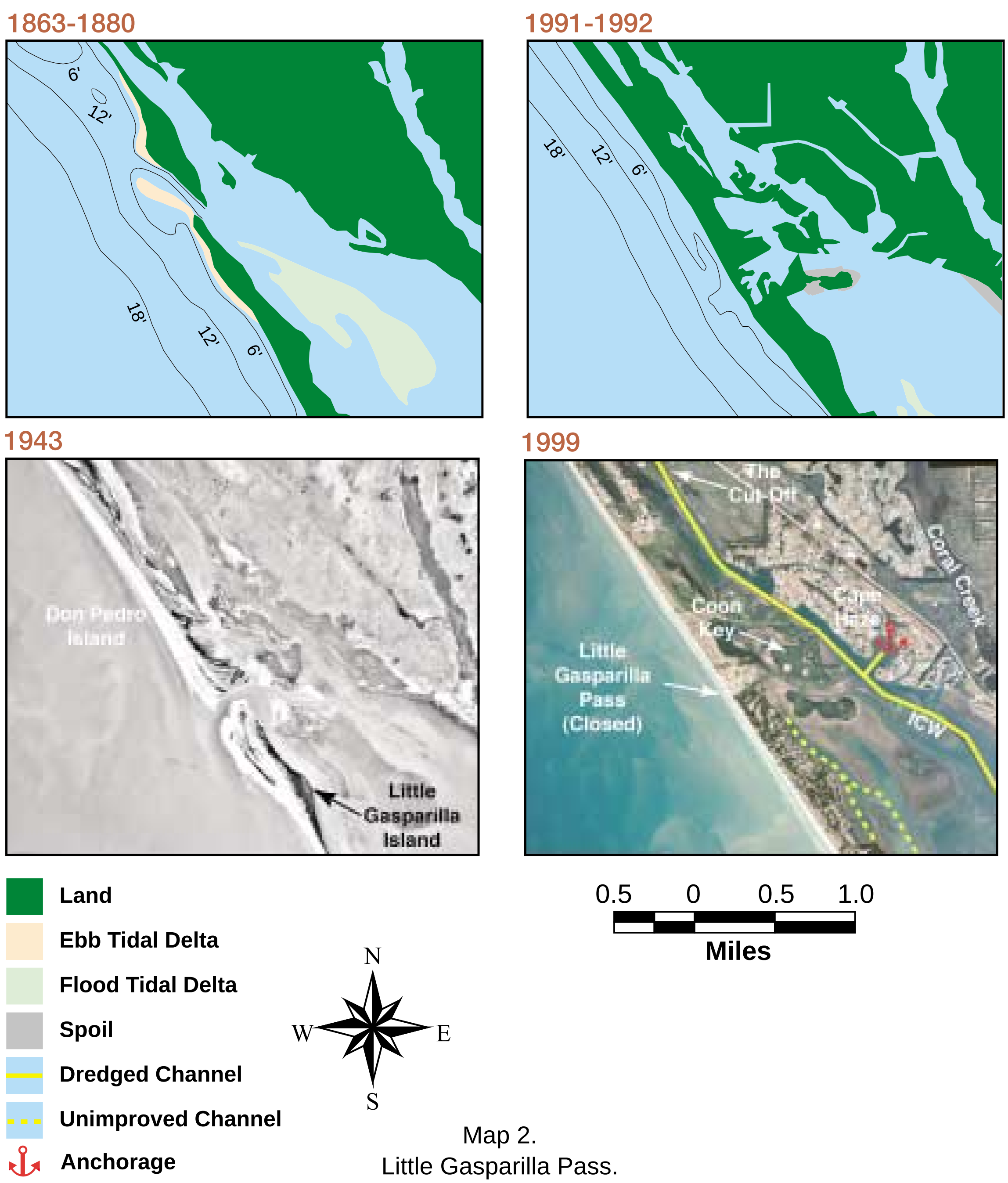
Historical Changes

Changes in inlets are revealed by historic charts and aerial photographs that provide an indelible image of the location and shape of these highly dynamic, visible features of the region's boating geography. The following section offers a description of these changes as seen through a selection of maps that recreate antecedent inlet features, along with historic and contemporary aerial photographs illustrating changing inlet conditions.

Little Gasparilla (Boca Nueva) Pass

This inlet existed in the 1880s about 1 mile south of Bocilla Pass (Historical Geography of Southwest Florida, Volume One) and 2 miles north of Gasparilla Pass (Map 3). The inlet was closed naturally by 1957. Pre–development conditions in Little Gasparilla Pass (1863-80 Map) show a mixed-energy ebb delta. The spit at the mouth of the inlet indicates a northward net littoral drift, opposite that of Bocilla Pass to the north and Gasparilla Pass to the south. The 1943 photograph shows that the main ebb channel within the inlet throat had been realigned more east-west and a marginal flood channel had developed along the north shore of Little Gasparilla Island. At that time, the ebb delta had a slight downdrift (south) orientation. There are remnants of a large flood-tidal delta which, with the inlet's closure and a reduction in the tidal exchange, have become stabilized with seagrasses.

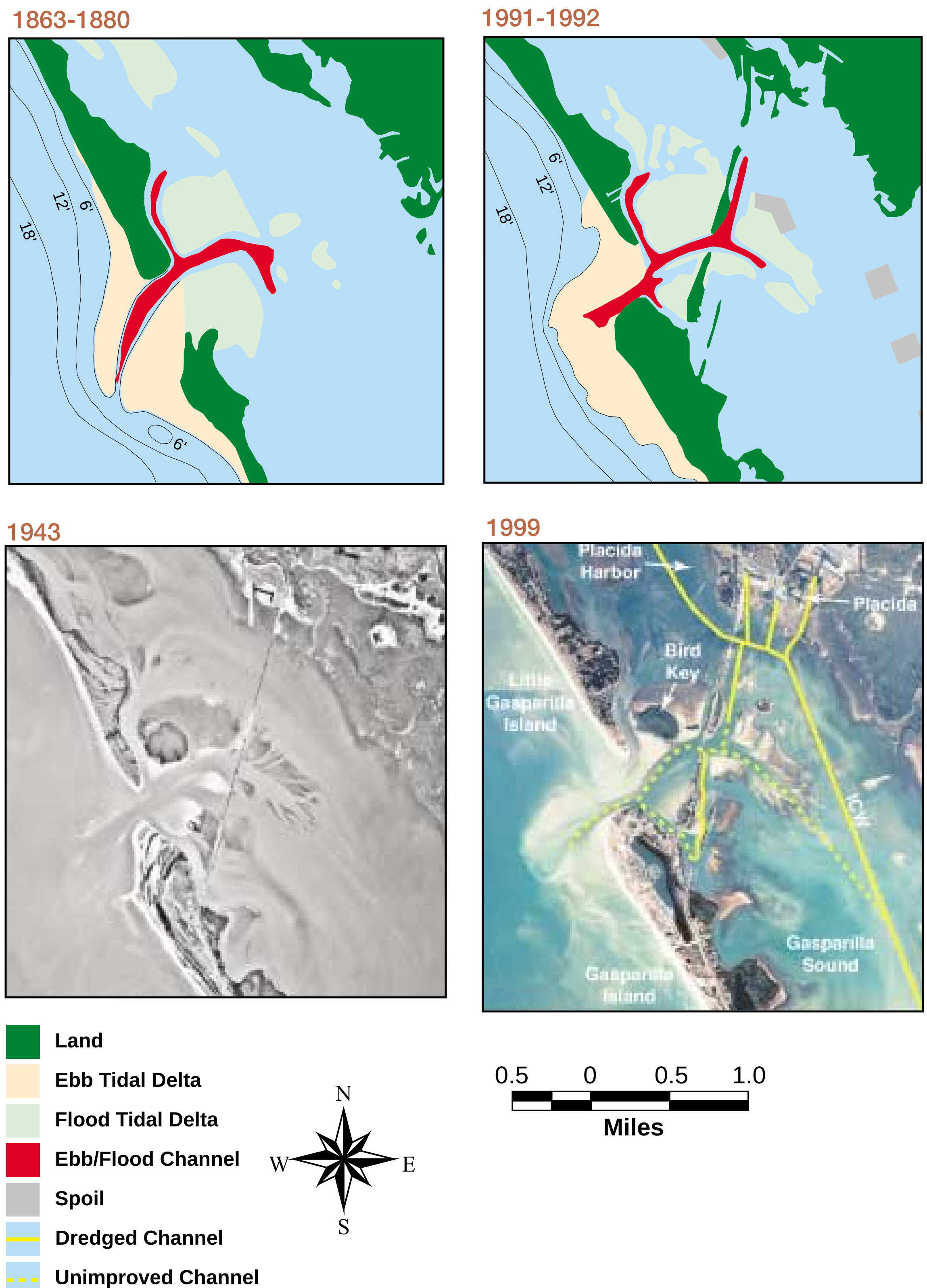
The bayside geography, shown in the 1991-92 map, has been drastically altered by land development on the Cape Haze peninsula and dredge-and-fill associated with the Gulf Intracoastal Waterway (ICW). Coon Key has spoil deposits from the ICW dredging of the 1960s. An anchorage, popular with boaters cruising the ICW, is situated in a dredged basin, adjoining a residential community, on the mainland (1999 photo).



Map 2.
Little Gasparilla Pass.

Gasparilla Pass

This is a large inlet, stable since the 1860s (Map 3). The ebb-tidal delta exhibits a mixed energy offset configuration (1863-80 map). The notable change since the 1860s has been a large increase in its downdrift, southward orientation (1991-92 map). Though Gasparilla is an unimproved inlet, dredge-and-fill associated with construction of the bayside causeways has modified the flood tidal delta (1943 photo). Bird Key has developed on flood deltaic sediments. A dredged channel south of the road causeway leads to a popular marina on the north end of Gasparilla Island (1999 photo). Ebb-flood channels are well developed and deep; boaters use them when running the inlet between the Gulf and Gasparilla Sound.



Map 3.
Gasparilla Pass.

Boca Grande

Boca Grande is the primary inlet serving Charlotte Harbor. Because of its size, width and large tidal prism, the inlet has been stable over time and — uniquely — has no flood-tidal delta (Map 4). The main inlet channel is deep (exceeding 70 feet in the throat), but abruptly shoals to less than 6 feet along the north lobe of the ebb-tidal delta (1863-80 and 1991-92 maps). Tarpon fishermen work this edge during the season.

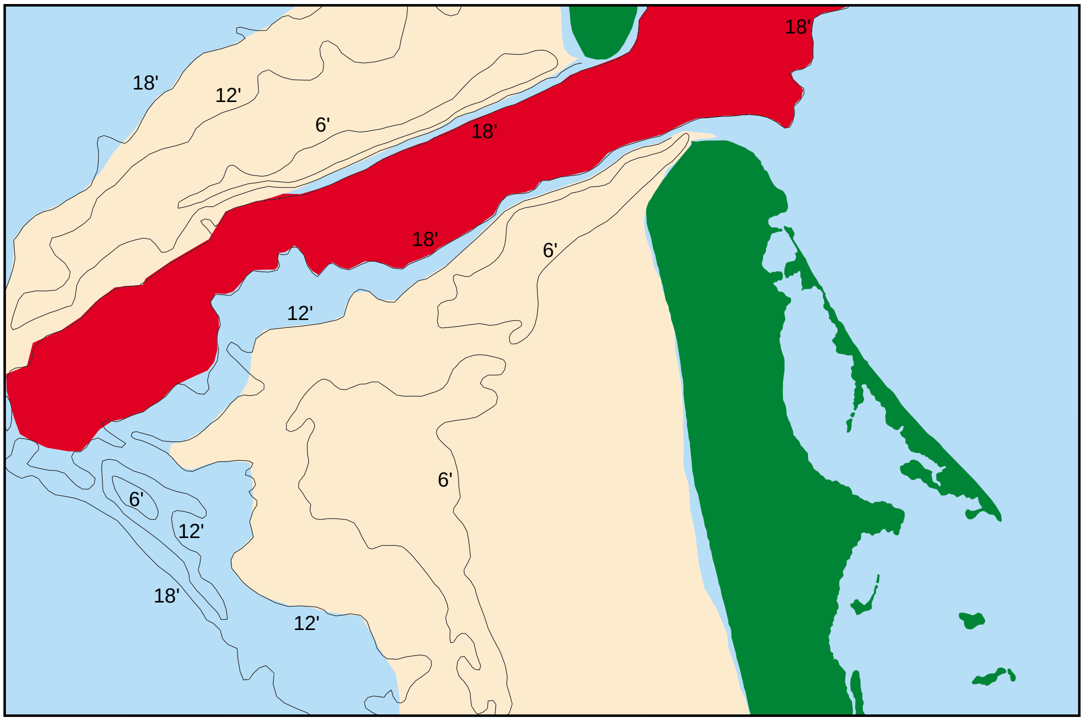
This is a federally maintained inlet. Port Boca Grande, at the south end of Gasparilla Island, once served as the terminus and storage facility for phosphate, shipped by rail from inland quarries and across the causeway at Placida (see Gasparilla Inlet photo in Map 3). The tide-dominated ebb delta is extremely large and asymmetrical. There is a narrow, 2.5-mile-long northern lobe containing spot

...Click went the reel, down went his thumb on the leather brake, and with a long, steady movement he swung his rod to the vertical position, when he took most of the pressure off the brake. Whiz! went the reel with lightning speed in the fraction of a second. Then, with a glorious leap, out sprang the king of game fish. His tail was three feet above the water, his head perhaps eight, while his six feet of polished silver side flashed in the sun.

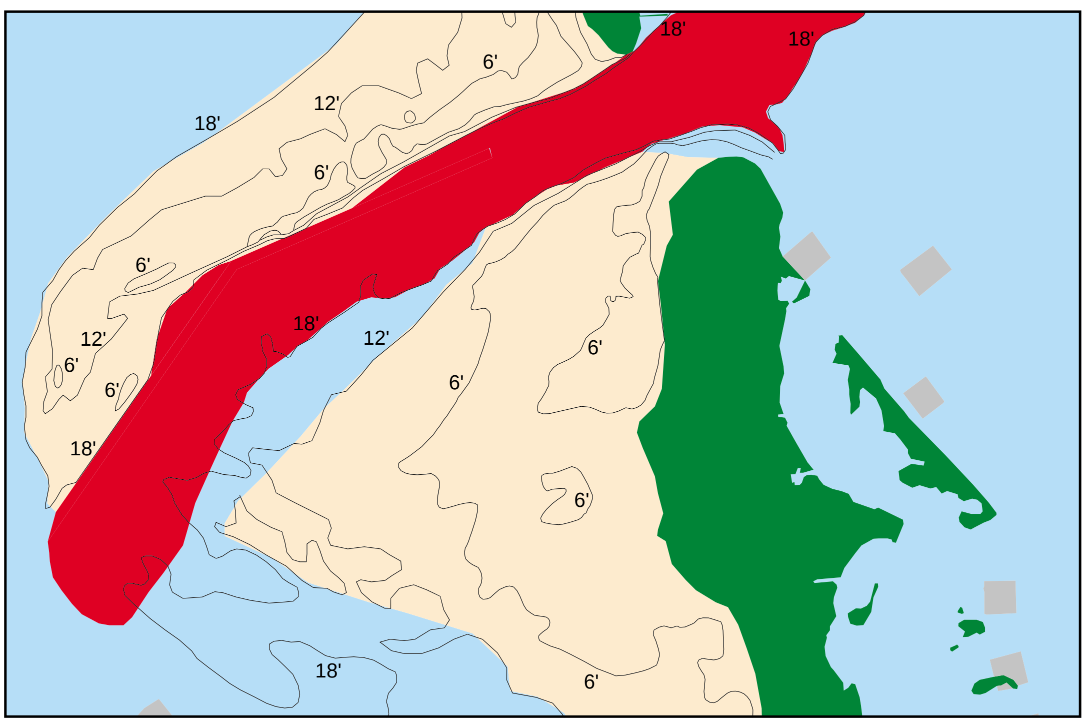
—O.A. Mygatt, "A Good Day's Tarpon Fishing" 1890

—*Tales of Old Florida* ©1987.

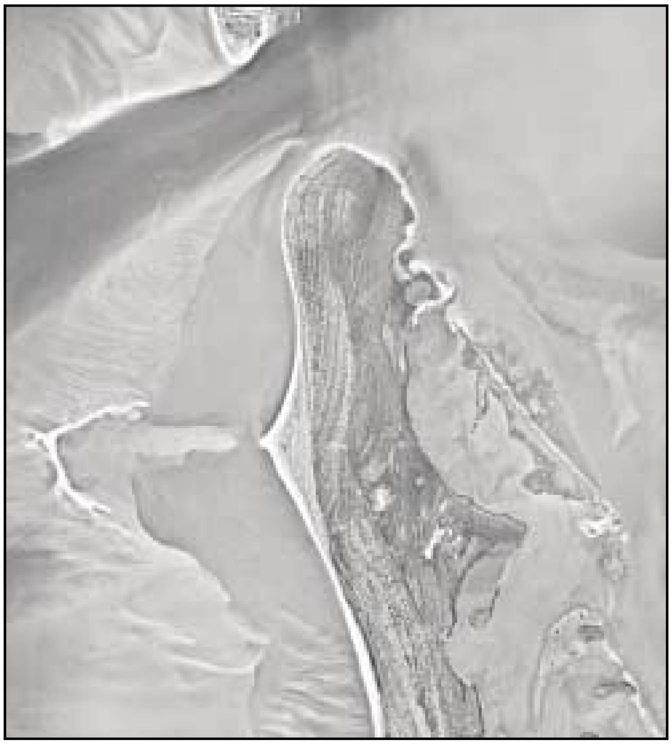
1863-1880



1991-1992

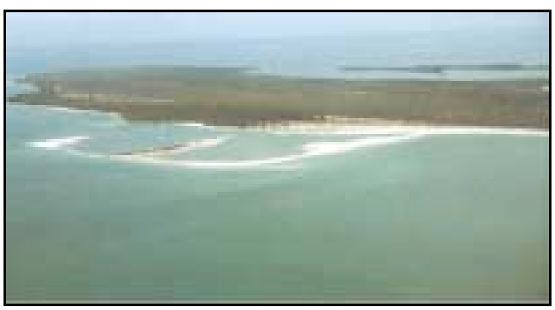


1944

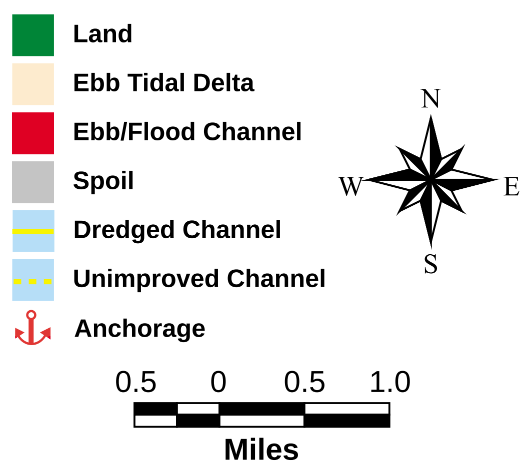


1999

Map 4.
Boca Grande.



Johnson Shoals, 1981.

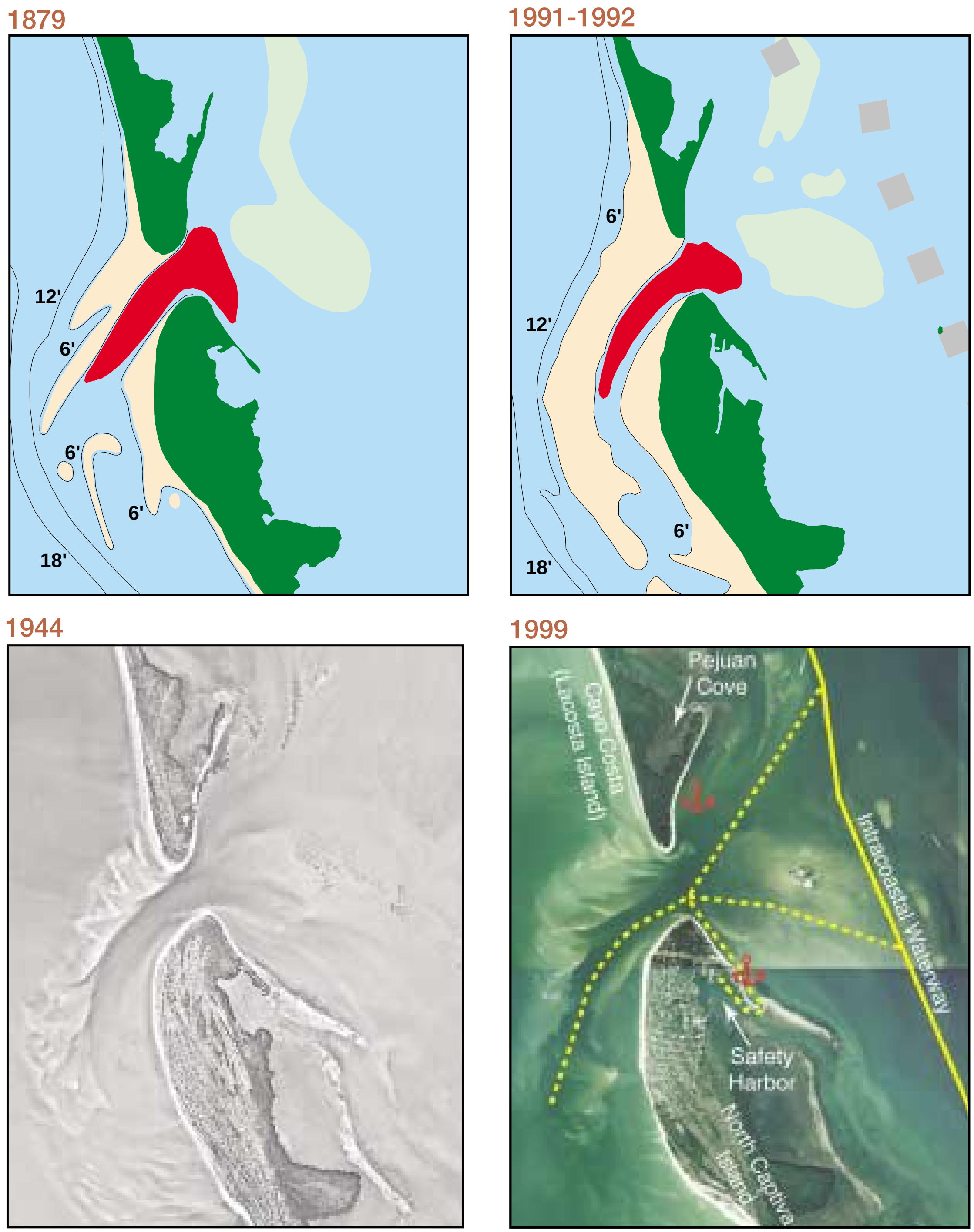


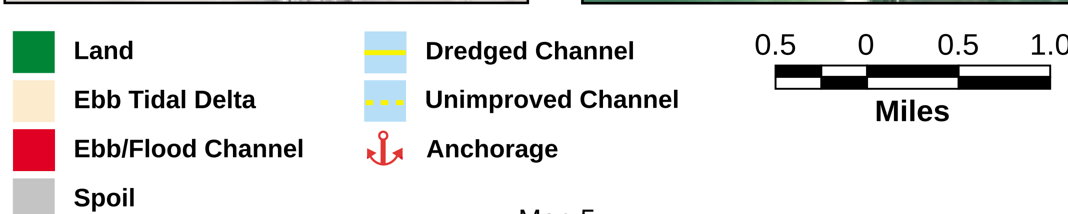
shoals less than 2 feet deep. The broad southern lobe that covers an extensive offshore area, Johnson Shoals, nourishes beach development on Cayo Costa, as sand is accreted and beach ridges are formed and move shoreward. Murdoch Point is a cuspate headland where erosion is taking place (1999 photo). The 1944 aerial photograph shows the parallel beach ridges on Cayo Costa.

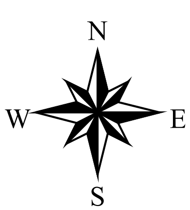
Johnson Shoals is a dynamic shoreline feature that in 1944 was an offshore bar. By 1999, it had migrated east and was attached to Cayo Costa barrier island. At times, this shoal has become stabilized and vegetated, as shown in the 1981 oblique aerial; when this occurs, Johnson Shoals is a prime fair-weather destination for recreational boaters.

Captiva Pass

Captiva Pass (Map 5) retains much of its pre–development form (1879 map and 1944 aerial photograph), with a large flood-tidal delta on the bayside and a mixed energy ebb-tidal delta, distinctly asymmetric and south drift-tending, on the Gulf side (1991 map). Both deltas are large, and the bayside form has many lobes, relatively deep water, and an extensive seagrass cover. The Gulf side ebb delta is similar in form to Big Sarasota Pass, with a main inlet channel that curves south and runs parallel to the North Captiva Island shore. This inlet is unmarked and requires local knowledge, but is a popular boating destination with anchorages adjoining the bayside inlet shore. Some amenities for boaters are available at Safety Harbor (1999 photo).





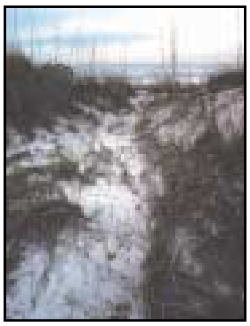


Map 5.
Captiva Pass.

Redfish Pass

The hurricane of 1921 created Redfish Pass, which separates Captiva and North Captiva Islands (Map 6). Not surprisingly, the 1879 map shows a relict flood channel of an antecedent inlet. This narrow ribbon of barrier island is subject to overwash of storm waves from the Gulf to the bayside, as occurred in 1960 (see aerial and ground photos). The pass has distinctive flood- and ebb-tidal deltas and a pronounced, deep water, ebb/flood channel in the inlet throat (1944 photo and 1991-92 map).

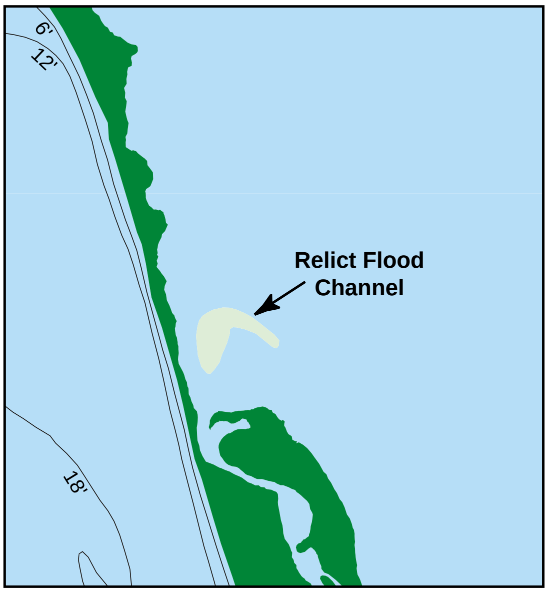
The Captiva Erosion Prevention District removed sediment from the offshore bar on the ebb-tidal (Gulf side) delta to renourish the beach on Captiva Island in 1981 and 1988. A dredged channel, which leads from the Intracoastal Waterway to South Seas Resort, a destination at the north end of Captiva Island, crosses the apron of the flood-tidal delta near the inlet (1999 photo). This approach channel is subject to shoaling because of strong tidal currents that transport and redeposit sediment from the Gulf beach. The inlet has a tide-dominated ebb delta with nearly symmetrical north and south-side depositional lobes and channel margin bars. Redfish Pass competes directly with Blind Pass, located 5 miles south, for water to flush Pine Island Sound. Since the emergence of Redfish Pass in 1921, the inlet's large tidal prism has been a contributing factor to the demise of Blind Pass.



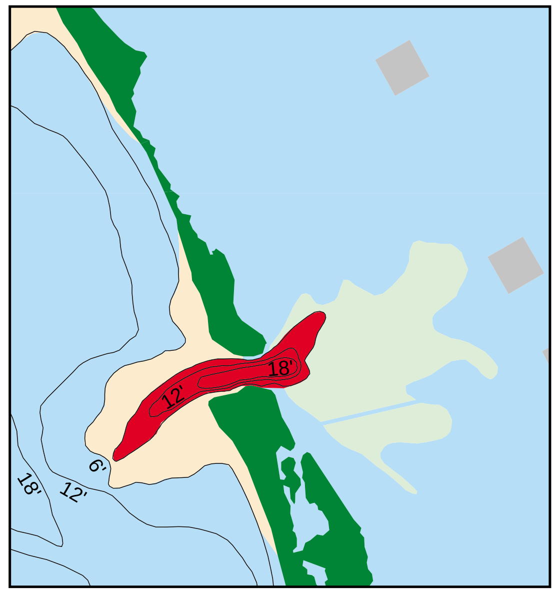
Ground view of overwash.

1960 aerial view of overwash.

1879

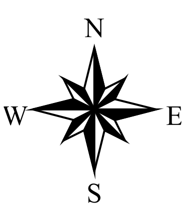


1991-1992

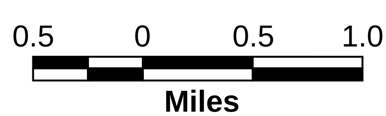


1944

1999



- Land
- Ebb Tidal Delta
- Flood Tidal Delta
- Ebb/Flood Channel
- Spoil
- Dredged Channel
- Unimproved Channel

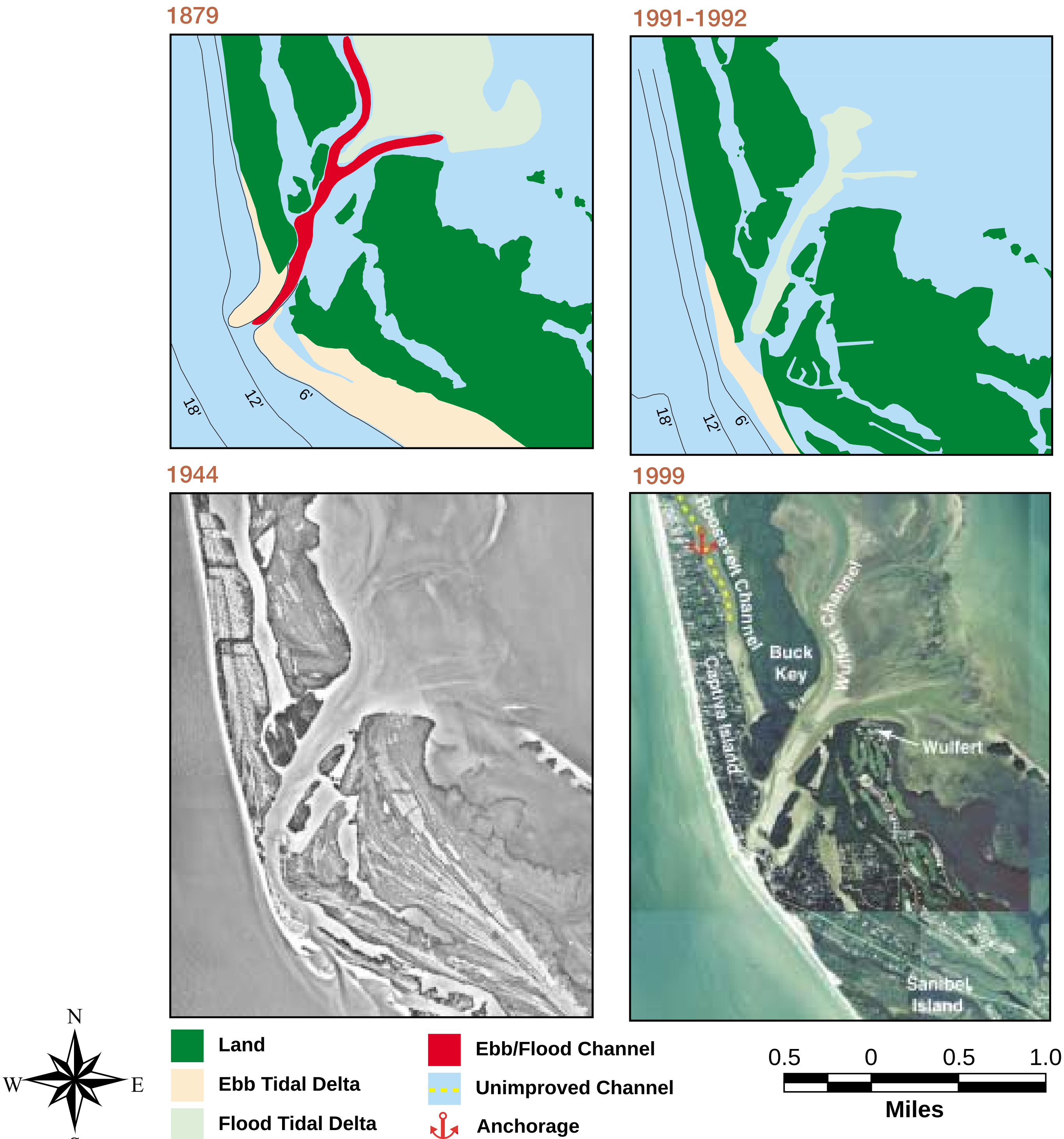


Map 6.
Redfish Pass.

Blind Pass

Blind Pass separates Captiva Island from Sanibel Island, though someone traveling overland would be hard-pressed to see where one island ends and the other begins (Map 7). Since Redfish Pass was formed by the hurricane of 1921, Blind Pass's future has been sealed: it lost most of Pine Island Sound's tidal prism, which led to its becoming a wave-dominated, "wild" inlet. An active beach renourishment program that provides a source of sediments to the Gulf shore of Captiva Island has continued to feed the existing south-trending spit, more than 1 mile in extent. Continued spit growth and placement of beach sand on northern Sanibel Island in 1996 contributed to the most recent closure of the inlet (1991-92 map). Its recent history is varied: the inlet closed in 1960, opened in 1972, closed again in 1977, only to open in 1982 and close again in 2000. The Captiva Erosion Prevention District dredged gulfward from the bridge to open the pass in 2000, not for navigation, but to provide some flushing for lower Pine Island Sound. The pass reclosed within a year.

Before Redfish Pass opened, Blind Pass was an inlet with a mixed-energy downdrift offset form (1879 map). The flood-tidal delta, developed under those pre-Redfish Pass conditions, was large and well-defined. Over the years, with the demise of the pass, this bayside feature has become stabilized with an extensive seagrass community. Boat access, from the Gulf to Pine Island Sound, in the pre–development period (1944 aerial), was through Wulfert and Roosevelt Channels. No longer a thoroughfare, Roosevelt Channel today is a popular boating destination, adjoining the town of Captiva, and a secure anchorage (1999 photo).

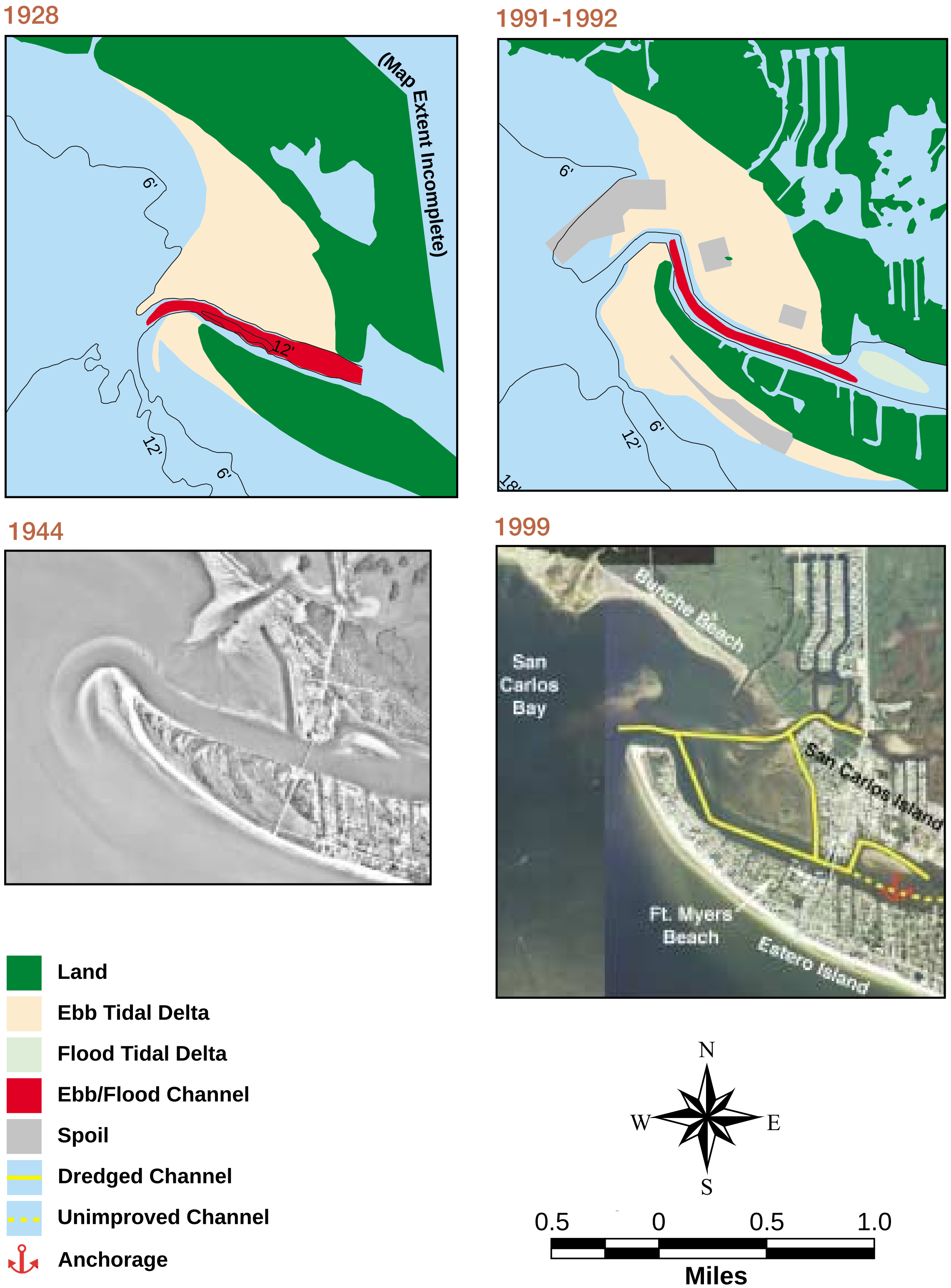


Map 7.
Blind Pass.

Matanzas Pass

Matanzas Pass has been remarkably stable over the past century (Map 8). It has a tide-dominated ebb delta due to its sheltered location from northerly winds in the lee of Sanibel Island and San Carlos Bay (1928 map). It has been federally maintained since 1961; spoil taken from the inlet has been placed on the north tip of Estero Island (1991-92 map). A small flood-tidal delta is situated inshore from the bridge connecting Ft. Myers Beach and San Carlos Island, immediately north of the anchorage (1944 and 1999 photographs).

The toll bridge over Matanzas Pass, linking Estero Island with the mainland by means of a single-lane, rutted road, cost 54 cents in 1921. With the opening of the wooden drawbridge, the beach boomed and got a new identity, as historic Estero Island became Fort Myers Beach. A hurricane in 1926 washed out the narrow bridge, which was then temporarily rebuilt; two years later a new, shorter highway and a new bridge replaced everything.



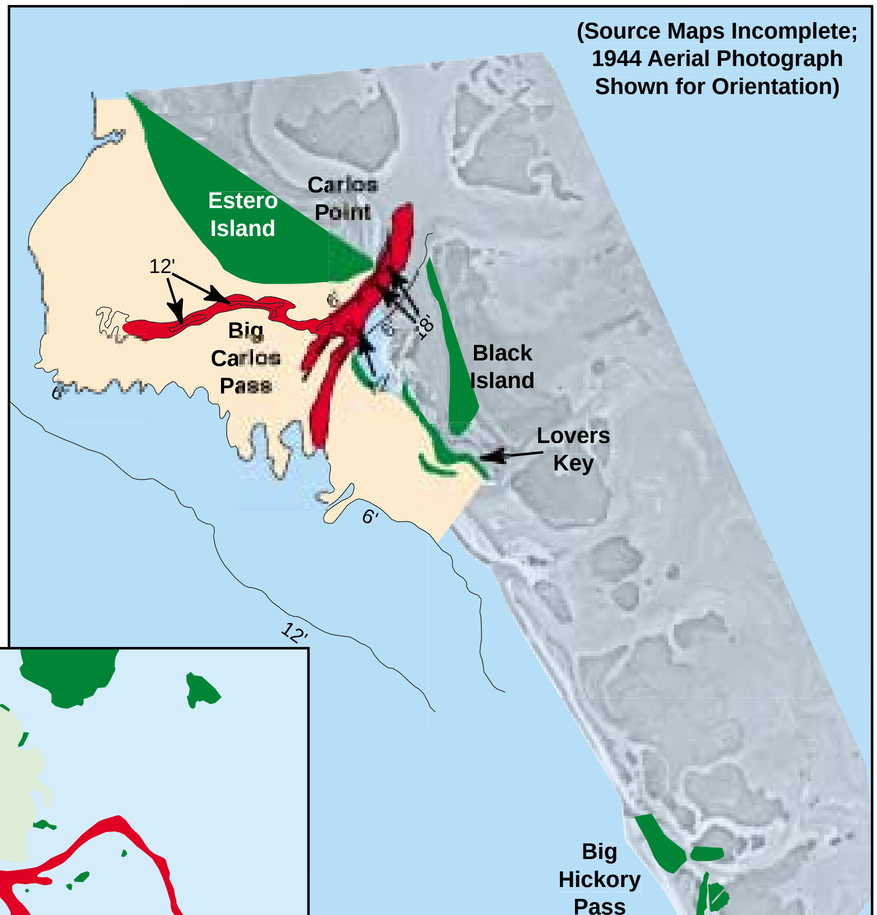
Map 8.
Matanzas Pass.

Estero Bay Passes: Big Carlos, Un–named, Little Carlos, Big Hickory

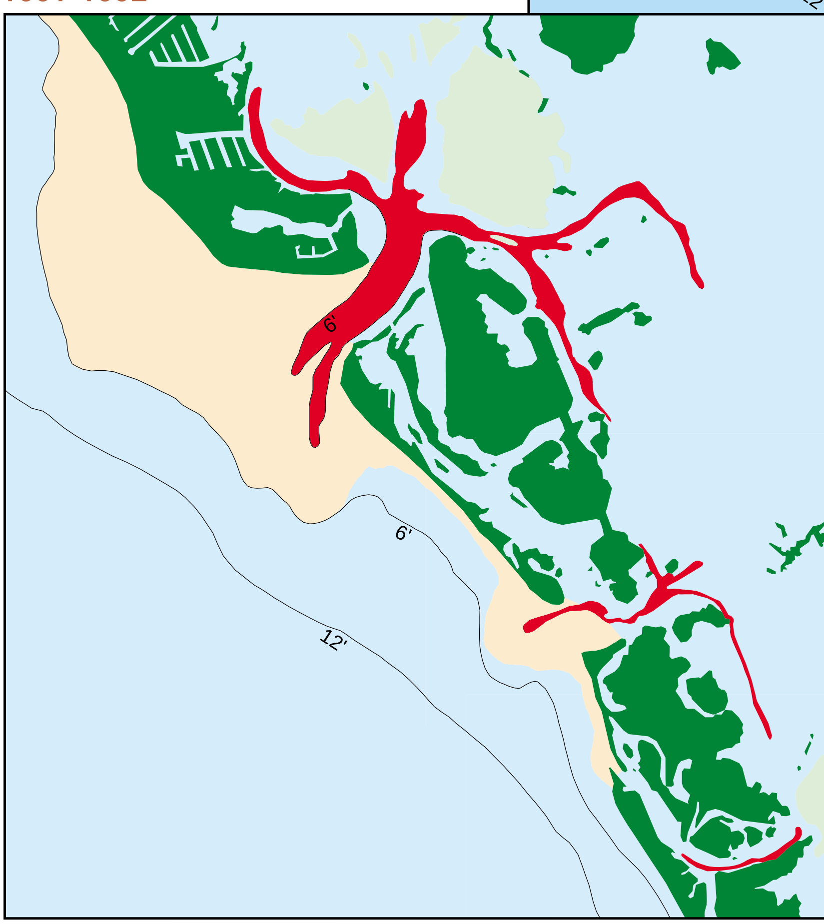
Tidal flushing for Estero Bay occurs through multiple inlets along a 3-mile stretch of the coast, south of Estero Island and north of Little Hickory Island (Map 9). Big Carlos Pass, the largest of these inlets, with a deep, wide channel, has remained essentially unchanged over the past century (1908-28 and 1991-92 maps). It has a tide-dominated ebb delta, due to the large prism and the low wave energy along this reach of the coast, sheltered from northerly storm waves by the coastline offset at Sanibel Island. Historically, there has been accretion of spits and beach ridges on both sides of Big Carlos Pass.

Pre–development era charts show Little Carlos Pass between Big Carlos and Big Hickory Passes; New Pass was nonexistent during the pre–development period. The 1944 aerial photograph shows the location of Little Carlos and New Pass. Development of New Pass appears to have resulted from hurricanes during the 1944-47 period. New Pass in 1944 shows a small ebb-tidal delta, but this has changed in recent years, as a substantial lobe has developed off the Gulf side.

1908-1928



1991-1992

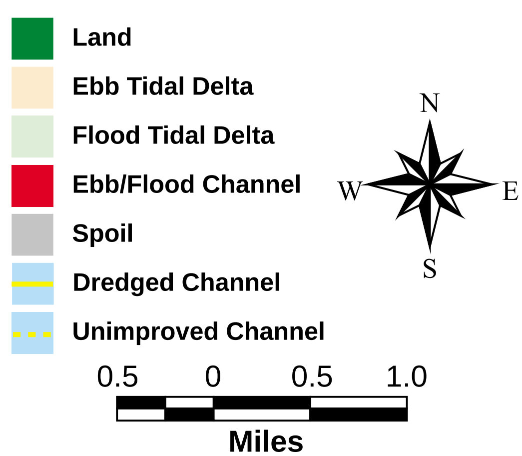


Because of the low energy wave climate, tide-dominated conditions prevail along the shoreline. Big Hickory Pass is a small, "wild" inlet that has migrated in a northerly direction over the past century. It was named for adjacent Big Hickory Island, not for the size of the inlet. Its history is marked by periodic openings and closings. Little or no ebb delta is present, though occasionally a small shoal builds from the south side and trends northwestward across the inlet mouth. Large, stable flood-tidal deltas developed bayside of these inlets over the past century, and large portions are covered with dense mangrove islands and seagrass communities.

Construction of the Route 865 causeway in the mid-1960s, linking Ft. Myers Beach (Estero Island) and Bonita Beach (Little Hickory Island), significantly altered inlet dynamics south of Big Carlos Pass. The causeway closed several tidal channels between Black Island and Little Hickory Island. With these closures, the islands west of Long Key emerged and attached themselves to Lovers' Key.

1999

1944

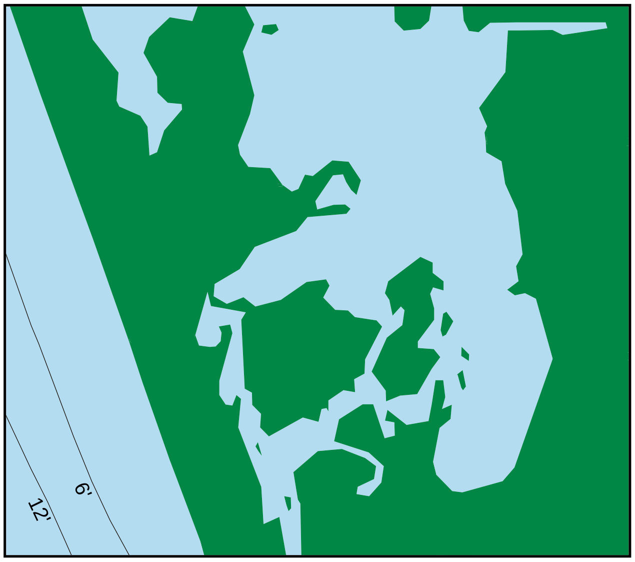


Map 9.
Estero Bay Passes.

Little Hickory Pass

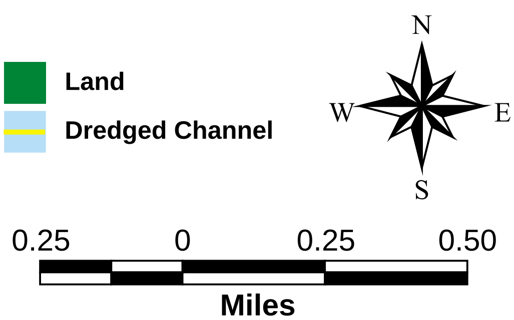
Little Hickory Pass is a closed inlet that ceased to exist in the early 1960s when developers closed the inlet in order to build an access road to beachfront properties. (Map 10). The 1944 aerial photograph shows the "wild" inlet, with tide-dominated conditions, no ebb or flood tidal deltas, and a prograding (growing) northward-trending spit at the pass entrance. The inlet's closure, coupled with construction of the causeway connecting the mainland and Little Hickory Island at Bonita Beach, has decreased water circulation within Little Hickory Bay (1991-92 map and 1999 photo).

1991-1992



1999

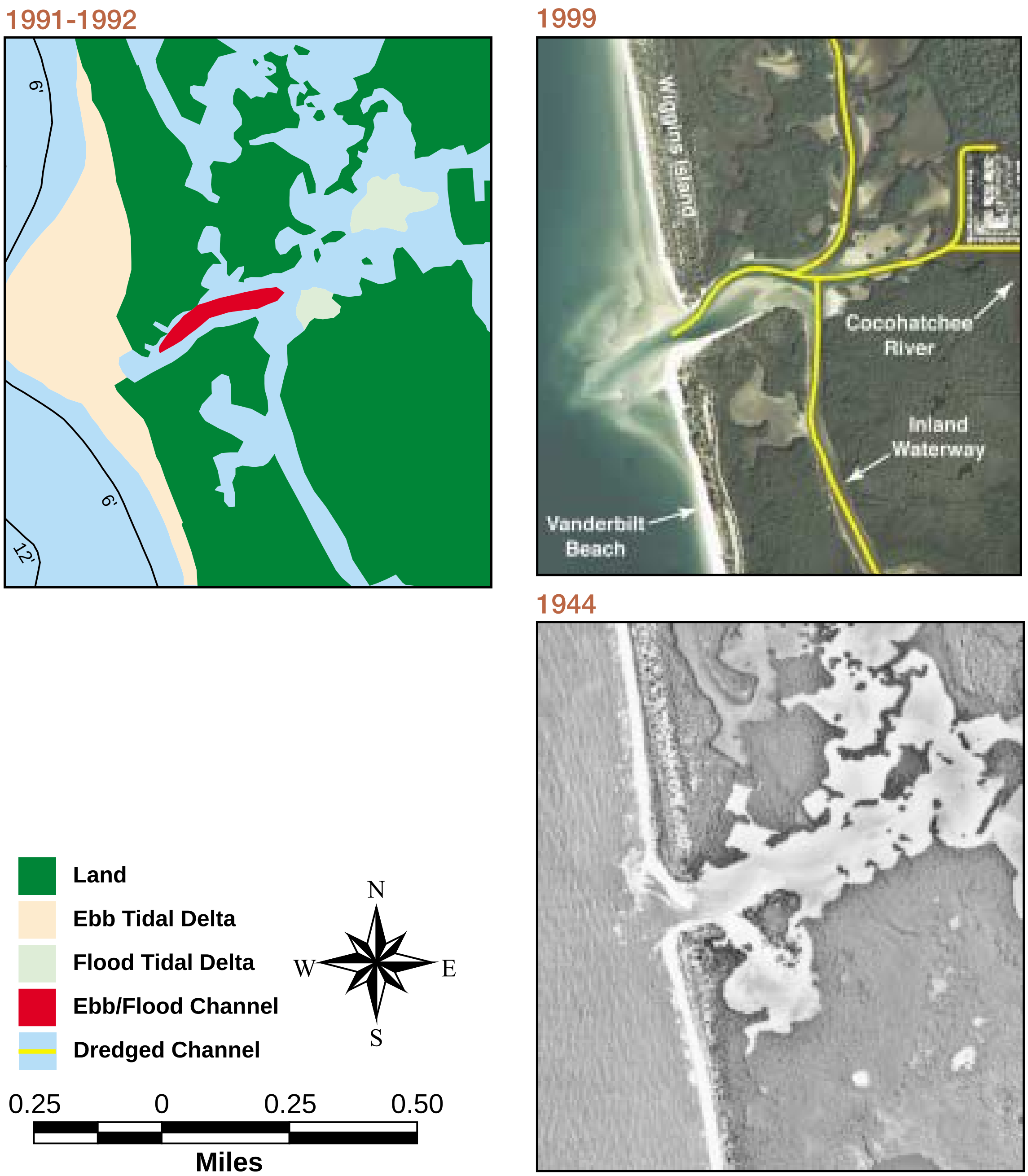
1944



Map 10.
Little Hickory Pass.

Wiggins Pass

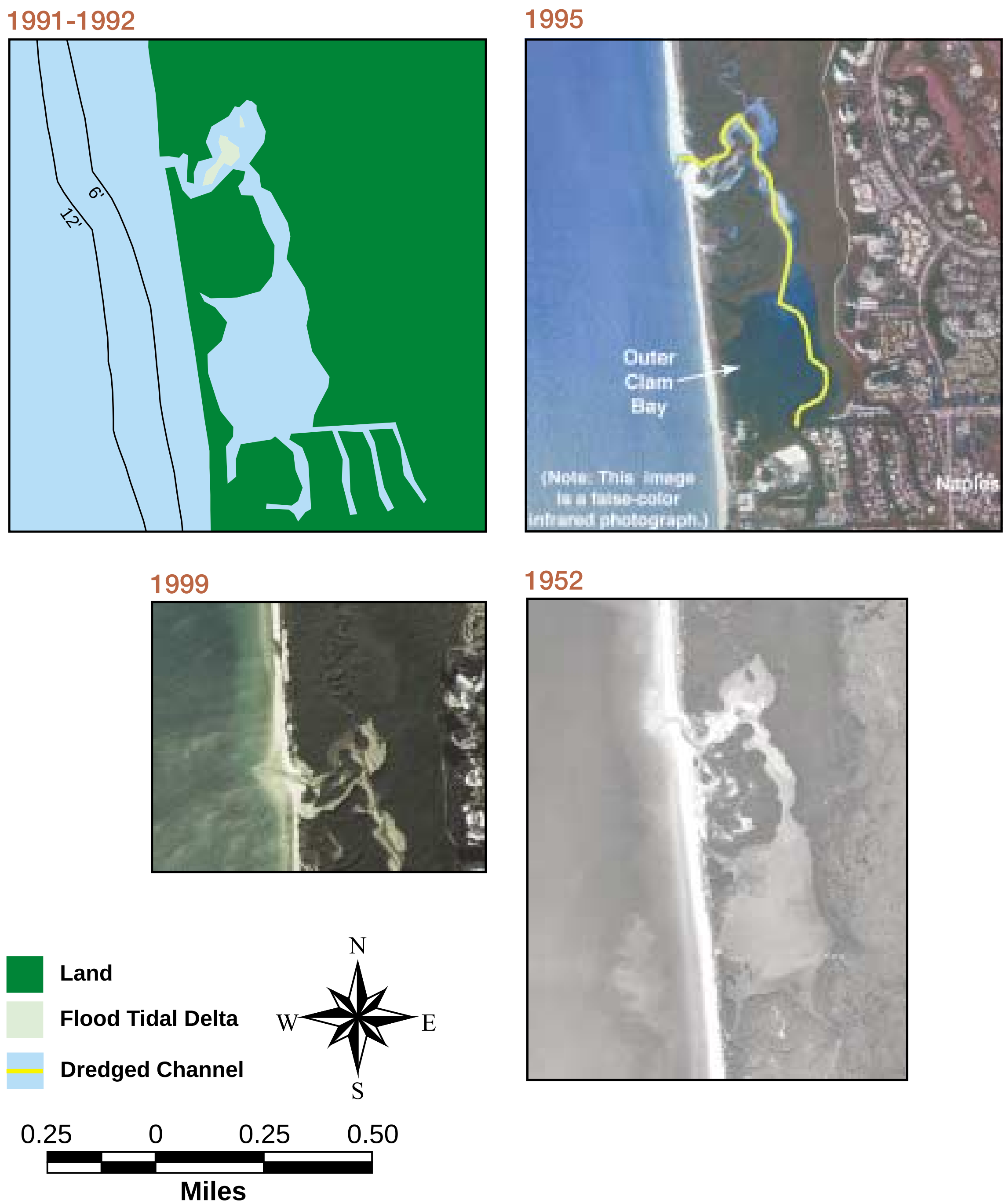
Wiggins Pass is a small inlet that was subject to periodic closings prior to 1952, when it was dredged for the first time (Map 11). The ebb-tidal delta at the mouth of the inlet shows modest accretion north and south of the entrance channel (1991-92 map). The small flood tidal shoals are partially vegetated (1944 photograph). The dredging that occurred since 1952 at the inlet and along the inland waterway south of Bonita Beach and north from Naples Park, as well as the closure of Little Hickory Pass two miles north, contributed to increasing the tidal prism and maintaining depths in the ebb-flood channel (1999 photograph).



Map 11.
Wiggins Pass.

Clam Pass

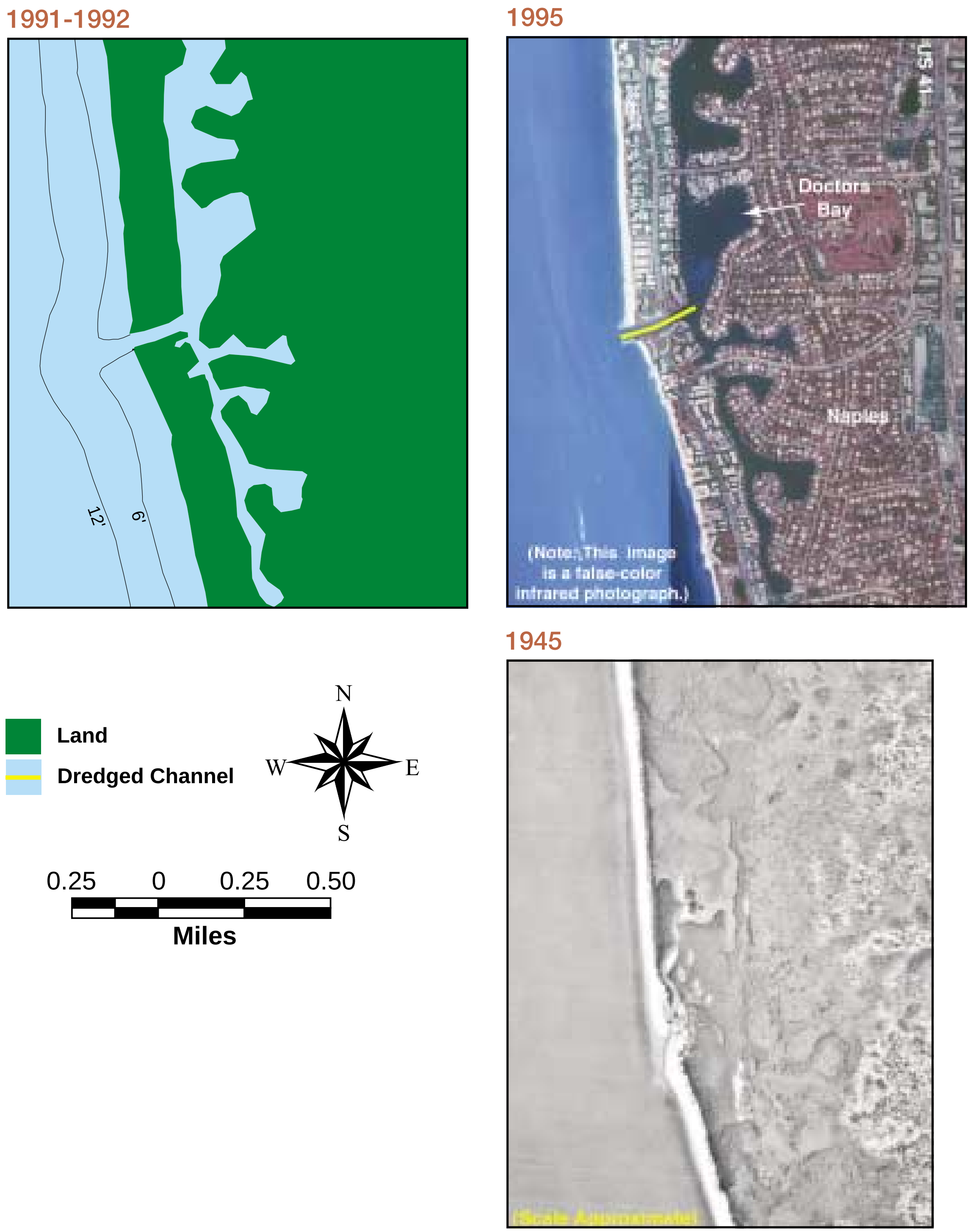
Clam Pass does not appear on the pre-development era charts. It is a very small inlet with an estuary and wetlands of limited extent (Map 12). The inlet mouth, which shifts seasonally and closes periodically, has been dredged (1952 and 1999 photos). A small flood-tidal delta is covered with mangroves (1991-92 map). Sand shoals build at the inlet mouth as do small spits (1995 photo). The 1999 color aerial photograph shows the emergence of a small ebb-tidal delta. Recent dredging has removed a portion of the flood shoal, which has increased the tidal prism.



Map 12.
Clam Pass.

Doctors Pass

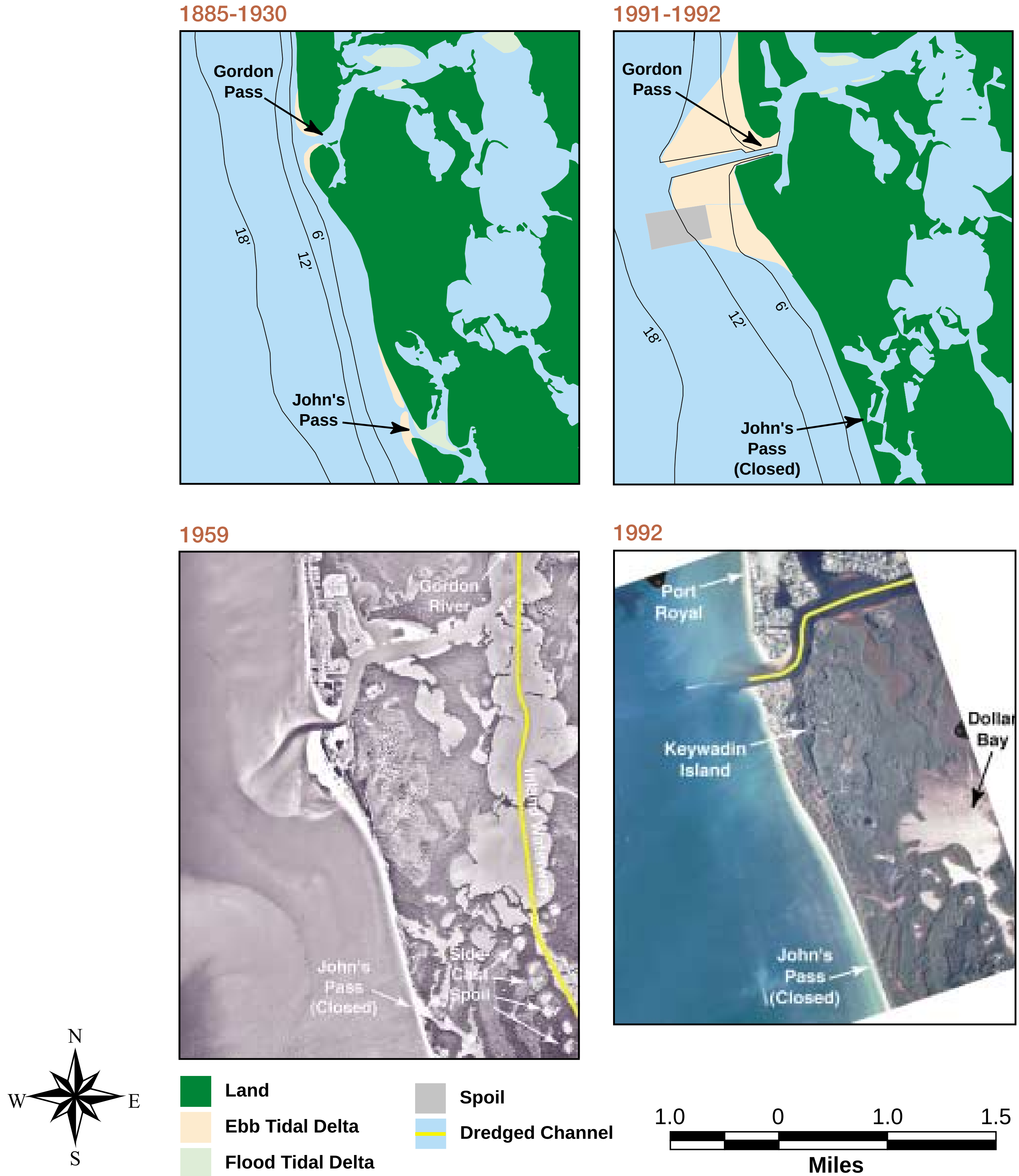
Doctors Pass provides access to the Moorings Bay system, formally called inner and outer Doctors Bays, in the City of Naples (Map 13). The 1945 aerial photograph shows a mixed-energy inlet with a prograding spit on the north, and submerged shoals extending across the mouth to the south. The pass was dredged in 1984 by the developers of the Moorings Bay Subdivision (1991-92 map). Jetties were constructed in 1960 (1995 photo).



Map 13.
Doctors Pass.

Gordon and John's Passes

Gordon Pass is the largest inlet between Big Carlos and Big Marco Passes (Map 14). The ebb-tidal delta is indicative of mixed energy conditions. Prior to dredging in 1962 and the placement of the north groin and south jetty, the ebb delta had a pronounced southward drift (1959 aerial). The entrance channel subsequently has been straightened (1991-92 map). Several deposits of flood-deltaic sediments are situated within the estuary and at its juncture with the Gordon River (1885-1930 map). Vegetated uplands and mangrove now cover these sites. John's Pass, a wave-dominated, "wild" inlet, was located 2.5 miles to the south in the pre–development period, but closed between 1938 and 1941 (1992 photo).

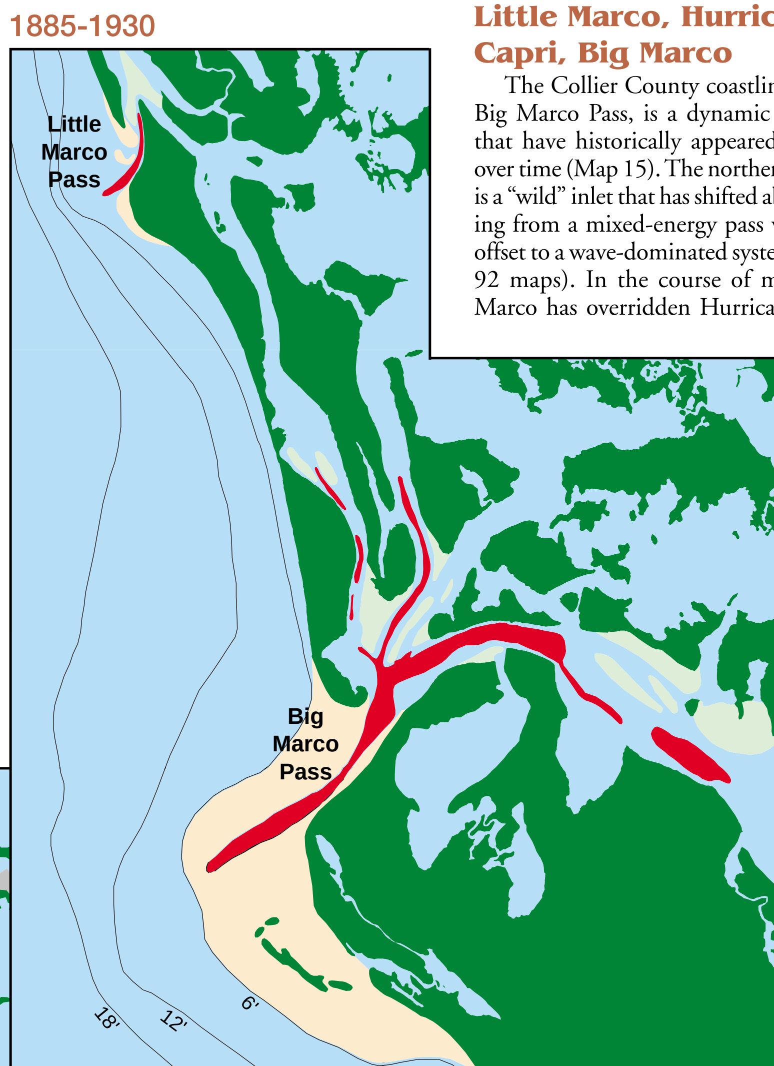


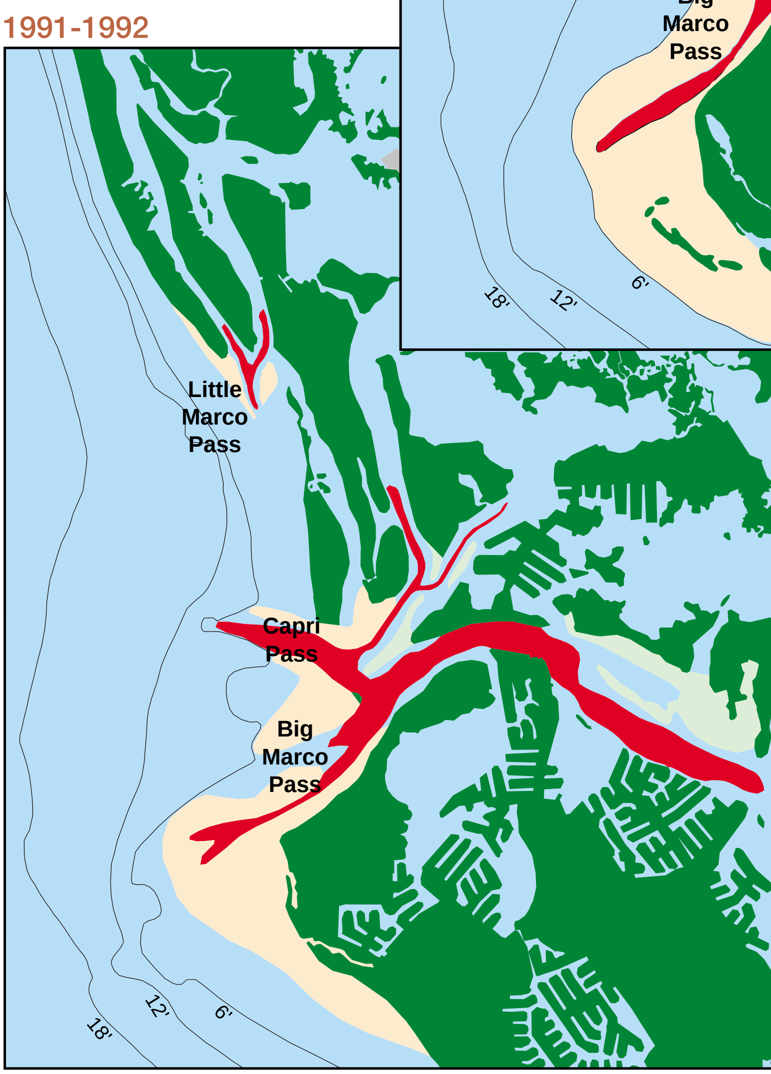
Map 14.
Gordon and John's Passes.

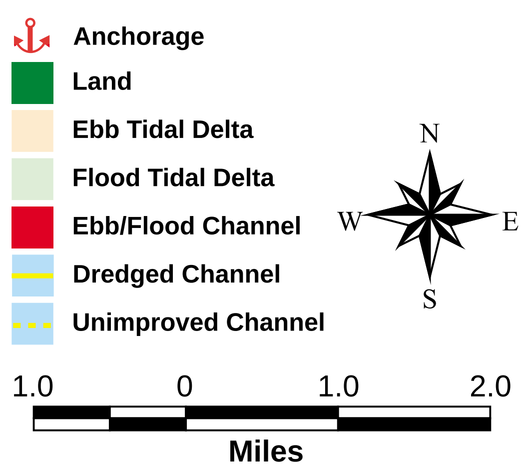
North Marco Island Passes: Little Marco, Hurricane, Capri, Big Marco

The Collier County coastline, from Gordon's Pass to Big Marco Pass, is a dynamic environment with inlets that have historically appeared and closed or migrated over time (Map 15). The northernmost inlet, Little Marco, is a "wild" inlet that has shifted about 2 miles south, changing from a mixed-energy pass with a distinct downdrift offset to a wave-dominated system (1885-1930 and 1991-92 maps). In the course of moving southward, Little Marco has overridden Hurricane Pass (1952 and 1992 photos). Today, there is a small, ephemeral sand shoal at the inlet mouth.

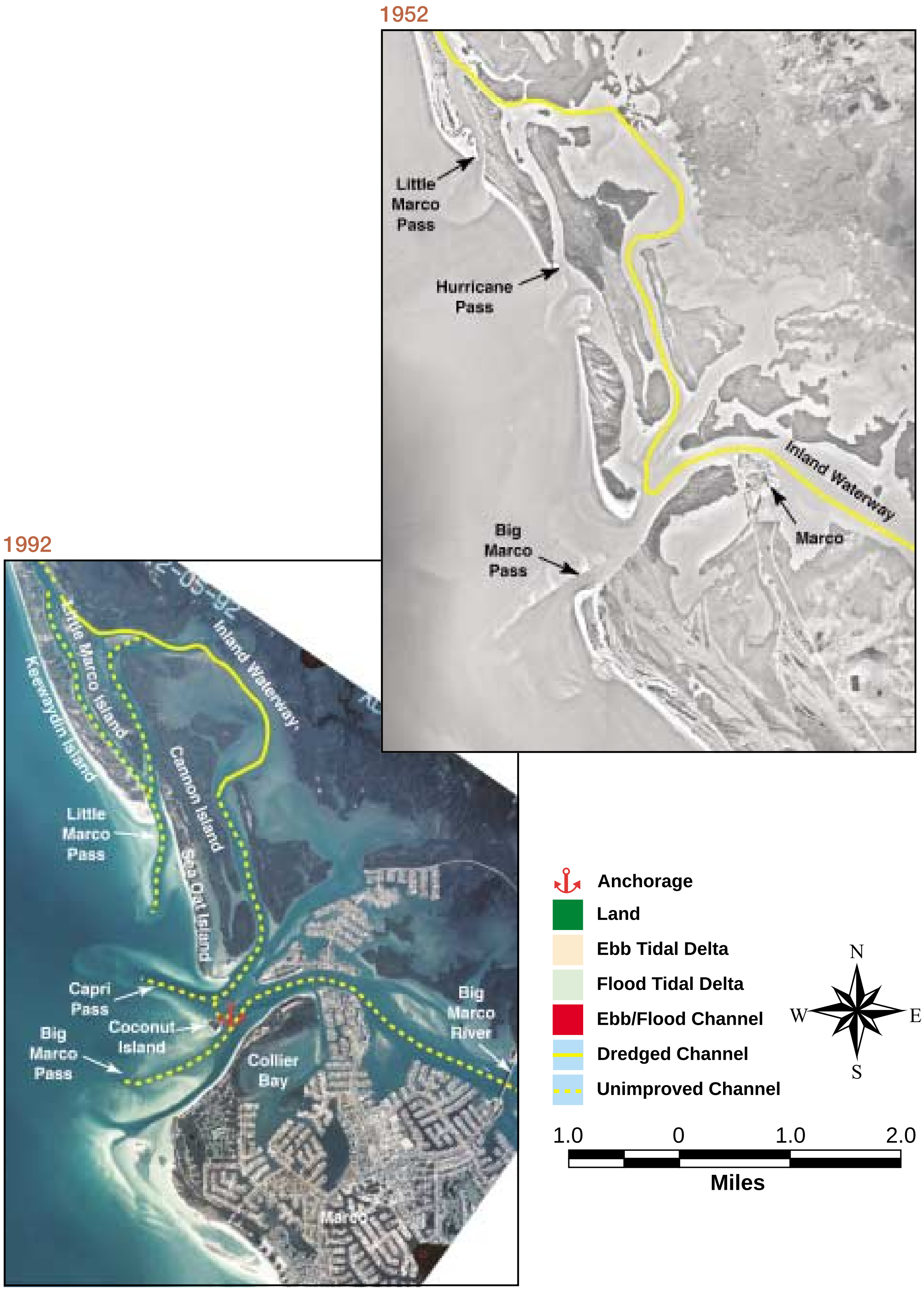
Big Marco Pass is one of the largest inlets along the Southwest Florida coastline. Sometime between 1962 and 1973, the narrow barrier island to the north, Sea Oat Island, was breached and Capri Pass was formed. Coconut Island was created by this process, which separates Big Marco and Capri Passes. Much of the tidal prism that historically flowed through Big Marco Pass now is channeled into Capri Pass. Capri is the main entrance channel from the Gulf to Marco Island (1992 photo). There is a popular fair-weather day anchorage on the bay side. The ebb–tidal delta at Big Marco Pass has the mixed-energy offset shape, with lobes north and south of its ebb-flood channel. The large, shallow-water shoal on the south side has contributed shoreward-migrating sand bars that have produced beach ridges and ponds on the north end of Marco Island (1952 photo).







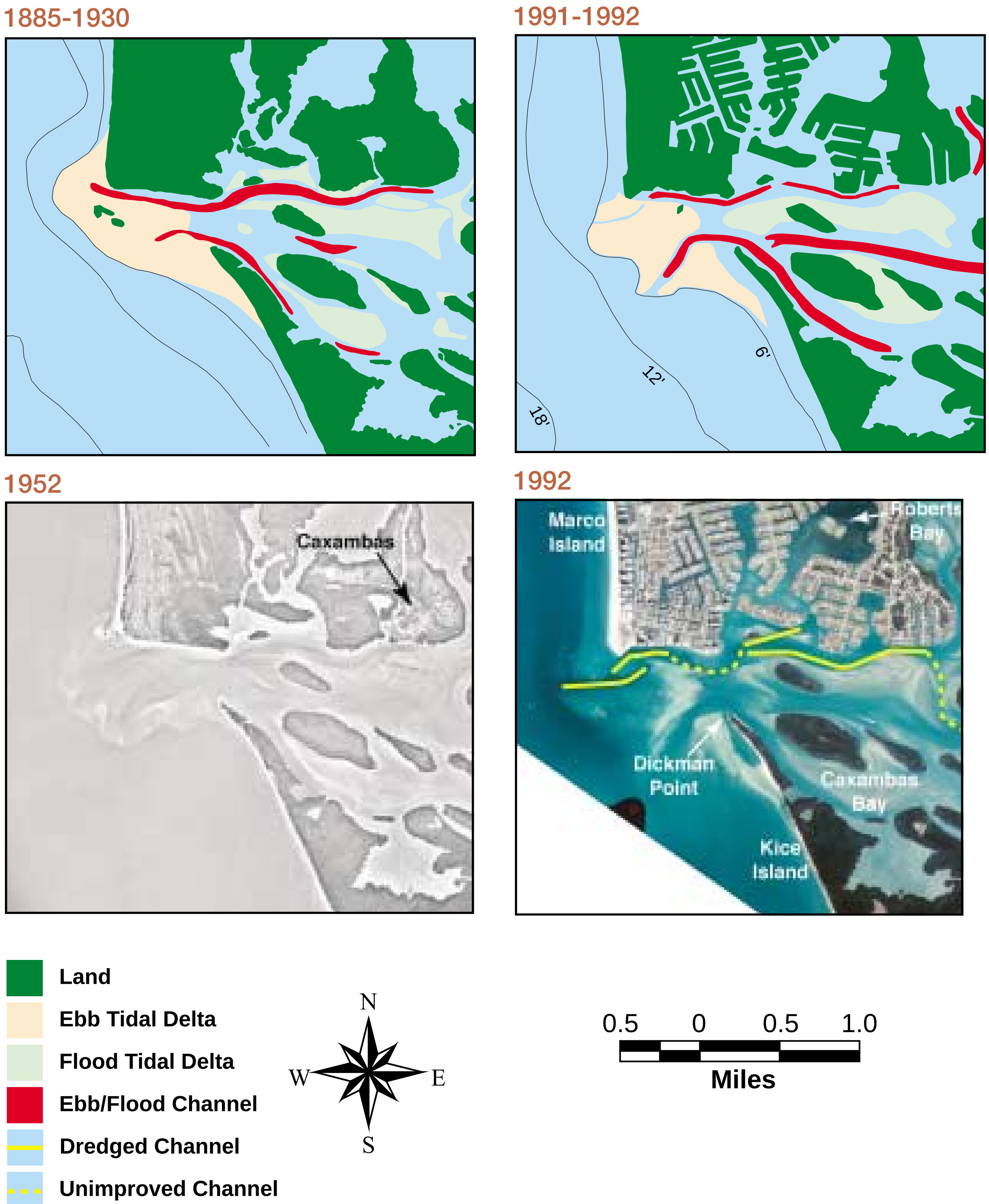
Map 15 (part 1).
North Marco Island Passes.



Map 15 (part 2).
North Marco Island Passes.

Caxambas Pass

Caxambas Pass is a mixed-energy inlet with a distinct northward offset (Map 16). Its ebb-tidal delta extends about 0.5 mile offshore (1885-1930 map). The seawall constructed at the south end of Marco Island in 1958 contributed to major changes in the inlet (1991-92 map). The ebb-tidal delta has been used as a sand source for the Marco Island Beach Nourishment Project, which included construction of two terminal groins slightly north of the pass. Sand recovery from the delta has deepened the pass for navigation (1992 map).



Map 16.
Caxambas Pass.

Long-Term Shoreline Change and Barrier Island Development

The Southwest Florida shoreline, where the saltwater of the Gulf meets freshwater and contacts the solid land base of the Florida peninsula, is a constantly changing boundary that has been influenced not only by short-term events, but also by long-term sea level fluctuations. Expansion and contraction of continental ice sheets during the Late-Cenozoic Ice Age (last 2 million years) have had a profound effect on the continental margins.

Imagine what would occur if the ice held on Antarctica melted along with all other glacial ice: the sea level rise of some 200 feet would inundate most of Florida. On the other hand, the growth of ice sheets would withdraw vast quantities of seawater from water bodies and a decline in sea level would occur.

In Figure 4, the shoreline of Charlotte Harbor during the Pleistocene glacial period is shown as a solid line (a) and the present shoreline as a dashed line (b). The green dotted line (c) represents the former coastal valleys of the Myakka, Peace, and Caloosahatchee Rivers. The mouth of the Peace River, at that time, extended through present-day Matlacha Pass, to reach the more distant shoreline.

As sea level rose, the same streams were forced to deposit alluvium and fill their valleys. In Figure 5, the flooded river mouths have led to creation of Charlotte Harbor and adjacent waters. Pine Island, part of the original mainland, is an eroded remnant. As sea level rise slowed at about 5000 before present, shoaling occurred along the headlands, such as north of Placida (see inset) and at Englewood. When post-glacial rise ebbed, longshore processes began to exert a force contributing to emergence, coastal deposition and spit or barrier island growth.

South-setting longshore currents produced elongated spits, bars, and barrier islands, extending from north of Englewood and from Placida (Figure 6). Storms periodically breached the barrier spits, creating inlets and islands. Continued progradation of the recurved barrier spit eastward towards Punta Rassa, along with growth of Little Pine Island, restricted discharge from the Myakka and Peace Rivers through Matlacha Pass and forced the outflow to seek a new route by way of the emerging barrier island inlets at Boca Grande and Captiva. This present condition of the Charlotte Harbor barrier island chain is shown in Figure 7.

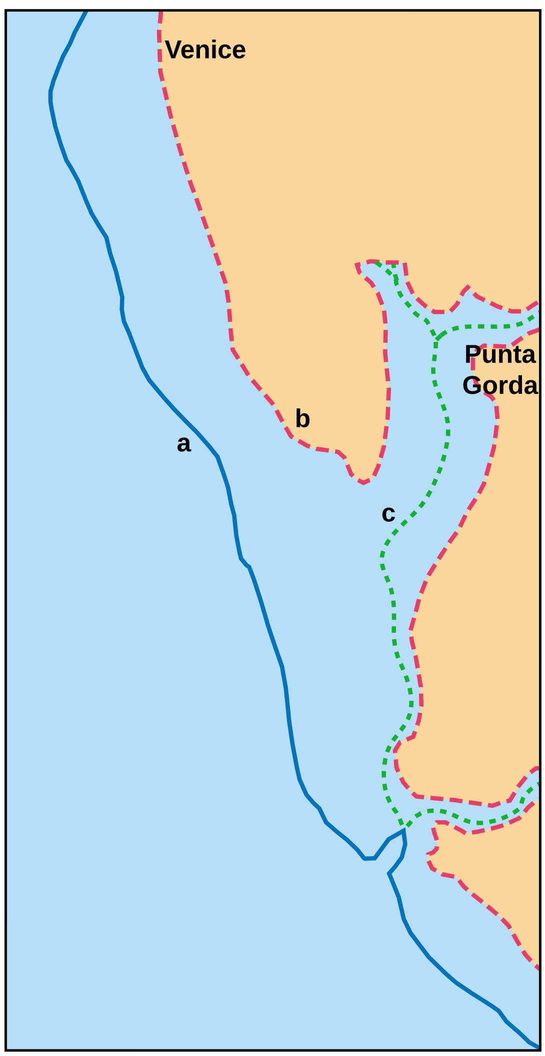


Figure 4. Charlotte Harbor shoreline in the Pleistocene Glacial Period.

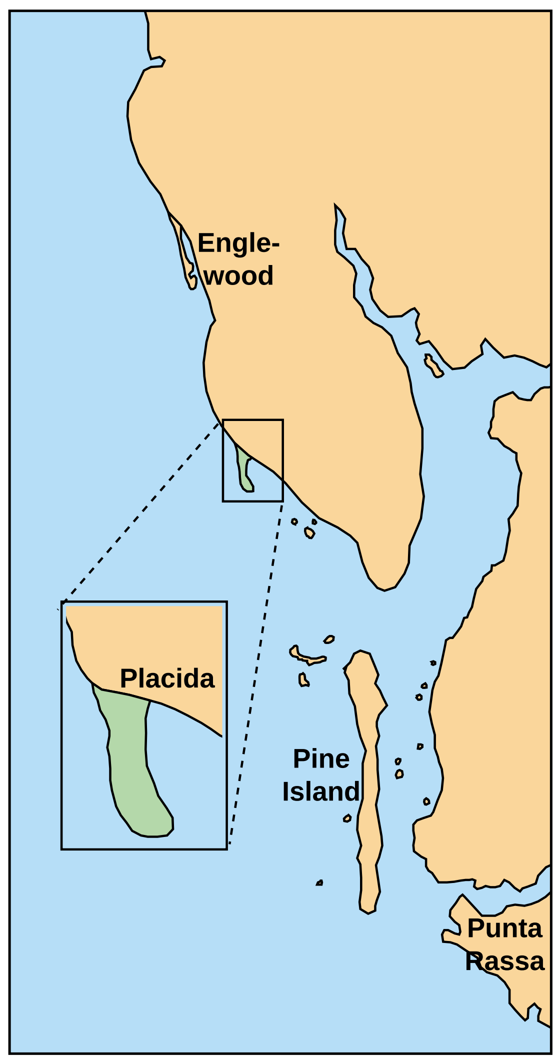


Figure 5. Charlotte Harbor shoreline approximately 5000 years ago.

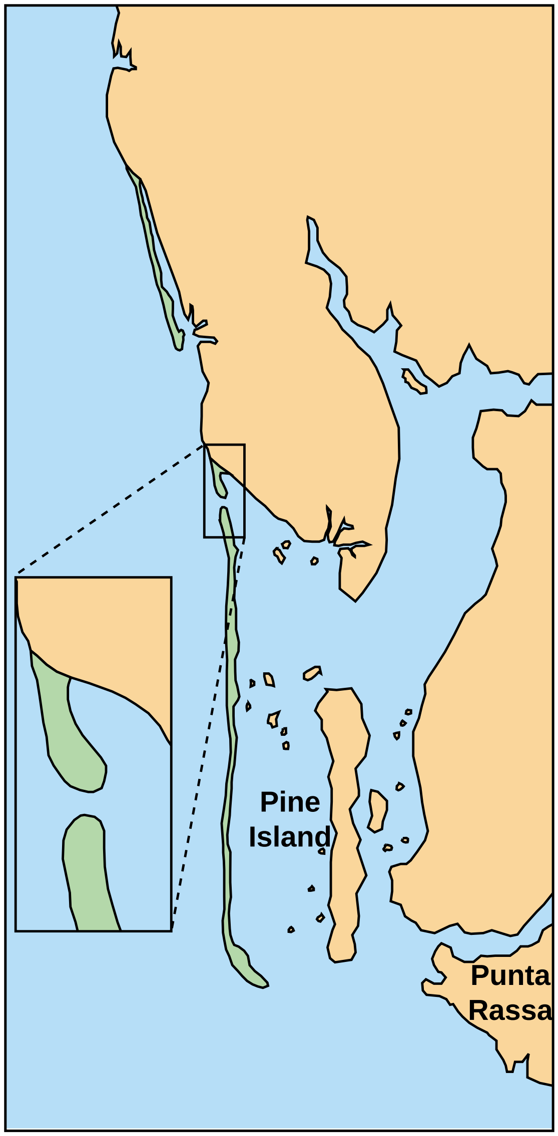


Figure 6. Charlotte Harbor showing intermediate stages of barrier island development.

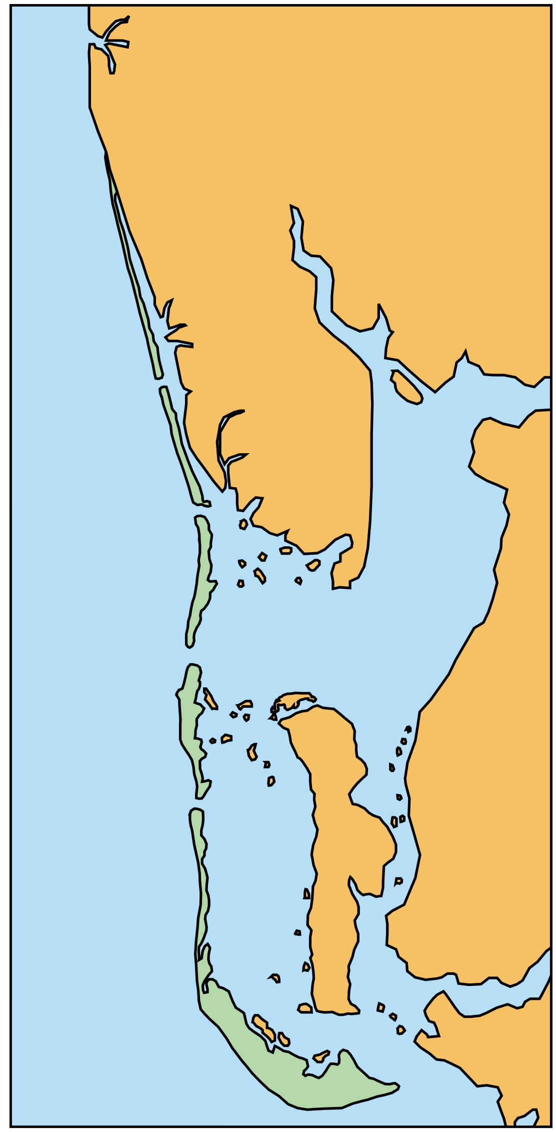


Figure 7. Modern shoreline of Charlotte Harbor and barrier islands.

Adapted from Stanley Herwitz, 1977, The Natural History of Cayo-Costa Island, New College Environmental Studies Program, Sarasota, Florida.

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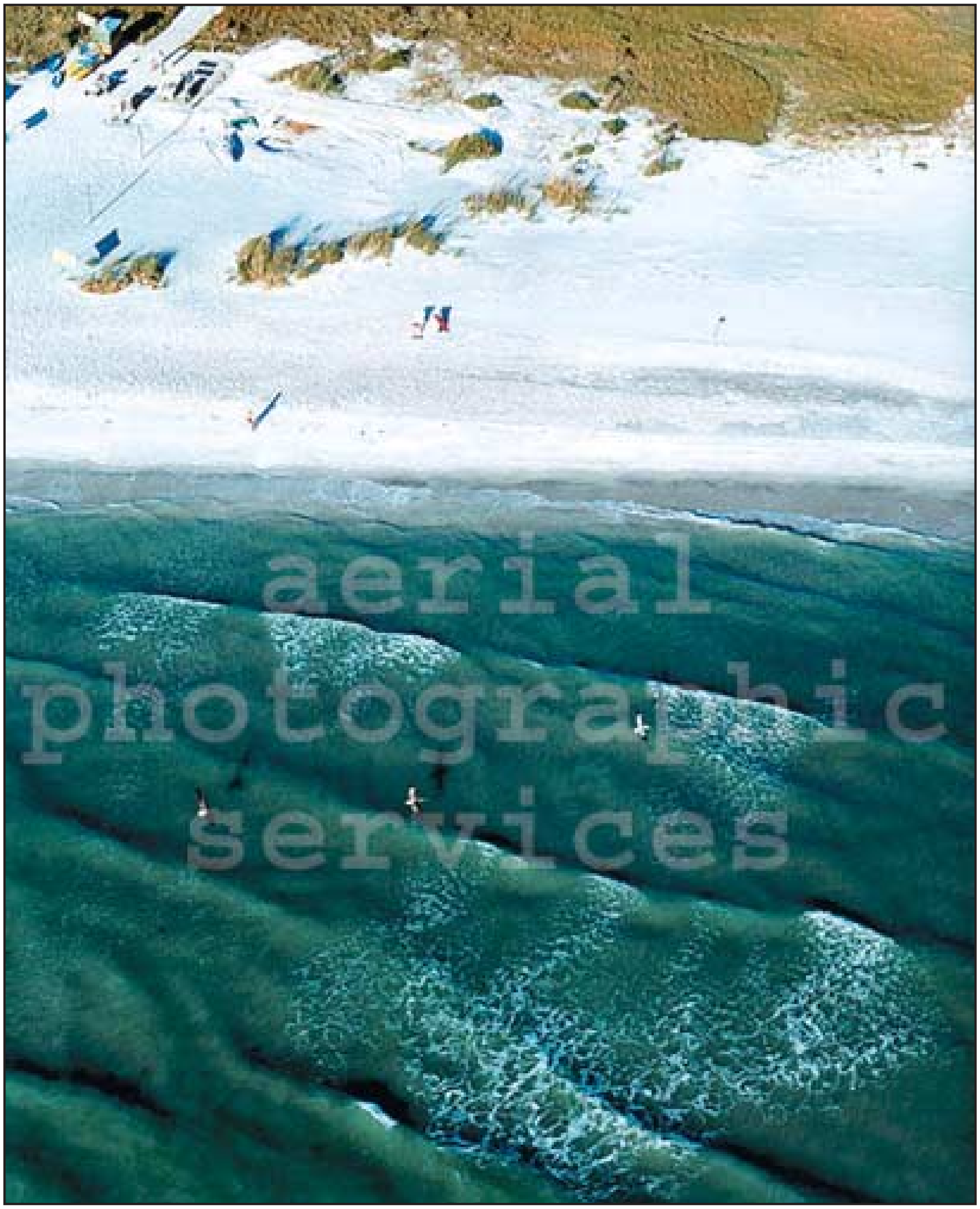
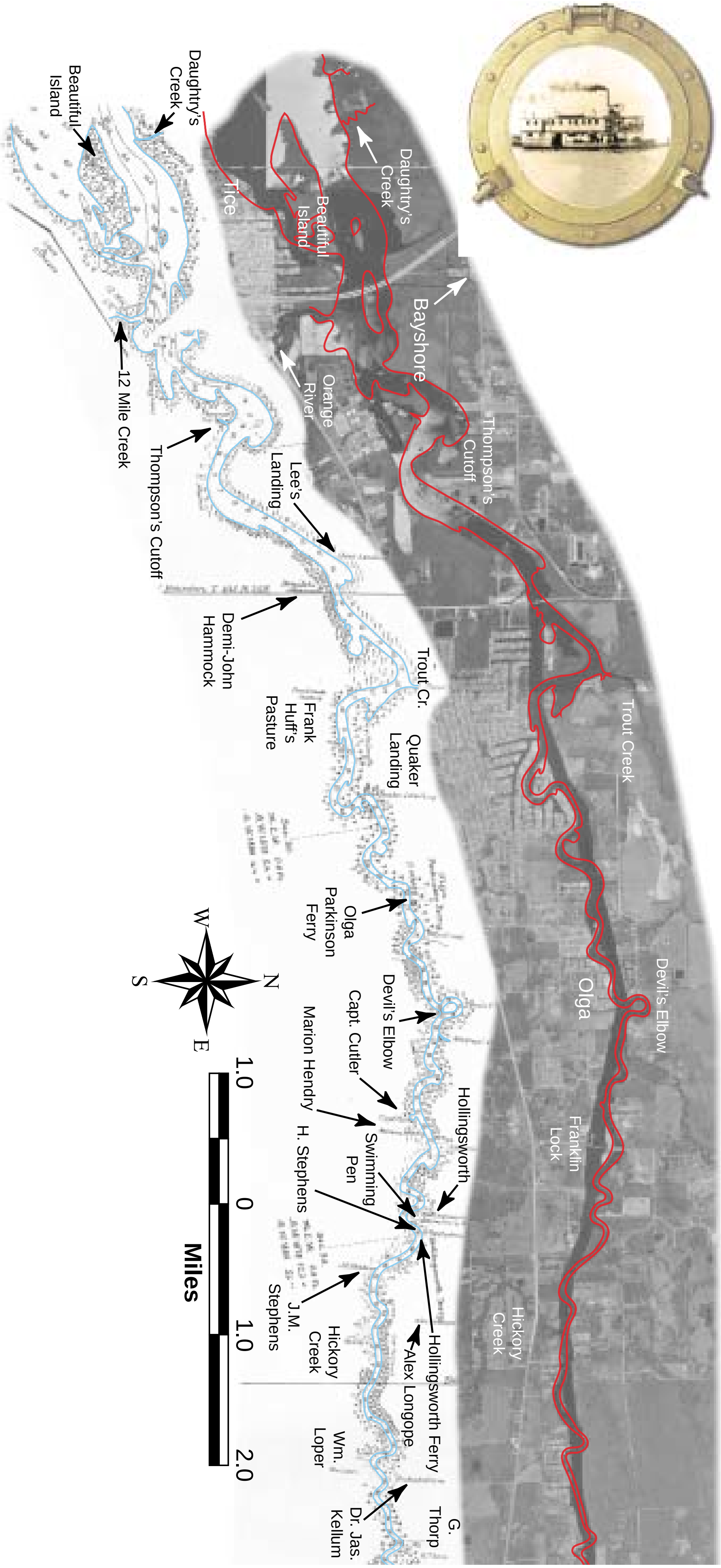


Waves refracting along Little Gasparilla Island, longshore current runs from left to right, carrying sand in the direction, parallel to the shoreline.

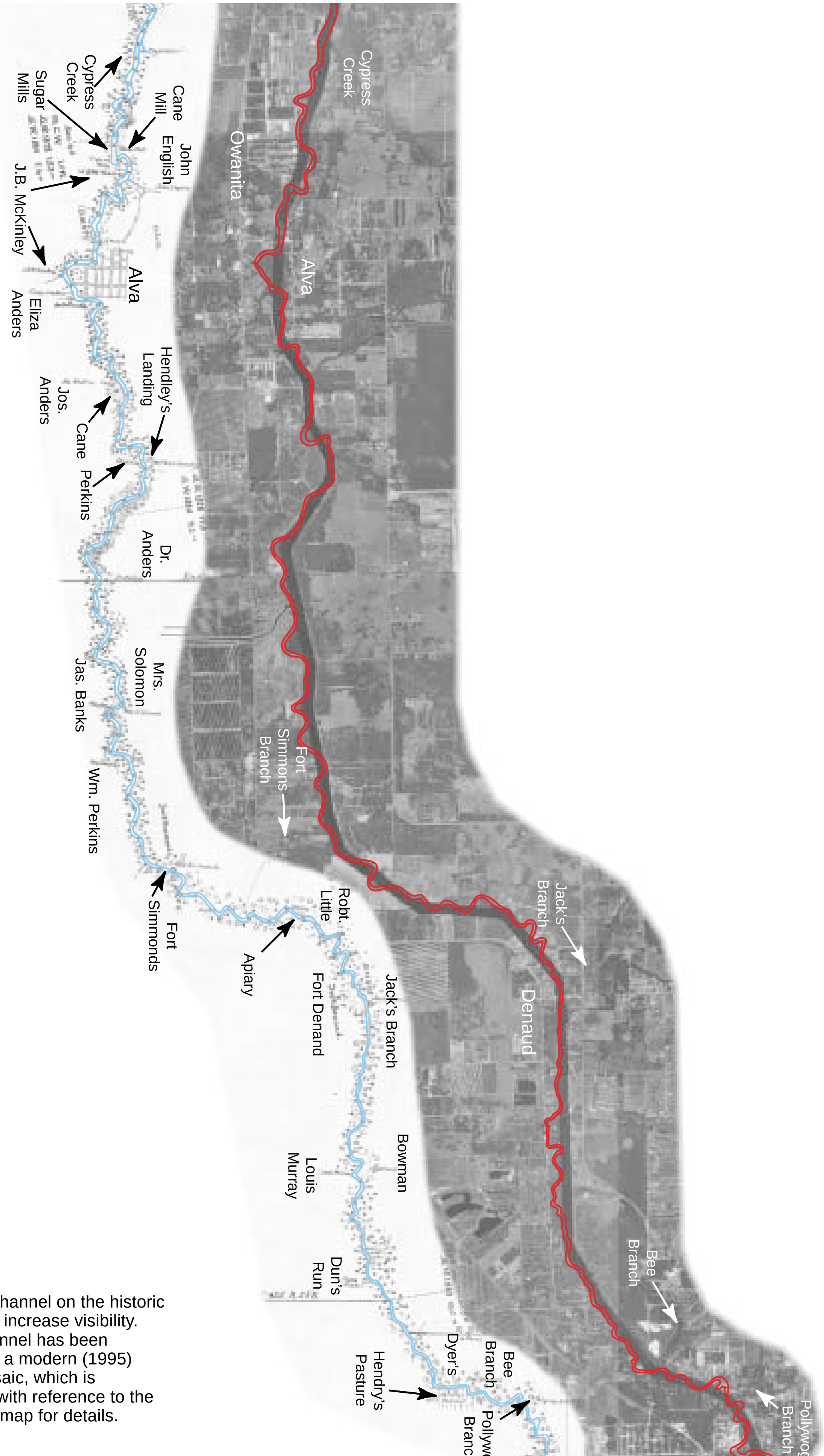
ALTERING THE CALOOSAHATCHEE FOR LAND AND WATER DEVELOPMENT



The Caloosahatchee [Caloosa = indigenous Native Americans who inhabited Southwest Florida, Hatchee = Seminole for 'river'] is a microcosm of Southwest Florida's waterways, in which multiple interests — striving to develop waterfront real estate, to create new land from formerly overflowed swamplands, and to increase and improve the navigable waterways — have propelled development in many profound ways.The river between Lake Okeechobee (on the east) and Beautiful Island (on the west) has been selected to illustrate the effects, both latent and direct, of land drainage and waterway construction policies on waterfront and waterway uses.

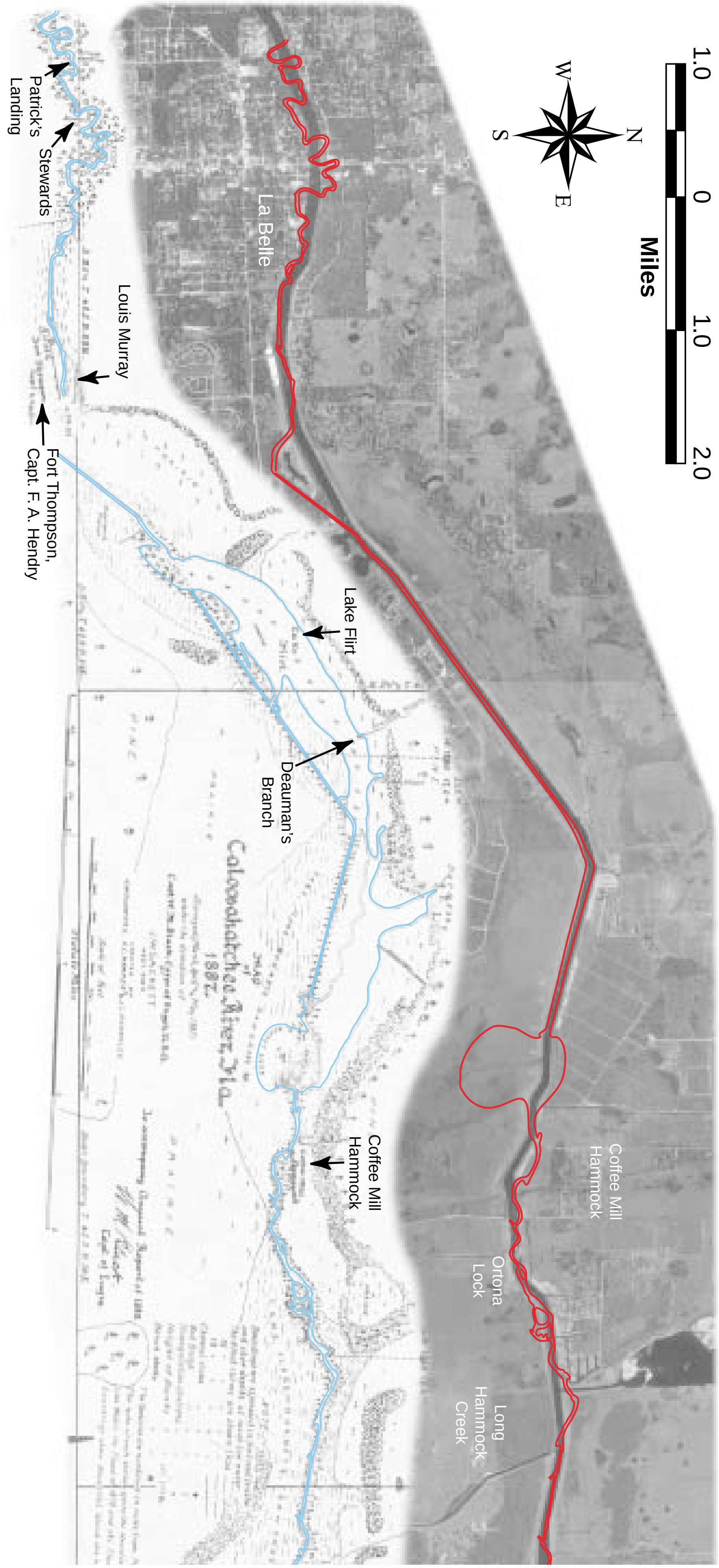
Pre–development Geography

It is hard to recognize from today's Okeechobee Waterway — with its abruptly cut banks and straight-lined, flood-controlled, navigation-optimized, dredged channel — the once meandering, shifting, rope-bending, snag-laden course of the Caloosahatchee. Today, the Caloosahatchee is the western portion of the Okeechobee Waterway, which stretches from Stuart, on the Atlantic Ocean, to San Carlos Bay and the Gulf of Mexico. The route crosses the state via the St. Lucie River and Canal, Lake Okeechobee, and the Caloosahatchee (see Map 1 in the Dredging History chapter). Map 1 in the present chapter shows the antecedent river course superimposed on the present waterway.



Note: The main river channel on the historic map is colored blue to increase visibility. The same historic channel has been interpreted in red over a modern (1995) aerial photograph mosaic, which is positionally accurate, with reference to the 1887 Army Engineers map for details.

Map 1 (part 1).
Caloosahatchee Channel, 1887 and 1995.


1.0
0
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Miles
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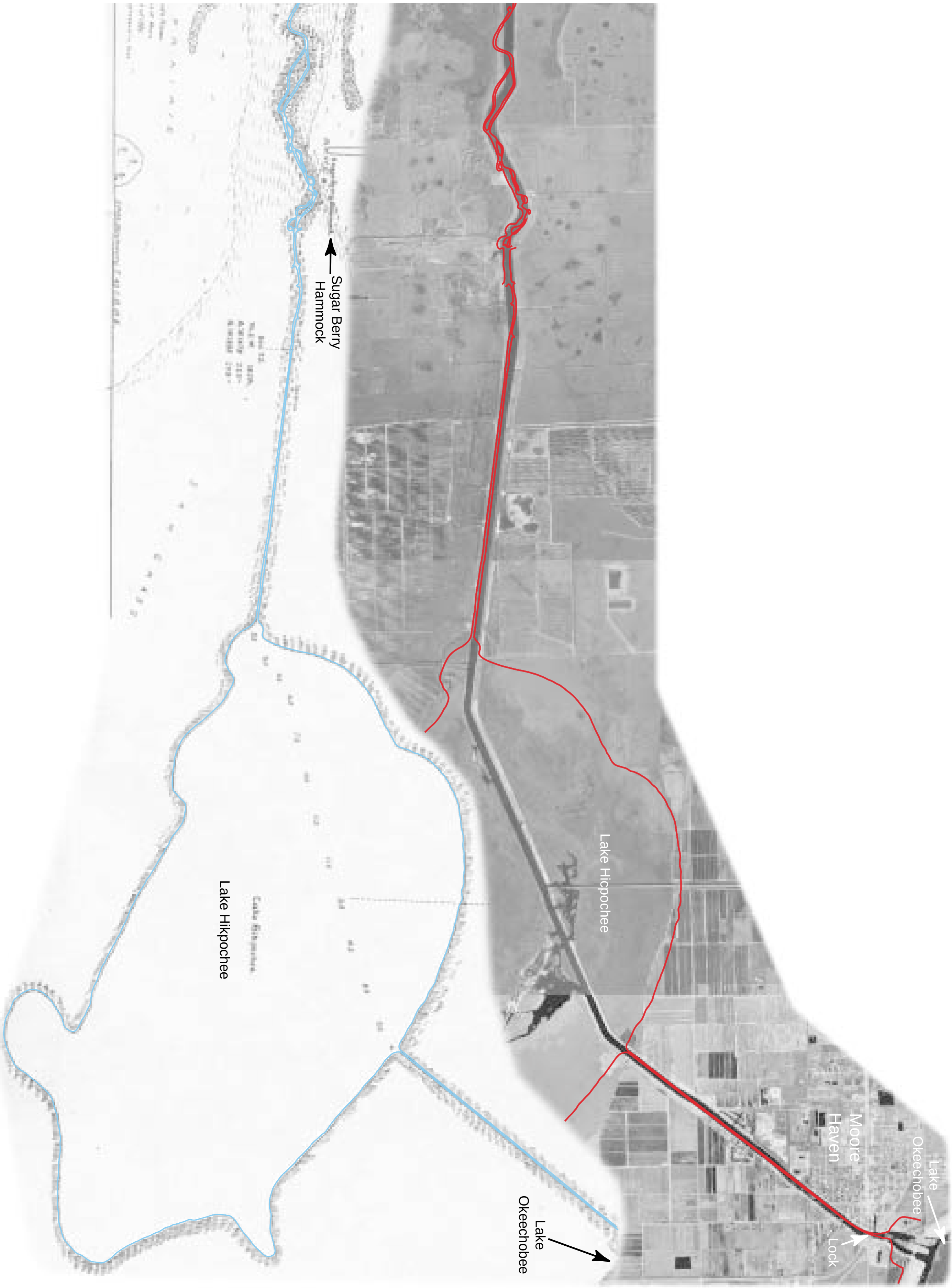
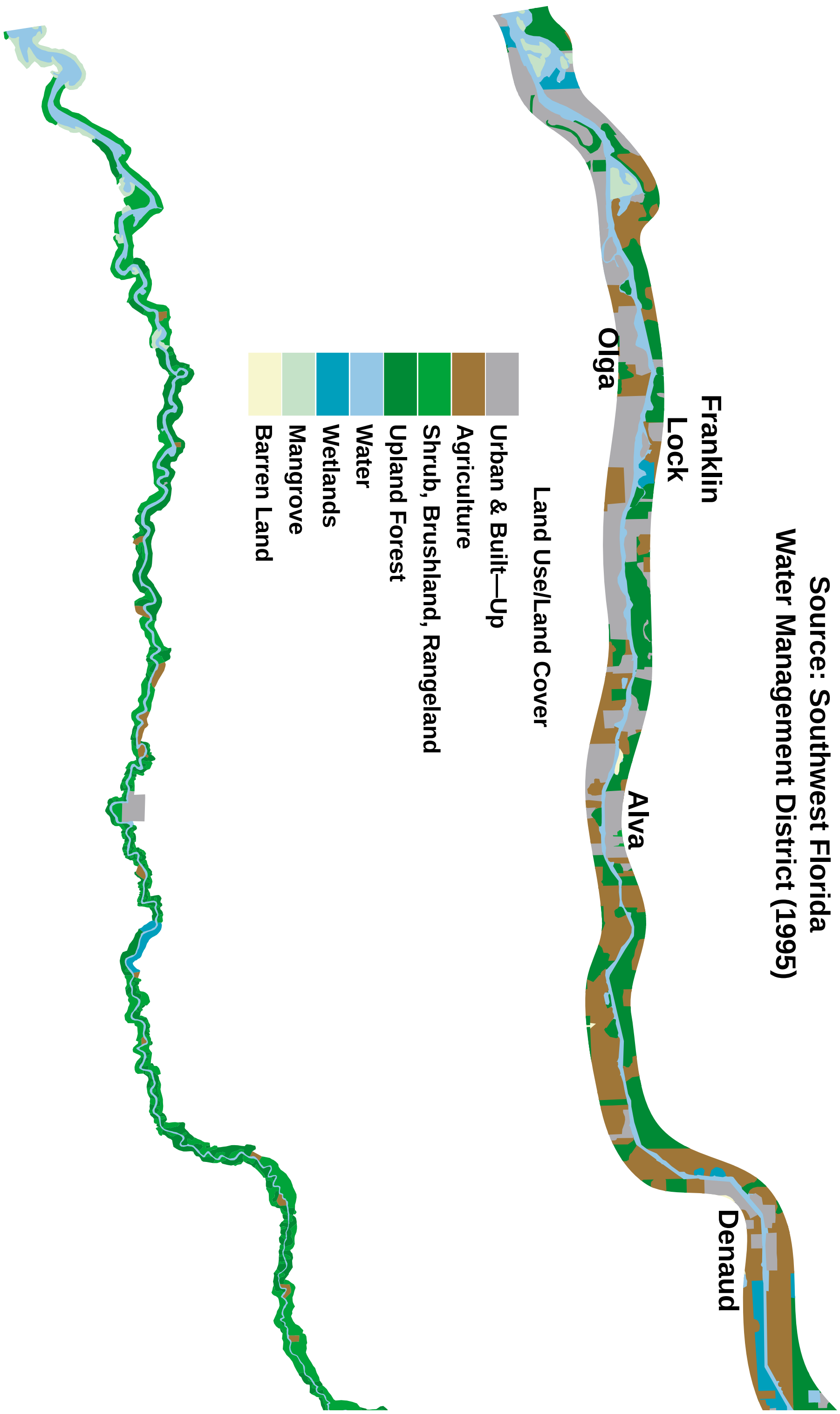
E
S
W
La Belle
Patrick's Landing
Stewards
Louis Murray
Fort Thompson, Capt. F. A. Hendry
Lake Flirt
Deauman's Branch
Caloosahatchee River, Fla.
1887
Coffee Mill Hammock
Coffee Mill Hammock
Ortona Lock
Long Hammock Creek

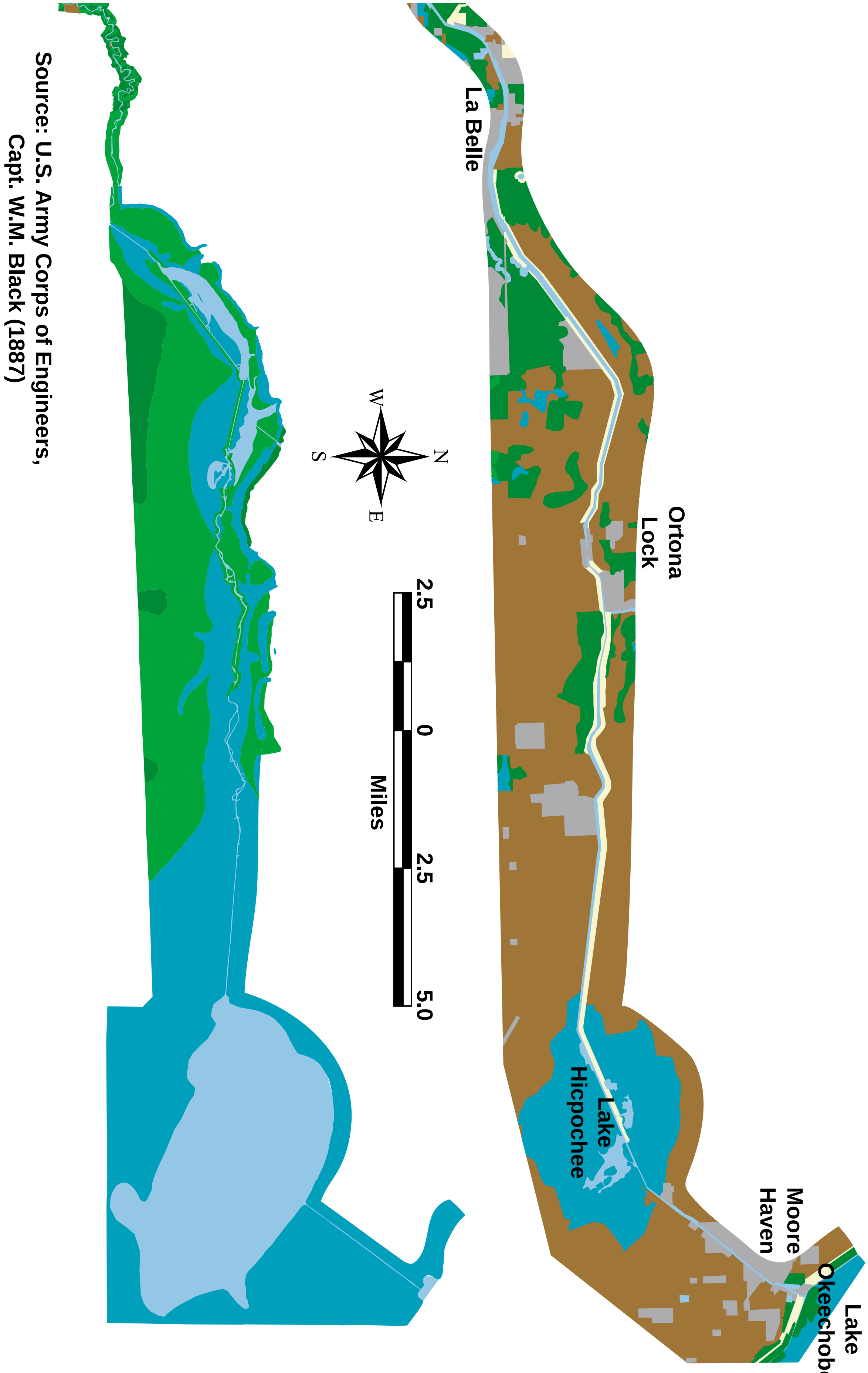


Map 1 (part 2).
Caloosahatchee Channel, 1887 and 1995.

Before human intervention, the Caloosahatchee originated in a geologic basin known as Lake Flirt, located at Ft. Thompson, approximately 2 miles east of La Belle. The formation was perched 4–10 feet (varying with seasonal water levels) above the western Caloosahatchee valley, creating 0.9-mile-long rapids that fed the Caloosahatchee. To the east, ephemeral marshes seasonally connected a series of lakes. In the wet season (May–October), high water would spill out of the shallow boundary of Lake Okeechobee and sheet flow through the ephemeral marshes and swamp forest to collect in several smaller lakes–Hicpochee (9,000 acres), Bonnet (500 acres) and Flirt (1,000 acres)–before spilling over the rapids and flowing into the Caloosahatchee and to the Gulf of Mexico. The Ft. Thompson Rapids set the head of navigation. The lower portion of Map 2, from the Black survey of 1887, shows land use and land cover before major development occurred.

During the dry season (November–April), the region of marshes surrounding Lake Hicpochee and the riverbed from that lake to the foot of Ft. Thompson Rapids would dry up so much that a horse could be ridden in the channel. Normal high water would raise the water level downstream by 2 feet at Ft. Thompson, 3 feet at Ft. Denaud (La Belle) and Alva, 2 feet at Olga and 1 foot at Ft. Myers. Freshets caused by continuous heavy precipitation increased the water level to historic heights above mean water of as much as 12 feet at Ft. Thompson, 17 feet at Ft. Denaud, 14 feet at La Belle, 13 feet at Alva, and 6 feet at Ft. Myers.





Map 2.
Land use/land cover along the Caloosahatchee, 1887 and 1995.

Distance and number of river bends between pre–development and contemporary conditions along the Caloosahatchee/Okeechobee waterway.

	Beautiful Island/Olga		Olga/Alva		Alva/La Belle		La Belle/Moore Haven		Total	
	Miles	River-Bends	Miles	River-Bends	Miles	River-Bends	Miles	River-Bends	Miles	River-Bends
Pre–development River	9.5	5	8.7	19	19.0	58	26.7	20	63.9	102
Okeechobee Waterway	7.7	3	7.0	2	14.0	10	27.0	11	55.7	26
Difference	-1.7	-2	-1.7	-17	-2.0	-48	+0.3	-9	-8.2	-76

Table 1.

Figure 1. Four-point rope bend.

Figure 2. Water wheel irrigation.

These extreme, cyclical variations in stream flow contributed to the Caloosahatchee's meandering course. There were 102 river-bends in the 64-mile stretch from Beautiful Island to Lake Okeechobee in the pre–development period (Table 1). Navigating the river was especially difficult at the low-water stage. Some of the sharper meanders required the larger vessels to "warp-around," that is, to run their bow up on shore, attach a spring line to trees, back down to a second point, swing around and go ahead at the next point, and so on until the bends were passed (Figure 1).

Torrential rains during the wet season dramatically increased the volume of discharge and sediment load, leading to channel scouring and flooding of adjacent lowlands. During this period, coarser-textured sediments were deposited both as point-bars on the inside of the meanders and along the banks of the natural levees. Channel deepening occurred on the outer bends, and fresh, fine-textured alluvium was deposited on the adjoining floodplain. At these high water stages, the meandering Caloosahatchee in places cut across the necks of the meander spurs, shortened its course, and created abandoned meanders or oxbows.

Land and waterway developments were slow to occur during the 19th century. The Seminole Wars and the Civil War were major deterrents to settlement expansion. Extensive cattle grazing was a common land use. Small settlements did evolve along the river, usually occupying former military outposts. Ft. Thompson was an important upriver location because of the ford where cattle drives crossed the rapids en route to the shipping pier at Punta Rassa. The land cover along much of the river's course south of Ft. Thompson was in upland forest, scrub, grassland, and some homesteads with small agricultural farms (Map 2). The lower portion of Map 1 highlights the names of some of the homesteaders. Rudimentary waterwheel-type irrigation systems permitted farming during the dry season (Figure 2).

The winter freezes of 1892 and 1899 prompted North Florida citrus growers to reestablish their groves south of the freeze line and in the Caloosahatchee Valley. Citrus production increased rapidly in subsequent years and the transport of fruits and shipment of supplies became dependent on riverboat transport (Figure 3). Large catches of fish were brought down the river from Lake Okeechobee, although the business did not become extensive until after the railroad entered Ft. Myers, in 1904.

The 1880-90s was a period wherein the upper river valley represented the backbone of potential growth that resided in its agricultural resources, but communities there depended on the lower river course for transport and communication with service centers downstream. The key to sustainable regional growth rested on creating a scheme to manage the floods, which drove the early settlers from their homes, damaged farmlands, and discouraged agricultural development.

Figure 3. SS *City of Athens,* 1910.

Land Reclamation or River Navigation?

The development history of the Caloosahatchee is a record of competing and conflicting interests, some wanting to control flooding by upland drainage and others striving to build an inland waterway for pleasure boating and commercial use.

The record of government intervention by the State of Florida and federal agencies had its origins in the 1880s, with attempts to drain the overflowed lands adjoining Lake Okeechobee and to reduce and maintain water levels in the river. By 1887, the Atlantic and Gulf Coast Canal and Okeechobee Land Company of Hamilton Disston had opened a channel, with a minimum cross-section of 22 feet by 5 feet, from Lake Okeechobee to the headwaters of the Caloosahatchee at the western end of Lake Flirt. The Disston dredges were brought up-river from Ft. Myers. Four of the most severe river bends west of Ft. Thompson were straightened in order to move the dredges upstream. The 4-mile stretch of rock-floored outcrops, including the Ft. Thompson Rapids west of Lake Flirt, was dynamited in order to deepen the channel. A provisional dam was built every few miles to the rear of the dredge to obtain sufficient water to float the equipment (Figure 4). Disston's work was not intended to benefit navigation. Indeed, since the contract with the state included the drainage of the Caloosahatchee Valley and confining the river to its banks, the dredged channel was to have been closed and a levee extended north–south just west of Lake Hicpochee. Nearly 2 miles of this levee was constructed when the company ceased operations and the channel was never closed.

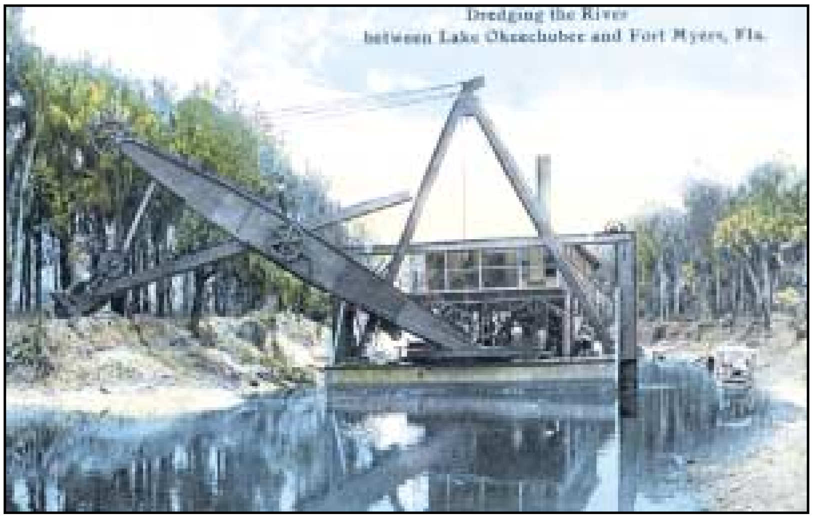


Figure 4. River dredge.

The net incidental result of Disston's dredging operation was to open up a water route for steamers some 300 miles long from the Gulf of Mexico to the interior of Florida via the Caloosahatchee and Lake Okeechobee to Kissimmee (Figure 5). But the dredged channel between Ft. Thompson and Lake Okeechobee was not maintained and shoals quickly appeared; boats drawing a mere 4 to 6 inches grounded repeatedly in Bonnet Lake and Lake Flirt. More significantly, during the wet season, floodwaters from Lake Okeechobee rushed unrestricted down the channel and caused severe flooding of the farms and citrus groves in the lower valley.

The dilemma facing the Caloosahatchee Valley at that time, much as it is today, was to devise a scheme that would coordinate land drainage with river navigation. Residents in 1913, for example, believed that floodwaters could be mitigated by straightening the river's course and navigation could be improved by deepening the channel, though attempts to straighten the river above Alva would probably require building levees well back from the river banks which would deprive a greater part of the citrus groves along the river from protection. The heated battle between land drainage and river navigation sometimes raged beyond the rule of law. Makeshift dams built by private interests across the canal between Lake Hicpochee and Bonnet Lake were blown up by unknown parties. In 1902, the state approved an application to close the canal but held Lee County responsible for all damages. The Army Engineers, at that time, agreed with local and state government that navigation interests were insufficient to warrant federal waterway improvements.

By 1913, however, drainage operations by the state elsewhere in central Florida had lowered the water level in Lake Okeechobee so much that navigation in the upper Caloosahatchee was seriously impaired and settlements were being abandoned. In 1914, the river at its junction with the lake dried out and at La Belle there was only 1.5 feet of water, not enough to allow the passage of commercial river traffic. The State of Florida dredged a 5-foot-deep by 40-foot-wide channel from Lake Okeechobee to La Belle. The seesawing of natural events–flooding of river lowlands followed by shoaling of navigation chan-

Figure 5. Tow steamer *Corona*.

1966 - The Necessity to Understand the Sea

"But the influence of the sea on man's daily life and on his future well-being is so great and still so poorly comprehended that the sea must be explored, studied, and understood so that it can be taken into account more intelligently whenever man is faced with any problem relating to his physical environment."

—H. B. Stewart, "In Deep Challenge," 1966.

—Published by Van Nostrand, NJ. p. 17.

nels–fostered ambivalent public policies and created a laissez-faire attitude which resulted in little prescriptive action or long-term planning.

Disastrous floods in 1922, 1923, 1926, and 1928 caused the loss of many lives and considerable property damage in the Lake Okeechobee region. The federal government authorized the Army Engineers in 1927 to survey the Caloosahatchee drainage area and work with the state's Flood Control District (now the South Florida Water Management District) to improve both flood protection and navigation. This decision led to construction of the Hoover Dike around Lake Okeechobee as well as the dredging and channel straightening of the Caloosahatchee. The 1930s was a period of river dredging and construction of drainage canals, navigation locks at Moore Haven and Ortona and pumping stations to remove excess water from adjoining river bottomlands.

As a result of this work, the Caloosahatchee upstream from Beautiful Island was forever changed from the picturesque, meandering river which existed prior to 1881. It took on a new form, that of vertical-banked and straight-lined, flood-controlled, navigation-designed, dredged channel. It was also transformed into the federally authorized, Army Engineers-maintained Okeechobee Waterway (C-43 Canal), an intrinsic western component of the Cross-State Ship Channel that links the Gulf of Mexico to the Atlantic Ocean.

The Okeechobee Waterway was again modified in the mid-1950s. The channel was enlarged to an 8-foot depth and 250-foot width. Bridge crossings were modernized. An additional lock and dam structure was built in 1962 at Olga to assure a freshwater supply for Lee County and to prevent saltwater intrusion upstream.

In 1969, the structure was re-dedicated as the W.P. Franklin Lock in honor of Walter Prospect Franklin, a local entrepreneur and concerned member of the Okeechobee Waterway Association. This lock artificially sets the eastern limit of the Gulf's tidal influence for the estuary, which historically extended to Ft. Denaud. The waterway was dredged again in the 1960s, but following passage of the Clean Water Act in 1972, the Army Engineers has restricted its functions to operation and annual maintenance of the locks at Moore Haven, Ortona, and Franklin.

The Caloosahatchee today is still in serious need of management and maintenance. It faces many of the same varied challenges of its past development and use, including competing demands for water by municipalities, agriculture, commercial and recreational boating activities, and the functional requirements of the natural aquatic system. In times of flooding, the Caloosahatchee is used as a conduit for discharge with little regard for the downstream impacts of water quality and water volumes. In times of drought, water releases from Lake Okeechobee often do not maintain minimum flows necessary to support the critical productive functions of natural systems nor do they retain necessary water depths in the federal navigation channel of Lake Okeechobee.

Resource managers with the South Florida Water Management District view and treat this waterway as a drainage and storage component of Lake Okeechobee and the multi-billion-dollar Comprehensive Everglades Restoration Project. Their concerns and program objectives are regional in scope and focus predominantly on water management functions, primarily flood control and water supply. Stakeholders and organizations concerned about the condition of the waterway have recently called for federal assistance from the Army Engineers to address its navigation and water-based eco-tourism needs by promoting coordinated management and sustainable use.

Does history repeat itself? Can we learn from past mistakes? Is there hope that both objectives–flood control and navigation–can be realized in the 21st century to provide for sustainable management that protects the resources and allows for use by all citizens who live, work and recreate along this waterway?

Contemporary Geography

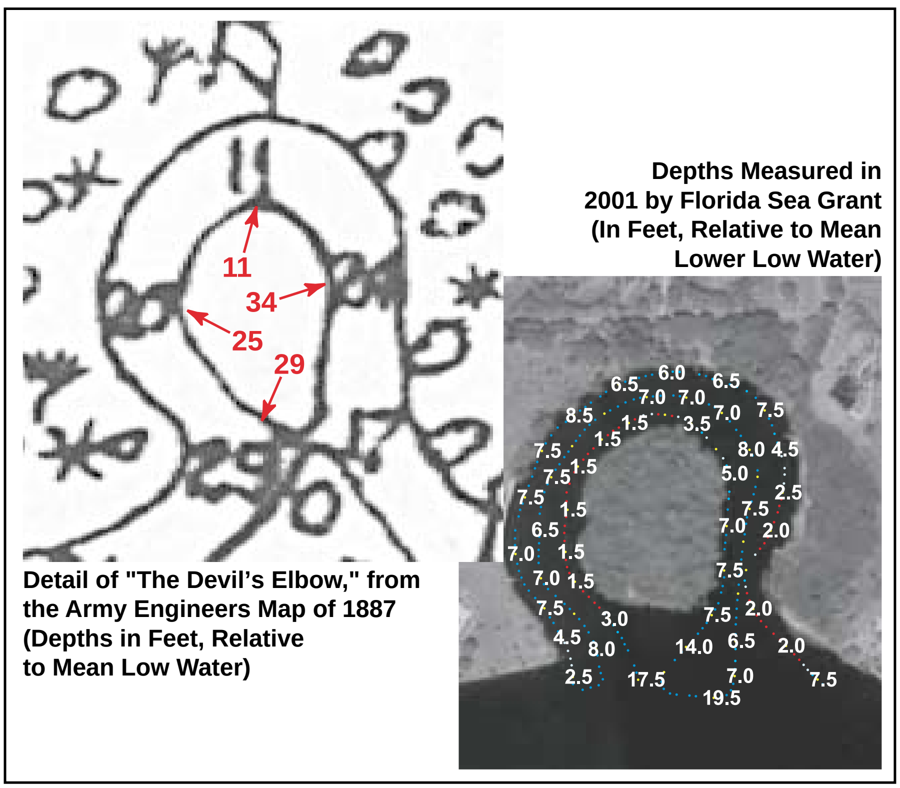
The scenic Caloosahatchee, the historic waterway that fostered settlement of interior Southwest Florida, functions today as a thoroughfare for transiting recreational boat traffic and a conduit for excess stormwater flows. Where once the river meandered, it is now a series of straight legs interrupted by 26 gentle bends (Map 1 and Table 1). Although one still, rarely, may encounter some tugs and barges, heavy commercial traffic of the past eras is gone. Both the form and function of the river have changed.

The Okeechobee Waterway and former vestiges of the Caloosahatchee lie side by side. About 35 abandoned meanders are situated between Olga and La Belle and another seven are in the estuarine portion of the river downstream from the Franklin Lock. The dichotomy of this landscape is striking: a straight-line, deep waterway with artificially configured banks, punctuated by intriguing side loops, heavily vegetated, shoaled, and snag-laden. A comparison of spot soundings from the years 1887 and 2002 shows the striking differences in water depths as channeled river discharge bypassed the meanders (Map 3). Today, nearly half of the meanders along the river are not fully navigable because of siltation caused by reduced water flow through the bends. Shoreline residences and boat docks are found on some, while others are quite pristine (see Changes on the Waterway and Along the Waterfront).

Lake Hicpochee, now approximately 215 acres of open water, is a mere relict of its past extent. Lake Flirt no longer exists, though the area is being studied to determine the feasibility of creating an above-ground reservoir with a total storage capacity of approximately 160,000 acre-feet (about 7 billion cubic feet). This proposed reservoir would be part of the Comprehensive Everglades Restoration Plan, a multi-billion dollar federal project to correct water flow problems created by dredging and channelizing the Okeechobee–Kissimmee–Everglades region.

There are recreational boat facilities along the Okeechobee Waterway. Some towns, like Moore Haven and La Belle, provide downtown docking for transient vessels. In-the-water boat storage is available at various locations within the freshwater section of the waterway; boats from northern states are left here during the summer season protected from coastal storms.

The land use and cover that confronts the passing boater has been dramatically altered from the historic past. Major riverine forest tracts are gone, replaced by agriculture and urban built-up uses. High levees run parallel to the waterway from Lake Hicpochee to the historic Ft. Thompson area, just east of La Belle (Map 2).



Map 3.
Detailed plans showing water depths in the Devil's Elbow in 1887 and 2001.

Ft. Myers riverfront.

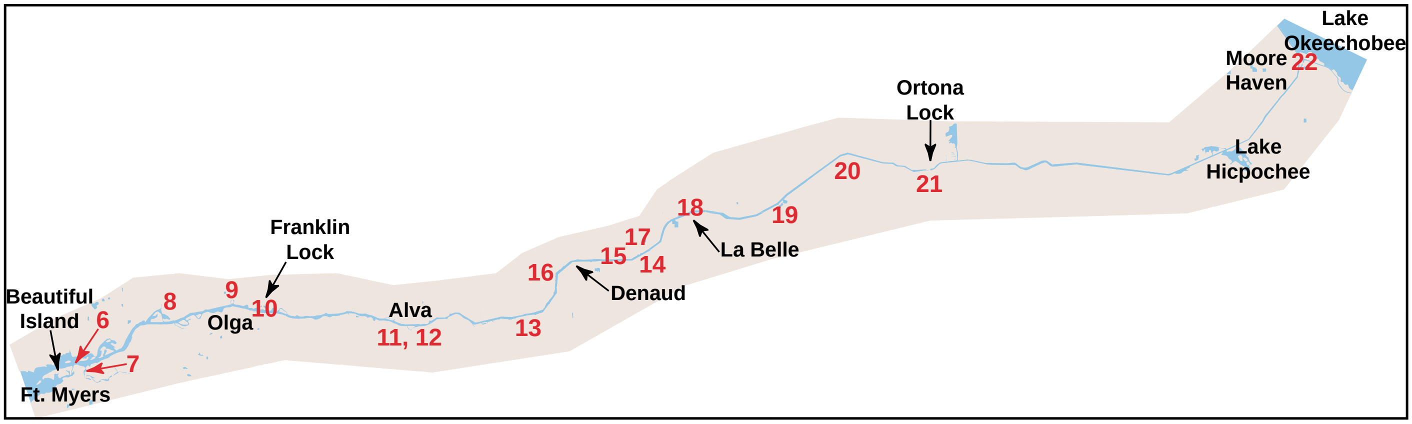

Stabilized Oxbow Slopes, Denaud.


Orange grove, packing house and the Caloosahatchee at Alva in 1912.

Changes on the Waterway and Along the Waterfront

The history of waterway changes is reflected in a record of past and contemporary photographs referenced to specific sites along the stretch of the river from Beautiful Island to Moore Haven and the western rim of Lake Okeechobee (Map 4).

The view from the railroad trestle span at Beautiful Island is very much the same today as in yesteryears (Figures 6a, b). Shoreline land use on the Orange River, however, has changed dramatically from citrus groves to residential use (Figures 7a, b). Photo 8 shows the mouth of Trout Creek and Figure 9 captures the Devil's Elbow on the north shore. Located opposite the historic settlement of Olga, the Devil's Elbow was an extremely tight river meander to navigate (thus its name), which required warping by larger vessels in order to pass through the tight rope-bend. Water depths there, once 11-34 feet, have been reduced to 7-9 feet as a result of waterway channeling that bypassed this meander. Devil's Elbow today is a favored "hurricane hole" because of its relatively deep water, minimal fetch and protected location.



Map 4.
Locations of photographs along the river.

Figure 6a. Old railroad trestle at Beautiful Island.

Figure 6b. Contemporary trestle at Beautiful Island.

Figure 7a. Steamer on the Orange River.

Figure 7b. Contemporary Orange River shore.

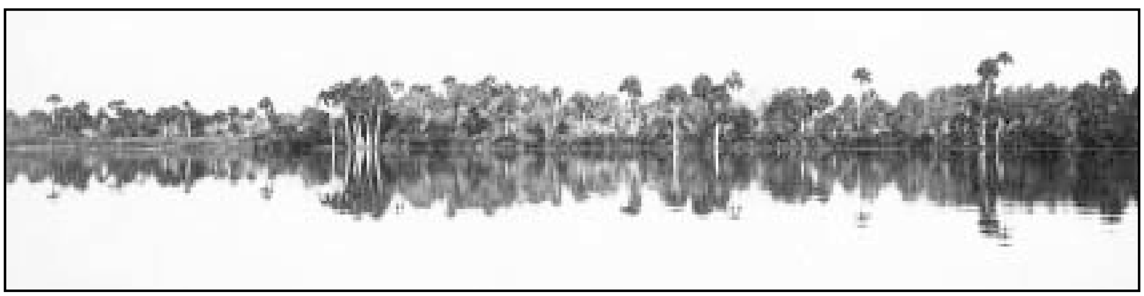


Figure 8. A pre–development view of Trout Creek, a tributary of the Caloosahatchee.

Photo 9. The Devil's Elbow, on the north shore, opposite Olga.

W. P. Franklin Lock is the western line of protection limiting storm surge from the Gulf and saltwater intrusion (Figure 10). The river scene looking west from Alva hasn't changed much (Figure 11a, b), though the view years ago of the town with its historic swing bridge (Figure 12a) is different from its appearance today (Figure 12b).

Figure 10. W.P. Franklin Lock, 1968.

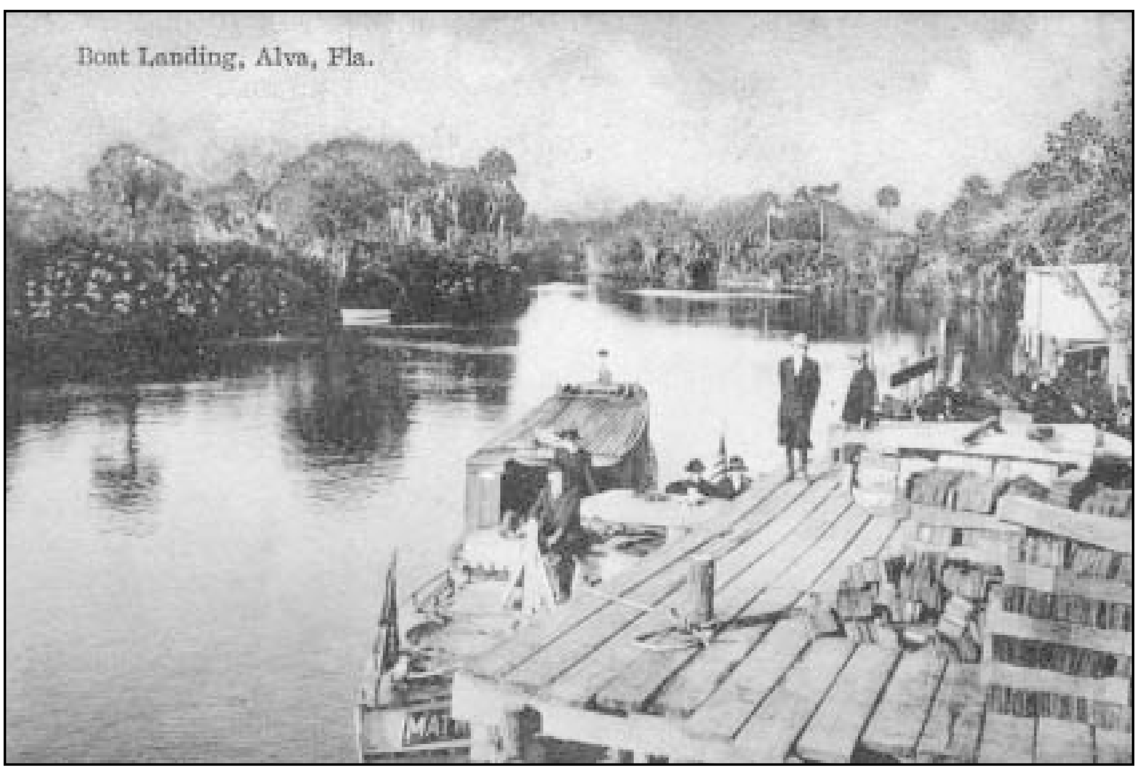


Figure 11a. Former boat landing at Alva.

Figure 11b. Today's contemporary boat landing at Alva.

Figure 12a. Historic Alva bridge, view to west.

Figure 12b. Alva bridge, 2001.

A boat trip into segments of the old Caloosahatchee, where the old riverine forest has been retained (Figures 13a, b), or where old homes, such as the Terrell House at Turners' Landing have been preserved (Figures 14a, b), is a step back in time. In some cases, however, large homes and boat docks line the former river bends (Figure 15) or the rim of the present waterway. Dredged spoil, side-cast on the north bank, appears near Rialto (Figure 16).

Figure 13a. Historic river near Ft. Denaud.

Figure 13b. Contemporary view of Oxbow, West of Denaud.

Figure 14a. Dr. Terrell house, Turners Landing today.

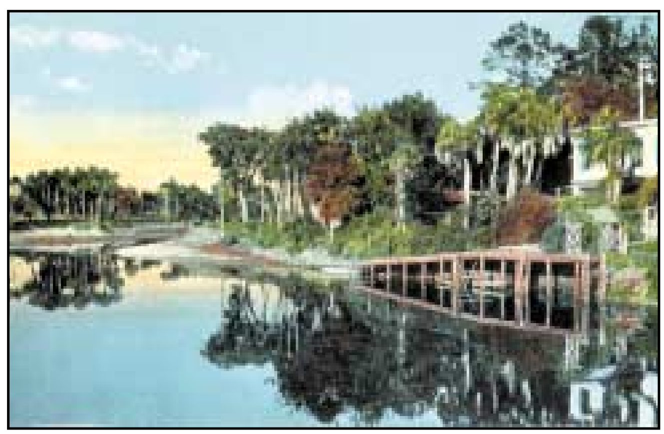


Figure 14b. Turners Landing in the early 1900s.


Figure 15. Rialto Oxbow (residential use).


Figure 16. Side cast spoil along waterway at Rialto.

La Belle, a historic river town, retains much of the character from bygone days especially along the waterfront (Figure 17a, b), though the old swing bridge has been replaced by a bascule bridge (Figure 17c, d). Nothing remains from Ft. Thompson although a historic marker has been erected at its location; Ft. Thompson was probably destroyed by dredging and portions of the settlement buried under spoil along the south bank of the waterway. Figure18a shows the flooded riverbanks years ago near Ft. Thompson, and Figure 18b is the cattle crossing at the Rapids. Lake Flirt no longer exists, but a number of dredged basins in that locale now harbor wet storage facilities (Figure 19).

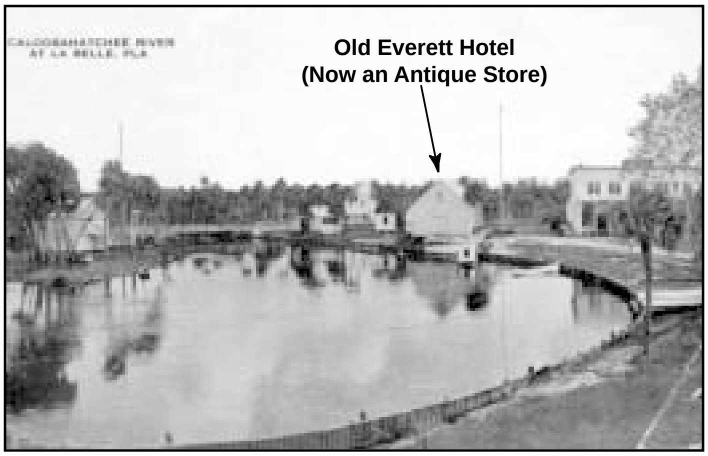


Figure 17a. La Belle riverfront (then).


Figure 17c. La Belle swing bridge (then).


Figure 17b. La Belle Town dock (now).


Figure 17d. La Belle bridge (now).

Figure 18a. River at Ft. Thompson.

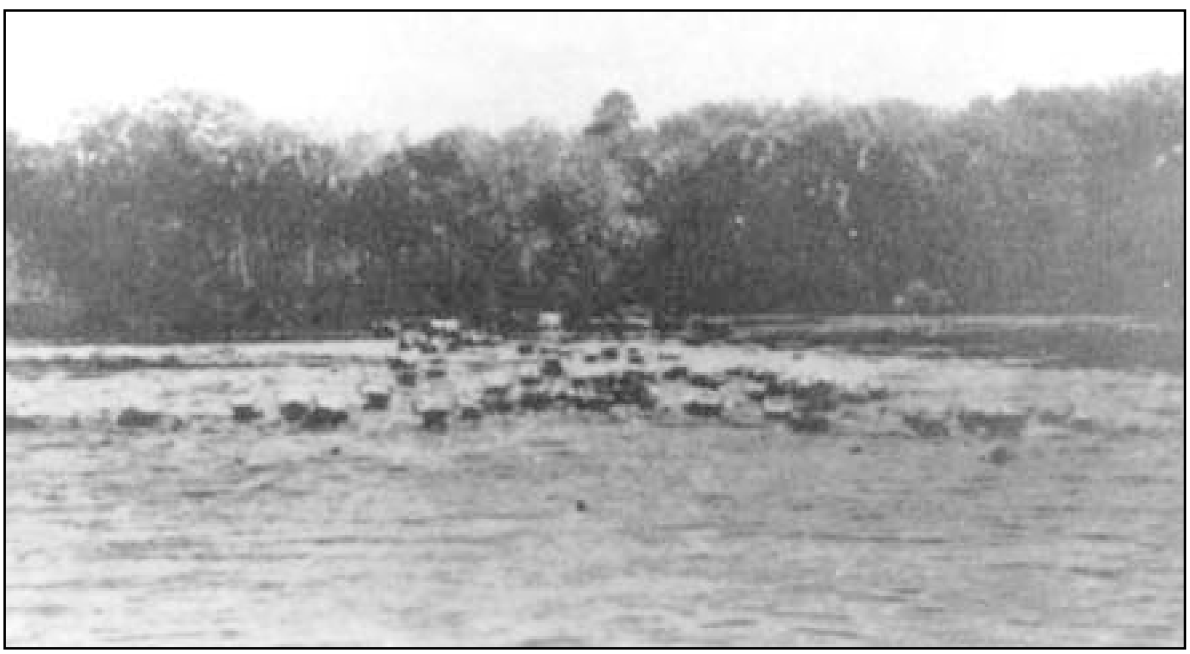


Figure 18b. Cattle crossing at Ft. Thompson.

Ortona Lock, near former Coffee Mill Hammock and west of the levee partially completed by Disston in the 1880s, is a major feature of the Okeechobee Waterway (Figure 20). For many years an important landmark guiding mariners across Lake Okeechobee, a sentinel cypress, known as *The Lone Cypress*, marked the eastern entrance to the Caloosahatchee and became a fixture of Moore Haven at the lock's location (Figures 21a, b).

Figure 19. Boats near former Lake Flirt.

Figure 20. Ortona Lock.

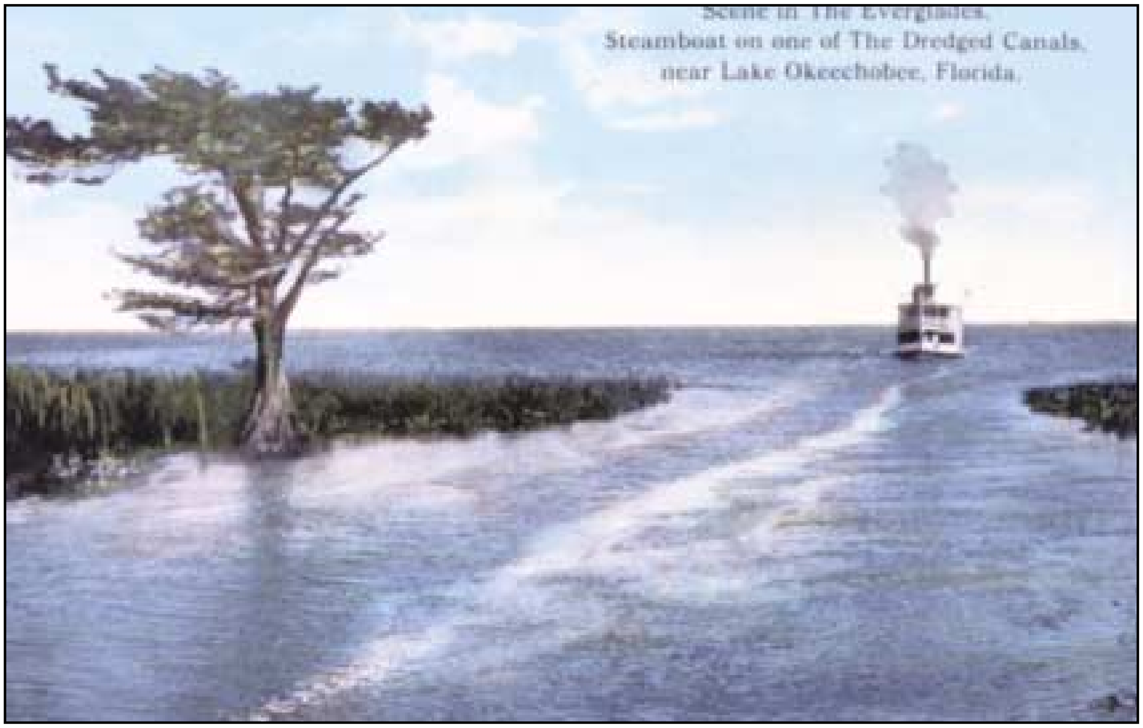
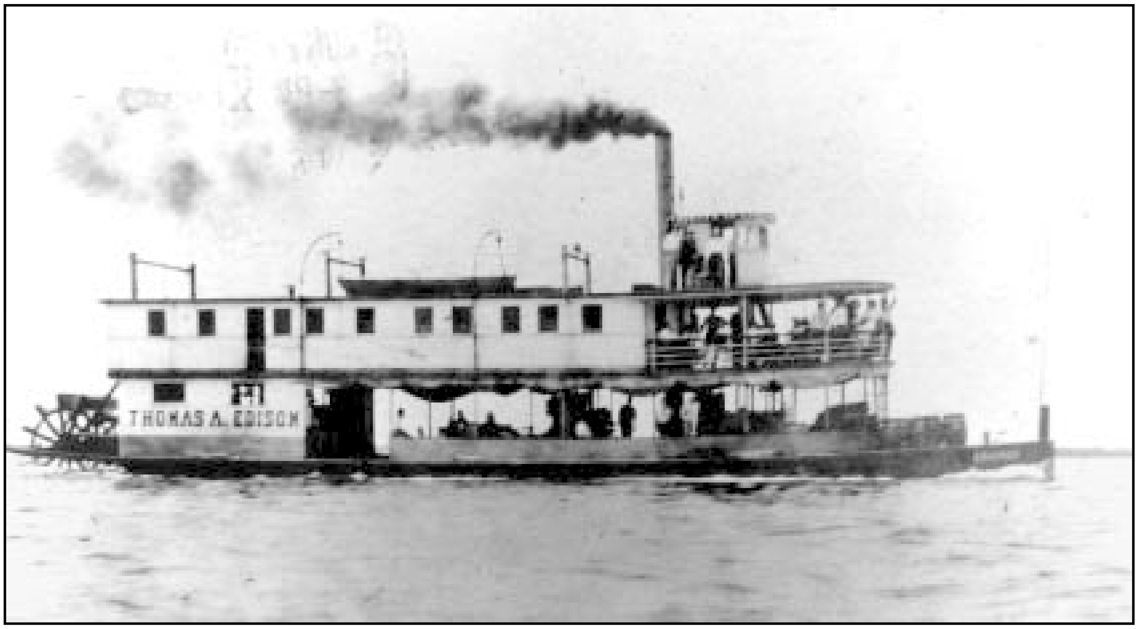


Figure 21a. Lone cypress at the lake and canal junction.

Figure 21b. Moore Haven lock.

Epilogue

Caloosahatchee history is the extreme case of altering land and water for coastal development in Southwest Florida. The river's form and function over the past 100 years have irrevocably changed. The historic river, which was relied upon by pioneers as a commercial artery for transporting goods and services, had a meandering, shifting course subjected to flood and drought conditions. Today, it is the straight-channel, dredged, Okeechobee Waterway, used by resource managers for flood control and by boaters transiting between the Eastern Seaboard and Gulf Coast. Hidden behind the waterway's artificially configured banks are isolated remnants of the Caloosahatchee's meanders, some pristine, others altered by development pressures from residential, agricultural and recreational uses. The dichotomy of waterway and river remain coupled by geography and history. The question of how this historic river and its water will be managed and provided to sustain the rich historical and ecological balance, which drives our current coastal economy, is a vexing enigma to this day.



Steamer *Thomas A. Edison* on a run up the Caloosahatchee to Ft. Myers during the early 1900s.

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For Your Information...

Physical Features of Southwest Florida Rivers and their Influence on Shoreline Use and Navigation

Rivers, such as the Caloosahatchee, Estero, Imperial, and Cocohatchee, share a number of common physical features that affect navigation and land use along their shorelines.

Viewed from the air, these streams display floodplains with a meandering river course. During the pre–development period, when flood-control structures were uncommon, overbank flooding occurred during the rainy season as the meandering river would leave its existing channel and inundate part or all of its floodplain. Early settlers described such events, wherein the increased flow kept the sediment load suspended, with the river channel oftentimes indistinguishable because of the floodwater's turbidity.

The meandering habit of these rivers alternately cuts and fills the valley floor, depositing sediments on the inside of bends and cutting away its banks on the outside, and in this process, the whole meander migrates down-valley. The Black map (1887) displays many of the Caloosahatchee's floodplain features of the pre–development period, downstream from Ft. Thompson (Figure 22). In time, the meanders develop narrow necks (Figure 22, a), and, in flood stages, the river may abandon, or cut-off, a meander loop (Figure 22, b). An oxbow lake forms (Figure 22, c) when the river deposits sediments across the ends of the abandoned channel.

In the active meanders, water pools along the outside bend because the river undercuts the bank, which results in caving that allows the meander radius to grow. Depths become shallow where the river crosses from one bend to the next and creates shifting sand bars known as riffles. Riverboat captains during the heydays of 20th century development were familiar with these channel characteristics as they navigated through the shifting shoals and sought the deepwater pools in the outer bends. Larger vessels were required to warp-around the tight rope-bends. Present day mariners seek out the remaining deepwater pools as storm havens or "hurricane holes."

Today, the lower Caloosahatchee, downstream from Beautiful Island, is an estuary (subject to tidal influence), but, in essence, it is a drowned river valley, inundated during the post-glacial rise in sea level. Many of its former river meanders are clearly visible along the shoreline (Figure 23, red dashed line).

Relict Meanders East of the Franklin Lock.

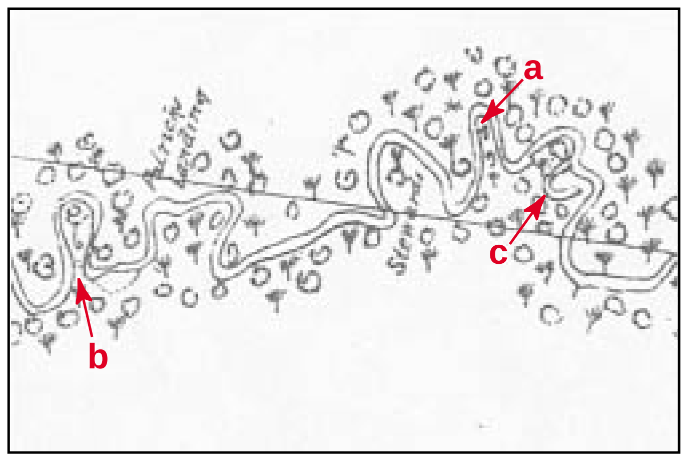


Figure 22. Meanders in the Caloosahatchee, 1887.

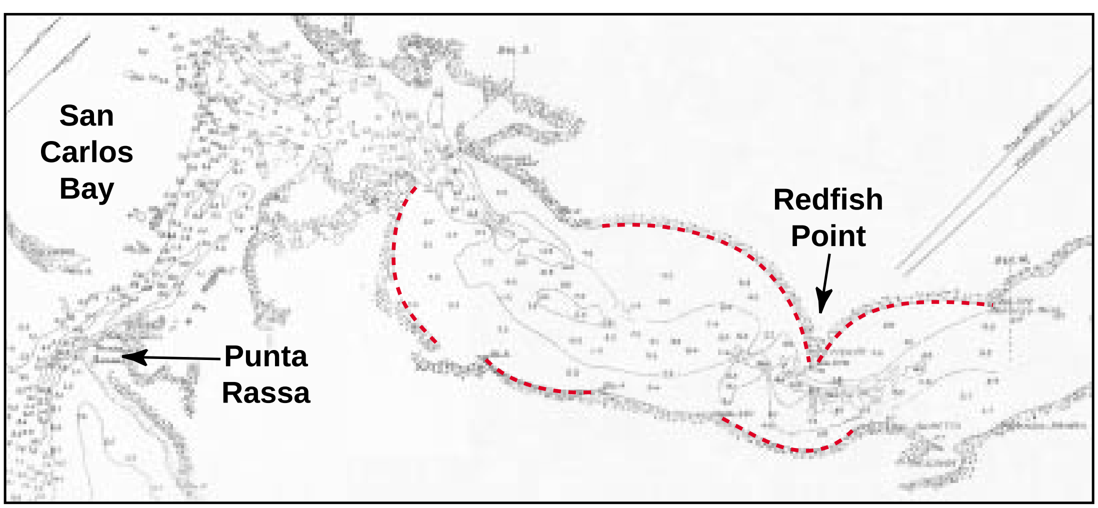


Figure 23. Drowned River Valley features.

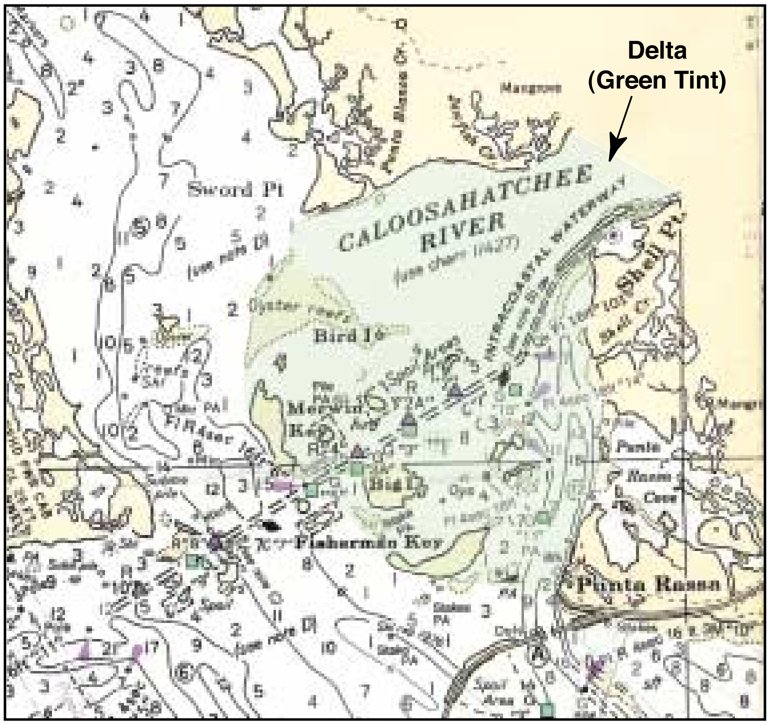


Figure 24. Chart of the Caloosahatchee delta.

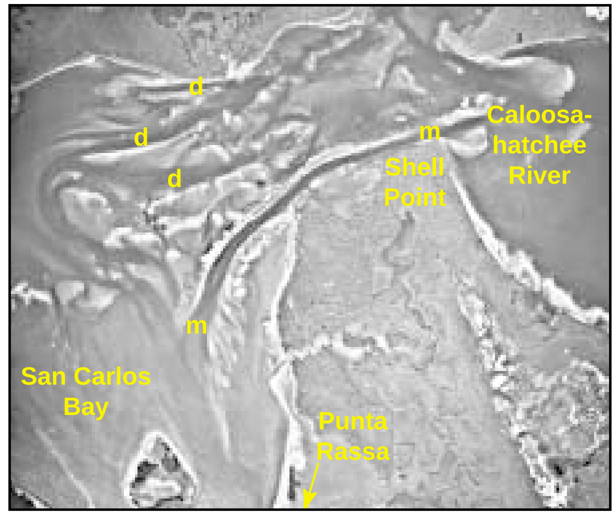


Figure 25. Caloosahatchee delta, 1944.

Figure 26. Imperial River delta, 1999.

Another feature of these rivers is the delta formed where the velocity of the stream rapidly decreases as it flows into a body of standing water. Distributary, intersecting, secondary channels form where the main river channel divides and pushes out into the bay. The configuration of the shoreline influences the shape of the delta. The Caloosahatchee delta, delineated by Shell Point at the apex (on the east) and a line drawn between Sword Point and Punta Rassa (on the west), has the characteristic *delta*-shape and is influenced by tidal currents flowing between Matlacha Pass and San Carlos Bay (Figure 24). Indeed, much of the shifting, shoaling character of the "Miserable Mile" segment of the Gulf Intracoastal Waterway through this area is attributable to tidal currents redistributing the river's delta deposits. The aerial photograph in Figure 25 predates the Gulf Intracoastal Waterway and clearly shows the many distributary channels ("d") in this area. The main, navigable channel through the delta ("m" in Figure 25) shows the side-cast spoil placed along the north bank of the channel. This is a federally-maintained channel that was first dredged by the Army Engineers in 1882.

The Imperial River's delta (Figure 26) extends across lower Estero Bay and abuts the barrier island. This delta has proved to be an effective barrier to navigation. Shallow-draft coastal vessels used one of the distributary channels, the "Auger Hole," during the early development period. In 1955, a private developer dredged a north-south channel across the delta in order to provide boat access between Estero Bay and Wiggins Pass.

CHARTING WATERWAY CHANGES

Coast Survey nautical charts, piloting tools used by skippers of coastal vessels include fine examples of Nineteenth Century cartography. Unfortunately, when compiling source maps of the land and water features for this historical geography series, the authors were unable to acquire nautical charts covering the entire study area.

The Coast Survey carefully preserved "compilation smooth sheets," the final working draft source maps — both hydrographic (water) "H-sheets" and topographic (land) "T-sheets" — which provided the baseline information for portraying bathymetric, shoreline, and land conditions on the charts. (In Volume 1, "Charting Sarasota Bay" described the fieldwork and cartographic processes in the creation of nautical charts.) The H-sheets portrayed soundings and depth contours derived from them. The T-sheets provided information on shore features of interest to navigators, generally showing terrain and landmarks to the inland extent visible from vessels. Therefore, for parts of our coast where the published pre–developement era nautical charts are no longer readily obtainable, the archived H- and T-sheets are an invaluable resource. This is the case for Southwest Florida.

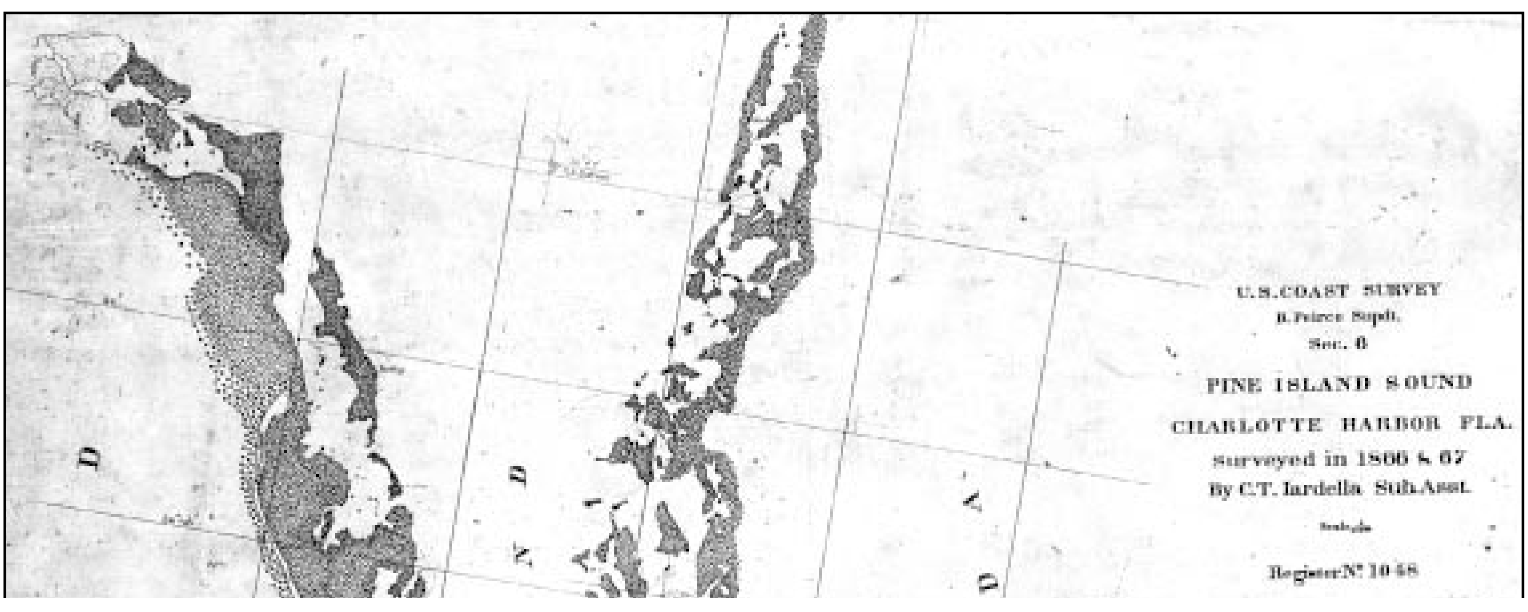
Figure 1 is a T-sheet, with an enlarged inset showing the amount of detail drawn to indicate land cover, here mostly mangrove forest. This map shows what is today known as Matlacha Pass, between Pine Island and the mainland near Cape Coral; the T-sheet, dated 1886-87, labels the pass "Pine Island Sound."

In every bay, estuary, and navigable river along Florida's Gulf of Mexico coast, the hydrographic surveys produced thousands of individual depths, each carefully measured by a sounding pole or a lead line heaved from a boat. Surveying techniques, based on sextant or transit sightings to or from shore stations, established a location for each sounding. Recording tide gauges allowed correction for the tidal variations. Shore parties performed the topographic surveys, mapping shorelines and other natural features, as well as roads, homesteads, farms, townships, and prominent buildings. Boundaries between land cover communities (mangrove, scrub, brushland, fresh and saltwater marshes, other wetlands, upland forests, etc.) were carefully drawn. The H- and T-sheets preserve abundant data on the state of water and land.

Today, Geographic Information System (GIS) computer programs facilitate quantitative analysis of change in shorelines, bathymetry, land use, etc., both among earlier eras and from historic to modern times. A printed historic map may be used as a data source, when input into a GIS via a file made by scanning either the paper map or a photograph of it. The GIS also needs the geographic coordinates of at least a few identifiable mapped features in order to relate all parts of the map to the coordinate system. Otherwise, the file is simply a picture or graphic, not a *georeferenced* map.

In low-energy coastal areas, away from inlets or other features subject to significant change due to storm events, scour, sedimentation, etc., it is often possible to identify presently existing natural or manmade features on historic maps. They can serve as *ground control points* (GCPs) for georeferencing. However, in Southwest Florida, especially near the barrier island passes, few natural or manmade features have survived unchanged since the mid- to late -1800s. The distinctive shoreline shapes and many small islands visible on historic maps, which might serve as GCPs if identifiable on modern maps or aerial photographs, usually reflect mangrove forest boundaries, which may have changed substantially in the intervening years.

Fortunately, historic T-sheets were drawn with accurate geographic grids, the familiar lines of latitude and longitude. Using visible grid intersections with known geographic coordinates as control points, georeferencing map scans is straightforward. Once the coordinates of selected grid intersections (or other ground control points) are associated with the corresponding pixel coordinates in the image file, the GIS then transforms all pixel coordinates to geographic ones. In addition, this process can *rectify* the image, correcting source map inaccuracies, as well as removing distortions induced in the paper maps over decades of storage and handling or introduced in the scanning process. Sophisticated mathematical operations (algorithms) start with the map coordinates of the GCPs and interpolate new positions for all other pixels in the image.



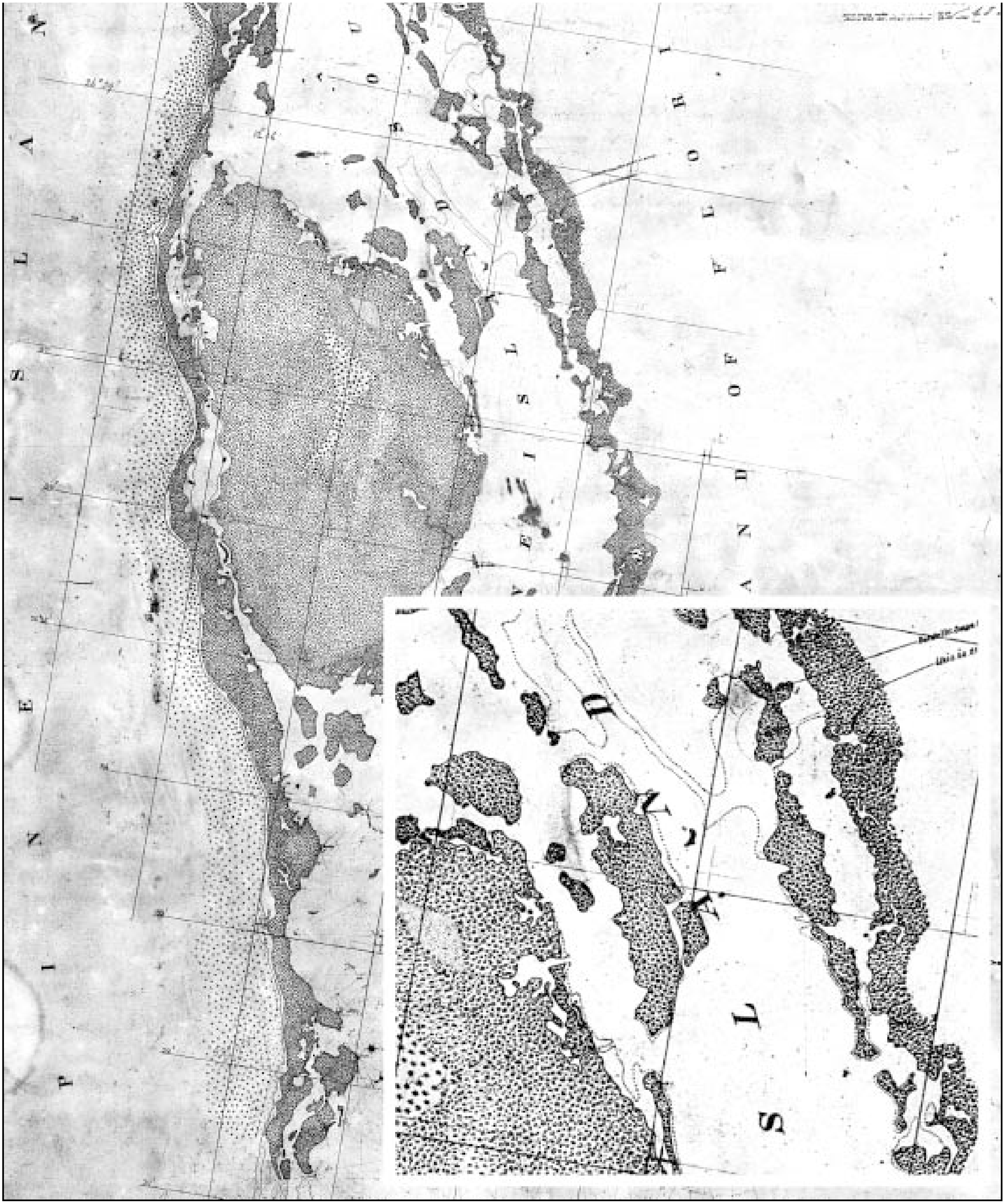


Figure 1. Example terrestrial smooth sheet (T-Sheet).

Many of the H-sheet scans do not show geographic grids, which may have been drawn so lightly that the scan process failed to capture them. Also, the cartographers often drew H-sheet shorelines in a simplified fashion, omitting small, distinctive features. However, H-sheets (and the T-sheets) show the shoreline *triangulation stations*, used for position determination in both the topographic and hydrographic surveys. Figure 2 is a small portion of an H-sheet scan, showing station "Annie," near the south end of Captiva Island. The scan shows no trace of a geographic grid, but the triangulation stations are visible, if only barely, as are parts of colored depth contours. The green line is the 6-foot contour.

Triangulation stations were points of precisely known location, distributed along the barrier island and mainland shorelines, often on prominent points. A few occupied small bay islands or oyster reefs. The survey crews selected sites that maximized views of the open water, performed careful surveys to determine their positions, and thoroughly documented each station's important characteristics.

The National Ocean Service provided the T-sheets as high-quality photographic negatives; thus, Figure 1 retains most of the detail visible on the original map. For the H-sheets, obtained as scans of much lower resolution, we plotted the scans onto paper at full size and then *digitized* depth contours, either tracing the original contours or interpolating between the point soundings. This process requires an operator to trace each contour with an electronic "puck" on a special table, following rigid rules of contour construction. Of the 95 control points used in the shoreline and depth contour mapping, 52 were triangulation stations. (The T-sheets and some better quality H-sheets also served as sources for land use/land cover interpretation. The operator did "heads up" digitizing on a computer screen, rather than moving a puck over a paper plot.)

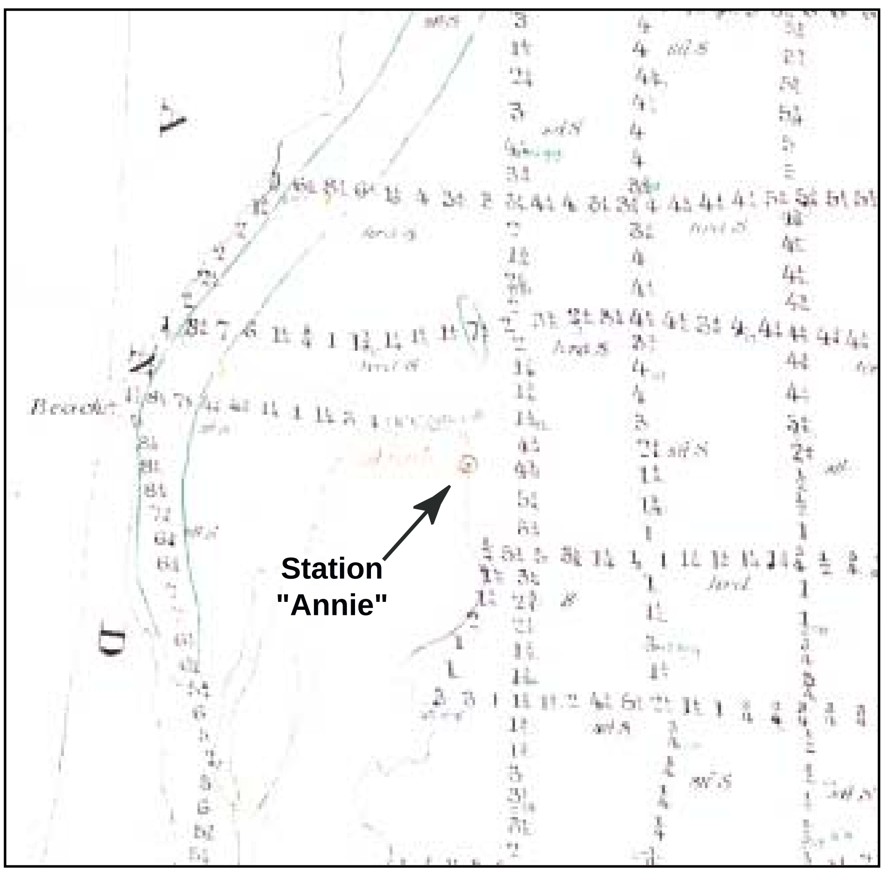


Figure 2. Detail of hydrographic smooth sheet (H-Sheet) scan.

Two source documents provide the coordinates of the triangulation stations in our study area. The *Report to the Superintendent of the United States Coast Survey, Showing the Progress of the Survey during the Year 1868*, tabulates some of them. These positions used the *Bessel ellipsoid*. An ellipsoid is a representation of the Earth's shape; improved knowledge of the true shape of the planet allows definition and adoption of more accurate ellipsoids (also called *spheroids*).

Another document, *Triangulation along the West Coast of Florida*, by Clarence H Swick, provided most of the station positions and descriptions. Station coordinates were based on the "Old North American" *datum* (mathematical model that fits the earth to an ellipsoid or spheroid); this datum used the Clarke 1866 spheroid, which succeeded the Bessel ellipsoid. Swick also discusses the Old North American Datum. In 1901, the Coast Survey adopted a single datum, the *United States Standard Datum*. This was made possible by analysis ("a very heavy piece of work") of data from the transcontinental triangulation of the United States, completed in 1899. Canada and Mexico adopted the new datum in 1913, and its name became the North American Datum. Later, the *North American Datum of 1927* (NAD27) became the standard, and the previous datum came to be referred to as the "Old North American Datum."

To summarize, converting historic source maps into forms usable for Geographic Information System analyses required transforming map coordinates of ground control points from the Old North American Datum (based on either of two obsolete spheroids) to the NAD27 Datum. The next step was conversion of the coordinates from NAD27 latitude and longitude degrees into modern *projected* systems that use meters or feet for units and yet other spheroids. (Projection displays the Earth's curved surface as a flat representation, such as a paper map. Unprojected coordinates are satisfactory for a globe, but not good for flat maps.)

The National Geodetic Survey generously supplied the triangulation station reference documents and provided formulas to transform coordinates from Bessel ellipsoid to Clarke 1866 spheroid-based coordinates, as well as from the "Old North American Datum" to NAD27. These transformations all vary from place to place; *Datum Differences: Gulf and Pacific Coasts*, published by the Coast and Geodetic Survey in 1936, specifies the corrections needed for the NAD27 transformation in Southwest Florida.

Table 1 is an example of the coordinate transformation steps. Transforming the Bessel-ellipsoid coordinates of station "Annie" to the Clarke 1866 spheroid required subtracting 3.32 arc-seconds from the original latitude (26 30 58.09 became 26 30 54.77) and adding 10.65 to the longitude (82 10 42.07 became 82 10 52.72). Then, to convert the Old NA coordinates to NAD27, latitude decreased by another 0.250 arc-second, and longitude increased by 0.039. The projection changed the degree-minute-second lat/lon coordinates to Annie's X-Y Albers coordinates: 580951.343/280297.497meters. Not shown is the conversion of degrees-minutes-seconds to decimal degrees, required for the projection operation. Each of the 95 ground control points required careful execution of these steps.

Example of geographic coordinate transformations.

Example Map Triangulation Station	Geographic Coordinates						Albers Projection	
	NA Datum		NA Datum		NAD27		NAD83	
	(Bessel Ellipsoid)		(Clarke 1866 Spheroid)		(Clarke 1866 Spheroid)		(GRS80 Spheroid)	
	Lat (DMS)	Lon (DMS)	Lat (DMS)	Lon (DMS)	Lat (DMS)	Lon (DMS)	X (m)	Y (m)
Mistake			26 37 43.030	82 10 44.200	26 37 42.780	82 10 44.239	581000.298	292887.974
Boca Captiva			26 36 40.539	82 13 28.750	26 36 40.289	82 13 28.789	576486.397	290895.047
Oyster Shell	26 32 46.57	82 07 23.10	26 32 43.25	82 07 33.75	26 32 43.000	82 07 33.789	586398.834	283724.254
Annie	26 30 58.09	82 10 42.07	26 30 54.77	82 10 52.72	26 30 54.520	82 10 52.759	580951.343	280297.497
Havelock			26 30 05.720	82 06 10.078	26 30 05.470	82 06 10.117	588784.823	278902.973
New Year	26 28 4.61	82 07 39.09	26 28 1.29	82 07 49.74	26 28 1.040	82 07 49.779	586089.004	275024.823
			→ Bessel Ellipsold to Clarke 1866 Spheroid: lat -3.32” lon +10.65”		→ NA Datum to NAD27: lat -0.250” lon + 0.039”		→ Geographic Coordinates to Albers Conic Equal-Area Projection	

Table 1.

How well did the process work? Figure 3 shows the pre–development bathymetry map of Matlacha Pass, with depth contours interpreted from an H-sheet, displayed in the GIS program. A recent (1999) georeferenced aerial photograph overlies the map. In places, the shoreline neatly continues from the photograph onto the map, indicating little change from the late 1800s to 1999. Other parts of the shoreline do not line up as well, suggesting change has occurred, either from natural processes, such as variation in mangrove coverage, or by the influence of man. At the upper and lower edges of the photograph, changes in the water depth — indicated by color variation, mostly due to sea grass beds — correlate well with the depth contours visible on the map. Matlacha Pass is a relatively low-energy waterway, not subject to the dramatic changes wrought by storm events at the barrier island Gulf passes, so the lack of major variation is not surprising.

Geographic Information System computer programs allow researchers to compare old and new maps, in a common reference frame, in order to visualize and quantify changes that occur over time. Many of the maps in this book required this capability in their creation. Traditional methods could have produced similar maps and even allowed simplified change analyses, but the time, expense, and limitations associated with those older techniques would have precluded our embarking on the task.

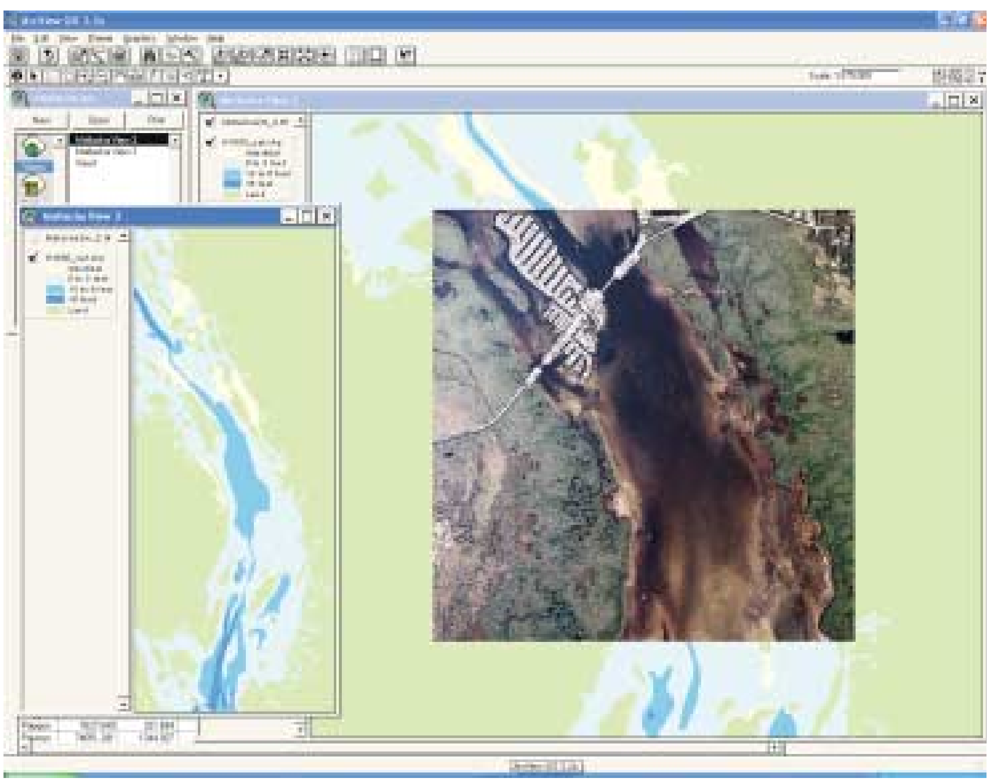


Figure 3.
Map of pre–development era bathymetry with modern aerial photograph.

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GLOSSARY OF TERMS

bascule bridge — A drawbridge with a counterbalanced span that lifts to allow passage of vessels.

benthic (organisms) — Living on or at the floor of a body of water.

chloropleth map — A map using varying colors to show the differences in the average value of a parameter among defined areas.

cuspate headland — A land mass, roughly triangular, jutting into a body of water.

downdrift — Moving in the direction of longshore currents; used especially with regard to inlet migration.

dredge-and-fill — Creation of land by deposition of material (spoil) dredged from nearby waterways.

ebb-flood channel — The principal channel in an inlet, maintained by scouring of sediments by tidal currents.

ebb-tidal delta — Mostly underwater sediment mass deposited seaward of inlets by tidal currents as the tide ebbs (falls) (cf., flood-tidal delta).

finger canals — Canals (often straight and parallel) branching from a common canal.

flood-tidal delta — Mostly underwater sediment mass deposited landward of inlets by tidal currents as the tide floods (rises) (cf., ebb-tidal delta).

georeference — Locate with respect to a geographic (map) coordinate system.

groin — A structure projecting from a beach to intercept sediment being transported by longshore currents.

groundswell — Increase in the height of waves entering shallow water.

intertidal — Land alternately covered with water and then exposed due to the rise and fall of tides.

jetty — A structure projecting from the shore to stabilize an inlet by intercepting sediment being transported by longshore current.

longshore drift — Movement of sediment (especially, sand) by wave-induced currents parallel to the shore.

marginal channel — A channel formed by currents along the ends of barrier islands, which may offer safe, deep passage through an inlet.

mixed-energy — Inlets subject to both wave and tidal influences where neither dominates.

overwash — Storm-driven waves flowing across a barrier island; the erosional/deposition features resulting from such flow.

oxbow — A crescent-shaped lake formed in an abandoned channel of a river.

prograding — Land growing seaward by deposition of sediment.

prop wash — Turbulent water flow generated by a boat's propeller.

renourishment — Addition of sand to a beach by artificial means.

run boat — A vessel that delivered supplies to fishermen and transported their catch back to processing or shipping facilities.

spill-over lobe — Local enlargement of a flood-tidal delta caused by sediment deposition.

snag boat — A vessel designed and equipped to remove obstacles, such as overhanging or fallen trees, from a waterway.

spit — Finger-like body of sediment projecting into deeper water, usually at an inlet.

swash platform — The zone of a beach or ebb-tidal delta, immediately shoreward of the breaker zone, where water from broken waves flows shoreward in low-energy sheets.

tidal prism — The volume of water flowing through an inlet during a tidal cycle.

tide-dominated inlet — Channel depths and shape subject to the effects of tides more than to wave effects (cf., wave-dominated).

wave-dominated inlet — Channel depths and shape subject to the effects of waves more than to tidal effects (cf., tide-dominated).

"wild" inlet — A wave-dominated, unstable, migrating inlet with varying shape and depth.

Wide-angle view southeast, above Useppa Island and Cabbage Key (middle foreground), down Pine Island Sound, Barrier island chain on right and Pine Island on left.

SCIENTIFIC, TECHNICAL, AND BOATING-RELATED INFORMATION ON THE WATERWAYS OF SOUTHWEST FLORIDA

The references listed below result from a decade-long Urban Boating Bay Water Management Research and Extension Program, sponsored by the National Oceanographic and Atmospheric Administration (NOAA), through Florida Sea Grant College Program, Coastal Services Center and The Marine Charting Division, and by the West Coast Inland Navigation District. Designed to help Florida boaters, residents, communities, and businesses achieve sustainable, self-regulated use of coastal waters, the program's goals are eliminating the need for costly and onerous regulation of boating citizens, enhancing the boating experience, and reversing the decline in quality of coastal waters. The program focuses on anchorage and waterway management, operating under the aegis of formalized agreements with the Florida Department of Environmental Protection.

Detailed resource inventories, scientific and technical investigations, and extension education publications (maps and guide materials) are some of the results of this ongoing effort. Copies of these materials can be examined at or obtained from the agencies referred to by number in ( ) below.

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(3) Boaters' Action & Information League, 5835 Wildwood Ave., Sarasota, FL 34231.

(4) Lee County, Marine Program, Natural Resources Division, P.O. Box 398, Ft. Myers, FL 33902-0398. http://www.lee-county.com/naturalresources/

(5) Charlotte County Planning Dept., 18500 Murdock Circle, Pt. Charlotte, FL 33948-1094.

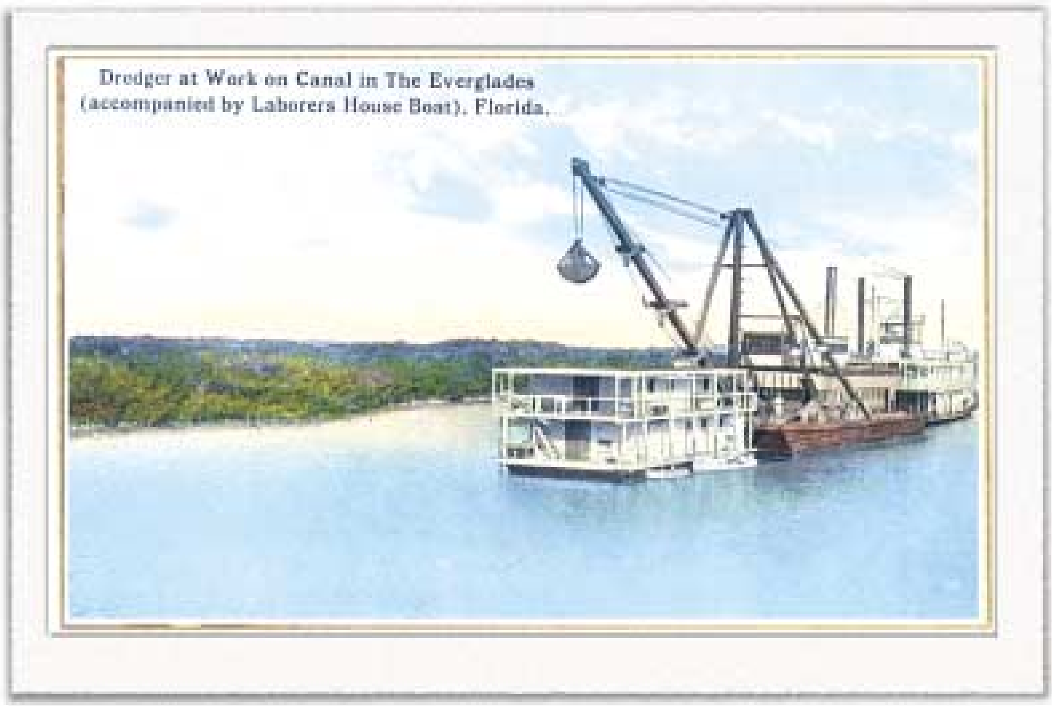
Boca Grande Town.

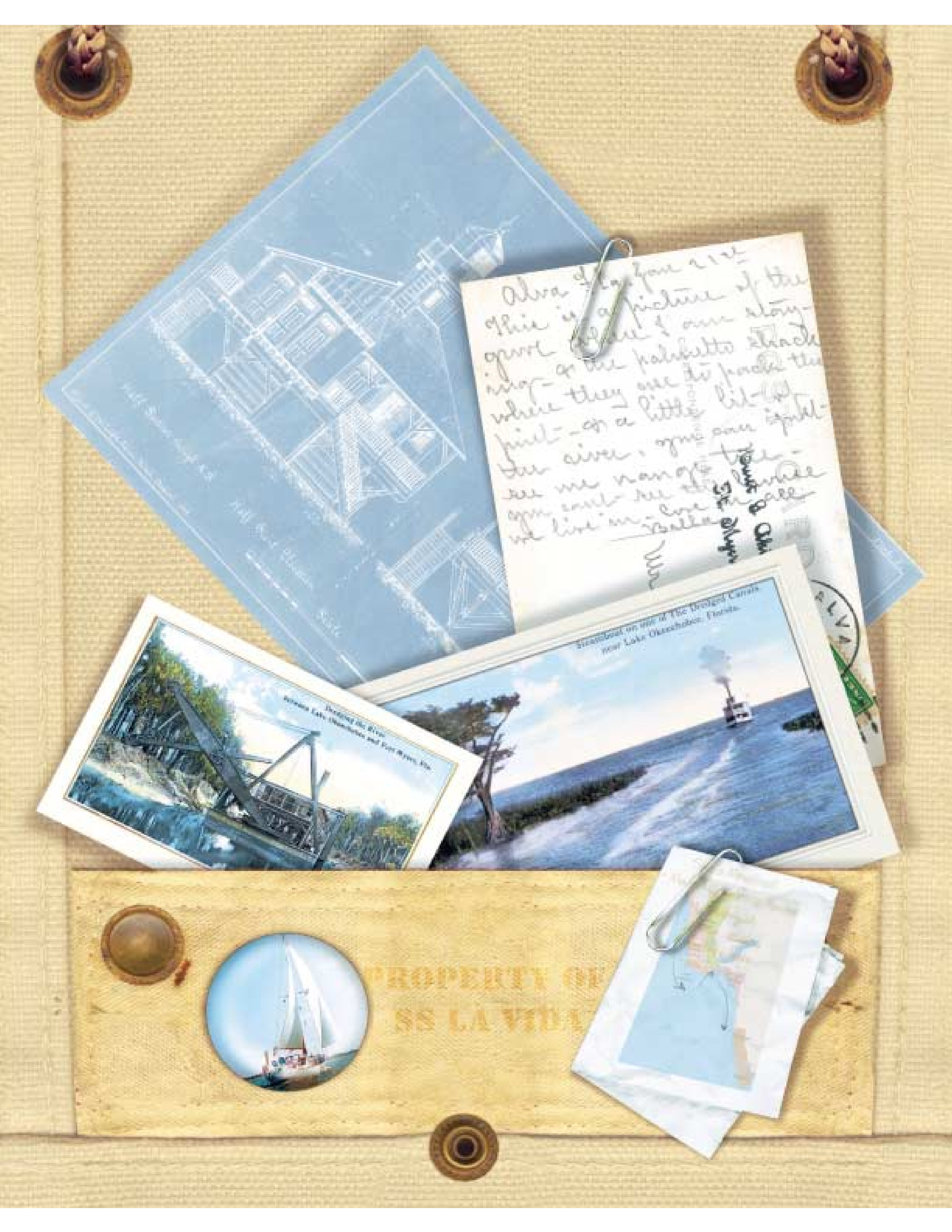

An Orange Packing House, Fort Myers, Fla.


Marco, Florida


Sanibel Ferry at P. Rassa


A THATCHED HOUSE ON THE BANKS OF THE UPPER CALOOSAHATCHEE RIVER, FLA.


Dredger at Work on Canal in The Everglades
(accompanied by Laborers House Boat). Florida.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