FLORIDA SEA GRANT PROGRAM

JOHN'S PASS AND BLIND PASS GLOSSARY OF INLETS REPORT #4

by A. J. Mehta, C. P. Jones, and Wm. D. Adams

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JOHN'S PASS AND BLIND PASS
GLOSSARY OF INLETS REPORT

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FOREWORD

The numerous inlets connecting Florida's inner waters to the Atlantic Ocean and the Gulf of Mexico are important from considerations of recreational and commercial vessel traffic and also because they provide small boats access to safe refuge during unexpected severe weather and waves. In addition, inlets act as flushing agents, providing renewal of bay waters by exchange with outer continental shelf waters. Unfortunately, inlets also contribute significantly to the serious beach erosion problem prevalent along most of Florida's shoreline. The complexities of the hydraulic and sediment transport mechanics in the vicinity of inlets present a formidable challenge to engineers and scientists. These factors, along with the interesting historical role that inlets have played in the early development of Florida, have resulted in considerable documentation pertaining to the major inlets of the State.

This report of John's Pass and Blind Pass is one of a "Glossary of Inlets" series to be prepared under the State University System Sea Grant project, "Nearshore Circulation, Littoral Drift and the Sand Budget of Florida." The purpose of this series is to provide for each inlet a summary of the more significant available information and to list known documentation. It is hoped that this series will yield an improved understanding of the overall effect of each inlet on the economics, recreation, water quality and shoreline stability of the surrounding area. The proper management, use and control of Florida's inlets will require an appreciation of the evolution and the past response of the inlets.

ACKNOWLEDGEMENT

We sincerely appreciate the assistance provided by Leroy Halbrook, city engineer of Treasure Island. Many thanks to Dean O'Brien for his comments on the report during its preparation. The assistance of H.K. Brooks and Todd Walton of the Coastal and Oceanographic Engineering Laboratory is acknowledged. Helpful comments were made by Dr. J. Covington of University of Tampa. The Corps of Engineers, Jacksonville District, made available much needed maps and surveys.

I. INTRODUCTION

John's Pass and Blind Pass[1] connect the Gulf of Mexico to the northern part of Boca Ciega Bay, which is west of the city of St. Petersburg, Florida. The coordinates of these two tidal inlets, shown in Figure 1.1 are:

Inlet	Latitude	Longitude
John's Pass	27° 46' 51" N	82° 47' 05" W
Blind Pass	27° 44' 18" N	82° 45' 18" W

Boca Ciega Bay is connected to Tampa Bay at the south end and to Clearwater Harbor through the Intracoastal Waterway in the Narrows at the northern end. John's Pass and Blind Pass lie at the north and south ends, respectively, of Treasure Island and separate this island from Sand Key to the north and Long Key to the south. Treasure Island is a relatively narrow barrier island about 3.5 miles long and having an average width of 1,500 feet, as shown in Figure 1.2. The entire barrier island chain west of St. Petersburg has been highly developed as a residential and tourist community. Both Sunshine Beach and Sunset Beach lie on Treasure Island; Madeira Beach lies on Sand Key, just north of John's Pass and St. Petersburg Beach lies on Long Key just south of Blind Pass. The bay shown in Figure 1.2 does not include its southern part, which is south of St. Petersburg Causeway. The dam on Long Bayou and the Conch Key area may be considered as the boundaries of the northern end of the bay. The body of water enclosed within these boundaries and the two passes constitutes a reasonably well-defined inlet-bay system, which may be broadly treated as a single geomorphic and hydraulic unit.

Even though the two inlets are connected to the same bay, they have widely different morphological characteristics. John's Pass (Figure 1.3) is 590 feet wide at the throat (location of the minimum flow cross-sectional area) with a mean depth of 16 feet. At the throat bulkheads define the width of the inlet. A curved rubble-mound jetty exists at the north bank of the inlet but the south bank near the Gulf is in a natural state with a sandy beach. This beach protrudes seaward and encloses a body of water south of the inlet known as O'Brien's Lagoon (Sedwick and Mehta, 1974; Sedwick, 1974). The reader is referred to section 5.3 for a brief description of the lagoon.

Blind Pass (Figure 1.4) has typically been less stable than John's Pass and most of the channel has been bulkheaded on both sides. The entrance

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[1]Apparently at one time, several inlets whose entrances were difficult to sight from the sea due to their peculiar offset orientation were referred to as Blind Pass. In addition to the Blind Pass in Pinellas County described here, there is an inlet by that name in Lee County between Sanibel and Captiva Islands, and another in Collier County near Cape Romano. The Spanish words Boca Ciega translate as Blind Pass.

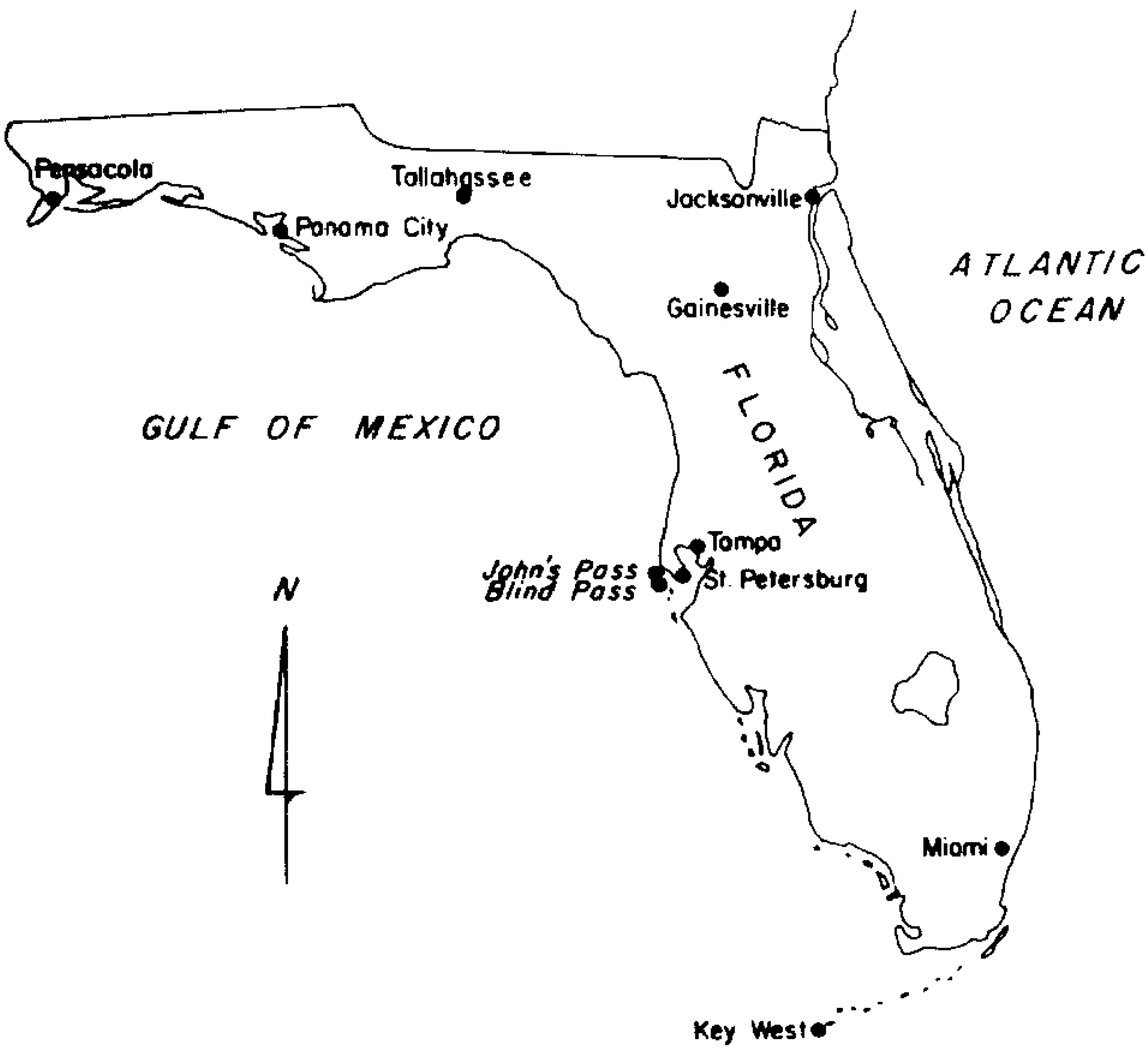


FIGURE 1.1. Map of Florida indicating locations of John's Pass and Blind Pass.

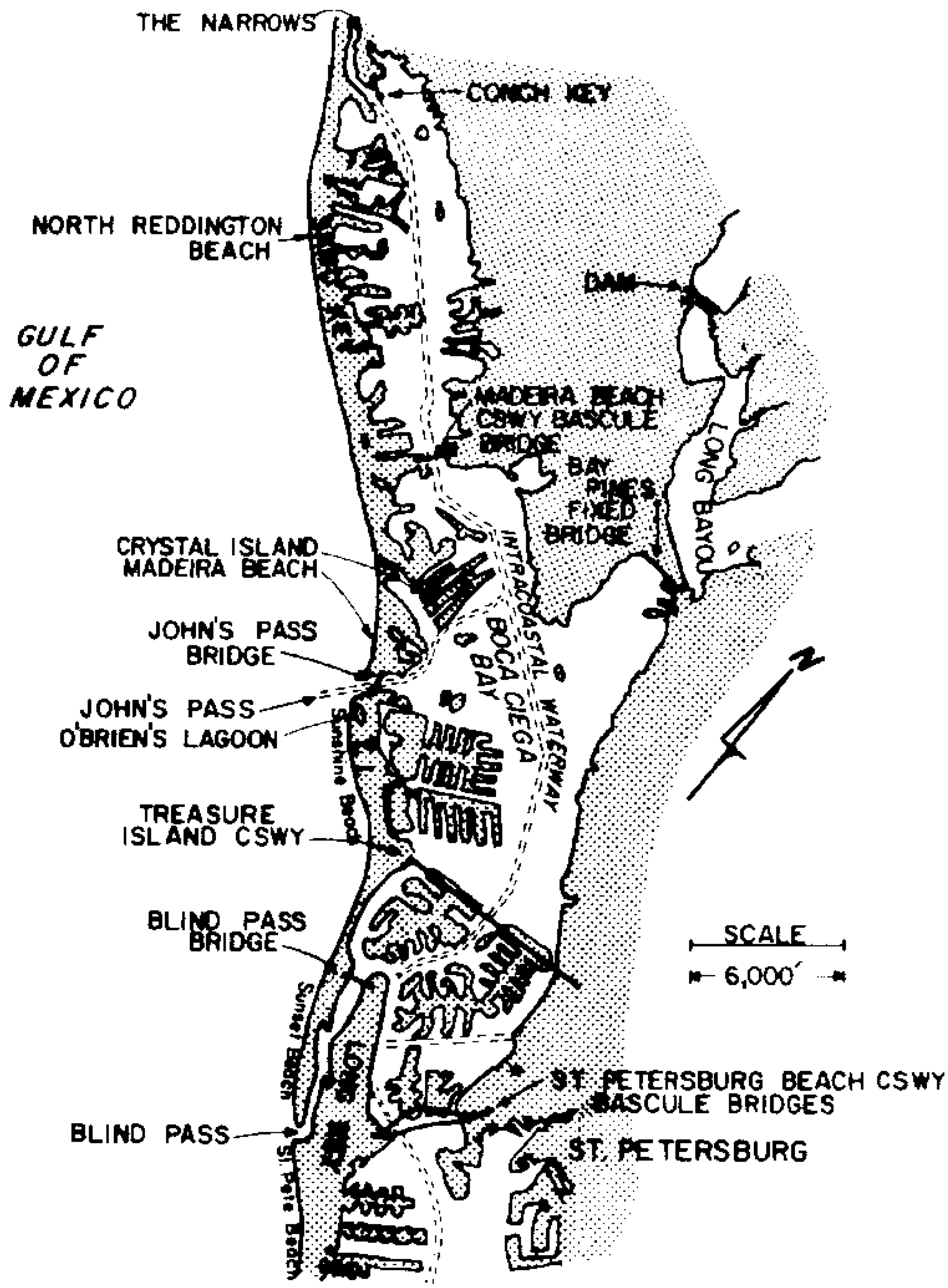


FIGURE 1.2. John's Pass, Blind Pass and the northern part of Boca Ciega Bay.

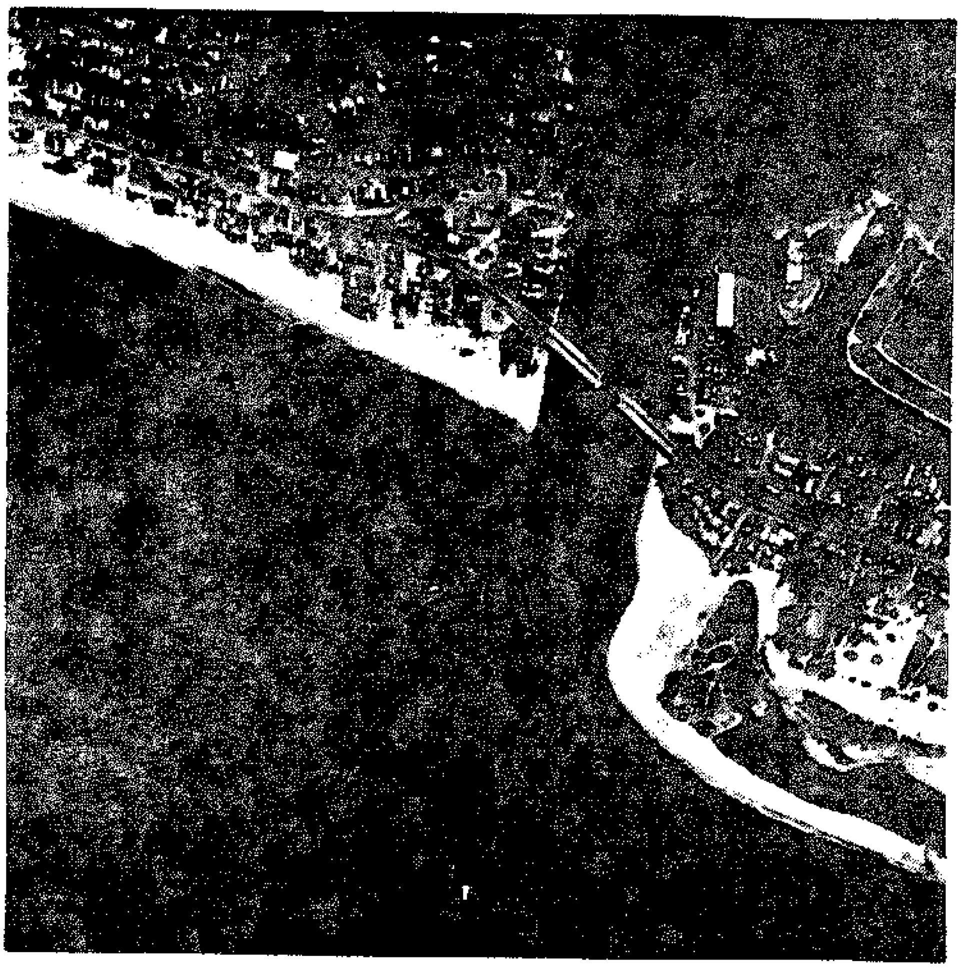


FIGURE 1.3. John's Pass in 1974. Notice the deep channel flanking the southern bank of the inlet. A portion of O'Brien's Lagoon is visible at the lower right hand corner.

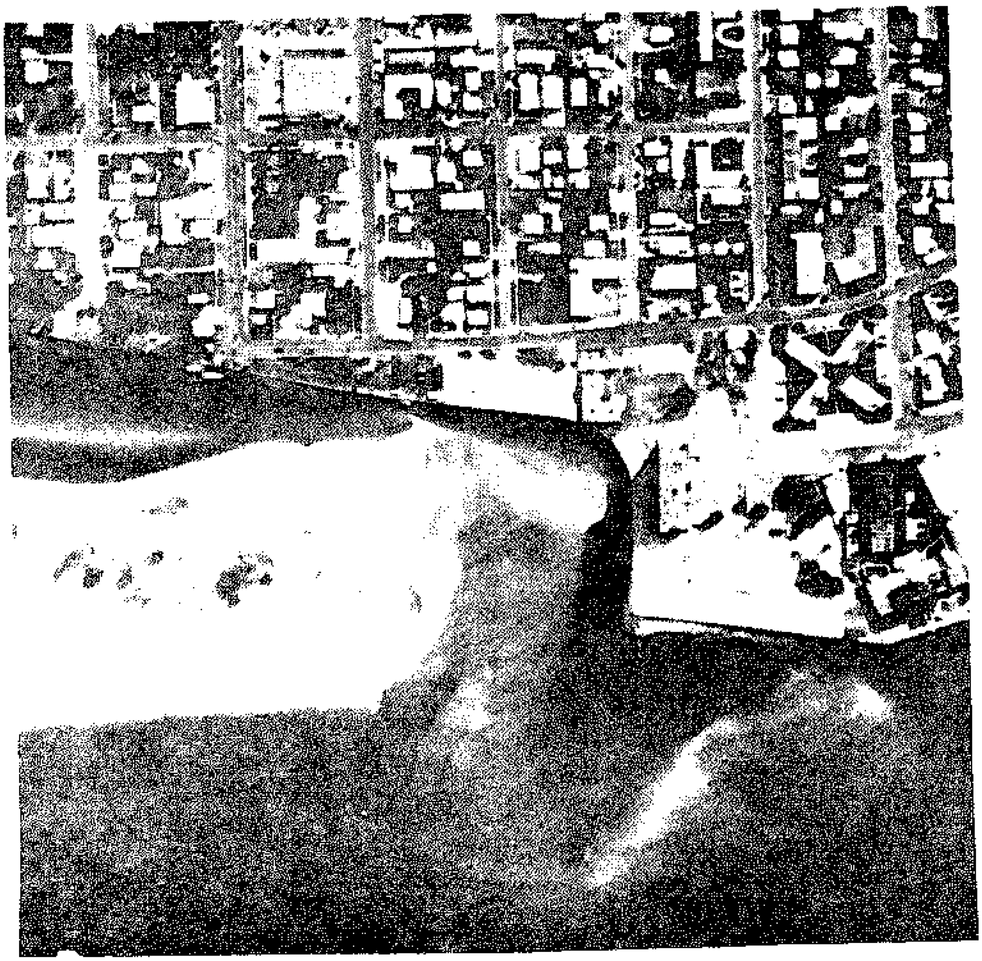


FIGURE 1.4. Blind Pass in 1974 prior to the jetty extensions. Notice the narrow throat section and sand accumulation in the entrance.

exhibits movements of the shoals and the outer bar. Blind Pass is 83 feet wide at the throat (based on survey in July 1974) with a mean depth of 6 feet below mean water level. The inlet length is on the order of 1,200 feet followed by a 7,000 foot long channel, where the currents are small compared to the throat. The channel is 560 feet wide and 9 feet deep on the average. Both of the jetties at Blind Pass have been lengthened recently as they were ineffective in controlling sand accumulation in the inlet region.

John's Pass is a part of the federally maintained navigable waterway system with a well-defined navigation channel that requires little dredging maintenance. Both the inlets are much used for navigational purposes. Whereas both commercial fishing boats and pleasure craft use the John's Pass channel, the shallow depths near the throat at Blind Pass preclude the use of this inlet for significant commercial boat traffic. The amount of traffic on the Intracoastal Waterway through Boca Ciega Bay has increased in recent years; in 1973 about 783,000 tons of cargo were transported along this federally maintained project[2] (9 foot depth by 100 foot width) between the Caloosahatchie River and the Anclote River (U.S. Army Corps of Engineers, 1975a).

Treasure Island is a thriving town that attracts a substantial number of tourists year round. Consequently, the beach between the two inlets is heavily used for recreational purposes. The permanent population of the island is about 8,000. During peak tourist season this number increases to 24,000. Another indication of the importance of this region is the increase in the number of bridge openings at John's Pass, as shown graphically in Figure 1.5. Between 1962 and 1974 there has been a five-fold increase in relatively large boat traffic through this inlet. The bridge itself is known for excellent fishing throughout the year. At Blind Pass several artificial reefs, made of automobile tires placed in a semi-circle, apparently exist about one mile offshore. These reefs have attracted reef fish such as snapper, grouper, rockfish and others. Although no inlet-specific data on fish landings are available, Pinellas County as a whole has the most extensive offshore commercial fishing industry on the west coast of Florida. This is obvious from Table 1-1, which gives the yearly total food and non-food fish landings and values for the years indicated.

TABLE 1-1

PINELLAS COUNTY TOTAL
ANNUAL FISH LANDINGS AND VALUES*

Year	Landing (lbs.)	Value $
1960	8,048,779	1,040,157
1963	8,712,055	1,170,808
1966	7,225,421	1,167,497
1969	6,217,732	1,372,007
1971	5,192,684	1,229,250

*Data from State of Florida Department of Natural Resources.

[2]This project was authorized by the 1960 River and Harbor Act.

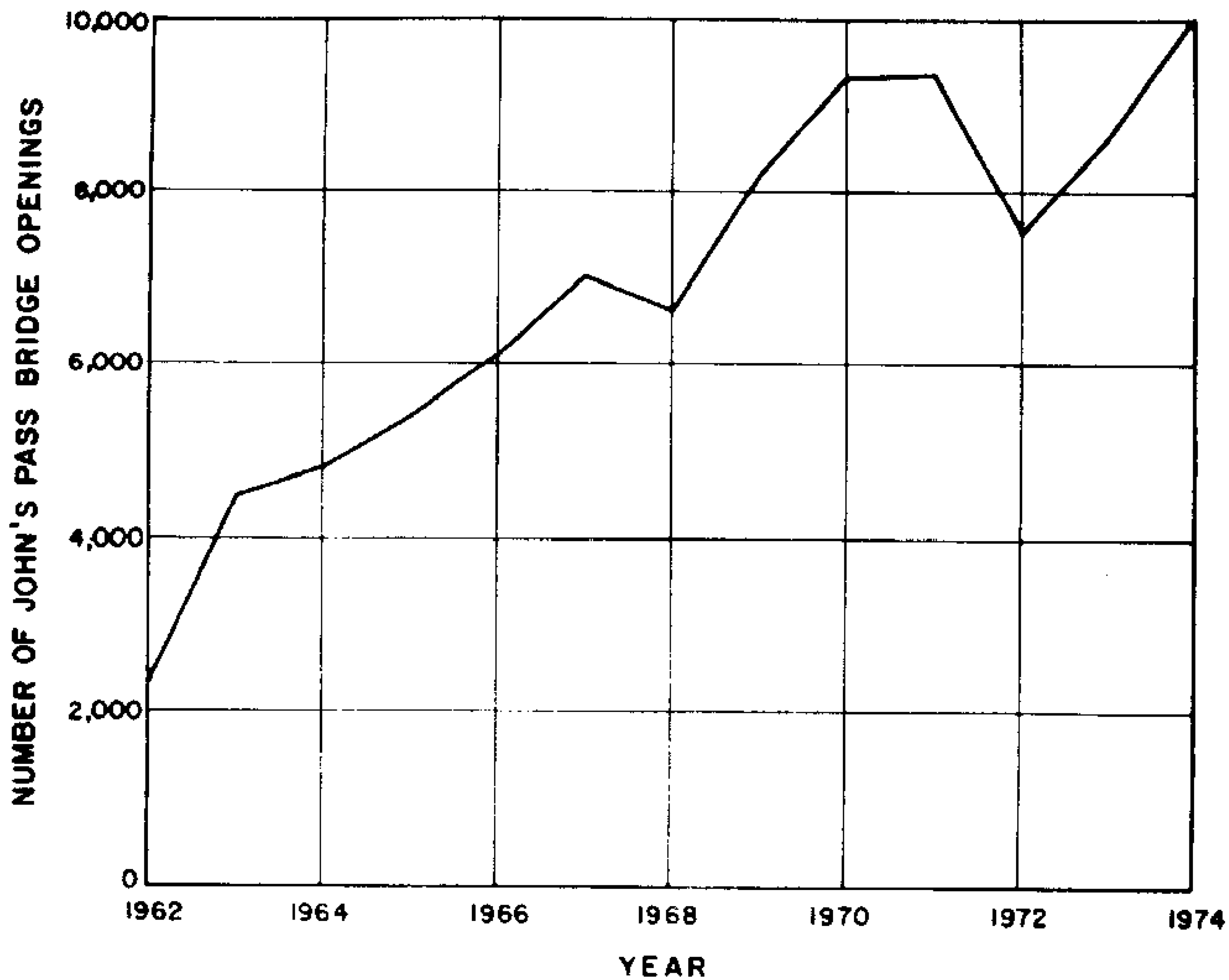


FIGURE 1.5. Number of John's Pass Bridge openings per year versus year.

II. GEOLOGIC SETTING

The bed rock of the study area is the Tampa limestone of Lower Miocene age. In Pinellas County the Tampa limestone is described by Cooke (1945) as being a fairly hard, dense, light-colored to yellowish limestone containing mollusk impressions. This formation outcrops along the shore in the northern portion of the county, although there is a three foot exposure of Tampa limestone at Indian Rocks (eight miles north of John's Pass) which is overlain by two to three feet of fine, carbonaceous sand. Rocks of Lower Miocene age outcrop in the offshore area of Pinellas County (Brooks, personal communication). In the southern portion of the Pinellas Peninsula the Tampa limestone is overlain by sediments of Lower Miocene and Plio-Pleistocene ages. The shelly surficial sands are Plio-Pleistocene.

Beach sand samples taken by the Coastal and Oceanographic Engineering Laboratory (COEL) at Treasure Island were composed of shell fragments, quartz sand and heavy minerals. The carbonate material varied from 6% to 44%. The proportion of heavy minerals in the modal sieve interval (either 0.18 mm to 0.25 mm or 0.13 mm to 0.18 mm) varied from 0.6% to 3.3% and averaged 1.6%. Heavy mineral analysis by Hoenstine (1973) and by Ceryak (1974) of nearby beaches and by Bates (1963) in the offshore area indicated that the predominant heavy minerals are zircon, ilmenite, magnetite, rutile, staurolite, and tourmaline. White (1970) believes that the sands composing the Gulf Coast barrier chain were derived by the erosion of Miocene "siliclastic" rocks making up the headlands between estuaries. However, Brooks (personal communication) has pointed out that sands derived from erosion of "siliclastic" rocks would be cherty or opaline in character. He is of the opinion (Brooks, 1973) that the sands composing these barrier islands were brought onshore from further out in the Gulf of Mexico.

The character of the surficial sediments can be obtained from the U.S. Department of Agriculture "Soil Survey of Pinellas County, Florida," (Sept., 1972). Figure 2.1 is adapted from aerial photographs presented in that report and indicates the extent of various soil types present on the barrier islands. There are five classifications shown:

1) Co (Coastal Beaches) - consists of narrow strips of tidewashed sand bordering islands and parts of the mainland. The sand is generally light gray to white and consists mainly of fine quartz particles with reworked shell fragments and some heavy minerals.

2) Ma (Made Land) - consists of mixed sand, clay, hard rock, shells and shell fragments that have been transported, reworked and leveled by earth-moving equipment. Some areas consist of material dredged from the bay and used to fill diked areas.

3) Pa (Palm Beach Sand) - consists of nearly level, well-drained sand mixed with shell and shell fragments that has typically been dredged from nearby areas.

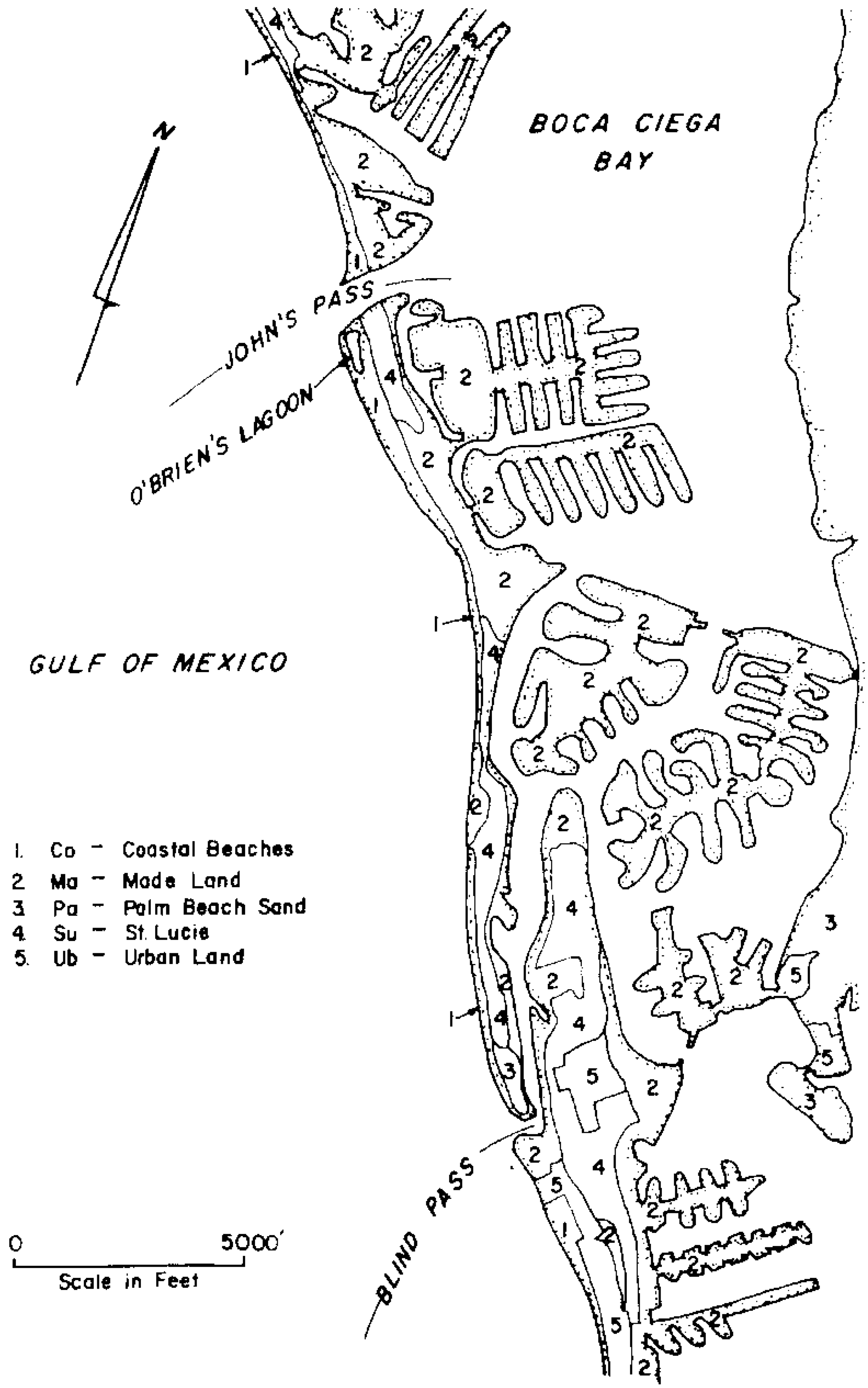


FIGURE 2.1. Soil classification in the vicinity of John's Pass and Blind Pass (U.S. Department of Agriculture, 1972).

4) Su (St. Lucie fine sand, shell substratum) - consists of nearly level soil on low ridges on barrier islands, typically being very dark, fine sand about three inches thick and being underlain by loose, fine, light gray sand. This is further underlain by pale brown, loose, fine sand and by layers of mixed light gray or white sand, seashells and shell fragments.

5) Ub (Urban Land) - consists of areas where the original soil has been modified through cutting, grading, filling and shaping or has been generally altered for urban development. Urban facilities (paved areas, buildings, houses, etc.) have been constructed on 75 percent or more of these altered areas.

The reader is referred to section 7.1 for a brief description of the sedimentary characteristics of the two inlets.

III. CLIMATE AND STORM HISTORY

3.1 Climate

Like the majority of the Florida peninsula, the climate of the Treasure Island vicinity is characterized by relatively humid summers and mild winters. Temperatures in the area are moderated somewhat by the Gulf of Mexico, Boca Ciega Bay and Tampa Bay. Precipitation occurs mainly during the months of June through October with approximately two-thirds of the total yearly amount falling during these months. This precipitation during the summer months is chiefly due to convective processes, while that rainfall occurring between November and May is due chiefly to frontal lifting.

The average yearly precipitation at the St. Petersburg weather station (U.S. Weather Bureau Sta. No. 7886) for the period 1911-1960 was 53.67 inches. The mean daily temperature at this same location was 73.8°F. The mean maximum daily temperature and mean minimum daily temperature were 81.9°F and 65.8°F. Table 3-1 summarizes both average monthly temperatures and rainfall rates for the area.

TABLE 3-1

AVERAGE MONTHLY TEMPERATURES
AND RAINFALL RATES FOR
ST. PETERSBURG 1911-1960*

Month	Mean Temp (°F)	Average Rainfall (in.)
Jan.	63.3	2.47
Feb.	64.7	2.77
Mar.	67.9	3.18
Apr.	73.1	2.89
May	78.4	2.82
June	81.8	5.88
July	82.7	8.88
Aug.	83.0	8.90
Sept.	81.6	8.02
Oct.	76.3	3.72
Nov.	68.9	1.85
Dec.	64.3	2.29
	73.8(Av.)	53.67(Total)

*From U.S. Weather Bureau (1964).

The prevailing winds in the area are from the NE and N during the winter months and from the E and S the remainder of the year. Table 3-2 gives wind velocity and direction frequencies for the area offshore at Treasure Island. These data are the results of 7,273 observations between the years 1881 and

1961 and may be found in the "Summary of Synoptic Meteorological Observations," Volume 5 (U.S. Naval Weather Service Command, 1970). These SSMO data were collected in the offshore area centered at 27°N, 86°W. Note that these wind direction data correlate well with the wave directional data from the wave height and period roses, Figures 6.2 and 6.3.

3.2 Storms

Storms that affect the area's beaches adversely are almost without exception tropical storms and hurricanes (locally severe prefrontal squalls and thunderstorms usually do not act over a significant fetch or over a length of time necessary to erode beaches seriously). Historical study shows that the return frequency of a hurricane passing within a 50 mile radius of the Treasure Island area is between 6 and 7 years. If one considers the return frequency of a tropical storm or hurricane within a 50 mile radius of the Treasure Island area, the likelihood of occurrence increases to about once every 2 to 3 years. Figure 3.1 shows the paths of some hurricanes and tropical storms in the area. A description of some of the more damaging and/or more recent storms follows:

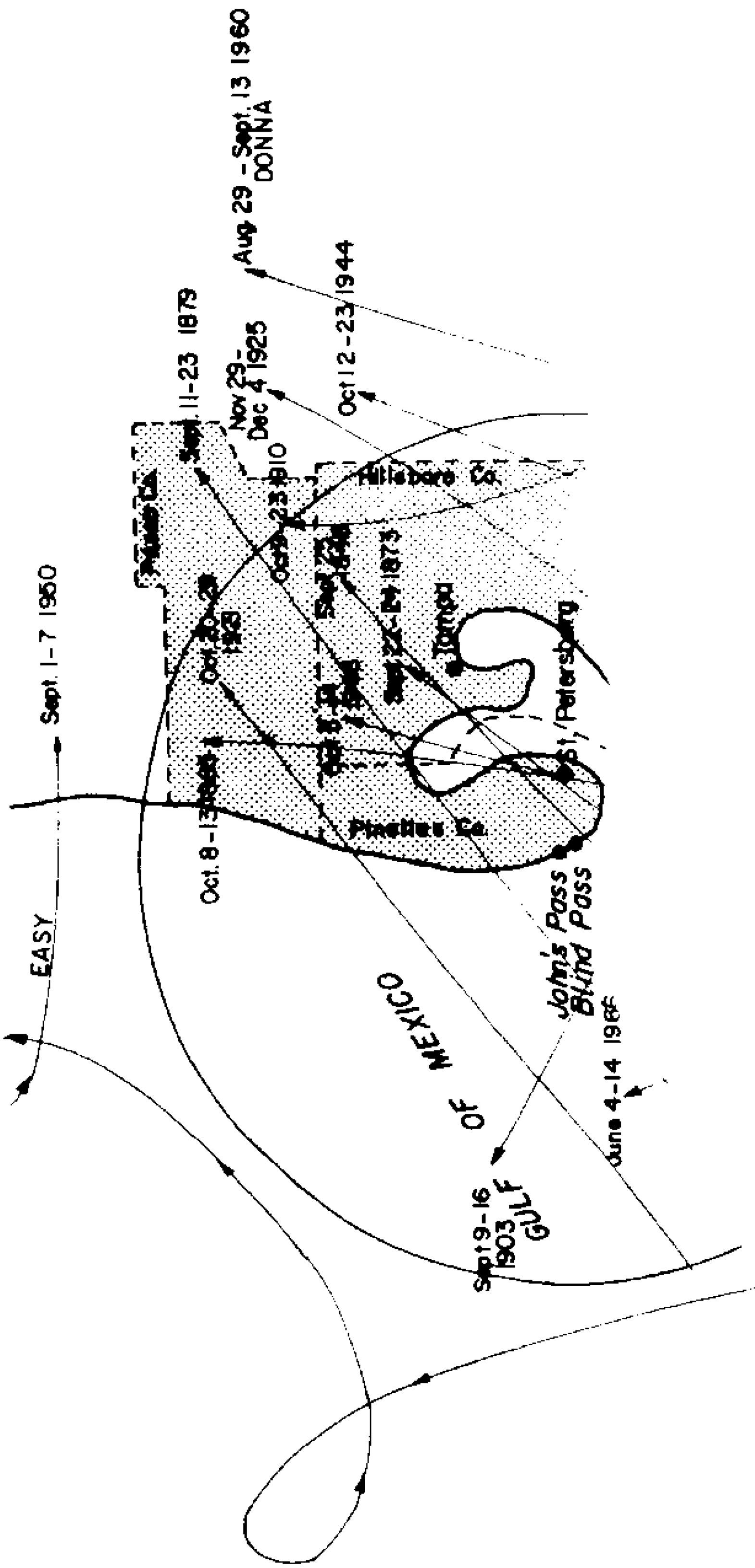
Sept. 25, 1848 - Details of this severe tropical storm are sketchy but it is known that extensive damage was reported at Charlotte Harbor (near Ft. Meyers), Tampa and the Cedar Keys area. Tides in the Tampa area were reported at about 14 feet above MSL. This storm reportedly opened John's Pass.

Oct. 20-29, 1921 - This hurricane entered the Florida coast north of Tarpon Springs on Oct. 25. Property damage from this storm was estimated at $3 million. Tides in the Tampa/St. Petersburg area were in excess of 9 feet above MSL.

Sept. 1-7, 1950 - Hurricane Easy caused an estimated $1 million in damages at Indian Rocks Beach, Sunset Beach and Madeira Beach. Seawalls, roads and residences were heavily damaged by winds and waves. The tides from this storm were about 9 feet above MSL (St. Petersburg Times, Sept. 6, 1950).

Aug. 29-Sept. 13, 1960 - Hurricane Donna, which moved inland at a point approximately 75 miles south of Tampa, did not damage the Treasure Island area extensively. Tides were 2 to 3 feet above normal. The highest recorded wind gust on Treasure Island was 65 mph (St. Petersburg Times, Sept. 12, 1960).

Sept. 29, 1963 - A low pressure cell and cold front centered approximately 100 miles west of St. Petersburg caused an estimated $1 million in damages to the beaches along Treasure Island. West winds gusting to 70 mph caused tides 6 to 8 feet above normal and allowed the heavy surf to erode the beaches and flood low-lying areas. (St. Petersburg Times, Sept. 30, 1963; U.S. Army Corps of Engineers, 1966).



Aug 29 - Sept. 13 1960
DONNA
Oct 12-23 1944
Nov 29-
Dec 4 1925
Sept. 11-23 1879
Hillsboro Co.
Sept. 1-7 1950
EASY
Oct. 8-13
Pinellas Co.
Tampa
St. Petersburg
John's Pass
Blind Pass
GULF
OF
MEXICO
June 4-14 1966
Sept 9-16
1903

TABLE 3-2

OFFSHORE WIND VELOCITY AND DIRECTION FREQUENCIES

Wind Direction	0-6	7-16	Speed (knots) 17-27	28-40	>41	Percent Frequency	Mean Speed
N	2.7	6.6	2.0	0.4	*	11.7	12.2
NE	3.2	9.5	2.5	0.3	*	15.5	11.8
E	5.0	12.4	2.8	0.2	*	20.4	11.2
SE	3.8	8.8	2.1	0.2	*	14.9	11.0
S	2.7	5.3	1.0	0.1	*	9.1	10.2
SW	2.0	3.8	0.5	0.1	*	6.4	10.0
W	2.4	4.6	1.3	0.3	*	8.6	11.5
NW	2.1	5.0	2.1	0.5	0.1	9.8	13.3
Calm	3.7					3.7	
Percent Frequency	27.6	56.0	14.3	2.1	0.1	100.1**	

* Indicate percent frequency less than 0.05.

**The total exceeds 100 percent due to rounding error.

June 4-14, 1966 - Hurricane Alma caused some serious erosion problems along Treasure Island. Two structures and one mobile home were undermined by erosion adjacent to John's Pass. Tides were 4 feet above normal (St. Petersburg Times, June 10, 1966).

Oct. 20-29, 1968 - Hurricane Gladys caused extensive damage to beaches and structures along Treasure Island. Damages were estimated at $1 million along the island with one-half occurring at Sunset Beach. Seawalls were heavily damaged and beach erosion was termed the worst in at least 15 years (St. Petersburg Times, Oct. 19-20, 1968).

June 15-22, 1972 - Hurricane Agnes caused about $545,000 in damages to Treasure Island. An estimated 225,000 cubic yards of beach restoration fill was washed or blown away. Tides were reported at 5.6 feet above MSL (St. Petersburg Times, June 21, 1972).

Figure 3.2 shows the relationship between the total tidal elevation above MSL (caused by the astronomic, barometric and storm surge forces) and the return period. The curves are based on data obtained by the National Oceanic and Atmospheric Administration (NOAA) and are applicable to the open coast areas in the vicinity of St. Petersburg and Clearwater (NOAA, 1975).

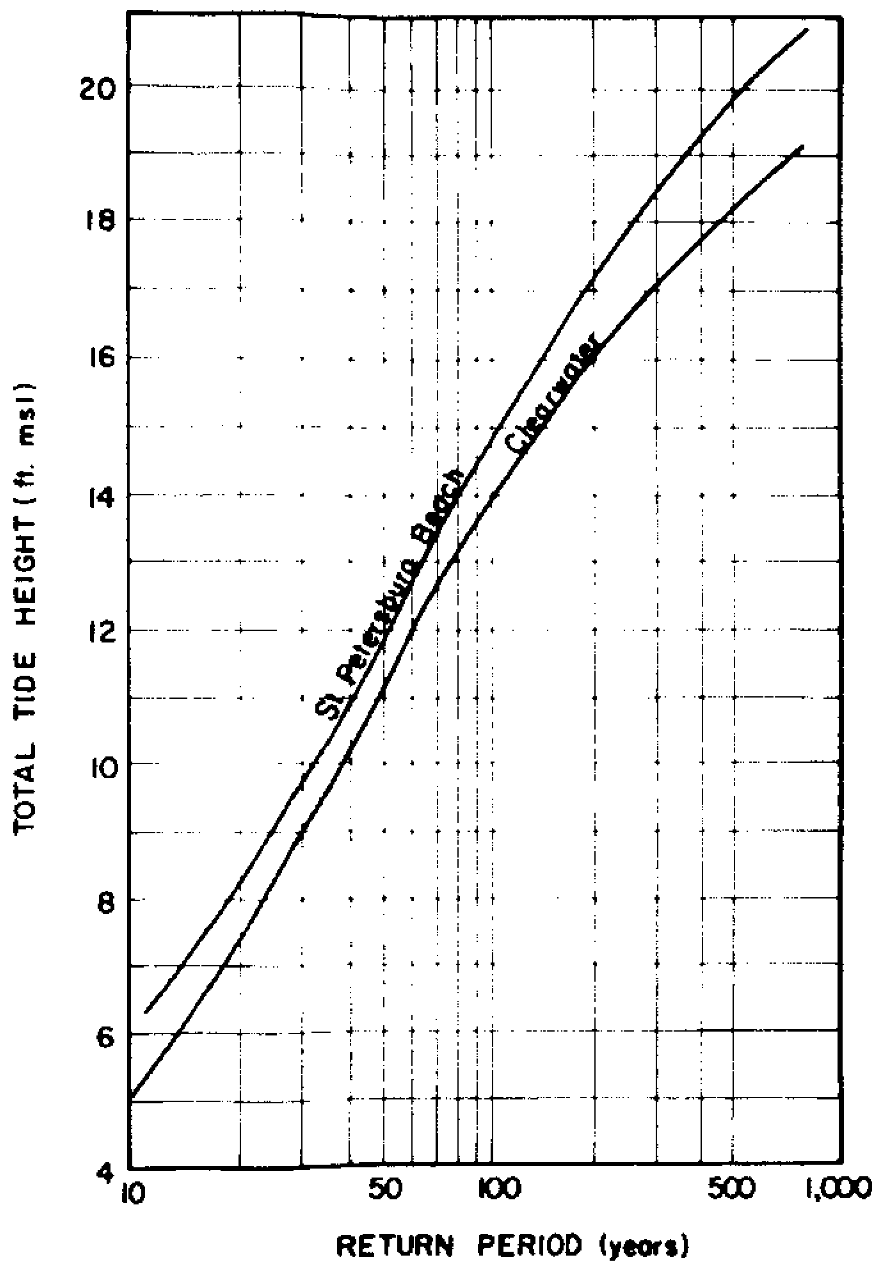


FIGURE 3.2. Total tide height (ft.) above MSL versus return period in years (NOAA, 1975). Curves applicable to St. Petersburg Beach - Clearwater coastline.

IV. HISTORY OF THE INLETS

4.1 Early History

Complete agreement does not exist among historians concerning the date when the first European sailor visited the Boca Ciega Bay area. Maps and charts of the area drawn in the late 1700's and mid-1800's (e.g. Figures 4.1 and 4.2) indicate numerous changes which have taken place within historic time. However, there are familiar features. On the chart of 1777 (Figure 4.1) and of 1779 (Figure 4.2) there is an inlet in the general vicinity of the present day Treasure Island, and there appear to be two small inlets at the Narrows, the site of the old Indian Pass.

Inlet closures and openings were common in the study area. The late historian Fuller (1955) reports that the present John's Pass was formed by the action of a severe hurricane in September 1848. A survey of the Pinellas Peninsula made in May and June of 1848 includes a sketch of the barrier islands. John's Pass is not shown in the sketch. Fuller states that John's Pass was named for John Levique, a fisherman and grove owner who had settled on the east shore of Boca Ciega Bay under the terms of the Armed Occupation Act of 1842. The hurricane of 1848 was reported to be so severe that it not only cut John's Pass, but also removed the timber from Passage Key, eroded the north side of Mullet Key, and destroyed several small keys between Mullet Key and Pass-A-Grille (U.S. Congress, 1939).

4.2 Engineering Projects

The earliest proposed modification of John's Pass was advanced in 1916 (U.S. Congress, 1917) by a local resident named Mitchell who owned a boarding house on the north side of the pass (the beach immediately north of John's Passwas known as Mitchell Beach). No action was taken after it was determined by the U.S. Army Corps of Engineers that John's Pass, in its existing conditon, served the needs of the local interests. However, numerous works have since been accomplished at John's Pass, at Blind Pass and on the nearby beaches. The following paragraphs summarize these works.

<u>1916</u> - The small entrance north of Blind Pass (Inlet B in Figure 5.7) was closed by pumping sand into it from an offshore bar (U.S. Congress, 1937).

<u>1926</u> - Pinellas County constructed bridges across Blind Pass and John's Pass and built a road on Treasure Island (U.S. Congress, 1937). Figure 5.1 shows the location of the bridge on John's Pass. This bridge was dismantled upon the completion of the new bridge in 1969.

<u>1924</u> - The Corps of Engineers closed Indian Pass in July to alleviate shoaling problems in the Intracoastal Waterway near the Narrows.

<u>1934</u> - Two 150 foot groins were built on the Veteran's Administration beach at Madeira Beach (U.S. Congress, 1954).

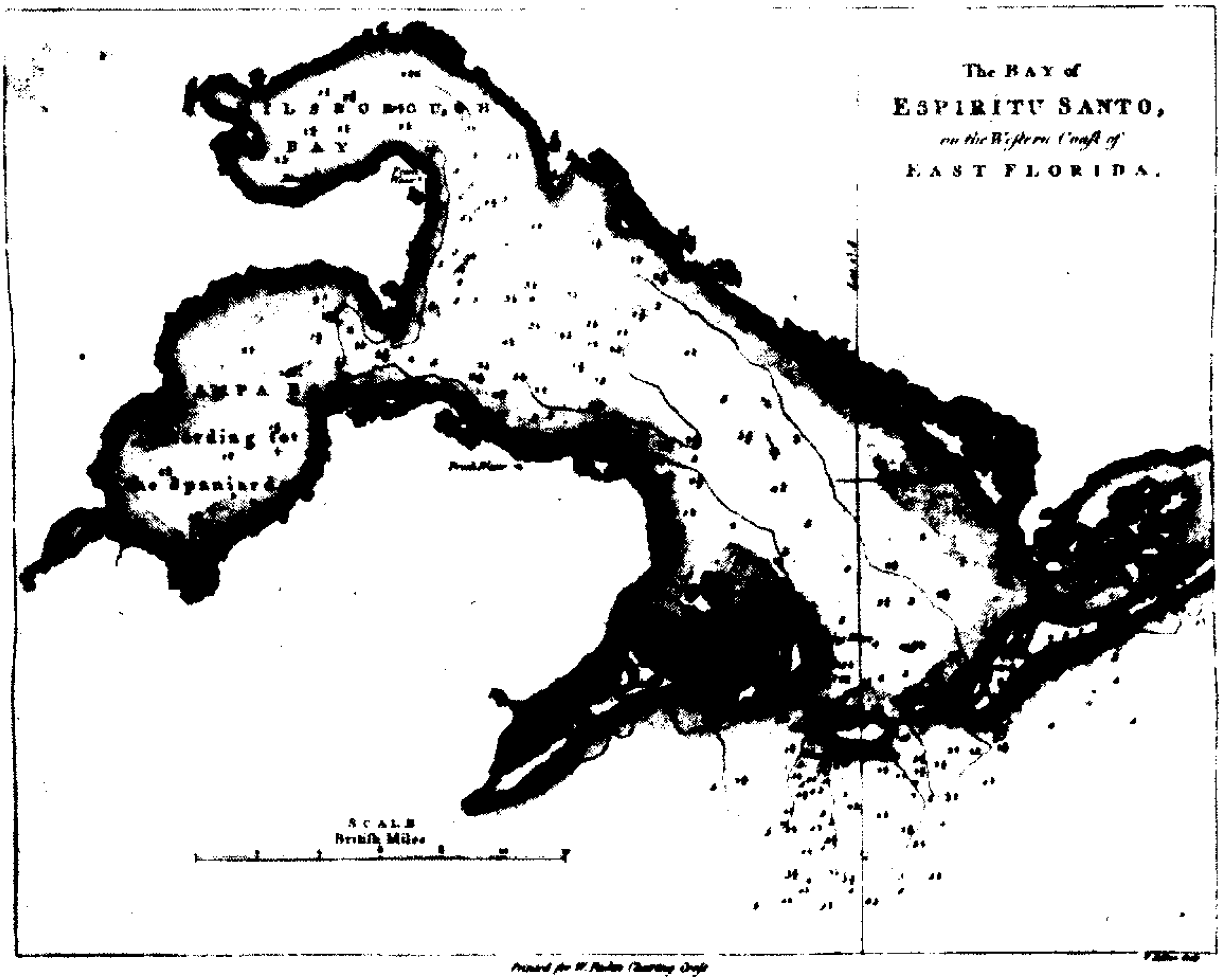


FIGURE 4.1. Tampa Bay and vicinity in 1777 (courtesy: P.K. Yonge Library of Florida History, University of Florida).

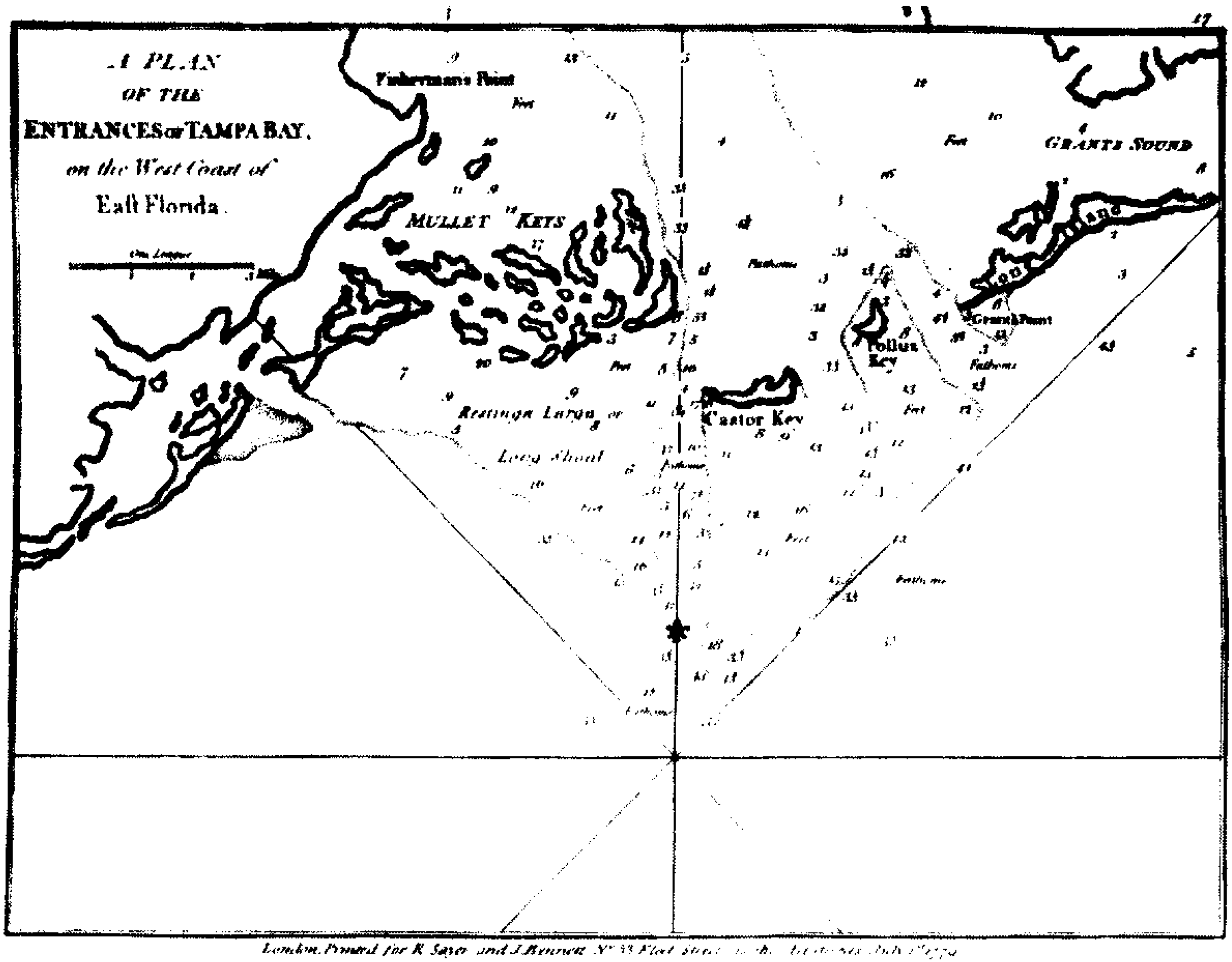


FIGURE 4.2. Tampa Bay and vicinity in 1779 (Courtesy: P.K. Yonge Library of Florida History, University of Florida).

1937 - Local interests on Long Key constructed a low jetty on the south side of Blind Pass to prevent further southward migration of the pass. A short channel was dredged across the shoals north of the jetty (U.S. Congress, 1954). This jetty was extended landward in the early 1950's.

1957 - The city of Madeira Beach built a groin field of 37 groins over its entire frontage. These groins were constructed of timber piles with adjustable timber and concrete panels (U.S. Congress, 1966). See the article by Eldred (1976) for details.

1960 - The city of Treasure Island installed a groin field of 56 groins on the southern frontage of Treasure Island at a cost of $228,000. A map showing the locations of these groins appears in a report by the Coastal and Oceanographic Engineering Laboratory, University of Florida (see COEL, 1960b). An additional $35,000 outlay was necessary to replace the timber panels with concrete panels (U.S. Congress, 1966). 94,000 cubic yards of material were dredged from John's Pass by local interests and placed on the outer bar of John's Pass, 20,000 feet offshore, south of the dredged channel (U.S. Army Engineer, 1969). See Figure 5.4. The Coastal and Oceanographic Engineering Laboratory studied the beach erosion problem at Madeira Beach. A north jetty for John's Pass was recommended (COEL, 1960a).

1961 - A 460 foot curved jetty was installed on the north side of John's Pass, and 30,000 cubic yards of beach fill were placed on the beach north of John's Pass. The total cost to the city of Madeira Beach for the groin field, the jetty and the beach fill was about $300,000 (U.S. Congress, 1966). Groin maintenance cost approximately $10,000 per year.

1962 - A native stone, 425 foot long, rubble-mound jetty was placed on the north shore of Blind Pass at a cost of $18,000 (U.S. Congress, 1966).

1964 - Blind Pass was dredged, and 10,000 cubic yards of material were placed on Sunset Beach. The cost of the dredging was $6,500 (U.S. Congress, 1966). It was noted that the Treasure Island groin field was ineffective in preventing beach erosion. A navigation project for John's Pass authorized by Section 107 of the 1960 River and Harbor Act was initiated. A channel of the following dimensions was planned: 10 x 50 feet across the outer bar, 8 x 100 feet into the pass, and 6 x 100 feet to the Intracoastal Waterway.

1965 - The Corps of Engineers collected sediment samples along two profile lines in the nearshore region along Treasure Island (see Figure 4.3 for the locations). The reader is referred to Section 7.1 for further information.

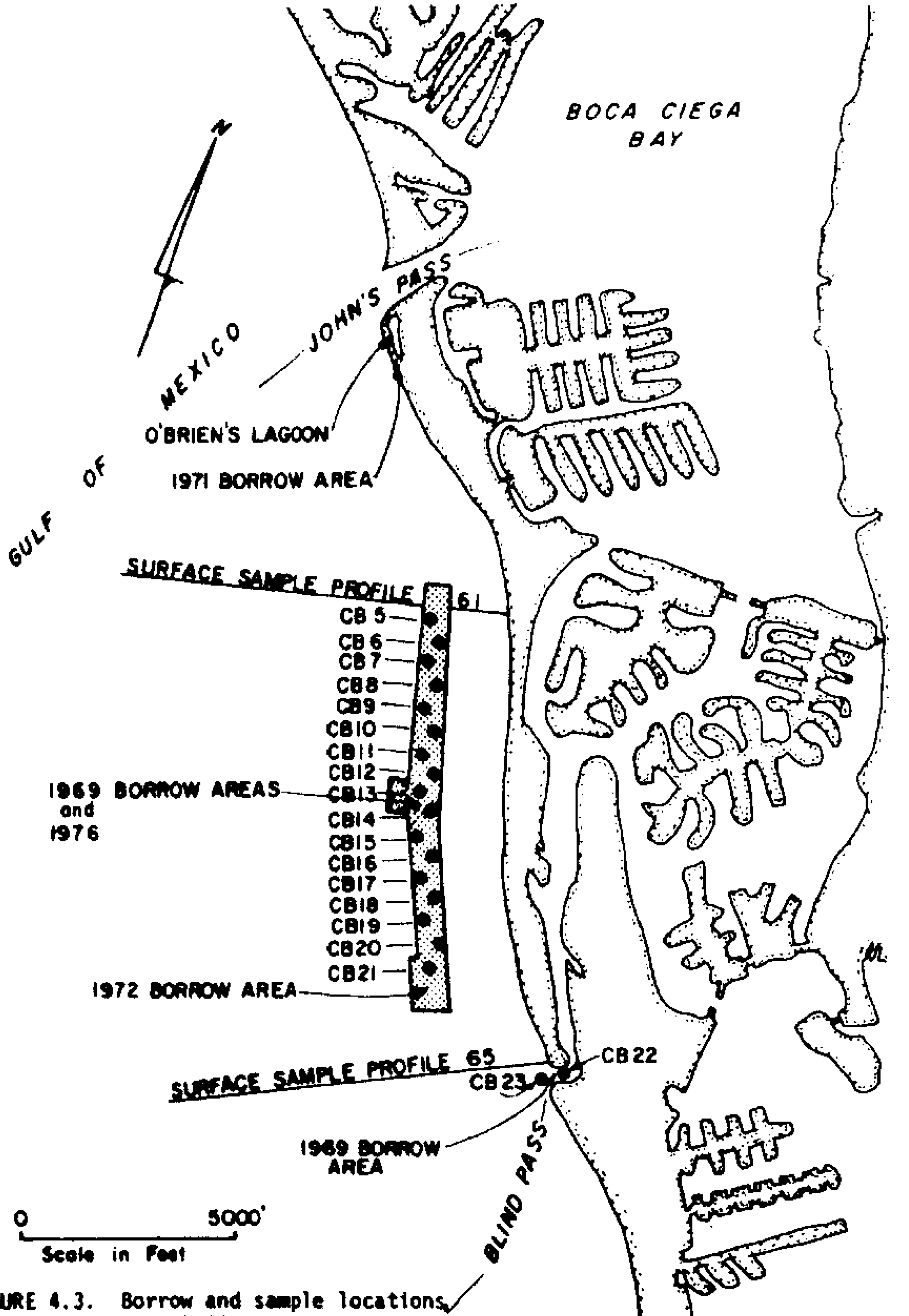


FIGURE 4.3. Borrow and sample locations, 1969-1972.

1966 - The dredging of John's Pass was completed. A total of 95,000 cubic yards of material was placed in an offshore spoil area south of the dredged channel. See Figure 5.4. The Coastal and Oceanographic Engineering Laboratory made a surface current study at John's Pass to investigate the effects of the presence of the dredge spoil on the flood and ebb current patterns at the entrance (COEL, 1966). A 920 ft. long revetment was placed along the south bank of the John's Pass. This cost approximately $106,000 (Army Corps of Engineers, 1966).

1968 - The Board of Trustees of the State of Florida approved the location of the Mean High Water line (MHW) along portions of Treasure Island and granted the Corps of Engineers easements for borrow areas and fill areas in preparation for the 1969 beach restoration project. See Figures 4.3 and 4.4 for the locations of the borrow and fill areas. The Corps of Engineers took 19 core borings in order to locate possible sources of restoration material for the beaches at Treasure Island (see Figure 4.3 for the location of the borings designated CB-5, CB-6, etc.). The reader is referred to Section 7.1 for further information. The Coastal and Oceanographic Engineering Laboratory investigated the possible effects of the proposed new bridge across John's Pass on the flow pattern and bank erosion in this inlet (COEL, 1969).

1969 - In an attempt to offset storm damage by Hurricane Gladys in 1968, Treasure Island placed 120,000 yards of material on the beach. This was followed by an additional 673,000 cubic yards of beach fill during April through July (COEL, 1971). This material was placed over a distance of 9,200 feet extending from 104th Avenue southward to a point 600 feet south of 77th Avenue. 100,000 cubic yards of material that were dredged from Blind Pass and placed on the beach eroded quickly due to the fine-grained nature of the material shoaled in Blind Pass (Halbrook, personal communication). A new bridge across John's Pass was completed.

1970 - An "erosion control line" or "bulkhead line" was established on Feb. 17, thus delineating private and public jurisdiction over the shoreline between 104th Avenue and 77th Avenue along Treasure Island.

1971 - The first periodic nourishment of the Pinellas County Beach Erosion Control Project at Treasure Island was completed in October. 75,000 cubic yards of beach fill (contract cost $41,250) were placed along a 1,600 foot stretch of beach between 104th Avenue and 108th Avenue. The source of material was a bar connected to the beach on John's Pass. The material was excavated and hauled by land-based equipment (U.S. Army Corps of Engineers, 1975b). See Figures 4.3 and 4.4 for the locations of the borrow and fill areas.

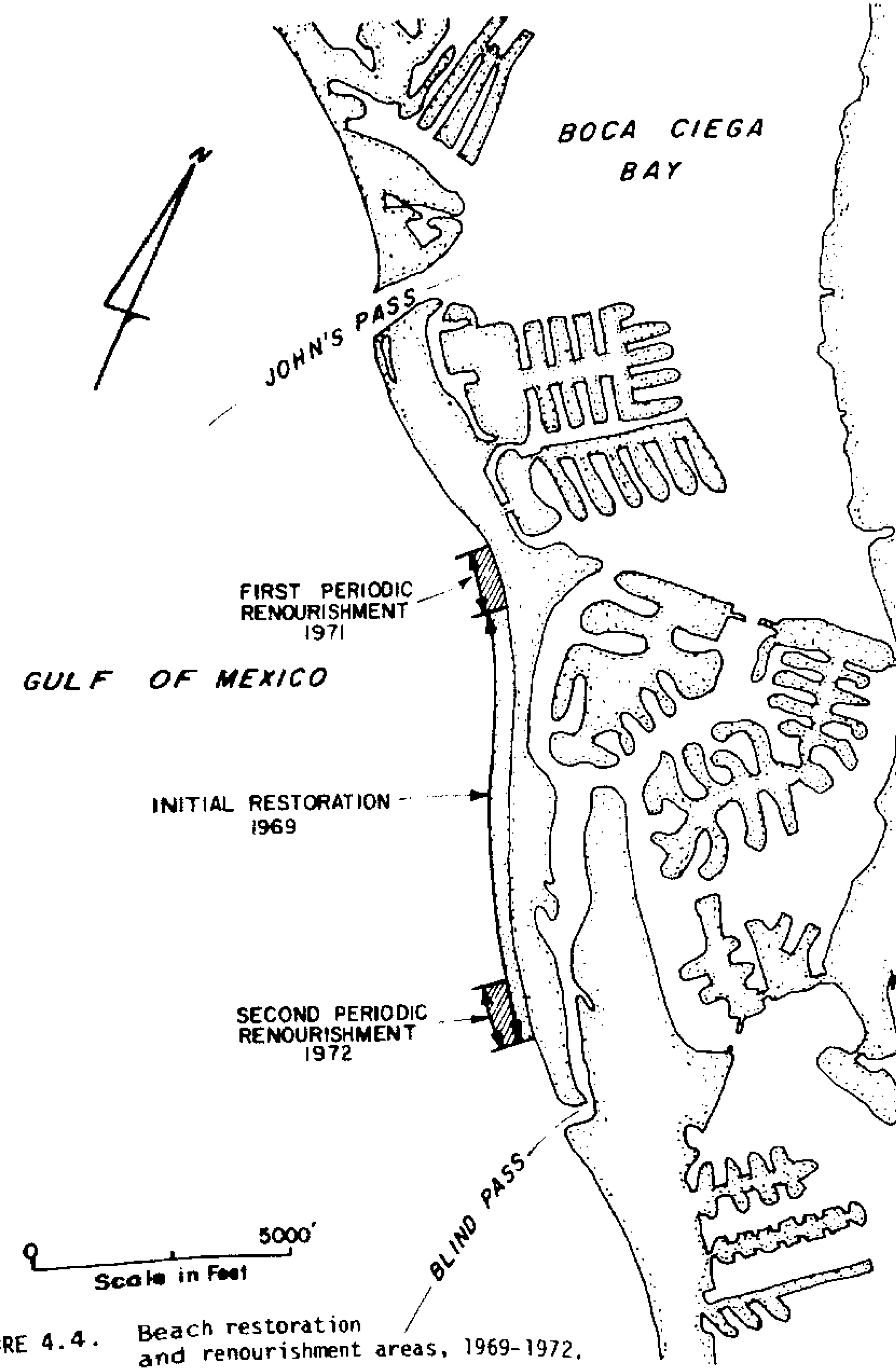


FIGURE 4.4. Beach restoration and renourishment areas, 1969-1972.

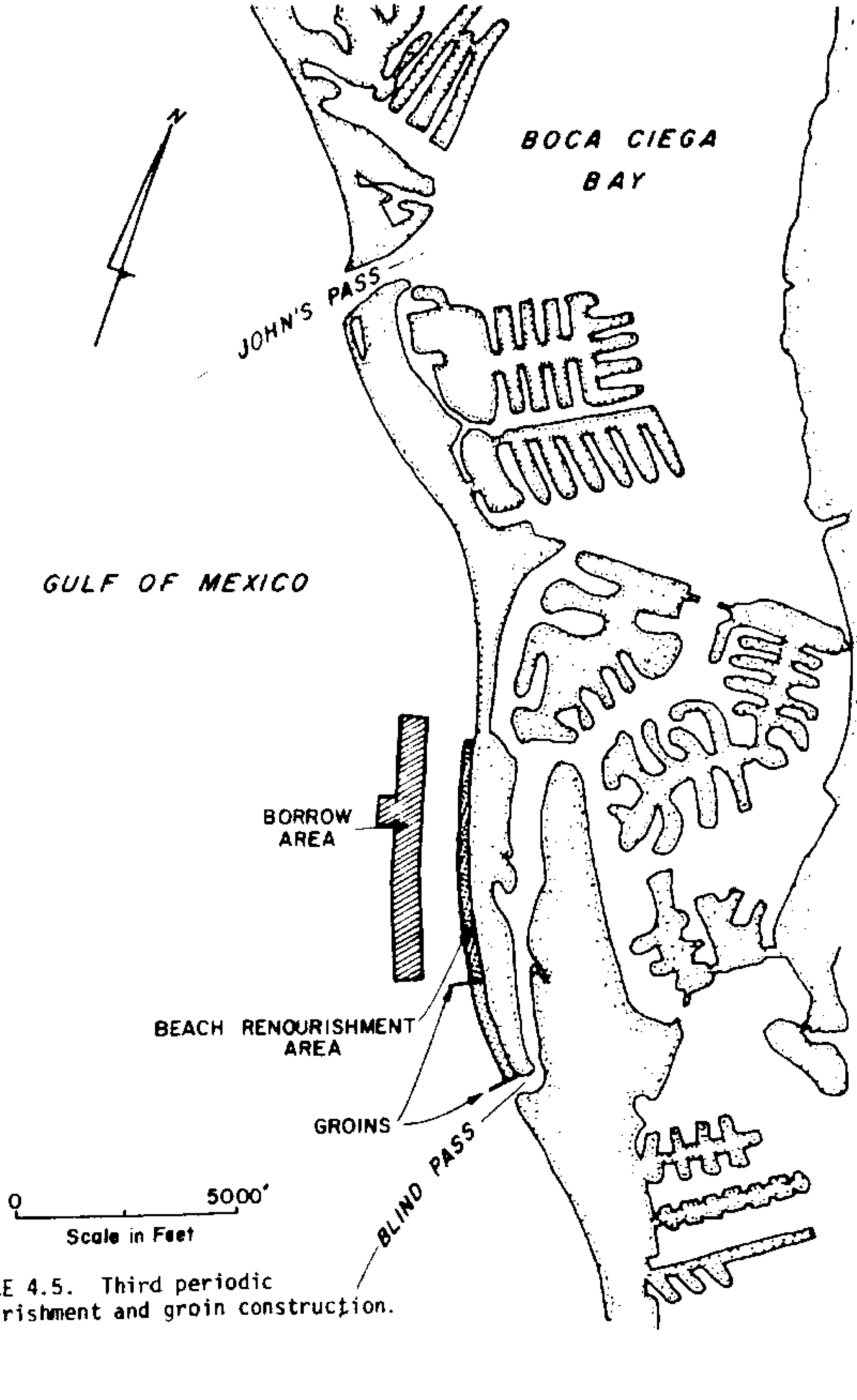


FIGURE 4.5. Third periodic renourishment and groin construction.

1972 - The second periodic nourishment of the beaches at Treasure Island was completed. 150,000 cubic yards of fill (contract cost $185,700) were placed along a 1,400 foot stretch of beach between 83rd Avenue and a point 600 feet south of 77th Avenue. The material was excavated by hydraulic pipeline dredge. See Figures 4.3 and 4.4 for the locations of the borrow and fill areas.

1974 - Beach profiles in Pinellas County were surveyed in conjunction with work on the Coastal Construction Setback Line. Figure 4.6 shows the locations of these profile lines in the vicinity of Treasure Island. (Note: at this time the setback line has been established on a preliminary basis and is undergoing hearings and revision).

1975/76 - The city of St. Petersburg Beach dredged approximately 75,000 cubic yards of sand from Blind Pass and placed it along a 2,500 foot length of beach south of Blind Pass. In addition, the jetty on the south side of Blind Pass was extended approximately 171 feet for a total length of 261 feet (the first 90 feet was also restored); two groins were built as indicated on Figure 4.7.

1976 - The Corps of Engineers began construction of two impermeable sheet pile groins and the third periodic nourishment of Treasure Island beaches north of Blind Pass (see Figure 4.5). The groin at the southern end of Treasure Island is 360 feet long and the second groin, some 2,300 feet north of the first, is 285 feet long (see Figure 4.8 for groin construction details). The total amount of sand excavated for the project was 404,849 cubic yards. The cost of the entire project was approximately $990,000 and was completed on September 9, 1976.

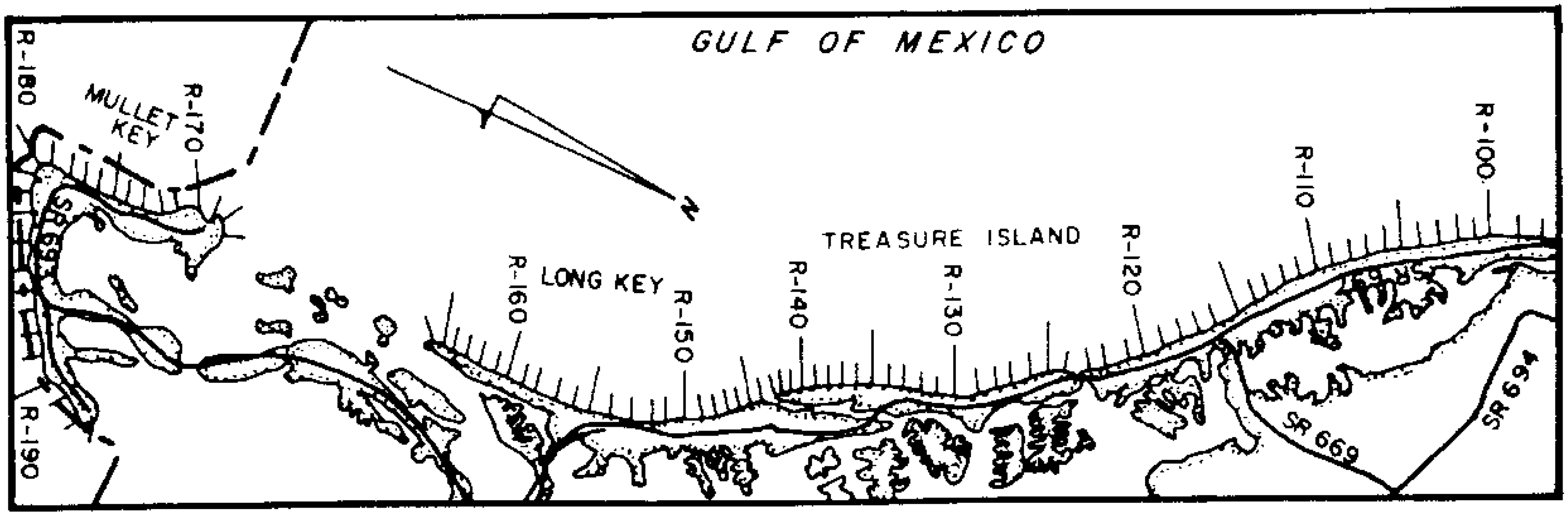


FIGURE 4.6. Beach profiles obtained in 1974 for determining the coastal construction setback line.

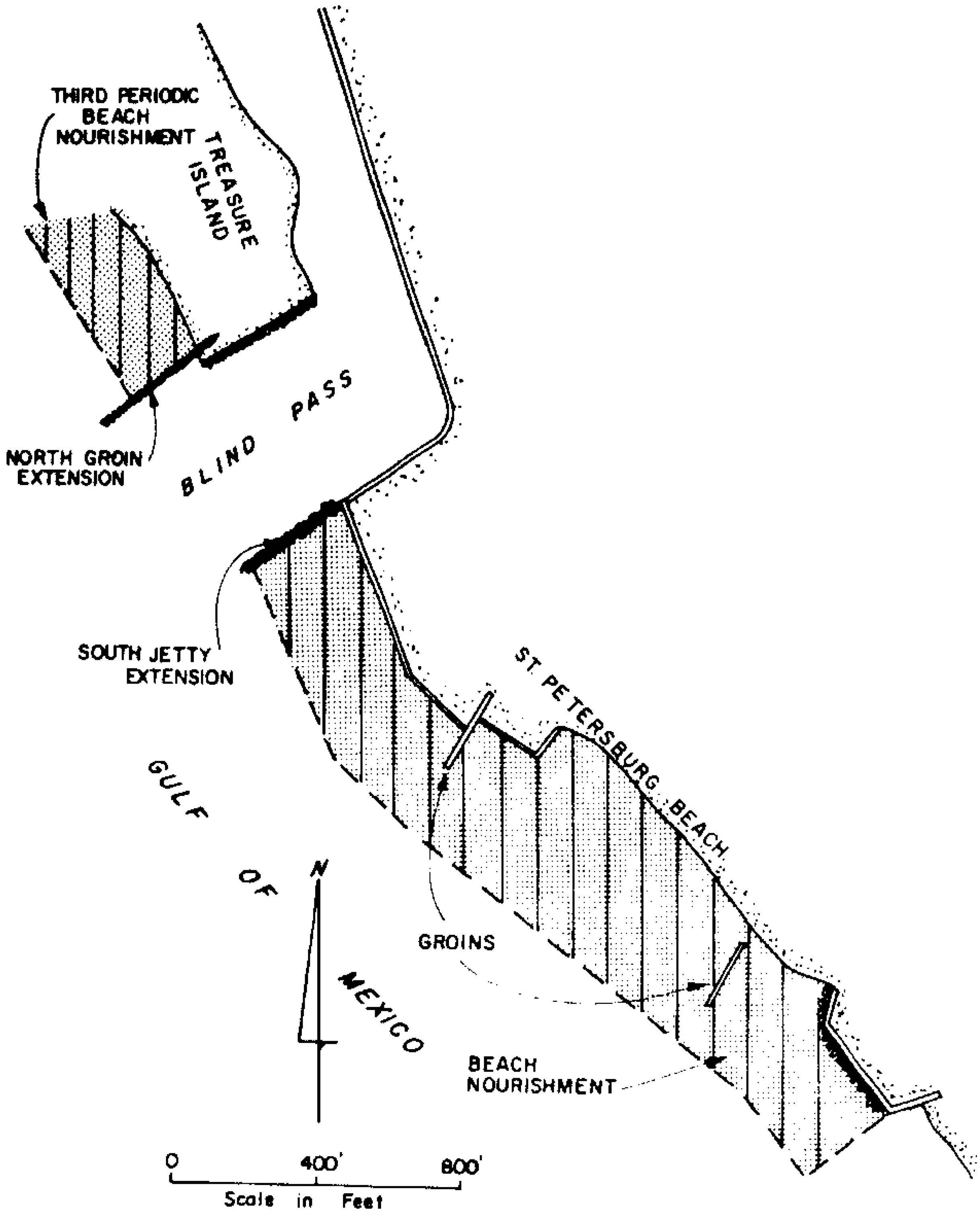
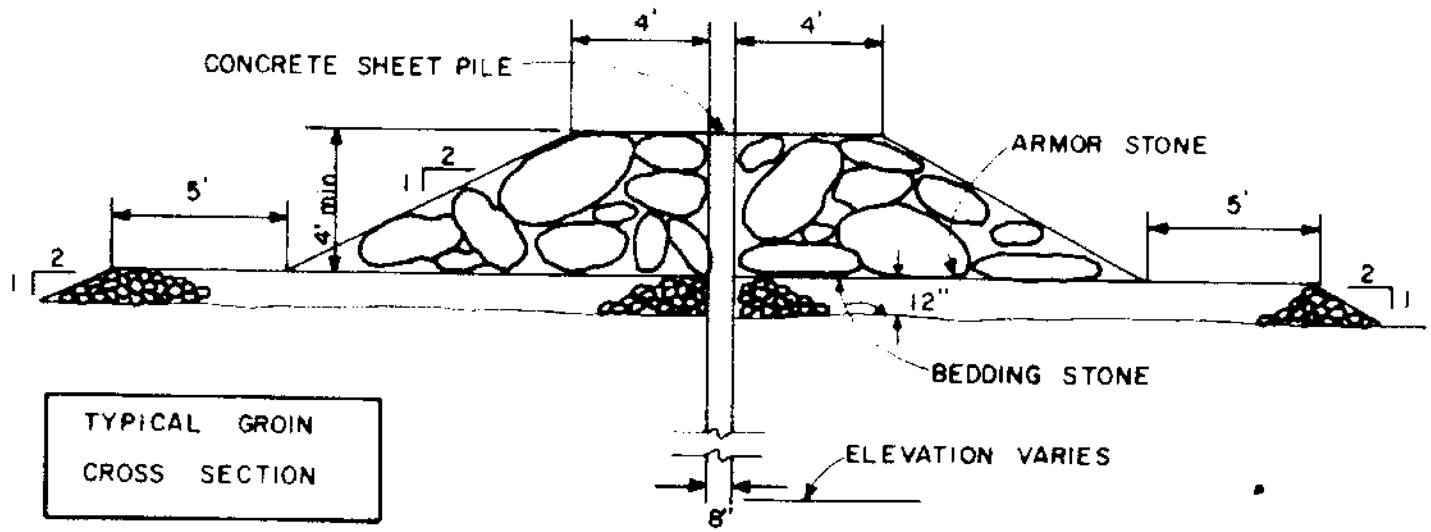


FIGURE 4.7. Beach nourishment project at St. Petersburg Beach, 1975/76.



ARMOR STONE WEIGHTS: 3/4 TONS TO 1 1/4 TONS WITH 75% WEIGHING 1 TON OR MORE.

BEDDING STONE WEIGHTS: 1 POUND TO 50 POUNDS.

FIGURE 4.8. Typical groin cross-section for two groins constructed at the southern end of Treasure Island in 1976.

V. MORPHOLOGY

5.1 Charts, Photographs and Surveys

There are no National Ocean Survey Sailing Charts for either inlet; however, Nautical Chart No. 11410 (replacing old Chart No. 858) shows the locations of channel markers at John's Pass and few depths (below MLW) in the seaward section of the John's Pass entrance channel. Geological Survey topographic quadrangles - Bay Pines (1943) and Pass-A-Grille Beach (photorevised 1969) also show the region of interest; however, the former is outdated and has been renamed Seminole (1974).

Aerial photographs have been obtained by the U.S. Department of Agriculture (1942-43, 1952, and 1957), by the National Ocean Survey, by various Department of Defense components, and by private concerns. A series of low altitude aerial photographs of the two inlets over twenty to thirty years is in the files of the office of the city engineer, Treasure Island. A list of available photographs of the two inlets has also been compiled by Barwis (1975).

Hydrographic surveys of the John's Pass-Blind Pass area by the United States do not begin until 1873. Since that time surveys of the area have been made by the U.S. Coast and Geodetic Survey (1873, 1883, 1926, 1939, and 1951-52) and by the U.S. Army Corps of Engineers (1936, 1941, 1950, and 1964-65).

5.2 Inlet Geometry

The data on inlet geometry reported here have been obtained from surveys of he inlets made in July 1974, by the Coastal and Oceanographic Engineering Laboratory.

John's Pass: As shown in Figure 1.2, the channel through the inlet is connected to the Intracoastal Waterway. In Table 5-1, cross-sectional dimensions of the inlet are given with respect to distance measured from the throat section (see Figure 5.1). The distance is considered to be positive seaward of the throat and negative bayward. The deepest part of the channel runs mainly along the southern bank of the inlet, as observed in Figure 5.1.

Blind Pass: Table 5-2 gives the geometric parameters of Blind Pass. The distances are measured with respect to the throat section which is shown in Figure 5.2. Maximum depths are not given.

5.3 Shoreline Changes

Changes in the outer coast shoreline are computed in Table 5-3 at 2,000 foot intervals from 6,000 feet north of John's Pass to 22,000 feet south of John's Pass. The measurements in the table were taken from a chart provided by the Jacksonville District Office of the U.S. Army Corps of Engineers. It was based on surveys made by the U.S. Coast and Geodetic Survey (1873, 1926

TABLE 5-1

GEOMETRIC PARAMETERS OF JOHN'S PASS*

Distance from Throat (ft)	Mean Depth below MWL (ft)	Max. Depth at MWL (ft)	Width at MWL (ft)
780	15.8	24	885
680	18.7	26	700
580	18.1	34	600
480	23.2	34	600
420	26.8	36	635
280	16.2	35	700
0	16.1	25	590
-100	16.5	23	570
-200	17.8	25	590
-300	19.8	32	635
-320	21.4	34	575
-500	19.0	31	640
-600	17.3	29	780
-740	14.1	23	950
-800	13.4	26	975
-960	13.8	24	1150

*Data obtained in July 1974

TABLE 5-2

GEOMETRIC CHARACTERISTICS OF BLIND PASS INLET AND CHANNEL*

Distance from Throat (ft)	Mean Depth below MWL (ft)	Width at MWL (ft)	Area below MWL (ft^2)
800	6.00	550	3300
600	5.70	550	3135
400	5.50	475	2613
200	5.30	375	1988
0	5.20	83	432
- 200	8.40	130	1092
- 400	7.40	165	1221
- 600	5.90	200	1180
- 800	8.40	306	2570
-1000	7.40	360	2664
-1200	7.40	368	2723
-1400	8.40	316	2654
-1600	5.90	320	1888

TABLE 5-2 continued

GEOMETRIC CHARACTERISTICS OF BLIND PASS INLET AND CHANNEL*

Distance from Throat (ft)	Mean Depth below MWL (ft)	Width at MWL (ft)	Area below MWL (ft^2)
-1800	10.40	340	3536
-2000	12.40	360	4464
-2200	10.90	366	3989
-2400	10.90	366	3989
-2600	8.90	486	4325
-2800	8.60	443	3810
-3000	8.70	400	3480
-3200	8.90	400	3560
-3400	8.90	508	4521
-3600	8.50	442	3757
-3800	9.60	674	6470
-4000	8.60	600	5160
-4200	9.10	600	5460
-4400	11.40	600	6840
-4600	11.10	540	5994
-4800	12.00	628	7536
-5000	11.20	652	7302
-5200	9.40	680	6392
-5400	6.60	720	4752
-5600	8.10	740	5994
-5800	10.20	720	5832
-6000	10.30	700	7210
-6200	10.20	668	6813
-6400	9.90	600	5940
-6600	9.60	620	5952
-6800	9.50	670	6365
-7000	9.50	720	6840
-7200	8.40	862	7240
-7400	6.60	1040	6864
-7600	6.90	900	6210
-7800	7.40	725	5365
-8000	7.90	910	7189
-8200	8.40	1230	10332
-8400	8.60	1365	11739
-8600	8.90	1510	13439

*Data obtained in July, 1974 (Sanchez-Diaz, 1975). Only the main channel is considered. The two "short arms" of the channel (Figure 5.2) are not included.

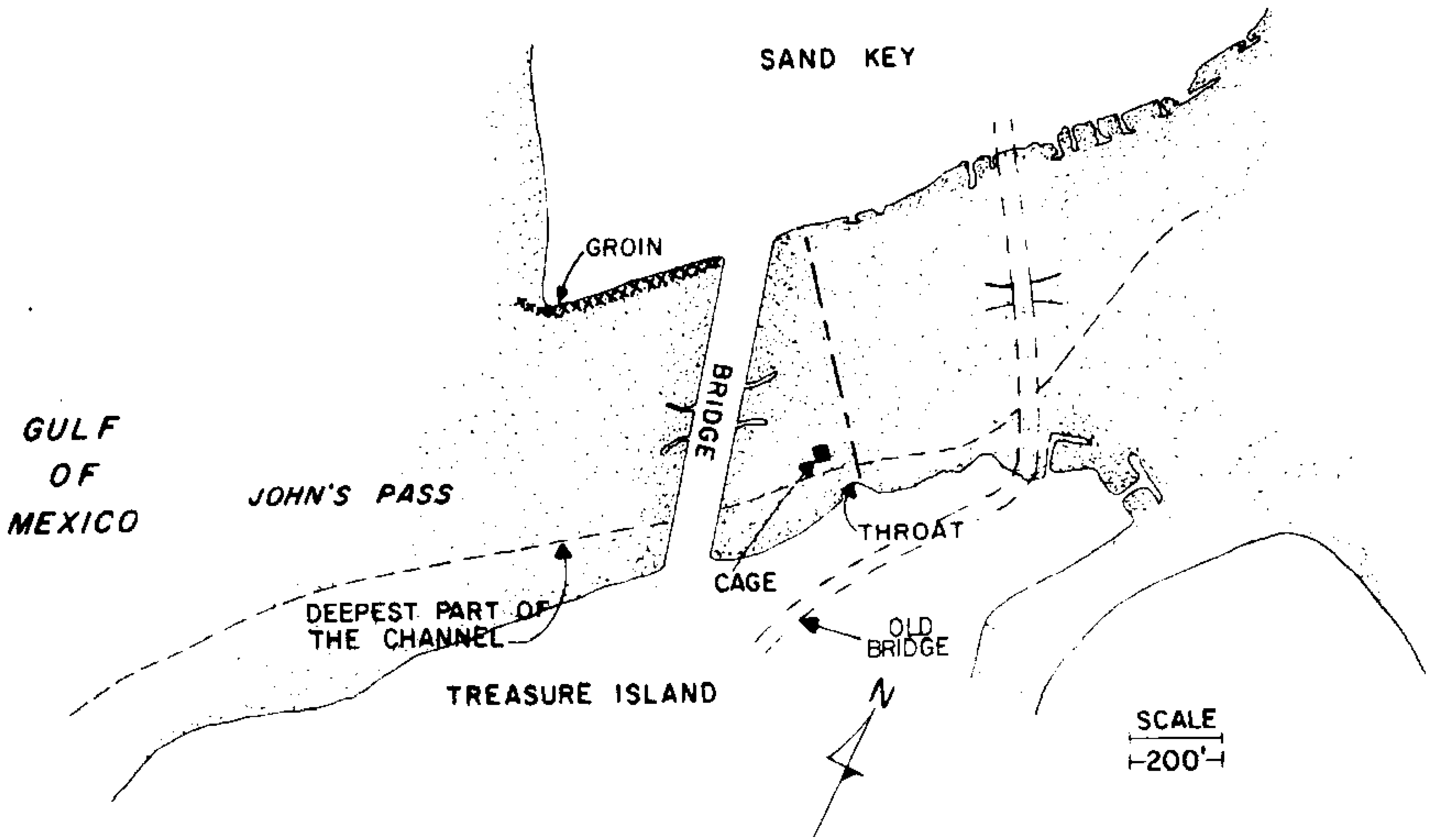


FIGURE 5.1. John's Pass, Florida. Note the location of the throat section which is bayward of the new bridge.

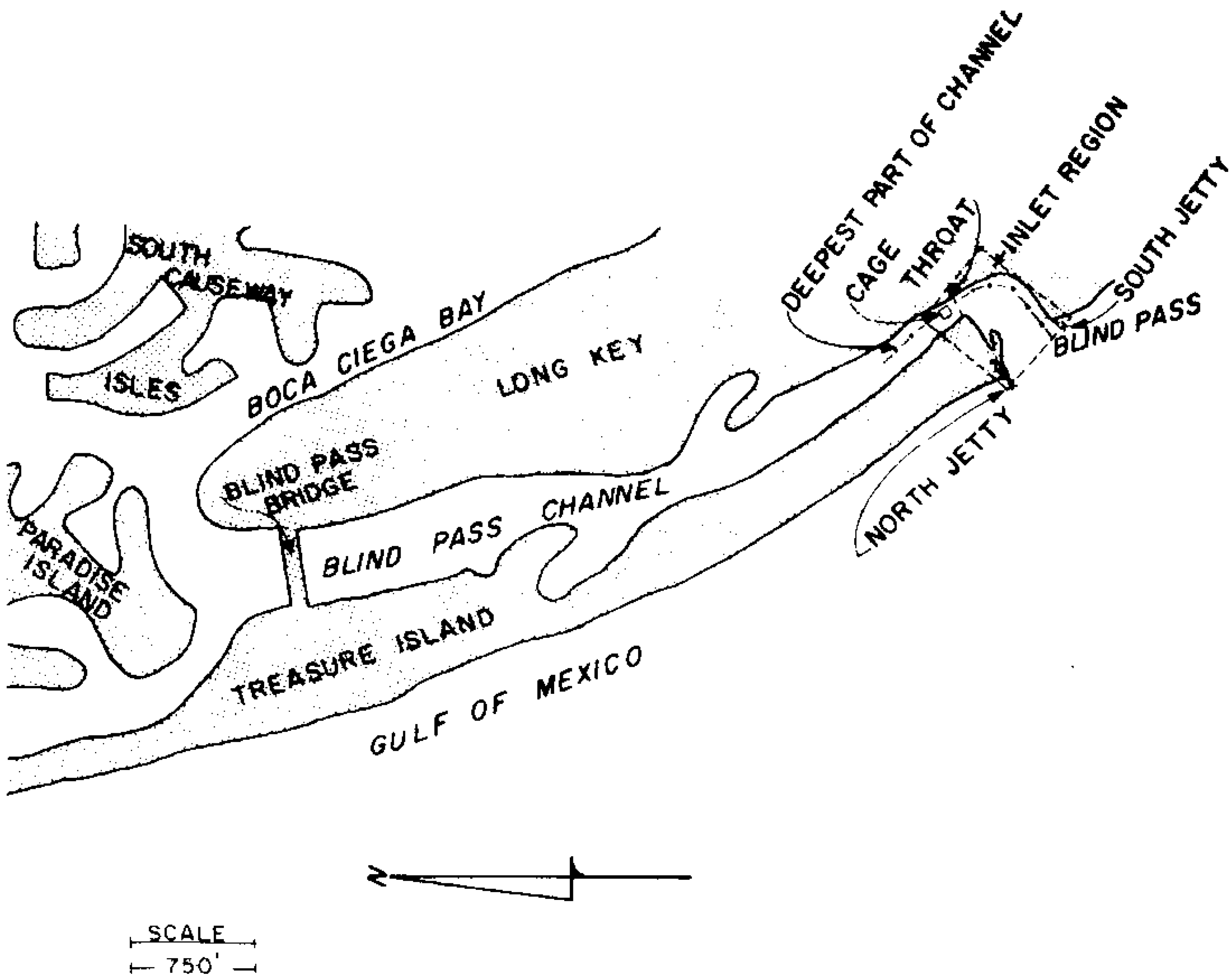


FIGURE 5.2. Blind Pass, Florida. Note the narrow throat section.

TABLE 5-3

SHORELINE CHANGES IN THE STUDY AREA, 1873-1965

Shoreline Change in Feet (a)

Distance in feet from John's Pass	1873-1926	1926-1939	1939-1950	1950-1965	Total 1873-1965	Average Annual
6,000 NW	-360	0	-40	+40	-360	-3.9
4,000 NW	-240	0	-160	+160	-240	-2.6
2,000 NW	-110	-90	-60	+150	-110	-1.2
2,000 SE	+730	+70	+70	+50	+920	+10
4,000 SE	+350	+130	+270	+30	+780	+8.5
6,000 SE (b)	-240	+20	-120	+120	-220	-2.4
8,000 SE	-170	0	+50	-50	-170	-1.8
10,000 SE	+120	0	-90	+90	+120	+1.3
12,000 SE (c)	+440 T.I. -80 L.K.	-70 T.I. +10 L.K.	+20 T.I. 0 L.K.	-20 T.I. 0 L.K.	+370 T.I. -70 L.K.	+4.0 T.I. -0.8 L.K.
14,000 SE (c)	(d) -1140 L.K.	-100 T.I. +60 L.K.	-60 T.I. -80 L.K.	-40 T.I. 0 L.K.	-200 T.I. -1160 L.K.	-5.1 T.I. -12.6 L.K.
16,000 SE (c)	(d) -1660 L.K.	+70 T.I. 0 L.K.	-20 T.I. 0 L.K.	+80 T.I. 0 L.K.	+130 T.I. -1660 L.K.	+3.3 T.I. -18.0 L.K.
18,000 SE (c)	(d) -340 L.K.	(d) -760 L.K.	-40 T.I. +10 L.K.	+40 T.I. -10 L.K.	0 T.I. -1100 L.K.	0 T.I. -12.0 L.K.
20,000 SE	-60	+380	+360	+60	+740	+8.0
22,000 SE	+560	-220	+170	+200	+710	+7.7
Average for Period	-161	-41	+25	+65	-102	-1.1
Average Annual	-2.8	-3.1	+2.3	+4.3	-1.1	

(a) + Denotes Accretion; - Denotes Erosion
(b) Vicinity of Treasure Island and "Elbow"
(c) Vicinity of Blind Pass
(d) Not Available Due to Migration of Treasure Island
L.K. - Long Key T.I. - Treasure Island

and 1939) and by the U.S. Army Corps of Engineers (1950 and 1964-65). The columns for total and average changes are based on the exposed shoreline only.

Study of Table 5-3 indicates that the shoreline in the vicinity of John's Pass and Blind Pass has experienced erosion overall, but there are local areas of shoreline accretion. The 6,000 foot stretch north of John's Pass was, on the average, an area of erosion. The period 1950 to 1965 was a period of accretion, but this was probably due to protective measures taken by the city of Madeira Beach in 1957 and in 1961 (U.S. Congress 1966). The area immediately south of John's Pass showed a net gain in the shoreline for each period between 1873 and 1965. The stretch of beach from the "elbow" in Treasure Island to the southern tip of this island has, on the average, been a zone of beach erosion although there was a net progradation of the beach at the points 10,000 feet and 12,000 feet south of John's Pass. This particular stretch of beach has been marked by several complex events including a drastic recession of the northern shore of Long Key, extension of the southern tip of Treasure Island with consequent migration of the mouth of Blind Pass (Table 5-4 and Beach Erosion Control Study, 1971), and the opening and closure of a small pass north of Blind Pass. South of Blind Pass, the exposed shore shows a net accretion for the period 1873-1965. It should, however, be pointed out that since the early 1960's, construction of seawalls and other structures south of Blind Pass has resulted in an erosion of approximately one-half mile of the shoreline immediately south of the pass. This has resulted in a recent beach nourishment project. (See Figure 4.7.)

TABLE 5-4

SOUTHWARD MIGRATION OF BLIND PASS, 1873-1939

Net Change for Period	1873-1926	1926-1939	Total 1873-1939
Range	3,900 ft*	2,200 ft**	6,100 ft
Azimuth	161°T	161°T	161°T
Avg. Annual Change	73.6 ft	170.8 ft	92.7 ft

*W.r.t. the inlet mouth in 1873; **w.r.t. mouth in 1926.

Cumulative changes in the twelve-foot depth contour for the years 1883, 1926 and 1950 followed the same general patterns of erosion and accretion as the shoreline (Table 5-3). These changes are, therefore, not tabulated here. The greatest changes occurred offshore from the two inlets. The twelve-foot contour off John's Pass was pushed further seaward while near Blind Pass it receded toward shore. This is probably a result of the increasing tidal flow through John's Pass and decreasing tidal flow through Blind Pass (see Section 5-5).

At least three other inlets have played a role in north Boca Ciega Bay since 1873. The northernmost of these was Indian Pass located at the Narrows. The other two were small unnamed inlets between John's Pass and Blind Pass. In 1873 and 1883, Indian Pass was a "blind pass" (Figure 5.3) with one opening to the Gulf of Mexico. By 1926, the long channel of this pass had undergone considerable shoaling, and a shallow breach of the barrier

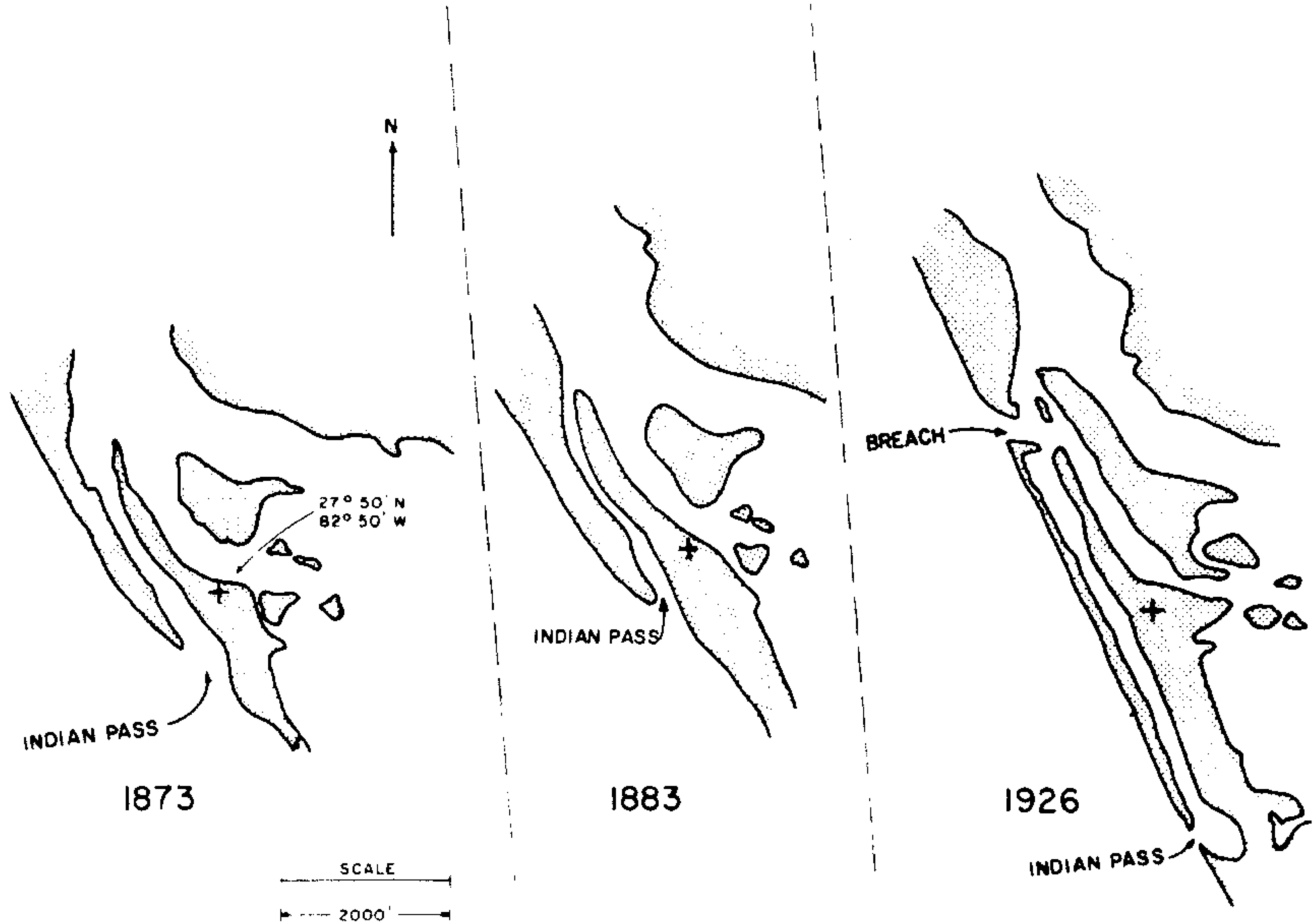


Figure 5.3. Indian Pass in 1873, 1883 and 1926.

had occurred approximately one mile north of the old entrance. Indian Pass was closed by the U.S. Army Corps of Engineers in July 1929. This action was taken since the pass was unstable and contributed to shoaling in the Intracoastal Waterway at the Narrows (U.S. Army Engineer, 1969). Howze (1950) indicated that Indian Pass was open in March 1950; however, aerial photographs taken in 1942 and in 1952 reveal no opening at the former site of Indian Pass. Both the other inlets were small and unstable. The inlet closer to John's Pass (Inlet A in Figure 5.7) was open in both 1873 and 1883. The inlet closer to Blind Pass (Inlet B in Figure 5.7) was closed in 1873 and was open in 1883. Inlet B was artificially closed in 1916. It was reopened by natural causes between 1916 and 1921. A tropical storm of 1921 reclosed this inlet, but it reopened in 1930. It last closed in the fall of 1935 (U.S. Congress, 1937).

O'Brien's Lagoon is a body of water trapped between the beach and a sand bar immediately south of John's Pass. About half of the lagoon is visible in Figure 1.3 at the lower right. Sedwick et.al (1975) traced the development of the lagoon from an offshore island resulting from the 99,000 cubic yards of dredge spoil 20,000 feet offshore in 1960. Other events such as hurricanes in 1960, 1966, 1968, 1972, a storm in 1963, the placement of another dredge spoil in 1966 (95,000 cubic yards) and possibly the nourishment of nearby beaches have contributed to the development of the lagoon and the surrounding accumulation of sand. The example of New Pass noted later in this section tends to suggest that the placement of dredge spoils offshore itself was possibly not the "triggering mechanism" for the development of O'Brien's Lagoon. A natural shifting of the inlet channel may in fact be the primary reason for the accumulation of sand south of John's Pass. Clearly, however, spoil dumping accelerated the formation of O'Brien's Lagoon by sheltering a portion of the beach south of the inlet from wave action. Figure 5.4 shows the crescent-shaped bar (labelled C) which was believed to be due to the direct result of the 1966 placement of the dredge spoil. The shoal labelled A was believed to be the remains of the 1960 dredge spoil whereas shoal B was probably formed as a result of the sheltering effect of A. B came into being before C, and is clearly visible in an aerial photograph in May 1964 (Sedwick et. al, 1975). O'Brien's Lagoon formed in 1968 as a result of the shoreward migration of sand in these offshore shoals which formed a single crescent-shaped bar which in turn attached itself to the beach. A body of water was thus trapped between the bar and the beach.

In 1973/74, Sedwick and Mehta (1974) studied the hydraulics and stability of a small inlet at O'Brien's Lagoon. Sedwick (1974) modelled the hydraulics and determined hydraulic constants for this inlet in a manner suggested by O'Brien and Clark (1973, 1974).

The surface area of the lagoon has been highly variable. It increased to a maximum of 1.65×10^6 ft.^{2} in January 1971. In January 1974 it was 8.70×10^5 ft.^{2} and was decreasing. At the time of writing of this report, data were not available, but the surface area of O'Brien's Lagoon has decreased considerably, due to filling by wave overtopping over the bar and also due to filling with the help of bulldozers.

The development of O'Brien's Lagoon is similar to the development of a lagoon south of New Pass, Sarasota County. This inlet is located about

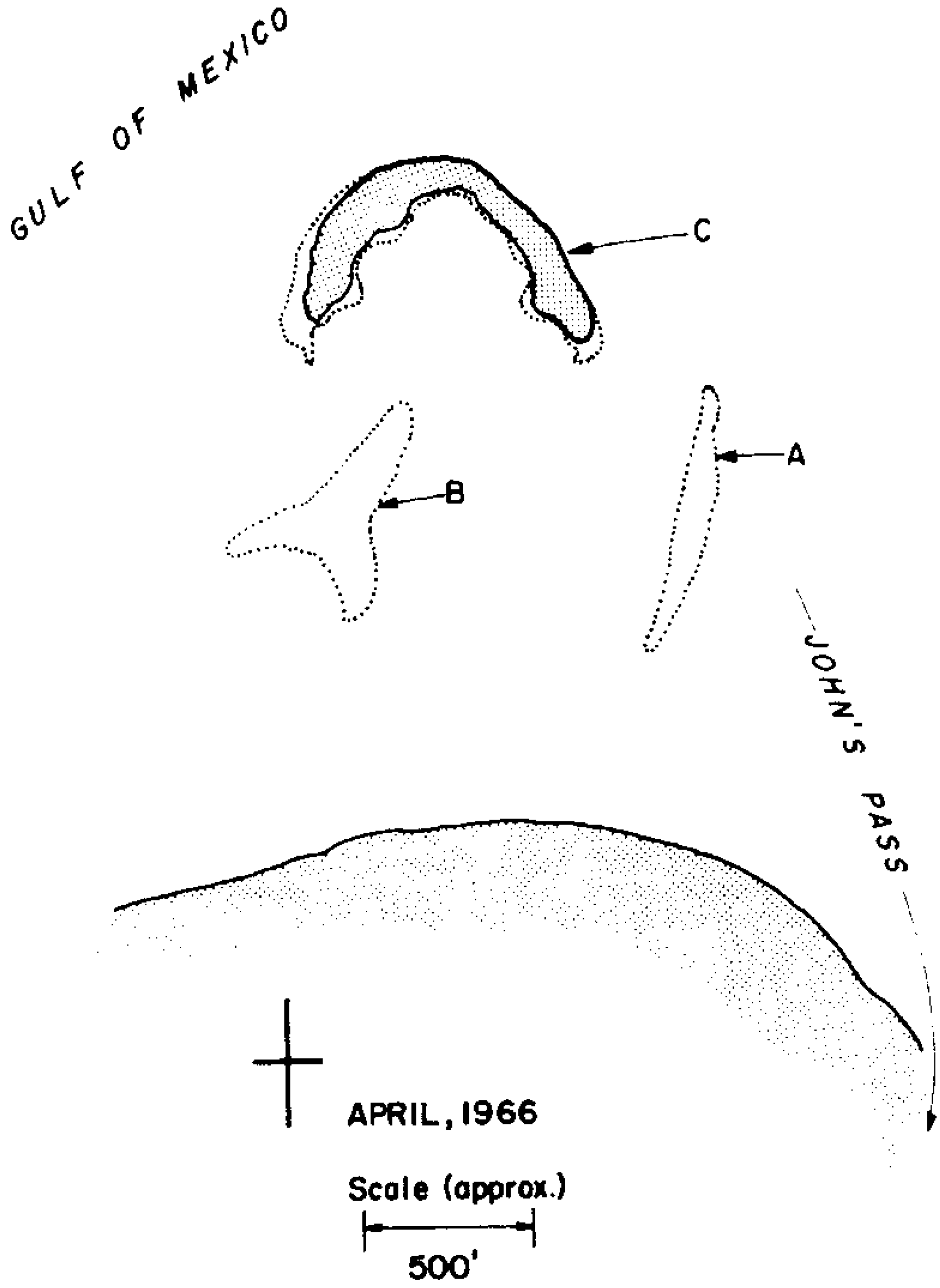


FIGURE 5.4. Offshore shoals south of John's Pass. Entrance channel in April 1966 (adapted from an aerial photograph).

35 miles south of John's Pass, and was reportedly opened by the hurricane of September 22, 1848 (Bruun, 1966). Bruun has shown a series of five photographs between 1951 and 1965 indicating the growth of a lagoon immediately south of New Pass at Lido Key. This inlet was dredged in 1964 and the spoil was placed offshore of the inlet south of the dredged channel. Bruun, however, attributes the primary cause to be a natural one. He points out that in 1951 a natural shoal existed north of the channel which, by 1965, moved south mainly by a natural shifting of the channel, from south to north. He concludes thus, "Nature showed the road to progress with respect to nourishment of Lido Key beaches. Man learned from nature and gave it a hand."

5.4 Bay Area

Changes in the surface area of north Boca Ciega Bay from 1873 to 1969 are depicted in Figure 5.5. The bay area from 1873 to 1926, obtained from U.S. Coast and Geodetic Survey charts, appears to have remained constant at about 2.99×10^8 ft.^{2}; however, the area has decreased successively since that time. The following values were obtained from photographs obtained by the U.S. Department of Agriculture: 2.54×10^8 ft.^{2} (1942-43), 2.49×10^8 ft.^{2} (1952) and 2.42×10^8 ft.^{2} (1957). The value obtained from photographs of the National Ocean Survey in 1969 was 2.21×10^8 ft.^{2}. These values represent a decrease of bay surface area by 7.8×10^7 ft.^{2} (26%) over a period of 43 years. These changes are attributed largely to dredge and fill operations in Boca Ciega Bay.

5.5 Inlet Throat Cross-Sectional Area

The throat cross-sectional areas of Blind Pass and of John's Pass taken at intervals over the period 1873-1974 are given in Table 5-5. The overall decrease in the cross-sectional area of Blind Pass from 1873 to 1974 is accompanied by an increase in that of John's Pass (Figure 5.6). The sum of both cross-sectional areas showed a decrease from 1873 to 1926. But this sum increased to approximate the 1873 combined area by 1957, and continued to approximate this level in 1974.

TABLE 5-5

THROAT AREAS* OF JOHN'S PASS AND BLIND PASS, 1873-1974

John's Pass			Blind Pass		
Year	Area, A_c (ft.^{2})	Width (ft.)	Year	Area, A_c (ft.^{2})	Width (ft.)
1873	5,100	425	1873	5,790	510
1883	4,640	370	1883	5,340	540
1926	5,720	445	1926	2,250	355
1941	6,850	510	1936	2,420	510
1952	9,140	600	1952	1,690	195
1974	9,500	590	1974**	442	83

* Below MWL
**Prior to the construction of the jetty extensions

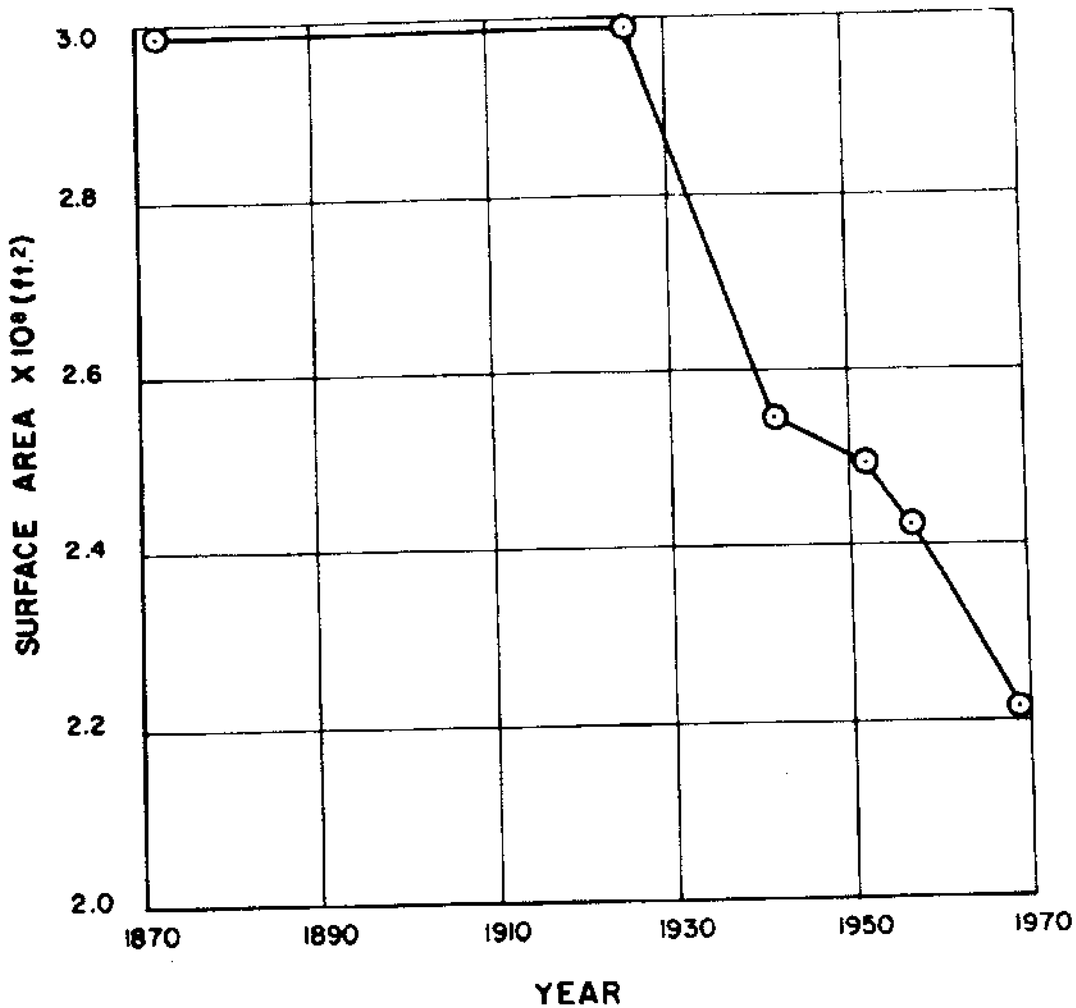


FIGURE 5.5. Reduction of north Boca Ciega Bay area.

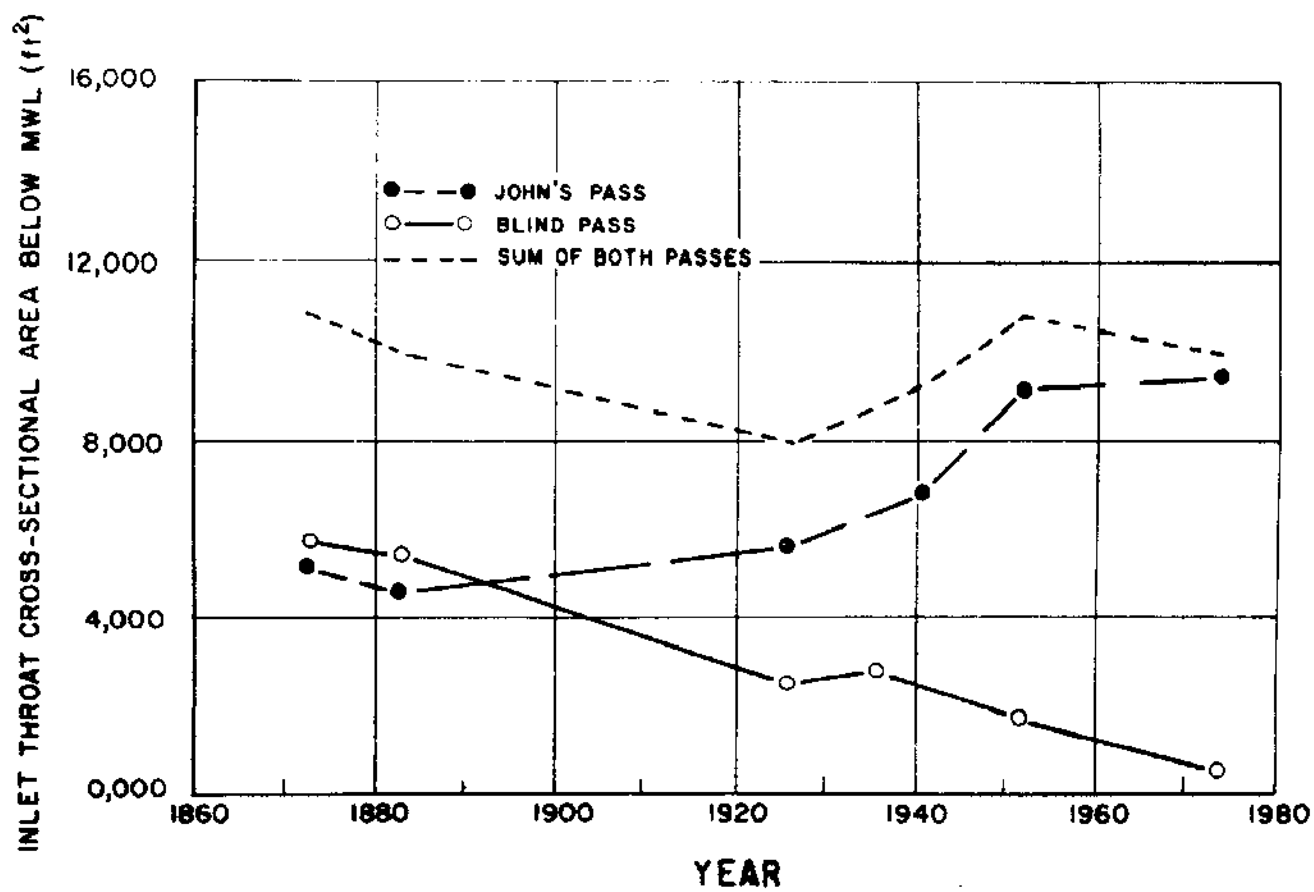


Figure 5.6. Throat cross-sections of John's Pass and Blind Pass between 1873 and 1974.

The decrease in the throat area of Blind Pass may be related to two factors, namely, the increase in channel length from 1873 to 1939 and the placement of Paradise Island at the bayside entrance of the channel. Table 5-4 and Figures 5.7 and 5.9 depict the increase in the length of Blind Pass Channel. It is believed that the increased channel length resulted in increased friction in the channel which led to lower tidal current velocities. The lower current velocities caused shoaling and an associated decrease in cross-sectional area. The positioning of Paradise Island (see Figure 1.2) at the north end of Blind Pass Channel may have further restricted flow through the channel.

The increase in the throat cross-section of John's Pass is probably directly related to the changes in Blind Pass. As less of the tidal prism of Boca Ciega Bay flowed through Blind Pass, more flowed through John's Pass causing enlargement of the latter inlet. The closing of Indian Pass in 1929 may also have had a long-term influence on John's Pass.

5.6 Channel Migrations

Channel depths greater than 14 feet (below MWL) were outlined for John's Pass (see Figures 5.7 and 5.8) for the years 1873, 1883, 1926 and 1952 (based on U.S. Coast and Geodetic Survey charts). The 1974 channel was obtained from a survey by the Coastal and Oceanographic Engineering Laboratory in July 1974. These figures show an overall southward migration of John's Pass. This southward migration was approximately 300 feet between 1873 and 1926 (U.S. Congress, 1954).

Depths of water greater than 8 feet (below MWL) for Blind Pass for the years 1873, 1883, 1926 and 1952 (U.S.C. & G.S.) and 1974 (COEL) are outlined in Figures 5.7 and 5.9. Shoaling is evident in the 1952 Blind Pass channel. The more uniform channel in 1974 is probably the result of dredging carried out by the City of Treasure Island in 1969.

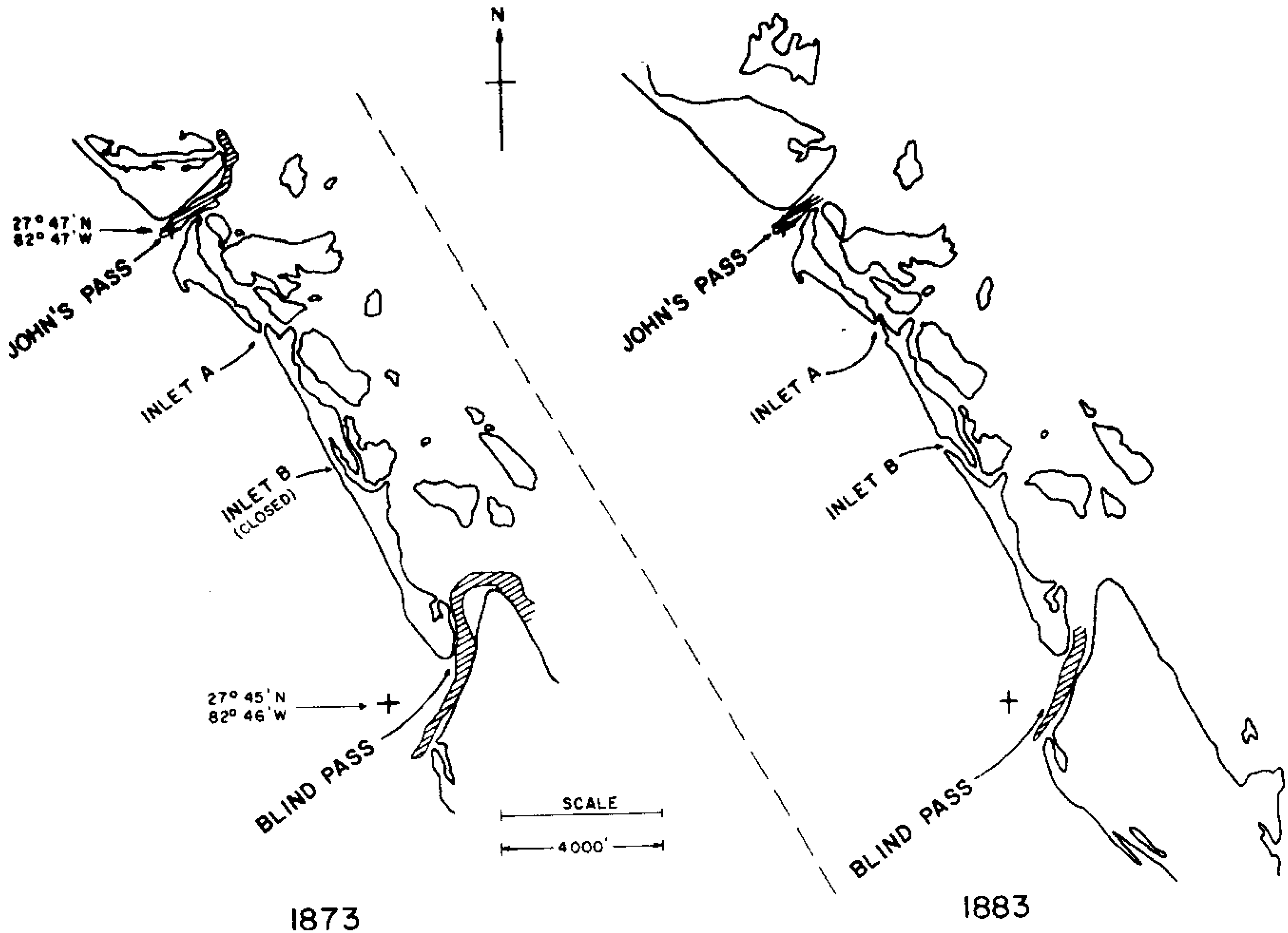


FIGURE 5.7. John's Pass and Treasure Island in 1873 and 1883. Channel areas indicated are 14 ft. and deeper at John's Pass, and 8 ft. and deeper at Blind Pass, below MWL.

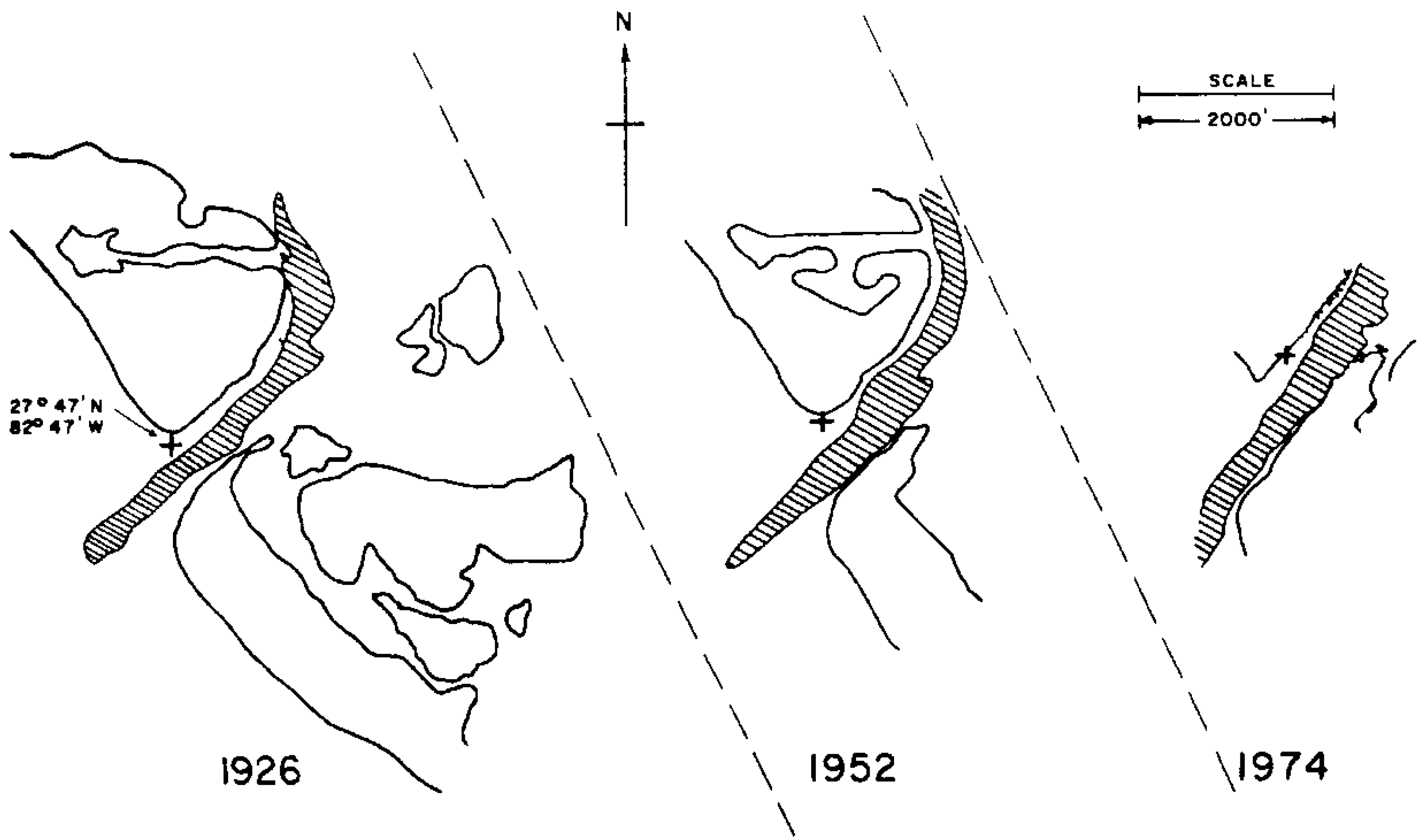


FIGURE 5.8. John's Pass Channel in 1926, 1952 and 1974. The indicated areas are 14 ft. and deeper below MWL.

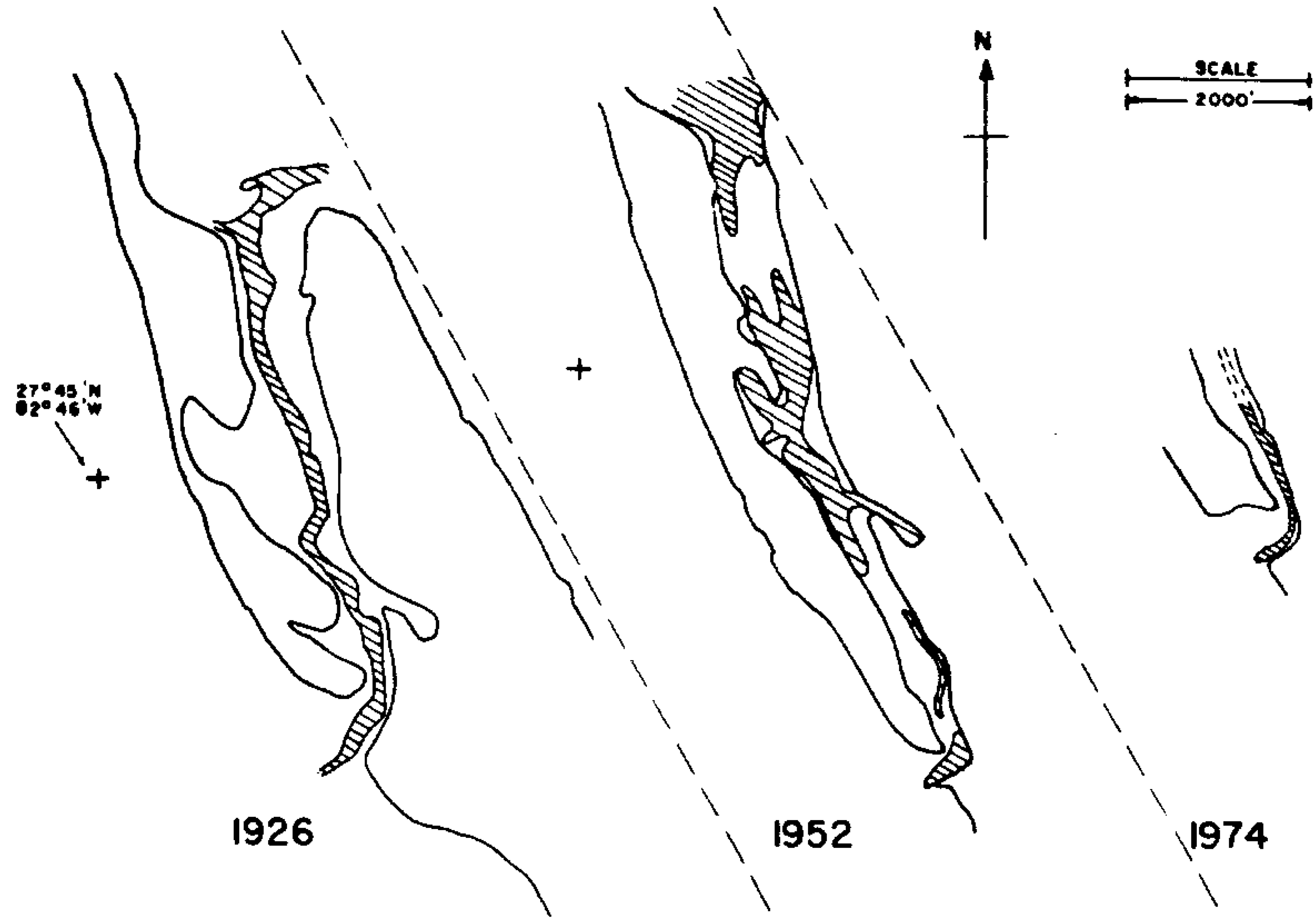


FIGURE 5.9. Blind Pass Channel in 1926, 1952 and 1974. The indicated areas are 8 ft. and deeper, below MWL.

VI HYDRAULICS

The hydraulic characteristics of the two inlets are derived primarily from tide, current and other hydrographic measurements obtained by the Coastal and Oceanographic Engineering Laboratory, Virginia Institute of Marine Science and by the Coastal Studies Institute, Louisiana State University, Baton Rouge, in August 1974.

6.1 Tides

National Ocean Survey (NOS) Tide Tables give the following spring (diurnal) ranges of tide in the northern part of Boca Ciega Bay:

TABLE 6-1
SPRING TIDE RANGES FROM TIDE TABLES

Gage Location	Spring Range (ft.)
St. Petersburg Beach Causeway	2.2
John's Pass	2.3
Madeira Beach Causeway	2.3

A mean range of tide for this region has not been defined because the tides are mixed. The mean tide level (or mean water level) is 1.1 ft. above the mean low water (MLW) datum at St. Petersburg Beach Causeway and 1.2 ft. at John's Pass and Madeira Beach Causeway. Based on two week tide records obtained by the Coastal and Oceanographic Engineering Laboratory in August 1974, an approximate spring tide range has been estimated for five additional locations in the area of the study. With reference to these locations shown in Figure 1.2, the ranges are as follows:

TABLE 6-2
ESTIMATED SPRING TIDE RANGES*

Gage Location	Spring Range (ft.)
Treasure Island (outer coast)	2.7
Blind Pass Throat	2.5
Treasure Island Causeway (west end)	2.5
Crystal Island (south end)	2.3
Bay Pines Bridge	1.1

*Based on data obtained in August 1974.

The Treasure Island (outer coast) location corresponds to the location of a tide gage which was 2,000 ft. north of the north jetty at Blind Pass, just off the beach (Sanchez-Diaz, 1975).

6.2 Currents

John's Pass:

Currents were measured at John's Pass by the Coastal and Oceanographic Engineering Laboratory in 1960 (COEL, 1966), 1966 (COEL, 1966), 1968 (COEL, 1969) and 1974 (Kojima, 1976). Whereas the 1960 float measurements were concentrated around the north jetty, the 1966 float measurements were close to the south side of the inlet. In the latter study, it was noted that the 1960 and particularly the 1966 dredge spoil bank (see Figure 5.4) were causing the currents to hug the south shore, thus increasing the possibility of erosion of that shore. As noted in Section 5.3, these spoil banks eventually formed a single crescent shaped bar which attached itself to the shore south of the inlet forming a small body of water known as O'Brien's Lagoon.

Current data in August 1974 were obtained in two different ways as follows:

1. Vertical and transverse profiles at the throat section (see Figure 5.1 for the location of the throat section) with the help of a single current meter. Kojima (1976) has analyzed these data.

2. Vertical profiles at the throat in the deepest part of the channel. These profiles were obtained in the bottom one meter of the flow with the help of a vertical array of five ducted impeller current meters installed inside a 4 ft. cube steel cage lowered to the bottom. Figure 5.1 shows the location of the cage. A detailed analysis of these data has been made by Mehta, Byrne and DeAlteris (1975, 1976). It suffices to note here that the near-bed profiles were found to be logarithmic.

Table 6-3 gives a record of the maximum cross-sectional average velocity, $\bar{V}_{max}$, the stage of tide, the tidal period, the range of tide in the Gulf (Treasure Island, outer coast), and the time lags of slack water after high water in the Gulf.

TABLE 6-3
HYDRAULIC CHARACTERISTICS OF JOHN'S PASS*

Max. Cross-Sectional Avg. Vel., $\bar{V}_{max}$ (fps)	Tide Stage**	Tidal Period, T h.m.	Range of Gulf Tide, $2a_0$ (ft.)	Time Lag of Slack Water h.m.
2.15	E	1350	2.30	0110
1.35	F	1240	1.50	0015
1.34	E	1240	1.23	0040
1.27	F	1245	1.47	0015
1.60	E	1245	1.60	0055
1.59	F	1130	1.50	0005
2.04	E	1130	1.37	0015

*Based on data obtained between August 5 and 7, 1974.
**E - ebb, F - flood.

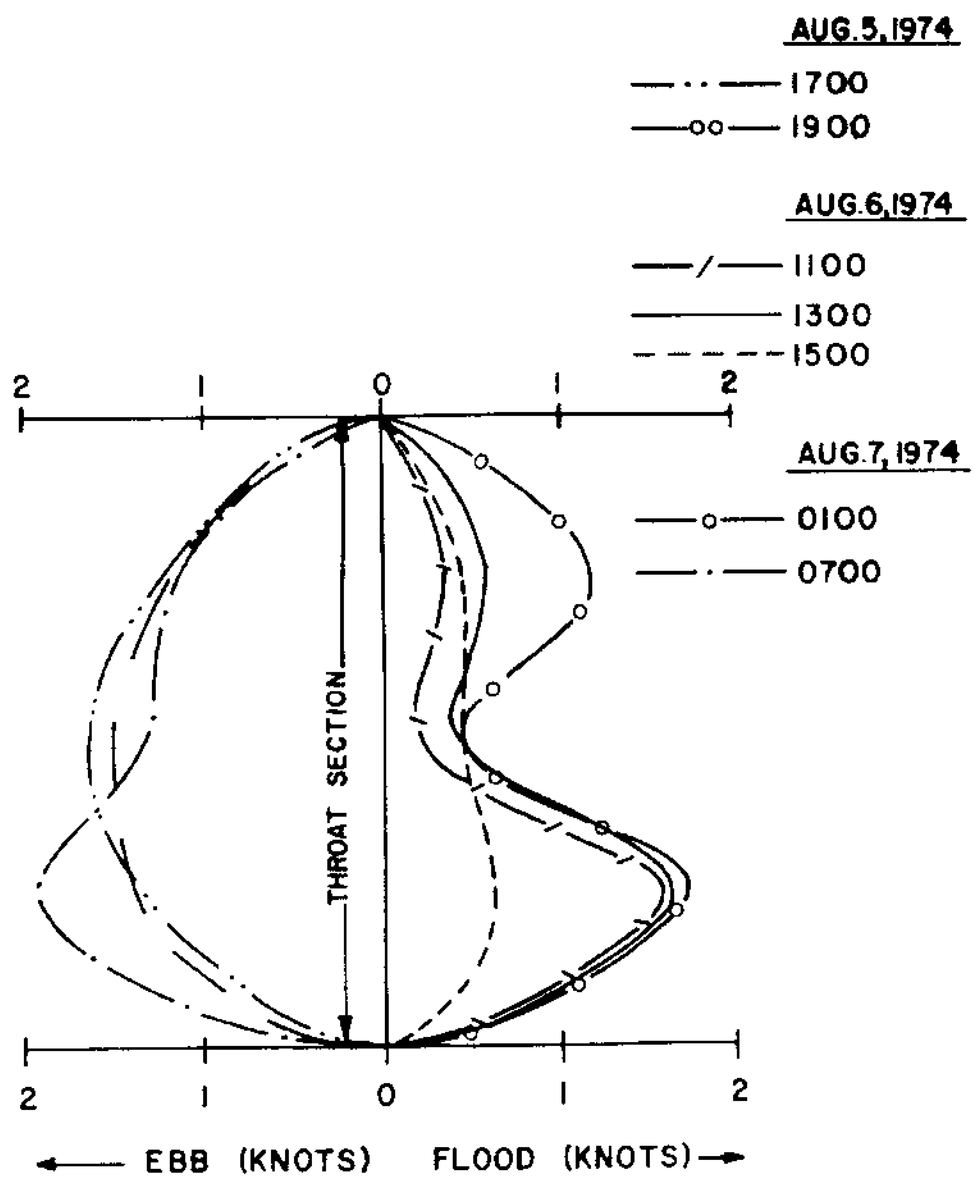


FIGURE 6.1. Examples of transverse, depth-averaged velocity distribution at the throat, John's Pass.

Note that the slack water, for which the time lag is reported, is the one at the end of the given stage of tide. Thus, for example, the lag of 1 hr. 10 min. in the first row corresponds to the slack water at the end of the ebb with a maximum cross-sectional average current of 2.15 fps under a 2.30 ft. range of tide in the Gulf. The tidal period of 13 hr. 50 min. is measured from the slack water before the preceeding flood to the slack water after the ebb.

The ratio, $V_{s \cdot ch}/\overline{V}$, between the near-surface current velocity, $V_{s \cdot ch}$, in the deepest part of the channel and the cross-sectional average velocity, $\overline{V}$, was found to be 2.50 for flood and 1.35 for ebb. These ratios enable the estimation of the cross-sectional average velocity, $\overline{V}$, at any given time, from a measurement of the surface velocity in the main channel. It is interesting to note that the flood flow at the throat section is channelized with a relatively strong current through the main channel close to the south bank. The ebb flow is more uniformly distributed across the throat. Figure 6.1, which shows some depth-averaged transverse profiles, exemplifies this phenomenon. The data are taken from an unpublished report by Kojima (1976).

Blind Pass:

Current measurements were obtained at Blind Pass in August 1974 in a manner similar to that at John's Pass (see the study by Sanchez-Diaz, 1975). See Figure 5.2 for the location of the steel cage containing an array of five ducted impeller current meters. These meters were used to obtain near-bed velocity profiles in the bottom one meter of the flow. Analysis of these profiles has been carried out by Mehta, Byrne and DeAlteris (1975, 1976).

Table 6-4 gives the hydraulic characteristics of Blind Pass. The columns give the same type of information as in Table 6-3. Note that the slack water, for which the time lag is recorded, is the one at the end of the given stage of tide. Thus, for example, the time lag of 1 hr. 15 min. in the first row corresponds to the slack at the end of the flood which had a maximum cross-sectional average current of 2.54 fps generated by a 1.38 ft. range of tide in the Gulf. The tidal period of 11 hrs. 35 min. is measured from the slack water before the flood to the slack water after the next ebb.

The ratio between the near-surface current velocity in the deepest part of the channel, $V_{s \cdot ch}$, and the cross-sectional average velocity, $\overline{V}$, was found to be 1.32, applicable to both flood and ebb flows. Current Tables do not give predictions for the current at the throat, but predictions for the flow near the bridge are available. Sanchez-Diaz (1975) noted that the predictions gave much higher velocities than measurements near the bridge.

6.3 Tidal Prism

Tidal prisms were computed for both the inlets by integrating the flow through the throat section over flood and also over ebb. The prism, P, given in Table 6-5 is the average of flood and ebb values.

TABLE 6-4
HYDRAULIC CHARACTERISTICS OF BLIND PASS*

Max. Cross Sectional Avg. Vel. V_{max} (fps)	Tide Stage**	Tidal Period T h.m.	Range of Gulf Tide $2a_o$ (ft)	Time Lag of Slack Water h.m.
2.54	F	1135	1.38	0115
2.34	E	1135	1.38	0120
2.36	F	1135	1.38	0110
2.38	E	1135	1.28	0125
1.94	F	1045	0.95	0105
1.98	E	1045	0.98	0110
2.04	F	1340	1.21	0100
2.41	E	1340	1.51	0120
2.03	F	1025	1.08	0105
1.57	E	1025	0.67	0100
1.96	F	1455	1.21	0100
2.40	E	1455	1.64	0140
1.72	F	0850	0.89	0100
0.81	E	0850	0.23	0030
1.77	F	1705	1.05	0055
2.90	E	1705	2.00	0205
1.86	F	0745	0.95	0115
0.76	E	0745	0.20	0020
1.74	F	1850	1.64	0040
2.95	E	1850	2.00	0155
2.48	F	0845	1.67	0130
0.78	E	0845	0.29	0040
2.28	F	1620	1.64	0100
3.76	E	1620	3.02	0215
2.63	F	0905	1.84	0125
1.05	E	0905	0.39	0035
2.45	F	1620	1.80	0045

*Data obtained between August 6 and 14, 1974.
**E - ebb; F - flood.

TABLE 6-5
TIDAL PRISMS AT JOHN'S PASS AND BLIND PASS

Date (Aug. 1974)	P at John's Pass (ft^3)	P at Blind Pass (ft^3)	Range of Gulf Tide $2a_c$ (ft)
5-6	2.12×10^8	--	1.47
6	2.08×10^8	--	1.50
6-7	2.18×10^8	--	1.50
7	--	1.87×10^7	1.51
7-8	--	1.74×10^7	1.57
8	--	1.29×10^7	1.15
8-9	--	1.66×10^7	1.18
9	--	1.15×10^7	1.21
9-10	--	1.89×10^7	1.38
10-11	--	2.92×10^7	1.77
11-12	--	3.29×10^7	2.46
12-13	--	3.45×10^7	2.52
13-14	--	3.44×10^7	3.05

The estimated spring range of tide for the Gulf is 2.7 ft., as indicated in Table 6-2. From Table 6-5 it is apparent that the corresponding spring tidal prism P_S is 3.45×10^7 ft.^{3} for Blind Pass. For John's Pass, the insufficient data in Table 6-5 cannot yield a value of P_S. Jarrett (1976) gives the following data on John's Pass:

TABLE 6-6
HYDRAULIC DATA OF JOHN'S PASS REPORTED BY JARRETT (1976)

Data Source	Spring Prism, P_S (ft^3)	Throat Area A_C (ft^2)	Mean Depth (ft)	Width Divided By Mean Depth
Cubature (NOS 1951-52)	5.03×10^8	8.86×10^3	14.9	40
NOS Current Data, May 1949	4.96×10^8	8.42×10^3	13.3	47

The relationship of O'Brien (1931, 1969, 1976) for inlets with jetties in sedimentary equilibrium is

$$A_c = 4.69 \times 10^{-4} \; P_s^{\,0.85}$$

For $A_C = 9.5 \times 10^3$ ft^2 according to the 1974 data, the above equation yields $P_S = 3.94 \times 10^8$ ft^3. Note that the 1974 survey of the throat gave a mean depth of 16.1 ft. and the width to mean depth ratio equal to 37.

6.4 Bed Friction

Based on the velocity profiles in the bottom one meter of flow, Mehta, Byrne and DeAlteris (1975, 1976) have studied bed friction characteristics at the two inlets. The Darcy-Weisbach friction factor, f, Manning's n and the equivalent sand roughness, k, for the bed near the throat are as follows:

TABLE 6-7
FRICTION CHARACTERISTICS OF JOHN'S PASS AND BLIND PASS

Inlet	Friction factor, f	Manning's n	Bed roughness, k
John's Pass	0.027	0.026	0.31 ft
Blind Pass	0.021	0.020	0.07 ft

Note that the bed near the throat at John's Pass is almost entirely laden with shells. Sand is found mainly in the interstitial zones between the shells. At Blind Pass patches of shells are surrounded by sand. Therefore the rather large values of the bed roughness, k, at the two inlets are entirely compatible with the structure of the bed.

6.5 Salinity, Temperature and Dispersion

Salinity and temperature profiles across the throat were obtained by the Coastal Studies Institute, LSU, in August 1974, concurrent with velocity profiles. A preliminary analysis of these data has been made by Kojima (1976). It suffices to note here that vertical salinity and temperature gradients during the period of measurement were found to be relatively small, signifying a vertically well-mixed situation. At Blind Pass, no data were obtained, but because of the shallow depths, no significant stratification is probable in the inlet region.

Sanchez-Diaz (1975) studied the dispersive characteristics of the Blind Pass channel. He found a longitudinal dispersion coefficient of 1 ft^2/sec applicable to the dispersion of dye in the channel.

6.6 Wave Climate

Walton (1973) has used the statistical information provided in the Summary of Synoptic Meteorological Observations (SSMO) to obtain wave height and period roses for the region of interest. Figure 6.2 shows the wave height rose and Figure 6.3 shows the wave period rose. The first gives a percent frequency as well as directional distribution of deep water wave heights on an annual average basis. It is observed that the dominant direction of onshore wave approach is from 280°T which is expected, inasmuch as this is approximately the direction of the longest oceanic fetch. The wave period rose exhibits a similar distribution. It should be pointed out that deep water wave characteristics are modified by refraction, shoaling, friction and percolation in shallow waters, depending on the nearshore sediment and bathymetry.

Bretschneider (1956) has also derived wave roses for a deep water (300 ft.) location off Tampa (Latitude 27° 35' N; Longitude 84° 23' W). Additionally, wave data are presented for shallow depths of 96, 48, 36, 24 and 12 ft. The effect of bottom friction is included in his computations, which are not based on the SSMO data, but rely on the information on atmospheric pressure distributions, winds and fetches over which the winds blow.

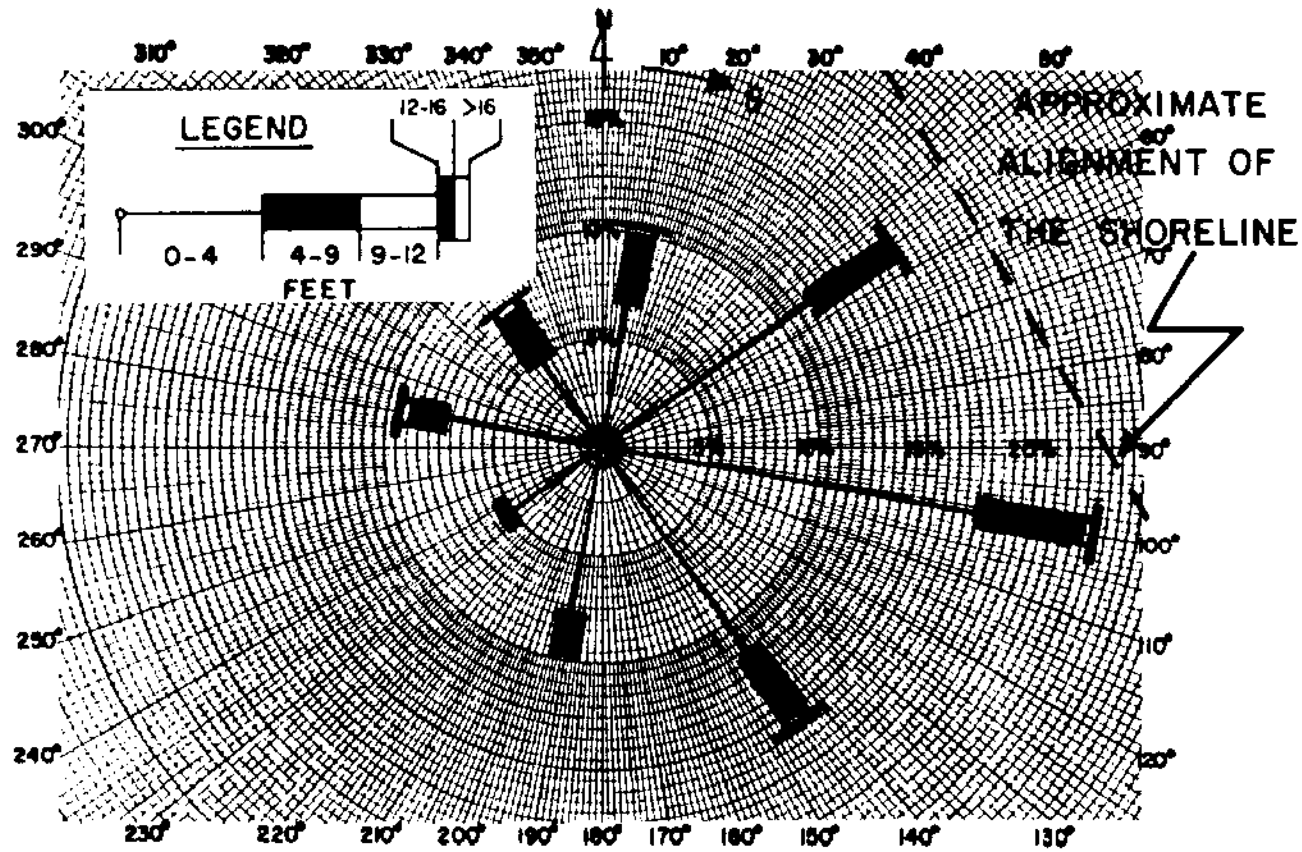


Figure 6.2. Annual average wave height rose (after Walton, 1973).

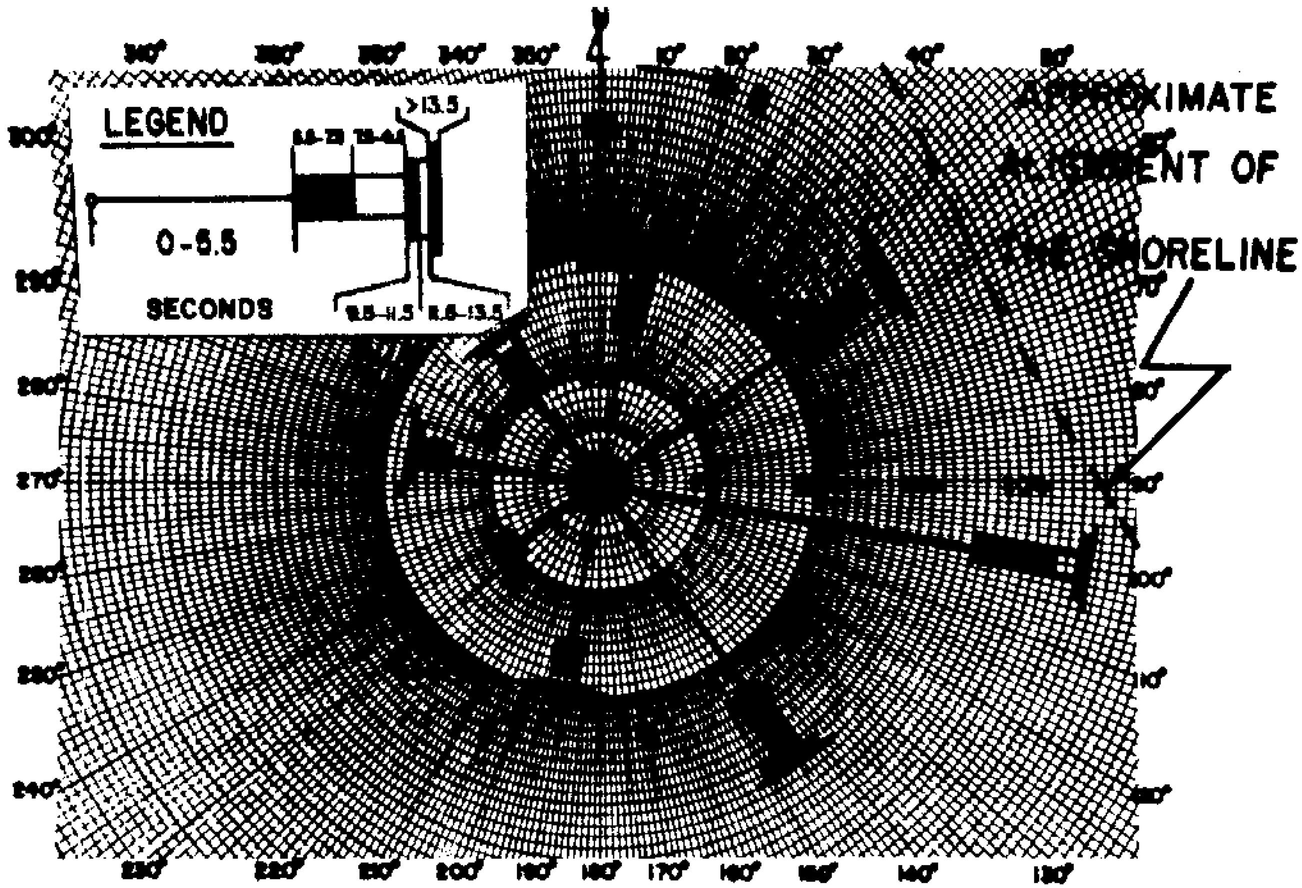


Figure 6.3. Annual average wave period rose (after Walton, 1973).

VII. SEDIMENTARY PROCESSES

7.1 Sediment Distribution

The sediment at the bottom of John's Pass and Blind Pass consists mostly of a mixture of sand and shell, with some fine material in the silt and clay range. Mehta, Byrne and DeAlteris (1975) have determined the coarse grain characteristics in the two inlets, as described below.

Table 7-1 gives the sieve diameters D_{25}, D_{50} and D_{75}, the sorting coefficient $S_0 = \sqrt{D_{75}/D_{25}}$ and the percent shell in samples seaward of the throat, at the throat and bayward of the throat. At both inlets, the material is in the gravel range, except seaward of Blind Pass throat where it is in the medium sand range. The relatively large size is mainly due to the presence of shells, which are abundant in both inlets (between 29 and 95% at Blind Pass and between 64 and 75% at John's Pass). Due to the same reason the sorting coefficients are large, indicating highly graded materials. Sediments from the two inlets were also analyzed after dissolving all the shell fragments in hydrochloric acid. The remaining material consisted mostly of fine to medium quartz sand with characteristics given in Table 7-2.

A comparison of the median diameters D_{50} (with and without shell) between the three regions in the two inlets indicates that, at both inlets, the material is coarser in the throat region. This is expected inasmuch as the stronger currents there cause the fine sand to be transported out of this region.

Sediment samples were collected by the Corps of Engineers in 1965 along the surface sample profile lines 61 and 65 (see Figure 4.3). Results indicated that the median grain diameter, D_{50}, decreases from a value of 0.24 mm at elevation +5.5 ft. (MLW) to a value of 0.11 mm at elevation -13.8 ft. (MLW). The sorting coefficient, S_0, generally decreased from 1.82 at elevation +5.5 ft. to 1.17 at elevation -13.8 ft. The average of the median grain sizes for ten sample locations was 0.178 mm.

Core borings were taken by the Corps of Engineers during April 1968 in the offshore area shown in Figure 4.3 and at two locations in Blind Pass. The average sorting coefficient, S_0, and average median grain diameter, D_{50}, for all the borings indicated were 1.67 and 0.196 mm, respectively. Table 7-3 shows the thickness of suitable sand readily available at core boring locations for beach nourishment purposes (U.S. Army Corps of Engineers, 1975b).

7.2 Sediment Transport

The Corps of Engineers (National Shoreline Study, 1971) have estimated

TABLE 7-1

BED SEDIMENT CHARACTERISTICS AT JOHN'S PASS AND BLIND PASS

Parameter	John's Pass	Size Classification	Blind Pass	Size Classification
		Seaward of the Throat		
D_{25}(mm)	1.10		0.18	
D_{50}(mm)	2.70		0.35	
D_{75}(mm)	5.00	Gravel	1.26	Medium
S_0	2.37		2.25	
Shell %	75.00		29.00	
		In the Vicinity of the Throat		
D_{25}(mm)	1.50		2.70	
D_{50}(mm)	3.30		5.90	
D_{75}(mm)	6.60	Gravel	7.50	Gravel
S_0	3.24		1.41	
Shell %	64.00		95.00	
		Bayward of the Throat		
D_{25}(mm)	--		1.70	
D_{50}(mm)	--		2.50	
D_{75}(mm)	--	--	3.90	Gravel
S_0	--		2.22	
Shell %	--		55.00	

TABLE 7-2

SHELL FREE BED SEDIMENT CHARACTERISTICS AT JOHN'S PASS AND BLIND PASS

Parameter	John's Pass	Size Classification	Blind Pass	Size Classification
		Seaward of the Throat		
D_{25}(mm)	0.16		0.17	
D_{50}(mm)	0.21		0.20	
D_{75}(mm)	0.32	Medium	0.23	Medium
S_0	1.41		1.16	
		In the Vicinity of the Throat		
D_{25}(mm)	0.20		0.16	
D_{50}(mm)	0.23		0.21	
D_{75}(mm)	0.31	Medium	0.26	Medium
S_0	1.28		1.29	
		Bayward of the Throat		
D_{25}(mm)	--		0.15	
D_{50}(mm)	--		0.17	
D_{75}(mm)	--	--	0.24	Fine
S_0	--		1.25	

TABLE 7-3

THICKNESS OF SUITABLE SAND LAYER READILY AVAILABLE AT CORE BORING LOCATIONS*

Core Boring Number	Thickness of sand (feet)
CB-5	13+
CB-6	6
CB-7	12+
CB-8	(excavated for 1969 restoration)
CB-9	(excavated for 1969 restoration)
CB-10	12+
CB-11	12+
CB-12	12+
CB-13	(excavated for 1969 restoration; 1976 nourishment)
CB-14	7
CB-15	(excavated for 1976 nourishment)
CB-16	8
CB-17	(excavated for 1976 nourishment)
CB-18	(excavated for 1976 nourishment)
CB-19	7
CB-20	(excavated for 1969 restoration; 1972 and 1976 nourishment)
CB-21	9
CB-22	(excavated for 1969 restoration; 1975/76 nourishment at St. Petersburg Beach)
CB-23	

*From U.S. Army Corps of Engineers, 1975b; personal communication Corps of Engineers, Tampa.

a net southerly littoral drift of 50,000 cubic yards per year in the southerly direction at Treasure Island. Walton (1973) has obtained a drift rose applicable to Treasure Island. This rose predicts a "null point" at a point which is approximately half-way between John's Pass and Blind Pass. The presence of such a null point implies that north of this point, the net littoral drift moves northward and south of this point, the net drift moves southward. The relatively long-term erosion of the beach in the middle of the island and accretion of the southern, and particularly the northern end has been cited by Walton as an evidence of the presence of a null point. Sedwick, et al. (1975) used this concept of null point to conclude that at least some of the sand from the nourished beach moves northward towards O'Brien's Lagoon, just south of John's Pass. However, in view of the complexity of sand movement near Treasure Island, the applicability of the null-point hypothesis remains to be verified.

At John's Pass and Blind Pass, considerable quantities of shells exist at the beds. In fact, at the throat sections the bed roughness is primarily defined by shells as noted in Section 6.4. Sand is found in the interstitial regions between the relatively much larger shells and shell fragments. As the current velocity increases past slack water, sand begins to move as bed-load. Mehta, Byrne and DeAlteris (1975, 1976) made observations on the critical bed shear stress for the incipient motion of sand at the throat sections of the two inlets. Mehta and Christensen (1976) have developed an entrainment function which correctly predicts the critical bed shear stress, given the sand grain diameter.

7.3 Sand Volumes

Calculations yielding the amount of sediment stored in the two inlets' outer bars have been made following the method described by Dean and Walton (1975). Results indicate that the amount of sediment in the outer bars at John's Pass and Blind Pass (calculated from the 1951/52 boat sheets) are 6.3×10^6 cubic yards and 0.43×10^6 cubic yards, respectively.

Recently, Walton and Adams (1976) have shown that, in general, an empirical relationship exists between the outer bar volume, $\forall$, and the spring tidal prism, P_s, for inlets in long-term sedimentary equilibrium. In such inlets exposed to a mild wave climate, e.g. the Gulf Coast of Florida, the proposed relationship is

$$\forall = 13.8 \times 10^{-5} P_s^{1.23}$$

where $\forall$ is in cubic yards and P_s in cubic feet. For John's Pass, Table 6-7 in Section 6.3 gives $P_s = 5.03 \times 10^8$ ft^3 (1952). This yields $\forall = 7.5 \times 10^6$ cubic yards which compares well with the measured value. For Blind Pass $P_s = 3.45 \times 10^7$ ft^3 based on 1974 measurements (see Section 6.3). Assuming that the ration of P_s to the throat cross-sectionals area, A_c, is invariant, $P_s = 1.32 \times 10^8$ ft^3 based on the ratio of throat sections in 1952 and 1974 (1690/442 = 3.82). This gives $\forall = 1.34 \times 10^6$ cubic yards which is three times the measured amount. Apart from the possible error introduced in estimating the 1952 spring tidal prism, the lower than predicted value of the sand volume in the outer bar at Blind Pass is likely to be due to the rather steady southward migration of Blind Pass since 1873. This migration could have prevented the establishment of a sedimentary equilibrium condition for the outer bar. When an inlet migrates at an appreciable rate, the outer bar, especially under a mild wave climate, does not have the opportunity to develop fully. Indeed, for such an inlet, the relationship of Walton and Adams is not applicable.

VIII. SUMMARY

John's Pass and Blind Pass are located in Pinellas County, Florida, separated by Treasure Island, which is a 3.5 mile long barrier island. Both the inlets connect the Gulf of Mexico to the northern part of Boca Ciega Bay near the cities of Tampa and St. Petersburg. The following is a brief summary of the information included in this report.

1. John's Pass has a groin-like north jetty. The throat is about 590 ft. wide with a mean depth of 16 ft. Blind Pass, which has typically exhibited less sedimentary stability was 83 ft. wide and 6 ft. deep at the throat in July 1974, prior to the improvement and extension of its two jetties.

2. The Treasure Island area has a thriving tourist trade. Both the inlets are heavily used by boats. John's Pass, which is deeper, is particularly used by commercial fishing vessels.

3. The bed rock of the study area is the Tampa limestone of Lower Miocene Age. This rock is overlain by surficial sand of ancient origin. The soils of the land have been altered in many places as a result of urban development.

4. The climate of the Treasure Island vicinity is characterized by long, relatively humid summers and mild winters. The average (for the period 1911-1960) yearly temperature at St. Petersburg was 73.8° F. and the annual total rainfall was 53.7 inches.

5. The prevailing winds in the area are from the NE and N during winter months and from the E and S during the remainder of the year. Several storms and hurricanes have damaged the beaches near the two inlets. One of the more recent ones was hurricane Agnes in June 1972, which caused an estimated $545,000 in damages.

6. John's Pass apparently opened in September 1848 as a result of a hurricane. Since that time, this inlet has widened to 9,500 ft^2 (throat cross-section below MWL), whereas Blind Pass has narrowed steadily from 5,790 ft^2 in 1873 to 442 ft^2 in 1974 (prior to the most recent jetty improvements).

7. The bay surface area appears to have remained constant from 1873 to 1926 at about 3.0×10^8 ft^2. However, since then the area has decreased successively to 2.2×10^8 ft^2 in 1969. This reduction is attributed to dredge and fill operations in the bay since the 1920's.

8. A number of engineering operations - jetty and groin constructions, channel dredging, beach nourishments, etc., have been carried out in the vicinity of the two inlets since 1916. Most recently, two new jetties have been constructed at Blind Pass. Also, beaches to the north and south of Blind Pass have been nourished. The nourishment of the beach north of this inlet has been a part of the periodic beach nourishment project undertaken by the Corps of Engineers, Jacksonville District.

9. The Spring tidal prism at John's Pass is 5.0×10^8 ft^3 (1949-52 data) and 3.5×10^7 ft^3 at Blind Pass (1974 data).

10. The Darcy - Weisbach friction factor, f, is 0.027 at John's Pass and 0.021 at Blind Pass. The corresponding bed roughnesses, k, are 0.31 ft. and 0.07 ft., respectively.

11. Salinity and temperature profiles obtained at the throat section of John's Pass in August 1974, indicated no significant flow stratification during that period.

12. On an annual average basis, the dominant direction of deep water wave approach to the shoreline is from 280° T.

13. The sediment at the bottom of John's Pass and Blind Pass consists mostly of a mixture of sand and shell with some fine material in the silt and clay range.

14. The Corps of Engineers has estimated a net southerly drift of 50,000 cubic yards per year in the vicinity of Treasure Island.

15. The outer bar sand volumes have been estimated to be 6.3×10^6 cubic yards and 0.43×10^6 cubic yards at John's Pass and Blind Pass, respectively, based on 1951/52 boat sheets.

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