

*Passage Key Inlet Management Plan*

**Office of Resilience and Coastal Protection**

**Florida Department of Environmental Protection**

**November 2024**



## **Final Order Adopting Passage Key Inlet Management Plan**

WHEREAS, pursuant to section 161.161, Florida Statutes (F.S.), the Florida Department of Environmental Protection (department or DEP) shall “evaluate each improved, modified or altered inlet and determine whether the inlet is a significant cause of beach erosion. With respect to each inlet determined to be a significant cause of beach erosion, the plan shall include the extent to which such inlet causes beach erosion and recommendations to mitigate the erosive impact of the inlet, including, but not limited to, inlet sediment bypassing; improvement of infrastructure to facilitate sand bypassing; modifications to channel dredging, jetty design and disposal of spoil material; establishment of feeder beaches; and beach restoration and beach nourishment.”

WHEREAS in 2008, the Florida Legislature amended section 161.142, F.S., finding, “The Legislature recognizes the need for maintaining navigation inlets to promote commercial and recreational uses of our coastal waters and their resources. The Legislature further recognizes that inlets interrupt or alter the natural drift of beach-quality sand resources, which often results in these sand resources being deposited in nearshore areas or in the inlet channel, or in the inland waterway adjacent to the inlet, instead of providing natural nourishment to the adjacent eroding beaches. Accordingly, the Legislature finds it is in the public interest to replicate the natural drift of sand which is interrupted or altered by inlets to be replaced and for each level of government to undertake all reasonable efforts to maximize inlet sand bypassing to ensure that beach-quality sand is placed on adjacent eroding beaches. Such activities cannot make up for the historical sand deficits caused by inlets but shall be designed to balance the sediment budget of the inlet and adjacent beaches and extend the life of proximate beach restoration projects so that periodic nourishment is needed less frequently;” and

WHEREAS in 2023, Manatee County sponsored an inlet management study of Passage Key Inlet, which compiled new survey data and information regarding its coastal processes and inlet and shoreline dynamics and updated its sediment budget; and

WHEREAS, in November 2024, the department finalized the development of an inlet management plan that contains corrective measures to mitigate the identified inlet erosion impacts to adjacent beaches; and

WHEREAS, Manatee County and the Town of Longboat Key is responsible for dredging and sand bypassing at Passage Key Inlet and, therefore, responsible for implementation of the inlet management plan; and

WHEREAS, this inlet management plan (attached) is consistent with the department's program objectives under Chapter 161, F.S.

**THEREFORE:**

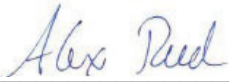
The department does hereby adopt the following implementation strategies, as set forth in the attached Passage Key Inlet Management Plan. Future inlet management activities conducted by the Manatee County and the Town of Longboat Key shall be consistent with the following five strategies:

- 1) A comprehensive beach and inlet hydrographic monitoring program shall be conducted** to evaluate the performance and impact of existing sand bypassing and nourishment projects and to periodically update the inlet sediment budget. Beach and nearshore surveys between DEP Reference Monuments R1 to R41.5 shall be conducted. Periodic inlet hydrographic surveys to include the inlet channel and the ebb shoal shall also be conducted. Along with topographic and hydrographic surveys of the inlet system and adjoining beaches, hydraulic monitoring may be conducted to enhance future modeling input data for investigations of inlet management alternatives.
- 2) Sand bypassing shall be performed from the inlet system to the adjacent gulf-fronting beaches to the south of the inlet on Anna Maria Island, principally between DEP Reference Monument R1 and R41.5.** The quantity of material to be bypassed shall be based on available quantities documented through the monitoring protocol of Strategy #1 above and the target bypassing identified in Strategy #3 below.
- 3) On an average annual basis, the initial target inlet sand bypassing quantity shall be 130,000 cubic yards per year to the south.** This target quantity may be modified or updated based on a minimum of five years of additional monitoring data indicating a change in the sediment budget.
- 4) The primary source of sediment for meeting the target sand bypassing quantities in Strategy #3 shall be the Passage Key Inlet ebb shoal borrow area identified as D+E in the inlet management study, or as otherwise authorized by permit.** Secondary or emergency borrow area sources may utilize the ebb shoal borrow areas identified as D, E, E1, J1 and J2. Acceptable beach quality sand may also be obtained from inland sand mines or offshore sources to achieve the target sand bypassing quantities.

- 5) The placement of sand from material dredged from Tampa Harbor or other acceptable sources may be used as a management approach for increasing sediment supply in the Passage Key Inlet ebb shoal.** The North Placement Area evaluated in the inlet management study shall be prioritized for sand placement to mitigate the critical erosion conditions at Passage Key pending further development and coordination.

Inlet management actions conducted by Manatee County and the Town of Longboat Key that implement the strategies contained in this plan are subject to further evaluation and subsequent authorization or denial, as part of the department's permitting process. Activities that implement these adopted strategies shall be eligible for state financial participation pursuant to section 161.143, F.S., subject to department approval of a funding request and an appropriation from the Florida Legislature. The level of state funding shall be determined based on the activity being conducted and the department's rules. The department may choose not to participate financially if the proposed method of implementation is not cost effective or fails to meet the intent of section 161.142, F.S., and this final order. Activities ineligible for cost sharing include, but are not limited to navigational construction, operation, and maintenance activities, except those elements whose purpose is to place or keep sand on adjacent beaches. Nothing in this plan precludes the evaluation and potential adoption of other strategies for the effective management of Passage Key Inlet and the adjacent beaches.

## Approval of Adoption



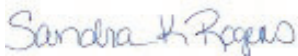
Alex Reed

Director of the Office of Resilience and Coastal Protection

Florida Department of Environmental Protection

## Filing and Acknowledgement

FILED, on this date with the designated Deputy Clerk, pursuant to  
section 120.52, F.S., receipt of which is hereby acknowledged.



Deputy Clerk

11/8/2024

Date

**Electronic Copies Furnished to:**

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## Notice of Rights

This action is final and effective on the date filed with the clerk of the department unless a petition for an administrative hearing is timely filed under sections 120.569 and 120.57, F.S., before the deadline for filing a petition. On the filing of a timely and sufficient petition, this action will not be final and effective until further order of the department. Because the administrative hearing process is designed to formulate final agency action, the hearing process may result in a modification of the agency action or even denial of the request for a variance or waiver.

### Petition for Administrative Hearing

A person whose substantial interests are affected by the department's action may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57, F.S. Pursuant to Rule 28-106.201, Florida Administrative Code (F.A.C.), a petition for an administrative hearing must contain the following information:

- (a) The name and address of each agency affected and each agency's file or identification number, if known;
- (b) The name, address, telephone number and any e-mail address of the petitioner; the name, address, telephone number and any email address of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests are or will be affected by the agency determination;
- (c) A statement of when and how the petitioner received notice of the agency decision;
- (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
- (e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;
- (f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and
- (g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the clerk) in the Office of General Counsel of the department at 3900 Commonwealth Blvd., Mail Station 35, Tallahassee, Florida 32399-3000. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

#### Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing must be filed within 21 days of receipt of this written notice. The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

#### Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the department's action may also request an extension of time to file a petition for an administrative hearing. The department may, for good cause shown, grant the request for an extension of time. Requests for extension of time must be filed with the Office of General Counsel of the department at 3900 Commonwealth Blvd., Mail Station 35, Tallahassee, FL 32399-3000, before the applicable deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.



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## ***Introduction***

Pursuant to subsection 161.101(2), F.S., the Florida Department of Environmental Protection (department or DEP) is the beach and shore preservation authority for the state of Florida. As part of the department’s statewide beach management plan adopted pursuant to section 161.161, F.S., the department is adopting this inlet management plan for Passage Key Inlet in Manatee County, Florida.

“Passage Key Inlet Management Plan” updates strategies for Passage Key Inlet that were adopted in the “Strategic Beach Management Plan” (DEP, 2023) to be consistent with current statutes and observed erosion<sup>1</sup> conditions. The “Strategic Beach Management Plan” (DEP, 2023) called for completing an inlet management study, adopting an inlet management plan and continuing to monitor the impacts from dredging the ebb shoal of Passage Key Inlet along the north end of Anna Maria Island.

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<sup>1</sup> As used in this document, the term “erosion” means wearing away of land or the removal of consolidated or unconsolidated material from the coastal system by wind or wave action, storm surge, tidal or littoral currents or surface water runoff. As used in this document, the term “accretion” means the buildup of land or accumulation of unconsolidated material within the coastal system caused by wind and wave action, storm surge, or tidal or littoral currents. The descriptions of coastal processes in this document are not intended to affect title to real property or real property boundaries.

## ***Program Objectives and Statutory Responsibilities for Inlet Management***

In 2008, the Florida Legislature amended Section 161.142, F.S., finding,

“The Legislature recognizes the need for maintaining navigation inlets to promote commercial and recreational uses of our coastal waters and their resources. The Legislature further recognizes that inlets interrupt or alter the natural drift of beach-quality sand resources, which often results in these sand resources being deposited in nearshore areas or in the inlet channel, or in the inland waterway adjacent to the inlet, instead of providing natural nourishment to the adjacent eroding beaches. Accordingly, the Legislature finds it is in the public interest to replicate the natural drift of sand which is interrupted or altered by inlets to be replaced and for each level of government to undertake all reasonable efforts to maximize inlet sand bypassing to ensure that beach-quality sand is placed on adjacent eroding beaches. Such activities cannot make up for the historical sand deficits caused by inlets but shall be designed to balance the sediment budget of the inlet and adjacent beaches and extend the life of proximate beach restoration projects so that periodic nourishment is needed less frequently.”

Pursuant to section 161.143, F.S.,

“Studies, projects and activities for the purpose of mitigating the erosive effects of inlets and balancing the sediment budget of the inlet and adjacent beaches must be supported by separately approved inlet management plans or inlet components of the statewide comprehensive beach management plan.”

The U.S. Army Corps of Engineers, Jacksonville District, and Manatee County have been the entities responsible for dredging Passage Key Inlet and consequently, mitigating the extent of beach erosion caused by the inlet, as specified in subsection 161.142 (6), F.S.

## ***History of Passage Key Inlet and Anna Maria Island Erosion Control Projects***

Passage Key Inlet is the southernmost of three large inlets at the entrance to Tampa Bay located in Hillsborough County and this inlet is in Manatee County between Passage Key and Anna Maria Island (**Figure 1**). Within the Tampa Bay entrance, Egmont Key and Passage Key are supratidal shoals that are part of the bay's ebb tidal shoal system and provide the separations for the three major entrance channels. The northern pass, Egmont Channel, is located between Mullet Key and Egmont Key, and hosts a federally authorized deep-water navigation channel to Tampa Harbor. Egmont Key is a federally owned National Wildlife Refuge and is cooperatively managed with the Florida Park Service as Egmont Key State Park. Egmont Key has 1.6 miles of critically eroded beach that has received periodic placement of maintenance dredge material from the federal navigation channel. South of Egmont Key to Passage Key is the Southwest Channel, which is a large natural pass without any dredging projects.

Passage Key is a National Wildlife Refuge established in 1905, and currently has 0.3 mile of critically eroded beach (DEP, 2023). Around 1900, the island had approximately 60 acres with mangroves and a freshwater lake. Passage Key was destroyed by a hurricane in 1921, and partially recovered to become a low sparsely vegetated and dynamic sand island. A review of National Oceanic and Atmospheric Administration (NOAA) nautical charts and aerial photography indicates that the island has existed as an ephemeral feature that cyclically emerges at the north end of the shoal, migrates south as it fluctuates in size up to approximately 20 acres, and erodes becoming submerged as it nears Passage Key Inlet. **Figure 2** compares aerial photographs from 1993 and 2007, which represent both its emergent and submerged conditions.

Passage Key Inlet is characterized by a pronounced, relatively deep channel (15-35-foot water depths within the inlet throat) that does not require maintenance dredging for navigation, and a large shallow ebb shoal complex (5-15-foot water depths). The ebb shoal has been subjected to multiple dredging events to obtain material to nourish beaches to the south. South of Passage Key Inlet is Anna Maria Island which is designated critically eroded along its 7.9 miles. The island has both federal and non-federal beach restoration projects. The federally authorized Manatee County Shore Protection Project covers 4.6 miles of shoreline between DEP reference

monuments R12 to R36, including the project's southern taper. Non-federal projects include the north (R7-R10) and south (R36-R41.3) ends of Anna Maria Island.

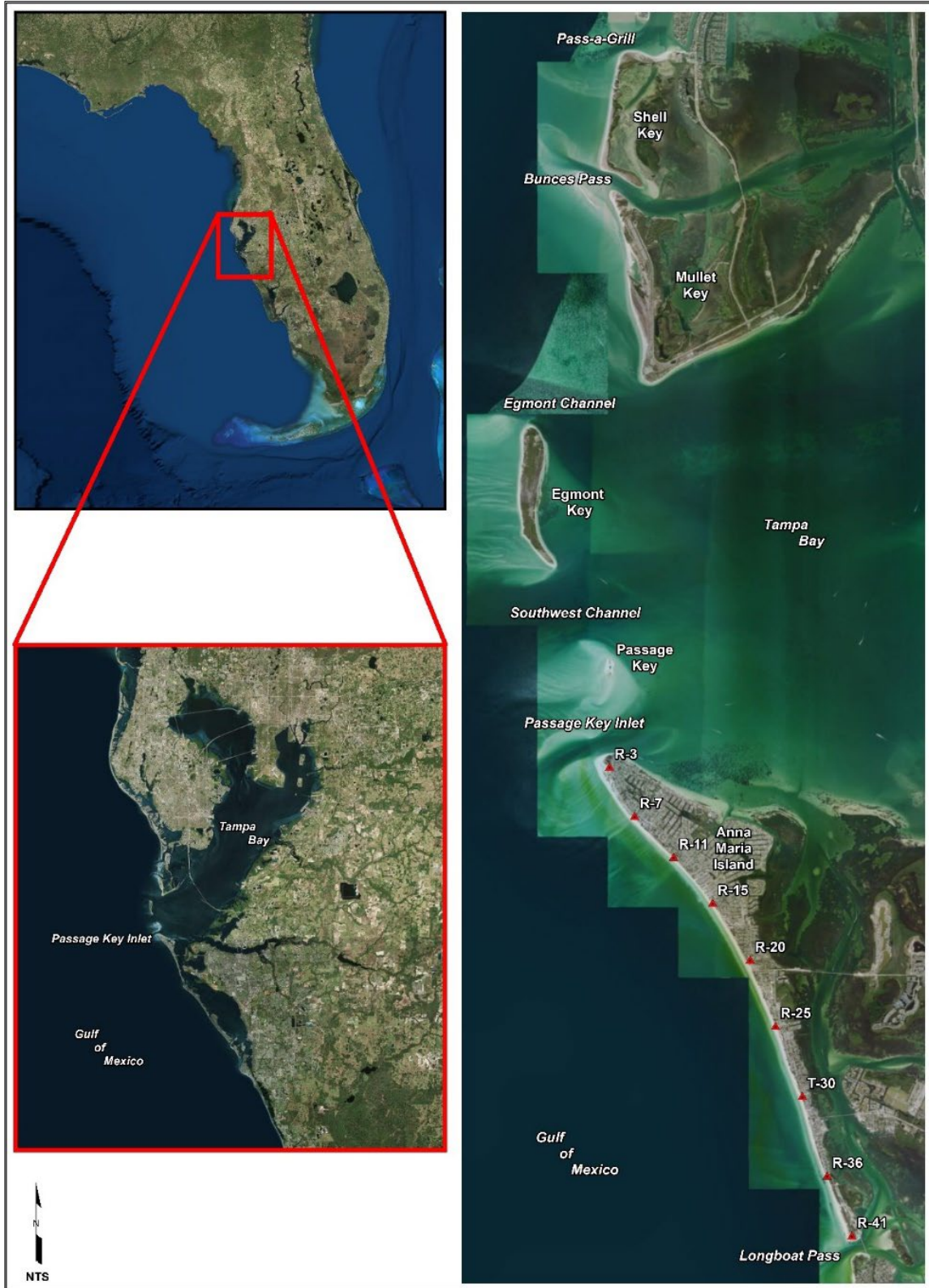


Figure 1. Location map of Tampa Bay entrance, including Passage Key Inlet (APTIM & CPE, 2023).



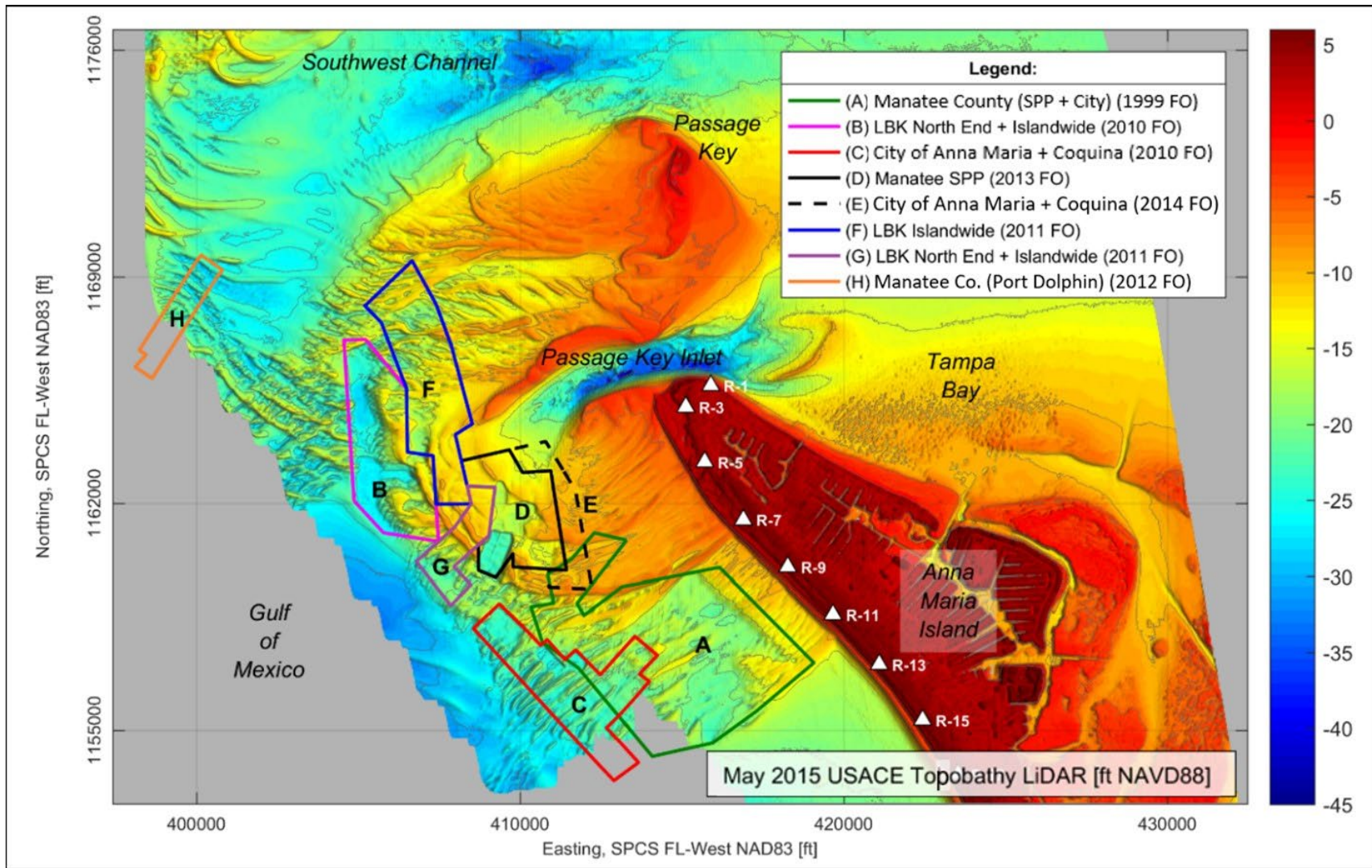
**Figure 2.** Aerial photography comparing emergent and submerged conditions of Passage Key in 1993 and 2007 (Google Earth, 2018).

It is important to understand the history of Passage Key Inlet and prior inlet management activities as well as beach erosion control activities along the adjacent beaches, to gain a perspective on the inlet’s dynamics and the need to change inlet management strategies over time. The Passage Key Inlet ebb shoal complex and proximate surrounding areas have been used as sand sources for beach nourishment projects on Anna Maria Island and Longboat Key since 2002. The permitted borrow areas within and in the immediate vicinity of the inlet’s shoal complex are shown in **Figure 3**. The legend notes the project and year of each DEP permit authorized for each borrow area labeled A through H. **Table 1** summarizes the borrow area details (APTIM & CPE, 2023).

**Table 1.** Borrow Area Summary (APTIM & CPE, 2023).

Figure Label	Permitted Borrow Area Name	FDEP Permit No.	Expiration Date	Placement Area	Year Dredged
A	North Borrow Area	0039378-001-JC	3/8/2006 (Expired)	City of Anna Maria Island Manatee County SPP Coquina Beach	2002 2002; 2005-06 2002
B	Borrow Area IX	0300119-001-JC; 0296464-001-JC	09/13/2020 (Expired); 10/26/2026	Longboat Key Islandwide Longboat Key North End	2005-06 2011; 2021
C	2008 AMI Borrow Area	00281452-001-JC, Mod 005-JN 0039378-010-JC, Mod 018-JN	7/23/2015 (Expired) 8/28/2028	City of Anna Maria Island Manatee County SPP Coquina Beach	2011 2011; 2013-14; 2020 2020
D	2013 AMI Borrow Area I	0039378-010-JC	8/28/2028	Manatee County SPP Coquina Beach	2013-2014; 2020 2020
E	2013 Coquina Borrow Area II	00281452-001-JC, Mod 005-JN 0039378-010-JC, Mod 018-JN	7/23/2015 (Expired) 8/28/2028	City of Anna Maria Island Manatee County SPP Coquina Beach	N/A 2020 2020
F	Borrow Area XA	0296464-001-JC	10/26/2026	Longboat Key Islandwide	2021
G	Borrow Area XB	0296464-001-JC	10/26/2026	Longboat Key Islandwide	Not Dredged
H	AMI Port Dolphin Sediment Source	00286121-008-JC	1/24/2027	North End of Anna Maria Island City of Anna Maria Island	Not Dredged Not Dredged





**Figure 3.** Permitted borrow areas in the vicinity of the Passage Key Inlet ebb shoal with the year of the DEP final order (FO) (APTIM & CPE, 2023).

In total, dredging of these shoals has resulted in the placement of approximately 5.8 million cubic yards of sand on Anna Maria Island (4,782,700 cubic yards) and Longboat Key (1,065,900 cubic yards). Erosion along the length of the gulf shoreline of Anna Maria Island resulted in numerous shore protection projects over the years. Prior to 1992, shoreline stabilization was primarily abated by construction of coastal armoring, which included seawalls, groins, bulkheads and revetments as outlined below (CP&E, 2000).

- 1950's: At the north end of the island between R5 and R9, approximately 100 rock groins varying in length from 50 to 70 feet were constructed.
- 1959: At Coquina Beach south from R36, 20 groins were constructed, averaging 90 feet in length.
- 1963: A 460-foot-long concrete permeable groin was constructed at Manatee County Public Beach between R20 and R21.
- 1964-65: Three concrete permeable groins averaging 330 feet in length were constructed at Bradenton Beach between R33 and R36.
- 1992: Several non-functional or derelict structures were removed prior to sand placement as part of the initial nourishment of the federal Manatee County Shore Protection Project.

Since 1992, beach nourishment has been the primary strategy for mitigating the critical erosion of Anna Maria Island's beaches as detailed in **Table 1** and **Figure 3**. The following is a summary of the recent beach nourishment events (DEP 2023; APTIM & CPE, 2023).

- 1992-93: The initial Manatee County Shore Protection Project (SPP) was constructed between R12 and R36. The project resulted in the placement of 2,320,000 cubic yards of sand obtained from a borrow area located approximately 2,000 feet offshore of the island between R23 and R35.
- 2002: The City of Anna Maria Island Beach Nourishment Project (R7-R10) was constructed in conjunction with the first nourishment of the Manatee County SPP (R12-R36). The projects resulted in the placement of 1,900,000 cubic yards of sand obtained from a borrow area located near the southern portion of the Passage Key Inlet ebb shoal complex offshore and between R7 and R12. No sand was placed between R10 and R12.
- 2005-06: The Manatee County SPP was nourished between R12 and R28 to partially offset storm damages related to 2004 Hurricanes Charley, Frances, Ivan and Jeanne. The project resulted in the placement of 213,000 cubic yards of sand obtained from a Passage Key Inlet ebb shoal complex borrow area.
- 2011: The City of Anna Maria Island Beach Nourishment Project (R7-R10) was nourished in conjunction with the initial nourishment of the Coquina Beach Nourishment Project (R35-R41).

The projects resulted in the placement of 24,709 and 204,773 cubic yards of sand, respectively, obtained from a Passage Key Inlet ebb shoal complex borrow area.

- 2013-14: The Manatee County SPP (R12-R36) and the Coquina Beach Nourishment Project (R33-R40.7) were nourished with overlapping taper sections, resulting in the total placement of 1,305,951 cubic yards of sand from borrow areas of the Passage Key Inlet ebb shoal complex. Approximately 973,839 cubic yards was obtained from a borrow area on top of the shoal and placed within the Manatee County SPP project limits and 332,112 cubic yards was obtained from a borrow area located to the south along the southern portion of the ebb shoal complex and placed within the Coquina Beach project limits.
- 2020: The Manatee County SPP was nourished using the Passage Key Inlet ebb shoal as the sand source. At the request of Manatee County, the USACE included the non-federal Coquina Beach Nourishment segment as “Additional Work” in the construction contract. The two fill placements were constructed sequentially. Approximately 761,989 cubic yards of sand were placed within the SPP area (R12-R33.5) and 250,197 cubic yards of sand were placed within the Coquina Beach project area (R33.5-R41.5).
- 2021: The Coquina Beach Storm Damage Restoration Project (R33-R41) replaced material lost due to the impacts of Hurricanes Hermine (2016) and Irma (2017) involving approximately 98,300 cubic yards of sand dredged from Longboat Pass to the south.

### ***2016 Inlet Dredging Study***

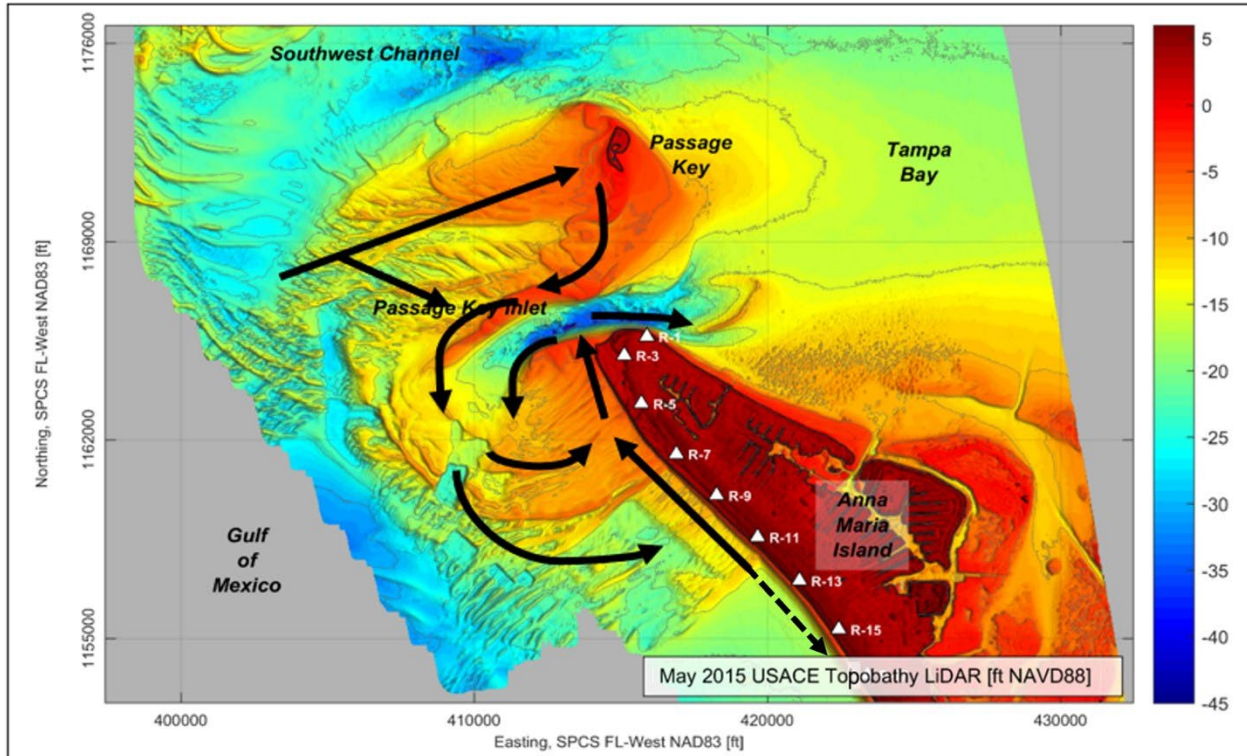
In 2016, the U.S. Army Corps of Engineers (USACE) conducted the Passage Key Inlet Sediment Mining Alternatives Study for Manatee County, Anna Maria Island Federal Shore Protection Project. This investigation conducted an alternatives analysis for several potential borrow areas in the Passage Key Inlet ebb shoal using the Coastal Modeling System (CMS). The study was conducted to further the current understanding of the inlet processes and to evaluate changes in the inlet shoal complex morphology and adjacent beaches due to ebb shoal dredging. The alternatives studied included the existing borrow area of 2013 and two other locations considered long-term depositional areas by comparing 1895 and 2015 bathymetries. The two features are the inlet’s northern marginal bar and a portion of the outer ebb shoal offshore of Passage Key Inlet and Southwest Channel. Seven alternatives with volumes ranging from 1.87 to 3.57 million cubic yards were simulated for an 11-month period and compared to a no action alternative for effects on morphology and wave height. The report concluded with the model results graphics with the anticipation that the inlet study was ongoing.

## ***2023 Inlet Management Study and Updated Sediment Budget***

In 2021, Manatee County sponsored an inlet management study of Passage Key Inlet conducted by Aptim Coastal Planning & Engineering, LLC (APTIM), and Coastal Protection Engineering LLC (CPE). This study carried forward the USACE (2016) study concepts for borrow area alternatives A, E, F and G for Delft3D modeling to evaluate sustainability, infilling rates to support future use, and long-term and storm effects on waves and morphology.

The study evaluated the physical inlet characteristics, its geology and sediments determined from prior geotechnical investigations, the wind and wave climate of the area, and tides. The net alongshore sediment transport within the region is generally from north to south. However, seasonal and annual fluctuations and reversals in response to storm events, shoreline orientation and inlets occur. The inlets within the entrance to Tampa Bay have interrupted the alongshore transport as sediments are redistributed by tidal currents creating shoals that are, in turn, reworked by waves. The constant exchange of sediments between the islands and the inlets contributes to the variable and intermittent erosion and accretion patterns within the region (APTIM & CPE, 2023).

Pursuant to section 161.142, F.S., dredging within an inlet system, including its shoals, should result in the placement of all beach quality sand on adjacent eroding beaches toward balancing the sediment budget between the inlet and adjacent beaches. A sediment budget is a balance of the volumes (or volume rate of change) for sediments entering and leaving a tidal inlet system and its adjacent beaches. A sediment budget quantifies the natural longshore sediment transport by waves and tides to and from the inlet, the entrapment of longshore sediment by the inlet channel and the ebb and flood shoals, and the mechanical “bypassing” of sediment, typically by a hydraulic dredge, from the inlet to the adjacent beaches or nearshore. Sediment transport volumes and pathways are unique to each inlet as influenced by regional geology, morphological characteristics, wave and tide conditions, and sediment characteristics and supply. A sediment budget is determined by comparing two or more surveys of an inlet system, including its channel, ebb and flood shoals, and the adjacent beaches. The sediment redistribution into and out of Passage Key Inlet is influenced by large-scale coastal processes. General observations regarding the inlet’s dominant sediment transport pathways were based on a review of available aerial photography between 1984 and 2016 and are graphically depicted in **Figure 4**.



**Figure 4.** Sediment pathways at Passage Key Inlet (APTIM & CPE, 2023).

### Sediment Budget

CP&E (2000) identified a “20-year cycle” of erosion and accretion at the north end of Anna Maria Island (R3-R7) using historical shoreline position data from DEP and Manatee County’s beach profile monitoring data. APTIM & CPE (2023) analyzed onshore sediment transport at the island’s north end from ebb shoal sand waves, as well as longshore sediment transport for time periods between 2002 and 2017. Passage Key Inlet sediment budgets were developed for two time periods between 2010 and 2015 and between 2015 and 2017 to consider the accretional and erosional trends, respectively, that may be occurring at the north end of Anna Maria Island. The longshore transport rates, beach volumetric changes, and directions of sediment transport along Anna Maria Island and sediment pathways were combined with estimated volumetric changes within the Passage Key Inlet complex to develop a sediment budget for the inlet’s area of influence. The sediment budget was also used to calibrate a Delft3D model used for evaluating inlet management alternatives.

The inlet complex and adjacent beaches were divided into cells within which the volume of sand gained or lost and the transport into or out of was estimated. The cells were delineated to

highlight features of the inlet complex and sediment pathways. Available topographic and bathymetric survey data sets spanning the entirety of the Passage Key Inlet complex for estimating the volumetric changes within the cells were limited. Data sets spanning the inlet complex considered in the sediment budget analysis included USACE LiDAR data collected in July 2010 and May 2015 and bathymetric surveys collected in November 2017 (APTIM, 2017). The inlet surveys were supplemented with beach profile surveys collected in October 2009, September 2015 and September 2017. The volumetric estimates within the inlet complex and along Anna Maria Island were adjusted to account for the borrow area dredging and sand placement quantities that occurred between surveys.

**Figure 5** presents the two sediment budgets developed to represent the movement of sand during the time periods between 2010 and 2015 (left panel) and between 2015 and 2017 (right panel). These time periods were chosen based on the available inlet survey data to evaluate the influence of the Passage Key Inlet complex with respect to the periodic cycle of accretion (2010 to 2015) and erosion (2015 to 2017) at the north end of Anna Maria Island.

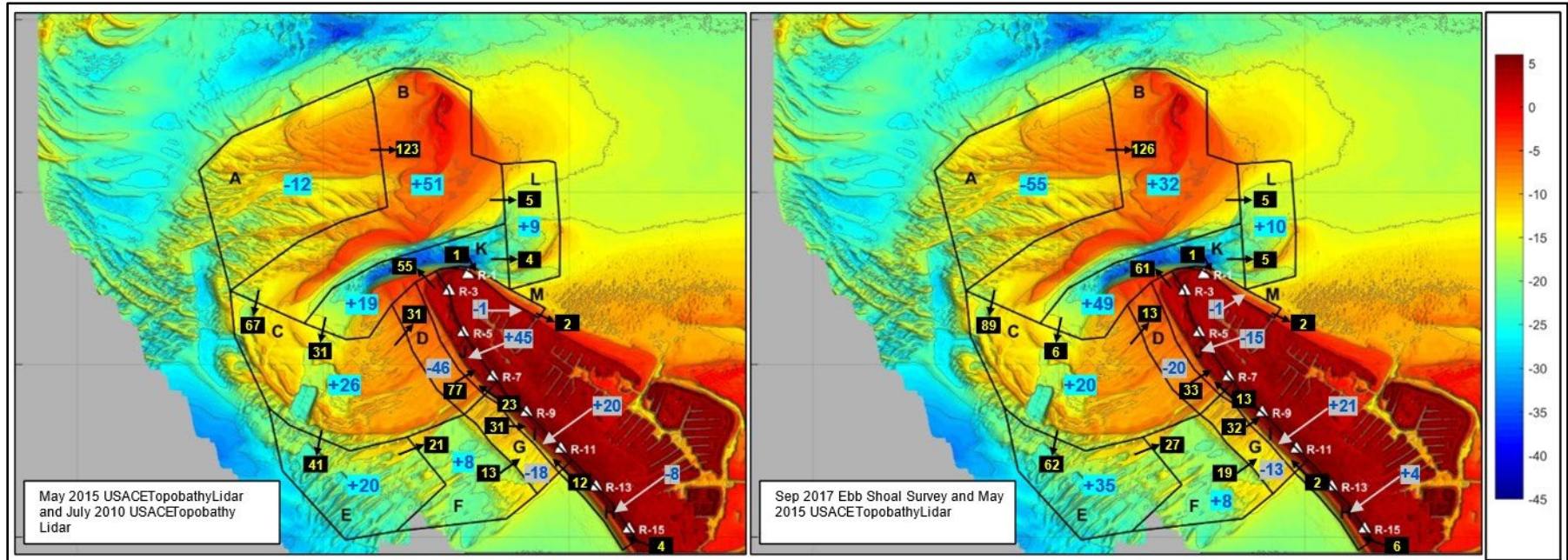


Figure 5. Passage Key Inlet sediment budgets for 2010-2015 (left panel) and 2015-2017 (right panel) (APTIM & CPE, 2023).

APTIM & CPE (2023) discusses the sediment budgets in detail to provide an initial understanding and quantification of the coastal processes influencing the Passage Key Inlet complex. The volumetric changes and derived transport rates presented in the sediment budgets were estimated based on bathymetric, topographic, and LiDAR survey data. Survey equipment and collection techniques have limited levels of accuracy and thus can introduce uncertainty in estimating volumetric changes. Additional data collection and future monitoring are necessary to periodically update the sediment budget and to continually assess the inlet's influence and response to dredging as a sand source. The key finding of APTIM & CPE (2023) is:

“The sediment budget shows that sediment input from the north ranged from 123,000 cubic yards per year between 2010 and 2015 to 126,000 cubic yards per year between 2015 and 2017. The sediment-trapping tendency of the inlet complex governs the net impact of Passage Key Inlet on adjacent beaches. The inlet complex holds a large amount of sand over a vast area and impacts the sediment budget by an estimated 130,000 cubic yards per year. The rate of sediment that is transported from Anna Maria Island back to the inlet was estimated to range from 55,000 cubic yards per year between 2010 and 2015 to 61,000 cubic yards per year between 2015 and 2017.”

Also,

“The inlet complex can support the sediment needs of Anna Maria Island with programmed sustainable dredging. Bypassing on an average annual basis of approximately 130,000 cubic yards per year through periodic dredging as an initial target quantity would help mitigate the effects of Passage Key Inlet on adjacent beaches and balance the sediment budget. Bypassed sediments should be placed along adjacent shorelines based on the need to manage beach erosion and protect upland property and infrastructure.”

Also,

“Periodic nourishment of 1.0-1.3 million cubic yards every 8-10 years is needed to maintain Anna Maria Island and restore regional sediment transport. The Passage Key Inlet ebb shoal has been regularly used as a borrow source for over 20 years at a rate of 250,000-300,000 cubic yards per year without any noticeable impacts.”

### *Inlet Management Alternatives*

The sediment budget analysis indicates that Passage Key Inlet acts as a sediment sink, which impacts the beaches of Anna Maria Island. To mitigate these impacts, there is a need to bypass inlet sediments to the critically eroded beaches by an estimated volume of 130,000 cubic yards per year. Based on the 2015 LiDAR survey, the inlet's ebb shoal contains approximately 17

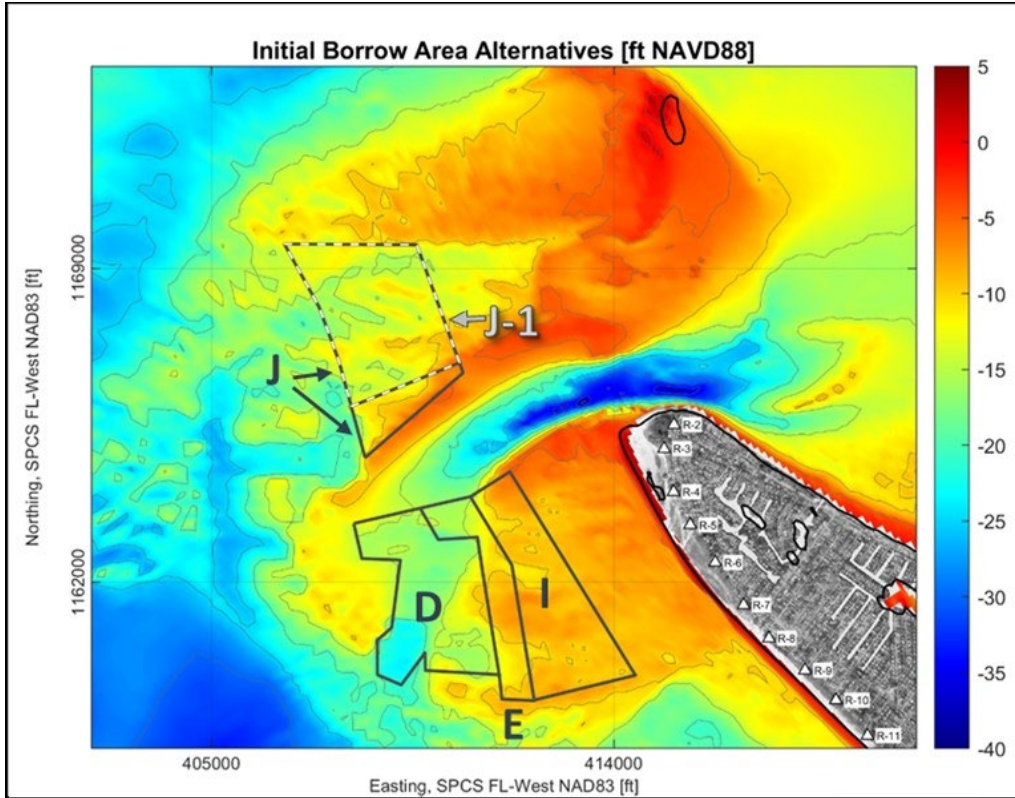


million cubic yards of sand above the -18-foot contour. A bypassing target of 130,000 cubic yards per year represents roughly one percent of the total ebb shoal volume.

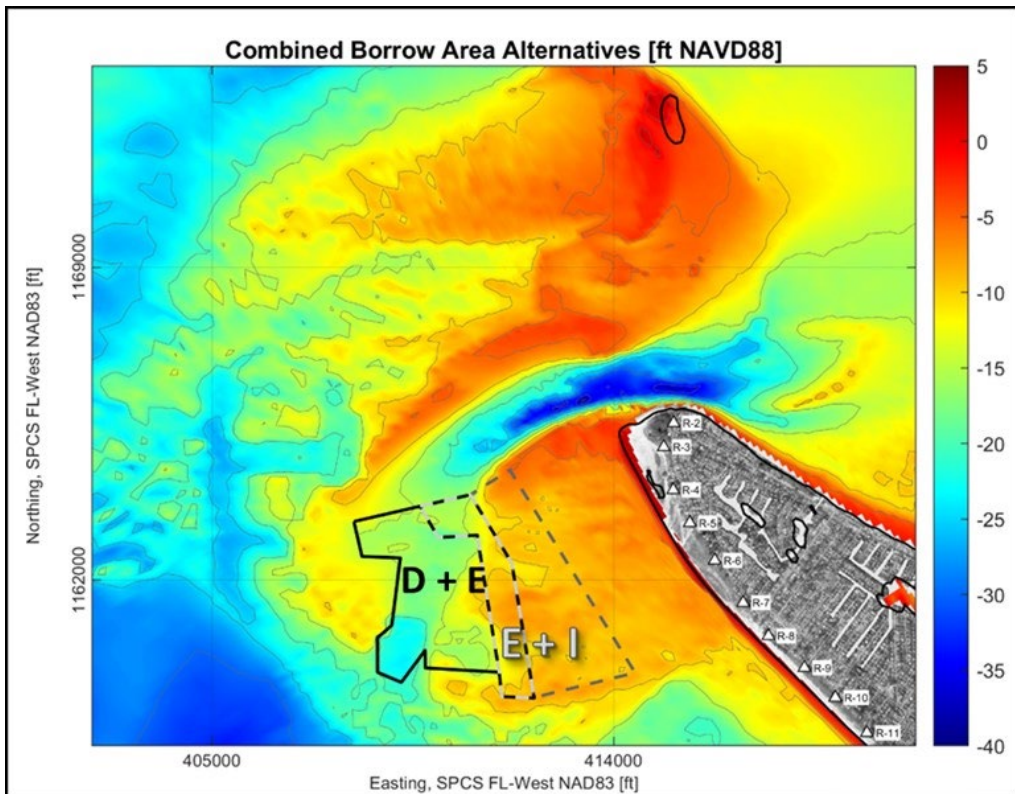
APTIM & CPE (2023) conducted a numerical modeling study of the Passage Key Inlet system and northern Anna Maria Island utilizing a Delft3D model, which is a state-of-the-art hydrodynamic and sediment transport model that allows for the simulation of effects of various alternatives. The analysis is described in a separate document in Appendix F – Numerical Modeling Report.

The calibrated Delft3D model was utilized to evaluate the various borrow area and placement alternatives. A total of eleven borrow area alternatives were developed and modeled under five years of average conditions. A “No Action” scenario, also referred to as the “status quo” or “existing conditions,” was the baseline scenario used to compare with all the borrow area alternatives. The alternatives were evaluated for use as a long-term sediment source while minimizing potential adverse impacts to adjacent shorelines. The borrow areas infilling rates were calculated to estimate re-use, and the effect on waves and erosion/sedimentation patterns within the shoal and adjacent shoreline were evaluated.

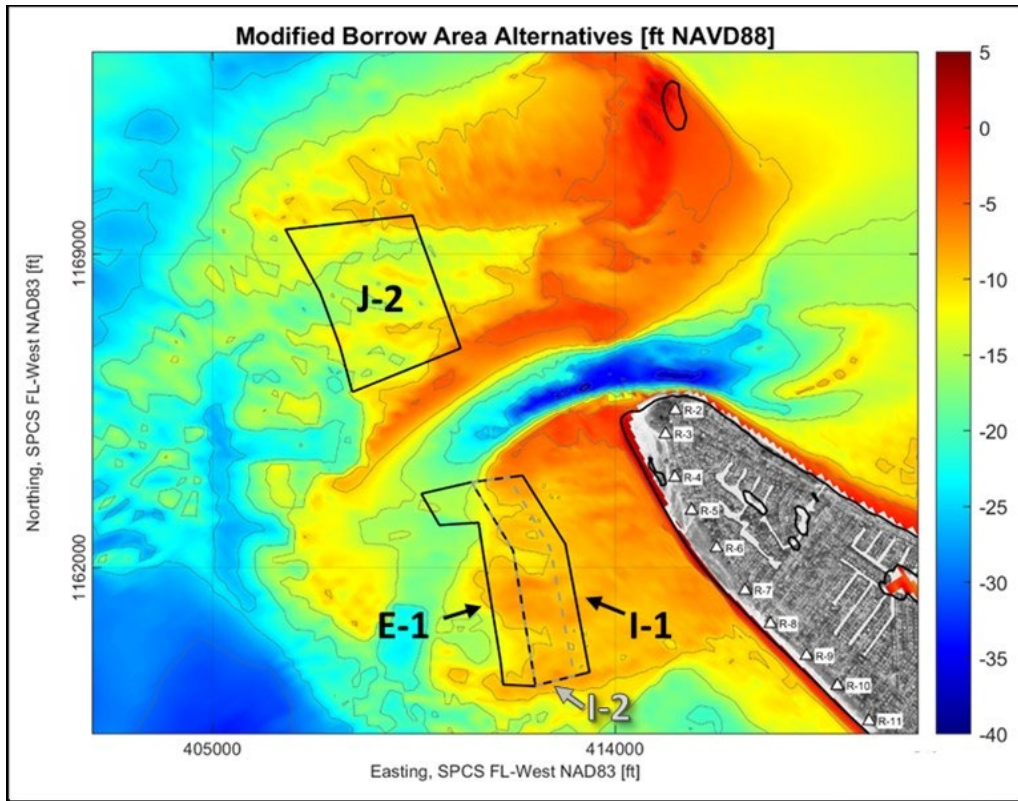
Five initial borrow area alternatives were developed based on previously permitted borrow areas and input from the inlet management study’s technical advisory committee (**Figure 6**). Subsequently two combined alternatives (**Figure 7**) and four modified alternatives (**Figure 8**) were developed.



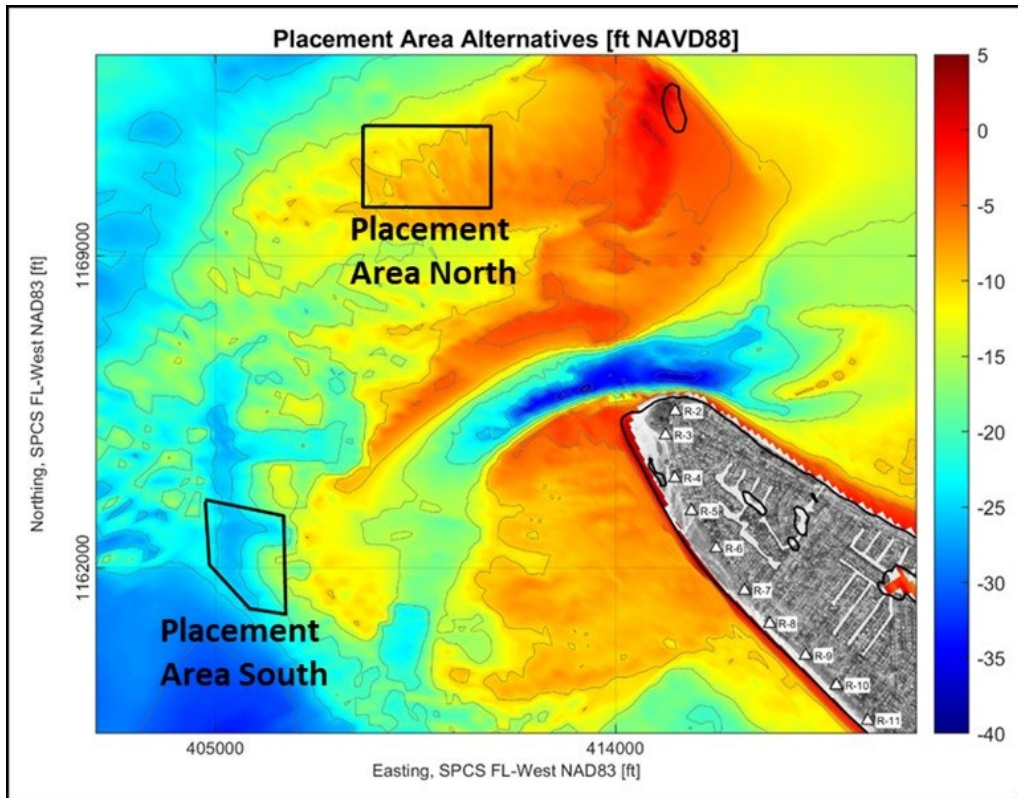
**Figure 6.** Five initial borrow areas: J, J-1, D, E and I.



**Figure 7.** Combined borrow areas: D+E and E+I.



**Figure 8.** Four modified borrow areas: J-2, E-1, I-1 and I-2.



**Figure 9.** Two offshore placement areas, north and south.

Additionally, two sand placement areas were developed based on input from the technical advisory committee during the study and discussion with the USACE on the potential use of Tampa Harbor dredge material to replenish borrow areas within the Passage Key Inlet ebb shoal (**Figure 9**).

**Note:** See chapter 8, pages 39 through 43 within the [inlet management study](#) that better describes the borrow areas and placement areas found in Figure 6 through Figure 9 above.

The results of the study determined that the combined borrow area D+E had an initial dredge volume and a 10-year in-filling rate that exceeded 1.0 million cubic yards with no observed impacts to the shoreline due to waves or morphology changes. This borrow area is recommended as a future primary borrow source. Five borrow area alternatives (D, E, E1, J1 and J2) likewise showed no wave or morphology impacts to the shoreline, but either had dredge volumes or 10-year in-filling rates less than 1.0 million cubic yards. These alternatives are recommended for future use as secondary or emergency borrow area sources. Borrow area alternatives J and I2 are recommended for further refinement and future consideration if necessary as they showed some effects on the shoreline due to waves and morphology changes, and although their projected dredge volume exceeded 1.0 million cubic yards, their 10-year in-filling rate was less than 1.0 million cubic yards. Borrow area alternatives I, I1 and I+E are not recommended for further consideration because they exhibited significant impacts on the shoreline due to high waves and morphology changes, and their 10-year in-filling rate was projected to be less than 1.0 million cubic yards.

The model simulations for the two placement alternatives (**Figure 9**) indicated minimal, or no, shoreline impacts and demonstrated a potential benefit to the overall coastal system. For Placement Area South, differences from the No Action scenario were observed within the ebb shoal, east of the placement area, without reaching the shoreline. In the case of Placement Area North, the most significant effects were near the placement area, with the placed sand moving eastward during the simulation. However, the substantial sediment deposition west of Passage Key acts as a protective barrier against wave action and stabilizes the tendency of the island to migrate eastward compared to the No Action scenario. In all cases, the observed differences were limited to the ebb shoal and did not affect the shoreline of Anna Maria Island.

## ***Recommended Inlet Management Plan Strategies***

The department staff recommends the following inlet management strategies be adopted to meet the requirements of Chapter 161, F.S.

- 1) A comprehensive beach and inlet hydrographic monitoring program shall be conducted** to evaluate the performance and impact of existing sand bypassing and nourishment projects and to periodically update the inlet sediment budget. Beach and nearshore surveys between DEP Reference Monuments R1 to R41.5 shall be conducted. Periodic inlet hydrographic surveys to include the inlet channel and the ebb shoal shall also be conducted. Along with topographic and hydrographic surveys of the inlet system and adjoining beaches, hydraulic monitoring may be conducted to enhance future modeling input data for investigations of inlet management alternatives.

***Discussion*** – A comprehensive beach and inlet hydrographic monitoring program is the most important element to manage the sediment at Passage Key Inlet. Topographic and bathymetric surveys provide reliable data to estimate the volumetric impact of the inlet on adjacent beaches and to establish a sand placement protocol that complies with section 161.142, F.S.

- 2) Sand bypassing shall be performed from the inlet system to the adjacent gulf-fronting beaches to the south of the inlet on Anna Maria Island, principally between DEP Reference Monument R1 and R41.5.** The quantity of material to be bypassed shall be based on available quantities documented through the monitoring protocol of Strategy #1 above and the target bypassing identified in Strategy #3 below.

***Discussion*** – Pursuant to section 161.142, F.S., Anna Maria Island south of Passage Key Inlet is the adjacent eroded beach directly impacted by the inlet system and is a proximate beach restoration project in need of periodic nourishment.

- 3) On an average annual basis, the initial target inlet sand bypassing quantity shall be 130,000 cubic yards per year to the south.** This target quantity may be modified or updated based on a minimum of five years of additional monitoring data indicating a change in the sediment budget.

**Discussion** – The recent sediment budget indicates a need to place an estimated annual quantity of approximately 130,000 cubic yards of sand on the eroded beaches south of the inlet to account for the inlet’s impact. Additional sand may be placed that is obtained from acceptable offshore sources or inland sand mines.

**4) The primary source of sediment for meeting the target sand bypassing quantities in Strategy #3 shall be the Passage Key Inlet ebb shoal borrow area identified as D+E in the inlet management study, or as otherwise authorized by permit.**

Secondary or emergency borrow area sources may utilize the ebb shoal borrow areas identified as D, E, E1, J1 and J2. Acceptable beach quality sand may also be obtained from inland sand mines or offshore sources to achieve the target sand bypassing quantities.

**Discussion** – The results of the inlet management study determined that the combined borrow area D+E had an initial dredge volume and a 10-year in-filling rate that exceeded 1.0 million cubic yards with no observed impacts to the shoreline due to waves or morphology changes. Five borrow area alternatives (D, E, E1, J1 and J2) likewise showed no wave or morphology impacts to the shoreline, but either had dredge volumes or 10-year in-filling rates less than 1.0 million cubic yards.

**5) The placement of sand from material dredged from Tampa Harbor or other acceptable sources may be used as a management approach for increasing sediment supply in the Passage Key Inlet ebb shoal.** The North Placement Area evaluated in the inlet management study shall be prioritized for sand placement to mitigate the critical erosion conditions at Passage Key pending further development and coordination.

**Discussion** – The shoal placement alternatives evaluated in the inlet management study indicated no adverse impacts on the adjacent shorelines and the placement of sand would increase the borrow area material available for bypassing to adjacent beaches. Material added to the North Placement Area formed a protective barrier against wave action and stabilized the tendency of critically eroded Passage Key to migrate eastward. Further engineering design refinement and permitting should be undertaken to optimize the use of this approach in collaboration with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

## ***References***

APTIM and CPE, 2023. [Inlet Management Study of Passage Key Inlet and Adjacent Beaches](#), p. 62 plus appendices.

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