

THE INLET MANAGEMENT STUDY OF PASSAGE KEY INLET AND ADJACENT BEACHES

Morjana Signorin, MSc, Coastal Protection Engineering (CPE)

Co-Authors:

Charlie Hunsicker, Manatee County

Thomas Pierro, PE, DCE, Coastal Protection Engineering (CPE)

Doris Otero, PhD, APTIM



FLORIDA SHORE & BEACH
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A League of Cities and Counties on Beach and Coastal Issues

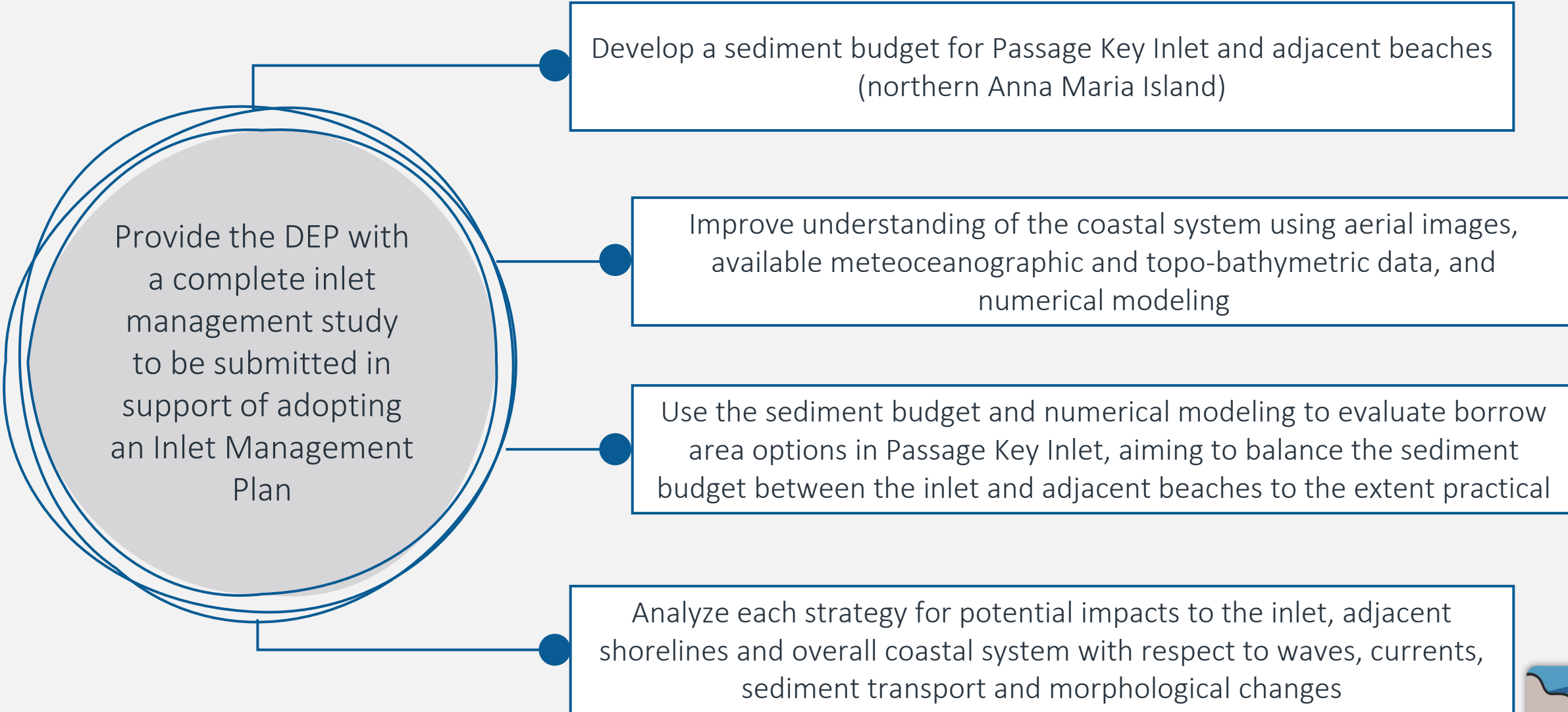
37th Annual National Conference on Beach Preservation Technology
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PROJECT LOCATION



STUDY OBJECTIVES AND APPROACH



Provide the DEP with a complete inlet management study to be submitted in support of adopting an Inlet Management Plan

Develop a sediment budget for Passage Key Inlet and adjacent beaches (northern Anna Maria Island)

Improve understanding of the coastal system using aerial images, available meteoceanographic and topo-bathymetric data, and numerical modeling

Use the sediment budget and numerical modeling to evaluate borrow area options in Passage Key Inlet, aiming to balance the sediment budget between the inlet and adjacent beaches to the extent practical

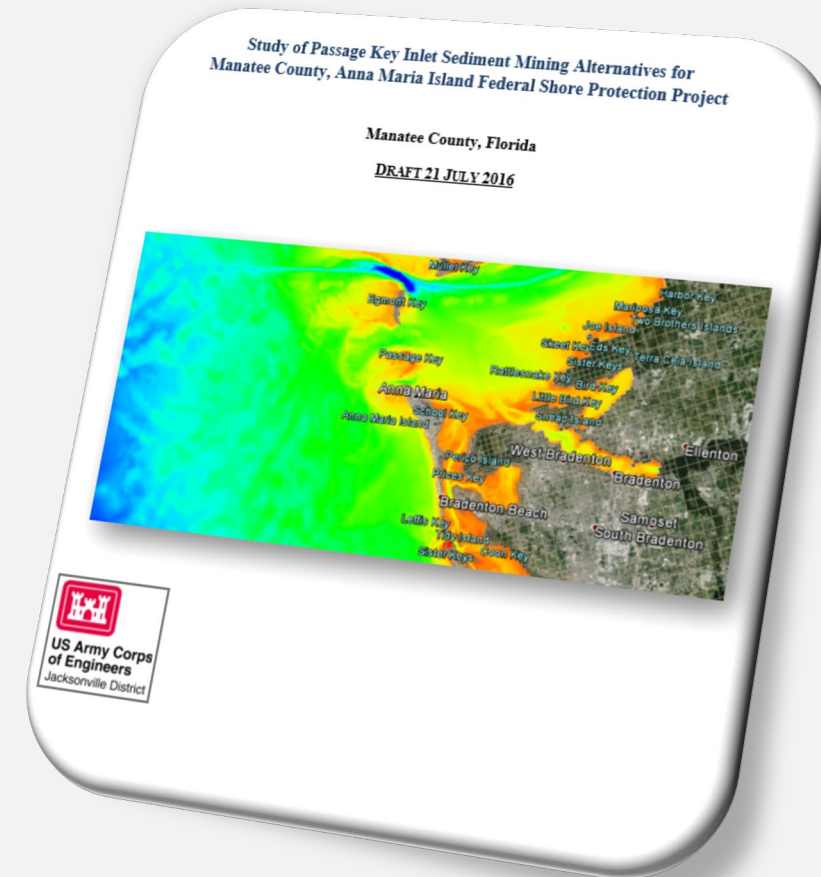
Analyze each strategy for potential impacts to the inlet, adjacent shorelines and overall coastal system with respect to waves, currents, sediment transport and morphological changes

PHASE I: USACE STUDY

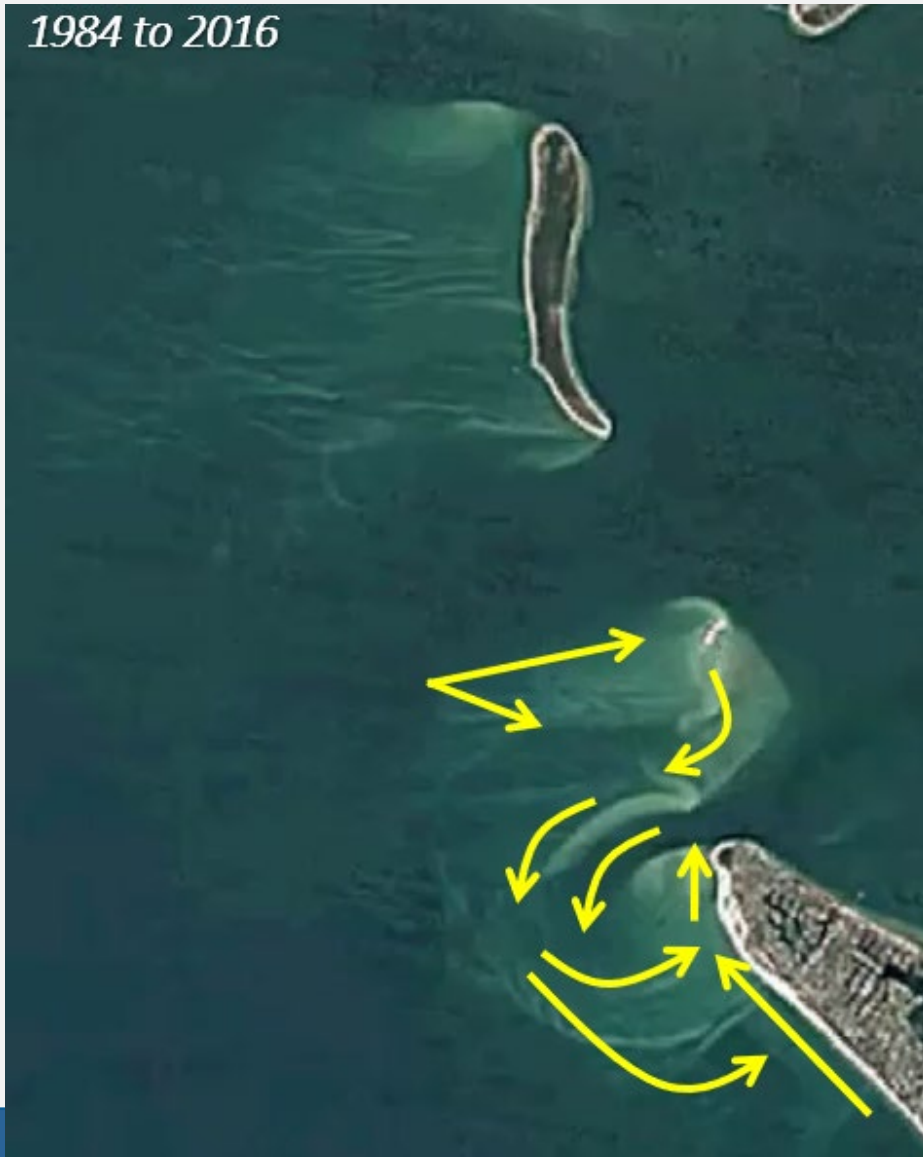
- Coastal Modeling System (CMS) short-term modeling simulations (11 months) to evaluate potential borrow areas in the ebb shoal
- A total of 7 alternatives were simulated and compared to the no action

PHASE II

- This IMS is the Phase II study, which involved assessing feasible concepts through Delft3D modeling, focusing on sustainability, re-use (infilling rates), and the long-term impacts on waves and morphology
- A Technical Advisory Committee (TAC) was established, and 3 meetings were conducted during the project



REGIONAL COASTAL HISTORY & MORPHOLOGY



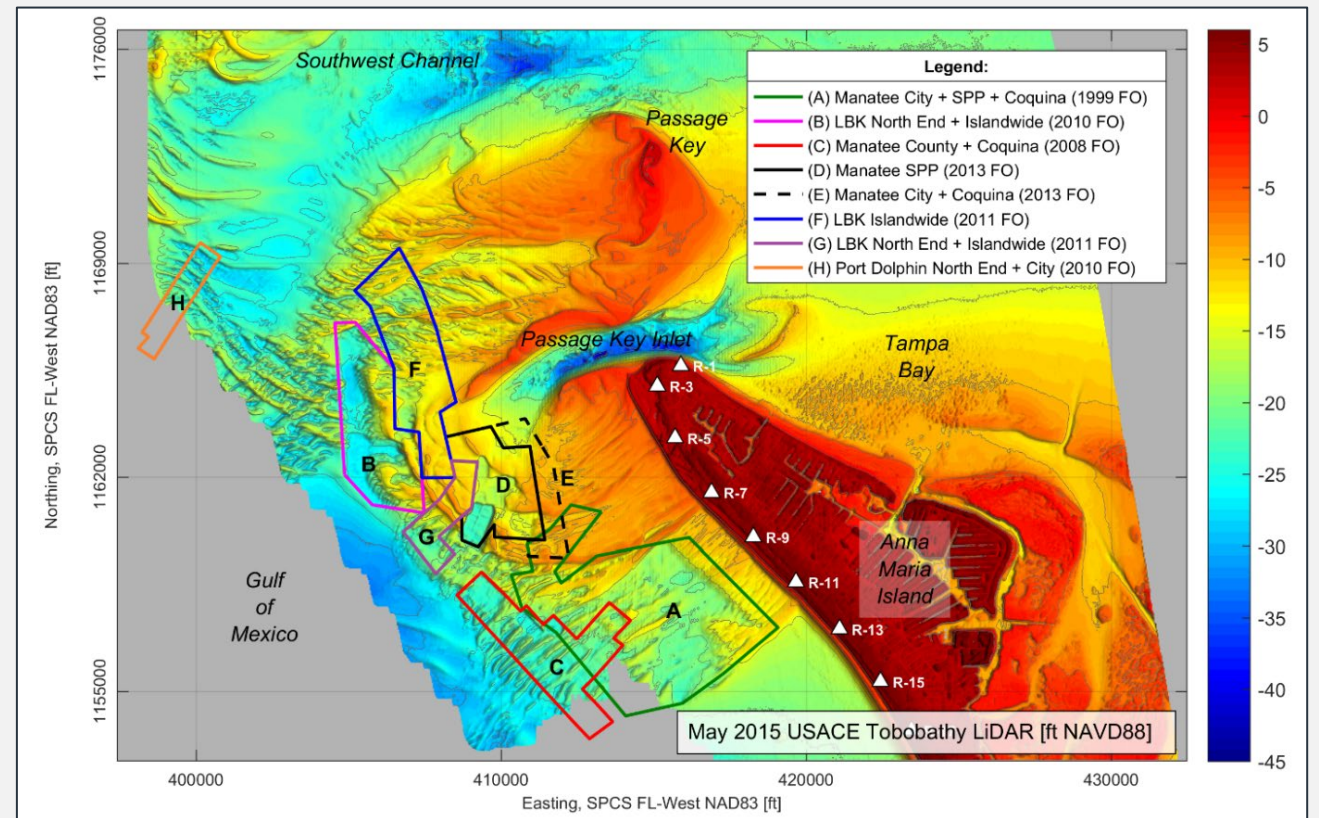
PASSAGE KEY & PASSAGE KEY INLET

- Passage Key is an uninhabited, ephemeral, morphologically dynamic island
- Passage Key Inlet is a natural, unstructured, unmaintained inlet that provides navigation access to shallow-draft vessels
- ~17M cy above -18 feet, NAVD (May 2015 LiDAR)
- Circulation pattern: north transport moves sand back toward pass and prevents bypassing to the southern portion of the island
- Onshore movement of sand to the north end of AMI with a 20-year cycle of erosion/accretion

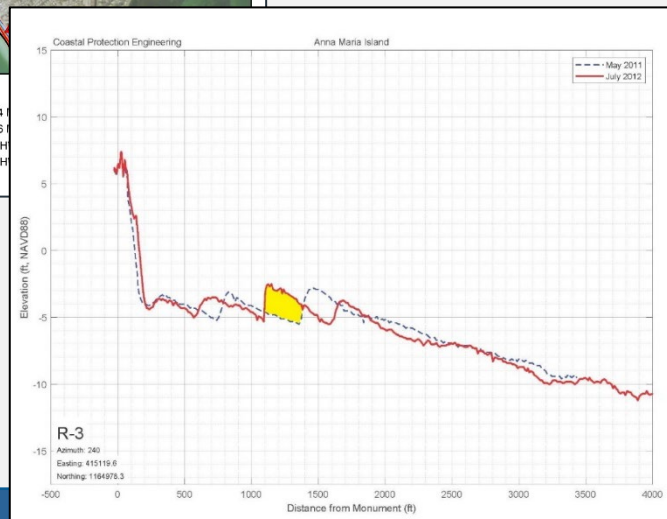
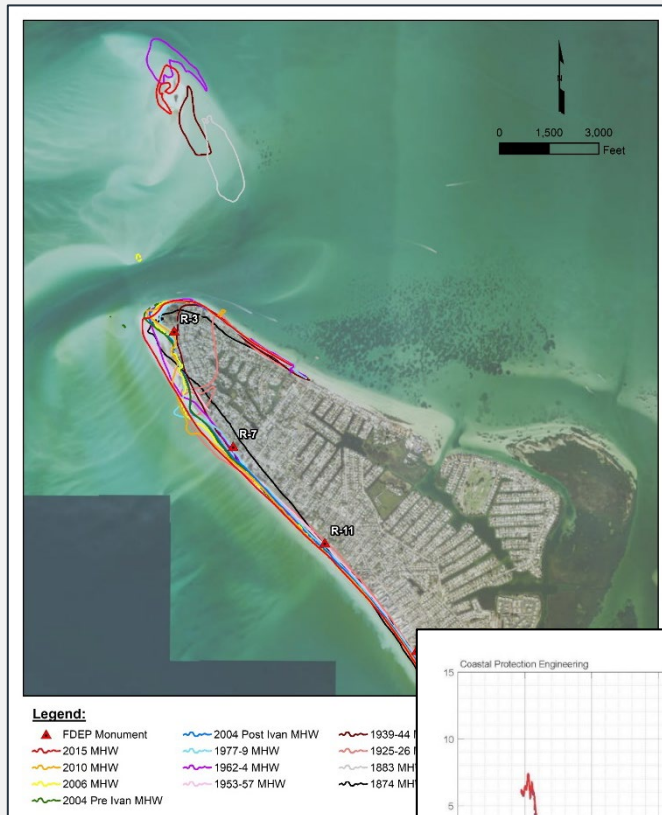
REGIONAL COASTAL HISTORY & MORPHOLOGY

PASSAGE KEY INLET AS SAND SOURCE

- Several borrow areas permitted for beach nourishment projects since 2002
- Used on beach nourishment projects on Anna Maria Island and Longboat Key
- Approximately 5.8M cy dredged from permitted borrow areas from 2002- 2022:
 - 82% to Anna Maria Island
 - 18% to Longboat Key



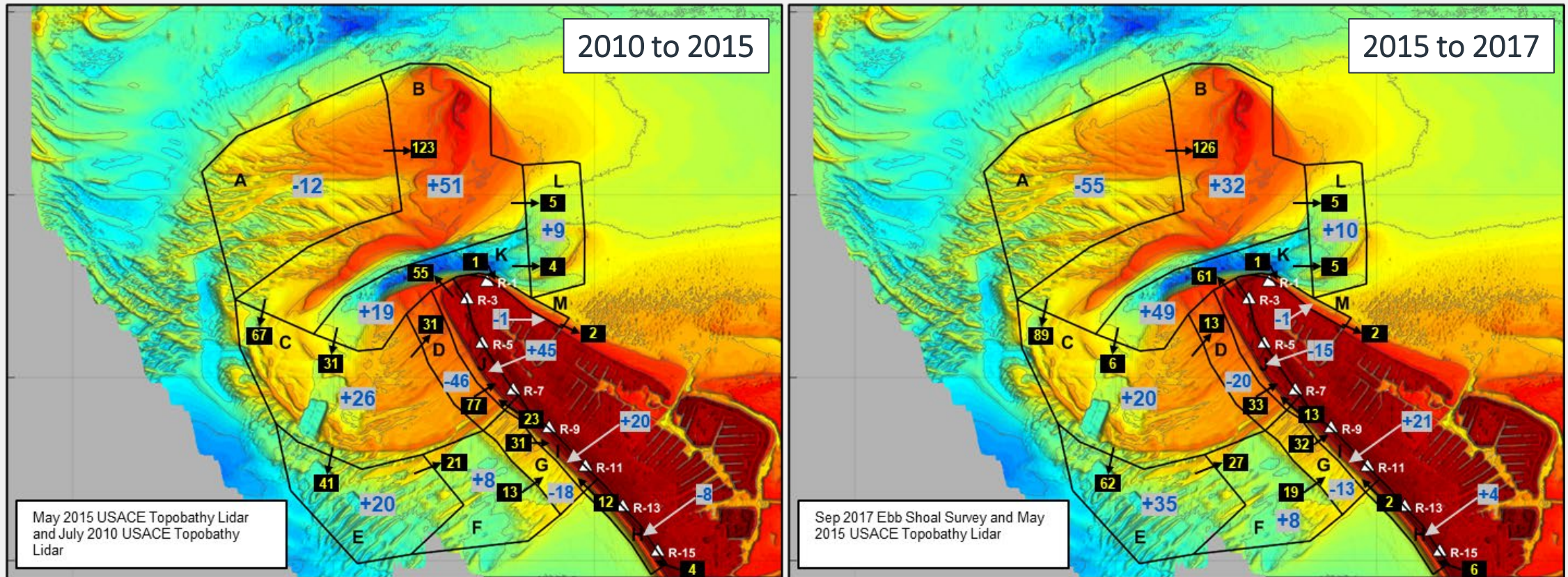
REGIONAL COASTAL HISTORY & MORPHOLOGY



ANNA MARIA ISLAND

- Numerous shore protection projects over the years, including structural shoreline stabilization in the southern end of the island
- Since 1992 beach nourishment has been the primary method of stabilizing the island's beaches (~6.2M cy placed since 1992)
- Onshore sediment transport in the north end with shorter-term periodic cycles of erosion/accretion (~20-yr cycle) correlated with the inlet dynamics
- Circulation patterns create a nodal zone near the center of the island

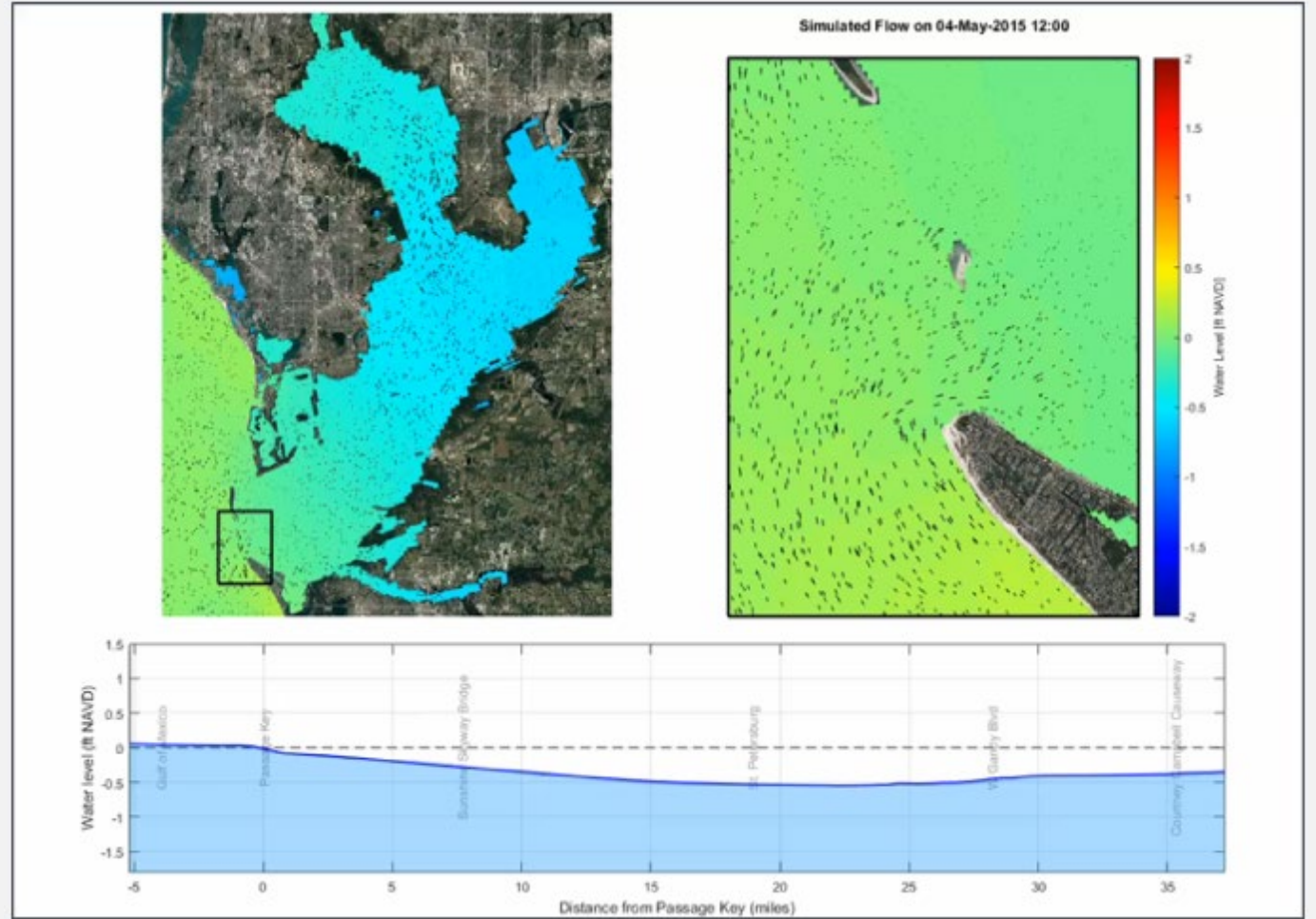
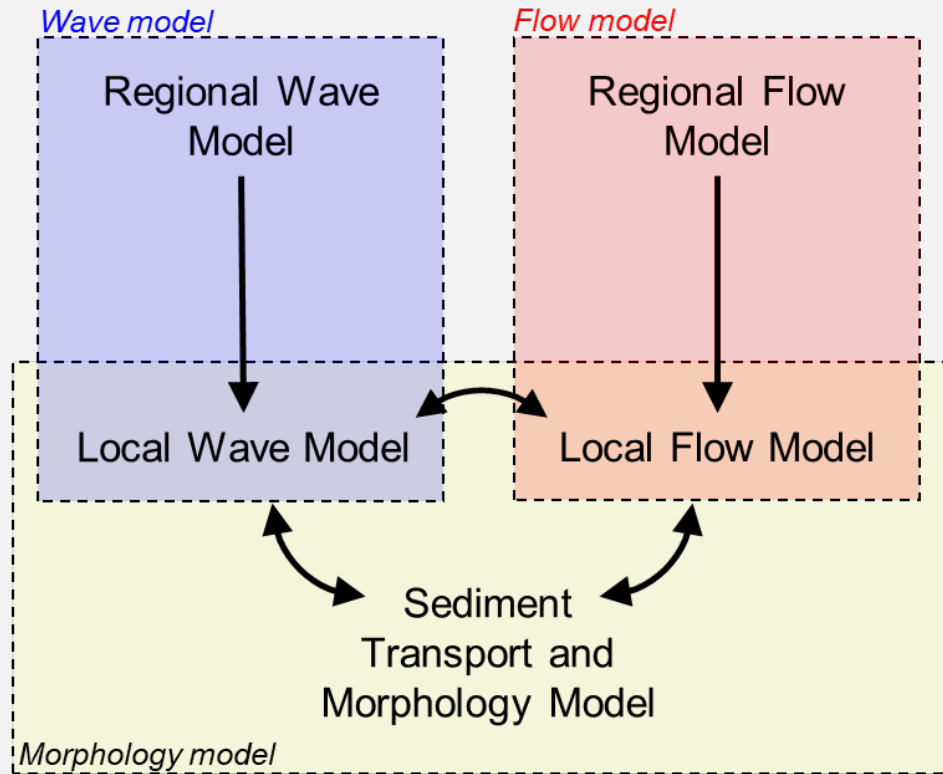
SEDIMENT BUDGET



- Two time periods represent a range of trends for inlet dynamics
- Net change in inlet and shoals (excluding beach cells) ~ 99k to 121k cy/yr
- Net impact to coastal system (including beach cells) ~ 127k to 132k cy/yr

NUMERICAL MODELING ASSESSMENT

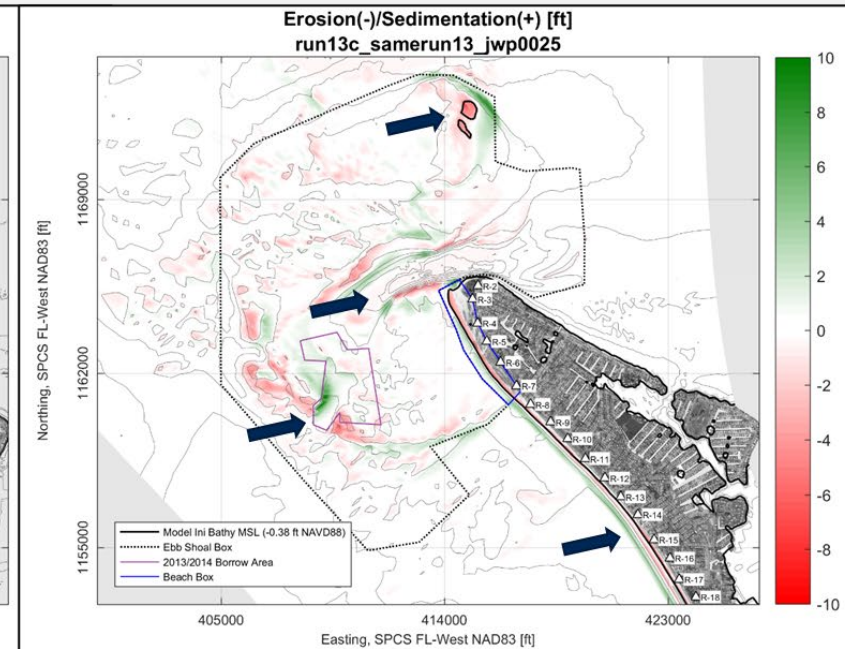
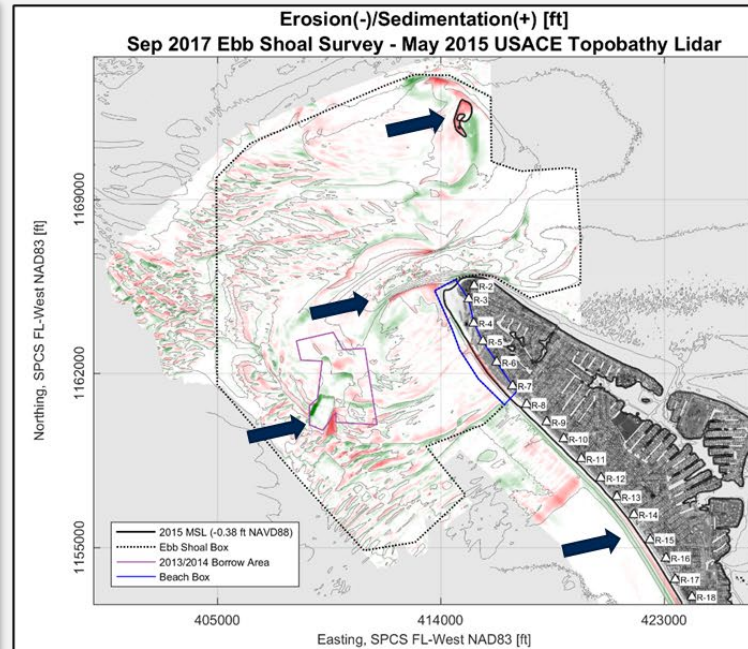
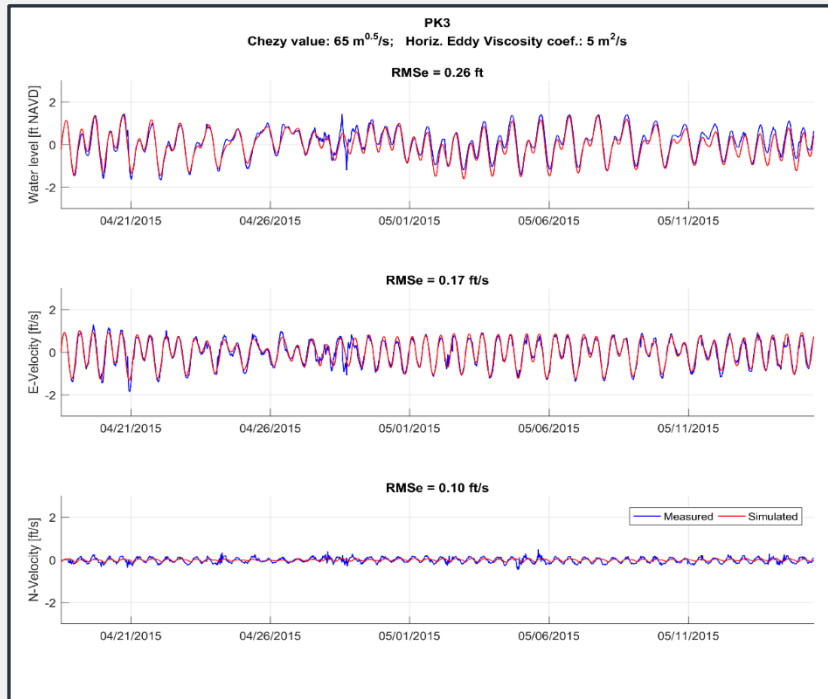
Modeling Approach → Delft3D,
nested regional and local grids



NUMERICAL MODELING ASSESSMENT

Model Calibration

- Hydrodynamic and wave calibration: USACE data collected between April 18, 2015, and May 19, 2015 (4 ADCPs).
- Morphology calibration: comparison with measured data (2015 to 2017).



ALTERNATIVES DEVELOPMENT

01

Initial Borrow Area Alternatives

5 alternatives were developed based on previously permitted borrow areas and input from TAC and Phase I study

02

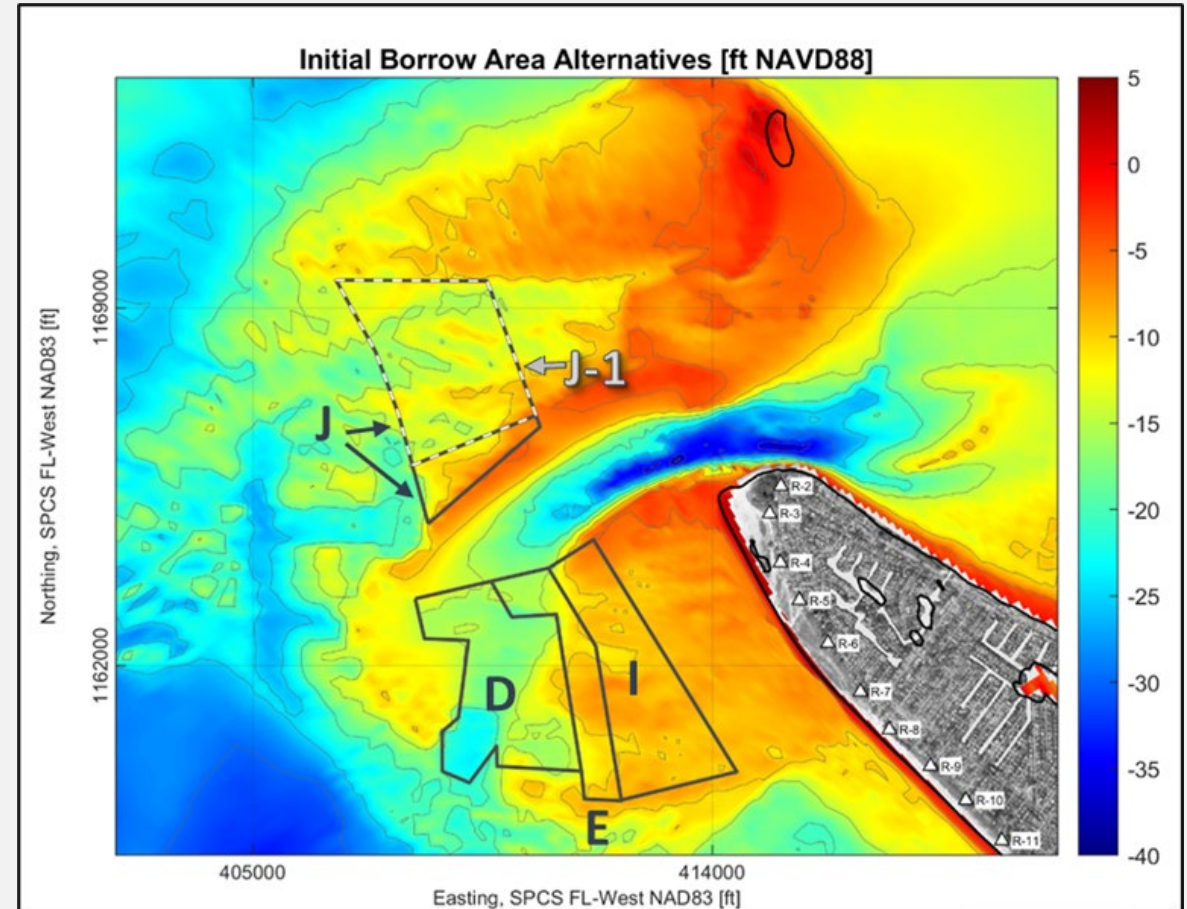
Combined Borrow Area Alternatives

2 combined alternatives were developed based on the outcomes of the initial alternatives

03

Modified Borrow Area Alternatives

5 modified alternatives were developed based on the outcomes of the initial alternatives



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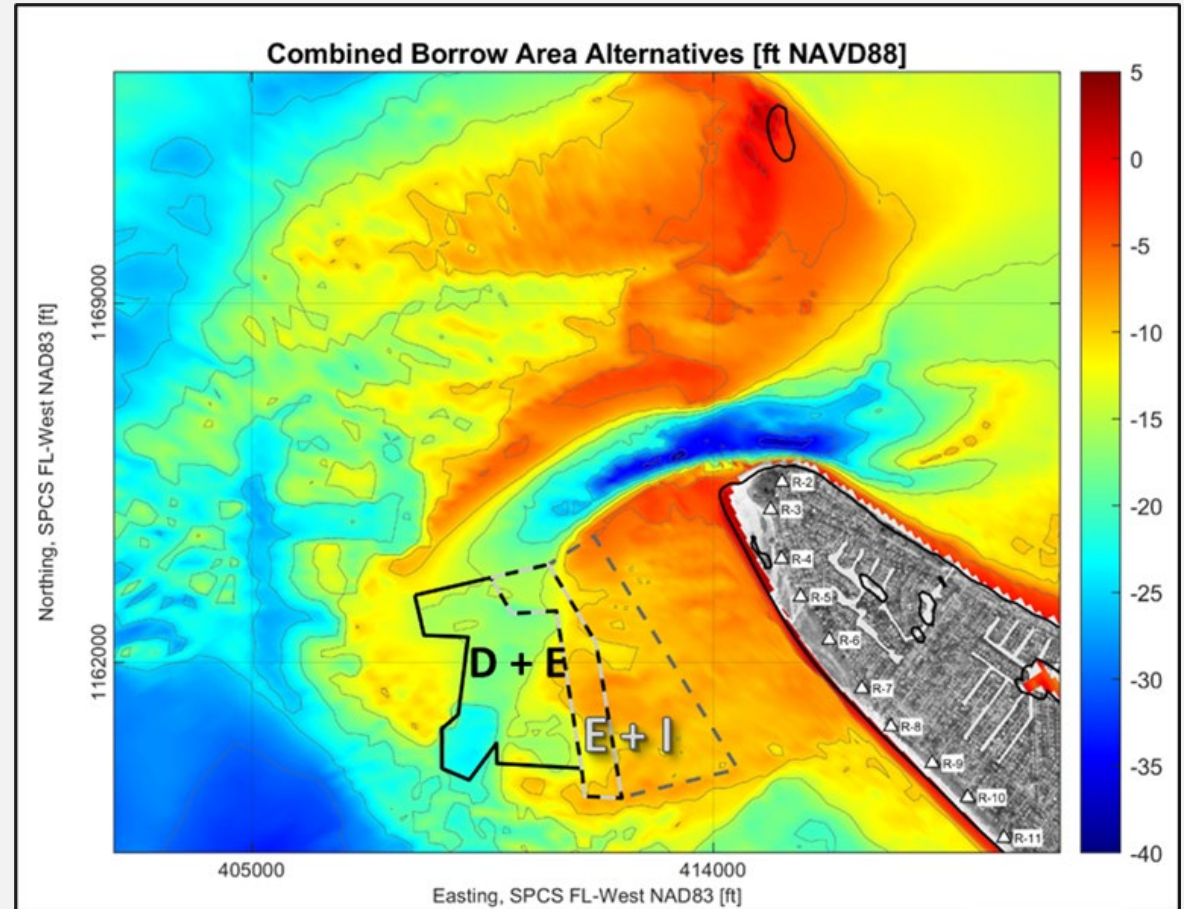
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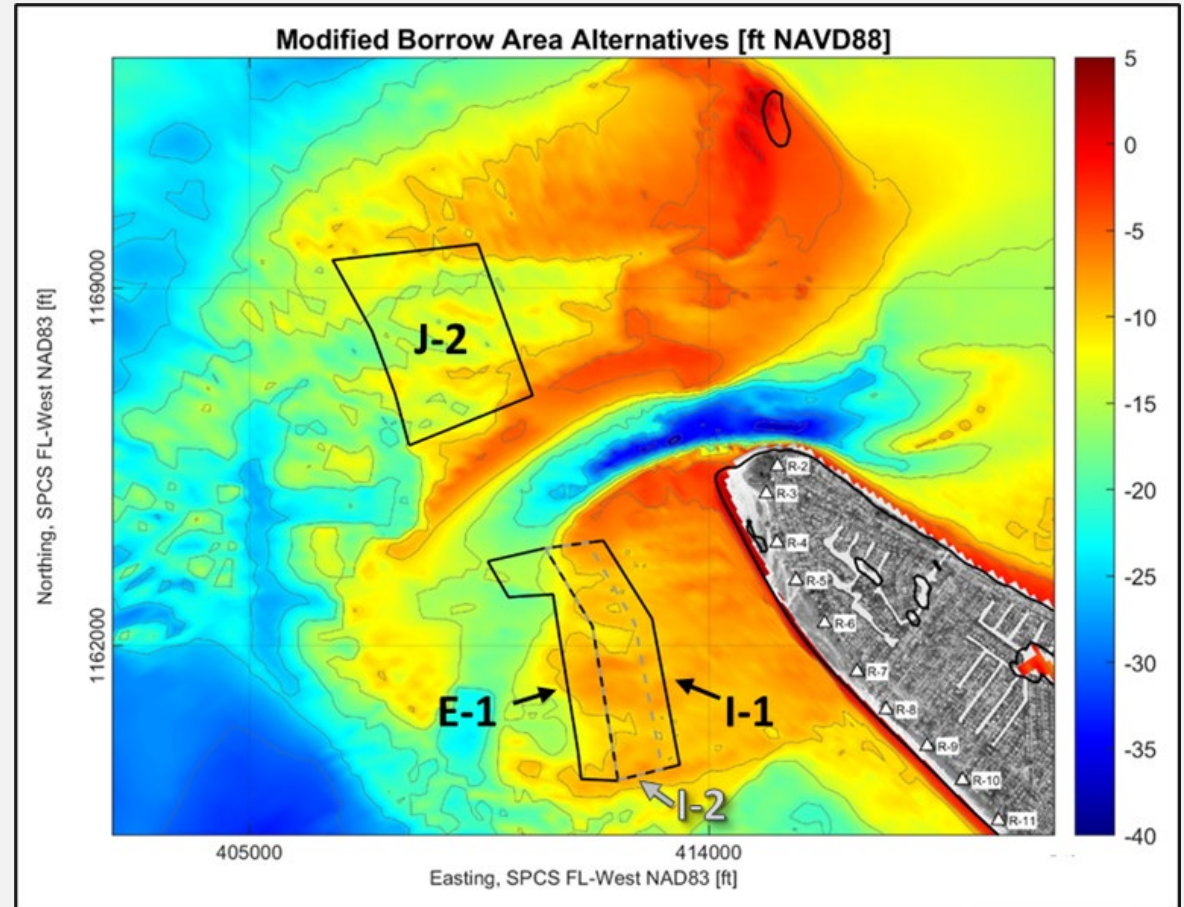
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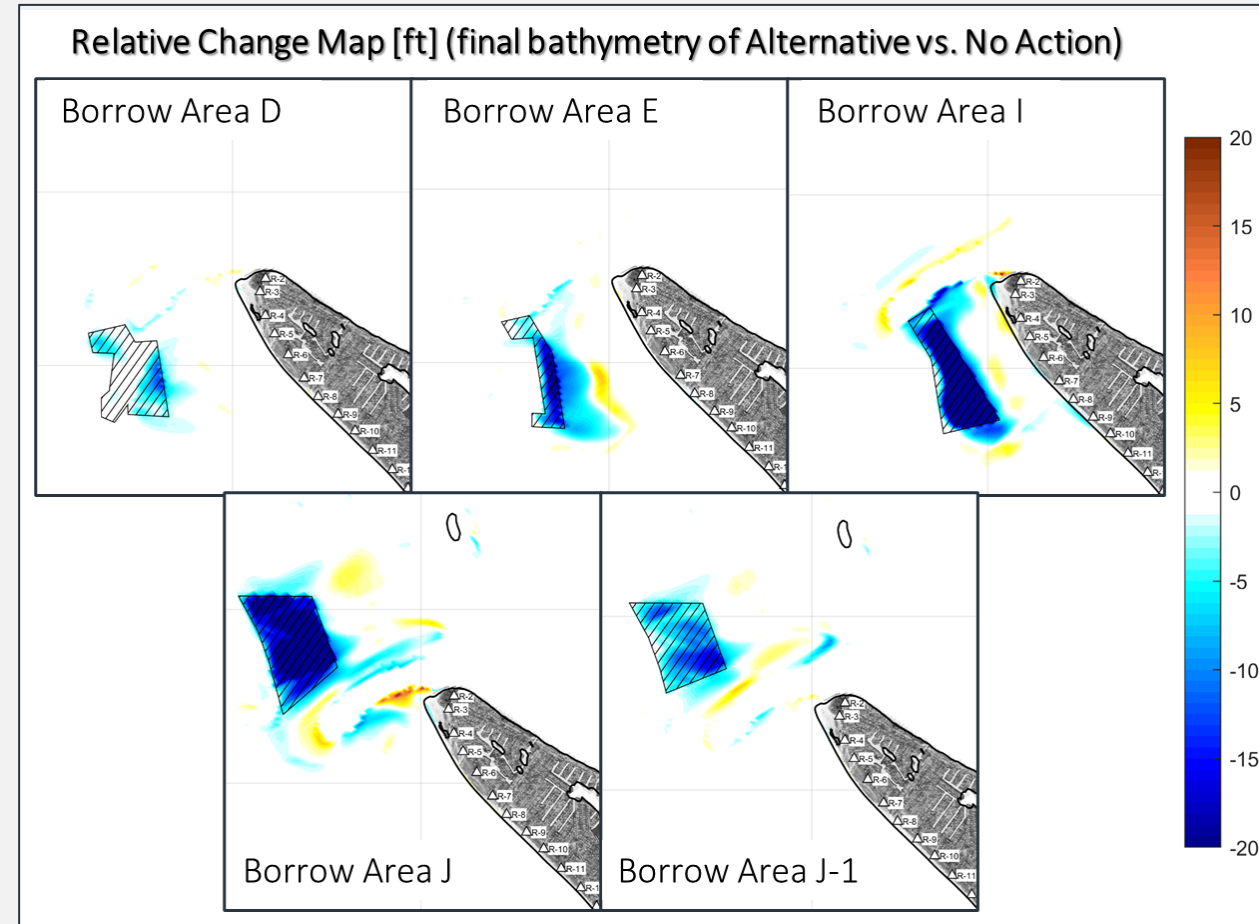
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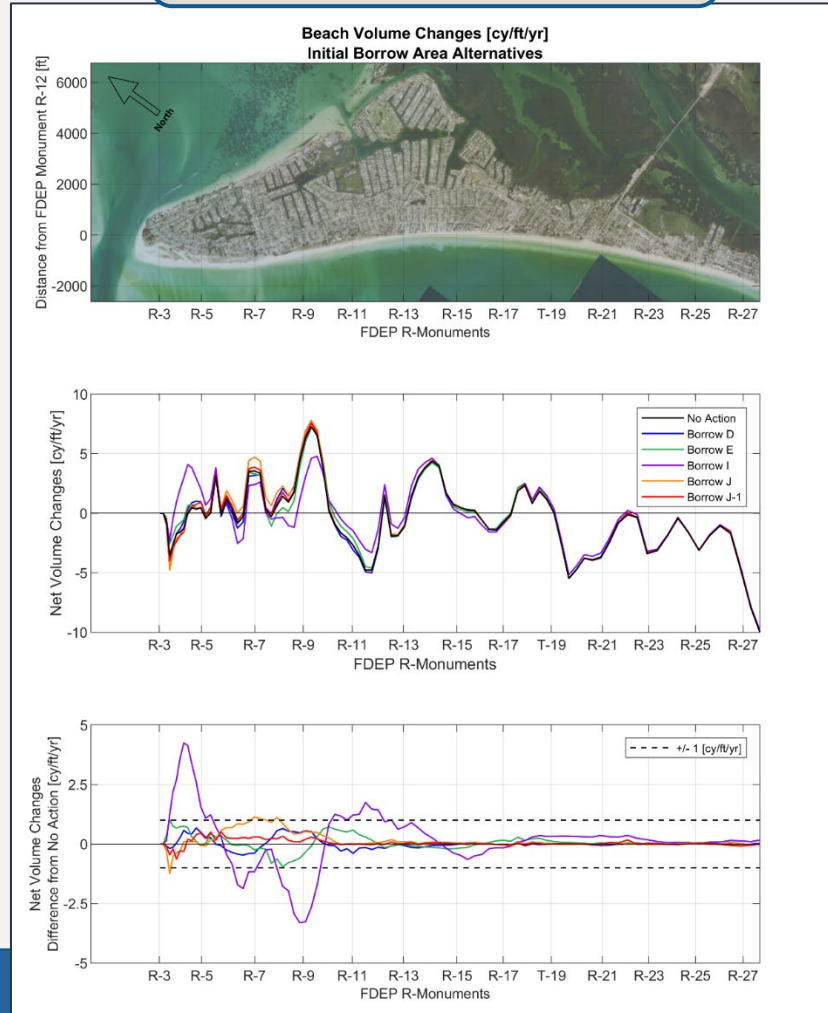
BORROW AREA ALTERNATIVES ANALYSES

- Alternatives simulated for 5 years (results extracted after 1, 3 and 5 years)
- “No Action” baseline for comparison
- Alternatives evaluation based on quantitative and qualitative analyses:
 - Waves and morphology impacts within the shoal and adjacent shoreline
 - Volume and longshore transport changes in northern Anna Maria Island
 - Initial dredging volume (based on the 2021 inlet survey)
 - Borrow areas infilling rates to estimate re-use

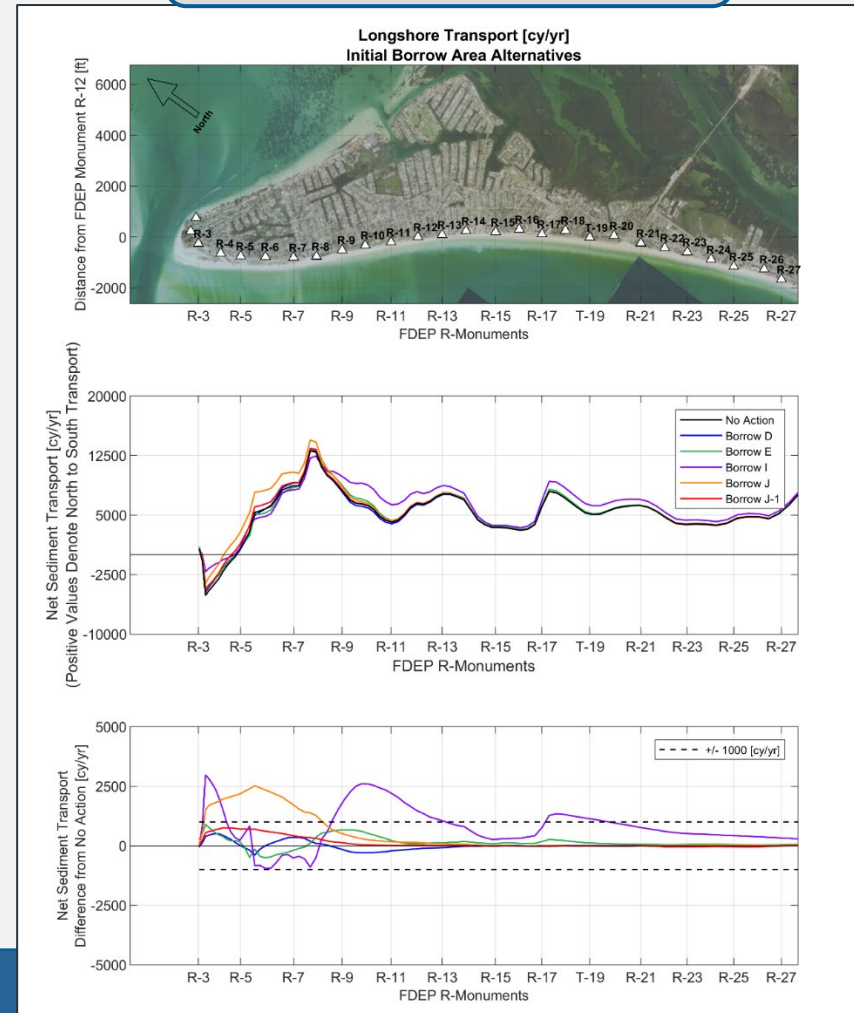


BORROW AREA ALTERNATIVES ANALYSES

Volume Changes



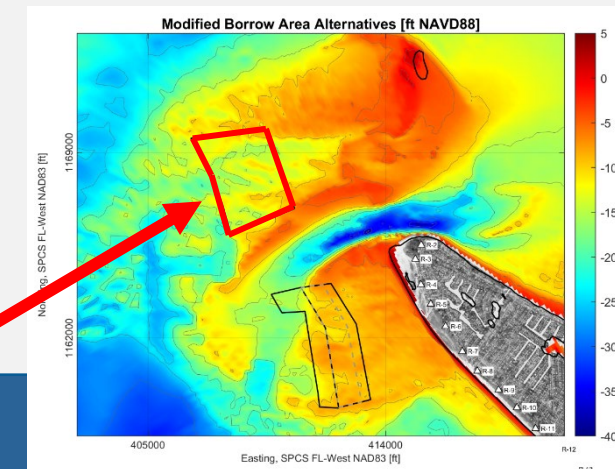
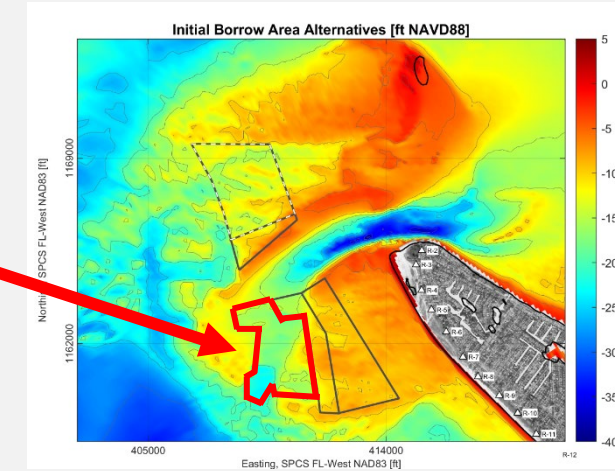
Longshore Transport



BORROW AREA ALTERNATIVES ANALYSES

Initial Dredging and Infilling Volumes [cy]

Alternatives	Initial Dredging [cy]	Infilling Volume [cy] After				
		1 Year (modeled)	3 Years (modeled)	5 Years (modeled)	10 Years (projected)	
Initial	Borrow D	358,000	100,000	328,000	554,000	1,168,000
	Borrow E	776,000	68,000	144,000	178,000	284,000
	Borrow I	2,199,000	121,000	303,000	446,000	794,000
	Borrow J	2,578,000	88,000	199,000	285,000	478,000
	Borrow J-1	903,000	41,000	100,000	143,000	250,000
Combined	Borrow D + Borrow E	1,069,000	140,000	403,000	641,000	1,244,000
	Borrow E + Borrow I	2,895,000	112,000	244,000	333,000	543,000
Modified	Borrow E-1	586,000	70,000	143,000	162,000	250,000
	Borrow I-1	1,649,000	108,000	276,000	403,000	724,000
	Borrow I-2	1,169,000	101,000	258,000	375,000	676,000
	Borrow J-2	1,335,000	53,000	130,000	185,000	325,000



BORROW AREA ALTERNATIVES ANALYSES

- Definition of a multi-level matrix based on two criteria:
 1. Initial dredging, and/or 10-yr infilling volume of ~1,000,000 cy
 2. Coastal process effects on Anna Maria Island

Level 1

- Meet the initial dredging/10-yr infilling criteria
- No/low coastal process effects

→ Recommend for future use as primary source

Level 2

- Don't fully meet the initial dredging/10-yr infilling criteria
- No/low coastal process effects

→ Recommended for future use as secondary or emergency source

Level 3

- Meet the initial dredging/10-yr infilling criteria
- Potential coastal process effects

→ Recommended for refinement and reserved for future consideration

Level 4

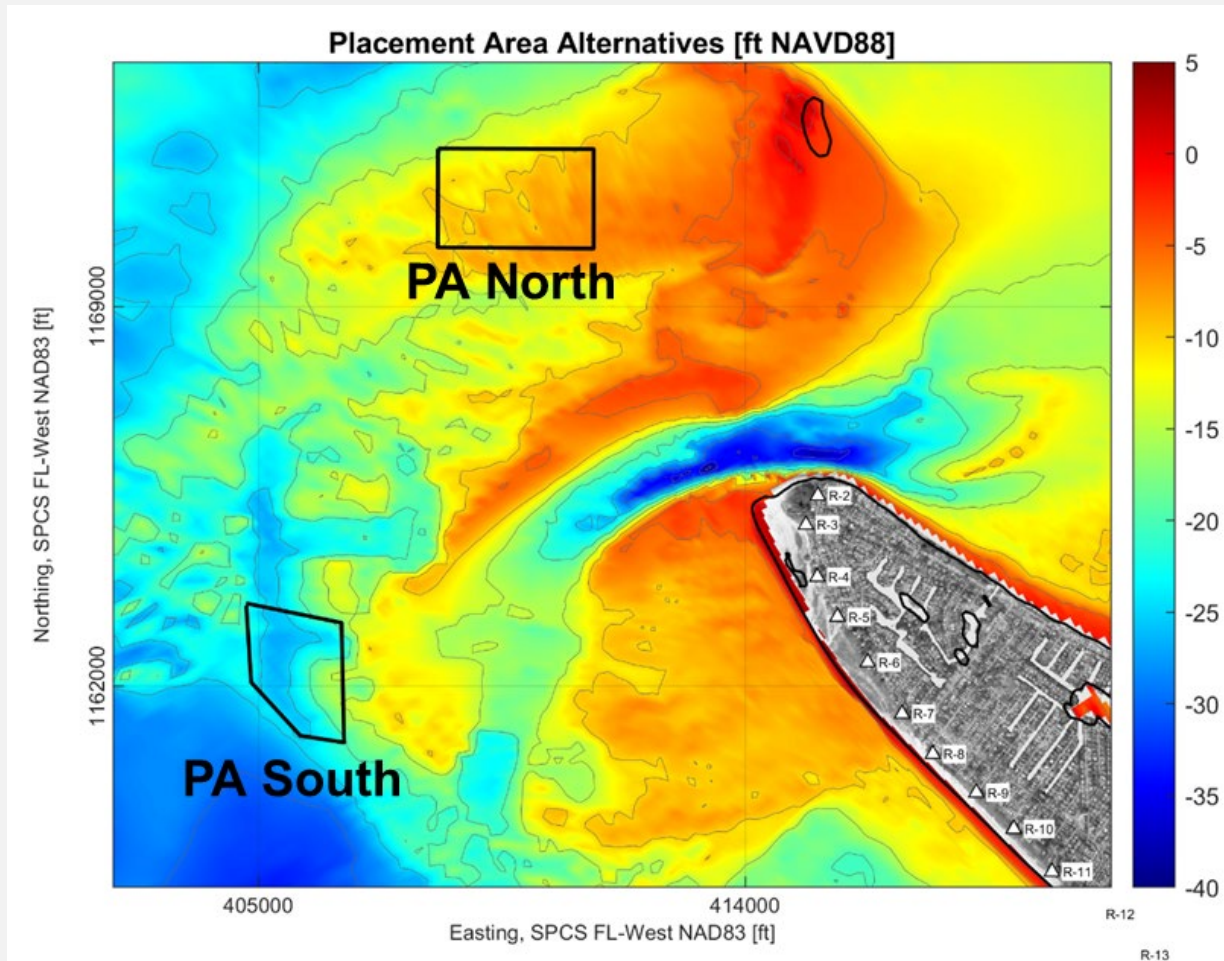
- Don't fully meet the initial dredging/10-yr infilling criteria
- Significant coastal process effects

→ Not recommended for future analysis

BORROW AREA ALTERNATIVES ANALYSES

Alternatives		Initial Dredging Higher Than 1M cy	10-Year Infilling Higher Than 1M cy	Potential for Coastal Process Effects	Borrow Area Classification Levels
Initial	Borrow D	No	Yes	Low	Level 2
	Borrow E	No	No	Low	Level 2
	Borrow I	Yes	No	High	Level 4
	Borrow J	Yes	No	Medium	Level 3
	Borrow J-1	No	No	Low	Level 2
Combined	Borrow D + Borrow E	Yes	Yes	Low	Level 1
	Borrow E + Borrow I	Yes	Yes	High	Level 4
Modified	Borrow E-1	No	No	Low	Level 2
	Borrow I-1	Yes	No	High	Level 4
	Borrow I-2	Yes	No	Medium	Level 3
	Borrow J-2	Yes	No	Low	Level 2

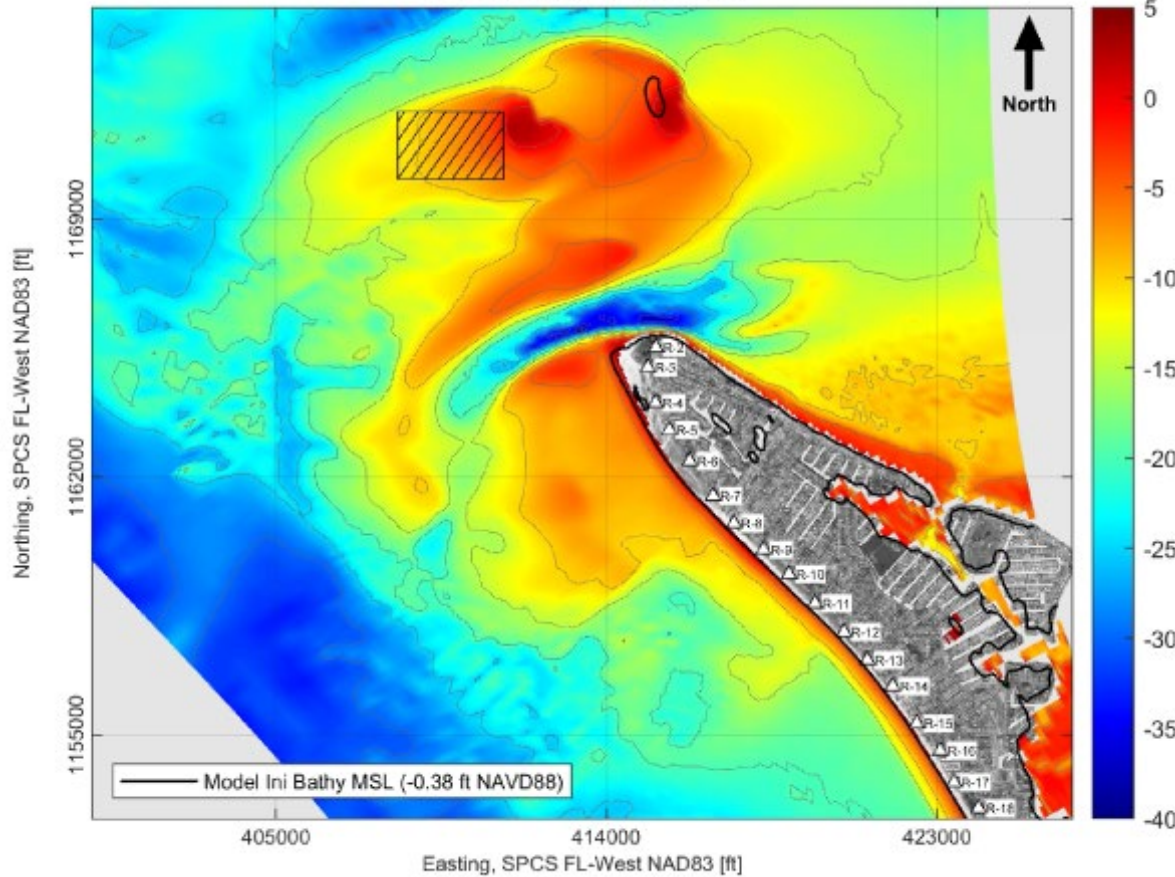
PLACEMENT AREA ALTERNATIVES



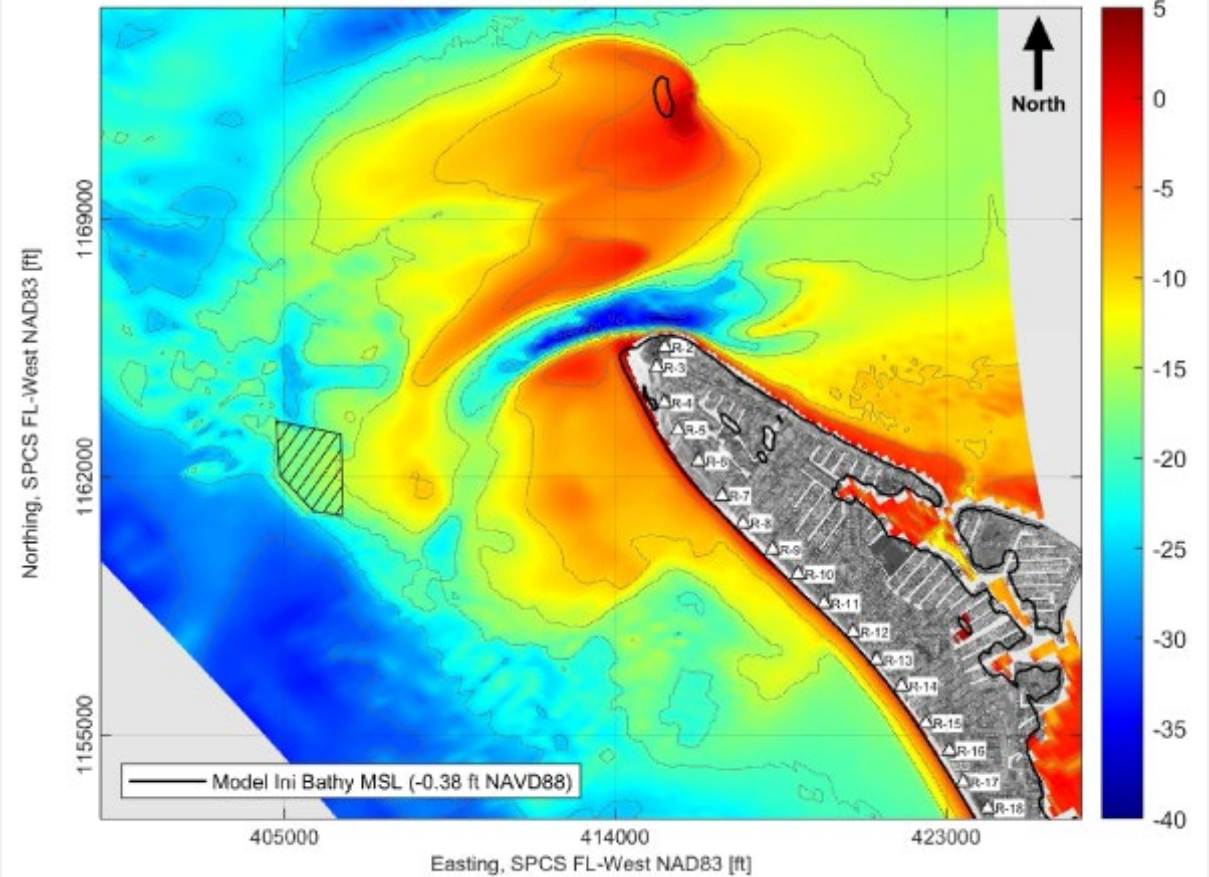
- Two sand placement areas within the Passage Key ebb shoal developed based on the inputs from the TAC meeting and discussion with USACE on the potential use of Tampa Harbor channel dredge material to replenish borrow areas for future shore protection projects in Manatee County:
 - **PA North** → Place sand in a location where it will be transported towards Passage Key to supply sand to ebb shoal and the ephemeral island
 - **PA South** → Place sand within existing permitted borrow areas with ~25 feet or more
- Placement volume = 1M cy

PLACEMENT AREA ALTERNATIVES

Model Final Bathymetry After 5 Years [ft NAVD88]
Placement Area North



Model Final Bathymetry After 5 Years [ft NAVD88]
Placement Area South



STUDY FINDINGS

Inlet and Shoreline Considerations

Anna Maria Island faces threats from shoreline fluctuations and volume deficits caused by sediment deposition and related transport cycles within the Passage Key Inlet complex, which disrupts the littoral transport and acts as a sediment sink

Sediment Management

To counter the inlet effects, a bypassing rate of approximately 130,000 cubic yards per year (1% of the total ebb shoal volume) is recommended as a minimum to balance the sediment budget on an average annual basis (the current average rate is approximately 160,000 cy)

Sand Source Recommendations

Borrow Area D + E is recommended as the primary sand source (Level 1) with no shoreline impact. Level 2 options (Borrow Areas E-1, J-1, J-2) are secondary/emergency sources. Level 3 (Borrow Areas J, I-2) requires refinement, and Level 4 alternatives are not recommended

Placement Area Benefits

The model simulations indicate minimal or no shoreline impacts and demonstrate a potential benefit to the overall coastal system

Future Steps

Additional refinement in engineering and design for permitting and implementation is recommended as a future phase of the study; coordination with other stakeholders

RECOMMENDED IMP STRATEGIES

Strategy #1. Conduct a comprehensive beach and inlet monitoring program

Evaluate the performance and impact of existing sand bypassing and nourishment projects and periodically update the inlet sediment budget

Strategy #2. Perform dredging from the Passage Key inlet ebb shoal and bypass the sand to adjacent downdrift beaches

130,000 cy/yr of accretion in the Passage Key inlet ebb shoal (1% of the total ebb shoal volume), which is the minimum recommended target to balance the sediment budget (dredging 650,000 cy every 5 years or 1,300,000 cy every 10 years). Continuous update based on Strategy #1

Strategy #3. Utilize the identified borrow areas in the Passage Key inlet as sediment sources for meeting the target sand bypassing in Strategy #2

Use the identified Level 1 borrow areas as future primary sources, Level 2 borrow areas as secondary or emergency borrow area sources. Level 3 borrow areas should be reserved for further refinement and future consideration. Further geotechnical analysis, engineering design, and permitting should be performed, and sand from inland sand mines or offshore sources may also be considered to supplement the sand needs on Anna Maria Island

Strategy #4. Consider placement of dredged material from Tampa Harbor for beneficial reuse

The placement of sand from Tampa Harbor may be used as a management approach for increasing sediment supply in the Passage Key inlet ebb shoal. Recommendations for further engineering design refinement and permitting should be undertaken to optimize the use of this approach in collaboration with the USACE

THANK YOU!

Morjana Signorin, M.Sc.

Senior Coastal Modeler/Coastal Engineer

Coastal Protection Engineering

mignorin@coastalprotectioneng.com

Special Thanks:

Manatee County Natural Resources Department

APTIM-CPE Project Team

TAC Members

Aerial Images Source: Texas Coast Geology (2011)

