Securing NASA's Coastline: Offshore Sand Source Investigation for Kennedy Space Center

FSBPA 39th Annual National Conference on
Beach Preservation Technology
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NASA

KENNEDY SPACE CENTER SAND SEARCH

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1. Project Location
2. Shoreline Conditions
3. Shoreline Change
4. Coastal Storm Risk Management
5. Offshore Sand Search
6. Local Geology
7. Borrow Area Design

PROJECT LOCATION

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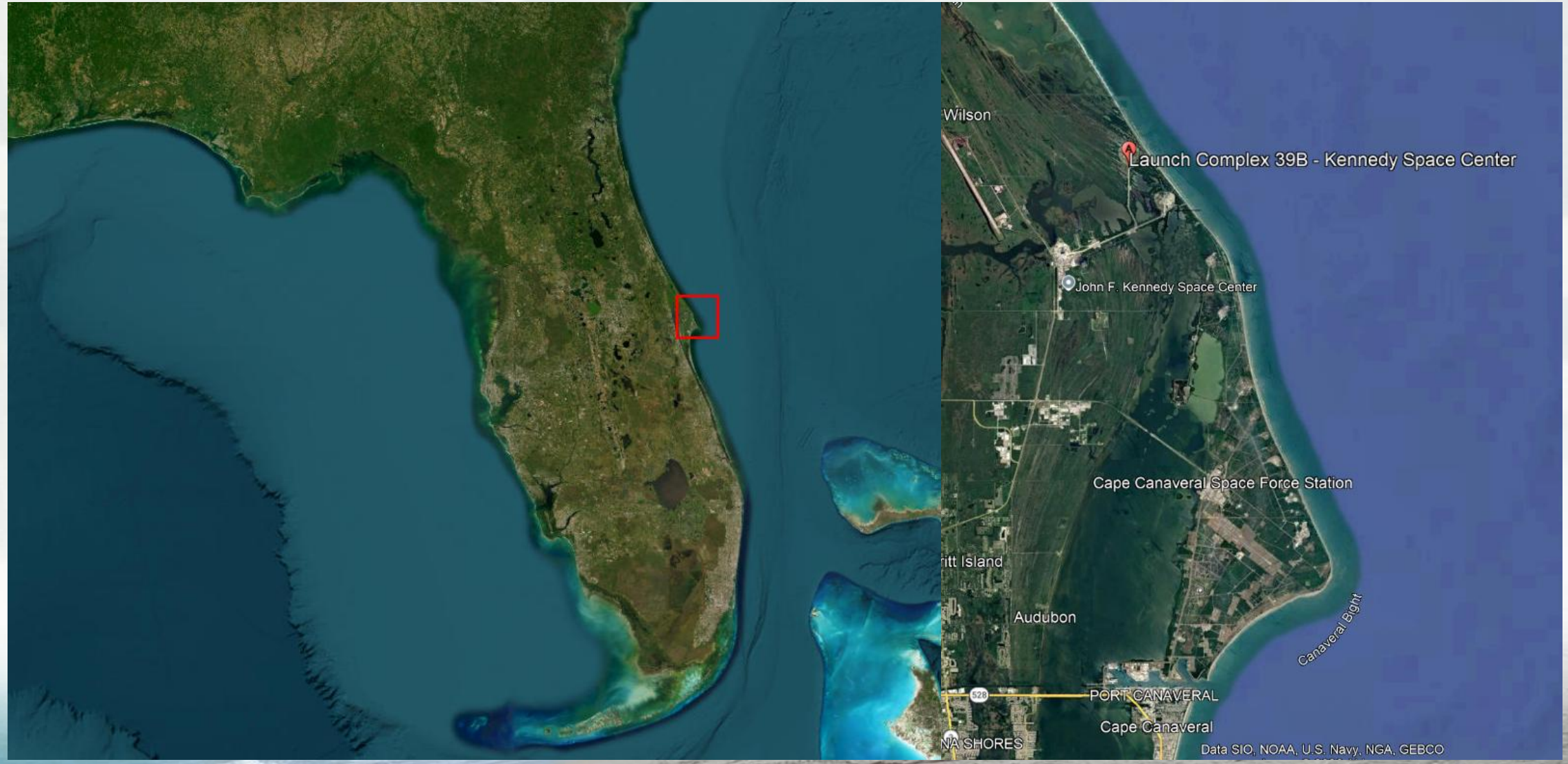

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PROJECT LOCATION

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PROJECT LOCATION

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Launch Complex 39A

- Apollo missions
- SpaceX Starship

Launch Complex 39B

- Apollo missions
- Shuttle flights
- Artemis program

SHORELINE CONDITIONS

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May 2025

SHORELINE CONDITIONS

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May 2025

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SHORELINE CHANGE

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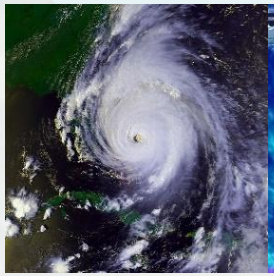
Storm impacts and Projects 1999 – Present

1999 Hurricane Floyd



2004 Hurricanes Frances Jeanne

2010 Dune Repair

2012 Hurricane Sandy

2014 Dune Repair

2016 Hurricane Matthew

2020 Hurricane Isaias

2024 Hurricanes Ian and Nicole

SHORELINE CHANGE

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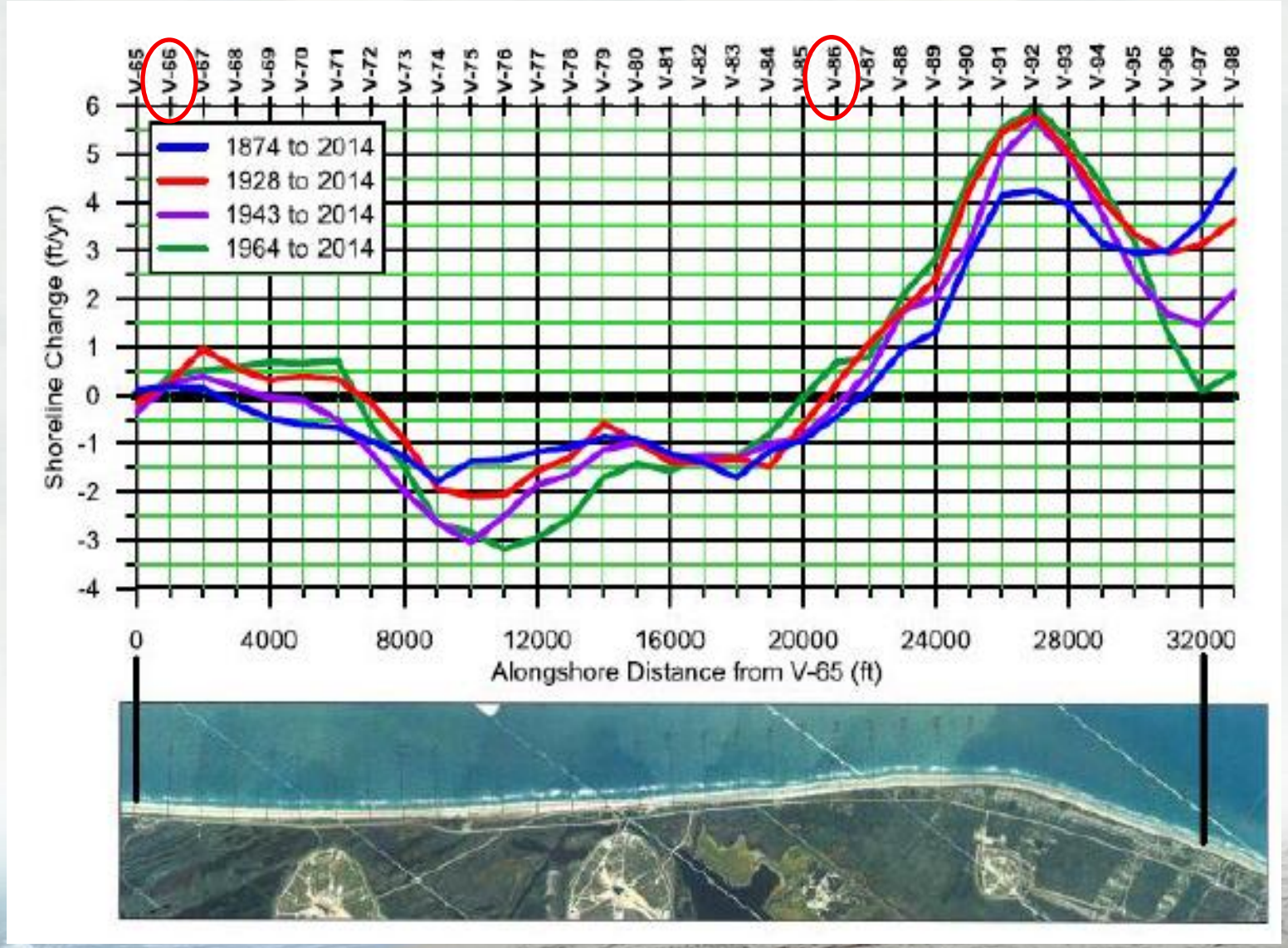

(AECOM, 2021)

SHORELINE CHANGE

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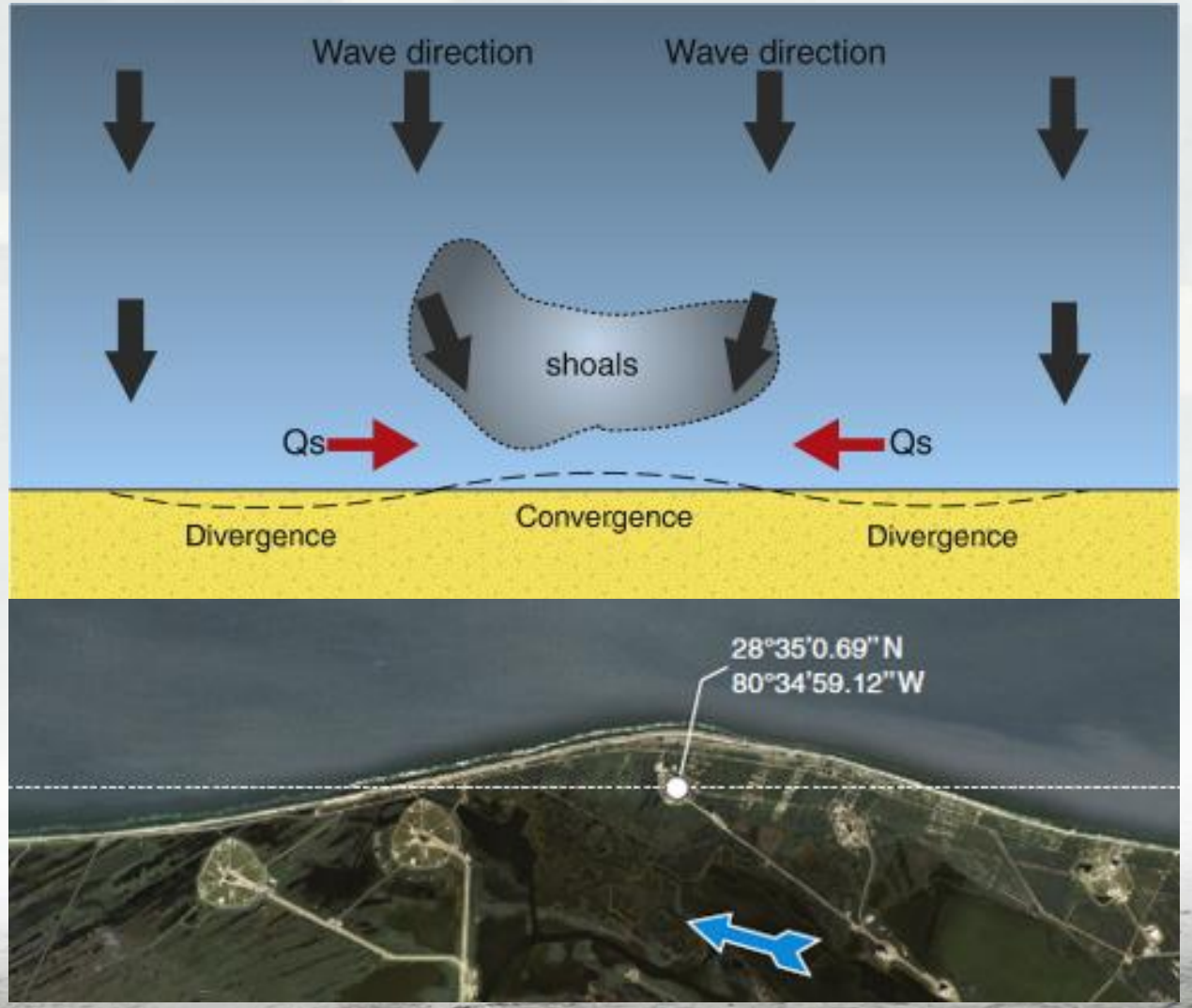
False Cape & Chester Shoal

- Shoal refracts offshore wave energy
- Convergence in shadowed area
- Divergence adjacent to shadowed area



(Limber et al., 2017)

SHORELINE CHANGE

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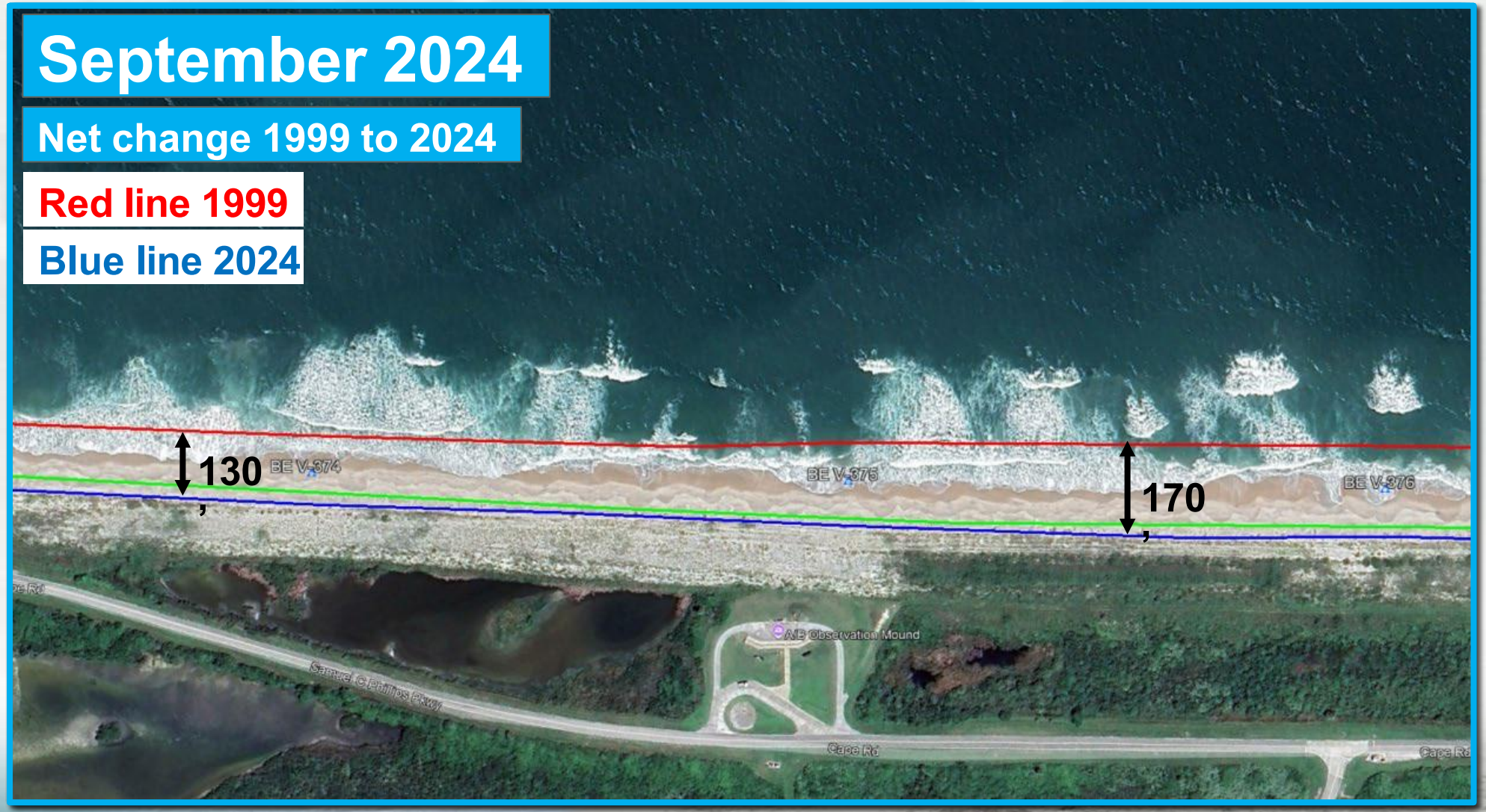

COASTAL STORM RISK MANAGEMENT

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- Construction planned late 2027
- V66 to V86 – 3.8 Miles
- Initial Construction: 2.5 - 3.0 Mcy

OFFSHORE SAND SEARCH

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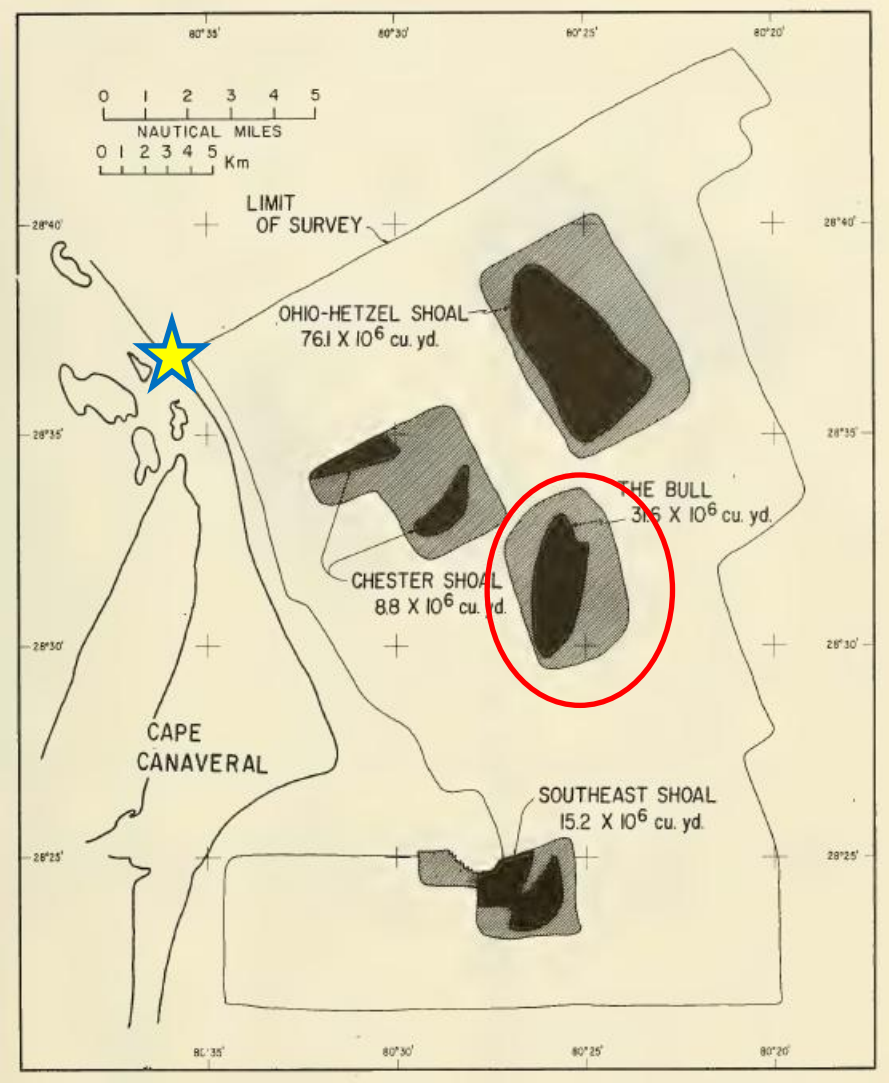

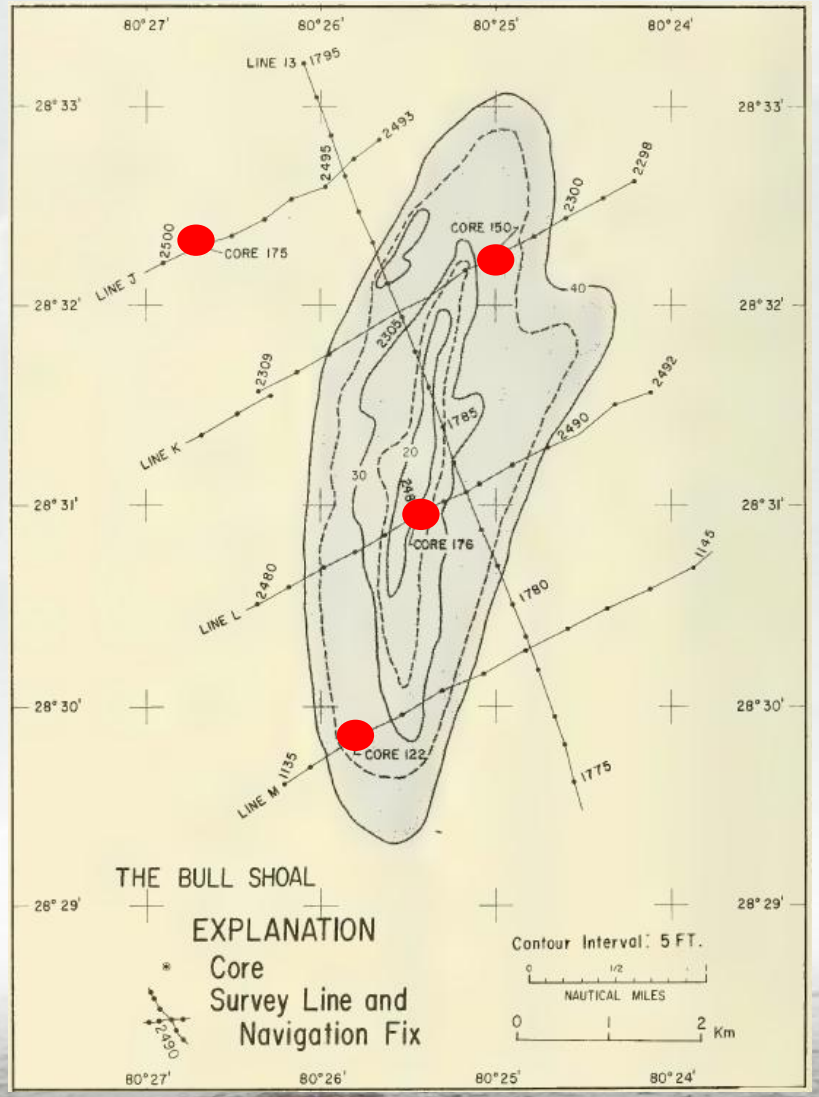

(Field & Duane, 1974)

OFFSHORE SAND SEARCH

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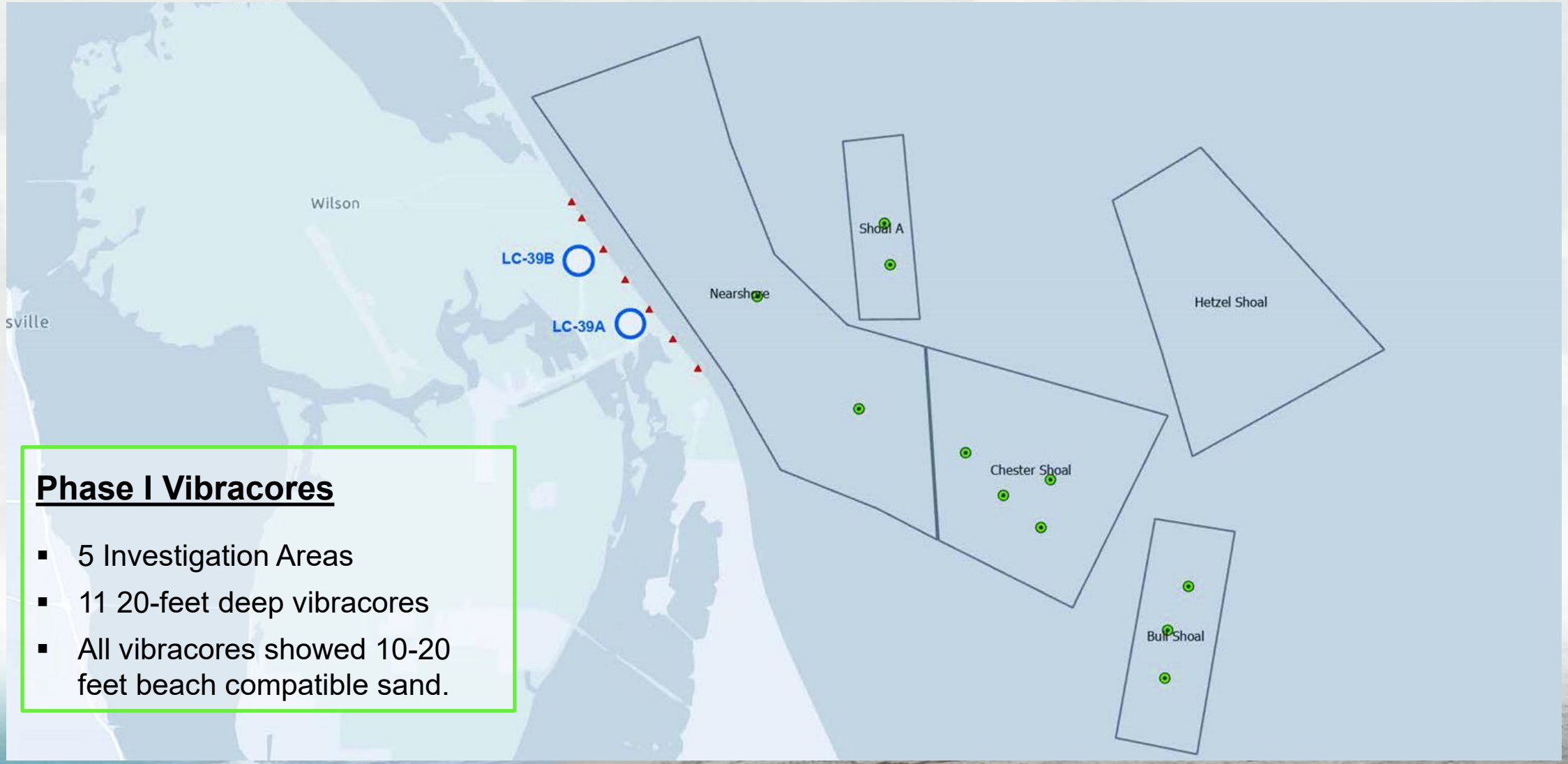

Phase I Vibracores

- 5 Investigation Areas
- 11 20-feet deep vibracores
- All vibracores showed 10-20 feet beach compatible sand.

OFFSHORE SAND SEARCH

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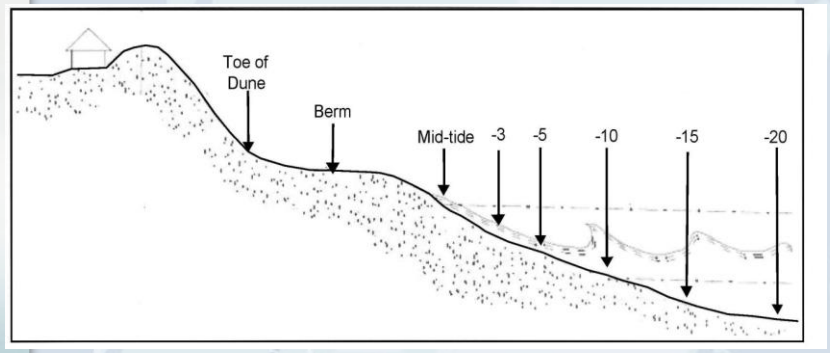
Phase II Vibracores

- 5 Investigation Areas
- 59 20-feet deep vibracores
- 15-20 feet beach compatible sand
- Approx. 2-3 Mcy each area

Pre-fill Beach Samples

- 7 R-Monument Profile Lines



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OFFSHORE SAND SEARCH

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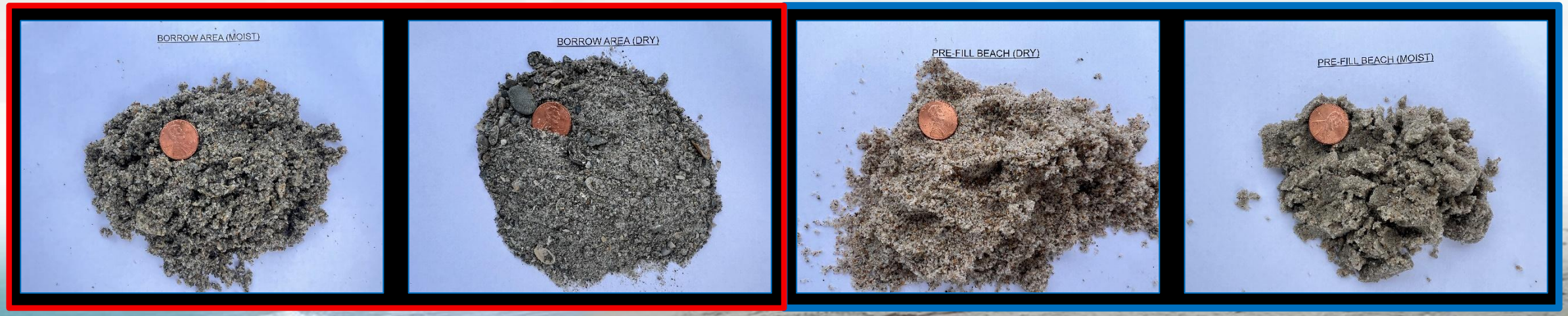
	Sand Rule (compliance)	Offshore Sand Source	Pre-fill Beach
Silt passing #230 Sieve	<5%	1.9%	2.7%
Retained in #4	<5%	0.8%	3.0%
Mean grain size (mm)	similar to beach	0.39	0.22
Color (darkness)	similar to beach	gray (5)	gray (5)



OFFSHORE SAND SEARCH

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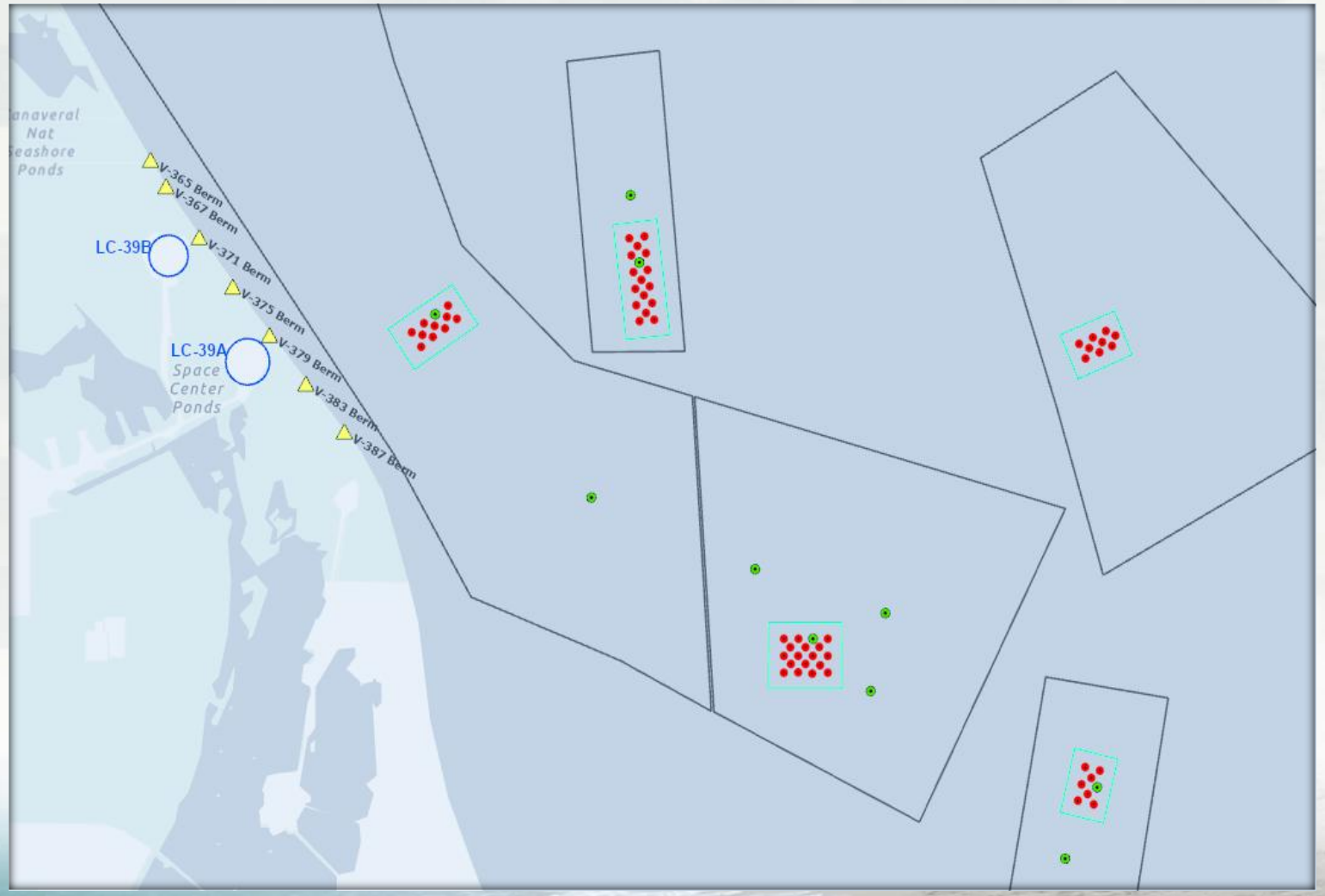

Results

- 70 Borings
- 5 investigation areas
- Sand thickness: 15-20 ft
- Volume:15+ Mcy

CAPE CANAVERAL GEOLOGY

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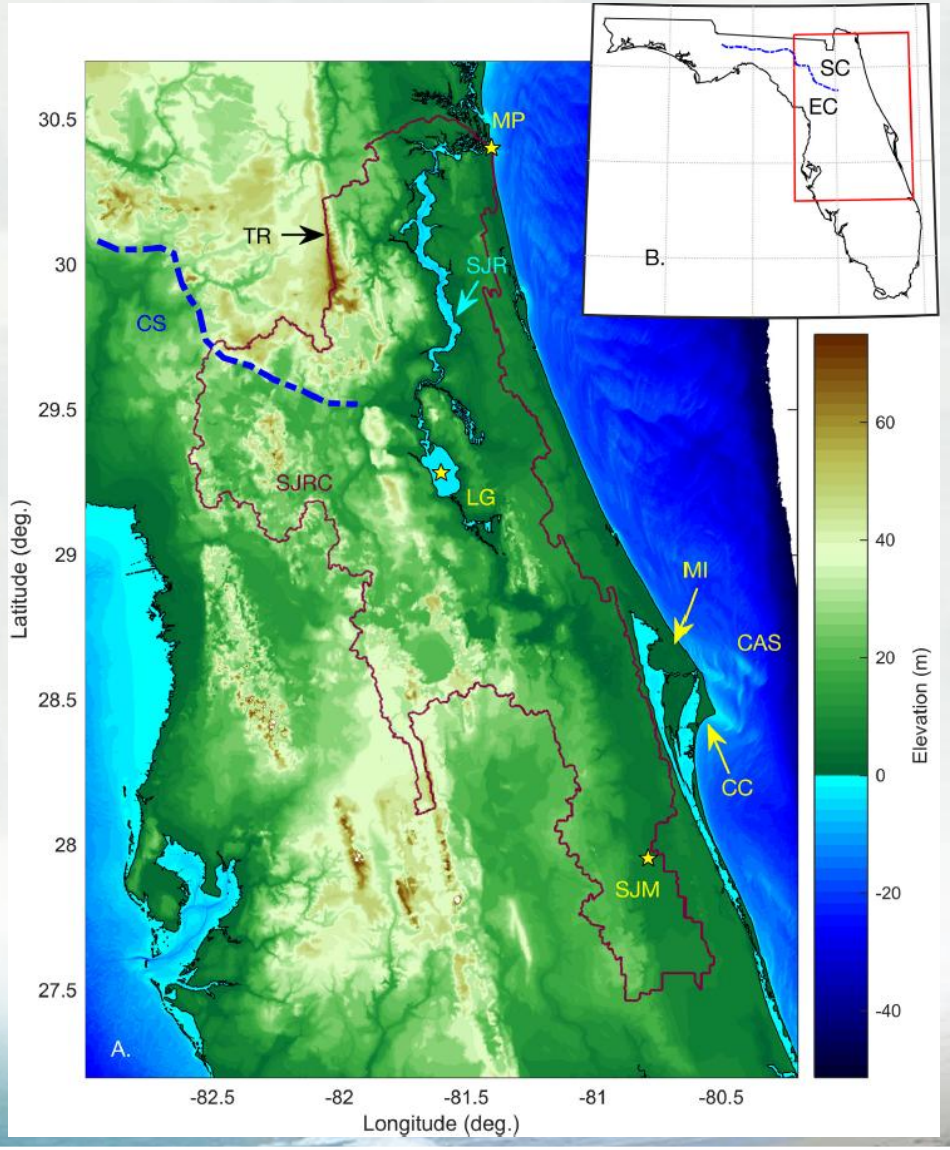

Geologic Origin Theories

1. Convergence of Opposing Currents
2. Anchoring by a Geologic Headland
3. Ancestral St. Johns River Paleodelta
   - 130-80K years ago flowed south
   - Tilting due to karst-driven uplift from carbonate rock dissolution

(Adams, 2018)

CAPE CANAVERAL GEOLOGY

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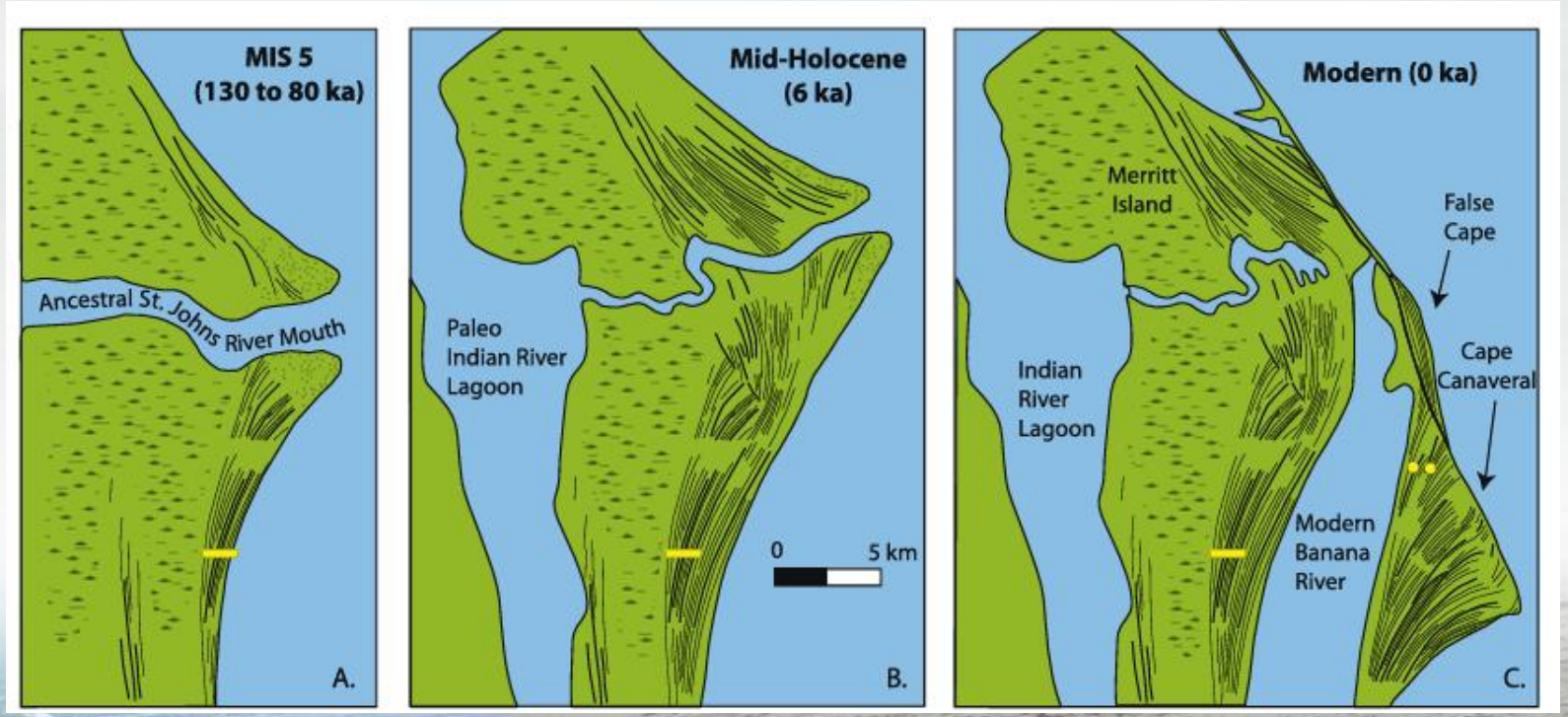
Cape Formation

A. Ancestral St. Johns River supplies sediment for delta formation
B. River reverses course, sediment supply cut off, waves erode the outer delta, longshore transport of sediment southward
C. Modern configuration of the Cape



(Adams, 2018)

CAPE CANAVERAL GEOLOGY

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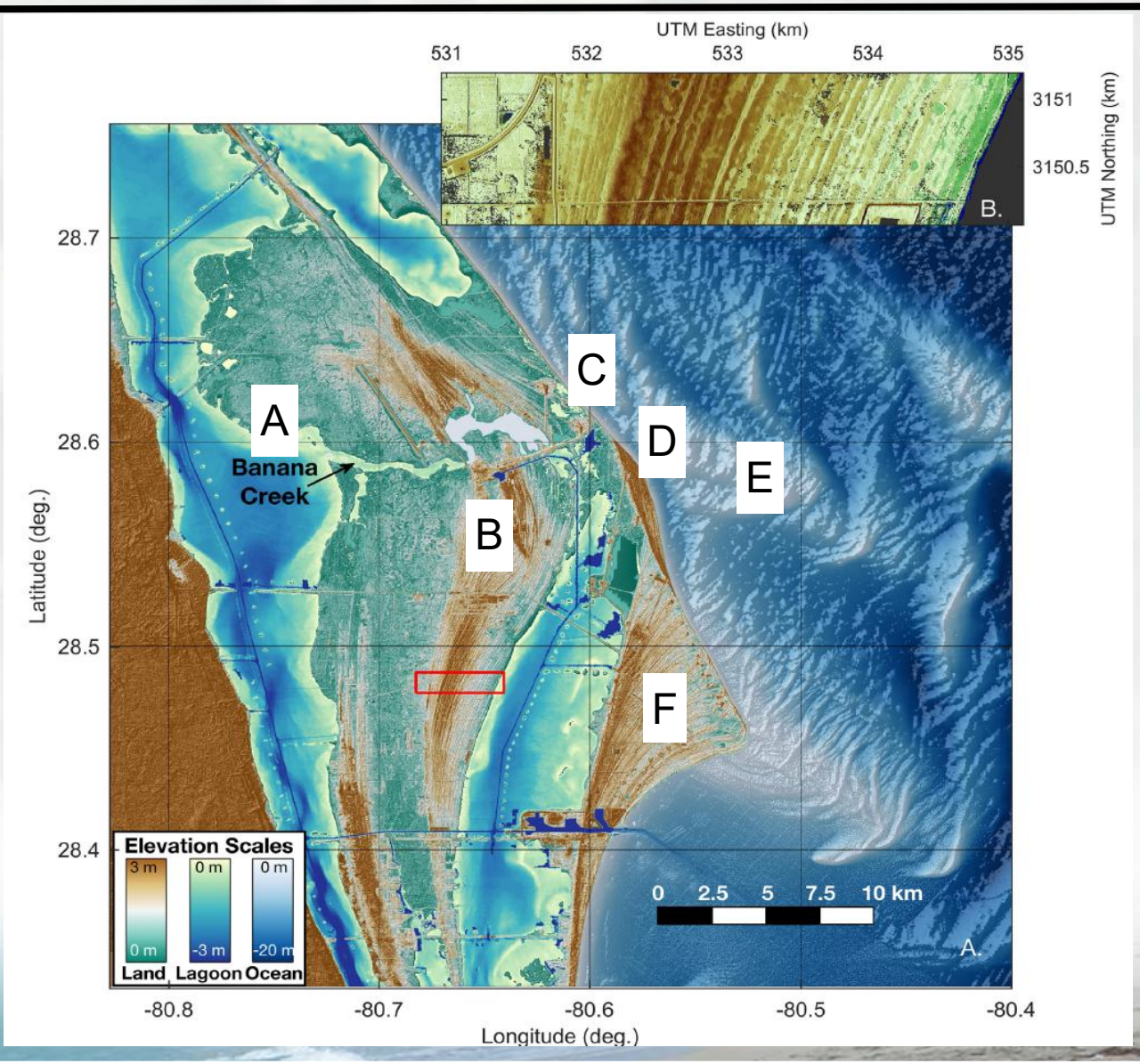

Geomorphologic Features

A. Banana Creek
B. Merritt Island
C. Study Area
D. False Cape
E. Chester Shoal
F. Cape Canaveral

(Adams, 2018)

BORROW AREA DESIGN

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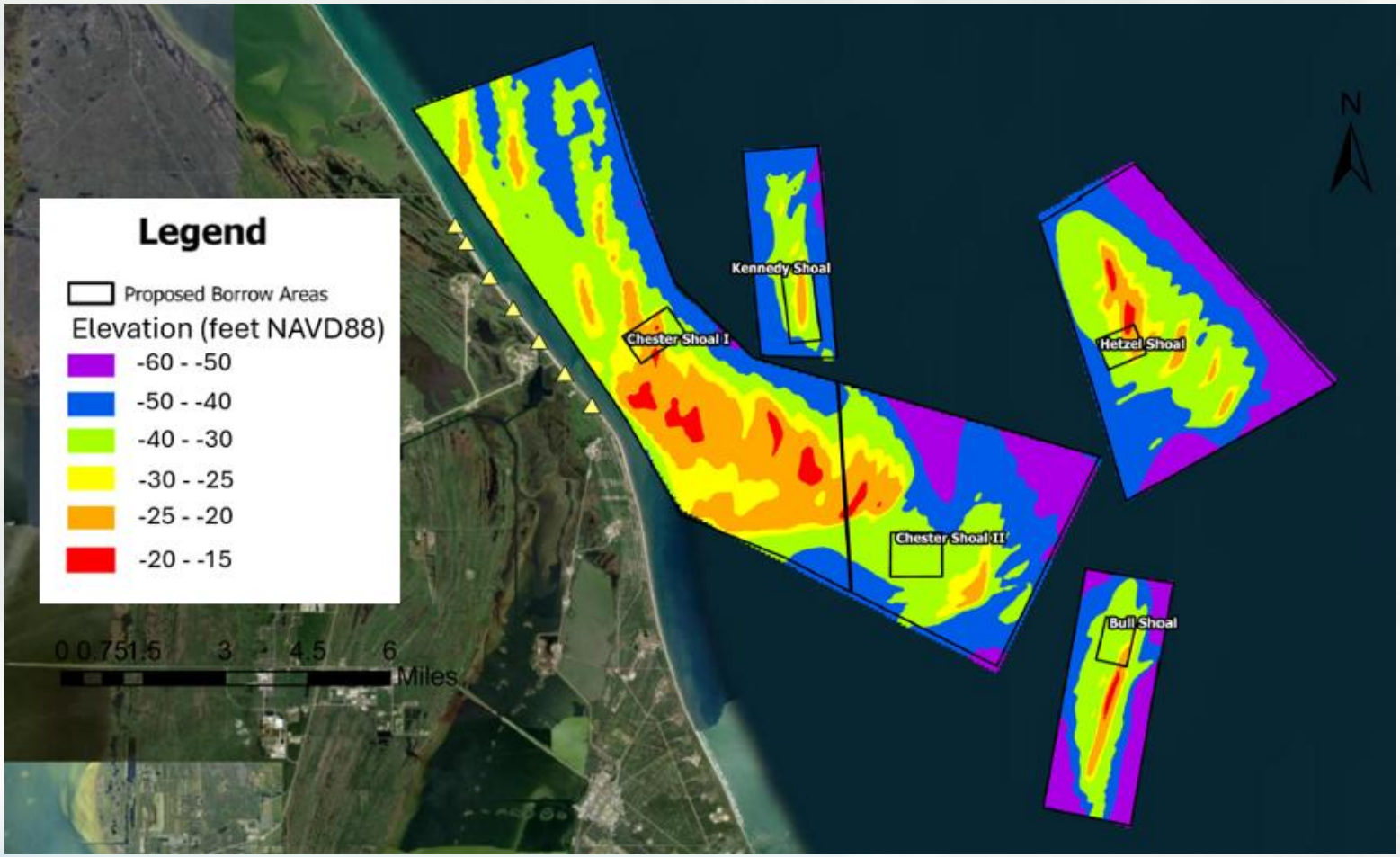


Design Considerations

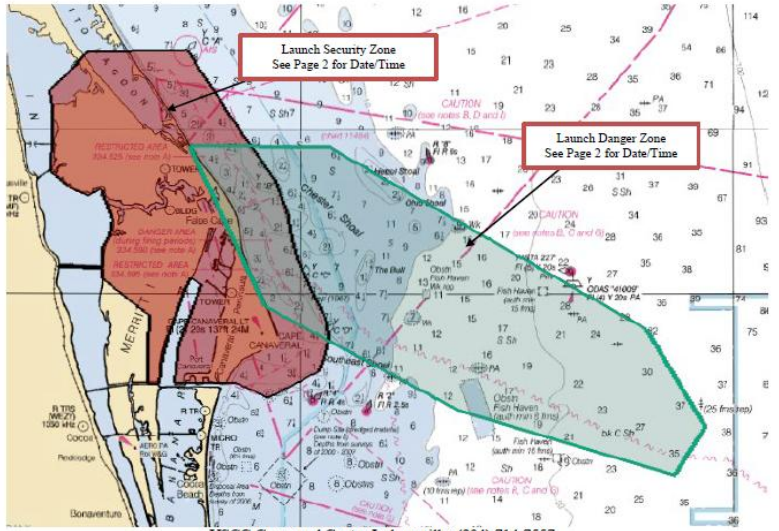
- Sand availability
- Proximity
- Dredge accessibility
- Rocket launch “danger zones”

BORROW AREA DESIGN

Rocket Launches

UNITED STATES COAST GUARD SECTOR JACKSONVILLE
SPACE LAUNCH DELTA 45

Space Operations Rocket Launch Advisory
FALCON 9 STARLINK 12-23



USCG Command Center Jacksonville: (904) 714-7557
USSF Launch Information Recorded Line: 1-800-470-7232

Mariners are advised to remain clear of all zones during the time of activation

Detailed Launch Information can be obtained using Coast Guard channel 16 or FM81A and Notice to Mariners @
https://www.navcen.uscg.gov/?pageName=lnmDistrict&region=7

WARNING

Launch Danger Zone
Extremely hazardous conditions will be present within the Launch Danger Zone. Mariners are strongly advised to avoid these areas while active.

Launch Security Zone

The U.S. Coast Guard will enforce the Security Zone as specified in 33 CFR 165.701 beginning 2 hours prior to the scheduled launch window in this notice until suspended by the Captain of the Port, Jacksonville, FL via broadcast on VHF-FM channel 16 and cancellation of this Broadcast Notice to Mariners message.

For up to date Launch Information:

1. Scan the QR Code or copy link
2. Go to Upcoming Launches near the bottom of the page
3. Open Launch Hazard Area
   https://www.patrick.spaceforce.mil/

BORROW AREA DESIGN

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Dredge Accessibility

- Chester Shoal I
- Chester Shoal II
- Kennedy Shoal
- Hetzel Shoal
- Bull Shoal

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SUMMARY

1. Beach erosion threatens critical launch infrastructure at KSC.
2. 2027 nourishment project requires 3 Mcy of sand.
3. 2025 offshore sand search located 15+ Mcy of compatible sand.
4. Offshore shoals provide ample sand sources while also influencing shoreline change.
5. Diversification of borrow areas is crucial for accommodating rocket launch safety zones and dredge accessibility.

QUESTIONS?

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