Currituck County
Beach Assessment and Beach Management Plan
Update:

Ken Willson, Senior Program Manager
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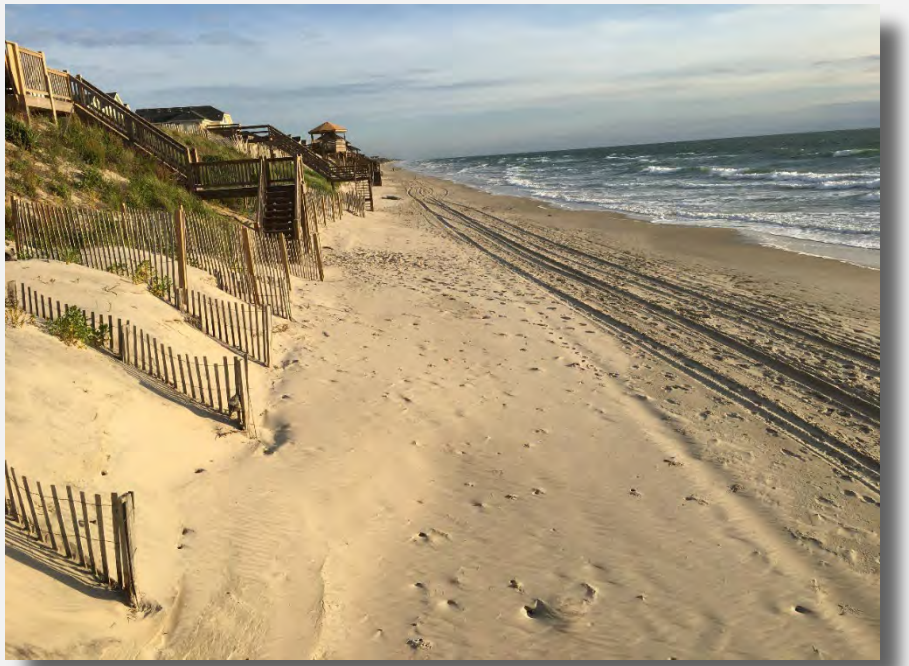
March 6, 2026



Presentation Outline:

- Beach Monitoring and Beach Stability Assessment
  - Goals of the Study
  - Project Overview
  - Shoreline Change Analysis Results
  - Volumetric Change Analysis Results
- Beach Management Plan
  - Goals
  - Hazards & Vulnerability
  - Beach Management Concepts
  - Next Steps…

BEACH MONITORING AND BEACH STABILITY ASSESSMENT

BEACH MONITORING AND BEACH STABILITY ASSESSMENT GOALS:

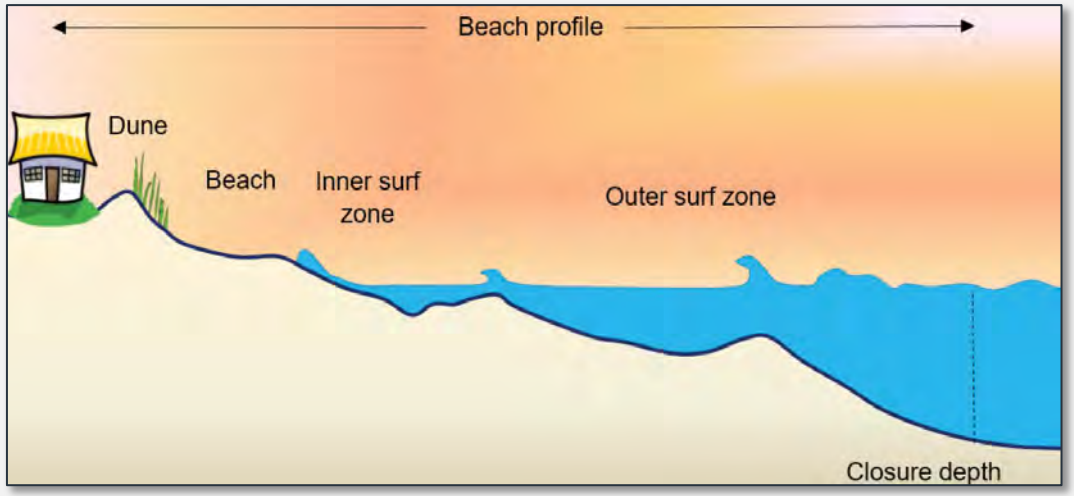
- Initial Study Goals (2020 – 2022)
  - Conduct 3 Annual Beach Surveys
  - Monitor the Beach and Evaluate Beach Stability
  - To Better Understand the Changes Occurring on the Beaches
  - To Assist the County in Making Informed Decisions Regarding Future Beach Management
- Continued Monitoring Goals (2023 through 2025)
  - Track and Assess Long-term and Short-term shoreline and Volumetric Changes
  - Odd Years – Surveys Conducted South of Horse Gate (C-059 to C-120)
  - Even Years – All Surveys Along Oceanfront Beaches Conducted (C-001 to C-120)

BEACH ASSESSMENT LOCATION:

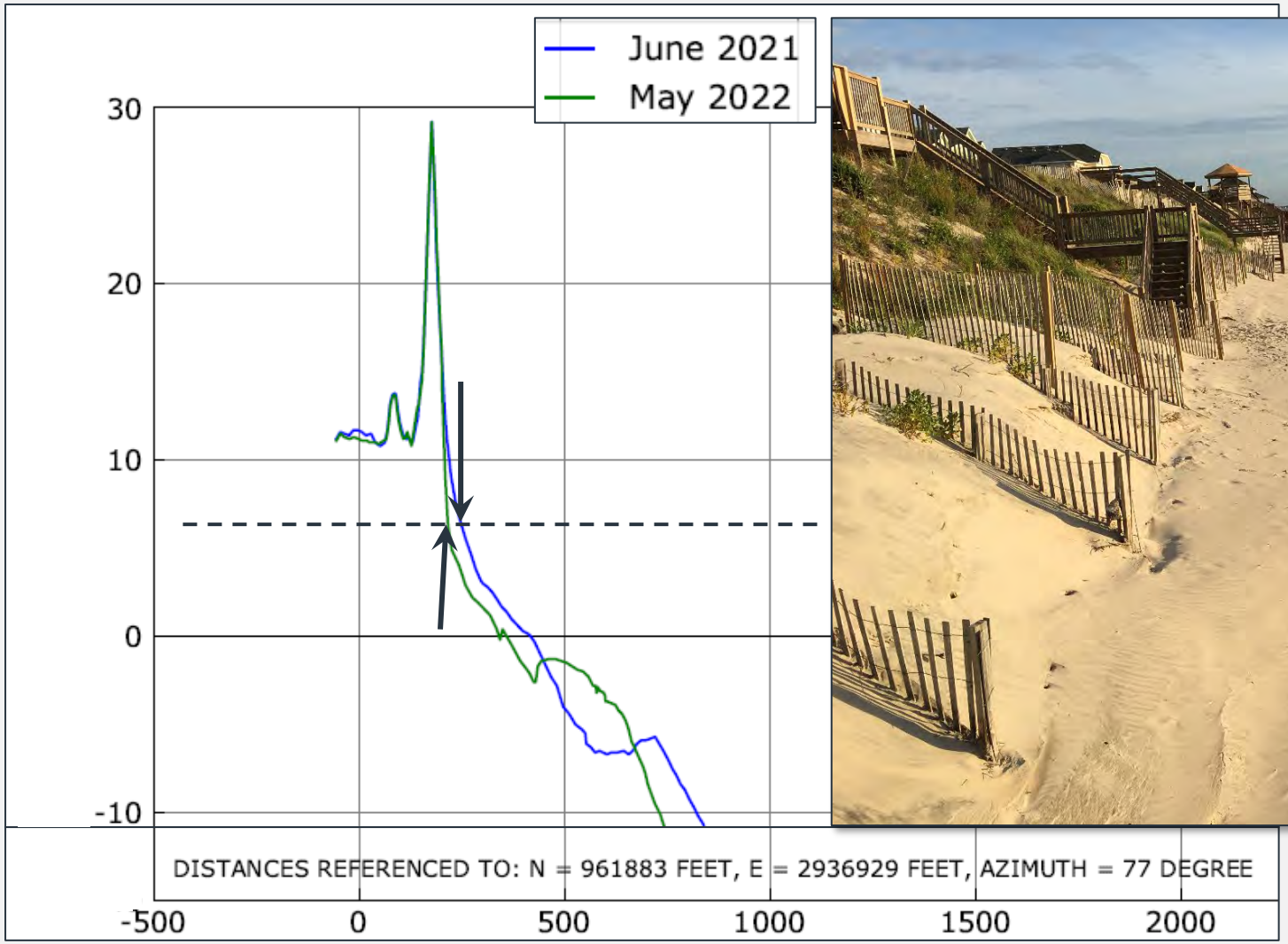
DATA SETS USED IN THE ASSESSMENT

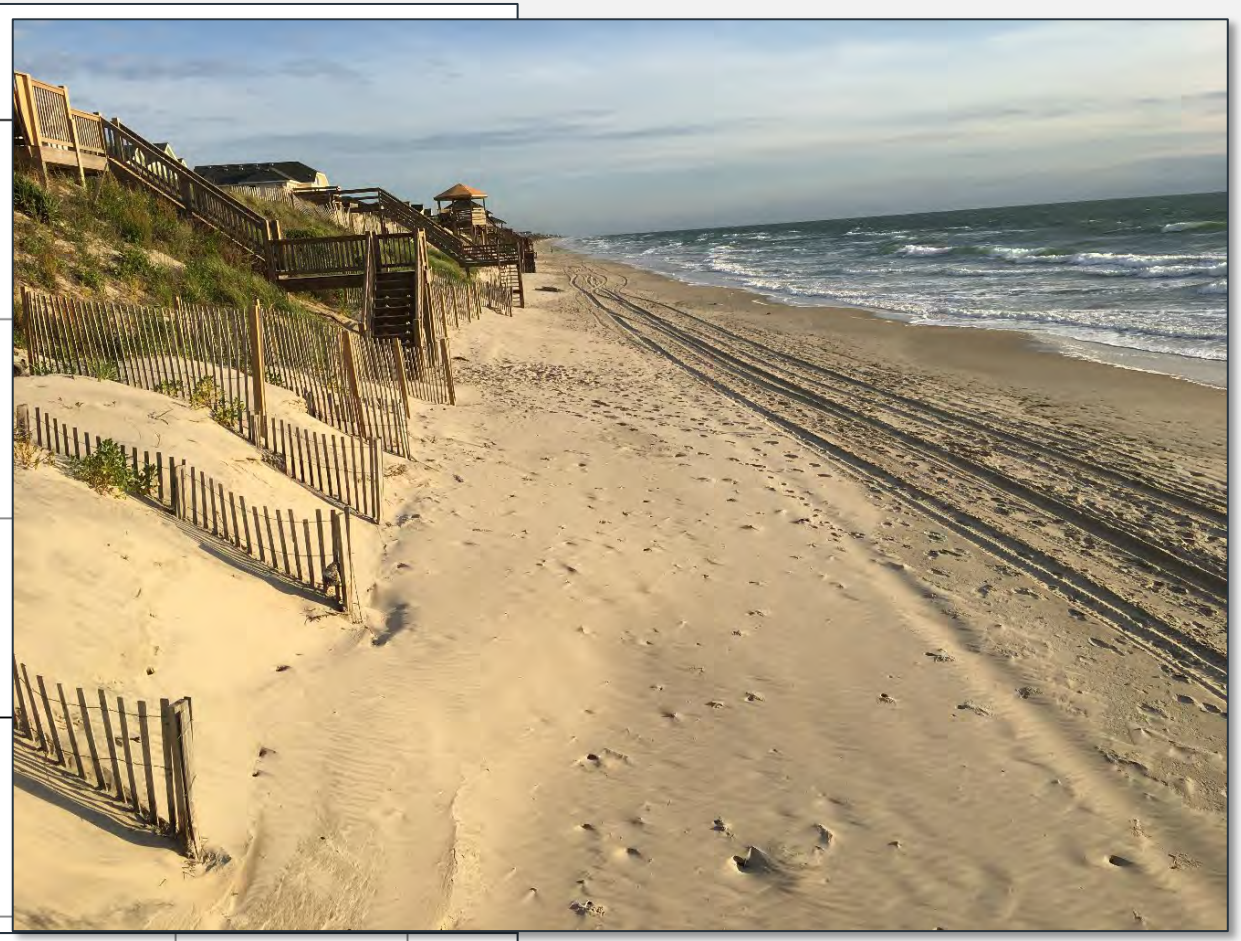
- LiDAR Data 2009, 2017, 2018, and 2019 (USACE/NOAA)
- Beach Profile Data (2020, 2021, 2022, 2023*, 2024, 2025*)
- Supplemental Beach Profile Data (2015 and 2017) – Pine Island Only

* Surveys only conducted south of “Horse Gate”



SHORELINE CHANGE





COASTAL PROTECTION ENGINEERING

SHORELINE CHANGE SUMMARY

Sections	Average Shoreline Change Rate: August 2009 – June 2025 (Ft. / Yr.)	Long-Term Rates Based on Average Setback Factor (Ft. / Yr.)
Corolla (C-059 to C-102)	-3.9	-2.28
Pine Island (C-102 to C-120)	-1.0	-2.00

Results of Analysis from 2025 South of the “Horse Gate”

Sections	Average Shoreline Change Rate: August 2009 – June 2024 (Ft. / Yr.)	Long-Term Rates Based on Average Setback Factor (Ft. / Yr.)
Carova (C-001 to C-027)	-0.9	-2.49
Reserve/Refuge (C-027 to C-059)	-3.6	-6.57

Results of Analysis from 2024 North of the “Horse Gate”

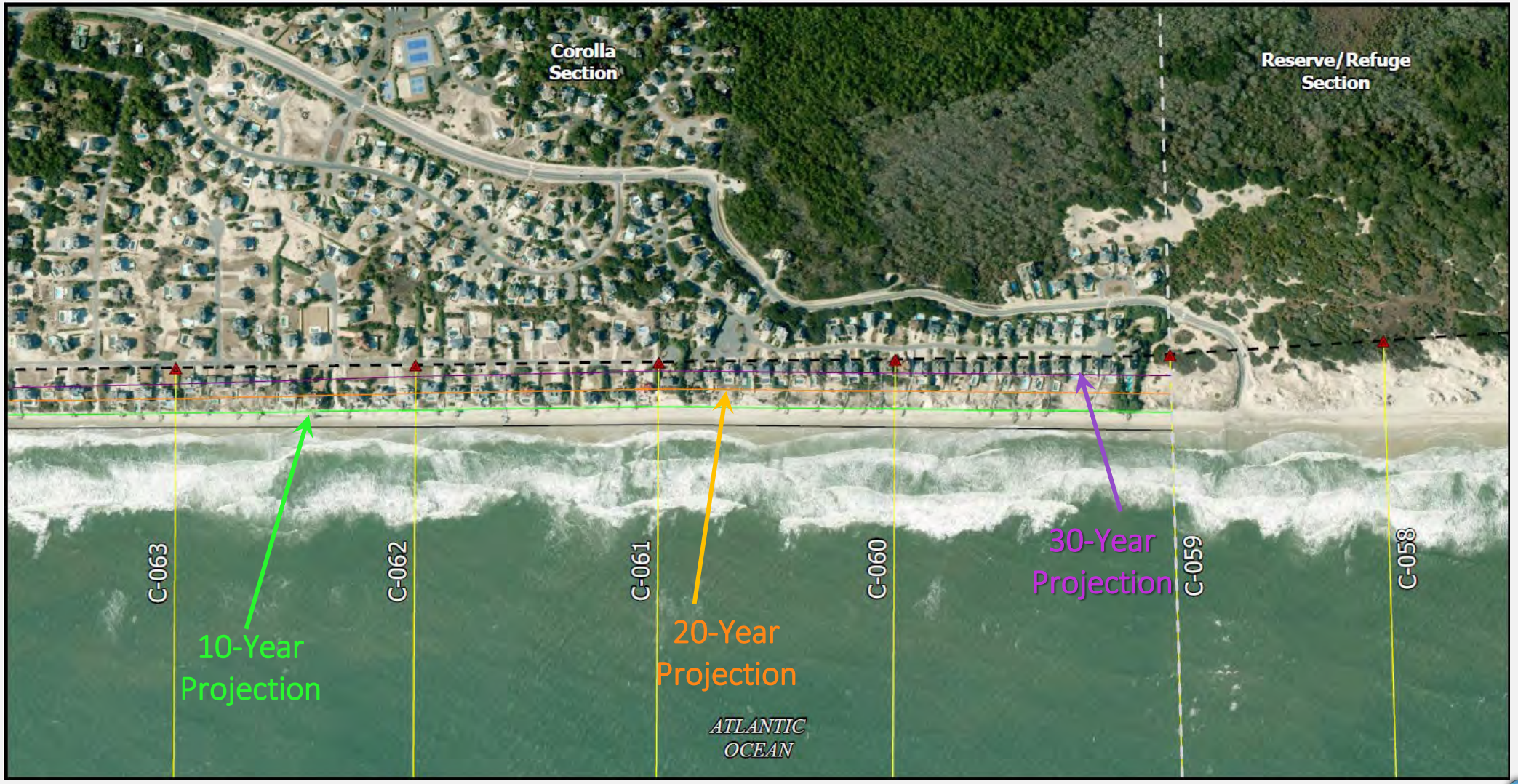
Coastal Protection Engineering

SHORELINE CHANGE SUMMARY

Sections	Average Shoreline Change Rate: August 2009 – June 2025 (Ft./Yr.)	Average Shoreline Change Rates: May 2020 – June 2025 (Ft./Yr.)	Average Shoreline Change Rates: June 2024 – June 2025 (Ft./Yr.)
Corolla (C-059 to C-102)	-3.9	+7.4	-15.6
Pine Island (C-102 to C-120)	-1.0	+2.4	-34.0

Coastal Protection Engineering

SHORELINE CHANGE SUMMARY



Coastal Protection Engineering

SHORELINE CHANGE SUMMARY

Section	10-Year	20-Year	30-Year
Corolla (C-059 to C-102)	0	19	43
Pine Island (C-102 to C-120)	0	0	0
Total Assessment Area	0	**19**	**43**

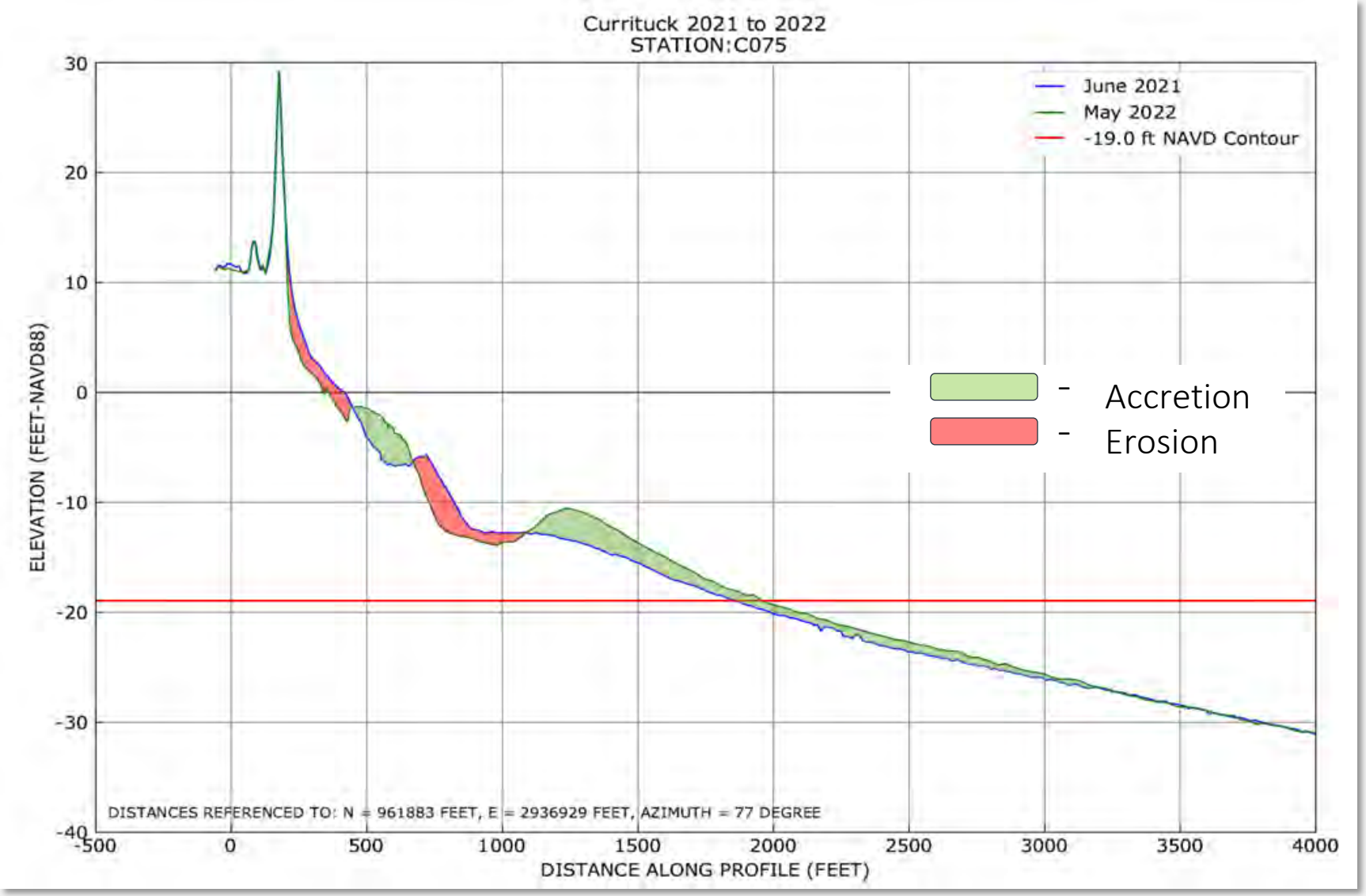
Results of Analysis from 2025 South of the "Horse Gate"

Section	10-Year	20-Year	30-Year
Carova (C-001 to C-027)	0	0	0
Reserve/Refuge (C-027 to C-059)	0	1	3

Results of Analysis from 2024 North of the "Horse Gate"

VOLUME CHANGE

VOLUME CHANGE



VOLUME CHANGE

Standard Dual Axle Dump Truck = ~ 10 CY

Coastal Protection Engineering

VOLUME CHANGE

Sections	Average Density Change Rate (cy/ft./yr)		Total Volume Change (cy)	
	May 2020 to June 2025	June 2024 to June 2025	May 2020 to June 2025	June 2024 to June 2025
Corolla (C-059 to C-102)	1.4	-6.5	305,800	-282,000
Pine Island (C-102 to C-120)	2.7	0.4	243,900	7,100
Total South of Horse Gate:	1.8	-4.5	549,700	-275,000

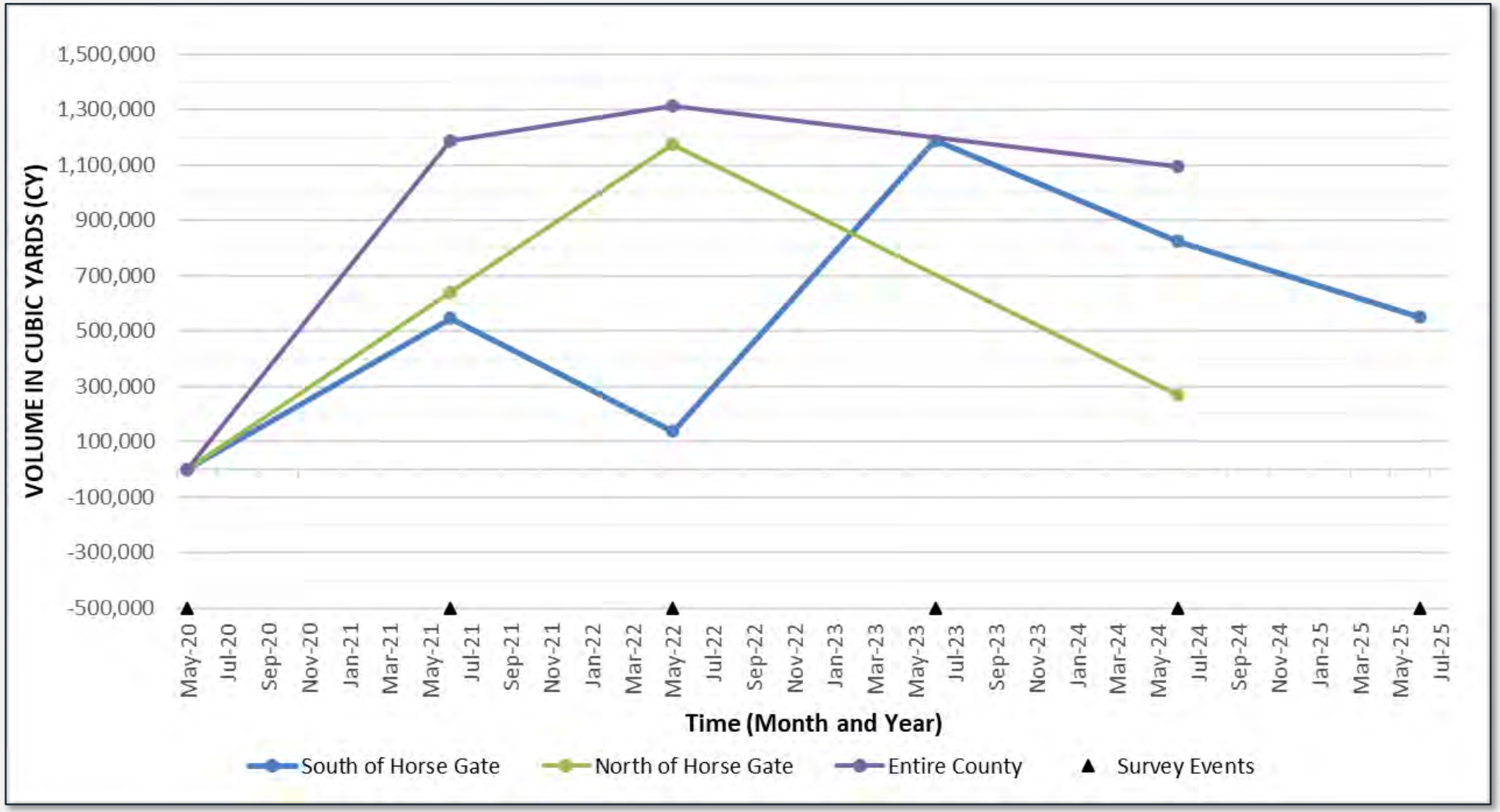
Results of Analysis from 2025 South of the “Horse Gate”

Sections	Average Density Change Rate (cy/ft./yr)		Total Volume Change (cy)	
	May 2020 to June 2024	June 2022 to June 2024	May 2020 to June 2024	June 2022 to June 2024
Carova (C-001 to C-027)	3.1	-5.3	337,000	-287,800
Reserve/Refuge (C-027 to C-059)	-0.5	-9.3	-67,100	-620,500

Results of Analysis from 2024 North of the “Horse Gate”

Coastal Protection Engineering

CUMULATIVE VOLUME CHANGE



VOLUME CHANGE

Section	Density Change Rate (cy/ft./yr.)			Total Volume Change (cy)		
	May 2020 to June 2025	May 2020 to June 2023	June 2023 to June 2025	May 2020 to June 2025	May 2020 to June 2023	June 2023 to June 2025
Corolla	1.4	5.6	-5.1	305,800	740,300	-435,900
Pine Island	2.7	8.1	-5.7	243,900	448,600	-204,700
South of the Horse Gate (C-059 to C-120)	**1.8**	**6.3**	**-5.2**	**549,700**	**1,189,000**	**-640,600**

2025 MONITORING ASSESSMENT CONCLUSIONS:

- Ocean Hills Community (C-059 to C-065) – Continues to be most vulnerable section. 66% of oceanfront houses identified as impacted over the 30-year planning horizon and past storm vulnerability analyses have indicated vulnerability along this area. Average volume change rate between June 2023 and June 2025 was -16.7 cy/ft./yr.
- Whalehead Beach Community (C-068 to C-084) – Past shoreline projection analyses and storm vulnerability analyses have identified vulnerability along this area. Average volume change rate between June 2023 and June 2025 was -5.2 cy/ft./yr.
- Spindrift Community (C-101 to C-103) – Short section of 9 oceanfront homes. Past shoreline projection analyses and storm vulnerability analyses have identified vulnerability along this area.

BEACH MANAGEMENT PLAN

What is a Beach Management Plan

- Framework for management, protection, and restoration of beaches and dunes
- Establishes the goals for managing the beach
- Provides concepts for meeting the beach management goals (include cost and time required to implement concepts)
- Provides thresholds for when to implement concepts

COUNTY GOALS

Overall goal: preserve tax revenues (sales taxes, bed taxes, and ad valorem taxes) generated as a direct result of having a healthy beach.

To preserve these tax revenues both directly and indirectly, the County's Beach Management Plan focuses on maintaining the beaches in such a way as to:

1) Reduce risk to oceanfront properties from coastal storms
2) Reduce the risk of dune breaching which can cause considerable flooding of beachfront communities
3) Protect public roads/emergency evacuation corridors
4) Reduce risk to oceanfront properties from long-term erosion
5) Provide sufficient recreational beaches that promote and encourage tourism

What about *Establish resilience planning* and *Pursue legislative changes to the prohibition of permanent shorelines stabilization devices?*

Coastal Protection Engineering

HAZARDS & VULNERABILITY

- Extreme Storm Analysis
- D3D Storm Simulations
- 2025 XBEACH 1D Storm Analysis
- Long-Term Shoreline Change Projections
- Volume Change Analysis
- Evaluation of Useable Beach Width
- Dune Breaching Analysis – XBEACH 2D (In Progress)

EXTREME STORM ANALYSIS SUMMARY

Storm	*Peak Wave Height(ft) and Return period*	*Peak Tp*	*Dominant Wave Direction*	*Dominant Wind Direction*	*Peak Water Level (ft, MHHW) and Return period*
Hurricane Isabel (2003) **	25.9 ft (50-100yr)	16 s	E - SE	NE	4.1 ft (50-100 yr)
Hurricane Irene (2011)	21.9 ft (10-20 yr)	16 s	SE	E	1.5 ft (<1 yr)
November 2006 nor'easter	18.0 ft (8-10 yr)	12.5 s	NE	NE	3.5 ft (10-25 yr)
November 2009 nor'easter **	16.4 ft. (4 yr)	13.3 s	NE	NE	3.0 ft (5-10 yr)
Hurricane Sandy (2012)	17.1 ft (6-7 yr)	13 s	NE	NE	3.0 ft (5-10 yr)
Hurricane Matthew (2016)*	16.7 ft (4-5 yr)	11 s	NE - E	NE	1.9 ft (<1 yr)
Hurricane Dorian (2019) **	15.4 ft (1-2 yr)	15 s	E - SE	SE	3 ft (5-10 yr)
TS Ophelia (2023)	21.1 ft (~10 yr)	12 s	E - SE	E	1.7 ft (<1 yr)

* Storm selected for qualitative morphology calibration

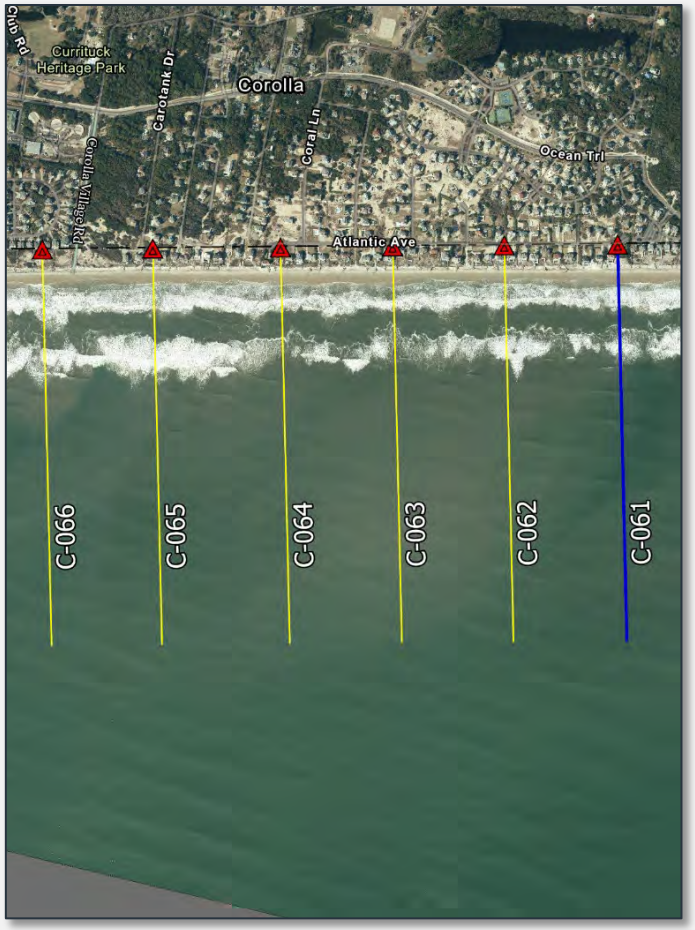
** Recommendation based on storm type, intensity and data availability

EXTREME STORM ANALYSIS SUMMARY

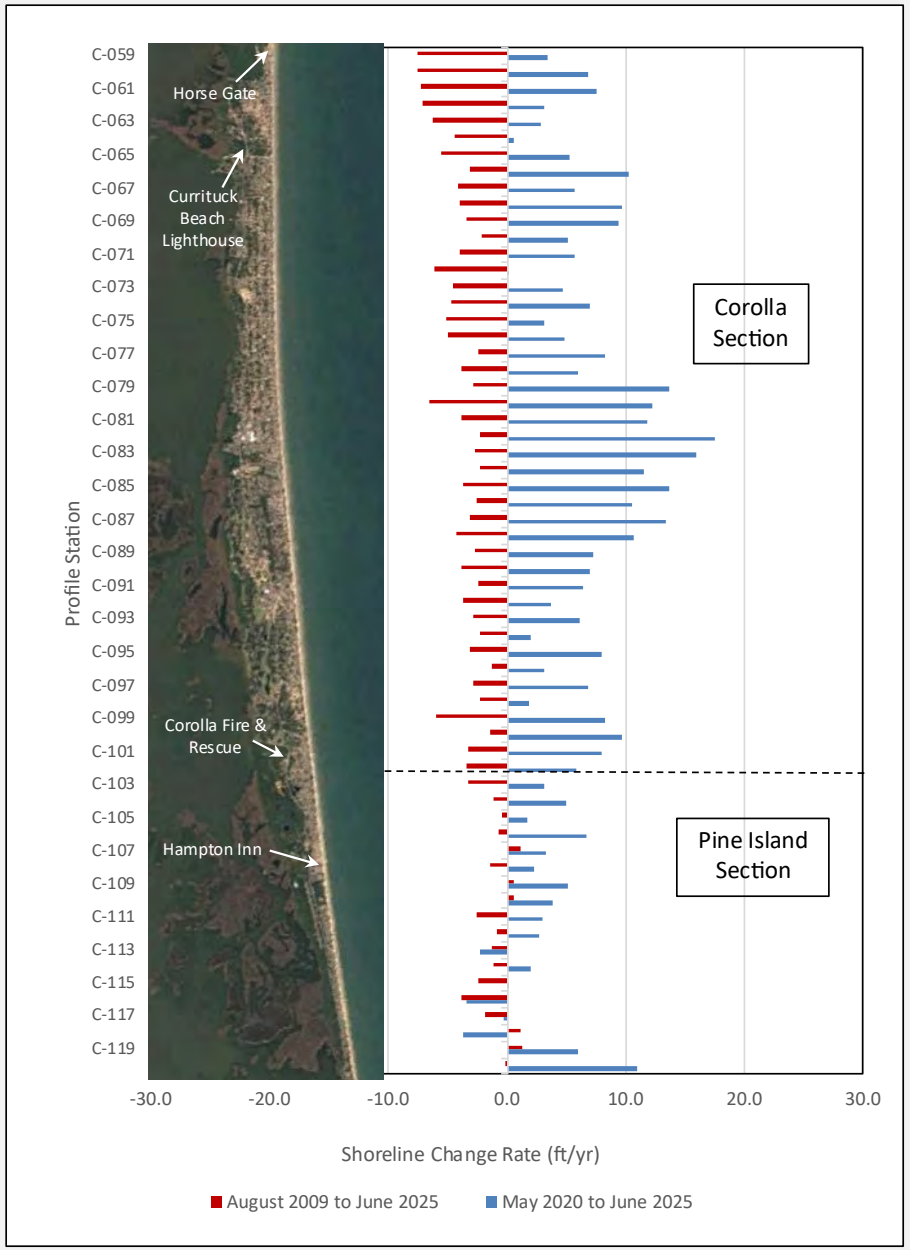
NOAA Imagery
https://storms.ngs.noaa.gov/

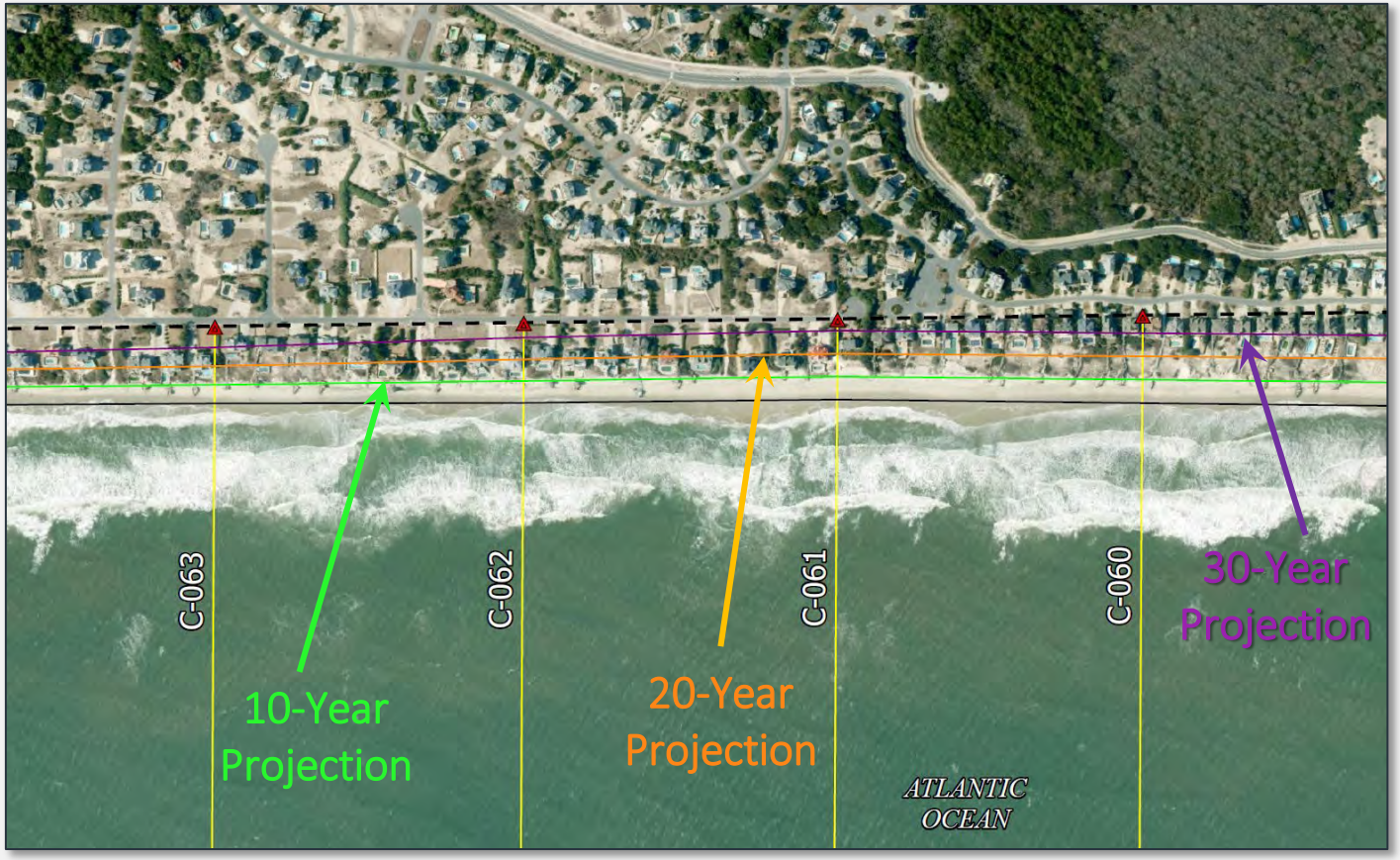
Post Hurricane Isabel 2003

XBEACH 1D STORM ANALYSIS



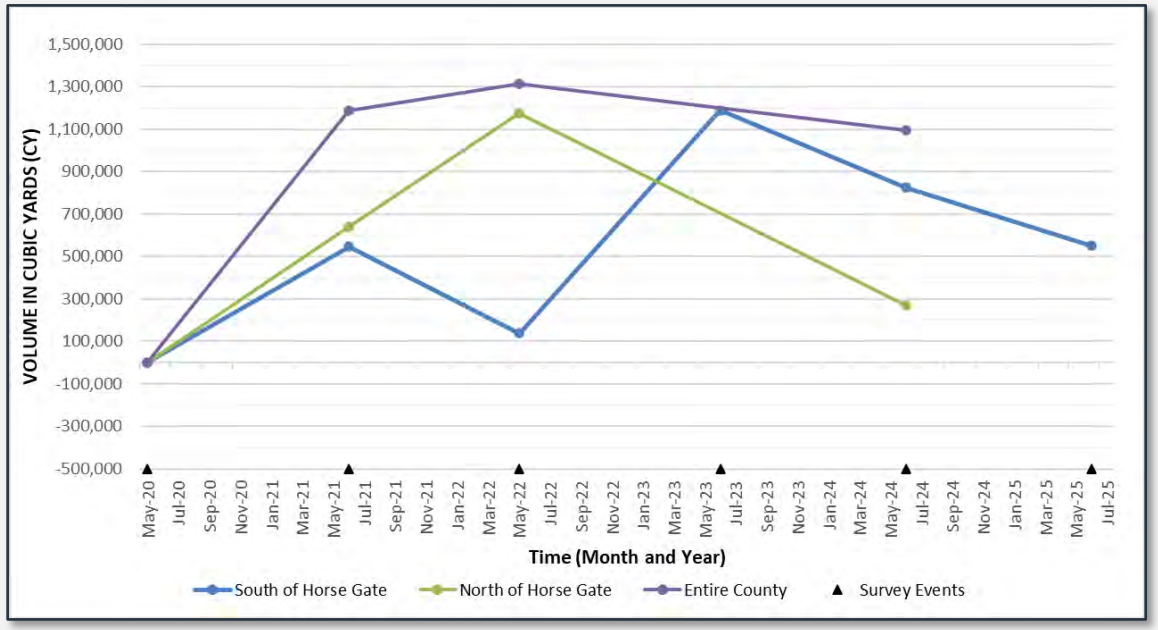
SHORELINE CHANGE PROJECTIONS



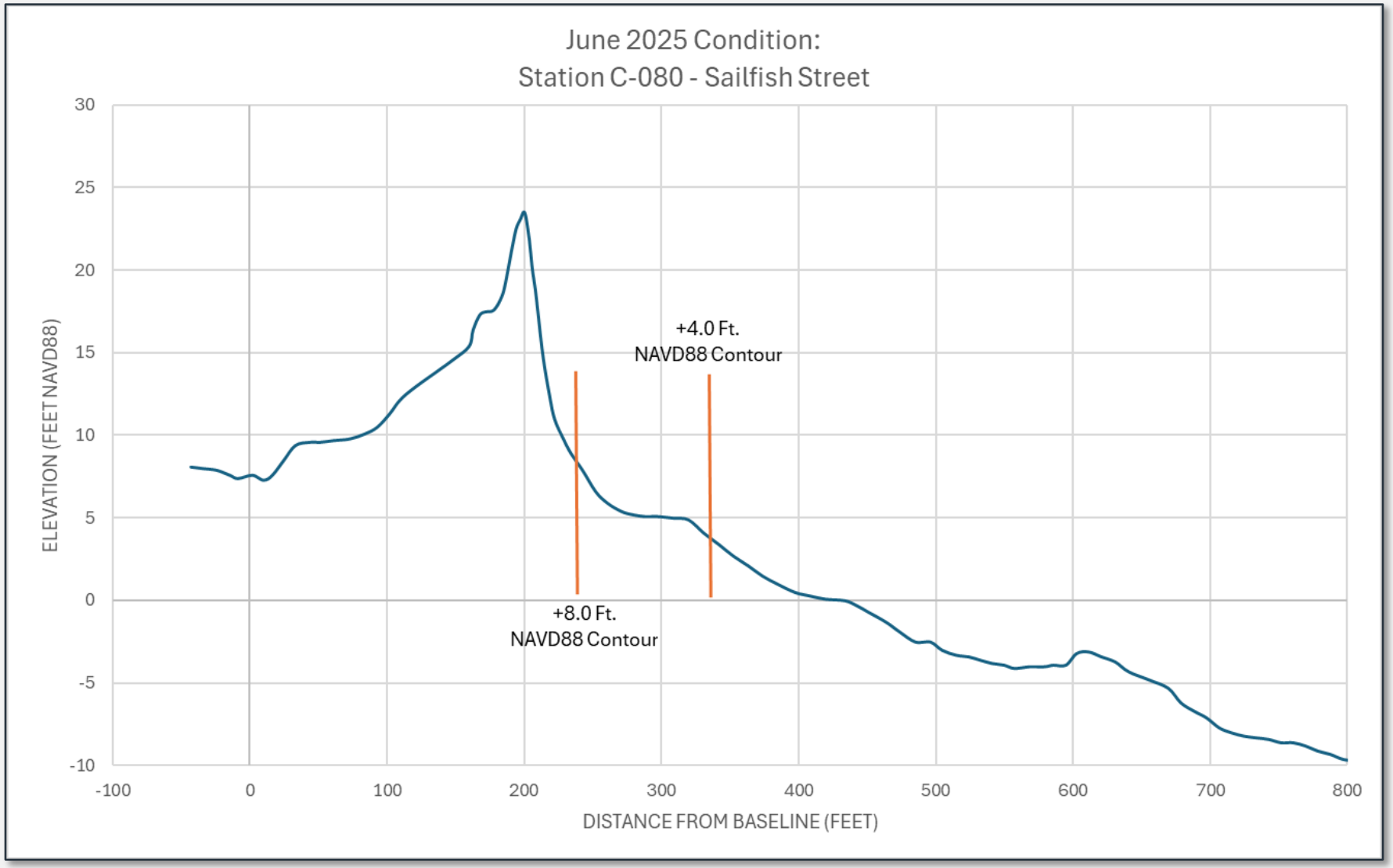


VOLUME CHANGE ANALYSIS

Section	Density Change Rate (cy/ft./yr) June 2023 to June 2025	Total Volume Change (CY) June 2023 to June 2025
Corolla	-5.1	-435,900
Pine Island	-5.7	-204,700
South of the Horse Gate (C-059 to C-120)	-5.2	-640,600



“SUFFICIENT” RECREATIONAL BEACH ANALYSIS



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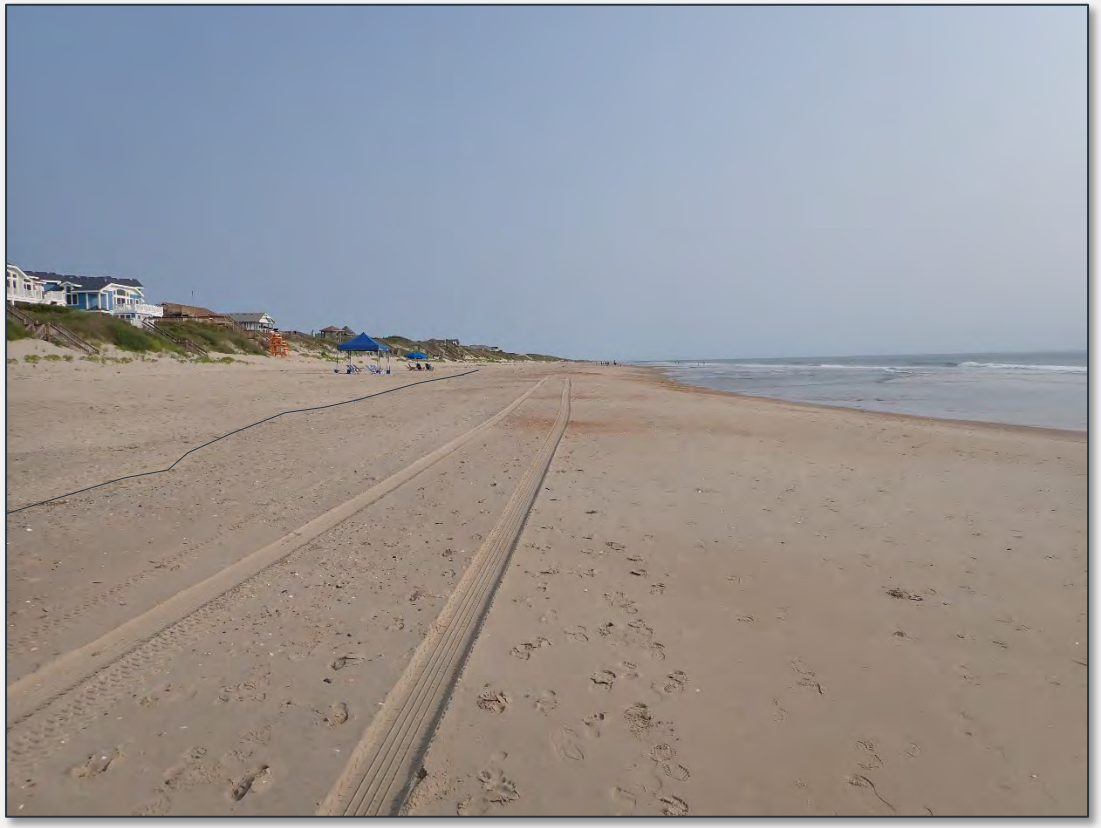


Sta. C-098 (57-foot width)

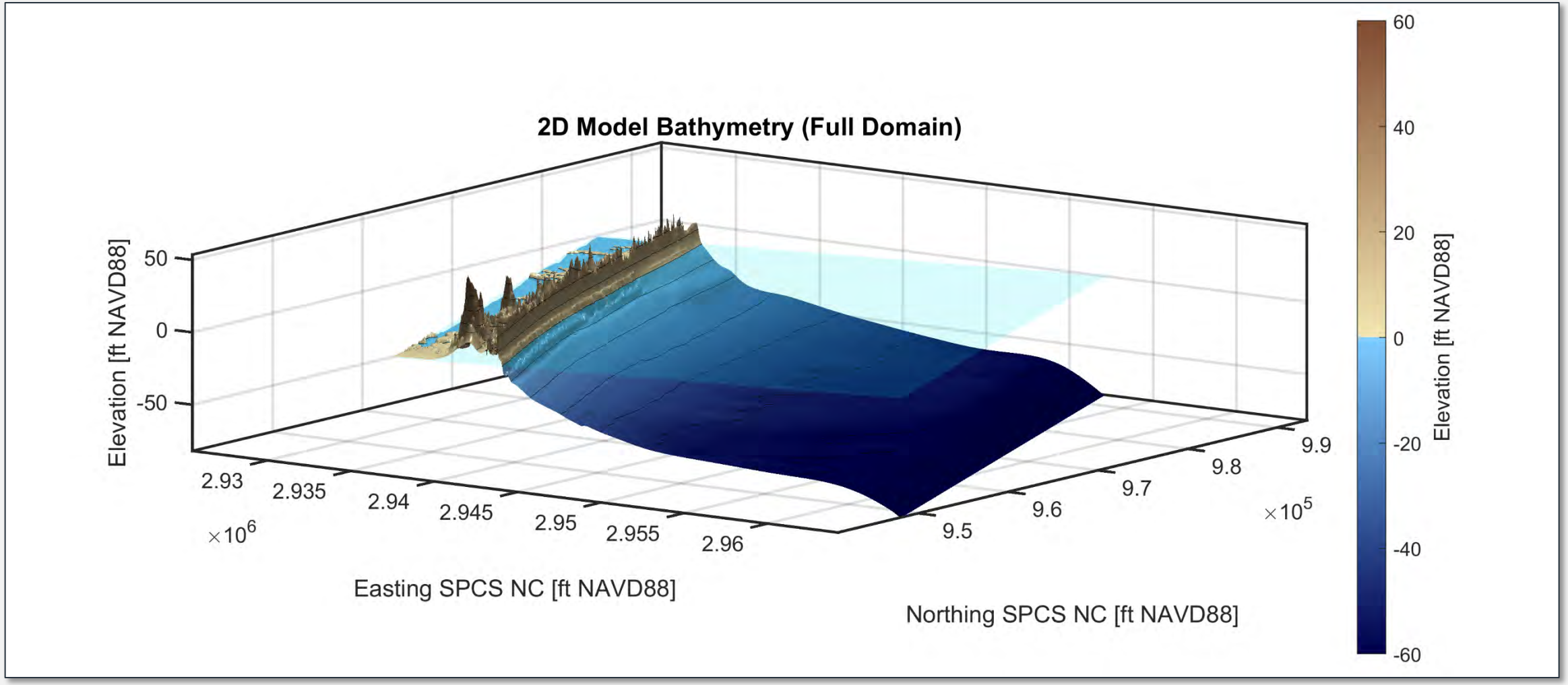
Sta. C-102 (58-foot width)

“SUFFICIENT” RECREATIONAL BEACH ANALYSIS

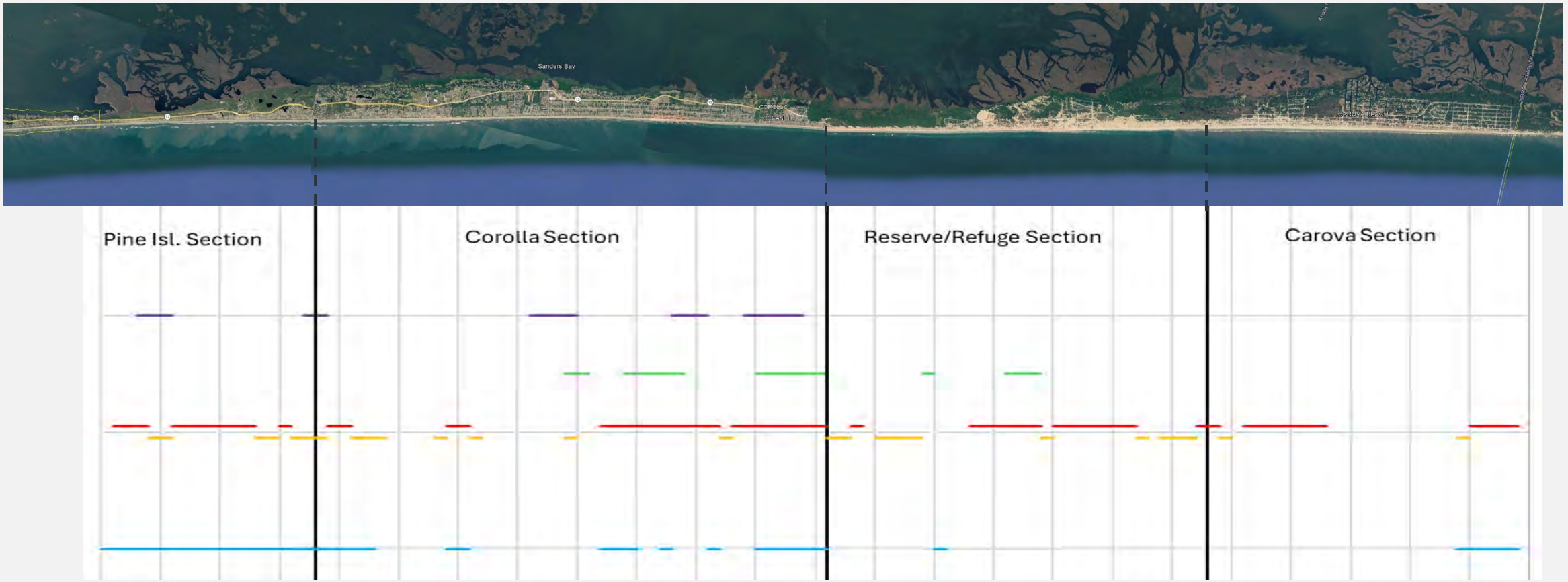
Sta. C-076 (73-foot width)

Sta. C-86 (94-foot width)

XBEACH 2D STORM ANALYSIS



HAZARDS & VULNERABILITY



GENERAL PRINCIPLES OF BEACH MANAGEMENT:

1. Allow the beach to migrate landward naturally and remove/relocate threatened structures;
2. Armor the coast with seawalls/revetments in an attempt to halt the landward retreat of the shoreline;
3. Actively add sand to the system to bolster protection and keep up with the loss of sand due to long term erosion; and
4. Attempt to slow the littoral transport of sand along the beaches and Dunes (groins/breakwaters/sand fencing/dune vegetation/ beach bulldozing).

BEACH MANAGEMENT CONCEPTS:

1. Relocation of vulnerable oceanfront structures;
2. Small-scale beach nourishment projects utilizing truck hauling to increase the size of the dunes and/or widen the beach along shorter segments;
3. Large-scale beach nourishment programs utilizing offshore dredging of sand;
4. Incorporation of coastal structures into beach nourishment programs;
5. Sand fencing and dune vegetation programs to increase the size of existing dunes; and
6. Beach bulldozing program to temporarily increase the volume of sand in the dunes

RELOCATION OF VULNERABLE STRUCTURES:

Photos Courtesy of Expert Movers and Sand Lifters

SMALL SCALE BEACH NOURISHMENT/TRUCK HAUL:

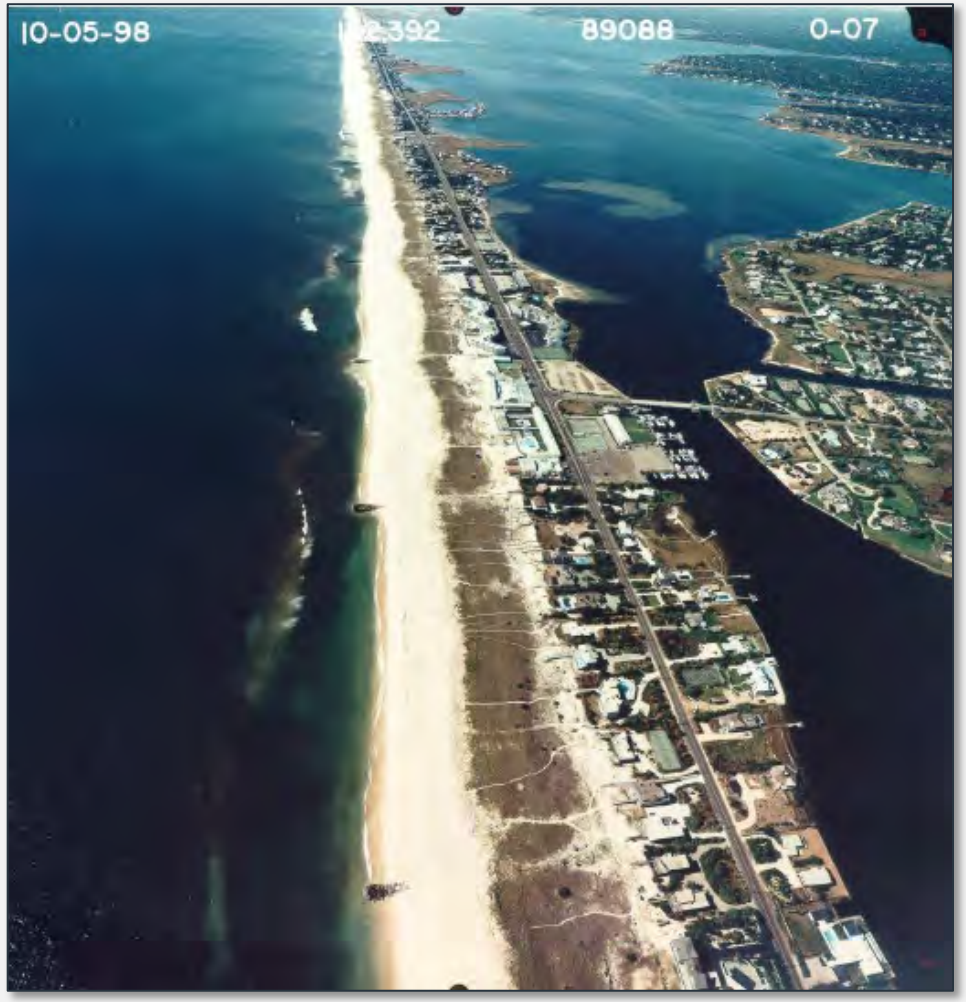
Increase size of dunes and/or widen the beach along shorter segments

LARGE SCALE BEACH NOURISHMENT

Utilizing offshore dredging of sand

COASTAL STRUCTURES

Incorporated into beach nourishment programs



SAND FENCING AND DUNE VEGETATION

Increase size of existing dunes

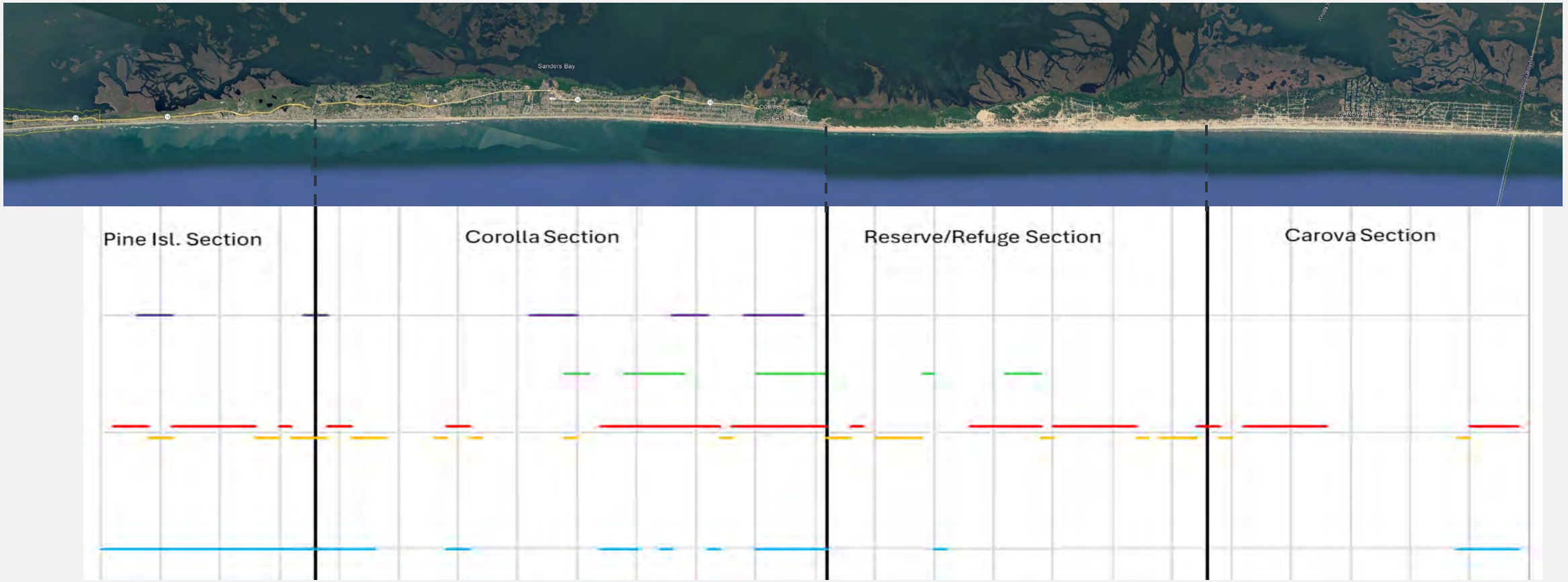
BEACH BULLDOZING

Temporarily increase the volume of sand in the dunes

Photo from Carley, J., *et al*. 2018
Beach Scraping as a coastal management option

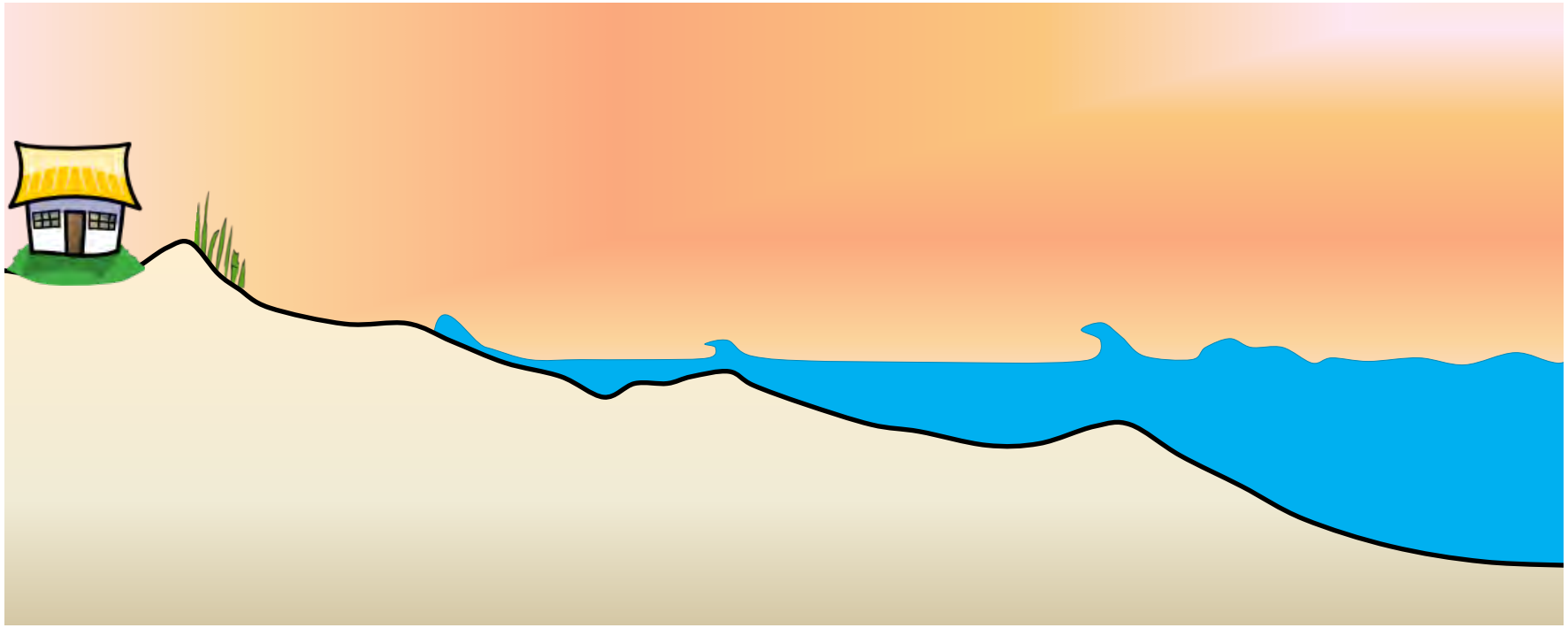
Photos Courtesy ABC North Coast: Bruce MacKenzie

HAZARDS & VULNERABILITY



HAZARDS & VULNERABILITY

Beach Nourishment Schematic



Pre-Project Conditions

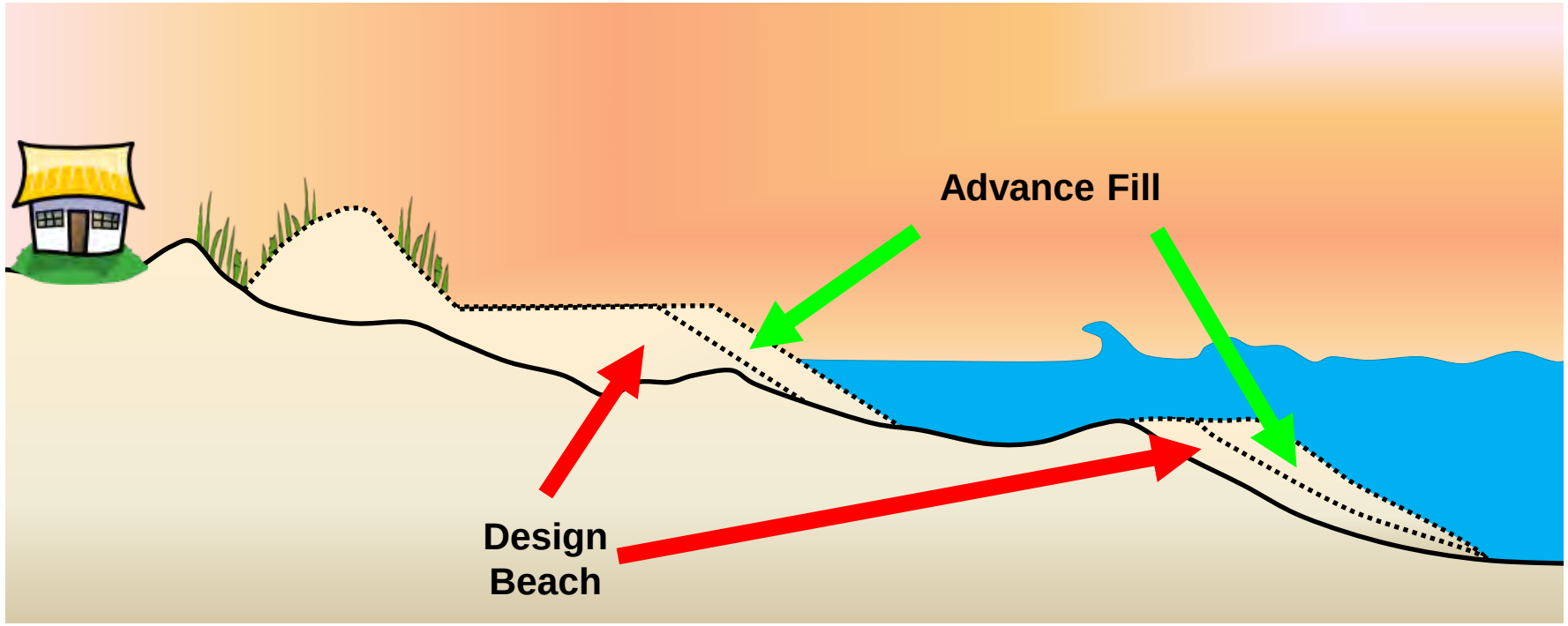
Pre-project condition February 2014 looking north along the Kitty Hawk oceanfront near Bennett St.

Collapsed portions of HWY 12 in Kitty Hawk prior to the initial construction in 2015.

EXTREME STORM ANALYSIS SUMMARY

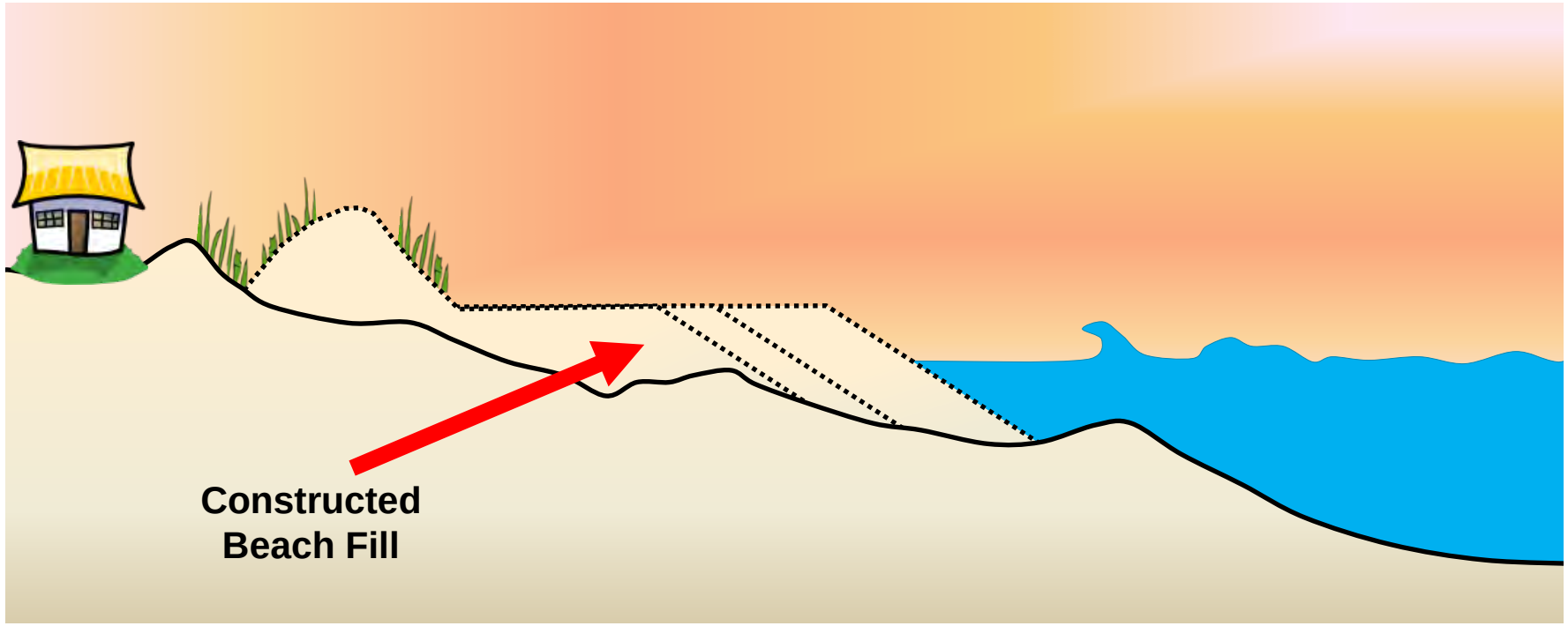
CPE Drone Imagery October 2025 Post Nor'easter

Beach Nourishment Schematic



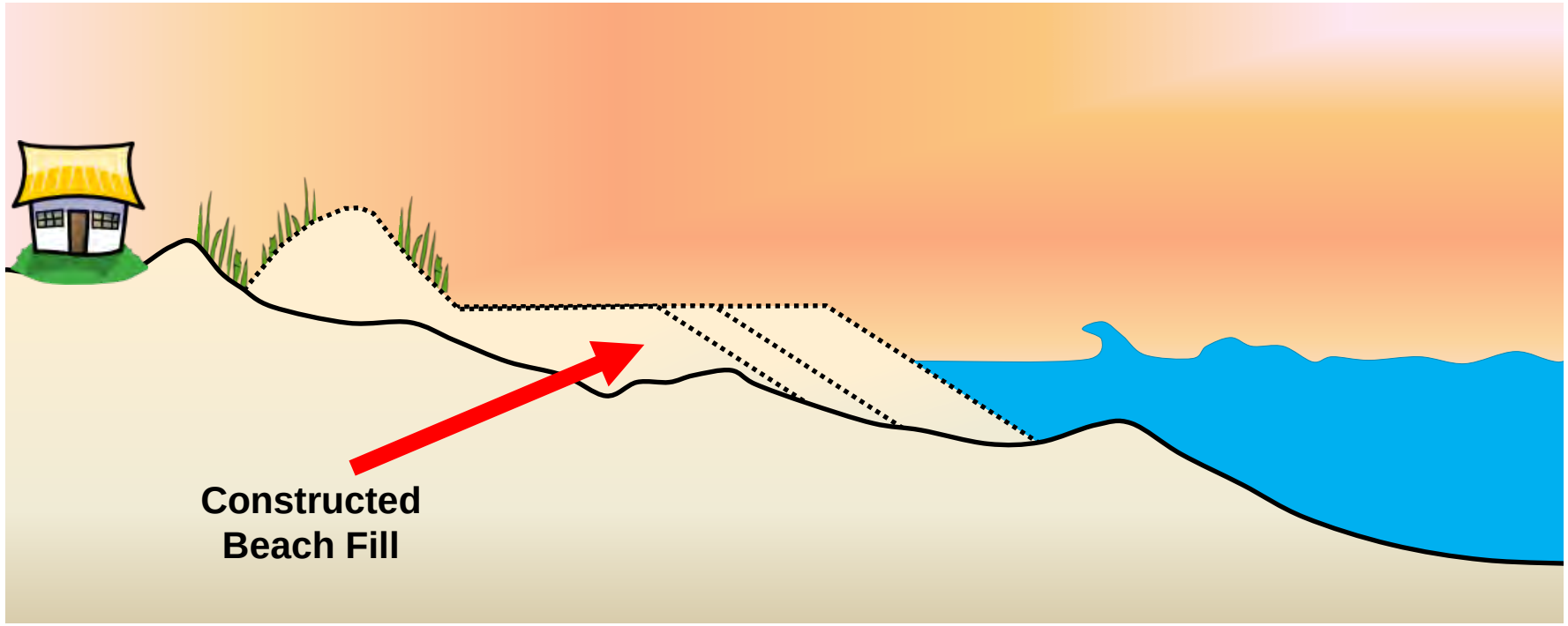
Nourishment Design

Beach Nourishment Schematic



Initial Construction

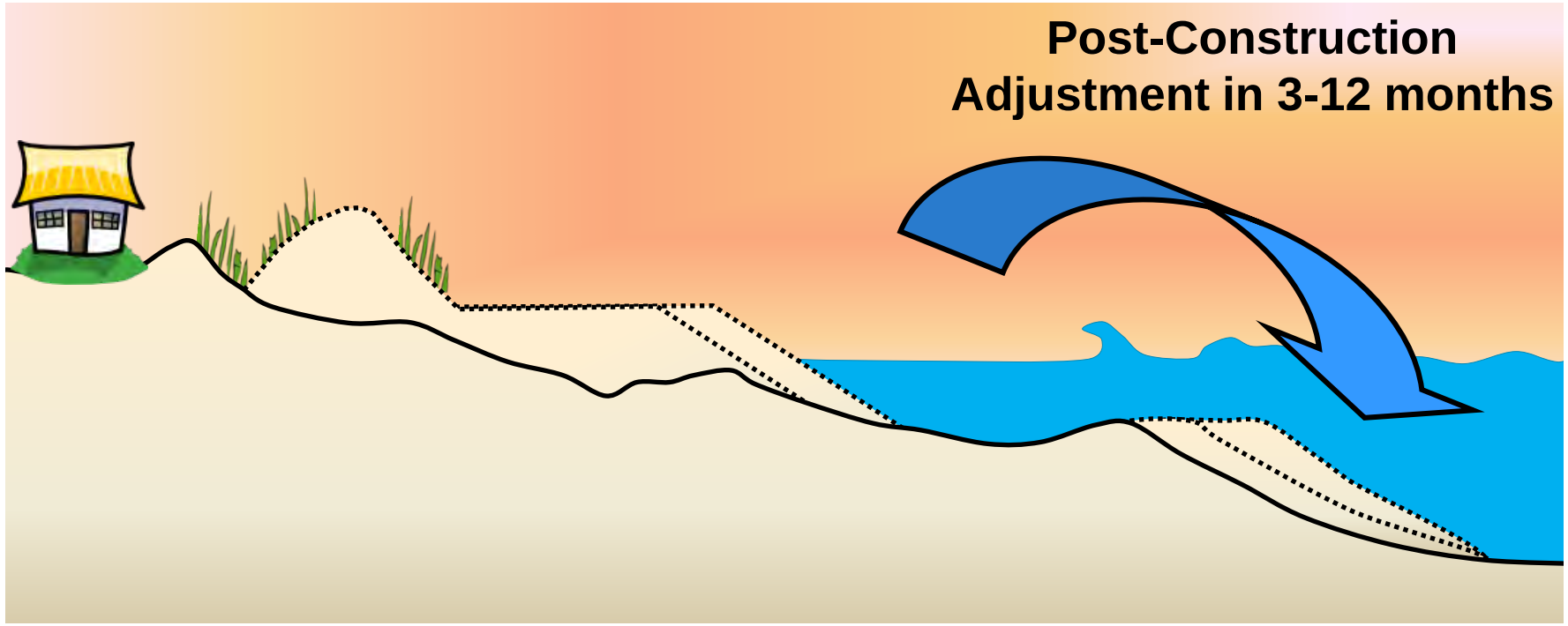
Beach Nourishment Schematic



Initial Construction

COASTAL PROTECTION ENGINEERING

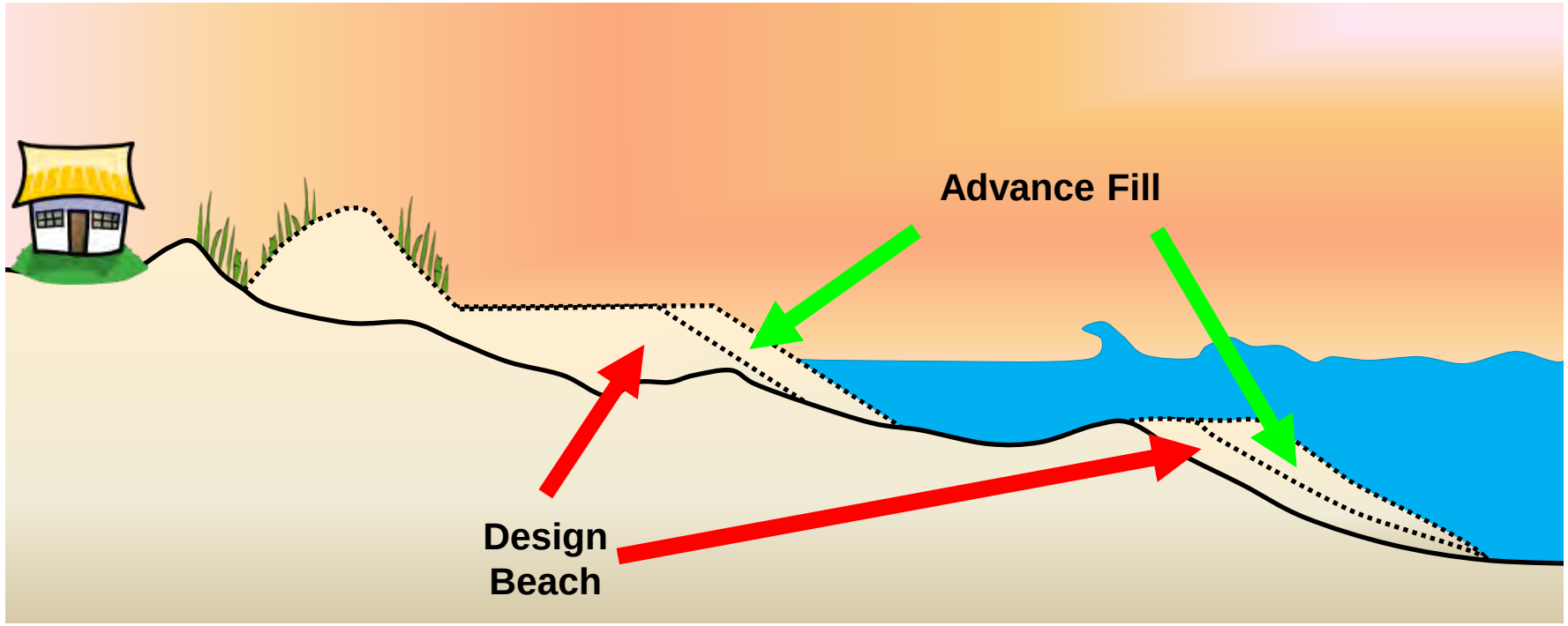
Beach Nourishment Schematic



Equilibration of Beach Fill

Coastal Protection Engineering

Beach Nourishment Schematic



Nourishment Design

Pre-project condition February 2014 looking north along the Kitty Hawk oceanfront near Bennett St.


Condition looking north along the Kitty Hawk oceanfront near Bennett St. in August 2025.

HAZARDS & VULNERABILITY

Thank You

Ken Willson

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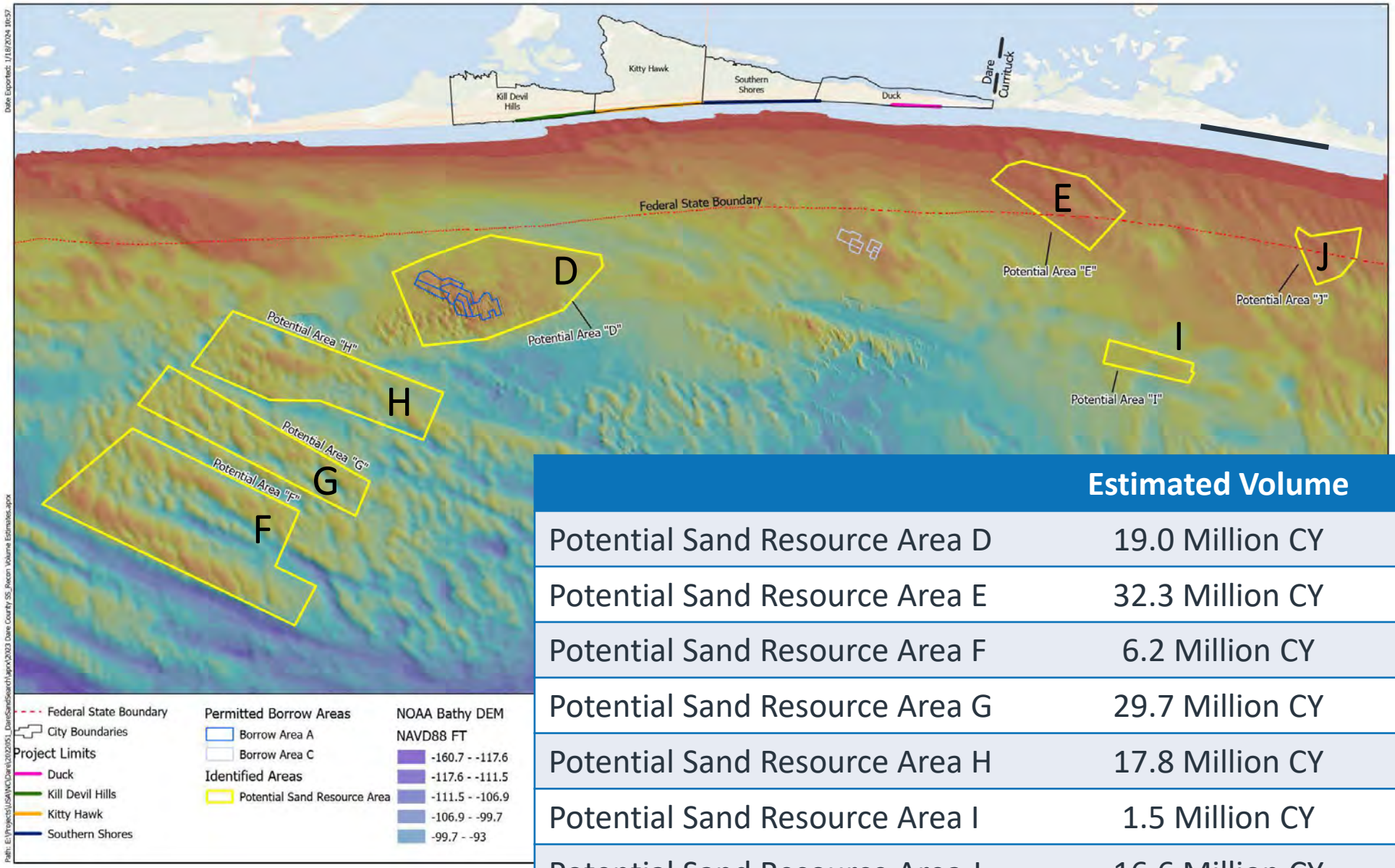

	Estimated Volume
Potential Sand Resource Area D	19.0 Million CY
Potential Sand Resource Area E	32.3 Million CY
Potential Sand Resource Area F	6.2 Million CY
Potential Sand Resource Area G	29.7 Million CY
Potential Sand Resource Area H	17.8 Million CY
Potential Sand Resource Area I	1.5 Million CY
Potential Sand Resource Area J	16.6 Million CY

Approximately 123 MCY of potential sand resources identified through reconnaissance level investigations

PROPOSED 2027 MULTI-TOWN BEACH NOURISHMENT

Total Volume: 19.3 MCY

E-8: 2.0 MCY

D-4: 1.7 MCY

D-5: 1.7 MCY

Original Borrow Area A: 10.2 MCY

Expanded Borrow Area A: 13.9 MCY

Coastal Protection Engineering