5 February 2016

TERMINAL GROIN JUSTIFICATION & CONSTRUCTION

FSBPA Technical Conference

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Coastal Engineering

Definitional Scheme
Terminal Groin – (T.G.)

Typically a shore perpendicular structure placed at the end of a littoral system – case in point – end of a barrier island

GOAL – Beneficially affect littoral transport …

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“Terminal Groin” vs “Jetty”

- A terminal groin is not a jetty … however a jetty can function as a de facto non-permeable terminal groin.
- A terminal groin can be warranted with or without a maintained navigation project channel in close proximity.

Basic Purposes of a Terminal Groin

- Stabilize the end of a barrier island (migration),
- Stabilize an updrift shoreline adversely affected by an unstabilized island terminus,
- Function as a template at the terminus of a beach fill.

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Basic Purposes of a Terminal Groin

- Reduce inlet or navigation channel effects at the terminus of an island and its littoral system,

- In contrast, a jetty is solely intended to benefit a navigation project channel.

Other Structures Can Perform Similar Functions

- Groin field,
- Detached breakwater(s),
- Special purpose weir groins (a weir jetty)

Local Site Considerations at Terminus of Barrier Islands

- Inlet interior littoral environment
  - May necessitate need for reduced, controlled littoral transport past the T.G.
- Degree of impact of the T.G. on the tidal inlet (ideally none).

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Local Siting Considerations at Terminus of Barrier Islands

- Potential morphological changes to the inlet system over time due to modifications to the barrier island's littoral system,
- Size of the adjacent inlet.

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Design Variations

- "Leaky" vs "Tight" structure (aka permeable vs impermeable),
  - Dependent upon the premise for deployment.
  - Dependent upon the downdrift littoral system (or lack thereof)

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Design Variations

- Groin length dependent upon reach of updrift benefit desired – versus – probability of reduced sediment transport past the structure (i.e. leaky),
- Spit formation (typically an indicator of success for a “leaky” structure.

Design Guidance

- Permeability of a T.G. can be achieved by elevation, length, porosity, materials selection, etc.
- Foundation considerations are extremely important if design intent is to be maintained over the project life.

Global Considerations

- A T.G. will generally have morphological considerations. One needs to know historical connotation of the site and be able to predict future.
- Pragmatically a T.G. is a permanent man-alteration to the environment. Modifications are possible – but the commitment to such a structure is "relatively" permanent.

Global Considerations

- Future structure maintenance should be addressed since changes in configuration (over time due to storms, settlement, etc.) can adversely affect the original design intent of the engineer and the entire premise of the project.
- Monitoring is a must …

EXAMPLES

- **Non-Permeable Structure**
  - **Bonita Beach, FL (1995)**
- **Permeable (“Leaky”) Structures**
  - **Amelia Island, FL (2004)**
  - **Hilton Head Island, SC (2012)**
  - **Bald Head Island, NC (2015)**

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BONITA BEACH TERMINAL GROIN

Pre-Project (May 1995)

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BONITA BEACH TERMINAL GROIN

Construction (September 1995)

Pre-Fill

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BONITA BEACH TERMINAL GROIN

Post-Project (October 1996)

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“LEAKY” TERMINAL GROIN DESIGN PRECEPTS

- Structure must have low crest elevation susceptible to overtopping,
- Structure should be “semi-permeable”,
- Rubble mound construction,
- Large uniform armor rock.

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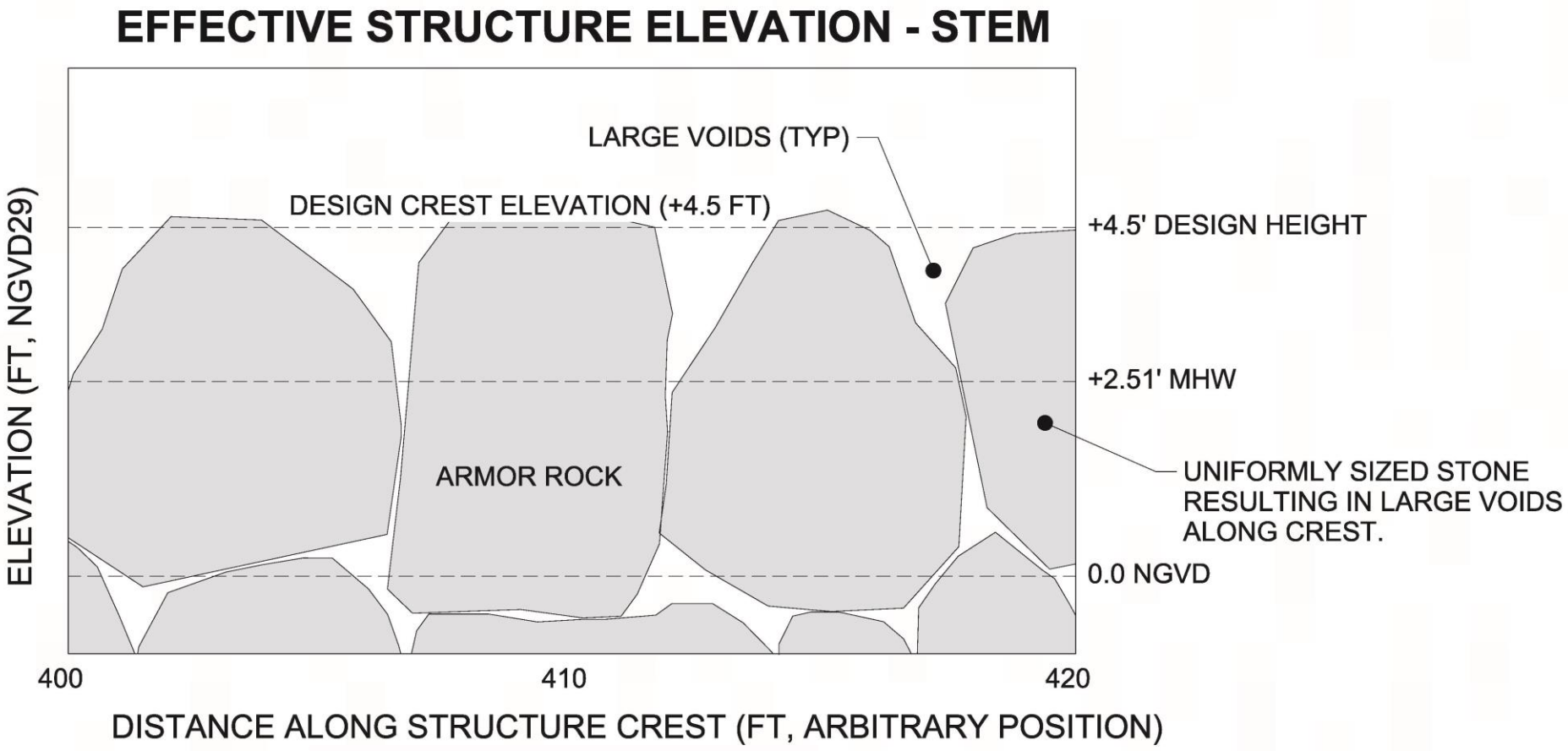
PERMEABLE DESIGN



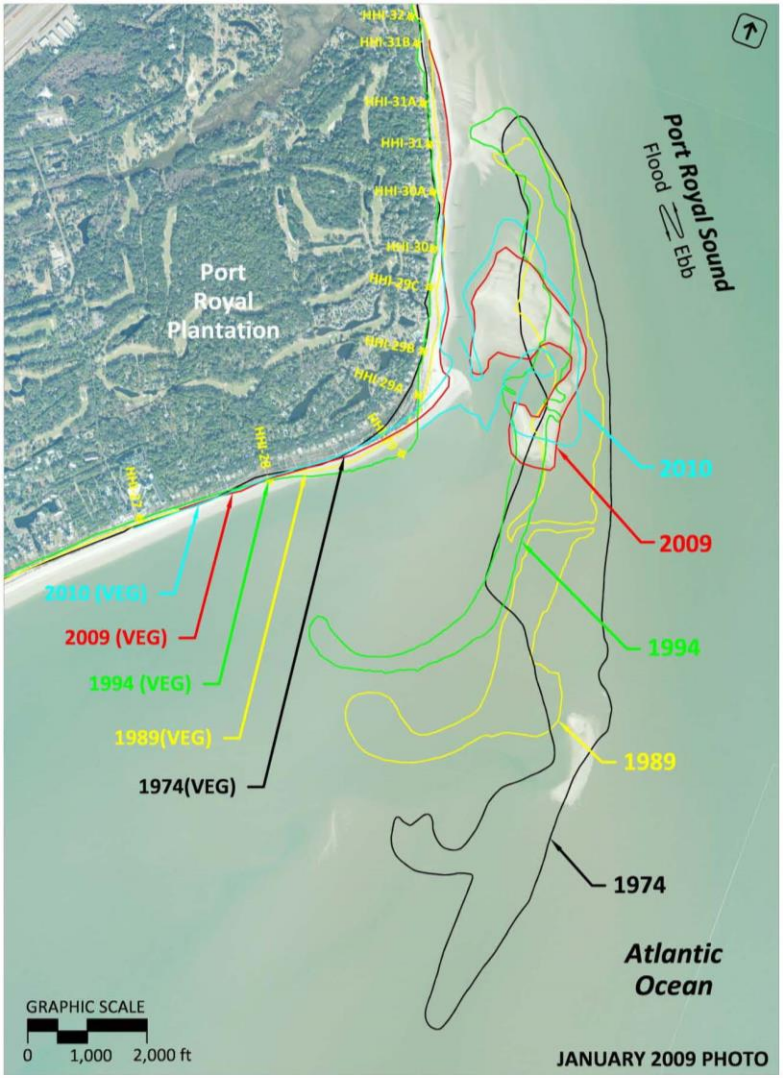
NO CHINKING STONE ALLOWED

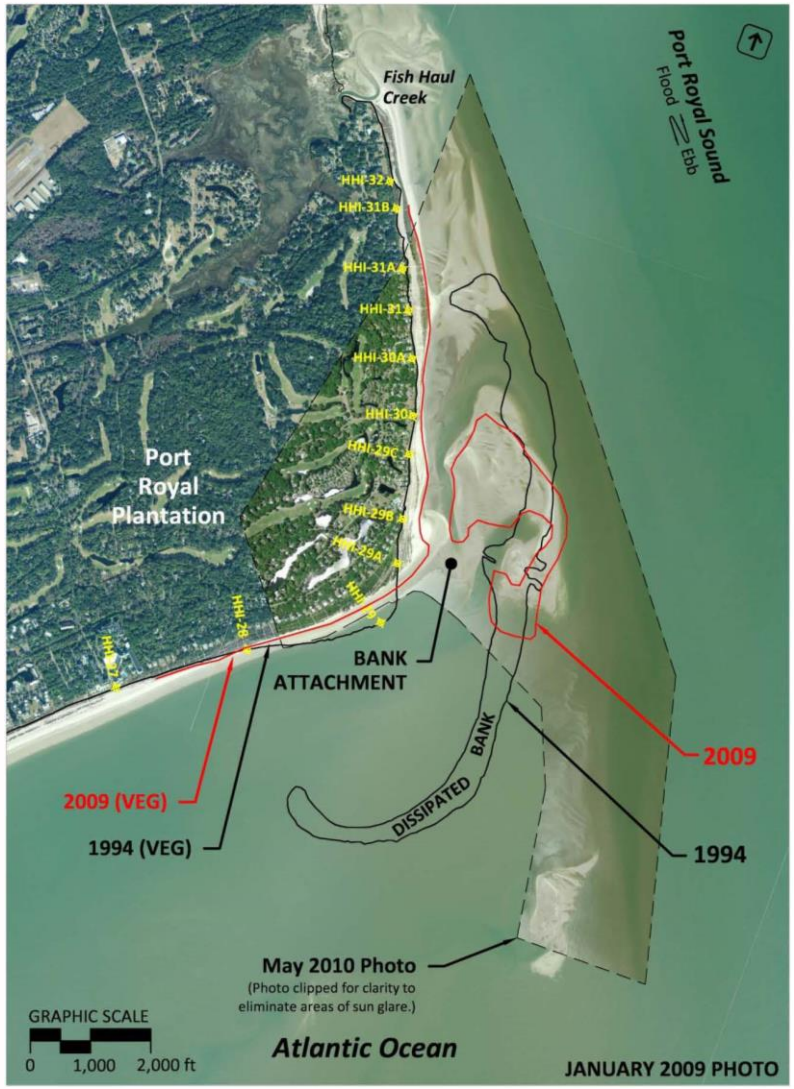
EFFECTIVE VOID RATIO OF 25-35%+

Town of Hilton Head Island, SC

Beach Nourishment and Terminal Groin Project

Christopher G. Creed, P.E.





Joiner Bank History - Recessional

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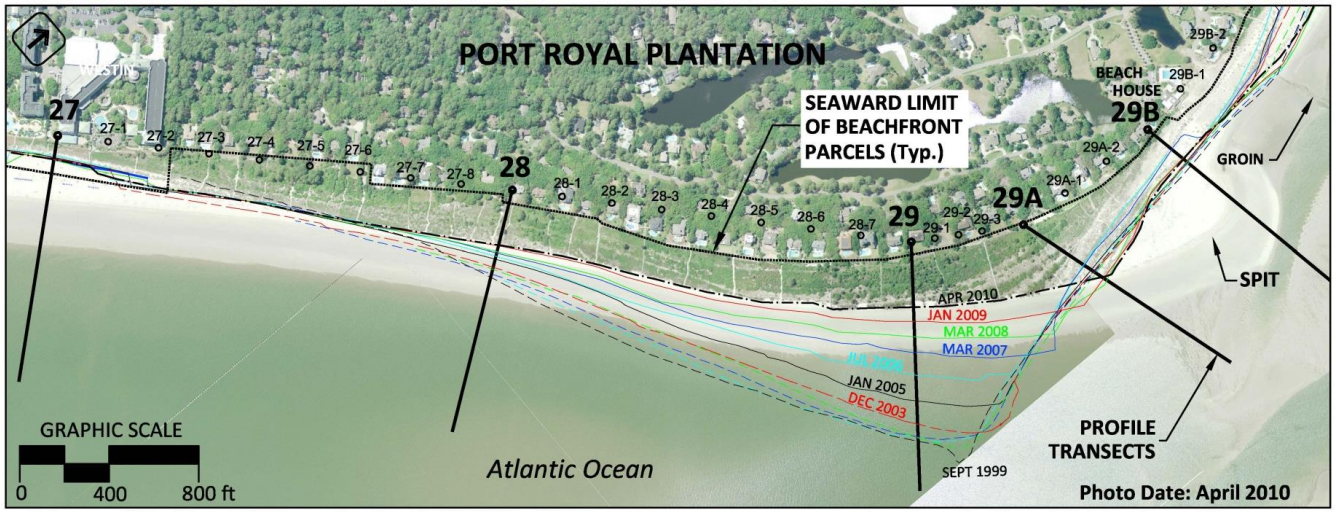

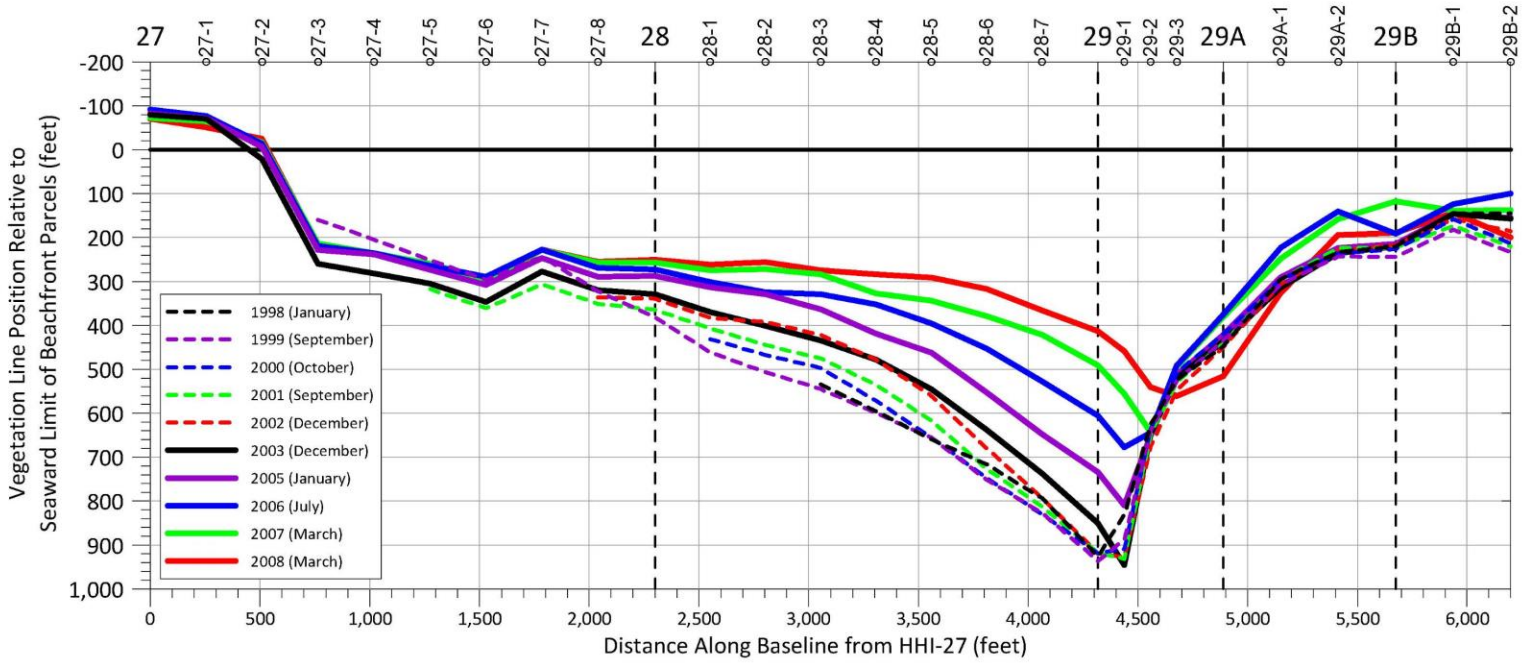

Shoreline Change Conditions at 'The Heel"

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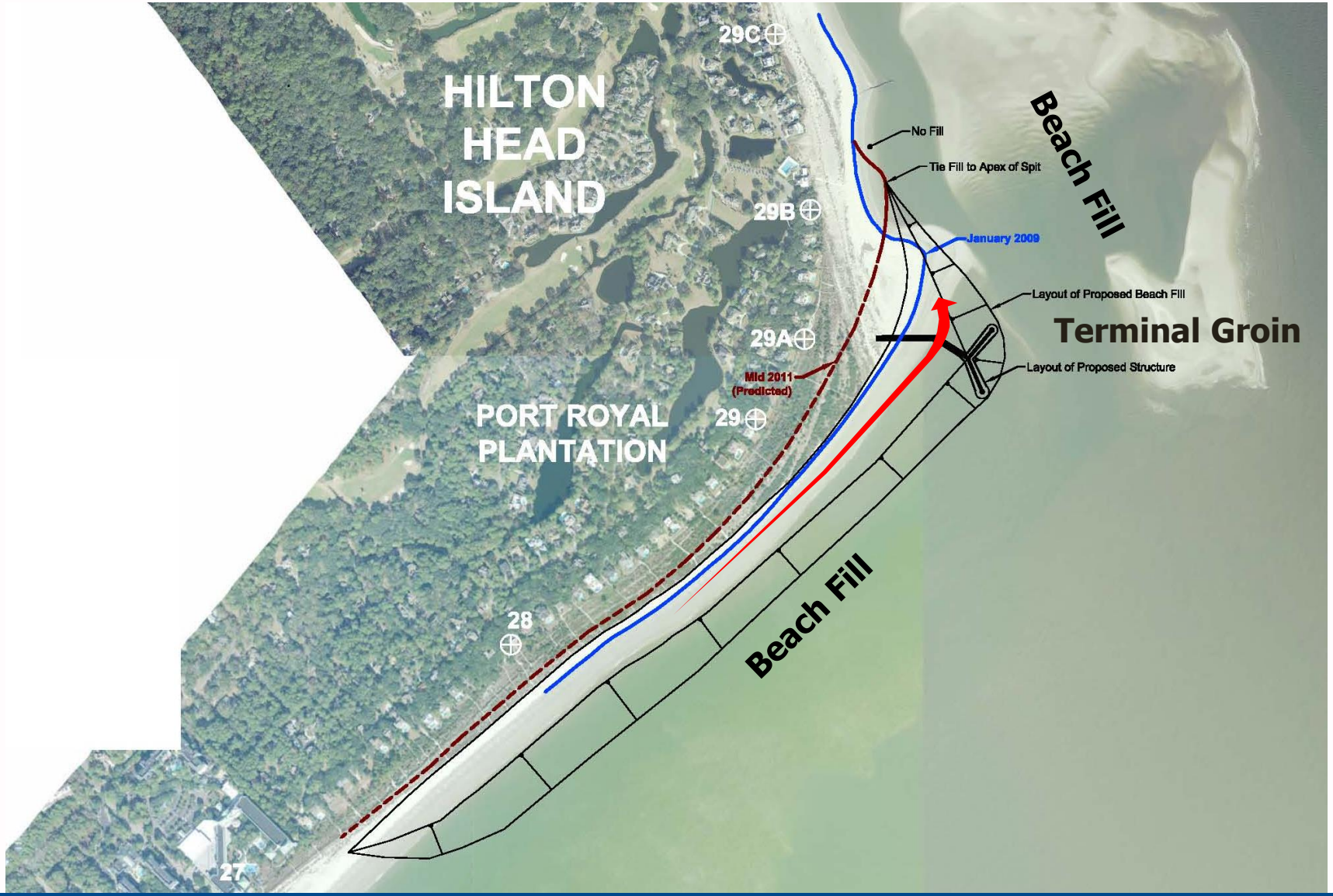


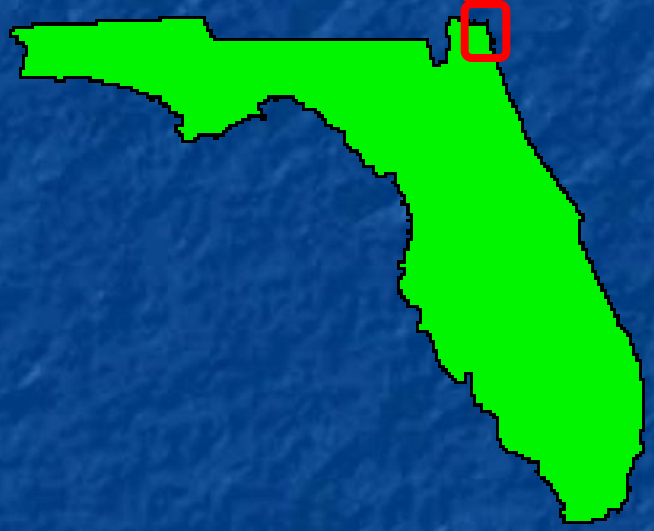
Solution: Beach Fill & Terminal Groin

Terminal Structure under construction - Feb 2012

Plan View

Post-Construction

Amelia Island



Cumberland Island, Ga

GA

FL

St. Mary's River Entrance

Amelia Island (15.2 km)

Project Area

Nassau Sound

Little Talbot Island

Ft. George Inlet

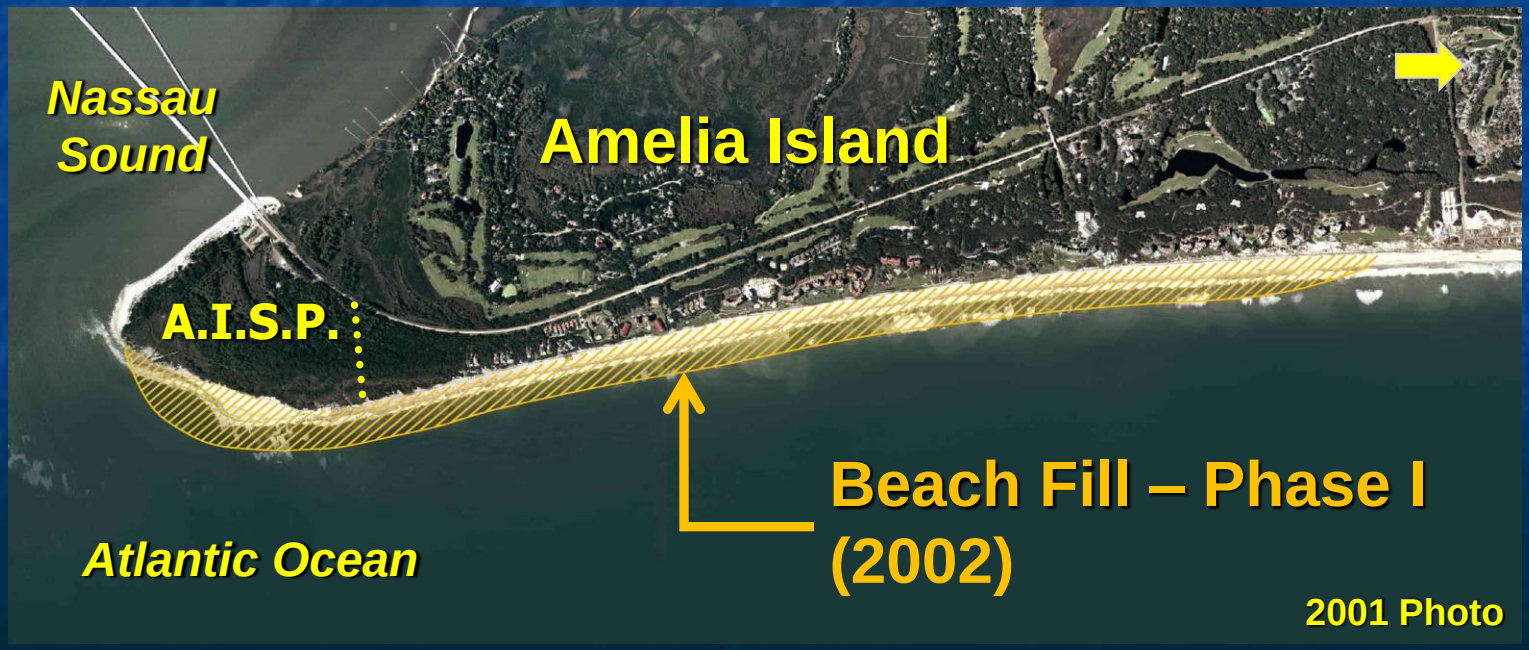
St. John's River Entrance

JACKSONVILLE

2001 Photo

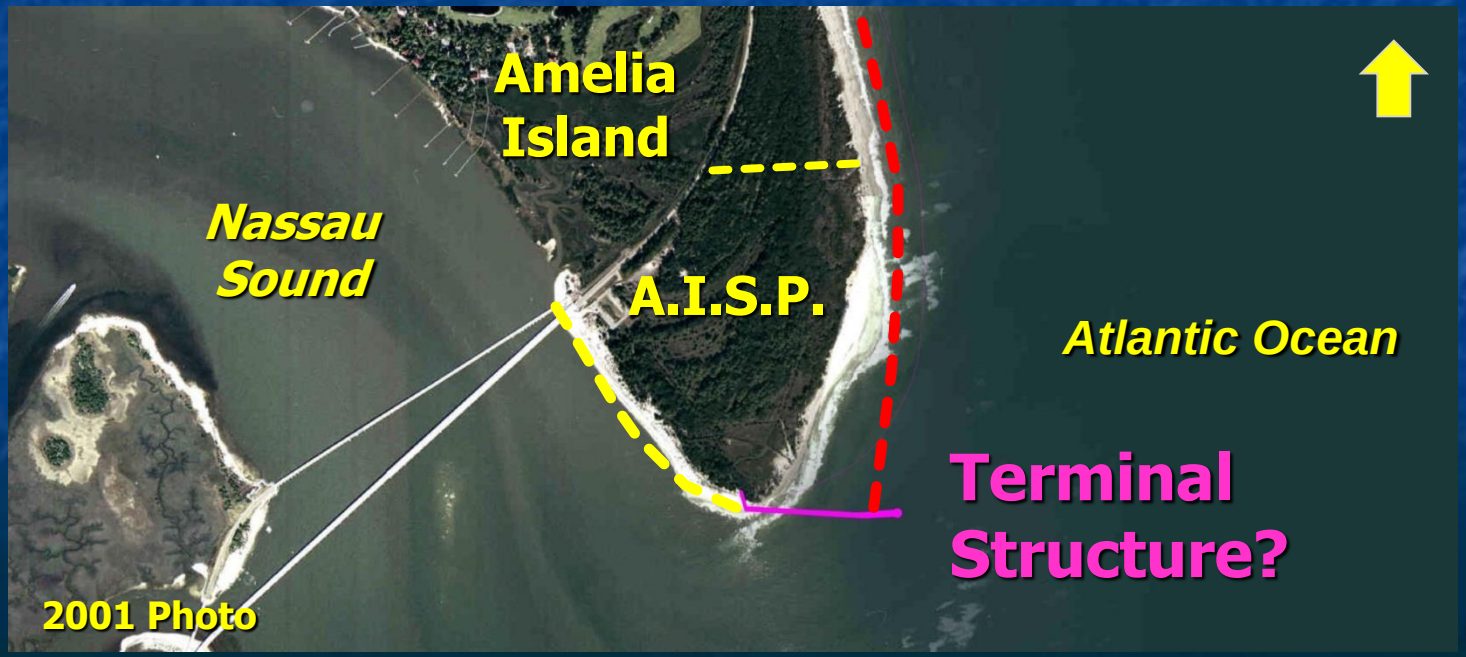
Phase II Stabilization

To introduce structural stabilization in order to reduce end losses from a 5.6 km (3.5 miles) updrift beach restoration project …

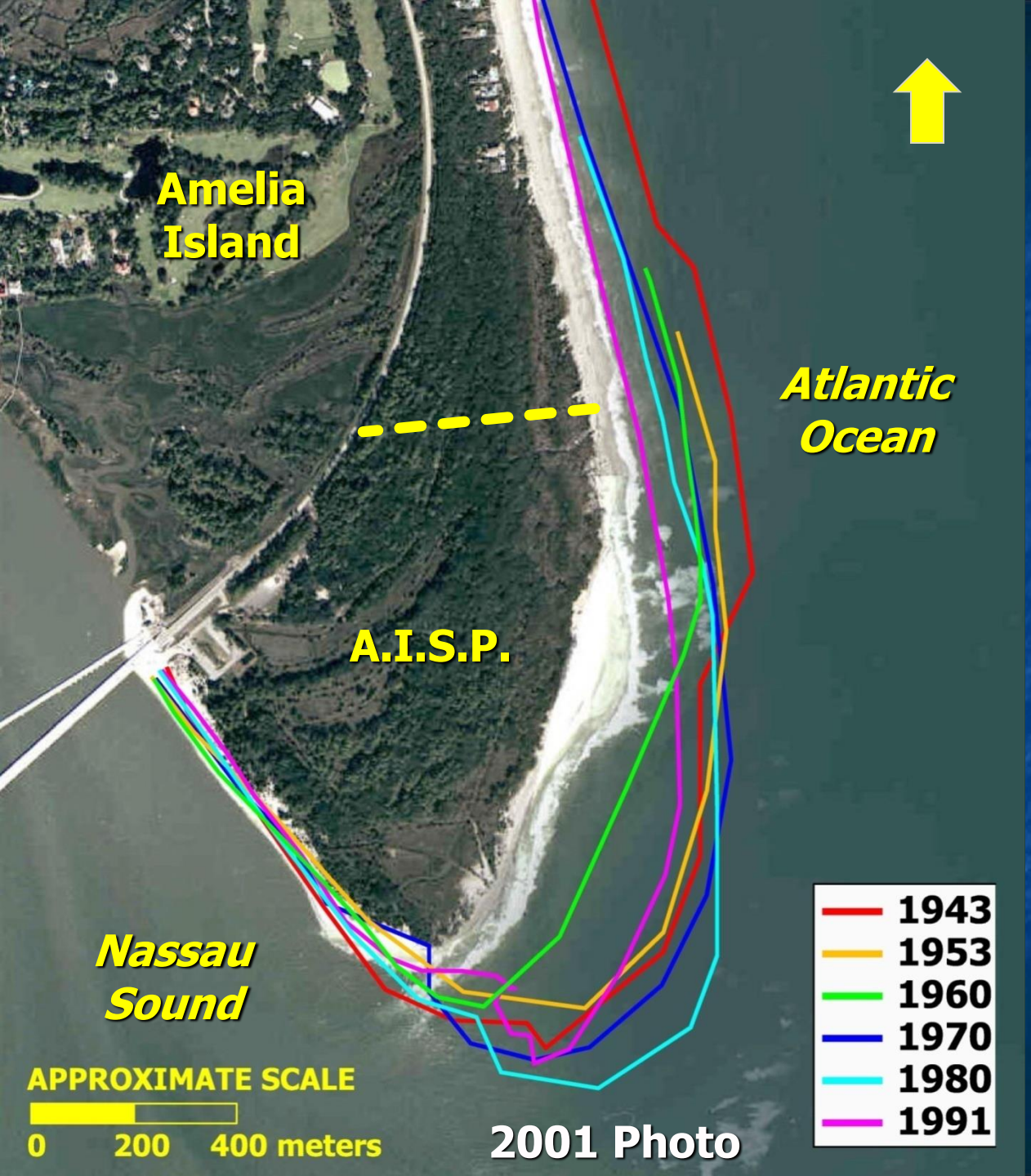


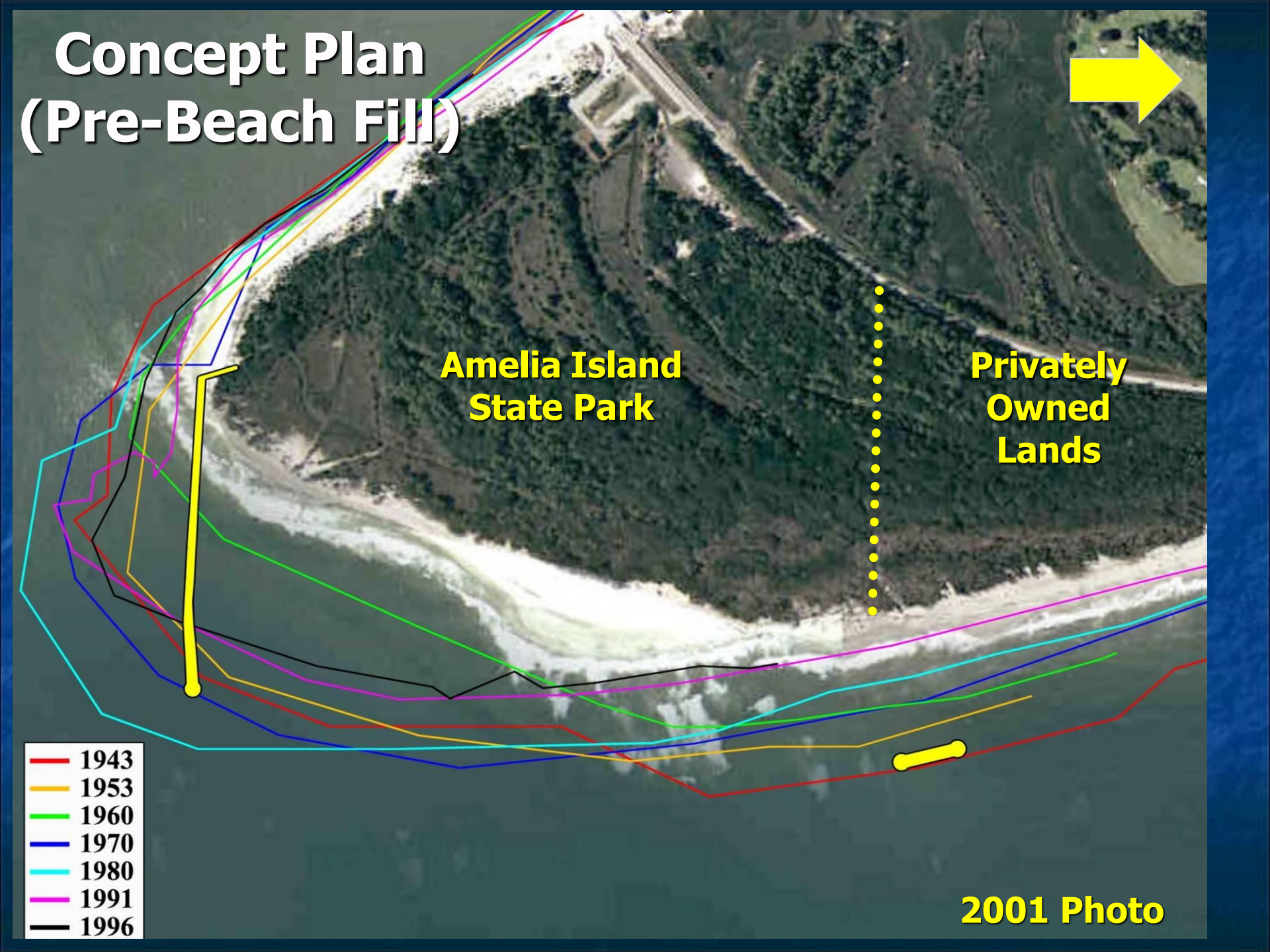
Project Goal

…without adversely affecting the balance of sediment transport required to maintain the downdrift inlet facing shoreline of a state park.

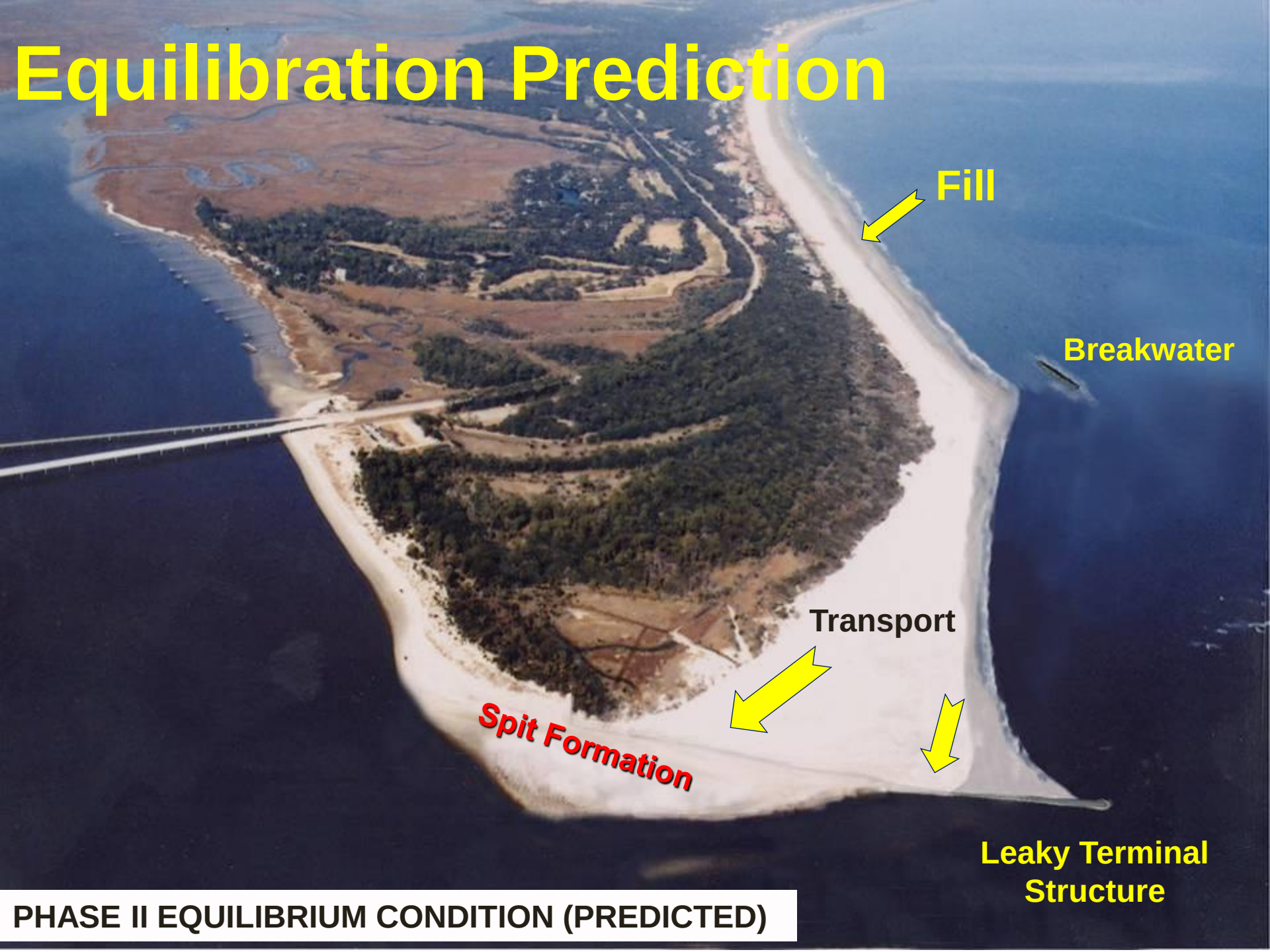


Historical Shorelines




Concept Plan
(Pre-Beach Fill)
Amelia Island
State Park
Privately
Owned
Lands
1943
1953
1960
1970
1980
1991
1996
2001 Photo

Equilibration Prediction



PHASE II EQUILIBRIUM CONDITION (PREDICTED)


March 2005

South Amelia Island, Florida

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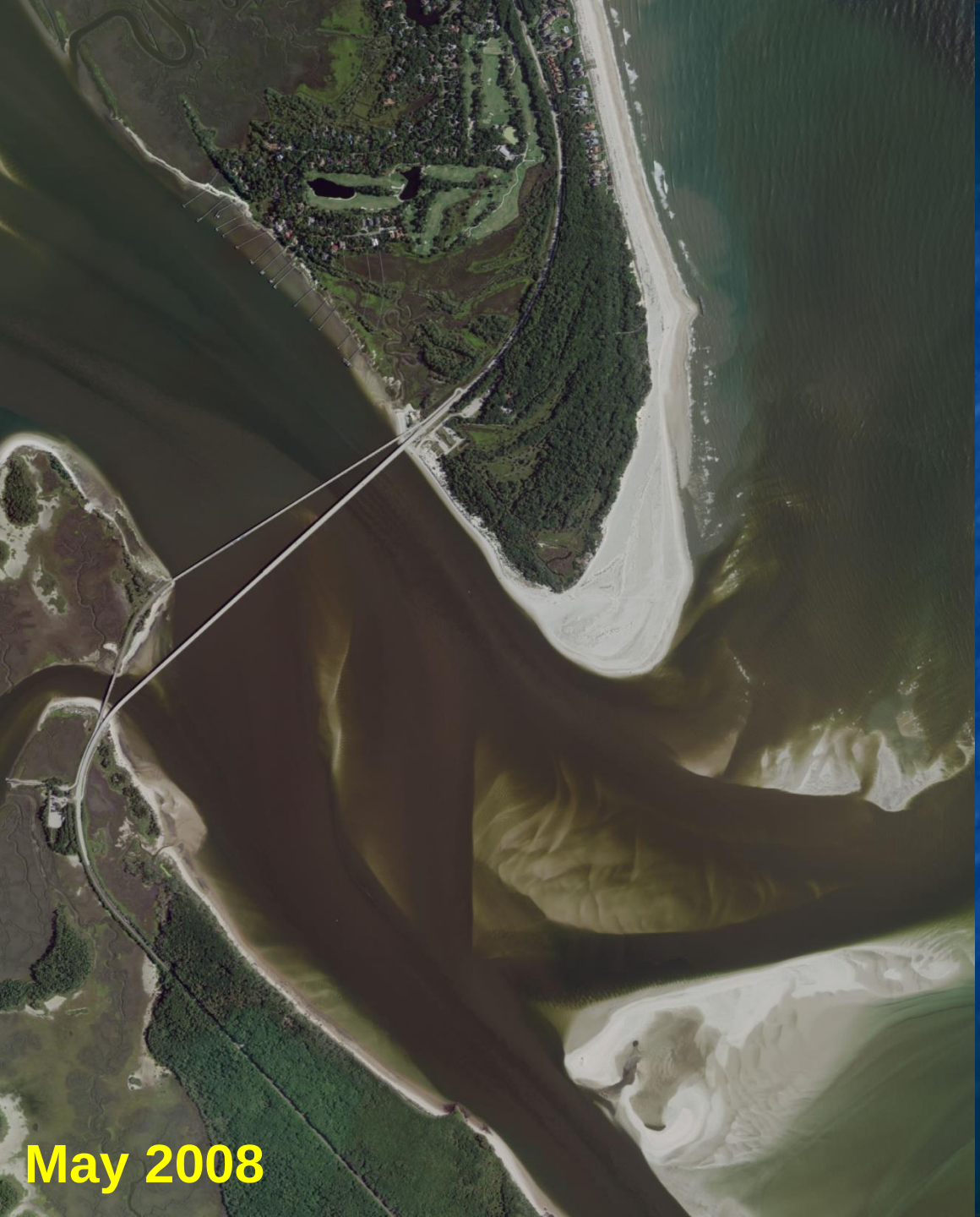
May 2008

THE TAKE-AWAY …

… the BEST terminal groin is a BURIED groin.

January 2016 Photo

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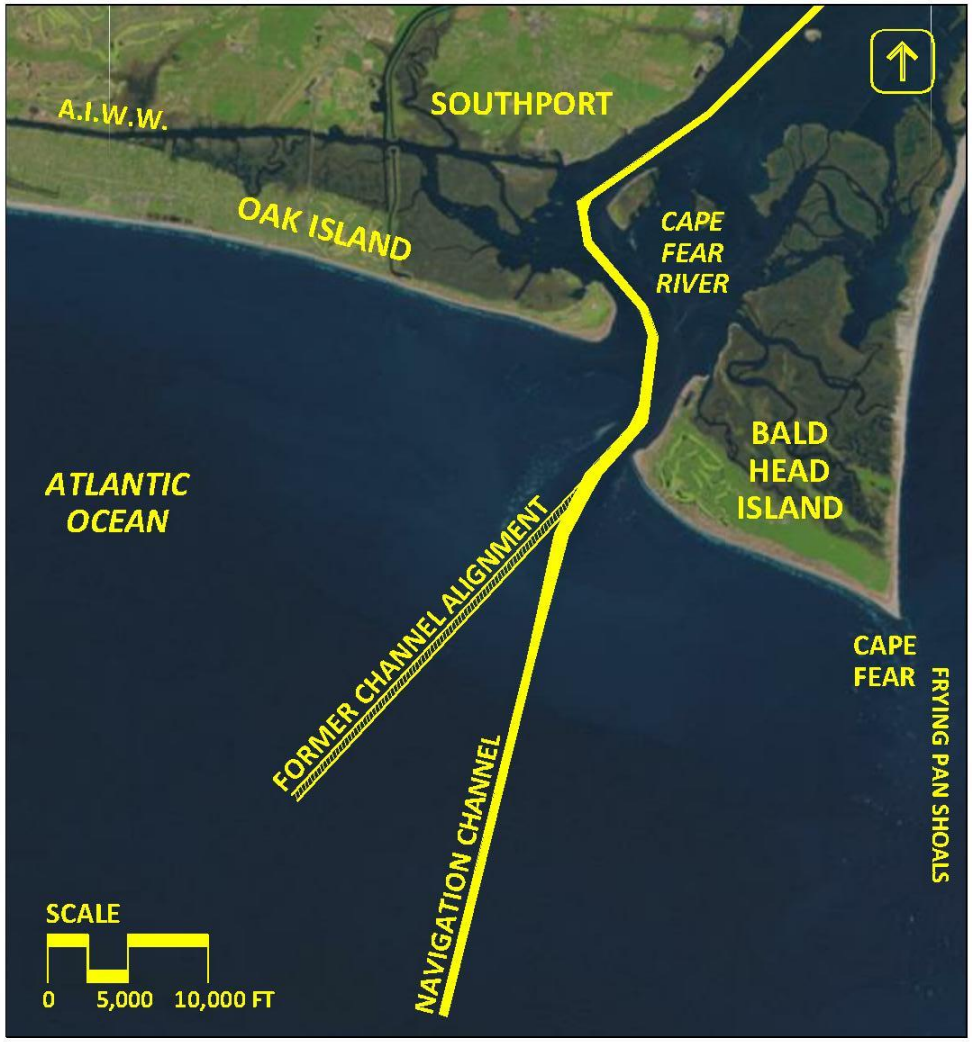
Bald Head Island, NC



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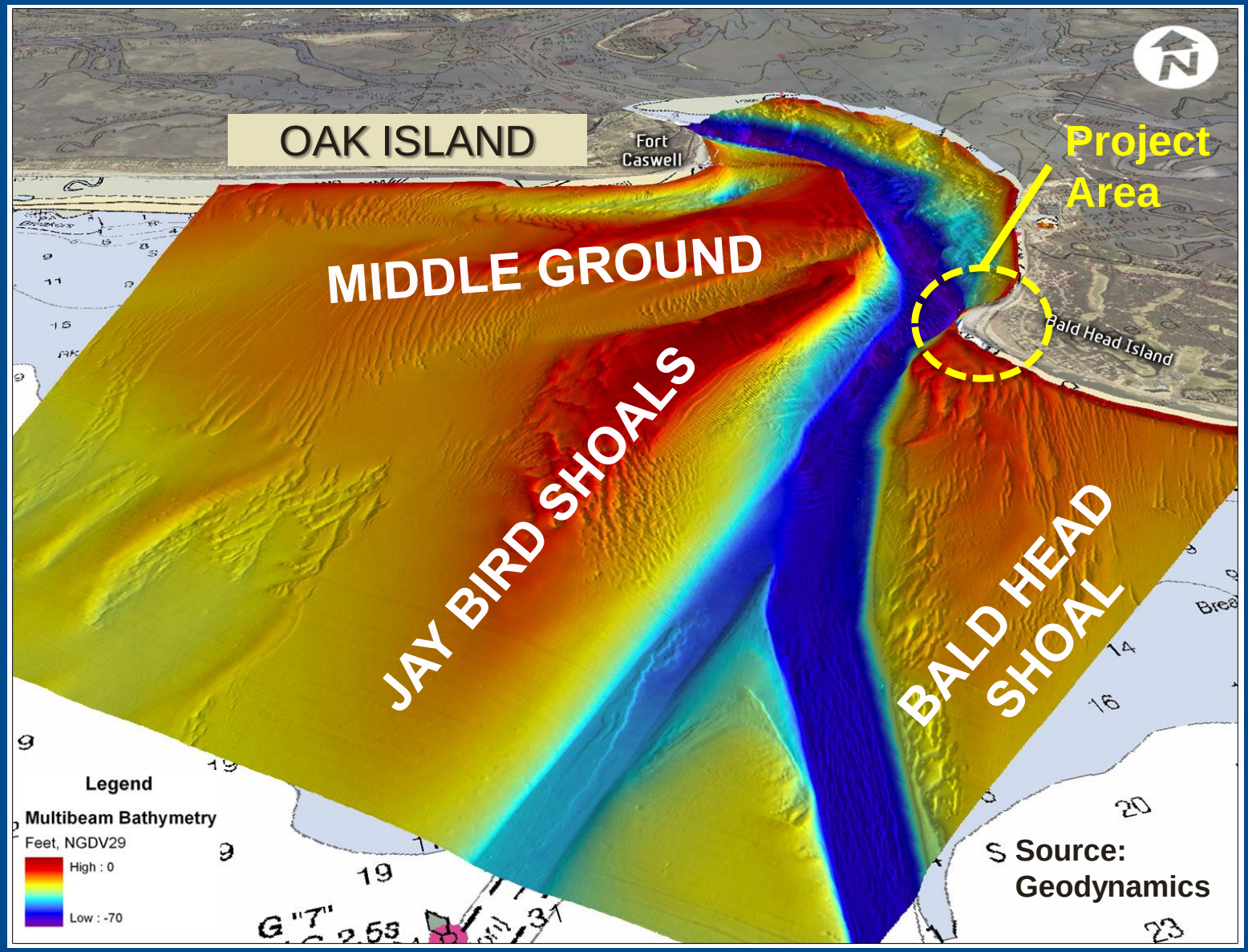

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VBHI - TERMINAL GROIN JUSTIFICATION / GOAL

- Reduce navigation project impacts,
- Reduce annual sand losses from beach nourishment and beach disposal projects,
- Provide a “template” for shoreline realignment conducive to reducing the rates of littoral transport.

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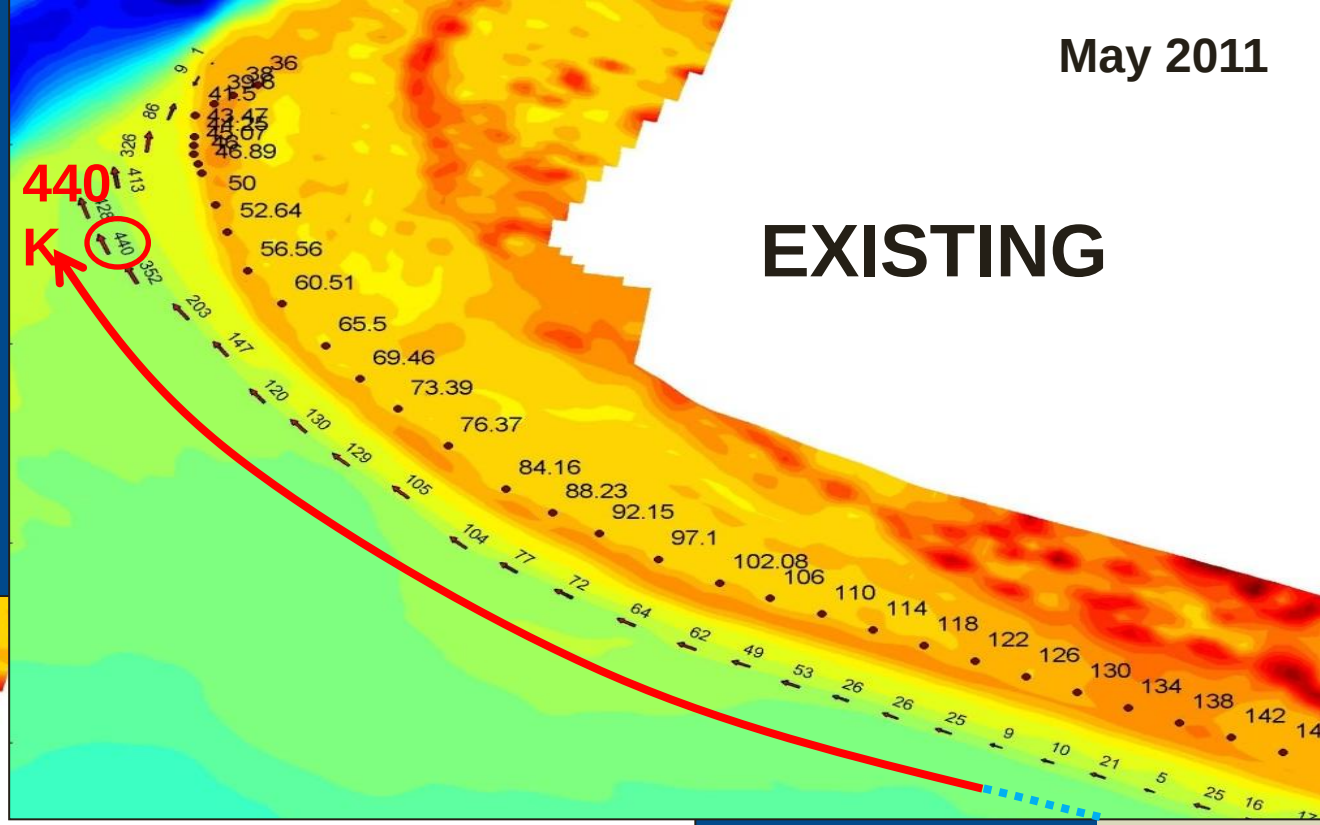
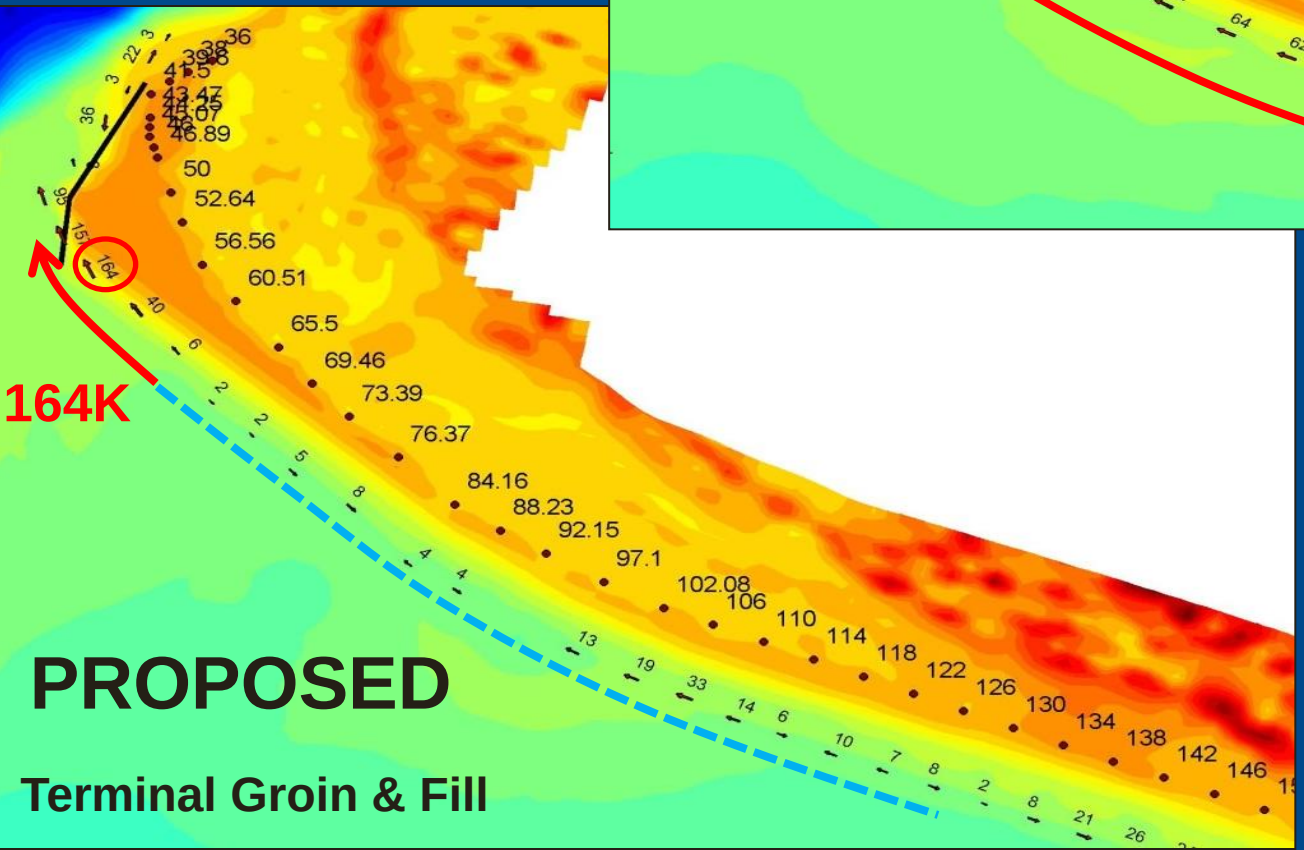
Sediment Transport Potential (cy/yr)

May 2011





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VBHI – TERMINAL GROIN DESIGN PRECEPTS

- Structure must be “leaky” (i.e. low and permeable),
- Rubble mound construction,
- Large uniform armor rock,
- Low maintenance,
- Marine mattress foundation,
- Storm resistant.

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PROJECT JUSTIFICATION – NEAR TERM

Dredging Operations at "The Point"

Initial Construction

2000 Deepening Project

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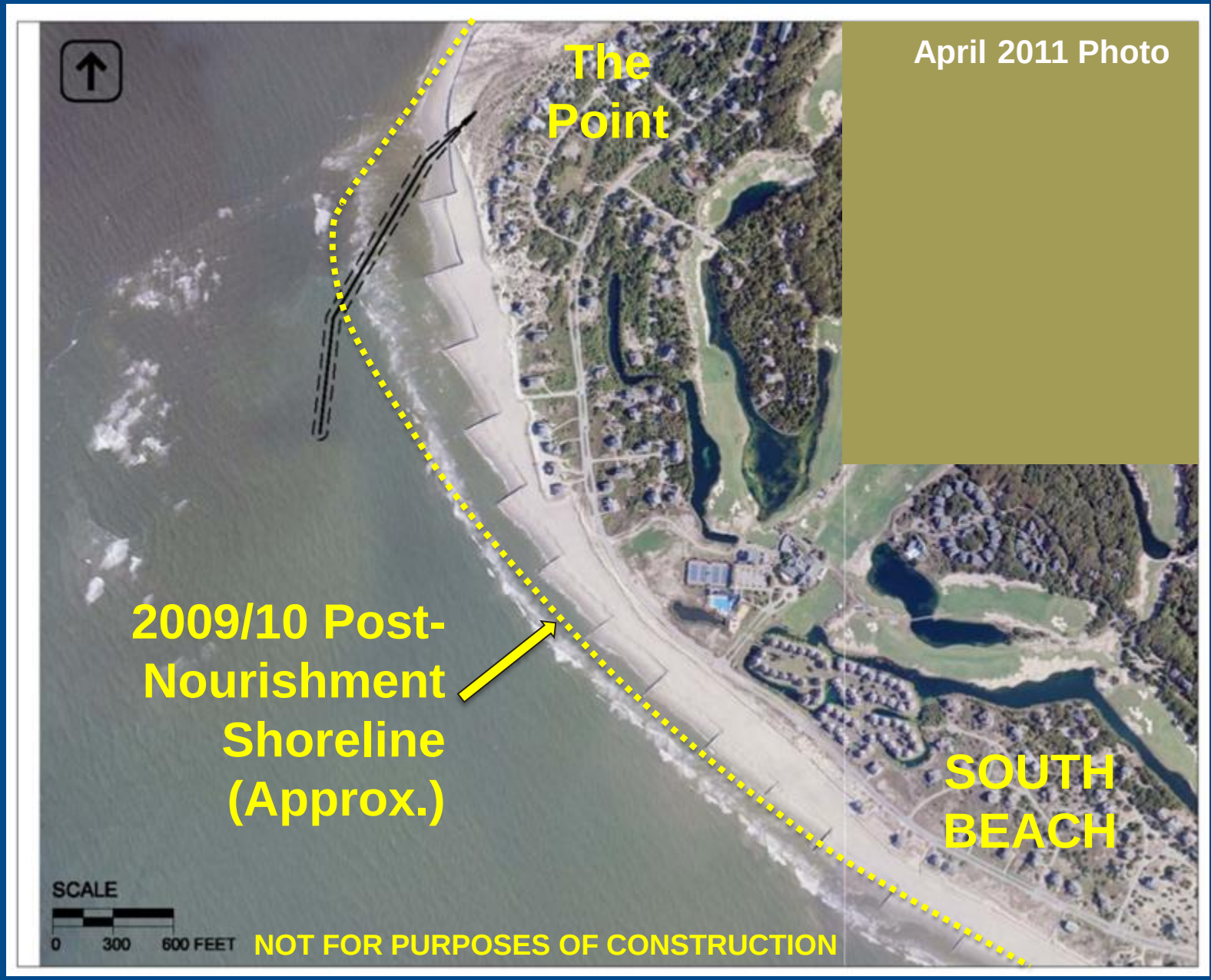
Conceptual Terminal Groin (Beach Fill Not Shown)



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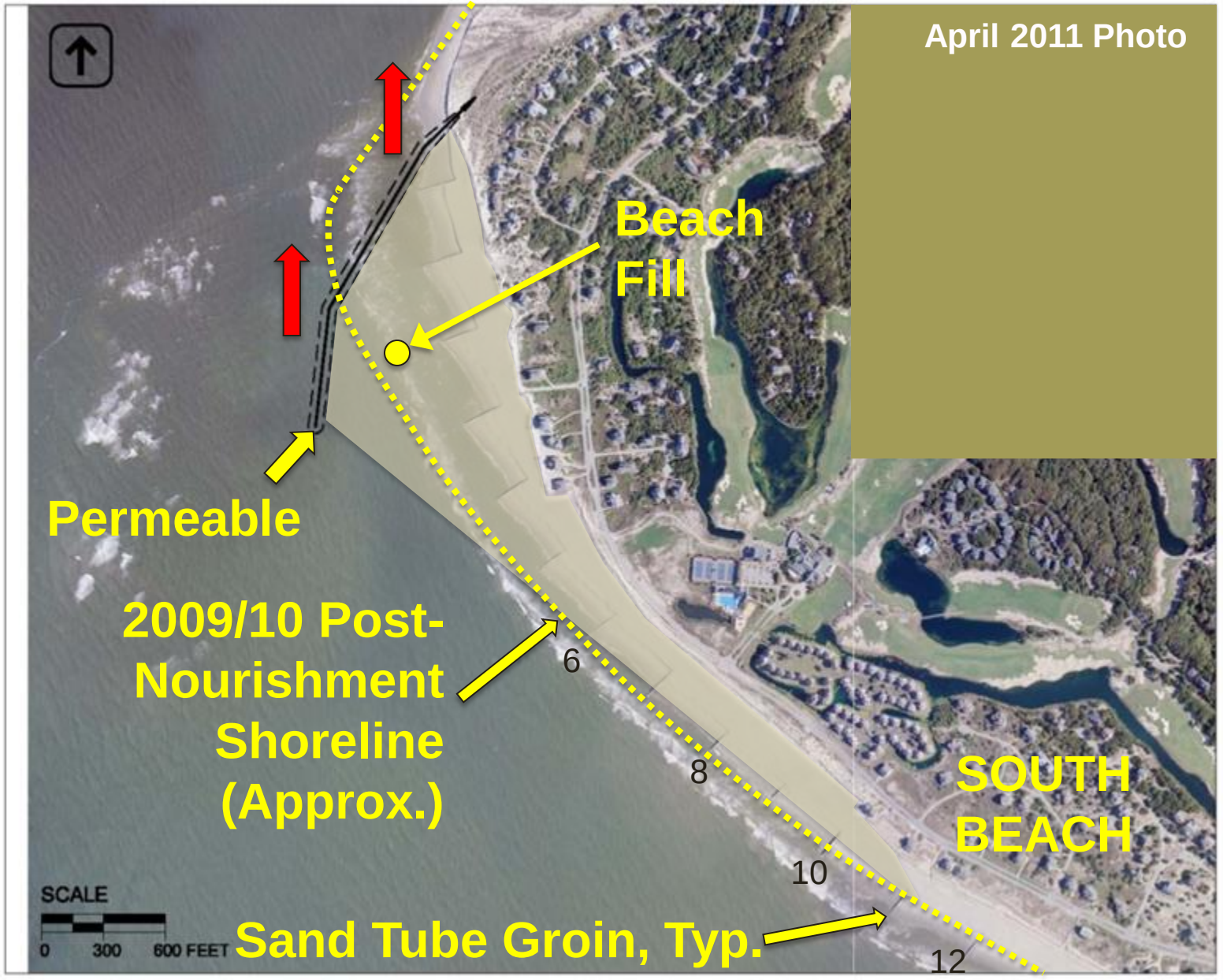
Conceptual Terminal Groin



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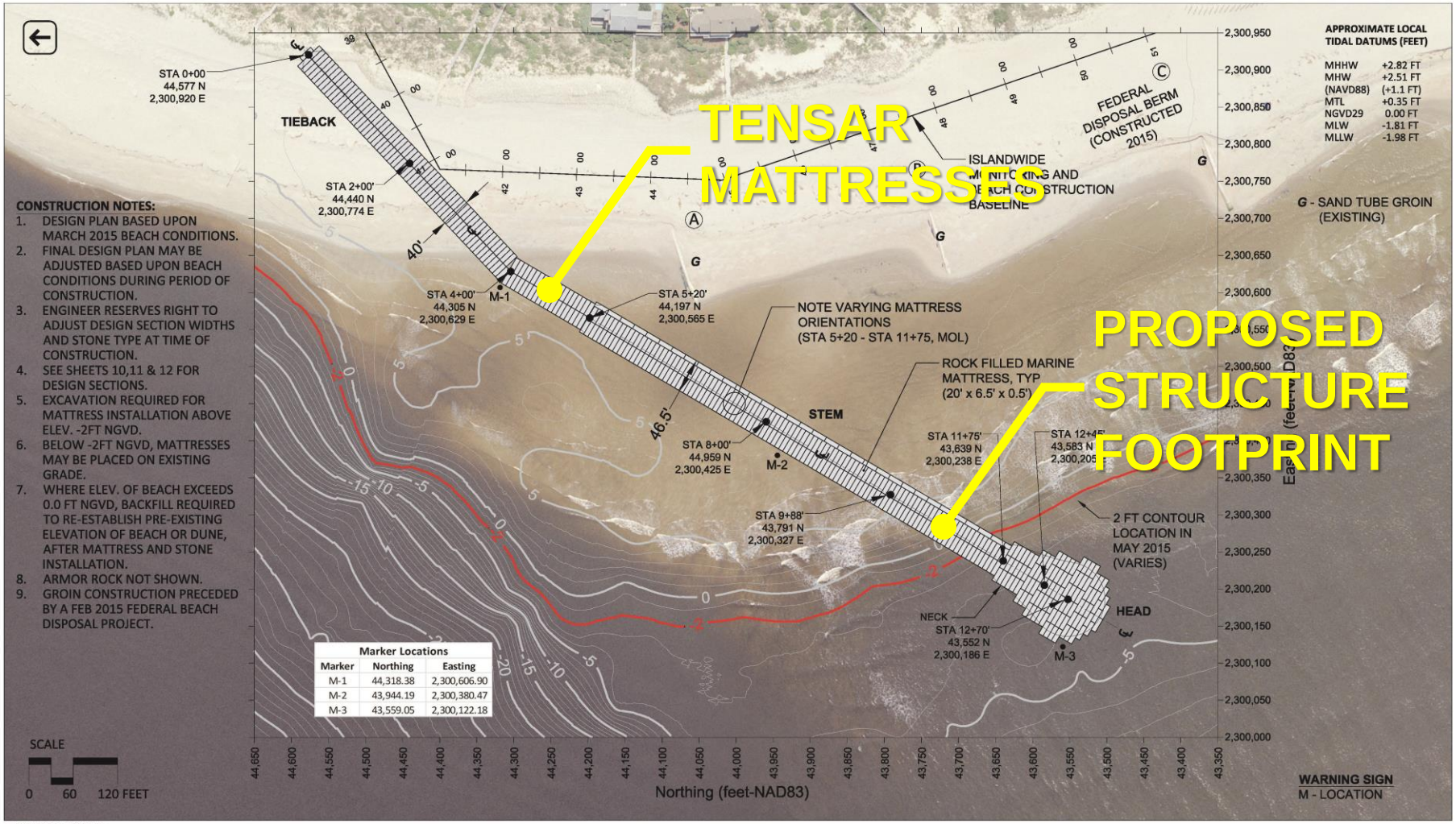

GENERAL NOTES:
1) CONTOURS AT TIME OF CONSTRUCTION WILL VARY FROM THOSE DEPICTED HEREIN.
2) BEACH AND NEARSHORE CONDITIONS SUBJECT TO CHANGE.
3) DATUM IS NGVD29 - SURVEY OF **9 AUGUST 2015**

REVISIONS				
LTR	DESCRIPTION	BY	DATE	APPRVD
A	ADDED MARKER LOCATIONS	ML	2/4/15	EJO
B	SURVEY UPDATED, REVISION OF NOTES, REVISED DESIGN AT HEAD	ML	04/17/15	EJO
C	MATTRESS LAYOUT REVISED; STA 5+20 TO STA 11+75	ML	08/07/15	EJO
D	SURVEY UPDATED, REVISION OF NOTES	WAH	08/17/15	EJO

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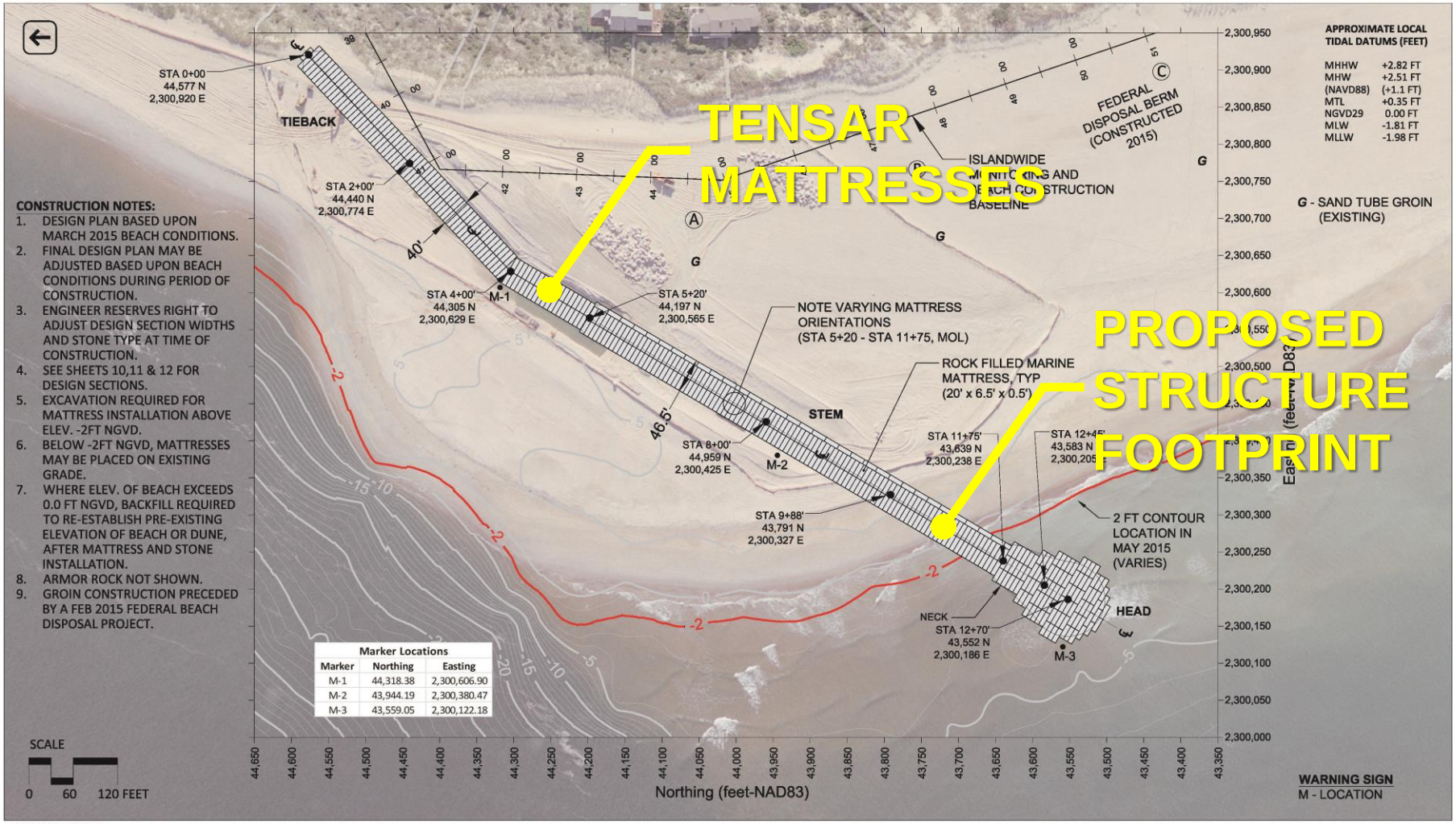
TERMINAL GROIN PROJECT
BALD HEAD ISLAND, NORTH CAROLINA
MATTRESS PLAN
DRAWN BY: ML DATE: 11/3/2014
CHECKED BY: DATE:
REVISED BY: DATE:
SHEET 8 OF 16

May 2014 Photography

PRE-BID BEACH CONDITIONS



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TERMINAL GROIN PROJECT
BALD HEAD ISLAND, NORTH CAROLINA
MATTRESS PLAN
DRAWN BY: ML DATE: 11/3/2014
CHECKED BY: DATE:
REVISED BY: DATE:

SHEET 8 OF 16

August 2015 Photography

7 MONTHS POST-BID CONDITION (AFTER FEDERAL FILL)

Post-Disposal Beach Condition


STA 8+00
BACKFILLED
19 AUGUST 2015


Backfilled
STA 9+00
18 SEPTEMBER 2015

COMPLETION OF GROIN HEAD


31 January 2016


TERMINAL GROIN
BALD HEAD ISLAND
CAPE FEAR
(THE END)