Initial Shoreline Response of an Open Coast Erosion Hot Spot to Permeable Adjustable Groins

By
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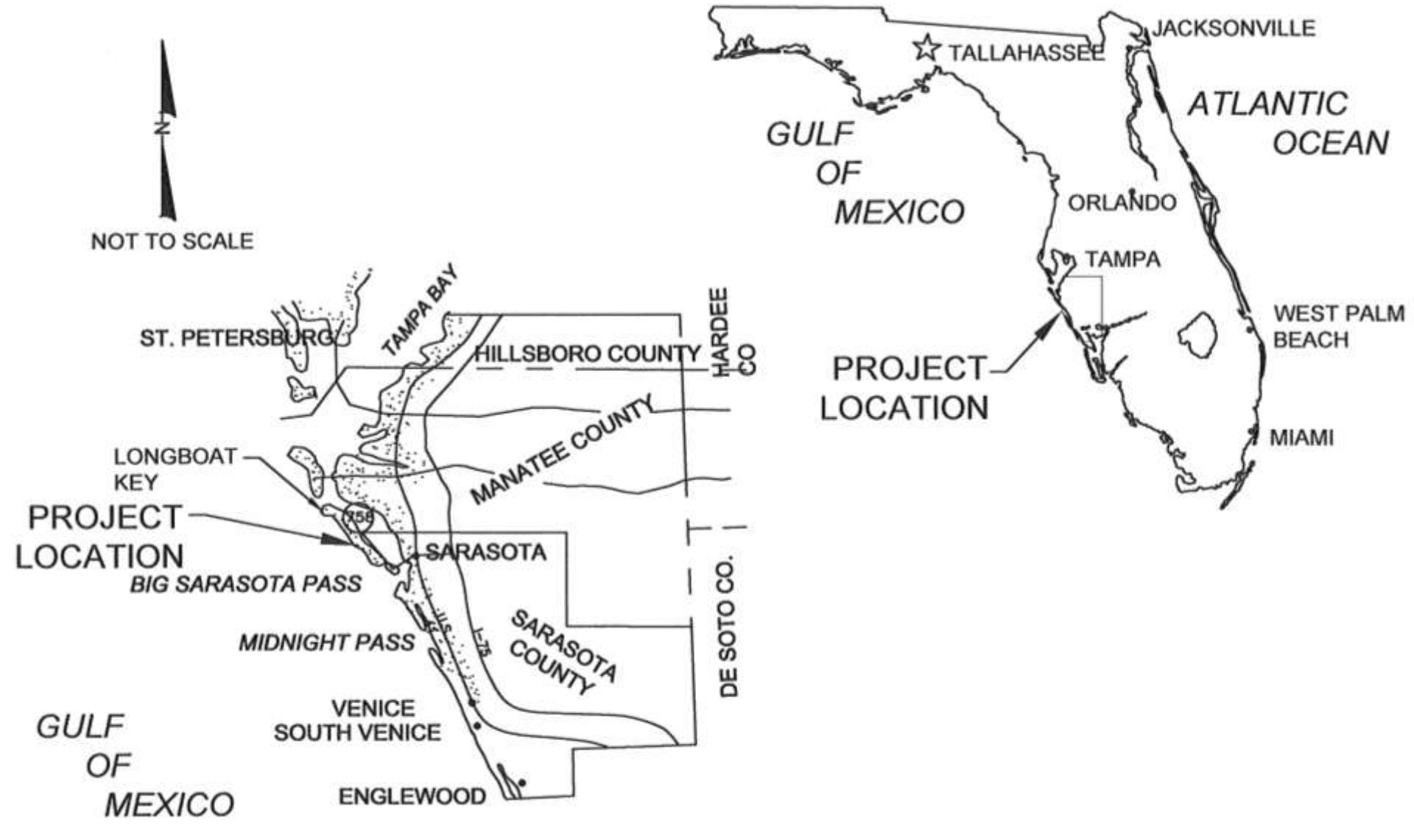
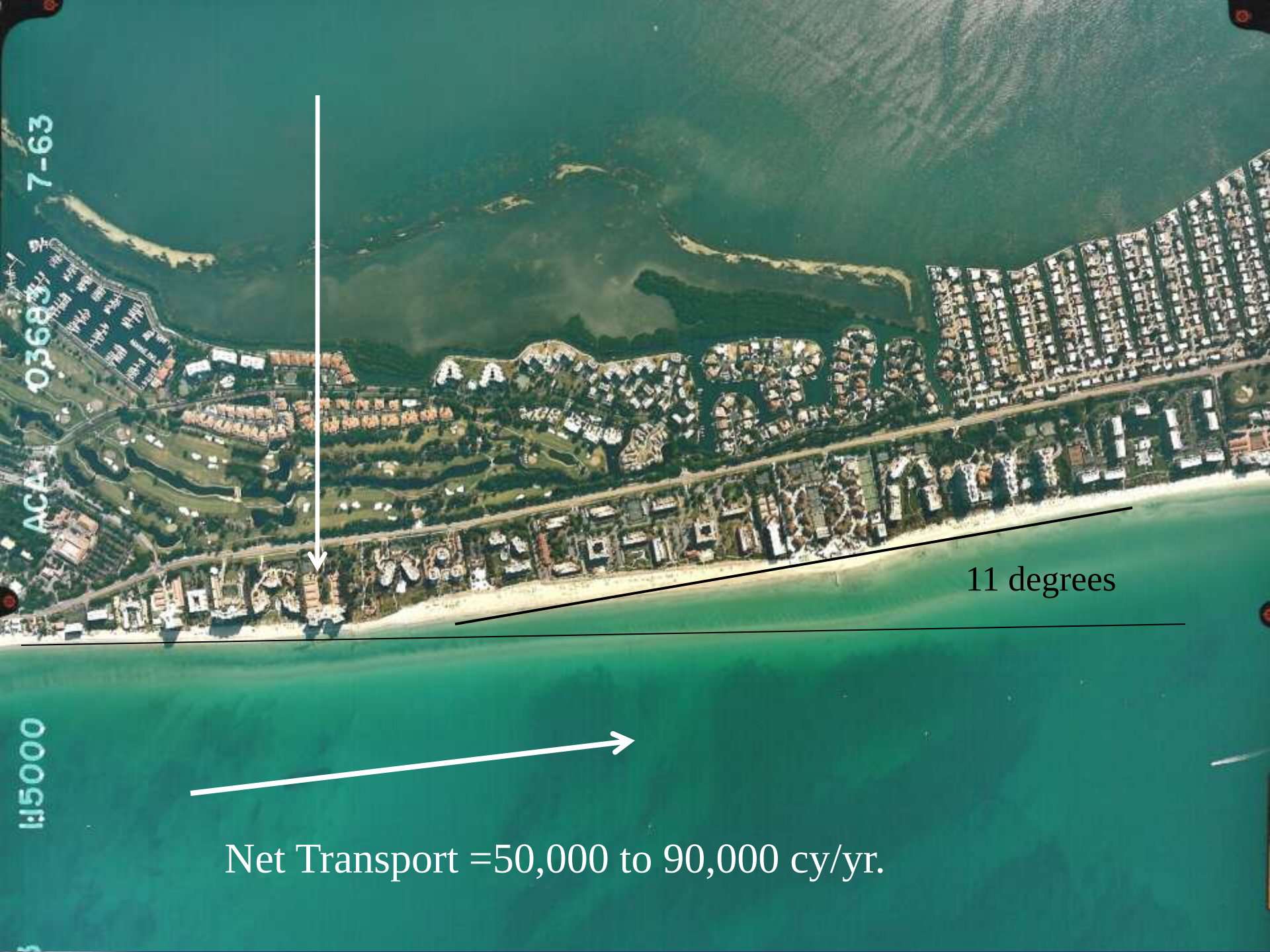
Overview

- History of the project site
- History of beach management efforts
- Coastal Processes summary
- Selection of a permeable adjustable groin
- Construction
- Initial beach responses

Location Map




11 degrees
Net Transport =50,000 to 90,000 cy/yr.

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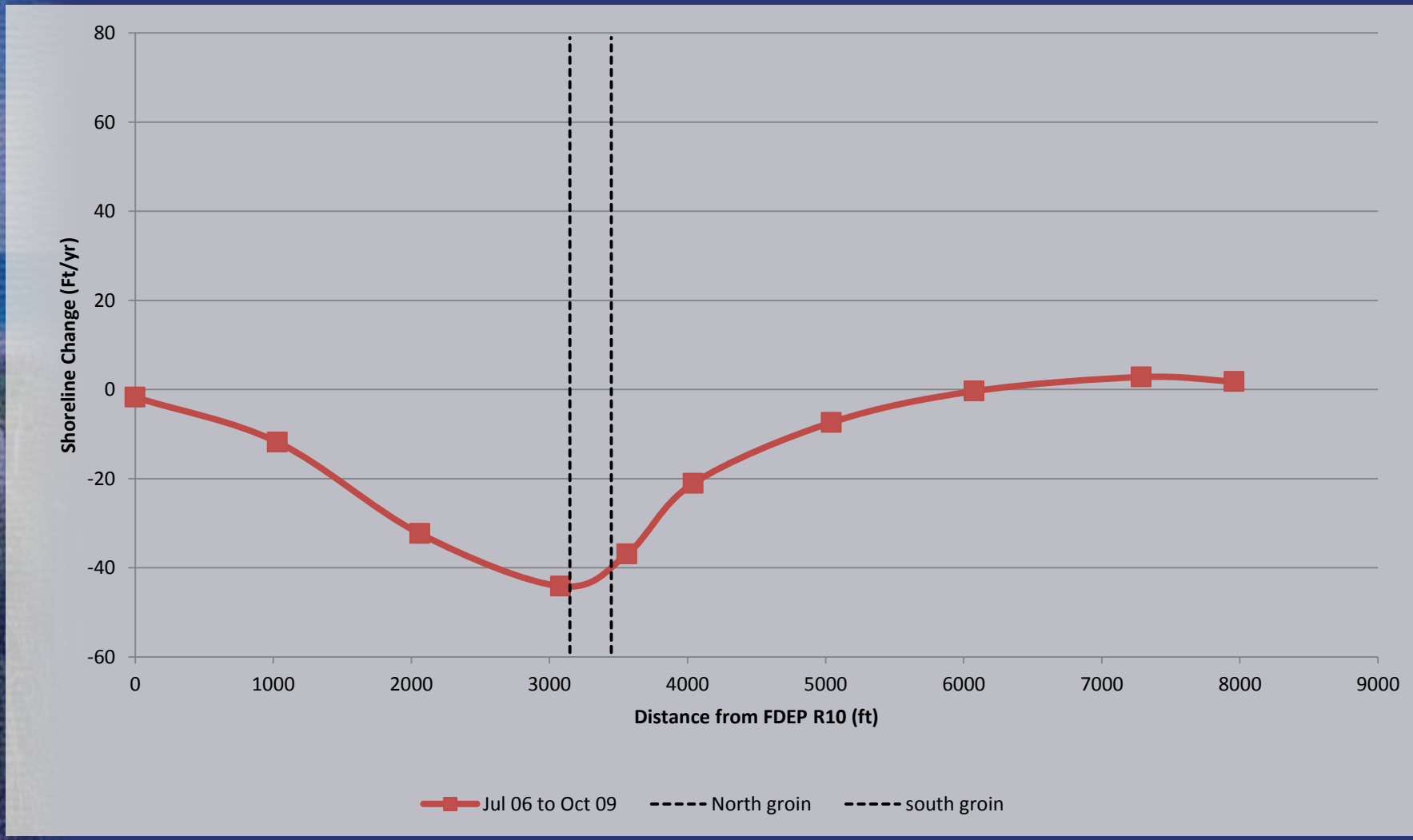
Historic Beach Management Efforts

1982 Photo
Courtesy of LBK

Nourishment History

- 1993 Initial Town wide nourishment. 1970's groins were removed.
- 1996/1997 Mid Key interim nourishment.
- 2001 100,000 cy nourishment.
- 2005/2006 Island wide renourishment w/template refills following storms.

Shoreline Changes




May 1998
Sand filled geotextile tubes

Coastal Process Lessons Learned
(circa late 90's)

- Hot spot likely caused by abrupt shoreline orientation change (Kraus and Galgano ,2001).
- Net transport is comprised of north and south directed transports.
- Northerly transport may not be of sufficient strength or duration to move sand north past the headland.
- Structural control is beneficial. A nourishment only management scheme is expensive and lacks durability.

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7-63
0368
ACA
1:5000
Colony Resort

Permeable Groin (by S.M. Wood)

(constructed circa 1966, rebuilt 1994)

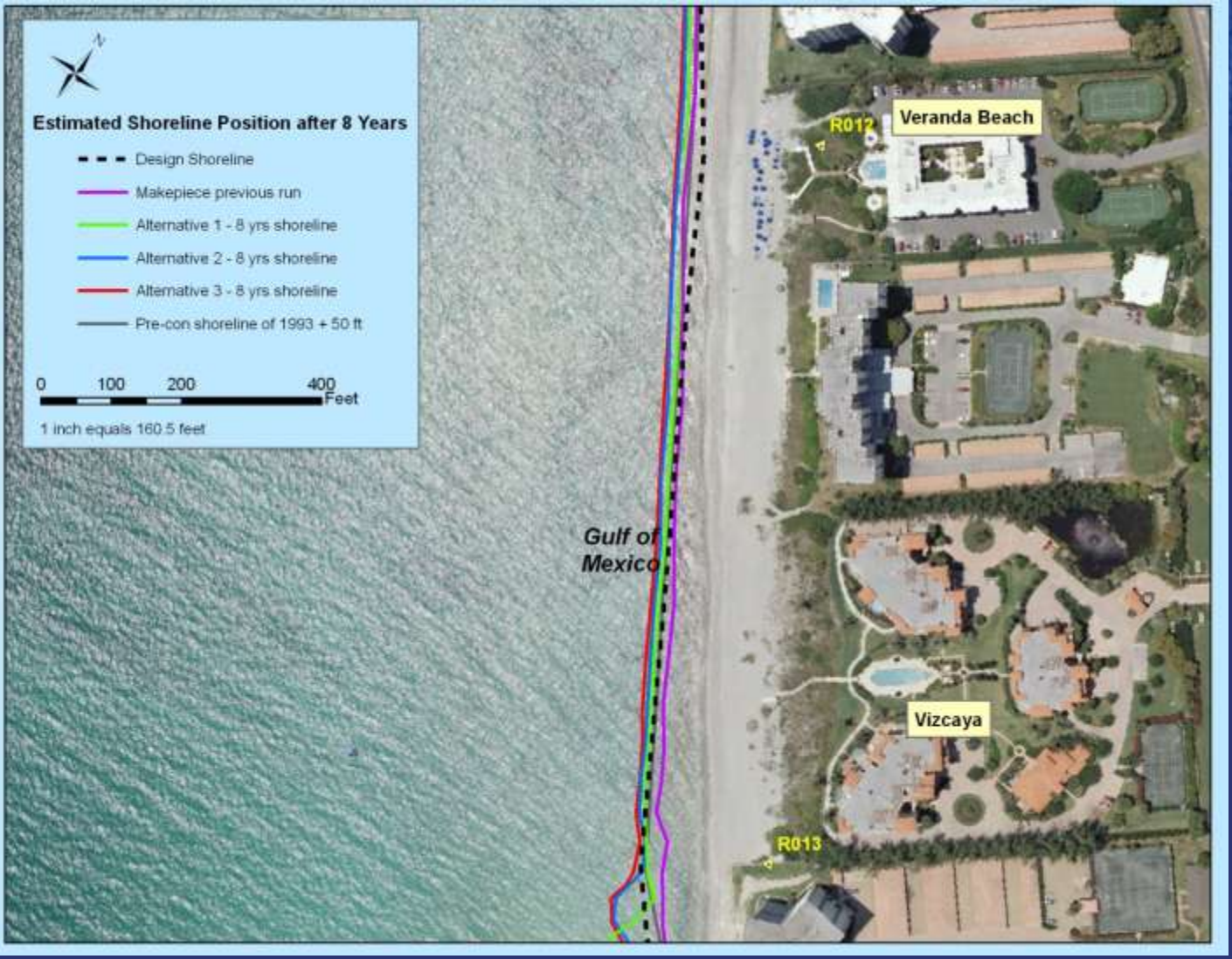
Author Photo September 2010.

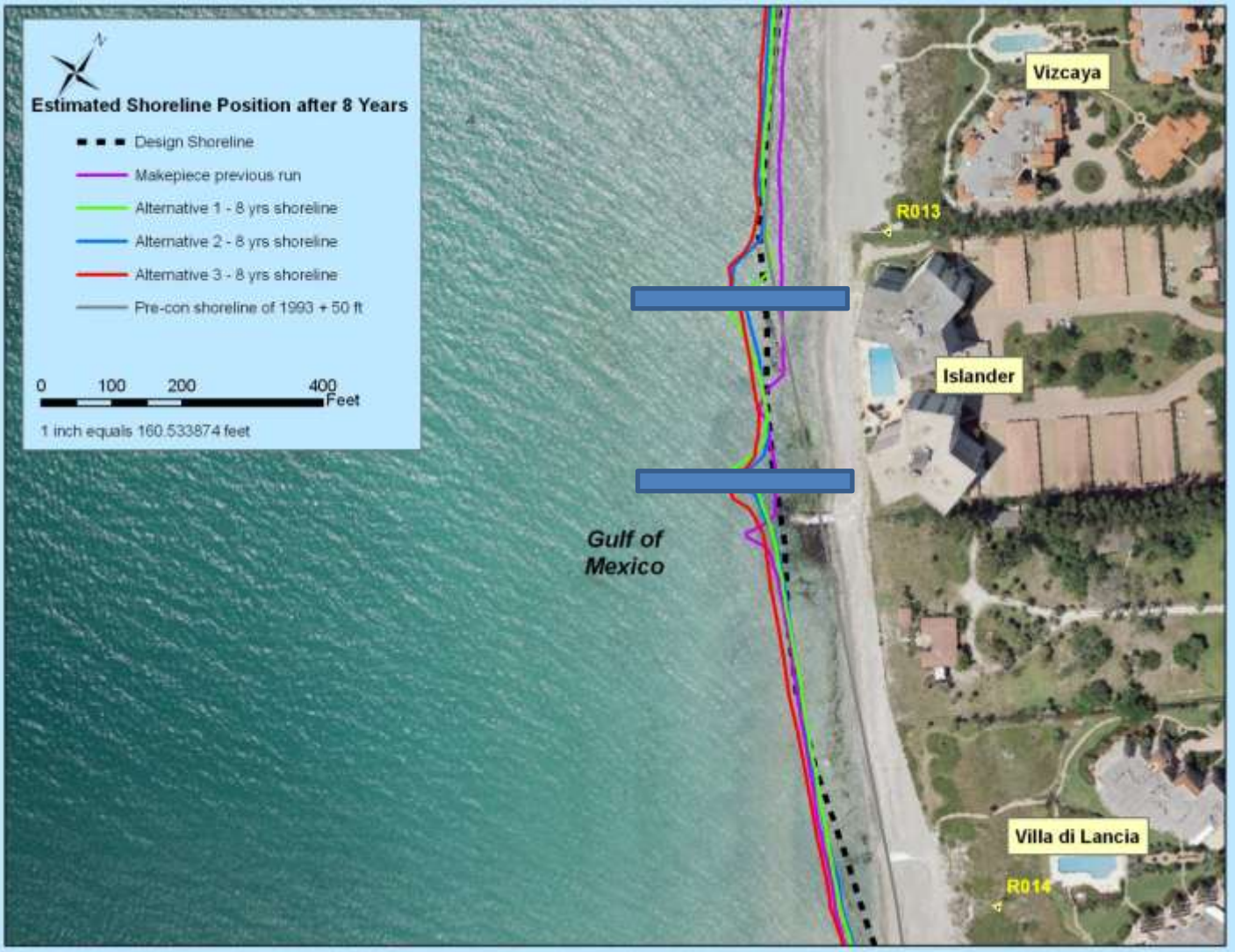
CEM Discussion

"Another way to smooth the shoreline is to make the groin more permeable… Other revisited or fresh concepts for groin designs …have only been proposed conceptually and have yet to be field tested. These new and innovative approaches…benefit from experience and modern understanding of coastal sediment processes. "

Modeling Efforts

- Delft3D (Walstra, et al. and CPE, 2006). Demonstrated the performance of two groins plus nourishment over a nourishment life cycle (8 years).


Estimated Shoreline Position after 8 Years
Design Shoreline
Makepiece previous run
Alternative 1 - 8 yrs shoreline
Alternative 2 - 8 yrs shoreline
Alternative 3 - 8 yrs shoreline
Pre-con shoreline of 1993 + 50 ft
0
100
200
400
Feet
1 inch equals 160.5 feet
Gulf of Mexico
R012
Veranda Beach
Vizcaya
R013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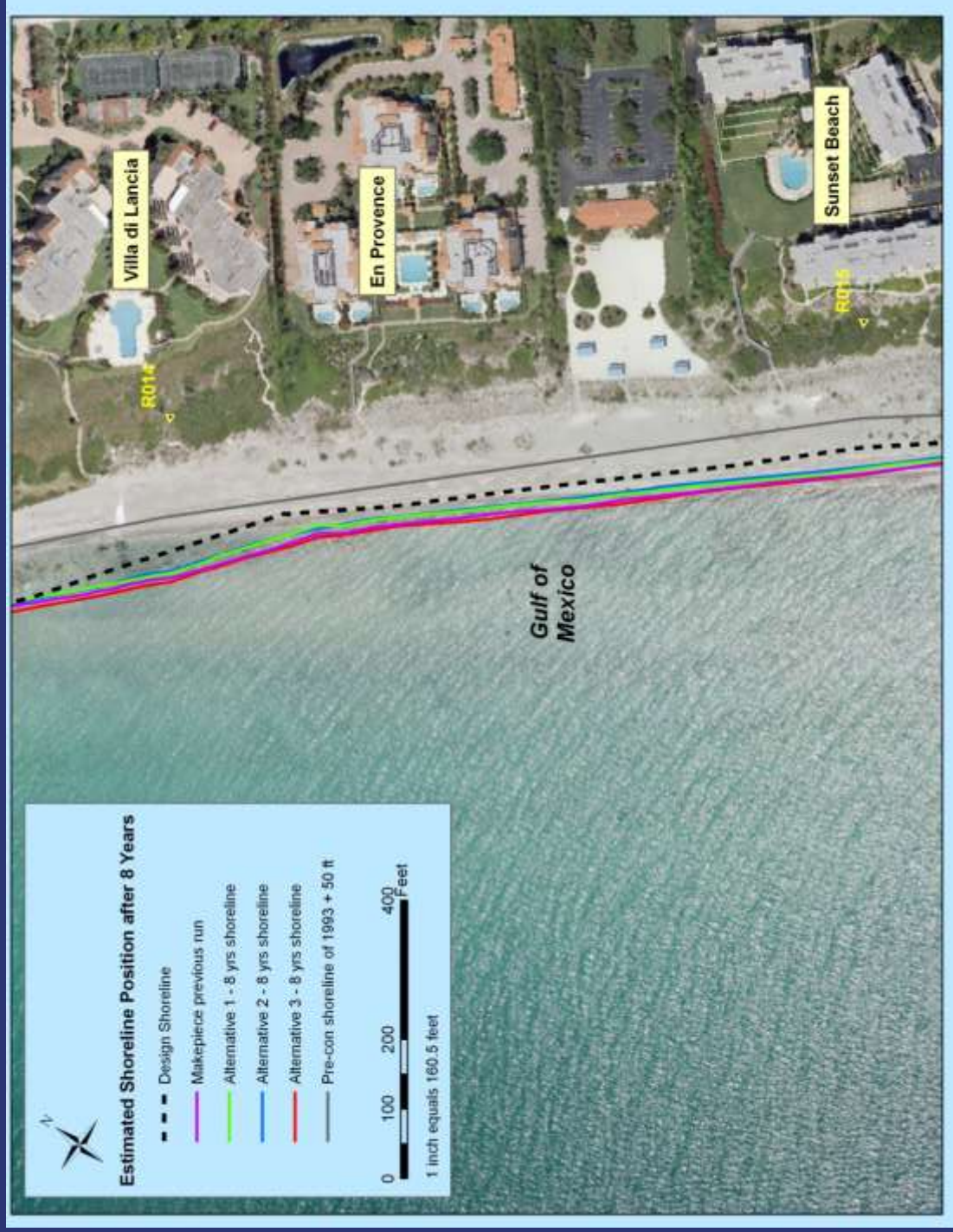
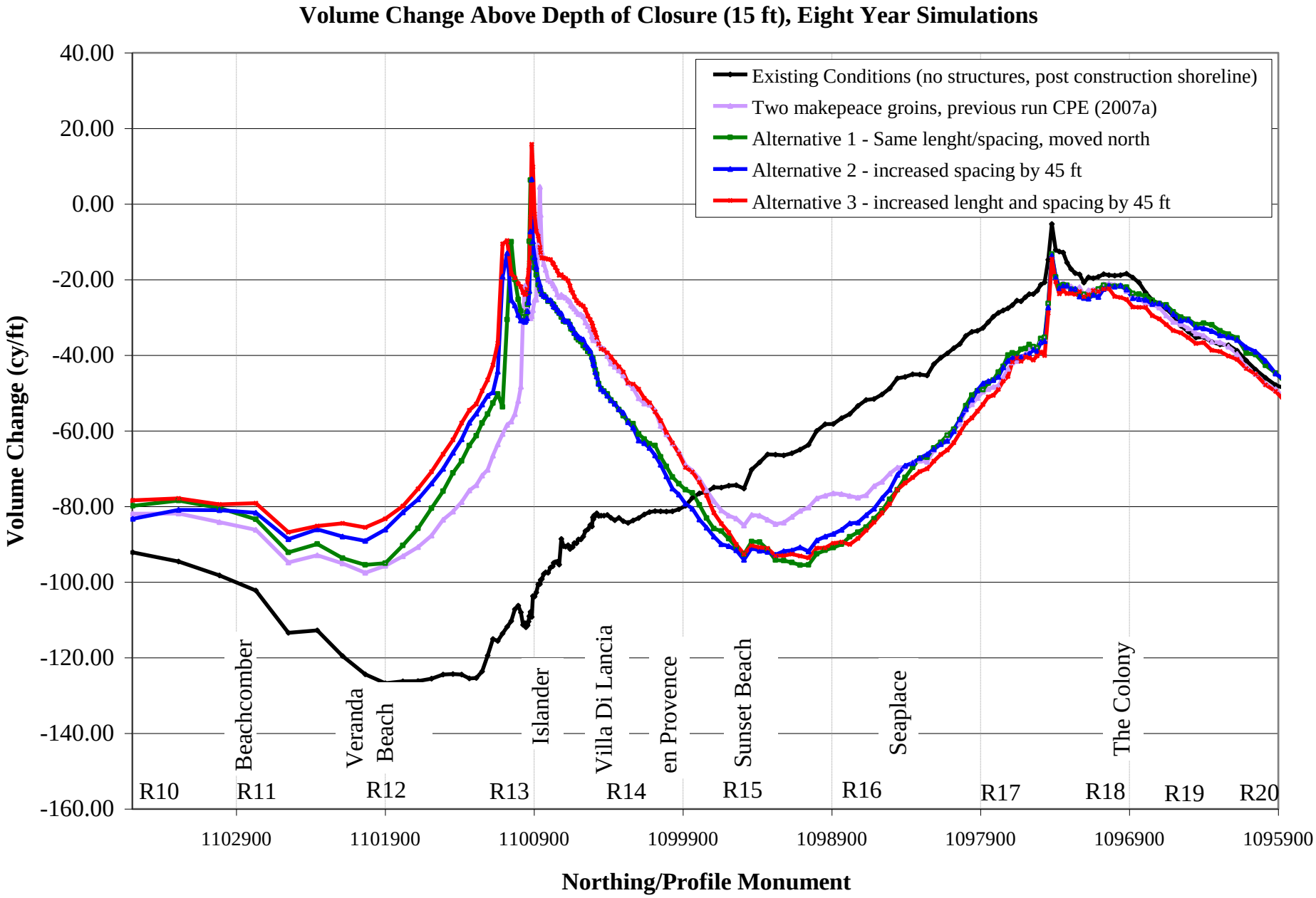
0
100
200
400
Feet
1 inch equals 160.533874 feet
Vizcaya
R013
Islander
Gulf of Mexico
Villa di Lancia
R014

- This effort lead to the conclusion that two Makepeace Wood type groins would be effective in conjunction with the Town's existing nourishment program.




Volume Change Above Depth of Closure (15 ft), Eight Year Simulations
Existing Conditions (no structures, post construction shoreline)
Two makepeace groins, previous run CPE (2007a)
Alternative 1 - Same lenght/spacing, moved north
Alternative 2 - increased spacing by 45 ft
Alternative 3 - increased lenght and spacing by 45 ft
Volume Change (cy/ft)
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
-120.00
-140.00
-160.00
Beachcomber
Veranda Beach
Islander
Villa Di Lancia
en Provence
Sunset Beach
Seaplace
The Colony
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
1102900
1101900
1100900
1099900
1098900
1097900
1096900
1095900
Northing/Profile Monument

Regulatory Considerations

- 10+ years of sand filled geotextile tube installation had yielded measurable information regarding coastal structure installation at the site.
- Realization by CPE that the modeled permeability might be different in the prototype and that adjustment may be necessary.
- Adjustment capability may make the permit process easier.
- 10 year monitoring and maintenance program committed to.

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Project Bids and Costs

- Low bid: $899,898 (accepted)
- 2nd bid: $1,387,300
- Final Contract Price: $920,740.68
- Bid date was early summer 2009.

Quality Precast Concrete by Castcrete

Groin deck slab.

10/01/09

11/18/09


116
12/21/09


DOOSAN
04/05/09


04/06/09


AMERICAN
04/06/09


This is a low tide condition.

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- Environmental Response
- Initial beach responses
  - Beach management perspective
  - Technical engineering perspective

Environmental Response

September 2010

A Note of Caution

- Observing the performance of the groins on any given day and drawing conclusions (positive or negative) is not recommended.

Comparison of the Islander Hot Spot

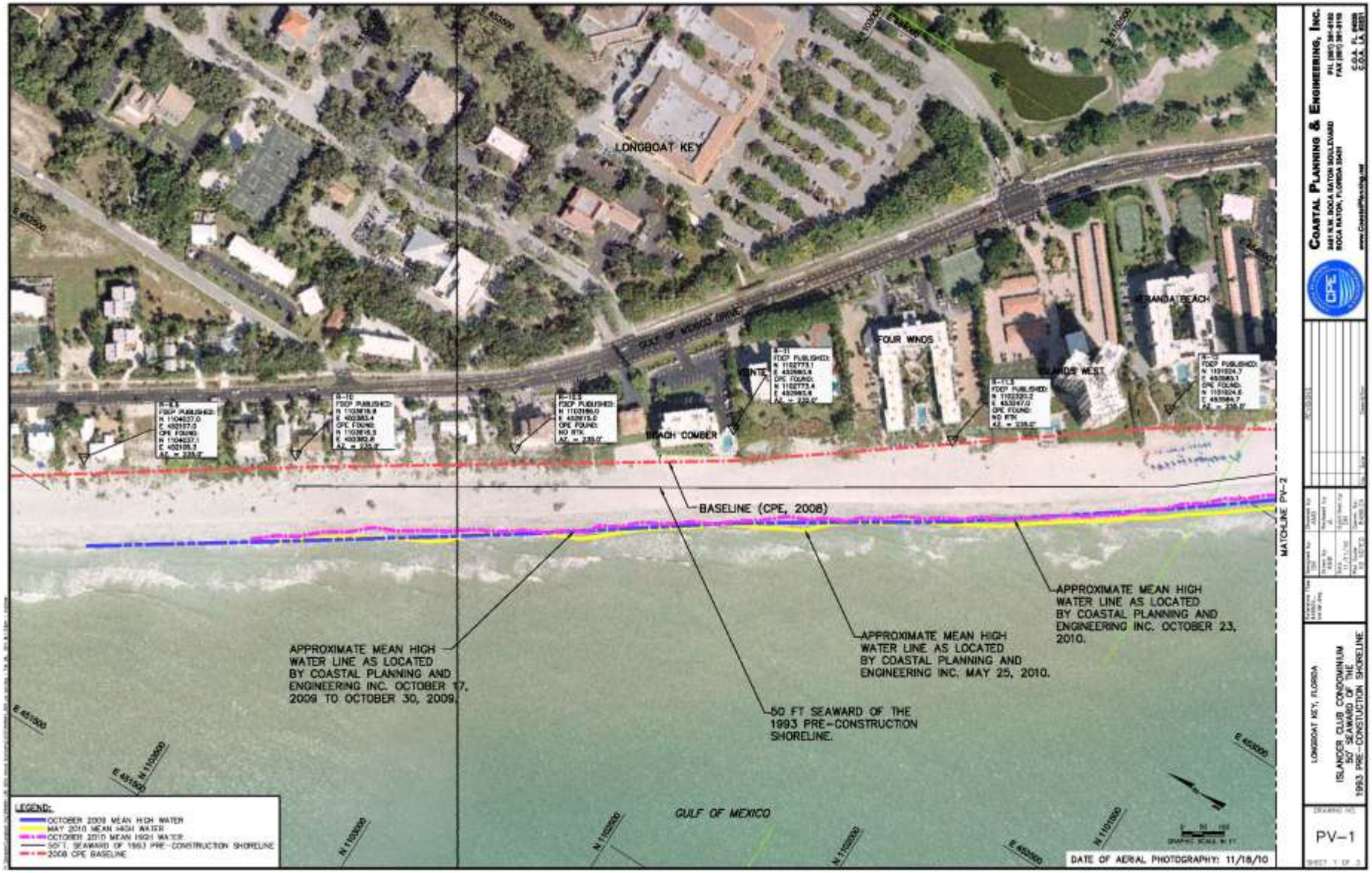
2010 (4 years post 2005/2006 nourishment)

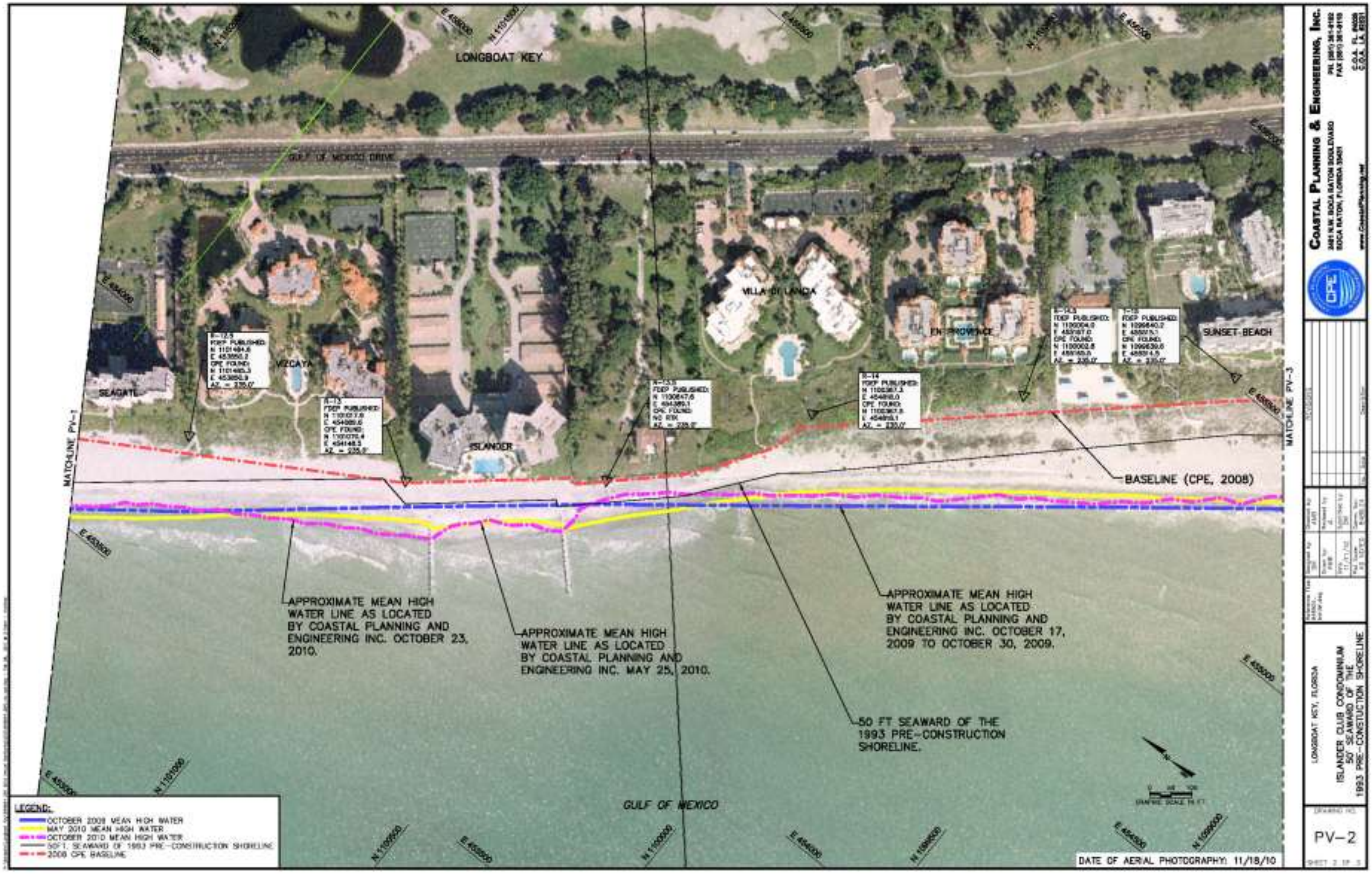
2004 (3 years post 2001 nourishment)

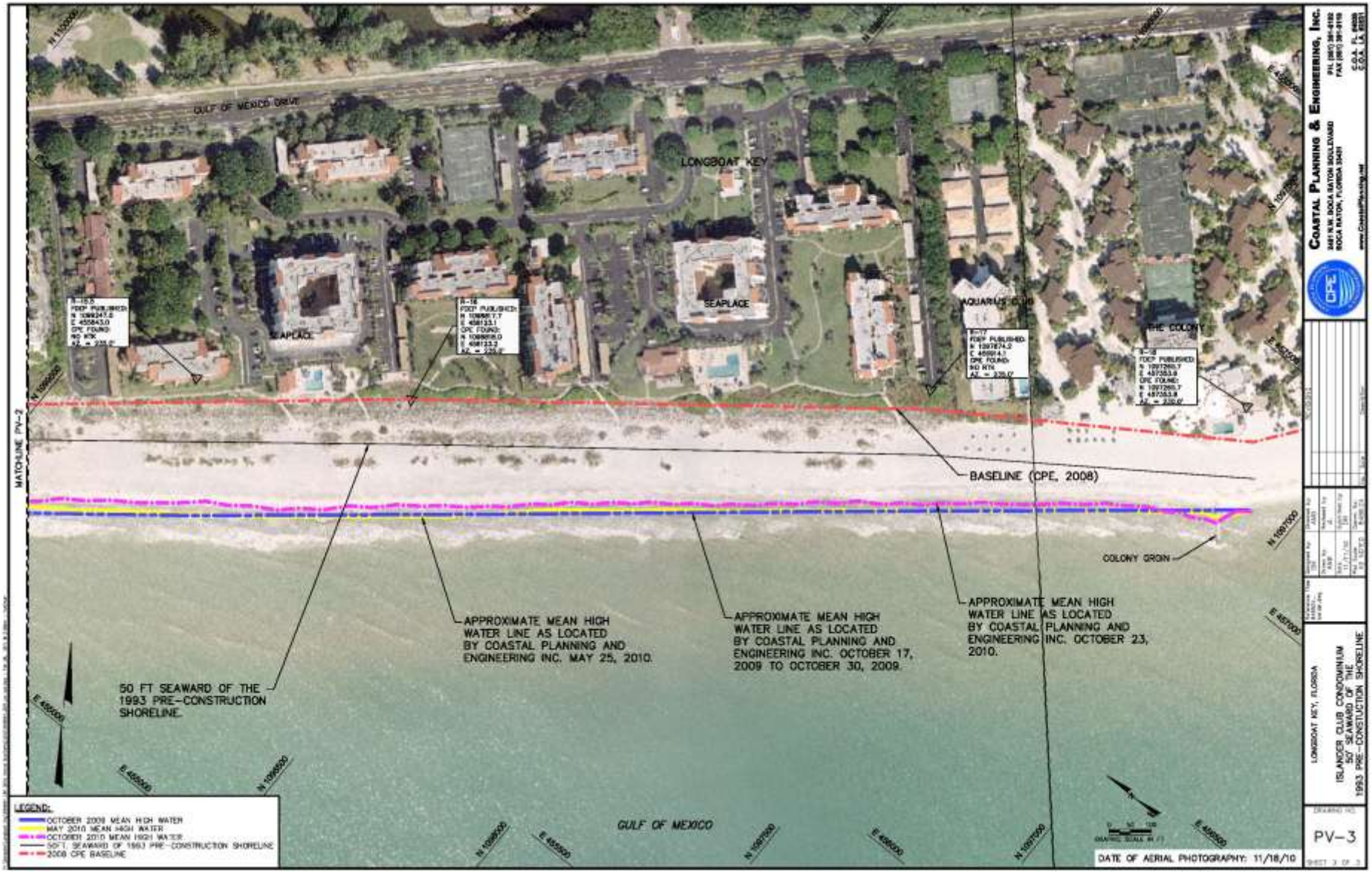
Storm Performance: Dec 13, 2010

Low Tide Condition. Photo Courtesy of LBK.

Shoreline Change Overview




LONGBOAT KEY
GULF OF MEXICO DRIVE
VIZCAYA
SEAGATE
ISLANDER
VILLA DI LANCIA
EN PROVENCE
SUNSET BEACH
MATCHLINE PV-1
MATCHLINE PV-3
BASELINE (CPE, 2008)
APPROXIMATE MEAN HIGH WATER LINE AS LOCATED BY COASTAL PLANNING AND ENGINEERING INC. OCTOBER 23, 2010.
APPROXIMATE MEAN HIGH WATER LINE AS LOCATED BY COASTAL PLANNING AND ENGINEERING INC. MAY 25, 2010.
APPROXIMATE MEAN HIGH WATER LINE AS LOCATED BY COASTAL PLANNING AND ENGINEERING INC. OCTOBER 17, 2009 TO OCTOBER 30, 2009.
50 FT SEAWARD OF THE 1993 PRE-CONSTRUCTION SHORELINE.
GULF OF MEXICO
LEGEND:
OCTOBER 2009 MEAN HIGH WATER
MAY 2010 MEAN HIGH WATER
OCTOBER 2010 MEAN HIGH WATER
50FT. SEAWARD OF 1993 PRE-CONSTRUCTION SHORELINE
2008 CPE BASELINE
DATE OF AERIAL PHOTOGRAPHY: 11/18/10
COASTAL PLANNING & ENGINEERING, INC.
LONGBOAT KEY, FLORIDA
ISLANDER CLUB CONDOMINIUM
50' SEAWARD OF THE
1993 PRE-CONSTUCTION SHORELINE
PV-2


GULF OF MEXICO DRIVE
LONGBOAT KEY
SEAPLACE
SEAPLACE
AQUARIUS CLUB
THE COLONY
BASELINE (CPE, 2008)
COLONY GROIN
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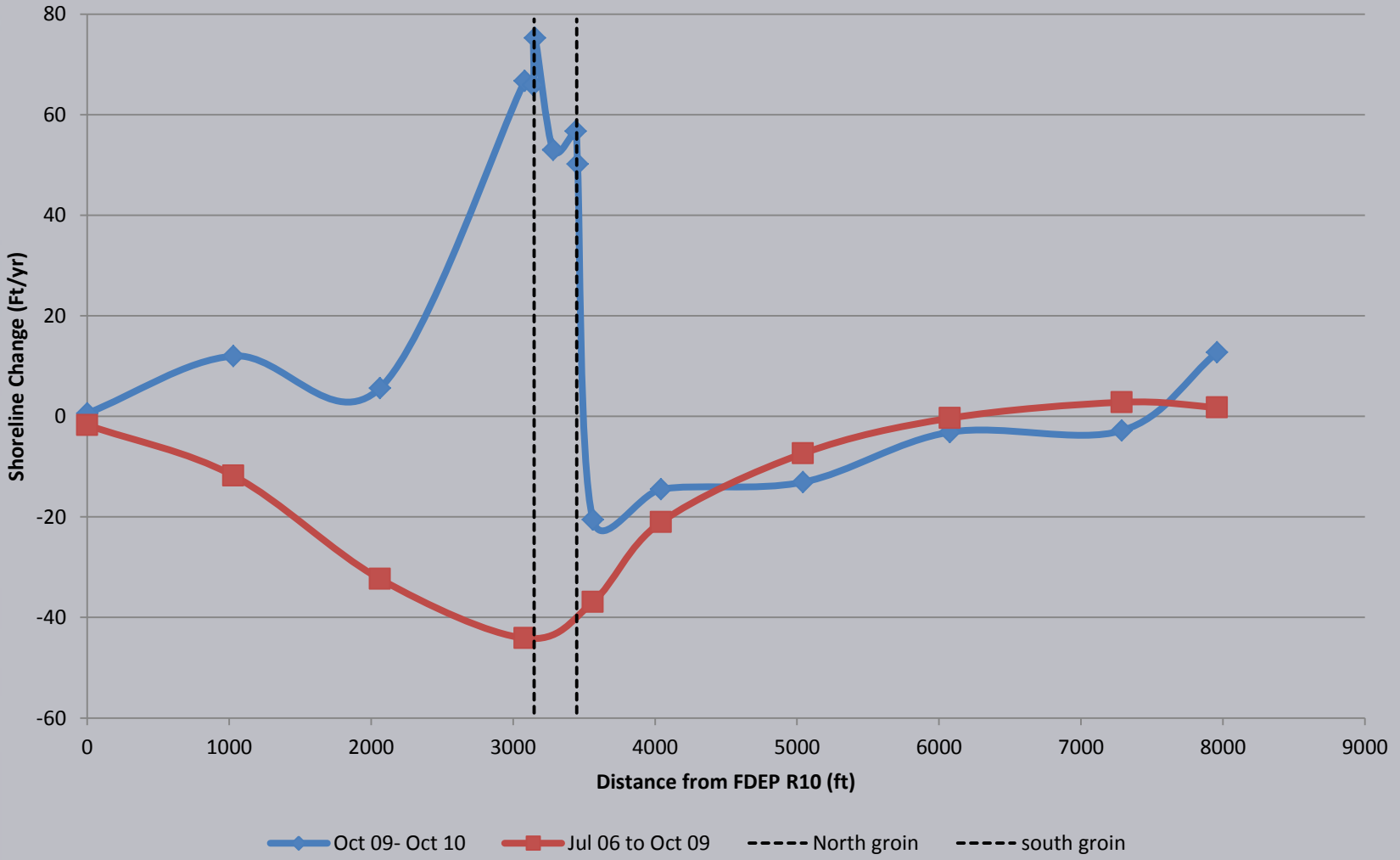
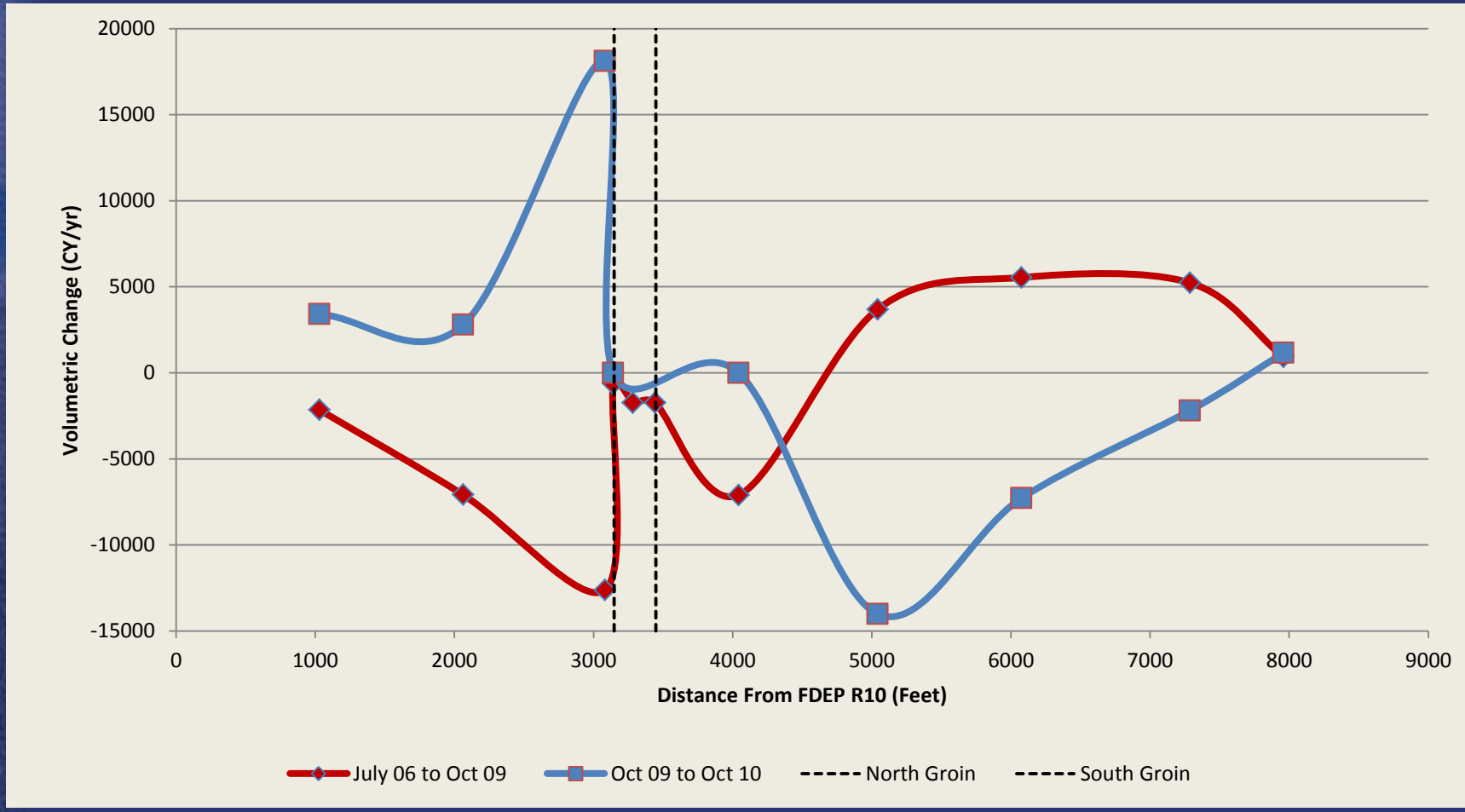
Shoreline Changes



Volumetric Changes



Conclusions from the Initial Monitoring

- Permeable adjustable groins show promise as a viable erosion control structure.
- From a beach management perspective, the groins in addition to the nourishment are better at managing the sand resources than nourishment alone.
- If the north beach trends continue, the groins may need to be adjusted to increase the permeability to enhance bypassing.

Future Activities

- Town is anticipating a nourishment of parts of the island in late 2011. This will include quantities to offset the groins impact on the southern shoreline.
- Future monitoring will continue, enabling the Town, CPE, and FDEP to determine any future actions in this area, which may include increasing the permeability of the seaward ends of one or both groins.

Acknowledgements

- Town of Longboat Key
- Juan Florensa, LBK Public Works Director
- Samantha Danchuk, PhD.
- Julien Devisse, E.I.
- Staff of Coastal Planning & Engineering, Inc.
- Dirk-Jan Walstra, Deltares
- Lindino Benedet, CPE do Brasil

"Despite the apparent simplicity of Groins, their interaction with the beach is complex, and existing functional design guidance is limited" Kraus & Rankin, 2004 s

Closing Quotes

"Such advances (in groin functional design) are expected to reduce the cost of beach nourishment while providing …. controlled longshore movement of sand."

-Nick Kraus (& Lynn Bocamazo), 2003.

"Despite the apparent simplicity of groins, their interaction with the beach is complex, and existing functional design guidance is limited."- Nick Kraus (& Kelly Rankin), 2004