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Beach Preservation Technology
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Modeling of Erosion Control Alternatives at Stump Pass, Charlotte County

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1, 3 COASTAL ENGINEERING CONSULTANTS INC

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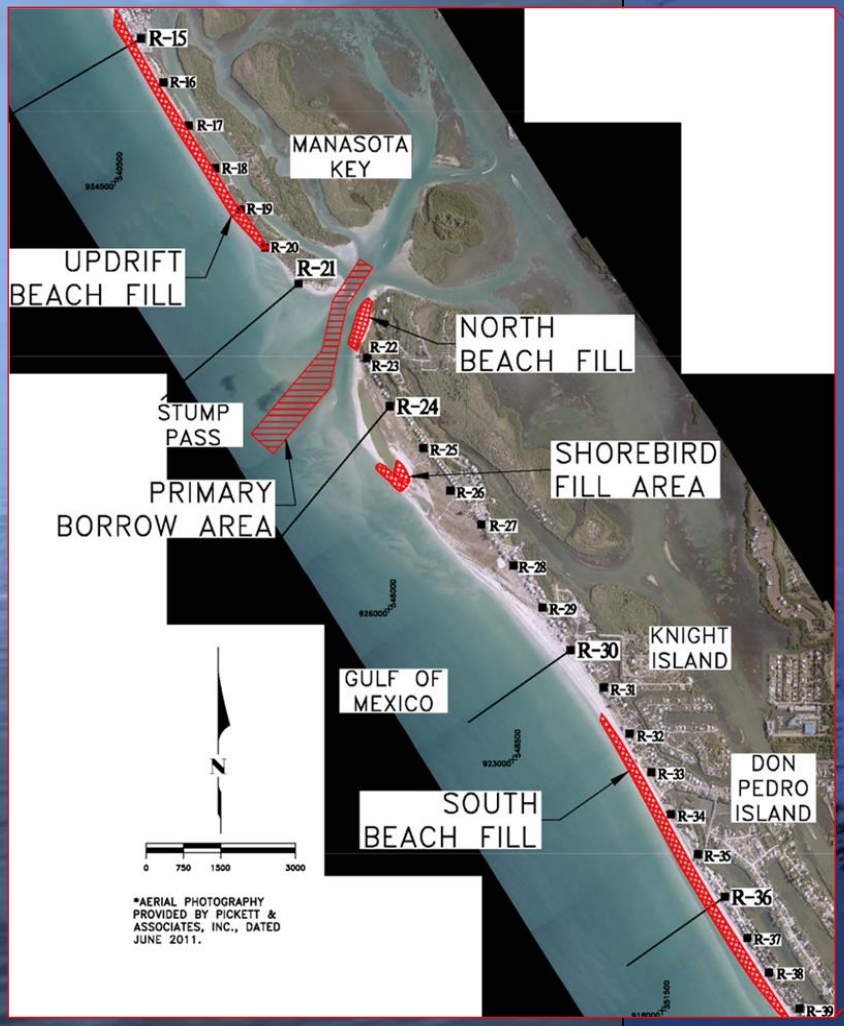
Public Outreach and Stakeholder Input

- Residents of Palm Island
- Residents of Manasota Key
- Elected Officials
- Advisory Committees
- State Agencies
- Federal Agencies
- Media
- Web

Location Map



Outline

- Historical Perspective
- Plan Formulation
- Alternatives Development
- Numerical Model Study
- Alternatives Analysis
- Performance Evaluation
- Summary and Recommendations

Historical Perspective

- By Late 1980's, Through 1990's, and Into Early 2000's Stump Pass and Adjacent Shorelines Experienced Significant Changes
- Channel Infilling Reduced Navigational Access, Spit Migration off Manasota Key Resulted in Significant Erosion on Palm Island (downdrift) Shoreline
- Breaching was Observed Both on State Park Beach as well as Gulf-front Beaches Downdrift of Stump Pass

Erosion Control Project History

- 2003: Initial Restoration
  - Placed ~925,000 CY from Stump Pass and Nearshore Area
  - Cut Through Spit Off Manasota Key to Restore 1980 Channel
- 2006: First Renourishment
  - Placed ~426,000 CY from Stump Pass
  - Modified Channel Alignment
- 2011: Second Renourishment
  - Placed ~374,000 CY from Stump Pass
  - Created Shorebird Habitat Area
- CURRENT: Develop New Long-Term Management Plan

Plan Formulation

Fill Renourishment and New Structural Complement

- Restore & Maintain Critically Eroding Beaches
- Provide Storm Damage Reduction Benefits Along Developed Shoreline Through "Engineered Beach Design"
- Provide for Improved Navigation Through Stump Pass
- Enhance Recreational Opportunities
- Provide Environmental Protection and Enhancement for T&E Species
- Apply Adaptive Management

Structural Desktop Summary

- Continue / Modify Beach Renourishment & Maintenance Dredging
- Terminal Groin (North of Inlet)
- Terminal Groins (North and South of Inlet)
- Groin Field (North and / or South of Inlet)
- Ebb Shoal Restoration
- Throat Armoring ~ Screened Out
- Seawalls / Revetment ~ Screened Out
- Breakwaters ~ Screened Out
- Innovative Technologies ~ Screened Out
- Interior Channel Dredging ~ Screened Out

Stakeholder Input

- Residents of Palm Island Revisited Alternatives and Expressed That They Did Not Favor a Terminal Groin on North End of Palm Island (South Side of Inlet)

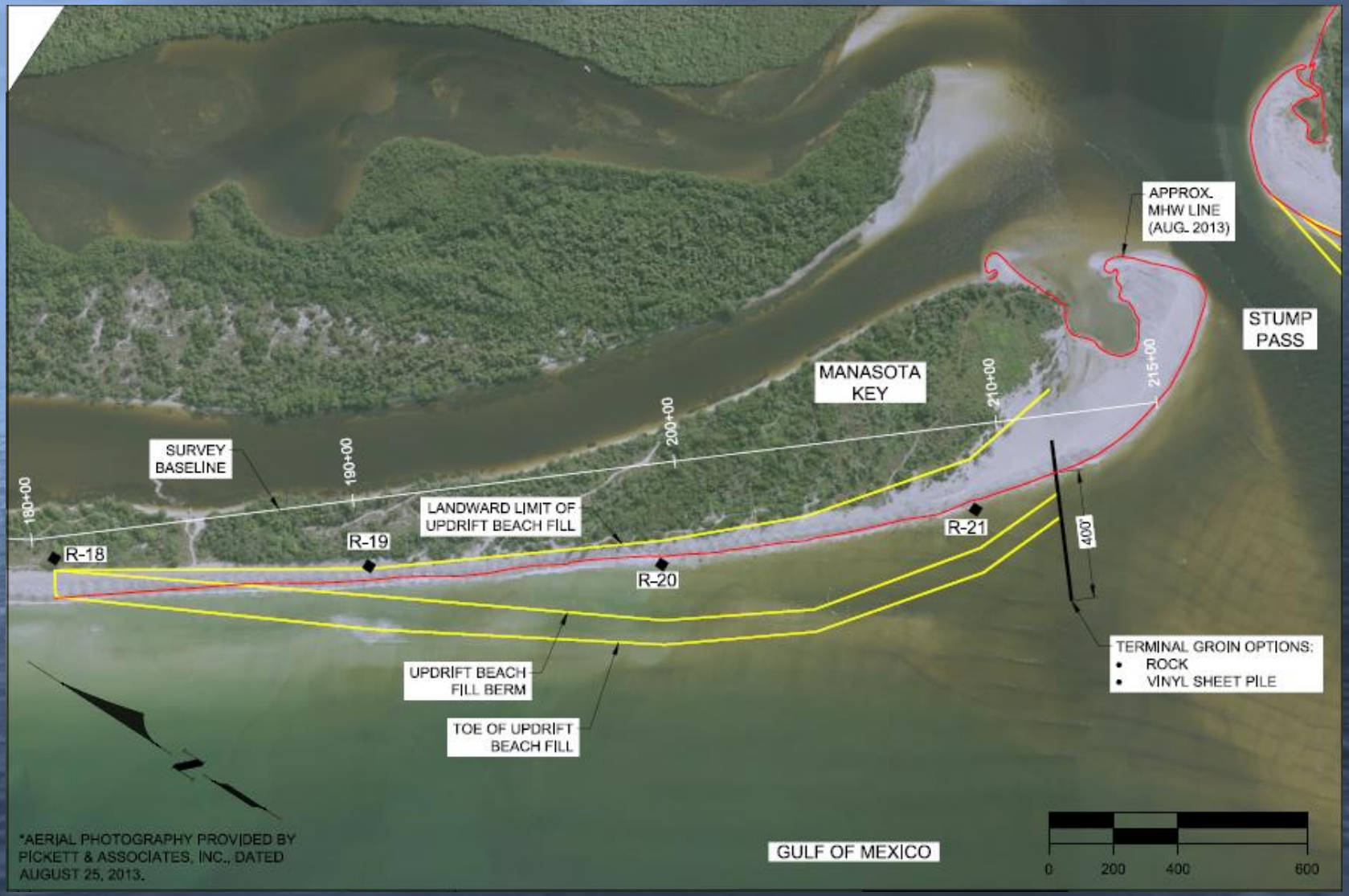
- Instead Preferring a T-groin Field if Alternatives Analysis Determined That a Structural Complement was Beneficial

Alternatives Development

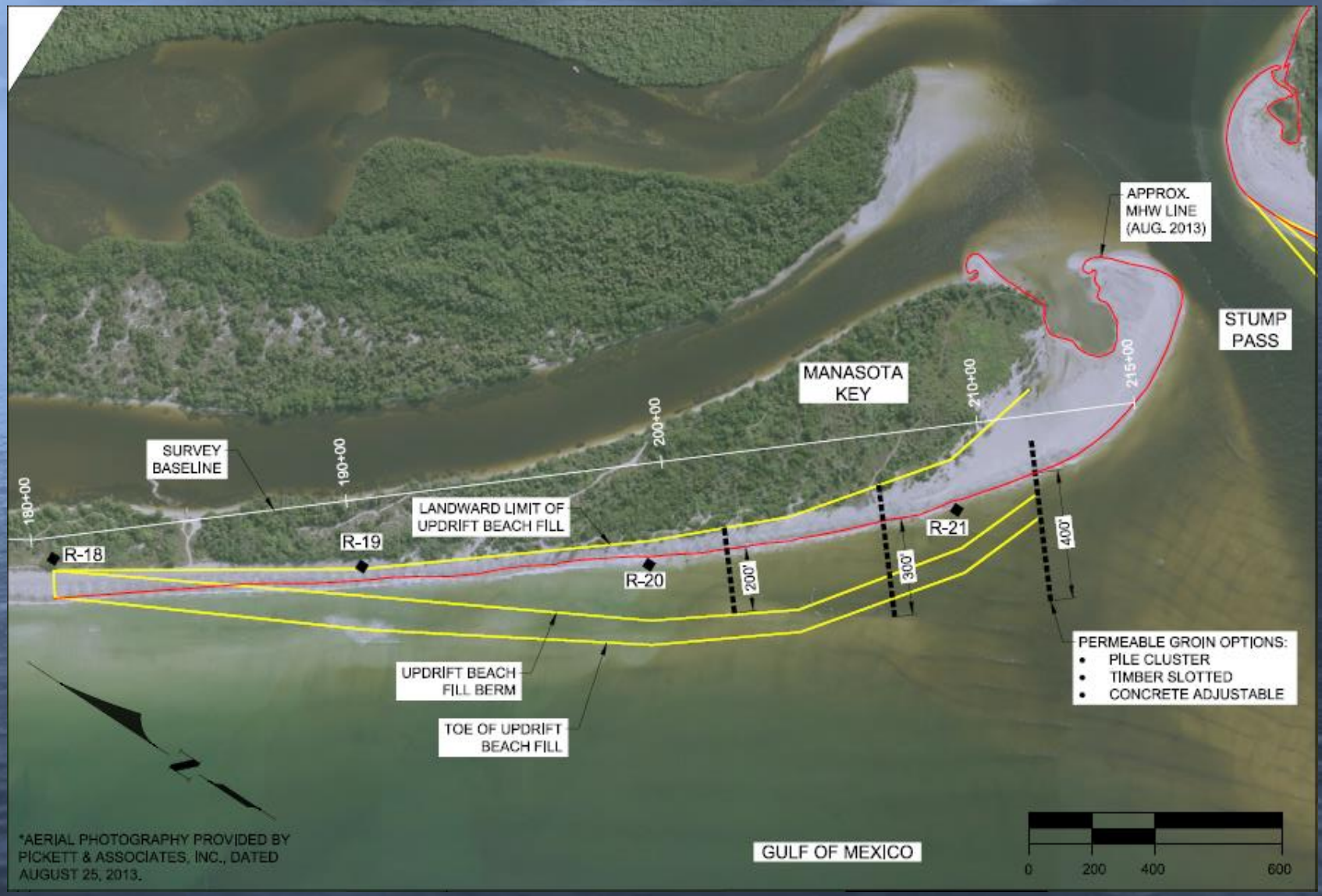
- Detailed Numerical Model Study
- Conceptual Plans
  - Beach Fills
    - Updrift (180,000 CY)
    - North (40,000 CY)
    - South (200,000 CY)
  - Structural Complements
    - Terminal Groin (MK)
    - Permeable Groin Field (MK)
    - T-groin Field (PI)
  - Ebb Shoal Restoration

Beach Fill and Terminal Structure

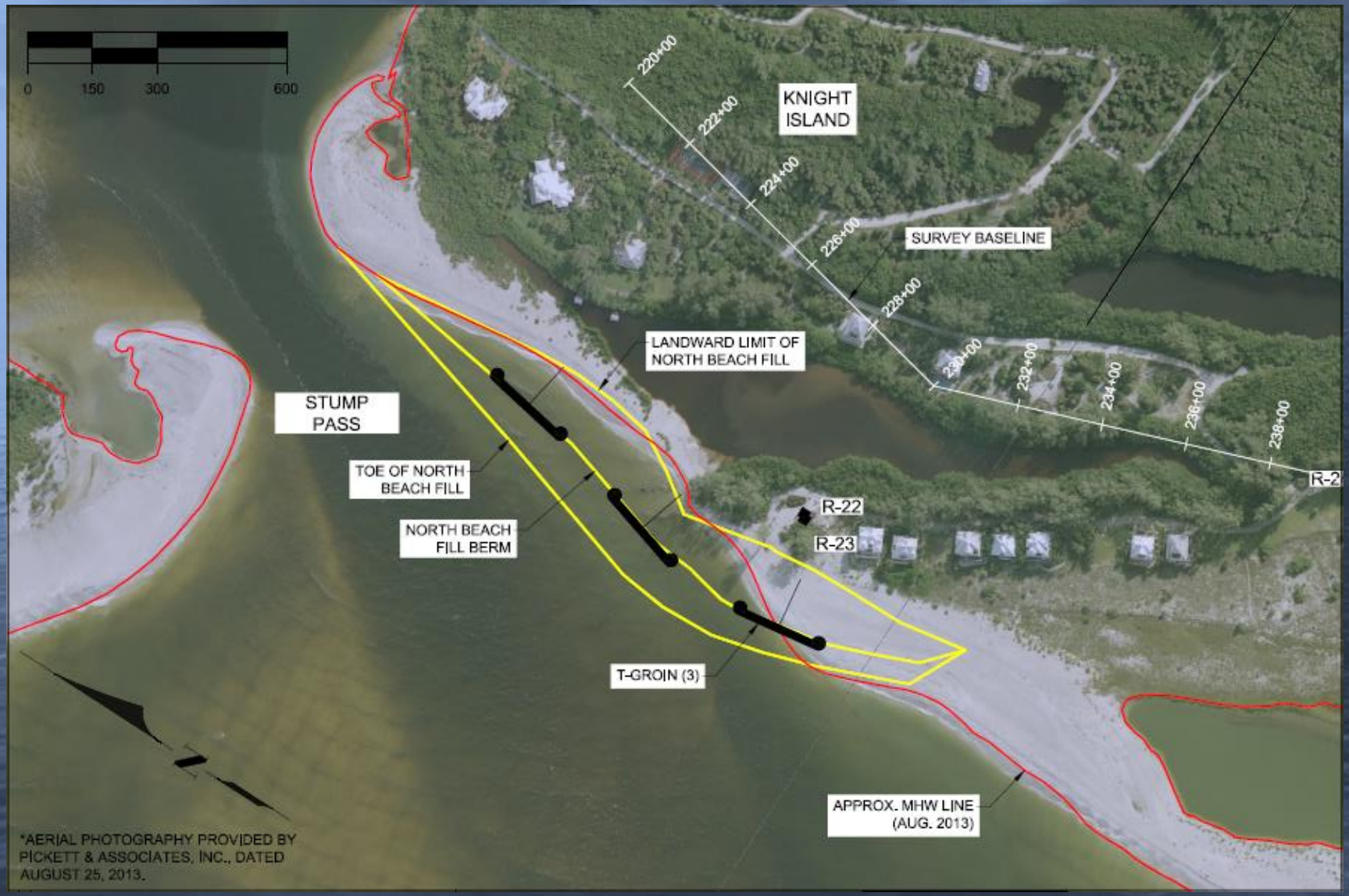
Alternative 1



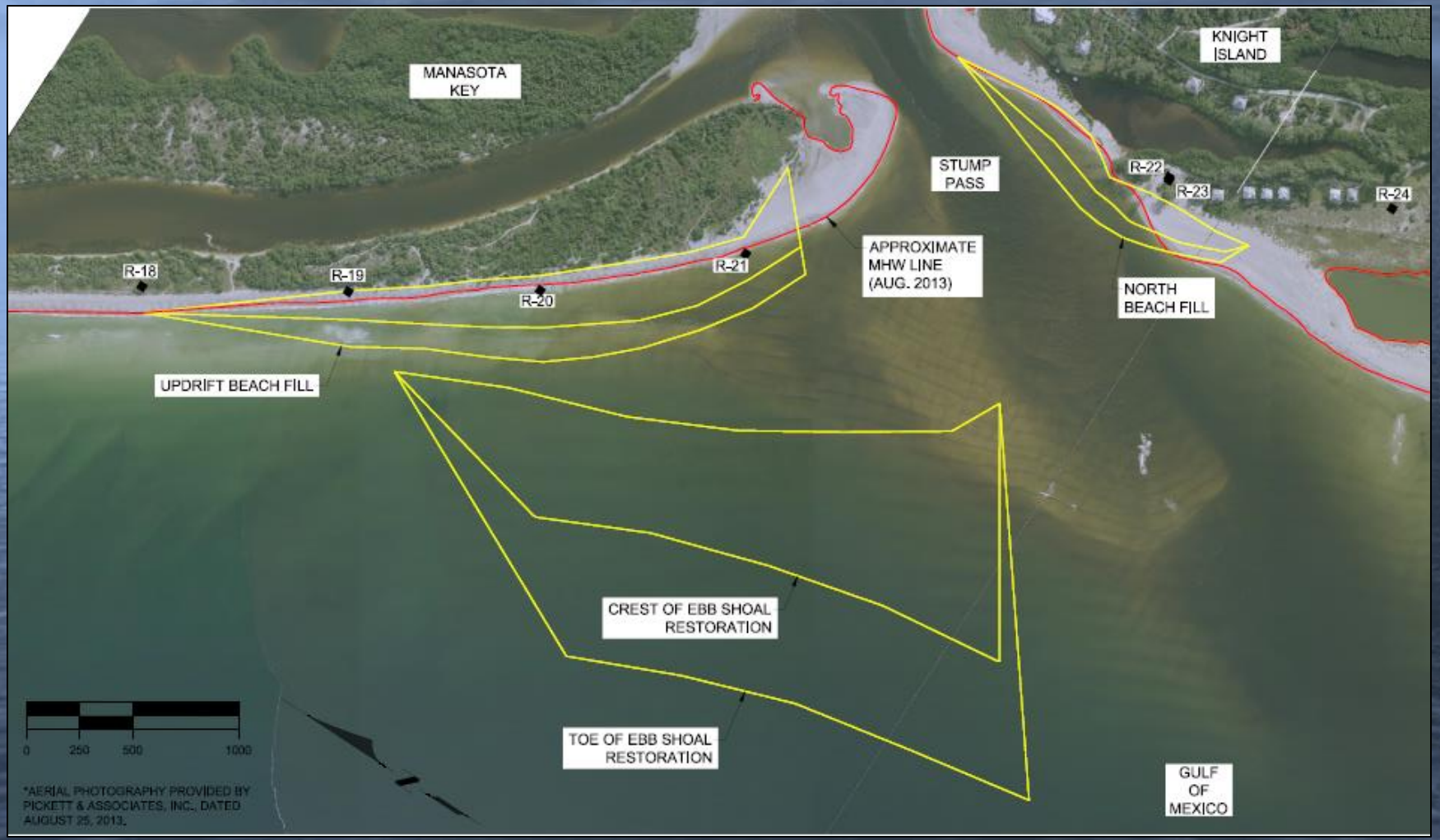
Beach Fill and Permeable Groin Field
Alternative 2



Beach Fill and T-Groin Field
Alternative 3



EBB SHOAL RESTORATION
ALTERNATIVE 4



Numerical Model Study

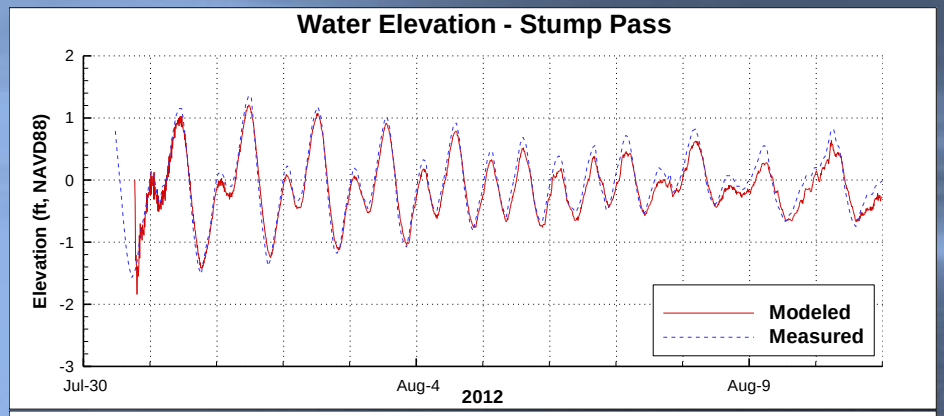
- Delft3D Model
  - Three-dimensional (3-D) State-of-the-art
  - Fully-coupled Simulation of Waves, Flow, and Sediment Transport
  - Open Source
- Model Calibration and Validation
  - Gauge Deployment to Collect Data
  - Topo/bathy Model Study Survey
  - Topo/bathy Historic Monitoring Surveys

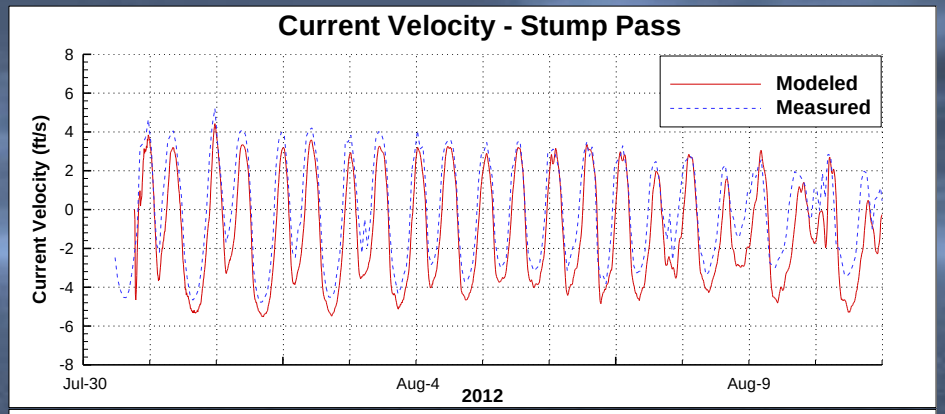
Model Calibration

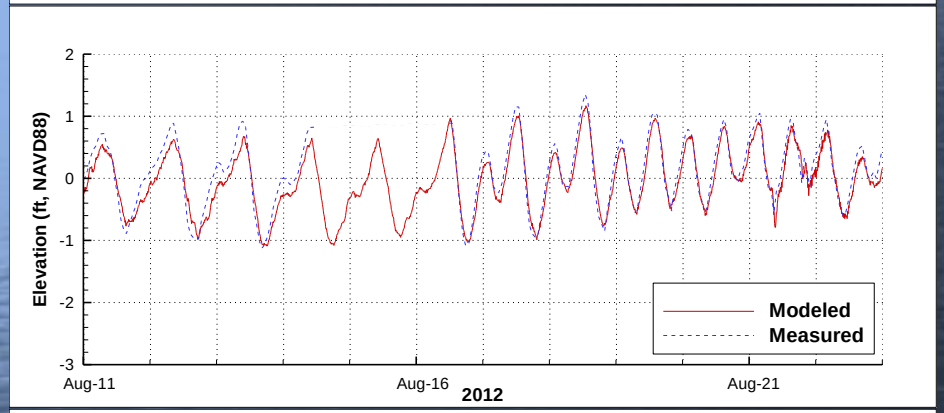
- July 30 – September 4, 2012
- 3-Dimensional(4 Layers)
- Forty-seven (47) Simulations with Various Combinations of Model Parameters and Formulations

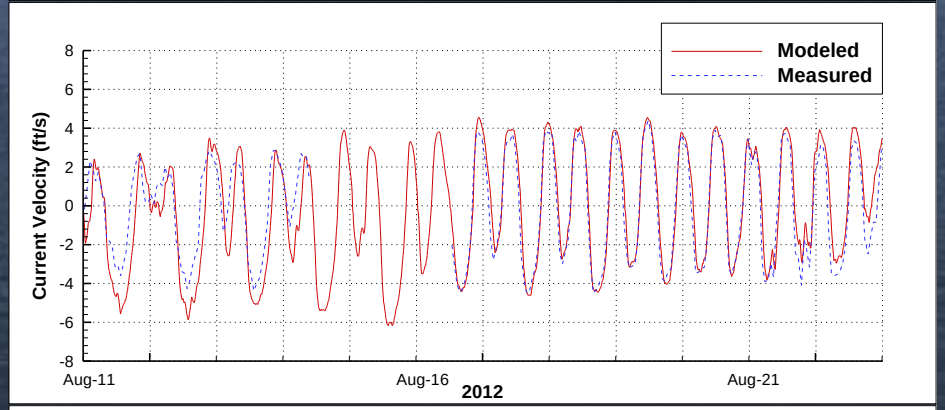
Parameter	Range
Number of Vertical Layers	1, 4, 8, 10
Sediment Size (mm)	0.1 – 0.43
Chezy Bottom Roughness	25 – 145
Stress Formulation due to Waves	Fredsoe, Grant, Van Rijn
Minimum Depth for Sediment Calculation (m)	0.1 – 0.5
Wave Related Transport Factor	0.05 – 1.0
Current Related Transport Factor	0.05 – 1.0

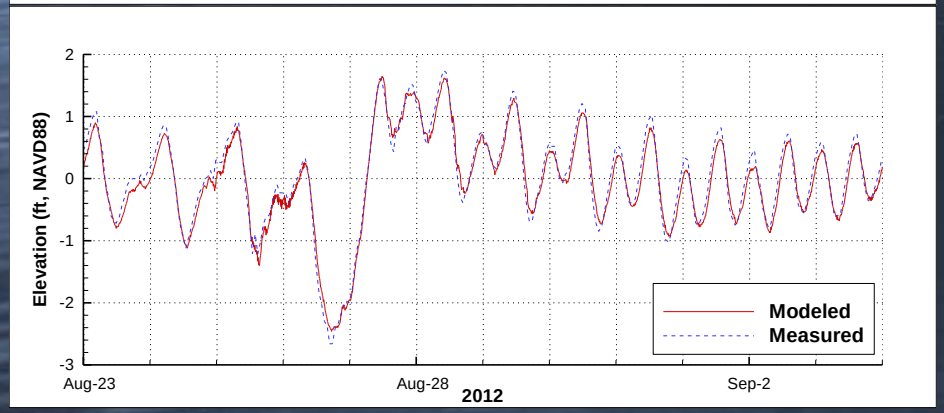
MODEL CALIBRATION: July 30 – Sept. 4, 2012

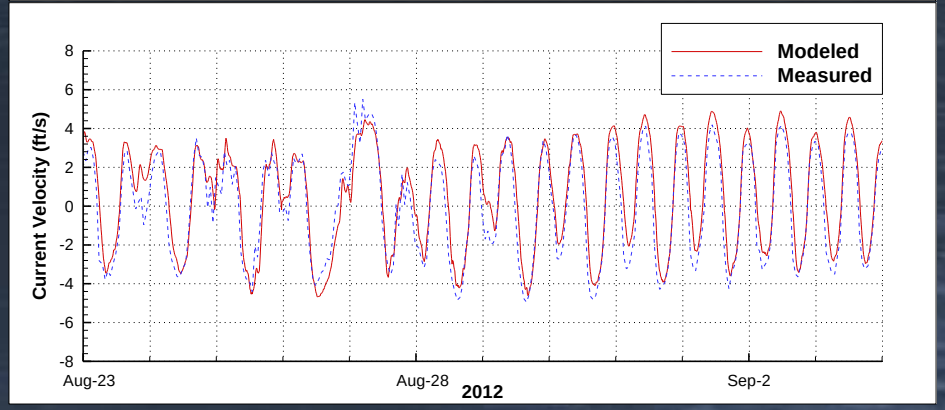












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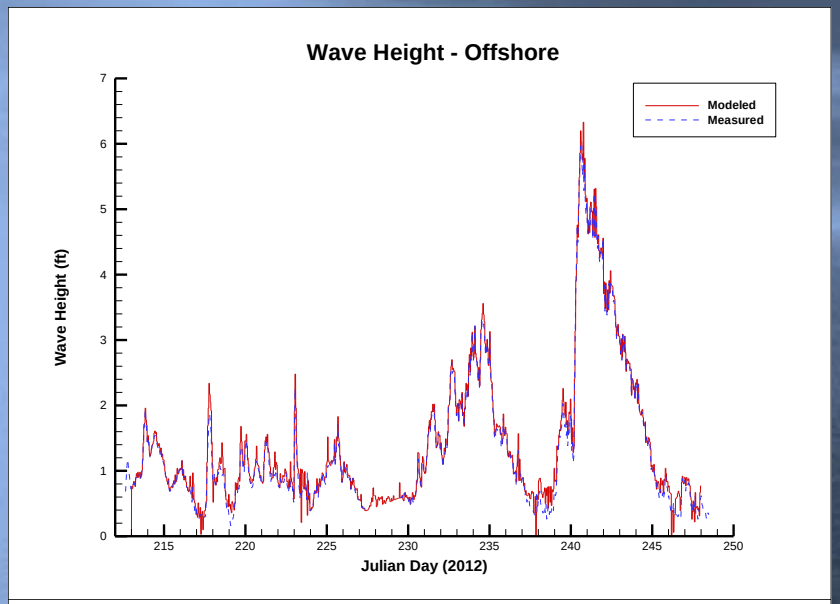

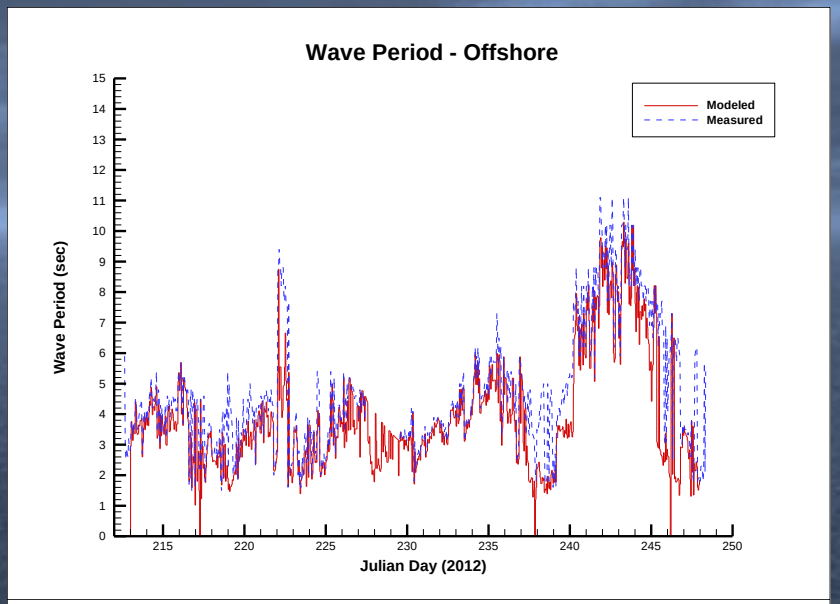

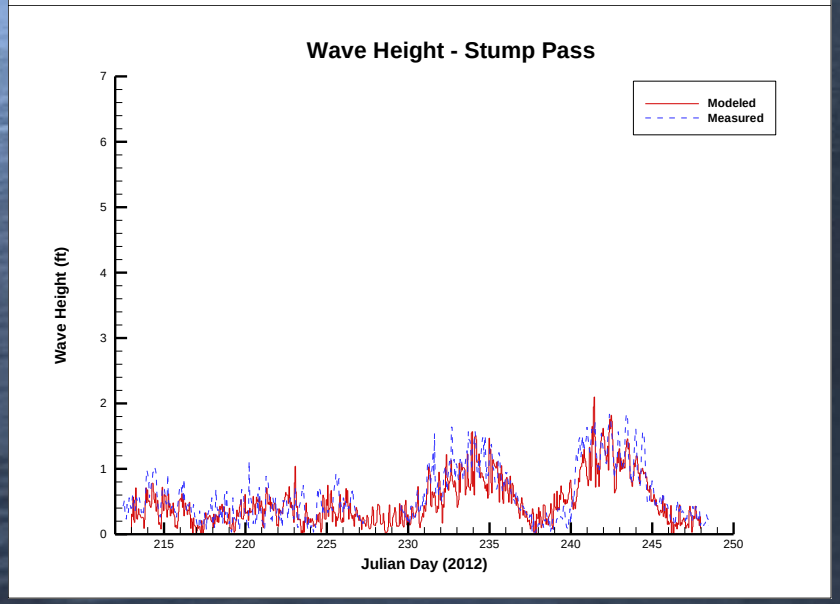

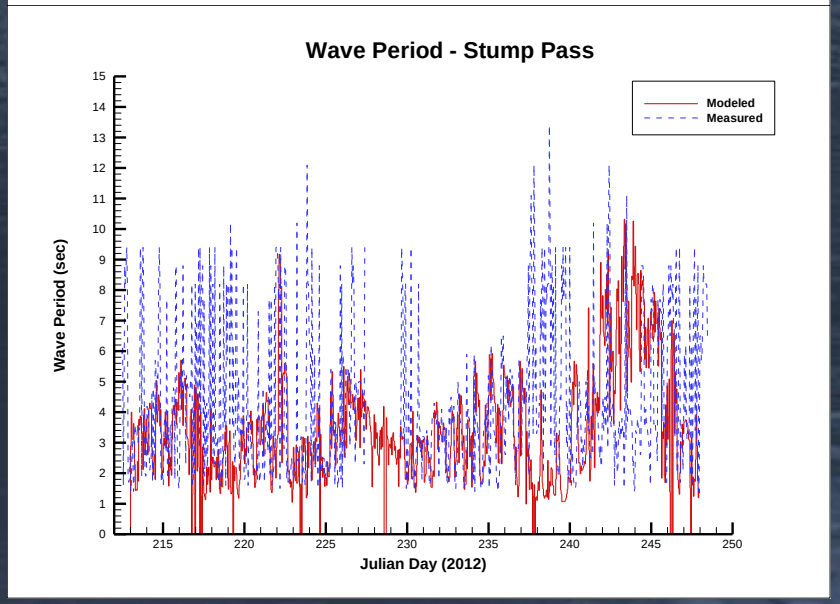

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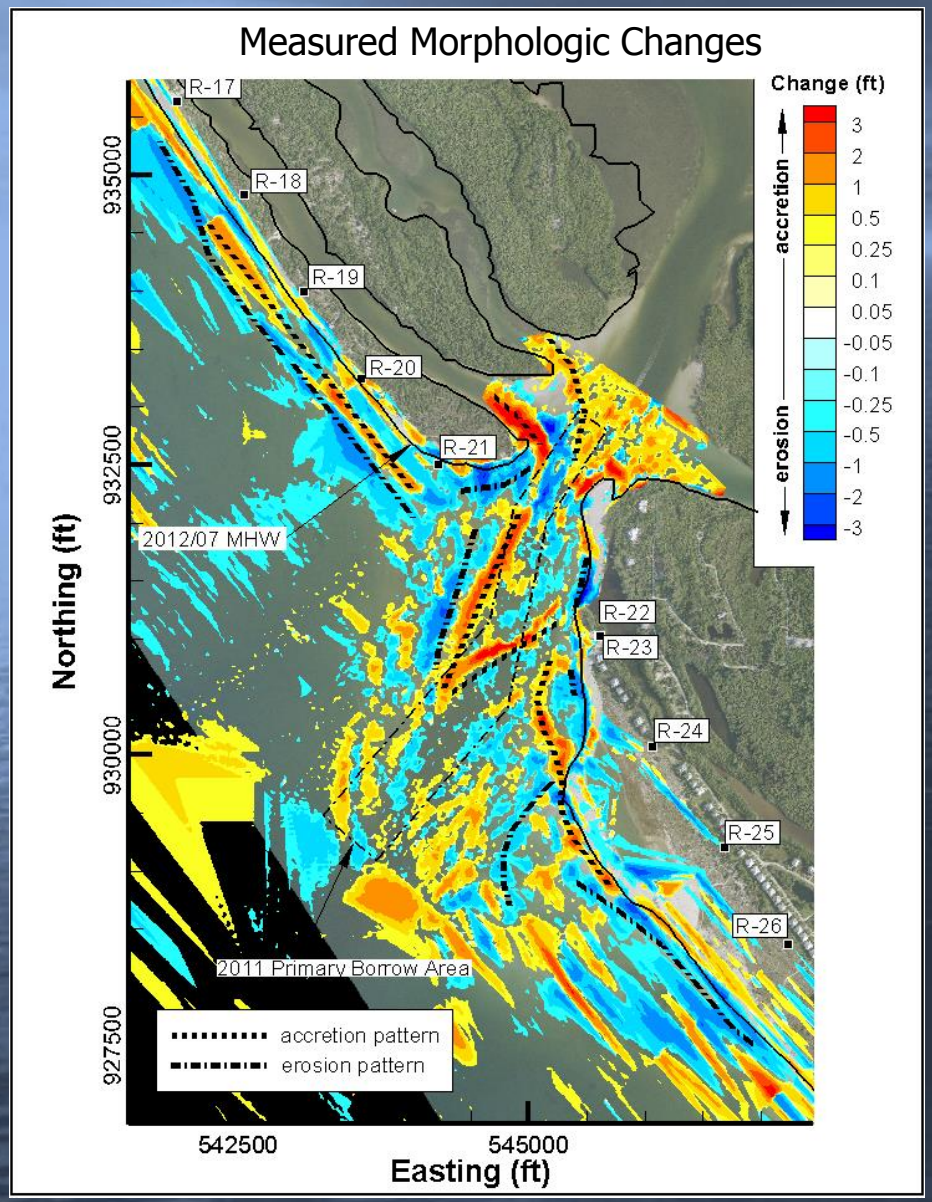
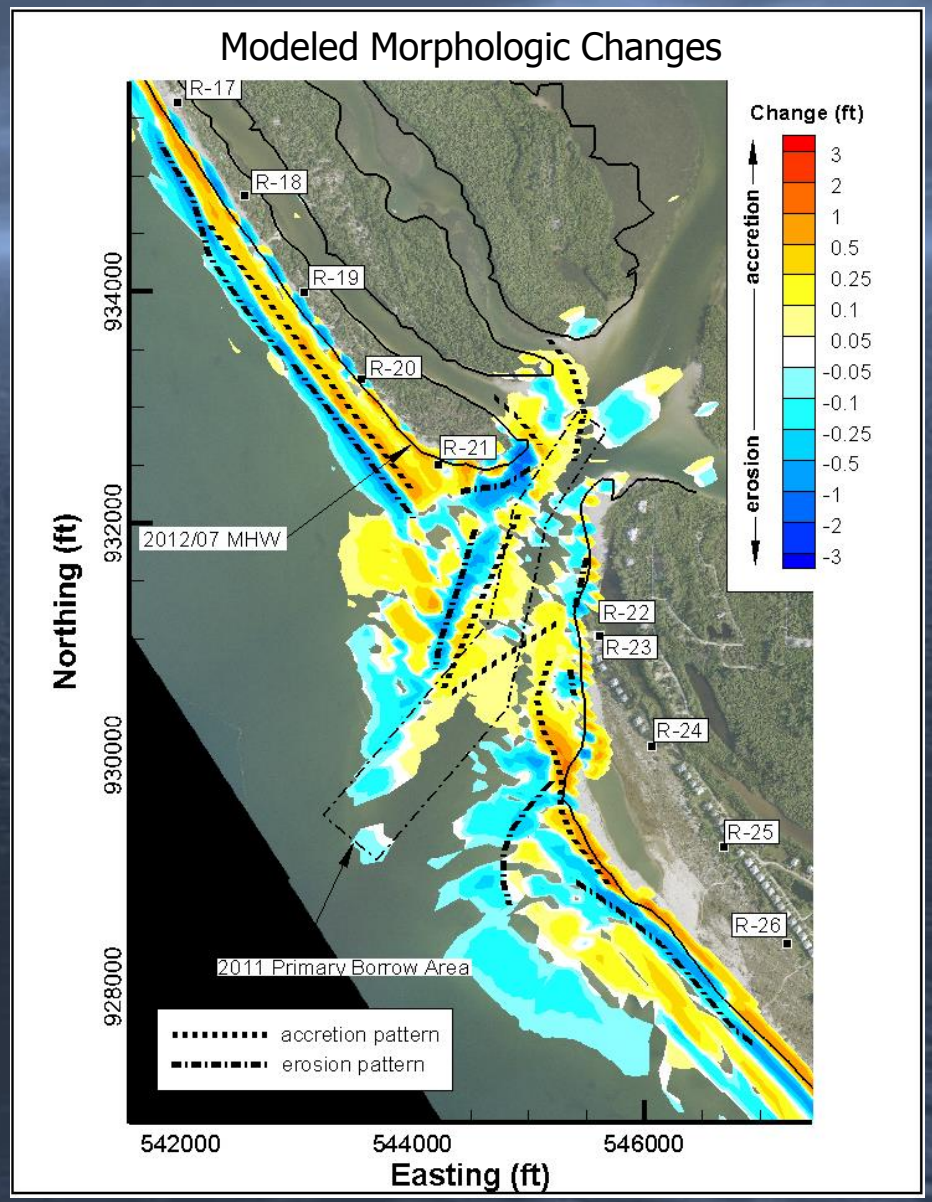




Model Calibration: July 30 – Sept. 4, 2012

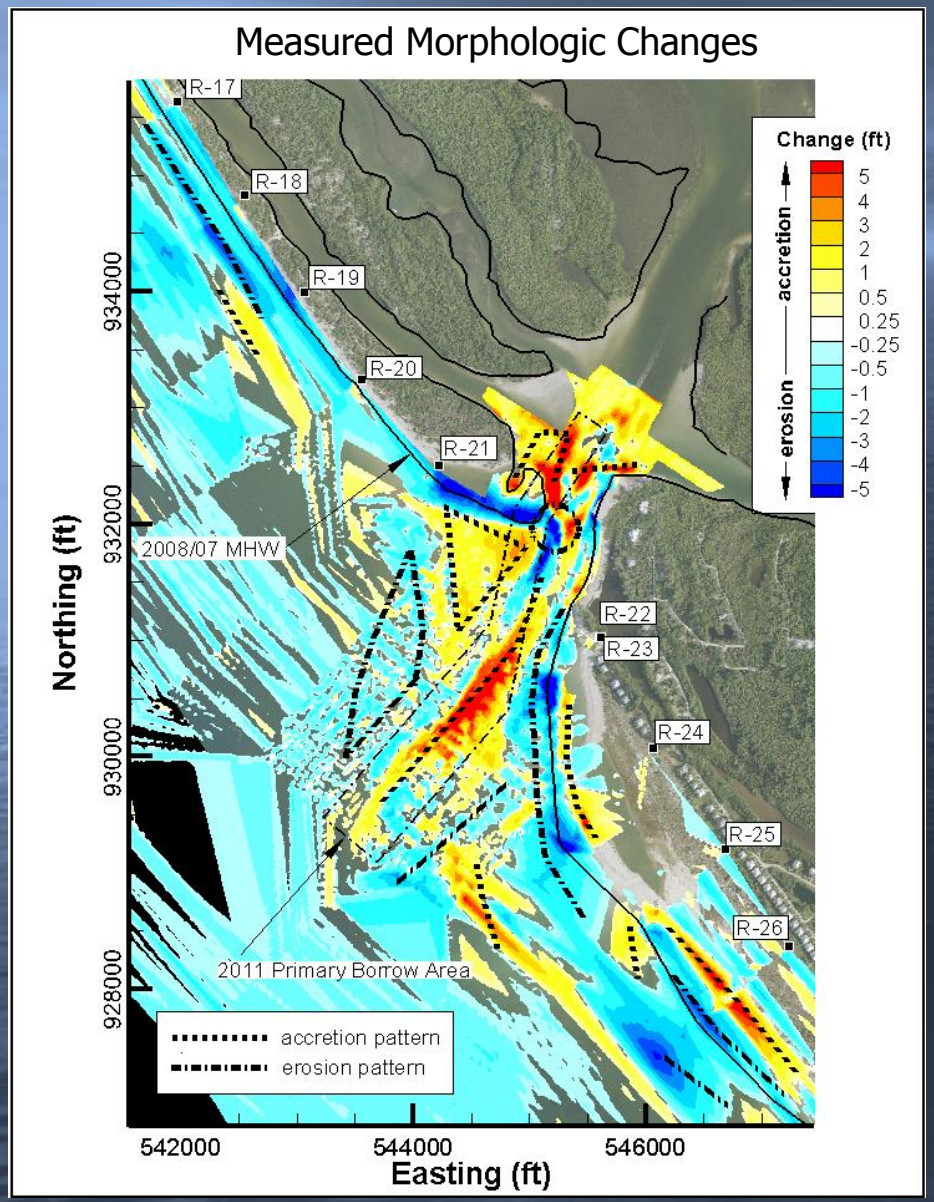
Shoreline Changes

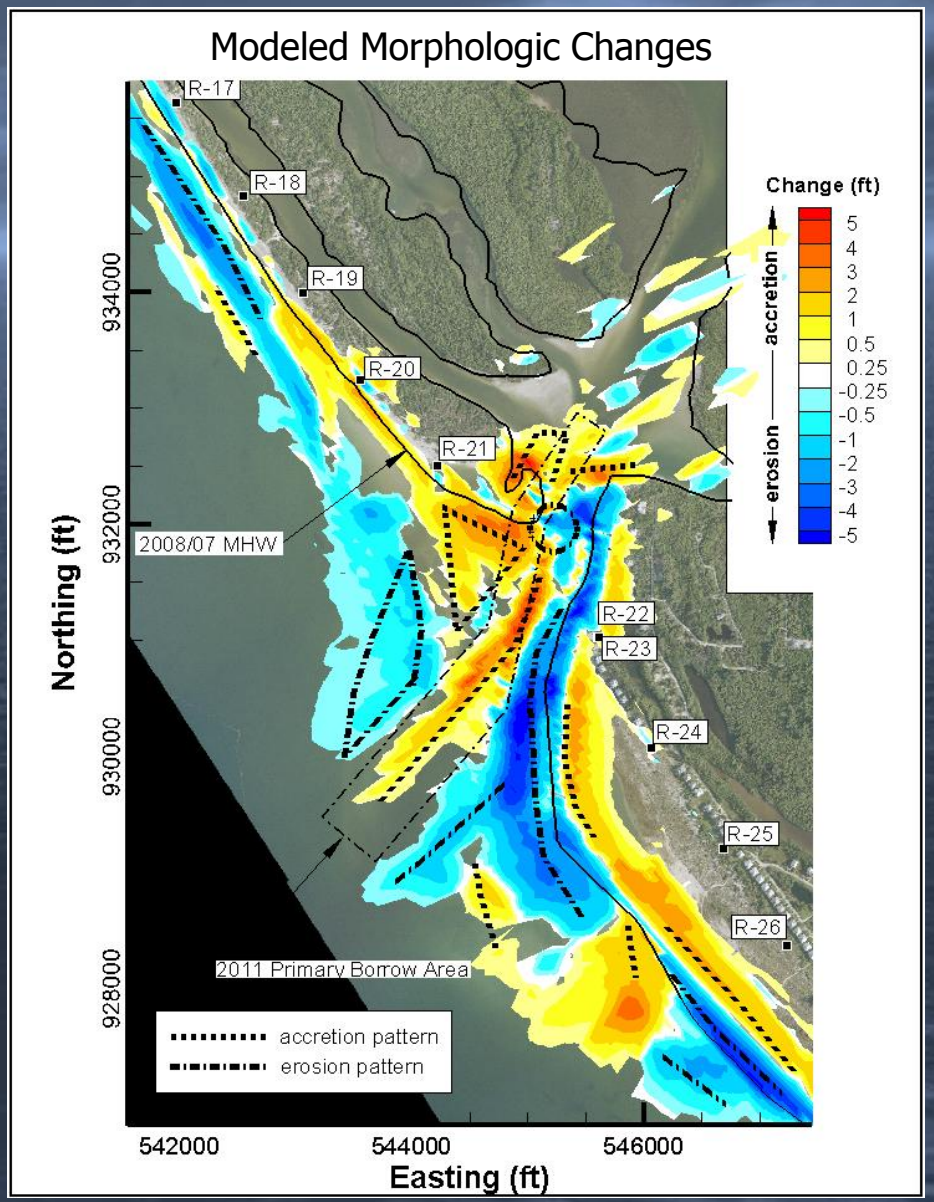
Cell #	Measured Shoreline Change at MHW (ft)	Modeled Shoreline Change at MHW (ft)
1: R-8 – R-14	-16.5	-0.8
2: R-14 – R-20	-0.02	-0.3
3: R-20 – Stump Pass	0.5	-12.2
4: Stump Pass	Not Applicable	Not Applicable
5: Stump Pass – R26	9.8	11.2
6: R-26 – R-29	16.7	14.3
7: R-29 – R-39	-0.5	-8.8
8: R-39 – R-47	-8.6	-8.6

Volumetric Changes

Cell #	Measured Volume Change to DOC (cy)	Modeled Volume Change to DOC (cy)
1: R-8 – R-14	2,120	2,777
2: R-14 – R-20	-3,360	-2,275
3: R-20 – Stump Pass	-2,837	-2,140
4: Stump Pass	9,861	2,097
5: Stump Pass – R26	-346	-468
6: R-26 – R-29	14,769	9,503
7: R-29 – R-39	-15,040	-3,902
8: R-39 – R-47	-7,534	-5,108

Model Validation: July 31, 2008 – Aug. 1, 2009





Model Validation: July 31, 2008 – Aug. 1, 2009

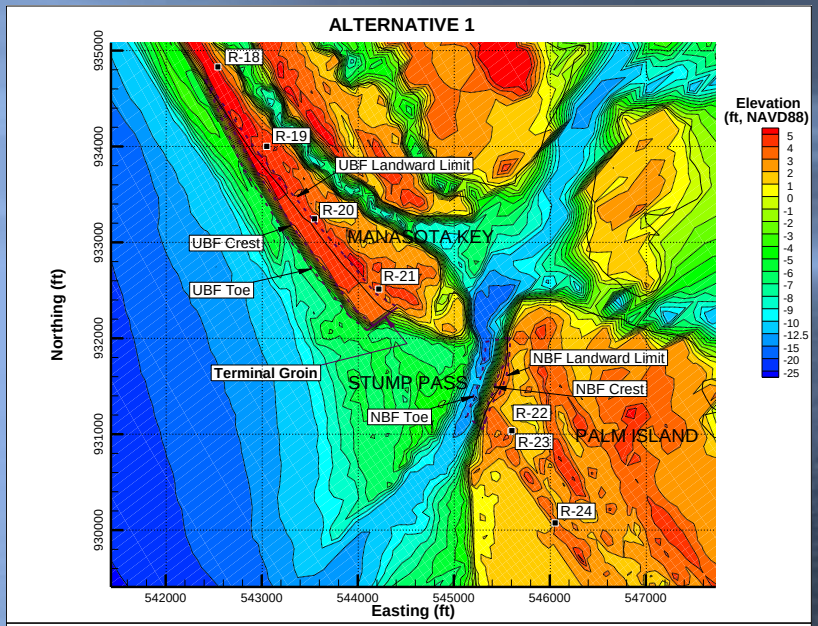
Shoreline Changes

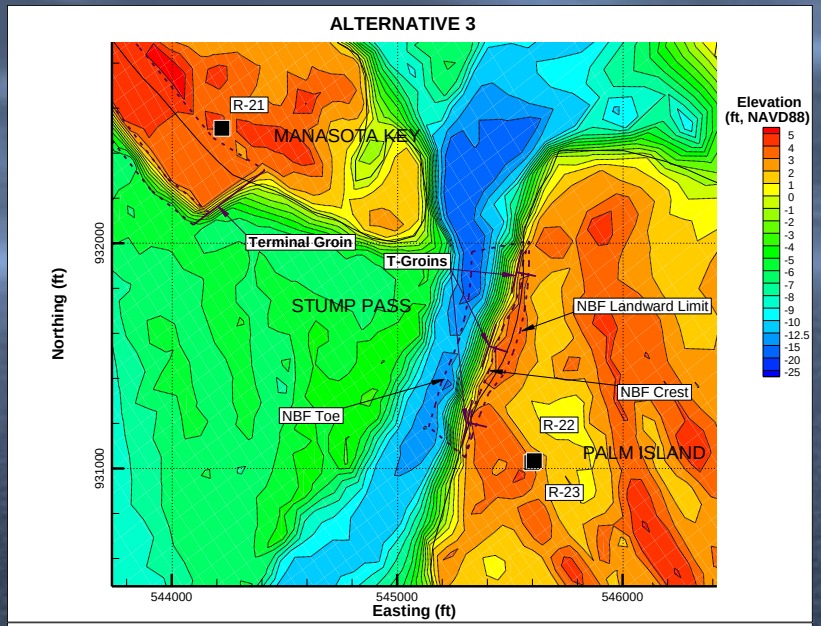
Cell #	Measured Shoreline Change at MHW (ft)	Modeled Shoreline Change at MHW (ft)
1: R-8 – R-14	-14.5	-23.8
2: R-14 – R-20	-29.8	-18.1
3: R-20 – Stump Pass	-7.7	-10.5
4: Stump Pass	Not Applicable	Not Applicable
5: Stump Pass – R26	-58.4	-120.6
6: R-26 – R-29	-31.1	-82.5
7: R-29 – R-39	-9.1	-17.3
8: R-39 – R-47	4.0	41.6

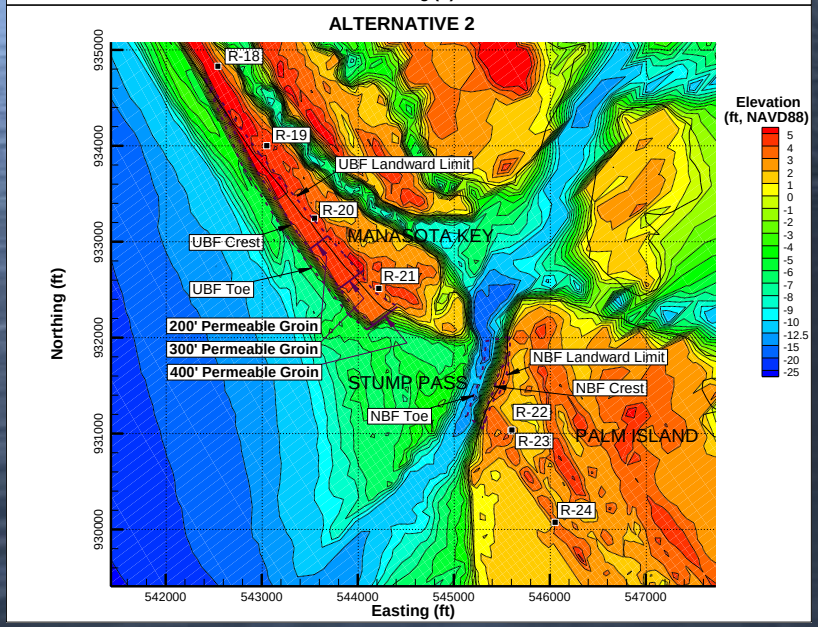
Volumetric Changes

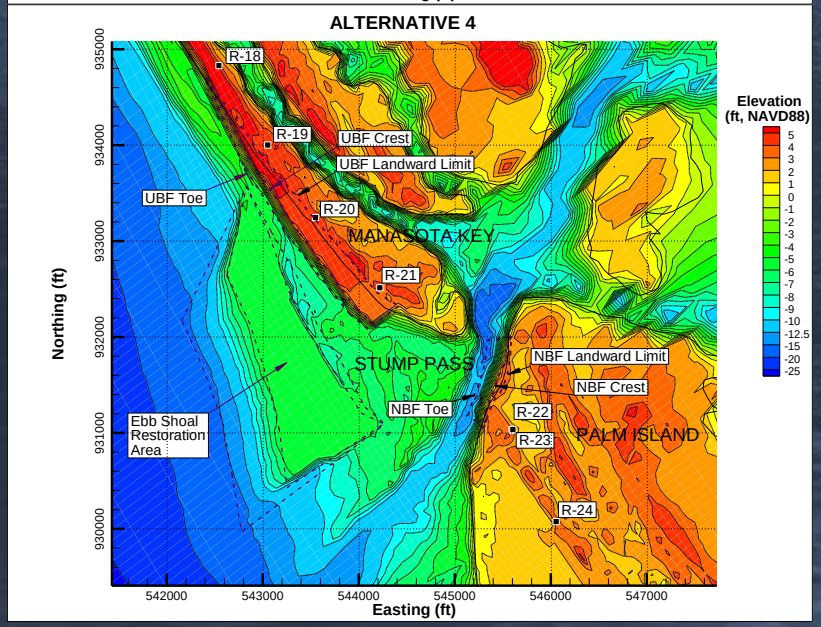
Cell #	Measured Volume Change to DOC (cy)	Modeled Volume Change to DOC (cy)
1: R-8 – R-14	38,979	22,110
2: R-14 – R-20	-78,250	-112,195
3: R-20 – Stump Pass	-5,369	-23,702
4: Stump Pass	54,710	79,229
5: Stump Pass – R26	-75,324	-128,066
6: R-26 – R-29	-18,014	-47,883
7: R-29 – R-39	78,283	39,472
8: R-39 – R-47	3,824	101,969

ALTERNATIVES ANALYSIS

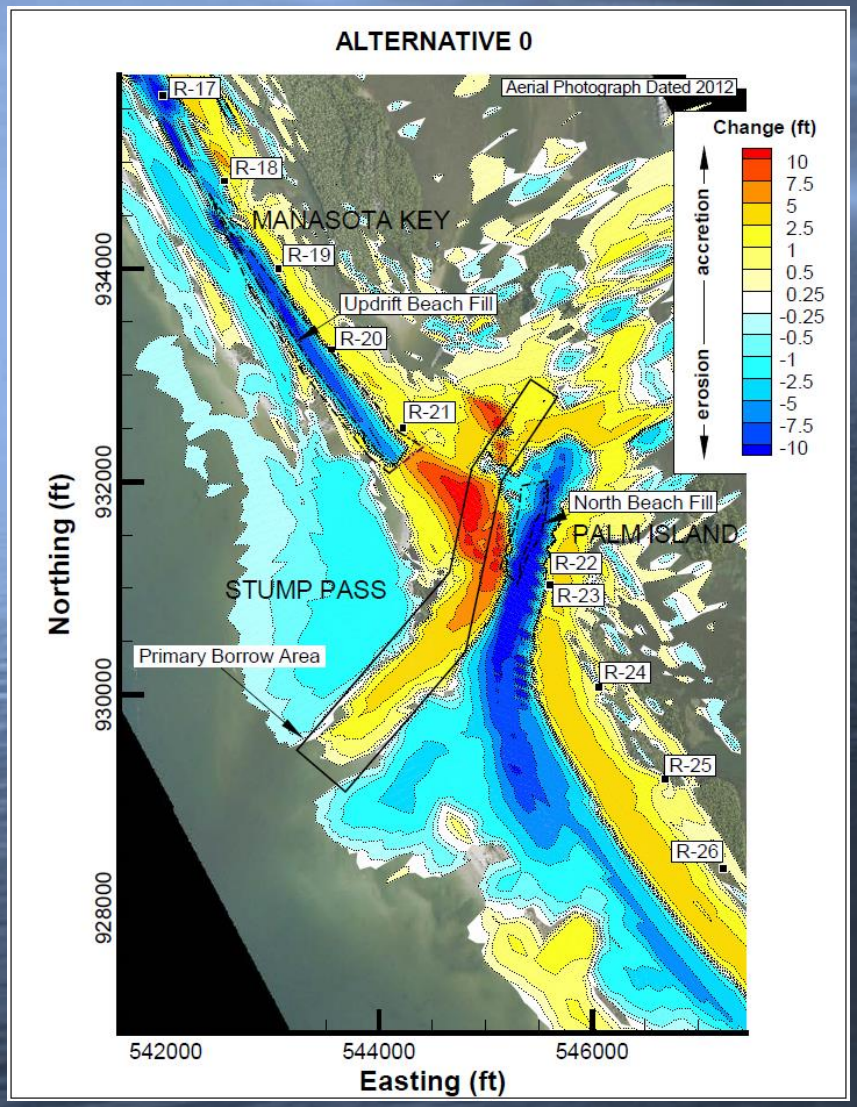




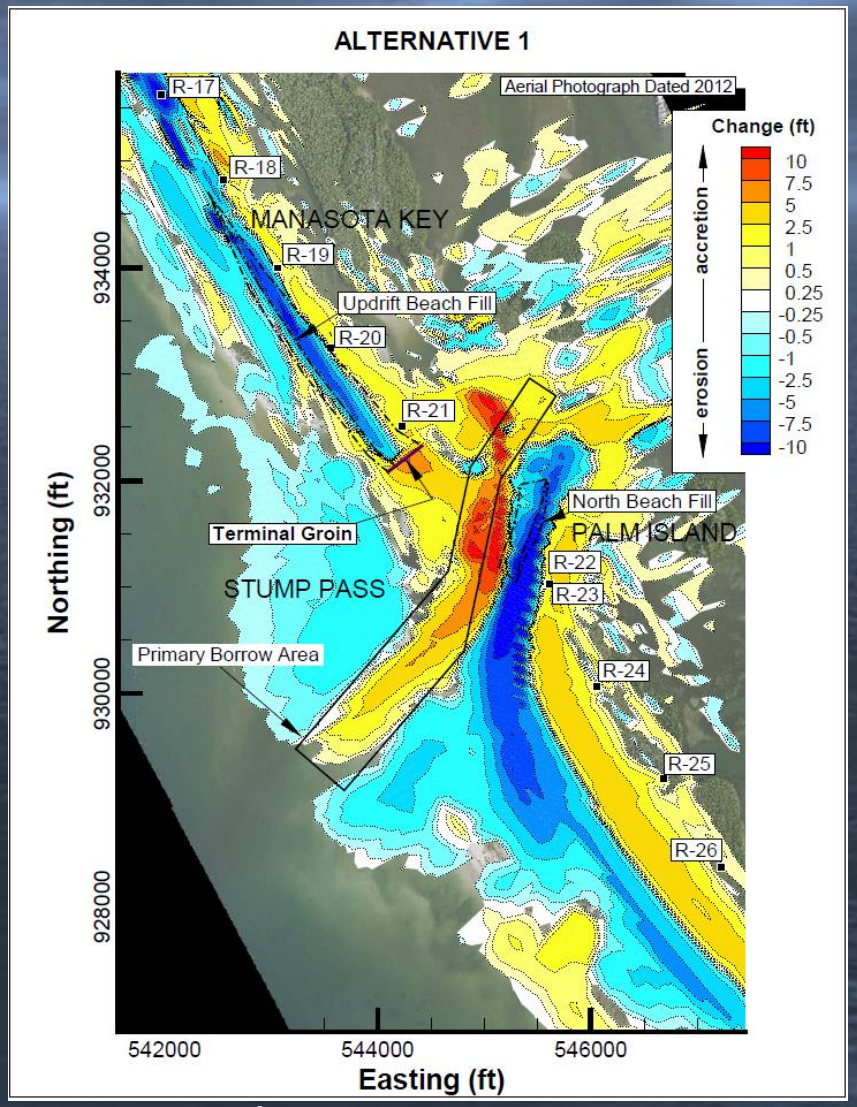




MODEL RESULTS: 4-YEAR SIMULATION



No New Action



Terminal Groin on Manasota Key

Performance Evaluation

- Acreage Change
- Volumetric Change
- Borrow Area Infilling
- Downdrift Effects
- Controlling Depth
- Construction Budget

Scoring Summary

ALTERNATIVE	ACREAGE CHANGE			VOLUME CHANGE			BORROW AREA INFILLING	DOWNDRIFT EFFECTS*	CONTROLLING DEPTH	CONSTRUCTION BUDGET	TOTAL SCORE	RANK
	UBF	NBF	SBF	UBF	NBF	SBF						
0	0	0	0	0	0	12	7	20	30	0	70	**#5**
1	7	0	12	19	14	10	5	10	30	25	132	**#4**
2	31	0	11	47	8	0	34	10	30	28	199	**#1**
3	6	3	13	18	45	16	20	0	30	23	174	**#2**
4	26	0	0	53	2	15	0	20	30	18	164	**#3**

0: No New Action
1: Terminal groin on Manasota Key (MK)
2: Permeable groin field on MK
3: Term. groin on MK & T-groin field on Palm Island
4: Ebb Shoal Restoration

* Higher Score = Better Performance

Discussion

- Perm. Groin Field on MK Identified as Preferred
- Term. Groin Identified as Viable Option
- Beach Renourishment Remains Critical and is Recommended on an 8-year Cycle
- Inlet Channel Maintenance Dredging is Recommended on a 4-year Cycle
- T-groin Field is Recommended as an Adaptive Management Strategy
- Ebb Shoal Restoration is Also Recommended as an Adaptive Management Strategy

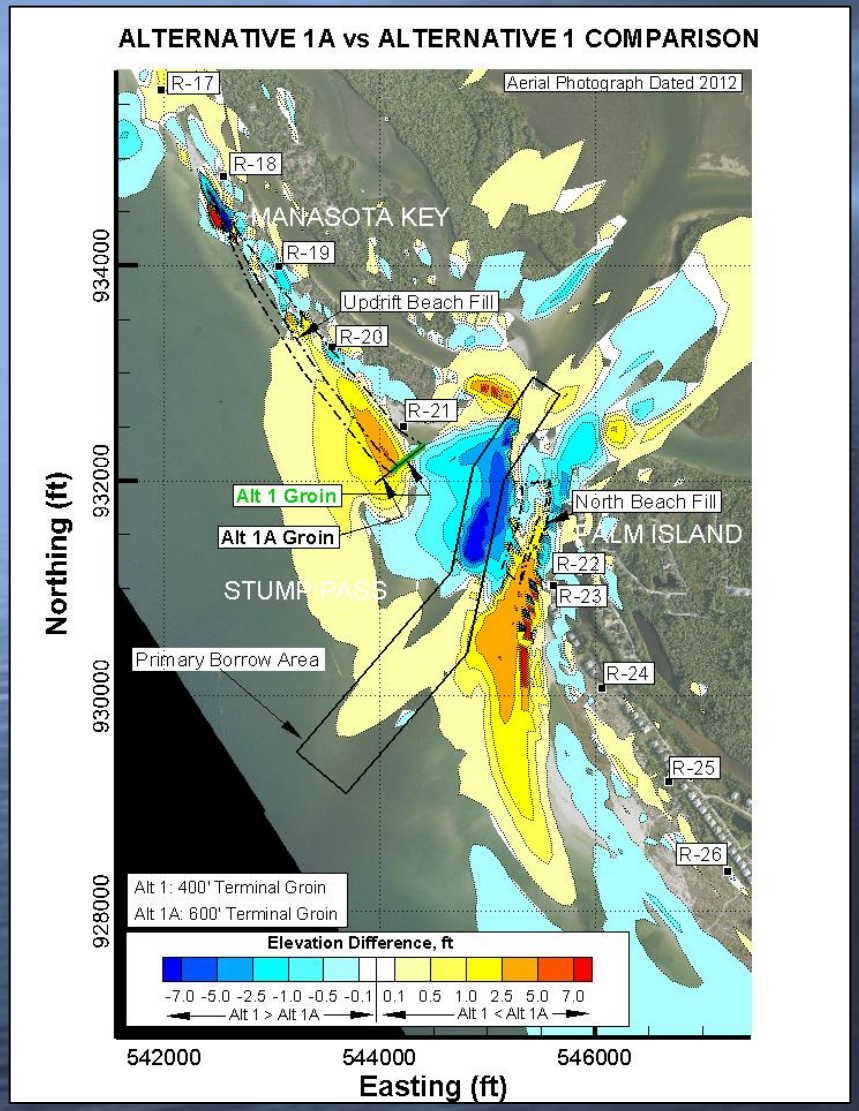
FDEP and Park Service Input

- Florida Park Service Concluded That the Term. Groin was Considered Favorable
- Concerns of Downdrift Impacts Immediately South of Proposed Terminal Groin (within State Park Beach) were expressed by Florida Park Service
- Additional modeling was suggested

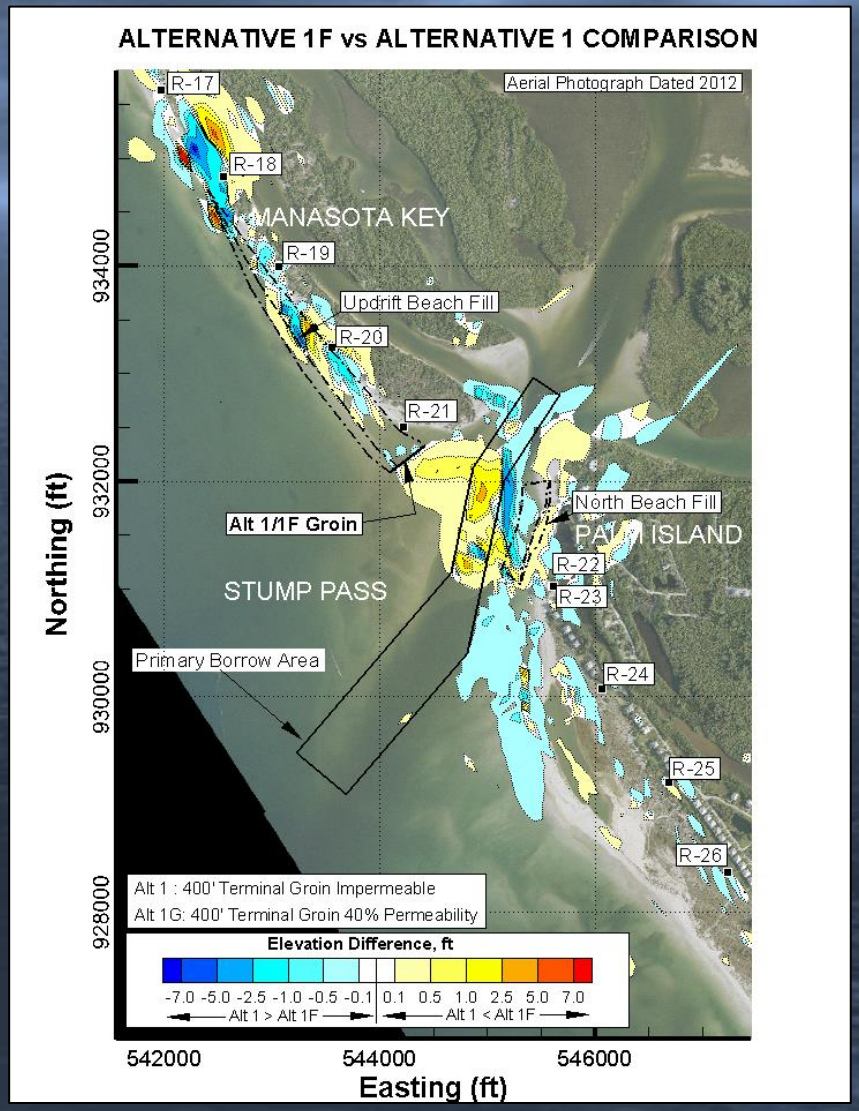
Terminal Groin Options

- Alt 1A: Terminal Groin is 200 Feet Longer
- Alt 1B: Terminal Groin is Shifted South 250 Feet
- Alt 1C: Terminal Groin is Shifted South 500 Feet
- Alt 1D: Terminal Groin's Orientation is Shifted 45°
- Alt 1E: Terminal Groin is 20% Permeable
- Alt 1F: Terminal Groin is 40% Permeable
- Alt 1G: Terminal Groin Crest is 1.5 Feet Lower

MODEL RESULTS: 4-YEAR SIMULATION



Alt 1A vs. Alt 1



Alt 1F vs. Alt 1

ADDITIONAL MODELING

Scoring Summary

Alternative	Acreage Change	Volume Change		Downdrift Effects*		Borrow Area Infilling	Construction Budget	Total Score	Rank
	UBF	UBF	NBF	MK†	PI‡				
1	4	3	11	15	15	15	28	91	#6
1A	18	25	14	0	22	42	12	133	#1
1B	15	14	0	24	0	4	17	74	#7
1C	28	38	2	21	5	0	0	94	#5
1D	3	2	2	18	4	11	18	58	#8
1E	4	5	10	27	13	14	31	104	#3
1F	0	0	10	33	13	11	33	100	#4
1G	4	5	13	6	19	27	33	107	#2

1A: Terminal Groin is 200 Feet Longer
1B: Terminal Groin is Shifted South 250 Feet
1C: Terminal Groin is Shifted South 500 Feet
1D: Terminal Groin's Orientation is Shifted 45°
1E: Terminal Groin is 20% Permeable
1F: Terminal Groin is 40% Permeable
1G: Terminal Groin Crest is 1.5 Feet Lower

* Higher Score = Better Performance

† MK = Manasota Key

‡ PI = Palm Island

RECOMMENDATIONS

- Screen Out Alternatives 1A, 1B, 1C, and 1D due to Potential Downdrift Impacts (and Higher Costs)
- Alternatives 1E and 1F (Increased Permeability) as well as Alternative 1G (Lower Crest Elevation) are Recommended for Consideration
- Seeking Input from FDEP and Florida Park Service to Select Permeability and Crest Elevation of Proposed Structure
- Submit JCP for Anticipated 2015 Construction

Acknowledgements

- Charlotte County BCC & Staff
- Advisory Committees
- Residents & Boating Community
- FDEP Beaches
- FL State Park Staff
- FFWCC & Aquatic Preserves
- Federal Agencies
- Shorebird and Sea Turtle Monitors
- Coastal Tech & Coastal Engineering