

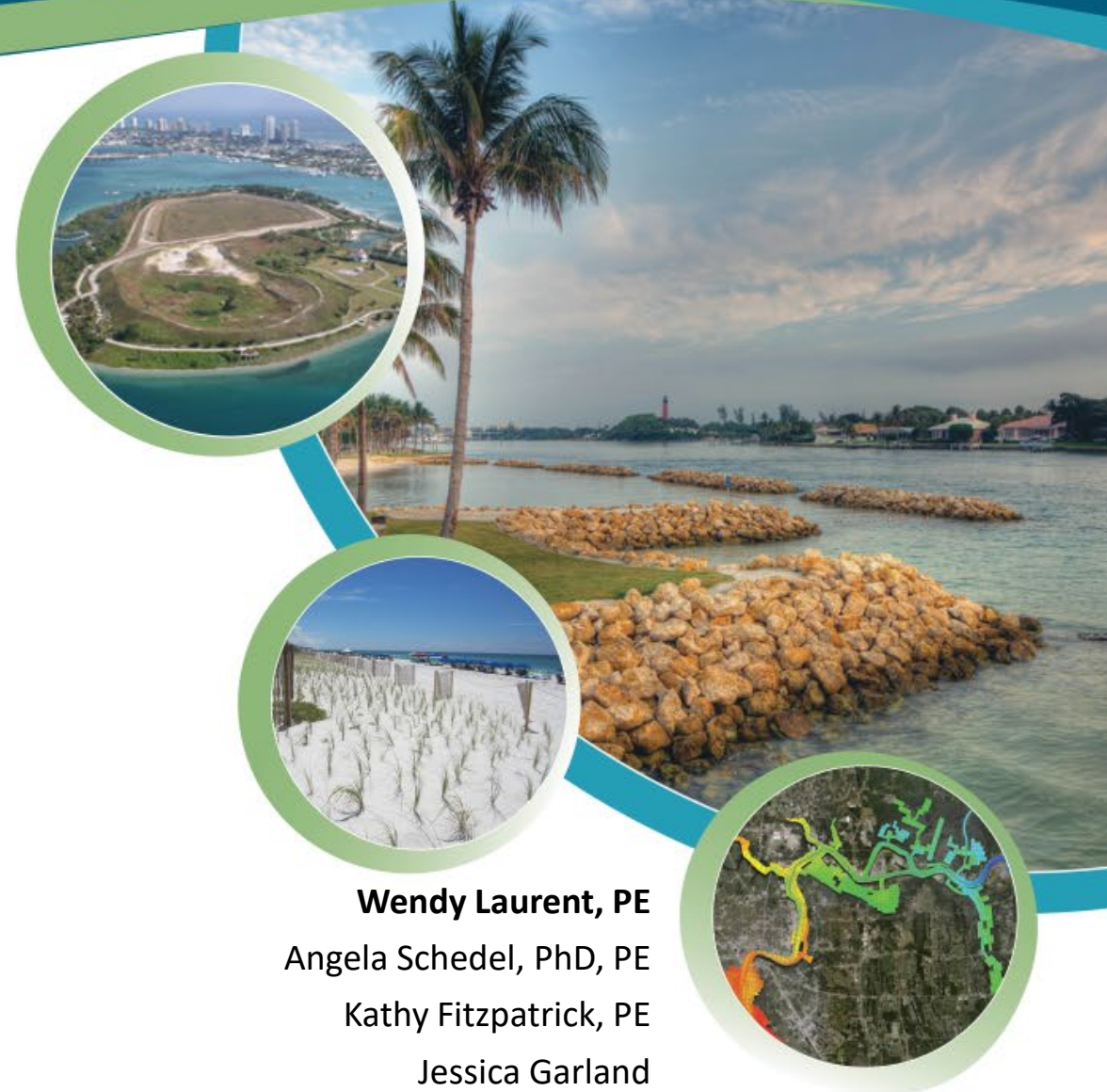


TAYLOR ENGINEERING, INC.

Martin County Four Mile Beach Resilience

FSBPA Technical Conference

February 3, 2022



Wendy Laurent, PE
Angela Schedel, PhD, PE
Kathy Fitzpatrick, PE
Jessica Garland

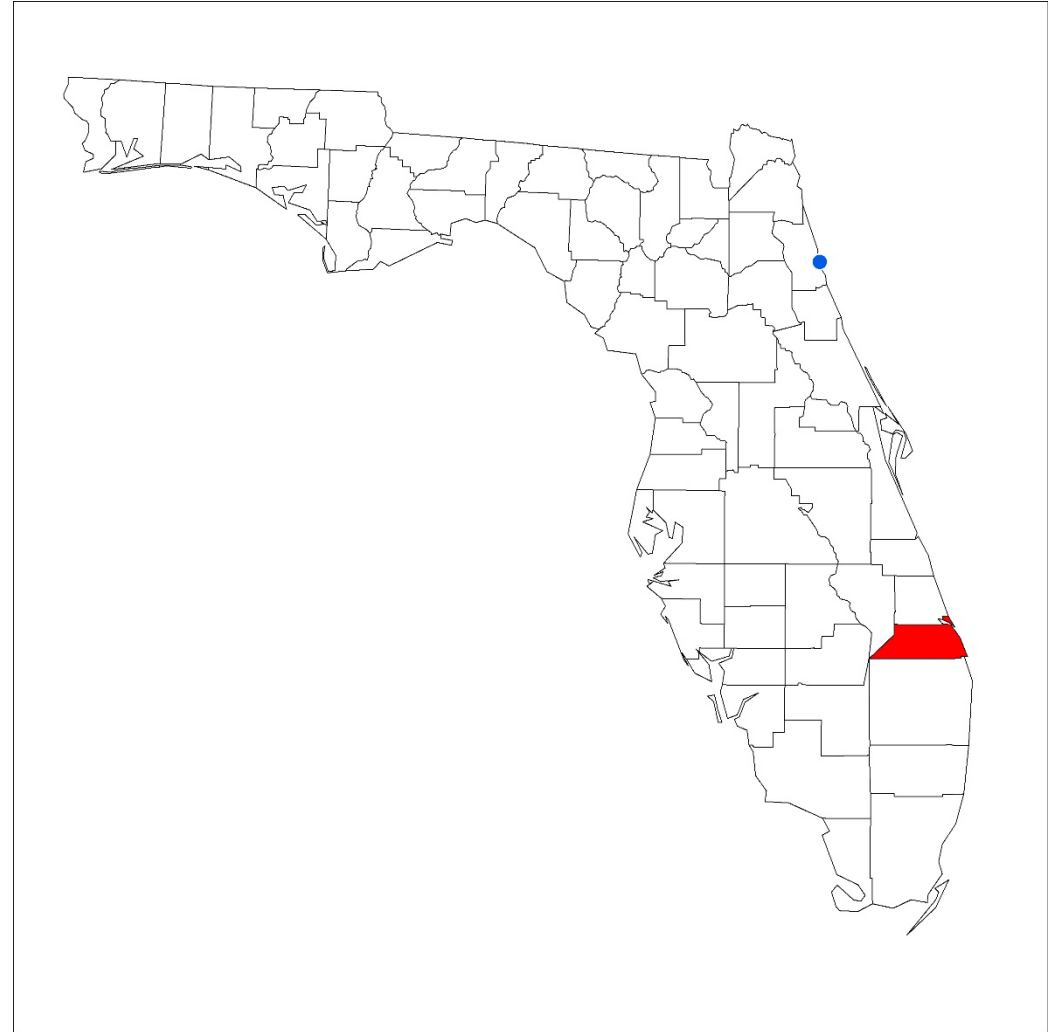
Presentation Outline

- Martin County Shore Protection Project
- Project Authorization
- Beach Nourishment History and Design Templates
- Significant Storms
- Water Level History and Projections
- Historic Project Performance
- Summary and Recommendations
- Looking Forward



Martin County SPP

- Northern-most 4 miles of Martin County (R-1 to R-25)
- Provides storm damage reduction in addition to recreation and environmental benefits

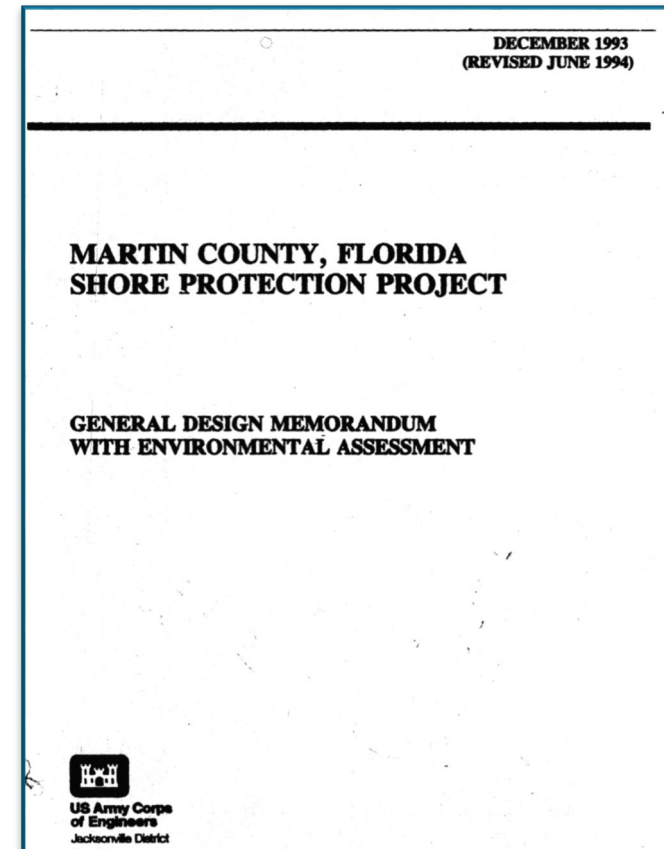


Martin County SPP Resilience

- The County is investigating options to modify the project design in the future to increase the performance of the beach fill and enhance resilience along this section of Hutchinson Island.
- JCP due to expire August 2021 🥲
- Our Path:
 - Summarize project history
 - Analyze historic beach trends
 - Begin discussions with permitting agencies
 - ... recommendations and next steps

Project Authorization

- Authorized in the Water Resource Development Act 1990 (WRDA 1990)
- GDM- General Design Memorandum
 - USACE 1994
 - Describes the project as:
 - (1) a protective beach berm and storm dune along approximately 4 miles (mi) of Hutchinson Island, FL;
 - (2) periodic nourishment of the restored beach and adjacent shoreline as needed and justified for the life of the project;
 - and (3) extensive, multiyear beach performance monitoring.
 - Federal participation (R-1 to R-23) expires in 2045



Permit History

- 3 JCPs since 1995
 - DBS9A0306/432336109 (1995)
 - One-time placement
 - Multiple modifications due to local option
 - 0169205-001-JC (2000)
 - One-time placement
 - Nourished in segments → more modifications
 - 0295380-001-JC (2011)
 - Multiple nourishments
 - ★ modification 009 allows for a 5-year extension (2026)

The collage shows four documents from the Florida Department of Environmental Protection:

- Top Document:** Department of Environmental Protection, Twin Towers Office Building, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Governor: Lawton Chiles. Secretary: Virginia B. Wetherell.
- Second Document:** Department of Environmental Protection, Marjory Stoneman Douglas Building, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399-3000. Governor: Jeb Bush. Secretary: David B. Struhs.
- Third Document:** Florida Department of Environmental Protection, Marjory Stoneman Douglas Building, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399-3000. Governor: Rick Scott. Lt. Governor: Jennifer Carroll. Secretary: Herschel T. Vinyard, Jr.
- Bottom Document:** FINAL ORDER OF VARIANCE, Florida Department of Environmental Protection, Bob Martinez Center, 2600 Blair Stone Road, Tallahassee, FL 32399-2400. Governor: Ron DeSantis. Lt. Governor: Jeannette Nuñez. Interim Secretary: Shawn Hamilton.

The bottom document includes the following text:

June 18, 2021

Martin County
Attn: Kathy Fitzpatrick, P.E.
2401 S.E. Monterey Road
Stuart, Florida 32996
kfitzpat@martin.fl.us

c/o
Kenneth R. Craig, P.E.
Taylor Engineering, Inc.
10199 Southside Boulevard, Suite 310
Jacksonville, Florida 32256
krcraig@taylorengeering.com

Permit Modification No. 0295380-009-IN
Permit No. 0295380-001-JC, Martin County
Martin County Beach Nourishment

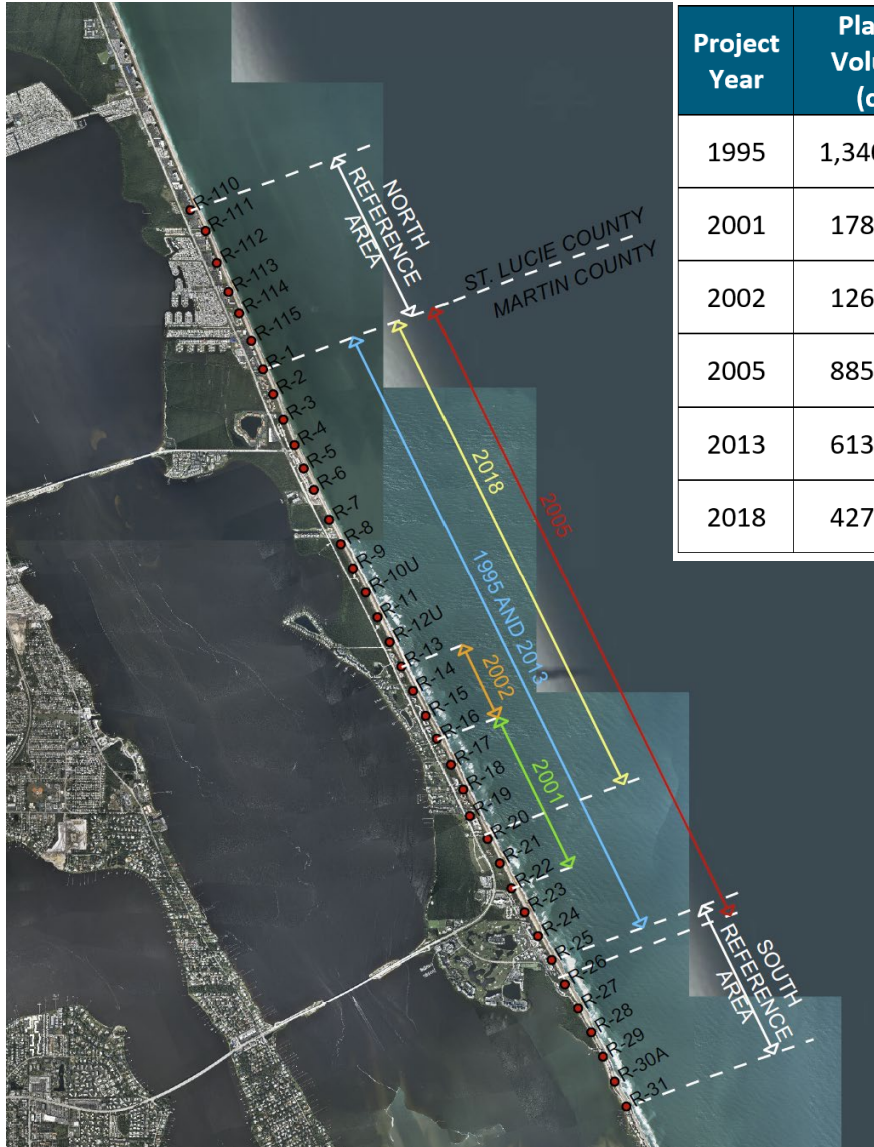
Your request to modify Permit No. 0295380-001-JC was received on May 12, 2021 and has been reviewed by the Florida Department of Environmental Protection (Department) staff. The proposed permit modification is to extend the permit expiration date by an additional 5 years to allow for the 15-year duration afforded by Rule 62B-49.011(1)(a), Florida Administrative Code (F.A.C.).

On August 11, 2011, the Department issued Permit No. 0295380-001-JC to Martin County to nourish approximately four miles of beach, from Department reference monuments R-1 to R-25. The proposed project was authorized to occur multiple times on an as-needed basis, with the first event requiring approximately 887,700 cubic yards of fill dredged from the St. Lucie Shoal Borrow Area. At the same time, the Department issued Variance No. 0295380-002-BV for the Martin County Beach Nourishment project, to establish an expanded turbidity mixing zone.

For additional background, please see the *CONSOLIDATED NOTICE OF INTENT TO ISSUE JOINT COASTAL PERMIT, VARIANCE AND AUTHORIZATION TO USE SOVEREIGN SUBMERGED LANDS* for Permit No. 0295380-001-JC and Variance No. 0295380-002-BV at the following website:

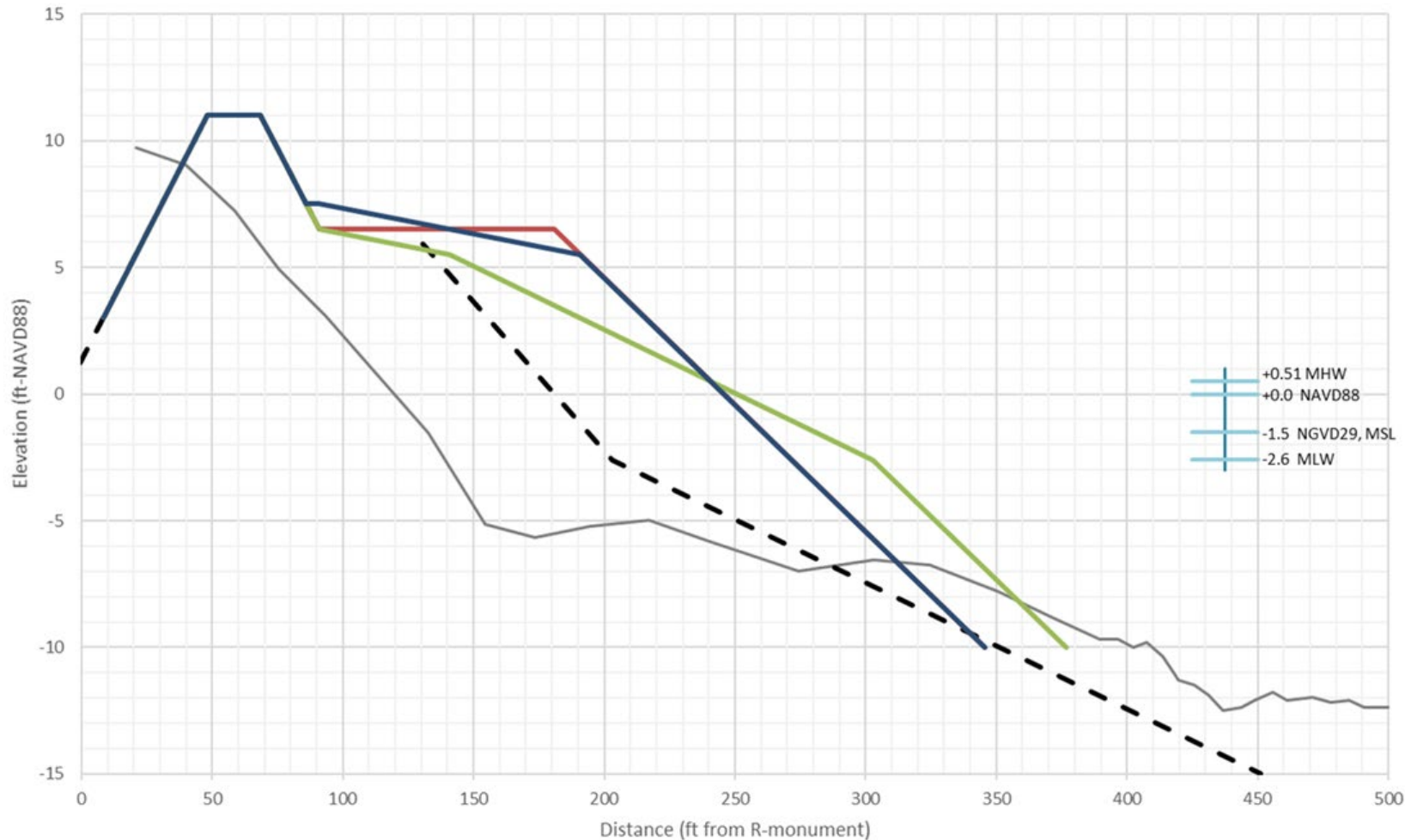
Beach Nourishment History and Design Templates

Project Year	Placed Volume (cy)	Placement Area	Borrow Area
1995	1,340,000	R-1 to R-25	Gilbert Shoal
2001	178,000	R-16.2 to R-22.3	Gilbert Shoal
2002	126,000	R-13.5 to R-16.2	Gilbert Shoal
2005	885,000	R-1 to R-25.6	Gilbert Shoal
2013	613,017	R-1 to R-25	St. Lucie Shoal
2018	427,763	R-1 to R-19.8	St. Lucie Shoal



Project Design Parameters

Martin County SPP Beach Nourishment Construction Templates



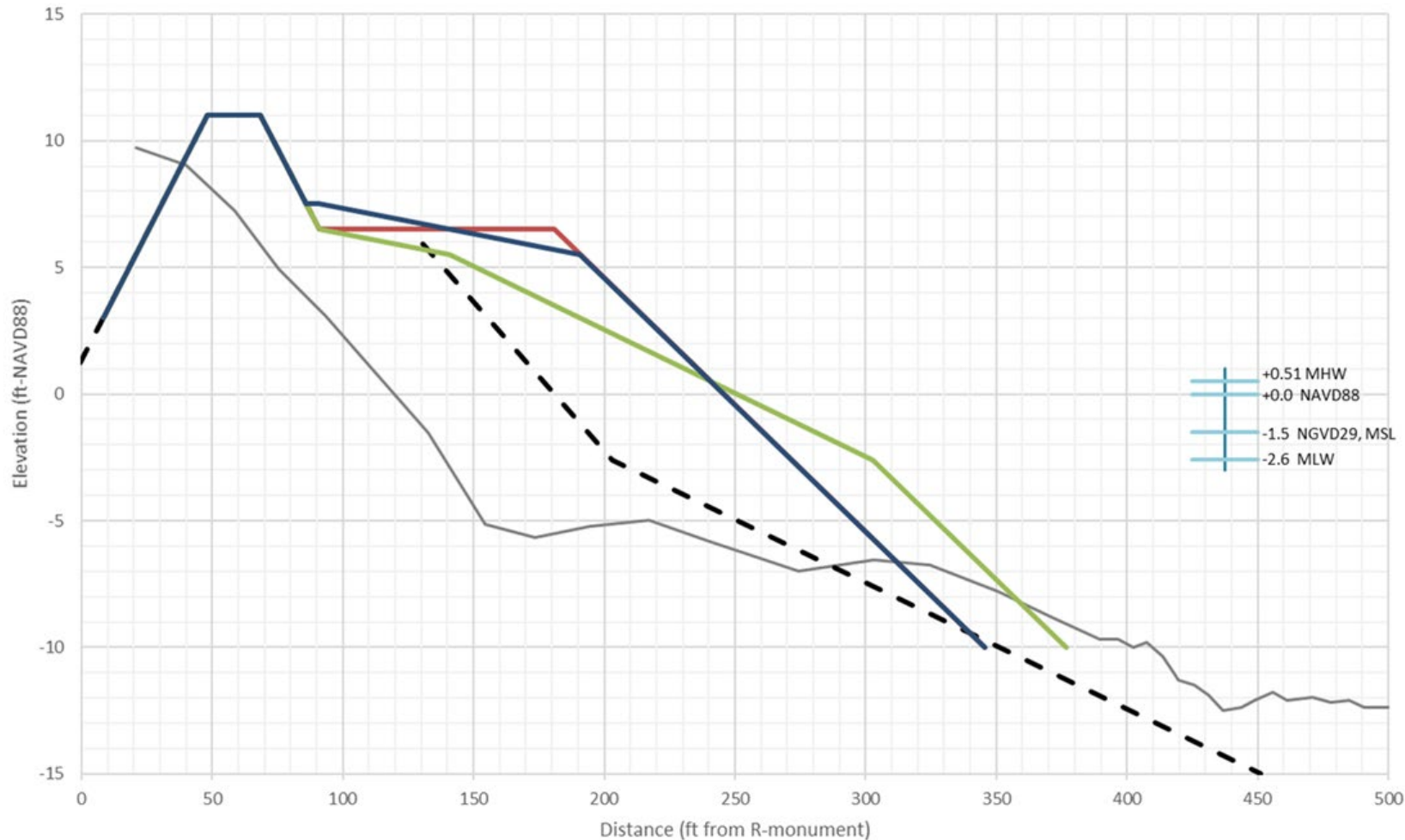
Design template — —

- Dune- 20 ft wide crest, +12.5 ft above MSL
- Berm- 35 ft wide, +8.0 ft above MSL
- Foreshore slope- 1V:8.5H to MLW then 1V:20H

Project Design Parameters

Project Year	Placed Volume (cy)	Placement Area	Borrow Area
1995	1,340,000	R-1 to R-25	Gilbert Shoal

Martin County SPP Beach Nourishment Construction Templates



— 2005 Baseline - - - Design template — 1995, 2001, 2002, 2005, & 2013 (traditional) template — 2013 "turtle-friendly" template — 2018 template

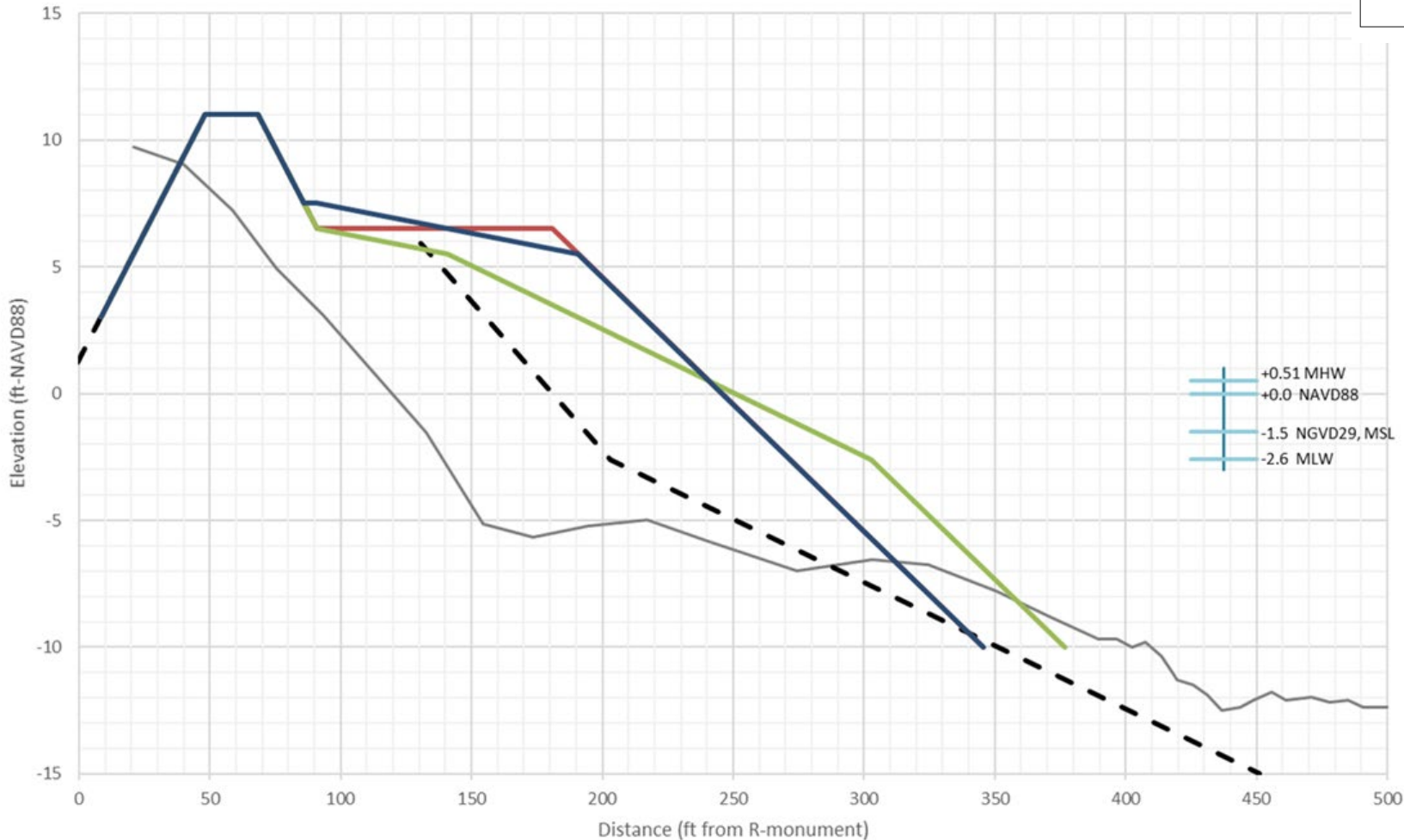
1995 nourishment —

- Dune- 20 ft wide crest, +12.5 ft NGVD, sloping at 1V:5H
- Berm- 90 ft wide, +8.0 ft NGVD
- Foreshore slope- 1V:10H

Project Design Parameters

Project Year	Placed Volume (cy)	Placement Area	Borrow Area
2001	178,000	R-16.2 to R-22.3	Gilbert Shoal
2002	126,000	R-13.5 to R-16.2	Gilbert Shoal
2005	885,000	R-1 to R-25.6	Gilbert Shoal

Martin County SPP Beach Nourishment Construction Templates



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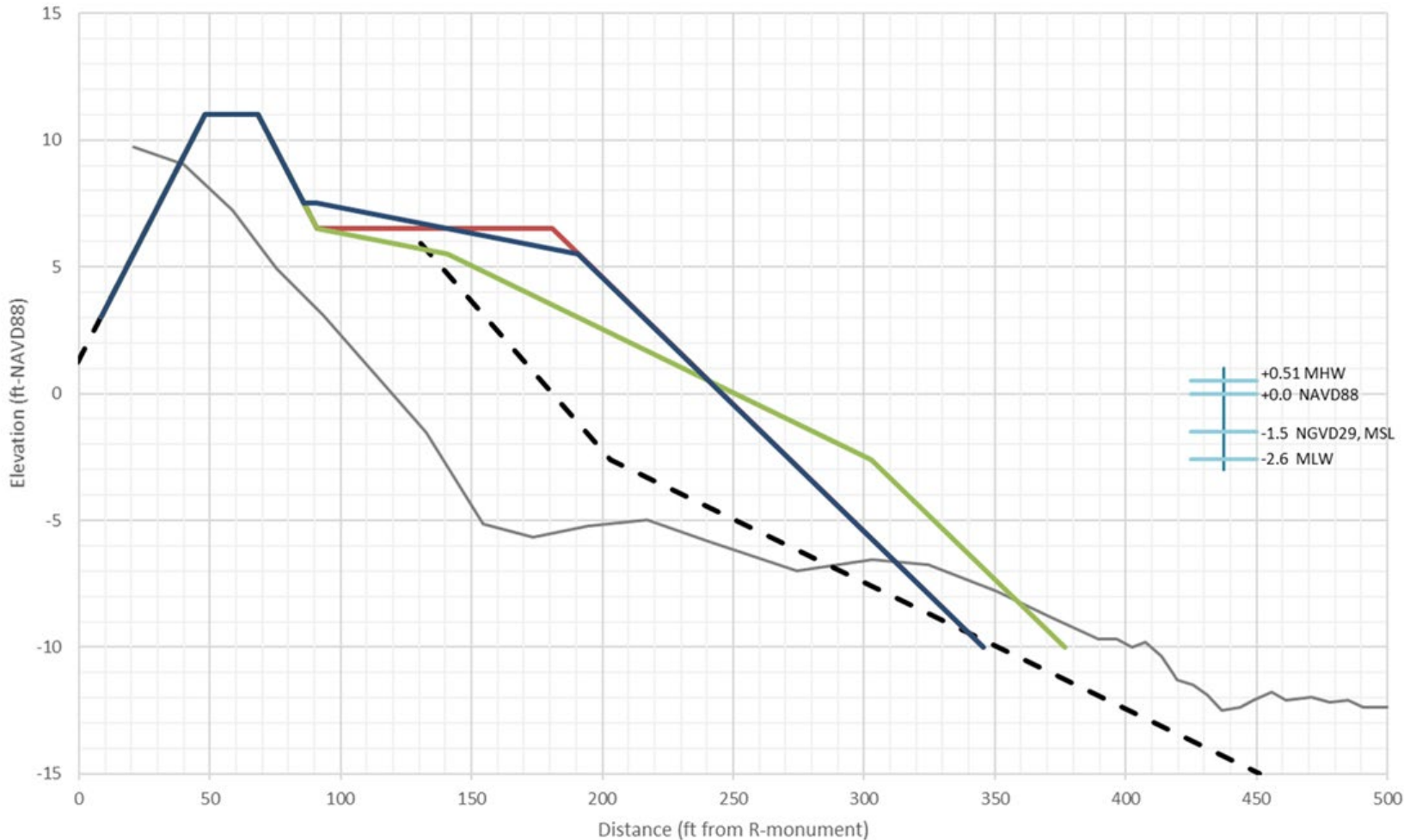
2001/2002/2005 nourishments

- Dune- 20 ft wide crest, +12.5 ft NGVD, sloping at 1V:5H
 - 2005- dune extended to R-25.6; increased dune elevation to +13.6 ft NGVD
- Berm- 90 ft wide, +8.0 ft NGVD
- Foreshore slope- 1V:10H

Project Design Parameters

Project Year	Placed Volume (cy)	Placement Area	Borrow Area
2013	613,017	R-1 to R-25	St. Lucie Shoal



Martin County SPP Beach Nourishment Construction Templates



— 2005 Baseline - - - Design template — 1995, 2001, 2002, 2005, & 2013 (traditional) template — 2013 "turtle-friendly" template — 2018 template

2013 nourishment 

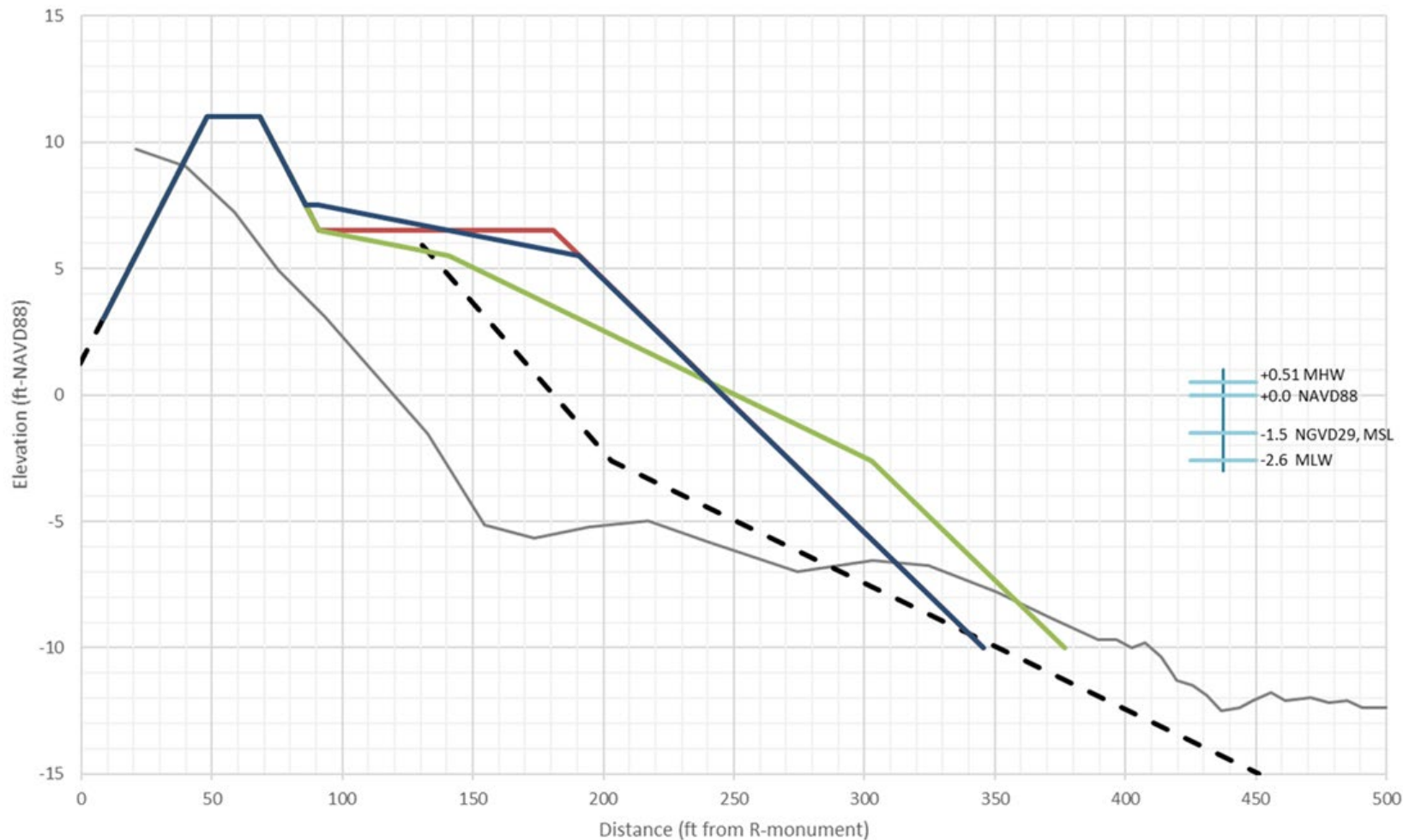
"turtle-friendly" design 

- Dune- 20 ft wide crest, +11.0 ft NAVD, sloping at 1V:5H
- Berm- 90 ft wide, +6.5 ft NAVD
 -  50 ft, +6.5 to +5.5 ft NAVD
- Foreshore slope- 1V:10H
 -  1V:20H to MLW then 1V:10H

Project Design Parameters

Project Year	Placed Volume (cy)	Placement Area	Borrow Area
2018	427,763	R-1 to R-19.8	St. Lucie Shoal

Martin County SPP Beach Nourishment Construction Templates



— 2005 Baseline - - - Design template — 1995, 2001, 2002, 2005, & 2013 (traditional) template — 2013 "turtle-friendly" template — 2018 template

2018 nourishment —

- Dune- 20 ft wide crest, +11.0 ft NAVD, sloping at 1V:5H
- Berm- 5 ft back berm, +7.5 ft NAVD; sloping 1V:50H to +5.5 ft NAVD
- Foreshore slope- 1V:10H

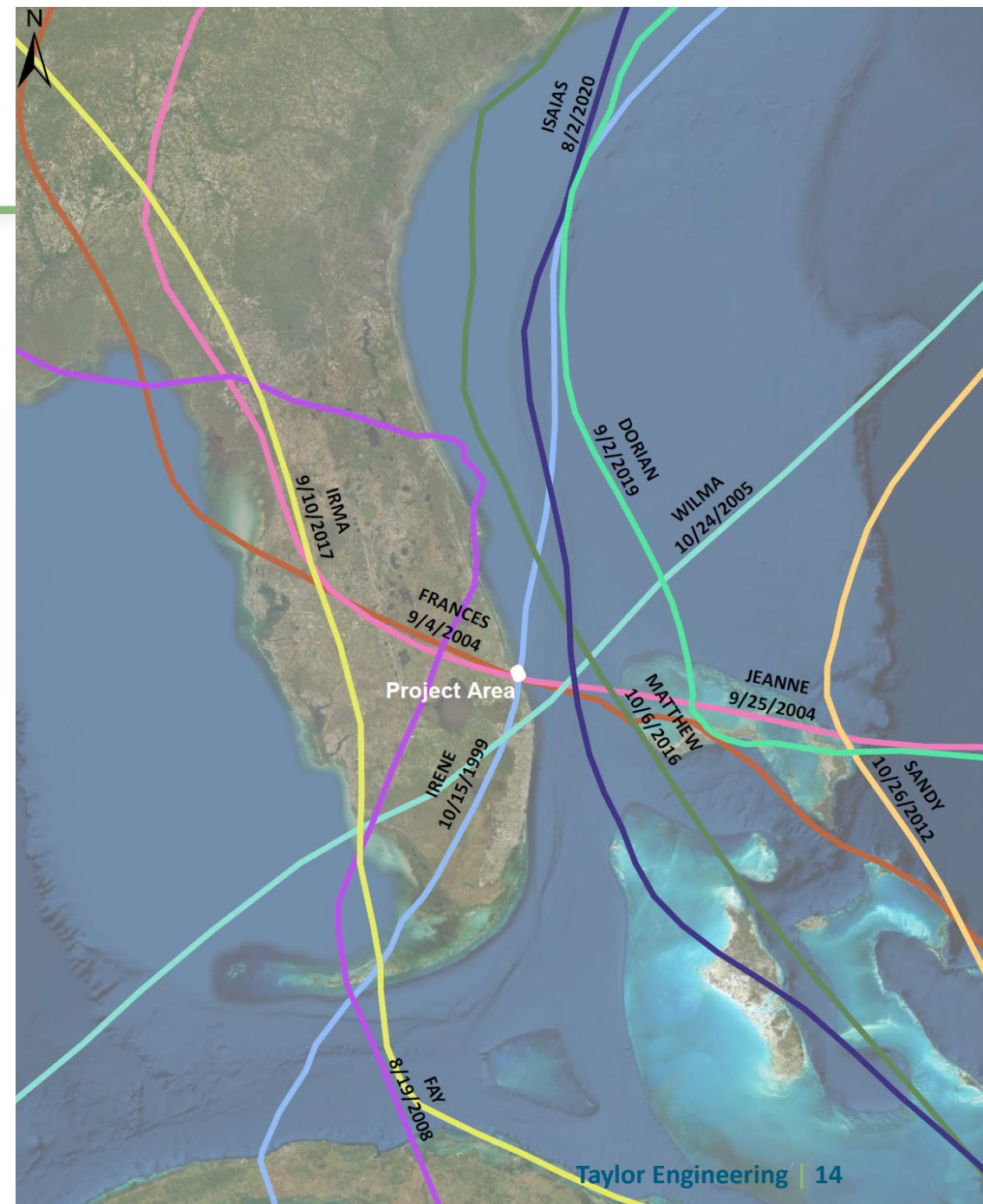
Project Design Parameters

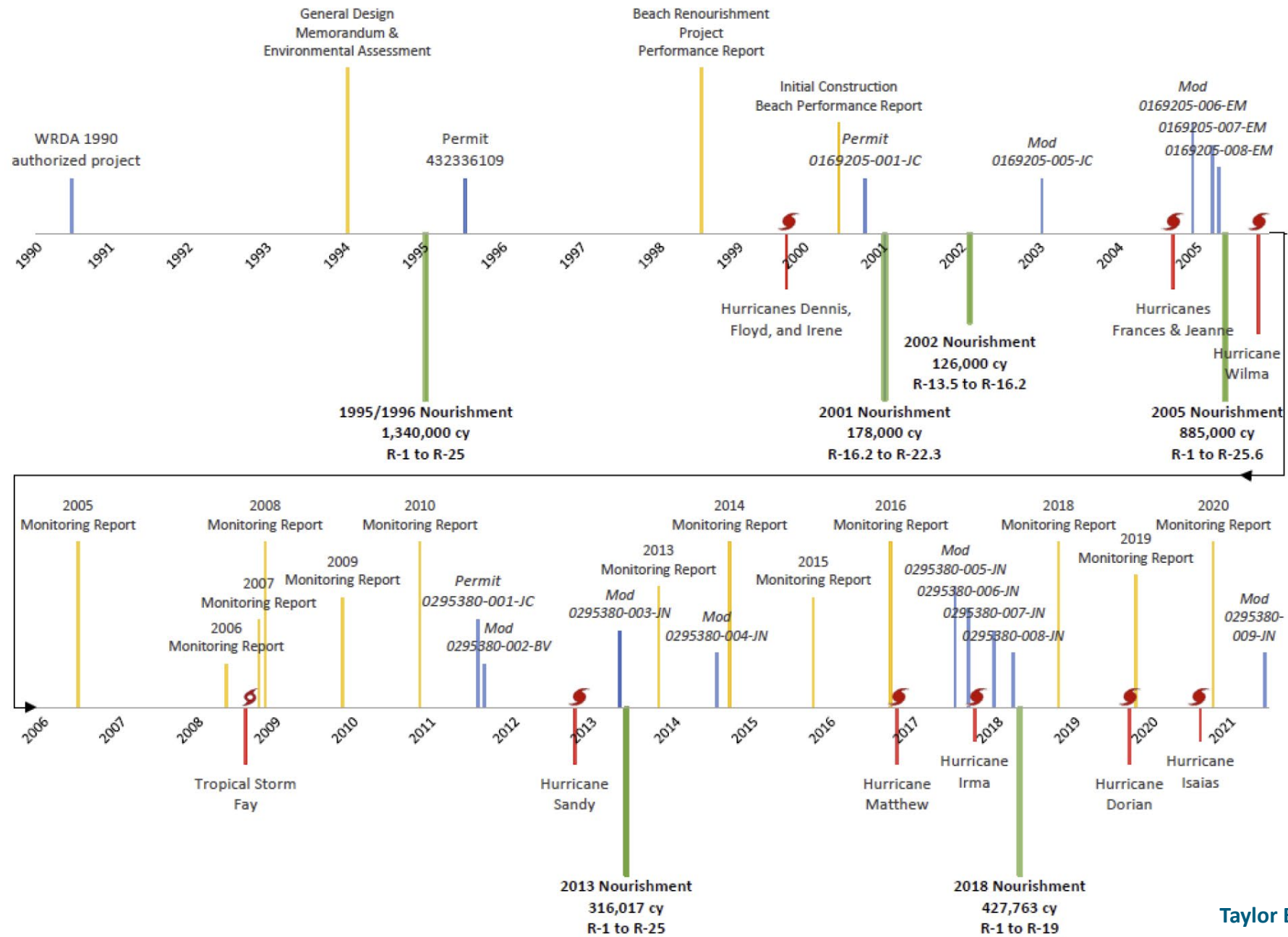
- 4 construction templates
- Variable reference datums
 - Tidal vs geodetic datums

Document	Datum	Conversion to NAVD88	MHW Elevation	Dune Elevation	Berm Elevation
★ 1994 GDM	MSL	-1.5 ft	+0.3 ft NAVD88 <i>+1.8 ft MSL</i>	+11.0 ft NAVD88 <i>+12.5 ft MSL</i>	+6.5 ft NAVD88 <i>+8.0 ft MSL</i>
	MLW	-2.6 ft	+0.3 ft NAVD88 <i>+2.9 ft MLW</i>	+11.0 ft NAVD88 <i>+13.6 ft MLW</i>	+6.5 ft NAVD88 <i>+9.1 ft MLW</i>
1994/1995 Permit Documents	NGVD29	-1.5 ft	+0.45 ft NAVD88 <i>+1.95 ft NGVD29</i>	+11.0 ft NAVD88 <i>+12.5 ft NGVD29</i>	+6.5 ft NAVD88 <i>+8.0 ft NGVD29</i>
2001 & 2003 Permit Documents	NGVD29	-1.5 ft	+0.3 ft NAVD88 <i>+1.8 ft NGVD29</i>	+11.0 ft NAVD88 <i>+12.5 ft NGVD29</i>	+6.5 ft NAVD88 <i>+8.0 ft NGVD29</i>
2005 Permit Documents	NGVD29	-1.5 ft		+12.1 ft NAVD88 <i>+13.6 ft NGVD29</i>	+6.5 ft NAVD88 <i>+8.0 ft NGVD29</i>
2013 Permit Documents	NAVD88	-	+0.4 ft NAVD88	+11.0 ft NAVD88	+6.5 ft NAVD88 with "turtle-friendly" sections sloping to +5.5 ft NAVD88
2018 Permit Documents	NAVD88	-	+0.51 ft NAVD88	+11.0 ft NAVD88	+7.5 ft NAVD88 sloping to +5.5 ft NAVD88

Significant Storms

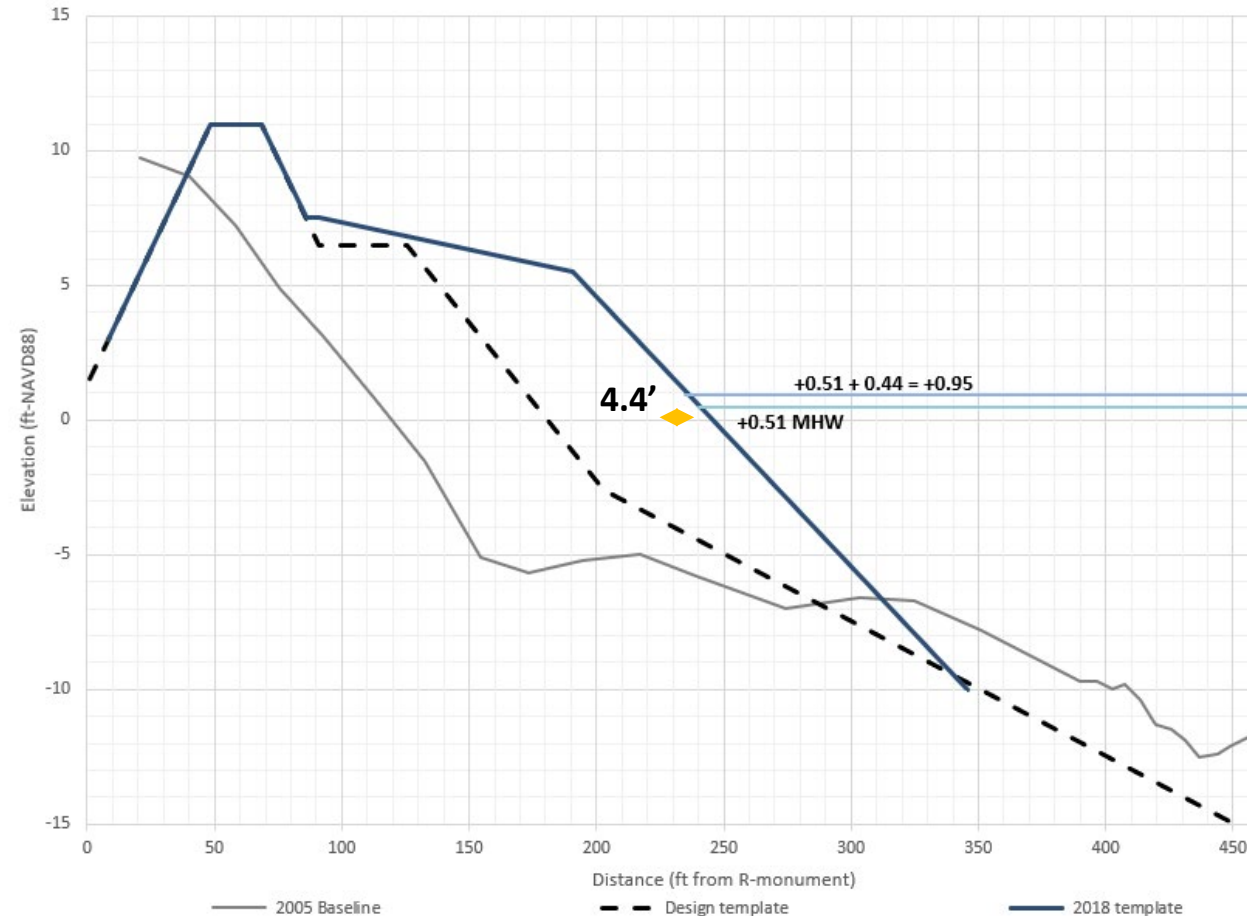
- FDEP Strategic Beach Management Plan & NOAA Climate Data Center Storm Events Database
- 2004- Frances, Jeanne, Ivan
 - Frances & Jeanne occurred within the same month and both made landfall within 2 miles of each other
 - NOAA models indicate both storms generated waves exceeding the 50-yr wave height
 - FDEP estimated a +12 ft NGVD29 (+10.5 ft NAVD88) storm surge for both hurricanes with 30 ft of dune retreat on average
 - FDEP acknowledged the benefits of the nourishment project stating that, “even though the erosion impacted the coastal dune system, the remaining beach restoration project prevented even more significant losses from occurring”





Water Level History and Projections

- Sea level change affects the beach width
 - As the MSL increases, corresponding decrease in the dry beach width
 - Change in the dry beach width can be estimated using the template's foreshore slope (1H:10V)
 - 1992-2021 → ~5.3" of SLR → horizontal beach width reduction of ~53"



Water Level History and Projections

- Using the Southeast Florida Climate Compact suggested SLR projections (IPCC Median and NOAA Intermediate-High)
 - MSL increase between 21” (1.75’) and 40” (3.3’) between 2020 and 2070
 - Assuming 1H:10V slope → horizontal beach width reduction between 210” (17.5’) and 400” (33.3’)

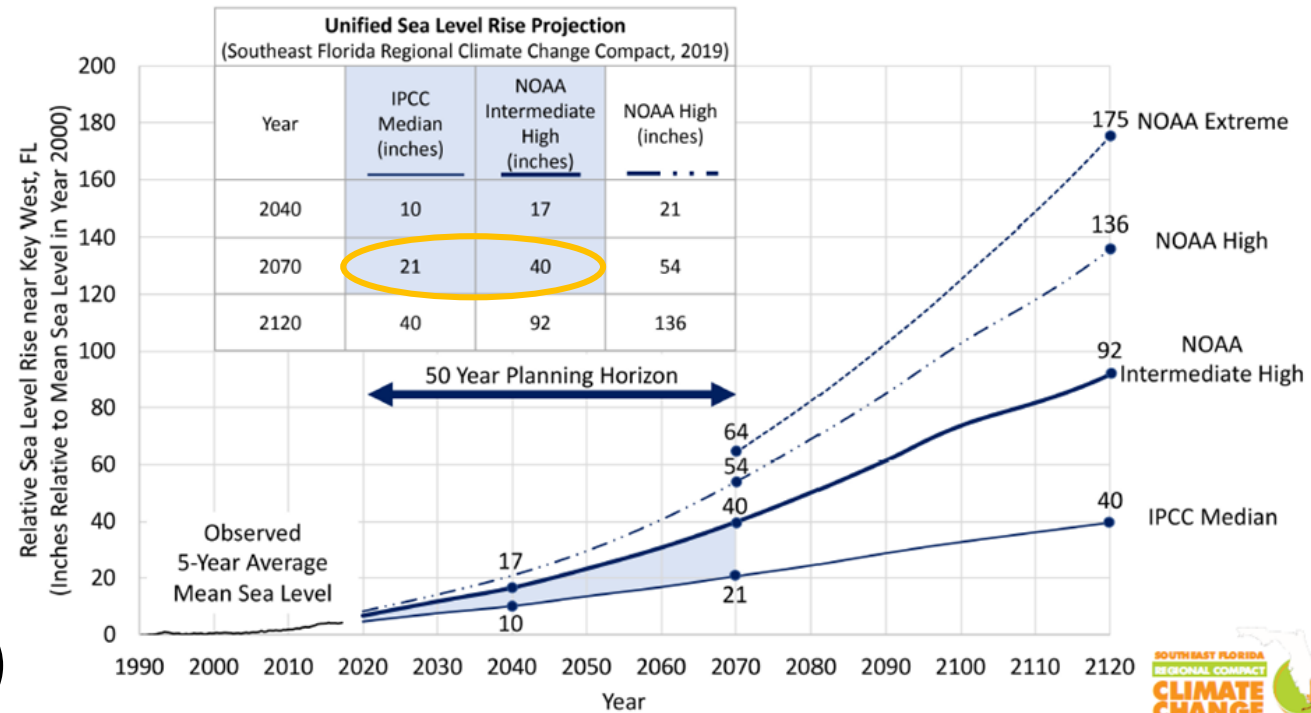
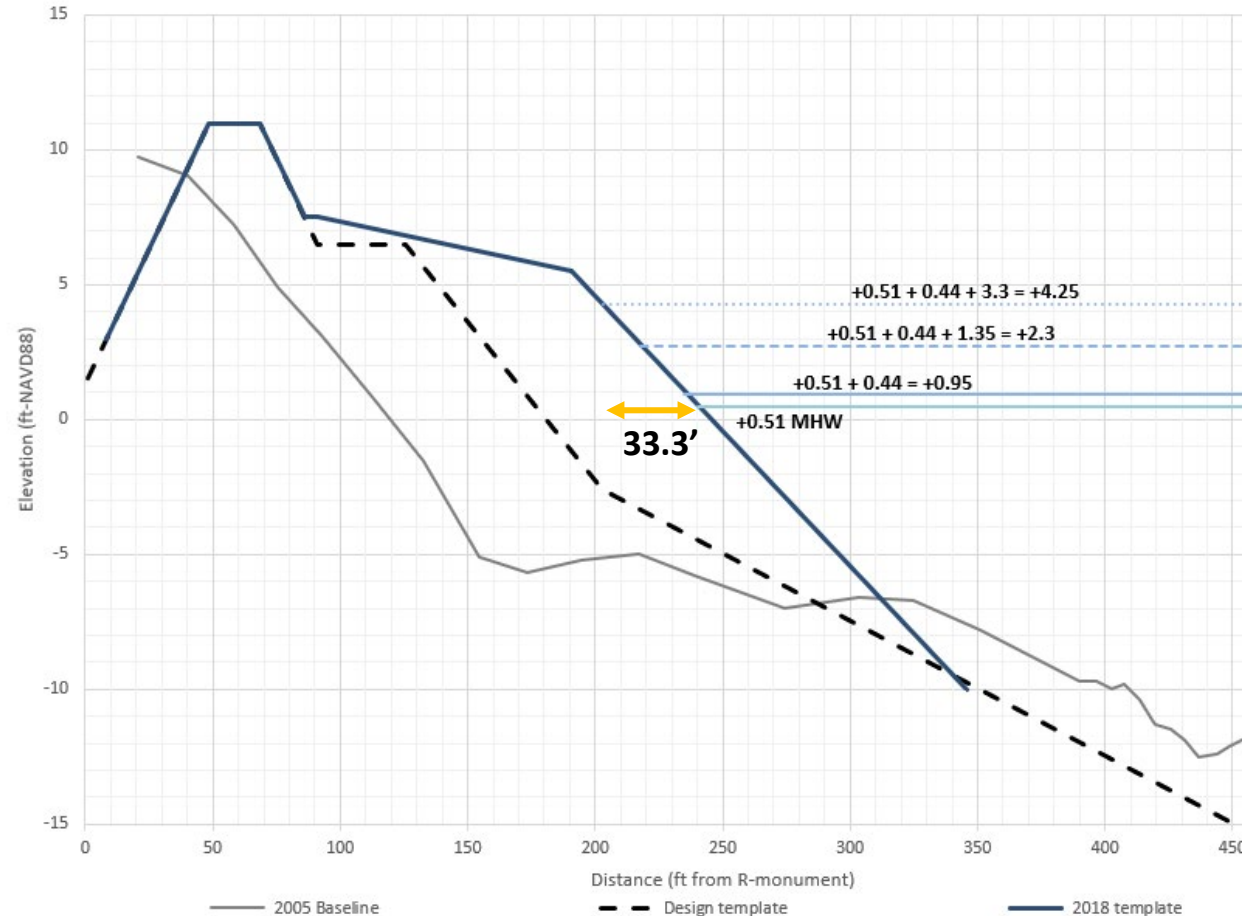


FIGURE 1: Unified Sea Level Rise Projection

Water Level History and Projections

- Using the Southeast Florida Climate Compact suggested SLR projections (IPCC Median and NOAA Intermediate-High)
 - MSL increase between 21" (1.75') and 40" (3.3') between 2020 and 2070
 - Assuming 1H:10V slope → horizontal beach width reduction between 210" (17.5') and 400" (33.3')



Historic Project Performance

- Extensive history of survey data



Figure 3.1 MHW Shoreline Position

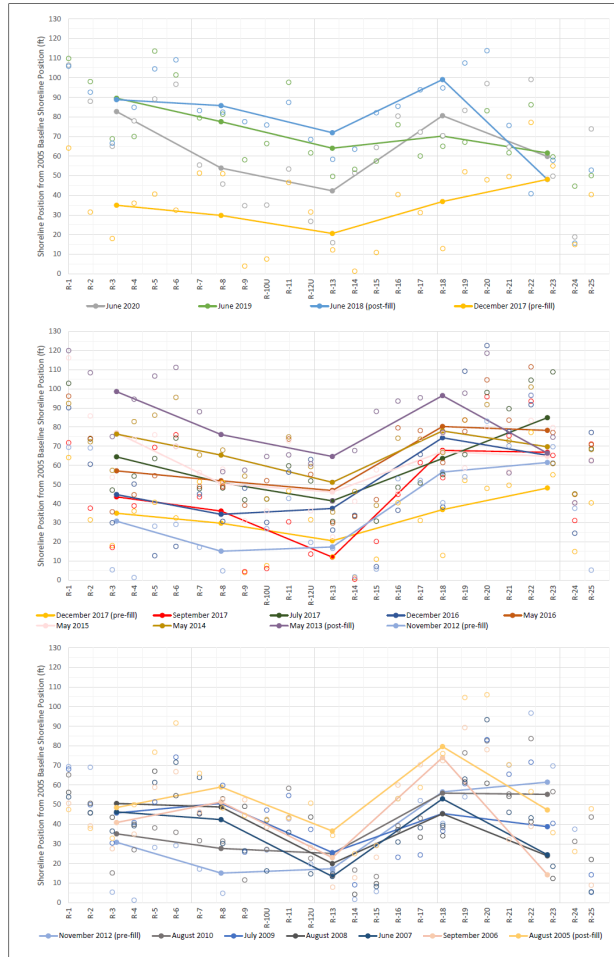


Figure 3.2 MHW Shoreline Position with Respect to the 2005 Baseline Shoreline Position

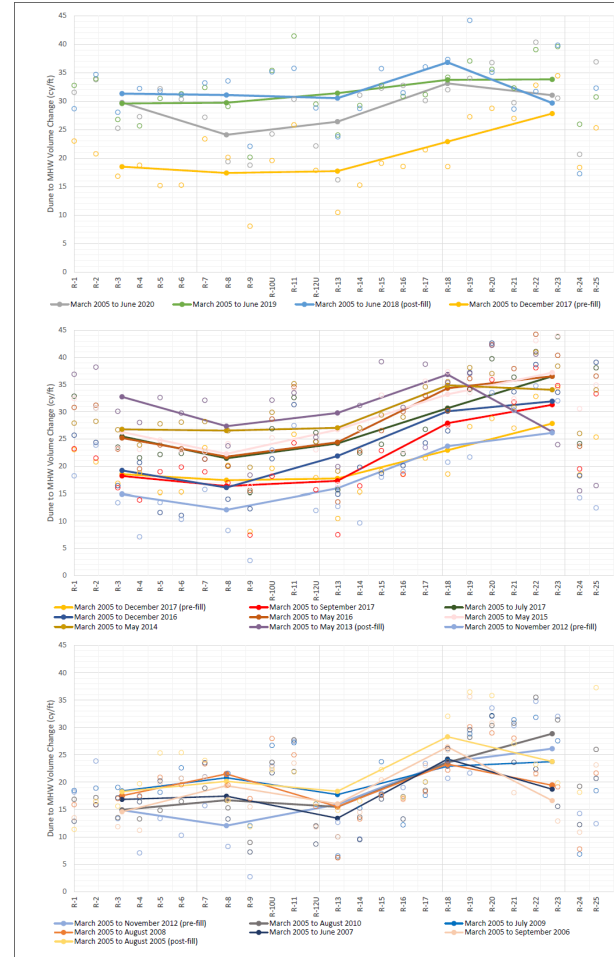


Figure 3.3 Dune to MHW Volume Changes (cy/R)

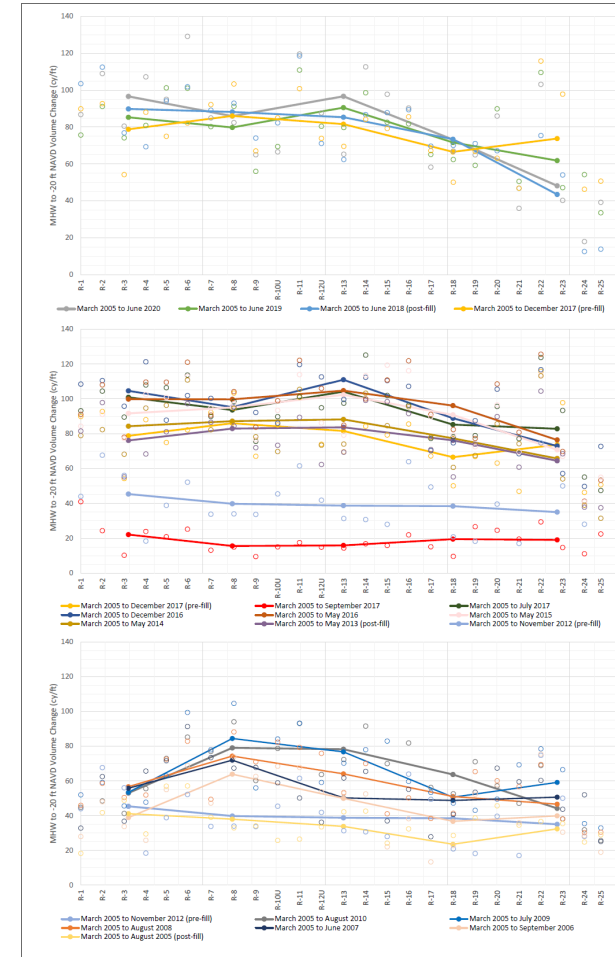


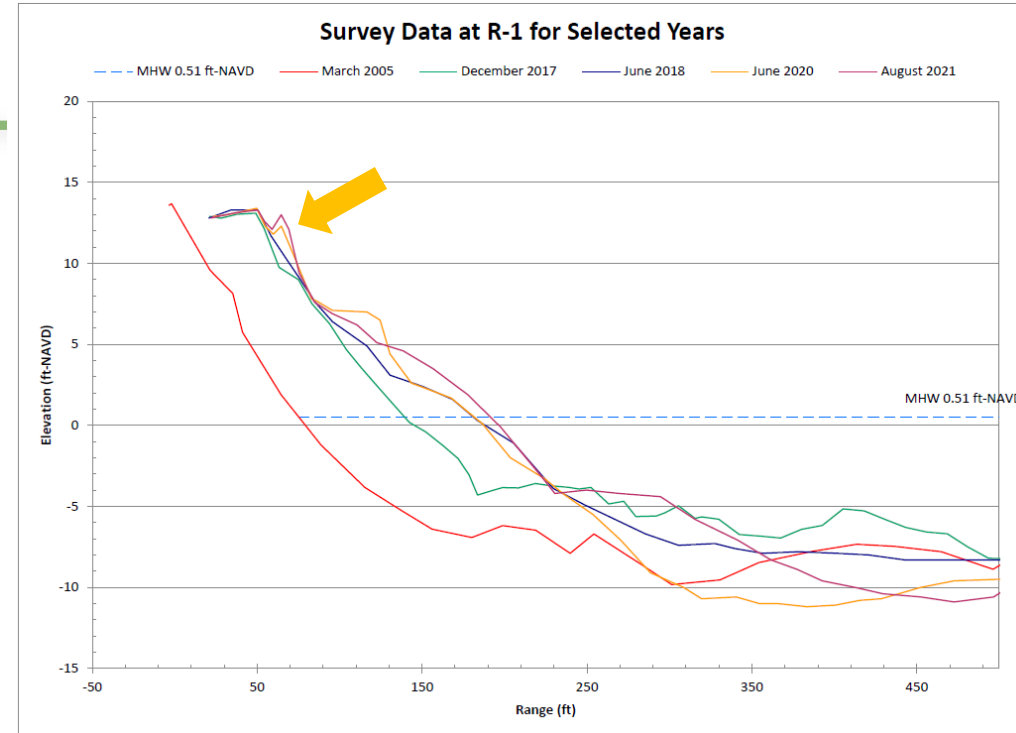
Figure 3.4 MHW to -20 ft NAVD88 Volume Change (cy/R)

Historic Project Performance

- Highly dependent on storm activity
 - 2000- significant losses during construction due to 1996 nor'easter, Hurricanes Dennis, Floyd, and Irene
 - 2005 report- Hurricanes Ivan, Frances, and Jeanne
 - 2013 report- Hurricane Sandy
 - 2018 report- Hurricanes Matthew and Irma
- Consistent erosion from the sub-aerial and nearshore areas followed by the slow natural recovery and onshore movement of a sand bar (if conditions allow)
- Never a full recovery and sand moves beyond the monitoring area

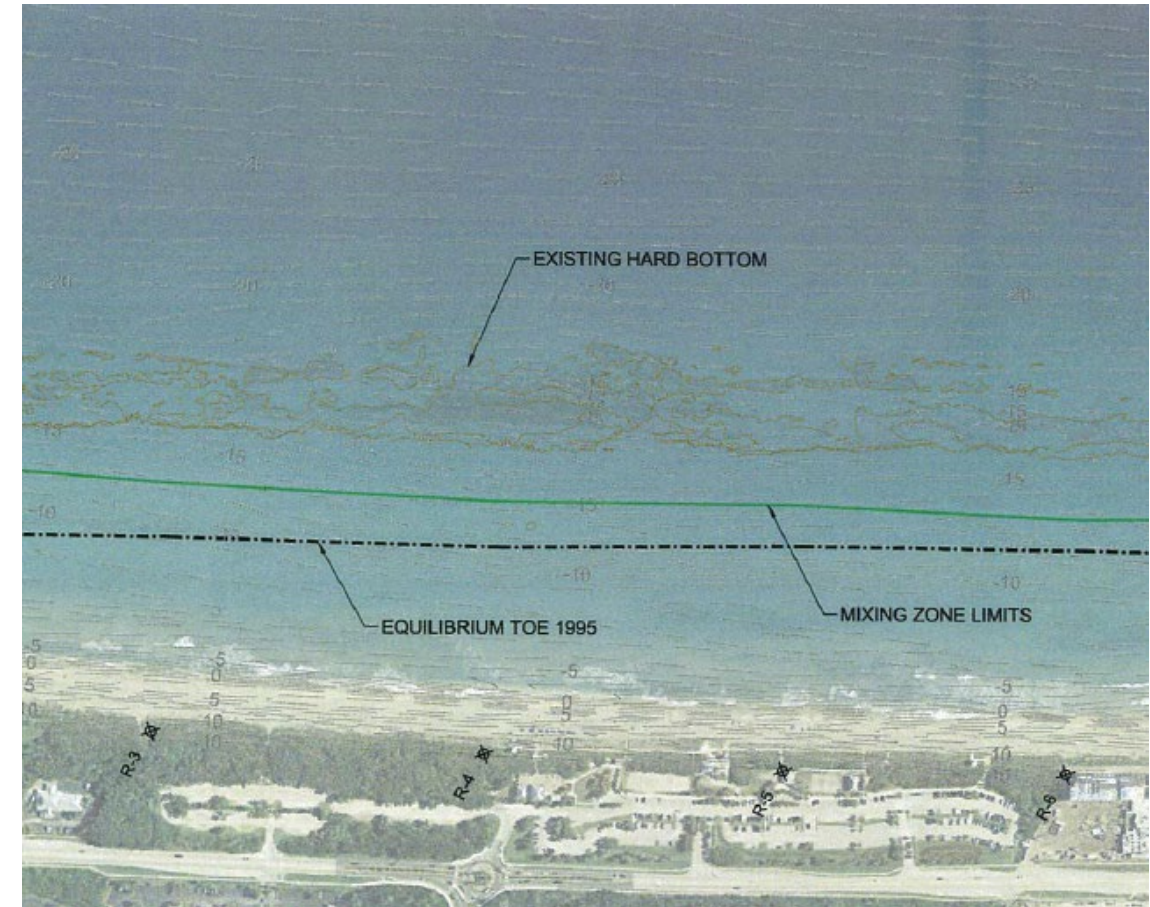
Historic Project Performance

- 2010, 2013, 2014, 2015, and 2016 indicate increase shoreline retreat and/or erosion in the northern portion of the project and increased stability to the south
- Profile steepening and the southerly dispersion of fill
- Stability along southern project extent
- Dune growth



Summary and Recommendations

- 5 additional years on JCP → next nourishment cycle
- Increase dune/berm height/width?
 - Permit limits volume, easements limit placement to the west, hardbottom resources limit placement to the east...
 - Authorizing documents allow for an increase in the berm elevation



Looking Forward

- Reevaluate the historic erosion rate, underestimated?
 - GDM calculated the SPP nourishment needs to be 424,000 cy every 8 years based on the established erosion rate of 53,000 cy/yr
 - Nourishment history indicates:
 - ~155,200 cy/yr placed between 1995 and 2018
 - ~148,000 cy/yr placed between 2005 and 2018
- Look into alternative beach templates, more detailed storm-induced erosion studies, evaluate tidal datum, additional volume, borrow area analyses
- Impact of South St Lucie Project
 - Regional modeling, monitoring, and planning?



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