



Nature-Based Coastal Resiliency for Barrier Islands in Southwest Florida

Case study of Tigertail Lagoon/ Sand Dollar Island Ecosystem Restoration Plan

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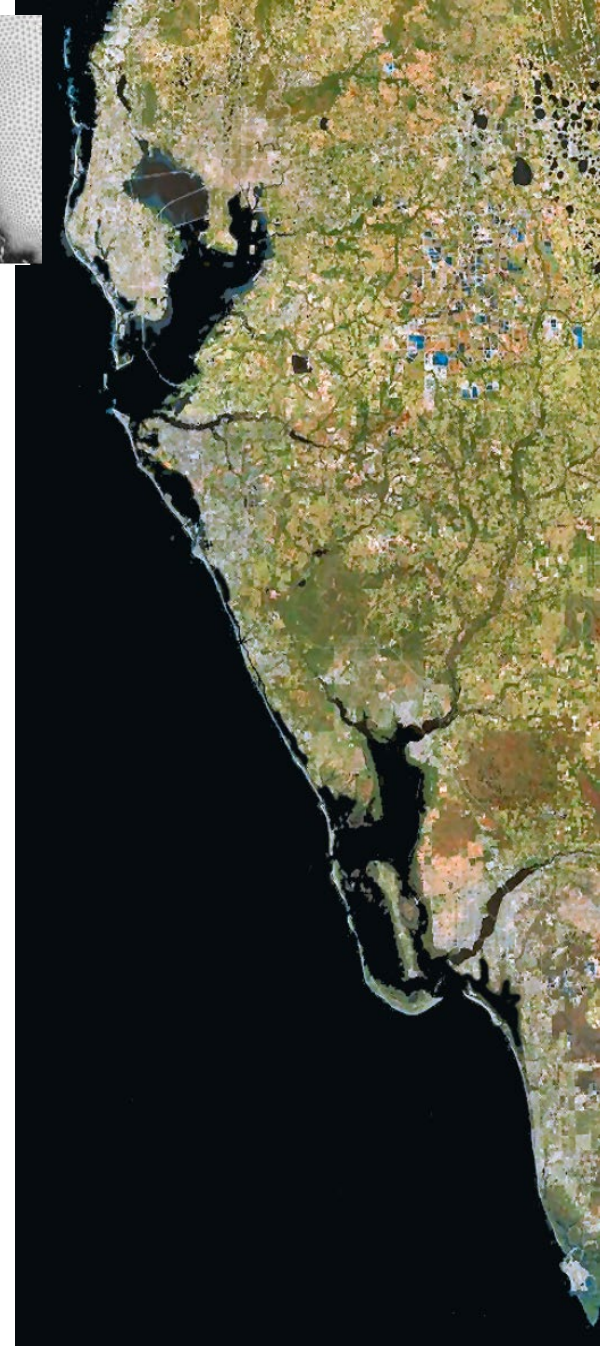
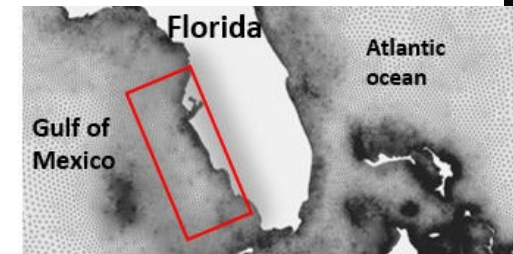
Dynamic Equilibrium

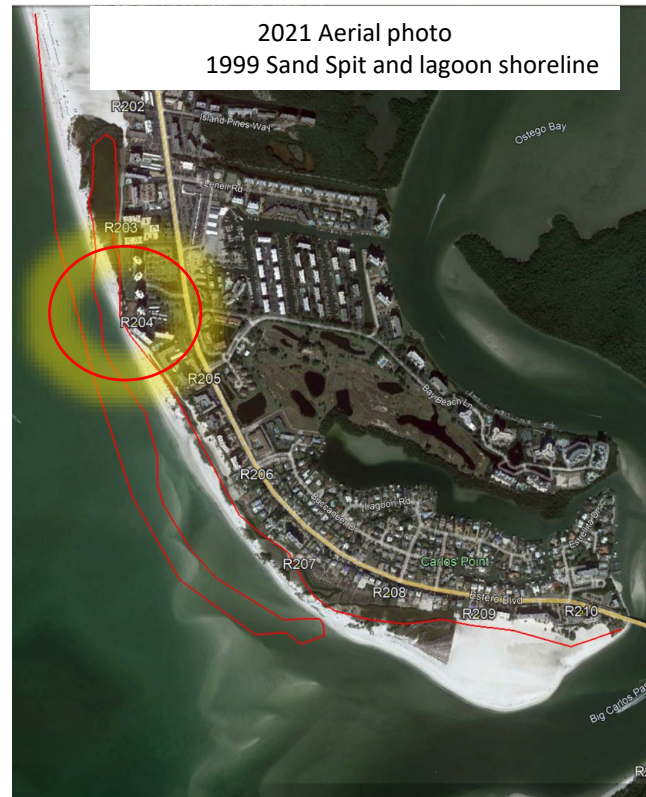
□ **Barrier island natural evolution (Centuries)**

- *Barrier Island landward migration*
- *Inlet evolution processes*
 - *Development*
 - *Migration*
 - *Barrier island breaching*
 - *Inlet closures/ opening*

□ **Anthropogenic change (Decades)**

- *Coastal Encroachment*
- *Inlet management*







1999 aerial photo of sand spit and tidal lagoon



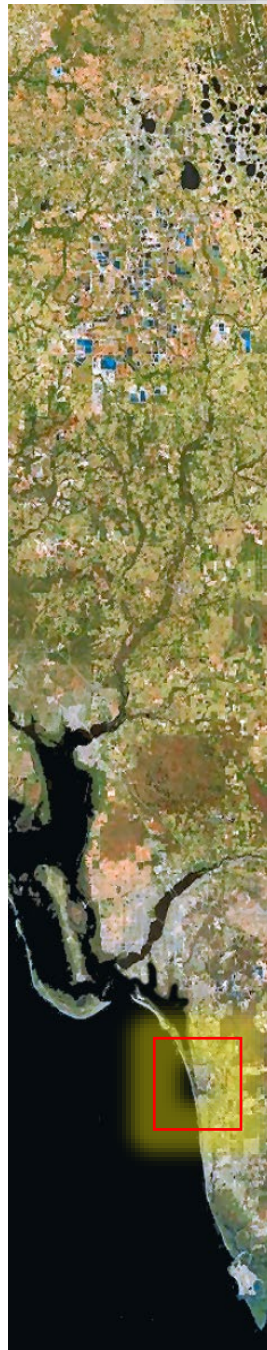
2021 Aerial photo
1999 Sand Spit and lagoon shoreline



2021 conditions



2022 post Ian



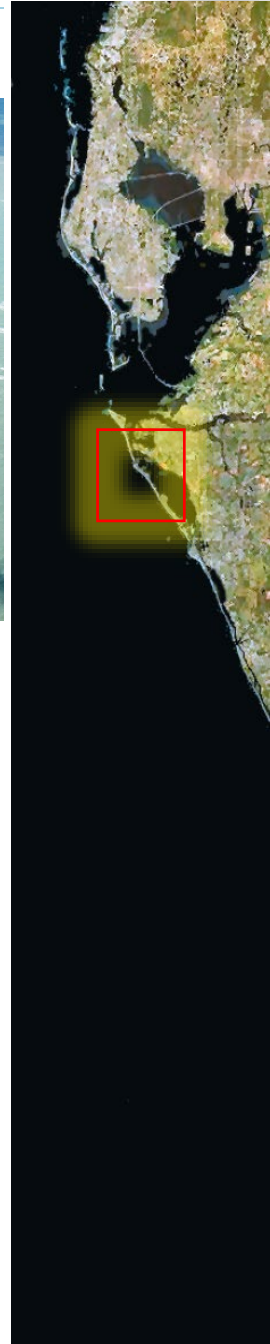
Aerial photo 2006

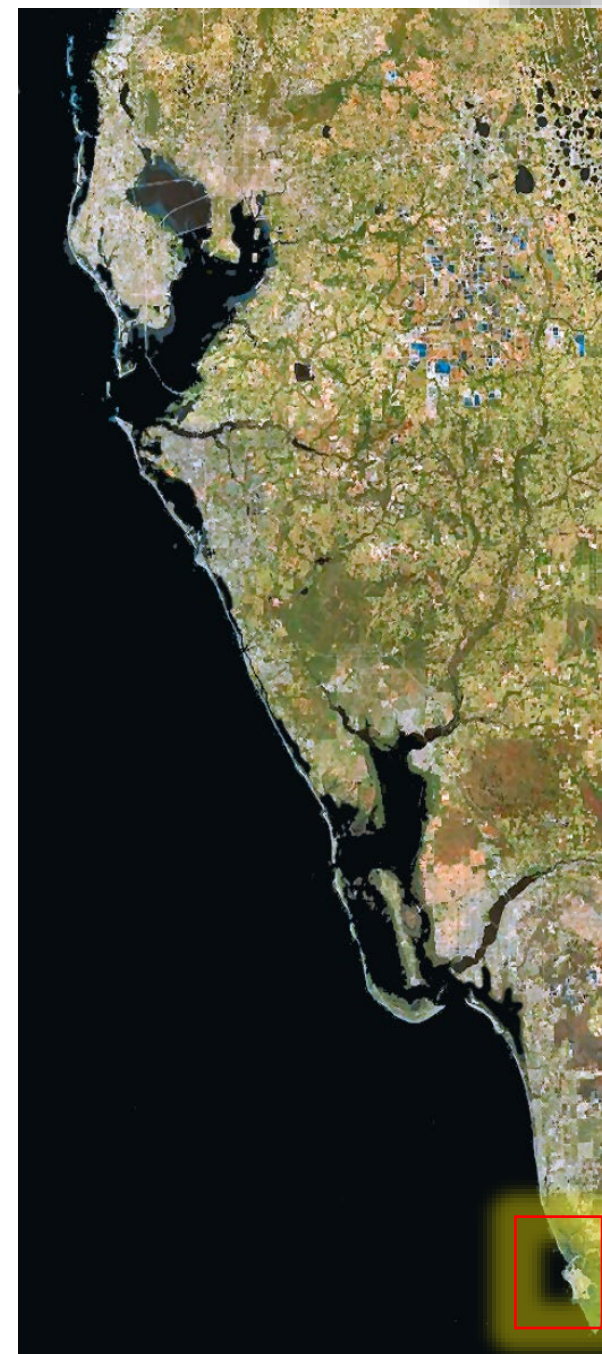


2014 conditions



2021 at construction of erosion control structure



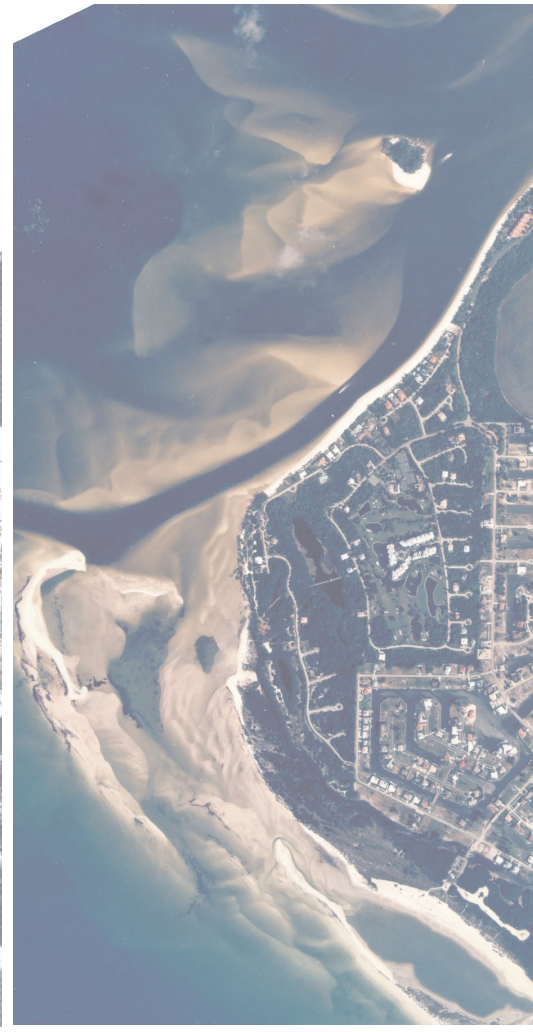




1969



1981



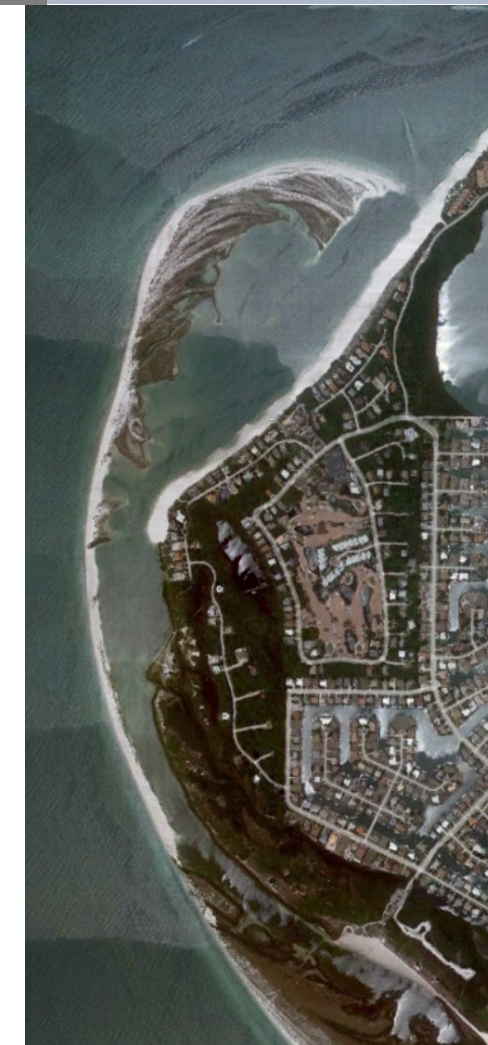
1994



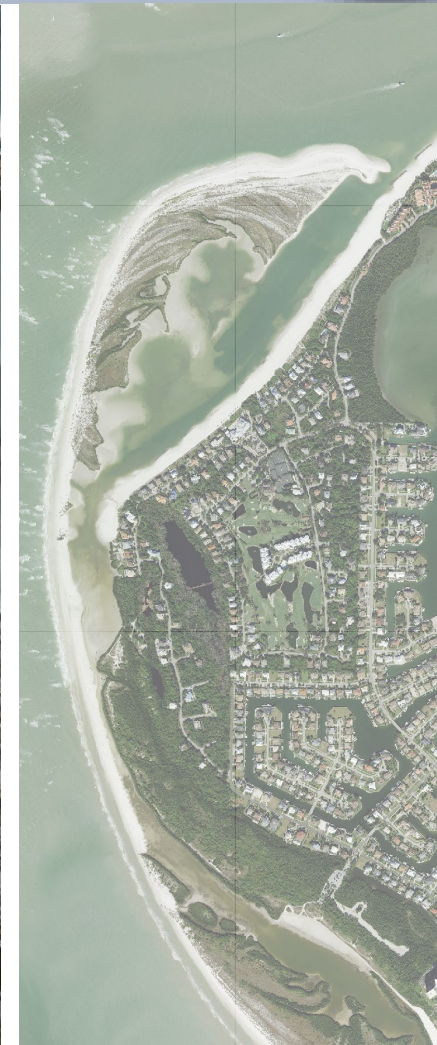
2017



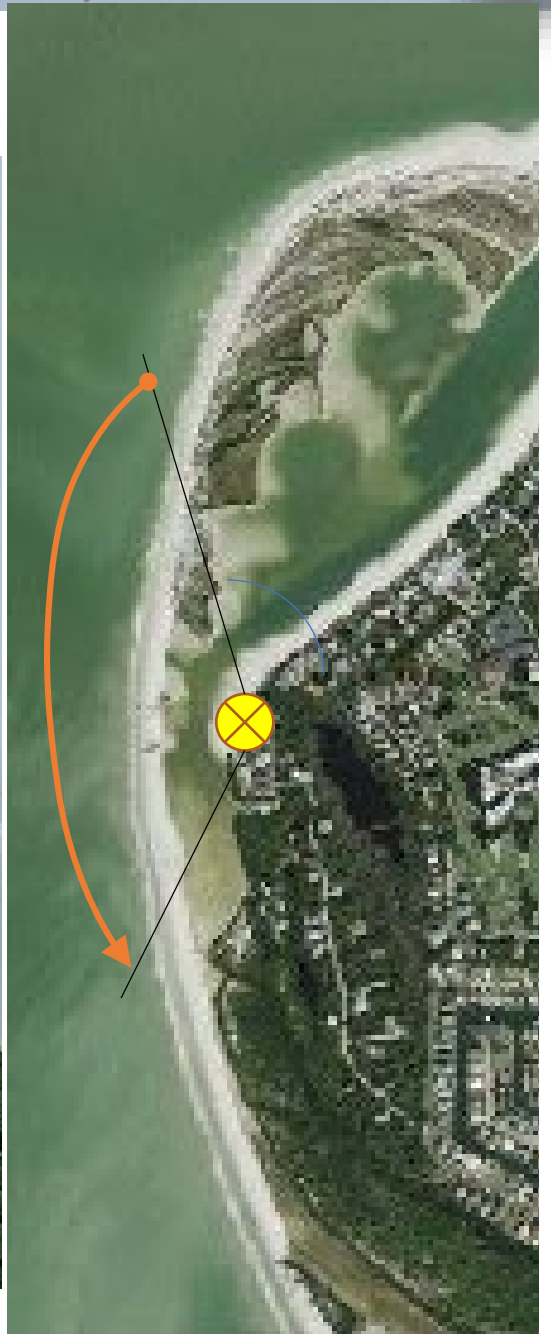
2021



2017



2021



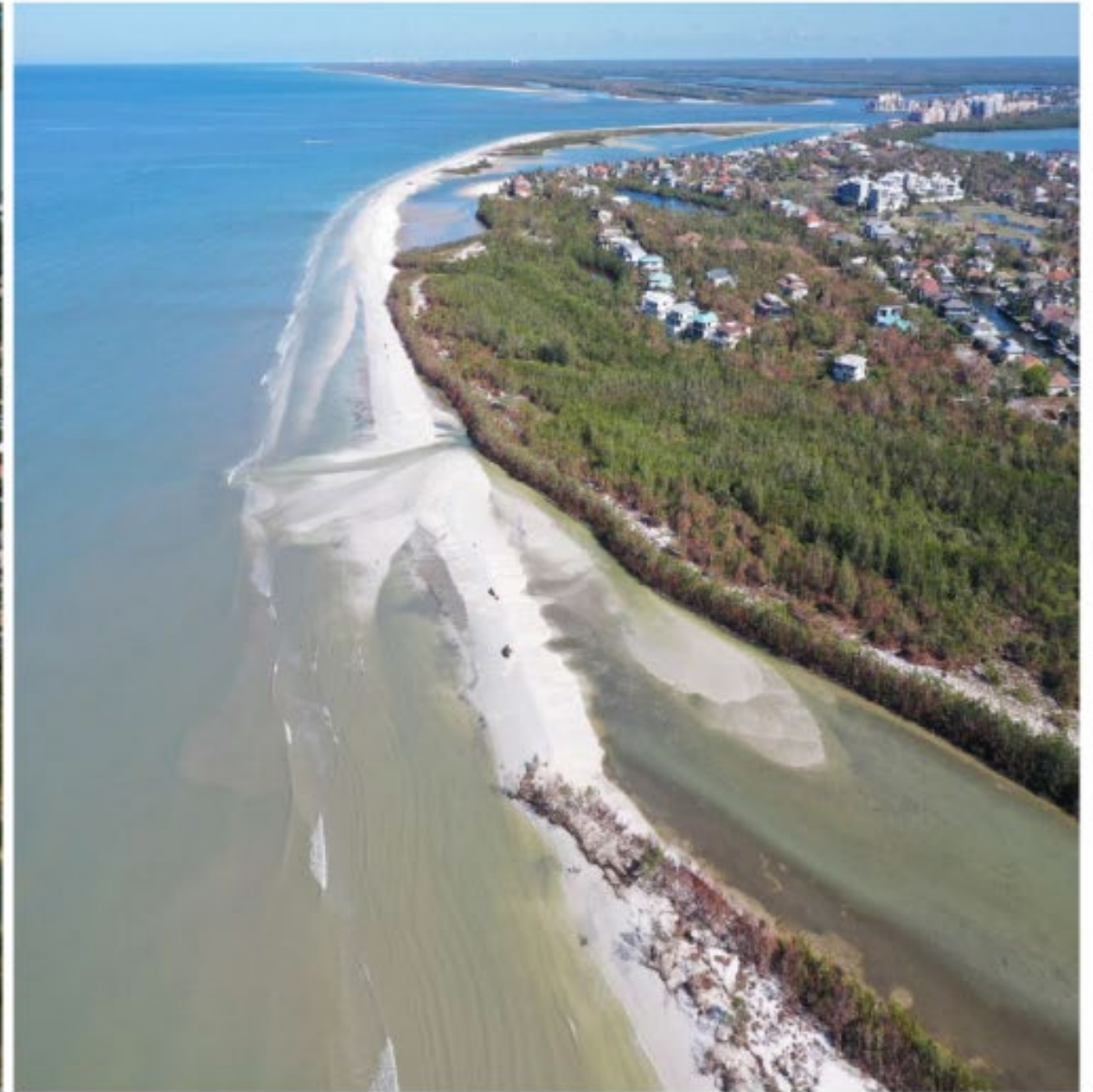






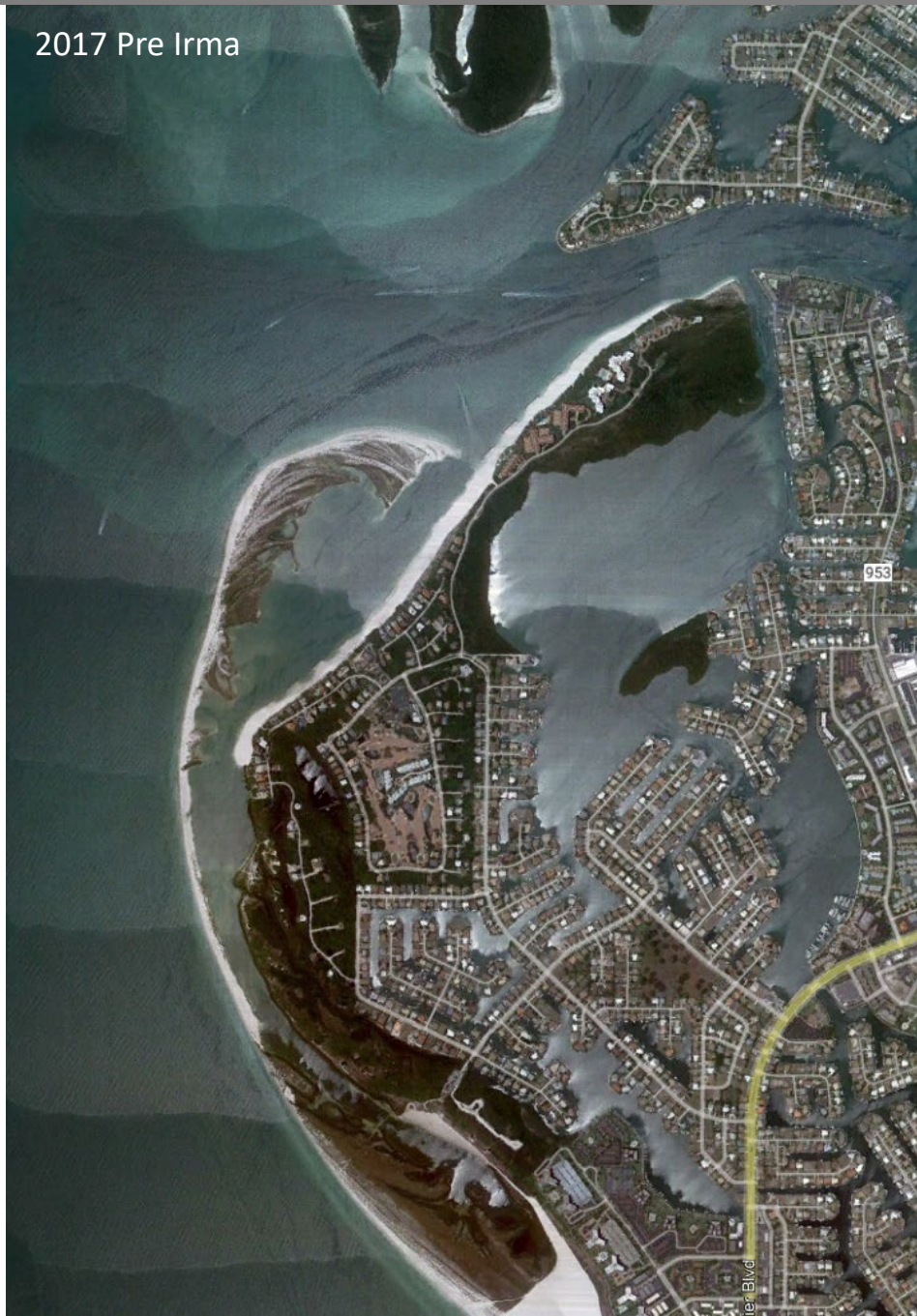


2017 conditions



2022 conditions

2017 Pre Irma



2022 Post Ian



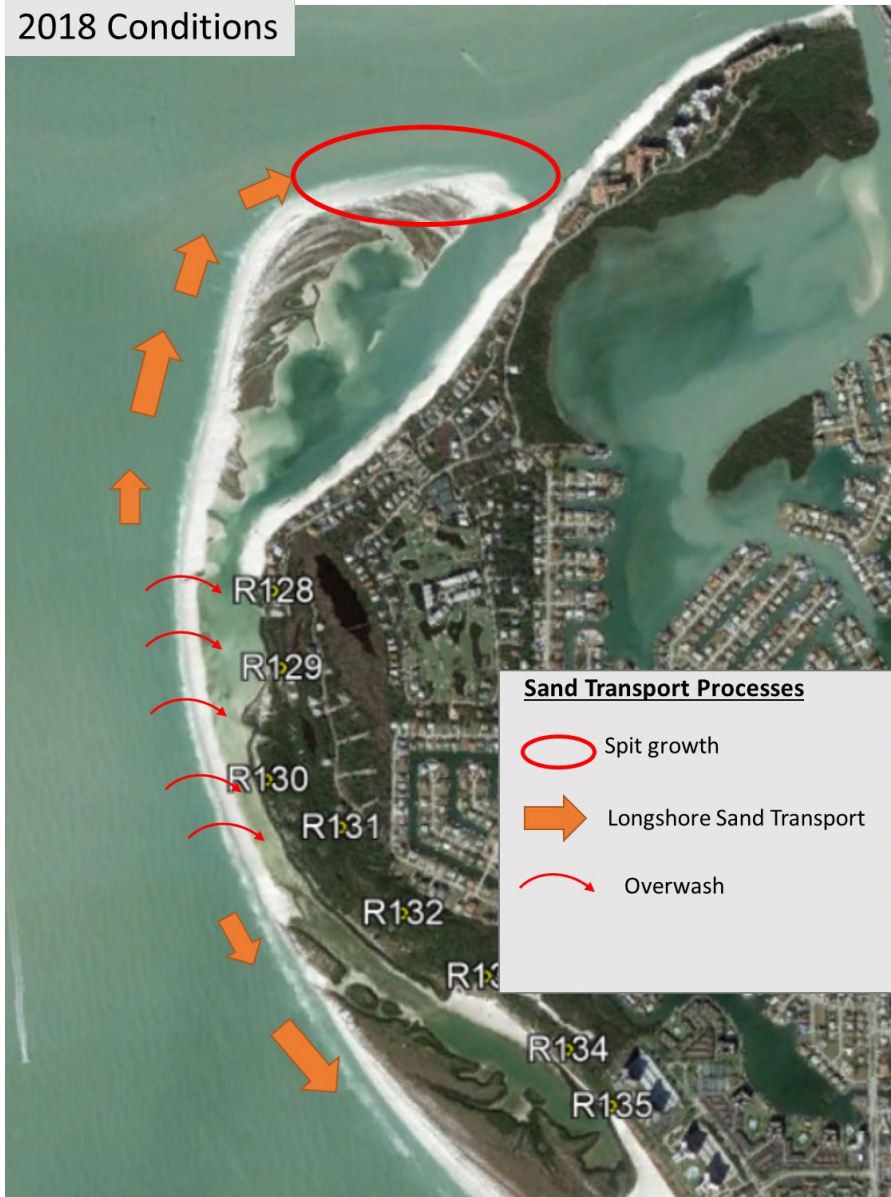
~ 15 acres growth

-20 acres wetland loss

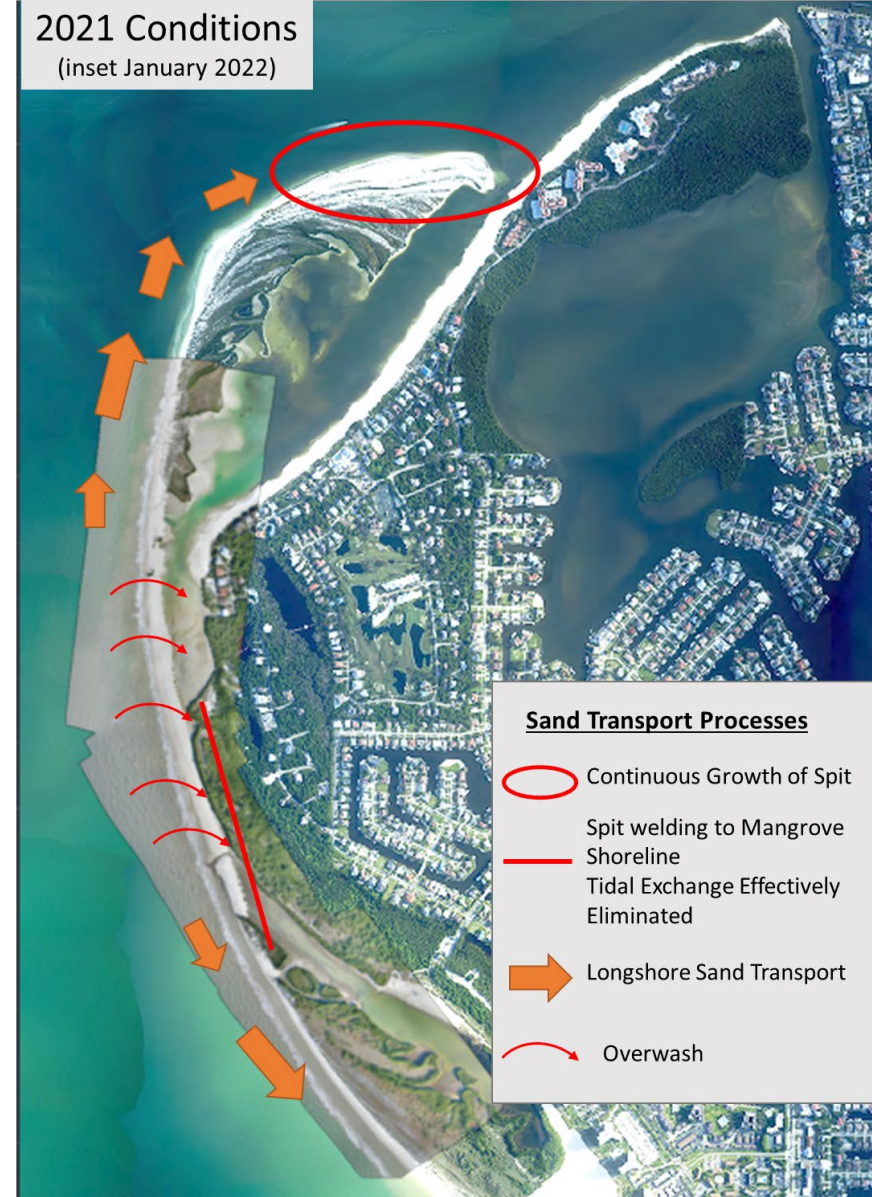
~ 400 ft Shoreline retreat

Water quality issues

2018 Conditions



2021 Conditions
(inset January 2022)



Schematic of coastal processes and morphologic responses (2018-2021)

□ Main Elements

- **Natural/ nature-based resiliency system**
 - **Multitier coastal storm risk management**
 - Sand Spit
 - Tidal Lagoon
 - Mangrove shoreline
- **Lagoon Flow Channel**
 - Restore tidal exchange
 - Improve water quality
 - Maintain and promote SAV
 - Inlet closures/ opening
- **Renewable sand source**
 - Sand trap
 - Maintain inlet open
 - Cyclic use of sand
 - Incremental adaptation



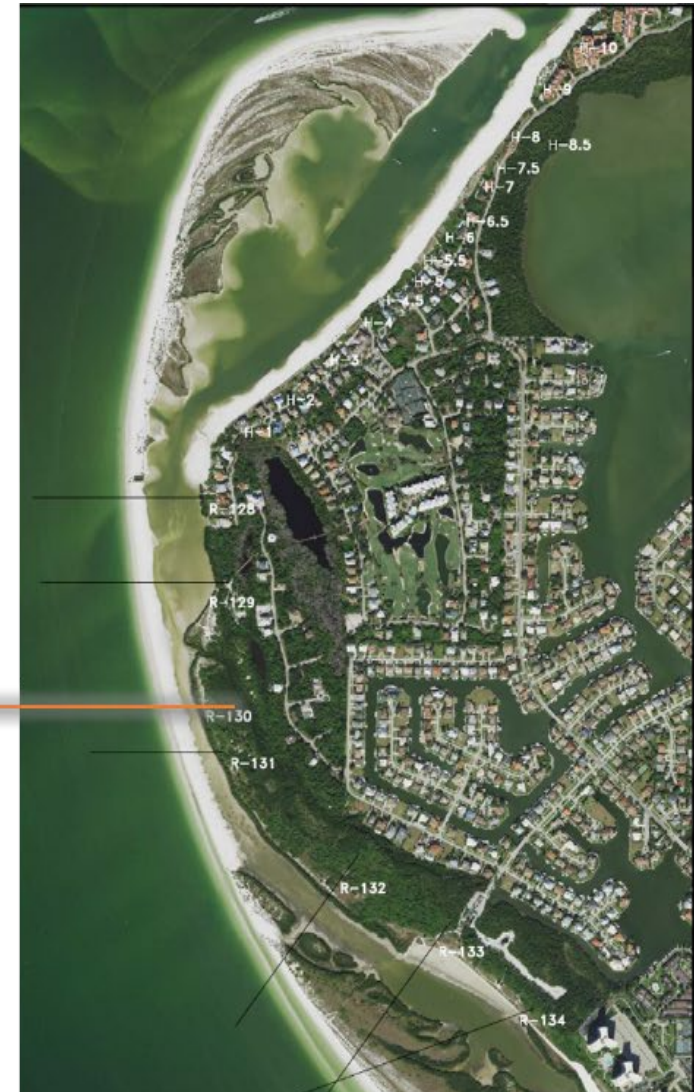
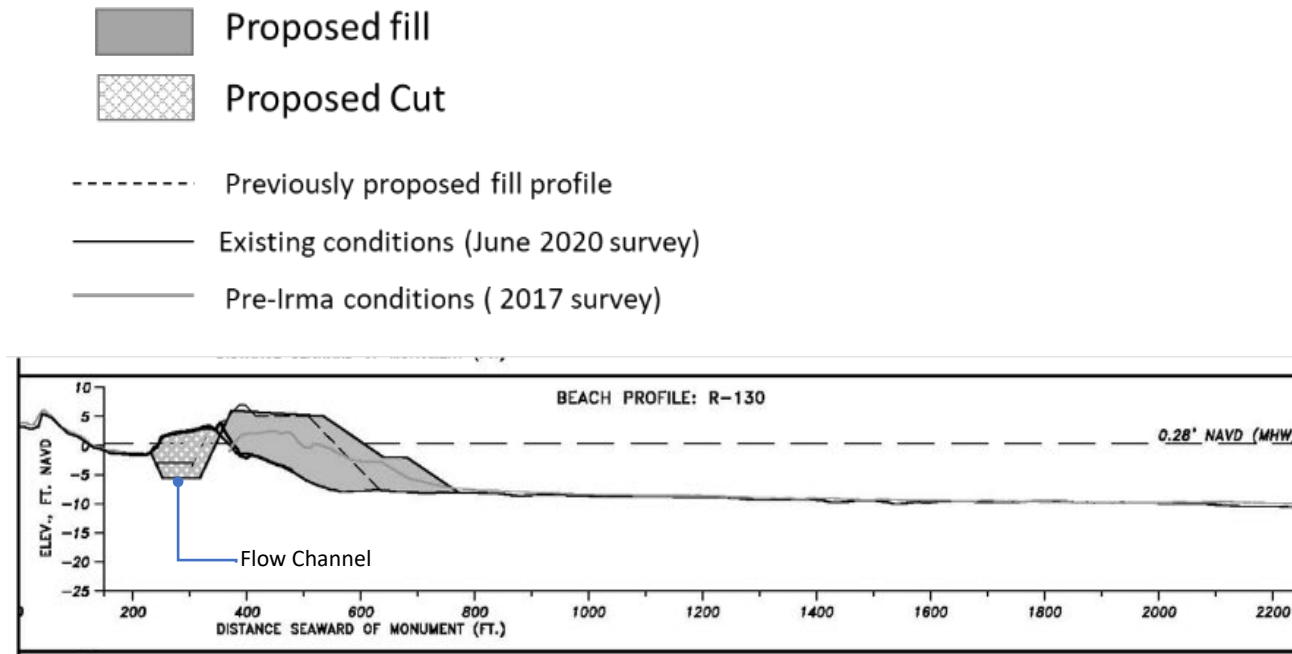
Schematic of nature-based restoration elements

Flow Channel



At extreme low tide model shows lagoon water level stops receding.

Resilient sand spit

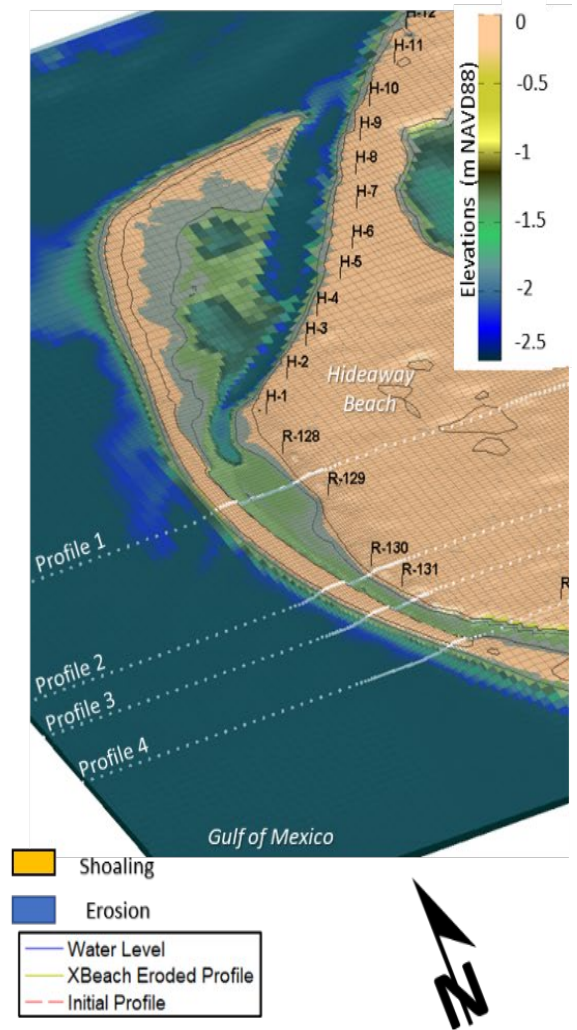
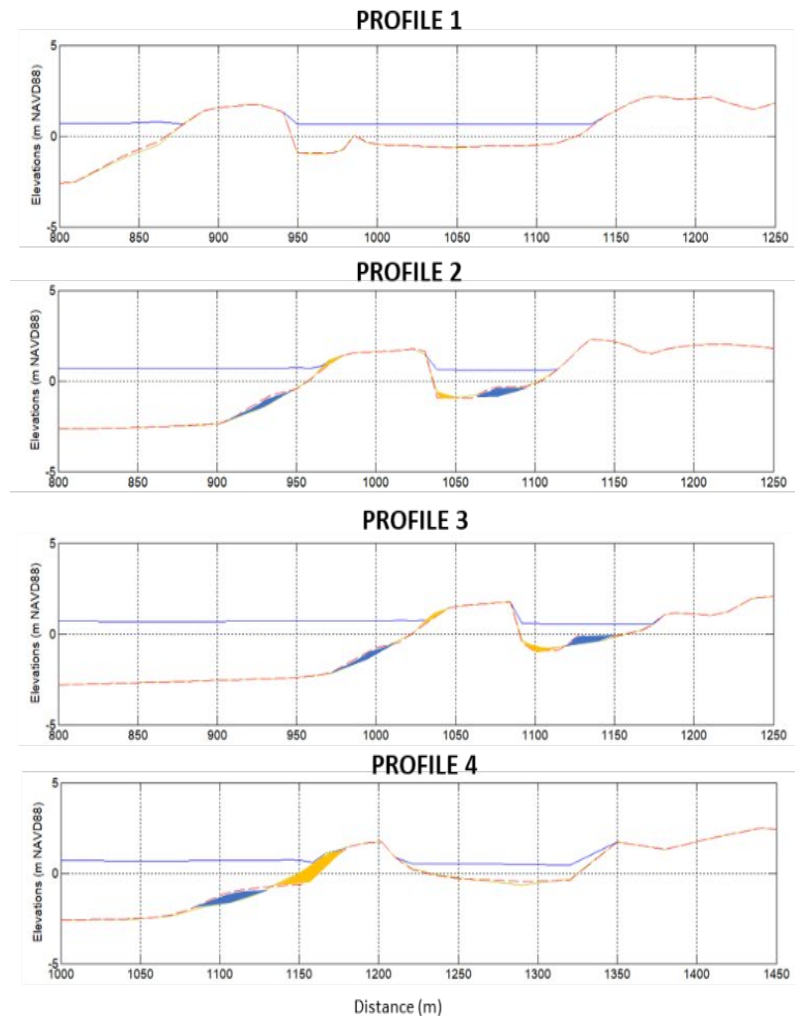
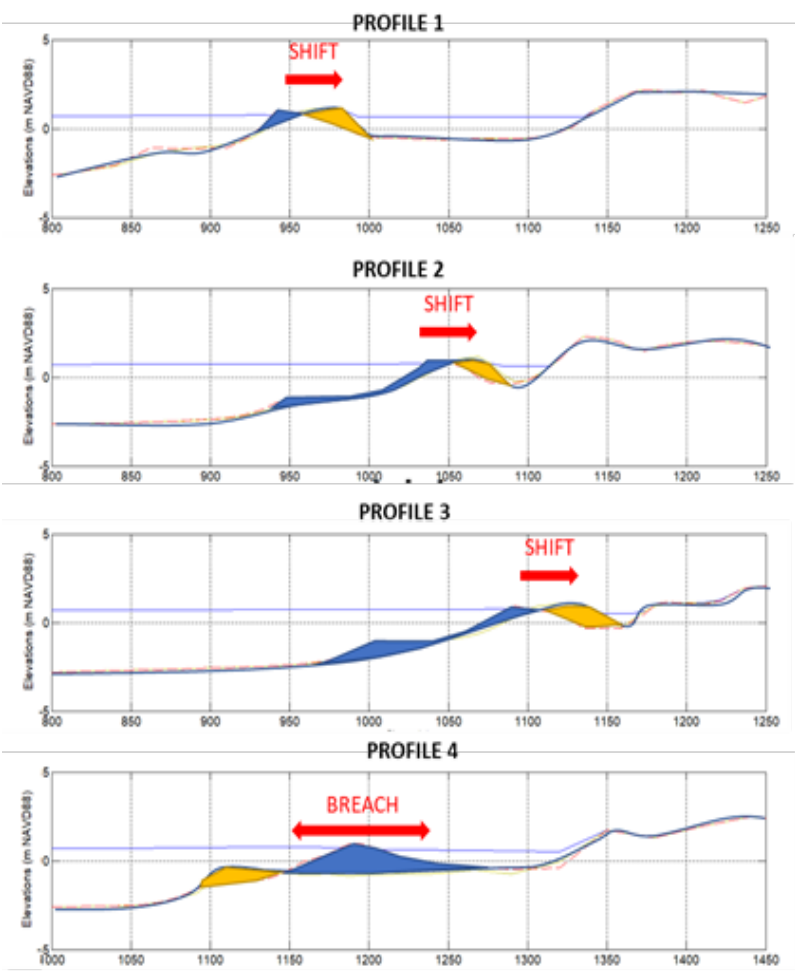


Flow channel and resilient beach berm design profile

Resilient sand spit

Existing Conditions

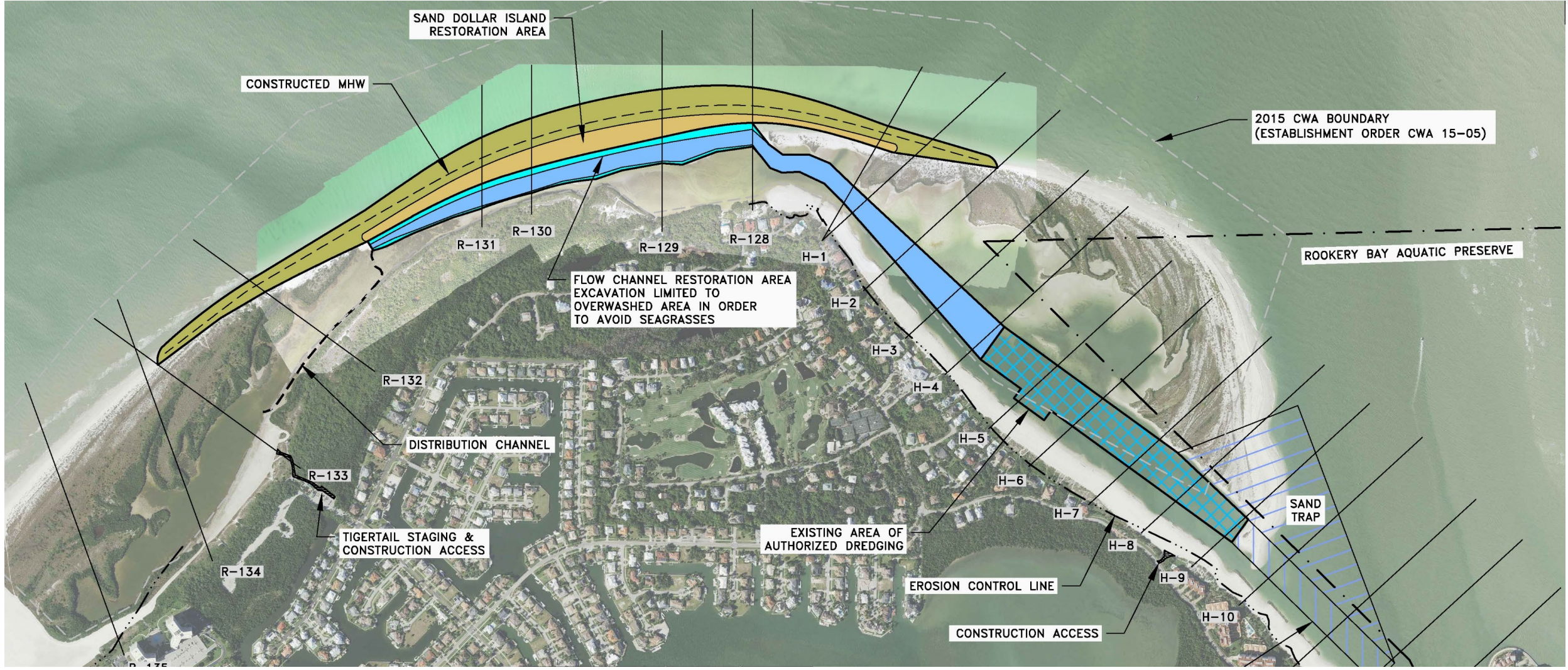
Design Conditions



XBeach morphologic evolution under high frequency storm event



- **Sand trap design as a renewable sand source**
 - *Maintain inlet open*
 - *Cyclic use of sand within the system*
 - *Incremental adaptation*



• **Site Plan**

PROGRESS UPDATE
TO JANUARY 05, 2023

- CUT AREA PROGRESS
- FILL AREA PROGRESS
- SAV MAPPING



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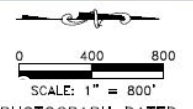


Berm Fill Area

South Flow Channel

Tigertail Beach Park

Sand Trap Dredging













Beach Access Trail

Tigertail Beach Park



Flow channel

Beach Access Trail

Beach Berm

Tigertail Beach Park



Natural and Nature Based Features(NNBF)

Working with Nature *one project at a time*

- *Incrementally working with nature towards **sustainable** and adaptive management programs*

Considerations

□ **Natural Dynamics**

- *Coastline evolution vs encroachment*
- *NNBF and adaptation ability*
- *Incremental implementation to address immediate needs within **regional concepts***

□ **Coastal resiliency challenges**

- *Conflicts in short term and long-term objectives*
- *Environmental resources conservation*
- *Encroachment Vs equilibrium platform*
- *Upland functions*
- *Existing policies, rules and regulations*



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Natural and nature based features for environmental enhancement and coastal storm risk management: a case study on Marco Island, Florida, United States

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Natural and Nature-Based systems provide an opportunity for adaptive response to Coastal Storm Risk Management and Sea Level Rise. The Tigertail Lagoon/Sand Dollar Island Restoration on Marco Island, Florida, presents a case study designed to maintain and enhance an existing coastal barrier system consisting of a 3-km-long sand spit and tidal lagoon ecosystem that is otherwise evolving toward closure. The case study is part of a nature-based adaptive management plan to restore and stabilize the sandspit and tidal lagoon through cyclic use of sediment within the system. This approach seeks to preserve existing protective habitats and landforms that also serve as natural coastal barriers to protect upland development. Design of the restoration plan considers the functions of a wildlife nature preserve and evolution of complex tidal inlet morphologic features bordered by a heavily developed barrier island. The design aims to restore and enhance a sandspit degraded by a sequence of storms since Major Hurricane Irma impacted Southwest Florida in 2017 and improve the existing deteriorated habitat by enhancing tidal exchange through restoration of the lagoon flow channel. Total wetland area will be increased by relocating the sand spit seaward of its present location to where it was located in approximately 2017. The reconstructed beach berm will provide enhanced resiliency to high frequency weather events. Sediment will be sourced from the existing sand spit and an innovative sand trap that will maintain the lagoon entrance open while providing beneficial re-use for excess sediment that continues to accumulate at the end of the spit. Components of the project were analyzed using existing engineering models and methods such as the Coastal Modeling System (CMS) and XBeach. Enhancing and preserving this barrier island feature and productive ecosystem provides an example of the enhanced coastal resiliency provided by natural and nature-based systems that are adaptable and responsive to sea level rise and ongoing coastal processes.

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- **US Army Corps of Engineers**
- **Fish and Wildlife Service**
- **NOAA Marine Fisheries Services**
- **FWC and Critical Wildlife Area administration**
- **Collier County**
- **Friends of Tigertail**

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