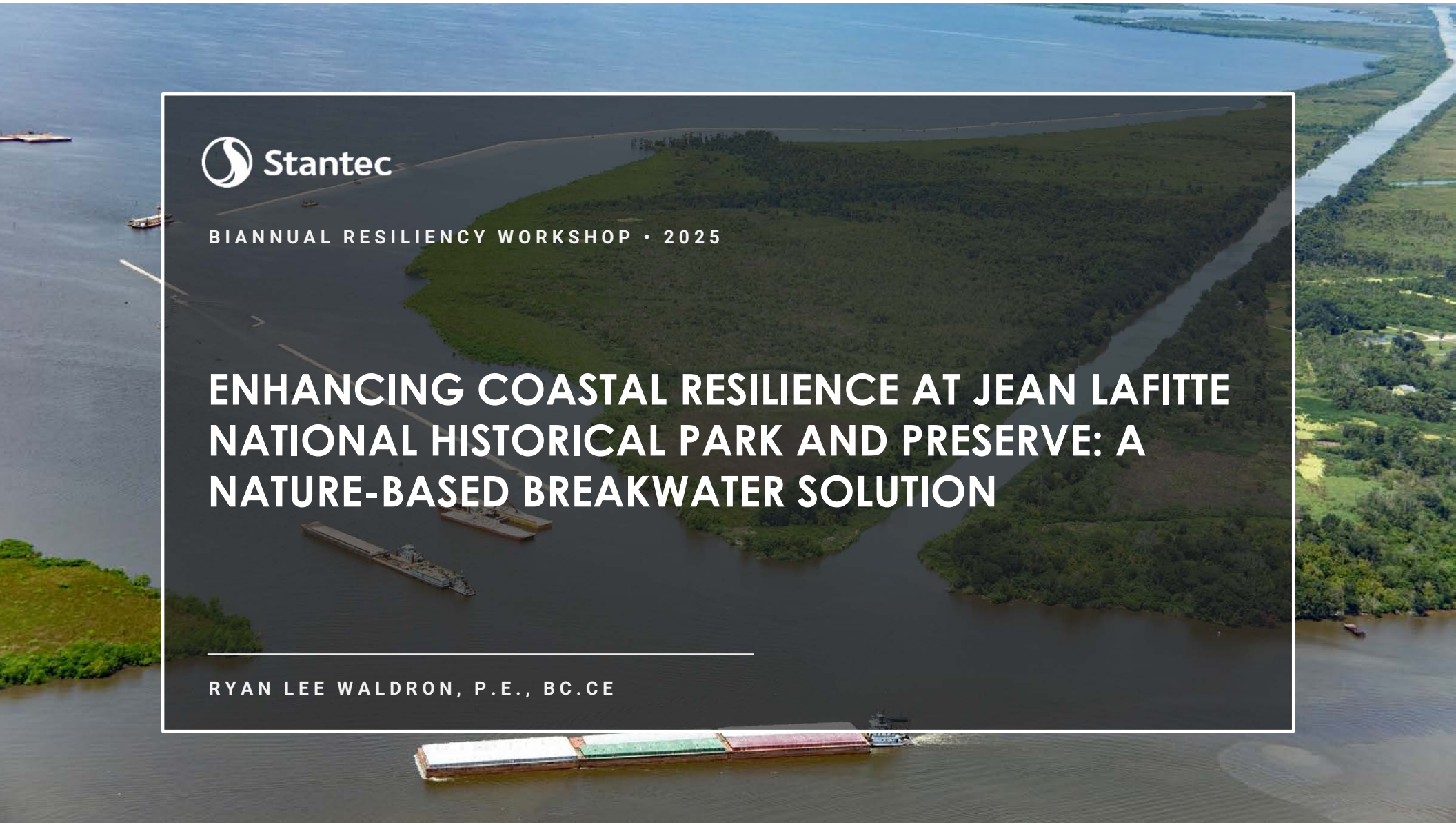


Stantec

BIANNUAL RESILIENCY WORKSHOP • 2025

ENHANCING COASTAL RESILIENCE AT JEAN LAFITTE NATIONAL HISTORICAL PARK AND PRESERVE: A NATURE-BASED BREAKWATER SOLUTION

RYAN LEE WALDRON, P.E., BC.CE

How do you restore an aquatic ecosystem?

Step 1: Get Some Barges Filled with Rock

Step 1: Get Some Barges Filled with Rock

Step 2: Dump Rock

Step 2: Dump Rock

Step 3: Done!

Step 3: Done!

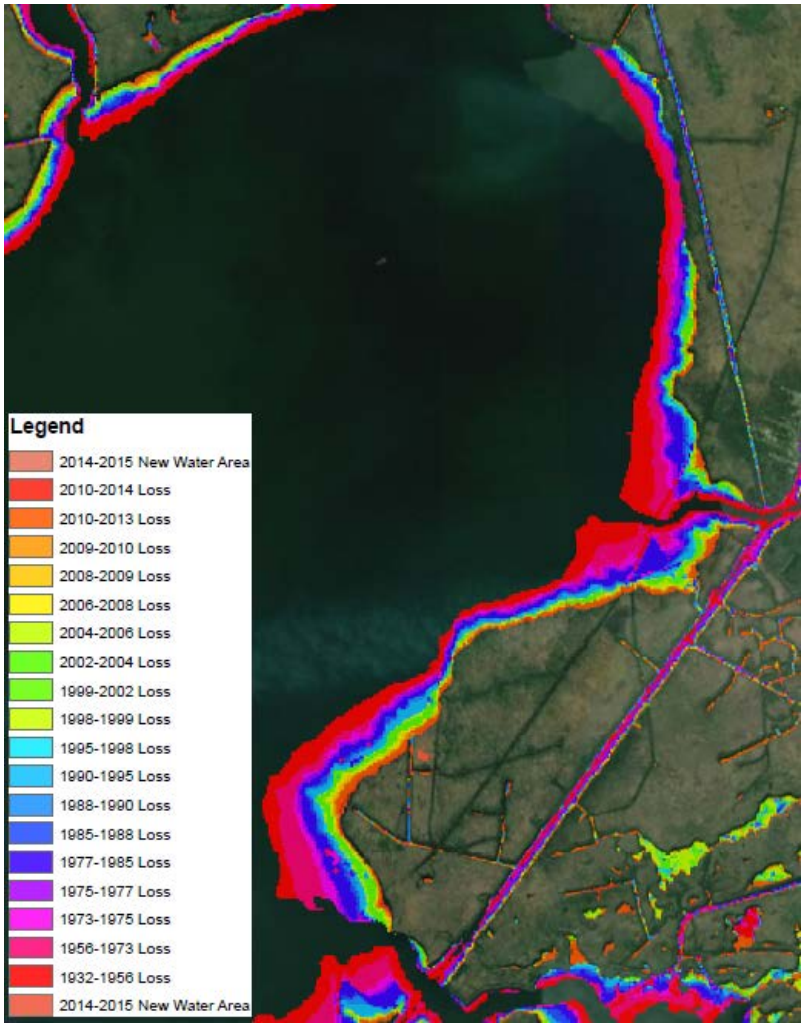
Thank you for coming to my Ted Talk!

Background

Project Location

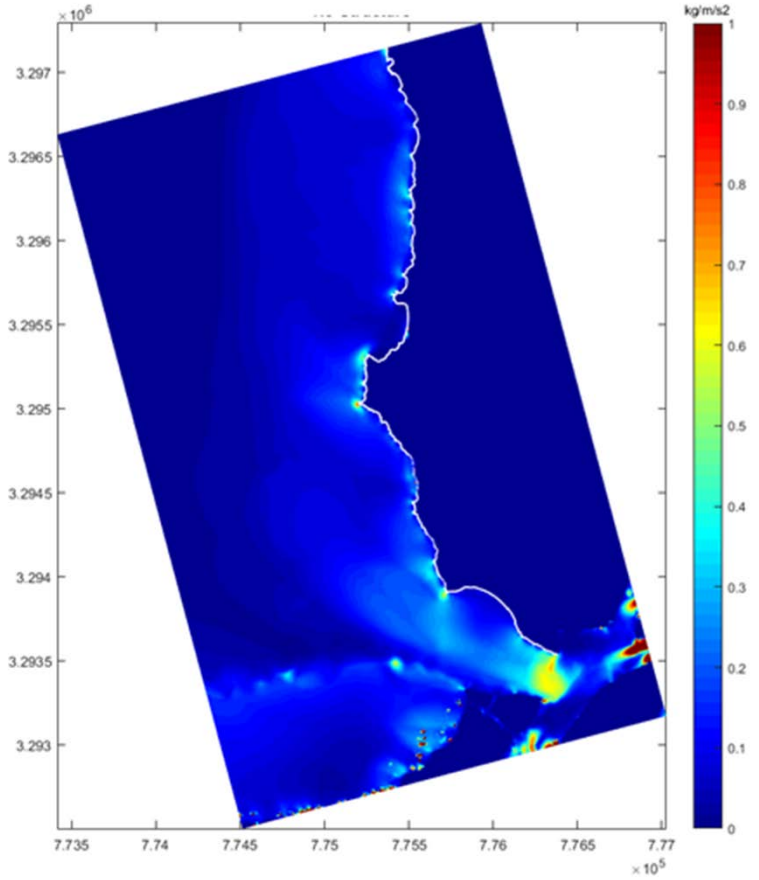
Background

- Shoreline Retreat Ongoing for Many Years
- BP Oil Spill
  - Davis Pond Diversion opened full for a longer period of time than usual to maintain flushing in area and keep oil out
  - Activities associated with Deepwater Horizon Oil Spill (DWH) resulted in a loss of a significant portion of the **Submerged Aquatic Vegetation (SAV)** population in Lakes Salvador and Cataouatche **(Diverted Fresh Water)**.
- NPS awarded DWH funding to Restore SAV Habitat



Background

- As SAV populations are an important component of these ecosystems, innovative analyses and design have been implemented to provide for suitable SAV habitat.
- The shorelines of Jean Lafitte National Historical Park and Preserve's Barataria Basin Preserve Unit along these lakes were key locations of population loss, as well as high rates of shoreline erosion.
- DWH related funding has allowed for the process of designing a solution to restoring SAV population by providing suitable habitat.



Bed Shear Stress ($kg/m/s^2$)

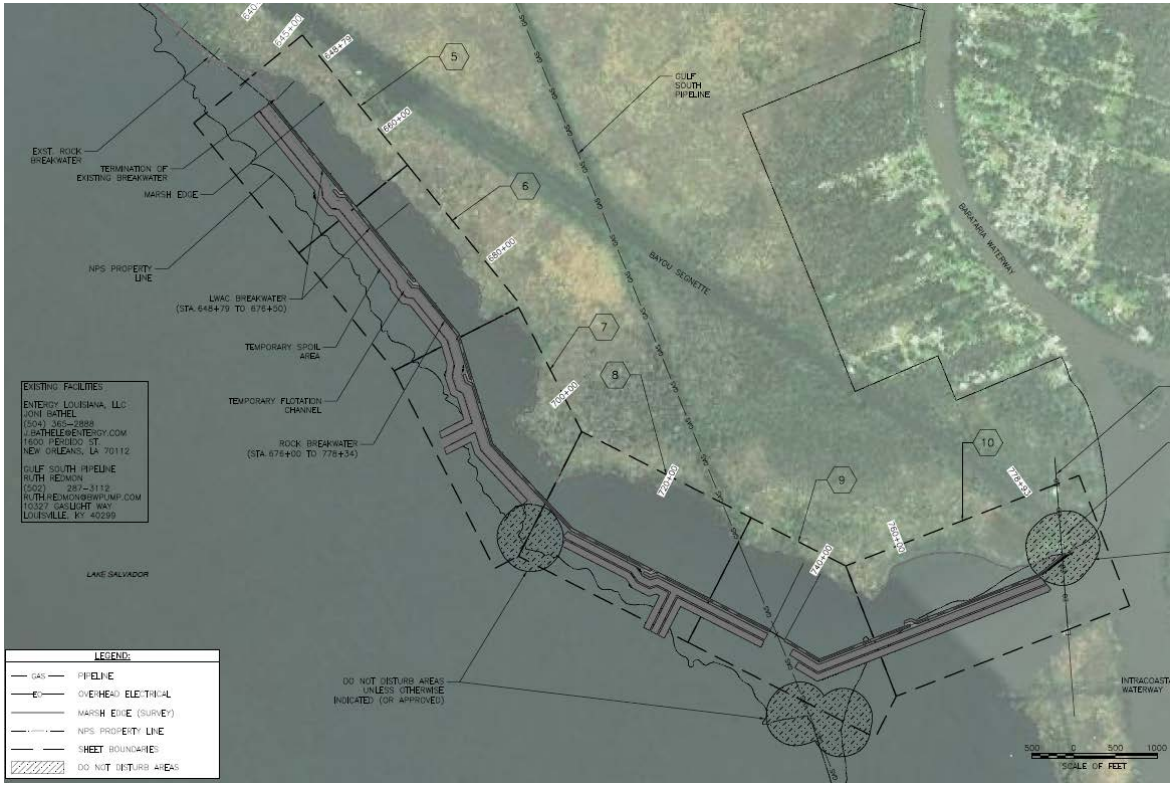
Background

- Through literature review & workshops with leading experts in aquatic ecosystems in Louisiana developed models to identify the factors that are limiting the SAV from reestablishing.
- Using these models, it was determined that the key factor to restoring SAV populations at this location was the reduction of bed shear stresses.
- Previously low, these stresses have increased with loss of former SAV populations that existed in this area and with shoreline retreat. The resulting key design criterion was that bed shear stresses should be below 1 pa.
- It was determined that wave energies should be reduced in the habitat restoration area through wave energy attenuation structures.

Analysis

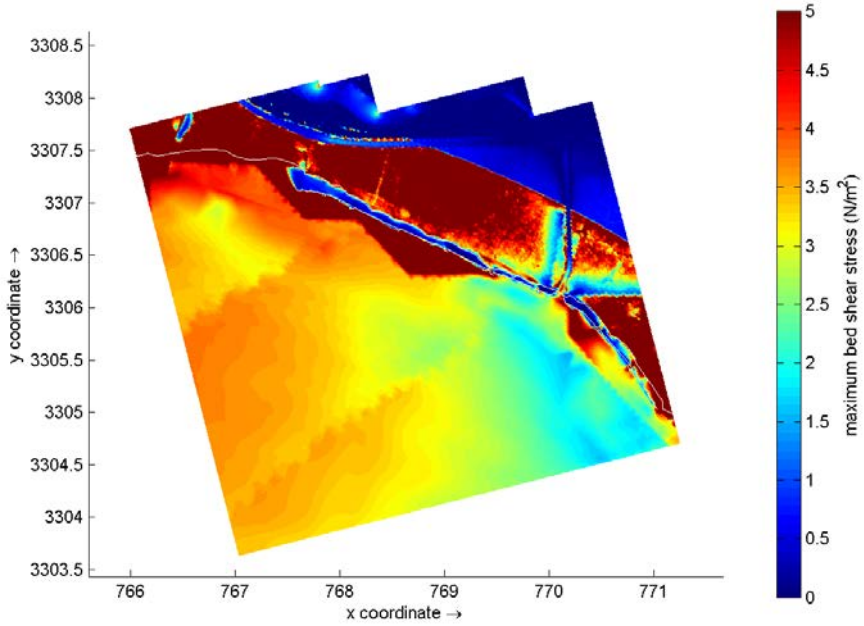
Design Criteria

- Rubble mound breakwaters were selected from product cost-value analyses combined with phase resolving wave modeling, as they best achieve the shear stress reductions while maximizing the amount of area protected.
- For re-vegetation of 50 acres, no less than 100-acres of suitable habitat is required to be protected.
- Thus, a breakwater alignment was developed that is further from shore than is typical.



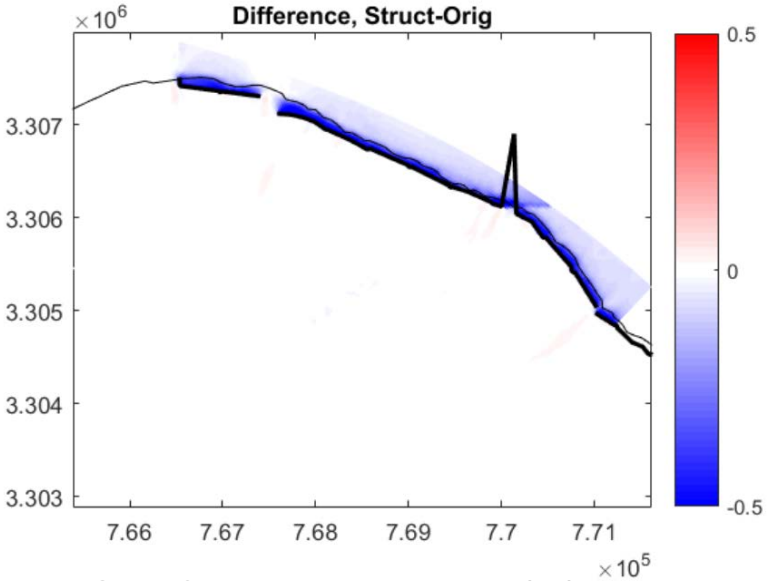
Modeling

- To evaluate the performance of and impacts from the proposed breakwater on current and wave behaviors, coupled Delft3D hydrodynamic/wave models were developed.
- Several alignments were evaluated in the models and corresponding changes in wave heights, currents, and bed shears stresses were compared to the thresholds set during the workshops.
- Results show that the proposed breakwaters reduce wave height, maximum currents, and bed shear stresses during non-storm conditions (below thresholds).
- During the 20-yr. design storm event, the bed shear stress threshold was exceeded, but for reduced periods in fewer locations.

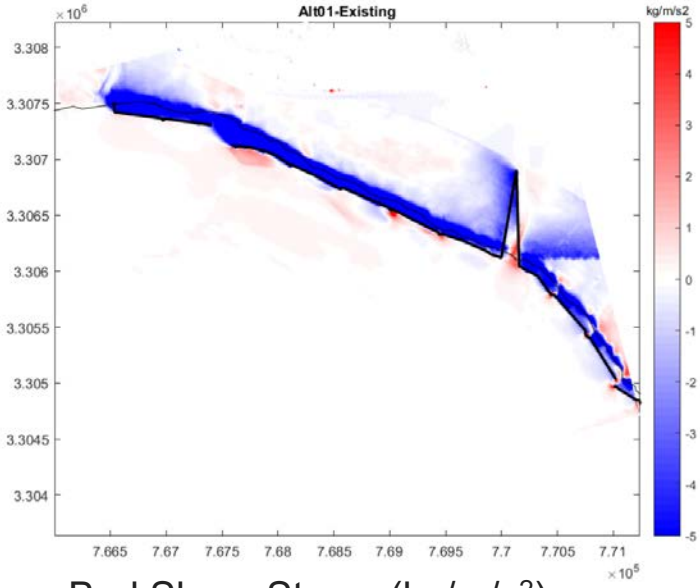


Bed Shear Stress (N/m^2)

Difference – FWOP v. FWP



Significant Wave Height (m)

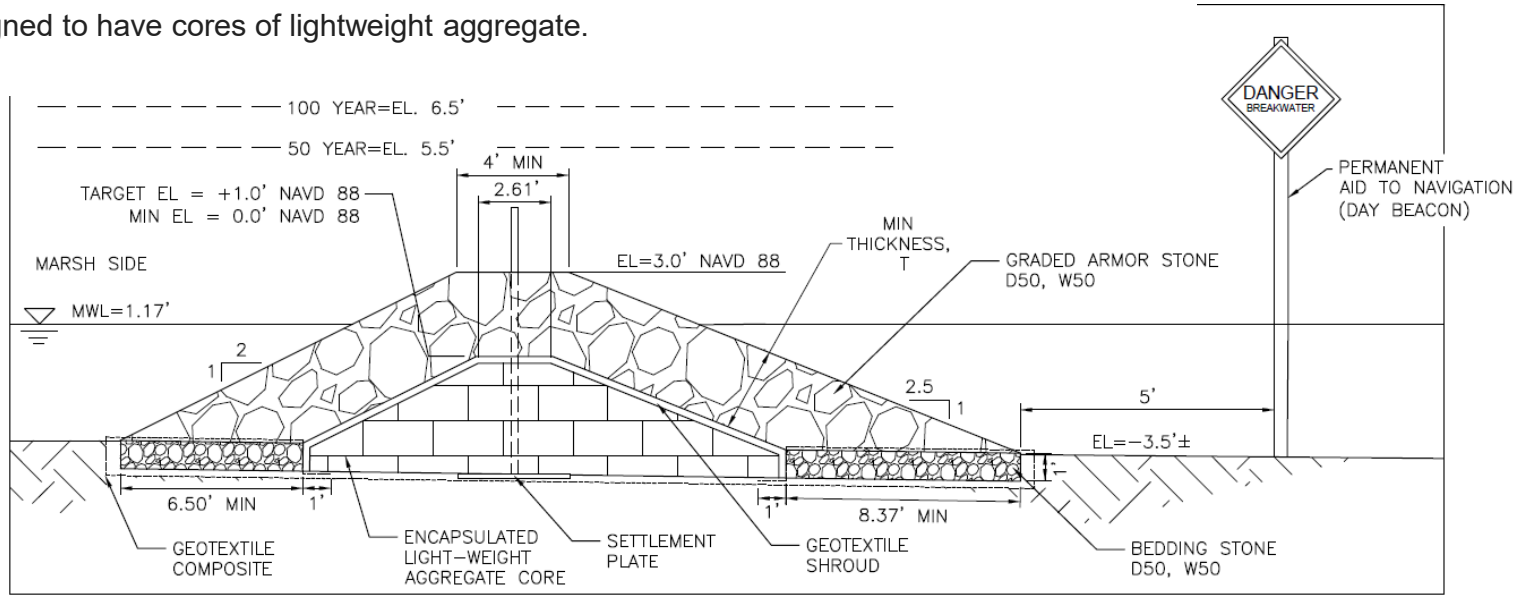


Bed Shear Stress (kg/m/s^2)

Design

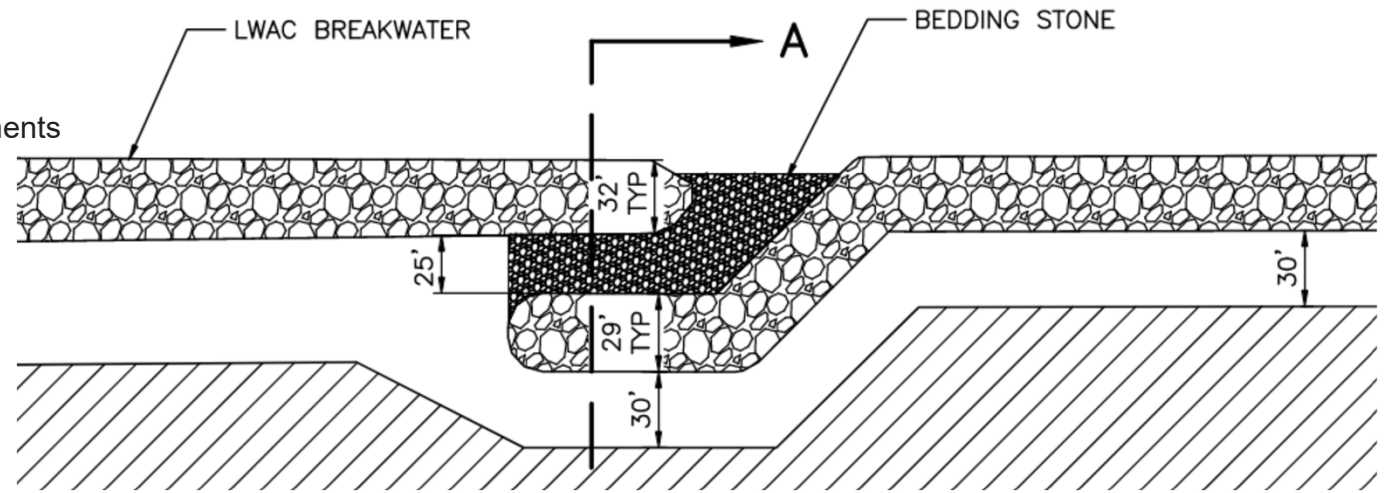
Engineering Design Considerations

- Breakwater system selection.
- Modeling results were used to determine stable armor stone size
- Geotechnical Considerations
  - Several breakwater segments were sited on soils that were not suitable for a traditional rubble mound structure.
  - Thus, they were designed to have cores of lightweight aggregate.



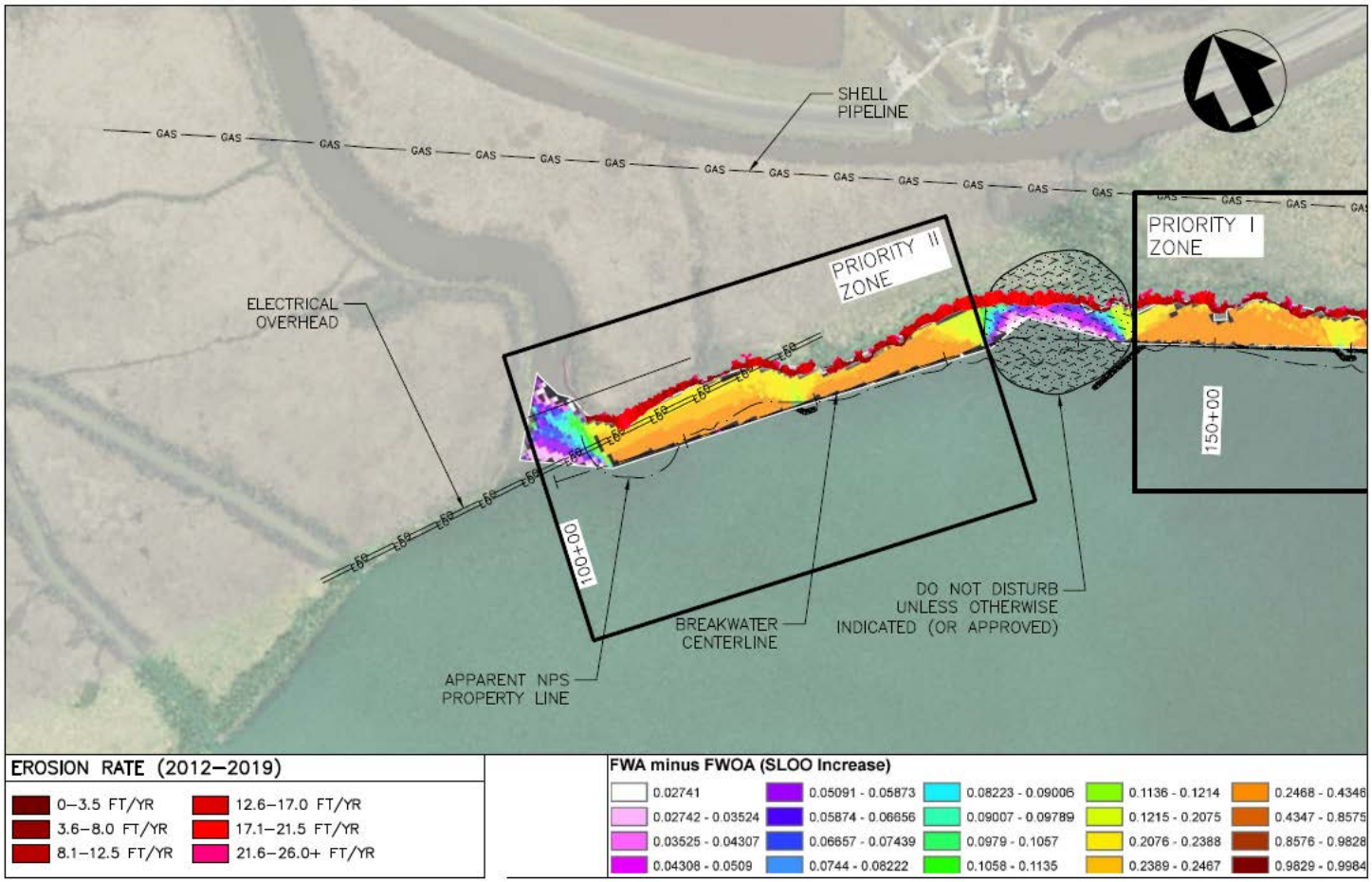
Key Design Approaches

- Thresholds for SAV Habitat suitability (e.g. Sheer Stress < 1 Pa.)
- Breakwater Configuration
  - Alignment (extra room for habitat, gap locations
  - Gaps Closures (elbows vs. open gaps)
- Prioritization & Bidding Method – Phase 2
- Breakwater Materials
  - Rubble Mound vs. Engineered products
  - LWAC for Weak Soils
- Elbows to protect gaps
  - To meet shear stress requirements



Phase 2

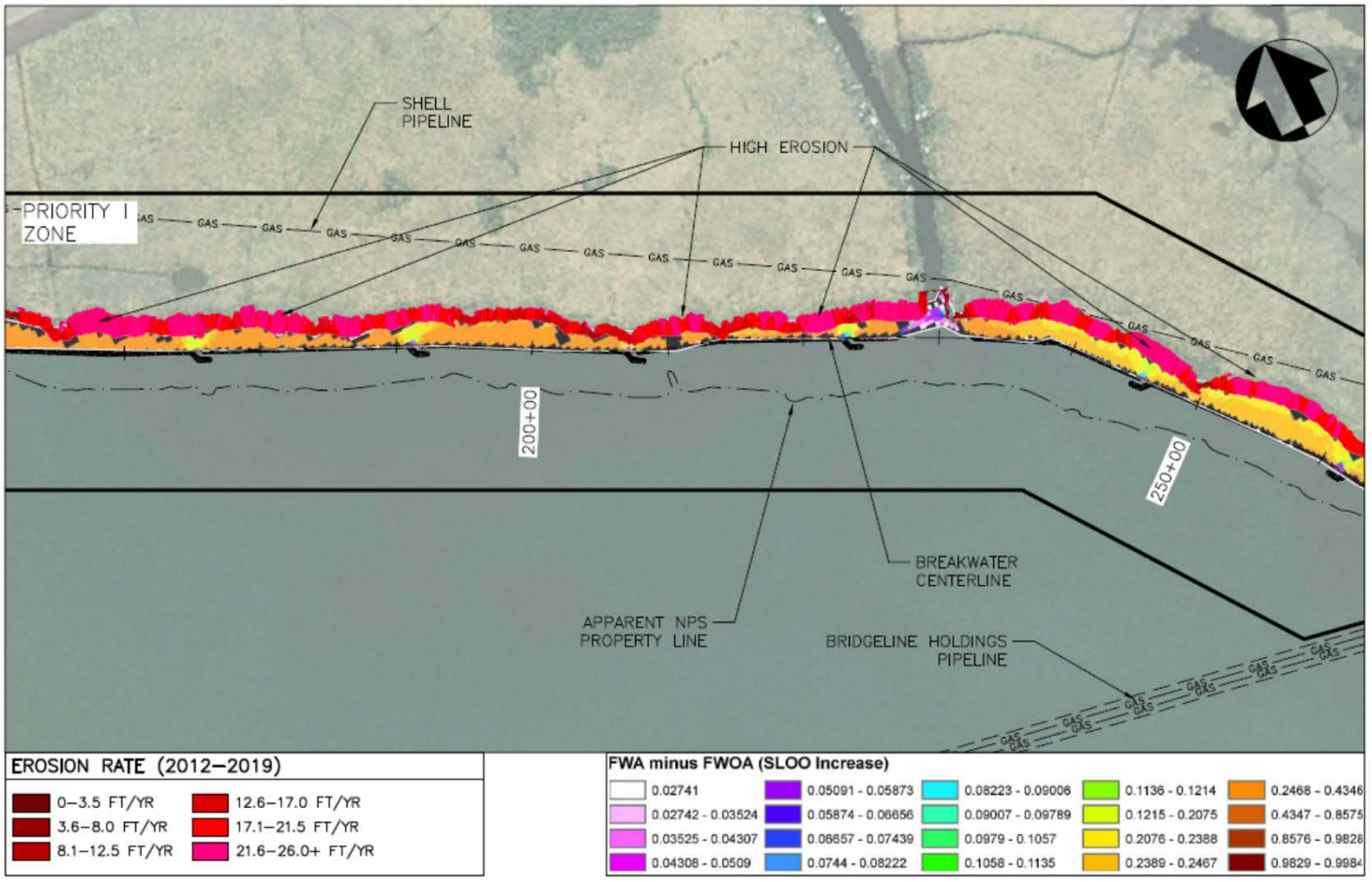
SLOO Increase & Shoreline Retreat



PLAN VIEW 1

SCALE: 1"=1000'

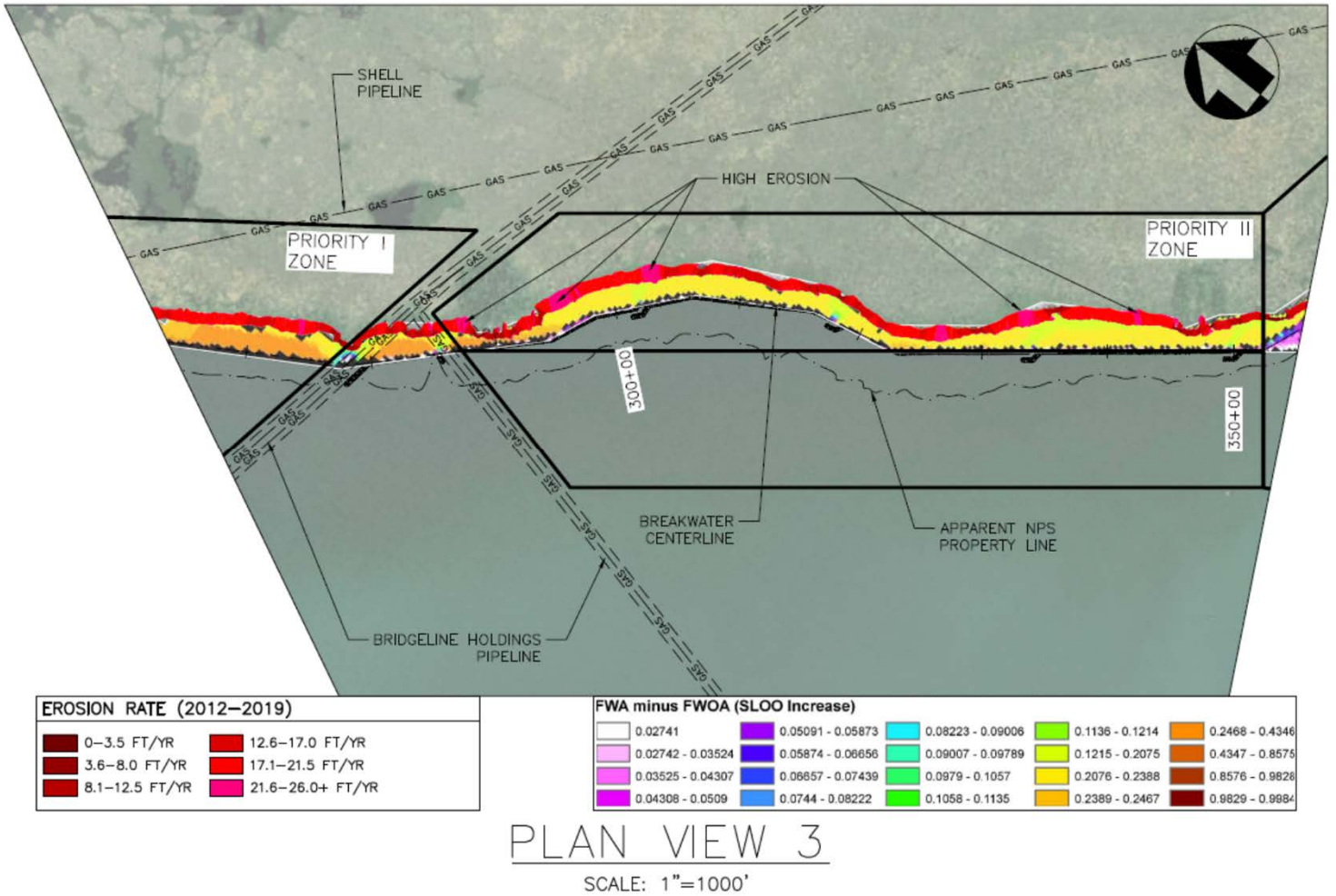
SLOO Increase & Shoreline Retreat



PLAN VIEW 2

SCALE: 1"=1000'

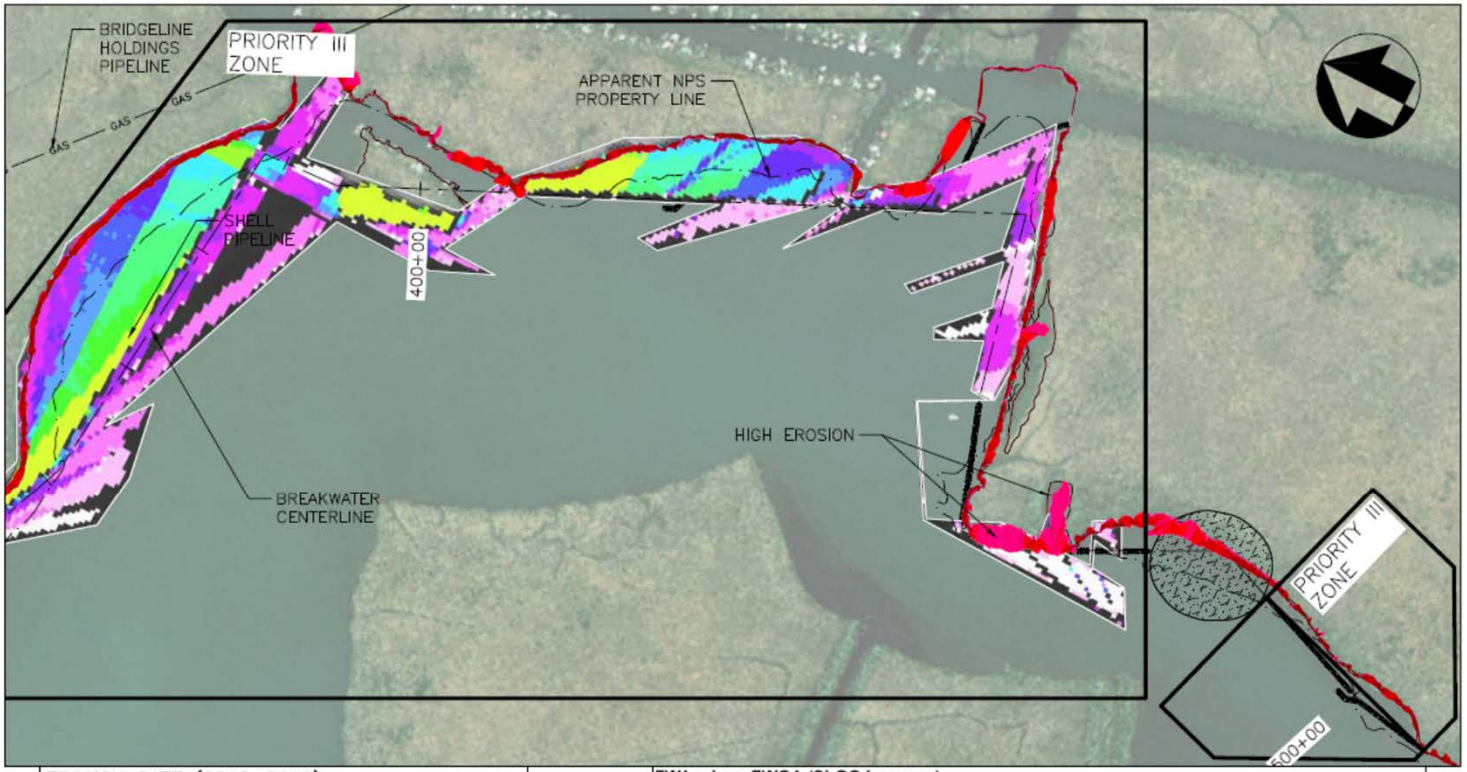
SLOO Increase & Shoreline Retreat



PLAN VIEW 3

SCALE: 1"=1000'

SLOO Increase & Shoreline Retreat

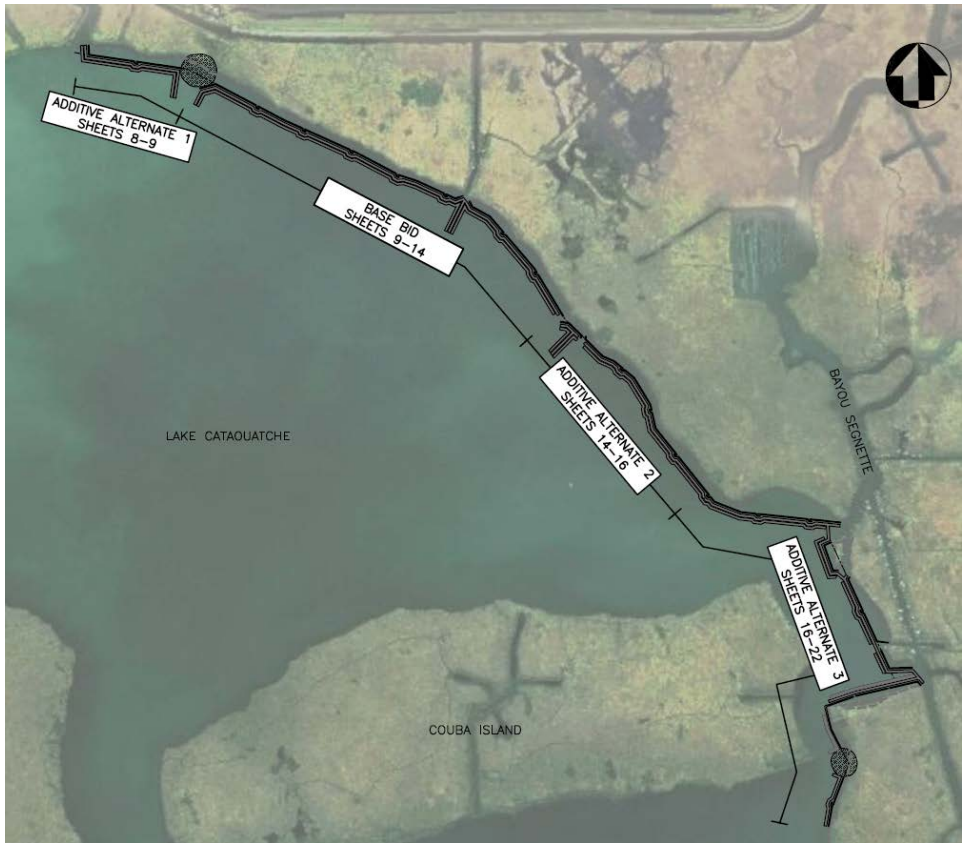


PLAN VIEW 4

SCALE: 1"=1000'

Funding Uncertainty & Prioritization

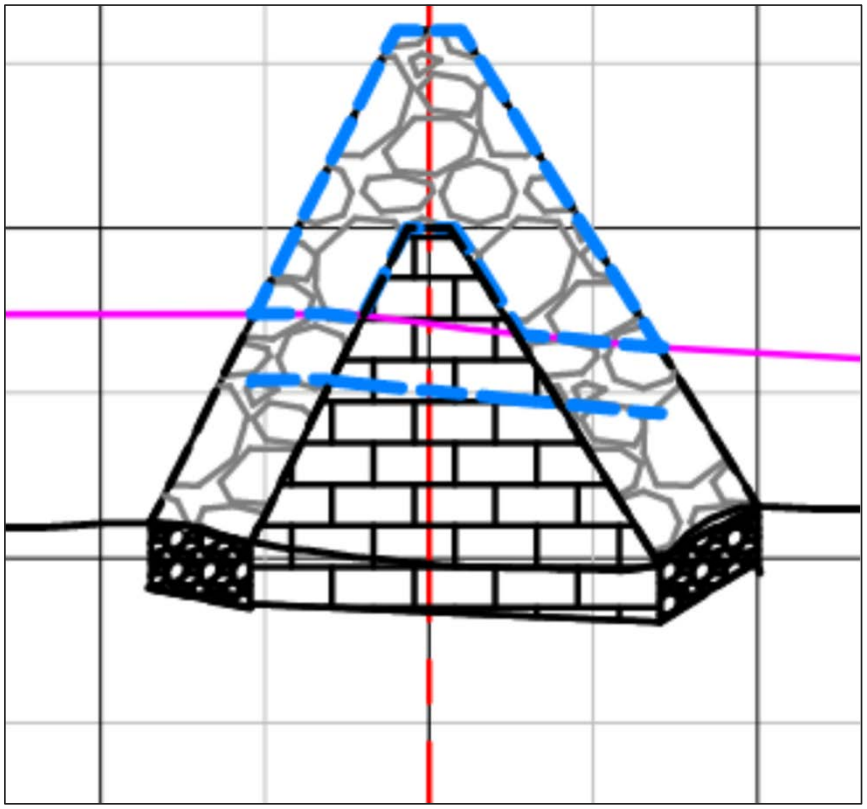
- Phase I Funding Secured (E&D, Construction, & Monitoring)
- Phase II E&D Funding Secured
- Phase II Construction Funding still to be identified
  - Base Bid/Additive Alternate Approach used to ensure flexibility for bid price and funding uncertainty.
  - Priority based on potential for increase in **Spatial Likelihood of Occurrence (SLOO)** and on shoreline retreat rate.



Construction

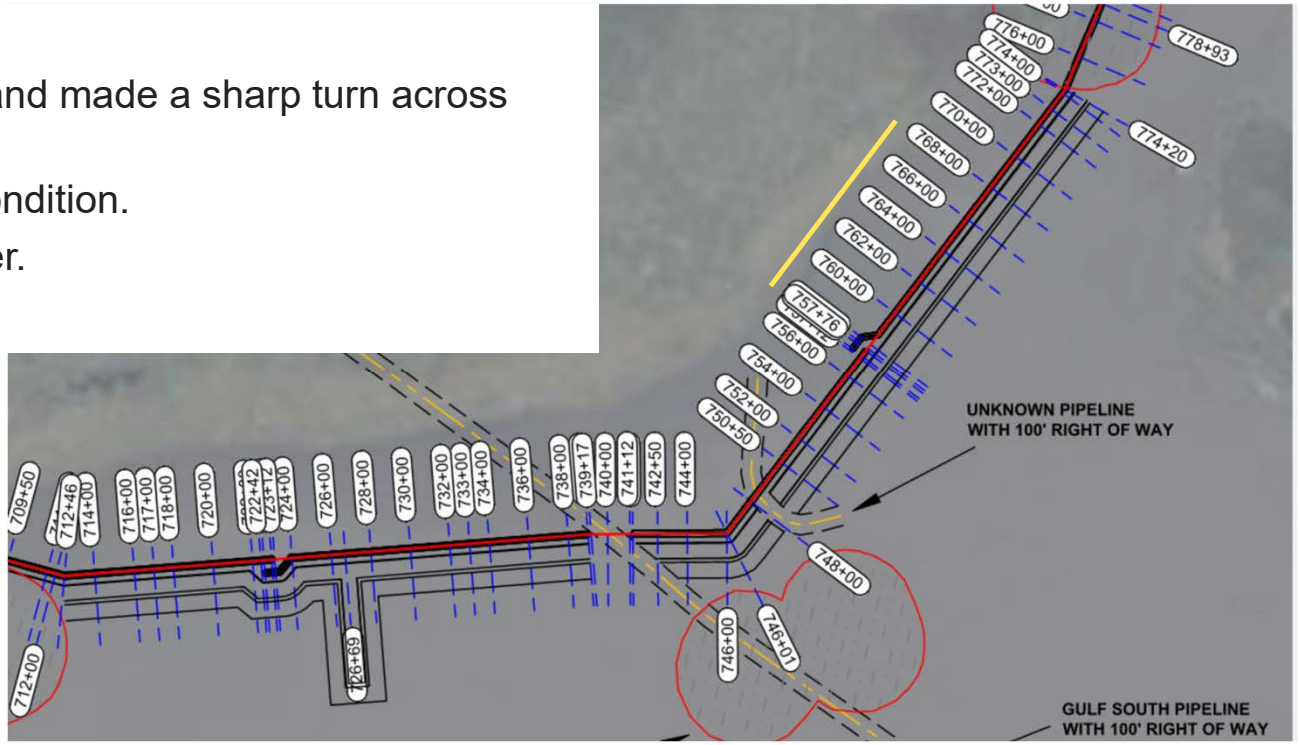
Construction Challenges – Post-Design Bed Level Changes

- **Hurricane Ida** occurred between completion of design and solicitation of bids
- Bed level decreased more than a foot in most of the LWAC area.
- Additional Quantities
  - Additional Cost
  - Geotechnical Considerations
    - Added material wait to the portion of the project with he weakest soils.
    - Likely the weakest soils that were erroded.



Construction Challenges
Site Conditions Cause a U-Turn in Design

- Pipeline who?
- Known pipeline continued, and made a sharp turn across alignment.
- Unknown owner, unkown condition.
- Identified with magnetometer.
- 100’ gap left in alignment.



Construction Challenges – End Collapse

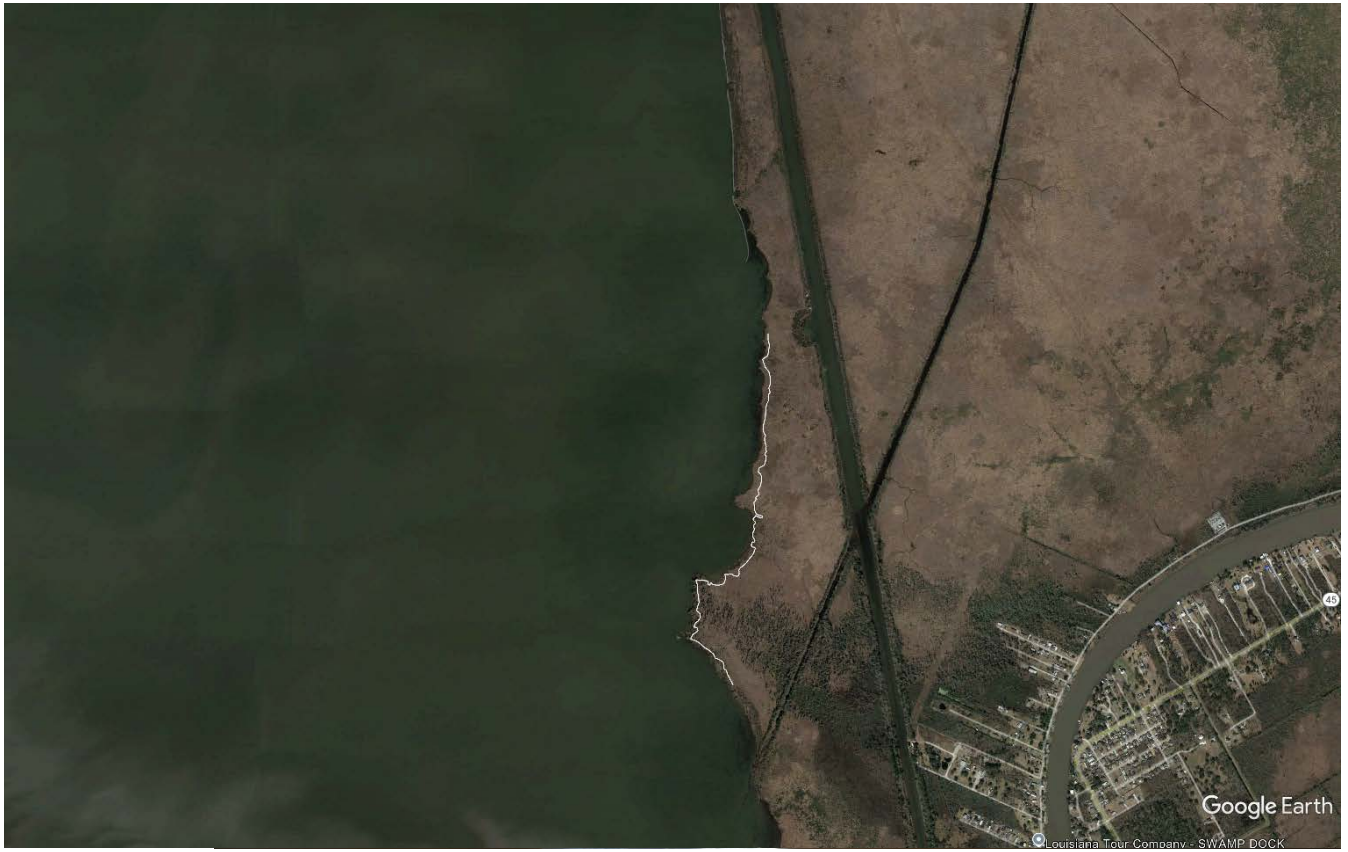
- Immediately upon placement, the northernmost 75’ of breakwater settled several feet in a single event.
- Bathymetry after Ida showed a scour hole between the end of the USACE breakwater and the beginning this one.
- Armor stone slid into the hole.
- An additional ~112 CY of Armor Stone

Construction Challenges – Shells

- Flotation access channel spoils contained shells
- Cultural Resources or Natural?
- An abundance of Rangia Clam (Rangia Cuneata) on the bed of Lake Salvador
- Already disturbed, and being returned.
- Progress as planned.

Hurricane Francine

- 2018 Aerial
- Pre-Hurricane Ida, 2021 Shoreline



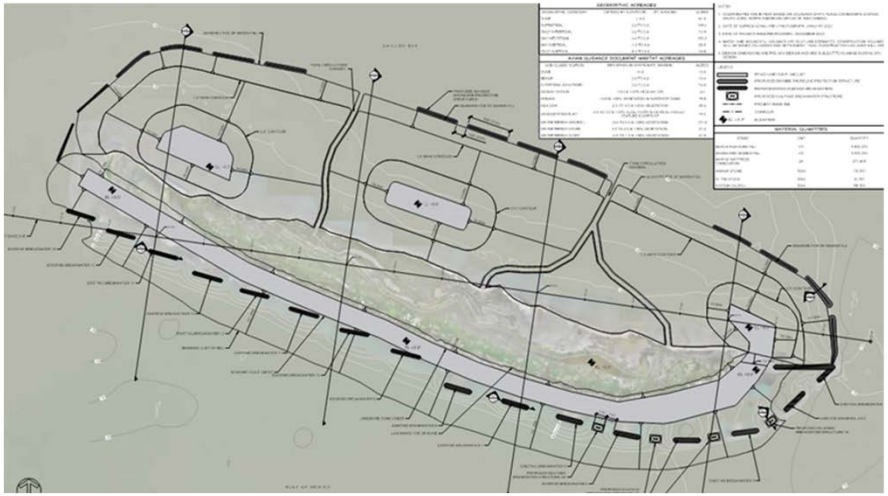
Hurricane Francine

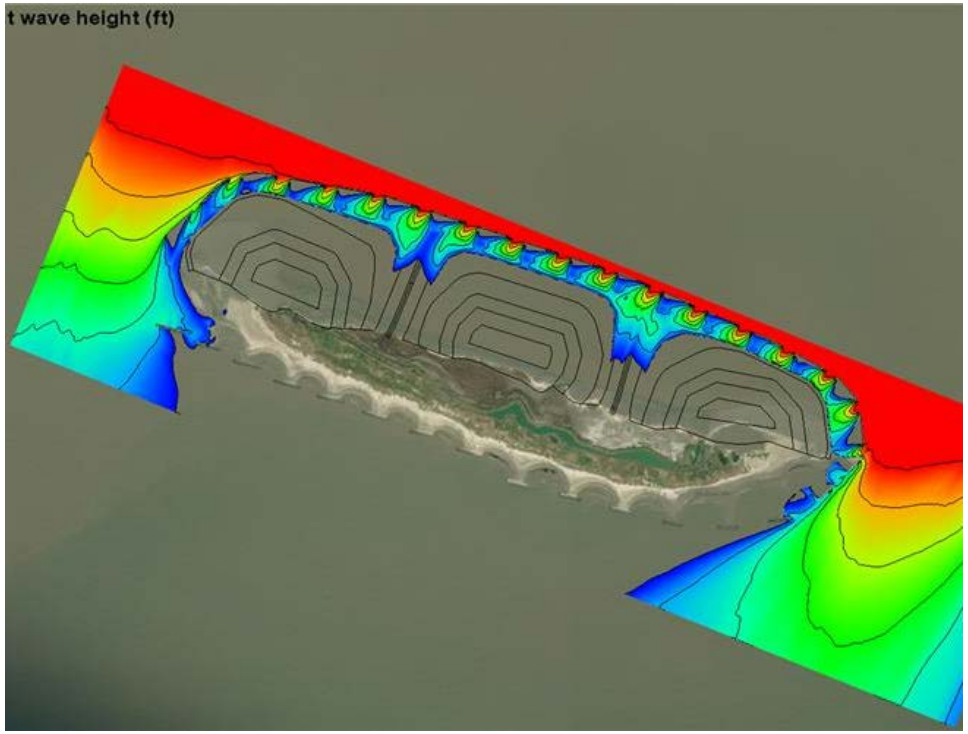
- May 2023
- Pre-Hurricane Ida, 2021 Shoreline
- Flotant Marsh Washed over!

Hurricane Francine – Flotant washed up!

Similar Work at Stantec

- Racoon Island – Terrebonne Parish, LA
- University Lakes Flood Risk Reduction Design – Baton Rouge, LA
- Laguna Madre Rookery – Port Mansfield, TX





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Questions?

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