



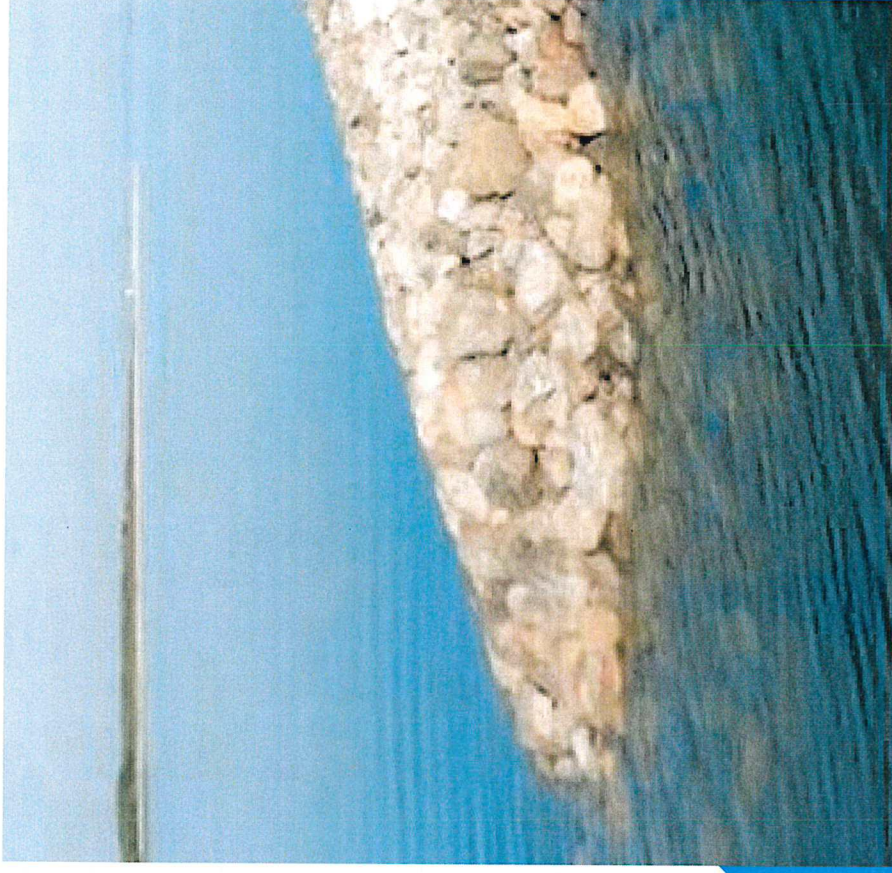
City of Port Lavaca

Living Shoreline Project

Coastal Engineering Analysis and Alternatives Selection

February 22nd, 2023

Non-confidential - Standard



Meeting Agenda

1
Introduction

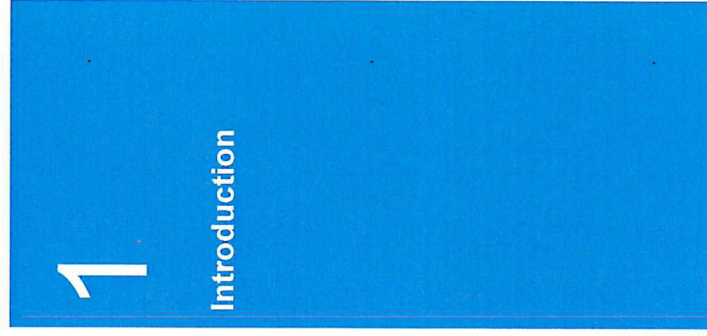
2
Wave Modeling

3
Alternative
Evaluation

4
Alternative
Selection

5
Conclusions and
Next Steps

Meeting Agenda



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Project Overview

Project Goals as defined in the Grant

1.

Reduce storm impact

Goal: Mitigate impact of storm surge on Port Lavaca Downtown through breakwaters and living shorelines

Solution: Reduce wave energy along the shoreline

2.

Reduce flooding

Goal: Protect stormwater outfalls to help reduce street flooding during heavy rains combined with high tides

Solution: Reduce wave energy along the shoreline

3.

Enhance ecosystem

Goal: Create marsh habitat to add to natural line of storm defence and enhance ecosystem

Solution: Marsh creation and reduce wave energy to coastal vegetation tolerances

4.

Enhance ecosystem

Goal: Create oyster reef to enhance ecosystem, increase visitation, education, and environmental sustainability and provide additional natural storm defence

Solution: Create Oyster reefs

5.

Outcome

Goal: Revitalize downtown area for economic development and opportunities for residents

Solution: All of the above

Project Overview

Conceptual project features defined in the Grant

Breakwater: 3160'
Oyster Reef: 2160'
Marsh Creation

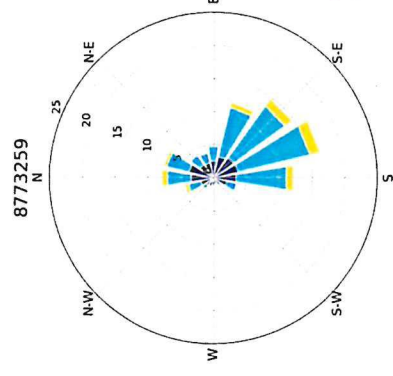
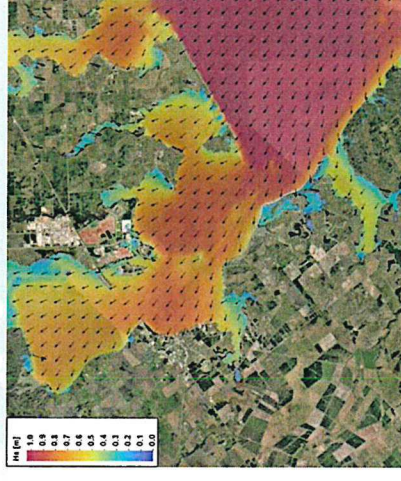
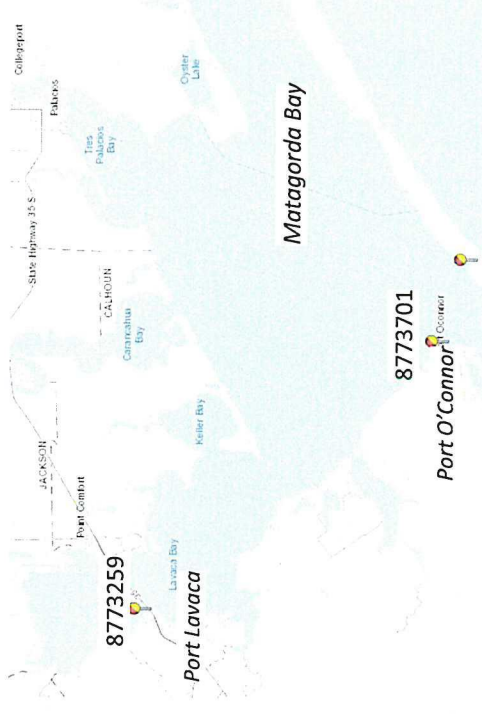
Note: Barge
removal not
specified in grant



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Previous Meeting Recap

1. Existing Data Analysis
 - NOAA gauge data to analyze wind and water level data, establish storm intensity / frequency
2. New Data Collection
 - Survey data, magnetometer data, bathymetry
3. Wave Climate Analysis
 - Use time series of water level and wind from NOAA gauge to predict non-tropical wave conditions
4. Modeling
 - Preliminary modeling to test hydrodynamic and structure interaction (wave transmission, flushing, etc.)
5. Proposed Alternatives
 - Project features, proposed borrow sites, marsh creation



WSPD [mph]
 0.0 : 10.0
 10.0 : 20.0
 20.0 : 30.0
 30.0 : inf

Meeting Objectives

1. Show wave model setup for existing conditions and alternatives

Modeling domain, return periods, and boundary conditions

2. Discuss alternatives analysis

Wave transmission, marsh wave tolerance analysis, and alternatives matrix

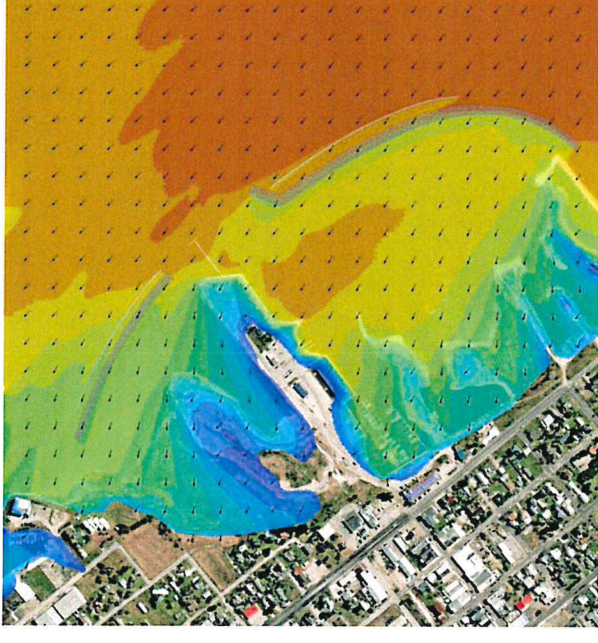
3. Review alternative selection

Show preferred alternative; obtain input from City of Port Lavaca team

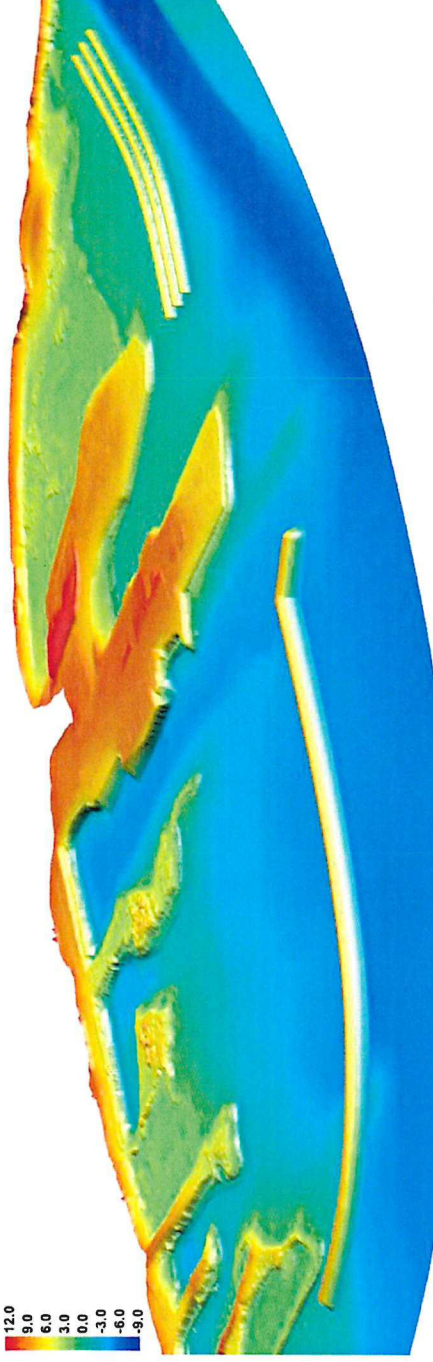
4. Path forward

30% design, engineering schedule

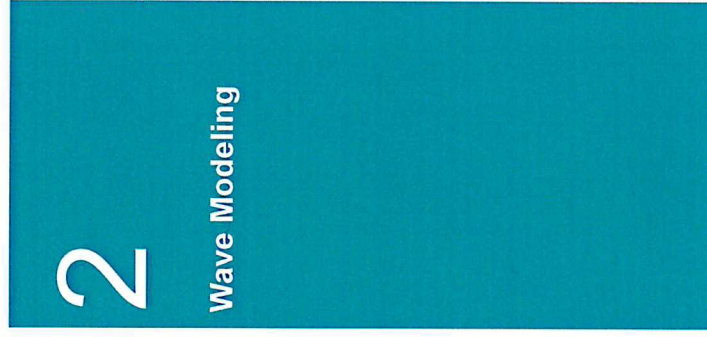
Open discussion with CPL team



Elevation [ft NAVD88]



Meeting Agenda



Model Methodology

SWAN Wave Model

Nested wave model

- Wave generation in Matagorda and Lavaca Bay
- Detailed resolution of Port Lavaca and Alternatives

Forcing conditions

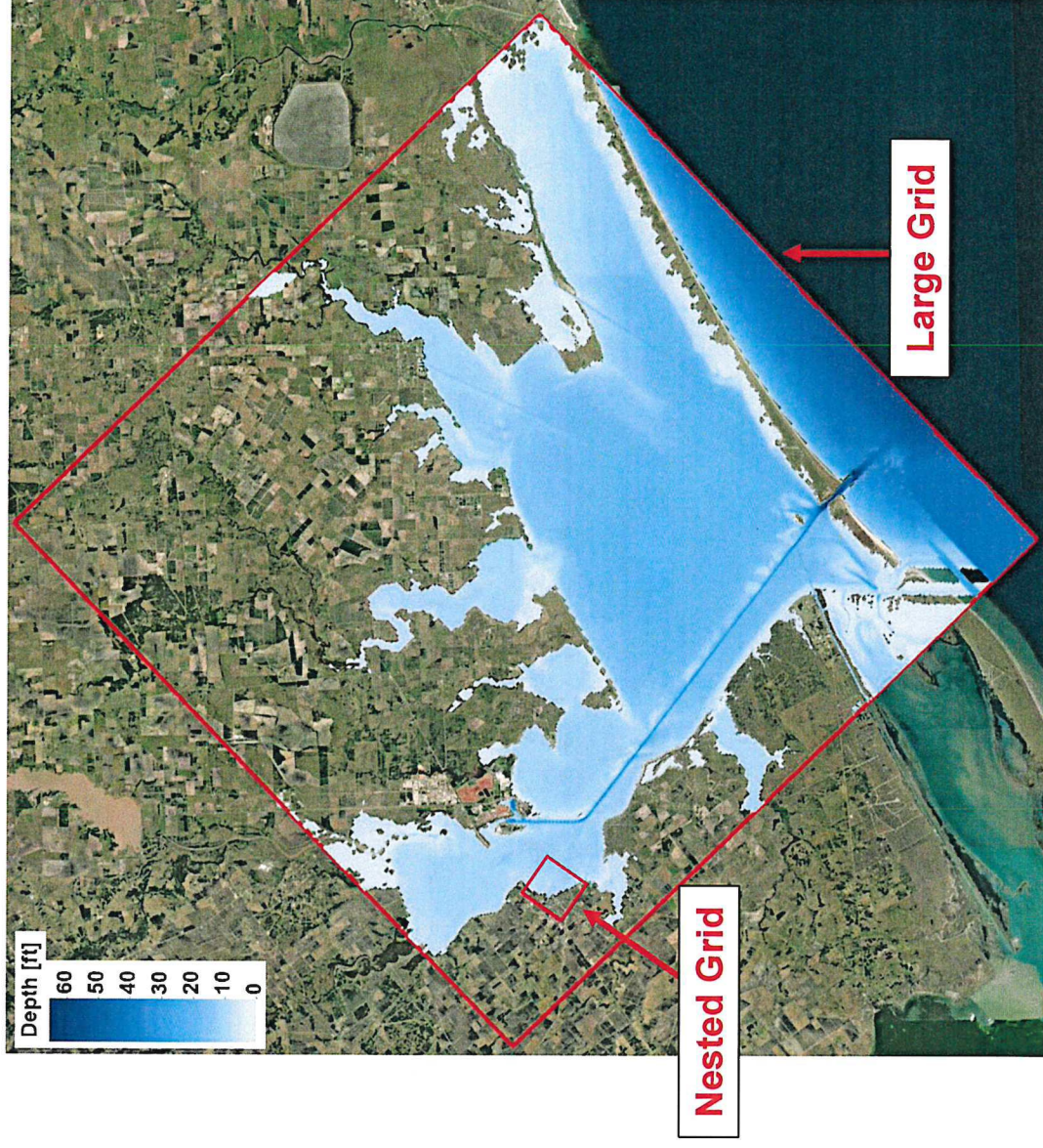
- 100, 20, 5, and 1 year return period storm conditions
- Southeast, East, and Northeast

Alternatives depend on structure parameters

- Rubble mound
- Oyster breakwaters

Performance analyzed in terms of wave attenuation at project shoreline

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Model Methodology

Alternatives

Alternative 1D



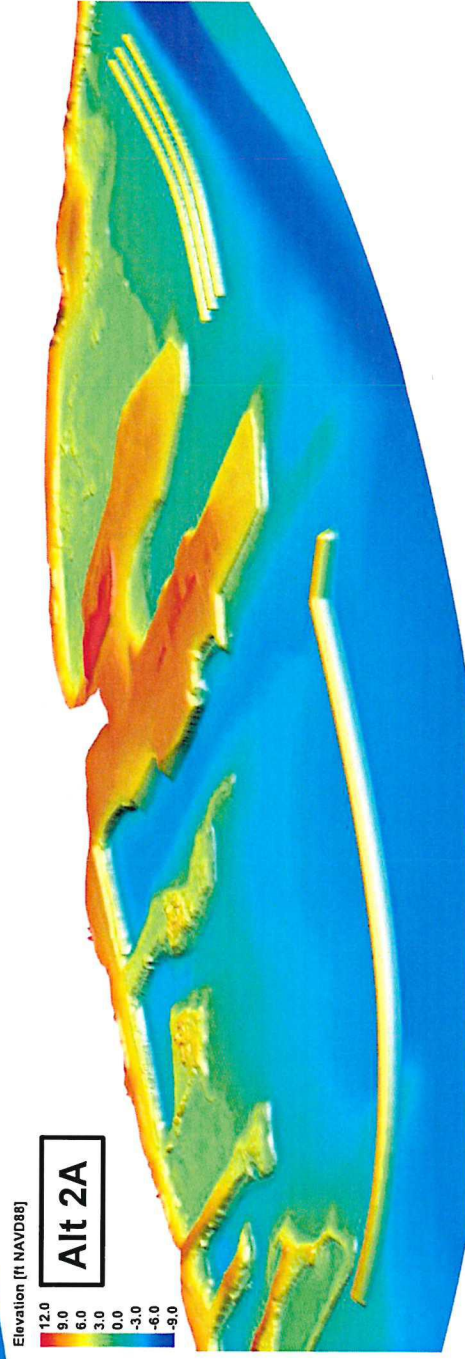
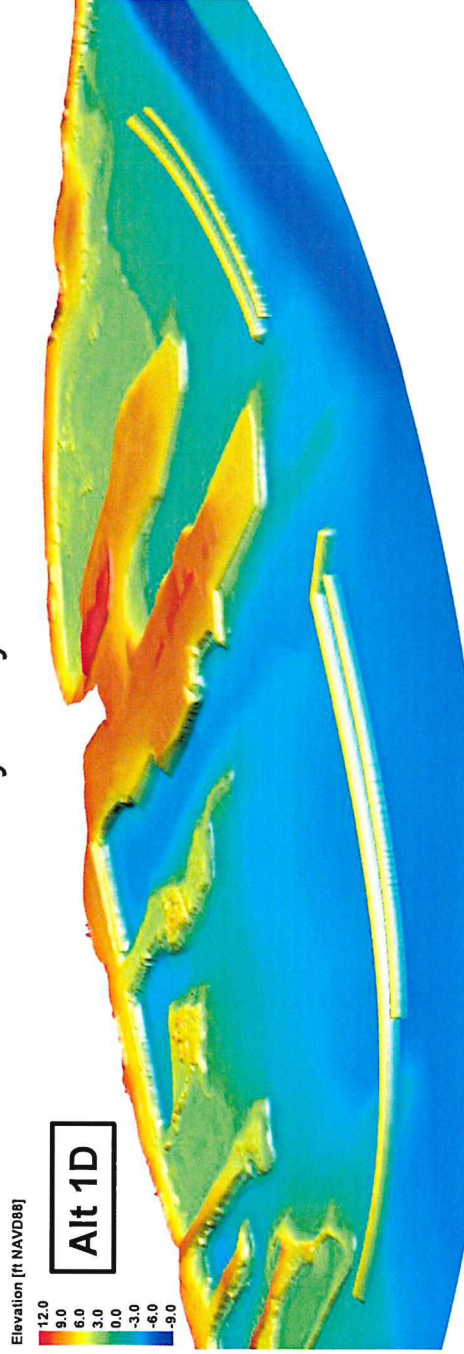
Alternative 2A



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Model Conditions

SWAN Alternative Bathymetry



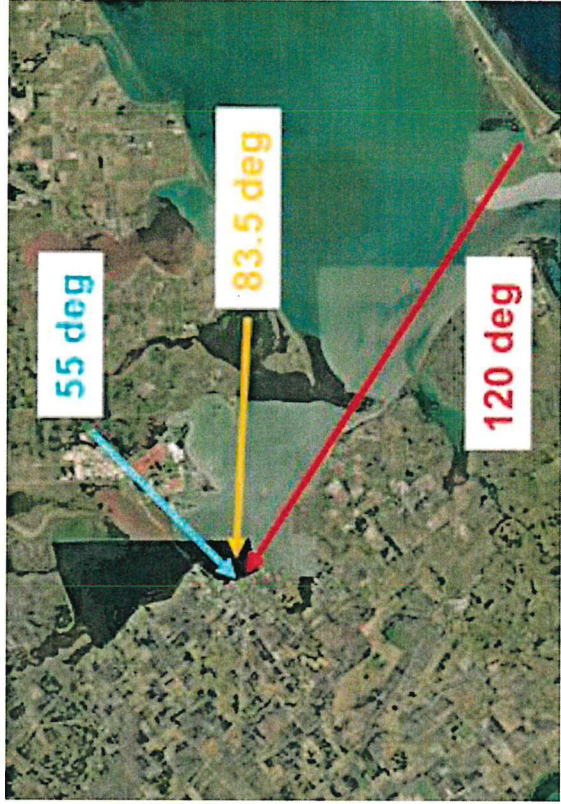
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Model Conditions

Forcing

- 12 Forcing combinations
 - 4 return periods
 - 3 directions
- 3 Scenarios
 - Existing conditions
 - Alternatives
- 36 simulated wave conditions at Project site

Return Interval [yr]	Water level [ft, NAVD]	Wind Speed [mph]
Typical	1.2	24
5	3.8	33
20	4.7	74
100	9.9	105

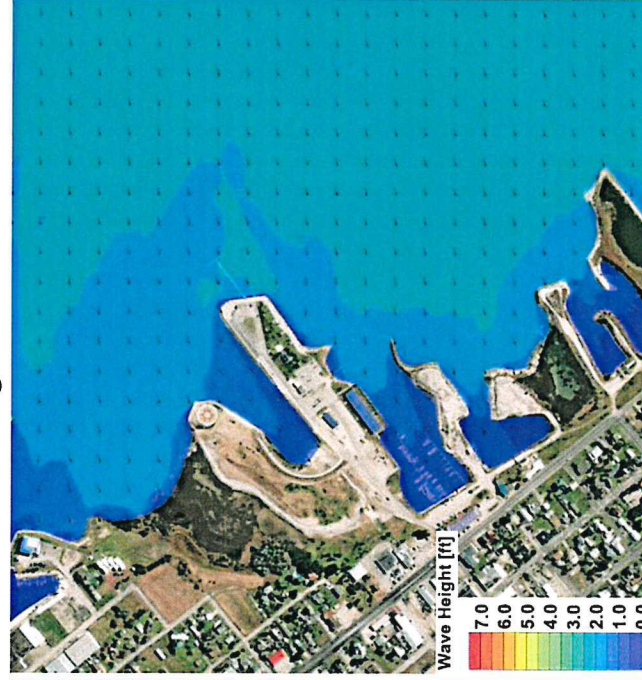


Existing Conditions Results

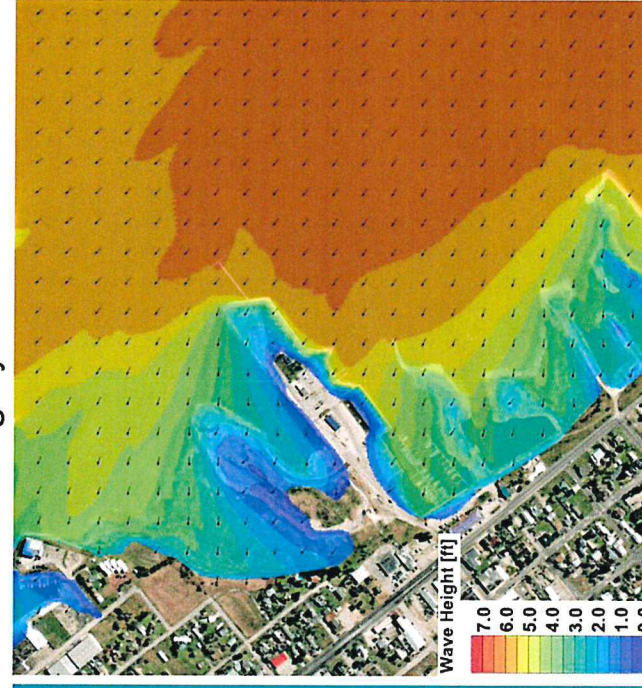
Typical SE
Typical Conditions



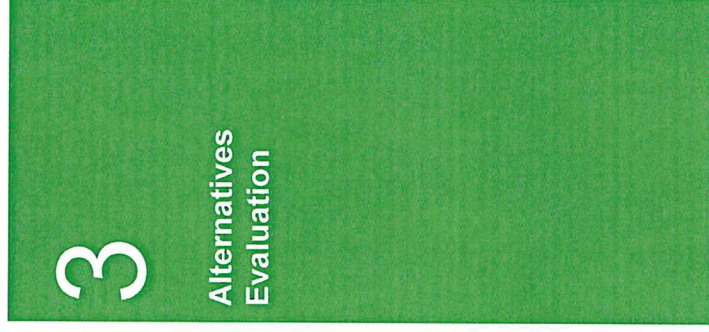
5yr NE
Strong Cold Front



100yr SE
~Category 4 Hurricane



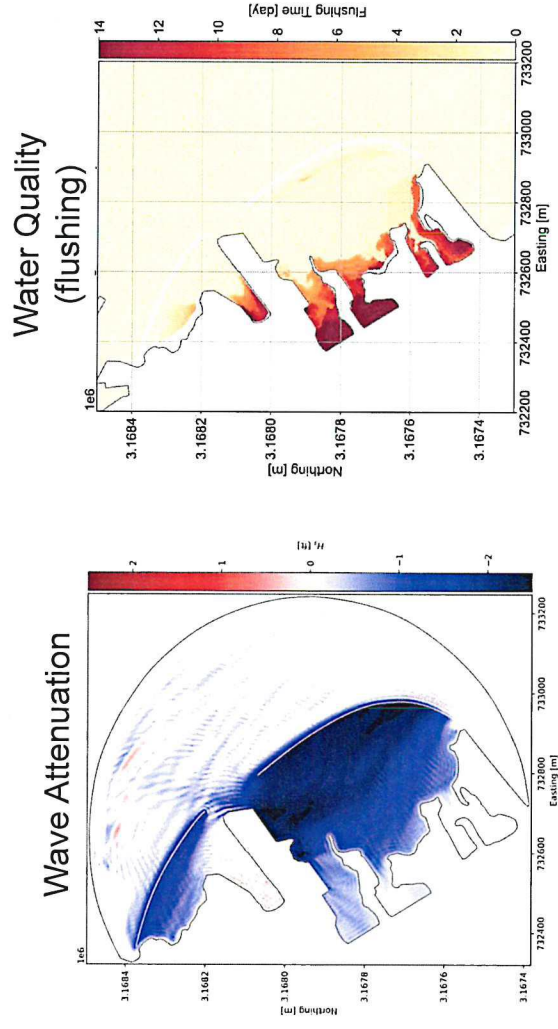
Meeting Agenda



Alternative Evaluation

Summary

1. Performance
 1. Wave attenuation
 2. Overtopping reduction
 3. Water quality (flushing)
2. Ecosystem benefits
 1. Oyster habitat
3. Costs and quantities
4. Aesthetic/cultural/recreational value



Water Quality (flushing)

Wave Attenuation



Storm Damage Reduction



Ecosystem Benefits

Alternative Evaluation

Wave Transmission

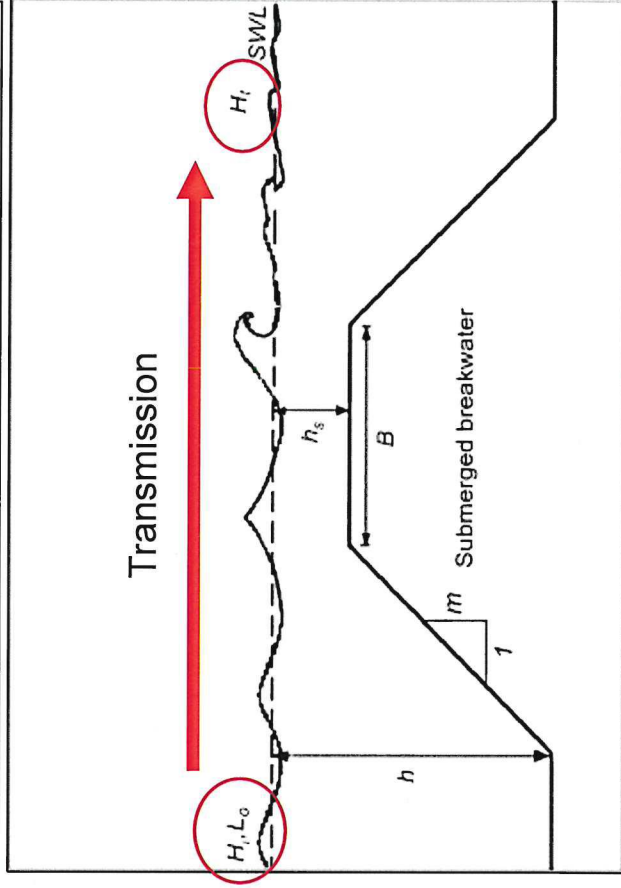
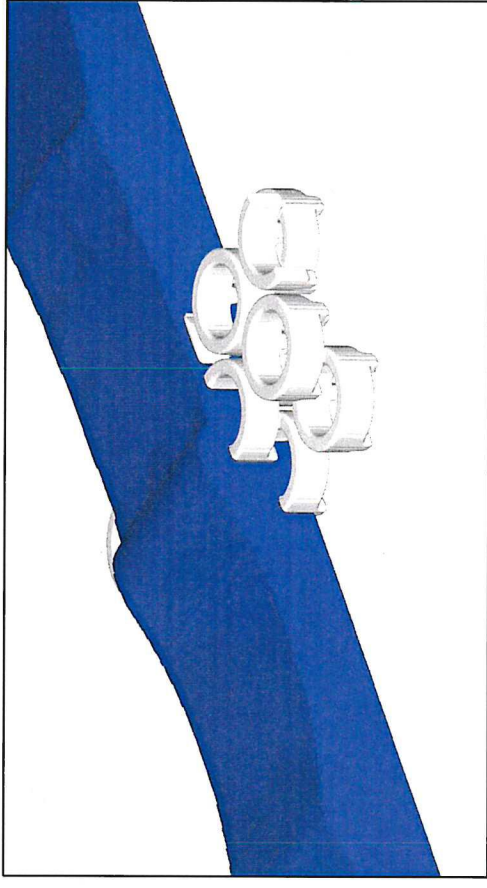
$$H_{tr} = k_t * H_{in}$$

Transmitted wave height Incident wave height

Transmission coefficient

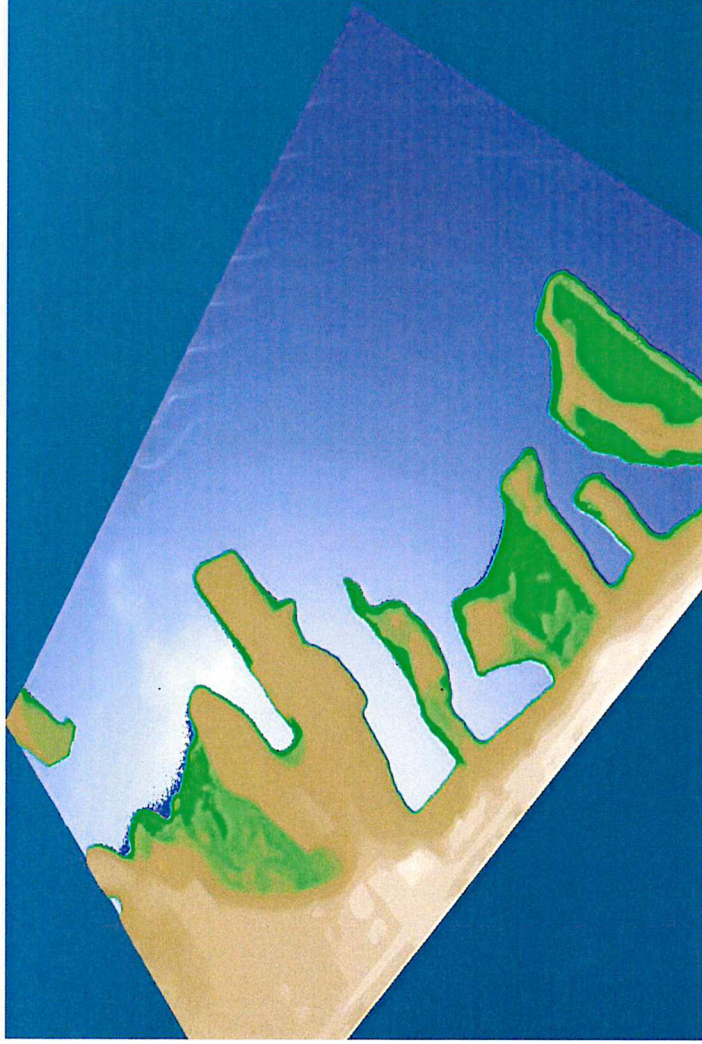
- Estimate wave energy (height) transmitted through structure
- Consider effects of geometry and material
 - Height, slope, width
 - Rock characteristics, oyster reef type
- Published empirical formulas
- Work done by MM to evaluate commercial artificial reef units

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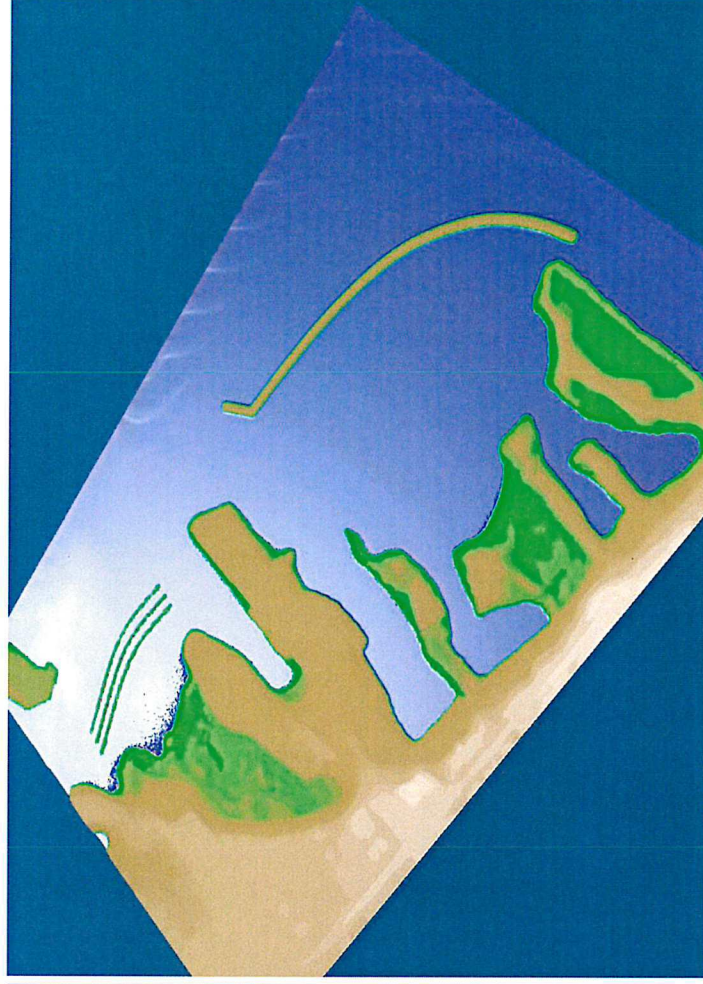


Southeast Waves

Existing Conditions

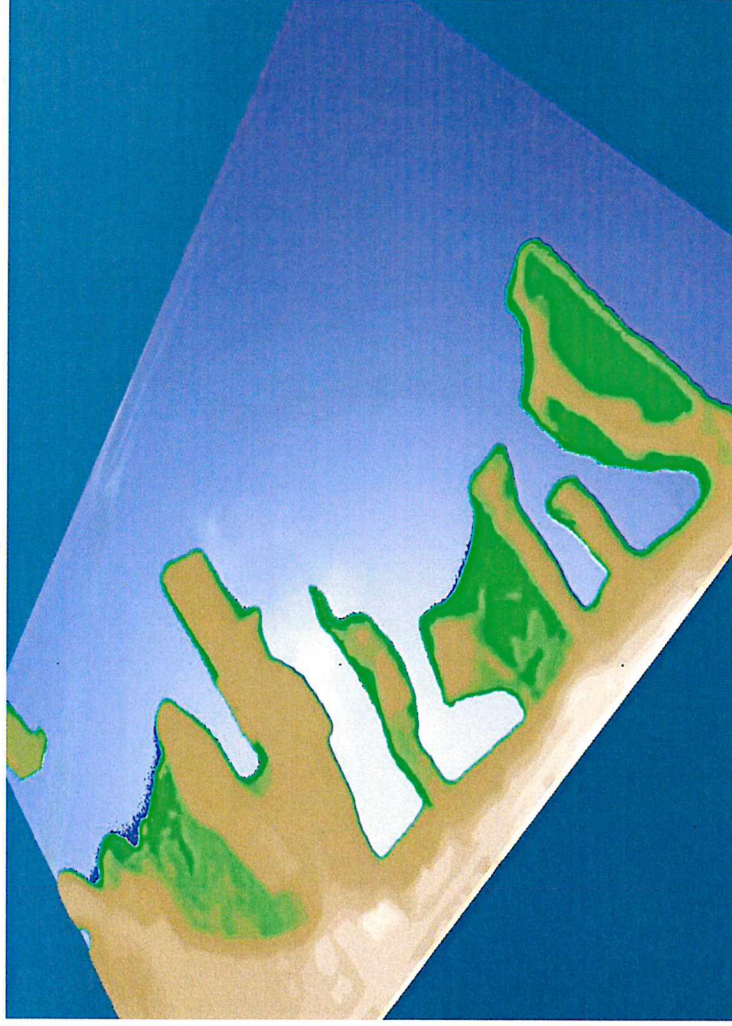


Alt 2A

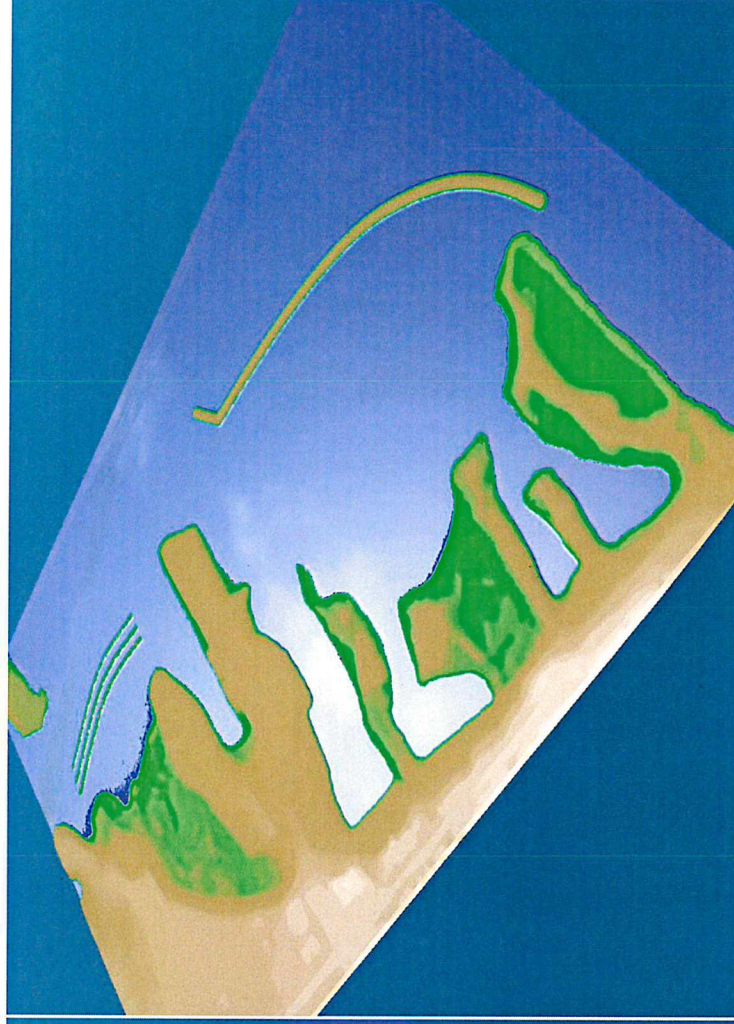


East-Northeast Waves

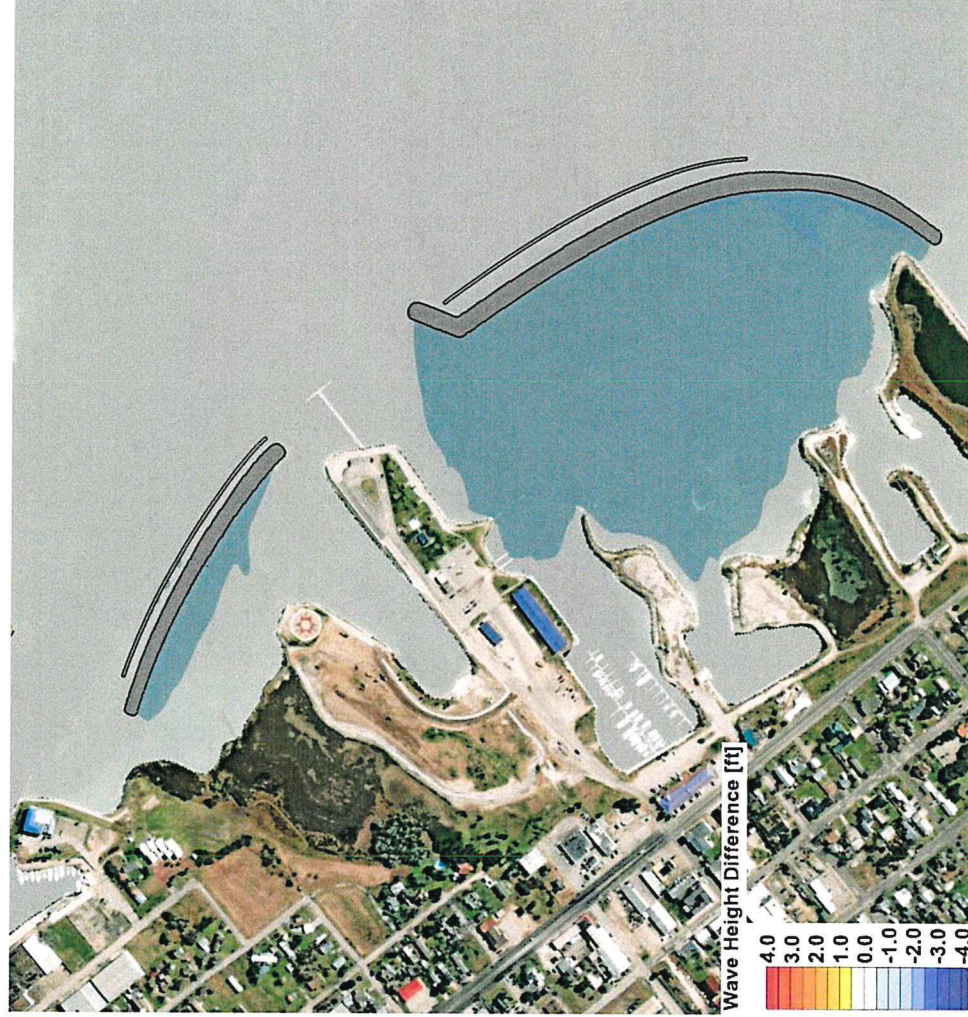
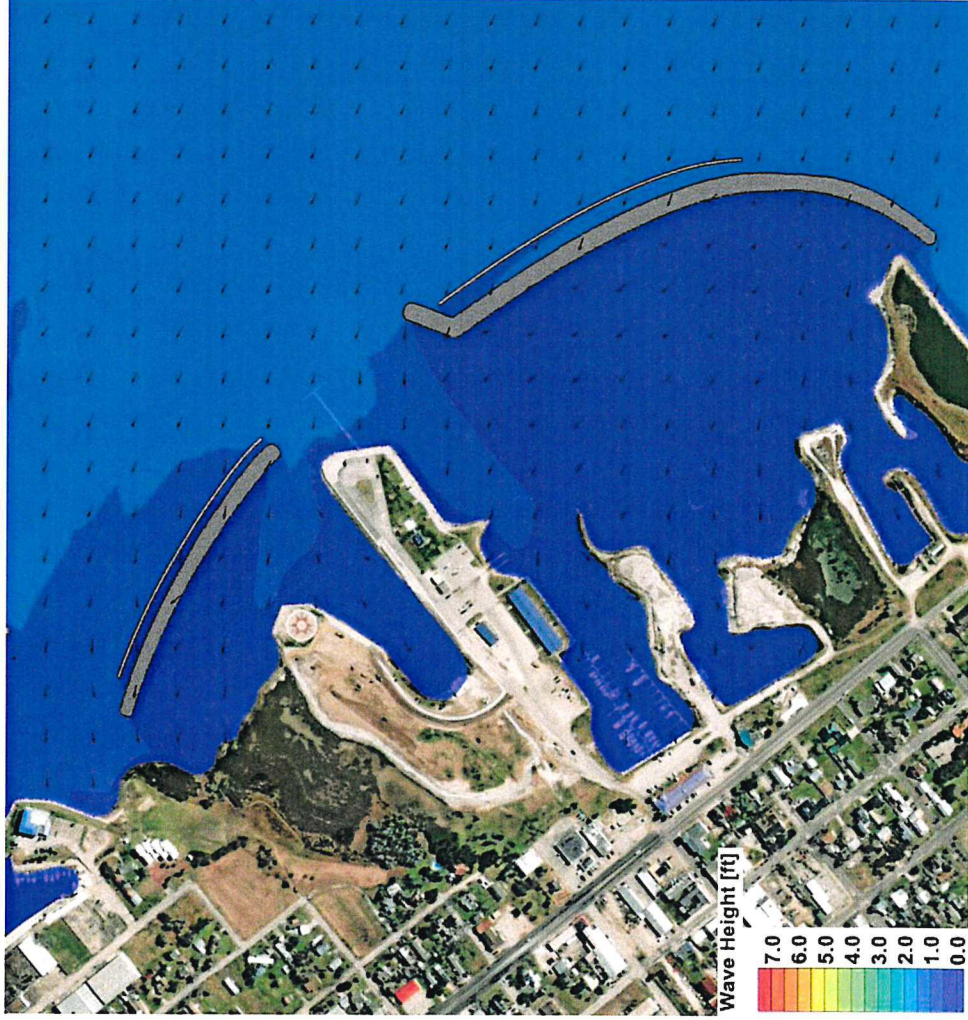
Existing Conditions



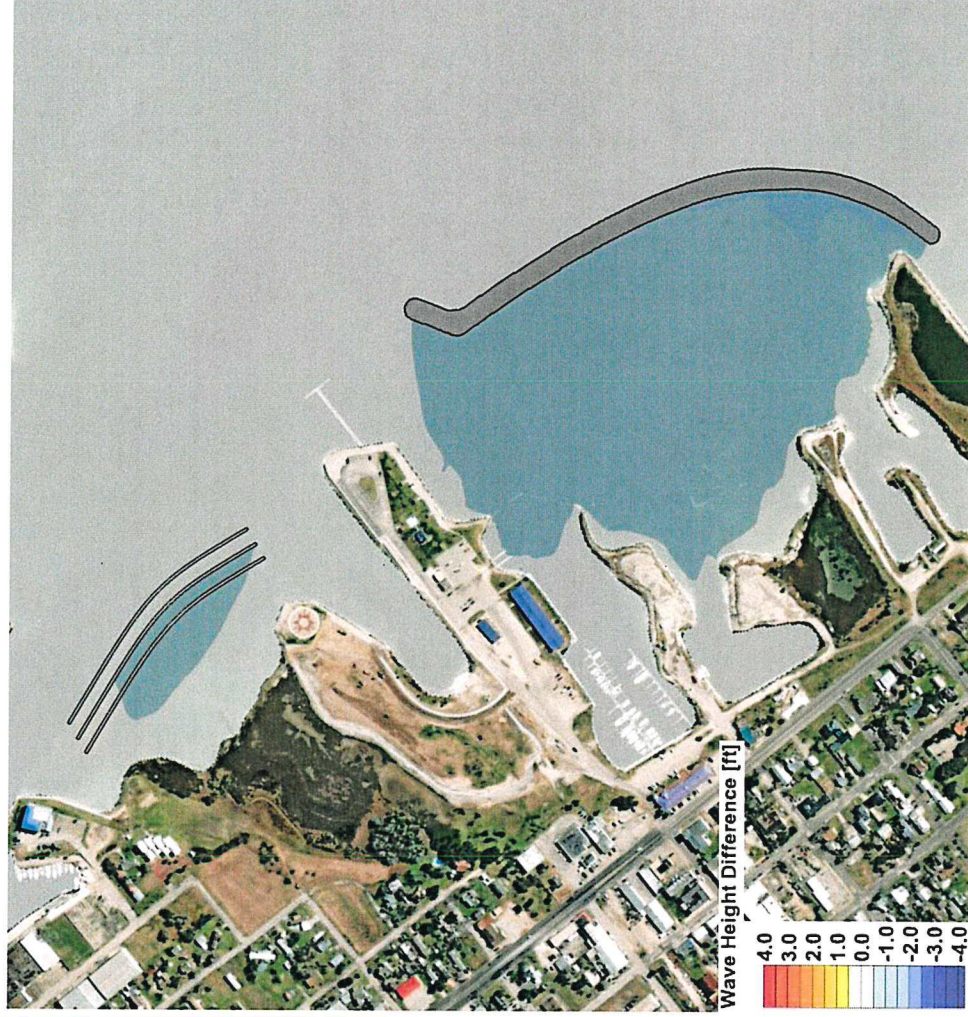
Alt 2A



Alt 1D– Typical SE Results



Alt 2A – Typical SE Results



Typical SE Results Summary

Existing Conditions



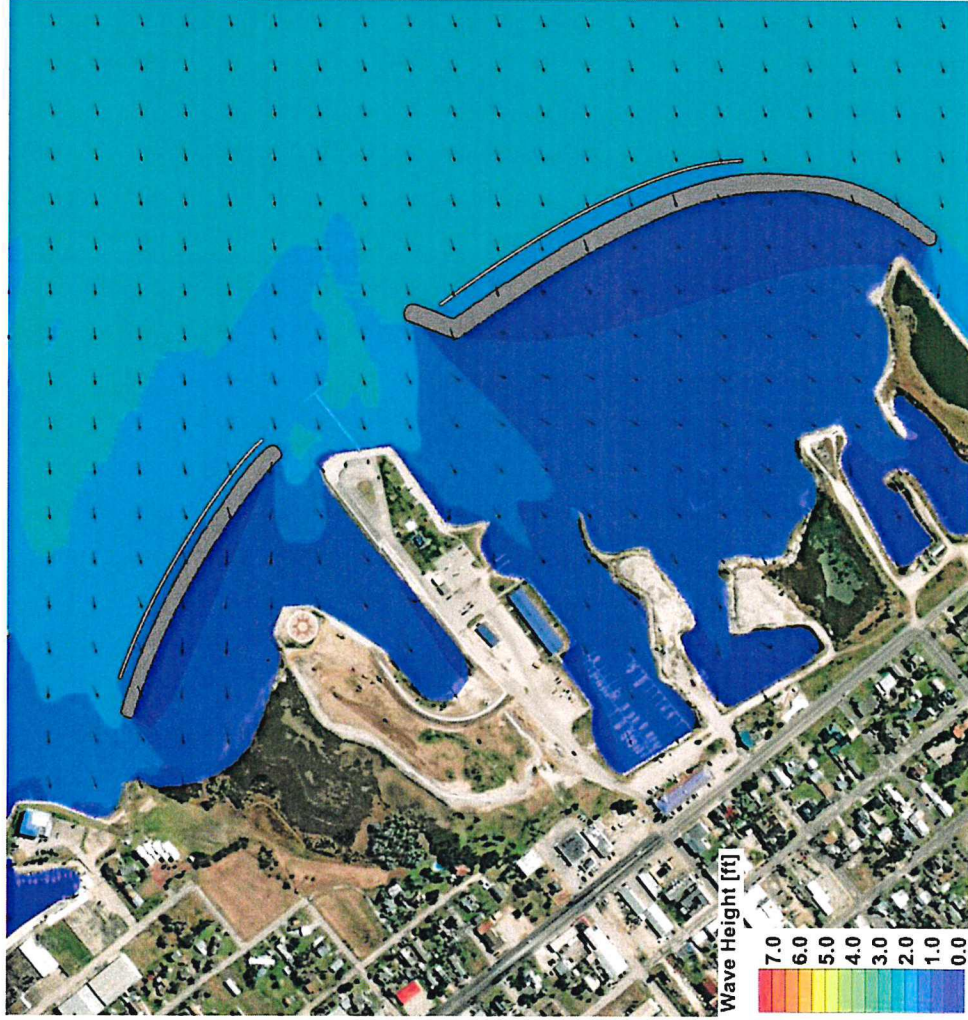
Alt 1D



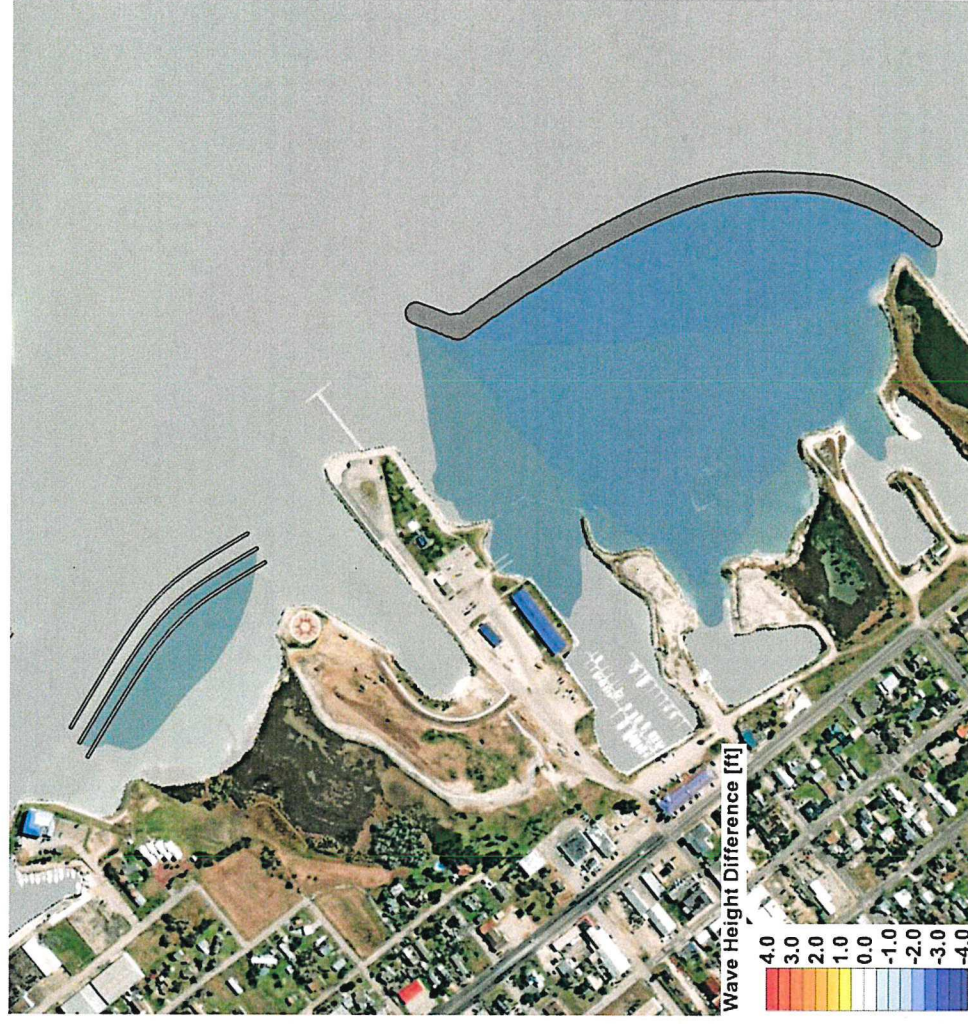
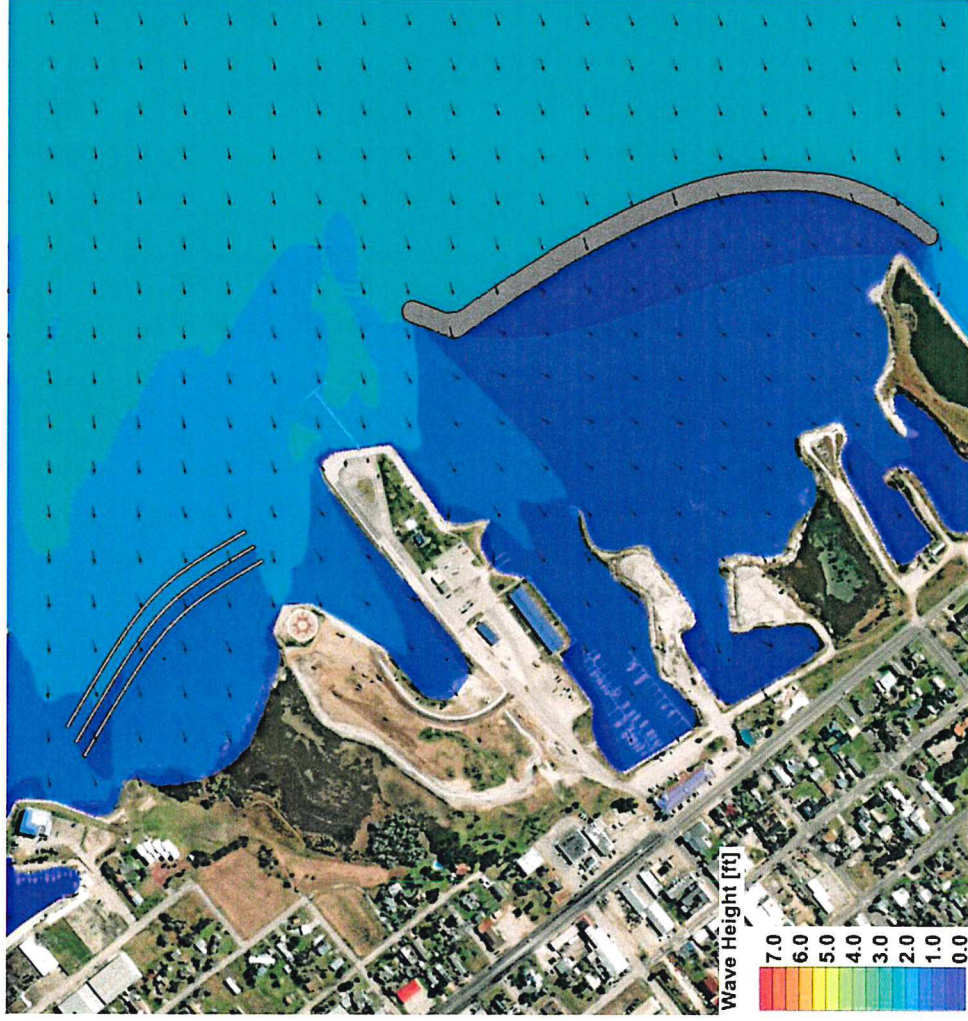
Alt 2A



Alt 1D- 5yr NE Results

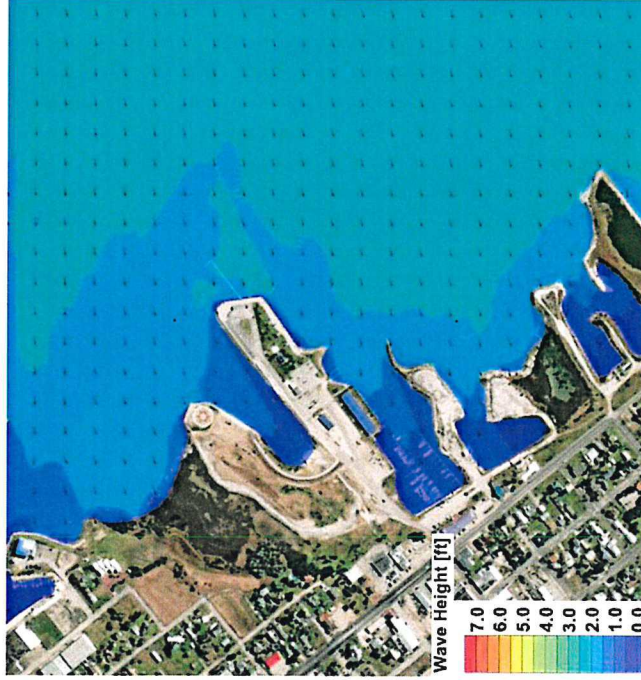


Alt 2A – 5yr NE Results

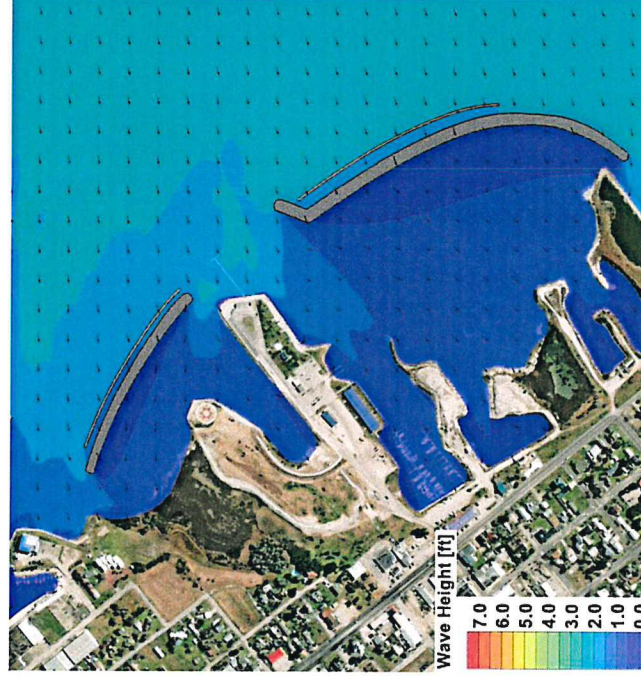


5yr NE Results Summary

Existing Conditions



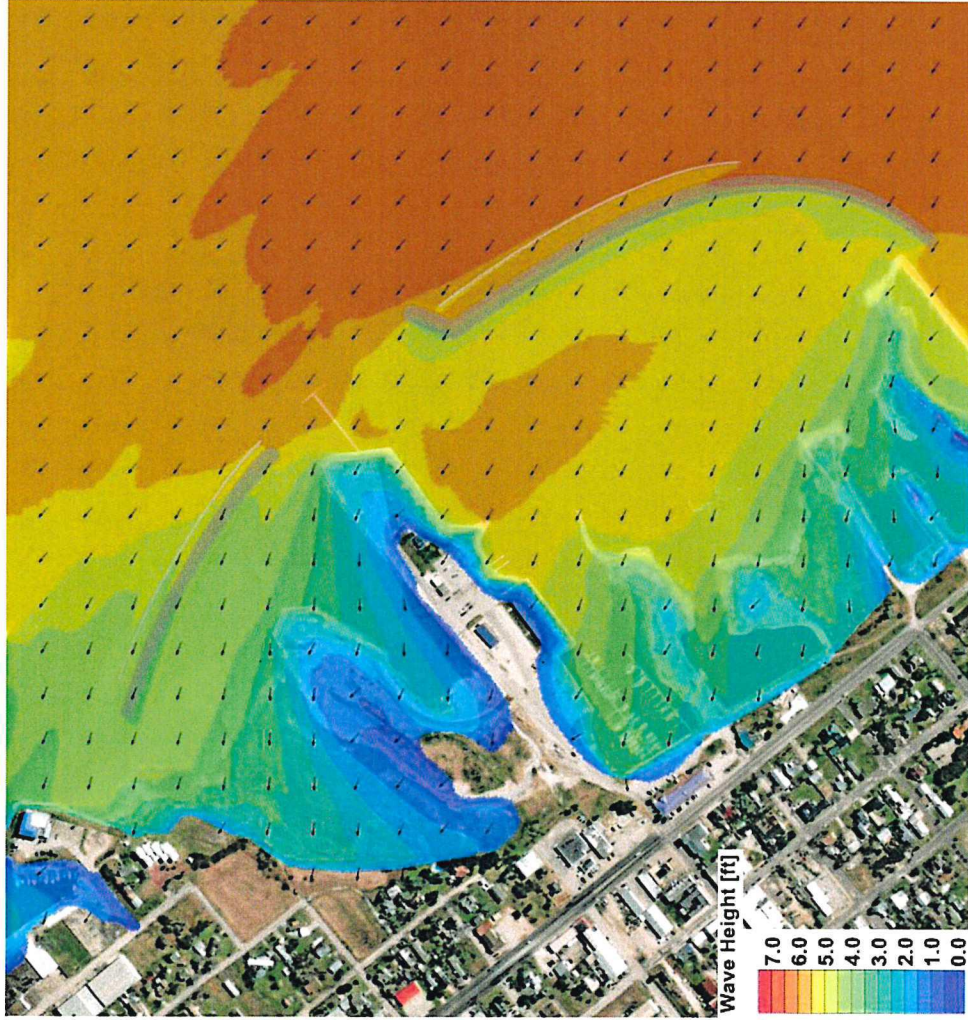
Alt 1D



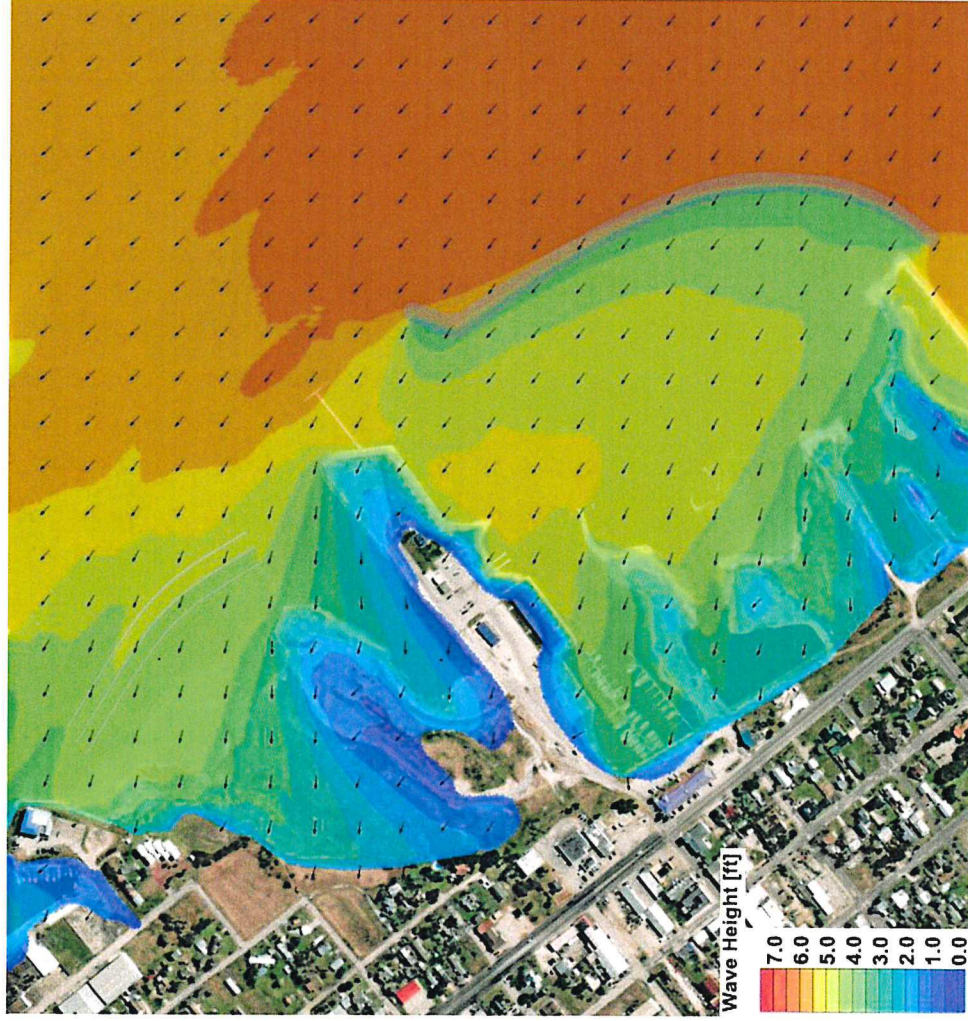
Alt 2A



Alt 1D- 100yr SE Results



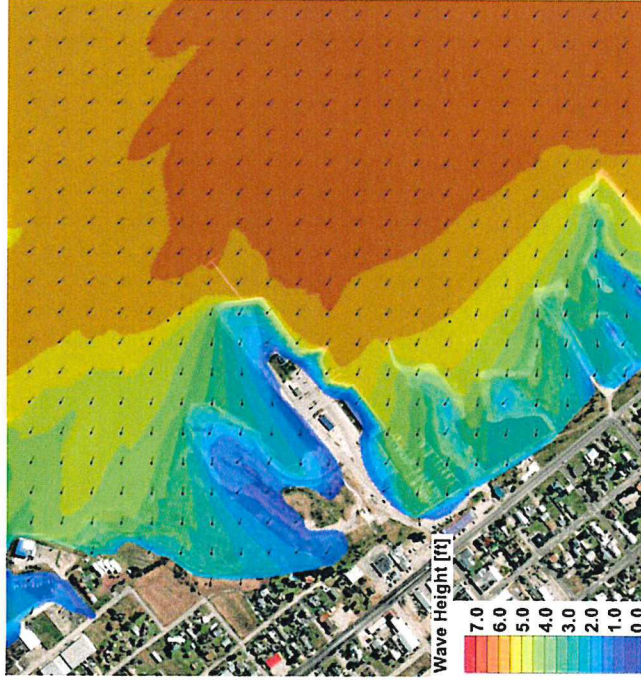
Alt 2A – 100yr SE Results



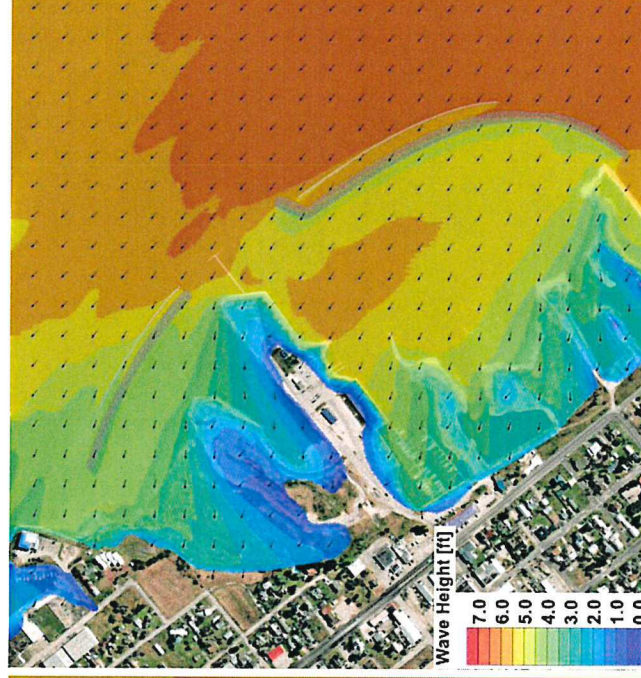
100yr SE Results

Summary

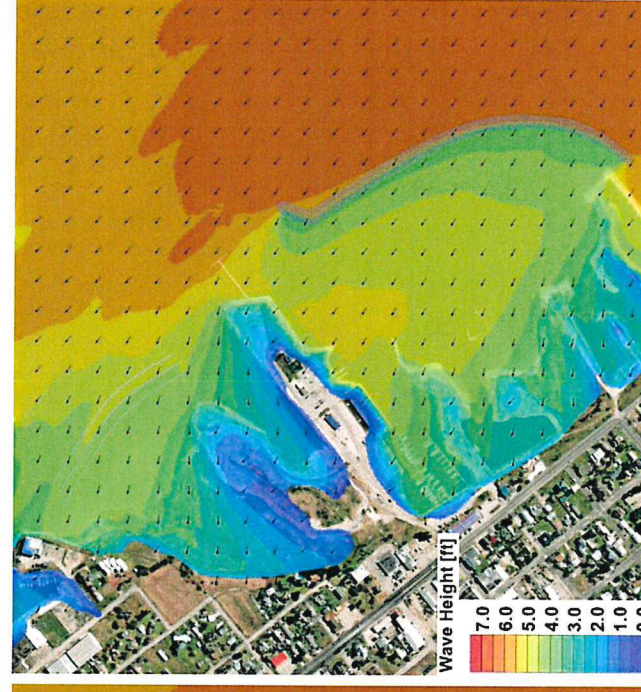
Existing Conditions



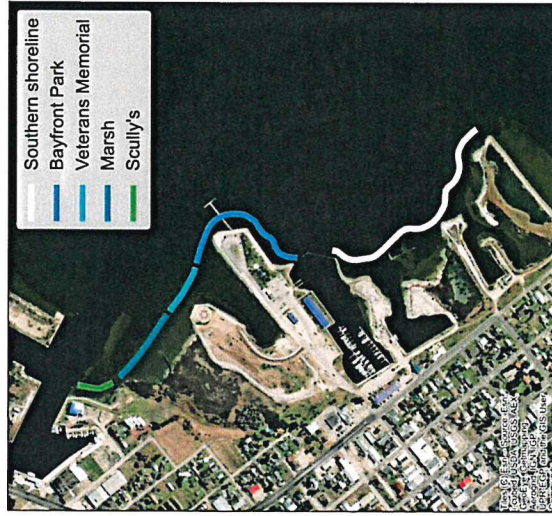
Alt 1D



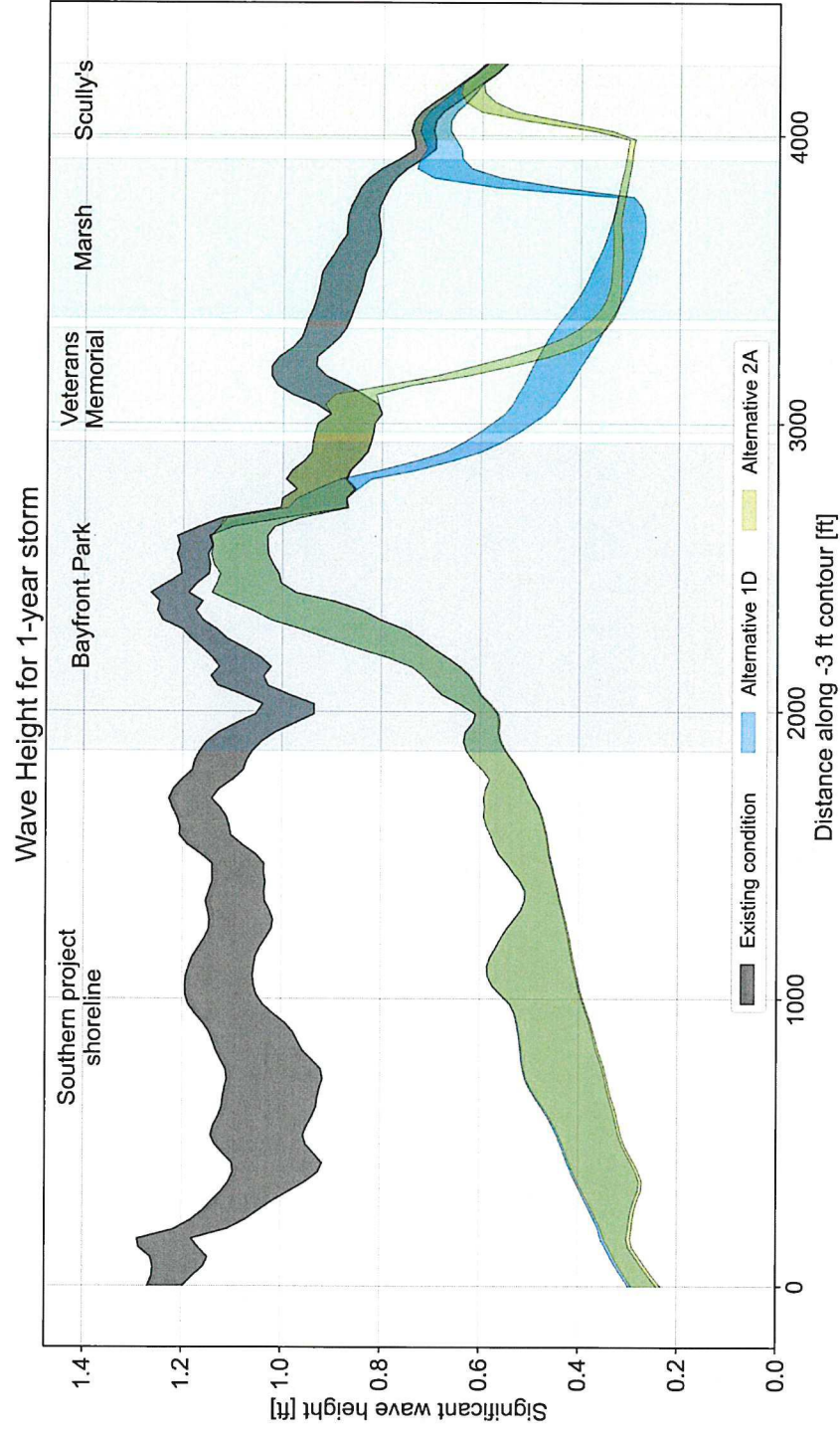
Alt 2A



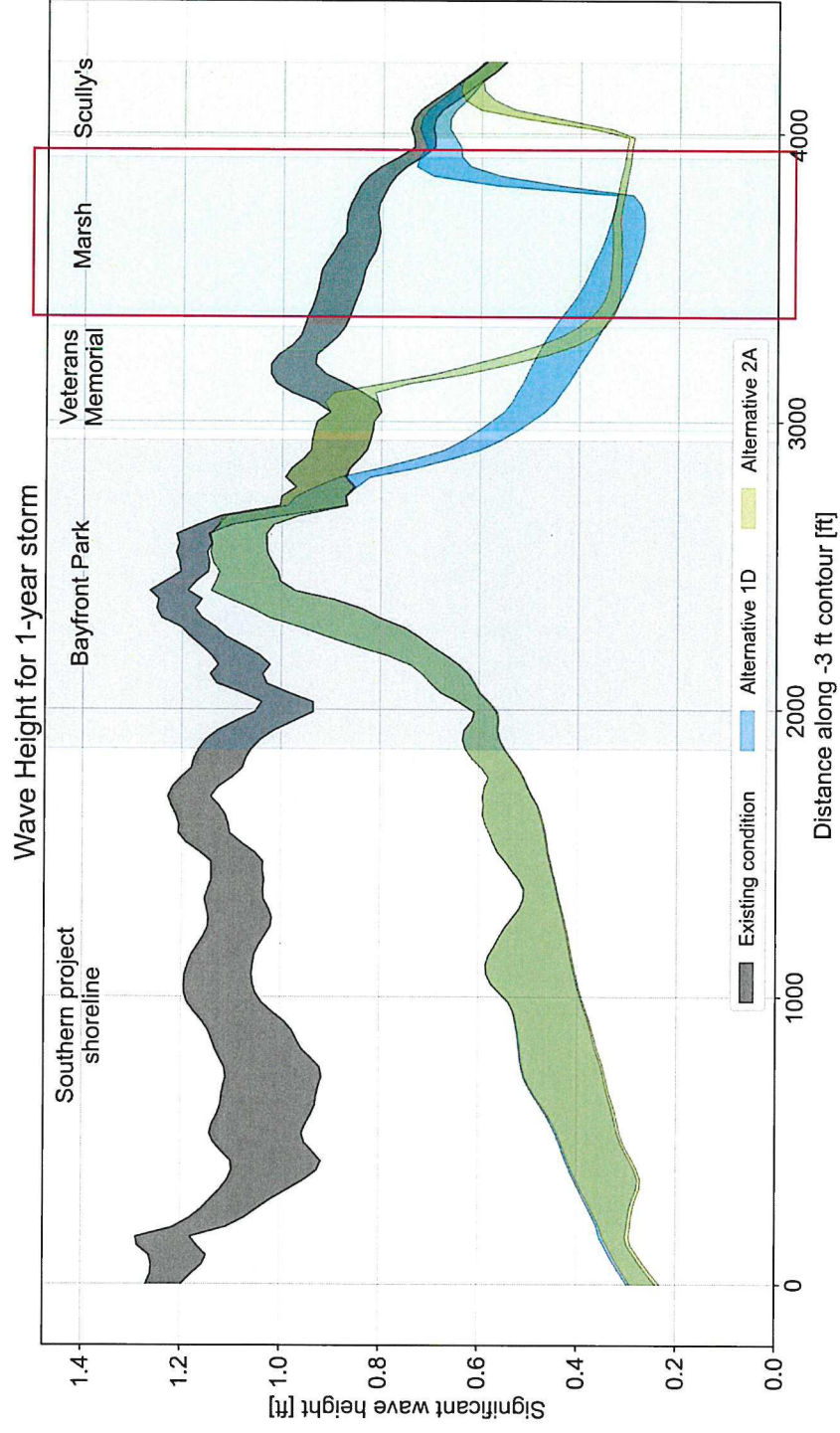
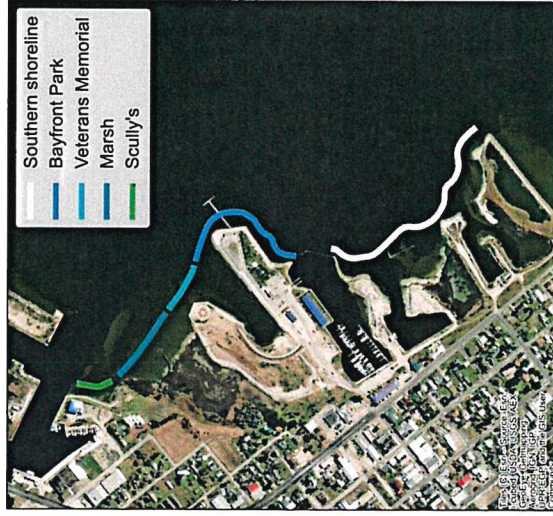
Typical Results



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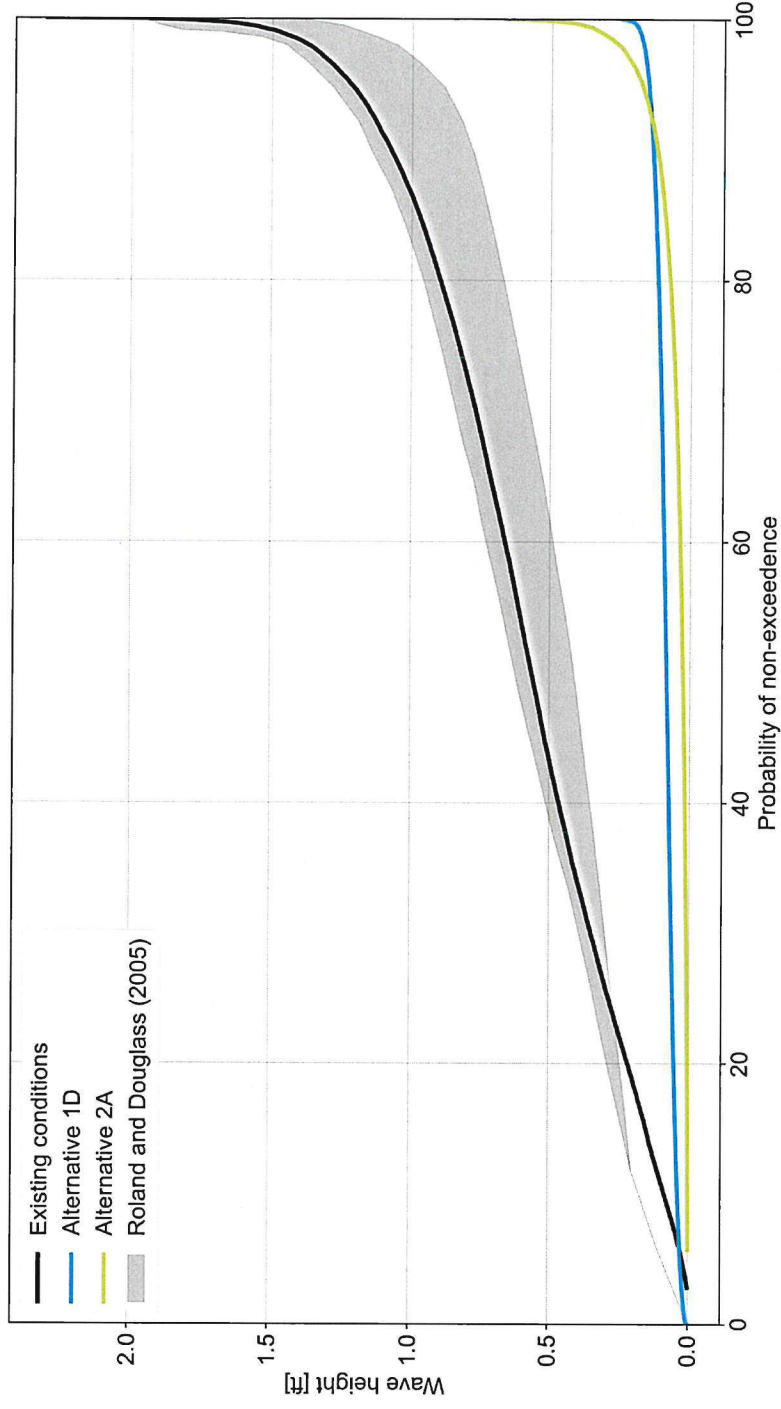
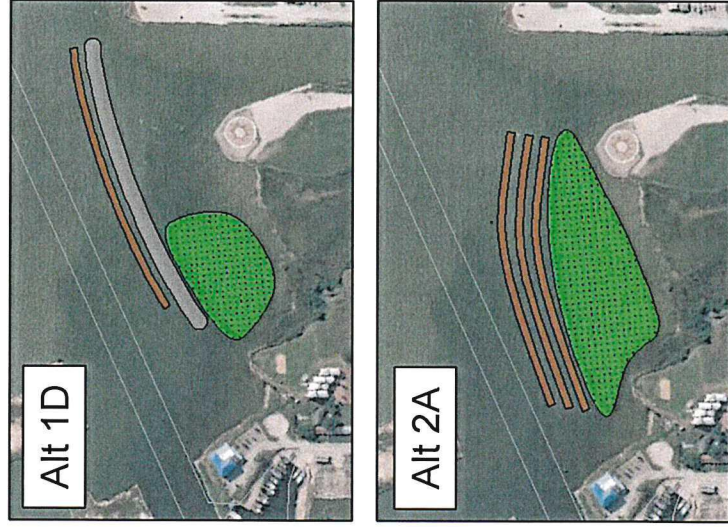
Typical Results



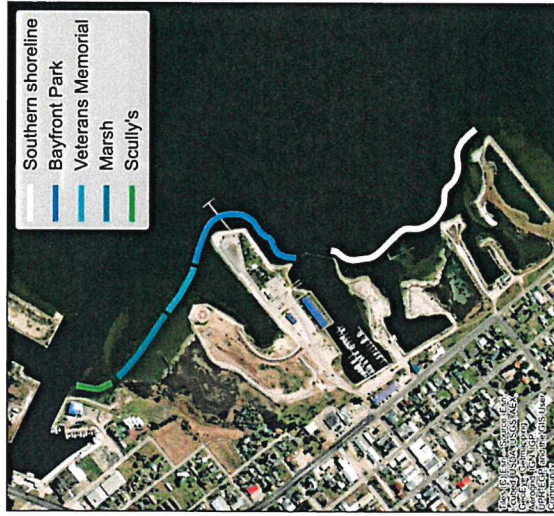
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Alternative Evaluation

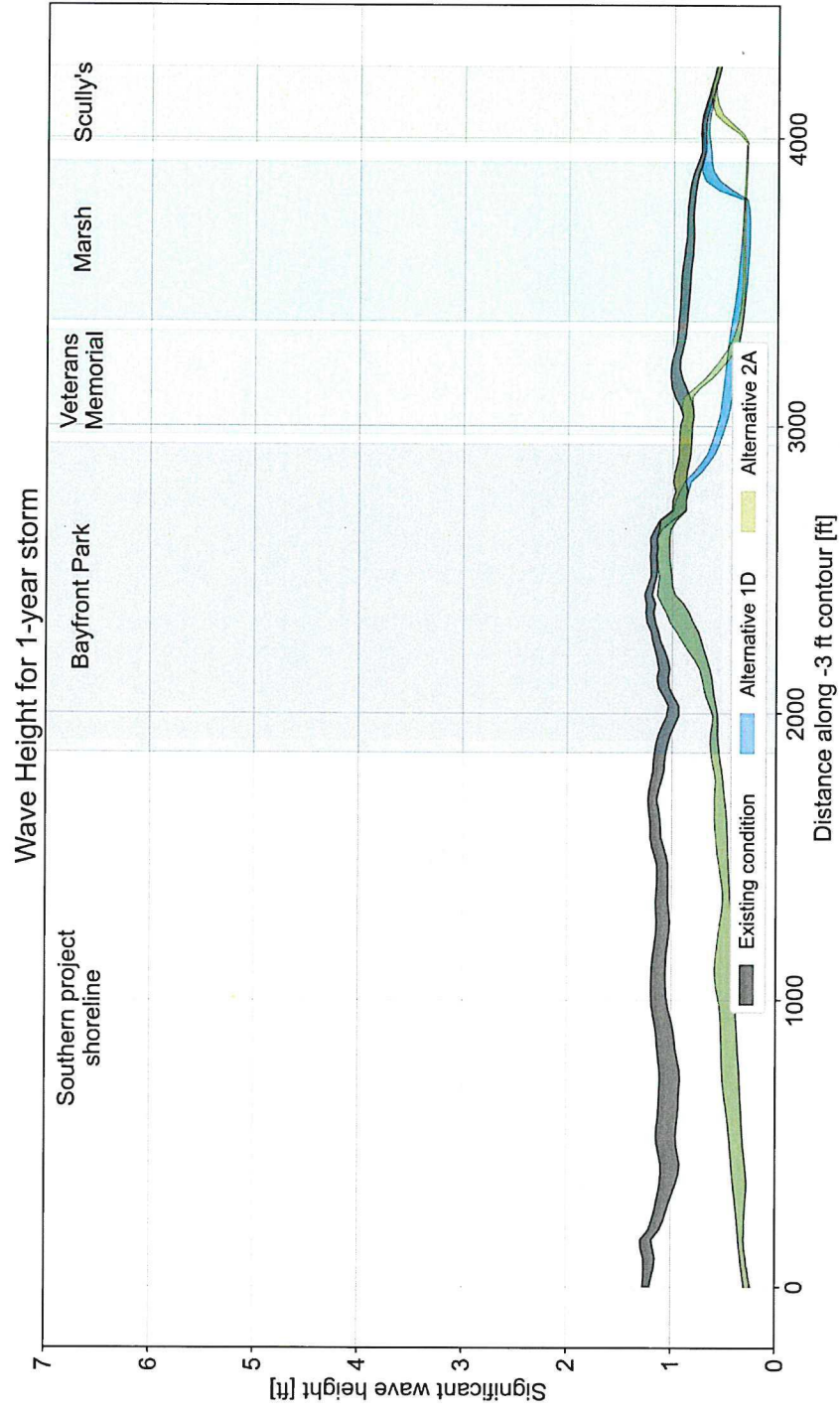
Wave transmission and marsh vegetation tolerance for day-to-day conditions



Typical Results

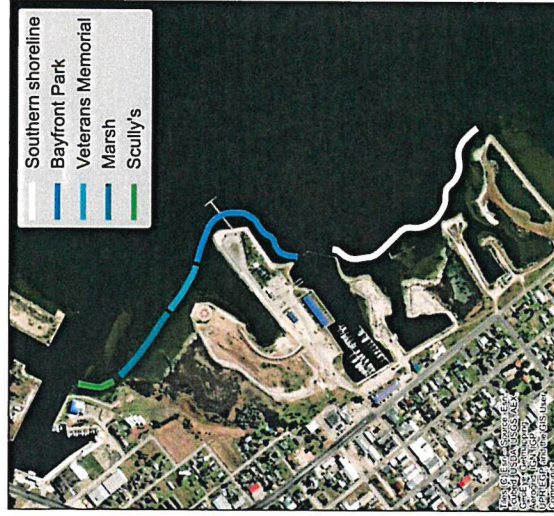


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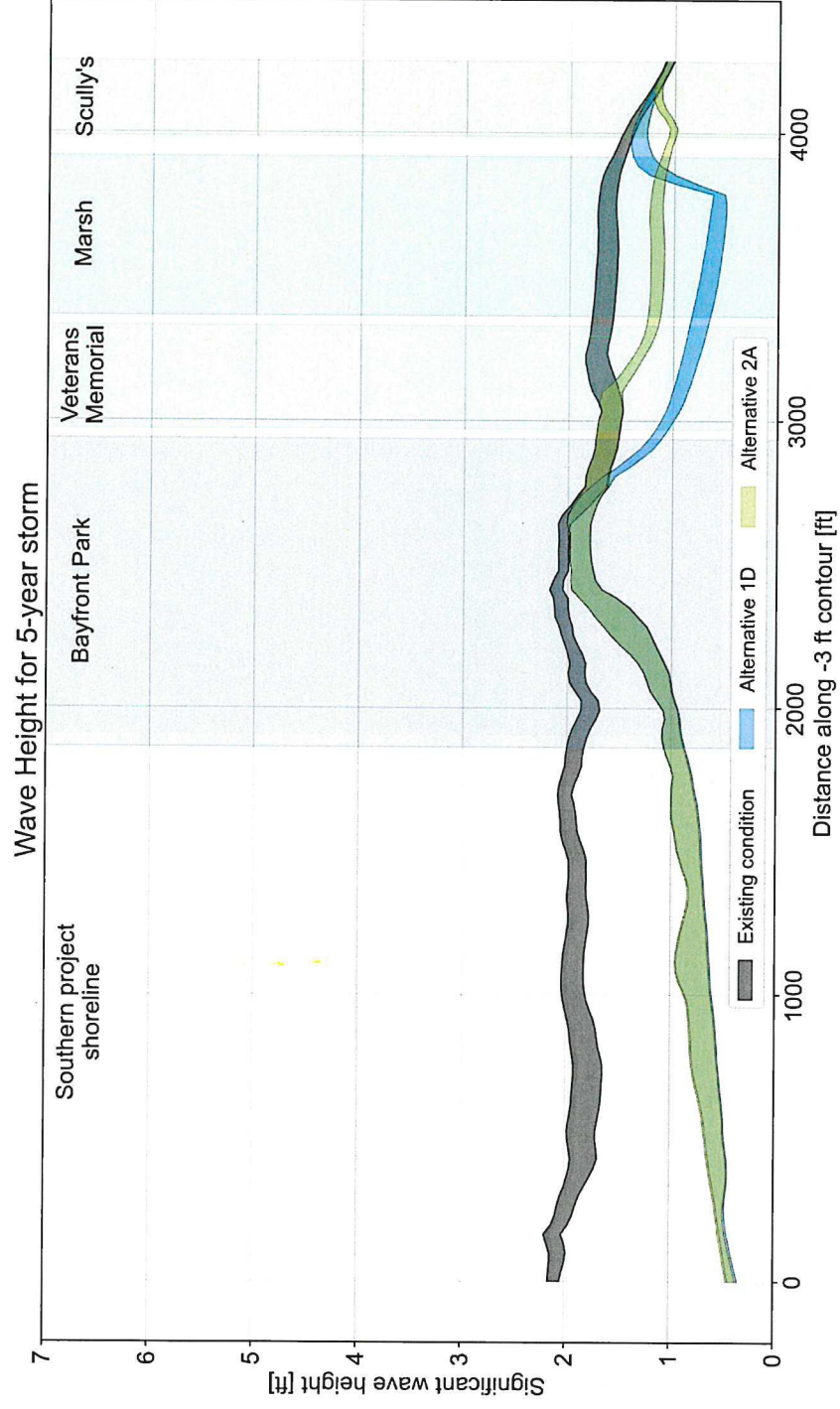


3/.

5yr Results

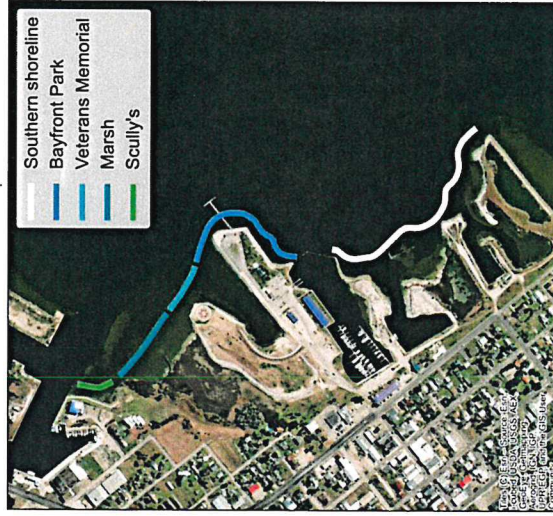


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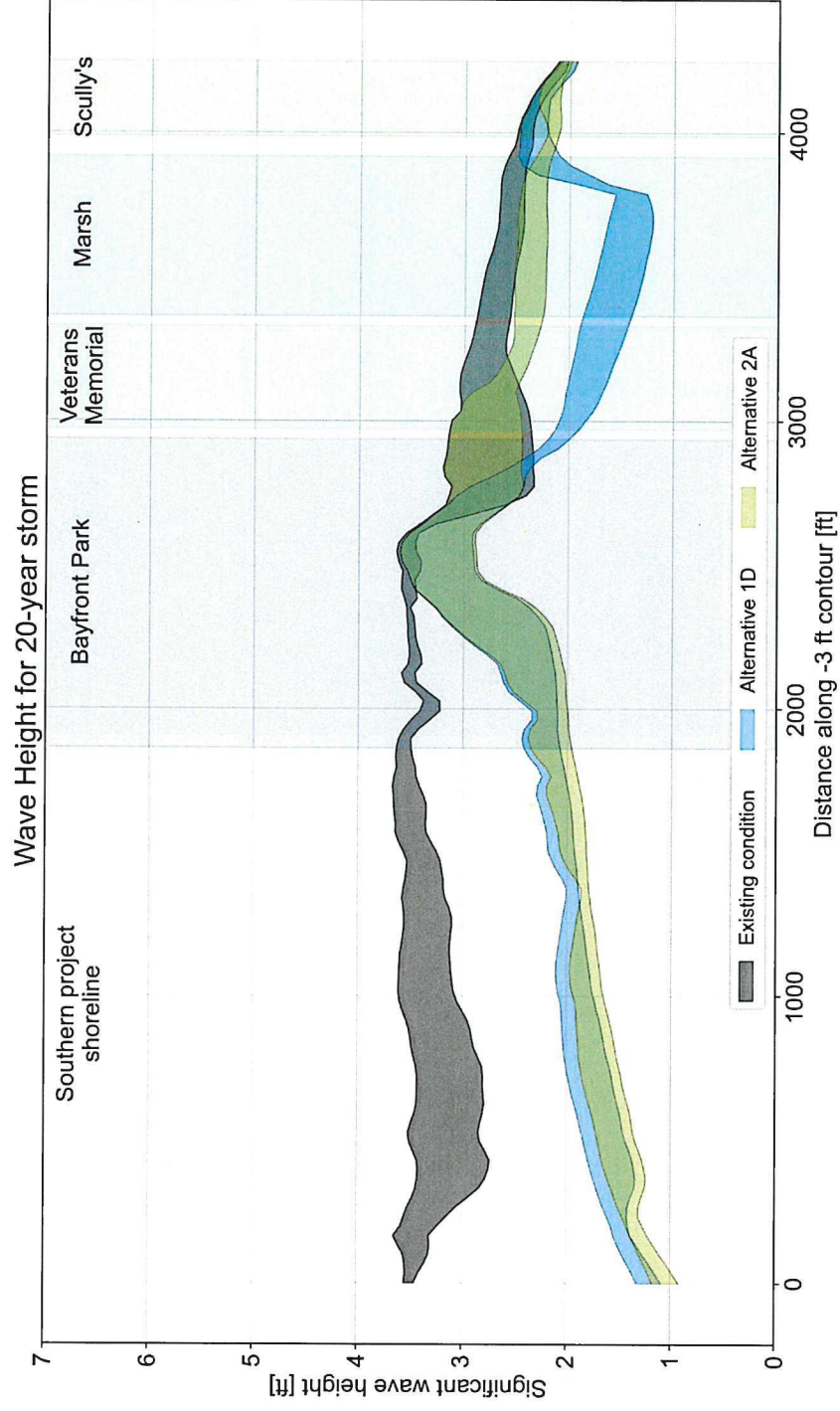


32.

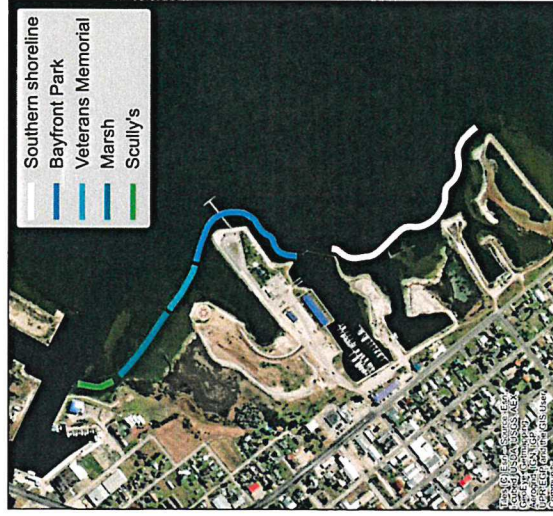
20yr Results



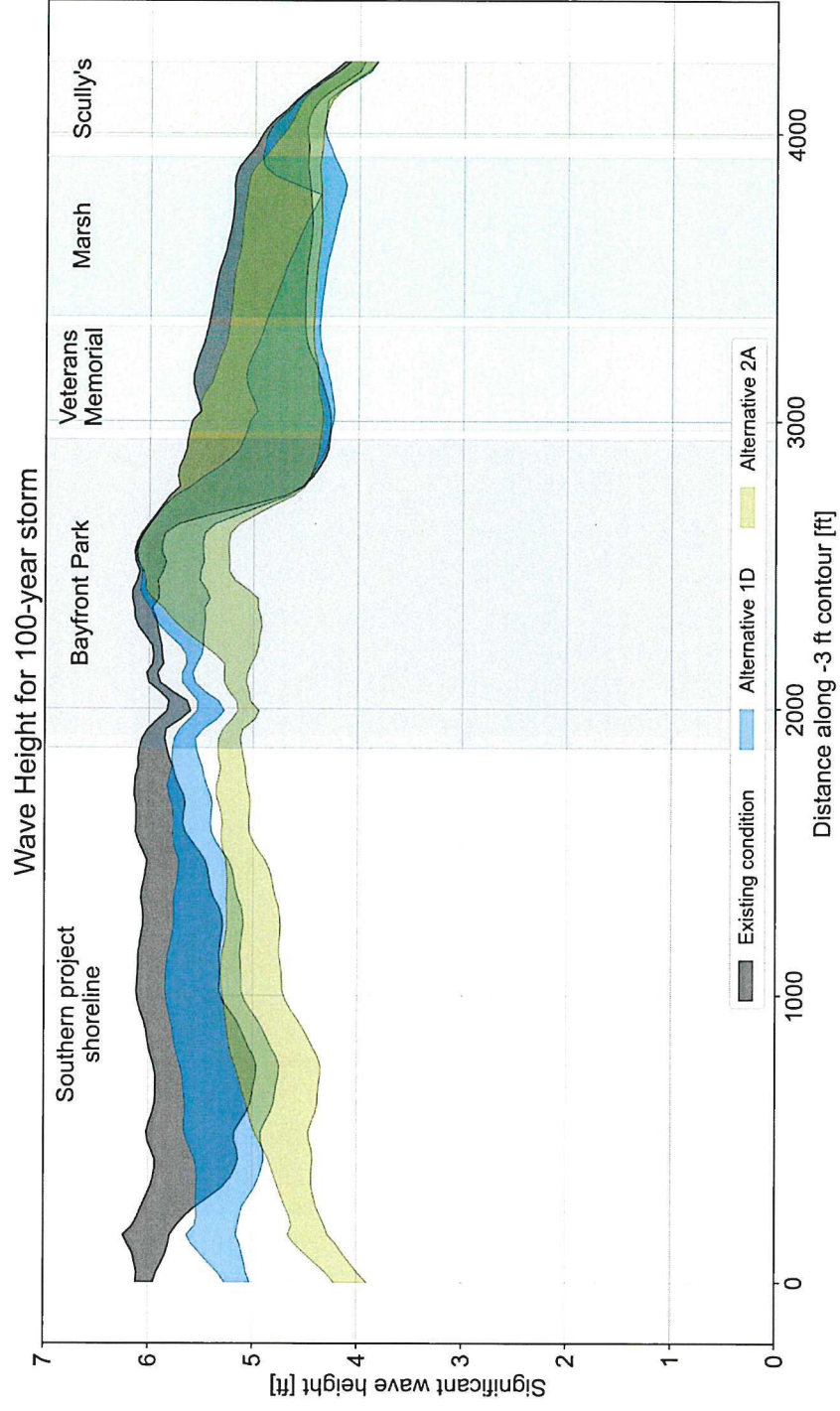
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100yr Results

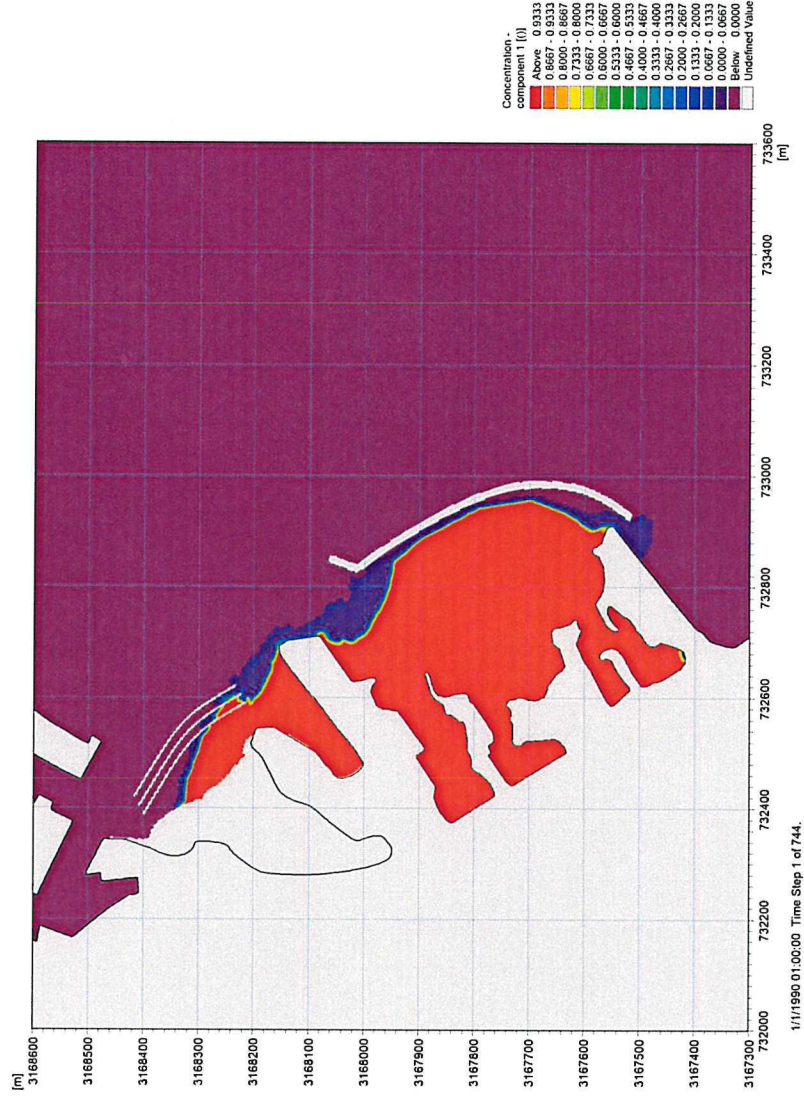
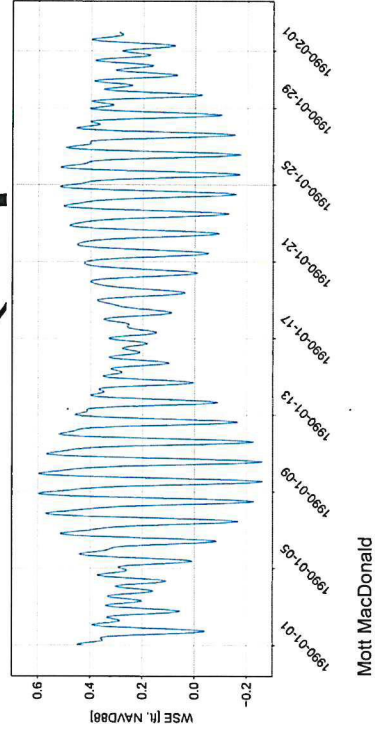
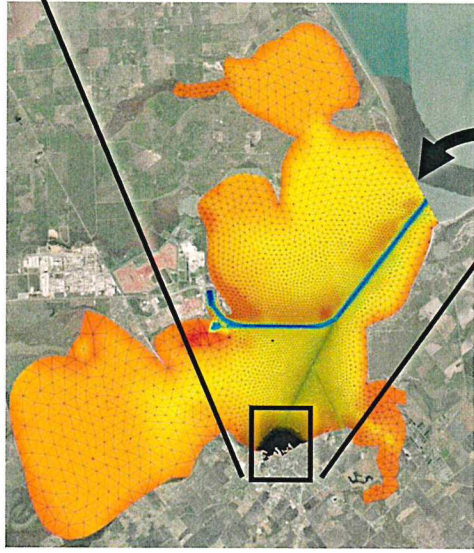


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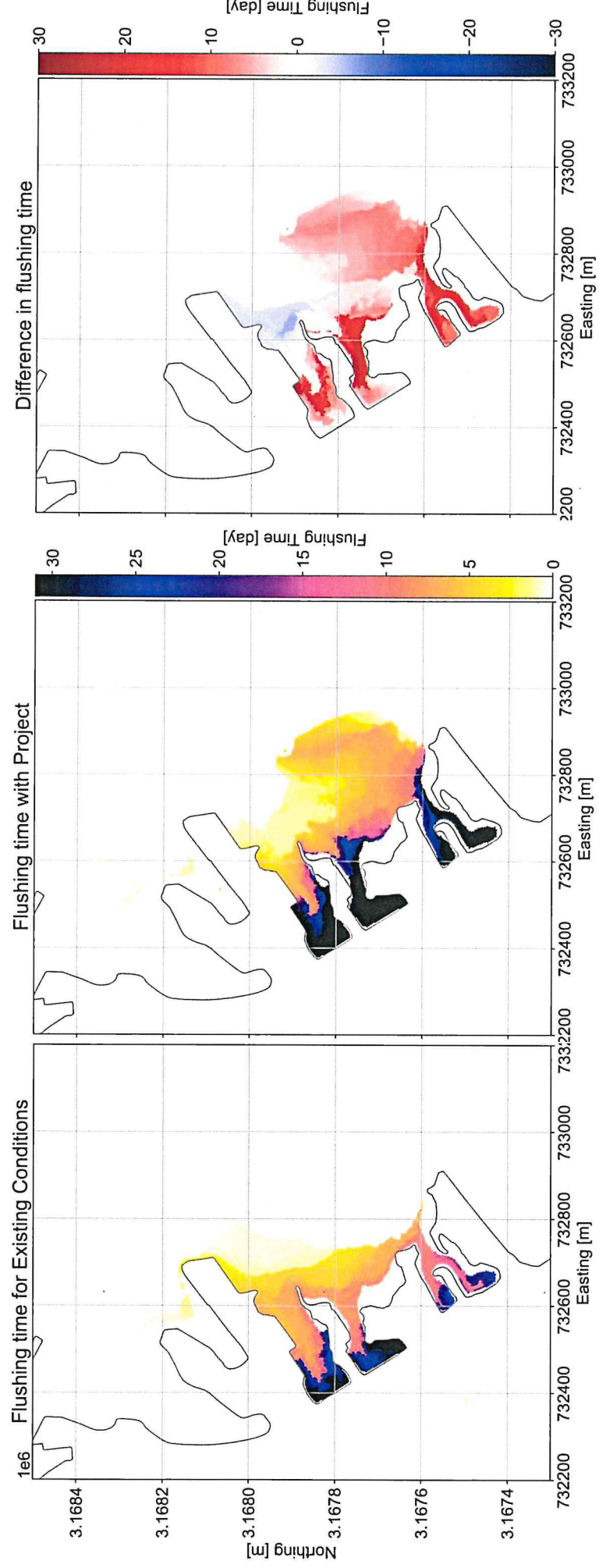
34.

Flushing Analysis



Flushing Analysis

Alternative 2A



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40

36.

Alternative Evaluation

Evaluation Matrix

City of Port Lavaca Breakwater - Alternatives Evaluation Matrix

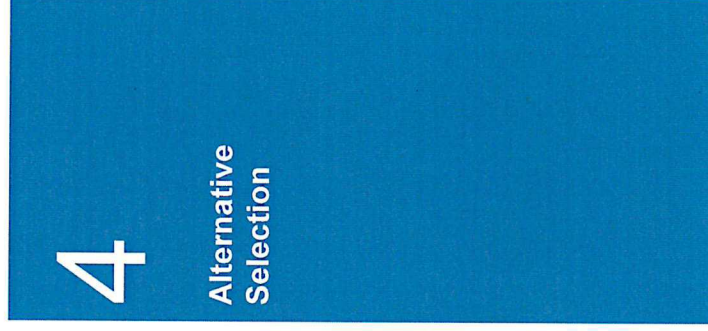
2/22/2023

Criteria	Constructability			Construction Cost			Performance - Wave Attenuation			Performance - Water Quality (Flushing)			Aesthetics			Habitat Gains - Oyster Growth			Habitat Gains - Marsh			TOTAL SCORE	RANK								
No. Alternatives	1 D	3	0.0	Score	0%	30%	Weighted Score	Rating	Score	30%	Weighted Score	Rating	Score	2	0.3	Weighted Score	Rating	Score	3	0.2	Weighted Score	Acres	Score	10%	Weighted Score	Acres	Score	5	0.5	2.8	2
	2 A	4	0.0	Good		\$11,100,000	1	0.3	Good	4	1.2	Good	4	0.2	Good	4	0.40	Good	4	0.2	Good	0.6	4	0.40	8.3	5	0.5	3.4	1		

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37.

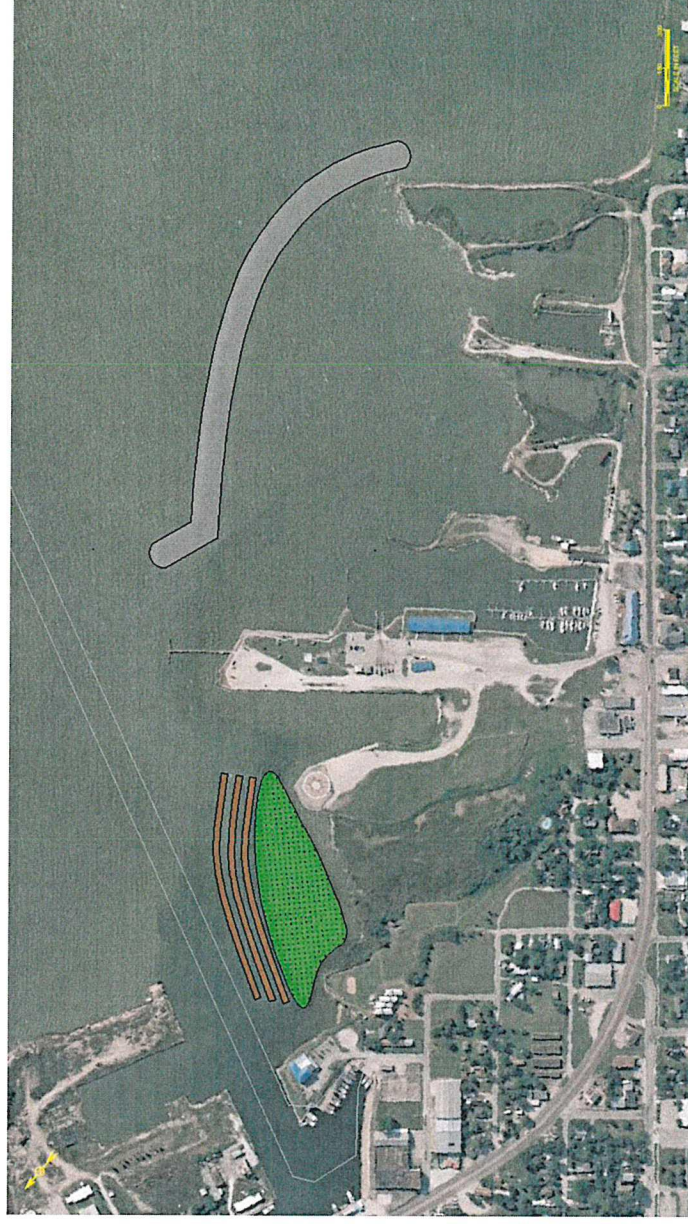
Meeting Agenda



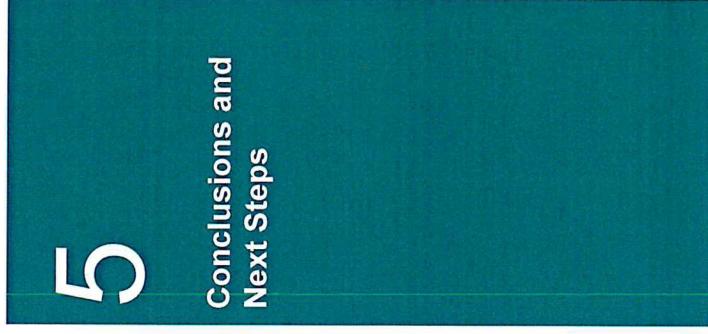
Recommendation

MM recommends Alternative 2A

- Enhanced wave protection at downtown waterfront
- Provides more habitat and ecosystem benefits
- Living shoreline protection concentrated at a location accessible to the public



Meeting Agenda



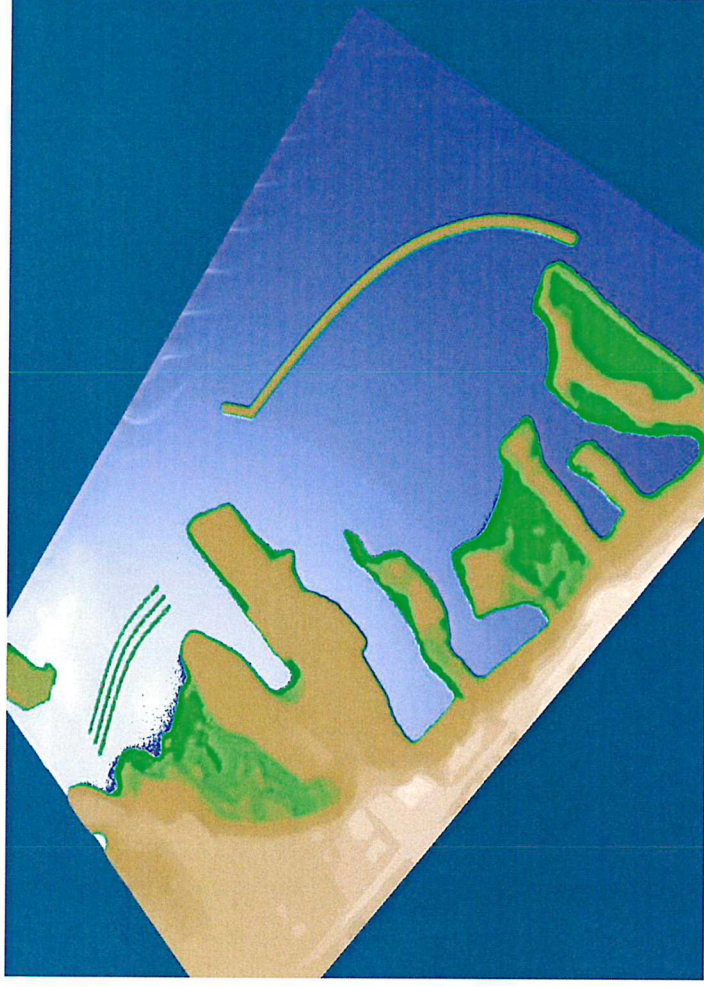
Conclusions and Next Steps

City of Port Lavaca concurrence on Alternative 2A?

Next steps:

- 30% Design optimizations
 1. Circulation through south breakwater gap protection
 2. Dog leg extension for maximum wave sheltering
 3. Marsh creation geometry
 4. Review for constructability
- Habitat and cultural resources surveys
- Geotechnical data collection
- Submit permit application
- Progress to final design

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Engineering Schedule

Task	Start	End
Engineering Notice to Proceed	May 9, 2022(A)	
✓ Task 1. Develop Project Understanding	May 2022(A)	June 2022(A)
✓ Task 2 Data Collection Coordination and Analysis (historical data; new bathy and mag survey)	June 2022(A)	Nov 2022(A)
✓ Task 3 Coastal Analysis, Alternatives Development & Evaluation	June 2022(A)	Feb 2023(A)
Task 4 Preliminary Design (30% design)	Feb 2023	May 2023
Task 5 Regulatory Compliance	Feb 2023	May 2024
Submit Permit Application		June 2023
Task 6 Final Design	June 2023	July 2024
Task 7 Bidding Support	July 2024	Oct 2024
Task 8 Engineering Services During Construction	Oct 2024	July 2025
Project Close		July 2025



Thank you

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