GIWW, COASTAL RESILIENCE STUDY, TX

Stakeholder Partnering Forum

11 AUG 2021

Patrick Corbitt Kerr, PhD, PE

STUDY AUTHORIZATION

Water Resources Development Act 2016
SEC. 1201. AUTHORIZATION OF PROPOSED FEASIBILITY STUDIES.

The Secretary is authorized to conduct a feasibility study for the following projects for water resources development and conservation and other purposes, as identified in the reports titled "Report to Congress on Future Water Resources Development" submitted to Congress on January 29, 2015, and January 29, 2016, respectively, pursuant to section 7001 of the Water Resources Reform and Development Act of 2014 (33 U.S.C. 2282d) or otherwise reviewed by Congress:

(25) GULF INTRACOASTAL WATERWAY, BRAZORIA AND MATAGORDA COUNTIES, TEXAS.—Project for navigation and hurricane and storm damage reduction, Gulf Intracoastal Waterway, Brazoria and Matagorda Counties, Texas.

STUDY PROPOSAL

From the Water Resources Reform and Development Act (WRRDA) proposal:

"It is proposed to modify the Gulf Intracoastal Waterway (GIWW) in Texas, pursuant to Sec 216 of the Flood Control Act of 1970, **to address the impacts of relative sea level rise, coastal storm forces, and historical losses to adjacent coastal features, on waterway conditions and functions, with the purposes that adjacent coastal features provide: (1) shelter for resilient transit of commercial vessels on the waterway against waves and currents of the open Gulf of Mexico (GoM), and (2) a reduction to channel sedimentation from GoM open seas for sustainable maintenance into the future."**

"The study would involve: describing waterway reaches that are **most vulnerable to losses in GIWW resiliency and sustainability, identifying sediment resources regionally, with emphasis on renewable sources, for harvesting and restoration of degraded adjacent coastal features, with periodic maintenance of these features over the project life cycle on the intended purposes.** Strategically, the recommended project modifications will also inform the comprehensive component of the Coastal Texas Protection and Restoration Study."

GULF INTRACOASTAL WATERWAY

- The GIWW is a 1,100-mile waterway that connects ports along the Gulf of Mexico from St. Marks, Florida to Brownsville, Texas

- The Texas portion of the GIWW main channel covers 379 miles of Texas coastline from the Sabine River to the Brownsville Ship Channel and connects 15 deep draft ports and 10 shallow draft ports.

FEDERAL INTEREST

- Provides a waterborne connection between ports along the coast
- Moved almost 80 million tons of cargo in 2018.
- The Texas portion of the GIWW handles 67 percent of all GIWW traffic
- An integral part of the petrochemical and manufacturing supply chains: more than 90% of cargo is classified as petroleum and chemical products.
- Was designated as “Marine Highway 69” in 2016, which makes certain projects eligible for federal grant funding.

FEDERAL INTEREST

WATERBORNE TRANSPORTATION

Using almost every available metric, waterborne transportation is a superior mode for moving freight in comparison to truck or rail.

CAPACITY: Tank Barge

Units to Carry 27,500 Barrels of Liquid Cargo

1 barge

46 rail cars

144 trucks

A loaded barge carries enough gasoline to keep 2,500 automobiles running for 1 year

ENVIRONMENT

Rate of Spills in Gallons per Million Ton-miles

2.59

4.89

10.41

Spills of More Than 1,000 Gallons

EFFICIENCY

Ton-Miles Traveled per Gallon of Fuel

616

478

150

SAFETY

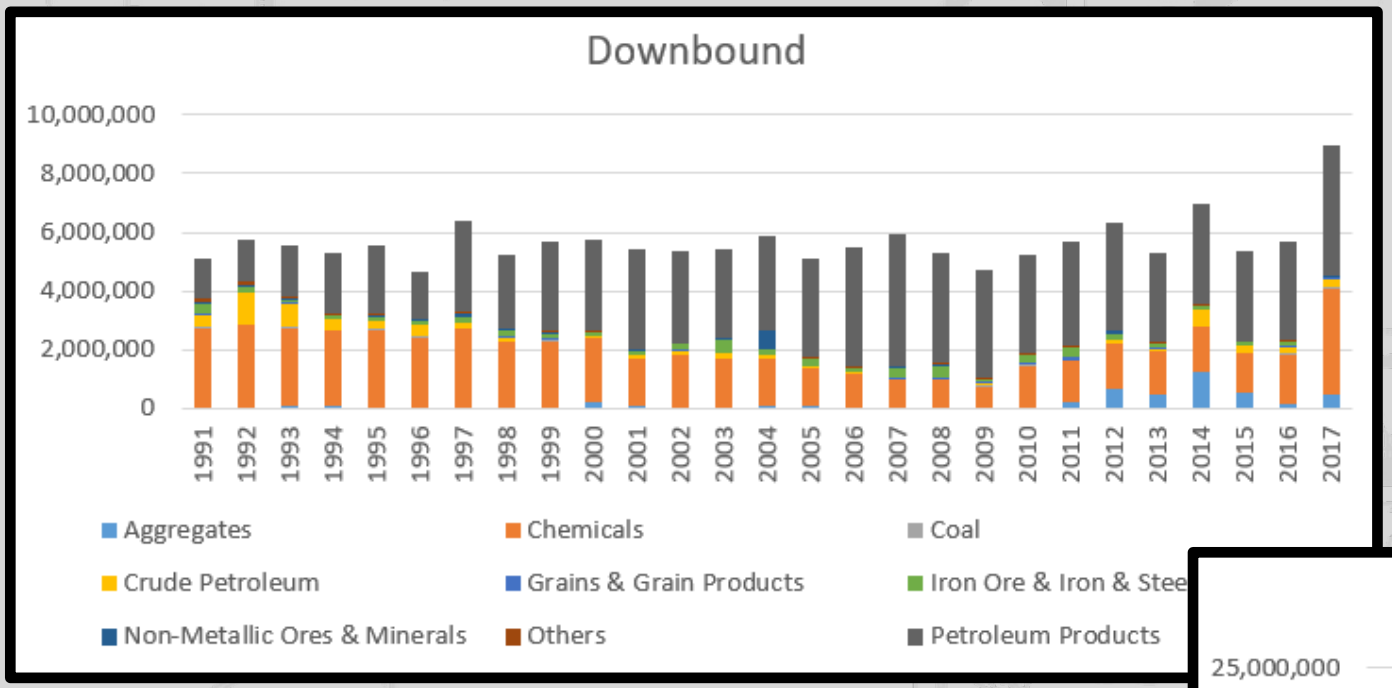
Rate of Injuries per Million Ton-miles

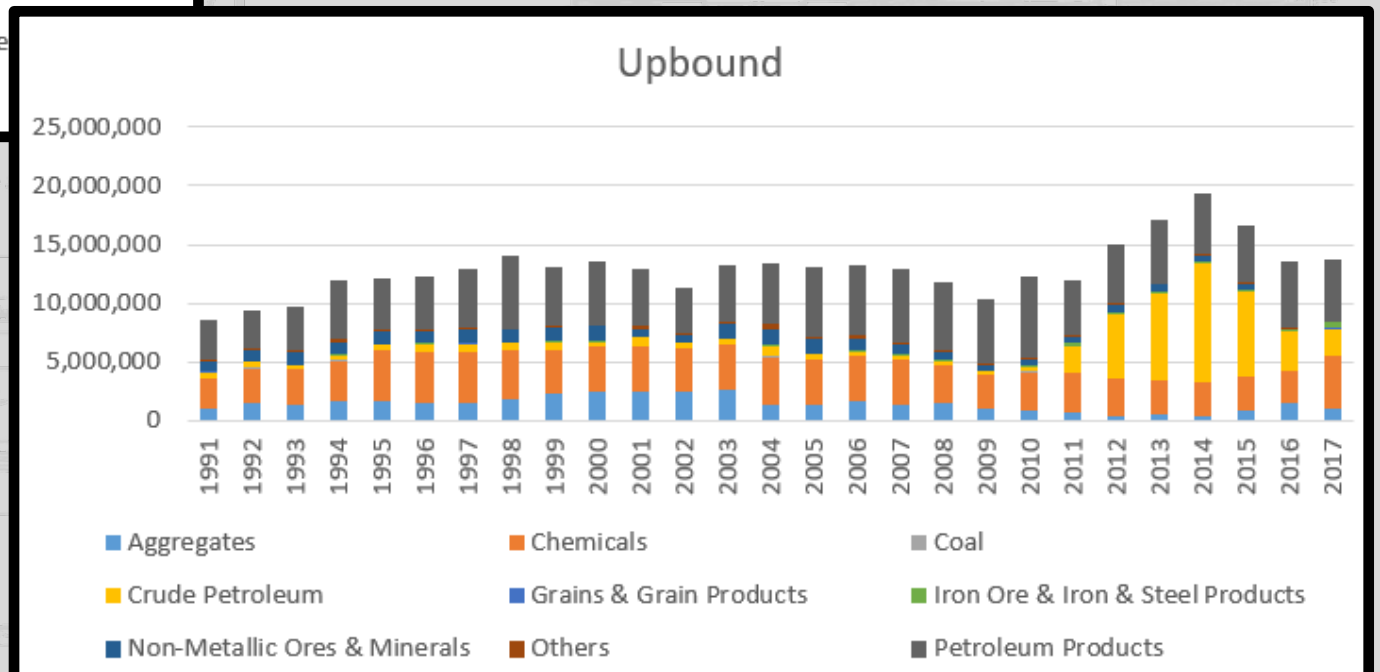
1,609.6

95.3

1.0

HISTORICAL TRAFFIC





- **Downbound is toward Corpus Christi**
- **Upbound is toward Houston**

DEFINITION OF RESILIENCE

Engineer Pamphlet (EP) 1100-1-2, *USACE Resilience Initiative Roadmap 2016*, dated 16 October 2017, supports the definition of resiliency originally defined under Executive Order 13653: "the ability to anticipate, **prepare** for and **adapt** to changing conditions and **withstand** and **recover** from disruptions."

Resilience is defined as the ability to **prepare**, **absorb**, **recover**, and **adapt**.

- **Prepare** is how proactively measures are planned for disruptive events
- **Absorb** is how effectively implemented plans withstand disruptive events
- **Recover** is how quickly normal operations can resume after disruptive events
- **Adapt** is how easily measures can be modified in response to changing conditions

PRINCIPLES OF RESILIENCE

USACE has identified four key principles of resilience from the many definitions of resilience that exist. These principles – Prepare, Absorb, Recover, and Adapt – exemplify the temporal aspects and actions that are inherent to the process of building community resilience capacity.

STUDY PURPOSE

The **purpose** of this study is to investigate modifications to the GIWW that would:

- Increase system **resilience**
- Improve navigability and navigation safety
- Reduce overall dredging and structure maintenance
- Reduce commercial transit delays and accidents
- Enhance regional sediment management practices

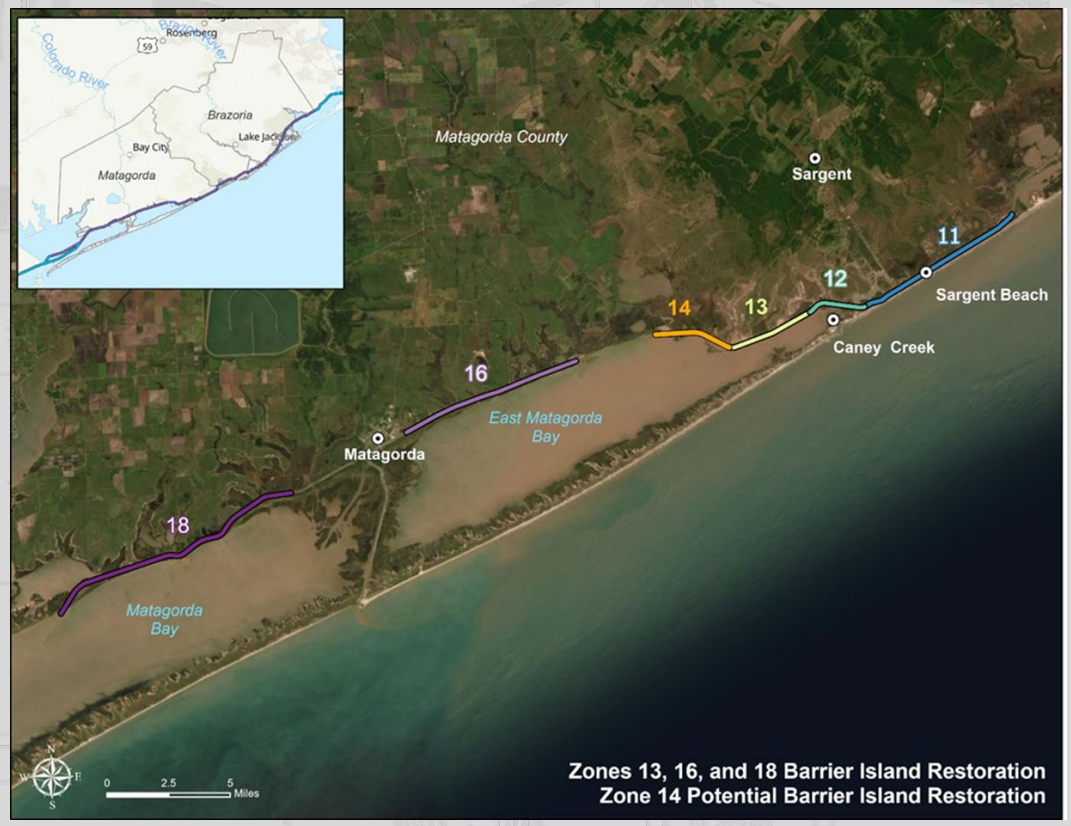
PROBLEMS

- Two meetings were held (20 May 2020 and 28 May 2020) between the PDT, the non-Federal Partner (TXDOT) and the Gulf Intracoastal Canal Association (GICA).

  Issues discussed included areas where fringe barrier islands have eroded away, exposing the GIWW users to waves and cross-currents, heavily shoaling areas with reduced navigable depths, lack of available passing width, shortage of moorings, specific areas where the channel is constrained due to docks and infrastructure, and reliability of the channel depth. These problems identified occur in Zones 1, 2, 4, 5, 7, 11, and 12

- The PDT evaluated the zones and determined that the priority high shoaling areas, including barrier loss, occurred in:

  ~~Brazos River (Zone 7)~~
  ~~Sargent Beach (Zone 11)~~
  Caney Creek (Zone 12)
  Exposed Segments (Zone 13,15)
  Eroding Barriers (Zone 14, 16, 18)
  ~~Colorado River (Zone 17)~~

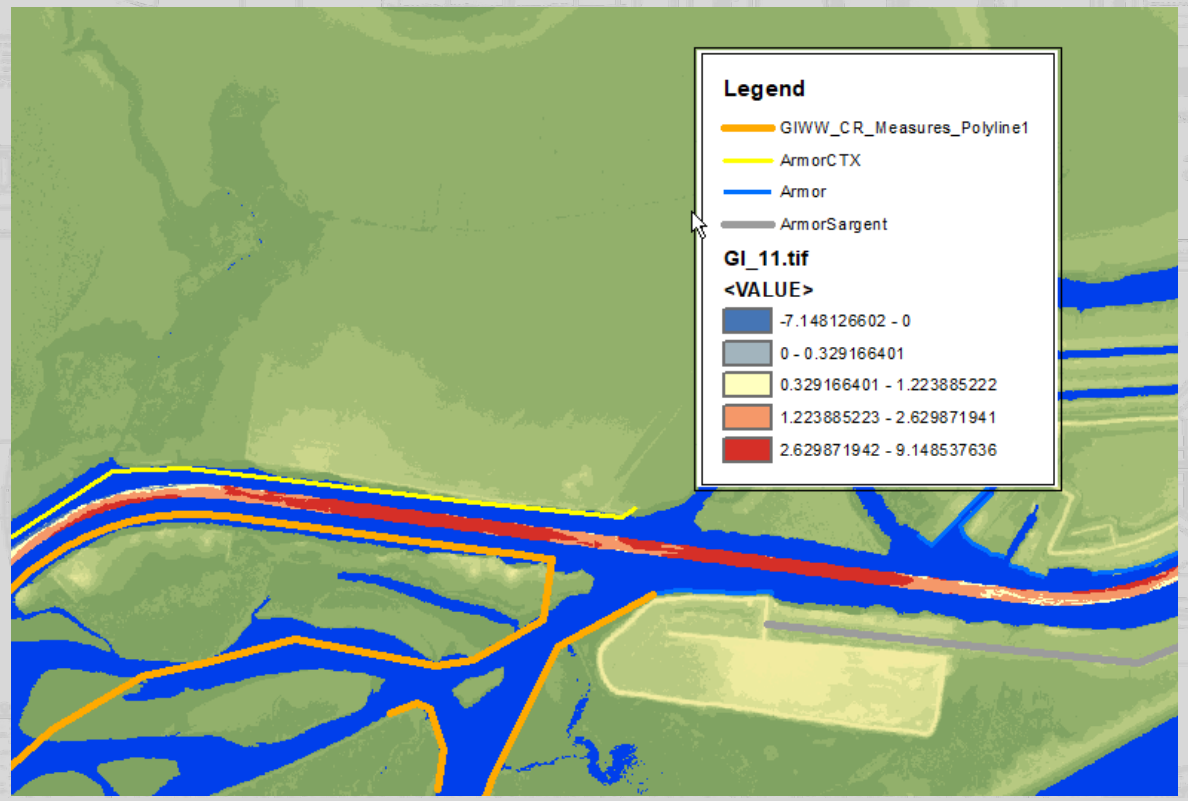


FUTURE WITHOUT PROJECT (FWOP) CONDITION ASSUMPTIONS

- Our assumption is Coastal TX, GIWW Brazos River Floodgates and Colorado River Locks (GIWW BRFG-CRL), and Texas GLO Projects will be constructed by 2030.
- Traffic levels and commodity tonnage are expected to continue as indicated in regional forecast prepared for the recently completed GIWW BRFG-CRL feasibility study.
- Increased exposure of navigation channel to winds and waves due to lost barrier islands.
- Intermediate projections of relative sea level rise (RSLR) are estimated at 0.25-ft for the 2030 project design year and 1.75-ft by year 2080, the 50-year design consideration.
- O&M of Sargent Beach Revetment

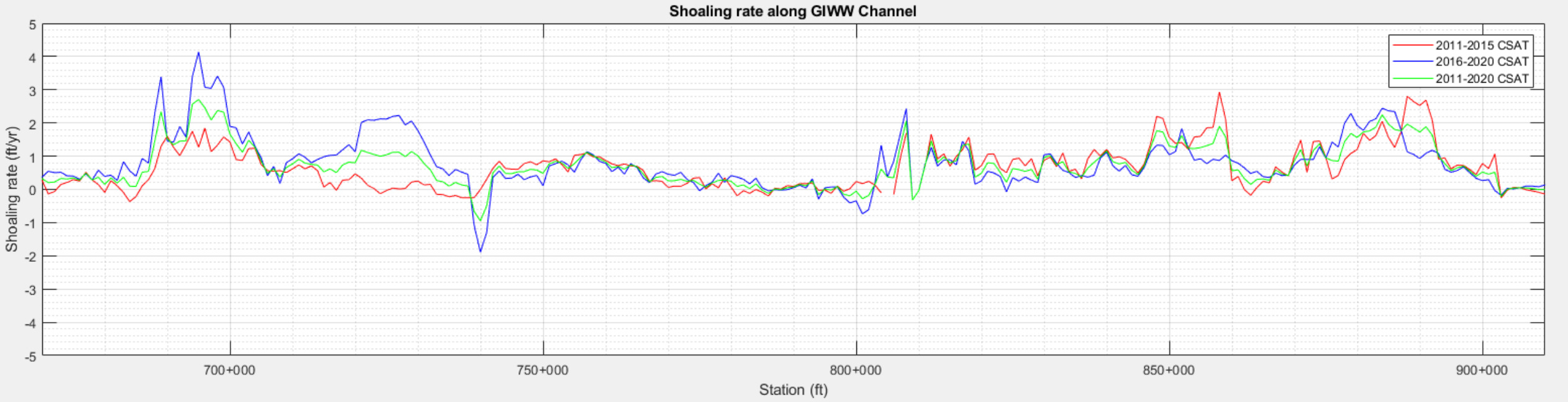
FUTURE WITHOUT PROJECT (FWOP) CONDITION ASSUMPTIONS

- Used historical survey and dredging history to estimate annual shoaling per 100 ft along GIWW
- Processed Data from 2011-2015 and 2016-2020 and determined Average Shoaling Rates



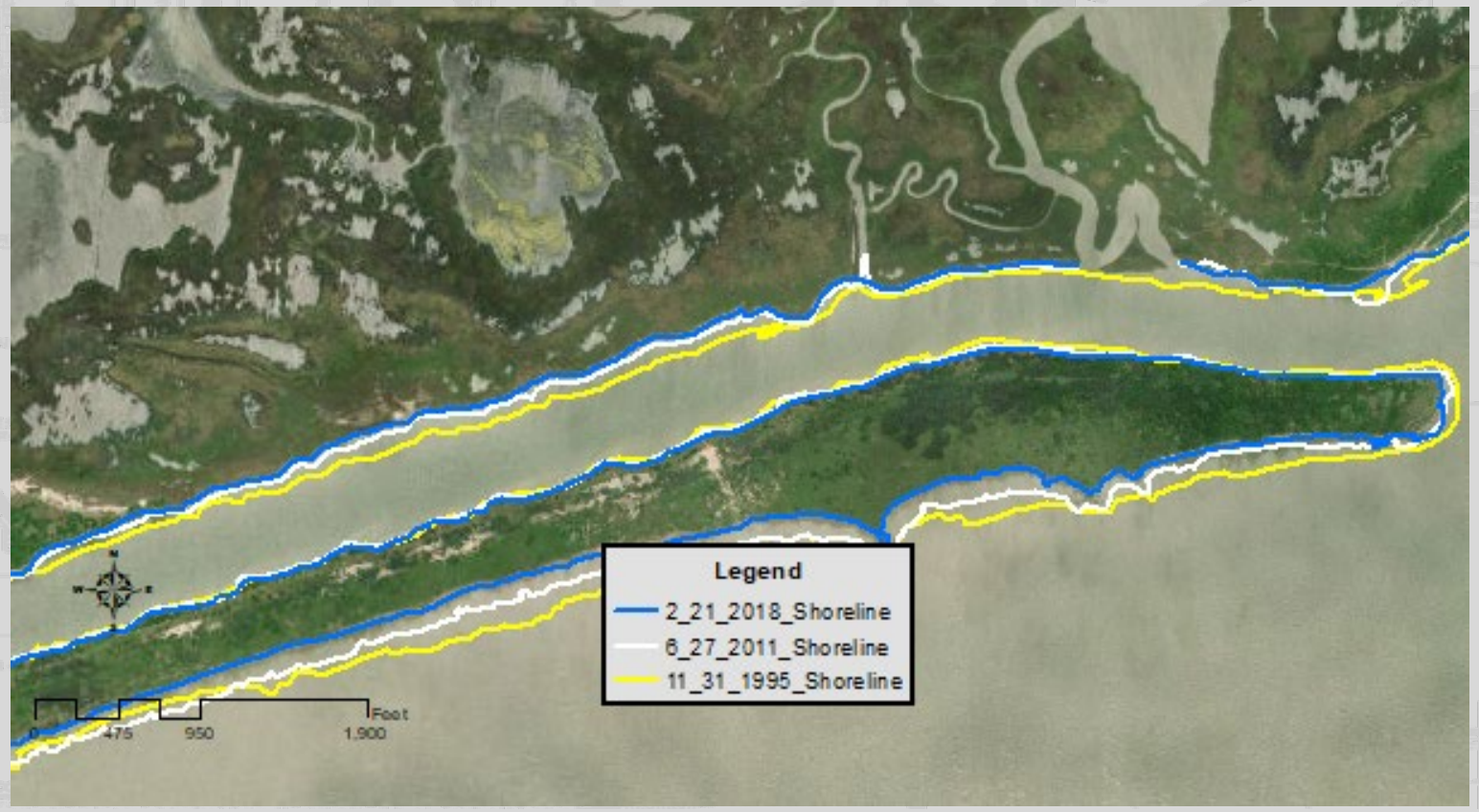
FUTURE WITHOUT PROJECT (FWOP) CONDITION ASSUMPTIONS

- Channel Shoaling Rate is 2+ ft/yr in select areas
  - ➢Causes Emergency Dredge Operations



FUTURE WITHOUT PROJECT (FWOP) CONDITION ASSUMPTIONS

- Erosion rates:
  - As much as 5 ft/yr along interior of GIWW
  - As much as 30 ft/yr along Bay side of the barriers



PROBLEMS, OPPORTUNITIES, OBJECTIVES AND CONSTRAINTS

Problems

1. Erosion and ship-induced waves and wind-driven waves from coastal storms have eroded channel shorelines and the barriers that have protected vessels on GIWW
2. Sea Level Rise and storms of increasing frequency and intensity will likely exacerbate the loss of barriers around the channel
3. Shoaling in the GIWW leads to light loading
4. Cross currents at Caney Creek increase navigation risk

Opportunities

1. Increase the flexibility and adaptability of maintenance dredging practices
2. Prolong the life of existing placement areas that have limited capacity

Objectives

1. Improve navigation resiliency - the ability of the GIWW navigation system in the study area to withstand, respond to, and recover from episodic disturbances (storms, hurricanes and floods) and ongoing erosion processes
2. Improve the economic efficiency of the GIWW
3. Reduce safety risks for vessels operating within the GIWW navigation system

Constraints

1. Other ongoing studies or authorized projects include components within the study area.
2. Avoid or minimize impacts to critical habitat
3. Do not duplicate evaluations of authorized or likely-to-be authorized components of other studies/projects
4. Do not negatively impact existing placement areas or CSRM projects
5. Avoid Hazardous, Toxic, Radioactive Wastes (HTRW) areas

RESILIENCY OF NAVIGATION CHANNEL EQUALS

1a. Analyzing Existing Conditions as related to strength and efficiency of channel – is it operating as originally authorized and intended by Congress?

- Metric: Reduction in light-loading; also provides economic efficiency and resiliency would be recovery after event or ability to during event in response to changing conditions, etc.

1b. Reliability – 90-95% of time normal operations…COVID, Eagle Point Shale, economic shocks (e.g. physical /non-physical shocks)

1c. Response Recovery – can recover quickly under adverse circumstances

- Metric – forecasted delays / outage days over the period of analysis. Measurement – Percentage of time when normal operations are anticipated using sea-level rise, forecasted coastal storms, improvement in sediment management to reduce light-loading.

2a. Prepare for sea level rise through process that allow navigation system features to withstand and adapt to continual changes over time

- Metric – System Robustness. Measurement - Use a sensitivity analysis for performance of other metrics (econ, env, etc) across a range of sea-level rise scenarios using the high-med-low rise scenarios.

3a. Analyze sedimentation trends to address erosional effects to provide a resilient operating channel that withstands or responds to erosional effects over time.

3b. Maintaining structure (channel template, marsh, barrier island, shoreline, etc.)

3c. Durability of features to withstand or absorb disruptions

- Metric – Forecasted Erosion Rates. Measurement: forecasted erosion rates of channel protective structures using engineering models.

4a. Protection and reduction of O&M

- Metric: O&M Costs. Measurement: Cost engineering forecasts of OMRR&R for various alternatives and change from FWOP condition.

5a. Adaptability to changes (market changes - vessel numbers, sizes, commodities, physical changes such as storm/wind/erosion, floods)

- Metric: Adaptability. (Ability of features to be adapted to future changes.) Measurement: Qualitative metric based on engineering judgment of which plans have the greatest flexibility and adaptability.

RESILIENCE CRITERIA

Completeness

- Life-cycle actions and costs to achieve and sustain beneficial effects

Effectiveness

- Miles of Navigation Channel Exposed to Bay or Gulf winds and waves (Proxy for safety risks and nav delays)
- Change in shoaling volumes over time
- Channel Reliability – percent of time channel draft is reduced or impeded annually
- Transportation Delay Costs

Efficiency

- Life-cycle costs to achieve the effectiveness metrics (cost-effectiveness)
- Sediment volumes used beneficially versus placed in PA's

Acceptability

- Acres of critical habitat impacts
- Compatibility with Agency lands

Four criteria (completeness, effectiveness, efficiency, and acceptability) described in the *Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, dated March 1983 (P&G).

ANALYSIS

Benefits

- Transportation Delays Savings
- Channel closure reductions
- Congestion delays (if any unaccounted for in other studies)

Models to Use:

Automatic Identification System Analysis Package (AISAP)

Spreadsheets

Project Life-Cycle Costs

- Design & Construction
- LERRDs
- Environmental Mitigation
- Incremental OMRR&R (Resiliency Objective)

IWR Planning Suite – Cost Effectiveness & Incremental Cost Analysis (CEICA)

Spreadsheets – Erosion reduction and Shoaling reduction

RISK AND UNCERTAINTY

1. **Low Formulation Risk: Screen measures and they do not get approved and/or addressed in Coastal Texas and Brazos River Flood Gates & Colorado River Locks (BRFG-CRL)**
   - Risk Event: Screen the overlapping measures from Coastal Texas and BRFG-CRL Selected Plans
   - Assumption: Both project plans are assumed to be approved and the FWOP condition for this study
   - Mitigation: PDT monitor both projects approval throughout this study and analyze problems with the overlapping zones for complimentary measures to navigation in this project

2. **Moderate Implementation Risk: O&M cost savings and budgeting shortfalls**
   - Risk Event: If benefits are calculated based on insufficient funding shortfalls, there is potential for double counting benefits already included in other existing ongoing projects
   - Assumption: BRGF-CRL will be approved and is the FWOP condition for this study
   - Mitigation: PDT will establish clear delineation between categories of monetized benefits as well as vertical team coordination

3. **Moderate Study/Schedule/Budget Risk:** Resiliency objectives versus economic efficiency - no existing guidance or precedent.
   - Mitigation: PDT continued coordination with vertical team.

4. **Residual Risk: Authorization and scope of the project is limited to Brazoria and Matagorda counties**
   - Risk Event: GIWW extends beyond these counties. Major problem areas have been identified by GICA (Port O'Connor) outside the authorized counties. Residual risk will remain in these areas with this project.

STUDY AREA

Selected Zones for Evaluation:

- Zone 12
- Zone 13
- Zone 14
- Zone 16
- Zone 18

Alternatives Include include:

- No Action
- Non-Structural
- Shoreline Stabilization
- Channel Modification
- Sediment Placement
- Combos…

ARRAY OF ALTERNATIVES EVALUATED

US Army Corps of Engineers

Color Key
No Change
Highest
High
Medium - High
Medium
Low - Medium
Low
Least

HIGHEST PREFERRED ↓ LEAST PREFERRED

ALT #	DESCRIPTION	SYSTEM RESILIENCE	ECONOMIC BENEFITS	INITIAL COST	ENVIRONMENTAL QUALITY	ENGINEERING FEASIBILITY	REAL ESTATE REQUIREMENTS
1	No Action	NA - No Change from existing	NA - No Change from existing	NA - No Change from existing	NA - No Change from existing	NA - No Change from existing	NA - No Change from existing
2	**Non-structural – SCREENED**	Limited resilience	Low effectiveness/ no further benefits	Low: low cost NS measures	Low: Low environmental impact expected	Low : Few engineering challenges	Low: No real estate required
3	**Shoreline Stabilization – Carried Forward**	Medium-High: Stabilization measures are the most likely measures to lead to resilience of navigation system	Medium: May reduce O&M costs over time	Medium-High: Construction of stabilization structures anticipated to be among most costly measures	Medium: Hard structures have the potential for Environmental Impacts but Natural features likely to benefit (may offset)	Medium: Some novel methods of natural stabilization may provide engineering challenges	Medium-High: Stabilization measures may require a significant amount of real estate
4	**Alt 2 + Sediment Placement - SCREENED**	Low-Medium: The incorporation of sediment placement would marginally increase resilience	Low-Medium: While this is likely to be an efficient method of disposal, unlikely to produce additional efficiencies	Low-Medium: Sediment Placement is relatively inexpensive in comparison to other measures	Medium-High Low impact from NS measures, Placement options vary in effects but no substantial negative effects anticipated	Medium-High: Some potential challenges with placement but relatively routine from an engineering perspective	Medium-High: Placement areas likely to require a significant amount of real estate
5	**Alt 4 + Channel Modifications - SCREENED**	Medium: Channel modifications would increase resilience over Alt 2, but may not significantly address resilience over time	High: Channel Modifications are likely to perform best at increasing economic efficiency	Medium: Channel modifications are less numerous than stabilization measures and less expensive to implement	Low-Medium Incorporation of channel modifications with Alt 4 likely to increase potential for Environmental Impacts	Medium: Some novel methods of channel modifications may provide engineering challenges	Medium-High: Same as Alt 4; In channel work not likely to increase real estate requirement
6	**Alt 3 + Alt 4 – Carried Forward**	High: Incorporation of sediment and placement likely to expand resilience over Alt 3	Medium: May reduce O&M costs over time	High: Second most costly, includes most measures except channel modifications	Low-Medium Incorporation of sediment and placement with Alt 3 could lead to some additional Environmental impacts	Low-Medium Incorporation of sediment and placement with Alt 3 could lead to some additional Environmental impacts	High: Second largest footprint requiring real estate
7	**Alt 3 + Alt 5 – SCREENED**	Highest: Offers the most robust and resilient set of measures to address problems over time	High: Channel Modifications are likely to perform best at increasing economic efficiency	Highest: Includes all measures, would be the most costly	High: Includes the greatest footprint and potential for impacts, although some benefits may be off-setting	High: Presents the greatest potential suite of engineering challenges	Highest: Greatest footprint requiring real estate

MEASURES

Non-structural:

- Light loading
- ~~Lightering~~ [1]
- Operational Scheduling
- Buyouts / relocations to address channel encroachments
- Speed restrictions for high speed vessels
- Additional Meters

[1] *Items crossed out indicate early screening*

Stabilization:

- Breakwaters / Wavebreaks
- Jetties / Terminal Groins
- Revetments / Shoreline Stabilization
- ~~Levees / Dikes~~ [1]
- Living Shoreline
- Barrier Creation / Restoration
- Oyster Reefs
- Coastal Marsh Creation / Restoration
- Beach / Berm / Dune Creation / Restoration / Strengthening

Channel Modifications:

- Bend Easing / Minor re-alignments
- Widen channel / Straightaways for Meeting
- Sediment Traps / Deepening
- Additional Moorings / Fleetings

Dredging and Placement:

- Offshore placement
- New Confined PAs
- Bed load collector
- ~~Sediment bypass~~ [1]
- Beneficial Use

ENVIRONMENTAL CONSIDERATIONS

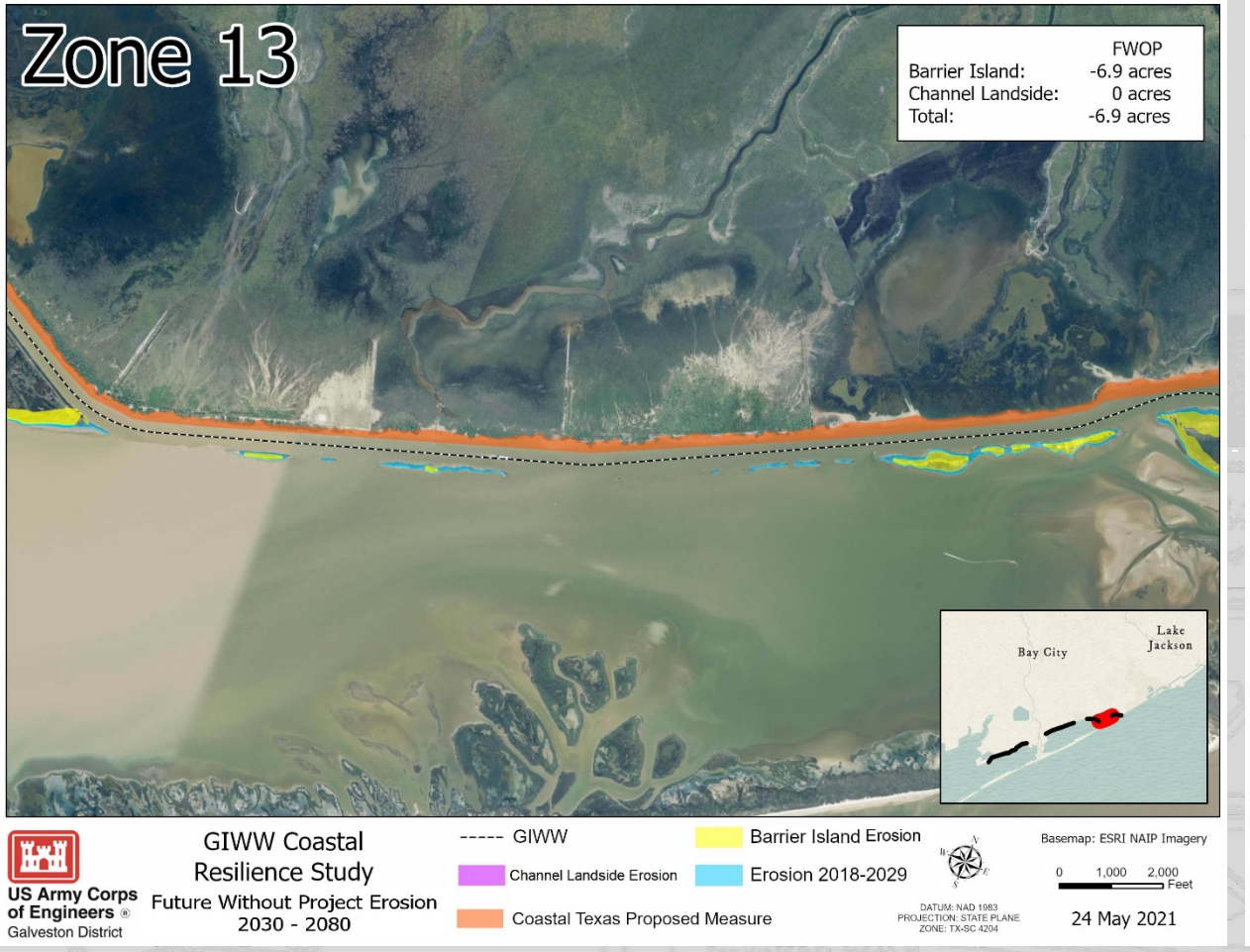
NEPA Compliance steps to be taken:

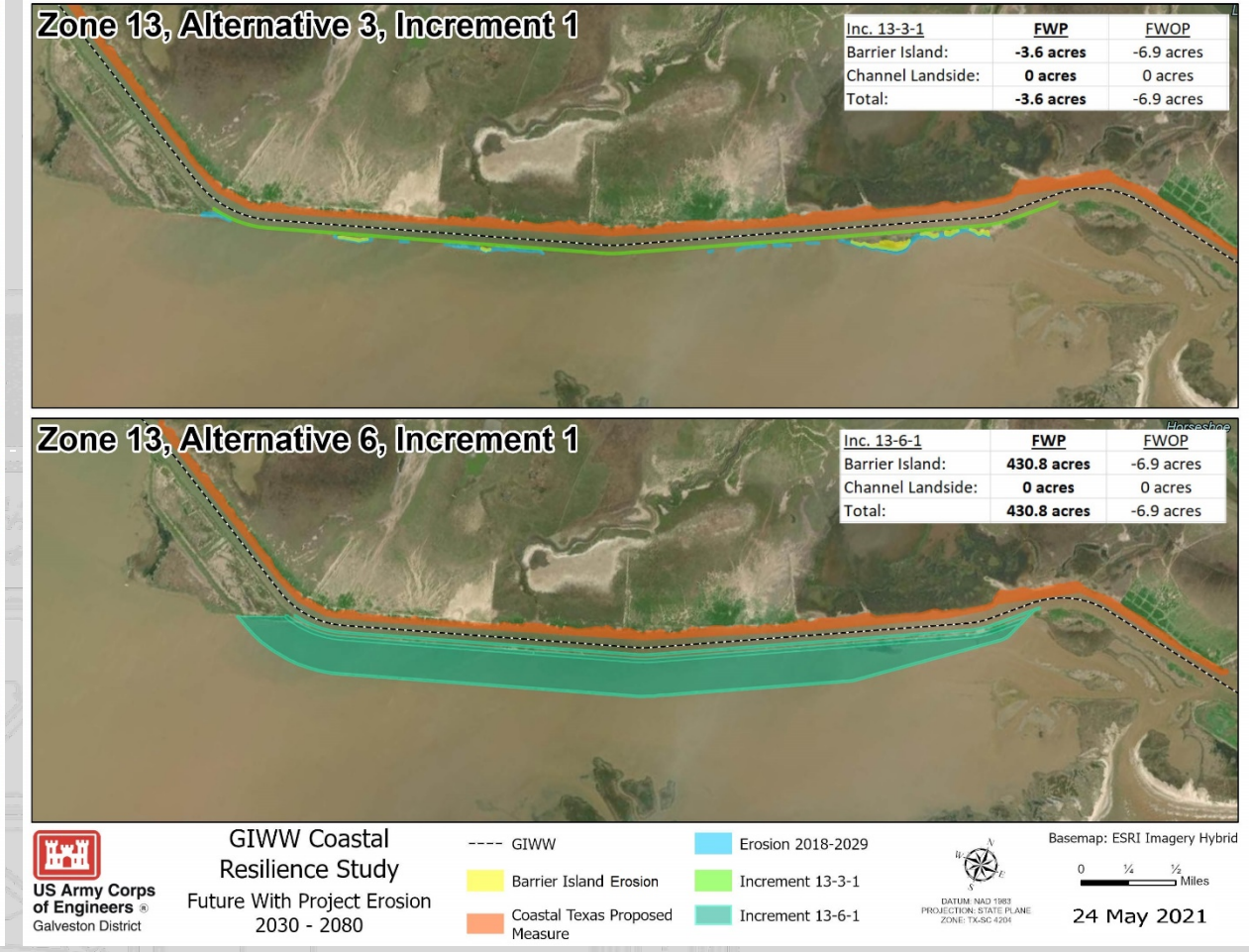
- 404(b)(1) Clean Water Act
- Endangered Species Act
- Coastal Barrier Resources Act
- Clean Air Act

Resources with potential to impact:

- Piping Plover critical habitat
- Oyster reef
- Essential fish habitat
- Migratory birds
- National Wildlife Refuges

ZONE 13 – FWOP VS. FWP EROSION





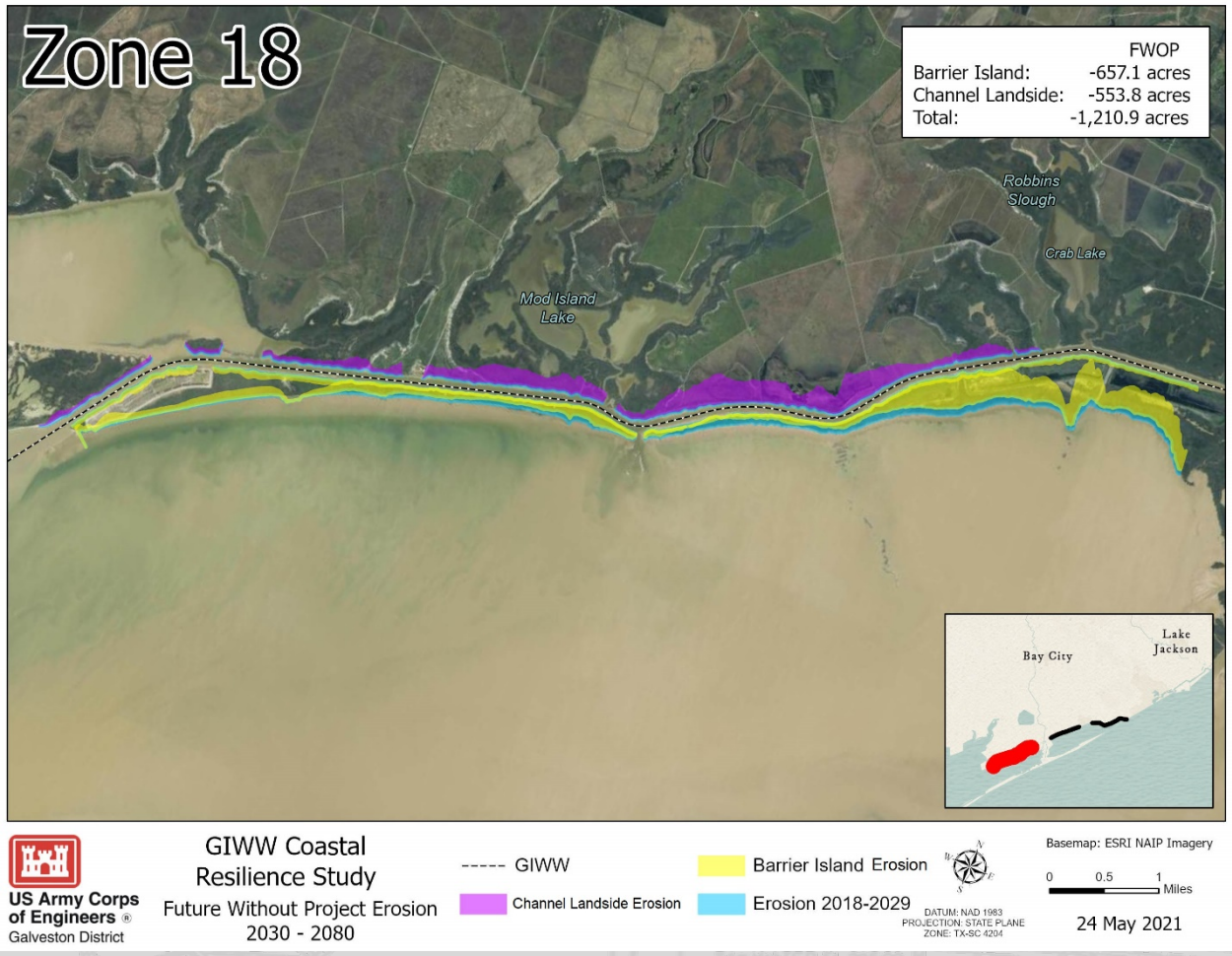
FWOP Notes:

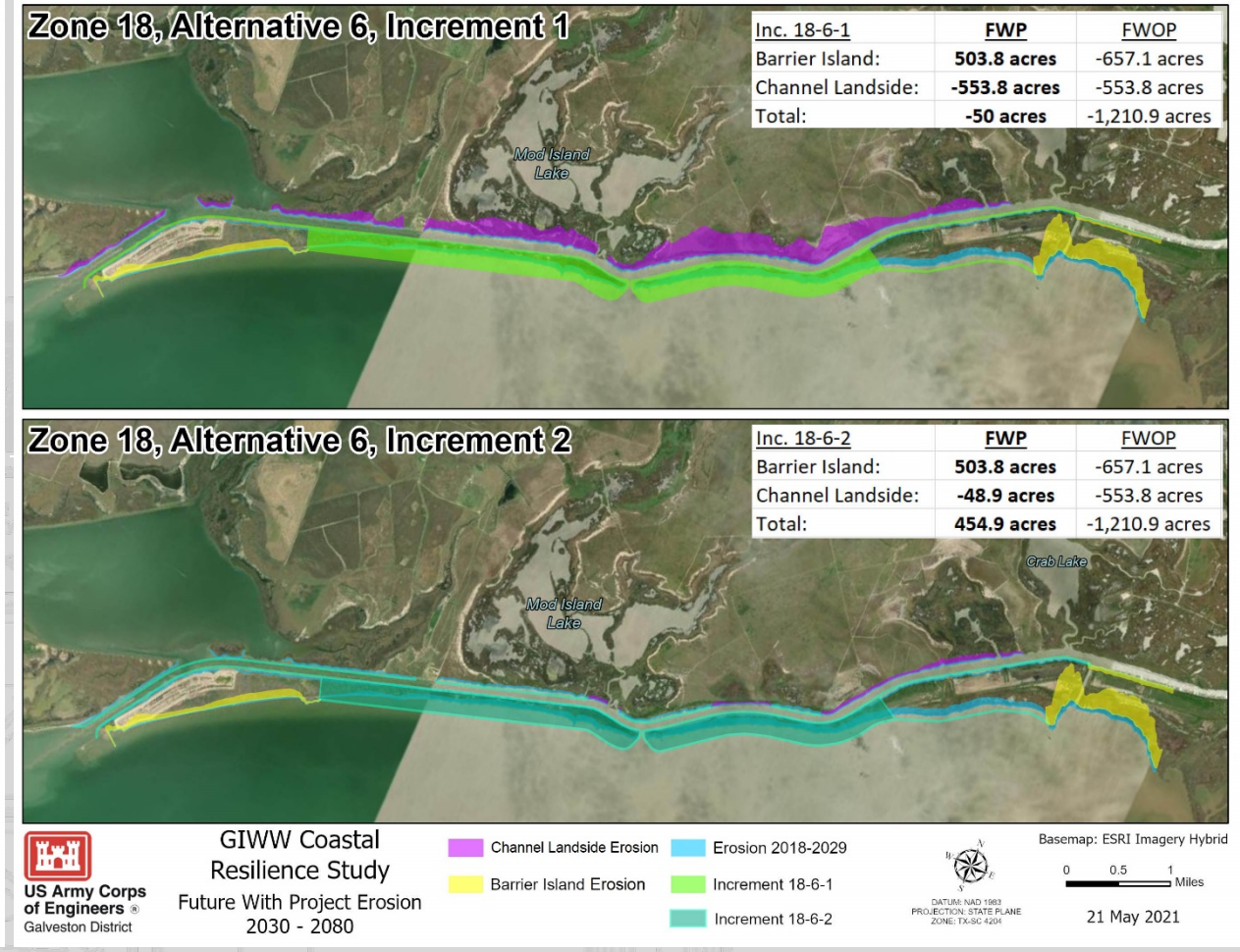
- The Coastal Texas project is proposing measures in areas along the channel landside
- Barrier islands will completely disappear by 2080 without a project in this zone

FWP Notes:

- The channel bayside breakwater provides channel protection for 13.3.1
- The channel bayside and bayside breakwaters contain sediment placement for 13.6.1

ZONE 18 – FWOP VS. FWP EROSION ALTERNATIVE 6





FWOP Notes:

- The barrier islands will be significantly eroded by 2080 without a project in this zone
- Complete breaches of the barrier islands significantly impact navigation in the channel

FWP Notes:

- The **bayside and channel bayside breakwaters** contain **sediment placement** to provide channel protection for 18.6.1
- The **bayside and channel bayside breakwaters** contain **sediment placement**, and the **channel landside breakwaters with reefballs** provide channel protection for 18.6.2

WHAT DOES A SMART STUDY LOOK LIKE?