



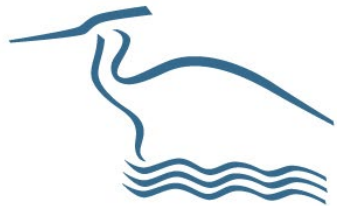
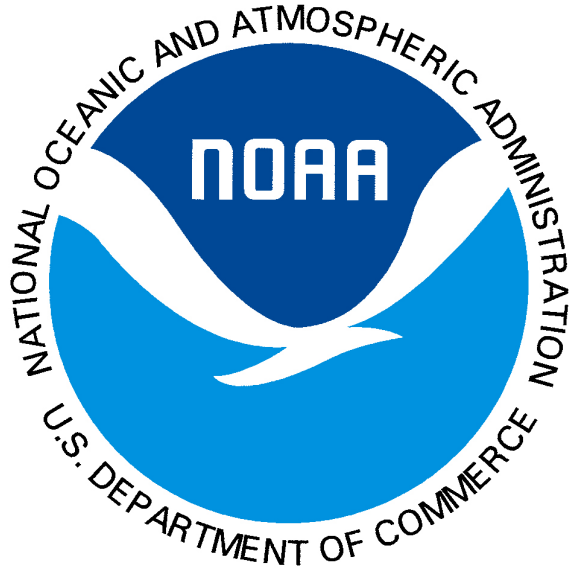
# UPPER COAST

## *Dine & Discuss*

### *Living Shorelines*

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- Welcome & Introductions
- What is a living shoreline?
- Tools & Resources
- Permitting
- Success Stories
- Q&A



GALVESTON BAY  
FOUNDATION



TEXAS A&M  
UNIVERSITY  
CORPUS  
CHRISTI

HARTE  
RESEARCH INSTITUTE  
FOR GULF OF MEXICO STUDIES

# A GUIDE TO LIVING SHORELINES IN TEXAS



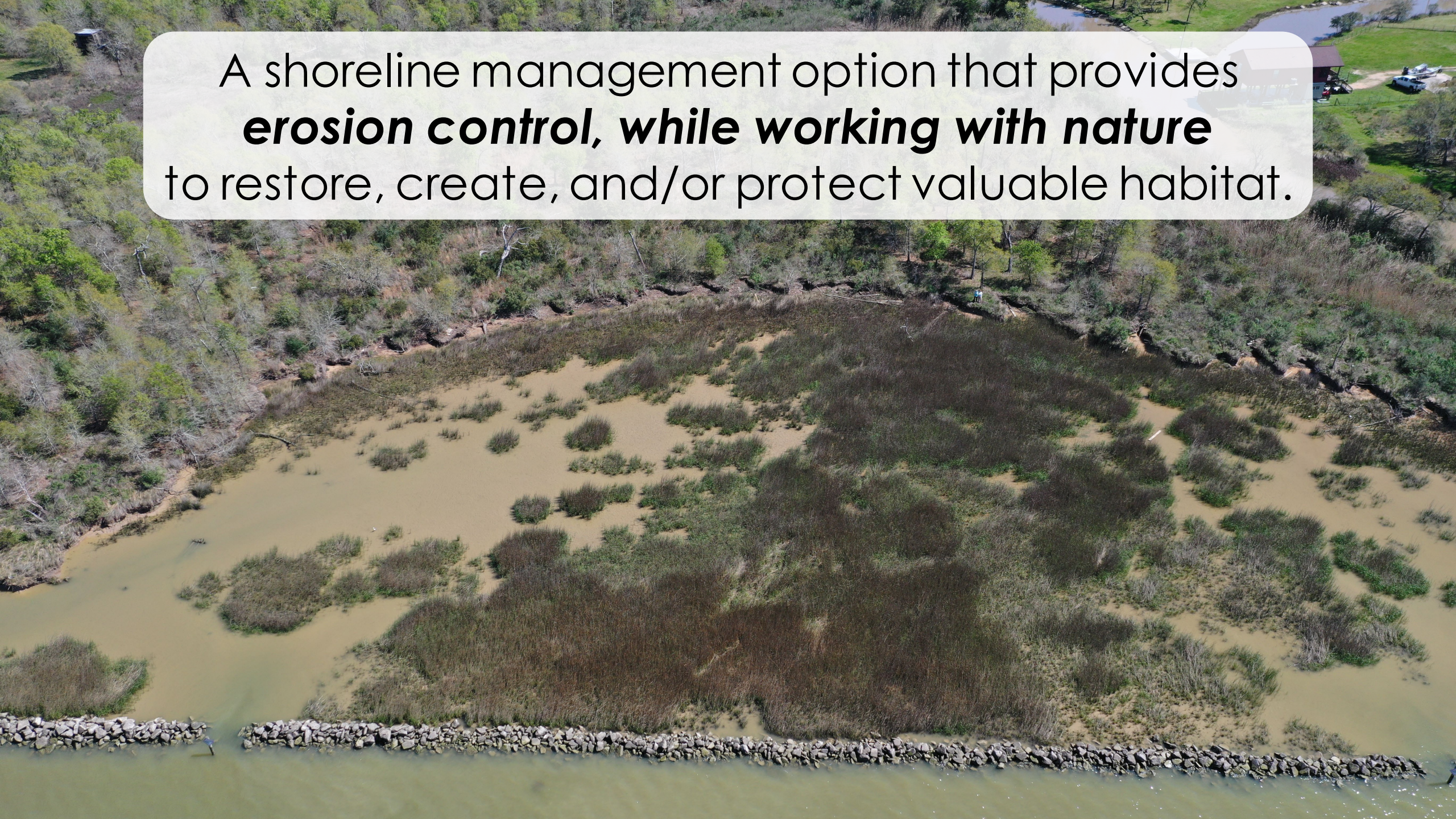
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Corpus Christi Bay. Photo: Texas General Land Office

**What is a  
“Living”  
Shoreline?**

An aerial photograph showing a wetland restoration project. A long, low stone wall runs across the bottom of the frame, separating a body of water from a large area of marshland. The marshland is filled with dense, brownish vegetation and patches of water. In the background, there are trees and a small building. A text overlay is present in the upper left quadrant.

A shoreline management option that provides ***erosion control, while working with nature*** to restore, create, and/or protect valuable habitat.









**Port Aransas**



**Corpus Christi**



**Texas coast is  
eroding ~ 4 feet  
per year (GLO)**

**Baffin Bay**



**Copano Bay**



**Galveston Bay**



**Trinity Bay**





Google Earth



Google Earth



Google Earth



# Hard Stabilization



# Living Shoreline





# Revetments

---





# Bulkheads

---



# 15-20 year Lifespan

*Erosion on adjacent properties  
Structure degradation over time*

*Habitat loss  
Not adaptable to SLR*

# Hidden maintenance costs...









- ✓ Absorb wave energy
- ✓ Restore land by trapping sediments
- ✓ Allow natural coastal processes to take place
- ✓ Filter pollutants from runoff
- ✓ Create/maintain vital habitat fish and shellfish
- ✓ Provide nesting and foraging areas for birds
- ✓ Enhance long-term coastal resiliency

# Living Shorelines vs. Hard Structures

BENEFITS	LIVING SHORELINES	HARD STRUCTURES
Reduce shoreline erosion	✓	✓
Deflect wave energy	✓	✓
Absorb wave energy	✓	✓
Minimal maintenance long term	✓	
Reduce storm surge and flood waters	✓	✓
Adapt to possible sea level rise	✓	
Increase recreational opportunities (fishing, wildlife viewing)	✓	
More potential for beach creation	✓	
Improve water quality	✓	
Maintain ecosystem functions (nutrient cycling, animal and plant habitat)	✓	
Create habitat for terrestrial and aquatic species	✓	
Enhance property aesthetics	✓	
Maintain the natural land/water connection	✓	

# Living Shorelines vs. Hard Structures

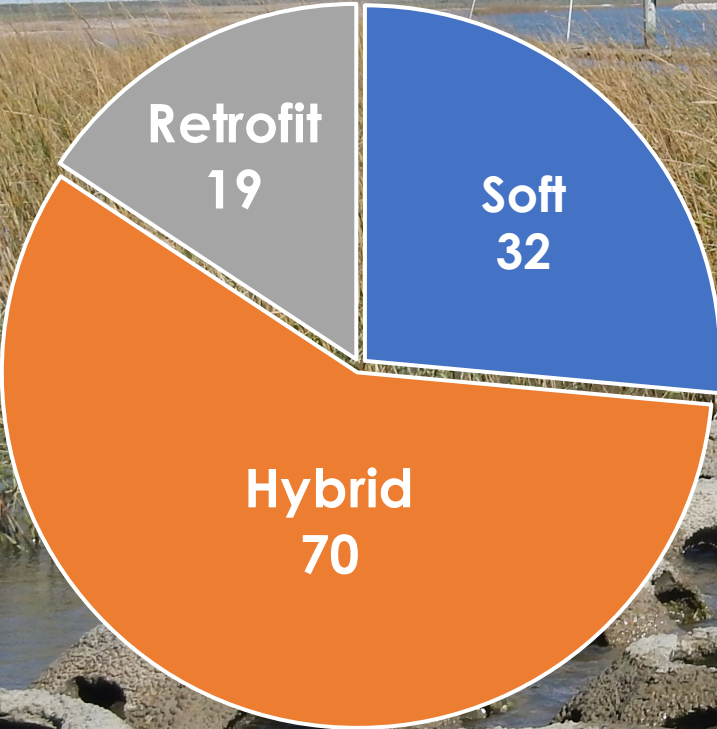
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More potential for beach creation	✓	
Improve water quality	✓	
Maintain ecosystem functions (nutrient cycling, animal and plant habitat)	✓	
Create habitat for terrestrial and aquatic species	✓	
Enhance property aesthetics	✓	
Maintain the natural land/water connection	✓	





# **Types of Living Shorelines in Texas**

# One size does not fit all...





# SOFT Stabilization

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- Non-structural
- Usually involve planting marsh grass along the existing shoreline

# BEFORE



# AFTER





# HYBRID Stabilization

---

- Use hard features for additional erosion control
- Incorporate materials used in “soft” technique



# Low-Profile Breakwaters

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# High-Profile Breakwaters

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# RETROFIT

## Stabilization

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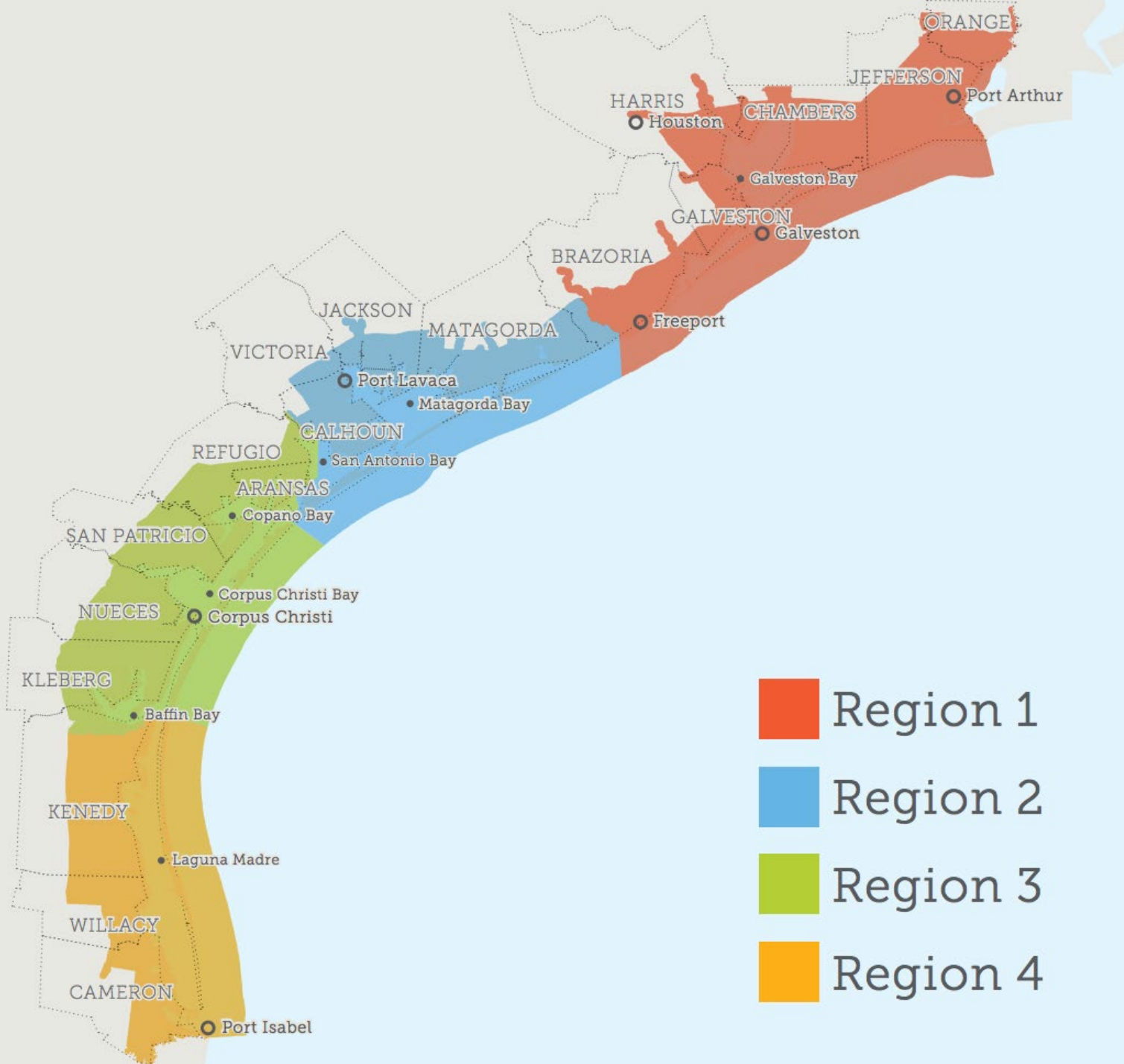
- Existing hard structure such as a bulkhead or revetment, paired with soft or hybrid stabilization





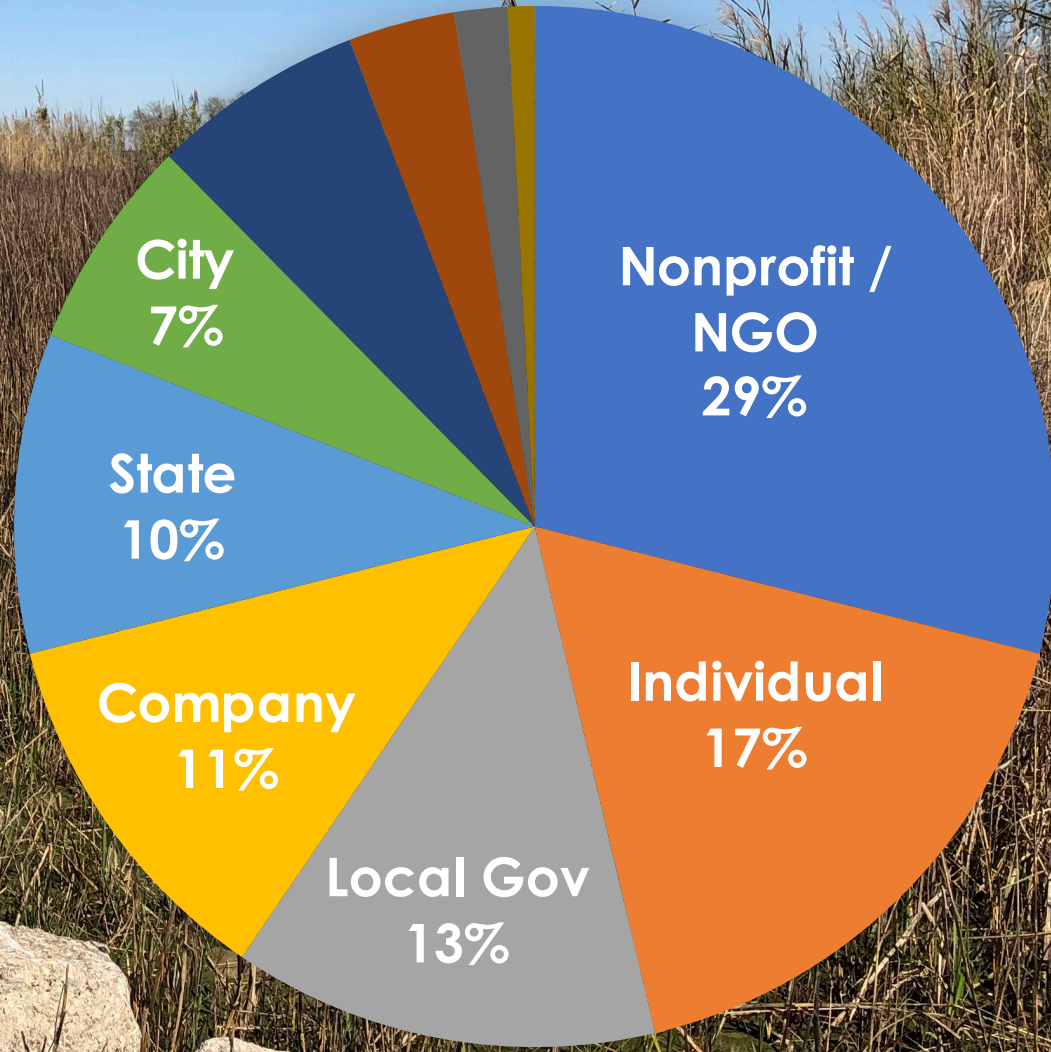
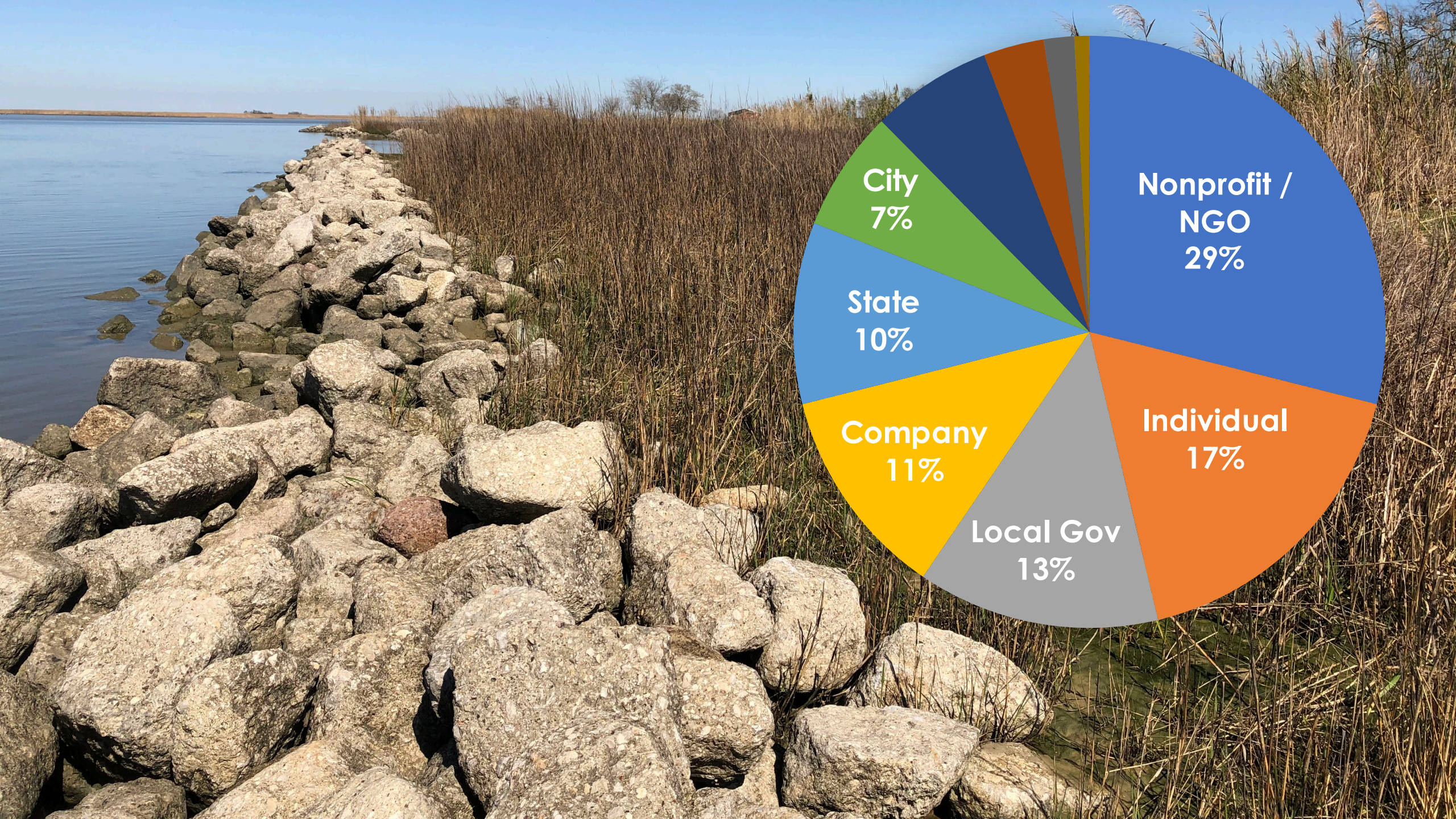


# 121 Living Shorelines in Texas



COUNTY	PROJECTS
Galveston	49
Chambers	13
Nueces	12
Harris	10
Calhoun	9
Aransas	8
Matagorda	5
Refugio	4
Brazoria	3
Cameron	2
Jackson	2
Orange	2
Kleberg	1
San Patricio	1
<b>TOTAL</b>	<b>121</b>





		SHORELINE TYPE			SLOPE			EROSION RATE			WAVE ENERGY			WATER DEPTH			SALINITY			
CATEGORY	OPTION	EXISTING BULKHEAD	MARSH	BEACH SAND/SHELL HASH	LOW	MODERATE	HIGH	LOW	MODERATE	HIGH	LOW	MODERATE	HIGH	SHALLOW	MODERATE	DEEP	FRESHWATER	BRACKISH	SALT	
SOFT STABILIZATION	Marsh Vegetation Plantings	x	✓	•	✓	•	•	✓	•	x	✓	✓	x	✓	•	x	✓	✓	✓	
	Coir Logs	x	✓	✓	✓	✓	•	✓	x	x	✓	x	x	✓	x	x	✓	✓	•	
HYBRID STABILIZATION	Submerged Oyster Shell Beds	•	✓	✓	✓	✓	✓	✓	✓	•	✓	✓	x	✓	•	x	x	✓	•	
	Reef Balls	•	✓	✓	✓	✓	✓	✓	✓	•	✓	✓	✓	✓	✓	x	•	✓	•	
	Articulated Mats or Blocks with Marsh Plantings	x	✓	✓	✓	✓	•	✓	✓	✓	✓	✓	•	✓	•	x	✓	✓	✓	
	Breakwater with Marsh Plantings	✓	✓	•	✓	✓	✓	•	✓	✓	•	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Riprap with Marsh Plantings	✓	✓	•	✓	•	•	•	✓	x	•	•	x	✓	•	x	✓	✓	✓	

✓	Best Management Strategy
•	Potential Management Strategy
x	Generally Not Recommended



# **Tools & Resources**

# Living Shoreline Site Suitability Model

Rhiannon Bezore\*, James Gibeaut, Michelle Culver, Marissa Dotson

Harte Research Institute for Gulf of Mexico Studies  
Texas A&M University – Corpus Christi



TEXAS A&M  
UNIVERSITY  
CORPUS  
CHRISTI

HARTE  
RESEARCH INSTITUTE  
FOR GULF OF MEXICO STUDIES

Goal: Create model that uses geospatial data to identify :

- What areas are suitable for a living shoreline?
- If suitable, what kind of shoreline technique should be used?



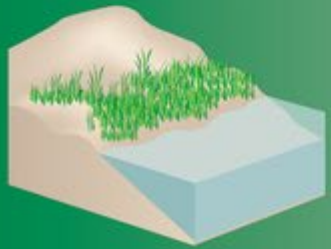
Input	Output
<ul style="list-style-type: none"><li>• Shoreline type</li><li>• Beach width</li><li>• Water depth</li><li>• Nearshore slope</li><li>• Presence of vegetation</li><li>• Erosion rate</li><li>• Exposure to wind and waves</li><li>• Distance to nearest channel</li></ul>	<ul style="list-style-type: none"><li>• Soft stabilization</li><li>• Hybrid stabilization</li><li>• Retrofit: Soft</li><li>• Retrofit: Hybrid</li><li>• Stop and seek expert advice</li></ul>

# HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?

## GREEN - SOFTER TECHNIQUES

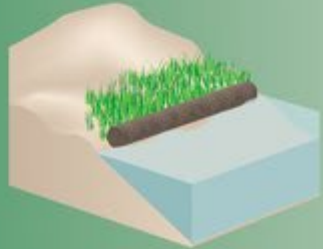
## GRAY - HARDER TECHNIQUES

### *Living Shorelines*



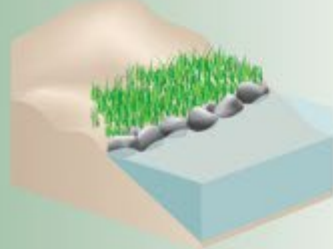
#### **VEGETATION ONLY -**

Provides a buffer to upland areas and breaks small waves. Suitable only for low wave energy environments.



#### **EDGING -**

Added structure holds the toe of existing or vegetated slope in place.



#### **SILLS -**

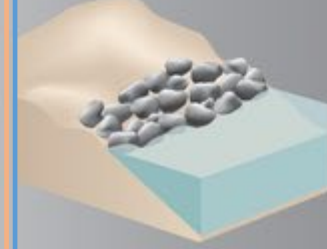
Parallel to existing or vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.



#### **BREAKWATER -**

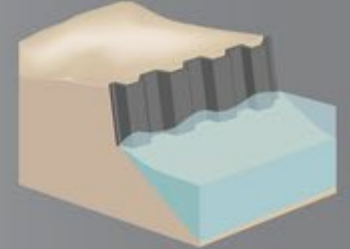
(vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.

### *Coastal Structures*



#### **REVETMENT -**

Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with pre-existing hardened shoreline structures.



#### **BULKHEAD -**

Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for areas highly vulnerable to storm surge and wave forces.

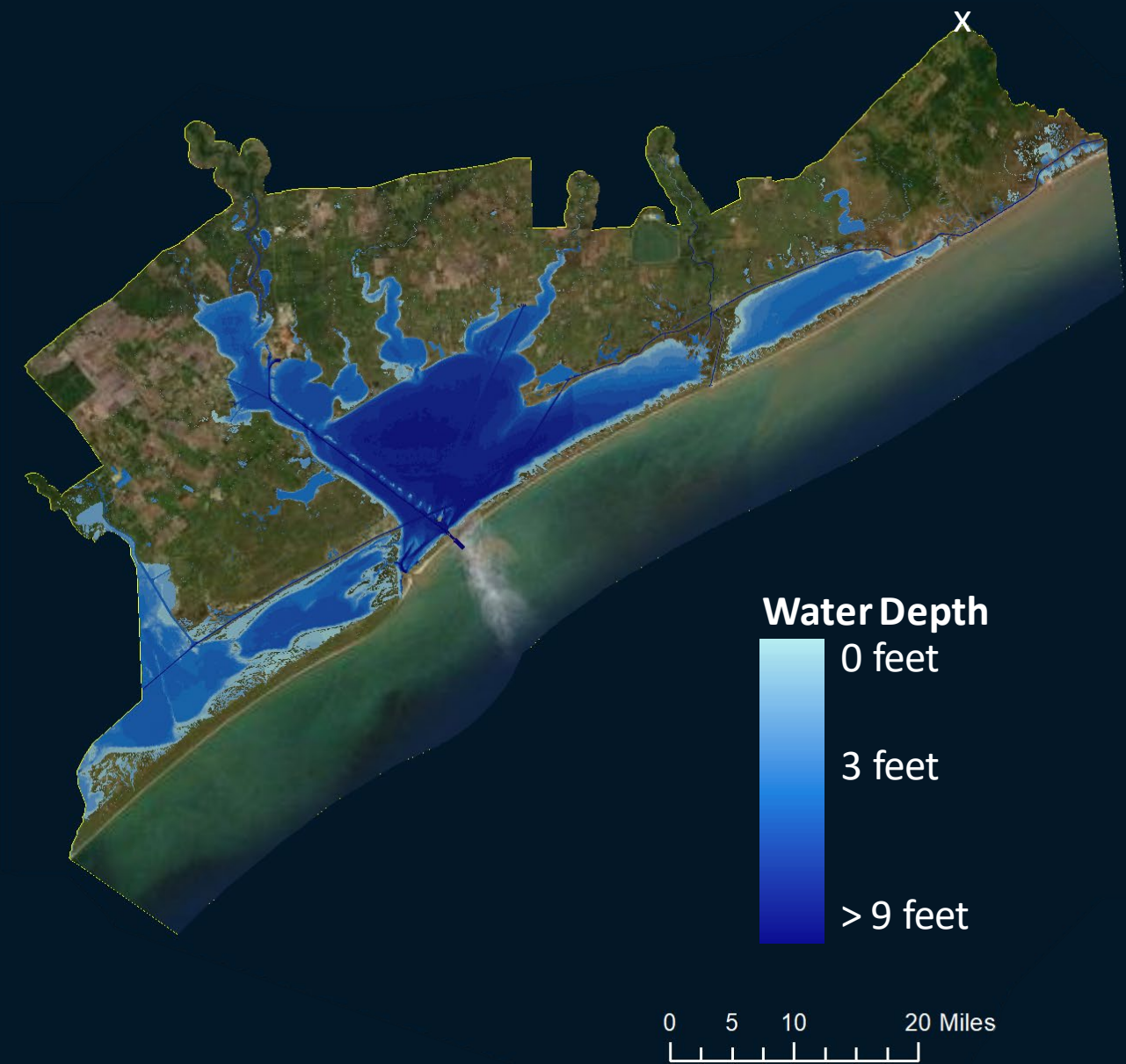
**Soft Stabilization**

**Hybrid Stabilization**

**Retrofit**

# Model Input Data

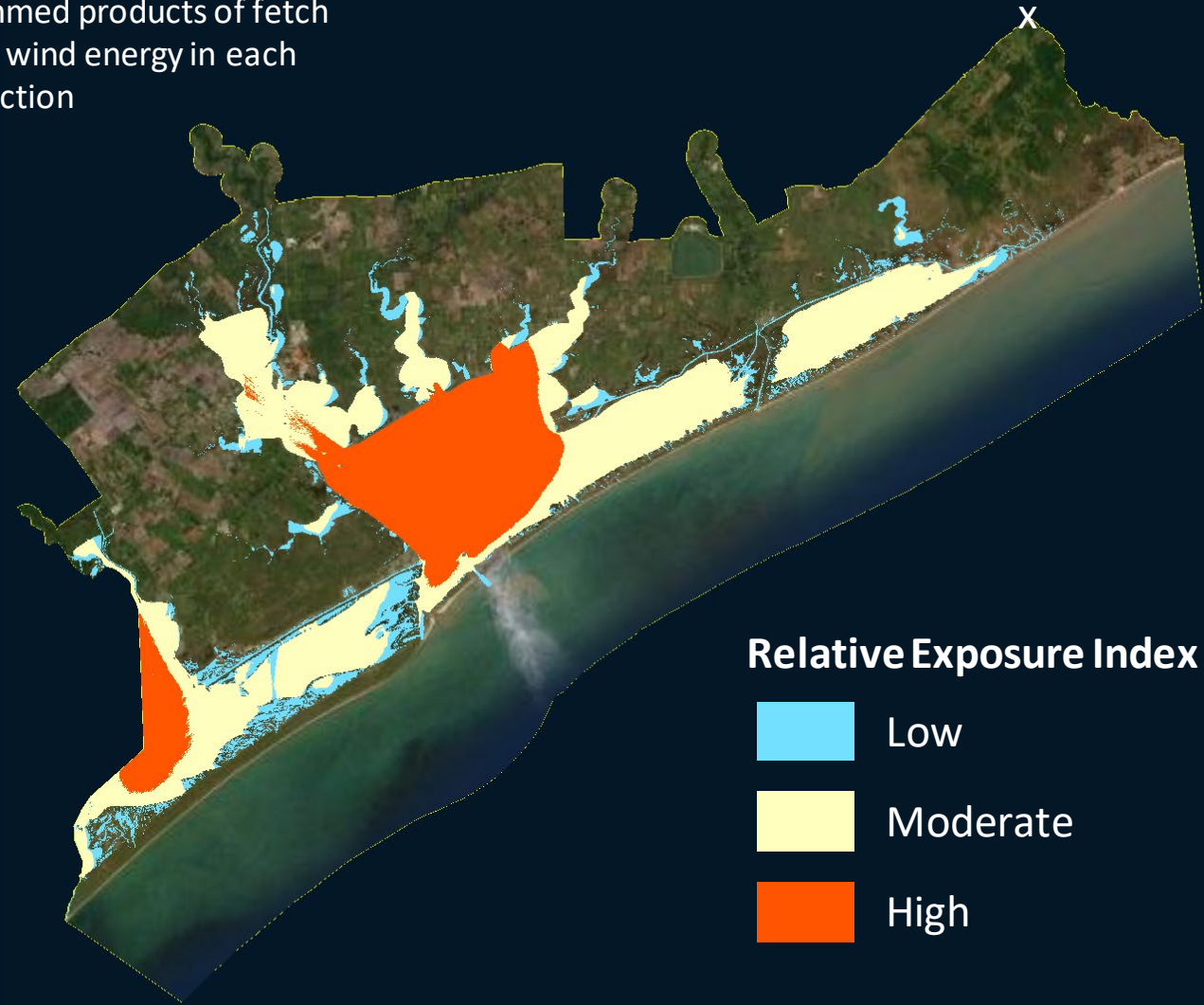
Factor	Data Source	Range
<b>Bathymetry</b>	USACE	Shallow Deep
<b>Relative Exposure Index</b>	NOAA Wind gauges; USGS Fetch Model	Low Moderate High
<b>Shoreline Type</b>	HRI mapped Environmental Sensitivity Index	Beach or Marsh Present Scarp Present Armoring Present
<b>Shoreline Change Rate</b>	BEG Historic Shorelines	Stable to Accretion Low Moderate High
<b>Proximity to Channel</b>	HRI Channel Polygon	Large or small channel? Border Near Far



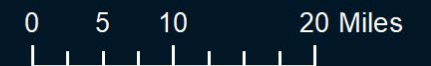
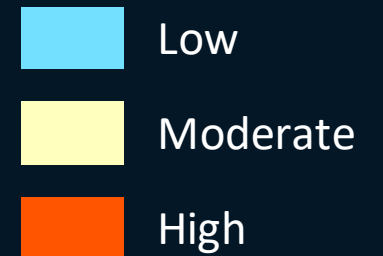
# Model Input Data

Factor	Data Source	Range
Bathymetry	ADCIRC Mesh	Shallow Deep
Relative Exposure Index	NOAA Wind gauges; USGS Fetch Model	Low Moderate High
Shoreline Type	HRI mapped Environmental Sensitivity Index	Beach or Marsh Present Scarp Present Armoring Present
Shoreline Change Rate	BEG Historic Shorelines	Stable to Accretion Low Moderate High
Proximity to Channel	HRI Channel Polygon	Large or small channel? Border Near Far

- 10 years of wind data
- Calculated average wind speed every 22.5 degrees
- Summed products of fetch and wind energy in each direction



**Relative Exposure Index**





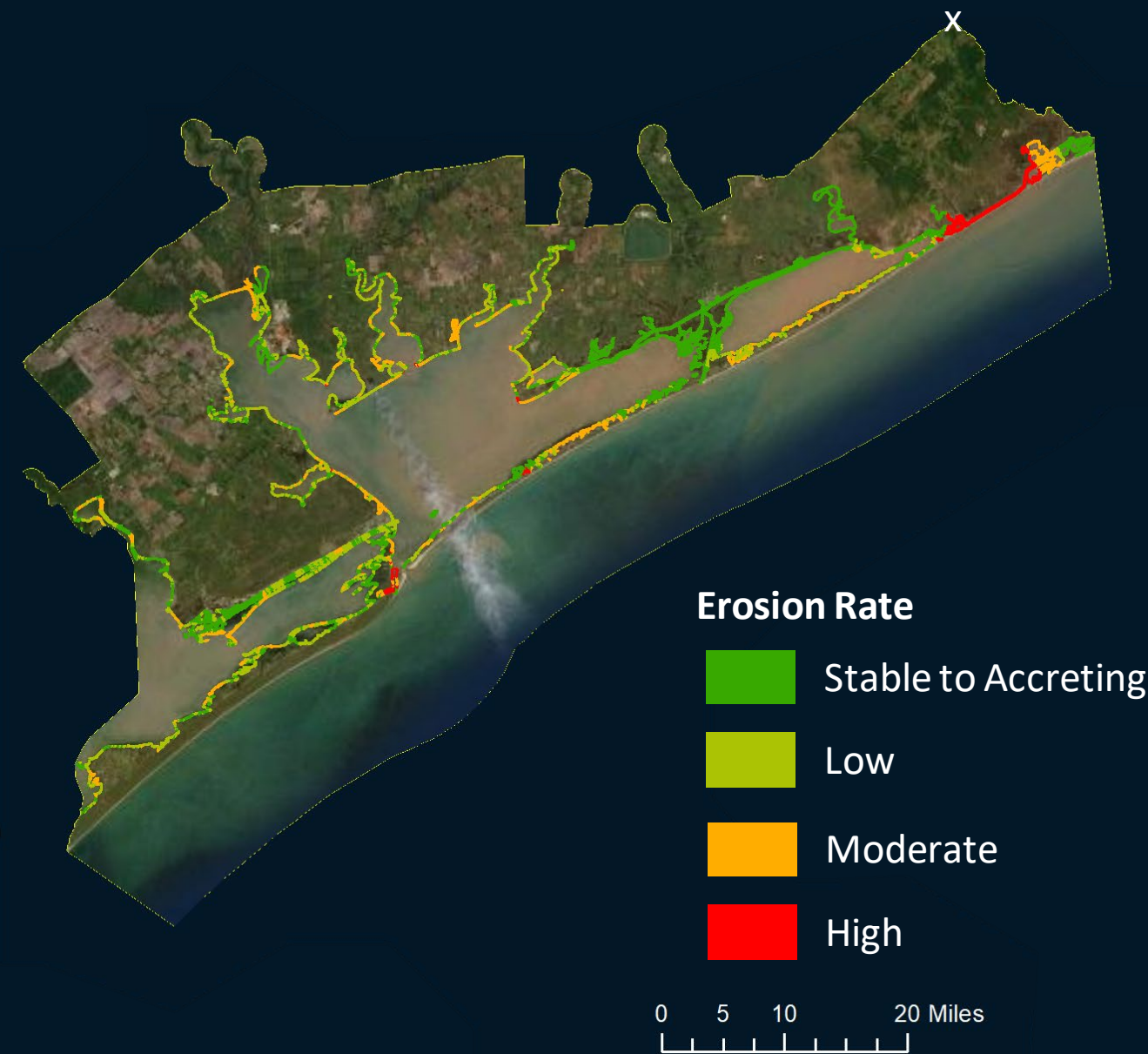
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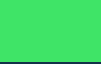






# Integrated model: what is changing?

- Integrating the VIMS Shoreline Management Model (SMM v5.1) and Galveston Bay Foundation model with the HRI Site Suitability Model
  - Adding:
    - Submerged aquatic vegetation
    - Tributaries
    - Oysters
    - Boat ramps
    - Conservation areas
  - Incorporating newest available data



# Site Suitability Output (original HRI model)

Map Symbol	LS Technique	Percent of Shoreline
	Soft Stabilization	43%
	Hybrid Stabilization	40%
	Retrofit: Soft Stabilization	2%
	Retrofit: Hybrid Stabilization	5%
	Not Suitable	10%





# Summary

- Living Shoreline Site Suitability Model developed to indicate potential for different shoreline stabilization techniques
  - Only recommendations based on available data – not the absolute answer to what technique should be used
  - Other factors should be considered
- Original HRI model is available online at <https://storymaps.arcgis.com/stories/d6989e741253424584c06ead83078c5d>
- GBF model is available online at <https://cmap2.vims.edu/GBShoreProtectViewer/>
- Integrated model will be available later this year
- Please contact HRI if you have any questions – [rhiannon.bezore@tamucc.edu](mailto:rhiannon.bezore@tamucc.edu)



# GLO Living Shorelines Resources and Tools

## Upcoming Living Shorelines GLO website

<https://glo-livingshorelines.com/> (demo)

- Manual and more
- Build
- Map “inventory”



## Current GLO Website

<https://www.glo.texas.gov/coast/coastal-management/permitting/index.html>

- Living shorelines manual
- Visual site assessment
- 2020 Living shoreline virtual workshop
- Plantings

Suitability model - HRI





# Permits, leases, & authorizations

Authorizations needed are dependent on project scope, components, and location.

- USACE: Individual Permit (IP) or Nationwide Permit (NWP)
- GLO: Coastal Boundary Survey and lease
- TPWD: planting permit

Other agencies may be involved through the USACE permitting process.





# GLO Leasing Contacts

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## Galveston

### Permit Service Center

Texas A&M University Galveston  
1001 Texas Clipper Road  
Building 3025, Room 193  
Galveston, Texas 77554  
Phone: 409-741-4057  
Fax: 409-741-4010  
Toll Free: 866-894-7664

## La Porte

### Coastal Field Operations

11811 North D St.  
La Porte, Texas 77571-9135  
Phone: 281-470-1191  
Fax: 281-470-8071

## Corpus Christi

### Permit Service Center & Coastal Field Operations

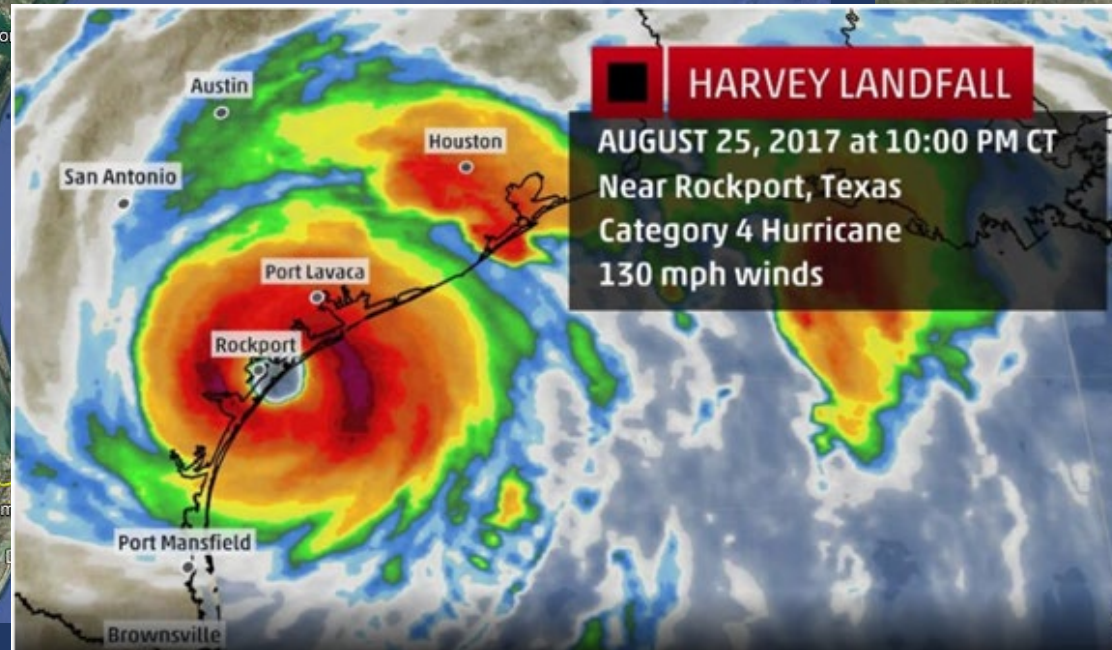
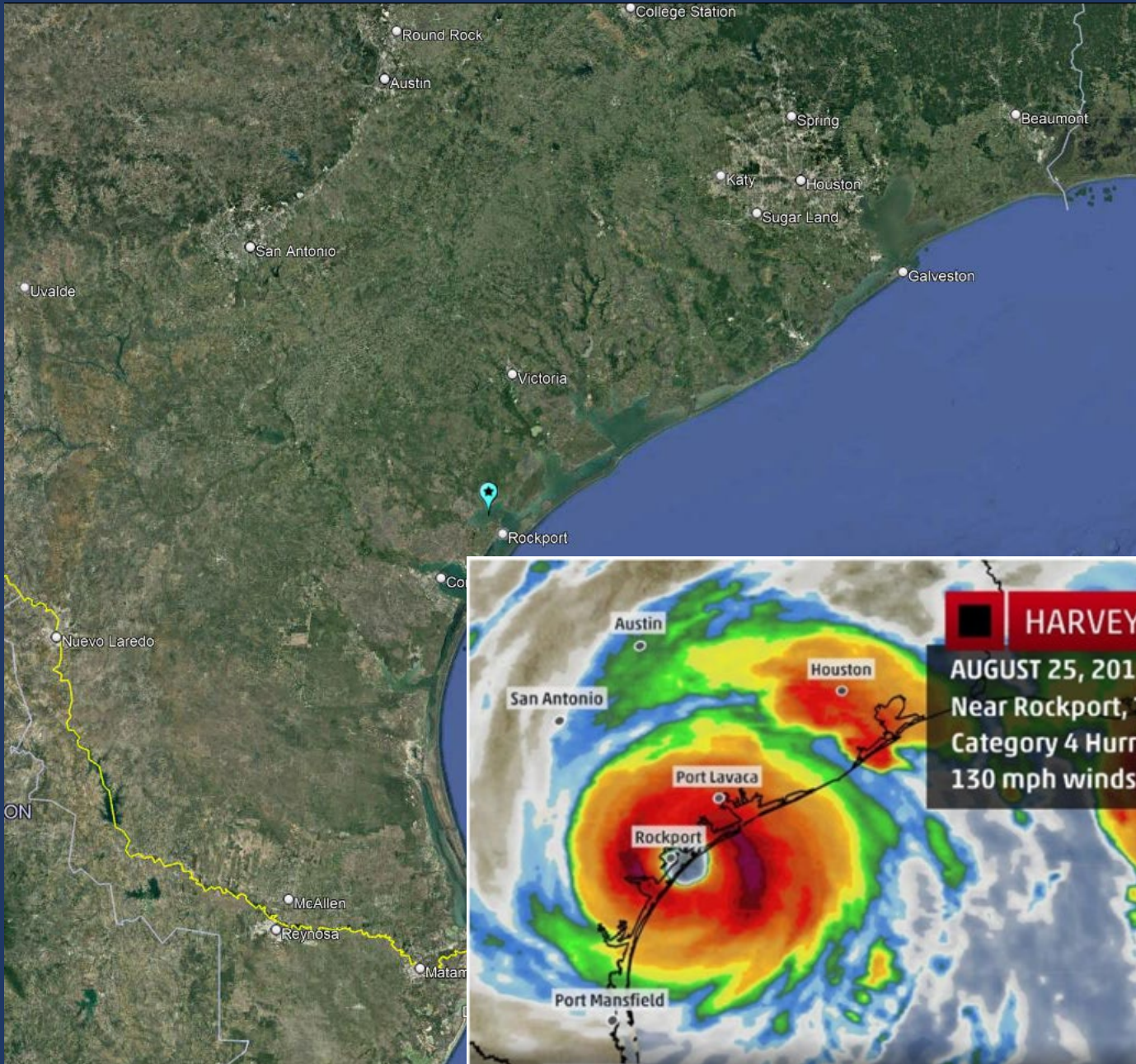
602 N. Staples Street, Suite 240  
Corpus Christi, Texas 78401  
Coastal Field Operations Phone: 361-886-1600  
Permit Service Center Phone: 361-886-1630  
Fax: 361-888-9305

[permitting.assistance@glo.texas.gov](mailto:permitting.assistance@glo.texas.gov)





# **Success Stories**



# Driscoll Rooke Park, Bayside TX

Texas General Land Office  
George P. Bush, Commissioner



Before: 2003



After: 2020

The Copano Bay Soil and Water Conservation District (CCBSWCD) worked with Coastal Bend Bays and Estuaries Program (CBBEP) to create a hybrid living shoreline project:

- Gently grade the eroding bluff
- Install articulated mat ~500 ft
- Build a sheet pile breakwater ~ 500 ft
- Plant *Spartina alterniflora*
- Project size ~25,500 square feet (0.59 acres)

# Driscoll Rooke Park, Bayside TX

Texas General Land Office  
George P. Bush, Commissioner



08/25/2017

Harvey



03/01/2017  
(Before)



09/20/2017  
(After)



# Copano Ridge Road, Rockport TX

This project was constructed to protect existing bulkheads and upland residential lots from erosion caused by high wave energy and to provide marsh habitat. Oysters have colonized the breakwaters, contributing to the ecosystem's habitat and the structure's overall effectiveness.



February 2020



- Bulkhead
- Rock rubble breakwater: 1,570 linear feet
- *Spartina alterniflora* planted: 13,068 square feet (0.3 acres)
- Project size ~108,340 square feet (2.49 acres)



# UPPER COAST

## Success Stories

1 in = 5 miles

Image Source: ESRI World Imagery



# Clear Lake Forest Park

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**INSTALLATION:** 2011

**RESULTS:**

~ 570 LF of shoreline protection

~ 0.40 ac of marsh restored

**TECHNIQUE:** Retrofit hybrid

*Low-profile rock breakwater*

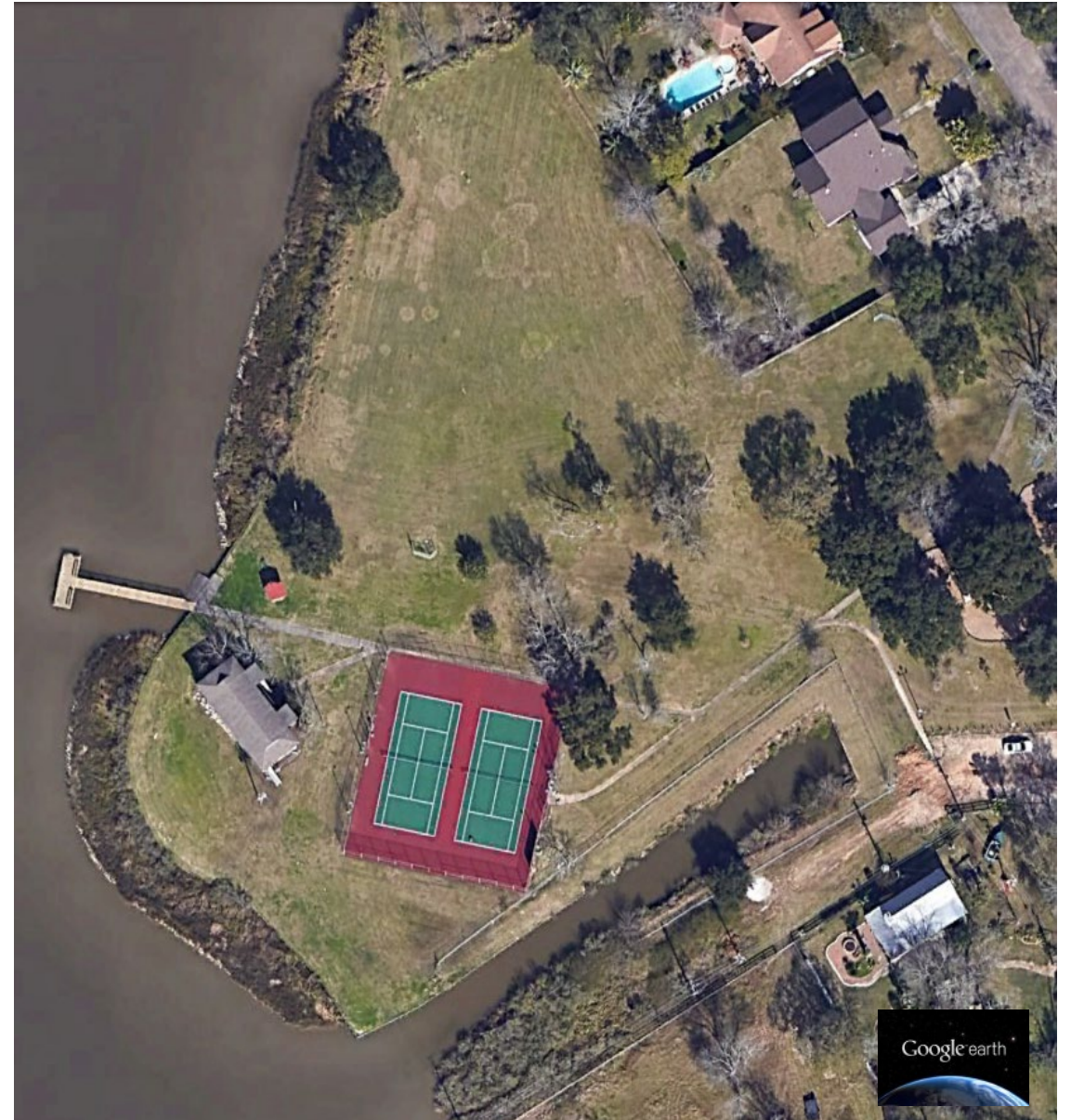
*Fill + marsh planting*



**BEFORE (2006)**



**AFTER (2019)**



# Sullivan Property

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**INSTALLATION:** 2011 & 2013

**RESULTS:**

~ 980 LF of shoreline protection

~ 2.00 ac of marsh restored

**TECHNIQUE:** Hybrid Stabilization

*High-profile rock breakwater*

*Marsh planting*







## **TOOLS & RESOURCES**

### **LIVING SHORELINES ACADEMY**

<https://www.livingshorelinesacademy.org/>

### **TX GENERAL LAND OFFICE WEBSITE**

<https://www.glo.texas.gov/coast/coastal-management/permitting/index.html>

*\*new version coming soon*

### **A GUIDE TO LIVING SHORELINES IN TEXAS (GLO)**

<https://cleancoast.texas.gov/documents/guide-to-living-shorelines-texas.pdf>

### **HRI MODEL**

<https://storymaps.arcgis.com/stories/d6989e741253424584c06ead83078c5d>

### **GBF MODEL**

<https://cmap2.vims.edu/GBShoreProtectViewer/>

## **LOWER COAST CONTACTS**

**PERMIT SERVICE CENTER:** 361-886-1630

**GENERAL LAND OFFICE:** Kristin Hames  
512-463-9271; [kristin.hames@glo.texas.gov](mailto:kristin.hames@glo.texas.gov)

**COASTAL BEND BAYS & ESTUARIES PROGRAM**  
361-336-0304; [info@cbbep.org](mailto:info@cbbep.org)

## **UPPER COAST CONTACTS**

**PERMIT SERVICE CENTER:** 409-741-4057

**GENERAL LAND OFFICE (LA PORTE):** 281-470-1191

**GALVESTON BAY FOUNDATION:** Haille Leija  
832-536-2270; [hleija@galvbay.org](mailto:hleija@galvbay.org)