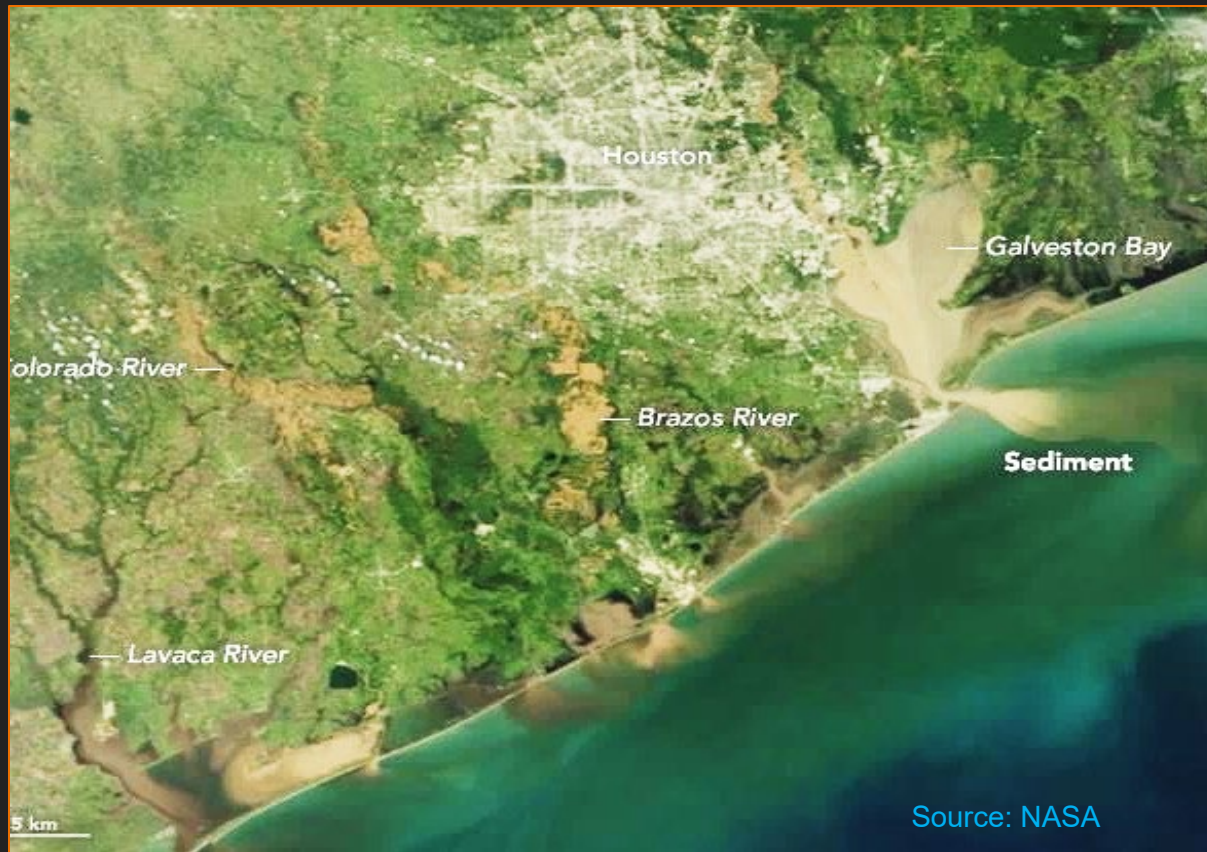


A Regionalization of the Texas GIWW Dredging Areas Under the Concept of Geological Domains



Juan Moya, Ph.D. P.G.

Ray Newby P.G.

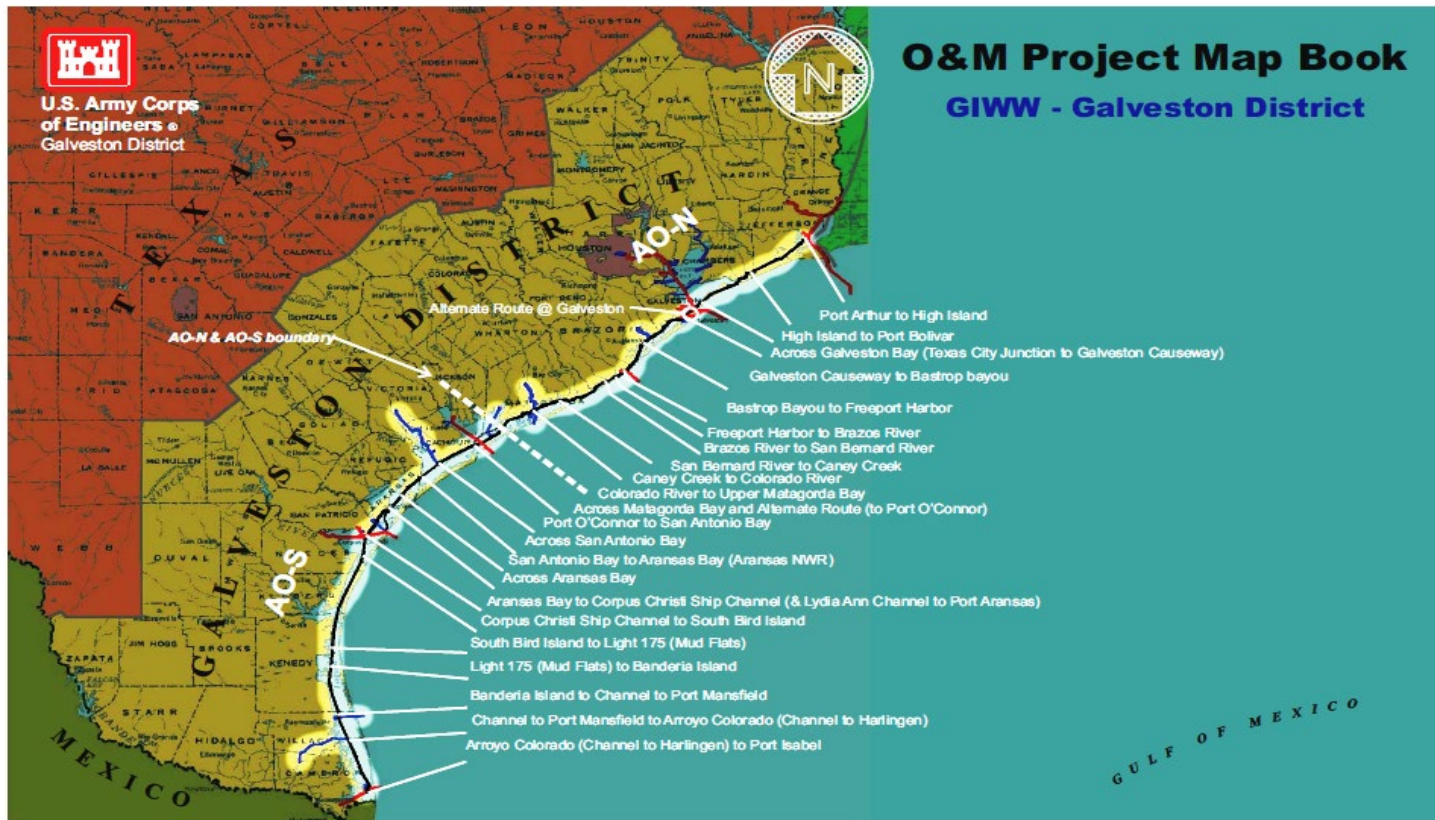
Matthew Mahoney P.G.





Texas GIWW

- 379-mile, shallow-draft waterway that connects 16 ports from the Sabine River to Brownsville, covering 13 Texas coastal counties.
- From 1998 through 2012, an average of 6.2 million cubic yards (cy) of sediments were dredged annually.
- Dredged material was placed in open-water bay disposal sites and inland confined disposal sites.
- ~240 active and inactive DMPAs.

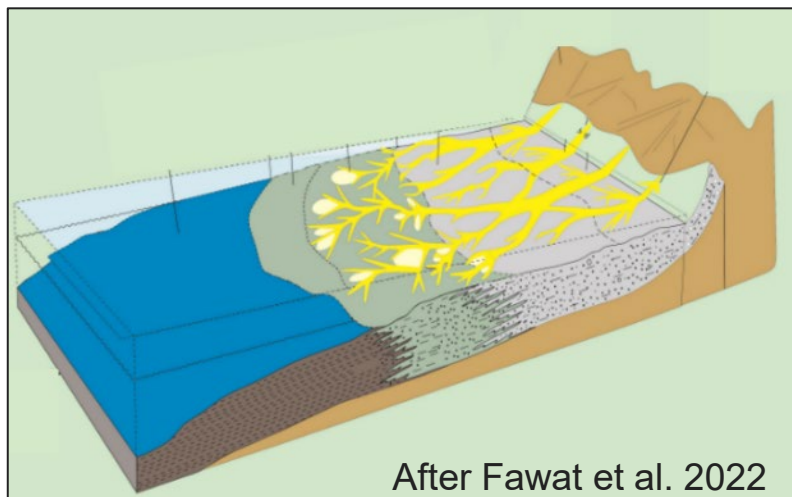




Introduction: Texas Coastal Geology










Texas Coastal Plain:

At least 700,000 years of natural deposition **Building Coastal Land** (Garvin, 2008).



After Fawat et al. 2022

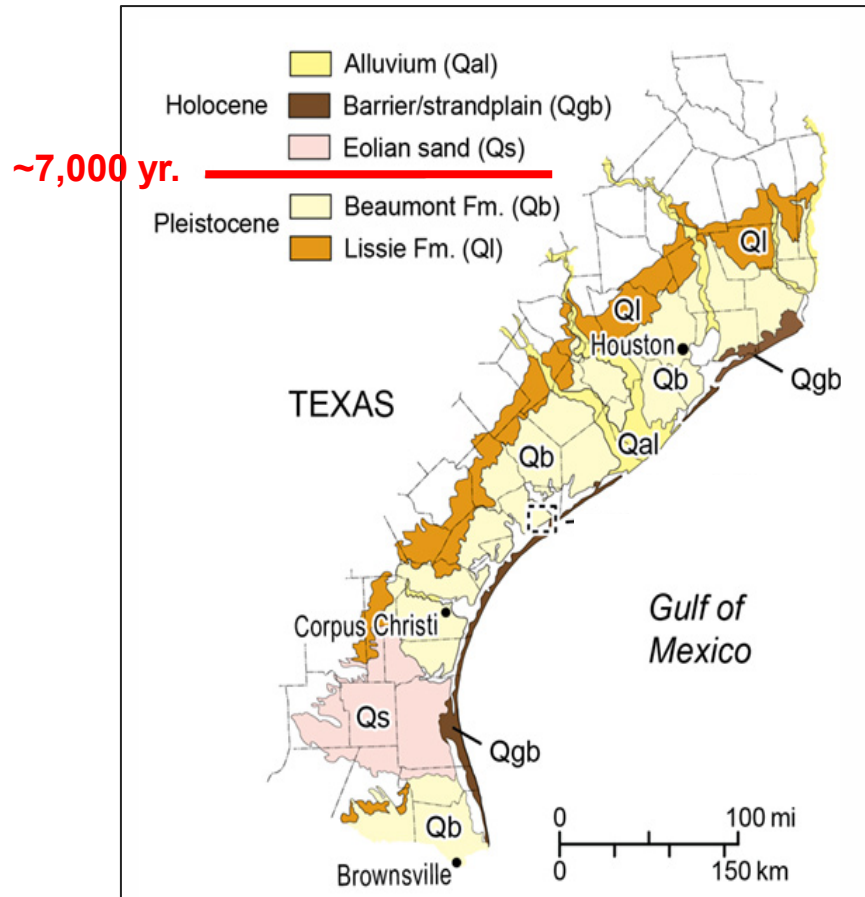
Geological Deposits:

-  Qal Alluvium
-  Qgb Barrier Island
-  Qgbs Strandplain
-  Qs Eolian Sand
-  Qm Mermentau (Marshes)
- 
-  Qbd Deweyville
-  Qbc Beaumont Clays
-  Qbs Beaumont Sands

<7,000 yr.

>7,000 yr.

Soft vs. Consolidated Deposits

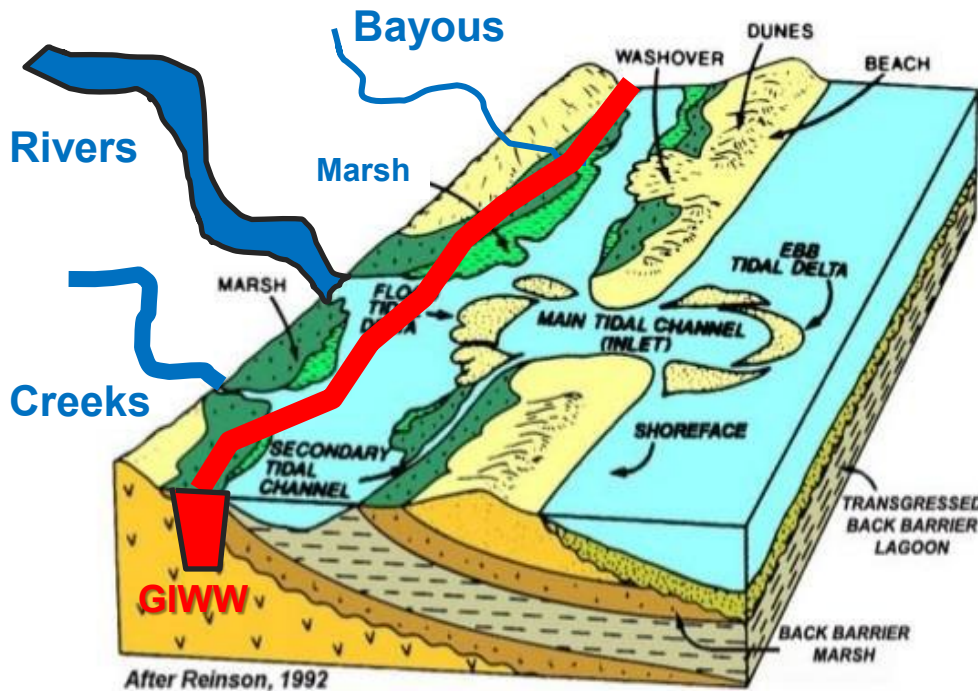
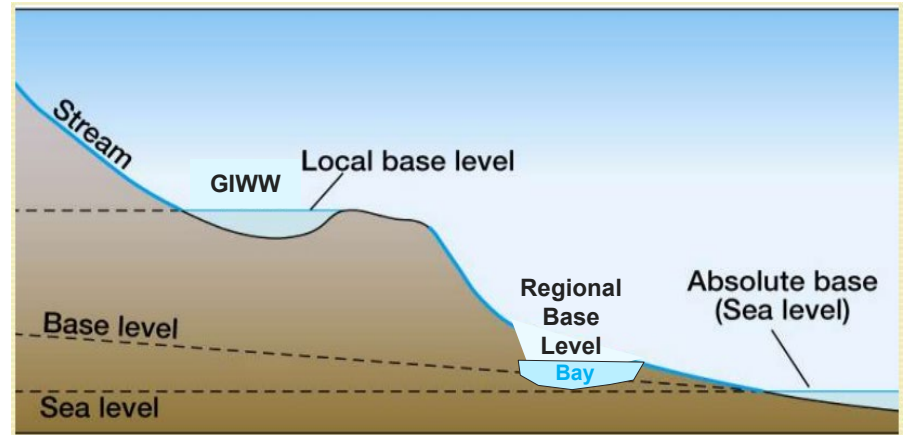
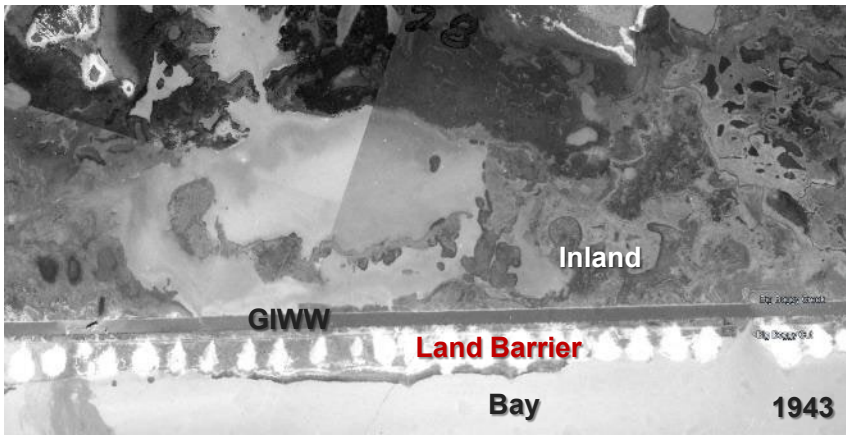


Paine et al. 2018

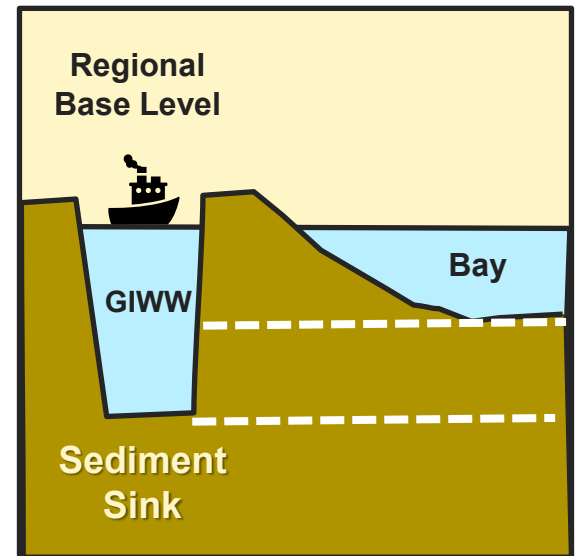


Geological and Geomorphologic Concepts

THE GEOLOGY OF THE GIWW



GIWW: Regional Sediment Sink





Questions:

- How important is the geology and geomorphological processes in the shoaling locations and rates of the GIWW?
- Are these locations distributed randomly or are they the result of specific geomorphologic processes by area?

Geologically, the GIWW acts as a **Depocenter**; an area or site of maximum deposition, or the geographic location of the thickest part of any ***depositional basin***. **GIWW is a depositional basin.**

Previous Work:

TXDOT-USACE conducted the inventory of the GIWW DMPAs.

- Opened new questions: What are the GIWW shoaling sources?

Geologic-Geomorphologic Model for the Sources of Shoaling along the GIWW

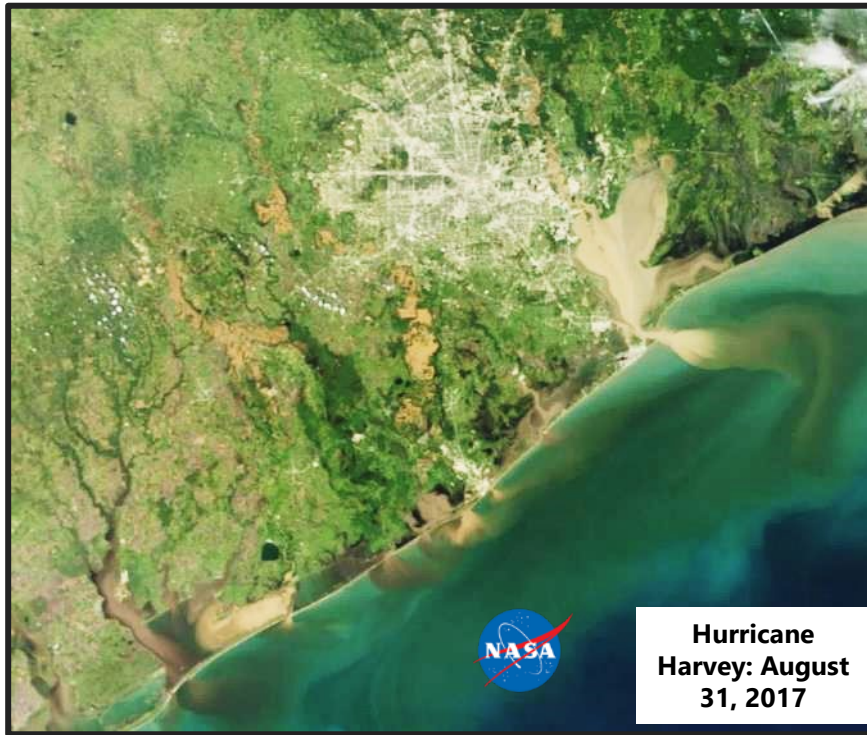
Methodology: - Analysis of hundreds of historic aerial photos
- Geology and Geomorphology (Potential sources of sediment)
- Historic dredging data



Sediment Shoaling the GIWW: Coastal Storms, El Niño

THE GEOLOGY OF THE GIWW

***Brazos River Delta Sediments: El Niño Cycles (Fratlicelli, 2010)**



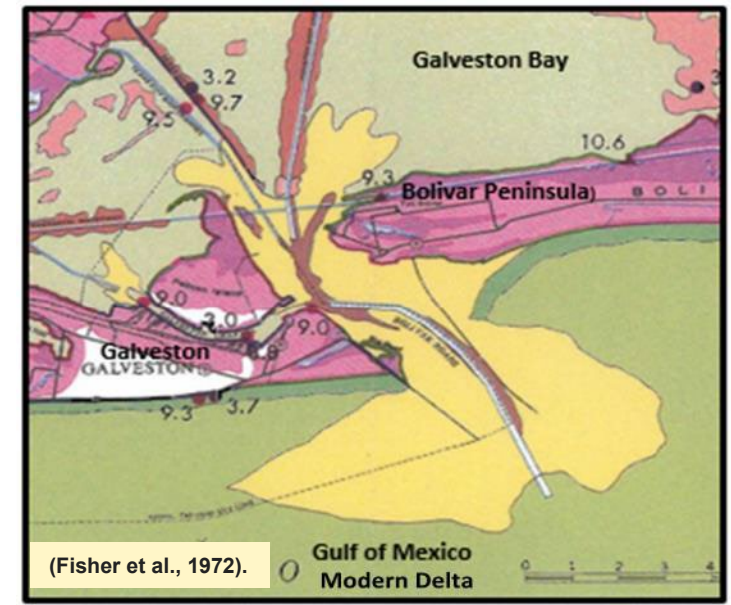


Sediment Shoaling the GIWW: Inlets and Bays

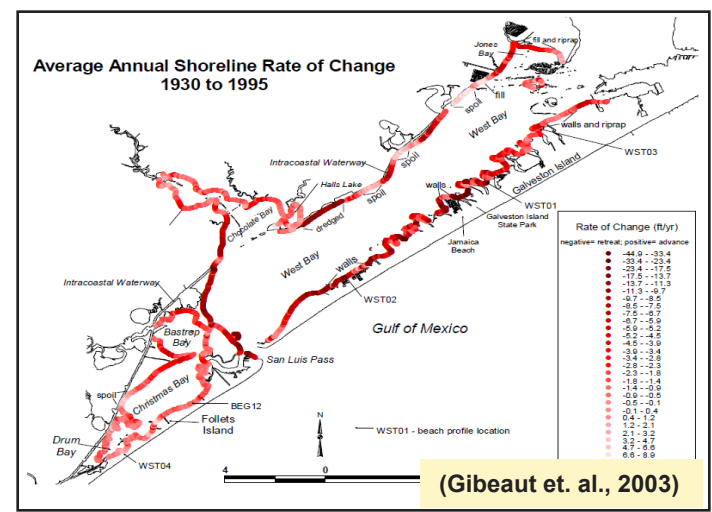
Gulf Inlet



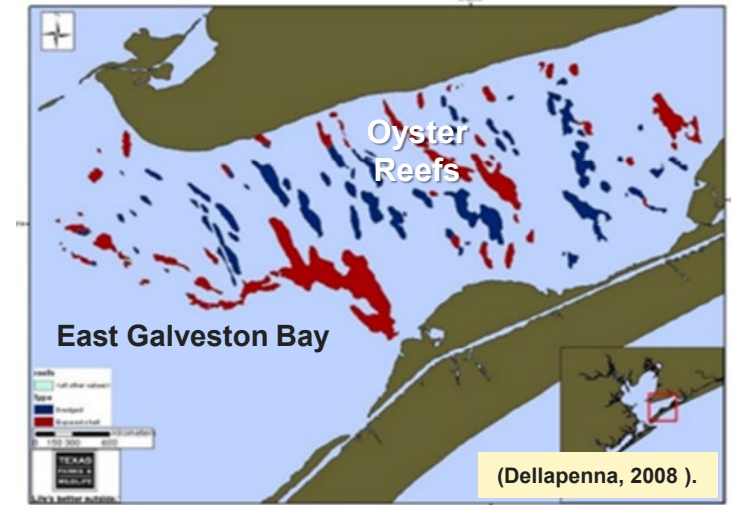
Galveston Inlet



Bay Shoreline Erosion



Bay Bottom Erosion





Sediment Shoaling the GIWW: Streams, Marshes, Land Gaps

Rivers



Inputs from Creeks and Marshes



GIWW-Bay Land Gaps



GIWW Bank Erosion





USACE-GIWW Historical Dredging Data

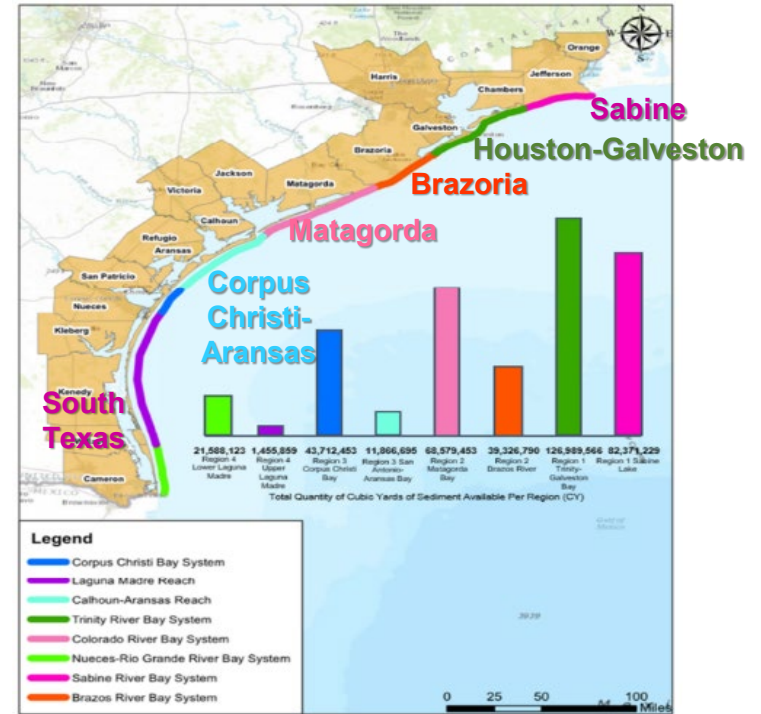


Source: Moya et al. 2016 (Freese and Nichols)
Funded by GLO.

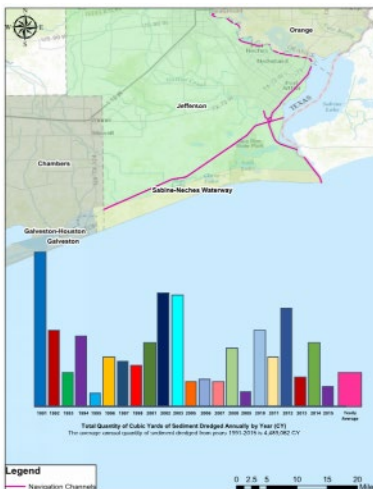
USACE Galveston District Cumulative Dredged Material by System (1991-2015).

Methodology:

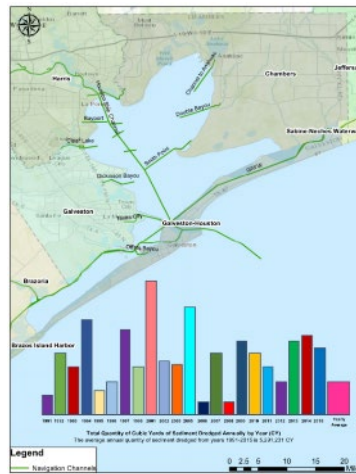
Focus on dredged areas with >500,000 cy. on the GIWW



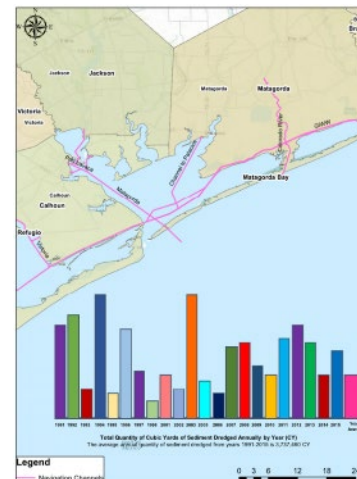
Sabine



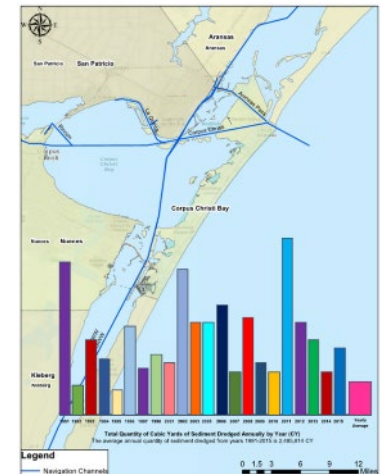
Houston-Galveston



Matagorda



Corpus Christi



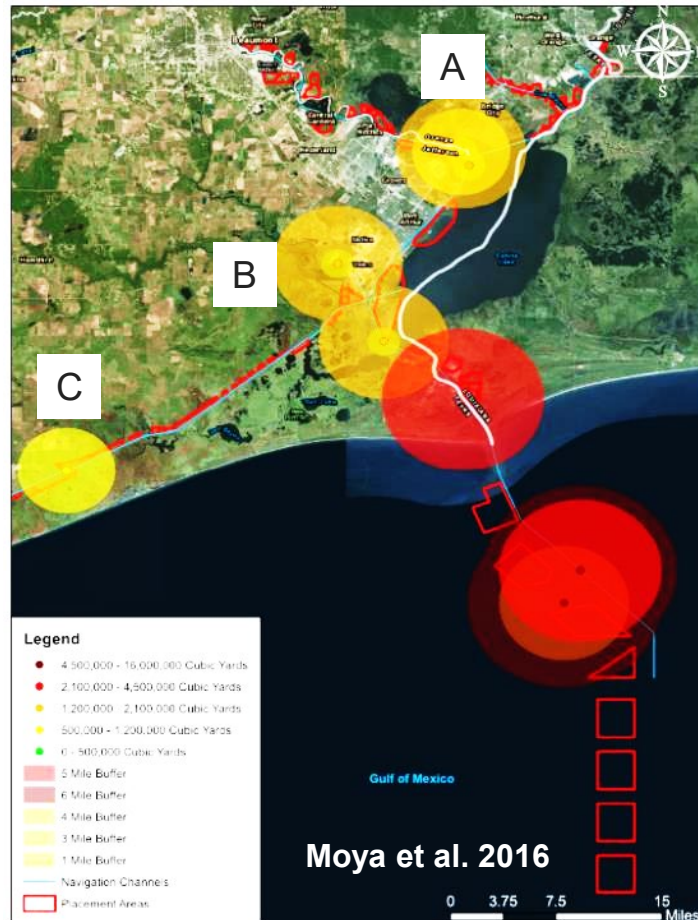


Sabine GIWW: Dredging vs Source

A: Neches River-Marshes

B: Sabine River

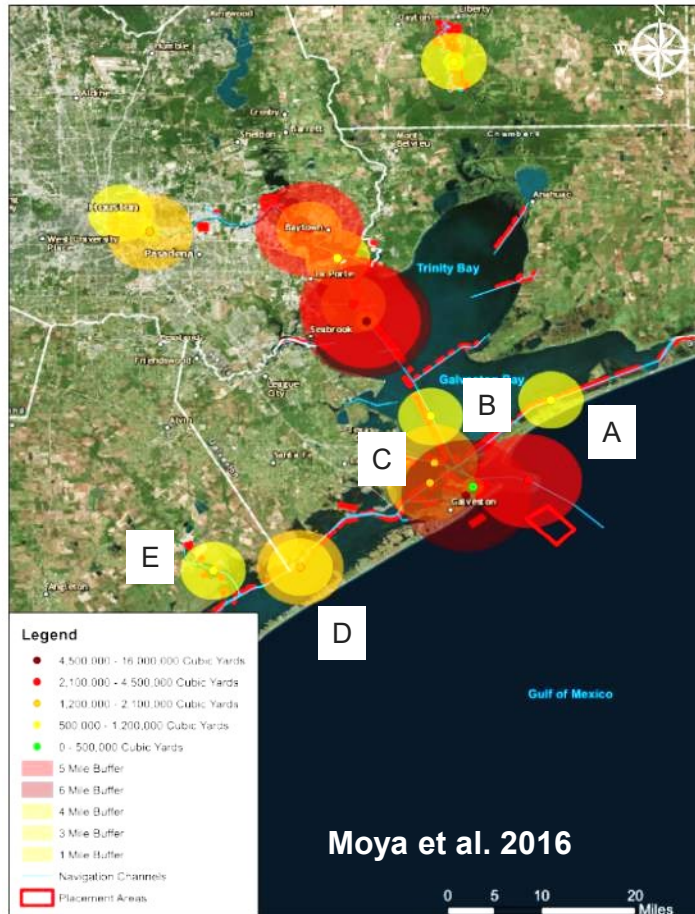
C: Local Bayous, Marshes, Shorelines





Galveston GIWW: Dredging vs Source

- A: GIWW-Bay Land Gap
- B: Gulf Inlet and Bay Circulation
- C: Gulf Inlet and Bay Circulation
- D: GIWW-Bay Land Gap
- E: Bay Circulation and Bayou Inputs





GIWW-Houston Ship Channel: Mouth of Large Watersheds

Geomorphic Role of Bolivar Roads:

- Largest Inlet in Texas.
- Mouth of large watersheds during coastal storms
- Largest concentration of active TX coastal sediments.
- Largest Economic Driven Inlet in the Gulf of Mexico





GIWW-Houston Ship Channel: USCG Bolivar Flare Groundings 2022

THE GEOLOGY OF THE GIWW

- Grounding
- Allision
- Collision

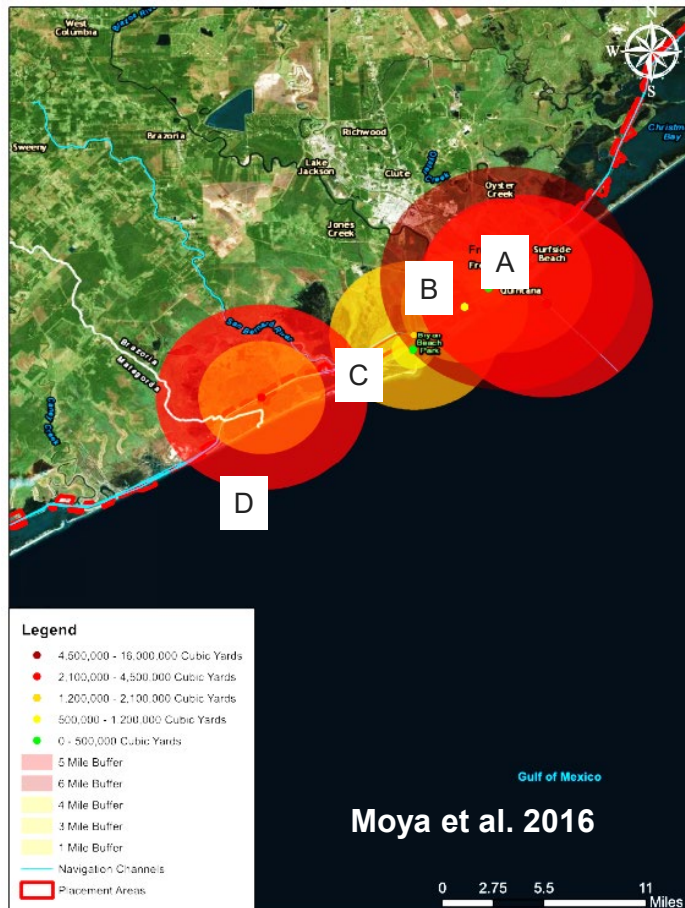


US Coast Guard 2023



Brazoria GIWW: Dredging vs Source

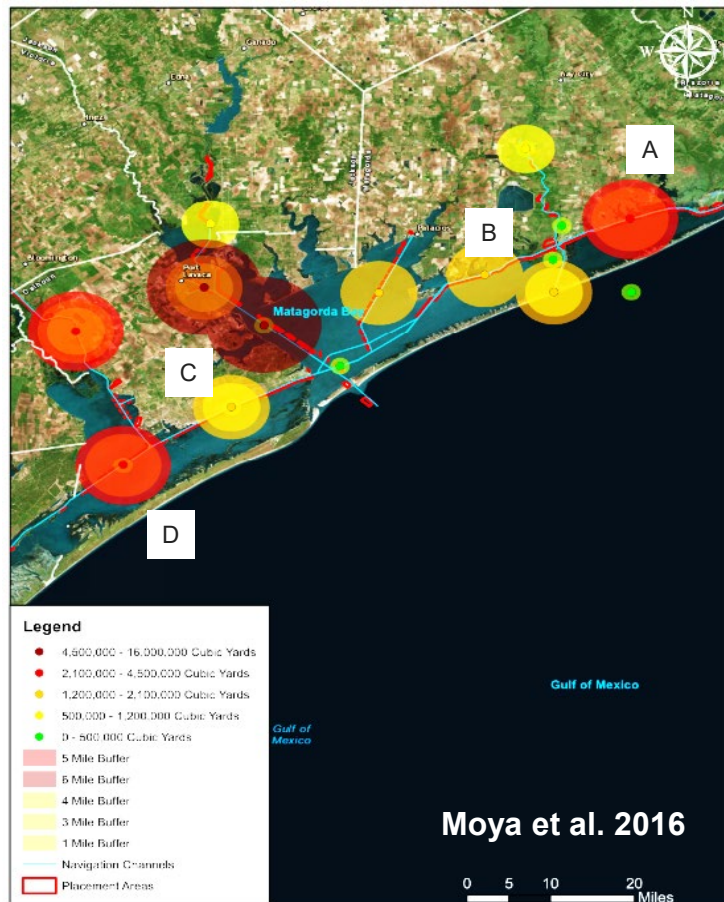
- A: Port Freeport Channel-Inlet, Brazos River
- B: Brazos River
- C: San Bernard River, Brazos River
- D: Marshes and Bayous





Matagorda GIWW: Dredging vs Source

- A: GIWW-Bay Land Gap
- B: Marshes, Bayous, GIWW-Bay Land Gap
- C: GIWW-Bay Land Gap, Shorelines
- D: Bay Circulation, San Antonio River

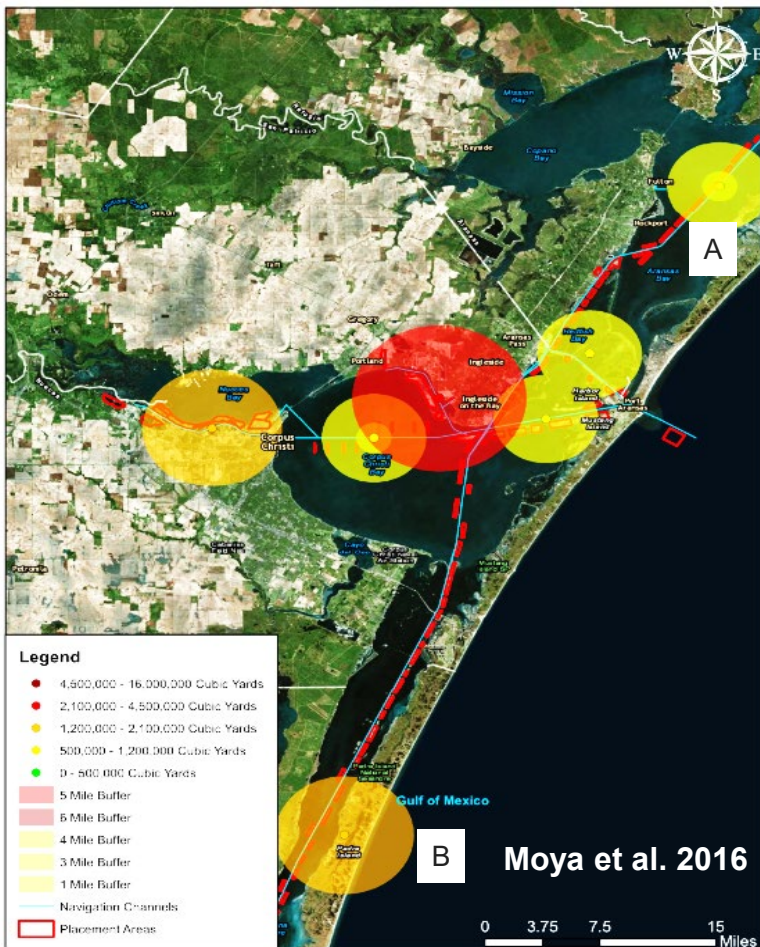




Corpus Christi-Aransas GIWW: Dredging vs Source

A: Bay Circulation

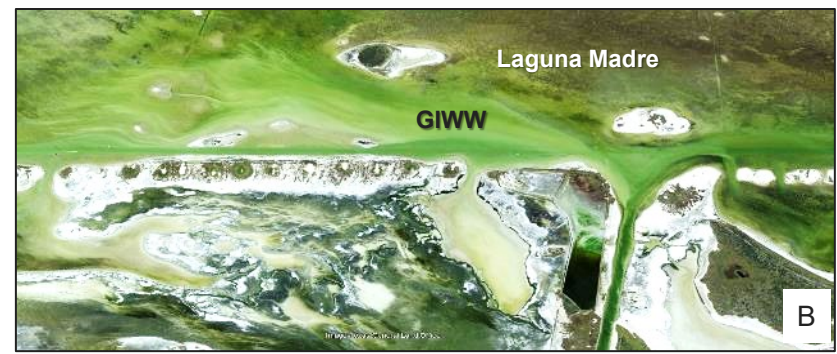
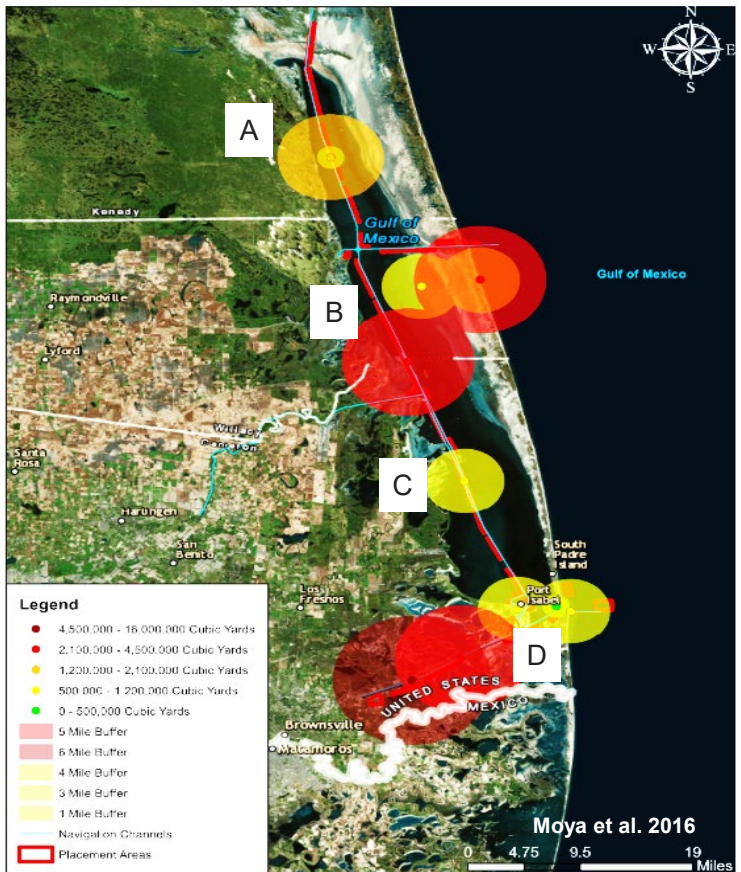
B: Bay Circulation and Shoreline Erosion





South TX GIWW: Dredging vs Source

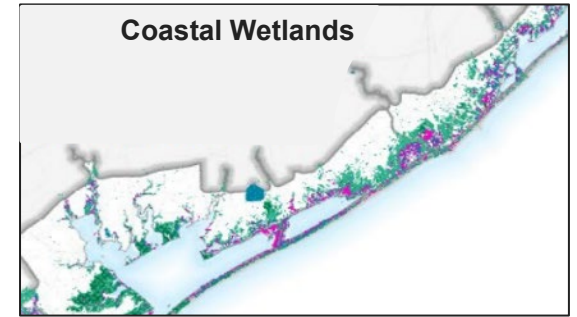
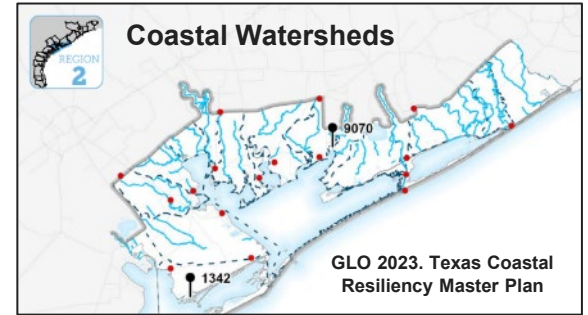
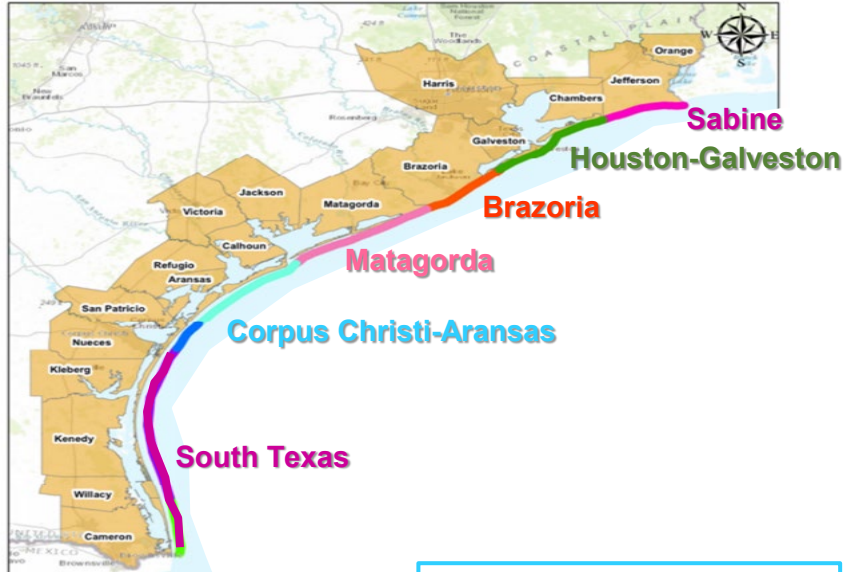
- A: Bay Circulation and Shoreline Erosion (Barrier Island and Landside)
- B: Arroyo Colorado, Shoreline Erosion
- C: Bay Circulation and Bay Bottom Erosion
- D: Inlet and Bay Circulation



THE GEOLOGY OF THE GIWW



Qualitative GIWW Regional Dredging Analysis of Shoaling Processes



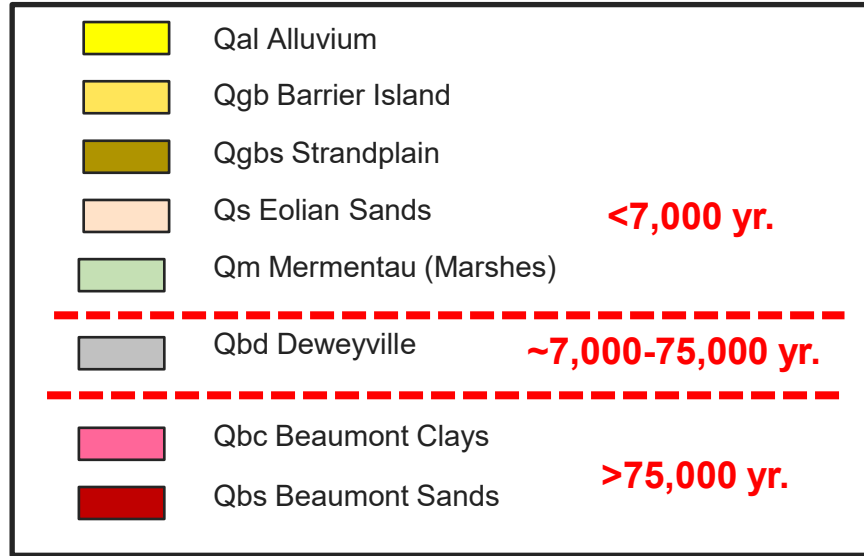
Shoaling from Local Watersheds

Region	Inlets	Bay Circulation	Creeks and Bayous	Marshes	Bay Erosion: Bottom and Shorelines	Rivers & Deltas	GIWW Shorelines	GIWW-Bay Gaps
Sabine			X	X		X	X	
Houston-Galveston	X	X	X	X	X		X	X
Brazoria	X		X	X		X	X	
Matagorda		X	X	X	X	X	X	X
Corpus Christi-Aransas		X			X		X	
South Texas	X	X	X		X		X	X

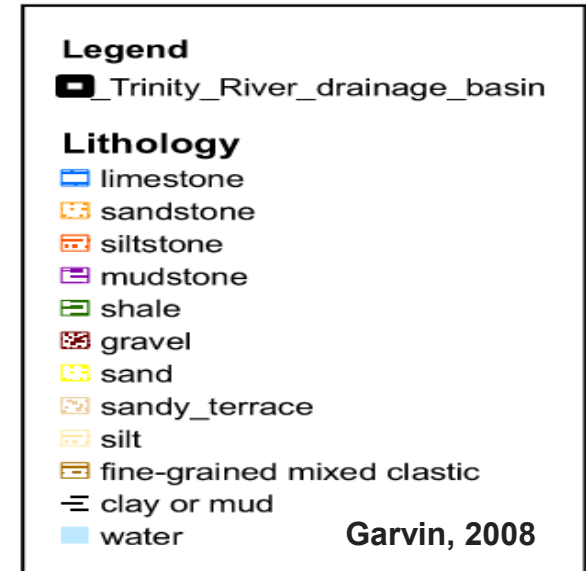


Quantitative GIWW Regional Dredging Analysis of Shoaling Processes

Geological Formations



Lithological Conditions



Region	Inlets	Bay Circulation	Creeks and Bayous	Marshes	Bay Erosion: Bottom and Shorelines	Rivers & Deltas	GIWW Shorelines	GIWW-Bay Gaps
Sabine			X	X		X	X	
Houston-Galveston	X	X	X	X	X		X	X
Brazoria	X		X	X		X	X	
Matagorda		X	X	X	X	X	X	X
Corpus Christi-Aransas		X			X		X	
South Texas	X	X	X		X		X	X

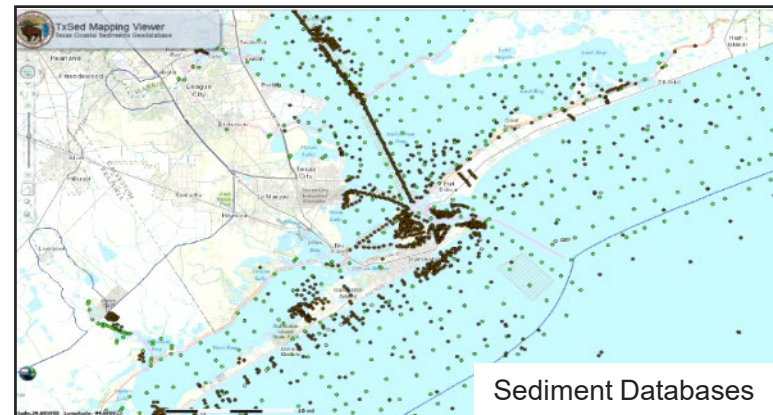
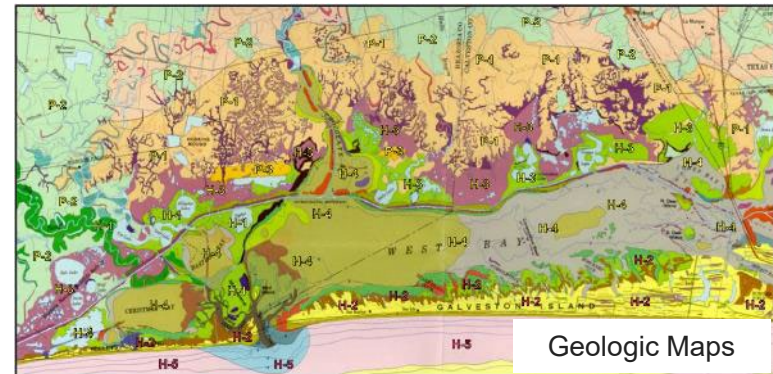
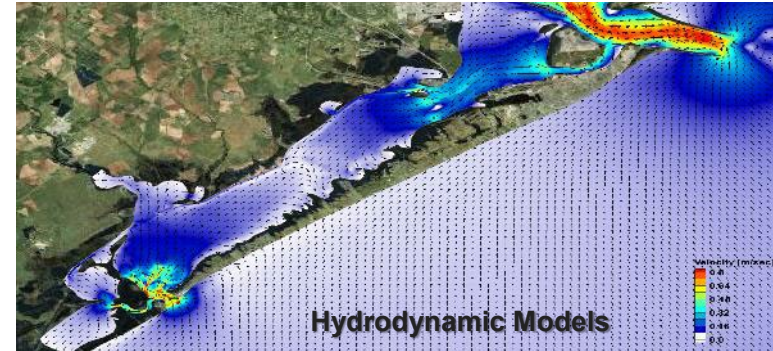
Conclusion: Where is the GIWW Shoaling Sediment coming from?

- Specific geology and geomorphological processes control shoaling areas along the GIWW
- Shoaling under Geomorphology:
Nature is Building Land
- Shoaling under Navigation:
Economic Impact-Maritime Disruption
- **Geology Matters!** The clays, silts, and sands in the GIWW can tell a story.
- New data can improve the analysis: models, geology, cores, grainsize, etc.

A Nature-Based Solution Goal:

Keep the sediment in the natural system when involves marshes and watersheds
 = **Natural Sediment Management**

Flood control projects that flush the waters will add more sediment to the GIWW.





Questions?



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Ray Newby P.G. Ray.Newby@txdot.gov

