



# Brazos Island Harbor Inlet Study

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Nathan Mays (JSU)

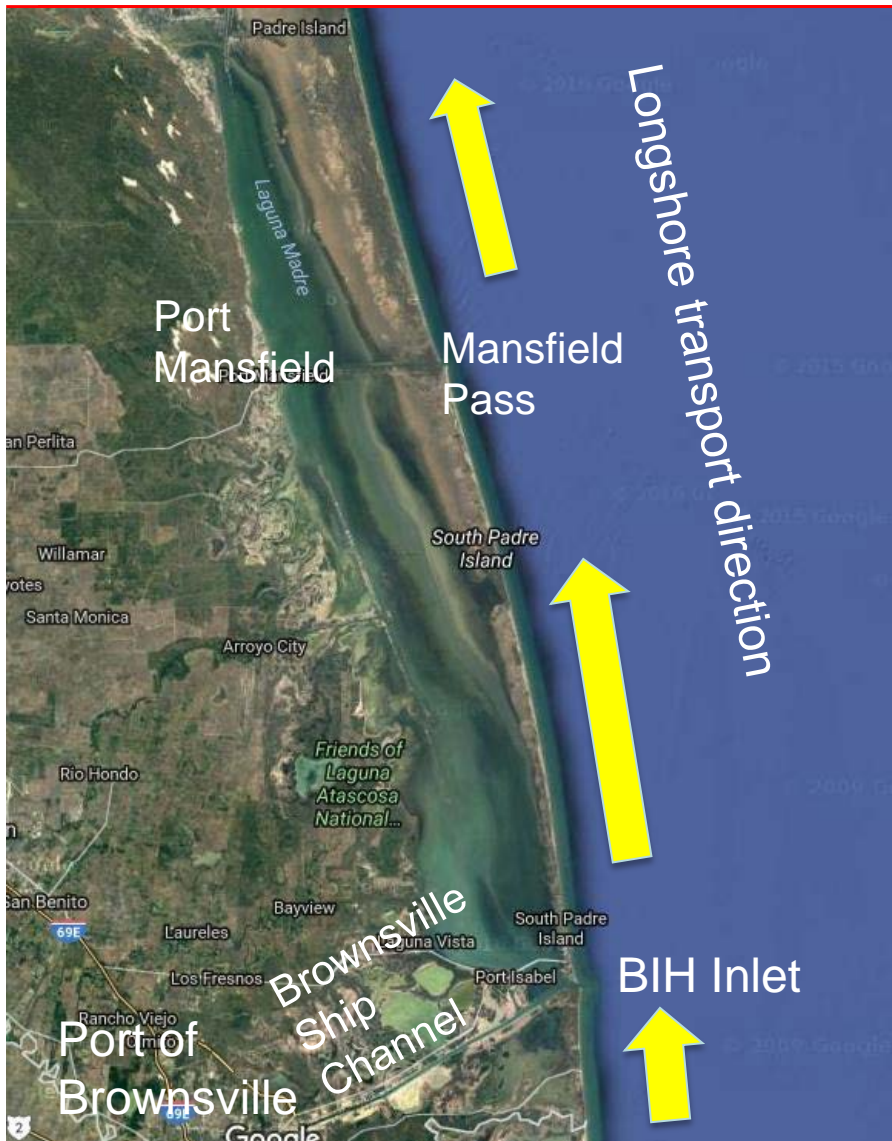
Products:

- TN: "Shoaling Analysis at Brazos Island Harbor Inlet, Texas "
- TR: "Brazos Santiago, Texas Inlet Sedimentation Study (Sept 30)
- CIRP Seminar (Sept 27)





# BIH Inlet Study: Background



Lower Laguna Madre system is a complex hydrodynamic environment.

System includes Port Mansfield and Mansfield Pass to the north and Brazos Island Harbor Inlet (BIH) to the south.

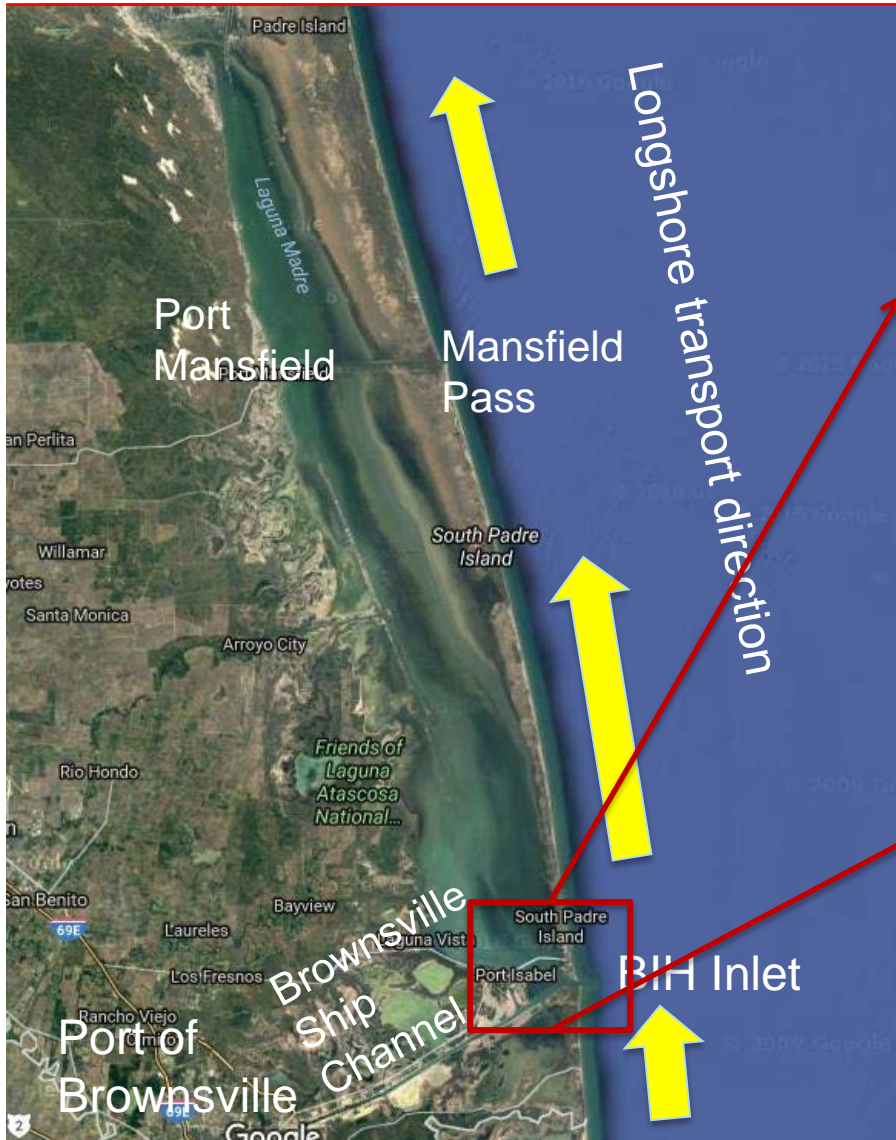
The BIH serves as an entrance for the Brownsville Ship Channel to the Port of Brownsville

Flow through Mansfield and Brazos Island Harbor Inlet impacts the overall transport dynamics of the system.

The alongshore transport of sediment is northward



# BIH Inlet Study: Background



Longshore transport of sand provides a sediment source for shoaling within the jetty expansion



# BIH Inlet Study: Motivation

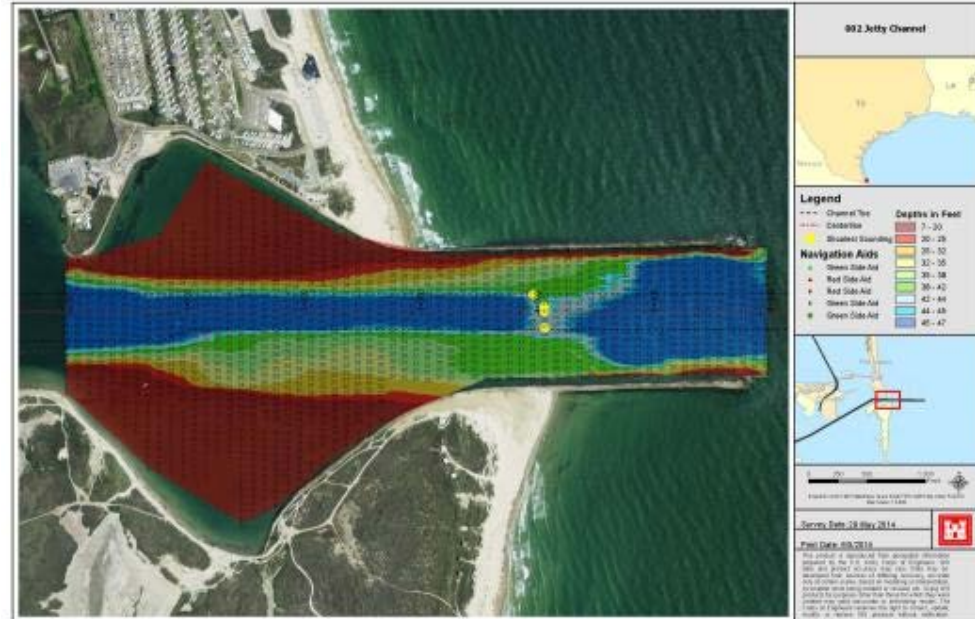
The Port of Brownsville, the only deepwater port located on the U.S. and Mexico border, provides a full range of services to ensure efficient and time cargo delivery worldwide.

Unfortunately harbor pilots have frequently reported increased shoaling within the Brazos Island Harbor Jetty Channel.

The shoaling, has resulted in implementation of 35 to 36 ft draft restrictions 9 to 12 months after maintenance dredging

The increased frequency of channel shoaling has posed a challenge for the USACE in maintaining the currently authorized depth of 44 ft MLT, resulting in vessels being sent to other ports

Annual cost of over \$5.7 million per year for a 38 ft draft restriction and could escalate to over \$19.4 million for a 35 ft draft restriction



Brazos Island Harbor Inlet Bathymetric Survey

Dredge depth = 44 ft



# BIH Inlet Study: Objective

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- Determine if inlet shoaling patterns have changed during the time when the inlet has been maintained at its current design configuration (1992 to present)
- Understand the shoaling process in BIH Inlet and provide the Galveston District with suggested sand management alternatives to reduce inlet maintenance dredging costs.
- Included in the formulation of reduced dredging cost alternatives is the understanding of the continuing need to provide beach-quality sediments to the South Padre Island gulf shoreline.



# BIH Inlet Study: Approach

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Task	Dates
Background Investigation and PMP Development	FY14
Application of the Navigation Shoaling Analysis Tool (NSAT)	FY14/15
1YR Field Data Collection	FY14/15
Numerical Modeling : Hydrodynamics and Wave	FY15
Numerical Modeling : Sediment Transport	FY15/16
Alternatives Investigation	FY16
Final Documentation	FY16



# Historical Dredging Frequency Analysis

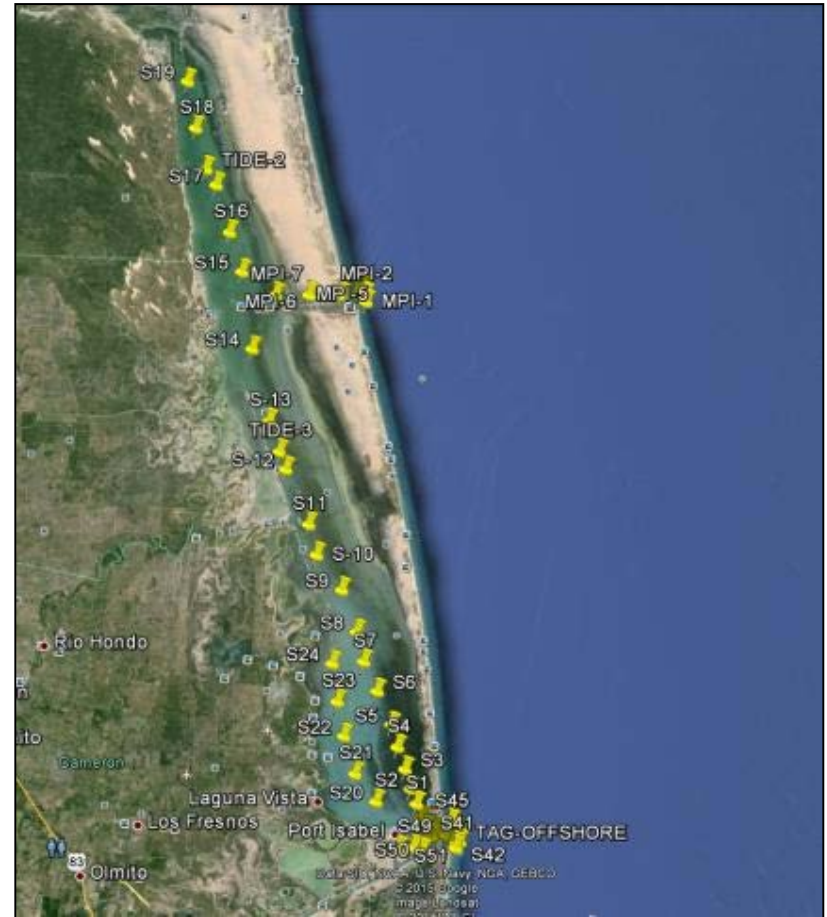
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- Navigation Shoaling Analysis Tool (NSAT) was used to analyze historical dredging data.
- Trends show an increased frequency of dredging over the last 20 years.
- Prior to 1995, dredging was sometimes performed as infrequently as every 3 years or more.
- In the last five years especially dredging has increased to approximately 1.25 years with one occurrence of 0.75 years in 2011.
- Little change in the total volume of material to be dredged



# Field Data Collection

- **1-year Field Data Collection effort:**
  - Wave and current (AWAC) measurements offshore of the inlet
  - Tidal gages collected water levels at 7 stations at BIH and Laguna Madre at strategic locations around the inlet and offshore. One station included a weather station.
  - Multi-beam surveys performed around the inlet and north and south of jetties
  - Bed sample collection (grain size and organic content) were performed at 60 stations



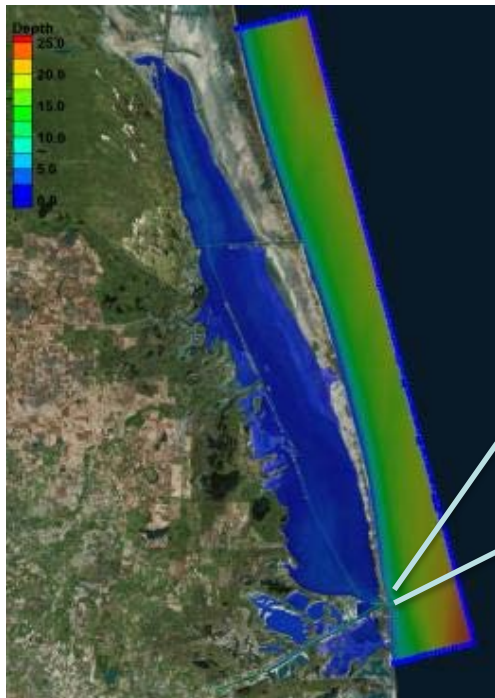
Sediment Collection Map



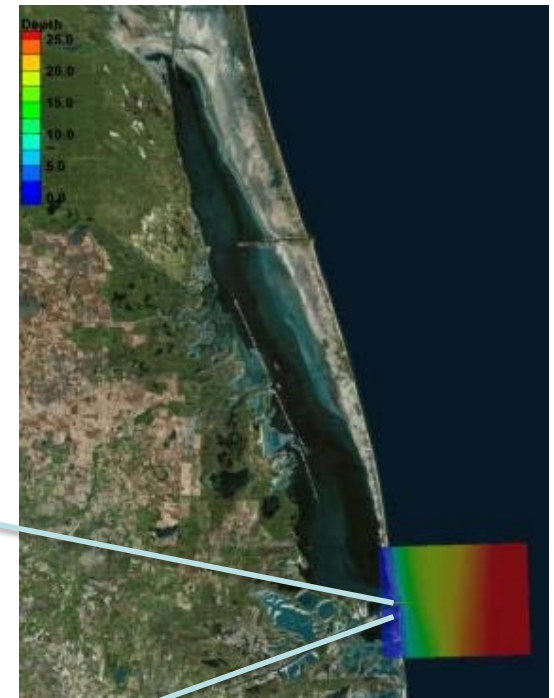
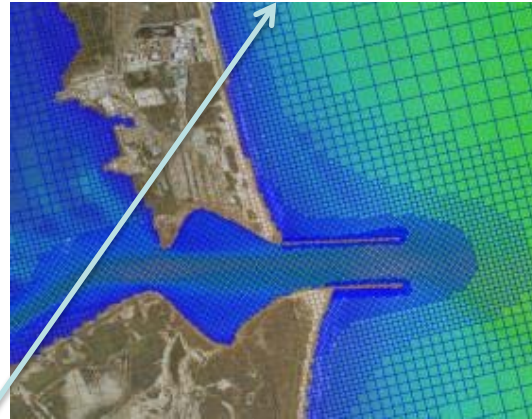


# CMS Numerical Modeling

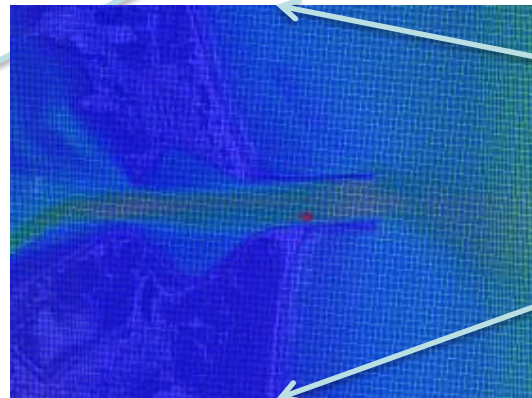
CMS – 2D coupled wave/flow/morphological model.



CMS Flow

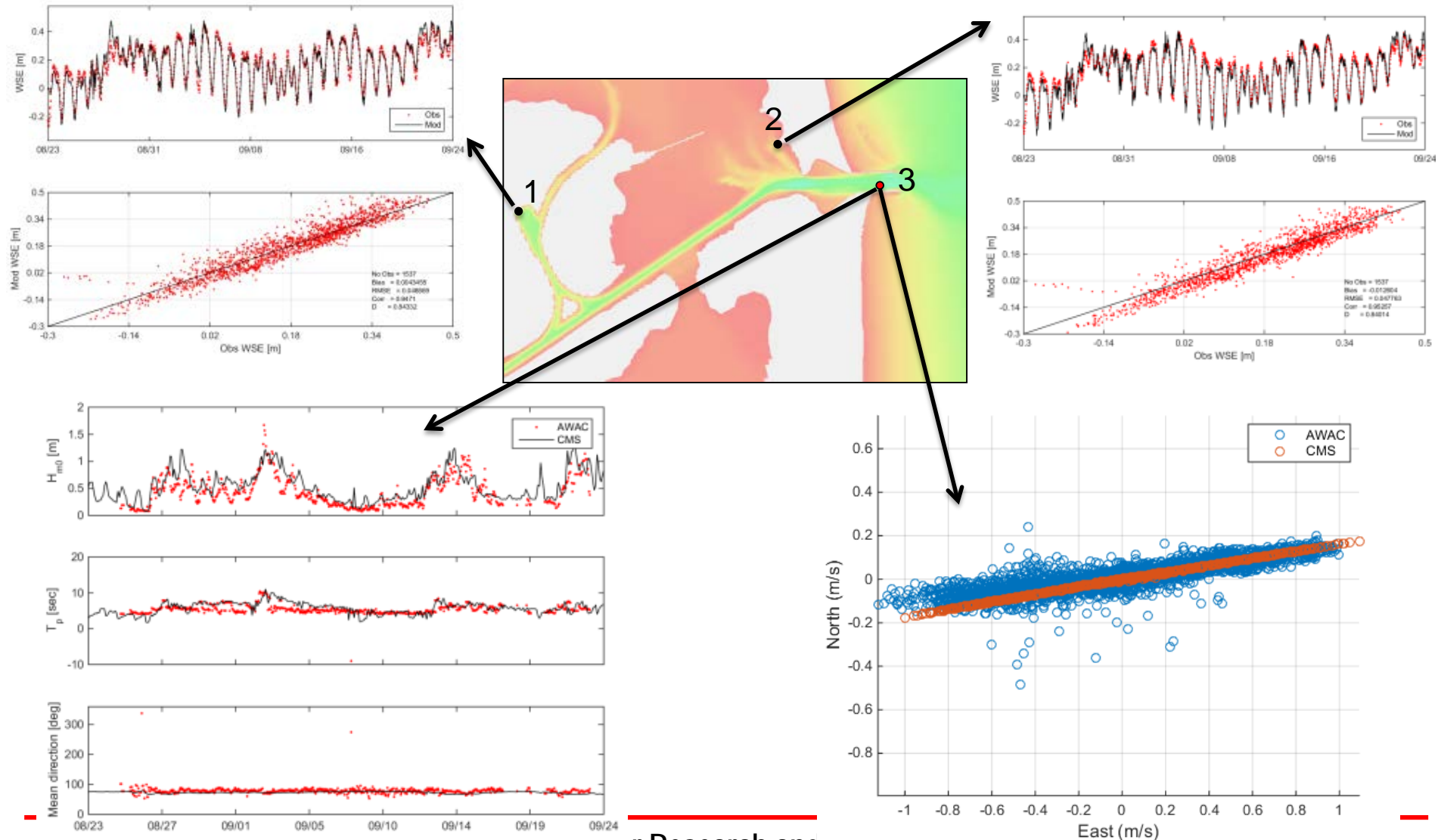


CMS Wave



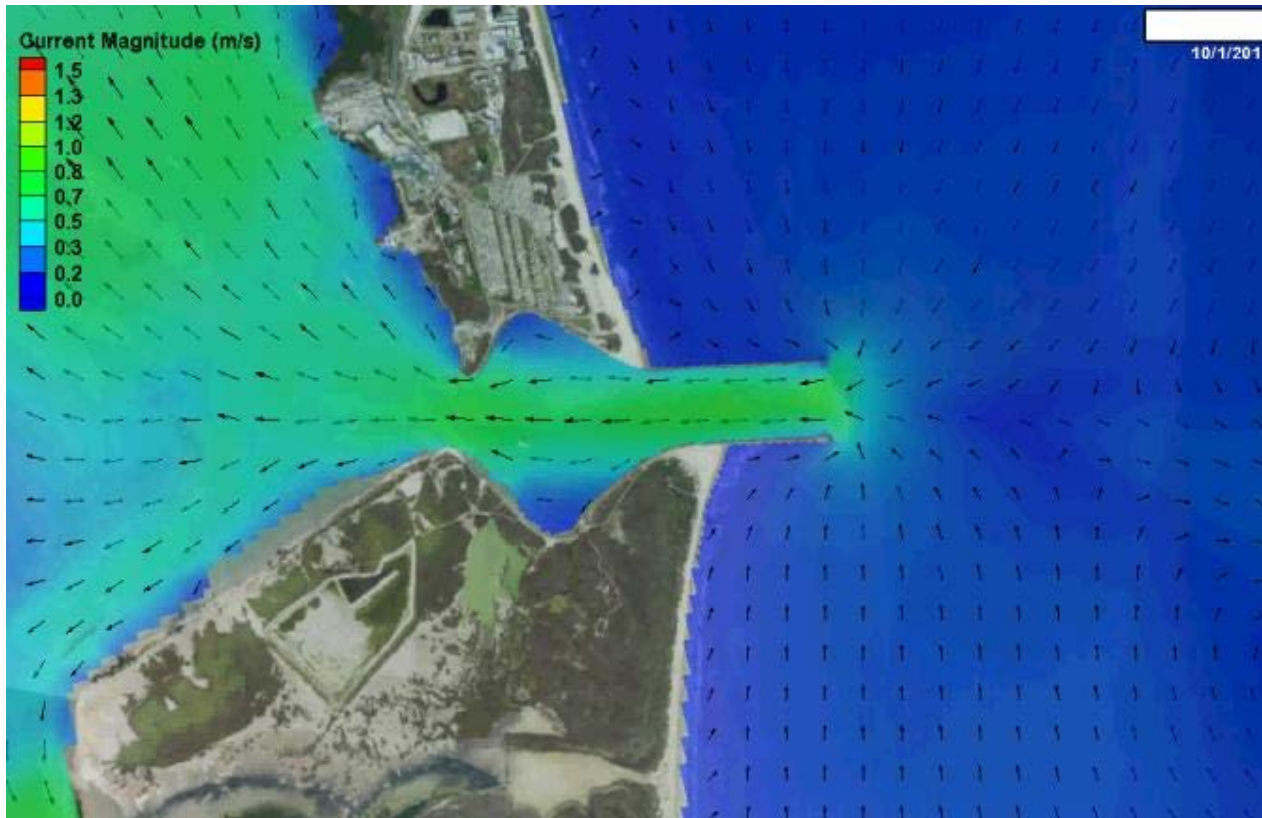


# CMS Numerical Comparison with Field Data





# CMS Numerical Modeling Results



- Largest velocities approximately 1.5m/s
- Longshore transport appears to be northward
- Recirculation region visible north of jetties
- Apparent transport pathway south of jetty into channel.

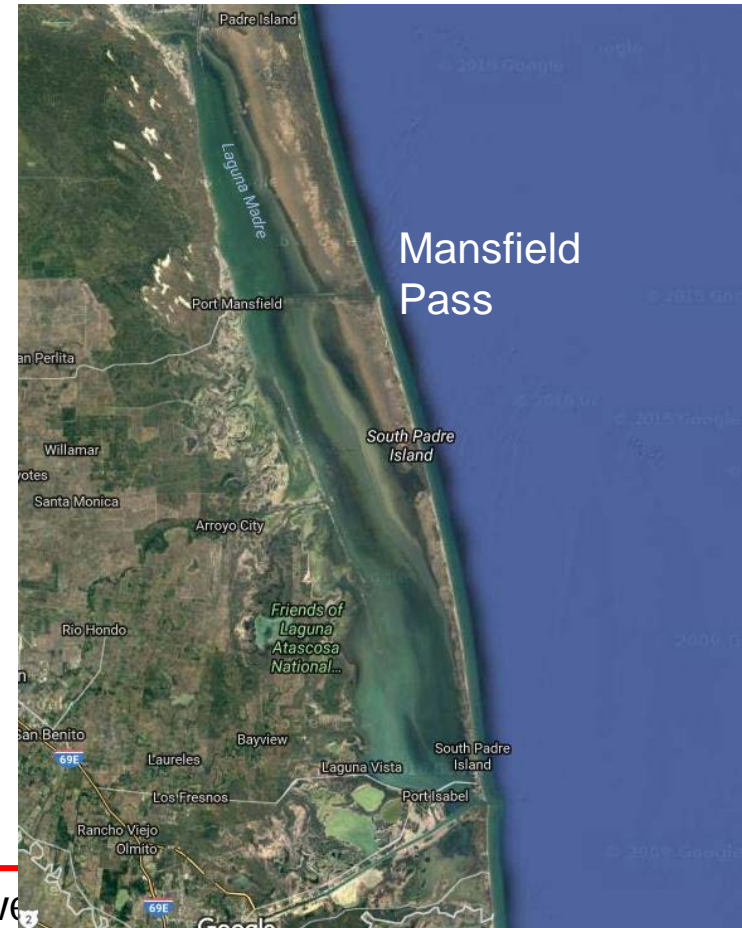
Velocity vectors and contours of velocity magnitude (m/s) at Inlet (2 weeks). Vectors indicate direction only.



# Alternative Investigation

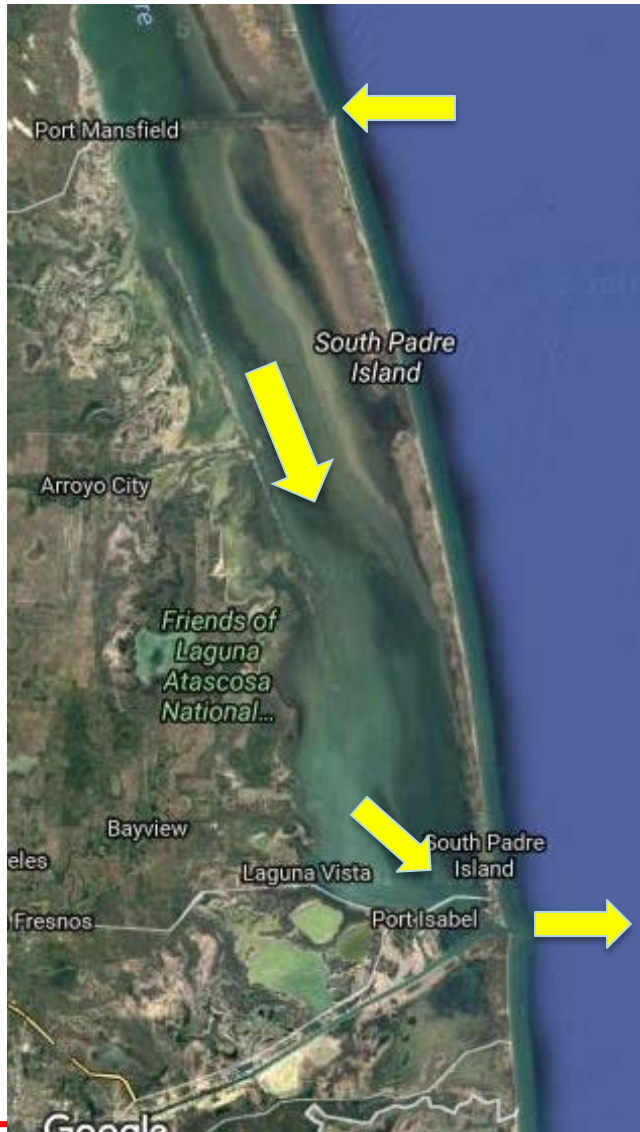
- ❖ **Influence of Mansfield Pass**
  - ✓ Mansfield Pass closed
  - ✓ Mansfield Pass deepened (from 12 ft to 20 ft )
- ❖ **Structural Changes to the Jetty**
  - ✓ **Seaward jetty Extension**
  - ✓ **Interior Jetty Realignment**
  - *Jetty Height Modification*
- ❖ **Dredging Specific Changes**
  - ✓ **In-Channel Sediment Trap**
  - *Dedicated Dredging Plant*

✓ Indicates that numerical modeling was performed





# Mansfield Pass Alternatives



- During winter months there is a counter-clockwise circulation with net flow coming in through Mansfield Pass, then south down the Laguna Madre and exiting into the Gulf of Mexico through Brazos Santiago Inlet.
- This net flow reverses direction during the summer months and becomes stronger.
- In 2011, the USACE discontinued maintenance dredging because Port Mansfield was designated as recreational, rather than commercial (a source of contention between USACE and locals, contacted by National Parks Service).

## Mansfield Pass alternatives:

- Mansfield Pass closed
- Mansfield Pass deepened (from 12 ft to 20 ft)



# Alternatives Description (cont)



Extend Jetty



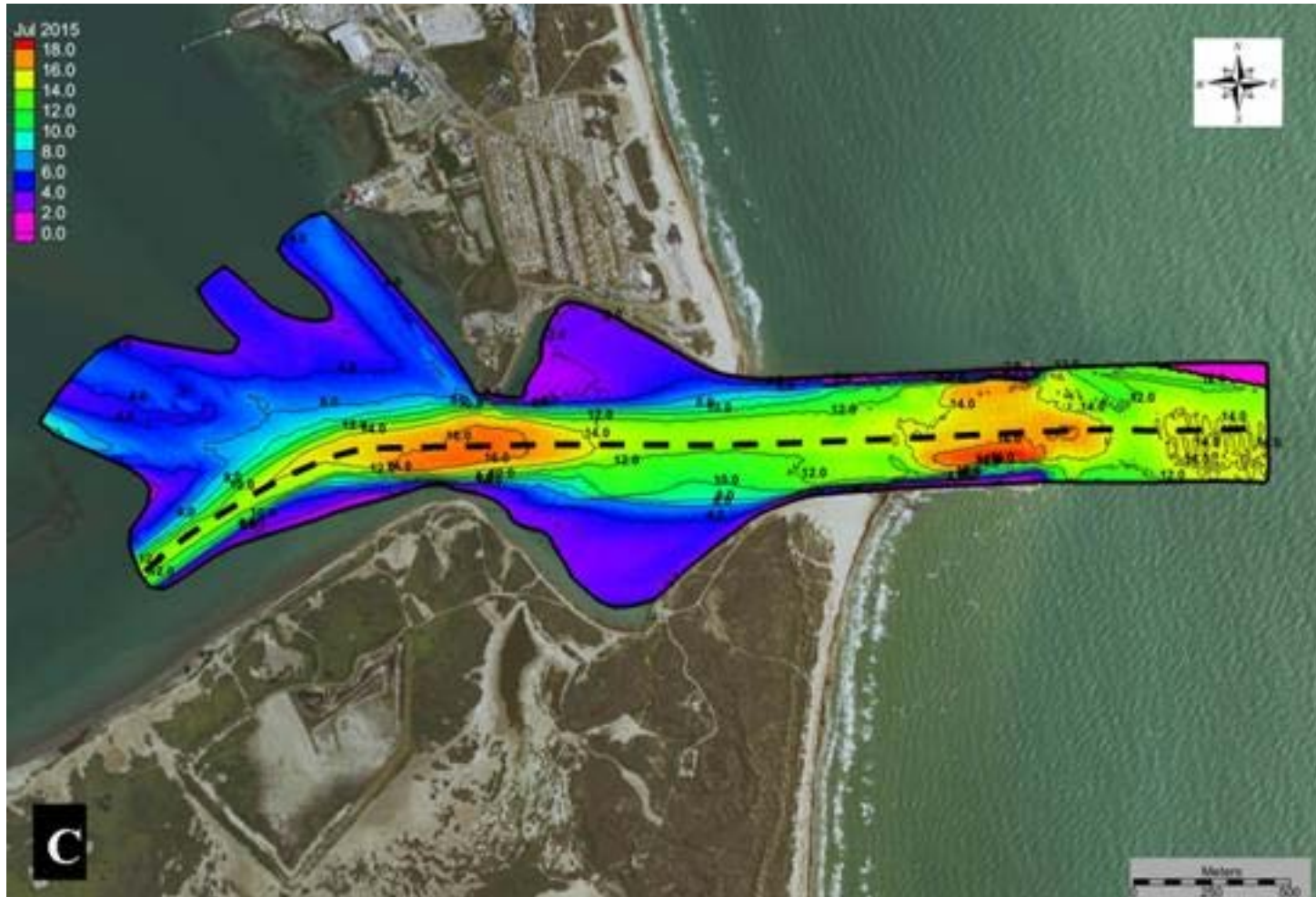
In-channel Sediment Trap (holds 200,000 cy of material)



Realigned Jetty



# Bathymetric Profiles

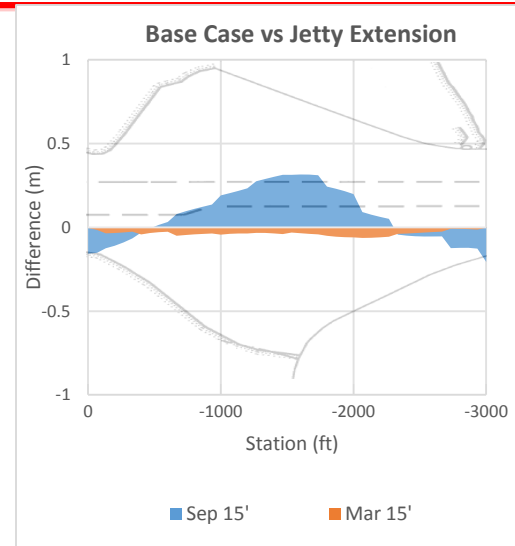
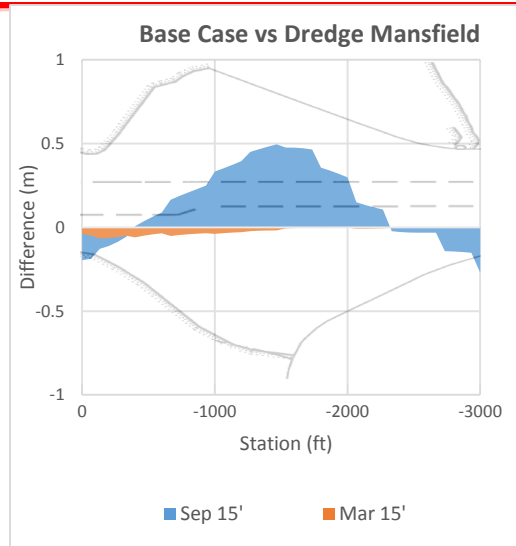
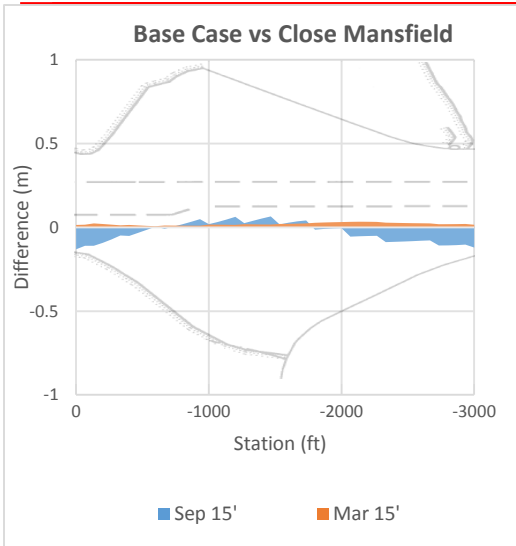


Bathymetry profiles were extracted along the channel centerline.

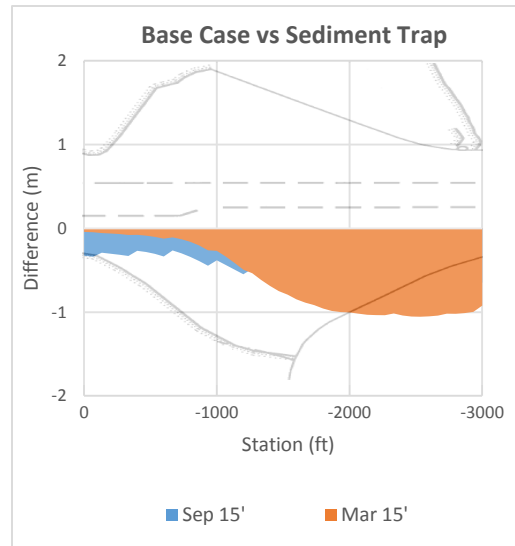
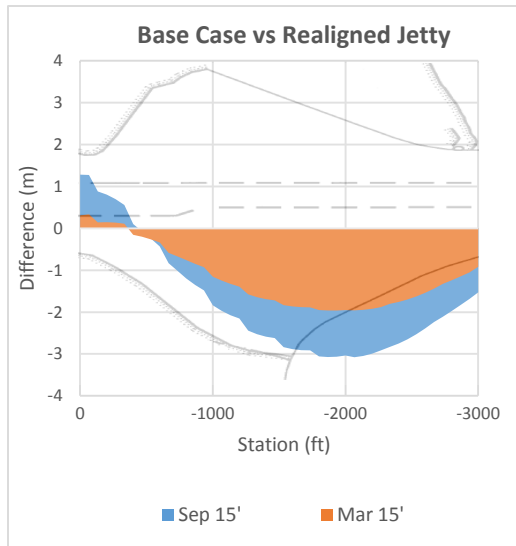
Surveys conducted in:  
Sept-2014  
March-2015  
July-2015



# Comparison of Bathymetric Profile of Base Case to Alternatives



Deposition height is larger after 1 year

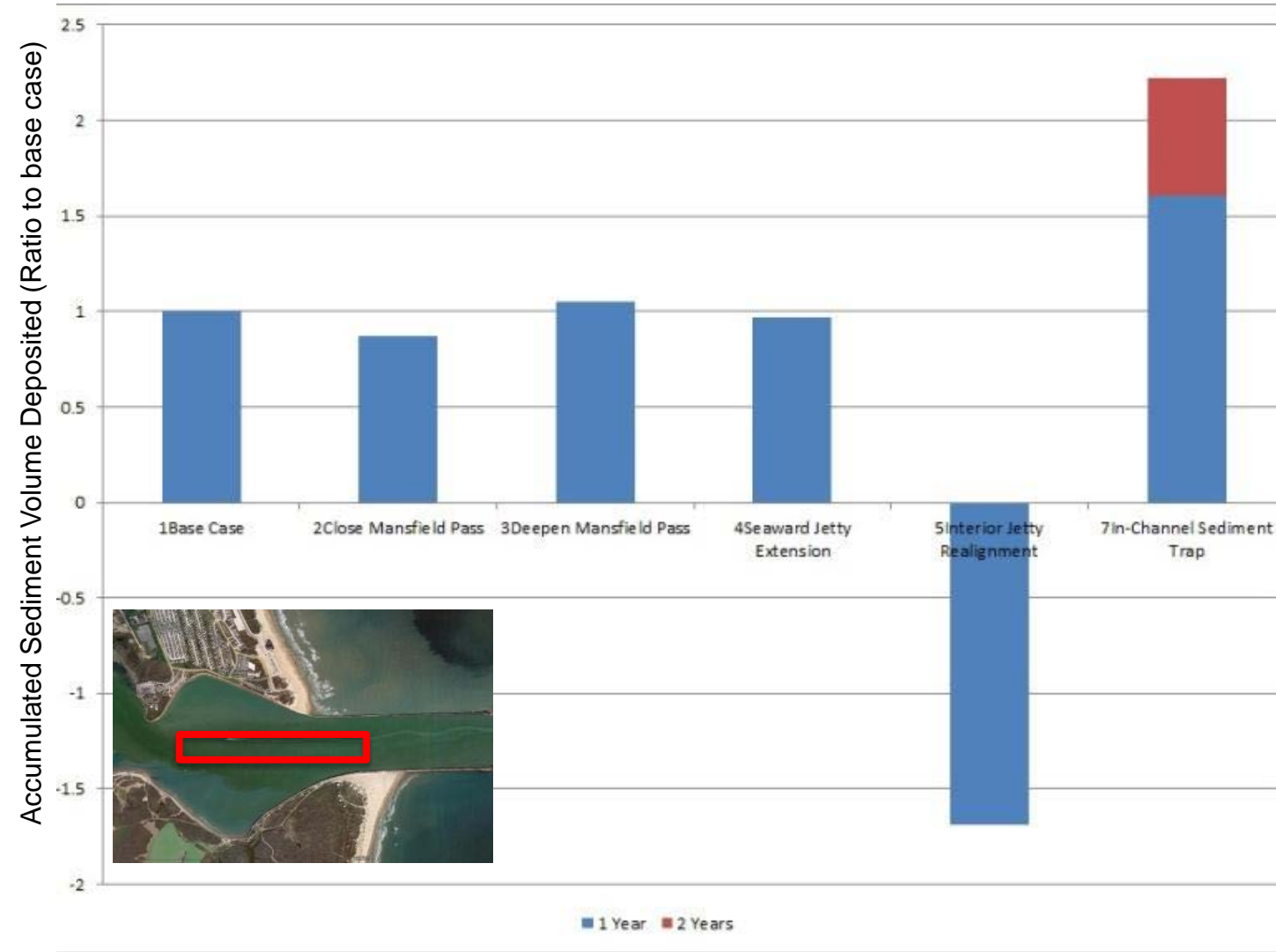


Deposition height is smaller after 1 year





# Comparison of the volume of sediment deposited



Values close to 1, indicate little change.

The realigned jetty option actually shows erosion at specified location

The sediment trap option shows larger deposition rate, but material deposits into a hole, so deposition height may still be lower

# Assessment of Alternatives

Alternative	Shoaling Rate Impact	Additional Positive Considerations	Additional Negative Considerations
<b>Close Mansfield Pass</b>	Minor decrease		<ul style="list-style-type: none"> <li>• Serious negative environmental impacts.</li> <li>• Local opposition likely.</li> </ul>
<b>Deepen Mansfield Pass</b>	Minor increase	<ul style="list-style-type: none"> <li>• Favored by locals.</li> <li>• Environmental benefits.</li> </ul>	Unstudied impacts on downdrift beach erosion.
<b>Seaward Jetty Extension</b>	Minor decrease		Significant construction costs are anticipated.
<b>Interior Jetty Realignment</b>	Major decrease	Potential beneficial uses for the abandoned portions of the channel.	<ul style="list-style-type: none"> <li>• Likely shift of flood shoal location; increase beneficial use cost.</li> </ul>
<b>In-Channel Sediment Trap</b>	Minor increase	<ul style="list-style-type: none"> <li>• Increases time between required dredging</li> <li>• Implementation straight-forward.</li> </ul>	Channel deepening may require congressional authorization.



# Assessment of Alternative

Alternative	Initial Assessment
<b>Close Mansfield Pass</b>	Not recommended for further consideration.
<b>Deepen Mansfield Pass</b>	Worth additional study
<b>Seaward Jetty Extension</b>	Not recommended for further consideration.
<b>Interior Jetty Realignment</b>	Worth additional study
<b>In-Channel Sediment Trap</b>	Worth additional study **
<b>Dedicated Dredge Plant and Distribution System</b>	Worth additional study
<b>Heighten Jetties</b>	Worth additional study



# FY17 Plans

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- Journal Paper focused on Hydrodynamics
  - Wind Driven Hydrodynamics at a Two Inlet System; Lower Laguna Madre, TX
  - Journal Paper focused on Alternatives

