Engineering with Nature Applied to a Dredging Project in Mobile Bay

ERDC
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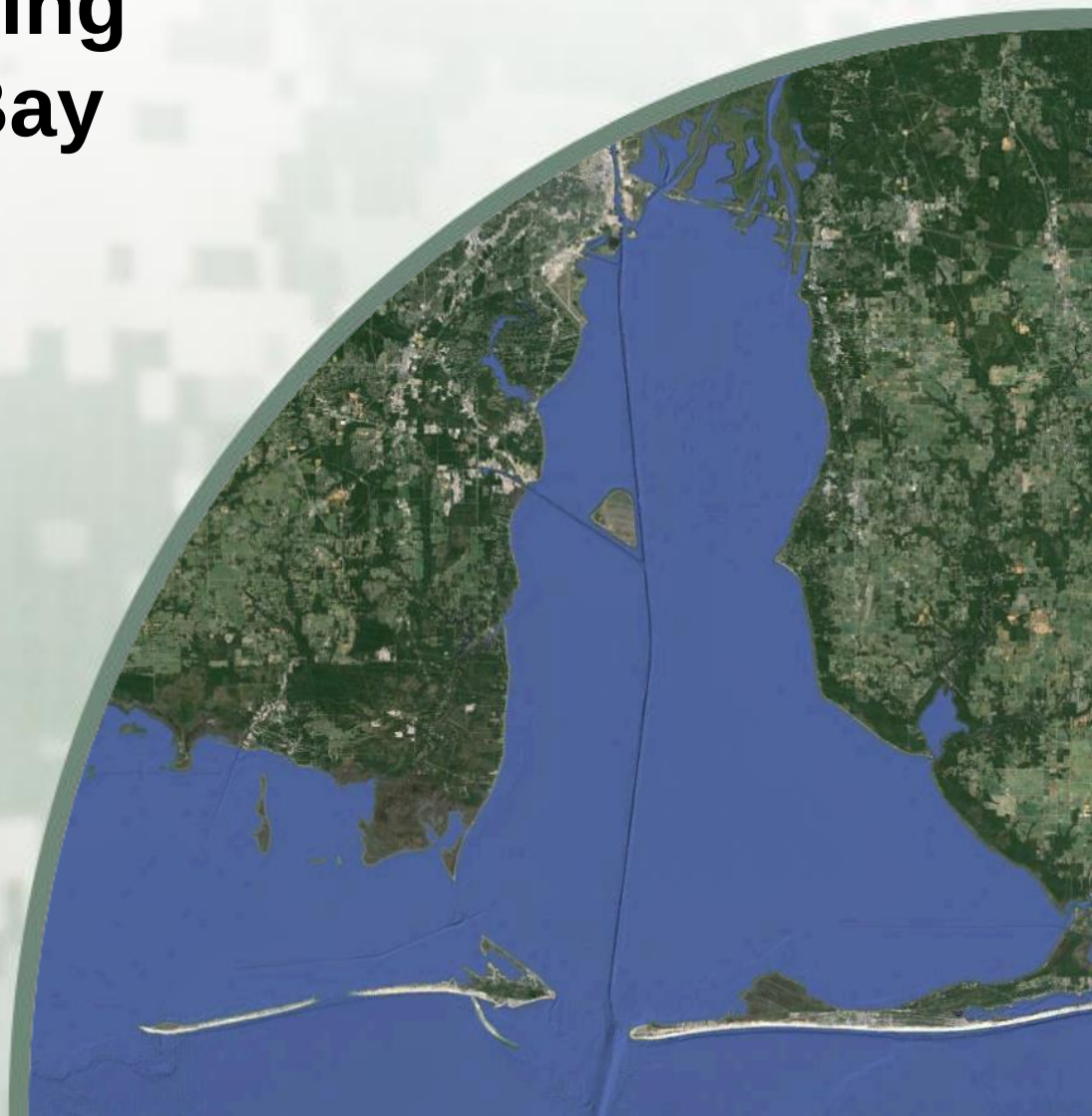

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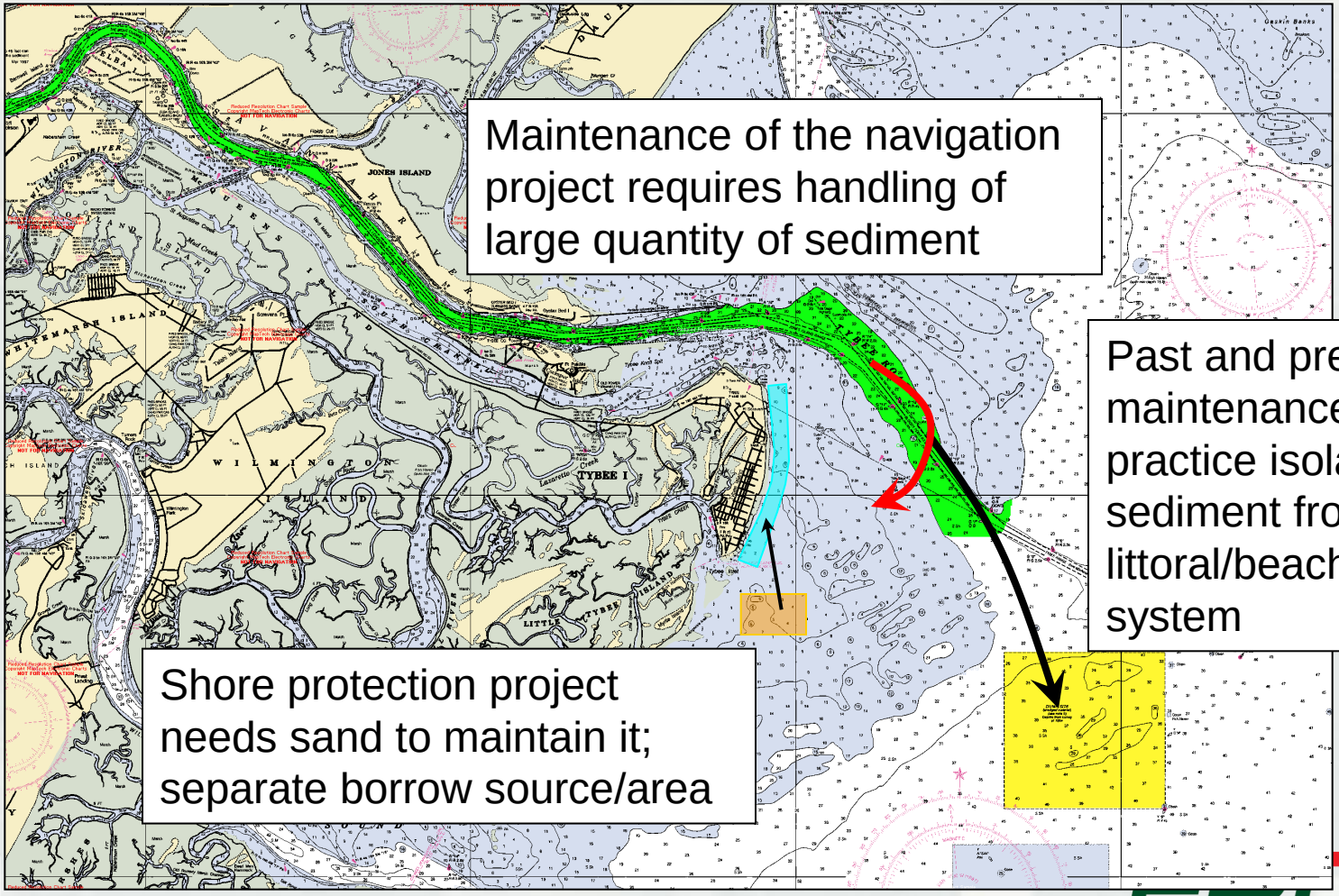
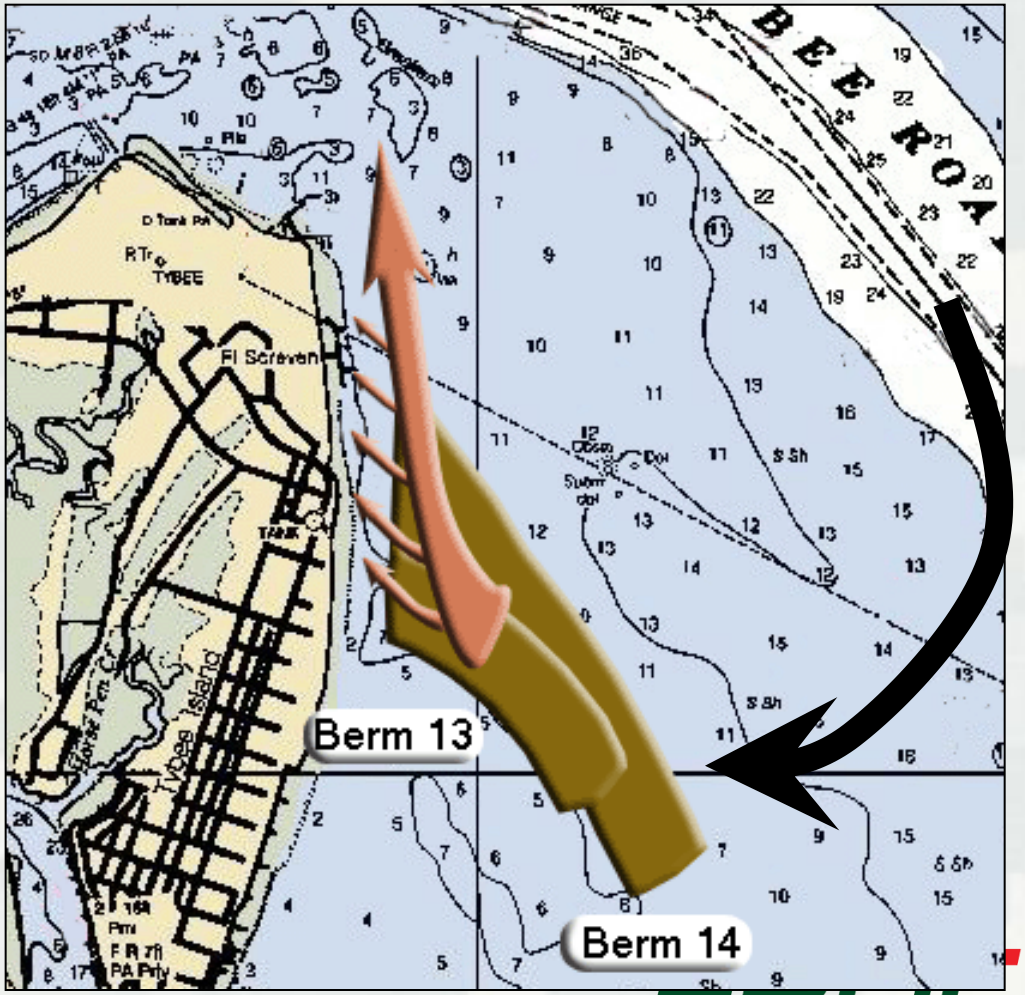
Example EWN Solution for DMM

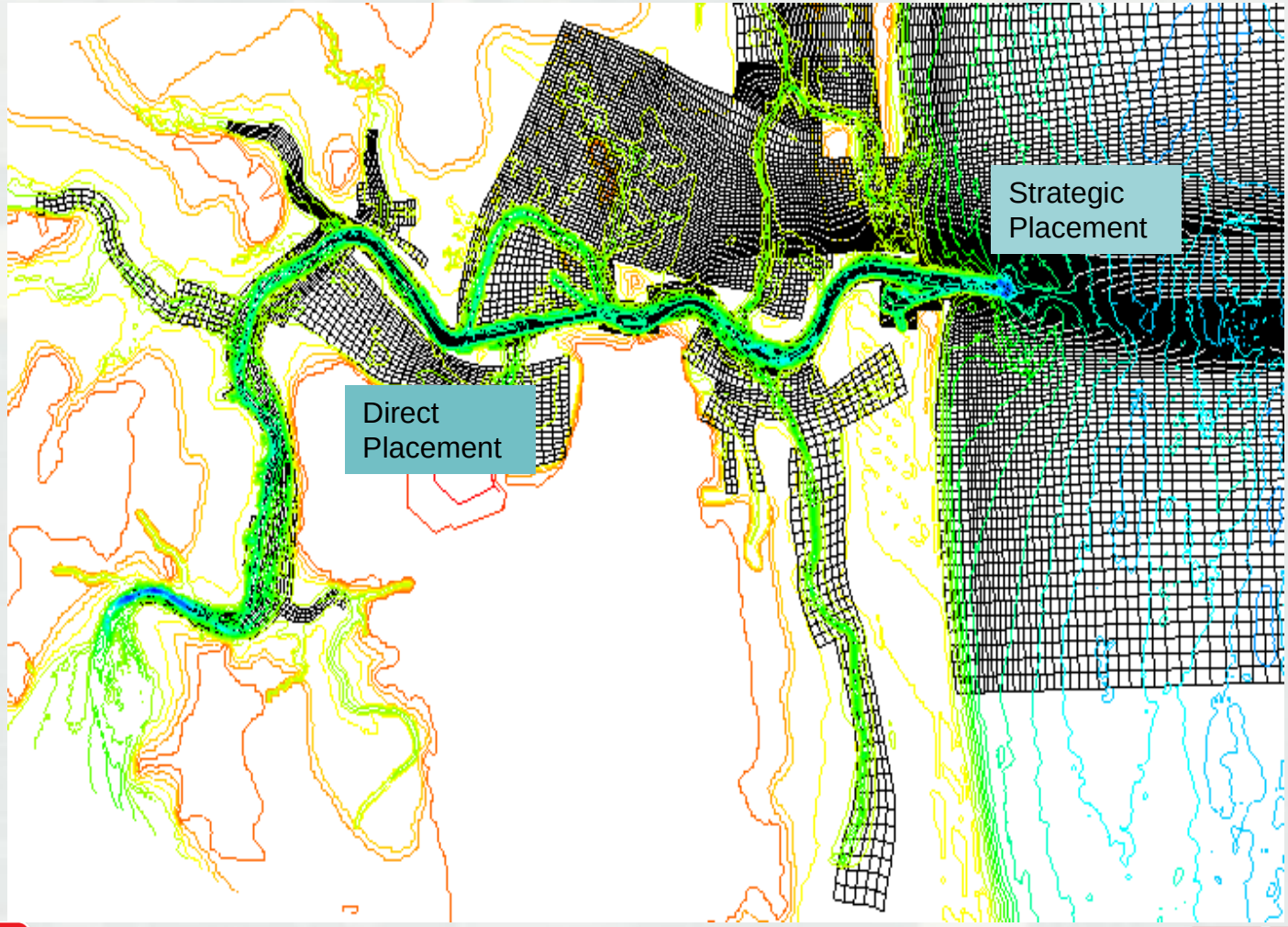


Example EWN Solution to DMM

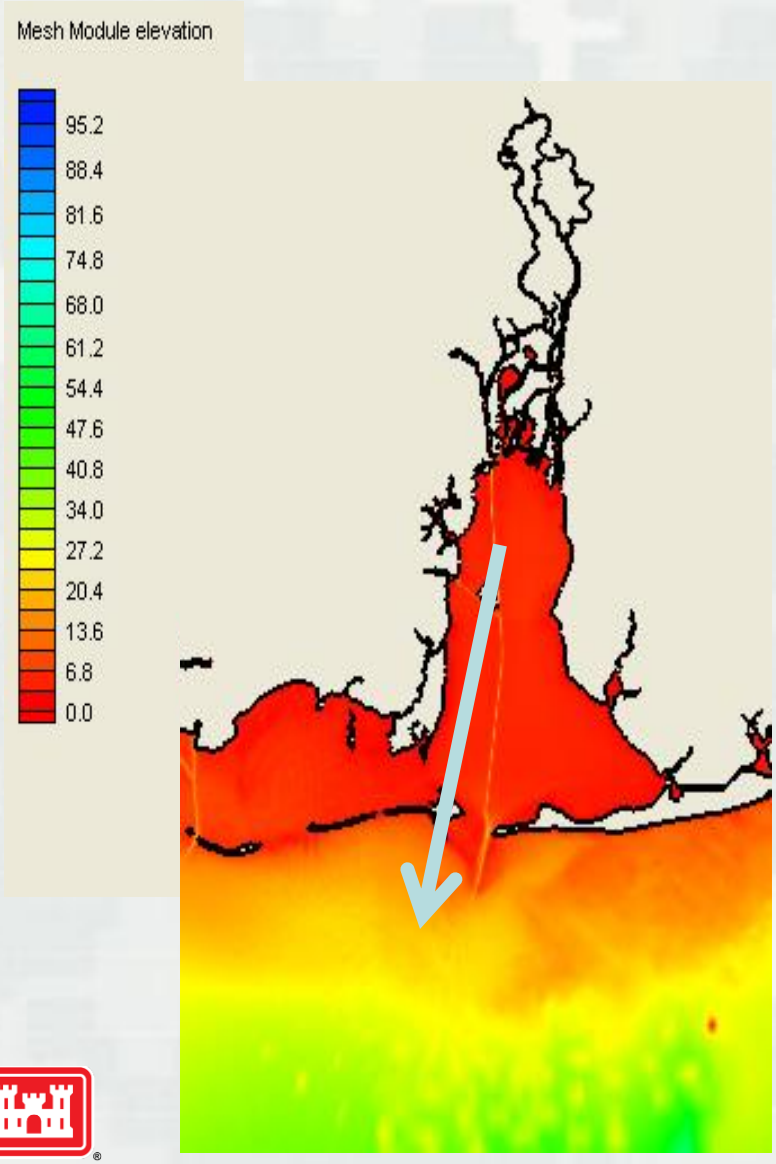
- Place mixed sediment from channel into nearshore berms
- Allow natural winnowing to remove fine content
- Longshore transport patterns will move sediment into north Tybee littoral zone



Example EWN Solution for DMM



Mobile Bay Dredging Practices

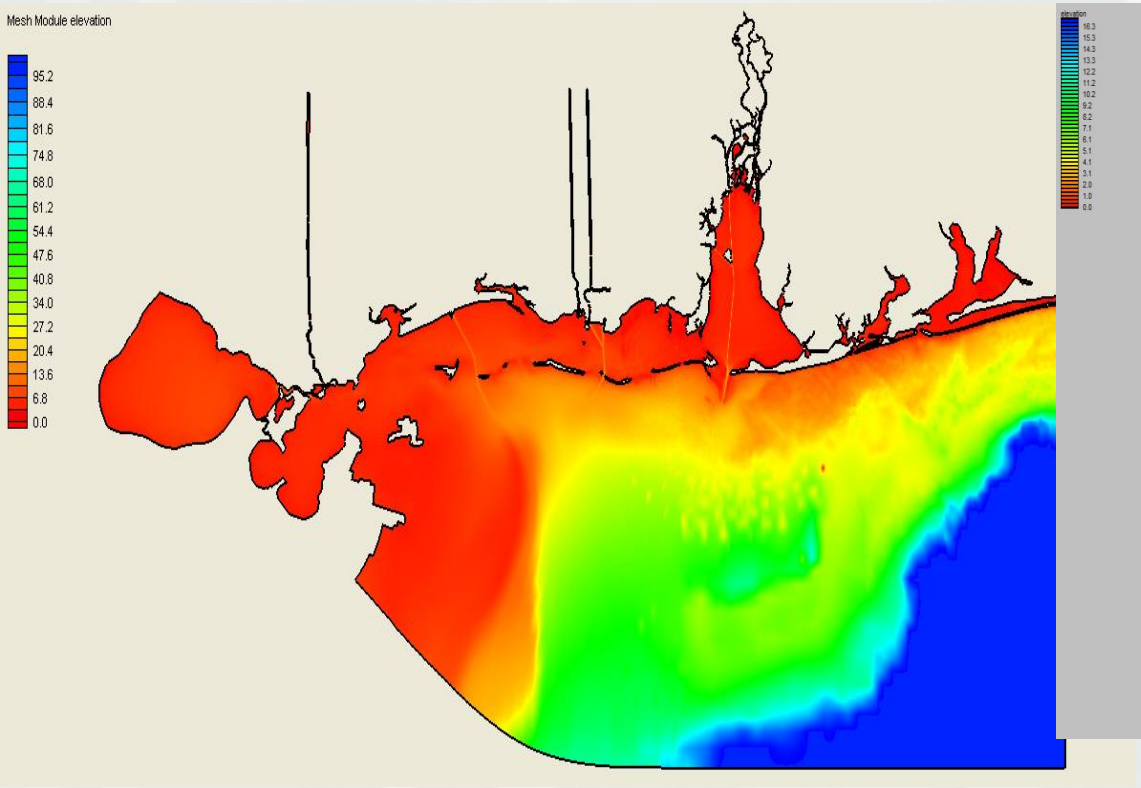


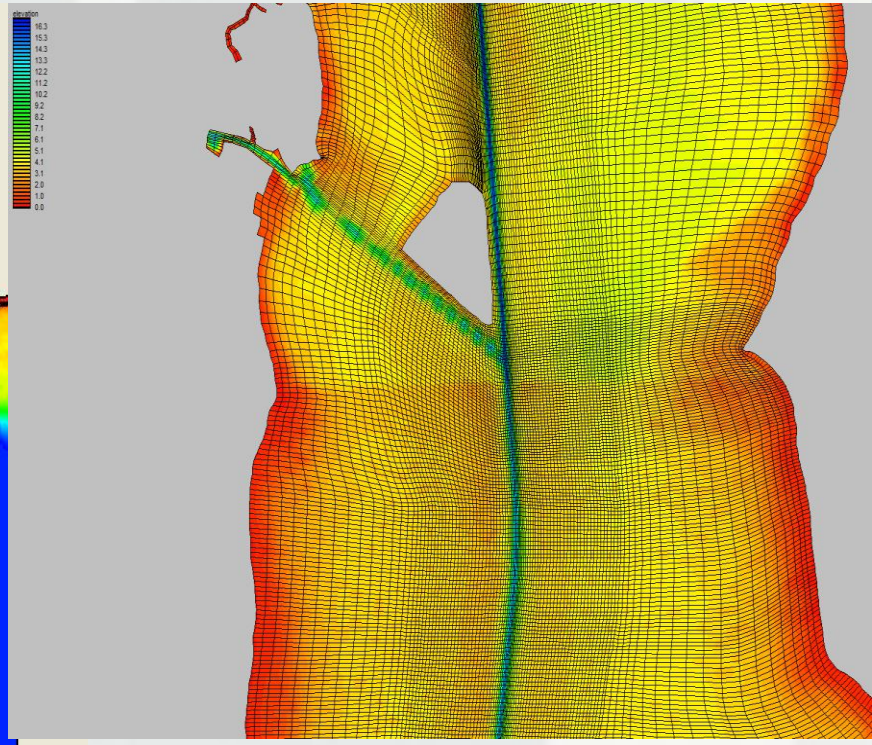
- Present dredging practice: remove sediment from bay to ODMDS
- This eliminates sediment from sediment-starved regional system (the Bay)
- Proposed practice: TLP within Mobile Bay to feed resources
- Issues: environmental impacts, rehandling, cost


N
Mobile
Spanish River
Mobile Bay
Gaillard Island
ODMDS Cells
Gulf of Mexico
1
2
3
4
5
6
7
8
10
11
12
13
14
15
16
17
Disposal Areas
Navigation Channels
Chickasaw Creek
Mobile River Channel
Mobile Upper Bay Channel
Arlington Ship Channel
Garrows Bend
Dog River
Fly Creek Channel
Theodore Ship Channel
Theodore Barge Channel
Mobile Lower Bay Channel
Fowl River
AL Gulf Intracoastal Waterway
Mobile Bar Channel
0 2.5 5 10
Miles

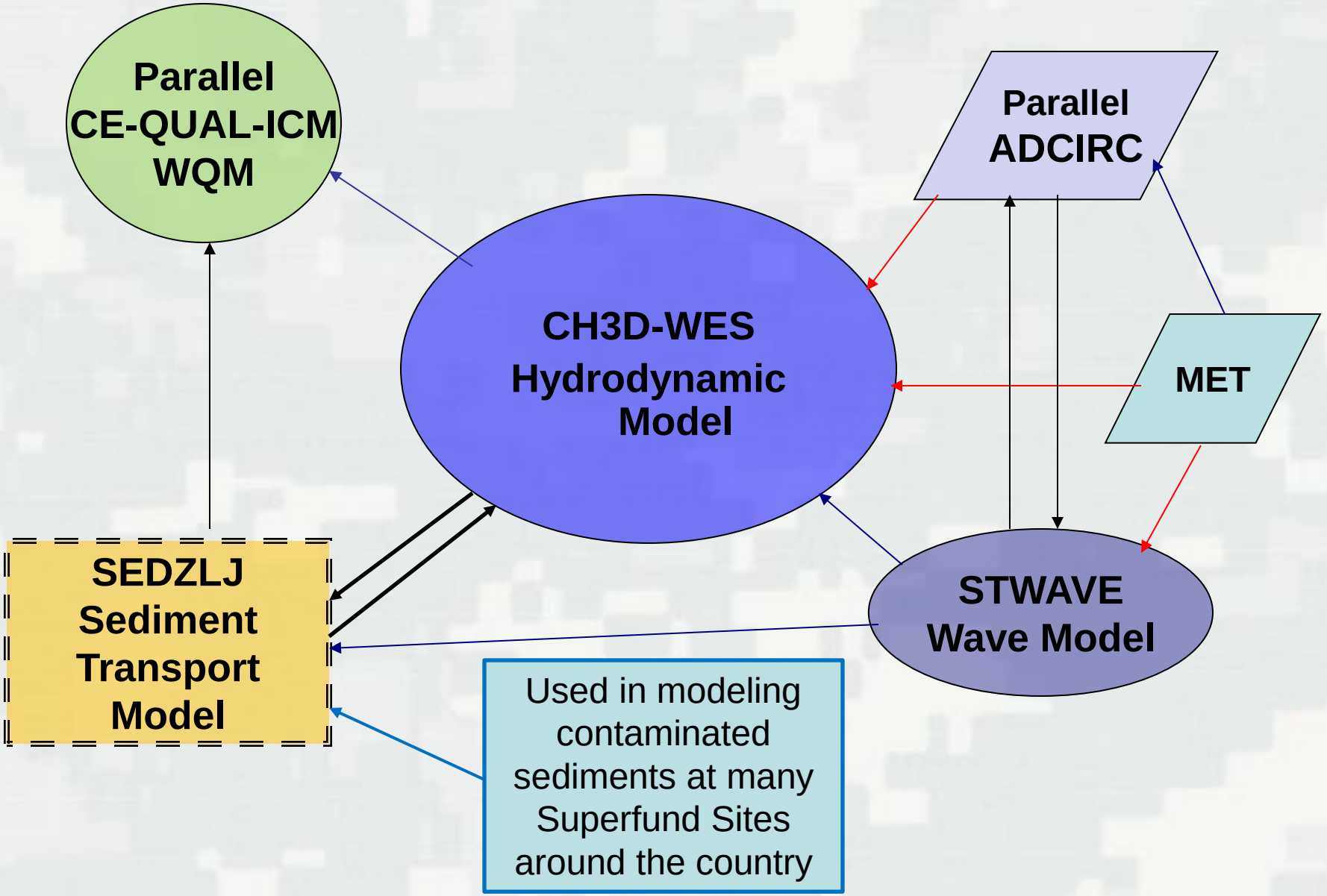
Mobile Bay Model Domain and Grid

- To address rehandling and environmental impact issues, a complex 3-D modeling exercise of sediment transport in the Bay was applied





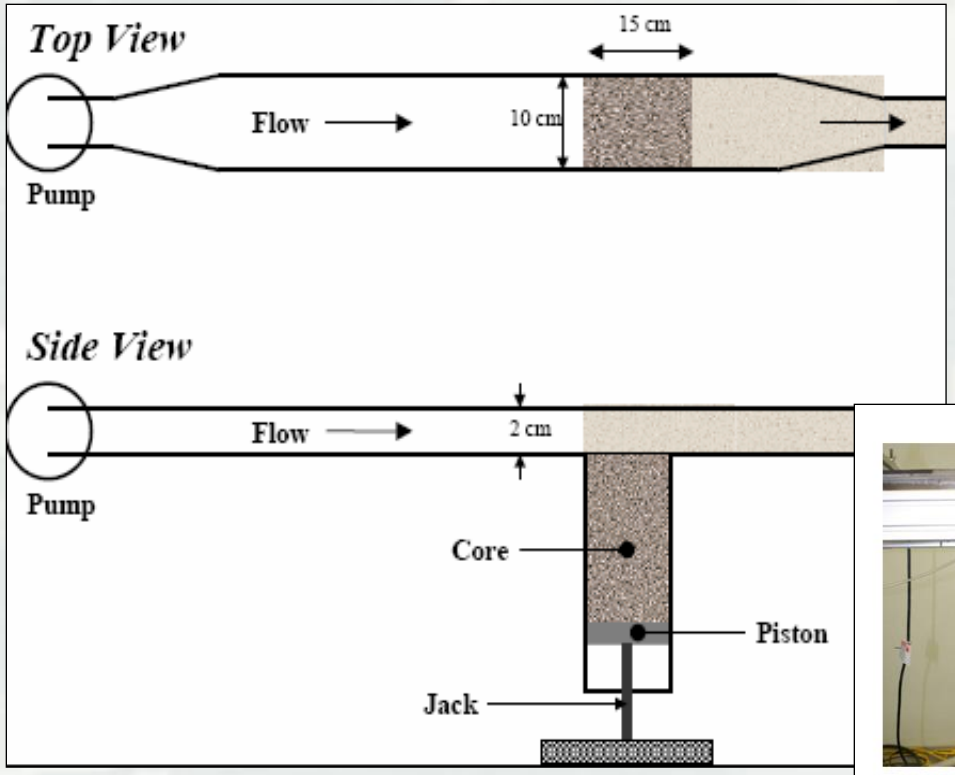
LTFATE Modeling Framework

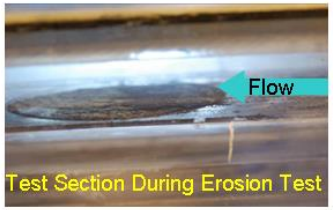


Setup of Sediment Transport Model

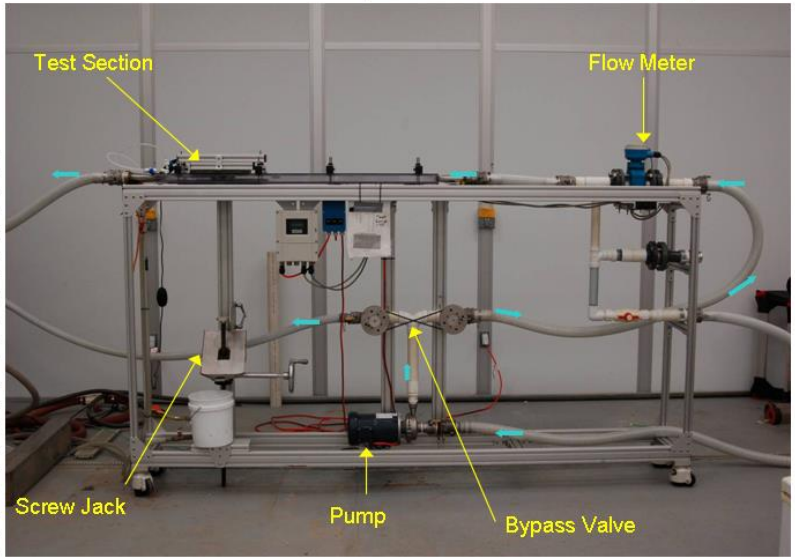
- Seven sediment size classes were modeled
  - Four size classes represent the native sediment (with sediment sizes of 3, 20, 120 and 500 *μm*)
  - Three size classes represent the TLP material (with sediment sizes of 3, 20, and 120 *μm*)
- The SEDFLUME results from the 11 cores collected in Mobile Bay were used to specify the spatially variable bed properties in the grid cells not within Disposal Areas 1-3, 10, 11 or 13.
- The SEDFLUME results from the TLP experiments were used to specify the spatially variable bed properties in the grid cells within Disposal Areas 1-3, 10, 11, and 13.

SEDFLUME





Shear stress t (Pa)	Flow Rate (GPM)
0.1	6.1
0.2	9.1
0.4	13.5
0.6	17.0
0.8	20.1
1.2	25.3
1.6	29.8
2.4	37.4
3.2	44.0
4	49.9
5	56.6
6.4	65.0
8	73.7
10	83.5
12	92.5
13	96.7
14	100.8



Modeling Approach

Current- and wave-induced sediment transport was simulated in Mobile Bay for the following conditions:

- Seasonal Event: Feb – May 2010
- Storm Events
  - Hurricane Gustav: Aug – Sep 2008
  - Hurricane Ida: Nov 2009

These three simulation periods were modeled ‘with’ project conditions and ‘without’ project conditions.

The ‘with’ project conditions assumes that 12 inch thick TLP deposits were placed evenly in the designated disposal areas.

The ‘without’ condition (base case) assumes that no TLP was placed and the sediments at the disposal sites are native (with corresponding erosion rates).

Modeling Scenarios

Four specific model scenarios were simulated for each of the three simulation periods:

1) TLP has least erosive potential based on Sedflume slurry tests (12 inches TLP thickness).

2) Sensitivity Simulation 1 (most erosive): TLP has same erosive potential as native sediment (12 inches TLP thickness).

3) Sensitivity Simulation 2: TLP has least erosive potential based on Sedflume slurry tests but half the difference in critical shear stresses (12 inches TLP thickness).

4) No TLP exists (base case).

Modeling Results

Ratio of Average Net Erosion Rates at Designated Placement Areas to the Base Case

Scenario Number	1	2	3	4
	TLP	Sensitivity Sim. 1	Sensitivity Sim. 2	Base Case (No-action)
Typical month	57%	104%	73%	100%
Active month	55%	105%	73%	100%
Hurricane Gustav	52%	103%	68%	100%
Hurricane Ida	53%	104%	70%	100%

Sensitivity Simulation 1: TLP has same erosive potential as native sediment

Sensitivity Simulation 2: TLP has erosive potential based on Sedflume slurry tests but only half the difference in critical shear stresses

Modeling Results

Average Channel Sedimentation Rates (cy/day)*

Scenario Number	1	2	3	4
	TLP	Sensitivity Sim. 1	Sensitivity Sim. 2	Base Case (No-action)
Typical month	18	46	33	42
Active month	25	61	40	56
Hurricane Gustav	33	75	55	69
Hurricane Ida	30	70	52	64

***Averaged over 80,000 ft**

Conclusions

- **Approximately 35% of the sediment that erodes from the designated disposal areas is transported and deposits in the navigation channel.**

- **The remaining 65% is widely dispersed throughout the bay by wind-, river-, and tide-driven currents.**

- **The dredge material placed in thin-layers is less erodible (~ 45%) than native sediment.**

- **Sediment transport to habitat is still being evaluated**

- **Alternative in-Bay placement locations are being evaluated**