The Potential for Using Open-Water Dredged Material Placements to Augment the Sediment Supply to Mudflats and Marshes in San Francisco Bay

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ANCHOR QEA

Motivation and Approach

- Motivation
  - Majority of tidal marshes surrounding San Francisco Bay are not likely to keep pace with sea level rise
  - Minimum of 40% of material dredged from San Francisco Bay is required to be put toward beneficial reuse
  - Natural dispersal of dredged material may be incorporated into a nature-based strategy for augmenting mudflat and marsh sedimentation and improving coastal resiliency

Motivation and Approach (cont.)

- Approach
  - Simulate continual erosion, deposition, and transport of sediment immediately following dredge material placement events

  - Track this sediment as it is transported throughout the entire Bay-Delta system

  - Assess whether dredged material placements at strategic locations can be used for wetland nourishment

  - Identify potential pilot study locations where open-water dredged material placements are likely to result in greatest potential for beneficial reuse through enhanced accretion on mudflats and marshes
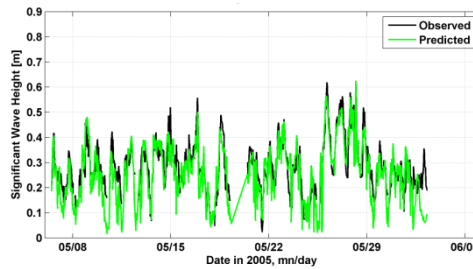
UnTRIM San Francisco Bay-Delta Model
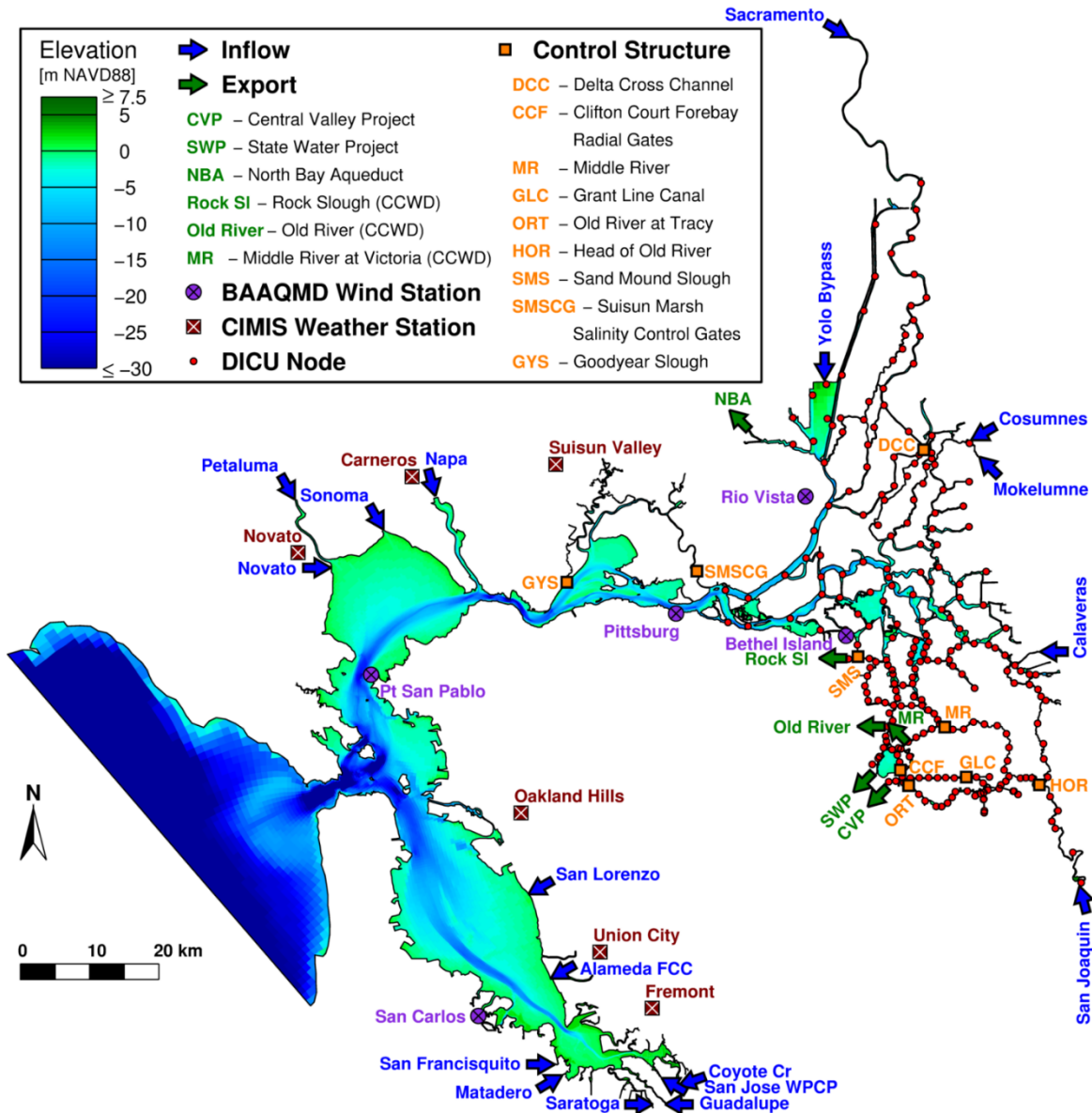
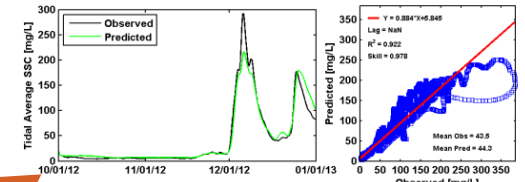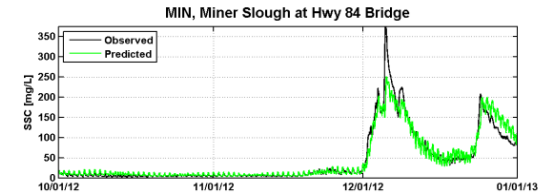# UnTRIM-SWAN-SediMorph Model Coupling
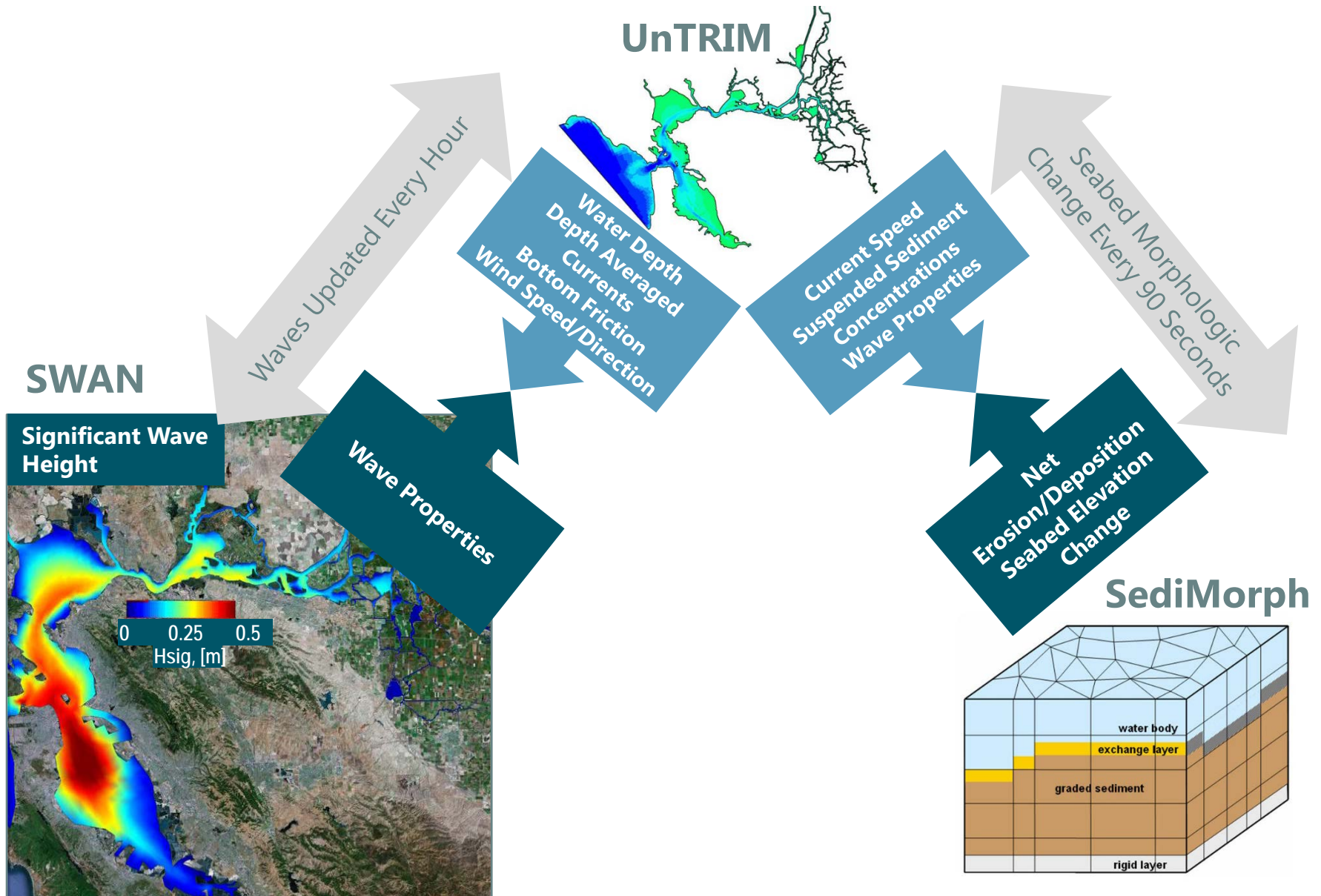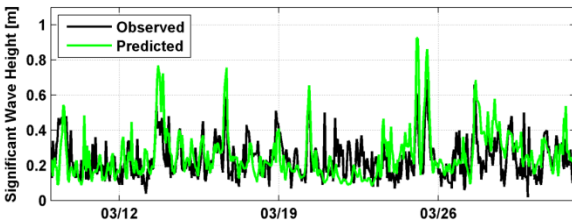
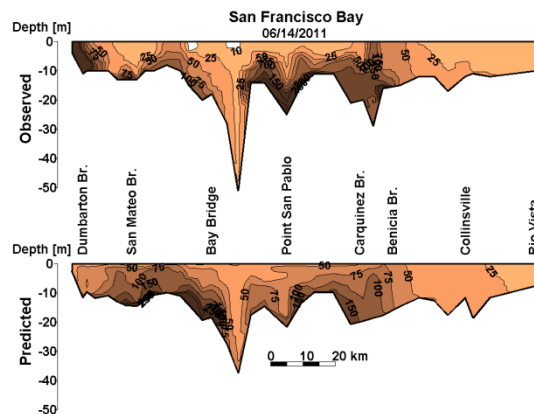# Sediment and Wave Validation Locations
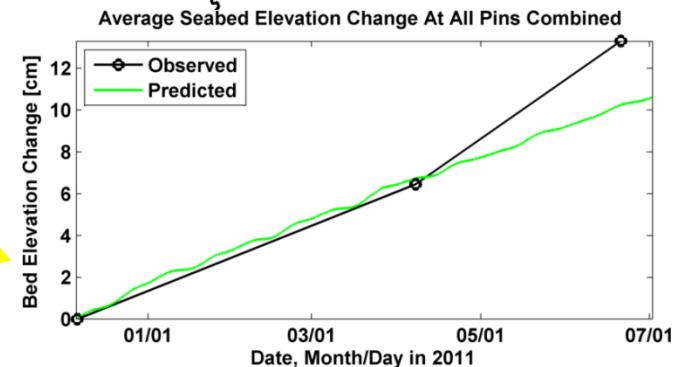

From: MacWilliams et al. (2012)

From: Delta Modeling Associates (2014)

From: Bever and MacWilliams (2013)

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Dredged Material Placement Overview

- Percentages of sediment in deposit and in suspension based on USACE simulations using Short-Term Fate of Dredged Material (STFATE) model

- Each placement occurs within a single grid cell

- Following placements, sediment undergoes continual erosion, deposition, and transport throughout San Francisco Bay
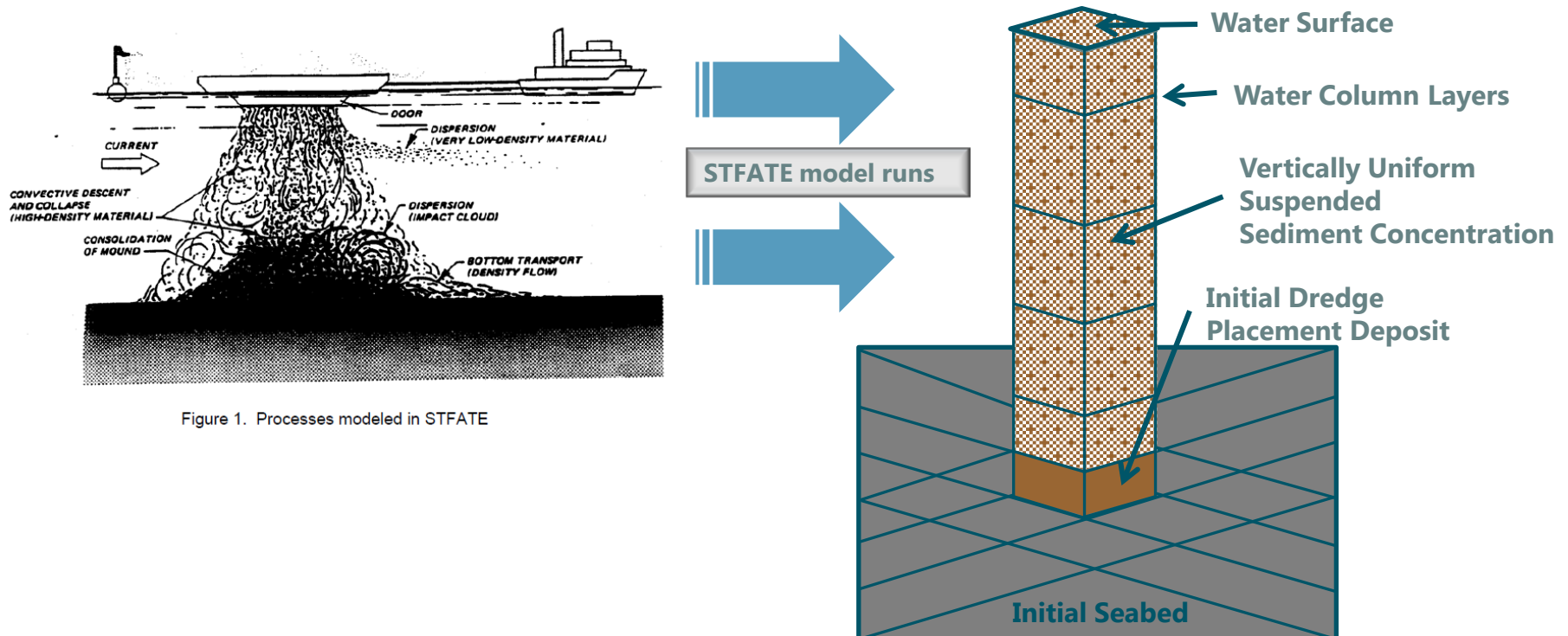
Figure 1. Processes modeled in STFATE

STFATE model runs

Water Surface

Water Column Layers

Vertically Uniform Suspended Sediment Concentration

Initial Dredge Placement Deposit

Initial Seabed

Dredged Material Placement Locations

Legend:
- ● Simulated Placement Sites
- ◆ Designated In-Bay Placement Sites
- — Federal Navigation Channels

Corte Madera Marsh

San Pablo Bay Shoals
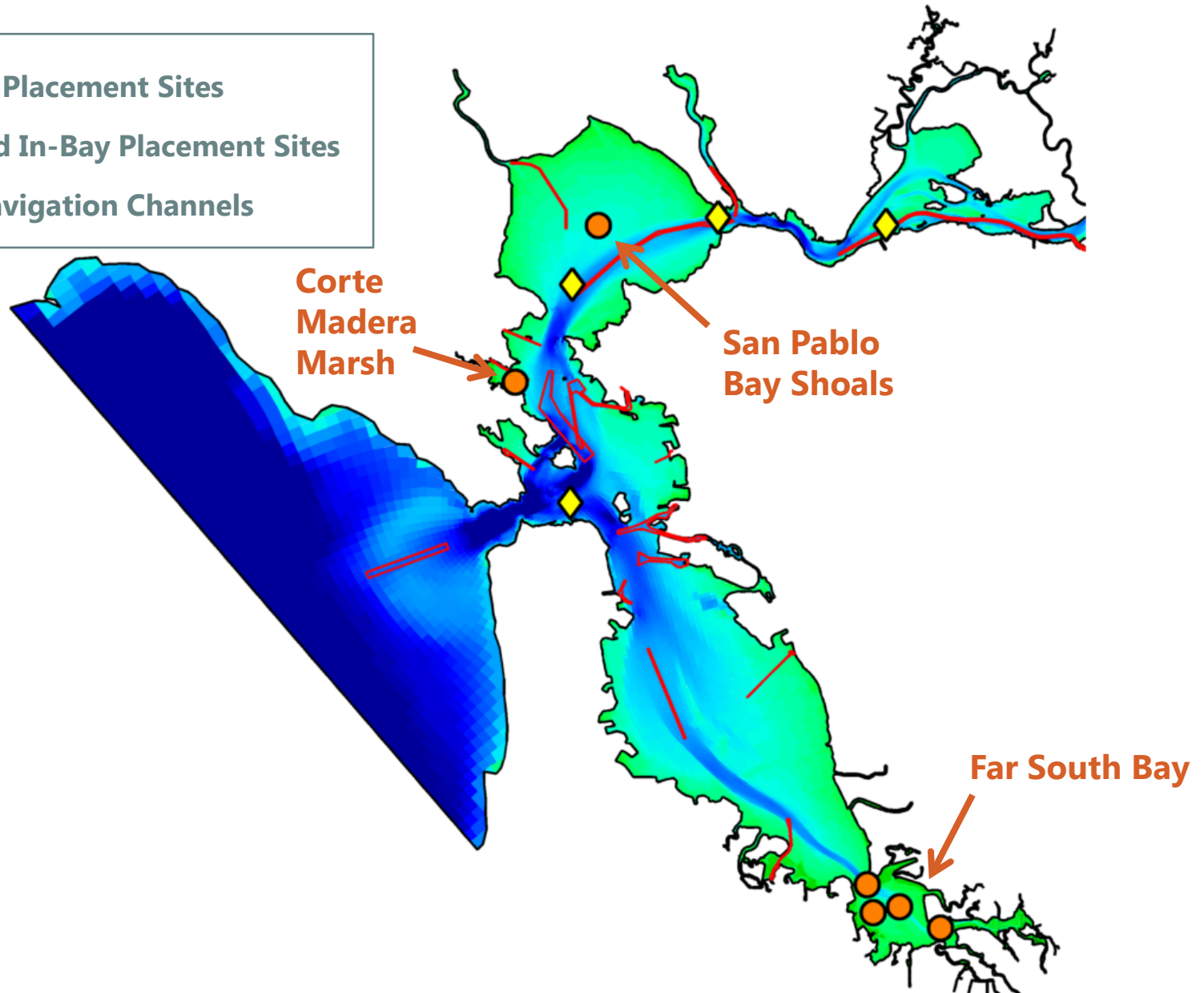
Far South Bay

Application: Far South Bay Dredged Material Placements

Breached Salt Ponds
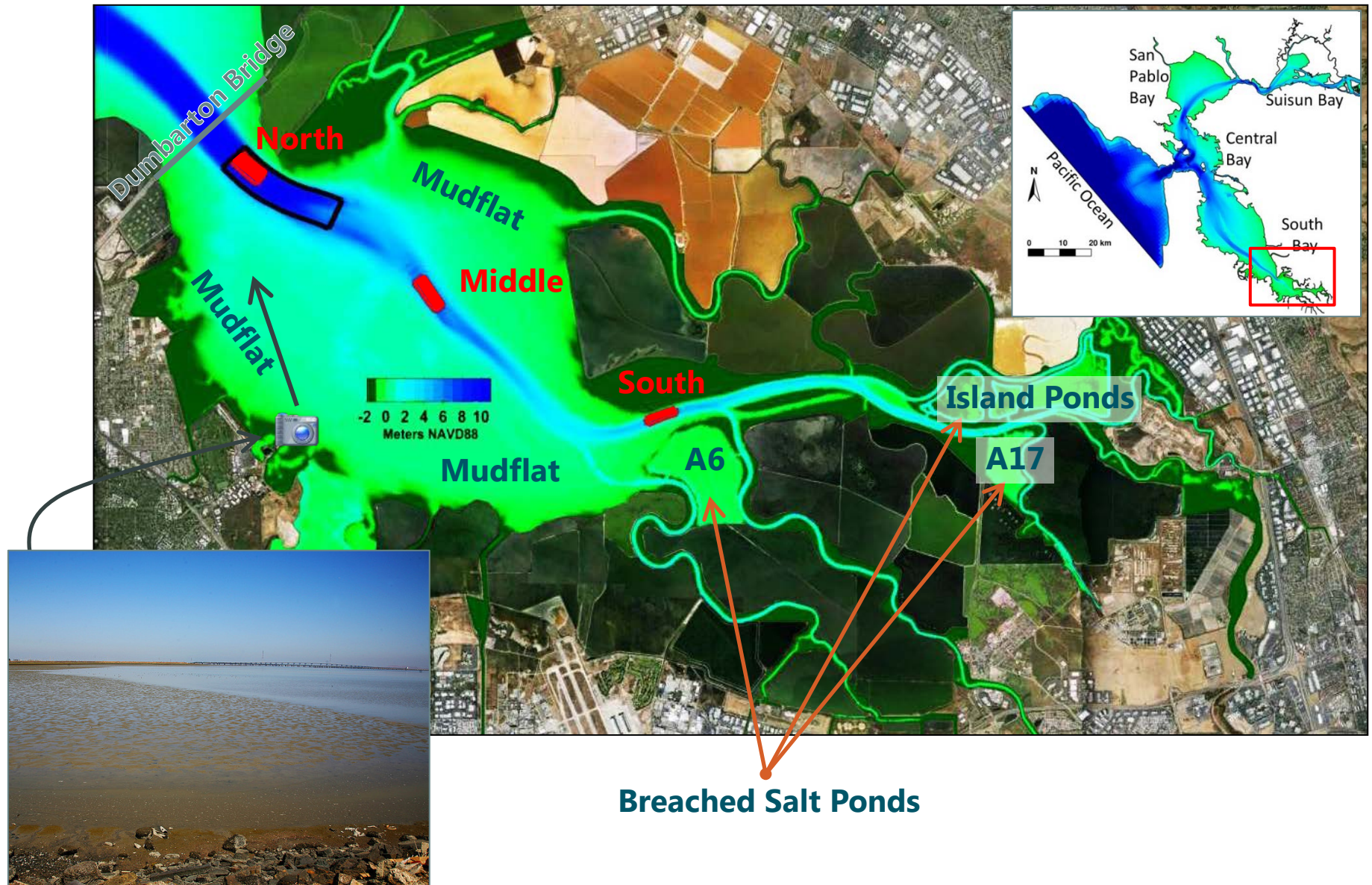
Application: Dredged Material Placement Simulations

- Placements evaluated at four locations in Far South Bay
- Two different sediment volumes simulated

Scenario Number	Placement Location	Simulation Duration	Placement Volume, yd³
1	Dumbarton Bridge	5 Months	48,000
2	Middle SB	5 Months	48,000
3	North of A6	5 Months	48,000
4	Near Dumbarton Bridge	1 Year	350,000

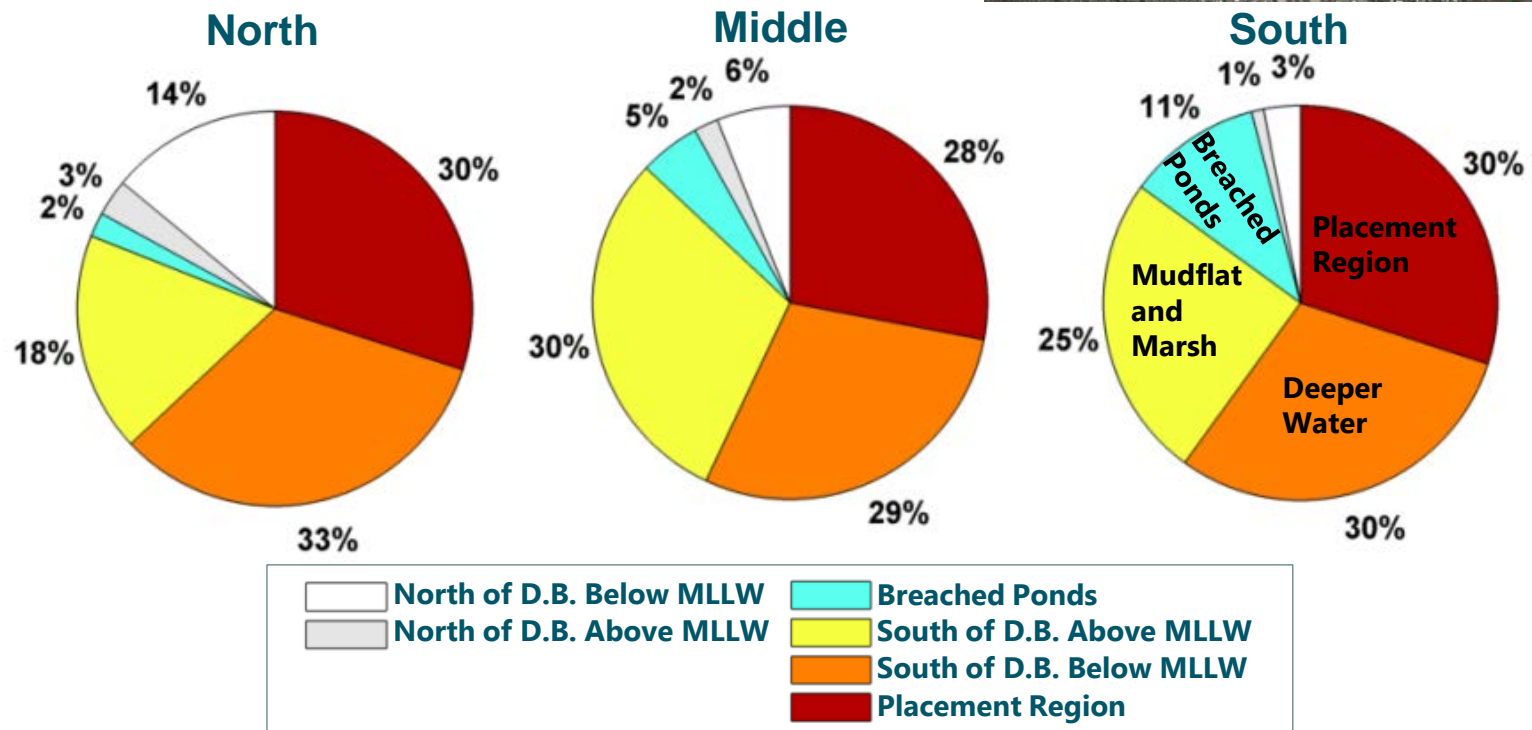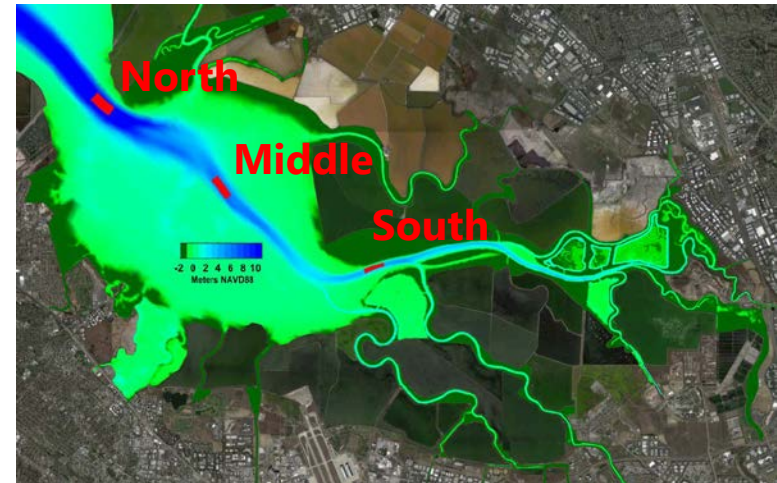# Results: Dredged Material Placement Simulations (5 Months)

- About 30% of dredged material predicted to be retained in placement region after 5 months

- Middle and South placements both supplied 37% of dredged material to mudflats/marshes and breached salt ponds over the 5 months

- Less than 0.4% transported back into federal navigation project channels

North

14% · 30% · 3% · 2% · 18% · 33%

Middle

6% · 2% · 5% · 28% · 30% · 29%

South

1% 3% · 11% · 30% · 25% · 30%

Breached Ponds · Placement Region · Mudflat and Marsh · Deeper Water

☐ North of D.B. Below MLLW	☐ Breached Ponds
☐ North of D.B. Above MLLW	☐ South of D.B. Above MLLW
	☐ South of D.B. Below MLLW
	☐ Placement Region

Results: Large Placement Volume Simulation (1 Year)

- Dredged material volume and scow size representative of maintenance dredging Redwood City Harbor

- Results qualitatively similar to smaller placement at North placement location

- Demonstrates feasibility of periodic large-scale dredged material placements for marsh and mudflat augmentation

1 Year : 350,000 yd³

1 Year : 350,000 yd³

North of D.B. Below MLLW		Breached Ponds
North of D.B. Above MLLW		South of D.B. Above MLLW
		South of D.B. Below MLLW
		Placement Region
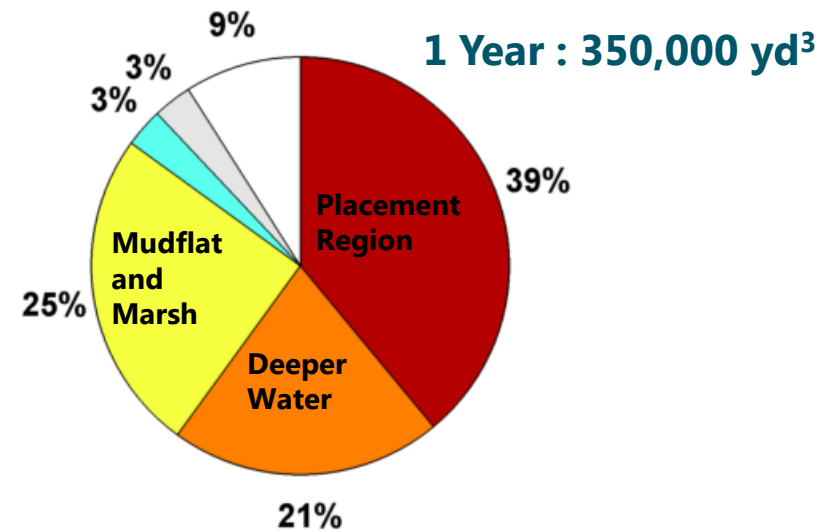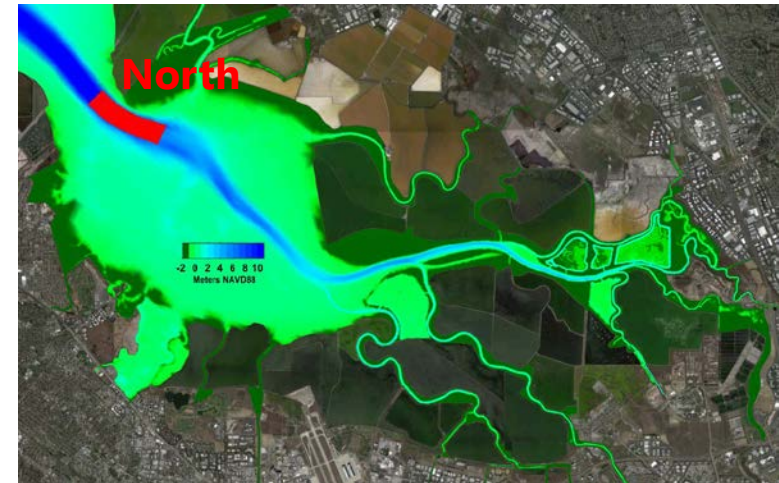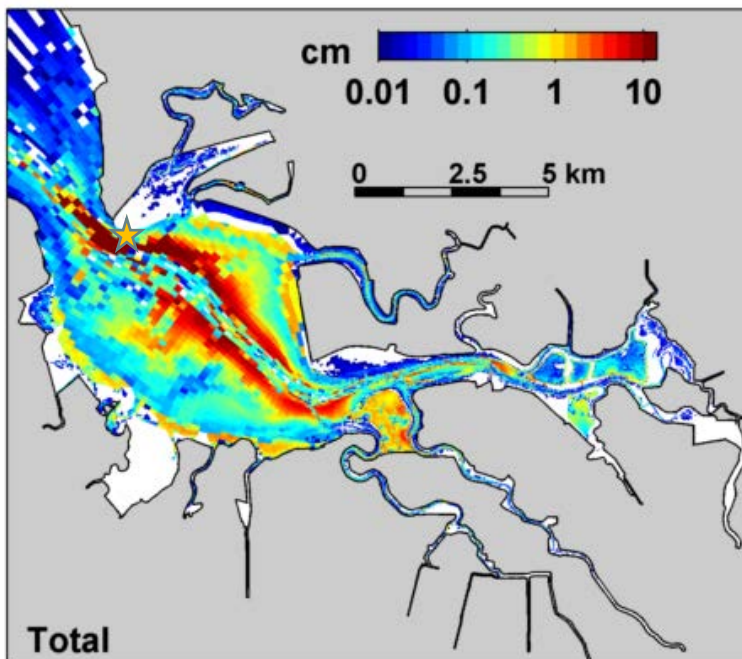
Conclusions

- Three-dimensional hydrodynamic, wave, sediment transport, and morphologic model applied to evaluate potential sites where open-water dredged material placements could be used to augment sediment supply to mudflats and marshes

- Locations evaluated in San Pablo Bay, Corte Madera Bay, and Far South Bay

- All four placement locations evaluated in Far South Bay maintained majority of dredged material south of Dumbarton Bridge and supplied sediment to breached salt ponds, existing marshes, and mudflats

- Increasing sediment accretion within restored ponds will improve shoreline resiliency and complement flood risk management goals of South San Francisco Bay Shoreline Study

- In-Bay placement has the potential to provide a low-cost placement option that also achieves goals of beneficial reuse.

Path Forward

✓ 1. Develop and validate three-dimensional hydrodynamic, wave, and sediment transport model for San Francisco Bay

✓ 2. Apply model to identify potential sites where dredged material placement could be used effectively to augment sediment supply to marshes

➡ 3. Implement and monitor pilot study to confirm model results, measure potential benefits, and provide additional data for model validation

   – Pre-placement bathymetry, benthic, and marsh surveys

   – Small pilot placement with tracers, extensive monitoring

   – Post-placement bathymetry, benthic, and marsh surveys

4. Refine model assumptions and validate refined model using data collected during pilot study

5. Policy changes will be required to allow for open-water dredged material placements for beneficial use

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UnTRIM Model

- Vincenzo Casulli

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