# *Working with Water: Improving Sediment Management for Marsh Resilience in SF Bay*

SFEP IC
May 21, 2025

**JULIE BEAGLE**
Environmental Services Branch Chief
Engineering with Nature Practice Lead
San Francisco District, USACE

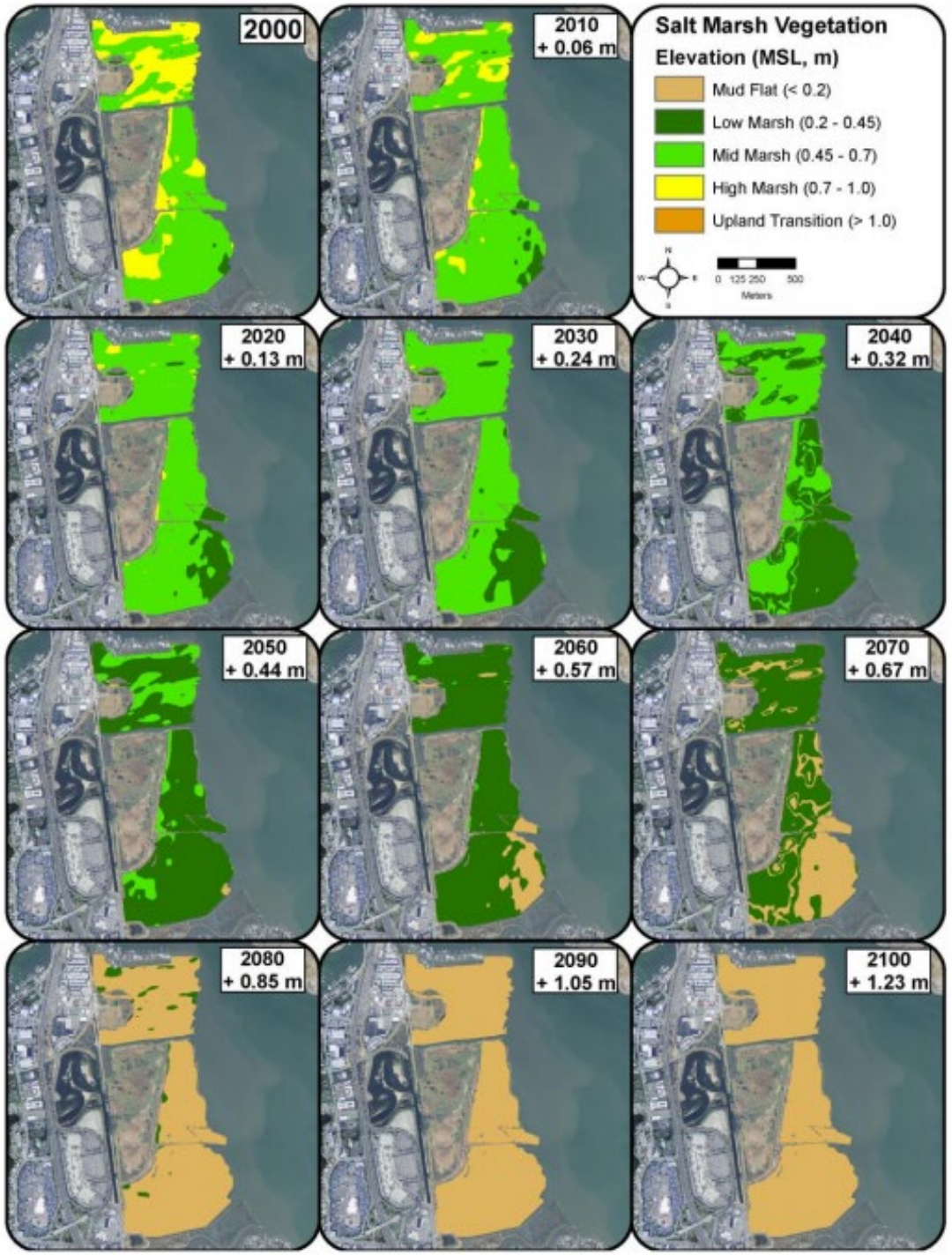
Engineering With Nature

US Army Corps of Engineers

USGS science for a changing world

**Arrowhead Marsh**
Peter Essick/Aurora

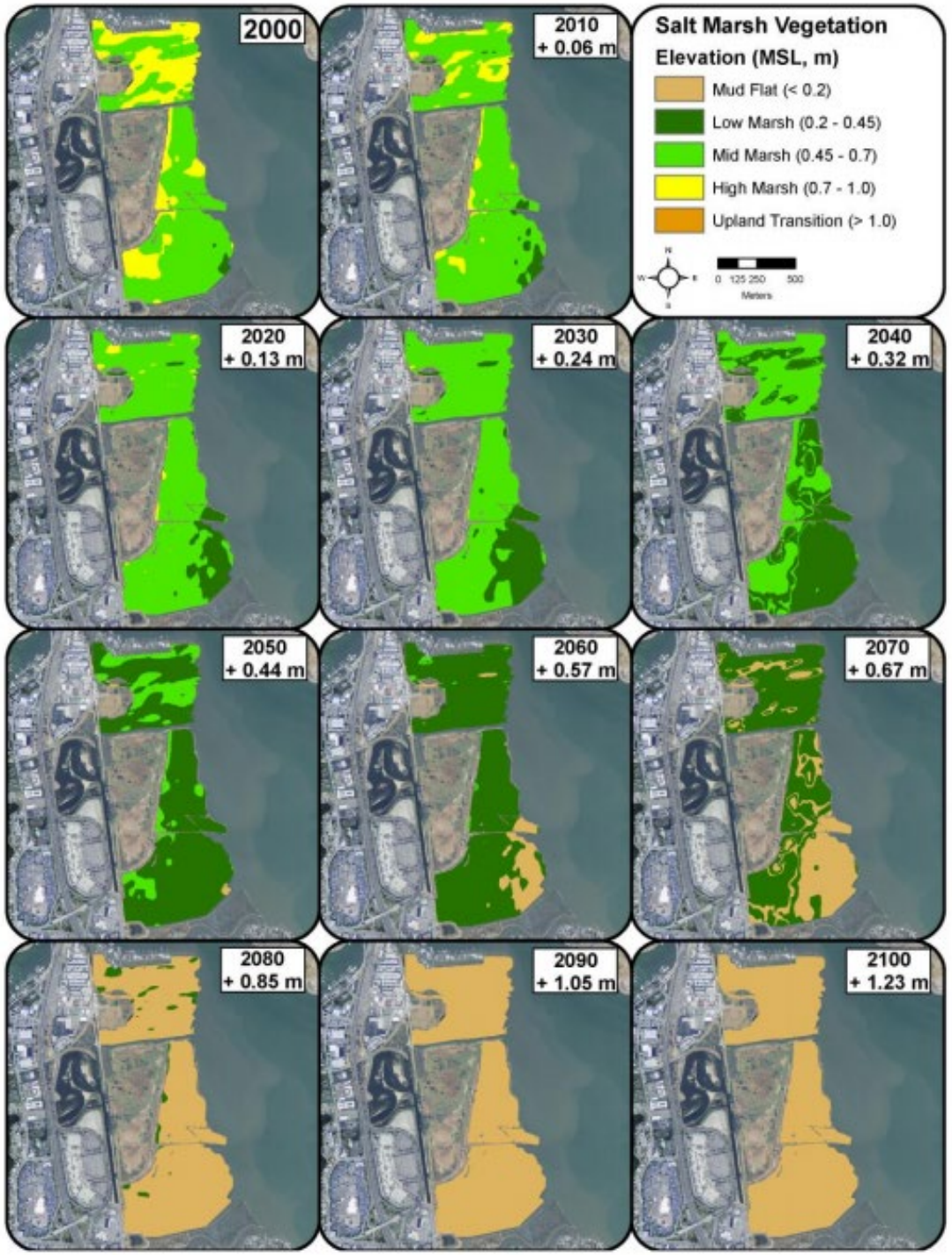
**Arrowhead Marsh**
**Boardwalk During King Tide**
1/22/2012
Flikr. KPaulsell




Corte Madera WARMER results in terms of vegetation category: mudflat, low, mid, or high marsh, or upland transition.
Karen Thorne, USGS

# PROBLEMS

- Limited **sediment supply** regionally + **sea-level rise**
  - Marsh drowning and erosion
  - **Habitat loss** for endangered and threatened species
  - Increased **flood risk** for low-lying communities




Corte Madera WARMER results in terms of vegetation category: mudflat, low, mid, or high marsh, or upland transition.
Karen Thorne, USGS

## PROBLEMS

- Limited **sediment supply** regionally + **sea-level rise**
  - Marsh drowning and erosion
  - **Habitat loss** for endangered and threatened species
  - Increased **flood risk** for low-lying communities

## OPPORTUNITY

- Reuse dredged material in innovative ways to support existing bayland ecosystems
- **Leverage dredged material** from navigation channels
  - Beneficial Use: Direct Placement
  - **Novel EWN Methods (e.g., Strategic Placement**)

# MARSH DROWNING/DOWNSHIFTING

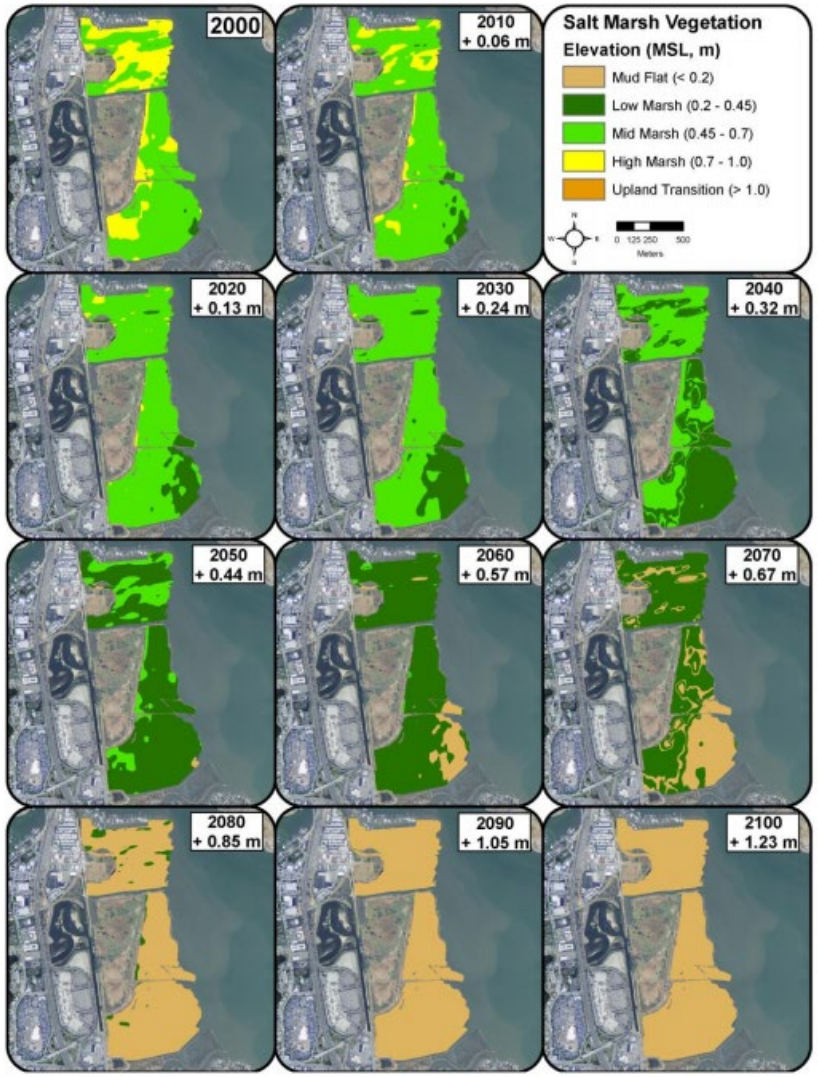



**Figure G-9.** Corte Madera WARMER results in terms of vegetation category: mudflat, low, mid, or high marsh, or upland transition.

From Karen Thorne, USGS

Habitat availability of Ridgways' rails over time

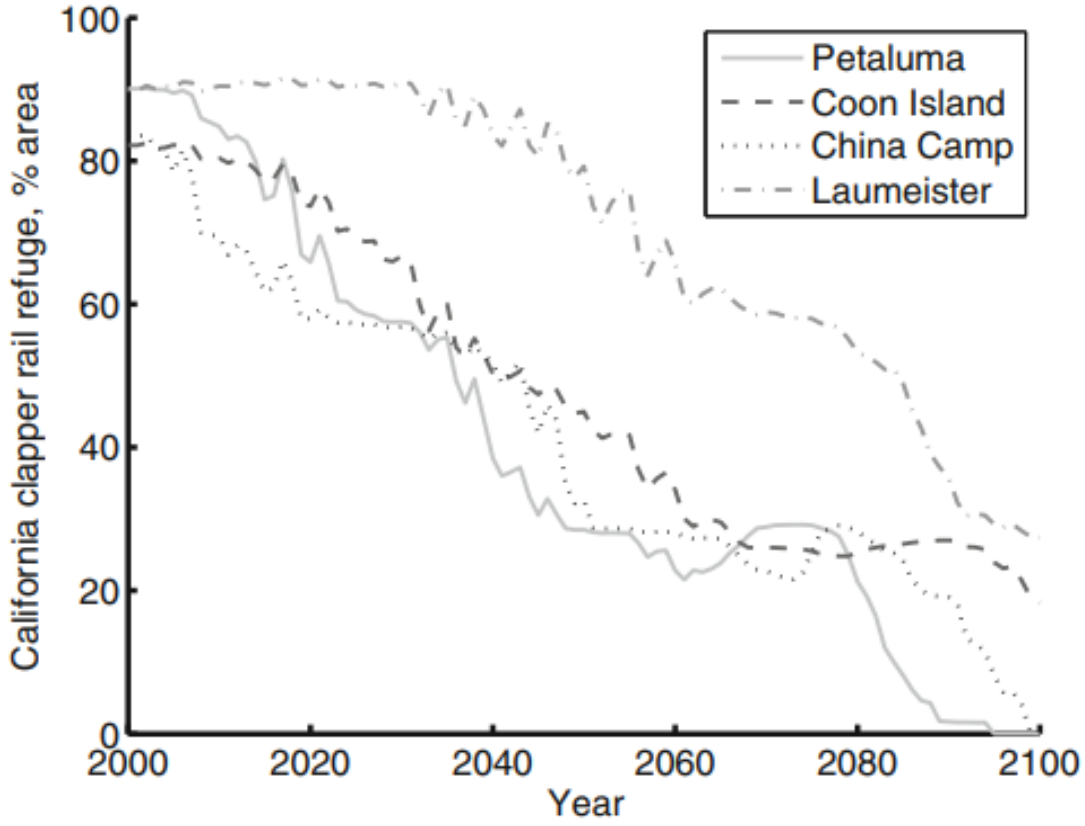



**Fig. 9** *R. longirostris obsoletus* habitat availability at MHHW. Projected marsh area (%) where elevation plus maximum vegetation height exceeds MHHW by at least 20 cm

Swanson et al. 2013

# MANY TOOLS IN THE BENEFICIAL USE TOOLBOX

## Remove obstructions

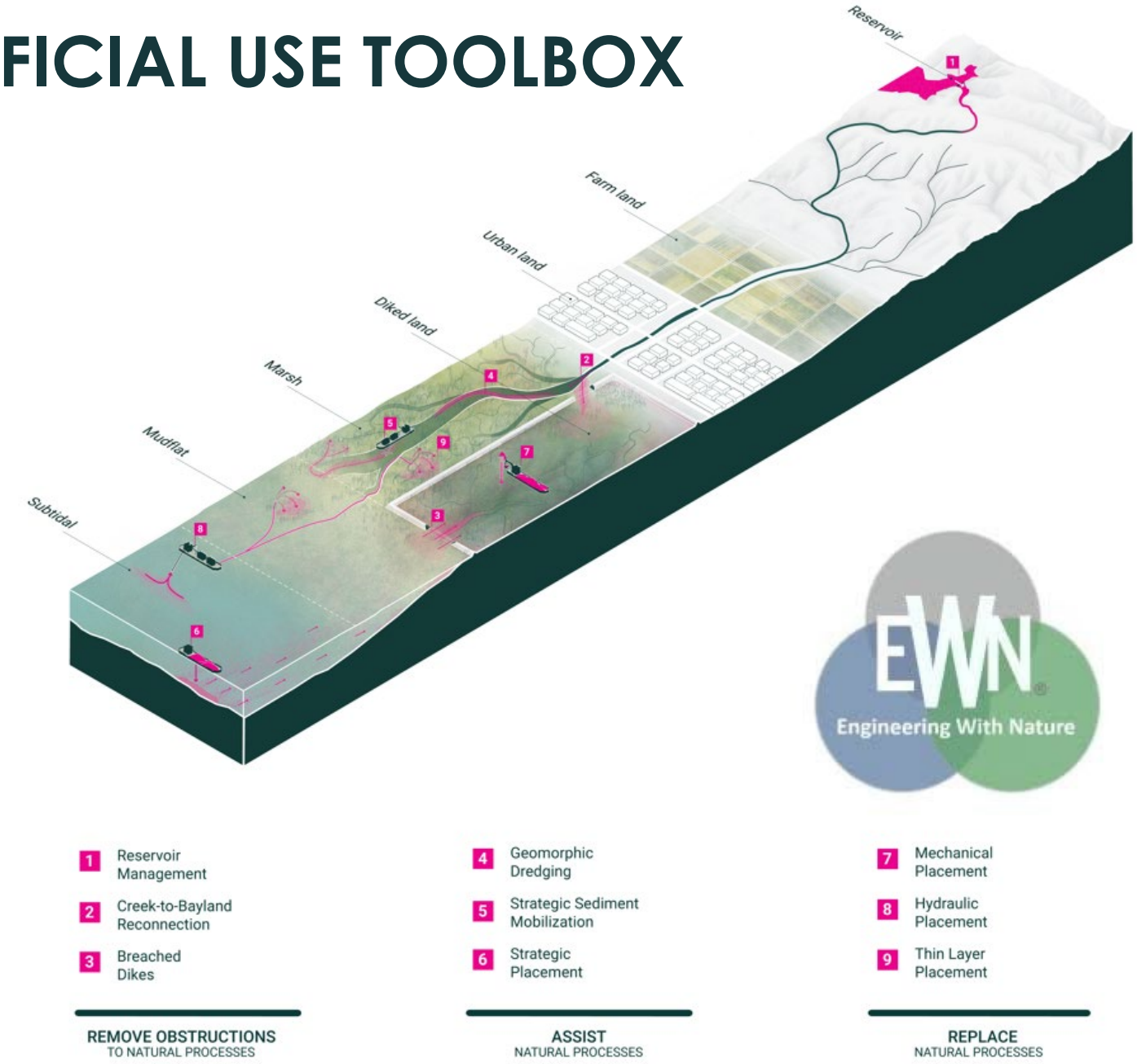
- Reservoir management
- Reconnect Creeks to Baylands
- Berm/pond breaches

## Assist natural processes

- Strategic shallow water placement
- Strategic pulse dredging in tidal channels

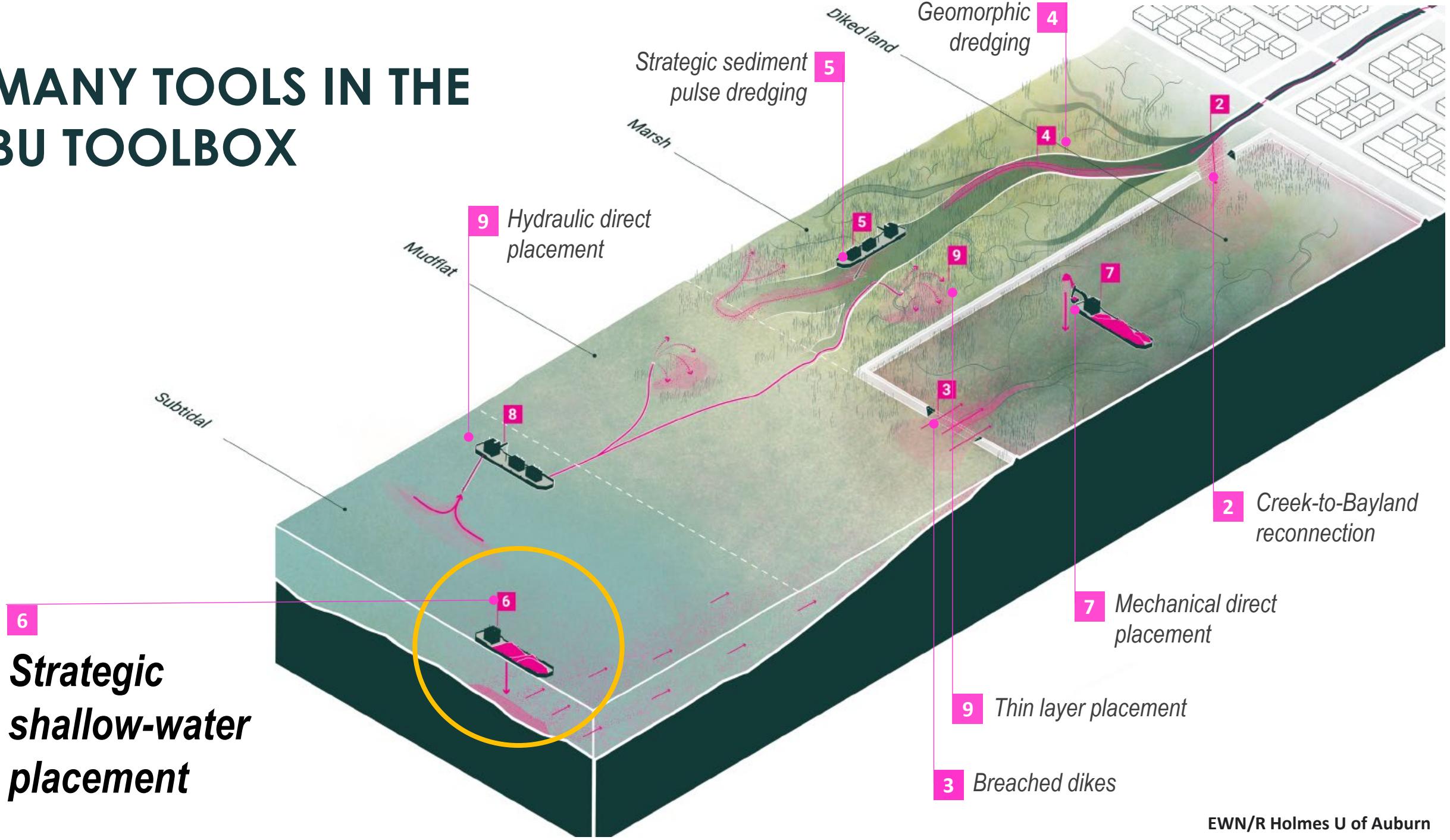
## Replace natural processes

- Mechanical placement (direct)
- Hydraulic placement




EWN/R Holmes U of Auburn

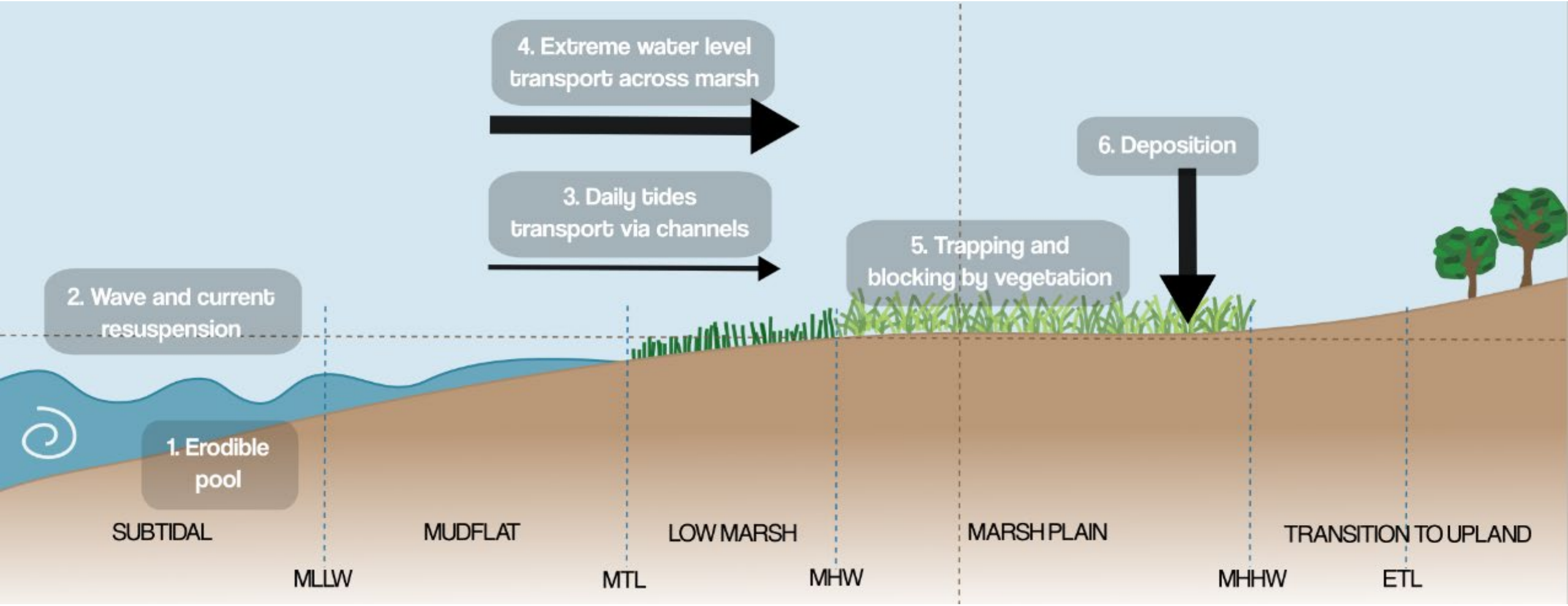
# MANY TOOLS IN THE BU TOOLBOX



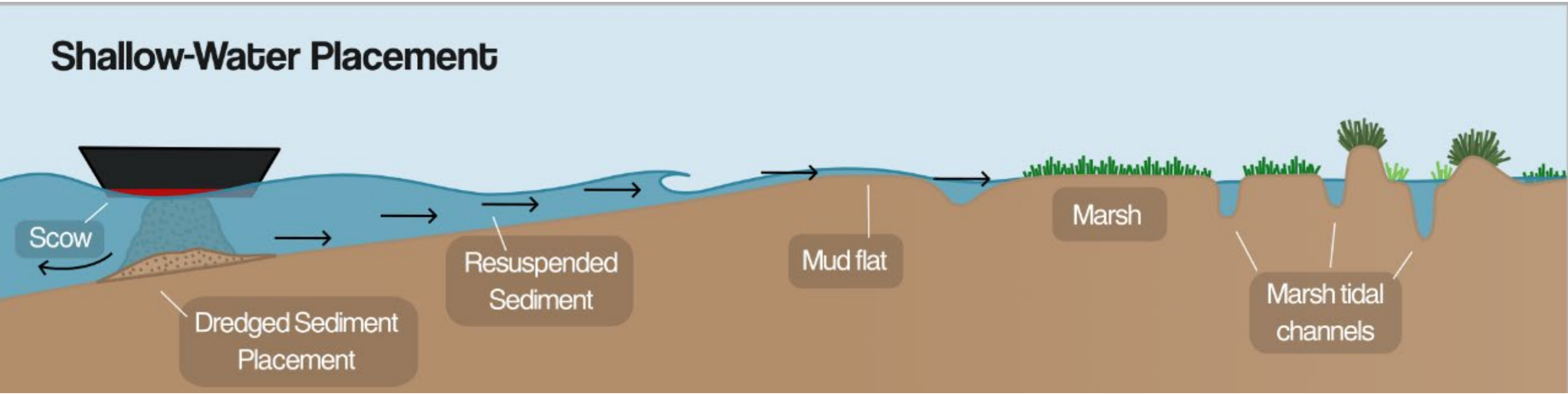

**Strategic shallow-water placement**

EWN/R Holmes U of Auburn

# SEDIMENT TRANSPORT BETWEEN SHALLOWS AND MARSH



# MIMICKING/BOOSTING SEDIMENT TRANSPORT PROCESSES



# WHERE CAN THIS TOOL BE USED?

## Site selection criteria

- Eroding or drowning marsh, lack of natural sediment supply
- Sufficient wind-wave action to resuspend sediment placed
- Open to tidal exchange
- Wind-wave shore-normal approach
- Deep water close to shore
- Avoiding large eelgrass beds/nearshore reef projects
- Flood protection for EJ/disadvantaged communities

# MODELING

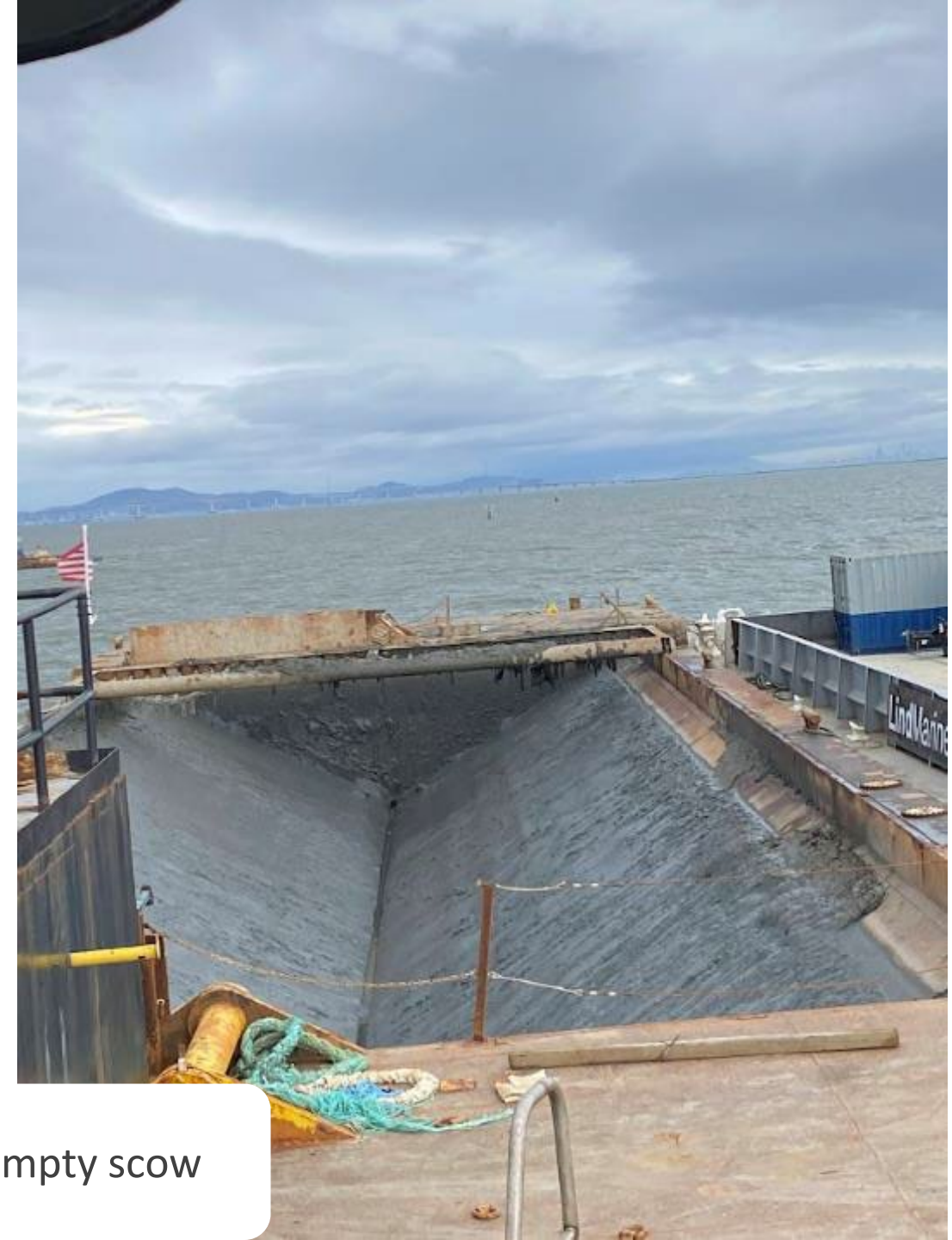
- Modeling using UnTRIM Bay-Delta model and sediment transport model to simulate existing conditions and placement alternatives
- **First Round – Site Selection**
  - Determine whether Emeryville or Eden Landing is most suitable for this pilot study
  - Evaluate different placement strategies
    - Testing 100,000 $yd^3$ total
    - Placement locations
- **Second Round –sensitivity analysis**
  - Different volumes
  - Seasonal differences
  - Size of placement footprint
  - Sediment sources


- **90,000 CY** dredged from the Port of Redwood City, Reach 1 and 2
- Dec 6-Dec 31, 2023

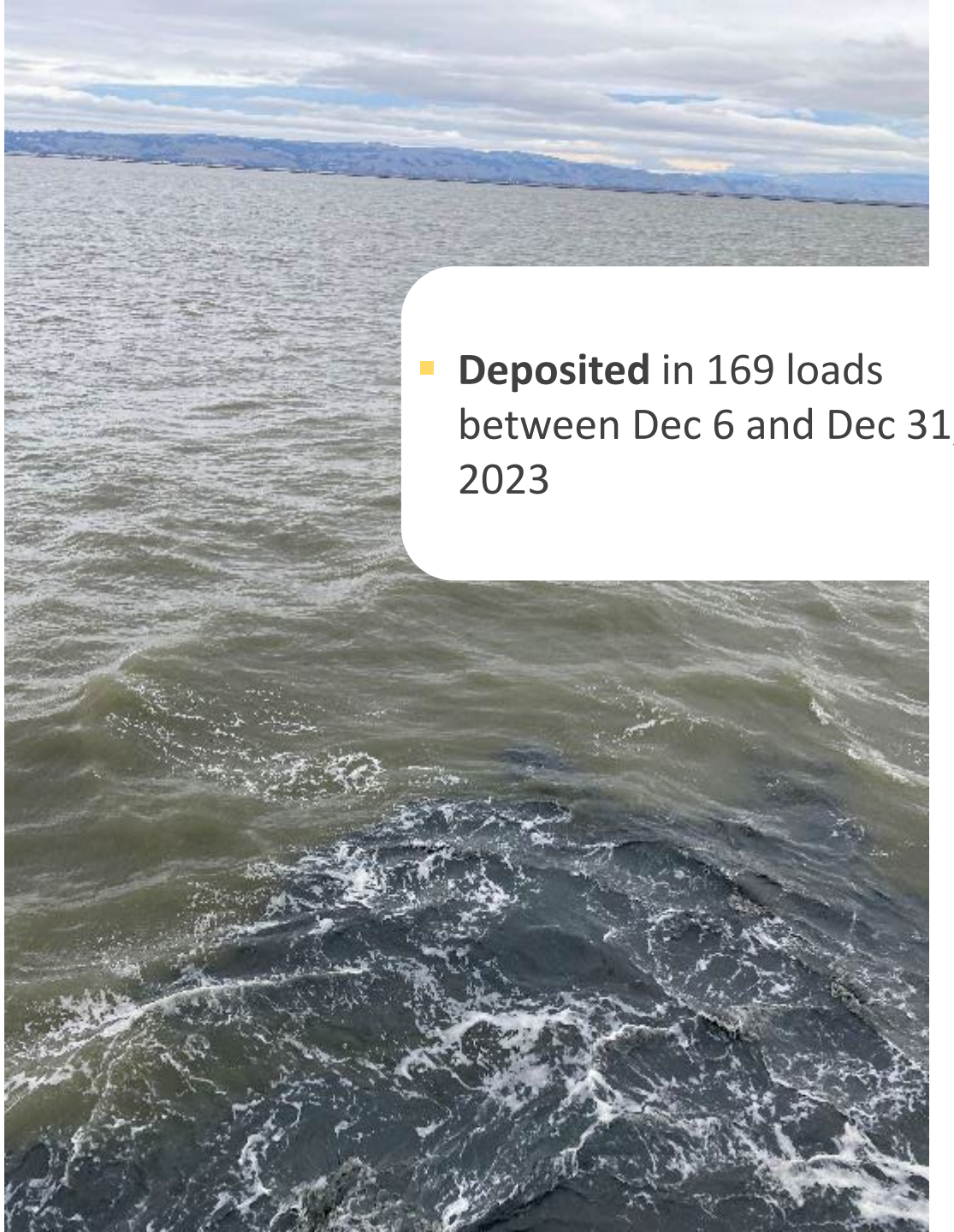
- Loaded **into shallow-draft scows** (1600 CY and 300 CY)

- Loaded into **shallow-draft scows** (1600 CY and 300 CY)


- Pushed across the Bay by Tugboat



- Empty scow



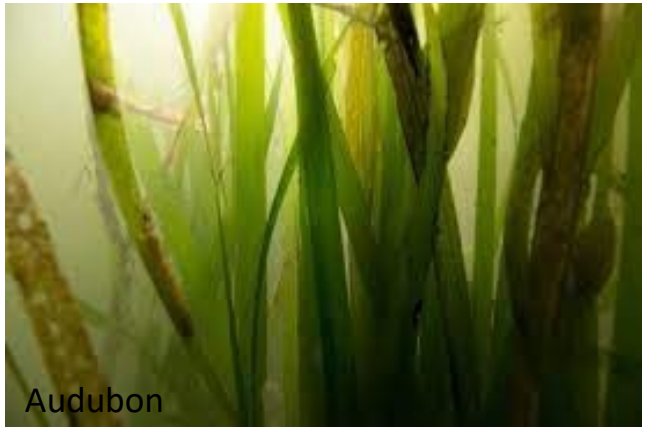
- **Deposited** in 169 loads between Dec 6 and Dec 31, 2023

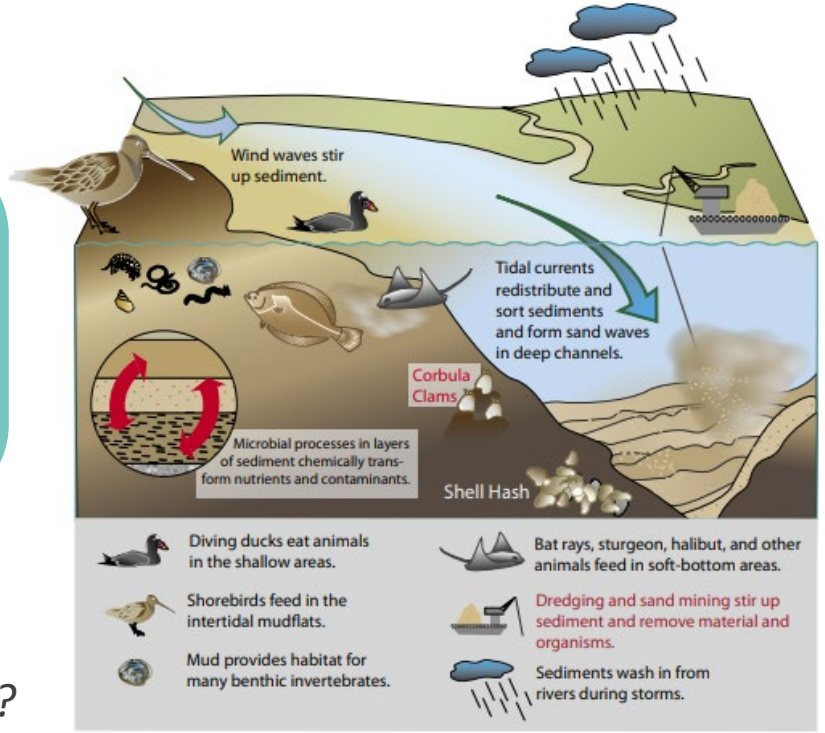
# KEY MONITORING QUESTIONS

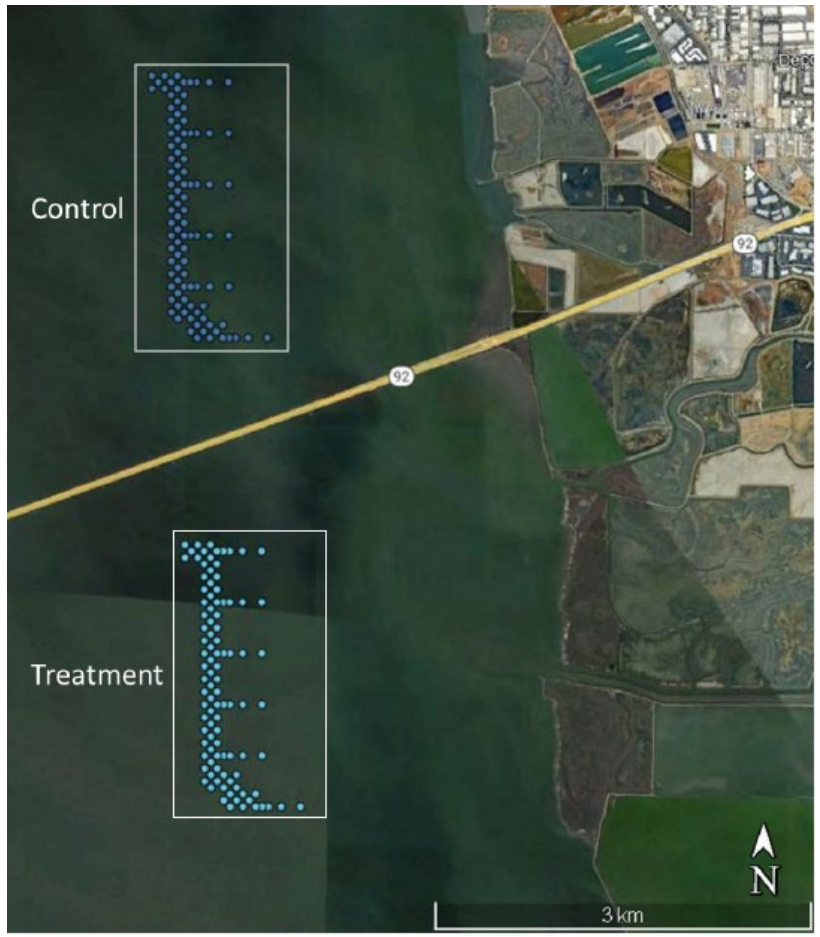
1

**What are the potential impacts on the benthos and ecological communities nearby?**

- *How long do the effects last?*
- *How far do the effects spread?*
- *What about eelgrass in the area?*



# KEY MONITORING QUESTIONS

1

**What are the potential impacts on the benthos and ecological communities nearby?**

- *How long do the effects last?*
- *How far do the effects spread?*
- *What about eelgrass in the area?*

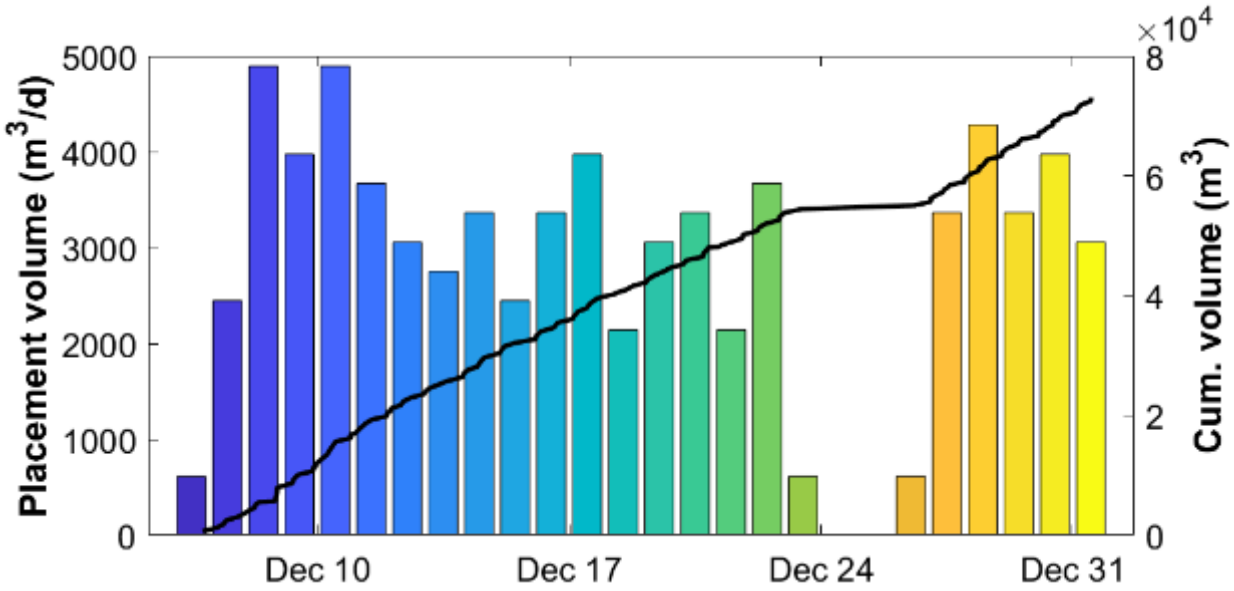
2

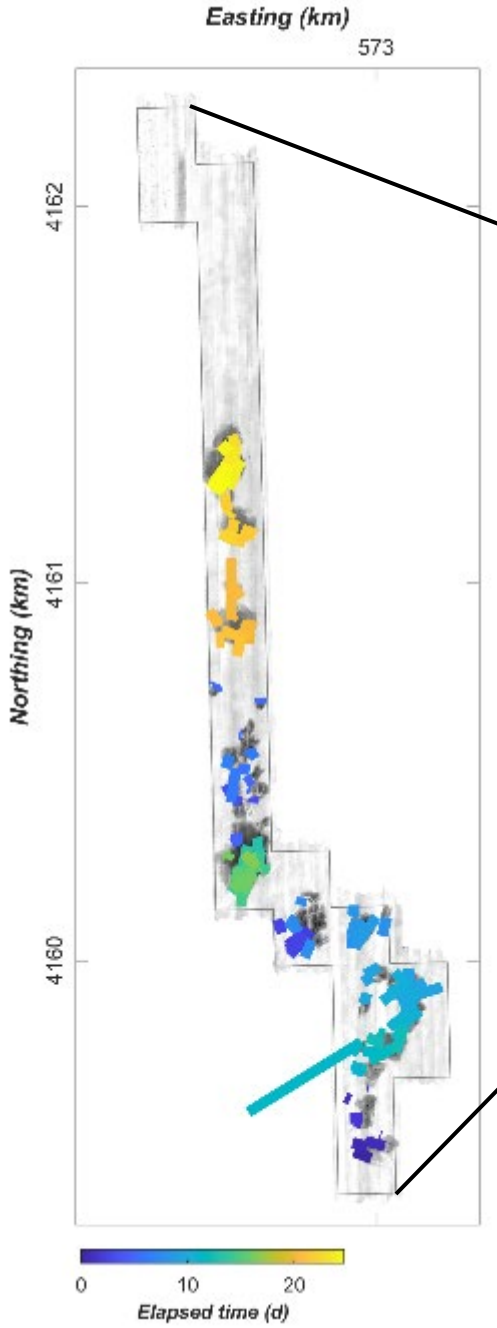
**Where does the sediment end up? How do physical processes (tides and waves influence its transport?**

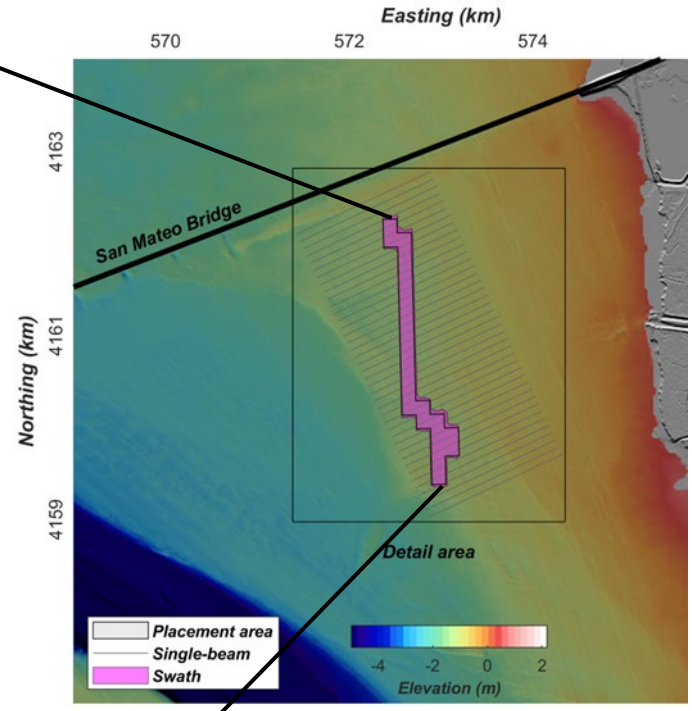
- *Repeat bathymetric surveys*
- *What wave conditions move sediment?*
- *Use of a particle tracking study*
- *Understanding deposition in mudflats, marshes, breached ponds*

# PLACEMENT DEC 6-31, 2023

Dredgers reported time, location and volume of each placement



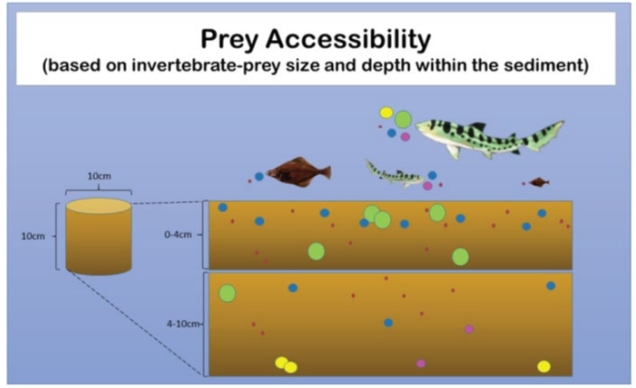



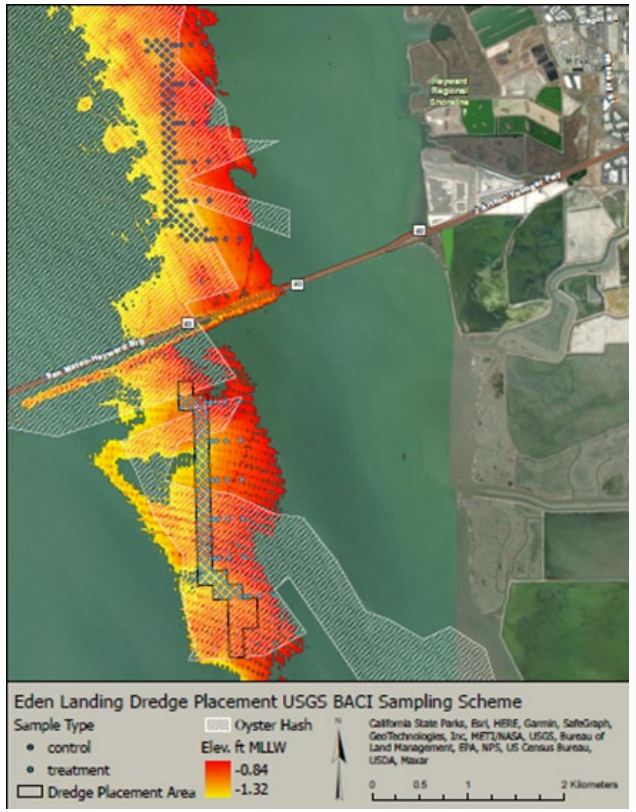

Placement area

Sediment fate and transport

# EFFECTS ON BENTHIC COMMUNITIES

Benthic community density, diversity and accessibility for predators




Before After Control Impact (BACI) design to evaluate effects:

- Distance from placement
- Time since placement

Intensive sampling effort

- immediately pre and post placement
- 6 months later

Potential impacts

*USGS WERC: De La Cruz, Woo, Graham*

# EELGRASS IMPACTS

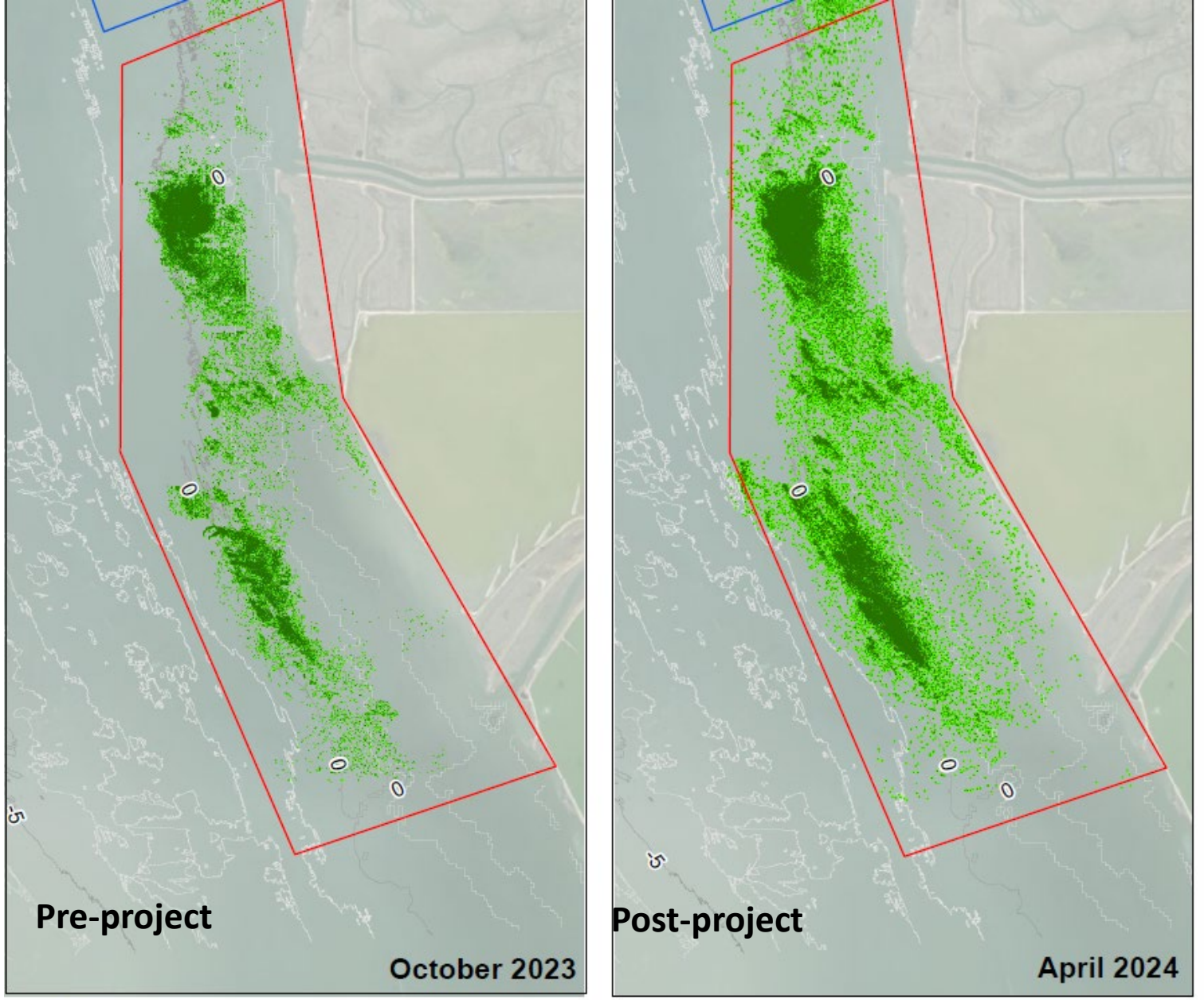
- 80% areal increase between pre- and post-construction surveys
- 27% increase in eelgrass density

**Table 2. Eelgrass Vegetated Areal Extent Summary**

| Location | Pre-Construction (October 2023) | Post-Construction (April 2024) | Area Difference (Post minus Pre) | Percent Change |
|---|---|---|---|---|
| APE | 37.64 | 67.37 | +29.73 $m^2$ | 80.0% increase |
| Reference Site | 4.03 | 7.98 | +3.95 $m^2$ | 98.0% increase |

**Table 3. Eelgrass Density Summary**

| Location | Pre-Construction Density (turion/$m^2$) | Post-Construction Density (turion/$m^2$) | Mean Percent Difference within the (Post/Pre)-1)*100 |
|---|---|---|---|
| APE | 95.2±20.4 | 120.8±22.3 | 26.9% increase |
| Reference Site | 72.0±21.7 | 134.4±30.0 | 86.7% increase |




**Pre to Post-construction Eelgrass Survey Comparison**
**October 2023 to April 2024**
San Francisco Bay Shallow-Water Strategic Placement Project
San Francisco Bay, California

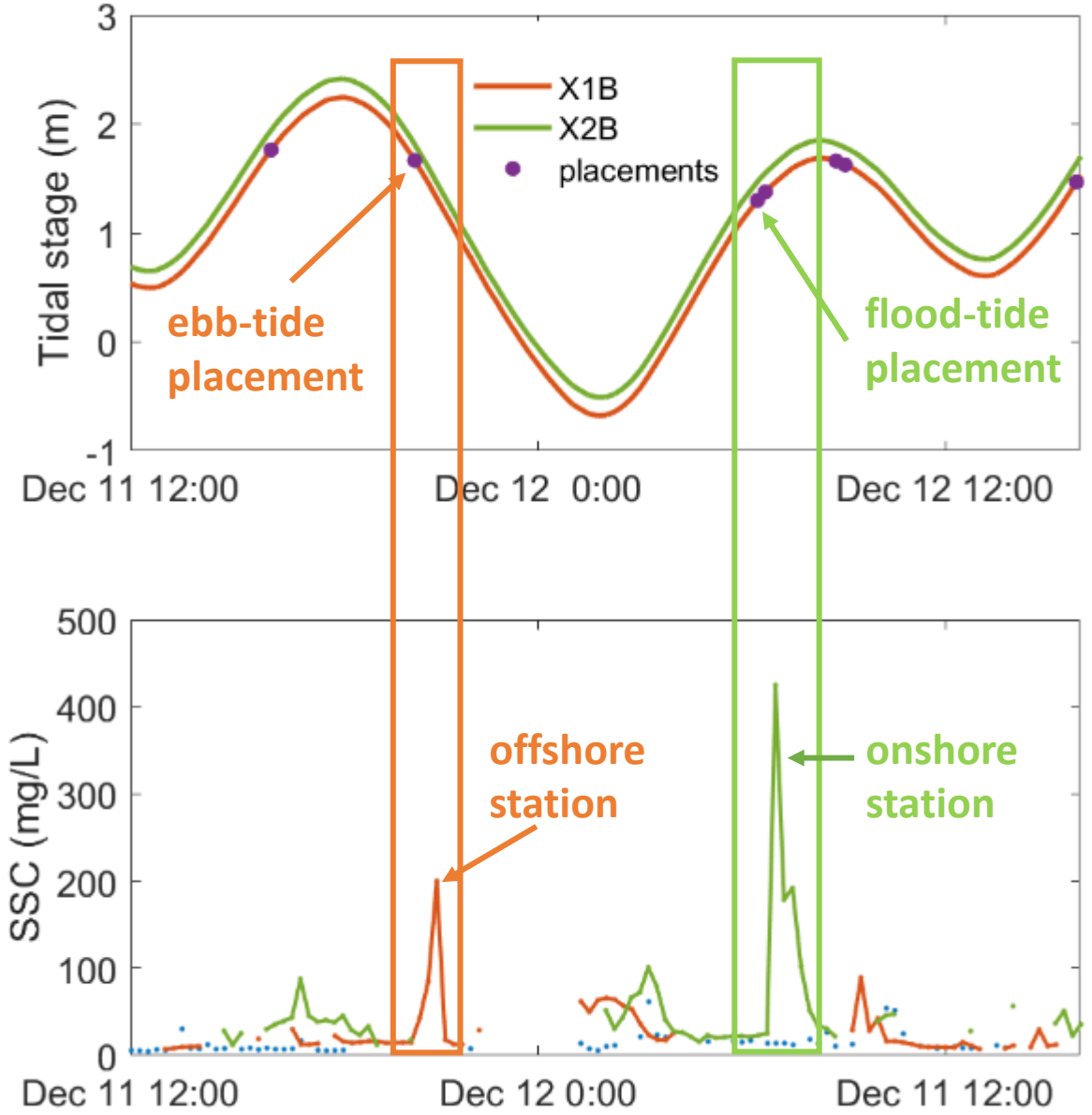
**Figure 3**

# SSC DURING PLACEMENT

Increased SSC reduces light penetration, a concern for eelgrass and phytoplankton

- Spikes in SSC occurred after many placement events
- Duration typically 1-1.5 hours
- Observed at ‘closest’ station in direction of tidal currents
- During wave events, SSC at all stations reached 150-300 mg/L for >12 hours

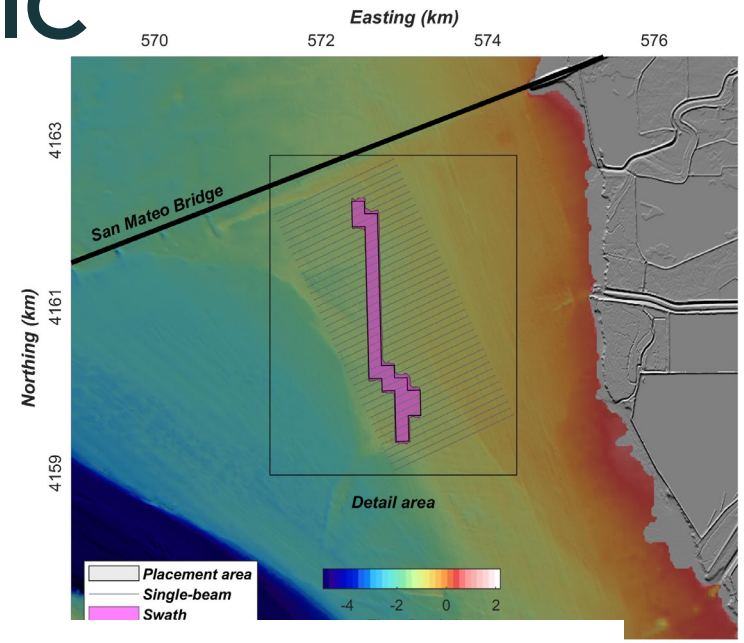
Placement increased SSC for short periods, without exceeding levels that occur naturally

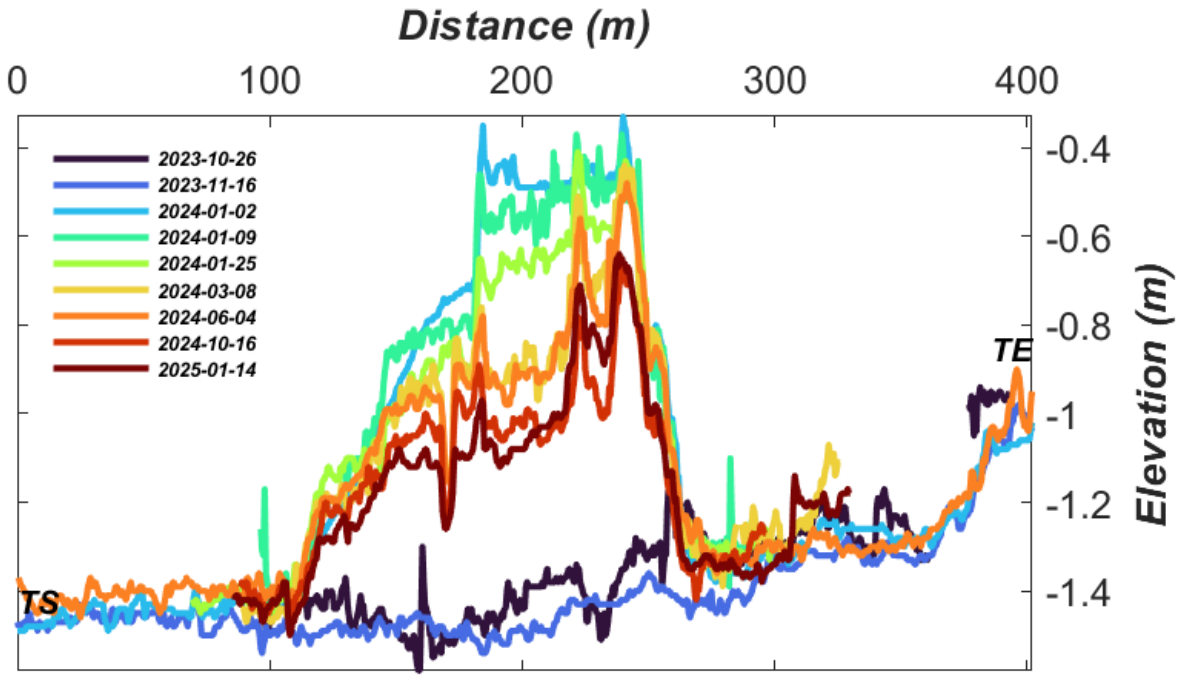


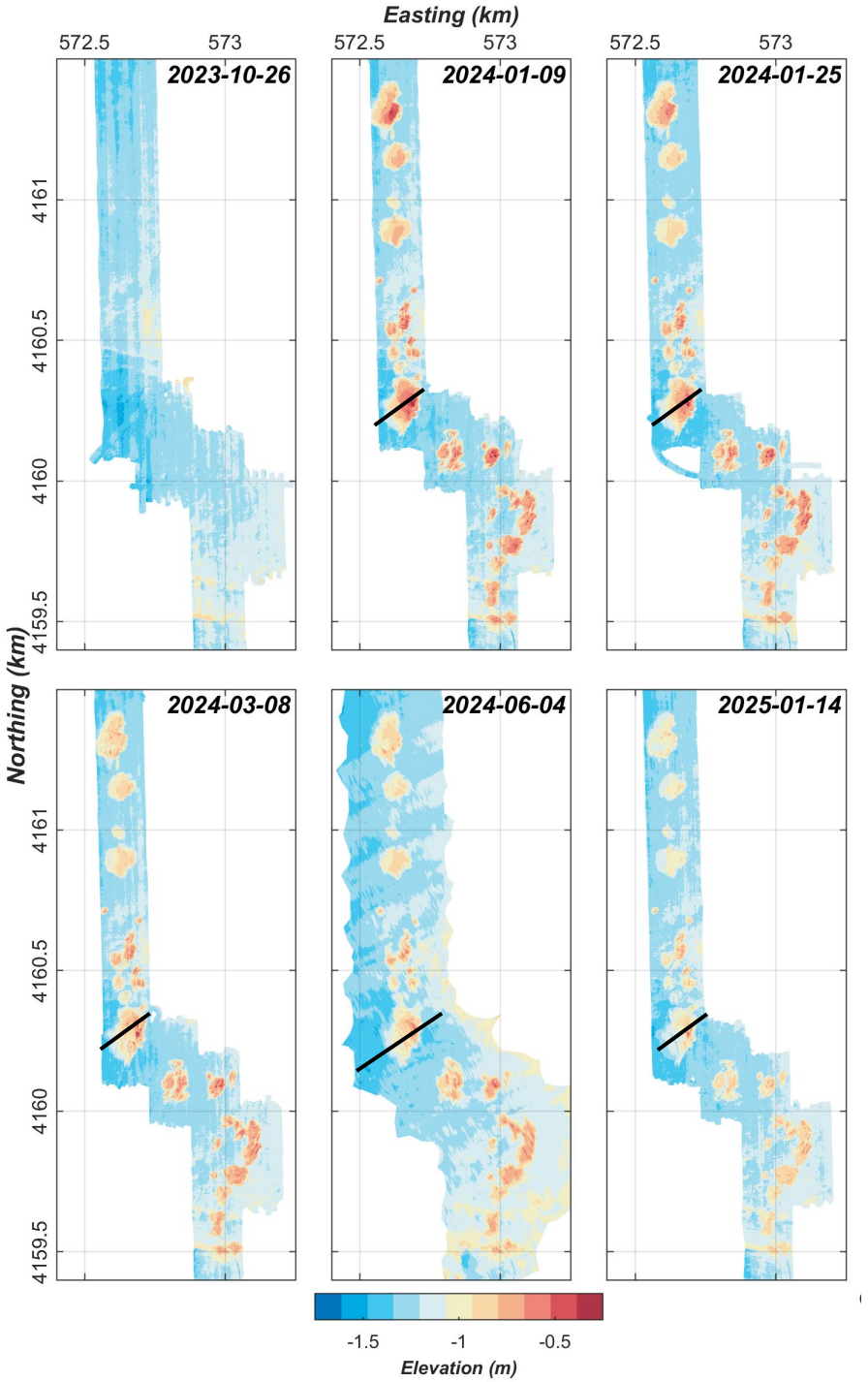

Potential impacts

# REPEAT BATHYMETRIC MAPPING:

- Multiple mounds
- Varying size
- Height and volume gradually decreasing



# TRACER STUDY

- 1,000 kg of fluorescent, magnetic coated silt particles (tracer)
- Deployed January 11, 2024
- One location in the placement area

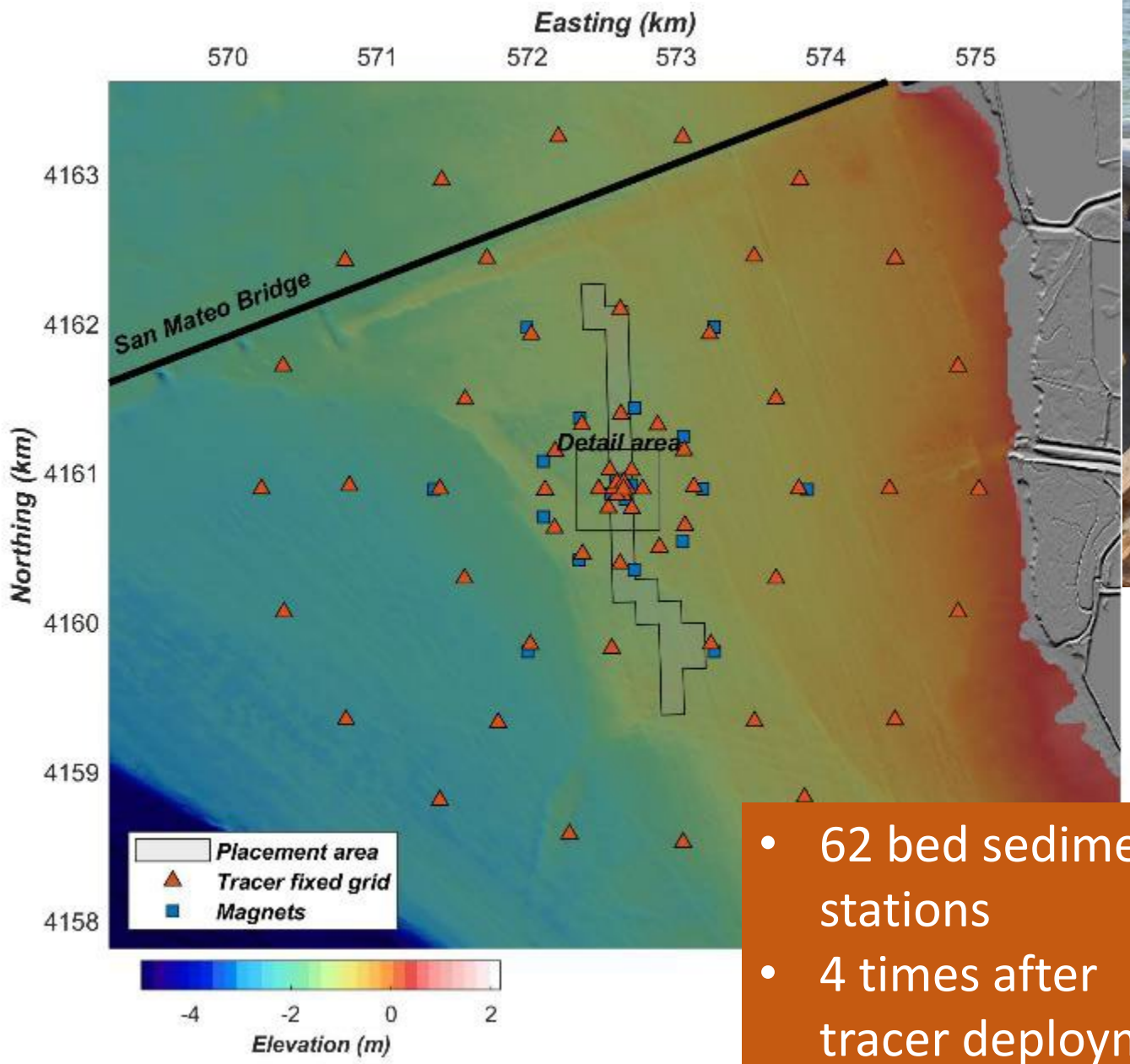

- What are the primary directions of transport from the placement area?
- Where does sediment from the placement area end up?
- How does that change over time?

USGS science for a changing world

PARTRAC

Sediment fate and transport

# TRACER SAMPLING IN THE SHALLOWS




19 magnet stations, one day after tracer deployment

- 62 bed sediment stations
- 4 times after tracer deployment

Sediment fate and transport


WHIRL

# MARSH AND RESTORATION AREA

Monthly from Nov 2023 to Dec 2024:

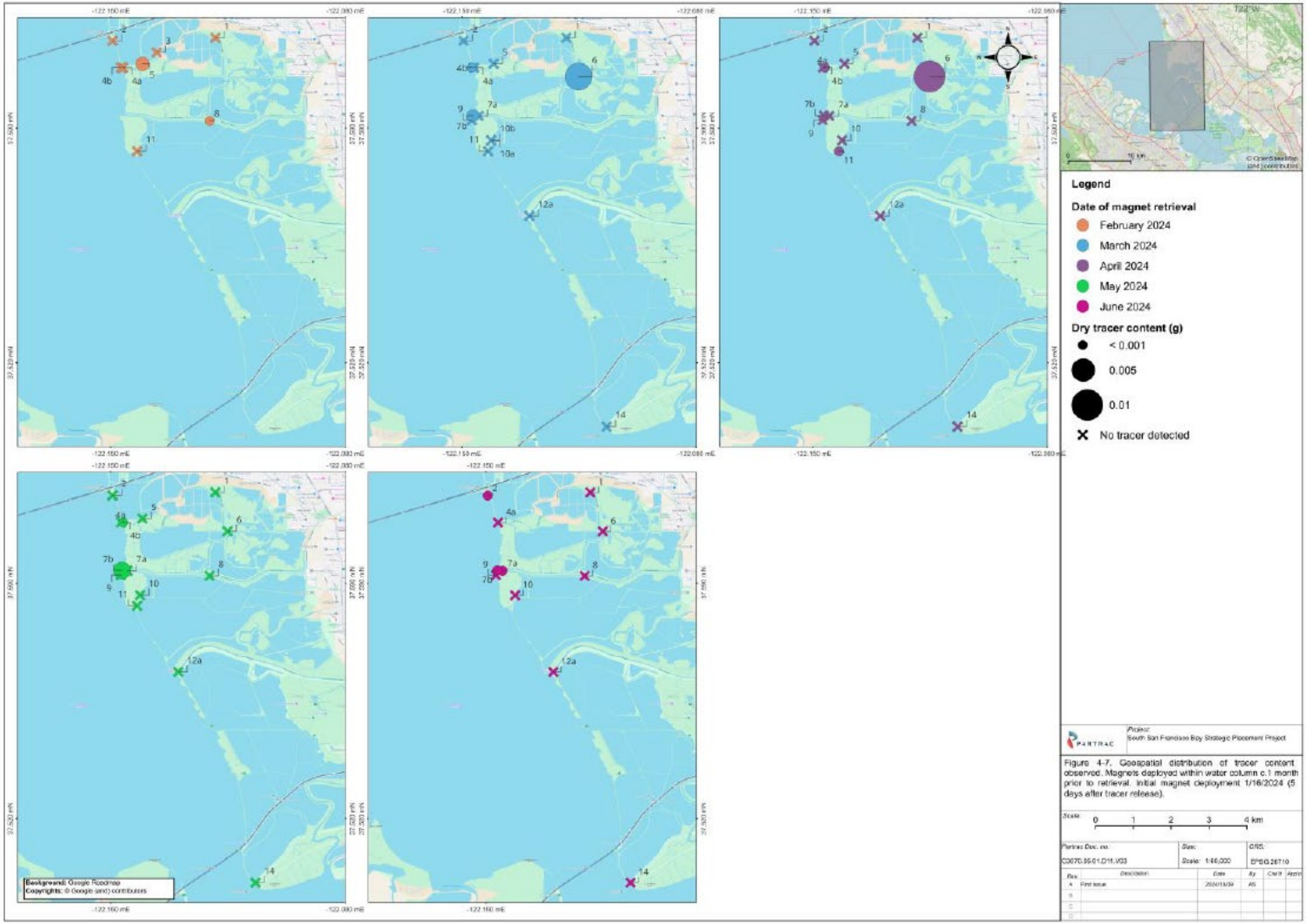
- Magnets deployed in tidal creeks to capture tracer
- Transects of sediment pads across marsh (6) and restored areas (6) to measure deposition

*USGS WERC: Thorne, Buffington*


Magnet stations in tidal creeks

Sediment fate and transport

# TRACERS IN THE MARSH!



# BENEFICIAL USE PILOT PROJECTS TAKE TEAMWORK!

**USACE**

Peter Mull - Project Manager
John Dingler- Planning Mentor
Arye Janoff - Planner
Julie Beagle- Environmental Planner
Eric Joliffe- Environmental Planner
Ellie Covington- Environmental Planner
Tiffany Cheng- Coastal Engineer
Fanny Chan- Civil Engineer
Kelly Boyd – Real Estate
Stephanie Sahinoglu-Cultural Resources

**Modeling**

Michael MacWilliams, Aaron Bever (AnchorQEA)

**Project Partners** CA Coastal Conservancy

Evyan Sloane (SCC)
Brenda Goeden (BCDC)

**SF Bay Regional Water Quality Control Board (CEQA Lead)**

Xavier Fernandez
Kevin Lunde
Jazzy Graham-Davis
Christina Toms

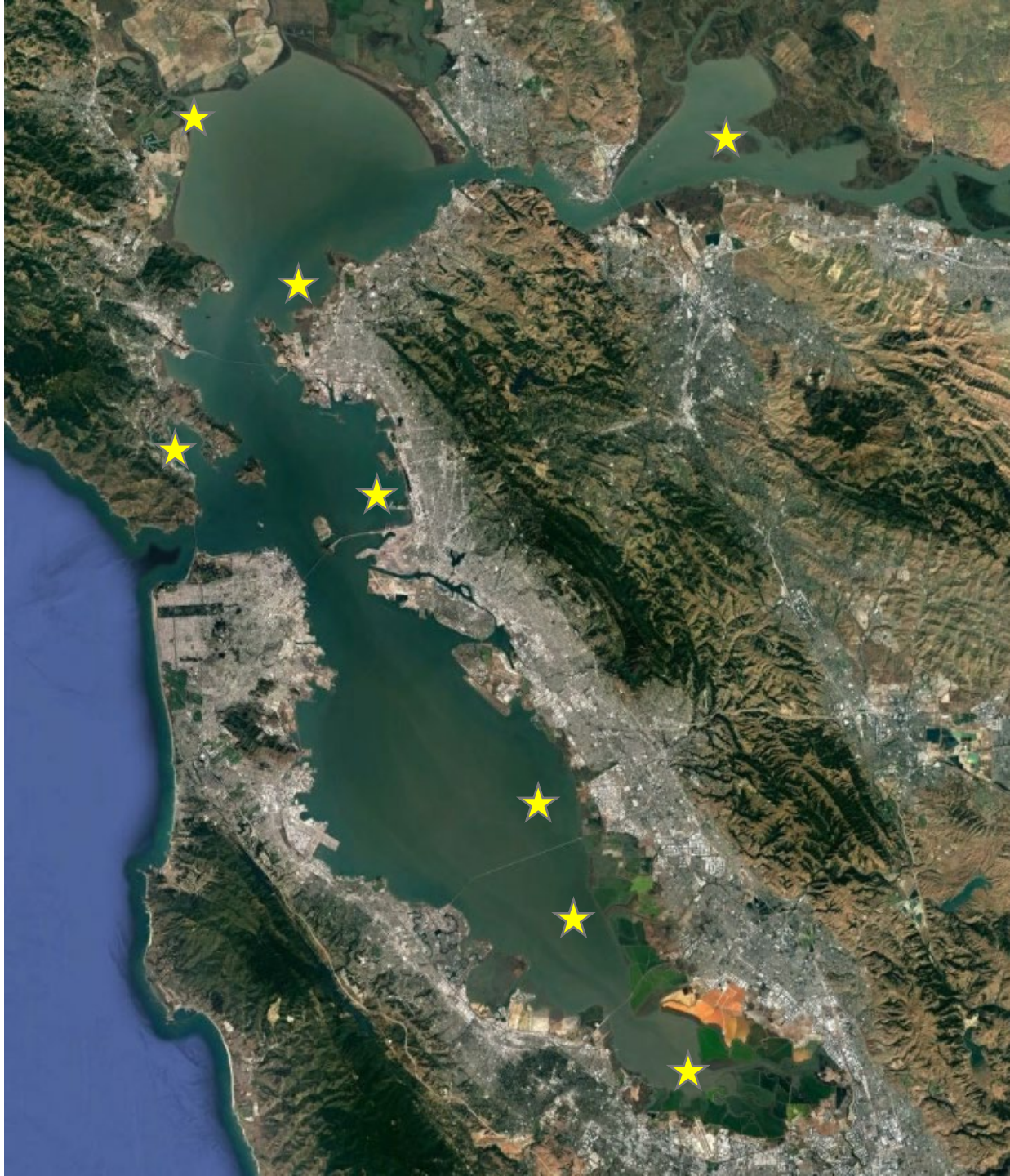
**USGS / Monitoring**

Jessie Lacy, Andrew Stevens, Sam McGill
Karen Thorne, Kevin Buffington, Lindsay Rankin
Susan de la Cruz, Isa Woo, Tanya Graham
Keith Merkel

**MANY OTHERS!**

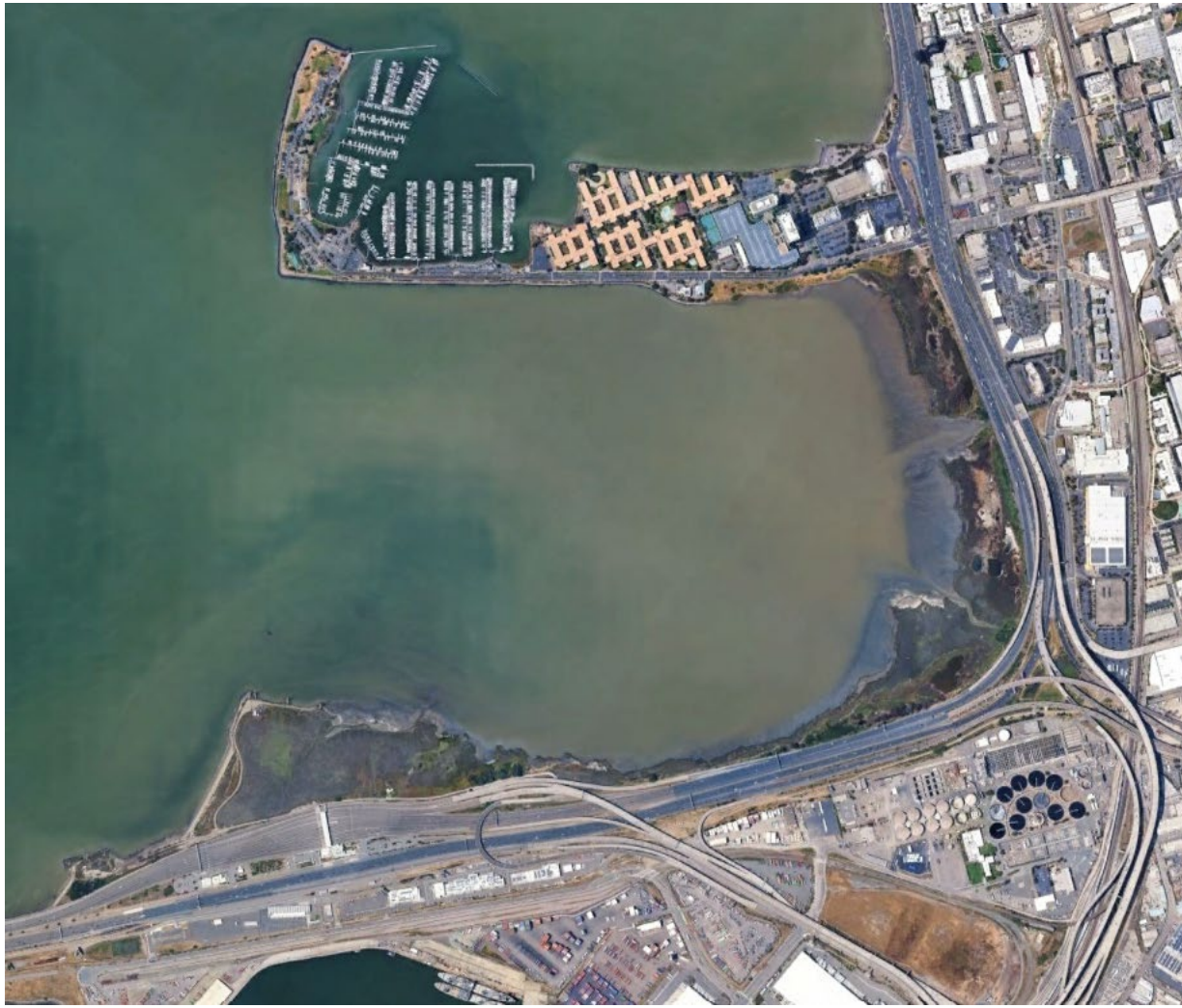
# What's next?

- Scaling up: Toward Marsh Maintenance Plan!
- What is the pathway to get there? Moving from pilot into practice.
- Lessons learned from Round 1
- Can we get to a Round 2?!!



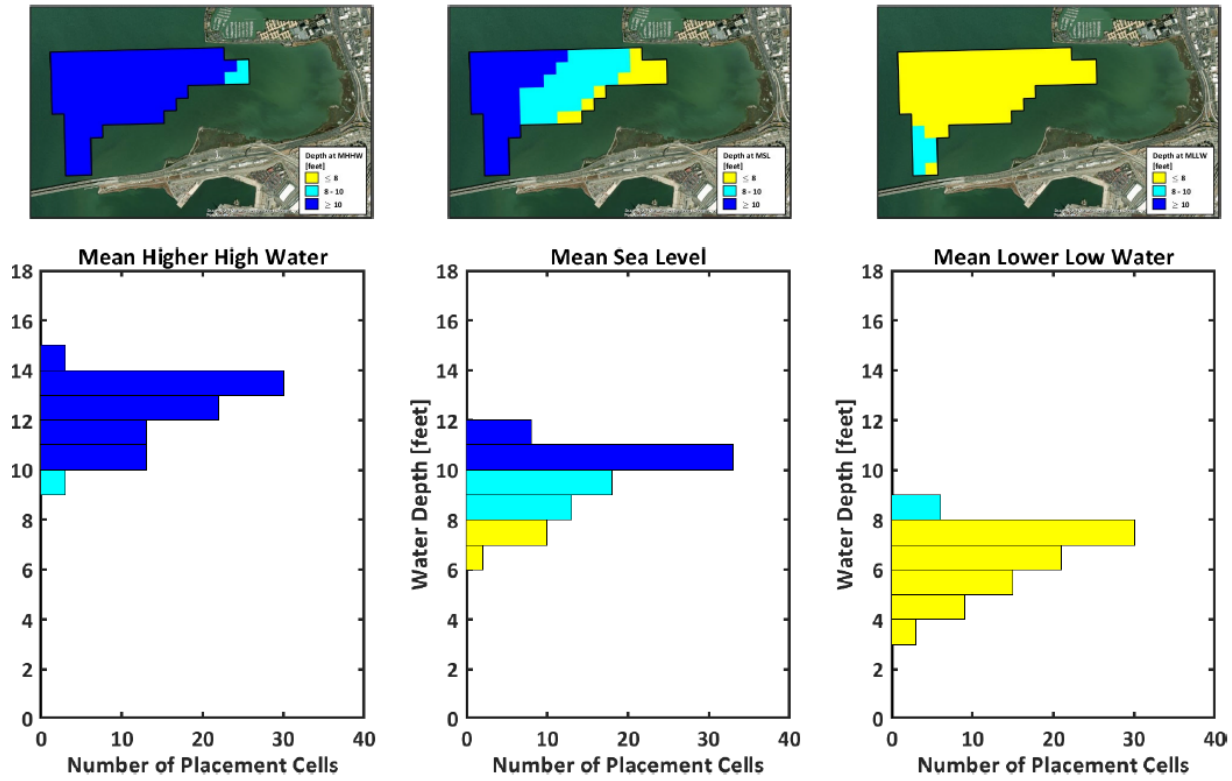
# Strategic Placement-Emeryville Crescent

- The Need:
  - Small eroding marsh, important for habitat in Central Bay, infrastructure
- Partners
  - SFEP
  - East Bay Regional Parks District
  - Cost share- State Coastal Conservancy through WRDA 2020 Section 125a
- Permitting pathways
  - Building from existing NEPA/CEQA from Eden Landing Pilot
  - Will start agency coordination this calendar year
  - Oakland Harbor O&M dredging
- Timing:
  - Targeting summer 2027 (or 28)



# CHALLENGES TO OVERCOME, LESSONS LEARNED

- How to increase resuspension
  - More control of shape/heights of mounds?
- Contracting lessons learned
- Avoid/monitor nearby eelgrass bed
- Which monitoring approaches worked the most effectively?



# THANK YOU

**Contact:** Julie.R.Beagle@usace.army.mil