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Strategic Placement of Dredged Sediment to Naturally Accrete in Salt Marsh Systems

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Agenda

1. Background
2. Strategic Placement Methods
3. Ecological Effects
4. Implementation
5. Conclusion and Next Steps

Background

Problems and Opportunities

A change in sediment regime, anticipated sea-level rise, and localized erosion could slow restoration efforts and lead to a long-term loss of mudflats and marshes in San Francisco Bay. Strategic placement techniques may offer one of many possible solutions to the problem of losing mudflats and marshes.

Background

Purpose of Framework

- Review effectiveness and feasibility of the methods for beneficial reuse
- Outline the potential beneficial and adverse effects these methods may have on habitats and biota
- Outline the logistical, regulatory, and equipment needs these approaches would require
- Identify unknowns needing research to reduce uncertainties

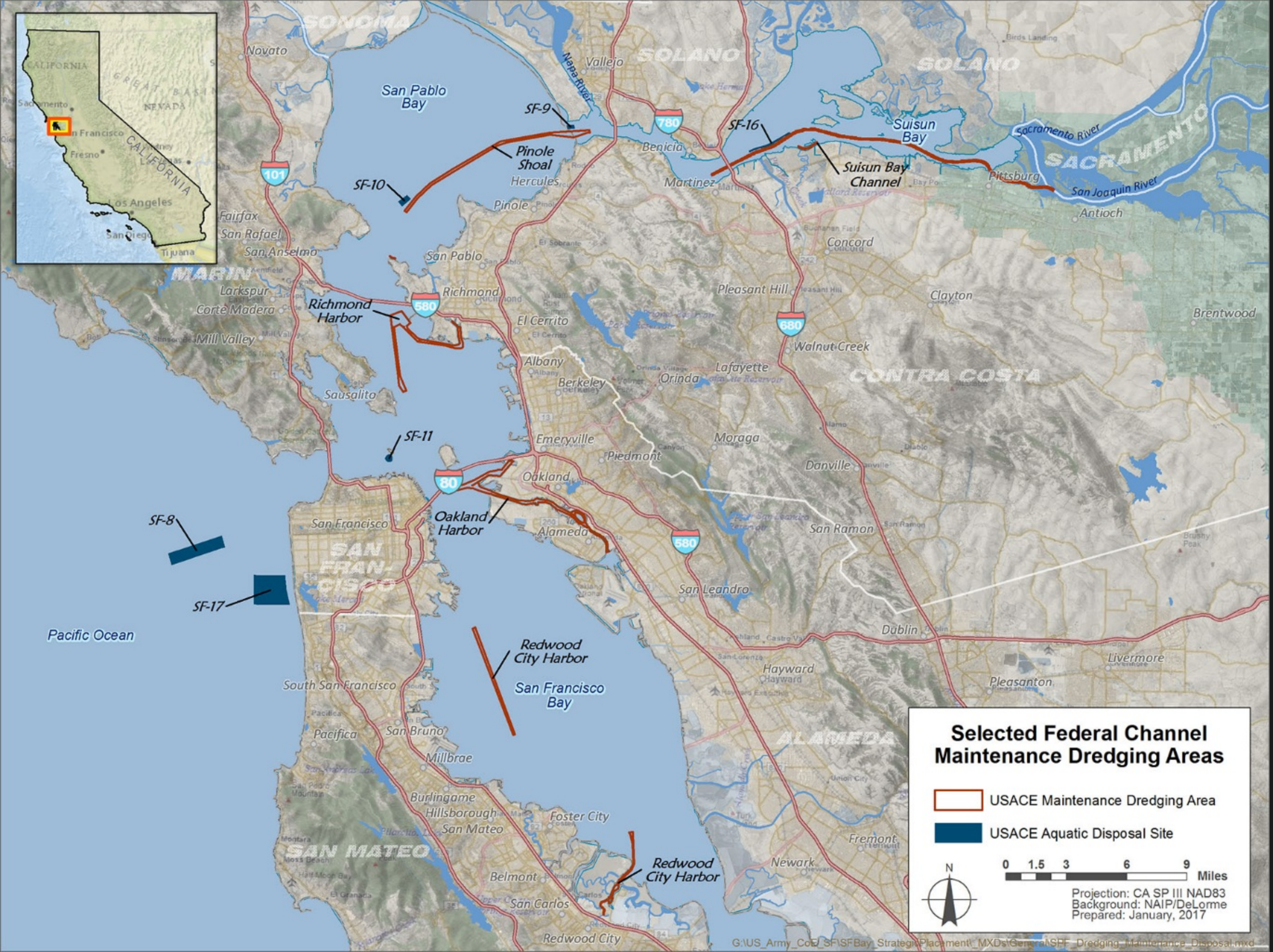
Development of Framework

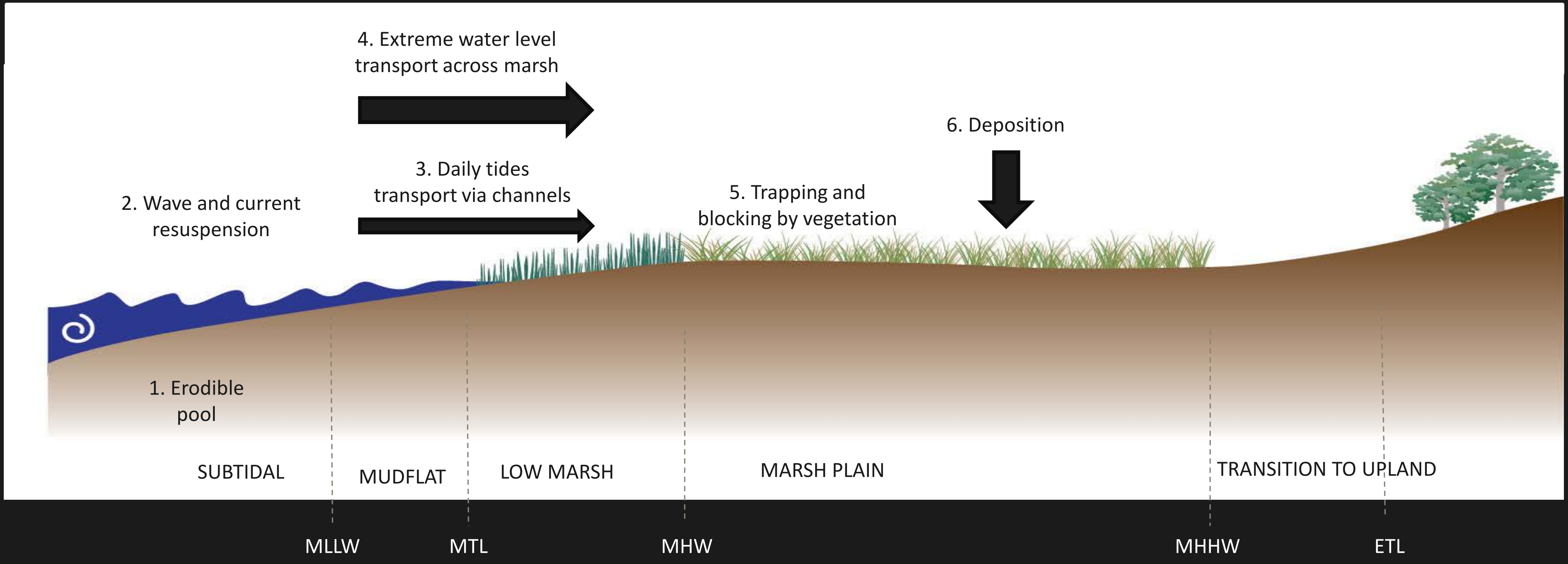
- Two workshops to elicit ideas of stakeholders in engineering, science, dredging, and regulatory communities
- Discussions with individual stakeholders to ID needs and challenges of methods and proposed pilot study
- Independent Review Panel input/comments on early drafts

Thank you to:

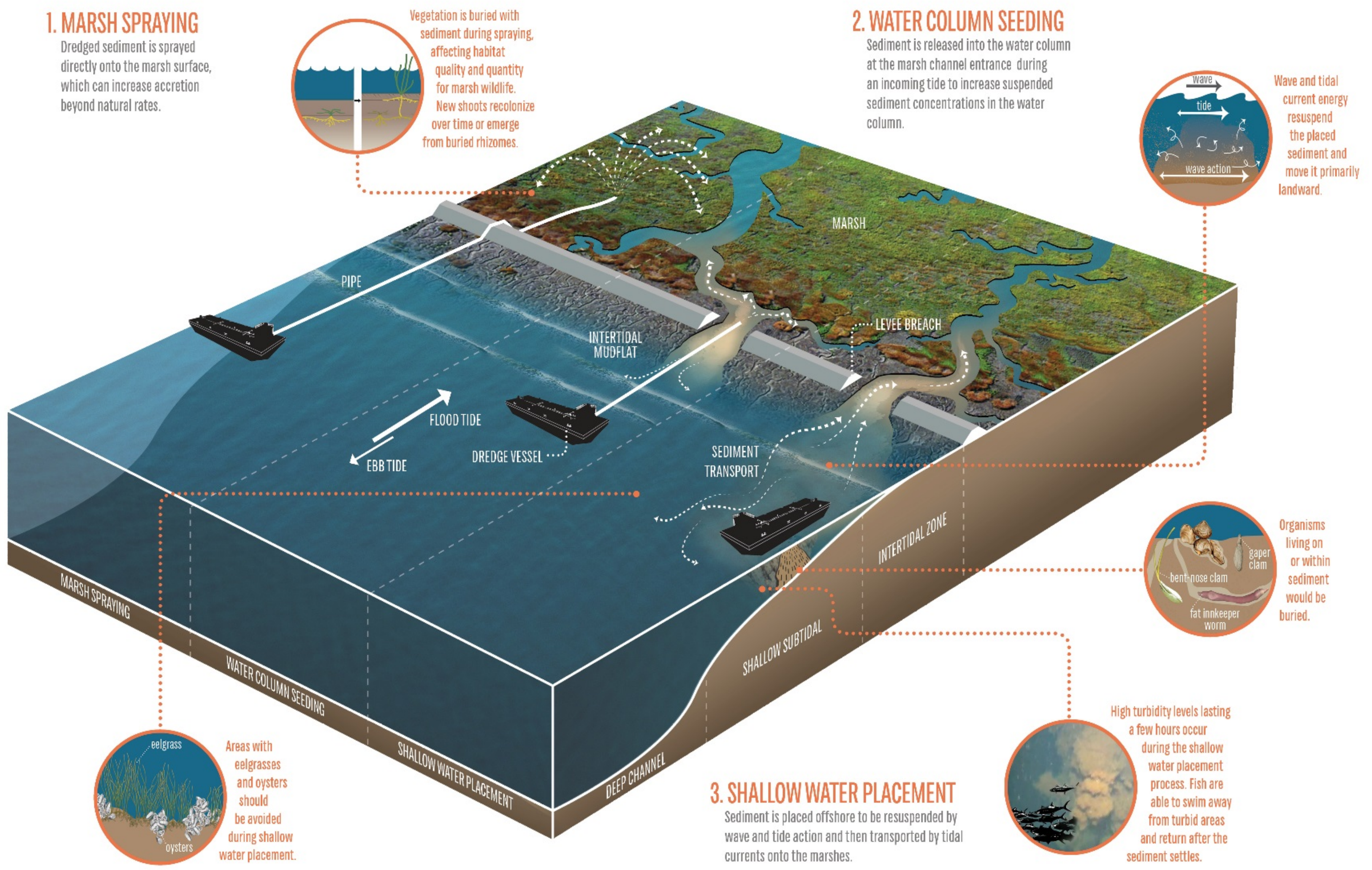
… and others

Federal Maintenance Dredging and Disposal Areas





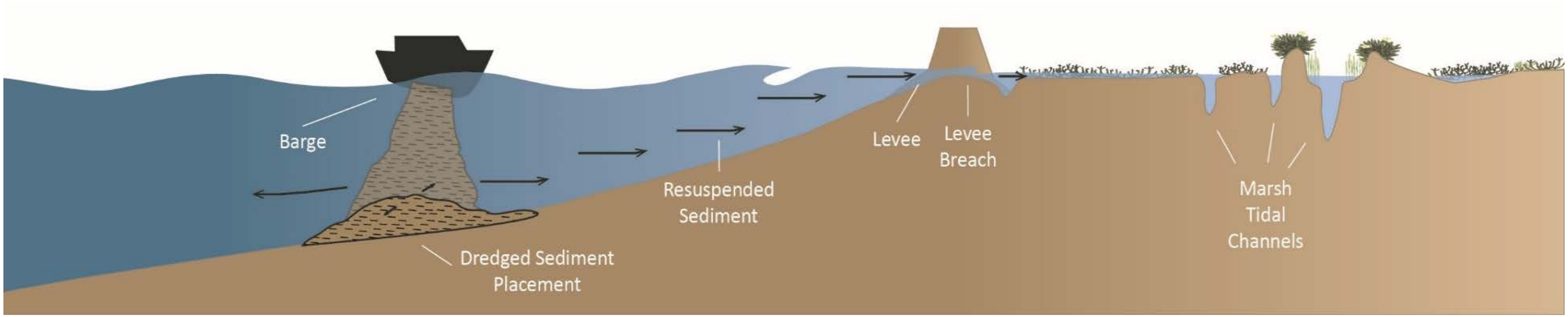
Conceptual Framework for a Method of Strategic Placement of Dredged Sediments



1. MARSH SPRAYING
Dredged sediment is sprayed directly onto the marsh surface, which can increase accretion beyond natural rates.
Vegetation is buried with sediment during spraying, affecting habitat quality and quantity for marsh wildlife. New shoots recolonize over time or emerge from buried rhizomes.
2. WATER COLUMN SEEDING
Sediment is released into the water column at the marsh channel entrance during an incoming tide to increase suspended sediment concentrations in the water column.
wave
tide
wave action
Wave and tidal current energy resuspend the placed sediment and move it primarily landward.
MARSH
PIPE
INTERTIDAL MUDFLAT
LEVEE BREACH
FLOOD TIDE
EBB TIDE
DREDGE VESSEL
SEDIMENT TRANSPORT
INTERTIDAL ZONE
SHALLOW SUBTIDAL
DEEP CHANNEL
MARSH SPRAYING
WATER COLUMN SEEDING
SHALLOW WATER PLACEMENT
gaper clam
bent-nose clam
fat innkeeper worm
Organisms living on or within sediment would be buried.
eelgrass
oysters
Areas with eelgrasses and oysters should be avoided during shallow water placement.
3. SHALLOW WATER PLACEMENT
Sediment is placed offshore to be resuspended by wave and tide action and then transported by tidal currents onto the marshes.
High turbidity levels lasting a few hours occur during the shallow water placement process. Fish are able to swim away from turbid areas and return after the sediment settles.

Strategic Placement Methods

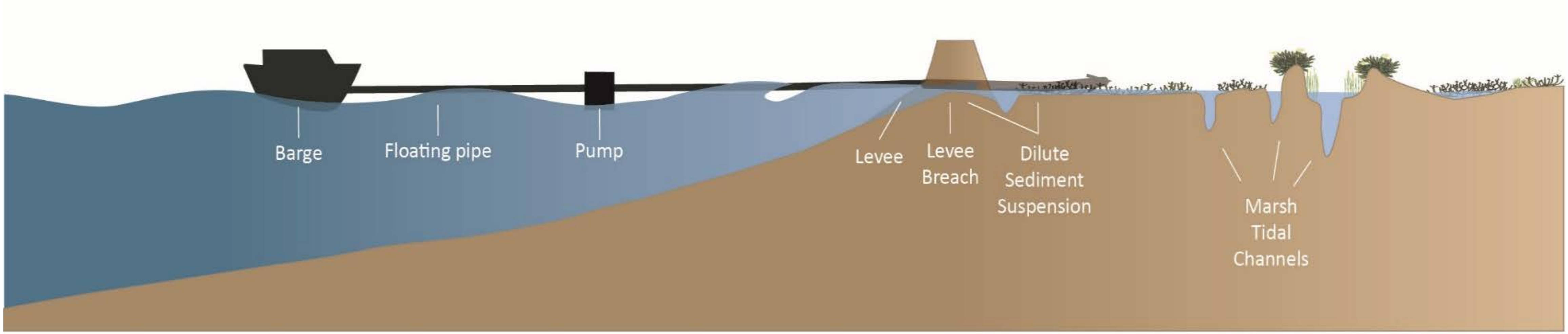
Shallow Water Placement



- Natural processes, rates are limited, timing and volumes less restricted
- Burial impacts, increase in local SSC
- Uncertainty – efficiency of transport pathway

Strategic
Placement
Methods

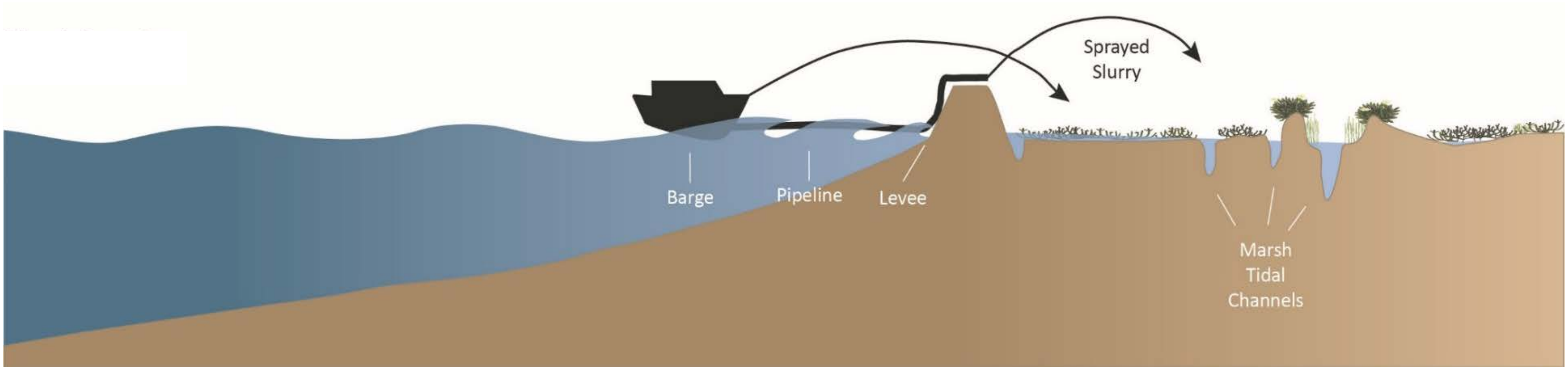
Water Column Seeding



- Increased certainty of placement, less dependent upon wave and tidal energy
- Timing constraints, coupled offloading/accretion
- Uncertainty – timing and volumes of placement

Strategic Placement Methods

Marsh Spraying

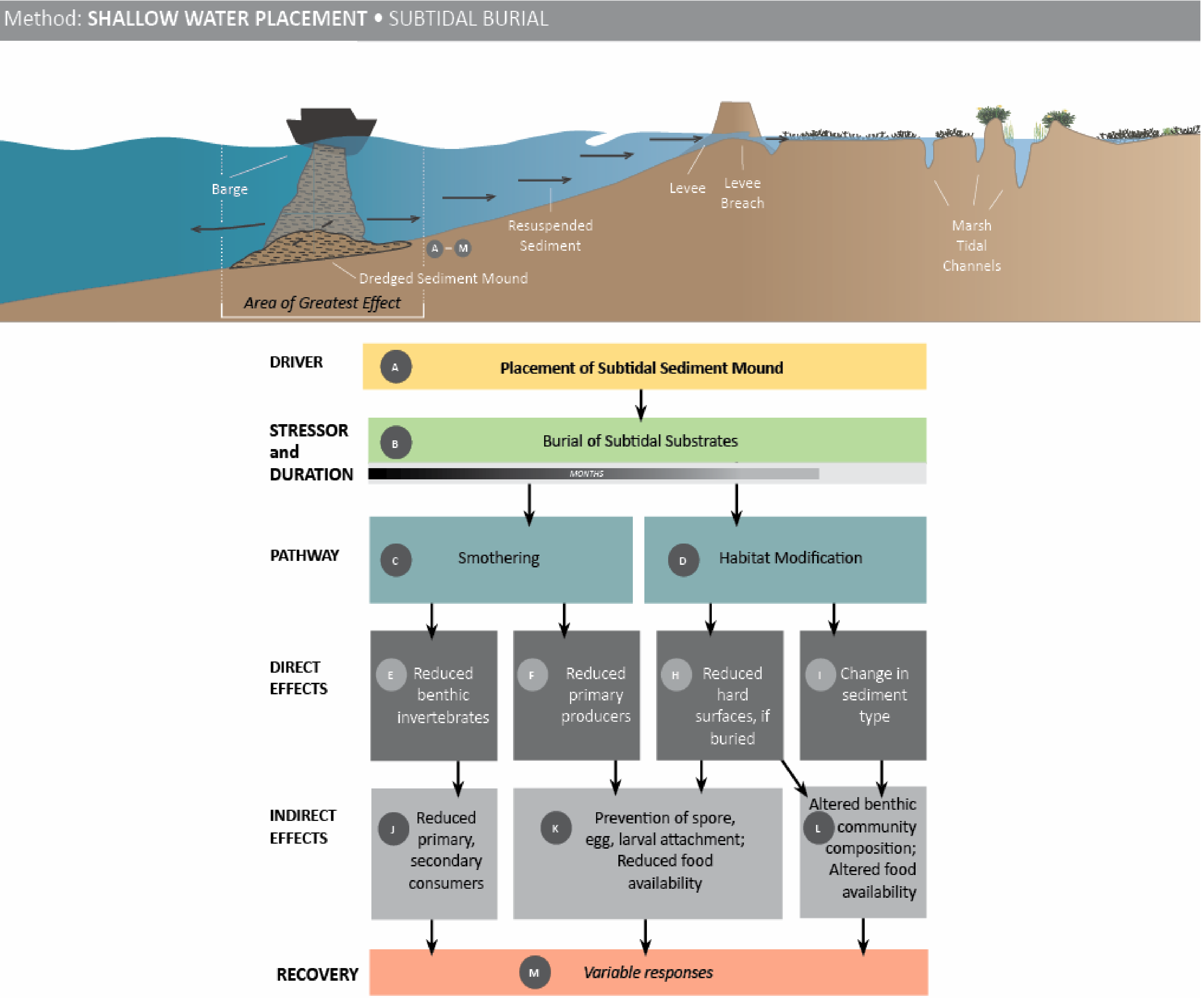


- Certainty of placement and timing; tried and tested
- Increasing infrastructure, unnatural rates of accretion and placement
- Uncertainty – burial impact on marsh, recovery time

How the Methods Compare

	Shallow Water Placement	Water Column Seeding: Channel Placement	Marsh Spraying
Reliance on natural transport processes	High	Medium-high	Low
Reliance on natural accretion processes	High	High	Low
Certainty of sediment reaching target area	Low	Medium-low	High
Volume that can be accommodated	High	Medium-low	Medium-low
Certainty that SSC is close to natural	High	Medium	Low
Certainty that accretion rates are close to natural	High	Medium	Low
Certainty that accretion results in natural topography	High	Medium-high	Low
Certainty that process is self-limiting	High	Medium-high	Low

Key:
SSC = suspended sediment concentration



Example Ecological Effects

- Burial of subtidal surfaces
- Soil texture could be altered
- Direct mortality of plants and animals is possible
- Food web effects possible
- Duration: months

How the Methods Compare: Ecological Effects

Effect	Shallow Water Placement	Water Column Seeding	Spraying
Replication of Natural Rates of Accretion to Mudflats and Marshes Expected	Highest	Somewhat	Lowest
Minimizes Impacts on Subtidal Benthic Community	Lowest	Neutral	Neutral
Minimizes Impacts on Mudflat Community	Neutral	Little	Little
Minimizes Impacts on Water Column Community	Neutral	Lowest	Little
Minimizes Impacts on Vegetated Marsh Community	Neutral	Neutral	Lowest
Minimizes Impacts on Marsh Channel Community	Neutral	Lowest	Lowest
Flexibility of Method in Avoiding Impacts	Somewhat	Somewhat	Somewhat

Maintenance Dredging Needs versus Strategic Placement Timing

- Maintenance dredging needs may not align with seasonal/daily variability for strategic placement
- Volume of material needed for strategic placement may differ from material available.
- Access to strategic placement sites with equipment more limited and costly in comparison to conventional sites.

Working Principles

Sediment delivery by natural processes keeps accretion within natural rates

Multi-year study would yield most meaningful results

Pilot study locations should be representative of strategic placement conditions

Regulatory Strategy

- Current plans (e.g. LTMS), policies, and decisions need to be revisited—and perhaps revised—before strategic placement can be approved on a large scale.
- Regulatory requirements will differ depending on implementing entity.
- Establishment or assignment of a regional entity could
  - Manage the timing and location of placement activities
  - Work with the DMMO to ensure smooth integration
  - Minimize disturbance to ongoing maintenance dredging operations and sensitive habitats and species.
- Pilot study program focused on demonstrating feasibility of, and resolving uncertainties for, both shallow-water placement and water-column seeding.

Implementation

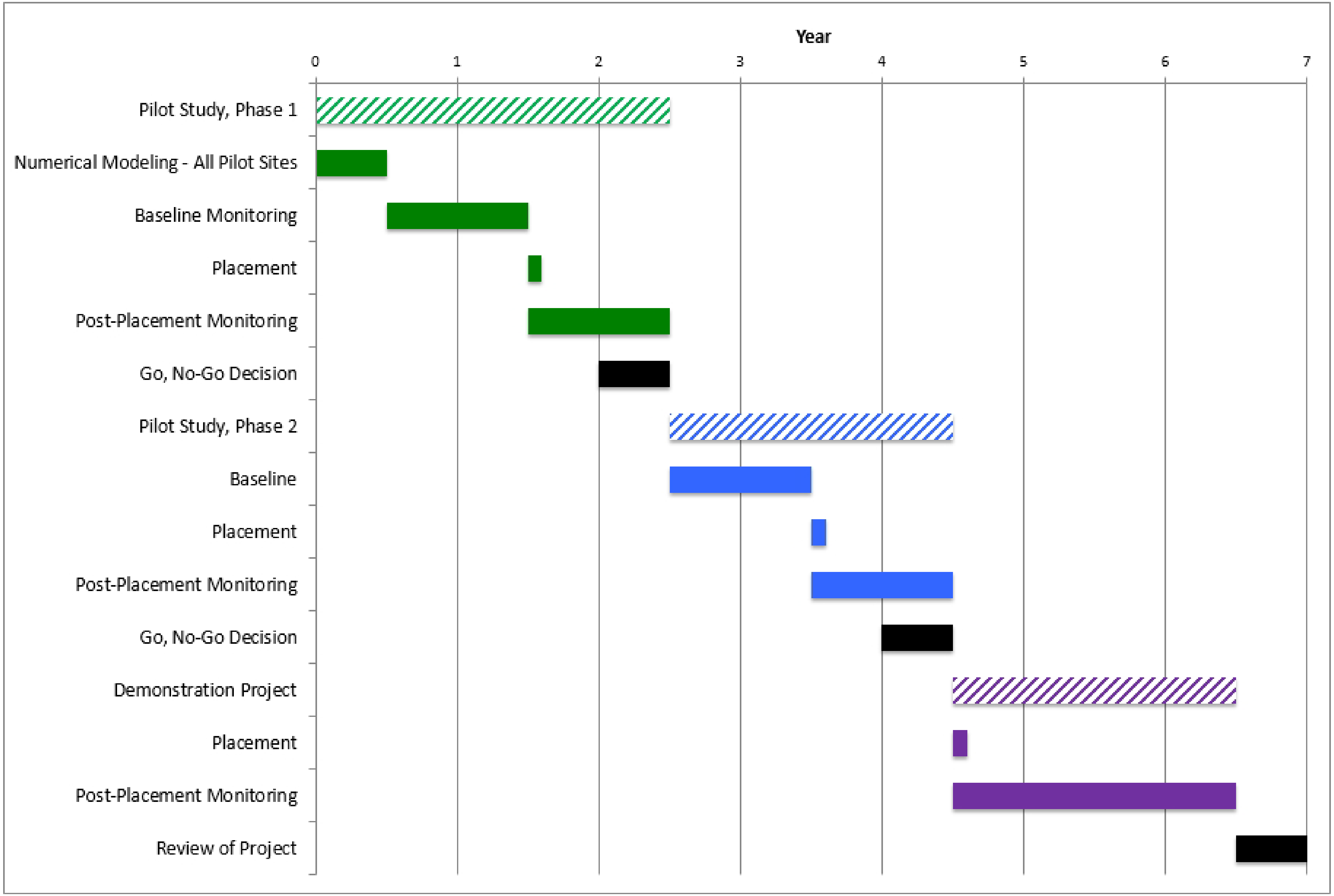
Program Implementation – A Phased Approach

Pilot Studies

- Form a governance structure to guide the long-term planning and permitting of strategic placement as an alternative to existing disposal options
- Determine efficacy, efficiency and impacts of strategic placement need investigation.
- Understand how future needs for efficient and effective sediment management in SF Bay marshes can be addressed using dredged sediments, either through natural processes or purposeful augmentation.
- Go / No-Go decision

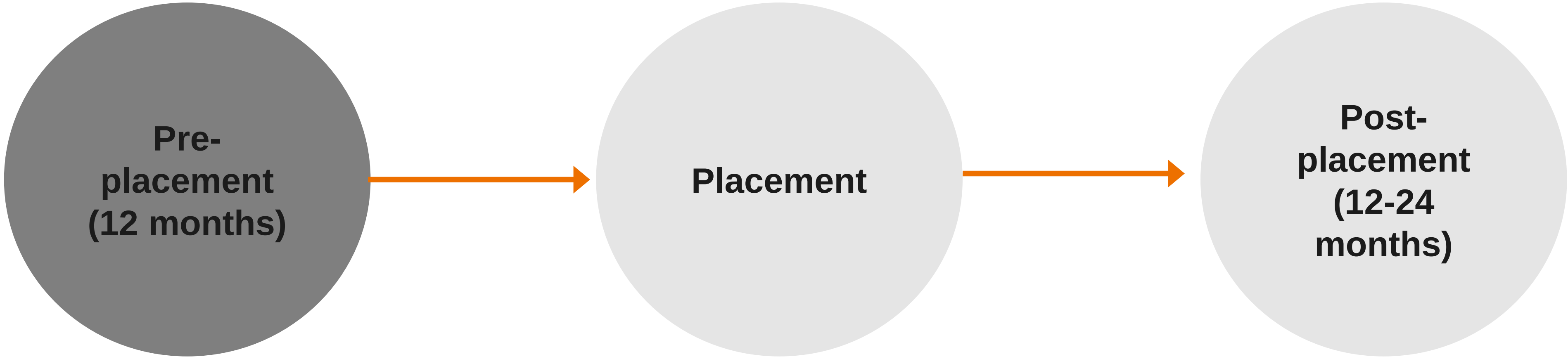
Demonstration Projects

- Place larger volumes of material in strategic shallow-water and water-column locations, and measure fate and impacts of sediment pathways over a longer period of time.
- Up to two years of control-site monitoring and one year of post-placement monitoring.
- Go / No-Go decision



Year
0
1
2
3
4
5
6
7
Pilot Study, Phase 1
Numerical Modeling - All Pilot Sites
Baseline Monitoring
Placement
Post-Placement Monitoring
Go, No-Go Decision
Pilot Study, Phase 2
Baseline
Placement
Post-Placement Monitoring
Go, No-Go Decision
Demonstration Project
Placement
Post-Placement Monitoring
Review of Project

Implementation



Baseline conditions monitoring and numerical modeling

- Use existing numerical models to determine locations, volumes and timing of placements.
- Match donor sediments to the receiving areas.
- Conduct baseline ecological monitoring for benthic macrofauna and fish.
- Trial placements of very small volumes of tracer to refine physical sampling techniques.

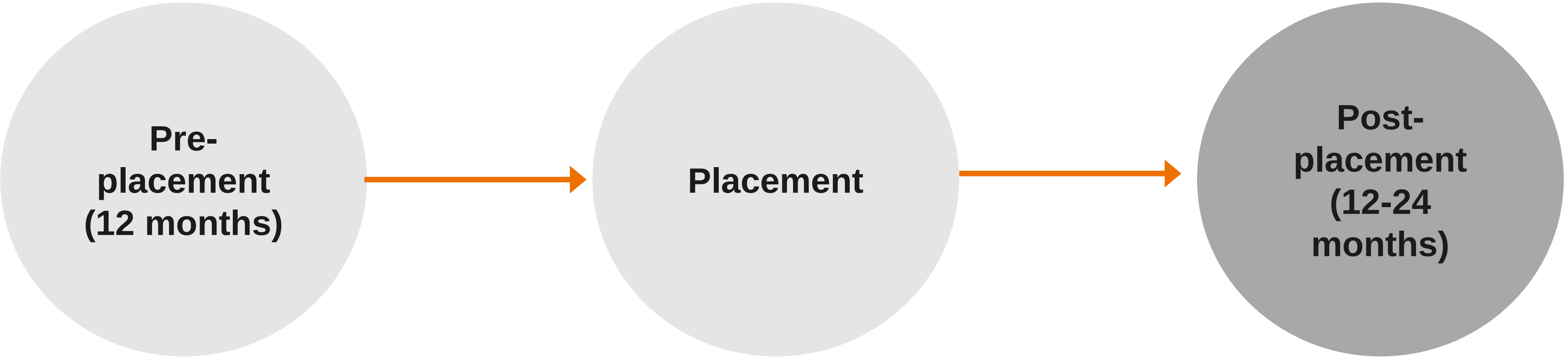
Implementation

Pre-placement (12 months) → **Placement** → **Post-placement (12-24 months)**

Placement and tracking of dredged sediment and monitoring of short-term effects

- Placement timed with ecological windows.
- Place three sediment mounds (up to 1,250 yd^3 each) in shallows.
- Up to 1,250 yd^3 for water column seeding at channel mouth (timed with tide).
- Monitor sediment resuspension using sediment flux measurement and tracing of sediment pathways using tagged sediment particles.

Implementation



Post-placement monitoring for mid- to long-term effects

- Continue particle tracing until fate of tracer has been determined (days to weeks).
- Measure and monitor the ecological recovery from both placement in the shallows and seeding in the water column (months).

Conclusions and Next Steps

Conclusions

- Urgent need for improving resilience of marshes to sea level rise
- Sediment replenishment options include regulatory, physical, logistical, and ecological opportunities & constraints
- Trade-offs and uncertainties
- Use of a pilot allows for exploration of options
- Partnership & collaboration key

Next Steps

- Multi-year, phased pilot using shallow water placement and water column seeding
  - Placement determined by numerical modeling
  - Collect pre-placement benthic and pelagic monitoring data
- Results from each phase inform the next phase
- Effectiveness & ecological effects monitored
- Initial impacts and rates of recovery compared to baseline
- Pilot informs future placements for demonstration projects

Questions

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