Sediment and Beneficial Reuse Commissioner Working Group

July 21, 2023

Project Team: Maya McInerney, Brenda Goeden, Erik Buehmann, Pascale Sumoy, Jaime Lopez, Kathryn Riley

San Francisco Bay Conservation and Development Commission

San Francisco Bay Regional Sediment Management

Agenda

1. Welcome and Project Updates
2. Considerations for Beneficial Reuse of Sediment in Wetland Restoration Projects
3. Sediment Challenges in Bay Area Restoration Projects
4. Public Comments
5. Adjournment

Photo: Hamilton Wetlands

Sediment for Wetland Adaptation Project

Goal:

To increase beneficial reuse of sediment and soil for wetland habitat restoration, resilience, and sea level rise adaptation in the SF Bay Area.

Beneficial Reuse for Green Infrastructure

Sediment & Soil

Dredging - navigation channels & flood protection channels

Upper watersheds - reservoirs, disconnected creeks

Excavated soils - construction

Where have we come from?

- Fill for Habitat Bay Plan Amendment (BPA 1-17)
- Working Group Meeting Presentations

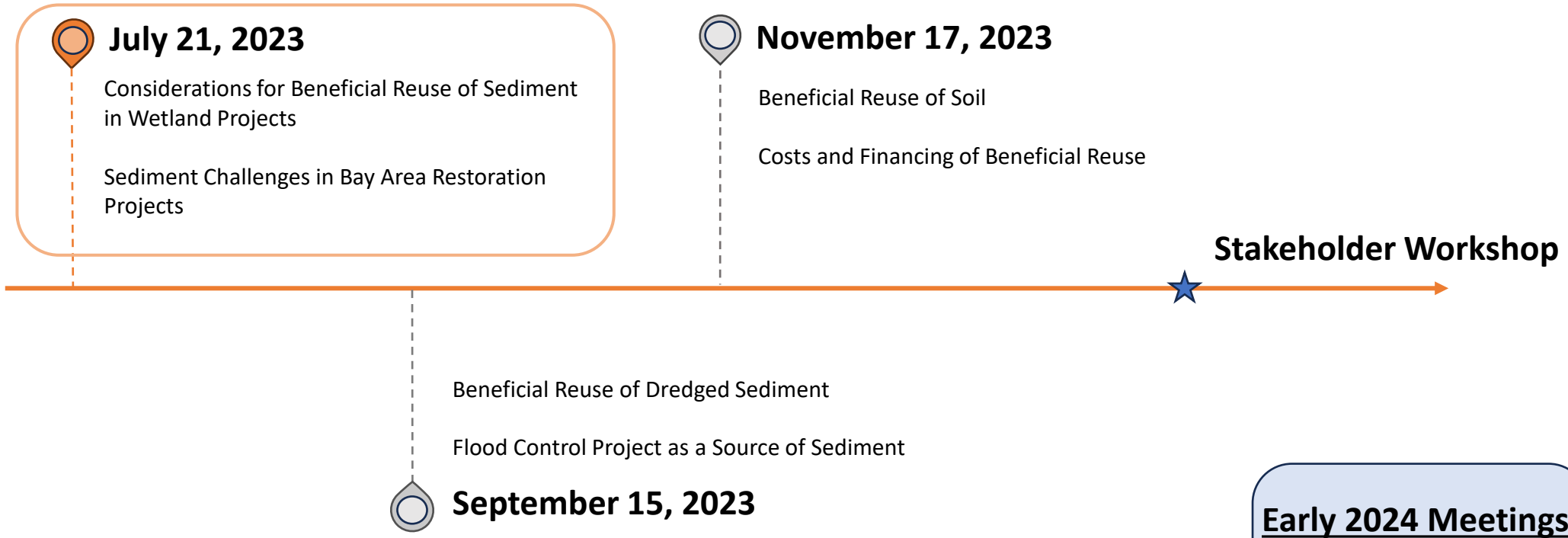
January
- Sediment and Soil in SF Bay Region
- Existing related Bay Plan Policies Affecting Beneficial Reuse

March
- Bay Plan Amendment Process
- Project Direction and Goals

May
- Sediment Transport in SF Bay
- Tidal Marsh Sediment Supply and Transport

Photo: Newark Slough courtesy of King Tides Project

Where are we going?



Early 2024 Meetings:

January 19
March 15

Stakeholder Workshop

Goals & Objectives

- Identify roles, responsibilities, and actions
- Create a strategic roadmap

Preparations

- Onboarding our facilitator
- Stakeholder outreach
- Issue papers on relevant topics

Issue Paper Topics

1. Overview of wetlands restoration and adaptation
2. Sources of sediment and soil
3. Sediment placement methods
4. Challenged sediment
5. Prioritizing sediment and soil use
6. Current funding overview

Questions / Discussion

Photo: Hamilton Wetlands

Considerations for Beneficial Reuse of Sediment in Wetland Restoration Projects

BCDC Sediment & Beneficial Reuse
Commissioner Working Group Meeting, July 21, 2023

Jeremy Lowe, San Francisco Estuary Institute

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Photo Horizon (2014)

Photo Horizon (2014)

Objectives

- Present a regional perspective on wetland restoration and beneficial reuse of sediment and soils and provide thoughts on how to prioritize this work.

- Offer thoughts on landscape-scale restoration, the limited sediment and soil supply, and how we might best capitalize on this limited resource in meaningful actions over time.

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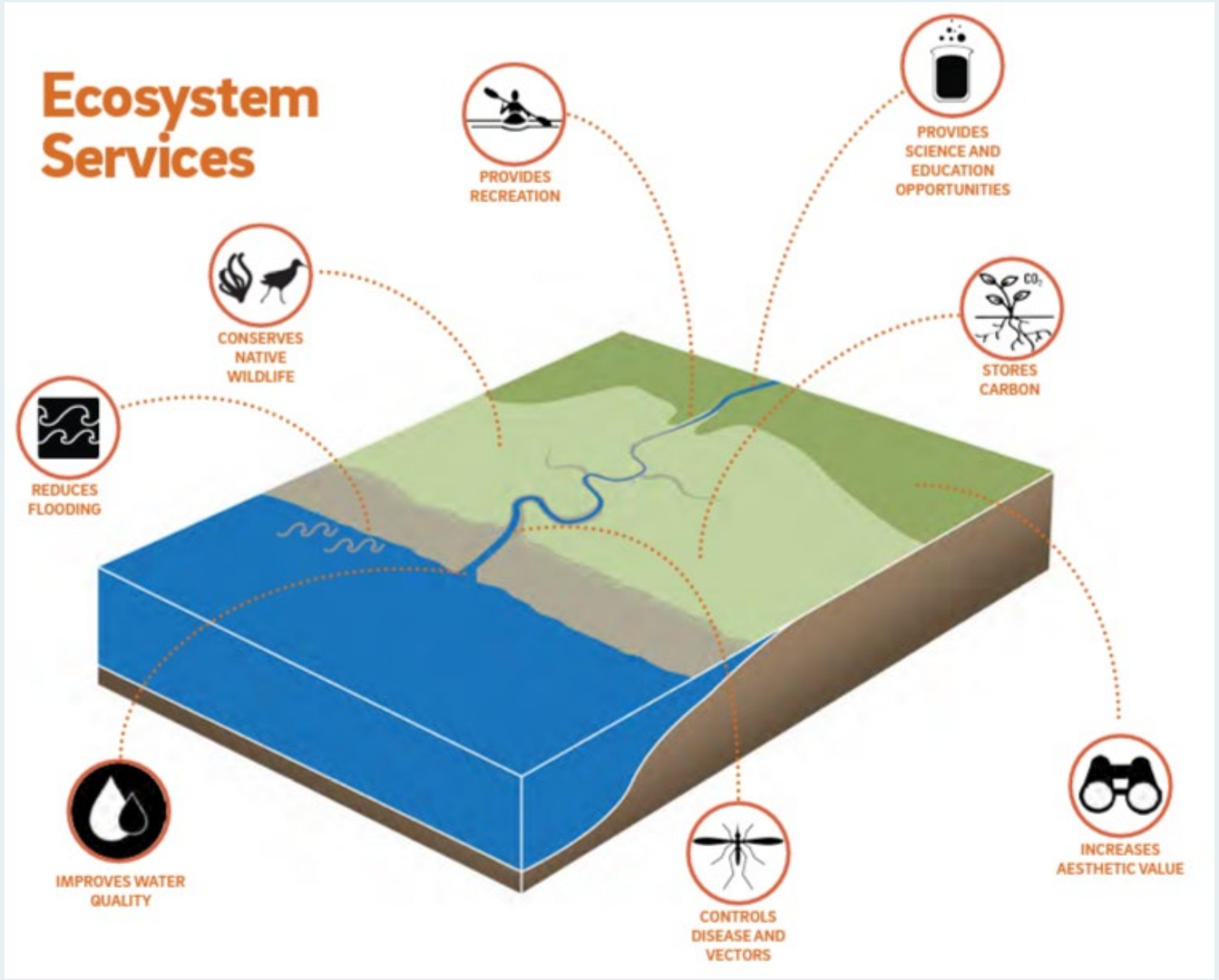
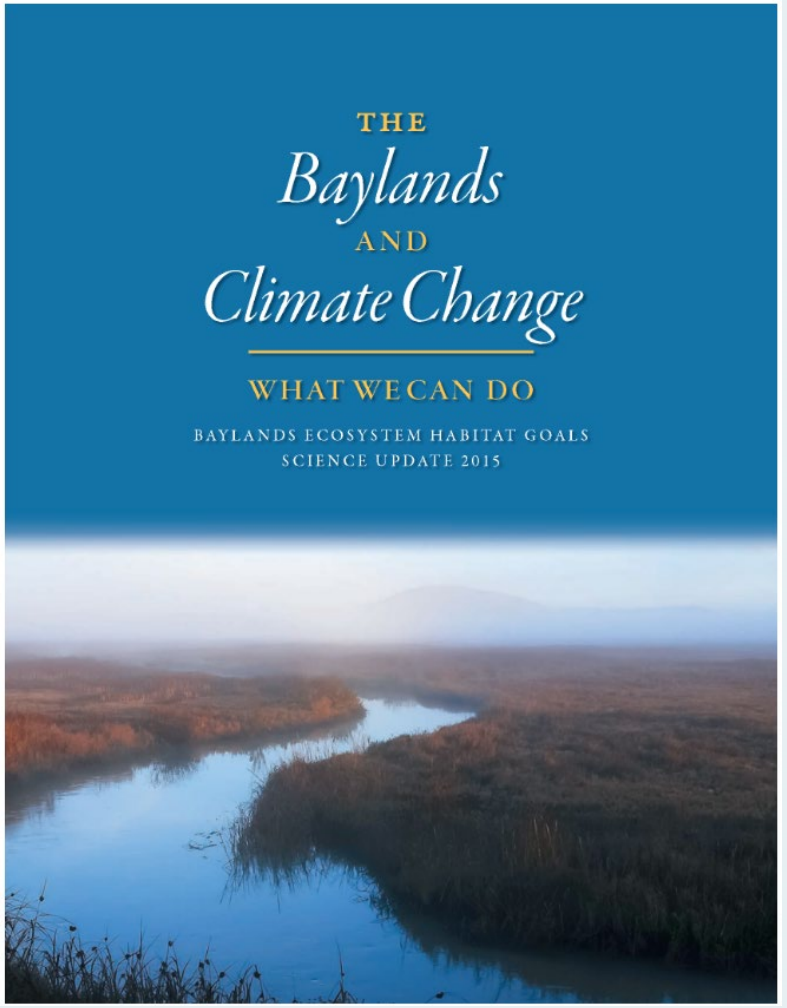
Source: USACE

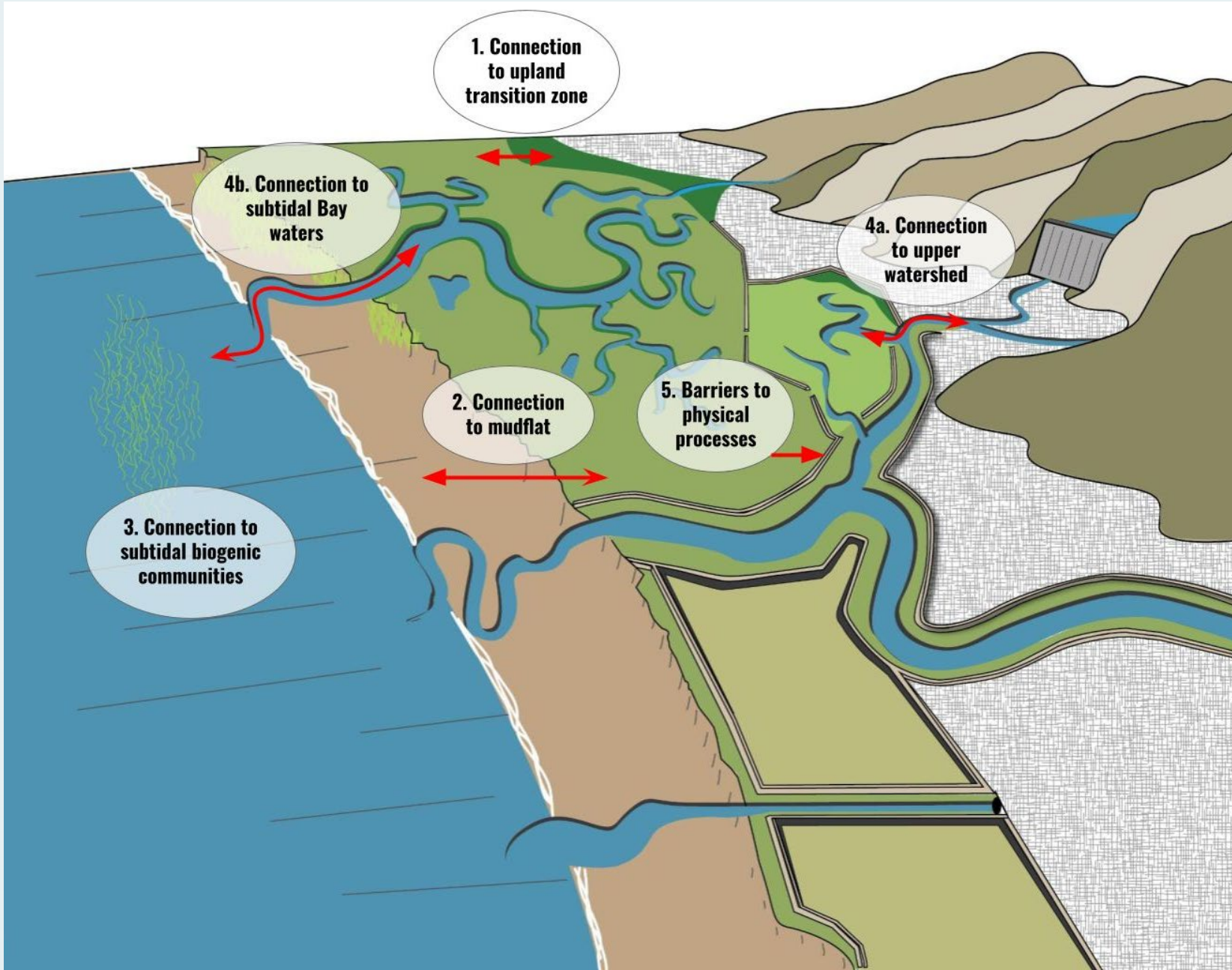




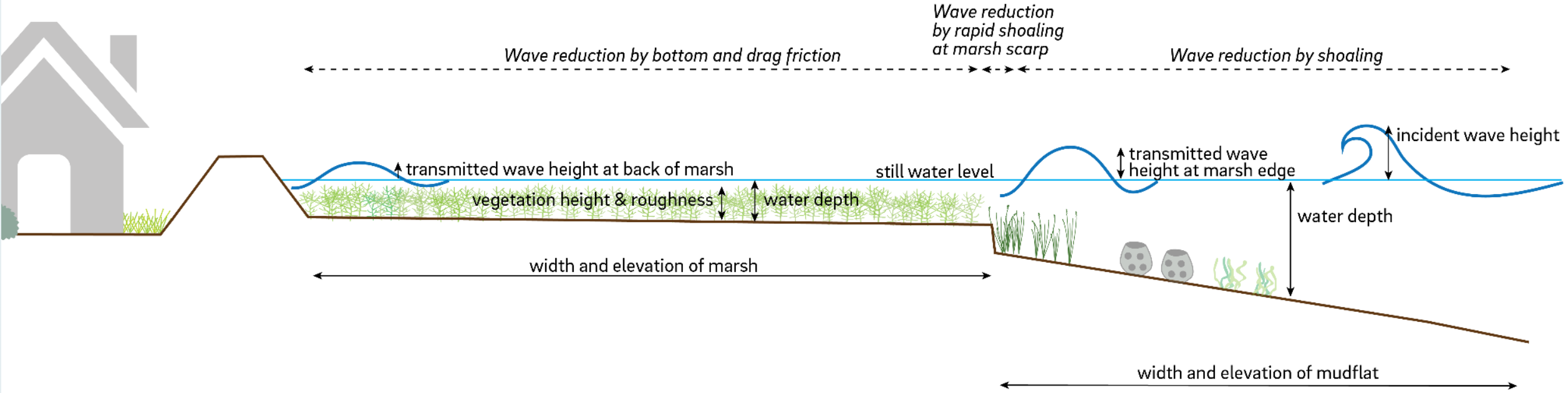
www.sfei.org/projects/baylandsgoals

Wildlife Support

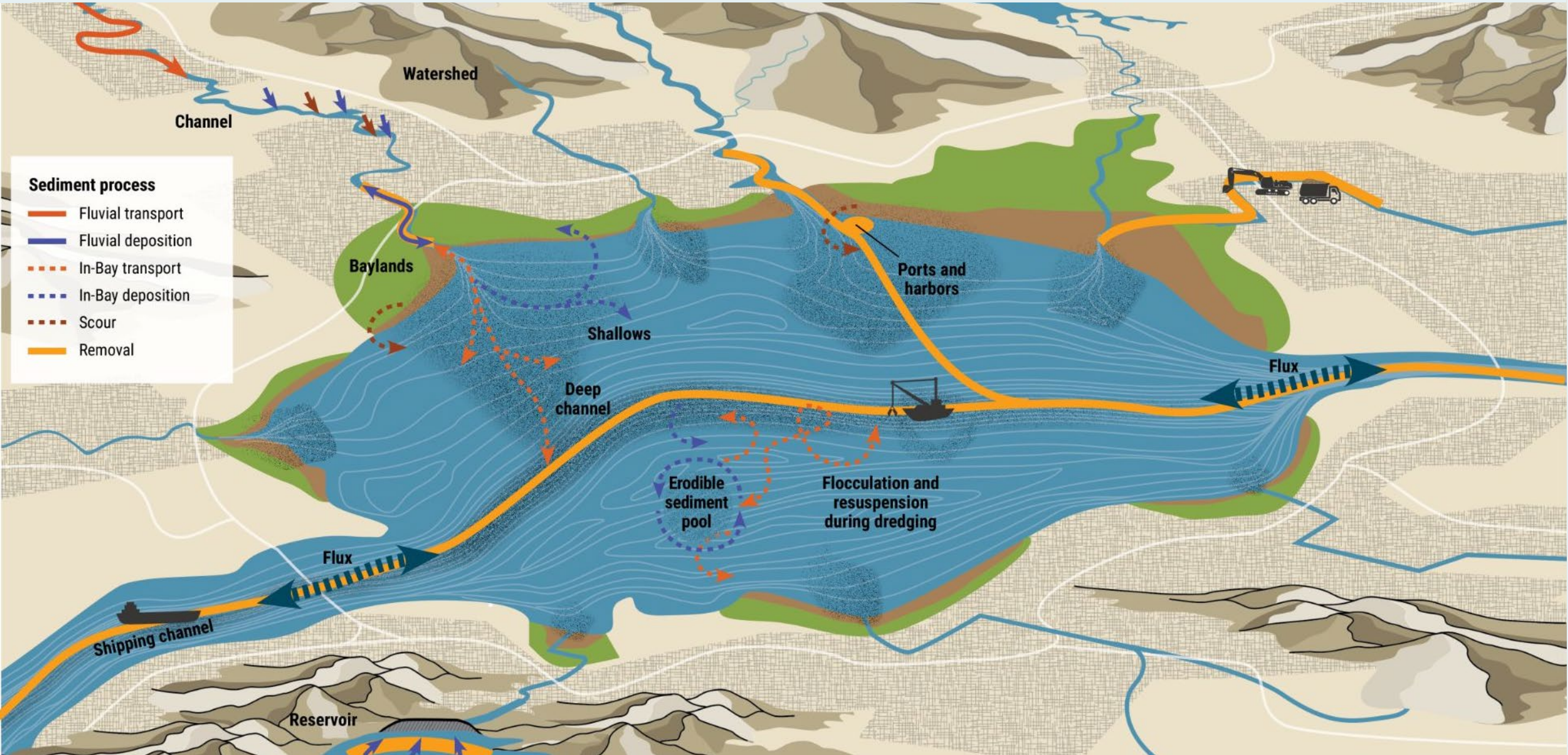
- Connectivity within the marsh (upland to subtidal)
- Connectivity among marshes
- Diversity/complexity of channel networks
- Topographic complexity
- Diversity/complexity of salinity patterns
- Redundancy
- Spatial scale
- Time scale



Flood Reduction



Subembayment



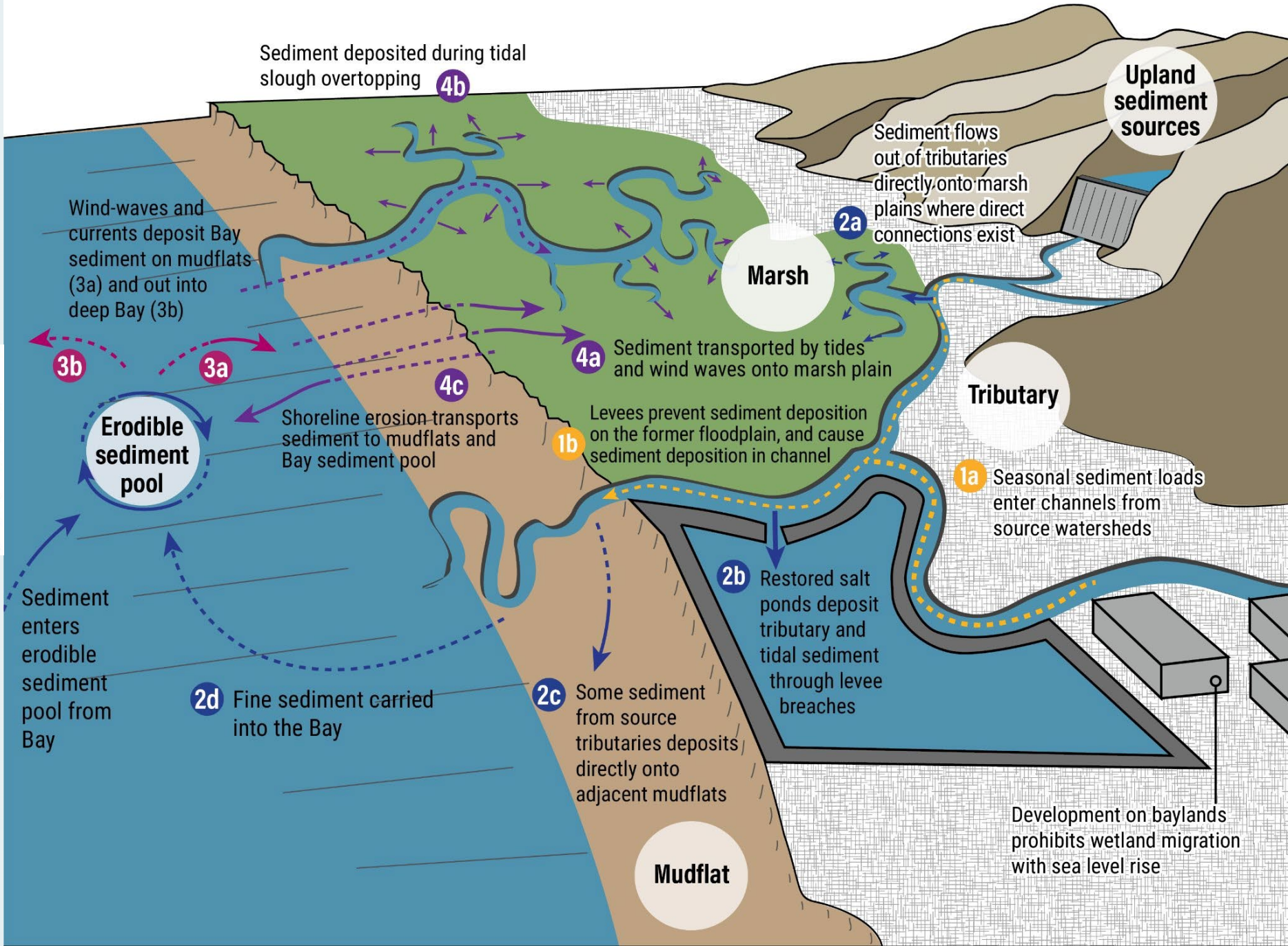
Baylands

Pathway 1: Uplands to tributaries

Pathway 2: Tributaries to marshes, mudlfats, & ESP

Pathway 3: ESP to mudflats & deep Bay

Pathway 4: Mudflats to marshes



- The build-up of sediment and vegetation takes time.
- Higher marshes keep up with sea-level rise for longer.

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- Landward limit of marsh set by tidal limit (white dotted line).
- Upland next to marsh is often farmed or developed.

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- Marsh migrates inland as sealevel rises (white dashed line).
- Levees constructed to protect developed areas.

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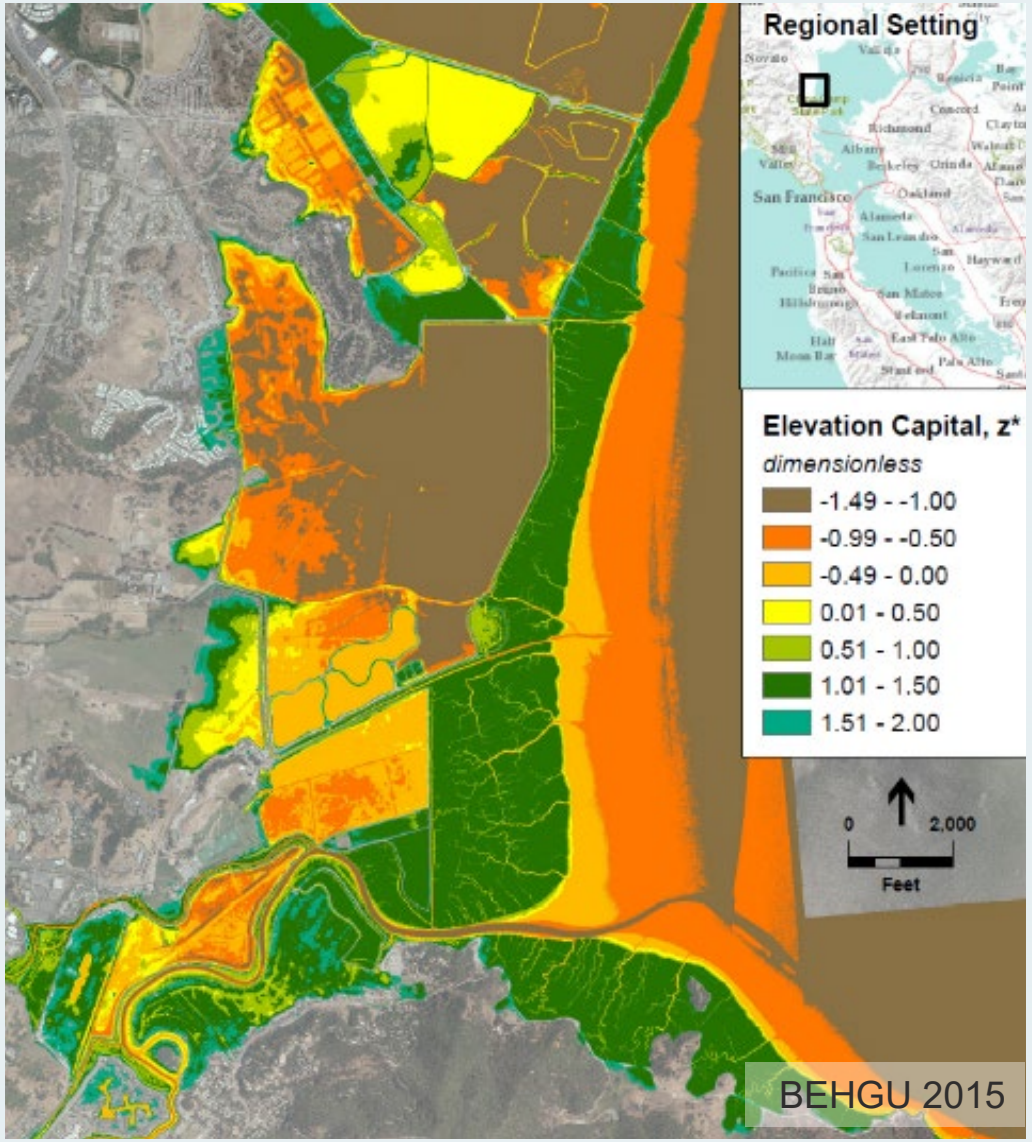

- Colors indicate elevation. Green is marsh elevation. Yellow, orange and brown are mudflat and shallow Bay.
- The diked baylands are lower than the marshes in front. Note Hamilton fill.

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Wetlands need…

- Elevation
- Space
- Sediment
- Time

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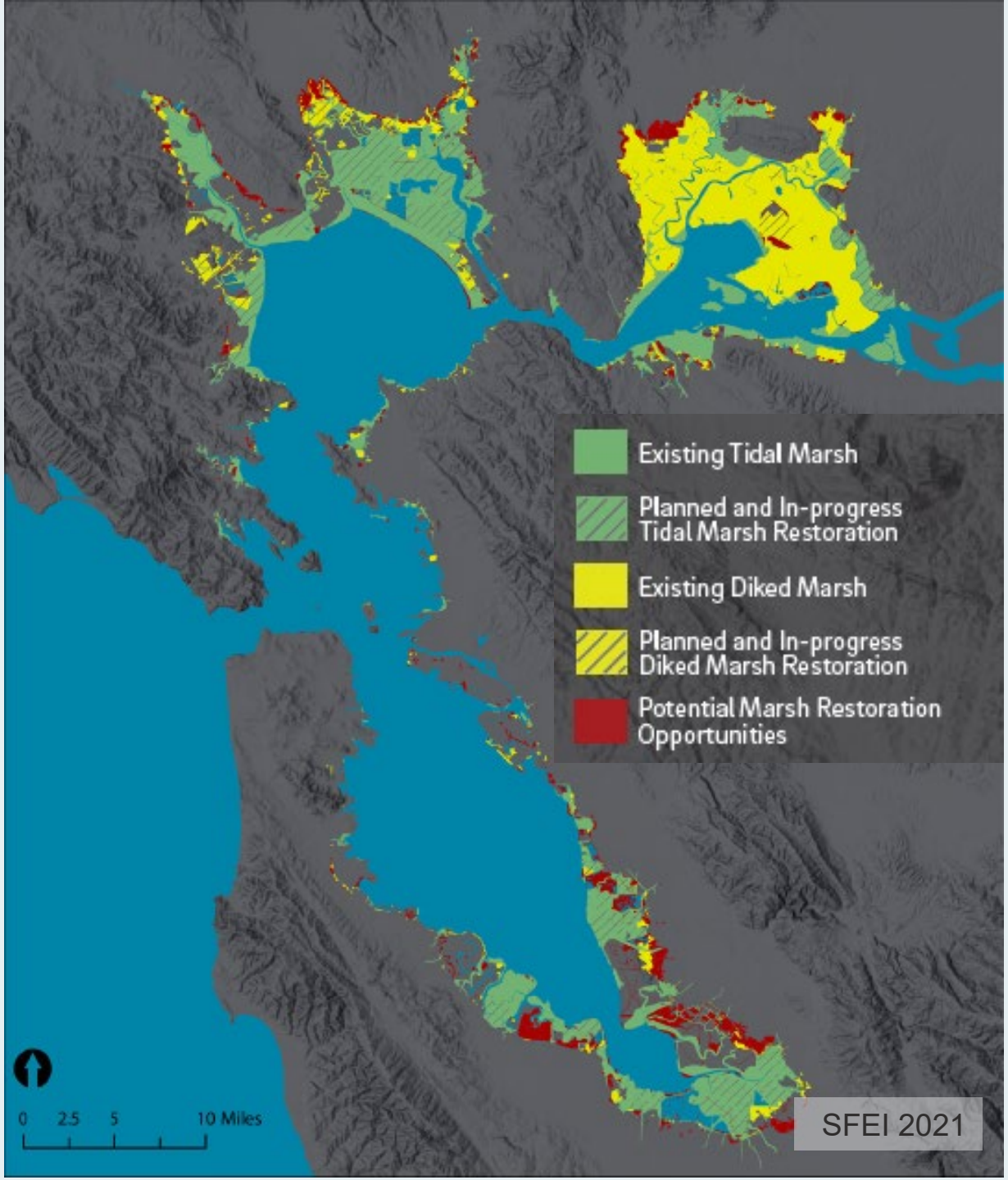
Present and Future Marshes

Distribution of existing tidal and diked marshes, planned and in - progress restoration projects, and potential restoration opportunities.



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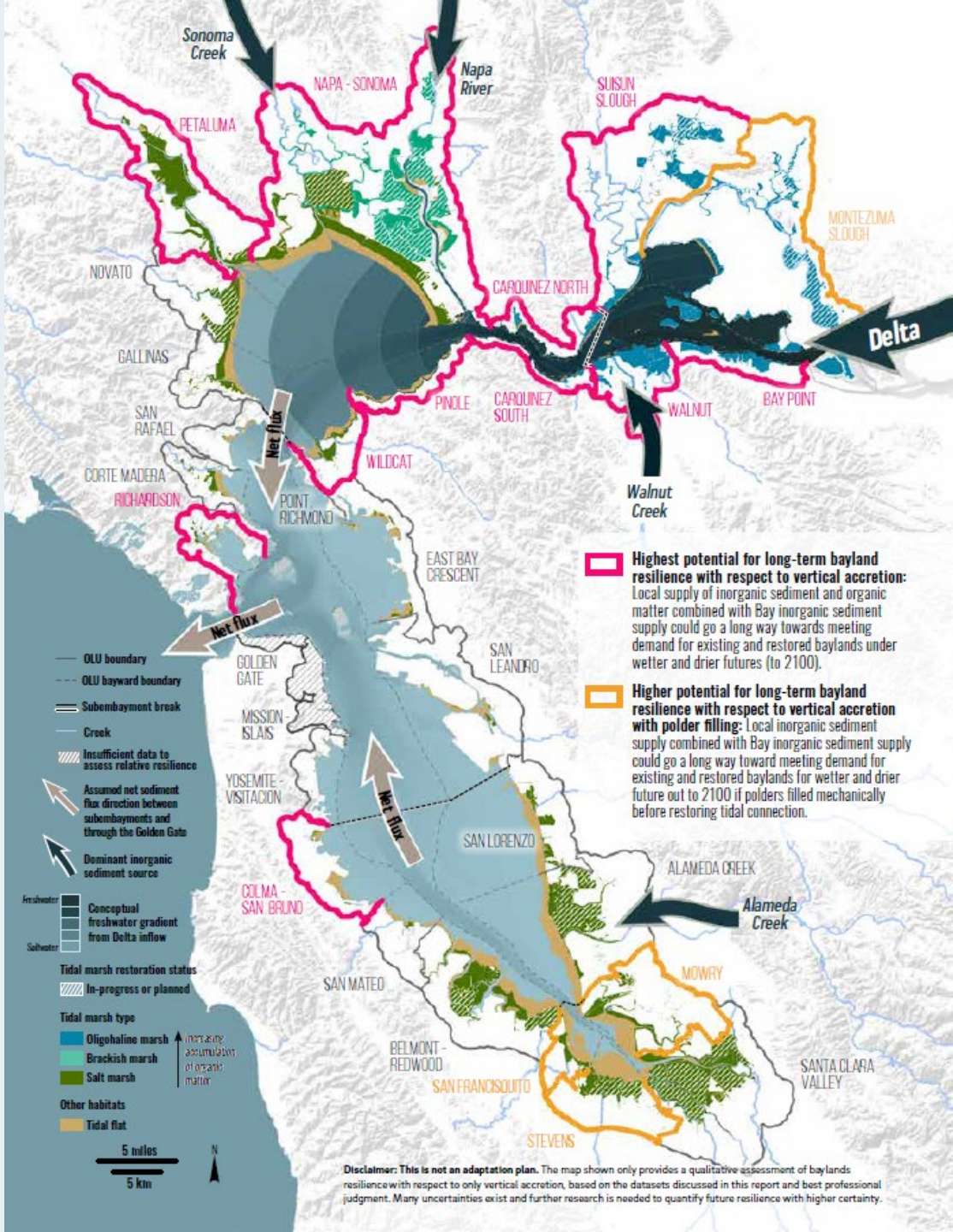
Future Sediment

- Red - highest potential for long - term resilience with respect to vertical accretion
- Orange - higher potential for long-term resilience with additional beneficial use of sediment

https://www.sfei.org/projects/sediment-for-survival



Placing sediment to increase resilience

	Wildlife support	Flood attenuation
Existing marshes and mudflats	Example: adding marsh mounds or islands for high tide refuge to existing marsh (e.g. Pond SF2)	Example: strategic or thin layer placement to maintain marsh plain (e.g. Bothin Marsh)
Diked baylands (potential future marshes and mudflats)	Example: placing sediment at transition zone elevation prior to breach (e.g. Pond A8)	Example: direct placement to restore marsh (e.g. Sonoma Baylands)

Questions to Ask

1. **What are we trying to achieve?**
   - What are the restoration opportunities?
   - What is the hazard, what is at risk, and how valuable is it?
2. **Where do marshes, beaches, reefs, etc make sense in the future?**
   - What is appropriate to the natural setting? What is the elevation?
   - How much space do you have? What is in front, behind, and to the sides?
3. **How effective, how expensive, and how long will it last?**
   - How do you prioritize the use of resources?
   - How do natural features combine with traditional levee approaches?

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Natural and Nature -Based Features

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Hamilton Airfield Marsh Restoration

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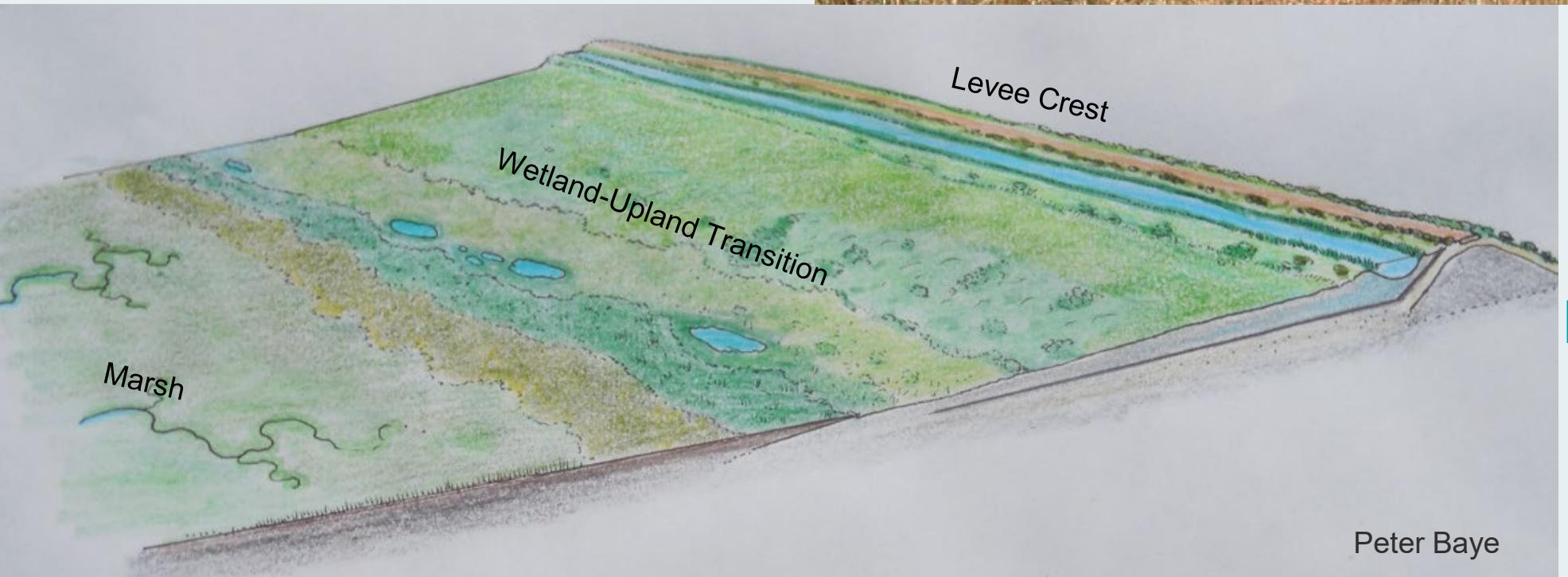
Upland

Wetland-Upland Transition



Horizontal Levee

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Ecotone Levee

Alviso, South Bay
Traditional Levee
3:1 (V:H)


Photo: Valley Water


Photo: Sonoma Land Trust

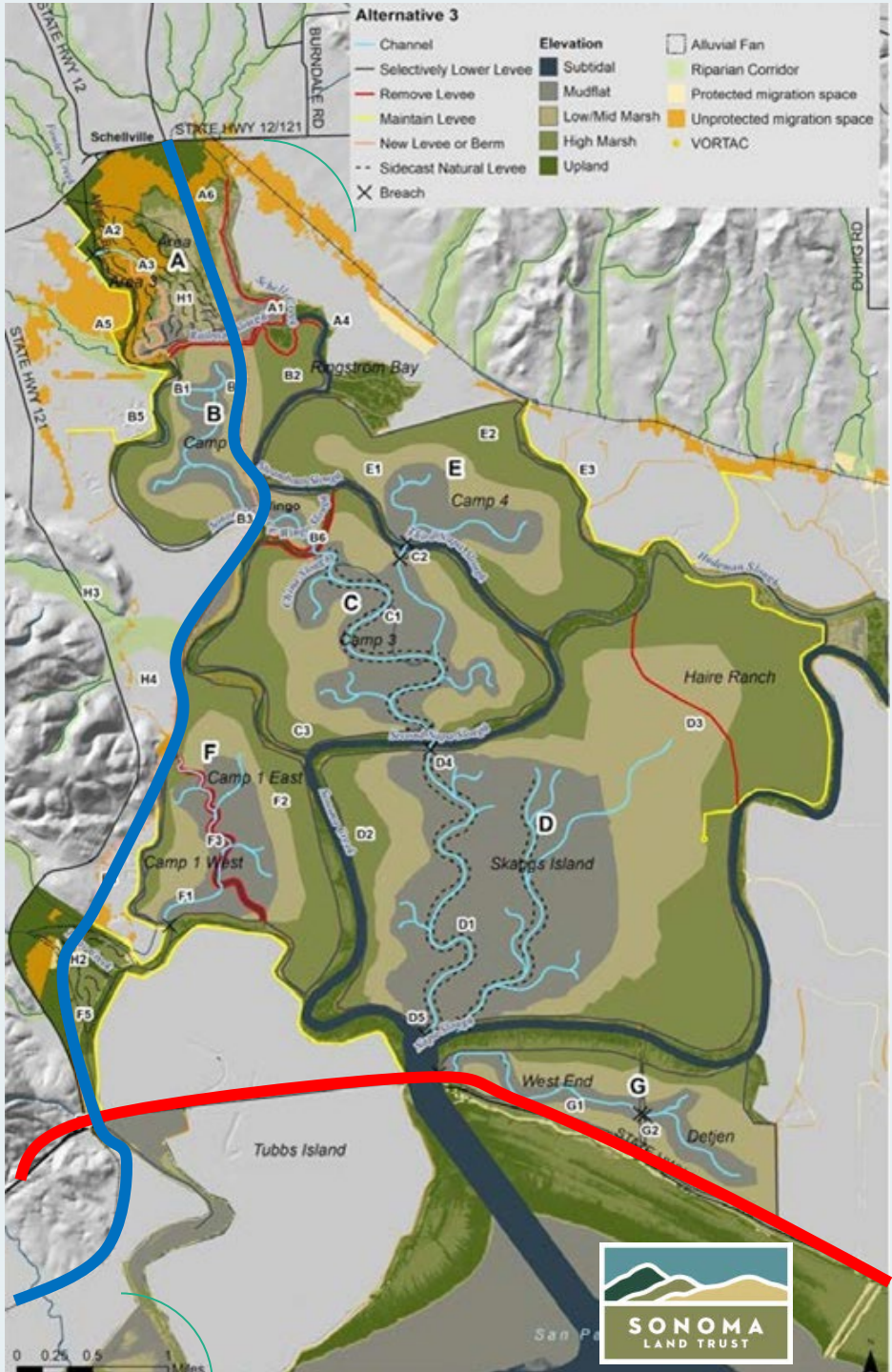
Sears Point, North Bay
Ecotone Levee
10:1 to 20:1 (V:H)

Sonoma Creek Baylands Strategy

- Support acquisition and design of restorations
- Recommendations for infrastructure
- Goals:
  - Habitat: Mixes of subtidal, tidal, freshwater, transitional, and upland habitats
  - Planning Horizon: 100 years (2100) assuming sea level rise up to 6.9ft
  - Urgency: Implement early more likely to succeed
  - Cost: Consider whole-life

“Integrate, Not Mitigate ”

1. **Present bridge crossings and embankments** disrupt hydrologic and habitat connectivity.
2. **Habitat restoration** can help manage extreme flows.
3. **Road and rail need to be raised** to accommodate sea-level rise and modified to increase connectivity.
4. **Bridges need to be lengthened** to accommodate future flows.



Natural and Nature -Based Features …and Processes

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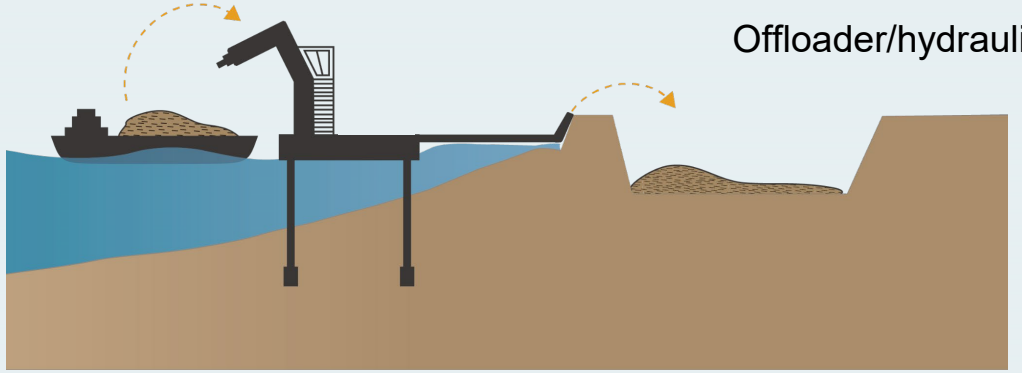
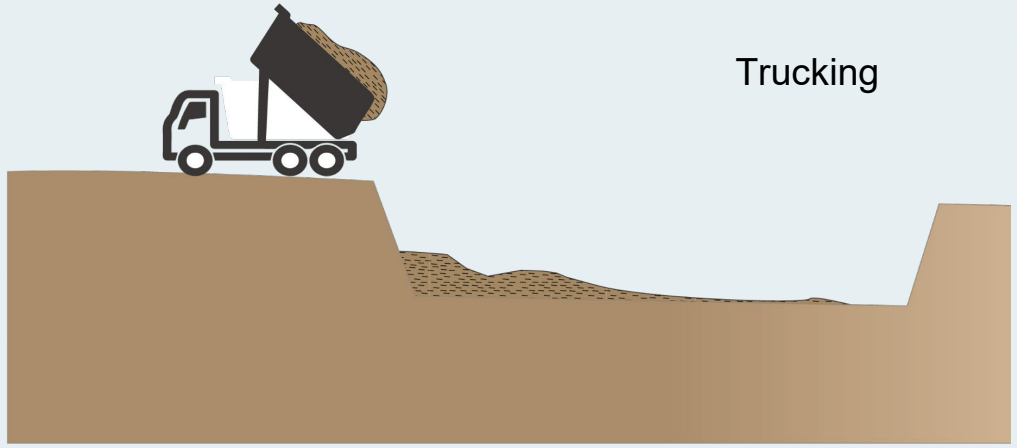
Methods of placement to consider

Direct placement

- Hydraulic pipeline
- Trucking



Offloader/hydraulic pipeline



Trucking

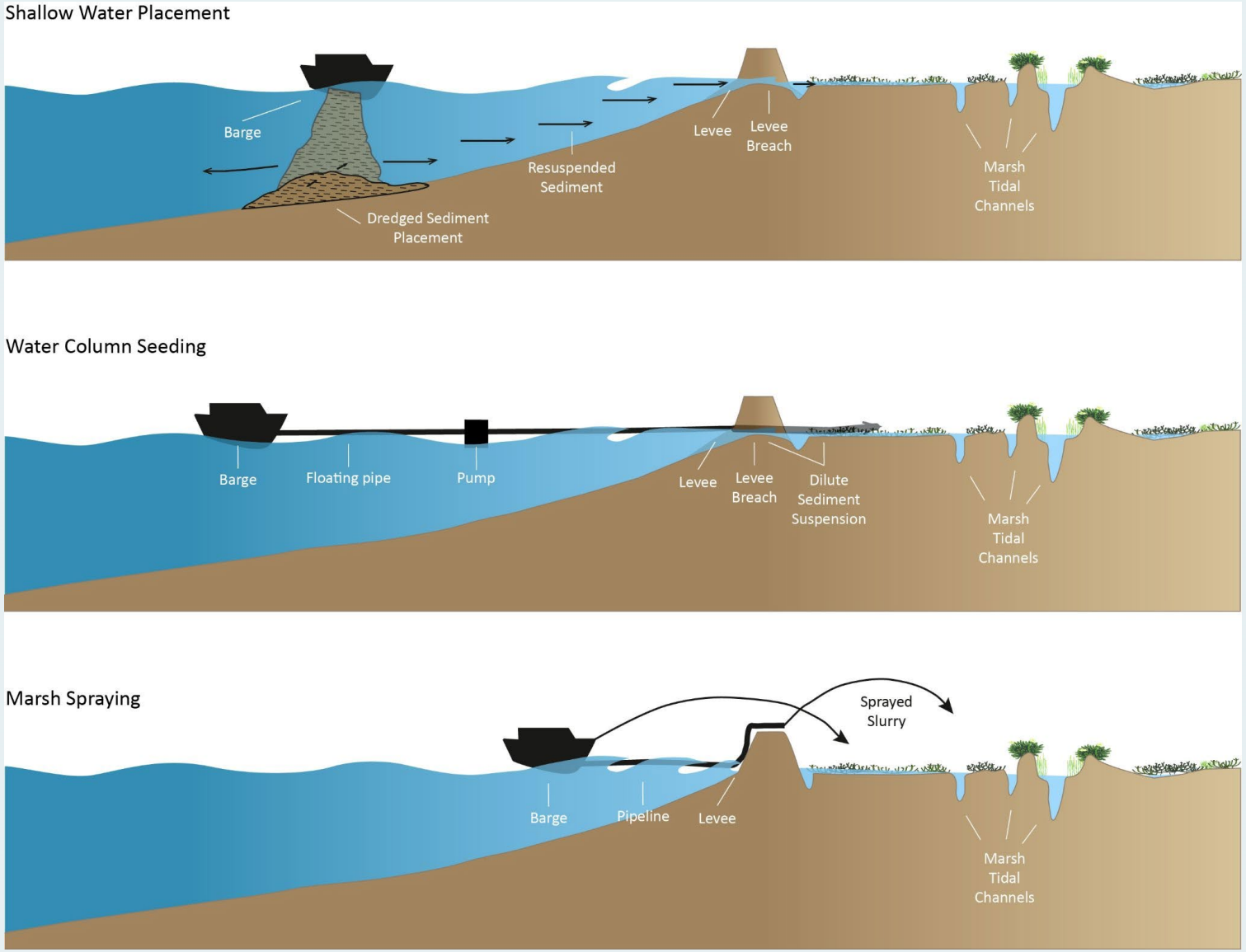
Methods of placement to consider

Direct placement

- Hydraulic pipeline
- Trucking

Strategic placement

- Shallow-water placement
- Water-column seeding
- Marsh spraying



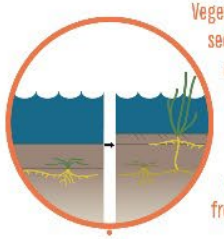
Thin-Layer Placement

Spraying at Seal Beach, CA

Alluvial Fan at Sonoma Baylands

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

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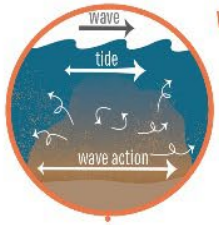

Wave and tidal current energy resuspend the placed sediment and move it primarily landward.

Organisms living on or within sediment would be buried.

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.

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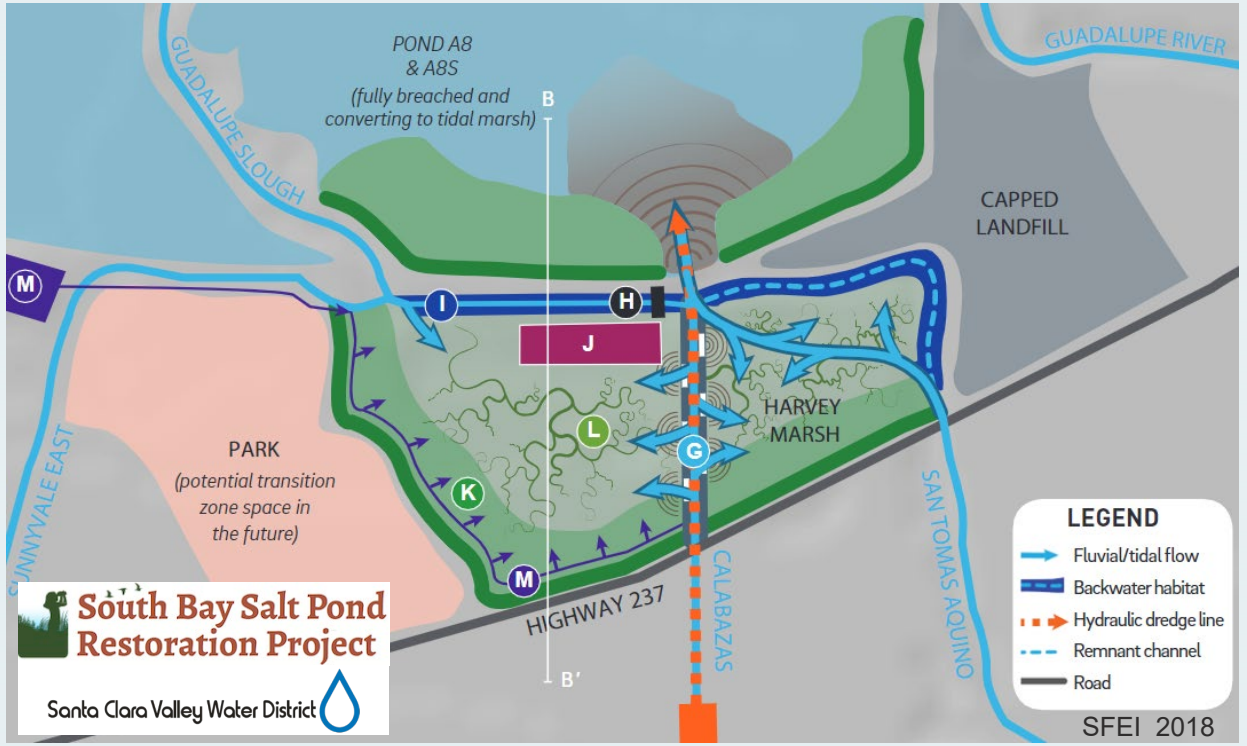
Reconnecting Creeks to Marshes



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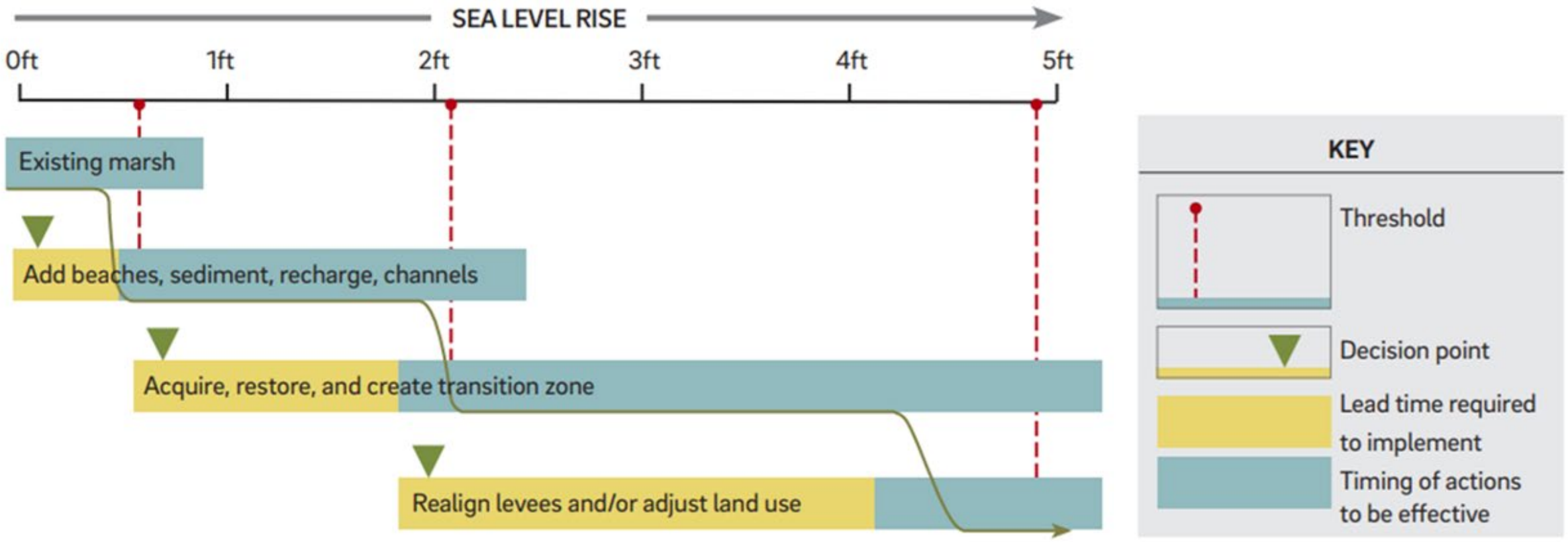
Adaptation Pathways



Conceptual phasing of measures triggered by sea-level rise, rather than a chronological timeline (adapted from Goals Project 2015).

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Cost

1. **Fill to change elevation** usually represents the largest impact and most costly part of any restoration project.
2. **Moving fill** around is large cost and highest potential impacts to the environment.
3. **Fill may be in short supply** and thus a finite resource.
4. **Competition for resources** between projects responding simultaneously to sea-level rise.

Question to ponder

We have limited elevation, space, sediment, time, and resources for restoration and adaptation.

What should guide the prioritization of our efforts?

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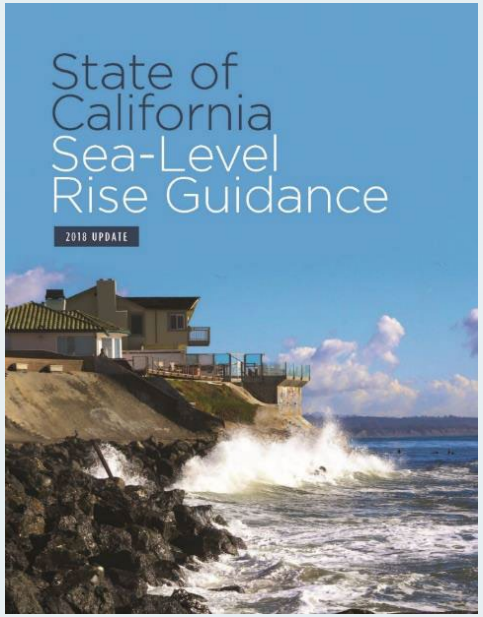
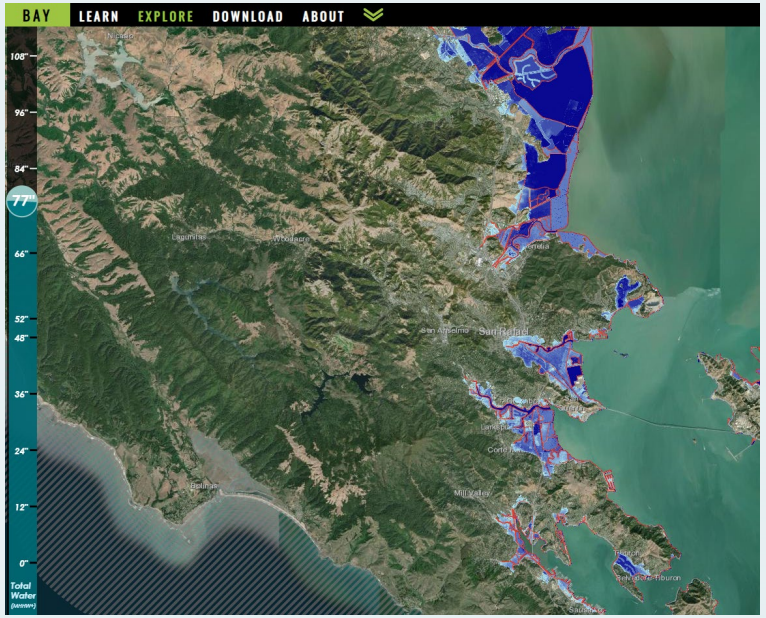


California Sea-Level Rise Guidance

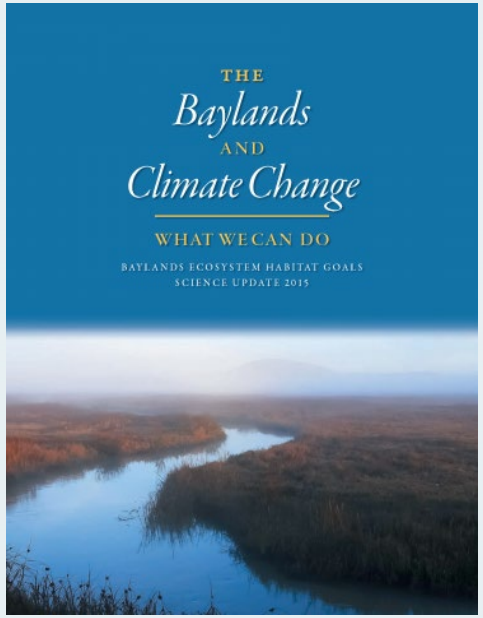
opc.ca.gov



BCDC Flood Explorer

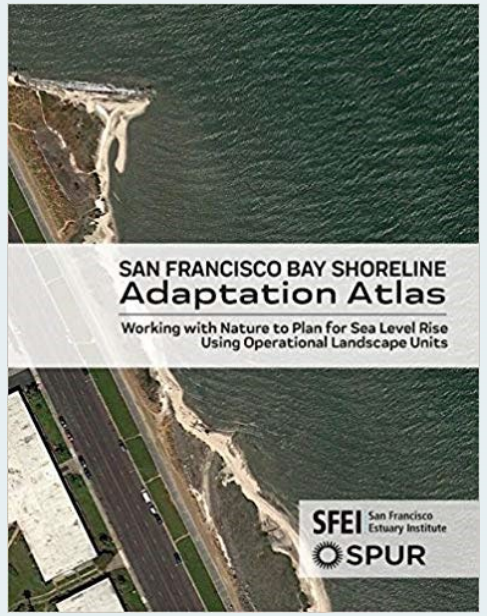
explorer.adaptingtorisingtides.org

Jeremy Lowe
JeremyL@sfei.org
San Francisco Estuary Institute



Habitat Goals Update

baylandsgoals.org



Adaptation Atlas

sfei.org/adaptationatlas

Sediment Challenges in Bay Area Restoration Projects

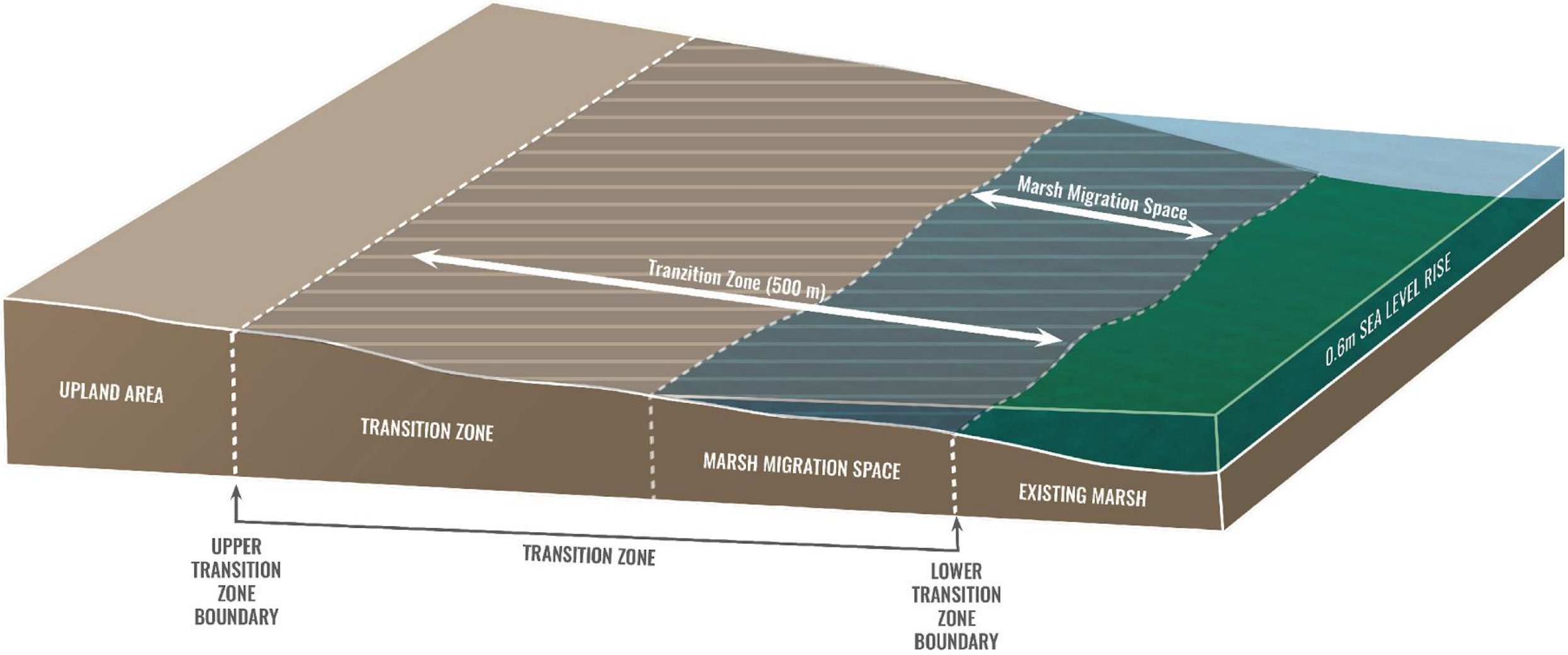
Evyan Borgnis Sloane
Deputy Bay Program Manager

Coastal Conservancy
STATE of CALIFORNIA

Outline

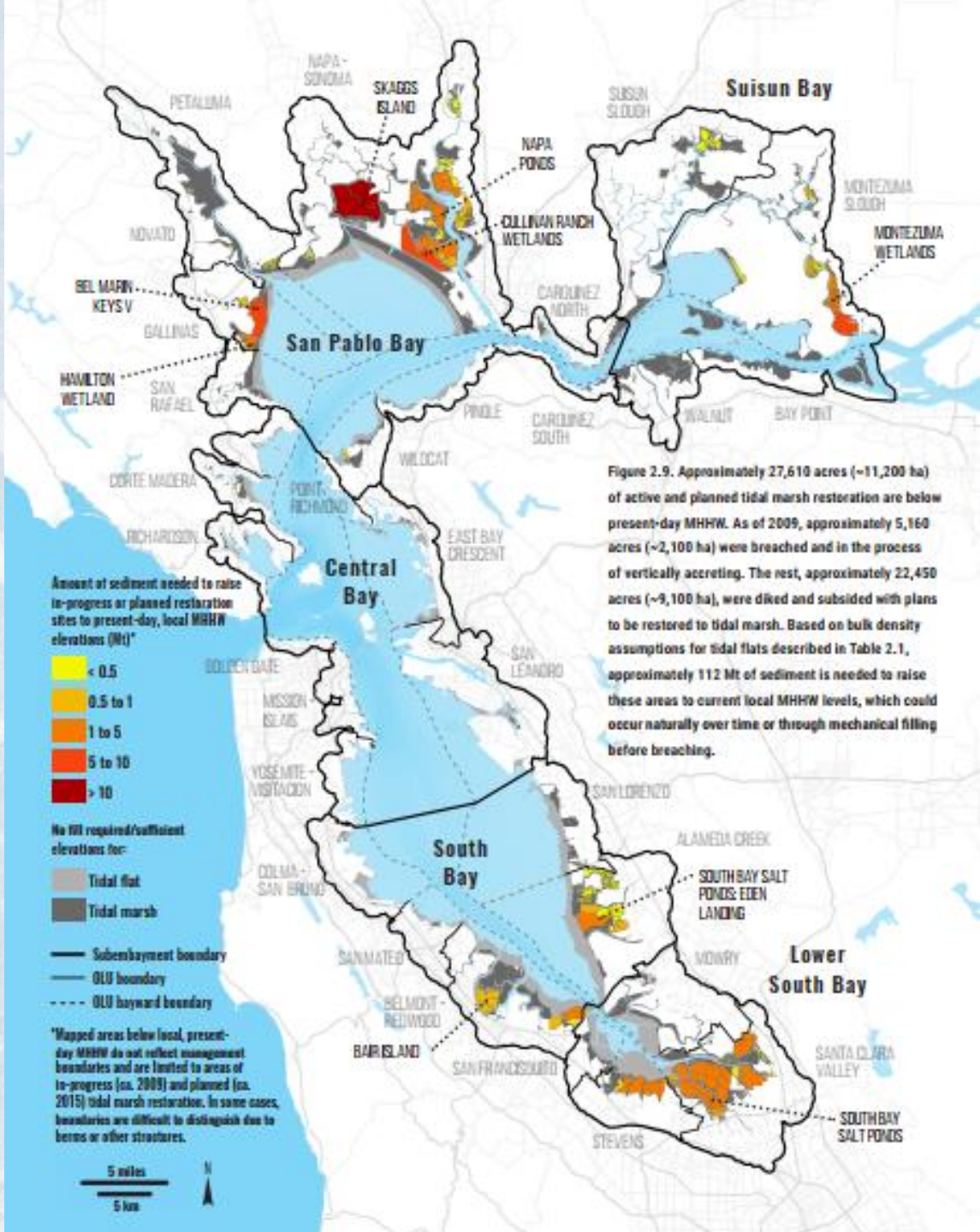
I. Glossary of Terms
II. Sediment & Soils Sources
III. Excavated Upland Soils
    I. Direct Placement
    II. Ecotone levees
    III. Levee repair/maintenance
IV. Dredged Sediment
    I. Direct Placement
    II. Strategic Placement
    III. Thin Lift
    IV. Water Column Seeding
V. Stream Maintenance Material
VI. Course Sediment

Transition Zone Terminology



Sediment for Survival

110 MT of sediment needed for in-progress and planned wetland restoration projects



Dusterhoff, S.; McKnight, K.; Grenier, L.; Kauffman, N. 2021. Sediment for Survival: A Strategy for the Resilience of Bay Wetlands in the Lower San Francisco Estuary. SFEI Contribution No. 1015. San Francisco Estuary Institute: Richmond, CA.

Sediment & Soils Sources

- **Excavated Upland Soils**

- **Dredged Material**

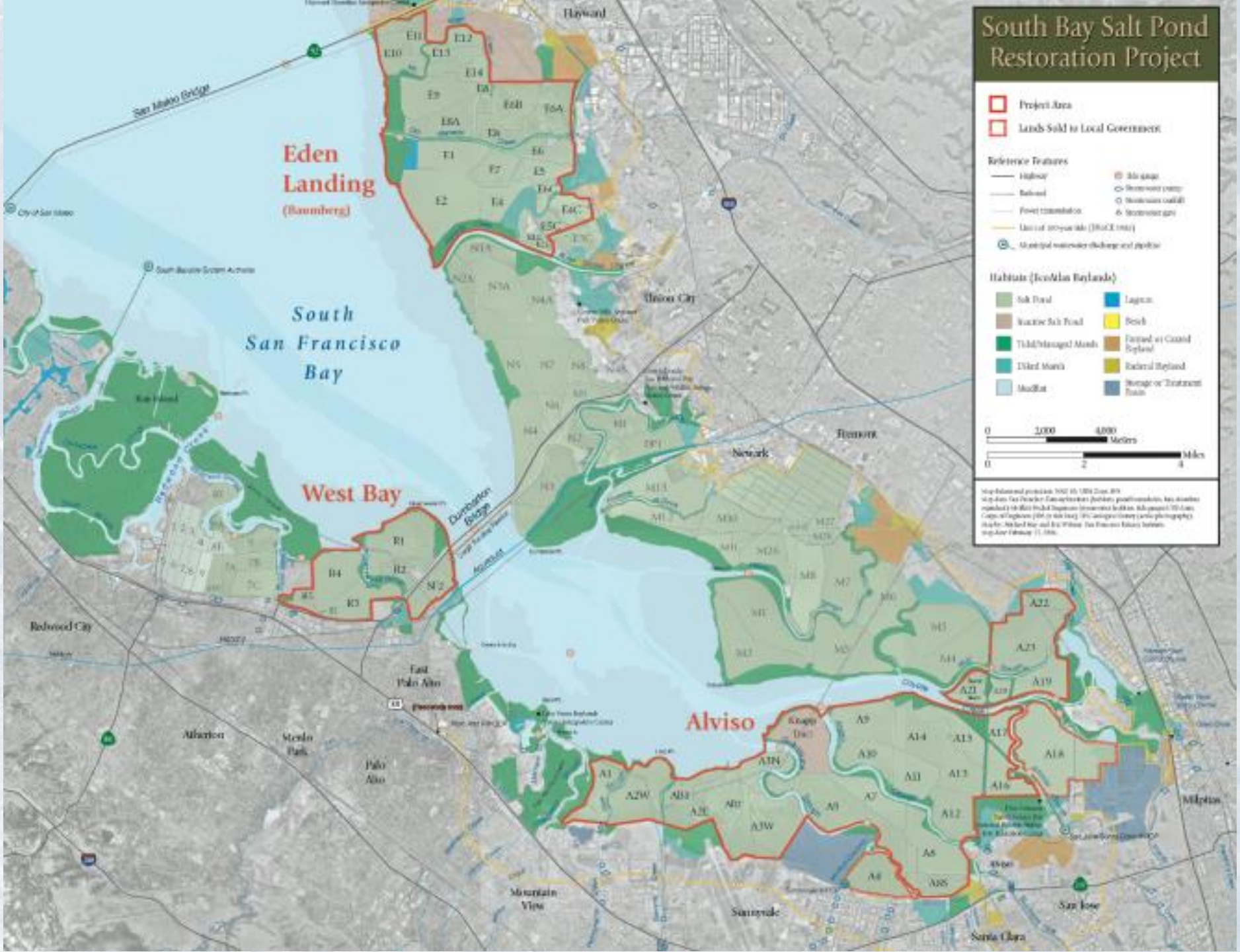
- **Stream Maintenance Material**

Photos: Dave Halsing, Dredging Contractors of America, & Valley Water

Excavated Upland Soils – Ecotone Levees

- South Bay Salt Pond Restoration Project
- Shoreline Phase 1
- A4 Resilient Habitat
- SAFER Bay
- Bel Marin Keys

SFEI Adaptation Atlas 2021


South Bay Salt Pond Restoration Project
Project Area
Lands Sold to Local Government
Reference Features
Habitats (EcoAtlas Baylands)
Salt Pond
Lagoon
Inactive Salt Pond
Beach
Tidal/Managed Marsh
Farmed or Grazed Baseland
Diked Marsh
Ruderal Baseland
Mudflat
Storage or Treatment Basin
0 2,000 4,000 Meters
0 2 4 Miles
Eden Landing
(Baumberg)
South San Francisco Bay
West Bay
Alviso
San Mateo Bridge
Dumbarton Bridge
Hayward
Union City
Fremont
Newark
Redwood City
East Palo Alto
Menlo Park
Palo Alto
Atherton
Mountain View
Sunnyvale
San Jose
Santa Clara
Milpitas

Excavated Upland Soils

- South Bay Salt Pond Restoration Project **ecotone levees**
  - A8 – ~200 thousand cubic yards (kCY)
  - R4 – one done (~90 kCY) & one almost done (~100 kCY)

Excavated Upland Soils

- A2W – 100 kCY
- A1 – needs 100 kCY

Excavated Upland Soils

- Eden Landing South – 500 kCY at a minimum

Excavated Upland Soils

- **Levee improvements and/or repair** needed for almost every project
- SBSPRP Phase 2 needed over **1 million CY** for all levee repairs

Excavated Upland Soils

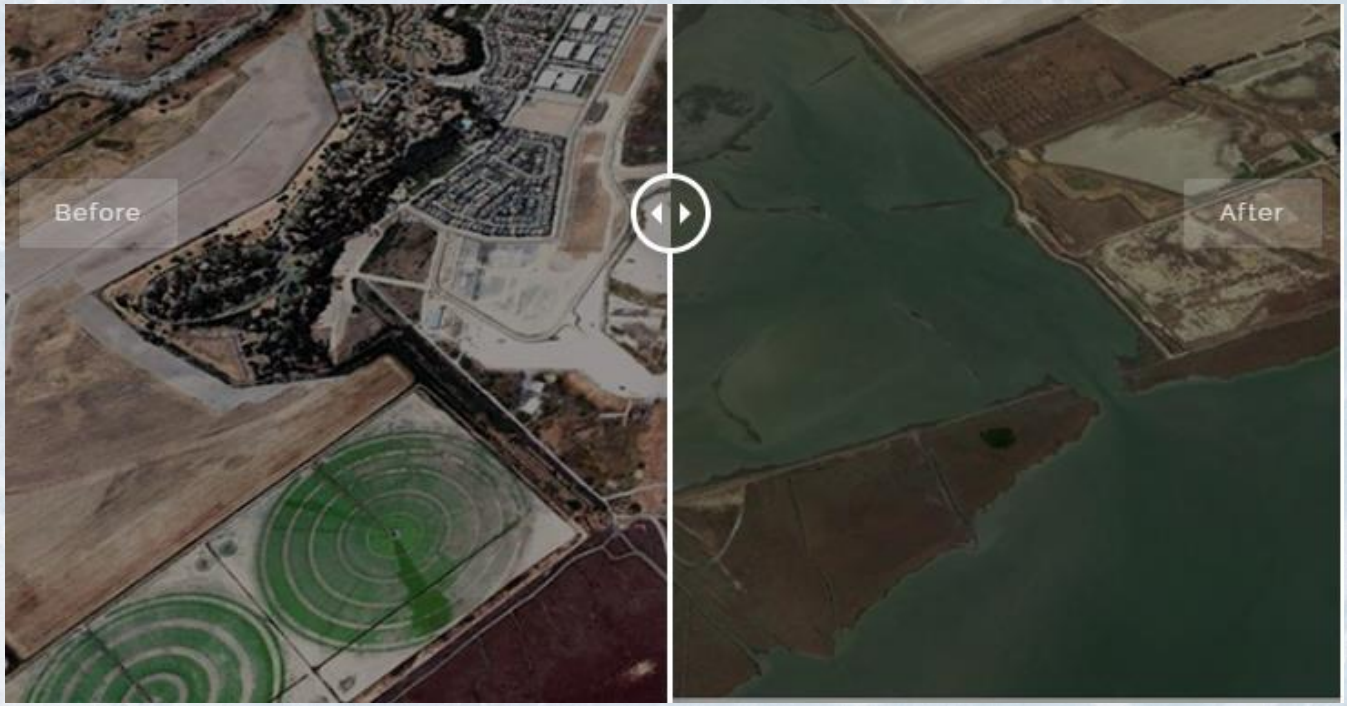
- Direct Placement to raise elevations of subsided former wetlands prior to breaching
  - Bair Island – 1 million CY of upland soils at Inner Bair
  - VTA – 3.5 million CY of "tunnel muck" to be placed at South Bay ponds

Excavated Upland Soils - Challenges

- Limited clean dirt supply
- Regulatory
- Agreements with a sole soil provider
- Site constraints
  - Access routes
  - Local govt approvals
  - Adjacent infrastructure Construction windows
- Funding

Dredged Sediments

- Direct Placement
  - Muzzi Marsh
  - Sonoma Baylands – 3.2 million CY
  - Hamilton Wetlands 5.9 million CY



Hamilton Wetlands, ESA

Dredged Sediments

- Direct Placement
  - Cullinan Ranch – 3 million CY accepted; needs 1 million CY more
  - Montezuma Wetlands – 9 million CY accepted to-date; needs 15-20 million CY more
  - Bel Marin Keys Unit V – up to 14 million CY

Montezuma Wetlands Phase 1

Cullinan Ranch, Dutra Group

Dredged Sediments

- Direct Placement in tidal waters - Tiscornia Marsh
  - ~17 kCY sediment needed

ESA – Preliminary Restoration Plan

Direct Placement of Dredged Sediments Challenges

- Cost
- Restoration Site Conditions
- Unexpected climate events
- Equipment
- Regulations

Dredging Today

USACE

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.

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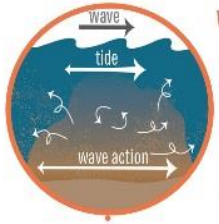

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Organisms living on or within sediment would be buried.

Areas with eelgrasses and oysters should be avoided during shallow water placement.

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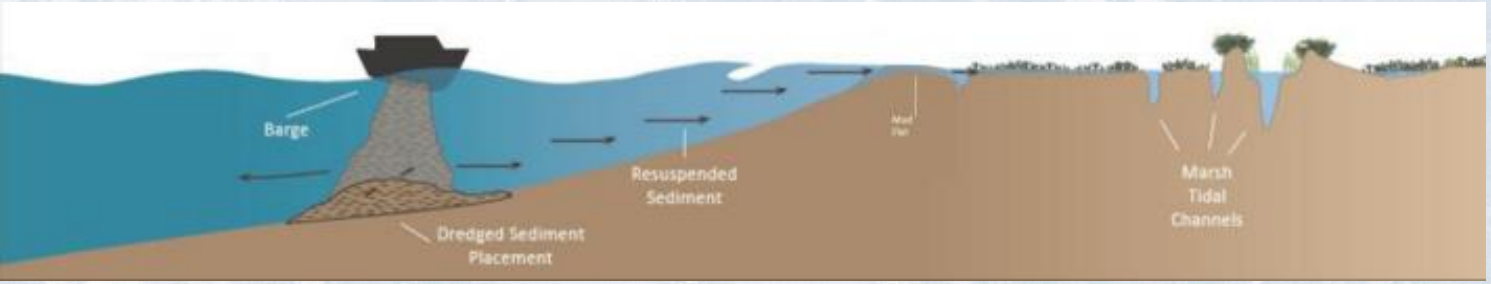
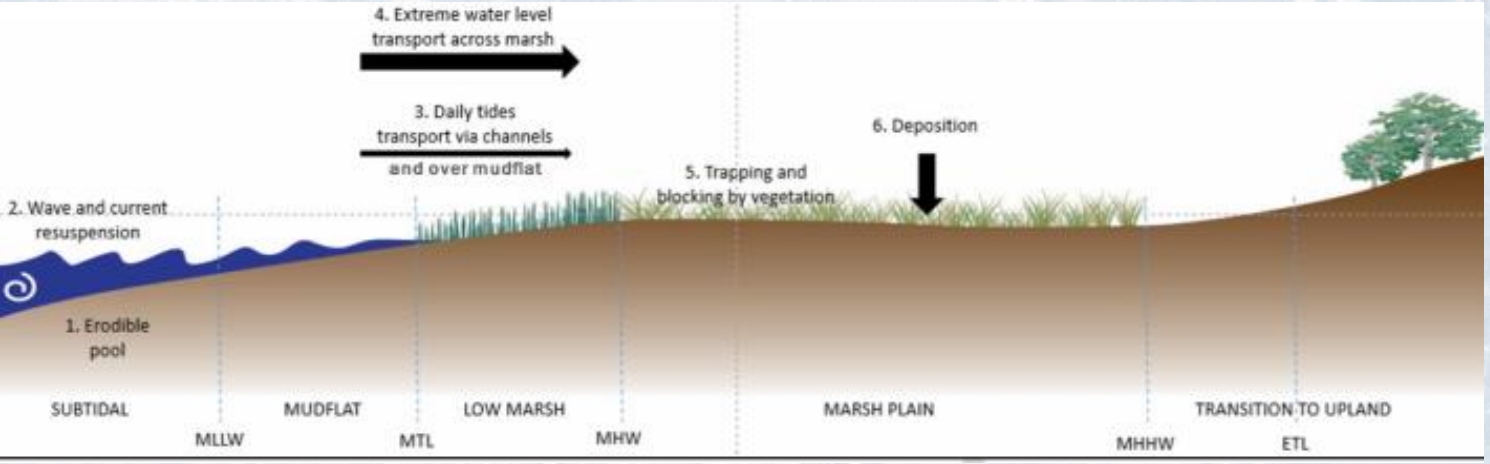
Sediment is placed offshore to be resuspended by wave and tide action and then transported by tidal currents onto the marshes.

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.

Dusterhoff, et al. 2021. Sediment for Survival: A Strategy for the Resilience of Bay Wetlands in the Lower San Francisco Estuary.

Strategic Placement – Eden Landing





Thin-lift Projects

- Tidal wetlands naturally adapted to sedimentation
- One pilot to-date in a tidally influenced marsh
  - Seal Beach Sediment Augmentation Project

China Camp, Roger Levanthal

Seal Beach NWR, USFWS

Thin-lift Pilots

- Deer Island Basin
- 2016 and 2020
- Re-slurried sediments brought in by truck
- Monitoring

Roger Levanthal, 2017

Methods

- Concrete pump
  - Slow & costly
  - Hard to slurry enough to be pumpable
- Flinging
  - Slow
  - Doesn't require mixing
  - Hard to control
- Mud Ponds
  - Requires most space
  - Mimics nature best

Roger Levanthal, 2017

Thin-lift Pilot at NERRs Nationwide

- Study as 8 NERR sites over 3 years (Raposa et al. 2023)
- Vegetation rebounded even up to 14 cm thicknesses
- Created a document recommending thin layer placement and design considerations

Guidance doc: https://www.nerra.org/wp-content/uploads/2020/02/TLP-Guidance-for-Thin-Layer-Placement-20200217-HRes.pdf

Raposa 2023: https://www.nerra.org/wp-content/uploads/2023/01/Raposa-2023-coordinated-sediment-addition-experiment-across-NERRS.pdf

New Thin-lift Planning

- Deer Island - 20,000 cy in 2024/2025
- McInnis Marsh - 50,000 - 100,000 cy from Gallinas creek
- Bothin Marsh Evolving Shorelines

McInnis Marsh, Marin County

Bothin Marsh, Marin County

Seal Beach NWR, SCC

Thin Lift Challenges

- Methodologies untested
- Costly
- Regulatory
  - Future wetlands considered habitat conversion or fill
  - Temporary impacts to species

Water Column Seeding

- USACE analyzing potential sites as a part of their Regional Dredged Material Management Plan
- Challenges
  - Unprecedented
  - Equipment
  - Site conditions
  - Species tradeoffs

Stream Maintenance Material

- Deer Island Basin thin-lift
- A8 ecotone
  - Small portion came from Valley Water's stream maintenance – 10-20K CY over 5-10 years
  - Most came from Enviromend

Pond A8, Dave Halsing

Stream Maintenance Material Challenges

- Lots of opportunities – Flood Control Districts around the Bay
- Regulatory
  - Cleanliness standards
  - Terrestrial in origin, but in aquatic environment

Coarse Sediment

- Bay beaches provide many habitat and physical benefits
  - Aramburu Island
  - Eden Landing South Pilot Gravel Beach
  - Greenwood Gravel Beach
  - Tiscornia Marsh

Richardson Bay Audubon

Aramburu Island 2016 monitoring report

Coarse Sediment Challenges

- Source material
  - Sand is expensive ($25/CY)
- Species tradeoffs

Closing Thoughts

- Sediment/soil is a critical resource of nature-based adaptation on the shoreline
  - Not only dredged sediment – upland soils needed!
- There are MANY projects actively in-need and pursuing sediment/soil
- There may not be enough without regulatory changes, local support, and increased funding
- Sediment/soil needs to be brought in faster

Thank you!

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