

Flood Protection Meets Ecosystem Restoration: A New Vision for Managing Channels at the Bay Margin



Scott Dusterhoff

Resilient Landscapes Program • San Francisco Estuary Institute

NBWA Board of Directors Meeting
May 6, 2016

SFEI-ASC

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Current & Recent North Bay Projects

*Petaluma Watershed
Historical Hydrology*



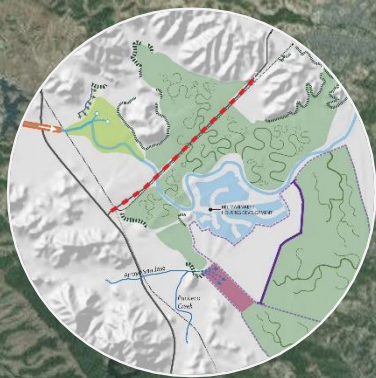
*San Pablo Bay
Shoreline Change*



*Napa Valley
Historical Ecology*



*Lower Novato Creek
Landscape Vision*

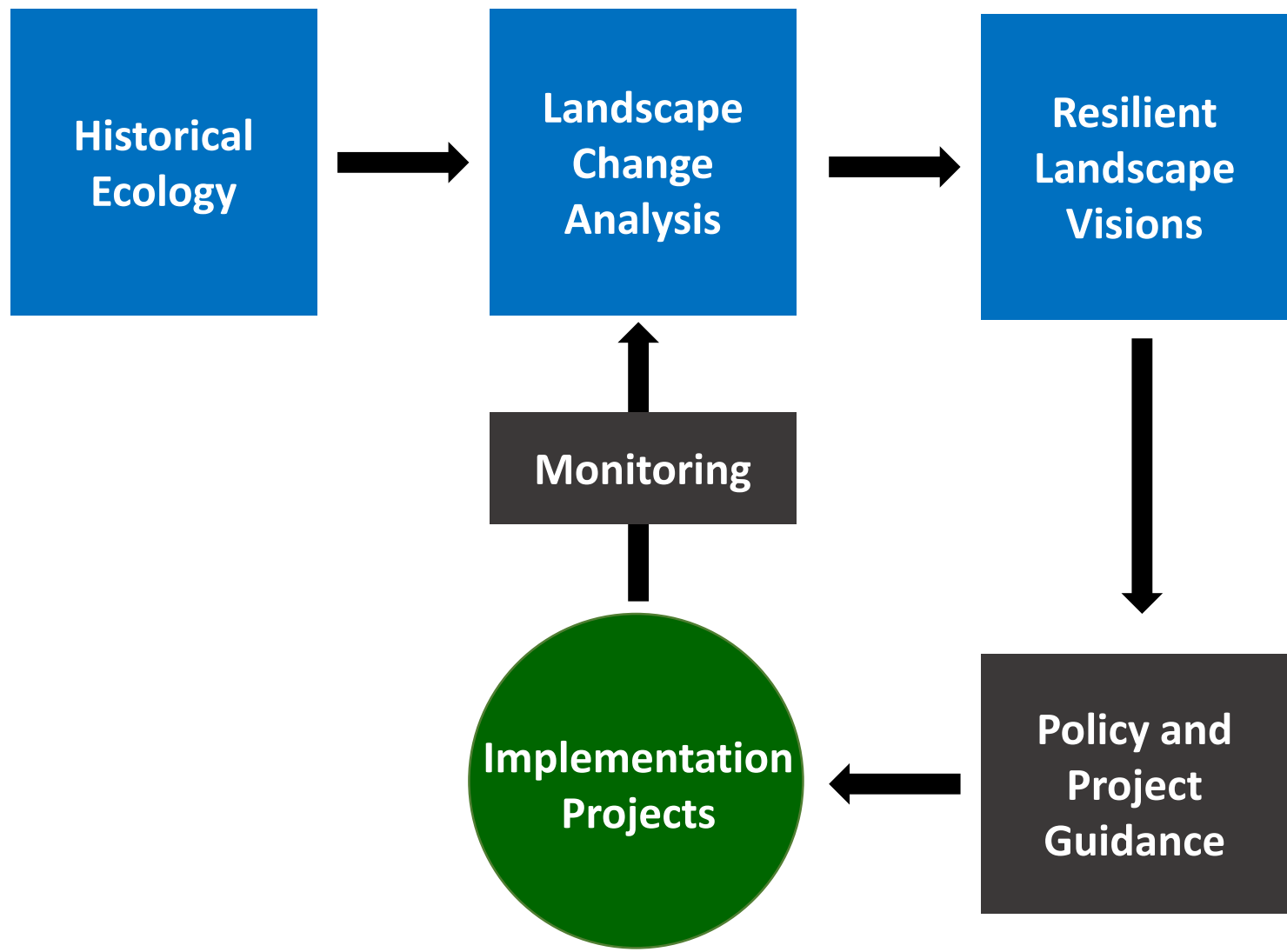


RESILIENT LANDSCAPES APPROACH

How things worked

How things work now

What's possible/needed

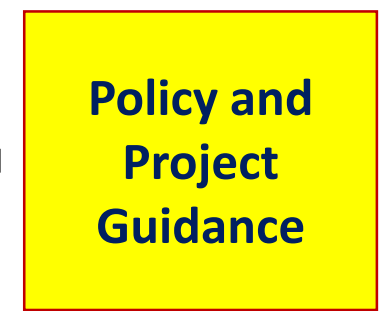


RESILIENT LANDSCAPES APPROACH

How things worked

How things work now

What's possible/needed



Flood control channels at the Bay interface:

A unique opportunity for a multi-benefit approach

Current flood management challenges

- Aging infrastructure
- Complex landscape setting
- Dredging impacts to habitat



21st century drivers for change

- Changing climate
- Outdated channel designs
- Increasing value of dredged sediment for bayland restoration



Flood control channels at the Bay interface: *A unique opportunity for a multi-benefit approach*

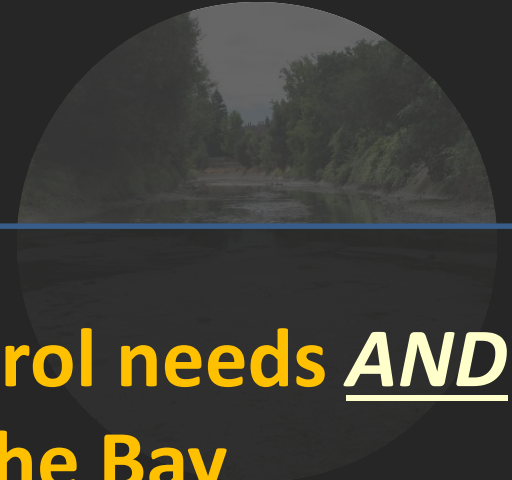
Current flood management challenges

- Aging infrastructure
- Complex landscape setting

How can we meet future flood control needs AND improve ecosystem functioning at the Bay interface?

21st century drivers for change

- Changing climate
- Outdated channel designs
- Increasing value of dredged sediment for bayland restoration



Flood Control 2.0 Project

Project Goal

Develop *tools* and a *process* for helping integrate habitat restoration and creation elements into flood risk management at the Bay interface

Project Leads

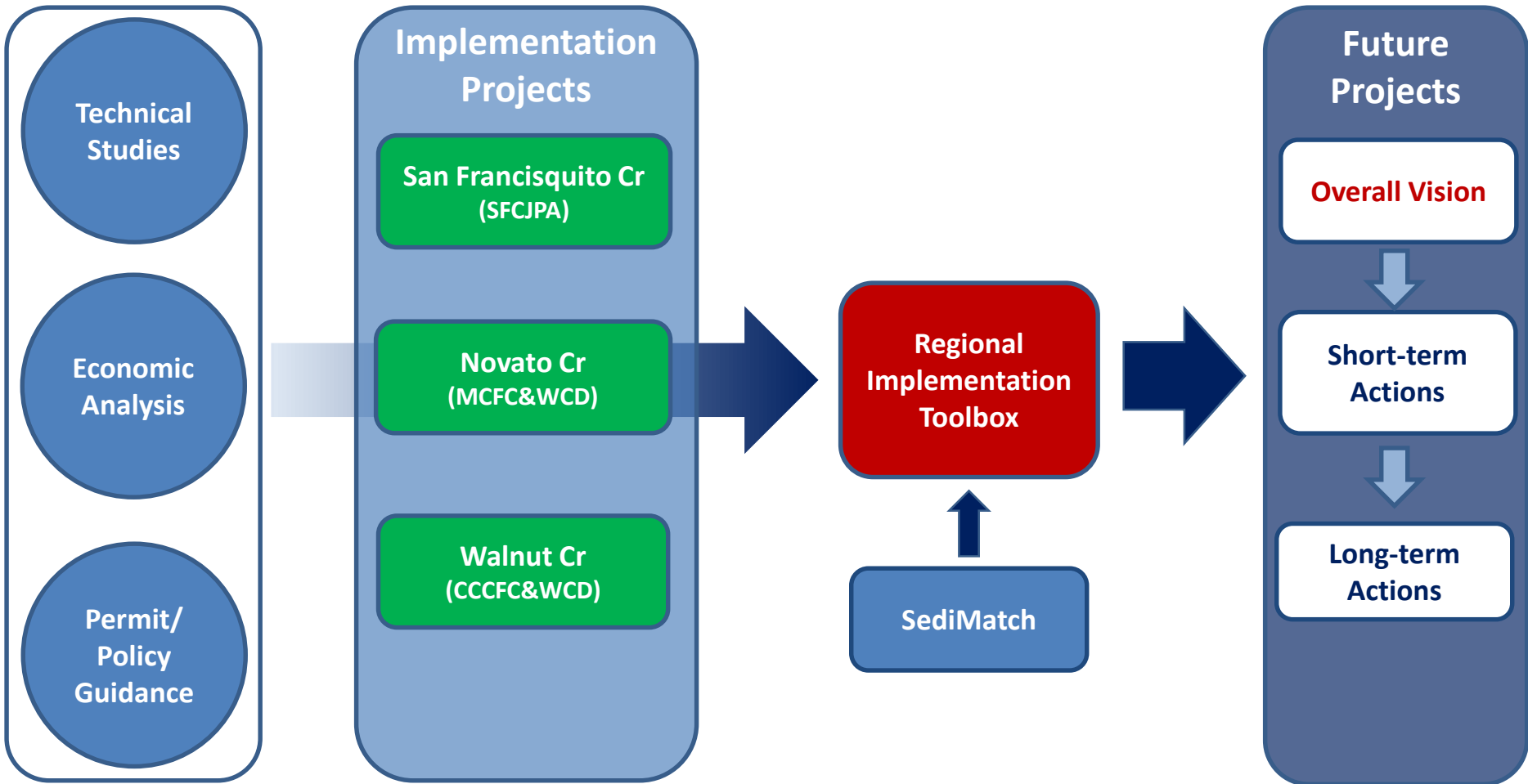
- San Francisco Estuary Partnership (SFEP)
- San Francisco Estuary Institute (SFEI)
- San Francisco Bay Joint Venture (SFBJV)
- Bay Conservation and Development Commission (BCDC)



Funding from EPA SF Bay Water Quality Improvement Fund

Flood Control 2.0

Project Overview



Management Concepts – Implementation Site

PROCESS

1. Understand Landscape Functioning

- Geomorphology and ecology
- Change from historical to contemporary



Management Concepts – Implementation Site

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1. Understand Landscape Functioning

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- Change from historical to contemporary

2. Develop a future Vision

- Identify opportunities and constraints
- Identify appropriate concepts
- Collaboration among local engineers, local planners, and regional scientists



Management Concepts – Implementation Site

PROCESS

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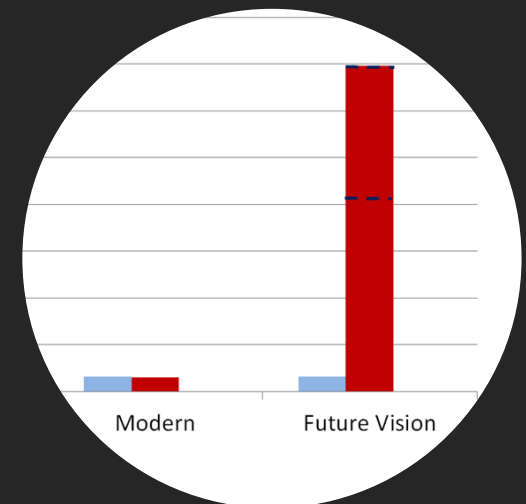
- Geomorphology and ecology
- Change from historical to contemporary

2. Develop a future Vision

- Identify opportunities and constraints
- Identify appropriate concepts
- Collaboration among local engineers, local planners, and regional scientists

3. Assess habitat improvements associated with the future Vision

- Quantify impact on landscape features

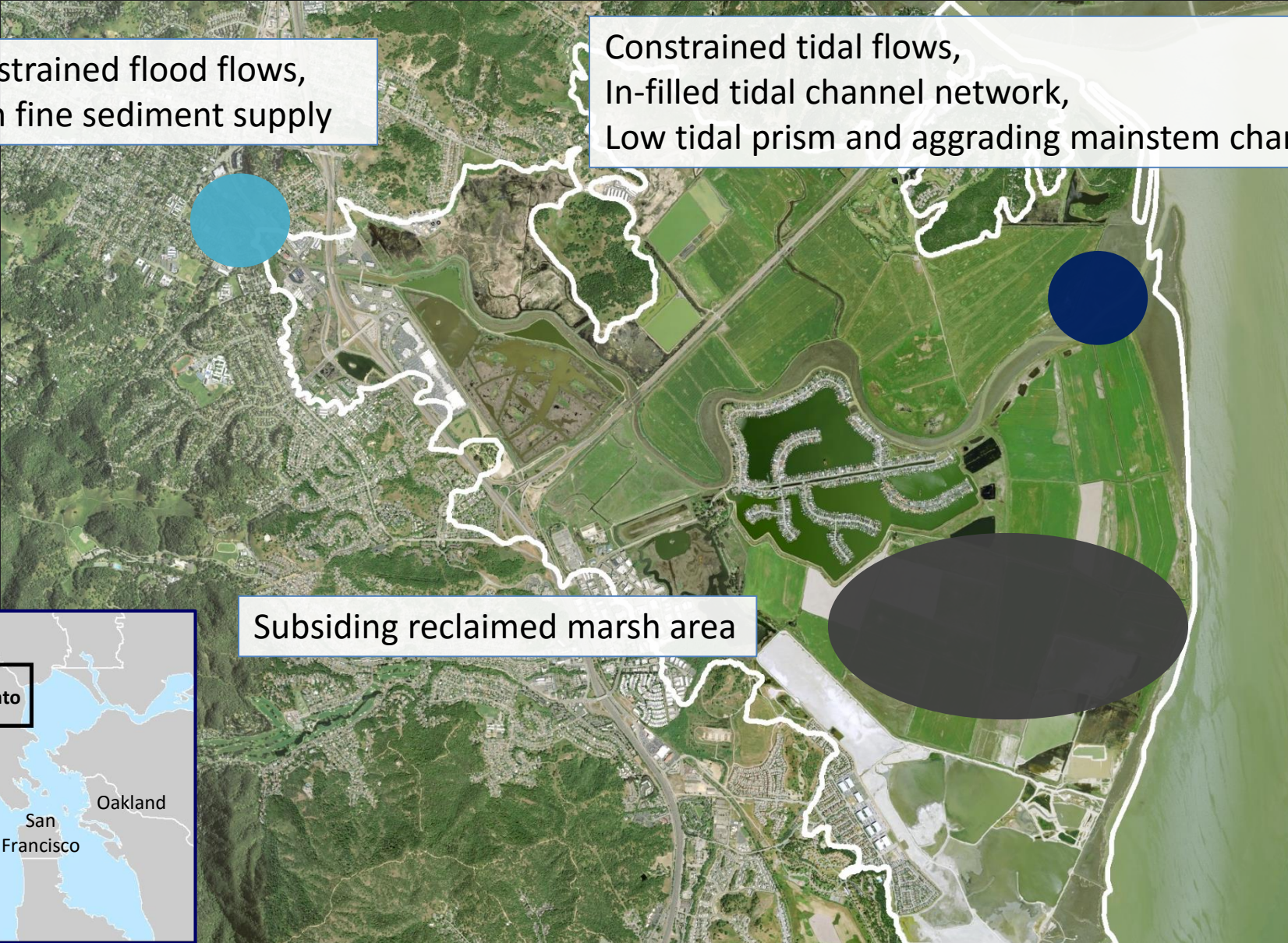


Novato Creek Baylands Landscape Change

Constrained flood flows,
High fine sediment supply

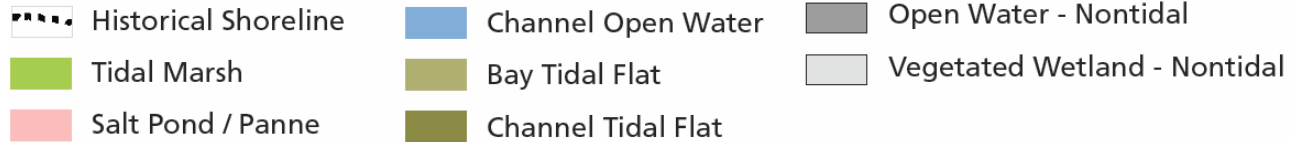
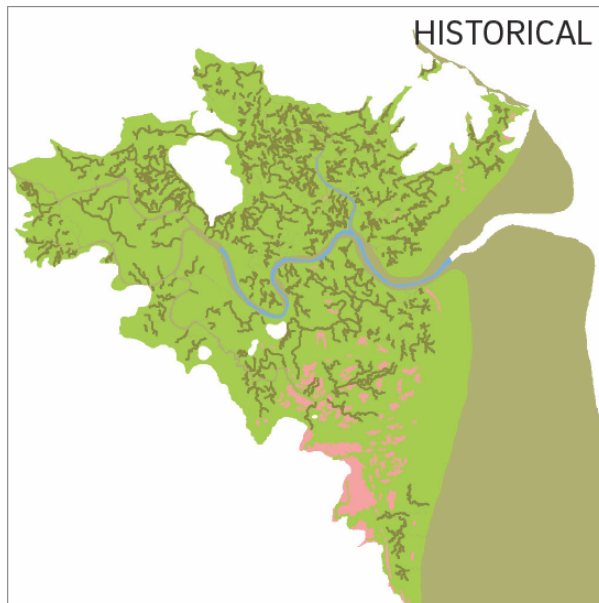
Constrained tidal flows,
In-filled tidal channel network,
Low tidal prism and aggrading mainstem channel

Subsiding reclaimed marsh area



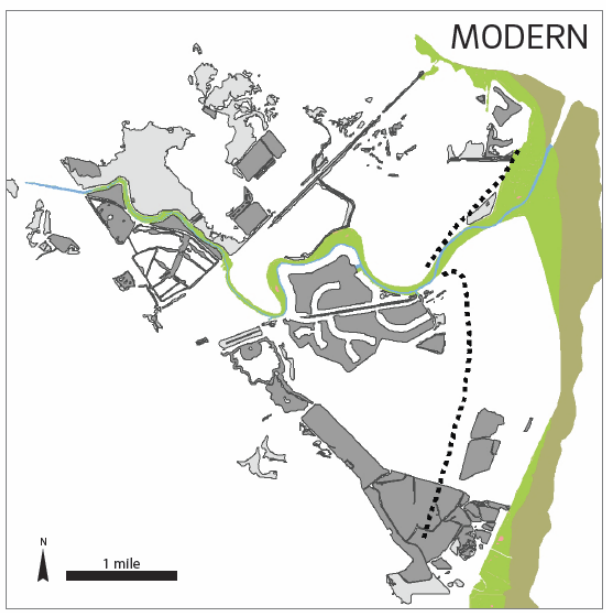
Novato Creek Baylands Landscape Change

Habitat Type



Novato Creek Baylands Landscape Change

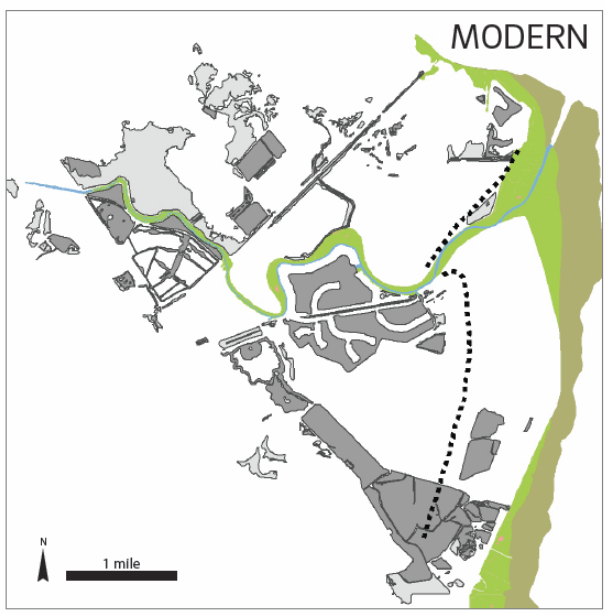
Habitat Type



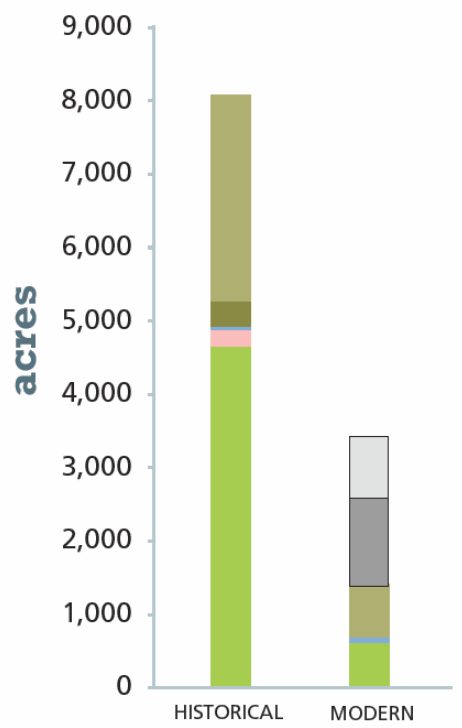
- Historical Shoreline
- Tidal Marsh
- Salt Pond / Panne
- Channel Open Water
- Bay Tidal Flat
- Channel Tidal Flat
- Open Water - Nontidal
- Vegetated Wetland - Nontidal

Novato Creek Baylands Landscape Change

Habitat Type

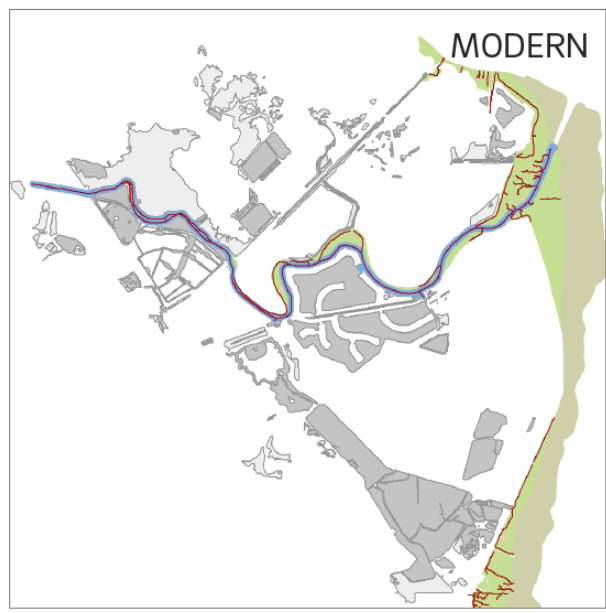
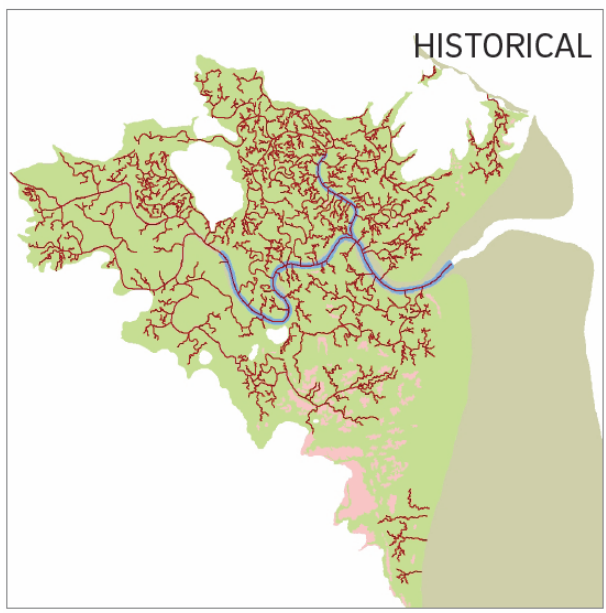


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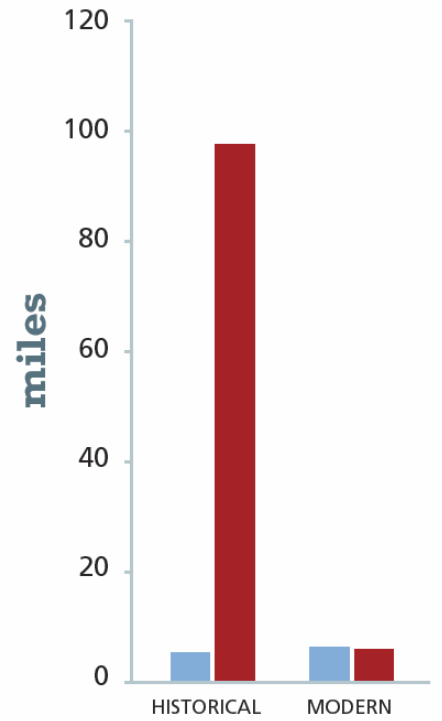


Novato Creek Baylands Landscape Change

Channel Length

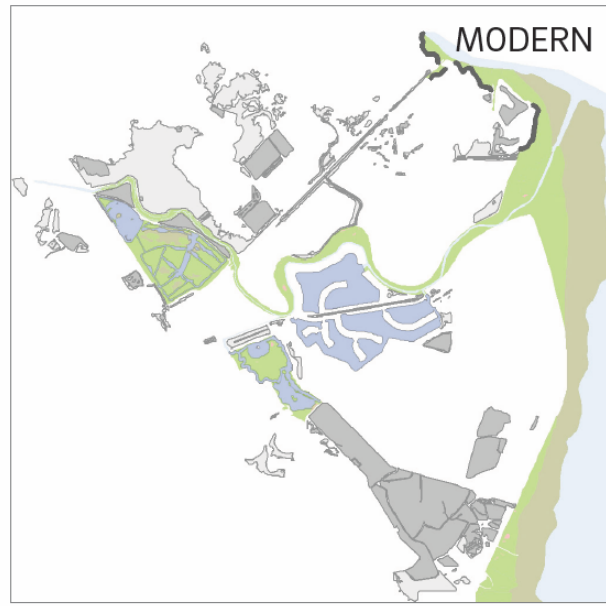
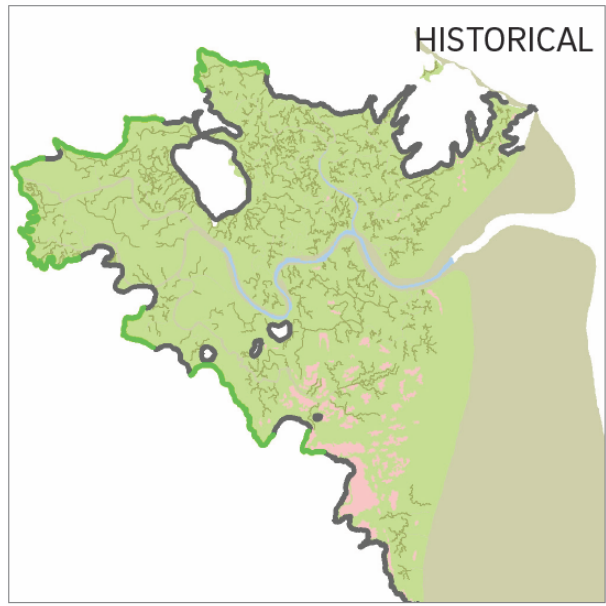


Blue Mainstem
Red Tributaries

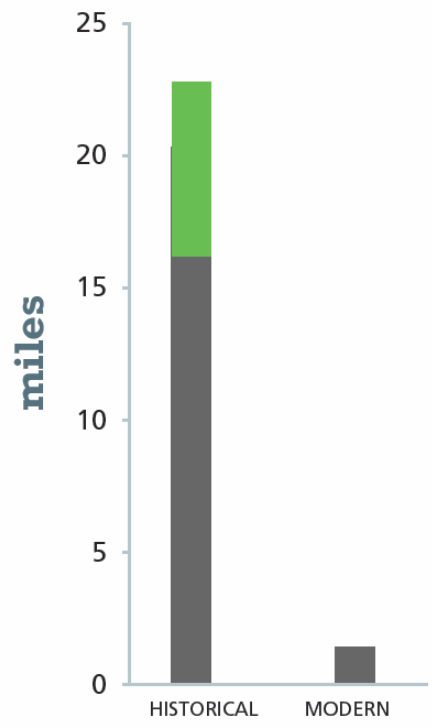


Novato Creek Baylands Landscape Change

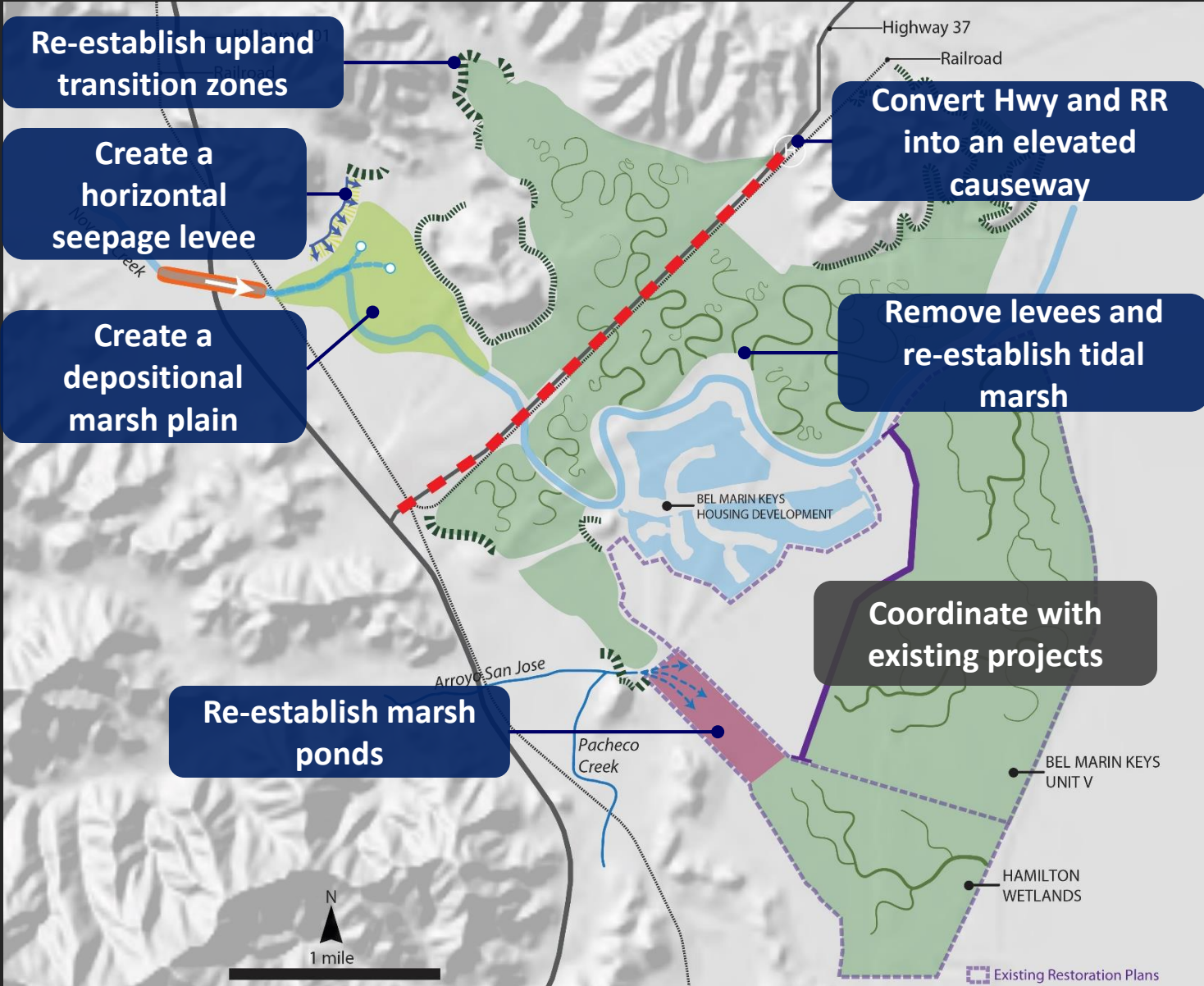
Marsh-Upland Transition Zone (Ecotone)



■ Broad Ecotone (Lowland)
■ Narrow Ecotone (Hillslope)



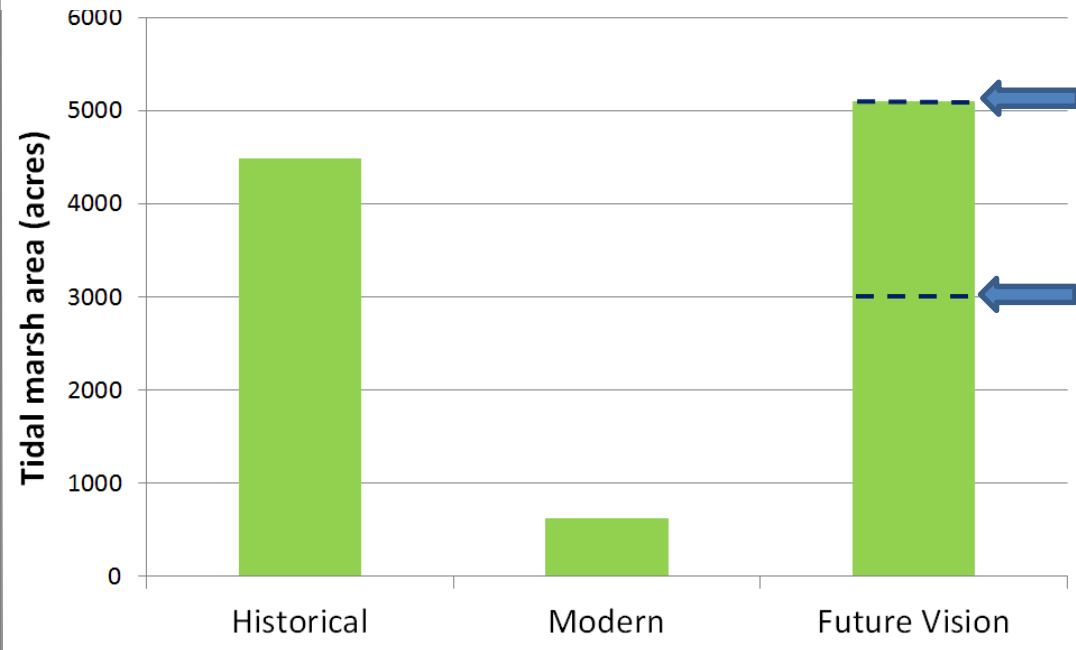
Novato Creek Baylands Long-term Vision



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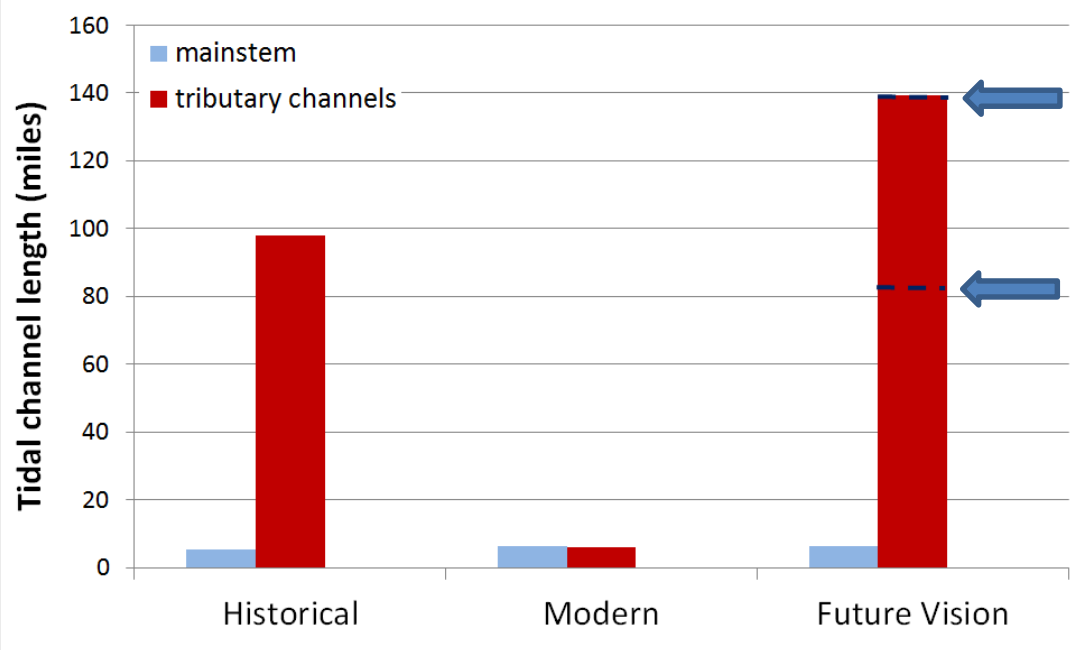
Tidal Marsh Area



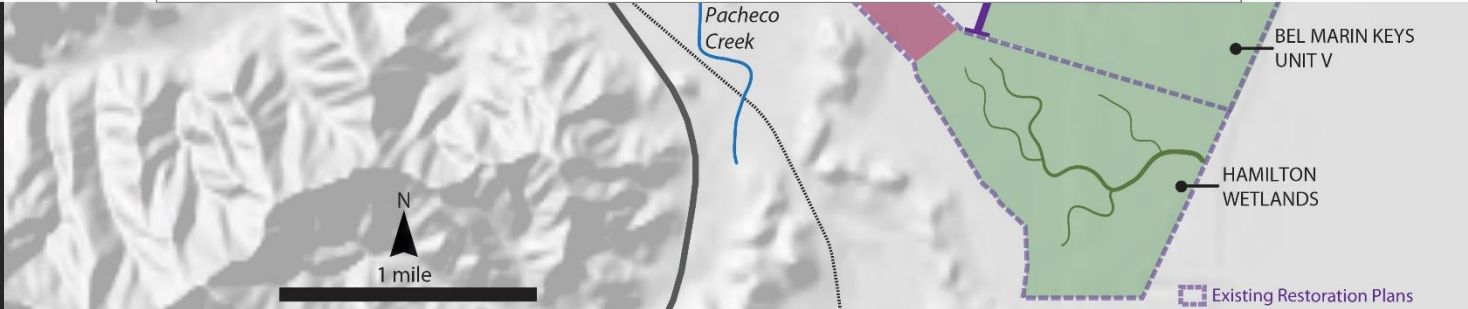
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Channel Length



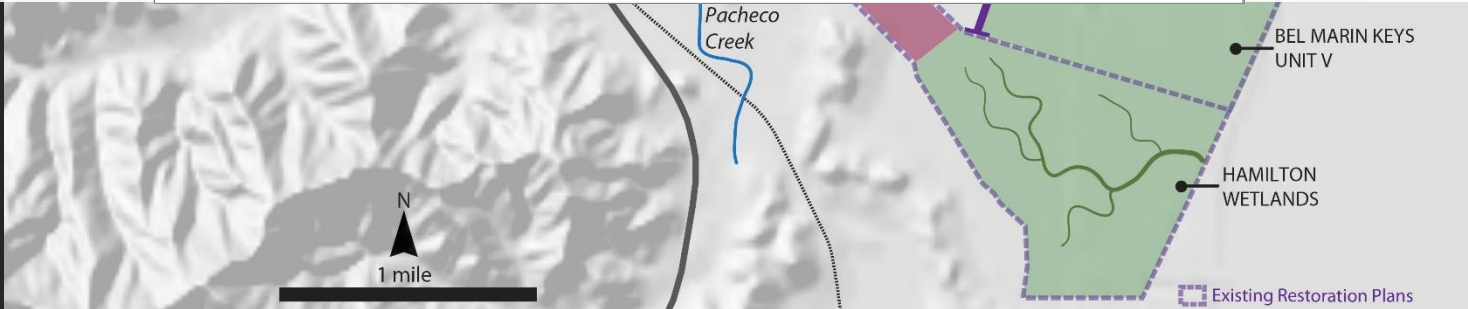
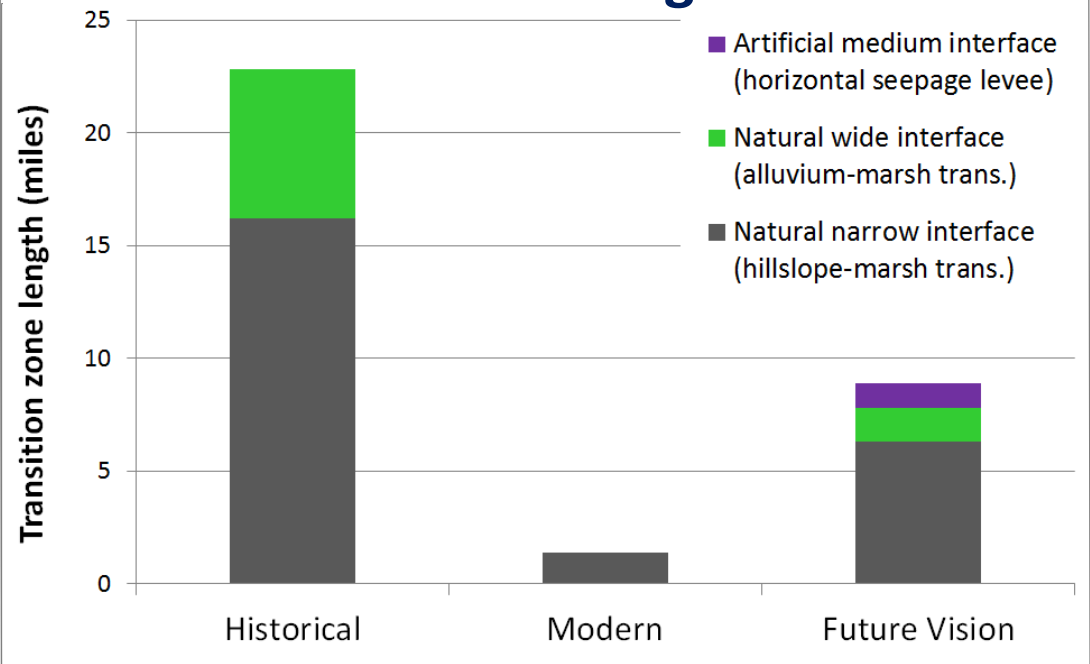
modern shoreline
historical shoreline



Novato Creek Baylands Long-term Vision



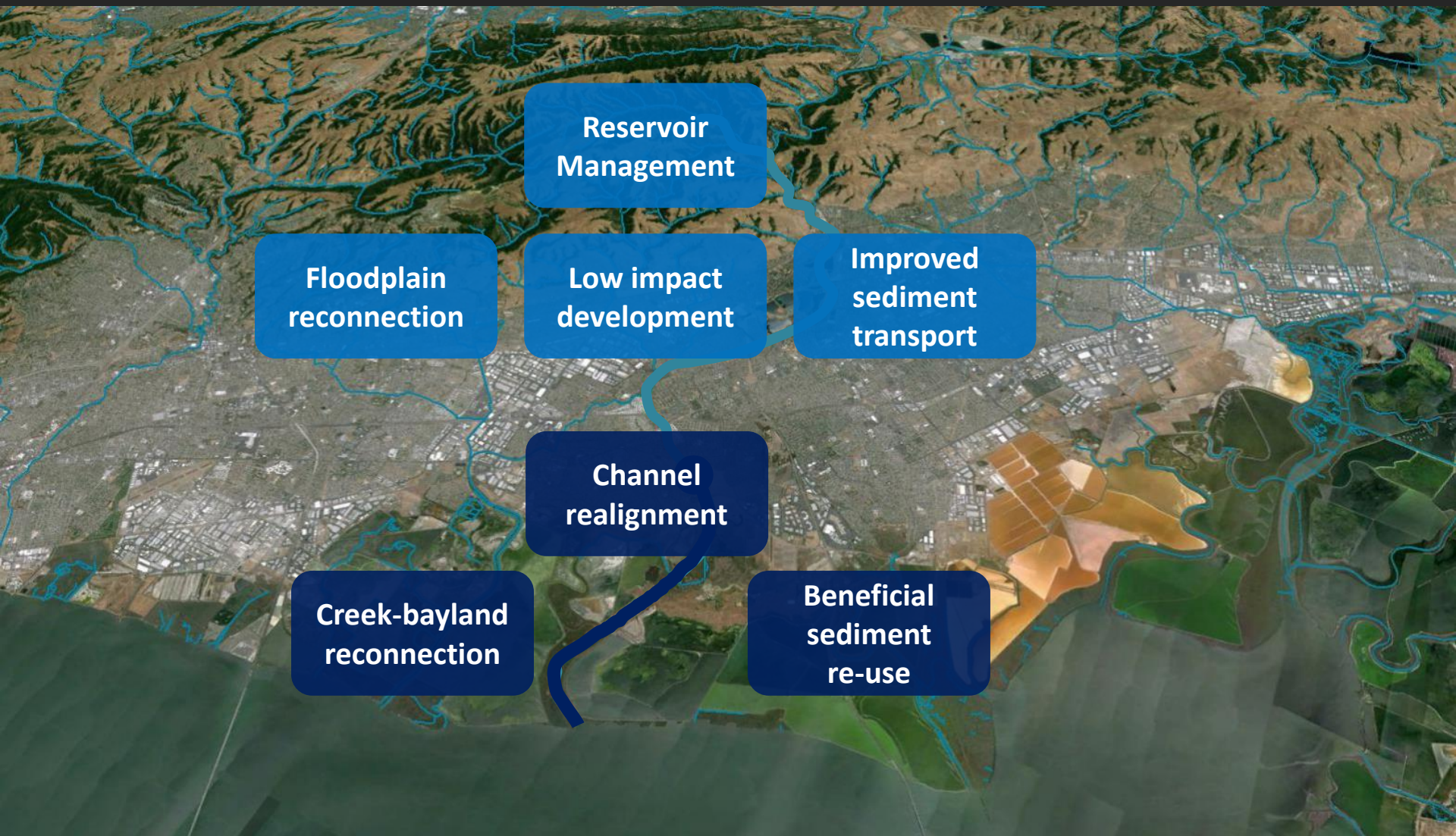
Ecotone Length



Management Concepts – What's Next?

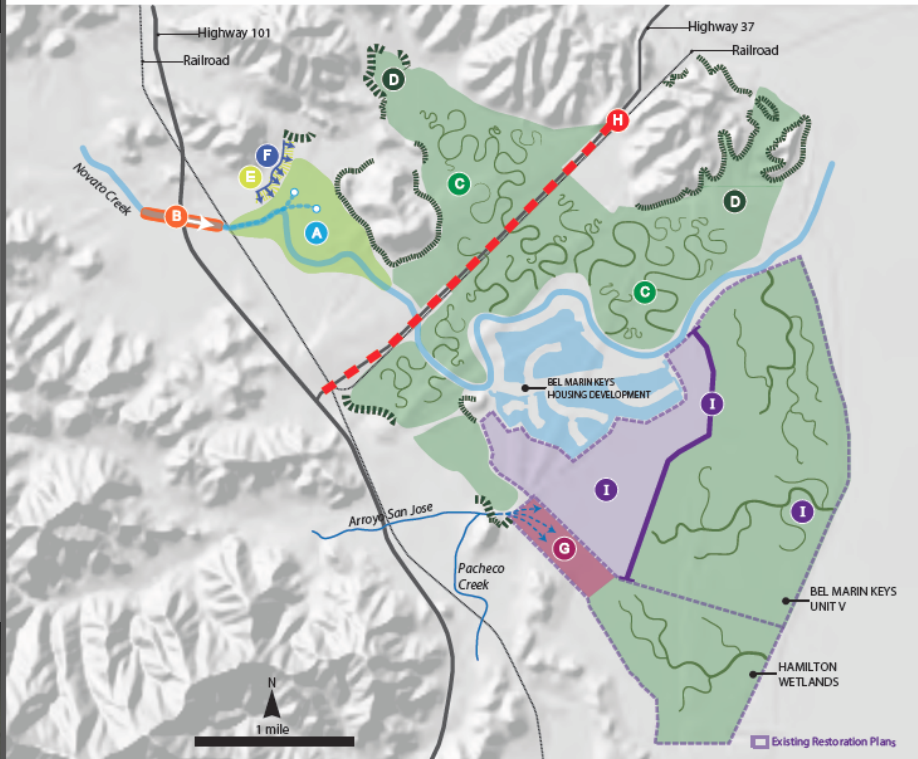


Management Concepts – What's Next?



Step 2
At Workshop

NOVATO CREEK BAYLANDS LONG-TERM VISION



Please Note:

- Bel Marin Keys Unit V & Hamilton Wetlands have existing restoration plans. The anticipated restored tidal marsh shown on Bel Marin Keys Unit V & Hamilton Wetlands is illustrated from the State Coastal Conservancy's completed and proposed restoration plans. Please reference the State Coastal Conservancy's plans for additional site actions and associated habitats that are not shown.
- This visioning did not include any modifications to the Bel Marin Keys Housing Development.

A DEPOSITIONAL MARSH PLAIN
(Sediment Accumulation Zone)

- ACTIONS**
- Natural and managed accumulation of sediment
 - Allow detritic distributary formation and channel movement
 - Designed in relation to floodwater detention basins
- BENEFITS**
- Builds marsh elevation to keep pace with sea level rise
 - In long term, reduces potential and severity of tidal flooding in relation to sea level rise and storm surge
 - Reduces channel sedimentation
 - Provides rare brackish tidal marsh

B ACTIVE STREAM SEDIMENT MANAGEMENT

- ACTIONS**
- Transport fine sediment to marsh depositional plain via slurry and/or short distance truck transport
 - Use coarse sediment to build and/or maintain seepage levees
 - Use sediment for coastal flood protection structures/slopes
- BENEFITS**
- Potential to reduce sediment maintenance removal costs
 - Maintains channel capacity and flood protection
 - Increases marsh resiliency to accelerated sea level rise
 - Protects developed areas and infrastructure from coastal flooding

C TIDAL MARSH

- ACTION**
- Remove levees and reconnect lower Novato Creek to adjacent baylands
- BENEFITS**
- Reestablishes functioning marsh plain (with tidal channels, mud flat, shallows)
 - Increases tidal prism to widen Novato Creek channel and improve floodwater transport capacity
 - Increases edge habitat between marsh and Bay
 - Increases marsh patch size for special status species
 - Reduces wave action due to wave attenuating vegetated marshes
 - Possible decrease in flood elevation with water spreading out onto the floodplain

D ESTUARINE-TERRESTRIAL TRANSITION ZONE

- Natural, narrow ecotone (hillslope transition)
 Natural, wide ecotone (lowland transition)
- ACTION**
- Reconnect tidal marsh to adjacent undeveloped grassland and oak woodland areas
- BENEFITS**
- Increases high water refuge habitat and migratory corridors for tidal marsh species
 - Provides opportunity for tidal marsh migration landward in response to sea level rise

E HORIZONTAL LEVEES*
(Constructed Transition Zone)

- ACTION**
- Establish wide, gently sloped flood protection levees
- BENEFITS**
- Protects vital infrastructure from flooding
 - Reuses dredged sediment
 - Provides transition zone habitats and marsh migration space
- * The term "Horizontal Levee" is a registered trademark of The Bay Institute.

F PERMEABLE SEEPAGE SLOPE
(Freshwater Inflow Zone)

- ACTION**
- Redirect treated wastewater from treatment ponds to permeable horizontal levees
- BENEFITS**
- Provides nutrient processing functions (e.g., denitrification, nutrient sequestration)
 - Creates brackish marsh gradients and habitat heterogeneity

G SEASONAL WETLANDS/SALT PANNES

- ACTION**
- Reroute Arroyo de San Jose and Pacheco Creek to support seasonal wetland habitat with direct freshwater and sediment inflow (possibly transitioning to salt pannes with sea level rise)
- BENEFITS**
- Takes flood water out of mainstem Novato Creek
 - Provides shorebird and waterfowl habitat
 - Provides potential area for tidewater goby reintroduction

H ELEVATED TRANSPORTATION INFRASTRUCTURE

- ACTION**
- Elevate highway and railroad to allow tidal flows to the northeast portion of the historical baylands
- BENEFITS**
- Increases total marsh area, tidal channel length, and natural transition zone
 - Increases tidal prism and flood control channel capacity
 - Decreases infrastructure vulnerability

I BEL MARIN KEYS UNIT V RESTORATION

- ACTIONS**
- Increase ground elevation
 - Remove Bay levee and establish tidal channel networks that drain to Bay
 - Build new levee inland to protect freshwater marsh area
- BENEFITS**
- Maximizes cost effectiveness of lower Novato Creek habitat restoration efforts
 - Increases resiliency to sea level rise with elevated marshes
 - Reduces wave action due to wave attenuating vegetated marshes

HOW CREEKS MEET THE BAY: Changing Interfaces

A Product of the Flood Control 2.0 Project

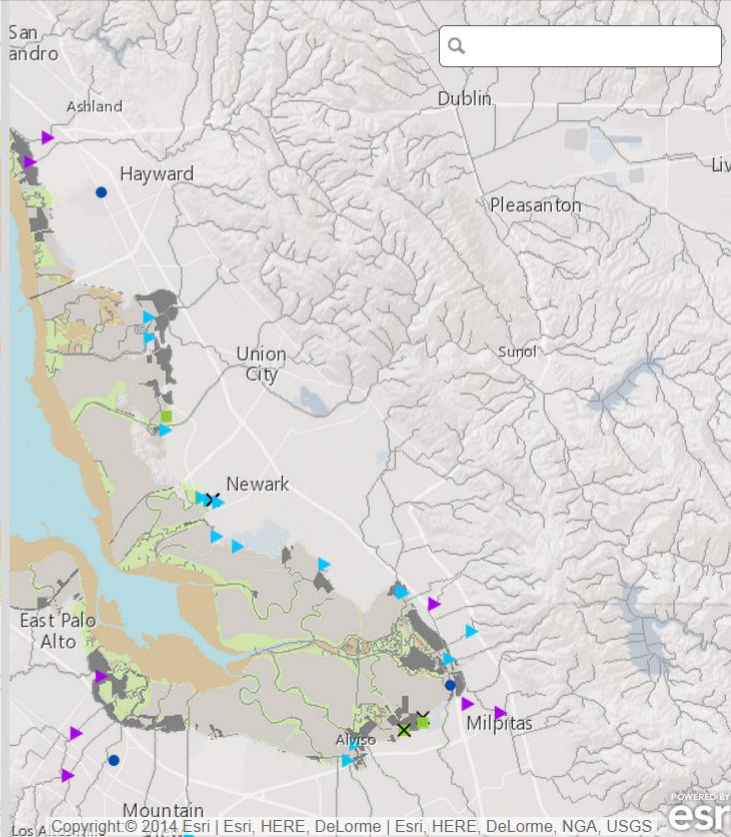
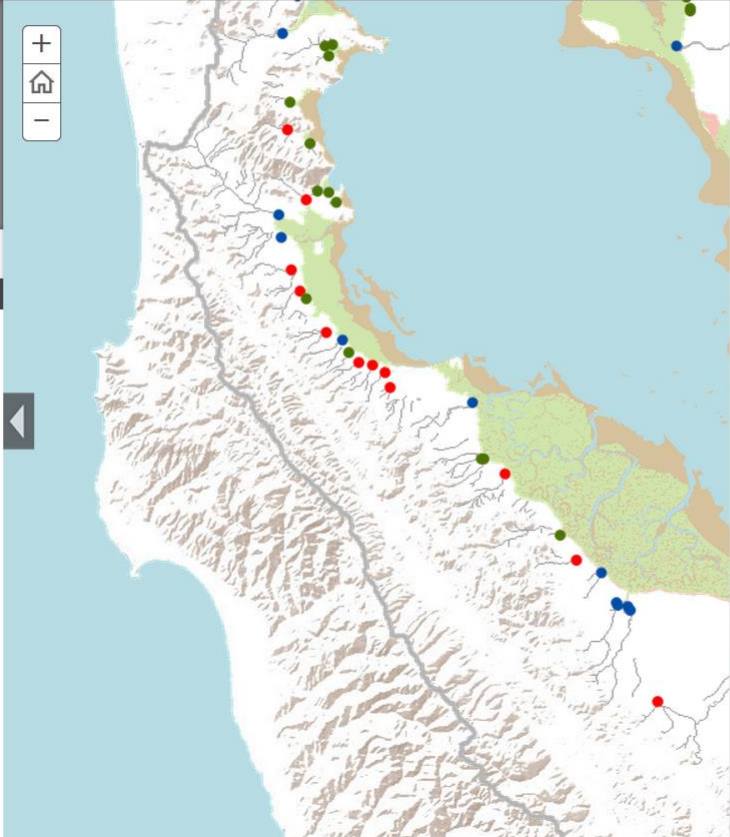


Slide the bar on the map to compare historical (mid-1800's) and contemporary (2014) fluvial-tidal interfaces around San Francisco Bay.

San Francisco Bay's connections to local creeks are integral to its health. These fluvial-tidal (F-T) interfaces are the points of delivery for freshwater, sediment, contaminants, and nutrients. The ways in which the F-T interface has changed affect flooding dynamics, ecosystem functioning, and resilience to a changing climate. As the historical baylands have been altered, the majority of contemporary F-T interface types have changed leading to additional F-T interface types within the present-day landscape. Illustrations of each F-T interface type and methods for classification are available [here](#).

This project is part of Flood Control 2.0. For further information, visit [www.sfei.org](#).

Historical Conditions	Contemporary Conditions
F-T Interface Location	F-T Interface Location
● Bay	● Bay
● Tidal marsh channel	● Tidal marsh channel
● Natural levee	▲ Tidal channel through diked baylands
● Tidal marshland	▲ Tidal channel through bayfill
● Natural levee	■ Diked baylands
● Disconnected	■ Bayfill
● Natural levee	▲ Tributary channel
Historical Baylands	✕ Channel no longer present
■ Water	Contemporary Baylands
■ Tidal Flat	■ Water
■ Tidal Marsh	■ Tidal Flat
■ Salt Pond or Panne	■ Tidal Marsh or Muted Tidal Marsh
■ Beach or Dune	■ Diked Baylands (Salt Ponds, Managed Marsh)
	■ Dune
	■ Bayfill



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QUESTIONS?

Thank You!

<http://sfei.org/projects/flood-control-20>

scottd@sfei.org

