

# Restoration Goals for the Region

Matt Gerhart, Bay Area Program Manager



Coastal Conservancy  
STATE *of* CALIFORNIA





# Coastal Conservancy

STATE of CALIFORNIA

We work with partners to protect, restore, and provide access to the California coast & SF Bay



Wink



BLM



Ocean Discovery Institute



Mary Small



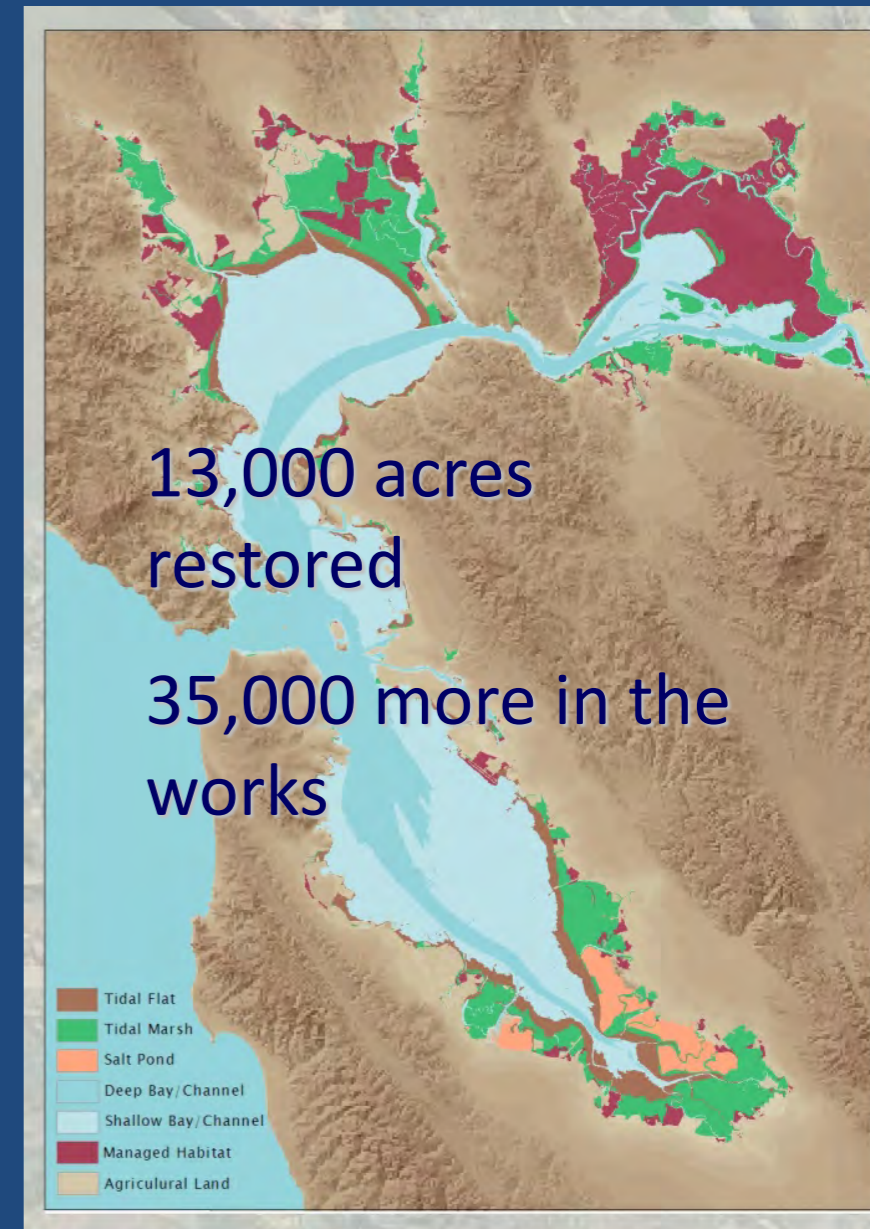
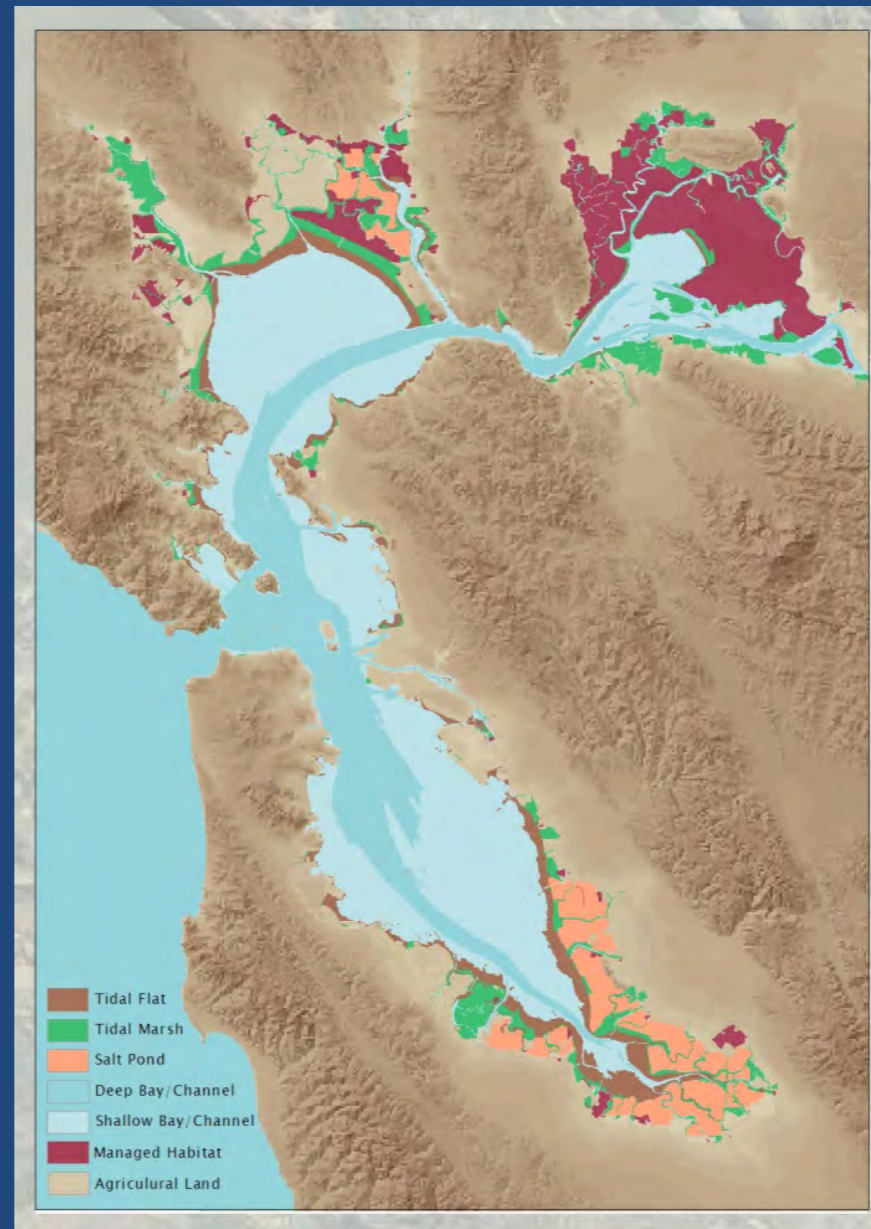
Alison Taggart-Barone

The

CHALLENGE



# Wetland Loss and Restoration



Past (~1850)

Present (~2000)

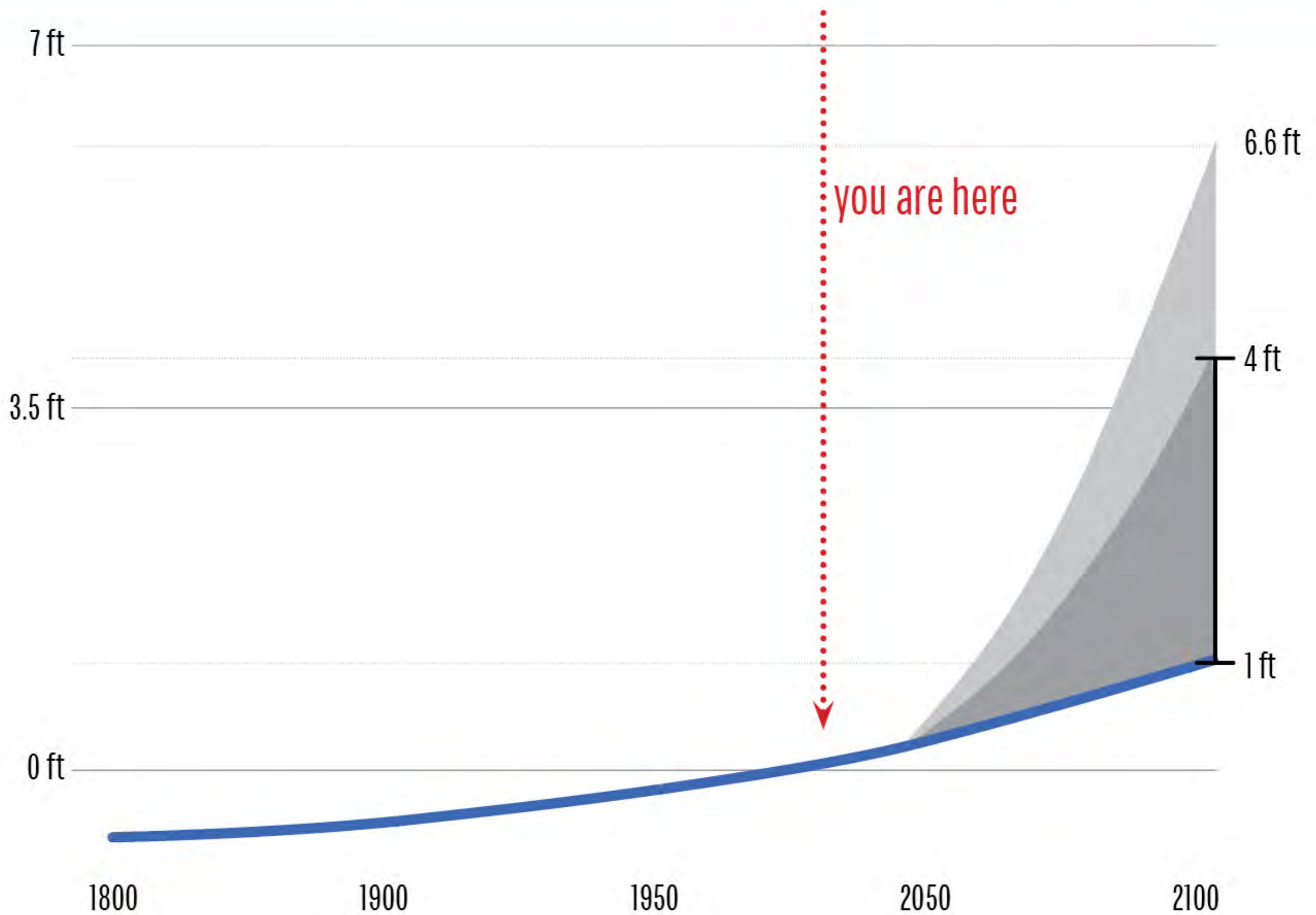
Future (~2030)







Russ Lowgren



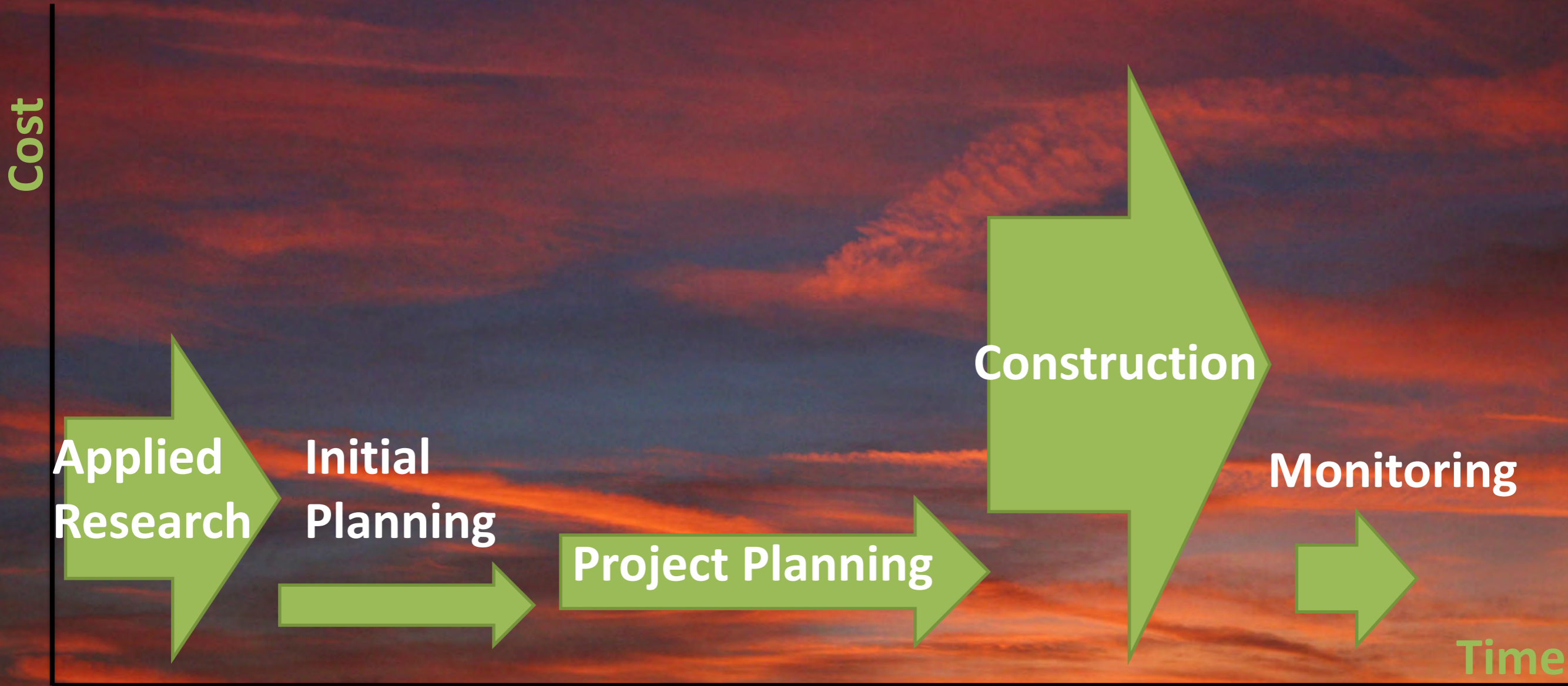




# Challenges for Natural Infrastructure Projects

- Science and Data Gaps
- Lack of Design Specs
- Cost & Maintenance
- Permit Challenges
- Physical Space Required





- Data Collection
- Modeling
- Tools

- Vulnerability Assessment
- Adaptation Plans
- Land Use Plans
  - LCPs
  - General Plans

- Feasibility Assessment
- Preliminary Design
- Environmental Impact Analysis
- Final Design/Engineering
- Permitting

- Bid/Contract
- Construction
- Compliance Monitoring

- Feeds into future research...and adaptive management

# The PLAN



THE  
*Baylands*  
AND  
*Climate Change*

WHAT WE CAN DO

BAYLANDS ECOSYSTEM HABITAT GOALS  
SCIENCE UPDATE 2015

- Science synthesis built on 1999 goals
- Goal: healthy ecosystem, providing resilient shore for people and wildlife

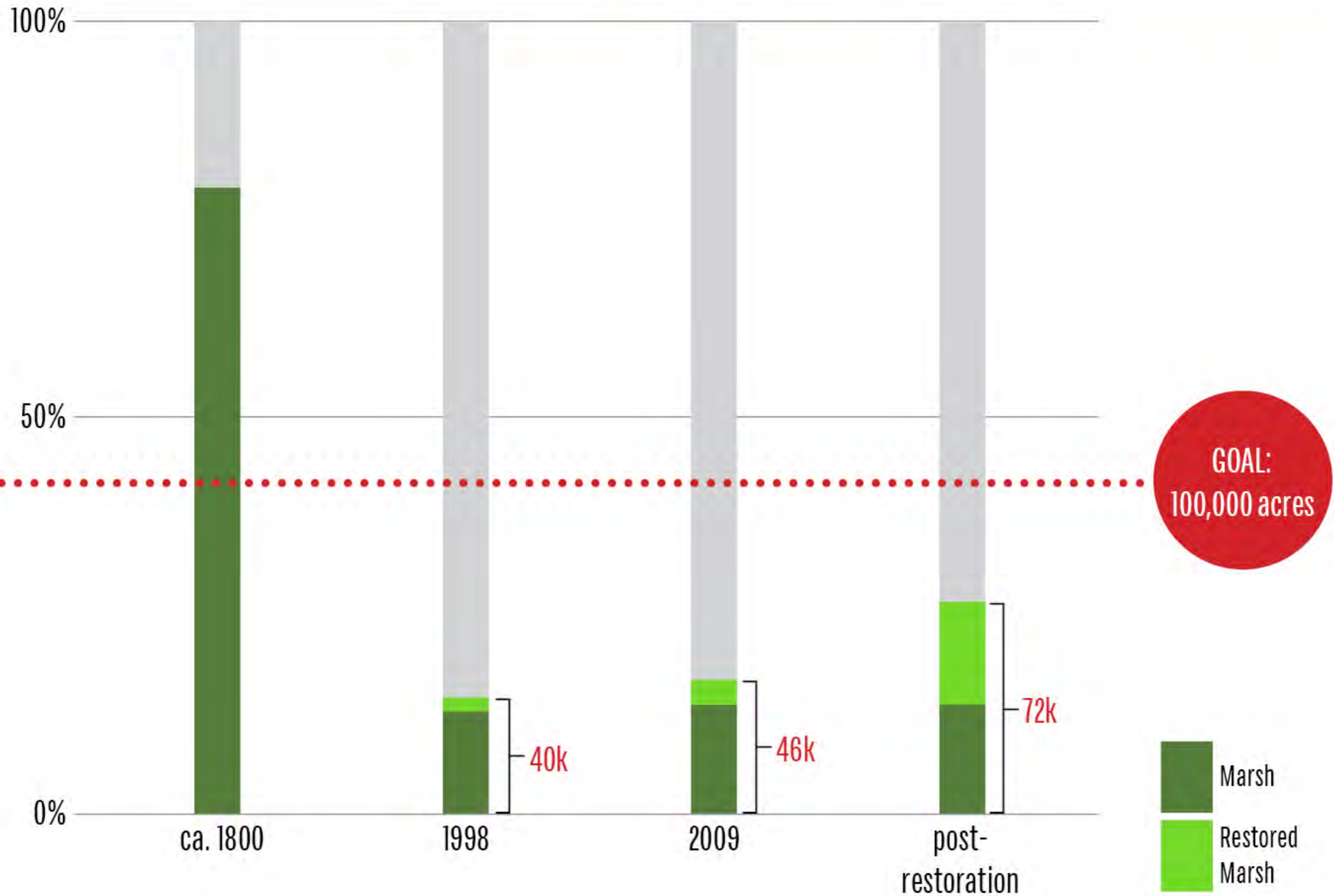
State of California

Coastal Conservancy



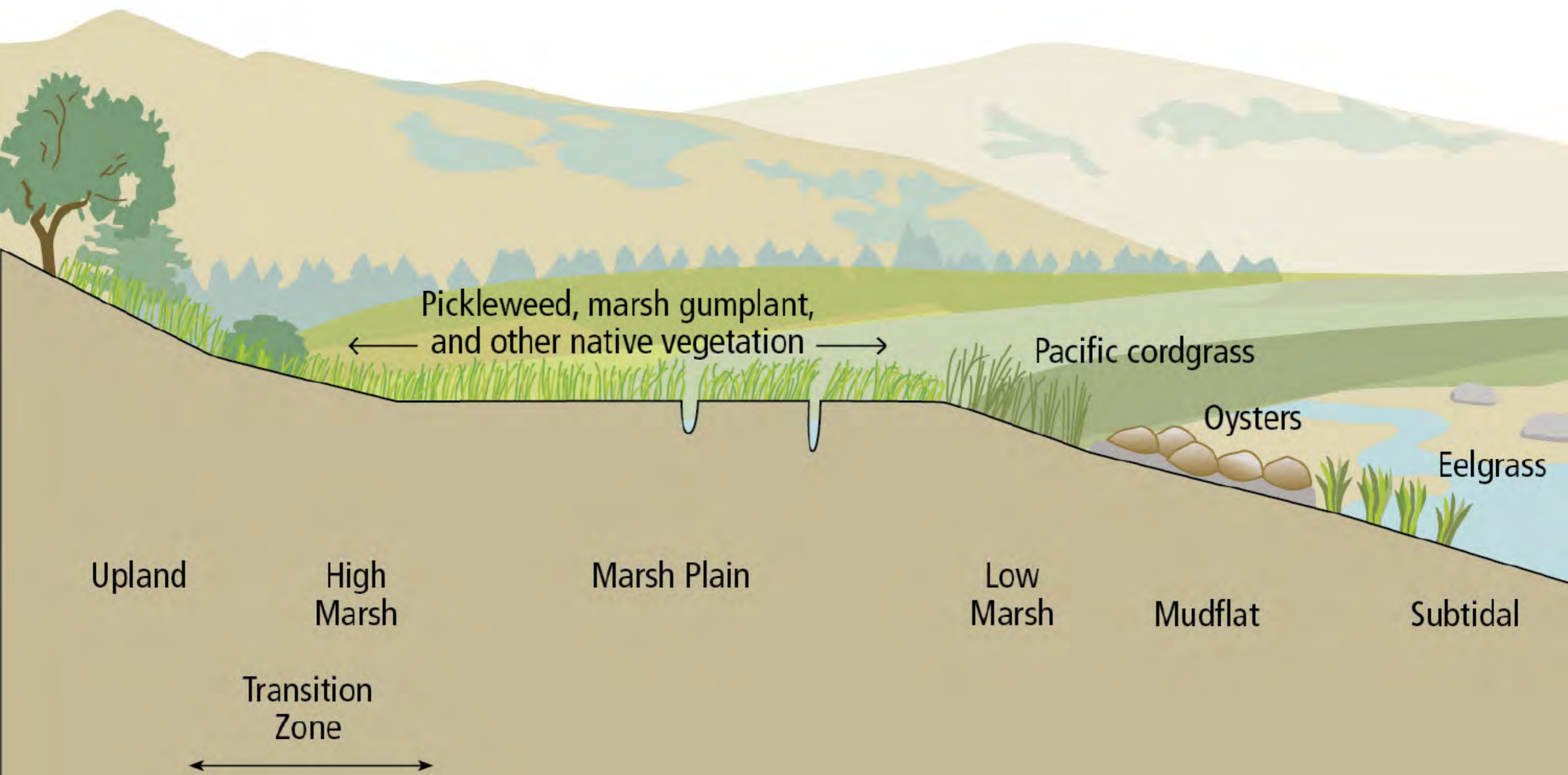
# TIDAL MARSH

# *restoration*





# Restore COMPLETE SYSTEMS



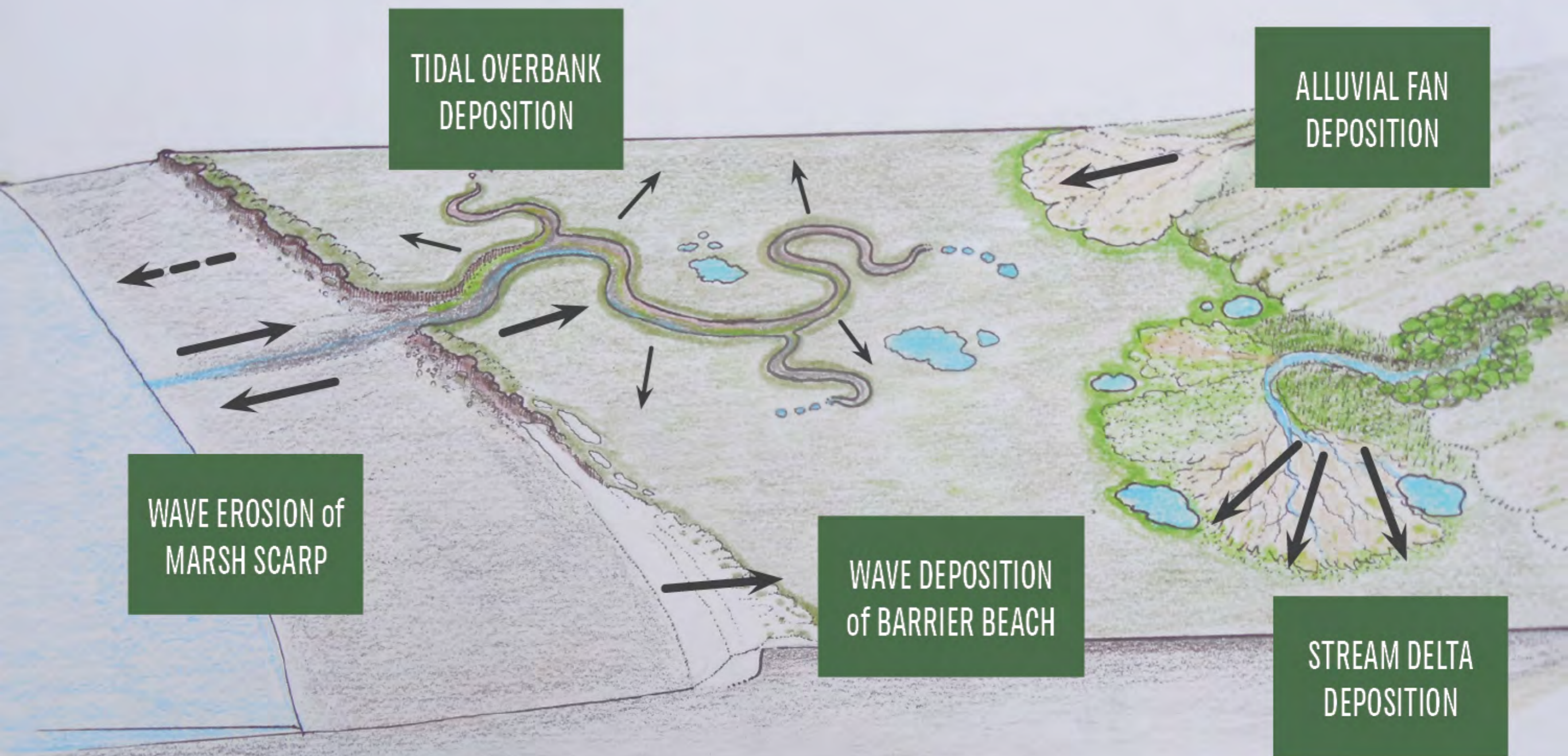


**MEANS  
RESTORING**

# PROCESSES

**NOT JUST  
PLACES**

COURTESY PETER BAYE





SEDIMENT  
ISA

*precious resource*





# PLAN FOR THE BAYLANDS TO *migrate*





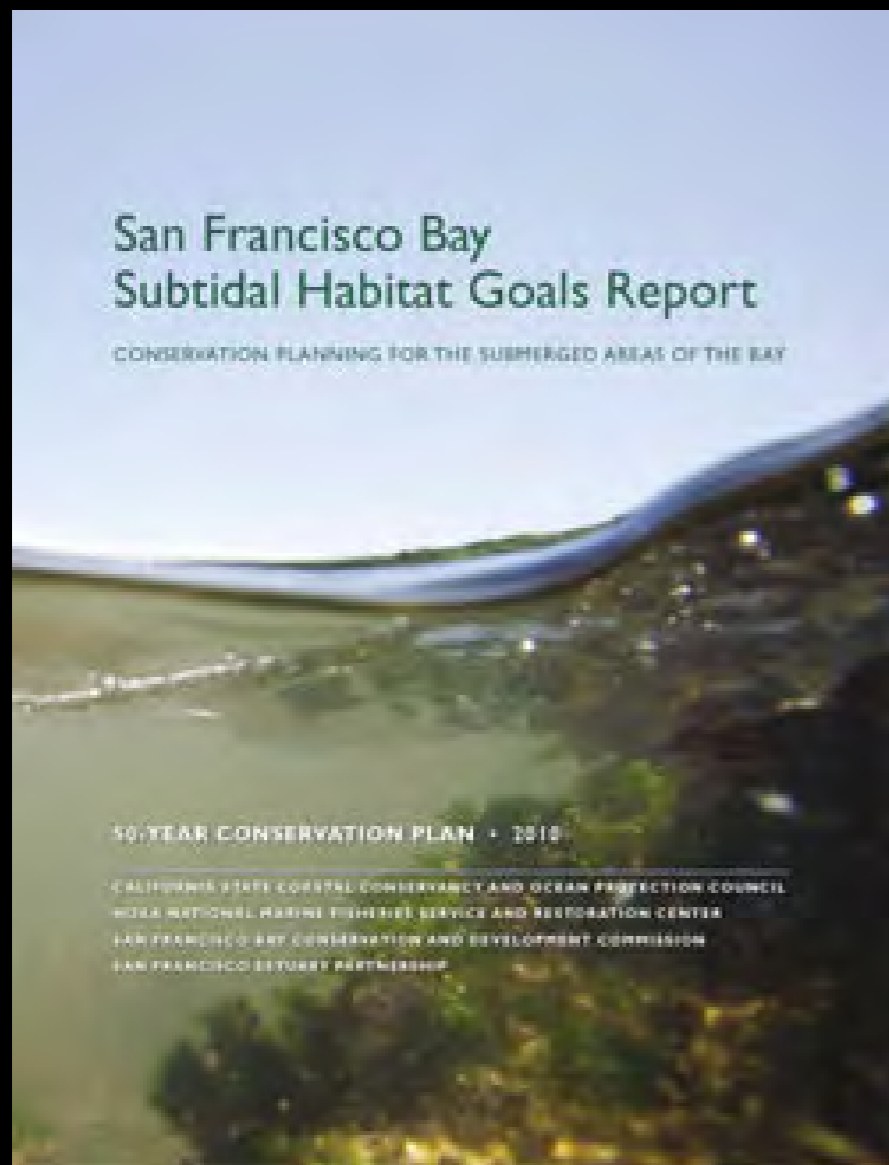
# PLAN FOR THE BAYLANDS TO *migrate*





# SF Bay Subtidal Habitat Goals

[www.sfbaysubtidal.org](http://www.sfbaysubtidal.org)



## San Francisco Bay Subtidal Habitat Goals Project

CONSERVATION PLANNING FOR THE SUBMERGED AREAS OF THE BAY

ABOUT REPORT HABITATS INTERACTIVE MAPS NEWS & UPDATES CONTACT

### SUBMERGED AQUATIC VEGETATION HABITAT DISTRIBUTION & STRESSORS

SAN FRANCISCO BAY Subtidal Habitat Goals Project

Map Satellite Hybrid Terrain

Map Gallery

Map Layers

- SUBMERGED AQUATIC VEGETATION**
  - Widgeon grass (*Ruppia maritima*)
  - Sago Pondweed (*Stuckenia pectinata*)
  - Eelgrass (*Zostera marina*)
- STRESSORS**
  - Commercial Fishing
  - Coastal Industry
  - Marina
  - Port / Wharf
  - Anchorage
  - Mooring / Warping Facility
  - Harbor Facility / Hulk Area
  - Dredge Area
  - Disposal of Dredged Sediment



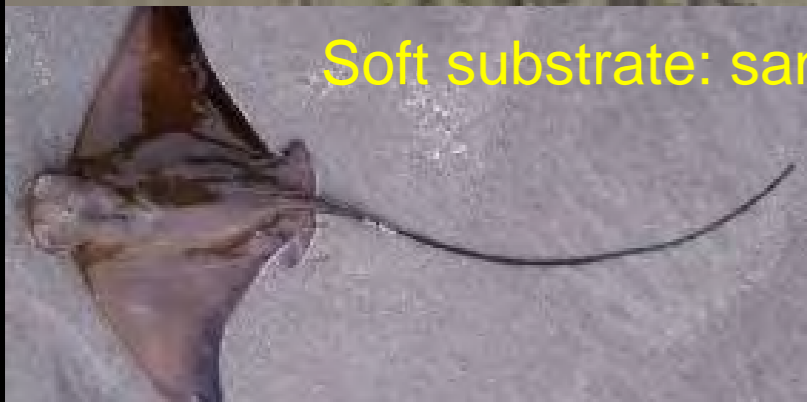
Submerged Aquatic Vegetation



Rock Habitats



Soft substrate: sand



Artificial Structures



Macroalgal Beds

Shellfish Beds



Soft Substrate: Mud/ shell mix





# Pilot Projects in San Francisco Bay

*(Oyster Reefs, Eelgrass Beds, Tidal Marsh, Upland Ecotone)*



**SF Bay Living Shorelines Project:  
Giant Marsh (oysters, eelgrass, tidal  
marsh, upland ecotone)**  
*(SCC, SF State, UC Davis, ESA, USGS, OEI)*

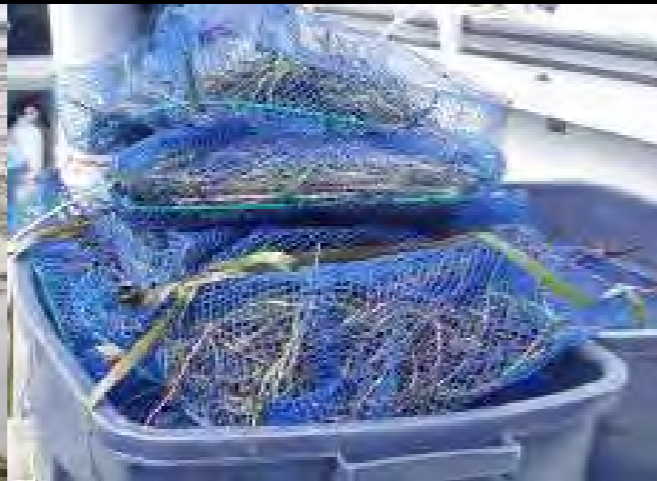
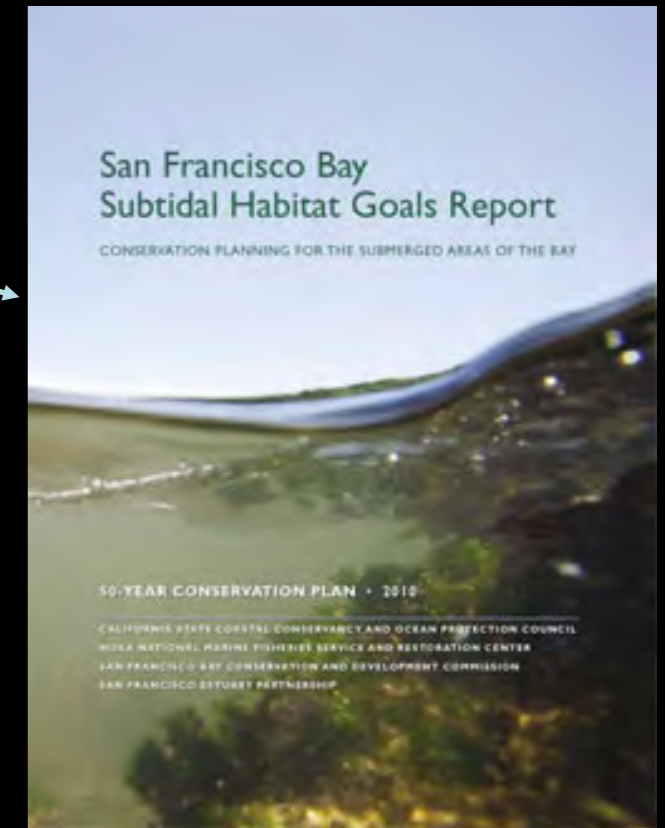
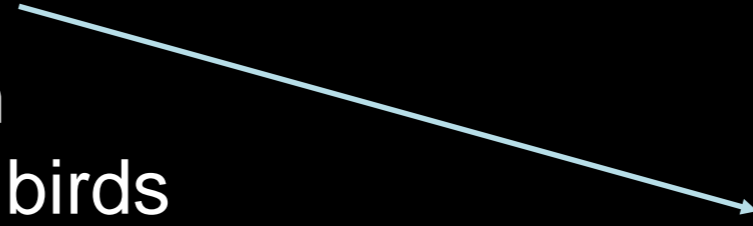
**SF Bay Living Shorelines Project: San Rafael  
(Olympia oysters, eelgrass)**  
*(SCC, SF State, UC Davis, ESA, USGS)*

**SF Bay Creosote Removal and Pacific  
Herring Restoration Project: Red  
Rocks (oysters, eelgrass, rockweed)**  
*(SCC, AECOM, Ducks Unlimited, Merkel)*



# Multiple habitats & objectives

- Link to Subtidal Habitat Goals
- Pilot scale, **experimental** approach
- Monitor use by invertebrates, fish, birds
- Assess **interactive effects** of oysters + eelgrass
- Evaluate **physical** benefits
- Pilot climate change adaptation
- Apply **lessons** learned to future projects



Photos, S. Kiriakopolos









# MARIN ADAPTATION FRAMEWORK PLANNING WITH NATURE

Julie Beagle, SFEI & Maya Hayden, Point Blue Conservation Science

Marin County SLR Adaptation Workshop

Mill Valley | March 21, 2019



Funding:



Marin  
Community  
Foundation







# Introduction

- Challenge of transitioning from vulnerability assessments to adaptation solutions
- Lots of interest in nature-based options, where are they appropriate?
- **Goal:** Develop a **framework process and set of tools** to support the transition from vulnerability assessment to adaptation strategies at a useful scale



**Sea level rise  
will not stop at  
city boundaries.**





# Addressing this challenge by:

- Dividing up the Bay into manageable units that respond to the **physical and ecological processes**
- Mapping **suitability** for **nature-based adaptation measures**
- **Evaluate tradeoffs** between the choices we need to make



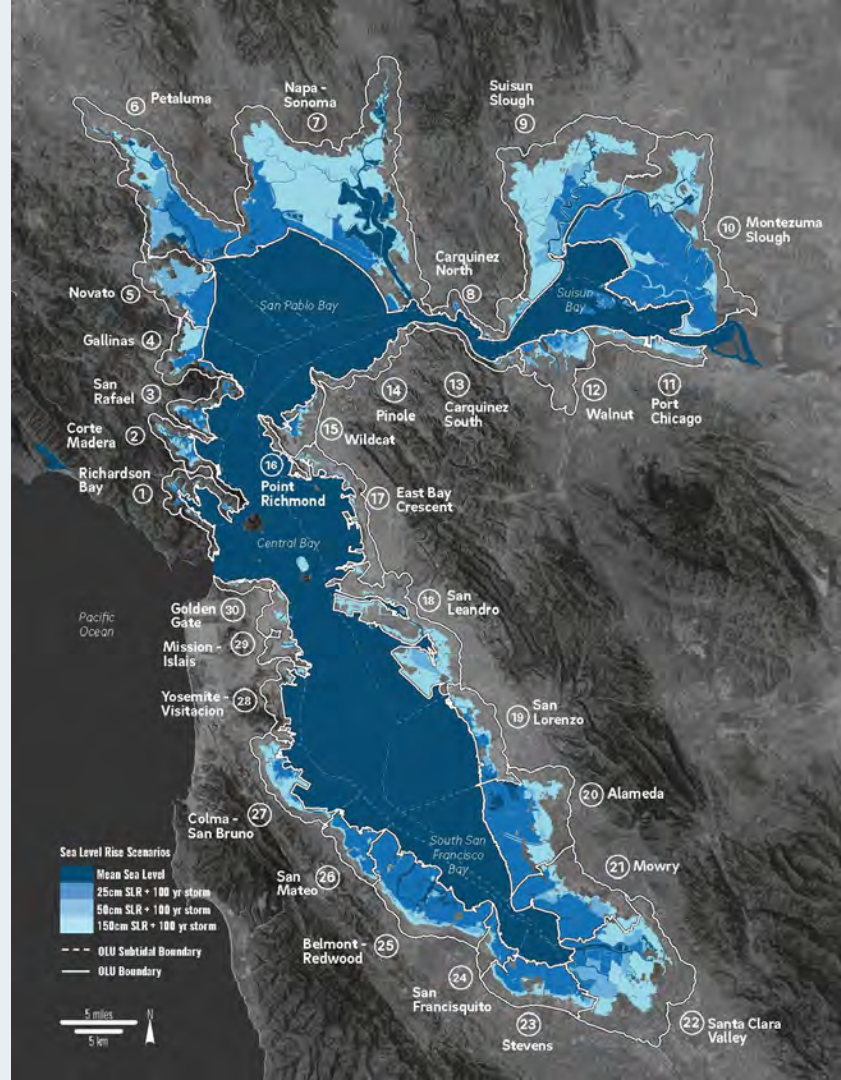


# What is a useful scale?

## Operational Landscape Units

Areas with shared geophysical and land use characteristics *suited for a particular suite of nature-based measures*

- *Bigger than a project*
- *Bigger than a City*
- *Smaller than a County*



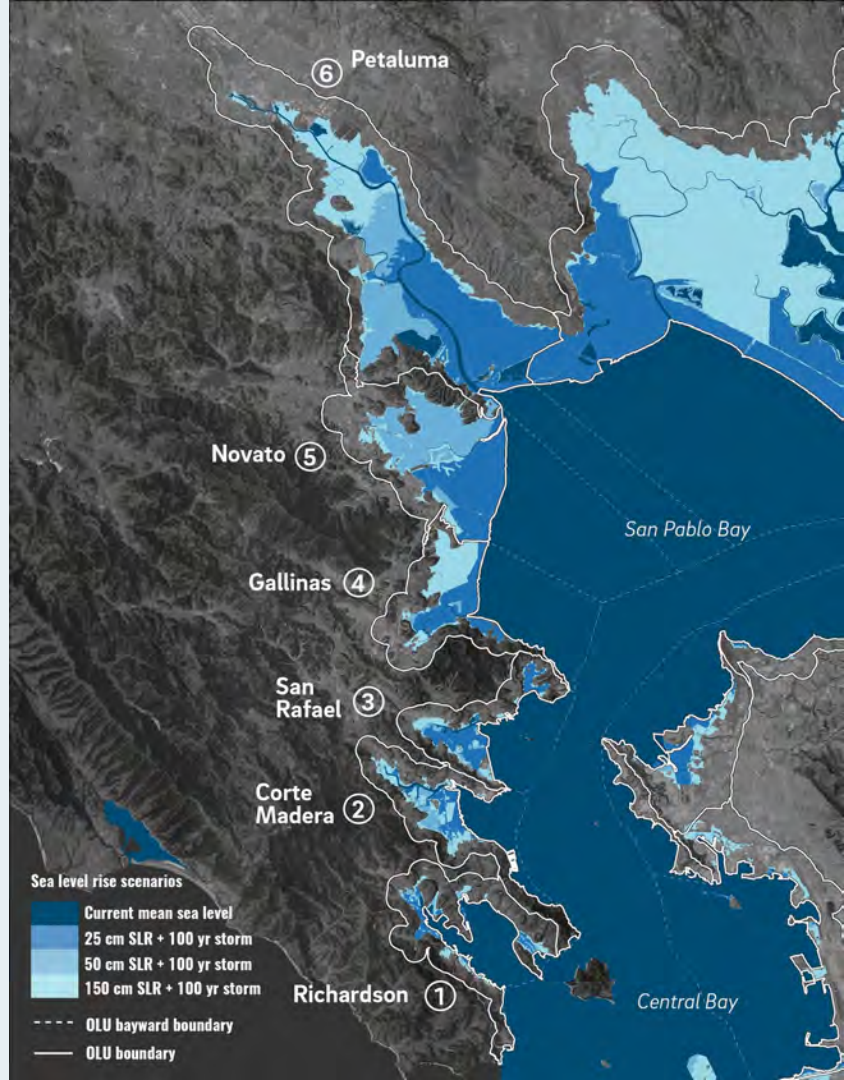


# What is a useful scale?

## Operational Landscape Units

Areas with shared geophysical and land use characteristics *suited for a particular suite of nature-based measures*

- *Bigger than a project*
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# FRAMEWORK

Planning within nature's boundaries

**STEP 1**

**Assess  
vulnerability**

*what assets are  
vulnerable & where;  
what is the source  
of vulnerability*

**STEP 2**

**Identify  
adaptation  
measures**

*that could work  
well in a given  
place and use  
nature as much  
as you can*

**STEP 3**

**Envision  
desired  
future(s)**

*what are desired  
outcomes?  
Develop  
visions/themes*

**STEP 4**

**Develop  
adaptation  
strategies**

*Strategy = a  
combination of  
“measures”;  
Develop for  
each desired  
future or theme*

**STEP 5**

**Evaluate  
and  
prioritize**

*assess benefits  
and tradeoffs  
among  
strategies*

# STEP 1

# Assess vulnerability

## NOVATO

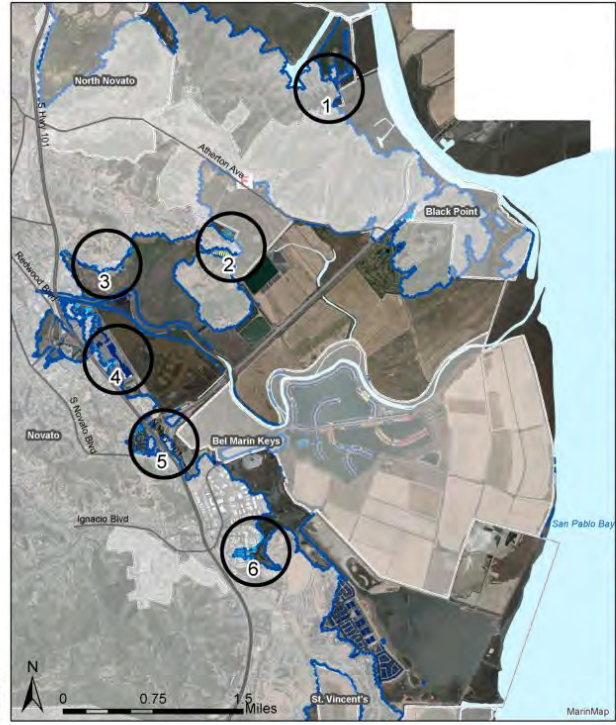
Map 107. Novato Vulnerable Buildings

### Vulnerable Assets

- F Fire Station
- Vulnerable Buildings**
- Scen. 1: 10" Sea Level Rise (SLR)
- Scen. 2: 10" SLR+Storm Surge
- Scen. 3: 20" Sea Level Rise
- Scen. 4: 20" SLR+Storm Surge
- Scen. 5: 60" Sea Level Rise
- Scen. 6: 60" SLR+Storm Surge

### Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



Disclaimer: Vulnerability Assessment maps, tables, etc. can be used as a resource to help identify potential hazardous areas and vulnerable assets. Marin County and data providers here in, make no warranties of the accuracy or completeness of maps and data. Maps are representational and subject to future revision. Local site conditions must be examined. Commercial use is prohibited.



Date: 3/30/2017





# STEP 1

## Assess vulnerability

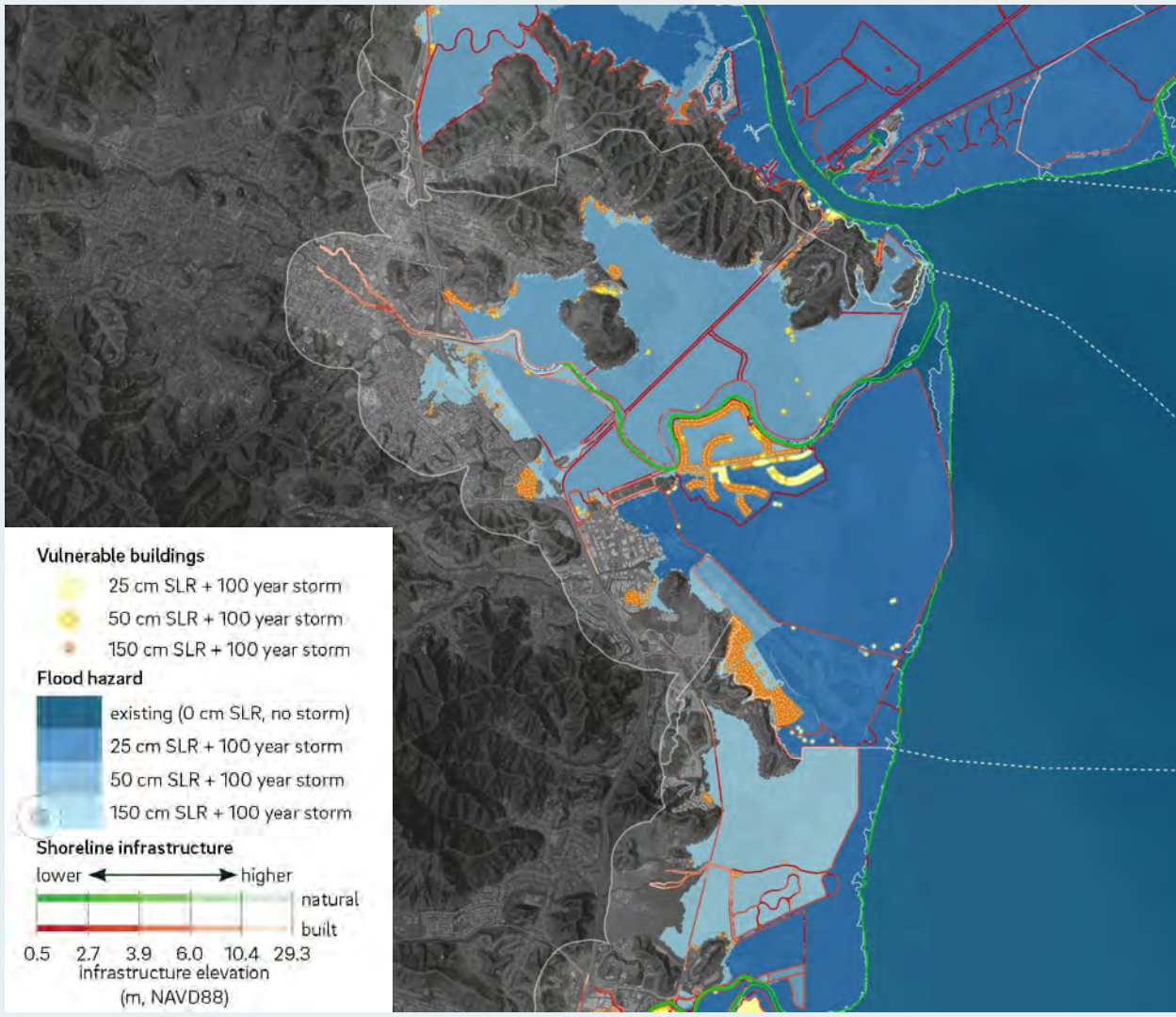
*(what assets are vulnerable & where; what is the source of vulnerability)*

### Sources of vulnerability

- Combined flooding
- Subsided lands behind levees
- Eroding shorelines
- Infrastructure

### Assets

- Less developed, in public ownership
- Topography, sediment



# STEP 2

# Identify adaptation measures

## Nature-based measures

- Nearshore reefs
- SAV (eelgrass)
- Beaches
- Tidal marsh
- Polder management
- Ecotone levees
- Migration space preparation
- Creek-to-bayland reconnections
- Green stormwater infrastructure



	Nearshore reefs	Submerged aquatic vegetation (eelgrass)	Beaches	Tidal marshes	Polder management	Ecotone levees	Migration space preparation
1. Richardson	●	●	●	◐	○	◐	○
2. Corte Madera	●	●	●	◐	◐	◐	◐
3. San Rafael	●	●	●	◐	◐	◐	○
4. Gallinas	◐	●	○	●	●	◐	●
5. Novato	○	○	○	●	●	◐	●
6. Petaluma	○	○	○	●	●	○	●





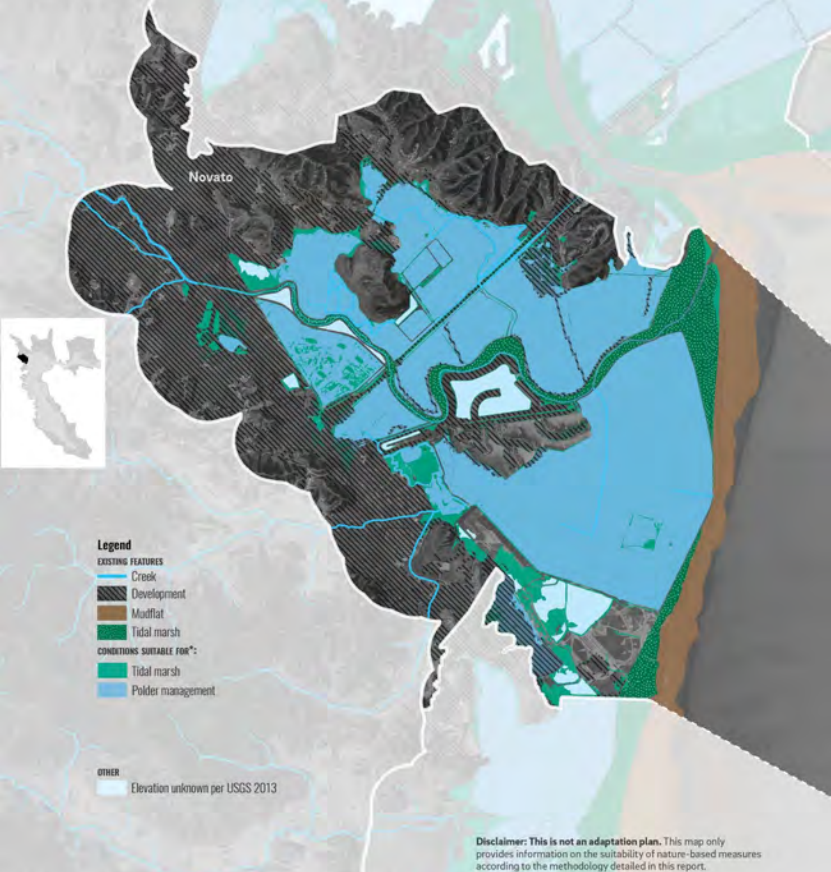
# Novato OLU: Suitable nature-based measures

- Tidal marsh



Breaching berms on land purchased by Marin Audubon in Novato to make way for tidal marsh  
(Photo by Chris Stewart)

draft



**Disclaimer:** This is not an adaptation plan. This map only provides information on the suitability of nature-based measures according to the methodology detailed in this report.

# Novato OLU: Suitable nature-based measures

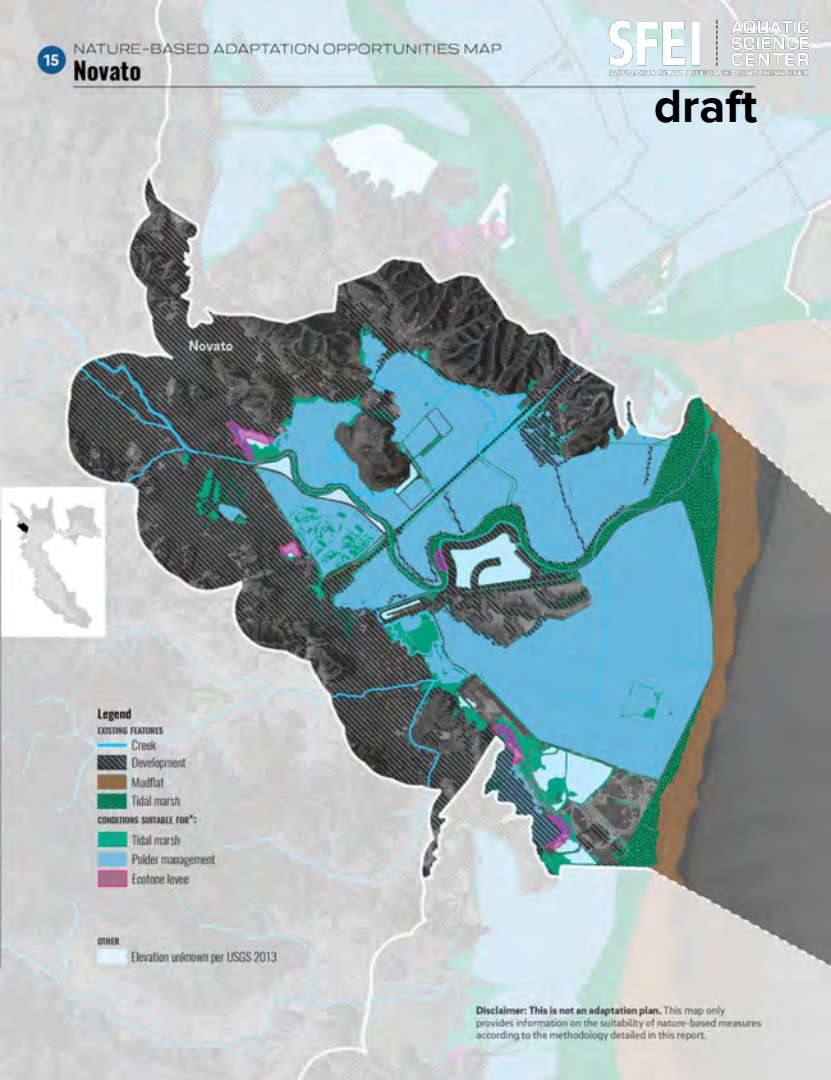
- Tidal marsh
- Polder management



A polder (the site of Hamilton Airfield) before and after being opened to tidal action. (Photo courtesy Google Earth)

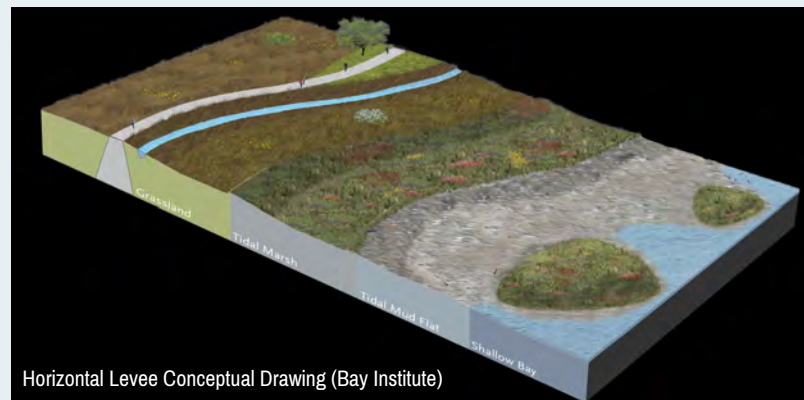


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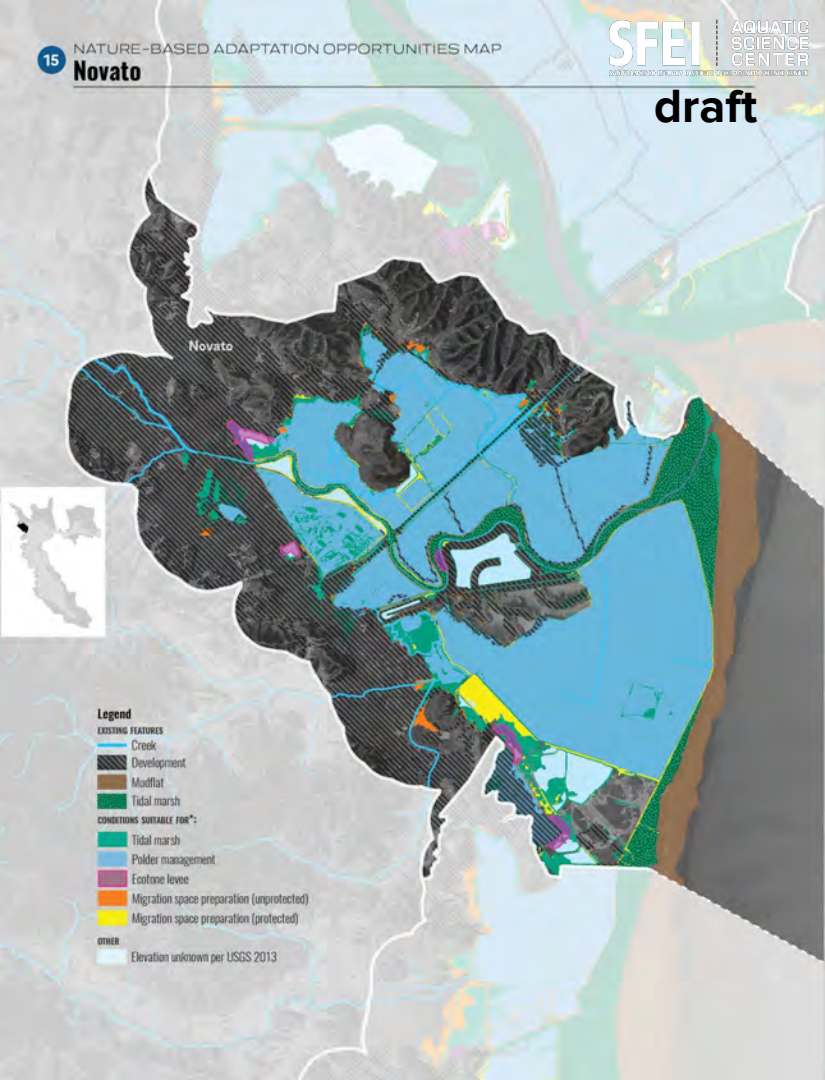


# Novato OLU: Suitable nature-based measures

- Tidal marsh
- Polder management
- Ecotone levee



Horizontal Levee Conceptual Drawing (Bay Institute)



# Novato OLU: Suitable nature-based measures

- Tidal marsh
- Polder management
- Ecotone levee
- Migration space preparation (unprotected and protected)

	Selected Measures	Suitability			
NATURE-BASED	Nearshore reefs	○			
	Submerged aquatic vegetation	○			
	Beaches	○			
	Tidal marshes	●			
	Polder management	●			
	Ecotone levees	◐			
	Migration space preparation	●			
-----					
○	Limited suitability	◐	Some suitability	●	High suitability



## STEP 3

# Envision desired futures

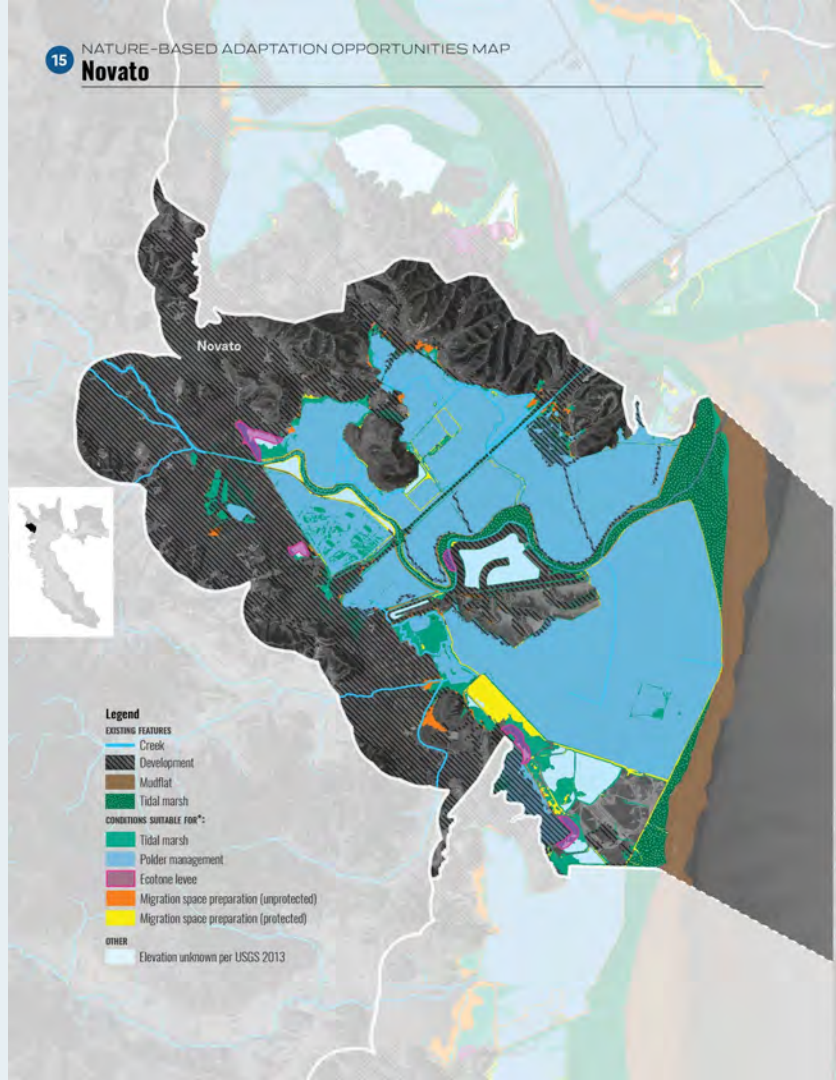
*(What are desired outcomes? Articulate visions/themes for the future)*

- **A “strategy” combines adaptation measures within an OLU**
- **A distinguishing goal/theme and criteria are needed to develop strategies**
- **Strategy themes should be developed with stakeholders**

# STEP 3

## Example Theme #1 “Hold the line”

- Build up existing defenses
- Employ nature-based adaptation options bayward of existing first line of defense





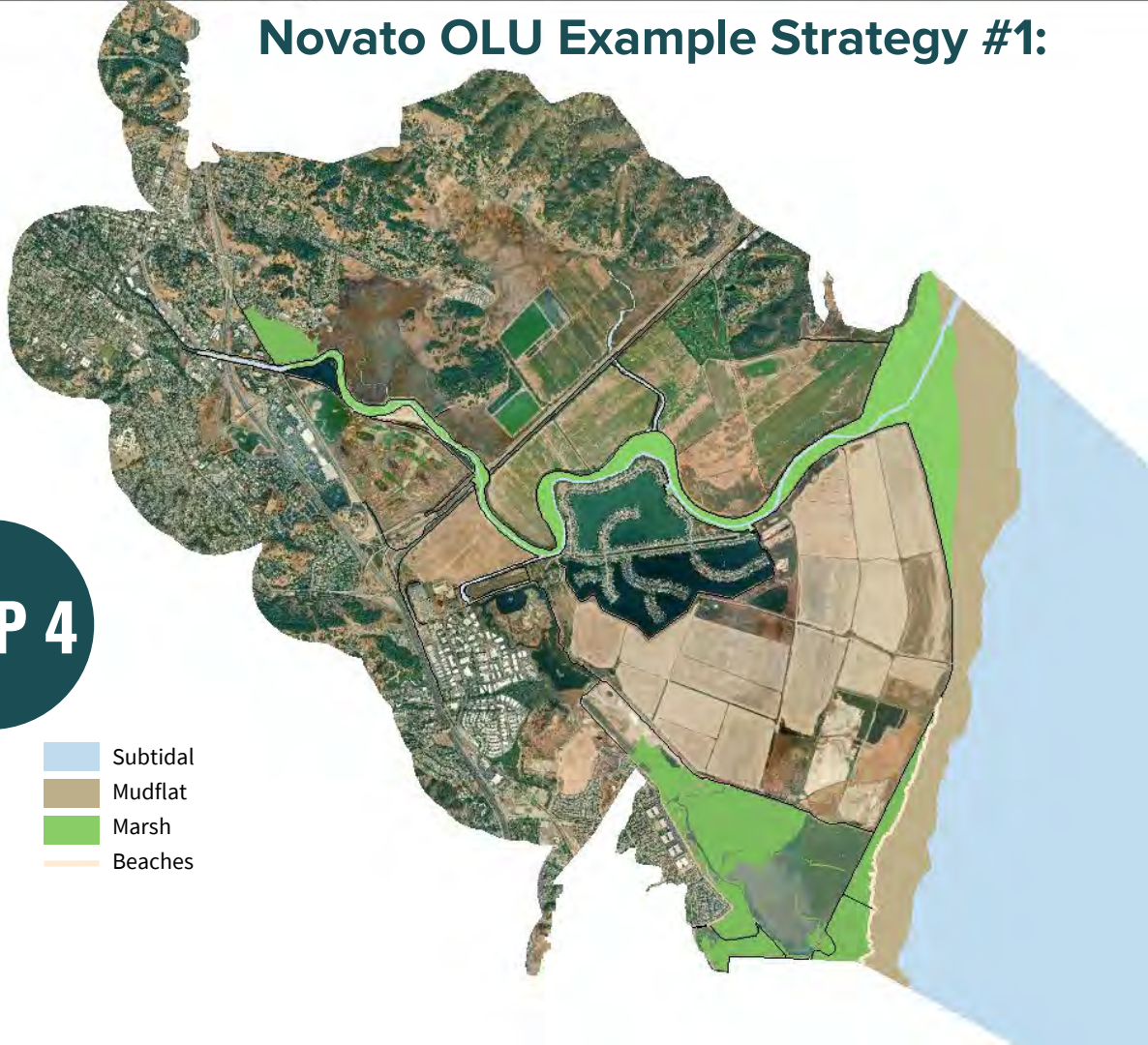
## STEP 3

### Example Theme #1 “Hold the line”

- Build up existing defenses
- Employ nature-based adaptation options bayward of existing first line of defense

## Novato OLU Example Strategy #1:

## STEP 4

- 
- The map displays the coastal area of Novato, California, with various land use zones highlighted. A legend in the bottom left corner identifies four categories: Subtidal (light blue), Mudflat (tan), Marsh (green), and Beaches (orange). The map shows a mix of urban development, agricultural fields, and natural coastal features. A prominent green marsh area is visible along the coast, and a large tan mudflat area is situated inland. The ocean is shown in light blue on the right side of the map.
- Subtidal
  - Mudflat
  - Marsh
  - Beaches

# STEP 3

## Example

## Theme #2:

## “Buffer w/ public open space”

- Existing people and infrastructure remain protected in place
- Retreat first line of defense only on public open space
- Retreat allows more space for additional nature-based options

Marin Adaptation Framework Project

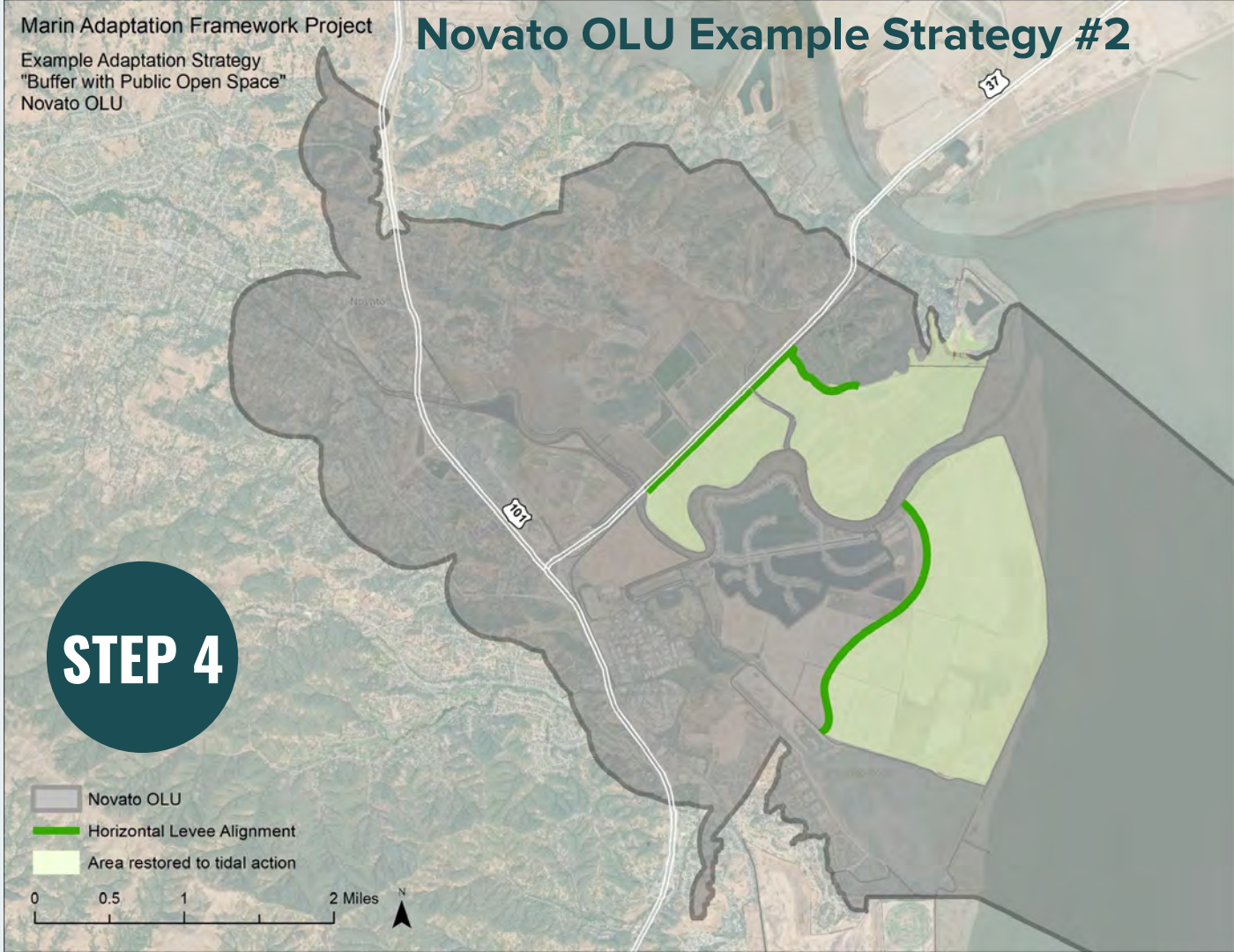
Example Adaptation Strategy  
“Buffer with Public Open Space”  
Novato OLU

# Novato OLU Example Strategy #2

# STEP 4

- Novato OLU
- Horizontal Levee Alignment
- Area restored to tidal action

0 0.5 1 2 Miles





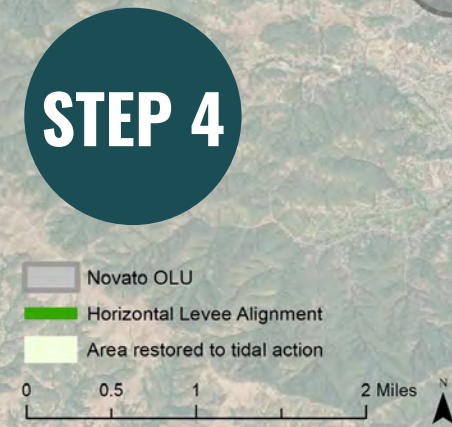
## STEP 3

### Example Theme #3: “Maximize habitat”

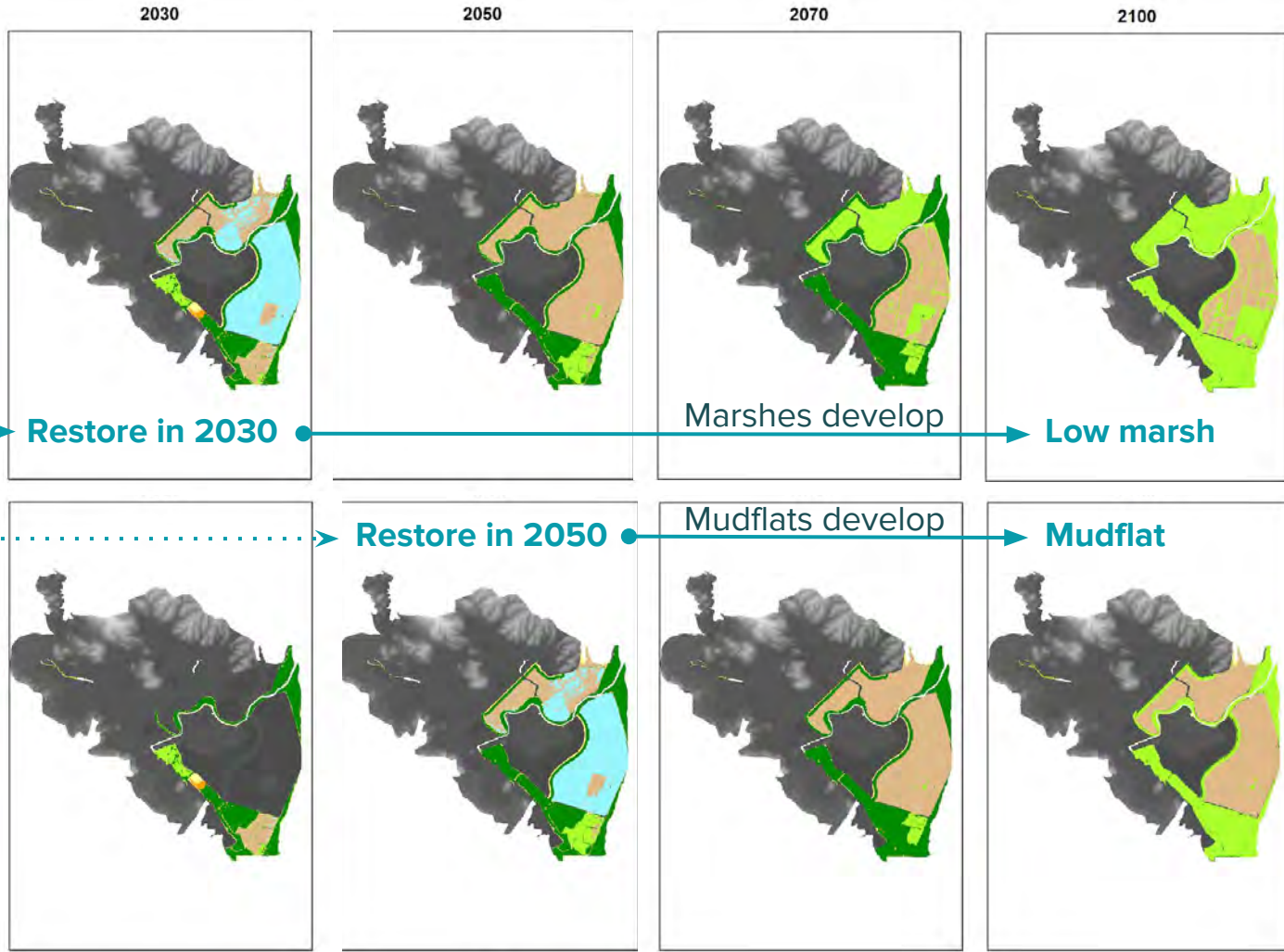
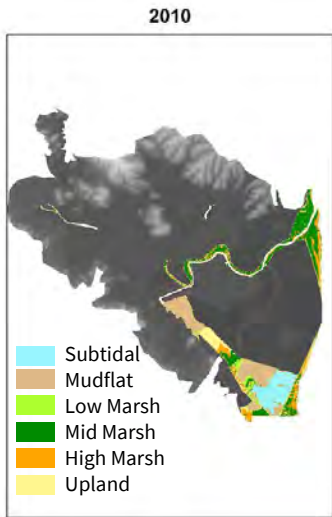
- Maximize opportunities for habitat enhancement
- Existing people/homes remain in place
- Key infrastructure may need to be re-aligned/ re-designed

Marin Adaptation Framework Project  
Example Adaptation Strategy  
“Maximize Habitat”  
Novato OLU

## Novato OLU Example Strategy #3



# Timing Matters



How might objectives change with SLR?



# STEP 5

## Evaluate and Prioritize Strategies

- Identify benefits / services important to stakeholders
- Identify “benefit-relevant indicators” that can be measured (quantitative or qualitative)
- Assess tradeoffs among strategies

### Cost Considerations

Low cost construction/maintenance  
Ease of permitting  
Political/community acceptability

### Regulating Services

Coastal hazard reduction  
Carbon sequestration and storage  
Water filtration (improved water quality)

### Supporting Services

Biodiversity support (habitat, species)  
Nutrient cycling

### Cultural/Social Services

Recreation  
Education  
Aesthetic  
Spiritual/Sense of place  
Services to disadvantaged communities/  
vulnerable populations

### Provisioning Services

Food (e.g., sportfish)  
Raw materials

### Examples of indicators

- Amount of fill needed
- Distance of existing shoreline protection to be raised/maintained
- Area of vegetated marsh habitat projected in Year 2050
- Total miles of trails
  
- Indicators defined by the community

NOTE: only need to quantify benefits that differ among strategies. For example, if coastal hazard reduction is equivalent across strategies (inherent in the designs)

# STEP 5

## Evaluate and Prioritize Strategies



- Higher values mean “more benefit”
- **Compare total benefits** of strategies, while still **seeing the tradeoffs**
- Can **weight** certain benefits more than others
- Supports an **informed choice**
- May lead to developing **alternative strategies**





# Lessons Learned

- There is **no one-size-fits-all approach** for SLR adaptation
  - Some places there are a lot of options for nature-based measures and some places there aren't.
- **Options change with SLR.** Developing pathways is important. **Timing matters.**
- Needs to be done with and led by **stakeholders and communities**



# Next Steps

- Developing **“User’s Guide”** of the framework with case study examples
- **Initial feedback** via existing planning process
- **Piloting approach in partnership** with the County



# THANK YOU

Funded by:



Contact: [mhayden@pointblue.org](mailto:mhayden@pointblue.org) AND [julieb@sfei.org](mailto:julieb@sfei.org)

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**Marilyn Latta, Kelly Malinowski, COASTAL CONSERVANCY**

Baywide OLU project:  
[sfei.org/projects/OLUs](https://sfei.org/projects/OLUs)

