

# San Francisco Estuary Institute

- 1986: Precursor founded as the Aquatic Habitat Institute
  - Pollutants and pollution effects in the Estuary
- 1993: Transformed into the San Francisco Estuary Institute
  - More comprehensive approach to the health of the Estuary

# San Francisco Estuary Institute



## Vision:

We envision resilient ecosystems where people and wildlife thrive.

## Mission:

We deliver visionary science that empowers people to revitalize nature in our communities.

# San Francisco Estuary Institute

- Clean Water
- Environmental Informatics
- Resilient Landscapes

# San Francisco Estuary Institute

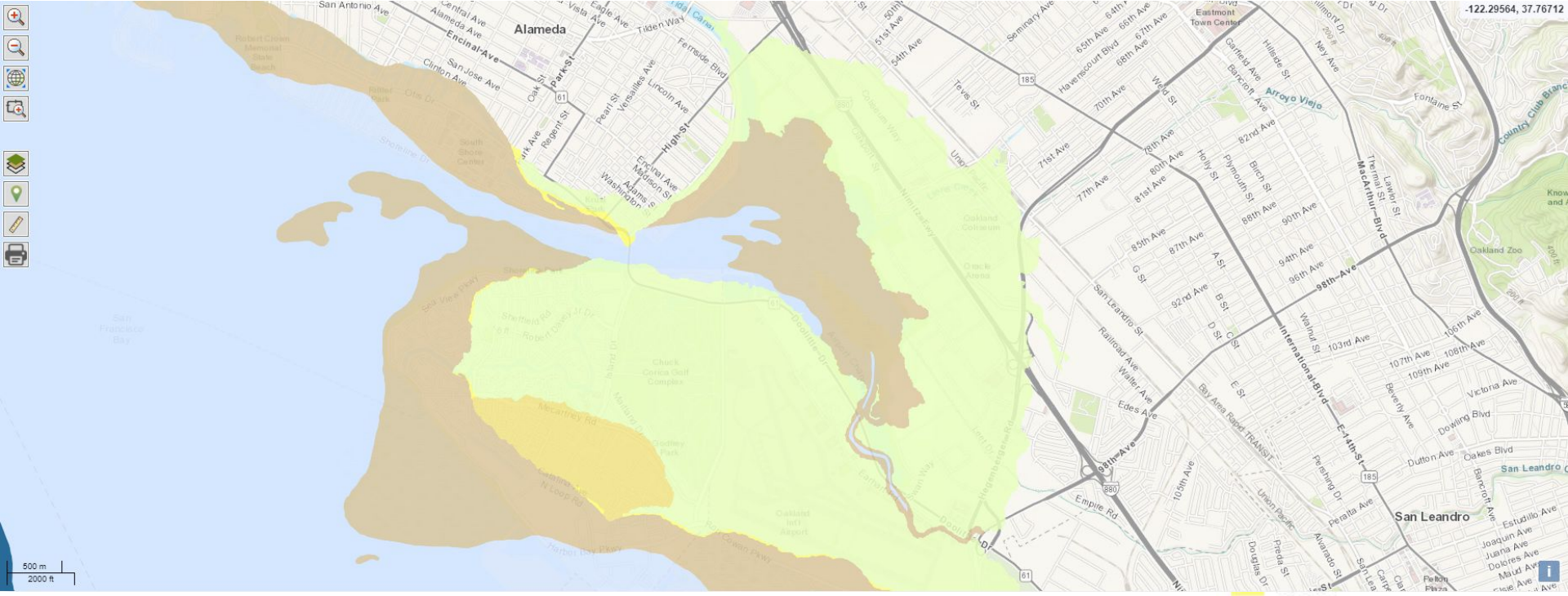
## Resilient Landscapes: Our Vision

- **Healthy ecosystems** supporting people and nature across the landscape: along the shoreline, in cities, in agricultural areas, and in open space.
- **Natural infrastructure** equips urban areas and their surrounding landscapes to better manage sea-level rise, water supply challenges, higher temperatures, water pollution, more severe drought and flooding, and other climate-related threats.
- **Green space** in developed areas improves the **health and quality of life** for all residents and for native wildlife

# SFEI Shoreline Tools & Data

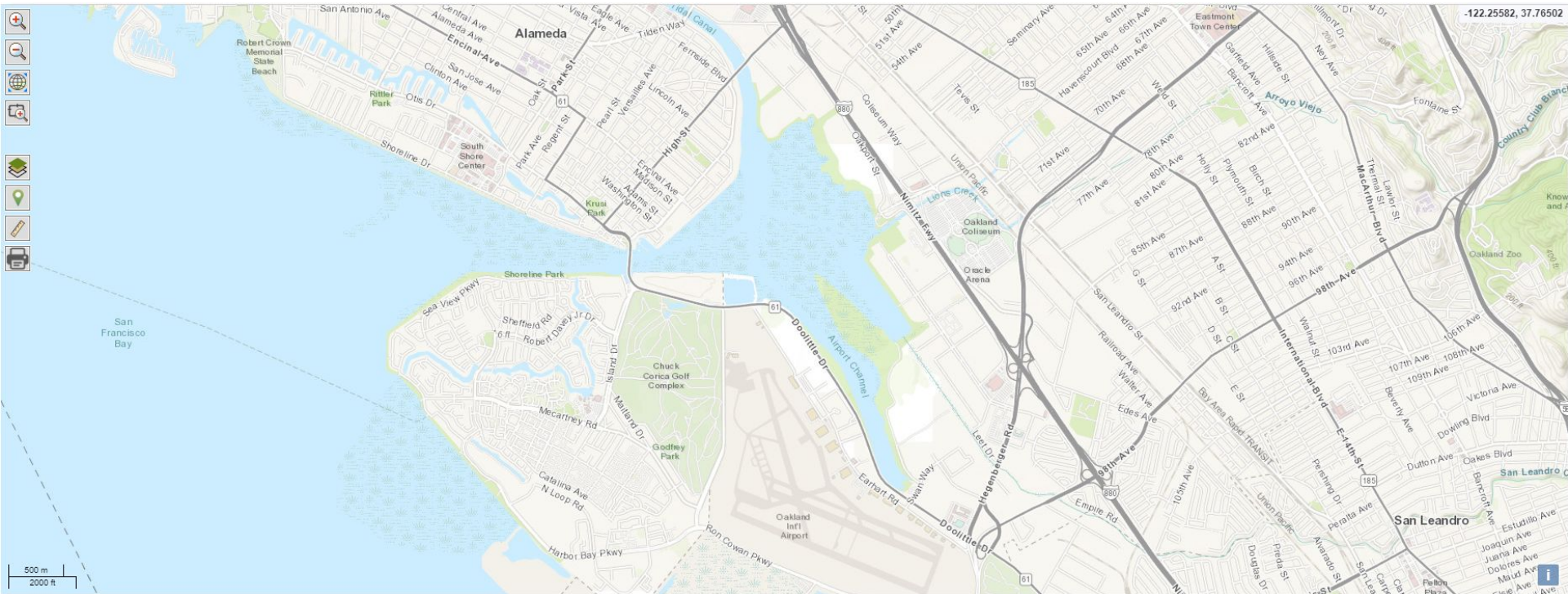
- Historical Ecology
- Modern Ecology
- Bay Shore Inventory
- Baylands Goals
- Adaptation Atlas

# Historical Ecology



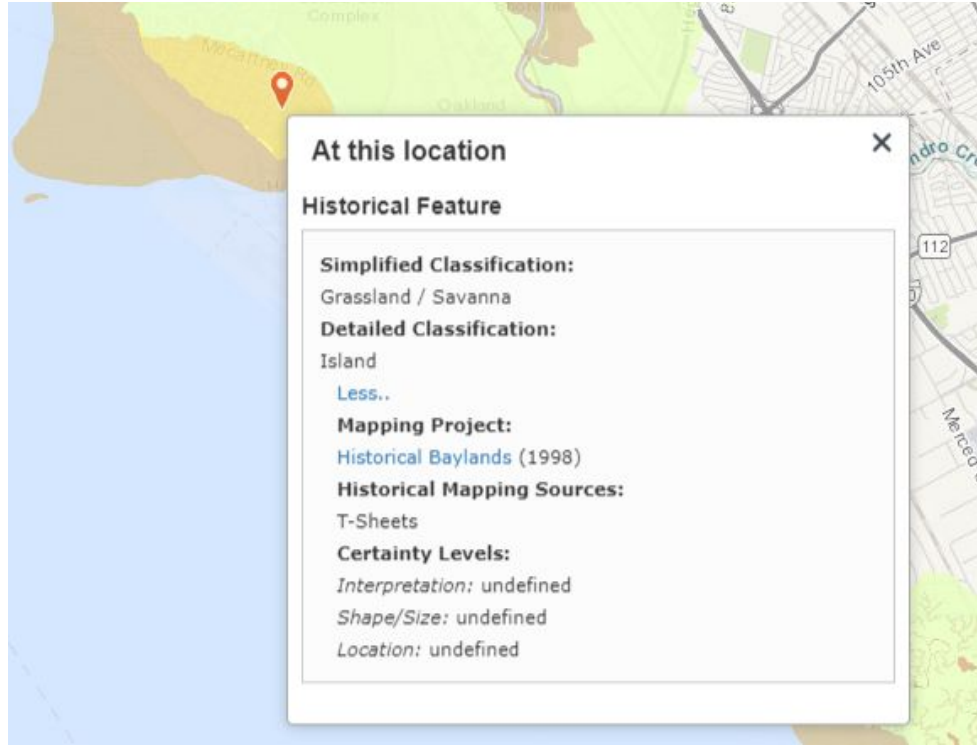
<https://www.ecoatlas.org/>





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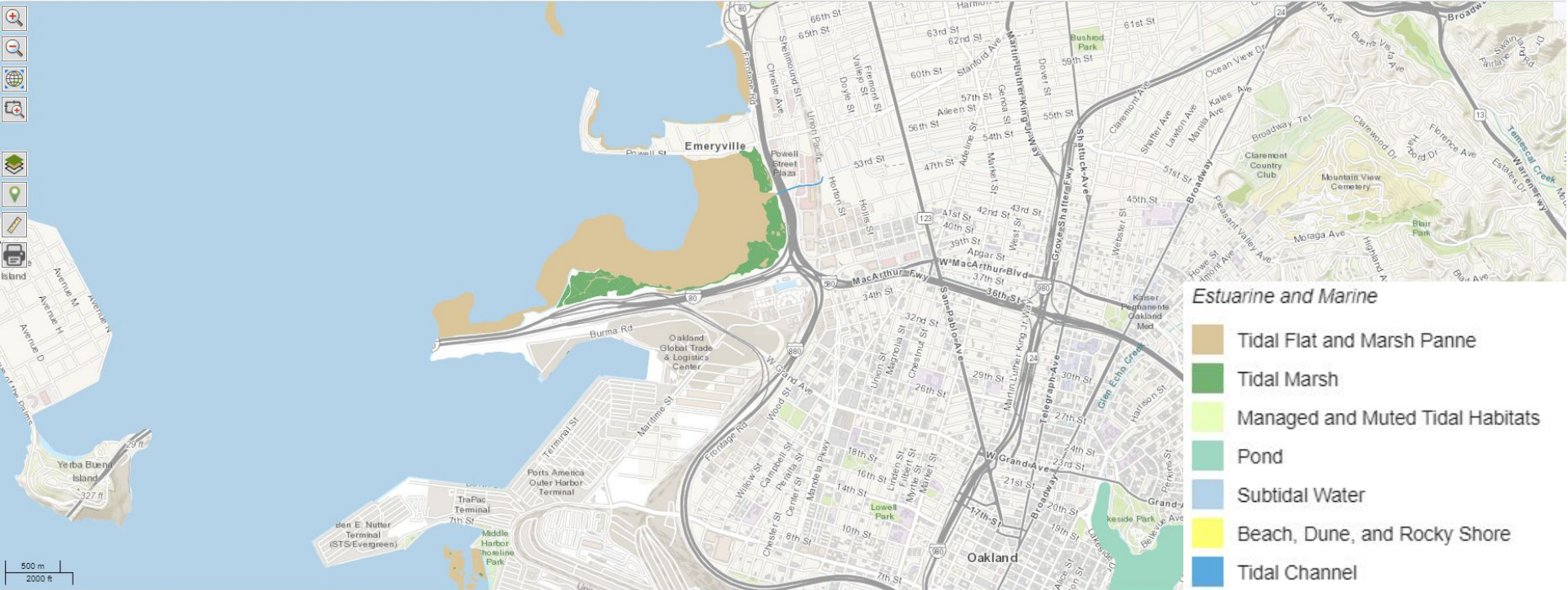
# Historical Ecology



<https://www.ecoatlas.org/>

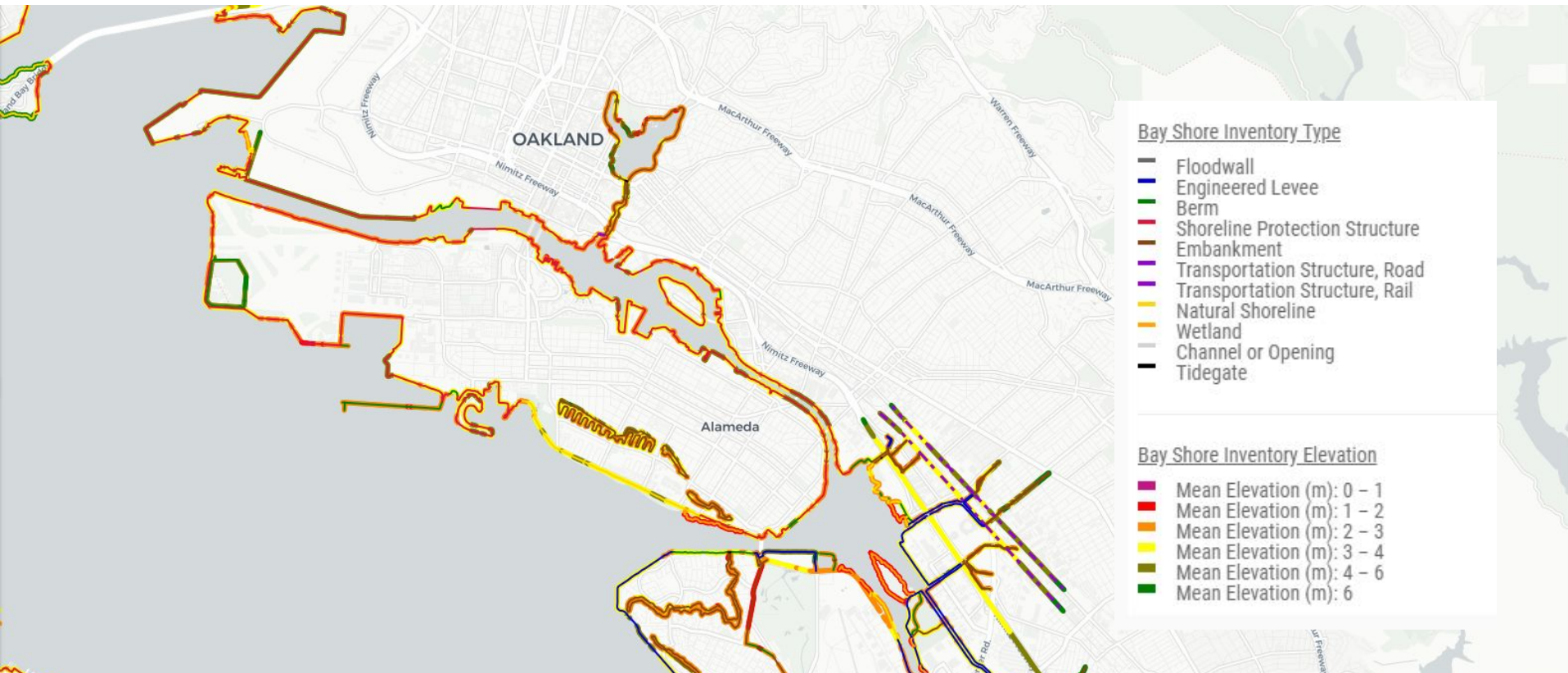


# Modern Ecology



<https://www.ecoatlas.org/>

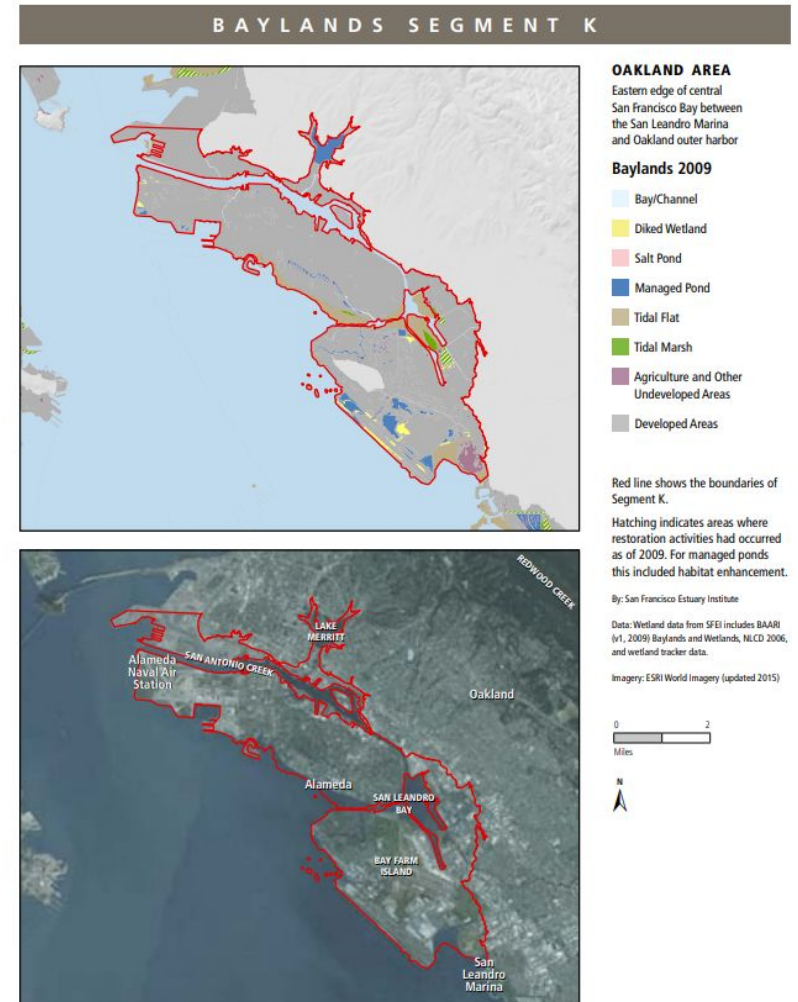
# Bay Shore Inventory



# Baylands Goals

- Recommended actions for each segment of the Bay shoreline
- Specifics for particular wildlife populations
- Challenges and opportunities

<https://www.sfei.org/projects/baylandsgoals>

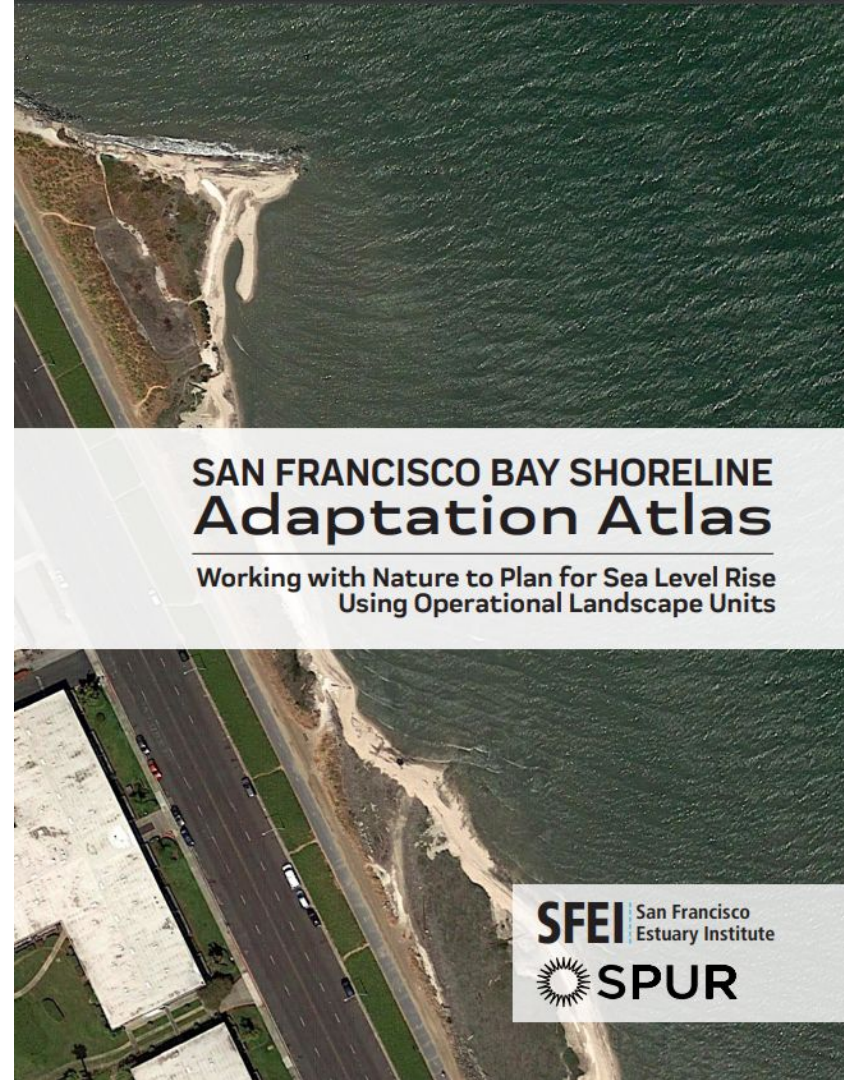




# Adaptation Atlas

- [Storymap](#)
- [Interactive map](#)

<https://www.sfei.org/adaptationatlas>



# What is nature-based adaptation?

Actions that **harness biodiversity and ecosystem services** to **reduce vulnerability** and **build resilience** to climate change.



Eelgrass



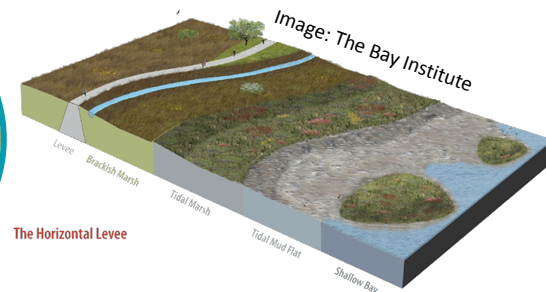
Oysters



Mudflats



Marshes



Ecotone levee  
(marsh + levee)

Range from fully natural → Hybrid (natural + engineered)

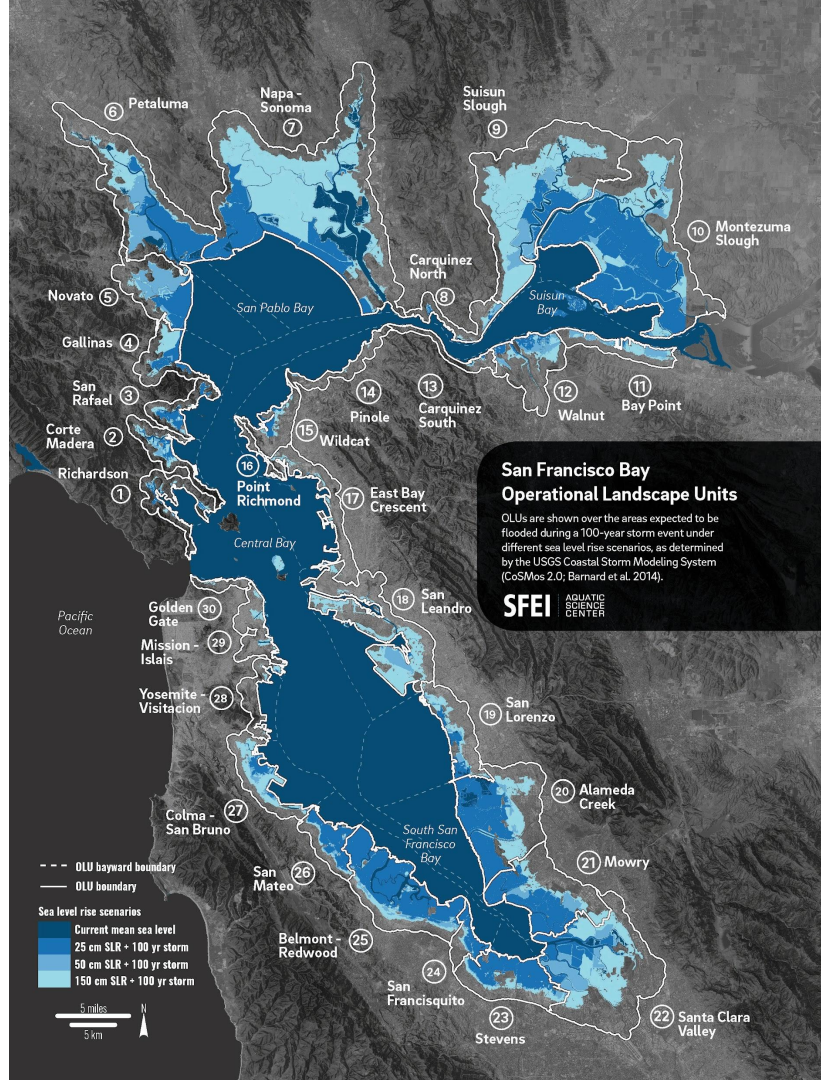
# Nature's Boundaries

## 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**

SFEI



# Adaptation measures

## Nature-based measures

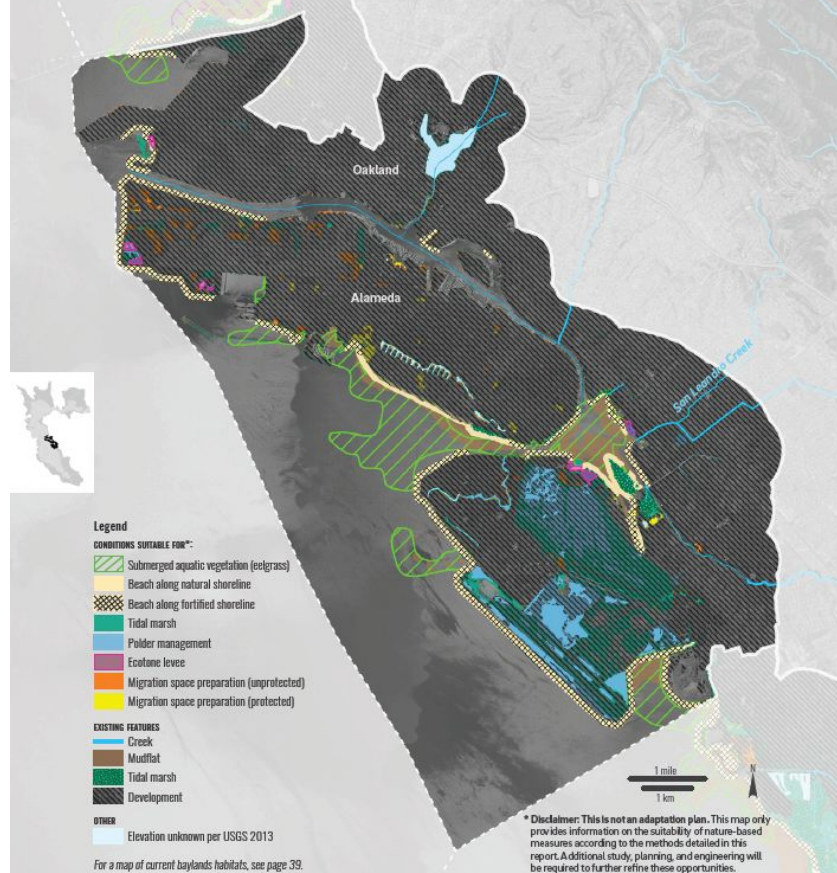
- Nearshore reefs
- Submerged aquatic vegetation (eelgrass)
- Beaches (sand, cobble, shell)
- Tidal marshes
- Polder management
- Ecotone levees
- Migration space preparation
- Creek-to-bayland reconnections
- Green stormwater infrastructure

## Regulatory, financial, policy tools

- Zoning and overlay zones
- Setbacks, buffers, and clustering
- Building codes and building retrofits
- Rebuilding and redevelopment restrictions
- Conservation easements
- Tax incentives and special assessments
- Geologic Hazard Abatement District
- Transfer of Development Rights
- Buyouts



## San Leandro



## SAN LEANDRO

## Nature-based Adaptation Measures

San Leandro is a highly urbanized, densely settled, mixed-use OLU including the Port of Oakland, the islands of Alameda and Bay Farm, the Oakland Coliseum, and Oakland Airport. There is very little open space, and the significant opportunities for natural and nature-based strategies are on the shoreline or in the subtidal areas, particularly around San Leandro Bay. Eelgrass beds and other submerged aquatic vegetation are suitable and could help increase ecosystem services and attenuate wave energy. Coarse beaches which can buffer wave energy and soften shorelines for habitat and recreation may be suitable when combined with stabilizing groins and nourishment. Management of these beaches would have to take into account the significant longshore transport of material into the Bay and nearshore areas. Parts of Alameda and Bay Farm islands are polders and will need to be managed accordingly. There are some limited opportunities for reconnecting creeks to San Leandro Bay and Lake Merritt, which could help manage combined flooding. Green stormwater infrastructure could be implemented in the upper watershed to reduce fluvial flooding in the developed areas. There is little room for ecotone levees adjacent to existing marshes, though in particular locations, and following the realignment of levees, they may be more appropriate. Though small, the San Leandro OLU has significant but isolated habitat patches, such as Arrowhead Marsh and the restored marsh at Martin Luther King Jr. Regional Shoreline, both of which provide critical habitat to endangered species.

(right) Aerial view of Coast Guard Island and Inner Harbor in Alameda (Photo by Craig Howell, CC BY 2.0)

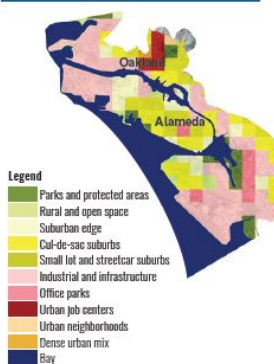
## Other Adaptation Opportunities

The San Leandro OLU has a significant amount of low- to moderate-density residential suburbs, and quite a lot of industrial land—much of it overlying fill that is subject to liquefaction and rising groundwater levels. Home to downtown Oakland, this OLU has the second highest amount of the urban job centers place type among all OLUs. Near-term sea level rise will most affect industrial and protected lands near the Oakland Airport and San Leandro Bay; over the long run, every place type is at risk. This is a highly complex OLU with many landowners, parcels, and densely developed areas. Opportunities exist to elevate land and roads, require retrofits of buildings and flood-proofing of ground floors, create floodable spaces upland in the watershed to minimize combined flooding, add green infrastructure, establish a sea level rise overlay zone to identify high-hazard areas and the policies and financial strategies that may be used to help them adapt, and build inland flood walls and berms as needed. A mix of gray and green infrastructure will likely be needed depending on the specific vulnerabilities along this OLU's long shoreline. Some businesses or industrial areas with repeat-flood issues in the future may be supported in moving to higher ground through a TDR program or tax incentives; residential neighborhoods could establish a GHAD to finance needed protections.

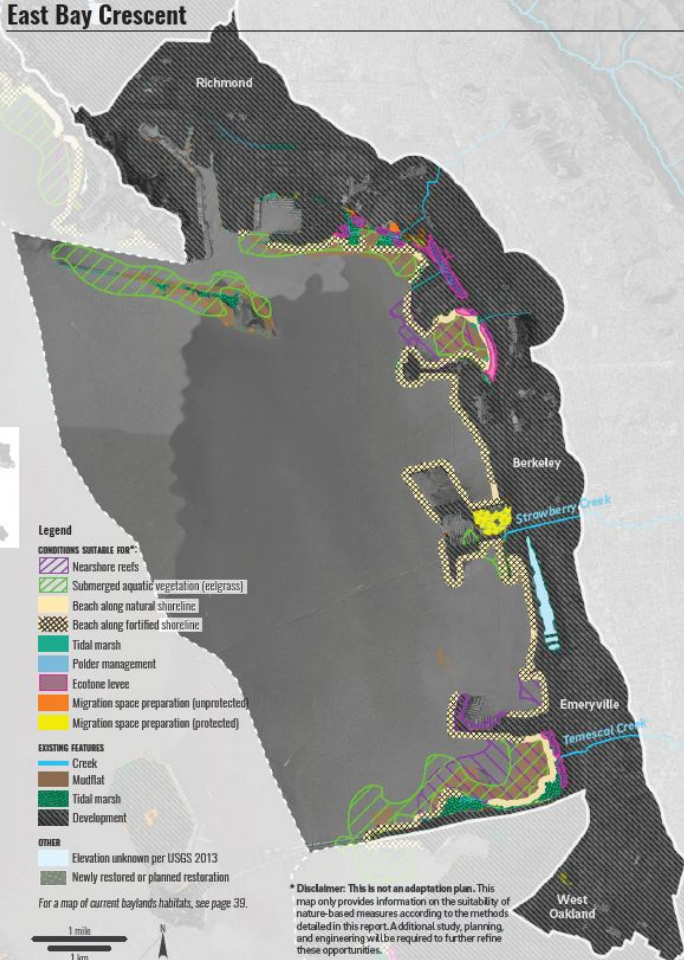
Selected Measures	Suitability
Nearshore reefs	○
Submerged aquatic vegetation	●
Beaches	●
Tidal marshes	●
Polder management	●
Ecotone levees	○
Migration space preparation	○
○ Limited suitability   ● Some suitability   ● High suitability	



## Place Types Map



## East Bay Crescent



## Nature-based Adaptation Measures

The East Bay Crescent is characterized by the headlands and landfills of Emeryville, Berkeley Marina, Albany Bult, and Point Isabel. The I-80 and I-580 highway corridors have buried the historical Fleming Beach, constrained the present-day marshes, and limited opportunities for marsh migration. In the short term, opportunities are limited to nearshore- and shoreline-focused natural and nature-based strategies. Both nearshore reefs and eelgrass beds are suitable. Creeks draining to the Bay, such as Temescal, Strawberry, Codornices, and Cerrito, have been significantly modified by culverting and channelizing. Their connection to the baylands could be enhanced to direct sediment loads to support mudflats or beaches. Coarse or composite beaches are appropriate along the length of shoreline as an alternative to riprap, and could be stabilized by the artificial headlands. The small areas of marsh could be enhanced with ecotone or horizontal levees that back up to the roads. These measures are meant to be layered and have been shown to have more adaptation potential when used in combination.

Selected Measures	Suitability
Nearshore reefs	●
Submerged aquatic vegetation	●
Beaches	●
Tidal marshes	●
Polder management	○
Ecotone levees	●
Migration space preparation	○
<div>○ Limited suitability</div> <div>● Some suitability</div> <div>● High suitability</div>	



Highways I-580/I-80 located next to tidal marsh in the East Bay Crescent OLU (Photo by Jay Haang Photography, CC BY 2.0)

## Other Adaptation Opportunities

This OLU has a mixed set of relatively intensive land uses, including a significant amount of low-density and moderate-density residential suburbs. It has the most small lot "streetcar" suburbs of any OLU—reflecting older neighborhoods—and it also has some suburban job centers, office parks, and industrial lands. As a result of these diverse uses, the East Bay Crescent has many adaptation options, including perimeter protection with grey or hybrid green/grey infrastructure, inland protection, and opening up floodable areas to retain water and reduce combined flooding—most likely with green infrastructure. This area is complex, with many parcels, landowners, tenants, and business owners, so private funding through a GHAD or other avenue may be a good option to help pay for infrastructure investments. Some commercial buildings or businesses in these areas may eventually find it a better investment to move out rather than protect in place. Highways I-580/I-80 near the bayward edge of the OLU could be redesigned or elevated to a levee to provide upland flood protection.

## Place Types Map

