Working with Nature Across the Land-use Spectrum:
A Holistic Approach to Ecological Resilience

SWAMP Science Symposium
20 June 2018

SFEI AQUATIC SCIENCE CENTER
SAN FRANCISCO ESTUARY INSTITUTE & THE AQUATIC SCIENCE CENTER

Transforming our cities and landscapes into ecologically resilient systems is both necessary and possible.

Where we work

What We Do

Science: Draw on cutting-edge science from across disciplines

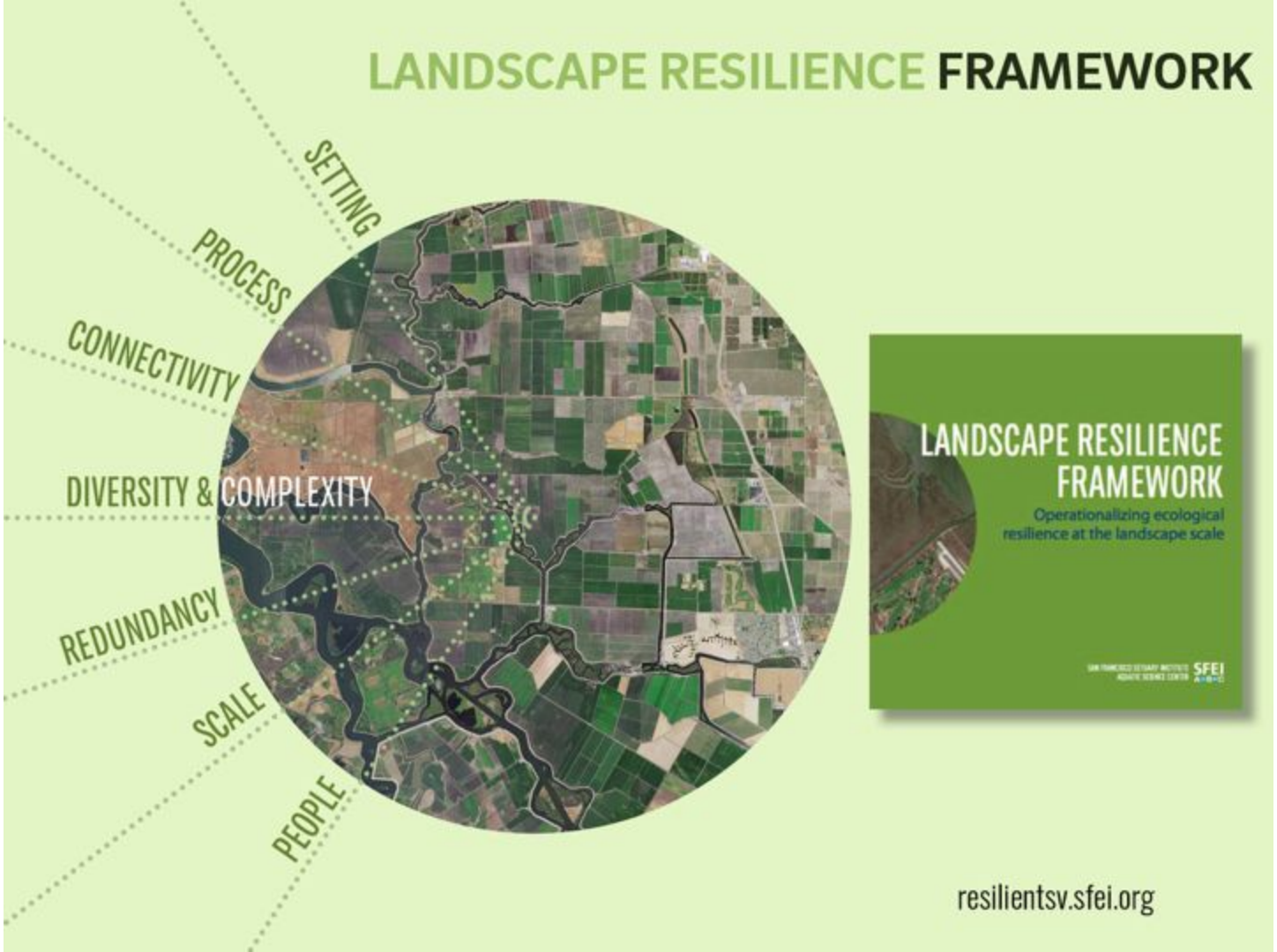
Translation: Turn science into usable local guidance, visions, tools

Implementation: Facilitate integrated actions via partnerships and planning

LANDSCAPE RESILIENCE FRAMEWORK

Beller E, Spotswood E, Robinson A, Anderson M, Grenier L, Grossinger R, Higgs E, Hobbs R, Suding K, Zavaleta E. in prep.

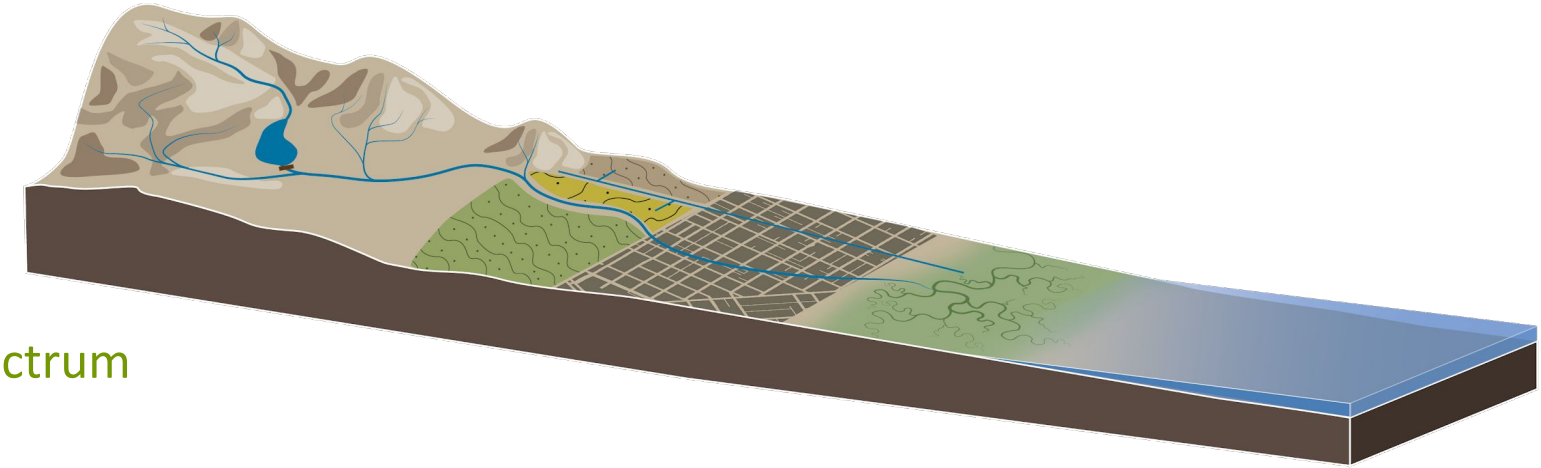
LANDSCAPE RESILIENCE FRAMEWORK



resilientsv.sfei.org

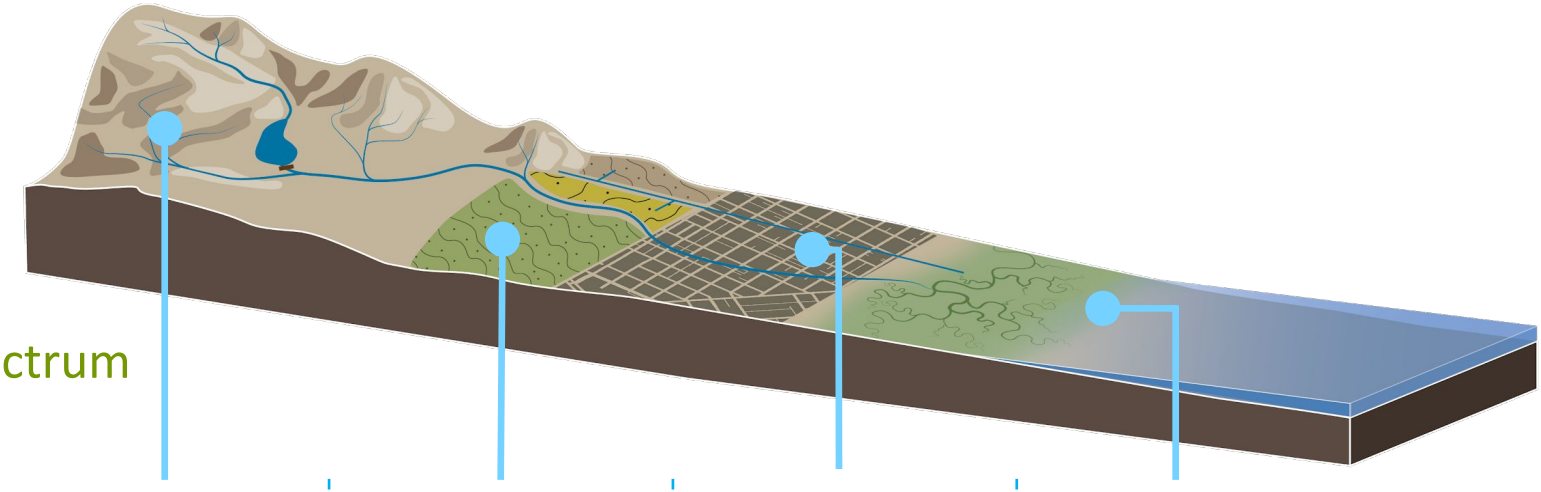
WORKING WITH NATURE

across the lands-use spectrum



WORKING WITH NATURE

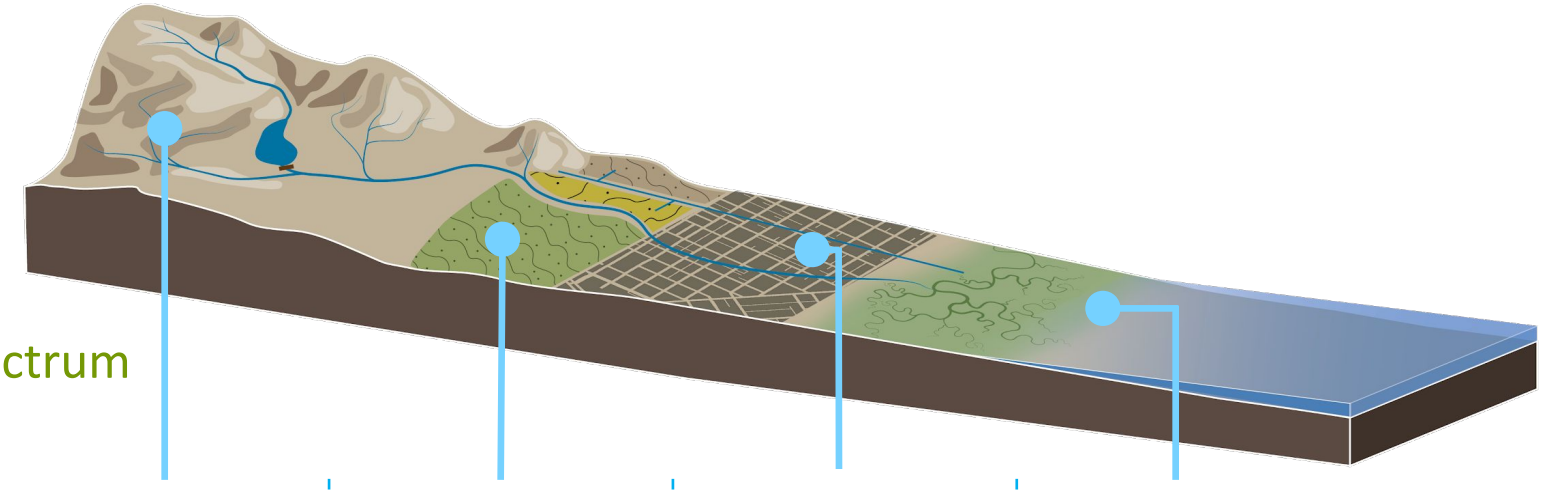
across the lands-use spectrum



	WILDLANDS	AGRICULTURE	URBAN	SHORE
Nature-Based Solutions				
Resulting Ecosystem Services				

WORKING WITH NATURE

across the lands-use spectrum



	WILDLANDS	AGRICULTURE	URBAN	SHORE
Nature-Based Solutions	Habitat conservation and restoration Emulate fire disturbance Prevent development			
Resulting Ecosystem Services	Water capture Carbon sequestration Manage wildfire risk			

Peninsula Watershed

San Mateo County

Hetch Hetchy Regional Water System

Services of the San Francisco Public Utilities Commission

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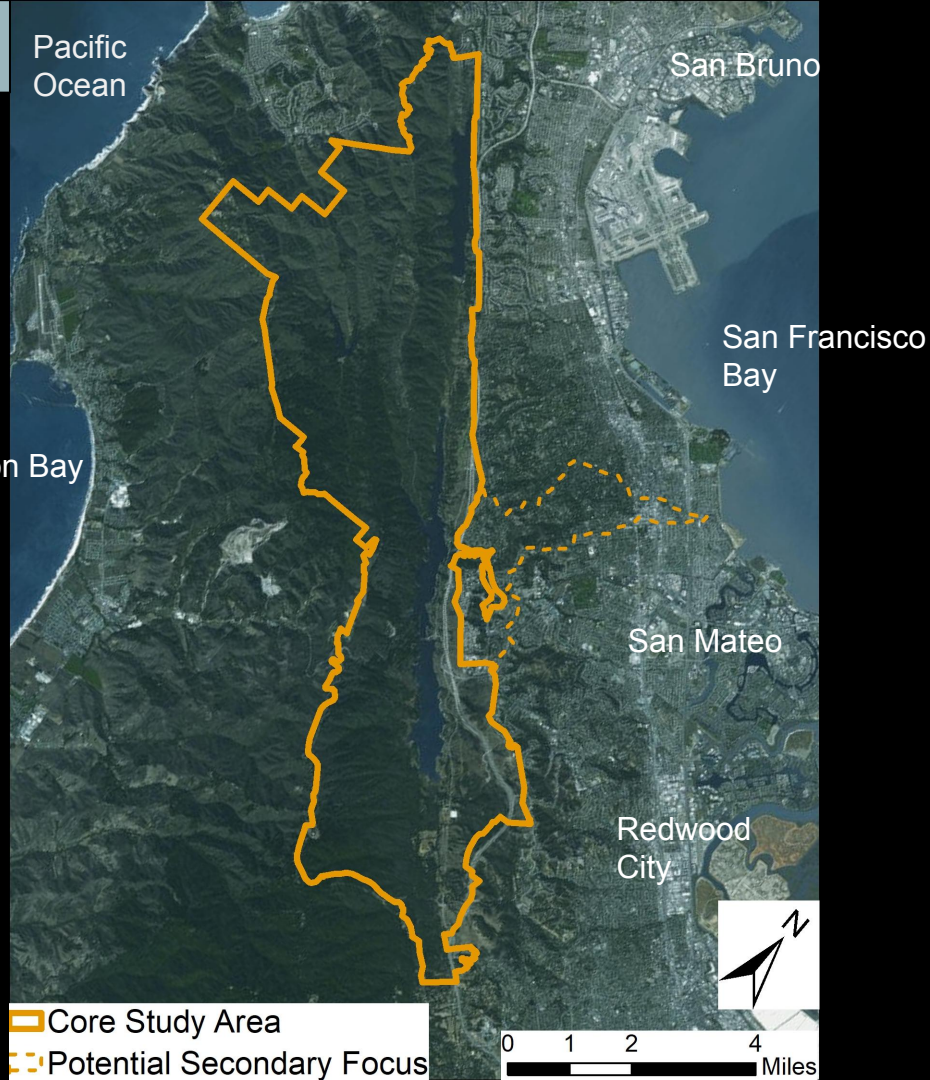
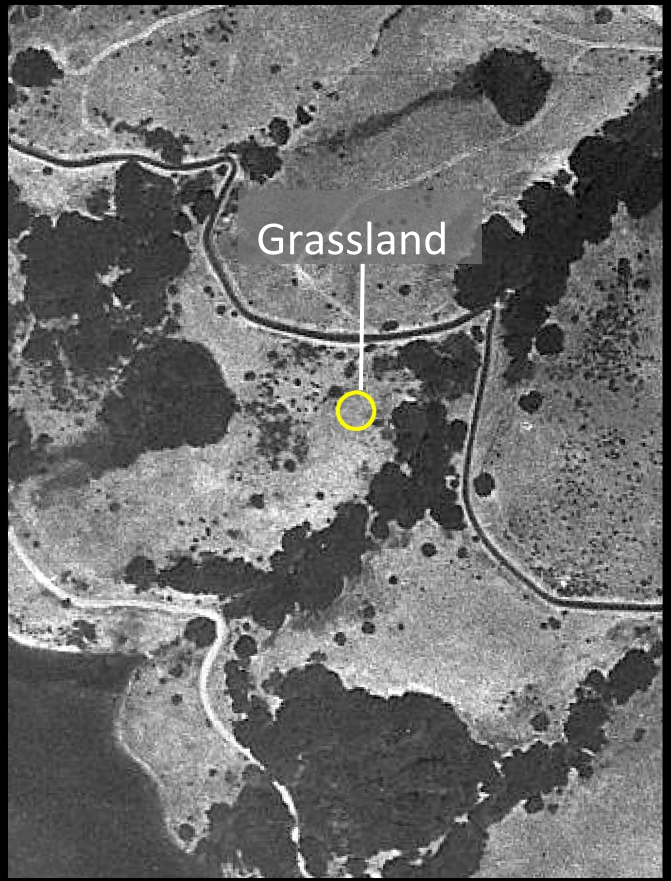
Study Area

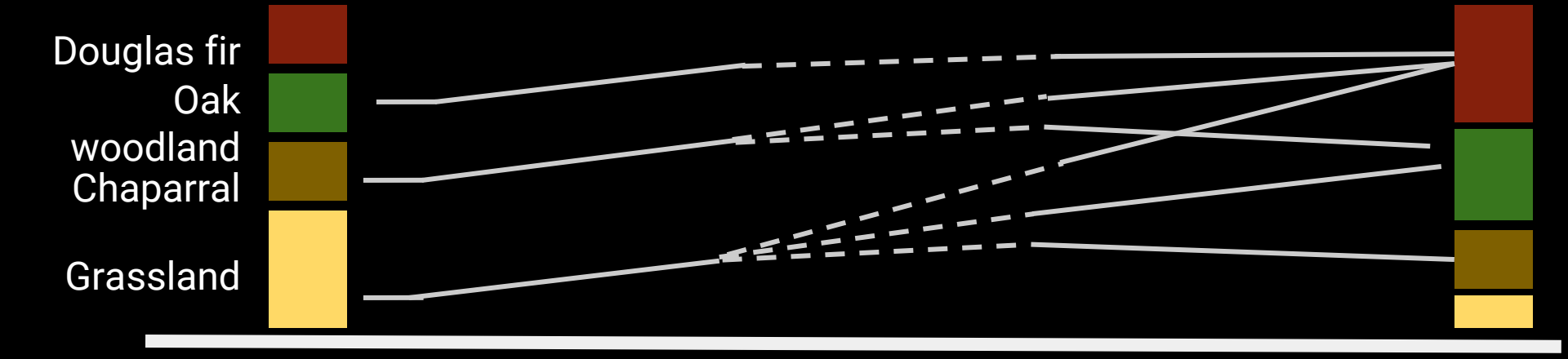

Pacific Ocean
San Bruno
San Francisco Bay
Half Moon Bay
San Mateo
Redwood City
Core Study Area
Potential Secondary Focus
0 1 2 4
Miles



1946

2015

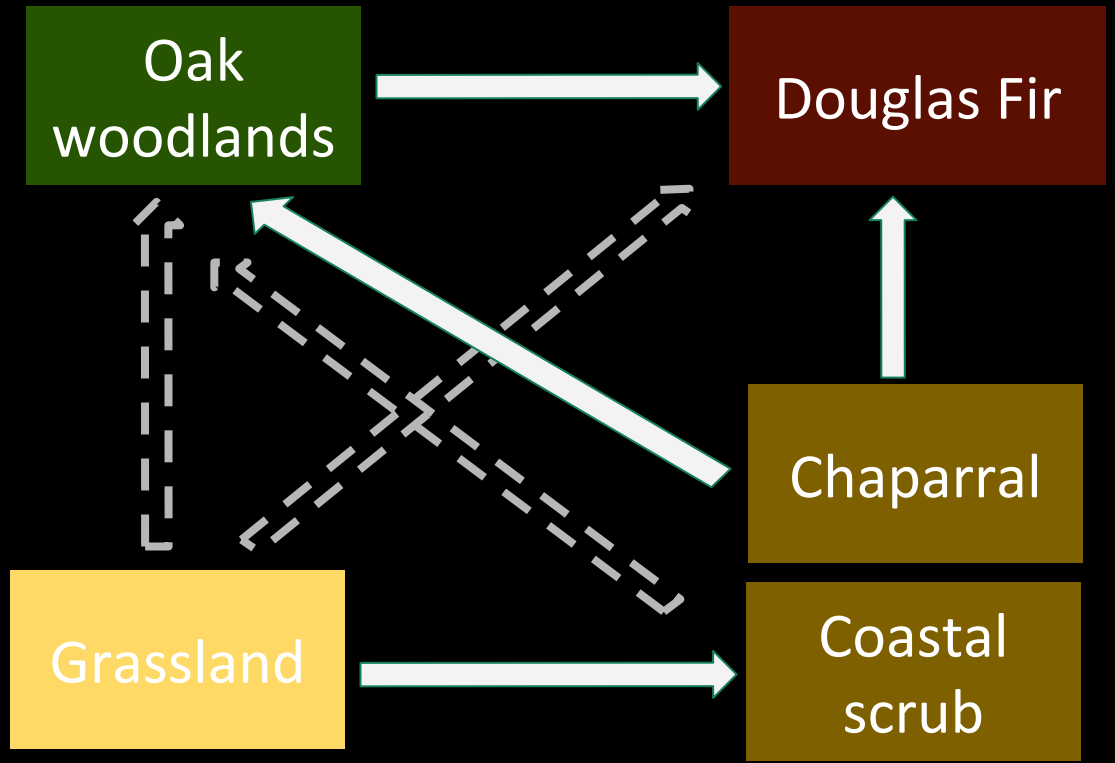
Expected vegetation shifts



Expected vegetation shifts

With fire suppression and grazing removal:

- Conifer expansion
- Oak woodland expansion
- Grassland contraction
- Coastal scrub encroachment



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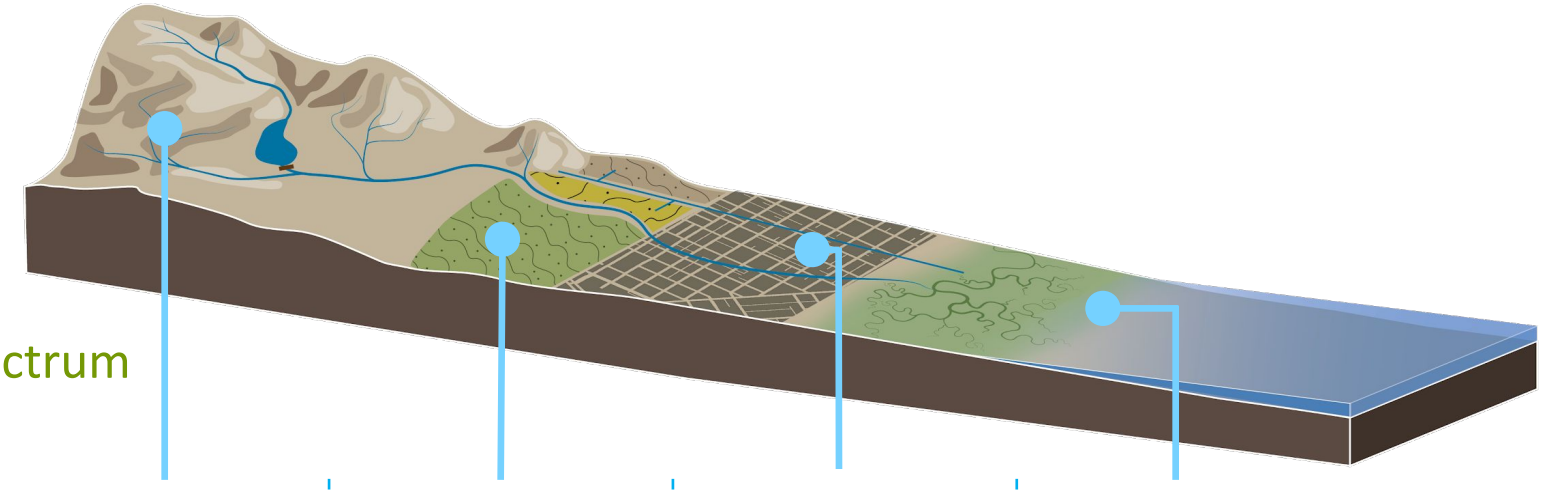

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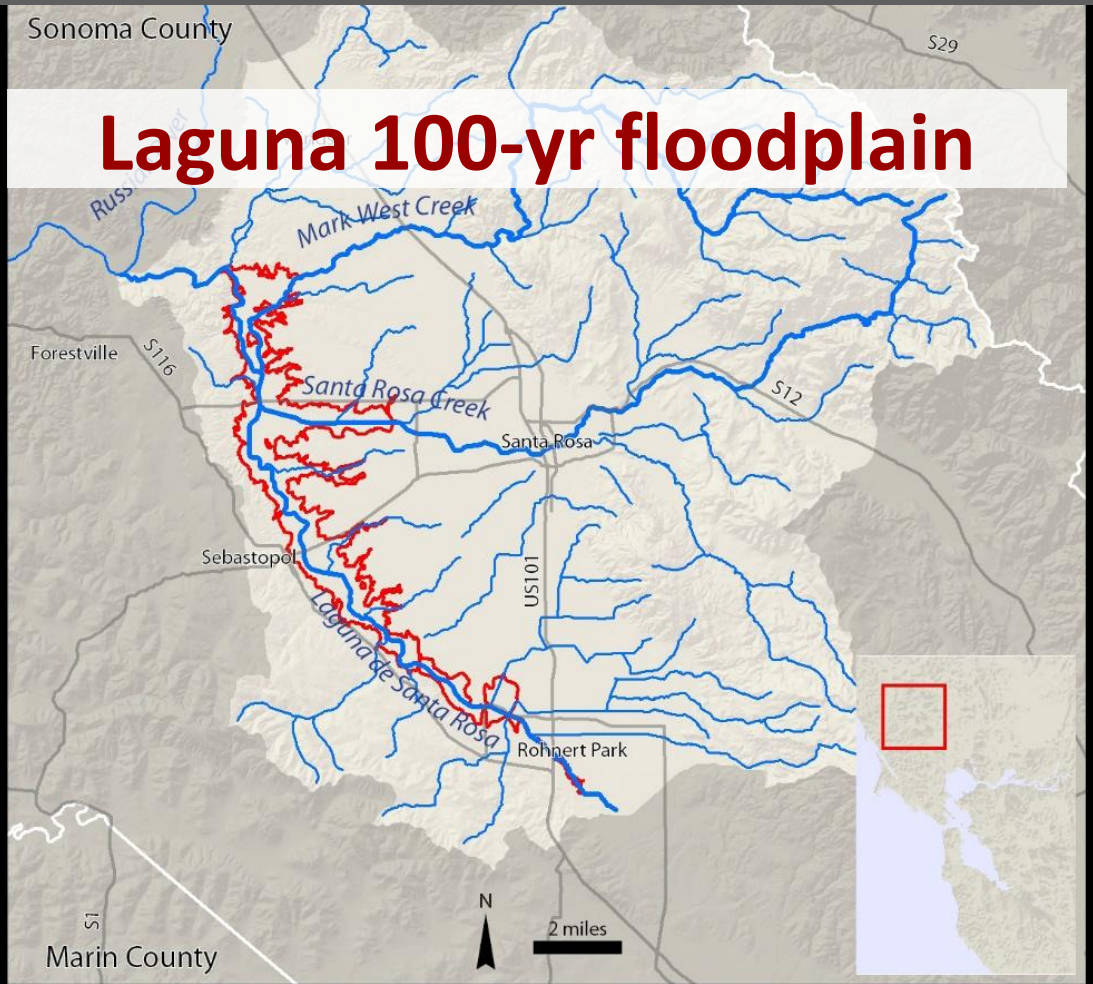
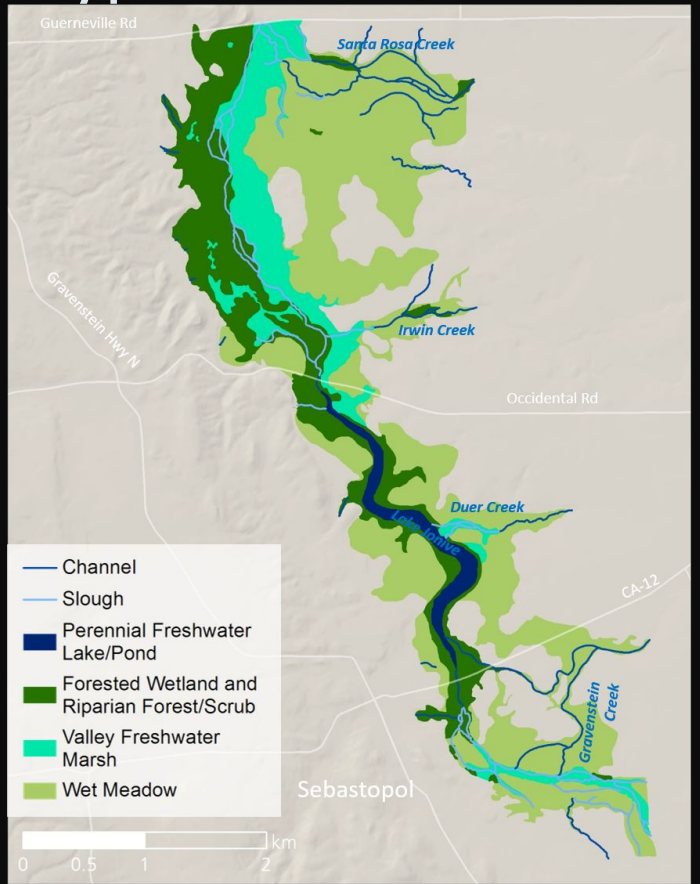
Laguna de Santa Rosa

Sonoma County

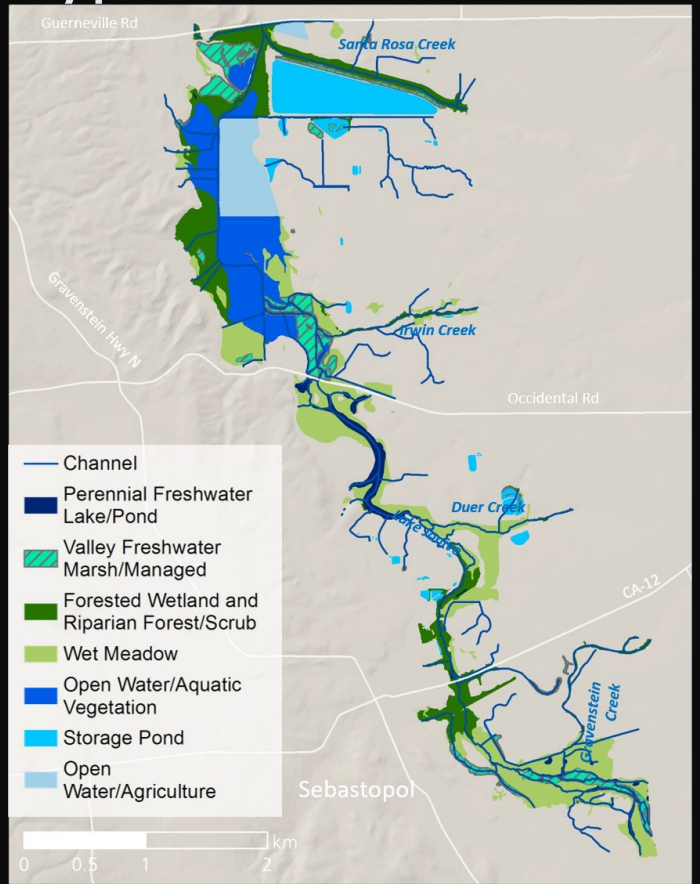
Project Focus Area



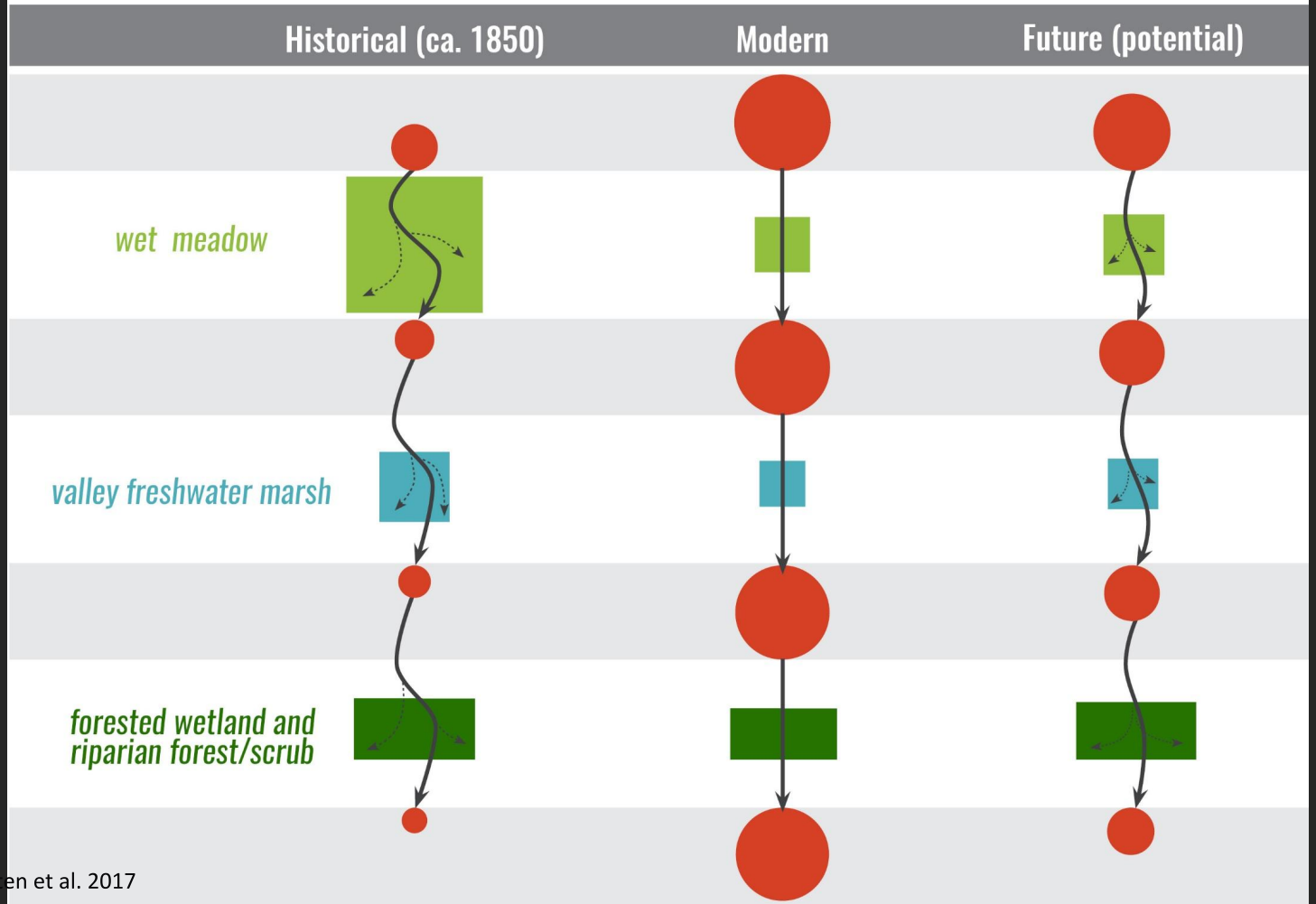
Historical Habitat Types and Channels



Modern Habitat Types and Channels



NUTRIENT TRANSPORT AND ASSIMILATION (CONCEPTUAL)



Source: Baumgarten et al. 2017

Project Components

Historical Ecology & Landscape Change

Restored Landscape Vision

Master Restoration Plan

Restoration Project Designs

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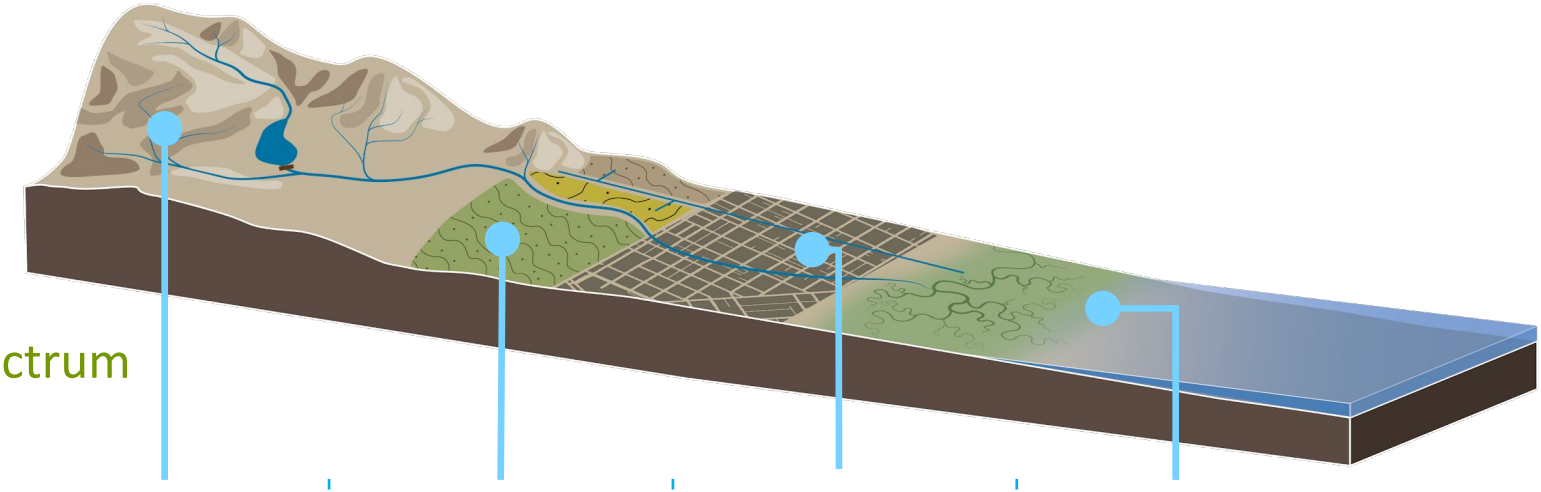
across the lands-use spectrum



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OAK GROVE


OAK IN
FRONT YARD


Park
[Open Space]
Commercial
Commercial
Single
Family Homes
[High-Density
Residential]
Traffic Circle


NATIVE
UNDERSTORY
SHRUBS


BIOSWALE


NATIVE
WILDFLOWERS


OAK + NATIVE PLANTS
TRAFFIC CIRCLE

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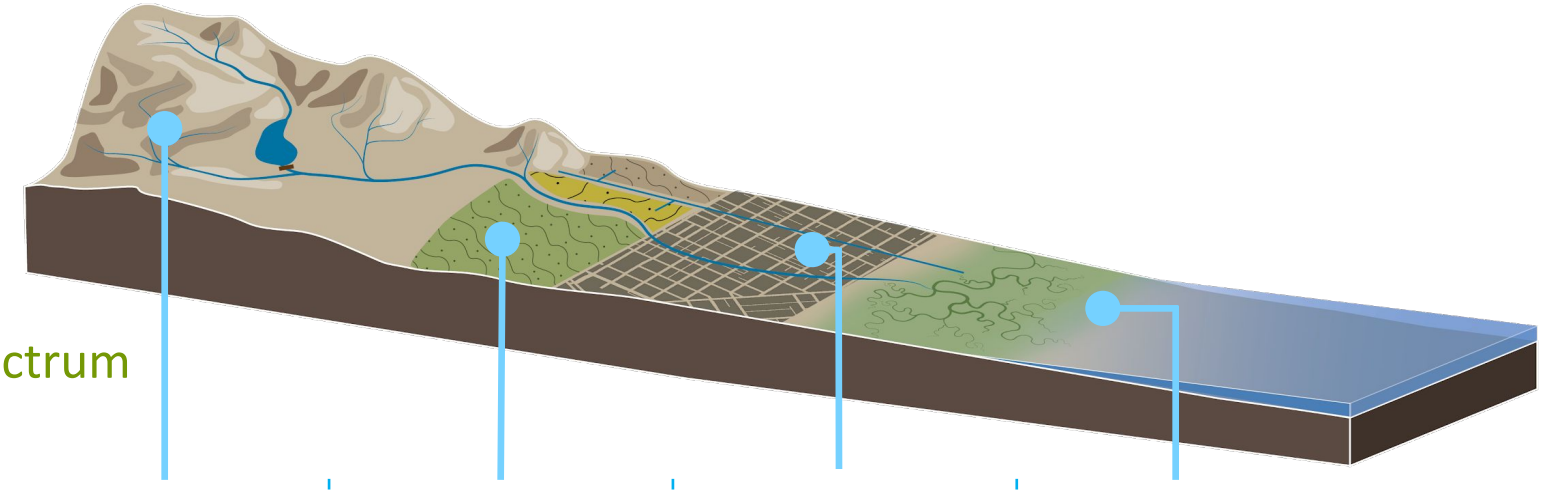

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OPERATIONAL LANDSCAPE UNITS FOR SF BAY:

Using nature's jurisdictions to plan for sea level rise

Funded by SF BAY RWQCB

SPUR

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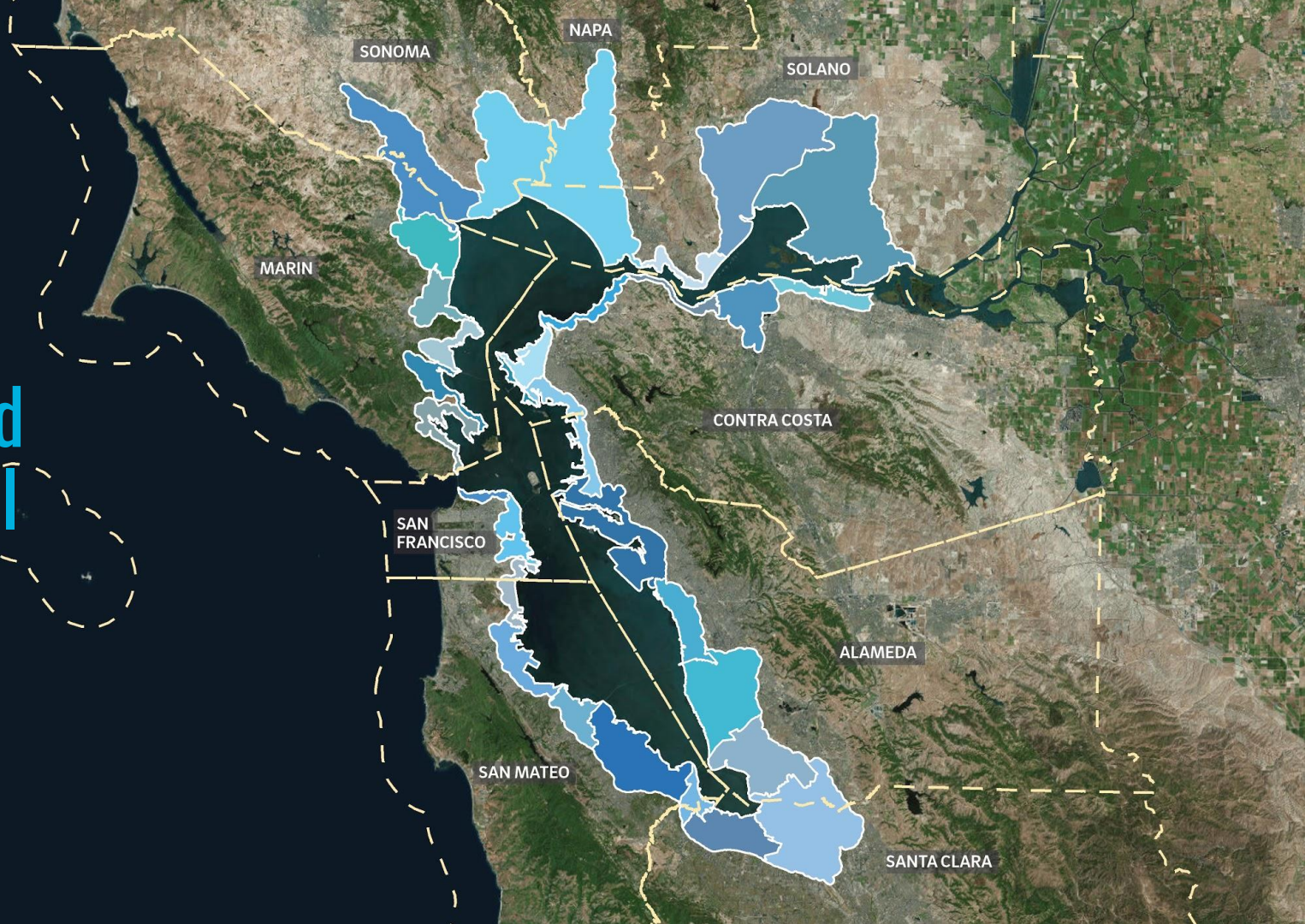
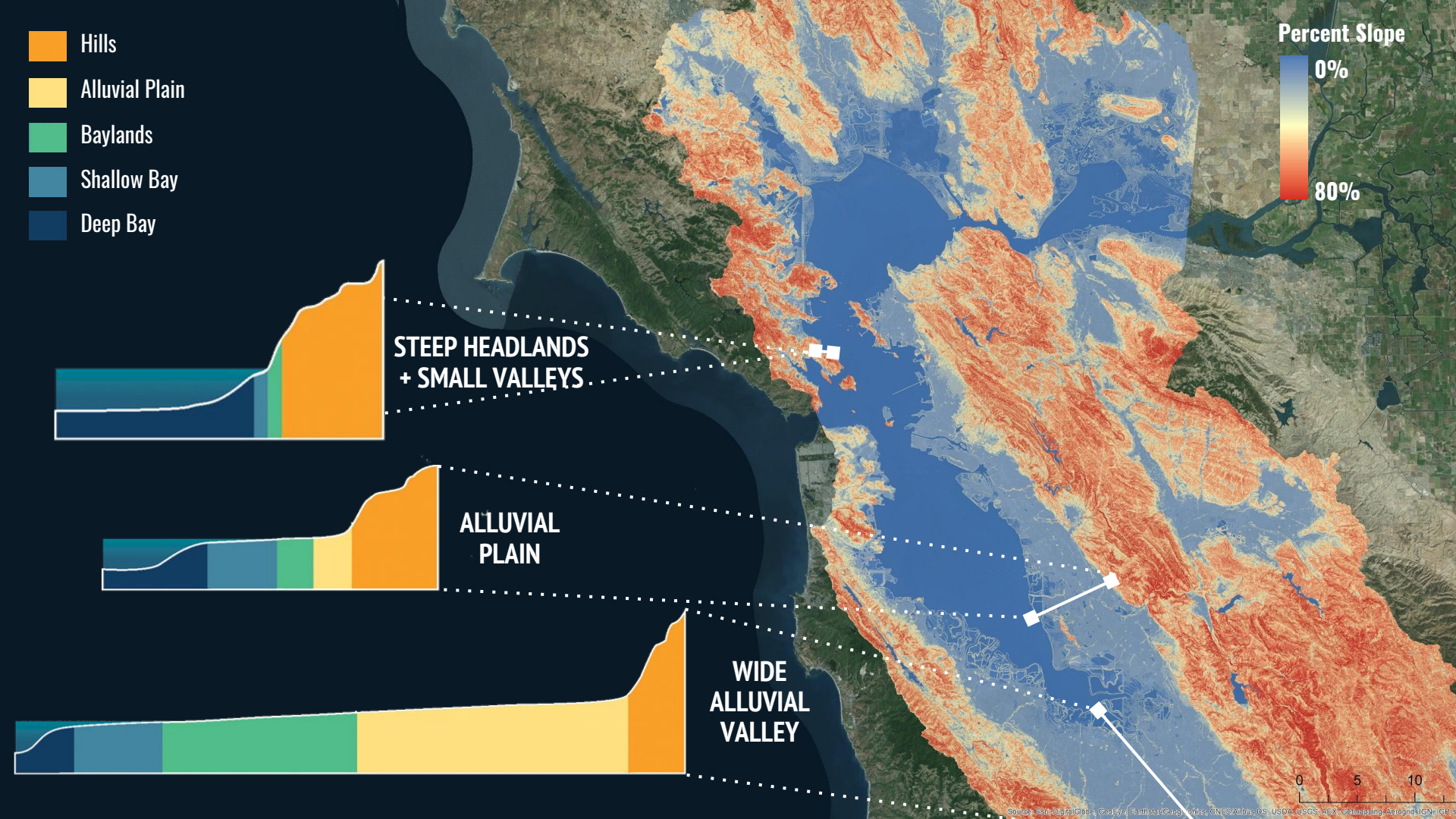
Shoreline planning units based on physical processes




Hills
Alluvial Plain
Baylands
Shallow Bay
Deep Bay
Percent Slope
0%
80%
STEEP HEADLANDS
+ SMALL VALLEYS
ALLUVIAL
PLAIN
WIDE
ALLUVIAL
VALLEY
0
5
10

Nature-based Solutions

Low-crested oyster reef

Submerged vegetation

Mudflat augmentation

Marsh

Cobble beach

Sand beach

Shell hash beach

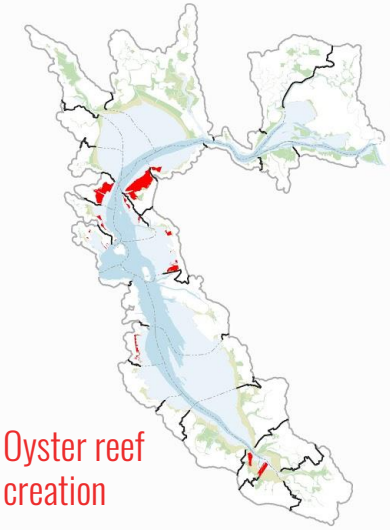
Polder management

Horizontal levee

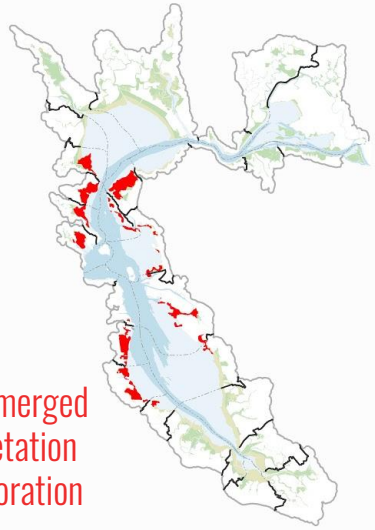
Migration space preparation

+Creek to bay connections

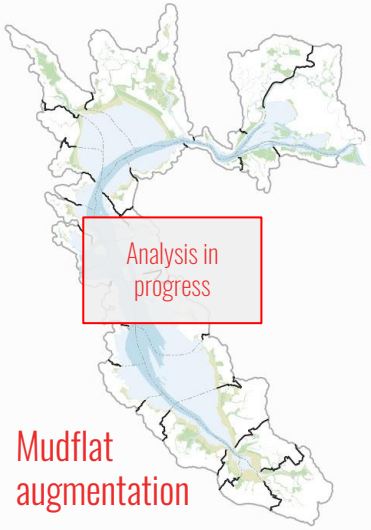
+Green stormwater infrastructure



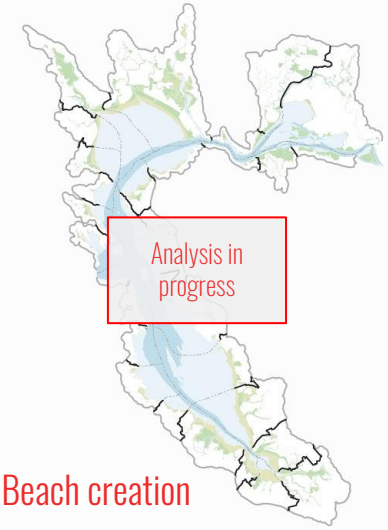
Oyster reef creation



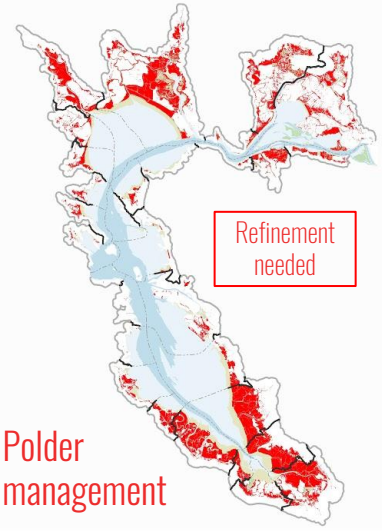
Submerged vegetation restoration



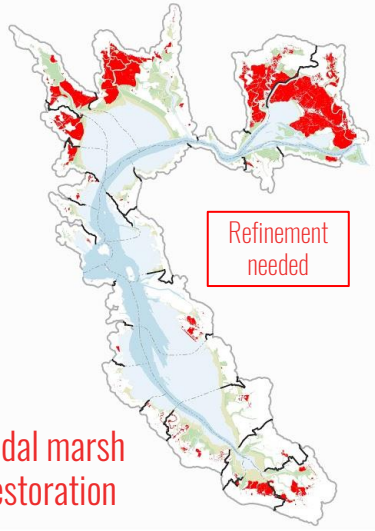
Mudflat augmentation



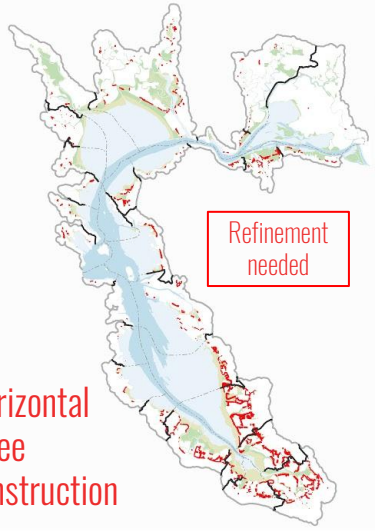
Beach creation



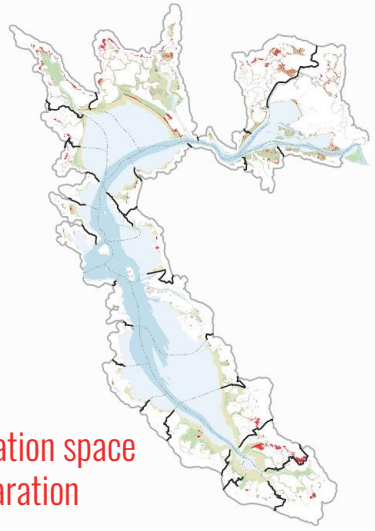
Polder management



Tidal marsh restoration



Horizontal levee construction

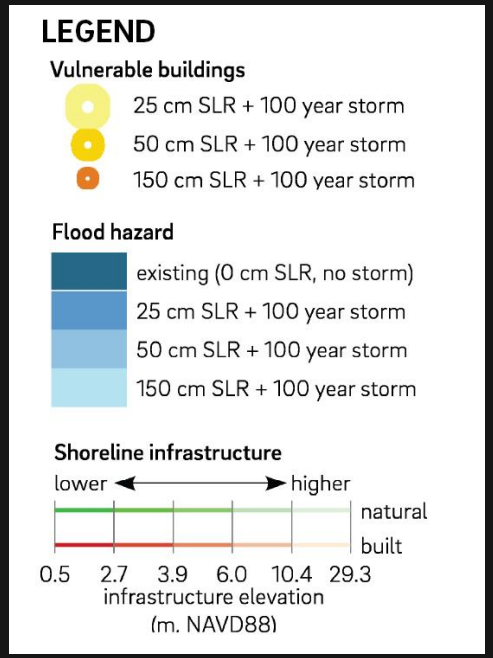


Migration space preparation

Pairing Problems with Measures

Problem	Cause	Example measure
Wave overtopping or erosion of levee with wide foreshore	Large waves reach levee	Marsh, fine beach, horizontal levee
Waves overtopping or erosion with narrow foreshore	Close to deep water	Coarse beach
Combined flooding	Loss of floodplain	Retention basins, setback levee
Combined flooding	Channel conveyance	Tidal restoration, geomorphic channels
Loss of marsh area	Wave erosion of scarp	Coarse beach, oyster reef
Loss of elevation capital	Low accretion rate	Strategic placement
No space to migrate marsh	Development up to levee	Horizontal levee
Subsided areas behind levee	Diking and draining of marshes	Reconnect to creeks, warping

Vulnerability

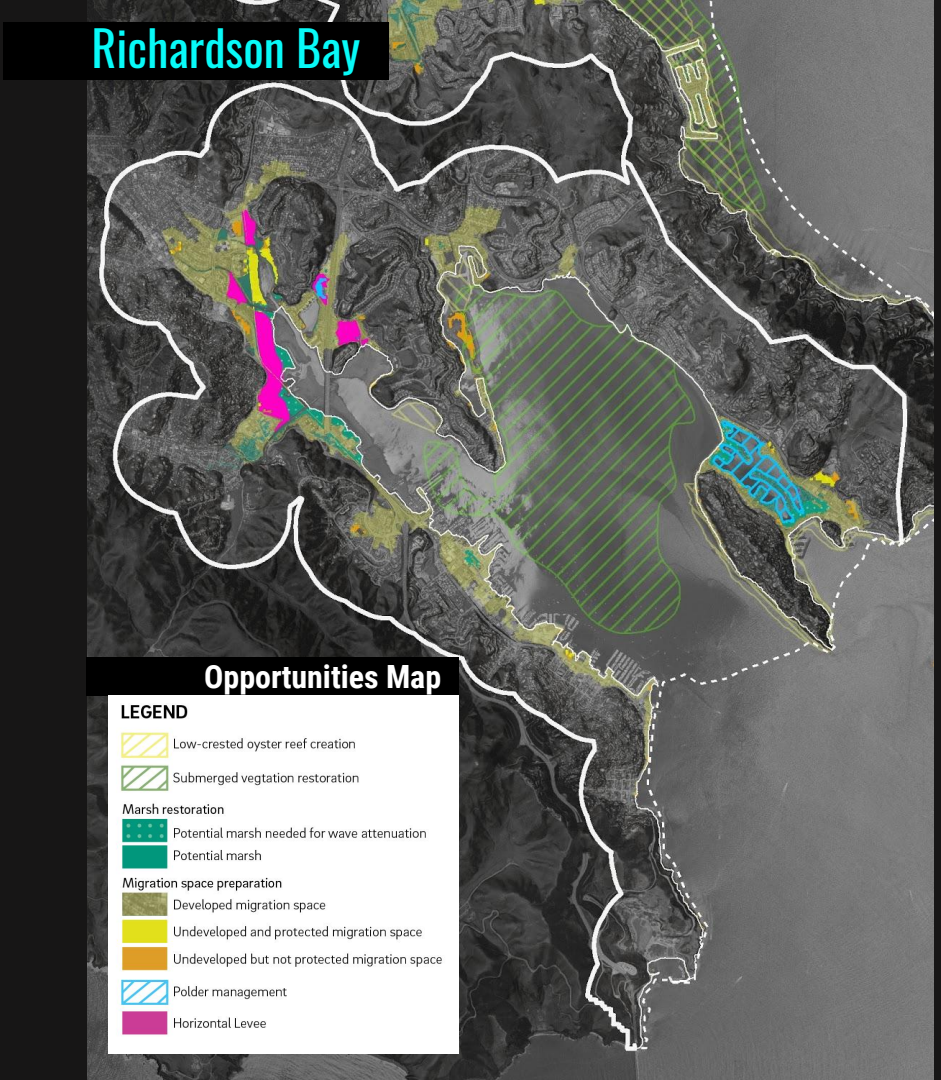


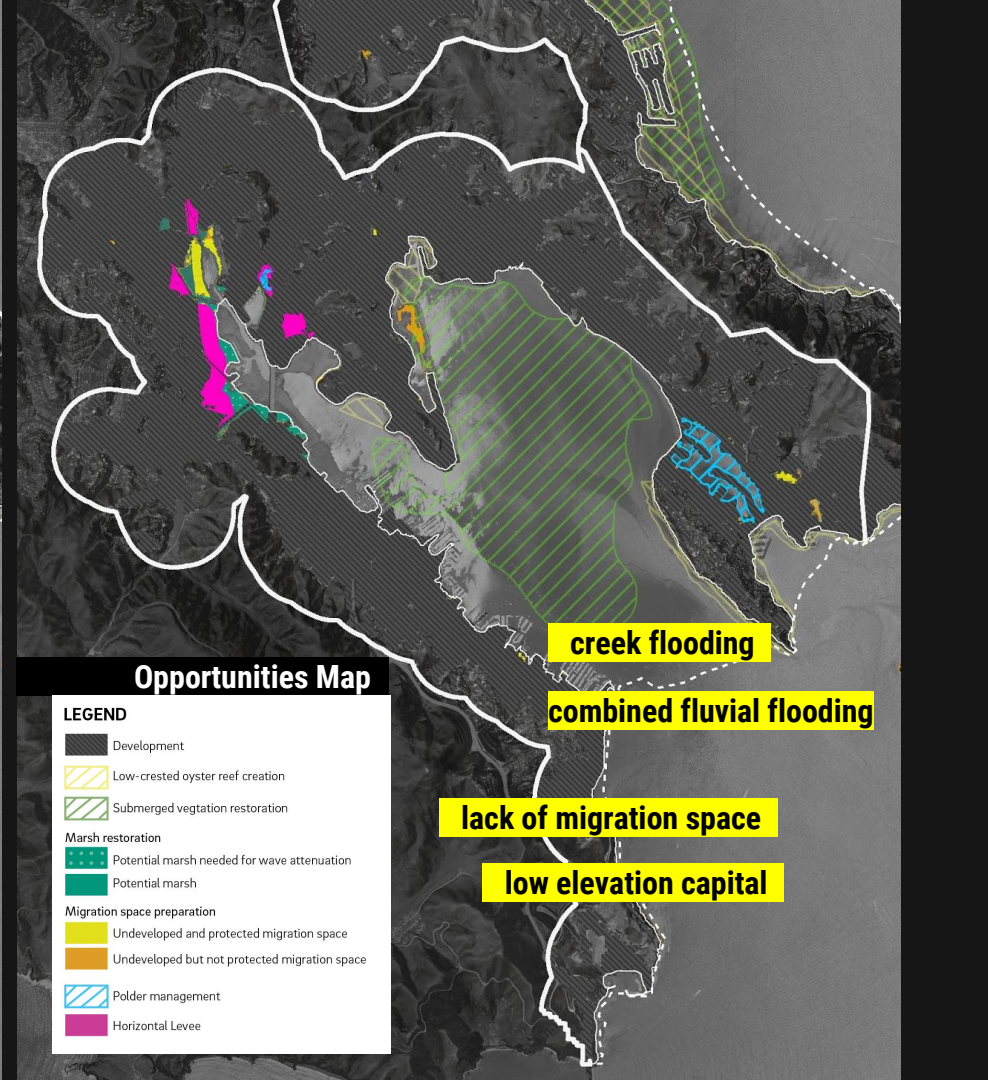
Data from BayWave

Physical Processes & Drivers

Also **sediment load** (see large map)

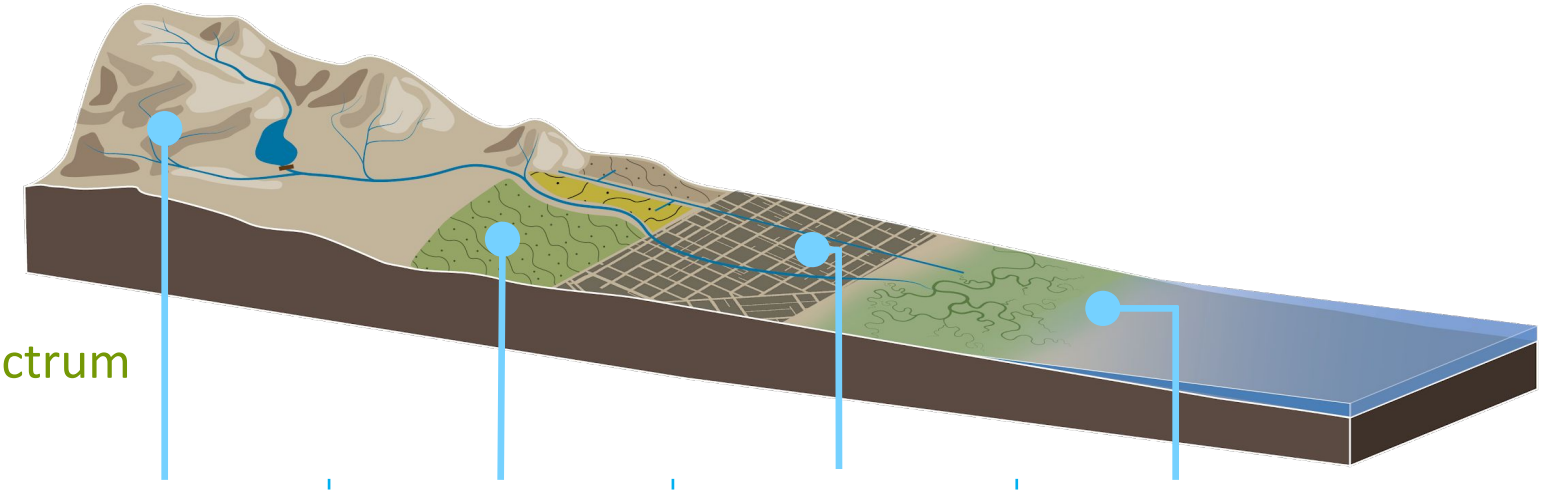
Richardson Bay





WORKING WITH NATURE

across the lands-use spectrum



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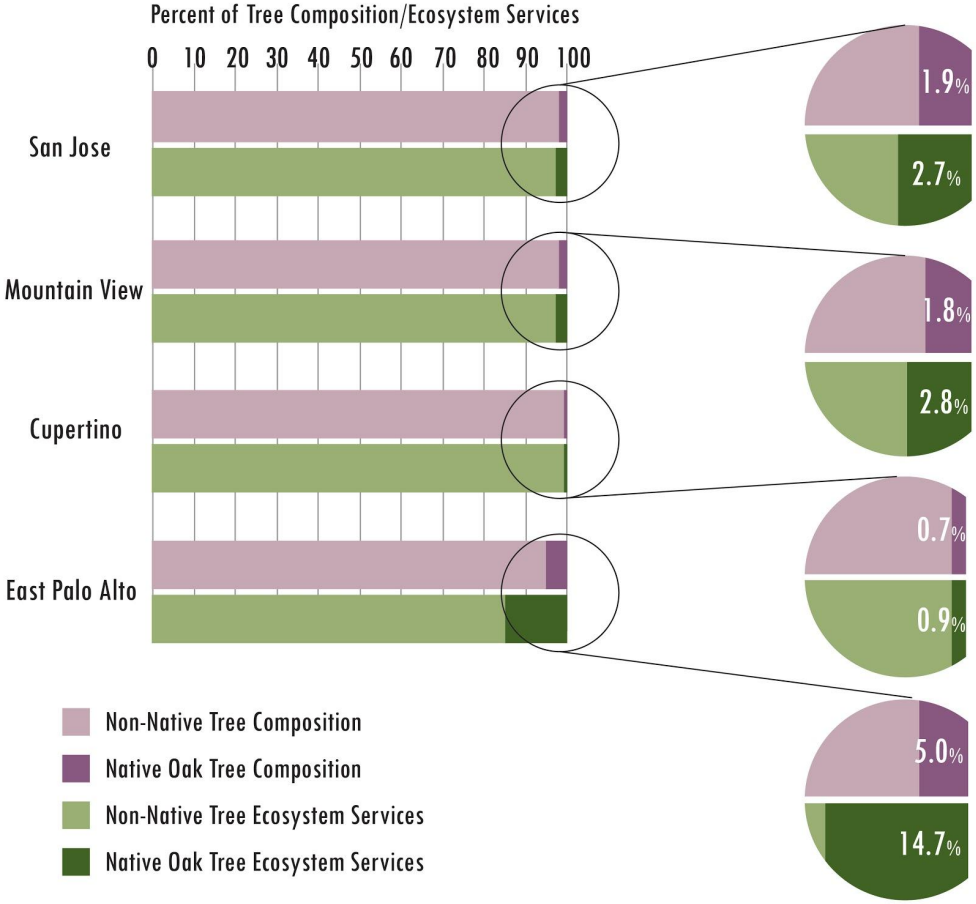
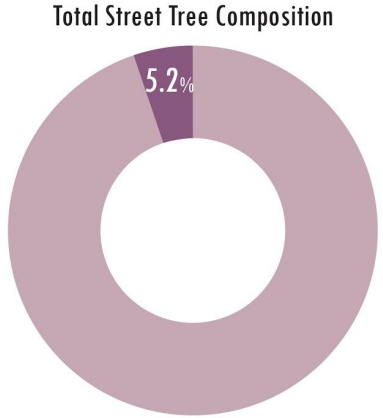
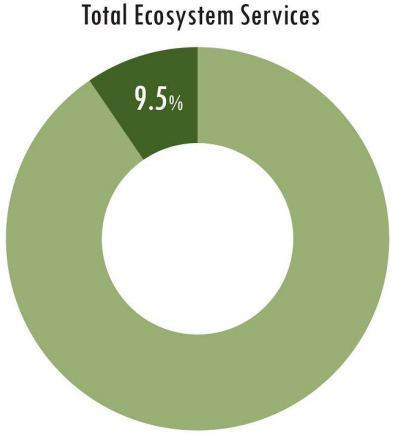
Thank You

Ecosystem Services Provided by Native Oaks

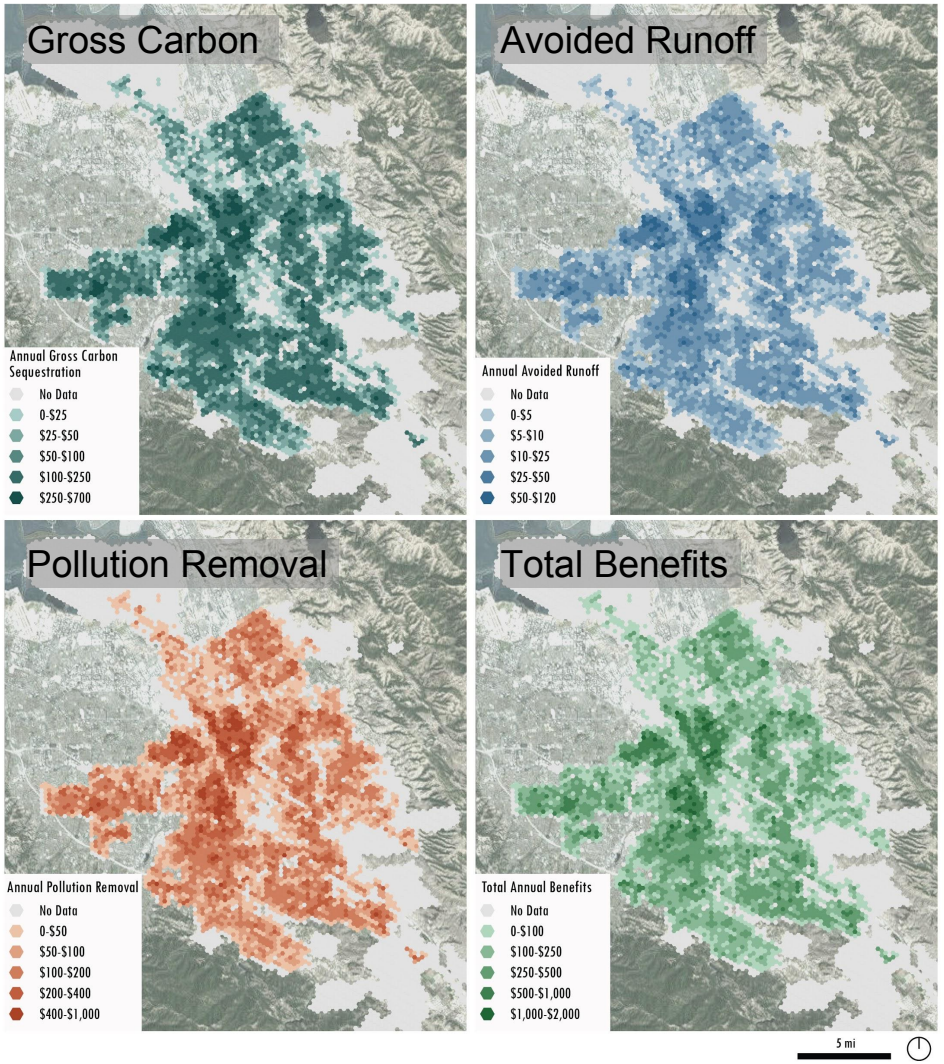






Distribution of Ecosystem Services

- The spatial distribution of ecosystem services is consistent across services provided.
- Hot spots of total annual benefits: central San Jose residential areas, some riparian corridors
- Cold spots of total annual benefits: undeveloped areas, hillsides, tidal marsh, and San Jose airport.



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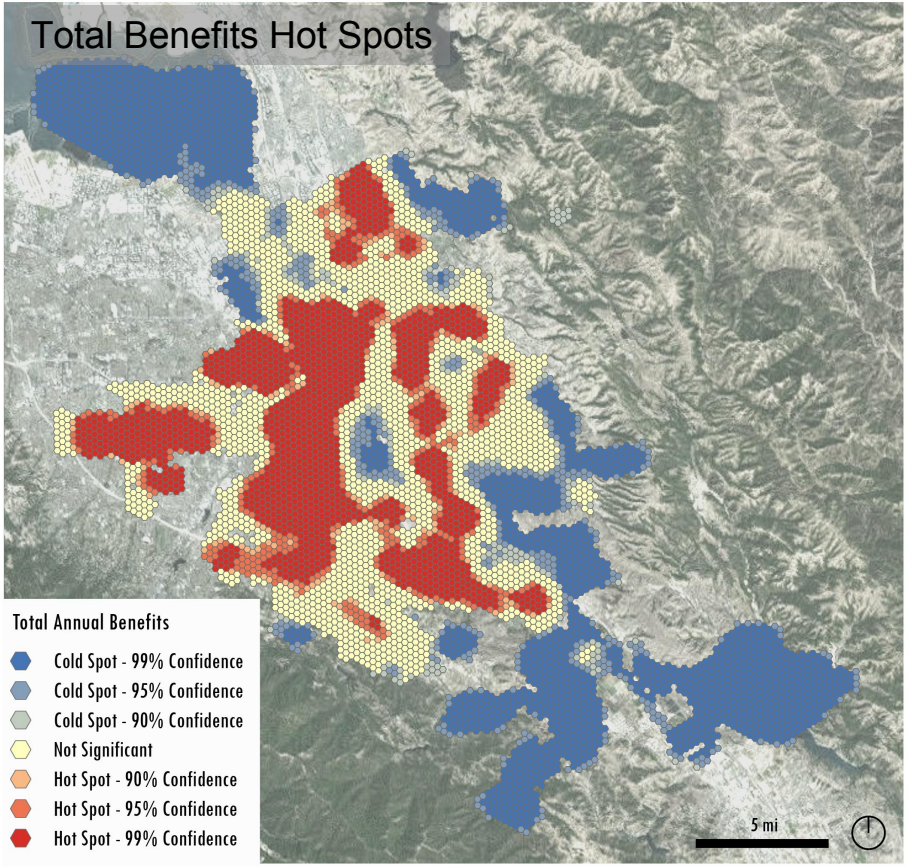



OAK GROVE


OAK IN
FRONT YARD


Park
[Open Space]
Commercial
Commercial
Single
Family Homes
[High-Density
Residential]
Traffic Circle


NATIVE
UNDERSTORY
SHRUBS

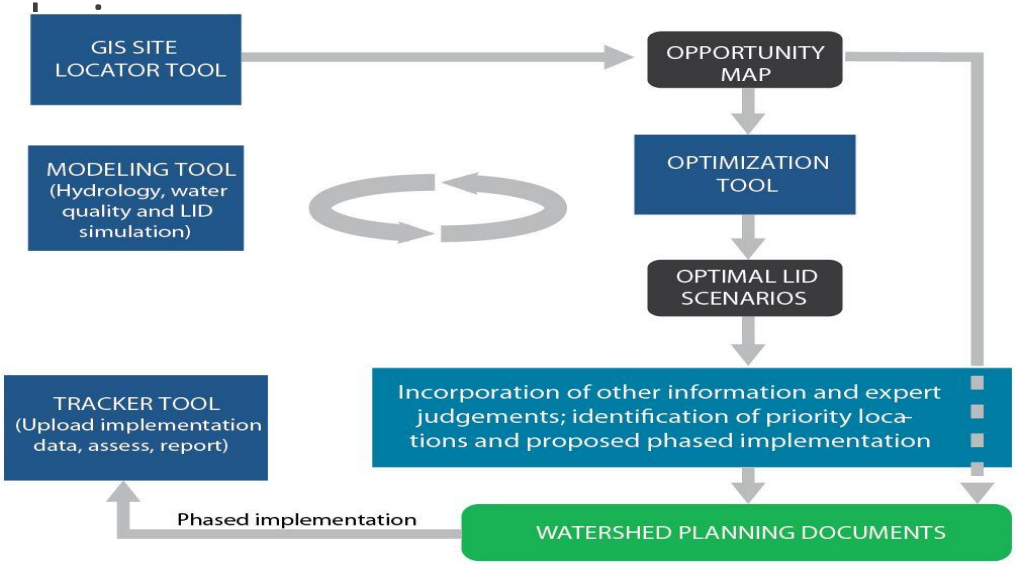

BIOSWALE


NATIVE
WILDFLOWERS


OAK + NATIVE PLANTS
TRAFFIC CIRCLE

GreenPlan-IT Overview

- Versatile & flexible to meet a range of stormwater management needs, from GI planning to Stormwater Resources Plans & Reasonable Assurance An
- Scientifically rigorous
- Public domain

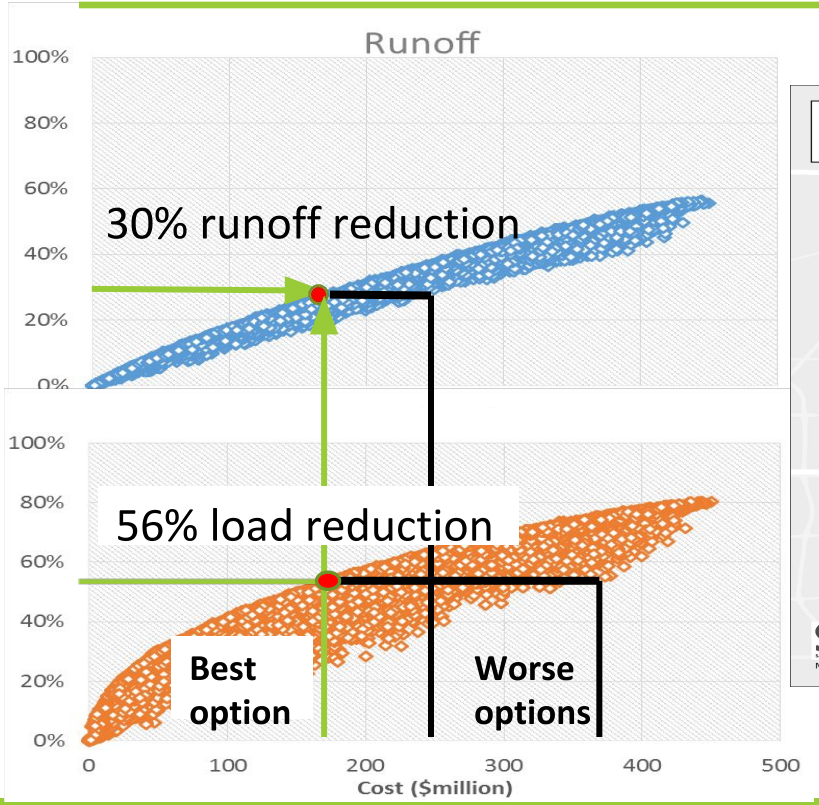


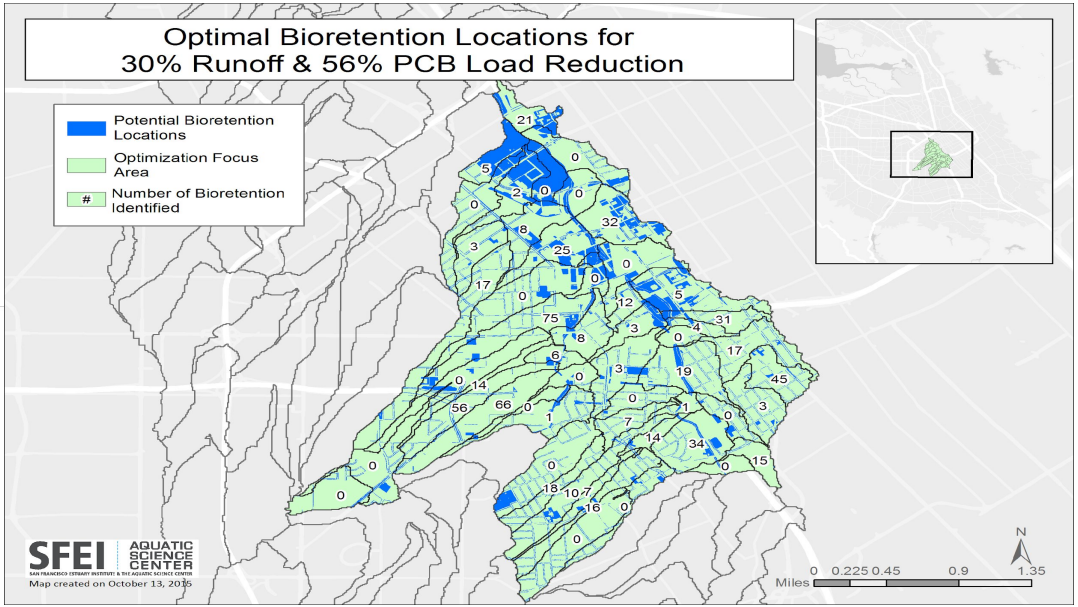
Examples of GIS data layers

GIS Layers

- Streets
- Parks
- Parking Lots
- Priority Development Areas
- Bike Lane Plans
- Storm Water Drainage network
- Storm Inlets
- Fire Hydrants
- Street Trees
- Pavement Condition
- Gas Lines
- City Owned Parcels
- Building Footprints
- High Trash Generation Areas
- Schools
- Public Spaces

Outputs of Optimization Tool





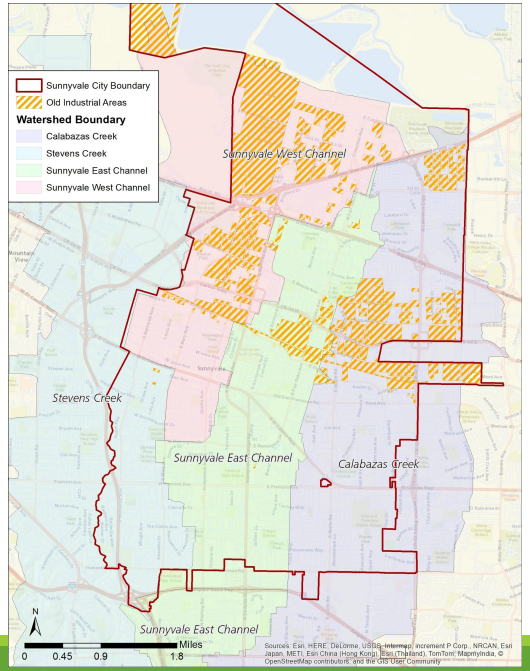
GreenPlan-IT Applications

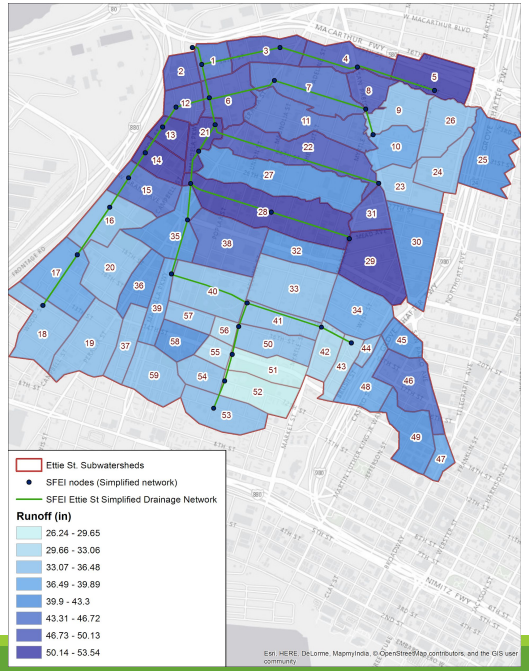
- Identified GI locations for City of San Mateo's Sustainable Street Plan

- Identified cost-effective GI locations for Downtown San Jose for PCB control

GreenPlan-IT Applications

Support GI watershed planning for controlling PCBs for Sunnyvale, Oakland, Richmond and Contra Costa County



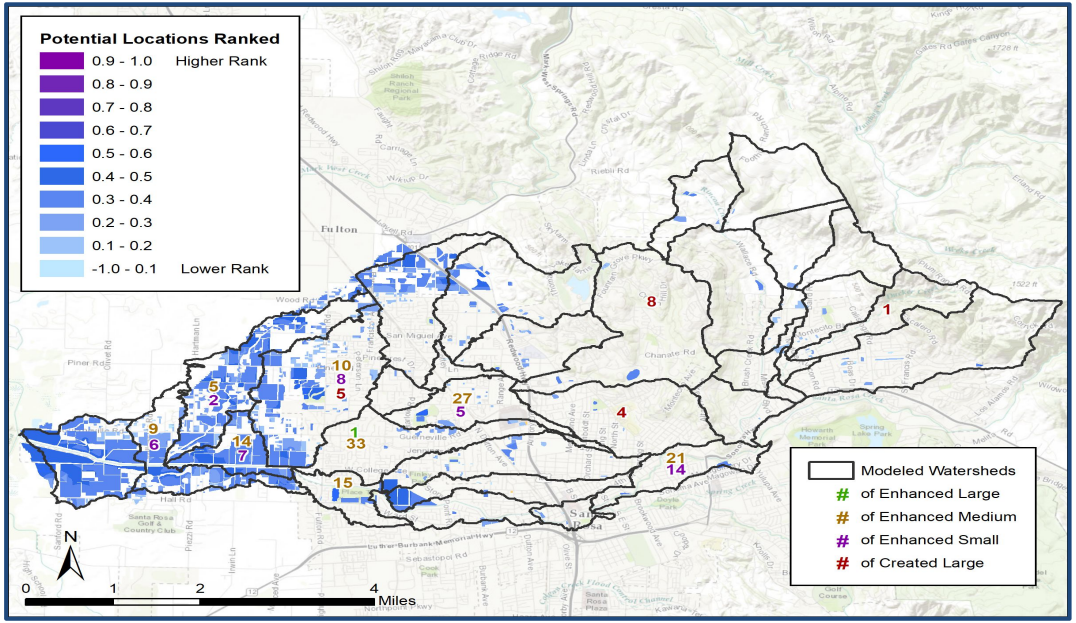


GreenPlan-IT Applications

Wetland restoration planning for nutrient load reduction

Building Capacity

- Reduce stormwater runoff and nutrient loads to Laguna de Santa Rosa
- Prioritize and identify watershed scale wetland restoration project sites



Healthy Watersheds Resilient Baylands

- Integrate water quality benefits and ecological functions
- Identify where GI and urban forestry can synergistically achieve multiple benefits

Identify local elements for landscape resilience…

Urban forests that **increase recharge and reduce stormwater peak flow**

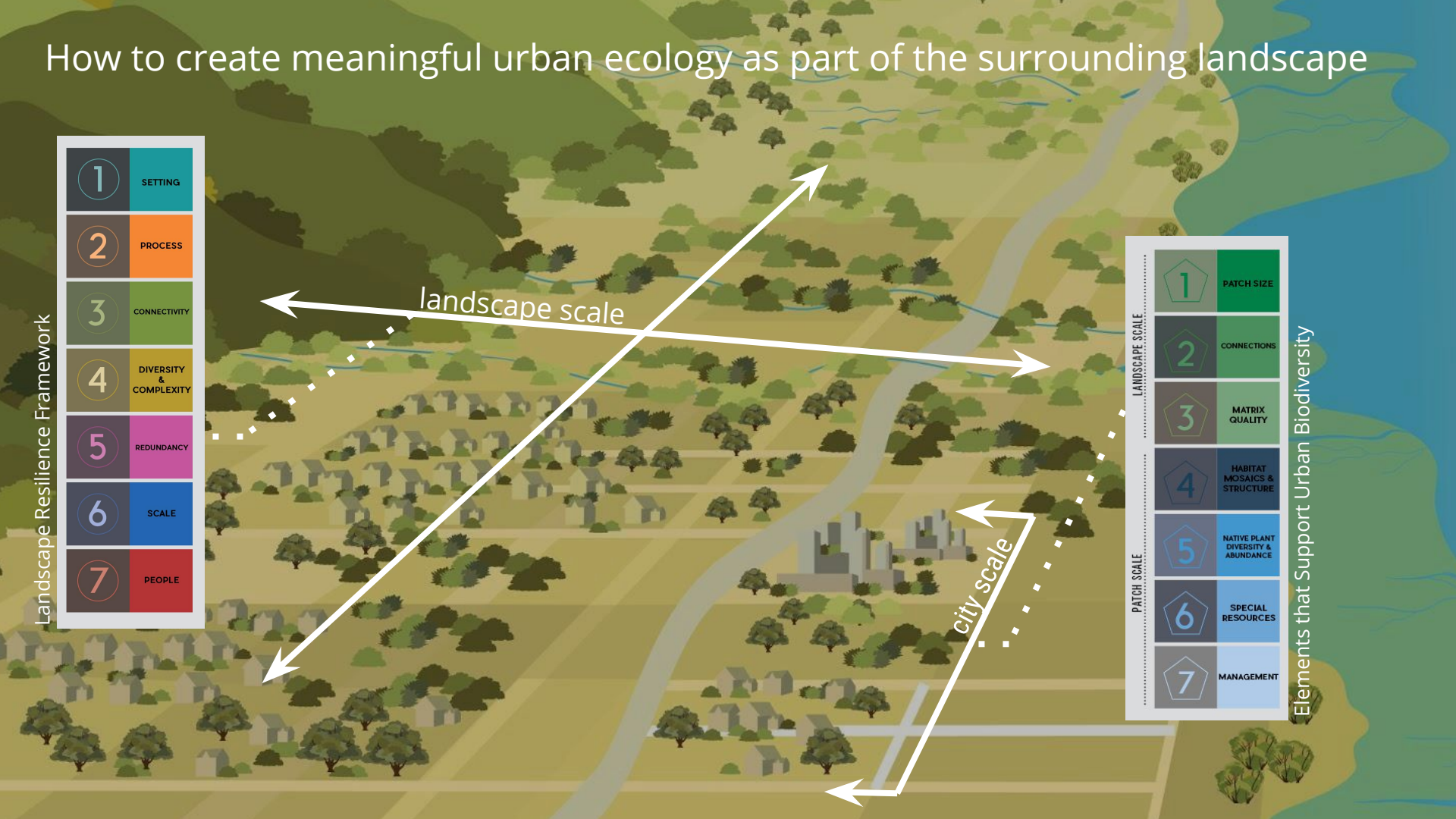
Native plant communities integrated into urban spaces **support native wildlife**

which increase community resilience…

Urban forests designed to **reduce heat, provide shade,** and **store carbon**

Native plant landscaping that is **drought tolerant, connects people to nature**, and makes city **unique**

How to create meaningful urban ecology as part of the surrounding landscape

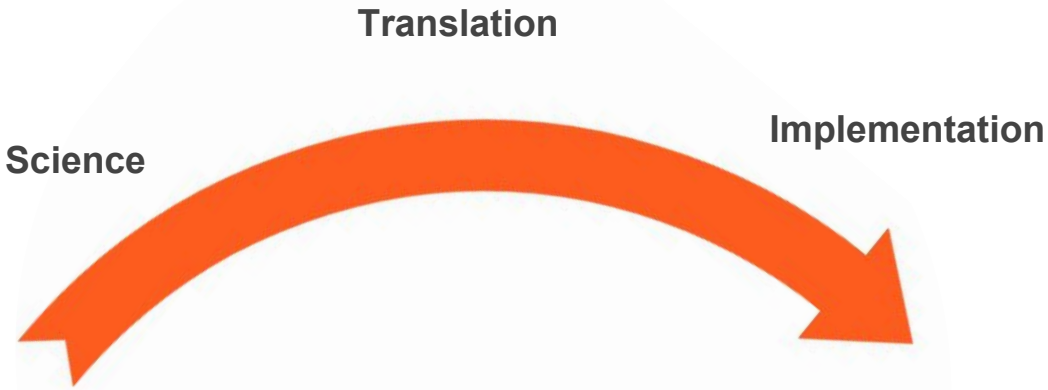


WHAT

CREATE A HEALTHIER FUTURE FOR PEOPLE AND WILDLIFE

by delivering science to maximize benefits of working with nature across the land use spectrum

How we do it



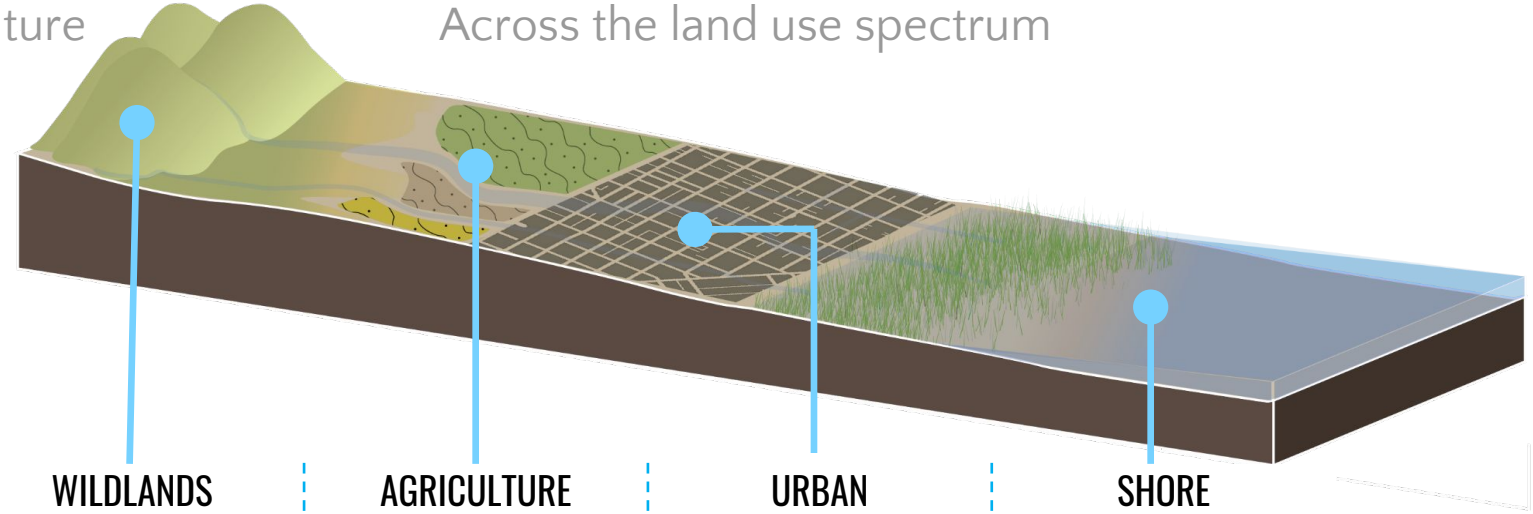
Science: Draw on cutting-edge science from across disciplines

Translation: Turn science into usable local guidance, visions, tools

Implementation: Facilitate integrated actions via partnerships and planning

Working with nature

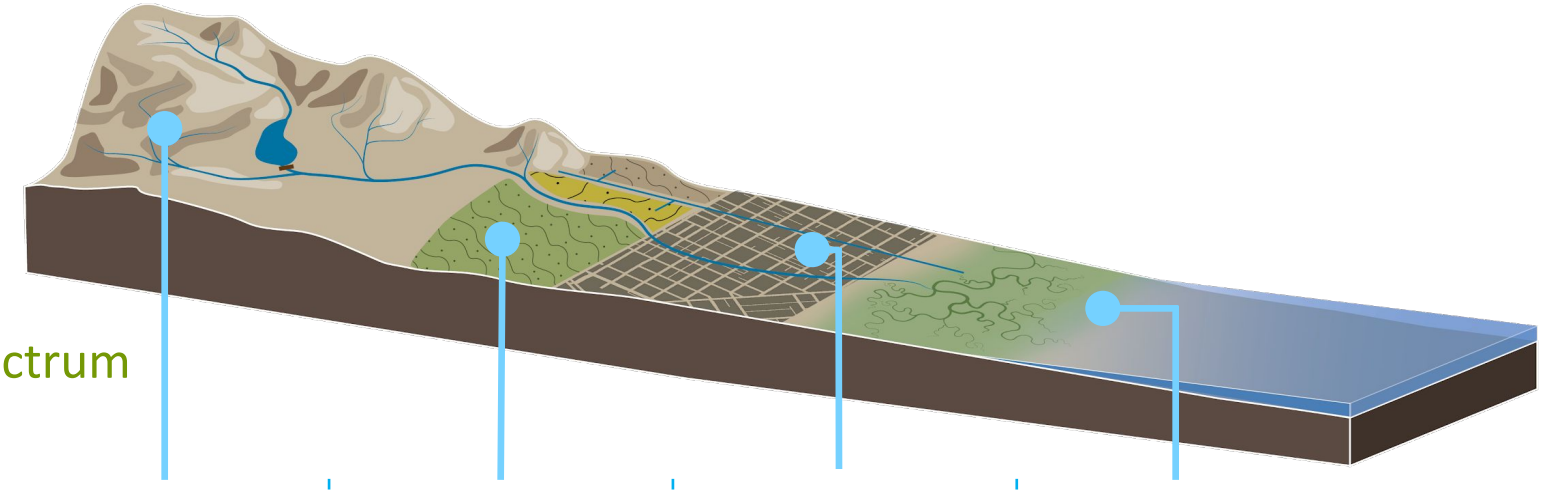
Across the land use spectrum



	WILDLANDS	AGRICULTURE	URBAN	SHORE
Nature-Based Solutions	Conservation/restoration Prevent development Fire management	Wildlife-friendly agriculture Hedgerows Prevent development	Native plant communities Mitigate barriers Floodplain restoration Creek realignment	Marshes Beaches Hybrid shorelines
Resulting Ecosystem Services	Water capture Carbon sequestration Biodiversity support	Water infiltration Habitat connectivity Pollination	Flood peak reduction Water quality improvement sediment transport	Shoreline protection Carbon sequestration Biodiversity support

WORKING WITH NATURE

across the lands-use spectrum



	WILDLANDS	AGRICULTURE	URBAN	SHORE
Nature-Based Solutions	Habitat conservation and restoration Prevent development Emulate fire disturbance	Wildlife-friendly agriculture Creek corridor restoration Prevent development	Native plant urban forest Mitigate barriers to wildife movement Creek realignment	Marshes Beaches Hybrid shorelines
Resulting Ecosystem Services	Water capture Carbon sequestration Manage wildfire risk	Water infiltration Habitat connectivity Pollination	Flood peak reduction Water quality benefits Sediment transport	Shoreline protection Carbon sequestration Water quality benefits

Project Goals

SFEI AQUATIC SCIENCE CENTER

Use archival and geophysical data to examine historical ecological, hydrological, and geomorphic patterns and local environmental variability within the Peninsula Watershed, with emphasis on terrestrial vegetation communities

Analyze and document landscape change over time and effects on desired ecological functions

Support SFPUC in identifying appropriate restoration targets and priorities

Inform watershed management activities related to water quality, vegetation, fire, sediment, wildlife, and public access