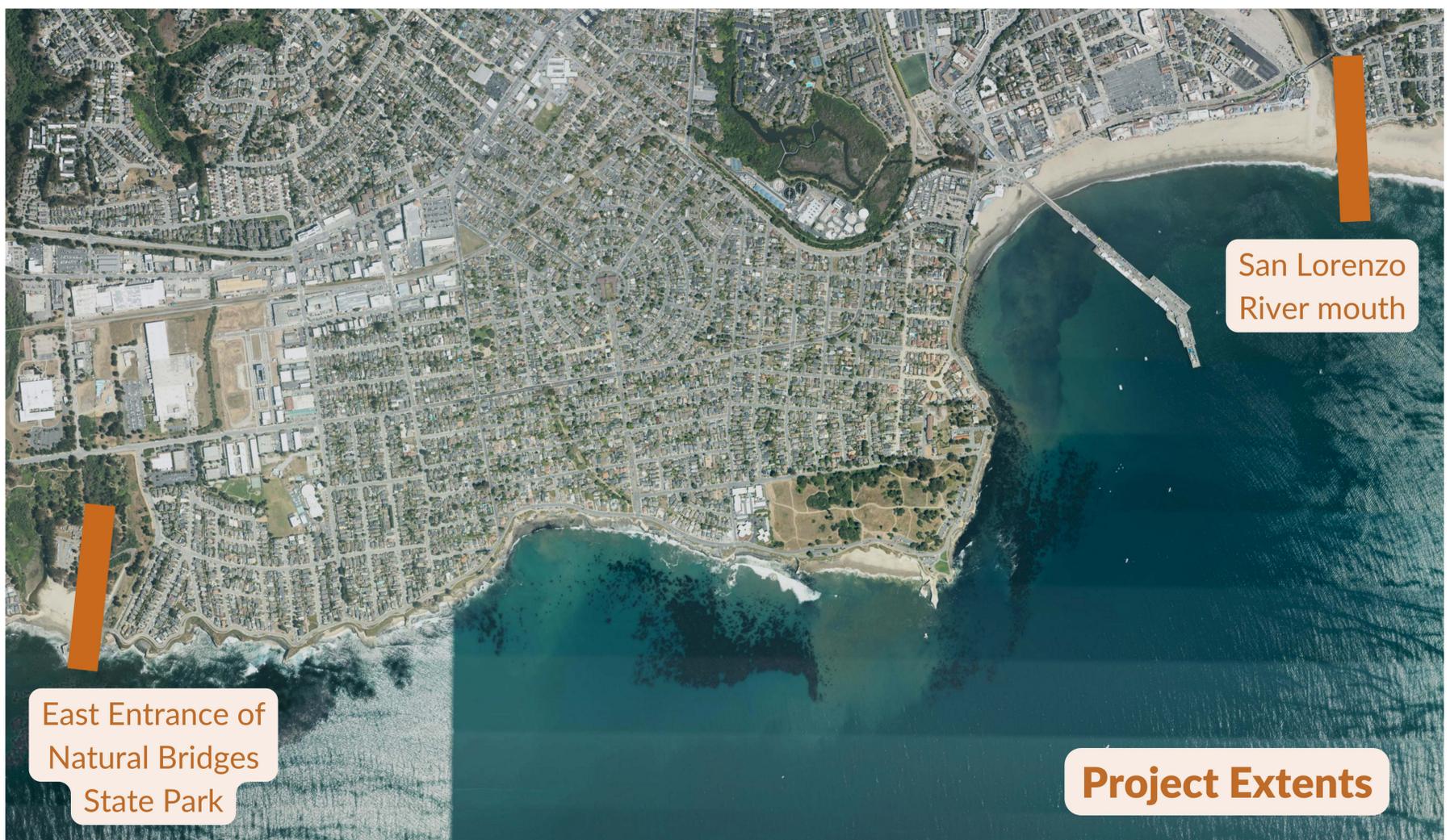


## WHAT IS OUR PROJECT?

We are conducting a feasibility study of nature-based solutions and sand management along the coastline from the east entrance of Natural Bridges State Park to the San Lorenzo River mouth. Nature-based solutions limit shoreline erosion and flooding or overtopping from high coastal water levels, and aim to preserve and enhance natural habitats. This study builds on prior work, will identify feasible nature-based solutions at various locations and offer recommendations for near and longer-term implementation. For the near-term recommendations, the project team will develop up to three conceptual designs. This project includes community engagement with focus groups, public events and a new virtual reality experience.



## WHAT ARE THE GOALS?

PROTECT FROM  
COASTAL HAZARDS

IMPROVE HABITAT

MAINTAIN COASTAL  
ACCESS

LEVERAGE LOCAL  
AND TRIBAL  
KNOWLEDGE

MAINTAIN  
RECREATION

CONSIDER PUBLIC  
SAFETY

CONSIDER  
ADAPTABILITY

# LIVING SHORELINES, NATURE-BASED SOLUTIONS, SAND MANAGEMENT FEASIBILITY STUDY

## SANTA CRUZ

### *What do we love about our coast?*

Nature. Otters. Beaches. Surfing. Sea Lions. Biking. Sunsets. Kayaking. Monarch Butterflies. Beach Volleyball. Tidepools. Sailing. Fishing. Boardwalk Strolling. Whales. Swimming. Lighthouses. Seabirds. Kelp Forests. Sunrises. And the list goes on...



## RICH IN COASTAL ACCESS, RECREATION AND BIODIVERSITY

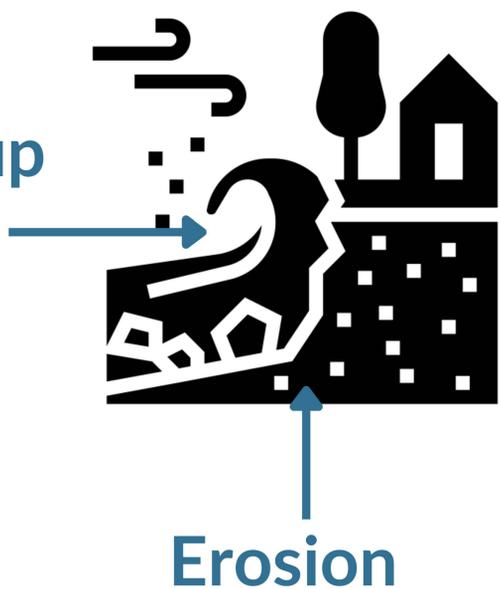
### **We've heard you. You love our coast!**

Nature-Based Solutions (aka Living Shorelines) incorporate natural features and processes to protect, conserve, restore, and manage the coastline and its ecosystems.

## COASTAL HAZARDS

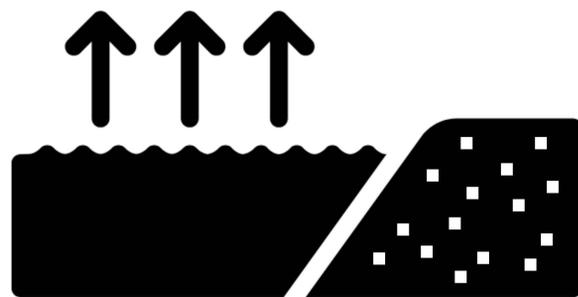
### Wave Runup

High tides and **wave runup** can cause flooding on the shoreline. Wave hazards will increase faster than sea level rise.



### Erosion

Wave action and stormwater runoff cause **cliff erosion**, while waves moving sand along the coast and offshore contribute to **beach erosion**.

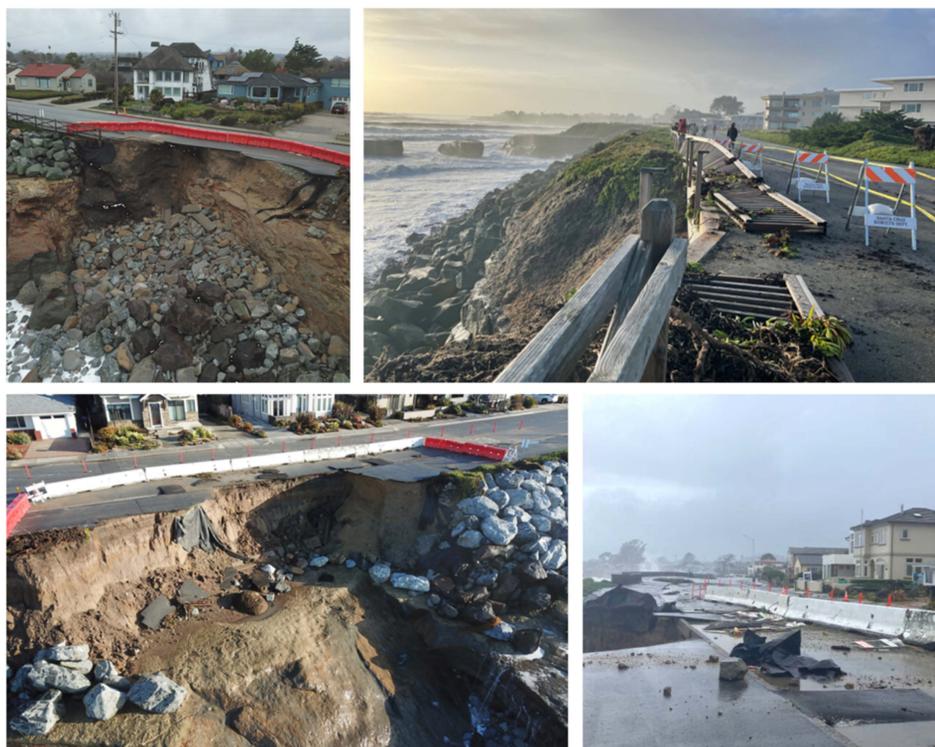


### Sea Level Rise

**Sea Level Rise** combined with wave action and high tides will increase the risk and intensify the impact of flooding and erosion along the shoreline.

## 2023 STORM EVENTS

In January 2023, large waves and extreme winds combined with very high tides (called King tides) caused extensive damage to the Santa Cruz area. 4,000 tons of riprap were displaced and 120 feet of pathway were destroyed. In December 2023, another storm with large waves added to the damage.



**WITH CLIMATE CHANGE AND SEA LEVEL RISE, THESE EVENTS WILL BECOME MORE COMMON AND MORE DAMAGING.**

## FUTURE VULNERABILITY WITH SEA LEVEL RISE



The vulnerability of each coastal segment is relative to other coastal segments, illustrating the combined vulnerability for flooding and erosion. In the case of blufftop locations, wave overtopping is considered flooding for the purpose of this analysis.

### Key Findings:

1. The segment from Woodrow Avenue to Columbia Street is highly vulnerable to wave overtopping and erosion.
2. Lighthouse Point and Its Beach are highly vulnerable to erosion.
3. Mitchell's Cove and Cowell/Main Beach are highly vulnerable to wave overtopping and flooding respectively.

Along with vulnerability to erosion and coastal flooding, project sites will also be chosen considering constraints, feasibility of nature-based solutions, and potential for project success. **See other posters for possible technically feasible options and to provide input on considerations and constraints.**

## WHAT ARE POSSIBLE NATURE-BASED SOLUTIONS?

### NATIVE PLANT RESTORATION



#### BENEFITS

- Limits erosion
- Improves habitat diversity
- Recruits sediment for dunes

#### FEASIBILITY

- Low cost
- Requires maintenance
- Vulnerable to strong storms

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### VEGETATED SAND DUNES



#### BENEFITS

- Limits erosion by absorbing wave energy
- Limits wave runup compared to walls and armor
- Co-exists with beach
- Increases habitat diversity

#### FEASIBILITY

- Needs wide, existing beach
- Needs ongoing maintenance

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### COBBLE BERMS



#### BENEFITS

- Limits erosion by absorbing wave energy
- Less wave runup compared to walls and rock armor
- Can coexist with beach
- Potential increase in habitat diversity

#### FEASIBILITY

- Minimum space requirements
- Less stable than rock armor

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### STORMWATER MANAGEMENT



#### BENEFITS

- Addresses rising groundwater
- Limits potential flooding from stormwater
- Limits bluff erosion

#### FEASIBILITY

- Relatively low cost (depends on extent of change)
- Low maintenance

## WHAT ARE POSSIBLE NATURE-BASED SOLUTIONS?

### LIVING BREAKWATERS/ARTIFICIAL REEFS



#### BENEFITS

- Limits erosion by 'tripping' waves offshore
- Can coexist with beach
- Potential increase in habitat diversity

#### FEASIBILITY

- High cost
- Difficult to construct
- May impact kelp beds

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### SAND MANAGEMENT



#### BENEFITS

- Can be paired with other solutions
- Maintains recreation and access
- Limits erosion during some events

#### FEASIBILITY

- Moderate cost
- Nearby examples for permitting
- Sand alone cannot defend against all events
- Requires maintenance/replenishment

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### SAND RETENTION WITH HEADLANDS



#### BENEFITS

- Potential to retain more sand
- Wider beaches can reduce wave erosion
- Headlands could be designed to improve habitat diversity

#### FEASIBILITY

- High cost
- Uncertain permitting pathway
- May impact subtidal habitats
- Sand will still erode in winter

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### GREEN-GRAY APPROACHES



We are also considering approaches that improve habitat along stretches of the coast that are currently armored with riprap or seawalls. These approaches contain a wide umbrella of designs (e.g. concrete tide pool units).

#### What about kelp?

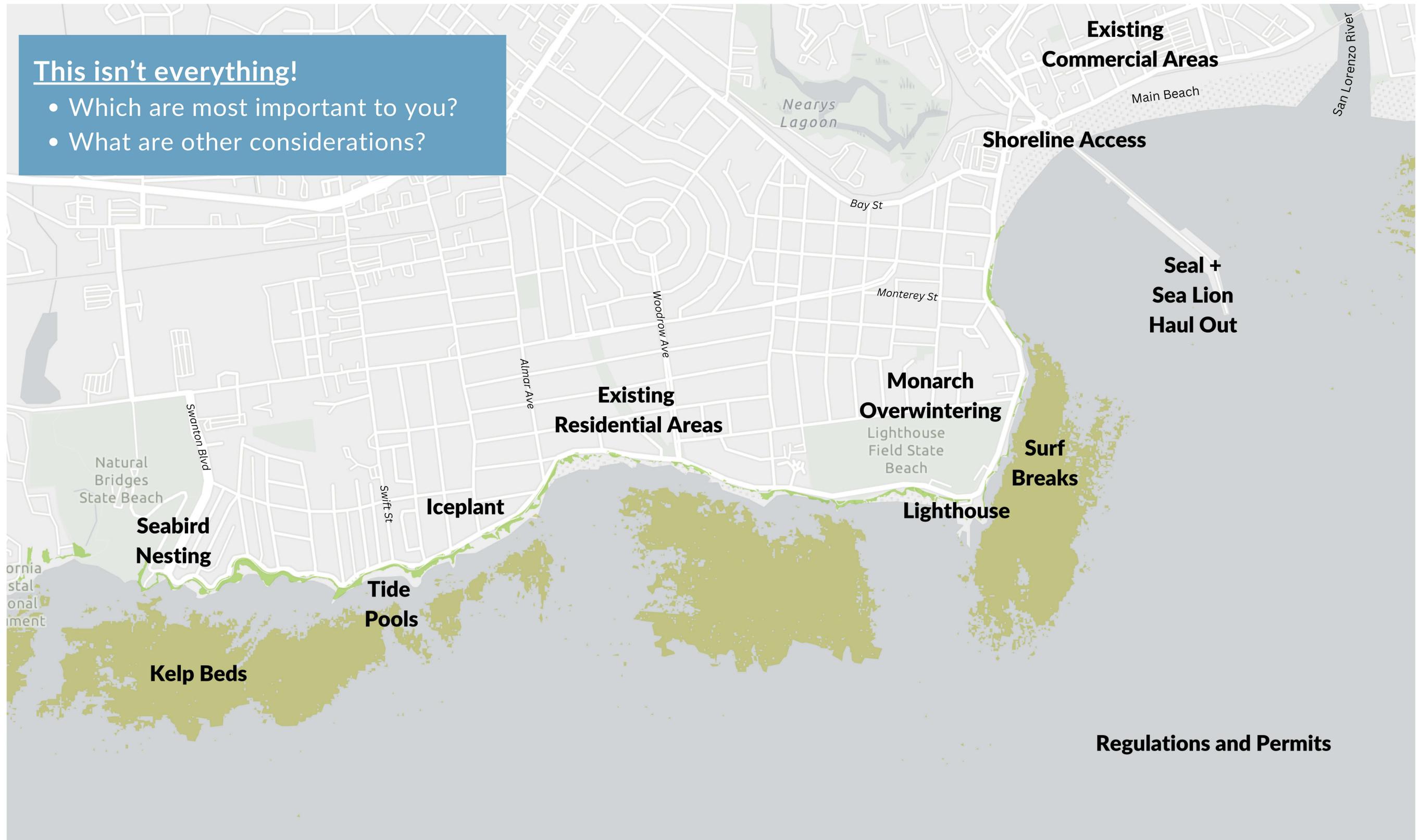
Our healthy kelp beds off the coast can help protect the shoreline from small, wind-driven waves. They cannot protect against large storm events with powerful waves. The location of these kelp beds impact the feasibility of certain nature-based solutions.



## CONSTRAINTS AND CONSIDERATIONS

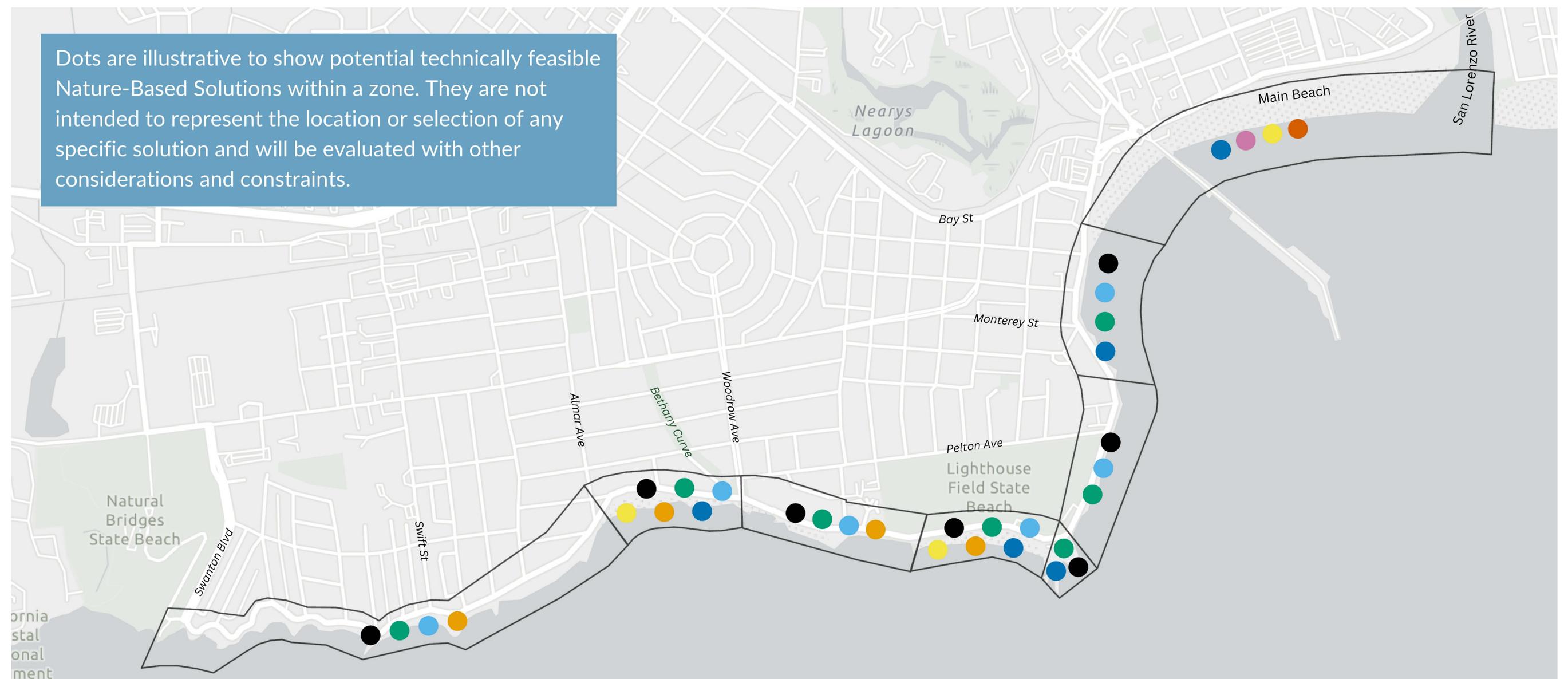
This isn't everything!

- Which are most important to you?
- What are other considerations?



## POSSIBLE NATURE-BASED SOLUTIONS

Dots are illustrative to show potential technically feasible Nature-Based Solutions within a zone. They are not intended to represent the location or selection of any specific solution and will be evaluated with other considerations and constraints.



Green-Gray Approaches



Native Plant Restoration



Stormwater Management



Living Breakwaters/  
Artificial Reefs



Cobble Berms



Sand Management



Sand Retention  
with Headland



Vegetated Sand Dunes