

# Designing for Resilience

For the Port of San Francisco Waterfront  
Waterfront Plan Update Workshop  
March 1, 2017



# Presentation Topics

Building the Seawall

Earthquake Vulnerability

Sea Level Rise & Flood Vulnerability

Resilience Solution Concepts



# Extent of the Seawall – 1878 to 1916

3 Miles

4 decades

500+ acres



Fisherman's  
Wharf

1850's Shoreline

Mission  
Creek

1878 - 1906

1906 - 1916

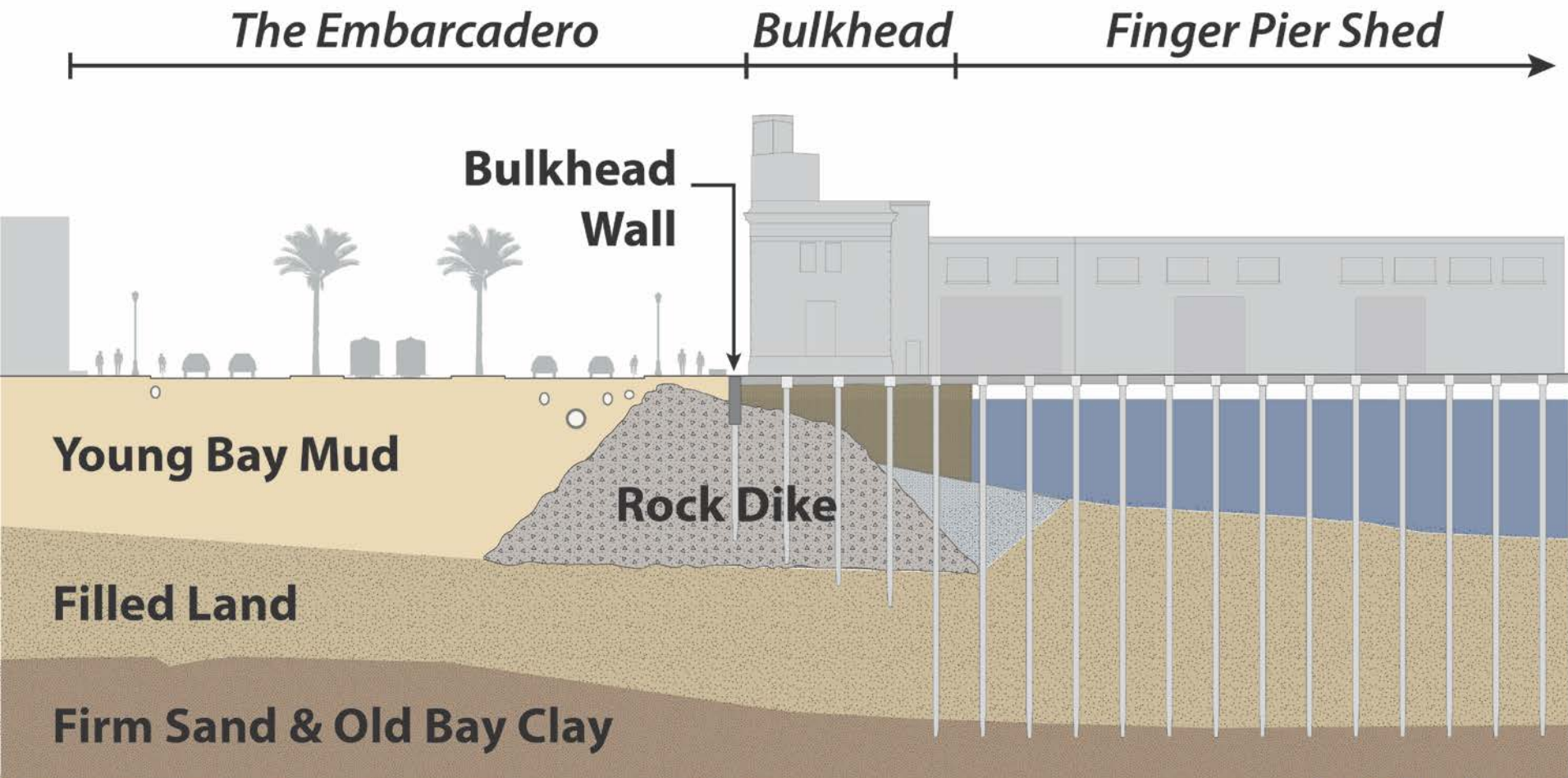


# Building Seawall and Piers 34 & 36 (1909)



## Building The Seawall

# Typical Construction



# Earthquake Vulnerability

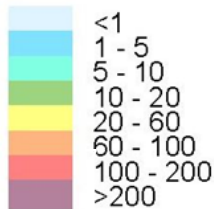
72% Probability of Major  
Earthquake by 2044



# Predicted Lateral Spreading



**Lateral Spreading Displacement, Inches**  
**M8.0 San Andreas (median) (approx. 20%/50yrs)**



# Sea Level Rise & Flood Vulnerability

Sea Level is Expected to  
Increase

12-24 Inches by 2050

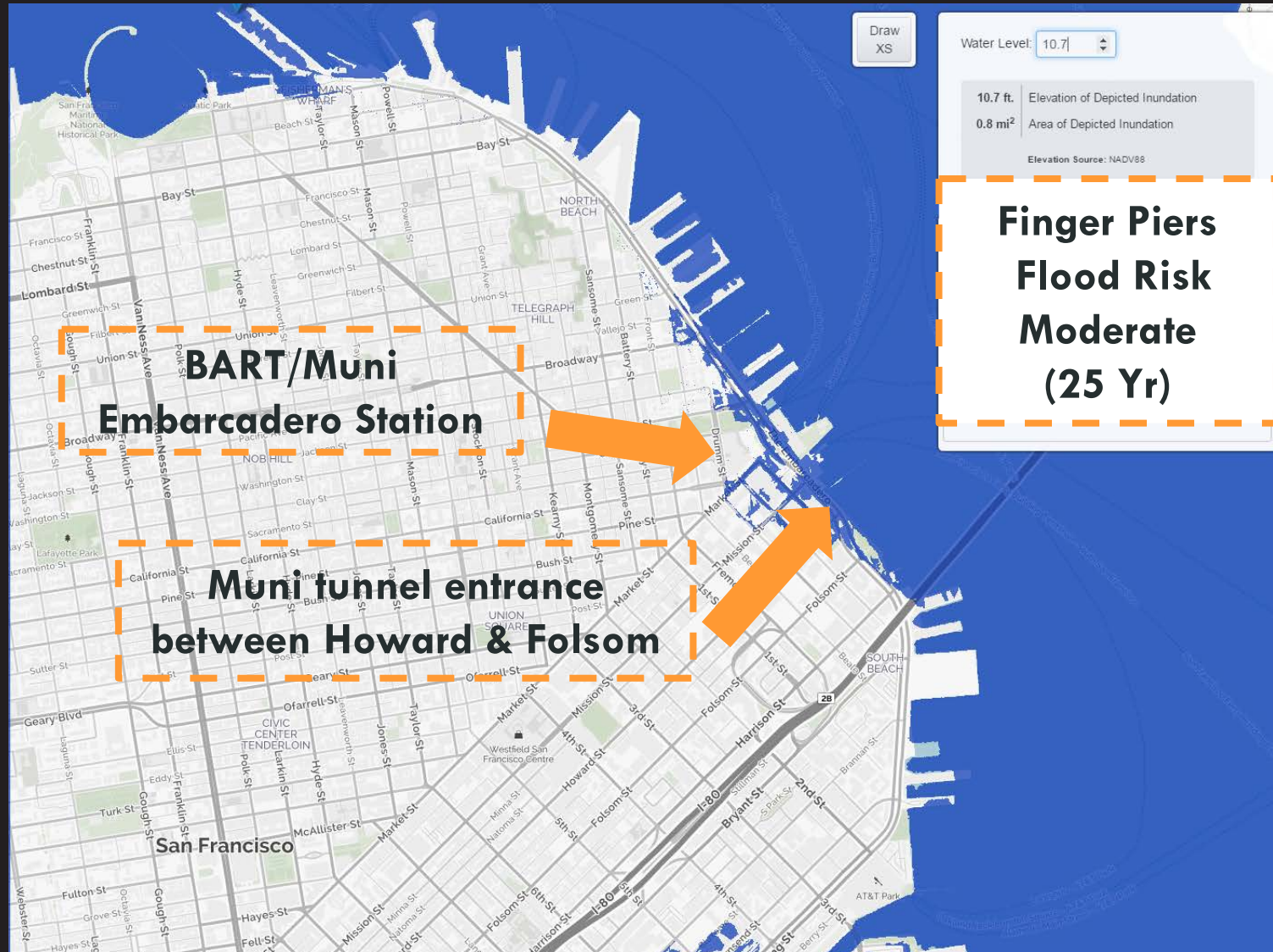
36-66 Inches by 2100



## Sea Level Rise

# 100 Year Flood Vulnerability

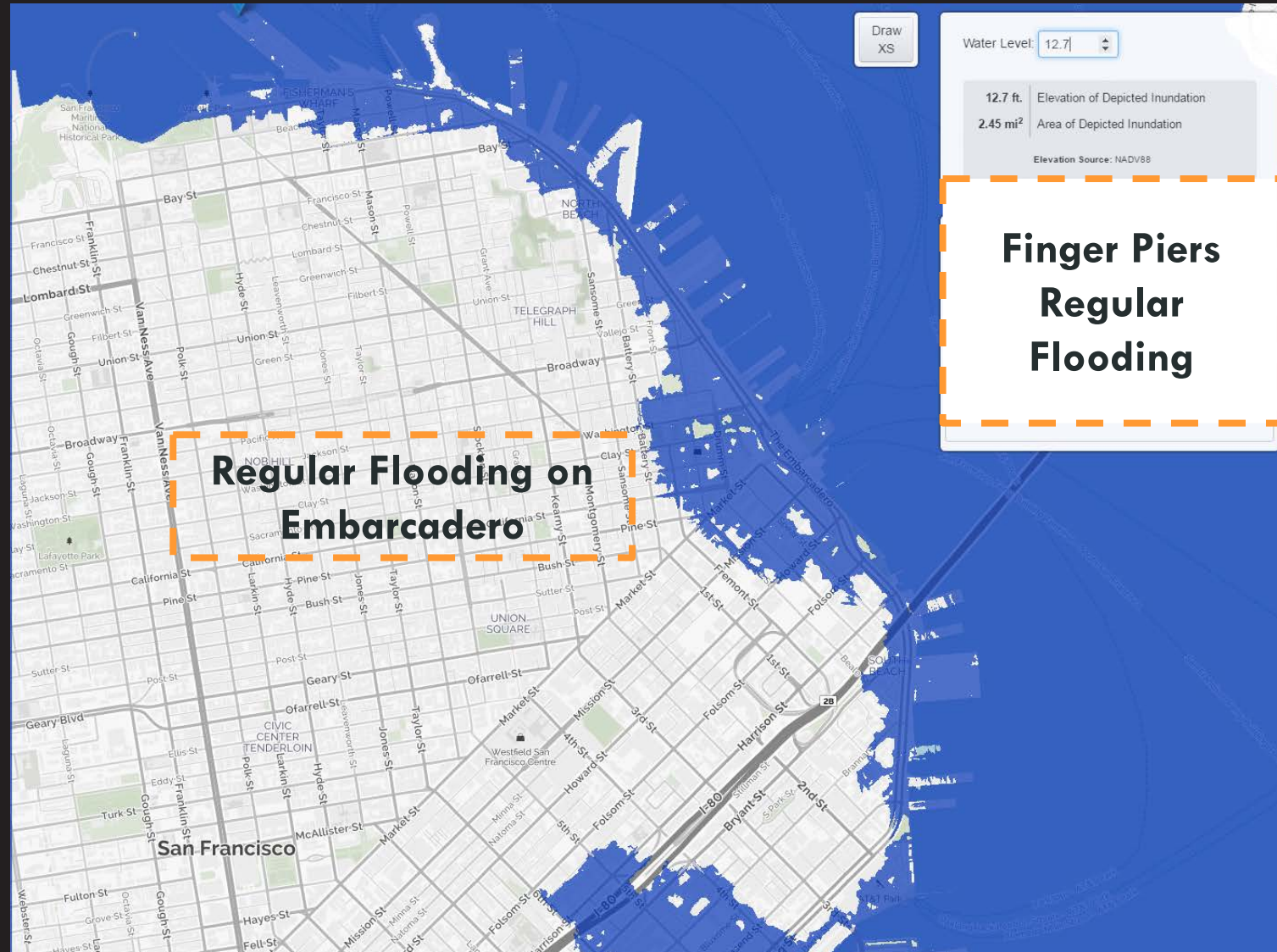
+12 inches | 2030 High Scenario | 2050 Likely Scenario



Sea Level Rise

# 100 Year Flood Vulnerability

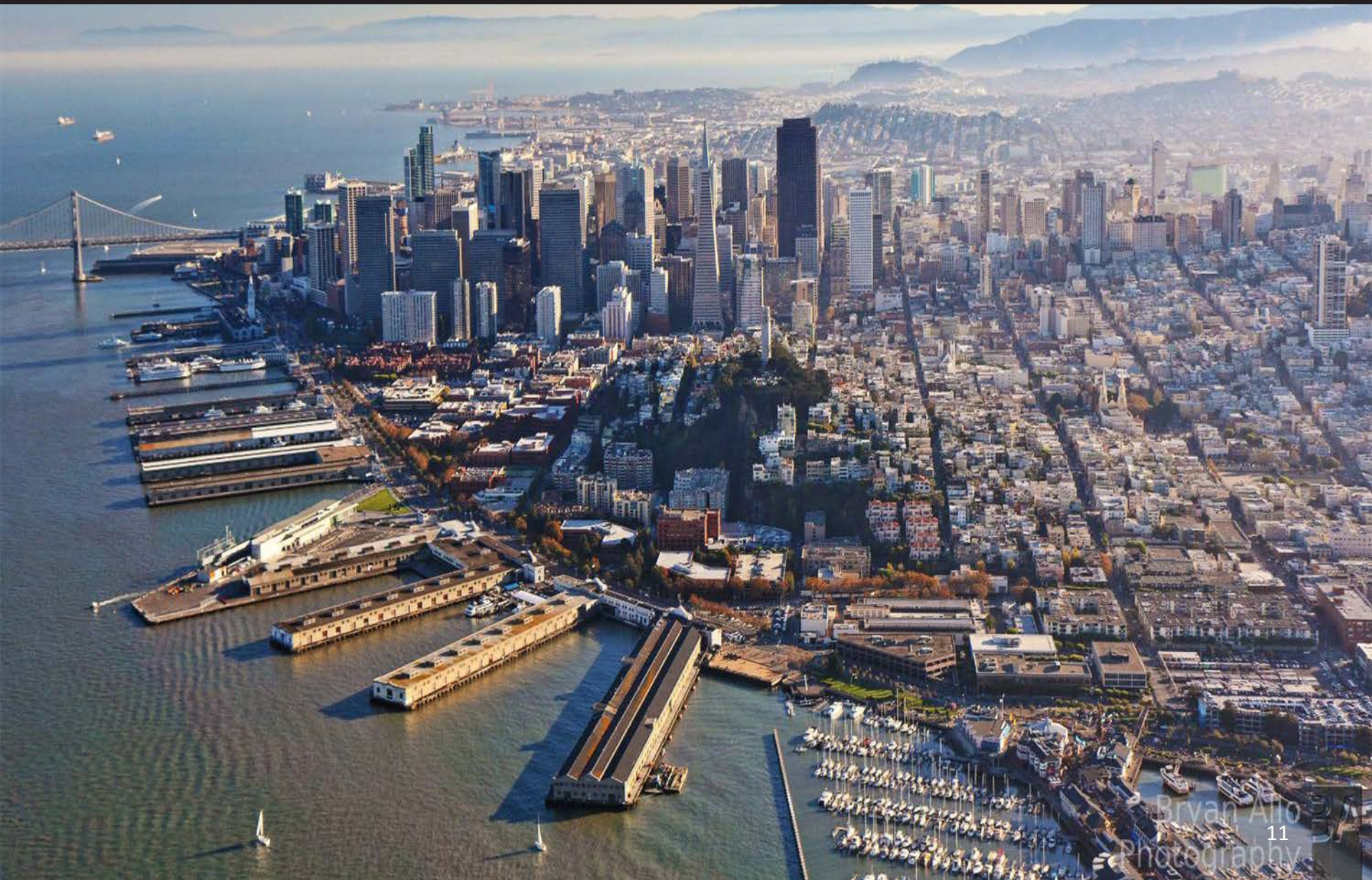
+36 inches | 2067 High Scenario | 2100 Likely Scenario





Impacts - Damage

# Embarcadero Historic District





# The Embarcadero & Bulkhead Buildings





Seawall Improvement Locations

# Embarcadero Roadway



# Below Bulkhead Buildings



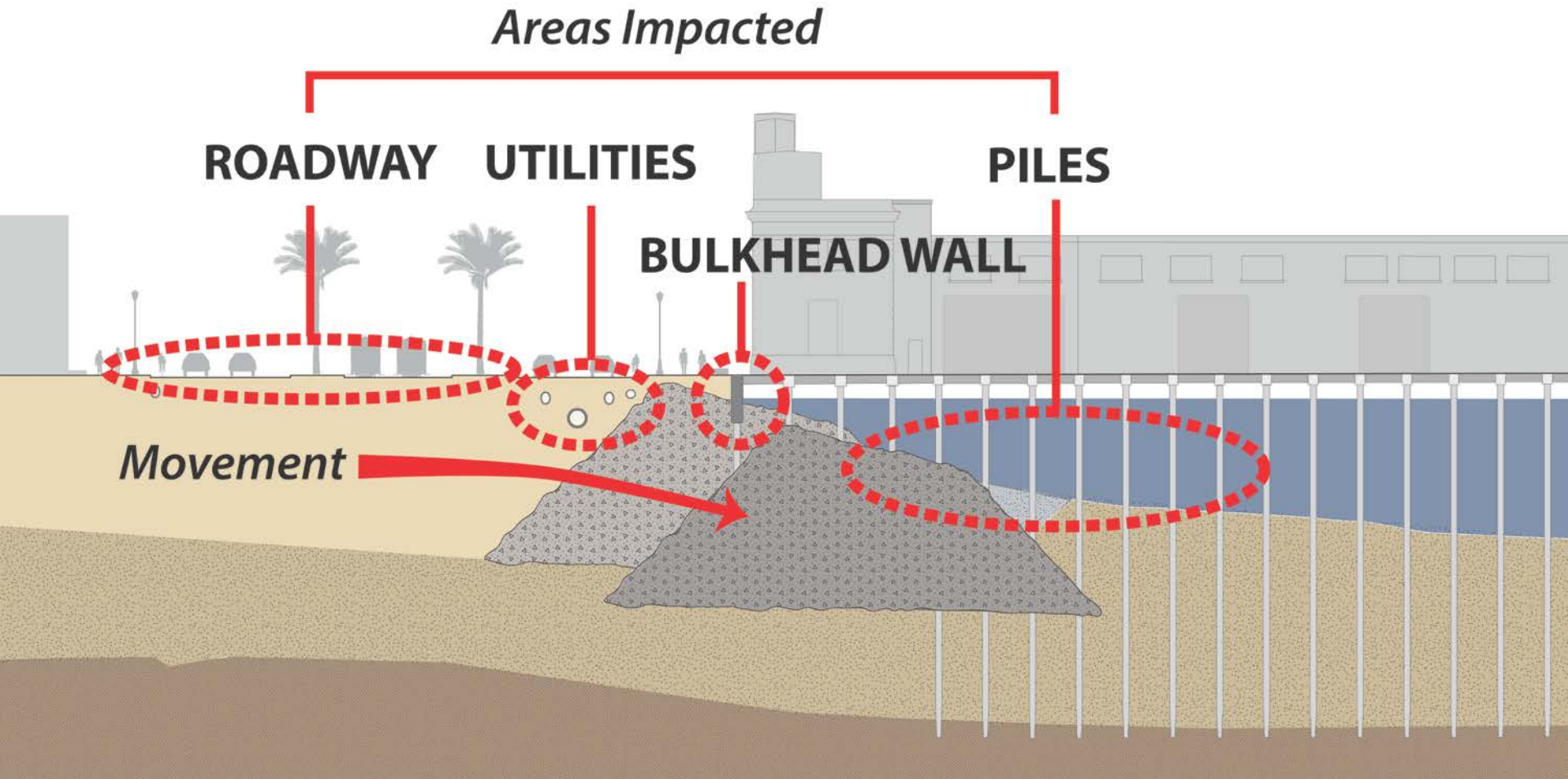


## Seawall Improvement Locations

# Bayward



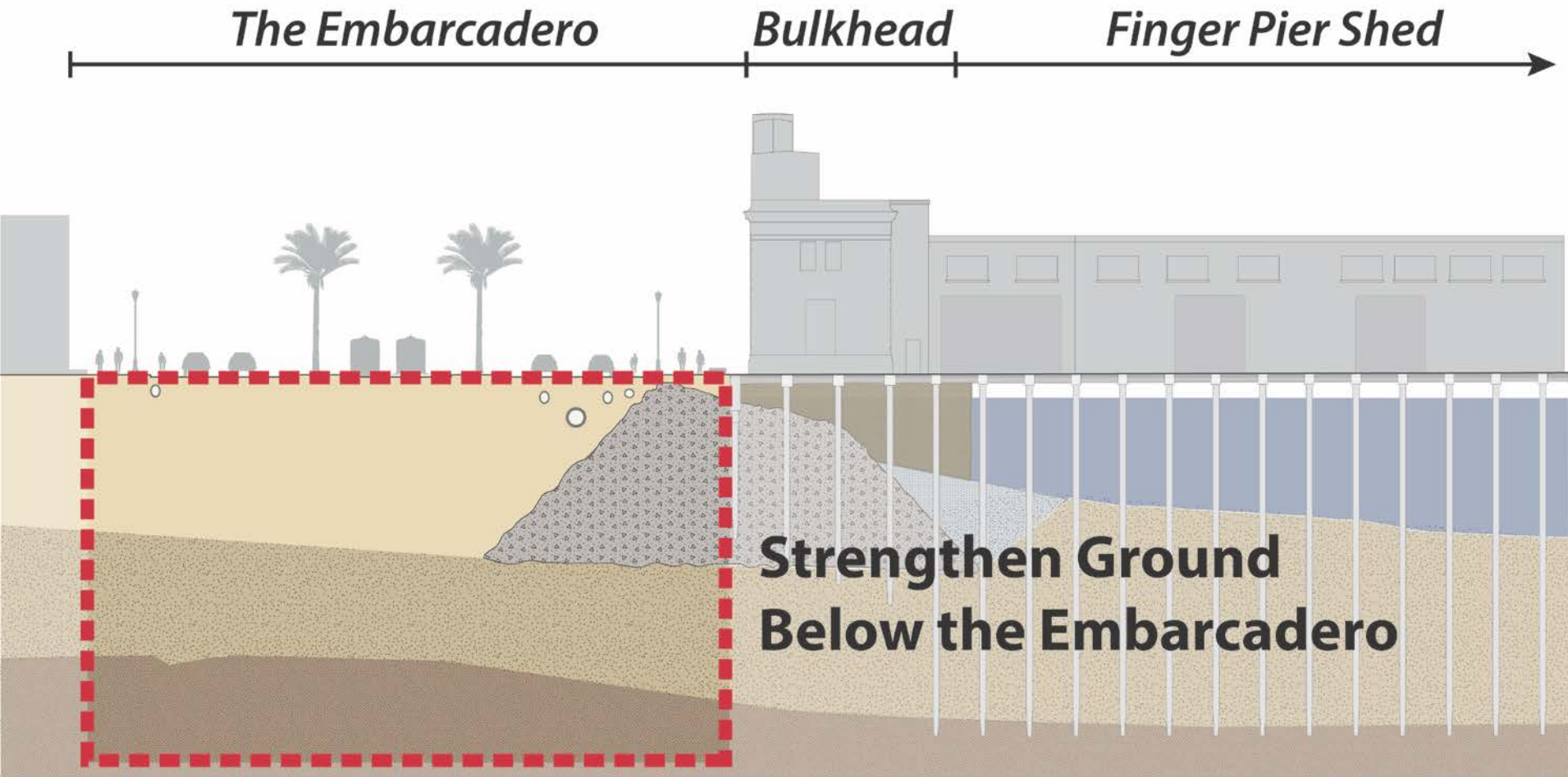
# Seawall Seismic Vulnerability



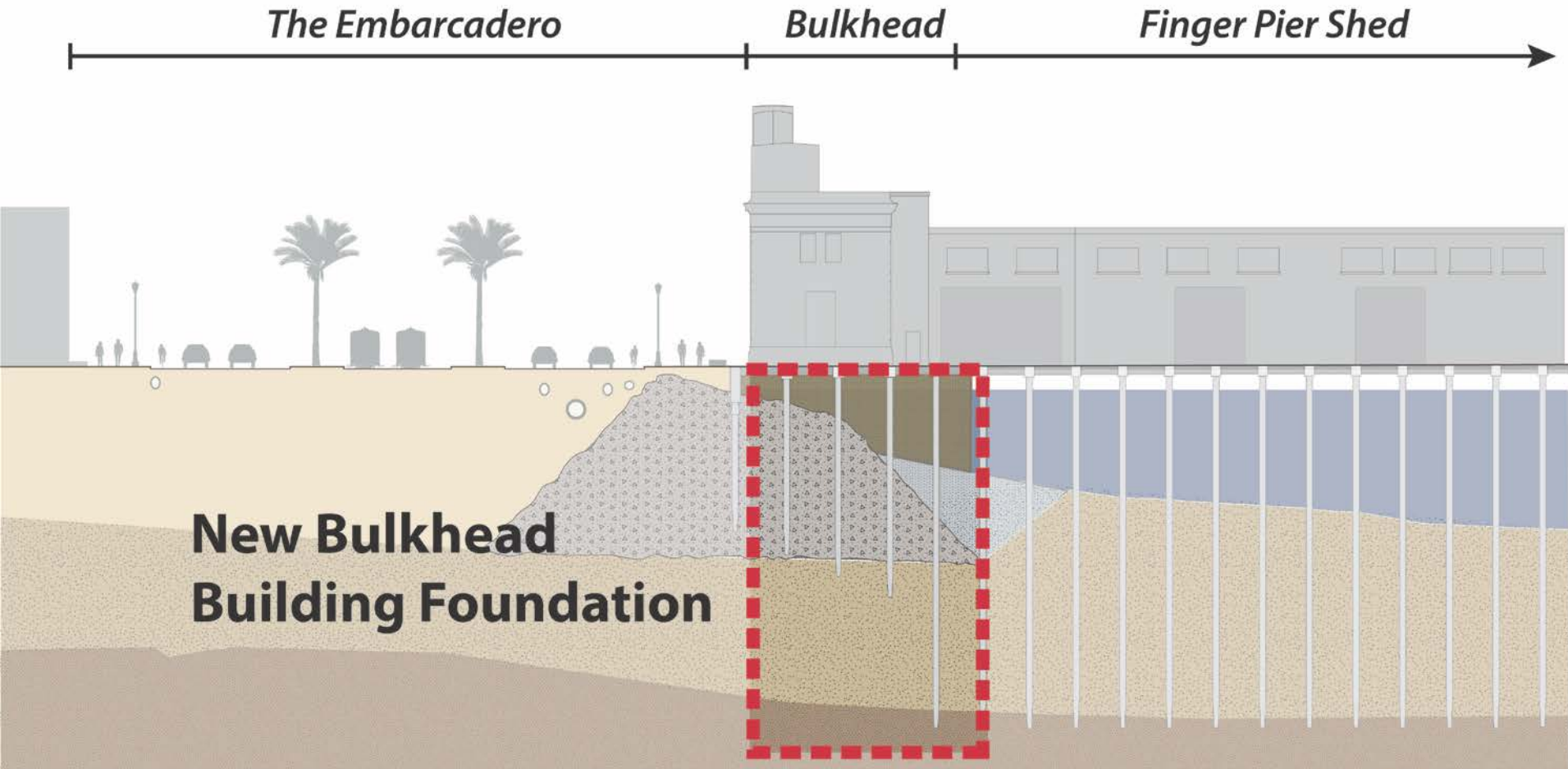


# Initial Concepts

# Seawall Improvement Locations

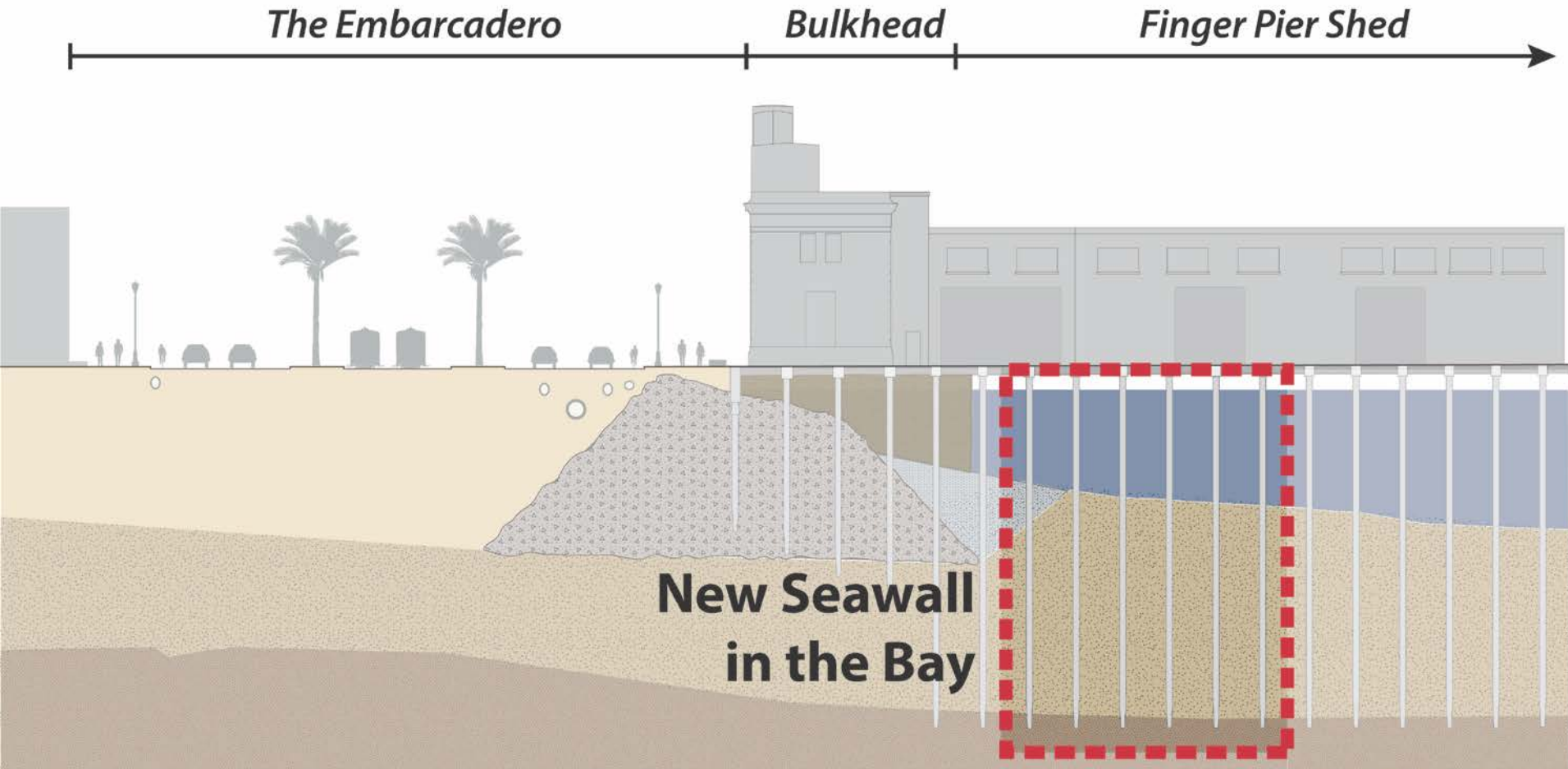


# Seawall Improvement Locations





# Seawall Improvement Locations

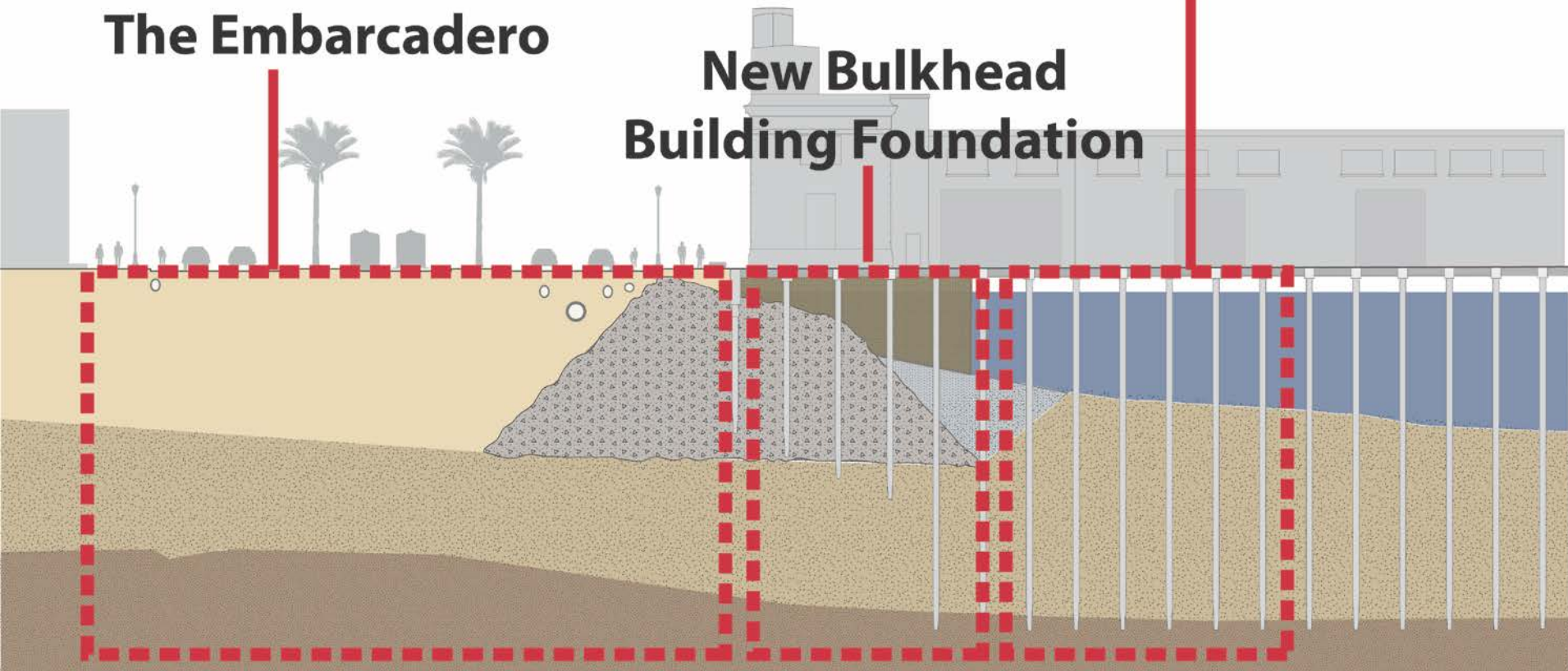


# Seawall Improvement Locations

**Strengthen  
Ground Below  
The Embarcadero**

**New Seawall  
in the Bay**

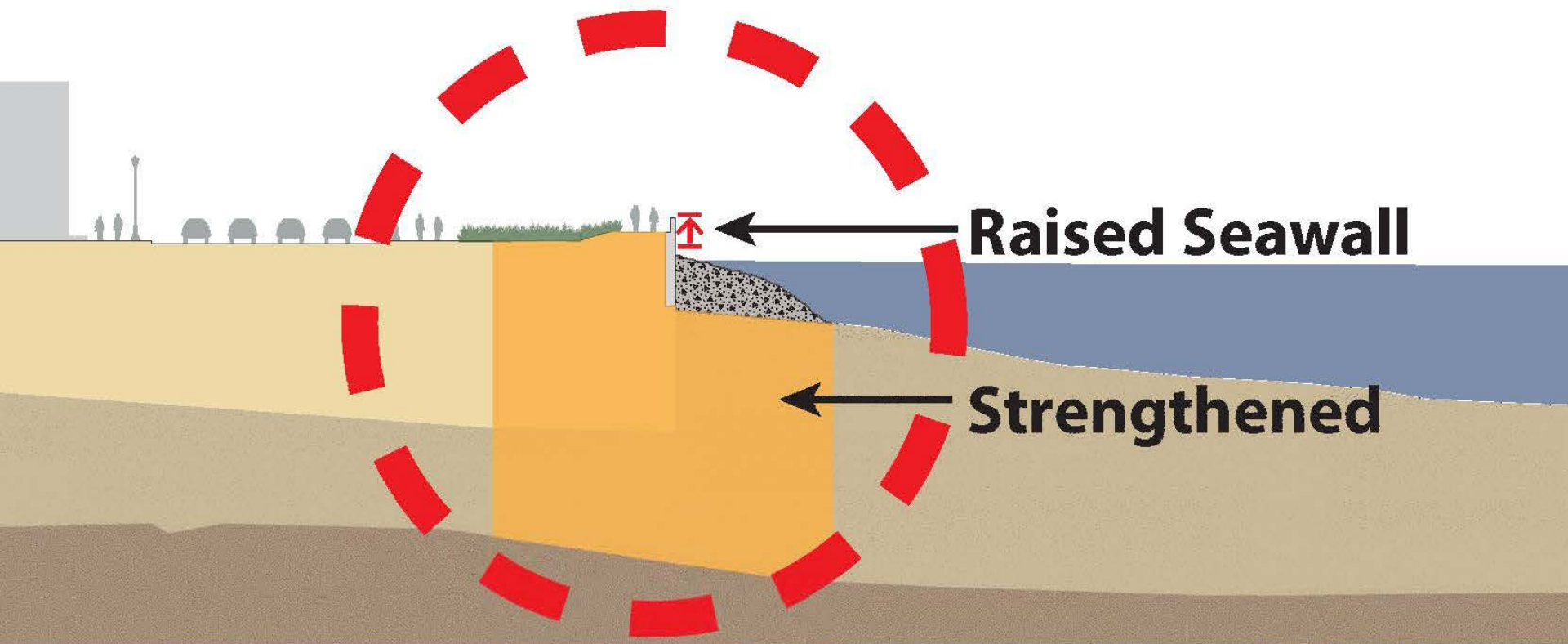
**New Bulkhead  
Building Foundation**



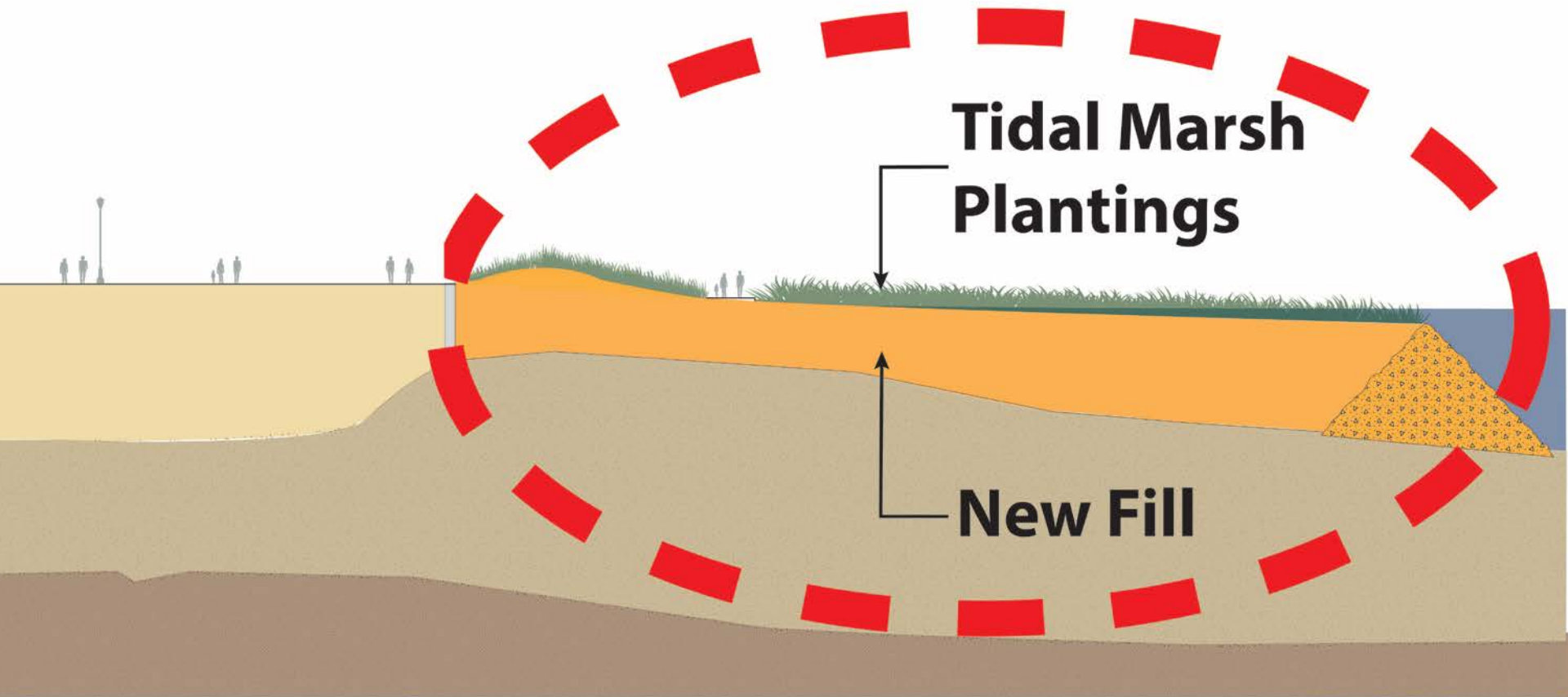
# Other Shoreline Conditions



# Armored Edge



# Living Shoreline







# Your Values for the Waterfront