SEAWALL EARTHQUAKE SAFETY PROGRAM

EERI June 29, 2018
Local Seismic Policy Panel

Steven Reel, PE
Seawall Program Manager
Port of San Francisco

Historic shoreline
Embarcadero Seawall
Port Jurisdiction
THE SEAWALL TRANSFORMED SAN FRANCISCO

- Built 1878 to 1915
- Rock dike & bulkhead
- 3 miles long
- 500 acres of filled land
- 126 acres pier & wharves
- Built to deep water
- Holds filled land in place
- Protects against flooding

ORIGINAL EMBARCADERO SEAWALL CONSTRUCTION

1. CHANNEL
2. ROCK ADDED
3. PILES + BULKHEAD WALL DRIVEN
4. TIMBER REPLACED WITH CONCRETE OVER TIME

1909
SAN FRANCISCO’S WATERFRONT TODAY

• Emergency response
• BART/Muni railway
• Utilities
• $100 billion in assets and activities
• Maritime facilities (Ferry, Water Taxi, Cruise Ship Terminal, etc.)
• Embarcadero Historic District
Seawall identified as one of the City's Top 5 most critical lifeline safety assets. Seismic and sea level rise vulnerabilities identified for further multi-hazard risk assessment to inform investment prioritization.

City sea level rise modeling identifies near-term flood risk, and maps rising tide and storm surge scenarios for years 2050 and 2100.

San Francisco establishes aggressive agenda for further sea level rise analysis, adaptation planning, and implementation.

Army of Corps of Engineers issues federal interest determination under its flood hazard mitigation authority.

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July 2016

Mayors Sea Level Rise Action Plan

March 2016

Seawall Earthquake Vulnerability Study

Seawall Earthquake Safety Program Created & Team Assembled

Dedicated Port team
Planning, Engineering, Environmental Consultant
Communications Consultant

June 2012

Lifelines Council Interdependency Study

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November 2016

Federal Interest Determination

November 2017

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April 2014

Sea Level Rise Inundation Analysis

Mayors Sea Level Rise Action Plan

July 2016

Seawall Earthquake Vulnerability Study

Seawall is found vulnerable to seismic hazards, posing risk to the City’s critical emergency response and lifeline assets.

November 2016

Federal Interest Determination

November 2017

Seawall Earthquake Safety Program Created & Team Assembled

Dedicated Port team
Planning, Engineering, Environmental Consultant
Communications Consultant

San Francisco establishes aggressive agenda for further sea level rise analysis, adaptation planning, and implementation.

July 2016

Mayor’s Sea Level Rise Action Plan

June 2012

Sea Level Rise Inundation Analysis

Lifelines Council Interdependency Study

Seawall identified as one of the City’s Top 5 most critical lifeline safety assets. Seismic and sea level rise vulnerabilities identified for further multi-hazard risk assessment to inform investment prioritization.
AGING INFRASTRUCTURE: DETERIORATION, SETTLEMENT, LIFE CYCLE STAGE
Lateral Spreading Displacement (Inches) – 975 yr Return Period

- 60-100 inches at Pier 27
- 20-60 inches much of Embarcadero
EARTHQUAKE RISK: COMMUNICATING GROUND FAILURE & NON-DUCTILE STRUCTURES

- EMBARCADERO CRACKS, UTILITIES RUPTURE
- BUILDING COLLAPSES
- BULKHEAD + WHARF FAIL

- LIQUEFACTION OF FILL
- STRONG GROUND SHAKING

- PILES FRACTURE
- FAILURE OF MUD BELOW DIKE
- DIKE SLIDES INTO BAY
<table>
<thead>
<tr>
<th>Current Condition</th>
<th>Future SLR Risk</th>
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**FLOOD RISK: CURRENT AND FUTURE FLOODING**

- Seawall supports the Embarcadero and provides flood protection
- Existing Embarcadero closures during king tide
- Muni and BART tunnels subject to flood risk
- CCSF sea level rise guidance:
  - 12”-24” by 2050
  - 36”-66” by 2100
Inundation Data:

Satellite Imagery:
Bing Maps
SEAWALL EARTHQUAKE SAFETY PROGRAM
(formerly Seawall Resiliency Program)

- $5B estimated total program, 25 years
- $500M critical upgrades by 2026
- Risk based decision making
SEAWALL EARTHQUAKE SAFETY PROGRAM: GOALS

1. Act quickly to improve disaster preparedness
2. Reduce earthquake damage
3. Improve flood resilience
4. Enhance the city & the bay
5. Preserve historic resources
6. Engage the community
WHY PRIORITIZE THE EMBARCADERO SEAWALL NOW?

THE SEAWALL IS A CRITICAL PART OF THE CITY’S NETWORK OF EMERGENCY RESPONSE

In the event of a major earthquake, the waterfront must be available for emergency response access. Ensuring the seismic reliability of the Seawall will allow the City to respond to a major disaster.

THE SEAWALL SUPPORTS AND PROTECTS IMPORTANT UTILITY INFRASTRUCTURE

This includes major wastewater, water, auxiliary water system, and power utilities.

THE SEAWALL IS KEY TO REGIONAL TRANSPORTATION

440,000 people arrive daily by boat at the Ferry Building or through the Transbay Tube on BART.

In addition, the Muni Metro system registers over half a million daily boardings on routes that terminate downtown.

$102.1B OF TOTAL ECONOMIC ACTIVITY AND $24.6B OF PROPERTY VALUE IS AT RISK FROM FAILURE OF THE SEAWALL

The value of assets at risk is 10–40x greater than the investment needed to strengthen the Seawall.
Seismic Hazards
• High risk today
• Increasing hazard over time
• No warning, life safety

Earthquake Risk

Flooding & Sea Level Rise
• Low risk today
• Increasing hazard over time
• Predictable events, warning
• Fundamental change by 2070 to 2100 due to increasing SLR rate and projections of 5+ ft

Multiple Hazards + Multiple Timeframes
SEA LEVEL RISE ADAPTATION STRATEGIES

- **+6’ SEA LEVEL RISE**
- **+3’ SEA LEVEL RISE**
- **CURRENT WATER LEVEL**

**RAISE/EXPAND LANDSCAPE EDGE**
PRIORITIZATION: SAMPLE EVALUATION CRITERIA

Life Safety

Emergency Response

Implementation Timeframe
Risk Avoided
Community and Social Benefits
Environmental Benefits

Minimize Disruption and Construction Impacts
Full infrastructure improvements are anticipated to cost up to $5 billion. The Port has identified potential sources for Phase I ($500 million) to address immediate life safety improvements including:

- $425 million City GO Bond Program
- $55 million State
- $10 million Federal
- $8 million Port of San Francisco
- $2 million San Francisco Municipal Transportation Agency and the Planning Department
Nearly ¾ of voters say they would vote “yes” on a bond measure to fund improvements to the Seawall.

<table>
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<tr>
<th>Response</th>
<th>Yes (%)</th>
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<tbody>
<tr>
<td>Definitely yes</td>
<td>37%</td>
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<tr>
<td>Probably yes</td>
<td>30%</td>
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<tr>
<td>Undecided, lean yes</td>
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<td>Probably no</td>
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<tr>
<td>Definitely no</td>
<td>14%</td>
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<tr>
<td>Undecided</td>
<td>11%</td>
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Total Yes: 75%

To protect San Francisco’s waterfront, BART and Muni tunnels, buildings, historic piers, and roads from earthquakes, flooding and rising sea levels by:

- repairing and upgrading the City’s 100-year old Seawall,
- strengthening the Embarcadero, and
- protecting critical transit infrastructure and utilities that provide water and power to residents and businesses,

shall the City of San Francisco issue $350 / $500 million in bonds, subject to independent citizen oversight and regular audits, with no increase in tax rates?

955 telephone/internet interviews with likely voters; English, Spanish, Chinese language speakers; January 11-21, 2018
STAKEHOLDER & COMMUNITY ENGAGEMENT

- Executive Steering Committee, City & Business
- Independent Seismic Peer Review Panel
- Resource Agency Working Group
- Quarterly Community Meetings
- Roadshows & Tours
- On-line Engagement

Stakeholder Groupings for Program Development

- City Partners
- Community Stakeholders
- Technical and Policy
- Tenants/Merchants/Businesses
- Regulatory
THANK YOU