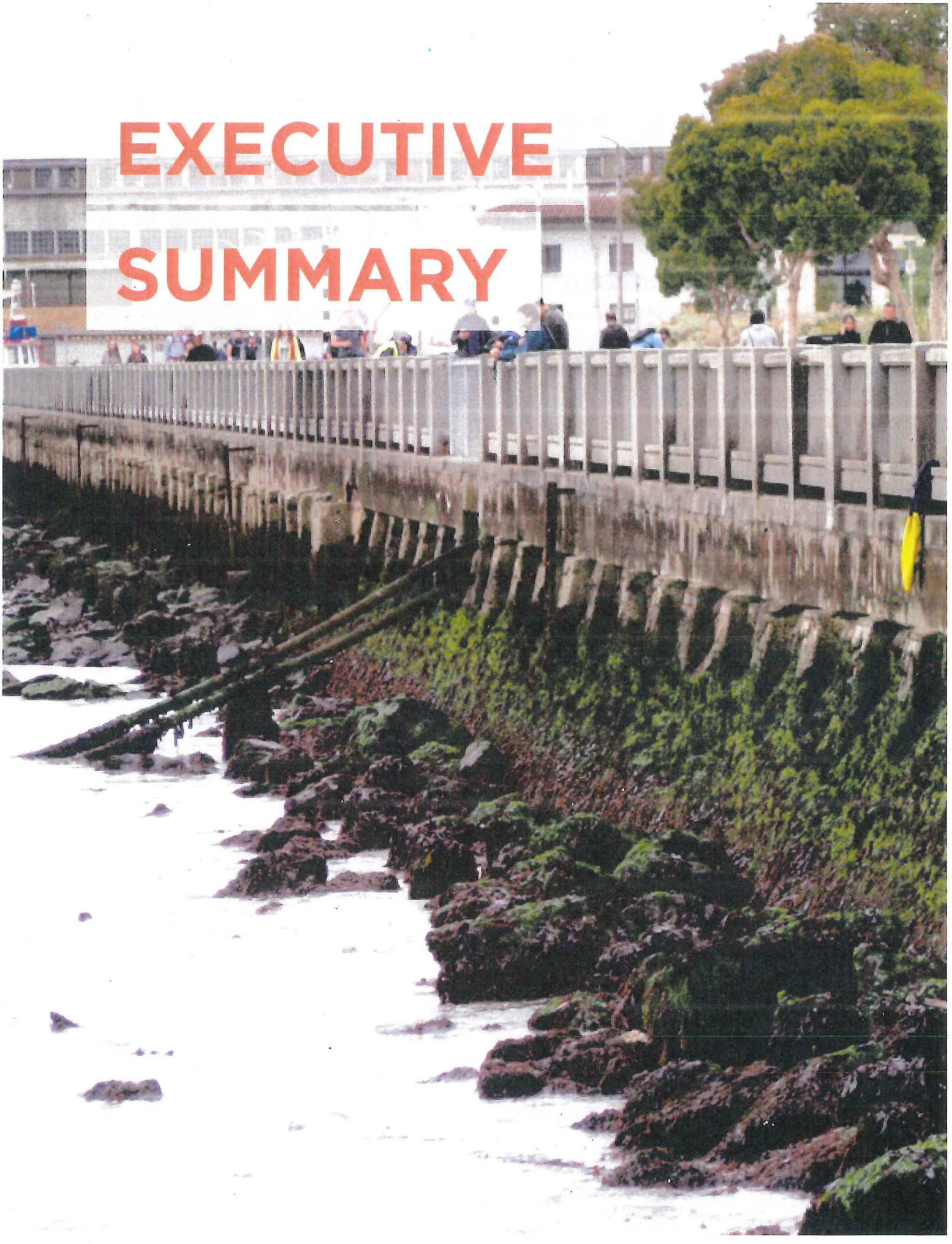
SEAWALL EARTHQUAKE SAFETY BOND REPORT

April 2018

sfseawall.com @portofsanfrancisco @sf_port @sfport

CONTENTS

EXECUTIVE SUMMARY



All of today's activity along the northern waterfront of San Francisco is made possible by the Embarcadero Seawall. The Seawall must be improved in order to withstand the next major earthquake and prepare San Francisco for increasing flood risk as sea levels rise.

Spanning three miles from Fisherman's Wharf to Mission Creek, the Seawall is one of San Francisco's oldest pieces of infrastructure. Constructed over 100 years ago by the State of California, the Seawall helped create over 500 acres of new land between San Francisco Bay and 1st Street.

The Seawall serves as the waterfront's foundation. It supports San Francisco's historic piers, wharves, local businesses, maritime uses, iconic tourist destinations, recreation facilities, and restaurants, which bring an estimated 24 million people to the waterfront annually. The Seawall also underpins key lifeline utility networks and infrastructure, including the Bay Area Rapid Transit (BART), Muni Metro, and ferry transportation networks. Additionally, the Seawall supports critical emergency response, evacuation, and recovery facilities and provides flood protection to downtown San Francisco neighborhoods. All told, the Seawall protects over $100 billion of assets and economic activity.

Recent analysis by the City of San Francisco (City) and the Port of San Francisco (Port) indicates that the Embarcadero Seawall will likely suffer significant damage during a major earthquake, causing widespread harm to the Embarcadero; historic buildings and piers; critical transportation, utility, and emergency response infrastructure; and the residents, workers, and visitors who depend on them. This seismic risk is compounded by the accelerating risk of flooding due to rising sea levels and subsidence. Today nuisance flooding impacts the Embarcadero and major storms pose flood risk to the Muni and BART underground transit systems.

The City, acting through the Port of San Francisco, launched the San Francisco Seawall Earthquake Safety and Disaster Prevention Program (Seawall Program), to improve earthquake safety and performance of the Embarcadero Seawall, provide near-term flood protection improvements, and plan for long-term resilience and sea level rise adaptation along the northern stretch of the City's waterfront. The first phase of the Seawall Program will address the most critical life-safety upgrades to the Seawall and is estimated to cost $500 million. The proposed $425 million Seawall Earthquake Safety Bond (Seawall Bond) will fund the majority of this work and leverage other funding sources including state, federal, and private funds.

The goals of the Seawall Program are to:

- Act quickly to improve disaster preparedness
- Reduce earthquake damage and disruption
- Improve flood resilience
- Enhance the City and the bay
- Preserve historic resources
- Engage the community

Seawall Bond funding will be used to develop the overall Seawall Program and to design and construct improvements that address the most significant seismic and flood risks to the most vulnerable and critical life-safety and emergency response assets along the Embarcadero. Construction of initial projects is scheduled for completion by the end of 2026. Possible improvements include strengthening the ground below and landside of the Seawall, constructing new Seawall segments, strengthening or replacing bulkhead walls and wharves along the Embarcadero Promenade, and relocating or replacing critical utilities.

The Port will develop and evaluate alternatives using criteria established with input from stakeholders and the community using a transparent and open process. To ensure that initial construction projects focus on the most critical life-safety and flood risk locations along the Seawall, the Program will include:

- Detailed seismic risk assessment of the Seawall and codependent infrastructure with an emphasis on life safety considerations.
- Detailed flood risk assessment with consideration of the most current sea level rise science and guidance.
- Close coordination with disaster and emergency response planners to assess facilities for importance to post disaster response and recovery operations.
- Close coordination with lifeline utility providers and codependent asset owners to assess system wide impacts caused by seawall failures.

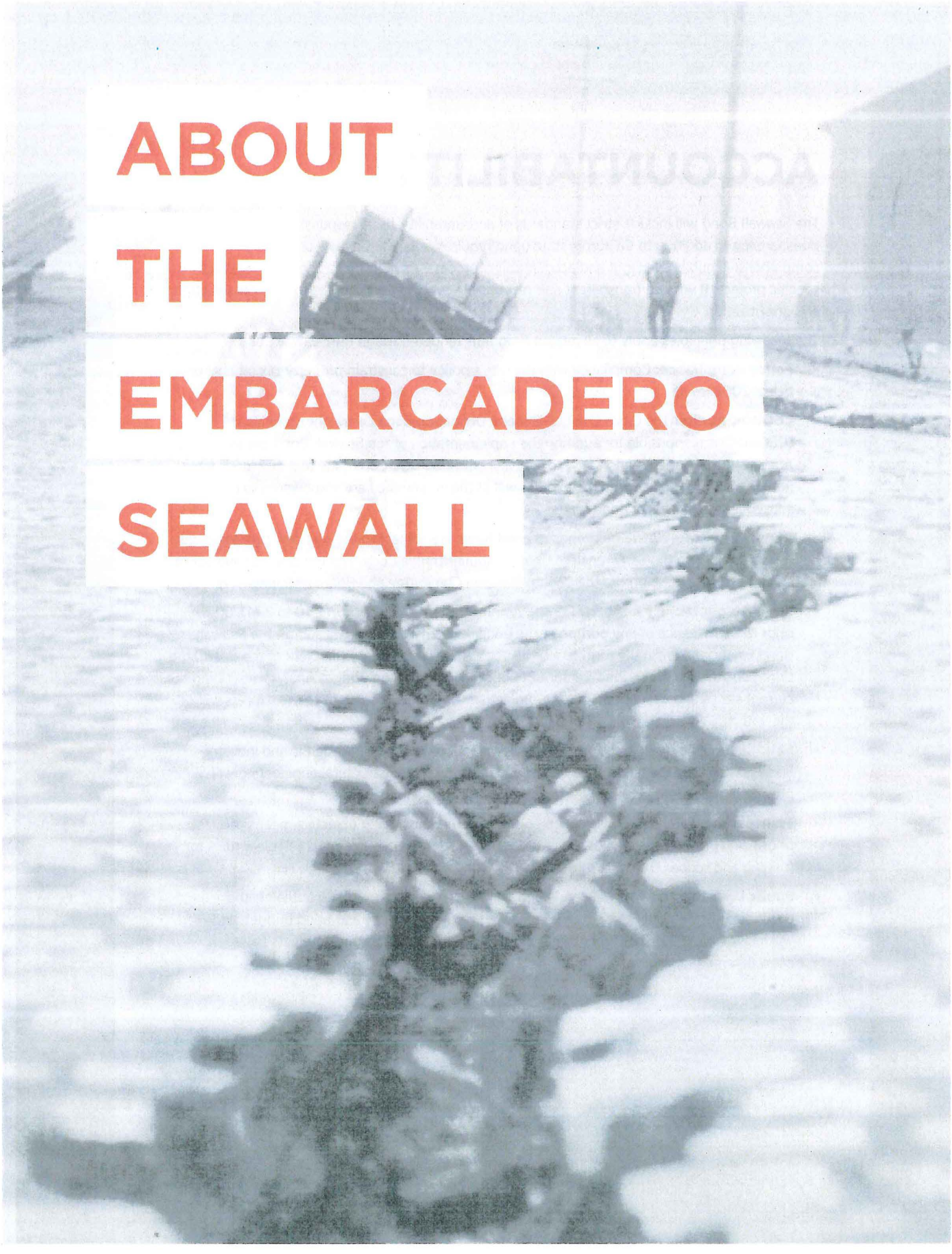
The Seawall Bond will include strict standards of accountability, fiscal responsibility, and transparency. Annual public review before multiple public bodies, bond accountability reports, seismic peer review, and public updates will ensure policy compliance and transparency in the Program's delivery.

ACCOUNTABILITY

The Seawall Bond will include strict standards of accountability, fiscal responsibility, and transparency. In addition to California state bond requirements, the City will undergo a comprehensive public oversight and accountability process. As the City has not yet identified specific projects it will use transparent and responsible oversight procedures for project selection and prioritization.

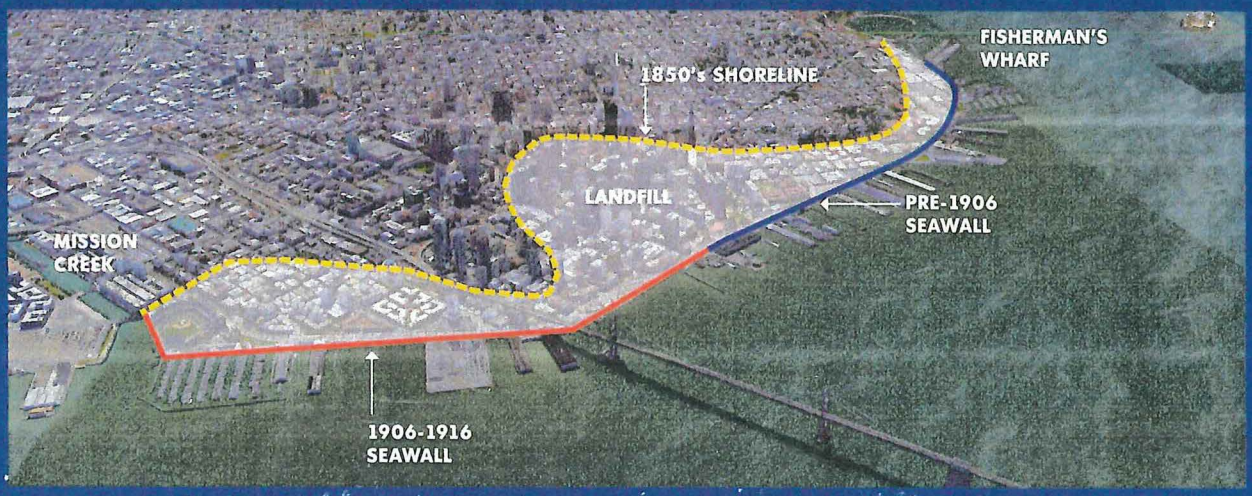
The following principles apply to all related programs funded through the Seawall Bond:

- **Policy Compliance:** Compliance with the City's policy to constrain property tax rates at or below 2006 levels
- **CGOBOC Audits:** The City's Citizens' General Obligation Bond Oversight Committee (CGOBOC) is responsible for auditing the implementation of the Seawall Bond per the Administrative Code (Section 5.30 to 5.36). Should CGOBOC determine that any funds were not spent in accordance with the express will of the voters, they are empowered to deny subsequent issuances of bond funds.
- **Annual Public Review:** The proposed bond funds are subject to the approval processes and rules described in the San Francisco Charter Administrative Code. The bond will be subject to annual public reviews before the Capital Planning Committee and Board of Supervisors.
- **Bond Accountability Reports:** Per the Administrative Code (Section 2.70 to 2.74), 60 days prior to the issuance of any portion of the bond authority, the Port will submit the Seawall Bond Financial Plan, in the form of a bond accountability report, to the Clerk of the Board, the Controller, the Treasurer, the Director of Public Finance, and the Budget Analyst describing the current status and description of each project and whether it conforms to the express will of the voters.
- **Seismic Peer Review:** A seismic peer review panel composed of academic and industry-leading experts in the fields of earthquake, geotechnical, and structural engineering will provide independent technical oversight of approaches and decisions.
- **Transparency:** Transparent selection criteria and rules, including objective means of prioritizing projects through use of criteria that are identified in the bond and clear rules for funding and scope.
- **Public Updates:** The Port will create and maintain a dedicated website outlining and describing the Seawall Bond program, progress, activity updates and bond budget, and will include project names and estimated construction schedules once projects have been determined.



ABOUT THE EMBARCADERO SEAWALL

THE SEAWALL CREATED 500+ ACRES OF NEW LAND



The Seawall makes possible all buildings, infrastructure, and activity along the northern waterfront-extending back to 1st Street.

San Francisco's Invisible Support

The Seawall's position underpinning the waterfront adjacent to the bay renders it largely invisible. The Embarcadero Seawall was built by dredging a trench through the mud, filling that trench with rock and rubble, capping the fill with a timber pile bulkhead wall and wharf, and then filling the tidal marshland area behind the Seawall. The Seawall acts as a retaining wall, stabilizing the filled land behind it. In addition to establishing and supporting the waterfront, the Seawall protects the City from flooding in the event of storm events and extremely high tides.

This vital but unseen piece of San Francisco infrastructure needs help. The Embarcadero Seawall was designed and constructed before the advent of modern engineering and the development of techniques that address seismic forces and soil liquefaction. Investigation by the Port shows that the Seawall has aged and settled and no longer offers the same level of protection it did when new.

The Seawall supports key utility networks and infrastructure, including the BART, Muni and ferry transportation systems and serves as a critical emergency response, evacuation and recovery area for the City and the region. If this critical piece of infrastructure were to fail, everyone in the Bay Area could be at risk. Downtown San Francisco and the Financial District could flood, damaging BART and Muni and creating service disruptions that strand hundreds of thousands of people and disproportionately affect the City's most vulnerable populations. A third of all BART riders and half of Muni's riders are characterized as low-income. Both systems enable large numbers of economically diverse workers to commute to their jobs across the Bay Area.

In addition to transit system failures, damage to the Seawall could cause utility systems to fail, disrupting power, sewer, water and communications service to residents and businesses. The City could also lose access to infrastructure necessary for emergency response and post-disaster evacuation. All told, San Francisco could suffer billions of dollars in property damage, economic disruption, and lost tax revenue in the event of a disaster affecting the Seawall.

Though it may be difficult to imagine today, San Francisco's waterfront was once a relatively quiet place. Just eleven ships dropped anchor in San Francisco Bay between April 1847 and April 1848. Conceived by the State of California

History & Today's Risks

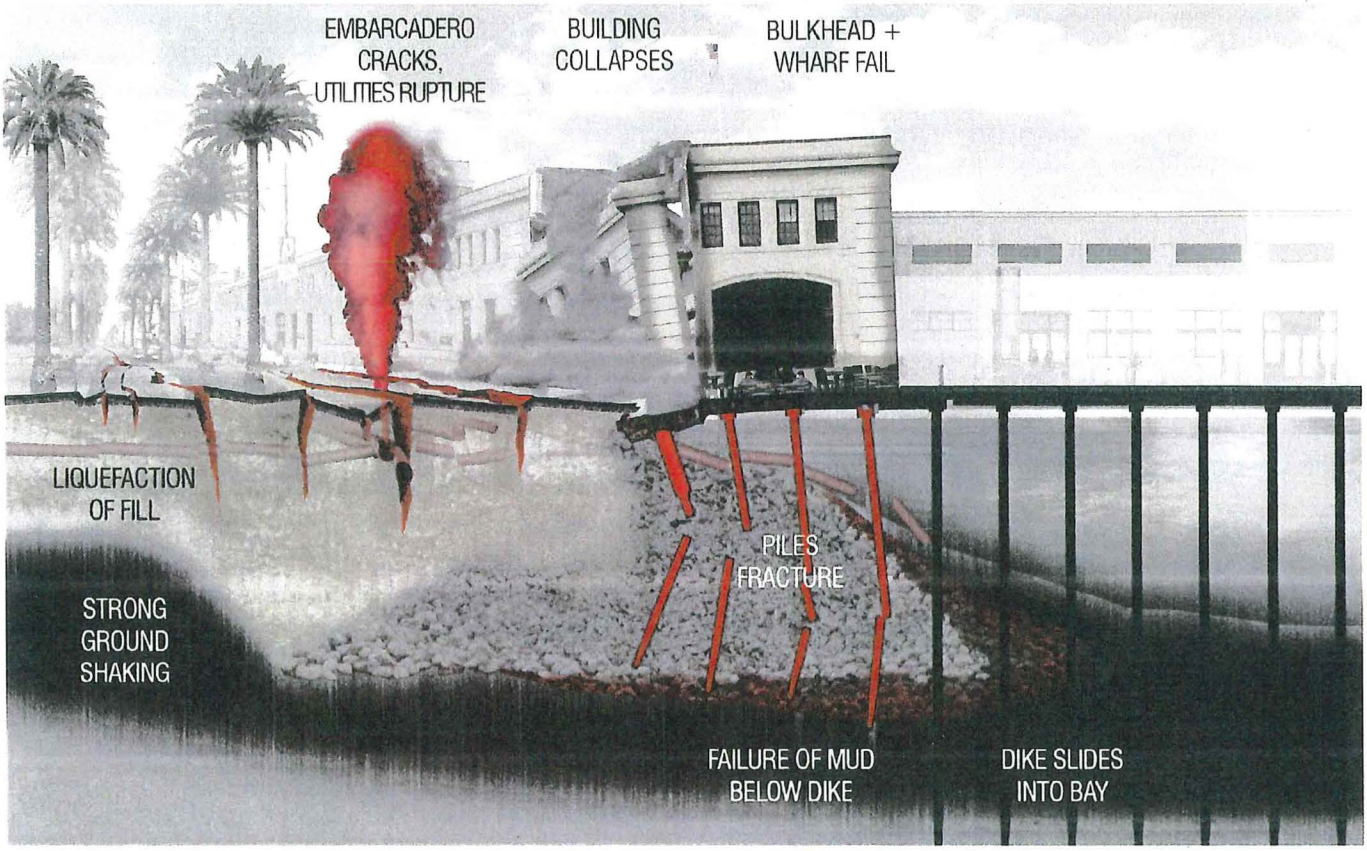
in the 1870s and completed in the 1910s, the Embarcadero Seawall transformed three miles of shallow tidelands into a world-class deep water port that propelled San Francisco's development and prosperity.

The San Francisco waterfront took shape during Seawall construction with the development of pile-supported bulkhead wharves and buildings and piers extending out into the bay. During this period, the City also completed other key projects that would come to define San Francisco, including the Ferry Building, erected in 1898. Many of the facilities built along and on top of the Seawall during this period make up the Embarcadero Historic District which has been on the National Register of Historic Places since 2006.

The Embarcadero waterfront is now an essential part of San Francisco's identity, and provides a home to businesses both large and small, the National Historic District, a thriving maritime and tourism industry, the City's Financial District, a regional transportation network hub, and parks and open spaces.

In 2014, the City's Lifelines Council completed an Interdependency Study that identified the Seawall as one of the City's five most critical lifeline safety assets. Lifelines are defined as utilities that provide essential infrastructure services to the community and include water, wastewater, power, communication and transportation. The report concluded that the Seawall would be at risk of failure in an earthquake and recommended that the Port improve Seawall seismic safety while concurrently addressing sea level rise due to the effects of climate change. The report also recommended that the Port conduct a more detailed multi-hazard risk assessment to refine analysis of the Seawall's vulnerabilities and inform project prioritization and design criteria.

In response to this study, the Port conducted preliminary seismic and flooding analyses in 2016. A broad, screening-level seismic analysis found that the Seawall is highly vulnerable to widespread damage from a major earthquake. Work to map flooding showed that the Seawall is also vulnerable to overtopping from storm events and high tides, with increasing flood risk as sea levels rise in the coming decades.



Earthquakes

The Embarcadero Seawall faces immediate earthquake risks. The United States Geological Survey (USGS) estimates that there is a 72 percent chance of a 6.7 or greater magnitude earthquake striking the Bay Area in the next 25 years. The Seawall was built prior to the development of modern engineering and an understanding of seismic forces and liquefaction. The City now knows that the bay fill used to create the land behind the Seawall is susceptible to liquefaction during earthquakes. The Port's analysis found that in a major earthquake, the Embarcadero Seawall will slide bayward, potentially by as much as five feet, due to the pressure of the liquefied soils behind it and the failure of weak bay mud below it. This movement will likely damage the Embarcadero Roadway and Promenade and utilities and regional transportation infrastructure, and cause localized failure of wharves and the bulkhead buildings at the heads of piers. Such damage to the Embarcadero may impede evacuation and disaster response (Interdependency Study, April 2017).

Flooding

The Embarcadero Seawall is already experiencing localized flooding due to higher water levels and settlement in certain areas. The shoreline from Pier 22 to Pier 9 includes some of the lowest shoreline elevations in San Francisco and these areas flood during king tides and storm events. The current 100-year flood event would send the bay over the current height of the Embarcadero Seawall and into the BART and Muni tunnels.

Data from the San Francisco tidal gauge shows that the San Francisco Bay has risen over eight inches since 1900. Most of the bay shoreline, including San Francisco, consists of filled land that was elevated just high enough so that it would not flood. As a result, much of the shoreline is low relative to the bay and will experience more flooding over larger areas of land at longer durations as sea levels rise.

To address risks to the Embarcadero Seawall, the Port of San Francisco must understand the water levels associated with different storm, tide and sea level rise activity. Identifying the threshold water levels for the Seawall will allow the Port and the City to develop actions to protect against current, temporary flooding and acute events that occur less frequently, while planning for higher water levels that will occur more frequently as sea levels rise.

The Seawall Program will identify these flood event thresholds for the Embarcadero Seawall. Based on existing assessments, the Port must consider three thresholds:

- The current and near-term flood risk which causes localized and temporary, short duration flooding and more significant flooding during an extreme event, will be the focus of initial flood protection projects and will address approximately 12 to 24 inches of flood risk.
- The next threshold for flood risk, approximately 24 to 36 inches, extends both the reach and the duration of flooding along the area protected by the Embarcadero Seawall. This water level will require additional measures, possibly including adapting and extending the reach of the previous flood protection measures, flood proofing buildings and living with more frequent closures of the Embarcadero Roadway and Promenade. Seawall Program mid-range planning will identify strategies and actions to address these water levels, adapting the actions taken in the first phase of the Program, expanding the affected areas and introducing new approaches to address the evolving risk.
- At approximately 36 to 48 inches of additional water, a significant portion of the Embarcadero Seawall is overtopped and the reach and duration of the flooding is much more extensive. The types of solutions necessary to address the level of flooding will likely include landscape scale solutions rather than the collection of flood measures described above. The vision phase of the Seawall Program will provide an opportunity to identify future options for addressing these higher water levels and determine the actions the City and the Port will take later in the Program.

What's at Stake

Critical Infrastructure

The Embarcadero Seawall supports an array of essential lifeline utilities including power, communication and water services, as well as significant sewer facilities including wastewater storage outfall structures, wastewater pumping stations, and auxiliary water intake valves and pumping stations. These assets provide critical City infrastructure supporting not just the waterfront and the Financial District but the entirety of northern San Francisco (Interdependency Study, April 2017). If the Embarcadero Seawall were to fail, these lifelines would likely be significantly damaged, causing substantial public health, safety, economic and societal impacts to the City and the region.

Emergency Response

The City has designated the Embarcadero Roadway as a lifeline corridor for emergency evacuation and recovery. In a disaster, the waterfront will support evacuation and delivery points for ships, fuel depots, and areas to supply food, water, sanitation, and coordination of city-wide emergency response. Significant aspects of the City's emergency plan depend on the stability of the waterfront and, in turn, the Embarcadero Seawall.

Following a major earthquake, the Embarcadero Roadway and waterfront will serve as an evacuation route, linked to Department of Emergency Management, Fire Department and Neighborhood Emergency Response facilities. The Embarcadero Roadway is one of the City's Priority Routes as defined by the Public Works Department and the Department of Emergency Management. As a major arterial, the Embarcadero is a vital route for first responders.

Additionally, if a catastrophic earthquake closes bridges, highways, and BART, the region will rely on water transportation at the Port to move large numbers of people into and out of the City. Ferry landings and boat docks along the waterfront will provide evacuation points for people leaving the City and landing areas for disaster service workers and emergency equipment and supplies. In addition, Port parks, open spaces, and parking lots will be used for staging people and materials.

The City's emergency planners expect to use open space along the Port as recovery areas. Immediately following an earthquake, these areas may be necessary for evacuation tents, triage zones, regional emergency responder offloading, and ferry queuing. Longer-term recovery may require staging areas for debris storage, and supplies. Improving the seismic safety of the Seawall will make it more likely that these areas adjacent to the Embarcadero will provide the City with critical spaces for emergency response and recovery.

Regional Transit Hub

The Embarcadero Seawall supports a regional transportation network, moving a significant number of local and regional residents and commuters. Approximately 1.1 million people enter the City each weekday, including 440,000 who arrive 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. The Muni Metro relies on its subway infrastructure to help transport hundreds of thousands of people on a daily basis from San Francisco's southern and

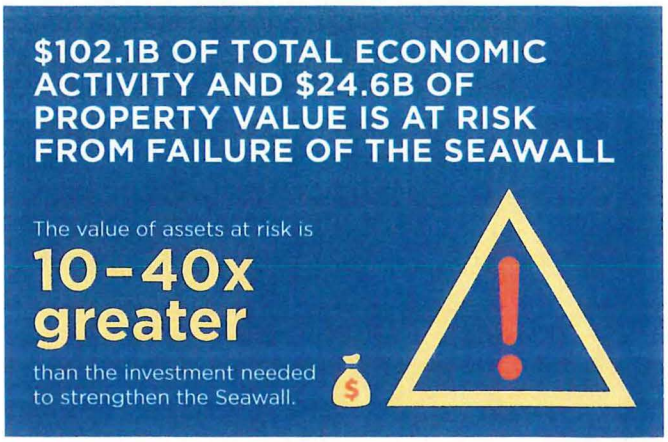
western neighborhoods to their jobs downtown. In addition to the risk from an earthquake, the Port and the United States Army Corps of Engineers have determined that the BART and Muni transportation networks are currently at risk of disruption from flooding during high tides and larger storms. Should this combined transit capacity be damaged by flooding the Bay Area would come to a standstill.

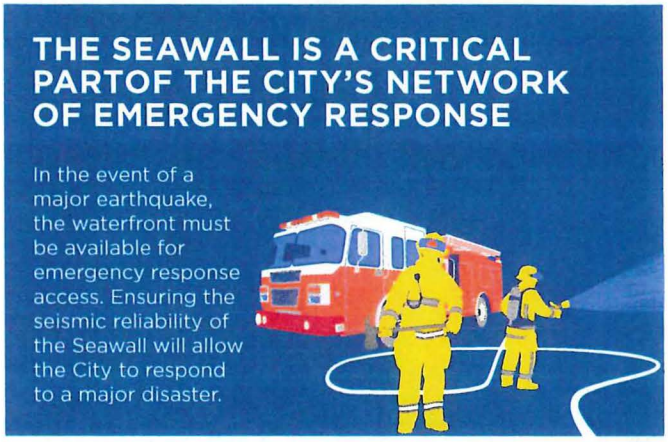
Economic Engine

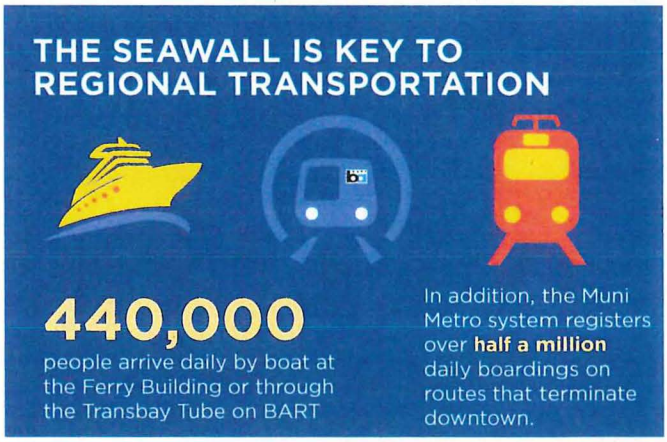
The Port of San Francisco is home to nearly 400 businesses which provide employment to San Franciscans and workers from around the Bay Area. In addition to the jobs on the Port, one out of every eight jobs in the Bay Area is located in downtown San Francisco. In 2017, the Port commissioned a study to estimate the total economic activity and property value at risk from a breach in the Embarcadero Seawall (BAE Urban Economics, May 2017). The study measured economic value including physical assets such as public facilities and private property, business activities, and tax revenues. The study concluded that the Seawall protects over $100 billion of assets and economic activity and found that property destruction from Seawall failure would disrupt neighborhoods and businesses, result in reduced wages and business revenues and reduce tax revenues to local, state and federal governments.

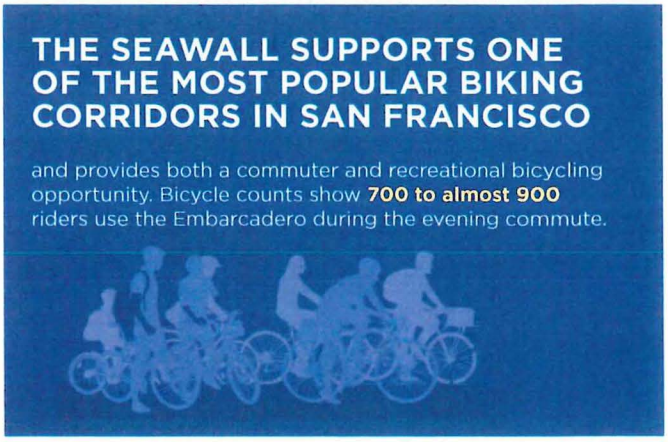
Recreation

The Embarcadero Promenade is one of San Francisco's most heavily used bicycle, pedestrian and recreational corridors. The Embarcadero offers both commuter and recreational bicycling opportunities with bicycle counts between 700 and 900 riders during the evening commute. The Embarcadero Seawall also supports numerous parks and open spaces providing outdoor experiences to Bay Area residents and tourists alike. Maritime uses, recreation, restaurants and food vendors, businesses, commercial fishing, tourism, transportation, and the natural environment converge along the Embarcadero Seawall drawing people from around the City, the region and the world.







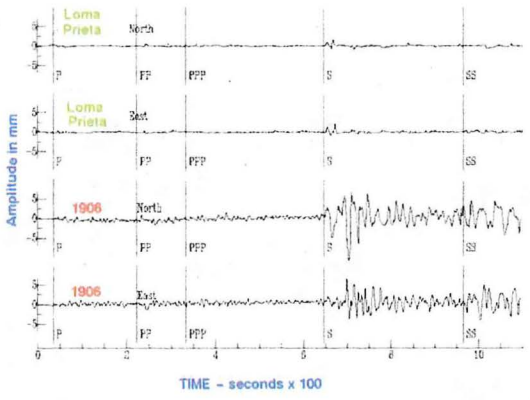


THE SAN FRANCISCO SEAWALL EARTHQUAKE SAFETY AND DISASTER PREVENTION PROGRAM

If the Embarcadero Seawall Survived 1906 and 1989, Why Are We So Worried Now?

San Francisco is one of the most seismically active areas in the world. The last major earthquake in San Francisco was the 1906 Earthquake which caused nearly 60 seconds of strong ground shaking. While significant, the 1989 Loma Prieta Earthquake, by comparison, was a minor event. With an epicenter located sixty miles away, it subjected the City to about 15 seconds of moderate shaking. Most of the Seawall and the infrastructure it protects did not exist in 1906 and has not been tested by a strong earthquake. Of the portions that did exist in 1906, evidence indicates that the Seawall settled and slid several feet toward the bay. The Loma Prieta Earthquake damaged some portions of the Seawall and caused some liquefaction in the Embarcadero, but ground shaking was not strong enough to cause Seawall failure. An earthquake similar to 1906 would severely test the Seawall and the infrastructure it protects.

Comparison of 1906 and Loma Prieta records at Gottingen, Germany



Seismic improvements to the Embarcadero Seawall will require local, state, and federal partnerships to develop, permit and fund. The Port estimates that immediate life-safety upgrades to the Seawall will cost $500 million and that long-term infrastructure enhancements will cost up to $5 billion and take up to 30 years to implement. To date, the City has invested nearly $10 million in project planning.

Given the estimated funding need and generational nature of the Seawall Program, the Port will phase program implementation and anticipates that it will undertake at least three phases of work to the Seawall. The Seawall Earthquake Safety Bond will address Phase I.

Schedule for Construction of Seawall Safety Improvements

The Port has engaged CH2M Hill/Arcadis as the project engineer for the Seawall Program and is conducting a multi-hazard risk assessment to evaluate the combined risks of earthquakes and flooding to the Seawall and the neighborhoods that it protects. In the near-term the Port and CH2M are finalizing a program schedule and planning geotechnical investigations to provide enhanced information to support development of project alternatives.

Faced with a needed investment of up to $5 billion over three decades and recognizing the different timeframes for seismic and sea level rise risks, the Port is developing a program of phased implementation. The Port anticipates that the Seawall Program will include at least three phases:

- **Phase I:** Near-Term Actions to be funded by the Seawall Bond to address life-safety and emergency response and recovery, planning and actions, estimated between 2017-2026
- **Phase II:** Mid-Range Plans to advance seismic and flood projects that will provide greater reliability and stability of the waterfront, for actions estimated between 2026-2050
- **Phase III:** Long-Term Vision, for actions estimated between 2050-2100

Phasing the program enables the Port to construct the most urgent safety improvements now while planning for longer range risks, opportunities, and constraints. The Port has adopted an aggressive schedule to complete repairs in the most vulnerable areas of the Embarcadero waterfront as soon as possible. Phase I project construction is scheduled to start in 2022 with completion by 2026. The schedule incorporates time for a robust stakeholder and public engagement process, including review and input, regulatory compliance, engineering design, and construction. Phasing the Seawall Program also will allow the Port to continue to develop an array of sources to fund the full program need.

With approval of the Seawall Bond, the Port will be able to complete program development, permitting, design, and construction of near-term actions, budgeted at $500 million.

Phase I: Near-Term Actions

- Detailed engineering risk assessment, development of program planning, decision-making and implementation framework, alternatives development, and stakeholder engagement.
- Definition of the overall program (up to $5 billion) and Phase I improvements budgeted at $500 million.
- Phase I improvements will be focused on the most critical infrastructure for disaster response and life-safety.
- Phase I will include earthquake safety improvements and associated flood protection improvements which will also result in enhancements to the urban and natural environments.
- Earthquake safety improvements may include ground strengthening, structural retrofits and replacements, and utility replacements/relocations.
- Flood protection improvements may include raising the Seawall, fixed and deployable barriers, movable gates, flood proofing of facilities, re-grading, and relocation of sensitive infrastructure.
- To create a stable foundation that may be adapted to future sea level rise, the Port will use the recent update to the State's sea level rise guidance released by the Ocean Protection Council.
- Depending upon the characteristics and locations of the earthquake safety and flood protection improvements, urban and environmental enhancements may include new public access, bicycle and pedestrian improvements, and water quality and habitat enhancements.
- Development of future phases of the Seawall Program that include prioritized improvements to continue to address the most critical seismic and flood risks.

Phase II and III: Mid-Range Plans and Long-Term Vision

- **Mid-Range Plans:** Focused on enhancing the use and enjoyment and safety of the iconic Embarcadero waterfront.
  - » Complete seismic and flood protection improvements to the Embarcadero Seawall.
  - » Coordinate construction of related utility and transit improvements with Seawall improvements.
  - » Secure additional federal, state, local and private funding for project implementation.
- **Long-Term Vision:** Climate change and sea level rise will require a bold new vision for the waterfront as adapting the current iconic infrastructure will become increasingly difficult and costly. Recently updated State Sea Level Rise guidance indicates that this new vision will likely need to be implemented by the end of this century. However, the timing of the increased flood risks will change as science evolves. The Seawall Program will create a framework to allow the City to evaluate options for long-term visions as it makes near and mid-term decisions. This framework will include:
  - » A process to work with city, regional, regulatory and expert stakeholders to consider future visions of the waterfront that balance issues of society and equity, environment, economy and safety and a framework for regularly updating and adapting these visions as the context and character of the waterfront change and the water levels rise.
  - » Continue to engage in the science of climate change and sea level rise; monitor conditions related to observed and measured changes in water levels, as well as the condition of the Port's and City's assets and services. Adapt and adjust action timelines based on projections.
  - » Secure additional federal, state, local and private funding.

Seawall Program Goals

The Port and its stakeholders have identified six initial goals for the program:

The Port's first goal for the Seawall Program is to act quickly. The Port's analysis clearly demonstrates immediate seismic and flooding risks to the Embarcadero Seawall. In light of this information and understanding the significant value of the utility, transportation and economic infrastructure that the Seawall protects, the City and the Port have launched Phase I of the Seawall Earthquake Safety and Disaster Prevention Program.

Estimated Project Schedule, Phases and Funding Need

($ millions)

PROGRAM PHASE	PHASE YEARS	PLANNED ACTIVITIES	ANNUAL SPENDING	CUMULATIVE COST
Vulnerability Study	15/16	Vulnerability Study	$0.0	$0.0
Planning	16/17	Project Management & Stakeholder Engagement	$0.3	$0.3
	17/18	Planning Services	$6.7	$7.0
	18/19	USACE CAP 103	$8.9	$15.9
Preliminary Design	19/20	Project Management & Stakeholder Engagement	$12.5	$28.4
	20/21	Environmental Approvals	$13.0	$41.4
	21/22	Preliminary Design USACE CAP 103	$72.8	$114.2
Final Design and Construction	22/23	Project Management & Stakeholder Engagement	$90.5	$204.6
	23/24	Final Design	$90.5	$295.1
	24/25	Design Support Services	$90.4	$385.5
	25/26	Construction Management	$90.4	$475.9
	26/27	Construction	$24.1	$500.0

The San Francisco Seawall Earthquake Safety Program G.O. Bond

INVESTMENT CATEGORY	EXAMPLE MEASURES TO BE INCLUDED AND EVALUATED
Project Implementation	• Program Development, Planning & Pre-Design • Design, Engineering & Other Soft Costs • Construction Management
Earthquake Improvements	• Ground Strengthening & Liquefaction Remediation • Bulkhead Wall, Wharf & Pier Retrofits & Replacements • Bulkhead Building Retrofits and Seismic Joints • Pier Building Retrofits • Critical Facility Retrofits & Replacements • Utility Replacements, Relocations & Bypasses • Matching Funds for Public & Private sources • Other Life Safety Improvements
Flood Protection Measures	• Flood Walls & Barriers • Surface Grade Changes • Flood Proofing • Planning for Future Adaptation • Enhanced Foundation for Future Adaptation • Other Flood Control Improvements
Mitigation & Enhancement	• Public Access Enhancements • Transportation/Mobility Improvements • Environmental Benefits • Other Public Benefits

San Francisco's Ten Year Capital Plan for Fiscal Year 2018-2027 includes a proposed $425 million General Obligation Bond for the November 2018 ballot to support the Seawall Earthquake Safety and Disaster Prevention Program. The bond will require two-thirds voter approval and will not raise tax rates. The Seawall Bond will fund Phase I of the Seawall Program, focusing on life-safety seismic enhancements, emergency preparedness and near-term flood risk. As the City, acting through the Port, makes these improvements to the Seawall, it will also be laying the groundwork to prepare for long-term resilience and sea level rise over time.

The proposed Seawall Bond will allow the City to begin infrastructure improvements to the Seawall. This bond will partially fund planning, development, preliminary design, environmental approvals, final design and construction to address the Embarcadero Seawall's immediate life-safety risks over the next ten years. Phase I of the Seawall Program will also include development of a framework for subsequent phases of the program, building upon the investigation, analysis, community and stakeholder outreach and financial planning completed in Phase I. This work will identify additional projects to enhance seismic reliability and flood resilience in Phases II and III of the program.

Bond Projects

The Port, in consultation with the City and other stakeholders and experts, will select the locations and construction methods for immediate Seawall life-safety improvements using the results of the multi-hazard risk assessment that is designed to reduce risk and enhance reliability in a cost-effective manner, maximizing the available construction dollars. Near-term investments likely to be funded by the bond include earthquake improvements, flood protection measures, and mitigation and enhancement projects, as well as core project implementation tasks like planning, design, and construction management.

The multi-hazard risk assessment that the Port is currently conducting will inform a more detailed understanding of risks and potential damages to the Embarcadero Seawall,

particularly as related to disaster preparedness. Through this evaluation, and with input from the public and regulatory agencies on topics of land use, society and equity, economy, environmental and urban design, the Port will identify initial Seawall improvements for near-term construction to be funded by the bond. The bond funding will address the most significant seismic and current and near-term flood risks to the most vulnerable and critical life-safety and emergency response assets.

Potential Seismic Projects

Several construction options are available to improve Seawall seismic reliability. These options may be implemented together, individually, or sequenced over time. Potential approaches to seismically reinforce the Seawall include:

- **Ground improvements:** Improving the soil conditions on the landside of the Seawall, or through/beneath the Seawall. Ground improvements would reduce the risk of liquefaction.
- **Seawall Replacement:** Construction of new Seawall segments, using modern seismic design. Seawall replacement would withstand the risk of liquefaction.
- **Structure Improvements:** Strengthening or replacing bulkhead walls and wharves to withstand seismic movement.
- **Utility Relocation or Replacement:** Relocating or replacing critical utilities that are currently protected by the Seawall.

Proposed seismic solutions will be subject to peer review by a panel of external seismic and geotechnical experts to assess their performance and applicability. Using a vetted set of project criteria, the Port will evaluate these methods to assess their site-specific risk reduction, cost, regulatory acceptance, adaptability to sea level rise, level of construction disruption, and co-benefits. This process will be conducted with input from the public and regulators.

Potential Flood Projects

As with seismic improvements, there are range of approaches to reduce flood risk. Flood mitigations could include both "hard solutions" such as raised seawalls, gates, deployable barriers, and "soft solutions" such as earthen berms and living shorelines. Modern seawall design provides an opportunity to ensure that public views and public access to the waterfront are retained or enhanced.

Option 1: Ground Improvement

Option 2: Ground Improvement under Seawall

Option 3: Bulkhead Replacement

Option 4: New Bayward Seawall

Alternatives for historic buildings and other Port properties could include "dry-proofing" to fully protect structures at risk of flooding, and "wet-proofing" to accommodate intermittent inundation. Examples of wet-proofing include moving critical electrical and plumbing equipment to upper stories and use of water-resistant flooring.

The Port will co-design flood mitigations with seismic improvements. Phase I of the Seawall Program will evaluate the applicability, effectiveness, risks, and costs of the short and mid-term seismic reinforcements and flood mitigations to Seawall reaches. The Port will consider these factors in the project selection criteria.

Potential Urban and Ecosystem Improvement Projects

While Phase I projects will focus on reduction of seismic and near-term flooding risk to reduce life-safety and emergency response risks, Phase I improvements may also include opportunities to enhance both the urban landscape and the bay environment. The Port will decide whether to include such enhancements based on the scale and location of the site-specific seismic and near-term flood risk reduction methods and the cost-benefit ratio of these infrastructure investments.

Urban landscape and bay environmental benefits may include enhanced open space and elevated parks and plazas, localized soft features such as stormwater gardens, opportunities for improved pedestrian and bike safety, public art, greater public access and enhanced views to the water.

Ecosystem enhancements may include mitigation measures adjacent to the Seawall, along the southern shoreline, or collaborations with regional ecosystem enhancements. Examples of potential ecosystem enhancements proximate to the Seawall include "living walls" which provide additional marine substrate for the establishment of habitat, hard substrate restoration to enhance oyster habitat, protected wetlands, and tidepools. Together, enhanced public access and nearshore habitat enhancements could provide bay ecosystem educational opportunities to school children and families throughout the Bay Area.

There will be opportunity for ample public input into the Port's selection of urban and ecosystem improvements.

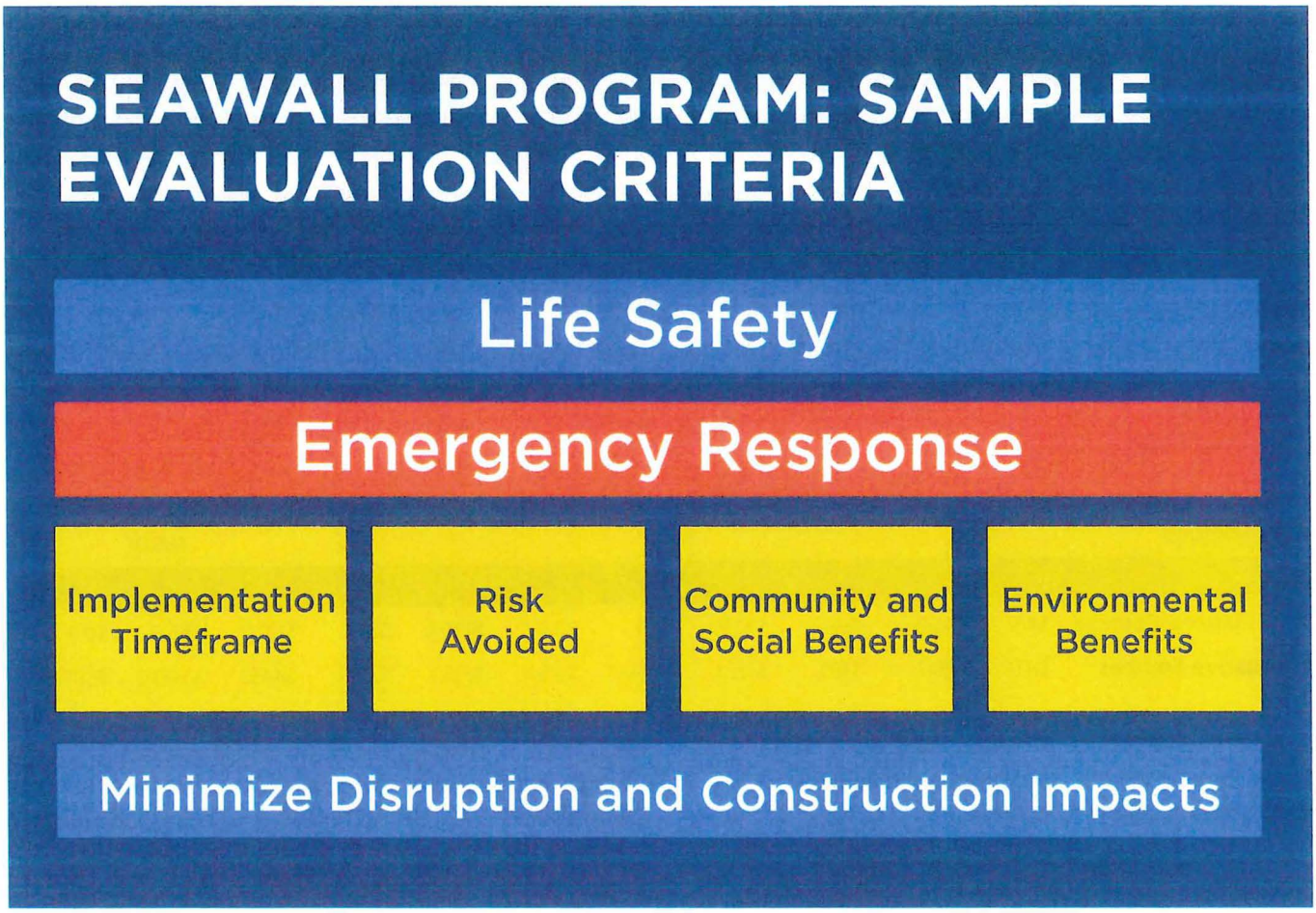
Project Prioritization

This G.O. Bond will fund construction of targeted improvements to enhance the life-safety seismic resilience and emergency response capabilities along the Embarcadero. The Port will select locations and construction methods for Phase I projects based on an engineering evaluation that will strive to reduce risk, enhance reliability and maximize available construction dollars.

The Seawall Program will be informed by a multi-hazard risk assessment designed to evaluate the combined risks of earthquakes and flooding to the Seawall and the neighborhoods that it protects. The Program will combine this engineering process with a prioritization process in partnership with stakeholders from City departments, the community and regional partners. The City and the Port have experience leading such efforts and will build off many years of work with a broad range of stakeholders.

To ensure Phase I construction projects focus on the most critical life-safety and flood risk locations along the Seawall, the project will:

1. **Analyze risks:** Perform a multi hazard risk assessment, including analysis of potential loss of life and property damage, to inform impacts of seismic and flood scenarios.
2. **Develop design criteria:** Design criteria will incorporate life-safety, seismic, flood, and disaster preparedness factors, consider urban design standards, and ensure compliance with land use policies, environmental and other regulatory requirements.
3. **Develop and evaluate alternatives:** Options will be developed to reduce seismic and flood risk. The risk reduction benefits of alternatives will be evaluated, along with potential co-benefits.
4. **Prioritize Phase I projects based on the evaluation:** Based on the evaluation of alternatives, projects will be recommended and prioritized. Port staff, in consultation with city, regional, regulatory, expert and community stakeholders, will recommend Phase I safety improvement projects to the Port Commission and will advance projects into design and construction after approval. The remaining projects will be incorporated into subsequent phases of the Seawall Program for future investment.
5. **Design and construct Phase I projects:** Based on an approved Phase I recommendation, the initial safety improvements will advance into design and construction. Construction completion is targeted for 2026.



The Port will compare project alternatives using evaluation criteria established with input from stakeholders and the community. Examples include whether the project meets life-safety goals, improves emergency response, can be completed in a timely fashion, avoids risk, provides community or environmental benefits and minimizes disruption to City residents, businesses and visitors. The evaluation criteria will guide the design process and project selection, steering the Seawall Program toward feasible, effective, and flexible solutions that achieve multiple benefits over time. The Port will continue to refine evaluation criteria as the Seawall Program progresses.

Funding The Program

In 2016 the City Administrator convened a Seawall Finance Working Group (SFWG) with staff from key City departments to analyze potential strategies and prepare a set of funding recommendations for the City and the Port. Given the Seawall's vast need, the SFWG realized that the City could not fund the Seawall Program through only local means and ultimately considered 48 different local, regional, state and federal funding sources. The group's final report, issued in July 2017, organized its recommendations into three areas: primary, secondary and supplementary funding sources.

The primary recommendations:

A. General Obligation (G.O.) Bonds – currently proposed for the 2018 ballot.

B. A Community Facilities District (CFD) to fund sea-level rise adaptations and seismic mitigation measures for the Seawall.

C. Local Property Tax Increment Revenue generated from Infrastructure Finance Districts (IFDs) from new development on Port property.

D. State Property Tax Increment Revenue generated from IFDs from new development on Port property, to be pursued through legislation at the State level – introduced in the California State Assembly.

E. State Resilience General Obligation (G.O.) Bond funding pursued through legislation at the State level.

FUNDING SOURCES	FISCAL YEAR ($ IN MILLIONS)										
	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27
Port Capital	$2.9		$1.1					$2.0	$2.0		
City Revolving Fund	$1.0	$3.0	$5.0	($9.0)							
SFMTA Contribution	$0.5	$0.5									
Planning Department Contribution	$0.5	$0.3	$0.3								
2018 General Obligation Bond				$110.0			$190.0		$125.0		
USACE			$3.0	$6.0	$1.0						
State Sources										$55.0*	
Total Planned Sources	$4.9	$3.8	$9.4	$107.0	$1.0	$0.0	$190.0	$2.0	$127.0	$55.0	$0.0
Cumulative Sources	$4.9	$8.7	$18.1	$125.1	$126.1	$126.1	$316.1	$318.1	$445.1	$500.0	$500.0

F. U.S. Army Corps of Engineers Funding at the federal level through the CAP 103 Program and a General Investigation (initiated in June 2017).

In accordance with the SFWG's recommendations, the Port is attempting to identify $500 million in funding for Phase I of the Seawall Program, including a planned $425 million General Obligation Bond. The City is also actively working with the U.S. Army Corps of Engineers and the State of California to identify additional program funding. The bond would comprise an important local match to any federal or state funding.

10-Year Capital Plan

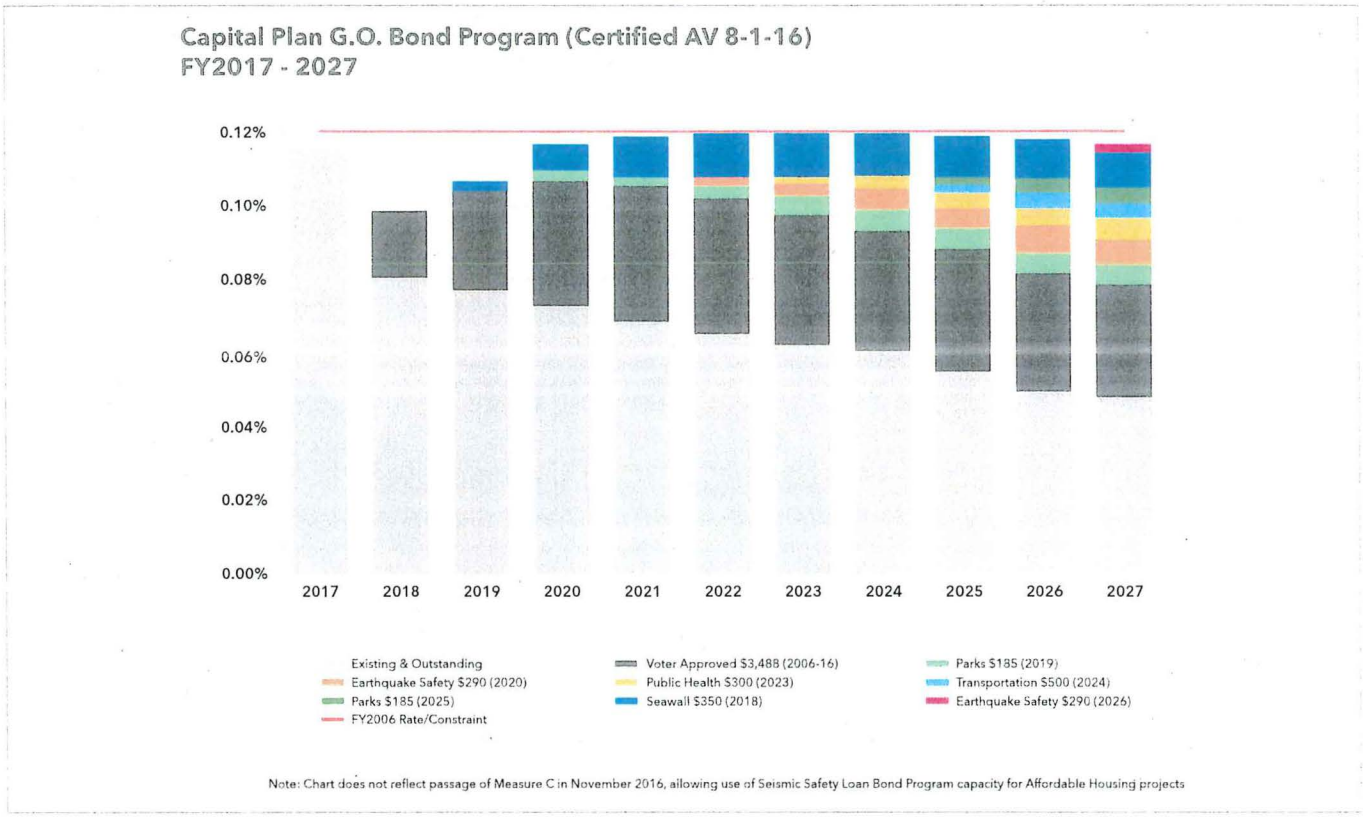
Adopted through legislation by the Mayor and Board of Supervisors in 2005, the Capital Planning Committee was created to guide and prioritize capital needs citywide. The 10-Year Capital Plan (the Plan) is developed by the Capital Planning Committee and adopted annually by the Board of Supervisors prior to adoption of the annual City budget. The Plan prioritizes critical capital projects that impact the public's safety and well-being; places a strong emphasis on accountability and transparency; and most importantly, demonstrates the highest levels of fiscal restraint and responsibility. Since its inception, the top priorities of the Capital Plan have been the seismic improvement of City infrastructure, including the Zuckerberg San Francisco General Hospital, which voters approved in November 2008, and City public safety and emergency response facilities, which voters approved in 2010 and 2014.

The City has invested significant General Fund dollars into the repair and rehabilitation of our capital assets over the years. However, the City cannot rely on annual funds alone to address these critical needs. Where annual funds are not adequate to pay the costs of major capital improvements, the Plan recommends using one of two sources of long-term debt financing: General Obligation (G.O.) bonds backed by property taxes upon approval by voters and General Fund debt programs backed by the City's General Fund upon approval by the Board of Supervisors and the Mayor. Both sources are appropriate means of funding capital improvements as they spread the cost of these facilities over their long useful lives and across the generations of San Franciscans that will reap their benefits.

The Capital Plan has adopted strict financial constraints on the use of long-term debt financing so as to not place an increased burden on future generations. Voter-approved G.O. bonds proposed by the Capital Plan are only proposed as the City retires existing debt from prior bonds. As the City pays off its obligations for other facilities, the City can initiate new capital projects without increasing property tax rates.

The Seawall Bond, therefore, will not increase property tax rates beyond their fiscal year 2006 levels.

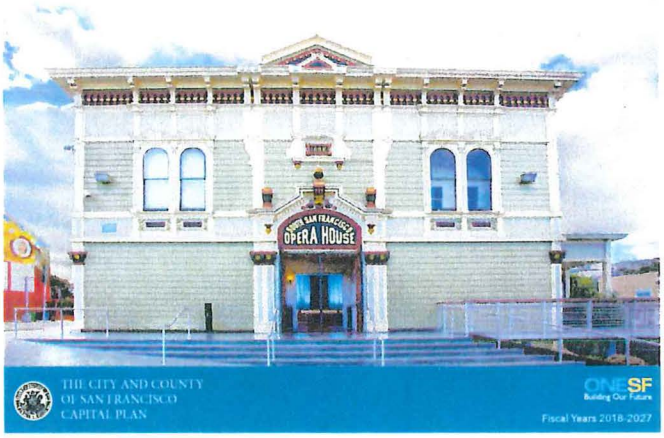
For more information on the City's Capital Plan, please visit **onesanfrancisco.org.**



Note: Chart does not reflect passage of Measure C in November 2016, allowing use of Seismic Safety Loan Bond Program capacity for Affordable Housing projects

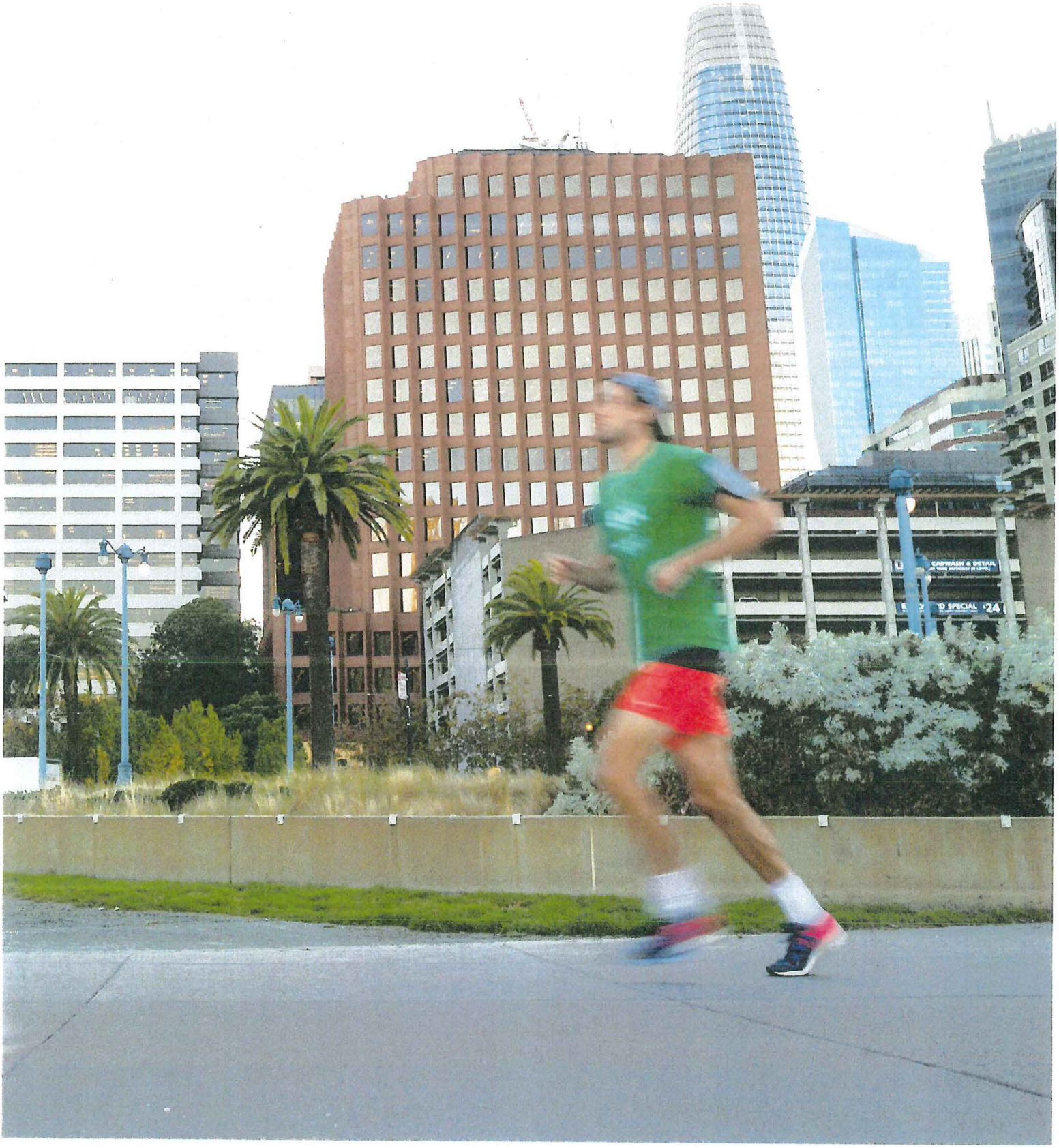
Conclusion

The City cannot afford *not* to improve the Embarcadero Seawall and must act as quickly as possible. Any undertaking to improve the Seawall today would be dwarfed by the size and scope of a project to restore the City should the Seawall fail. The value of the assets at risk from Seawall failure is between 10 and 40 times greater than the $2 to $5 billion that the City must spend to strengthen the Seawall and address sea level rise. The proposed Seawall Bond supports good public policy, makes economic sense and will enable the City to avoid future disaster.



Credits/Notes

All photos and renderings by the Port of San Francisco.



PORT OF SAN FRANCISCO
Pier 1, The Embarcadero | San Francisco, CA 94111 | T: 415 274 0400