

Waterfront Plan Update – Resilience Subcommittee

Resilience Policy Ideas for Discussion

Draft policy ideas for discussion and comment by the Working Group’s Resilience Subcommittee and the public at the 3.29.17 Resilience Subcommittee Meeting

Note: Subcommittee policy discussions provide guidance to Port Staff as they draft proposed updates to the 1997 Waterfront Land Use Plan. The discussions are on-going and iterative, and will require further revision and reconciliation with ideas generated in the Land Use and Transportation Subcommittee meetings, full Working Group meetings, and other public forums, before ultimately being considered by the Port Commission.

Policy Context - General

Resilience – the capacity of the Port to maintain its function and vitality in the face of natural or human-caused disruptions or disasters – is a new subject for the Port of San Francisco Waterfront Land Use Plan (“Waterfront Plan”). Although the 1997 Waterfront Plan touched on some policy issues often included in resilience policies today (e.g. preservation of important characteristics and functions of the San Francisco Waterfront, diversity and equity) it did so with a relatively light touch. The Waterfront Plan also preceded current understandings about the nature and extent of the Port’s seismic, climate change, and public safety challenges.

Since the Waterfront Plan was adopted in 1997, resilience goals and policies have increasingly made their way into land use planning documents of cities and ports throughout the United States and beyond. Although such policies vary depending on the unique attributes, challenges and priorities of different jurisdictions, common themes include how to prevent, withstand, respond to, and recover from sudden threats (e.g. earthquakes, tsunamis, terrorism) as well as slower moving or evolving threats (e.g. sea level rise, more frequent and severe storms, and other impacts of climate change, lack of social cohesion and equity, etc.)

While an earthquake is the most likely imminent threat to the Port, and sea level rise is an ongoing and increasing long-term challenge, the Port also must grapple with emergency management and homeland security vulnerabilities associated with the City’s geography, population density and demographics, burgeoning tourist industry, and presence of nationally prominent landmarks. Terrorism is an ever-present concern that affects the design of and access to Port facilities. Given these realities, emergency preparedness is very important and requires targeted investments and unwavering and continuous support by City leadership.

Resilience works best when developed at the individual, local, regional, and federal level; integrated, coordinated, and tested in advance; and reflects a shared vision for the future. Then, when a disruption occurs, all levels can quickly communicate, respond, and begin to recover. Like for environmental sustainability, the City and County of San Francisco (CCSF) has taken a leadership role in resilience planning for the City. The Port actively participates in City-wide efforts, while also pursuing compatible policies and projects to protect its unique waterfront assets and businesses. Successful resilience planning for climate change, sea level rise, disaster response, and social equity also requires that local entities like the Port collaborate with agencies beyond their jurisdictional boundaries. Examples of the Port’s local and regional collaborations include:

Resilient SF

In 2016, the CCSF released [Resilient San Francisco – Stronger Today, Stronger Tomorrow](#) (Resilient SF) – a strategic vision developed in partnership with the public, private, and nonprofit sectors, along with local community leaders and stakeholders. Hallmark actions in the strategy that are significant for the Port include:

- Construct a disaster-resilient waterfront by 2040
- Seismically retrofit vulnerable buildings and set a higher level of safety for new buildings
- Advance City-wide adaptation planning for sea level rise.

Mayor's Sea Level Rise Coordinating Committee

In addition, the Port and SF Planning co-chair the Mayor's Sea Level Rise Coordinating Committee, and the City and Port are working side-by-side to fund and implement the Port's Seawall Resilience Project to protect the northern waterfront and its historic district. The work of the Mayor's Sea Level Rise Coordinating Committee extends well beyond the boundaries of the City and the Port. The Committee is working throughout the Bay Area to develop an increased understanding of the shared responsibilities between public, private, and community interests in adapting to rising seas, including how stakeholders can combine resources to make necessary investments for the protection and adaptation of the coastlines.

BCDC

BCDC has been actively engaged in regional efforts to address climate change and sea level rise for over five years. In 2011, BCDC updated the San Francisco Bay Plan to address expected climate change impacts on the Bay. The policies call on the Commission, working with other agencies and the general public, to develop a regional strategy for:

- Protecting critical developed areas along the shoreline from flooding;
- Enhancing the natural resources of the Bay by preserving existing and identifying areas where tidal wetlands can migrate landward; and
- Improving the ability of communities to adapt to sea level rise in ways that advance economic prosperity, social equity, and environmental protections.

Since then, BCDC has undertaken the Policies for a Rising Sea project and the Adapting to Rising Tides Program and, in 2016, launched a workshop series to:

- Bring to its Commission and a broader range of participants issues identified during these efforts;
- Accelerate BCDC's efforts to address challenges resulting from rising sea level;
- Establish a series of short- and medium-term actions to hasten sea level rise adaptations;
- Engage in new/expanded coordination, collaboration, and partnership to advance adaptation locally and regionally.

At the same time, the State has been developing more robust statewide policies, processes and resources to help guide regional and local agencies as they plan for and invest in climate change

and sea level rise. (See 9.23.16 [BCDC Staff Report on Final Recommendations for Commissioner Series](#) for a more detailed discussion of BCDC and State efforts)

CHARG

Port staff also participates in CHARG, or Coastal Hazards Adaptation Resiliency Group, a forum at which local, regional, state, and federal scientists, engineers, planners, and policy makers are working collectively to increase the resiliency of San Francisco Bay Area communities by adopting a regional approach to reducing the long-term risk to human life and property from flooding and other hazards caused by sea level rise and extreme tides.

The Waterfront Plan Update Process – Resilience Subcommittee

The discussions and recommendations from the Resilience Subcommittee, Waterfront Plan Working Group and the public will provide direction about environmental, urban design, transportation, historic preservation, economic and sustainability values that should be reflected in the longer-term planning processes summarized above. Port staff has recommended a new resilience goal and related policies for the Waterfront Plan Update to:

- Elevate resilience as a key “value” and goal of the Waterfront Plan;
- Incorporate existing City and Port resilience, emergency preparation and disaster recovery requirements that affect waterfront land use, planning, development and construction;
- Guide the Port’s land use and planning decisions to ensure they continue to reflect public values about the form and function of the waterfront to inform the design and development of resilience improvements, including the Seawall Resilience Project; and
- Inform and coordinate with City and regional resilience planning efforts.

This new Resilience goal should align with the Port’s Strategic Plan Resiliency Goal: “Lead the City’s efforts in addressing threats from earthquakes and flood risks through research and infrastructure improvements to the Seawall and Port property”, and also should serve as an umbrella for multiple policies “beneath it”, for example: **Identify and pursue strategies to increase the Port’s resilience to sea level rise, floods, seismic events, and emergencies/disasters, while protecting the Port’s unique historic, maritime, and cultural assets and environment, to the maximum feasible extent.** Resilience policy ideas emerging from Subcommittee meetings and the Designing for Resilience Workshop begin on page 5 and are organized for discussion purposes under three topics:

- Topic 1 - Emergency Preparedness & Disaster Recovery
- Topic 2 - Sea Level Rise and Flood Protection
- Topic 3 - Seismic Safety

New and updated Waterfront Plan goals and policies also should reflect current knowledge of the importance of social cohesion and equity to the ability of communities to respond to and recover from emergencies and disasters. This topic will be calendared for a future Resilience Subcommittee or Working Group meeting.

Reviewers should keep in mind that although the Resilience Subcommittee discussed environmental sustainability policy ideas at [earlier meetings](#), resilience and environmental sustainability are interrelated issues. For example, sustainable land management practices to improve wetlands and tidal habitats can make areas more resilient to sea level rise, water pollution, and other stresses. As the Waterfront Plan Update process moves forward, there will be further redrafting and integration of all policy ideas to ensure clarity and consistency.

Reviewers also will note policy ideas under each topic that address intergovernmental coordination and financial and other partnerships for successful implementation of Port resilience projects and policies. We expect to further refine these policies, combine them with similar policies arising in the Transportation and Land Use Subcommittees, and discuss them with our regional and other agency partners (e.g., SF Planning, BCDC, ABAG, etc.) as the update process continues.

Planning Resources Reviewed - The Waterfront Plan's new resilience policies should be consistent with the significant resilience planning and policy work in place and underway in the City, Bay area and beyond. In addition to information and discussions shared in Working Group and Subcommittee meetings, Port staff reviewed a wide range of policy documents as it developed policy ideas and guidance for Subcommittee discussion. They include:

Association of Bay Area Governments, Regional Resilience Initiative - Policy Agenda for Recovery, March 2013
Community Safety Element of the San Francisco General Plan, October 2012
Climate Change Hits Home and other resilience research papers from SPUR
Central SOMA Plan and Implementation Strategy, SF Planning, 2016
Resilient San Francisco, 2016
San Francisco Bay Conservation and Development Commission, Policies for a Rising Bay Project Final Report, November 2016
Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning, FEMA, May 2005
San Francisco Bay Conservation and Development Commission, San Francisco Bay Plan, 2012
San Francisco Sea Level Rise Action Plan, March 2016
San Francisco Bay Area Water Emergency Transportation Authority, 2016 Strategic Plan
Port of San Francisco Climate Action Plan, March 2014
Port of San Francisco Waterfront Plan Update Vision Workshop Summary & Online Survey, 2016
Treasure Island/Yerba Buena Island Sustainability Plan, June 2011
pLAn, Los Angeles Sustainable City Plan
Resilient Berkeley, 2016 and Resilient Oakland, 2016
Waterfront Seattle Concept Design and Framework Plan, 2012
Vision 2020 - New York City Comprehensive Waterfront Plan, March 2011, and Waterfront Revitalization Program

Topic #1 Emergency Preparedness & Disaster Recovery

Background:

The Port of San Francisco's disaster preparedness, response and recovery activities and plans are designed and implemented to ensure the most effective allocation of resources for the protection of people and property in times of emergency. In advance of an emergency, activities include improving readiness, increasing response capabilities, mitigating hazards, and developing longer term recovery and reconstruction strategies. For the purpose of this discussion, these activities are divided into 5 categories – planning, training, hazard mitigation, response, and recovery.

Planning - The Port's Emergency Operations Plan (EOP) addresses the planned response to emergency situations associated with natural disasters, technological incidents, and national security emergencies. Its objective is to coordinate the facilities and personnel of the Port into an efficient organization by assigning tasks and specifying policies and procedures. As a department of the CCSF, the organizational and planning principles of the CCSF EOP and, ultimately, the Port EOP are based on a [myriad of local, state and federal regulatory documents](#) and procedures for conducting and supporting emergency operations.

The EOP is reviewed and exercised periodically and revised as necessary to meet changing information. It addresses direction, control and communications, and provides detailed information and checklists for each emergency position. The EOP reflects the following assumptions:

- The Port may be subject to a variety of natural or man-made emergencies requiring a declaration of an emergency or disaster.
- The EOP spans the entire spectrum of contingencies, ranging from relatively minor incidents to large-scale disasters.
- A buildup or warning period will precede some emergencies, providing sufficient time to warn the public and implement mitigation measures; other emergencies will occur with little or no advance warning.
- Port Divisions must be prepared to promptly and effectively respond to any foreseeable emergency.
- After a disaster, it is likely that one of the only ways in and out of the city for responders, residents and supplies will be via maritime transportation. It is vital that the Port maintain these functions post disaster.

The Port's emergency planning team works within the Port's Homeland Security Division to plan and coordinate emergency response and damage assessment training and exercises. The team also is responsible for the annual review and update of the EOP, and maintains contact with the CCSF Department of Emergency Management (DEM) to ensure that new citywide directives and planning data are incorporated into the Port documents.

The Port is developing Tenant Emergency Guidelines to further improve emergency preparedness and response on Port property. Tenant and public understanding of the nature of potential emergencies, the likely response of emergency services, and awareness of how to increase chances of survival are vital to ensuring partnerships required for successful response and recovery operations.

Training - At least once/year, the Port conducts a full-scale emergency response exercise, and either a tabletop or functional exercise at least semiannually. The Port also participates in full-scale exercises that include the movement of workers, equipment, and resources required to demonstrate coordination and response capability.

Hazard Mitigation - is defined as any action taken to reduce or eliminate the long-term risk to human life and property from natural or man-made hazards or disasters (e.g., property and natural resource protection, public education and awareness.)

Response – The Port’s emergency response priorities are:

- Ensure the safety of Port personnel, tenants, and visitors.
- Conduct damage assessments, control damage, and secure Port facilities.
- Coordinate activities with the CCSF EOC, making available, if possible, Port buildings, piers, and open space for emergency staging, warehousing, and docking.
- Coordinate with regional transit agencies to provide facilities for emergency ferry service.
- Coordinate response and recovery activities related to Port tenants and businesses.

Recovery - Recovery activities restore services to the public and return affected facilities, systems, and operations to pre-emergency conditions. They occur in [three general phases](#). The first phase overlaps with emergency response and includes immediate actions to reduce life-safety hazards and make short-term repairs to critical lifelines. The second phase provides for ongoing needs before permanent restoration is complete. This phase may continue for weeks or perhaps months. The third phase includes planning for and implementing the rebuilding of damaged transportation infrastructure and the resumption of normal services. It may include a reconsideration of pre-disaster conditions, and may continue for several years. Port recovery phase priorities include:

- Reopen Pier 1 and other facilities for business.
- Return Port employees back to full-time work and normal business schedules as soon as possible.
- Relocate Port tenants from badly damaged buildings.
- Clear debris, restore utilities, and clean facilities so that tenants can return to buildings that are not badly damaged.
- Re-establish or relocate maritime and ferry operations to restore normal operations.

Policy and Discussion Ideas:

New Waterfront Plan policy ideas for discussion at the 3.29.17 meeting include:

Planning, Training and Mitigation

1. Develop and maintain/update plans to ensure availability of Port facilities and lands needed for the movement of people, goods and debris after an emergency.
2. Maintain and update the Port’s Emergency Response Plan, in compliance with applicable City, state and federal regulations.
3. Retain waterside access for loading/unloading vessels, and space to stage people and resources.
4. Maintain flexible areas of Port lands (parks, parking lots, under-developed industrial lands) that can be used for staging response and recovery operations after a disaster.

5. Improve the Port's ability to facilitate evacuations by strengthening the structures and improving the capacity and flexibility of existing ferry, water-taxi, and other vessel landing facilities.
6. Identify where additional facilities may be needed; determine if existing waterfront infrastructure could be modified to enable emergency ferry access (e.g., openings in railings, mooring features, and dual docking capacity).
7. Integrate protection of the Port's historic and cultural resources in the Port EOP for all phases of emergency response and disaster recovery and reconstruction efforts.
8. Continue to monitor and integrate climate change projections into the Port's emergency planning and preparedness efforts, and assess how SLR may affect critical facilities.
9. Develop and maintain mutual aid agreements and regional joint exercises with local, regional and state governments as well as other relevant agencies.
10. Encourage tenants to evaluate their earthquake risks, and work closely with them to maximize emergency preparedness and disaster recovery operations; foster tenant-to-tenant connections to advance disaster readiness and response.
11. Identify and replace vulnerable infrastructure and critical service lifelines in high-risk areas.

Response and Recovery

1. Develop a long-term recovery plan to bridge the gap between emergency response and long-term recovery of Port activities/operations, including focused attention on cost recovery.
2. Work closely with the SFMTA, BART, WETA, Golden Gate Ferries, and other regional transportation providers to increase the resiliency of Port, City and regional transportation facilities and ensure continuity of operations to serve the Port.
3. Continue coordination with emergency managers, tenants, water transit agencies, ferries and private boat operators to facilitate safe and efficient water transport and maritime evacuations; collaborate with regional partners to maximize water-borne movement of supplies, reconstruction materials and debris.
4. Seek state and federal funding for mitigation projects, collaborating with other local and regional agencies as needed to maximize success.
5. Continue participation in the San Francisco Lifelines Council and support development of a regional lifelines council of Bay Area cities and agencies; water, energy, transportation, and communication and other "lifeline" providers; and non-governmental organizations, to improve communication and collaboration, share disaster response and recovery planning, and coordinate restoration of lifeline systems as quickly as possible after a disaster.
6. Utilize green building practices and ensure quality design in rebuilding projects.

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Topic 2 - Sea Level Rise and Flood Protection

Background:

Over the coming decades, Port properties will become increasingly at risk of damage and inundation from sea level rise (“SLR”) and the increasing frequency and intensity of storms. Some areas of the Port, such as Mission Creek, Islais Creek, Pier 94-96, Heron’s Head Park and the Ferry Building already are currently at risk from coastal flooding associated with a 100-year flood event because they are at lower elevations. Areas currently not subject to flood risk also could begin to experience periodic coastal and/or urban flooding, and all Port property lies within the SLR vulnerability zone currently projected for the year 2100. The currently estimated asset value of Port Buildings at risk is \$4.5 billion at 66” of SLR, rising to \$4.9 billion when coupled with a 100-yr extreme tide.

Port staff has been analyzing and incorporating design solutions to projected SLR into specific Port projects since 2009. These project-specific adaptation strategies have varied, reflecting each project’s unique location as well as evolving guidance on SLR projections and best practices for responding to risks. Examples include:

- Bayfront Park - Raised shoreline with rip rap edge to adapt to 16” of SLR
- Brannan Street Wharf – Deck height was set to prevent wave overtopping w/16” of SLR and designed for wave and current forces for 66” of SLR, with adaptive capacity
- Downtown Ferry Terminal - Elevate to 14.5’ NAVD 88 to address sea level rise through 2070 (50 year design life) with adaptive capacity through 2100
- Crane Cove Park - Designed to accommodate 28” of SLR with occasional flooding of minor paths and coastal flood protection to inland infrastructure for the 100-year flood
- Pier 1 - Pier deck elevation remains the same; tenant assumes responsibility for flood safety interventions, including raising utilities and installing short flood walls
- Pier 70 Waterfront Site - Raise site to accommodate 66” of SLR; Bay Trail will flood earlier
- Seawall Lot 337 - Raise building pads and streets to accommodate 66” of sea level rise plus 100 Year Flood, with grading down to existing elevations along 3rd Street and Terry Francois Boulevard. Examine near term improvements to Pier 48 and adaptation strategies

The Port has also been conducting and participating in broader, planning-level studies of SLR. In May 2011, under the direction of Port Engineering, a joint venture of URS and AGS published a Sea Level Rise and Adaptation Study which analyzed available studies related to SLR and performed a detailed coastal engineering analysis to develop existing and projected 100 year flood water levels (a statistical combination of tides, storm surge, ocean swell, wind waves, and fresh water inflow at twenty locations along the Port’s Northern Waterfront) at twenty locations along the Port’s Northern Waterfront.

In 2014, in consultation with BCDC, the Port and other City departments including SF Planning, Public Works, Public Utilities Commission, Office of Community Investment and Infrastructure, and Capital Planning Committee (under the City Administrator), teamed with the Dutch government to study one of the lowest lying areas on Port property: Mission Creek. The study, published in 2016,

provides a [conceptual design-level analysis](#) to illustrate different forms of adaptation responses, issues, tradeoffs, and regulatory considerations to help inform future City and regional SLR planning discussions.

In early 2016, the Mayor's Sea Level Rise Coordinating Committee released the San Francisco [Sea Level Rise Action Plan](#) which reflects vulnerability analyses then-completed by City Departments, including inundation maps for waterfront properties within Port jurisdiction. The Action Plan's guiding principles are the first step towards the development of a citywide Sea Level Rise Adaptation Plan, expected to be completed by the end of 2018. The Adaptation Plan will set a planning framework to prioritize investments that can provide climate resilience, while protecting economic and environmental value. In addition to co-chairing the SLR Coordinating Committee, the Port's responsibilities include continuing to develop near-term adaptation strategies for high risk assets and low-lying areas of the waterfront, including the Seawall and the finger piers, and monitoring and tracking storm events. Port staff participates in related sub-committees for tracking science and developing technical guidance, coordinating efforts among all City agencies, and a public-private advisory committee. Port staff also is consulting with the U.S. Army Corps of Engineers to examine federal funding options for a flood protection feasibility study that considers SLR.

Policy and Discussion Ideas:

New Waterfront Plan policy ideas for discussion at the 3.29.17 meeting include:

Port-wide Considerations

1. Develop a strategy that includes short, mid- and long-term planning and implementation timeframes to ensure that new Port projects include appropriate flood protection and SLR adaptations that advance the Port's and City's goals; develop near-term adaptation plans for higher risk assets and areas.
2. Continue to examine the risk of flooding due to the effects of climate change, including storm surges, changes in precipitation patterns, and SLR, to develop a more-detailed, site-specific understanding of the Port's vulnerability and prioritize action areas.
3. Work closely with FEMA to accurately reflect current flood risks at the Port.
4. Take an agile adaptive management approach to planning and implementing SLR adaptations that reflect evolving best practices and changing conditions; evaluate costs and benefits, monitor results, and adjust future actions accordingly.
5. Consider a wide range of strategies for managing SLR, including armored edges, elevated land or floors, floating development, floodable development, living shorelines or wetlands, and managed retreat; choose strategies that reflect the unique character, location, and land uses of adjacent neighborhoods.
6. Leverage SLR adaptation planning to achieve a broad range of Waterfront Plan urban design, historic preservation, public access, transportation, maritime, ecological, and recreational goals and other public benefits.
7. Develop a publicly-vetted cost benefit analysis framework to evaluate and prioritize public benefits that should be achieved in major resilience and public infrastructure improvements.
8. Protect contaminated lands from inundation caused by rising seas.
9. Work closely with the historic preservation community, SHPPO, and other interested stakeholders to integrate protection of the Port's historic and cultural resources with

resilience planning and design. Develop guidelines for acceptable changes and interventions to maximize protection of historic resources.

10. Work proactively with Port maritime and non-maritime tenants, legacy businesses, and development partners to identify early investments in resilience projects, including interim measures that would eliminate or reduce later, more costly repairs or optimize the life of Port assets; explore innovative leasing, financial and other incentives to bring them to fruition.
11. Prioritize protection of City and regional transportation and utility networks (e.g., BART, MUNI, Ferry System, sewer and stormwater systems.)
12. Leverage existing intergovernmental alliances with City, regional, state and federal partners and form innovative, new partnerships to catalyze policy changes, pilot projects and spur investments to meet the Port's most pressing resilience challenges.
13. Promote public understanding of resilience challenges and opportunities (e.g., SLR adaptation, earthquakes and other disasters, protection of the historic, cultural, and ecological resources) and develop support for planning, funding and implementing resilience improvement measures.

Project-level Considerations

When evaluating design alternatives for Port projects, consideration should be given to the following priorities:

- a. Avoid major changes to the existing form of the waterfront that may prove unnecessary; instead design to support future adaptations, if/when needed.
- b. Maximize protection of existing working waterfront berthing and dockside operations and future use/adaptation of the waterfront's edge for vessel docking, berthing or tie-ups, including for emergency response operations and water recreation.
- c. Maximize protection of the Port's historic and cultural resources.
- d. Avoid significant impediments to existing physical and visual public access and/or provide new or enhanced public access, views, and connections to the Bay.
- e. Preserve and enhance existing natural shoreline edges to the maximum feasible extent.
- f. Integrate existing SLR adaptations with retrofits that slow down, capture and reuse water that flows into creeks and the Bay from Port and upland areas.
- g. Use materials for new shoreline edges and in-water structures that foster a rich marine habitat, promote ecological functioning, and enhance the Bay.
- h. Provide inviting connections to and between waterfront public access and open spaces.
- i. Incorporate resilience best practices for raising structures or ground floors; protecting and elevating critical power, mechanical, hazardous material, fuel and trash storage and other infrastructure; cladding and bolstering vulnerable building exteriors.
- j. Minimize short-term, construction impacts and maximize long-term improvements to the waterfront's multi-modal transportation network.

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Topic 3 – Seismic Safety

Background:

There is scientific consensus that a damaging earthquake is nearly certain to occur in the Bay area within the next 30 years; it could occur at any time. Given this context, careful and informed decision-making is necessary to direct limited resources to the Port's most pressing seismic safety improvements.

The Seawall Resilience Project

The Seawall Resilience Project is a major City and Port effort to improve safety and resilience of the historic Embarcadero waterfront. The Project will plan, design, and implement the most critical improvements over the next decade and, along with the Waterfront Plan Update, provide the framework for ensuring a disaster resilient waterfront by 2040, a major goal of the City's ResilientSF Plan.

The Seawall is the backbone of the North Embarcadero Historic District, stretching three miles from Fisherman's Wharf to Mission Creek. It stabilizes the filled lands underlying the Embarcadero, protects the waterfront and Downtown from flooding, and provides the foundation for many of the historic bulkhead buildings, wharves, and the Embarcadero Promenade. The recently completed earthquake vulnerability study indicates that most of the waterfront is highly susceptible to earthquake damage associated with seawall movement and localized failure of the bulkhead. The executive summary of the [completed study](#) is available on the Port's website. The overall results are summarized below:

- Most of the Seawall is built over Young Bay Mud that tends to amplify earthquake shaking and is susceptible to earthquake induced lateral spreading and settlement.
- Fill that was used to create the land behind the Seawall is susceptible to liquefaction.
- Large earthquakes will likely cause most of the Seawall to settle and move outward toward the Bay due to a combination of weakness in the underlying Bay Mud and increased pressure from the liquefiable fill.
- Seawall movement will significantly increase earthquake damage and disruption along the waterfront. Historic bulkhead wharf structures built of non-ductile concrete are particularly at risk to increased levels of damage. Piers are at risk to increased damage where they connect to the bulkhead wharves, and to disruption from utility damage and land access. The bulkhead wall may be compromised in some areas leading to erosion from tides and waves. Within The Embarcadero, lateral spreading and settlement associated with Seawall movement will increase damage to utilities, The Embarcadero Promenade and roadway, and Muni light rail tracks.
- \$1.6B in Port assets are at risk from earthquake damage within the Seawall zone of influence; \$2.1B of rents, business income, and wages are generated yearly in these Port assets. Besides direct and indirect impacts to the Port, the Northern Waterfront is a major contributor to the tourism industry, valued at over \$1.1B per year, and of significant overall economic importance to the City and Bay Area. Recent disasters have shown that reducing recovery time is the key to managing the overall impact of a major disaster, both economic and to human suffering. Port water transportation and maritime facilities in the

Northern Waterfront will be significant players in any post-disaster recovery effort, so the accessibility and continued function of these facilities is a priority.

- It is feasible to stabilize the Seawall by improving the soils below and the fill behind, however construction is costly and disruptive. Stabilizing the Seawall will greatly improve the earthquake safety and performance of the Northern Waterfront, including the existing wharves, piers, utilities, roadway, and light rail. The Study evaluated various concepts and developed rough order of magnitude costs that exceed several billion dollars. At this stage, these are very conceptual improvements and costs are subject to change.
- The Vulnerability Study indicated that up to \$5 billion is likely needed to fully stabilize the entire seawall, backlands, and infrastructure, and support potential SLR adaptation measures. This Study goes a long way to advance understanding of the seismic safety of the Seawall; however, much more study and outreach with stakeholders is needed to inform decision-making on the scope and approaches for improving the earthquake performance of the Seawall.

Project Timeline and Budget - The initial Project is budgeted as an 11 year effort with an overall budget of \$500 million to plan, design, and construct the most critical improvements. Additional improvements will be needed to fully stabilize the waterfront and adapt to mid to end of century SLR projections.

Planning Phase (mid 2016 – mid 2018) - Complete condition and risk assessment of facilities, identify problems and opportunities, develop conceptual level alternatives, engage stakeholders in a robust process to evaluate and compare alternatives, select preferred alternatives and develop an overall phased program.

Preliminary Design and Approval Phase, Initial Improvements (mid 2018 – mid 2020) - Advance design of initial improvements and secure approvals including choosing preferred alternatives and environmental clearance.

Final Design and Construction Phase, Initial Improvements (mid 2020 – end 2025) - Complete final designs and construct initial improvements. It is expected that 2-4 separate construction projects will be implemented.

Project Organization and Staffing - The Port has formed a City executive advisory team to ensure Project alignment with CCSF short and long-term vision, goals, and priorities. The Executive Advisory Team includes the Mayor's Budget Director, the Director of the Office of Public Finance, Director of Capital Planning, the Chief Resilience Officer, the City Engineer, and a representative from the City Administrator's Office, the Office of Emergency Management, the Municipal Transportation Agency, and the Public Utilities Commission.

The Port also will form a volunteer Technical Advisory Panel comprised of leaders and technical experts in waterfront design, seismology, structural engineering, geotechnical engineering, construction, and the Bay environment. This panel is expected to include university professors, industry leaders, and subject matter experts that are independent from potential consultants that may be hired to support the Project. The panel will be formed early in the Project and serve as an independent technical advisor throughout the Project.

Financing - The City and Port have identified \$9.5 million to advance the planning phase. In December 2015, the Seawall Resiliency Project was selected to participate in the Citi Foundation

and Living Cities City Accelerator program to explore financing options to address funding gaps for high priority projects.

Policy and Discussion Ideas:

New Waterfront Plan policy ideas for discussion at the 3.29.17 meeting include:

Port-wide

1. Reduce structural and nonstructural hazards to life safety and minimize property damage resulting from future seismic events; provide information and guidance to help tenants incorporate earthquake safety in their uses and operations of Port facilities.
2. Continue to seismically retrofit vulnerable Port buildings, piers and other infrastructure.
3. Work with City officials, design professionals, and community members as they develop higher standards for building safety and post-earthquake re-occupancy, ensuring their applicability to the Port's unique structures.
4. Reduce risks to life safety while still preserving the architectural character of buildings and structures important to the unique visual image of the San Francisco waterfront, and increase the likelihood that historically valuable structures will survive future earthquakes.
5. Create a database of vulnerable Port buildings, seismic evaluations, and seismic retrofits to track progress, record inventories, and evaluate and report on retrofit data.
6. Recognize and ensure projects evaluate unique seismic issues associated with filled lands and shoreline stability, such as liquefaction, lateral spreading, and amplified ground motions.

Seawall Resilience Project

1. Improve earthquake safety of the historic Embarcadero Seawall and reduce the potential for seismic damage and disruption to Port facilities, and City transportation and utilities within The Embarcadero and upland properties, without delay.
2. Develop a planning framework so that near-term Seawall seismic improvements are informed by an outlook and strategy for short-, mid-, and long-term sea level rise adaptation.
3. Incorporate easily implementable near-term measures that can improve life safety, protect critical infrastructure and assets, and control damage of historic structures.
4. Recognize and support the public commitment to maintenance and rehabilitation of structures in the Embarcadero Historic District (including the Seawall), which is a defining feature of San Francisco.
5. Include opportunities for ecological and environmental enhancements to the Bay in the Seawall Resilience Project.
6. Limit disruption during construction, especially to business and transportation.
7. Seek a wide variety of local, state, federal and private funding sources.
8. Ensure transparency and accountability to the public and all stakeholders.

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