



MEMORANDUM

September 9, 2022

TO: MEMBERS, PORT COMMISSION
Hon. Willie Adams, President
Hon. Kimberly Brandon, Vice President
Hon. John Burton
Hon. Gail Gilman
Hon. Steven Lee

FROM: Elaine Forbes 
Executive Director

SUBJECT: Informational presentation on the Initial Southern Waterfront Earthquake Assessment

DIRECTOR'S RECOMMENDATION: Information Only – No Action Required

EXECUTIVE SUMMARY

This staff report provides the key findings from the Initial Southern Waterfront Earthquake Assessment (ISWEA) and ends with next steps for how these findings will be advanced, mitigated and/or incorporated into on-going efforts by Port staff. ISWEA was initiated at the direction of the Port Commission in order to further the understanding of seismic hazards and vulnerabilities to southern waterfront facilities, as a companion to the Embarcadero Seawall Multi-Hazard Risk Assessment (MHRA), which was underway at the time of this request. It is imperative to recognize that this Initial Southern Waterfront Earthquake Assessment is much different than the MHRA, in part due to its nature as an initial assessment but also as a result of the different character of the southern waterfront, much of which is not currently publicly accessible which changes the potential consequences in the event of an earthquake. Although ISWEA is not comparable to the MHRA, it will allow the Port to move forward with further study, design and improvement projects based on the potential hazards and vulnerabilities identified.

The completion of ISWEA and public release of information from the assessment is a key milestone that informs current and future lease negotiations, enables Port staff to leverage funding opportunities, supports the development and public engagement for Draft Waterfront Adaptation Strategies in Fall 2022 as part of the US Army Corps of Engineers

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(USACE) San Francisco Waterfront Coastal Flood Study, and sets the stage for projects to address identified hazards and vulnerabilities.

STRATEGIC OBJECTIVES

Completion of ISWEA is a stated goal of the Port's 2021-2025 Strategic Plan, the project supports the goals of the Port's Strategic Plan as follows:

Economic Recovery: *Identify and implement external funding sources.* ISWEA findings have been used to inform and support multiple funding requests including securing funding for a Pier 50 earthquake assessment via the American Rescue Plan Act and pursuing a FEMA Pre-Disaster Hazard Mitigation Grant for Pier 96.

Resilience: *Conduct seismic analysis – finalize the Southern Waterfront Seismic Hazard & Vulnerability Assessment.* ISWEA advances the Port understanding of seismic hazards and vulnerabilities in the southern waterfront, which will inform all future projects, leases, and plans, including the Draft Waterfront Adaptation Strategies currently being advanced by the Waterfront Resilience Program in partnership with the USACE.

Engagement: *Strengthen understanding and support, engage advisory groups, communities, and stakeholders.* Although an initial study, ISWEA is an important step in comprehensively documenting and describing the earthquake hazards along the Port's southern waterfront jurisdiction. The findings of this assessment and next steps have been shared with the Southern Advisory Committee, Maritime Commerce Advisory Committee and impacted tenants. The findings and next steps are also important context for the Draft Waterfront Adaptation Strategy public release and community meeting series anticipated for Fall 2022.

BACKGROUND

The purpose of the ISWEA is the initial characterization of geotechnical hazard and structural vulnerability of select Port facilities south of Mission Creek. For these facilities, the existing conditions, available information, seismic hazards and expected behavior is documented where key elements of with potential seismic risk are highlighted based upon professional judgment. Additionally, the report gives an indication of potential seismic risk mitigation strategies for these facilities, along with an order of magnitude estimate of capital cost associated with fully mitigating these seismic hazards or vulnerabilities.

As an initial study, the main objective of this report is to identify gaps in available information and establish actionable next steps to further refine the understanding of seismic risk informed by this early planning level assessment. This effort is similar to the 2016 Earthquake Vulnerability Study for the Seawall, which was a catalyst for what became the Embarcadero Seawall Program through the successful Proposition A General Obligation Bond in 2018. The level of detail or certainty about identified seismic hazards and vulnerabilities in this report should not be compared to the Embarcadero Seawall Program's Multi-Hazard Risk Assessment completed in 2020, which was supported by field investigations and detailed soil-structure earthquake analysis not performed as part of this initial assessment.

KEY FINDINGS

The following subsections provide a general summary of the assessment findings, as well as key hazards and vulnerabilities at specific facilities. While the findings presented in the general summary apply to most all facilities in the southern waterfront, a few facility-specific findings were identified as interesting facts or areas of concern based upon professional judgment. As such, next steps are likely to include further, more targeted evaluation to refine understanding of seismic risk at individual facilities.

General Summary

Based on the initial geotechnical analysis performed using available data, many of the facilities along the southern waterfront are likely to undergo significant lateral, vertical, and rotational displacements under the 225- and 975-year return period earthquake events. For reference, the 225-year earthquake is expected to be an earthquake approximately equal to the 1906 San Francisco earthquake, and the 975-year earthquake is approximately the building code level earthquake, which is expected to be larger than the southern California Northridge earthquake in 1994. Although earthquakes of this size are rare, it is important to consider such events in the context of seismic standards in the current building code and for the purpose of disaster response scenario planning.

The prevalence of liquefiable sand layers behind seawalls or sand dikes and the presence of deep soft Young Bay Mud throughout the southern waterfront contribute to the seismic hazard and vulnerability. Several facilities, including Piers 80, 94, and 96, contain marginal wharves supported on piles that are embedded in sand dikes, and may experience potential lateral displacements exceeding 5 ft in the bayward direction and potential vertical settlements greater than 2 ft. There is a moderate to very high risk of liquefaction at all facilities for the 100-, 225-, and 975-year return period earthquake events. Buildings located on the piers are likely to experience differential settlement consistent with the displacement and settlement of the piers, in addition to potential structural damage caused by the shaking and ground displacement.

Pier 50

- The existence of Mission Rock (a rocky outcropping in the bay) within the footprint of Pier 50 leads to unique, potentially improved, seismic performance of the pier relative to that of typical finger piers since the bay end of the pier is braced by the rock. Damage would still be expected, and it is likely that a seismic evaluation would conclude that the pier structure and sheds do not meet current seismic codes.
- A joint occurs in the pier deck between the landward portion of Pier 50 and the Mission Rock portion. This joint is a weak point in the deck and damage at the joint would be expected.

Pier 80

- The marginal wharf is supported on piles embedded in a sand dike, which is likely to liquefy under seismic loading. The lateral movement and settlement of the liquefied dike would result in damage to the wharf and any supported structures.

- Sheds A and D are located partially on the wharf and partially on land and would be particularly susceptible to damage at the location where they cross the joint between the two.
- A significant 60-inch SFPUC force main outfall pipeline runs along the south wharf and is susceptible to damage due to movement of the sand dike. As described below, Port staff is collaborating with SFPUC on further study of the outfall vulnerability.

Pier 94/96

- Similar to Pier 80, the marginal wharf is supported on piles embedded in a sand dike, which is likely to liquefy under seismic activity. The lateral movement and settlement of the liquefied dike would result in damage to the wharf and any supported structures.
- Along the southern edge the sand dike incorporates a steel sheet pile wall with a tie back anchored in the foundation of Building E on the wharf (currently occupied by Recology). Liquefaction would likely result in failure of the sheet pile wall and significant lateral spreading and settlement of the soils supporting Building E, which would likely experience significant damage. Port staff has briefed the tenant on these findings and will continue discussions about potential mitigations.

Pier 92

- The typical lateral spreading vulnerability along the shoreline edge.
- Liquefaction and settlement of the soils behind the wharf structure would also be expected, which could result in damage to infrastructure located landward.

Pier 54

- Low potential for lateral spreading due to shallow bedrock and rock dike construction, but liquefaction induced settlement of landward soils anticipated.
- The buildings at Pier 54 have not been retrofitted and would be susceptible to earthquake damage due to shaking.

Pier 68 Shipyard

- The typical lateral spreading vulnerability along the shoreline edge.
- Liquefaction and settlement of the soils behind the wharf structure would also be expected, which could result in damage to infrastructure and buildings located landward. Building 6 is currently red tagged and Buildings 105 and 109 are yellow tagged due to a compromised lateral force restraining system, which makes them especially vulnerable. Buildings 105 and 109 were included in the 2021 FIRPA study. All of these buildings are vacant and staff continues to monitor their condition for public safety.

Mission Bay Ferry Landing at Bayfront Park

- The proposed site of the Mission Bay Ferry Landing at Bayfront Park was the subject of a geotechnical study in 2017 that showed the liquefaction potential was low and significant strength loss during liquefaction was not expected. The study also concluded that the potential for lateral spread is low at the site and seismic settlement is expected to be less than 3 inches and will likely occur in random

isolated areas. The adjacent Chase Center was recently constructed on piles and liquefaction was addressed at some locations on that site by removing liquefiable fills and extending the piles below liquefiable layers.

- The Ferry Landing Project accounts for seismic hazards to meet current code requirements.

Pier 52, Heron's Head Park & Western Pacific Property

- Limited information is available at these three sites. The best working assumption from a geotechnical perspective is that the issues of liquefaction, lateral spreading, and settlement that have been discussed at other sites are also present at these sites.
- Pier 52 is a timber pier in an advanced state of disrepair and is currently red tagged.
- The one story EcoCenter building was constructed in 2010 and is the only structure on the Heron's Head Park site. Due to the nature of construction for this building, some amount of differential settlement from liquefaction or lateral spreading may be able to be accommodated.
- There are currently no vulnerable structures at the former Western Pacific Property adjacent to Pier 80.

NEXT STEPS

The Initial Southern Waterfront Earthquake Assessment was the first step toward comprehensively understanding, documenting and addressing the seismic risk in the southern waterfront. ISWEA will serve as a foundational building block for all future planning, leasing and project endeavors that the Port undertakes in this geography.

The scale of construction funding necessary to fully mitigate all seismic risks in the southern waterfront is estimated to be greater than \$300 million which will be a considerable challenge to fund and will take many years. However, if funding sources can be aligned this level of investment provides substantial opportunity to infuse capital into aging facilities nearing the end of their useful life, thus allowing them to evolve with the changing maritime needs of the Port, City and region, adapt to rising water levels and provide broader public benefits in conjunction with the Port's overall resilience efforts.

In terms of immediate next steps along the path to those seismic mitigations it is not currently anticipated that a Multi-Hazard Risk Assessment approach similar to the Embarcadero Seawall MHRA will be required to prioritize investment and make progress in addressing earthquake risk in the southern waterfront. This staff recommendation results from the observations that the southern waterfront is primarily comprised of geographically distinct and contained facilities, current lack of public access and associated public life-safety risk along the immediate shoreline, and most City utility infrastructure located an appreciable distance from the affected shoreline areas. Accordingly, the Port is moving forward with projects at a few key facilities based on the potential hazards and vulnerabilities identified by ISWEA and available capital project funding. Coastal flood risk

in the southern waterfront will also be assessed as part of the USACE San Francisco Waterfront Coastal Flood Study.

In the near term, the findings of this study have already been utilized to identify earthquake resilience projects for the FY22/23 Port capital budget, pursue outside funding opportunities and inform Port capital improvement projects and other strategic planning efforts in the southern waterfront. Notable examples of where these findings have been implemented into Port actions include:

Pier 50

The unique nature and age of Pier 50 warrants a detailed condition assessment and advanced earthquake analysis to determine the expected earthquake performance with certainty, thus enabling a conceptual seismic retrofit scheme to be defined. These next steps have been funded with approximately \$3M allocated in the FY22/23 Port Capital Budget, utilizing funding made available through the American Rescue Plan Act (ARPA) of 2021. Additionally, the Port intends to seek state or federal grant funding through programs like MARAD's Port Infrastructure Development Grant Program or FEMA's Building Resilient Infrastructure and Communities to complete pre-design and environmental clearance (CEQA) for subsequent earthquake risk mitigation projects at this facility.

Pier 80

This facility has two capital improvement projects in the approved FY22/23 Port Capital Budget, neither of which is directly intended to address the seismic hazards and vulnerabilities determined in this assessment. However, these hazards and vulnerabilities will be considered in the design of the capital projects, allowing them to be implemented in a way that makes them both less vulnerable in their own right as well as complementary with anticipated future earthquake risk mitigation projects. The two approved capital projects include a Subsidence Rehabilitation project for \$800,000 and a Mooring Point and Fendering project for \$9.4M.

In addition to these two projects, Port staff will continue to collaborate with the San Francisco Public Utilities Commission (SFPUC) on their further planning, analysis and implementation steps toward any Pier 80 outfall projects, since this critical infrastructure lies within the area of potential lateral spreading and liquefaction hazard along the southern berths of Pier 80. Finally, the Port intends to seek state or federal grant funding through programs like MARAD's Port Infrastructure Development Grant Program to complete pre-design and environmental clearance (CEQA) to initiate earthquake risk mitigation projects at this facility.

Pier 94/96

In collaboration with the Department of Emergency Management (DEM), in 2021 the Port held a disaster response exercise to evaluate and test the current disaster responses plans with an understanding of expected seismic performance of waterfront facilities. Information from ISWEA was used to inform the performance expectations for southern waterfront facilities.

A key finding from this exercise was that Piers 94/96 are critical to the disaster response and recovery for the City due to the adjacency of deep draft berths to the large backland

area capable of fulfilling multiple post-disaster functions and needs. Therefore, the exercise concluded that the expected earthquake hazard and vulnerability needs to be addressed to ensure the facility can fulfill the disaster response role after a major seismic event. The findings of this exercise were leveraged in a pre-disaster grant application through the FEMA Hazard Mitigation Grant Program, where the grant would fund further assessment, pre-design and potentially environmental clearance with a budget of \$3.6M.

The application was recommended for funding by the California Governor's Office of Emergency Services (a disaster response exercise participant) and is currently under review by FEMA, with announcement of grant award expected in Fall 2022. If successful, FEMA would fund 75% of the cost for this work to advance analysis of an earthquake risk mitigation project at this facility, potentially setting up construction funding through a subsequent grant opportunity or public-private partnership. Successfully securing this \$3.6M grant for pre-design sets up subsequent federal funding opportunities through the FEMA's Hazard Mitigation Grant Program or Building Resilient Infrastructure and Communities to complete detailed design and construction of earthquake risk mitigation projects at this facility.

LOCAL BUSINESS ENTERPRISE

The assessment was completed by the Parsons-RJSD Joint Venture through the 2020-2023 Engineering On-Call contract pool. Parsons led the project management of the assessment, while Ryan-Joyce Structural Design (RJSD) a qualified LBE consultant was responsible for the structural engineering and Earth Mechanics Incorporated (EMI) a non-LBE consultant completed the geotechnical engineering. Through completion of this contract service order 37% of the invoiced value has been allocated to RJSD who is an LBE prime consultant for this contract.

OUTREACH EFFORTS

The Initial Southern Waterfront Earthquake Assessment was initiated as an internal assessment of earthquake hazards and vulnerability to improve the Port's understanding of these potential risk factors. Upon receipt of the findings, Port staff have engaged with tenants in areas of potentially high hazard or highly vulnerable, including but not limited to, Pasha (Pier 80), Recology (P96), Martin Marietta (P94), CEMEX and Central Concrete (P92), Westar (P50), as well as with advisory groups with interests in the southern waterfront such as the Southern Advisory Committee (SAC) and Maritime Commerce Advisory Committee (MCAC). Additional dissemination of this information will continue as the Waterfront Resilience Program rolls out the Draft Waterfront Adaptation Strategies through community meetings, in-person outreach and online engagements in Fall 2022.

SUMMARY

In summary, the Initial Southern Waterfront Earthquake Assessment is an important step forward in the Port's current understanding of the conditions and vulnerabilities of its Southern Waterfront facilities. This understanding will serve as a foundational building block and resource for strategic funding decisions, future planning efforts, leasing

discussions and project endeavors that the Port pursues in the southern waterfront. The assessment identified several key earthquake hazards and vulnerabilities at facilities that are essential to the Port's maritime business line as well as critical for the City's emergency response and recovery operations. The cost to fully mitigate these hazards and vulnerabilities will exceed \$300M, which will be a significant challenge to fund, but by parsing out and specifying these vulnerabilities in more detail Port staff intend to make strides on improving each individual facility as opportunities are presented. This scale of investment also provides an opportunity for multi-benefit projects that will allow the waterfront to evolve with changing maritime needs and infuse capital into facilities nearing the end of their useful life. Port staff are actively pursuing next steps to further analyze, fund and mitigate the hazards and vulnerabilities identified as part of this assessment and will keep the Commission apprised as these efforts continue.

Prepared by: Matt Wickens, Project Manager
Waterfront Resilience Program

For: Rod Iwashita, Chief Harbor Engineer
Engineering Division