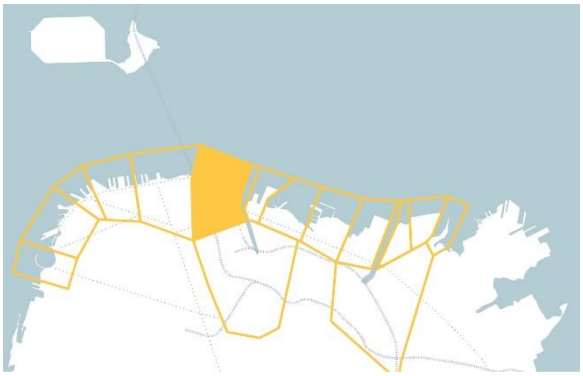
Subarea Profile

# South Beach

## Subarea 3-1

| SHORELINE TYPE: | SEISMIC RISK[1]: | FLOOD RISK[2]: | |
|---|---|---|---|
| | **Shoreline Instability:** Low to Moderate | **Tipping Point Elevation:** | 66" above high tide |
| **Engineered:** Filled land with rock dike and pile supported bulkhead wall and wharf, mostly original from the early 1900s. | **Liquefaction Risk:** High in Embarcadero Fill | **Coastal Flood Events** | **Timing** |
| | **Shoreline Structure Vulnerability:** Moderate to High due to ground shaking | | |
| **Subsurface Profile:** Non-engineered fill, shallow bay mud, dense sands and clay | **Unique Conditions:** Unique and unstable seawall near Ballpark; Original (100+ year old) bulkhead wall and wharves | 100-yr Flood + 26" SLR | 2043 - 2067 |
| | | High tide + 66" SLR | 2084 - 2140 |

## SUBAREA DESCRIPTION



South Beach is home to historic piers, South Beach Harbor, parks, iconic waterfront views, affordable housing developments, and the San Francisco Giants ballpark. It is part of San Francisco's rich maritime history, home to neighborhoods and neighborhood and visitor serving uses and current efforts to create a sustainable and resilient waterfront for generations to come.

The subarea shoreline is entirely engineered, and without the protection of the piers, most of the shoreline would be in a wave hazard zone. Winter storms with large waves have damaged the piers and shoreline, and under existing conditions the wave hazards are greatest between the Bay Bridge and the Pier 40 breakwater.

The primary flooding pathway is overtopping along the shoreline. Overtopping first occurs over several stretches of the Embarcadero shoreline (not including piers), impacting the Embarcadero roadway and immediate inland areas. Flooding also comingles with the adjacent Subarea 2-2. Flooding also enters Subarea 3-1 from the adjacent Subarea 3-2 via a flood

[1] Shoreline Instability ratings within Embarcadero Seawall Program area based on advanced shoreline stability analysis and averaged over each subarea. Shoreline Structure Vulnerability based on Mean Damage Ratio calculated for the 225 year seismic event averaged across subarea.

[2] The timing of coastal flood events that will cause significant flooding in this subarea is provided as a range of dates based on the sea level rise projection scenarios provided by the California Ocean Protection Council (OPC) per the Likely and 1-in-200 chance of occurrence projections.

pathway on Berry Street near the Peter R. Maloney Bridge (4th St Bridge). Higher Bay water levels would result in overtopping along most of the shoreline, allowing floodwaters to extend several streets inland.

## COMMUNITY IDENTIFIED PRIORITIES:

### Places

- San Francisco Giants' ballpark
- Ballpark ferry terminal
- Third Street Bridge
- South Beach Harbor
- South Beach Park
- Brannan Street Wharf
- South Park
- Piers 30-32
- Muni T-line
- Bay Trail

Since 2017, the Port has connected to tens of thousands of community members through the Waterfront Resilience Program. Public feedback collected about South Beach underscores the importance of keeping people moving and connected to the city. From Bay Bridge access and transit options to bike lanes, ferries and boats, transit rose as a key South Beach feature to protect and improve. Recreation, such as paths on the waterfront, and emergency preparedness, such as access to evacuation routes and staging areas, also emerged as top values.

Further feedback highlights additional community priorities including opportunities to improve seismic safety, enhance disaster response communication, increase transit options and reduce traffic congestion, provide safer and continuous bike paths, expand public parks and recreation activities, and support local tourism opportunities

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### FIRST FLOODING OF ASSETS

The chart below describes the vulnerability of specific assets within the South Beach subarea to flooding. These assets will be exposed to coastal flooding when the water level in the Bay reaches a certain height above the current high tide. The heights at which each asset is exposed to flooding is indicated with the shaded cells in the table. Over time and due to sea level rise these water levels can occur due to large storm events such as a 100 year flood of daily high tides. For example, the Embarcadero Roadway is exposed to flooding when the water rises 66 inches above current high tide, which could occur due to a 100 year flood with 3 ft. of sea level rise or as during daily high tide with 5.5 ft. of sea level rise.

● High Tide ○ 100 Year Flood ▭ Shaded cells indicate the water levels at which assets are exposed to flood

| | | WATER LEVEL ABOVE CURRENT HIGH TIDE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEA LEVEL RISE | | 0” | 12” | 24” | 36” | 48” | 52” | 66” | 77” | 84” | 96” | 108” |
| Today | | ● | | | | ○ | | | | | | |
| 1 ft. SLR | | | ● | | | | ○ | | | | | |
| 3 ft. SLR | | | | | ● | | | | ○ | | | |
| 5.5 ft. SLR | | | | | | | | ● | | | | ○ |
| **Historic and Cultural** | | | | | | | | | | | | |
| | Pier 40 | | | | | | | | ▭ | ▭ | ▭ | ▭ |
| | HiDive Bar | | | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| | Red’s Java House | | | | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| | Oracle Park | | | | | | | | ▭ | ▭ | ▭ | ▭ |
| **Disaster Response** | | | | | | | | | | | | |
| | Assembly Areas (Pier 30-32, Seal Plaza) | | | | | | | | ▭ | ▭ | ▭ | ▭ |
| | Assembly Areas (Seawall Lot 328, 330) | | | | | | | ▭ | ▭ | ▭ | ▭ | ▭ |
| | Emergency Fire Water Pump Station 1 | | | | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| | Fire Department HQ | | | | | | | | | | | > |
| **Open Space and Ecology** | | | | | | | | | | | | |
| | Bay Trail | | | | | | | ▭ | ▭ | ▭ | ▭ | ▭ |
| | Pier 40 Bay Water Trail Boat Launch | N/A (Asset may continue to function as sea level rises) | | | | | | | | | | |
| | Pier 40 Boat Launch | | | | | | | | ▭ | ▭ | ▭ | ▭ |
| | Pier 42 Fishing Pier | | | | | | | | ▭ | ▭ | ▭ | ▭ |
| | Promenade | | | | | | | ▭ | ▭ | ▭ | ▭ | ▭ |

# South Beach

## Subarea 3-1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Brannan Street Wharf | | | | | | | | | | | |
| | Giant's Promenade | | | | | | | | | | | |
| | South Beach Park | | | | | | | | | | | |
| | Willie Mays Plaza | | | | | | | | | | | |
| **Maritime** | | | | | | | | | | | | |
| | Ferry Terminal | | | | | | | | | | | |
| | South Beach Harbor | | | | | | | | | | | |
| | Pier 40 Water Taxi Dock | | | | | | | | | | | |
| | Pier 30-32 | | | | | | | | | | | |
| **Transportation** | | | | | | | | | | | | |
| | Embarcadero Roadway | | | | | | | | | | | |
| | MTA King Street Substation | | | | | | | | | | | |
| | Muni Light Rail (E, T) | | | | | | | | | | | |
| **Utilities** | | | | | | | | | | | | |
| | Bay Bridge Pump Station | | | | | | | | | | | |
| | Moscone Substation | | | | | | | | | | | > |
| | North Channel Transport / Storage Box | N/A (Buried assets are not directly impacted by flooding) | | | | | | | | | | |
| **Critical Facilities** | | | | | | | | | | | | |
| | Homeless Navigation Center | | | | | | | | | | | |
| | SOMA Mental Health | | | | | | | | | | | > |

## EARTHQUAKE AND FLOODING RISKS: MULTI-HAZARD RISK ASSESSMENT KEY FINDINGS

As detailed in the Seawall Earthquake Safety General Obligation Bond Report prepared when Proposition A was considered for the November 2018 ballot, the Port has spent the past two years assessing what is at risk on the Embarcadero waterfront when considering an earthquake or flood event to establish a basis for the development of Proposition A projects. This study is called the Multi-Hazard Risk Assessment, or MHRA.

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## Subarea 3-1

We knew the Port's aging Embarcadero Seawall was at grave risk from earthquakes. MHRA findings tell us there are areas more at risk of earthquake damage due to different soil conditions - and some less so.

Specifically, we now know:

- In the South Beach subarea, earthquake instability of the Seawall is lower than previously thought. Lateral spreading and Seawall movement is not expected to be a problem in the area, but strong ground shaking is expected to damage wharves and the roadway.

- The Embarcadero roadway has significant seismic risk, which could impact disaster response and local and regional transportation. Due to the presence of weak soil, the Embarcadero transportation and utility corridor is at significant seismic risk. In a 1906-size earthquake, damage to the Seawall and Embarcadero may be severe enough to significantly hamper disaster response efforts along the waterfront. A more likely earthquake like the 1989 Loma Prieta earthquake – but centered close to San Francisco – is expected to lead to loss of the Embarcadero as a transportation route for up to 1 year.

- Many historic buildings and bulkhead wharves are at high risk. The bulkhead wharves are the structures located where the pile supported piers over the Bay meet the land. These structures are interconnected with the seawall and support the ornate, historic bulkhead buildings that line the Embarcadero. These structures are at high risk of earthquake damage and will flood with increasing sea levels.

### Life Safety and Disaster Response

- South Beach Subarea is more sparsely occupied along the waterfront; however, Oracle Park is a major draw and brings high activity levels along the promenade and queuing at the adjacent ferry terminal. The ballpark itself is a newer structure built to modern seismic standards.
- Wharves and buildings adjacent to the seawall are high risk due to seawall-related earthquake damage and consequences for promenade and pier access.
- The Embarcadero roadway, a critical lifeline during disaster response and recovery, is expected to sustain damage along its entire length due to lateral spreading and settlement, especially at the 225-year and 975-year earthquake scenarios. The high damage predicted to the wharves and piers adjacent to the Embarcadero in the 225-year earthquake will also significantly impact all missions as these structures connect maritime facilities to the Embarcadero.

### Utilities

- The Bay Bridge Pump Station serves as the sole source of water for the Treasure Island and Yerba Buena water distribution system (approximate service population on Treasure Island: currently 3,000 residents, planned development for 8,000 homes).
- Pump Station No. 1 provides water for the Auxiliary Water Supply System (AWSS), which delivers water at high pressures, and serves as a backup to the primary source of AWSS water from the series of reservoirs.
- Within the last 5 years, PG&E installed an additional new 230-kV transmission line to expand the Embarcadero and Potrero Substations (Illinois Street between 22nd and 23rd streets). This new line provides an additional source of reliability for electricity in San Francisco, in addition to the two existing 230-kV lines that feed the Embarcadero Substation (which is beyond the program boundary). The new transmission line is ~3.5 miles in length. 2.5 miles are installed offshore in the seafloor of the San Francisco Bay between Pier 30 and 23rd Street (CPUC, 2014). This new line is partially within the Embarcadero Seawall Program boundary.

- The surface light rail transit KT and N lines provide critical connections to the 3rd Street corridor and to the Caltrain station, which connects riders to the Peninsula.
- AWS): Damage to key AWSS assets, while less than most utilities, is anticipated to have significant impacts on systemwide performance. Components expected to experience earthquake damage include system transmission line breaks, compromised access to 3 (out of 5 systemwide) fireboat intake manifolds, and compromised access to 20 (out of 35 systemwide) bay water suction manifolds. In addition, the critical saltwater intake tunnel for Pump Station No 1 runs through the seawall near Pier 38 and warrants further analysis.
- Floodwaters may enter conduits, boxes, and electrical equipment that is sensitive to flooding. The AWSS seismically reliable motorized valves have underground battery vaults, that if inundated could render them inoperable. If buried water distribution pipelines are compromised, saltwater infiltration from increased groundwater levels could affect the quality of drinking water.

## Transportation Assets

- Major repairs to the Embarcadero could take 6 months to 1 year following a 100-year earthquake, and severe damage following a 225-year earthquake would likely require complete reconstruction of some sections resulting in 1 to 2 years of construction and disruption.
- Local transit will likely be out of service for at least a few weeks and could be out for over 1 year. For a 43-year earthquake, the light rail trackway will likely be offline for 2 to 3 weeks, as checking and testing will be required even if damage is limited. This disrupts a total of 110,000 trips daily.
- At 2.2 feet of sea-level rise, expected to occur between 2050 and 2075, the Embarcadero roadway and promenade reach a tipping point, where the 100-year flood causes widespread overtopping of the shoreline, resulting in complete elimination of function for multimodal movement with far reaching impacts to mobility patterns for both the city and region.
- The groundwater table will rise in unison with sea-level rise. By 2.2 feet of sea-level rise, the bedding underneath the Embarcadero roadway and SFMTA Muni light rail surface tracks will start to become continuously saturated, leading to a surge in operation and maintenance costs for the critical Embarcadero transportation corridor.

## Historic Resources

- The South Beach Subarea contains the oldest surviving pier structures in the historic district; Piers 38 and 40 were built in 1908. In addition, though it has been heavily modified, Pier 40's transit shed is the oldest building in the district. Finally, while most of the buildings along the waterfront are Classical Revival in style, this subarea has the last surviving examples of Mission Revival and Renaissance Revival style sheds and bulkhead buildings (Piers 26, 28, and 38).
- As a group, the bulkhead wharves and bulkhead buildings represent the greatest risk. Damage to or loss of the bulkheads would greatly affect the feeling of the district from the city side and could impact the district's integrity with regard to architecture, planning, engineering, and government.

## Buildings and Structures

- The early 1900s concrete bulkhead wharves (Piers 22 ½ through 40) in South Beach, where the ground below the seawall is more stable, are highly vulnerable to ground shaking damage and potential collapse due to weak connections of the deck to the wall. These are some of the oldest structures on the waterfront and can be improved with simple retrofits.
- Extensive damage is expected where historic finger piers are rigidly connected to the wharves. The finger piers and wharves were built together and will likely move differently during an earthquake (wharves shake quick and piers shake slow), resulting in a hotspot for damage to the marine structures and buildings.

- Between 1.1 and 2.2 feet of sea-level rise, the proportion of physical damage anticipated from a 100-year extreme tide shifts from being primarily on Port property to being primarily in the floodplain beyond Port property, which includes North Beach/Fisherman's Wharf, Financial District, and South of Market/Mission Bay neighborhoods.

### Open Space and Public Realm

- The 43-year earthquake is predicted to cause minor damage and result in minimal disruption to the use of the promenade. There will be some inconvenience due to higher damage near the Ferry Building and near Oracle Park.
- The 100-year earthquake is predicted to severely reduce the promenade function. It may be generally accessible, but many waterside destinations would be disrupted for a few months. In particular, areas near the Ferry Building, Fisherman's Wharf, and Oracle Park are likely to be significantly impacted, with the potential to affect access and use for approximately 570,000 users per month for a duration of 3 to 9 months.
- Under 2.2 feet of sea-level rise, a 100-year flood will make the entire waterfront unusable and inaccessible due to widespread flooded areas. This same widespread inaccessibility would occur an average every 10 years under 3.3 feet of sea-level rise, and on a daily basis under 5.3 feet of sea-level rise.

### Economic Risks

- The job sectors with the highest earthquake risk include restaurants (37 percent), and entertainment and media industries (within the seawall area these include Oracle Park, the Exploratorium, and television stations) (23 percent). These industries are most prevalent along the Embarcadero, a place of high public use, and represent sectors that depend on tourism and waterfront access to function at current capacity. Jobs within the program area and throughout California are expected to be impacted by earthquake activity within the program area.

### Environmental

- The South Beach Subarea contains herring spawning sites, exposed seawall areas that provide habitat value, open bay and opportunities for ecological improvements. Open bay and subtidal habitats are important ecological resources and are often overlooked when considering the habitat values that are provided by the San Francisco Bay estuary.

## WHAT'S AT STAKE?

Given the specific impacts of earthquakes, flooding, and future sea level rise, what is at stake in South Beach?

Seismic and flood impacts could impact housing and access to transportation, health care, jobs and open space in this subarea. In South Beach, elderly residents who live in this subarea and residents who receive services at the Embarcadero SAFE Navigation Center are most at risk during a seismic or flood event. Organizations like Delancey Street Foundation are vital in this subarea for providing services and fostering community cohesion and earthquakes and sea level rise may impact the ability for those organizations to continue playing an integral role in the community.

Subarea Profile

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## Subarea 3-1

FUTURE POTENTIAL MEASURES UNDER CONSIDERATION IN THIS SUBAREA:

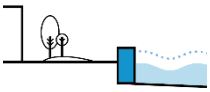
## FLOOD MEASURES:

### Physical Infrastructure

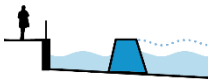
Floodwalls

Levees

Ecological Marine Structures

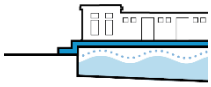


Seawalls

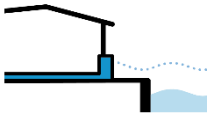


Breakwaters

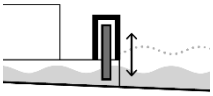
Aquatic Habitat



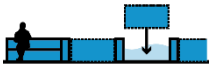
Raised Marine Structures



Building Adaptations



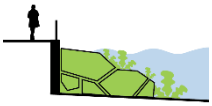
~~Tide Gates~~



Deployables

### Ecological Infrastructure

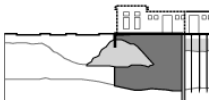
Ecological Features



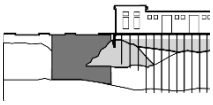
Ecological Shorelines

## SEISMIC MEASURES:

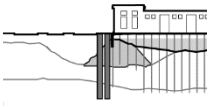
### Shoreline Stabilization



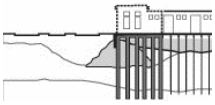
~~Nearshore Buttress~~



~~Landside Buttress~~



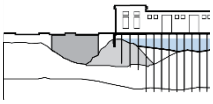
~~Drilled Shafts~~



~~Super Bulkhead Wharf~~

### Targeted Measures

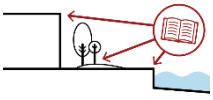
Bulkhead Wharf Retrofit



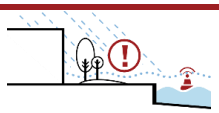
Liquefaction Mitigation

## FLOOD AND SEISMIC MEASURES:

### Policy and Emergency Preparedness



Policies and Zoning



Emergency Preparedness