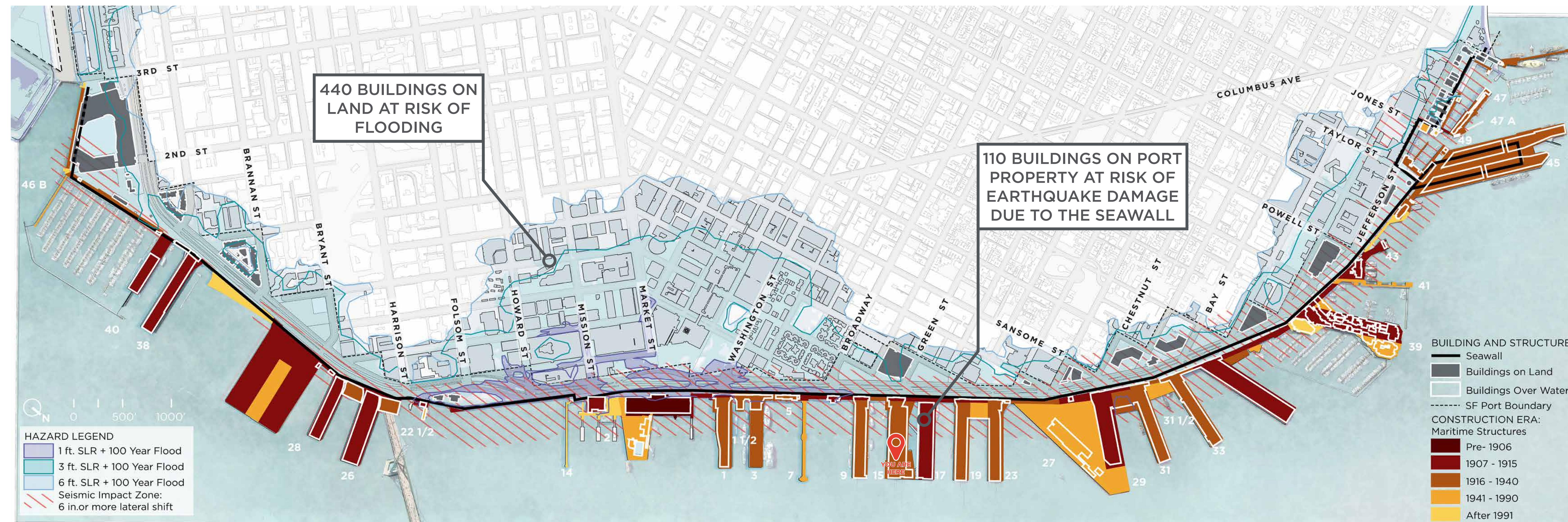


MULTI-HAZARD RISK ASSESSMENT BUILDINGS, PIERS, AND WHARVES



MAP OF BUILDINGS, PIERS, AND WHARVES



We Heard You!

Here is a summary of what we heard from the community since 2017:

Public Assets:

- There is a desire for the Port to prioritize the resilience of buildings and structures that are accessible to the public.

Embarcadero Historic District and Historic Piers:

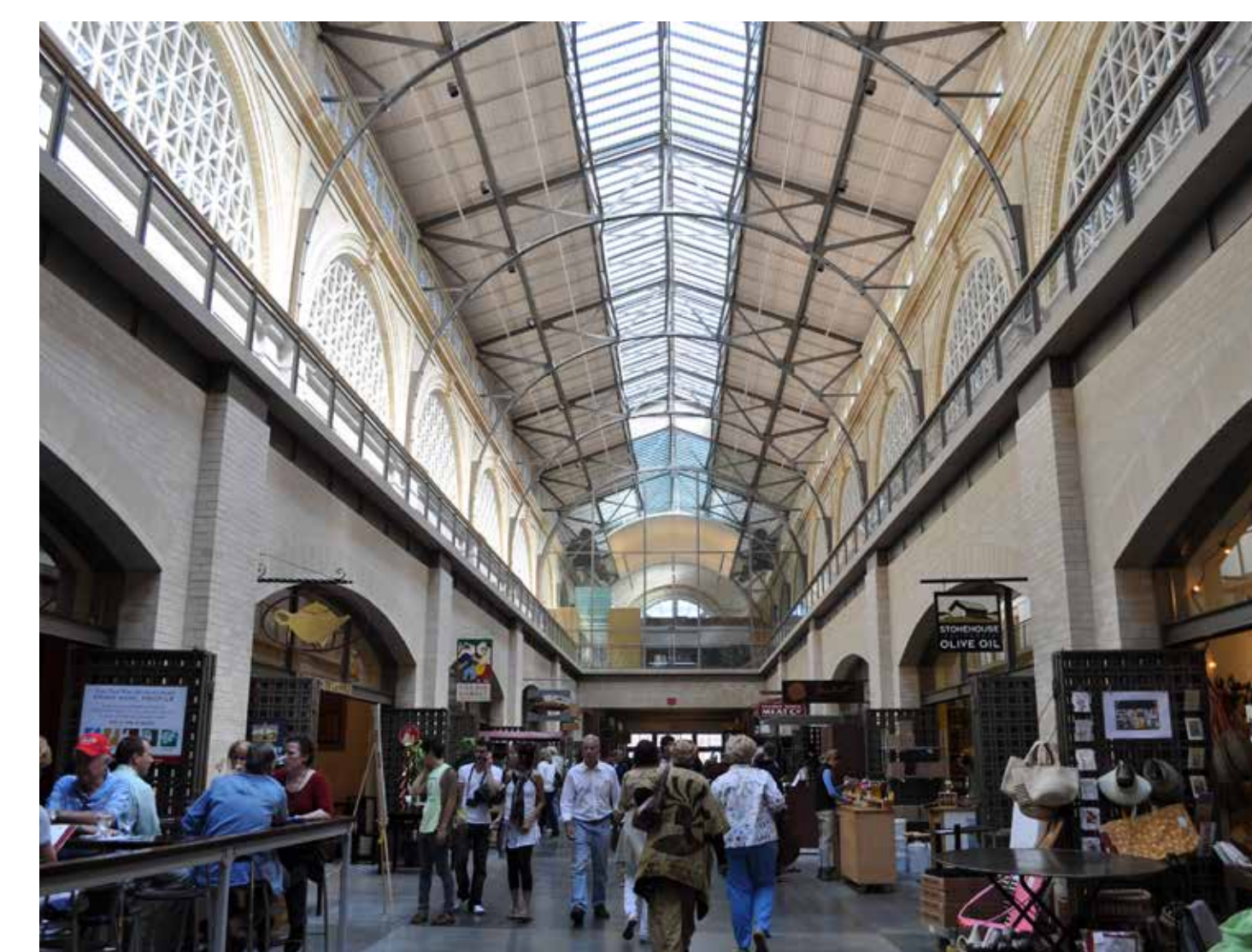
- The Embarcadero waterfront is prioritized as an important asset both because of the visitors and the local economy it supports, and because locals enjoy the promenade.
- The Embarcadero Historic District contains many of the most prioritized buildings along the waterfront, including: the Ferry Building, Fisherman's Wharf, and the Exploratorium.

Ferry Building:

- The most prioritized location along the waterfront.
- Hub for transit, visitors, and small businesses.

Housing:

- While no housing is currently built on the Port's side of the Embarcadero Roadway, there is a desire to prioritize protecting housing.



WHAT ARE THE BUILDINGS, PIERS, AND WHARVES ALONG THE EMBARCADERO WATERFRONT, AND HOW ARE THEY EXPOSED TO HAZARDS?

The buildings and structures on the Embarcadero waterfront are the Port's primary economic asset and an important part of San Francisco's economy and character.

The Port is assessing the buildings and structures along the Embarcadero waterfront that could be impacted by seismic and flood hazards. In addition, the Port has measured the economic impact caused by damages and the disruption to the economy as a result of those damages.

Some hazards will have a very large impact but are very rare, and others will have a smaller impact but happen more frequently. To understand the overall risk, the impacts of all of these hazards are assessed against their chance of happening.

The Port wants to make sure it is protected from as many of these risks as possible, without spending money to protect against events that are so unlikely that the cost of protection is greater than the value of what is being protected.

The results of this analysis will be a series of measurements that show the cost of the risk posed to the Port and the City:

- Casualties to people (see Life Safety for details)
- Cost of repair and replacement of structures
- Cost of loss of income from rent and use of properties
- Cost of disruption to businesses and society

BUILDINGS, PIER & WHARVES IN THE SEAWALL EARTHQUAKE HAZARD ZONE

The Seawall

- 3 miles of rock dike and bulkhead wall
- Built between 1878 and 1915

Piers and Wharves

- 5 million square feet (120 acres)
- Supported by 30,000+ piles
- Majority built between 1907 and 1940
- \$2.6 billion replacement value

Buildings over Water

- 110 buildings
- 5.6 million square feet
- \$1.9 billion replacement value

BUILDINGS, PIER & WHARVES IN THE LONG TERM FLOOD HAZARD ZONE

The Seawall and all Port Piers, Wharves, and Buildings

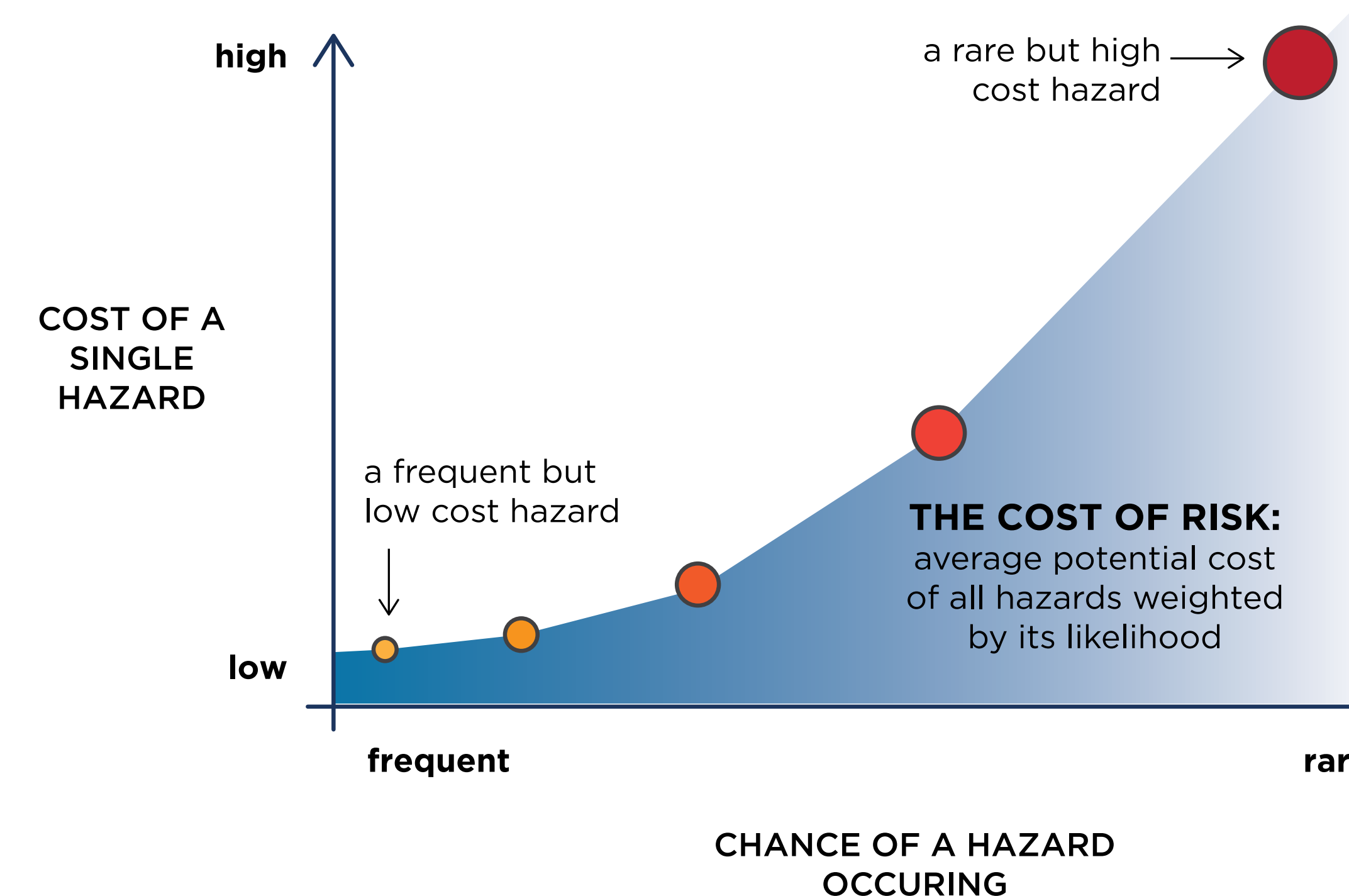
Non-Port Buildings on Land

- 440 Buildings, mostly privately owned
- \$16 Billion replacement value

MEASURING THE COST OF RISK TO THE EMBARCADERO WATERFRONT

The Port is predicting damages to buildings, piers and wharves under a variety of earthquake and flood hazard scenarios, including sea level rise. Economic costs of damage include cost to repair damage, loss of buildings/structures, loss of income from rent and use, and cost of disruption to business and society. The Port is analyzing the expected damages to inform potential first phase projects.

GRAPH OF COST OF RISK AS AVERAGE OF HAZARD OCCURANCE

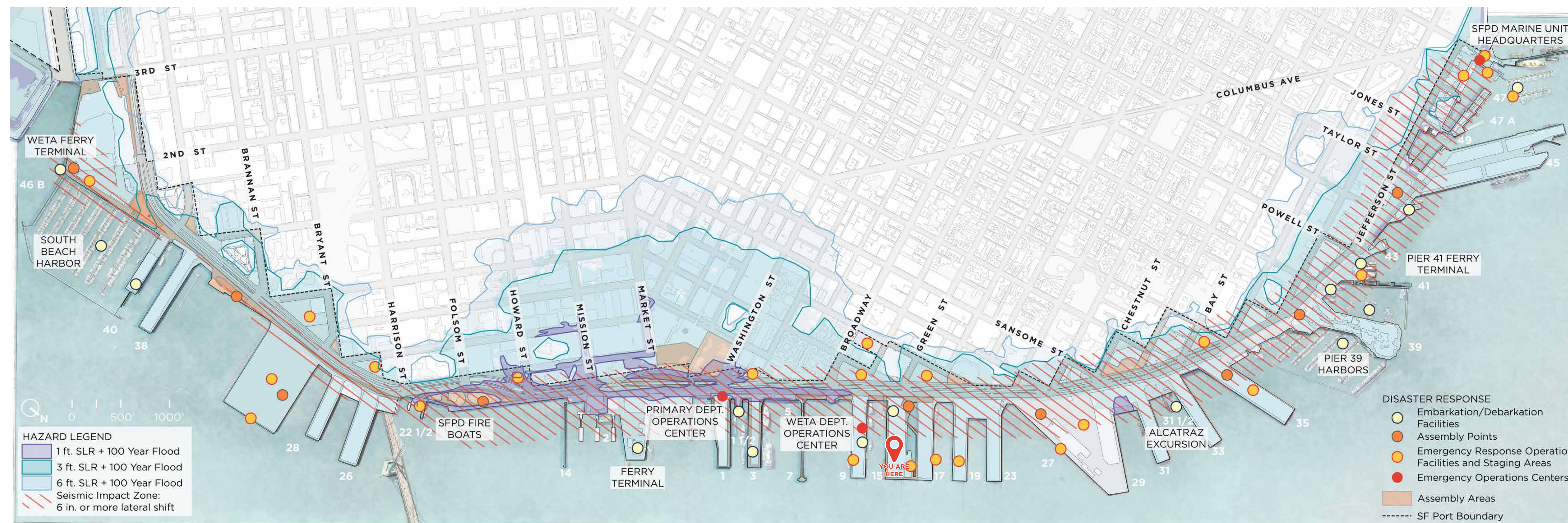


Share your thoughts:



MULTI-HAZARD RISK ASSESSMENT DISASTER RESPONSE

MAP OF DISASTER RESPONSE ASSETS



Share your thoughts:



HOW DOES THE EMBARCADERO SERVE THE CITY AND REGION IN RESPONSE TO DISASTERS?

The Embarcadero waterfront is used for a number of important disaster response and recovery functions for the City and region:

Assembly Areas

- Sites where people can gather and organize after a disaster.

Evacuation Facilities

- Locations where people can board vessels (including WETA ferries) and supplies and emergency personnel can be unloaded. WETA ferries can evacuate 15,000 people per hour when operating at full capacity.

Staging and Operations Areas

- Areas that support disaster response and recovery efforts.

Emergency Operations Centers

- Facilities where disaster response and recovery efforts are organized and coordinated.

KEY FINDINGS FOR DISASTER RESPONSE

- 250,000 daily commuters in downtown may require evacuation in the case of a major earthquake.
- Following a major earthquake, BART and the bridges may be unavailable; the City will look to the Port to facilitate evacuation—primarily via ferry.
- The Ferry Building and its related facilities—ferry terminals, queuing areas, and assembly areas—consistently ranked as the most critical disaster response assets along the Embarcadero waterfront.
- The entire Embarcadero waterfront, including the Port's disaster response facilities, are susceptible to extensive damage due to strong ground-shaking, liquefaction, and slope failure.
- Only one ferry terminal in the northern waterfront—the Downtown Ferry Terminal Phase 2, currently under construction near the Agriculture Building—is designed to essential facilities standards to survive very strong earthquakes and remain operable. The Mission Bay Ferry Landing, which is about to start construction will also be constructed to this standard.
- Emergency plans by the Port, City of San Francisco, regional, and state agencies are not yet detailed regarding waterborne evacuation, nor are they well-coordinated.

Next Steps

- The Port will conduct two major exercises with state and local partners to understand emergency planning gaps.

We Heard You!

Here is a summary of what we heard from the community since 2017:

Top Program Priority

- From the inception of the Embarcadero Seawall Program, the Port, City partners, and the public have all prioritized life safety and disaster response.
- A safe waterfront is part of the Seawall Program's vision, prioritizing life safety and disaster response is the first Program principle, and life safety and disaster response are a key part of the Program's evaluation criteria.

San Franciscans Support Prioritizing Disaster Response

- In 2017 and 2018, the Port conducted polling to better understand San Franciscans' priorities for the waterfront:
 - Ensuring that firefighters can access water supplies to fight fires after an earthquake was very or extremely important to 86 percent of those polled.
 - Protecting facilities that support emergency response and recovery efforts, like evacuation and bringing emergency supplies and responders into the city, was very or extremely important to 81 percent of respondents.
- Over the past year, through ongoing community and stakeholder engagement, the Port has heard community feedback that life safety and disaster response should be the top Program priority.

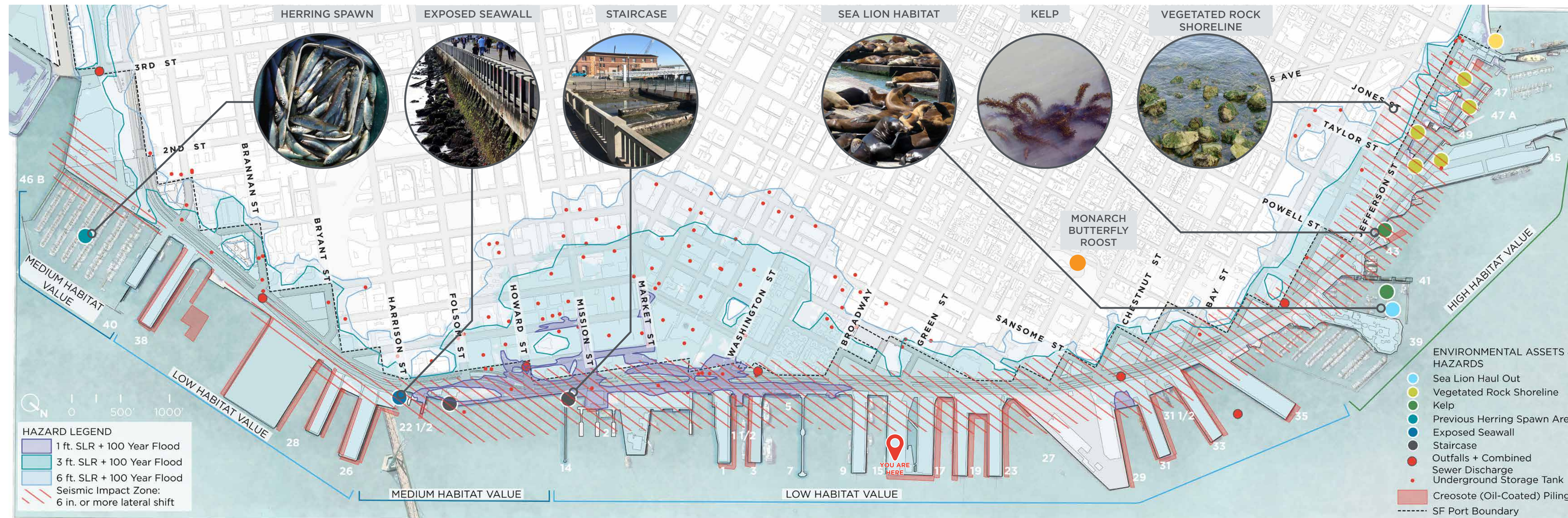
Priorities to Protect

- It is a priority to protect shelter and staging areas to support disaster response.
- It is a priority to protect facilities that allow the many people who commute into the city the ability to return home and be with their families in the event of a disaster.
- It is a priority to protect SFPD facilities, including the fireboats and Fire Station No. 35, which will soon be the first floating building along the waterfront.
- SFPD facilities are frequently noted during the Port's asset mapping engagement as key priorities.

MULTI-HAZARD RISK ASSESSMENT ENVIRONMENT



MAP OF ENVIRONMENTAL ASSETS AND HAZARDS



We Heard You!

Here is a summary of what we heard from the community since 2017:

Bay Habitat and Marine Life:

- It is a priority to protect wildlife and expand habitat along the waterfront
- Sightings of birds and marine life, such as seals and sea lions, are treasured
- It is important to protect fish populations to support recreational fishing and allow Port tenants to continue selling local fish

Nature in the City

- A key part of what makes San Francisco special is that residents and visitors alike are close to the water
- When San Franciscans envision the future waterfront, it is a priority to deepen the connection between the city and the Bay ecosystem
- Tackling sea level rise and future flooding is seen as an opportunity to increase habitat and create a more ecologically rich waterfront and bay

Water Quality

- There are concerns over water quality, including drinking water, especially concerning the wastewater treatment facility near PIER 39

Share your thoughts:

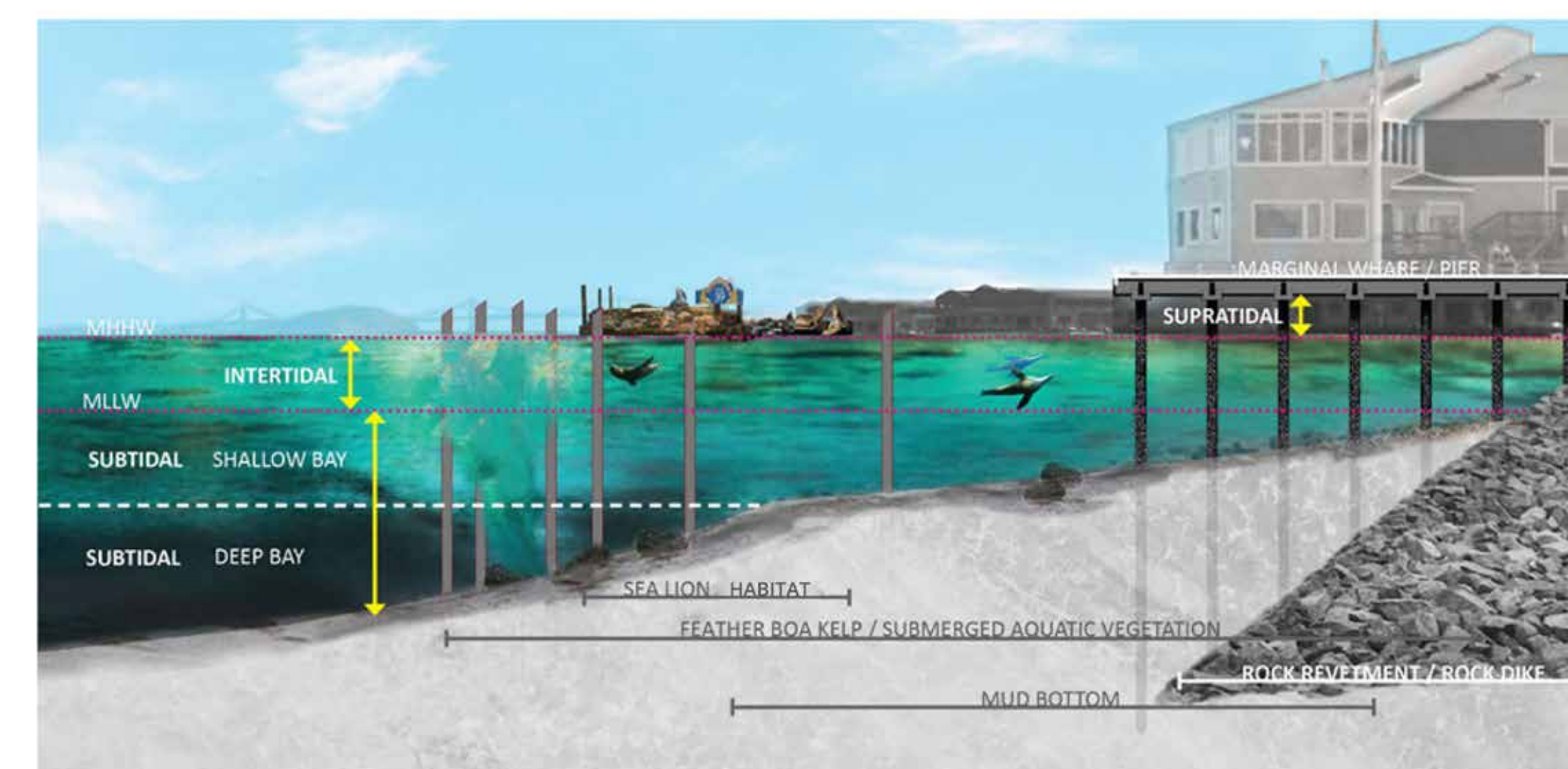


KEY FINDINGS FOR THE ENVIRONMENT

Due to the historic industrial and maritime uses of the Embarcadero waterfront, there are environmental contaminants in the groundwater and soil under the Embarcadero and along the shoreline. Failure of the Seawall due to an earthquake or flooding due to sea level rise could result in the spread of these contaminants into the near shore water, which could impact the environment of the waterfront and its uses:

- Bay water from the waterfront is used by the Exploratorium, Aquarium of the Bay, and the San Francisco Fire Department for various purposes.
- Water recreation such as kayaking, swimming, and recreational fishing.
- Habitat for animals, plants, and aquatic creatures that depend on the health of the subtidal ecology of the Bay.

TIDAL HABITATS ALONG THE WATERFRONT



EVALUATING THE ENVIRONMENT OF THE EMBARCADERO WATERFRONT

The Port is evaluating the ecological value of the waterfront to identify environmental conditions for protection and improvement. To conduct the evaluation, the Port is using the following categories for assessment:

Ecological Abundance and Diversity

- Observed and documented species abundance and diversity.

Foraging and Primary Productivity

- Abundance of species that form the base of the food chain and support other species.

Habitat Diversity and Structure

- Diversity of habitat types present and connectivity between those habitat types.

Opportunities for Ecological Enhancement

- Feasibility of ecological restoration and the potential ecological benefits to be gained by restoration.



WHAT IS THE ENVIRONMENTAL CONDITION OF THE EMBARCADERO WATERFRONT?

The Embarcadero waterfront is the result of human intervention over the last 150 years. The biggest transformation of the shoreline came with the construction of the Seawall around the turn of the 20th century. The Embarcadero Seawall transformed what was once tidal mudflats into today's waterfront. The area behind the Seawall was filled, greatly expanding the footprint of the city and becoming downtown and the waterfront neighborhoods. As a result, very little of the historical ecology of the Bay shoreline remains.

Despite alterations to the waterfront, the quality of the aquatic environment is important to the habitat of animals, plants, and aquatic creatures in the San Francisco Bay. The water of the Bay is also used for recreation by people and for commercial fishing.

SPECIAL STATUS WILDLIFE

Animal, fish and insect species that are very adaptable are present in the terrestrial and aquatic habitat along the Embarcadero waterfront.

AMERICAN PEREGRINE FALCON



CALIFORNIA LEAST TERN



DOUBLE-CRESTED CORMORANT



LONGFIN SMELT



MONARCH BUTTERFLY



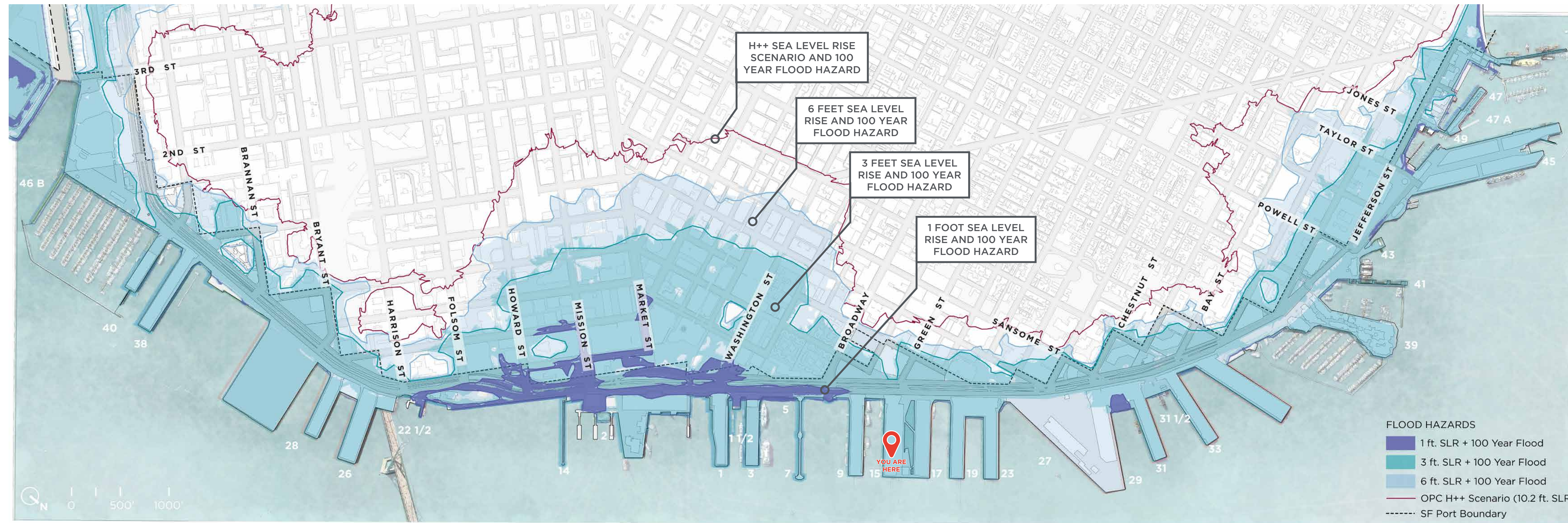
STEELHEAD SALMON



MULTI-HAZARD RISK ASSESSMENT FLOOD HAZARD



MAP OF FLOOD HAZARDS



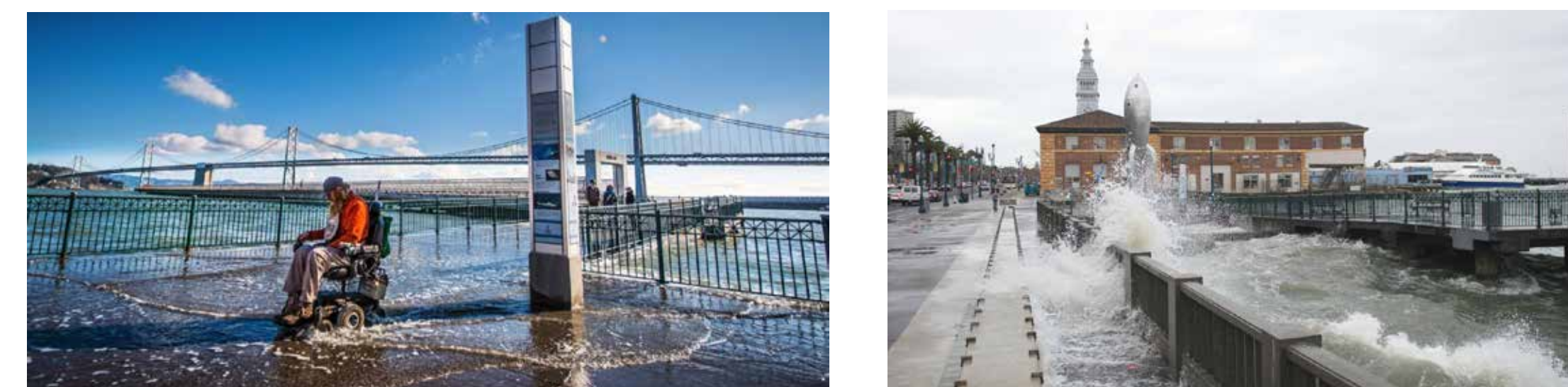
We Heard You!

Here is a summary of what we heard from the community since 2017:

Preparing for Sea Level Rise

- The Port conducted polling to better understand the public's priorities for the waterfront. 52 percent of respondents found the threat of future sea level rise very concerning and 83 percent reported it was concerning
- Residents are concerned about flooding affecting the downtown area, the transportation hub around the Ferry Building, and the Muni tunnel by Rincon Park.
- There is concern that flooding will affect commutes and people getting to and from their jobs, and may disconnect transit routes from the southern waterfront to the northern waterfront.

Share your thoughts:



WHAT IS THE FLOOD HAZARD TO THE EMBARCADERO WATERFRONT?

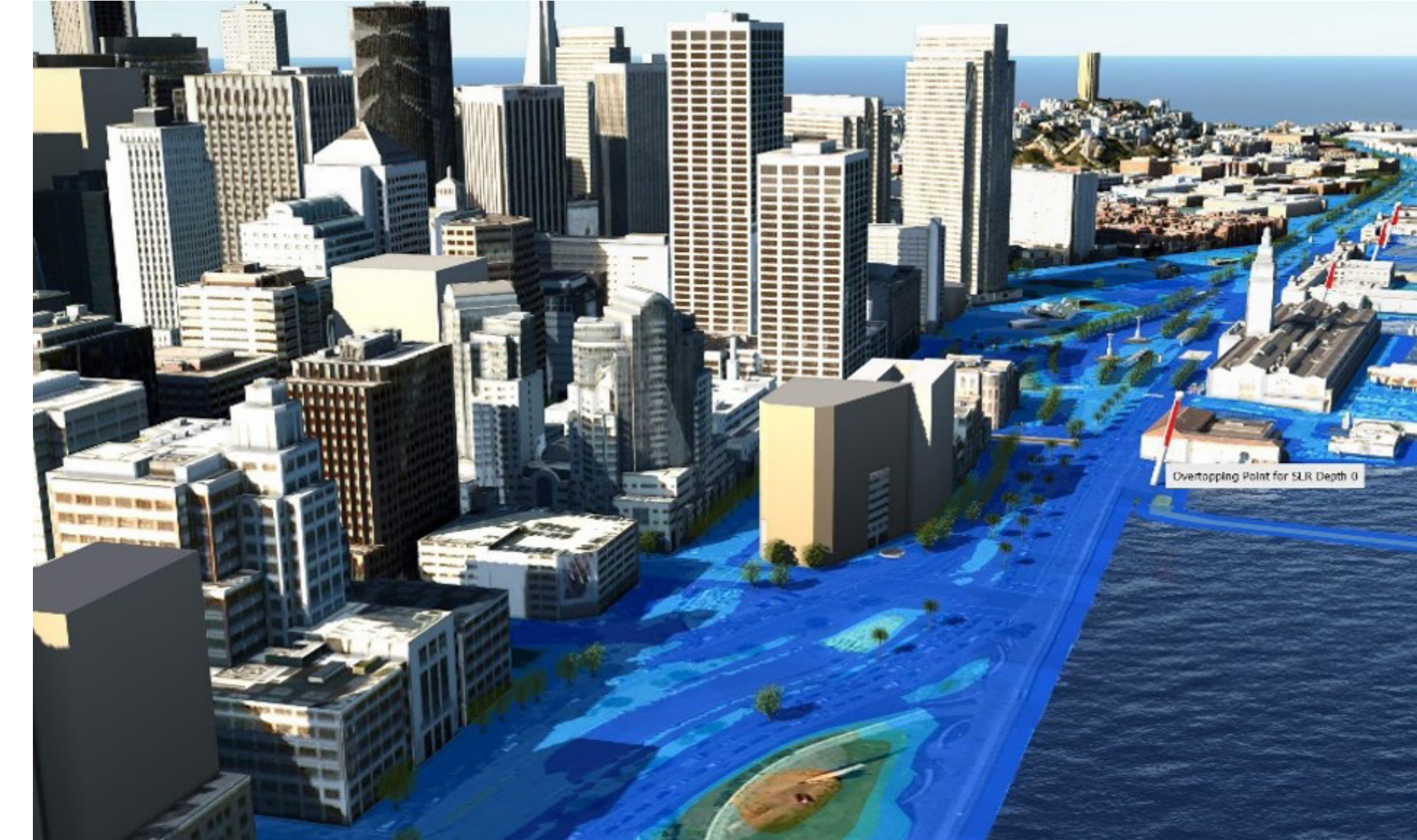
Today, the Embarcadero floods intermittently, requiring Embarcadero Promenade and Roadway closures. A 0.2% chance storm today, or a 1% chance storm with approximately 12 inches of sea level rise, would send the Bay over the Embarcadero Seawall and into the BART and Muni tunnels, disrupting transit and the regional economy.

Unfortunately, the threat from sea level rise and flooding is increasing. The San Francisco Bay could rise up to 6 feet over the next century, which would result in daily flooding downtown.

As part of the Embarcadero Seawall Program, the Port is developing a flood risk analysis that looks at the flood depth and the extent of flooding at a range of water levels to better understand the exposure of various assets and services along the Embarcadero Seawall. The flood events being evaluated are the current 1-year to 500-year flood levels, combined with sea level rise up to 7 feet.

Because the depth and extent of flooding can be made worse by waves, the Port will conduct a wind and wave analysis to determine the total extent of potential flooding. This extent will be used to understand the potential effects of flooding on waterfront assets and services. Additionally, wave run-up and over-topping will be evaluated along the Embarcadero waterfront and the finger piers using new bathymetric and Lidar information.

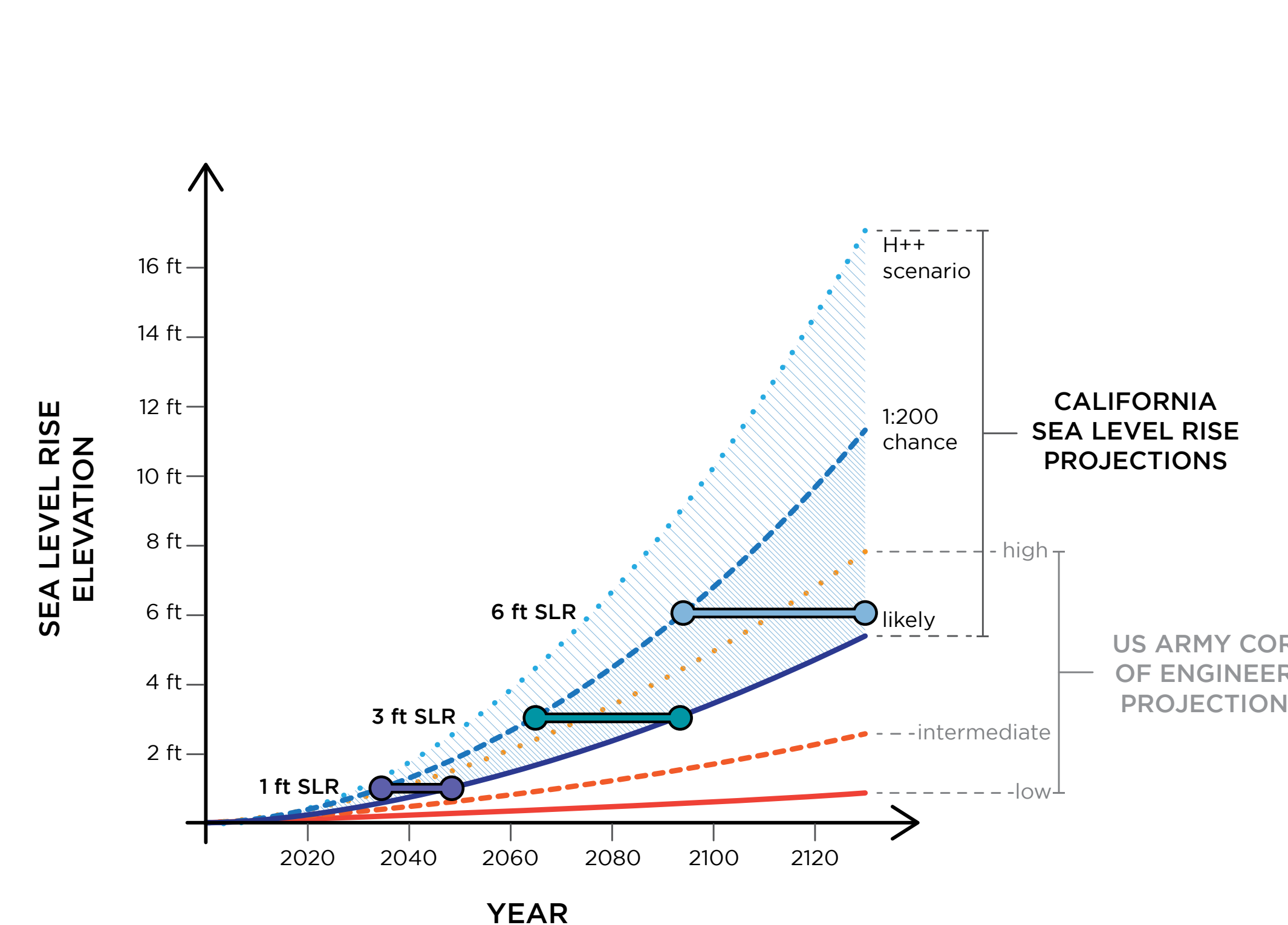
FLOOD REPRESENTATION OF 6 FEET OF SEA LEVEL RISE WITH A 100 YEAR FLOOD



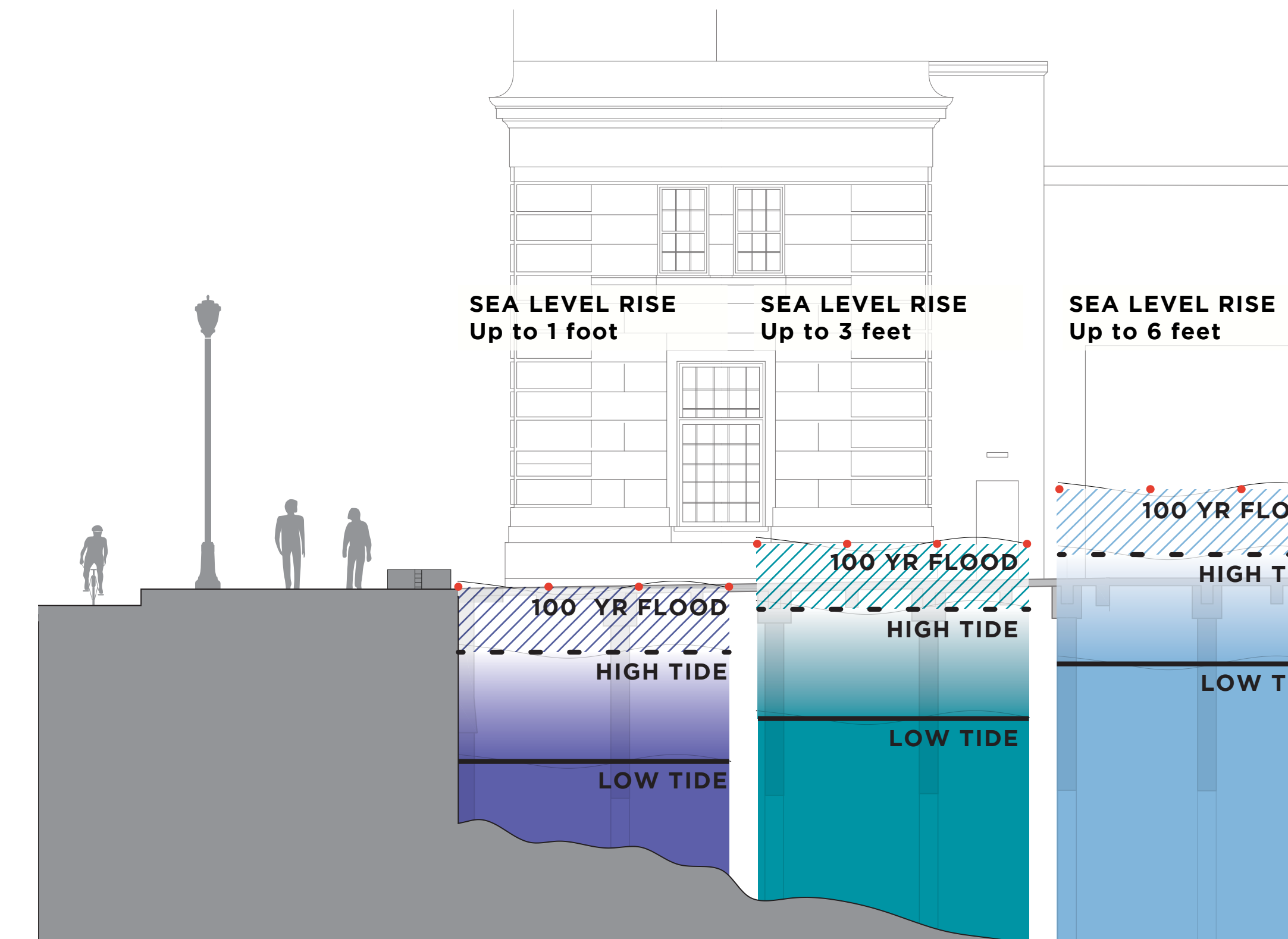
POTENTIAL FLOOD RISK TO MUNI AND BART TUNNEL AT RINCON PARK



PROJECTED SEA LEVEL RISE IN SAN FRANCISCO BAY



EXPECTED WATER LEVELS OVER TIME AT THE EMBARCADERO



100 YEAR FLOOD: A flood event that has a 1 in 100 chance of occurring in any given year.

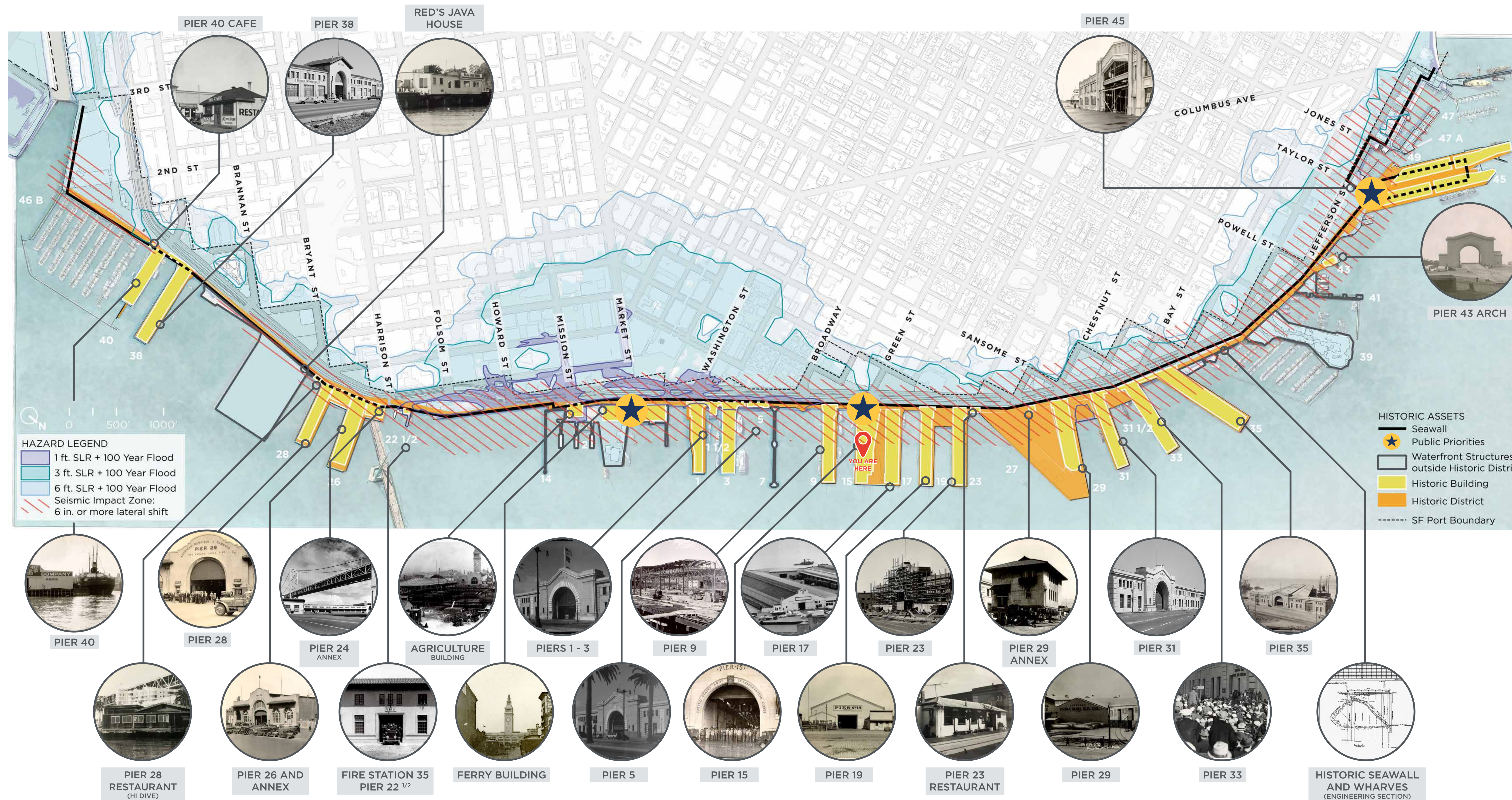
WAVE RUN UP: During a storm event waves on the water can raise water levels above the flat elevation of the water and cause flooding further inland than otherwise expected.

H++ SCENARIO: An extreme sea level rise scenario associated with catastrophic ice loss from the West Antarctic Ice Sheets.

MULTI-HAZARD RISK ASSESSMENT HISTORIC RESOURCES



MAP OF HISTORIC RESOURCES



We Heard You!

Here is a summary of what we heard from the community since 2017:

Embarcadero Historic District and Historic Piers

- The Embarcadero waterfront is seen as iconic and a key part of San Francisco's identity
- The Embarcadero waterfront is understood as a top destination that attracts 24 million people annually
- The Embarcadero waterfront is prioritized as an important asset both because of the visitors and the local economy it supports, and because locals enjoy the promenade
- For many, the Embarcadero Historic District is a place visited for both special occasions and frequent, more casual trips
- The Embarcadero Historic District contains many of the most prioritized buildings along the waterfront, including: the Ferry Building, Fisherman's Wharf, and the Exploratorium

Ferry Building an iconic resource within the Embarcadero Historic District

- Most prioritized location along the waterfront
- Hub of transit, visitors, and small businesses

Pier 45 and the Pier 33 Arch in Fisherman's Wharf

- Priority location as a top visitor destination with thriving local businesses
- Key part of San Francisco's commercial fishing industry

Exploratorium

- Priority location and example of a recently rehabilitated historic bulkhead
- Serves as a way people connect with the waterfront and the Embarcadero, including many students

WHAT ARE THE EMBARCADERO WATERFRONT'S HISTORIC RESOURCES ?

Three miles of waterfront from Pier 45 to Pier 48—including the Seawall, wharves, and piers—are of national significance, and are important to the enduring history of San Francisco. These parts of the Embarcadero waterfront have been recognized since 2006 as the Embarcadero Historic District by the National Register of Historic Places.

The Embarcadero Historic District is important for its contribution to the growth and development of both San Francisco and the nation between 1878 and 1946. During this period, the waterfront saw advances in commerce, transportation, labor, governance, engineering, architecture, and urban design.

The Embarcadero Historic District is the only largely intact and surviving break bulk port in the country. Its pier structures range in age from 1908 to 1931. The Seawall and bulkhead wharves were built in 21 individual sections ranging in length from hundreds to thousands of feet, connecting end to end for 3 miles.

While the form of the Embarcadero waterfront is ever-changing, many aspects of it can evolve while respecting its historic integrity. Examples of changes since the historic designation include:

- Pier 27 Cruise Terminal
- Piers 1 1/2, 3, and 5
- The Exploratorium (Pier 15)
- Pier 29 - Reconstructed bulkhead after fire
- Brannan Street Wharf

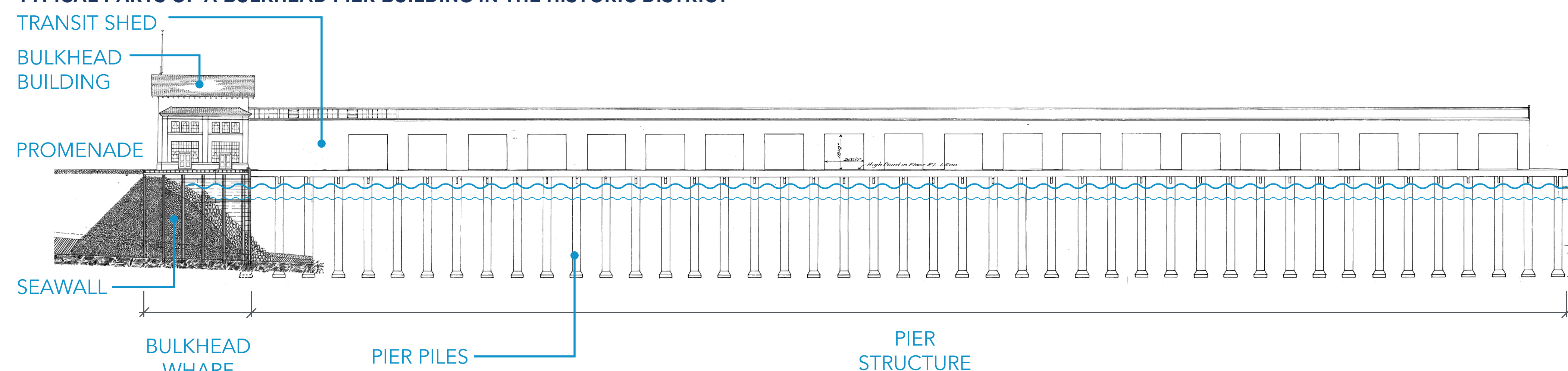
KEY FINDINGS FOR HISTORIC RESOURCES

- Every historic resource has value as a contributor to the historic district. A contributor is a building, site, or structure that adds to the history and significance of the district, and reflects the period of significance between 1878 and 1946.
- The historic district is valuable as a whole due to the form, character, and relationship of its historic resources. Changing individual buildings and structures needs to be carefully considered for its impacts to the entire district.
- Most of the district's historic buildings and structures have not been seismically improved and are vulnerable to damages during a significant seismic event.
- In the near term, a few historic buildings are at risk of damage due to flooding: the Ferry Building, Agriculture Building, and Piers 1 through 5. Over the coming century, every historic resource within the district is at risk of damage due to increased flooding.

EXPOSURE AND CONSEQUENCES OF HAZARDS TO THE EMBARCADERO WATERFRONT'S HISTORIC RESOURCES

- All of the historic buildings and structures are equally important to the integrity and historic value of the nationally registered historic district. Damage to any of them will impact the historic district which could jeopardize historic tax credits - a vital tool for funding historic rehabilitation.
- An evaluation of the existing conditions of the historic buildings on the waterfront is underway to determine how resilient or fragile they may be to seismic and flood hazards.

TYPICAL PARTS OF A BULKHEAD PIER BUILDING IN THE HISTORIC DISTRICT



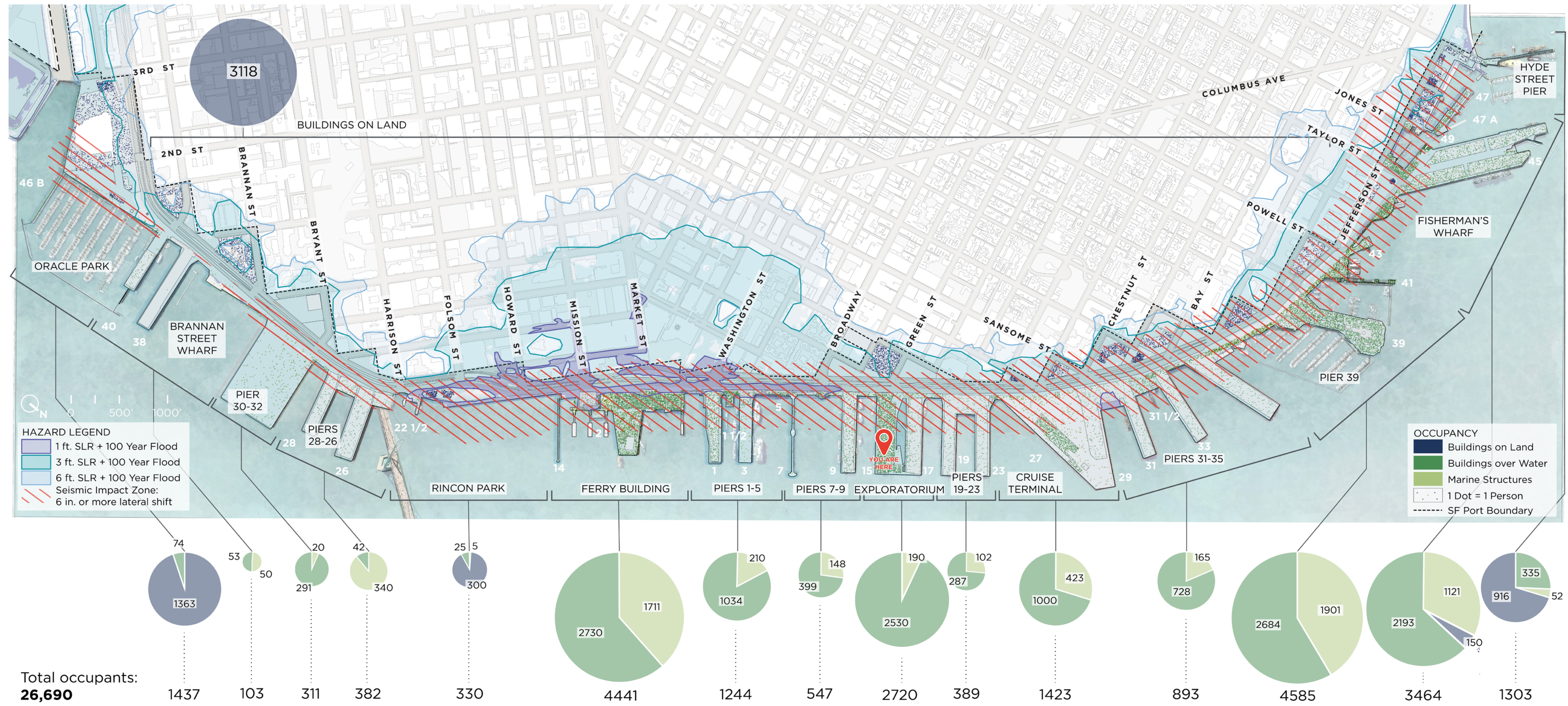
Share your thoughts:

MULTI-HAZARD RISK ASSESSMENT

LIFE SAFETY



MAP OF AVERAGE ESTIMATED AMOUNT OF PEOPLE ON THE WATERFRONT



We Heard You!

Here is a summary of what we heard from the community since 2017:

- Top Program Priority:**
- Advancing safety and protecting life safety is the first and most urgent goal of the Embarcadero Seawall Program
 - Protecting the lives of San Franciscans and making the Embarcadero waterfront safer and more resilient is the reason why the Port started the Seawall Program
 - While the Seawall Program is dedicated to robust community and stakeholder engagement, fiscal responsibility, accountability, and transparency, protecting life safety is the driving factor in project selection for the Seawall Program

San Franciscans Support Prioritizing Life Safety:

- Over the past year, through ongoing community and stakeholder engagement, the Port has heard community feedback that life safety and disaster response should be the top Program priorities
- Through ongoing community engagement, the Port has heard no opposition to its approach to prioritize life safety

Share your thoughts:



WHAT ARE THE RISKS TO LIFE SAFETY ON THE EMBARCADERO WATERFRONT?

At any given time there are 10,000 to 27,000 or more people on the waterfront. Some people are inside buildings, some outside, and many of these buildings and outdoor areas are built over the water of the Bay.

In the event of an earthquake the buildings and structures pose unique hazards to the life and safety of people on the waterfront in the event of an earthquake.

Older buildings may collapse and trap people within them; parts of buildings may fall and injure people outside of them; and wharves and piers may collapse into the water, which will injure and expose people to the risk of drowning.

KEY FINDINGS FOR LIFE SAFETY

- The risk to people in a building or on a structure over water is higher than when on land.
- Providing emergency services to a long, narrow pier is particularly challenging if access to the pier from land is disrupted.
- The goal of the Waterfront Resilience Program is to prioritize the life and safety of people using the waterfront in the event of an earthquake.

EVALUATING EXPOSURE AND CONSEQUENCES FOR LIFE SAFETY ON THE WATERFRONT

The Port developed scenarios of how many people are on the waterfront to measure the risk the life safety due to earthquakes. These scenarios include a typical day during the tourism season

as well as a scenario when there are large events that bring many people to the waterfront, such as baseball games or Fleet Week.

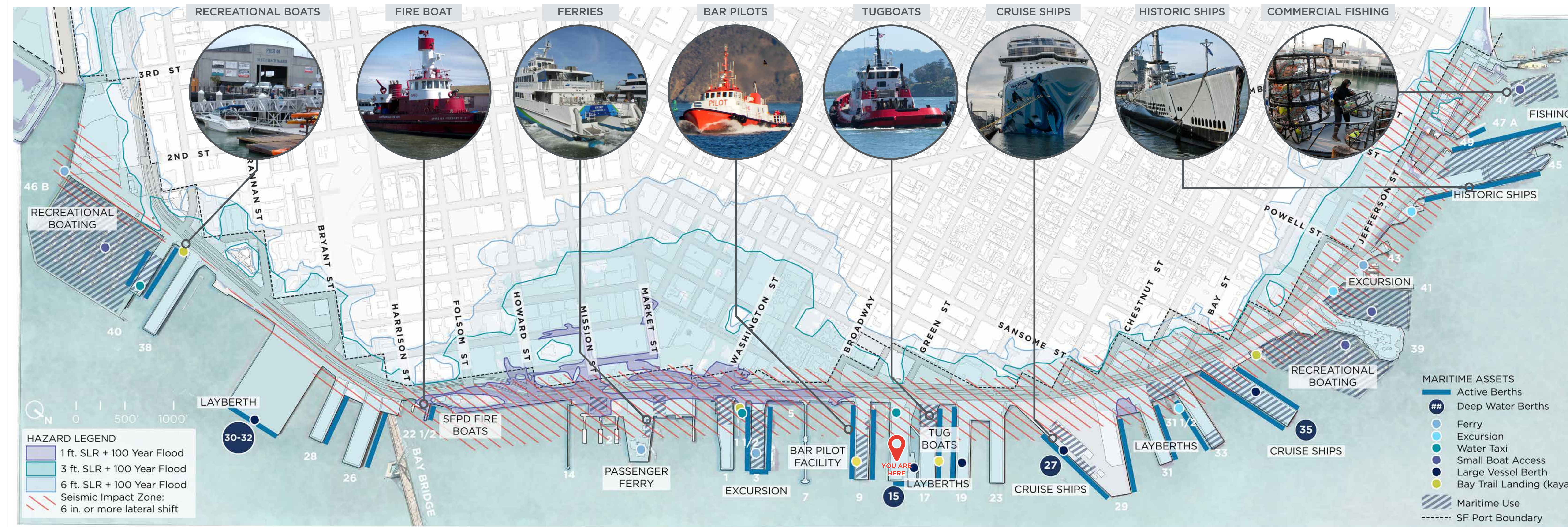
To analyze these scenarios the Port is using a method standardized by the Federal Emergency Management Agency (FEMA) for estimating the impact that natural disasters will have on groups of people in and around structures during an earthquake. This method is called HAZUS.

HAZUS applies statistics gathered during previous hazardous events to estimate the amount and type of injuries and casualties that people may suffer during a hazardous event.

MULTI-HAZARD RISK ASSESSMENT MARITIME



MAP OF MARITIME ASSETS



We Heard You!

Here is a summary of what we heard from the community over the last year as part of the Waterfront Plan public process:

Fisherman's Wharf and Local Businesses

- Fisherman's Wharf and the local fishing industry is a priority, both to generate visitors and support local businesses

Cruise Ship Terminal

- Like Fisherman's Wharf, the Cruise Ship Terminal at Pier 27 is a priority for supporting local businesses and attracting visitors to San Francisco

Ferry Ridership

- Ferry ridership has doubled since 2012 and is expected to continue to grow
- There is a desire to accommodate the increasing demand for ferry ridership and support new routes and expanded service

Evacuation

- It is a priority to protect facilities that allow the many people who commute into the city the ability to return home and be with their families in the event of a disaster
- This includes water evacuation in the event that BART and the Bay Bridge are temporarily unavailable

Recreation

- For many, proximity to the waterfront is part of what makes San Francisco so special
- This includes the ability to get out on the water through sailing, kayaking, or other boating opportunities

Share your thoughts:



WHAT ARE THE EMBARCADERO WATERFRONT'S MARITIME RESOURCES?

The Port of San Francisco manages one of the most diverse maritime portfolios in the nation. This includes cargo, cruise, excursion, ferry, harbor services, ship repair, temporary berthing, historic ships, and water recreation. Maintaining and enhancing assets for water-dependent industry and recreation is a core public trust responsibility of the Port Commission.

The public embraces the history of San Francisco's working waterfront. The mix of historic piers and active maritime operations maintains an authentic character that is intrinsically interesting and distinguishes San Francisco from other waterfronts in the Bay Area and the State.

KEY FINDINGS FOR MARITIME ASSETS

- Maritime revenues generate approximately \$36 million per year, roughly 1/3 of Port annual operating revenues. The highest revenue contributors are located along the Embarcadero Seawall, including cruise, excursion, fishing, and South Beach Harbor recreational boat facilities.

- Some of San Francisco's maritime industries rely upon either proximity to the Golden Gate in order to service cargo vessels (bar pilots/harbor services), or to San Francisco as a destination city (cruise, excursion) or for its local business economy (bulk cargo/sand and gravel used for local construction; Tesla exports).
- The fishing industry is long-established and home to the largest concentration of fish processors of any port in California. These fishing industries are not replicated elsewhere in the region.
- San Francisco, unlike other Bay Area ports, offers deep-water berths for temporary berthing of large vessels (layberths), including military and research ships. Some deep-water locations are self-scouring and require no maintenance dredging and associated Bay water impacts.
- The Ferry Building is the regional hub of the Bay Area's passenger ferry system. This includes the Downtown Ferry Terminal Expansion. Other ferry terminals are located at Pier 41 in Fisherman's Wharf, China Basin ballpark, and the interim ferry terminal in Mission Bay. Annual ridership was 4.7 million passengers in 2015, and the numbers are growing.

EXPOSURE AND CONSEQUENCES OF HAZARDS TO THE EMBARCADERO WATERFRONT'S MARITIME ASSETS

Maritime berths, or where ships are docked, and other maritime infrastructure cannot retreat upland in response to sea level rise hazards. This means the Port's maritime assets have little flexibility for relocation and must be adapted in place to accommodate flooding.

Maritime Facilities

- 26 active berthing locations for ferries, large vessels, cruise ships, water taxis, fire boats, and the bar pilots.
- 3 marinas for small boats with multiple berths

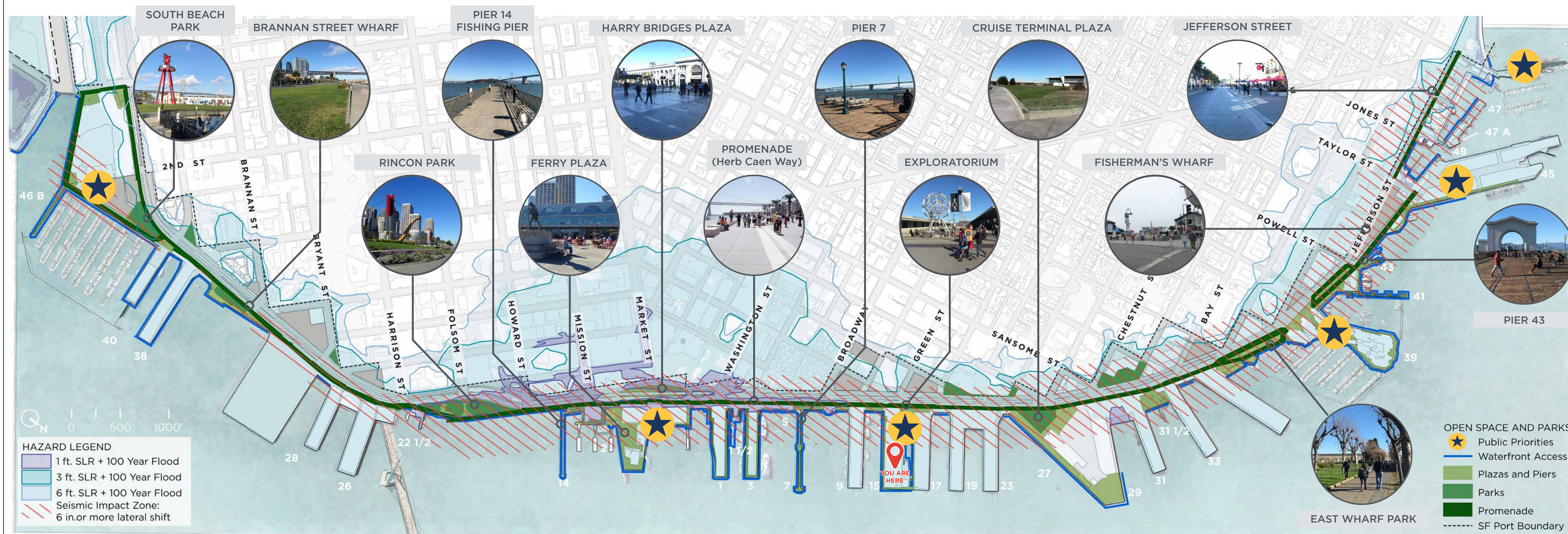
Commercial Maritime Uses

- 10 fish processing facilities at Fisherman's Wharf

MULTI-HAZARD RISK ASSESSMENT OPEN SPACE AND PARKS



MAP OF OPEN SPACE AND PARK ASSETS



We Heard You!

Here is a summary of what we heard from the community since 2017:

Embarcadero Promenade:

- The Embarcadero Promenade is a top priority as a coveted public space along the waterfront
- There is a desire to have continuous waterfront space, such as an uninterrupted waterfront trail or path
- There is a desire to feel connected to the water and the Bay

Waterfront with lots of Public Space:

- There is a desire for public spaces designed for families, seniors, kids, and people of all income levels
- There is a desire to have a variety of activities available, such as playgrounds, dog parks, bike trails, and picnic tables

Public Art and Free Waterfront Activities:

- Emphasis on increasing accessible and free activities along the waterfront
- There is a desire to increase park space and public art such as Cupid's Span and opportunities to see the Bay Bridge Lights

Waterfront Views:

- Current love of the waterfront views and that parks and open spaces are a priority as they provide waterfront views for everyone

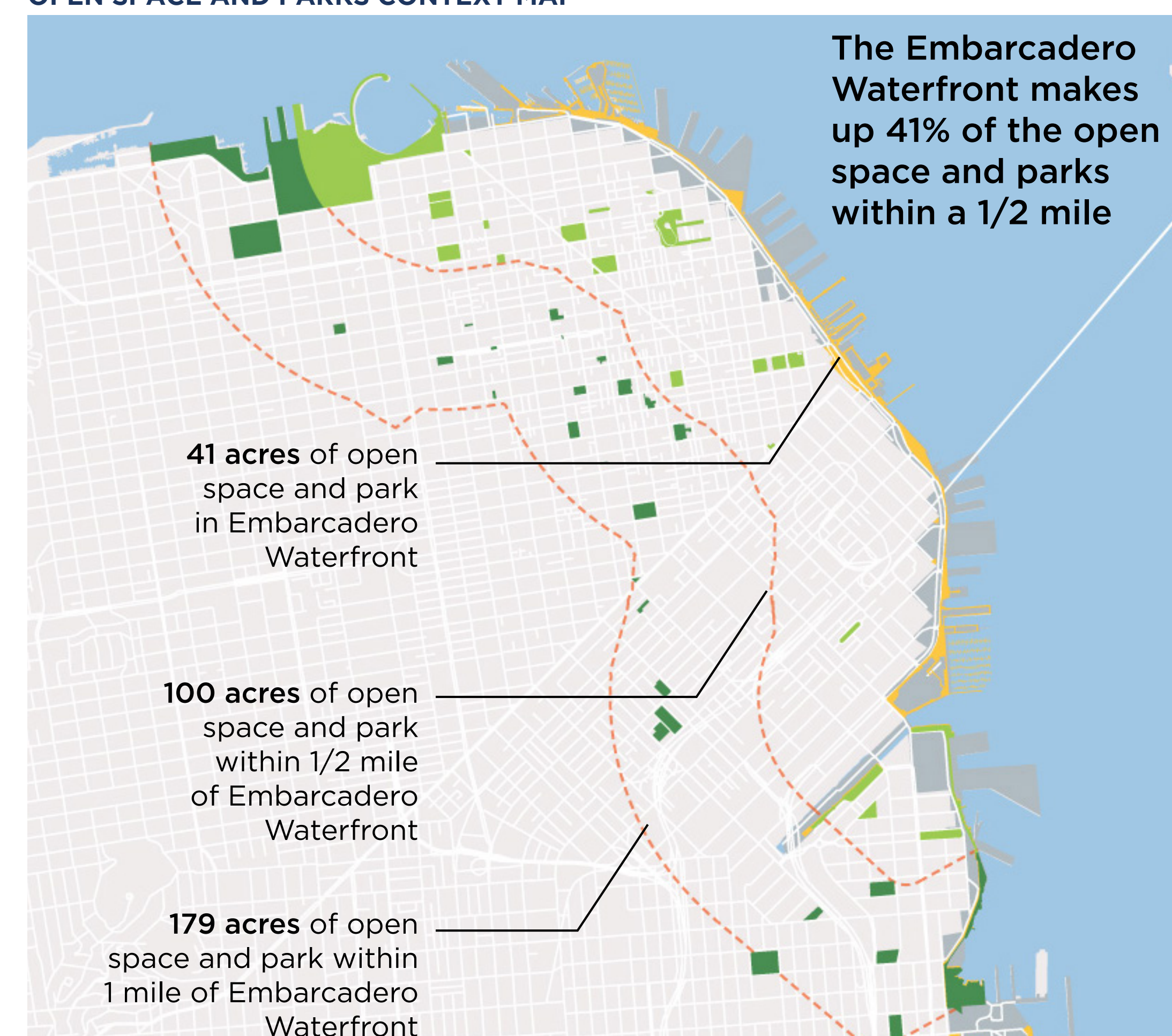
Share your thoughts:

KEY FINDINGS FOR OPEN SPACES

The primary part of the waterfront's public realm is the promenade that connects all of the other assets along a consistent and continuous path of travel.

- The sequence of destinations and amenities along the waterfront creates a rhythm of active and passive uses.
- At nearly 42 acres, the open space network of the Embarcadero waterfront is a major component of the open space system for the downtown area of the city. Many people that live and work in San Francisco use it for recreation and exercise.
- With 1 foot of sea level rise the flood risk will threaten a small but important part of the waterfront open space around the Ferry Building, Piers 1 through 7, and Rincon Park.
- With 3 feet of sea level rise the flood risk to the waterfront will impact the majority of the public realm due to the consistent elevation of the Seawall and promenade.

OPEN SPACE AND PARKS CONTEXT MAP



EXPOSURE AND CONSEQUENCES OF HAZARDS TO THE WATERFRONT'S OPEN SPACES

EXPOSURE

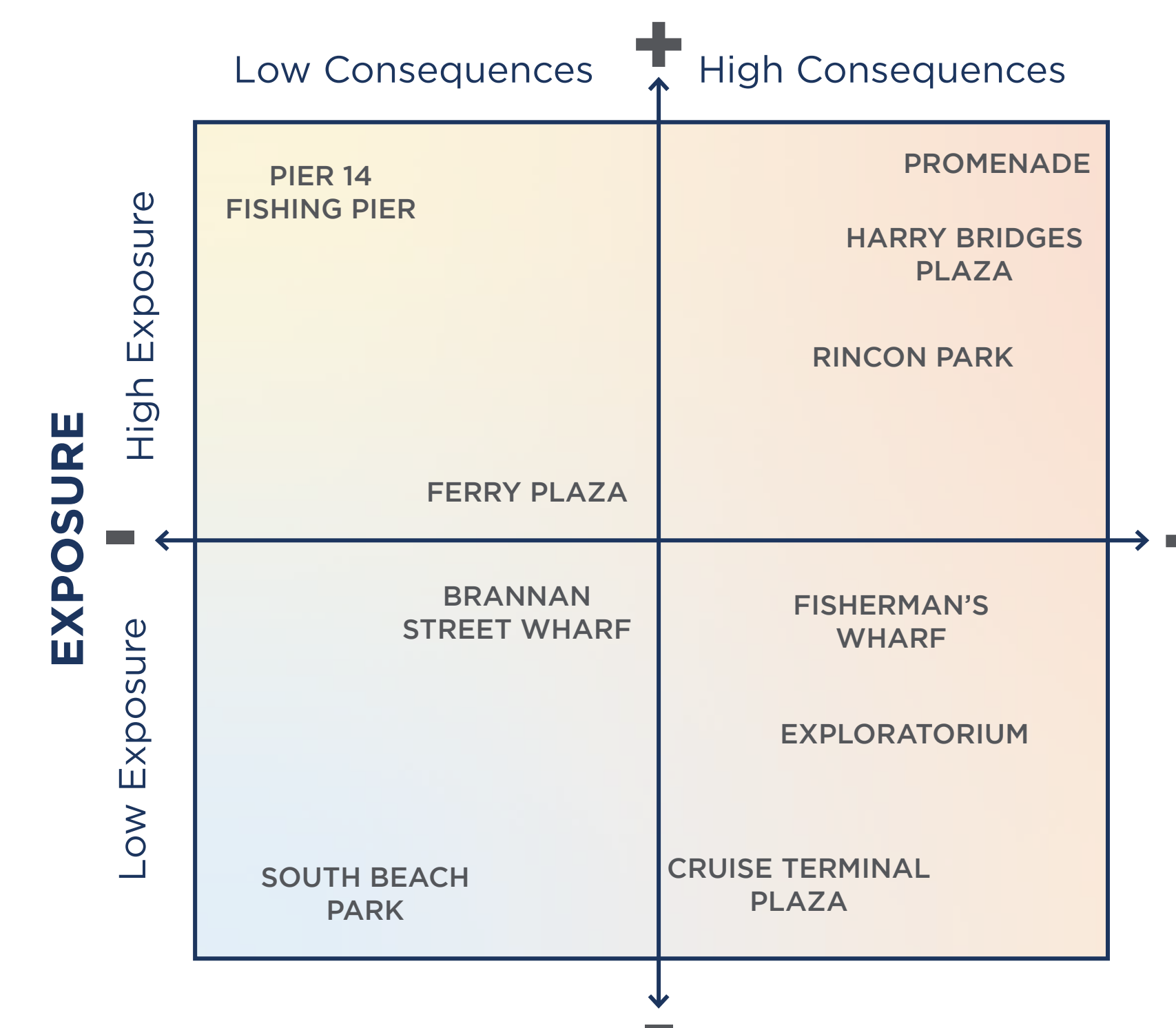
47% OF PUBLIC OPEN SPACE EXPOSED TO SEISMIC HAZARD

14% OF PUBLIC OPEN SPACE EXPOSED TO NEAR TERM FLOOD HAZARD

73% OF PUBLIC OPEN SPACE EXPOSED TO MID TERM FLOOD HAZARD

91% OF PUBLIC OPEN SPACE EXPOSED TO LONG TERM FLOOD HAZARD

CONSEQUENCES



EXPOSURE: The potential that a hazard will impact a given asset or function.

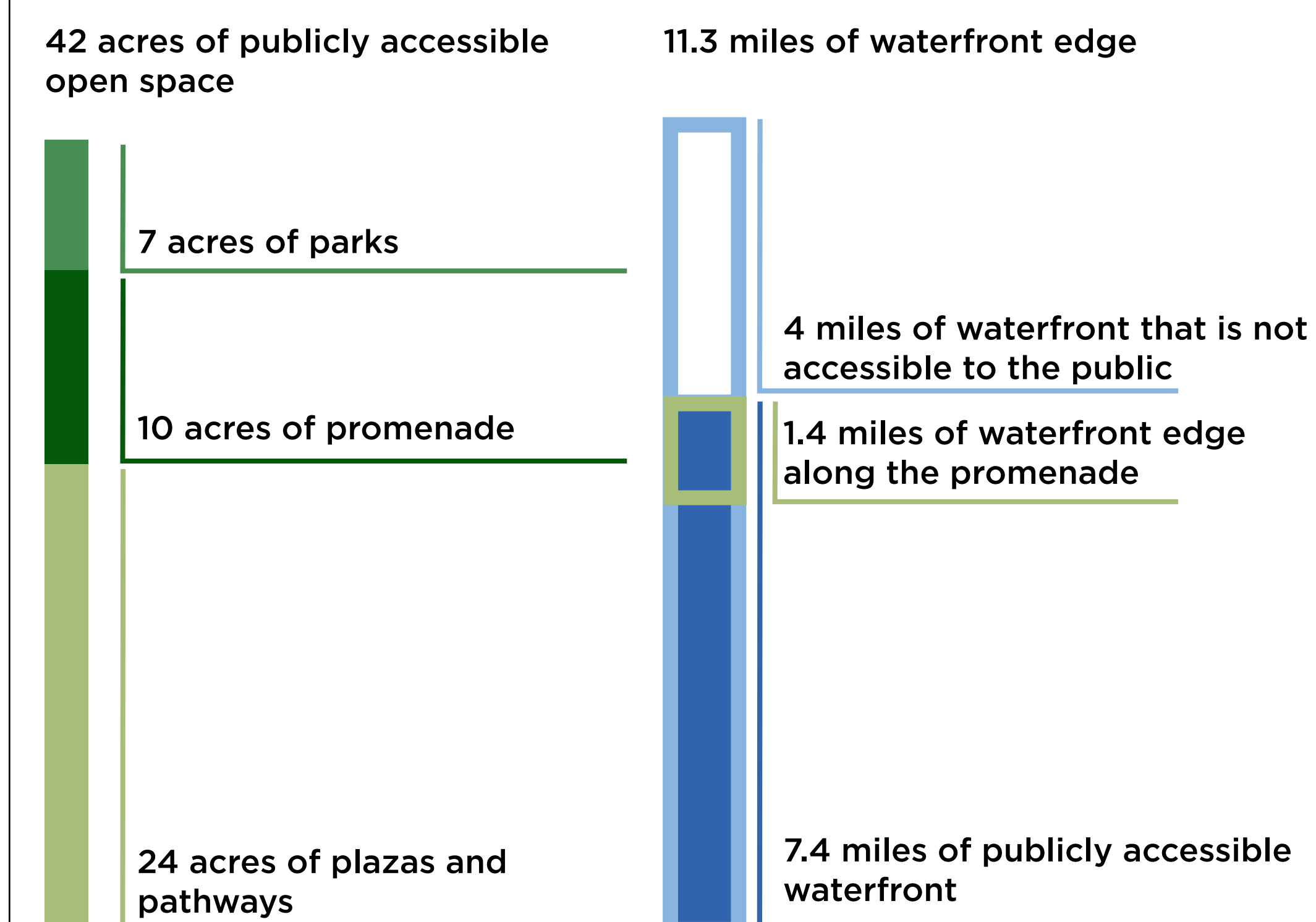
CONSEQUENCE: The resulting impact that exposure to a hazard will have on a given asset or function.

WHAT ARE THE EMBARCADERO WATERFRONT'S OPEN SPACES?

The Embarcadero waterfront's public realm is all of the public spaces along the length of the waterfront that people have access to, enjoy, and use regularly. The promenade is the most important part of this network of public spaces as it connects all of the parts of the waterfront along its three miles of continuous walkways.

Along this stretch are parks, plazas, and publicly accessible pier edges that provide people places to gather, relax, exercise, and enjoy the waters of the San Francisco Bay and excellent views of the City.

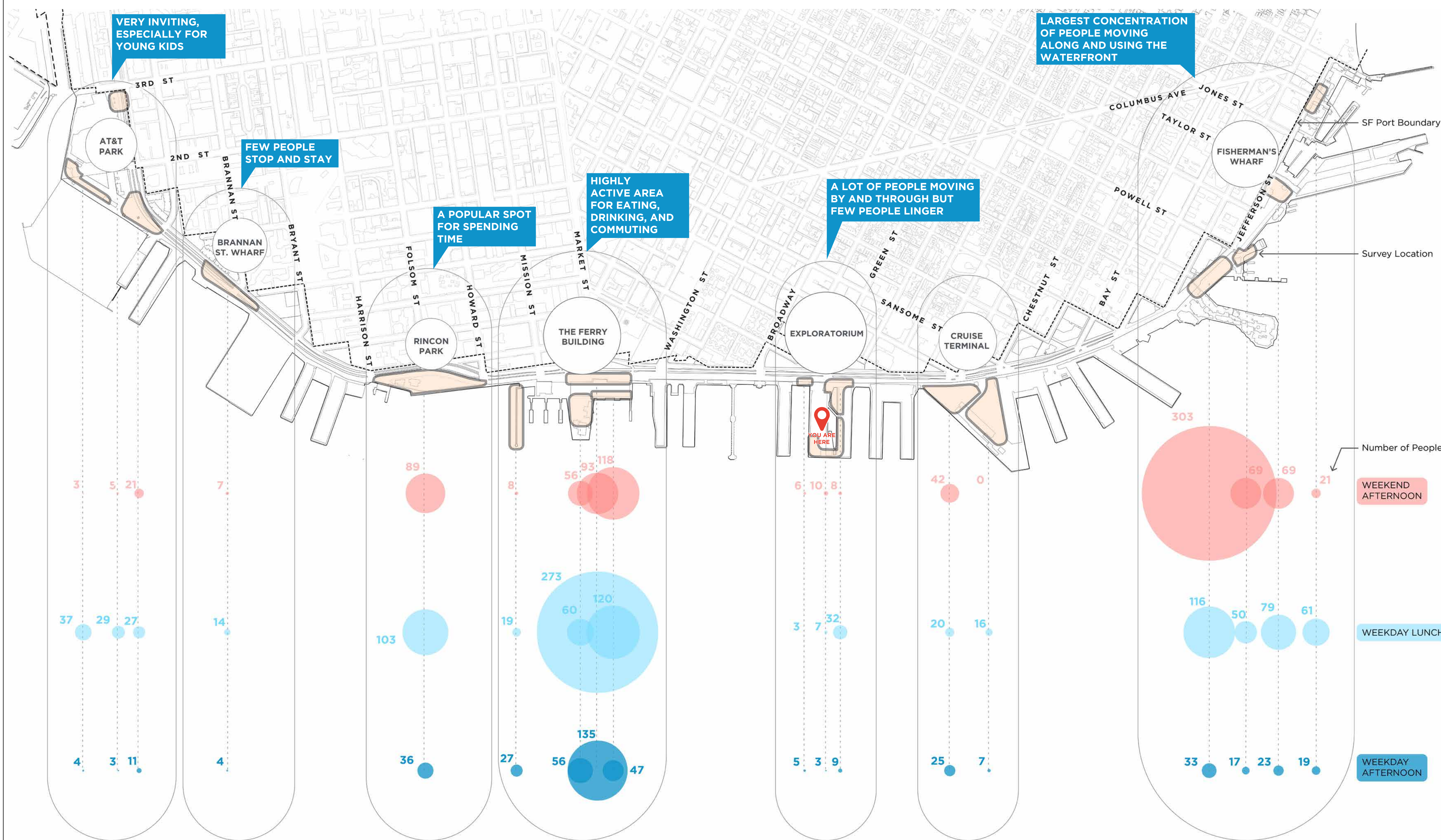
SUMMARY OF EMBARCADERO WATERFRONT OPEN SPACE



MULTI-HAZARD RISK ASSESSMENT PUBLIC LIFE AND USE



MAP OF PUBLIC LIFE AND USE SURVEY DATA



We Heard You!

Here is a summary of what we heard from the community since 2017:

Recreation:

- The Embarcadero Promenade is currently a hub for walking, running, biking, and the launching point for water sports and activities
- There is a desire for increased access to safe, easy recreation along the Embarcadero waterfront

Accessible and Connected Waterfront:

- There is a desire to increase diverse transportation options, including making it easier and safer to bus, bike, drive, or walk to the waterfront

Waterfront Destinations:

- Port tenants such as the many restaurants, the Exploratorium, Fisherman's Wharf, and the Giants bring people to the waterfront

Share your thoughts:



WHAT IS THE LIFE OF THE EMBARCADERO WATERFRONT, AND HOW IS IT USED BY THE PUBLIC?

An estimated 24 million people visit the Embarcadero waterfront every year. These visits include a wide range of activities and a variety of different people. To better understand waterfront use, the Port conducted a survey of public life in the fall of 2018. Ten locations were surveyed along the Embarcadero waterfront at three different times during a typical week. Shown in the circles on the map above indicate how many people were counted.

Observational data was collected to provide a clearer picture of who uses the waterfront, the types of activities that happen there, and impressions of the waterfront. Nearly 140 people responded to survey questions about what brought them to the waterfront and how they used it.

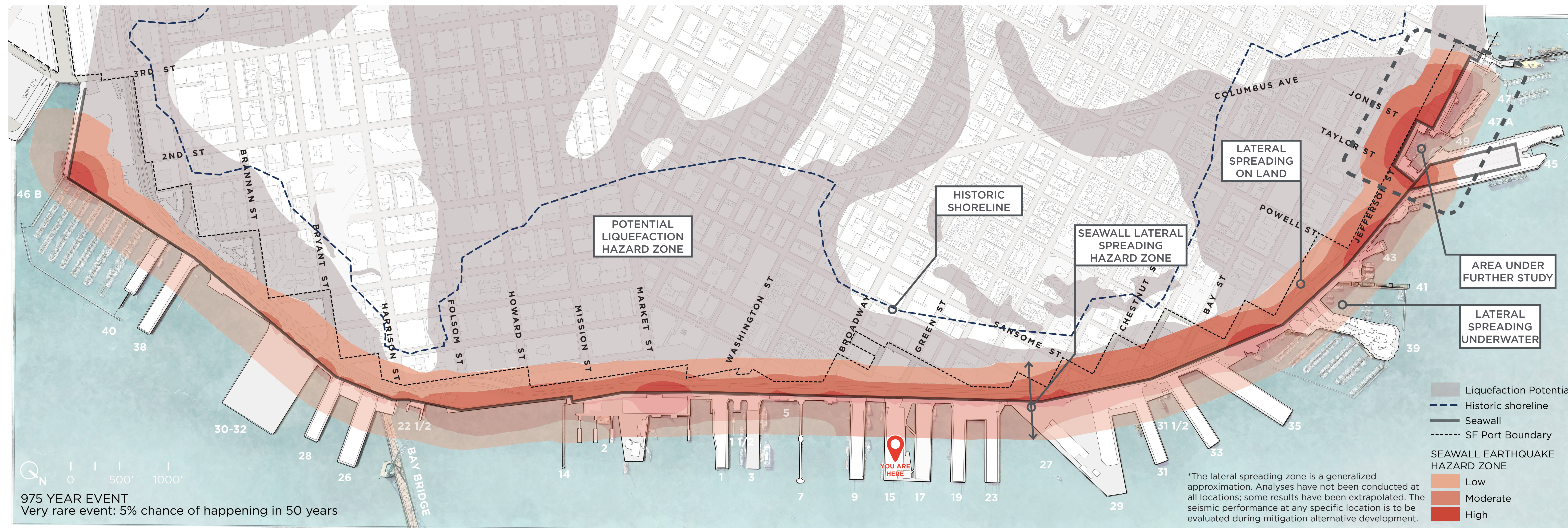
KEY FINDINGS FOR PUBLIC LIFE AND USE

- People feel strongly about the connection to the water; they like the view, the scenery, the water, and the peaceful atmosphere of the Embarcadero waterfront. They want more connection to the water, such as water-based recreation.
- The Embarcadero waterfront is both a part of daily life and a special place to visit. One out of five people visit the waterfront daily. One out of four people are visiting for the first time.
- The vast majority (93%) of people feel safe on the Embarcadero waterfront. Those who do not say it is because of "homelessness" and "drug-use."
- People recognize earthquakes as a major risk but they are not aware of the Embarcadero Seawall.
- A lot of people move along and visit the Embarcadero waterfront each year:
 - 185,000 people visit the Exporatorium every year
 - 1.3 million people visit the Ferry Building Farmers Market
 - 3.4 million people attend events at the Giant's Ballpark
 - 12 million people visit Fisherman's Wharf and PIER 39
 - 300,000 people come and go through the Cruise Terminal
 - 83% of people are traveling by foot
- People come to the Embarcadero waterfront to spend time in specific locations. 58% of people spend more than 1 hour on the waterfront, and 10% spend more than 4 hours.
- People mostly spend time eating and drinking (20%), exercising (19%), sightseeing (16%), and commuting to and from work (15%).
- Young kids, kids, and older adults are underrepresented. On average, only 14% of Embarcadero waterfront users are kids or older adults.

MULTI-HAZARD RISK ASSESSMENT SEISMIC HAZARD



MAP OF EARTHQUAKE HAZARDS



HOW LIKELY ARE EARTHQUAKES?

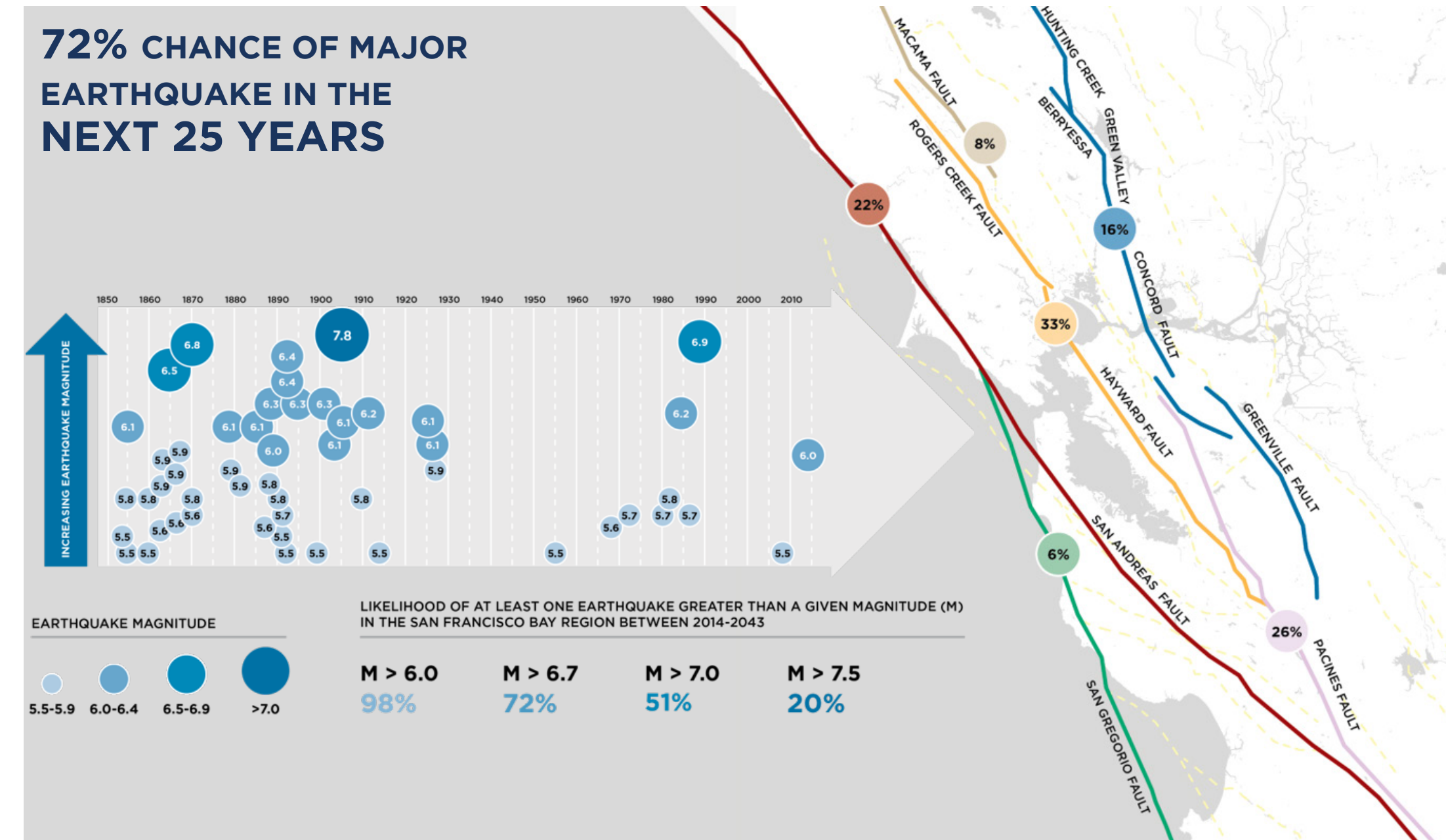
Earthquakes happen when faults rupture, causing the earth to shake. The Bay Area is home to many faults.

Seismologists study the stress on faults and estimate the likelihood of ruptures, from minor to large, and where ruptures may occur. These regional fault models are used to predict the likelihood of shaking intensity and duration at specific locations in the Bay Area, like the Embarcadero.

The Hayward and San Andreas faults are most critical for San Francisco. The Hayward can produce a magnitude 7 earthquake and the San Andreas can produce a magnitude 8 earthquake. This can be larger than 1906.

Fault models were updated in 2014. There is a 72% chance of a major earthquake in the Bay Area by 2044.

Fault Map



WATERFRONT EARTHQUAKE HAZARDS

The Port is characterizing the intensity and likelihood of the unique earthquake hazards along The Embarcadero. See the Seismic Hazard Map and Diagram. These hazards are:

Ground Shaking

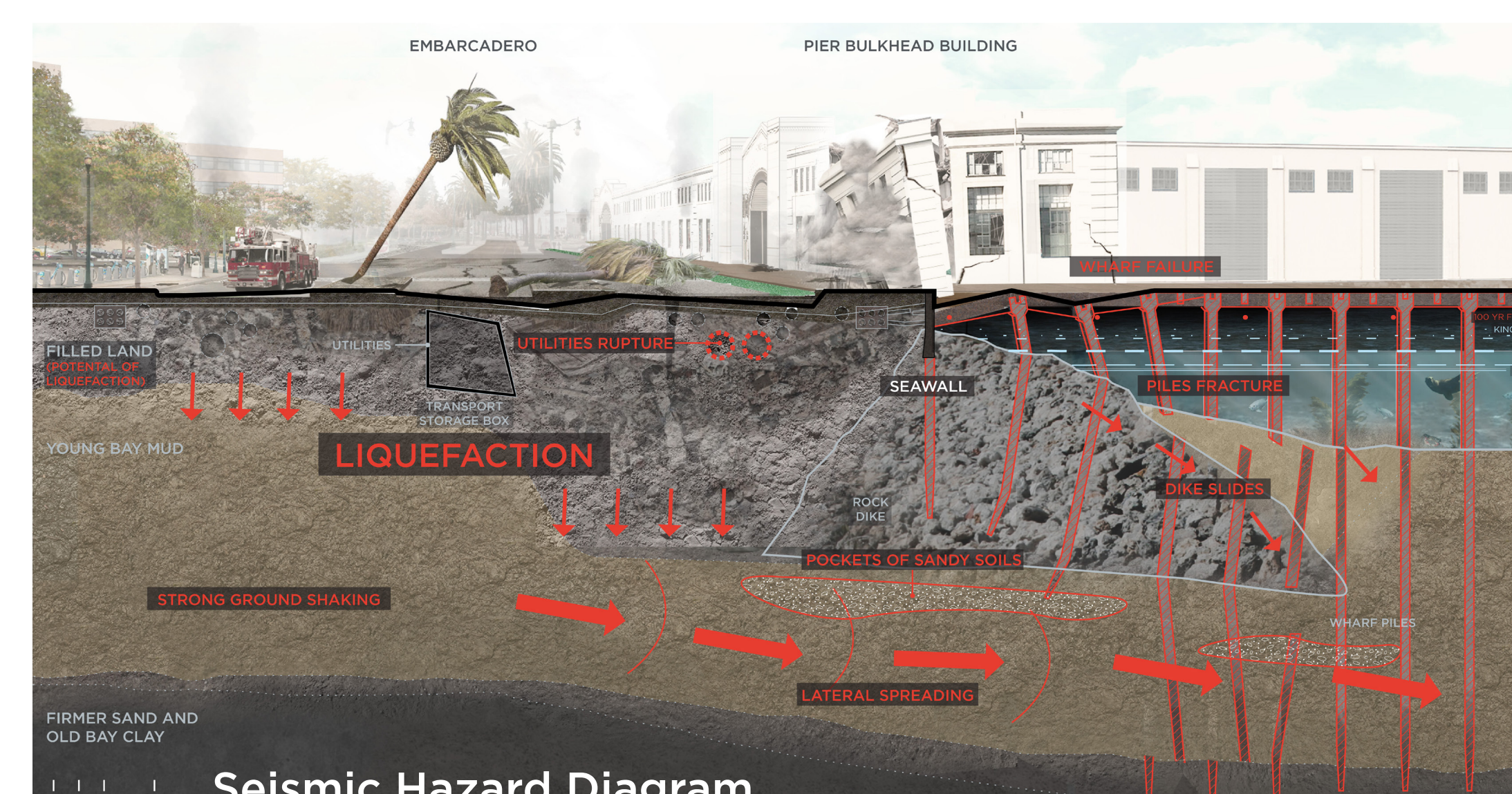
- This is the driving seismic hazard and depends on the size of the fault rupture (magnitude), the distance to the epicenter, and the type of soils and rocks underground.
- Young bay mud amplifies ground shaking, making a moderate earthquake more damaging. The downtown area is particularly susceptible to this because it sits over a deep layer of young bay mud.

Liquefaction

- This can occur during shaking in sandy soils below the water table. When soil liquefies, it loses strength and behaves like a liquid.
- Fill behind the Seawall and natural sand deposits below the Seawall can liquefy during ground shaking.
- Liquefaction can damage roadways, utilities, and buildings on shallow foundations.

Lateral Spreading

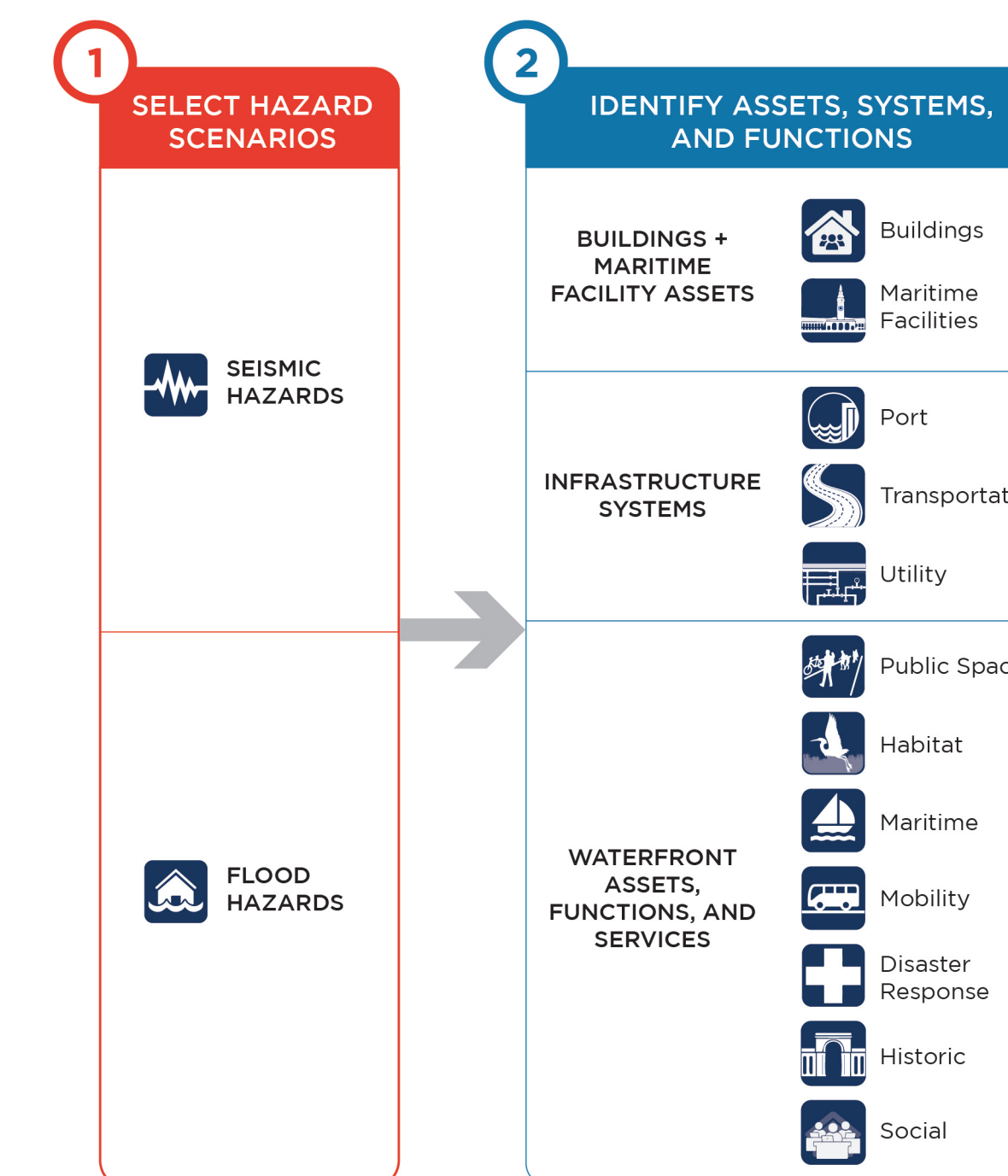
- This happens when surface soils slide and crack due to liquefaction or weak clay, often occurring along shorelines and river beds.
- This hazard can be very damaging for the Embarcadero waterfront, and can damage roadways, infrastructure, wharves, and buildings.
- Recent geotechnical exploration and engineering analyses have been focused on refining predictions of ground shaking, liquefaction, lateral spreading, and pier and building performance.



RISK ASSESSMENT OF SEISMIC HAZARDS

For earthquakes, the MHRA is focused on the Port's assets and the Seawall hazard zone. The Port is using the range of earthquake probabilities depicted below. It is currently predicting damages to assets and estimating the consequences of damage, downtime, and life safety.

Economic losses will be annualized so that they can be compared with expected flood losses, and the economic benefit of various improvement options can be evaluated against the costs.



Earthquakes Being Considered

LIKELIHOOD	RETURN PERIOD (CHANCE IN 50YRS)	HISTORICAL CONTEXT
Frequent	43yr (70%/50yrs)	Similar to shaking in San Francisco from 1989 Loma Prieta (M6.9 60 miles away)
Expected	100yr (40%/50yrs)	M7+/- nearby (within 10 miles)
Rare	225 yr (20%/50yrs)	M7.5+/- nearby, 1906 EQ is estimated to be slightly larger
Very Rare	975 yr (5%/50yrs)	M8+, larger than 1906

We Heard You!

Here is a summary of what we heard from the community since 2017:

Preparing for Seismic Activity:

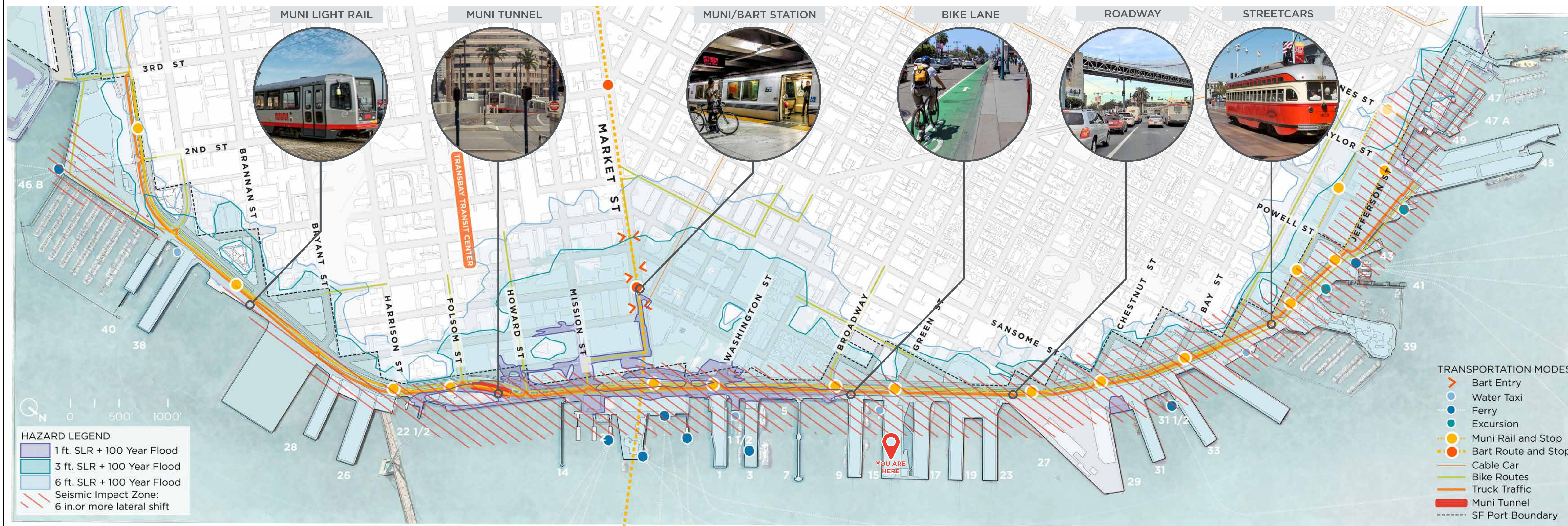
- The Port conducted polling to better understand the public's priorities for the waterfront. Protecting the waterfront from the impact of a major earthquake was very or extremely important to 82 percent of respondents

Share your thoughts:

MULTI-HAZARD RISK ASSESSMENT TRANSPORTATION



MAP OF TRANSPORTATION ASSETS



We Heard You!

Here is a summary of what we heard from the community since 2017:

Prioritize Transportation Networks:

- It is a priority to protect the transportation networks that depend on the Embarcadero Seawall. This includes BART and Muni, the Embarcadero Roadway, the bicycle and pedestrian infrastructure, and the growing ferry infrastructure.
- Getting around is one of the primary ways people depend on the Seawall.

Protecting the BART and Muni:

- The Port conducted polling to better understand the public's priorities for the waterfront. Muni and BART were very or extremely important to 88 percent of those polled.
- Through asset mapping with the community, the Muni tunnel and BART tube were identified as highly prioritized waterfront transportation assets for their role in connecting San Francisco to the region.

Embarcadero Promenade:

- For many, the Embarcadero Promenade is the most loved part of San Francisco's iconic waterfront.
- Biking and running along the Embarcadero Roadway are extremely popular for both people commuting and recreating.
- There is a desire to increase waterfront access, create continuous pathways, and create safer opportunities for people walking and biking.



WHAT MOVES US ALONG THE EMBARCADERO WATERFRONT?

Traveling along the Embarcadero Roadway is a popular activity for visitors, daily recreation for residents, and an essential means to traverse the City for commuters and deliveries. The roadway provides dedicated space for historic streetcars running north, Muni light rail running underground and south, and bicycles moving alongside multiple lanes for vehicle traffic. Yet walking and running outnumber other surface trips up and down this corridor. Workers, students, sports fans, and shoppers arrive at – or under – the Embarcadero when traveling by ferry, BART, or Muni.

MOBILITY, ACCESS, AND SAFETY FOR ALL USERS

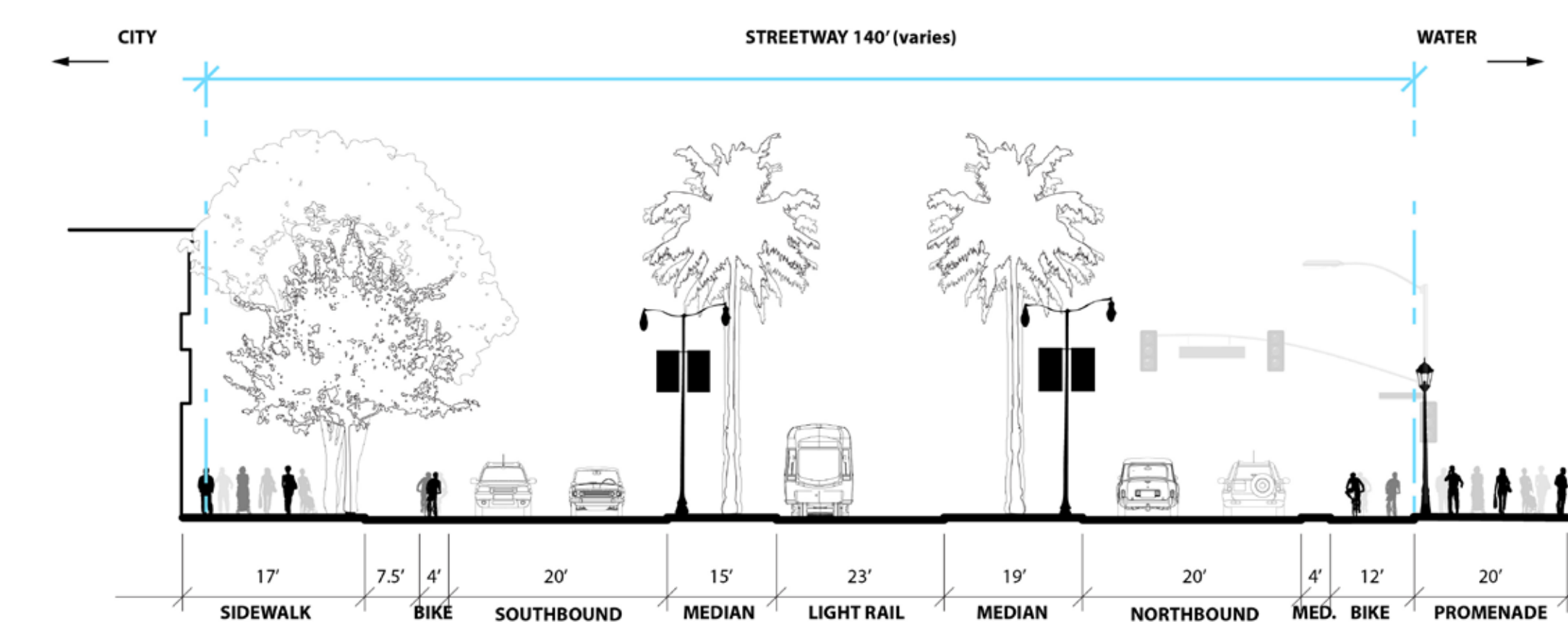
The City's waterfront is both an iconic destination and vital circulatory system for the movement of people, goods, and services. As the demand for trips along the corridor and across the Bay increases over time, our transportation network must also evolve to be safer, more resilient, and able to accommodate more trips.

The Waterfront Plan

As part of a 3-year public planning process, the Port's 2019 update to the Waterfront Plan laid out future aspirations and established policy guidance for an integrated multi-modal transportation system including:

- Walking and Cycling
- Public Transit
- Water Transit
- Movement of Goods and Commercial/Industrial Access
- Transportation Demand Management
- Private Autos
- Curb Use
- Parking
- Streets and Street Maintenance

TYPICAL EMBARCADERO STREET SECTION



Emergency Response

Our urban waterfront is not only part of the day-to-day transportation network, it is a vital connection in the City's emergency response plans. Resilient transportation infrastructure, including piers and roads, will be relied on for both evacuation and relief staging following a major earthquake.

KEY FINDINGS FOR TRANSPORTATION

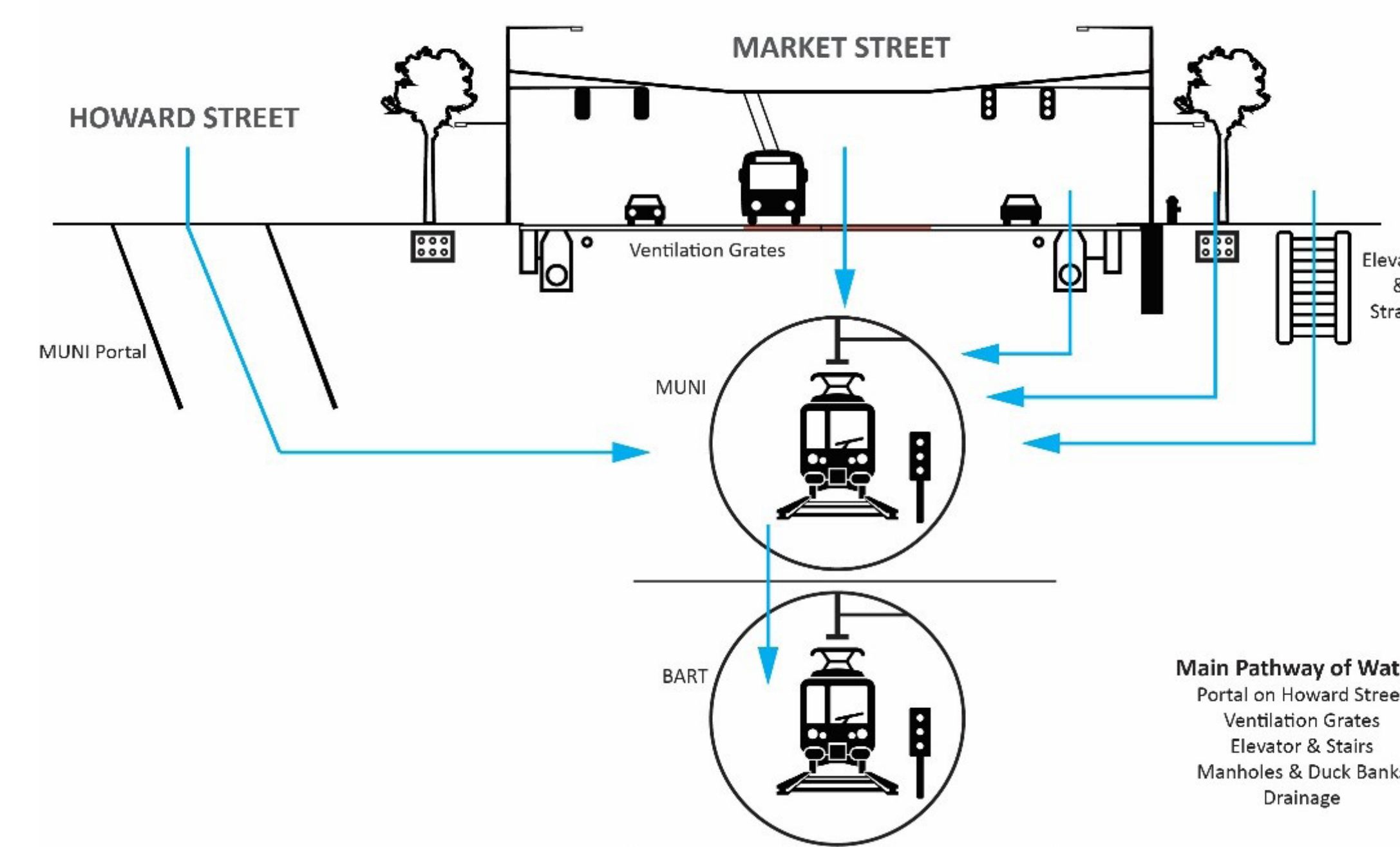
- Every Muni rail line, and the 170,000 daily passengers who ride throughout the city, rely on smooth operations near the waterfront at Embarcadero Station and through the adjacent Muni Metro Turnaround.
- Half of all BART trips, roughly 215,000 daily passengers, pass through the Seawall and under the Embarcadero Roadway.
- In addition to those traveling underground by rail, every day an estimated 307,000 people move along the waterfront by surface transportation:
 - 19,000 Bus Trips
 - 20,000 Historic Streetcar Trips
 - 15,000 Ferry Trips
 - 39,000 Vehicles for 48,000 Passenger Trips
 - 5,200 Bicycle Trips
 - 200,000 Pedestrian Trips
- The Muni Portal on the Embarcadero at Folsom allows trains to pass from the road surface into the subway. In the event of severe flooding, this tunnel would flood Muni and BART.

EVALUATING RISK AND CONSEQUENCES FOR EMBARCADERO WATERFRONT TRANSPORTATION

- Billions of dollars in transportation assets are located within the project area.
- With most Bay Area transportation systems operating near capacity, flexibility to shift modes is limited when a major system like BART goes offline.
- Damage to the shared Muni/BART subway results in tens of thousands of workers not reaching their jobs or residence.
- For a road network near capacity, adding more vehicles reduces vehicle throughput – when transit goes offline, traffic will also gridlock.
- Embarcadero waterfront transportation disruption will result in significant lost wages and productivity.
- In an emergency, failure of key transportation assets (piers, pedestrian pathways, and emergency vehicle access) could result in loss of life.

MUNI AND BART TUNNEL FLOOD PATHWAYS

If water rises to 12.2 ft. SWEL, lasting 5.5 hours, there would be 97,246,751 gallons of water in the subway—that's over 147 Olympic size swimming pools of water.



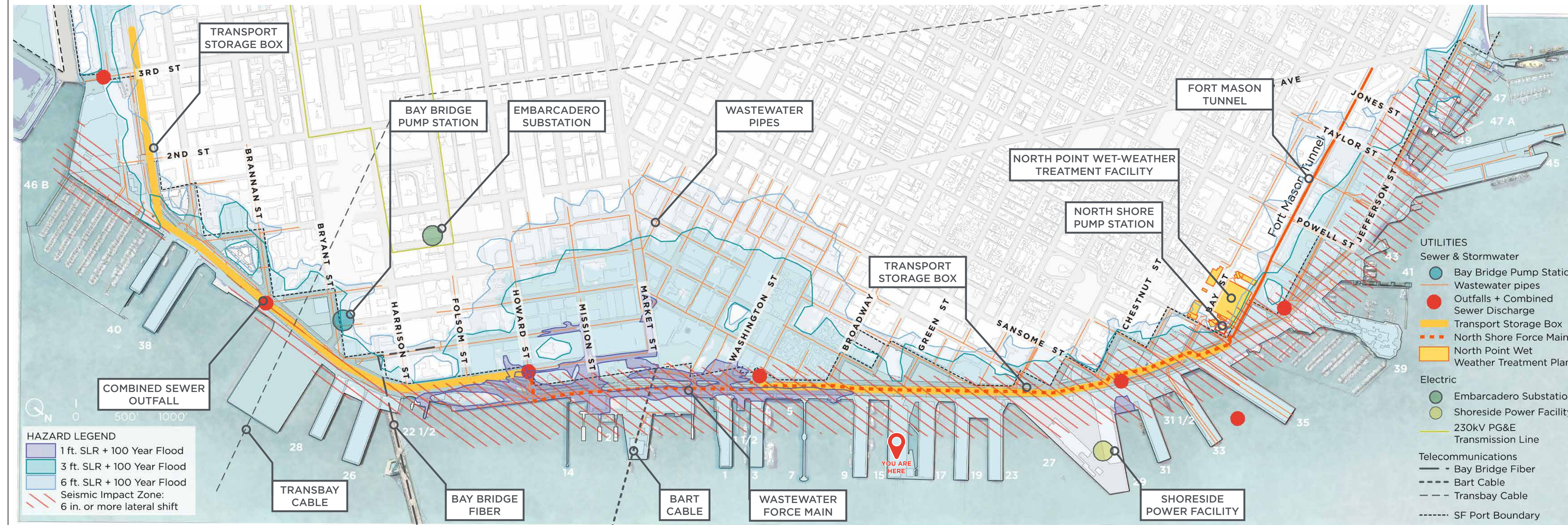
Share your thoughts:



MULTI-HAZARD RISK ASSESSMENT UTILITIES



MAP OF UTILITIES ASSETS



We Heard You!

Here is a summary of what we heard from the community since 2017:

Utility Networks

- There is a desire to prioritize protecting the utility networks that depend on the Embarcadero Seawall, including wastewater, stormwater, power, and cellular towers, among others
- Through asset mapping with the community, utilities were identified as highly prioritized assets for their impact on the entire city
- The Port conducted polling to better understand the public's priorities for the waterfront. Protecting vulnerable parts of San Francisco's citywide water, sewer, and electrical infrastructure was very or extremely important to 88 percent of those polled

Share your thoughts:

WHAT UTILITIES ARE IN THE EMBARCADERO WATERFRONT?

There is a complex network of utilities within the Embarcadero Seawall section of the waterfront. The utilities that are most important for public safety and health are the sewer and stormwater, domestic water supply, and emergency firefighting water supply systems. The city has the responsibility to maintain and protect these public utilities. Other utilities within the Embarcadero waterfront are privately owned and maintained, such as electrical power lines, natural gas, and telecommunications utilities.

CRITICAL UTILITIES EXPOSED TO HAZARDS

Public Utilities:

Sewer and Stormwater

- **Transport Storage Boxes** are large underground tanks that collect stormwater and sewage and direct them to wastewater treatment plants. These structures are important to minimizing the discharge of wastewater into the Bay during storm events, and serve 369,000 people in the downtown and northeast part of the city.
- **The North Point Wet-Weather Treatment Facility** provides wastewater treatment during storm events. It serves 58,000 people in the North Beach and Russian Hill neighborhoods.
- **The North Shore Pump Station** conveys wastewater between the Transport Storage Boxes and the Wet-Weather Treatment Facility.

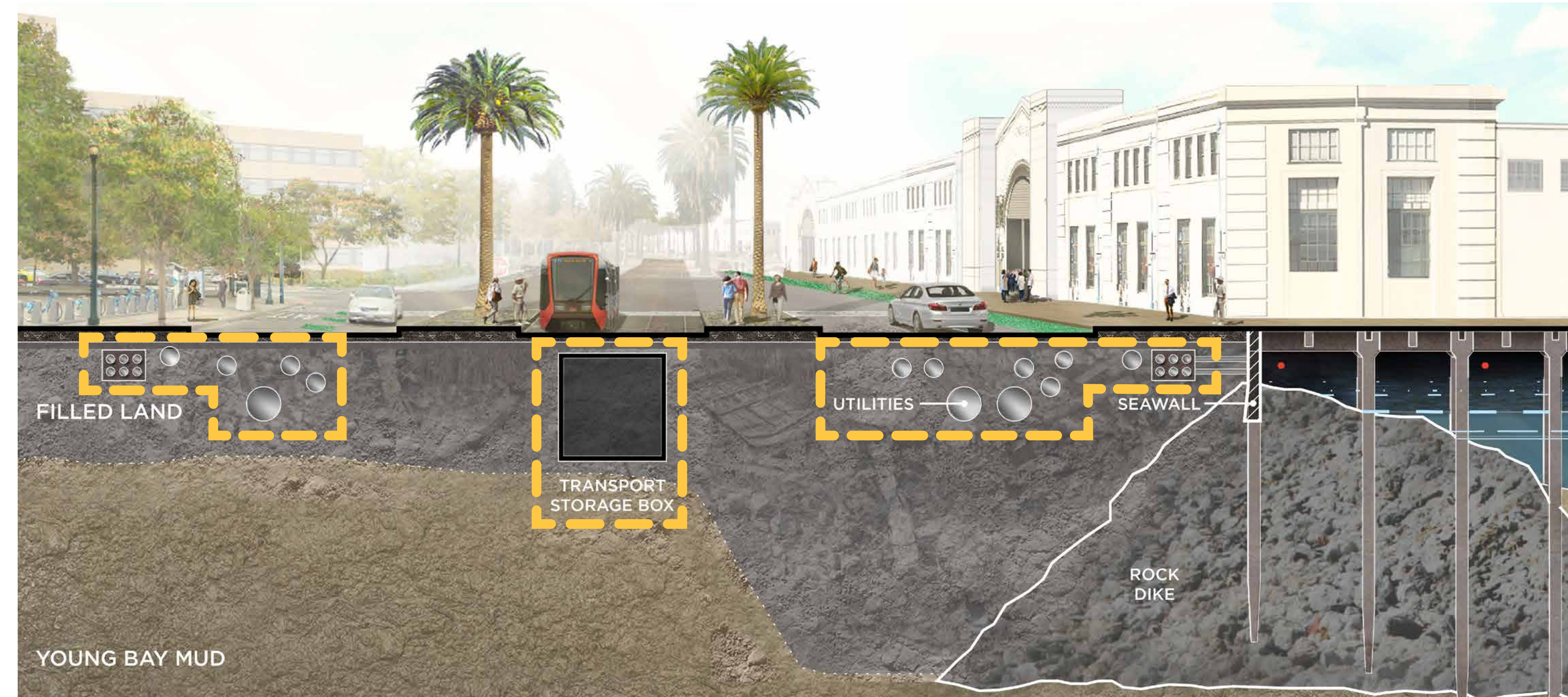
Domestic Water Supply

- **The Bay Bridge Pump Station** is the sole source of water to Treasure Island and Yerba Buena Island. It currently serves 2,300 people but will eventually serve approximately 20,000 residents with the development projects now underway.

Emergency Firefighting Water Supply

- Also known as the **Auxiliary Water Supply System (AWSS)**, this system provides high pressure water to the fire department for fire fighting purposes. There are two pump stations near the waterfront that draw water from the bay through five pump inlets as a backup to the primary system.

UTILITIES BELOW THE EMBARCADERO WATERFRONT



Private Utilities:

Electric Power

- **The Shoreside Power Facility at Pier 27** provides cruise ships with hydro-power at berth.
- **The PG&E Embarcadero Substation** is near the waterfront and is connected to a large electrical transmission line that provides power to most of downtown.

Natural Gas

- Small distribution pipelines serve residents and office buildings throughout the Embarcadero waterfront area.

Telecommunications

- Numerous fiber optic and wireless communication utilities run below and through the Seawall.

EXPOSURE AND CONSEQUENCES OF HAZARDS TO THE EMBARCADERO WATERFRONT'S UTILITIES

The Port is studying the impacts of seismic and flood hazards on critical utility assets to determine how best to protect this system. Some of the consequences of exposure to hazards are:

- Earthquake damage to the wastewater system may allow wastewater to enter the bay. The transport boxes are more recently constructed and durable, but other older parts are in worse condition.
- The backup water supply for the Emergency Firefighting system may be damaged and not function due to earthquake and flood hazards.
- Electrical and natural gas distribution systems are currently planned to be moved due to future flood risk. This effort will be led by PG&E.