

USACE FLOOD RESILIENCY STUDY UPDATE

Port Commission Agenda Item #11A

October 27, 2020



Waterfront Resilience Program



AGENDA

Overview of the USACE Flood Resiliency Study



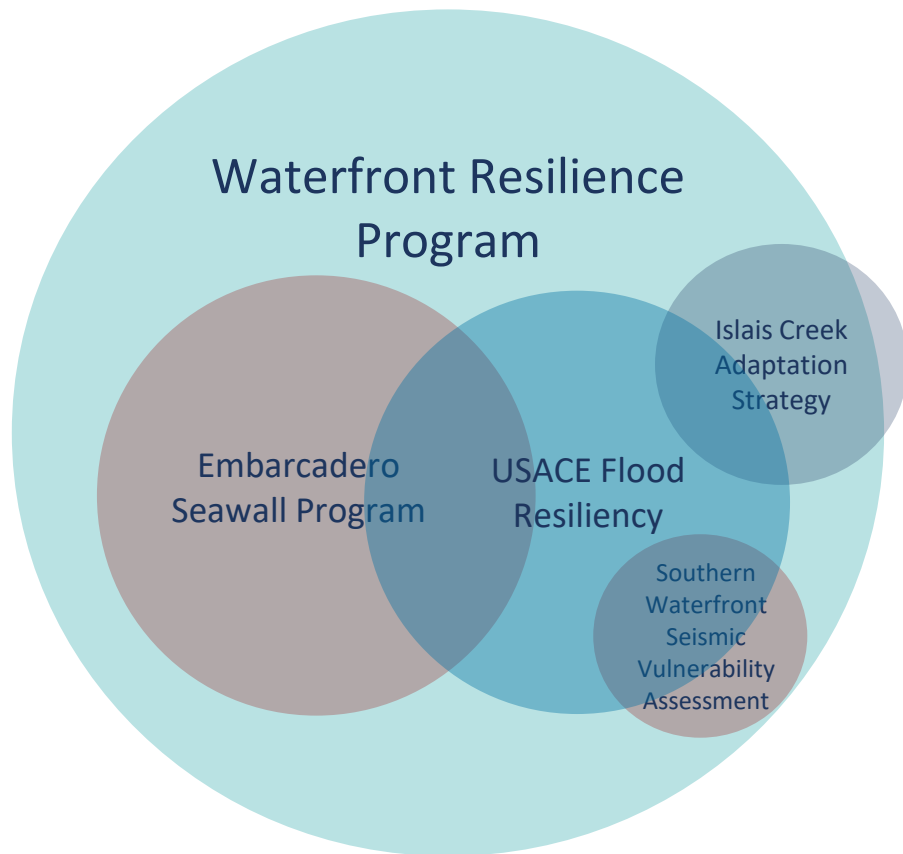
- Flood Resiliency Study Overview and Key Milestones
- Future Without Project
- Stakeholder Input To Date
- Focused Array
 - Measures
 - Themes and Key Findings
- Key Considerations for Port Commission
- Next Steps

WATERFRONT RESILIENCE PROGRAM EFFORTS

Presentation Focus: USACE Flood Resiliency Study



USACE FLOOD RESILIENCY STUDY AND EMBARCADERO SEAWALL PROGRAM



USACE FLOOD RESILIENCY STUDY

Overview and Key Highlights



- Port is local sponsor, seeking assistance since 2012
- Local and Federal Expertise
- ~5 years (subject to waiver), 50/50 cost share
- Assess flooding under five sea level rise curves, including 3 USACE curves (low, medium, high) and two additional State of California curves
- Robust community and stakeholder input
- If USACE finds a Federal interest and Congress authorizes a Project:
 - Design/construction of project cost-shared 65% Federal, 35% Local

USACE FLOOD RESILIENCY STUDY PROCESS

Develop, evaluate, refine, and narrow alternatives under consideration

1 Future Without Project (FWOP) - **in process**
(flood damages and consequences)

Detailed Economic Analysis

- National Economic Development (NED) Account
- Regional Economic Development (RED) Account
- Other Social Effects (OSE)
- Environmental Quality

2 Problems, Opportunities, Objectives, Constraints, and Considerations (POOCCs)

3 Iterative Multi Step Alternative Formulation

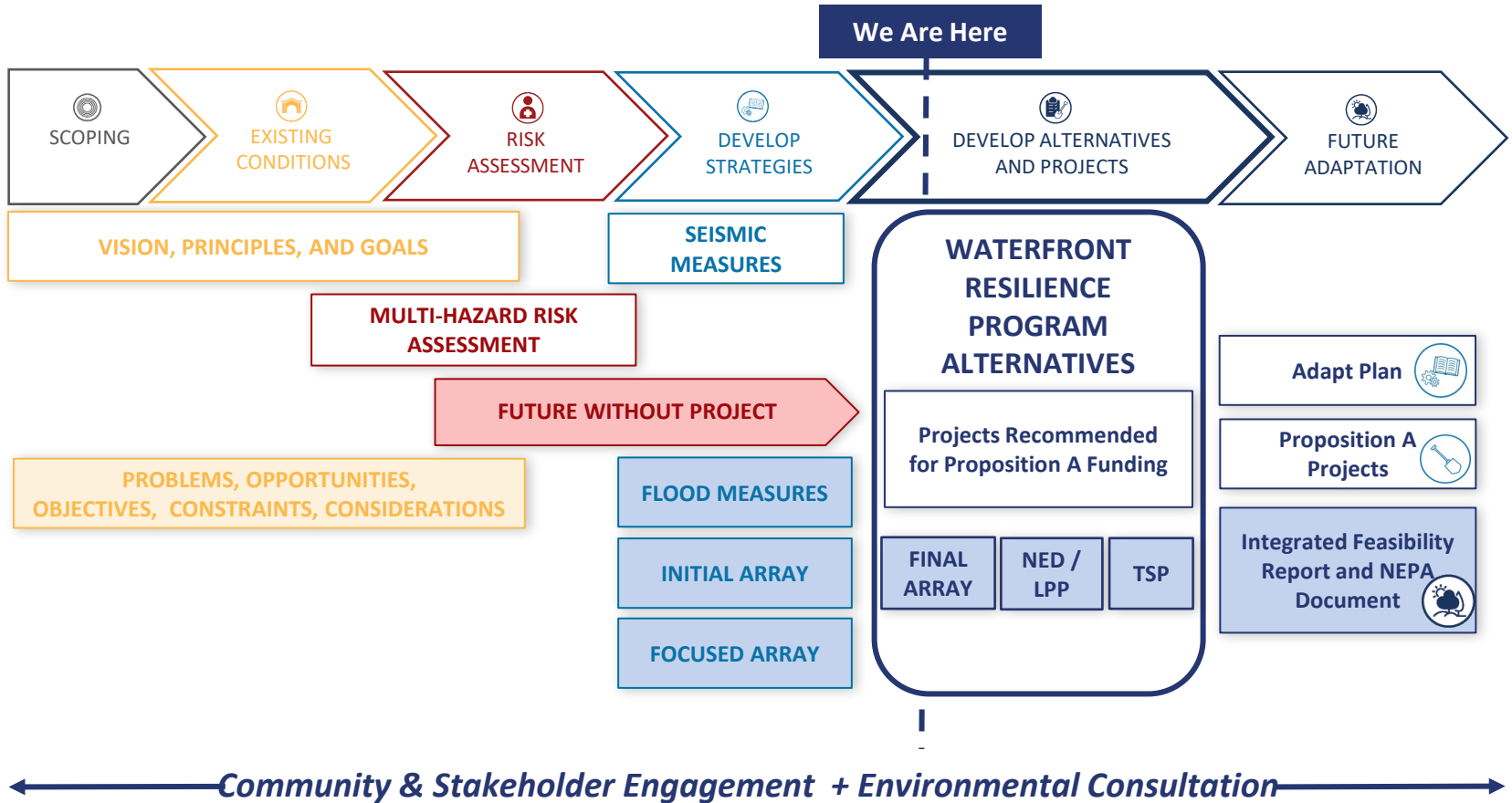
- Initial Array
- Focused Array – **We Are Here**
- Final Array

4 National Economic Development (NED) Plan / Locally Preferred Plan (LPP)

5 Tentatively Selected Plan (TSP)

6 Feasibility Report and National Environmental Policy Act (NEPA)

USACE FLOOD RESILIENCY STUDY ALTERNATIVES DEVELOPMENT PROCESS



USACE FLOOD RESILIENCY STUDY MAJOR MILESTONES

Dates may be adjusted with Agency Technical Review recommendations

Future Without Project	Winter 2020
NEPA Early Scoping	August – October 2020
Focused Array Alternatives	Winter 2020
Final Array Alternatives	Early 2021
NEPA Notice of Intent	Mid 2021
NED Plan / Locally Preferred Plan	Mid 2021
Tentatively Selected Plan	2022

Future Without Project Condition

Purpose and Update



FUTURE WITHOUT PROJECT (FWOP) CONDITION

Purpose

1

Flood events will cause damages and impacts felt throughout the city, region and beyond as sea level rises

2

The Flood Resiliency Study will quantify damages and impacts to determine the level of "Federal Interest"

3

Future Without Project (FWOP) is which all Federal actions are measured

4

Account for all projects taken by the Port or City in advance of a Federal project which will impact flood risk (i.e. Mission Rock, Pier 70, Potrero Point)

5

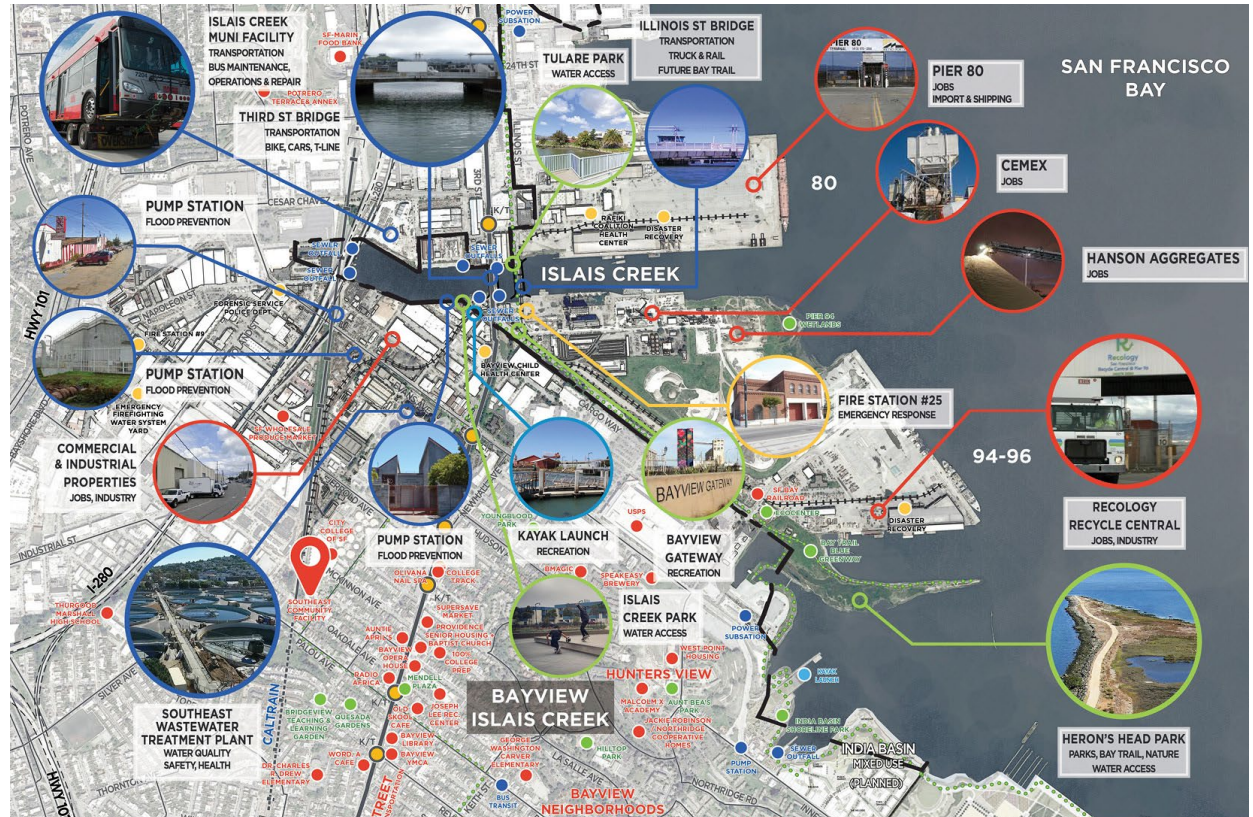
There is a high likelihood of Federal investment to prevent future damages when the cost of mitigation actions are less than the potential damage

COMPILE ROBUST INVENTORY OF ASSETS

FWOP – Step 1

Collaborated with City partners, Port tenants and other stakeholders to:

- Assign value to physical infrastructure
- Estimate impact of disruption and downtime for businesses and services
- Evaluate vulnerability of each asset to flood risk based on water depth
- Compile exhaustive database of all assets within the flood plain for use in the planning model



COMPILE ROBUST INVENTORY OF ASSETS

FWOP – Step 1

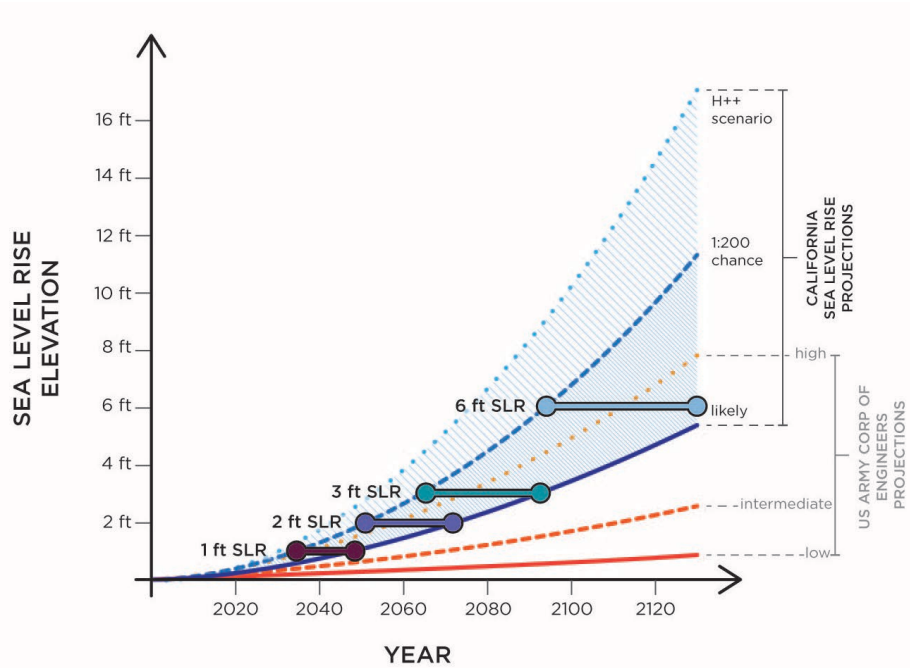


Assets at risk include more than:

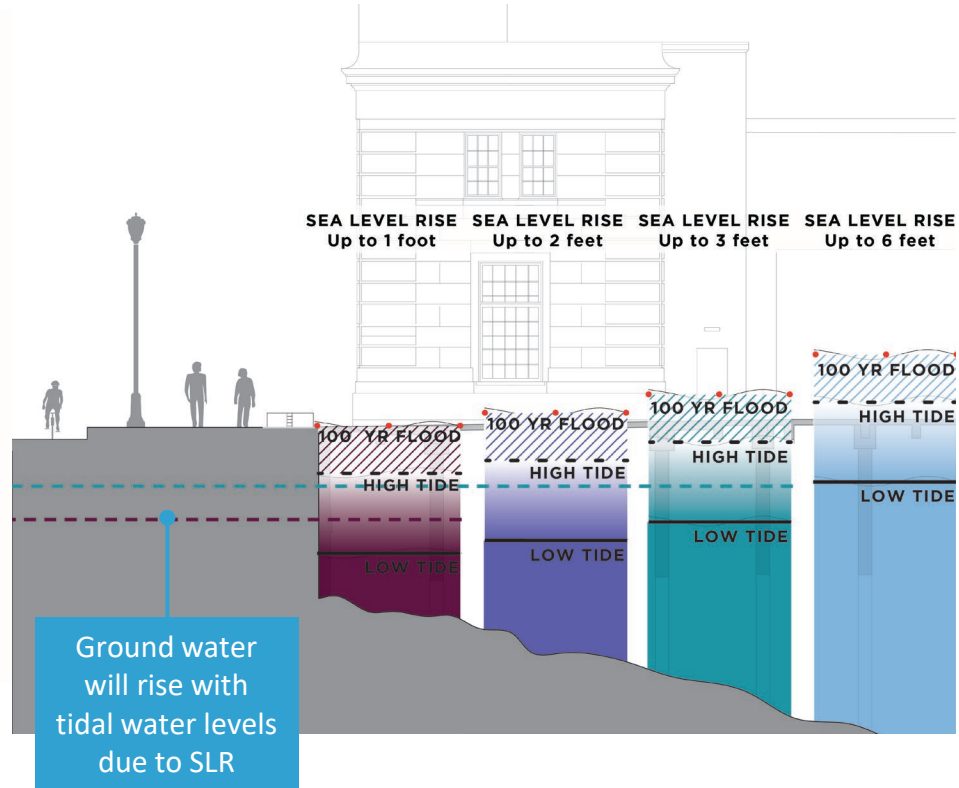
- 40 miles of roadway
- 25 miles of muni & cable car track
- 5 miles of freight railway
- 6 fire stations
- Dozens of other critical facilities
- 11,000 jobs
- 360,000 regional commuters
- 2,600 residential and commercial buildings
- 13,500 residents, 58% people of color
- Wastewater functions for 580,000 residents

DETERMINE FLOOD SCENARIOS

FWOP – Step 2

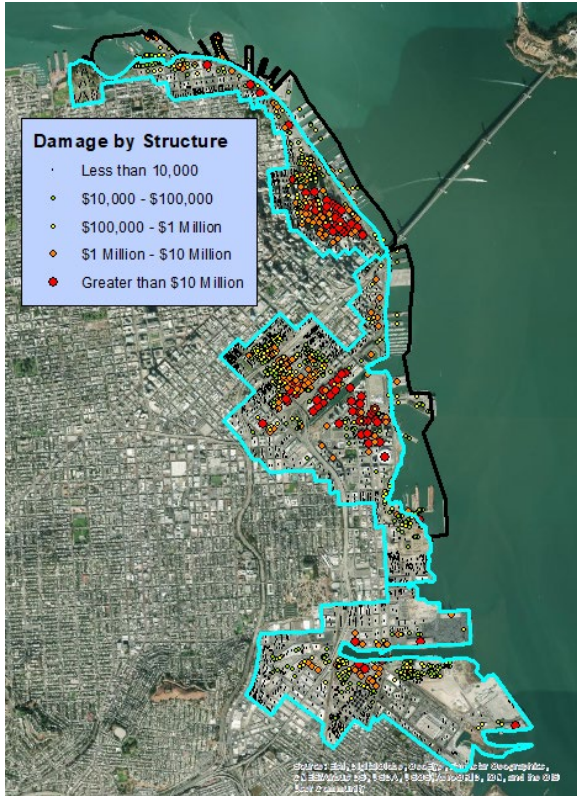


State of CA – Updated 2018; USACE – Updated 2013



PLANNING MODEL TO ANALYZE FWOP DAMAGES

FWOP – Step 3



Coastal Flood Scenarios



Robust Asset Inventory



Planning Model
(Economic Damages)

*DRAFT – work in progress

COMPILE FLOOD DAMAGES TO USACE ACCOUNTS

USACE has several categories to classify damages, which all carry different weight in selection of a flood risk mitigation plan:

National Economic Development (NED)

Changes in the economic value of the national output of goods and services. NED effects are displayed in monetary values.

Environmental Quality (EQ)

Non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans.

Regional Economic Development (RED)

Changes in property values, business revenue, employment, regional and state tax impacts.

Other Social Effects (OSE)

Impacts to population distribution, health and safety, social connectedness, economic vitality, community identity, and leisure and recreation.

USE OF ACCOUNTS IN DEVELOPMENT OF PLAN RECOMMENDATIONS

Complete Plans Consider All Four Accounts Holistically

- All of the accounts are available to be used in **comparison of complete plans** through evaluation against the FWOP baseline, but the NED account is the only account used for determination of the **benefit-to-cost ratio**, such that it is desirable from a local perspective to count as many USACE policy compliant damages in the NED account as possible to maximize Federal funding.
- While not all damages will be recognized in the NED account, the City will **leverage the other accounts (RED and OSE) to inform the Locally Preferred Plan (LPP)**.
- Various metrics are used to predict the **quantitative impacts** of the FWOP and the **benefits** of plan alternatives.



Community



Critical
Facilities



Disaster
Response



Open Space
& Ecology



Maritime



Mobility



Utilities



Historic &
Cultural

FUTURE WITHOUT PROJECT (FWOP)

Summary

1

The Future Without Project (FWOP) scenario effectively defines the size and scope of a potential federal investment in flood risk reduction for the San Francisco waterfront

2

Due to the complexity of the San Francisco Waterfront and challenges with USACE technical tools, this milestone is delayed

3

The Port and USACE have been working together to identify to accurately define the potential federal investment, consistent with USACE rules, policies, and guidelines

4

The study is at the nexus of several issues that are new to USACE:

- Use of the computerized life-cycle planning model (G2CRM)
- Application of future tidal flood damages which equate to frequent disruption of city function
- Integration of RED/OSE into decision making – updated USACE policy in development



Stakeholder Engagement

A community-driven process



COMMUNITY & STAKEHOLDER ENGAGEMENT OVERVIEW

Ongoing Engagement

The Port is proud to work with a diverse group of LBE, WBE, and MBE subcontractors to plan and execute engagement, which has included:

- Connected with thousands of San Francisco residents at City wide neighborhood events
- Community meeting series in three waterfront geographies
- Casual "mixers" to engage key stakeholders and interested public
- Digital engagement
- Youth engagement
- Public housing engagement
- Over 100 presentations to neighborhood, business, community, and CAC groups along the waterfront and citywide
- Targeted Port tenant engagement
- Press

STAKEHOLDER ENGAGEMENT HIGHLIGHTS

Ongoing engagement with City departments, local and regional agencies, resource agencies, and more

Problems, Opportunities, Objectives, Constraints, and Considerations
Fisherman's Wharf
 Subarea 1-2



Subarea Description
 Fisherman's Wharf (Subarea 1-2) includes Fisherman's Island, an active fishing industry and popular tourist area that features:

Problems, Opportunities, Objectives, Constraints, and Considerations
Ferry Building
 Subarea 2-2



Subarea Description
 Ferry Building (Subarea 2-2) includes the iconic Ferry Building, maritime park, the city administration Ferry Terminal, and portions of San Francisco's Financial District, with various significant city and regional:

Problem, Opportunities, Objectives, Constraints, and Considerations
Islais Creek
 Subarea 4-2



Subarea Description
 Islais Creek (Subarea 4-2) covers a large portion of the neighborhood surrounding Islais Creek. It includes the navigable lower watershed on the western portion of Islais Creek, Islais Creek Channel, and the northern portion of the Bayview-Hawesbury neighborhood north of Fabos Avenue.

Problem, Opportunities, Objectives, Constraints, and Considerations
San Francisco Bay



The area contains several key infrastructure assets, including the Southeast Waterway Treatment Plant, as well as multiple transportation, storage, maintenance, and operations facilities that serve the entire city.

Subarea Description
 The Southeast Waterway Treatment Plant is San Francisco's largest wastewater facility. It is responsible for treating flows from the City's Recreation and Business Center from the City and Bayview, the Southeast Treatment Plant (operates 24 hours a day, and treats up to 100,000 gallons of effluent), neighborhood served by the plant include the Marina, Financial District, South of Market Area, Mission, Potrero, and Union Square.


Subarea Description
 More than 80 percent of the total annual wastewater flow from the city is processed by the Southeast Treatment Plant. Wastewater and stormwater are transported through a network of transport and storage facilities, sewers, and five long-spanning pipes options prior to reaching the Southeast Treatment Plant. Treated wastewater and stormwater is discharged to the San Francisco estuary via the SFO.

Subarea Description
 Disaster response assets, such as the stations and terminals of the Emergency Freshening Water System (EFWS), also known as the Auxiliary Water Supply System or AWSS), are in the subarea. The EFWS is supported by the local potable water system and obtained from San Francisco Bay and distributed via a separate network from the potable water system.

Subarea Description
 The subarea includes the northern portion of the 3rd Street neighborhood commercial district. Third Street, including the Islais Third Street Light Rail Station (LRT) at critical north-south transportation corridors, including Third Street and the Market T-Line cross Islais Creek along the Third Street Bridge. The other roadway crossing over Islais Creek is Third Street, via the Third Street Bridge. The Third Street Bridge primary spans to provide north-south and heavy truck access to Piers 30-36, while also relieving congestion on Third Street. Islais Street and the Third Street Bridge are also part of the City's disaster response system.

Subarea Description
 Within the Islais Creek area, the shoreline is primarily engineered, but small strips of natural shoreline are located between the sea and this elevated area. Some of these areas are integrated as parks with public beaches and trail access. The City received funding from Caltrans to develop strategies to address sea level rise and coastal flooding adjacent to Islais Creek through the Islais Creek Adaptation Strategy. The project will develop near-term resilience measures, mid-term adaptation, and a long-range vision for the Islais Creek shoreline that protects transportation infrastructure, enhances shoreline access and habitat, and increases community resilience to adjoining neighborhoods. Islais Creek is included in the Port and U.S. Army Corps of Engineers Flood Risk Study, which is evaluating flood risks along San Francisco's major waterways. The Islais Creek channel is also part of the Port of San Francisco Piers 30-36 Resilience Eco-Industrial Strategy (Maritime Ecosystem Capital), which is generally bounded by 20th Street on the north, Islais Creek on the east, and Geary Street on the south. The Port defines the Maritime Eco-Industrial Center as an area that co-locates maritime industrial uses to enable


Measure Profile
New Seawall Bayward
 Flood Adaptation Measure



PHYSICAL INFRASTRUCTURE



SHORELINE LOCATION



DESIGN LIFE
 100+ years

COASTAL FLOOD HAZARD
 Sea Level Rise

MEASURES COMPATIBLE
 Flood

CONSIDERATIONS:
 • Fill in will raise surrounding building

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Measure Profile
Locks
 Flood Adaptation Measure



PHYSICAL INFRASTRUCTURE



SHORELINE LOCATION



DESIGN LIFE
 100+ years

COASTAL FLOOD HAZARD
 Sea Level Rise

MEASURES COMPATIBLE
 Flood

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Measure Profile
Earthen Levee
 Flood Adaptation Measure



PHYSICAL INFRASTRUCTURE



SHORELINE LOCATION



DESIGN LIFE
 100+ years

COASTAL FLOOD HAZARD
 Sea Level Rise

MEASURES COMPATIBLE
 Flood

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- The **Interagency Coordinating Team**, which is convened jointly by USACE and Port staff, enables each agency to partner in the Study
- A **Cooperation and Participating Resource Agency Working Group (RAWG)** was established consisting of representatives from the USACE, the Port, and the various State and Federal agencies concerned with the study area



COMMUNITY MEETINGS

Feedback via digital meetings on seismic and flood risk reduction measures

What we heard:

- Understanding of the challenges of applying measures
- Balancing near- and long-term risk
- Interest in preserving historic resources
- Focus on Bay ecology and health
- Desire to preserve and enhance access to and along the waterfront
- Interest in exploring alternative modes of transport

1b AQUATIC PARK + FISHERMAN'S WHARF SUBAREAS

FACILITATORS: BRAD BENSON - LAUREN WONG

REPORT OUT NOTES

1. What are the most important considerations for reducing measures?

ADAPTABILITY COST-EFFECTIVE DESIGN LIFE ABLE TO BE REPLACED

ECOLOGICAL FEATURES (COMBIO WITH STRUCTURAL) LONG TERM SOLUTION NEEDED TOO

2. Which concerns do you have about any of the measures?

ASSET LEGEND

FLOOD MEASURES

	DESIGN LIFE	ADAPTABILITY	IMPACT ON THE WATERFRONT	COST	COMPATIBLE MEASURES
LEVELS	75+ years	Low	Major Intervention	\$\$\$\$\$	Nearshore Buttress, Bulkhead Wharf Retrofit, Ecological Features
SEAWALLS	50-100 years	Varies	Major Intervention	\$\$\$	Nearshore Buttress, Drilled Shafts, Ecological Shorelines
RAISED MARINE STRUCTURES	50+ years	Medium	Major Intervention	\$\$\$\$\$	Drilled Shafts, Ecological Features
FLOODWALLS	30-50 years	Low	Minor Intervention	\$\$	Bulkhead Wharf Retrofit, Drilled Shafts
ECOLOGICAL FEATURES	10-50+ years	Medium-High	Minor Intervention	\$*	All Flood Measures and Seismic Measures
ECOLOGICAL SHOULDER	Decades	Medium-High	Typically Minor Intervention	\$*	All Flood Measures and Seismic Measures
NEARSHORE BUTTRESS	100+ years	Very High	Major Waterside Intervention	\$\$\$\$\$	Trees, Seawalls, Ecological Features
DRILLED SHAFTS	75+ years	Medium	Moderate Landside Intervention	\$\$\$	Raised Marine Structures, Floodwalls, Seawalls
BULKHEAD WHARF RETROFIT	30 years	Low	Minor Waterside Intervention	\$\$	Levers, Floodwalls, Ecological Features
EMERGENCY PREPAREDNESS			No physical impact	\$	All Flood Measures and Seismic Measures

SEISMIC MEASURES

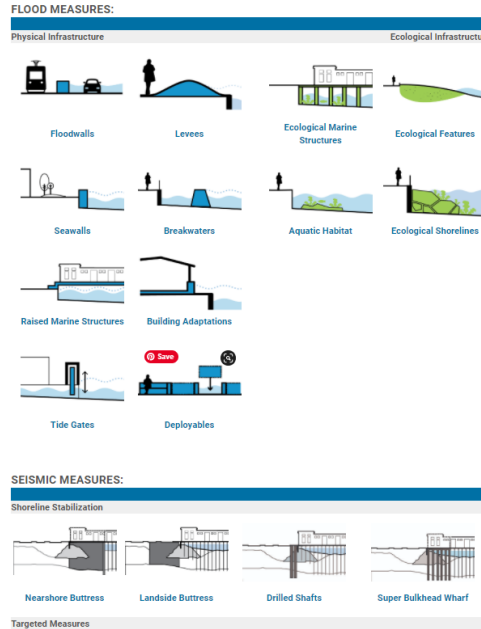
SHORELINE STABILIZATION

EMERGENCY PREPAREDNESS

REPORT OUT REPRESENTATIVE

DIGITAL ENGAGEMENT HIGHLIGHTS

Feedback via Waterfront Resilience Story Maps and a Measures Explorer



<https://www.sfportresilience.com/planning-for-our-future>

- To date, there have been more than **100K page visits** across all Measure Explorer and Story Maps pages
- The top three measures with the most page views: **Levees, Floodwalls, Seawalls**
- The top three Story Maps with the most pages views: **South Beach, Aquatic Park, Fisherman's Wharf**
- The top three themes with the most page views: **Open Space, Transportation, Maritime**

An aerial photograph of an industrial waterfront area. A prominent feature is a tall, narrow building facade covered in a vibrant, multi-colored mural of geometric shapes, including triangles and diamonds in red, blue, yellow, and green. To the left, a large body of water is visible with several ships and cranes. To the right, there are various industrial structures, including a large concrete wall and a building with the name 'MEERS' visible. The sky is clear and blue.

Focused Array

Introduction and Overview

FOCUSED ARRAY ITERATION WORK

Subarea Material Development

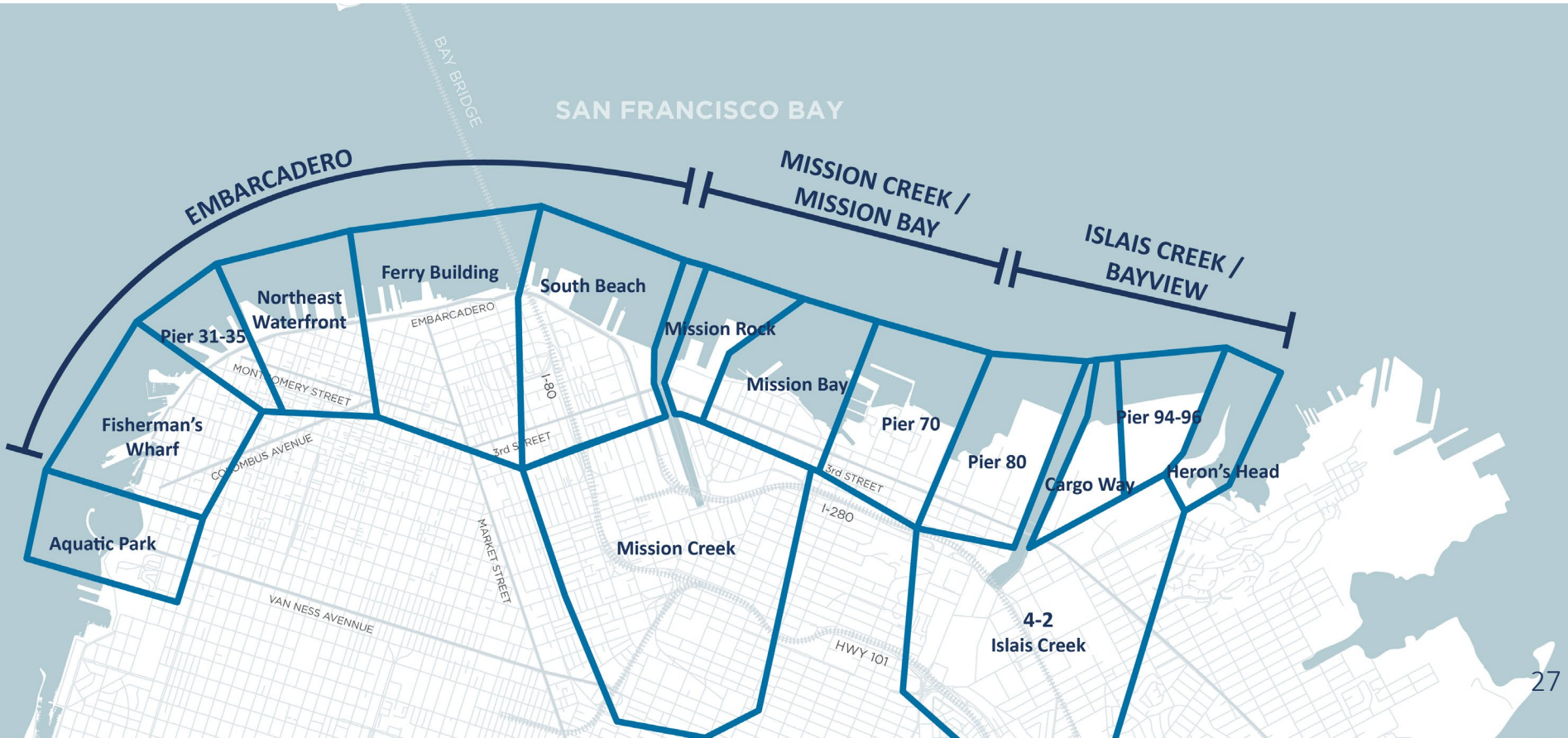
- To support the Focused Array work, the team developed material at a subarea scale to provide detailed information on:
 - Existing Conditions
 - Assets and services
 - Stakeholder priorities
 - Flood and seismic hazards
 - Risks and consequences
 - Existing and proposed projects
 - Measures and Approaches

in the entire project area which includes both Port and City

- Relied on knowledge from **City staff to refine understanding of assets and services in the City**
- Using an integrated team to develop alternatives that **address issues in an integrated way – flooding and seismic**
- **Public feedback informed goals, assets, evaluation criteria** to support a transparent decision-making process

USACE FLOOD RESILIENCY STUDY AREA

Subareas support community prioritization and evaluation of conditions / measures



SUBAREA PROFILES

Subarea Overviews

Subarea Profile
Aquatic Park
Subarea 1-1



SHORELINE TYPE:	SEISMIC RISK:
Armored & Beach: Riprap revement and beach backed by concrete seawall and mixed use trail.	Shoreline Instab Not As Liquefact Not As Shoreline Vulner Not As
Subsurface Profile: NOT ASSESSED - likely non-engineered fill, interspersed sands and mud, shallow rock at Fort Mason	Unique and vulner Not As

SUBAREA DESCRIPTION

The A attrac Park, the M Munic that is Golde Franc of are The is shoreline protection structures), but the western limits betwee higher shoreline elevations. The breakwater wall supporting A Fisherman's Wharf provides shelter from wave hazards.

Flooding would initially occur at the western edge of this subar Pier. Flooding will occur as water levels exceed the lower-lying

¹ Evaluation of seismic risk in this area is based on engineering ju
² The timing of coastal flood events that will cause significant flooding in this scenario provided by the California Ocean Protection Council (COPC) per the

Subarea Profile
Mission Rock
Subarea 3-3



SHORELINE TYPE:	SEISMIC RISK:
Engineered: Filled land retained pile supported bulkhead wall and wharf. Mostly original from the early 1900s.	Shoreline Instab Not Assessed - like Liquefaction R Not Assessed - like Shoreline Struc Vulnerability Not Assessed - poten due to age of stru
Subsurface Profile: Not Assessed - likely non-engineered fill, shallow bay mud, with shallow rock outcropping at Mission Rock	Unique Conditions: Fill over deep bay mud, hit piers. Unique Pier 50 parais (potentially liquefiable) loc rock outcropping (Mission I

SUBAREA DESCRIPTION

The Mission R 48, and China Mission Creek spaces. The M market-rate a space, and op incorporate st Mission Rock: generations to The Subarea 3 hardened edg embankment with riprap armoring to protect the landward China Bazi

There is a narrow flood pathway (on Terry Francois Boulevard) that co higher Bay water levels would result in overtopping along the entire

¹ Evaluation of seismic risk in area outside of the Embarcadero Seawall Program are ba Southern Waterfront Seismic Vulnerability Assessment is complete in Spring 2021.
² The timing of coastal flood events that will cause significant flooding in this subarea is scenario provided by the California Ocean Protection Council (COPC) per the Likely and

PORT OF SAN FRANCISCO Waterfront Resilience Program

Subarea Profile
Heron's Head
Subarea 4-5



SHORELINE TYPE:	SEISMIC RISK:	FLOOD RISK:
Beach, Armored & Marsh: Filled lands forming peninsula with protected slopes on one side and natural shoreline slope supporting tidal habitat on the other.	Shoreline Instability: Not Assessed Liquefaction Risk: Not Assessed Shoreline Structure Vulnerability: Not Assessed	Tipping Point Elevation: 38" above high tide Coastal Flood Events Timing 100-yr Flood Today High tide + 36" SLR 2068 - 2101
Subsurface Profile: Not Assessed - likely non-engineered fill originally classified as debris dike	Unique Conditions: Restored tidal wetland area, with no structures present	

SUBAREA DESCRIPTION

The Heron's Head subarea primarily consists of the 23-acre Heron's Head Park, originally constructed as part of never-completed construction of a new cargo terminal, "Pier 38," and officially zoned as an industrial area. It is now home to native plants and more than 100 bird species and one of the few wetlands on San Francisco's shoreline. The EcoCenter at Heron's Head Park is the first LEED Platinum - Zero Net Energy Building in San Francisco, using sustainable on-site power, and wastewater systems. The educational community center at the EcoCenter as well as the park walking paths, bird watching, and ecosystem restoration activities are part of a commitment to create a sustainable waterfront for generations to come.

This shoreline within this subarea is primarily an embankment that is fronted by marsh or varying degrees of rock protection. The primary pathways of flooding are from overtopping over broad stretches of mostly natural shoreline along the northern edge of Heron's Head Park, and along the India Basin Shoreline to the south of this subarea. The wetland area at Heron's Head Park and the India Basin Shoreline already experience regular inundation during high tides today.

¹ Evaluation of seismic risk in area outside of the Embarcadero Seawall Program are based on engineering judgment and will be updated once the Southern Waterfront Seismic Vulnerability Assessment is complete in Spring 2021.
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 (COPC) per the Likely and 1-in-200 chance of occurrence projections.

PORT OF SAN FRANCISCO Waterfront Resilience Program

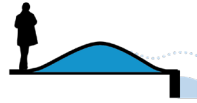
- One of the many tools created to support the development of alternatives
- All Subarea Profiles, POOCCs, and Flood Risk Profiles for all 15 Subareas are online
- Includes data on flood and seismic risk
- Includes community-prioritized assets



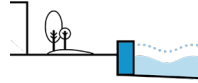
FLOOD MEASURES

Draft flood improvements under consideration by the Port

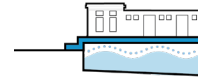
Physical



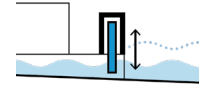
Levees



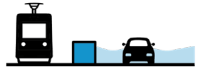
Seawalls



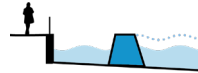
Raised Marine Structures



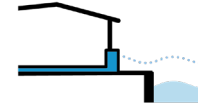
Tide Gates



Floodwalls



Breakwaters



Building Adaptations



Deployables

Ecological



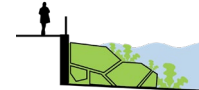
Ecological Marine Structures



Ecological Features



Aquatic Habitat



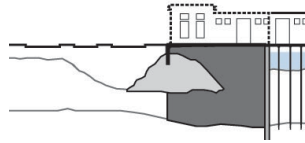
Ecological Shorelines

EMBARCADERO SEAWALL SEISMIC MEASURES

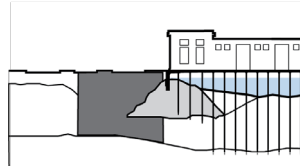
Draft seismic improvements under consideration by the Port

Seismic Measures

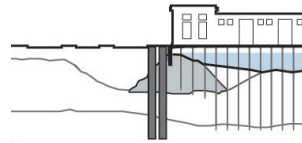
Shoreline
Stabilization



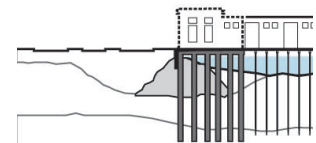
Nearshore
Buttress



Landside
Buttress

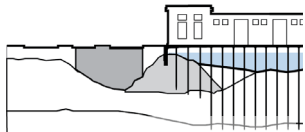


Drilled Shafts

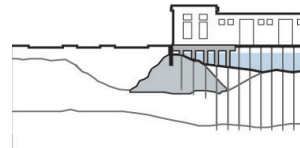


Super Bulkhead
Wharf

Targeted
Measures



Liquefaction
Mitigation



Bulkhead
Wharf Retrofits

For each seismic measure:

- Preliminary Engineering
- Cost Estimates
- Construction Production Rates
- Construction Impacts
- Feasibility
- Adaptation for Sea Level Rise

Focused Array Themes

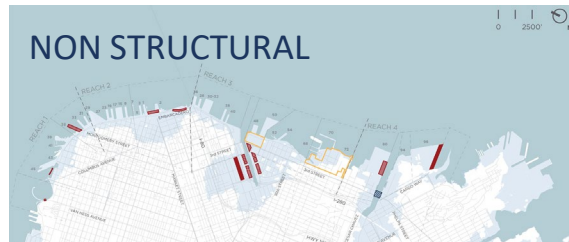
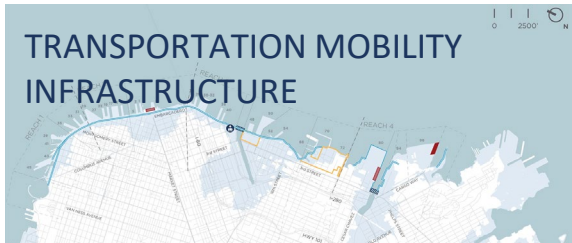
Key Findings from Themes



Waterfront Resilience Program

FOCUSED ARRAY THEMES

Introduction and Overview by Measure Classes



- A theme is a planning tool to spark brainstorming of alternatives
- A theme can serve as an alternative that addresses a set of specific issues and illuminate trade-offs
- Some themes work better in certain locations and not as well or at all in other locations
- Themes may include ideas that also address issues from other themes

OVERALL KEY FINDINGS FROM FOCUSED ARRAY DEVELOPMENT



PIERS

The piers are not likely to be included in the federal interest because the NED cost benefit ratio for most of these assets will likely not meet required thresholds



CREEK CONSIDERATIONS

The approaches for flood risk reduction at the creeks are very challenging due to combined flood risk and the presence of low-lying bridges



NON-STRUCTURAL MEASURES

USACE policy requires the consideration of non-structural measures, such as relocation, waterproofing, ring walls and structure elevation increases for assets, and local policies and zoning

OVERALL KEY FINDINGS FROM FOCUSED ARRAY DEVELOPMENT



ECOLOGICAL ENHANCEMENTS

Ecological enhancements to structural measures are broadly applicable throughout the waterfront



ADAPTATION ZONE

In many areas of the waterfront, there is a narrow space within which to place flood measures, requiring work in the road or the Bay or both



LEVEL OF FLOOD PROTECTION

The Port, City and USACE need to establish a desired level of flood protection to further inform the Flood Resiliency Study

OVERALL KEY FINDINGS FROM FOCUSED ARRAY DEVELOPMENT



INTEGRATED ALTERNATIVES

An integrated alternatives process that combines both seismic and flood risk measures is critical for most of the San Francisco Waterfront



INTERAGENCY COORDINATION

A significant amount of the flood risk is inland of the Port's jurisdiction and engagement and partnership with City departments has been and will remain critical

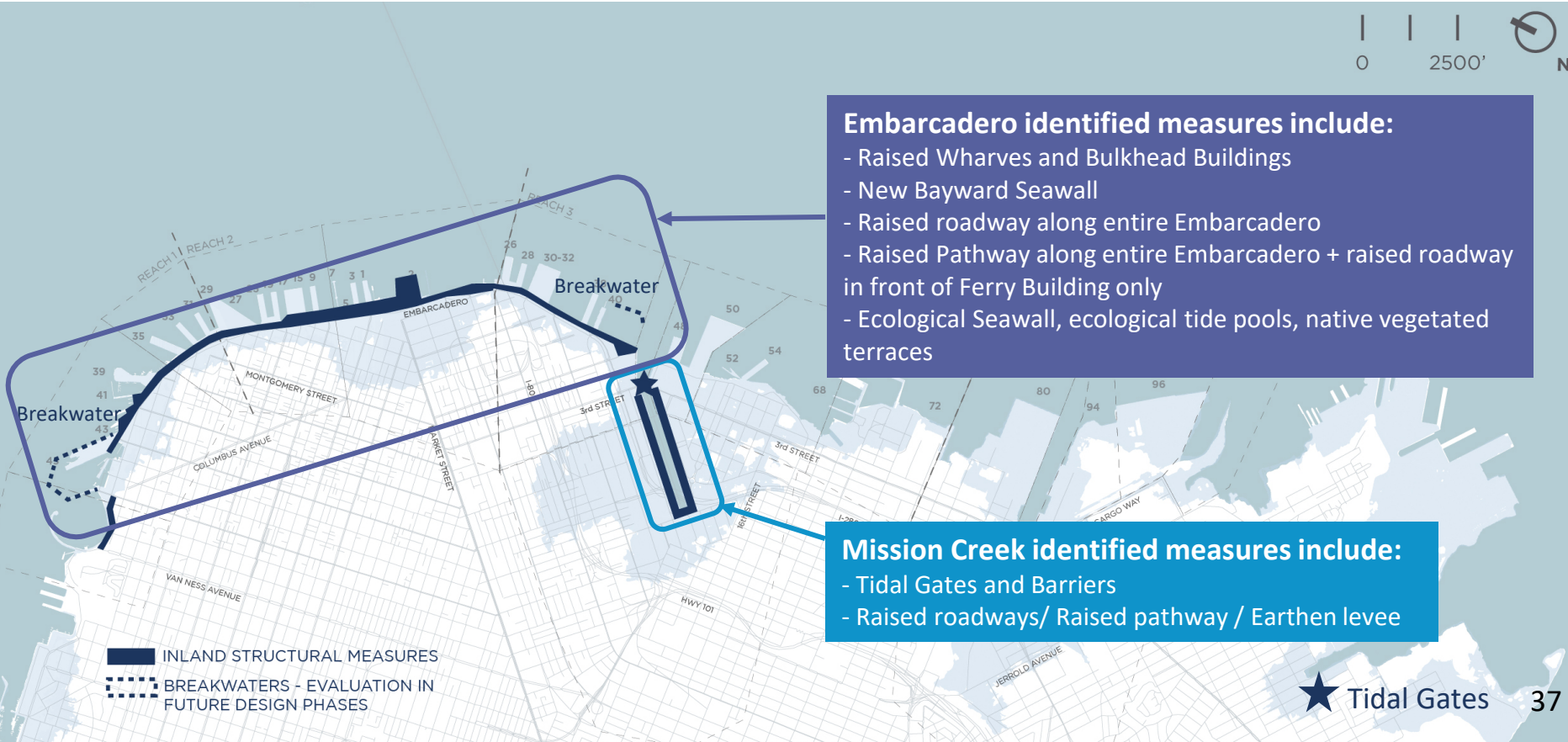


CONSTRUCTION CONSIDERATIONS

Many of the flood risk reduction approaches will require large construction areas and at least temporary disruption

MEASURES KEY FINDINGS

Structural Measures / Northern Waterfront



Embarcadero identified measures include:

- Raised Wharves and Bulkhead Buildings
- New Bayward Seawall
- Raised roadway along entire Embarcadero
- Raised Pathway along entire Embarcadero + raised roadway in front of Ferry Building only
- Ecological Seawall, ecological tide pools, native vegetated terraces

Mission Creek identified measures include:

- Tidal Gates and Barriers
- Raised roadways/ Raised pathway / Earthen levee

- INLAND STRUCTURAL MEASURES
- BREAKWATERS - EVALUATION IN FUTURE DESIGN PHASES

MEASURES KEY FINDINGS

Structural Measures / Southern Waterfront



Mission Bay identified measures include:

- Levee with revetment
- Raised pathway / Raised features
- Native, Vegetated Terraces

Islais Creek identified measures include:

- Tidal gates and barriers
- Raised bridges
- Raised pathways / Raised features

Piers 80/94/96 identified measures include:

- Raised features
- Raised wharves
- Ecological improvements

Pier 92 identified measures include:

- Raised pathway
- Raised features
- Earthen levees

- INLAND STRUCTURAL MEASURES
- BREAKWATERS - EVALUATION IN FUTURE DESIGN PHASES

MEASURES KEY FINDINGS

Non-Structural Measures



Considerations :

- Ground improvements may be required for future development and to maintain existing uses
- Piers may not be covered by federal interest / NED
- Zoning, raising structures, water-proofing and relocating assets and services
- Site specific measures at high consequence assets (Muni Portal, BART)



MEASURES KEY FINDINGS

Non-Structural Measures



Embarcadero policy considerations:

- Pier-specific strategies needed; piers may not be included in federal interest for an NED plan.
- Elevating structures (bulkhead buildings, Piers, Parks)
- Dry floodproofing (bulkhead buildings and piers)

Mission Creek and Pier

80 policy considerations:

- Structures elevation (Park in front of Oracle Park + Bridges across the creek)
- Dry floodproofing (Ground floors around Mission Creek + industrial buildings on Pier 80)
- Ground Improvement on bay-fill piers

Islais Creek policy considerations:

- Elevate Bridges across the creek
- Dry floodproofing Buildings around Islais Creek
- Ground Improvement on bay-fill piers



 POLICY CONSIDERATION, INCLUDING STRUCTURE RELOCATION AND REMOVAL

 Raised Bridges

MEASURES KEY FINDINGS

Ecological Measures / Northern Waterfront



Fisherman's Wharf

Ecological Measures:

- Vegetated Terraces at Pier 39
- Beach nourishment at Aquatic Park
- Ecological enhancement of the breakwater between Pier 45 and Pier 39

Embarcadero Ecological

Measures:

- Vegetated Terraces at Rincon Park
- Ecological enhancements of the seawall along the Embarcadero

Mission Creek Ecological Measures:

- Combination of vegetated terraces and stepped slopes around the creek

Structural Measures Ecological Enhancements:

- Tide pools units
- Textured concrete
- Shellfish reefs
- Vegetated revetments



MEASURES KEY FINDINGS

Ecological Measures / Southern Waterfront



Central Waterfront Ecological Measures:

- Combination of beaches and vegetated revetments bayward at Bayfront Park and Pier 70

Piers 80/94/96 Ecological Measures:

- Combination of stepped slopes and vegetated revetments softening the edges at Warm Water Cove, Pier 94 wetlands and Heron's Head.
- Ecological enhancements of Pier 80/94/96

Structural Measures

Ecological Enhancements:

- Tide pools units
- Textured concrete
- Shellfish reefs
- Vegetated revetments

Islais Creek Ecological Measures:

- Stepped slopes reshaping the geography of Islais Creek



TRENDS TO INFORM FINAL ARRAY



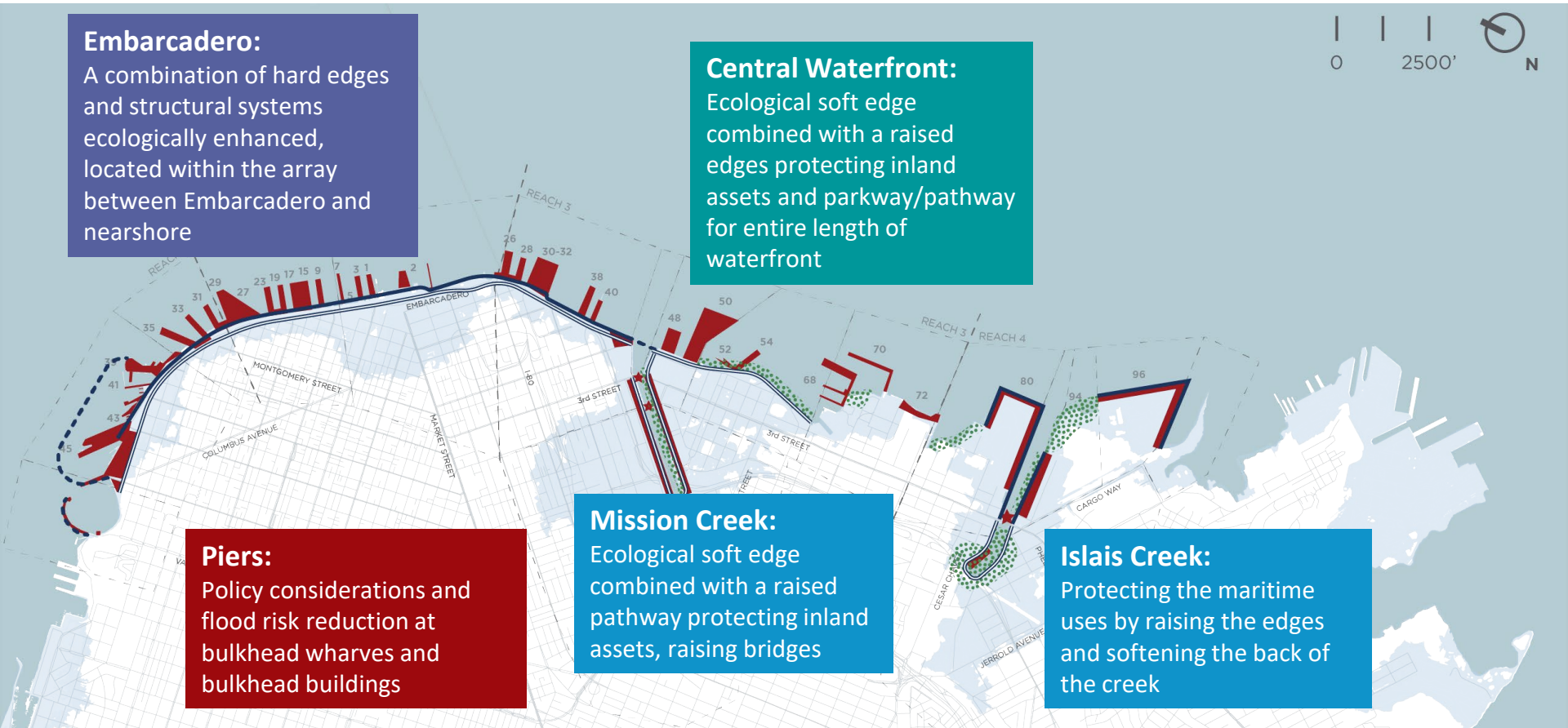
Embarcadero:
A combination of hard edges and structural systems ecologically enhanced, located within the array between Embarcadero and nearshore

Central Waterfront:
Ecological soft edge combined with a raised edges protecting inland assets and parkway/pathway for entire length of waterfront

Piers:
Policy considerations and flood risk reduction at bulkhead wharves and bulkhead buildings

Mission Creek:
Ecological soft edge combined with a raised pathway protecting inland assets, raising bridges

Islais Creek:
Protecting the maritime uses by raising the edges and softening the back of the creek



Key Considerations for Port Commission Input



KEY CONSIDERATIONS FOR PORT COMMISSION INPUT ON FOCUSED ARRAY

Historic Piers



- If successful, the Flood Resiliency Study will result in Federal funding for a coastal flood protection project to protect San Francisco from flooding and sea level rise, subject to a benefit cost ratio that determines a Federal Interest
- **As Port staff who are participating in the PDT advance this analysis with USACE, are there any objectives and guidance from the Port Commission we should consider in relation to historic piers?**
- There remain other investment strategies – including pier rehabilitation and floodproofing individual piers – that can allow the piers to function through much of this century

KEY CONSIDERATIONS FOR PORT COMMISSION INPUT ON FOCUSED ARRAY

Non-Structural Measures



- In addition to evaluation of structural and ecological measures, USACE requires that alternatives include policy measures, such as building code requirements to flood proof or elevate buildings in a flood plain, building or asset relocations, and coastal setback limits
- As the PDT advances the analysis of non-structural measures, are there any objectives and guidance from the Port Commission that the team should consider?
- For instance, in addition to core maritime functions that must remain at the water's edge, are there other specific functions that cannot be moved upland?

KEY CONSIDERATIONS FOR PORT COMMISSION INPUT ON FOCUSED ARRAY

Ecological Measures and Enhancements



- While parts of the Port's waterfront are human-made and include steep and often vertical slopes, the Resilience team has identified that are potential ecological enhancements that can improve Bay habitat along most of the Port's waterfront
- We are pursuing a pilot called the Ecological Seawall Pilot Project to test this approach
- **Is ecological enhancement along the Seawall and in the creeks an important value to the Port Commission?**

KEY CONSIDERATIONS FOR PORT COMMISSION INPUT ON FOCUSED ARRAY

Seismic and Flood Protection



- Staff has been operating on the assumption that it is better to build projects that increase seismic safety and provide future flood protection, wherever possible or having the seismic safety alternatives serve as a foundation for future actions to reduce future flood risk
- **Port staff will also be evaluating this objective as we develop Proposition A project alternatives for Commission consideration early next year**
- **When staff presents Proposition A alternatives, we will share any tradeoffs associated with this approach compared with options that focus primarily on seismic safety**

Next Steps



NEXT STEPS



Finalize Future Without Project analysis and policy compliance reviews



Continue iterative alternatives development and evaluation, informed by technical studies and stakeholder input



Refine and revise POOCCs based on input received from Port Commission and stakeholders



Commission engagement through a series of meetings in January, February, and March to gain strategic direction



Ongoing community and stakeholder engagement

A photograph of two children riding bicycles on a dirt path. The child in the foreground is wearing a red and white jersey and a yellow helmet. The child in the background is wearing a dark jersey with 'CERRY 30' on the back and a dark helmet. They are riding away from the camera towards a body of water under a clear blue sky. There are some trees and a signpost on the right side of the path.

Thank You!

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