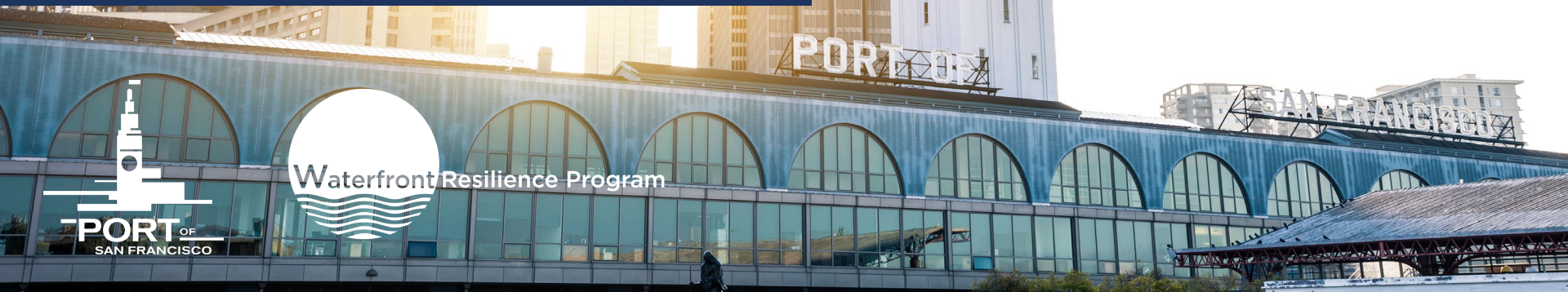




# DRAFT WATERFRONT ADAPTATION STRATEGIES

Mission Bay Citizens Advisory Committee Meeting

December 8, 2022





# TODAY'S AGENDA

## Presentation Overview

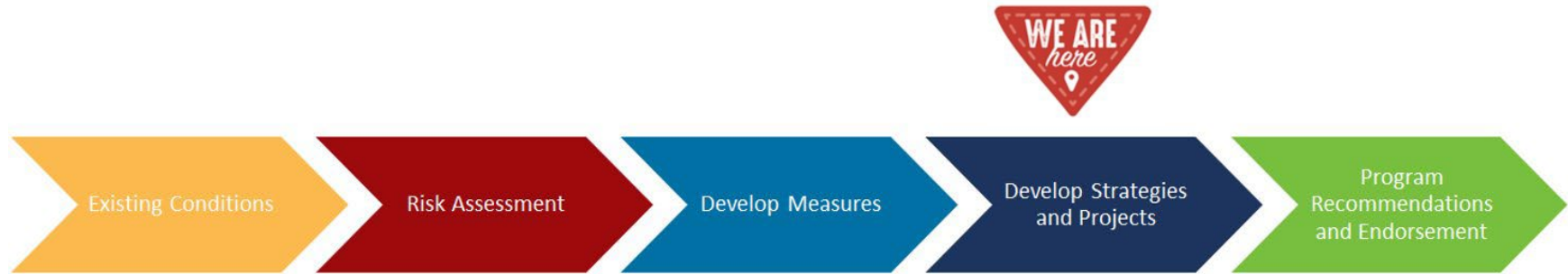


- Understanding the Risks
  - *What we're facing*
- Waterfront Resilience Program
  - *What we're doing*
- Community Priorities
  - *What we've heard*
- Range of Possibilities
  - *What we're considering*
- Draft Waterfront Adaptation Strategies in Mission Creek / Mission Bay
- Next Steps
- Q&A



# DRAFT WATERFRONT ADAPTATION STRATEGIES

## Presentation Overview



The Port of San Francisco has developed seven high-level Draft Waterfront Adaptation Strategies through a collaborative interagency process and over five years of public engagement.

The draft Strategies are ready for public feedback, with a goal of reaching a Draft Waterfront Adaptation Plan by Summer 2023.

# DRAFT WATERFRONT ADAPTATION STRATEGIES

Port-led, City of San Francisco Agencies, and USACE Partnered in Development Process





# Understanding the Risks *What We're Facing*



Waterfront Resilience Program

# CLIMATE CHANGE HAS GLOBAL IMPACTS

Including Here In San Francisco



## San Francisco Chronicle

S.F.'s Embarcadero needs to be raised as much as 7 feet to prepare for sea level rise, city says

John King  
Nov. 3, 2021 | Updated: Nov. 1, 2023 6:20 p.m.



A car drives through floodwaters caused by large waves crashing into Pier 14 along the Embarcadero in San Francisco in 2018. The Port of San Francisco has obtained a court restraining order suggesting parts of the area need to be raised seven feet to avoid future flooding.



# RIISING TO THE CHALLENGE

San Francisco Faces Urgent Seismic, Coastal, and Inland Flood Risks Today

## SEISMIC RISKS



San Francisco, 1906



Marina, 1989

## COASTAL FLOODING



Recology



The Embarcadero

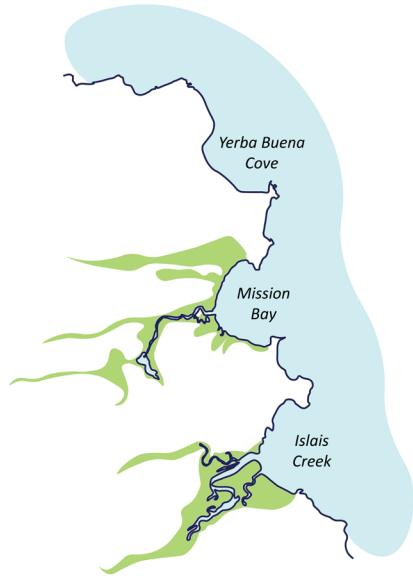
## INLAND FLOODING



Islais Creek outfall and Marin St.

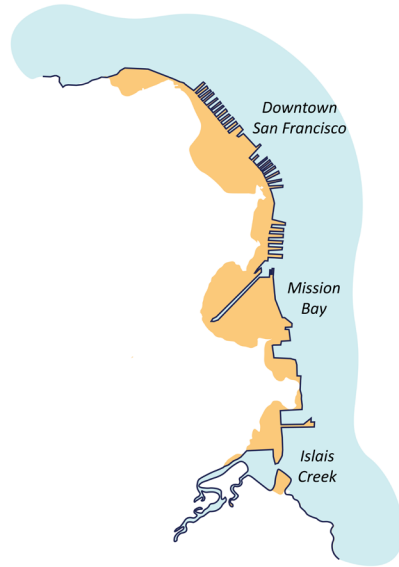
# HISTORIC SHORELINE + BAY FILL

From the 1800s



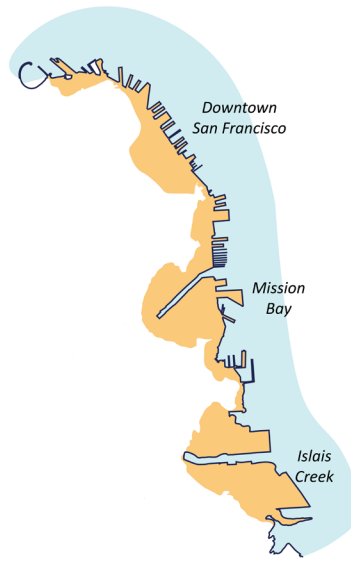
~1800

Pre-Bay Fill Shoreline



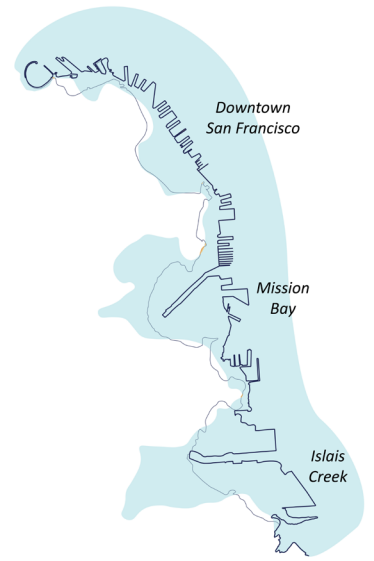
~1900

Downtown and Mission  
Creek Bay Fill



~2000

Islais Creek Bay Fill



~2100

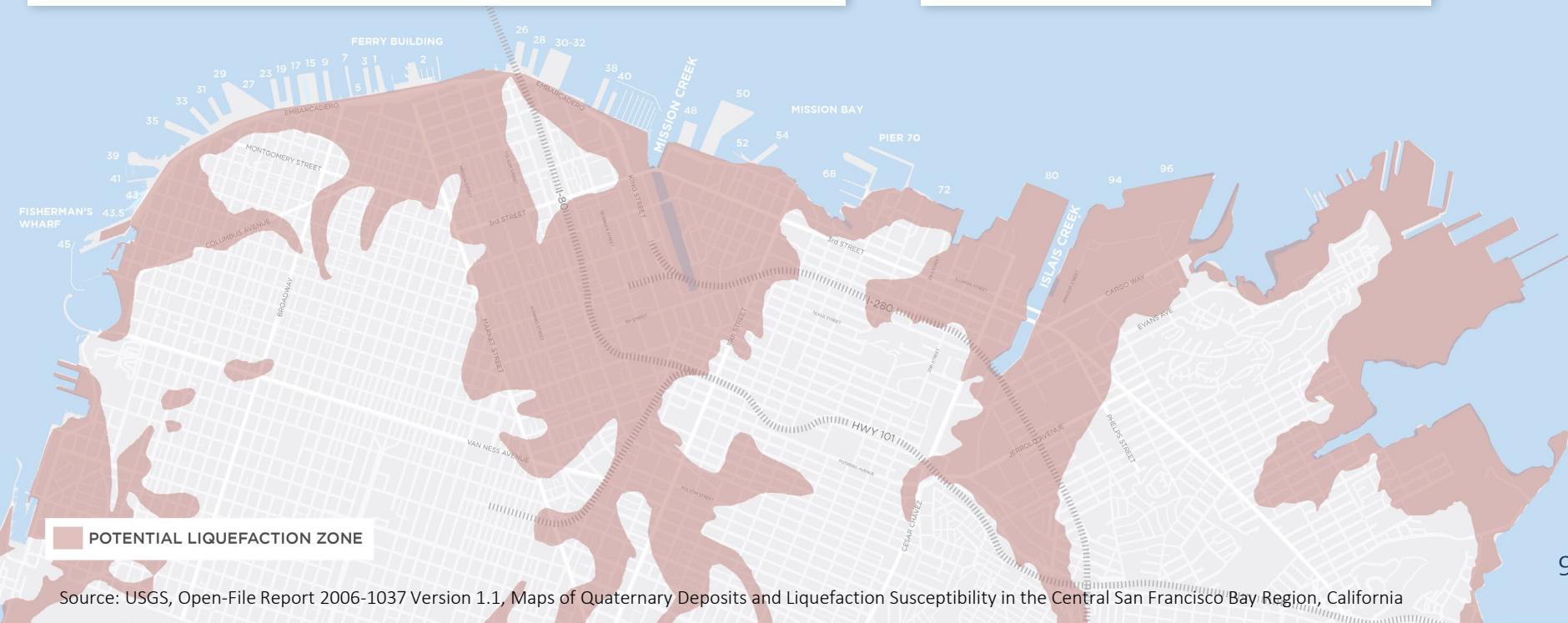
No Action: 7' of SLR +  
100-yr Flood

# WATERFRONT WIDE EARTHQUAKE HAZARDS

## Very High Earthquake “Liquefaction” Risk

Liquefaction occurs when water-saturated sediment (like sand) temporarily loses strength and acts as a fluid

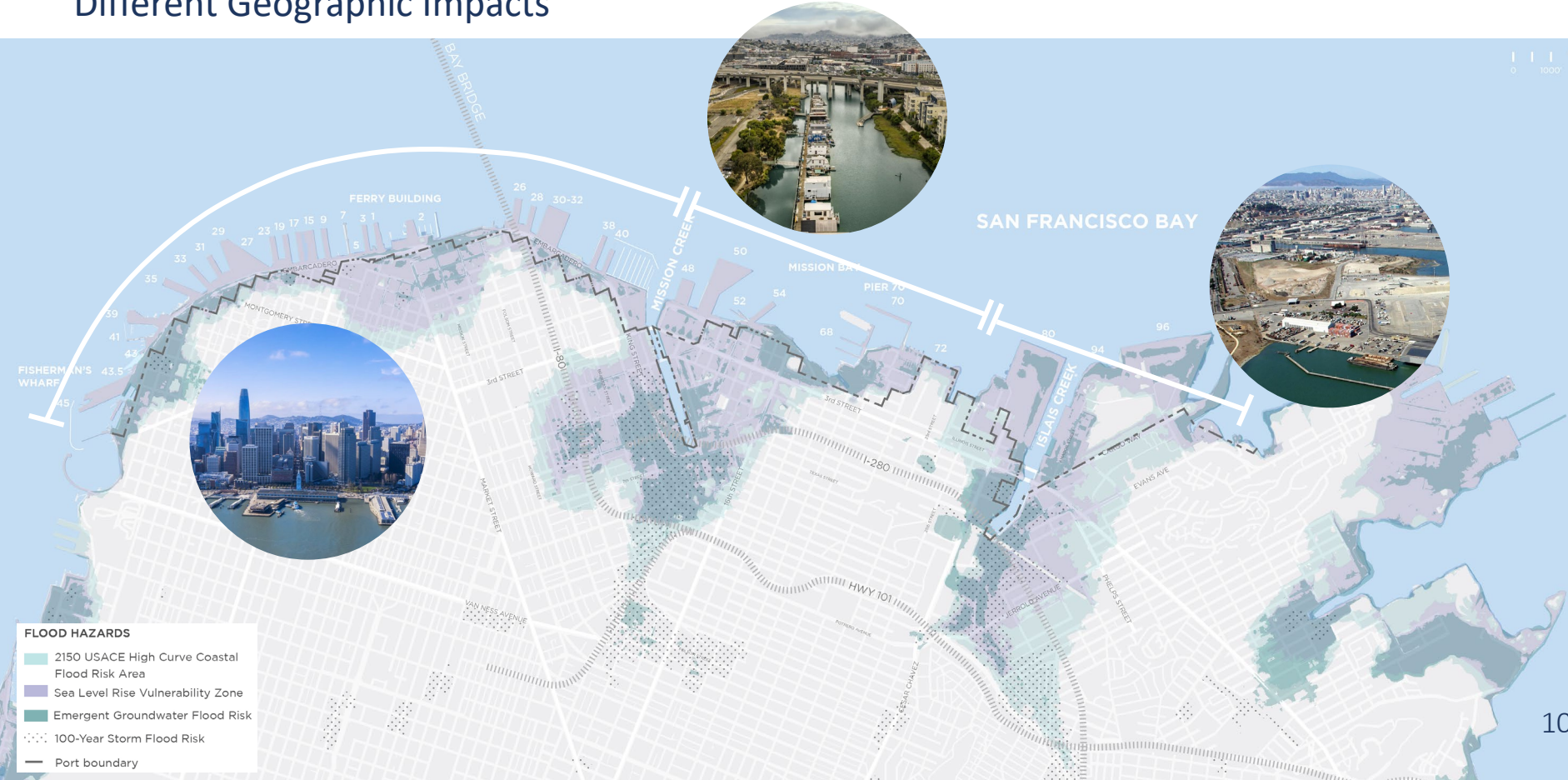
Various levels of lateral spreading risk along the shoreline



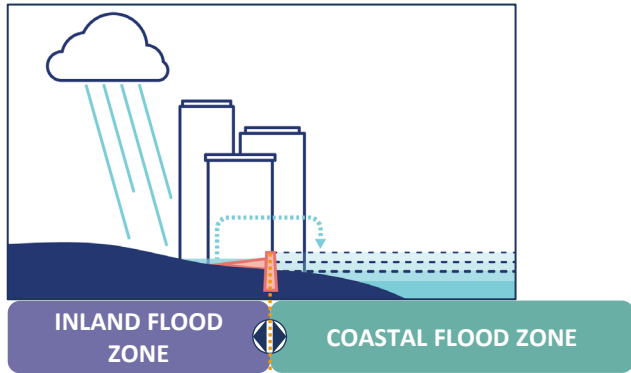
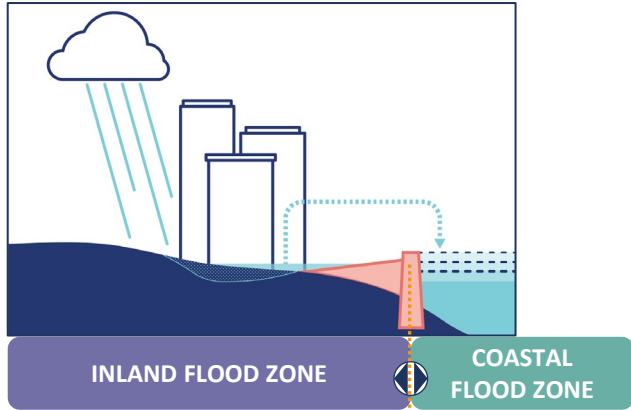


# COASTAL AND INLAND FLOOD RISK

## Different Geographic Impacts



# COASTAL AND INLAND FLOOD RISK



Any solution endorsed by the City of San Francisco will aim to address **all three risks**: seismic risks, coastal flooding and inland flooding.

Two related forms of flooding



# Waterfront Resilience Program

## *What We're Doing*

LADY FISH  
SAN FRANCISCO, CA

BESHA II  
SAN FRANCISCO

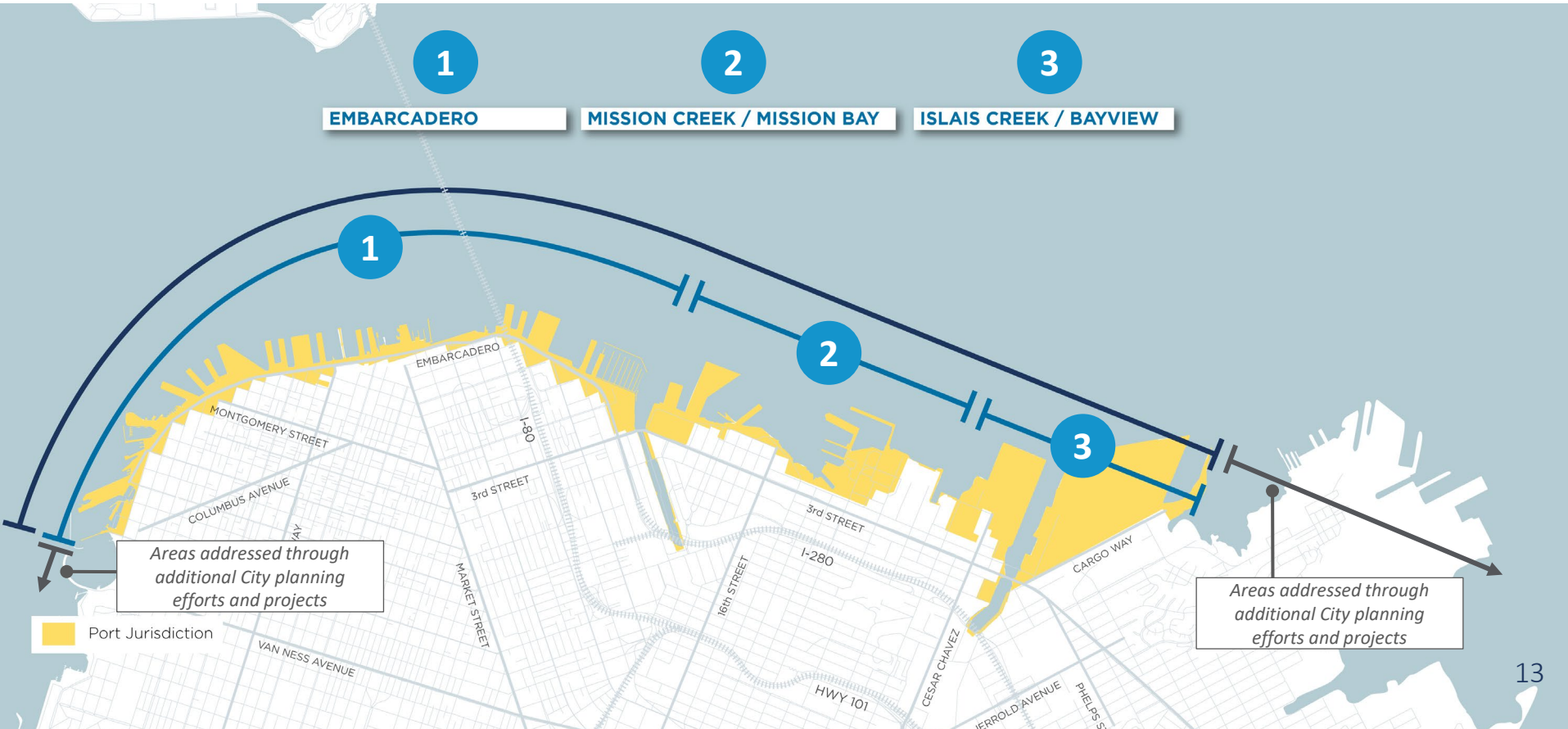
Waterfront Resilience Program





# PROGRAM AREA

Focus is Conceptual-Level Strategies Within the Port's Jurisdiction





# Community Priorities

## *What We've Heard*





# DRAFT WATERFRONT ADAPTATION STRATEGIES

Community Input Helped Define the WRP

1

Focus on life safety & emergency response

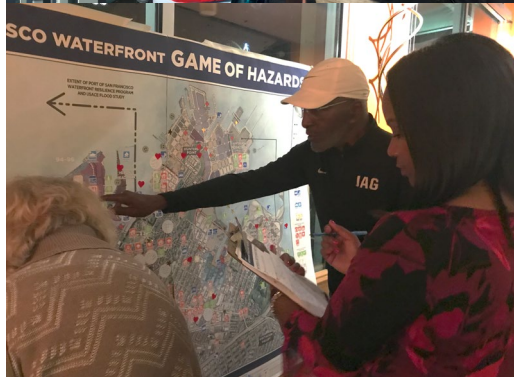
2

Prioritize assets most loved by the community and most important to the city

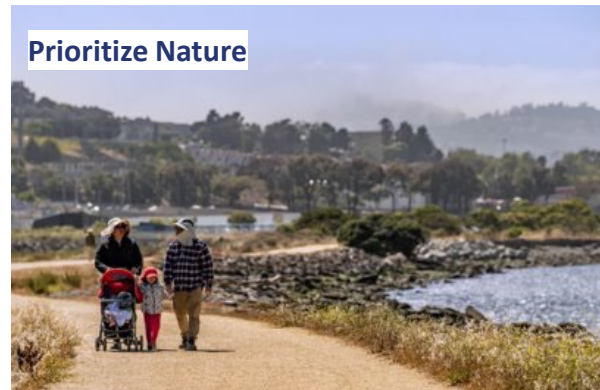
3

Put people first

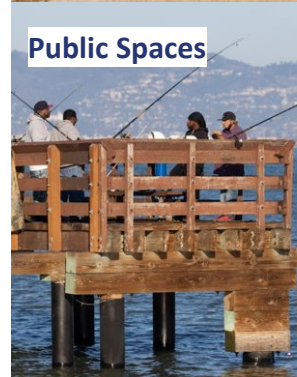
Assets and services most prioritized: housing, disaster recovery facilities, utilities, transportation and businesses



Prioritize Nature



Public Spaces



Equity



# WHAT WE HEARD

## Spotlight on the Mission Creek / Mission Bay Waterfront



- Key community-prioritized assets include: the Giants ballpark, water and public space access, the environment
- We heard the importance of prioritizing homes, including low-income housing
- Environmental issues were highlighted, including Mission Creek as an ecological and open space asset
- We also heard how vital it is to reach youth via our public engagement effort

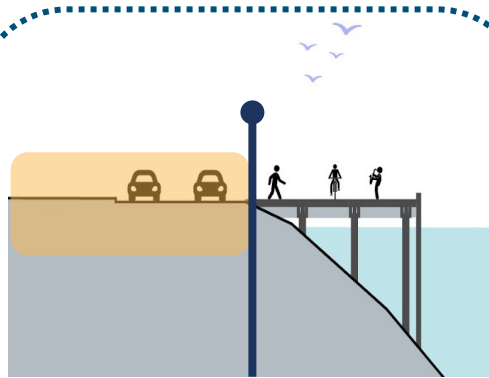




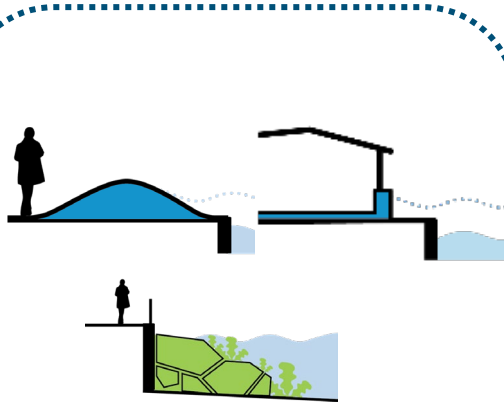
Range of Possible Solutions  
*What We're Considering*

# DRAFT WATERFRONT ADAPTATION STRATEGIES

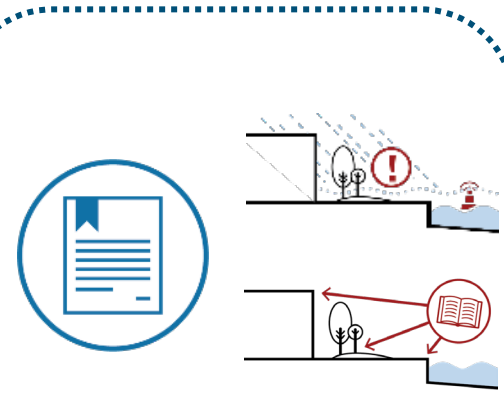
## Key Components



**Coastal Flood Defense  
Location + Height**  
*And area of elevation  
change*



**Physical Changes**  
*Such as earthquake-  
resilient berms,  
floodproofing, and  
nature-based features*



**Policy Changes**  
*Such as resilient codes,  
warning systems, and land  
use changes*



# USACE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY

## Draft Waterfront Adaptation Strategies

***What if...***  
we **did not adapt**  
to mitigate the  
risks?

STRATEGY A

***What if...***  
we adapted by  
**floodproofing**  
and **moving**  
buildings and assets,  
*without* coastal flood  
structures?

STRATEGY B

***What if...***  
we address flooding  
at a **lower rate** of  
sea level rise?

STRATEGY C

STRATEGY D

***What if...***  
we address flooding  
at a **higher rate** of  
sea level rise,  
as recommended by  
**CA and SF guidance?**

STRATEGY E

STRATEGY F

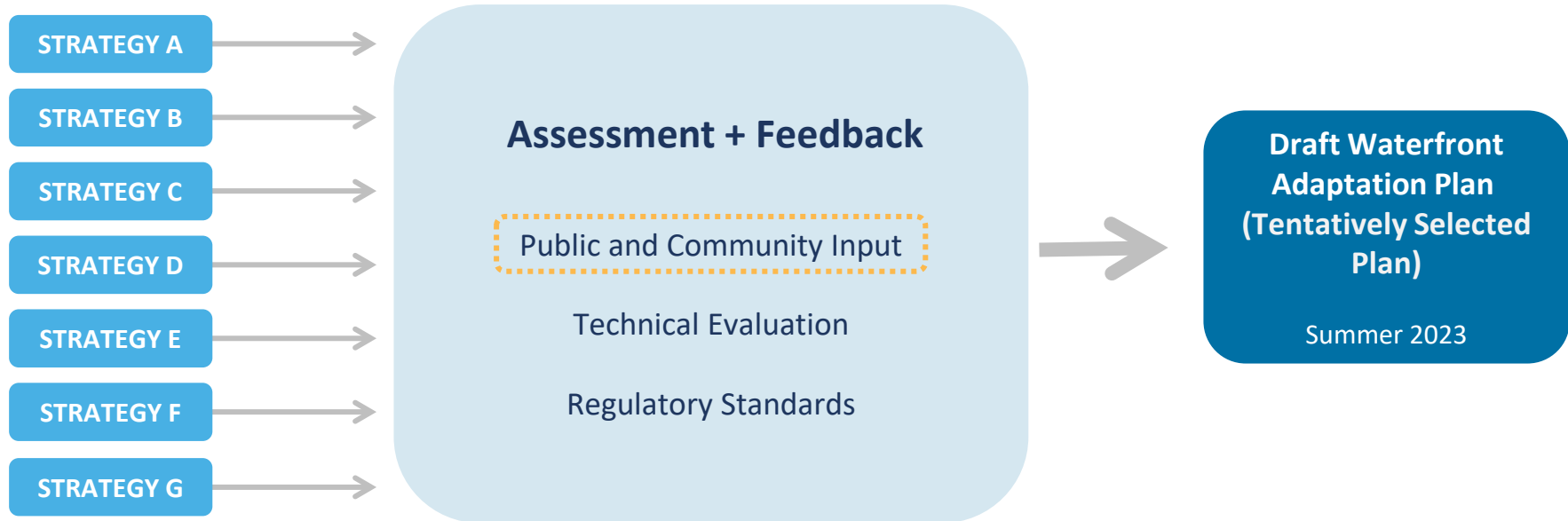
STRATEGY G

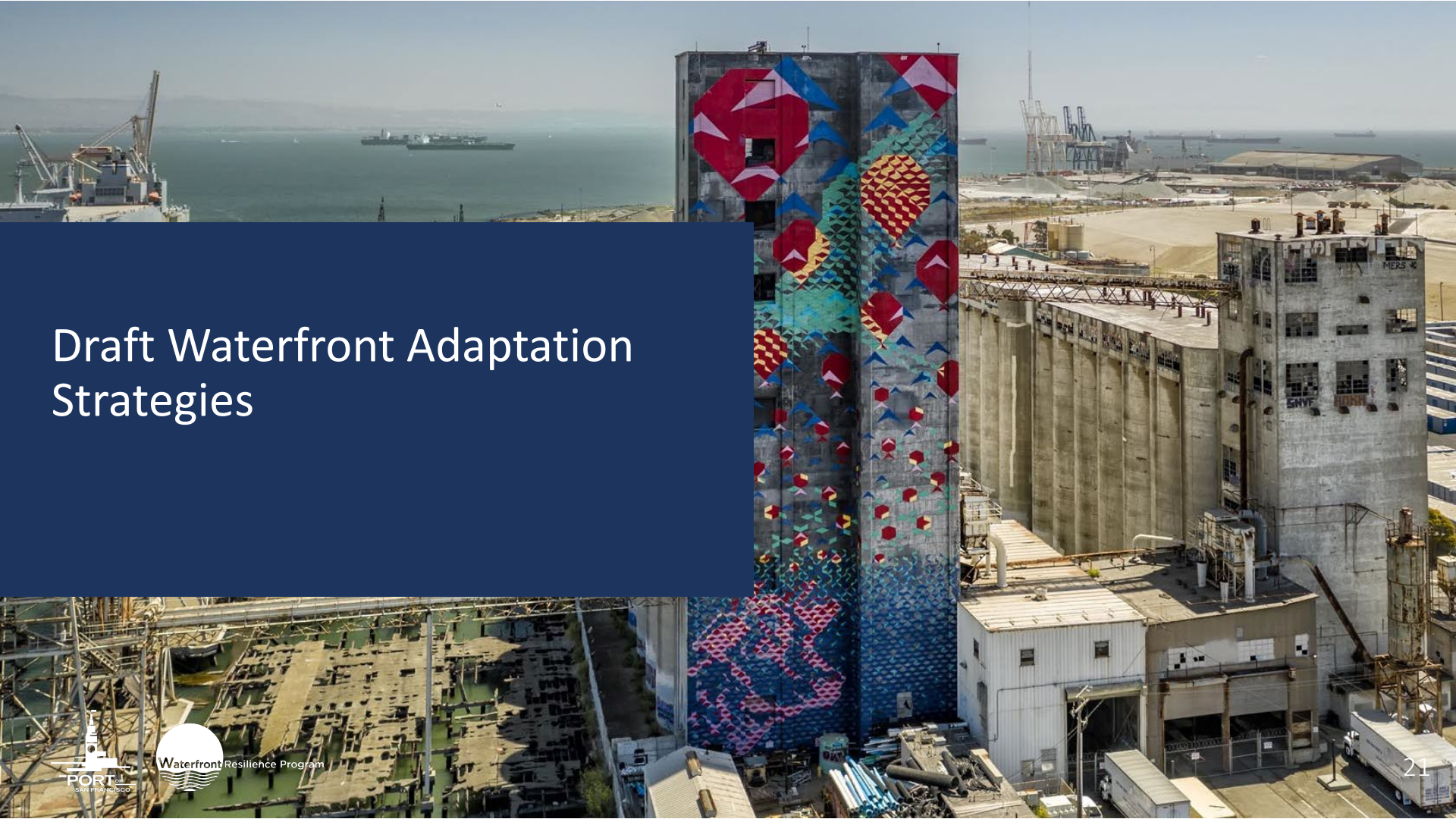




# THE ROLE OF COMMUNITY FEEDBACK

## Pathway to the Draft Waterfront Adaptation Plan





# Draft Waterfront Adaptation Strategies



# SEA LEVEL RISE



**2090**

*Long Term  
Adaptation*

**2040**

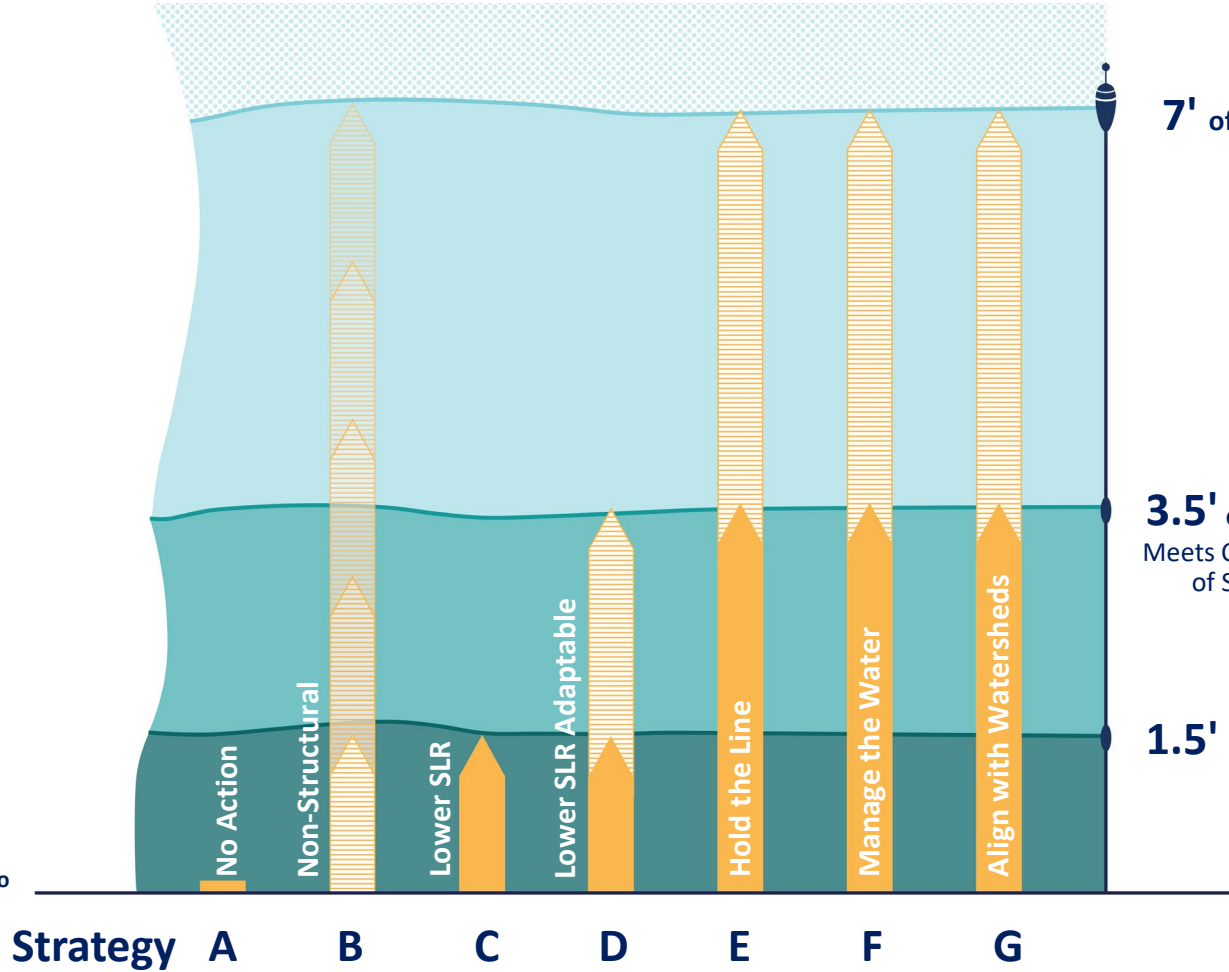
*Mid Term  
Adaptation*

**7'** of sea level rise

**3.5'** of sea level rise  
Meets CA State and City  
of SF Guidance

**1.5'** of sea level rise

 Adaptable to  
 Initially built to

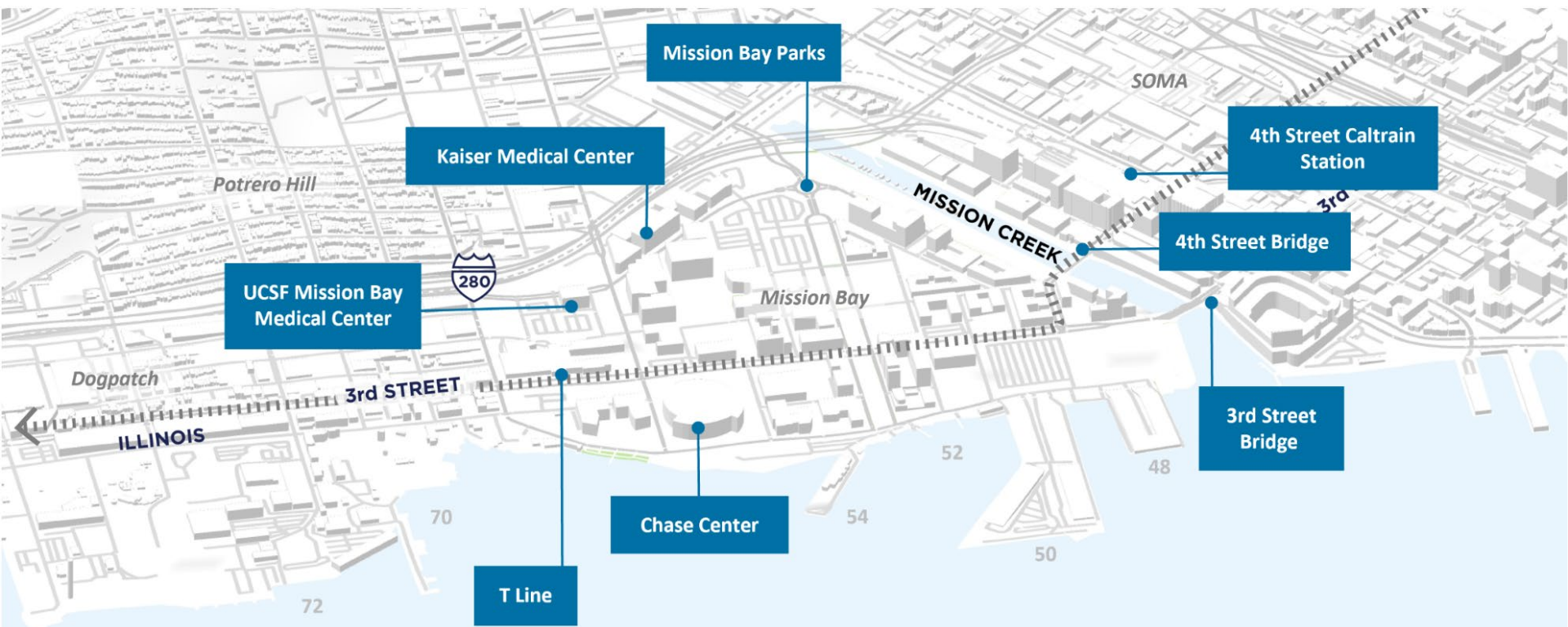


**TODAY**  
*Early Projects*

**Strategy A B C D E F G**

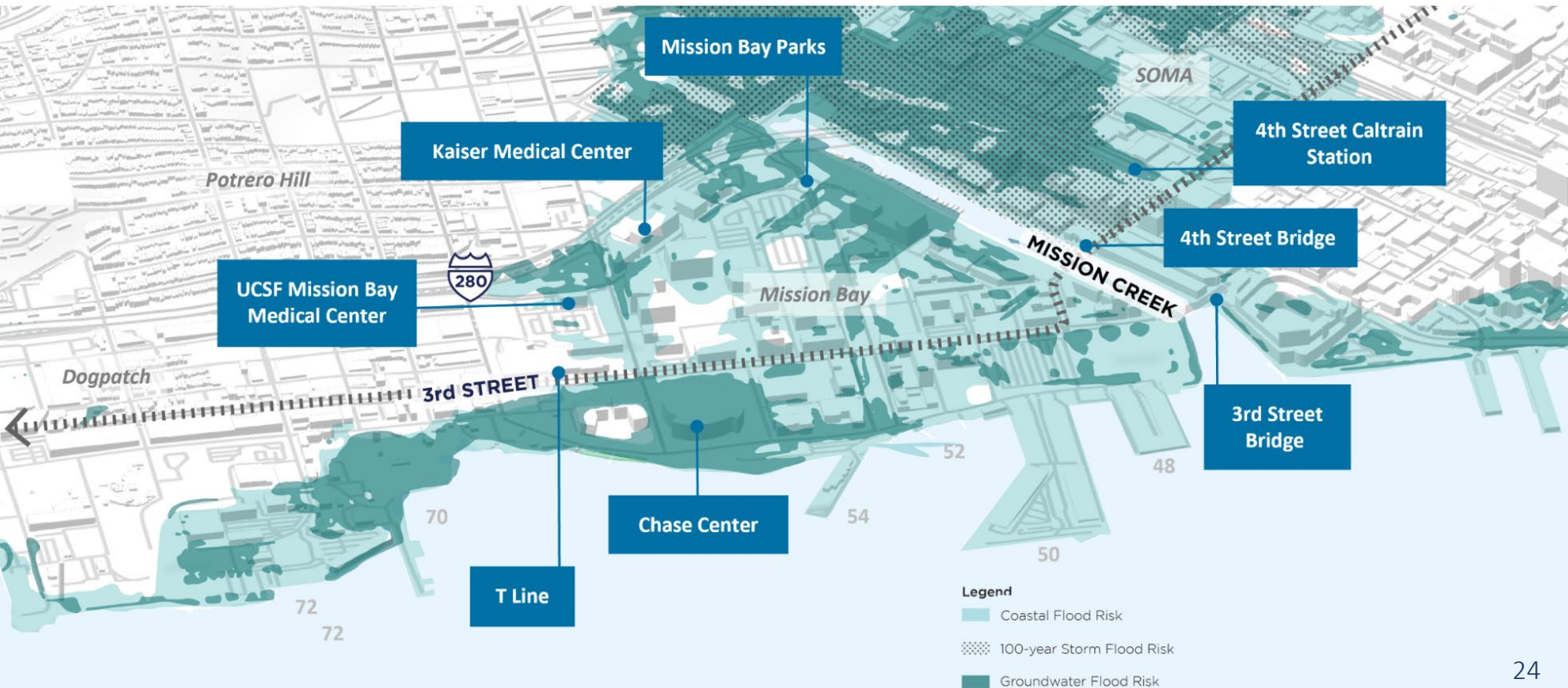


# MISSION CREEK / MISSION BAY





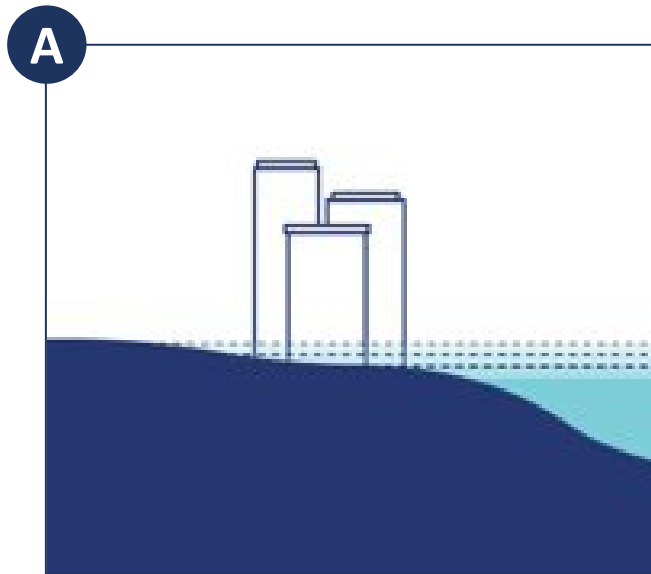
# MISSION CREEK / MISSION BAY







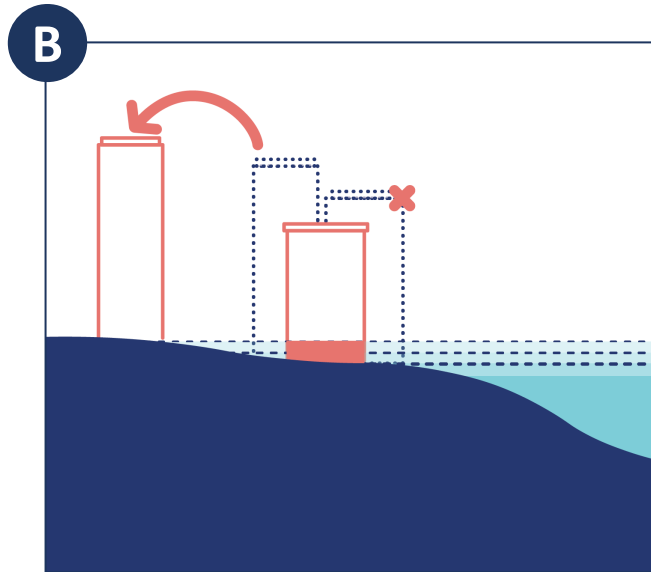
# STRATEGY A – NO ACTION



**This strategy takes no actions to reduce flood risks beyond projects that are already approved**



## STRATEGY B – NONSTRUCTURAL OPTION

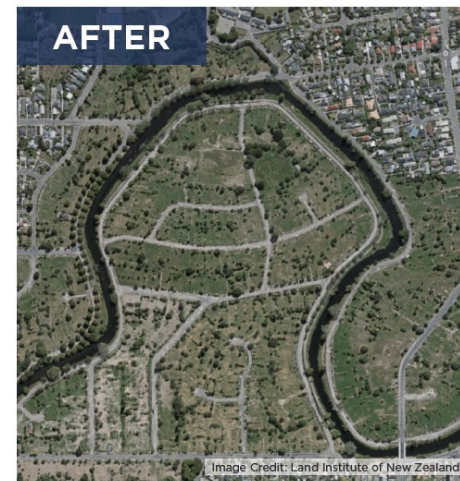
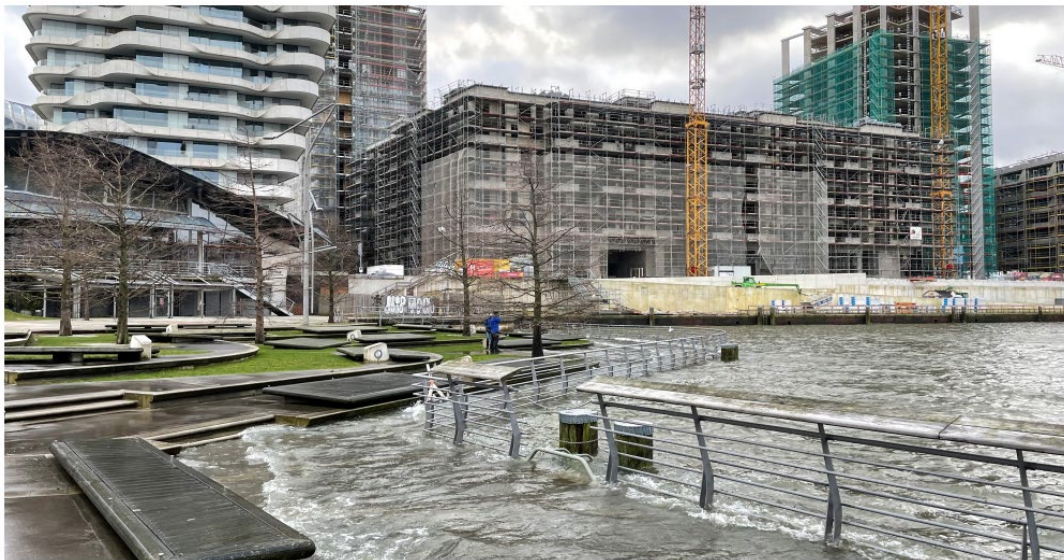


**Moves people and assets away from the risk, uses nonstructural measures (such as floodproofing) to reduce risks, and allows water to go where it wants rather than constructing traditional structural solutions**

# STRATEGY B – NONSTRUCTURAL OPTION

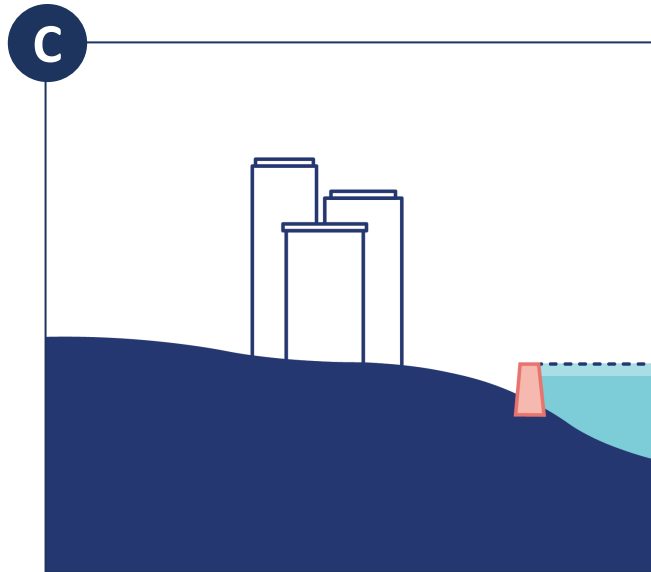
## Examples

- Floodproofing
- Raising structure in place
- Floodable spaces
- Buyouts
- Warning systems





## STRATEGY C – LOWER SEA LEVEL RISE



**Adapts the shoreline to withstand 1.5' of sea level rise by 2040 using a combination of structural and nonstructural measures**

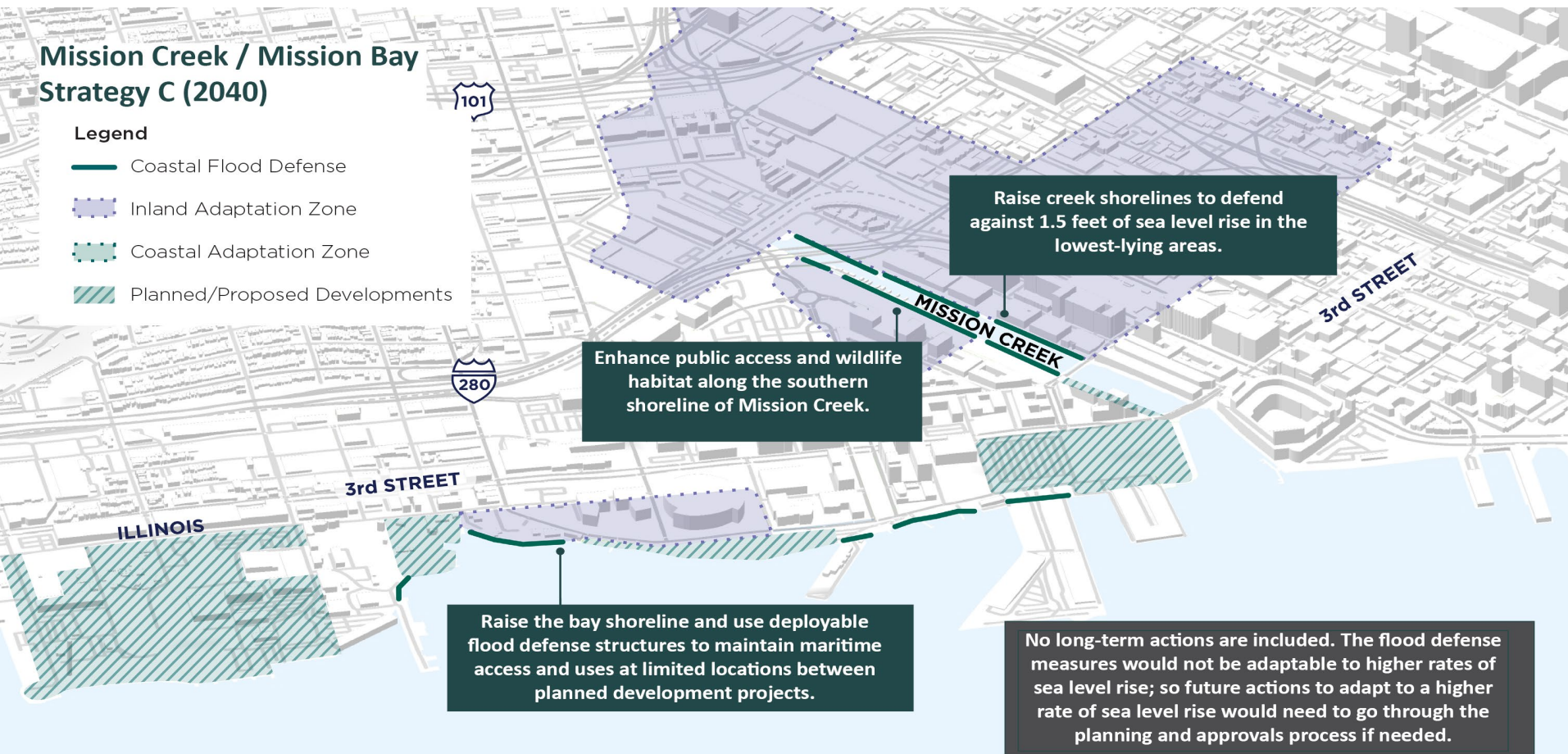


# STRATEGY C – LOWER SEA LEVEL RISE

## Mission Creek / Mission Bay Strategy C (2040)

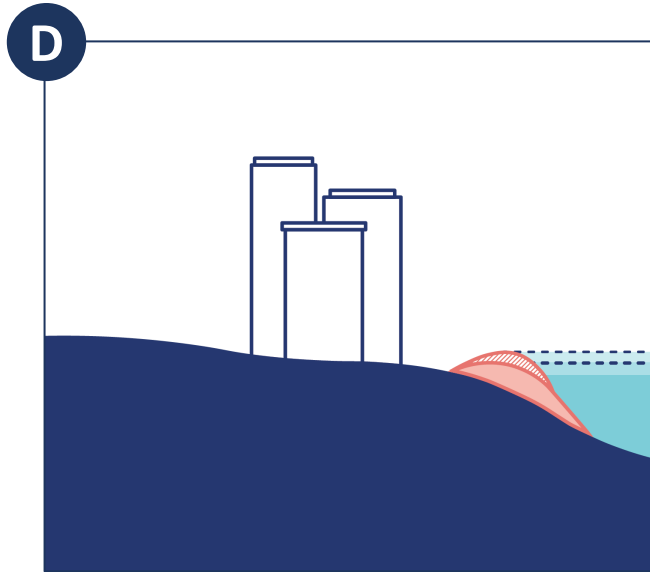
### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- Planned/Proposed Developments





## STRATEGY D – LOWER SEA LEVEL RISE – ADAPTABLE



**Adapts the shoreline to withstand 1.5' of sea level rise by 2040, with the possibility of building higher by 2090**

# STRATEGY D – LOWER SEA LEVEL RISE – ADAPTABLE

## Mission Creek / Mission Bay Strategy D (2090)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- Planned/Proposed Developments



In the long term, 2090 and beyond, implementation of Strategy D in Mission Creek / Mission Bay, would raise the shoreline protections to defend against up to 3.5 feet of sea level rise.

NOTE: ALL DRAWINGS FOR FEASIBILITY STUDY ONLY. NOT A PROPOSED DESIGN.





# USACE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY

Focused on Strategies E, F, and G

***What if...***  
we **did not adapt**  
to mitigate the  
risks?

STRATEGY A

***What if...***  
we adapted by  
**floodproofing**  
and **moving**  
buildings and assets,  
*without* coastal flood  
structures?

STRATEGY B

***What if...***  
we address flooding  
at a **lower rate** of  
sea level rise?

STRATEGY C

STRATEGY D

***What if...***  
we address flooding  
at a **higher rate** of  
sea level rise,  
as recommended  
by **CA and SF**  
**guidance?**

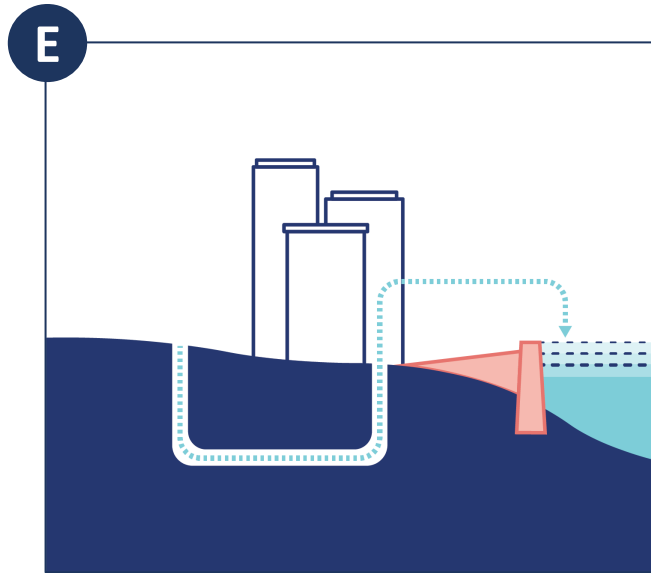
STRATEGY E

STRATEGY F

STRATEGY G



# STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE



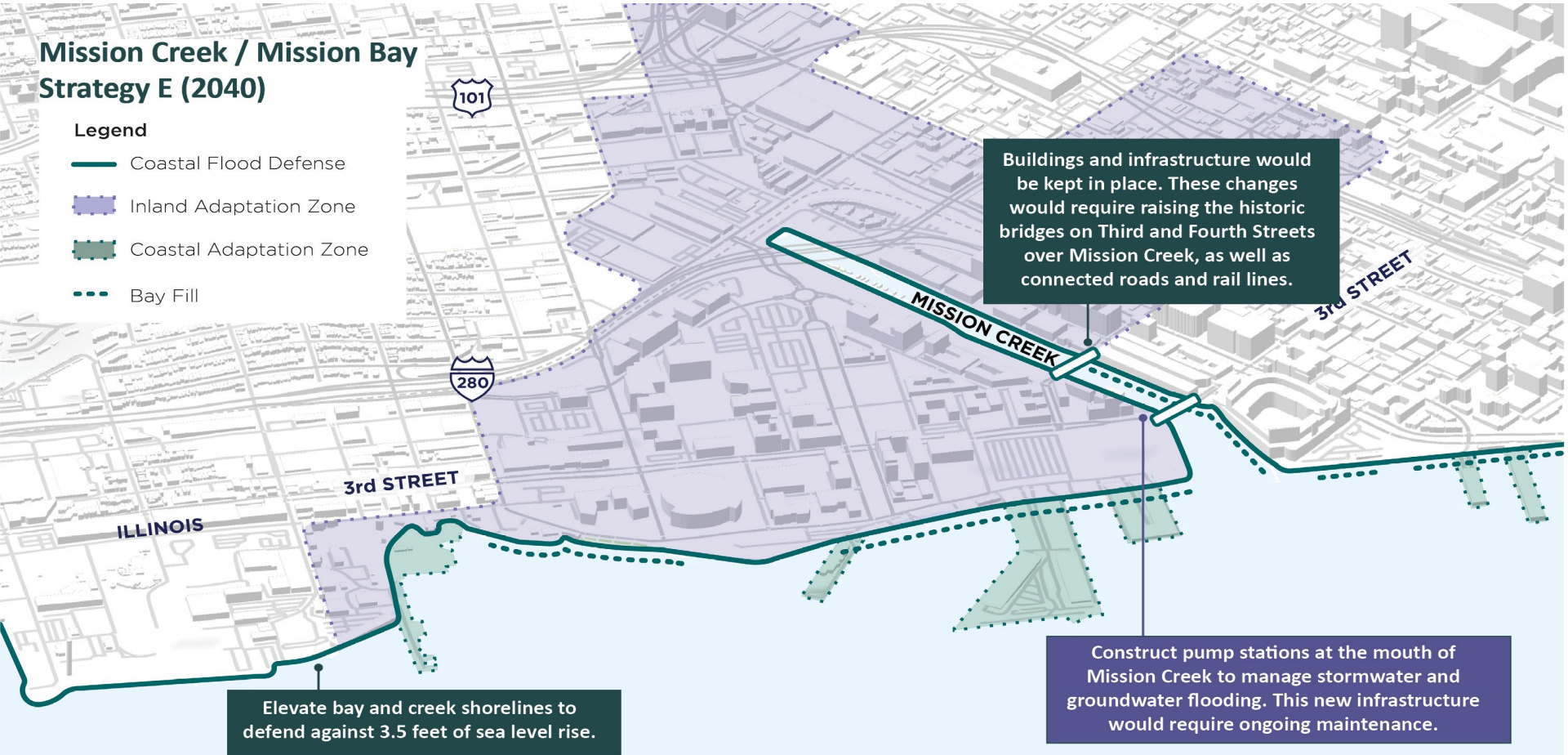
**Preserves a waterfront that looks and functions much as it does today by adapting the shoreline**

# STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

## Mission Creek / Mission Bay Strategy E (2040)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- Bay Fill





# STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

## Mission Creek / Mission Bay Strategy E (2040)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- ⋯ Bay Fill



Buildings and infrastructure would be kept in place. These changes would be consistent with the historic



Elevate bay and creek shorelines to defend against 3.5 feet of sea level rise.

A pumping station is a facility, usually housed in a small building, that uses powerful pumps to move water over an elevated shoreline. Pump stations exist in the city today, but this strategy would require building new pump stations, requiring funding and land.

# STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

## Mission Creek / Mission Bay Strategy E (2090)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- Bay Fill





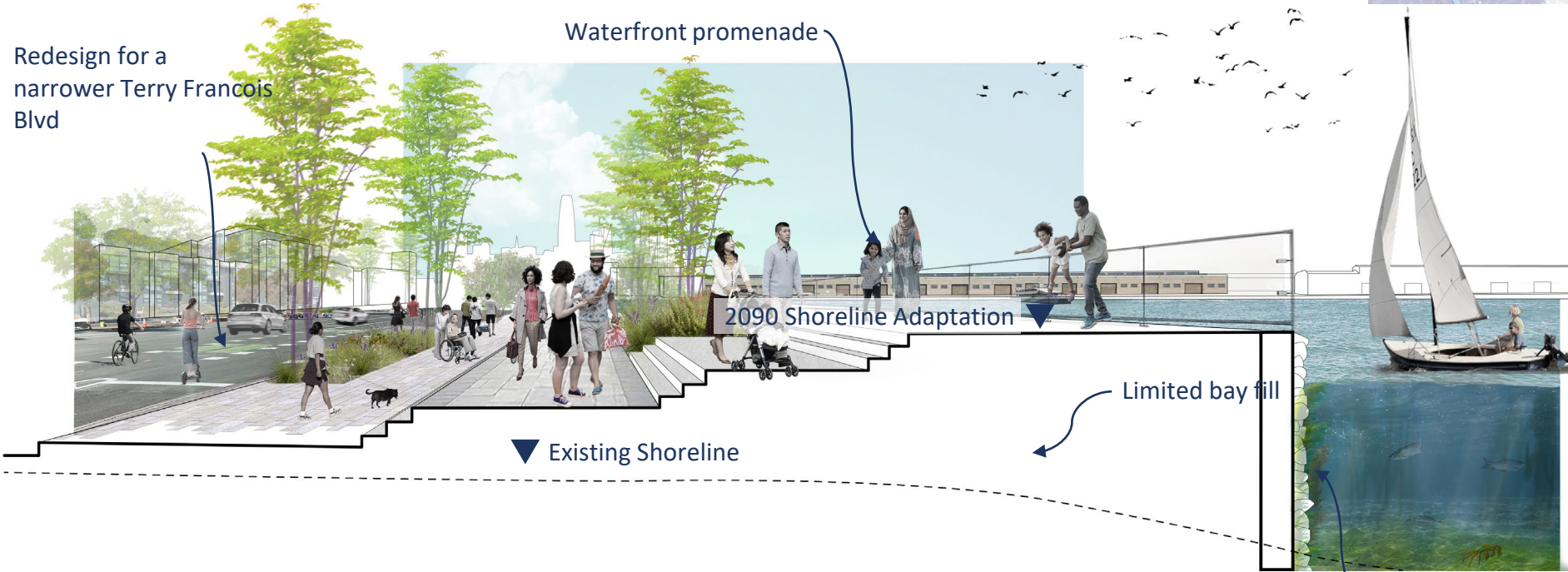
# STRATEGY E – HIGHER SEA LEVEL RISE – HOLD THE LINE

## Mission Creek / Mission Bay in 2090



Redesign for a narrower Terry Francois Blvd

Waterfront promenade



2090 Shoreline Adaptation

Existing Shoreline

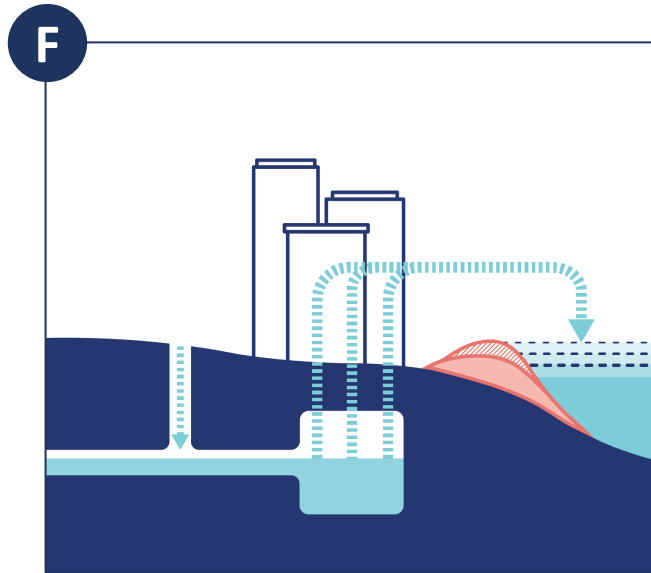
Limited bay fill

Eco seawall





# STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER



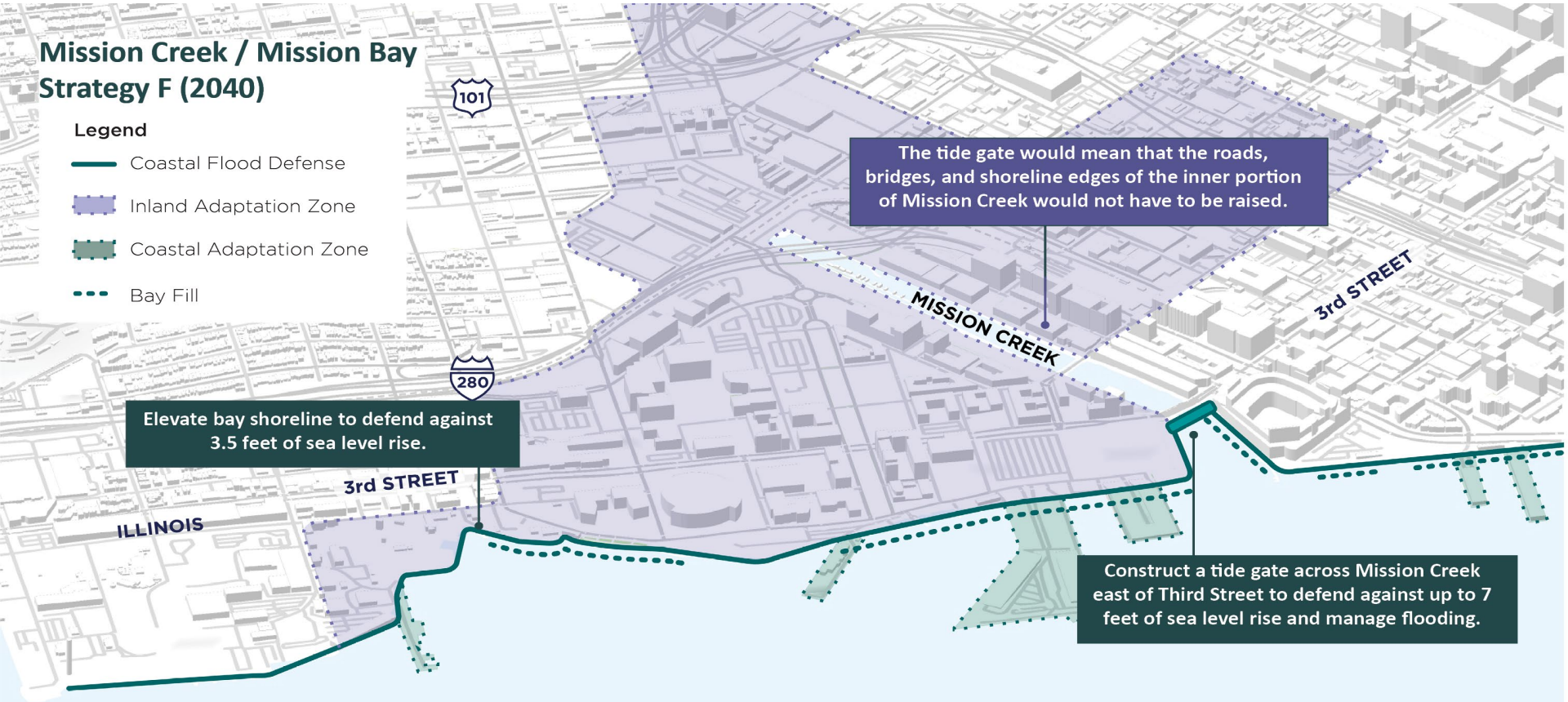
**Creates an active system for managing flooding by heavily relying on machinery**

# STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

## Mission Creek / Mission Bay Strategy F (2040)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- Bay Fill



Elevate bay shoreline to defend against 3.5 feet of sea level rise.

The tide gate would mean that the roads, bridges, and shoreline edges of the inner portion of Mission Creek would not have to be raised.

Construct a tide gate across Mission Creek east of Third Street to defend against up to 7 feet of sea level rise and manage flooding.

# STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

## Mission Creek / Mission Bay Strategy F (2040)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- Bay Fill

Elevate bay shoreline to defend against  
3.5 feet of sea level rise.

3rd STREET

ILLINOIS



A tide gate is a structure across a waterway that can be closed to reduce flood risk during storm events or extreme high tides.



# STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

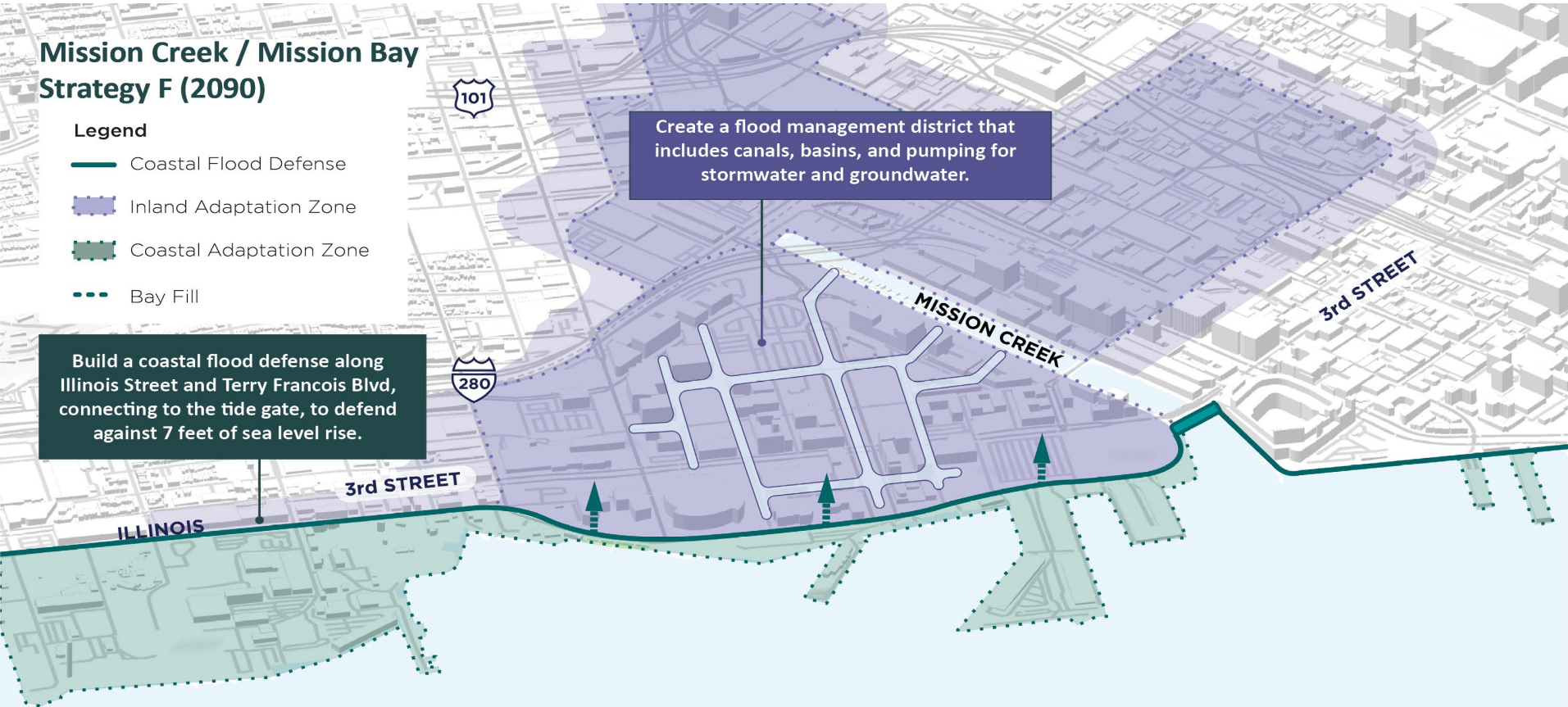
## Mission Creek / Mission Bay Strategy F (2090)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone
- ⋯ Bay Fill

Build a coastal flood defense along Illinois Street and Terry Francois Blvd, connecting to the tide gate, to defend against 7 feet of sea level rise.

Create a flood management district that includes canals, basins, and pumping for stormwater and groundwater.



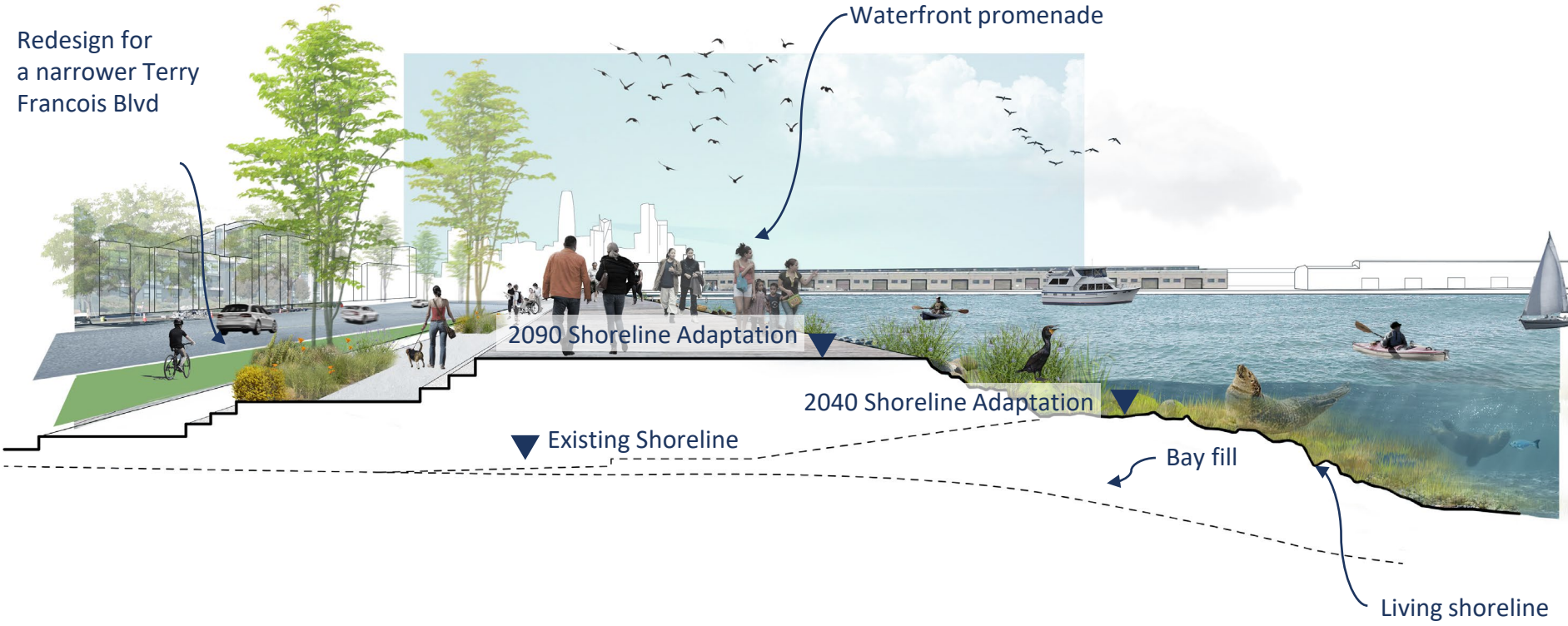
# STRATEGY F – HIGHER SEA LEVEL RISE – MANAGE THE WATER

## Mission Creek / Mission Bay in 2090



Redesign for a narrower Terry Francois Blvd

Waterfront promenade



2090 Shoreline Adaptation

2040 Shoreline Adaptation

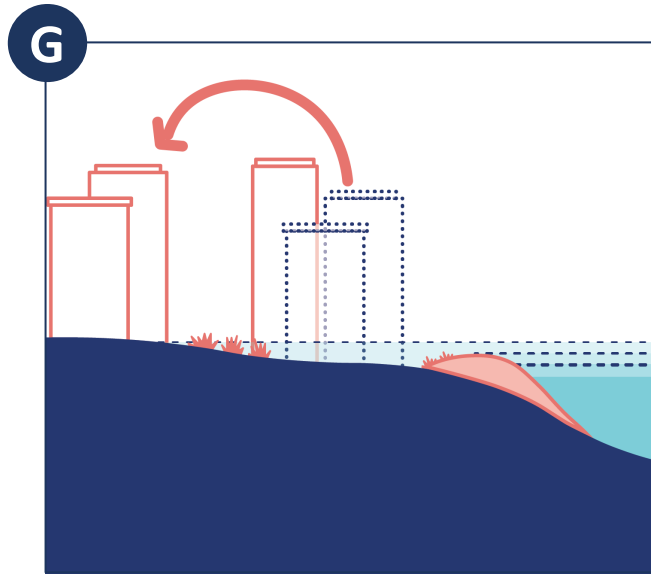
Existing Shoreline

Bay fill

Living shoreline



# STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS



**Advances shoreline adaptation while working with natural inland flooding patterns to floodproof some buildings and infrastructure and move others away from the highest risk areas**



# STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

## Mission Creek / Mission Bay Strategy G (2040)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone



Elevate bay shoreline to defend against 3.5 feet of sea level rise.

During extreme events, temporary closure structures would be placed on both sides of the Third and Fourth Street bridges over the creek to reduce inland flooding.

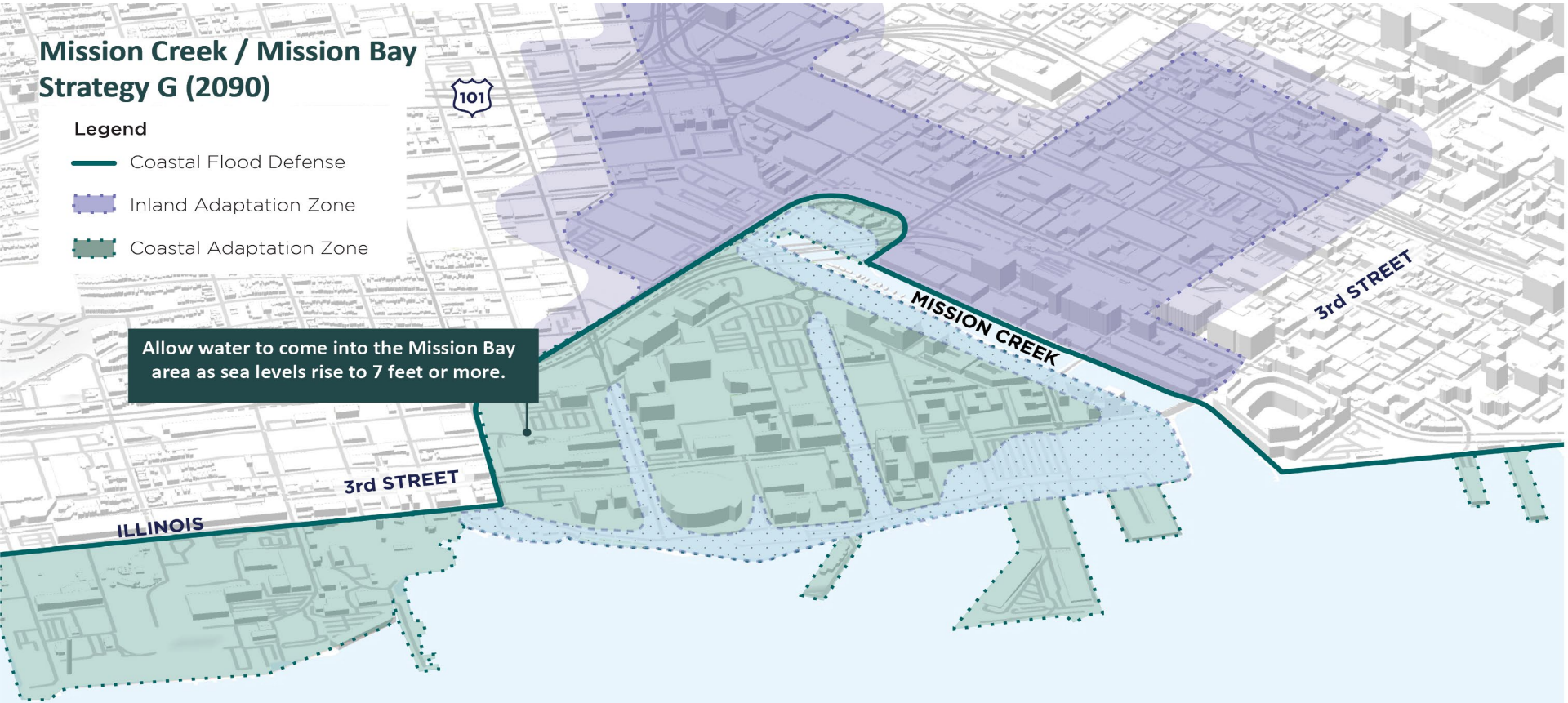
# STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

## Mission Creek / Mission Bay Strategy G (2090)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone

Allow water to come into the Mission Bay area as sea levels rise to 7 feet or more.





# STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

## Mission Creek / Mission Bay Strategy G (2090)

### Legend

- Coastal Flood Defense
- Inland Adaptation Zone
- Coastal Adaptation Zone

Mission Bay would be transformed to a floodable district, with significant changes to all urban systems. Housing would not be relocated or removed but will need accommodations to deal with flooding and access.

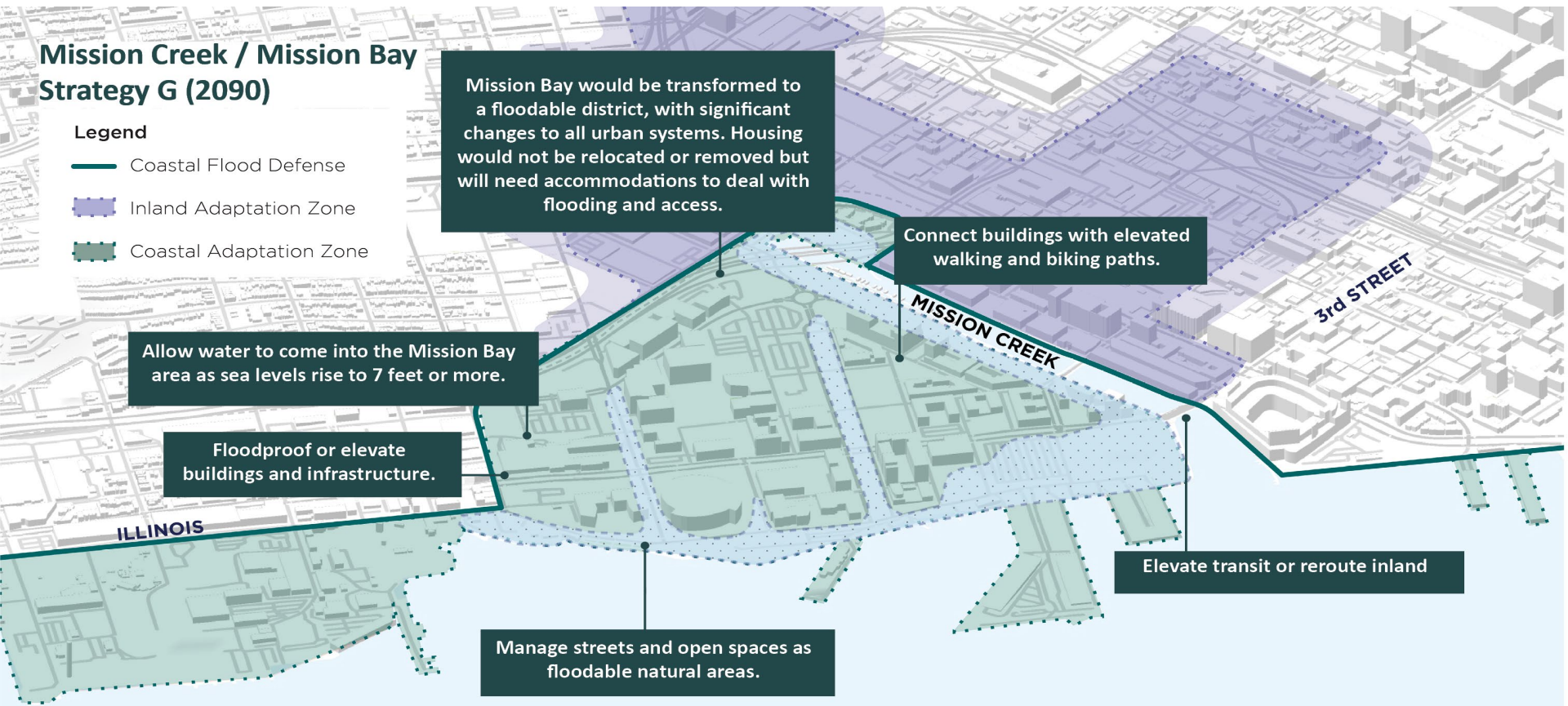
Connect buildings with elevated walking and biking paths.

Allow water to come into the Mission Bay area as sea levels rise to 7 feet or more.

Floodproof or elevate buildings and infrastructure.

Manage streets and open spaces as floodable natural areas.

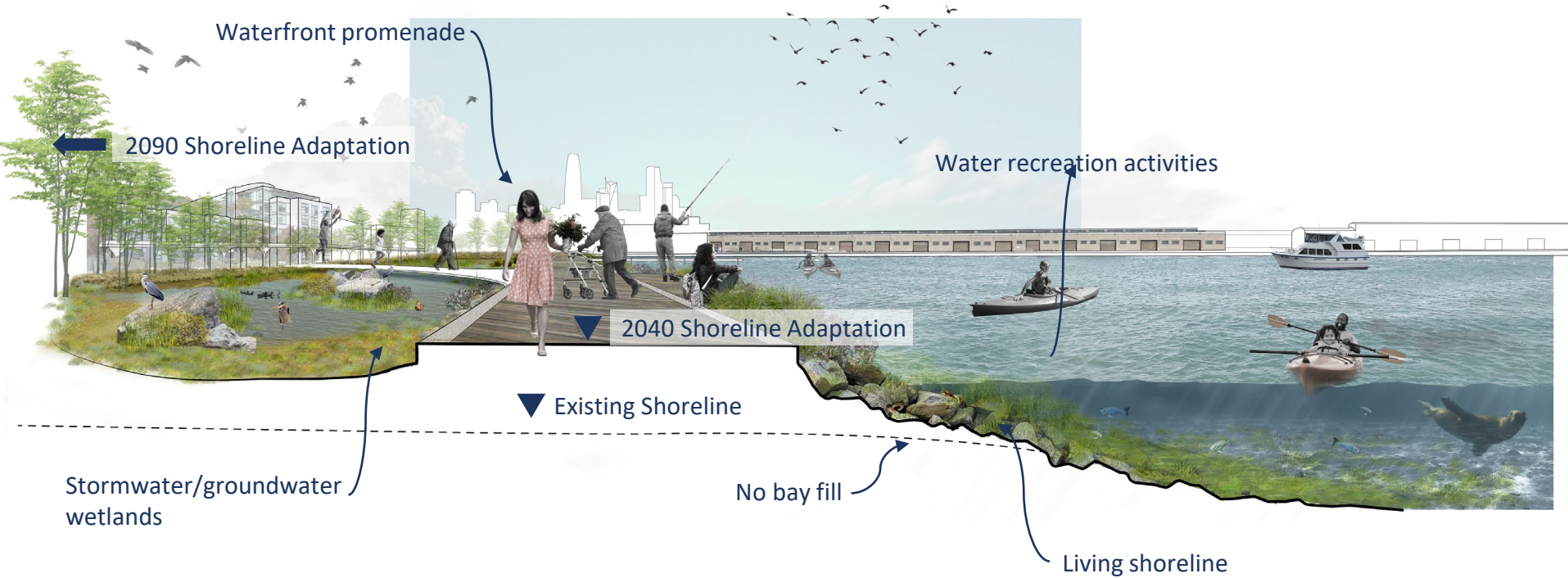
Elevate transit or reroute inland





# STRATEGY G – HIGHER SEA LEVEL RISE – ALIGN WITH WATERSHEDS

Mission Creek / Mission Bay in 2090

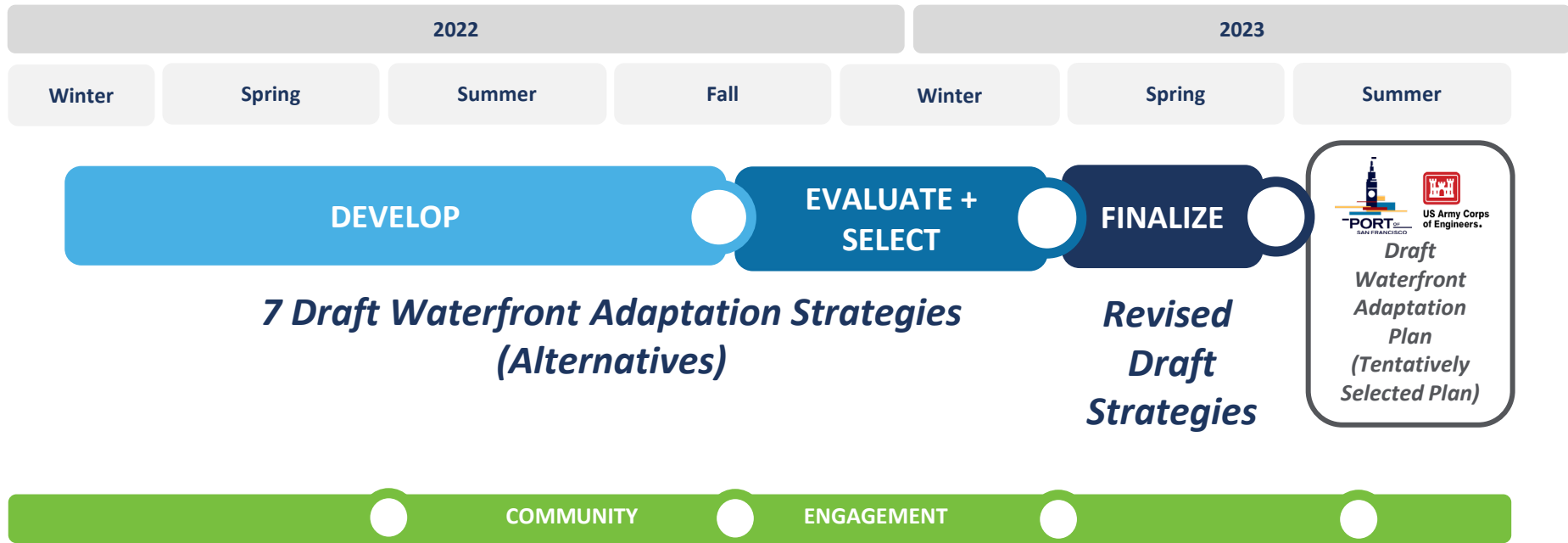


# Next Steps





# DRAFT WATERFRONT ADAPTATION STRATEGIES DEVELOPMENT SCHEDULE





# WHAT WE'VE HEARD SO FAR



- Summer Survey of over 1000 respondents
- Openness to exploring many kinds of adaptation approaches (including more transformative options)
- Desire to preserve and expand connections between the city and the waterfront
- Curiosity about feasibility, cost, and disruption impacts



# Thank You

Adam Varat | [luiz.barata@sfport.com](mailto:luiz.barata@sfport.com)



Waterfront Resilience Program

