ISLAIS CREEK SOUTHEAST MOBILITY ADAPTATION STRATEGY

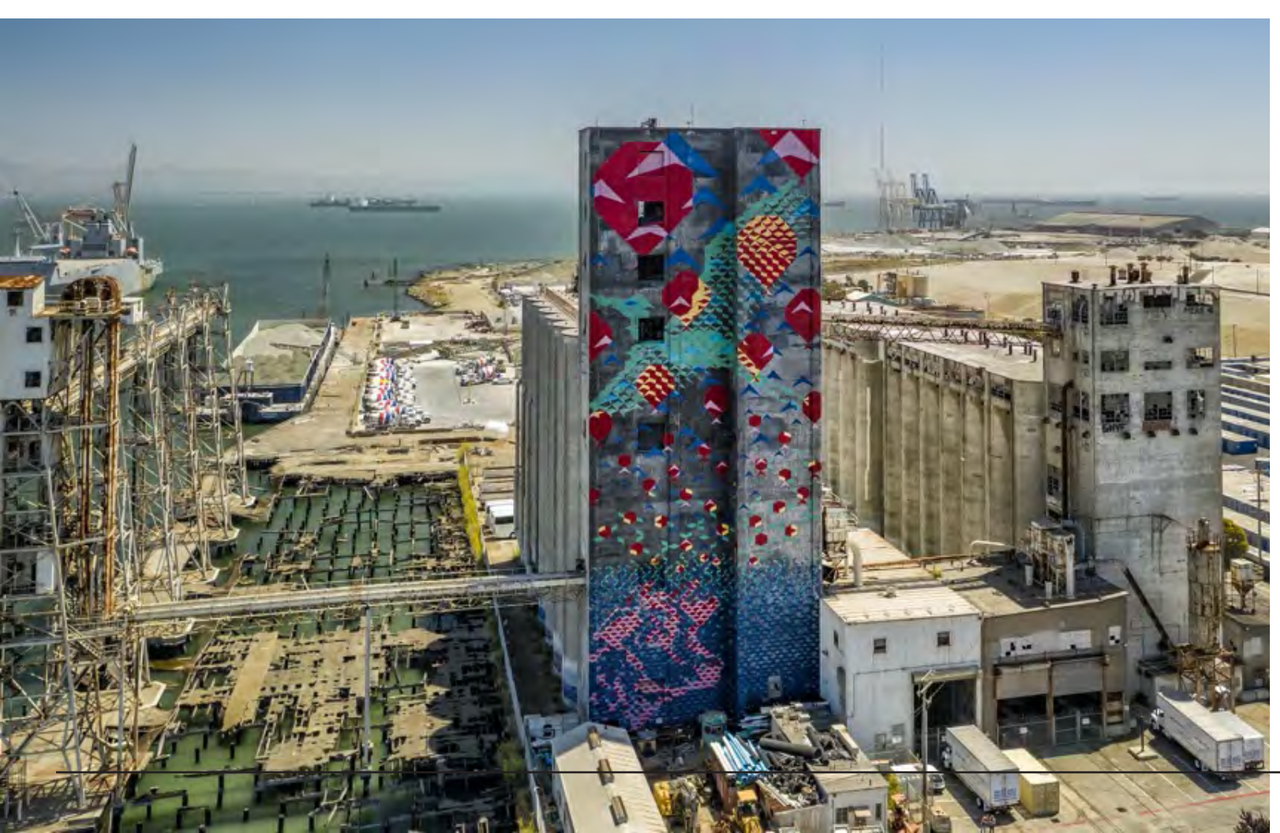
June 30, 2021

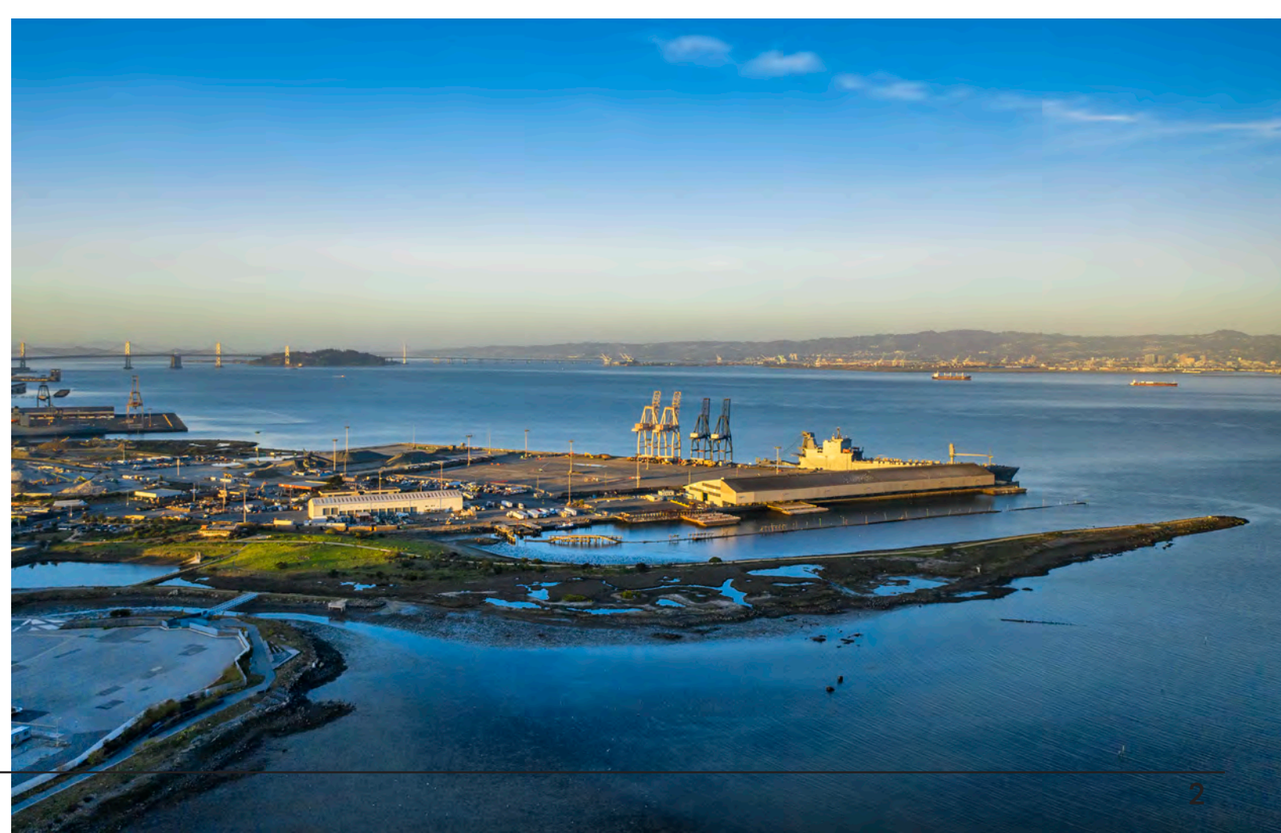
San Francisco Planning

SFMTA

PORT OF SAN FRANCISCO

San Francisco Water Power Sewer





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About This Project

A comprehensive set of adaptation pathways to protect the Islais Creek shoreline and surrounding district from inland and coastal flooding and sea level rise through 2080

OVERVIEW:
As a historic wetland along the San Francisco Bay, the low-lying Islais Creek district is already vulnerable to stormwater and coastal flooding today, and at risk to significant flooding and sea level rise (SLR) inundation caused by climate change in the future. The area hosts several critical transit facilities, key transportation connections, most of the city's remaining maritime industrial and manufacturing uses, and a unique watershed ecosystem. It is also surrounded by residential neighborhoods, regional highways, and the main sewage treatment plant.

The Islais Creek Southeast Mobility Adaptation Strategy (ICSMAS) seeks to provide a deeper understanding of the district's complex flood hazard risks and a comprehensive suite of adaptation pathways to protect the area and its key public assets from flooding and permanent inundation. The project is led by the San Francisco Planning Department (Planning), Municipal Transportation Agency (SFMTA), Port of San Francisco (the Port), and the San Francisco Public Utilities Commission (SFPUC), supported by a consultant team led by AECOM; together referred to as the ICSMAS Team. The effort was funded by a two-year grant from Caltrans along with City staff resources.

The effort seeks to adapt and enhance critical multi-modal transportation, economic, and open space assets that benefit the local community and city at large. By better understanding the future, the City may implement near-term flood protection measures that address today's threats in manners that will withstand rising tides through 2080. This holistic approach also ensures efficient and effective public investments that deliver maximum community benefits.

SETTING:
ICSMAS features the district between southern Dogpatch and northern Bayview neighborhoods, elevated highways to the west and the San Francisco Bay to the east. As shown in Figures 1 and 2, the district is a mix of hilly and flat residential neighborhoods, lower-lying areas full of warehouses and manufacturing, and large maritime-industrial piers. The city's original shoreline bifurcates the district meaning much of the flatter areas and all of the piers are constructed on landfill, and are particularly susceptible to SLR, coastal storm events, and wave run-up.

As shown in Figure 3 (next page), the Islais Creek district already experiences precipitation-based stormwater flooding and coastal storm events multiple times a year. A changing climate will have profound impacts on San Francisco's shoreline communities, critical infrastructure, transportation systems, and ecology. Sea levels are anticipated to rise by up to 6 to 10 feet by 2100. Over the next several decades, coastal flood events are projected to increase in frequency and extent. These climate threats require thorough planning and urgent action to help mitigate risks and build a more resilient city.

This diverse neighborhood is home to much of San Francisco's African American community and its cultural district. As with most communities of color, racial injustice and disinvestment have unfairly disenfranchised the Bayview. This identified environmental justice community suffers disproportionate pollution, social, economic, and health burdens, as well as disproportionate impacts of climate change. During the 2017 heat wave, this concrete-heavy part of the city experienced ground temperatures upwards of 50 degrees hotter than in the city's northwest Golden Gate Park. ICSMAS is committed to serving and advancing this vulnerable community and advancing equitable resilience in the district.

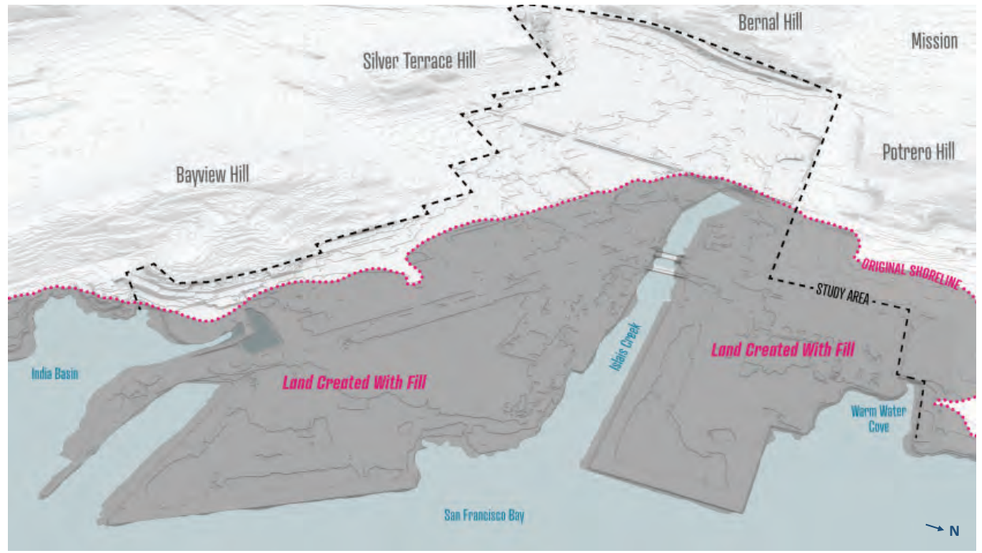


Figure 1: Local Topography and Geology

Figure 2: General Land Use

About This Project

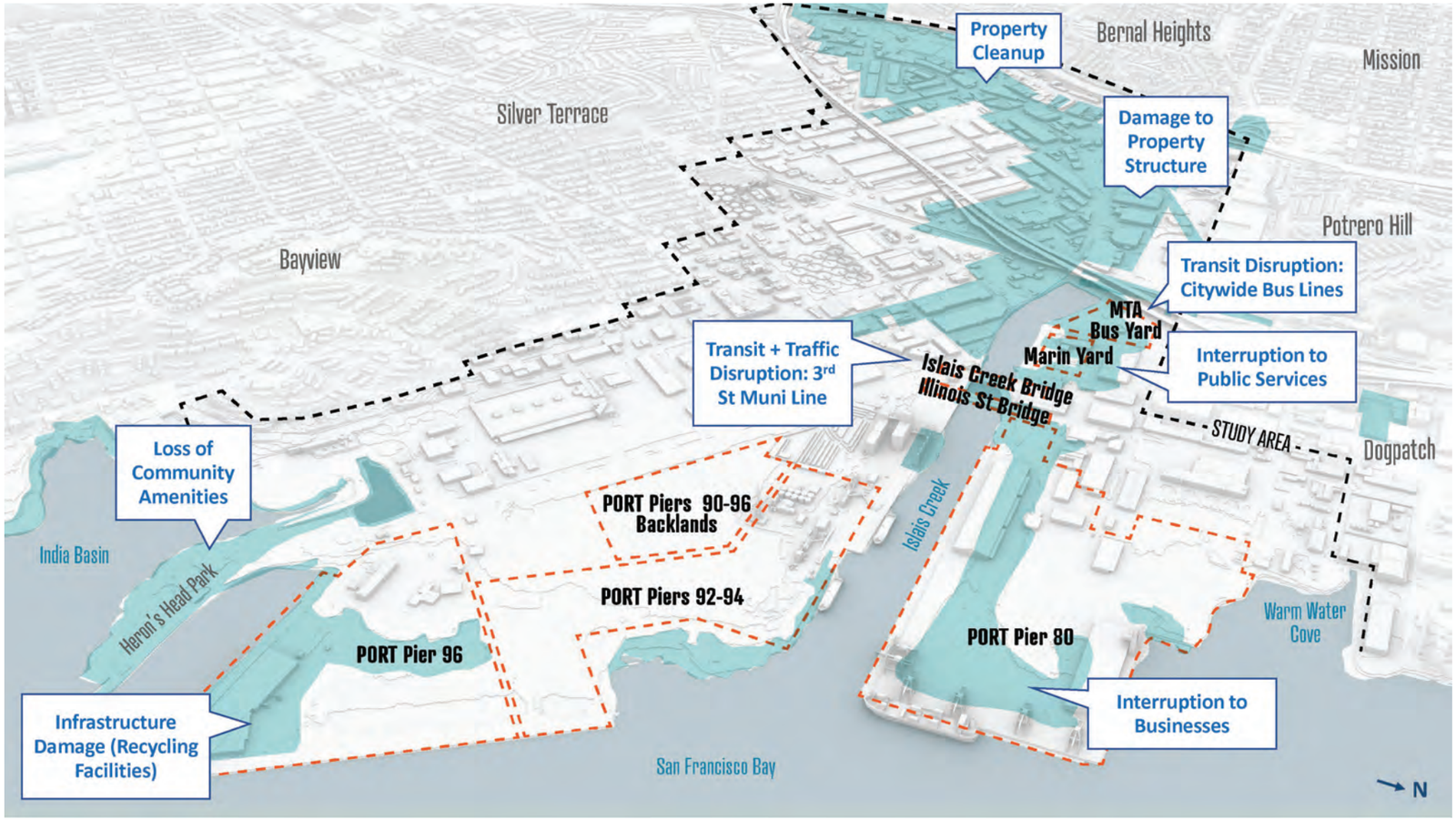


Figure 3: Current flooding and impacts under a 100-year storm event

APPROACH:
The ICSMAS Team assessed future climate risks and identified a range of potential adaptation strategies (i.e., physical infrastructure improvements, policy changes, and community investments). ICSMAS includes the city's first combined flood mapping effort, including stormwater and coastal flooding plus SLR to truly reveal the district's growing vulnerabilities. Proactive planning will help ensure the safety of San Francisco's citizens and prevent serious damage to vulnerable waterfront communities and city infrastructure over the long term. Please see the Methodology section for more detail.

As outlined in the next section, ICSMAS is inspired and grounded by community engagement and inputs. The ICSMAS Team convened community workshops at the beginning of the project to co-create a set of goals to guide the adaptation strategies. Building on this stakeholder input, staff worked together with its inter-disciplinary consultant team to envision a district-scale adaptation framework and develop asset-specific recommendations to ensure a resilient, creek-centered neighborhood. In alignment with the community goals, the ICSMAS flood adaptation pathways seek to:

a. Lead with equity and ensure an authentic and transparent process.
b. Improve and protect multi-modal transportation within the district and along critical connectors to the rest of the city.
c. Adapt important transit facilities to ensure reliable citywide MUNI operations over time.
d. Enhance shoreline open spaces and trails and improve the Islais Creek and Bay ecology.
e. Protect and enhance production, industrial, and maritime areas to support economic growth and local jobs.

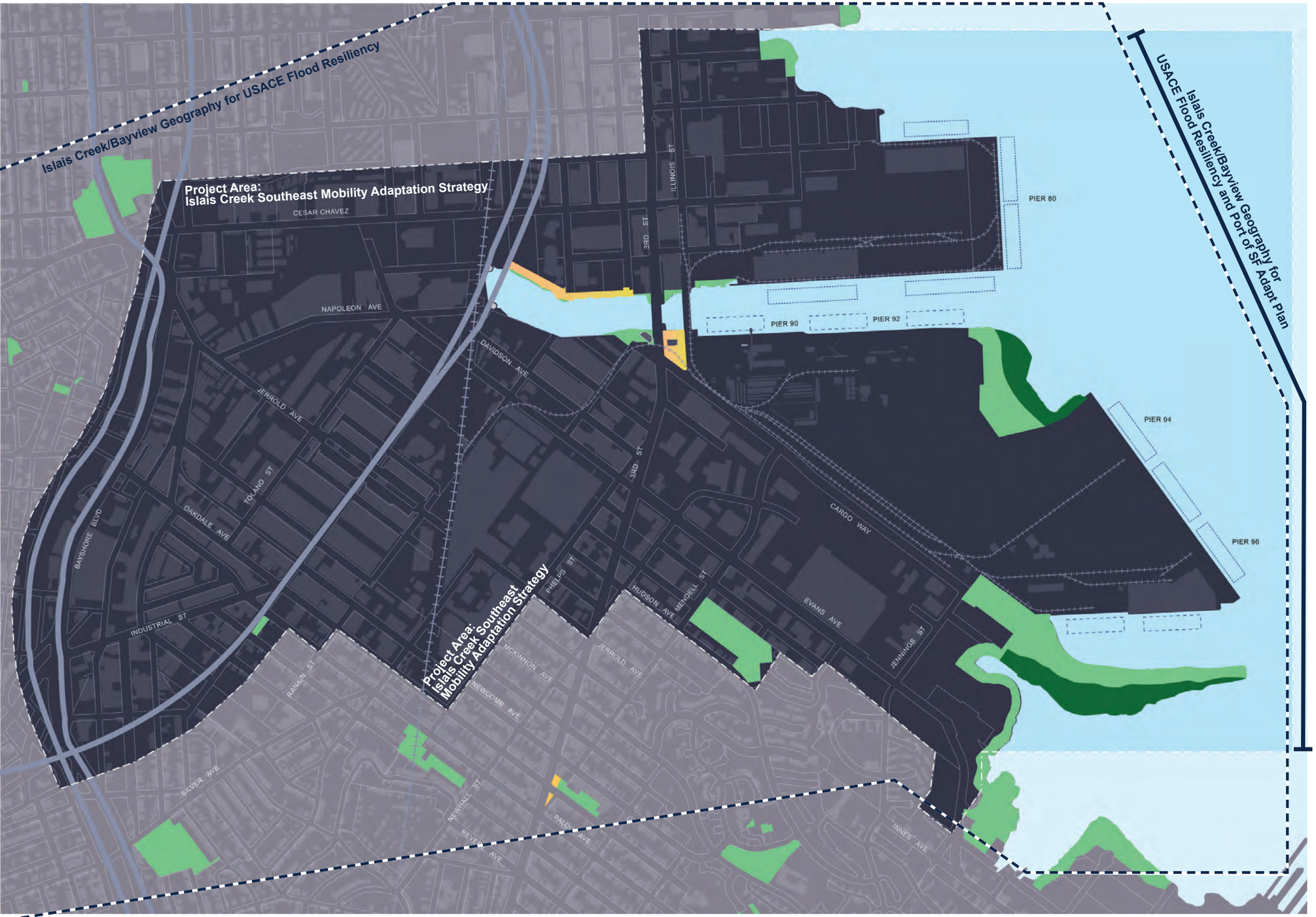
PLANNING CONTEXT AND COORDINATION:
The City is undertaking multiple coordinated efforts along its Bay and Ocean shorelines to adapt to the unavoidable impacts of climate change, see Figure 4 (next page). The Port's Waterfront Resilience Program (WRP) includes the 7.5 miles of Bay shoreline it manages, from Fisherman's Wharf to Heron's Head Park. ICMSAS will serve as a key input to the range of flood adaptation alternatives and strategies being explored by the WRP, including:

- The Adapt Plan, a seismic and flood "resilience roadmap" that outlines phased resilience actions, policies and funding strategies to guide adaptation of the Port-managed shoreline over time. It will include near-and long-term actions for addressing earthquake, coastal flooding, and SLR risks. The Plan considers the Port's unique public trust responsibilities; marine infrastructure; and historic assets; critical City infrastructure and functions that collectively support a wide array of water-dependent maritime industries; shoreline access and enjoyment; local and regional economic vitality; and critical disaster response and recovery functions for the city. By guiding the security of the Port's waterfront, the Adapt Plan will protect people, infrastructure, and activities at risk well beyond the Port's immediate jurisdiction, in coordination with other City resilience and sustainability efforts.
- The Flood Study, led by the US Army Corps of Engineers (USACE) in partnership with the Port, explores a range of flood adaptation strategies and costs with a goal of identifying a federally funded flood risk reduction project. This Study began in 2018 and will continue through 2025, pending a USACE exemption request to the Assistant Secretary of the Army to extend the Flood Study beyond the typically allotted 3 years and $3 million in funding. USACE will identify a preferred Federal Plan that maximizes net benefits and the Port, working with the community and City departments, can also identify a Locally Preferred Plan. The goal is to recommend a final net-benefit plan to Congress.

The ISCMAS work provides a robust and community-grounded vision for Islais District of the WRP and will facilitate early planning and funding coordination to protect critical City assets and deliver local benefits.

The ICSMAS adaptation strategies and WRP efforts are guided by robust and coordinated community engagement. The WRP and ICSMAS teams led an equitable stakeholder engagement process and identified community goals that support all resilience planning for the Islais Creek geography. From 2019 through Winter 2021, the teams (led by WRP) joined dozens of community organizations' meetings to share information about flood risks, map critical assets in the area, discuss alternative measures for the Flood Study, and provide updates for ICSMAS. Likewise, the teams (led by the ICSMAS team) hosted two Community Circle-Back events, and presented together at several community and public commission meetings in May 2021 to hear community and agency feedback. As resilience planning and project implementation moves forward, continued community engagement and interagency coordination will be guided by the community goals and vision for an Islais Creek district that adapts to flood risks while ensuring healthy and resilient communities.

Project Area and Existing Features



Legend

- Existing Promenades or Plazas
- Existing and Planned Open Spaces
- Existing Marsh Wetlands
- Existing Buildings

Key Map

0 0.25 0.50 MI

Figure 4: Project Area and Related Projects

Vision

Islais Creek adapts to flood risks while ensuring healthy and resilient communities

At the outset of the project, the ICSMAS Team worked with the WRP engagement team to plan and co-host a series of events and three in-person community workshops in late 2019 and early 2020 to connect with residents, workers, property owners, local organizations, and service providers. In addition to sharing the project scope and site analysis with attendees, these engagement and listening events helped develop and establish the community's goals for the Islais Creek district, as shown in Figure 5. These goals inspired the ICSMAS strategies and will continue to guide all flood resilience work in the area.

GOALS:

Transportation: A transportation system that is resilient and adaptable to flood risk.

- Adapt key transportation facilities and assets in the near term, increase system capacity and resiliency in the long term.
- Improve and expand transit, bicycle, and pedestrian connections within and through the area.
- Ensure accessible and equitable transportation between the waterfront, the city, and region for people and goods.

Environment: A healthy environment for residents, workers, visitors and ecologies.

- Identify multi-purpose solutions and strategies that benefit the entire Islais Creek watershed.
- Prioritize nature-based solutions and green infrastructure.
- Improve access to and create new resilient open spaces along the creek and Bay shoreline.

Economy: A sustainable economy that benefits local residents, workers, and industries.

- Support local, blue-collar industries, small businesses, and artists.
- Maintain and increase women and minority-owned businesses.
- Explore flexible land use regulations and building types that can accommodate future commerce and industry.
- Prepare local workforce for the current and future economy through training and mentorship.

Community and Social Equity: A socially and environmentally resilient neighborhood.

- Encourage neighborhood vitality, character, and diversity with mixed-income housing.
- Develop equitable solutions for a wide variety of community members.
- Adapt buildings, open spaces, and services for flooding that ensure safety and preparedness.
- Support neighborhood social resilience efforts now and into the future.

Governance: Authentic and transparent public engagement during and beyond planning.

- Identify and share individual histories and stories about Islais Creek.
- Build a long-lasting basis of support with a transparent, authentic engagement process.
- Engage across generations, especially with youth, to build long-term understanding, capacity, and stewardship.
- Acknowledge the significance of the newly designated African American Arts and Cultural District.
- Establish a working group of public agencies to ensure integrated capital planning, funding, financing, and implementation of the Strategy.

Figure 5: I AM ISLAIS - Community Outreach

Methodology

An innovative and comprehensive approach to risk assessment and climate adaptation planning

EXISTING CONDITIONS REVIEW AND SCENARIOS DEVELOPMENT:
A thorough existing conditions review was carried out that included GIS data sets, previous studies in the project area, and future plans or proposals. It also included several levels of flood modeling, as outlined in the next section.

Building on this analysis and community engagement inputs, the ICSMAS Team explored several scenarios for flood adaptation in the Islais Creek District through the 2080 time frame. The scenarios investigated strategies for protecting the creek and assets vulnerable to flooding in a manner that could maximize co-benefits to one of the community priorities: economics, mobility and environment. From those scenarios, a robust set of district- and asset-scale strategies was refined and vetted with the ICSMAS Team, as presented in this report.

REACHES AND ADAPTATION PATHWAYS:
The strategies proposed in the District-Scale Concept have been grouped into **five Reaches** based on their geographic location and how the strategies work together to provide comprehensive flood protection. The Reaches are:

- Reach 1 – Northeastern Waterfront
- Reach 2 – Creek Channel Crossing
- Reach 3 – Northwestern Creek Bank
- Reach 4 – Southwestern Creek Bank
- Reach 5 – Southeastern Waterfront

Adaptation pathways are a sequence of linked strategies that are triggered by a change in environmental conditions, and in which initial decisions can have low regrets and preserve options for future generations" (Barnett et al, 2014). This approach is critical for managing risk under uncertain future conditions. It allows decision-makers to examine a variety of potential actions within the context of both current conditions and potential future conditions at multiple time scales. Depending on the geographic scale of the study and a variety of local conditions (community priorities, existing conditions, rate of change in the physical environment, political and policy considerations, etc.), adaptation pathways may be relatively simple or highly complex.

Adaptation pathways are included that detail how and when the strategies could be implemented and phased, which will provide the City with clear guidance on how the shared vision of the District-Scale Concept and the specific strategies can move forward as future projects. An adaptation pathway is an implementation strategy comprised of a sequence of manageable steps that recognizes key inputs (e.g., funding, science, market forces) and associated decision-points over time, which together helps manage risk under uncertain future conditions. Rather than over-projecting and committing to a horizon of decisions and investments now, the approach is designed to schedule decision-making: it identifies what needs to be confirmed in the near-term versus in the future. Adaptation pathways therefore support strategic, informed, flexible, and structured decision-making, which allows the City to respond to a variety of future conditions (community priorities, SLR, etc.) while still remaining focused on long-term goals and generating public benefits.

The team also developed adaptation pathways for the Reaches. The focus of the **ICSMAS adaptation pathways** is on reducing the risk of SLR inundation and coastal and inland flooding over time, as these risks will increase with a warming climate. Risk from other hazards, such as earthquakes, tsunamis, heat waves, droughts, fires, and more are not directly addressed.

NOTE: As acknowledged in San Francisco's recently adopted Hazards & Climate Resilience Plan, future phases of this work will continue to add considerations for other climate-related hazards such as extreme heat, poor air quality due to wildfire smoke, drought, and more.

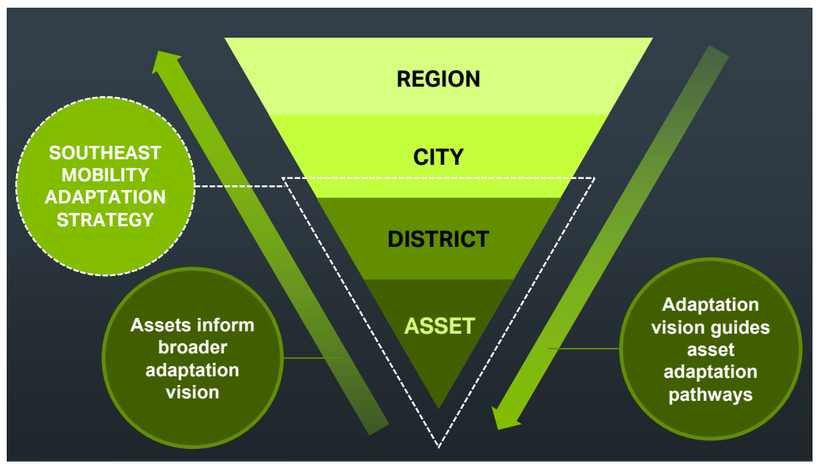


Figure 6: Asset-Level Strategies

ASSET-SPECIFIC ADAPTATION STRATEGIES:
SF Planning, the Port, SFMTA, SFPUC and Public Works all have critical infrastructure along the shoreline, that serve both the local neighborhood and wider city, see Figure 6. From this list of critical assets, the community and City identified **eight key assets** that would be studied in more detail at the 2050 time frame:

- **Islais Creek Bus Facility** (SFMTA): Bus maintenance yard with buildings for operator, dispatch and maintenance staff
- **Marin Yard** (SFMTA): Bus maintenance facility and staff lockers, restrooms and breakroom
- **Islais Creek Bridge** (Public Works): Operable, 4-lanes, transit, automobiles
- **Illinois Street Bridge** (Public Works): Operable, 2-lanes, truck freight route to highways, regional rail route, regional Bay Trail
- **Pier 80** (Port): Cargo terminal
- **Pier 90-96** Backlands (Port): Industrial and PDR use area
- **Pier 92-94** (Port): Cargo terminal, concrete batching, co-located with dry-bulk cargo
- **Pier 96** (Port): Cargo terminal, recycling facilities

These asset-level strategies provide near-term protection, complement the preferred district-scale concept, and provide redundant resilience to other nearby interventions. **Three key assets** are studied in further detail, based on criteria such as timing of inundation, remaining life-span of asset, and criticality of asset to the system:

- Islais Creek Bus Facility
- Islais Creek Bridge
- Pier 96

Hazard Mapping & Sea Level Rise Mapping

Combined Coastal and Precipitation-Based Stormwater Flooding Plus Sea Level Rise Inundation

As sea levels rise, coastal flooding, wave hazards, and rainfall-driven stormwater flooding are all likely to worsen. Therefore, the development of appropriate shoreline adaptation strategies must consider how SLR may exacerbate all future flooding conditions.

A set of combined flood hazards maps were created to support the comprehensive adaptation pathways and asset-specific strategies. See Figures 8 and 9. The maps depict the areas that could experience different types of flooding under six future SLR scenarios:

- **Storm Surge Flooding:** Extreme tide and storm surge events may cause Bay waters to rise above the shoreline elevation and flood low-lying inland areas. ICSMAS hazard mapping considers coastal flooding that could occur during a future 100-year extreme tide (i.e., the simultaneous occurrence of an astronomically high tide with strong storm surge) on top of SLR.
- **Wave Hazards:** Storms produce wind-driven waves that propagate across the Bay and runup and overtop the shoreline. Wave hazards are generally most damaging at or near the shoreline, causing coastal erosion and undermining shoreline structures. Waves can also overtop the shoreline and travel inland across low-lying, flat areas resulting in inland flooding. ICSMAS wave hazard mapping considers overland wave impacts associated with a 100-year coastal storm event.
- **Stormwater Flooding:** High-intensity rain events may result in runoff that exceeds the capacity of the City's stormwater management system, causing flooding in areas with limited or no connectivity to conveyance infrastructure or the Bay. ICSMAS stormwater hazard mapping considers flooding that could occur during a 100-year, 3-hour rainfall event coupled with SLR during a 2-year extreme tide. The City's combined sewer system is designed to handle stormwater from a 5-year storm, after which City streets are designed to convey overflow. In some areas of the city stormwater can overtop curbs, exposing adjacent buildings to flood risk.

The combined flood hazard maps depict areas of overlapping hazards, assuming each type of flooding is independent. However, in areas where hazards overlap, the combined hazard is likely to be more severe than mapped; i.e., SLR inundation due to storm surge could increase the area impacted by stormwater flooding if both types of flooding occur concurrently. The information presented is sufficient to inform the development of flood risk reduction strategies; however, additional analysis may be warranted to support adaptation strategy design.

SEA LEVEL RISE SCENARIOS:
Six SLR scenarios were selected for the combined flood hazard maps, per hazard data produced by the SFPUC for its Climate Adaptation Plan and maps used by the San Francisco Bay Conversation and Development Commission (BCDC) as part of the Adaptation to Rising Tides program. The scenarios were chosen based on a review of existing mapping, identification of early shoreline overtopping locations, and alignment with other City efforts like the Port's Flood Study (with USACE) and Envision process for re-imagining the long-term future of the waterfront. The six SLR scenarios (12, 23, 41, 52, 83 and 122 inches of SLR) are additive to the respective 100-year storm condition for each flooding type, thus representing the potential hazards that may occur during a future 100-year storm condition as shown in Appendix A.

For the purposes of developing the district-scale concept, SLR projections were selected in line with Ocean Protection Council (OPC) guidance for this type of project (containing critical assets) for two key planning time horizons: 2050 and 2080. The two combined hazard maps shown on the next page (Figures 8 and 9) illustrate permanent SLR as well as the other three flooding types; please see the Appendix for the complete, detailed analysis and set of combined hazard maps.

- 2050: 1:200 Chance, MHHW +23" Sea Level Rise (SLR)
- 2080: 1:200 Chance, MHHW +52" Seal Level Rise (SLR)

It is important to note that today's SLR projections vary, particularly beyond 2050 when the rate of SLR will be primarily determined by the success or failure of reducing greenhouse gas emissions (GHGs) in the next decades. The OPC 1:200 SLR projections used in ICSMAS assume lower success at containing GHG emissions globally. As shown in the Figure 7 below, USACE uses a different range of SLR projections including the high-curve that falls between the two OPC projections and an intermediate and low curve that assume a slower rate of SLR. Adaptation Pathways are an excellent tool to adapt to this uncertain future because they allow planners to respond to higher or lower water levels when needed.

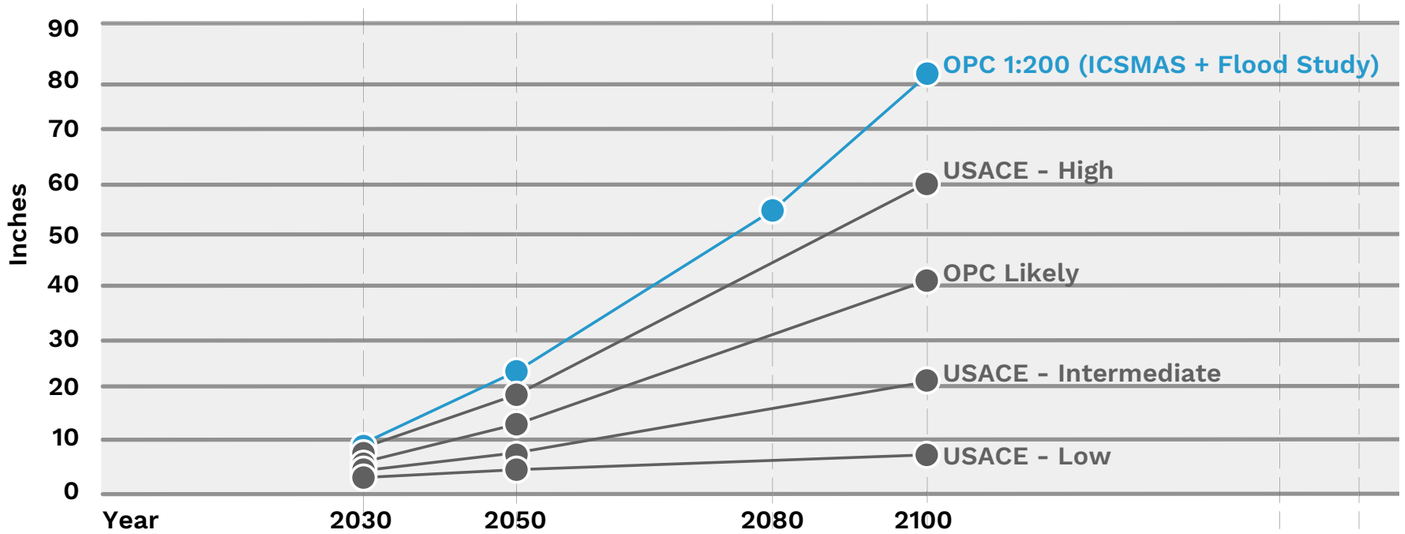
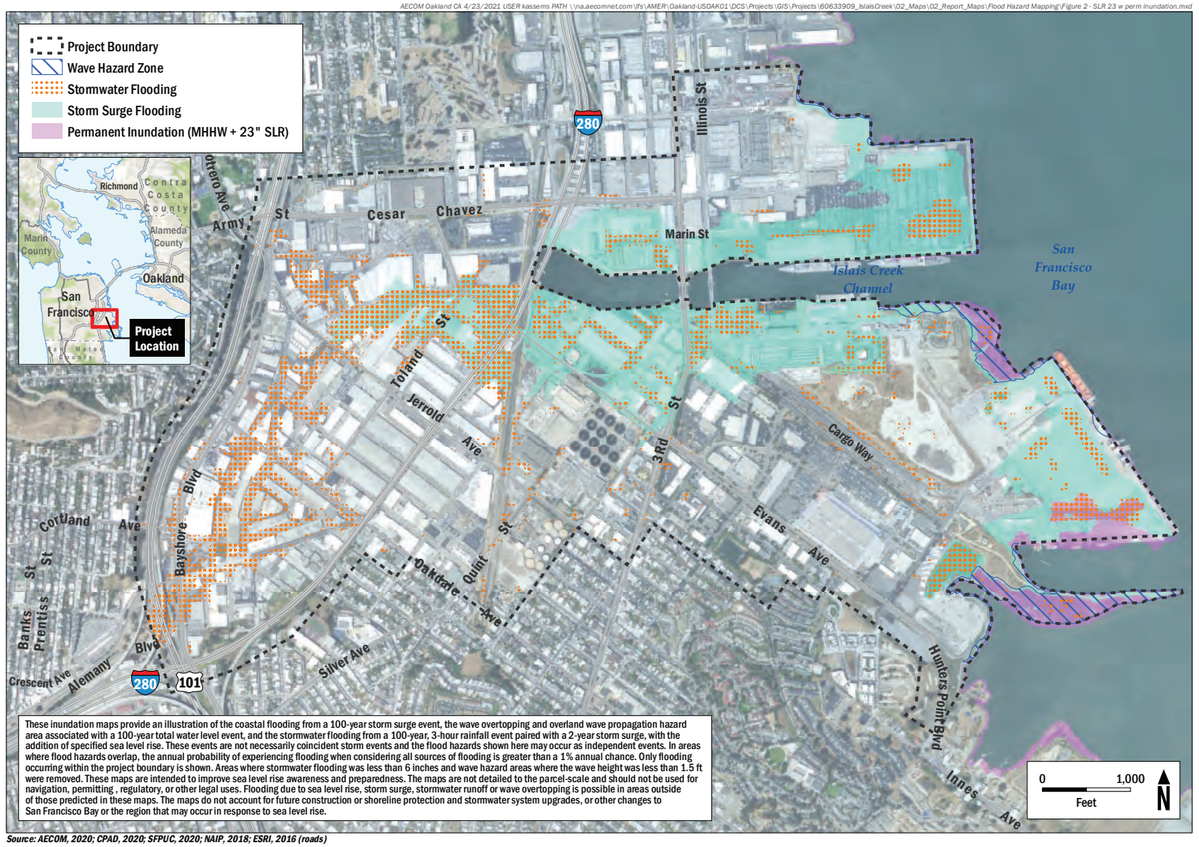


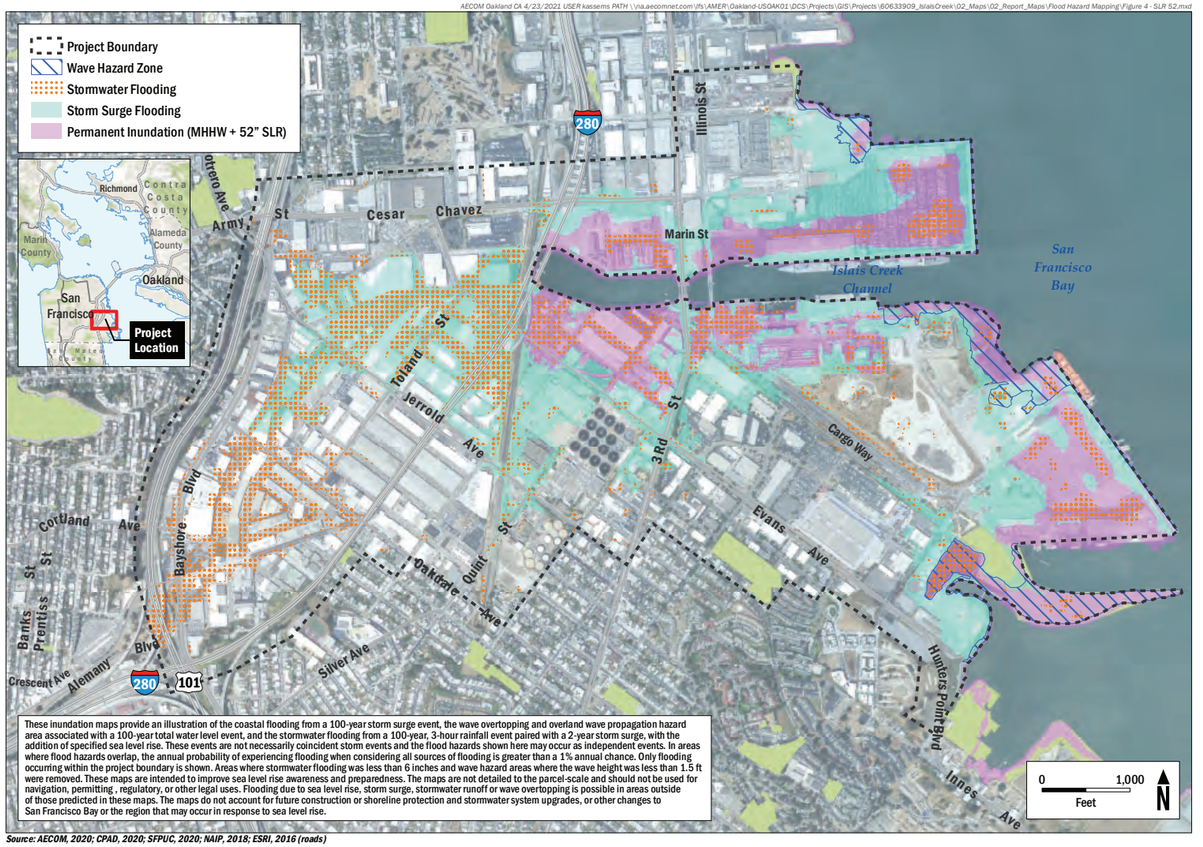
Figure 7: Sea Level Rise Scenarios

Sea Level Rise & Storm Surge Mapping



Source: AECOM, 2020; CPAD, 2020; SFPUC, 2020; NAIP, 2018; ESRI, 2016 (roads)

FIGURE 8: 2050 COMBINED FLOOD HAZARD MAPPING
MHHW + 23" permanent SLR inundation (assuming 1:200 Chance SLR scenario) plus 100-year coastal storm surge (up to 41"), wave hazards and stormwater flooding



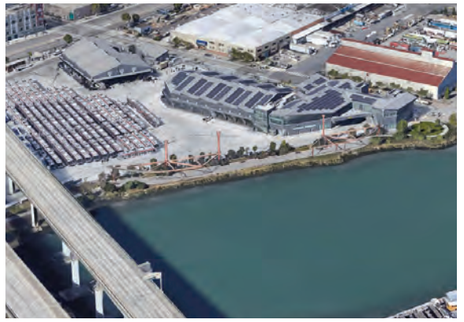
Source: AECOM, 2020; CPAD, 2020; SFPUC, 2020; NAIP, 2018; ESRI, 2016 (roads)

FIGURE 9: 2080 COMBINED FLOOD HAZARD MAPPING
MHHW + 52" permanent SLR inundation (assuming 1:200 Chance SLR scenario) plus 100-year coastal storm surge (up to 41"), wave hazards and stormwater flooding

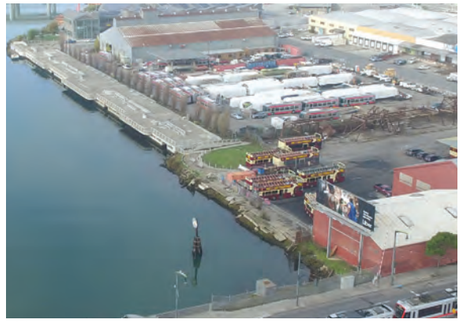
NOTE: These inundation maps provide an illustration of the coastal flooding from a 100-year storm surge event, the wave overtopping and overland wave propagation hazard area associated with a 100-year total water level event, and the stormwater flooding from a 100-year, 3-hour rainfall event paired with a 2-year storm surge, with the addition of specified sea level rise. These events are not necessarily coincident storm events and the flood hazards shown here may occur as independent events. In areas where flood hazards overlap, the annual probability of experiencing flooding when considering all sources of flooding is greater than a 1% annual chance. Only flooding occurring within the project boundary is shown. Areas where stormwater flooding was less than 6" and wave hazard areas where the wave height was less than 1.5' were removed. These maps are intended to improve SLR awareness and preparedness. The maps are not detailed to the parcel-scale and should not be used for navigation, permitting , regulatory, or other legal uses. Flooding due to SLR, storm surge, stormwater runoff or wave overtopping is possible in areas outside of those predicted in these maps. The maps do not account for future construction or shoreline protection and stormwater system upgrades, or other changes to San Francisco Bay or the region that may occur in response to SLR.

Key Assets at Risk, Selected for ICSMAS Focus

Figure 10: Key Assets at Risk Map



1 Islais Creek Bus Facility



2 Marin Yard

3 Islais Creek Bridge

4 Illinois Street Bridge

5 Pier 80

6 Pier 90-96 Backlands

7 Pier 96

8 Piers 92-94

Adaptation Summary, District-Scale

A framework of adaptation strategies that relate and coordinate with each another and maximize economic, environmental, and mobility benefits for the district and community

Figure 11: Economic Opportunity (through 2080)

LEGEND

POTENTIAL JOB GROWTH ZONES

- Production, Distribution, Repair (PDR) areas
- Maritime Industrial area (SF Port)
- PDR, Multi-modal Corridor
- Mixed-commercial/PDR, Multi-modal Corridor
- SFMTA Facilities
- SFPUC Facilities

LAND USE

- City-owned Parcels
- Existing Buildings
- Project Area

Economically, the Islais Creek area supports some of the city's last remaining production-distribution-repair (PDR), industrial, and maritime cargo uses. These uses help create and sustain a critical sector of skilled, middle-wage job opportunities, which helps maintain a diverse economic and employment base in San Francisco. See Figure 11. The district's proximity to the Dogpatch and Bayview residential neighborhoods also supports a diverse labor pool.

PDR & MIXED-COMMERCIAL:
ICSMAS supports opportunities to enhance and grow PDR businesses in several zones on the west and south sides of the Islais Creek Channel, especially along Evans Ave. The unique building typologies and sizes foster light manufacturing and craftsman, as well as automotive, machinery, and processing businesses.

As a major transit corridor, 3rd Street also has the potential to host increased density of residential, retail, and other local services, which in turn could help pay for adaptation strategies and other neighborhood benefits. The acknowledgement of the Bayview as the city's African American Arts and Cultural District also provides further opportunities to support local businesses in collaboration with community groups. Finally, with affordable housing needs in mind, mixed-commercial/PDR development could also be introduced along key transit corridors and/or where transit operations are consolidated and modernized on City-owned parcels, where permitted.

MARITIME INDUSTRIAL:
The Port's Maritime Eco-Industrial Center Strategy for Piers 80–96 co-locates maritime with industrial uses to enable product exchange, optimize resource use, incorporate green design and technologies onsite, foster resource recovery and reuse, and provide economic opportunities that employ local residents. This area is the only location in San Francisco that supports land-intensive cargo terminal operations, supported by deep-water berths. Maritime functions are reliant upon viable berths and adjacent usable land for efficient operations, storage, and transportation of materials. These areas also support Federal Emergency Management Agency (FEMA) and City plans for disaster response and recovery.

ICSMAS offers multiple measures to preserve and optimize existing maritime industrial facilities and operations, especially as they benefit local resident workers. It also recommends exploring new vessel berthing and cargo conveyance infrastructure as they support adaptation. Regional plans forecast growth in cargo, industrial, and PDR uses in this area through 2050. The recent San Francisco Bay Conservation and Development Commission's (BCDC) "Seaport Plan" and the Maritime Element of the Metropolitan Transportation Commission's (MTC) "Regional Transportation Plan", identifies sufficient shoreline areas to accommodate future growth in maritime cargo, minimizing the need for new Bay fill for port development. BCDC's 2050 cargo forecast identified San Francisco Pier 96 as a key expansion site required to have sufficient capacity for Ro-Ro (automobile) and Dry Bulk cargo under a moderate-growth scenario, assuming the continued full utilization of Piers 80, 90, 92, and 94. ABAG's (Association of Bay Area Government) and MTC's "Plan Bay Area 2050 Final Blueprint" also designates the Islais Creek geography as a "Priority Production Area" to enable industrial growth that expands middle-wage jobs close to more-affordable housing. Regional objectives for economic growth and related transportation systems are an Important consideration for this district-wide adaptation strategy.

See Appendix B and C for the BCDC Sea Port Plan's "Pier 80-96 Port Priority Use Area" and the MTC Plan Bay Area 2050's "Growth Geographies".

Adaptation Summary, District-Scale

Figure 12: Environment & Open Space (through 2080)

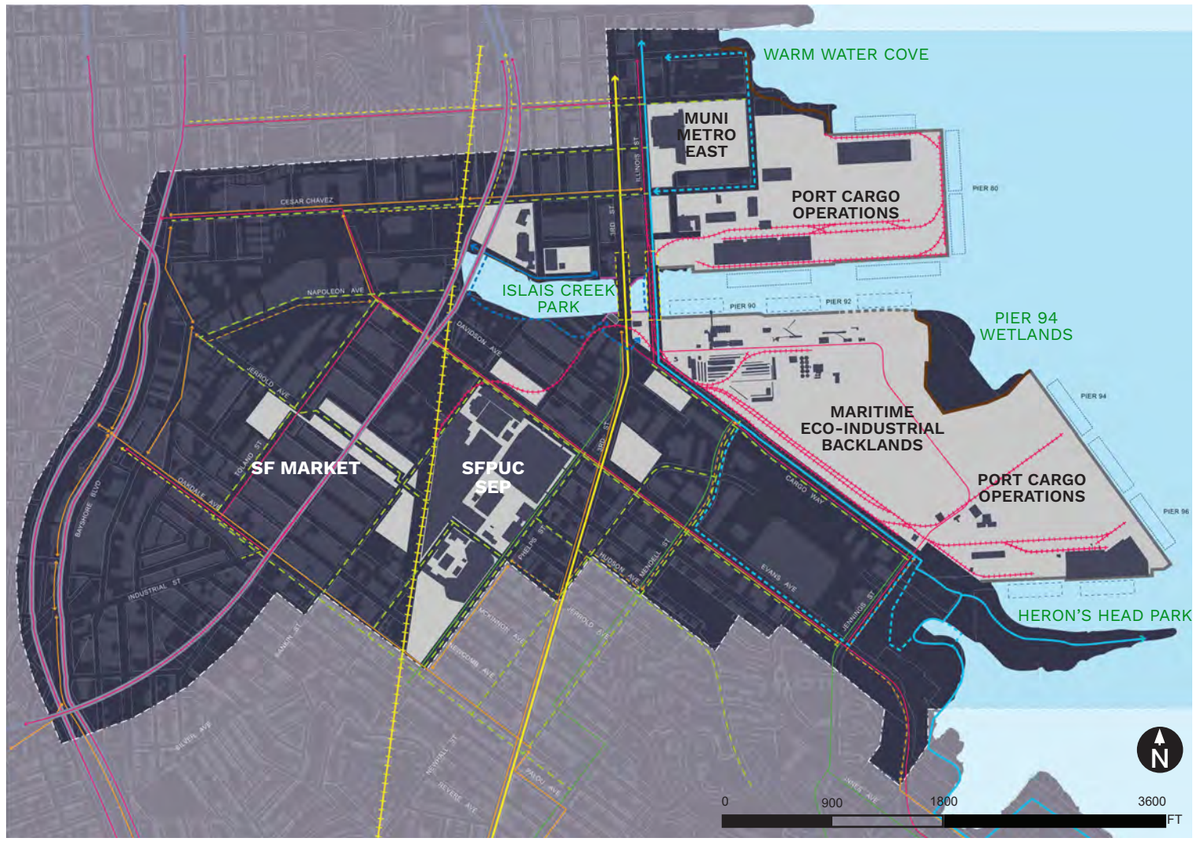


Figure 13: Mobility (through 2080)

LEGEND

NATURE-BASED FLOOD PROTECTION
- Existing Promenade or Plaza
- Existing Open Space
- New or Improved Open Space
- New Floodable Park
- New or Improved Marsh Wetlands
- New Eel Grass Beds
- New Oyster Reefs
- New Beach
- New Rock Groyne
- New Green Streets

LAND USE
- Opportunity Area: Open Space & Mixed-commercial /PDR
- City-owned Parcels (Consolidated & Optimized)
- Existing Buildings

HARD FLOOD PROTECTION
- Raised & Rebuilt Pier Edge
- New Pier Edge
- New Flood Wall
- New Berm
- Existing Promenade or Plaza
- Project Area

Where feasible, nature-based and living shoreline adaptation strategies should be used to provide flood protection while increasing parks and habitat areas, as shown in Figure 12:

- Remove aging waterfront structures in favor of living shoreline features that restore a natural edge condition and create passive recreation opportunities.
- Consider expanding open space in opportunity areas that could be developed as a public/private partnership (Southwestern Creek Bank).
- Maintain existing wetland areas and consider regrading areas where they could migrate over time (Pier 94 Wetlands, Heron's Head Park).
- Introduce green streets and street-level green infrastructure to reduce localized urban flood risk, reduce peak flows, increase biodiversity and enhance neighborhood character.

LEGEND

MOBILITY
- Primary Blue Greenway
- Proposed Blue Greenway
- Existing Creek Trail
- Proposed Creek Trail
- Existing MUNI Corridor
- Proposed MUNI Corridor
- Existing Class 1, 2 or 3 (<<) Bikeways
- Proposed Class 1, 2 or 3 (<<) Bikeways
- Existing Truck Route
- Existing Freight Rail
- Existing Caltrain Line

MARITIME INDUSTRIAL
- Deep Water Berth
- General Water Berth

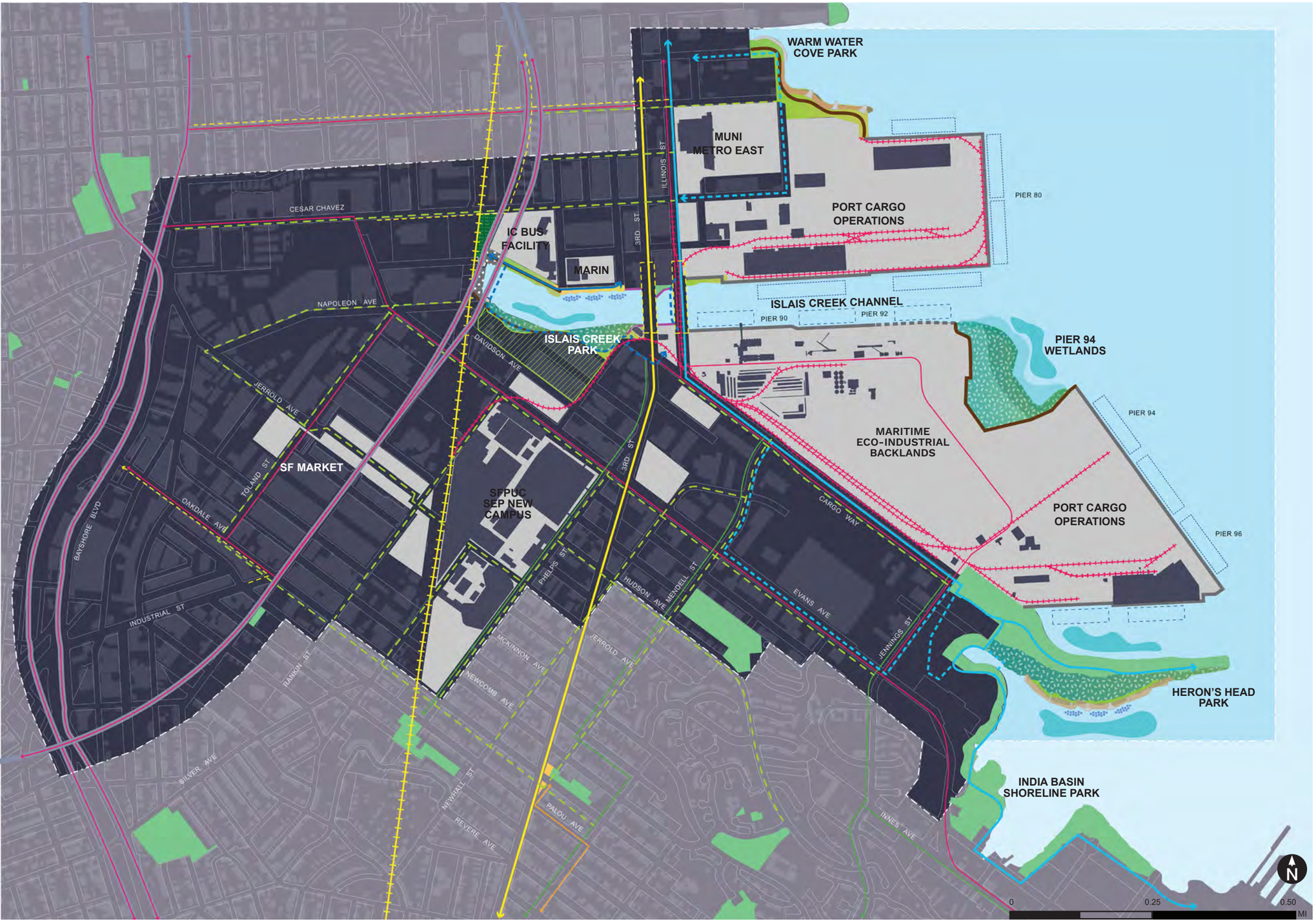
LAND USE
- City-owned Parcels (Consolidated & Optimized)
- Existing Buildings

HARD FLOOD PROTECTION
- Raised & Rebuilt Pier Edge
- New Pier Edge
- New Flood Wall
- New Berm
- Project Area

ICSMAS seeks climate adaptation investments that expand active transportation and transit, enhance traveler safety, and improve connections between maritime and industrial uses and regional highway and rail systems, as shown in Figure 13:

- Implement improvements to the Blue Greenway along Illinois St and Cargo Way. Consider potential additions to improve access to the waterfront.
- Enhance key transit corridors to improve East/West connectivity including Evans Ave, which helps ease the burden on the Islais Creek and Illinois St bridges and reduces North/South traffic.
- Improve infrastructure and safety for people that walk and bike.
- Maintain and enhance truck and freight rail to sustain cargo and maritime operations. Revisit need for freight rail to Pier 80 when the Illinois Street Bridge is reconstructed.
- Use green streets/infrastructure (e.g. bulbouts) to slow traffic and create safety buffers from vehicles.

District-Scale Adaptation Framework (through 2080)



The District-Scale Concept illustrates a framework of coordinated and synergistic flood adaptation strategies within the project area. This comprehensive approach seeks to achieve a resilient district that supports the community's goals and maximizes public benefits.

LEGEND

NATURE-BASED FLOOD PROTECTION

- Existing Open Space
- New or Improved Open Space
- New or Improved Marsh Wetlands
- New Floodable Park
- New Eel Grass Beds
- New Oyster Reefs
- New Beach
- New Rock Groyne
- New Green Streets

HARD FLOOD PROTECTION

- Raised & Rebuilt Pier Edge
- New Pier Edge
- New Flood Wall
- New Berm
- Replaced Bridge
- Existing Promenade or Plaza

MOBILITY

- Primary Blue Greenway
- Proposed Blue Greenway
- Existing Creek Trail
- Proposed Creek Trail
- Existing (T Third Street)
- Existing Truck Route
- Existing Freight Rail
- Existing Caltrain Line

MARITIME INDUSTRIAL

- Deep Water Berth
- General Water Berth

LAND USE

- Opportunity Area: Open Space & Mixed-Use
- City-owned Parcels (Consolidated & Optimized)
- Existing Buildings
- Project Area

Figure 14: District-Scale Adaptation Framework (through 2080)

Toolkit Strategies

Legend

- **Hard:** Engineered structures as primary line of defense
- **Nature-Based:** Attenuating flood protection by conserving, restoring or managing ecosystems
- **Earthen:** Non-engineered and engineered mounds or packed earth
- **Event-Based:** Temporary flood protection measures to address infrequent, short-duration flooding events
- **Stormwater:** Facilities or strategies that reduce runoff and improve water quality

SEAWALL		A hardened vertical structure, that is anchored into and above the ground on both sides.	BEACH CREATION		Supporting or creating a beach through strategic placements of fine or coarse sand—can attenuate waves in front of other structures.
LEVEE		Engineered structure made of packed earth with an impermeable core.	RAISED EDGE		Adding a hardened lip or wall to an existing shoreline structure.
NATURE BASED / HYBRID SHORELINE		A variety of solutions that support flood protection and wave attenuation properties of natural shorelines.	AUTOMATIC BARRIERS		Installed mechanical devices that can be raised during storm events.
RAISED PIER		Raising a pier, either from underneath by increasing the height of the support structures, or by adding to the height of the pier surface itself.	FLOODABLE PARKS		Shoreline recreation and open spaces that are designed to accommodate water during storm events without resulting in permanent damage.
DEPLOYABLE BARRIERS		Flood barriers that can be temporarily installed during storm events.	REVETMENT		Armoring placed on the slope of embankments or berms as a defense against erosion—revetments can be constructed from large rocks, tetrapods, etc.
LIVING EDGE		A gently sloping earthen structure, possible backed by a levee, providing and ecotone slope for marsh vegetation and attenuating wave action.	STORMWATER MANAGEMENT		Diffuse inland green infrastructure strategies that absorb stormwater to prevent ponding and reduce peak flows during flood events.
WAVE ATTENUATION EDGE		Structural armoring built on the slope of embankments, such as interlocking concrete tiles or steps.	OFFSHORE SOLUTIONS		Structures that are placed in the water offshore to attenuate wave action—may be hardened structures or green/living structures.
LAND USE CHANGE		Strategies that allow the shoreline edge to migrate inland, with associated land use changes behind.	RAISE INFRASTRUCTURE		Elevating bridges, roads, or other infrastructure to be above flood waters. Raised infrastructure can also contribute to the protection of inland assets.
BERM		Earthen non-engineered mounds, potentially vegetated.	RAISE STRUCTURE		Elevating individual structures inland to be above flood waters, with measures like pile supports or elevated foundations.

Figure 15: Toolkit Strategies

Shoreline Protection - Toolkit Strategies

Legend

- **Hard:** Engineered structures as primary line of defense
- **Nature-Based:** Attenuating flood protection by conserving, restoring or managing ecosystems
- **Earthen:** Non-engineered and engineered mounds or packed earth
- **Event-Based:** Temporary flood protection measures to address infrequent, short-duration flooding events

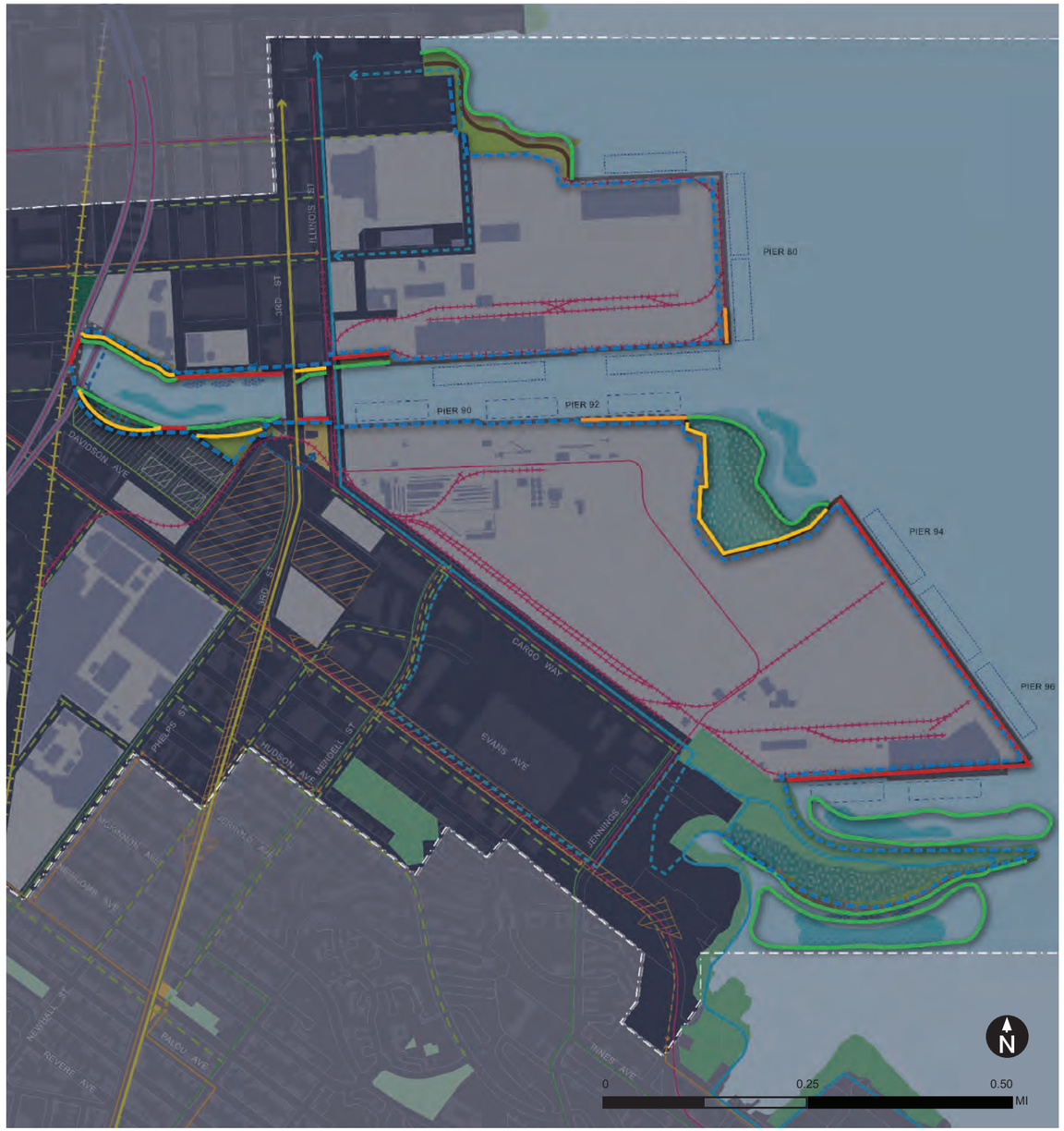


Figure 16: Shoreline Protection through 2050

Figure 17: Shoreline Protection through 2080

Adaptation Pathways & Key Asset Strategies, by Reach

These five Reaches are grouped adaptation strategies organized by related geographical area

The following section in this document provides more detail on the strategies proposed in each of the five Reaches. Each Reach includes an overview of existing conditions, an enlargement diagram of the District-Scale Adaptation Framework, a Strategy Matrix and an Adaptation Pathways diagram. For the selected key assets, an additional summary of strategies to be implemented by 2050 is also included.

1 Reach 1 - Northeastern Waterfront:
Introduce nature-based shoreline adaptation strategies to expand Warm Water Cove Park and elevate and protect Pier 80 to support maritime function. Key assets include:

- Pier 80 (Port)

2 Reach 2 – Creek Channel Crossing:
Rehabilitate and replace Islais Creek and Illinois Street bridges. Key assets include:

- Islais Creek Bridge (Public Works)
- Illinois Street Bridge (Public Works)

3 Reach 3 – Northwestern Creek Bank:
Introduce flood protection measures at critical SFMTA facilities and enhance public access to the creek's shoreline. Key assets include:

- Islais Creek Bus Facility (SFMTA)
- Marin Yard (SFMTA)

4 Reach 4 – Southwestern Creek Bank:
Create new tidal marsh and expand Islais Creek Park.

5 Reach 5 – Southeastern Waterfront:
Optimize use of cargo terminal and industrial operations at Piers 90-96 and the Backlands. Key assets include:

- Pier 92-94 (Port)
- Pier 96 (Port)
- Pier 90-96 Backlands (Port)

Figure 18: Adaptation Reaches Key Plan

Northeastern Waterfront

Introduce nature-based shoreline adaptation strategies to expand Warm Water Cove Park and elevate and protect Pier 80 to support maritime function

Figure 19: Existing Conditions

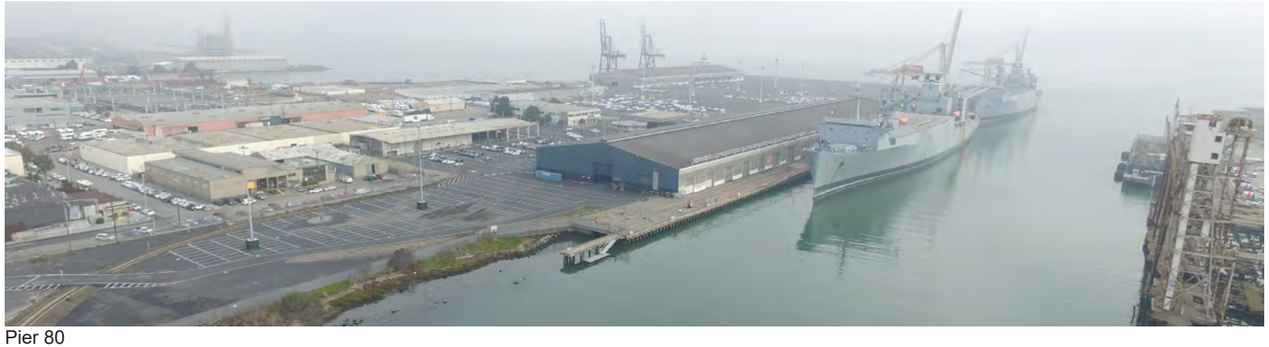
BACKGROUND:
The shoreline at Warm Water Cove Park is a combination of embankment and revetment and connects to the northern wharf edge of Pier 80. The park is adjacent to the Blue Greenway, just east of Illinois Street and the Port has plans to expand the Blue Greenway to connect with 25th St.

The shoreline of Pier 80 is a pier structure on piles and is one of the Port's remaining cargo facilities and a Ro-Ro terminal, mainly for auto exports though it has imported them as well in the past.

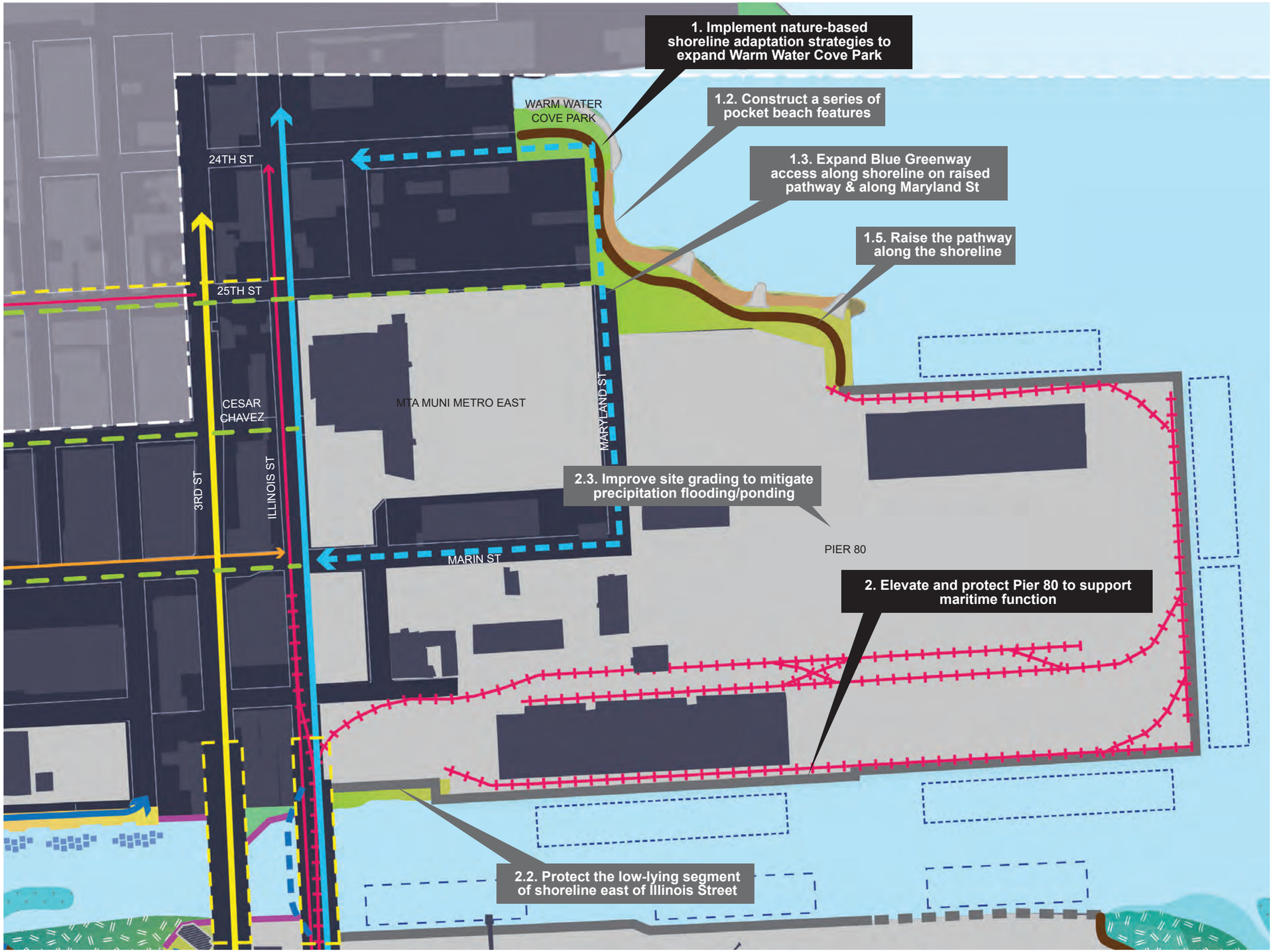
Further inland, the Muni Metro East facility managed by SFMTA is a MUNI light-rail maintenance yard. Any shoreline protection strategies implemented at Warm Water Cove Park and Pier 80 would also protect Muni Metro East. See Figure 19 Existing Conditions.


Muni Metro East


Warm Water Cove Park


Pier 80

Northeastern Waterfront STRATEGY SUMMARY



Legend

NATURE-BASED FLOOD PROTECTION
- Existing Open Space
- New or Improved Open Space
- New or Improved Marsh Wetlands
- New Floodable Park
- New Eel Grass Beds
- New Oyster Reefs
- New Beach
- New Rock Groyne
- New Green Streets

HARD FLOOD PROTECTION
- Raised & Rebuilt Pier Edge
- New Pier Edge
- New Flood Wall
- New Berm
- Replaced Bridge
- Existing Promenade or Plaza

MOBILITY
- Primary Blue Greenway
- Proposed Blue Greenway
- Existing Creek Trail
- Proposed Creek Trail
- Existing (T Third Street)
- Existing Truck Route
- Existing Freight Rail
- Existing Caltrain Line

MARITIME INDUSTRIAL
- Deep Water Berth
- General Water Berth

LAND USE
- Opportunity Area: Open Space & Mixed-Use
- City-owned Parcels (Consolidated & Optimized)
- Existing Buildings
- Project Area

N

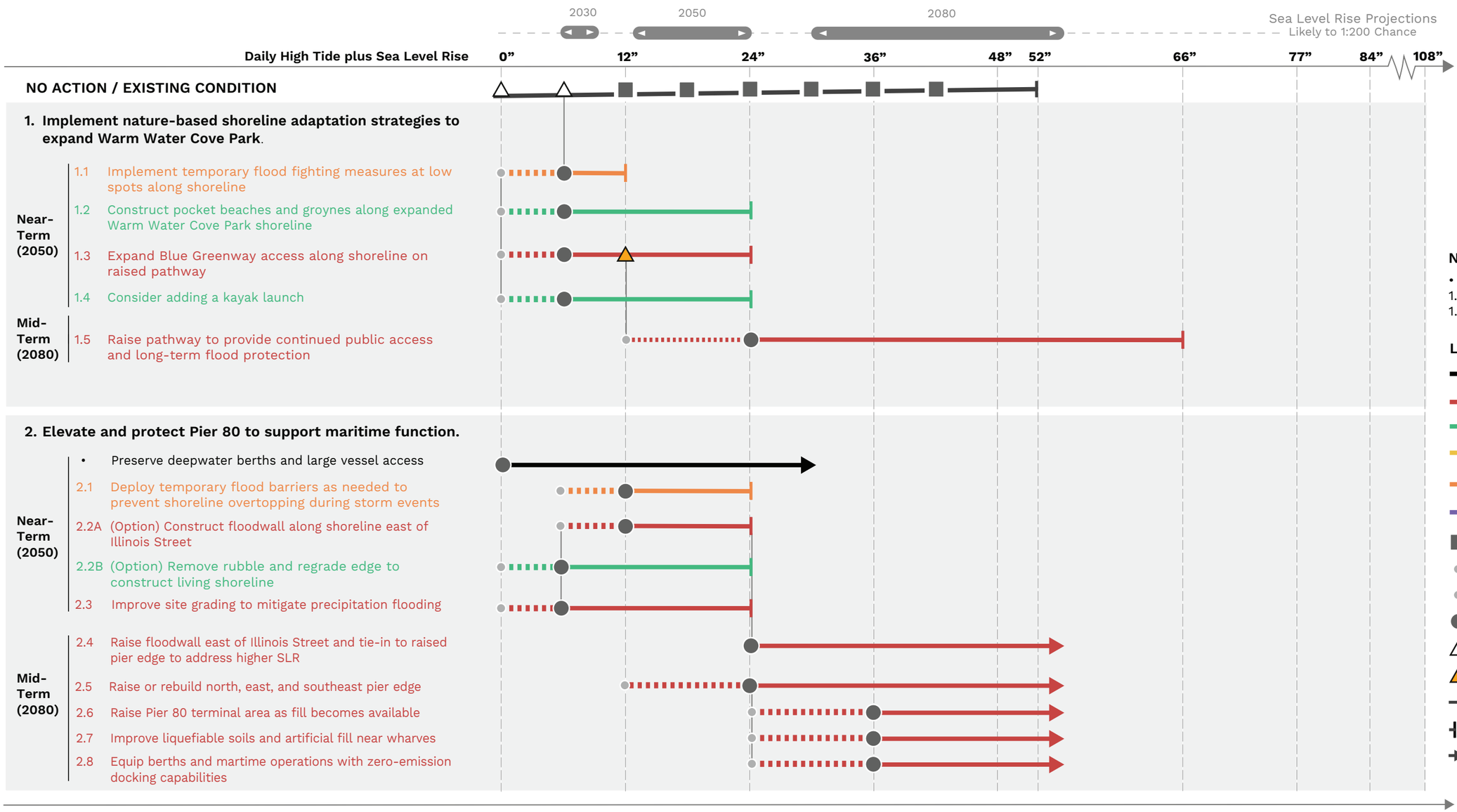
0 250 500 FT

Figure 20: Northeastern Waterfront Strategy Summary

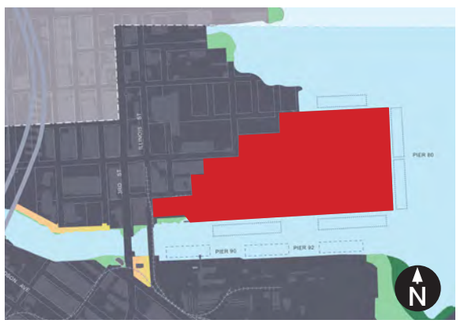
Northeastern Waterfront STRATEGY MATRIX

	1.Implement nature-based shoreline adaptation strategies to expand Warm Water Cove Park	2. Elevate and protect Pier 80 to support maritime function
Near-Term (2050)	**Adaptation Strategies:** 1.1. Implement temporary flood fighting measures at key low spots in between Warm Water Cove Park and the northern edge of Pier 80 1.2. Construct a series of pocket beach features to protect the northern edge of Pier 80, Muni Metro East, and the full potential of Warm Water Cove Park. 1.2.1. Construct pocket beach features by placing coarse sand and gravel on top of the existing revetment along the expanded Warm Water Cove Park shoreline 1.2.2. Stabilize pocket beaches with groynes. Construct headland anchor points at the north and south ends of the shoreline to retain the beach material. Place artificial tide pool features in the new headlands to provide intertidal habitat for marine organisms. 1.2.3. Re-nourish the beaches, as needed, as sand and gravel disperse along the shoreline and as sea level rises to maintain a natural edge. With 24" of sea level rise, it is likely that the beach will become submerged. Set back the existing shoreline, relocate the existing revetment landward, and provide space for the beach to migrate over time if it is desired that the beach have a longer lifespan; however, this would be a more substantial project and would occupy a larger footprint that potentially encroaches upon areas designated for Port Priority Use at Pier 80 in BCDC's Seaport Plan; Muni Metro East; and/or private property . 1.3. Expand the Blue Greenway access along the shoreline at Warm Water Cove Park, connecting to Illinois Street via 24th Street. 1.4. Consider adding a kayak launch at Warm Water Cove Park at the northern tip of the park. This location is closest to existing parking and would be easily accessible for launching. Additional evaluation of maritime hazards in this area should be conducted to confirm that safe use of adjacent waterways is possible.	**Planning and Support Strategies:** • Preserve deepwater berths and large vessel access for working waterfront uses and emergency staging at Pier 80. **Adaptation Strategies:** 2.1. Deploy temporary flood barriers as needed along the edge of Pier 80 to prevent shoreline overtopping during storm events. 2.1.1. Place deployable barriers at the southeast corner of Pier 80. 2.1.2. Floodproof any critical maritime buildings and equipment and establish an event-response plan to relocate sensitive inventory prior to flood events. 2.2. Protect the low-lying segment of shoreline east of Illinois Street and west of the developed edge of Pier 80. This is a low spot and flood pathway that may result in flooding of the Pier 80 terminal area. 2.2A (Option): Construct a reinforced concrete floodwall along shoreline east of Illinois Street. 2.2B (Option): Construct a living shoreline and provide public access connecting to Illinois Street by removing rubble and regrading the shoreline, provided it would not impair existing or future use of the site for Port purposes. A setback raised path could be constructed along a more inland alignment to provide flood protection and expand public access. 2.3 Improve site grading to mitigate precipitation flooding/ponding.
Mid – Term (2080)	1.5. Raise the pathway along the shoreline to provide continued public access and long-term flood protection for higher levels of sea level rise. Expand rock revetment upslope as needed to provide protection for raised pathway.	2.4. Raise the floodwall that was previously constructed east of Illinois Street (Strategy 2.2, Option A) and tie-in to a raised Pier 80 edge to provide continued sea level rise protection 2.5. Raise or rebuild the north, east, and southeast wharf structures along the edge of Pier 80 to protect flexible deepwater berthing operations at Pier 80. 2.6. Raise the Pier 80 terminal area as fill becomes available. The extent to which the backlands need to be raised for continuity with the raised pier edge will depend on the future maritime uses. Raising wharf elevations will require extensive ramps and drainage infrastructure to maintain operations. Alternatively, increasing the backland terminal elevation to match raised wharf edges would reduce drainage challenges associated with differential wharf and terminal elevations. 2.7. Improve liquefiable soils and artificial fill near the wharves. This will support future raising and mitigate known seismic hazards. 2.8. Equip berths and other maritime operations with zero-emission docking capabilities where feasible.

Northeastern Waterfront ADAPTATION PATHWAYS



Pier 80 (Selected Key Asset) - Summary of Strategies by 2050



Location

Flood Vulnerability

- Very minor permanent overtopping with 24” SLR.
- Widespread temporary flooding during 100-year coastal storm surge with 12” SLR.

Existing Shoreline Typology

- **Structure - On Pile:** Concrete structures that extend out over the water and are supported by timber or concrete piles.

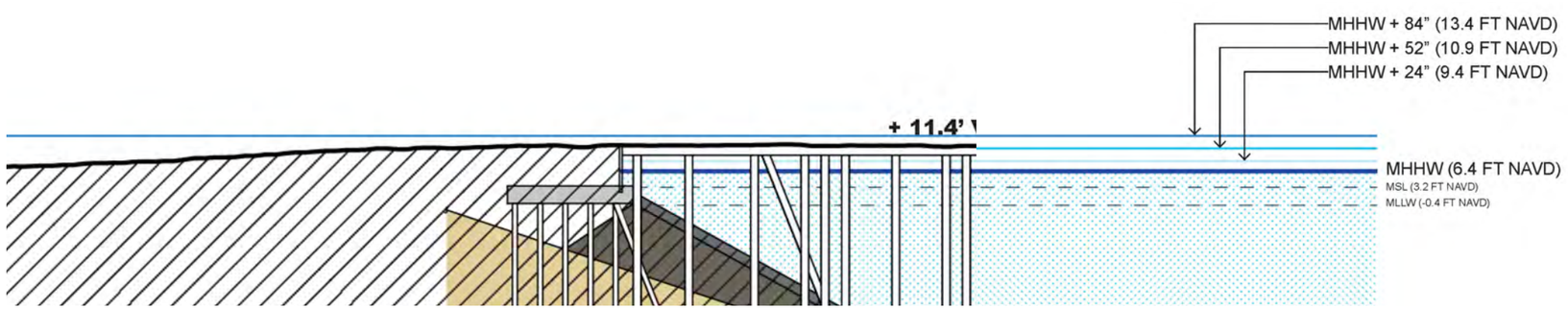


Figure 22: Existing Site Section - Pier 80

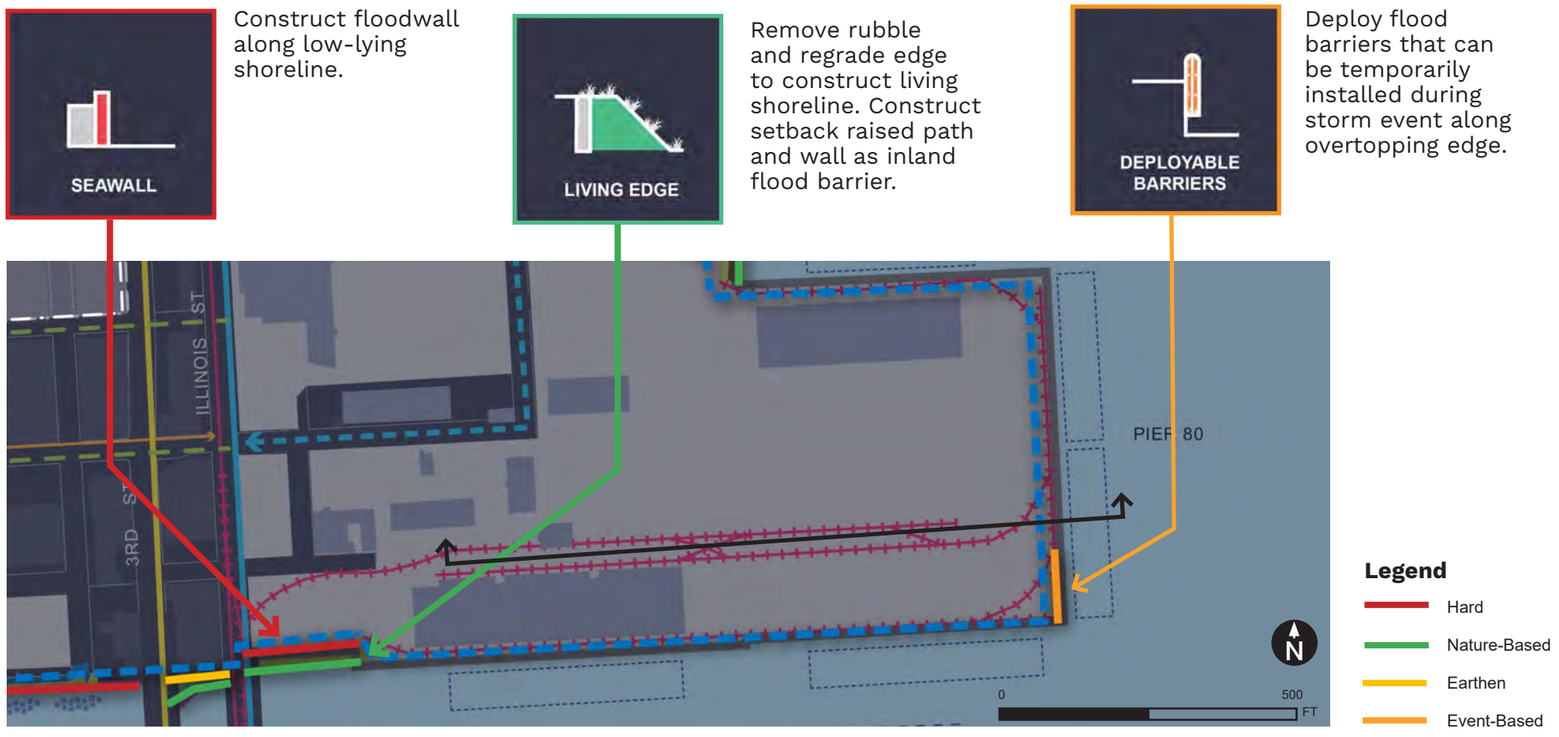


Figure 21: Toolkit Strategies By 2050

Creek Channel Crossing

Rehabilitate and replace Islais Creek Bridge and Illinois Street Bridge

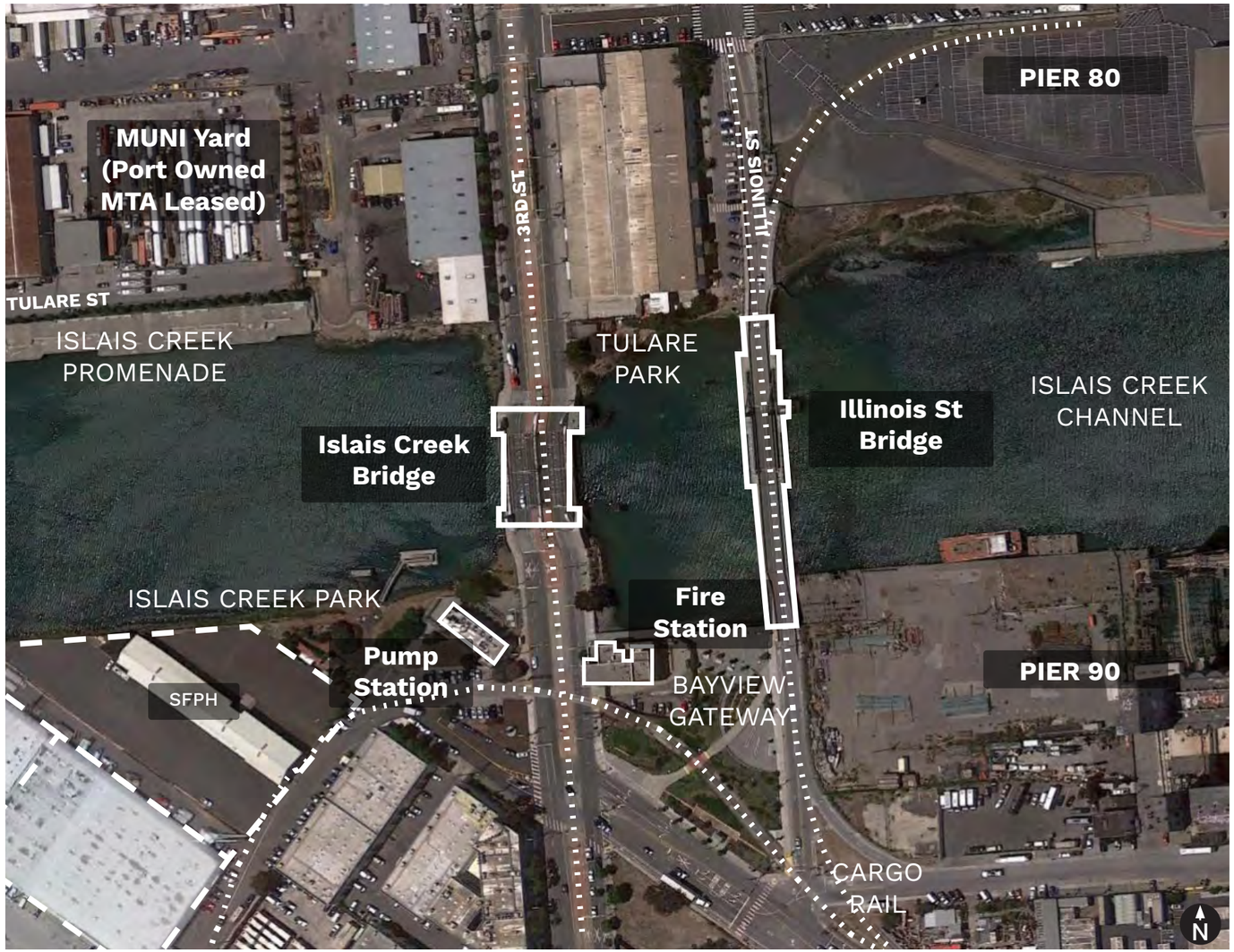
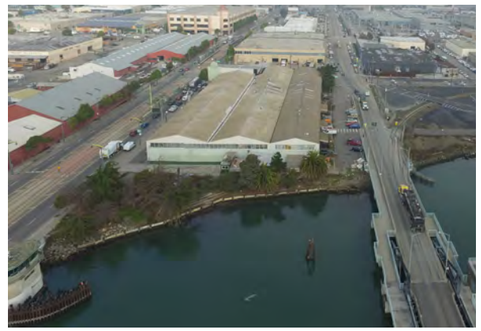


Figure 23: Existing Conditions



Tulare Park (between both bridges)

Islais Creek Bridge

Illinois Street Bridge

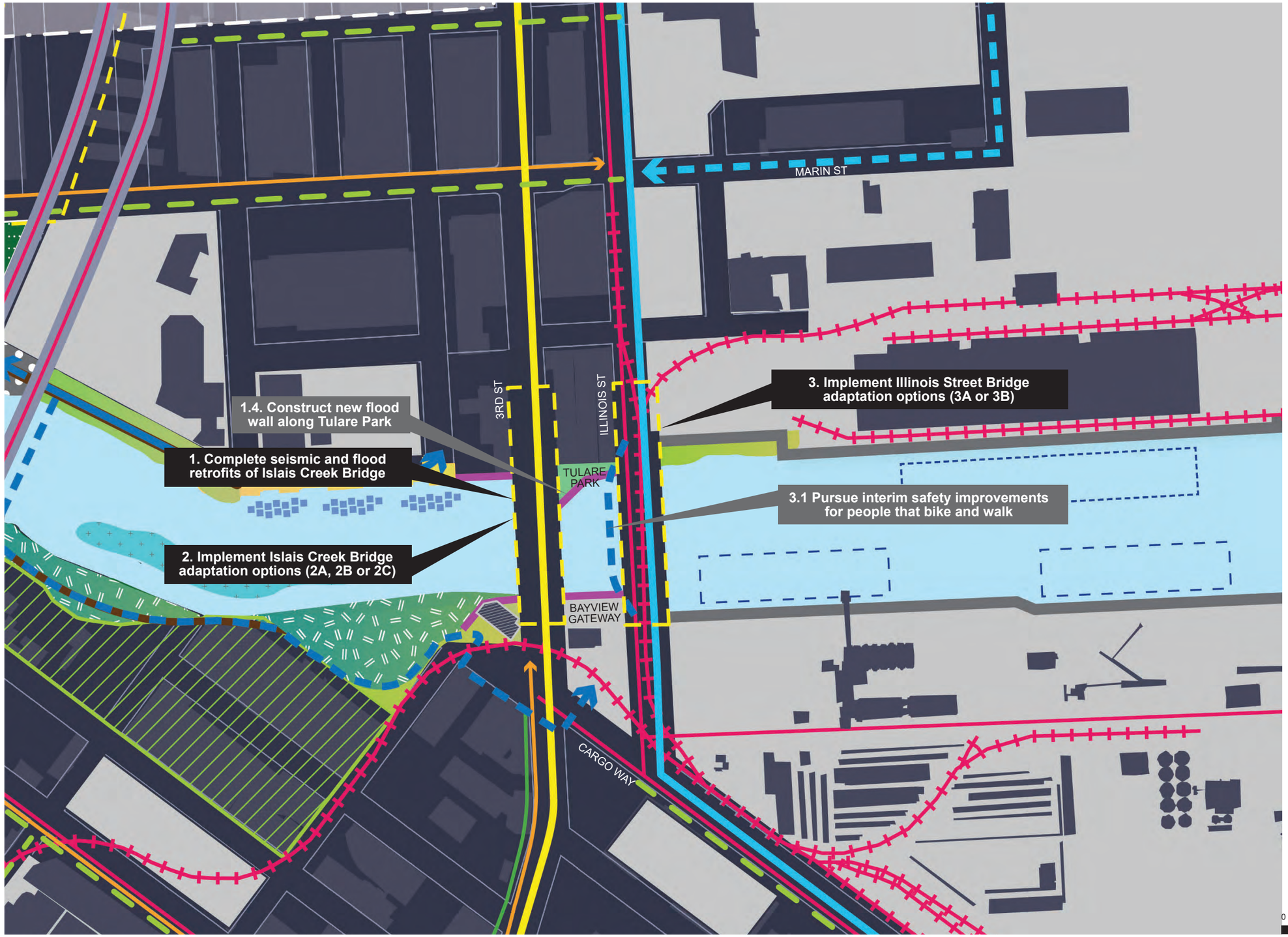
BACKGROUND:
The Islais Creek Bridge Rehabilitation Project led by Public Works is intended to extend the life of the bridge by 50 years (2070–2080). This is a rehabilitation and retrofit of the superstructure, with some upgrades to MUNI above surface that support the overhead wire.

The project is currently on hold and reached 65% Design. Estimated construction to start in 2022–2024. The project is awaiting approval on federal funding, administered through Caltrans. Current funding for the rehabilitation project is only for seismic retrofit and does not include funding for SLR related upgrades.

Additional nearby projects include replacement of SFPUC pipes in 2022 parallel to the creek and the dogleg around the Islais Creek and Illinois Street bridges.

OVERVIEW:
The Coast Guard will be consulted to change the status of the creek channel to navigable for only recreational human-powered boats (see Strategy Matrix and Adaptation Pathways). By 2080, Islais Creek Bridge is rehabilitated or replaced and would accommodate MUNI and vehicular traffic. By 2080, the Illinois Street Bridge is also replaced to accommodate truck freight between marine terminals and the regional highway system and will include bike and pedestrian improvements meeting Vision Zero standards. The need for freight rail to Pier 80 will be re-evaluated before the bridge is rebuilt. As the singular north-south bicycle route in the area, interim safety improvement for people that bike and walk will be pursued along Illinois Street and across the creek in the near term. See Figure 24.

Creek Channel Crossing STRATEGY SUMMARY



Legend

NATURE-BASED FLOOD PROTECTION
- Existing Open Space
- New or Improved Open Space
- New or Improved Marsh Wetlands
- New Floodable Park
- New Eel Grass Beds
- New Oyster Reefs
- New Beach
- New Rock Groyne
- New Green Streets

HARD FLOOD PROTECTION
- Raised & Rebuilt Pier Edge
- New Pier Edge
- New Flood Wall
- New Berm
- Replaced Bridge
- Existing Promenade or Plaza

MOBILITY
- Primary Blue Greenway
- Proposed Blue Greenway
- Existing Creek Trail
- Proposed Creek Trail
- Existing (T Third Street)
- Existing Truck Route
- Existing Freight Rail
- Existing Caltrain Line

MARITIME INDUSTRIAL
- Deep Water Berth
- General Water Berth

LAND USE
- Opportunity Area: Open Space & Mixed-Use
- City-owned Parcels (Consolidated & Optimized)
- Existing Buildings
- Project Area

NOTE: Creek crossings will likely require significantly more real estate than is shown to gain the necessary elevation with allowable vehicular and rail grades. At intersections with Cargo way or Cesar Chavez this will be an important consideration.

N

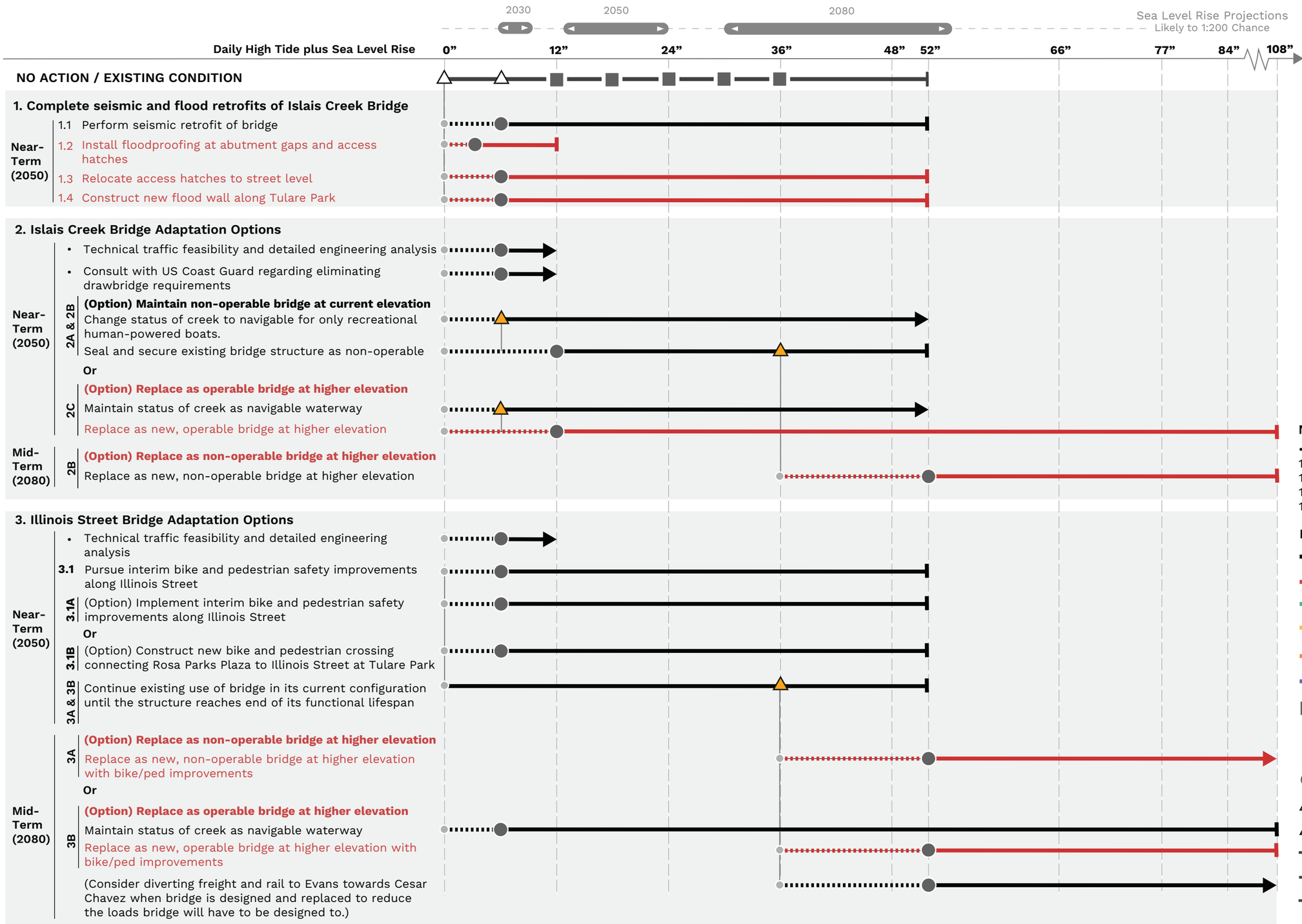
0 500 1000 FT

Figure 24: Creek Channel Crossing Strategy Summary

Creek Channel Crossing STRATEGY MATRIX

	1. Complete seismic and flood retrofits of Islais Creek Bridge	2. Islais Creek Bridge Adaptation Options	3. Illinois Street Bridge Adaptation Options
Near-Term (2050)	**Adaptation Strategies:** 1.1. Perform seismic retrofit of bridge. 1.2. Install temporary (removable) floodproofing at abutment gaps and floodproof access hatches with watertight gaskets. If floodproofing is not implemented, temporary mitigation measures such as suspending bridge lifts during storms and running sump pumps to drain the machinery pits could be implemented, Or 1.3. Relocate access hatches to street level (if feasible) 1.4. Construct new flood wall along Tulare Park, between the Islais Creek Bridge and Illinois Street Bridge. *Consider expanding the scope of the project if additional funding can be secured to implement one of the long-term adaptation options. The current rehabilitation project's life span is only for 50 years (2070-2080 planning horizon) and funding is for a seismic retrofit of the superstructure only and includes limited sea level rise related upgrades. An option to adapt to 12" SLR (possible by 2030 and likely by 2050) will be needed to protect access hatches, machinery pit and gap at abutment from flooding. One of the long-term adaptation options could be implemented if additional funding can be secured.*	**Planning and Support Strategies:** • A technical traffic feasibility analysis and detailed engineering analysis are recommended next steps. Assume bridge would continue to accommodate MUNI and vehicular traffic. These bridge projects should be phased in a way that one of the bridges remains open while the other is under construction. The priority is to rehabilitate or replace the Islais Creek Bridge first. • Consult with the United States Coast Guard regarding eliminating drawbridge requirements for the bridges over Islais Creek, which would allow construction of fixed bridges over the creek. This would have the effect of limiting vessel activity in the creek west of the bridges. The U.S. Coast Guard manages a public process to consider requests like this that affords the public a chance to comment. If the federal navigability requirements are changed to allow construction of fixed bridges, consider Options 2A and 2B. **Adaptation Strategies:** 2A & 2B (Options): Maintain as non-operable bridge at current elevation. Change status of the creek to navigable for only recreational human-powered boats. By 2030 (+12" SLR) seal and secure existing bridge structure as non-operable, to protect access hatches, machinery pit and gap at abutment from flooding through 2080 (+52" SLR). Or, 2C (Option): Replace as operable bridge at higher elevation by 2030 (+12" SLR), considering SLR anticipated over lifespan of structure (approximately 75 years). Maintain status of creek as navigable waterway. Replace as new, operable bridge at higher elevation. Consider the flood risk of access hatches, machinery pit and gap at abutment from flooding (if applicable, depending on bridge design). Replace both the sub and superstructures and the new elevation shall aim to keep the bridge's operable components out of flood risk. The approaches would be raised and sloped no steeper than 6-7% given the MUNI rail limitations. Assume the high point of the bridge is closer to the northern edge of the creek and is not centered on the creek, due to the physical constraint of the pump station and fire station and the freight rail crossing to the south. Freight track design standards for grade changes on curves are very restrictive (1.5% maximum), thus raising the freight/Muni rail crossing point will necessitate raising the freight track for a considerable distance on either side.	**Planning and Support Strategies:** • A technical traffic feasibility analysis and detailed engineering analysis are recommended next steps or next projects. These bridge projects should be phased in a way that one of the bridges remains open while the other is under construction. The priority is to rehabilitate or replace the Islais Creek Bridge first. During construction of the Islais Creek bridge, all traffic would be detoured to Evans and Cesar Chavez. During construction of the Illinois Street bridge, all traffic would be diverted to the Islais Creek bridge, except for freight, which may need to be detoured to Evans-Cesar Chavez if the new Islais Creek bridge design maintains existing turning radii constraints. **Adaptation Strategies:** 3.1. Pursue interim safety improvements for people that bike and walk along Illinois Street and across the creek in the near-term, as this is the singular north-south bicycle route in this part of the city. 3.1A (Option): Implement interim bike and pedestrian safety improvements along Illinois Street. Or, 3.1B (Option): Construct a new dedicated bike and pedestrian crossing connecting Rose Parks Plaza to Illinois Street at Tulare Park. 3A & 3B (Options): Continue existing use of bridge in its current configuration until the structures reaches the end of its functional lifespan (approximately 2080).
Mid–Term (2080)		2B (Option): Replace as non-operable bridge at higher elevation by 2080, considering SLR anticipated over lifespan of structure (approximately 75 years). Re-evaluate rail, transit, bike, and pedestrian needs and incorporate as needed into new bridge design.	3A (Option): Replace as non-operable bridge at a higher elevation. If successful with navigability status change, replace as new, non-operable bridge at higher elevation with bike/ped improvements. Or, 3B (Option): Replace as operable bridge at higher elevation. Maintain the status of the creek as a navigable waterway. Replace as new, operable bridge at a higher elevation with bike/ped improvements. *The need for freight and rail to Pier 80 will be re-evaluated when this bridge is rebuilt. Consider removing rail and diverting freight to other routes when bridge is replaced to reduce the loads bridge will have to be designed to.*

Creek Channel Crossing ADAPTATION PATHWAYS



Islais Creek Bridge (Selected Key Asset) - Summary of Strategies by 2050

Location

Flood Vulnerability

- Temporary flooding during 100-year coastal storm surge with 24" SLR.

Existing Shoreline Typology

- **Embankment - Armored (north and south banks):** Shoreline that is fully armored with riprap or broken concrete.
- **Embankment - Partially Armored (north bank):** Gradient between fully armored shoreline and unarmored earthen shoreline.
- **Structure - On Pile:** Extends out over the water and are supported by timber or concrete piles.

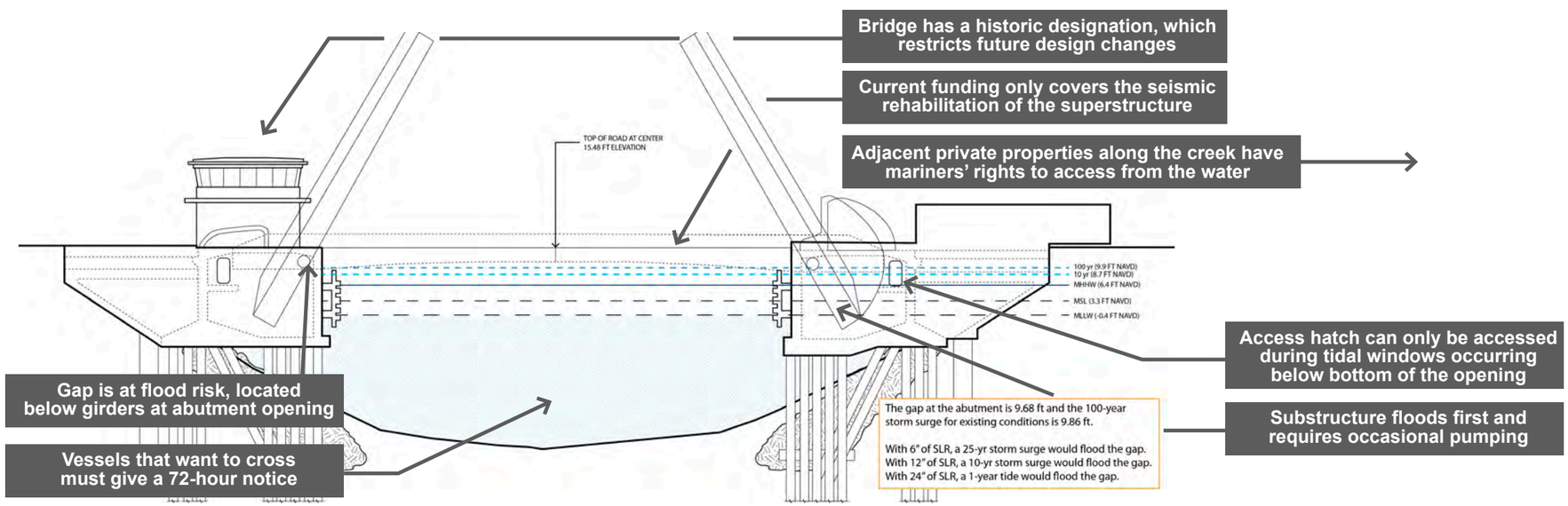


Figure 25: Existing Conditions

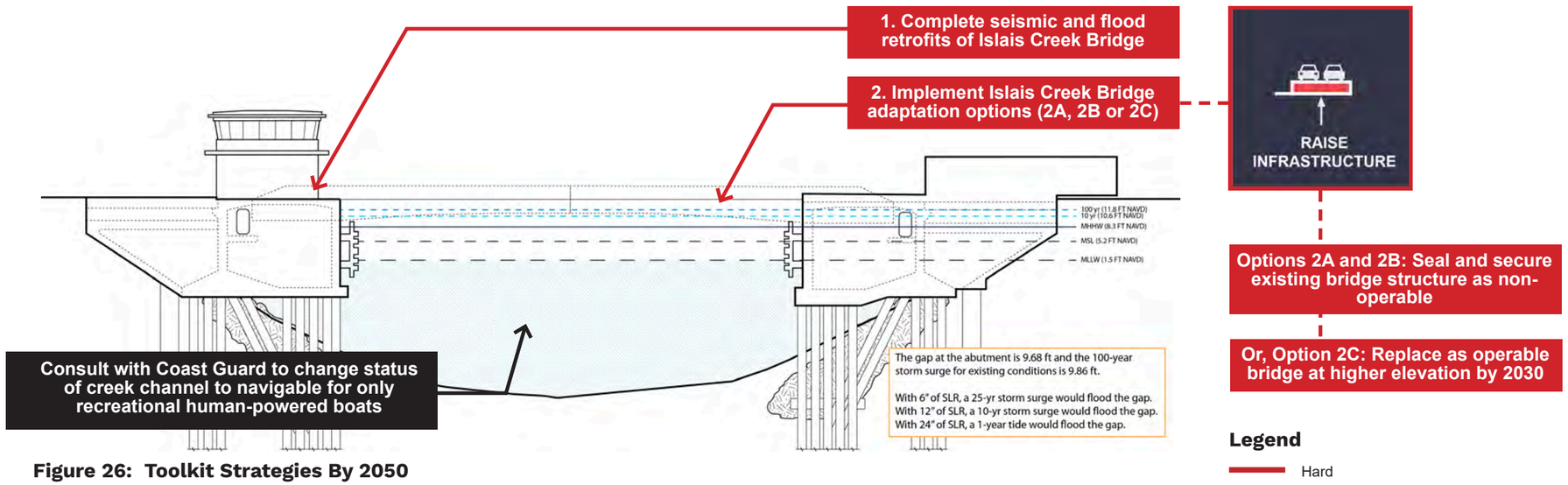


Figure 26: Toolkit Strategies By 2050

Illinois Street Bridge (Selected Key Asset) - Summary of Strategies by 2050

Location

Flood Vulnerability

- Temporary flooding during 100-year coastal storm surge with 24” SLR.

Existing Shoreline Typology

- **Embankment - Armored (north and south banks):** Shoreline that is fully armored with riprap or broken concrete.
- **Embankment - Partially Armored (north bank):** Gradient between fully armored shoreline and unarmored earthen shoreline.
- **Structure - On Pile:** Extends out over the water and are supported by timber or concrete piles.

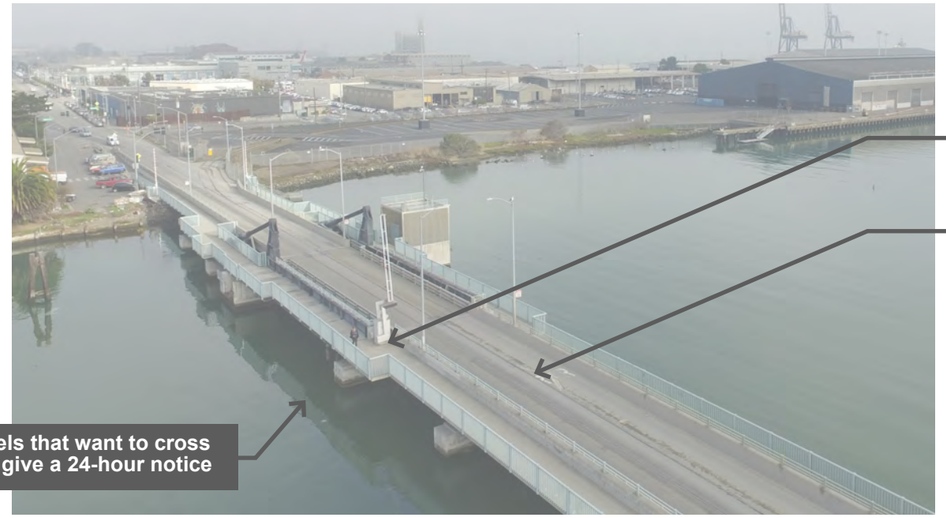


Figure 28: Existing Conditions

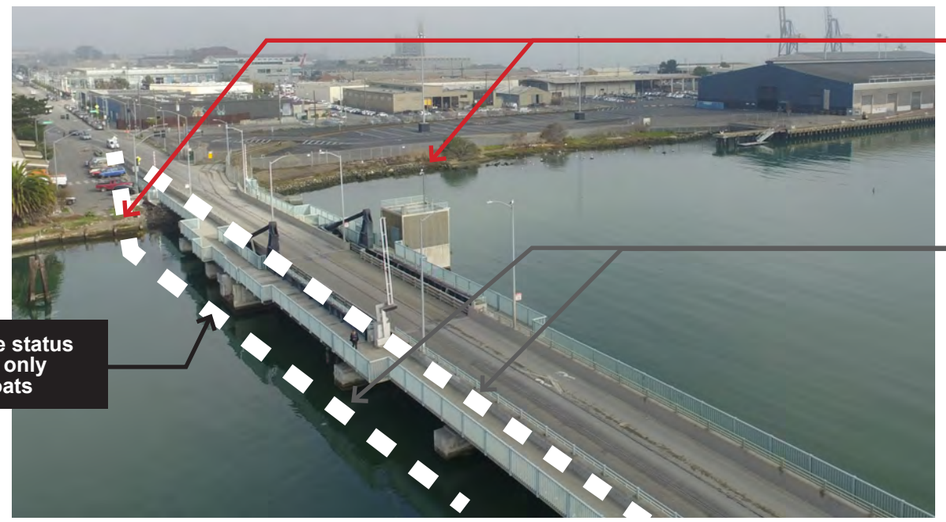


Figure 29: Toolkit Strategies By 2050

Northwestern Creek Bank

Introduce flood protection measures at critical SFMTA facilities and enhance public access to the creek channel's shoreline

Figure 30: Toolkit Strategies By 2050

BACKGROUND:
The Islais Creek Shoreline Access has a partially armored embankment and was constructed with the Bus Facility improvements in 2018. The facility is an 8.3 acre bus maintenance yard with buildings for operator, dispatch and maintenance staff. The Islais Creek Promenade was built by the SFPUC and is adjacent to the Marin Yard, which is leased to the SFMTA and owned by the Port. See Figure 30.

Islais Creek Shoreline Access

Islais Creek Shoreline Access (under I-280)

Islais Creek Bus Facility

Islais Creek Promenade and Marin Yard

Northwestern Creek Bank STRATEGY SUMMARY

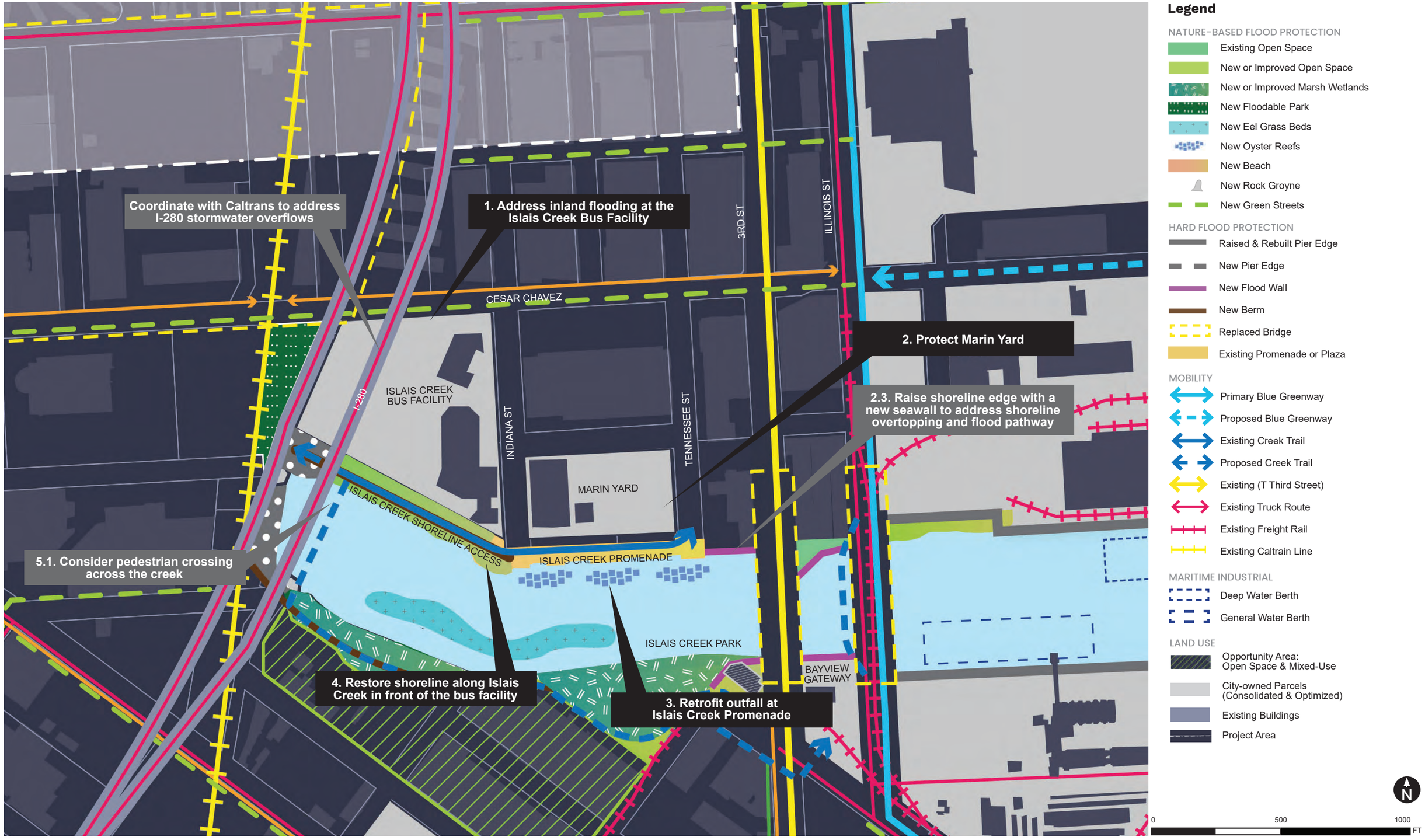
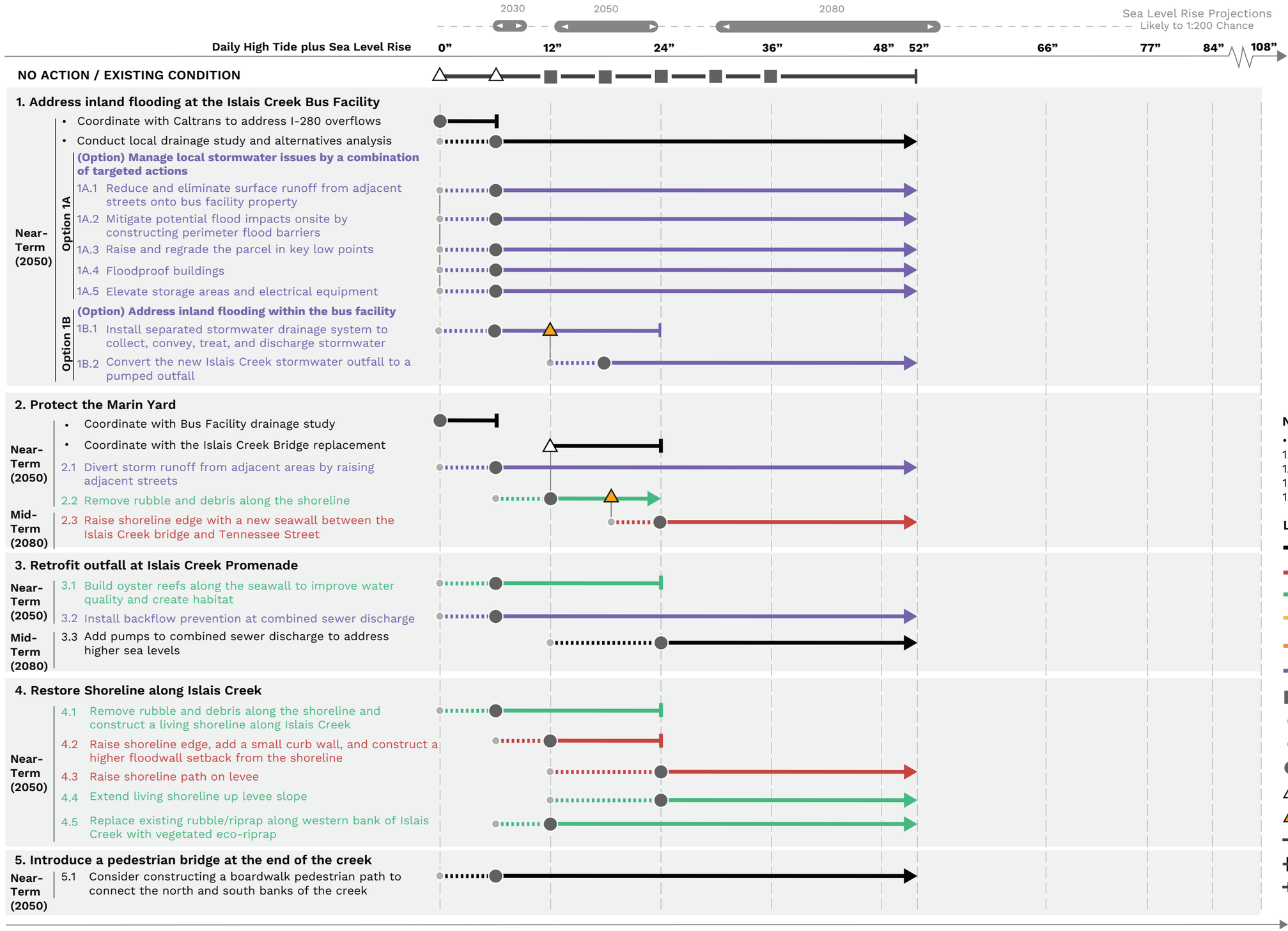


Figure 31: Northwestern Creek Bank Strategy Summary

Northwestern Creek Bank STRATEGY MATRIX

	1. Address inland flooding at the Islais Creek Bus Facility	2. Protect the Marin Yard	3. Retrofit outfall at Islais Creek Promenade	4. Restore shoreline along Islais Creek	5. Introduce a pedestrian bridge at the end of the creek
Near-Term (2050)	**Planning and Support Strategies:** • Coordinate with Caltrans to address overflows of ponded stormwater from the I-280 overpass above the bus facility. • Conduct a local drainage study and alternative analysis at the bus facility and Marin Yard to identify the causes of stormwater related flooding and evaluate potential solutions. Two high level options (described below) are identified and would be evaluated further in the study to determine technical feasibility, effectiveness, and costs and benefits of each. **Adaptation Strategies:** 1A (Option): Manage local stormwater issues by a combination of targeted actions. 1A.1: Reduce and eliminate surface runoff from adjacent streets onto bus facility property. 1A.2: Mitigate potential flood impacts onsite. Actions may include diverting offsite runoff by constructing perimeter flood barriers (permanent and temporary pop-up barriers at entry points). 1A.3: Raise and regrade low spots on the property. 1A.4: Floodproof buildings. 1A.5: Elevate storage areas and electrical/mechanical equipment off the ground and increase the frequency of storm drain maintenance. 1B (Option): Address inland flooding within the bus facility by separating the stormwater drainage system. 1B.1: Install a separated stormwater drainage system to collect, convey, treat, and discharge stormwater directly to Islais Creek. This would eliminate the connection to the combined sewer system, which currently backs up and floods low-lying areas on the bus facility property. While there would be challenges associated with permitting a new stormwater discharge point to the Bay, this may be the most effective option to address local stormwater flooding at the site. 1B.2: Convert the new Islais Creek stormwater outfall to a pumped outfall when necessary to address higher sea level conditions in the future.	**Planning and Support Strategies:** • Coordinate with the local drainage study at the Islais Creek bus facility to identify stormwater strategies that may be mutually beneficial to both sites. Ensure that actions at the bus facility do not worsen flooding issues at the Marin Yard and vice versa. • Coordinate with actions at Islais Creek Bridge. If bridge is replaced, look for opportunities to tie-in shoreline protection to bridge abutment and potentially expand public access along the shoreline. **Adaptation Strategies:** 2.1. Divert storm runoff from adjacent areas by raising adjacent streets, deploying temporary flood barriers or constructing a permanent perimeter floodwall. 2.2. Remove rubble and debris along the shoreline from Islais Creek Bridge to Tennessee Street.	**Adaptation Strategies:** 3.1. Build oyster reefs along the seawall to improve water quality and create aquatic habitat. 3.2. Install backflow prevention by 2030 (12" of SLR), at the Islais Creek North combined sewer discharge (CSD). Installation of backflow prevention at CSD is identified as a high-priority action for SFPUC.	**Adaptation Strategies:** 4.1. Remove rubble and debris along the shoreline and construct a living shoreline project along the creek bank by 2030 (12" of SLR). A living shoreline could be implemented by regrading the shoreline and placing fill to create a more gradual edge that could sustain vegetated marsh and mudflat. 4.2. Raise shoreline edge, add a small curb wall, and construct a higher floodwall setback from the shoreline to protect the bus facility by 2030 (12" of SLR). 4.3. Raise the shoreline path on the levee to protect the bus facility and address higher sea levels. 4.4. Extend living shoreline up levee slope to provide space for marsh vegetation to migrate upslope in response to SLR. 4.5. Replace existing rubble and riprap along western bank of Islais Creek with vegetated eco-riprap.	**Adaptation Strategies:** 5.1. Consider constructing a new pedestrian crossing (e.g. boardwalk or floating walkway) to connect the north and south banks of the creek. This would contribute towards creation of a complete loop of the western portion of the creek for pedestrians and bikes. The recommended location is further inland from Islais Creek Bridge, but outside of I-280 ROW to comply with Caltrans standards.
Mid–Term (2080)		2.3. Raise shoreline edge with a new seawall to address shoreline overtopping and flood pathway from Islais Creek Bridge to Tennessee Street.	3.3. Install pumps at the Islais Creek North CSD when needed to address higher sea levels in the future.		

Northwestern Creek Bank ADAPTATION PATHWAYS



Islais Creek Bus Facility (Selected Key Asset) - Summary of Strategies by 2050

Location

Flood Vulnerability

- Widespread temporary flooding during 100-year coastal storm surge with 12” SLR.

Existing Shoreline Typology

- **Embankment - Partially Armored:** Between fully armored shoreline and unarmored earthen shoreline.

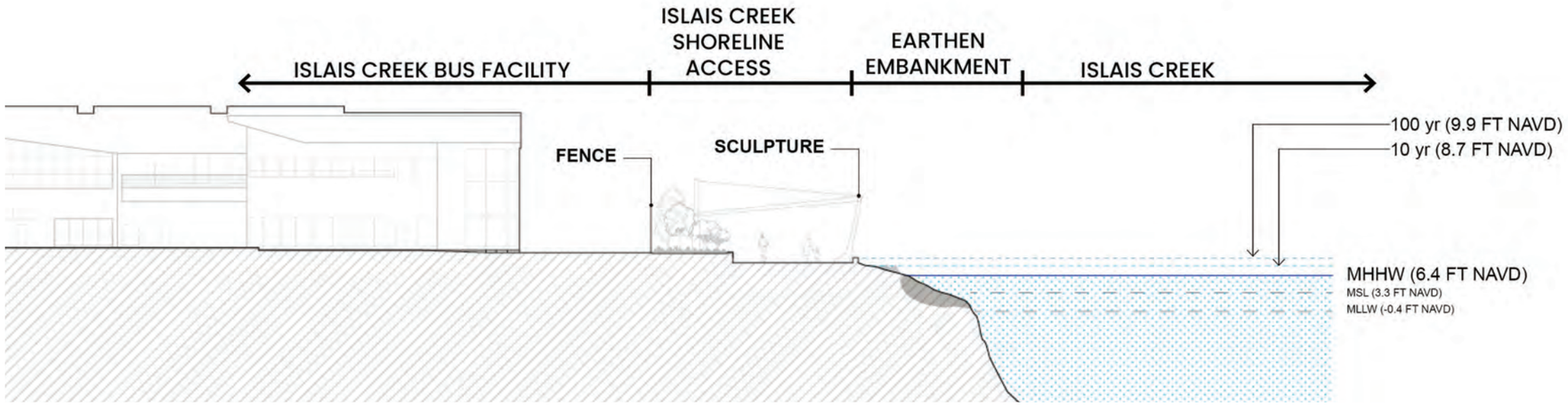


Figure 32: Existing Conditions

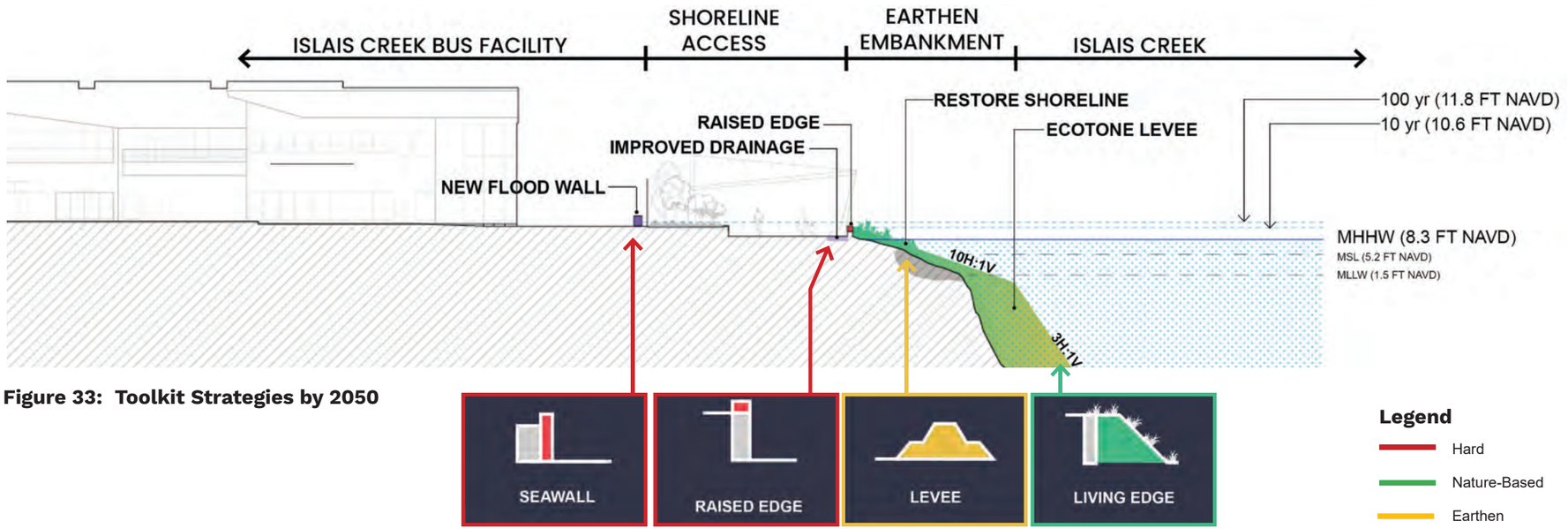


Figure 33: Toolkit Strategies by 2050

Marin Yard (Selected Key Asset) - Summary of Strategies by 2050

Location

Flood Vulnerability

- Widespread temporary flooding during 100-year coastal storm surge with 12” SLR.

Existing Shoreline Typology

- **Structure - Bulkhead:** Hard vertical surfaces, generally constructed out of concrete or metal.

Figure 34: Existing Conditions

Figure 35: Toolkit Strategies by 2050

Coordinate with the local drainage study at the Islais Creek bus facility to identify stormwater strategies that may be mutually beneficial to both sites.

Coordinate with actions at Islais Creek Bridge. If bridge is replaced, look for opportunities to tie-in shoreline protection to bridge abutment and potentially expand public access along the shoreline.

Southwestern Creek Bank

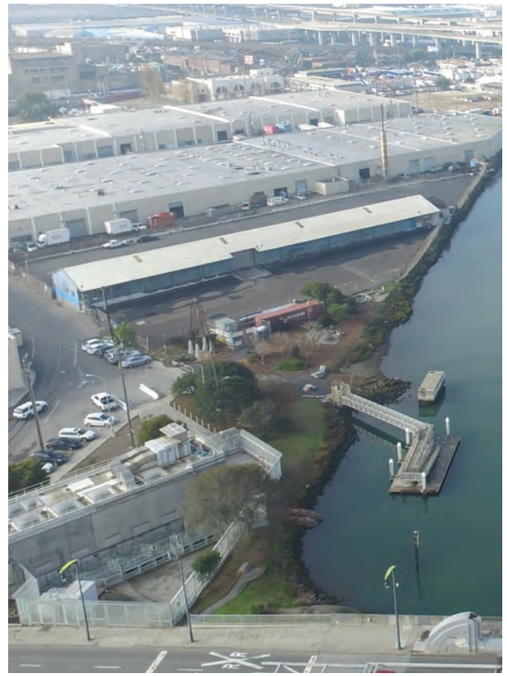
Create new tidal marsh and expand Islais Creek Park

Figure 36: Existing Conditions

BACKGROUND:
The shoreline along the southwestern bank of the channel is a partially armored embankment and vulnerable to coastal flooding and overtopping with the 100-year coastal storm surge.

Islais Creek Park is a sloped beach with an revetment embankment and includes a kayak launch (gangway).

The Booster Pump Station is located close to the shoreline edge and is an abovegrade pump station that serves the Southeast Treatment Plant. It is located immediately west of the Islais Creek Bridge. See Figure 36.



View of Southwestern Creek Bank

View from the channel towards SFPH and Theodore R sites

Southwestern Creek Bank STRATEGY SUMMARY

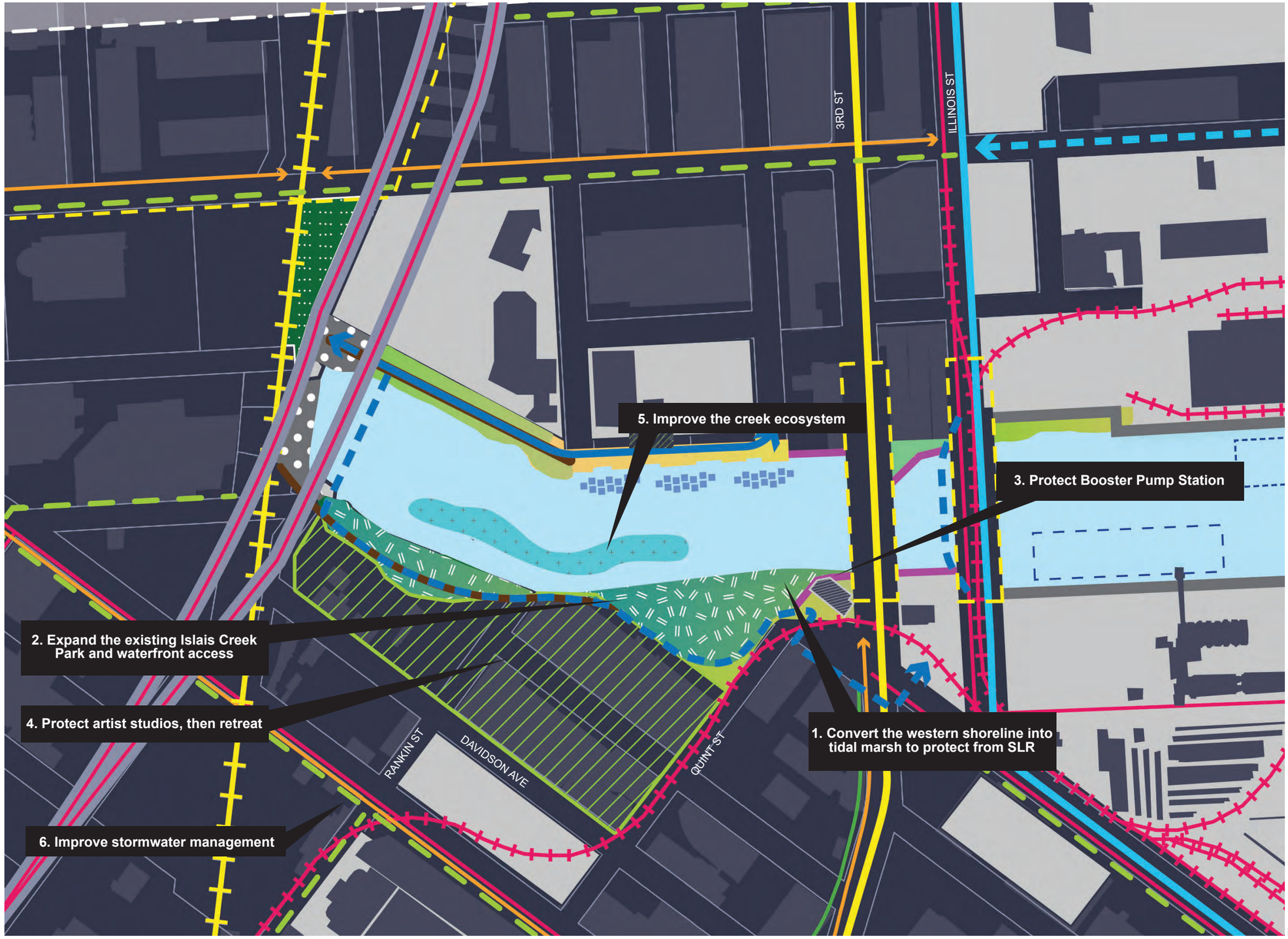
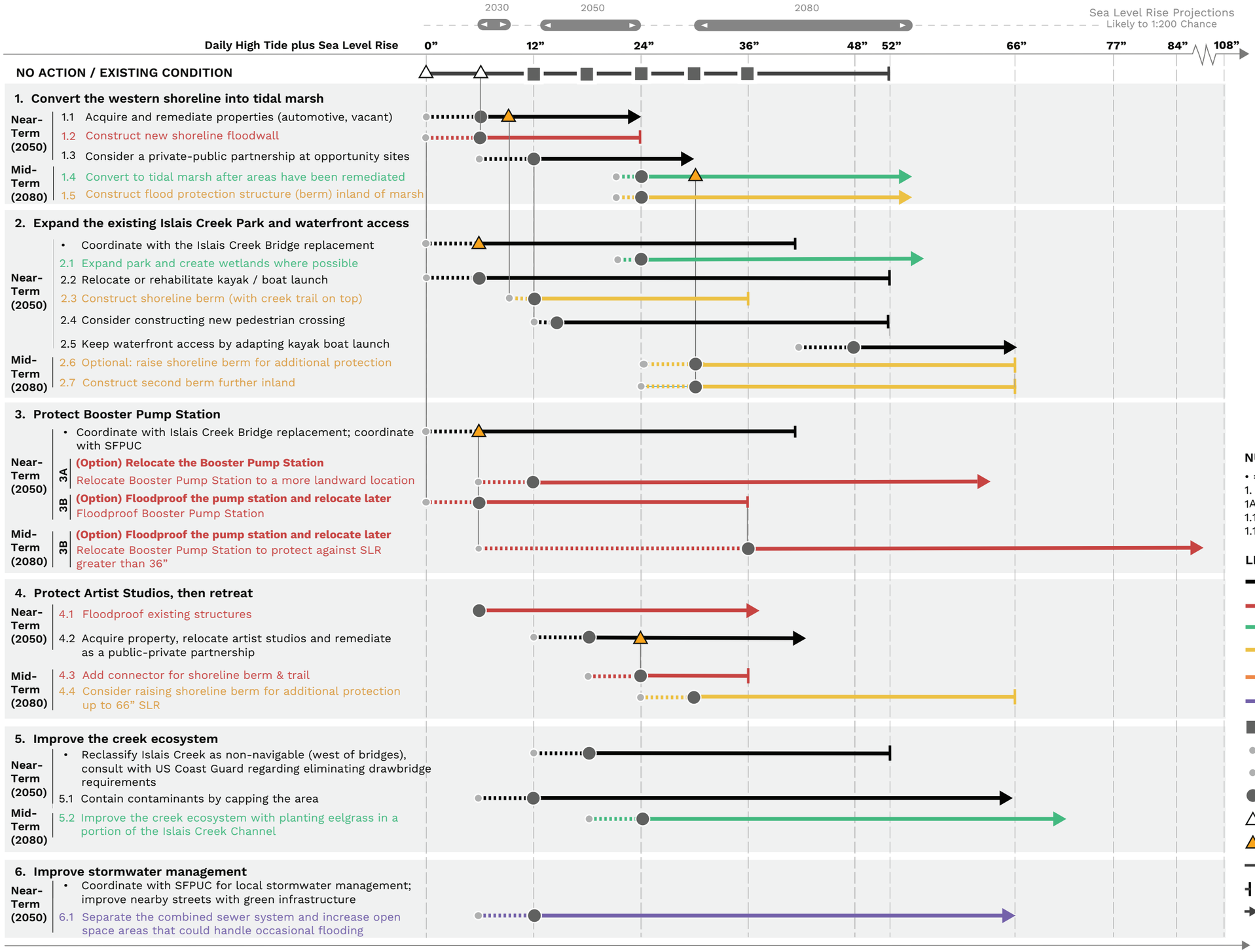


Figure 37: Southern Creek Bank Strategy Summary

Southwestern Creek Bank STRATEGY MATRIX

	1. Convert the western shoreline into tidal marsh to protect from SLR	2. Expand the existing Islais Creek Park and waterfront access	3. Protect Booster Pump Station	4. Protect artist studios, then retreat	5. Improve the creek ecosystem	6. Improve stormwater management
Near-Term (2050)	**Adaptation Strategies:** 1.1. Acquire and remediate properties (automotive, vacant property next to Park) 1.1.1. Acquire properties 1.1.2. Remediate contaminants in the existing fill area of the properties 1.2. Construct a new shoreline floodwall 1.2.1. Remove rubble and riprap along the shoreline 1.2.2. Construct a sheet pile floodwall to provide limited flood mitigation through 24" of SLR (Any existing sheet pile wall may require a condition assessment and possible removal before a new sheet pile wall is constructed.) 1.3. Consider a public-private partnership at opportunity sites to consolidate uses and protect them from flooding. These areas could be converted into a shared open space and development project, with the goal of keeping artists' studios and other existing uses.	**Planning and Support Strategies:** • Coordinate with the Islais Creek Bridge replacement. **Adaptation Strategies:** 2.1. Expand the existing Islais Creek Park and create wetlands where possible. 2.2. Relocate or rehabilitate the existing kayak launch to maintain public water access. (With community users, re-design with flood adaptation to 52" SLR, consider beach area or gangway). 2.3. Construct a shoreline berm and transform to shoreline park and wetlands. The berm would be engineered, likely a small earthen or ecotone levee, and serve as the first line of defense against coastal flooding and protects up to 36" SLR. It would separate the new bayside tidal wetlands from the landside area and could be designed with a creek trail on top. This will serve as a new continuous creek trail to improve waterfront access. Coordinate with pedestrian creek crossing project. 2.4. Consider constructing a new pedestrian crossing (e.g. boardwalk or floating walkway) to connect the north and south banks of the creek. This would contribute towards creation of a complete loop of the western portion of the creek for pedestrians and bikes. The recommended location is further inland from Islais Creek Bridge, but outside of I-280 ROW to comply with Caltrans standards.	**Planning and Support Strategies:** • Coordinate with Islais Creek Bridge replacement; coordinate with owner SFPUC (The station currently pumps treated effluent from the Southeast Treatment Plant to the Bay through the Southeast Bay Outfall. Relocation or replacement of the pump station could be timed with the permanent raising of Islais Creek Bridge (Reach 2– Creek Crossing), due to the close proximity of the two structures. **Adaptation Strategies:** 3A (Option): Relocate the Booster Pump Station to a more landward location outside the SLR vulnerability zone. 3B (Option): Floodproof the Booster Pump Station and relocate later (Floodproofing and associated maintenance requirements could be done within the operations and maintenance planning for the facility. Floodproofing could allow the Booster Pump Station to remain at its current site beyond 36" SLR).	**Adaptation Strategies:** 4.1. Floodproof existing structures: Current owners could floodproof to address current and near-term urban stormwater risk. 4.2. Acquire property, relocate artist studios, and remediate as a public-private partnership.	**Planning and Support Strategies:** • Reclassify Islais creek as non-navigable (west of bridges), consult with US Coast Guard regarding eliminating drawbridge requirements and identify ecosystem enhancement pilot studies to create habitat and improve water quality. **Adaptation Strategies:** 5.1. Contain contaminants (if required in addition to remediating) by capping the area.	**Planning and Support Strategies:** • Coordinate with SFPUC for local stormwater management, including the Port's separated stormwater system on Port lands. In coordination with SFPUC, local stormwater management techniques (e.g. collection, conveyance) must be incorporated into all coastal defense and other infrastructure actions to minimize surface ponding and localized flooding. • Improve nearby streets with green infrastructure. **Adaptation Strategies:** 6.1 Separate the combined sewer system and increase open space areas that could handle occasional flooding to improve stormwater management on non-Port lands.
Mid–Term (2080)	1.4. Convert to tidal marsh after area has been remediated. 1.5. Construct a flood protection structure or berm inland of the tidal marsh and allow the marsh to gradually migrate landward toward this second line of defense as sea level rises.	2.5. Keep waterfront access by adapting kayak boat launch to rising water levels. 2.6. Option: Raise shoreline berm for additional protection up to 66" SLR (could conflict with (1) tidal marsh creation) and create an opportunity area for public/private partnership. 2.7. Construct second berm further inland; expand park; optional trail on inland berm around park. (2nd berm would be constructed to a higher elevation, with protection up to 66" SLR.). The role of the shoreline berm (i.e., the first line of defense) will gradually shift from providing flood protection from extreme coastal storms to providing protection from smaller storms.	3B (Option): Relocate the Booster Pump Station to protect against SLR greater than 36".	4.3. Add connector for shoreline berm and trail. 4.4. Consider raising shoreline berm for additional protection up to 66" SLR, convert to flood-proofable multiuse opportunity area; optional trail on shoreline berm (could be in conflict with tidal marsh creation).	5.2. Improve the creek ecosystem with planting eelgrass in a portion of the Islais Creek Channel (timing would depend on navigation requirements, as eelgrass is not compatible with dredging due to increased suspended sediments and turbidity).	

Southwestern Creek Bank ADAPTATION PATHWAYS



Southeastern Shoreline

Optimize the Port's maritime cargo and industrial areas (Pier 94-96 and Backlands) to facilitate sustainable economic growth and deliver local community benefits

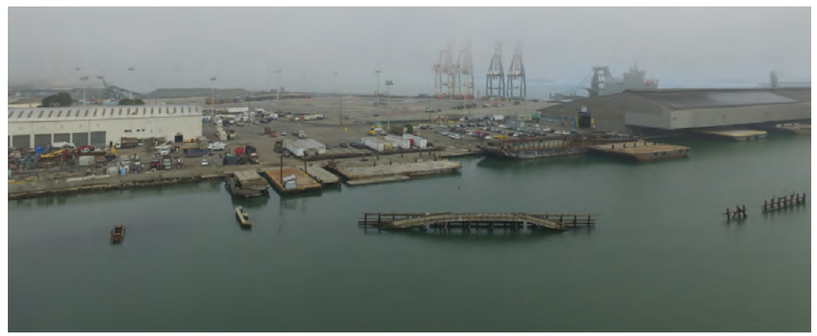
Existing Conditions

Figure 38: Existing Conditions

Background:
The shoreline from Pier 90 to 96 is a combination of piers/ wharfs on piles, bulkhead structures, partially armored embankment and marsh. The Port of San Francisco has jurisdiction over these piers, as well as the upland area known as the Maritime Eco-Industrial Backlands. Most of the city's maritime cargo operations are located here, along with Pier 80 in Reach 1. See Figure 28.

Piers 90, 92, and 94 Wetlands

Backlands



Pier 96 (view from Lash Lighter Basin)

Southeastern Shoreline STRATEGY SUMMARY

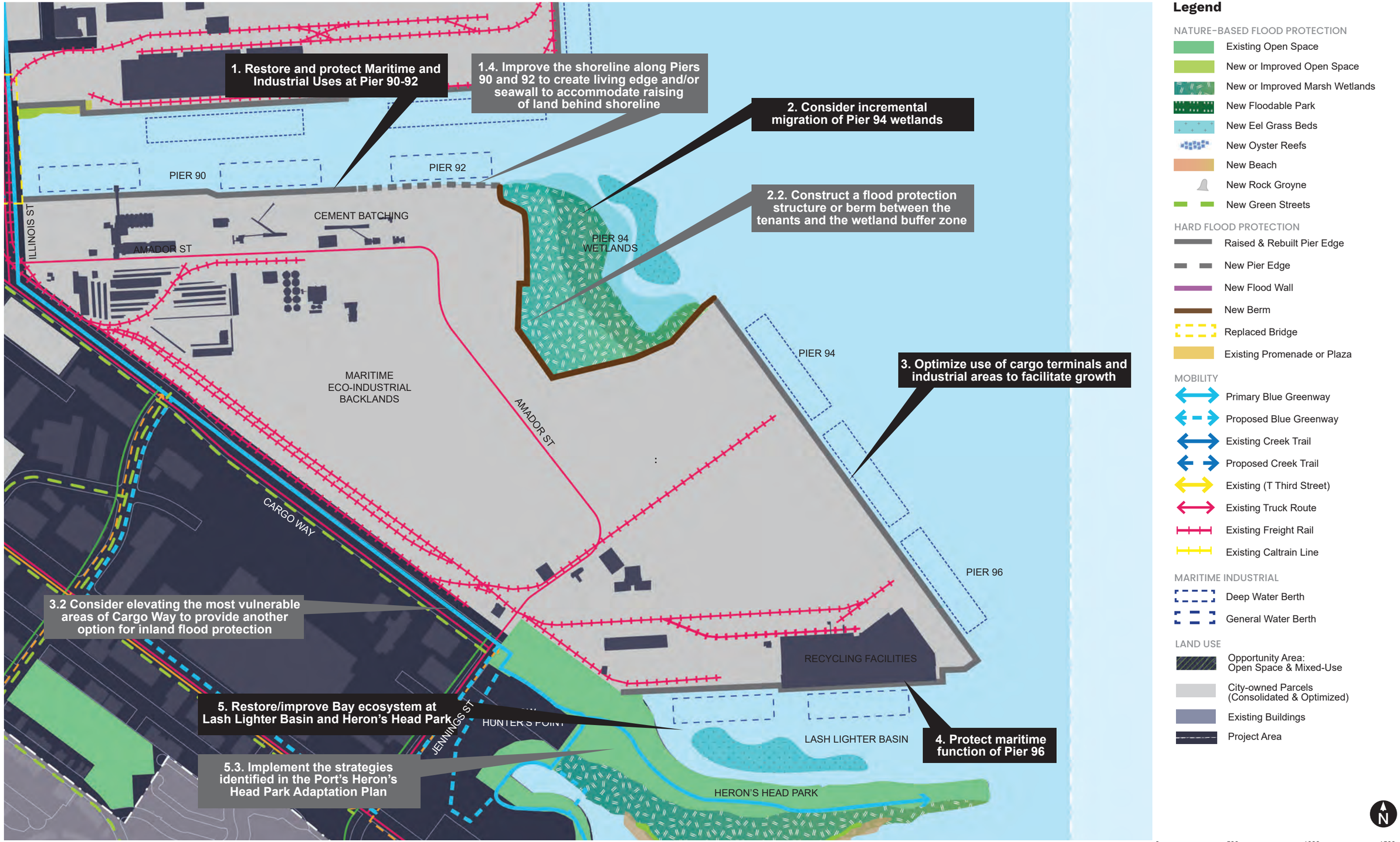
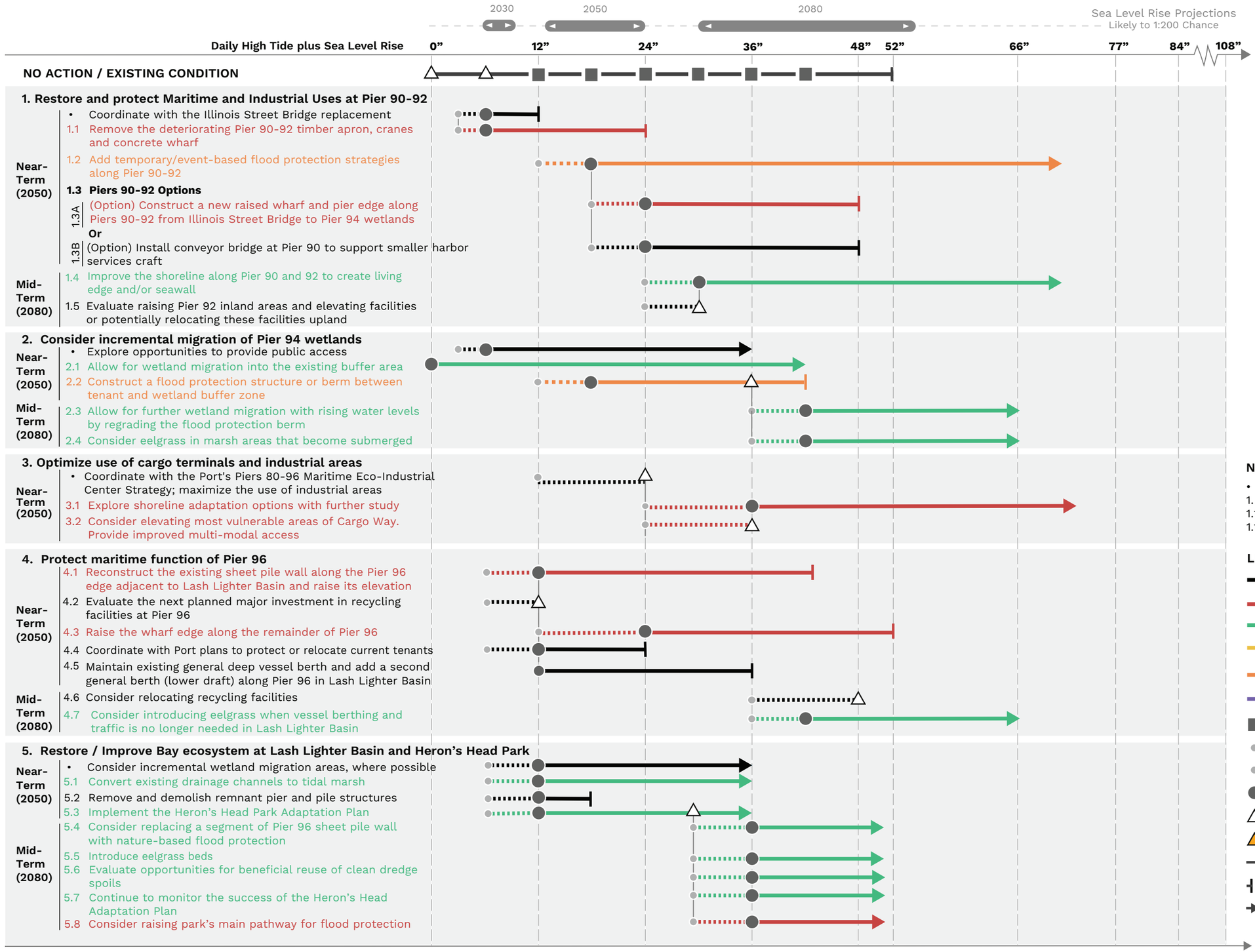


Figure 39: Southeastern Shoreline Strategy Summary

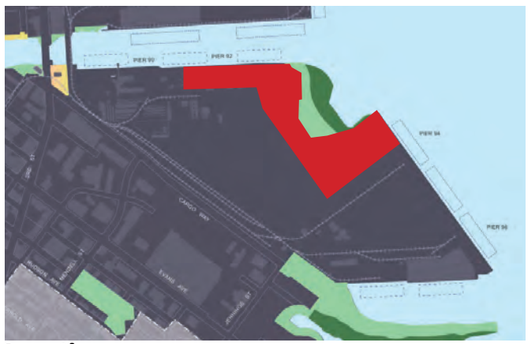
Southeastern Shoreline STRATEGY MATRIX

	1. Restore and protect Maritime and Industrial Uses at Pier 90-92	2. Consider incremental migration of Pier 94 wetlands	3. Optimize use of cargo terminals and industrial areas to facilitate growth	4. Protect maritime function of Pier 96	5. Restore/improve Bay ecosystem at Lash Lighter Basin and Heron's Head Park
Near-Term (2050)	**Planning and Support Strategies:** • Coordinate with the Illinois Street Bridge replacement to ensure continuous coastal protection. **Adaptation Strategies:** 1.1. Remove the deteriorating Pier 90-92 timber apron, cranes and concrete wharf, while preserving bulk cargo and cement batch plant functions at Pier 92. 1.2. Add temporary/event-based flood protection strategies along Pier 90-92 (e.g. sandbags or deployables) 1.3. Piers 90-92 Options: 1.3A: (Option) Construct a new raised wharf and pier edge along Piers 90-92 from the Illinois Street Bridge to the Pier 94 wetlands. The wharf would support one existing and one new berth and additional maritime functions (allow sufficient distance between vessel berths and the bridge). 1.3B: (Option) Install conveyor bridge at Pier 90 to support smaller harbor services craft. Improve dry bulk barge unloading facilities at Pier 92 by installing offshore mooring dolphins, offshore dry-bulk hopper, and elevated conveyor bridge to transfer material over shoreline to land.	**Planning and Support Strategies:** • Explore opportunities to provide public access to the Pier 94 wetlands area in consultation with the Port and San Francisco Audubon Society, considering the impacts on habitat areas and public safety priorities for cargo-industrial operations on the surrounding marine terminal. **Adaptation Strategies:** 2.1. Allow for wetland migration into the existing buffer area and up to the edge of the aggregate/sand import leasehold boundary (line of defense), given that the existing Pier 94 wetlands are low-lying areas vulnerable to permanent flooding by 2050. 2.2. Construct a flood protection structure or berm between the tenants and the wetland buffer zone.	**Planning and Support Strategies:** • Coordinate with the Port's Piers 80-96 Maritime Eco-Industrial Center Strategy to look for opportunities to optimize the current terminal and industrial areas. • Maximize the use of industrial areas designated as Priority Production Areas within MTC/ABAG's Plan Bay Area. **Adaptation Strategies:** 3.1. Explore shoreline adaptation options with further study that maintain maritime terminal berth functions, including the feasibility of shifting shoreline adaptation further inland with new vessel berthing and cargo conveyance infrastructure that could reach deep water berths Bayward of the shoreline. 3.2. Consider elevating the most vulnerable areas of Cargo Way to provide another option for inland flood protection and a resilient connection between Hunters Point and other parts of the City by advancing the Cargo Way plan. Provide improved multi-modal access and improved north-south access to Bayview and Hunters Point Shipyard. Cargo Way and companion flood improvements would be a secondary "line of defense" for backland areas.	**Adaptation Strategies:** 4.1. Reconstruct the existing sheet pile wall along the Pier 96 edge adjacent to Lash Lighter Basin and raise its elevation for flood protection. This reach is the most vulnerable stretch of shoreline in the study area. 4.2. Evaluate the next planned major investment in recycling facilities at Pier 96 in tandem with reconstructing the sheet pile wall. Consider elevating this facility or relocating later to a more protected location to retain these facilities in the general area to retain jobs for the District. 4.3. Raise the wharf edge along the remainder of Pier 96. 4.4. Coordinate with Port plans to protect or relocate the current tenants. 4.5. Maintain existing general vessel berth and add a second general berth (lower draft) along Pier 96 in Lash Lighter Basin. Maintain existing deep vessel berths along the Pier 96 Bay edge.	**Planning and Support Strategies:** • Consider incremental wetland migration areas, where possible. **Adaptation Strategies:** 5.1. Convert existing drainage channels to tidal marsh at toe of slope of Pier 96 backlands. 5.2. Remove and demolish any remnant pier and pile structures within Lash Lighter Basin. 5.3. Implement the strategies identified in the Port's Heron's Head Park Adaptation Plan.
Mid–Term (2080)	1.4. Improve the shoreline along Piers 90 and 92 to create living edge and/or seawall to accommodate raising of land behind shoreline. 1.5. Evaluate raising Pier 92 inland areas and elevating facilities or potentially relocating these facilities upland at the end of the useful life of existing batch operations at Pier 92, with conveyor access to berths on the south side of the Creek.	2.3. Allow for further wetland migration with rising water levels by regrading the flood protection berm if Bay Area regional cargo forecasts or BCDC's Seaport Plan Priority Use Areas are modified such that port terminal area is no longer reserved for maritime-industrial and harbor serving purposes. This area could be used to provide additional upland transition and wetland migration space for the existing marsh. 2.4. Consider eelgrass in the marsh areas that become submerged when maritime use eases and as water levels rise. Note that existing water depths Bayward of the existing marsh are likely too deep to support eelgrass.		4.6. Consider relocating recycling facilities outside of the future floodplain, but nearby, to retain employment for the District. 4.7. Consider introducing eelgrass when vessel berthing and traffic is no longer needed in Lash Lighter Basin, to enhance habitat in this area, (see Strategy 5).	5.4. Consider replacing a segment of Pier 96 sheet pile wall immediately west of the Pier 96 shed (adjacent to Heron's Head Park) with nature-based flood protection and expanded open space to connect with the park and Eco Center, if Bay Area regional cargo forecasts or BCDC's Seaport Plan Priority Use Areas are modified such that port terminal area is no longer reserved for maritime-industrial and harbor serving purposes. 5.5. Introduce eelgrass beds by 2050 to promote sediment accretion, improve water quality, enhance creek biodiversity, and protect the northern shoreline of Heron's Head Park. 5.6. Evaluate opportunities for beneficial reuse of clean dredge spoils for purposes of improved nearshore habitat and tidal marsh in this area of the waterfront. 5.7. Continue to monitor the success of the Heron's Head adaptation plan to assess if longer term adaptation strategies are needed.

Southeastern Shoreline ADAPTATION PATHWAYS



Pier 92-94 (Key Asset) - Summary of Strategies by 2050



Location

Flood Vulnerability

- Some permanent inundation with 24” SLR
- Temporary flooding during 10-year coastal storm surge with 0” SLR.

Existing Shoreline Strategy

- **Structure - Bulkhead:** Hard vertical surfaces, generally constructed out of concrete or metal.
- **Structure - On Pile:** Extends out over the water and are supported by timber or concrete piles.
- **Embankment - Revetment:** Armored embankments refer to shoreline that is fully armored with riprap or broken concrete.

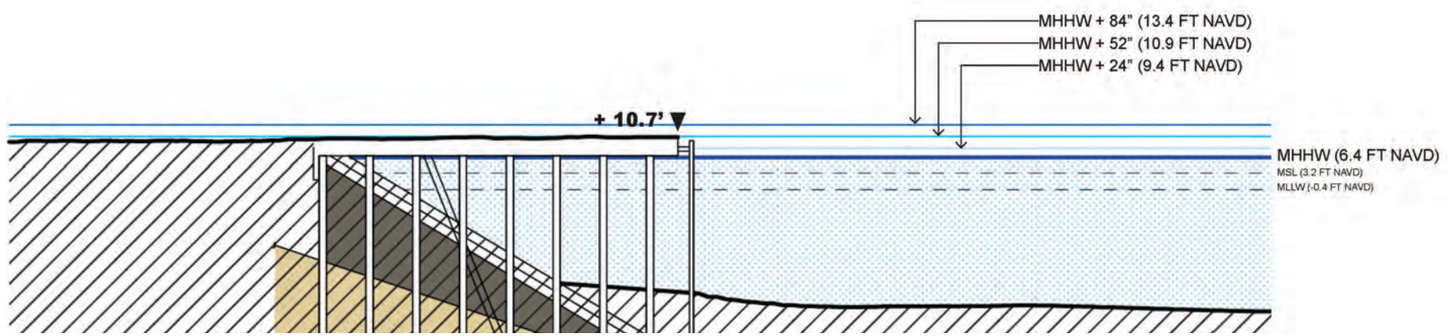


Figure 40: Existing Conditions

1.2. Add temporary/ event-based fl ood protection strategies along Pier 90-92 (e.g. sandbags or deployables).

2.1. Allow for wetland migration into the existing buffer area and up to the edge of the aggregate/sand import leasehold boundary (line of defense).

4.1. Reconstruct the existing sheet pile wall.

2.2. Construct a flood protection structure or berm between the tenants and the wetland buffer zone.

Legend

- Hard
- Nature-Based
- Earthen
- Event-Based

Figure 41: Toolkit Strategies by 2050

Pier 96 (Key Asset) - Summary of Strategies by 2050

Location

Flood Vulnerability

- Some permanent inundation with 24” SLR
- Temporary flooding during 10-year costal storm surge with 0” SLR.

Existing Shoreline Typology

- **Structure - Bulkhead:** Hard vertical surfaces, generally constructed out of concrete or metal.

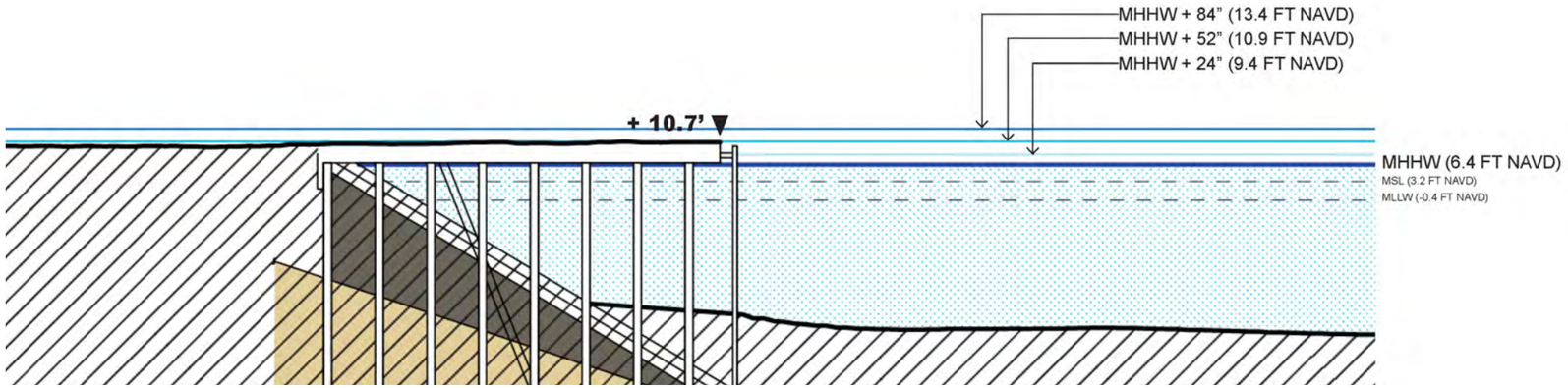
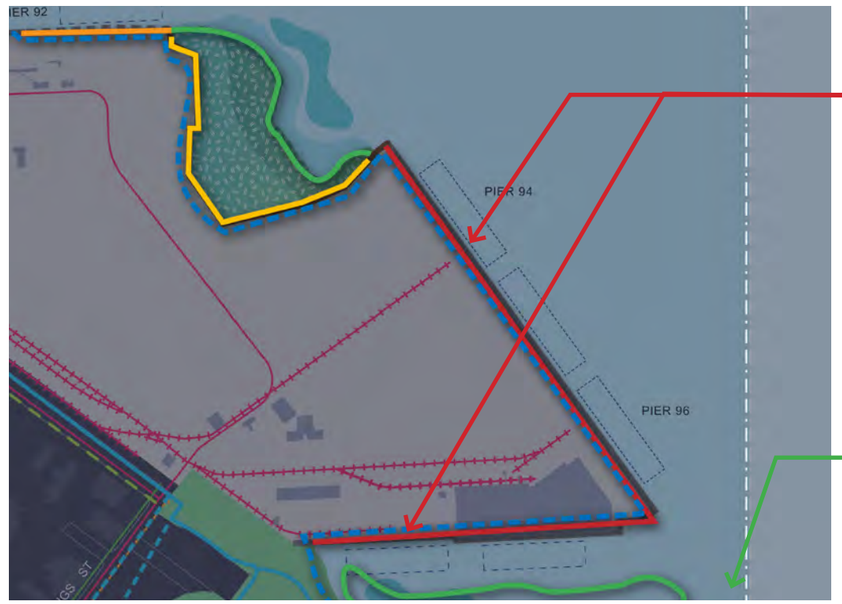


Figure 42: Existing Conditions



Legend

Hard

Nature-Based

4.1. Reconstruct the existing sheet pile wall long the Pier 96 edge adjacent to Lash Lighter Basin and raise its elevation for flood protection.

4.3. Raise the wharf edge along the remainder of Pier 96.

5. Restore/improve Bay ecosystem at Lash Lighter Basin.

5.3. Implement the strategies identified in the Port’s Heron’s Head Park Adaptation Plan.

Figure 43: Toolkit Strategies by 2050

Backlands (Key Asset) - Summary of Strategies by 2050

Location

Flood Vulnerability

- No exposure to temporary or permanent flooding with 24” SLR or 52” SLR.

Existing Shoreline Strategy

- Adjacent to partially Armored Embankment (Pier 94 Wetlands) and Structure On Pile (Pier 80).

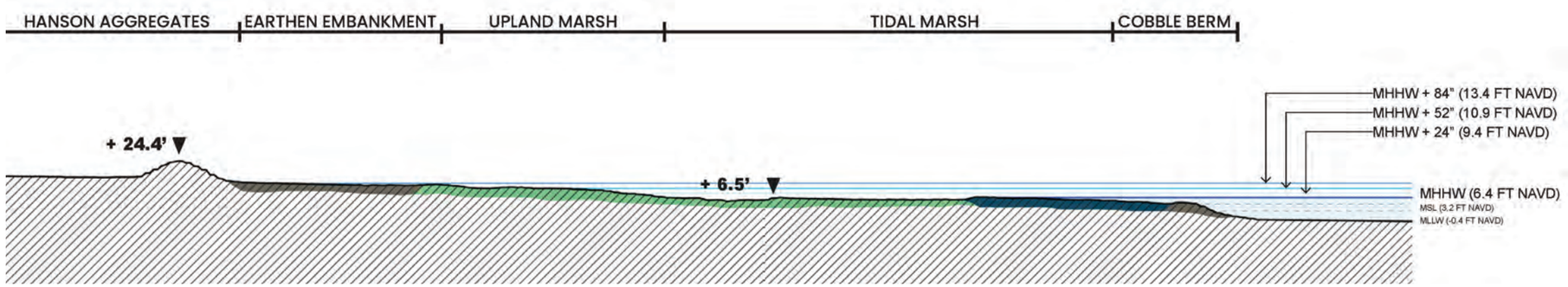


Figure 44: Existing Site Section (through Backlands and Pier 94 Wetlands)

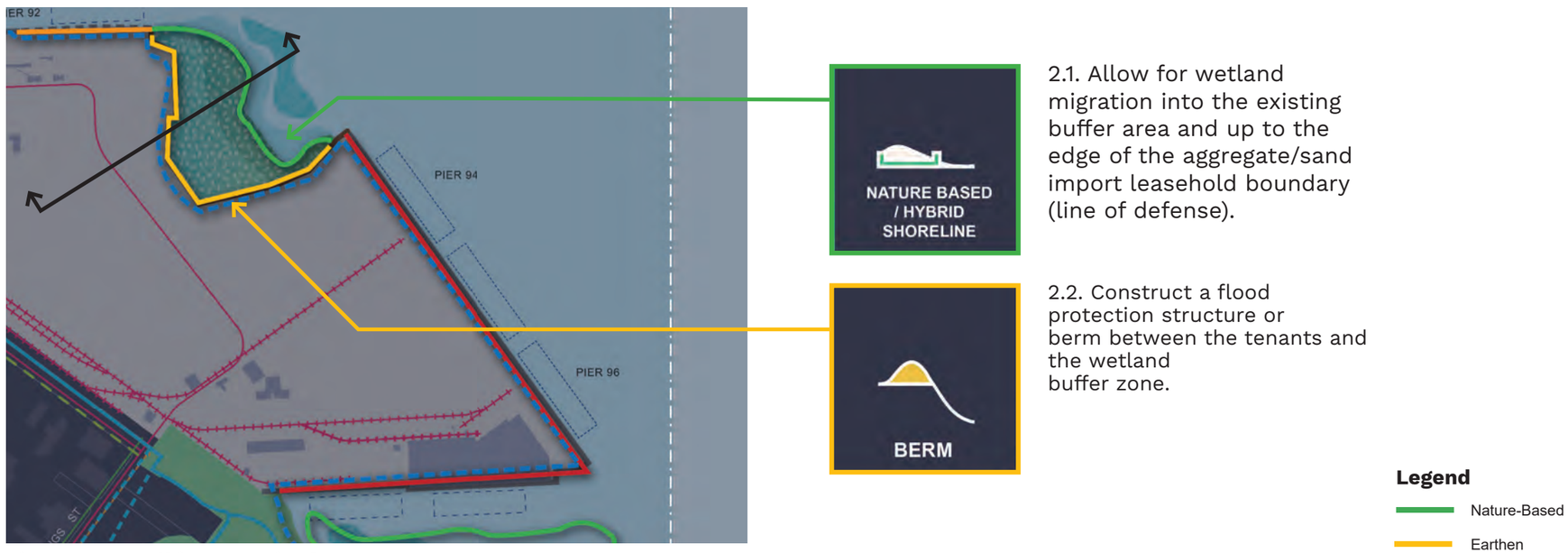


Figure 45: Toolkit Strategies by 2050

Next Steps

The ICSMAS Team will work with the community and decision-makers to identify which strategies may provide the most benefits for the least costs—demonstrating near-term resilience “wins” for all

Across the ICSMAS district and the five proposed Reaches, there are nearly 70 near-term strategies for improving flood resilience, mobility, environmental conditions, and economic vitality. Implementing these strategies–even just a fraction of them–will be most effective if several projects are pursued in tandem. In order to ensure the most effective and efficient outcomes, multiple coordinated strategies will be planned and implemented together. Next steps for this effort may include:

- **Conduct analysis of total economic, social, and environmental co-benefits offered by the strategies.** Prioritization of projects to implement first will be dependent on understanding which projects offer the most short- and long-term benefits to the community, local economy, and environment. While the ICSMAS “Economic Impacts of the Near-term Strategies on Port Assets” analysis summarizes the economic impacts of near-term strategies related to the Port’s key assets, the analysis exclusively considers the economic impacts of implementing (e.g. designing, engineering, and constructing) capital projects and does not consider the long-term benefits of avoided flood damages, protected industrial and business operations, increased mobility, and environmental protection. Further analysis of all benefits, such as a triple bottom line analysis (as used previously by the SFPUC), will clarify which projects offer the highest cost-benefit ratios.

- **Identify synergies with upcoming general obligation bond schedules.** The City’s 2022 – 2031 capital improvement plan (CIP), the Office of Resilience and Capital Planning of the City and County of San Francisco (OneSF), proposes issuing general obligation (G.O.) bonds almost every year between 2022 and 2031 with each year’s bond issuance funding specific types of projects. The 2022 bond is expected to fund transportation-related projects while the 2026 bond will fund waterfront safety projects and the 2028 bond will fund parks and open space projects. ICSMAS strategies that fall into these categories may find funding and financing synergies with the City’s G.O. bond schedule, which would require pre-planning for these projects to begin in the immediate future.

- **Identify alignment opportunities with other planned capital projects.** One way of identifying relatively easy projects to implement, thus offering potential for quick wins, is by determining whether there are planned capital improvements, including those funded by forthcoming G.O. bonds, in the area and exploring opportunities to augment those projects to include ICSMAS strategies. In this vein, SFPUC has committed to coordinating with the project team to contribute data on relevant capital investments via a future memo, since this grant project was primarily focused on SFMTA and Port assets.

- **Determine which strategies will require environmental review, technical analysis, and/or complex partnerships and permitting.** Many of the ICSMAS strategies will have longer implementation timelines. These strategies, such as those that require multiple implementation partners and/or oversight agencies, tend to have numerous and lengthy steps before reaching the design and engineering phase. Beginning the first phase of work on these longer-term projects can build on the momentum created by this planning effort and capitalize on the current grant context, which favors mitigation and adaptation projects in underserved communities.

- **Pursue a cohesive implementation mechanism.** The interventions that the City has identified for the District are highly interdisciplinary and advance the goals of many agencies and stakeholders. With that in mind, the team is aware that new models of integrated planning and project delivery will be needed to be successful. The ICSMAS team will explore the Joint Benefits Authority (JBA) implementation mechanism, a tool for advanced capital planning and blended funding, to advance the project goals. Efforts to formalize a JBA will take time and resources. Once established, the JBA will need additional time and resources to secure staffing, funding sources, and operational practices. While conversations about JBA have already been underway, next steps may include strategic conversations with the City’s other joint authorities and engaging the City’s legal department for initial discussions. The JBA should, ideally, be in place to implement the first round of and quick wins projects.

While these next steps are underway, the City and Port should continue to explore how shoreline and shoreline-adjacent improvements can best be accessed by San Franciscans and how this connectivity, in the form of green infrastructure for stormwater management/flood resilience and improved pedestrian/bike access, can be a driver for improved neighborhood spaces in the District. The ICSMAS team should look at site-specific flood resilient design strategies both for the public right-of-way and for assets within the District.

ICSMAS TEAM:

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PORT OF SAN FRANCISCO
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CONSULTANT TEAM:

AECOM
- Adaptation Strategies
- Flood Mapping
- Adaptation Financing
- Port Planning
- Landscape Design
- Transportation Engineering
- Cost Estimating
- Environmental Permitting

Claire Bonham-Carter, Principal in Charge
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SILVESTRUM CLIMATE ASSOCIATES
- Environmental Planning
- Adaptation Strategies

FEHR & PEERS
- Transportation Planning

LOTUS WATER
- Water Resources Engineering

ANDREA BAKER CONSULTING
- Public Outreach

TECHNICAL APPENDIX

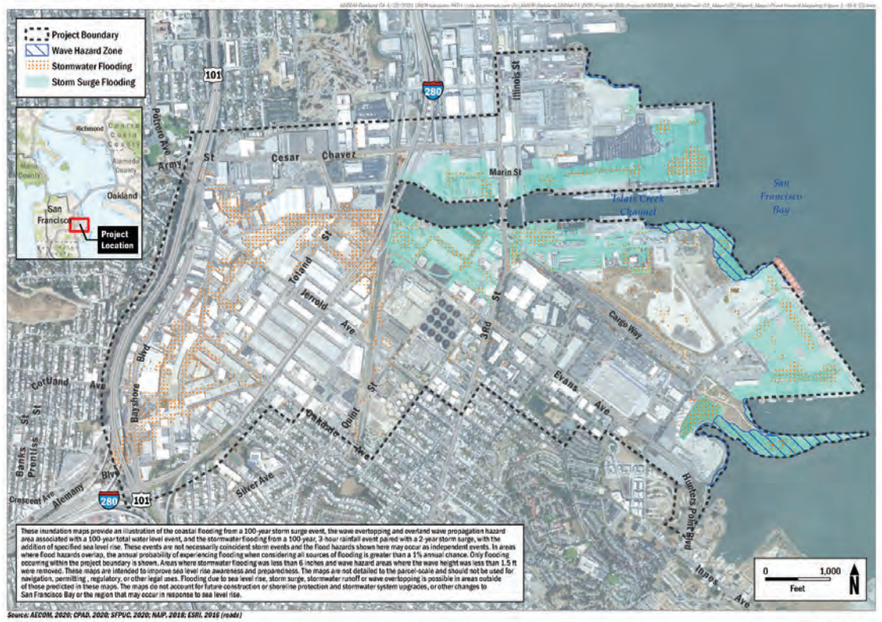
Hazard Mapping

Combined Coastal and Stormwater Flood Hazard Mapping

A set of combined flood hazards maps was created to support the ICSMAS alternatives development efforts. The memo titled Islais Creek Combined Flood Hazard Analysis and Mapping (January 26, 2021) describes the process used to create the maps. The maps depict areas that could experience flooding under six future SLR scenarios during the 100-year storm condition for three types of flooding: SLR inundation, stormwater flooding and wave hazards.

The combined flood hazard maps depict areas of overlapping hazards, assuming each type of flooding is independent. However, in areas where hazards overlap, the combined hazard is likely to be more severe than mapped; i.e., SLR inundation due to storm surge could increase the area impacted by stormwater flooding if both types of flooding occur concurrently. The information presented is sufficient to inform the development of flood risk reduction strategies; however, additional analysis may be warranted to support adaptation strategy design.

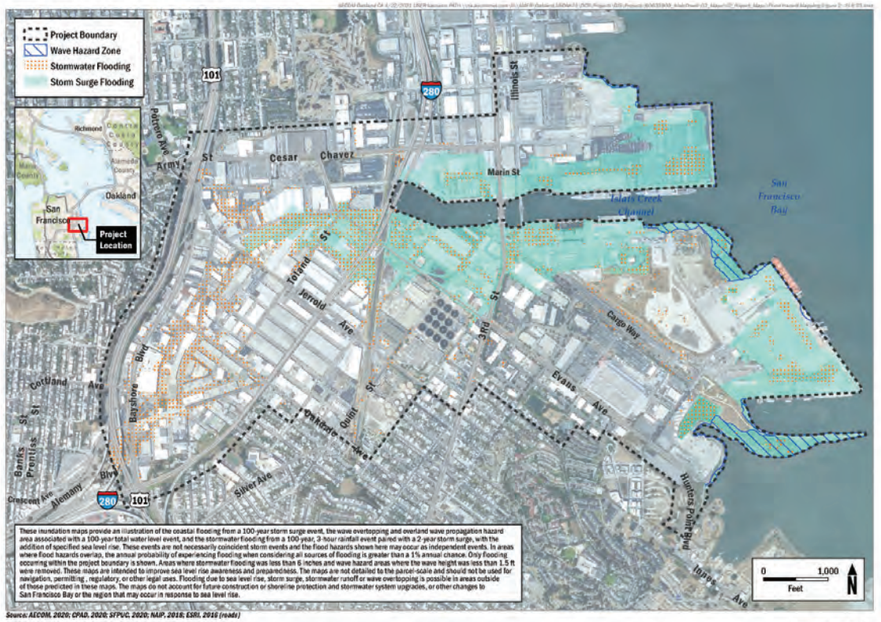
NOTE: Figure numbers are related to the Combined Flood Hazard Analysis and Mapping memo. These inundation maps provide an illustration of the coastal flooding from a 100-year storm surge event, the wave overtopping and overland wave propagation hazard area associated with a 100-year total water level event, and the stormwater flooding from a 100-year, 3-hour rainfall event paired with a 2-year storm surge, with the addition of specified sea level rise. These events are not necessarily coincident storm events and the flood hazards shown here may occur as independent events. In areas where flood hazards overlap, the annual probability of experiencing flooding when considering all sources of flooding is greater than a 1% annual chance. Only flooding occurring within the project boundary is shown. Areas where stormwater flooding was less than 6” and wave hazard areas where the wave height was less than 1.5’ were removed. These maps are intended to improve SLR awareness and preparedness. The maps are not detailed to the parcel-scale and should not be used for navigation, permitting , regulatory, or other legal uses. Flooding due to SLR, storm surge, stormwater runoff or wave overtopping is possible in areas outside of those predicted in these maps. The maps do not account for future construction or shoreline protection and stormwater system upgrades, or other changes to San Francisco Bay or the region that may occur in response to SLR.



Source: AECOM, 2020; CPAD, 2020; SFPUC, 2020; NAIP, 2018; ESRI, 2016 (roads)

AECOM
Islais Creek Southeast Mobility Adaptation Strategy
Combined Coastal and Stormwater Flood Hazard Mapping

FIGURE 1
100-Year Storm + 12” Sea Level Rise

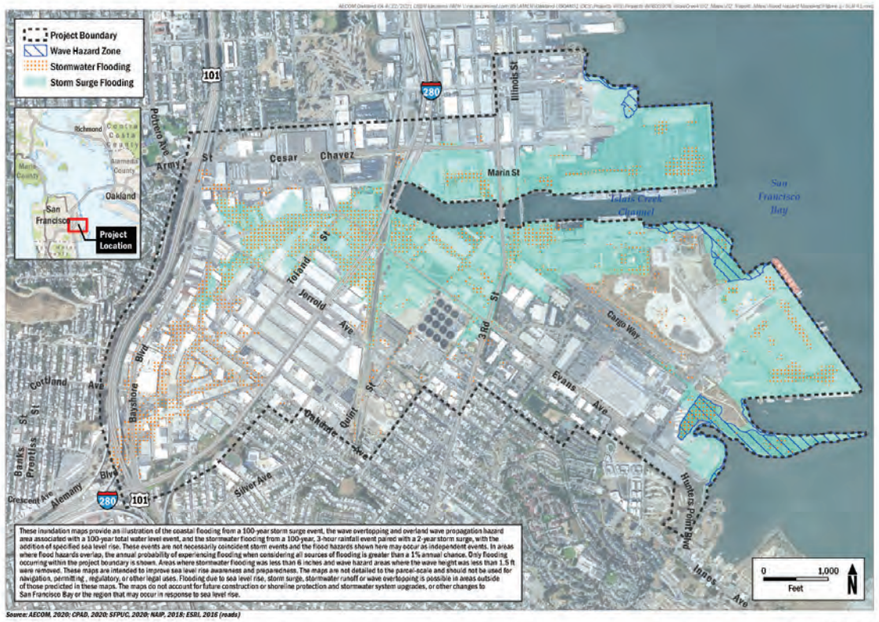


Source: AECOM, 2020; CPAD, 2020; SFPUC, 2020; NAIP, 2018; ESRI, 2016 (roads)

AECOM
Islais Creek Southeast Mobility Adaptation Strategy
Combined Coastal and Stormwater Flood Hazard Mapping

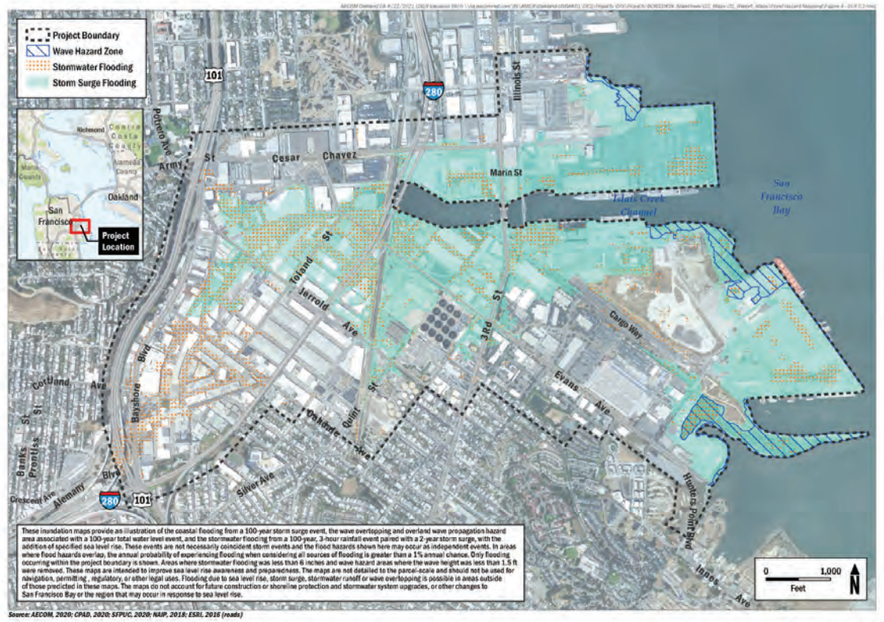
FIGURE 2
100-Year Storm + 23” Sea Level Rise

Combined Coastal and Stormwater Flood Hazard Mapping



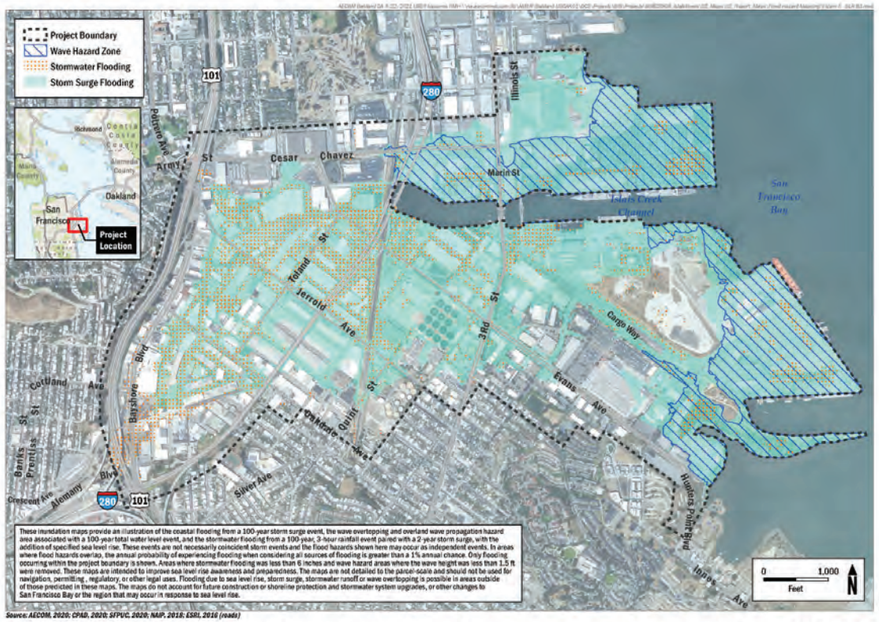
AECOM
Islais Creek Southeast Mobility Adaptation Strategy
Combined Coastal and Stormwater Flood Hazard Mapping

FIGURE 3
100-Year Storm + 41" Sea Level Rise



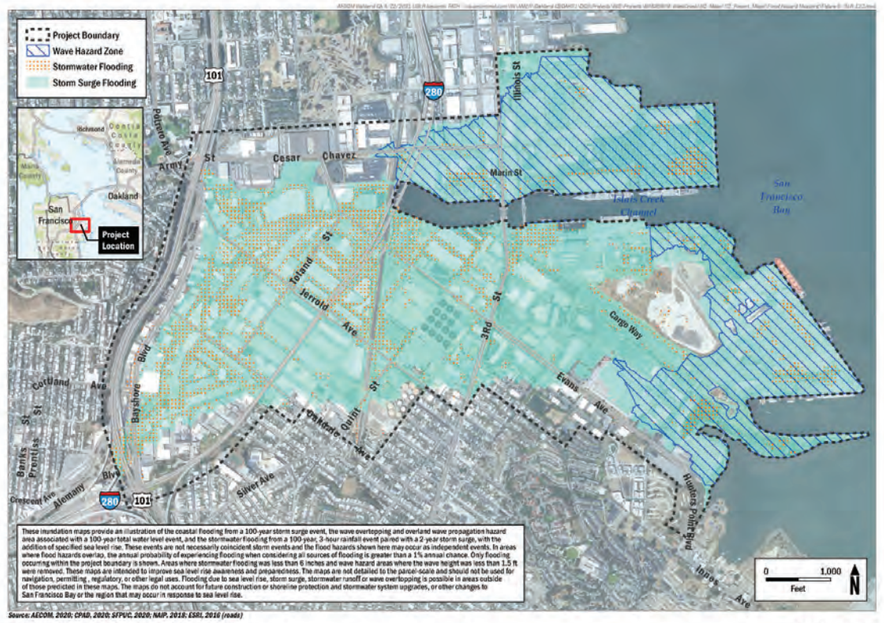
AECOM
Islais Creek Southeast Mobility Adaptation Strategy
Combined Coastal and Stormwater Flood Hazard Mapping

FIGURE 4
100-Year Storm + 52" Sea Level Rise



AECOM
Islais Creek Southeast Mobility Adaptation Strategy
Combined Coastal and Stormwater Flood Hazard Mapping

FIGURE 5
100-Year Storm + 83" Sea Level Rise



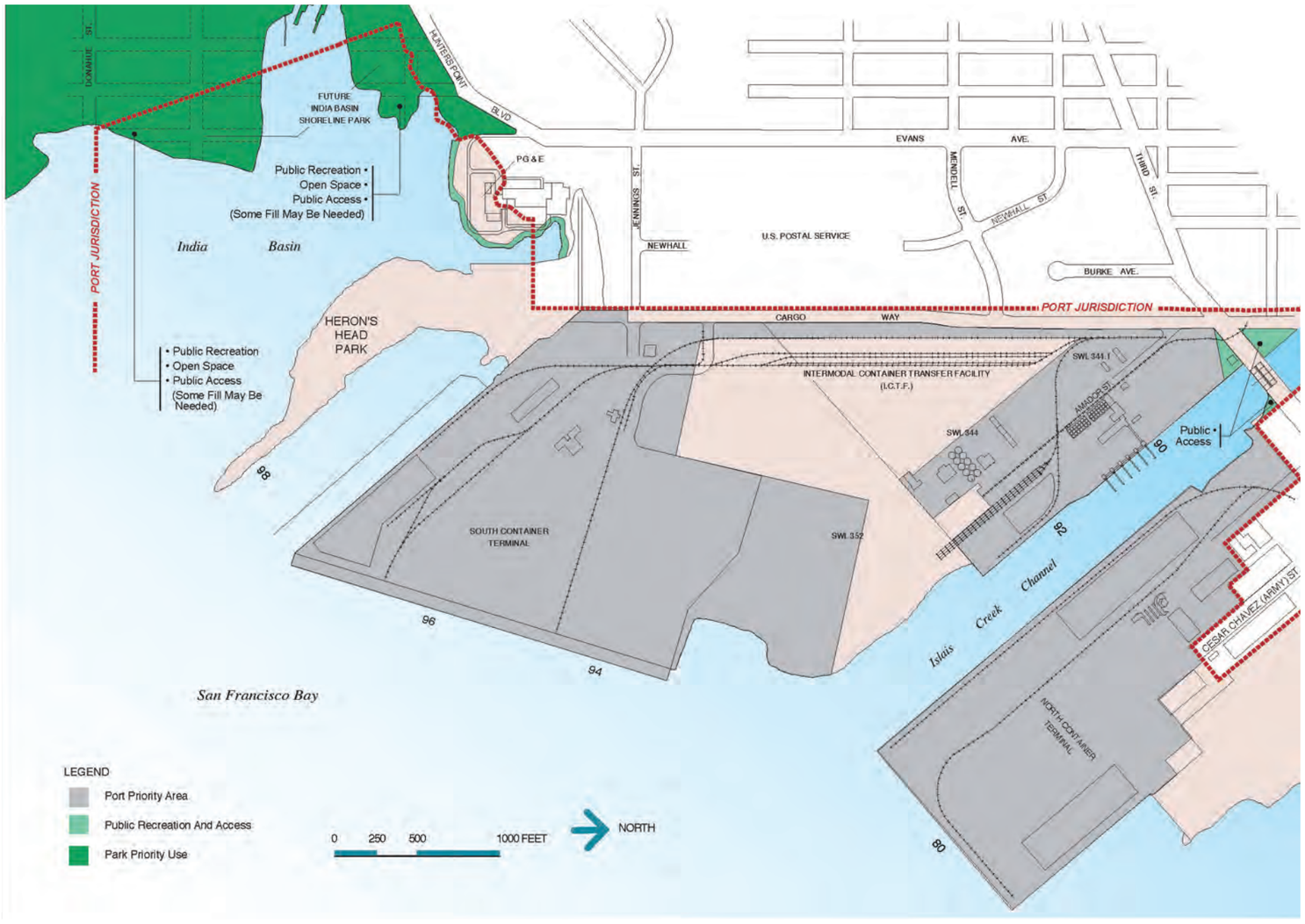
AECOM
Islais Creek Southeast Mobility Adaptation Strategy
Combined Coastal and Stormwater Flood Hazard Mapping

FIGURE 6
100-Year Storm + 122" Sea Level Rise

NOTE: Figure numbers are related to the Combined Flood Hazard Analysis and Mapping memo. These inundation maps provide an illustration of the coastal flooding from a 100-year storm surge event, the wave overtopping and overland wave propagation hazard area associated with a 100-year total water level event, and the stormwater flooding from a 100-year, 3-hour rainfall event paired with a 2-year storm surge, with the addition of specified sea level rise. These events are not necessarily coincident storm events and the flood hazards shown here may occur as independent events. In areas where flood hazards overlap, the annual probability of experiencing flooding when considering all sources of flooding is greater than a 1% annual chance. Only flooding occurring within the project boundary is shown. Areas where stormwater flooding was less than 6" and wave hazard areas where the wave height was less than 1.5' were removed. These maps are intended to improve SLR awareness and preparedness. The maps are not detailed to the parcel-scale and should not be used for navigation, permitting , regulatory, or other legal uses. Flooding due to SLR, storm surge, stormwater runoff or wave overtopping is possible in areas outside of those predicted in these maps. The maps do not account for future construction or shoreline protection and stormwater system upgrades, or other changes to San Francisco Bay or the region that may occur in response to SLR.

BCDC Seaport Plan

Pier 80-96 Port Priority Use Area



Source: San Francisco Bay Area Seaport Plan

Plan Bay Area 2050

Growth Geographies

Legend

- Priority Development Area
- Priority Production Area
- Transit-Rich Area (Outside High Resource Area)
- Transit-Rich Area (Within High Resource Area)
- High Resource Area with Basic Bus Service

Source: Plan Bay Area 2050 Final Blueprint Documents | Plan Bay Area, “Growth Geographies” maps