

SF BAY TRAIL RISK ASSESSMENT & ADAPTATION PRIORITIZATION PLAN

April 15, 2021



SF BAY TRAIL RISK ASSESSMENT & ADAPTATION PRIORITIZATION PLAN

April 15, 2021

CONTENTS



Acknowledgments 06

Executive Summary 09

1. Understanding the Shoreline 19

- a. Introduction*
- b. Project Setting*
- c. Scales of Understanding*
- d. Analysis Roadmap*
- e. Planning Horizons for a Resilient Bay Trail*
- f. Understanding Shoreline Assets*
- g. Project Goals and Vision*

2. What is At Risk? 41

- a. Overall Shoreline Analysis*
- b. Risk Assessment*
- c. Eight Priority Bay Trail Sites*

3. Adapting the Bay Trail 61

- a. Broad Guidance: the Shoreline & the Bay Trail*
- b. Adaptation Strategies*
- c. Adaptation Methods based on Shore Type*
- d. Partnerships and Funding Opportunities*

4. Prototype Sites 89

- a. Overview of Prototype Sites*
- b. Alameda Point*
- c. McLaughlin Eastshore State Park*
- d. Martin Luther King Jr. Regional Shoreline*

References and Glossary 139

Appendices (under separate cover)

Appendix 1: Sea-Level Rise Hazard Mapping and Coastal Data Memo, ESA

Appendix 2: Risk Assessment Methodology and Results, Arup

Appendix 3: Broad Guidance for Natural Systems and Bay Trail Adaptation to Sea-Level Rise, ESA

Appendix 4: Funding and Partnership Strategy Memo, OnClimate

Appendix 5: Summary of Stakeholder Engagement, WRT

ACKNOWLEDGMENTS

Sponsoring Agency

East Bay Regional Park District

Project Team

Chantal Alatorre / Senior Planner
Neoma Lavalle / Principal Planner
Brian Holt / Chief of Planning,
Trails & GIS
Ren Bates / Capital Program
Manager
Jeff Manley / Shoreline Unit
Manager
Becky Tuden / Environmental
Services Manager

Institutional Support

Meg Peterson / GIS Technician
Lisa Baldinger / Legislative and
Policy Management Analyst
Carmen Erasmus / Landscape
Architect
Katy Hornbeck / Grants Manager
Matt Graul / Chief of Stewardship
Sean Dougan / Trails Program
Manager
Katherine Dudney / Management
Analyst
Alexandra Kurylko / Accounting
Technician
Erich Pfuehler / Chief of
Government and Legislative
Affairs
Lisa Goorjian / Chief of Design &
Construction
Tiffany Margulici / Business
Services Manager
Erdem Durgunoglu /
Administrative Analyst I
David Caulboy / Acting
Administrative Analyst II

Management Team

Sabrina Landreth / General
Manager
Robert Doyle / General Manager
Emeritus (served 2010-2020)
Dr. Ana Alvarez, PhD / Deputy
General Manager
Kristina Kelchner / Assistant
General Manager - ASD

Board of Directors

Ward 1 – Elizabeth Echols
Ward 2 - Dee Rosario
Ward 3 - Dennis Waespi
Ward 4 - Ellen Corbett
Ward 5 - Ayn Wieskamp
Ward 6 - Beverly Lane
Ward 7 - Colin Coffey

Stakeholder Agencies

Funding Agency

Consultant Team

San Francisco Bay Trail

City of Berkeley

City of Alameda

US Navy

San Francisco Bay Conservation and Development Commission (BCDC)

Caltrans

A Caltrans Adaptation Planning Grant funds the Project with a local match from Park District's staff time.



WRT

Prime Consultant / Resiliency Planning & Design / Stakeholder Engagement
www.wrtdesign.com

ESA

Ecological Systems Design / Coastal Engineering

Arup

Risk Assessment / Climate Adaptation / Infrastructure Systems

San Francisco Estuary Institute

Resilient Landscapes + Bay Science Experts

OnClimate

Funding and Partnership Strategies





EXECUTIVE SUMMARY

The San Francisco Bay Trail Risk Assessment and Adaptation Prioritization Plan (RAAPP) reimagines restoration and public access along the East Bay shoreline in the wake of sea level rise. Impacts of sea level rise will be seen on critical infrastructure, employment centers, housing, educational opportunities, access to regional transportation, and habitat for endangered species along the shoreline. The Bay Trail is a regional asset that has taken several decades and significant investment of funds to establish. It is highly vulnerable in low-lying areas along several parts of the shoreline. More importantly, impacts of sea level rise will be experienced disproportionately by disadvantaged communities, and perhaps at a generational scale.



- BAY TRAIL
- CITY BOUNDARIES
- COUNTY BOUNDARIES
- OPERATIONAL LANDSCAPE UNITS

LOCATION MAP

The RAAPP identifies vulnerabilities, examines possible adaptation approaches, and provides guidance for planning within a complex geographical, environmental, and regulatory context. It does not assign responsibilities to any single agency or stakeholder for implementation or maintenance of shoreline infrastructure, rather it charts a path for establishing strategic partnerships between various stakeholders to take action in the near, mid, and the long term.

The RAAPP builds on the work previously conducted by San Francisco Bay Conservation and Development Commission (BCDC) for Adapting to Rising Tides (ART) program and the Adaptation Atlas developed by the San Francisco Estuary Institute (SFEI), and takes it further by outlining adaptation strategies for varied shore types along the East Bay and showing potential trail-specific adaptation approaches for the Park District to strengthen shoreline resilience along the Bay Trail.

The following pages summarize key takeaways and recommendations.

1. Understanding the Shoreline

The Bay Trail is a regional asset that provides critical access to nature, recreation, educational opportunities, and alternative mobility choices, especially for disadvantaged populations. It is the first line of defense for most of the East Bay shoreline, in the event of storm flooding and sea level rise. Hence, what is at risk is not limited just to the bay trail. The regional nature of the threats from sea level rise calls for regional partnerships with aligned goals.

At a high level, RAAPP is focused on balancing goals related to advancing ecological restoration, recreation, critical mobility, and building important interpretive educational opportunities. It applies a multi-scale approach, from a broader synoptic understanding of the regional shoreline to site-specific scale, in characterizing vulnerabilities and providing adaptation guidance. It prioritizes nature-based adaptation strategies to provide multiple benefits, and also recognizes,

however, the need for a coastal armoring approach to respond to site-specific conditions.

Natural and nature-based adaptation involves features that are created and evolve over time through the actions of environmental processes, or human-designed features that mimic natural processes to provide coastal protection and other ecosystem services. These include near-shore reefs, submerged aquatic vegetation, mudflat augmentation, beaches, vegetated marshes, polder management, creek-to-baylands reconnection, green stormwater infrastructure, and horizontal levees, among others.

Establishing clear planning horizons that map projected rise in water level within the established time frames, is critical in planning for future sea level rise impacts and for consistent analysis across the shoreline.

Project Goals

1. Resilience to Coastal Hazards
2. Restoration Potential
3. Minimize Recurring Maintenance
4. Adjacency to Critical Infrastructure
5. Serving Disadvantaged Communities
6. Access to Nature/ User Experience
7. Funding and Partnership Potential
8. Alignment with Park District Master Plan Goals and Priorities
9. Representation of a diversity of coastal conditions and geographies



DOOLITTLE DRIVE AT SWAN WAY, OAKLAND
 Source: King Tide California Project

2. What is at Risk?

The range of potential consequences from elevated water levels combined with the uncertainty of when these events will occur, drives the need and urgency for a coordinated, data-driven approach to plan effective near and long-term adaptation interventions along the shoreline. As manager and steward of 55 miles of Bay Trail within Alameda and Contra Costa Counties, the Park District has a pressing need to understand;

- Where the trail is most vulnerable.
- Where the trail has greatest value, hence is at the greatest risk.

- What adaptation strategies can be used to protect high-risk trail segments and associated landscapes.
- How implementation of adaptation projects can be prioritized over the near, mid, and long-term.

Integrating opportunities for restoration into the Bay Trail adaptation approach provides multiple benefits for the region within each project and is one of the Park District's project goals. Trail adaptation projects provide opportunities to better serve the adjacent communities, especially

those most vulnerable. Future trail adaptation projects will likely need to be integrated into larger infrastructure improvements and could be designed in a way that improves shoreline access for the region. Therefore, analysis of the overall shoreline included the factors below.

- Coastal hazards such as tidal inundation, storm flooding, groundwater emergence, and wave exposure
- Restoration potential
- Impact on nearby communities, especially disadvantaged communities
- Proximity to infrastructure

Subsequent to the shoreline analysis, the Park District project goals were applied to the trail segments to narrow them down to 8 sites for conducting a risk assessment. Assessing risk for coastal flooding and sea level rise involved:

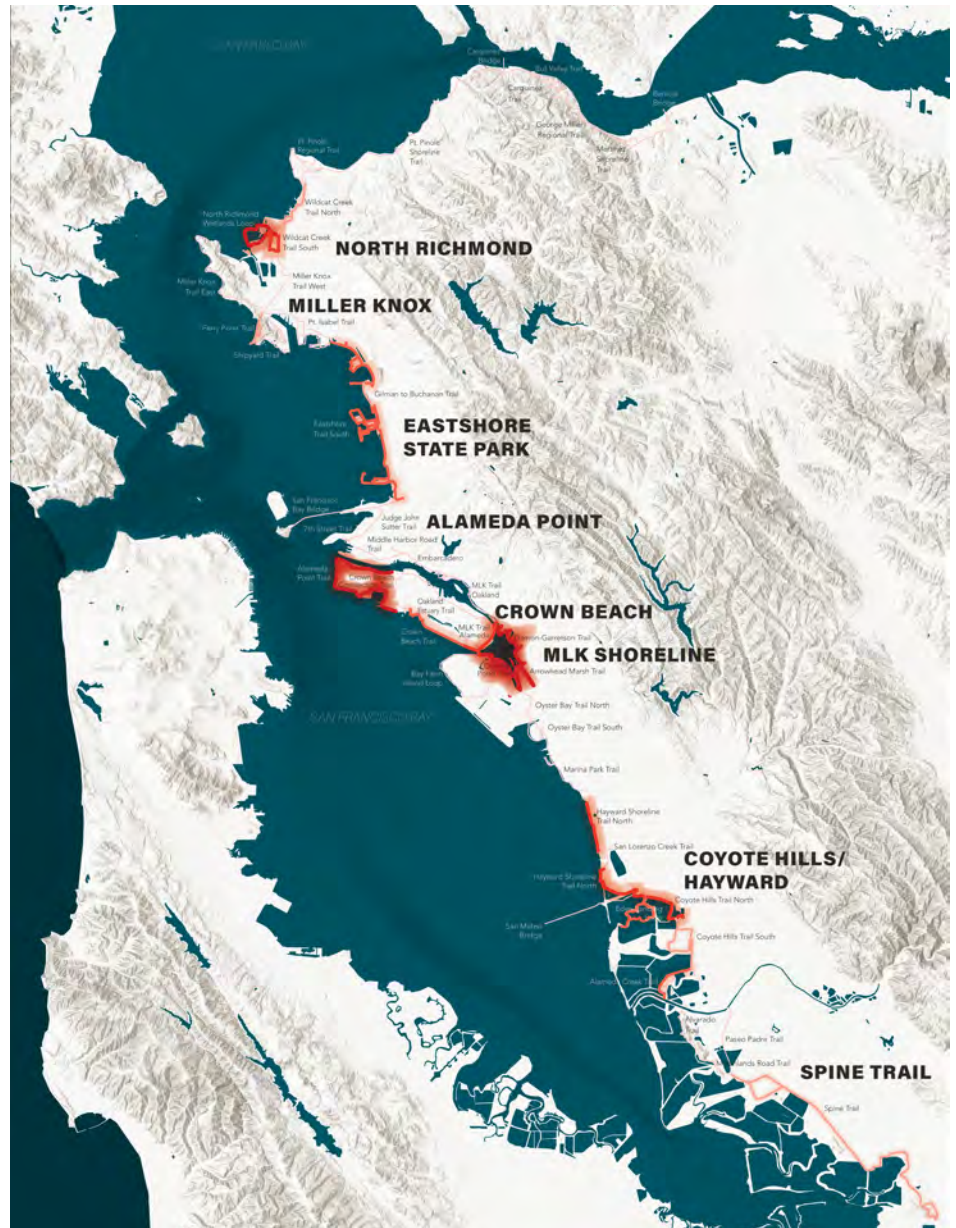
- Assigning hazard score
- Assigning vulnerability scores
- Assigning consequence scores

The Risk Assessment establishes a clear and objective baseline for where to focus attention when pursuing projects with the greatest potential co-benefits across the categories of economic, environmental, social equity, recreational, and connectivity.

It also gives an early indication of which projects may yield the most favorable benefit-cost relationships, which is critical for Capital Planning. Ultimately, it provides a critical foundation for risk-informed, strategic decision making around how and when to address sea level rise.

Eight Bay Trail Priority Sites

1. Martin Luther King Jr. Regional Shoreline
2. Alameda Point
3. Coyote Hills/Hayward
4. North Richmond
5. Eastshore State Park
6. Spine Trail
7. Crown Beach
8. Miller Knox



EIGHT PRIORITY BAY TRAIL SITES

See more details about the risk assessment and prioritization process in Chapter 2: What is at risk?.

3. Adapting the Bay Trail

Broad Guidance on Adaptation Measures

The RAAPP provides an overview of shoreline typologies and potential adaptation opportunities. Each example addresses nature-based adaptation solutions that support biologic benefits and sustainable future shoreline management. The availability of space landward for migration along the Park District segments of the Bay Trail will be key to determining what adaptation measures will be pursued at that location.

The RAAPP also focuses on presenting nature-based adaptation measures that are relevant and implementable to San Francisco Bay and the East Bay shoreline, since traditional armored approaches have been shown to be more susceptible to catastrophic failure and correlated with negative ecological impacts for habitat. Most likely, the future East Bay shoreline will be “adapted” with a mix of green-gray infrastructure.

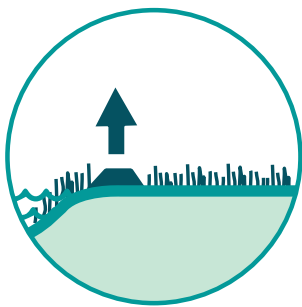
The following shore types and potential adaptation approaches are described in this chapter:

1. Tidal Marshes and Mudflats
2. Estuary-Creek Connections

3. Armored Shorelines
4. Earthen Levees
5. Coarse-grained Beaches
6. Filled Reclaimed Areas

An interest from regional agencies in permitting innovative projects that include Bay fill for habitat enhancement may overlap with sea-level rise adaptation. This is most likely to occur where the placement of select materials to construct resilient nature-based shore-forms addressing dynamic sea level rise conditions may be most effective to mitigate potential flooding, provide public access, establish diverse habitats and allow for the migration of those habitats over time.

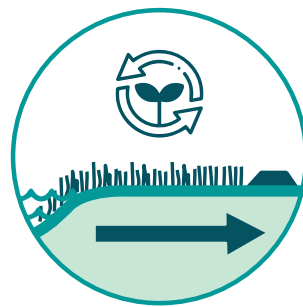
Adaptation Measures



Hold the Line



Buffer with Public Open Space



Maximize Habitat and Realignment



Hybrid Approach

Partnership and Funding Opportunities

Due to the undeniable regional impact of sea level rise, there is a reinstated need for regional stakeholders to be working together towards a common goal. The RAAPP outlines an overall strategy for building partnerships and seeking funding to support implementation, and then identifies partnership opportunities and next steps for each of the three prototype sites. It assumes that building partnerships will enable the Park District to increase funding opportunities for Bay Trail sea level rise adaptation in the near and long term.

Potential funding sources may include:

- Grant programs, including local, state, and federal
- Public asset owners whose asset is affected by the Bay Trail (infrastructure owners including Caltrans, Federal and State property)
- Private property owners and businesses that may benefit from adaptation of the Bay Trail

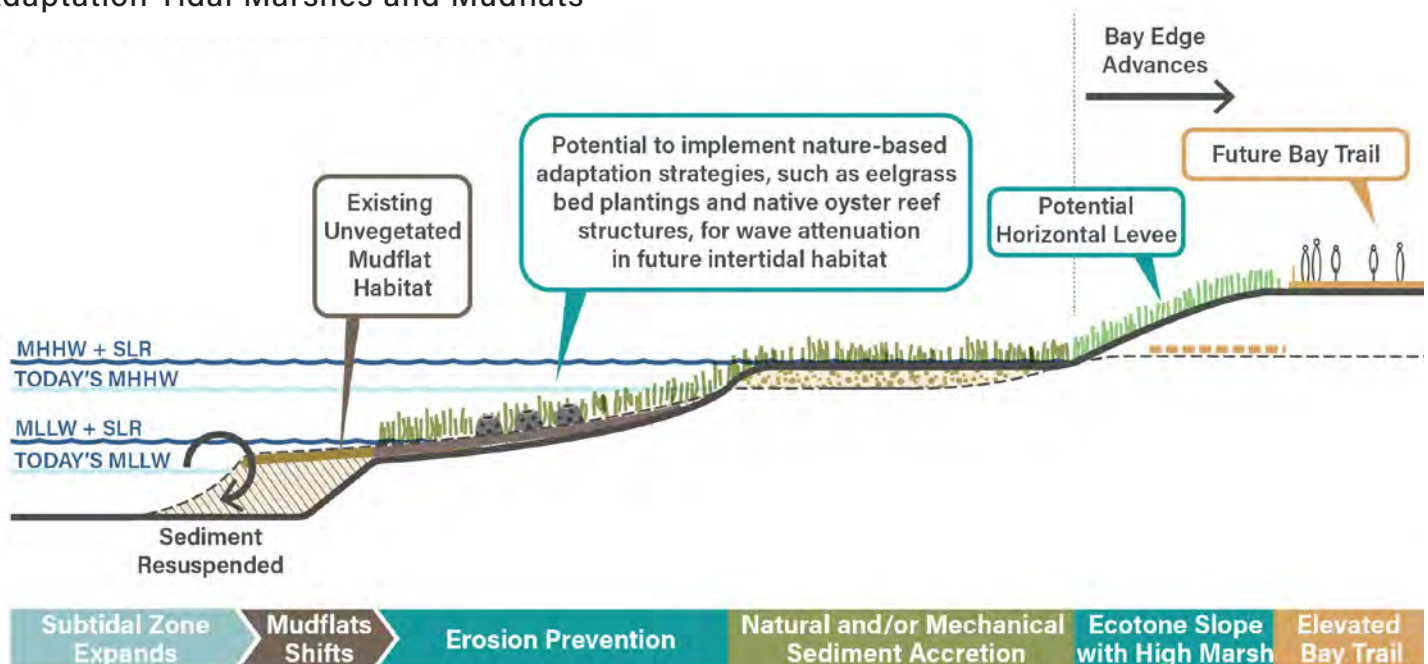
The multiple benefits provided by Bay Trail adaptation could make the Park District and its partners competitive for several grant types, under the following categories:

- Habitat Restoration
- Non-motorized Transportation
- Climate resilience and pre-disaster mitigation

The RAAPP Funding and Partnership strategy defines partnerships as acting in coordination with another public or private organization, and may take many forms such as:

- Information sharing
- Aligning goals and priorities
- Joint grant seeking
- Memorandum of Understanding
- Joint Powers Authority

Adaptation Tidal Marshes and Mudflats



4. Prototype Sites

Three Bay Trail sites were selected after the risk assessment that illustrate a localized approach to nature-based adaptation solutions in areas that are at risk of sea level rise inundation in both the mid-century and end-of-century planning scenarios. Additionally, next steps for continued conversations with stakeholders and the broader community are identified.

Alameda Point

Alameda Point is at risk in both the mid and end-of-century planning scenarios explored in this study. The site is in the process of being planned as a new regional park with a Bay Trail extension to be managed by the Park District and is part of a larger master plan coordinating contamination mitigation, and ongoing planning processes with the Park District's partners, including the City of Alameda, the US Navy, and the US

Department of Veterans Affairs (VA). The vision proposes a regional park in the northwest corner, referred to as the Northwest Territory, and includes a Bay Trail connection around the full extent of the point. If contamination issues are addressed, this site offers significant opportunities for extensive tidal habitats.

Key design considerations include:

- Views across the Bay towards San Francisco and across the estuary to the Port of Oakland

ALAMEDA POINT - MID-CENTURY FULL POTENTIAL ADAPTATION VISION



- High wave action from wind and Port activity along the point and the estuary
- Low elevations and inundation that pose a risk to existing structures, but can be planned as a benefit for marsh and habitat creation
- Seasonal access to the Bay trail, if the access road remains accessible and resilient year-around and through century's end



- Contamination Sites that will need to be monitored and maintained unless contaminants are removed

McLaughlin Eastshore State Park

The Bay Trail segments along McLaughlin Eastshore State Park are managed by several different groups in addition to the Park District, including the City of Berkeley, Caltrans, and CA State Parks. While the main branch of the trail adjacent to the frontage road is not at high-risk within the park, the lengths of the Bay Trail that connect to César Chávez Park and the sensitive habitats within the Berkeley Meadow will see major changes in tidal inundation in the mid and end-of-century planning scenarios. The adaptation approach emphasizes a transitional landscape where upland and seasonal freshwater habitats in the meadow shift to the North Basin Strip. New pathways are envisioned to be built above projected flood levels and nature-based flood protection strategies are recommended for adapting existing infrastructure.

Key design considerations include:

- Nature-based shoreline stabilization opportunities along

shoreline, trail, and access road edges

- Integration with Berkeley Meadow restoration
- Opportunities for green infrastructure to alleviate future storm flooding in the City of Berkeley
- Key coordination to provide resilient access and habitat areas through end-of-century

Martin Luther King Jr. Regional Shoreline

The Martin Luther King Jr. Regional Shoreline - specifically the Doolittle Drive segment along the south side of the San Leandro Estuary - was identified as an ongoing challenge for adaptation planning. Due to the high ecological value of Arrowhead Marsh and the adjacent shoreline areas around the estuary, the Park District has been challenged when considering potential trail elevation near these areas. Adaptation of the San Leandro Estuary will require integrated coordination across partners including Caltrans, City of Oakland, City of Alameda, and others. The RAAPP outlines partnerships opportunities which will be key to any future adaptation planning.



UNDERSTANDING THE SHORELINE

The accelerating rate of climate change has made sea level rise a real and immediate threat to the coastal communities in California. The Bay Area is centered around the largest estuary on the west coast of North America. As the region has grown, the Bay shoreline has been substantially altered to accommodate growth, resulting in a large network of critical infrastructure, dense development including housing and industries, and protected natural lands within low-lying, flood prone areas. The region is experiencing sea level rise at a higher rate than the global average. The range of potential consequences from elevated water levels combined with the uncertainty of when these events will occur, drives the need and urgency for a coordinated, data-driven approach to plan effective near and long-term adaptation interventions along the shoreline.

INTRODUCTION



BAY TRAIL INUNDATION NEAR ALBANY BEACH DURING A KING TIDE IN DECEMBER 2020
Source: King Tide California Project

The Park District's Mission

The East Bay Regional Park District (Park District) has a dual mission to preserve a rich heritage of natural and cultural resources while simultaneously providing recreational access to open space, parks, and trails. The Park District comprises nearly 125,000 acres in 73 parks, including over 1,250 miles of trails and 55 miles of shoreline, which encompass parks and segments of the San Francisco Bay Trail (Bay Trail)

that serve as critical recreational spaces and commute corridors in a heavily urbanized region. The Park District recognizes their parks and trails are not immune to threats of climate change and that these assets will become inaccessible to the community due to inundation if they do not determine the vulnerabilities and proactively respond to the threats.

With that intent, the Park District has undertaken the Risk Assessment and Adaptation Prioritization Plan (RAAPP) for segments of the Bay Trail

within their jurisdiction. The RAAPP is a visioning document that examines possible adaptation approaches and provides guidance for planning within a complex geographical, environmental and regulatory context. While the scope of this study is focused on outlining a range of preferred options for adapting the Bay Trail, ensuring continued equitable access to the shoreline in future years means the trail cannot be studied in isolation.

The Bay Trail, in many cases, will act as the first line of defense against sea level rise for critical infrastructure, employment centers, housing, educational opportunities, access to regional transportation, and habitat for endangered species along the shoreline. The regional nature of the threats from sea level rise undoubtedly calls for strategic partnerships between public agencies; local, state, and federal government; and private entities who are key stakeholders along the shoreline. The Park District has initiated an important process with the RAAPP, which identifies vulnerabilities, and explores nature-based adaptation solutions. It does not assign responsibilities to any

single agency or stakeholder for implementation or maintenance of shoreline infrastructure, rather charts a path for establishing strategic partnerships between various stakeholders to take action in the near, mid, and the long term.

The RAAPP applies a multi-scale approach, from a broader synoptic understanding of the regional shoreline to site-specific scale, in characterizing vulnerabilities and providing adaptation guidance. It prioritizes nature-based adaptation strategies to provide multiple benefits such as ecological restoration, recreation, critical mobility, and public education for the region. Nature-based approaches to coastal

adaptation present an opportunity to counter biodiversity loss, restore natural processes, and strengthen shoreline resilience against sea level rise. However, the RAAPP also recognizes the need for an armored approach to respond to certain site-specific conditions. The RAAPP builds on the work previously conducted by San Francisco Bay Conservation and Development Commission (BCDC) for the Adapting to Rising Tides (ART) program and the Adaptation Atlas developed by the San Francisco Estuary Institute (SFEI) and takes it further by outlining adaptation strategies for diverse shore types along the East Bay and showing potential trail-specific adaptation approaches for the Park District to strengthen shoreline resilience along the Bay Trail.

The RAAPP serves two purposes:

1. Provide guidance to the Park District for prioritizing future implementation projects by identifying sites that are most at-risk, challenges involved, and potential adaptation opportunities using nature-based strategies.
2. Outline potential opportunities for partnerships with key stakeholders, and future funding sources for planning and implementation projects for climate adaptation.



MLK - STEWARDSHIP DAY
Source: East Bay Regional Park District



Photo Credit: East Bay Regional Park District

CÉSAR CHÁVEZ PARK, BERKELEY, CA
Source: San Francisco Bay Trail

Why is the Bay Trail important?

The Bay Trail is a planned 500-mile pathway that circumnavigates the region's shoreline and provides a crucial link connecting people and communities to parks, open spaces, schools, and transit opportunities. The Bay Trail is integrated into the landscape and often is built upon levees and other types of infrastructure that protect inboard

resources like marshes, highways, and even residential and industrial areas. In many cases, that infrastructure is not designed to accommodate the impacts of climate change and sea level rise. The Park District manages 55 miles of shoreline in the region's East Bay, which includes parks and segments of the Bay Trail serving as critical recreational spaces and commute corridors in a heavily urbanized region. The Park District recognizes their parks and trails are

not immune to threats of climate change and these assets will become inaccessible to the community due to inundation, if they do not determine the vulnerabilities and proactively respond to the threats. The Park District also recognizes the partnership and coordination challenges facing the region as multiple stakeholders responsible for managing the shoreline must work together to adapt.

Approach

The RAAPP evaluates the vulnerabilities facing the East Bay's shoreline and provides guidance for prioritizing nature-based adaptation projects to provide multiple benefits for the region.

The plan is focused on balancing goals related to advancing ecological restoration, recreation, critical mobility, and building important interpretive educational opportunities.

It introduces conceptual models of shore response to sea level rise and adaptation strategies for the diverse shore types found along the East Bay. Ultimately, the information presented in this document is meant to support trail-specific adaptation approaches taken by the Park District and key partners to strengthen shoreline resilience along the Bay Trail.

Regional tools, such as the San Francisco Bay Shoreline Adaptation Atlas (Adaptation Atlas) developed by the San Francisco Estuary Institute (SFEI), identify possible nature-based adaptation strategies around the

Bay Area shoreline for Operational Landscape Units (OLUs). The RAAPP builds upon the Adaptation Atlas, presenting broad adaptation guidance for natural systems and the Bay Trail, downscaling the range of appropriate nature-based adaptation measures along the East Bay shore.

Nature-based shoreline treatments are emerging as an alternative to traditional, engineered structures, however, they remain a relatively young field. Coastal managers and planners need specific, place-based guidance considering the range of

environmental settings naturally found in that region and large-scale human modifications. (Note: "place-based" refers to a scale that can be defined by specific or unique processes and conditions at the site level that are considered relevant in analysis and planning).

The RAAPP identifies which segments of the Bay Trail within the Park District's jurisdiction need the most immediate attention and will provide a vision and recommended approach for future implementation.





VETERAN'S PIER IN ALAMEDA DURING A KING TIDE EVENT IN NOVEMBER 2020

Source: King Tide California Project





FIGURE 1-1:
LOCATION MAP

-  BAY TRAIL
-  CITY BOUNDARIES
-  COUNTY BOUNDARIES
-  OPERATIONAL LANDSCAPE UNITS



PROJECT SETTING

The study focuses on the segments of Bay Trail located within Contra Costa County and Alameda County. Figure 1-1: Location Map shows the extents of the study area, which encompasses the East Bay shore from Benicia-Martinez Bridge in the north and Coyote Creek in the south.

Contra Costa County has over 80 miles of Bay Trail, which are adjacent to tidal marshes, protected wildlife areas, recreational areas, as well

as industrial and residential areas. Railway infrastructure is located along parts of the shoreline. The Bay Trail in Contra Costa County is connected to the North Bay via the Richmond-San Rafael Bridge, the Carquinez Bridge, and the Benicia Bridge.

Due to the urban setting, shoreline use in Alameda County is wide-ranging. Generally, recreation, light industrial, and commercial uses of the shoreline are common, with large

swaths of residential housing located east/inland of the trail. The shoreline south of Oakland International Airport is comprised of recreational areas, salt and tidal ponds, wetlands, and wastewater treatment facilities. Several pieces of major transportation infrastructure connect the Bay Trail segments in Alameda County to other parts of the Bay, including the San Francisco-Oakland Bay Bridge, San Mateo-Hayward Bridge, and Dumbarton Bridge.

BAY TRAIL IN HAYWARD DURING A KING TIDE

Source: East Bay Regional Park District



SCALES OF UNDERSTANDING



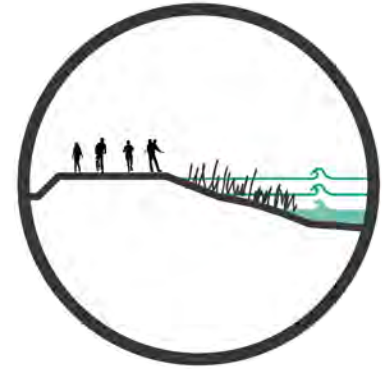
Shoreline Scale

The overall analysis includes shoreline areas along both Alameda and Contra Costa counties, to understand varying shoreline conditions, land use development patterns, ecology, critical infrastructure, transportation network, economic activities, ongoing projects and plans, and most importantly, coastal hazards associated with sea level rise.



Eight Priority Sites

Based on the existing shoreline conditions analysis and established project goals and priorities, eight sites located along the regional shoreline were examined in an in-depth risk assessment. The team created evaluation criteria to compare Bay Trail segments based on exposure to flooding, landscape response to flooding, and potential impacts that may result from flooding both in the near-term and long-term considering sea level rise. Ultimately a weighted list was developed to identify tiers of first, second and third priority sites ranked according to risk.



Three Prototype Sites

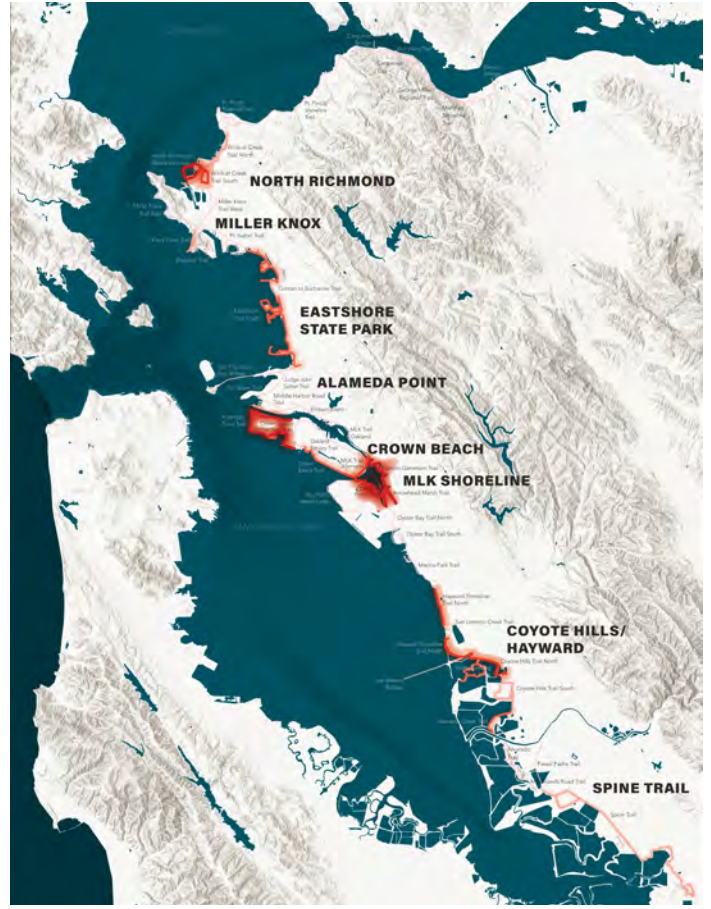
From the list of eight priority sites, three sites were identified in collaboration with the Park District team as sites to explore a broad range of adaptation concepts and approaches across the East Bay. This visioning process begins to develop a range of possible approaches that could inform a regional response to future sea level rise impacts.

The sites include Alameda Point, McLaughlin Eastshore State Park, and the Martin Luther King Jr. Regional Shoreline.



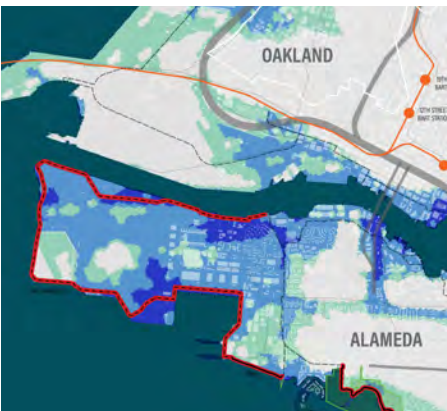
MAP OF BAY TRAIL OPERATORS

See detailed map in Chapter 2.



EIGHT PRIORITY BAY TRAIL SITES

See more details about the risk assessment and prioritization process in Chapter 2.



3 PROTOTYPE SITES - ALAMEDA POINT, McLAUGHLIN EASTSHORE STATE PARK, AND MARTIN LUTHER KING JR. REGIONAL SHORELINE

See detailed map in Chapter 4.

ANALYSIS ROADMAP

The SF Bay Trail RAAPP approach is structured around a process that explores the existing conditions and predicted impacts of climate change and sea level rise across multiple scales. First, by looking across the full East Bay shoreline along both Alameda and Contra Costa counties, identifying the top at-risk zones and developing a Risk Assessment; and then by zooming in to exemplar focus areas to illustrate potential adaptation strategies and approaches that could be applied in multiple locations across the region. At each scale, and through the process, the analysis and design are guided by the Park District goals, and informed by ongoing conversations with key partners and stakeholders.

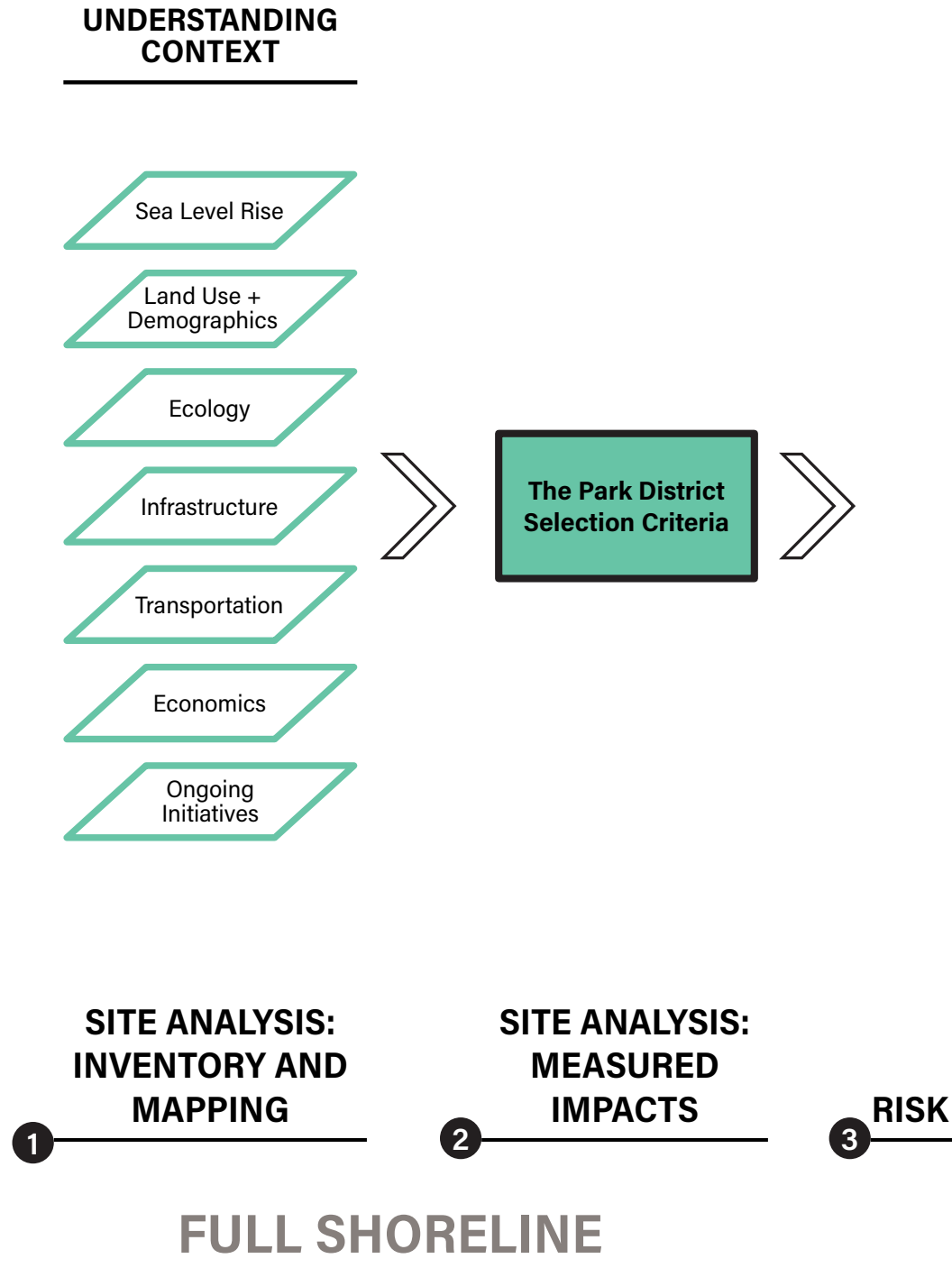
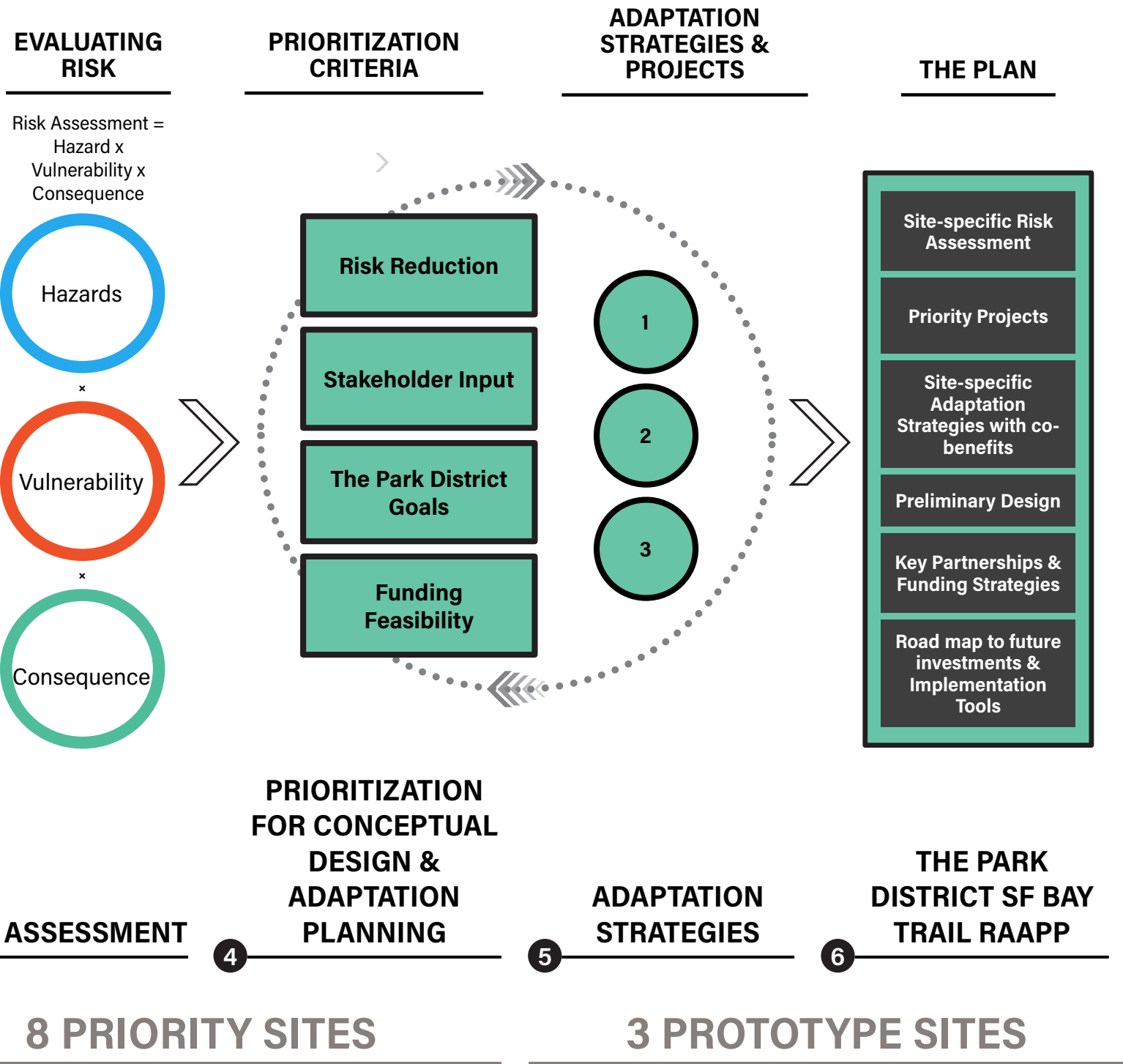


FIGURE 1-2: PROCESS DIAGRAM



PLANNING HORIZONS FOR A RESILIENT BAY TRAIL

A critical step in planning for the impact of future sea level rise is contingent on establishing clear horizons which define the level to which water rises, and projecting a timeline for the rise. This allows for consistent analysis across the Bay Area.

The following description relates the 3-foot and 6-foot sea level rise projections and compares it to local and state wide guidance for future planning in the area.

The State of California provides guidance established by the Ocean Protection Council to develop planning guidelines for anticipated sea level rise. The most recent update to the State of California Sea-Level Rise Guidance was published in 2018. Table 1: Projected Sea-Level Rise (in feet) for San Francisco identifies the range of sea level rise projections associated with different levels of probability and risk aversion identified for each project.

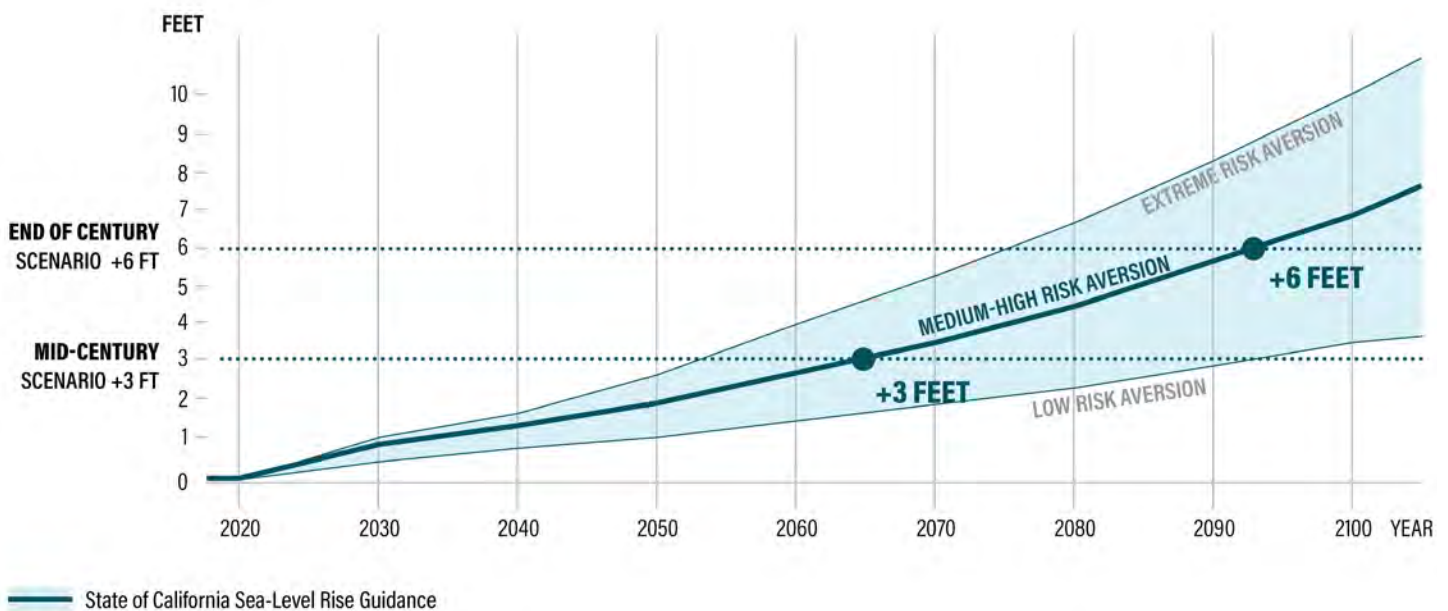
Based on guidance received from BCDC, planning for a resilient Bay Trail should refer to the Medium-Risk Aversion 0.5% probability projection for High Emissions scenarios defined by state guidance.

For planning purposes, this report identifies three and six feet of sea level rise to depict mid-century and end-of-century planning scenarios, respectively. The following chart in Figure 1-3: Planning Horizons identifies the ranges of sea level rise projections provided by the state over the next century and illustrates how the sea level rise depths depicted in this report relate to the anticipated time ranges. The planning scenarios are consistent throughout the Risk Assessment and the Priority Sites analyses.

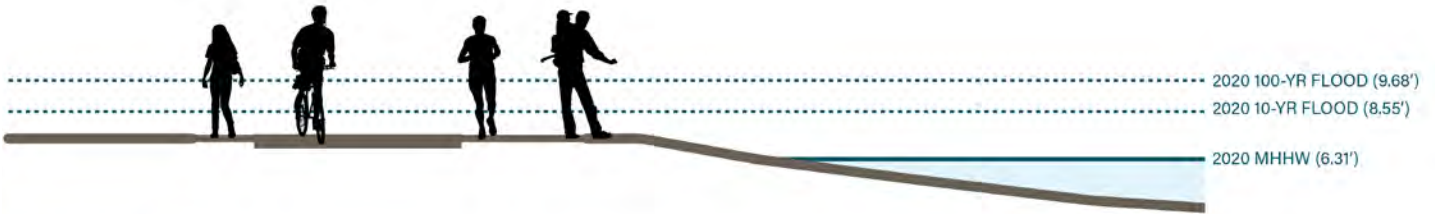
More details are available in the memo attached in Appendix.

FIGURE 1-3: PLANNING HORIZONS

Source: Graphic by WRT, based on OPC's State of California Sea-Level Rise Guidance, 2018.

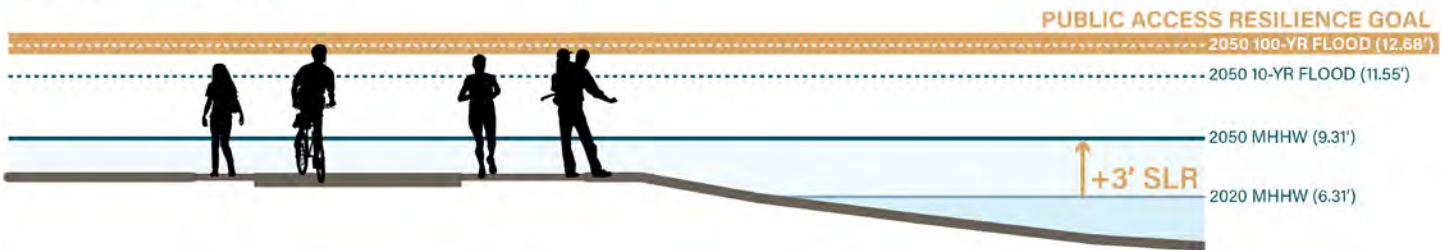


TODAY



NEAR TERM

MID-CENTURY SLR



LONG TERM

END OF CENTURY SLR

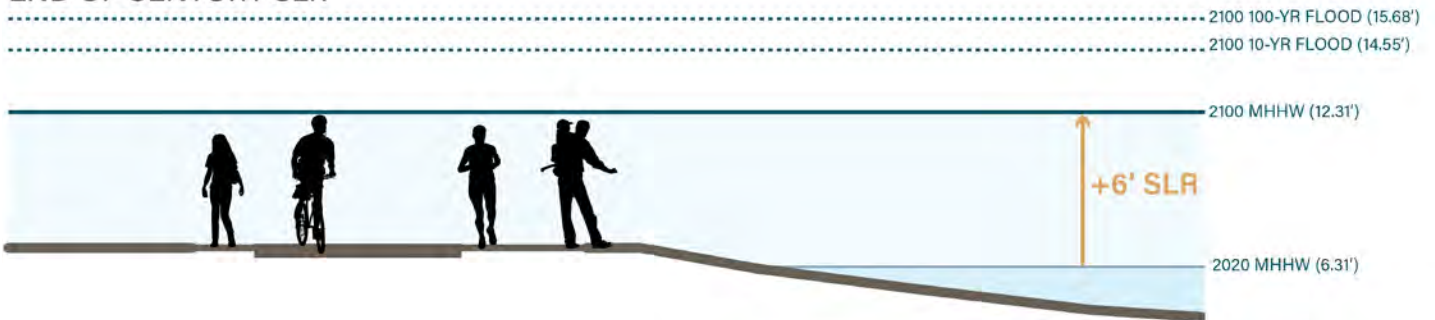


FIGURE 1-4: PLANNING HORIZONS

Source: Graphic by WRT, based on OPC's State of California Sea-Level Rise Guidance, 2018.

The cross-sections in Figure 1-4: Planning Horizons illustrate the implications of sea level rise on the elevation of a resilient Bay Trail. For the purposes of this study, when applying sea level rise projections to a typical shoreline cross-section, the total water level builds from the existing mean higher high

water level (MHHW) identified at the site and includes sea level rise and 100-year storm event levels in combination. Other factors like wave run-up conditions and erosion were considered and included in the risk assessment separately (See Appendix for more information).

Projects undergoing design review with BCDC should provide an adaptation plan that provides public access that is resilient to a 100-year storm with sea level rise for the year 2050. For the purposes of this study, this will be the “Public Access Resilience Goal” for the mid-century scenario.

UNDERSTANDING SHORELINE ASSETS



RICHMOND'S SHORELINE

Source: Photo by Micha Salomon, SFEI

A Regional Asset

The bay shoreline offers multiple benefits to the region, contributing a wealth of environmental, social, educational, and economic value.

Sea level rise poses a risk to shoreline access via the Bay Trail as well as the shoreline assets that border the trail. To fully gauge the losses resulting from future inundation, the broader risks involved, and to prioritize responses, it is important to understand the regional value of the shoreline. It is particularly important to understand the impacts of this loss

on all bay communities, especially under-served and disadvantaged communities that will experience proportionally greater impacts due to loss of access to recreation, education, jobs, and housing.

The preliminary context analysis at the shoreline scale included understanding shoreline assets broadly categorized as below:

- Ecological value
- Recreational and public access value
- Educational value
- Critical infrastructure
- Economic Value

The Bay Trail is a critical transportation infrastructure providing access to the shoreline, important connections between communities and recreational amenities, and a key car-free dependent mobility option.

Ecological Value

In the last century, we have lost 98% of SF Bay wetlands and sea level rise threatens the scarce habitats remaining. The remaining shoreline areas that support natural shores and marshes have a high ecological value due to this scarcity. Small portions of the shoreline benefit from protection afforded by natural features. However, the majority of the shoreline consists of former Baylands that have been filled and are vulnerable to flooding.

Some of the tidal marshes such as Arrowhead Marsh in the Martin Luther King Jr. Regional Shoreline, habitats in McLaughlin Eastshore State Park, and Cogswell and Oro Loma marshes offer significant habitat for endangered species.

In addition to protecting existing resources, the future adaptation of the shoreline along the East Bay offers opportunities for the Bay Trail to be integrated in larger areas of new habitat restoration.



BERKELEY MEADOW - McLAUGHLIN EASTSHORE STATE PARK, BERKELEY

Source: Photo by Sean Gin, Berkeleyside.



RIDGWAY'S RAILS ON SAN FRANCISCO BAY

Source: Photo by Edwin Mercado, Birdnote.

Recreational & Public Access Values

Crown Beach in Alameda is one of the few shoreline areas where the coast is fronted by a beach. A series of wetlands front the shoreline at McLaughlin Eastshore State Park and between Albany Bulb and Marina Bay. Additionally, while these beaches did not exist as part of the natural historic landscape, pocket beaches have formed around engineered shorelines (e.g. Richmond) along the East Bay shore. These pocket beaches are vitally important to capitalize on in order to create nature-based shorelines. Although these beaches are artificial, they are still vital and important opportunities to reclaim the coastal area.



McLAUGHLIN EASTSHORE STATE PARK

Source: Photo by Five Nests, *The Intrepid Tourist*.



BIG BREAK MARINA, OAKLEY, CA

Source: East Bay Regional Park District

Educational Value

Facilities such as the Hayward Interpretive Center, and Crab Cove Visitor Center and Aquarium offer valuable educational opportunities focused on bay habitat, science, and environment. These centers operate primarily as resource centers for local schools' educational field trips to inspire a sense of appreciation and stewardship for the Bay. Additionally, the Park District also runs educational programs along the shoreline.



HAYWARD INTERPRETIVE CENTER

Source: Photo by Frank Balthis



CRAB COVE VISITOR CENTER

Source: the Saklan School Friday Blog



BAY TRAIL IN BERKELEY, CA
Source: Ride Chronicles



BERKELEY MARINA
Source: Berkeley Marina

Critical Infrastructure

The Bay Trail has important transportation benefits such as providing a commute alternative for cyclists and connecting to numerous public transportation facilities including ferry terminals, light-rail lines, bus stops and Caltrain, Amtrak, and Bay Area Rapid Transit (BART) stations.

In many sections of the Bay Area's existing shoreline, the San Francisco Bay Trail acts as the de facto first line of defense against coastal flooding and sea level rise. The consequences of damage or failure of structural shorelines could result in the loss of critical facilities, services and infrastructure that local communities and the greater region rely upon. The loss of connected Bay Trail segments could result in more people driving rather than walking or bicycling to their destinations and reduced opportunities to access the shoreline. Interrupted trail connectivity presents unique challenges to community access to nature and recreation for certain populations, in particular, people with disabilities or reduced mobility. Impacts to major transportation infrastructure adjacent to the trail make the need for collaboration even greater.

Economic Value

Economic activities such as economic drivers, retail main streets, light industrial and manufacturing activities and other businesses along the shoreline are at risk from impacts of sea level rise. Planning for adaptation and resilience is warranted to avoid and mitigate potential consequences.

PROJECT GOALS AND VISION

The Park District staff and project team established project goals to guide the risk assessment and visioning process for future Bay Trail adaptation strategies and partnerships. The future shoreline could provide the region with multiple benefits that increase overall community resilience guided by the following goals:



1. RESILIENCE TO COASTAL HAZARDS



2. RESTORATION POTENTIAL



3. MINIMIZE RECURRING MAINTENANCE



4. ADJACENCY TO CRITICAL INFRASTRUCTURE



5. SERVING DISADVANTAGED COMMUNITIES



6. ACCESS TO NATURE, USER EXPERIENCE



7. FUNDING AND PARTNERSHIP POTENTIAL



8. ALIGNMENT WITH PARK DISTRICT MASTER PLAN GOALS AND PRIORITIES



9. REPRESENTATION OF A DIVERSITY OF COASTAL CONDITIONS AND GEOGRAPHIES



ARROWHEAD MARSH
Source: Photo by Jerry Ting



2

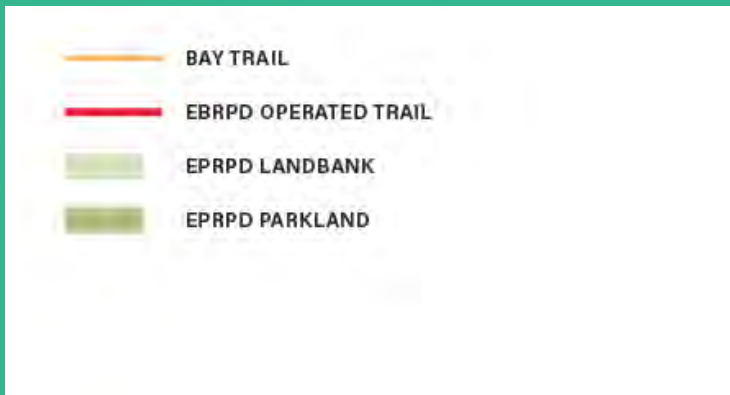
WHAT IS AT RISK?

The accelerating rate of climate change has made sea level rise a real and immediate threat to the coastal communities in California. The Bay Area is centered around the largest estuary on the west coast of North America. As the region has grown, the Bay shoreline has been substantially altered to accommodate growth, resulting in a large network of critical infrastructure, dense development including housing and industries, and protected natural lands within low-lying, flood-prone areas. The range of potential consequences from elevated water levels combined with the uncertainty of when these events will occur, drives the need and urgency for a coordinated, data-driven approach to plan effective near and long-term adaptation interventions along the shoreline.



**FIGURE 2-1:
BAY TRAIL OPERATORS**

Source: East Bay Regional Park District



SHORELINE ANALYSIS

As part of the initial phase of the risk assessment, the overall shoreline analysis summarizes the data gathered to characterize impending coastal hazards to the Bay Trail. Coastal hazards documented in this study include permanent tidal inundation, storm inundation, groundwater emergence, and wave exposure. Other aspects of the shoreline context mapped in the following series relate to the overarching project goals and include: restoration potential, impact on nearby communities, especially disadvantaged communities, and the proximity and exposure of critical infrastructure that may be adjacent to the Bay Trail.

The following series of maps illustrate the overall analysis which provided the foundation for the selection of the East Bay's top eight most at-risk priority Bay Trail sites.

Bay Trail Operators

The Bay Trail Operators map to the left illustrates the full extent of the Bay Trail in the East Bay and highlights the segments which are currently operated by the Park District. In addition to those segments highlighted, other areas are in management transition and will soon be operated by the Park District. For this reason, the analysis was not initially limited to areas under Park District jurisdiction only, although they did receive additional consideration when prioritizing sites for adaptation.

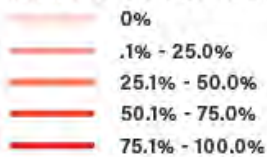
This map also highlights the relationship between the Bay Trail segments and the major open spaces managed by the Park District along the shoreline.



**FIGURE 2-2:
TIDAL INUNDATION W/
GROUNDWATER +3 FT SLR**

Source: LIDAR & SFEI Shoreline Inventory / ART & CoSMoS

PERCENT INUNDATION



INUNDATION DEPTH (FT)



**SHALLOW
GROUNDWATER**





Coastal Hazards +3 FT Sea Level Rise

Mapping of coastal hazards includes factors such as permanent tidal inundation, storm inundation, groundwater emergence, and wave exposure. The Bay Trail segments have been analyzed based on the total percent of inundation across these factors and weighted in the risk assessment accordingly.

In the mid-century scenario shown in Figure 2-2, the analysis illustrates the coastal impacts related to three feet of sea level rise. Areas of permanent tidal inundation and areas of potential groundwater shallowing and emergence are mapped for reference.

More information related to the planning horizons and anticipated time ranges associated with mid-century and end-of-century sea level rise are described in Chapter One.

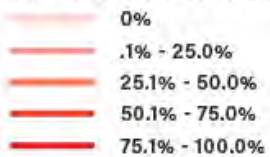




**FIGURE 2-3:
TIDAL INUNDATION W/
GROUNDWATER +6 FT SLR**

Source: LIDAR & SFEI Shoreline Inventory / ART & CoSMoS

PERCENT INUNDATION



INUNDATION DEPTH (FT)



**SHALLOW
GROUNDWATER**





Coastal Hazards +6 FT Sea Level Rise

Mapping of coastal hazards includes factors such as permanent tidal inundation, storm inundation, groundwater emergence, and wave exposure. The Bay Trail segments have been analyzed based on the total percent of inundation across these factors and weighted in the risk assessment accordingly.

In the end-of-century scenario shown in Figure 2-3, the analysis illustrates the coastal impacts related to six feet of sea level rise. Areas of permanent tidal inundation and areas of potential groundwater shallowing and emergence are mapped for reference.

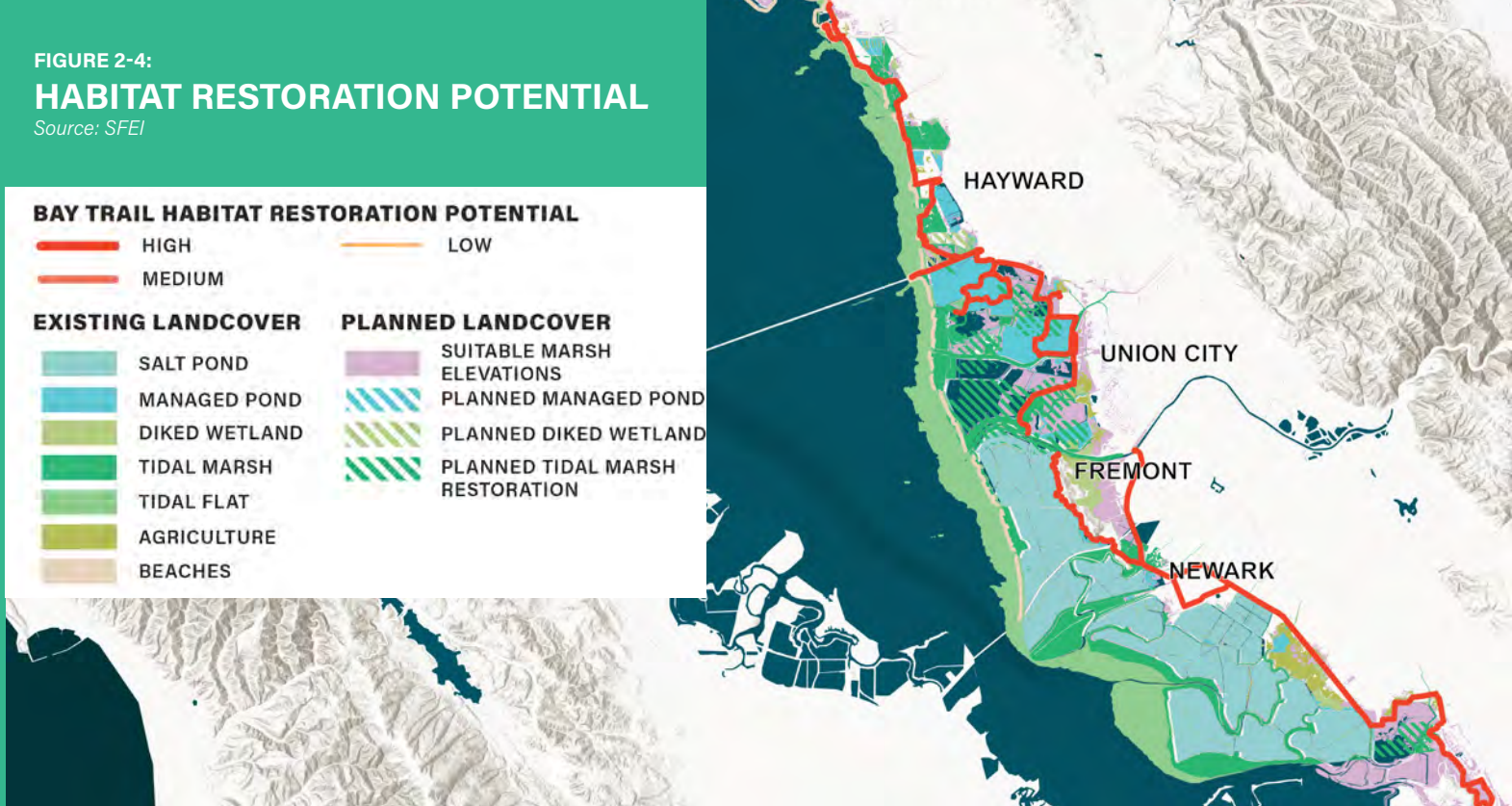
More information related to the planning horizons and anticipated time ranges associated with mid-century and end-of-century sea level rise are described in Chapter One.

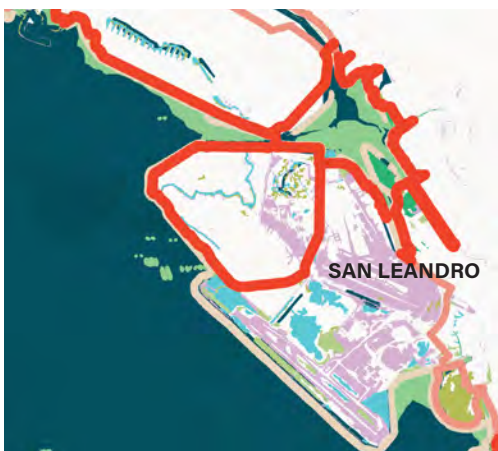
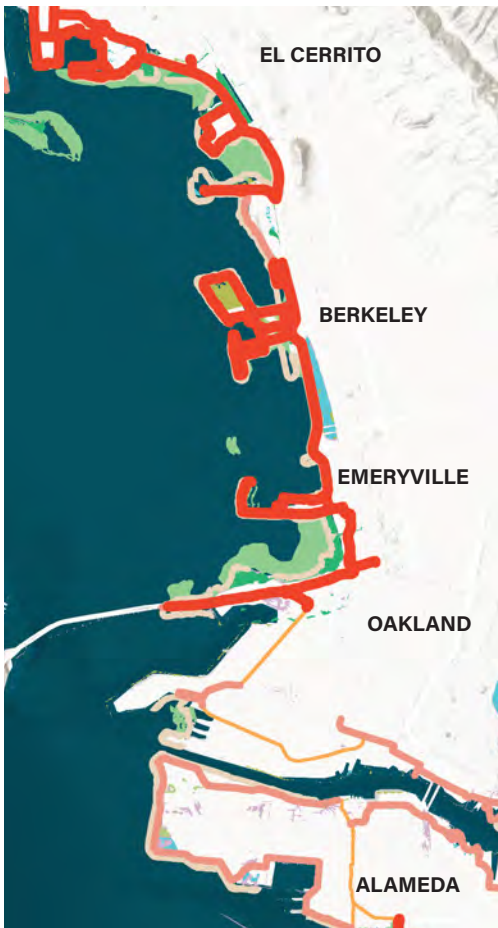


FIGURE 2-4:
HABITAT RESTORATION POTENTIAL

Source: SFEI

BAY TRAIL HABITAT RESTORATION POTENTIAL





Habitat Restoration Potential

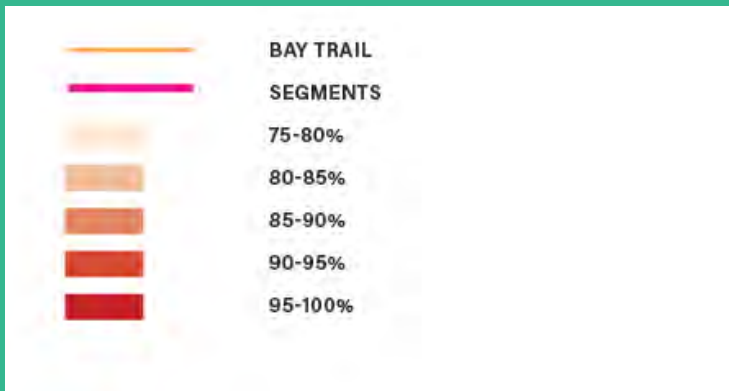
Ecological conditions along the East Bay shoreline are diverse and the Bay Trail is integrated into many different land types. The Habitat Restoration Potential map analysis focuses on the Bay Trail's proximity to existing ecological resources, opportunities for restoration of existing habitats, and the potential for new habitat areas adjacent to the Bay Trail. With the support of SFEI, the habitat data was reviewed and integrated into the risk assessment. In this category, trail segments adjacent to existing habitats received a high ranking, adjacency to areas that could be suitable for future habitat as sea levels rise received a medium ranking, and all others received a low ranking.

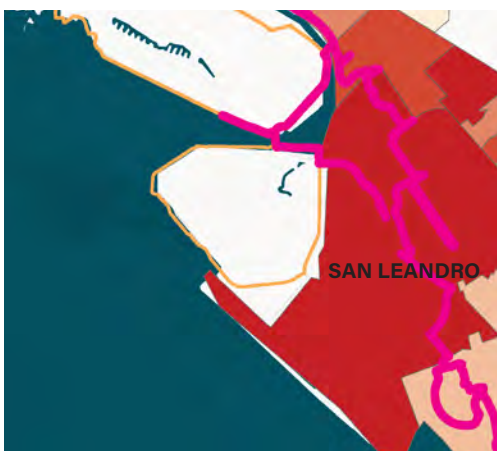
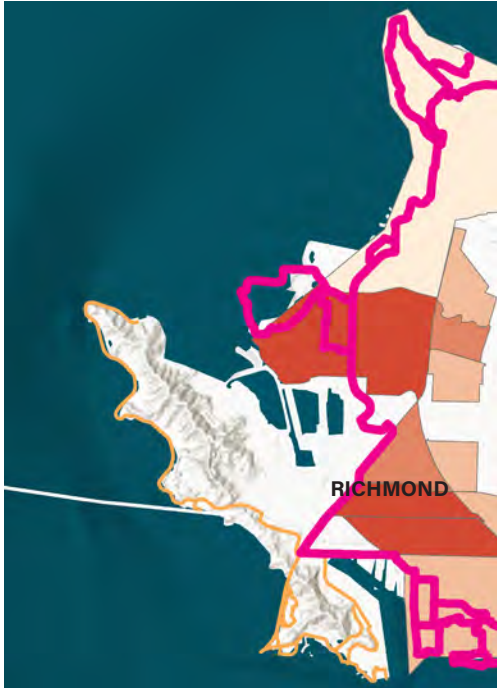
Integrating opportunities for restoration into the Bay Trail adaptation approach provides multiple benefits for the region within each project and is an important part of the Park District's project goals.



**FIGURE 2-5:
BAY TRAIL DISADVANTAGED
COMMUNITIES**

Source: CalEnviroScreen 3.0





Opportunity to Improve Public Health & Serve Disadvantaged Communities

The East Bay Shoreline And nearby communities impacted by sea level rise are also areas where additional community challenges exist today, including multiple socio economic and environmental health factors as have been documented by the state in the CalEnviroScreen dataset.

The Disadvantaged Communities map analysis assessed which trail segments were adjacent to the census block groups identified as being in the 75th percentile and above of social disadvantage. The percentages in the map show the population of each block group that identify as disadvantaged. It is notable that these communities are concentrated along the shoreline areas. Trail adaptation projects provide opportunities to better serve the adjacent communities, especially those most vulnerable.

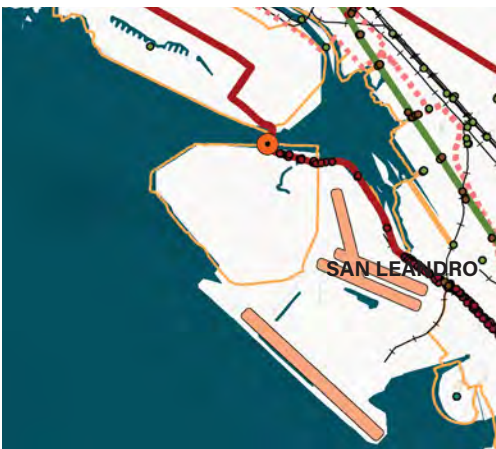


FIGURE 2-6:

CRITICAL INFRASTRUCTURE

Source: Caltrans, California Energy Commission DATA, BART, AC Transit, County Connection, SFEI





Critical Infrastructure

In addition to the Bay Trail, the East Bay shoreline has an extensive network of regionally-significant critical infrastructure which will be impacted by sea level rise. The Critical Infrastructure map illustrates highways, railroads, airports, utilities, wastewater treatment plants, and landfills in the region. The map shows that the extent of infrastructure along the shoreline is pervasive. Future trail adaptation projects will likely need to be integrated into larger infrastructure improvements and could be designed in a way that improves shoreline access for the region.

RISK ASSESSMENT

How is Risk Measured?

After conducting the shoreline analysis, the team applied the Park District goals and priorities described earlier, to screen trail segments within the project boundary and narrowed them down to eight sites for further study.

The general approach used for assessing risk of coastal flooding and sea level rise across the eight Bay Trail segments involves four steps:

- Assigning hazard scores
- Assigning vulnerability scores
- Assigning consequence scores
- Integrating all of the scores to reveal one final risk score

The risk assessment involved the development of a risk matrix structure to collate data and compare segments based on exposure to flooding, landscape response to flooding, and potential impacts that may result from flooding both in the near-term and long-term considering sea level rise.

Hazard Assessment

The hazard assessment estimates the relative likelihood and corresponding intensity of different hazards affecting each site segment. The natural hazards quantified include tidal inundation, storm flooding, extreme wave conditions, and groundwater emergence. The segments are assigned a score for each metric which add up to one hazard score for each. A weighting is then applied to the scores to allow for different explorations of the hazard results. The different weightings include mid-century focus, end-of-century focus, or present-day focus. Each weighting reveals answers to different questions.

Different weightings were applied to hazard, vulnerability, and consequence scores allow the risk matrix to be tested against dynamic priorities. In addition to developing thematic weightings based on unique needs for each assessment, Arup administered a survey of the project team to narrow in on important preferences from subject matter experts. Recognizing that this weighting approach has limitations related to potential bias, we included a ‘team weighting’ which was developed from the results of this survey.

The hazard assessment reveals that the Martin Luther King Jr. Regional Shoreline has the highest overall hazard score based on both end-of-century weighting and present-day weighting while Coyote Hills/Hayward received the highest hazard score when the mid-century weighting is applied. Coyote Hills and Alameda Point receive the highest hazard scores based on team weighting.

Every site received its highest hazard score when the end-of-century weighting was applied, pointing to the importance of planning for adaptation strategies today in anticipation of increased sea level rise and coastal flooding in the future.

Vulnerability Assessment

The vulnerability assessment considers the susceptibility of each segment to damage with a focus on potential for erosion and overtopping from flooding. The assessment takes into account the various elements of green and gray infrastructure present along the shoreline to determine how vulnerable each segment is, looking at everything from mudflats to trail composition. The same method that is used in the hazard assessment is applied here except with different weighting schemes: outboard protections, trail focus, or marsh focus.

Risk = Hazard x Vulnerability x Consequence

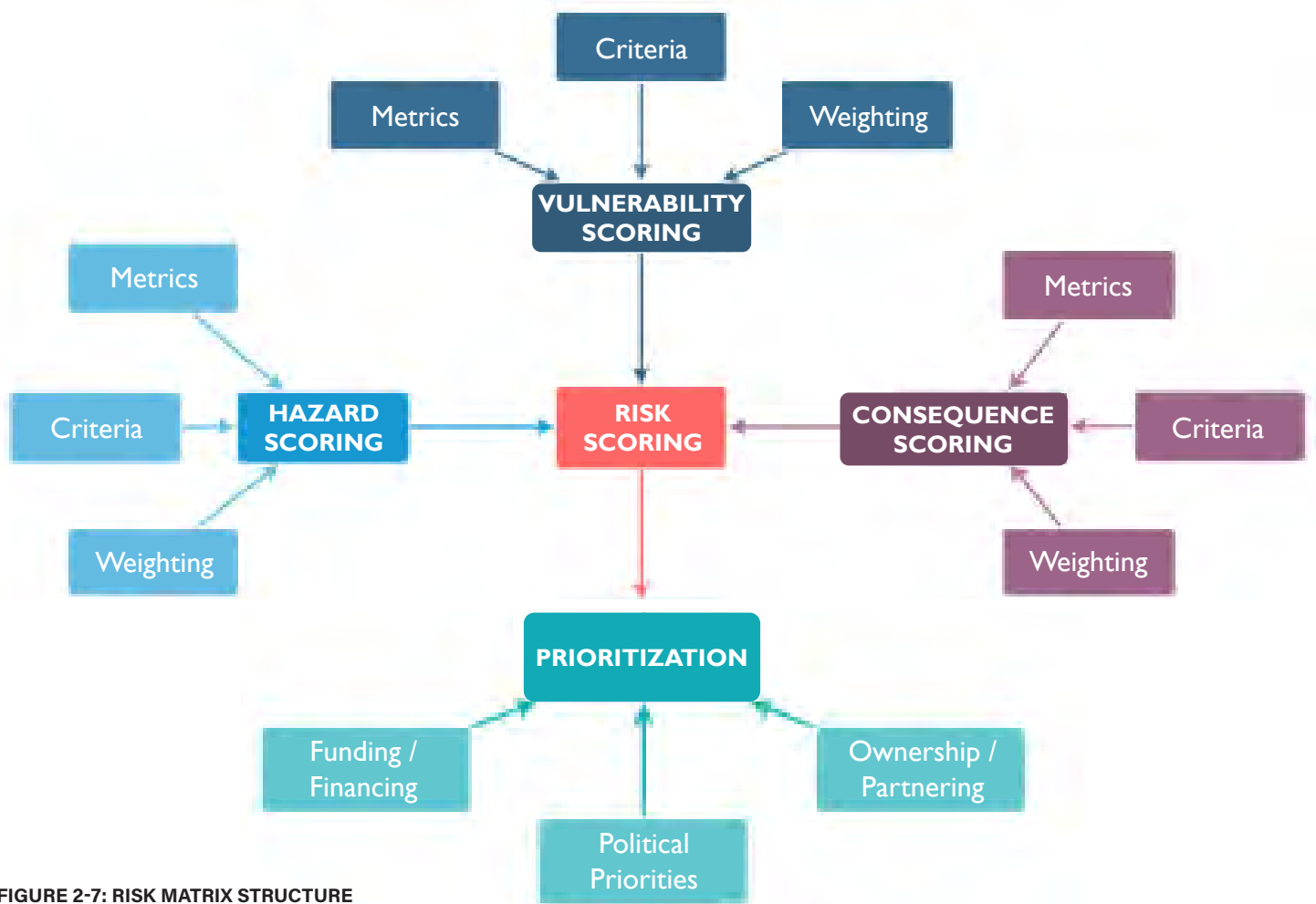


FIGURE 2-7: RISK MATRIX STRUCTURE
 Source: San Francisco Bay Trail Risk Assessment Methodology and Results

The vulnerability assessment exposes Alameda Point and Miller Knox as particularly vulnerable trail segments with high scores across all weighting schemes, elevating the need for more shoreline protection along these segments. This result also highlighted the lack of protective natural

infrastructure at these sites, such as outboard marshes or wetlands.

Consequence Assessment

The consequence assessment measures the expected severity and extent of the impact of hazards

on the trail and surrounding communities. The weighting applied to the consequence scores include economic, environmental, and social equity focuses. The different weightings allowed the Park District to tailor their decision-making around specific and dynamic priorities,

ensuring the tool is flexible enough to meet their needs in the context of a changing climate and a changing funding landscape.

The consequence assessment shows the Coyote Hills/Hayward segment as having the highest consequence scores for most weighting schemes, likely caused by its proximity to nearby neighborhoods and community places, while Miller Knox and Crown Beach show low scores across all weighting schemes both of which are further removed from population centers. With a social equity weighting, however, the Spine Trail score spikes as the segment with highest consequences given its proximity to a disadvantaged community. Of note, economic and environmental weighting schemes yield almost identical scores across all sites.

Risk Assessment

Finally, the Risk Assessment integrates all the scores from the assessment to reveal one final risk score for each segment. Over 15 weighting schemes were developed and ultimately, after incorporating feedback from the project team and consolidating all results, a list was developed for first, second, and third priority sites ranked according to risk.



BAY TRAIL - HAYWARD SHORELINE

Source: WRT

The section of the Bay Trail that runs along the East Bay is varied and complex, with differing exposure levels to hazards from the Bay, differing coverage and quality of green and gray infrastructure that determine vulnerability, and differing surroundings that define how consequential the impacts of sea level rise and coastal flooding will be on community resources. We know the impacts from climate change will change our relationship with the Bay as it threatens public access along the shoreline. This assessment reveals how truly diverse the conditions along the shoreline are and as a result, how diverse the impacts will be, providing a roadmap for the Park District and its stakeholders to

prioritize adaption interventions in the near-term to achieve long-term benefits for the region.

Ultimately, this risk assessment provides a critical foundation for risk-informed, strategic decision making around how and when to address sea level rise by leveraging the Bay Trail within the Park District's 55-miles of East Bay shoreline.

Following the Risk Assessment, segments of the Bay Trail within the Park District’s purview found to be at the highest risk of coastal flooding and sea level rise were prioritized for additional adaptation design visioning. Segments were ranked based upon their risk level, funding needs, ownership structure and partnership opportunities, political support, and co-benefits resulting from adaptation. The risk assessment is useful in that it establishes a clear and objective baseline for where to focus attention when pursuing projects with the greatest potential co-benefits across the categories of economic, environmental, social

equity, recreational, and connectivity. Risk assessment also gives an early indication of which projects may yield the most favorable benefit-cost relationships, which is critical for capital planning. Ultimately, this risk assessment provides a critical foundation for risk-informed, strategic decision making around how and when to address sea level rise by leveraging the Bay Trail within the Park District’s 55-miles of East Bay shoreline.

See Appendix: San Francisco Bay Trail Risk Assessment Methodology and Results, November 6, 2020; Arup for detailed description of the methodology

Application of Prioritization Matrix

The prioritization matrix combines the outcomes of risk assessment with the Park District's goals, and the potential for funding and partnership. The sites that had a higher cumulative score rose to the top. This scoring informed the selection of three prototype sites for developing adaptation concepts within the scope of the RAAPP. An additional consideration that informed the prototype site selection was whether or not planning and design work was currently underway for any of those sites. Sites where planning wasn't currently in process were prioritized.

TABLE 2-1: ADAPTATION PRIORITIZATION MATRIX

	MLK Shoreline	Alameda Point	Coyote Hills/ Hayward	North Richmond	Eastshore State Park	Spine Trail	Crown Beach	Miller Knox
Risk Reduction	+++	+++	+++	++	++	+	+	+
EBRPD Project Goals	+++	+++	++	+++	+++	+	++	++
Funding & Partnership Potential	+	+++	+++	+++	++	+++	++	+++
	+++ Highest Priority	++ Higher Priority	+	High Priority				



**FIGURE 2-8:
BAY TRAIL PRIORITY SITES**

- HIGHEST PRIORITY
- HIGH PRIORITY
- MID PRIORITY
- LOW PRIORITY
- OTHER BAY TRAIL SEGMENTS

EIGHT PRIORITY BAY TRAIL SITES

In summary, the risk assessment process involved creating evaluation criteria to compare Bay Trail segments under the Park District management based on exposure to flooding, landscape response to flooding, and potential impacts that may result from flooding both in the near-term and long-term considering sea level rise.

Metrics were developed to measure hazard, vulnerability, and consequences from sea level rise and coastal flooding to assess the eight priority sites and assign risk profiles to each. Through that analysis the sites were grouped into tiers of prioritization for the Park District to consider in future planning efforts.

Figure 2-8 illustrates locations of the eight priority Bay Trail sites identified and studied in detail as part of the Risk Assessment.

The results of the risk assessment and prioritization process were subsequently used to identify three prototype sites for developing adaptation concepts. The adaptation concepts for the three sites depict a range of strategies and partnership potential and are illustrated in more in the Prototype Sites chapter.

Bay Trail Tiers of Priority

FIRST TIER PRIORITY SITES

1. Martin Luther King Jr. Regional Shoreline
2. Alameda Point
3. Coyote Hills/Hayward

SECOND TIER PRIORITY SITES

4. North Richmond
5. Eastshore State Park
6. Spine Trail

THIRD TIER PRIORITY SITES

7. Crown Beach
8. Miller Knox



3

ADAPTING THE BAY TRAIL

The San Francisco Bay shoreline exhibits great diversity along its entire extent, due to varying geology, hydrology, ecology, microclimate, land use and development patterns, demographics, and opportunities for access, which influences the types of vulnerabilities found along the shoreline. This diversity calls for a range of responses and adaptation strategies that address specific local conditions.

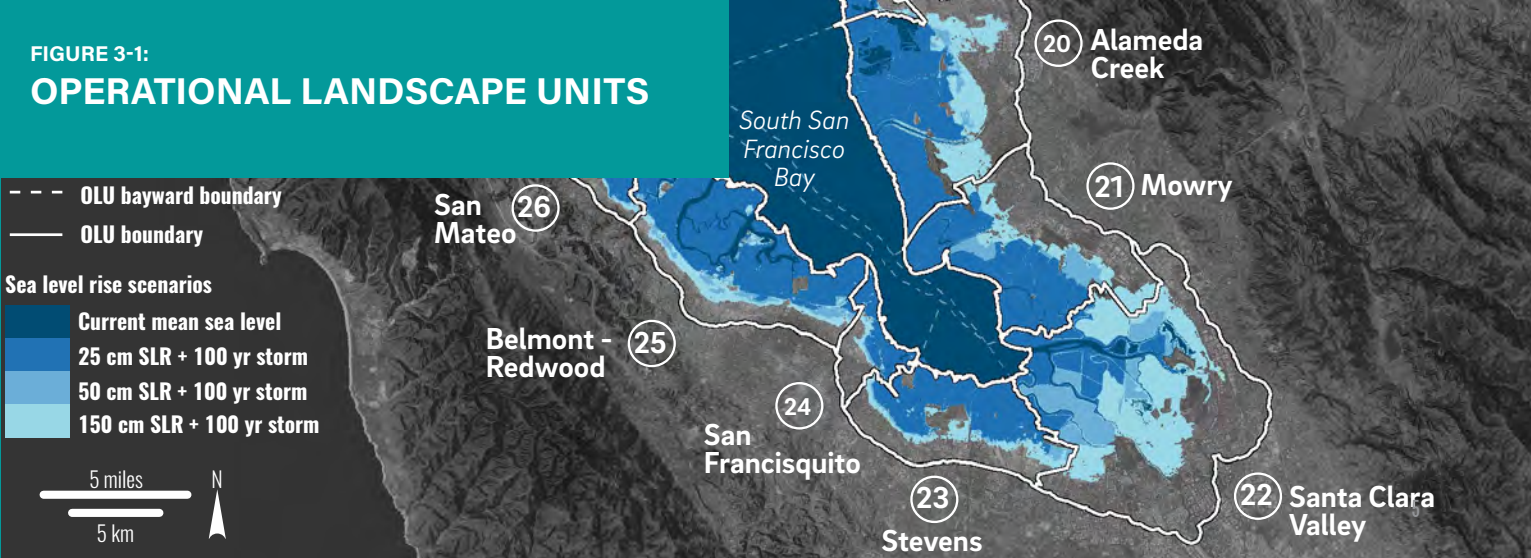
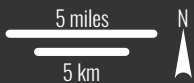
In addition to understanding the diverse conditions and processes that shape the existing shoreline, assessing the extent of risk along various segments of the Bay Trail was an important step in the process to prioritize responses.



FIGURE 3-1: OPERATIONAL LANDSCAPE UNITS

--- OLU bayward boundary
 — OLU boundary

Sea level rise scenarios



BROAD GUIDANCE: THE SHORELINE & THE BAY TRAIL

The Bay Trail weaves through a complex and diverse series of habitats and shoreline types throughout the East Bay. The Bay Trail design standards are clear about basic cross-section and clearances to provide safe use. This is appropriate for a static system. Applying the lens of adaptation in response to sea level rise, it is necessary to consider the changing ecological context and geomorphological conditions expected over the coming decades.

This section of the document focuses on shoreline typologies and potential adaptation opportunities. Each example addresses nature-based adaptation solutions that support biologic benefits and sustainable future shoreline management. Some of these concepts are later applied to the three example sites in the last section of the document.

Using Landscape Units to Plan for the Future

The complex nature of multi-objective planning is underscored by the complex characteristics of the shoreline along the East Bay, the associated alignment of the Bay Trail, the present land use and habitats, the historical context, and the desired future by community stakeholders. Current management approaches by the Park District and regional climate change adaptation planning practices recommend the delineation of sub-areas along the shoreline, guided by the geomorphic setting and natural processes, in order to enable effective place-based planning.

The Adaptation Atlas (SFEI, 2019) introduces the concept of the Operational Landscape Unit (OLU), which are defined as “connected, geographic areas sharing physical characteristics that would benefit from being managed as a unit to

provide particular desired ecosystem functions and services.” This framework was applied to the Bay Area and a group of Baylands OLUs were identified as recommended planning units for nature-based sea level rise adaptation. Bayland OLUs are connected by flow of water and sediment and consist of both landscape features and built environment. Datasets used to group the OLUs include geomorphic settings, Baylands, shoreline and land use characteristics. Figure 3-1: Operational Landscape Units shows the OLU extents across the entire Bay area.

This project focuses on the nine distinct OLUs identified by the SFEI Adaptation Atlas in the East Bay (north to south): 13 Carquinez South, 14 Pinole, 15 Wildcat, 16 Point Richmond, 17 East Bay Crescent, 18 San Leandro 19 San Lorenzo, 20 Alameda Creek, and 21 Mowry.

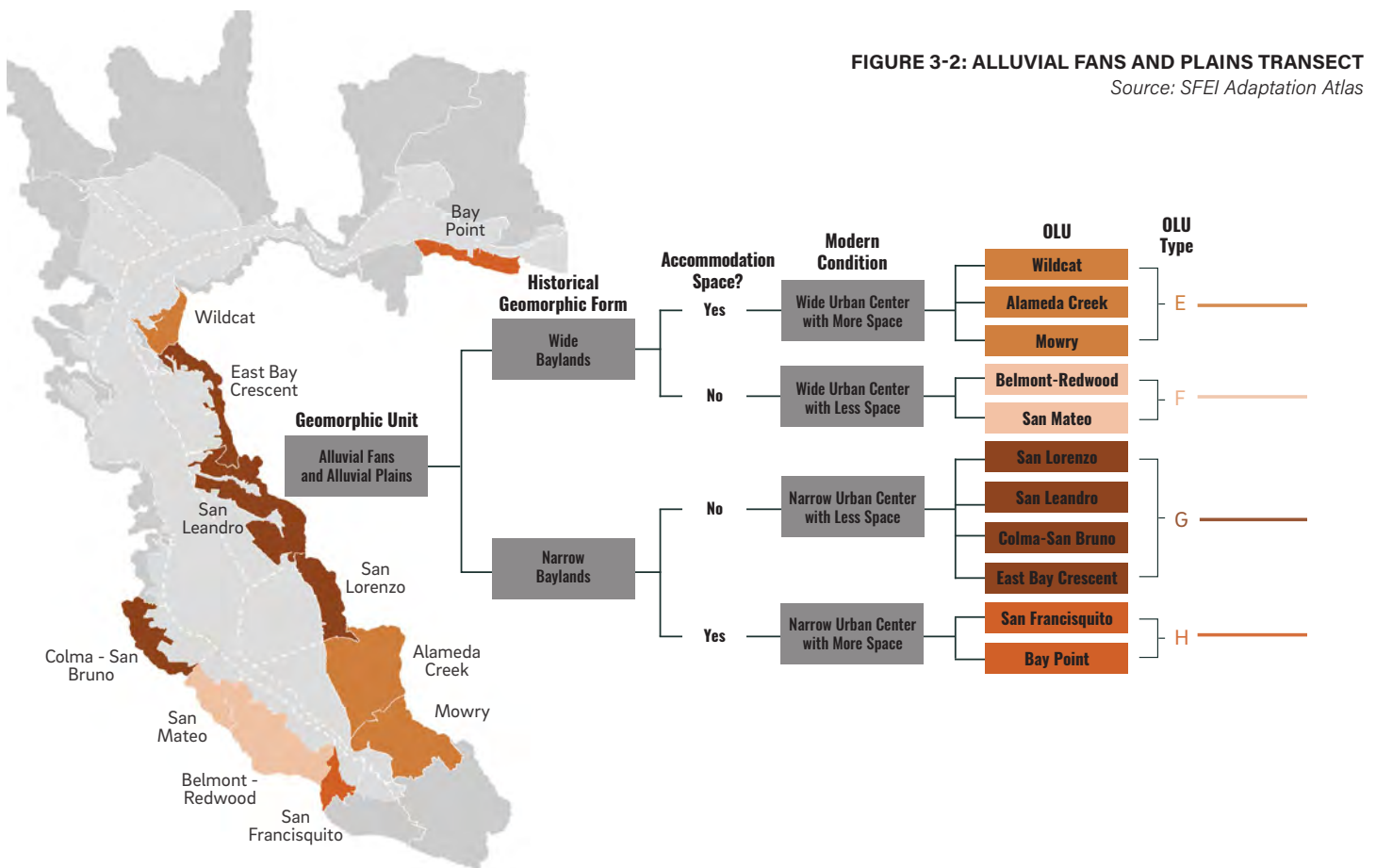
Shoreline Habitats: Understanding critical tidal/habitat elevations and physical processes

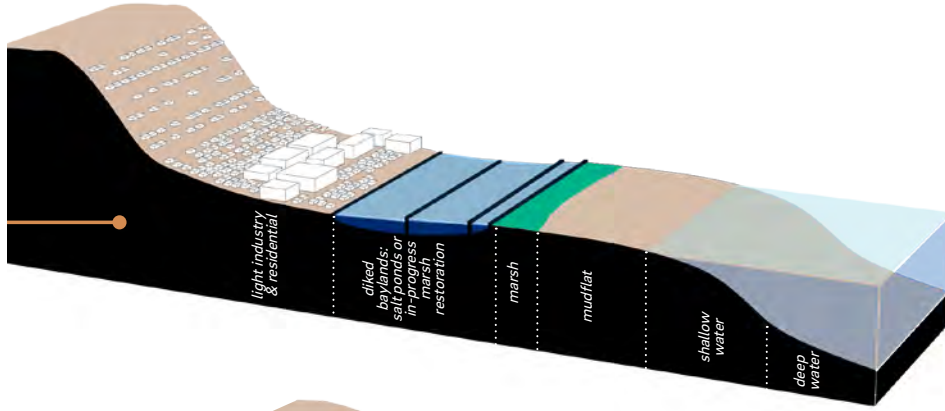
Designing appropriate adaptation strategies for each segment of the Bay Trail should be informed by an understanding of the unique interplay of physical processes at each shore location. The geomorphology and flood risk of natural and developed shorelines by the Bay Trail are influenced heavily by both typical physical processes (e.g. tides and

waves) and those corresponding to extreme weather events (e.g. coastal storm surge, wave action). The shape and size of natural landform features, such as the crest elevation of a beach berm, can be related to local water level patterns experienced at the site through time. Major coastal and fluvial storms generally result in the overtopping of landforms through wave runup and flooding and can cause the greatest rates of geomorphic change.

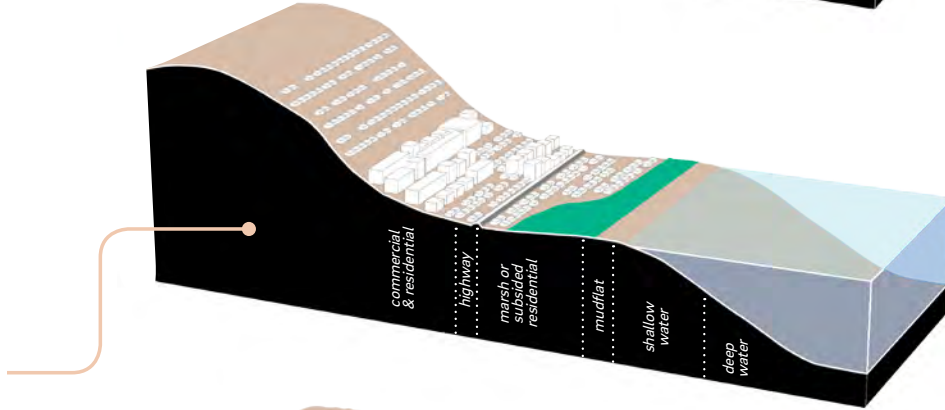
The primary physical processes to be considered along the Bay Trail shoreline include:

- Tides and Coastal Storm Surge
- Wind waves
- Fluvial Flows
- Overtopping of landforms by coastal and/or fluvial inputs
- Sediment transport

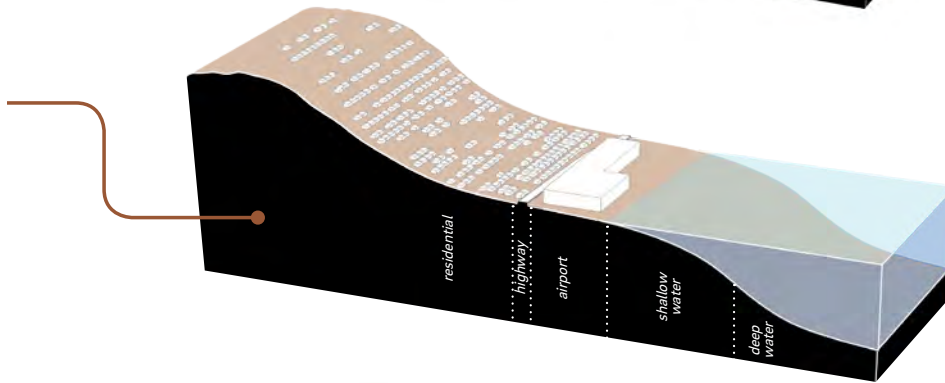




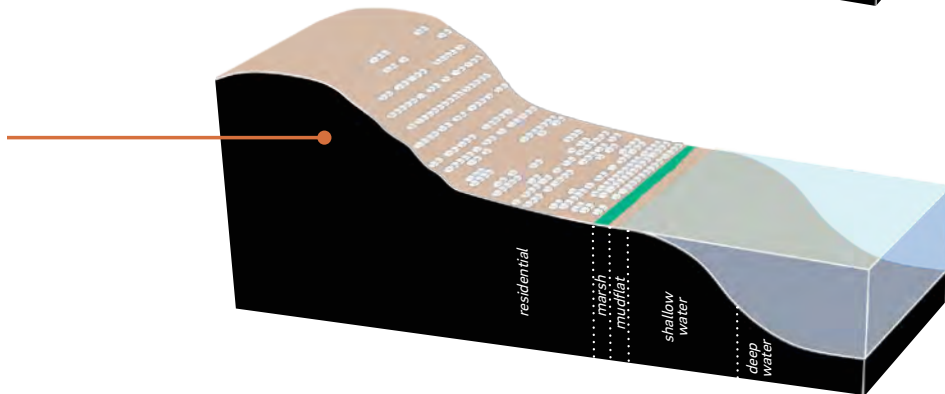
TYPE E: Wide Baylands, Urban Centers With More Space



TYPE F: Wide Baylands, Urban Centers With Less Space



TYPE G: Narrow Baylands, Urban Centers With Less Space



TYPE H: Narrow Baylands, Urban Centers With More Space

Shoreline Habitats: Additional Regulatory Considerations

Due to a variety of site specific conditions and spatial constraints, such as development and critical infrastructure, alternative approaches for sea level rise adaptation should include placing fill bayward of the existing shore. These alternative fill placements would include, but are not limited to, horizontal levees, coarse (cobble and gravel) beaches, perched beaches and sand

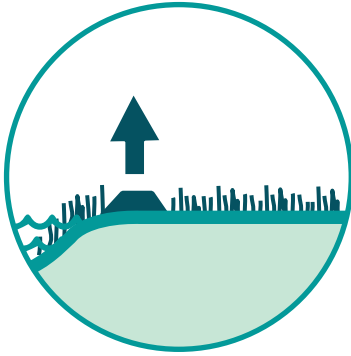
placement. New interest in permitting innovative projects that include bay fill for habitat enhancement may overlap with sea-level rise adaptation. The placement of select materials to construct resilient nature-based shore-forms can address dynamic sea level rise conditions and may be most effective to mitigate potential flooding, provide public access, establish diverse habitats and allow for the migration of those habitats over time.

NEARLY FLOODED DOOLITTLE DRIVE NEAR MARTIN LUTHER KING REGIONAL SHORELINE PARK DURING A KING TIDE

*Source: Photo from King Tide California
Project, February 9, 2020.*



ADAPTATION STRATEGIES



Hold the Line

Maintains and defends existing shoreline configuration by upgrading flood protection infrastructure and limited use of natural and nature-based adaptation approaches.



Buffer with Public Open Space

Moving the existing first line of shoreline defense landward by creating a buffer of public open space where some areas can be temporarily inundated, providing potential additional habitat. Requires minimal reconfiguration of existing vulnerable infrastructure. Use of nature-based adaptation measures as necessary for identified vulnerabilities.



Maximize Habitat and Realignment

Realignment of vulnerable shoreline infrastructure as necessary in order to maximize opportunities for nature-based approaches, with an emphasis on restoring/enhancing connectivity of natural processes.



Hybrid Approach

Combines different strategies over time and/or space to balance objectives for infrastructure, open space, and habitat.

ADAPTATION MEASURES BASED ON SHORE TYPE



TIDAL MARSHES AND MUDFLATS - CODORNICES CREEK *Source: ESA*



ESTUARY-CREEK CONNECTIONS - OAKLAND ESTUARY *Source: ESA*



ARMORED SHORELINES *Source: UW News*

The availability of space landward for migration along distinct segments of the Bay Trail will be key to determining what general adaptation strategy (and series of adaptation measures implementing the strategy) will be pursued at that location. Nature-based adaptation measures, such as the use of native oyster reefs and coarse-grained beaches, can offer flood protection as well as a number of ecological, recreational and aesthetic co-benefits that are compatible to the Bay Trail. The RAAPP focuses on presenting nature-based adaptation measures that are relevant and implementable to San Francisco Bay and the East Bay shoreline, since traditional armored approaches have been shown to be more susceptible to catastrophic failure and correlated with negative ecological impacts for habitat. Most likely, the future East Bay shoreline will be “adapted” with a mix of green-gray infrastructure, depending on adjacent land use. For each shore type, several examples of potential adaptation are shown. See Appendix for more in-depth information on the shore types and suitability of different nature-based adaptation measures.

The existing East Bay shore by the Bay Trail has been historically modified by human presence and is continually shaped by a number of coastal physical processes. As sea levels rise, these physical processes as well as the geomorphic response of natural and built shorelines will change. The RAAPP categorizes the East Bay shore into distinct shore types: tidal marsh, tidal flats and mudflats, estuary-creek connections, coarse-grained beaches, filled reclaimed areas, earthen levee/embankment and armored shorelines. If there is available space at the backshore, some shore types are predicted to migrate upwards and landwards (e.g. coarse-grained beaches, tidal marshes); others may erode or experience catastrophic failure (e.g. engineered structures).

The following shore types and potential adaptations are described in this chapter:

1. Tidal Marshes and Mudflats
2. Estuary-Creek Connections
3. Armored Shorelines
4. Earthen Levees
5. Coarse-grained Beaches
6. Filled Reclaimed Areas



EARTHEN LEVEES AND DIKES - HAYWARD SHORELINE Source: Google Map



COARSE SAND AND GRAVEL BEACHES - BERKELEY MEADOW Source: Google Map



FILLED RECLAIMED AREAS - McLAUGHLIN EASTSHORE STATE PARK Source: ESA

ADAPTATION MEASURES BASED ON SHORE TYPE

1. Tidal Marshes and Mudflats

Tidal marshes are coastal wetlands exposed to tidal action and/or freshwater inputs and include a range of estuarine habitats such as salt marsh, freshwater marsh, mudflats and others. This estuarine habitat is typically found adjacent to tidal flats and mudflats, where sediments in offshore flats are suspended by wind waves and subsequently deposited in the marshes (top right). Without a sufficient sediment supply, marsh vegetation will effectively drown under higher water levels and

eventually the tidal marsh will convert into an barren flat. The disappearance of marsh habitat results in the loss of a buffer against wave action and tidal currents. This may accelerate sediment transport processes and potential erosion at the shoreline landward of the marsh.

Nature-based adaptation measures for tidal marsh and mudflat environments could include use of eelgrass plantings and oyster reef structures at the appropriate tidal elevation bands to provide wave attenuation and encourage sediment retention for tidal marsh. Where it is

possible, landward assets (like the Trail) can be set back to create a wider buffer of future marsh habitat and decrease risk of being in the future flood zone.

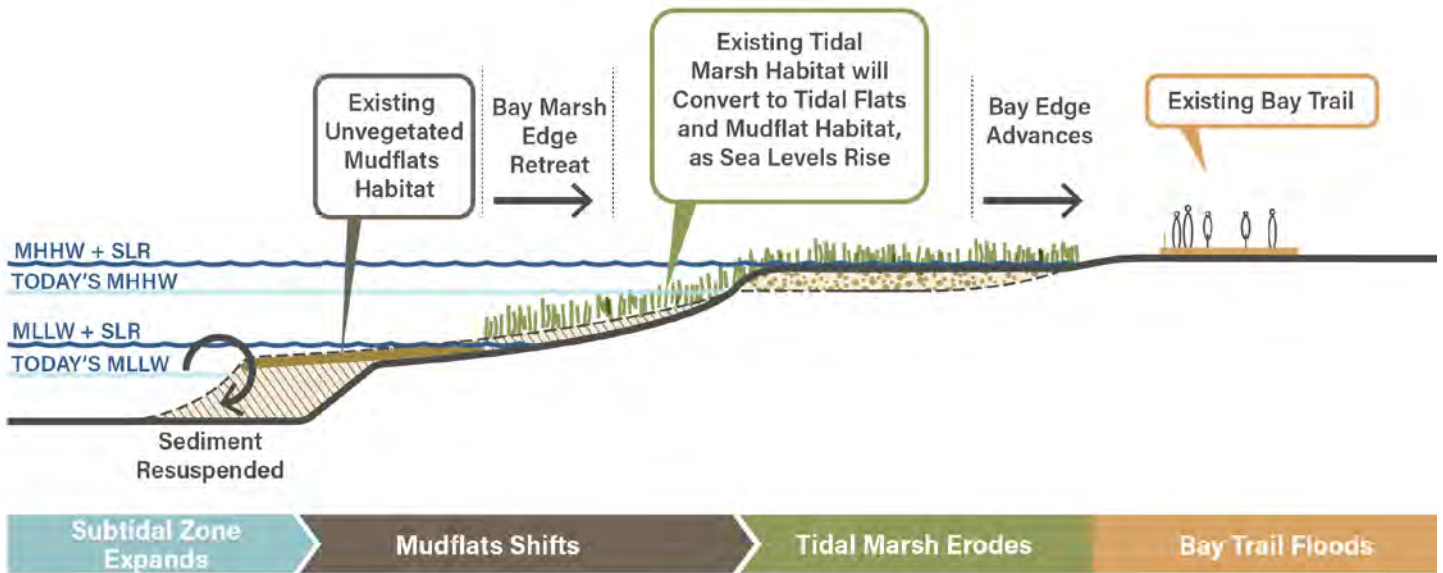
Horizontal Levee and Ecotone Slope Opportunities

Transitions from wetlands to uplands elevations can incorporate horizontal levees, which are gently sloping, vegetated, ecotone slopes, that dissipate wave energy and provide room for habitats to transgress with sea-level rise.

TIDAL FLATS AND MUDFLATS - CODORNICES CREEK
Source: ESA



NO-ACTION SCENARIO - TIDAL MARSHES AND MUDFLATS



ADAPTATION TIDAL MARSHES AND MUDFLATS

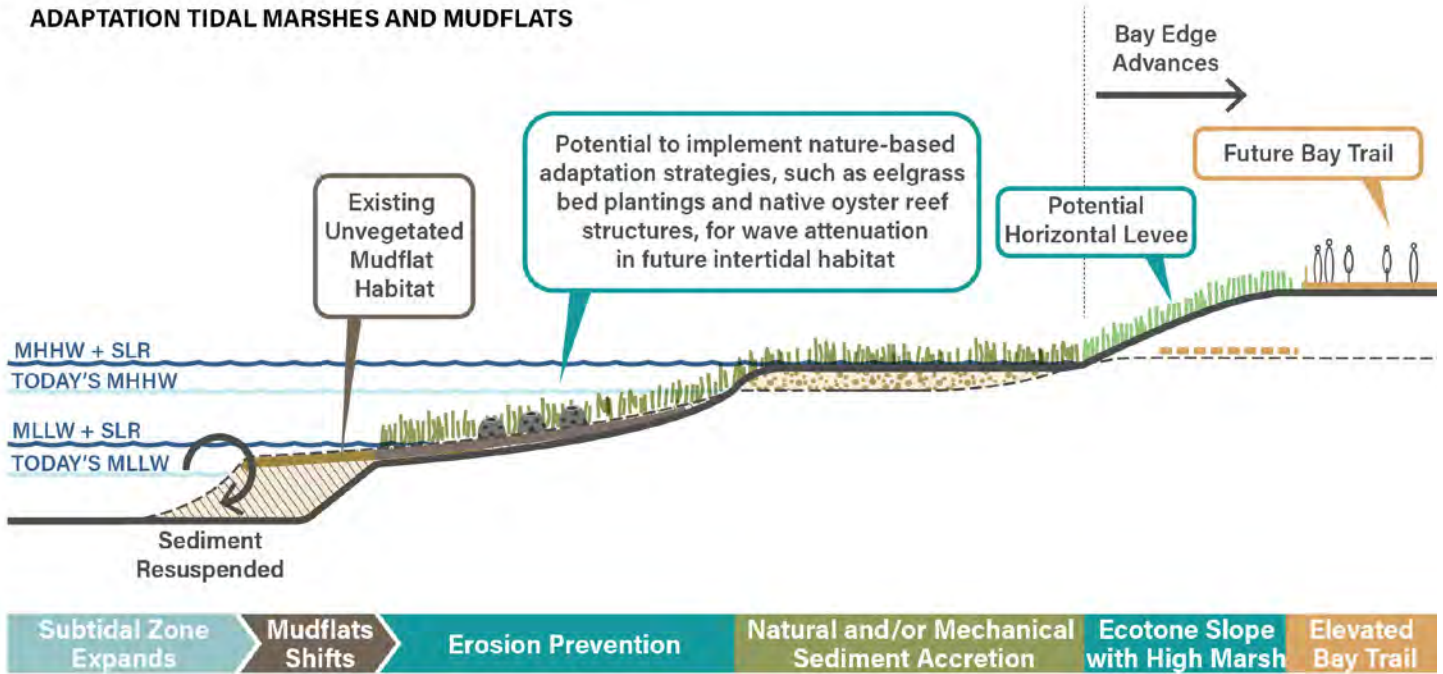


FIGURE 3-3: TIDAL MARSHES AND MUDFLATS PROCESSES AND ADAPTATION APPROACHES

ADAPTATION MEASURES BASED ON SHORE TYPE

2. Estuary-Creek Connections

The connections of creeks at the bay shore create and contribute to unique and diverse ecosystems due to the interaction of dynamic fluvial and tidal environments that support a range of aquatic, terrestrial and avian species. Sediment contributions from estuary-creek connections play a critical role in sustaining tidal marsh and tidal flat habitats in the intertidal

zone and can potentially support coarse-grained beach sediment supply at the shoreline. The many creeks that drain watersheds of the East Bay are important opportunities to plan for and incorporate expansion and restoration of these critical habitat areas and, when considered together, could represent significant and important elements of successful adaptation strategies for sea level rise and public access.

THE MOUTH OF SCHOOLHOUSE CREEK IN BERKELEY

Source: Photo by Neil Mishalov, Berkeleyside



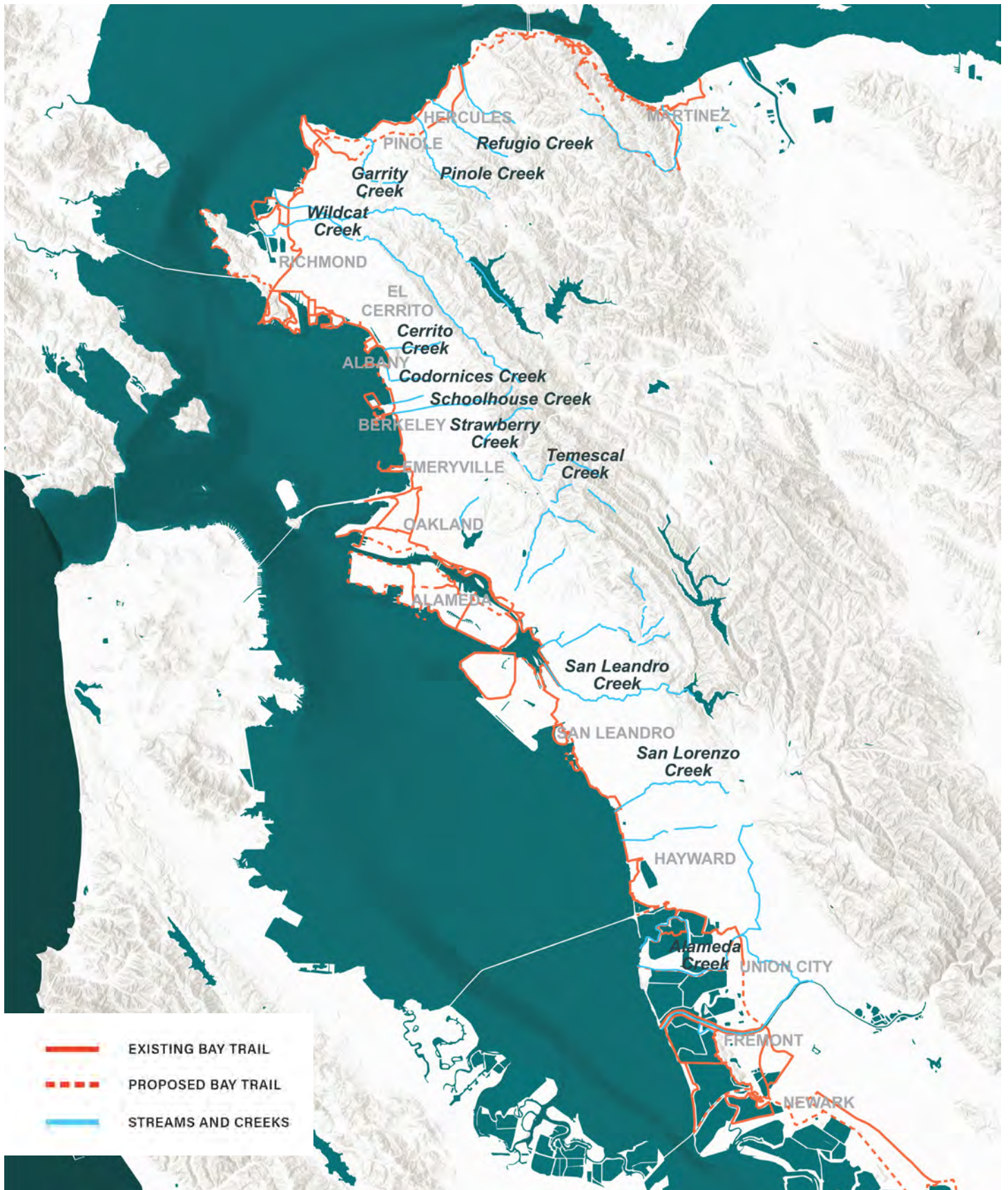


FIGURE 3-4: EAST BAY STREAMS AND CREEKS

Source: WRT, San Francisco Bay Trail (2020); USGS National Hydrography Dataset (2020)

ADAPTATION MEASURES BASED ON SHORE TYPE

3. Armored Shorelines

Armored Shorelines Are shorelines modified with erosion-resistant materials with a steep aspect ratio (height/width) for shoreline and flood protection purposes and minimal space footprint and material volume. These can include rock revetment, reinforced concrete seawall, compacted earth levee or other arrangements that 'harden' the shoreline in addition to its primary function (e.g. railway elevated on embankment). An example of an armored shoreline in the East Bay is the constructed rock revetment along the Albany 'Neck', where concrete

rubble and debris were removed and replaced with an engineered shoreline using imported rock.

Armored shorelines are susceptible to failure (e.g. flooding of landward assets) via risk of overtopping of the structure crest from sea level rise and wave runup. Potential adaptation actions in the short-term may include constructing new armoring on top of the existing structure to keep pace with sea level rise. However, as the rate of sea levels increases in the latter part of the century, this may ultimately be a costlier and less effective solution.

ARMORED SHORELINE - ALBANY NECK

Source: ESA



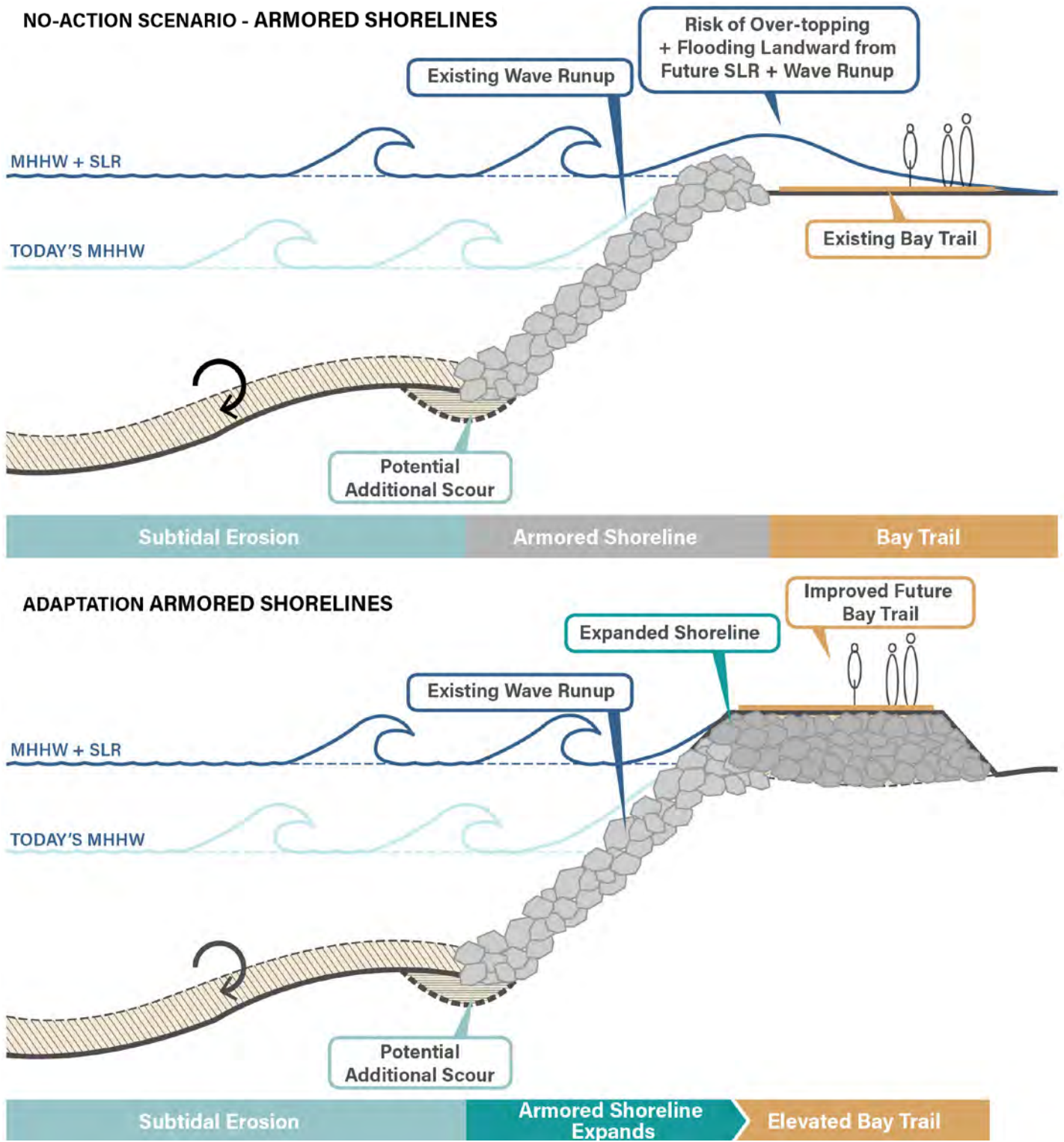


FIGURE 3-5: ARMORED SHORELINES PROCESSES AND ADAPTATION APPROACHES

ADAPTATION MEASURES BASED ON SHORE TYPE

4. Earthen Levees

Earthen levees are earth fill embankments designed to obstruct surface flows and provide flood protection for landward assets, typically at a lower elevation than mean sea level. In this study, levee refers to a flood control structure constructed to protect people and property that are intolerant to flooding. Sections of the shoreline at Point Isabel are examples of an earthen levee shore type located by the Bay Trail.

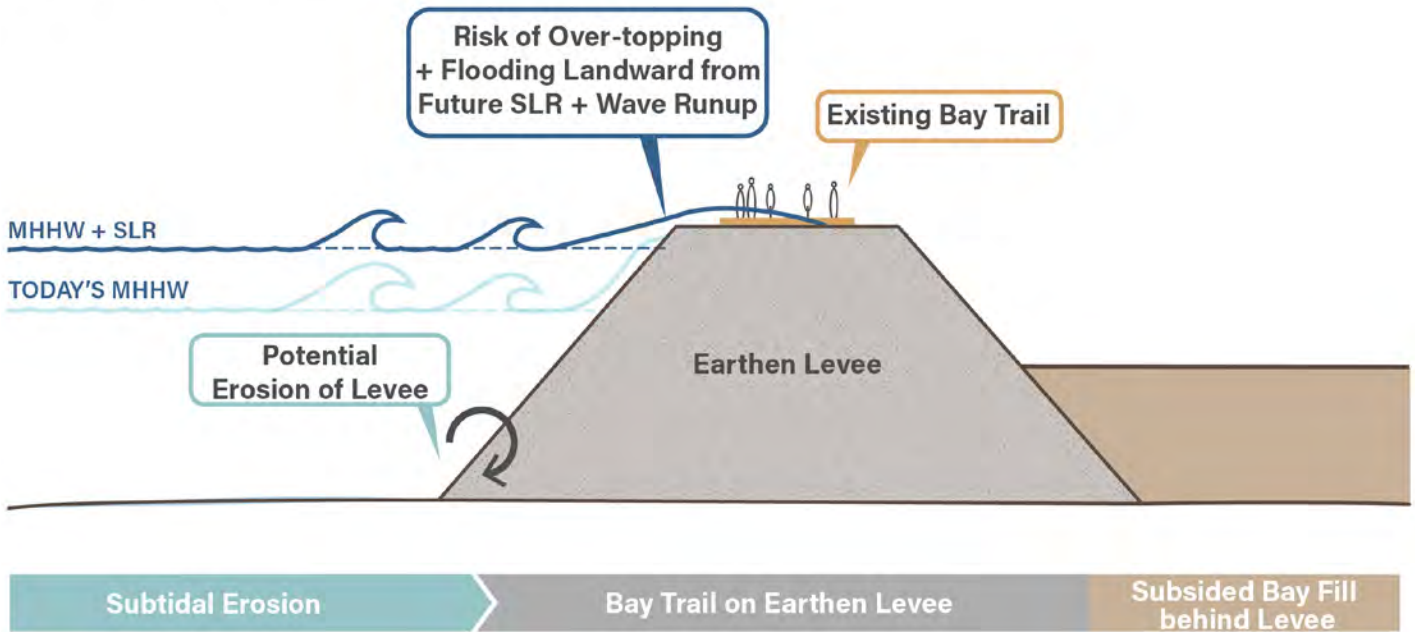
Potential adaptation actions to preserve the trail may include adapting/retrofitting the existing structure by placing new earth fill with an increased crest elevation and footprint, with the trail location on top. If there is adequate space landward, the construction of a new earthen levee inland may be feasible. A horizontal levee approach, which entails the construction of a shallow slope on the bayward side of the existing embankment, is also another potential adaptation approach.

EARTHEN LEVEE - POINT ISABEL

Source: ESA



NO - ACTION SCENARIO - EARTHEN LEVEE



ADAPTATION EARTHEN LEVEE

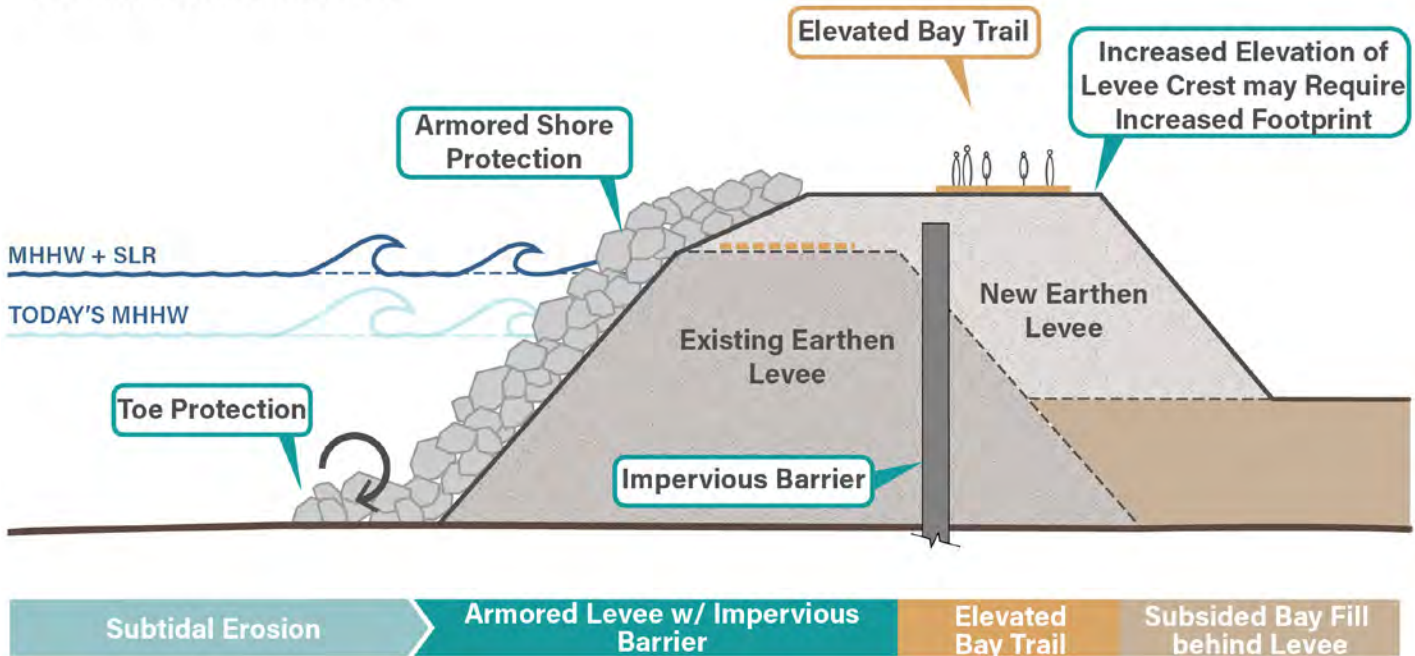


FIGURE 3-6: EARTHEN LEVEE PROCESSES AND ADAPTATION APPROACHES

ADAPTATION MEASURES BASED ON SHORE TYPE

5. Coarse Beaches

Coarse-grained beaches are dynamic coastal landforms comprised of sand, gravel and/or cobble. Beaches include a supratidal beach berm, formed by wave deposition, and a beach face. As water levels increase, waves will break closer to the shore and the landward extent of wave deposition (which influences the berm location) will shift landward. If there is sufficient volume of beach sediment and space landward, the beach crest will increase in height.

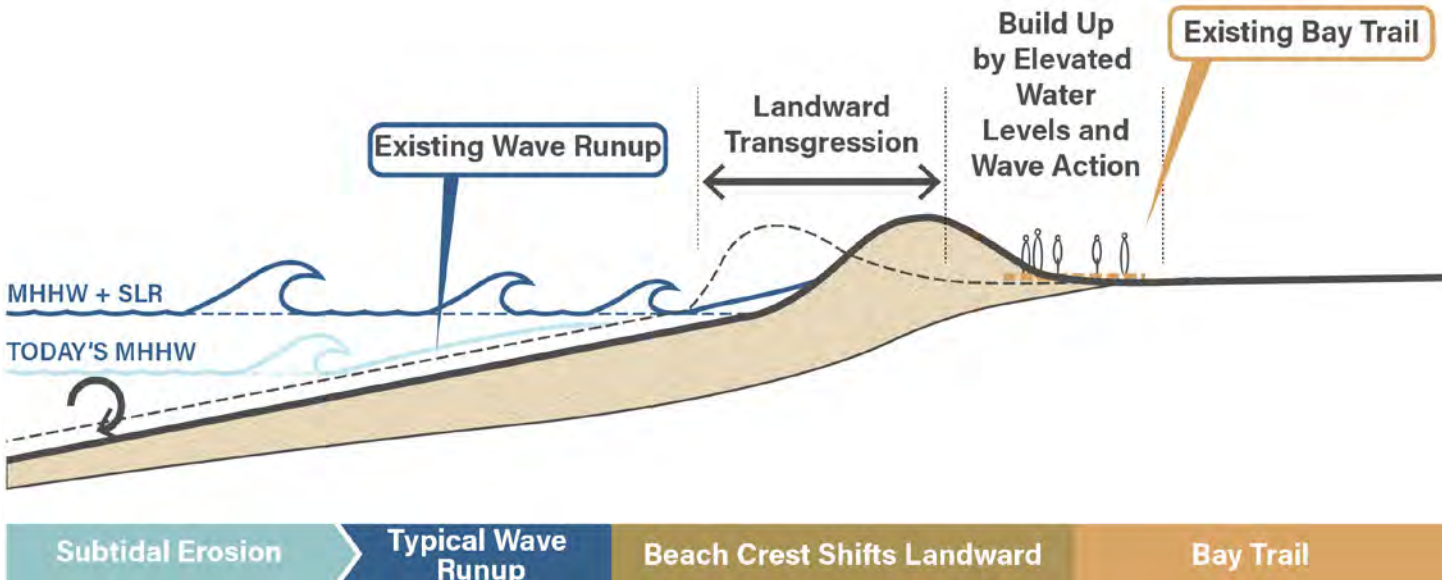
Adaptation actions for an existing coarse-grained beach can include 1) setting back to the trail to allow for landward transgression of the beach edge and 2) nourishing the coarse-grained sediment supply of the beach and elevating the trail on top of the future beach crest. Features such as large boulders or other natural groins found around coarse-grained beaches can help to limit alongshore drift and support sediment retention.

COARSE SAND AND GRAVEL BEACHES - BERKELEY MEADOW

Source: Photo by Justin Thewlis, Google Map, November, 2019.



NO-ACTION SCENARIO - COARSE GRAINED BEACHES



ADAPTATION COARSE GRAINED BEACHES

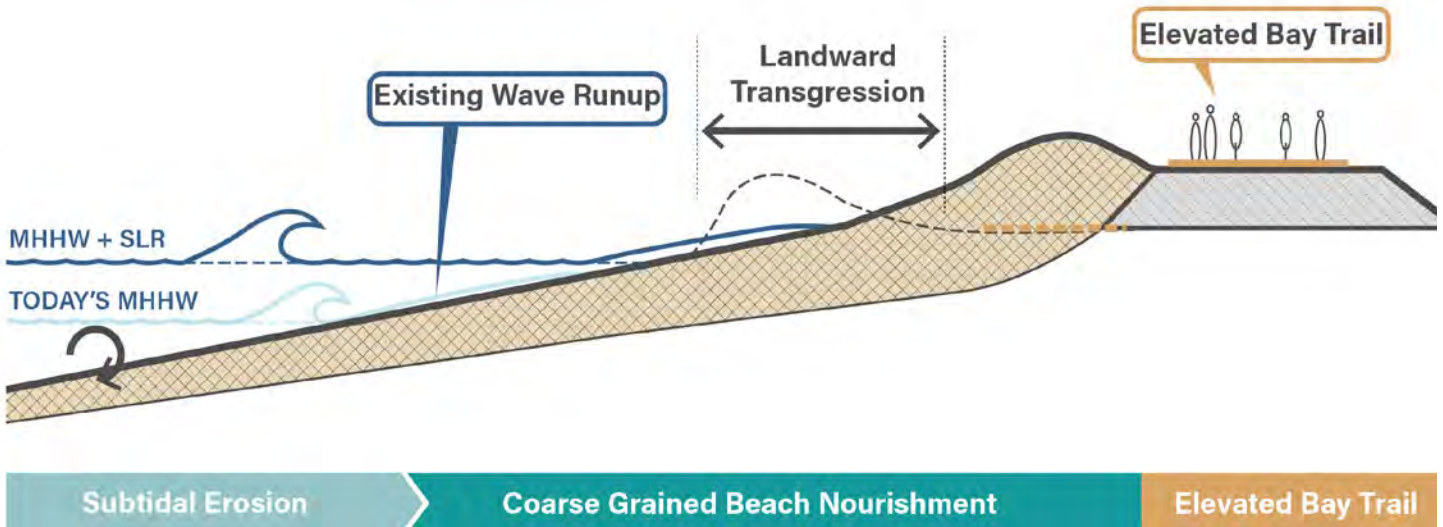


FIGURE 3-7: COARSE-GRAINED BEACHES PROCESSES AND ADAPTATION APPROACHES

ADAPTATION MEASURES BASED ON SHORE TYPE

6. Filled Reclaimed Shore Edges

Filled reclaimed shoreline areas refer to lands that were historically low-lying tidal flats and marshlands in San Francisco Bay that were drained, diked and filled in for human use. These areas are prone to experiencing groundwater emergence as sea levels rise, which will impact land use. It is possible, in some areas, that flooding from elevated groundwater will occur

first before flooding from coastal sources. This phenomenon has the potential to change and potentially worsen overland flooding patterns during extreme events. Generally, adaptation of these shore types must consider the potential presence of contaminants and how adaptation actions may impact existing and future management.

Potential adaptation actions for filled reclaimed shorelines could include

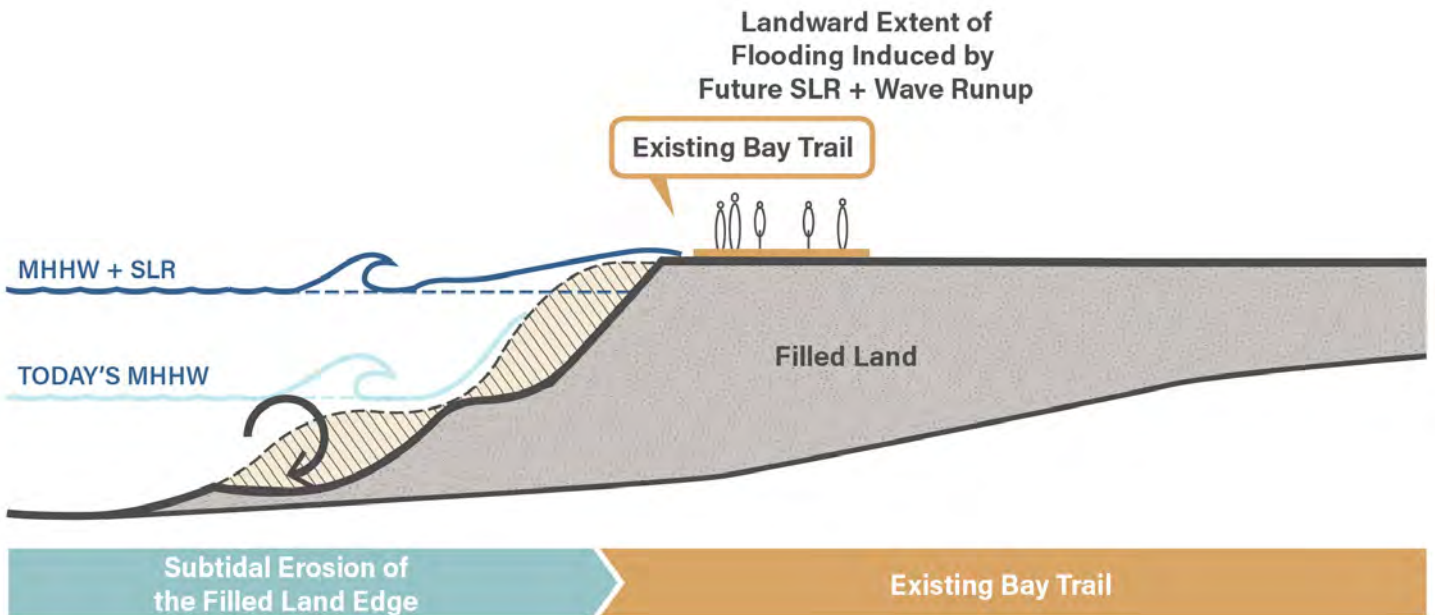
construction of a new coarse-grained beach face at the water/land interface, which would minimize further erosion of the shore edge materials (e.g. fill, debris) into the Bay and provide flood protection for landward assets. The trail could be elevated by the new beach crest, allowing for closer access to the Bay. In a no-action scenario, the trail location would likely have to be set back in order to avoid flooding impacts.

FILLED RECLAIMED AREAS - EASTSHORE NORTH BASIN STRIP

Source: ESA



NO-ACTION SCENARIO - FILLED RECLAIMED SHORE EDGE



ADAPTATION FILLED RECLAIMED SHORE EDGE

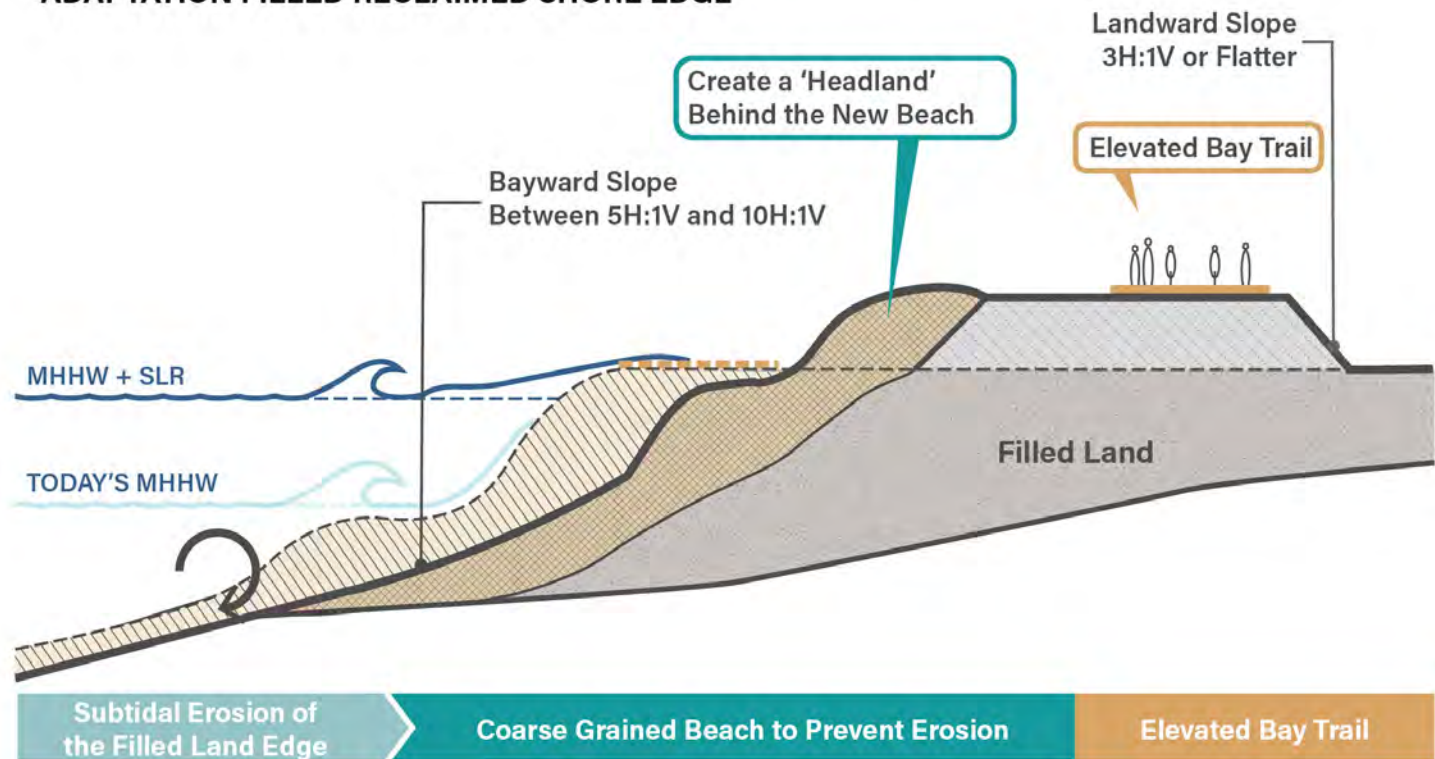


FIGURE 3-8: FILLED RECLAIMED SHORE EDGE PROCESSES AND ADAPTATION APPROACHES

PARTNERSHIP AND FUNDING OPPORTUNITIES

The partnership and funding strategy was developed based on discussions held with the City of Berkeley, the City of Alameda, and Caltrans. This chapter presents an overarching strategy for building partnerships and seeking funding to support future implementation projects. Chapter 4 identifies partnership opportunities and next steps for each of the three Prototype Sites. This chapter assumes that building partnerships will enable the Park District to increase funding opportunities for Bay Trail sea level rise adaptation, in the near and long-term. It provides a roadmap for identifying partners and common

interests that will enable the Park District to jointly seek funding.

Overview of Funding Sources

Potential additional funding sources include:

- Grant programs, including local, state, and federal
- Public asset owners whose asset is affected by the Bay Trail (infrastructure owners including Caltrans, federal and state property)

BIG BREAK - PICNIC

Source: East Bay Regional Park District



- Private property owners and businesses that may benefit from adaptation of the Bay Trail

Grants

Grant sources are likeliest form of funding in the near term. The Park District already actively pursues grant funding for its programs and intends to use the RAAPP as the basis for seeking grants specific to sea level rise adaptation.

Partnerships are important to prepare competitive grant applications, as they demonstrate a broader base of support for a project seeking funding and highlight the multiple benefits the project can provide. The RAAPP implementation strategy highlights partnerships for each of the priority sites that could better position the Park District for grant funding. The multiple benefits provided by the Bay Trail adaptation could make the Park District and its partners competitive for several grant types, under the following categories:

Habitat Restoration

- San Francisco Bay Restoration Authority Measure AA
- Environmental Enhancement & Mitigation Grant Program
- Coastal Conservancy grants

- Proposition 68 – The California Governor’s 2021-2022 Budget Summary calls for \$17.4 million over two years through Proposition 68 funds for projects that support biodiversity and climate resilience by improving coastal and marine ecosystem health.

Non-Motorized Transportation

- The Urban Greening Grant Program, U.S. Department of Transportation

Climate Resilience and Pre-Disaster Mitigation

- Federal Emergency Management Agency (FEMA) pre-disaster mitigation grant programs, including the Flood Mitigation Assistance (FMA) program
- Building Resilient Infrastructure and Communities (BRIC) program

Public Asset Owners

The Bay Trail segments under Park District jurisdiction abut a wide range of public assets, including roadways, wastewater and stormwater infrastructure, and federal and state lands. Each of these asset owners face decisions on how to adapt to sea level rise. If the Park District aligns its own

decisions regarding the Bay Trail with the adaptation investment decisions these asset owners make, it can engage those asset owners in pooling funds and sharing the costs related to adaptation. The Bay Trail adaptation measures could also potentially contribute to the protection of public assets inland, which could provide the basis for cost sharing, including payments for ecosystem services, where appropriate. As a starting point, an economic case would need to be made for the value of the asset being protected and the degree of protection offered by the adaptation measure.

Private Property Owners and Businesses

Private property owners currently are not planning for sea level rise in a coordinated, systematic way. As with public asset owners, private property owners and businesses in low-lying areas throughout the Bay Area face decisions on how to protect their assets and ensure the continuity of their business operations. These decisions will likely not be sufficiently urgent to motivate private property owners and businesses in the near-term to seek partnership with public agencies such as the Park District to coordinate on adaptation measures. It would be, however, important

for the Park District to keep these stakeholders in mind as potential future partners who could be interested in cost-sharing. This will be especially true if special districts form in the future to fund adaptation to sea level rise through district-based fees or tax assessments.

Conditions that Position Partnerships to Get Funding

Partnering with other stakeholders will improve the Park District's opportunities in each of the above funding sources. In terms of grants, most grant programs prioritize applicants that can demonstrate the support of and coordination with other entities. In terms of public asset owners and private property owners and businesses, coordination will be necessary to align activities to produce co-benefits.

The RAAPP Funding and Partnership strategy defines partnerships as acting in coordination with another public or private organization. Partnerships related to sea level rise adaptation can take the form of (in order of least to greatest effort):

- Information-sharing: This

can include sharing data relevant to the success of the project, including sea level rise projections, habitat and ecosystem health, and information on site users.

- Aligning goals and priorities: This would include referring to plans prepared by other agencies (such as climate action plans, green infrastructure plan, bicycle and pedestrian plans) when designing adaptation projects. It would also include coordination between the Park District and other partners on various regional sea level rise adaptation plans along the Bay Trail.
- Joint grant seeking: This can range from signing letters of support for the Park District's grant applications to one or more entities applying with the Park District on a joint grant application, which may include collaboratively designing the project they are seeking to fund.
- Memorandum of Understanding: This could be established to provide the basis for the Park District to coordinate with one or more entities to share resources (e.g. equipment and facilities), or to implement programs together, including environmental education or habitat restoration programs.
- Joint Powers Authorities

(JPAs) and other formalized governance structures: This requires the most effort to establish. Creating a JPA may make sense if there is an ongoing revenue stream associated with a Park District adaptation project which needs to be managed and allocated. This solution does not seem to be an obvious fit for the three prioritized concept plans.

When considering partnerships to increase funding opportunities for adaptation to sea level rise, conditions for success include:

- Align with long-term climate plans with all partners so grant pursuits are strategic rather than opportunistic.
- Identify the role in a partnership that best positions The Park District for achieving its adaptation goals. In some cases, this may be convening other partners; in other cases, this may require leading the project and pursuing funding. In still other cases, it may take the form of raising awareness among other partners for the need for sea level rise adaptation measures.



MLK - DAY OF SERVICE
Source: East Bay Regional Park District

Partners for Seeking Funding

While specific partners who will enable the Park District to increase opportunities for funding will vary depending on the segments of the Bay Trail that the Park District is focused on. There are a few categories of potential partners where the Park District will likely want to build partnerships, in an effort to combat the threats of sea level rise. These include city governments, public asset owners, and non-profit organizations.

City and County Governments

Most of the local jurisdictions through which the Bay Trail passes have sea level rise adaptation goals that can be accomplished in part by adapting the Bay Trail. These include climate action plans, adaptation plans, hazard mitigation plans, bicycle and pedestrian plans, and sustainability plans for respective cities. These plans can serve as the starting point for identifying common goals and narratives that can support joint grant seeking. The Park District also has the

opportunity through its adaptation projects to provide a model to other jurisdictions seeking to incorporate sea level rise into their capital improvement plans.

Caltrans

The California Department of Transportation (Caltrans) owns and operates the interstate highways and state routes that adjoin Bay Trail segments in many places. Preserving bicycle and pedestrian access along those routes by adapting the Bay Trail to sea level rise aligns with Caltrans bicycle and pedestrian mobility goals. As Caltrans incorporates sea level

rise adaptation into its own project planning decisions, the Park District has an opportunity to highlight the potential role of the Bay Trail in meeting climate adaptation goals as well as non-motorized travel goals.

Non-Profit Organizations

The Park District's plans to adapt portions of its Bay Trail segments to sea level rise present an opportunity to align with, and gain the support of non-profit organizations with related mandates. These include the Regional Parks Foundation and other organizations focused on mitigating and adapting to climate

MLK - DAY OF SERVICE

Source: East Bay Regional Park District



change, environmental justice, shoreline access, environmental education, and habitat restoration. While these organizations are not likely to be the source of funds beyond seed funding, partnership with them could increase the competitiveness of the Park District's grant applications. In particular, the Regional Parks Foundation's focus on youth development, environmental stewardship, access, and engagement would align well with the McLaughlin Eastshore State Park and Alameda Point prioritized concept plans.

Current and Future Resources

In building partnership to seek funding for adaptation projects along the Bay Trail, the Park District can build on its own internal resources. This includes building on existing relationships and grant seeking efforts to support the RAAPP strategy. Through its own funding sources such as voter-approved Measure FF and Measure WW, the Park District can

provide "first money in" on RAAPP projects and thereby increase its competitiveness when seeking grant funding. The Park District can also draw on its own research, such as the "Quantifying our Quality of Life" economic benefits analysis report published in 2017. Further quantifying the benefits provided by preserving and increasing access to the Bay Trail and expanding those benefits to include potential protections and ecosystem services provided by adaptation projects could further increase the competitiveness of grant applications. With the ongoing COVID-19 pandemic, the Park District has contributed significantly to the region's resilience and public health by offering access to safe, outdoor recreation opportunities. The large increase in users since the start of the pandemic highlights the benefits of access to nature and outdoor recreation and underscores the importance of adapting the Bay Trail to climate change.



4

PROTOTYPE SITES

Three Bay Trail sites were selected after the risk assessment to demonstrate the potential pathways for shoreline adaptation in more detail. This chapter illustrates a localized approach to nature-based adaptation solutions in areas that are at risk of sea level rise inundation in both the mid-century and end-of-century planning scenarios. In addition to the adaptation approach, each site also identifies next steps for continued conversations with stakeholders and the broader community.

OVERVIEW OF PROTOTYPE SITES



EIGHT PRIORITY BAY TRAIL SITES

See more details about the risk assessment and prioritization process in *Chapter 2: What is at risk?*

From Eight Priority Sites to Three Prototypes

Three Bay Trail sites were selected after the risk assessment to demonstrate the potential pathways for shoreline adaptation in more detail. Those include Alameda Point, McLaughlin Eastshore State Park, and Martin Luther King Jr. Regional Shoreline.

This chapter illustrates a localized approach to nature-based adaptation solutions in areas that are at risk of sea level rise inundation in both the mid-century and end-of-century planning scenarios. In addition to the adaptation approach, each site also identifies next steps for continued conversations with stakeholders and the broader community.

Several of the areas identified as priority sites in the risk assessment within the study area are undergoing parallel planning efforts. Those include the Hayward Shoreline Master Plan effort led by HASPA, and North Richmond planning efforts. While this report fully supports the prioritization of those areas, they were not explored in more detail in this chapter.

Alameda Point

Alameda Point and more specifically, the Northwest Territory, is at risk in both the mid- and end-of-century planning scenarios explored in this study. The site is in the process of being planned as a new regional park with a Bay Trail extension to be managed by the Park District and is part of a larger master plan coordinating contamination mitigation, and ongoing planning

processes with the Park District's partners, including the City of Alameda, the US Navy, and the US Department of Veterans Affairs (VA). The recommended adaptation approaches vary based on the long-term decisions related to site cleanup, but both examples show the potential for the Bay Trail and the new regional park to adapt through the end-of-century.

FIGURE 4-1: ALAMEDA POINT



OVERVIEW OF PROTOTYPE SITES



FIGURE 4-2: McLAUGHLIN EASTSHORE STATE PARK

McLaughlin Eastshore State Park

The Bay Trail segments along McLaughlin Eastshore State Park are managed by several different groups in addition to the Park District, including the City of Berkeley, Caltrans, and CA State Parks. While the main branch of the trail adjacent to the frontage road is not at high-risk within the park, the lengths of the Bay Trail that connect to César Chávez

Park and the sensitive habitats within the Berkeley Meadow will see major changes in tidal inundation in the mid- and end-of-century planning scenarios. This adaptation example highlights the opportunities associated with planning for a long-term trail alignment and habitat migration and demonstrates use of coarse-grained beaches as an alternative to rip-rap along the East Bay shoreline.



FIGURE 4-3: MARTIN LUTHER KING JR. REGIONAL SHORELINE

Martin Luther King Jr. Regional Shoreline

Finally, the Martin Luther King Jr. Regional Shoreline, specifically the Doolittle Drive segment along the south side of the San Leandro Estuary, was identified as an ongoing challenge for adaptation planning. Due to the high ecological value of Arrowhead Marsh and the adjacent shoreline areas around the estuary, the Park District has been challenged

when considering potential trail elevation near these areas. Adaptation of the San Leandro Estuary will require integrated coordination across partners including Caltrans, City of Oakland, City of Alameda, and others. This guidance focuses on potential options for developing these partnerships which will be key to any future adaptation planning.

ALAMEDA POINT



Planning Context and Key Stakeholders

The decommissioning of the Naval Air Station in Alameda created the opportunity for new uses to serve the city and region. Planning efforts for the site have included a vision which includes open space, trails, a veteran’s clinic and columbarium, in addition to mixed-use housing and commercial neighborhoods along the eastern edge. Many stakeholders are involved in the planning process, including the US Navy, the US Department of Veteran Affairs (VA), and the Park District. As part of the

transition of the land to local control, the US Navy has an important responsibility to ensure that the site is safe and that any contamination on the site is remediated.

The vision proposes a regional park in the northwest corner, referred to as the Northwest Territory, and includes a Bay Trail connection around the full extent of the point. The Park District has been a partner in establishing the new public land for the regional park and Bay Trail in the Northwest Territory and developing and managing the park in the future.

Due to its low-lying elevation, it is critical to understand the impacts of climate change and sea level rise

on the site. In recent years, some of the impacts of climate change and sea level rise have been incorporated into high-level guiding documents for the Naval Air Station Base Reuse Plan, e.g. in the Master Infrastructure Plan and its Amendment. However, the coordination of coastal protection and sea level rise adaptation planning for Alameda Point is still in early stages. The design of the Northwest Territory and Bay Trail will need to address unique site conditions that are unlike other areas on the island.

As part of this study, the design team and Park District organized stakeholder meetings with City of Alameda staff to discuss future park

design coordination efforts with all partners, including the US Navy and the VA.

First, the Park District and City of Alameda determined the need to coordinate with the VA specifically regarding their approach to sea level rise impacts in the area. Questions regarding the planned elevations for buildings and the access road were documented as potential areas for collaboration with the Park District.

Second, this conversation indicated that the contamination clean-up efforts managed by the US Navy as part of the transition of the property to the City of Alameda may not adequately address the impacts of sea level rise and may require extensive actions in the future to meet mitigation goals. The current lack of removal of existing contaminated soil establishes major constraints on the conceptual design including the creation of habitat and use of adaptive shoreline treatments that protect the area as sea levels rise through the next century.

In addition to coastal protection and inundation risks, groundwater emergence caused by sea level rise can cause unforeseen movement of buried and capped contaminants. Groundwater studies are ongoing in Alameda and may reveal that the

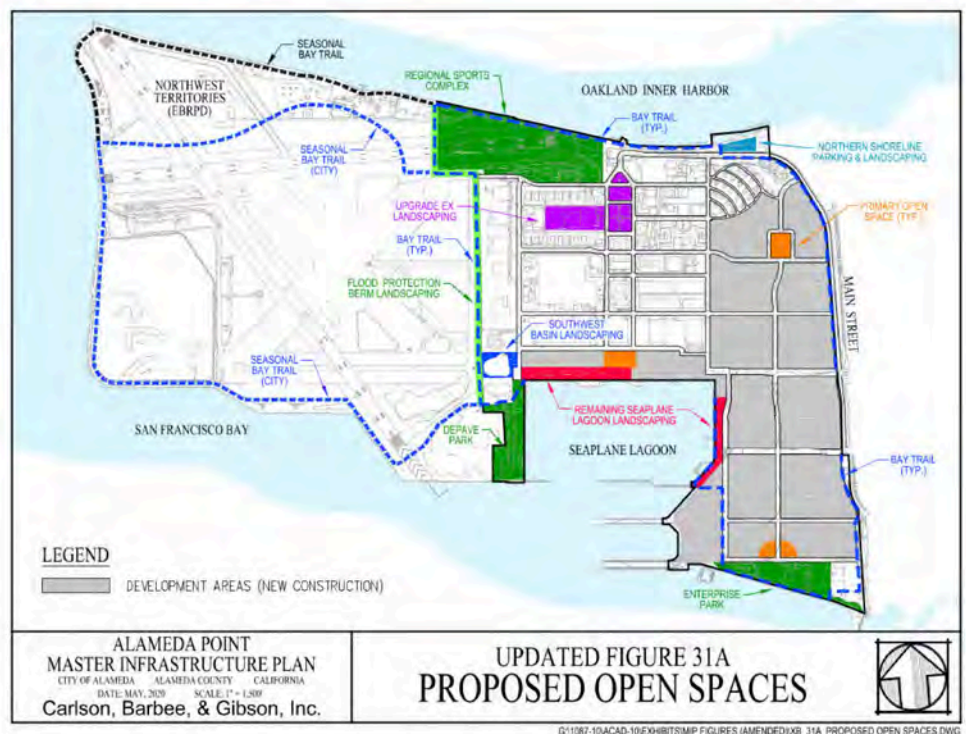


FIGURE 4-4: ALAMEDA POINT PROPOSED OPEN SPACES

Source: Master Infrastructure Plan Amendment, August 2020

approach to mitigating contamination in these areas may need to be more robust than originally planned.

Two Design Options

To both address the constraints of contamination and to advance multi-benefit approaches to long term resiliency, two distinct approaches for the design of the regional park and Bay Trail alignment are proposed.

The first approach illustrates the potential for more extensive marsh habitat areas that could provide ecosystem benefits including coastal

protection to the park and adjacent areas. This scheme relies on a more robust remediation of contaminated areas.

The second approach illustrates the more constrained marsh area and park amenities that would be limited if remediation of contaminants remains as proposed in the Record of Decision documents released by the US Navy. This also assumes that the shoreline protection designed to contain the contaminants on the site would be reinforced in place and monitored throughout the next century.

ALAMEDA POINT

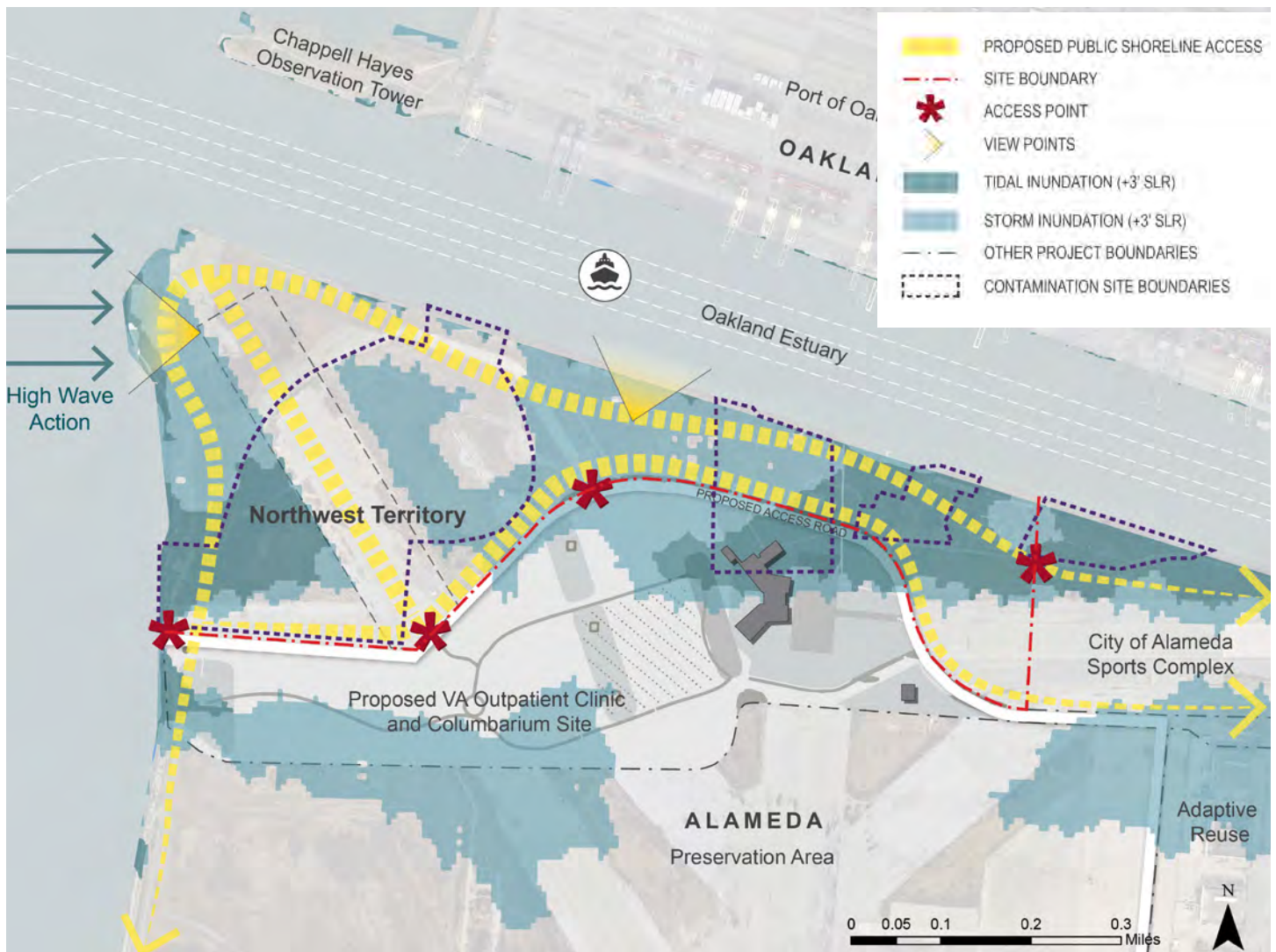
Opportunities & Constraints

Based on existing elevations, the following maps show the extent of tidal and storm inundation across the site at mid-century and end-of century. The maps also show the locations of the cleanup areas being managed by the US Navy, and the

proposed plans for the clinic and columbarium developed by the VA.

The Bay Trail extension around the point, with connections to the future City of Alameda Sports Complex and the future preservation area, are indicated below. Additional access points to the regional park along the proposed access road are also indicated.

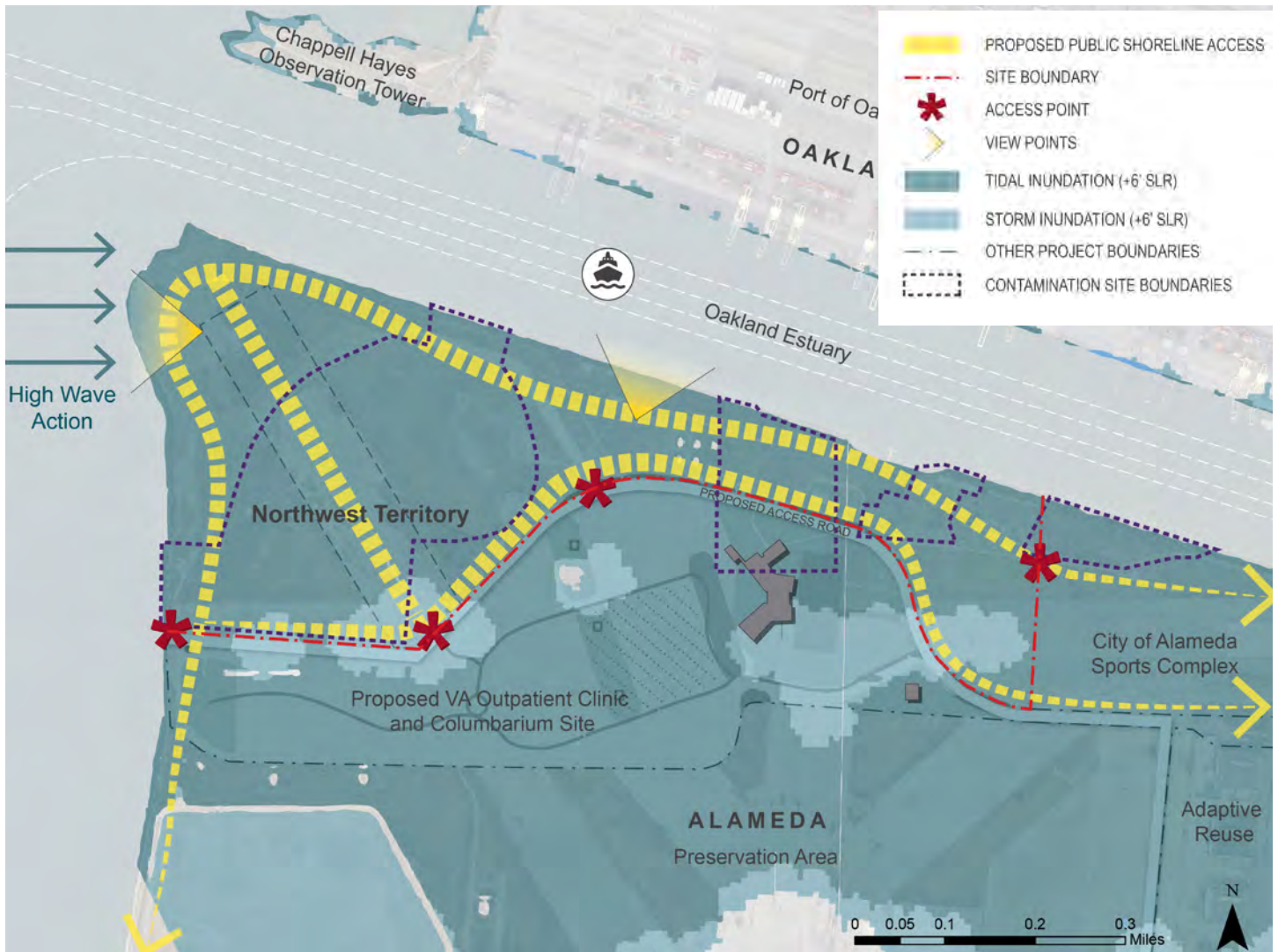
**FIGURE 4-5:
ALAMEDA POINT MID
CENTURY - 3FT SLR**



Key Considerations

- Views across the Bay towards San Francisco and across the estuary to the Port of Oakland
- High wave action from wind and Port activity along the point and the estuary
- Low elevations and inundation are risks to existing structures, but can be planned as a benefit for marsh and habitat creation
- Bay Trail segments along the shoreline could be designed to have seasonal access, if the access road remains accessible and resilient year-round and through century's end
- Contamination sites must be monitored and maintained unless contaminants are removed

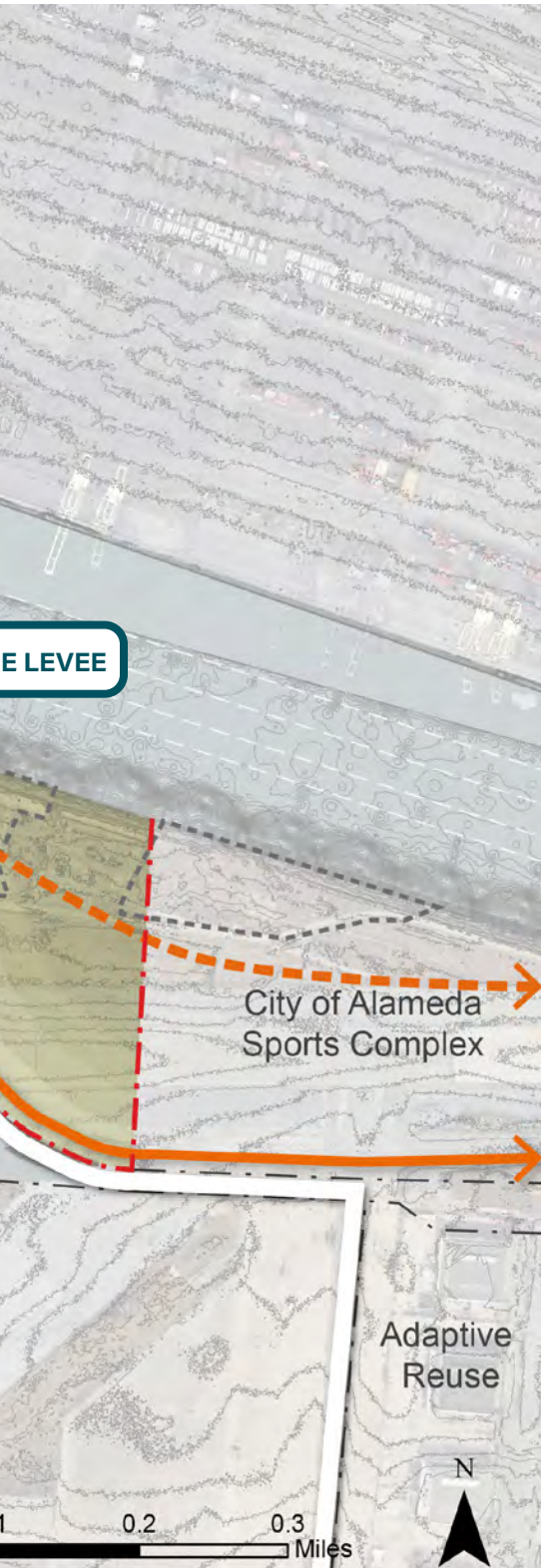
FIGURE 4-6: ALAMEDA POINT END OF CENTURY - 6FT SLR



ALAMEDA POINT

OPTION 1 FULL POTENTIAL





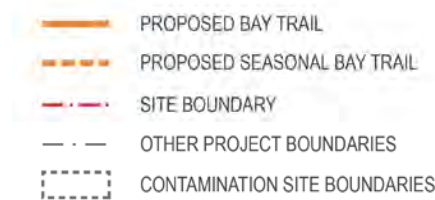
Alameda Point Concept Plan Option 1: Full Potential

The conceptual design of the Northwest Territory in Option 1 proposes creation of significant wetland habitat to bring regionally and locally significant ecosystem benefits. Over a hundred acres of tidal marsh is created. The plan supports a range of ecological diversity from coastal uplands and dunes to tidal marshes and beaches that will provide important regional connectivity for species around the Bay Area. Nature-based adaptation strategies including ecotone slopes and coarse beaches provide buffer for erosion and address future sea level rise impacts. The western edge of the site requires special treatments to

protect the site from high wind and wave impacts. The shoreline must resist forces of erosion as sea level rises to provide defense of the inland areas of soil contamination, wetlands, and public use areas. The coarse beach is a nature-based adaptation strategy that will shift with sea level rise. The shoreline at the Point will continue to require hardened armoring and is proposed to be build higher.

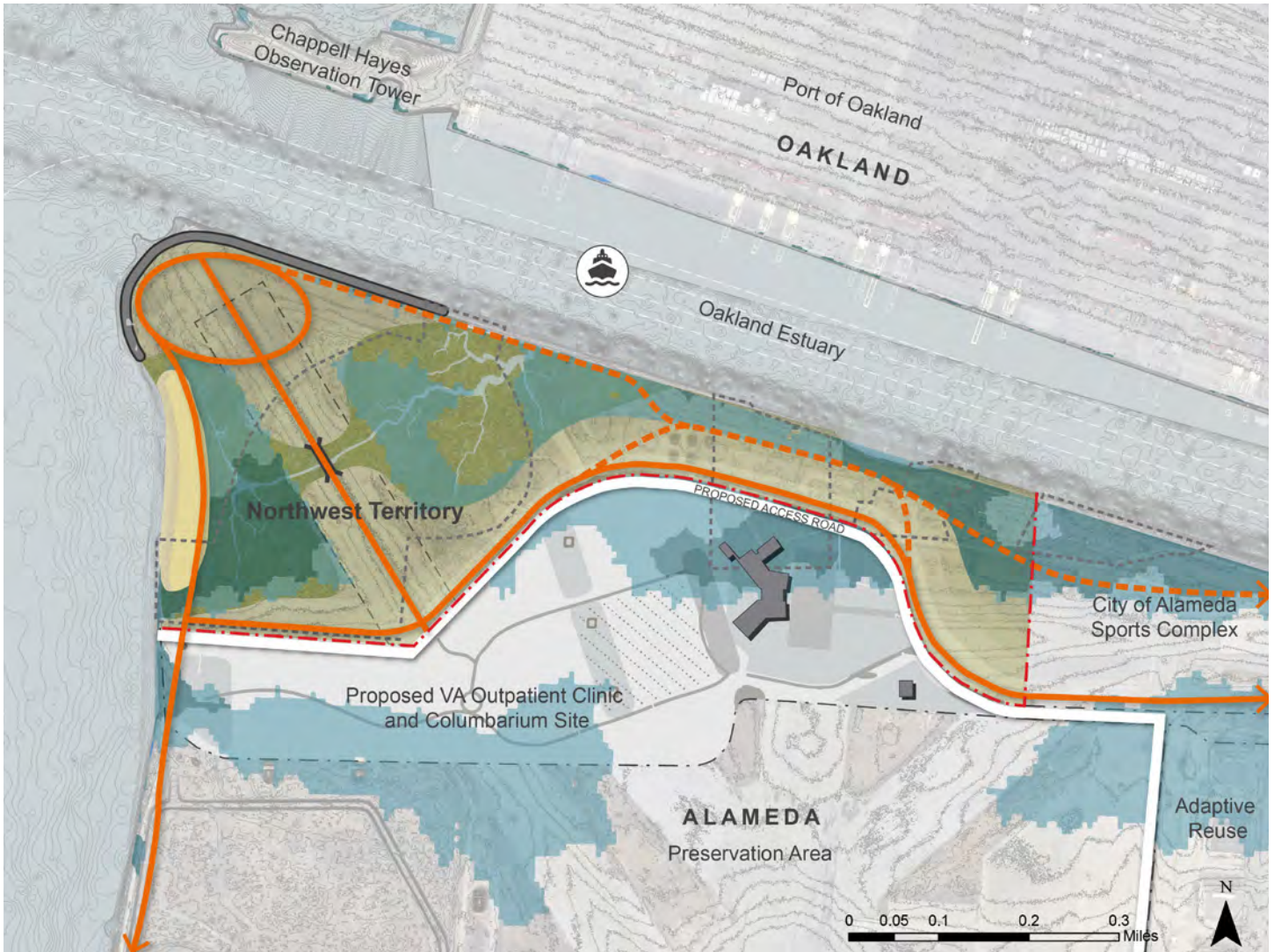
In addition to the robust habitat benefits and shoreline protection benefits, the concept plan offers public access to visitors throughout the end of century. The following figures illustrate the extent of inundation at mid-century and end-of-century. Note that this option assumes building the site and adjacent roads higher than water levels at end of century.

FIGURE 4-7: ALAMEDA POINT CONCEPT PLAN OPTION 1



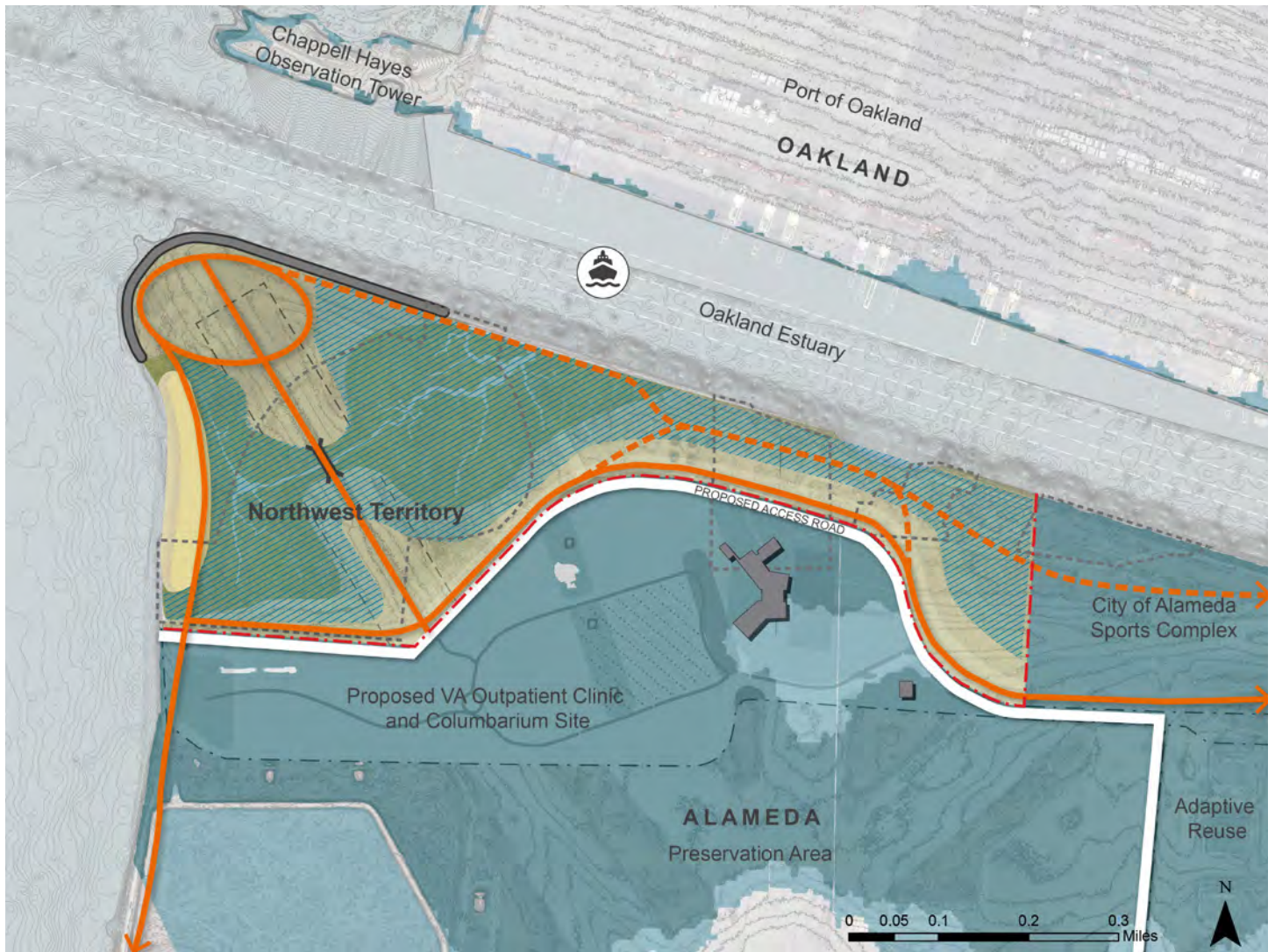
ALAMEDA POINT

OPTION 1 FULL POTENTIAL



**FIGURE 4-8: ALAMEDA POINT CONCEPT PLAN OPTION 1
MID CENTURY - 3FT SLR**

- PROPOSED BAY TRAIL
- - - PROPOSED SEASONAL BAY TRAIL
- · - · SITE BOUNDARY
- TIDAL INUNDATION (+3' SLR)
- STORM INUNDATION (+3' SLR)
- - - OTHER PROJECT BOUNDARIES
- - - - CONTAMINATION SITE BOUNDARIES



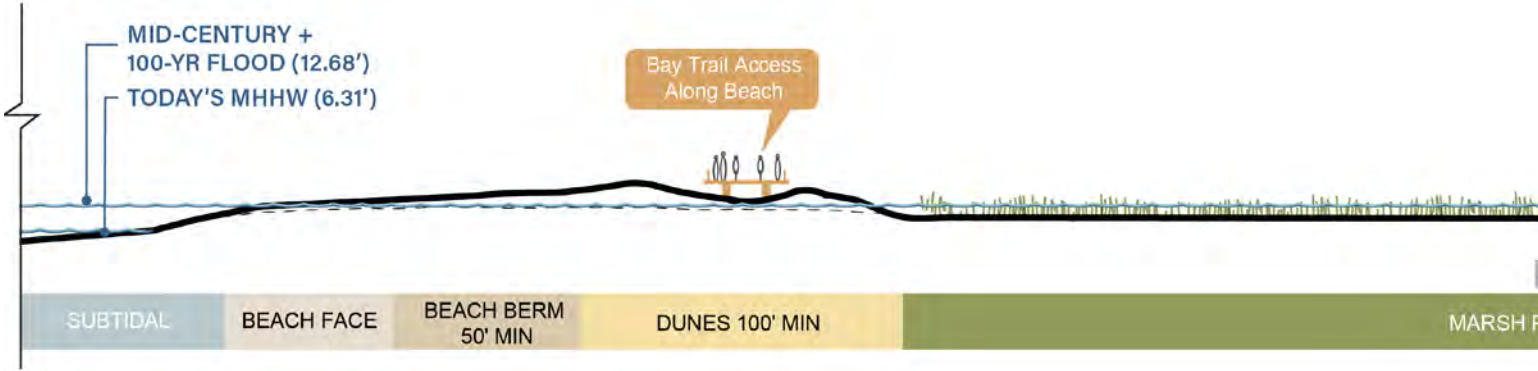
**FIGURE 4-9: ALAMEDA POINT CONCEPT PLAN OPTION 1
END OF CENTURY - 6FT SLR**

- PROPOSED BAY TRAIL
- - - PROPOSED SEASONAL BAY TRAIL
- · - · - SITE BOUNDARY
- TIDAL INUNDATION (+6' SLR)
- STORM INUNDATION (+6' SLR)
- OTHER PROJECT BOUNDARIES
- CONTAMINATION SITE BOUNDARIES

ALAMEDA POINT

OPTION 1 FULL POTENTIAL

SECTION A-A



SECTION B-B

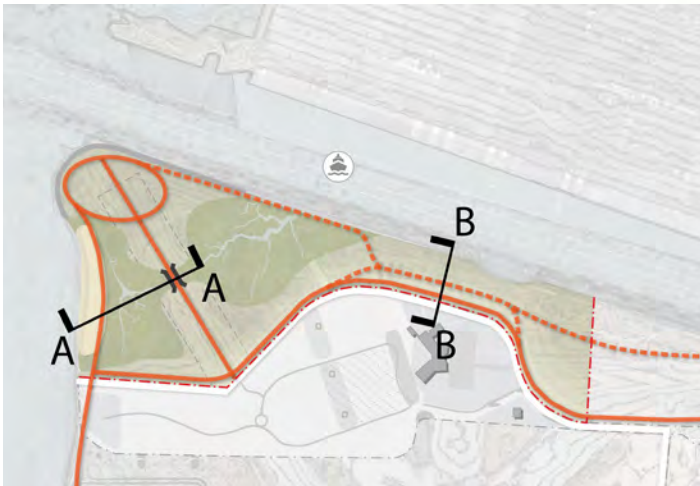
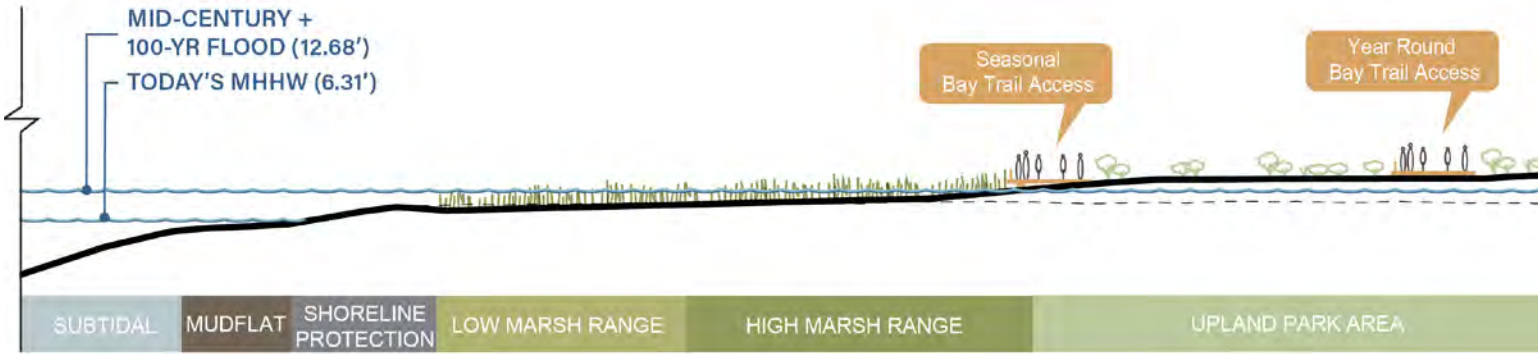
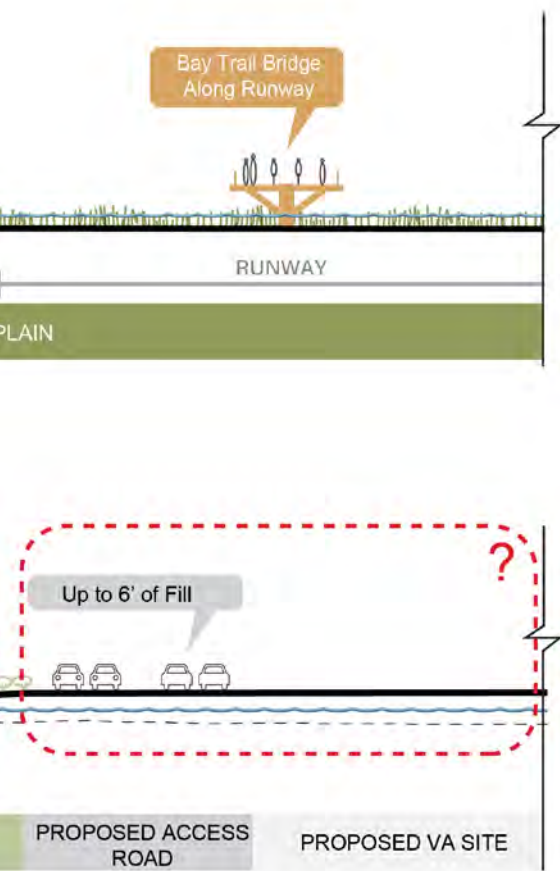


FIGURE 4-10: ALAMEDA POINT CONCEPT PLAN OPTION 1
Cross Sections and Key Plan



Alameda Point Shoreline Conditions Option 1

Conceptual cross-sections show how shoreline treatments protect inland areas. Section A-A from the western beach to the runway illustrates the extensive coarse beach and dune system that offers greatest resiliency and habitat value. If contamination is removed as proposed in this concept, a back bay and marsh system can be established, hydraulically connecting the beach zone to the estuary marsh. Public access is built up on a boardwalk through the dunes. The runway path is shown as a bridge for the section crossing the new tidal channel.

Section B-B from the estuary channel to the road illustrates the gradual transition of the ecotone slope. Extensive areas of low and high tidal marsh allow migration of habitats as sea level rises. The shoreline trail is seasonal or built on floats. The road proposed by the VA is raised above end of century flood levels to protect the clinic site beyond. The full width Bay Trail is combined with the road levee to ensure public access.

ALAMEDA POINT

OPTION 2 LIMITED POTENTIAL








Alameda Point Concept Plan Option 2: Limited Potential

The conceptual design of the Northwest Territory in Option 2 works within the known design parameters set by soil contamination clean up and the VA clinic development. The concept proposes creation of a modest wetland habitat along the estuary. Up to sixteen acres of tidal marsh is created in areas without known soil contamination. The plan supports ecological diversity from coastal uplands and dunes to tidal marshes and beaches. The limited wetland area requires additional research to evaluate its regional benefit for species migration and connectivity. Nature-based adaptation strategies including

ecotone slopes and coarse beaches provide buffer for erosion and address future sea level rise impacts. The western edge of the site requires special treatments to protect the site from high wind and wave impacts. The shoreline must resist forces of erosion as sea level rises to provide defense of the inland areas of soil contamination, wetlands, and public use areas. The coarse beach is a nature-based adaptation strategy that will shift with sea level rise. The shoreline at the Point will continue to require hardened armoring. This concept leaves the ground elevations as proposed by the US Navy. Therefore inundation is expected by end of century compromising the site integrity including capped soil contamination, wetlands, and public access.

The following figures illustrate the extent of inundation at mid-century and end-of-century. The mid-century condition shows a majority of the park and public access intact. Note again, however, that this option reflects current knowns and unknowns in the planning by the US Navy, City of Alameda, and the VA. As shown, the entire site, the road, and the VA clinic are flooded by end of century.

FIGURE 4-11: ALAMEDA POINT CONCEPT PLAN OPTION 2

-  PROPOSED BAY TRAIL
-  SITE BOUNDARY
-  CONTAMINATION SITE BOUNDARIES

ALAMEDA POINT

OPTION 2 LIMITED POTENTIAL

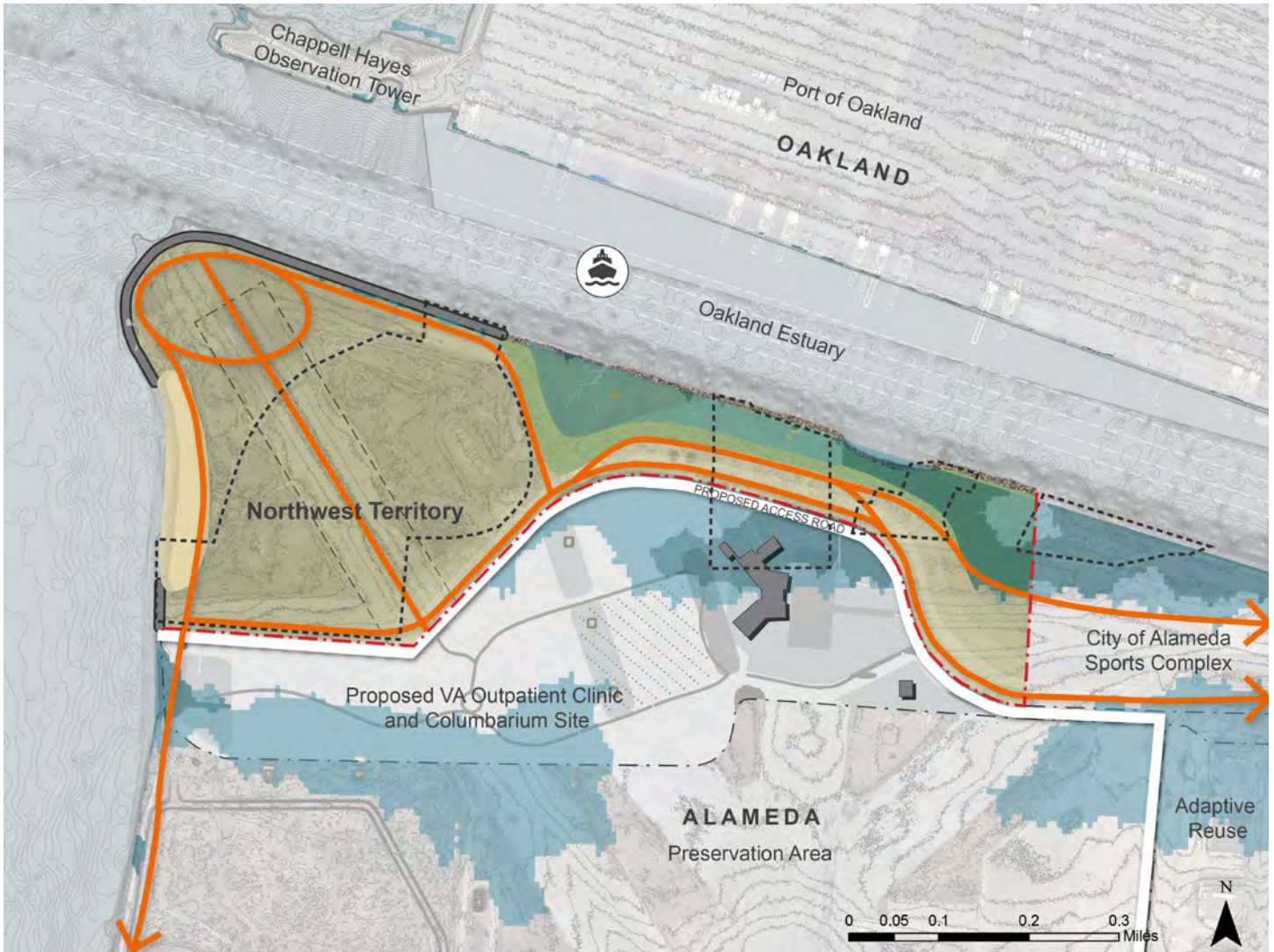


FIGURE 4-12: ALAMEDA POINT CONCEPT PLAN OPTION 2

Mid-Century - 3ft SLR

- PROPOSED BAY TRAIL
- - - SITE BOUNDARY
- TIDAL INUNDATION (+6' SLR)
- STORM INUNDATION (+6' SLR)
- - - OTHER PROJECT BOUNDARIES
- - - CONTAMINATION SITE BOUNDARIES

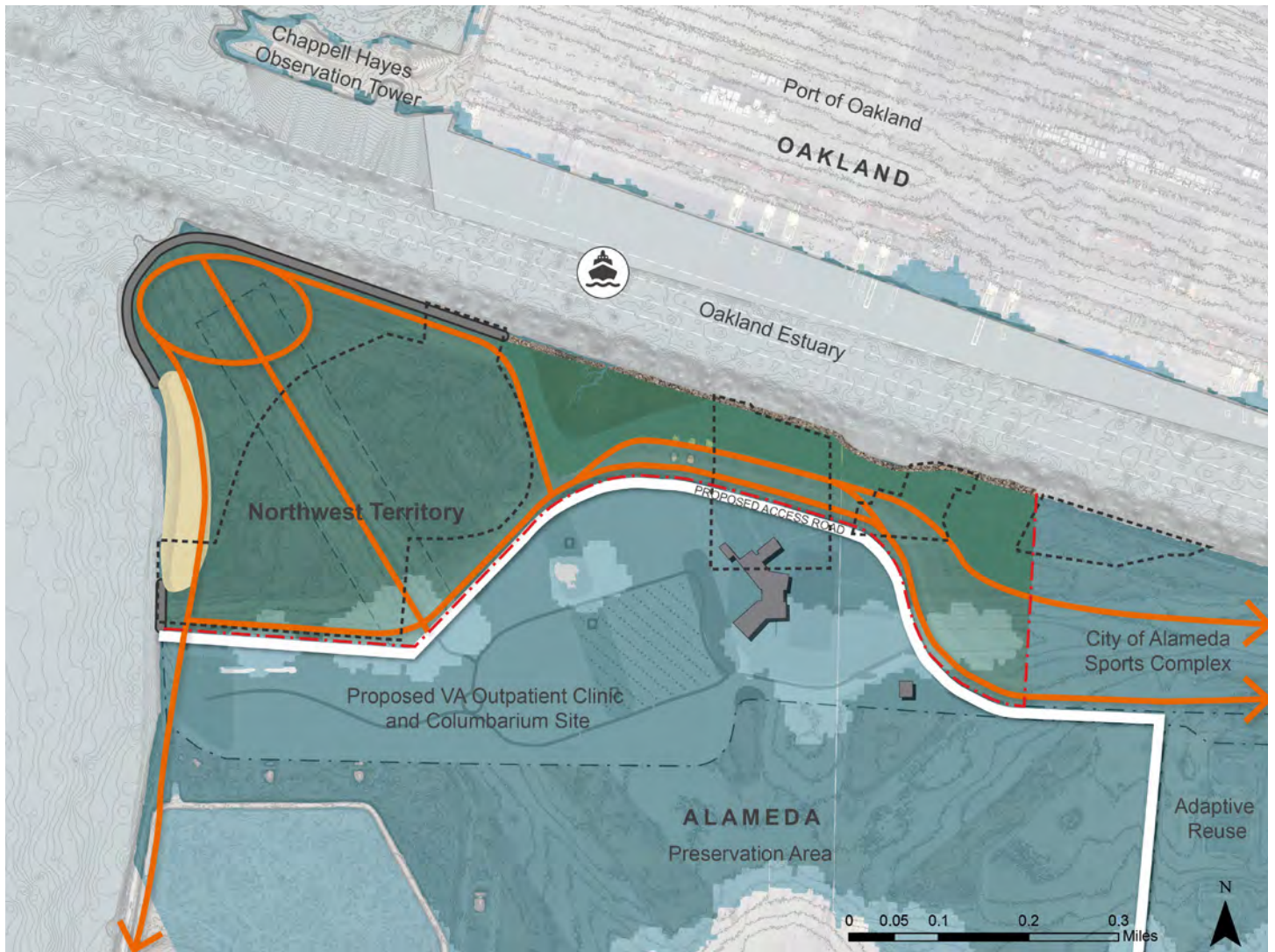


FIGURE 4-13: ALAMEDA POINT CONCEPT PLAN OPTION 2

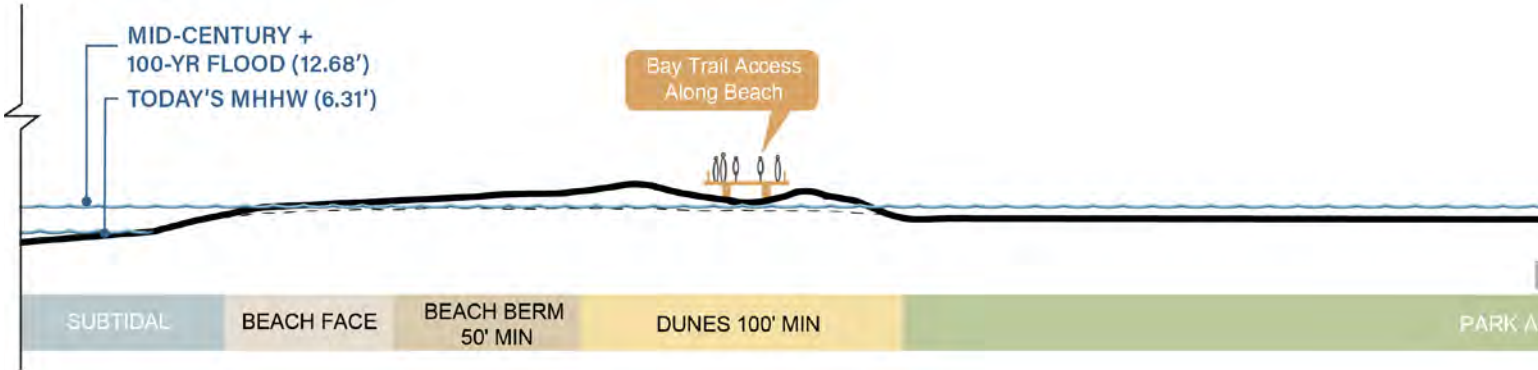
End of Century - 6ft SLR

- PROPOSED BAY TRAIL
- - - SITE BOUNDARY
- TIDAL INUNDATION (+6' SLR)
- STORM INUNDATION (+6' SLR)
- OTHER PROJECT BOUNDARIES
- CONTAMINATION SITE BOUNDARIES

ALAMEDA POINT

OPTION 2 LIMITED POTENTIAL

SECTION A-A



SECTION B-B

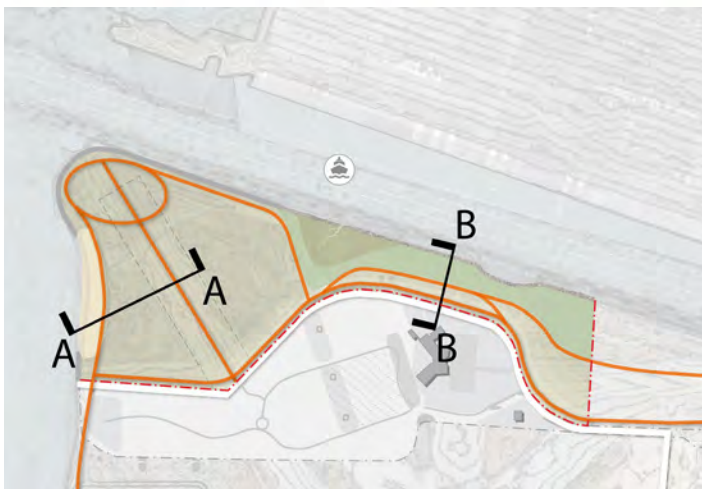
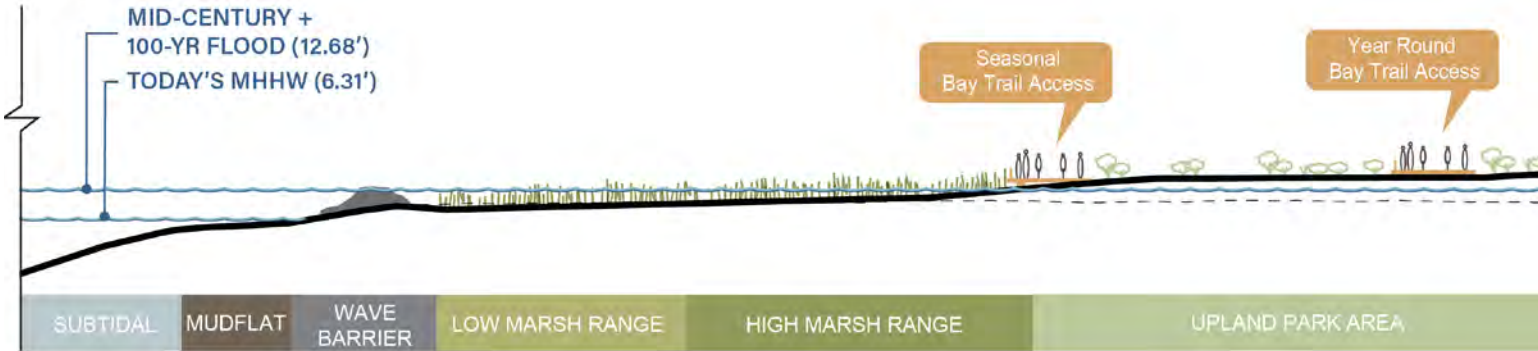
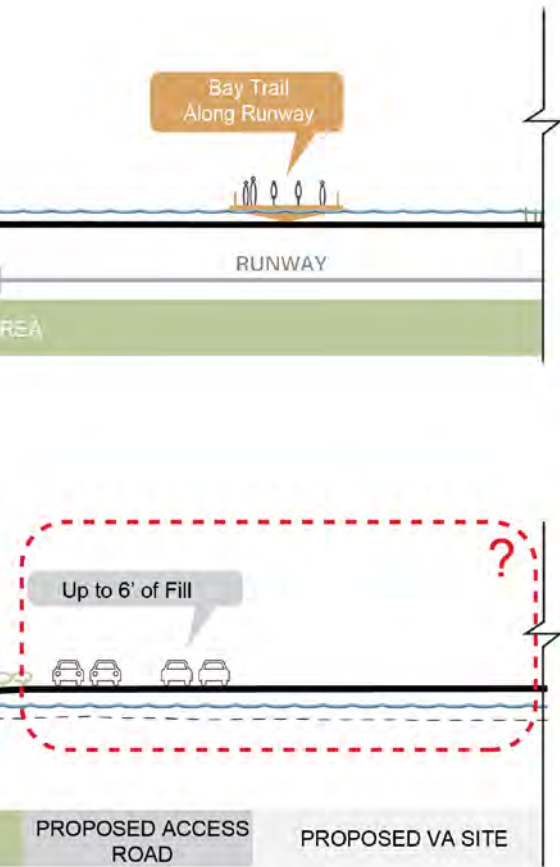


FIGURE 4-14: ALAMEDA POINT CONCEPT PLAN OPTION 2
Cross Sections and Key Plan



Alameda Point Shoreline Conditions Option 2

Conceptual cross-sections show how areas of the site are resilient through mid-century while total flooding occurs by end-of-century if elevations are not raised. Section AA from the western beach to the runway, illustrates the extensive coarse beach and dune system that offers greatest resiliency and habitat value. The inland capped areas of the park are relatively flat and offer upland habitat until flooding occurs. Public access is built up on a boardwalk through the dunes. The runway path is shown as an elevated embankment or raised boardwalk to allow public access for a longer planning horizon.

Section BB from the estuary channel to the road illustrates the gradual transition of the ecotone slope to the existing grades of the inland areas. Some migration of habitat is afforded until the mid-century. at some point before end of century, the entire site floods including the road, the Bay Trail and the VA site.

ALAMEDA POINT



FIGURE 4-15: ALAMEDA POINT CONCEPT PLAN OPTION 1 RENDERING



UPLAND PARK AREA

TIDAL MARSH

ALAMEDA POINT

Alameda Point Funding and Partnership Strategy

This section provides an initial strategy for seeking funding for Alameda Point that applies to both concept plan options. It identifies the elements of the concept plans that the Park District can highlight when seeking funding, the partners with whom the Park District can engage, and steps the Park District can take in the short term to set itself up for future funding opportunities.

Site Features That Present Opportunities For Funding

The Alameda Point Northwest Territories (NW Territories) concept plan provides several benefits that could serve as the starting point for funding requests. These include access to nature and recreation opportunities, habitat restoration, and protection against sea level rise.

Access to Nature and Recreation Opportunities

The NW Territories concept plan could attract funding from programs aiming to increase access to nature for specific populations. By providing access from the planned VA outpatient clinic to the shoreline, the concept plan also provides opportunities for incorporating nature into the medical center's therapeutic and wellness services. The concept plan would also connect the shoreline with the proposed columbarium adjacent to the VA outpatient clinic, offering visitors the opportunity to pay their respects in a beautiful natural setting. The links between the site's natural, healing, and memorial functions would be further strengthened by designing the nature center planned for this site, in a way that provides space

for quiet reflection and honors the service of members of the Armed Forces. The concept plan also increases access to the shoreline for low-income populations, including residents of the nearby Alameda Point Collaborative neighborhood.

Habitat Restoration

The NW Territories concept plan features the creation of tidal marsh habitat, which could attract funding sources supporting habitat restoration and ecosystem health. If the restored habitat fosters the reintroduction of endangered species to the site, the project potentially could be used as a habitat mitigation bank, depending on the requirements of the agencies seeking the offsets.

Protection Against Sea Level Rise

In adapting the Bay Trail to sea level rise, the NW Territories concept potentially could also help protect adjacent properties from coastal flooding. Its design is expected to result in wave attenuation at the mouth of the Oakland Estuary, which could benefit Port of Oakland seaport operations. Depending on the design of the proposed access road just beyond the Park District site's southern edge, the fortified edge and



VIEWS OF THE BAY AND SAN FRANCISCO SKYLINE FROM ALAMEDA POINT

Source: East Bay Regional Park District

tidal marsh elements of the concept plan could support any flooding protection provided by the access road to the VA outpatient clinic and columbarium.

Partnership Opportunities

The Park District can increase its opportunities for funding the NW Territories concept plan by partnering with other public agencies and community organizations active on or near the site. These include the City of Alameda, the US Department of Defense, the Port of Oakland, and local non-profit organizations.

City of Alameda

The City of Alameda and the Park District have already created a framework for partnership in the form of an MOU established in August 2020. The City departments most relevant to the NW Territories are the Base Reuse Department, Public Works Department and Recreation & Parks Department.

The City of Alameda will be an important partner in applying for grant funding for the NW Territories concept plan. The City applied for Measure AA grant funding for another site on Alameda Point, the proposed De-Pave Park. The City is also in the

ALAMEDA POINT

early stages of a year-long effort to prepare to apply for federal pre-disaster mitigation grant programs, including the FEMA FMA and BRIC grant programs. The City's intent is to package multiple sea level rise protection projects into one grant application. This package would include the NW Territories project and priority projects identified in the City of Alameda Climate Action and Resiliency Plan, the northern shoreline near the Webster and Posey Tubes, and the Veterans Court shoreline near the Bay Farm Bridge.

US Department of Defense

Two US Department of Defense agencies, the US Army Corps of Engineers (USACE) and the VA, are involved in redeveloping the site adjacent to the NW Territories site into the VA outpatient clinic and columbarium. USACE leads the project construction and the VA will be the end user of the site. The Park District has already started to engage with USACE and the VA on the design of the NW Territories and an on-site visitors center, which the VA may be in a position to fund. The Park District can demonstrate linkages between the VA's goals for its site and the NW Territories concept plan's contributions to VA visitors' well-being and access to nature. By coordinating

together, the Park District and USACE have an opportunity to achieve site designs that protect the VA site from sea level rise over time.

Port of Oakland Seaport

The NW Territories concept plan could reduce wave action at the mouth of the Oakland Estuary. This could provide benefits to the Port of Oakland Seaport, located on the other side of the channel. The Port may not yet have identified wave attenuation as a priority, but it could be interested in supporting future grant applications, such as the FEMA pre-disaster mitigation grants for which the City of Alameda is beginning to prepare.

Non-profit organizations

The NW Territories concept plan aligns with the goals of a range of non-profit organizations focused on veterans' health and well-being, habitat restoration, and improved access to nature for low-income communities. These organizations present opportunities for supporting or partnering on future grant applications for the site.

Recommended Next Steps

The Park District can take the following actions to increase opportunities for funding the development of the NW Territories concept plan:

1. Continue to convene and coordinate with key partners, including the City of Alameda and Department of Defense agencies.
2. Consider including the Port of Oakland Seaport in discussions of possible sea level rise and wave action protections offered by the NW Territories concept plan.
3. Coordinate with the City of Alameda to support grant applications, including for Measure AA and for FEMA pre-disaster risk mitigation grants.
4. Continue to coordinate with the VA on the possibility of its funding the construction of a nature center and seek to align its features with the services the VA aims to offer visitors to its outpatient clinic and columbarium.

VIEWS OF ALAMEDA POINT
Source: WRT



McLAUGHLIN EASTSHORE STATE PARK



VIEW OF McLAUGHLIN EASTSHORE STATE PARK ALONG THE NORTH BASIN STRIP AND AT THE MOUTH OF SCHOOLHOUSE CREEK
Source: WRT

Planning Context and Key Stakeholders

The McLaughlin Eastshore State Park shoreline area is made up of a complex landscape of jurisdictional relationships. The state park is adjacent to city park areas, in addition to a critical transportation network that includes the Bay Trail, Interstate 80, and University Avenue access roads, making planning and coordination across multiple stakeholders critical.

The design team and Park District organized a coordination meeting with the City of Berkeley, Caltrans, and Bay Trail representatives in order to discuss the ongoing planning efforts to address near-term and long-term challenges and opportunities at the site.

A clear area for collaboration in the future is centered on shoreline stabilization and access routes. Because of the property ownership limitations, the City of Berkeley is not able to explore nature-based shoreline adaptation solutions independently without extensive

encroachment on state park lands. By working together, the agencies could design resilient regional shoreline access that provides multiple benefits ecologically and to the local and regional community.

Nature-based adaptation solutions also benefit the region by diversifying the shoreline habitat types along the East Bay. Today, much of the shoreline is a combination of fill material and concrete revetment usually in the form of rip-rap. By working together across jurisdictions, the partners could reduce the pervasive extent of rip-rap along the

shoreline and provide a diversity of new habitat areas that also provide similar shoreline stabilization benefits.

Nature-based shoreline solutions also offer higher adaptive capacity when compared to shoreline hardening solutions. As sea levels rise throughout the coming century, shoreline areas with a wider range of elevations can support habitat migration across a transect of wetland to upland environments. This approach will be critical as sediment and resources become scarce across the Bay Area.

Another key area for collaboration at McLaughlin Eastshore State Park is at the connection of Schoolhouse Creek and the Bay. As identified in the General Plan in 2002, there are multiple benefits to daylighting Schoolhouse Creek within the park, including the creation of wetland habitat. As sea levels rise, the interaction between Bay and the creek will change, and the design of stormwater systems upland from the park will likely need modification. This offers the potential to coordinate with the City of Berkeley's green infrastructure initiatives to design opportunities for distributed stormwater retention and detention upstream.

Phased Approach to Adaptation

The following conceptual designs propose a phased approach to adaptation in mid and end-of century conditions in McLaughlin Eastshore State Park. In the mid-century scheme, shoreline stabilization is focused on a coarse beach approach along the Berkeley Meadow and North Basin shorelines. The major access areas along Marina Drive and the future extension of the Bay Trail

are elevated as part of an ecotone slope design along the perimeter of the Berkeley Meadow.

In the end-of-century proposal, the access areas and ecotone slope design are extended along all three sides of the Berkeley Meadow to provide resilient public access while also making room for habitat migration.

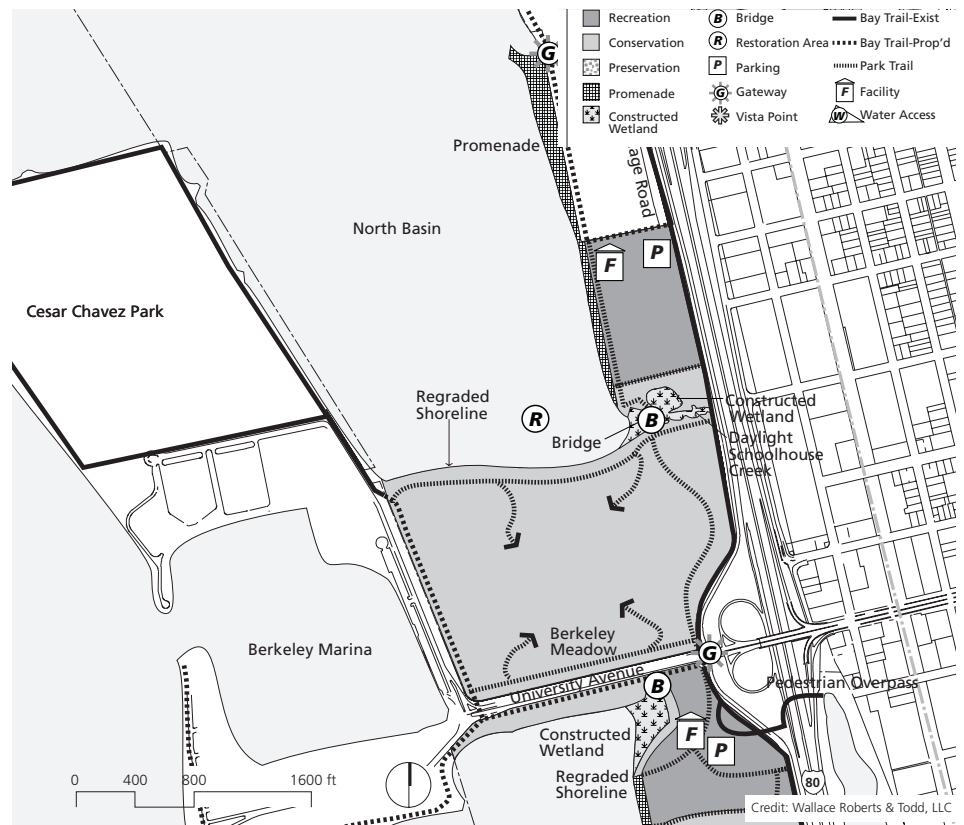


FIGURE 4-16: McLAUGHLIN EASTSHORE STATE PARK: BERKELEY MEADOW AND NORTH BASIN DETAILED PLAN

Source: *Eastshore State Park General Plan, 2002*

McLAUGHLIN EASTSHORE STATE PARK

Opportunities & Constraints

Based on existing elevations, the following maps show the extent of tidal and storm inundation across the site at mid-century and end-of century.

The Bay Trail connections around the North Basin and Berkeley Meadow, are currently focused along the north edge of the meadow. The Bay Trail connections along University Avenue and Marina Boulevard are also important to include in future planning efforts.

The connection to Schoolhouse Creek offers opportunities to provide tidal marsh wetland areas along the shoreline.

FIGURE 4-17: McLAUGHLIN EASTSHORE STATE PARK
Mid-Century - 3ft SLR



Key Considerations

- Nature-based shoreline stabilization opportunities along shoreline and trail and access road edges
- Integration with Berkeley Meadow restoration
- Opportunities for green infrastructure to alleviate future storm flooding in the City of Berkeley
- Key coordination to provide resilient access and habitat areas through end of century

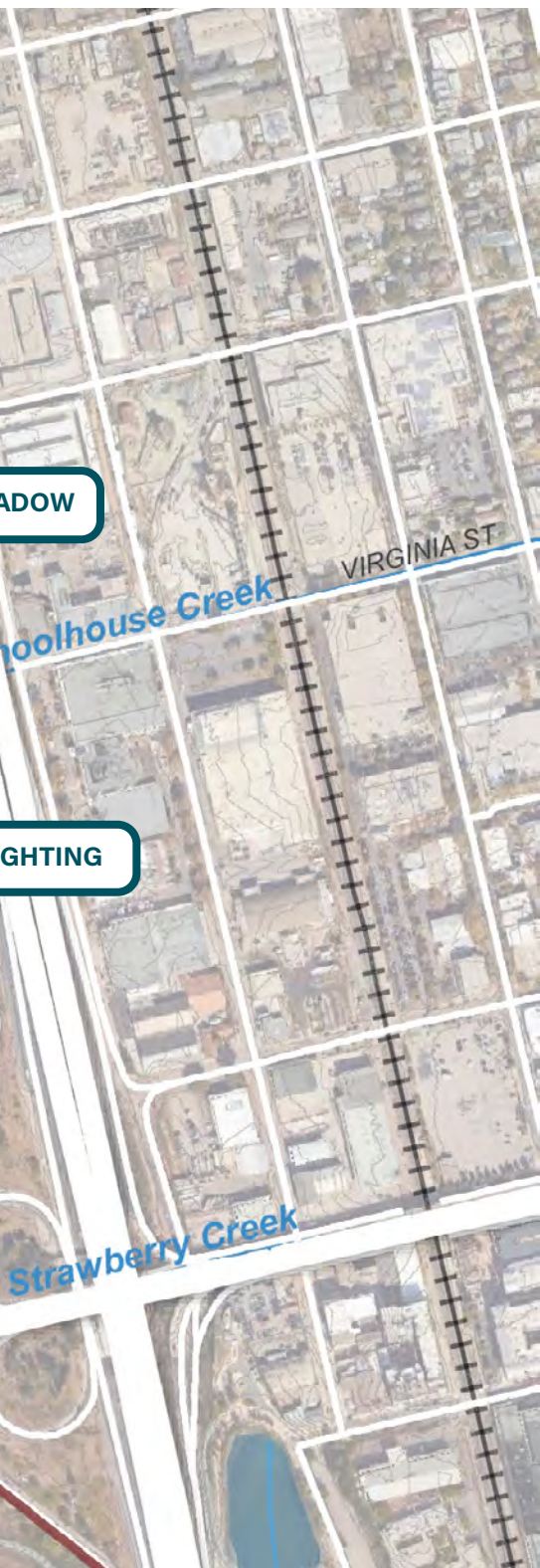
FIGURE 4-18: McLAUGHLIN EASTSHORE STATE PARK
End-of-Century - 6ft SLR



McLAUGHLIN EASTSHORE STATE PARK



4. PROTOTYPE SITES





Mid-Century Concept Plan

The mid-century concept provides needed public access enhancements while implementing nature-based shoreline treatments that build long-term site resilience. A majority of the upland areas including the Berkeley Meadow and North Basin Strip remain intact through mid-century sea level projections (see figure 3-22). The exception is the western shoreline of the meadow, where the low-lying areas will become inundated. This concept embraces the natural processes set to occur and allows tidal marshes to begin to establish in the meadow. The daylighting of Schoolhouse Creek between the

existing outfall and the frontage road offers opportunity to create freshwater wetlands and highlight the unique system of creeks along the East Bay shoreline. Existing public access in the North Basin Strip on gravel roads and trails is formalized to be clearly defined paths for bicyclists and pedestrians. Spur trails that degrade habitat areas are removed and the areas restored. The existing gravel road along the meadow shoreline is not improved due to near term inundation and long-term abandonment. Existing trails along the City's Marina Boulevard are improved and incorporated into an ecotone slope extending into the Meadow.

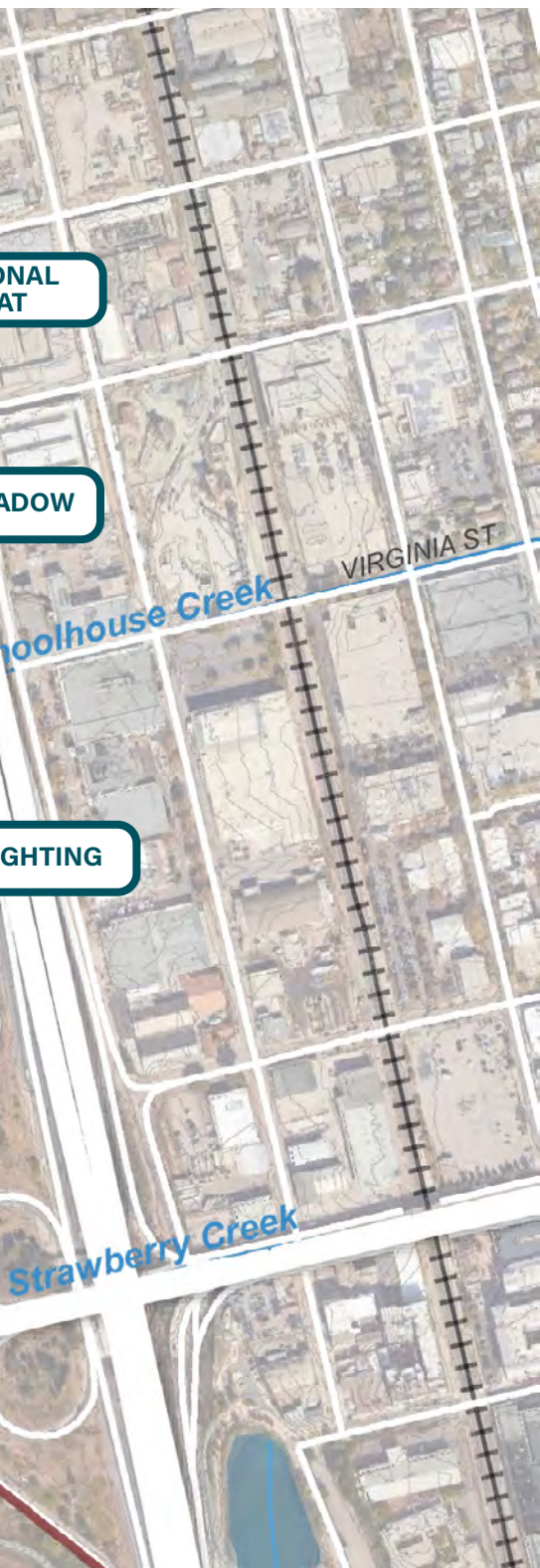
FIGURE 4-19: McLAUGHLIN EASTSHORE STATE PARK CONCEPT PLAN
 Mid-Century - 3ft SLR

-  PROPOSED BAY TRAIL ON SITE
-  PROPOSED BAY TRAIL OUT OF SITE
-  EXISTING BAY TRAILS
-  EXISTING TRAILS

McLAUGHLIN EASTSHORE STATE PARK



4. PROTOTYPE SITES



End-of-Century Concept Plan

By end-of-century, significant inundation is projected to occur. This concept emphasizes a transgressional landscape where upland and seasonal freshwater habitats in the meadow shift to the North Basin Strip. The Meadow is envisioned to have two hydrologic connections to the bay. The first occurs where shown in the mid-century concept. The second is near the mouth of Schoolhouse Creek. Minor excavation would help create the convention and direct seasonal freshwater from the creek to the emerging wetlands. Shoreline treatments installed earlier as shown in the mid-century concept, are protecting the remaining upland areas and prevent waves

from reaching the vulnerable tidal wetlands forming in the Meadow. These treatments also protect public access routes in the North Basin Strip. While portions of trails within Eastshore State Park are protected, major active transportation routes in the City of Berkeley along University Avenue and Marina Boulevard are subject to inundation by end-of-century. The concept plan proposes new pathways built above flood levels to connect to the Berkeley Marina along the north side of University Avenue. The frontage road which hosts the Bay Trail currently along the edge of the Meadow and North Basin Strip also requires elevating. Partnerships between landowners are required to ensure these adaptation strategies are achieved.

FIGURE 4-20: McLAUGHLIN EASTSHORE STATE PARK CONCEPT PLAN
End-of-Century - 6ft SLR

-  PROPOSED BAY TRAIL ON SITE
-  PROPOSED BAY TRAIL OUT OF SITE
-  EXISTING BAY TRAILS
-  EXISTING TRAILS

McLAUGHLIN EASTSHORE STATE PARK



FIGURE 4-21: McLAUGHLIN EASTSHORE STATE PARK MID CENTURY CONCEPT PLAN WITH SLR INUNDATION

Mid-Century - 3ft SLR

- PROPOSED BAY TRAIL ON SITE
- - - PROPOSED BAY TRAIL OUT OF SITE
- EXISTING BAY TRAILS
- EXISTING TRAILS
- TIDAL INUNDATION (+3' SLR)
- STORM INUNDATION (+3' SLR)
- FLOODING RISK



FIGURE 4-22: McLAUGHLIN EASTSHORE STATE PARK END OF CENTURY CONCEPT PLAN WITH SLR INUNDATION
End-of-Century - 6ft SLR

- PROPOSED BAY TRAIL ON SITE
- PROPOSED BAY TRAIL OUT OF SITE
- EXISTING BAY TRAILS
- EXISTING TRAILS
- TIDAL INUNDATION (+6' SLR)
- STORM INUNDATION (+6' SLR)
- FLOODING RISK

McLAUGHLIN EASTSHORE STATE PARK



FIGURE 4-23: McLAUGHLIN EASTSHORE STATE PARK MID CENTURY RENDERING



McLAUGHLIN EASTSHORE STATE PARK



PEOPLE BIKING ALONG THE NORTH BASIN STRIP IN McLAUGHLIN EASTSHORE STATE PARK
Source: WRT

McLaughlin Eastshore State Park Funding and Partnership Strategy

This section provides an initial strategy for seeking funding for the McLaughlin Eastshore State Park prioritized concept plan. It identifies the elements of the concept plan that the Park District can highlight when seeking funding, the partners with whom the Park District can engage, and steps the Park District can take

in the short term to position itself for future funding opportunities.

Site Features That Present Opportunities For Funding

The McLaughlin Eastshore State Park prioritized concept plan focuses on daylighting Schoolhouse Creek where it flows into the bay and restoring habitat to the north of the creek. The RAAPP concept plan for this site provides several benefits that could serve as the starting point for funding requests. These include access to

nature and recreation opportunities, habitat restoration, non-motorized mobility, and protection against sea level rise.

Access to Nature and Recreation Opportunities

The concept plan proposes to daylight Schoolhouse Creek and create coarse beaches along the shoreline north of the creek. The daylighting of Schoolhouse Creek could provide new opportunities for youth environmental education, adding to programs currently

offered by the City of Berkeley Parks, Recreation & Waterfront Department and by the Park District. This could serve as the basis for seeking funding from foundations and grant programs aimed at increasing environmental education opportunities.

The concept plan also proposes water access through a coarse beach north of the creek. This access could position the Park District for grants such as Measure AA and others focused on shoreline access. While the site does not currently qualify for Disadvantaged Community status under the State's mapping tool, a case can be made for the concept plan providing increase shoreline access to low-income populations living in Berkeley, Oakland and elsewhere in the East Bay. The development of additional pedestrian bridges over Interstate 80 further strengthens this case. Pedestrian bridge access to McLaughlin Eastshore State Park currently exists off of Addison Street, connecting south of Schoolhouse Creek. An additional pedestrian bridge is under development off Gilman Street, north of Schoolhouse Creek. Another pedestrian bridge is in the planning phase, which is expected to be at the Ashby Interchange and could increase access to McLaughlin Eastshore State Park for residents of Emeryville and potentially West Oakland.

Habitat Restoration

The McLaughlin Eastshore State Park concept plan provides two alternative scenarios for the area north of Schoolhouse Creek: 1) the restoration of tidal marsh habitat and 2) the restoration of upland habitat. Either habitat restoration scenario could attract funding sources supporting habitat restoration and ecosystem health. If the restored habitat fosters the reintroduction of endangered species to the site, the project potentially could be used as a habitat mitigation bank, depending on the requirements of the agencies seeking the offsets.

Non-Motorized Mobility

The existing Bay Trail along McLaughlin Eastshore State Park serves as a bicycle commute route connecting jobs and housing along the East Bay. With the planned completion of the bicycle lane on the Bay Bridge span connecting Yerba Buena Island and the City of San Francisco, bicycle commuting on the McLaughlin Eastshore segment of the Bay Trail could increase. The McLaughlin Eastshore State Park concept plan proposes a way to reduce the impact of sea level rise on the existing Bay Trail and to divert some bicycle and pedestrian traffic

closer to the shoreline. This could attract funding and support from organizations aiming to increase bicycle-based commuting and would align with existing climate action plans seeking to reduce transportation-based greenhouse gas emissions.

Protection Against Sea Level Rise

The proposed habitat restoration and daylighting of Schoolhouse Creek help lay the groundwork for future adaptations to sea level rise along the segments of the Bay Trail that parallel Caltrans roadways. The use of a nature-based near-term adaptation to sea level rise could provide the starting point for engaging with Caltrans on longer-term sea level rise protection needs. These efforts could attract planning grants and other funding opportunities to pilot approaches that could be applied throughout the Bay Area shoreline.

McLAUGHLIN EASTSHORE STATE PARK

Partnership Opportunities

The Park District will increase its opportunities for funding the McLaughlin Eastshore State Park Schoolhouse creek concept plan by partnering with other public agencies and community organizations active on or near the site. These include the City of Berkeley, Caltrans, and local non-profit organizations.

City of Berkeley

The Park District can benefit from coordinating with the City of Berkeley on McLaughlin Eastshore State Park adaptations to sea level rise, particularly in terms of gaining the City's support or partnership on grant pursuits. In 2020 the City of Berkeley submitted a Measure AA grant application for habitat restoration and public access in the Berkeley Aquatic Park. The City could build on these efforts by supporting or jointly submitting a future Measure AA grant for the McLaughlin Eastshore State Park concept plan.

The Park District can also continue to coordinate with the City of Berkeley on environmental education opportunities offered through the City of Berkeley Parks, Recreation & Waterfront Department, as well as the City's Marina Master Plan update.

The Department of Public Works created in 2019 a Green Infrastructure Plan whose goals may align with the daylighting of Schoolhouse Creek. In any case, daylighting can serve as the start of a conversation on improving stormwater drainage from the neighborhoods east of Interstate 80 towards the Bay.

Caltrans

Caltrans owns and operates Interstate 80. The agency has not yet engaged with the Park District on opportunities to protect the interstate from sea level rise. The Caltrans State Bicycle and Pedestrian Plan, published in 2017, could serve as a starting point for communicating the value the Bay Trail brings to Caltrans bicycle and pedestrian goals. This could lay the groundwork for future conversations regarding sea level rise adaptation and how to protect Caltrans' assets while also maintaining bicycle and pedestrian access.

Non-profit organizations

The McLaughlin Eastshore State Park concept plan aligns with the goals of a range of non-profit organizations focused on habitat restoration, creek daylighting, bicycle mobility, and environmental education. These organizations present opportunities

for supporting or partnering on future grant applications for the site.

Recommended Next Steps

The Park District can take the following actions to increase opportunities for funding the development of the McLaughlin Eastshore State Park concept plan:

1. Take the lead on seeking funding sources, including Measure AA, and identify co-benefits that can attract joint applicants and supporters.
2. Continue to engage with Caltrans to lay the groundwork for future coordination on protecting the Bay Trail and Interstate 80 from sea level rise.
3. Continue to coordinate with the City of Berkeley to align the Schoolhouse Creek daylighting project with related City infrastructure initiatives, including the Green Infrastructure Plan, the Marina Master Plan Update, and projects funded by Measure M.

COARSE BEACH IN McLAUGHLIN EASTSHORE STATE PARK

Source: WRT



MARTIN LUTHER KING JR. REGIONAL SHORELINE



VIEW OF ARROWHEAD MARSH FROM THE MARTIN LUTHER KING JR. REGIONAL SHORELINE CENTER

Source: East Bay Regional Park District

Planning Context And Key Stakeholders

The Martin Luther King Jr. Regional Shoreline area is a complex tapestry of geography and ownership ringing San Leandro Bay. The impacts of sea level rise will adversely affect critical transportation networks, job centers, vulnerable communities, recreational assets, and highly productive estuary ecologies home to special status species. While solutions to any single challenge or location can be explored,

all paths to adaptation lead to the need for a comprehensive approach. The Martin Luther King Jr. Regional Shoreline area can become a model for forging jurisdictional partnerships that achieve multiple benefits and deliver greater resilience.

The Physical Setting and Ownerships

San Leandro Bay is a tidal estuary along the eastern shoreline of San Francisco Bay. It terminates at the south end of the Oakland Estuary between the cities of Oakland

and Alameda. To the east, the neighborhoods of East Oakland host vulnerable communities, industrial job centers, and major redevelopment sites like the Oakland Coliseum. The Park District's Martin Luther King Jr. Regional Shoreline park provides important public shoreline access to adjacent communities. To the south and east, the Port of Oakland owns and operates the Oakland International Airport, and Caltrans owns and manages the shoreline road Doolittle Drive linking Hegenberger Road to Bay Farm Island and Alameda. The

Bay Trail rings the entire Bay with major trail segments in the Martin Luther King Jr. Regional Shoreline area and along Doolittle Drive. Planned bicycle connections extend inland from the Bay along San Leandro Creek.

The relatively calm waters are protected on the west from high energy bay waves by Alameda and Bay Farm Island, allowing a rich marine estuary to flourish. The ecological setting is anchored by Arrowhead Marsh, named for its distinctive shape as seen from above. Protected and federally-listed Ridgeway's Rail and the Salt Marsh Harvest Mouse are notable species who call the marsh home. The Martin Luther King Jr. Regional Shoreline hosts a small tidal marsh at the mouth of Damon Slough. A majority of the other shoreline areas are covered in rock revetment, limiting its ecological value and thus making Arrowhead Marsh unique and an island habitat. Several freshwater creeks enter into the Bay from the east including San Leandro Creek, Lion Creek, and Elmhurst Creek. Recent research by SFEI highlights the regional habitat significance and suggests priority protection for the San Leandro Bay.

Key Issues

Arrowhead Marsh

Future sea level rise will destroy the marsh ecosystem by drowning the vegetation and causing the species who call it home to leave. There is limited upland areas adjacent to the marsh that can allow the gradual migration of habitat and species. Recent restoration efforts along the Airport Channel provide some benefit, but those areas too will become inundated by mid-century. Moving forward, the entire San Leandro Bay shoreline areas must be considered for future restoration and expansion of habitat beyond what exists today. This will require placement of beneficial fill into the bay to build up the land. Existing landward areas must be converted from parkland, roads, and even buildings to allow new marshlands to establish at higher elevations. While these actions are controversial, they must be considered as part of a comprehensive strategy to preserve the ecological value of San Leandro Bay and Arrowhead Marsh.

Doolittle Drive and Bay Trail

The CalTrans-owned Doolittle Drive and Park District-owned Martin Luther King Jr. Regional Shoreline with the Bay Trail are both subject

to mid-century flooding that will cut off regional transportation routes. The shoreline area moving from inland to the bay is characterized by the airport and existing commercial land uses, the roadway, the Bay Trail, and shoreline park. The proximity of the road to the water in some areas makes elevating the Bay Trail impossible without either also elevating the road or placing the trail over the water. The complexity of permitting and potential environmental impacts make adaptation projects difficult if not impossible. In less constrained areas, there may be opportunities to solve for multiple benefits including protecting regional transportation assets and creating new shoreline habitat. Shoreline improvements may also double as protection against flooding for the airport. An example project could be elevating and relocating Doolittle Drive with the Bay Trail inland and adapting shoreline park areas for tidal marsh migration in a manner that also affords protection of the airport. While complex and expensive, a project supported by multiple jurisdictions will yield greater benefit and be better equipped to navigate permitting.

MARTIN LUTHER KING JR. REGIONAL SHORELINE



FIGURE 4-24: MARTIN LUTHER KING JR. REGIONAL SHORELINE
 Mid-Century - 3ft SLR

-  PROPOSED BAY TRAIL
-  CITY BOUNDARY
-  EXISTING TRAILS
-  TIDAL INUNDATION (+3' SLR)
-  STORM INUNDATION (+3' SLR)



FIGURE 4-25: MARTIN LUTHER KING JR. REGIONAL SHORELINE
End-of-Century - 6ft SLR

-  PROPOSED BAY TRAIL
-  CITY BOUNDARY
-  EXISTING TRAILS
-  TIDAL INUNDATION (+6' SLR)
-  STORM INUNDATION (+6' SLR)

MARTIN LUTHER KING JR. REGIONAL SHORELINE

Martin Luther King Jr. Regional Shoreline Funding and Partnership Strategy

This section provides an initial approach for engaging with partners along the Bay Trail segment that runs north along Doolittle Drive (State Route 61) from the MLK Jr Shoreline Center to the Bay Farm Island Bridge. As this concept plan depends on the actions of other partners, this strategy focuses on the partners with whom to engage.

Site Features that Present Opportunities for Funding

The northern Martin Luther King Jr. Regional Shoreline segment presents an opportunity to strengthen bicycle access along the Bay Trail between the City of Alameda (Bay Farm and Alameda Island) and the City of San Leandro. Given the risk of sea level rise along Doolittle Drive, this segment also presents the opportunity to contribute to the design of sea level rise adaptations to Caltrans assets in a way that preserves and enhances bicycle and pedestrian access.

Partnership Opportunities

The Park District's opportunities to increase bike access and adapt this portion of the Bay Trail to sea level rise will depend in large part on the other public agencies who own or are connected by this section of Doolittle Drive: Caltrans, City of Alameda, the City of Oakland, and the Port of Oakland.

Caltrans

Caltrans owns and operates State Route 61. The agency has begun to engage with the Park District and other stakeholders on the need to protect the Doolittle Drive section of State Route 61 in the near term from high tides and rising sea levels. The Park District can continue to engage with Caltrans and other interested stakeholders on the design of a raised or otherwise modified road and to communicate the need for the design to include bicycle access. The Caltrans State Bicycle and Pedestrian Plan, published in 2017 could serve as a starting point for communicating the value the Bay Trail brings to Caltrans' bicycle and pedestrian goals.

City of Alameda

As mentioned in the Alameda Point section, the City of Alameda is in the early stages of a year-long effort to prepare to apply for federal pre-disaster mitigation grant programs, including the FEMA, FMA, and BRIC grant programs. The City's intent is to package multiple sea level rise protection projects into one grant application, including the Veterans Court shoreline near the Bay Farm Bridge. As this area is just along the northern end of Doolittle Drive, the federal grant application could provide an opportunity for both the Park District and Caltrans to partner with the City of Alameda in seeking funding to protect the areas near Bay Farm Bridge from sea level rise while also providing Bay Trail bicycle access. Increasing bicycle access along this section could align with the Alameda Active Transportation Plan, currently under development.

Port of Oakland Airport

Any efforts to raise or otherwise modify Doolittle Drive to protect it from sea level rise will affect – and potentially benefit – the Port of Oakland Airport's plans to adapt its runways and facilities to sea level rise. While bicycle access is likely not a priority co-benefit in these plans, it will be useful to continue

to communicate the Park District's priorities in conversations with the Port and other stakeholders about changes to Doolittle Drive.

City of Oakland

This section of Doolittle is mostly within the City of Oakland. The Park District can continue to engage as needed with the City of Oakland on ways to increase Bay Trail access along the Martin Luther King Jr. Regional Shoreline.

Recommended Next Steps

The Park District can take the following actions to increase opportunities for funding the development of the Bay Trail along the northern segment of Doolittle Drive:

1. Continue to coordinate with key partners to raise awareness for the need for a bike lane in any future changes to Doolittle Drive to adapt to sea level rise. The Park District may have the opportunity to play a convening role to keep highlighting the multiple co-benefits associated with protecting Doolittle Drive from sea level rise in a way that provides Bay Trail bicycle access.
2. Coordinate with the City of Alameda to support grant applications for FEMA pre-disaster risk mitigation that involve the Veterans Court / Bay Farm Island Bridge area.



REFERENCES

A. References

B. Glossary

REFERENCES

“Alameda Point Conceptual Planning Guide.” Alameda, CA: City of Alameda, August 20, 2013. https://www.alamedaca.gov/files/assets/public/departments/alameda/base-reuse/final-planning-documents/ap_planning_guide_final_9.12.13_red_0.pdf.

“Albany Neck & Bulb Transition Study: A Planning Tool for Site Enhancement.” Albany, CA: City of Albany, June 2016. <https://www.albanyca.org/recreation/waterfront/albany-bulb-transition-planning-process>.

“Bay Fill for Habitat Restoration, Enhancement, and Creation in a Changing Bay Staff Report.” San Francisco, CA: BCDC San Francisco Bay Conservation and Development Commission, May 24, 2019. <https://www.bcdc.ca.gov/BPAFHR/20190524ChangingBay.pdf>.

Beagle, Julie, Jeremy Lowe, Katie McKnight, Samuel Safran, Laura Tam, and Sarah Szambelan. San Francisco Bay Shoreline Adaptation Atlas: Working with Nature to Plan for Sea Level Rise Using Operational Landscape Units. Richmond, CA: SFEI & SPUR, 2019. <https://doi.org/10.13140/RG.2.2.22416.46083>.

“Eastshore State Park General Plan.” California: California Department of Parks and Recreation, East Bay Regional Park District, California State Coastal Conservancy, 2002. https://www.parks.ca.gov/pages/21299/files/eastshore_sp_gp_final.pdf.

“Master Infrastructure Plan Alameda Point.” Alameda, CA: City of Alameda, March 31, 2014. <https://www.alamedaca.gov/files/content/public/government/initiatives/climate-action-and-resiliency-plan/mip-final.pdf>.

“Master Infrastructure Plan Amendment Alameda Point.” Alameda, CA: City of Alameda, August 2020. <https://www.alamedaca.gov/files/assets/public/departments/alameda/base-reuse/final-planning-documents/master-infrastructure-plan-amendment.pdf>.

Plane, Ellen, Kristina Hill, and Christine May. “A Rapid Assessment Method to Identify Potential Groundwater Flooding Hotspots as Sea Levels Rise in Coastal Cities.” *Water* 11, no. 11 (November 2019): 2228. <https://doi.org/10.3390/w11112228>.

San Francisco Bay Trail Design Guidelines and Toolkit. San Francisco Bay Trail, 2016. http://baytrail.org/pdfs/BayTrailDGTK_082616_Web.pdf.

State of California Sea-Level Rise Guidance, 2018 Update. California Ocean Protection Council (OPC), 2018. <https://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/>.

GLOSSARY

Adaptation pathway

An adaptation pathway is a planning approach addressing the uncertainty and challenges of climate change decision-making. It enables consideration of multiple possible futures, and allows analysis/exploration of the robustness and flexibility of various options across those multiple futures

ART - Adapting to Rising Tides

A program of the San Francisco Bay Conservation and Development Commission (BCDC) to look at the impacts of sea level rise on the Bay Area.

Bay Trail

When completed, the San Francisco Bay Trail will be a 500-mile green transportation and recreation route for walking and cycling around the entire San Francisco Bay. Senate Bill 100, authored by former State Senator Bill Lockyer and passed into law in 1987, created the vision of the Bay Trail and directed the Association of Bay Area Governments (ABAG) to develop a plan for a “ring around the Bay”. The Bay Trail Plan, adopted by ABAG in July 1989, includes a proposed alignment, a set of policies

to guide the future selection and implementation of routes, and strategies for implementation and financing.

Baylands

The baylands are the lands that lie between the elevations of the high and low tides, including those areas that would be covered by the tides in the absence of levees or other structures.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The federal law establishing a program to identify hazardous waste sites and procedures for cleaning up sites to protect human health and the environment.

Consequence

The expected severity and extent of impact given hazard, focus on economic, environmental, equity, recreation and connectivity

CoSMoS – Coastal Storm Modeling System

A dynamic modeling approach that has been developed by the United

States Geological Survey in order to allow more detailed predictions of coastal flooding due to both future sea-level rise and storms integrated with long-term coastal evolution (i.e., beach changes and cliff/bluff retreat) over large geographic areas (100s of kilometers).

Geomorphology

The scientific study of the origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface.

Green and Gray infrastructure

Green infrastructure refers to natural systems including forests, floodplains, wetlands and soils that provide additional benefits for human well-being, such as flood protection and climate regulation. Gray infrastructure refers to the human-engineered infrastructure for water resources such as water and wastewater treatment plants, pipelines, and reservoirs.

Groin

A hard shoreline structure designed as so-called "permanent solution" to

GLOSSARY

beach erosion. A groin is a shoreline structure that is perpendicular to the beach. It is usually made of large boulders, but it can be made of concrete, steel or wood.

Groundwater

Water in the subsurface that fills pores in the soil or openings in rocks. As sea levels rise, areas adjacent to tidally influenced water bodies may experience groundwater emergence at a similar rate to sea level rise.

Hazard

The intensity and likelihood of a particular threat focused on tidal, storm, waves, and groundwater flooding.

IR site (Installation Restoration Site)

The US Department of Defense's comprehensive program to investigate and cleanup environmental contamination at military facilities in full compliance with CERCLA.

MHHW (Mean Higher High Water)

The average of the higher high water height of each tidal day observed

over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.

Nature-based adaptation

Physical landscape features that can evolve over time through the actions of environmental processes, such as the flow of water and sediment. They can be naturally occurring, or engineered to mimic natural processes. They can reduce the vulnerability of communities to flood hazards related to climate change while also providing a wide array of additional benefits that most traditional hard armoring solutions lack (e.g., fish and wildlife habitat, recreational opportunities, and carbon sequestration). Examples include nearshore oyster reefs, submerged aquatic vegetation, beaches, and wetlands.

Operational landscape units (OLUs)

OLUs are a practical way to manage the physical and jurisdictional complexity of the Bay shoreline. They are connected geographic areas that share common physical

characteristics and that would accordingly benefit from being managed as individual units.

Planning Horizon

The length of time into the future that is accounted for in a particular plan. In sea level rise analysis planning horizons are often set to levels of sea level rise instead of time, because of the uncertainty related to sea level rise projections. Often plans will establish planning horizon ranges for both time and sea level rise depth.

Record of Decision (ROD)

A decision document published by the US Navy that identifies the remedial alternative chosen for implementation at a CERCLA site.

Risk

The probability of adverse outcomes, the integration of hazard, vulnerability, and consequence

Storm inundation

The temporary inundation of low-lying areas, associated with riverine and coastal flooding during weather events.

Tidal inundation

Tidal Inundation is most commonly referenced to the average daily highest tide, or Mean Higher High Water (MHHW) tidal datum. Inundation typically begins when water levels reach above this level. In sea level rise analysis, tidal inundation refers to the permanent change in the MHHW tidal datum in each scenario.

Vulnerability

The susceptibility to damage given a certain hazard, focus on potential for erosion and overtopping.

