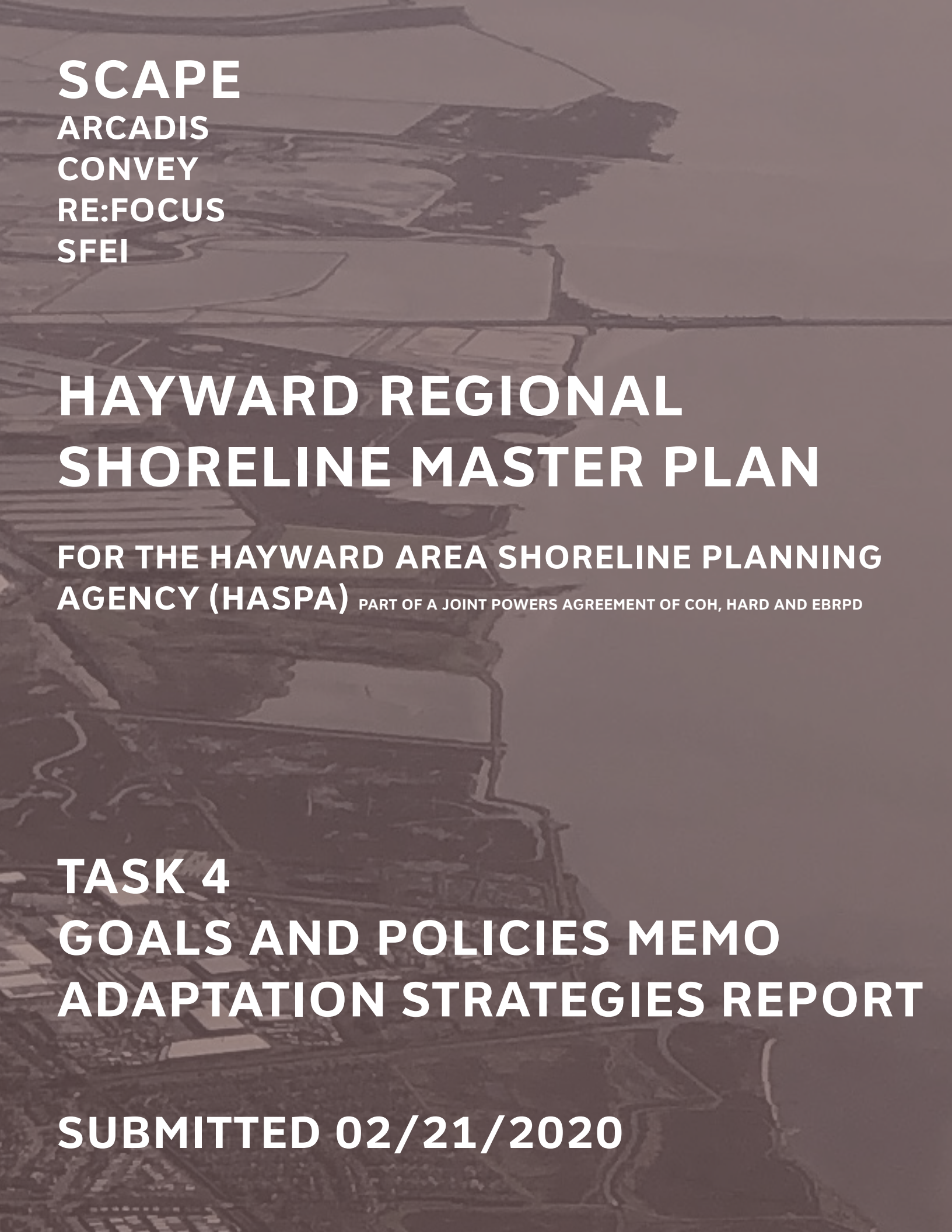

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HAYWARD REGIONAL SHORELINE MASTER PLAN

FOR THE HAYWARD AREA SHORELINE PLANNING AGENCY (HASPA) PART OF A JOINT POWERS AGREEMENT OF COH, HARD AND EBRPD

TASK 4
GOALS AND POLICIES MEMO
ADAPTATION STRATEGIES REPORT

SUBMITTED 02/21/2020



Bay Trail and Tidal Channel at Hayward Landing Canal

EXECUTIVE SUMMARY

The Hayward Regional Shoreline Master Plan was commissioned in 2019 by the Hayward Area Shoreline Planning Agency. The Master Plan will serve as a guide to the protection of important features along the Hayward shoreline that are vulnerable to sea level rise. The shoreline is home to critical urban infrastructure, including wastewater treatment plants, the San Mateo-Hayward Bridge (State Route 92) approach, and landfills. The project area also supports ecological bayland resources, hosts recreational opportunities along the San Francisco Bay Trail, and facilitates educational programming for adjacent residential neighborhoods and businesses. The Master Plan will develop various multi-benefit strategies for the shoreline, its existing infrastructure, and the surrounding natural habitat.

In accordance with the scope of work outlined for Task 4 – Goals and Policies and Adaptation Strategies and Implementation Actions, the Project Team has prepared an Adaptation Report for the study. The Project Team has considered the full project area of the Hayward Regional Shoreline Master Plan, stretching nearly four miles from San Lorenzo Creek south to State Route 92, to produce a catalog of potential design strategies to help the shoreline adapt to climate change. The feasibility and applicability of these strategies as outlined in this report considers each strategy in isolation from every other strategy. They will start to be combined into draft master plan alternatives in Task 5.

During this phase, the Project Team formulated a set of project goals that will guide the master plan development, as well as policy considerations. A public shore tour was also conducted and feedback from a broad range of stakeholders was solicited for every adaptation strategy. Key takeaways from these discussions can be found in the compiled option pages at the end of each strategy section.

Document Summary

Project Goals

This is a set of goals developed by the Project Team that will guide the master plan and selection/combination of adaptation strategies.

Policy Considerations

This section outlines the policy context of the Hayward Regional Shoreline Master Plan and presents a table of all relevant organizations, agencies, plans, and policies that will be considered as part of the Master Plan Process.

Adaptation Strategies

Multiple options were identified for each adaptation strategy and were used to spark discussion and solicit feedback from stakeholders.

Nature-Based:

This section provides a catalog of nature-based design strategies that incorporate coastal risk reduction and ecological infrastructure to adapt shoreline assets.

Engineered:

This section provides a catalog of engineered design strategies that are usually constructed with harder materials and mainly address the adaptation of built infrastructure.

Non-Structural:

This section provides a catalog of design strategies that deal with policy and regulatory measures.

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PROJECT GOALS

PROJECT GOALS

PROJECT STATEMENT:

The Hayward Regional Shoreline Master Plan creates a framework for resilience to prepare for sea level rise (SLR), groundwater intrusion, and storm surge. The Master Plan is being managed by the Hayward Area Shoreline Planning Agency (HASPA), a joint power authority including the City of Hayward, Hayward Area Recreation and Park District (HARD), and East Bay Regional Park District (EBRPD).

The Hayward Regional Shoreline Master Plan project area is bounded on the north by the Bockman Channel (also called the Bockman Canal) and extends approximately 3.25 miles south to the State Route 92 San Mateo Bridge approach. The extent of the project area into the Bay was defined by the outermost limit of the Hayward Area Shoreline Planning Agency Jurisdictional boundary, and the inland extent of the project area are drawn at the rail corridor. In total, the project area covers six square miles of various land uses, including open space, urban infrastructure, industrial, and residential.

The project area supports ecological bayland resources, hosts recreational opportunities along the San Francisco Bay Trail, and facilitates educational programming for adjacent residential neighborhoods and businesses at the Hayward Shoreline Interpretive Center. The shoreline is also home to critical urban infrastructure, including wastewater treatment plants, the San Mateo-Hayward Bridge approach (State Route 92), and landfills. The Master Plan will develop various multi-benefit strategies for the shoreline, its existing infrastructure, and the surrounding natural habitat. The Master Plan will consider multiple planning time horizons and sea level rise scenarios. Additionally, it will consider a range of adaptation strategies that can evolve and respond over time to changing sea levels.

The shoreline master plan encompasses four goals.

PROJECT GOALS

Create a Resilient Shoreline Environment for People and Ecology

- Enhance the shoreline's ecological value and adapt to sea level rise
- Enhance recreational opportunities and adapt to climate change
- Create a management framework for adapting to sea level rise over time
- Provide refuge to help endangered shoreline species to adapt climate change

Enhance the Shoreline Environment to Reduce Risk to Critical Infrastructure and Built Assets

- Align with and enhance existing management and capital improvement plans
- Reduce risk to regional critical utilities from sea level rise, groundwater intrusion, and flood events
- Reduce risk to transportation infrastructure from sea level rise, groundwater intrusion, and flood events
- Reduce risk to agency assets such as the San Francisco Bay Trail and marsh restoration project(s)

Build Social Resilience in the Community

- Promote social equity, environmental justice, and public health
- Preserve the local economy and increase resilience to climate change
- Prevent the disruption of key community services

Build Capacity for Future Generations to Adapt to climate change

- Build organizational and community capacity
- Provide a place for education, interpretation and understanding of the shoreline and climate change
- Foster stewardship of the shoreline's cultural and ecological resources

POLICY CONSIDERATIONS

POLICY CONSIDERATIONS

ROLE OF POLICIES IN THE HAYWARD SHORELINE MASTER PLAN

Before developing adaptation strategies, it is important to understand the planning and policy context for the Hayward Shoreline Master Plan. There are a variety of ways in which the plans and policies of project stakeholders will inform the development of strategies and the eventual master plan. Policies can present opportunities, such as the ability to shape a funding plan or regulatory change to promote the shoreline master plan's implementation. Policies can also shape the project or the process by presenting regulations or processes that must be accommodated.

KEY POLICY CONSIDERATIONS

Following an extensive review of stakeholders in the project area, we've identified the following initial key policy considerations. These can be updated as the project progresses.

- **There is broad support and consensus around the need to plan for sea level rise with a focus on habitat restoration, and an evolving playbook on how to balance long-term, conflicting needs.**
  Planning agencies, regulatory bodies, and infrastructure operators are well-aligned on the need to plan for sea level rise. Not all wetland restoration projects have considered sea level rise in the past, but the concept of adaptive management is gaining acceptance and becoming part of regulation. While there is no clear answer on how to balance the needs of vulnerable infrastructure and communities with the opportunities to maintain and improve habitat, there are many active organizations focused on developing policies and plans to address all aspects of these issues.

- **There is an extensive permitting process and many regulatory requirements that will likely drive the implementation process.**
  There are numerous agencies that will likely be involved in the permitting processes for any modifications to the Hayward shoreline. Recent reforms aimed at streamlining the process are positive signs, though they are focused on ecological restoration, and it is unclear how hybrid grey infrastructure approaches will be treated.

- **There are many stakeholders in how water is managed with specific interests that will need to be navigated in order to identify an implementable strategy.**
  The Hayward shoreline contains an extensive water management infrastructure network, including water treatment, wetland management, and flood control. Changes to the system may have system-wide impacts and require buy-in the from agencies and authorities involved.

- **Innovative approaches to shoreline access may be needed to allow for a full exploration of potential strategies.**
  While the Bay Trail has historically prioritized a "blue water" experience with the trail directly adjacent to the shoreline, there is an opportunity to create a diverse shoreline recreational experience, including moving inland to accommodate shoreline habitats and the inclusion of high points at vistas.

- **There are opportunities for the Shoreline Master Plan to advance regional policy on climate adaptation and ecosystem management.**

There are numerous organizations and agencies active in sea level rise adaptation and habitat restoration in the Bay Area. While numerous studies and toolkits are being advanced, there is a need for built projects to test and advance innovative ideas for how to adapt to sea level rise while improving ecosystem health. This project can serve as a test bed for such ideas and serve to advance this issue across the region.

- **The East Bay Regional Park District Master Plan sets forth policies on climate change that should guide the Shoreline Master Plan.**

  Climate change is expected to affect the park's resources in various ways. Changes in the ranges of various species and increased potential for wildfires and pests are anticipated with this change in weather. In a manner consistent with the desire to "conserve and enhance" its resources, the District must closely track the impact of this phenomenon, and if necessary, act to relocate or protect in situ resources that are being degraded or potentially lost by this change.

  The District will specifically track and monitor the effects of Climate Change on its resources, interceding when necessary to relocate or protect in-situ resources that are being degraded or lost by this shift in the environment.

  To help mitigate the effects of climate change, the District will endeavor to conserve and connect habitat for native species through its acquisition and planning processes.

- **The City of Hayward General Plan includes a Hazards Element with policies relevant to flooding and sea level rise that should guide the Shoreline Master Plan.**

  One of the plan's goals is to "protect life and minimize property damage from potential flood hazards." As part of this goal, the plan calls for the City to coordinate with the Alameda County Flood Control and Water Conservation District to evaluate the need to expand the capacity of flood control facilities in response to climate change to promote greater public awareness of flooding hazards. And promote resources and programs to help property owners protect their homes and businesses from flood damage.

  Another goal is to "safeguard the Hayward shoreline, open space, recreational resources, and urban uses from flooding due to rising sea levels." As part of this goal, the plan calls on the city to coordinate with the Hayward Area Shoreline Planning Agency, the Bay Conservation Development Commission, and other agencies to develop and implement a "Regional Shore Realignment Master Plan" that shall identify a preferred long-term strategy and implementation program to protect the shoreline, interim standards to regulate development within areas potentially affected by sea level rise prior to the construction of shoreline protection, and potential flood mitigation measures to apply to development projects within potentially affected areas.

The attached chart provides a summary of relevant organizations, agencies, plans, and policies. The second column summarizes the agency's or organization's general role or mission. The third column highlights the specific regulatory or planning jurisdictions, land ownership, or policies that specifically relate to the study area or master plan. The last column identifies relevant regulations, plans, or guidance documents.

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
Hayward Area Shoreline Planning Agency (HASPA)	• Joint powers agency comprised of representatives from Hayward Area Recreation and Park District, East Bay Regional Park District, and the City of Hayward. • Works with the Hayward Area Shoreline Citizens Advisory Committee (HASCAC) to coordinate agency planning activities and adopt and carry out policies for the improvement of the Hayward Shoreline for future generations.	• Under a joint exercise of powers agreement, HASPA is charged with the power to undertake all planning activities associated with sea level rise, and the power to develop plans, prepare studies and reports, and make recommendations for the Hayward Shoreline. [1]	• Preliminary Study of the Effect of Sea Level Rise on the Resources of the Hayward Shoreline (2011) • Adapting to Rising Tides Resilience Study (March 2015)[2]
Hayward Area Recreation and Park District (HARD)	• Independent special use district created to provide park and recreation services for the over 280,000 residents in the Hayward area. • HARD's park system includes 104 sites covering about 1,357 acres. • Member of HASPA	• Owns and manages 788 acres in the project area including: HARD marsh (a 79-acre, fully tidal marsh), Triangle Marsh (an 8-acre muted tidal marsh system restored in 1990), Oliver Salt Ponds, the San Lorenzo Community Park and other diked ponds and wetlands south of Sulphur Creek. In addition HARD owns and manages to over 40 parks and trails in Hayward, as well as playground areas and playing fields at local schools.[3] • Runs the Hayward Shoreline Interpretive center. • Manages the Skywest Golf Course, which is leased from the City of Hayward.	• Regulations Governing Use of Parks, Recreation Areas, and Facilities[4]
East Bay Regional Park District (EBRPD)	• Regional park district managing 73 parks and 124,000 acres of space and 1,250 miles of trails throughout East Bay in Alameda and Contra Costa counties. • Member of HASPA	• Owns and manages Cogswell Marsh (250 acres tidal/low marsh habitat), Salt Marsh Harvest Mouse Preserve (27 acres muted tidal system), and the Hayward Marsh (145-acre fresh and brackish water marsh that relies on secondary treated effluent as freshwater source). • Supports proposed project to modify Hayward Marsh to convert from a freshwater effluent fed system to a fully tidal or muted tidal system. EBRPD plans to put out a bid for full design in the future.	• Ordinance 38 Rules and Regulations[5] • 2013 Master Plan[6] - defines the mission and vision for the Park District for its stewardship and development • Board of Directors has adopted multiple plans including: ADA Self Evaluation and Transition Plan, Environmental Review Manual, Park Operations guidelines, Sustainability Policy, Wildlife Hazard Reduction and Resource Management Plan • District Standard Plans[7] - design guidelines for districts • Climate Smart Initiative[8] that promotes adaptive management

1 https://lafco.acgov.org/lafco-assets/docs/JPAs/HASPA%20(Hayward%20Area%20Shoreline%20Planning%20Agency).pdf
2 http://www.adaptingtorisingtides.org/wp-content/uploads/2014/12/HaywardShorelineResilienceStudyReport_sm.pdf
3 https://www.hayward-ca.gov/residents/arts-leisure/parks-recreation
4 https://www.haywardrec.org/DocumentCenter/View/2874/District-Regulation-Handbook?bidId=
5 https://www.ebparks.org/activities/ord38.htm
6 https://www.ebparks.org/civicax/filebank/blobdload.aspx?BlobID=23499
7 https://www.ebparks.org/about/bids/district_standard_plans.htm
8 https://www.ebparks.org/climatesmart.htm

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
City of Hayward	• Land use planning and zoning • Conducts development and environmental review • Capital improvement planning • Hazard mitigation planning • Member of HASPA	• Manages capital improvement plan for city infrastructure, including the wastewater treatment plant and local roadways. • Owns and operates Hayward Executive airport. • Owns the Skywest Golf Course that is leased to HARD. • Develops changes to the zoning code to implement land use plans	• General Plan[9] • Zoning maps and use charts[10] • Capital Improvement Budget[11] • Economic Development Strategic Plan[12] • Design Guidelines[13] • Neighborhood Plans[14] • 2016 Hayward Local Hazard Mitigation Plan[15] • Green Infrastructure Plan[16]
San Francisco Bay Restoration Regulatory Integration Team (BRRIT)[17]	• Composed of staff from the six state and federal regulatory agencies with jurisdiction over wetland restoration projects: U.S. Army Corps of Engineers (Corps); U.S. Fish and Wildlife Service (USFWS); NOAA National Marine Fisheries Service (NOAA Fisheries); San Francisco Bay Regional Water Quality Control Board (RWQCB); California Department of Fish and Wildlife (DFW); and San Francisco Bay Conservation and Development Commission (BCDC). Also includes representatives from the U.S Environmental Protection Agency (EPA).	• The purpose of the BRRIT is to improve the permitting process for multi-benefit wetland restoration projects and associated flood management and public access infrastructure in San Francisco Bay.	• Webinar on how to submit projects[18]
California Natural Resources Agency	• The Natural Resources Agency develops guidelines for the implementation of the California Environmental Quality Act (CEQA), a broad environmental law with the goal of disclosing to the public the significant environmental effects of a proposed project through the preparation of an Initial Study (IS), Negative Declaration (ND), or Environmental Impact Report (EIR). • Unlike NEPA, requires adoption of all feasible measures to mitigate environmental impacts	• CEQA applies to all discretionary projects proposed to be conducted or approved by a California public agency, including private projects requiring discretionary government approval • Construction of seawalls, revetments/riprap, bulkheads, or super levee that would modify land near the shoreline or the elevation of land might trigger CEQA • Geologic Hazard Abatement Districts are exempt from CEQA • Impacts to wetlands would have to be addressed under CEQA	• Governor's Office of Planning and Research (OPR) and the Natural Resources agency develop CEQA guidelines[19]

9 https://www.hayward2040generalplan.com/
10 https://www.hayward-ca.gov/services/city-services/explore-zoning-use-charts
11 https://www.hayward-ca.gov/your-government/documents/capital-improvement-program
12 https://www.hayward-ca.gov/your-government/documents/economic-development-strategic-plan
13 https://www.hayward-ca.gov/your-government/documents/planning-documents
14 https://www.hayward-ca.gov/your-government/documents/planning-documents
15 https://www.hayward-ca.gov/sites/default/files/pdf/2016%20City%20of%20Hayward%20Local%20Hazard%20Mitigation%20Plan.pdf
16 https://www.hayward-ca.gov/green-infrastructure-plan
17 http://www.sfbayrestore.org/san-francisco-bay-restoration-regulatory-integration-team-brrit
18 https://www.youtube.com/watch?v=UBcWVP9qQfM&feature=youtu.be
19 http://opr.ca.gov/ceqa/updates/guidelines/

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Alameda County Flood Control & Water Conservation District (ACFCWCD)	• Provides flood protection for the citizens and business of Alameda County, while safeguarding the Bay Area's natural environment • Prevents waste of water or diminution of the water supply • Owns and operates flood control infrastructure (system of pump stations, erosion control structures, dams, and pipeline, channels, levees, and creeks) • Works with federal, state, and local governmental agencies (USACE, FEMA, USGS, NOAA, Water Board, etc.)	• Owns and operates flood control infrastructure in the study area, including: Storm drains, channels, pipelines to San Lorenzo Creek Cull and Don Castro Reservoirs Nine pump stations (Eden Landing, Ruus Road, Besco, Westview, Alvarado, Industrial, Ameron, Stratford, Eden Shores)[20] • Channel property under ACFWCD ownership (Bockman, Sulfur, Line A) could be opened up to public access, potentially aligning with project goals (if maintenance and liability responsibilities can be passed on to another agency). • Considers larger-scale, regional flood protection planning to be beyond their mission.	• Currently conducting Coastal and Riverine Flood Assessment • Hydrology & Hydraulics Manual: Defines current practices for the hydrologic and hydraulic design of all flood control facilities in Alameda County that are subject to District approval • Alameda County Public Works Agency Engineering Design Guidelines • Floodplain Management Ordinance[21] • Stormwater Management and Discharge Ordinance[22] • Grading, Erosion, and Sediment Control Ordinance[23] • California Regional Water Quality Board, Municipal Regional Stormwater NPDES Permit[24] • Zone 3A Drainage Master Plan Study[25]
Alameda County Mosquito Abatement District (ACMAD)	• Formed by City Councils of Berkeley, San Leandro, Hayward, Oakland, Alameda, Piedmont, and Emeryville to address the problem of large flights of mosquitoes from the bay marshes to the hills from March to October • Developed ditching in the marshes to promote drainage of salt marsh mosquito breeding sources • Committed to improving the health and comfort of Alameda County residents by controlling mosquitoes and limiting the transmission of mosquito-borne diseases	• Provides assistance to local code enforcement agencies to enforce state laws, regulations, and local ordinances related to rodent, wildlife, or insect vectors that pose a threat to public health and safety	• Control Program[26] • Invasive Mosquito Response Plan[27] • ACMAD Strategic Plan 2018-2021[28] • BMPs for Mosquito Control[29]

20 http://acfloodcontrol.org/wp-content/uploads/2016/02/acfcd2004report.pdf
21 https://library.municode.com/ca/alameda_county/codes/code_of_ordinances?nodeId=TIT15BUCO_CH15.40FLMA
22 https://library.municode.com/ca/alameda_county/codes/code_of_ordinances?nodeId=TIT13PUSE_CH13.08STMADICO
23 https://library.municode.com/ca/alameda_county/codes/code_of_ordinances?nodeId=TIT15BUCO_CH15.36GRERSECO
24 https://www.waterboards.ca.gov/rwqcb2/board_decisions/adopted_orders/2009/R2-2009-0074.pdf
25 https://acfloodcontrol.org/projects-and-programs/flood-control-projects/zone-3a-drainage-master-plan-study/
26 https://www.mosquitoes.org/files/c1804f413/Control+Program.pdf
27 https://www.mosquitoes.org/files/12711fa88/ACMAD-Invasive-Mosquito-Species-Response-Plan-09_07_2017-1.pdf
28 https://www.mosquitoes.org/files/8206d6935/Alameda+Strategic+Plan.pdf
29 https://www.mosquitoes.org/files/4210fdde3/BMPsforMosquitoControl.pdf

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
Union Sanitary District	• Independent special district which provides wastewater collection, treatment and disposal services to the residents and businesses of the cities of Fremont, Newark and Union City in Southern Alameda County, CA • Sanctioned under California law to perform specific local government functions within certain boundaries • Derives authority from California Health & Safety Code	• Operates a 33 million gallon per day wastewater treatment facility in Union City and provides collection, treatment and disposal services to a total population of over 347,000 in Fremont, Newark, and Union City, CA • Maintains over 800 miles of underground pipelines in its service area	• Sewer System Management Plan[30]
East Bay Dischargers Authority (EBDA)	• Formed in 1974 by a joint exercise of powers agreement by the City of Hayward, City of San Leandro, Oro Loma Sanitary District, Union Sanitary District, and Castro Valley Sanitary District • Purpose is to collectively manage the wastewater treatment and disposal of these agencies, servicing about 800,000 people[31] • Owns and operates four effluent pump stations, a dichlorination facility, and a force main and Bay Outfall system for effluent disposal into the San Francisco Bay[32]	• Operates pipelines connecting various wastewater treatment facilities, allowing treated effluent to enter a single pipeline that discharges into the center of the Bay – this infrastructure runs through the Hayward Regional Shoreline project area, crossing tidal marshes, diked baylands, and industrial lands • EBDA is a partner in the Hayward Marsh redesign (see above). • Joint Powers Agreement (JPA) sets flow amounts, and that is in the process of being updated for the next 20 years, to plan for future alternatives to the EBDA system	• East Bay Dischargers Authority Sea Level Rise Adaptation Planning Project, 2015[33] • Wastewater Reclamation and Reuse Study for the Union Sanitary District Area, May 1976[34] • Joint Powers Agreement
East Bay Municipal Utility District (EDMUD)	• Provides high-quality drinking water for 1.4 million East Bay customers in a 332 square mile area • Wastewater system serves 685,000 people in an 88-square mile area	• Some properties in the City of Hayward get water from EBMUD	• East Bay Watershed Master Plan[35] • Watershed Rules and Regulations[36]
Calpine (Russell City Energy Center)	• Private power company serving 600,000 households • PG&E is contracted to buy the energy produced by the plant and will ship it to San Francisco and San Mateo counties[37]	• Plant is in study area, opened in 2013, built on former landfill site, owned by Union Sanitary District. • Combined-cycle, natural gas-powered electric generating facility with advanced air emissions control technologies. Plant consists of two combustion turbine generators, two heat recovery steam generators with duct burners and a single condensing steam turbine generator. • Plant will likely be decommissioned in the next thirty years, making the land available for reuse by Sanitary District.	

30 https://www.unionsanitary.com/images/documents/USD-SSMP-2018-19-Update.pdf
31 http://www.ebda.org/
32 http://www.ebda.org/about-us
33 http://www.ebda.org/sites/default/files/EBDA%20Climate%20Ready%20Final%20Report%20Report_August2015.pdf
34 http://www.ebda.org/sites/default/files/WW_Reclamation_and_Reuse_Study_1976.pdf
35 https://www.ebmud.com/recreation/east-bay/east-bay-watershed-master-plan-update/
36 https://www.ebmud.com/recreation/rules-and-regulations/
37 https://www.eastbayexpress.com/oakland/foes-of-hayward-power-plant-fight-back/Content?oid=1905883

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
San Francisco Bay Trail	• Partnered with State Coastal Conservancy to develop 500-mile regional trail • Offers grants to local entities to assist in completion of the trail • Works with state and federal agencies, towns, cities, counties, park districts, etc. • Connects communities to parks, open spaces, schools, transit and to each other and provides a commute corridor	• Bay Trail Plan adopted by the Association of Bay Area Governments per Senate Bill 100 in 1989 • Policies and design guidelines are intended to complement rather than supplant adopted regulations and guidelines of local managing agencies • Alternative locations for the Bay Trail were investigated during the Adapting to Rising Tides study, including inland routes, that were considered incompatible with the Bay Trail's 'blue water experience' that they prioritize. • Preference for hard surfaces, though may accommodate other surfaces on top of a levee.	• Bay Trail Plan, Design Guidelines & Toolkit[38]
PG&E	• Provides natural gas and electric service to 16 million people throughout a 70,000 square mile service area • Although the company has infrastructure throughout Hayward, the City now requires all commercial and residential properties to switch from PG&E and instead buy power from non-profit provider East Bay Community Energy[39] • Overseen by California Public Utilities Commission	• PG&E overhead transmission lines cross the Hayward Regional Shoreline project area. The towers are on concrete bases, but sea level rise could cause issues with access for maintenance and repairing the infrastructure. • Additional energy infrastructure is present in the study area that may impact project design.	
Union Pacific Railroad	• Freight railroad owner and operator in Western U.S.	• Owns and operates freight rail line in the study area. Part of the Union Pacific Coast Line that runs from Los Angeles to the Bay Area. • Work near the railroad must be coordinated with Union Pacific	
California Public Utilities Commmission (CPUC)	• CPUC regulates electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation utilities and companies.	• PG&E and Union Pacific Railroad are regulated by CPUC. Changes to their assets may be subject to review by CPUC.	

38 https://baytrail.org/wp-content/uploads/2015/12/San-Francisco-Bay-Trail_-Bay-Trail-Plan-Summary.pdf
39 https://sanfrancisco.cbslocal.com/2018/03/08/hayward-goodbye-pge-renewable-energy/

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
San Francisco Bay Conservation & Development Commission	• California state planning and regulatory agency with regional authority over the San Francisco Bay, the Bay's shoreline, and the Suisun Marsh • Mission is to protect and enhance San Francisco Bay and encourage the Bay's responsible and productive use • Leads the Bay Area's multi-agency regional effort to address impacts of rising sea level on shoreline communities and assets • Authority found in McAteer-Petris Act, San Francisco Bay Plan, and other special area plans and laws and policies. • Issues Coastal Zone Management consistency determination.	• Issues permits for fill in the Bay (including intertidal lands and salt ponds) and for projects within a 100-foot buffer from the bay. Permit conditions require projects to minimize any fill and maximize feasible public access for all projects within the Bay's 100-foot shoreline band. • Interested in highlighting and sharing this project as example of innovative projects in the bay and as a way to share lessons learned around the region. • Proposed Habitat for Fill Bay Plan Amendment is intended to ease the permitting burden for habitat restoration projects. This change may make it easier to get a permit for fill to pursue thin layer placement, gravel beaches, strategic placement of dredge / mudflat seeding. Such projects are likely to require monitoring and adaptive management plans.[40]	• San Francisco Bay Plan (updated with environmental justice and social equity amendment) – includes policies to guide future use of the Bay and shoreline and maps that apply the policies to the Bay and shoreline • Special area plans and design guidelines[41]
California State Coastal Conservancy (SCC)	• State agency established in 1976 to protect and improve natural lands and waterways, help people access and enjoy the outdoors, and sustain local economies along the length of California's coast and San Francisco Bay[42] • Climate Ready Program helps natural resources and human communities along California's coast and San Francisco Bay adapt to the impacts of climate change	• Provides grants and guidance for climate adaptation planning and projects consistent with the Strategic Plan	• "The Baylands and Climate Change: What We Can Do: The 2015 Science Update to the Baylands Ecosystem Habitat Goals Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project" • Strategic Plan[43] • Adaptation Tools Spreadsheet[44]
Metropolitan Transportation Commission (MTC)	• Metropolitan planning organization for nine-county San Francisco Bay Area (federal designation) and regional transportation planning agency (state designation), responsible for Bay Area transportation and long-range planning • Assigned duties by federal government, state Legislature, and Bay Area voters • Regional transportation and financing in the Bay Area, oversee toll revenue on state-owned bridges	• Have decision-making authority over the State Transportation Improvement Program (STIP) and administer various federal funding • With ABAG, developing regional plan (Bay Plan 2050), which identifies priority conservation areas, priority development areas, and priority production areas. Hayward Shoreline is eligible to be a PDA-Connected Community, which may provide opportunities for transit funding. Requires passage of policies to reduce vehicle miles traveled.	• Plan Bay Area 2040[45] • Plan Bay Area 2050[46]

40 https://bcdc.ca.gov/BPAFHR/FillHabitat.html
41 https://bcdc.ca.gov/publications/
42 https://scc.ca.gov/
43 https://scc.ca.gov/files/2018/01/CoastalConservancy_StrategicPlan_2018_2022.pdf
44 https://scc.ca.gov/climate-change/climate-change-projects/#slr-adaptation
45 https://mtc.ca.gov/sites/default/files/Final_Plan_Bay_Area_2040.pdf
46 https://www.planbayarea.org/

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
CA State Lands Commission	• Established in 1938, manages 4 million acres of tidal and submerged lands and beds of navigable rivers, streams, lakes, bays, estuaries, inlets, and straits (mostly Public Trust lands) • Monitors sovereign land granted in trust by the California Legislature to approximately 70 local jurisdictions that generally consist of prime waterfront lands and coastal waters • Issues leases for use or development, provides public access, resolves boundaries between public and private lands, and implements regulatory programs to protect state waters from oil spills and invasive species	• Mostly has jurisdiction over sovereign land (tidal and navigable waters) and school lands (lands granted to public school system)	• Strategic Plan 2016-2020[47]
San Francisco Estuary Institute	• Aquatic and ecosystem science institute dedicated to providing scientific support and tools for decision-making and communication through collaborative efforts • Through Resilient Landscapes, develops strategies to adapt to climate change[48] • Advises state, federal, and regional agencies, as well as business and NGO leaders	• On the Hayward Shoreline Master Plan team • Prepared the San Francisco Bay Shoreline Adaptation Atlas with SPUR, which includes the study area	• San Francisco Bay Shoreline Adaptation Atlas[49] • Regional Monitoring Program for Water Quality in San Francisco Bay[50] • Alameda Creek Historical Ecology study[51] • Forthcoming Healthy Watershed Resilient Baylands study looking at an updated sediment budget for the Bay
SPUR (San Francisco Bay Area Planning and Urban Research Association)	• Non-profit research, education, and advocacy organization focused on planning and governance issues in SF	• Prepared the San Francisco Bay Shoreline Adaptation Atlas with SPUR, which includes the study area	• San Francisco Bay Shoreline Adaptation Atlas • SPUR's Agenda for Change • SPUR Regional Strategy 2070[52]
San Francisco Bay Restoration Authority	• Regional agency created to fund shoreline projects that will protect, restore, and enhance San Francisco Bay • Allocates funds raised by the Measure AA parcel tax	• Measure AA funding can go towards projects that protect, restore and enhance the San Francisco Bay, including habitat restoration projects; flood protection projects that are part of a habitat restoration project; and shoreline access and recreational amenity projects that are part of a habitat restoration project. [53]	• Grant Program Guidelines[54]

47 https://www.slc.ca.gov/wp-content/uploads/2018/07/StrategicPlan.pdf
48 https://www.sfei.org/contact#sthash.WinLZ0L2.dpbs
49 https://www.sfei.org/adaptationatlas
50 https://www.sfei.org/sites/default/files/biblio_files/2019%20Multi-Year%20Plan%20-%20SC%20Approved%2020190430%20-%20050119.pdf
51 https://www.sfei.org/projects/AlamedaCreekHE#sthash.1JuSjXnU.dpbs
52 https://www.spur.org/featured-project/regional-strategy
53 http://www.sfbayrestore.org/
54 http://sfbayrestore.org/sites/default/files/2019-09/final_grant_program_guidelines_9.17.19.pdf

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
Alameda County Water District (ACWD)	• Supplies water to residents and businesses of southern Alameda County • Sources of water supply – 40% State Water Project, 20% San Francisco PUC, 40% Alameda Creek Watershed Runoff • Service area includes about 357,000 residential and 84,000 business customers[55]	• The District's jurisdictional boundary includes the southern portion of the City of Hayward • Owns and operates groundwater wells in the project area	• Five Year Strategic Plan [56] • Urban Water Management Plan 2015-2020
Association of Bay Area Governments (ABAG)	• Regional planning agency and council of governments for the counties, cities, and towns of the Bay region. • Works on regional issues such as land use, environmental stewardship, energy efficiency, and water resource protection. • Shares joint responsibility for Plan Bay Area with MTC.	• With MTC, developing regional plan (Bay Plan 2050), which identifies priority conservation areas, priority development areas, and priority production areas. Hayward Shoreline is eligible to be PDA-Connected Community, which may provide opportunities for transit funding. Requires the passage of policies to reduce vehicle miles traveled.	• Plan Bay Area 2050
Cal Trans (California Department of Transportation)	• Manages California's highway and freeway lanes, provides inter-city rail services • Executive department of the US State of California, part of the cabinet-level California State Transportation Agency	• Owns State Route 92 (plaza and eastern approach to San Mateo-Hayward Bridge) which is vulnerable to SLR and has drainage issues. • Cal Trans sees the need for more study of the hydrologic conditions around the bridge approach, hasn't yet developed an adaptation plan for the asset.	• Caltrans Climate Change Vulnerability Assessment[57] • Climate Change Vulnerability Assessment[58]
SF Regional Water Quality Control Board (WQCB)	• A division of the State Water Resources Control Board charged with the protection of water quality through regulation of stormwater discharges, landfills, alteration of federal water bodies, and other activities. • Issues water discharge requirements, takes enforcement action against violators, and monitors water quality	• Submerged features, like fill, require Water Board permits, as do modifications of the shoreline. • Regulates landfills and waste ponds, including both active and closed facilities. Regulation consists of design standards for liners, covers, etc., environmental monitoring, and cleanup when necessary. • Consultation likely required in permitting process.	• Water Quality Control Plan for the San Francisco Bay Basin[59]
California Department of Fish and Wildlife (CDFW)	• Mission is to manage the State's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. • Issues permits to ensure regulatory compliance and statewide consistency with the California Endangered Species Act.	• Issues permits to ensure regulatory compliance and statewide consistency with the California Endangered Species Act. • Consultation likely required in permitting process.	

55 https://www.acwd.org/DocumentCenter/View/1264/ACWDs-2015---2020-UWMP?bidId=
56 https://www.acwd.org/DocumentCenter/View/2048/2018-ACWD-Strategic-Plan-?bidId=
57 https://dot.ca.gov/programs/transportation-planning/office-of-smart-mobility-climate-change/climate-change
58 https://www.arcgis.com/apps/webappviewer/index.html?id=517eecf1b5a542e5b0e25f337f87f5bb
59 https://www.waterboards.ca.gov/sanfranciscobay/basin_planning.html

AGENCY OR ORGANIZATION	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, GUIDANCE, AND STUDIES
U.S. Fish and Wildlife Service (USFWS)	• Issues permits for activities that impact plants and animals designated as endangered or threatened, and the habitats upon which they depend.	• Several known species in the study area (Salt Marsh Harvest Mouse, Ridgway's Rail, California Least Tern, and the Western Snowy Plover) are federally designated endangered species. • Consultation likely required in permitting process.	
NOAA National Marine Fisheries Service (NMFS)	• With USFWS (above) implements the National Endangered Species Act. • Responsible for endangered and threatened marine and anadromous species	• Consultation may be required in permitting process.	
Federal Emergency Management Agency (FEMA)	• Develops Flood Insurance Rate Maps (FIRMs) and administer National Flood Insurance Program • Administers standards for flood resistant construction codes	• Accreditation of flood protection structures and levees to enable neighborhoods, infrastructure, and developed areas to be eligible for reduced or eliminated flood insurance rates under the NFIP • Sets insurance rates under the NFIP, currently under reform[60]	• FIRMS[61] • Guidance on Levee Accreditation[62]
United States Army Corps of Engineers (USACE)	• Regulatory agency responsible for issuing permits for all structures and work on waterways within its jurisdiction of waters of the United States, including dredging, marinas, piers, wharves, floats, intake/outtake pipes, pilings, bulkheads, ramps, fills, and overhead transmission lines. • Develops plans for regional dredge management and is studying strategic placement of dredge material and identifying opportunities for beneficial use in the Bay Area.	• Developed and constructed Alameda County's flood control system, including the Alameda Creek, San Lorenzo Creek, and San Leandro Creek flood channels (although the channels are maintained by the ACFCWCD)	• Regional Dredge Material Management Plan[63] • Permitting regulations and guidance[64]

60 https://www.fema.gov/nfiptransformation

61 https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd&extent=-122.43945211509653,37.43674391029817,-121.86129659751919,37.708853832347565

62 https://www.fema.gov/media-library/assets/documents/9208

63 https://www.spn.usace.army.mil/Portals/68/docs/Dredging/DDMP/PMP_SFBay_RDMMP_DRAFT%205-23-19docx.pdf?ver=2019-07-09-184445-433

64 https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Federal-Regulation/

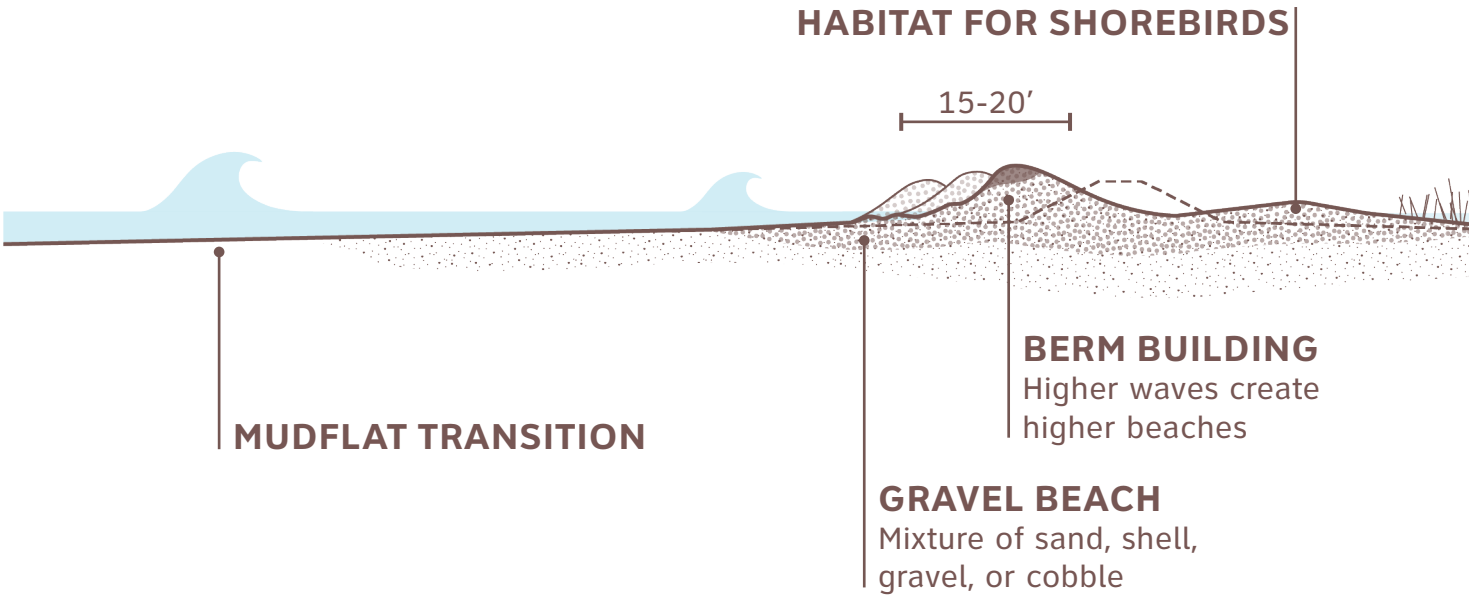
ADAPTATION STRATEGIES

NATURE-BASED STRATEGIES

FINE AND COARSE GRAIN BEACHES

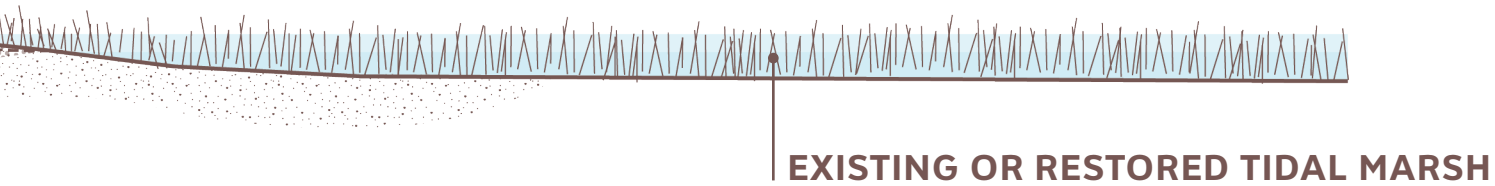
Definition

Coarse or composite estuarine beaches are **dynamic features** that consist of a mixture of **sand, shell, gravel, or cobble.** Beaches include a supratidal beach berm and a beach face. Gravel and cobble beaches can **dissipate wave energy over shorter distances** and are generally more suitable within the urbanized and constrained estuary than sand beaches. They can be placed in front of levees, roads or other vulnerable infrastructure to **reduce erosion**. Many beaches provide **habitat benefits to shorebirds.**



OBJECTIVES

- Reduce erosion of levees
- Ecological enhancement (provide shorebird nesting habitat)



FINE AND COARSE GRAIN BEACHES

Precedents

Arambaru Island Enhancement Project
Richardson Bay, CA

Size: 3 acres of new beach
Cost: $2.2 million
Implementation Timeline: Completed 2012

Applicability: A gravel beach and associated marsh restoration can help create a layered shoreline, reduce erosion, provide new habitat, and grow with SLR.

Description: A restoration project to stabilize the eroding eastern shoreline, enhance habitats, and encourage seabird and seal use. A new beach gives the habitats time to transition as sea levels rise.

- Focus is on creating habitat for terns and other water birds
- Gravel, sand, and oyster shell hash shoreline with eucalyptus log stabilization infrastructure
- Larger rocks and driftwood help trap finer sediments
- Erosion of island was slowed, holding up against winter storms and continual increases in waves



Open expanse of gravel provides nesting habitat



Gravel beach after construction

FINE AND COARSE GRAIN BEACHES

Option 1: Beaches in Front of Landfills

OBJECTIVE

Reduce the risk of erosion to the two landfills and enhance shoreline ecology with gravel nesting habitat.

DESCRIPTION

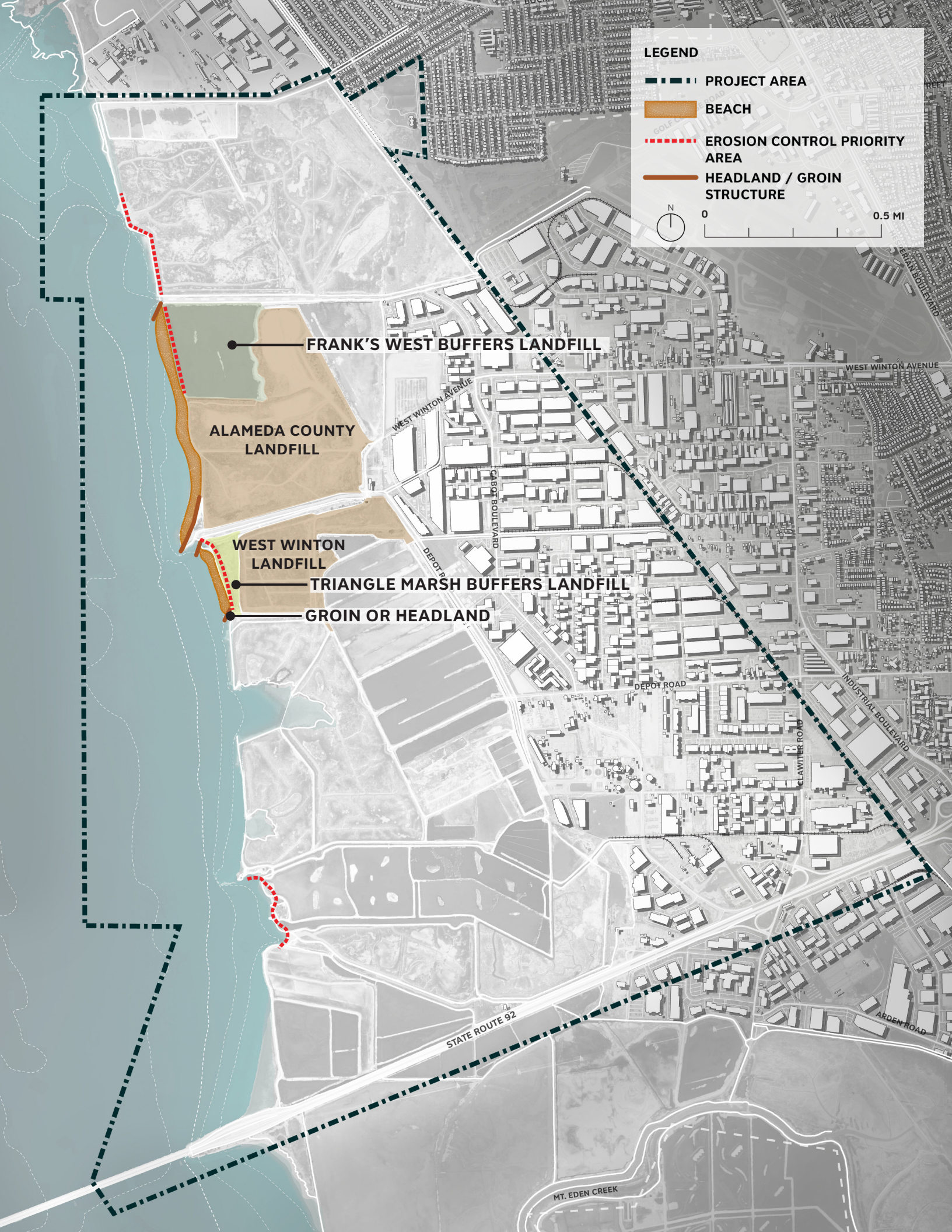
- Gravel beaches in front of Bay shoreline structures adjacent to Alameda County and West Winton landfills

PROS

- Reduce erosion to landfill edges
- Reduce levee/berm maintenance adjacent to landfills
- Could enhance shorebird and beach habitat

CONS

- May require artificial replenishment
- May require the installation of lateral containment structures
- Considered fill under current regulations, which might present permitting challenges


LEGEND
PROJECT AREA
BEACH
EROSION CONTROL PRIORITY AREA
HEADLAND / GROIN STRUCTURE
N
0
0.5 MI
FRANK'S WEST BUFFERS LANDFILL
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
TRIANGLE MARSH BUFFERS LANDFILL
GROIN OR HEADLAND
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

FINE AND COARSE GRAIN BEACHES

Option 2: Beaches in Front of Existing Marshes

OBJECTIVE

Reduce the risk of erosion to outboard berms and levees in front of existing marshes and enhance shoreline ecology with gravel nesting habitat.

DESCRIPTION

- Gravel beaches along the Bay shoreline structures in front of existing marshes

PROS

- Reduce erosion of outboard marsh edges
- Potential to lower maintenance of bayside levee/berms
- Reduced maintenance costs of outboard berms

CONS

- May require artificial replenishment
- May require the installation of lateral containment structures
- Considered fill under current regulations, which might present permitting challenges


LEGEND
PROJECT AREA
BEACH
EROSION CONTROL PRIORITY AREA
HEADLAND / GROIN STRUCTURE
N
0
0.5 MI
ORO LOMA MARSH
WEST WINTON LANDFILL
GROIN OR HEADLAND
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

FINE AND COARSE GRAIN BEACHES

Option 3: Beaches along Entire Shoreline

OBJECTIVE

Reduce the risk of erosion along the entire shoreline and enhance shoreline ecology with gravel nesting habitat.

DESCRIPTION

- Gravel beaches in front of all outboard Bay shoreline structures

PROS

- Reduce erosion to all outboard shoreline structures
- Reduce erosion and maintenance costs of shoreline berms and levees

CONS

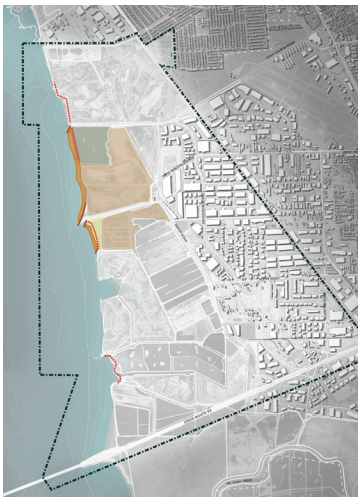
- May require artificial replenishment / long-term cost
- May require the installation of lateral containment structures
- Would require a lot of material / high initial cost
- Could require the implementation of multiple groins to hold beaches between channels
- Considered fill under current regulations, which might present permitting challenges


LEGEND
PROJECT AREA
BEACH
EROSION CONTROL PRIORITY AREA
HEADLAND / GROIN STRUCTURE
N
0
0.5 MI
ORO LOMA WWTP PONDS
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
GROIN OR HEADLAND
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

FINE AND COARSE GRAIN BEACHES

Stakeholder Feedback

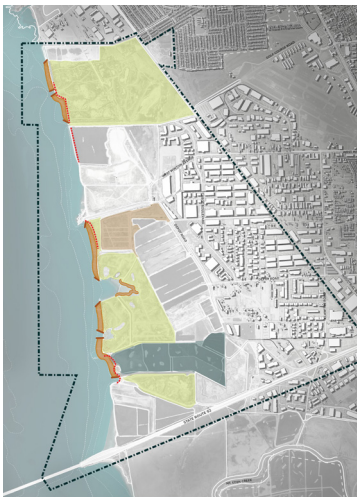
1: Beaches in Front of Landfills



COMMENTS

- EBRPD expressed concerns about gravel size and depth. If this strategy is implemented, additional feasibility and engineering studies will be needed to address these questions.
- EBRPD questioned the impacts to nesting birds and how beaches will change their breeding habitat. Gravel beaches can be be designed to provide nesting habitat. If this strategy is implemented, additional feasibility studies about breeding habitat will have to be considered with any project that is identified.
- EBRPD expressed concern over the gravel's impact to mudflats adjacent to the existing outboard levees. The mudflat-to-beach transition naturally occurs and SFEI has advised that coarse or composite estuarine beaches are often characterized by a transition to mudflat in their lowest portion. A gravel beach can be designed to limit nearshore drift of material with minimal impacts to adjacent mudflats.
- EBRPD indicated that it may only be practical in areas where the beach won't need to be replenished so you don't have to regularly go back and address erosion. Most of sediment is transported parallel to the shoreline through longshore drift, and the design of groin structures or headlands can limit or contain longshore drift and create suitable conditions for beach establishment. If this strategy is implemented, further maintenance studies would be required based on the site conditions.
- EBRPD expressed concern over flooding impacts or edge erosion to land that is immediately adjacent to a beach. Gravel gravel beaches do not provide flood protection. However, they may help reduce erosion through the dissipation of wave action.

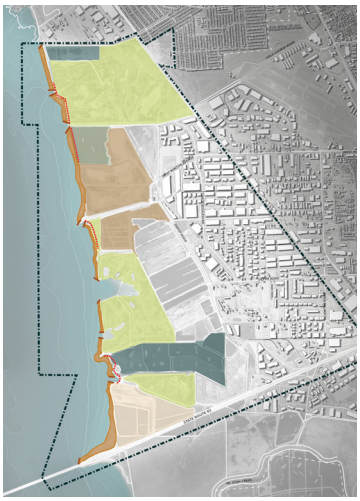
2: Beaches in Front of Existing Marshes



COMMENTS

- EBRPD questioned if scouring is expected to occur at the inlets to Oro Loma and Cogswell Marsh. The options presented are high-level strategies that will require further feasibility and engineering studies to address this question.
- EBRPD asked where will all the sand would end up. To control beach material transport, we are considering coarse grain estuarine beaches that would be placed in front of the existing levees and contained by groin or headland structures. The sand and shell that comprises the beach face may be intermittently lost to longshore drift but also naturally redeposited by the tides and waves.
- EBRPD questioned the possibility of sand and gravel coexisting. The final material would likely be a mixture of different grain sizes depending on the design criteria and intended performance. Coarse or composite estuarine beaches characterize the historic condition. A predominately coarse beach is highly permeable and needs less space compared to a composite or fine beach that can form a steep profile in response to storm events.
- EBRPD asked if sediment would drift into the adjacent marshes. A gravel beach moves primarily longshore, or parallel to the shore in the direction of the prevailing wind. Migration inland will happen, but the beach could be placed in front of an existing levee or berm that would prevent drift into the marsh. If this strategy were to be implemented, additional study based on site conditions and design would be required.

3: Beaches along Entire Shoreline



COMMENTS

- EBRPD brought up impacts to other areas to the north and south that are not protected. These beaches are only planned for shoreline segments within the study and would be contained with headland or groin structures that would minimize impacts to the north and south and prevent longshore drift.
- EBRPD asked about more impacts due to widening of San Mateo bridge. To address this question, additional feasibility and engineering studies will be needed.
- EBRPD questioned the benefit to marshes or landfill protection. Gravel beaches may help reduce erosion to outboard berms that shelter inland marshes or landfills.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
BCDC: Bay Conservation & Development Commission
Teal text indicates a response from SCAPE

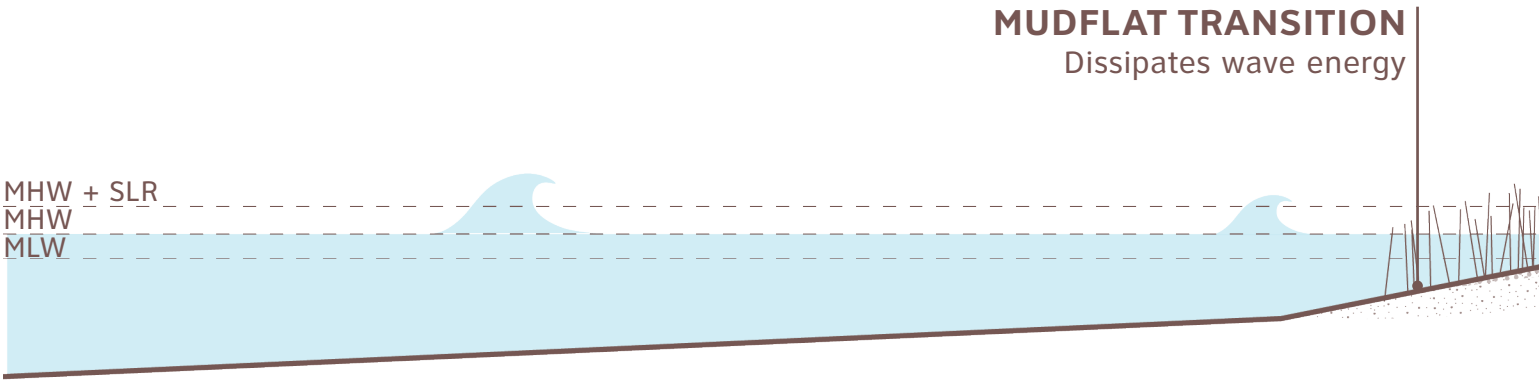
GENERAL COMMENTS

- EBRPD indicated this may not be a good option where it will need to be replaced regularly, and questioned how often the gravel will need to be maintained and replenished. In order to address this question, additional feasibility and engineering studies will be needed.
- EBRPD asked about the environmental disturbance of replenishing the gravel. In order to address this question, additional feasibility and engineering studies will be needed.
- EBRPD asked if the assumption is that overtime the gravel will erode or accrete sediment. Over time, the erosion of sediment may occur, and some replenishment may happen naturally or may be needed artificially, but this is all dependent on specific site conditions. If this strategy is implemented, additional feasibility and engineering studies will be needed.
- EBRPD is not sure if they want to be the pilot project of this method. The SCC has already begun a 300' gravel beach pilot project at Eden Landing in front of an existing levee. This pilot may be valuable to for lessons learned. If other criteria are desired to be tested at the Hayward Shoreline, we will work to identify another partner.
- COH indicated that these look like great options for the Park Districts (EBRPD & HARD) to consider for their assets. Hayward's Public Works Utilities may need to provide comment regarding these options.
- BCDC noted that the Port of SF is doing a cobble beach at Heron's Head Marsh where they must find a way to show the beach utilizes the minimum amount of fill needed for that form of protection.
- BCDC brought up the fact that beaches do provide more habitat than riprap and BCDC does have an active application for them.
- BCDC advised to make sure that sediment and water flow into the marshes behind the beach are not restricted.
- BCDC noted that there is a provision in the new fill for habitat policy for these types of projects.
- BCDC advised that it is important to understand the properties that impact longshore transport, which will impact where the beaches are sited. They should be located in places that generate new findings.
- BCDC indicated that the biggest issues are how many groin structures there are and whether sand must be constantly moved. Fill for gravel is viewed more positively than fill for a groin structure.
- BCDC recommended that incorporating reef-type rock structures in the groin itself to provide habitat is beneficial from a regulatory perspective.

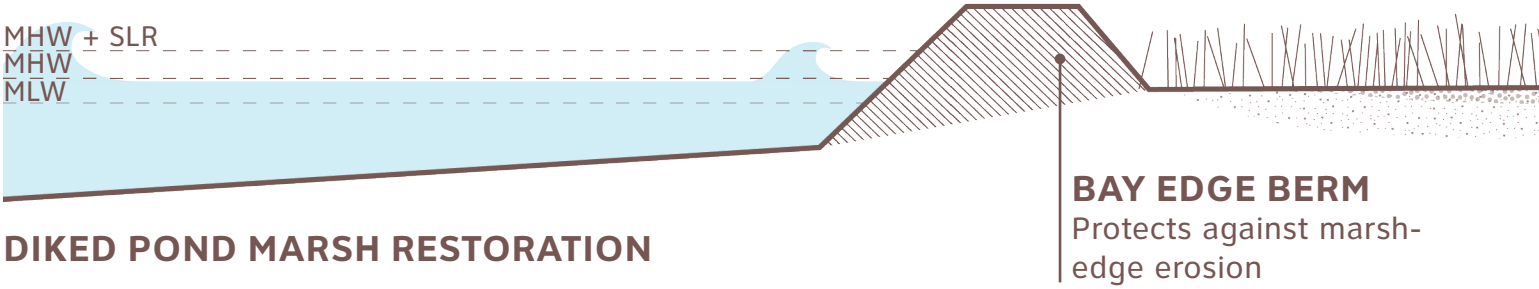
TIDAL MARSH RESTORATION

Definition

In the face of climate change, protecting, maintaining, and restoring tidal marshes and their associated mudflats is critical to **maintain flood control and ecosystem services**. Techniques include restoring diked baylands, planting native species to accelerate colonization, placing sediment to raise subsided areas, and creating high tide refugia within marshes. Existing marshes have the **capacity to vertically accrete along with sea level rise if they have sufficient sediment supply**. In low sediment scenarios, they may convert to mudflats or subtidal ecosystems.



BAY EDGE MARSH

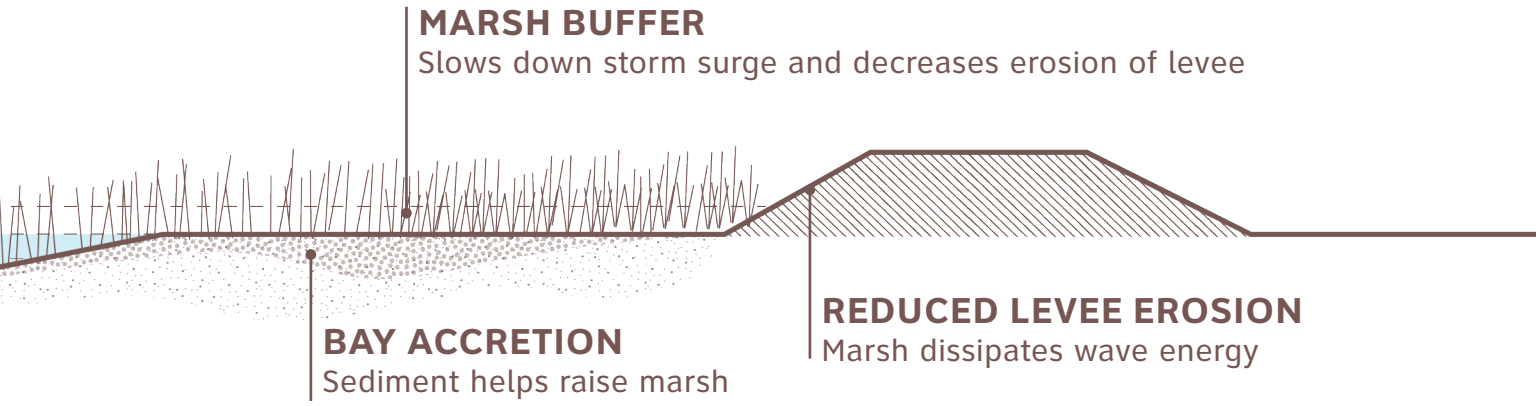


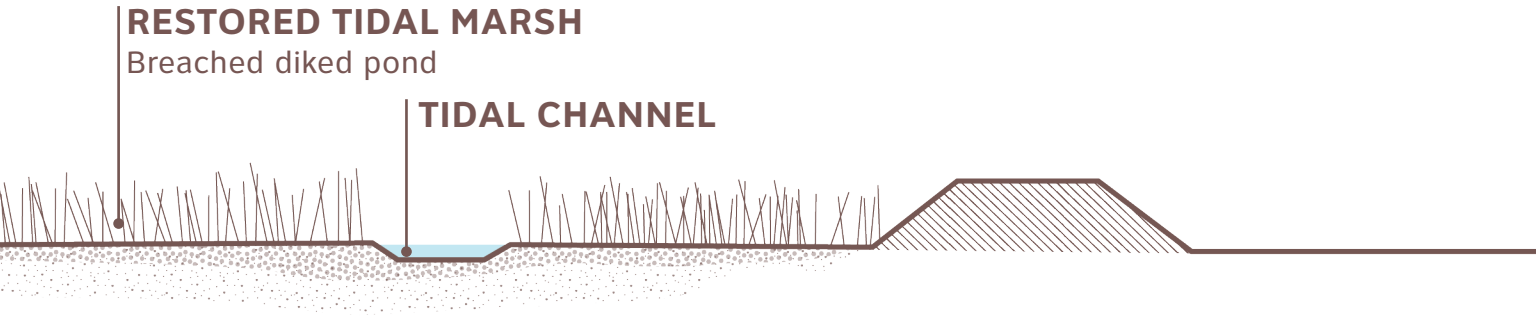
DIKED POND MARSH RESTORATION

SCAPE

OBJECTIVES

- Ecological enhancement (provide critical habitat)
- Reduce erosion risk along the shoreline and attenuate waves





TIDAL MARSH RESTORATION
Precedents

Bair Island Wetland Restoration
Redwood City, CA

Size: 1,400 acres of tidal marsh restoration
Cost: $10 million
Implementation Timeline: 2006-2015

Applicability: Utilizing upland fill to lift subsided ponds is applicable before breaching and restoring to tidal marsh.

Description: The breaching of perimeter levees of this formerly diked complex allowed for the restoration of tidal marshes to improve water quality, expand and enhance wildlife habitat, and reduce mosquito breeding conditions by restoring tidal flow.

- Formerly diked and drained for agriculture
- Restored 1,552 acres of tidal wetland
- Pedestrian bridge and trail access
- Subsided ponds were raised with dredge material and upland fill over 8 years with over 1.5 million CY of fill
- Perimeter levee was breached in the restoration



Aerial View of Restoration



Levee Breach

TIDAL MARSH RESTORATION

Option 1: Hayward Marsh Restoration

OBJECTIVE

Restore Hayward Marsh to a tidal marsh that can accrete sediment, adapt to SLR, and create habitat.

DESCRIPTION

- Restore Hayward Marsh to a tidal marsh

PROS

- Hayward Marsh restoration is already being planned

CONS

- If Hayward Marsh is restored as a muted marsh, it will need improved levees for water control and may not accrete as much sediment as a fully tidal system
- Once a diked Bayland is restored to a tidal marsh, the area cannot be used again for stormwater storage because it becomes regulated and protected


LEGEND
PROJECT AREA
EXISTING TIDAL MARSH
PROPOSED TIDAL MARSH CREATION
NEW HYDRAULIC CONNECTIONS
N
0
0.5 MI
ORO LOMA MARSH
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
WEST WINTON AVENUE
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

TIDAL MARSH RESTORATION

Option 2: Restore Bay-Side Ponds to Tidal Marsh

OBJECTIVE

Restore diked ponds along the shoreline to tidal marshes that can accrete sediment, adapt to SLR, and create habitat.

DESCRIPTION

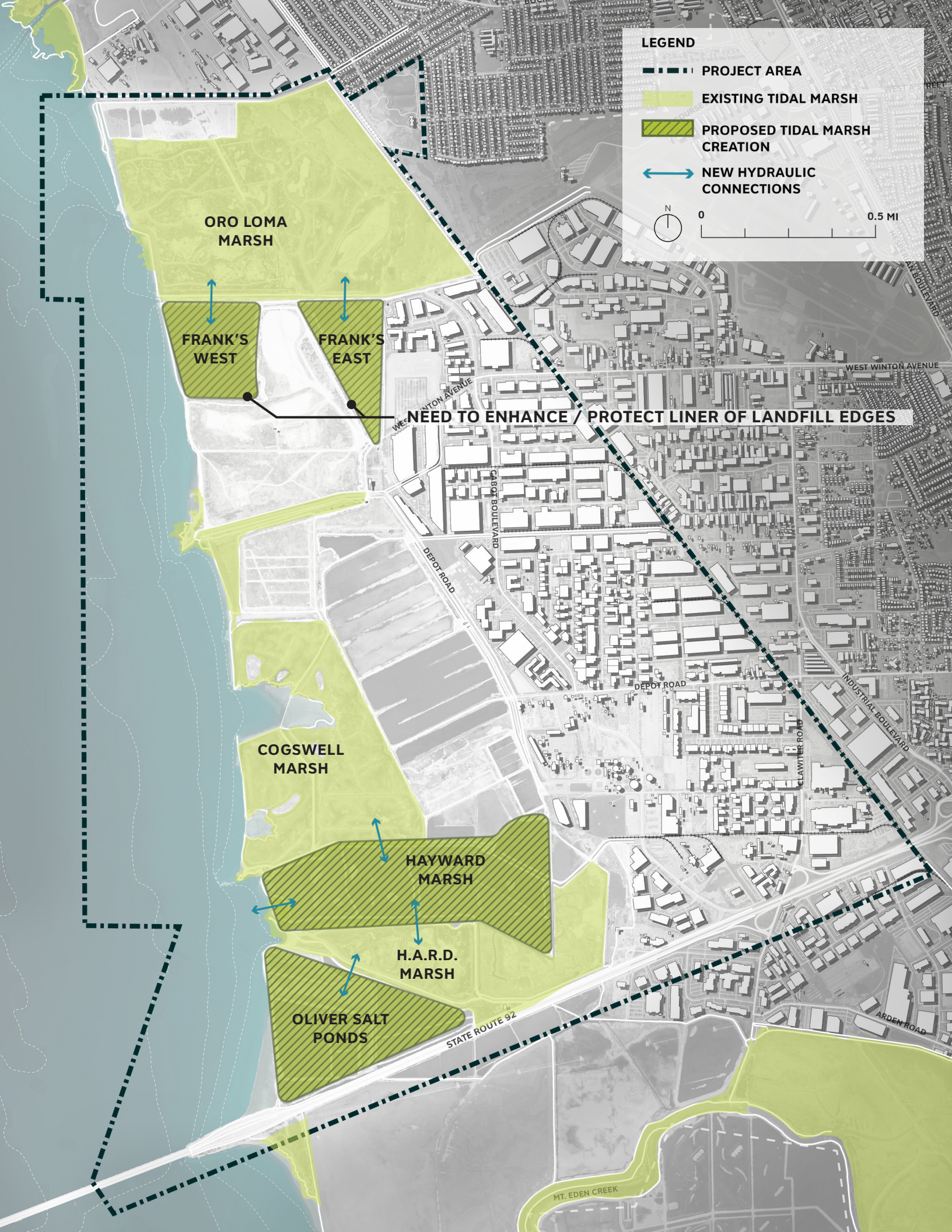
- Restore Frank's West, Frank's East, Hayward Marsh, and Oliver Salt Ponds to tidal marshes

PROS

- Marshes at Bay edge may be able to accrete more sediment (from Bay and fluvial sources)
- If paired with fine sediment augmentation, it may help the marshes keep pace with SLR
- Frank's East and West could help buffer the landfill against erosion

CONS

- Lose existing salt pond shorebird habitat- impacts to endangered species habitat
- Once a diked Bayland is restored to a tidal marsh, the area cannot be used again for stormwater storage because it becomes regulated and protected
- Lose shorebird refuge at Frank's West during high tide
- Landfill edges will need to be protected against erosion


LEGEND
PROJECT AREA
EXISTING TIDAL MARSH
PROPOSED TIDAL MARSH CREATION
NEW HYDRAULIC CONNECTIONS
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
FRANK'S EAST
NEED TO ENHANCE / PROTECT LINER OF LANDFILL EDGES
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

TIDAL MARSH RESTORATION

Option 3: Restore All Diked Ponds and Golf Course

OBJECTIVE

Maximize tidal marsh restoration to buffer the shoreline and enhance its ecological value.

DESCRIPTION

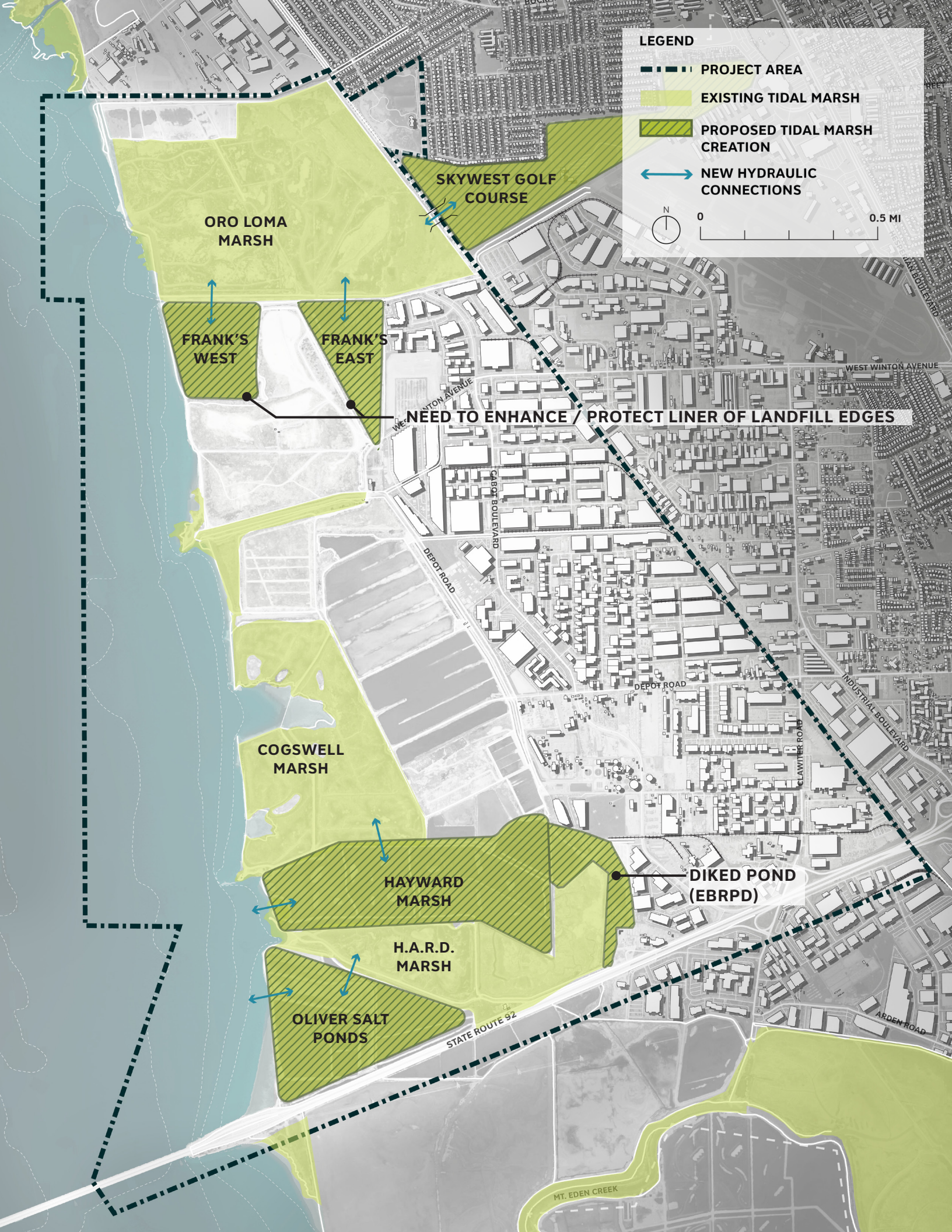
- Restore Skywest Golf Course, Frank's West, Frank's East, Hayward Marsh, and Oliver Salt Ponds to tidal marshes

PROS

- Increased marsh may buffer the shoreline from storm surge and reduce erosion
- Increased habitat benefits
- Larger tracts of connected marshes

CONS

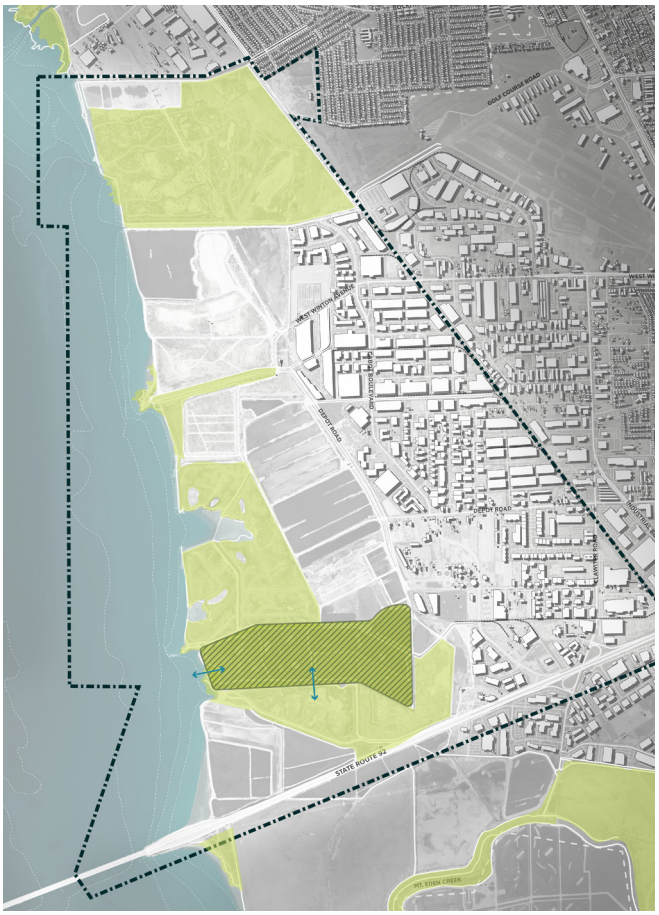
- Loss of stormwater detention storage space
- Loss of existing shorebird habitat at Oliver Salt Ponds- impacts endangered species habitat
- Once a diked Bayland is restored to a tidal marsh, the area cannot be used again for stormwater storage because it becomes regulated and protected
- Landfill edges will need to be protected against erosion


LEGEND
PROJECT AREA
EXISTING TIDAL MARSH
PROPOSED TIDAL MARSH CREATION
NEW HYDRAULIC CONNECTIONS
N
0
0.5 MI
SKYWEST GOLF COURSE
ORO LOMA MARSH
FRANK'S WEST
FRANK'S EAST
NEED TO ENHANCE / PROTECT LINER OF LANDFILL EDGES
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
COGSWELL MARSH
HAYWARD MARSH
DIKED POND (EBRPD)
H.A.R.D. MARSH
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

TIDAL MARSH RESTORATION

Stakeholder Feedback

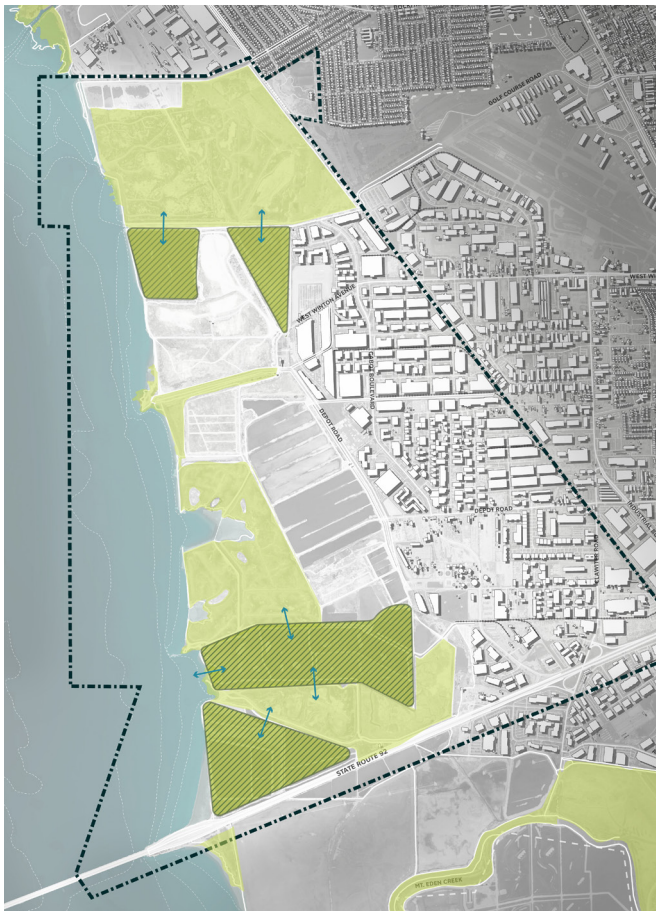
1: Hayward Marsh Restoration



COMMENTS:

- EBRPD asked if Hayward Marsh will need a combination of tidal and muted/managed tidal marsh to be resilient and preserve shorebird nesting habitat. The resilience of Hayward Marsh is dependent on the specifics of the restoration plan and management procedures. This team will work with EBRPD to identify the habitat goals of Hayward Marsh and provide recommendations accordingly. Shorebird nesting habitat is located upland of the tidal marsh zone, which is not inundated with daily tides, and requires a unique design not addressed in this option.

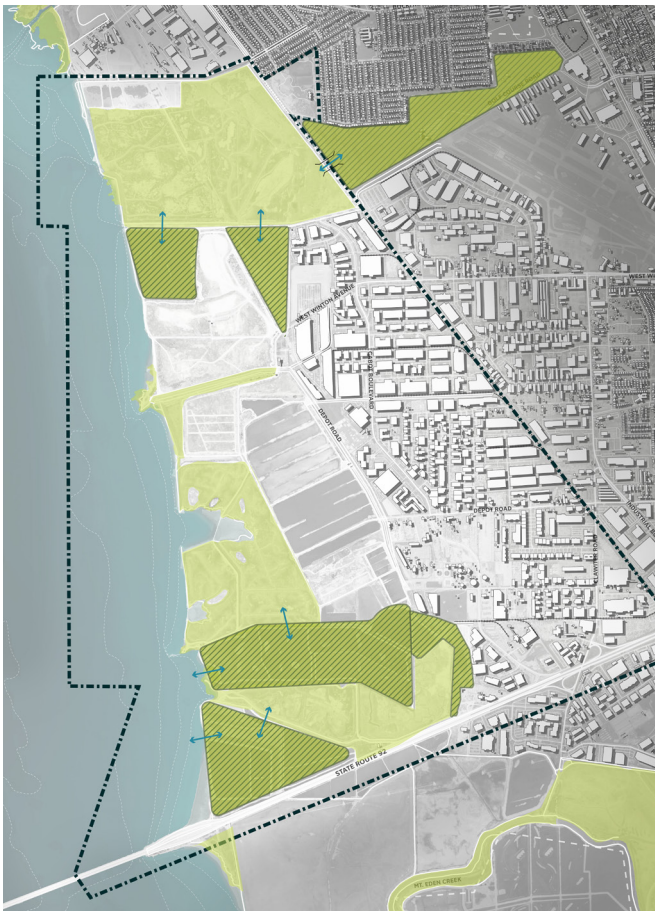
2: Restore Bay-Side Ponds to Tidal Marsh



COMMENTS:

- EBRPD is working to enhance habitat near/in Oliver Salt Pond. If it is fully tidal, EBRPD expressed concern over the protection of inboard areas from erosion. Marshes do help buffer shorelines and dampen wave action to a certain extent. If full erosion protection is desired, it will likely require a suite of strategies to create a layered strategy of risk-reduction along the shoreline.
- EBRPD noted that Frank's West offers shorebird refuge during high tide.
- EBRPD asked how sediment could be brought in. In this option, sediment would flow into the restored marshes through select breaches from the adjacent channels, shown in blue arrows. ACFCD has advised to breach from the channels, not from the Bay, since it reduces wave induced erosion.

3: Restore all Diked Ponds and Golf Course



COMMENTS:

- EBRPD asked which marshes are muted/managed tide? In this option, all of the marshes would be restored to be fully tidal, besides Skywest Golf Course, which is shown as muted tidal.
- EBRPD noted that the Pro section says it "may" buffer the shoreline from storm surge and reduce erosion and questioned if it actually will. If this strategy were to be implemented, additional feasibility and engineering studies will be needed to address this question. Tidal marshes are known for reducing wave action and water elevation through friction. Depending on the sea level rise rate and the ability of the marshes to keep up with SLR, the benefits of this option may vary.
- EBRPD asked how this strategy relates to the Bay Habitat Goals in SFEI Adaptation Report. In the report, tidal marsh restoration was identified at Frank's West, the Oxidation Ponds, and Oliver Salt Ponds in the SFEI Adaptation Atlas. However, their maps were based on conceptual maps and suitability analysis, and further study, planning, and engineering would be required to identify fully suitable sites if this strategy were to be implemented.

GENERAL COMMENTS:

- It was advised to review the SF Bay Habitat Goals and see what is proposed or designated have for this area. The SF Bay Habitat Goals note that where landward migration of marsh is constrained, diverse habitat pockets could be linked together to create a sub-regional habitat corridor. Low elevation marsh and wetland could be restored, creating wetlands bay-ward of the flood-protection levees. Using wastewater to enhance habitat on the slope could provide space for landward migration, and 'warping up' diked ponds could be undertaken to allow accretion of the ponds to avoid deep tidal ponds.
- COH indicated that options 1 and 2 will need input from park district staffs. Option 3, which shows the use of Skywest golf course as a tidal marsh, would ultimately need to be reviewed by the City of Hayward Public Works Utilities staff, City Manager, and City Council.
- ACFCD advised that it is best to create a tidal connection from the channels, not the Bay edge, so it will be less subject to wind and wave erosion.
- ACFCD expressed no issues with restoring these marshes as long as they are optimized. The marshes dampen tidal elevation. For this option, the project team has been advised by SFEI to restore the marshes as fully tidal, not muted, so they are able to accrete sediment and keep pace with SLR, and to enhance marsh health.

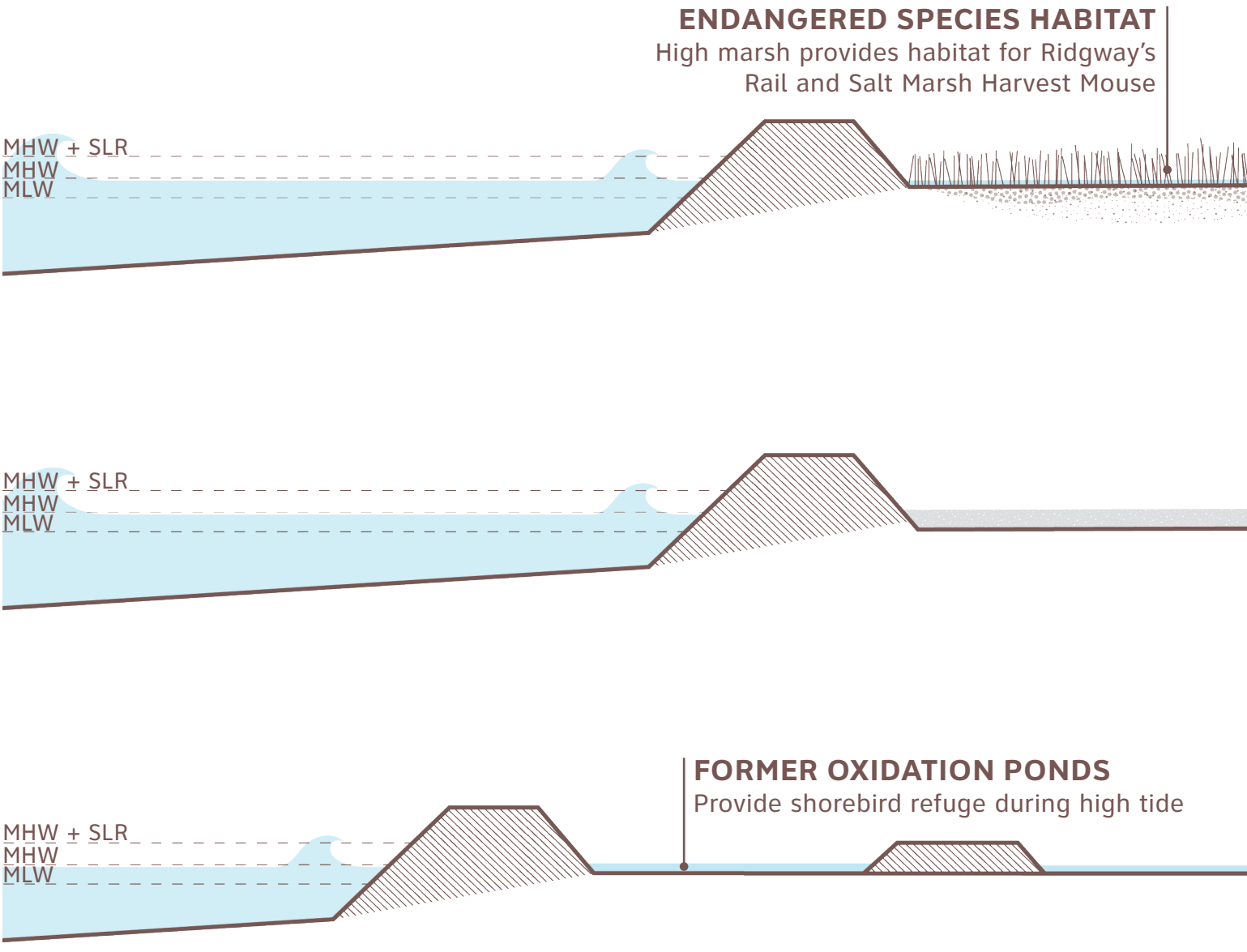
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
ACFCD: Alameda County Flood Control District
SFEI: San Francisco Estuary Institute
Teal text indicates a response from SCAPE

DIKED POND MANAGEMENT

Definition

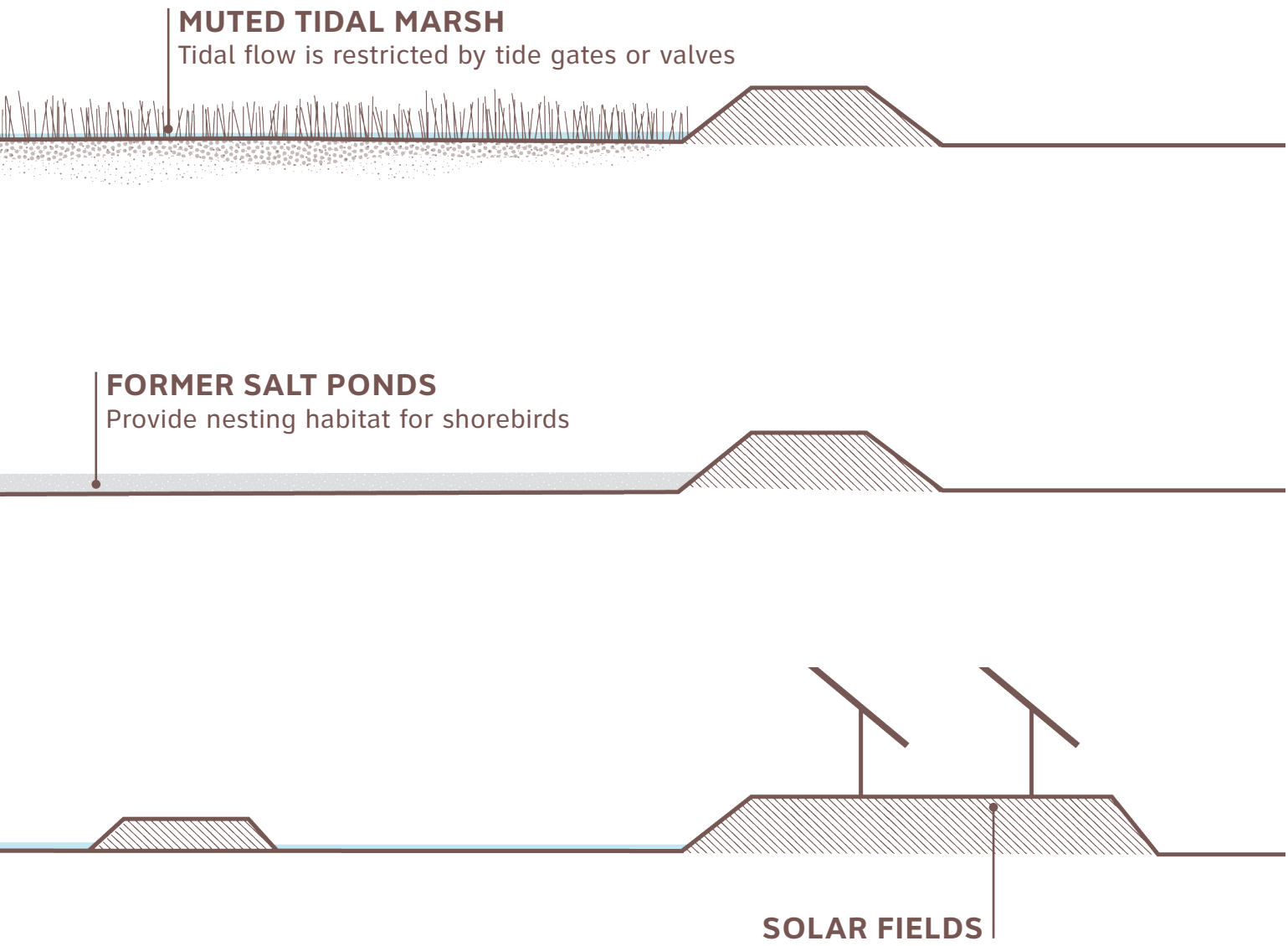
Diked baylands are managed as flood retention basins or can be used for habitat purposes. They are also used to locate transmission lines, rail lines, wastewater lines, and other infrastructure. Low-lying diked baylands **often accumulate runoff that needs to be drained and pumped to the bay**. Diked ponds can be **used or expanded to increase stormwater water storage** from precipitation or flood events. They can also be used to store groundwater pumped from urban areas. Salt ponds **provide critical habitat** for endangered species, particularly shorebirds.



SCAPE

OBJECTIVES

- Flood control (provide stormwater storage space)
- Ecological enhancement (provide shorebird habitat)



DIKED POND MANAGEMENT
Precedents

Shorebird Marsh
Corte Madera, CA

Size: 11 acres
Cost: $332 million
Implementation Timeline: 1983-1974

Applicability: Utilizing diked ponds for shorebird habitat and stormwater detention can provide multiple benefits for flood control and ecological services.

Description: Former tidal marsh that was diked and filled with construction refuse. Efforts between 1983-1974 restored tidal flow and designed the marsh with the dual purpose of providing shorebird habitat while serving as a stormwater detention basin.

- Delivered by a series of channels and lagoons, treated stormwater from the Town of Corte Madera collects in the low-lying marsh area
- Flows between Shorebird Marsh and the San Francisco Bay are managed by the town's pump station
- Water levels are adjusted to increase storage capacity for winter storms and for seasonal enrichment of bird habitat
- The water flow management regime reduces erosion and sedimentation from the connecting channel
- Ring levee surrounds and protects critical habitat within the marsh



Aerial view of Corte Madera Ecological Reserve



Restored marsh provides habitat

DIKED POND MANAGEMENT
Precedents

Noordwaard Polder Project
Noordwaard Polder, The Netherlands

Size: 4,450 hectares
Cost: $332 million
Implementation Timeline: 2012-2015

Applicability: Lowering or breaching select dikes can open up marshes and/or salt ponds to tidal flows, mitigating the effects of SLR.

Description: Elimination of the a 14 mile levee along the Noordwaard polder allows high tides to flow into a number of creeks within the polder. Lowering dikes creates inlets and outlets for water and allows the Nieuwe Merwede river to overflow in flood conditions, reducing water levels by up to 2’ as far as 5 miles downstream.

- 43 miles of new dikes and quays were constructed to control flood waters within the polder
- Over 141 million cubic feet of earth was moved, 33 new bridges constructed, and 31 pumping stations added, in addition to various hydrological infrastructure
- Existing infrastructure is kept intact as much as possible. Roads in the high-water polders are suitable for cars, agricultural vehicles and cyclists. Roads in the low-water polders are primarily intended for agricultural vehicles and bicycles. During periods of extreme high water, high quays form evacuation routes.



River has room to flood during periods of high water



Dike relocation opens up tidal flow

DIKED POND MANAGEMENT

Option 1: No Action

OBJECTIVE

Maintain all diked pond uses with sea level rise, storm surge, and groundwater emergence.

DESCRIPTION

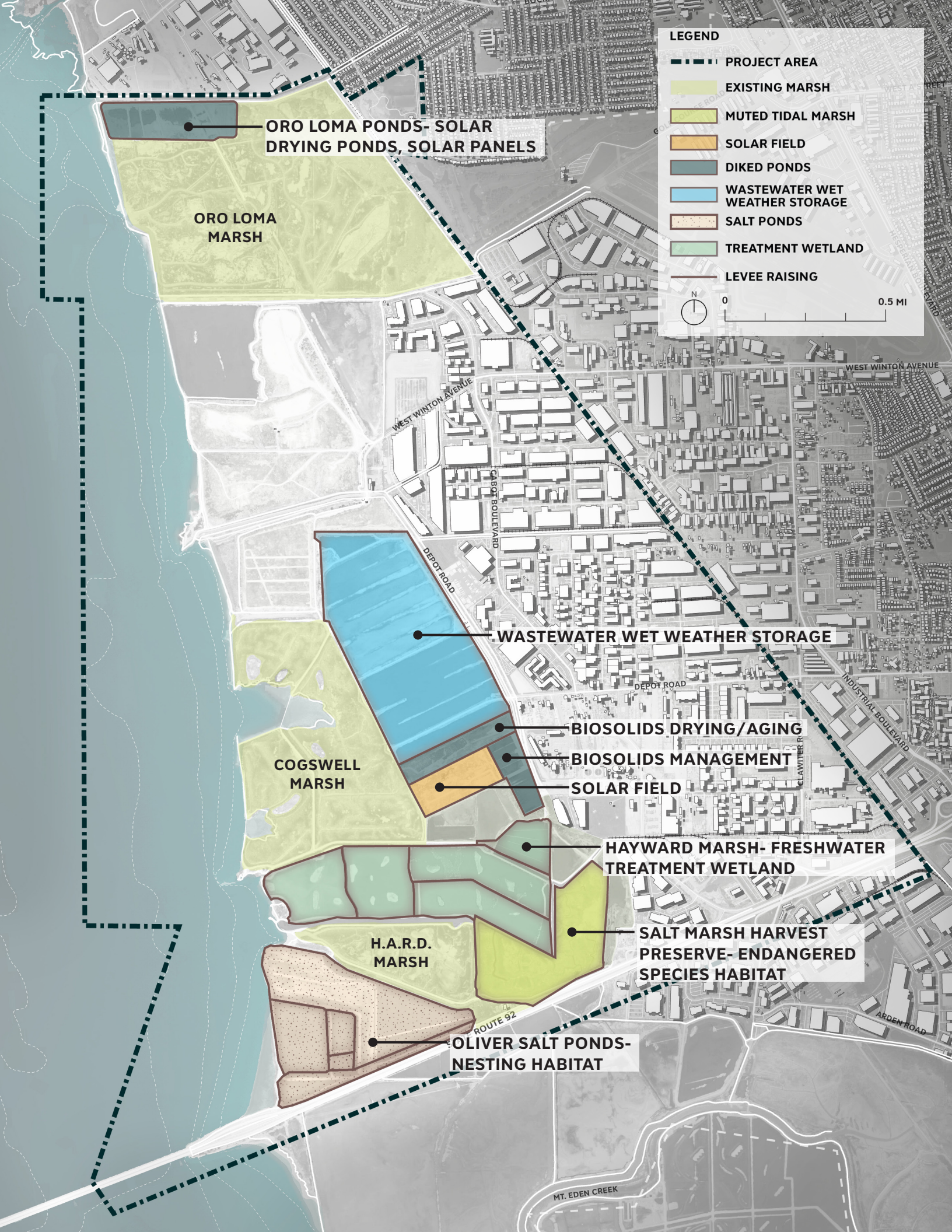
- Raise levees and provide erosion protection to maintain all diked pond uses as they exist today

PROS

- Maintain current uses and stormwater storage capacity

CONS

- Long-term and costly strategy to maintain uses with sea level rise. Will require more pumping and raising / repair of berms and levees
- This is not a viable option for EBRPD


LEGEND
PROJECT AREA
EXISTING MARSH
MUTED TIDAL MARSH
SOLAR FIELD
DIKED PONDS
WASTEWATER WET WEATHER STORAGE
SALT PONDS
TREATMENT WETLAND
LEVEE RAISING
N
0
0.5 MI
ORO LOMA PONDS- SOLAR DRYING PONDS, SOLAR PANELS
ORO LOMA MARSH
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
WASTEWATER WET WEATHER STORAGE
BIOSOLIDS DRYING/AGING
BIOSOLIDS MANAGEMENT
SOLAR FIELD
COGSWELL MARSH
HAYWARD MARSH- FRESHWATER TREATMENT WETLAND
SALT MARSH HARVEST PRESERVE- ENDANGERED SPECIES HABITAT
H.A.R.D. MARSH
OLIVER SALT PONDS- NESTING HABITAT
INDUSTRIAL BOULEVARD
ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

DIKED POND MANAGEMENT

Option 2: Tidal Restoration + Stormwater Management

OBJECTIVE

Restore ecological services at the Bay's edge and manage stormwater inland.

DESCRIPTION

- Restore Frank's East and West, half of the Oxidation Ponds, Hayward Marsh, and Oliver Salt Ponds to tidal marshes
- Utilize Skywest Golf Course and half of the Oxidation Ponds for wet weather storage

PROS

- Increase stormwater detention capacity
- Large areas of new marsh restoration
- New marshes at bay edge that may accrete and sustain with SLR

CONS

- Disrupts shorebird habitat at Oliver Salt Ponds
- Will require more pumping as sea levels rise


LEGEND
PROJECT AREA
EXISTING MARSH
WETLAND RESTORATION
STORMWATER STORAGE
NEW HYDRAULIC CONNECTIONS
N
0
0.5 MI
ORO LOMA MARSH
SKYWEST GOLF COURSE- STORMWATER DETENTION
FRANK'S WEST- TIDAL RESTORATION
NEED TO ENHANCE / PROTECT LINER OF LANDFILL EDGES
FRANK'S EAST- TIDAL RESTORATION
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
MAINTAIN CURRENT USES OF THE OXIDATION PONDS
COGSWELL MARSH
CONNECT TO COGSWELL MARSH
DIKED PONDS (EBRPD)
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS- TIDAL RESTORATION
WEST WINTON AVENUE
WEST WINTON AV
ABOT BOULEVARD
DEPOT ROAD
CLAWITER ROAD
INDUSTRIAL BOULEVARD
PERALTA BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

DIKED POND MANAGEMENT

Option 3: Restore Salt Ponds Inland, Double as Stormwater Detention

OBJECTIVE

Maintain and restore habitat and ecological services, while managing stormwater inland.

DESCRIPTION

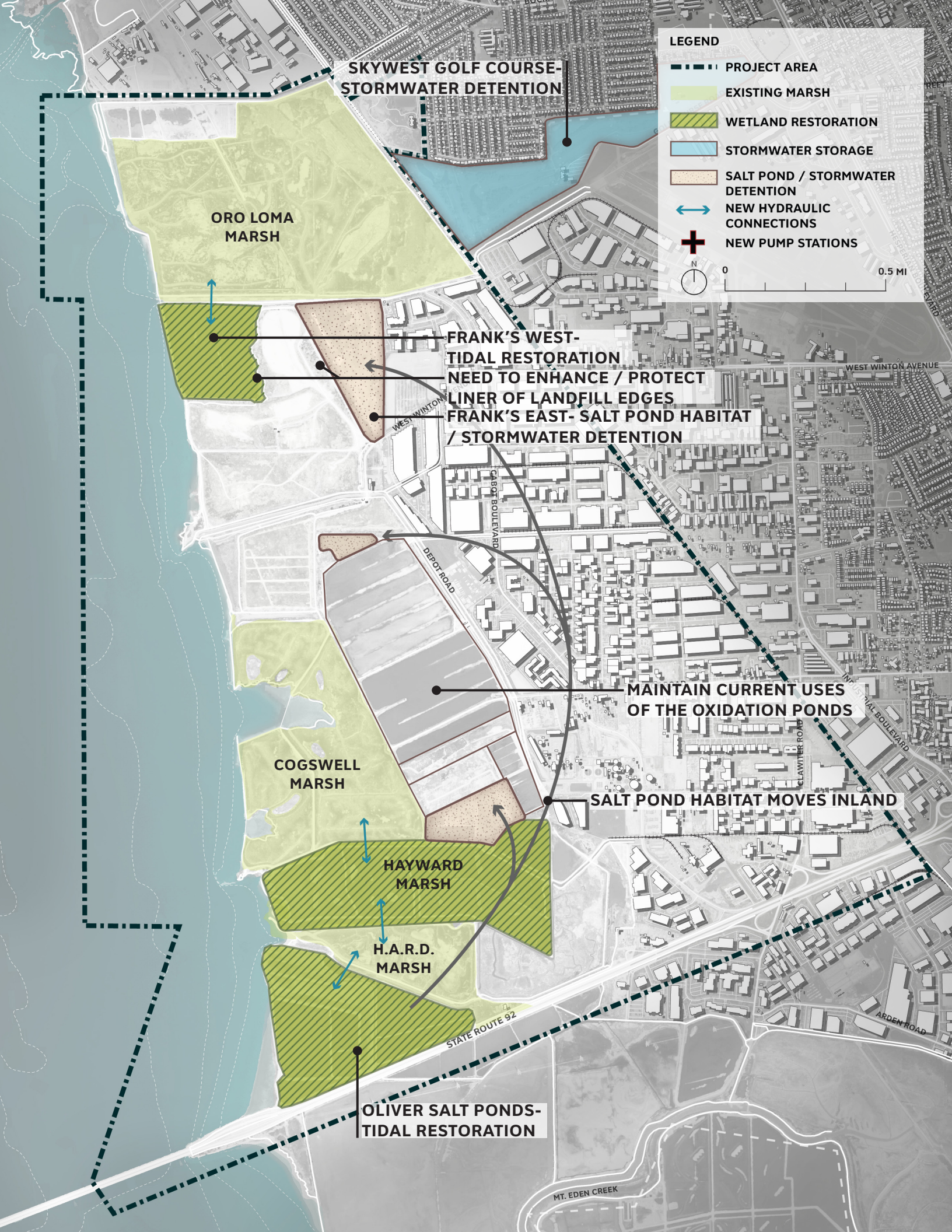
- Restore Frank's West, Hayward Marsh, and Oliver Salt Ponds to tidal marshes
- Move salt pond habitat inland to Frank's East and the diked ponds near the east of Hayward Marsh. Salt ponds may be utilized for stormwater detention during storm events.
- Use Skywest Golf Course for wet weather storage

PROS

- Maintain salt pond habitat, while moving it inland so it's less vulnerable to SLR

CONS

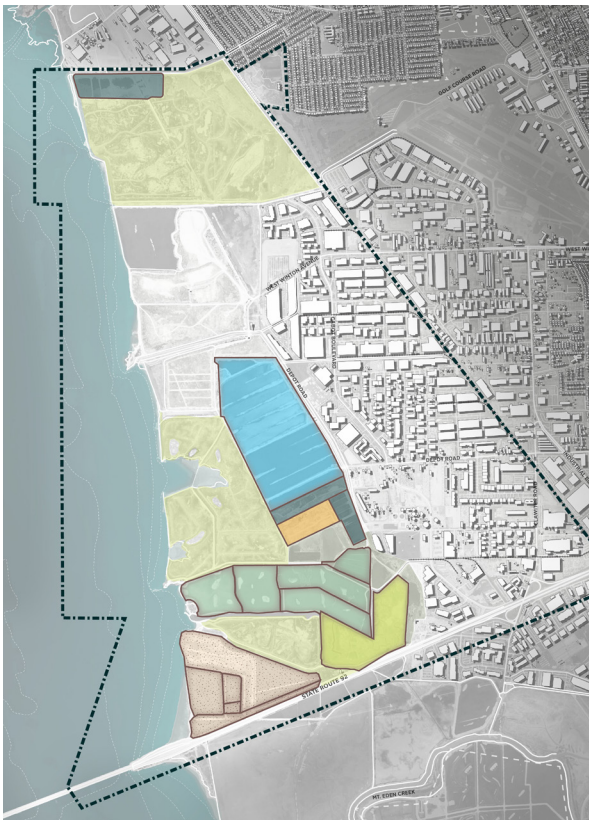
- Disrupts shorebird habitat at Oliver Salt Ponds


LEGEND
PROJECT AREA
EXISTING MARSH
WETLAND RESTORATION
STORMWATER STORAGE
SALT POND / STORMWATER DETENTION
NEW HYDRAULIC CONNECTIONS
NEW PUMP STATIONS
N
0
0.5 MI
SKYWEST GOLF COURSE- STORMWATER DETENTION
ORO LOMA MARSH
FRANK'S WEST- TIDAL RESTORATION
NEED TO ENHANCE / PROTECT LINER OF LANDFILL EDGES
FRANK'S EAST- SALT POND HABITAT / STORMWATER DETENTION
MAINTAIN CURRENT USES OF THE OXIDATION PONDS
SALT POND HABITAT MOVES INLAND
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS- TIDAL RESTORATION
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

DIKED POND MANAGEMENT

Stakeholder Feedback

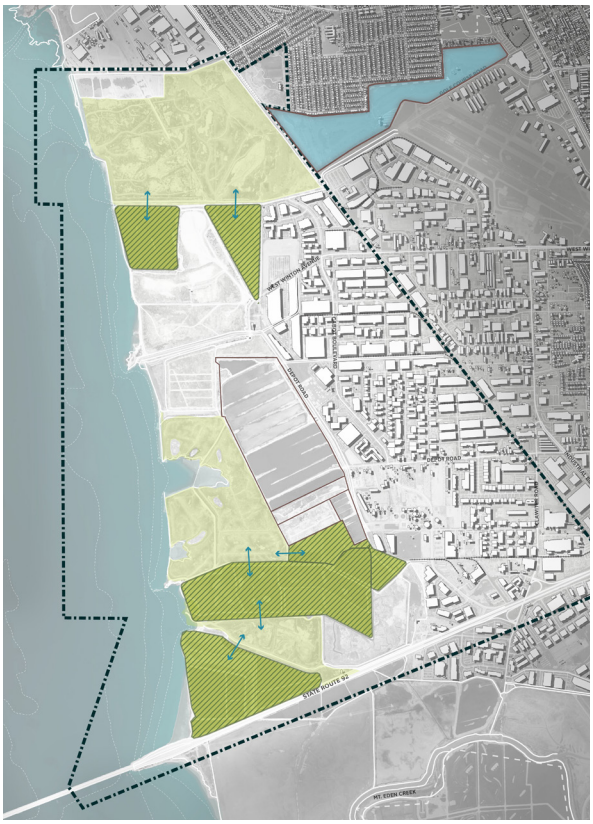
1: No Action



COMMENTS:

- EBRPD expressed that this option will not be considered by the agency. The team will not consider this option moving forward.
- COH noted that the former Oxidation Pond is still actively being used as part of the wastewater process. Please also note that the area that is now the solar fields is not pond land and the area has been raised to approximately 10 feet above grade. The project team scheduled follow up meetings with Public Works and the Hayward wastewater treatment plant to discuss the oxidation ponds. The design team has also updated the SLR maps to reflect the elevation change.
- ACFCD is not in support of this option and they prefer restoring ponds as marshes to buffer and dampen wave action.

2: Tidal Restoration + Stormwater Management



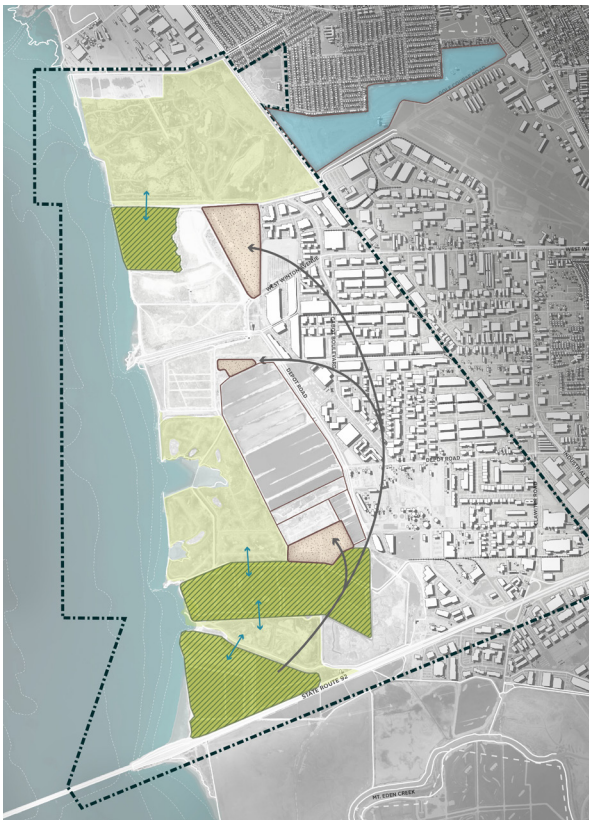
COMMENTS:

- COH indicated that all of the options involving either the Skywest golf course or City of Hayward oxidation ponds will need to be reviewed by the Public Works Utilities staff and/or the City Manager's Office if this strategy were to be implemented.
- EBRPD questioned if Oliver Salt Ponds will be fully opened to tidal action and if it is already. Oliver Salt Ponds is not currently open to tidal action. In this option it would be breached from the channel and restored to fully tidal. SCAPE will add breach locations to the diagram.
- COH reiterated that wet weather storage is a critical part of the WPCF overall process and function.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
HASPA: Hayward Area Shoreline Planning Agency
EBDA: East Bay Dischargers Authority
ACFCD: Alameda County Flood Control District
Teal text indicates a response from SCAPE

3: Restore Salt Ponds Inland, Double as Stormwater Detention



COMMENTS:

- EBRPD questioned if retention ponds would be required. With climate change and increased precipitation, the project area may require additional storage space for flood control purposes. If this strategy were to be implemented, additional engineering and feasibility studies would be required.
- EBRPD questioned where the ponds will discharge to. The ponds would discharge to adjacent flood control channels or directly into the bay.
- COH noted that the solar fields have been raised approximately 10 feet above grade. The design team updated the SLR maps to reflect the elevation change.
- ACFCD is in support of this option. They are considering an option for dry ponds / stormwater detention. It is recommended to make sure that the pond will not be inundated for a long period of time and that it can drain. The drainage time should be a couple of weeks maximum.

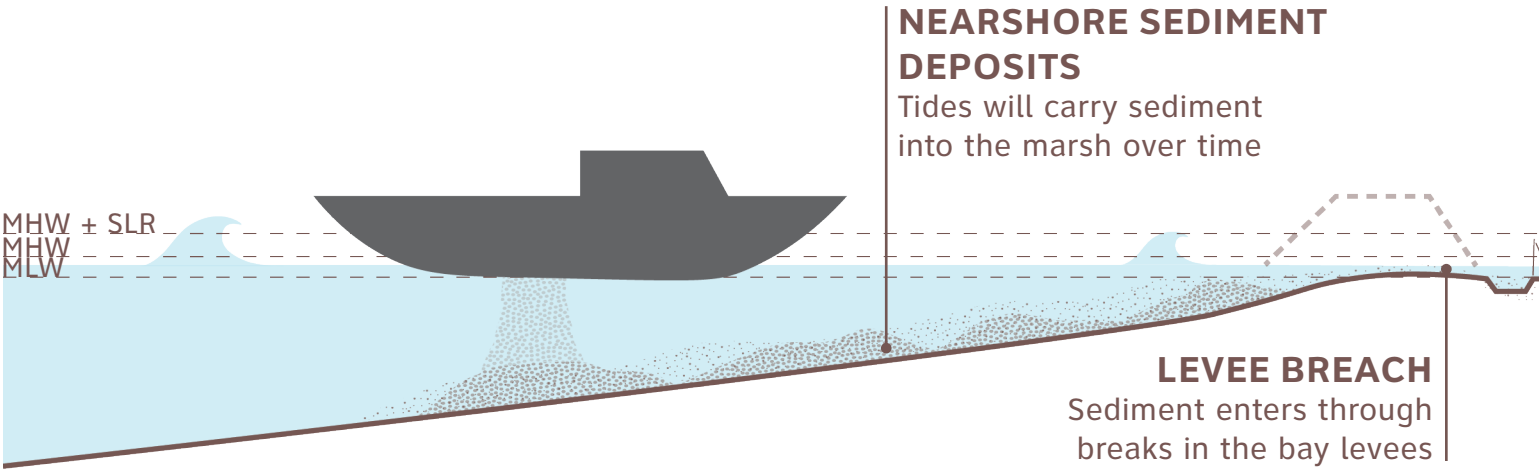
GENERAL COMMENTS:

- COH reiterated that all options involving either the Skywest golf course or City of Hayward oxidation ponds will need review by the Public Works Utilities staff and/or the City Manager's Office if this strategy is to be implemented.
- A stakeholder (during the Stakeholder Meeting #2) brought up the idea of creating a riparian corridor at Skywest Golf Course.
- HASPA noted that all of the diked ponds presented as part of the different options seem to be an unnatural state. These strategies should be thought of in a way that provides greater resilience over time.
- HARD noted that there is snowy plover habitat at Oliver Salt Ponds, which is an endangered species. It is also a CA-designated historical landscape with historic remnants. Any intervention within the Salt Ponds should carefully consider those two points.
- HASPA indicated that Skywest Golf Course as a retention basin seems unrealistic.
- COH noted that Public Works has concerns regarding the use of Skywest Golf Course as retention as well.
- EBDA noted that they have a grant to look at the oxidation ponds to evaluate the feasibility of a portion of the ponds to be transformed as seasonal wetlands and/ or wetland treatment function during the dry season.
- Hayward Public Works brought up issues with stormwater detention as the current permits only cover wastewater uses. They currently can't manage other types of water, since it has different contaminants.
- Hayward Public Works noted that the amount of space needed in the oxidation ponds varies depending on the type of storm events they have to deal with. Based on their new agreement with EBDA, they can only discharge 35-15 MGPD, so they need storage capacity during major storms.
- Hayward Public Works stated that the current discharge capacity of the oxidation ponds is about 500 million gallons and they wish to maintain this volume and their capacity to store water.
- Hayward Public Works indicated that if Bay water gets into the oxidation ponds they would not be able to treat it under their current permits.
- Hayward Public Works noted that the oxidation ponds are clay lined so groundwater emergence should not be an issue.
- Hayward Public Works noted they are not opposed to reducing to storage capacity of the oxidation ponds, but it will ultimately depend on EBDA and the potential decommission of the EBDA pipeline.

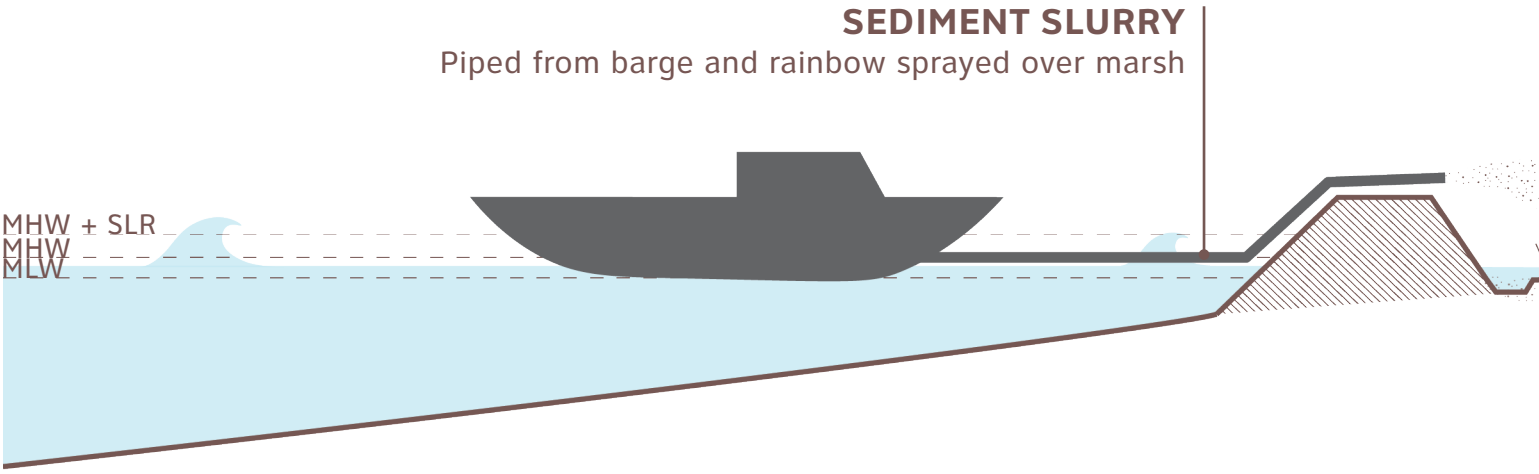
FINE SEDIMENT AUGMENTATION

Definition

The direct or indirect placement of fine sediments to **increase mudflat and marsh elevation** relative to the tides. This can help **protect and sustain marshes,** mudflats, and shorelines when sediment supply is low to **help them accrete and keep pace with sea level rise.** Techniques include water column seeding, nearshore placement, and thin layer placement.



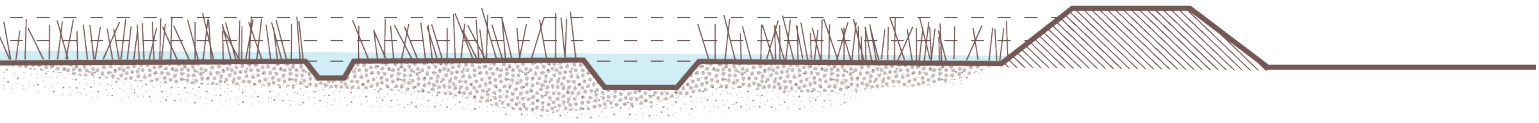
SHALLOW WATER PLACEMENT

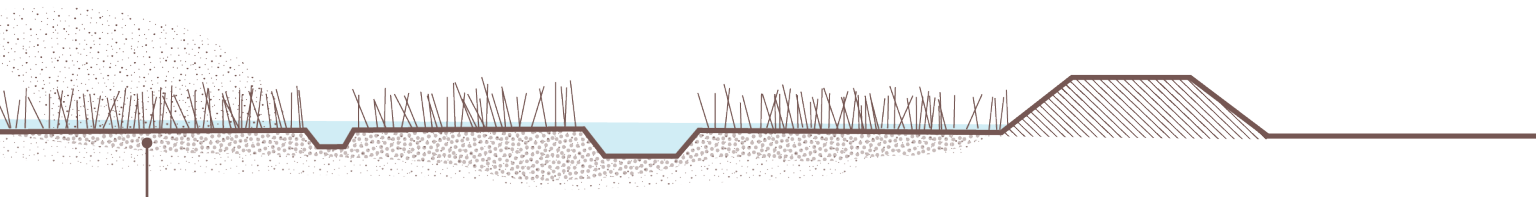


MARSH SPRAYING

OBJECTIVE

- Maximize the potential of marshes to maintain themselves in the future with sea level rise





MARSH ACCRETION

Spraying helps raise marsh plain elevation to keep pace with SLR

FINE SEDIMENT AUGMENTATION
Precedents

Salt Marsh Sediment Augmentation Project
Seal Beach, CA

Size: 8 acres
Cost: $3.3 million
Implementation Timeline: Completed 2016

Applicability: This technique may be used on existing marshes to help them keep pace with SLR. Establishment of vegetation after spraying has proved sparse.

Description: Subsidence, limited sediment accretion, and sea level rise led to the complete inundation of the refuge's Pacific cordgrass and eliminated natural rail nesting areas during high tide. The marsh was augmented with thin-layer sediment placement to raise the marsh plain to keep pace with SLR.

- 10" layer of sediment applied through rainbow spraying from sediment slurry delivered via a floating or submerged pipeline directly from a dredge or barge
- Thin-layer placement of sediment on 8 acres of existing low salt marsh habitat
- One of the goals was to improve habitat for the rail



Sediment being sprayed on marsh



Marsh after spraying

FINE SEDIMENT AUGMENTATION

Option 1: Feed from the Bay

OBJECTIVE

Enhance Bay ecology and adapt with SLR through natural processes.

DESCRIPTION

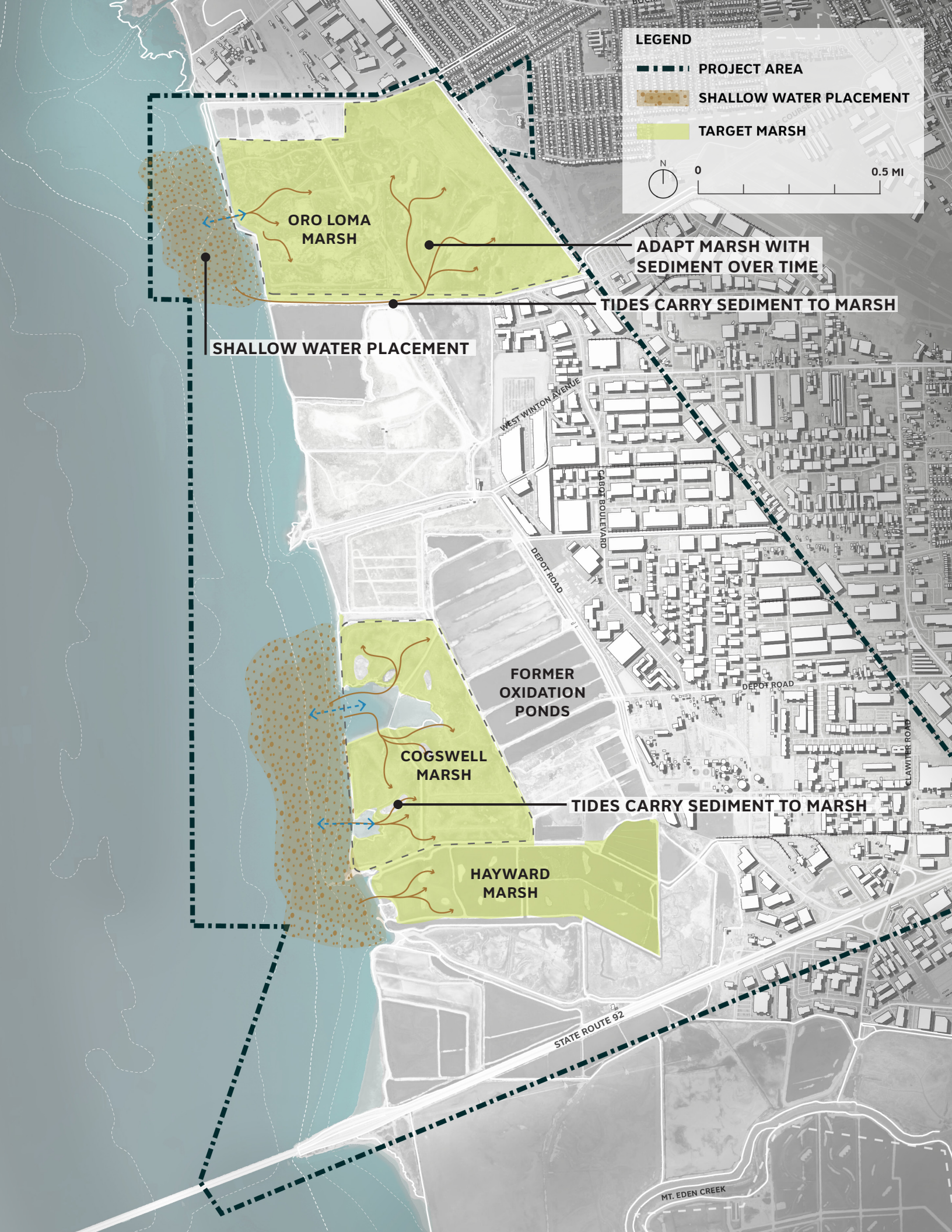
- Shallow water sediment placement on the mudflats in front of Oro Loma, Cogswell, and Hayward Marsh

PROS

- Allow natural processes to facilitate accretion
- Prioritize large marsh adaptation to keep pace with SLR

CONS

- Might be considered as fill. Filling the Bay is a regulatory challenge.
- Hard to get material to the mudflat because it is shallow
- Many unknowns about sediment transport and retention; highly dependent on local hydrology
- Potential negative impacts to existing habitat


LEGEND
PROJECT AREA
SHALLOW WATER PLACEMENT
TARGET MARSH
N
0
0.5 MI
ORO LOMA MARSH
ADAPT MARSH WITH SEDIMENT OVER TIME
TIDES CARRY SEDIMENT TO MARSH
SHALLOW WATER PLACEMENT
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
FORMER OXIDATION PONDS
COGSWELL MARSH
TIDES CARRY SEDIMENT TO MARSH
HAYWARD MARSH
STATE ROUTE 92
MT. EDEN CREEK

FINE SEDIMENT AUGMENTATION

Option 2: Nourish from an Upland Pipeline

OBJECTIVE

Enhance Bay ecology and adapt to SLR.

DESCRIPTION

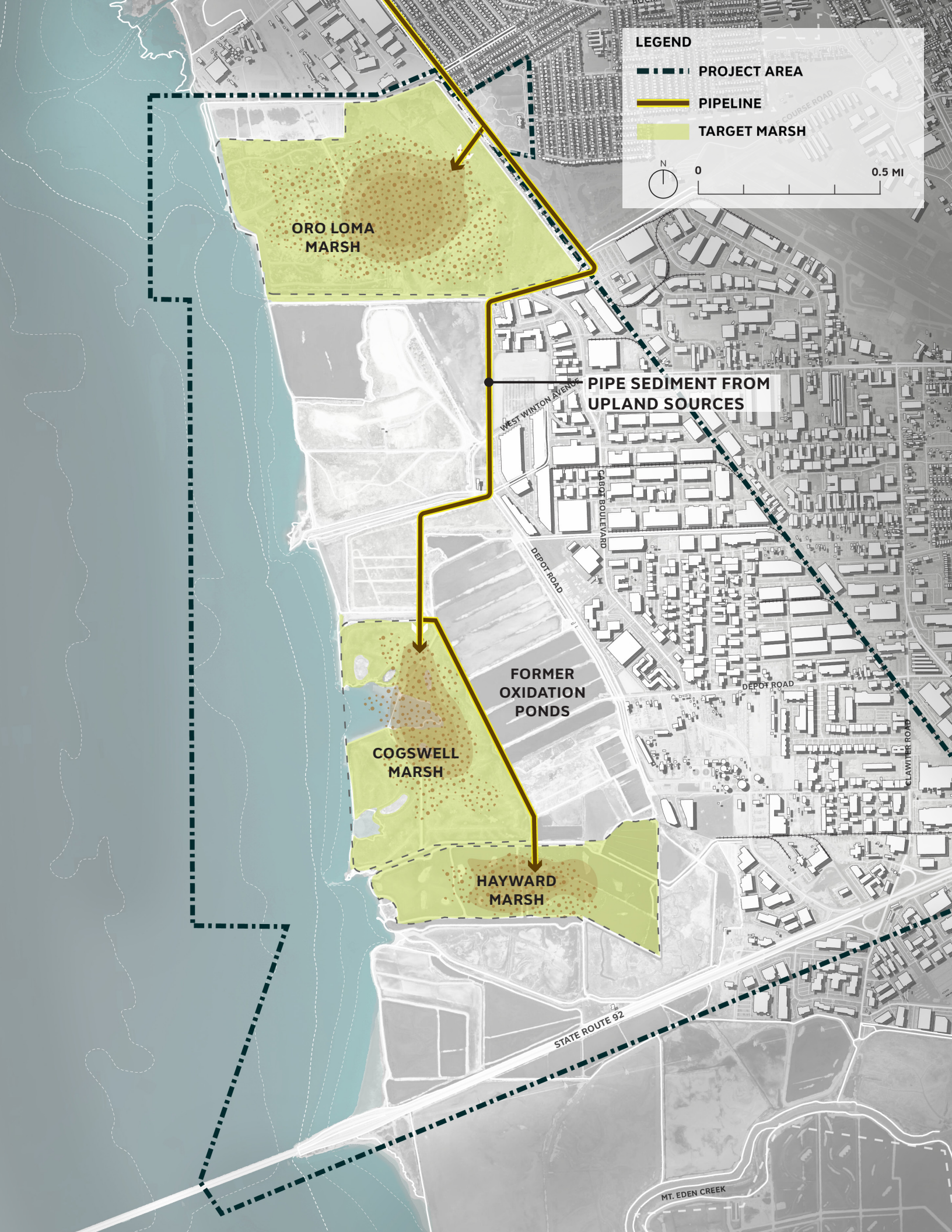
- Pipe sediment for deposition in existing marshes from Don Castro Reservoir or other upland sources
- Deposit sediment at Oro Loma Marsh, Cogswell Marsh, and Hayward Marsh

PROS

- Pipe infrastructure could be used for sediment delivery over time
- Utilize upland sediment sources
- Potential to utilize sediment from Don Castro Reservoir

CONS

- Might be considered as fill. Filling the Bay is a regulatory challenge
- Pipeline infrastructure could be costly
- Many unknowns about sediment transport and retention
- Potential negative impacts to existing habitat


LEGEND
PROJECT AREA
PIPELINE
TARGET MARSH
N
0
0.5 MI
ORO LOMA MARSH
PIPE SEDIMENT FROM UPLAND SOURCES
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
STATE ROUTE 92
MT. EDEN CREEK
CLAWITER ROAD

FINE SEDIMENT AUGMENTATION

Option 3: Prep Sites for Future Inundation

OBJECTIVE

Prepare sites for future tidal marsh restoration.

DESCRIPTION

- Deposit sediment via floating pipes from a barge onto Frank's West, Frank's East, Hayward Marsh, part of the Oxidation Ponds, and Oliver Salt Ponds to lift them to marsh plain elevation

PROS

- Proactive approach to prepare diked Baylands for marsh restoration

CONS

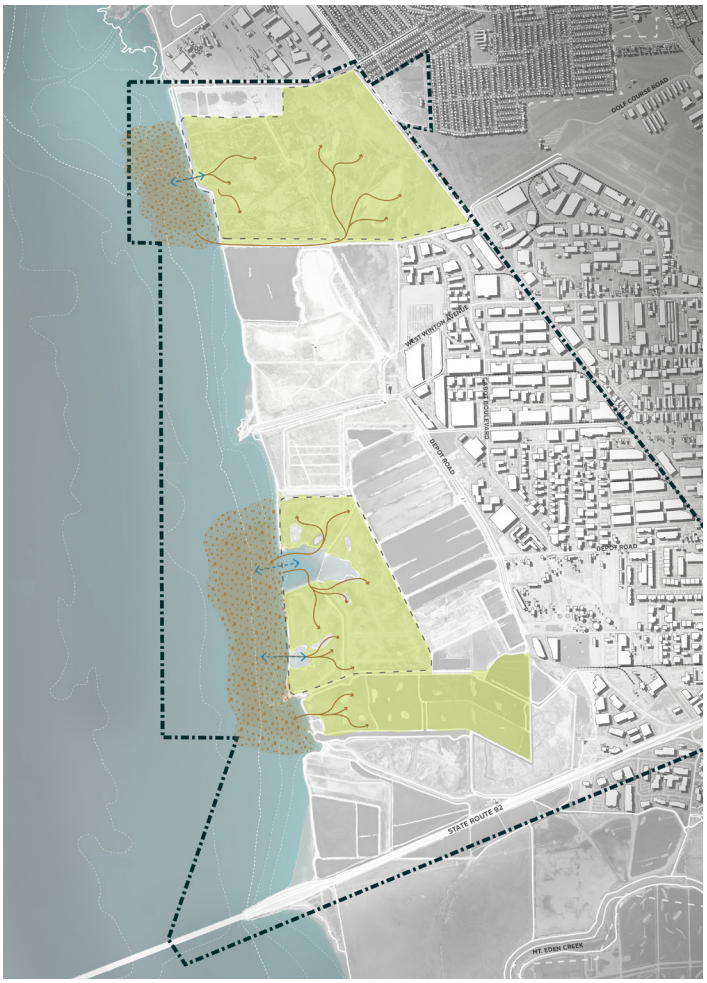
- Potential negative impacts to existing habitat
- Power for pumping the sediment is very expensive
- An offloader and booster pumps will likely be required, which are very expensive


LEGEND
PROJECT AREA
FLOATING PIPE
AREA TO PREP FOR FUTURE RESTORATION
N
0
0.5 MI
FRANK'S WEST
FRANK'S EAST
PREP FOR RESTORATION
NEED TO ENHANCE / PROTECT LINER OF LANDFILL EDGES
PIPE SEDIMENT FROM BARGE
CABOT BOULEVARD
DEPOT ROAD
FORMER OXIDATION PONDS
HAYWARD MARSH
OLIVER SALT PONDS
STATE ROUTE 92
MT. EDEN CREEK

FINE SEDIMENT AUGMENTATION

Stakeholder Feedback

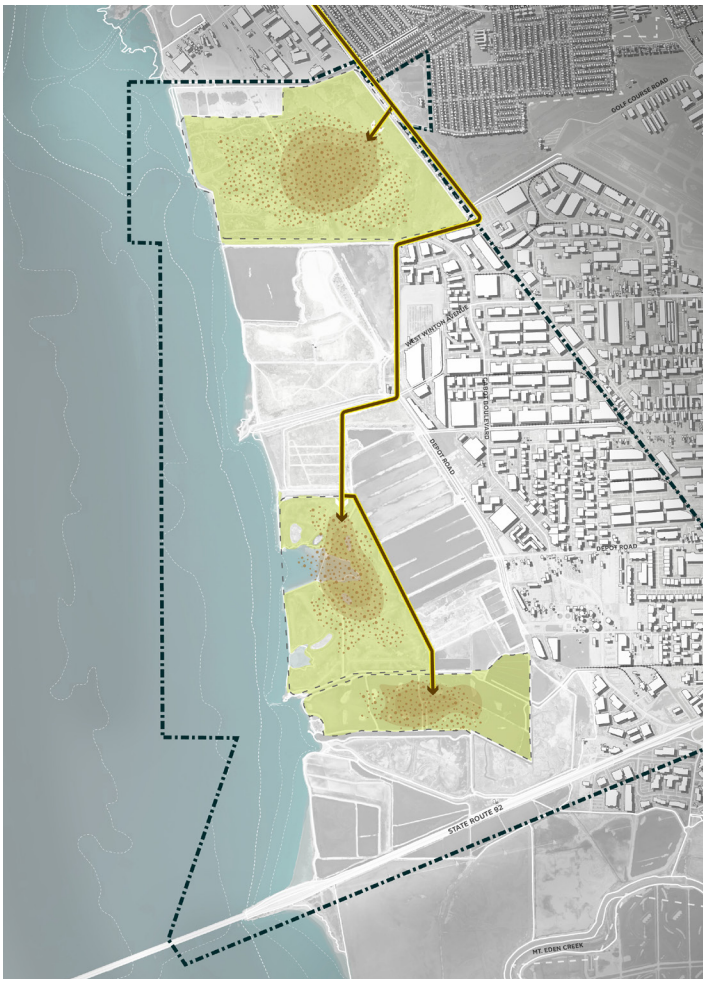
1: Feed from the Bay



COMMENTS:

- BCDC expressed that sediment is a precious resource that should be carefully managed. New models (from SFEI) show that the sediment availability in the South Bay might actually be lower than previous assumptions.

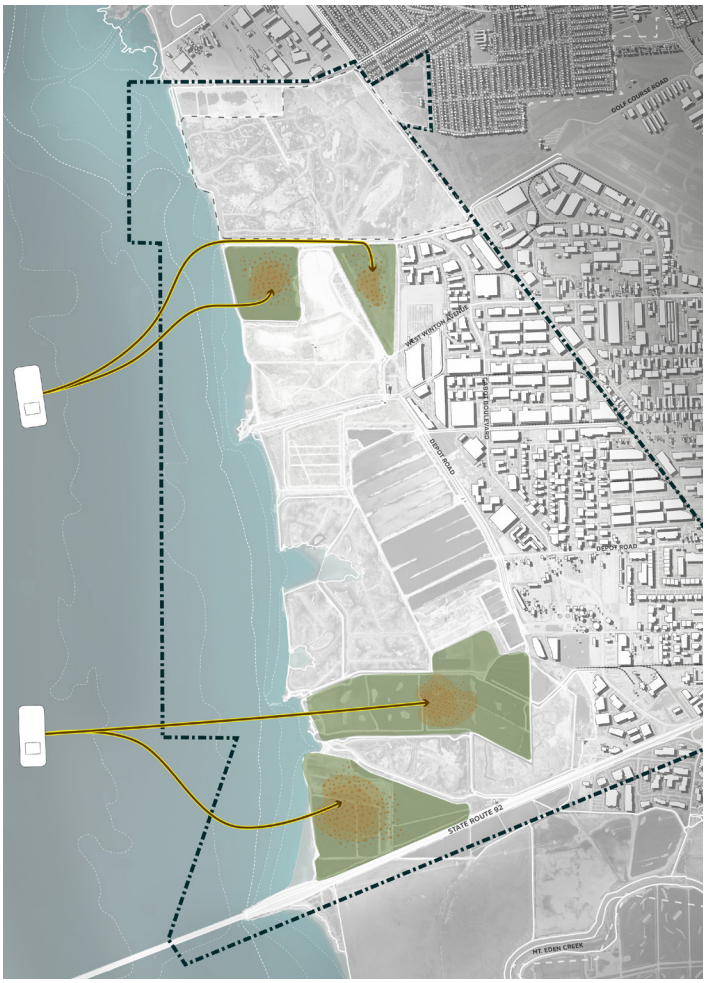
2: Nourish from an Upland Pipeline



COMMENTS:

- BCDC indicated that sediment from a more direct upland pipeline may be more suitable to minimize the amount of fill and lessen impacts to the mudflats.
- ACFCD is trying to find the money to implement the Don Castro Sediment Pipeline. Hydraulic dredging and piping sediment from behind the dam is half as expensive as trucking.

3: Prep Sites for Future Inundation



COMMENTS:

- See General Comments

GENERAL COMMENTS:

- EBRPD brought up the question of material quality and criteria that should be used to screen sediment before placement. Material quality should be compliant with existing state and local regulations. If this strategy were to be implemented, additional feasibility and engineering studies will be needed to address this question.
- EBRPD asked about other examples of how this has been utilized and how often sediment would need to be added to create meaningful elevation changes. There is a precedent for marsh spraying noted in this document. The design team does not have any precedents for shallow water placement. The USACE is advancing a pilot project for these techniques, but it is still in the planning stages. Additional feasibility and engineering studies will be needed to address how often sediment would need to be added.
- COH indicated this is a great idea. Key input from our park district partners is needed here. Option 3 might need input from Hayward's Public Works Utilities staff.
- A stakeholder (during the Stakeholder Meeting #2) brought up the idea of creating a network of pipes in the marsh, as opposed to spraying from just one pipe.
- A stakeholder (during the Stakeholder Meeting #2) noted that the power for pumping sediment slurry from the deep water navigation channels is very expensive. One or two booster pumps and a lot of electricity will most likely be required.
- HASPA asked if it is possible to consider wastewater effluent as a source of sediment. This idea may be difficult to implement since biosolids dissolve more easily in water and don't have the same mineral quality that marshes need.

ACRONYMS

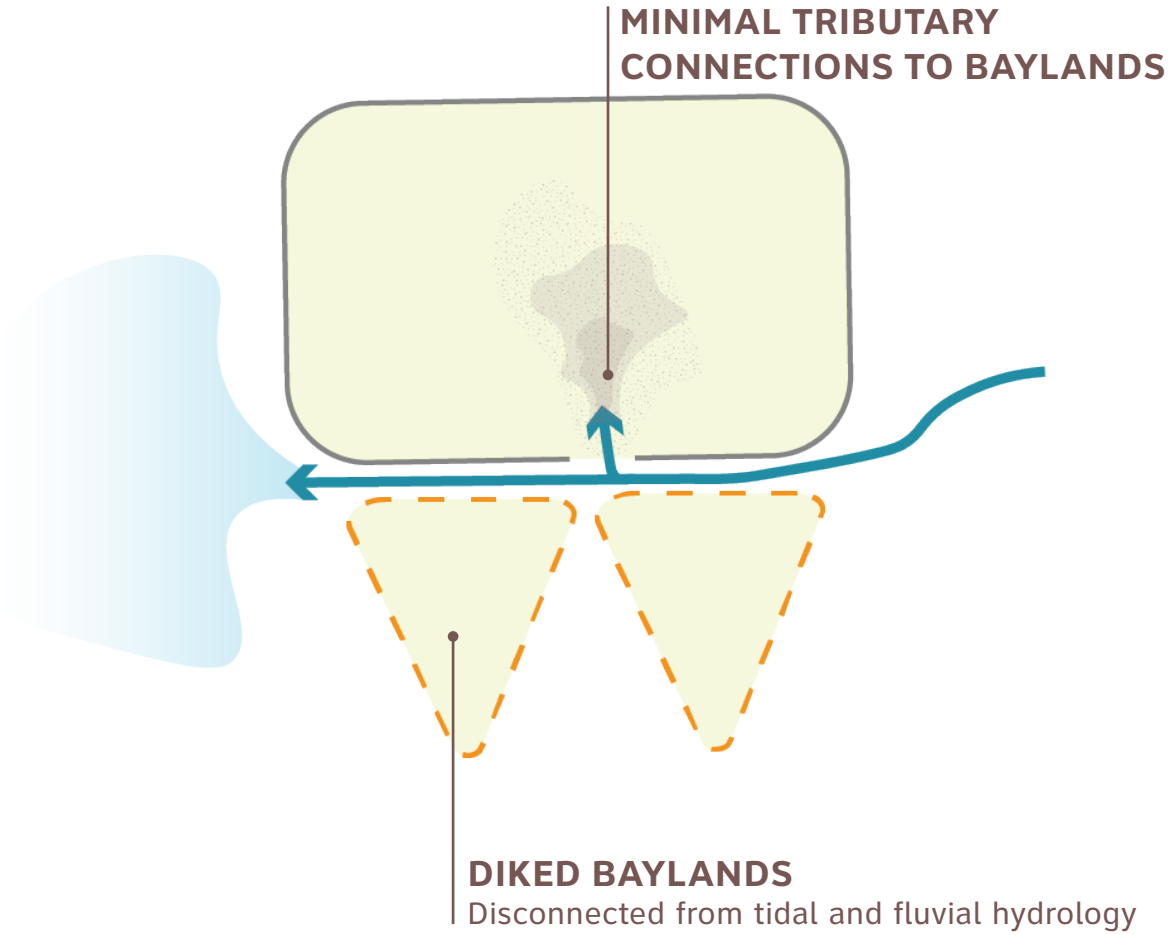
EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
HASPA: Hayward Area Shoreline Planning Agency
ACFCD: Alameda County Flood Control District
BCDC: Bay Conservation & Development Commission
Teal text indicates a response from SCAPE

TRIBUTARY CONNECTION TO BAYLANDS

Definition

Reconnecting creeks to their adjacent baylands through **levee breaching or removal** helps **improve sediment supply, nutrient, and freshwater delivery** to the Baylands while achieving **flood risk management** and **habitat benefits.**

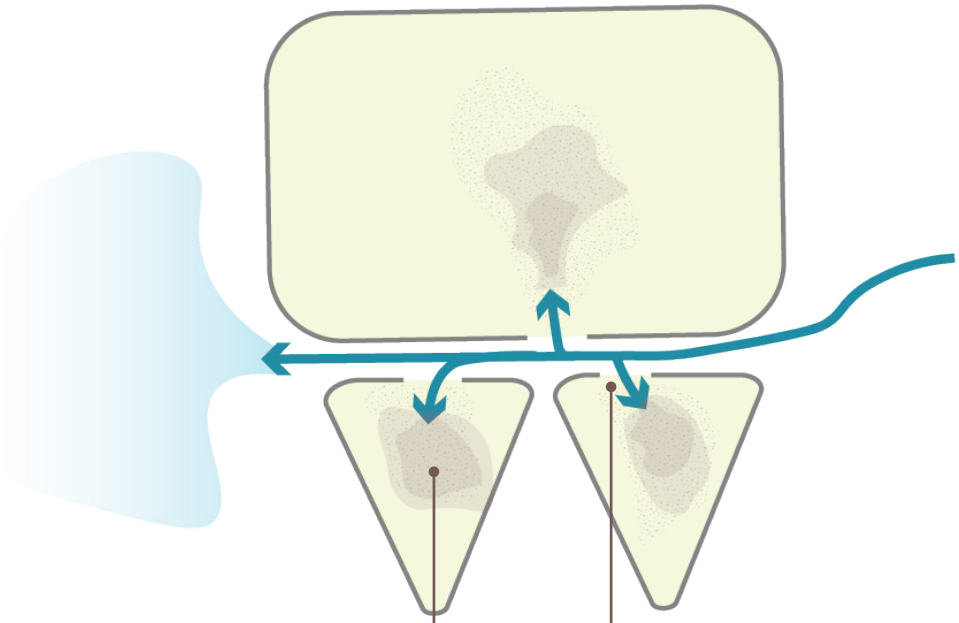
BEFORE



OBJECTIVE

- Ecological enhancement (restore sediment and tidal flows for marsh restoration / health)

AFTER



LEVEE BREACH
Restore hydrological flows to diked baylands

RESTORED TIDAL FLOW
Facilitates sediment accretion and tidal marsh restoration

TRIBUTARY CONNECTION TO BAYLANDS

Precedents

Lower Walnut Creek Restoration Project
Contra Costa County, CA

Size: 224 acres
Cost: $10.3 million
Implementation Timeline: 2017-2021

Applicability: Breaching existing flood control levees will restore tidal inundation to existing non-tidal wetlands. Restored tidal marshes develop complex vertical biotic structures that support diverse plant and wildlife communities and SLR resiliency.

Description: The project will restore and enhance wetlands and associated habitats while also providing sustainable flood management and increased resiliency to sea level rise. Restoration will allow increased opportunities for public access and recreation.

- In 2014, legislation removed the USACE from management of the lowest 4 miles of Walnut and Pacheco Creeks
- Creeks are now locally controlled by the FCD, allowing restoration work
- On-site placement of material
- Improved biological connectivity- levee lowering and marsh plain excavation



figure 13
Pacheco Marsh
Plan View of Preferred Alternative

Plan of restoration project



Walnut Creek and adjacent marsh

TRIBUTARY CONNECTION TO BAYLANDS

Option 1: Sulphur Creek

OBJECTIVE

Enhance marsh ecology and facilitate adaptation to SLR.

DESCRIPTION

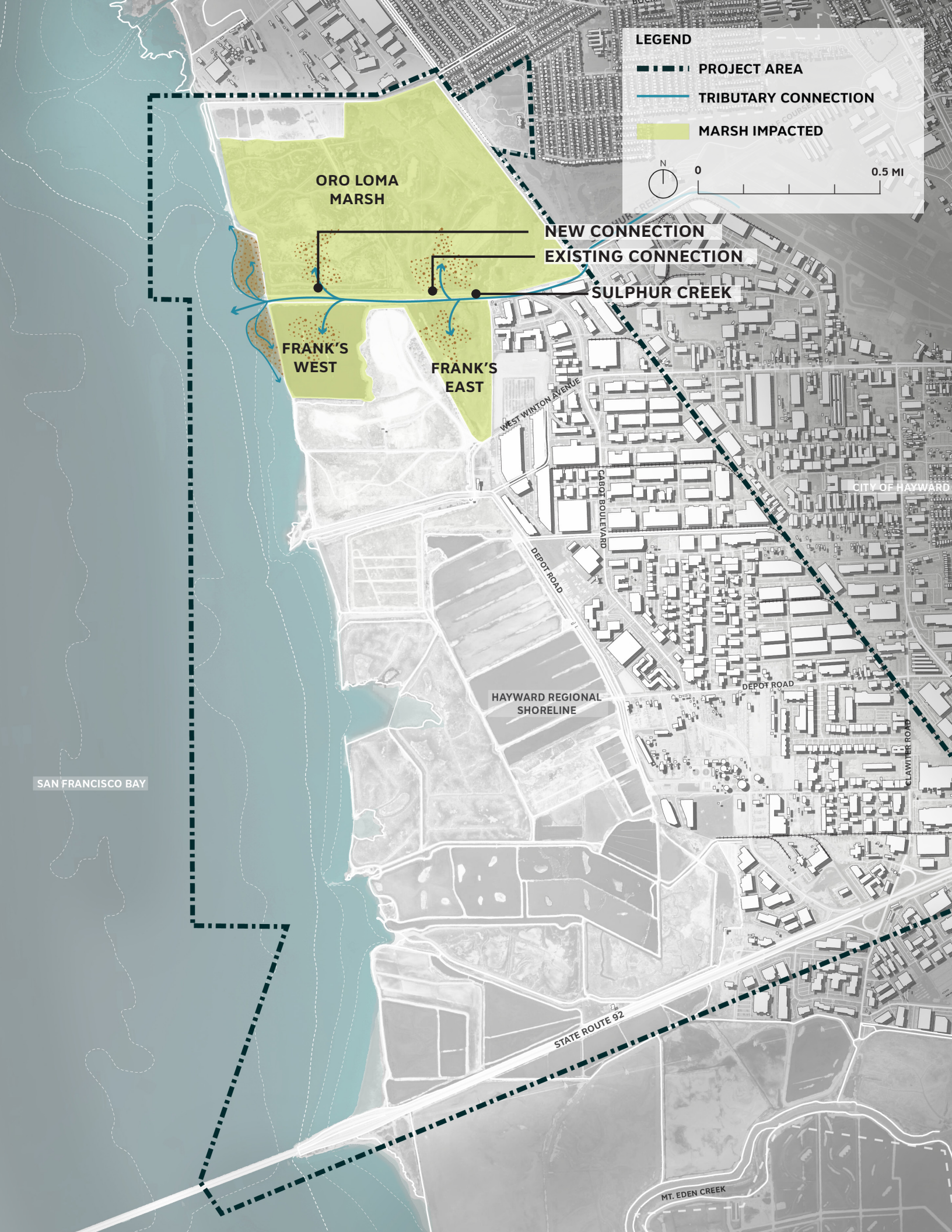
- Breach berms between Sulphur Creek and Oro Loma Marsh, Frank's East, and Frank's West

PROS

- Connect marshes to a large upland watershed
- Can help restore tidal marshes

CONS

- May impact flood control upstream- need to relocate tide gate
- May not do much for flood protection or SLR adaptation


LEGEND
PROJECT AREA
TRIBUTARY CONNECTION
MARSH IMPACTED
N
0
0.5 MI
ORO LOMA MARSH
NEW CONNECTION
EXISTING CONNECTION
SULPHUR CREEK
FRANK'S WEST
FRANK'S EAST
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CITY OF HAYWARD
HAYWARD REGIONAL SHORELINE
SAN FRANCISCO BAY
CLAWITER ROAD
STATE ROUTE 92
MT. EDEN CREEK

TRIBUTARY CONNECTION TO BAYLANDS

Option 2: All Channels

OBJECTIVE

Enhance marsh ecology and facilitate adaptation to SLR.

DESCRIPTION

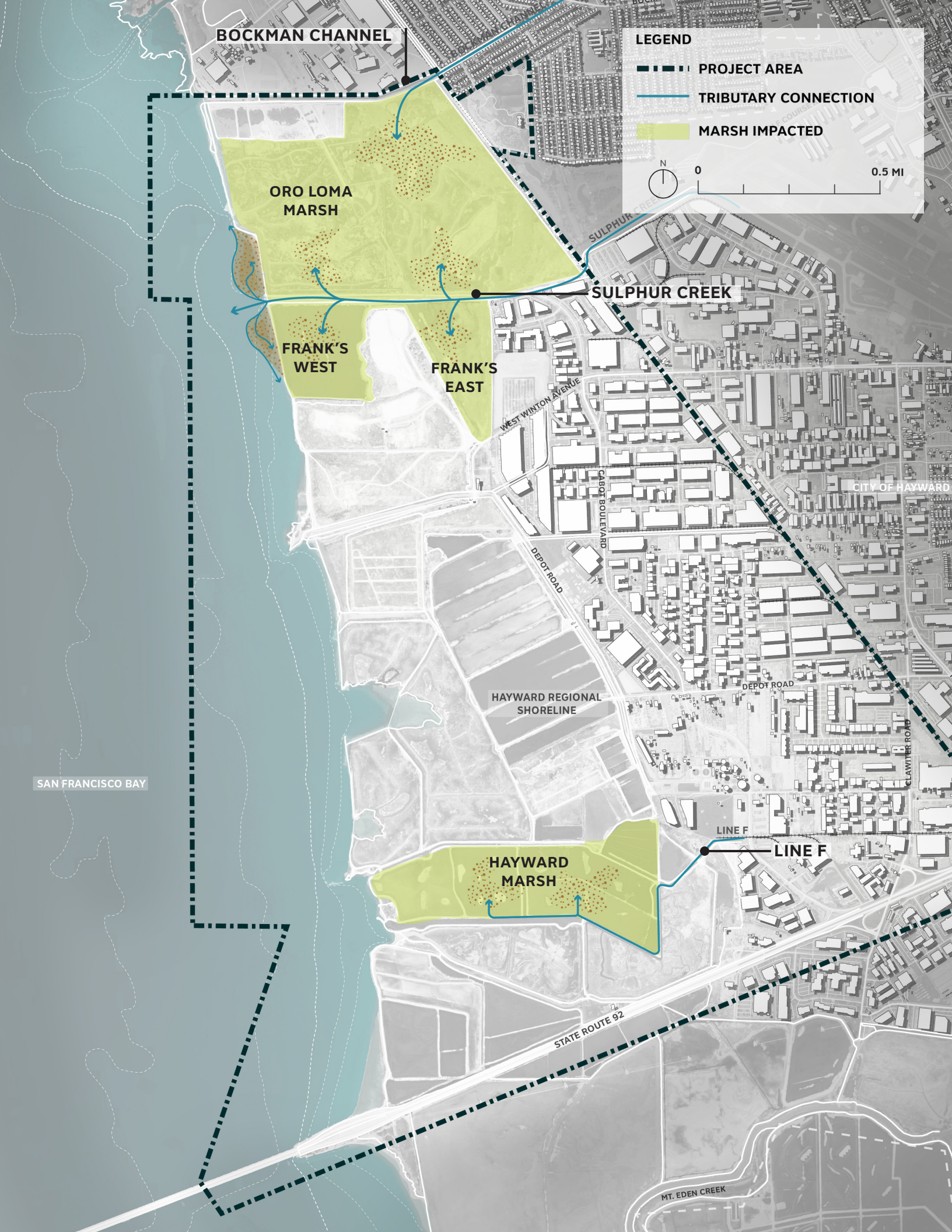
- Breach berms between Sulphur Creek and Oro Loma Marsh, Frank's East, and Frank's West
- Breach berms between Line F and Hayward Marsh

PROS

- Connect marshes to most viable upland watersheds
- Potential to nourish a large area of marsh with sediment

CONS

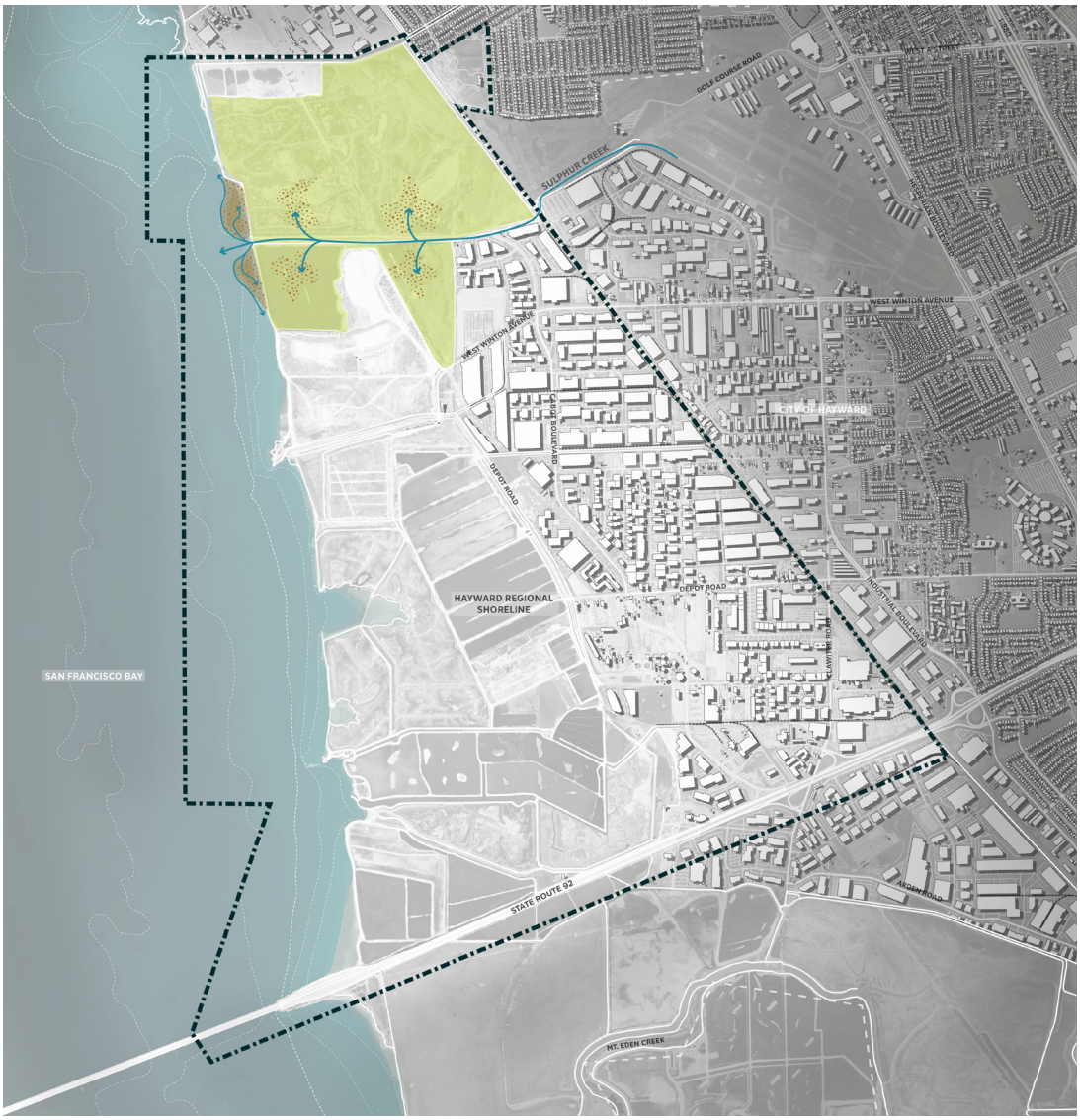
- May impact flood control upstream- need to relocate tide gate
- Bockman Channel has low water quality today which may negatively impact Oro Loma marsh
- May not do much for flood protection or SLR adaptation
- Concern over the water quality in Line F, which may impact Hayward Marsh


BOCKMAN CHANNEL
LEGEND
PROJECT AREA
TRIBUTARY CONNECTION
MARSH IMPACTED
N
0
0.5 MI
ORO LOMA MARSH
SULPHUR CREEK
SULPHUR CREEK
FRANK'S WEST
FRANK'S EAST
WEST WINTON AVENUE
CABOT BOULEVARD
CITY OF HAYWARD
DEPOT ROAD
DEPOT ROAD
HAYWARD REGIONAL SHORELINE
SAN FRANCISCO BAY
CLAWITER ROAD
LINE F
LINE F
HAYWARD MARSH
STATE ROUTE 92
MT. EDEN CREEK

TRIBUTARY CONNECTION TO BAYLANDS

Stakeholder Feedback

1: Sulphur Creek



COMMENTS:

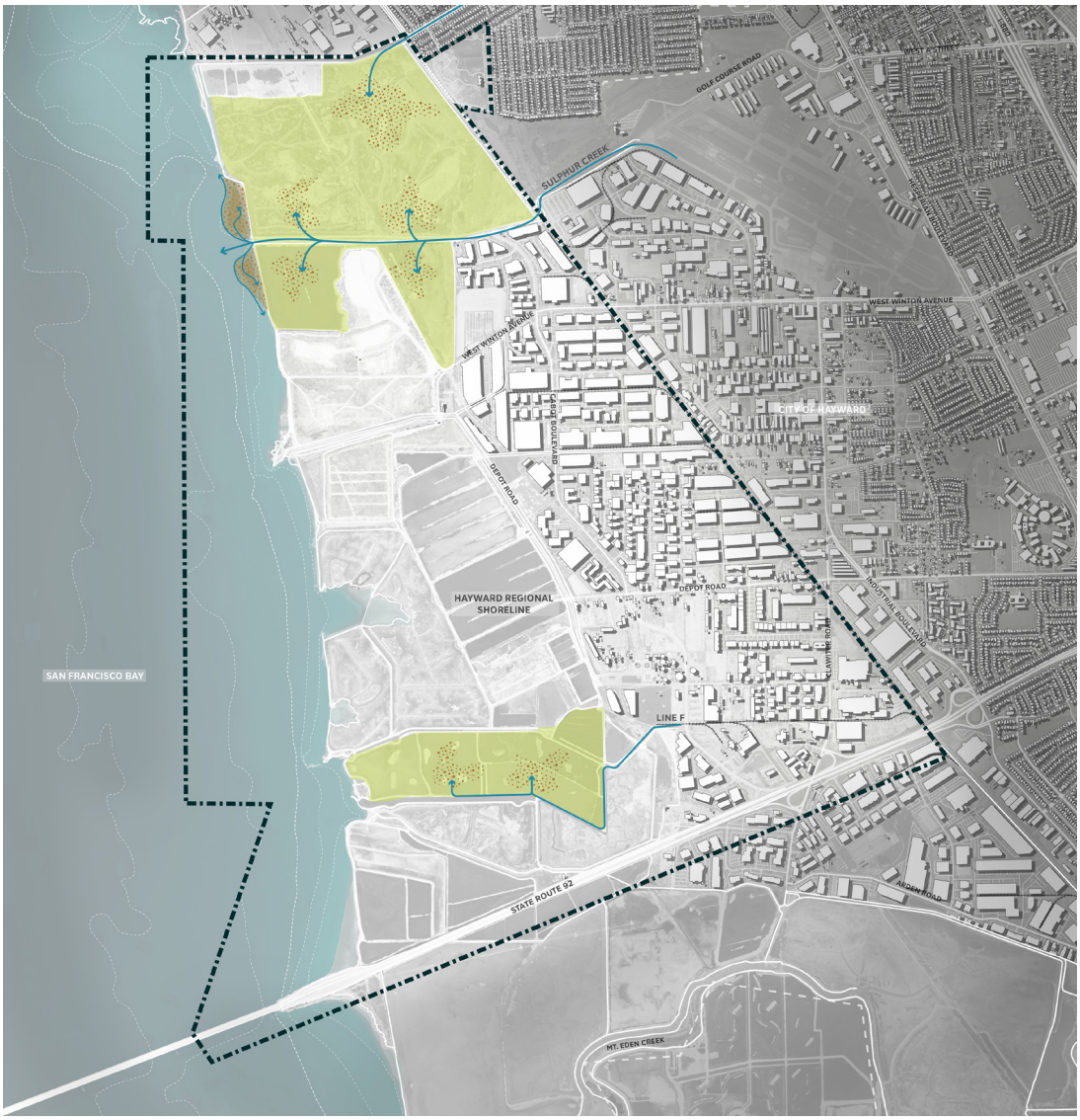
- EBRPD has concerns about water quality present in Line F and whether the water would contaminate/impact marshlands.

GENERAL COMMENTS:

- COH noted that the park districts should provide comments on these options.
- ACFCD is in support of these options as long as the line of protection is moved east of any breach.

SCAPE

2: All Channels



COMMENTS:

- See General Comments.

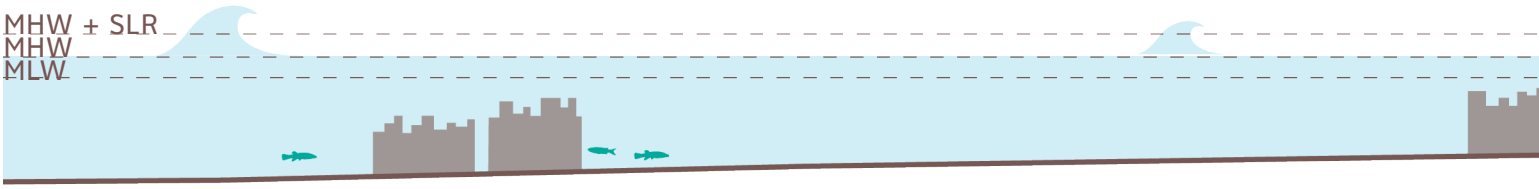
ACRONYMS

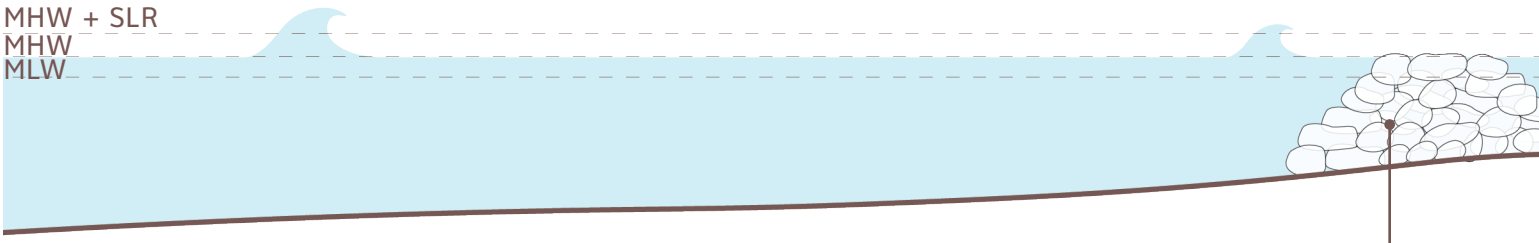
EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
ACFCD: Alameda County Flood Control District
Teal text indicates a response from SCAPE

REEFS AND LIVING BREAKWATERS

Definition

Nearshore reefs made of **oyster shell and Baycrete** (a cement mixture composed mostly of Bay sand and shells) **provide hard substrate** for shellfish and other aquatic plants and animals. They can **reduce wave transmission** at lower tidal elevations and **stabilize areas in their lee.** Breakwaters **reduce the intensity of wave action** in inshore waters, thereby reducing coastal erosion.

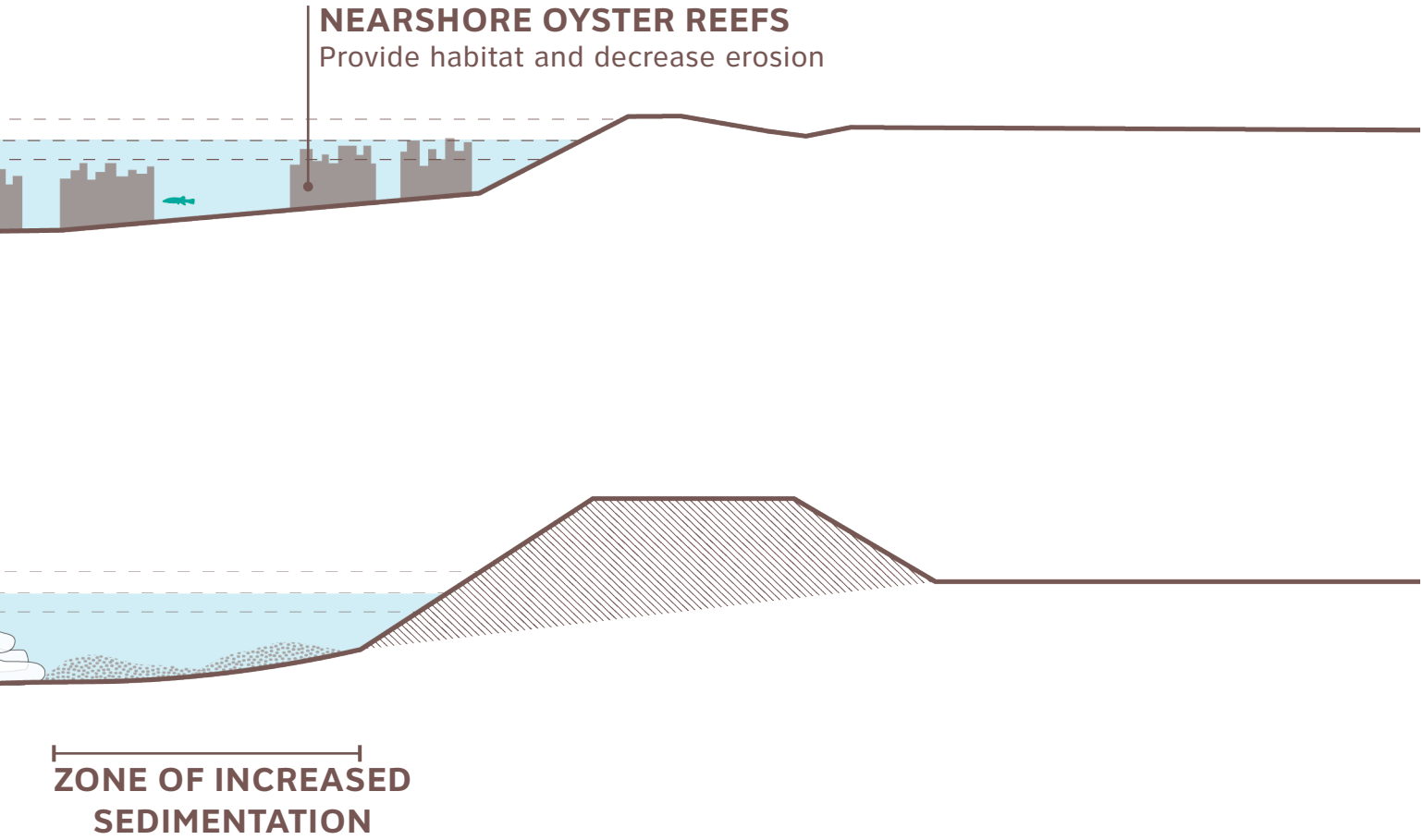




BREAKWATER
Placed in front of levee to reduce erosion from the Bay

OBJECTIVE

- Reduce erosion to critical infrastructure
- Ecological enhancement (hard substrate habitat)



REEFS AND LIVING BREAKWATERS
Precedents

SCC Living Shorelines Project
Point Pinole, Richmond, CA

Size: 2 acres
Cost: $3 million (cost of pilot, experimentation, monitoring)
Implementation Timeline: 2018

Applicability: A layered shoreline with enhanced ecosystems is applicable to the transect from subtidal to upland transition.

Description: Living shorelines use nature-based infrastructure to create shoreline buffers that reduce impacts of sea level rise and erosion, while creating habitat for fish and wildlife.

- 350 oyster reef elements are made of a mixture of native sand and oyster shell mixed with cement
- Subtidal habitat restoration of native oyster + eelgrass beds, provide habitat for Pacific Herring and Olympia Oyster
- Natural structures buffer and protect adjacent tidal wetlands



Plan of project restoration



Installation of oyster reef

REEFS AND LIVING BREAKWATERS
Precedents

Wave Screen
Loggerhead Marina, Stuart, FL

Size: 1,300 LF
Implementation: 2015 (5 months)

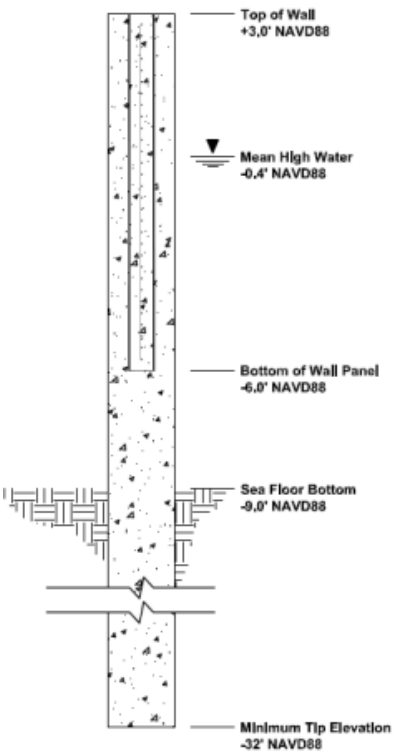
Applicability: A wave screen may be more applicable than breakwaters to address localized erosion, since the posts can be piled deep into the Bay mud.

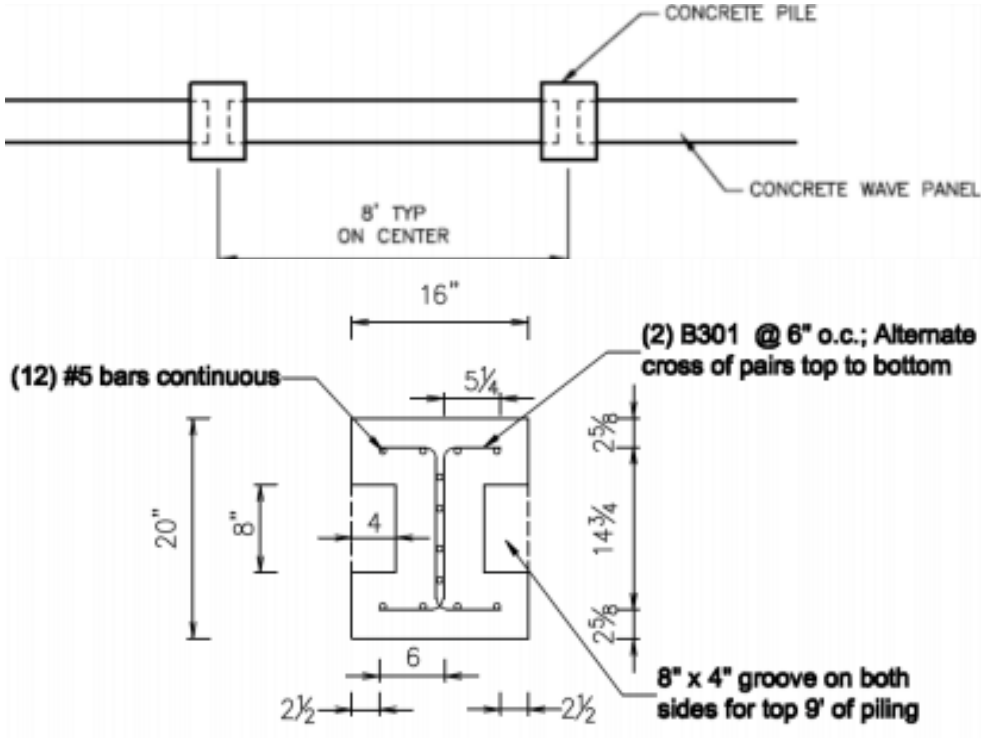
Description: Wave screens offer an alternative form of protection against coastal erosion, addressing some of the shortcomings/ challenges of fixed breakwater and floating attenuator structures. The original floating attenuator at Loggerhead Marina was not enough.

- Standard fabricated king pile and panel system
- These structures are mainly intended to minimize wave damage caused by wind or boat traffic.
- Panels were installed every 8’ around the perimeter of the basin using a barge
- Wave screen received minimal damage during Hurricane Irma (slight settlement of some panels). It was overtopped but provided superior wave protection during the storm.
- Wave screens provide protection against longer wave periods than floating attenuators can, which are limited to a maximum of 7-8 seconds



Wave screen along the perimeter of the basin, made of all concrete





Design details

REEFS AND LIVING BREAKWATERS

Option 1: Offshore Oyster Reefs

OBJECTIVE

Enhance shoreline habitat for oysters and shellfish and potentially reduce the risk of erosion.

DESCRIPTION

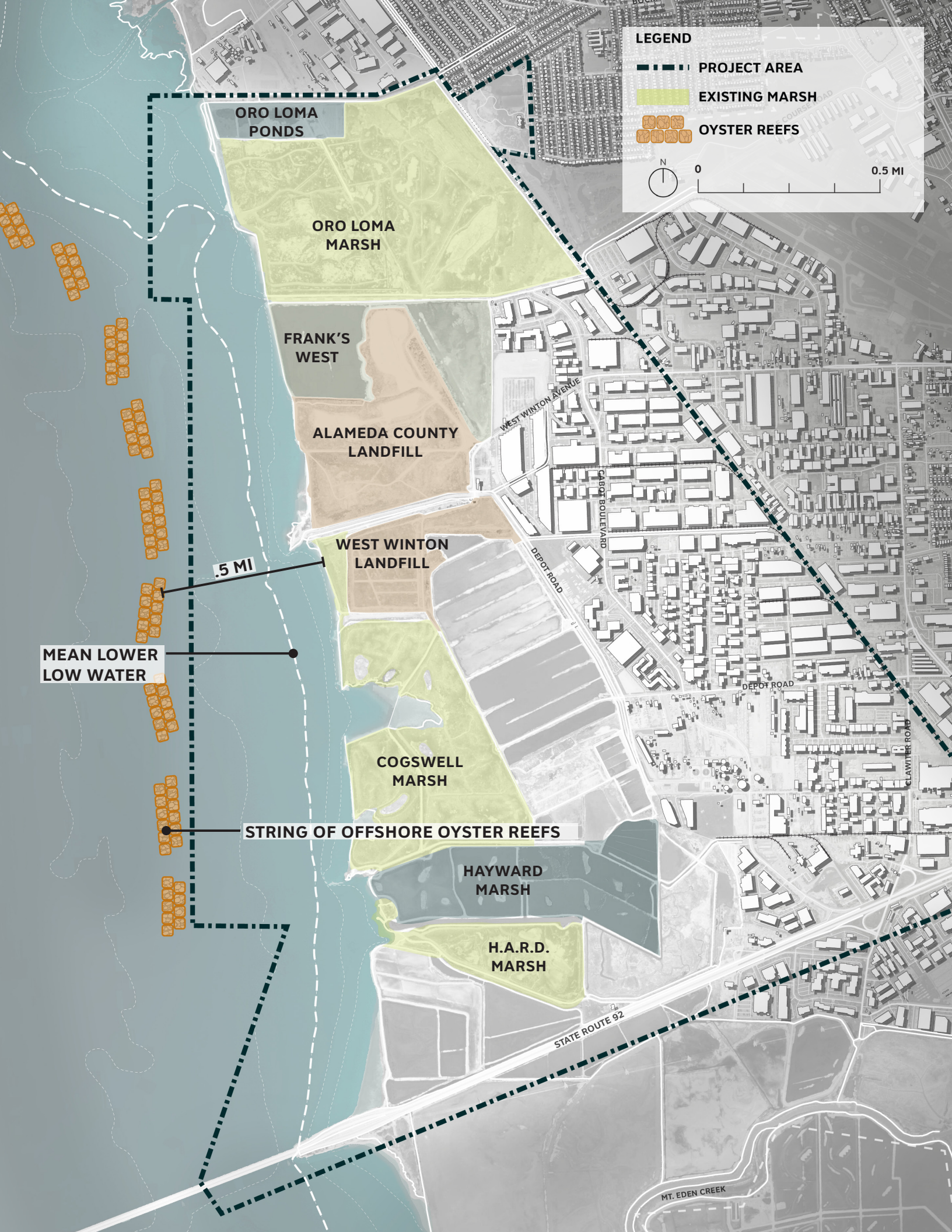
- String of oyster reefs offshore from Oro Loma Marsh to Hayward Marsh

PROS

- Reduce erosion along shoreline
- Provide hard substrate habitat

CONS

- Has to be far offshore because the Bay is shallow- may not get as much accretion along shoreline
- May not be stable on bay mud- potential to sink
- Considered fill under current regulations, which might present permitting challenges
- Oyster reefs may cause issues with NPDES permit and near shore discharge requirements


LEGEND
PROJECT AREA
EXISTING MARSH
OYSTER REEFS
N
0
0.5 MI
ORO LOMA PONDS
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
.5 MI
MEAN LOWER LOW WATER
COGSWELL MARSH
STRING OF OFFSHORE OYSTER REEFS
HAYWARD MARSH
H.A.R.D. MARSH
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
STATE ROUTE 92
MT. EDEN CREEK

REEFS AND LIVING BREAKWATERS

Option 2: Engineered Breakwaters

OBJECTIVE

Reduce the risk of erosion along vulnerable shoreline structures in front of critical infrastructure.

DESCRIPTION

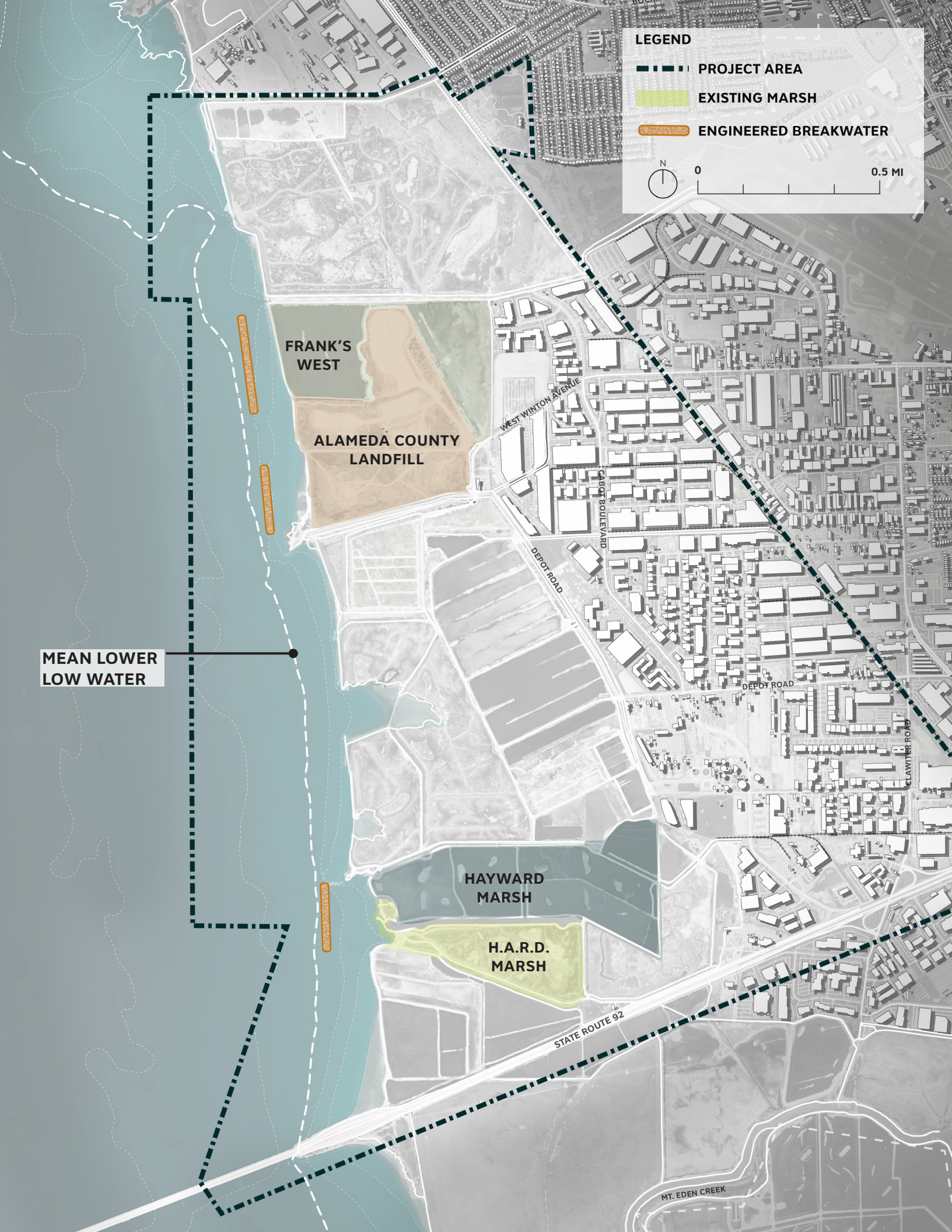
- Breakwaters in front of Frank's West, Alameda County Landfill, and Hayward Marsh

PROS

- Reduce erosion to outboard levees and berms in front of critical infrastructure
- May provide rocky substrate habitat

CONS

- May not be stable on bay mud- potential to sink
- May have negative impacts to muddy bottom habitats
- Considered fill under current regulations, which might present permitting challenges


LEGEND
PROJECT AREA
EXISTING MARSH
ENGINEERED BREAKWATER
N
0
0.5 MI
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
MEAN LOWER LOW WATER
HAYWARD MARSH
H.A.R.D. MARSH
STATE ROUTE 92
MT. EDEN CREEK

REEFS AND LIVING BREAKWATERS

Option 3: Floating Breakwaters at Breaches

OBJECTIVE

Reduce the risk of erosion at marsh breaches.

DESCRIPTION

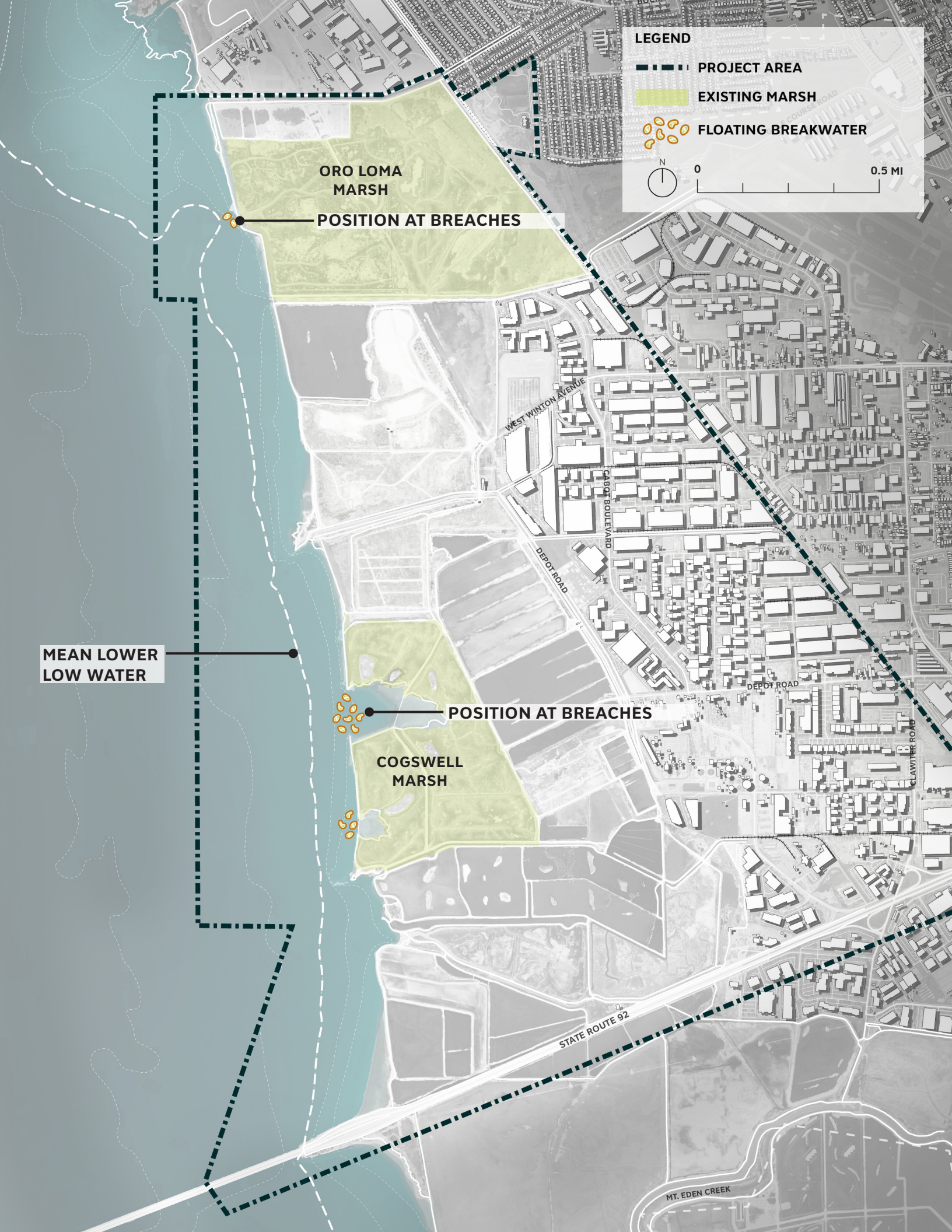
- Floating breakwaters at all Bay-side marsh breaches

PROS

- Less risk of sinking into bay mud
- May help accrete sediment along shoreline
- May reduce shoreline erosion during daily tides

CONS

- High maintenance requirements
- Won’t reduce erosion due to storm surge, only daily tides
- Suited for small marinas- best for attenuating boat wake
- May not provide as much accretion along shoreline


LEGEND
PROJECT AREA
EXISTING MARSH
FLOATING BREAKWATER
N
0
0.5 MI
ORO LOMA MARSH
POSITION AT BREACHES
MEAN LOWER LOW WATER
POSITION AT BREACHES
COGSWELL MARSH
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
STATE ROUTE 92
MT. EDEN CREEK

REEFS AND LIVING BREAKWATERS

Option 4: Wave Screens

OBJECTIVE

Reduce the risk of erosion due to wave action in front of critical infrastructure

DESCRIPTION

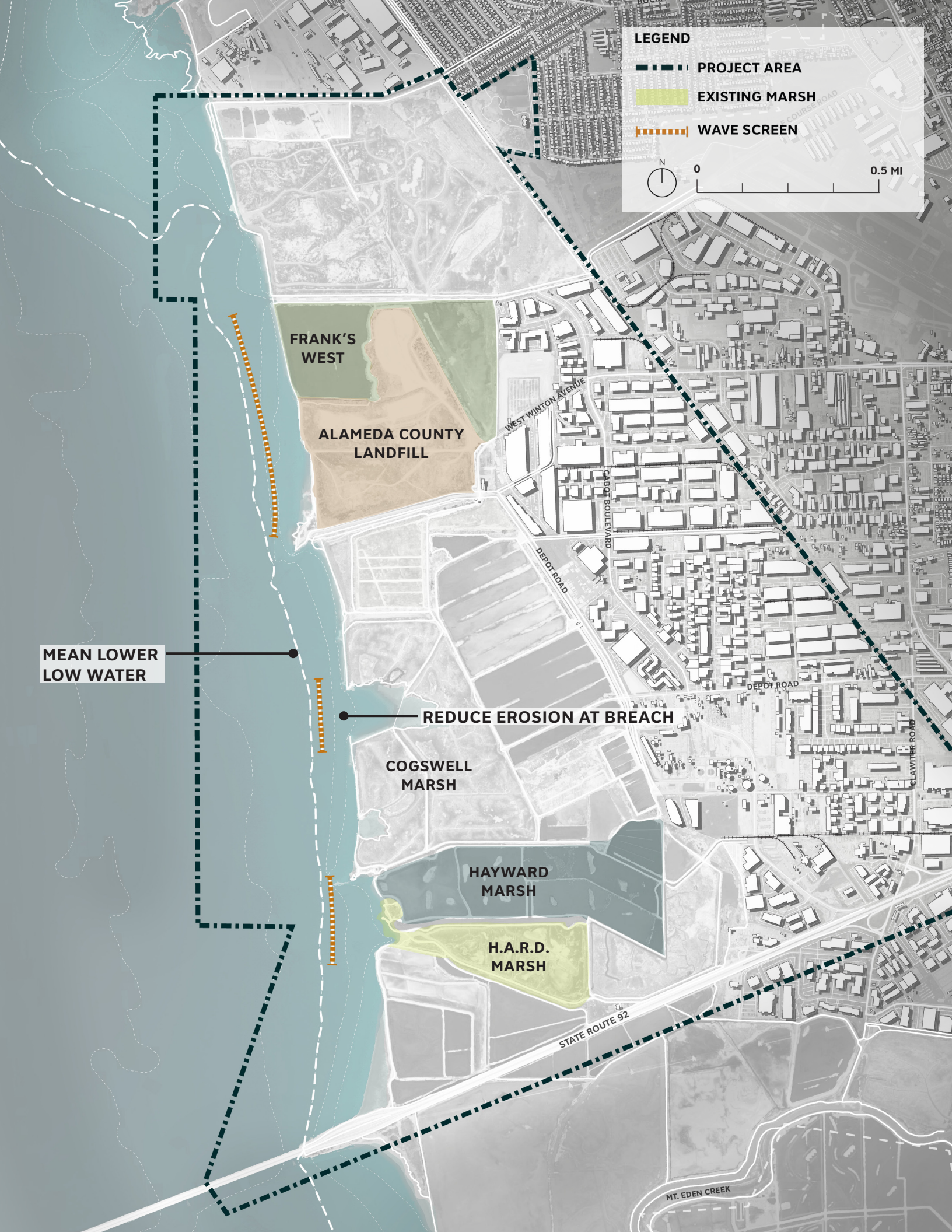
- Wave screens in front of Frank's West Alameda County Landfill, Cogswell Marsh Breach, and Hayward Marsh

PROS

- Structurally sound from deep pile construction
- Could incorporate ECOnconcrete in the panels to provide additional habitat
- May facilitate tidal flow underneath the screen if the lowest panel is lifted off the ground
- Maintains most natural water circulation

CONS

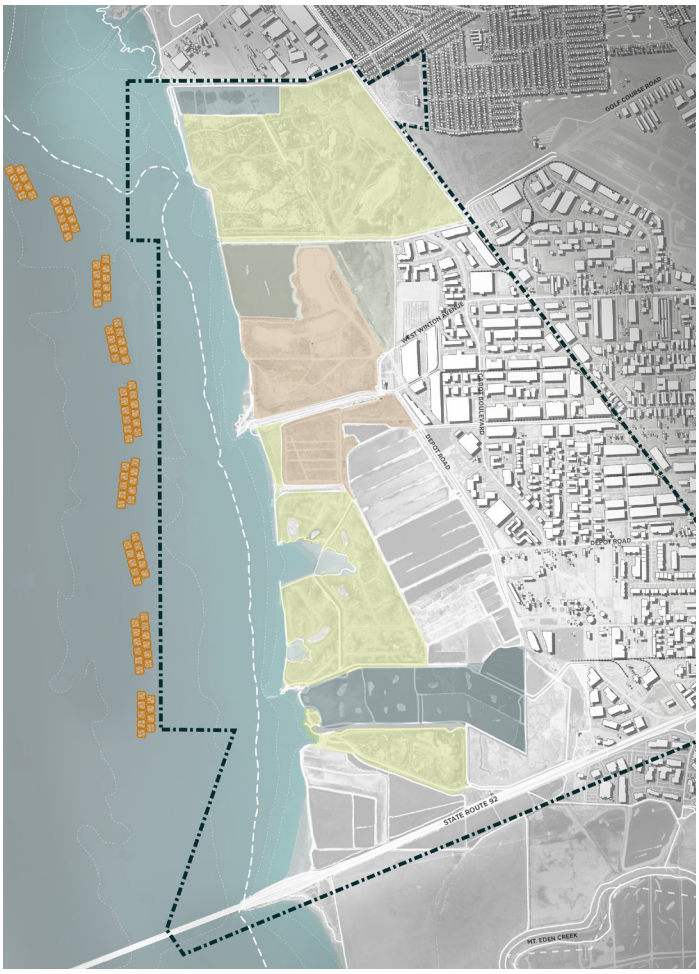
- Potential permitting issues
- May cause wave reflection issues


LEGEND
PROJECT AREA
EXISTING MARSH
WAVE SCREEN
N
0
0.5 MI
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
MEAN LOWER LOW WATER
REDUCE EROSION AT BREACH
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
STATE ROUTE 92
MT. EDEN CREEK

REEFS AND LIVING BREAKWATERS

Stakeholder Feedback

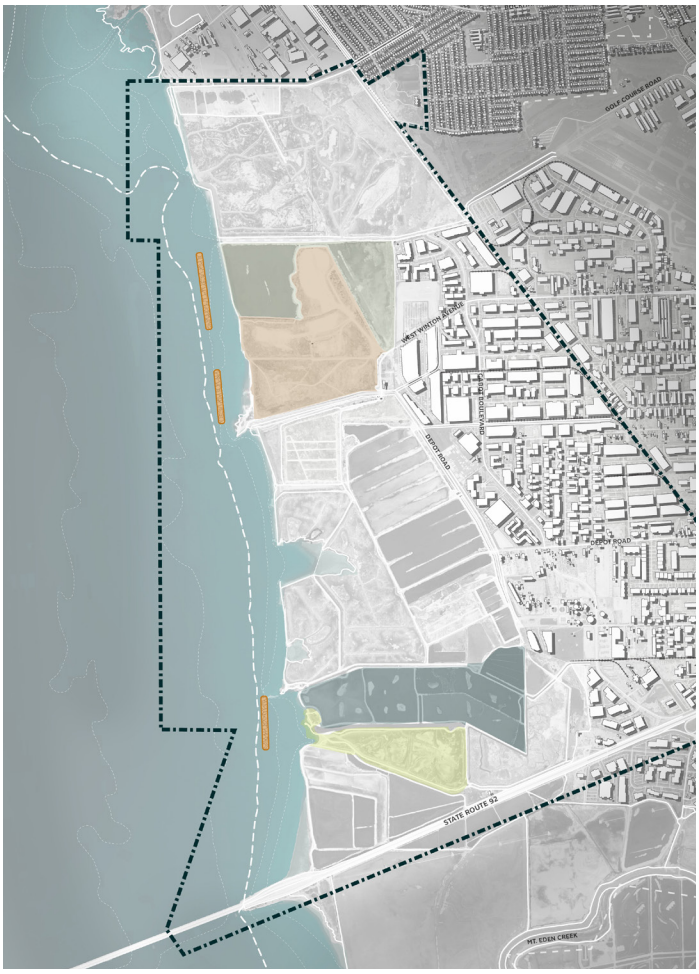
1: Offshore Oyster Reefs



COMMENTS:

- COH noted that oyster reefs may cause issues with the NPDES permit and near shore discharge requirements.
- Hayward Public Works raised a concern over putting oyster beds in the Bay. If oysters are in the Bay, permits won't allow Hayward Public Works to discharge locally.

2: Engineered Breakwaters



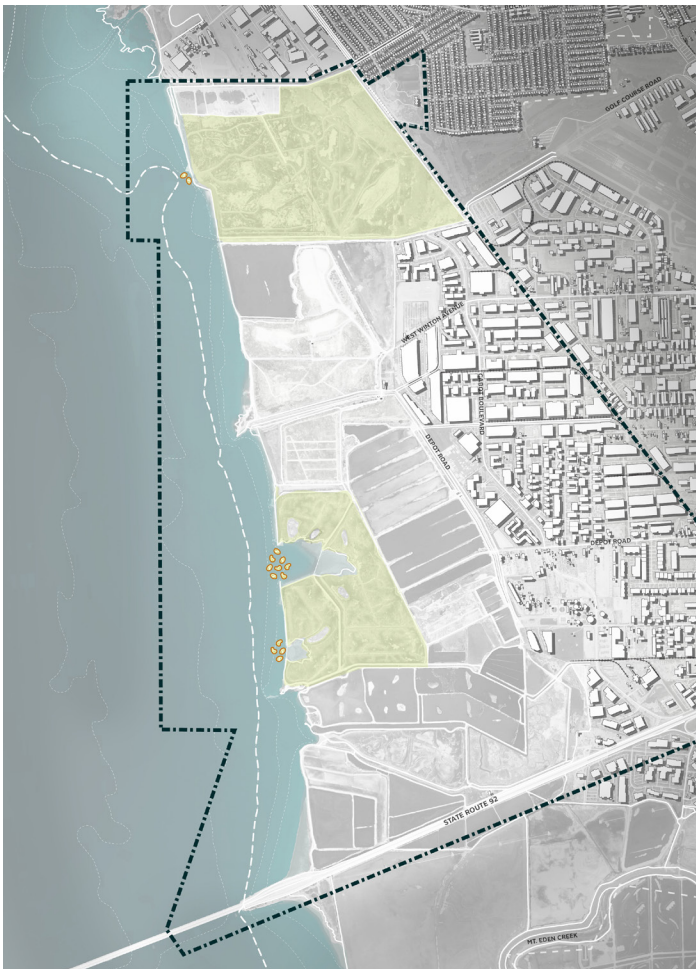
COMMENTS:

- EBRPD expressed concern with engineered breakwaters becoming raptor/predator perches adjacent to the marsh and asked what techniques could be used to prevent perching. If this strategy were to be implemented, additional feasibility studies will be needed to address this question.

GENERAL COMMENTS:

- COH indicated that they are in support of all the options. The park districts should provide input since these options will impact their shoreline assets.

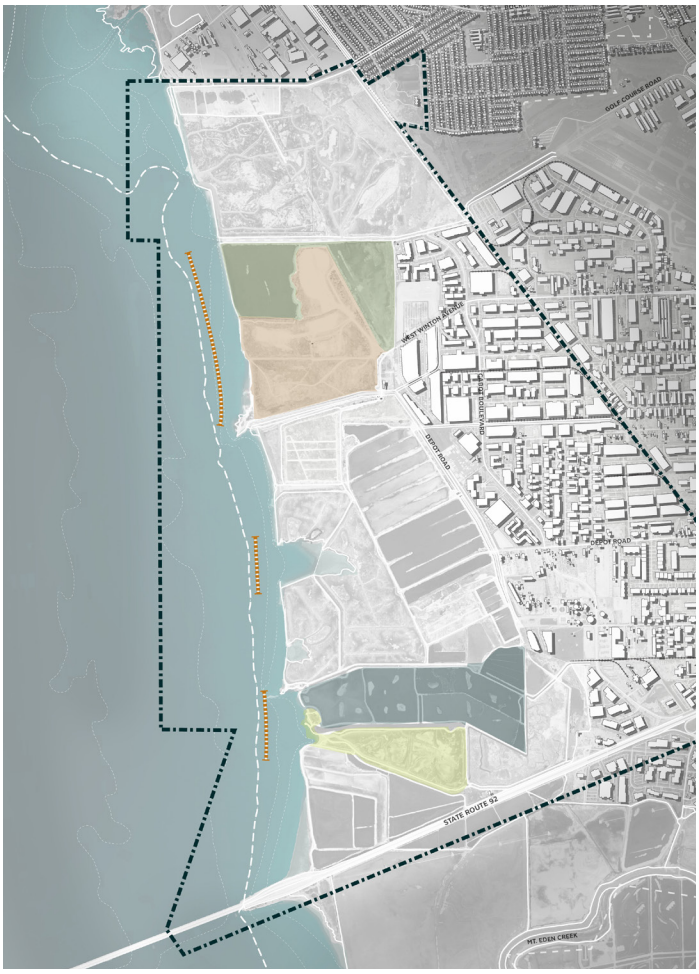
3: Floating Breakwaters at Breaches



COMMENTS:

- See general comments.

4: Wave Screens



COMMENTS:

- EBRPD noted that wave screens seem to require detailed engineering and asked if this technique been used to successfully protect marshes. Smaller scale techniques, such as wood fascines or wave screens made with treated marine timber, have been used to attenuate wave energy and reduce marsh erosion and are successful in certain locations. Harder structures and wave screens with concrete panels are typically found around marinas.
- EBRPD asked about what maintenance will be required. If this strategy were to be implemented, additional feasibility and engineering studies will be needed to address this question.

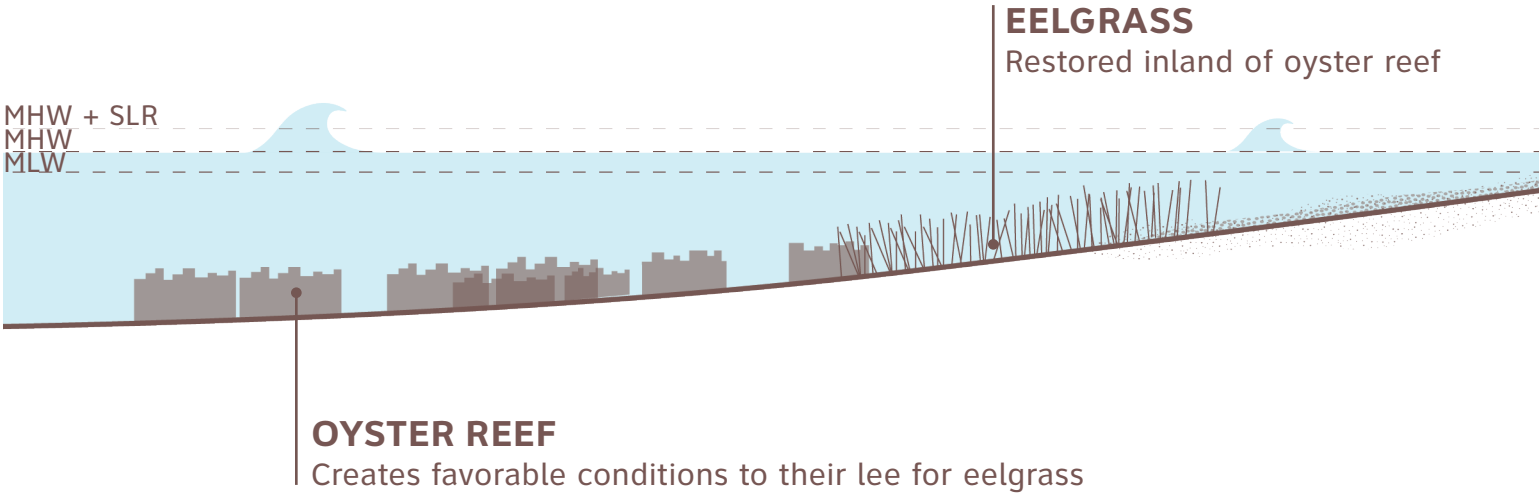
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE

EELGRASS RESTORATION

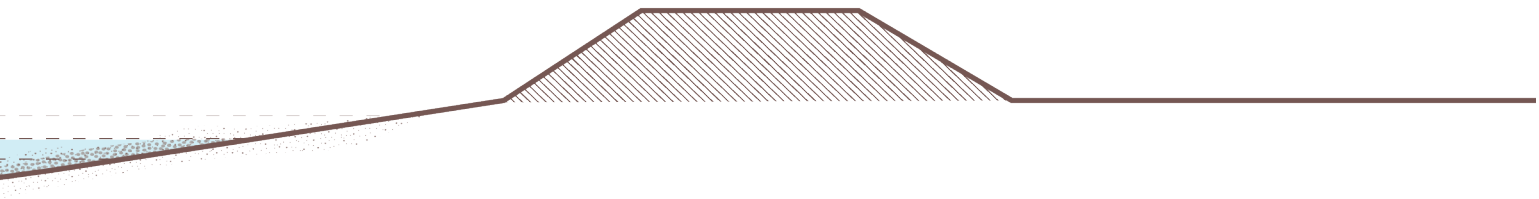
Definition

Eelgrass is **submerged aquatic vegetation** that contributes to **trapping sediment** and **slowing shoreline erosion.** Habitat suitability depends on depth of water, light, current speed, exposure to wind waves, water temperature, and salinity.



OBJECTIVE

- Ecological enhancement (provides habitat)



EELGRASS RESTORATION
Precedents

SCC Living Shorelines Project
Point Pinole, Richmond, CA

Size: 2 acres
Cost: $3 million (cost of pilot, experimentation, monitoring)
Implementation Timeline: 2018

Applicability: Eelgrass restoration is highly site specific and some of the planting methods explored in this project may prove useful if implemented. Eelgrass did better on the shoreside, rather than Bayside, of the reefs.

Description: Eelgrass provides valuable ecological services by supporting diverse communities of invertebrates, fish, and waterfowl. Eelgrass is one of several habitat elements combined at Giant Marsh to create a living shoreline.

- Subtidal habitat restoration of native oyster + eelgrass beds
- Use natural structures to buffer and protect adjacent tidal wetlands



Plan of project restoration



Eelgrass planting

EELGRASS RESTORATION

Option 1: Enhance Existing Bed

OBJECTIVE

Enhance shoreline ecology.

DESCRIPTION

- Restore eelgrass at the larger Cogswell Marsh breach

PROS

- Eelgrass is already located at the breach in conditions that facilitate its growth
- Eelgrass could help minimally reduce erosion as part of a layered ecological shoreline

CONS

- Highly erosive environment
- Eelgrass is highly sensitive to changing environmental conditions


LEGEND
PROJECT AREA
EELGRASS RESTORATION
N
0
0.5 MI
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CITY OF HAYWARD
COGSWELL MARSH BREACH
COGSWELL MARSH
SAN FRANCISCO BAY
STATE ROUTE 92
MT. EDEN CREEK

EELGRASS RESTORATION

Option 2: Promote at Breaches

OBJECTIVE

Enhance shoreline ecology.

DESCRIPTION

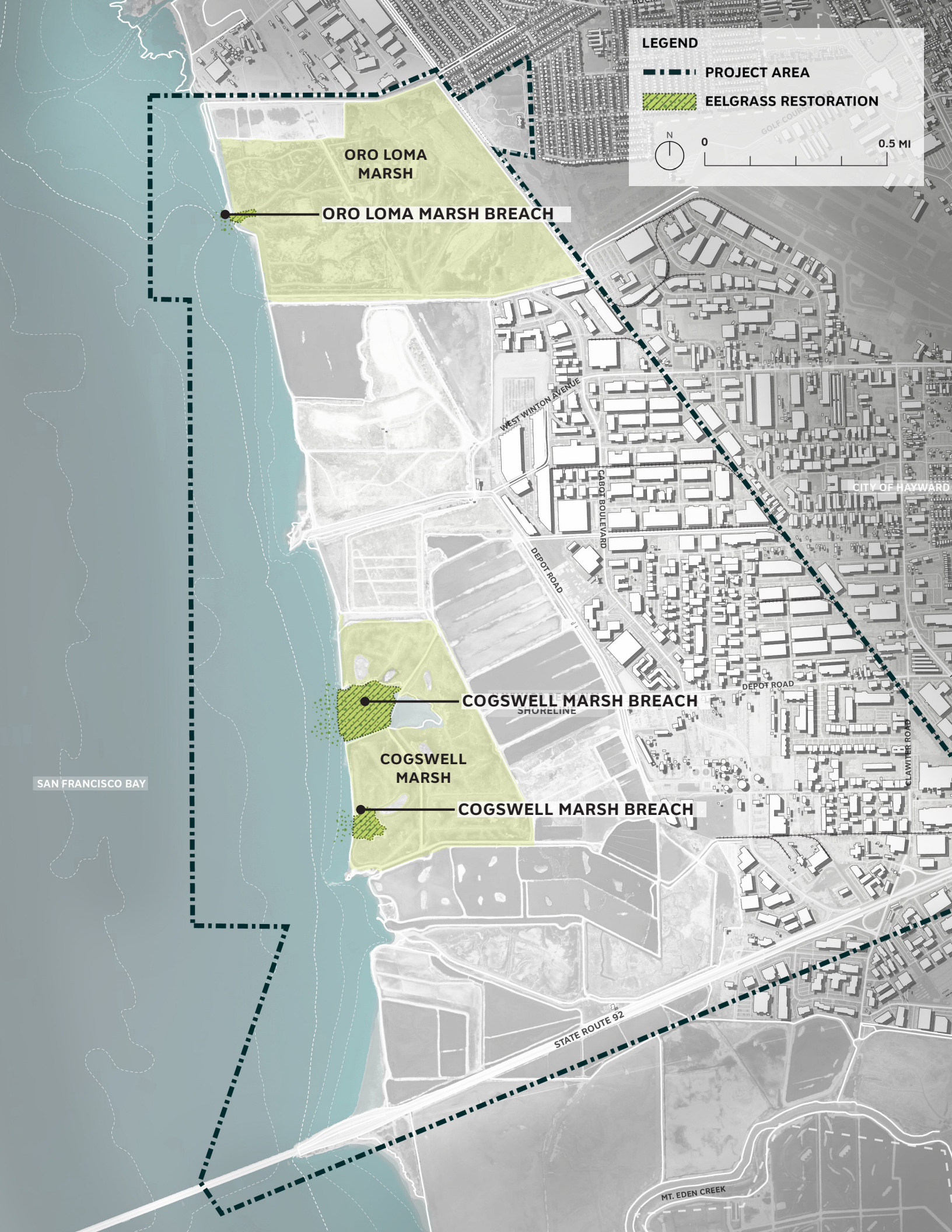
- Restore eelgrass at Oro Loma Marsh breach and Cogswell Marsh breaches

PROS

- Eelgrass could help minimally reduce erosion as part of a layered ecological shoreline

CONS

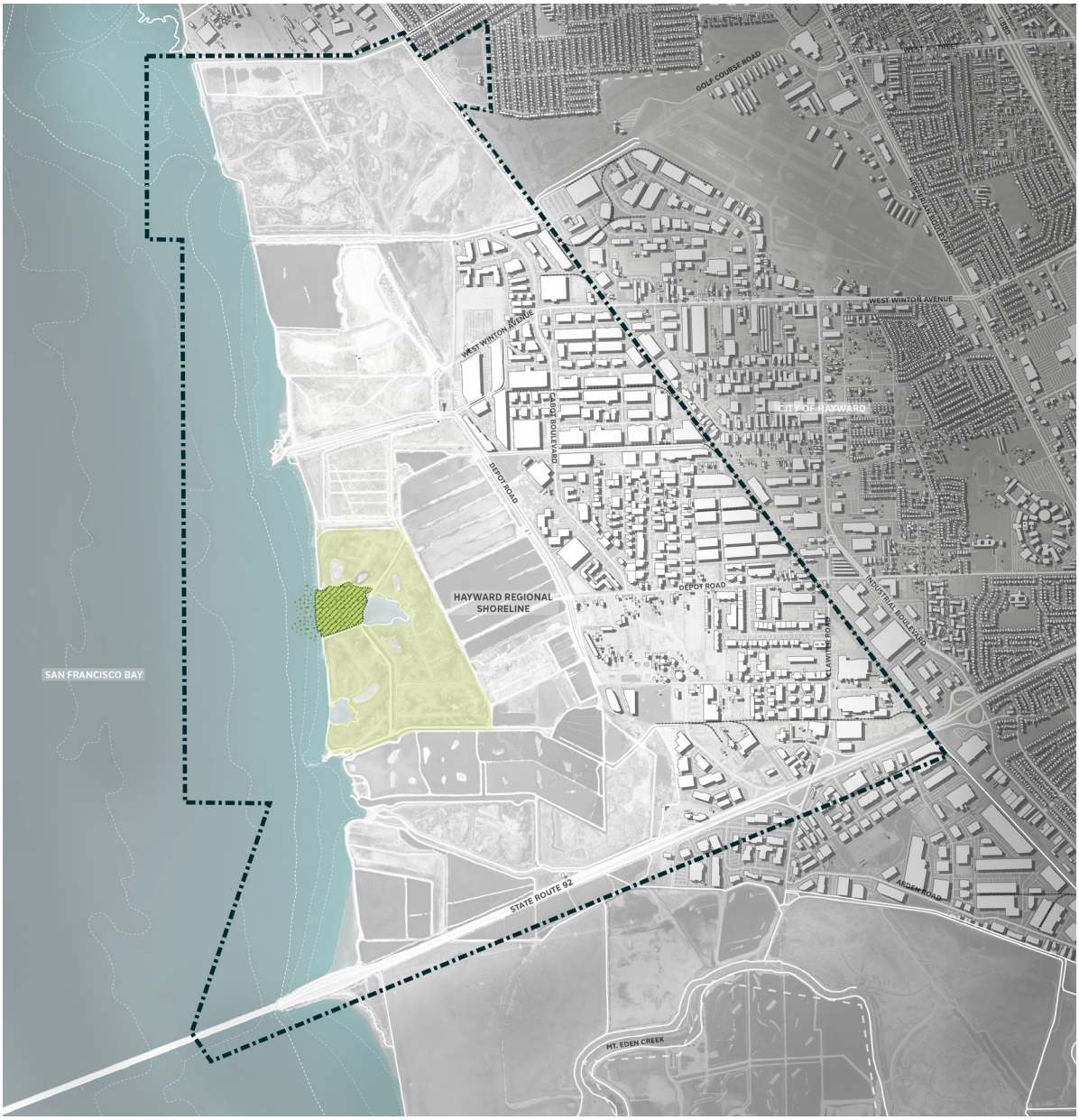
- May not be ideal conditions for eelgrass
- May need to increase open water to encourage eelgrass growth
- Eelgrass is highly sensitive to changing environmental conditions


LEGEND
PROJECT AREA
EELGRASS RESTORATION
N
0
0.5 MI
ORO LOMA MARSH
ORO LOMA MARSH BREACH
COGSWELL MARSH
COGSWELL MARSH BREACH
COGSWELL MARSH BREACH
SAN FRANCISCO BAY
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
CITY OF HAYWARD
STATE ROUTE 92
MT. EDEN CREEK

EELGRASS RESTORATION

Stakeholder Feedback

1: Enhance Existing Bed



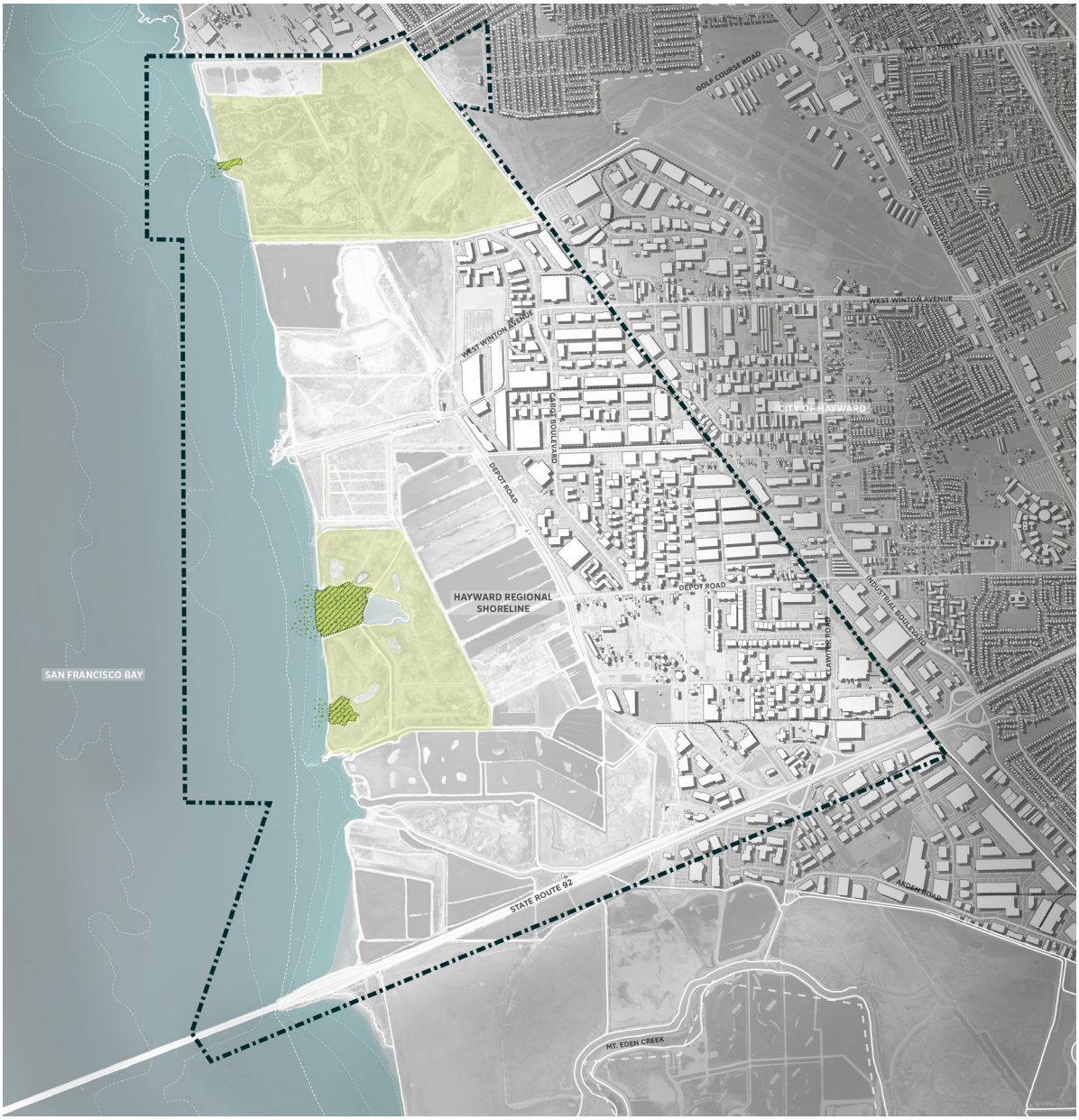
COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- COH indicated that they are in support of all the options. The park districts should provide input here since these options will directly impact their shoreline assets.

2: Promote at Breaches



COMMENTS:

- See General Comments.

ACRONYMS

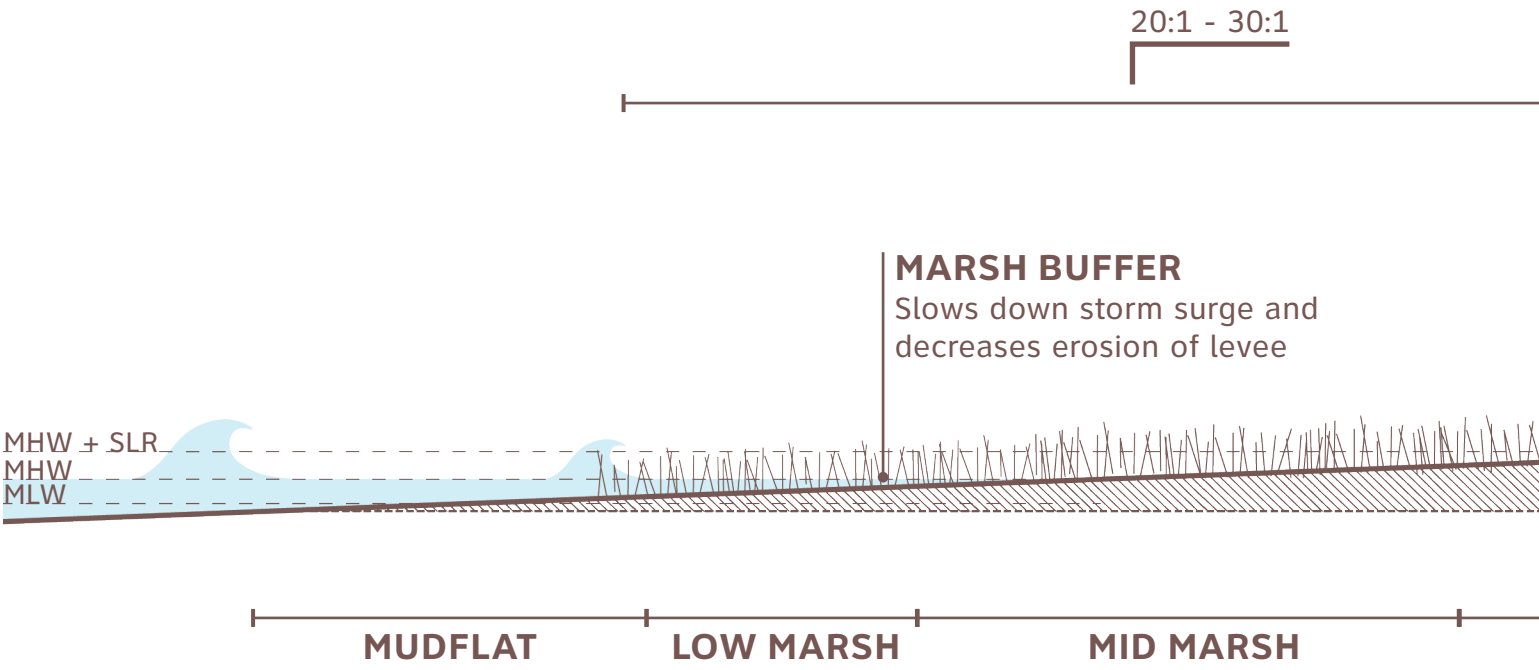
EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE

ENGINEERED STRATEGIES

ECOTONE LEVEE

Definition

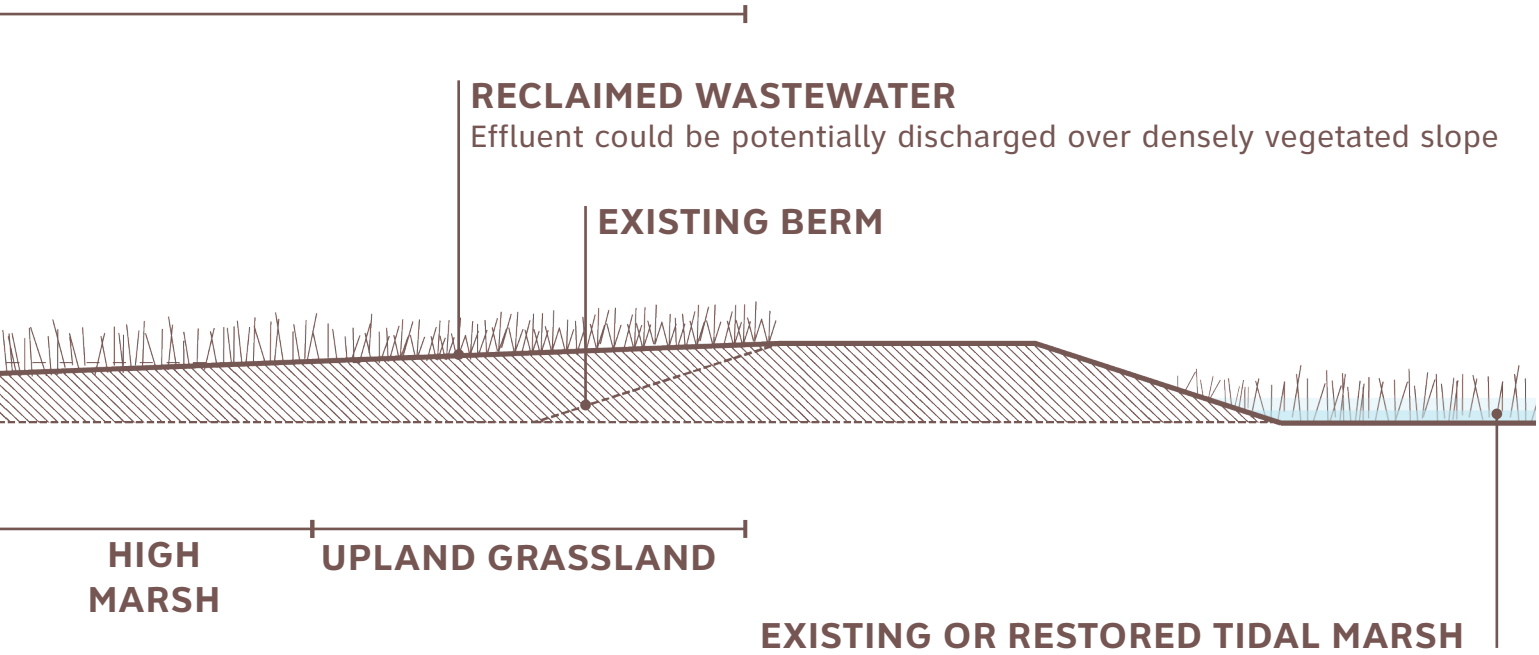
Ecotone levees are **vegetated gentle slopes** or ramps on the bay side of a levee. They can attenuate waves, provide high-tide refuge for marsh wildlife, and allow room for marshes to migrate upslope with sea level rise. Ecotone levees have a **larger footprint** but can provide many **resilience benefits.**



SCAPE

OBJECTIVE

- Provide flood protection
- Enhance ecological function (provide transition zone, marsh migration space)



ECOTONE LEVEE
Precedents

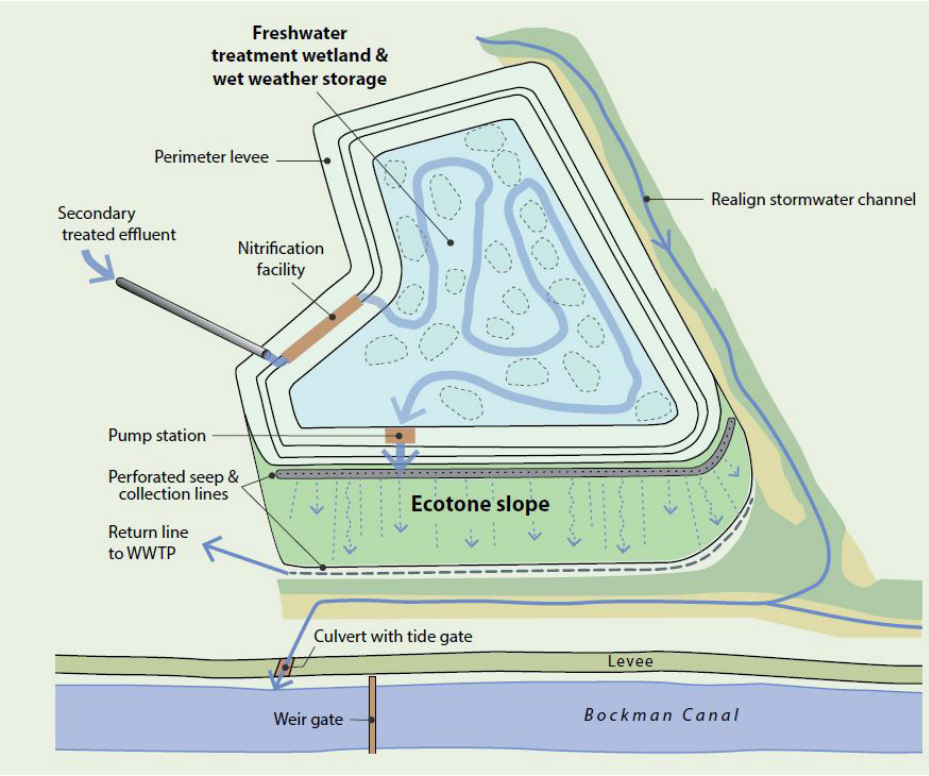
Oro Loma Sanitary District
San Lorenzo, CA

Size: 1.7 acres spread across a 456 LF horizontal levee / 2 acre treatment wetland
Cost: $6.8 million (only cost for experimental facility)
Implementation Timeline: 2014-2017

Applicability: The dual system of wet weather storage and horizontal levee has potential to be deployed at the oxidation ponds with local discharge into an adjacent marsh.

Description: A partnership between the Oro Loma and Castro Valley Sanitary Districts, UC Berkeley, Save the Bay, and others, this project is testing different techniques to utilize natural systems to filter wastewater and protect the shoreline.

- Vegetated slope on Bay side of levee serves as a natural alluvial fan / creek mouth
- Restores groundwater flow that used to occur with treated wastewater
- Vegetated slope of 30H:1V filters the water over 150 linear feet
- Potential to further decentralize EBDA pipeline
- Operated to deliver 30,000-70,000 gpd
- Vegetation establishment has exceeded all expectations- nearly 100% of native cover has been observed. Plants are growing with vigor. Irrigation with nitrogen rich treated effluent has provided abundant water supply and high nutrient loads
- Containment berm was constructed with standards similar to a flood control levee- holds up to 7.5 million gallons of primary treated effluent during extreme wet weather events



Plan diagram of WWTP system



View of ecotone levee

ECOTONE LEVEE
Precedents

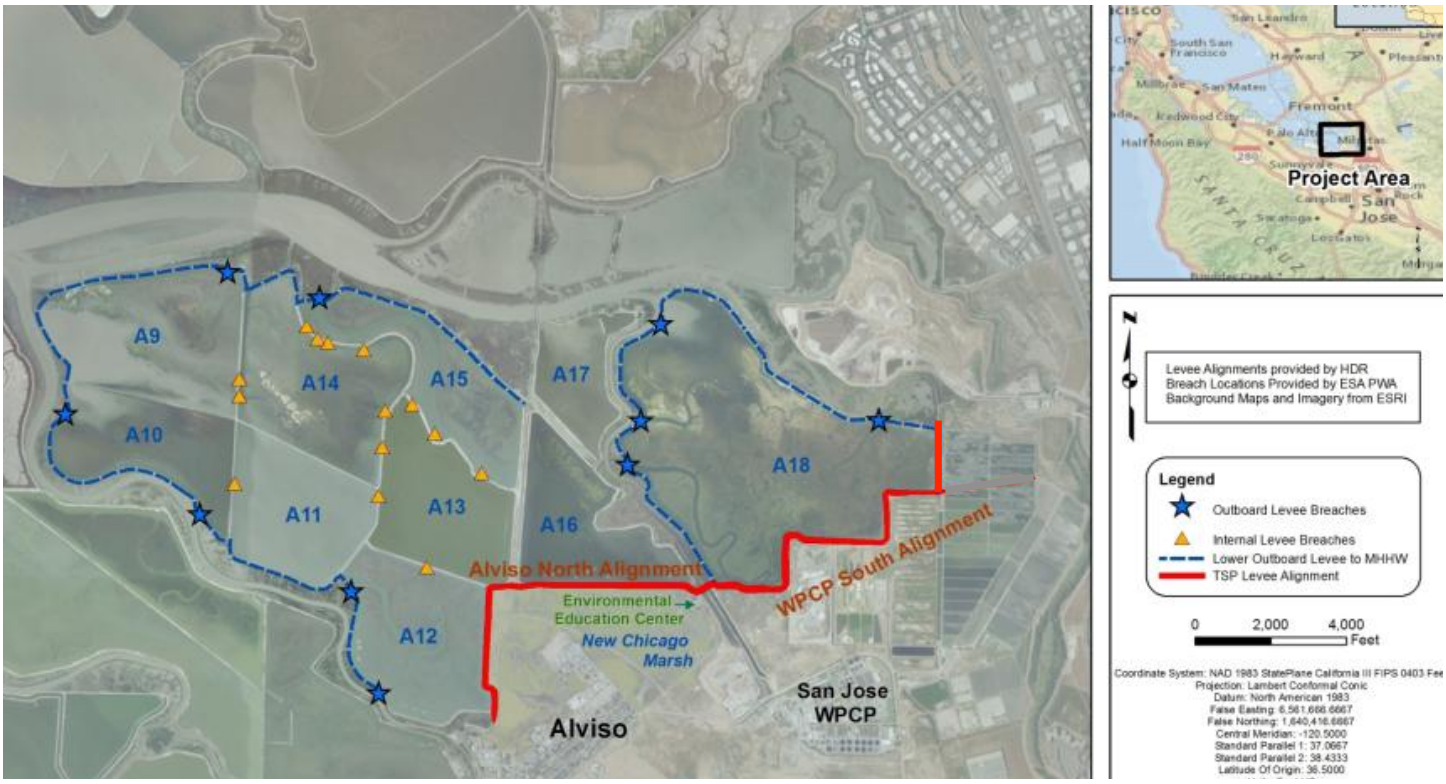
South San Francisco Bay Shoreline Project
Alviso, CA

Size: 4 miles of levee / 2,900 acres of tidal wetlands and transition habitats
Cost: $177 million
Rough Unit Costs: $10k per acre of marsh;
$3.7k per LF of FRM levee + $2.3k per LF of ecotone slope = $6k per LF of levee.
Implementation Timeline: 3 Phases from 2018-2032

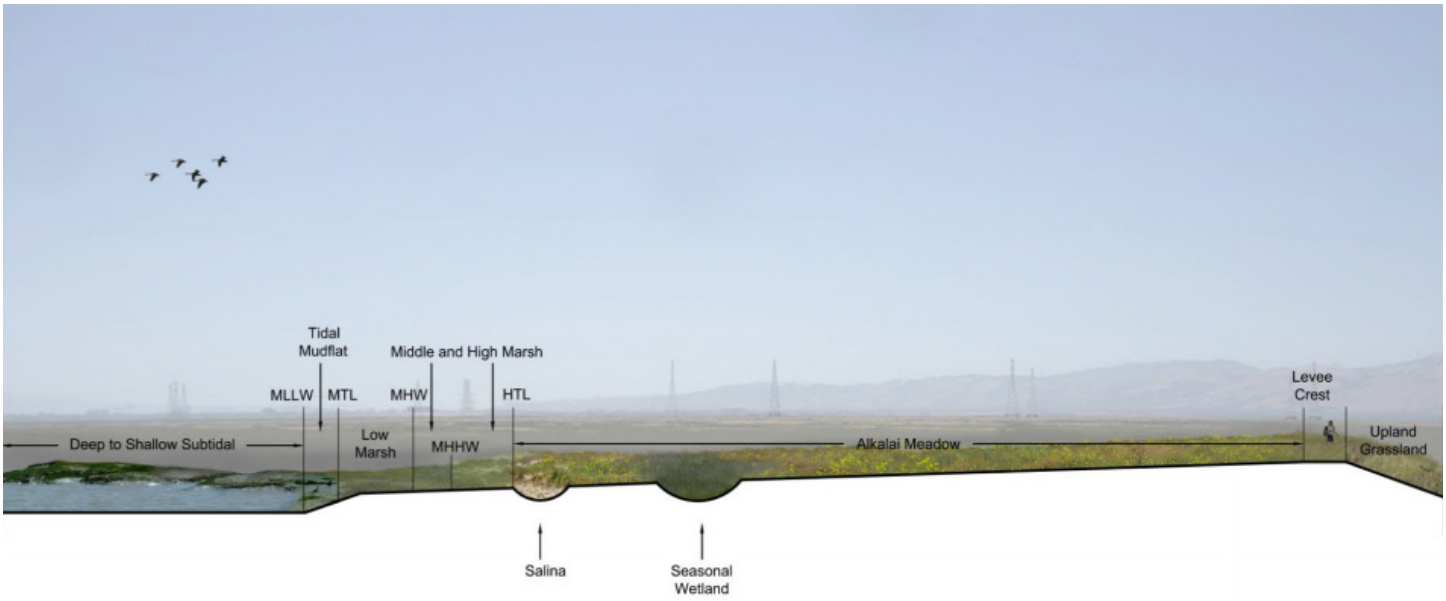
Applicability: This layered shoreline with multi-benefit infrastructure manages flood risk for adjacent communities while incorporating ecosystem restoration and increasing habitat. An ecotone levee is more resilient and adaptable over time.

Description: Uses natural infrastructure to provide increased flood protection, restore Bay habitats, evolve in the future, and to allow public access.

- Authorized by the USACE, Santa Clara Valley Water District, and the SCC
- Ties into existing accredited levees on both ends of the project
- Combination of traditional levee and ecotone levee with restored marsh
- Utilizes flood protection levees and wetlands
- Provides key connections to the SF Bay Trail and viewpoints
- Manages flood risk for population of ~5,500, ~1,100 and a regional wastewater facility



Plan of proposed levee alignments



Section diagram of flood protection levee, ecotone slope, and wetlands

ECOTONE LEVEE

Option 1: Protect Critical Infrastructure

OBJECTIVE

Reduce risk to critical infrastructure (Hayward WWTP and CalPine / Russell Energy Center). Enhance marsh migration space and transition zone.

DESCRIPTION

- Ecotone levee from SR-92 to Depot Road
- Depot Road raised, ties back to high ground
- Standard levee along SR-92 that ties back to high ground

PROS

- Existing tidal connections remain
- Some water control structures will be preserved (Line A)
- Increased level of flood protection for an anticipatory potential increase in frequency of storm events

CONS

- May require a portion of Line E to be relocated
- Oxidation ponds are unprotected
- Substantial electrical capacity would be required to operate pump stations behind the levee
- Predators may roost on the ecotone levee


LEGEND
PROJECT AREA
ECOTONE LEVEE
LOW ← HIGH
NEW PUMP STATION
FLOOD CHANNEL
PROTECTED FLOOD CHANNEL
STANDARD LEVEE / RAISED ROAD
N
0
0.5 MI
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
LINE A
WEST WINTON LANDFILL
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
LINE E
RAISED DEPOT ROAD
INDUSTRIAL
CALPINE / RUSSELL CITY ENERGY CENTER PROVIDES POWER TO 600,000 HOMES
HAYWARD WWTP TREATS 11.3 MILLION GALLONS OF WASTEWATER PER DAY
TIES BACK TO HIGH GROUND
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

ECOTONE LEVEE

Option 2: Maintain Oxidation Ponds

OBJECTIVE

Provide flood protection for a majority of the southern portion of the industrial business district. Enhance marsh migration space and transition zone.

DESCRIPTION

- Ecotone levee that extends from SR-92, on the Bayward side of the Oxidation Ponds, and ties back to the West Winton Landfill
- Levee raising along Line E to prevent inundation with 4’ of SLR
- Utilize the Oxidation Ponds for multi-purpose wet weather storage (groundwater, stormwater, wet weather equalization)

PROS

- Increases level of flood protection from a potential increase in the frequency and severity of storm events

CONS

- Requires the management of a larger amount of stormwater on the inland side of the levee through increased storage space or pump stations
- Substantial electrical capacity would be required to operate pump stations behind the levee
- Predators may roost on the ecotone levee
- Negatively impacts Cogswell Marsh


LEGEND
PROJECT AREA
ECOTONE LEVEE
LOW ⟵ HIGH
NEW PUMP STATION
FLOOD CHANNEL
PROTECTED FLOOD CHANNEL
STANDARD LEVEE / RAISED ROAD
N
0
0.5 MI
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
LINE A
WEST WINTON LANDFILL
WEST WINTON AVENUE
CABOT BOULEVARD
RAISED ROAD
LINE E
TIES BACK TO HIGH GROUND OF LANDFILL
FORMER OXIDATION PONDS
DEPOT ROAD
INDUSTRIAL
CALPINE / RUSSELL CITY ENERGY CENTER PROVIDES POWER TO 600,000 HOMES
HAYWARD WWTP TREATS 11.3 MILLION GALLONS OF WASTEWATER PER DAY
COGSWELL MARSH
HAYWARD MARSH
TIES BACK TO HIGH GROUND
H.A.R.D. MARSH
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

ECOTONE LEVEE
Option 3: Upland Levee

OBJECTIVE

Reduce risk to critical infrastructure and provide flood protection for inland neighborhoods. Enhance marsh migration space and transition zone.

DESCRIPTION

- Ecotone Levee
- Pump stations along Line A, Sulphur Creek, and Bockman Channel
- Standard levee tie back along SR-92 to high ground

PROS

- Provides potential groundwater (pumped from underground), stormwater, and WWTP wet weather equalization storage areas in oxidation ponds
- Allows for upland marsh migration
- Increases level of flood protection from a potential increase in the frequency of storm events
- Low-gradient slope does not need to be constructed from highly engineered levee core

CONS

- Requires the management of more stormwater on the inland side of the levee with increased storage space or pump stations
- Substantial electrical capacity would be required to operate pump stations behind the levee
- Dependent on levee raising along the rail corridor outside of the project boundary to the north
- Line A unprotected, Line E to be relocated
- FEMA does not certify transition slope levees and would not recognize the flood protection benefits of this levee in their flood maps
- Construction would require filling the bay and modifying shoreline topography- requires multiple permits
- Predators may roost on the ecotone levee
- Negatively impacts Cogswell Marsh


TIES BACK ALONG RAIL CORRIDOR
LEGEND
PROJECT AREA
ECOTONE LEVEE
LOW ← HIGH
NEW PUMP STATION
FLOOD CHANNEL
PROTECTED FLOOD CHANNEL
STANDARD LEVEE / RAISED ROAD
N
0
0.5 MI
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
LINE A
WEST WINTON LANDFILL
TIES BACK TO HIGH GROUND OF LANDFILL
TIES BACK TO HIGH GROUND OF LANDFILL
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
CALPINE / RUSSELL CITY ENERGY CENTER PROVIDES POWER TO 600,000 HOMES
HAYWARD WWTP TREATS 11.3 MILLION GALLONS OF WASTEWATER PER DAY
TIES BACK TO HIGH GROUND
WEST WINTON AVENUE
WEST WINTON AVENUE
CA BOULEVARD
LINE E
DEPOT ROAD
INDUSTRIAL
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

ECOTONE LEVEE

Option 4: Upland Levee Alternate

OBJECTIVE

Reduce risk to critical infrastructure and provide flood protection for inland neighborhoods. Enhance marsh migration space and transition zone.

DESCRIPTION

- Ecotone Levee
- Pump stations along Line A, Sulphur Creek, and Bockman Channel
- Standard levee tie back along SR-92 to high ground

PROS

- Fewer LF of ecotone levee while still providing a full 'line of protection'
- Potential groundwater (pumped from underground), stormwater, and WWTP wet weather equalization storage areas in oxidation ponds
- Allows for upland marsh migration
- Increases level of flood protection from a potential increase in the frequency of storm events
- Low-gradient slope does not need to be constructed from highly engineered levee core

CONS

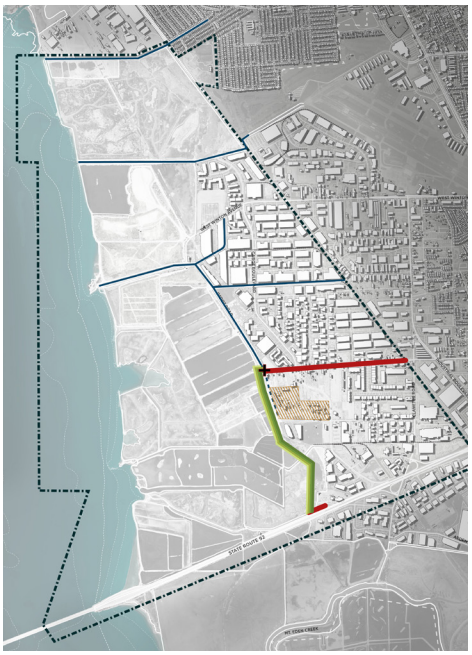
- Requires the management of more stormwater on the inland side of the levee with increased storage space or pump stations
- Substantial electrical capacity would be required to operate pump stations behind the levee
- Dependent on levee raising along the rail corridor outside of the project boundary to the north
- Line A unprotected, Line E to be relocated
- FEMA does not certify transition slope levees and would not recognize the flood protection benefits of this levee in their flood maps
- Construction would require filling the bay and modifying shoreline topography- requires multiple permits
- Predators may roost on the ecotone levee
- Negatively impacts Cogswell Marsh


TIES BACK ALONG RAIL CORRIDOR
LEGEND
PROJECT AREA
ECOTONE LEVEE
LOW ← HIGH
NEW PUMP STATION
FLOOD CHANNEL
PROTECTED FLOOD CHANNEL
STANDARD LEVEE / RAISED ROAD
N
0
0.5 MI
ORO LOMA MARSH
SULPHUR CREEK
TIES BACK TO HIGH GROUND OF LANDFILL
FRANK'S WEST
WEST WINTON AVENUE
ALAMEDA COUNTY LANDFILL
LINE A
TIDE GATE AND TIE BACK TO HIGH GROUND OF LANDFILLS
WEST WINTON LANDFILL
LINE E
TIES BACK TO HIGH GROUND OF LANDFILL
FORMER OXIDATION PONDS
DEPOT ROAD
INDUSTRIAL
CALPINE / RUSSELL CITY ENERGY CENTER PROVIDES POWER TO 600,000 HOMES
HAYWARD WWTP TREATS 11.3 MILLION GALLONS OF WASTEWATER PER DAY
COGSWELL MARSH
HAYWARD MARSH
TIES BACK TO HIGH GROUND
H.A.R.D. MARSH
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

ECOTONE LEVEE

Stakeholder Feedback

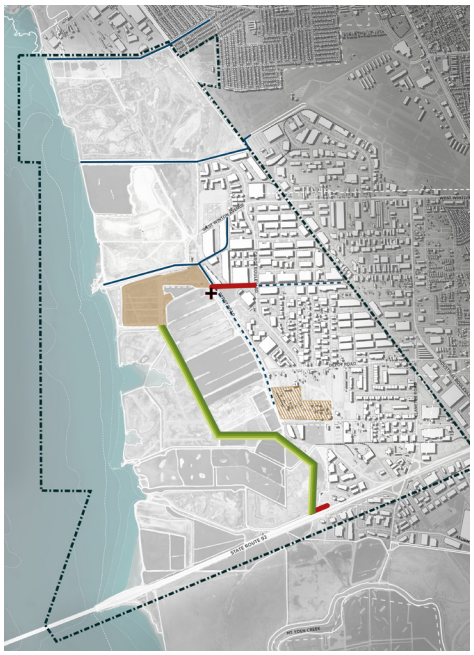
1: Protect Critical Infrastructure



COMMENTS:

- See General Comments.

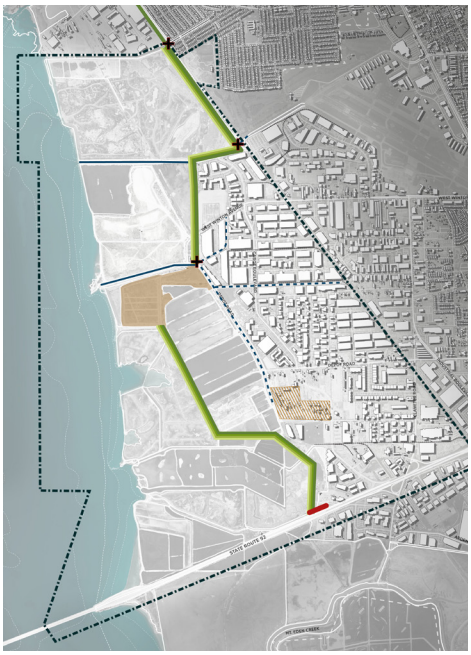
2: Maintain Oxidation Ponds



COMMENTS:

- See General Comments.

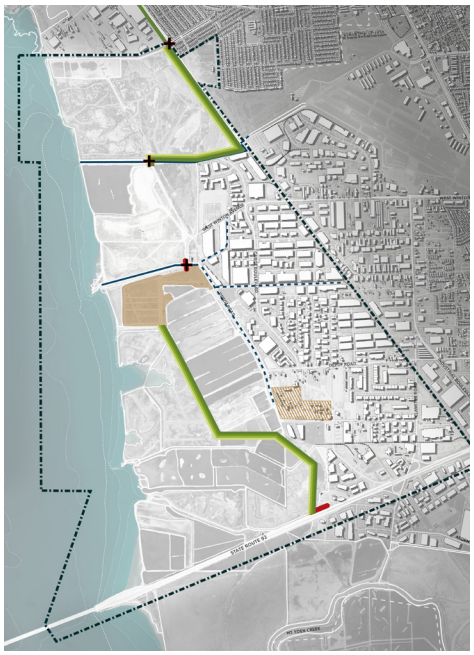
3: Upland Levee



COMMENTS:

- ACFCD expressed that moving the line of protection as far inland as possible is preferable.
- ACFCD wants to move the tide gate at Bockman Channel closer to the rail corridor, as shown. However, if Oro Loma Marsh becomes muted, the current location of the tide gate could be maintained.
- EBDA confirmed that the alignment along the rail corridor in the back of Oro Loma Marsh is generally in the area they have been considering for the First Mile project.
- EBDA noted that the horizontal levee would treat a very small amount of wastewater, based on the Oro Loma demonstration project. There is no scenario where all of EBDA's wastewater could be treated using this feature.

4: Upland Levee Alternate



COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- EBRPD expressed concern over predators.
- EBRPD suggested moving the ecotone levee to the back of the oxidation ponds. The oxidation ponds provide critical WWTP infrastructure and the City of Hayward would like to preserve their uses and storage capacity.
- COH noted that the options need review by the City of Hayward's Public Works Utilities staff.
- A stakeholder (during the Stakeholder Meeting #2) noted that the acquisition of fill is a big area of concern.
- A stakeholder (during the Stakeholder Meeting #2) brought up the potential to tap into hazard mitigation funds, potentially large amounts of money through FEMA for creating habitat to offset infrastructure (marsh restoration + ecotone levee).
- A stakeholder (during the Stakeholder Meeting #2) discussed findings from the State of the Estuary Conference: The salt marsh harvest mice aren't really using the upland transition zone. They are swimming around and staying put, due to predators or maybe competitors. Suggest providing more localized shelter such as small trellis-like structures for high tide refugia.
- BCDC does have policies regarding transition zones. Habitat impacts are more of an issue for the resource agencies: depending on where fill is placed, it may not be in BCDC's jurisdiction. If a zone is tidally inundated, it is in BCDC jurisdiction.
- BCDC noted that it is great to see the idea of pulling back the line of protection to create a layered system.
- BCDC's policies for climate change state that projects have to be resilient to mid-century SLR (2050). Shoreline protection is based on the life of a project. The design must show adaptability with a suite of adaptation options for 2100. These projections are med-high risk level with high emissions: 2050 1.9' SLR + 100 year storm, 2100 6.9' SLR + 100 year storm.
- BCDC advised to think about setting the levee in a location where it could be build it higher in the future.
- ACFCD noted that for a coastal system, ACFCD typically uses a 100-year storm event for flood protection.
- ACFCD suggests 2' for SLR, 2' for freeboard on top of the existing 100-year event.
- ACFCD noted that for FEMA certification, the elevation has to be at least 2' above the existing 100-year event. ACFCD will not build a levee that is not FEMA certified.
- ACFCD expressed concerns over an ecotone levee being used for WWTP effluent since it is considered a "wet levee" and might not receive FEMA certification.
- HASPA indicated a preference for inland ecotone levees with effluent discharge. This might be more expensive, but it does open up potential funders.
- Oro Loma Wastewater Treatment Plant noted that because it is so far out in the Bay with limited space, it would be hard to implement a horizontal levee around the plant. The sludge ponds have more room for a natural levee system.
- SFEI advised that freshwater seep over the ecotone slope inhibits the growth of invasive species. There is a problem with habitat conversion with any fill into existing marshes.
- SFEI noted that the construction of the levee would likely require an impermeable membrane to separate the FEMA certified levee from the slope and seepage zone.
- EBDA indicated that you wouldn't build a horizontal levee without a FEMA certified levee in the back.

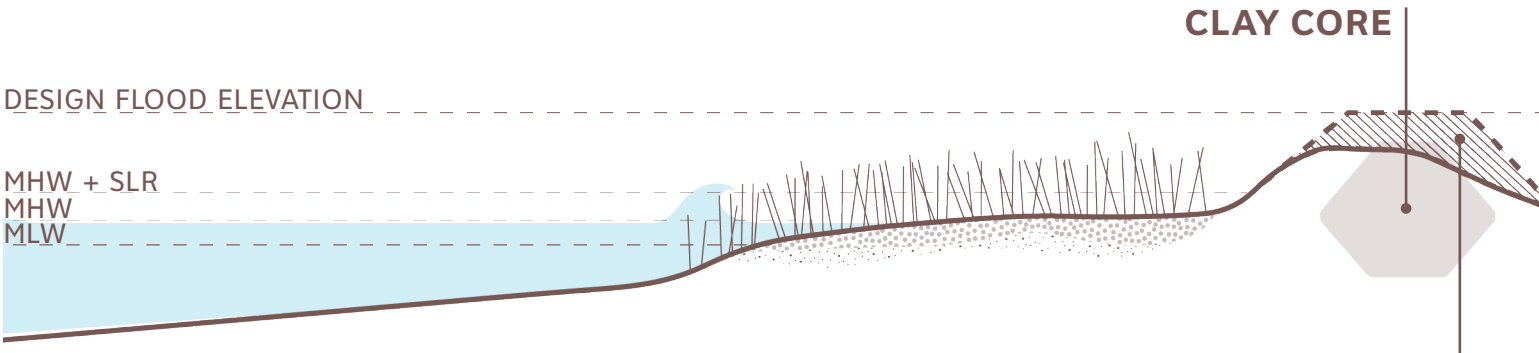
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
HASPA: Hayward Area Shoreline Planning Agency
SFEI: San Francisco Estuary Institute
ACFCD: Alameda County Flood Control District
Teal text indicates a response from SCAPE

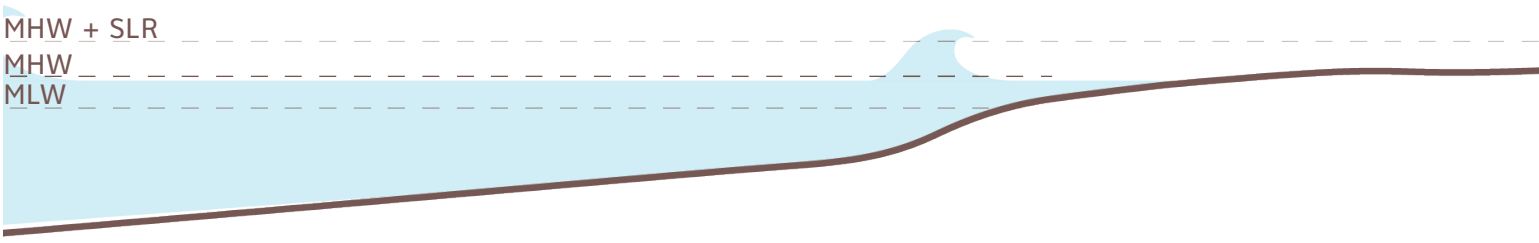
LEVEE IMPROVEMENTS

Definition

Existing levees can be raised, repaired, or strengthened to **increase their resiliency** to storms and sea level rise.



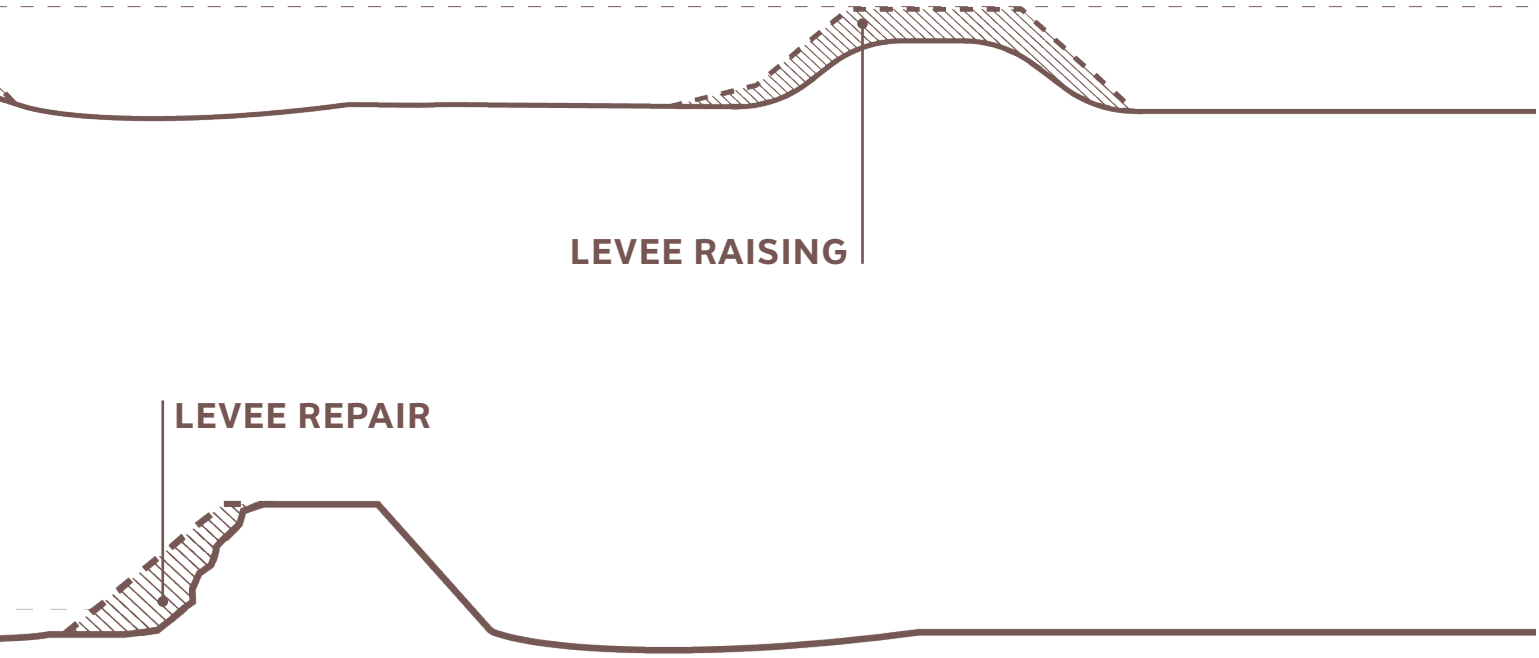
LEVEE RAISING



LEVEE REPAIR

OBJECTIVE

- Provide further flood protection
- Reduce erosion to marshes / infrastructure in their lee
- Enhance recreational opportunities



LEVEE IMPROVEMENTS
Precedents

Southport Sacramento River Levee Improvement Project
Sacramento, CA

Size: 5.6 mile levee
Cost: $80 million
Implementation Timeline: 2017-2018

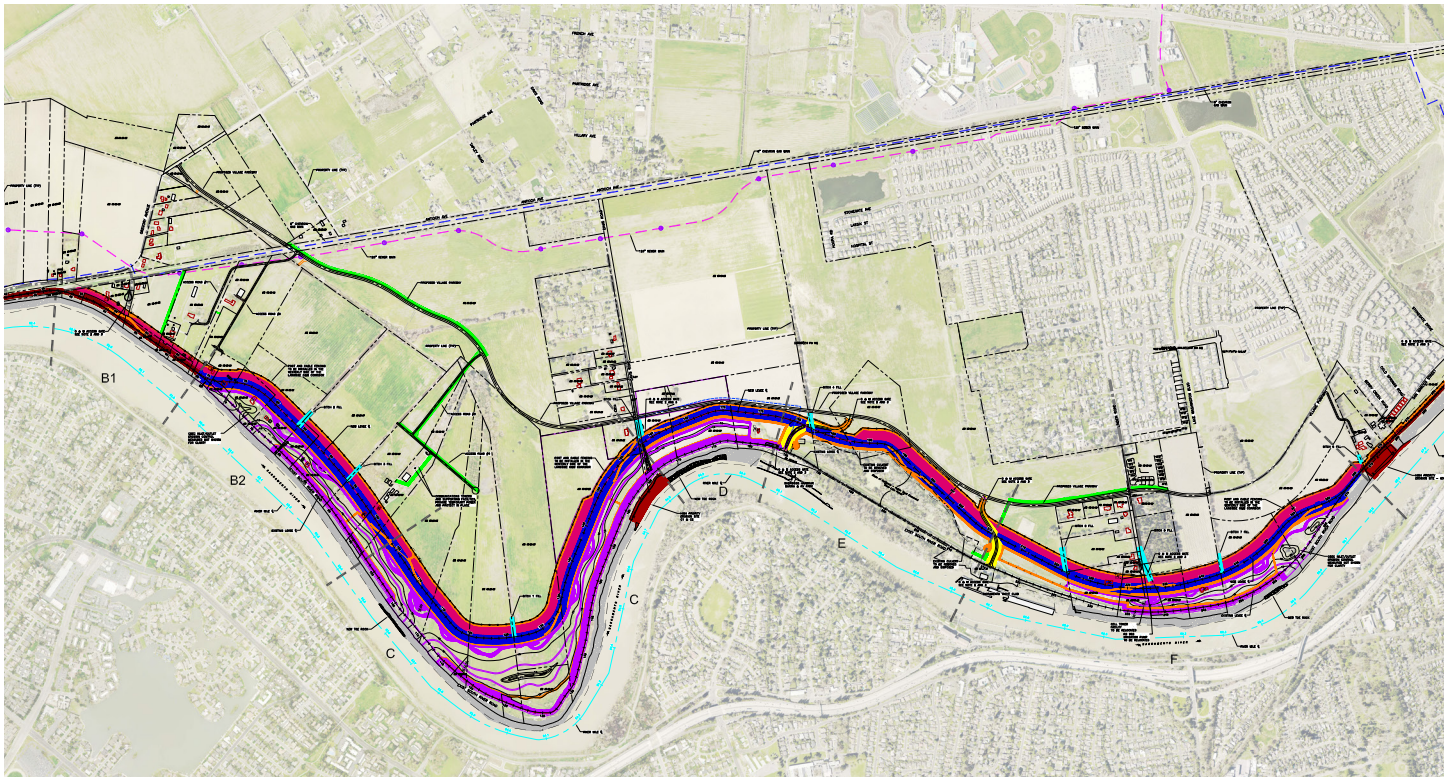
Applicability: Selected levee repairs and setbacks combine with congruent strategies to improve flood protection and provide other benefits. Repairing and enhancing existing levees along the shoreline may prove useful for inland flood protection and enhanced ecosystem services.

Description: A combination of existing levee improvements and embankment setbacks will increase flood protection and repair the most vulnerable part of the City's levee system to achieve a 200-year minimum level of levee performance for West Sacramento.

- Flood-risk reduction measures along vulnerable levee segments of the Sacramento River
- Includes construction of levee embankment, cutoff walls, seepage berms, and associated relocation and improvement measures
- An increased floodplain between the old and new levee allows for wetland creation and increased storage space



View of levee improvements



Plan for levee improvements

LEVEE IMPROVEMENTS

Option 1: Targeted Raising

OBJECTIVE

Reduce risk of levee overtopping and provide flood protection.

DESCRIPTION

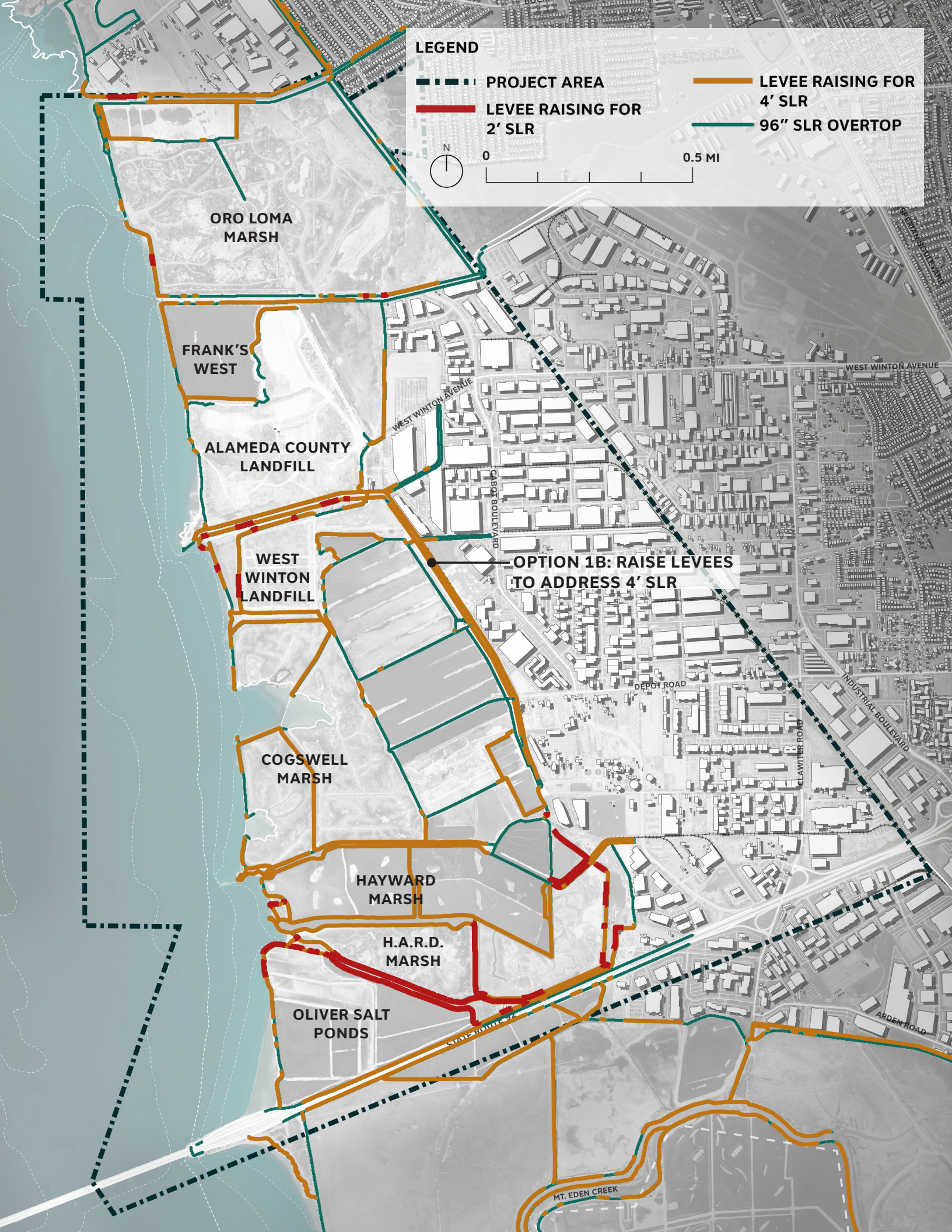
- Raise all levees that are projected to overtop with 2’ of SLR

PROS

- May help prevent localized flooding and erosion

CONS

- Short-term strategy that only addresses a 2’ SLR scenario
- Does not address future storm surge or sea level rise
- Does not account for freeboard- levees may still overtop with storm surge or wave action


LEGEND
PROJECT AREA
LEVEE RAISING FOR 2′ SLR
LEVEE RAISING FOR 4′ SLR
96″ SLR OVERTOP
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
OPTION 1B: RAISE LEVEES TO ADDRESS 4′ SLR
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CLAWITER ROAD
INDUSTRIAL BOULEVARD
ARDEN ROAD
MT. EDEN CREEK

LEVEE IMPROVEMENTS
Option 2: Address 4’ of SLR

OBJECTIVE

Reduce risk to critical infrastructure and provide flood protection to inland communities.

DESCRIPTION

- Raise and repair inland levees for flood risk management
- Raise and repair levees along flood control channels
- Maintain Bay levees to reduce erosion

PROS

- Provides full protection to upland communities
- Prevents flooding from sea level rise in most areas
- Permits may be easier to attain if there is precedent in the area
- Preserves existing infrastructure, less disruptive than demolishing or replacing with a new construction

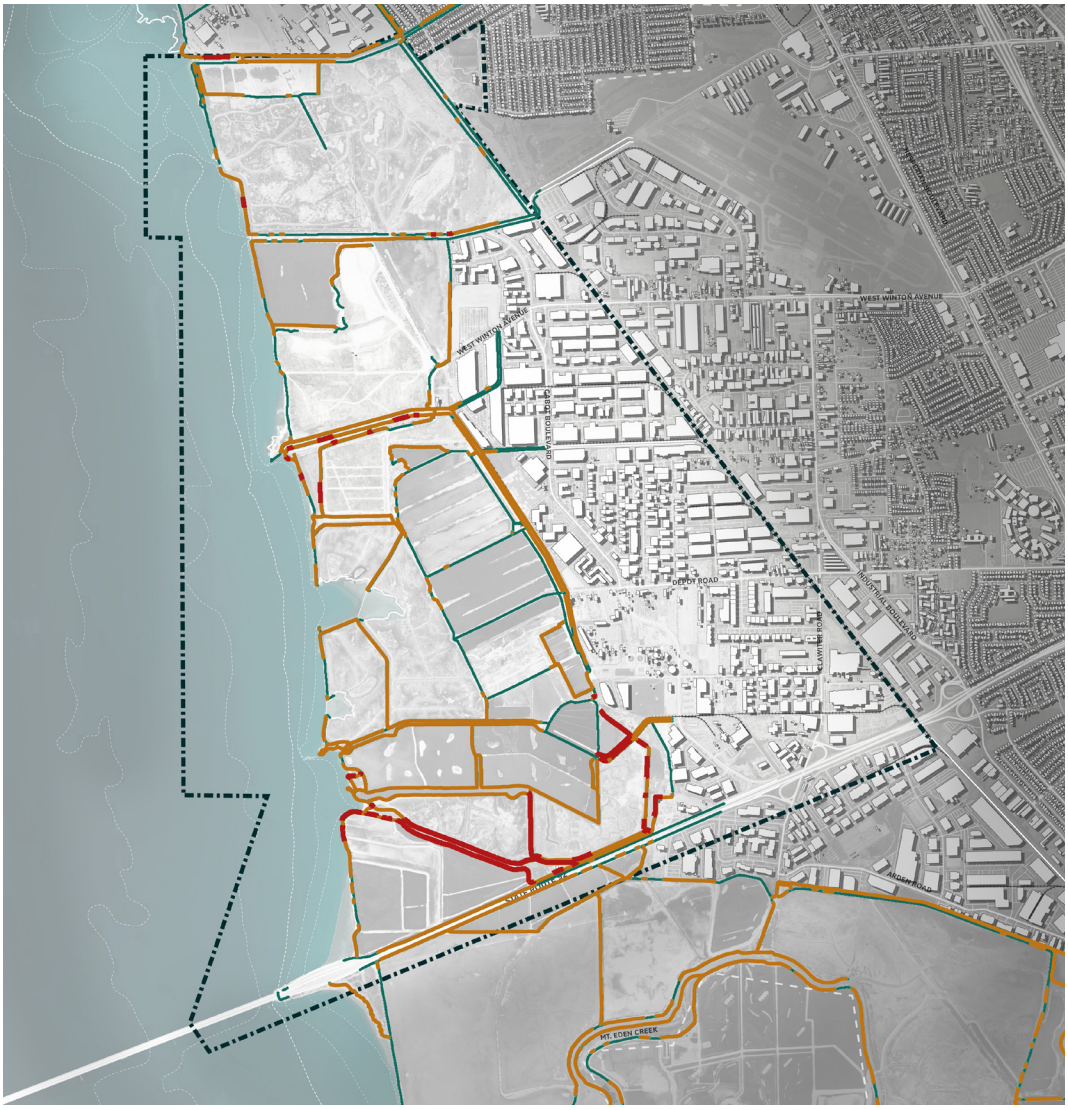
CONS

- Requires pump stations on all flood control channels or increased inland stormwater storage space
- Removes tidal connection for all marshes
- Levees could be extremely tall and wide
- May cause displacement of people, infrastructure and wildlife
- May require the demolition of pre-existing structures to raise ground
- Mid-term strategy that only addresses a 4’ SLR scenario


TIES BACK ALONG RAIL CORRIDOR
LEGEND
PROJECT AREA
FLOOD RISK MANAGEMENT LEVEE
WATER CONTROL BERM
EROSION CONTROL BERM
LEVEE RAISING
NEW TIDE GATE
PUMP STATION
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
FLOOD CONTROL CHANNEL LEVEE RAISING
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

LEVEE IMPROVEMENTS
Stakeholder Feedback

1: Targeted Repairs



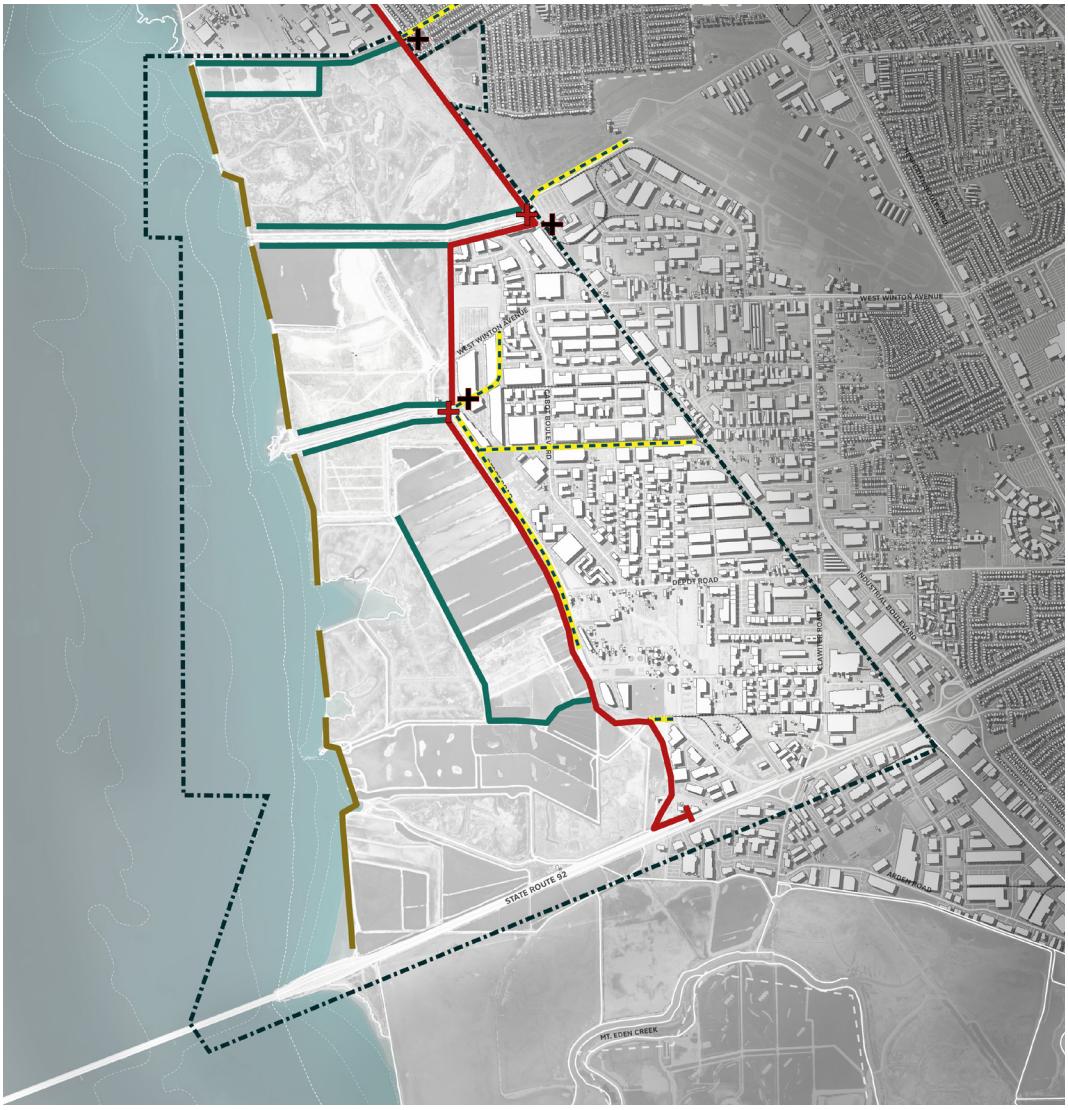
COMMENTS:

- ACFCD does not recommend this option. It would require repair to too many levees that would be exposed and outboard of a “line of defense”.

GENERAL COMMENTS:

- COH is generally supportive of all levee improvements that will ultimately protect the City’s industrial area. The City of Hayward Public Works Utilities staff will need to comment on their assets and if levee improvements are acceptable to their team.
- A stakeholder (during the Stakeholder Meeting #2) noted that it is difficult to build levees in certain environments because levees weren’t built to flood control standards. Access and the transport of materials is also a concern, especially further into the Bay.
- ACFCD recommends accounting for freeboard when setting the levees’ height.

2: Address 4’ of SLR



COMMENTS:

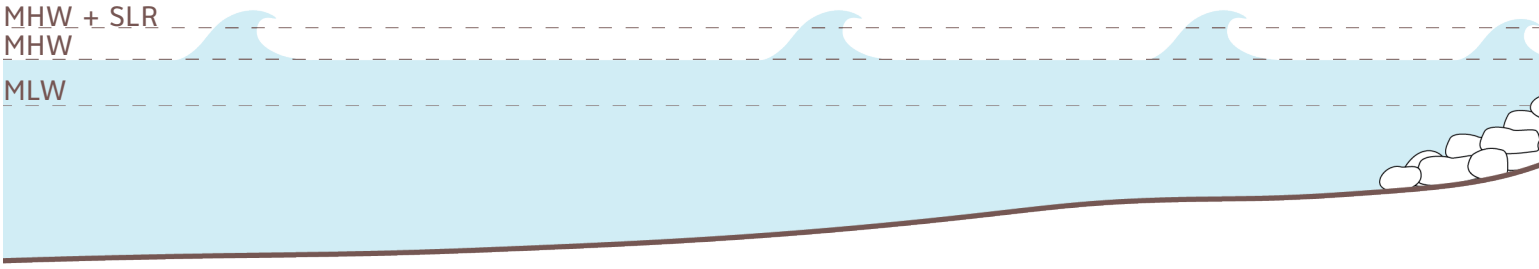
- ACFCD recommends utilizing the water control berms to align a horizontal levee.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
ACFCD: Alameda County Flood Control District
Teal text indicates a response from SCAPE

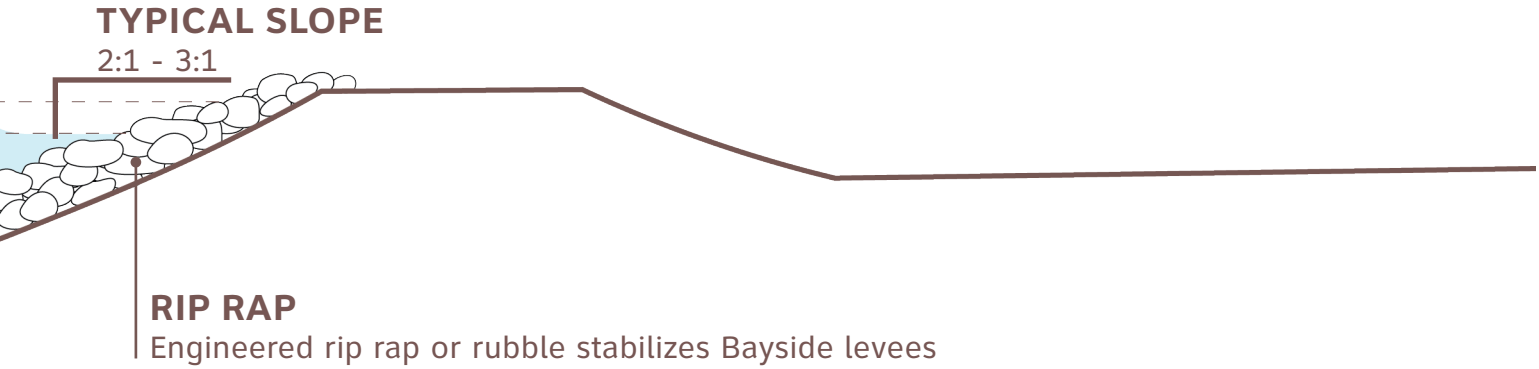
REVETMENTS
Definition

Edge stabilization provides **protection along tidal areas to prevent wave erosion.** Revetments are hardened structures made of concrete, rocks, wood, or other materials that are placed along waterways to **stabilize them against wave erosion**. Riprap, which is rock or concrete rubble, is the most common form of shoreline protection revetment structure in San Francisco Bay.



OBJECTIVE

- Reduce erosion along levees, landfills, and marshes



REVETMENTS
Precedents

Eastern Scheldt Dike Enhancement
The Netherlands

Size: 1.25 miles
Cost: ~ $370/LF
Implementation Timeline: 2008-2013

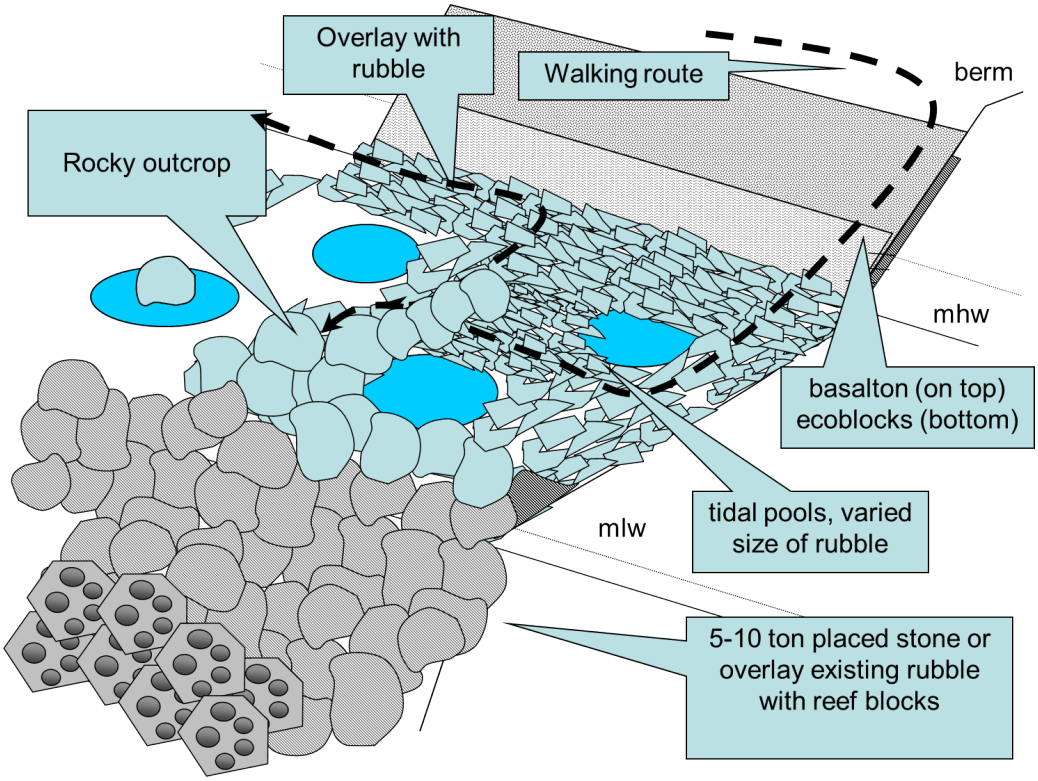
Applicability: Ecological enhancement can be tied to the implementation of new and existing dike improvement projects, adding habitat near shoreline marshes and spurring ecological processes (e.g reef building) that increase coastal resiliency. However, species found in rocky habitats may not flourish in the muddy shore of the Hayward shoreline.

Description: Dike enhancement included the provision of tidal pools, or "eco-basins," intended to improve biodiversity and bio-productivity.

- Important design parameters include the shape and the slope of the structure, the choice of materials, the size distribution, and the porosity of the structure
- Materials such as limestone and lava stone were selected to provide different substrates for species to attach to. Stones were loosely stacked to provide spaces that shelter species from predators. Stones are heavy enough to withstand the forces of wave impact
- The design could be tailored to provide habitat for reef builders such as mussels and oysters (including associated species, such as crabs), or for macro-algae, which provide habitat for fish and invertebrates
- A design with dune or salt marsh vegetation could be achieved at the supratidal level



Tidal pool along stabilized revetment



Dike enhancement components

REVETMENTS
Precedents

Foster City Levee
Foster City, CA

Size: 8 miles
Cost: $75 million
Implementation Timeline: 2015-ongoing

Applicability: Targeted revetments along levees reduces outboard erosion and could be combined with other strategies for additional food protection benefits.

Description: Foster City improved the existing levee system to provide flood protection in accordance with updated FEMA guidelines and regained FEMA levee accreditation. The flood maps of 2014 showed levee vulnerability, which required the raising and repair of levee segments.

- Roughly 85% of the levee system does not meet FEMA requirements
- FEMA granted Foster City a temporary "seclusion mapping" designation in 2015 to remain classified as Zone X, as long as progress was made to address the deficiencies of the levee



Aerial view of proposed levee improvement project. Source: Adapting to Rising Tides



Rip rap levee along Beach Park Blvd, looking north

REVETMENTS

Option 1: Address Current Erosion Issues

OBJECTIVE

Reduce erosion at vulnerable locations.

DESCRIPTION

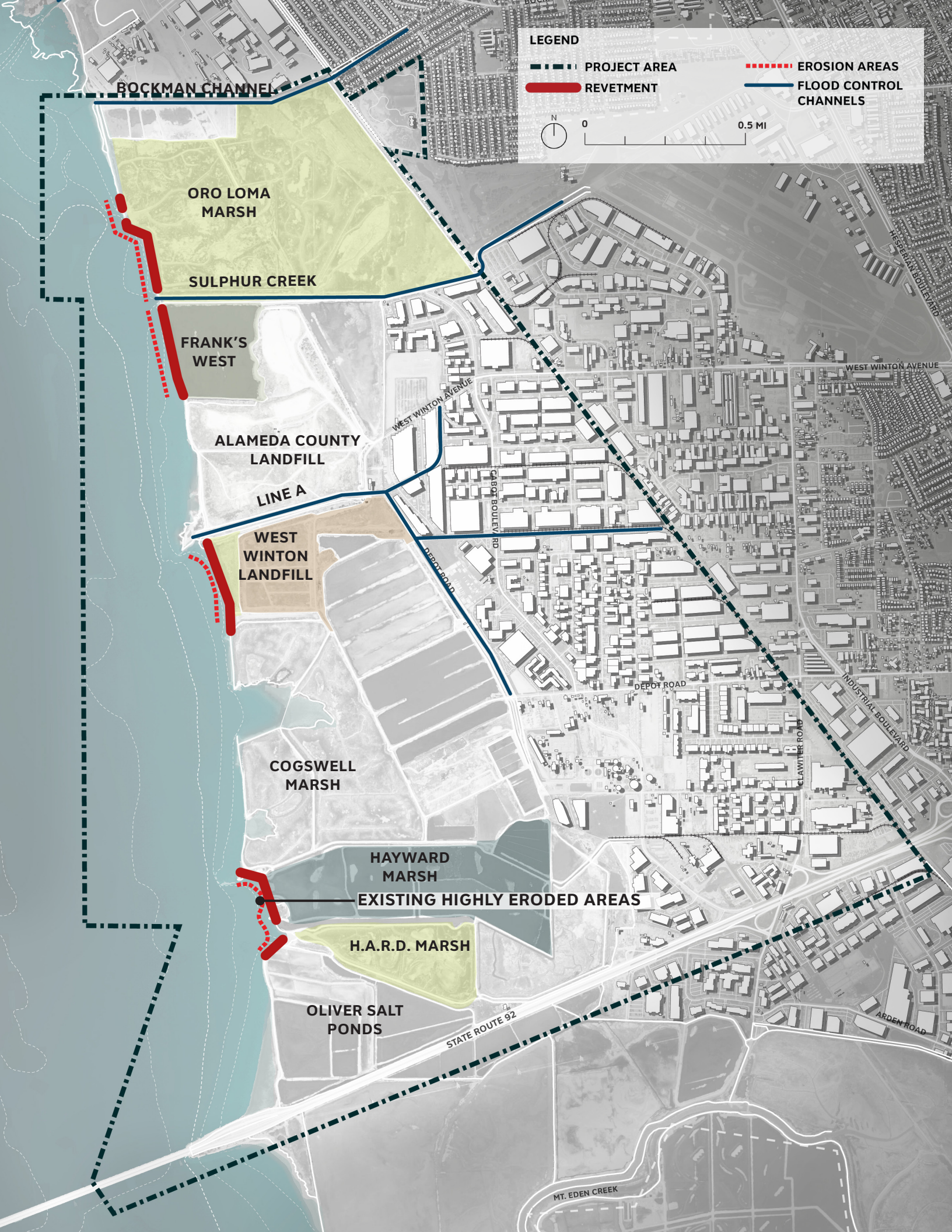
- New revetments along the Bayside berms at Oro Loma Marsh, Frank's West, Triangle Marsh, and Hayward Marsh

PROS

- Stabilizes landfill edges / erosion control
- More cost-effective than bulkheads or seawalls
- Can be designed to provide habitat value
- May facilitate water access
- Can incorporate habitat for animal and plant species

CONS

- Requires more space for implementation (typically 2:1 slope)
- Requires multiple permits


LEGEND
PROJECT AREA
REVETMENT
EROSION AREAS
FLOOD CONTROL CHANNELS
N
0
0.5 MI
BOCKMAN CHANNEL
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
LINE A
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
EXISTING HIGHLY ERODED AREAS
H.A.R.D. MARSH
OLIVER SALT PONDS
STATE ROUTE 92
MT. EDEN CREEK
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CLAWITER ROAD
INDUSTRIAL BOULEVARD
ARDEN ROAD
HESPERIAN BOULEVARD

REVETMENTS

Option 2: Stabilize Vulnerable Infrastructure

OBJECTIVE

Reduce erosion to critical infrastructure

DESCRIPTION

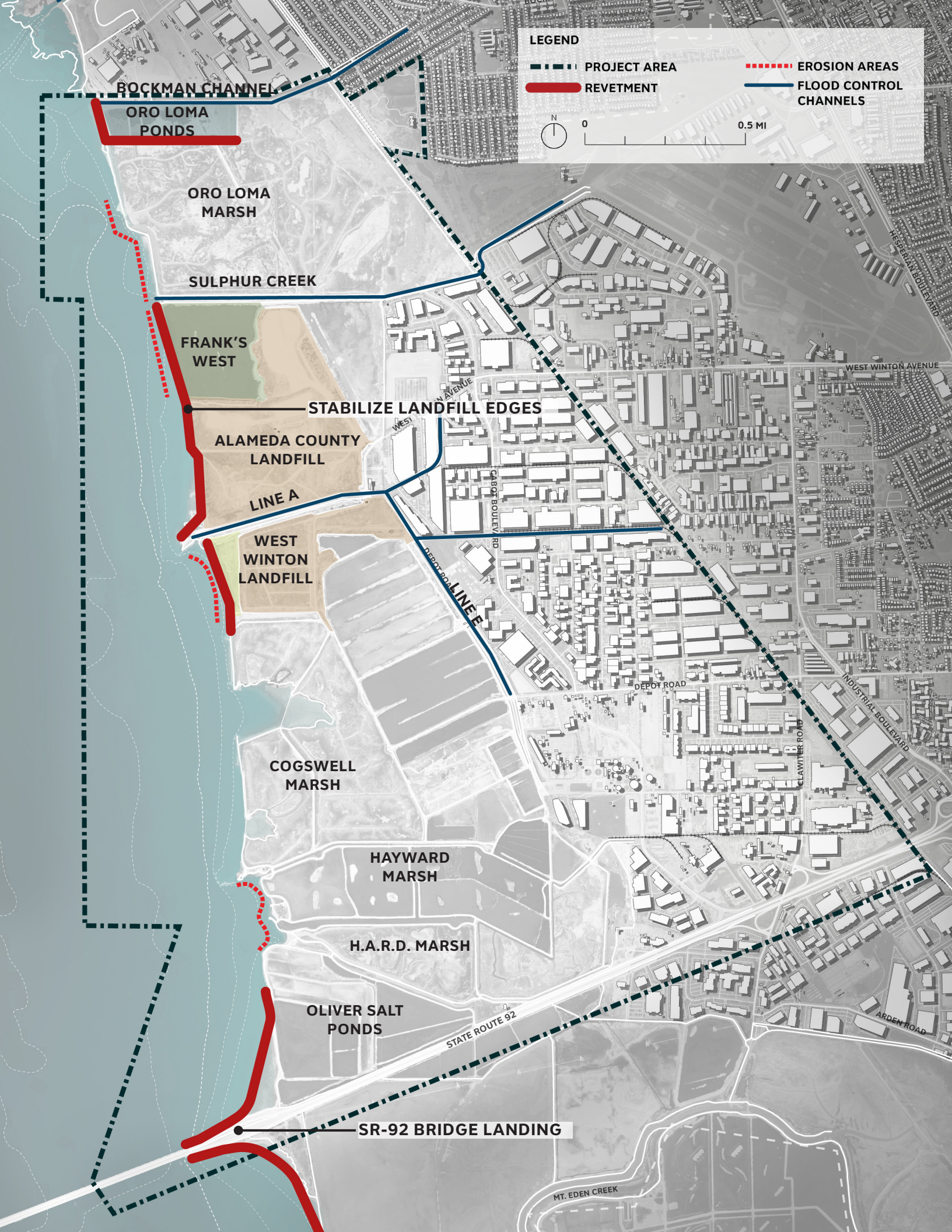
- New revetments along the berms at Oro Loma Ponds, Frank's West, Alameda County Landfill, Triangle Marsh, and SR-92 Bridge Landing

PROS

- Stabilizes landfill edges / erosion control
- More cost-effective than bulkheads or seawalls
- Can be designed to provide habitat value
- May facilitate water access
- Can incorporate habitat for animal and plant species

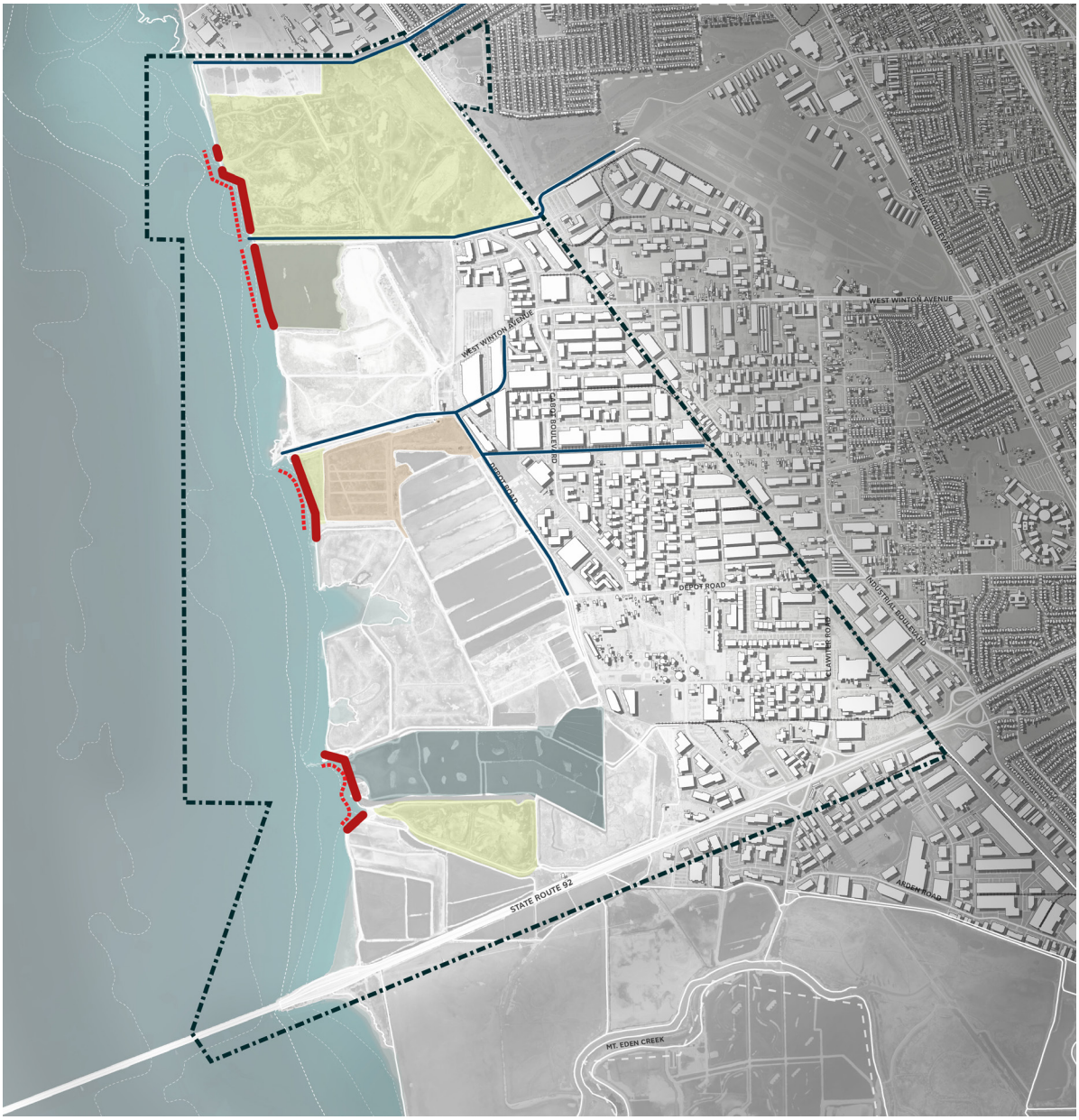
CONS

- Requires more space for implementation than a wall (typically 2:1 slope)
- Requires multiple permits


LEGEND
PROJECT AREA
REVETMENT
EROSION AREAS
FLOOD CONTROL CHANNELS
N
0
0.5 MI
BOCKMAN CHANNEL
ORO LOMA PONDS
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
STABILIZE LANDFILL EDGES
ALAMEDA COUNTY LANDFILL
LINE A
WEST WINTON LANDFILL
LINE B
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
SR-92 BRIDGE LANDING
HESPERIAN BOULEVARD
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

REVETMENTS
Combined Options

1: Address Current Erosion Issues



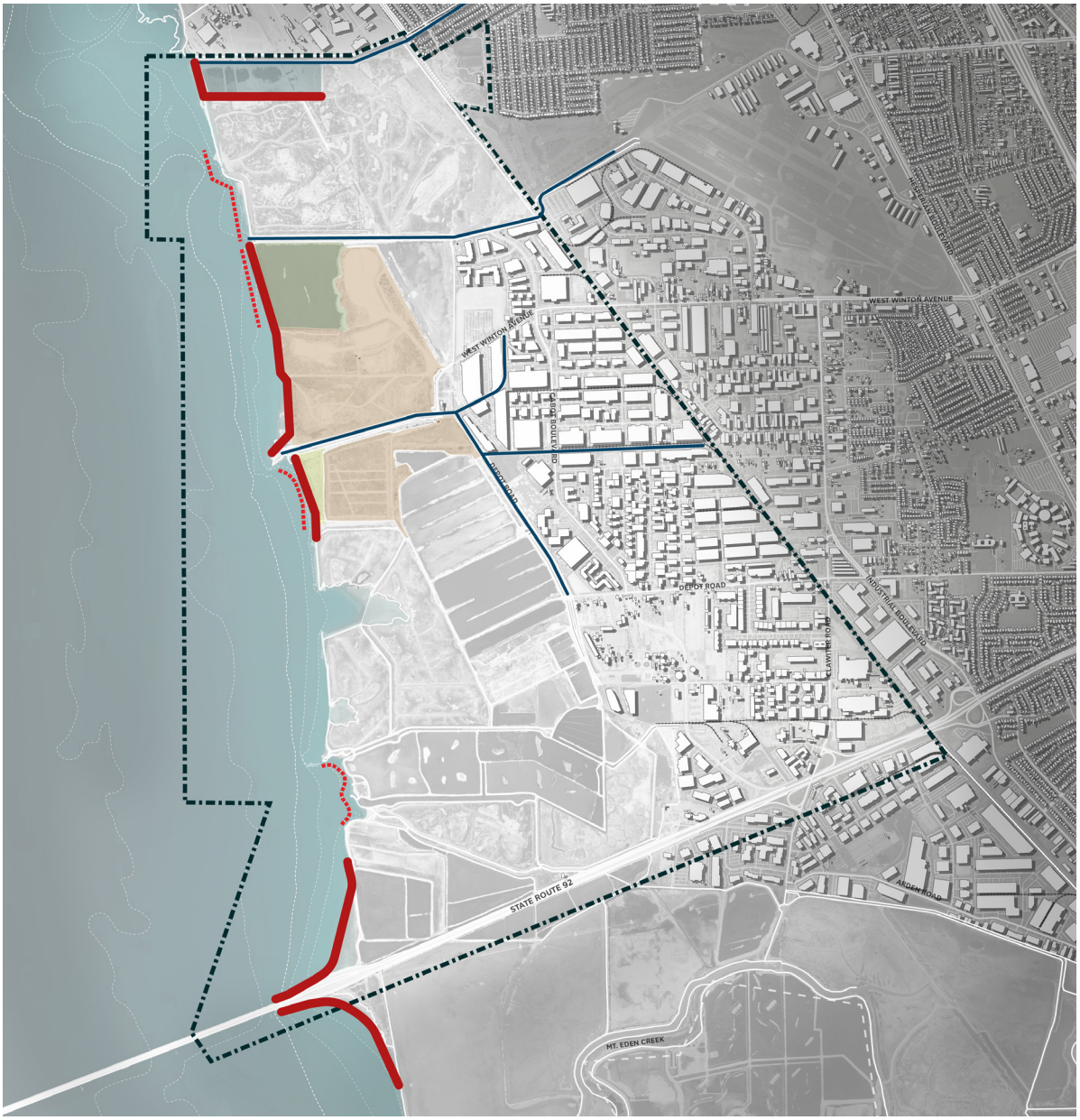
COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- COH noted that it appears that both revetment options benefit HARD and EBRPD assets, which are supported by the City of Hayward. Option 2 also appears to benefit the Caltrans San Mateo Bridge approach, also supported by the City of Hayward.

2: Stabilize Vulnerable Infrastructure



COMMENTS:

- See General Comments.

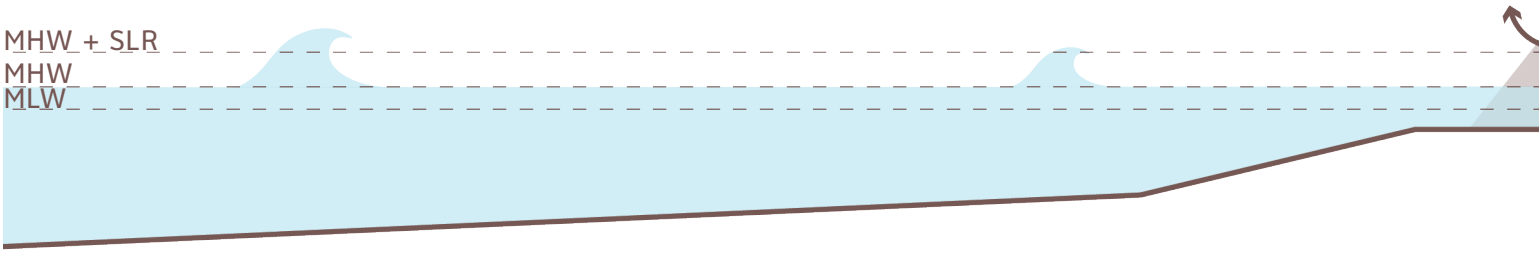
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE

TIDE GATES & WATER CONTROL STRUCTURES

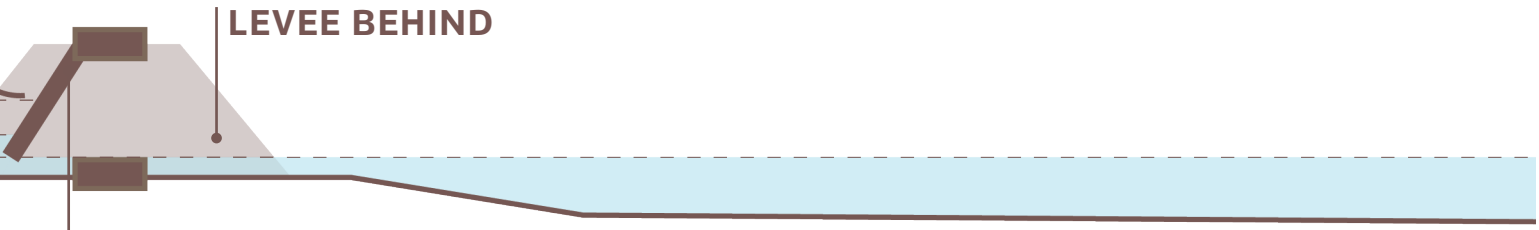
Definition

Tide gates **control the movement of water**, specifically **from a tidewater area and a drained, upland area**. The gates have hinged doors at the end of culverts; they are controlled by mechanisms that open or close them as tides ebb and flow.



OBJECTIVE

- Flood protection (prevent tidal water from entering channel, allow stormwater out)
- Limit maximum elevation of water (“muted tidal”- tide gates close at a certain elevation, open at same elevation on ebb tide)



TIDE GATE
Limits or stops tidal flow entering flood control channels

TIDE GATES & WATER CONTROL STRUCTURES

Existing Conditions, 2019



Bockman Channel Tide Gate



Line E Tide Gate at Depot Road



Marathon Pump Station at Sulphur Creek



Tide gate at southern end of Hayward Marsh

TIDE GATES & WATER CONTROL STRUCTURES

Precedents

Ballona Wetlands Project
Los Angeles, CA

Size: 600 acres
Cost: $10.3 million
Implementation Timeline: 2004

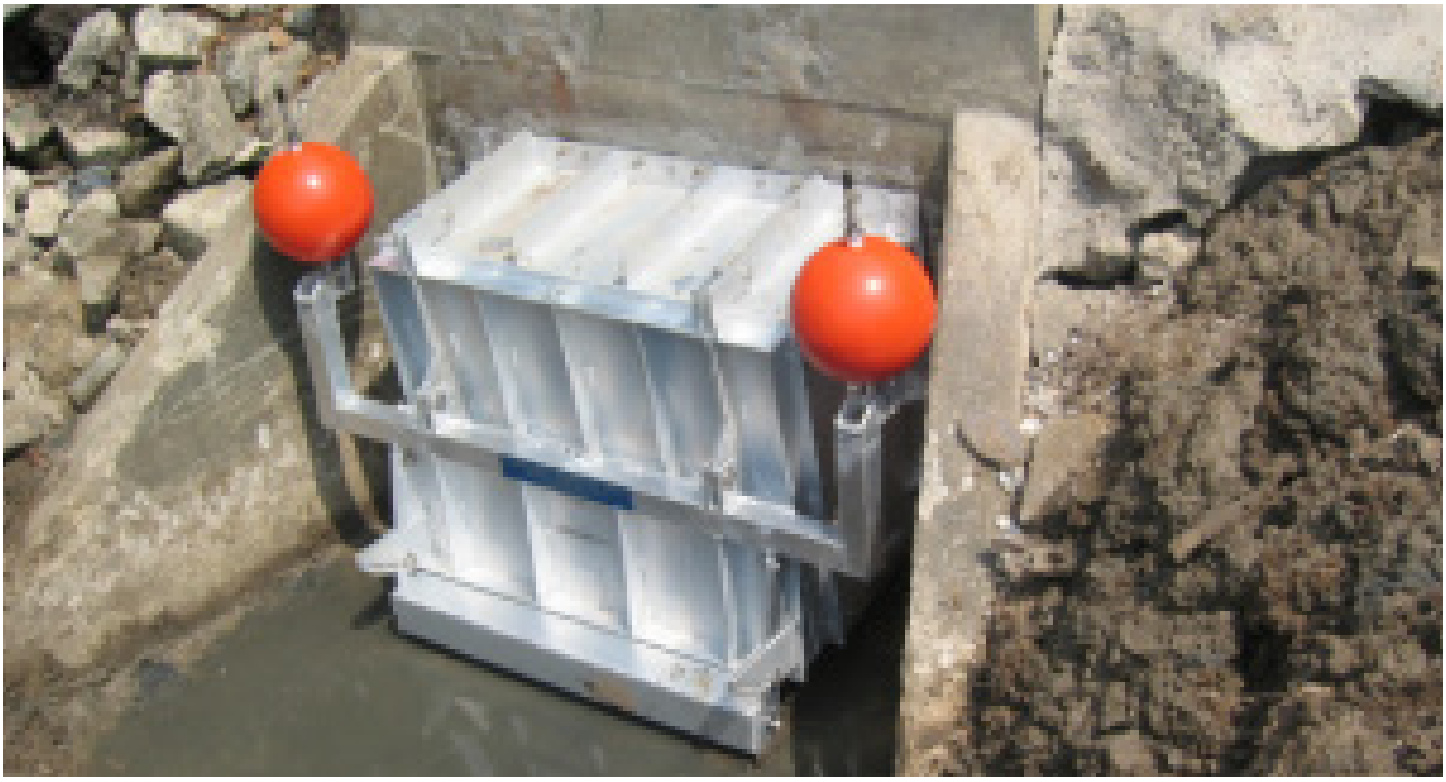
Applicability: The use of tide gates can provide benefits for flood control, while opening up areas for marsh restoration.

Description: 600 acres of the once 2,000-acre mosaic of marshes, mud flats, salt pans, and sand dunes make up the Ballona Wetlands Reserve. A new tide gate is part of the Ballona Wetlands Restoration Project to revive natural coastal wetland functions where they were drastically reduced by residential development.

- Manages flood control while allowing water to flow into the Reserve - recreating a tidal influence
- Enables fish to access wetland habitat
- Increased tidal flushing enhances aquatic habitat
- Seawater within the salt marsh reaches one meter in height



Tidal channels at the Ballona Wetland restoration site



Tide gate enables water flow into the reserve

TIDE GATES & WATER CONTROL STRUCTURES

Option 1: Upland Tide Gate Relocation

OBJECTIVE

Flood risk reduction.

DESCRIPTION

- Tide gate at Sulphur Creek is moved inland to the rail corridor
- Levees are raised along flood control channels inland of tide gates at Bockman Channel, Sulphur Creek, and Line F. Outboard levees could be lowered or removed.

PROS

- Opens up the potential to breach tributaries into the Baylands to restore tidal marsh
- Cheaper to locate control structures as close to the line of protection as possible
- Cheaper to raise and maintain shorter lengths of levees along the channels

CONS

- Need for automated tide gate in a more complex hydraulic system


LEGEND
PROJECT AREA
EXISTING TIDE GATE
MODIFIED TIDE GATE
NEW TIDE GATE
RAISED LEVEE / WALL
FLOOD CHANNEL
NEW HYDROLOGICAL CONNECTION
PROPOSED TIDAL MARSH
N
0
0.5 MI
BOCKMAN CHANNEL
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
LINE A
WEST WINTON LANDFILL
WEST WINTON AVENUE
CABOT BOULEVARD
LINE E
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
COGSWELL MARSH
TIDE GATES MOVED INLAND
HAYWARD MARSH
H.A.R.D. MARSH
LINE F
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

TIDE GATES & WATER CONTROL STRUCTURES

Option 2: Storage in Flood Channels / Downstream Tide Gate Relocation

OBJECTIVE

Increase stormwater storage capacity in the channels only.

DESCRIPTION

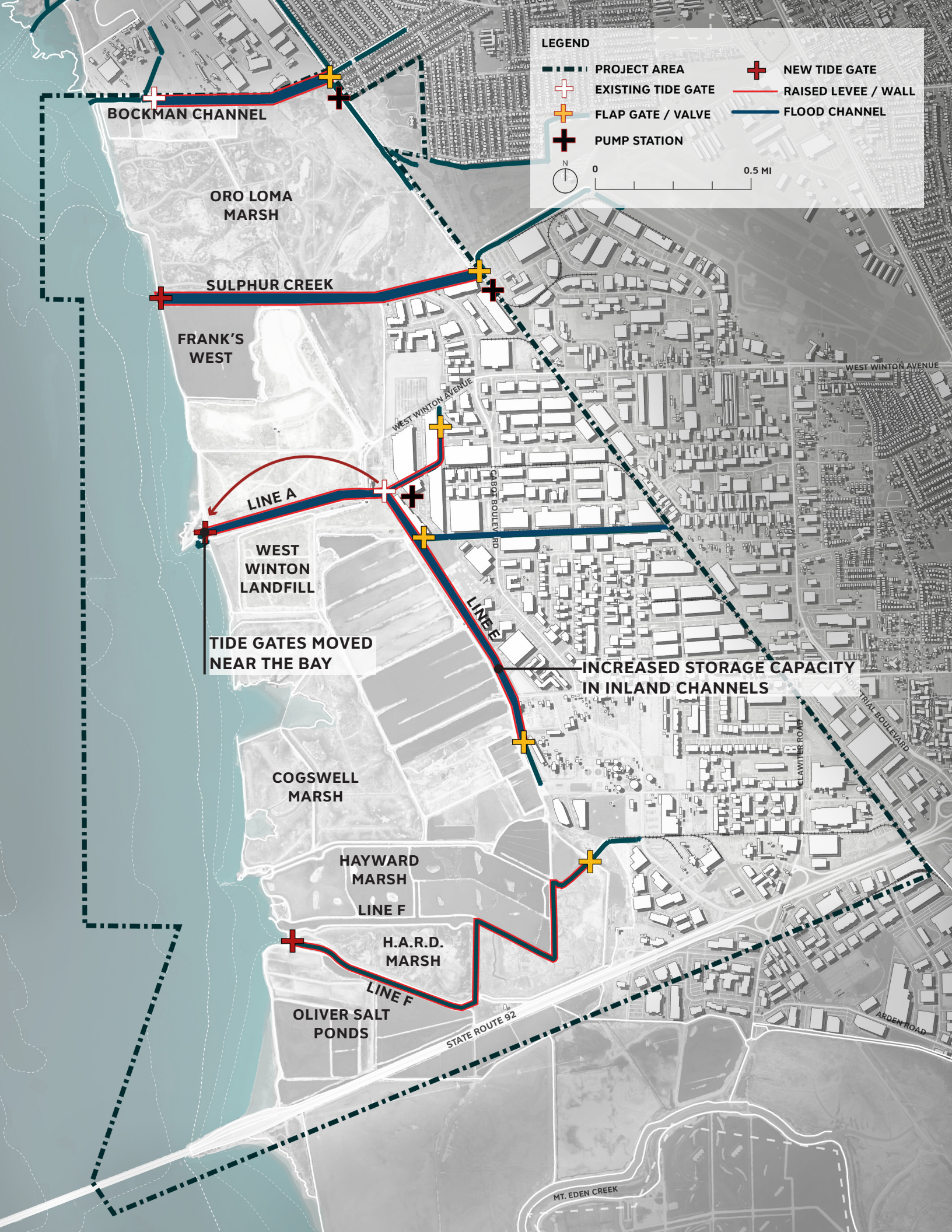
- New tide gates at the Bay's edge along Bockman Channel, Sulphur Creek, Line A, and Line F
- New flap gates inland along Sulphur Creek, Line E, and Line F
- Levees raised along Bockman Channel, Sulphur Creek, Line A, and Line F, inland of the new tide gate locations
- New pump stations at Bockman Channel, Sulphur Creek, and Line A

PROS

- Improved storage capacity

CONS

- Would require pump stations
- Would require increasing the length and height of levees
- Few viable locations for significant storage volumes
- Limits or eliminates tidal flow in channels which could provide habitat
- May trap sediment before it reaches the Bay, which would require maintenance dredging
- Storage volume assessment required


LEGEND
PROJECT AREA
EXISTING TIDE GATE
FLAP GATE / VALVE
PUMP STATION
NEW TIDE GATE
RAISED LEVEE / WALL
FLOOD CHANNEL
N
0
0.5 MI
BOCKMAN CHANNEL
ORO LOMA MARSH
SULPHUR CREEK
FRANK'S WEST
WEST WINTON AVENUE
WEST WINTON AVENUE
CABOT BOULEVARD
LINE A
WEST WINTON LANDFILL
TIDE GATES MOVED NEAR THE BAY
LINE E
INCREASED STORAGE CAPACITY IN INLAND CHANNELS
INDUSTRIAL BOULEVARD
CLAWITER ROAD
COGSWELL MARSH
HAYWARD MARSH
LINE F
H.A.R.D. MARSH
LINE F
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

TIDE GATES & WATER CONTROL STRUCTURES

Option 3: Detention Pond Storage / Improving Flood Channels

OBJECTIVE

Increase stormwater storage capacity.

DESCRIPTION

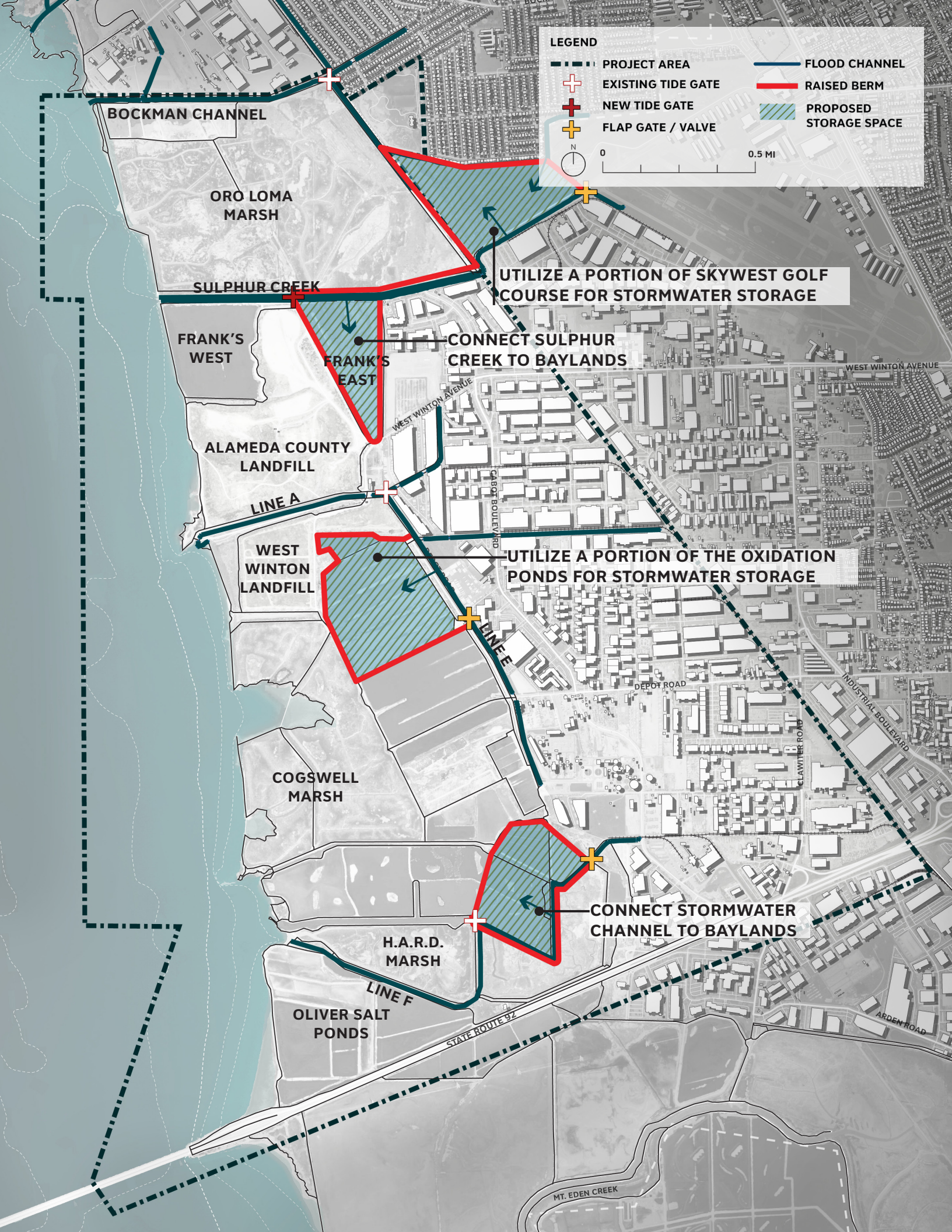
- New flap gates at Sulphur Creek, Line E, and Line F
- New berms around portions of Skywest Golf Course, Frank's East, Oxidation Ponds, and Hayward Marsh

PROS

- Provides increased storage
- Provides further protection from sea level rise

CONS

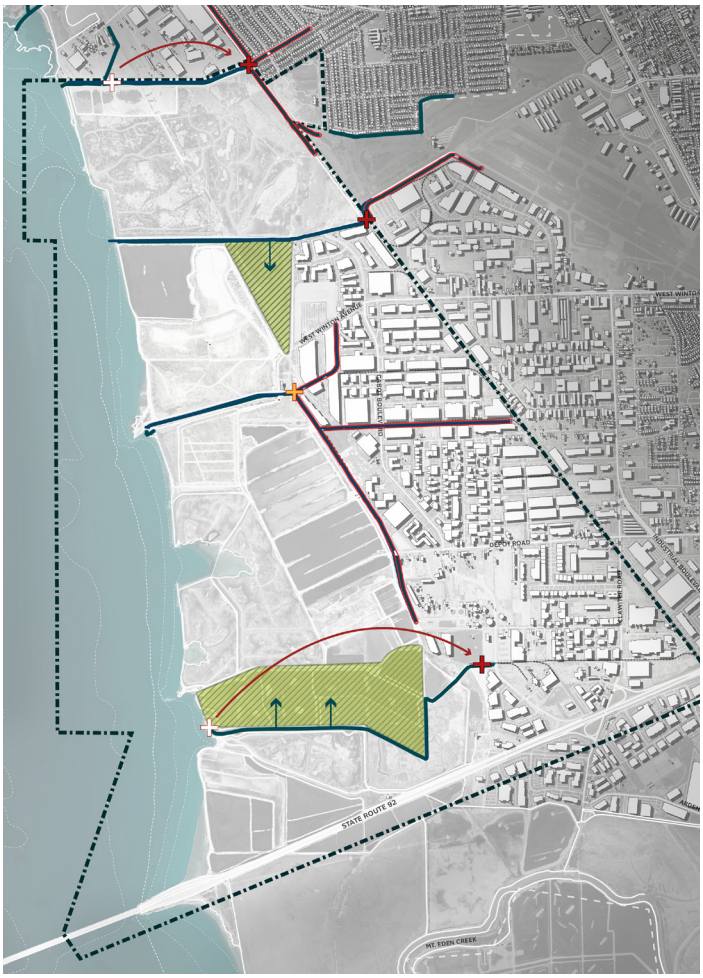
- May contribute to groundwater ponding
- May exacerbate flooding pumping capacity is insufficient
- Public Works is concerned about the partial loss of oxidation ponds
- Would require pump stations long-term
- May have negative ecological impacts in the water storage areas- salinity shocking
- Storage volume assessment required


LEGEND
PROJECT AREA
EXISTING TIDE GATE
NEW TIDE GATE
FLAP GATE / VALVE
FLOOD CHANNEL
RAISED BERM
PROPOSED STORAGE SPACE
N
0
0.5 MI
BOCKMAN CHANNEL
ORO LOMA MARSH
SULPHUR CREEK
UTILIZE A PORTION OF SKYWEST GOLF COURSE FOR STORMWATER STORAGE
FRANK'S WEST
FRANK'S EAST
CONNECT SULPHUR CREEK TO BAYLANDS
WEST WINTON AVENUE
ALAMEDA COUNTY LANDFILL
LINE A
CABOT BOULEVARD
WEST WINTON LANDFILL
UTILIZE A PORTION OF THE OXIDATION PONDS FOR STORMWATER STORAGE
LINE E
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
COGSWELL MARSH
CONNECT STORMWATER CHANNEL TO BAYLANDS
H.A.R.D. MARSH
LINE F
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

TIDE GATES & WATER CONTROL STRUCTURES

Stakeholder Feedback

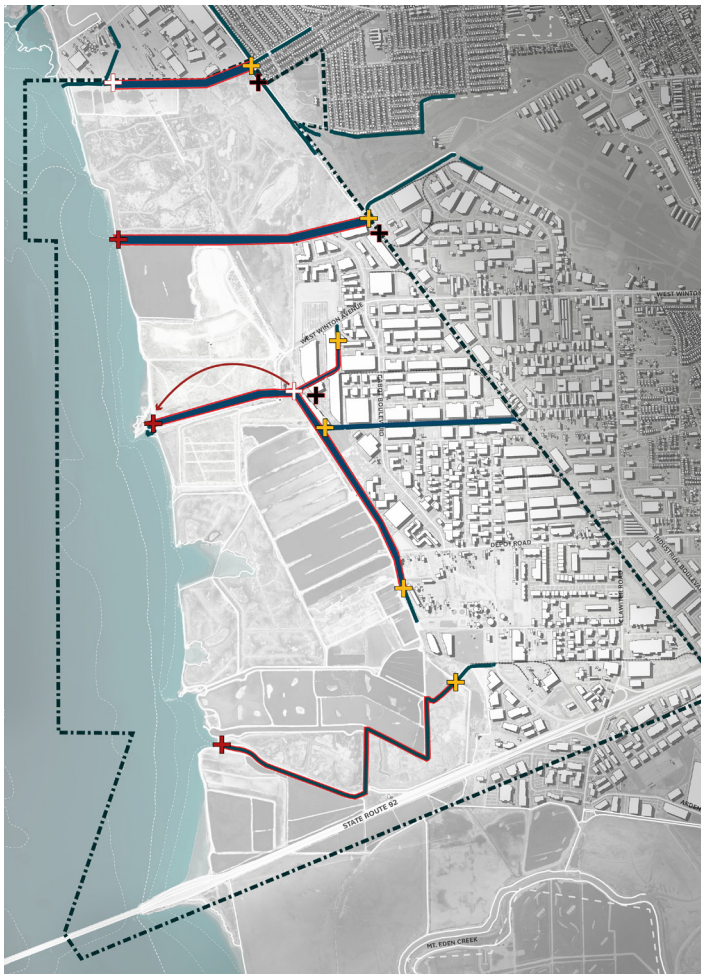
1: Upland Tide Gate Relocation



COMMENTS:

- SFEI advised that moving tide gates upstream may in fact cause more flooding in upstream developed areas if a storm intersects with a high tide and the gates are closed (or when they are permanently closed due to sea level rise).

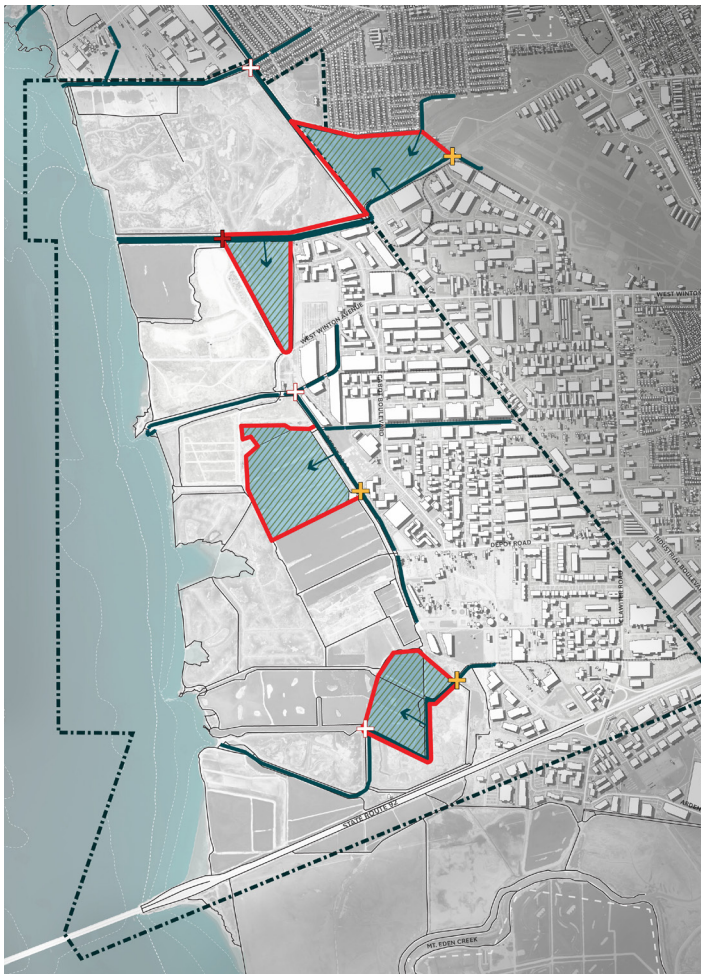
2: Storage in Flood Channels / Downstream Tide Gate Relocation



COMMENTS:

- ACFCD noted that the amount of storage available in these reaches is nowhere near the amount of storage that would be needed.
- ACFCD expressed that this option wouldn't be pursued or supported by the agency. The team will not consider this option moving forward.

3: Diked Pond Storage / Improving Flood Channels



COMMENTS:

- EBRPD noted that the use of the Skywest Golf Course might be considered by the City of Hayward. City Manager and City Council review of this idea would be needed if this strategy were to be implemented.
- ACFCD expressed that this option has the most flood control benefit.

GENERAL COMMENTS:

- EBRPD expressed the need to address height of gates. At this point the design team will not be addressing height of gates. If this strategy were to be implemented, additional feasibility and engineering studies will be needed to address this question in coordination with ACFCD.
- COH noted that options involving the oxidation ponds would need input from Hayward's Public Works Utilities staff. Use of the Skywest golf course would need to be considered by the City Manager and Hayward's City Council. Most options would also need input from the County Flood Control District staff.
- SFEI advised that this is a brittle strategy- after a certain threshold, the gates will need to be closed all the time due to sea level rise.

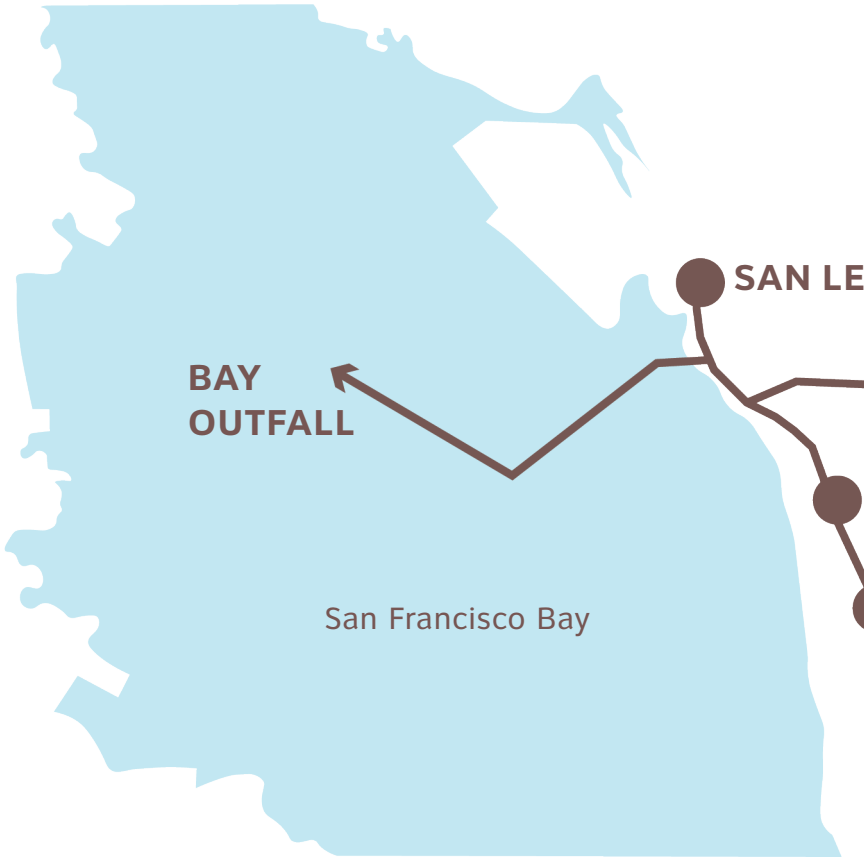
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
SFEI: San Francisco Estuary Institute
ACFCD: Alameda County Flood Control District
Teal text indicates a response from SCAPE

WASTEWATER TREATMENT ADAPTATION

Definition

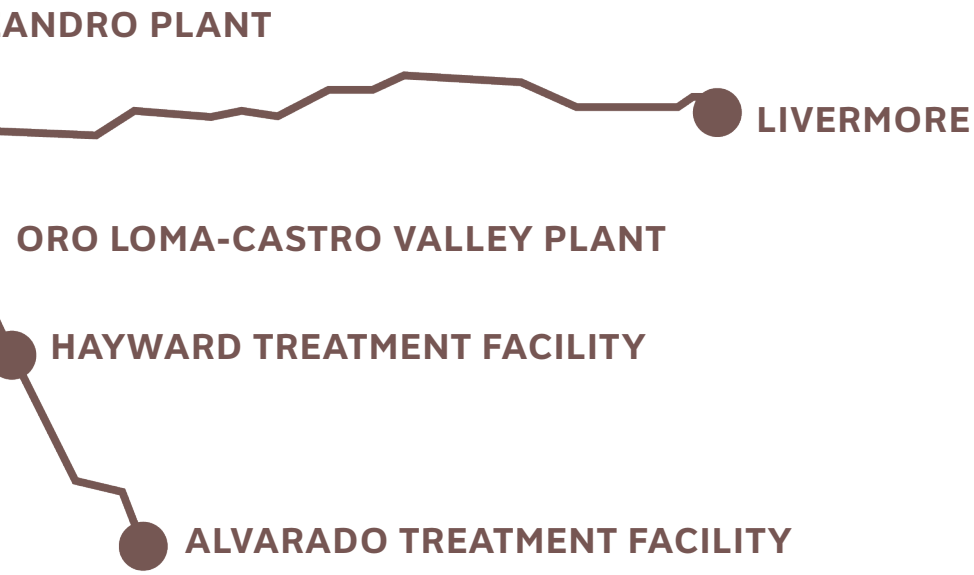
There is potential to **retrofit wastewater treatment plants** along the shoreline, where they are vulnerable to sea level rise. There is interest in studying the **decentralization of WWTP treated discharge,** the decommissioning of the EBDA pipeline, and the potential to **introduce freshwater inputs** to the shoreline with horizontal levee features and other methods of **water polishing and local discharge.**



MAP OF EBDA PIPELINE

OBJECTIVE

- Reduce risk to regional critical utilities



WASTEWATER TREATMENT ADAPTATION

Precedents

Novato Wastewater Treatment Plant
Novato, CA

Size: 16.5 acres
Cost: $90 million (only for WWTP upgrade)
Implementation Timeline: Completed in 2011

Applicability: Upgrading or retrofitting existing WWTPs can prove effective to increase their resilience in the future with climate change.

Description: An upgraded plant replaced two aging facilities and combines the capacity to meet future needs with a reduced carbon footprint through greater energy efficiency.

- New WWTP was raised to improve the hydraulic gradient so wastewater flows depend more on gravity and less on pumping. Added bonus is that it is less vulnerable to sea level rise, some parts were raised 10 to 14 feet higher
- Lowered energy costs dramatically by cutting pumping demand in half
- The sewer collection system master plan is working to upgrade, improve, and maintain the whole collection system for the Novato Sanitary District



Aerial view of upgraded plant

WASTEWATER TREATMENT ADAPTATION

Precedents

Bay Park Sewage Treatment Plant
Nassau County, NY

Size: 46 acres / 6,700 LF flood wall
Cost: $830 million
Implementation Timeline: 30 months / 2.5 years

Applicability: Facility specific protection with community benefits / amenities.

Description: A flood barrier system was constructed around the perimeter of the facility and unit substations were raised for added flood protection.

- A berm and flood wall perimeter protection system act as the primary line of defense, protecting the facility from projected 500-year storm surge while providing two points of access to the facility.
- Non-submersible equipment was elevated and new electrical unit substations were constructed above projected flood elevations.
- Improvements to surrounding park facilities, including green infrastructure and enhancements and alternative drainage systems, eliminated standing water under normal storm and tidal conditions which had previously been an issue.



View of berm and flood wall



View of upgraded flood wall and flood gate

WASTEWATER TREATMENT ADAPTATION

Option 1: Oro Loma Local Discharge

OBJECTIVE

Adapt critical infrastructure and enhance marsh migration space.

DESCRIPTION

- Horizontal levee along the back of Oro Loma Marsh

PROS

- Restore salinity gradient to tidal marsh
- Local discharge with EBDA retirement
- May align with the First Mile horizontal levee project

CONS

- Need to maintain and raise levee with sea level rise
- May have negative impacts to Oro Loma marsh- increased freshwater would change salinity gradient
- Endangered species habitat loss
- Resource agency permits may be difficult to obtain


LEGEND
PROJECT AREA
FRESHWATER MARSH
HORIZONTAL LEVEE
WWTP EFFLUENT
N
0
0.5 MI
4,050'
ORO LOMA MARSH
DISCHARGE INTO TIDAL MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
HAYWARD REGIONAL SHORELINE
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
CO BAY
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CITY OF HAYWARD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
HESPERIAN BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

WASTEWATER TREATMENT ADAPTATION

Option 2: Hayward Treatment + Storage

OBJECTIVE

Adapt critical infrastructure, provide stormwater storage, and enhance freshwater marsh habitat.

DESCRIPTION

- Freshwater treatment marsh in the Oxidation Ponds
- Raised outboard berm
- Dependent on EBDA decommissioning

PROS

- Increase storage capacity during wet weather events
- Hayward is one of the only WWTPs that can do wet weather equalization

CONS

- Not directly connected to the bay
- Need to maintain and raise levee with sea level rise
- Resource agency permits may be difficult to obtain
- Loss of solar fields and biosolids management/ drying area near the oxidation ponds


LEGEND
PROJECT AREA
FRESHWATER MARSH
HORIZONTAL LEVEE
WWTP EFFLUENT
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
HAYWARD REGIONAL SHORELINE
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
CO BAY
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CITY OF HAYWARD
HESPERIAN BOULEVARD
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK
OUTBOARD BERM
WET WEATHER STORAGE
TREATMENT MARSH
MAINTAIN BIOSOLIDS DRYING/AGING
MAINTAIN BIOSOLIDS MANAGEMENT
MAINTAIN SOLAR FIELD

WASTEWATER TREATMENT ADAPTATION

Option 3: Hayward Local Discharge

OBJECTIVE

Adapt critical infrastructure, enhance marsh migration space, provide stormwater storage space.

DESCRIPTION

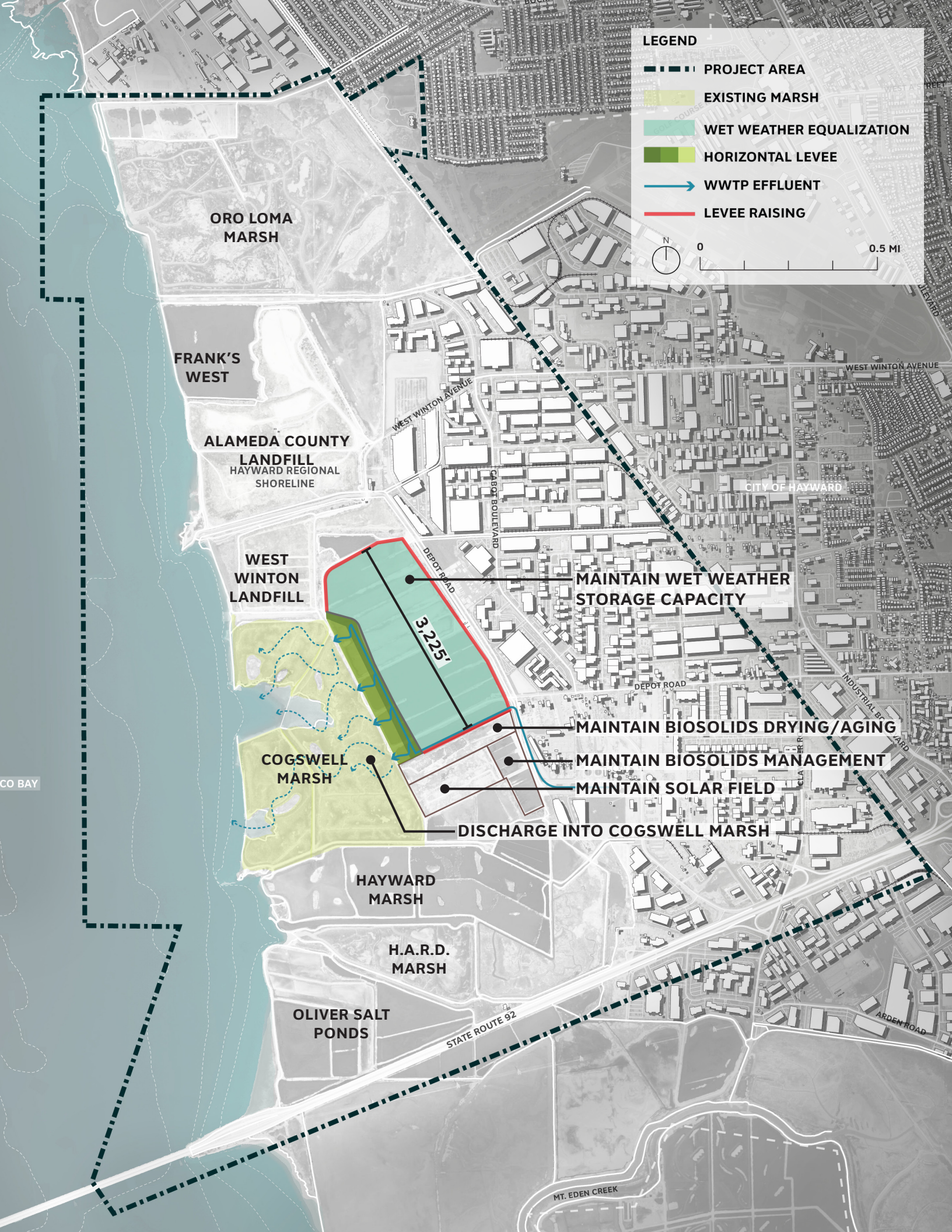
- Horizontal levee along the western extent of the Oxidation Ponds
- Stormwater storage improvements in the rest of the Oxidation Ponds

PROS

- Discharge effluent locally
- Protect Oxidation Ponds
- Can tie into a larger ecotone levee

CONS

- May have negative impacts on Cogswell Marsh- increased freshwater would change salinity gradient
- Partial loss of oxidation ponds
- Resource agency permits may be difficult to obtain


LEGEND
PROJECT AREA
EXISTING MARSH
WET WEATHER EQUALIZATION
HORIZONTAL LEVEE
WWTP EFFLUENT
LEVEE RAISING
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
HAYWARD REGIONAL SHORELINE
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
CO BAY
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CITY OF HAYWARD
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK
3,225'
MAINTAIN WET WEATHER STORAGE CAPACITY
MAINTAIN BIOSOLIDS DRYING/AGING
MAINTAIN BIOSOLIDS MANAGEMENT
MAINTAIN SOLAR FIELD
DISCHARGE INTO COGSWELL MARSH

WASTEWATER TREATMENT ADAPTATION

Option 4: Fully Tidal Discharge

OBJECTIVE

Adapt critical infrastructure, enhance marsh migration space, provide stormwater storage space.

DESCRIPTION

- Horizontal levee in the back of Oro Loma Marsh and through the middle of the Oxidation ponds
- Water storage improvements on the inland side of the Oxidation Ponds
- Dependent on EBDA decommissioning

PROS

- Fully tidal system, able to accrete and connect to Cogswell Marsh
- Pair with horizontal levee
- Restore salinity gradient to tidal marsh
- Local discharge with EBDA retirement

CONS

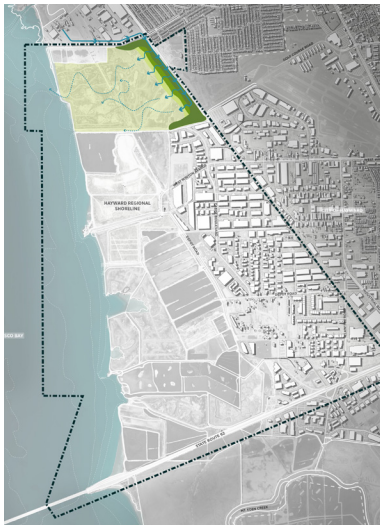
- Restrictions on discharge into fully tidal system- not permitted yet
- Nearshore discharge would be less likely than maintaining the EBDA pipeline
- May negatively impact existing marsh systems- increased freshwater would change salinity gradient and may lead to loss of habitat over time if the area is fully tidal
- Partial loss of oxidation ponds
- Resource agency permits may be difficult to obtain
- Not a viable option for the City of Hayward


LEGEND
PROJECT AREA
EXISTING MARSH
WET WEATHER EQUALIZATION
RESTORED MARSH
HORIZONTAL LEVEE
WWTP EFFLUENT
LEVEE RAISING
N
0
0.5 MI
4,050'
ORO LOMA MARSH
DISCHARGE INTO TIDAL MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
HAYWARD REGIONAL SHORELINE
WEST WINTON LANDFILL
FORMER OXIDATION PONDS
COGSWELL MARSH
MAINTAIN BIOSOLIDS DRYING/AGING
MAINTAIN BIOSOLIDS MANAGEMENT
MAINTAIN SOLAR FIELD
DISCHARGE INTO TIDAL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
CITY OF HAYWARD
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK
CO BAY

WASTEWATER TREATMENT ADAPTATION

Stakeholder Feedback

1: Oro Loma Local Discharge



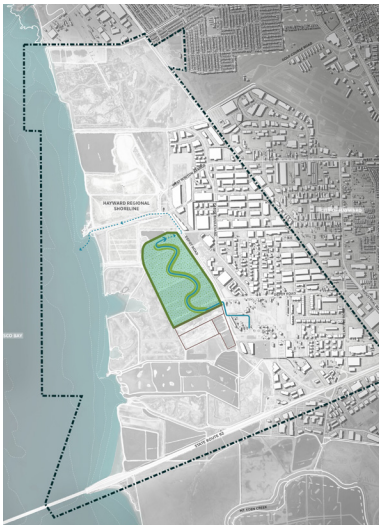
COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- COH noted that all possible adaptation measures should be reviewed and commented on by the City of Hayward's Public Works Utilities staff.
- A stakeholder (during the Stakeholder Meeting #2) brought up concerns over public access around water treatment uses.
- Hayward Public Works noted that Hayward is one of the only treatment plants that have wet weather storage capacity and that this should be maintained as long as the EBDA pipeline is in use.
- HASPA expressed concern over keeping a wet transition zone with a horizontal levee- it might create mosquito habitat.
- Oro Loma Wastewater treatment plant indicated that 50 years from now, wastewater may be used for drinking. In this case, there would be need to outlet the treated effluent unless there is a good ecological reason.
- Oro Loma Wastewater treatment plant brought up the idea of pumping the "urban drool" over the horizontal levee for treatment, which may be a more likely scenario.
- Hayward Public Works noted that at their current level of treatment, they can treat the entire flow during storm events before it gets to the oxidation ponds. After tertiary treatment, where more nutrient removal occurs, the water is still non-potable and near shore discharge is possible.
- Hayward Public Works noted that if the EBDA pipeline remains in use, this would be the cheapest option.

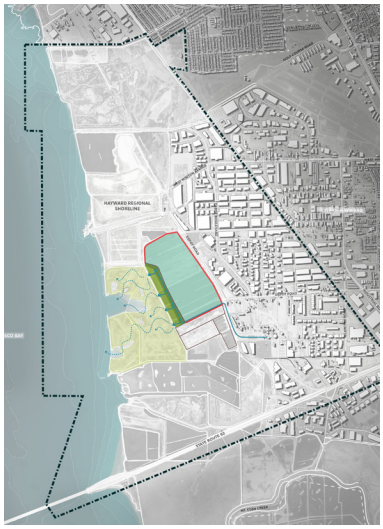
2: Hayward Treatment + Storage



COMMENTS:

- Hayward Public Works is in support of a treatment marsh that would then discharge into the Bay, but it depends on the decommission of the EBDA pipeline.

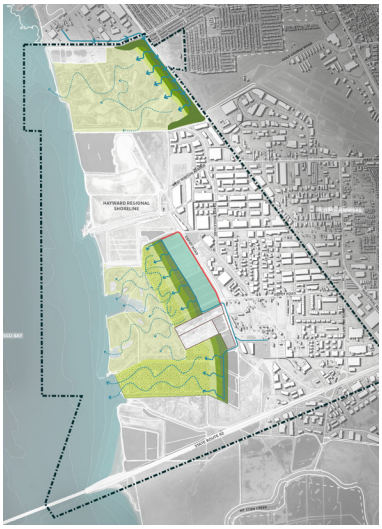
3: Hayward Local Discharge



COMMENTS:

- Hayward Public Works indicated support for a horizontal levee and near shore discharge.

4: Fully Tidal Discharge



COMMENTS:

- EBRPD expressed concerns over the impacts to the existing marsh system and loss of habitat over time if area is fully tidal.
- Hayward Public Works noted that if the EBDA pipeline was decommissioned, they would try to have all effluent discharged locally. It was originally discharged into Line A.

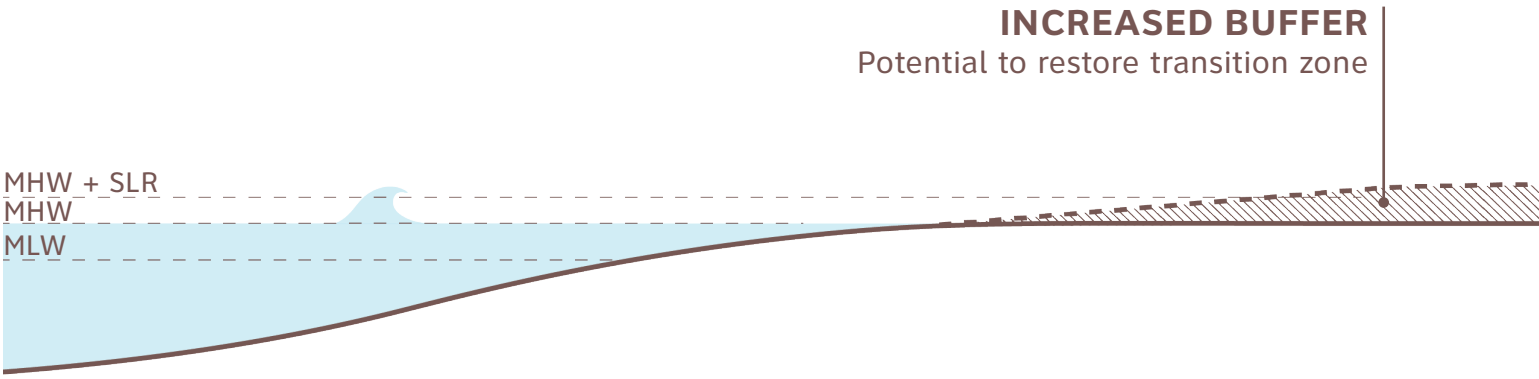
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE

LAND ELEVATION

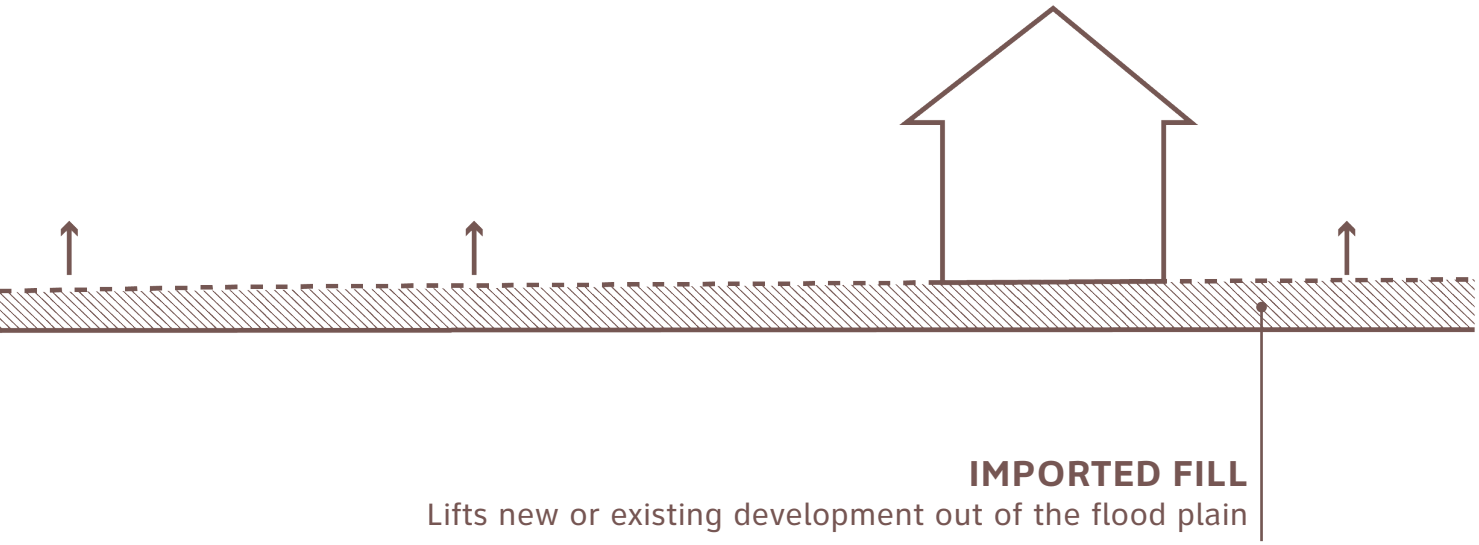
Definition

Elevating the ground level at the site or district scale above the design flood elevation **lifts future development and transportation assets out of the flood zone**. This is often done to **reduce the risk of flooding** for new development or new uses.



OBJECTIVE

- Reduce risk to SLR, flood events, and groundwater emergence



IMPORTED FILL
Lifts new or existing development out of the flood plain

LAND ELEVATION
Precedents

Arverne-By-The-Sea
Queens, NY

Size: 120 acres
Cost: $1 billion
Implementation Timeline: 2003-2017

Applicability: Raising land elevation of key sites may be appropriate for infrastructure assets that would be hard to relocate. This would lift them above the flood or SLR inundation elevation. However, access to these areas may be impacted.

Description: Developers added more than half a million cubic yards of fill to raise most of the site 3-9' above the 100 year flood level. Combined with a number of other resiliency features such as expanded beach, fortified dunes, extensive stormwater drainage, and on-site stormwater retention, this strategy protected the infrastructure during Superstorm Sandy.

- Wide beach and fortified dunes act as first line of defense against storm surges and sea level rise
- Sandy dunes may not settle as much as compacted fill
- Utilities were installed underground and some, like electrical infrastructure, were protected with waterproofing measures.
- Storm drains throughout the development connected to underground drainage system that included on-site water retention
- Resilience measures help avoid significant damage in storm events and save costs associated with flood insurance



Open expanse of gravel provides nesting habitat



Gravel deposition during construction

LAND ELEVATION

Option 1: West of Cabot Boulevard

OBJECTIVE

Reduce risk of groundwater emergence and SLR inundation.

DESCRIPTION

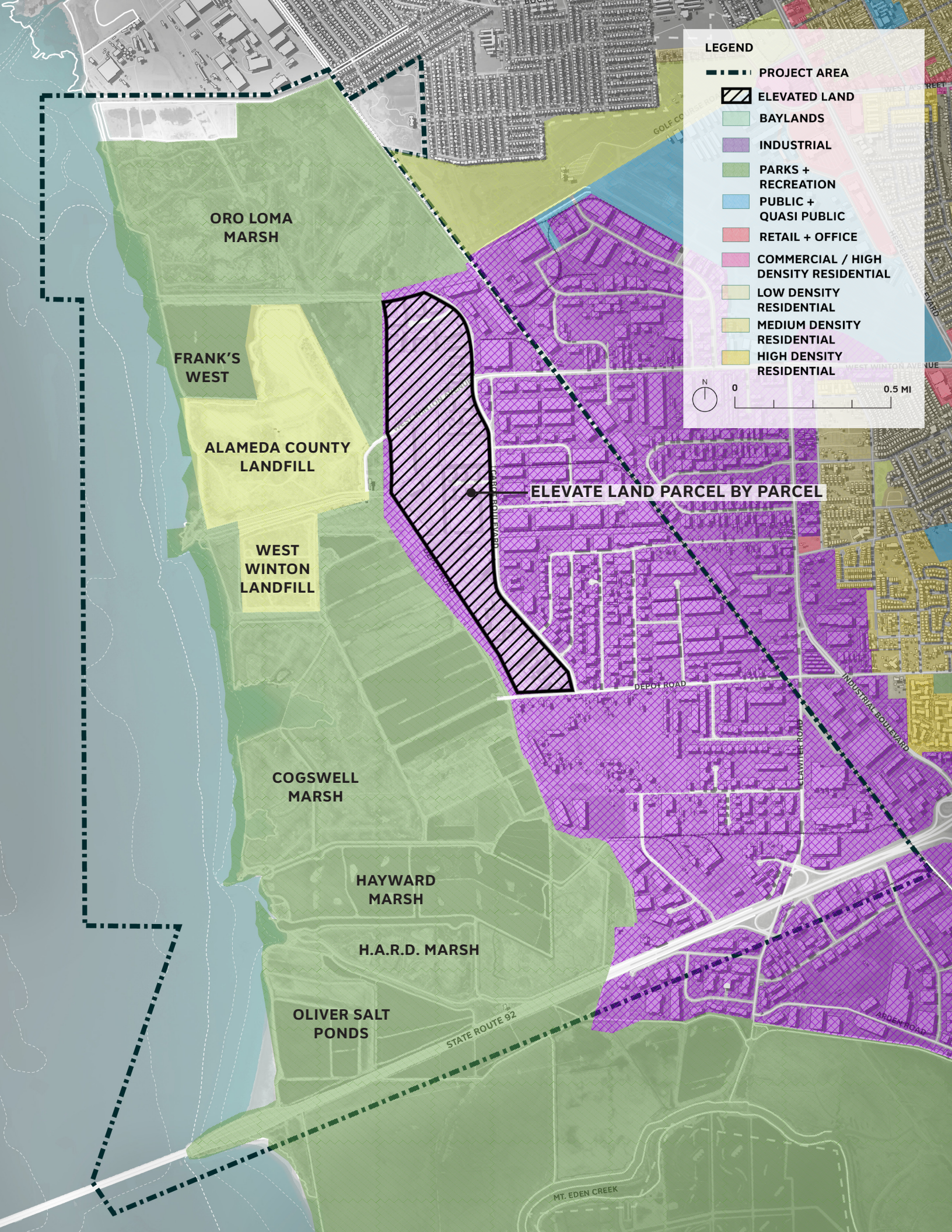
- Elevate land parcel-by-parcel as businesses retrofit buildings or build new ones

PROS

- Reduces risk of future development and transportation assets to flooding and groundwater emergence in targeting area of highest risk
- May help remediate brownfields and reduce flood insurance rates

CONS

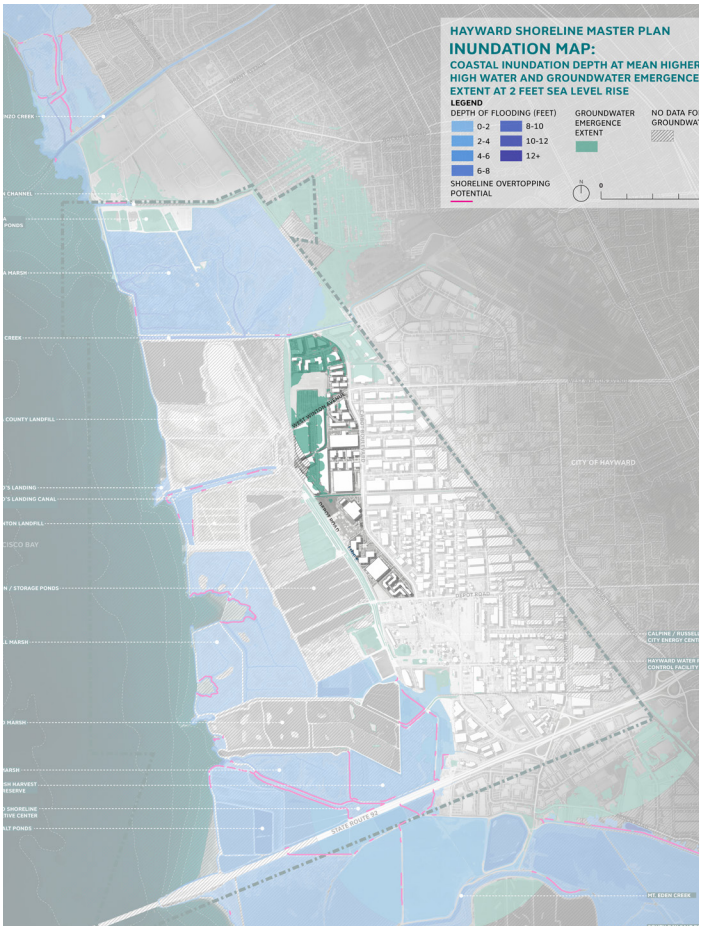
- Requires a significant amount of clean dirt or fill
- Raising land elevation on historic marshes and Bay mud may lead to significant settlement and subsidence
- Raising elevations in a patchwork pattern is difficult for transportation and drainage connectivity
- Can lead to compaction and subsidence
- May cause disturbance to adjacent land
- May only provide short-term solution for sea level rise
- Would be very costly
- May create an isolated island with SLR and connectivity may be compromised


LEGEND
PROJECT AREA
ELEVATED LAND
BAYLANDS
INDUSTRIAL
PARKS + RECREATION
PUBLIC + QUASI PUBLIC
RETAIL + OFFICE
COMMERCIAL / HIGH DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
HIGH DENSITY RESIDENTIAL
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
ELEVATE LAND PARCEL BY PARCEL
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK
WEST WINTON AVENUE

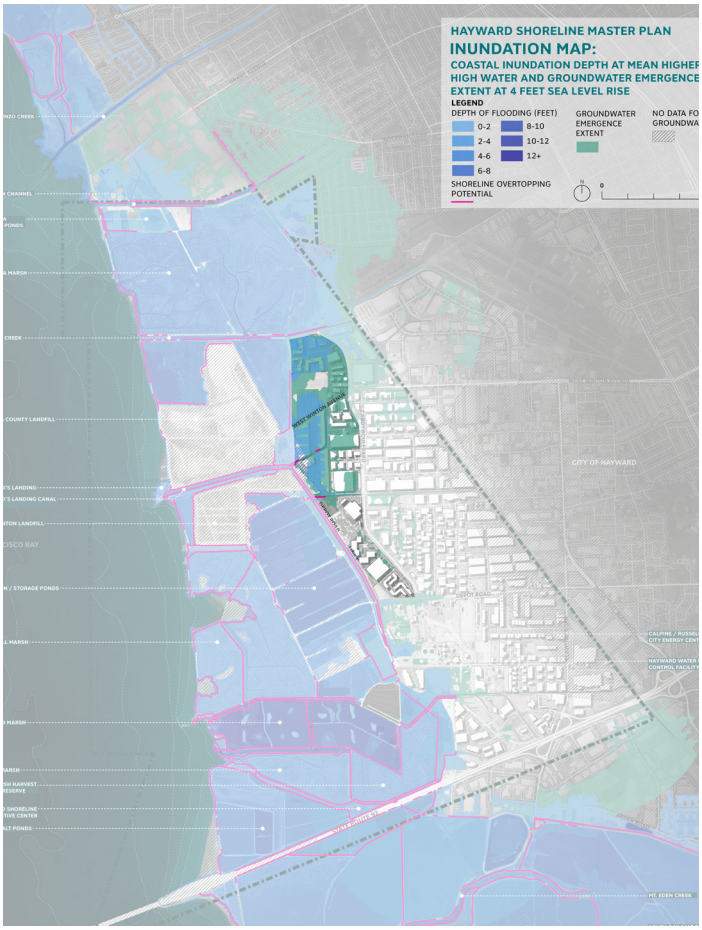
LAND ELEVATION

Option 1: West of Cabot Boulevard

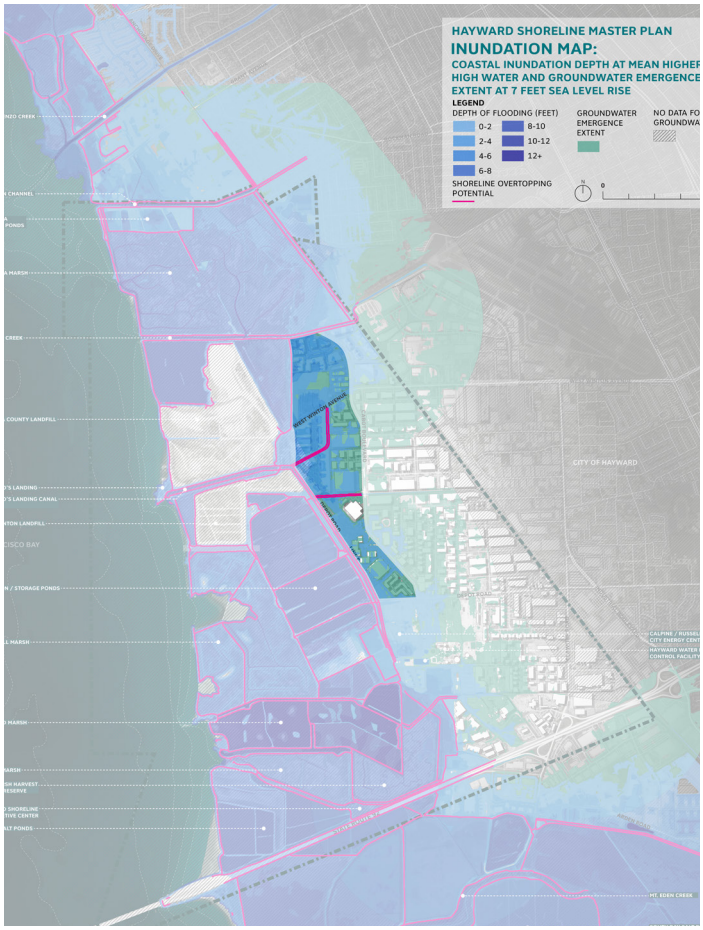
2’ SLR



4’ SLR



7’ SLR


HAYWARD SHORELINE MASTER PLAN
INUNDATION MAP:
COASTAL INUNDATION DEPTH AT MEAN HIGHER
HIGH WATER AND GROUNDWATER EMERGENCE
EXTENT AT 7 FEET SEA LEVEL RISE
LEGEND
DEPTH OF FLOODING (FEET)
0-2
2-4
4-6
6-8
8-10
10-12
12+
GROUNDWATER EMERGENCE EXTENT
NO DATA FO
GROUNDWA
SHORELINE OVERTOPPING POTENTIAL
CITY OF HAYWARD
MT. EDEN CREEK

LAND ELEVATION
Option 2: Bay Buffer

OBJECTIVE

Reduce risk of groundwater emergence and SLR inundation.

DESCRIPTION

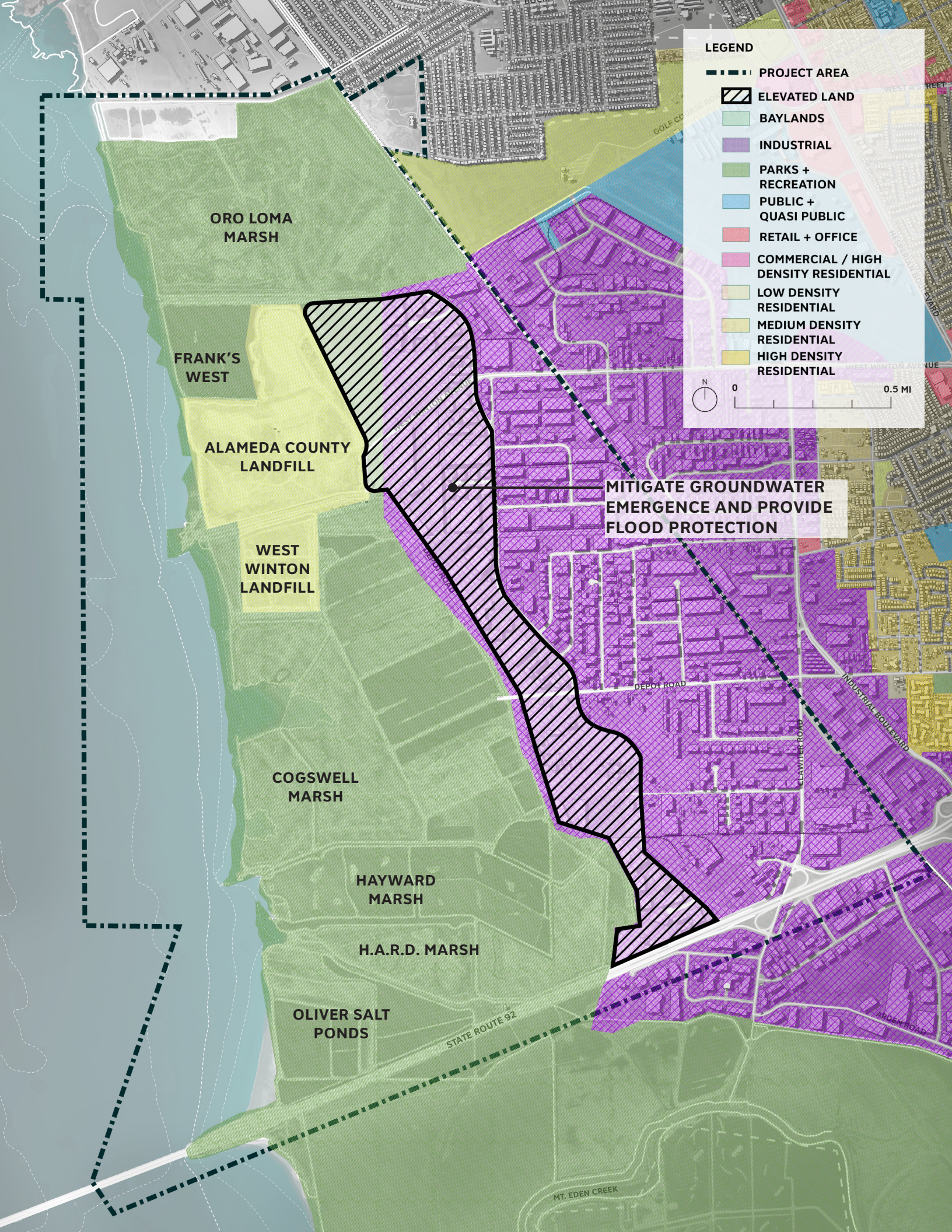
- Elevate industrial parcels west of Cabot Blvd

PROS

- Reduces risk to industrial park of flooding and groundwater emergence
- May help remediate brownfields and reduce flood insurance rates
- Potential to connect to a regional line of protection
- Connectivity is less of an issue- specific sites can raise the road to new developments

CONS

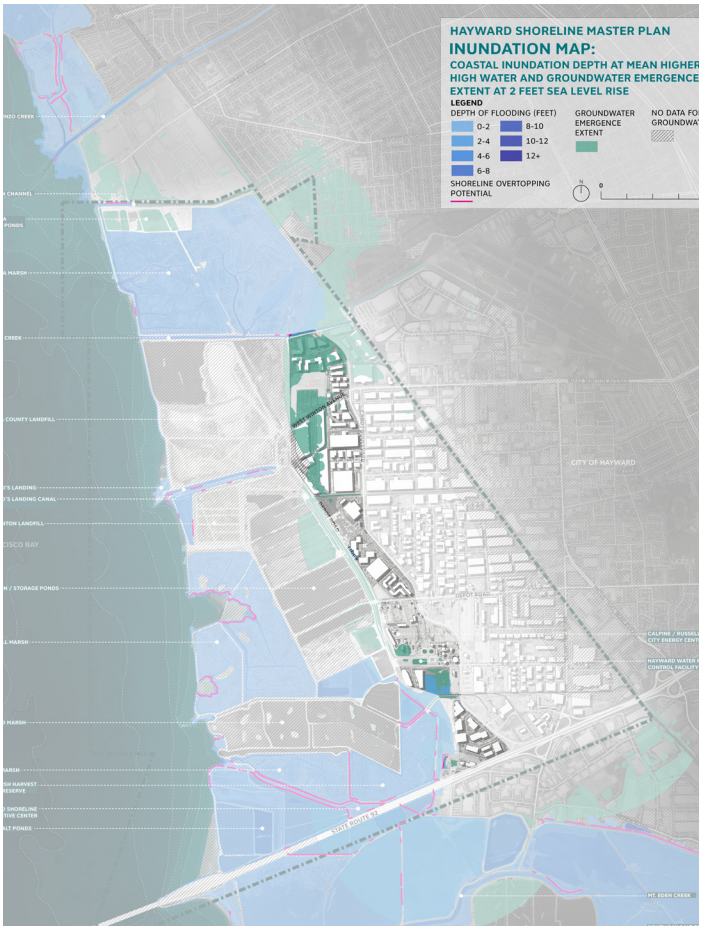
- Requires redevelopment of a portion of the industrial park, causing significant temporary displacement
- Requires a large amount of clean dirt or fill
- Raising land elevation on historic marshes and Bay mud may lead to significant settlement and subsidence
- May cause disturbance to adjacent land
- Would be very costly


LEGEND
PROJECT AREA
ELEVATED LAND
BAYLANDS
INDUSTRIAL
PARKS + RECREATION
PUBLIC + QUASI PUBLIC
RETAIL + OFFICE
COMMERCIAL / HIGH DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
HIGH DENSITY RESIDENTIAL
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
MITIGATE GROUNDWATER EMERGENCE AND PROVIDE FLOOD PROTECTION
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK
WEST WINTON AVENUE

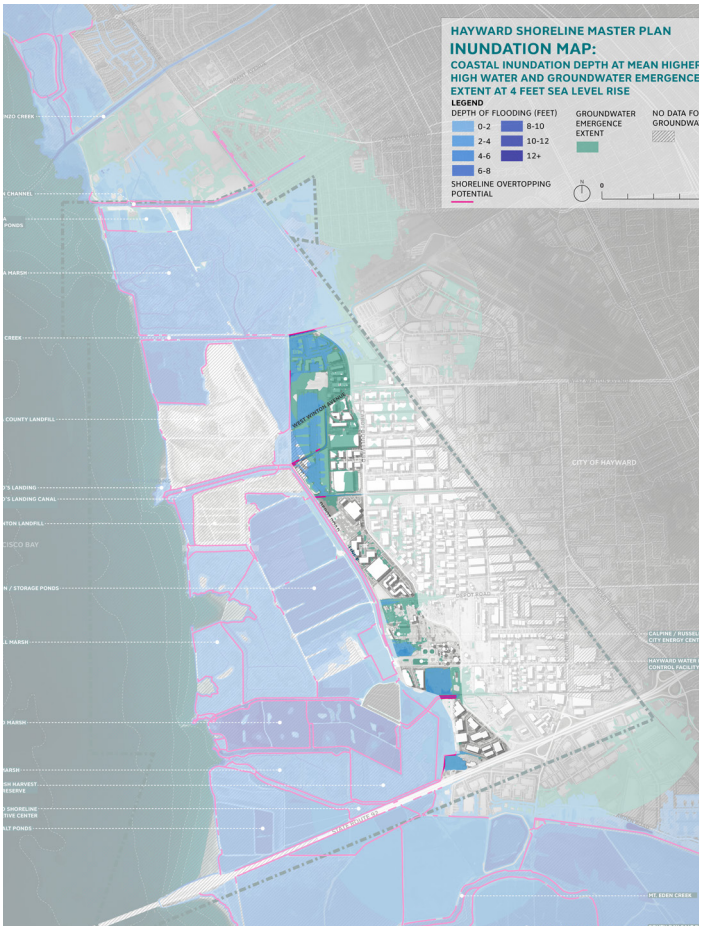
LAND ELEVATION

Option 2: Bay Buffer

2’ SLR

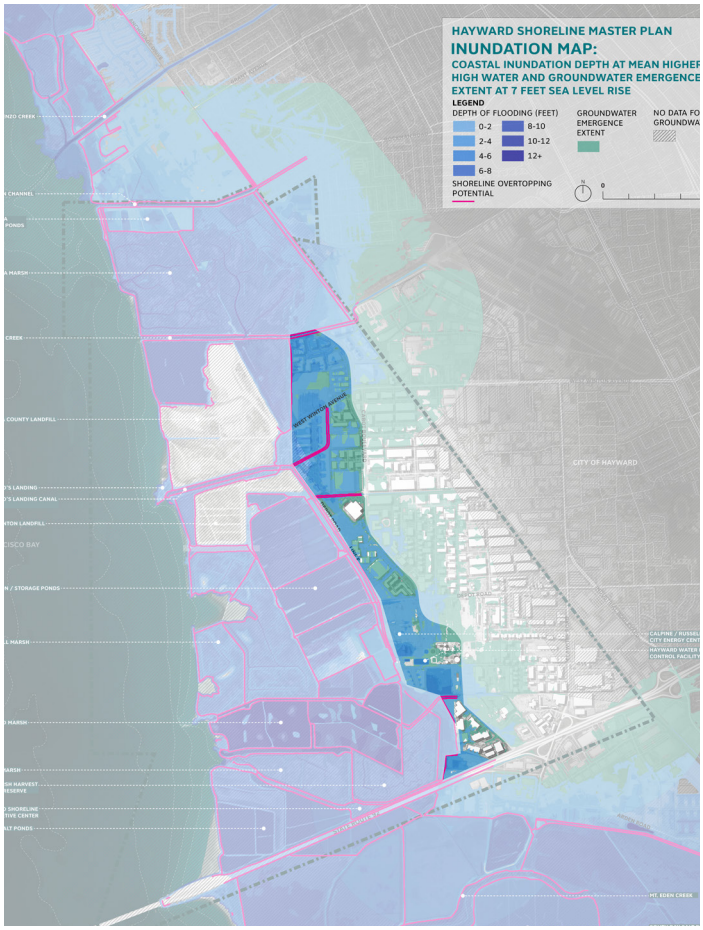


4’ SLR



SCAPE

7’ SLR


HAYWARD SHORELINE MASTER PLAN
INUNDATION MAP:
COASTAL INUNDATION DEPTH AT MEAN HIGHER
HIGH WATER AND GROUNDWATER EMERGENCE
EXTENT AT 7 FEET SEA LEVEL RISE
LEGEND
DEPTH OF FLOODING (FEET)
0-2
2-4
4-6
6-8
8-10
10-12
12+
GROUNDWATER EMERGENCE EXTENT
NO DATA FO
GROUNDWA
SHORELINE OVERTOPPING POTENTIAL
CITY OF HAYWARD
MT. EDEN CREEK

LAND ELEVATION
Option 3: Industrial Neighborhood

OBJECTIVE

Reduce risk of groundwater emergence and SLR inundation.

DESCRIPTION

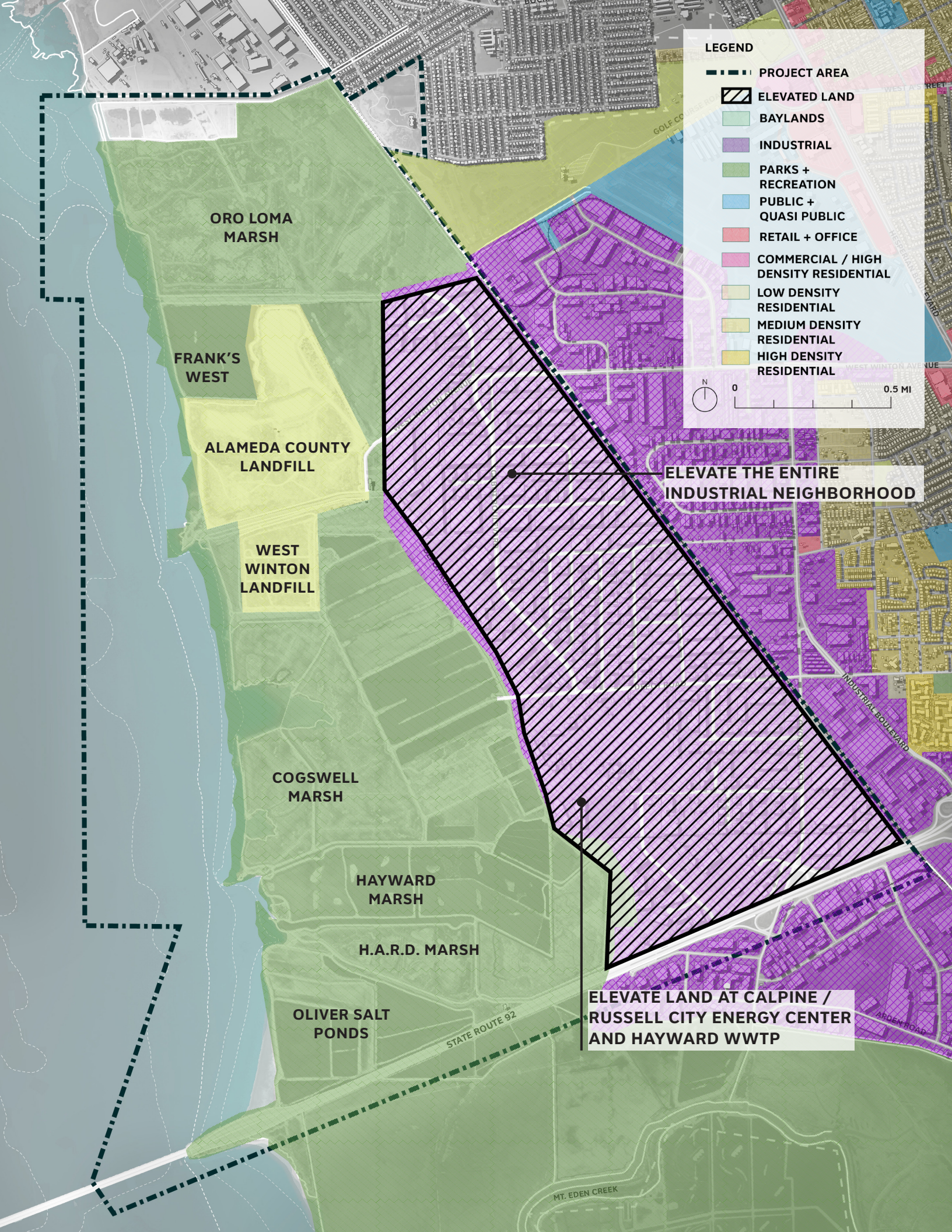
- Elevate the entire industrial neighborhood

PROS

- Reduces risk to industrial park of flooding and groundwater emergence
- May help remediate brownfields and reduce flood insurance rates

CONS

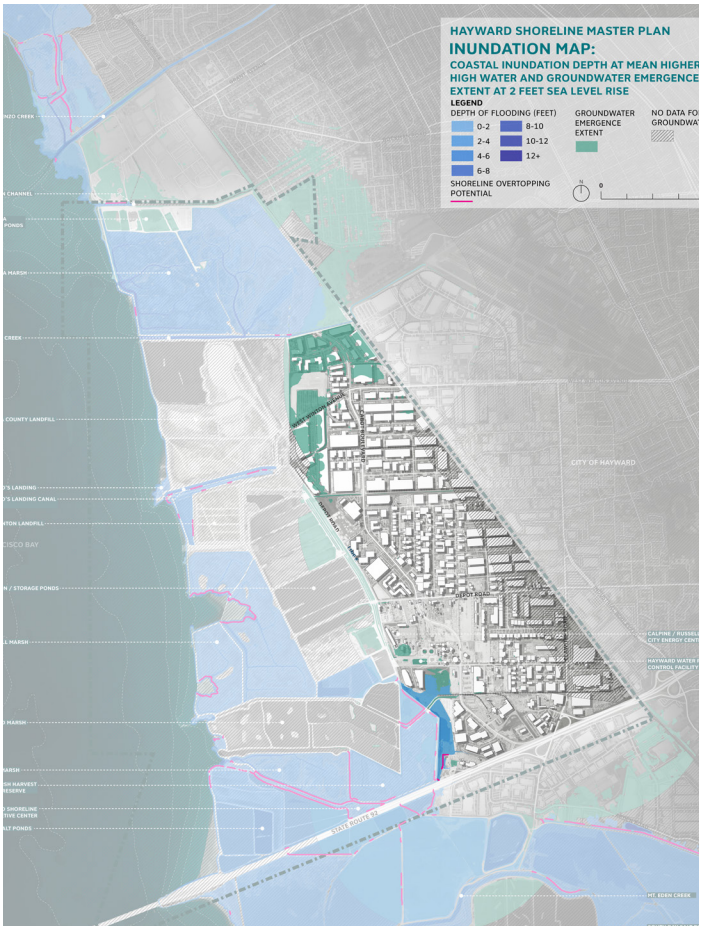
- Requires complete redevelopment of industrial park, causing significant temporary displacement
- Requires a large amount of clean dirt or fill
- Raising land elevation on historic marshes and Bay mud may lead to significant settlement and subsidence
- Raising elevations in a patchwork pattern is difficult for transportation and drainage connectivity
- May cause disturbance to adjacent land
- May only provide short-term solution for SLR
- Would be very costly
- May create an isolated island: with SLR, connectivity may be compromised


LEGEND
PROJECT AREA
ELEVATED LAND
BAYLANDS
INDUSTRIAL
PARKS + RECREATION
PUBLIC + QUASI PUBLIC
RETAIL + OFFICE
COMMERCIAL / HIGH DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
HIGH DENSITY RESIDENTIAL
N
0
0.5 MI
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
ELEVATE THE ENTIRE INDUSTRIAL NEIGHBORHOOD
ELEVATE LAND AT CALPINE / RUSSELL CITY ENERGY CENTER AND HAYWARD WWTP
INDUSTRIAL BOULEVARD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK

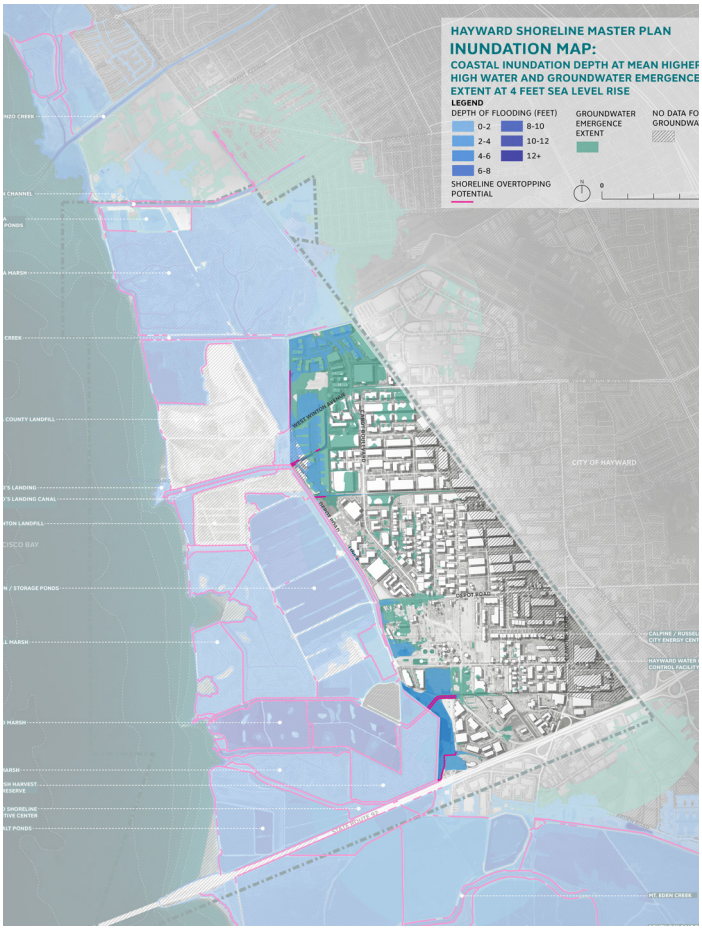
LAND ELEVATION

Option 3: Industrial Neighborhood

2’ SLR

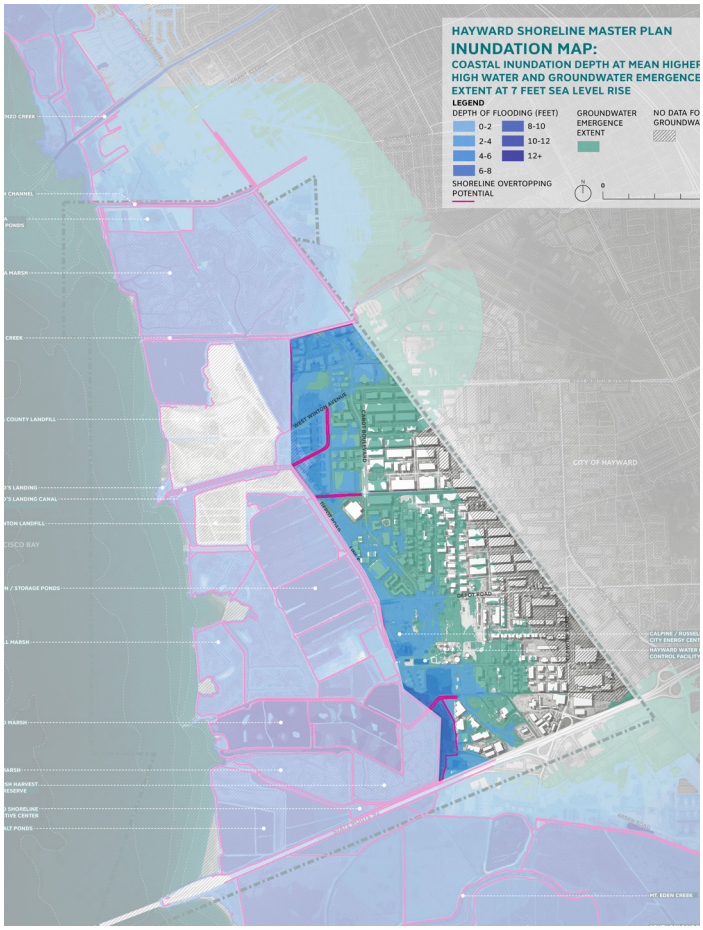


4’ SLR



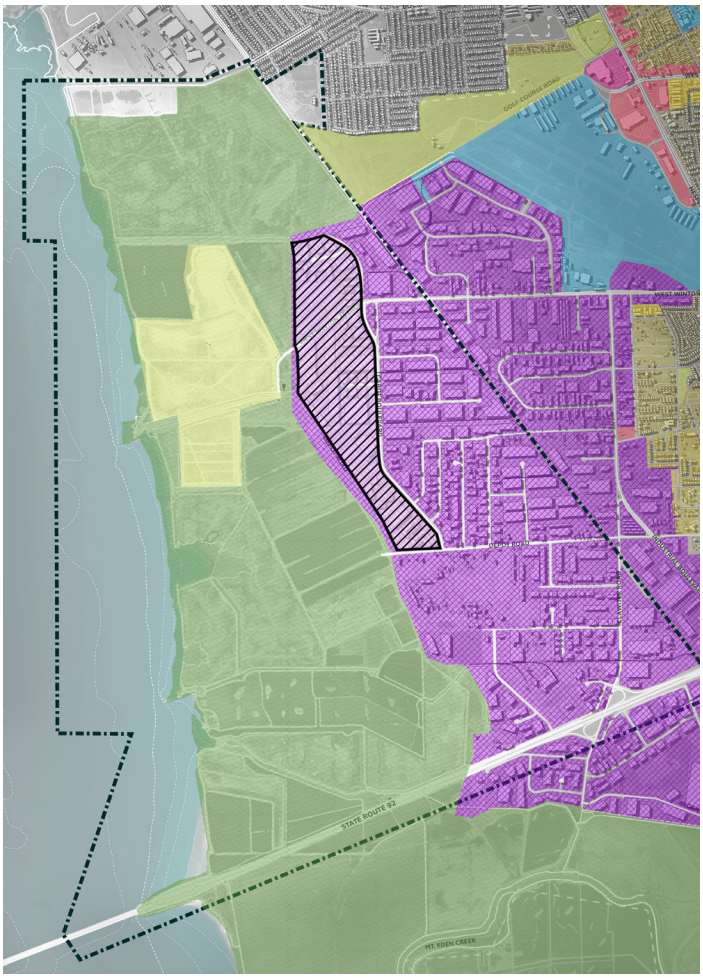
SCAPE

7’ SLR


HAYWARD SHORELINE MASTER PLAN
INUNDATION MAP:
COASTAL INUNDATION DEPTH AT MEAN HIGHER
HIGH WATER AND GROUNDWATER EMERGENCE
EXTENT AT 7 FEET SEA LEVEL RISE
LEGEND
DEPTH OF FLOODING (FEET)
0-2
2-4
4-6
6-8
8-10
10-12
12+
GROUNDWATER EMERGENCE EXTENT
NO DATA FO
GROUNDWA
SHORELINE OVERTOPPING POTENTIAL
CITY OF HAYWARD
MT. EDEN CREEK

LAND ELEVATION
Stakeholder Feedback

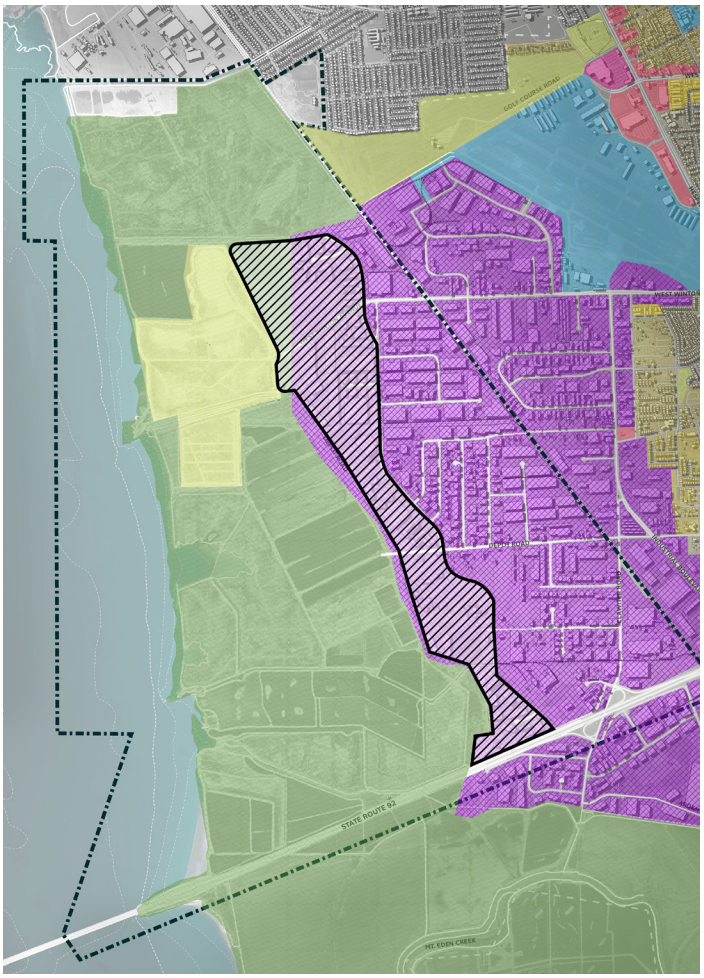
1: West of Cabot Boulevard



COMMENTS:

- See General Comments.

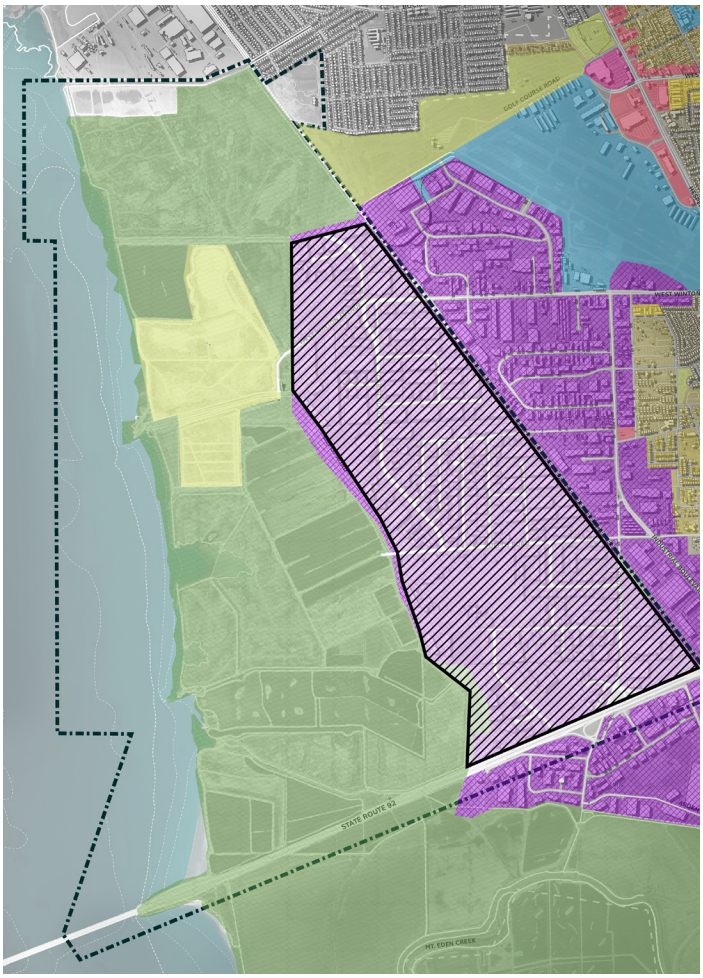
2: Bay Buffer



COMMENTS:

- See General Comments.

3: Industrial Neighborhood



COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- EBRPD noted that these options do not address protection of the marshes. Marsh adaptation and protection strategies are covered in other strategies, such as fine sediment augmentation, levee improvements, and fine and coarse grain beaches. Ultimately, multiple options will be combined into design alternatives.
- COH indicated that, given the cost implications and disruption to existing business operation in the westernmost City of Hayward industrial areas, no proposed option would be supported by the City of Hayward. This is understood. However, the team does recommend maintaining this as an option in the building scale adaptation strategies. It is one of the only two solutions to reduce risk of groundwater emergence and could be implemented parcel by parcel with new construction or building retrofits.
- SFEI advised that subsidence is a major concern. Due to cost concerns, floodproofing buildings may be a lot more reasonable than raising the ground.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
SFEI: San Francisco Estuary Institute
Teal text indicates a response from SCAPE

SAN MATEO BRIDGE LANDING
Definition

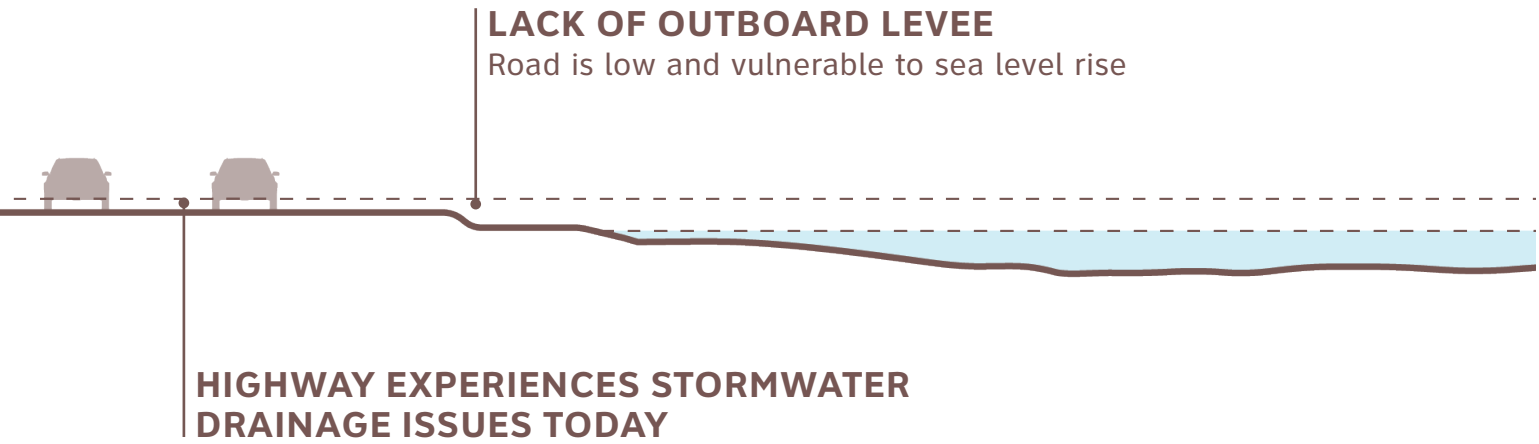
The eastern approach to the San Mateo-Hayward Bridge (SR-92) is **critical infrastructure** that is vulnerable to inundation by sea level rise. SR-92 is used by 86,000 passengers, 1,600 transit riders, and 6,000 trucks daily. Any flooding of the bridge would **impact regional mobility** and increase congestion.



EXISTING CONDITION

OBJECTIVE

- Reduce risk to transportation infrastructure from SLR, groundwater intrusion, and flood events



SAN MATEO BRIDGE LANDING
Precedents

Miami Beach: Rising Above
Miami Beach, FL

Cost: $500 million
Implementation Timeline: 2015- 2025

Applicability: Raising the road above MHW + SLR would help alleviate risk of flooding and disruption to critical transportation infrastructure. Miami beach is built on limestone, while Bay mud tends to settle more.

Description: City of Miami Beach aims to have all roads elevated to 3.7'NAVD88 to mitigate flooding issues.

- Roadways in Sunset Harbor Neighborhood have been raised by approximately 3 feet
- Sidewalks and adjacent public space have been retrofitted to align with the increased road elevation



Raised road during construction



Public space and sidewalk along a raised road

SAN MATEO BRIDGE LANDING
Precedents

KTA Bridge Raising Program
Sumner and Sedgwick Counties, Kansas

Size: 21 bridges
Cost: $3.7 million
Implementation Timeline: 2016

Applicability: The potential to raise the portion east of the toll booths inland to Clawiter Road on a low-pile structure could lift the roadbed out of the flood zone.

Description: Kansas Turnpike Authority raised 21 bridges between 12 and 21 inches to accommodate and encourage freight traffic, streamline maintenance, and improve safety in nearby communities.

- 10 hydraulic pumps were used to push 486,000 pounds of steel girders and concrete deck upward, one inch at a time. Within one day of pumping, shimming, inspecting and repeating, each bridge rested on new bearings, secured with steel anchor bolts.



Construction of bridge raising



Construction of bridge raising

SAN MATEO BRIDGE LANDING
Precedents

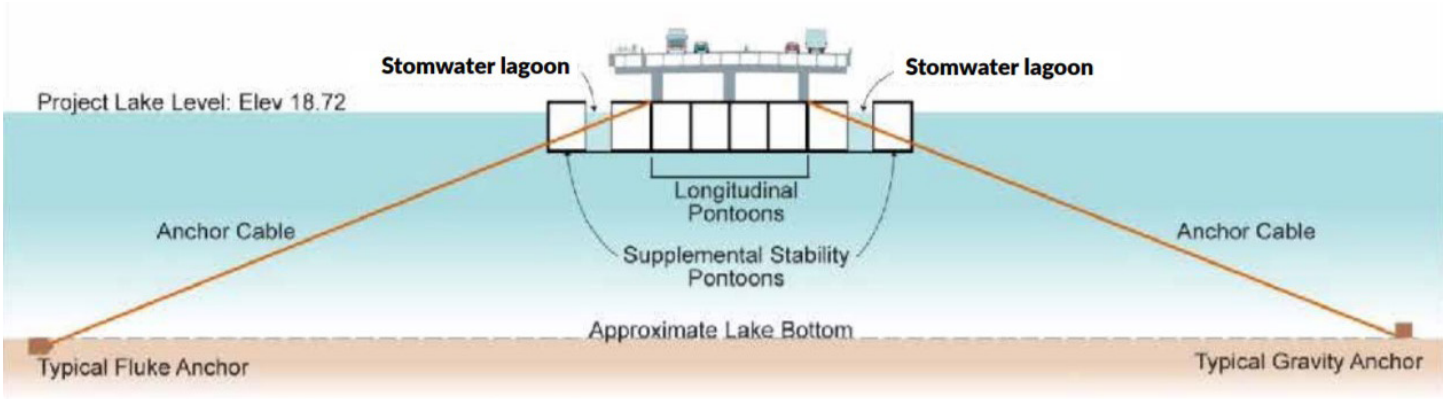
SR 520 Floating Bridge
Seattle/Medina, WA

Size: 7,708 LF
Cost: $2.75 billion (includes highway enhancements to either end of bridge)
Implementation Timeline: 2011-2016

Applicability: Retrofitting bridges to float could eliminate the risk of highway flooding. Floating bridges are also well suited in areas with soft ground conditions.

Description: The SR 520 floating bridge replaces the old bridge which had become vulnerable to windstorms and earthquakes after over 50 years in use. At 7,708', it is the world longest floating bridge.

- A floating bridge is used in Lake Washington because soft silts and sediments on the lake bed would make a conventional bridge more expensive to construct.
- Individual bridge pontoons are built on dry land and floated to the bridge site. Pontoons are connected rigidly from end to end and are held in place by steel cables to anchors deep in the lake bed.
- Constructed atop 77 watertight concrete pontoons, the deck height sits at 20' above water, 13.5' higher than the previous bridge.
- Bridge includes separated bicycle and pedestrian paths.



Bridge Cross Section and Anchor System



SR 520 Floating Bridge

SAN MATEO BRIDGE LANDING
Option 1: Flood Walls

OBJECTIVE

Reduce risk to critical transportation infrastructure given future SLR, storm surge, and groundwater emergence.

DESCRIPTION

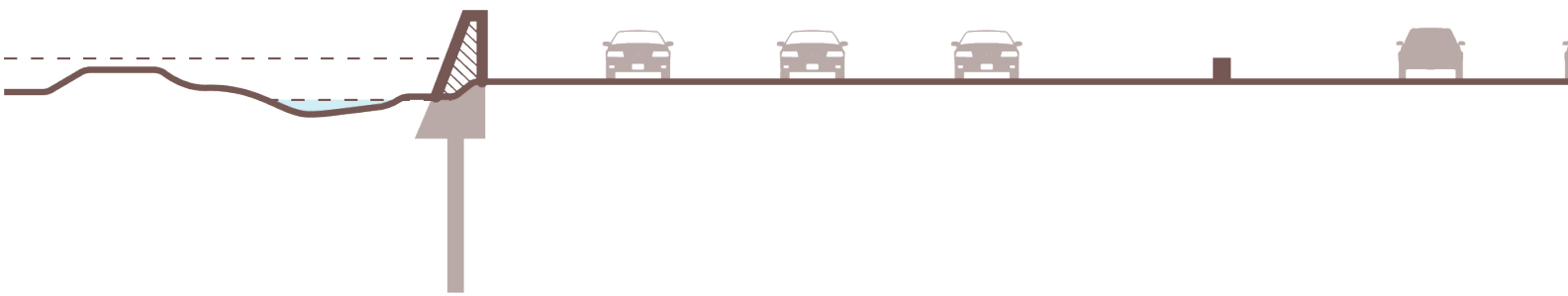
- Build two flood walls along the SR-92 bridge landing

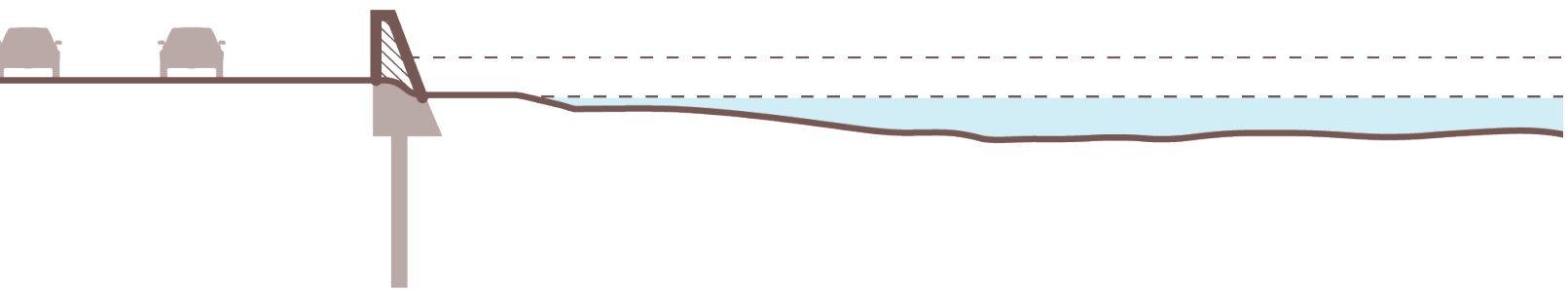
PROS

- Might not disrupt traffic flow during construction
- Does not need a new R.O.W. to the north or south of the existing R.O.W.
- Reduces risk of still-water flooding and SLR inundation
- Flood walls have a relatively small footprint

CONS

- Would create a bathtub effect- need to drain and pump water off the bridge itself
- Maintenance costs
- May have issues with exits that would require temporary gates / barriers





SAN MATEO BRIDGE LANDING

Option 2: Flood Protection Levees

OBJECTIVE

Reduce risk to critical transportation infrastructure given future SLR, storm surge, and groundwater emergence.

DESCRIPTION

- Build two levees on either side of the eastern SR-92 bridge landing

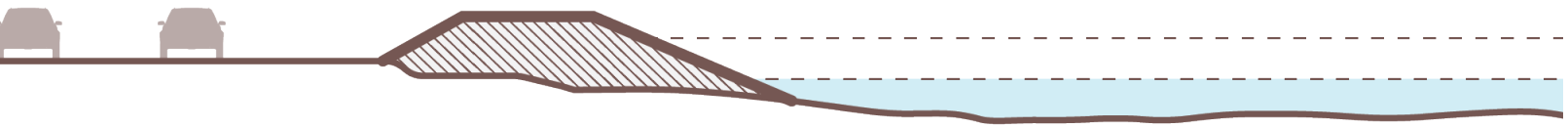
PROS

- Might not disrupt traffic flow during construction
- Reduces risk of still water flooding and SLR inundation
- Does not need a new R.O.W. to the north or south of the existing R.O.W.
- Maintains access road to the Hayward Shoreline Interpretive Center

CONS

- Levees would be vulnerable to erosion
- Would create a bathtub effect- need to drain and pump water off the bridge itself
- Maintenance costs





SAN MATEO BRIDGE LANDING

Option 3: Elevate Land

OBJECTIVE

Reduce risk to critical transportation infrastructure given future SLR, storm surge, and groundwater emergence.

DESCRIPTION

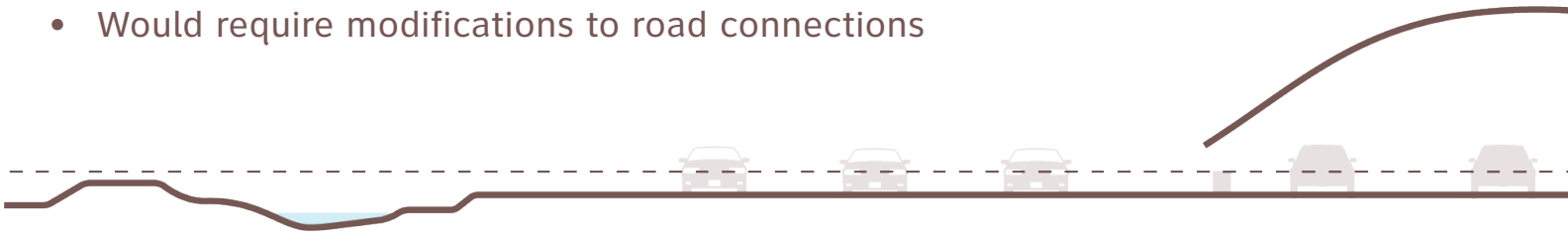
- Elevate the eastern approach to SR-92 above the flood and SLR inundation zones

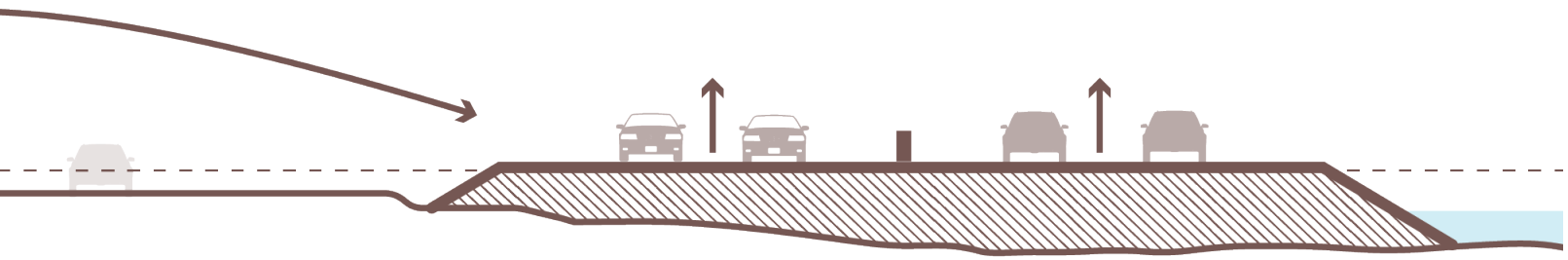
PROS

- Potential to lift the whole road out of flood and SLR inundation zones

CONS

- Would require a new R.O.W. to the south of the existing R.O.W.
- Levee edges would be vulnerable to erosion
- In order to avoid traffic disruption, would require piling up fill in existing marsh, which is a permitting challenge
- May experience a significant amount of settlement and subsidence
- Would require modifications to road connections





SAN MATEO BRIDGE LANDING

Option 4: Raise on Piles

OBJECTIVE

Reduce risk to critical transportation infrastructure with future SLR, storm surge, and groundwater emergence, and restore tidal connectivity between marshes.

DESCRIPTION

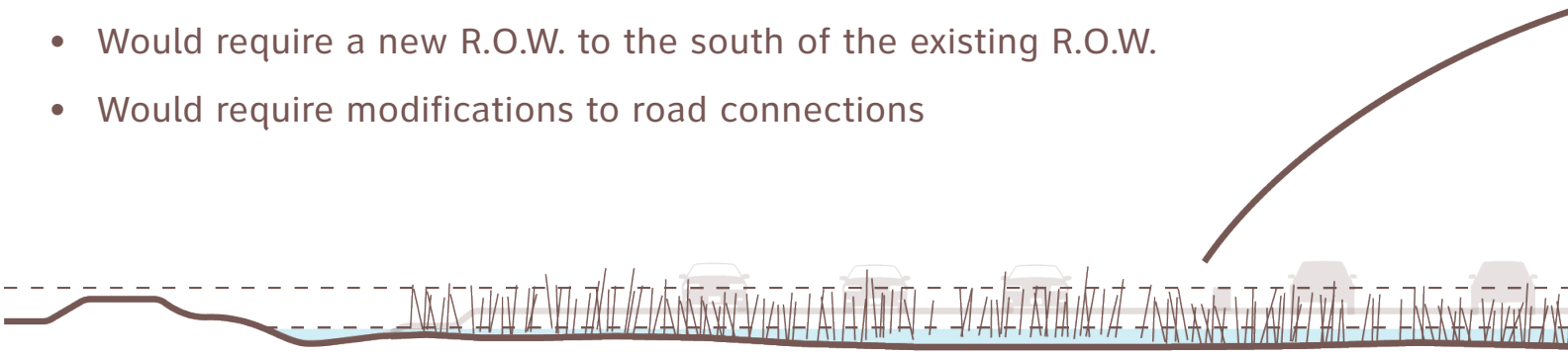
- Rebuild SR-92 on piles
- Restore tidal marsh in its current location

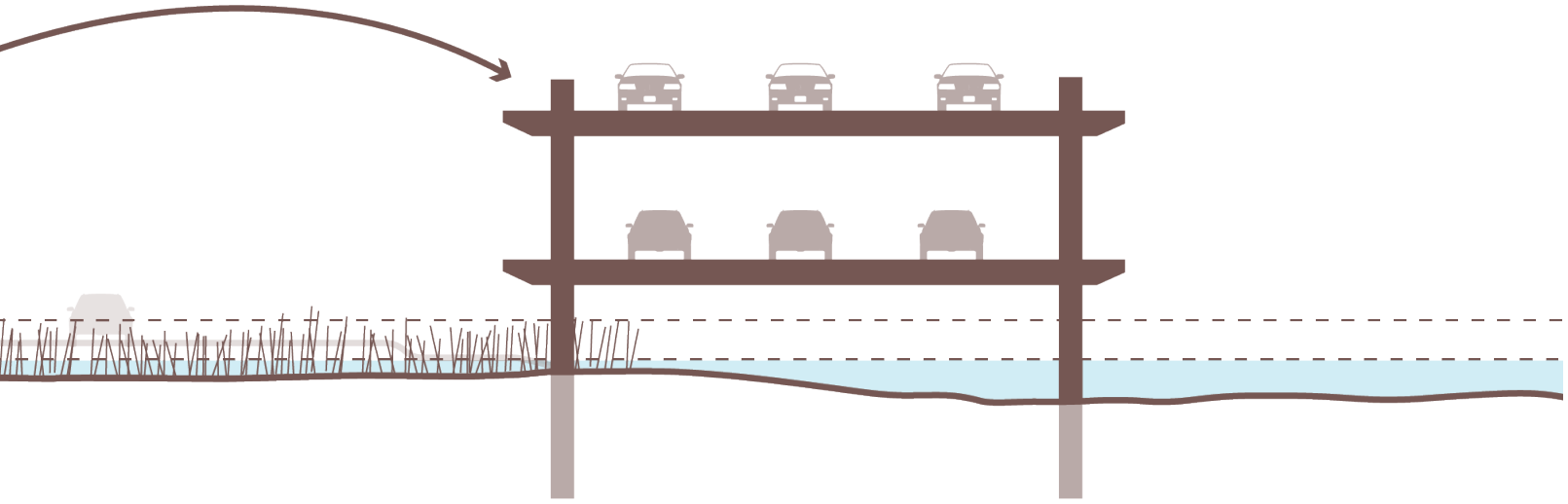
PROS

- Increase ecological connectivity of the marshes below
- Potential to raise bridge landing above the flood and all SLR inundation zones

CONS

- Costly strategy
- Would require a new R.O.W. to the south of the existing R.O.W.
- Would require modifications to road connections





SAN MATEO BRIDGE LANDING
Option 5: Floating Bridge

OBJECTIVE

Reduce risk to critical transportation infrastructure given future SLR, storm surge, and groundwater emergence.

DESCRIPTION

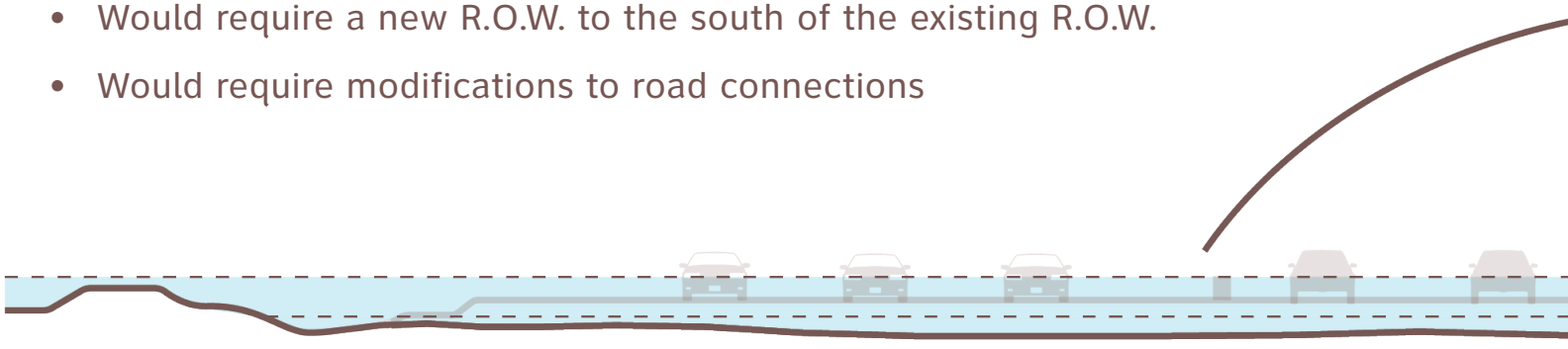
- Rebuild SR-92 as a floating bridge adjacent to the existing highway
- The existing approach may be retreated further inland if the existing approach is converted to floating

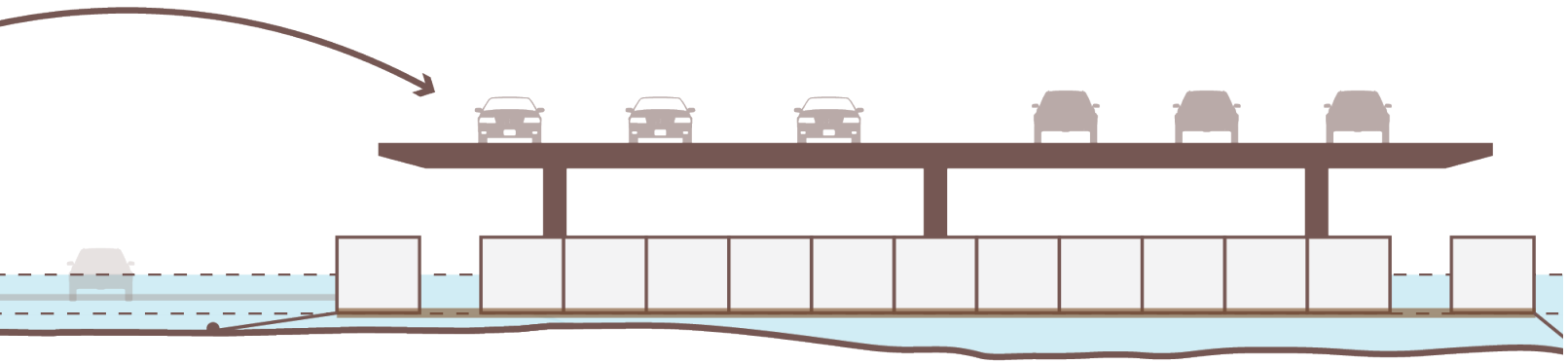
PROS

- Potential to lift the whole road out of flood and SLR inundation zones
- Adaptable to varying water levels

CONS

- Costly strategy
- Would require a new R.O.W. to the south of the existing R.O.W.
- Would require modifications to road connections

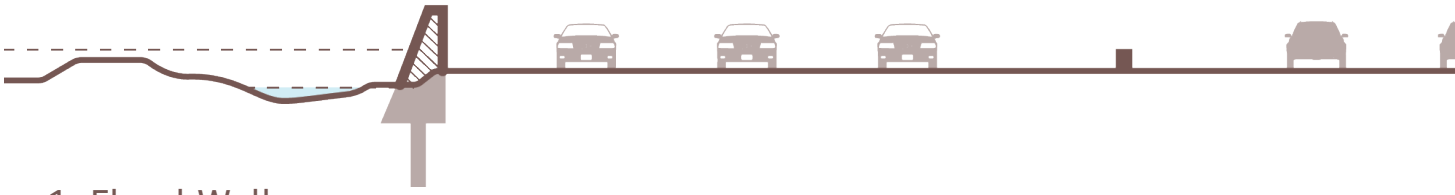




SAN MATEO BRIDGE LANDING
Stakeholder Feedback

GENERAL COMMENTS:

- EBRPD is in support of option #2.
- EBRPD asked how rising groundwater will influence these options. Additional pumping or engineering to prevent seepage may be required. The bathtub effect that would be created, and stormwater management issues, represent challenges to some of those options. These are reflected in the cons. If any of the options were to be implemented, additional studies would be required to address this question.
- COH indicated that all proposed options should be considered for the San Mateo Bridge approach.
- COH supports all options.
- SFEI is pretty confident that groundwater is already very shallow here, even though it is marked as “no data”.
- CalTrans noted that for Options 1 and 2, the bathtub effects aren’t as big of a problem if groundwater emergence isn’t a problem.
- CalTrans indicated that maintenance may prefer any strategy that maintains its current alignment.
- CalTrans is going to remove the toll booths and make tolls electronic.



Option 1: Flood Walls

COMMENTS:

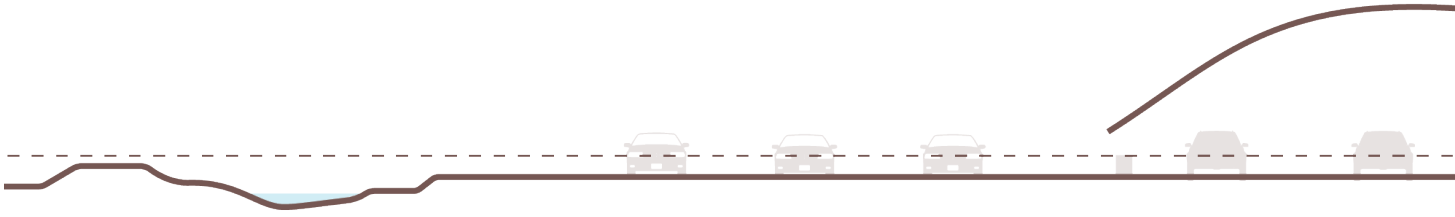
- CalTrans advised that if groundwater emergence is an issue, this is not a feasible option.



Option 2: Flood Protection Levees

COMMENTS:

- CalTrans advised that if groundwater emergence is an issue, this is not a feasible option.



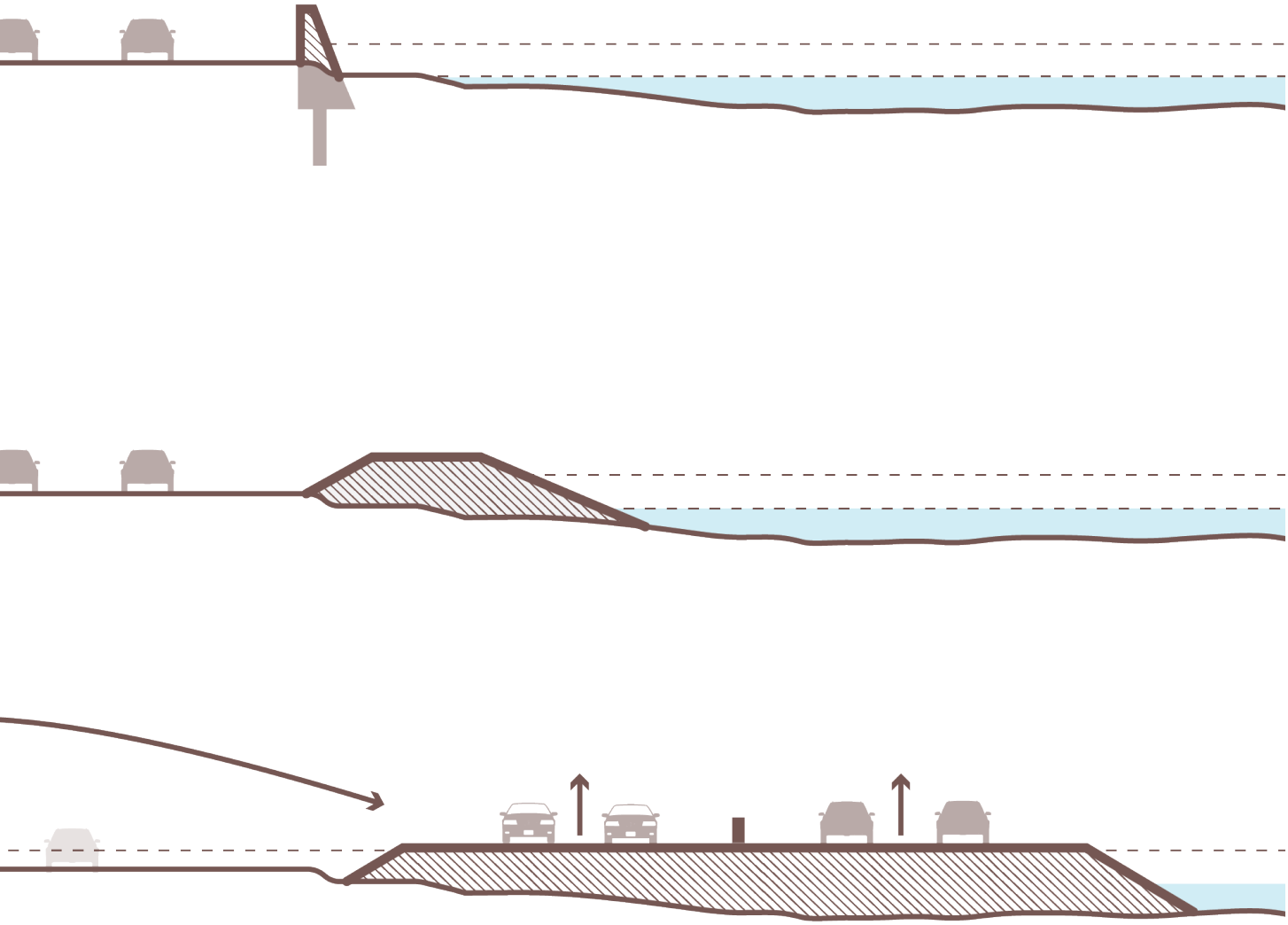
Option 3: Elevate Land

COMMENTS:

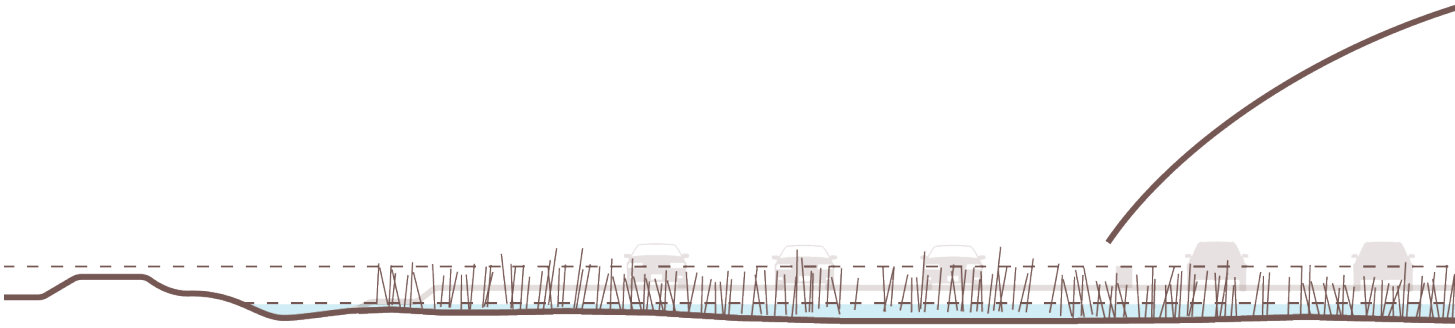
- CalTrans noted that this option might be feasible while maintaining the current alignment and by elevating 2 lanes at a time.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
SFEI: San Francisco Estuary Institute
Teal text indicates a response from SCAPE



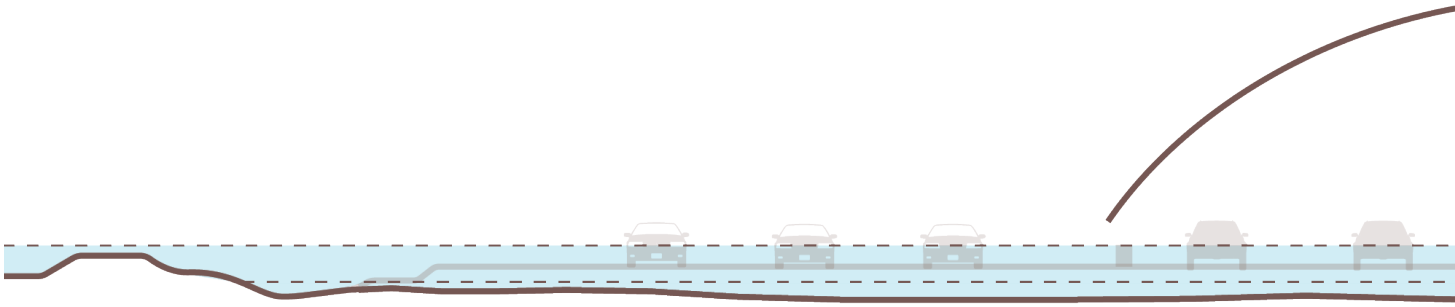
SAN MATEO BRIDGE LANDING
Stakeholder Feedback



Option 4: Raise on Piles

COMMENTS:

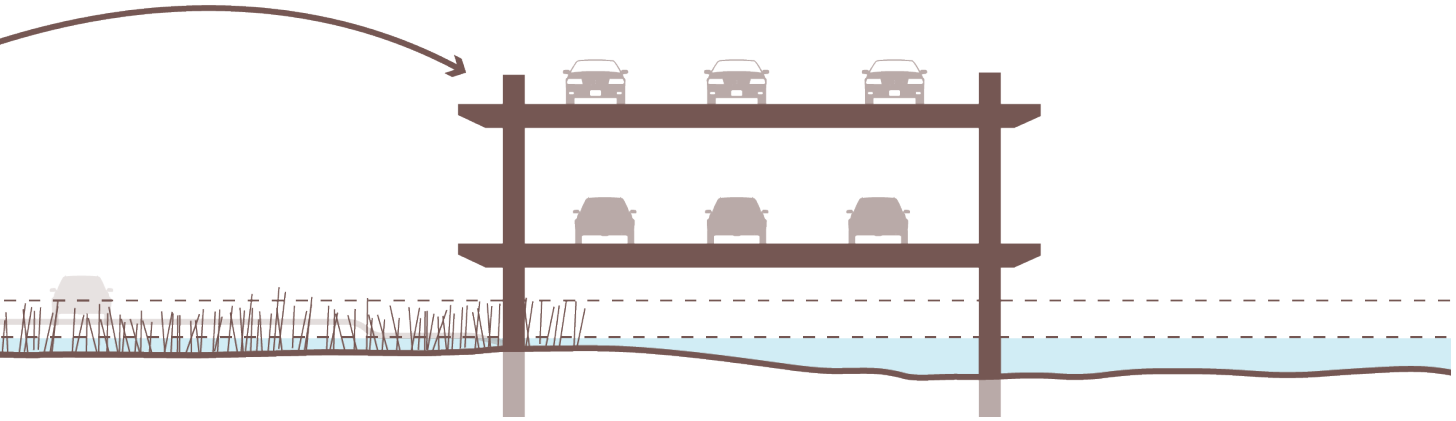
- See General Comments.

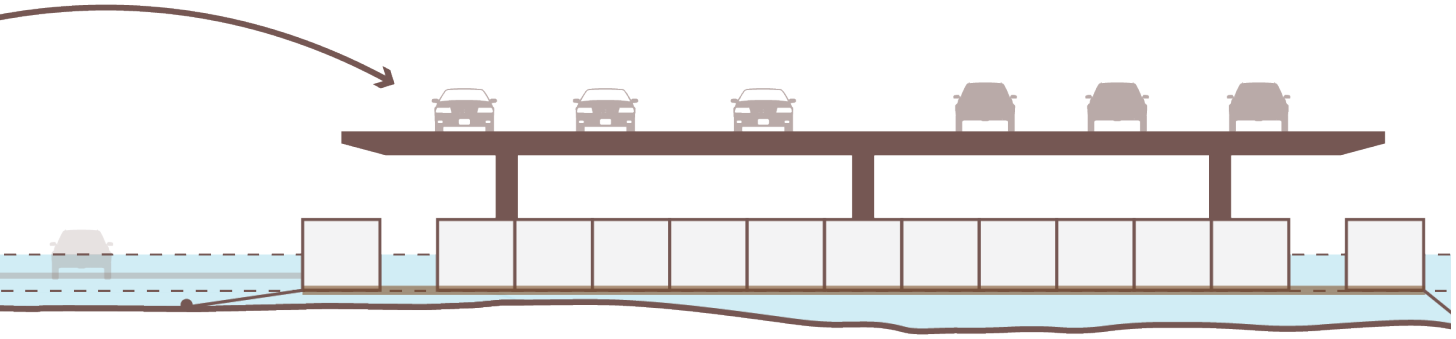


Option 5: Floating Bridge

COMMENTS:

- See General Comments.

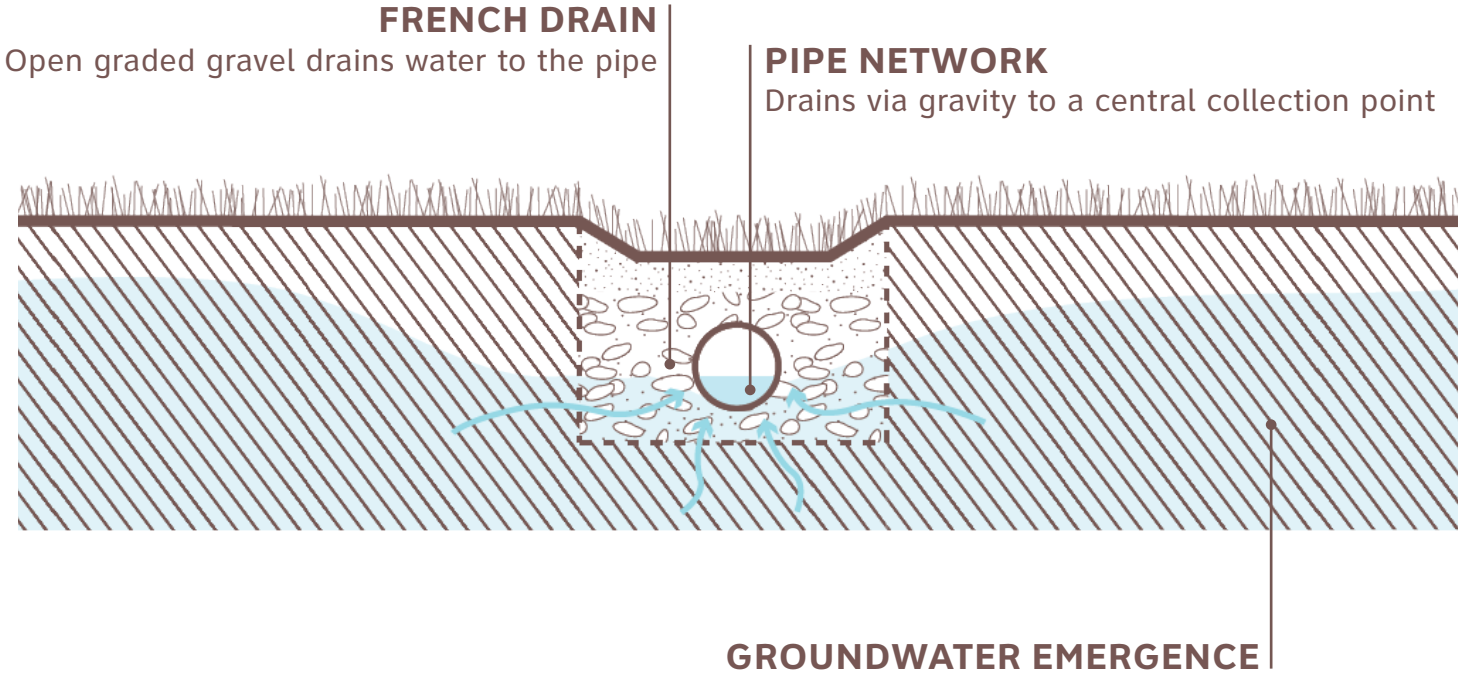




SUBSURFACE DRAINAGE

Definition

Rising groundwater tables can be addressed through an **expanded subsurface drainage network** that feeds into trenches/canals that flow to the bay at low tide. Tide gates are needed to prevent the influx of high tides. This strategy would require **additional inland storage space** to collect and manage groundwater during storm events while it is pumped to the Bay.



OBJECTIVE

- Reduce risk of groundwater emergence

SUBSURFACE DRAINAGE

Option 1: Subsurface Drainage Network

OBJECTIVE

Reduce risk of groundwater emergence.

DESCRIPTION

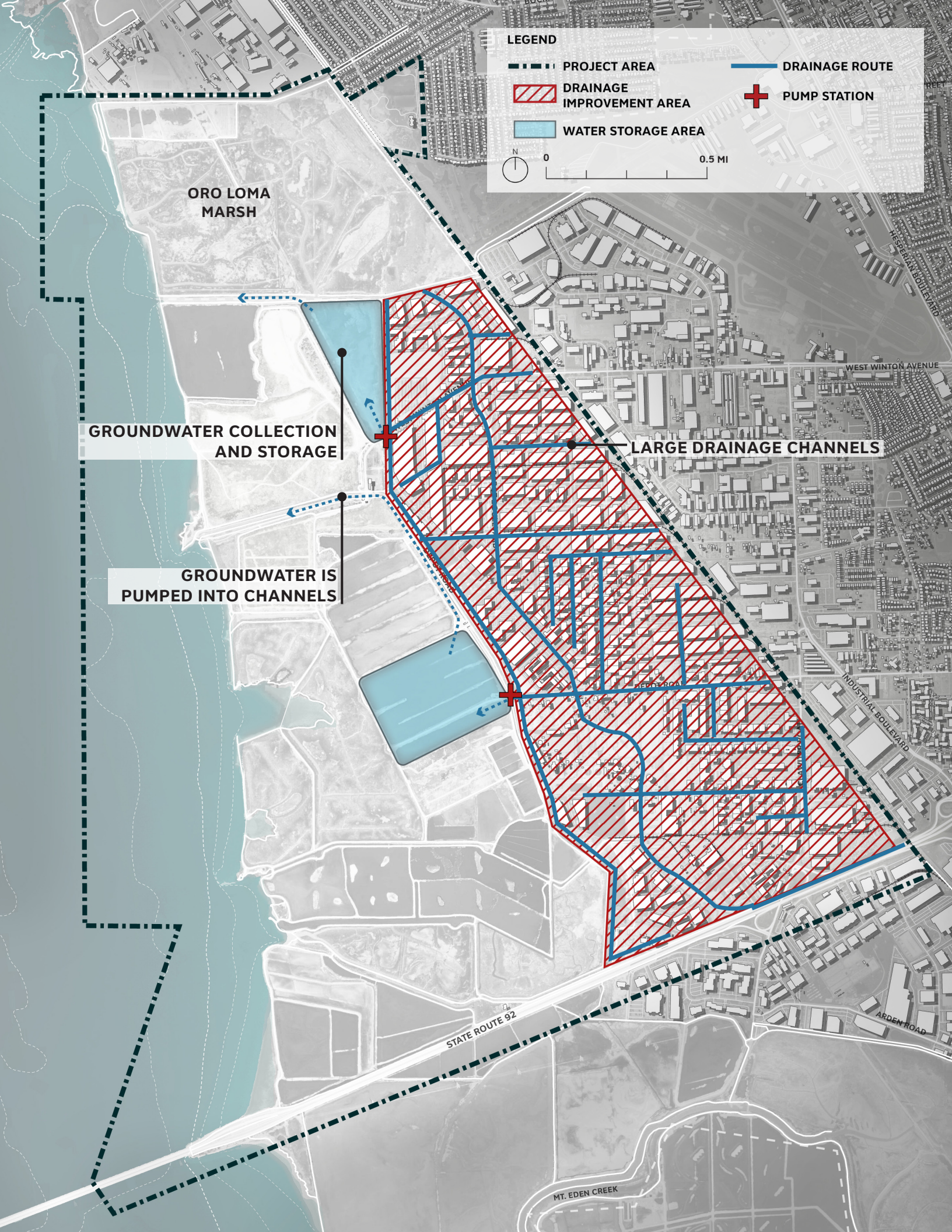
- Underground network of french drains to drain groundwater to a collection point. Must be as dense as a stormwater or sewer system to substantially affect the water table
- Create storage ponds at Frank's East and part of the Oxidation Ponds to collect groundwater
- Pump stations at each water storage pond discharge groundwater into adjacent channels

PROS

- Addresses rising groundwater tables
- Good medium-term strategy

CONS

- Requires additional inland storage space
- Partial loss of the oxidation ponds
- Need to use in combination with other measures, such as tide gates and making use of the existing flood control structures.
- Needs an outlet for the collected water, and therefore is not a long-term solution
- Requires the creation of a high density system of trenches/ditches and perforated pipelines
- If the drainage network is too flat, pumps will be required
- Not supported by the City of Hayward at this time due to potential cost


LEGEND
PROJECT AREA
DRAINAGE IMPROVEMENT AREA
WATER STORAGE AREA
DRAINAGE ROUTE
PUMP STATION
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ORO LOMA MARSH
GROUNDWATER COLLECTION AND STORAGE
GROUNDWATER IS PUMPED INTO CHANNELS
LARGE DRAINAGE CHANNELS
WEST WINTON AVENUE
HESPERIAN BOULEVARD
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

SUBSURFACE DRAINAGE
Stakeholder Feedback

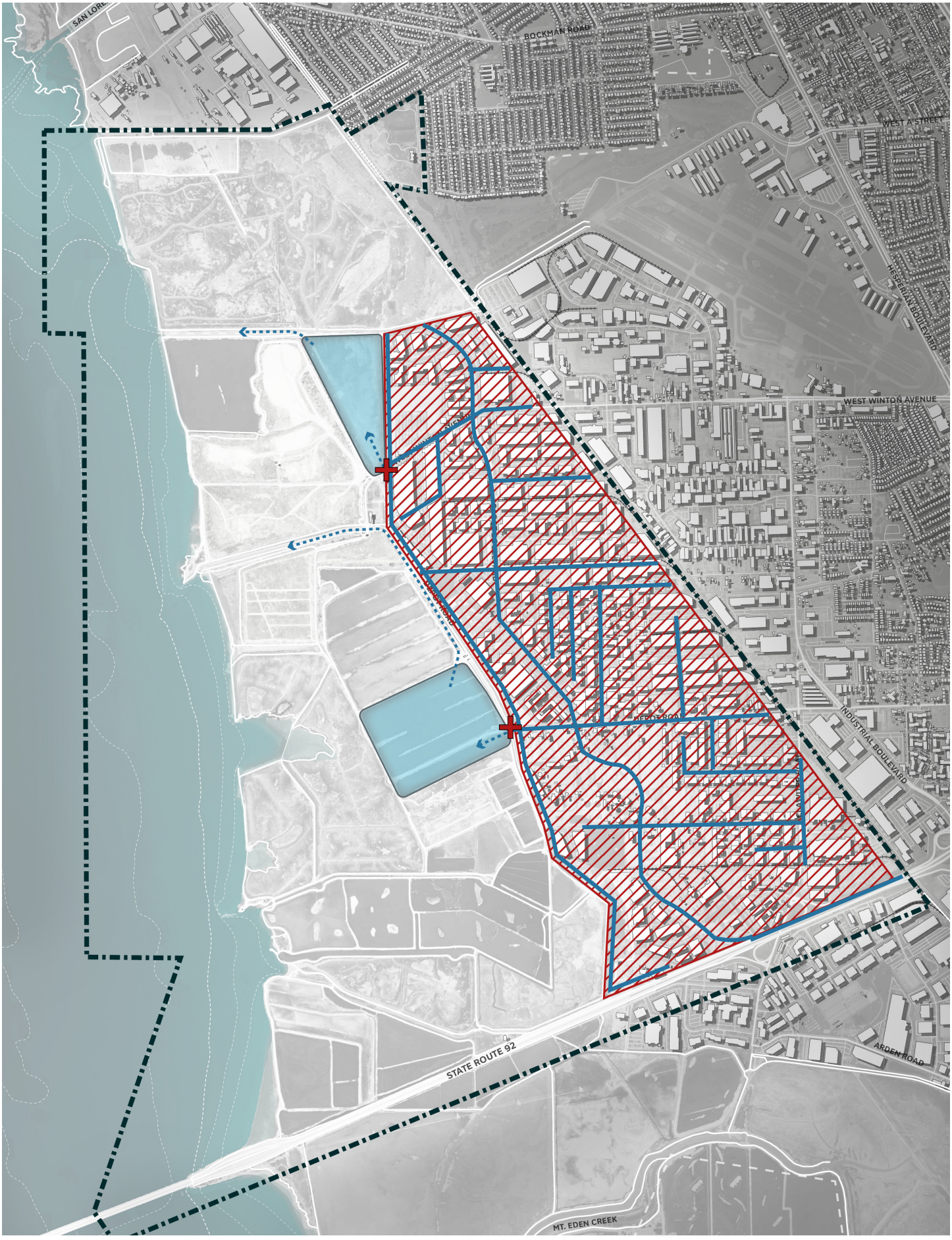
GENERAL COMMENTS:

- COH indicated that, given the extreme cost associated with creating this infrastructure, the City of Hayward would not support this concept at this time. The design team does recommend keeping this strategy as an option since it is only one of two solutions to mitigate groundwater emergence.
- SFEI advised that building more levees and walls increases groundwater emergence.
- ACFCD is in support of this idea. It is normal and feasible to have a smaller pump running constantly.

COMMENTS:

- COH noted no support for this option. The design team does recommend keeping this strategy as an option since it is only one of two solutions to mitigate groundwater emergence.

ACRONYMS
EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
SFEI: San Francisco Estuary Institute
ACFCD: Alameda County Flood Control District
Teal text indicates a response from SCAPE

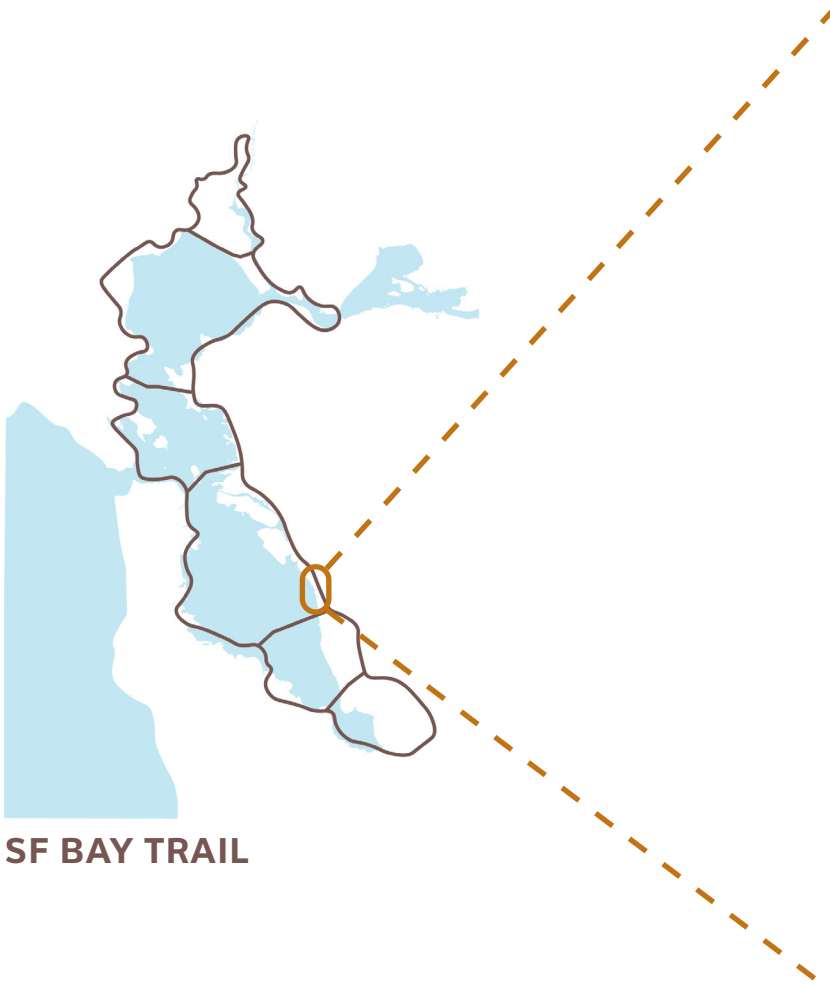

BOCKMAN ROAD
WEST A STREET
HESPERIAN BOULEVARD
WEST WINTON AVENUE
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

NON-STRUCTURAL STRATEGIES

PUBLIC ACCESS & THE BAY TRAIL

Definition

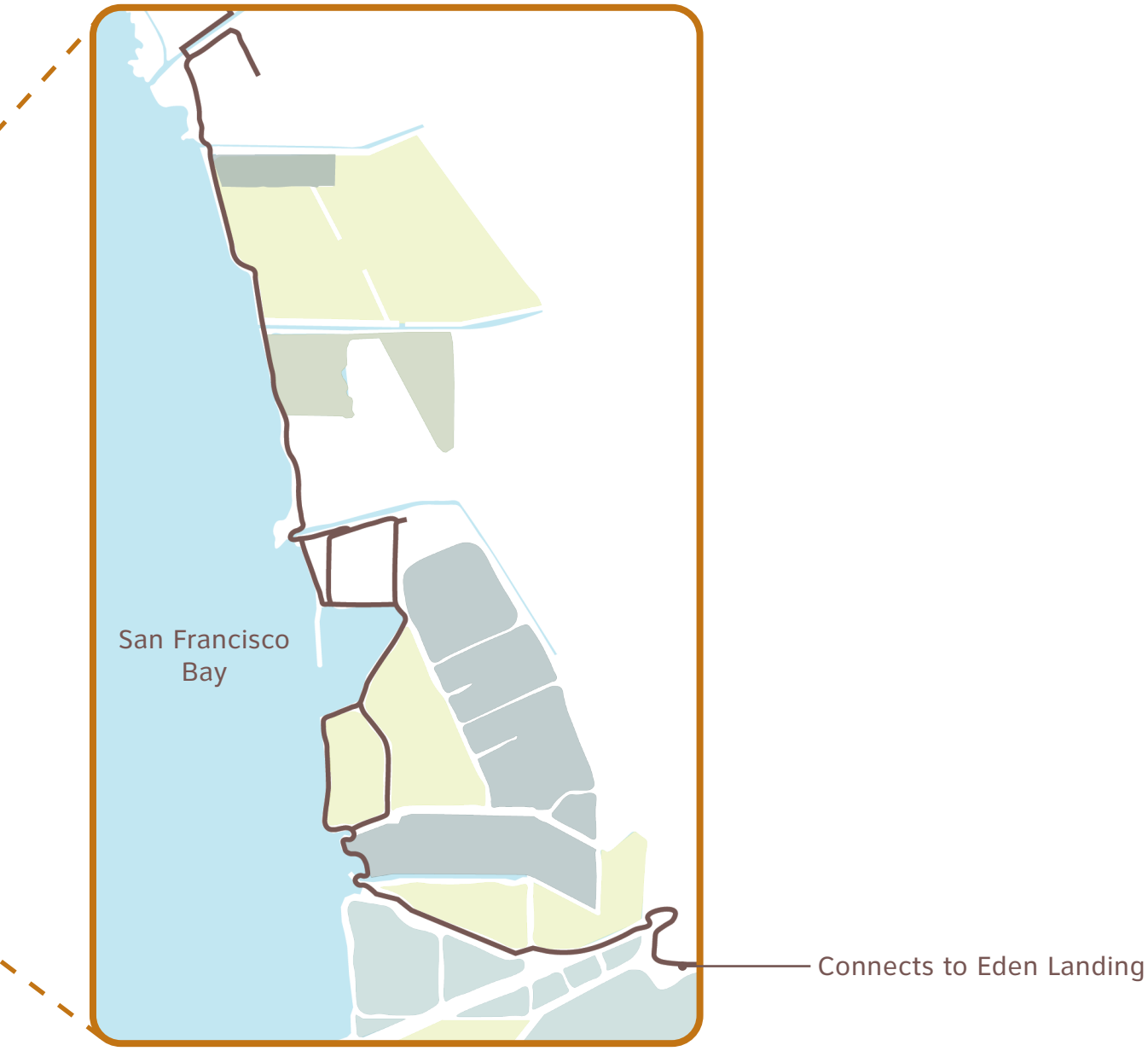
Public access strategies include **Bay Trail adaptation plans,** additional sites for public access, new types of recreation, expansion of the SF Bay Water Trail, and enhanced connections. Aligning with other adaptation and restoration projects may **enhance recreation benefits** and **increase community connections.**



SF BAY TRAIL

OBJECTIVE

- Enhance recreational opportunities and adapt to SLR
- Create a management framework for adapting to SLR over time



EAST BAY ENLARGEMENT

PUBLIC ACCESS & THE BAY TRAIL

Bay Trail site photos, 2019



View at Cogswell Marsh breach



View at Bay's edge



View at Oro Loma Marsh



View from West Winton landfill





Bay Trail flooding during Jan 2017 King Tide
Source: H.A.R.D.

PUBLIC ACCESS & THE BAY TRAIL

Option 1: Maintain Current Alignment of the Bay Trail

OBJECTIVE

Maintain recreational opportunities.

DESCRIPTION

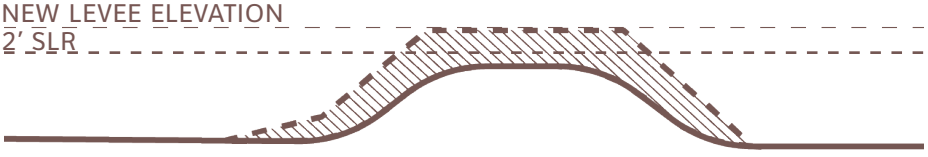
- Raise and repair all levees projected to overtop with 2’ SLR (accounting for 2’ freeboard)

PROS

- Diverse bay experience adjacent to blue water
- Maintains current alignment which is existing and permitted
- Maintains existing habitats

CONS

- Short-term solution
- Bay trail remains in exposed position near bay edge
- May have to elevate, repair levees that are not associated with other restoration / flood protection projects
- Costly to elevate and repair levees



LEVEE RAISING


LEGEND
PROJECT AREA
PUBLIC ACCESS AREA
BAY TRAIL
NEED TO RAISE LEVEE
INFORMATION
RESTROOMS
PARKING
BUILDING
N
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0.5 MI
ORO LOMA MARSH
LEVEES NEED TO BE RAISED- ACCOUNTS FOR 2' SLR OVERTOPPING + 2' FREEBOARD
FRANK'S WEST
EBRP OFFICE
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
HAYWARD SHORELINE INTERPRETIVE CENTER
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
MT. EDEN CREEK

PUBLIC ACCESS & THE BAY TRAIL

Option 2: Adapt the Bay Trail over Time

OBJECTIVE

Develop a management framework to adapt recreational resources to SLR over time.

DESCRIPTION

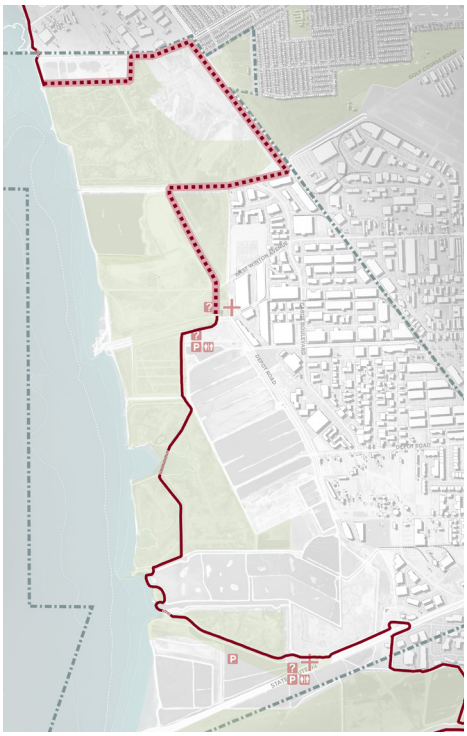
- Relocate the Bay Trail in 3 phases over time with SLR

PROS

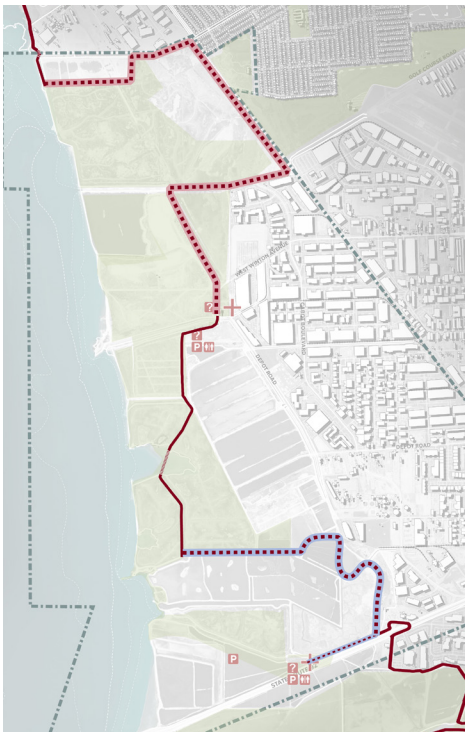
- Phased approach may be easier to implement and fund

CONS

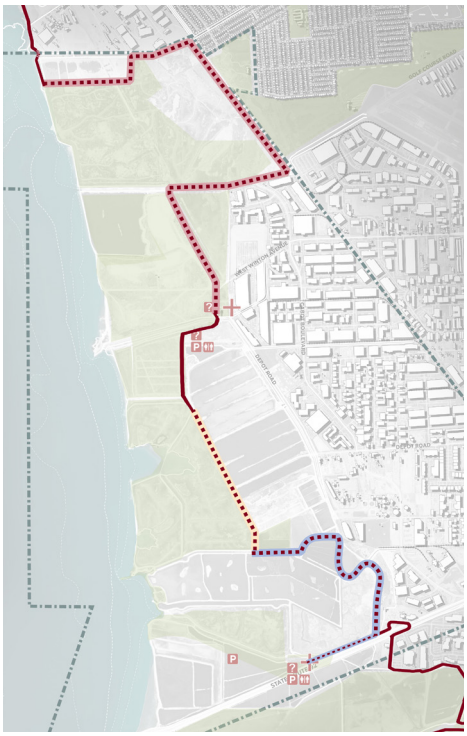
- Trail connections at the bay will be vulnerable with SLR
- Proximity to WWTP uses could pose an issue



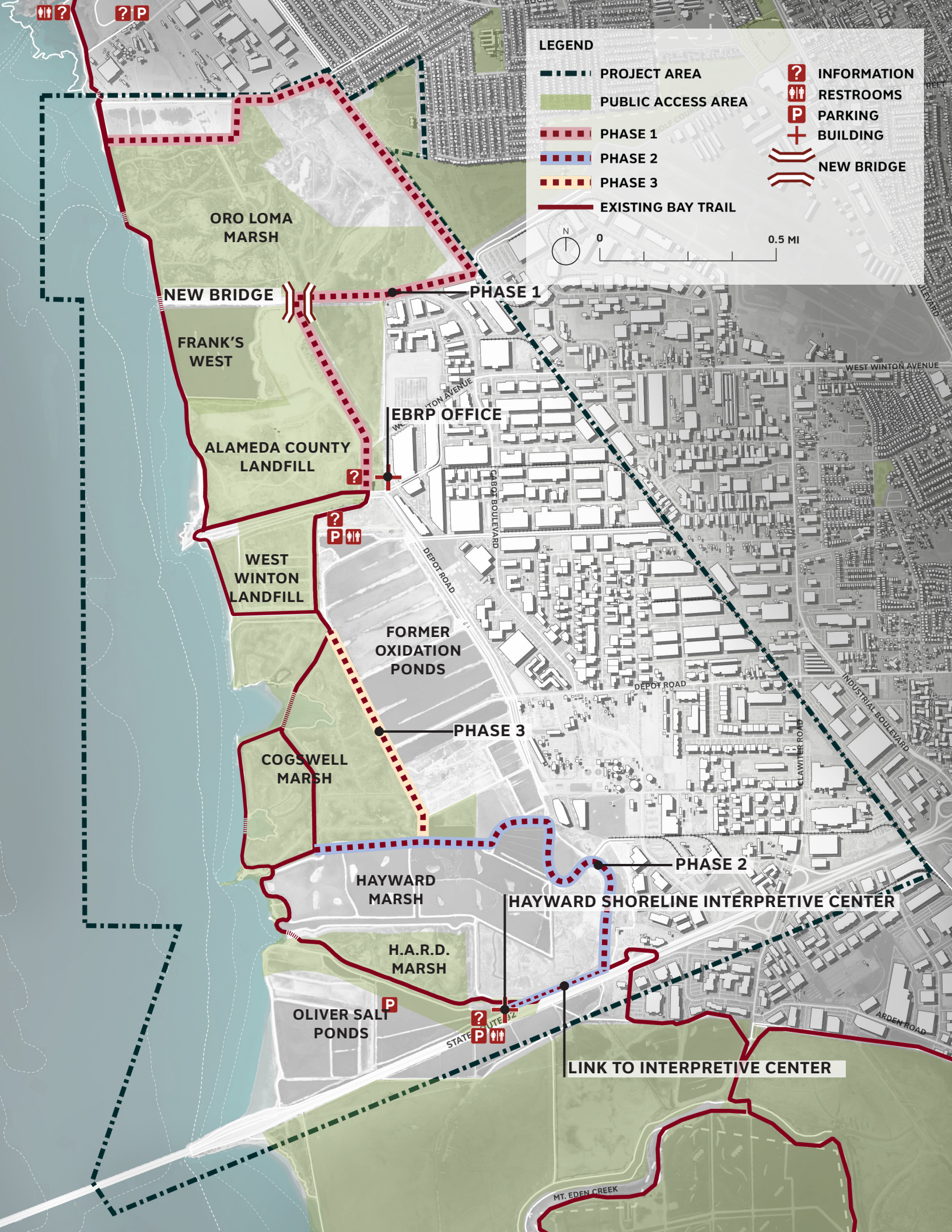
Phase 1



Phase 2



Phase 3


LEGEND
PROJECT AREA
PUBLIC ACCESS AREA
PHASE 1
PHASE 2
PHASE 3
EXISTING BAY TRAIL
INFORMATION
RESTROOMS
PARKING
BUILDING
NEW BRIDGE
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ORO LOMA MARSH
NEW BRIDGE
PHASE 1
FRANK'S WEST
EBRP OFFICE
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
FORMER OXIDATION PONDS
PHASE 3
COGSWELL MARSH
HAYWARD MARSH
PHASE 2
HAYWARD SHORELINE INTERPRETIVE CENTER
H.A.R.D. MARSH
OLIVER SALT PONDS
LINK TO INTERPRETIVE CENTER
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DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
MT. EDEN CREEK

PUBLIC ACCESS & THE BAY TRAIL

Option 3: Realign with New Infrastructure Improvements

OBJECTIVE

Create a management framework to adapt recreational resources to SLR.

DESCRIPTION

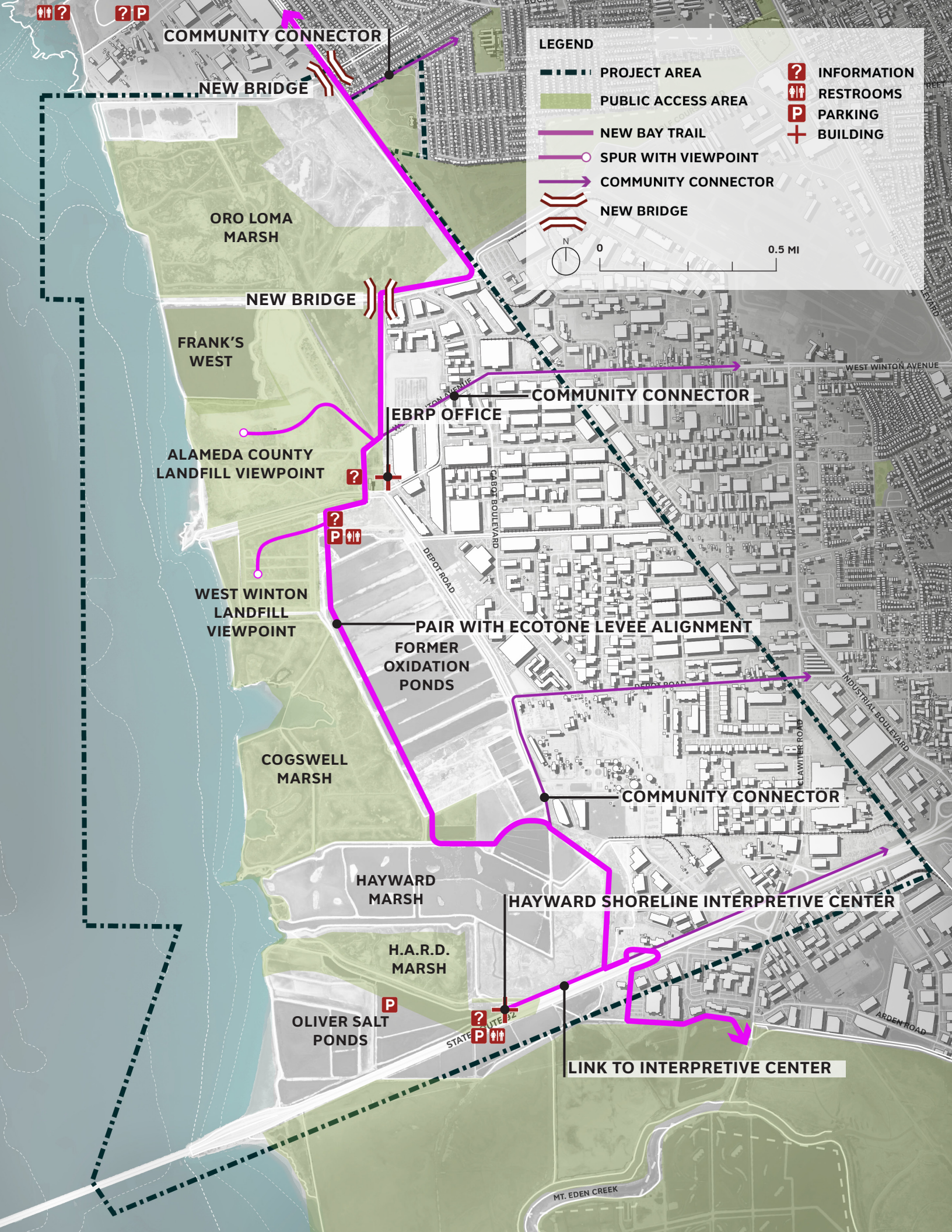
- Move the Bay Trail inland to higher ground and pair with new infrastructure improvements

PROS

- Closer to adjacent community- enhance key connections inland
- Could be paired with horizontal levee / other infrastructure projects
- Landfill spurs provide unique views of the shoreline and bay
- Buffered from direct wave erosion from the bay
- Bypasses existing infrastructure (restrooms, parking, etc.)

CONS

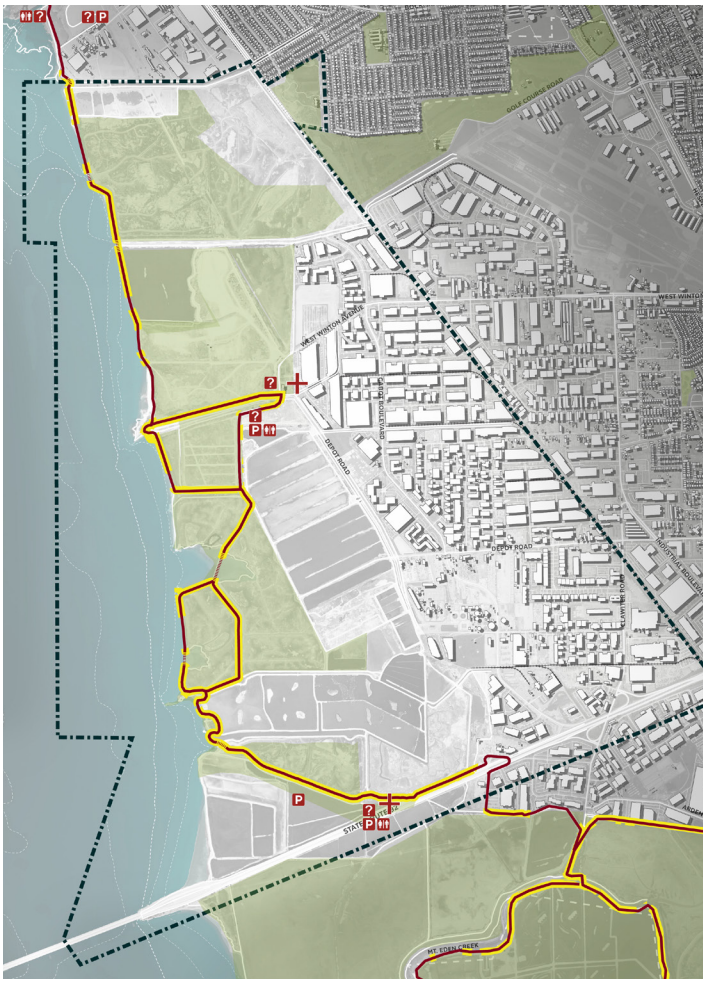
- Bay Trail could be far from blue water experience if construction occurs before SLR inundates the shoreline
- Proximity to WWTP or industrial uses could be an issue


LEGEND
PROJECT AREA
PUBLIC ACCESS AREA
NEW BAY TRAIL
SPUR WITH VIEWPOINT
COMMUNITY CONNECTOR
NEW BRIDGE
INFORMATION
RESTROOMS
PARKING
BUILDING
N
0
0.5 MI
COMMUNITY CONNECTOR
NEW BRIDGE
ORO LOMA MARSH
NEW BRIDGE
FRANK'S WEST
WEST WINTON AVENUE
COMMUNITY CONNECTOR
EBRP OFFICE
ALAMEDA COUNTY LANDFILL VIEWPOINT
CABOT BOULEVARD
DEPOT ROAD
WEST WINTON LANDFILL VIEWPOINT
PAIR WITH ECOTONE LEVEE ALIGNMENT
FORMER OXIDATION PONDS
INDUSTRIAL BOULEVARD
CLAWITER ROAD
COGSWELL MARSH
COMMUNITY CONNECTOR
HAYWARD MARSH
HAYWARD SHORELINE INTERPRETIVE CENTER
H.A.R.D. MARSH
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
LINK TO INTERPRETIVE CENTER
MT. EDEN CREEK

PUBLIC ACCESS & THE BAY TRAIL

Stakeholder Feedback

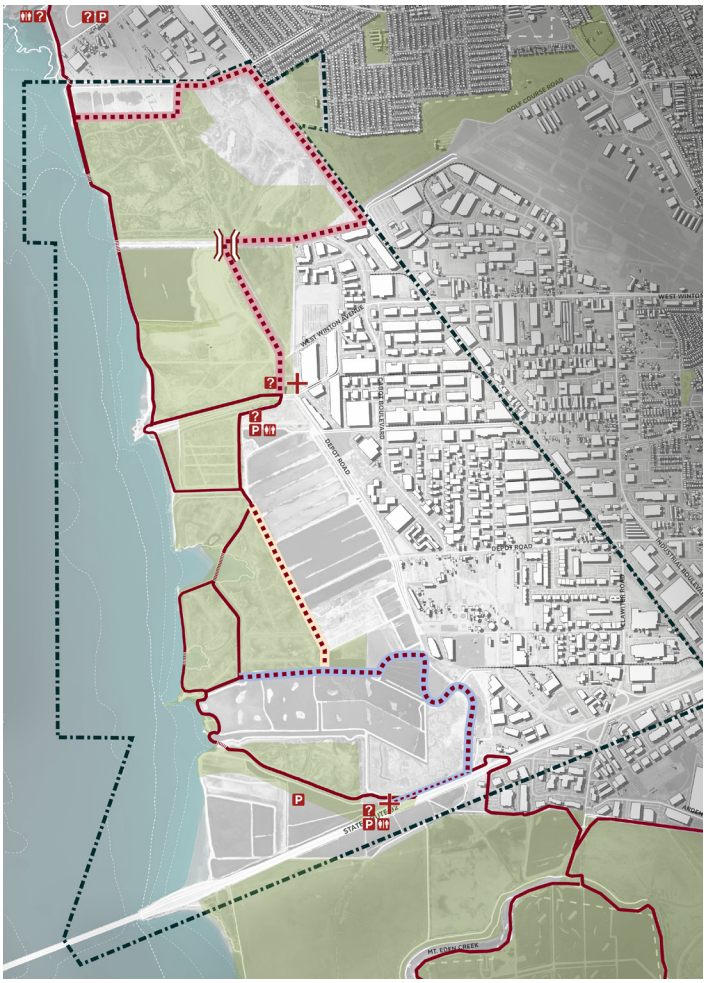
1: Maintain Current Alignment of the Bay Trail



COMMENTS:

- EBRPD indicated this is positive since it maintains habitats.
- COH noted very little support for this option.

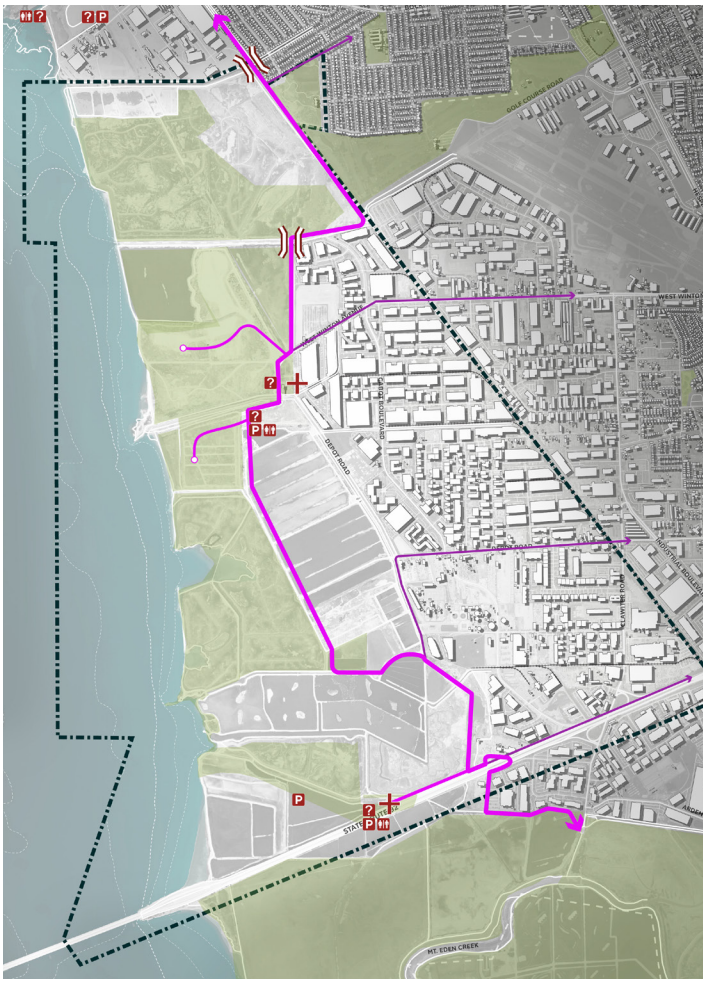
2: Adapt the Bay Trail over Time



COMMENTS:

- COH indicated support for this option.
- Bay Trail raised concerns over a trail alignment east of the Oxidation Ponds if they are not restored to tidal marsh.
- Bay Trail prefers a phased approach that would have the best of both worlds- maintain the current alignment and simultaneously build the realignments in phases.
- BCDC indicated a preference for this option.

3: Realign with New Infrastructure Improvements



COMMENTS:

- COH indicated support for this option.
- Bay Trail raised concern over a realignment on the back of Oro Loma Marsh - fencing would be required and it is in proximity to the rail. The trail could be raised high enough along the informal access road to get an expansive view of the marsh and be paired with an ecotone / flood protection levee that would protect the railroad.
- Bay Trail likes the spur alignments that gets users close enough to the blue water edge.
- ACFCD expressed that the county does not want to use the Alameda County Landfill as a site for any recreation. They intend to use the site for a solar plant.

GENERAL COMMENTS:

- COH supports long-term solutions to any future alignment of the Bay Trail. This is important since the current Bay Trail location will be extremely difficult to save when sea level rises more than two feet.
- Bay Trail advised that public access strategies should align with their goals: Maintain a level of blue water experience, feel like you're in the Bay or going through a Bay Habitat, and maintain a diversity of experiences (wood bridges, mudflats, marshes)
- Bay Trail is in support of the community connections, since there are only a handful of points to access the Bay Trail in this region.
- Bay Trail noted that a lot of people access the trail from the north at the San Lorenzo parking lot and from the Park District office access point. More walkers tend to access the trail from the Interpretive Center.
- BCDC indicated that maintaining even a spur trail to the Bay is important. Access to gravel beaches may be feasible and should be considered as well.
- HASPA expressed concern over the Bay Trail not feeling like it's in the Bay. There is support for a phased approach that maintains the trail in place until it's inundated to preserve a blue water experience for as long as possible.

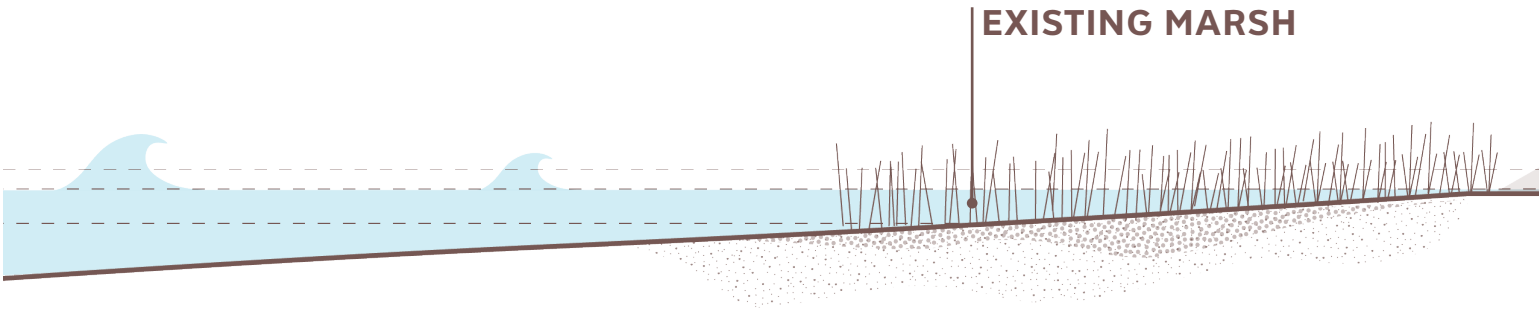
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
SFEI: San Francisco Estuary Institute
ACFCD: Alameda County Flood Control District
BCDC: Bay Conservation & Development Commission
HASPA: Hayward Area Shoreline Planning Agency
Teal text indicates a response from SCAPE

MARSH AND MUDFLAT MIGRATION PLANNING

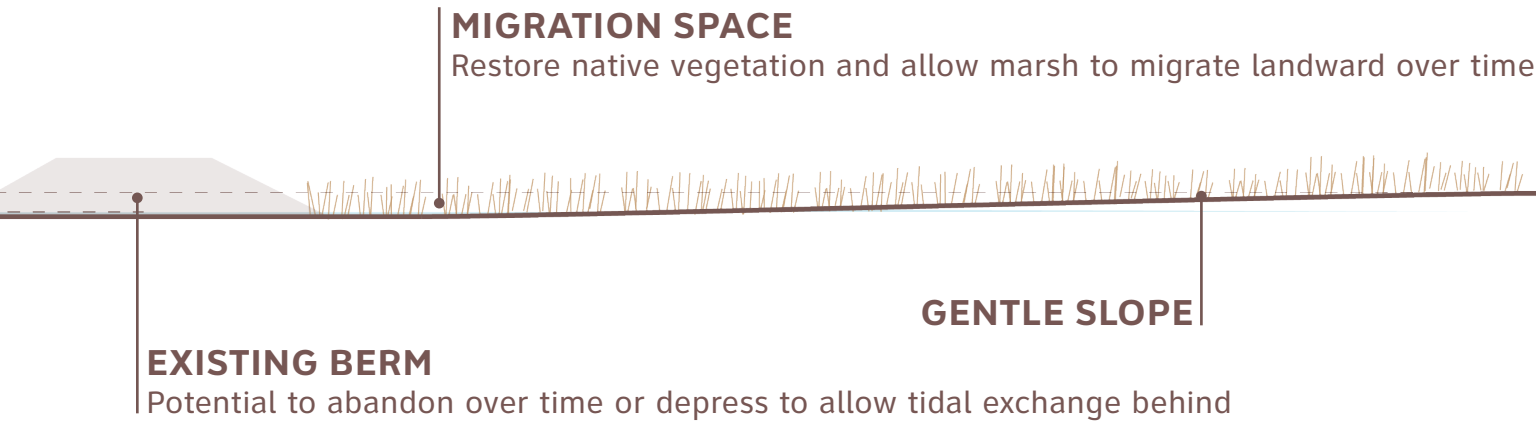
Definition

Natural **wetland-upland transition zones** adjacent to present and potential marshes can be protected, enhanced, or restored to **allow marshes to migrate landward as sea level rises**. This can be paired with levee / berm realignment and other flood control projects and may require the removal of berms to **ensure hydrological connectivity.**



OBJECTIVE

- Create a management framework for adapting to SLR over time



MARSH AND MUDFLAT MIGRATION PLANNING

Precedent

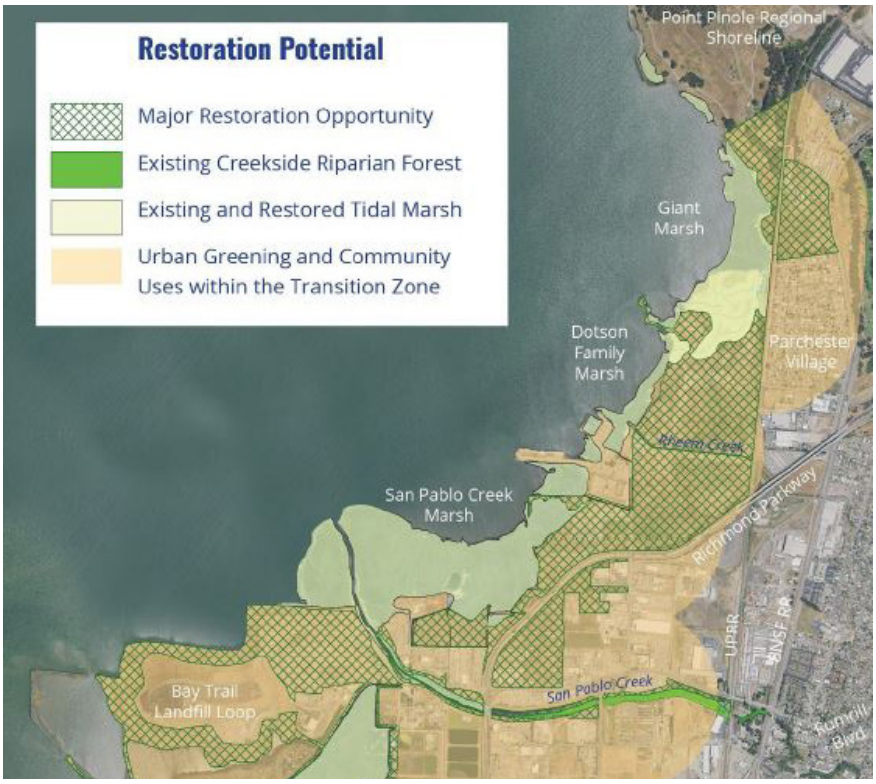
North Richmond Shoreline Vision
North Richmond, CA

Size: 2,790 acres
Implementation Timeline: 2017-2050

Applicability: Anticipating SLR can allow for robust planning processes to facilitate marsh and mudflat migration. Similar planning strategies nearby can provide a template for action and opportunity to incorporate lessons learned.

Description: Sea level rise will subject the North Richmond shoreline to inundation and greater wave action, increasing shoreline erosion and threatening the viability of tidal marshes. An area between the Baylands and uplands was historically composed of wet meadows and alluvial fans. Though the area is highly urbanized, it remains an important zone of connection between the Bay and the watershed, providing wildlife movement corridors and habitat for sensitive species. This area will provide space for marshes to migrate landward as sea level rises. The plan's strategies include:

- Acquiring contiguous shoreline parcels from willing sellers to protect and conserve open space
- Connecting and completing Bay Trail segments to improve and increase shoreline access and public understanding
- Supporting compatible uses within the transition zone such as renewable energy pilot projects
- Completing Giant Marsh Living Shorelines project and other opportunities to restore and enhance a diversity of habitats
- Developing economic incentives for businesses and homeowners to contribute for sustainable economic and environmental development



Plan of potential marsh migration space



Aerial view of North Richmond shoreline

MARSH AND MUDFLAT MIGRATION PLANNING

Option 1: Oro Loma Marsh Migration

OBJECTIVE

Maintain Oro Loma Marsh ecosystem despite sea level rise.

DESCRIPTION

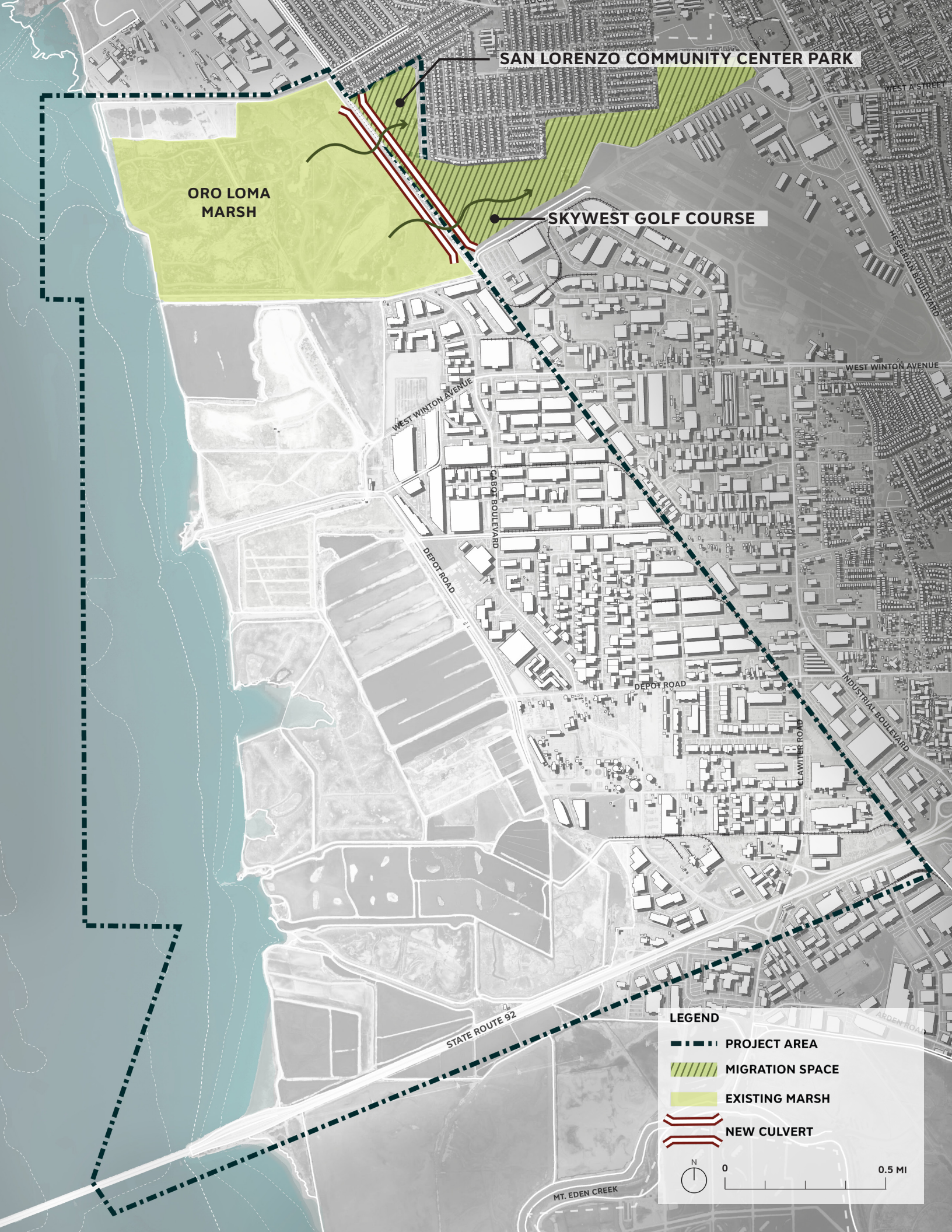
- Prepare San Lorenzo Community Center Park, Skywest Golf Course to be future marsh migration space (upland grassland with shallow slope)

PROS

- Large space for migration
- Connect new recreation space to adjacent community

CONS

- Marsh and wildlife needs to cross railroad through culverts, which is a tough right of way
- Needs to cross existing utility corridor in Oro Loma Marsh
- Land could require significant preparation to facilitate migration and disrupt the current uses


SAN LORENZO COMMUNITY CENTER PARK
ORO LOMA MARSH
SKYWEST GOLF COURSE
WEST A STREET
HESPERIAN BOULEVARD
WEST WINTON AVENUE
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK
LEGEND
PROJECT AREA
MIGRATION SPACE
EXISTING MARSH
NEW CULVERT
N
0
0.5 MI

MARSH AND MUDFLAT MIGRATION PLANNING

Option 2: Larger Migration Potential

OBJECTIVE

Maintain marsh ecosystems despite sea level rise.

DESCRIPTION

- Prepare San Lorenzo Community Center Park, Skywest Golf Course, and the Oxidation Ponds as future marsh migration space (upland grassland with shallow slope)

PROS

- Two large migration spaces

CONS

- Loss of stormwater detention capacity at oxidation ponds
- Need to cross existing utility corridor in Oro Loma Marsh
- Land could require significant preparation to facilitate migration and disrupt the current uses


SAN LORENZO COMMUNITY CENTER PARK
ORO LOMA MARSH
SKYWEST GOLF COURSE
COGSWELL MARSH
HAYWARD MARSH
SMHM PRESERVE
DIKED POND (CITY OF HAYWARD)
DIKED POND (EBRPD)
DIKED POND (EBRPD)
WEST A STREET
HESPERIAN BOULEVARD
WEST WINTON AVENUE
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
DEPOT ROAD
WITER ROAD
INDUSTRIAL BOULEVARD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK
LEGEND
PROJECT AREA
MIGRATION SPACE
EXISTING MARSH
NEW CULVERT
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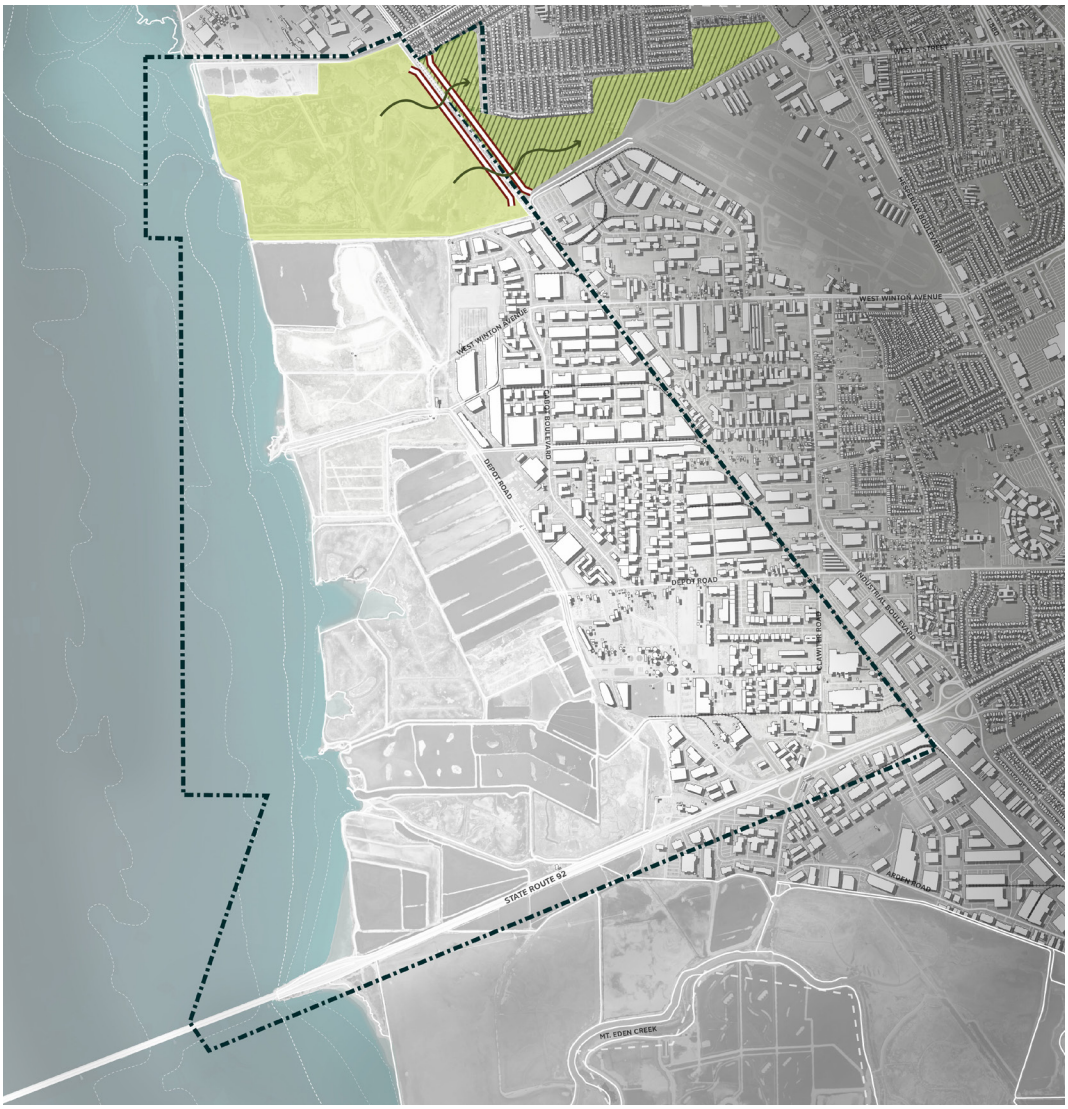
0.5 MI

MARSH AND MUDFLAT MIGRATION PLANNING

Stakeholder Feedback

1: Oro Loma Marsh Migration



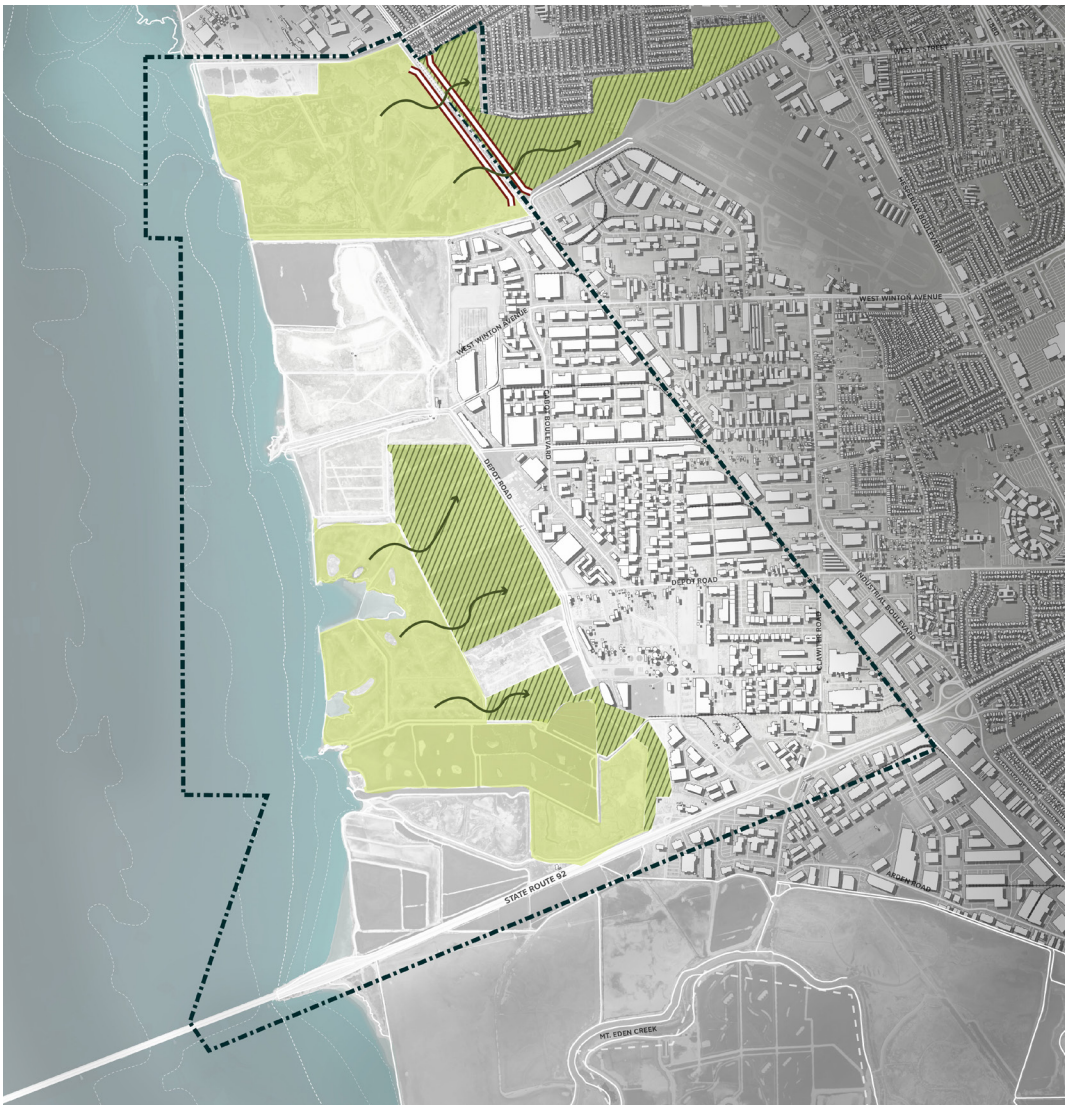
COMMENTS:

- EBRPD asked about the railroad. Culverts would have to be constructed below the railroad in this option, which may be costly.

GENERAL COMMENTS:

- COH noted that all possible adaptation measures should be reviewed and commented on by the City of Hayward's Public Works Utilities staff. There might be some support for the Skywest golf course transformation.
- A stakeholder (during the Stakeholder Meeting #2) suggested connecting Sulphur Creek to Skywest, since it would be hard to connect tidal flows under the rail tracks and high pressure gas pipeline.

2: Larger Migration Potential



COMMENTS:

- See General Comments.

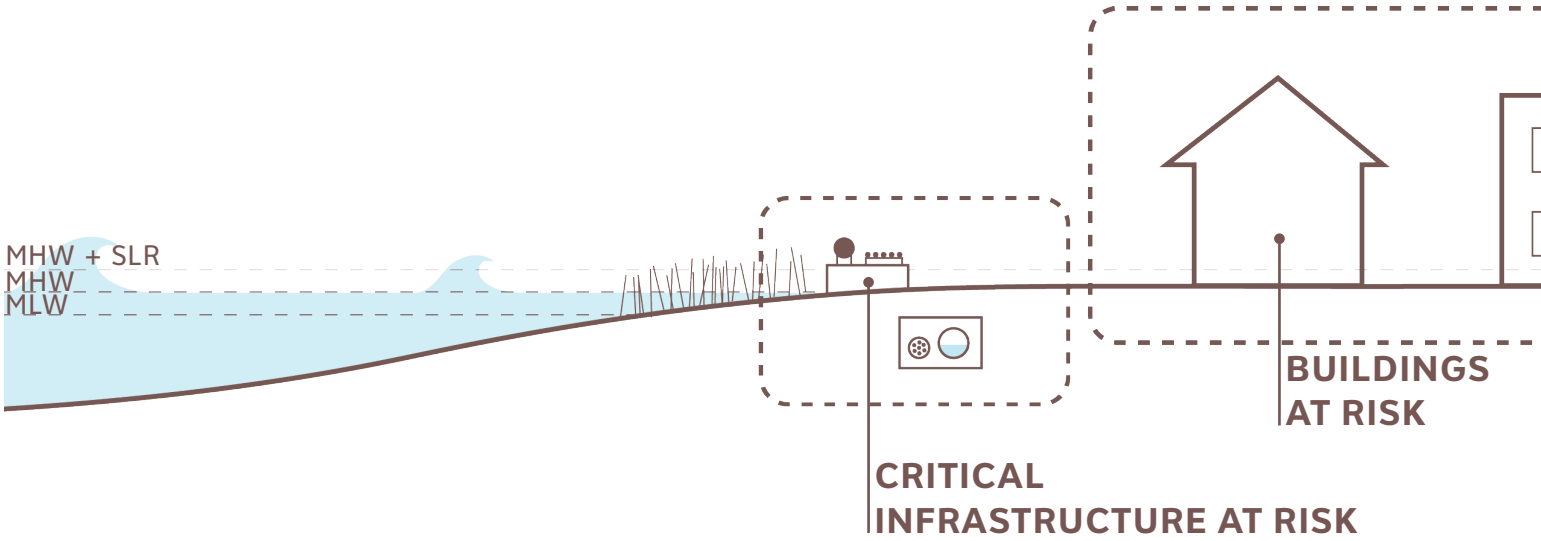
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE

MANAGED RETREAT

Definition

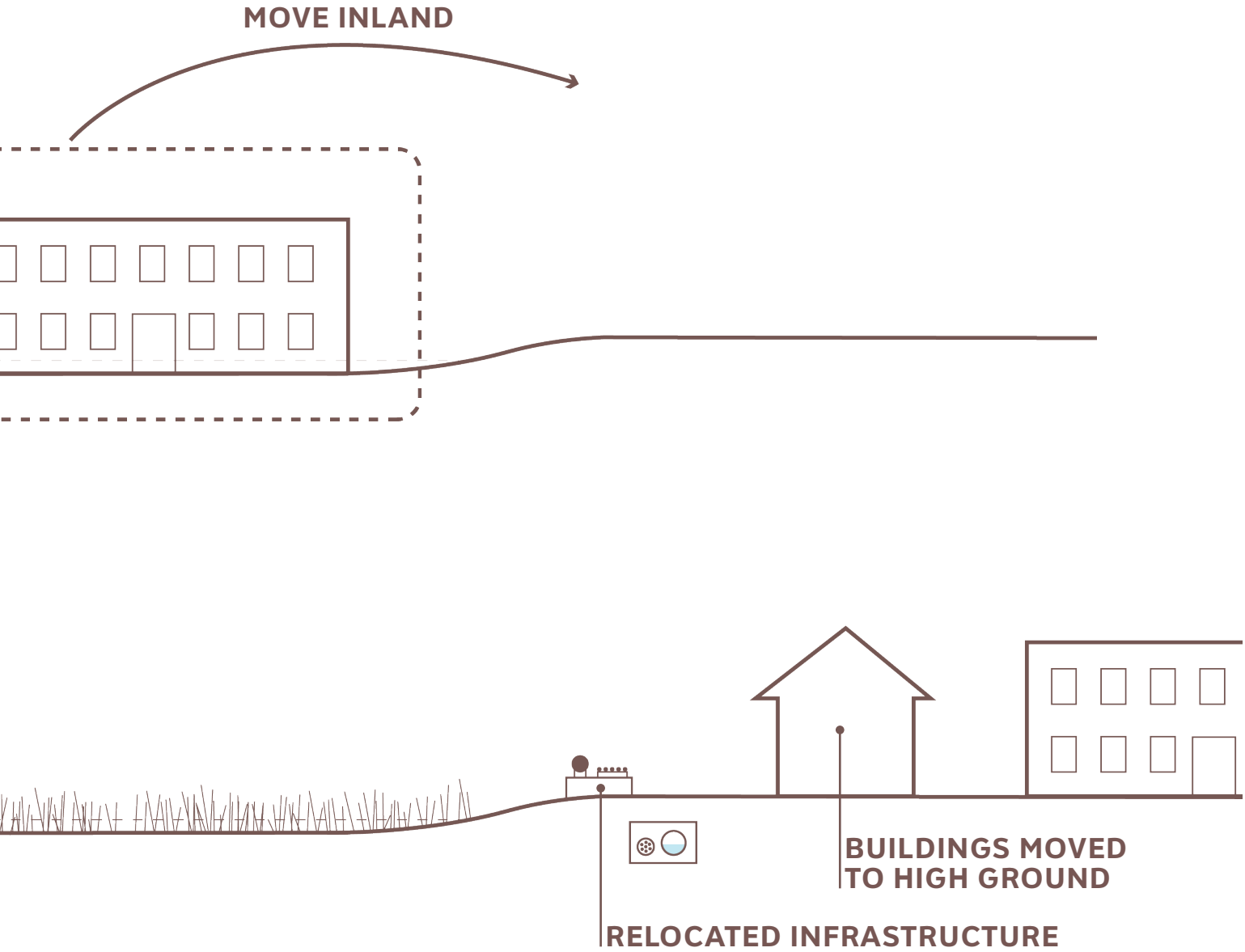
Managed retreat is a management strategy for **retreating from vulnerable coastal areas,** moving the shoreline inland, and **restoring natural areas,** thereby **providing a buffer from flooding** and better managing hazard risk.





OBJECTIVE

- Create a management framework for adapting to SLR over time



MANAGED RETREAT
Precedents

America Center Drive
Alviso, CA

Size: 63 acres
Implementation Timeline: 2007-2009

Applicability: Landfills can provide raised sites to relocate nearby infrastructure/developments above SLR levels.

Description: America Center is a 63-acre brownfield redevelopment project that contains 30 acres of land preserve dedicated for burrowing owl habitat. Phase 1 of the project included two six-story office buildings located on top of a closed landfill that extends 65’ deep. Phase 2 added two more buildings in 2018.

- Concrete reinforced piles were used after cores were drilled out to avoid environmental contamination from pile driving through land fill



Access roads were raised to reach the higher elevation



Aerial view looking towards Alviso

MANAGED RETREAT
Precedents

Neighborhood Retreat after Sandy
Staten Island, NY

Size: Approx. 3.75 square miles
Implementation Timeline: 2012-2022

Applicability: The managed retreat of vulnerable neighborhoods reduces future risk and damage, and opens up the potential to restore natural systems along the shoreline.

Description: A response to the aftermath of Hurricane Sandy for Graham Beach, Oakwood Beach and Ocean Breeze neighborhoods, the retreat of these neighborhoods is part of New York City's strategy to face sea level rise and goal to limit "exposure to increasing coastal hazards"

- Purchased by New York State government to be demolished and preserved as restored wetland, creating a coastal buffer for future storms
- Homeowners offered choice between buyout at pre-storm value and relocation assistance, or newly restrictive zoning codes
- Careful consideration necessary for the quality of life and economic viability for the relocated and remaining populations



Number of days the residents have been displaced



Vacant parcel

MANAGED RETREAT
Precedents

Isle de Jean Charles Resettlement
Isle de Jean Charles, LA

Size: 2 miles long, 1/4 mile wide (historically 11 miles long, 5 miles wide)
Cost: $48.3 million
Implementation Timeline: 2016-ongoing

Applicability: Retreat from vulnerable coastal areas can reduce long-term costs associated with flooding and can open up land to help mitigate flooding in nearby areas.

Description: Isle de Jean Charles Resettlement is a federally funded initiative to voluntarily resettle the residential population of Isle de Jean Charles, a small settlement on the coast of Louisiana. Due to a number of environmental factors, the island has experienced 98 percent land loss since 1955.

- 515 acres of farmland purchased in a more resilient and historically contextual community 40 miles north for resettlement
- Residents may opt to move to a new home in the newly settled community, a vacant lot in the new community, or an existing home elsewhere in Louisiana outside current 100-year flood zones.
- Program aims to ensure community is economically sustainable in new location.
- Program aims to facilitate preservation of islanders' cultural identities and traditions



Vulnerable roads and infrastructure



Raised homes

MANAGED RETREAT
Precedents

Yup'ik Village Relocation
Newtok, Alaska

Size: 380 people / 44 housing units
Cost: $92-$96 million
Implementation Timeline: 2003 (agreement)-2023 (approximate)

Applicability: Retreat from vulnerable coastal areas can reduce long-term costs associated with flooding and can open up land to help mitigate flooding in nearby areas.

Description: Disappearing land beneath Newtok, through the slow and steady process of thawing permafrost and erosion, has engendered the development of Mertarvik, a new village to which the Yup'ik community is in the process of relocating.

- Melting sea ice and rising seas send water surging up rivers, causing erosion and flooding
- As permafrost soils thaw, they crumble and the land (and town) succumbs to the Ninglik River
- Created by Congress, the village of Mertarvik is located on higher, volcanic ground
- Through Congressional legislation, the Newtok area will transition to become part the Yukon Delta National Wildlife Refuge
- Pilot for relocation of other Alaskan communities due to erosion



Current community



Erosion and flooding have led to the relocation

MANAGED RETREAT
Precedents

Ecomaine Landfill Mining
South Portland, Maine

Size: 10,5000 CY material removed / added space
Cost: $7.42 million revenue in recovered metals,
Estimated value of new space: $430,000
Implementation Timeline: November 2011- March 2014

Applicability: The excavation, mining, and relocation of landfills has the potential to decrease their vulnerability to erosion and SLR inundation, that could lead to an increase in leaching and pollution.

Description: The old landfill was filled with ash, a by-product of waste combustion. The metal content of the ash was processed, separated, and repurposed. The removal of this material opened up valuable space.

- Harvested metals turned into electricity source
- The value of mined resources helped to offset the cost
- The costs associated with excavating, sorting, and reburying waste were exceeded by the value of recovered materials
- Alternative benefits that offset the cost include pollution prevention, transforming waste into electricity, recovery of space for environmentally friendly disposal methods, reducing greenhouse gas emissions, and eliminating groundwater contamination



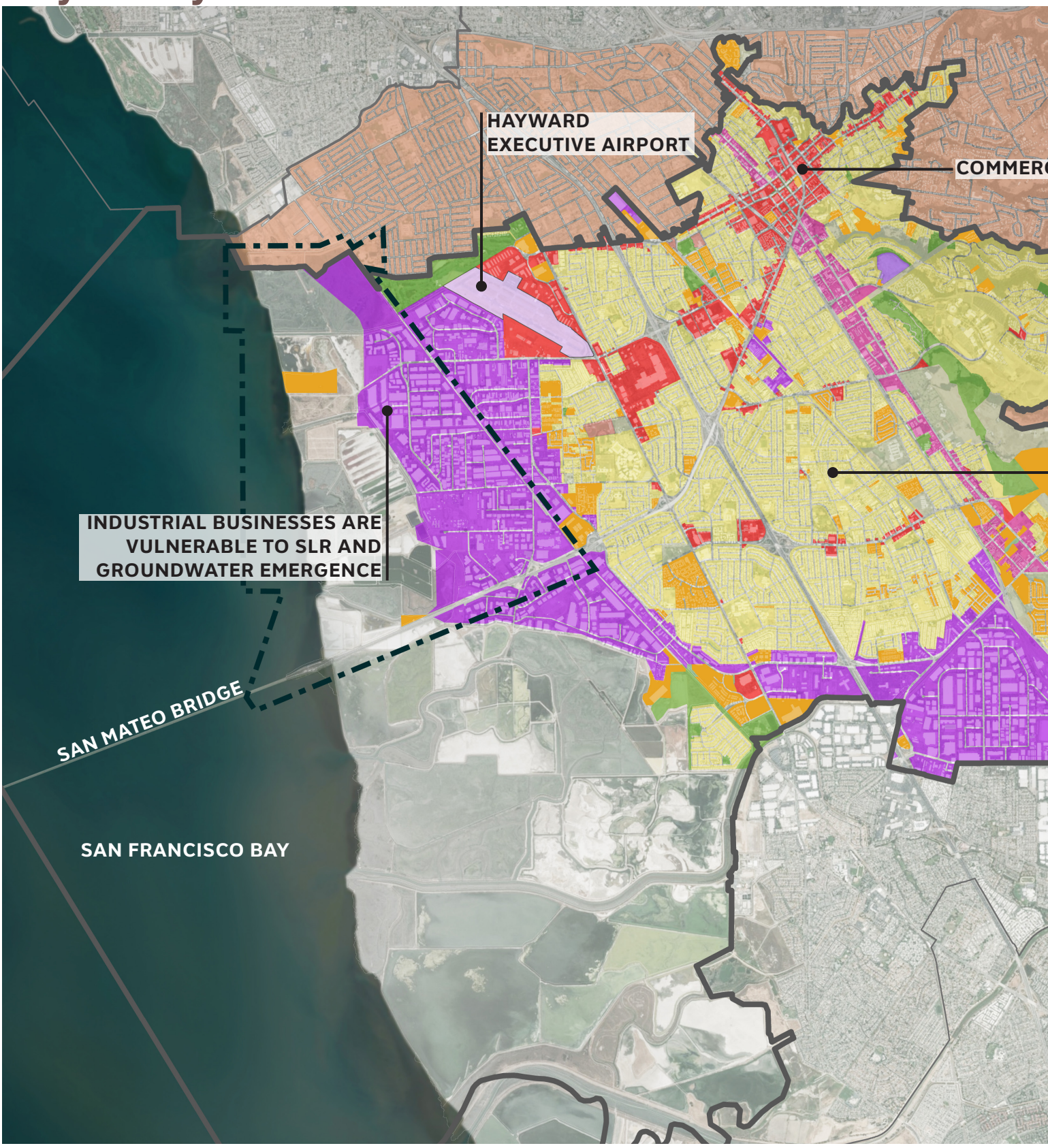
Excavation of the landfill



A private company reclaimed metals from the landfill

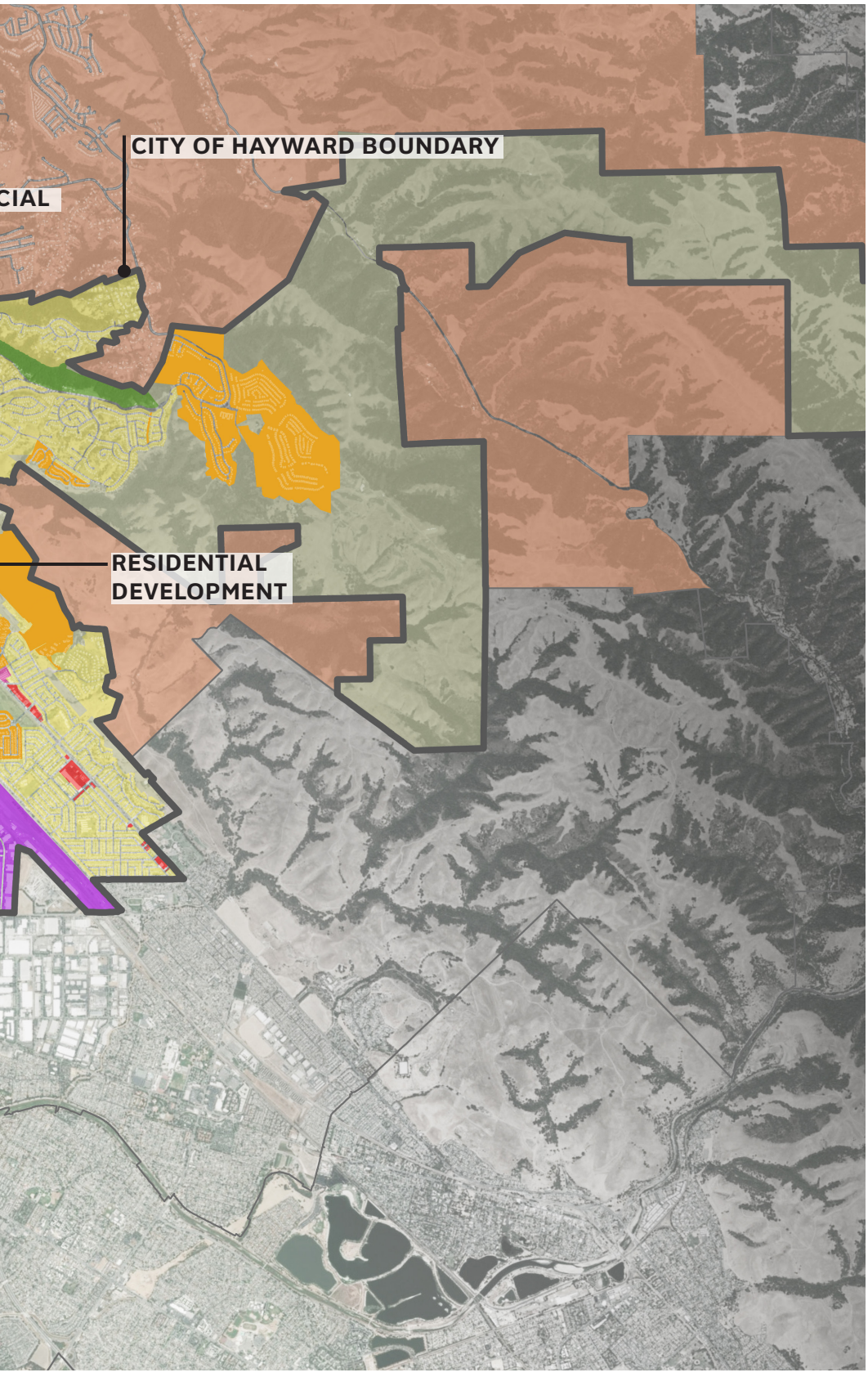
MANAGED RETREAT

City of Hayward



City of Hayward Land Use

SCAPE


CITY OF HAYWARD BOUNDARY
CIAL
RESIDENTIAL DEVELOPMENT
Planned Development
Open Space
Residential
Commericial
Industrial
Airport
Urban Center
Agriculture
Alameda County
Project Area
Hayward City Limit
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MILES

MANAGED RETREAT

Option 1: Relocation of Key Assets

OBJECTIVE

Relocate key assets out of future tidal inundation zones.

DESCRIPTION

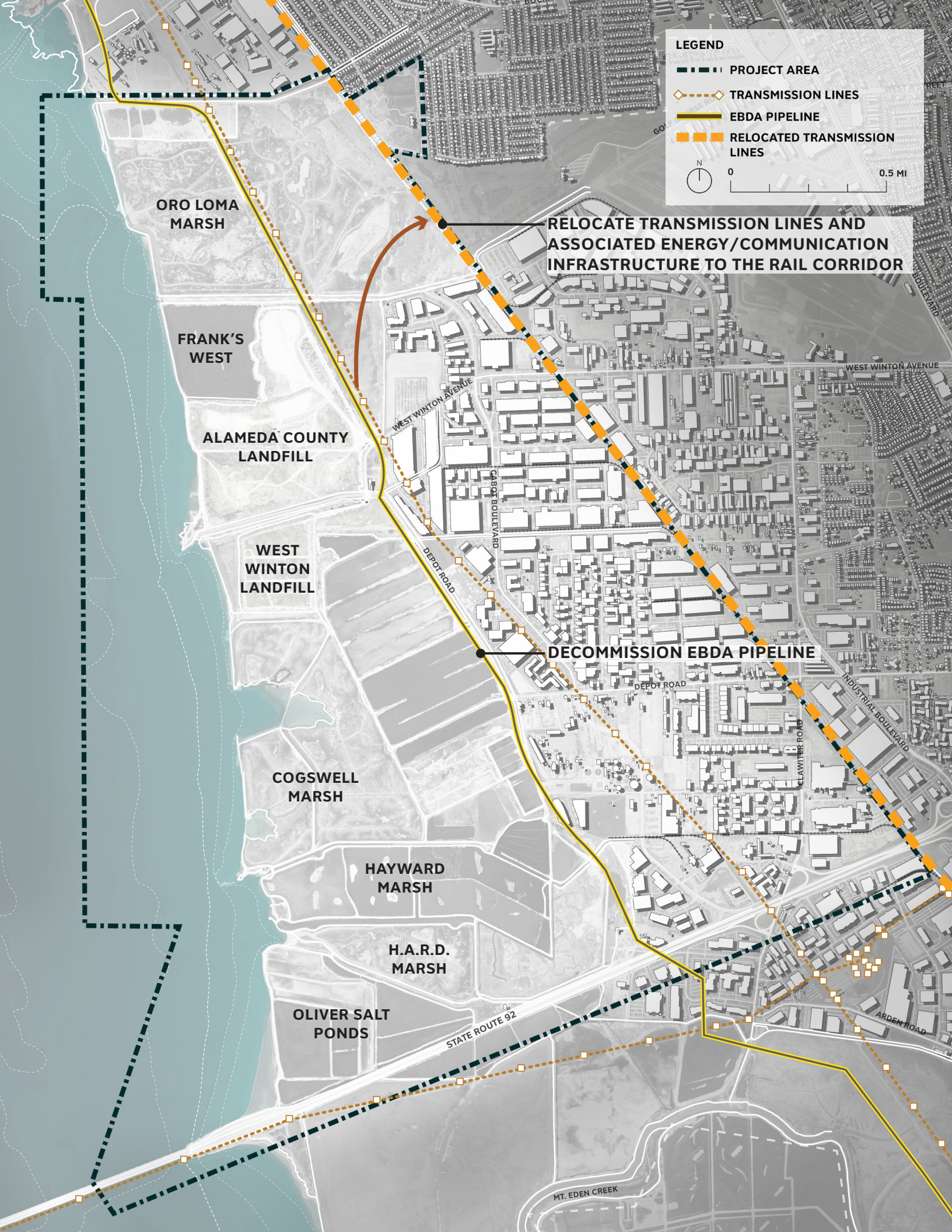
- Decommission EBDA pipeline and retrofit WWTPs for local discharge
- Relocate transmission lines and associated energy/ communication infrastructure to the rail corridor

PROS

- Reduce risk of damage from future SLR and flooding

CONS

- Requires multiple-agency coordination and long-term planning
- Short-term solution
- Railroad R.O.W. includes a high pressure gas pipeline and fiber optic lines


LEGEND
PROJECT AREA
TRANSMISSION LINES
EBDA PIPELINE
RELOCATED TRANSMISSION LINES
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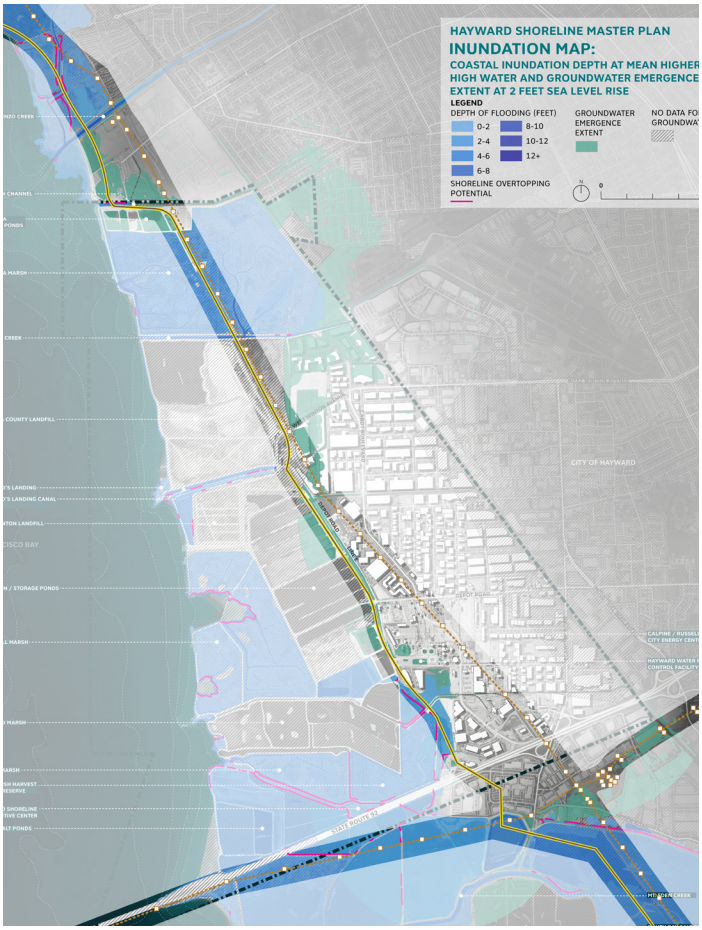
0.5 MI
RELOCATE TRANSMISSION LINES AND ASSOCIATED ENERGY/COMMUNICATION INFRASTRUCTURE TO THE RAIL CORRIDOR
DECOMMISSION EBDA PIPELINE
ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

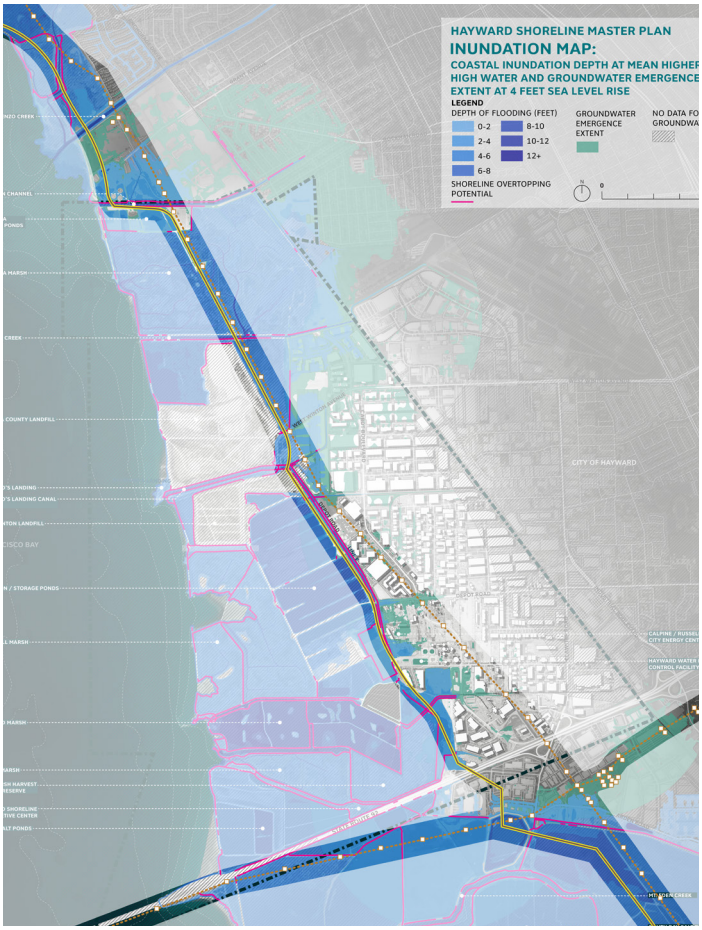
MANAGED RETREAT

Option 1: Relocation of Key Assets

2’ SLR

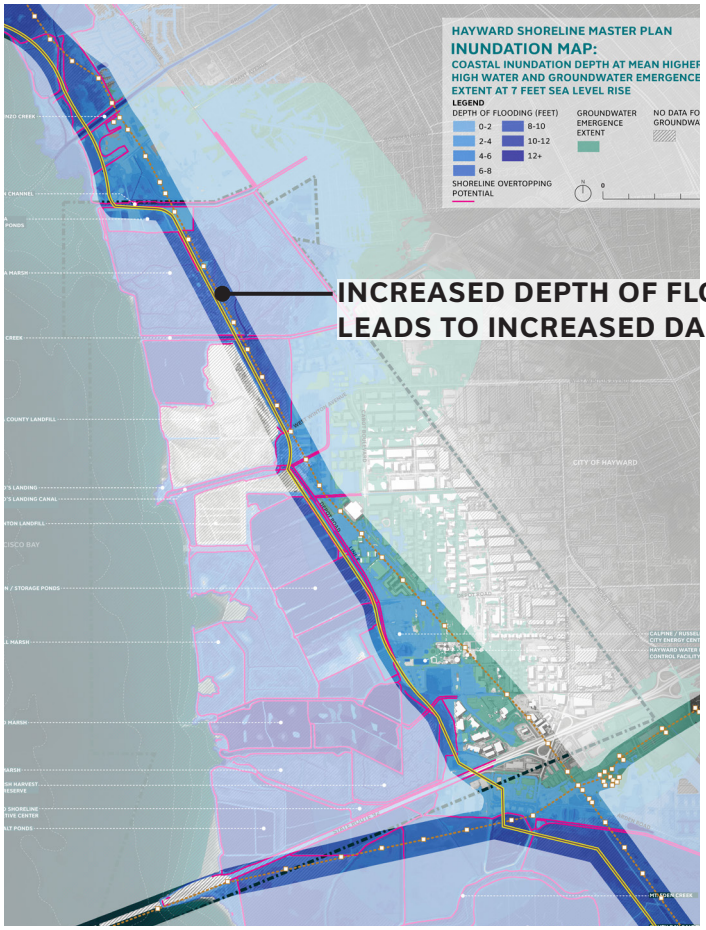


4’ SLR



SCAPE

7’ SLR



INCREASED DEPTH OF FLOODING LEADS TO INCREASED DAMAGE

MANAGED RETREAT

Option 2: Relocation of All Critical Infrastructure

OBJECTIVE

Relocation of critical infrastructure assets out of the tidal inundation zone.

DESCRIPTION

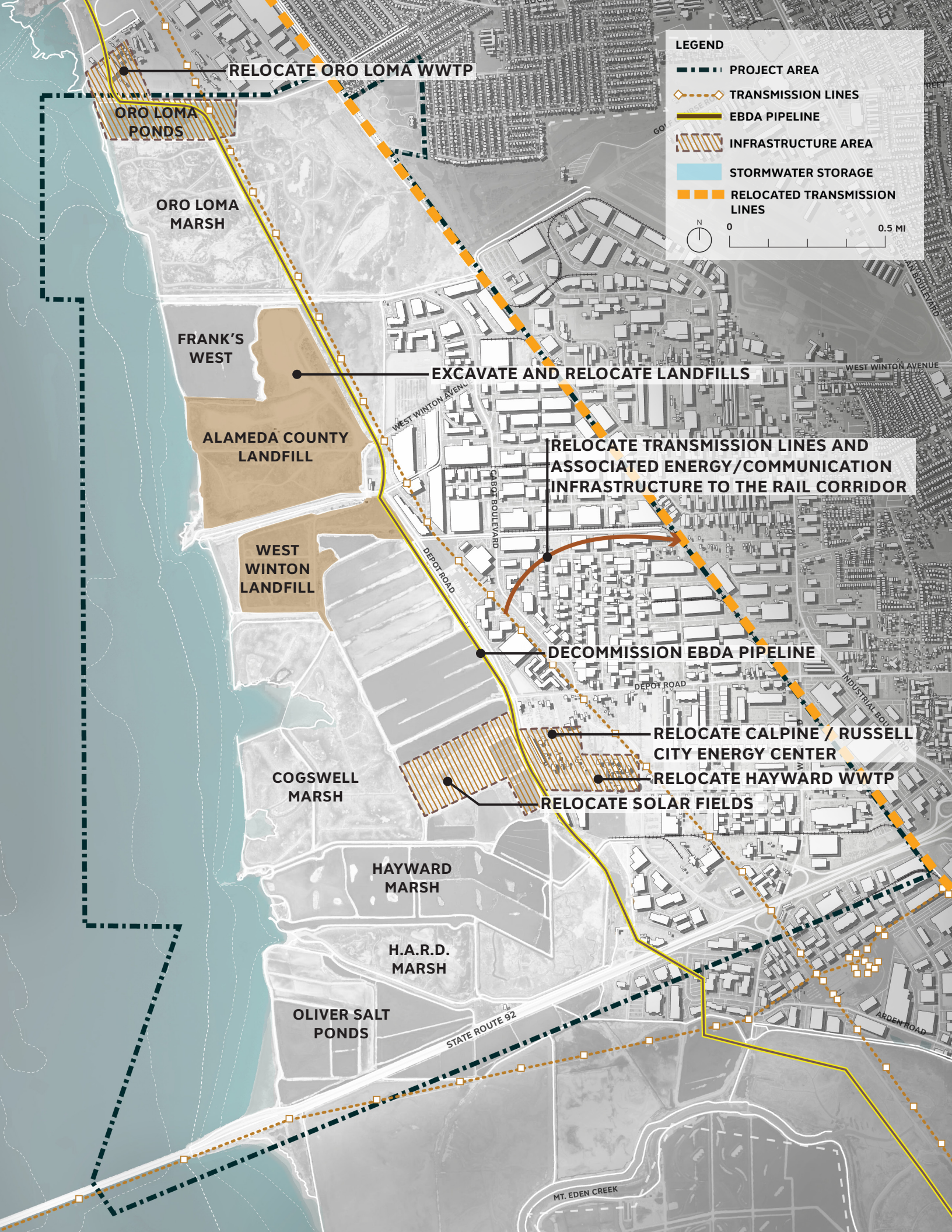
- Excavate landfills and remove materials
- Relocate Oro Loma and Hayward WWTPs upland
- Relocate CalPine / Russell City Energy Center upland
- Decommission EBDA pipeline and retrofit WWTP's for local discharge
- Relocate transmission lines to the rail corridor

PROS

- Reduce risk of damage from future SLR and flooding
- Maintain access to coastal areas while enhancing protection
- Enhance ecosystem function with natural infrastructure by returning land to natural habitat

CONS

- Very costly
- In order to substantially reduce vulnerability, would require raising land at rail corridor to lift it out of SLR inundation and storm surge zones
- Lack of available land to move these assets. Purchase may require eminent domain
- Requires multiple-agency coordination and long-term planning
- "Takings" Law


LEGEND
PROJECT AREA
TRANSMISSION LINES
EBDA PIPELINE
INFRASTRUCTURE AREA
STORMWATER STORAGE
RELOCATED TRANSMISSION LINES
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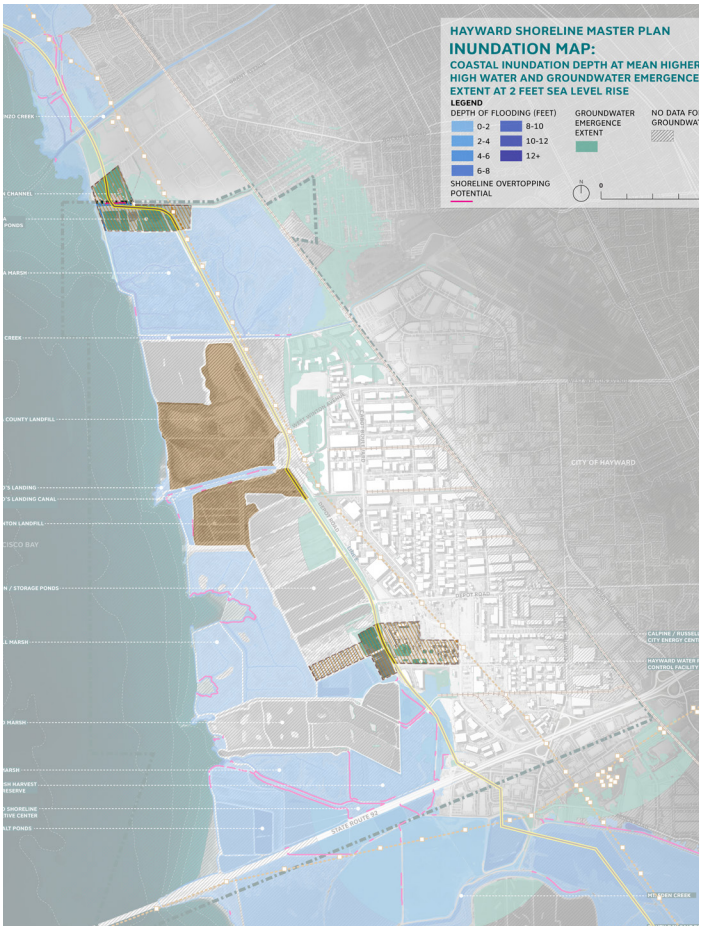
0
0.5 MI
RELOCATE ORO LOMA WWTP
ORO LOMA PONDS
ORO LOMA MARSH
FRANK'S WEST
EXCAVATE AND RELOCATE LANDFILLS
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
RELOCATE TRANSMISSION LINES AND ASSOCIATED ENERGY/COMMUNICATION INFRASTRUCTURE TO THE RAIL CORRIDOR
DECOMMISSION EBDA PIPELINE
RELOCATE CALPINE / RUSSELL CITY ENERGY CENTER
RELOCATE HAYWARD WWTP
RELOCATE SOLAR FIELDS
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

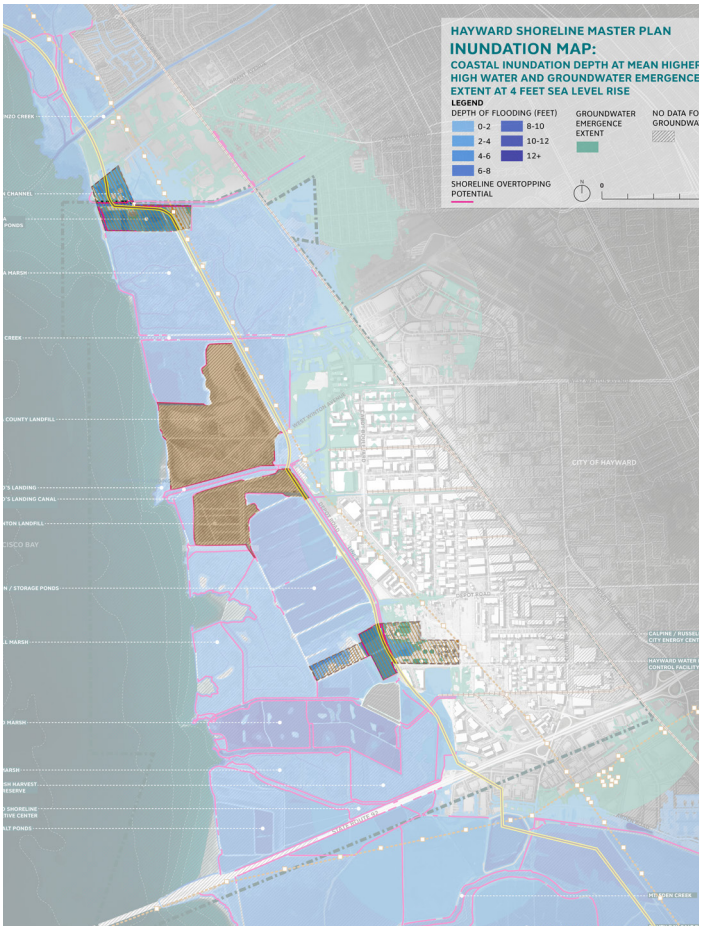
MANAGED RETREAT

Option 2: Relocation of All Critical Infrastructure

2’ SLR

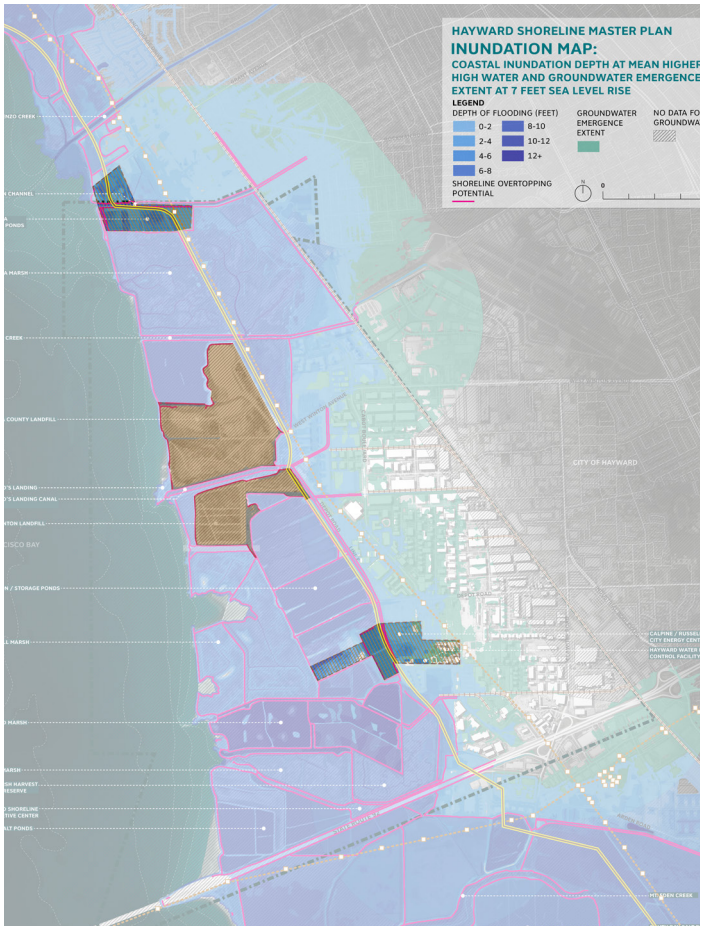


4’ SLR



SCAPE

7’ SLR


HAYWARD SHORELINE MASTER PLAN
INUNDATION MAP:
COASTAL INUNDATION DEPTH AT MEAN HIGHER
HIGH WATER AND GROUNDWATER EMERGENCE
EXTENT AT 7 FEET SEA LEVEL RISE
LEGEND
DEPTH OF FLOODING (FEET)
0-2
2-4
4-6
6-8
8-10
10-12
12+
GROUNDWATER EMERGENCE EXTENT
NO DATA FO
GROUNDWA
SHORELINE OVERTOPPING POTENTIAL
CITY OF HAYWARD

MANAGED RETREAT

Option 3: Managed Retreat of Vulnerable Neighborhoods/ Industrial Areas

OBJECTIVE

Relocate vulnerable neighborhoods out of the tidal inundation zone.

DESCRIPTION

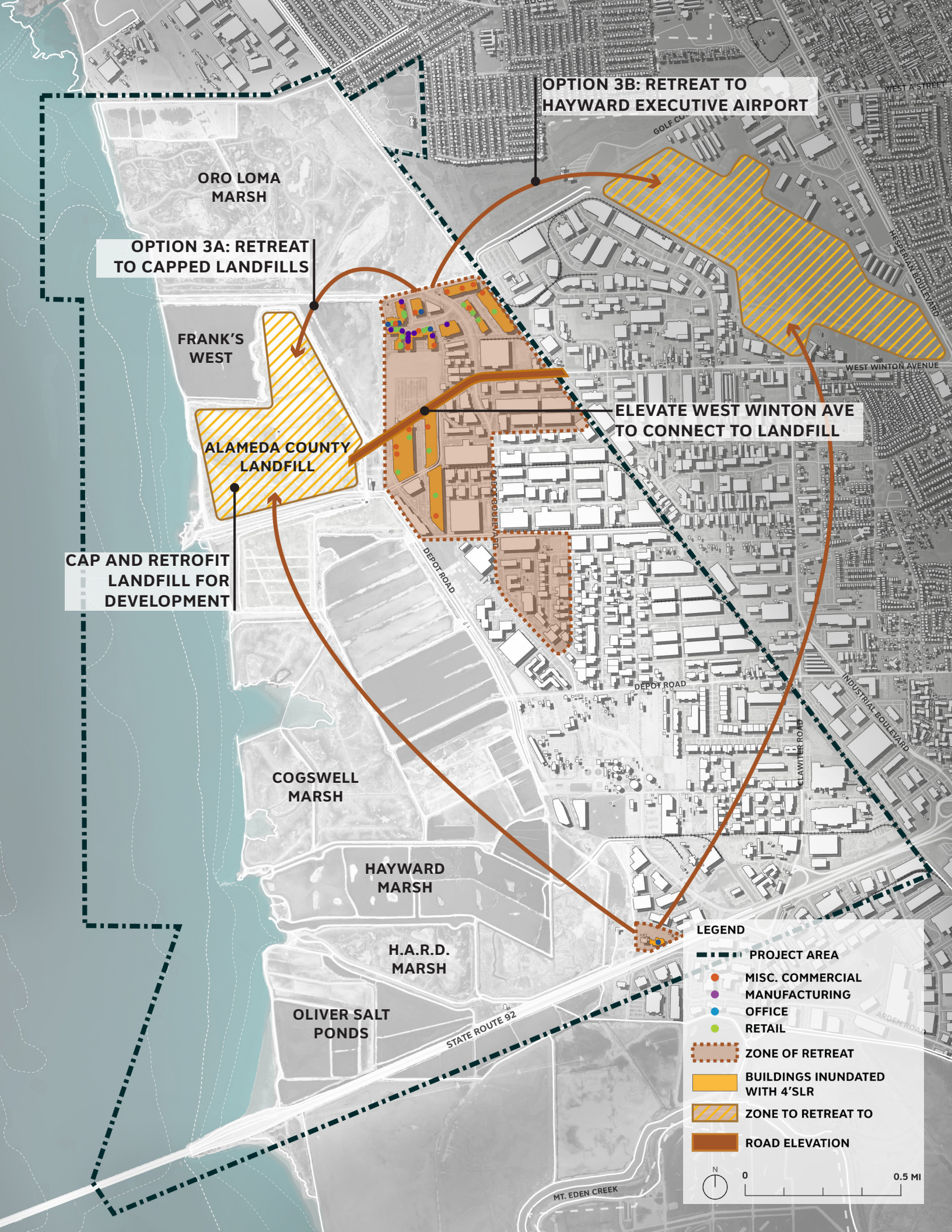
- Retreat businesses impacted by 4' of SLR or groundwater emergence
- 3a: Retreat to the landfills
- 3b: Retreat to Hayward Executive Airport

PROS

- Reduce risk of damage from future SLR and flooding
- Reduce cost associated with recovery if not relocated
- Maintain access to coastal areas while enhancing protection
- Enhance ecosystem function with natural infrastructure by returning land to natural habitat

CONS

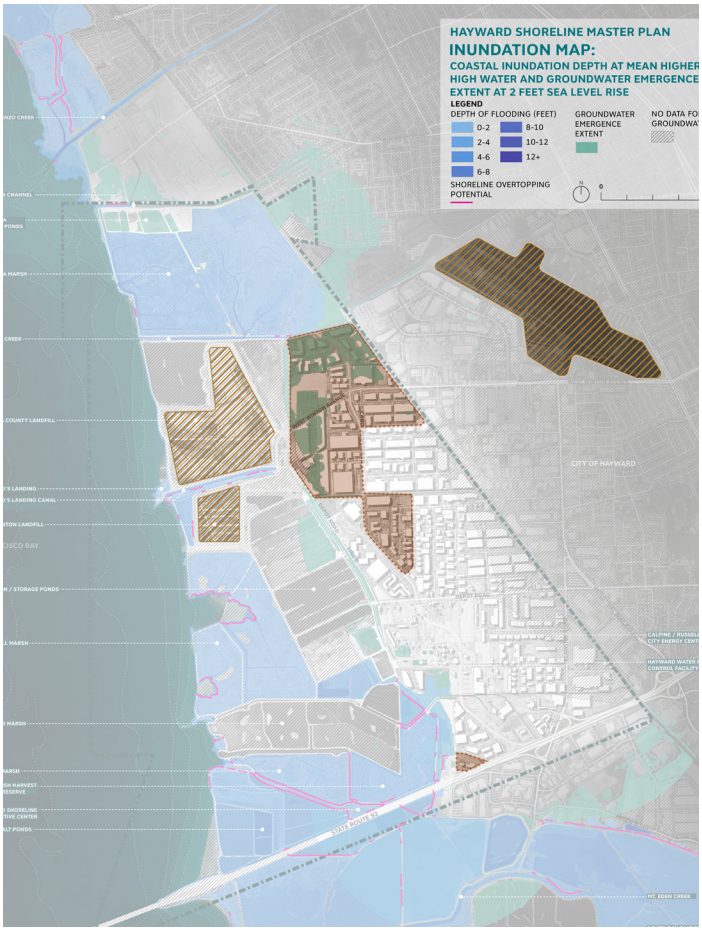
- Requires available land to move neighborhoods and industrial areas to
- Moving industrial businesses encroaches on other land uses further inland
- Potential remediation concerns
- Very costly
- No precedent for buyout program of industrial area
- Counter to City's goals for economic development
- Requires property-owner buy-in
- Reduces tax base
- Not supported by the City of Hayward


OPTION 3B: RETREAT TO HAYWARD EXECUTIVE AIRPORT
ORO LOMA MARSH
OPTION 3A: RETREAT TO CAPPED LANDFILLS
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
ELEVATE WEST WINTON AVE TO CONNECT TO LANDFILL
CAP AND RETROFIT LANDFILL FOR DEVELOPMENT
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
WEST A STREET
HESPERIAN BOULEVARD
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK
LEGEND
PROJECT AREA
MISC. COMMERCIAL
MANUFACTURING
OFFICE
RETAIL
ZONE OF RETREAT
BUILDINGS INUNDATED WITH 4'SLR
ZONE TO RETREAT TO
ROAD ELEVATION
N
0
0.5 MI

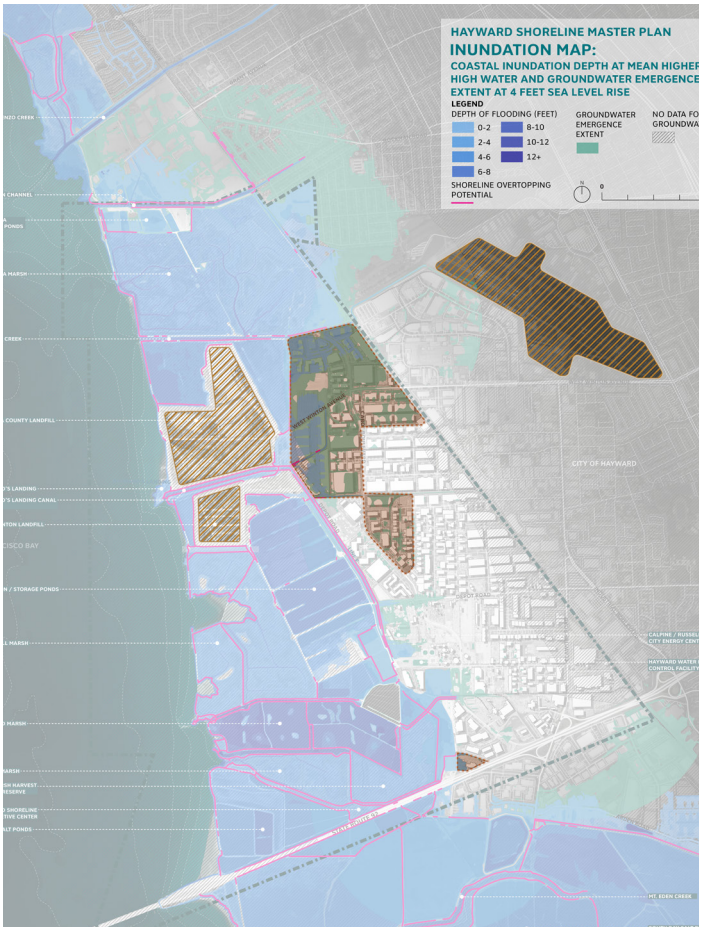
MANAGED RETREAT

Option 3: Managed Retreat of Vulnerable Neighborhoods/ Industrial Areas

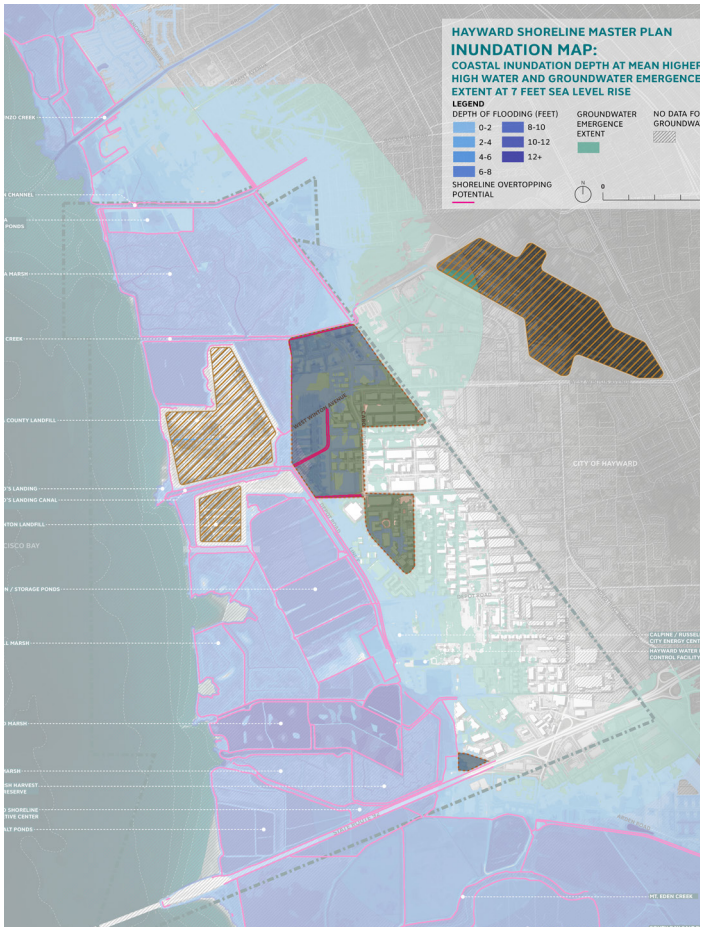
2’ SLR



4’ SLR



7′ SLR


HAYWARD SHORELINE MASTER PLAN
INUNDATION MAP:
COASTAL INUNDATION DEPTH AT MEAN HIGHER
HIGH WATER AND GROUNDWATER EMERGENCE
EXTENT AT 7 FEET SEA LEVEL RISE
LEGEND
DEPTH OF FLOODING (FEET)
0-2
2-4
4-6
6-8
8-10
10-12
12+
SHORELINE OVERTOPPING POTENTIAL
GROUNDWATER EMERGENCE EXTENT
NO DATA FO
GROUNDWA
CITY OF HAYWARD

MANAGED RETREAT

Option 4: Discourage rebuilding in vulnerable locations while increasing growth in other areas

OBJECTIVE

Discourage rebuilding in vulnerable locations while increasing growth in other areas.

DESCRIPTION

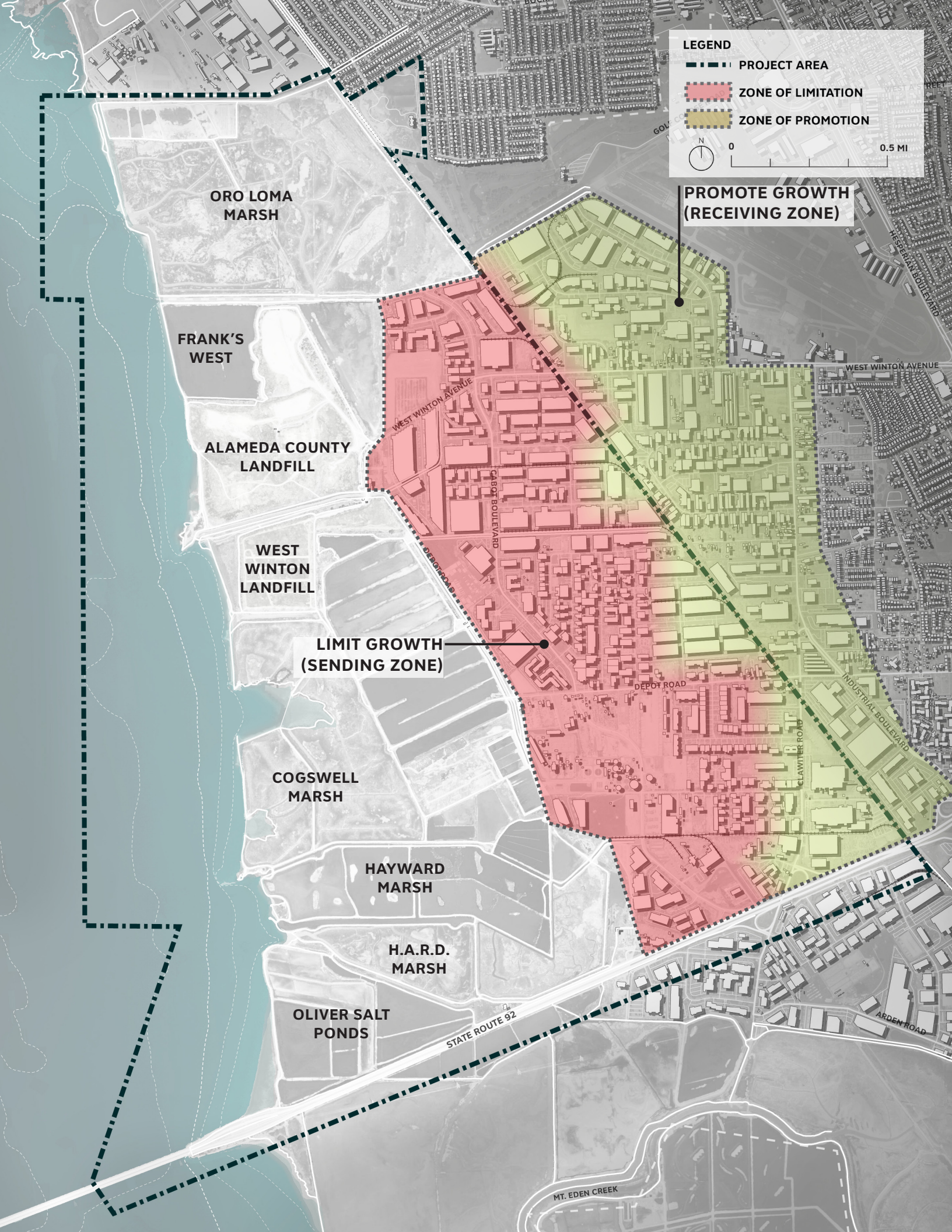
- Enact policies to limit investments and development potential of high-risk areas and encourage growth and investment in less risky areas

PROS

- Reduce risk of damage from future SLR and flooding
- Maintain access to coastal areas while enhancing protection
- Enhance ecosystem function with natural infrastructure by returning land to natural habitat
- Can be implemented through zoning changes, or by creating a transfer of development rights (TDR) program
- Can complement economic development strategy of increasing intensity of industrial uses towards tech/innovation sector

CONS

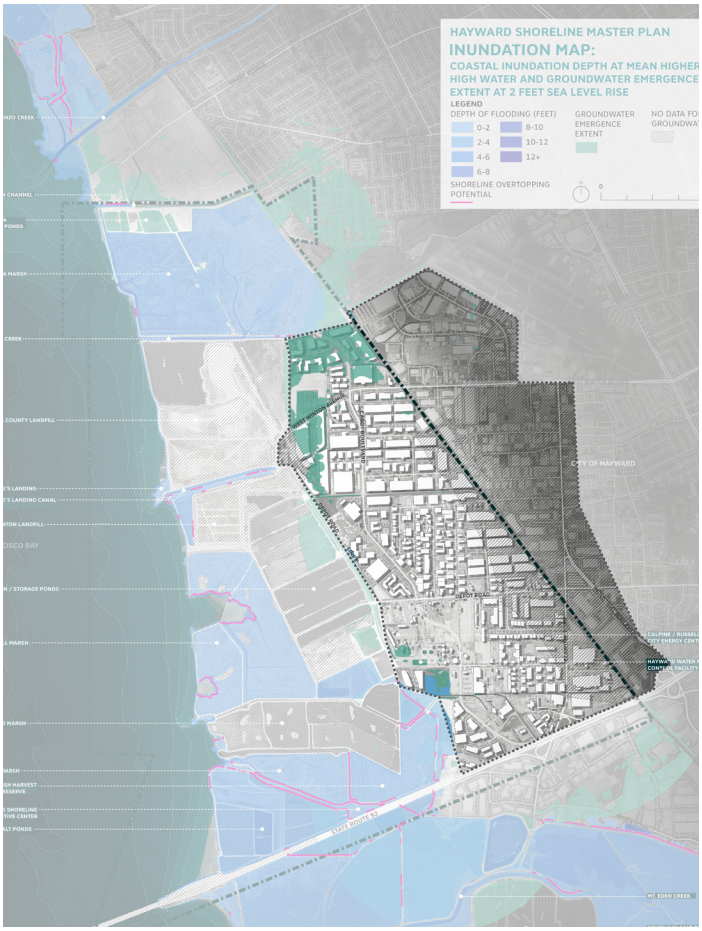
- Could be placing those who are unable to retreat at a disadvantage
- May lead to a patchwork of remaining properties
- Displacement
- Legal aspects of restricted development
- Could reduce tax base
- Areas for growth already built out


LEGEND
PROJECT AREA
ZONE OF LIMITATION
ZONE OF PROMOTION
N
0
0.5 MI
PROMOTE GROWTH
(RECEIVING ZONE)
LIMIT GROWTH
(SENDING ZONE)
ORO LOMA
MARSH
FRANK'S
WEST
ALAMEDA COUNTY
LANDFILL
WEST
WINTON
LANDFILL
COGSWELL
MARSH
HAYWARD
MARSH
H.A.R.D.
MARSH
OLIVER SALT
PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
HESPERIAN BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK

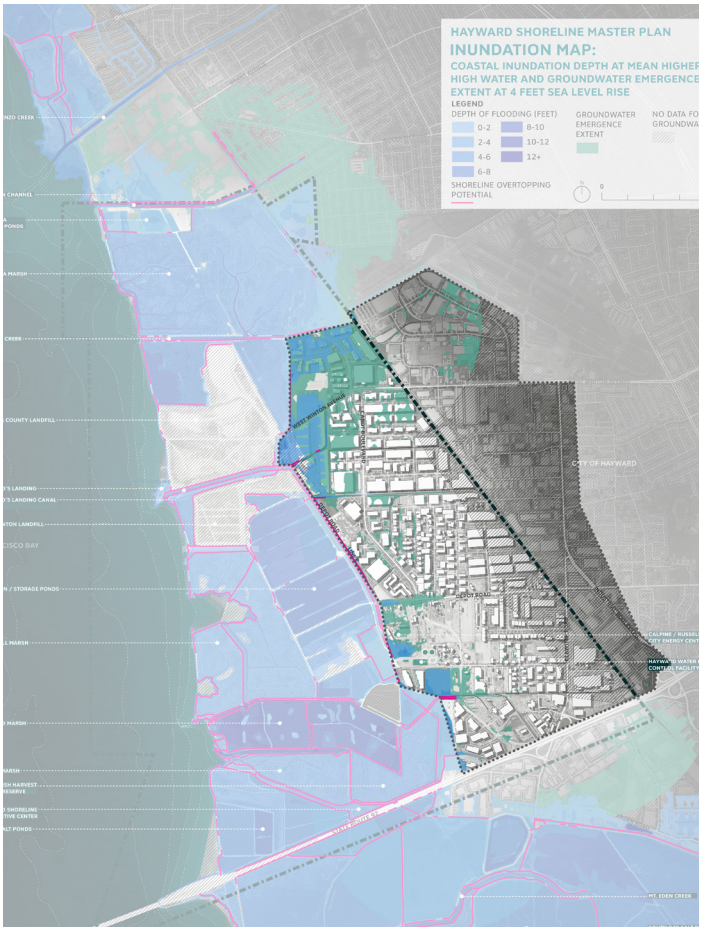
MANAGED RETREAT

Option 4: Discourage rebuilding in vulnerable locations while increasing growth in other areas

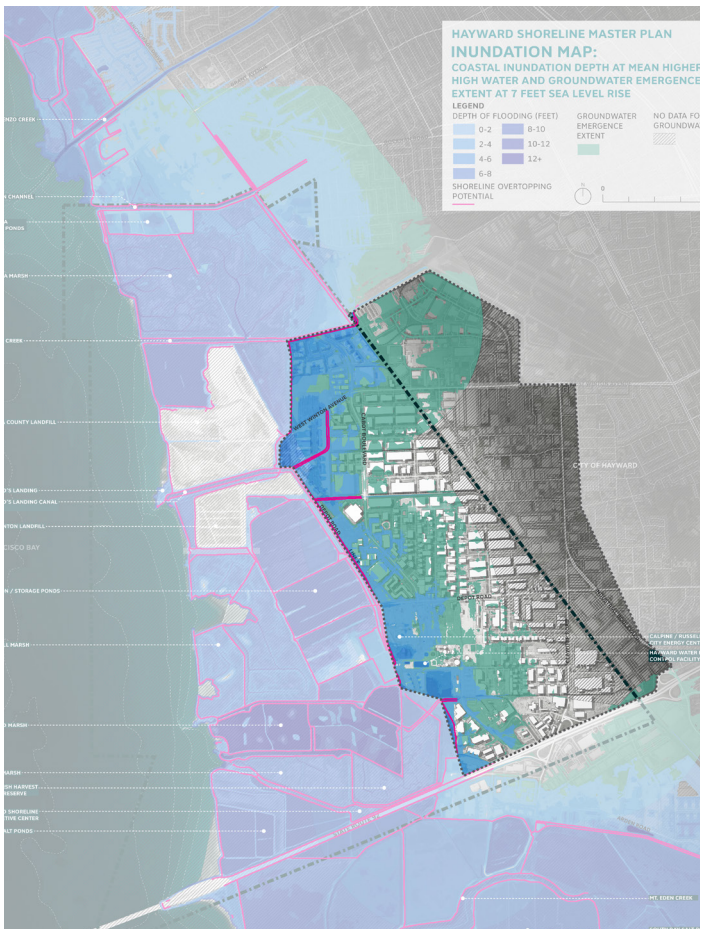
2′ SLR



4′ SLR



7′ SLR


HAYWARD SHORELINE MASTER PLAN
INUNDATION MAP:
COASTAL INUNDATION DEPTH AT MEAN HIGHER
HIGH WATER AND GROUNDWATER EMERGENCE
EXTENT AT 7 FEET SEA LEVEL RISE
LEGEND
DEPTH OF FLOODING (FEET)
0-2
2-4
4-6
6-8
8-10
10-12
12+
SHORELINE OVERTOPPING POTENTIAL
GROUNDWATER EMERGENCE EXTENT
NO DATA FO
GROUNDWA
CITY OF HAYWARD
MT. EDEN CREEK

MANAGED RETREAT

Stakeholder Feedback

1: Relocation of Key Assets



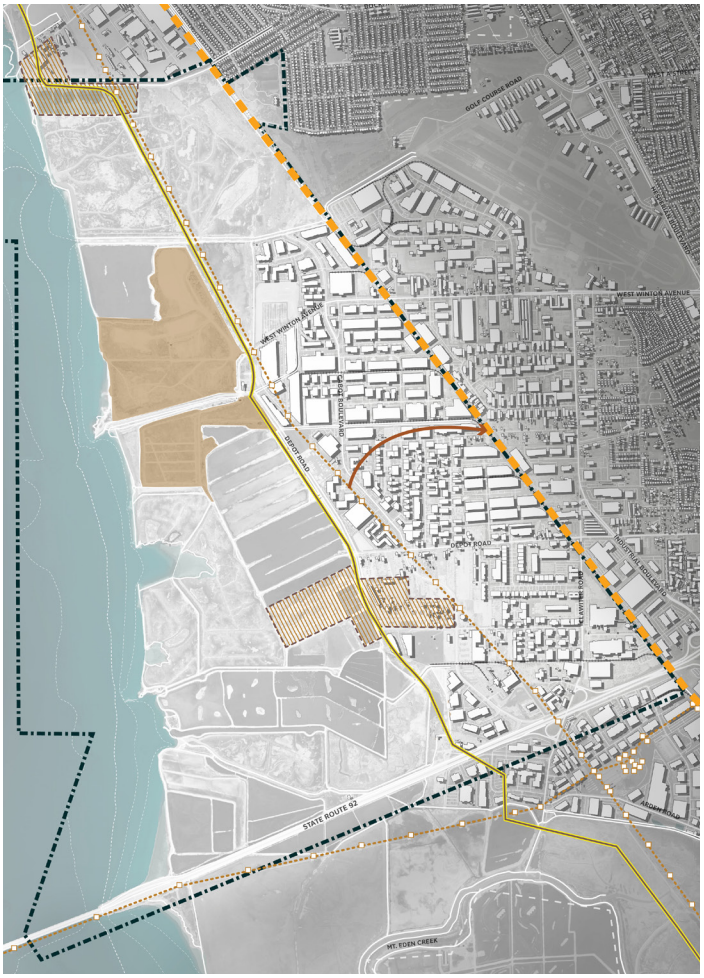
COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- EBRPD asked why the marshes aren't viewed as an asset in the relocation of key assets. Marsh planning, restoration, and adaptation are covered in other strategies. Specifically, Marsh and Mudflat Migration Planning looks at marsh migration / relocation over time. Marshes and other ecologically valuable features are seen as assets. These options are looking into relocation of built assets only.
- COH indicated that all possible adaptation measures related to the City of Hayward WWTP should be reviewed and commented on by the City's Public Works Utilities staff.

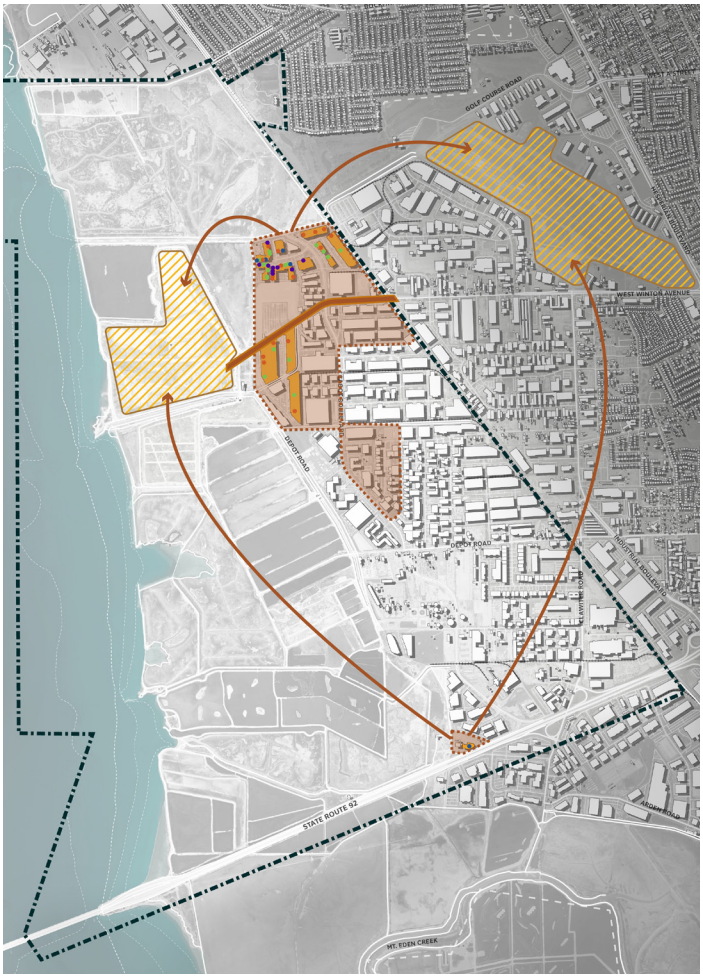
2: Relocation of All Critical Infrastructure



COMMENTS:

- EBRPD asked how the landfills could be relocated. The landfills would have to be excavated and remediated. The material could be mined for valuable metals, as is indicated by the Ecomaine Landfill Mining precedent in this report, and relocated to another landfill site that is less vulnerable.

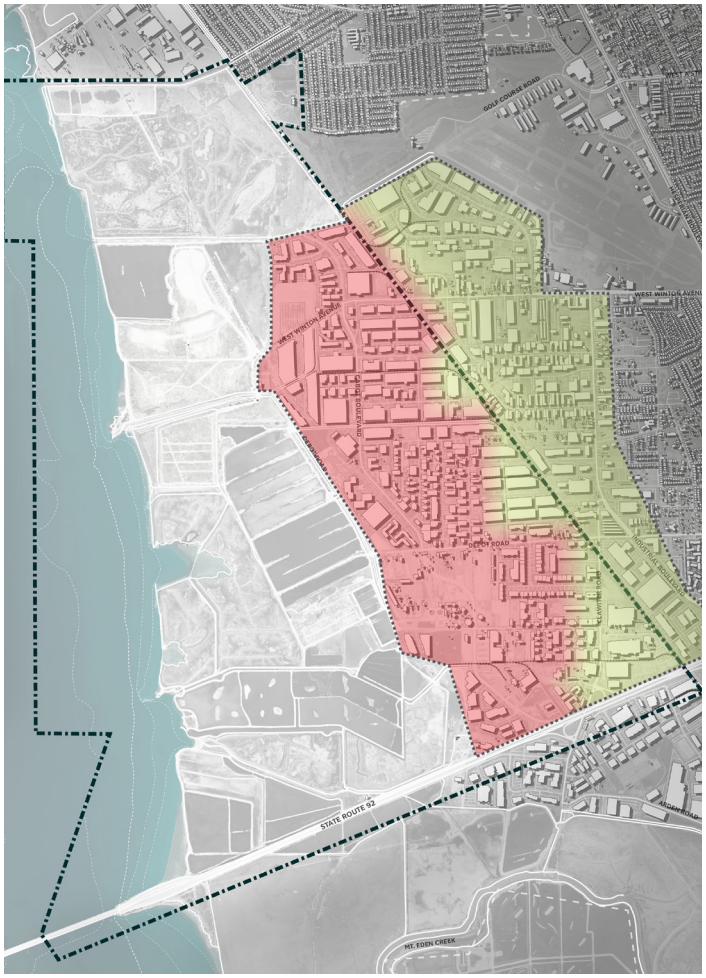
3: Managed Retreat of Vulnerable Neighborhoods/ Industrial Areas



COMMENTS:

- EBRPD asked what would be developed on the landfills. The landfills could potentially accommodate industrial uses or businesses if they were capped and retrofitted accordingly. This would also necessitate raising access roads to the landfill to ensure connectivity over time.
- COH questioned retreat towards the Bay- it seems counterintuitive. Also, if neighborhoods/industrial areas are moved to the landfill, there are concerns over how connectivity will be maintained. The landfills were identified as a potential retreat location since they are the main high point in the study area that is undeveloped. This option would have to be paired with raising of West Winton Avenue to ensure connectivity.
- COH indicated that since there is potentially a high cost associated with this option, Option 3 is not supported by the City of Hayward.

4: Discourage rebuilding in vulnerable locations while increasing growth in other areas



COMMENTS:

- COH indicated support regarding this adaptation option.

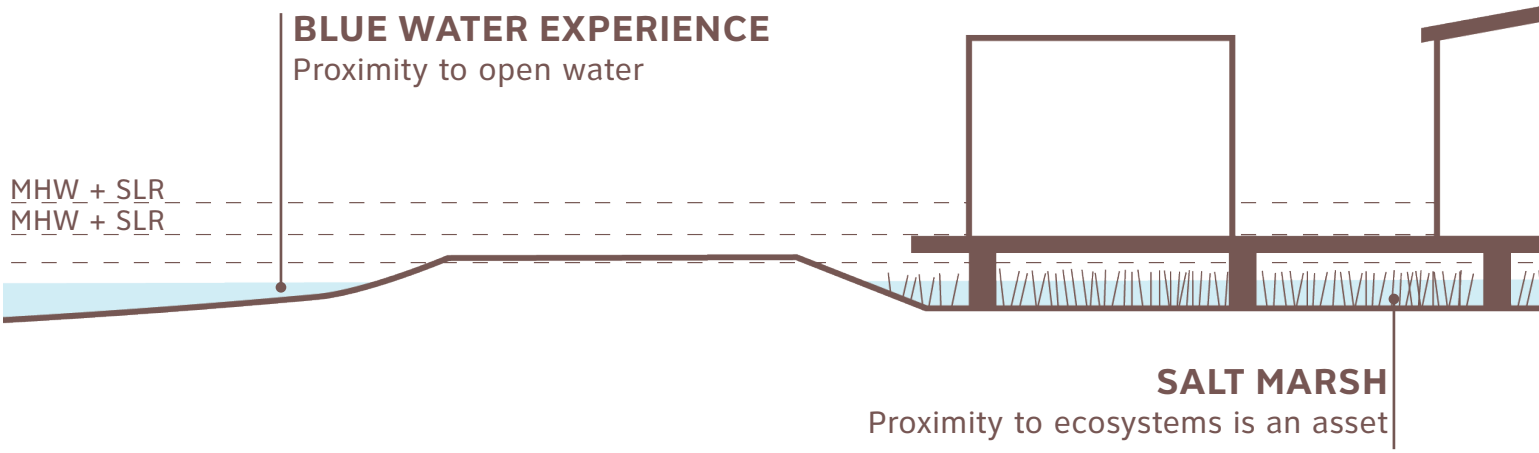
ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

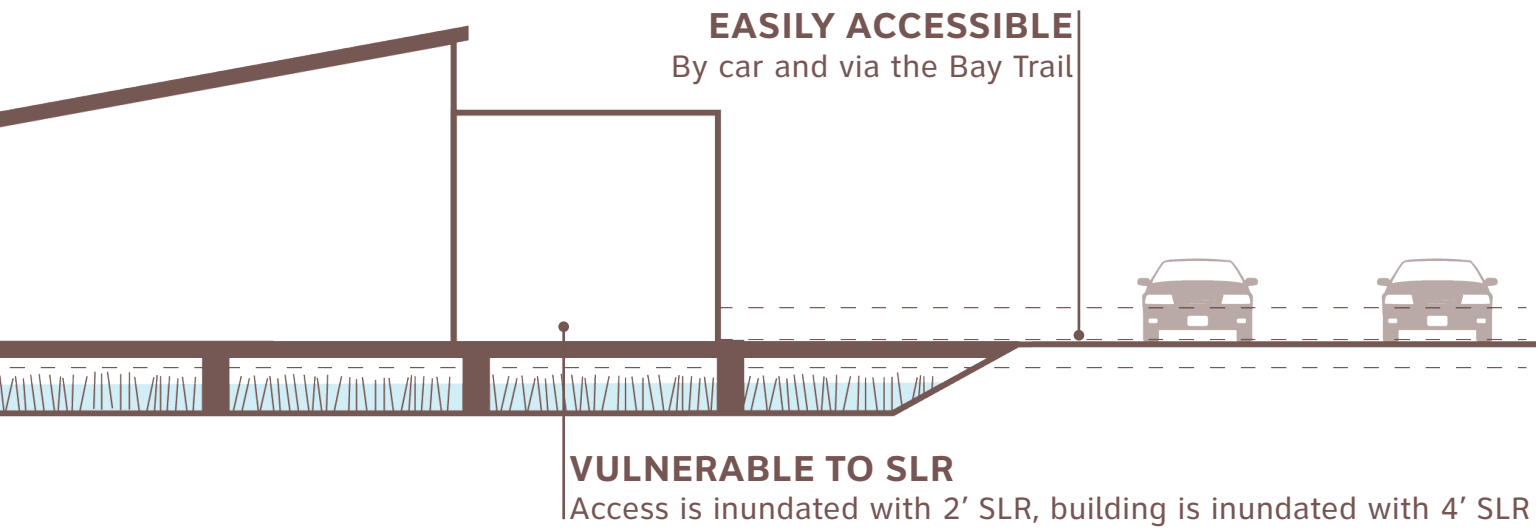
Description

Relocation or retrofitting strategies may help the Hayward Shoreline Interpretive Center maintain its educational program and **adapt to sea level rise.** Pairing relocation with new restoration or pilot projects can provide **new educational and stewardship opportunities.**



OBJECTIVE

- Enhance educational opportunities and adapt to SLR
- Create a management framework for adapting to SLR over time



HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Precedents

Makoko Floating School
Lagos, Nigeria

Size: 2,350 SF
Implementation Timeline: 2013

Applicability: A floating building / educational center has the ability to adapt to fluctuating water levels, SLR, and storm surge.

Description: A floating school pilot project was developed to address social and physical community needs in the face of climate change and increased urbanization to generate sustainable, ecological, and alternative building systems for Africa's coastal regions.

- Built from locally sourced wood and bamboo
- Buoyed by recycled plastic barrels- an ideal shape for tall floating objects on water
- 3 levels- open play area, community space, enclosed space for 2 classrooms and 60 students
- Adapts to tidal changes and varying water levels- invulnerable to flooding and storm surges
- Designed to use renewable energy, recycle organic waste, and harvest rainwater



Network of floating buildings



Floating school built with local materials

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Precedents

Elizabeth River Project Learning Barge
Norfolk, VA

Size: 120’ x 32’
Cost: $163,000 / year to operate
Implementation Timeline: 2009-ongoing

Applicability: A floating barge has the ability to adapt to fluctuating water levels, SLR, and storm surge.

Description: The Learning Barge is a floating wetland classroom and “stewardship ship” that teaches children about environmental stewardship of the river.

- Floating Wetland Classroom "steward ship"
- Teaches children of the river environmental stewardship actions and shows how to make the Elizabeth River healthier
- Every 4th grader in Norfolk visits
- Powered by solar and wind
- Live wetlands, enclosed classroom, composting toilets, and a rainwater filtration system



Floating wetland facilitates educational activities



Floating Barge with wind and solar power

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Precedents

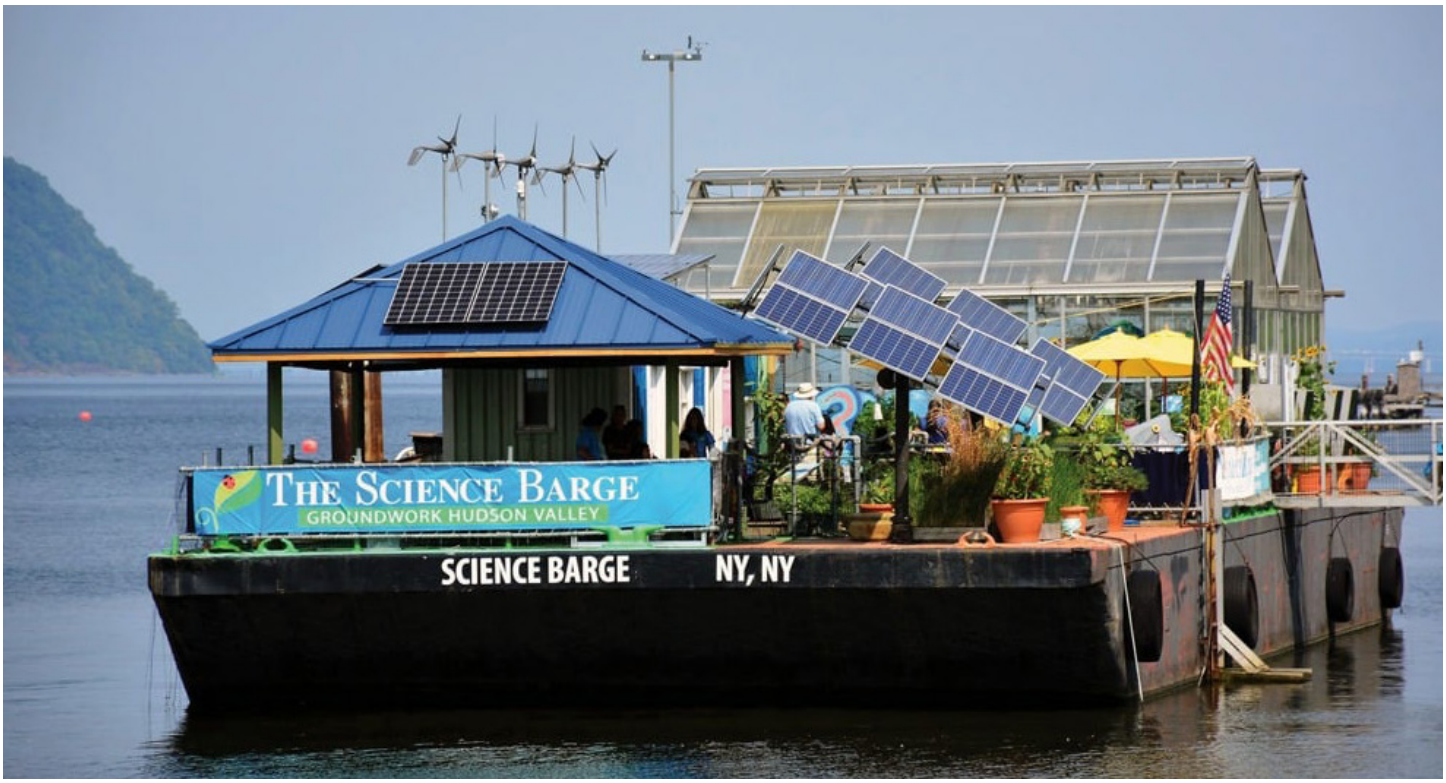
Science Barge
Yonkers, NY

Size: 115’ long
Cost: $1 million in renovations (past 2 years)
Implementation Timeline: 2017-2019

Applicability: A floating barge has the ability to adapt to fluctuating water levels, SLR, and storm surge.

Description: The Science Barge is a prototype sustainable urban farm that is operated by Groundwork Hudson Valley and used as an environmental education center.

- Sustainable urban farm and environmental education center
- Net zero carbon emissions, zero pesticides, zero runoff, solar panels, wind turbines, biofuels, hydroponic greenhouse irrigated by rainwater
- Used for field trips for schools, camps, and other groups



Floating Science Barge



Greenhouses on the Science Barge

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Precedents

Arcata Marsh & Wildlife Sanctuary
Arcata, CA

Size: 1,540 SF
Cost: $580,000
Implementation Timeline: 1991-1993

Applicability: The pairing of an interpretive center with pilot projects, enhanced by increased accessibility and recreation, provides enhanced educational opportunities.

Description: The Arcata Marsh Interpretive Center has interactive exhibits, free maps and literature, and a bookstore. It is located directly adjacent to a series of sewage treatment ponds and wetlands.

- Arcata's wastewater is treated locally, utilizing natural wetland processes
- Combination of treatment plant, publicly accessible wetlands, wildlife habitat, and recreational opportunities
- Integration of conventional wastewater treatment with natural processes of constructed wetlands
- Freshwater marshes, salt marsh, tidal sloughs, grassy uplands, mudflats, brackish marsh, and 5 miles of trails
- Interpretive Center has interactive exhibits, free maps and literature, bird checklists, and a bookstore.



Aerial view of WWTP pond system



Arcata Marsh Interpretive Center

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 1: Remain in Place / Elevate

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Maintain current location of the Interpretive Center and elevate it to withstand SLR

PROS

- Maintain current location
- Blue water experience - proximity to shoreline marshes
- Building is highly visible in its current location

CONS

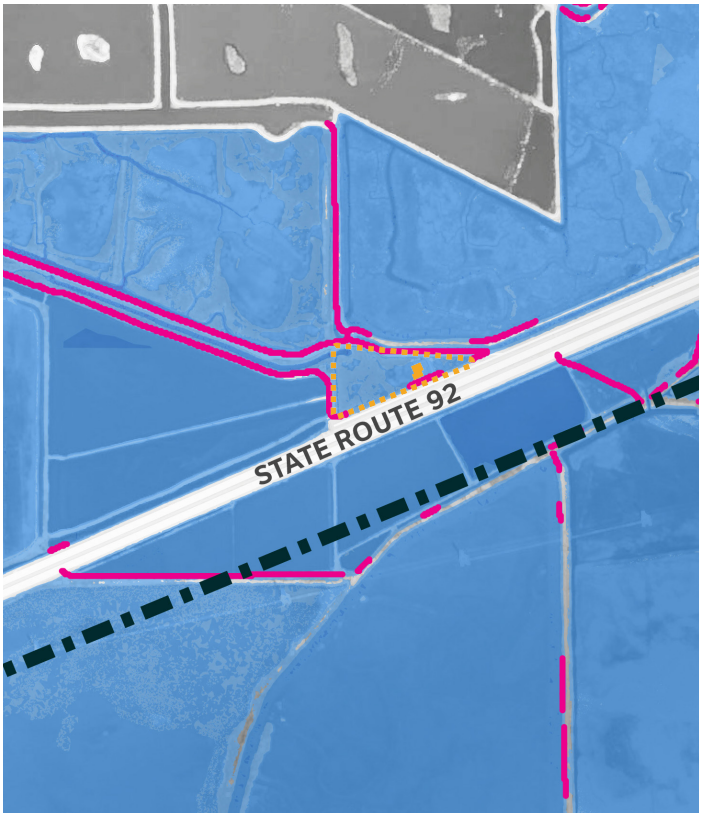
- Access paths to the shoreline and Bay get inundated with SLR
- Raising the building may be costly, only for it to be inundated with 7’ SLR
- ADA accessibility might be a challenge


ORO LOMA MARSH
FRANK'S WEST
AERIAL ZOOM IN
EXISTING CONDITION
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
SMHM PRESERVE
OLIVER SALT PONDS
STATE ROUTE 92
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
MT. EDEN CREEK
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

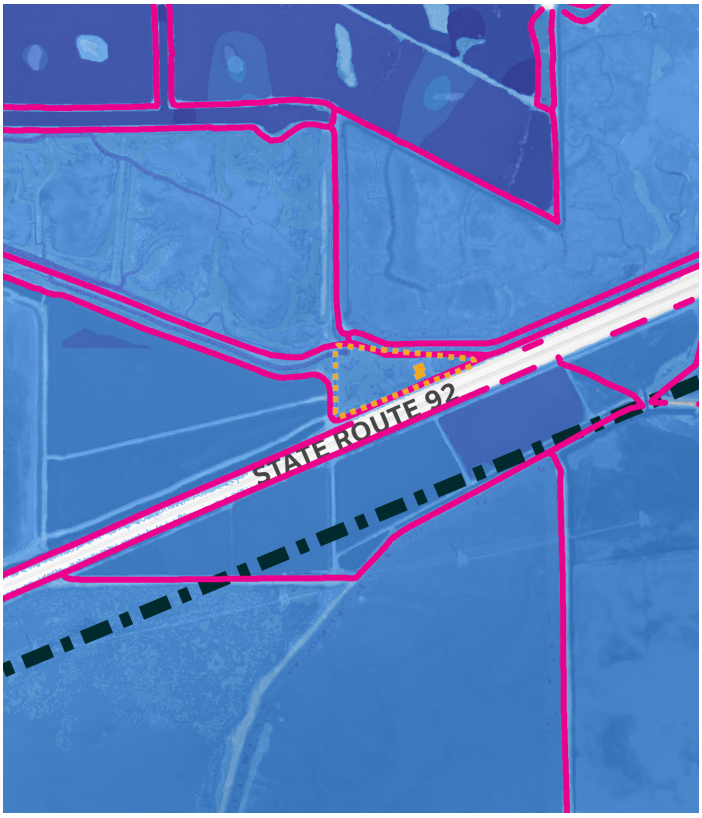
Option 1: Remain in Place / Elevation

2’ SLR



- Bay Trail access is inundated

4’ SLR



- Need to raise building, which becomes inundated

7’ SLR



- Site is severely compromised
- All access, including roads, is inundated; need to relocate the building

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 2: West Winton Landfill

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Relocate the Interpretive Center to the West Winton Landfill

PROS

- Blue water experience- proximity to marshes
- Expansive views of the shoreline

CONS

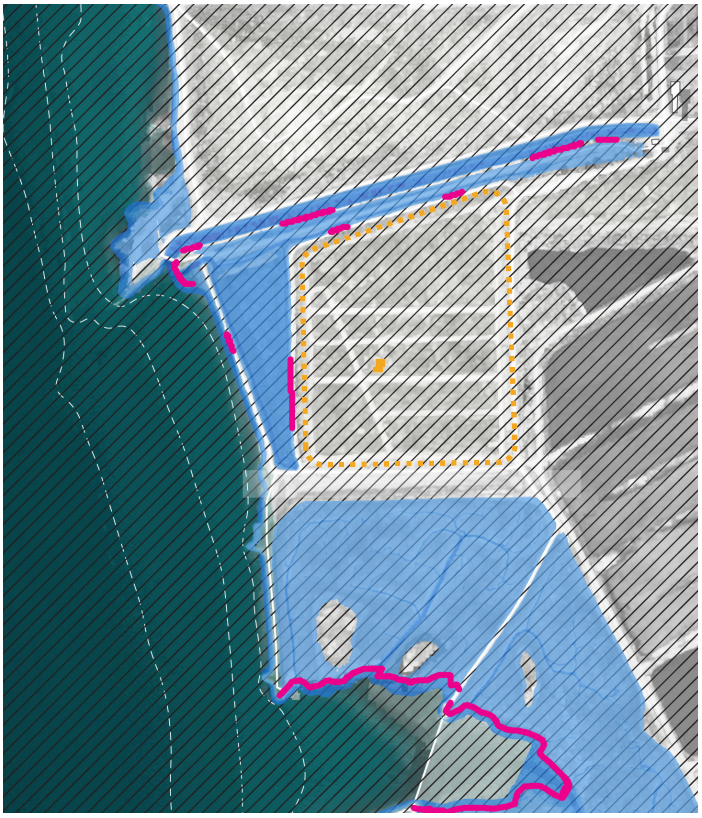
- Landfill poses maintenance concerns- may be unstable. Building would likely require deep piles that go through the landfill
- May be costly to drive foundations through landfill
- Car access inundated with 4’ SLR- would require raising the road


EXISTING CONDITION
AERIAL ZOOM IN
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
DEPOT ROAD
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

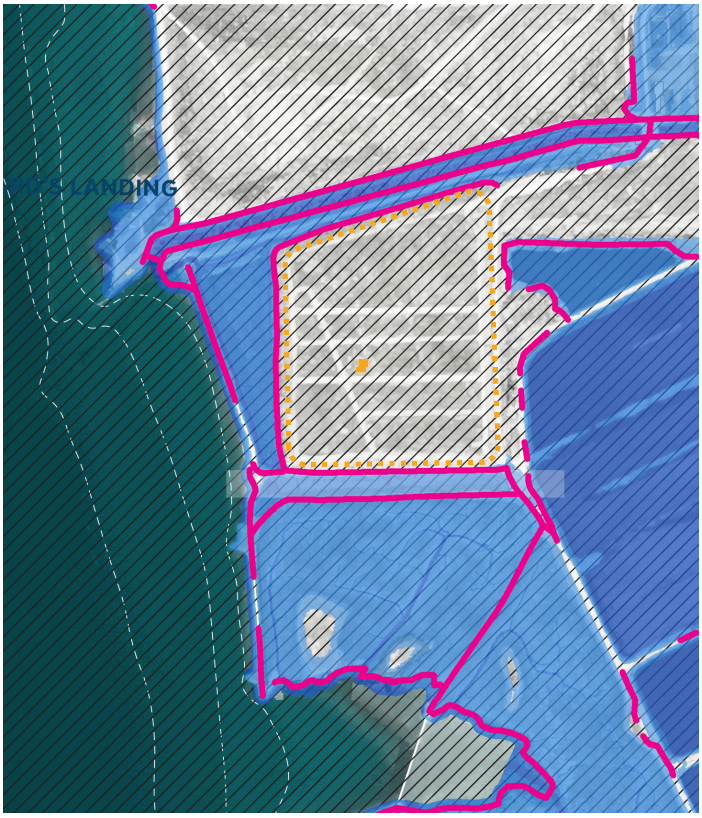
Option 2: West Winton Landfill

2′ SLR



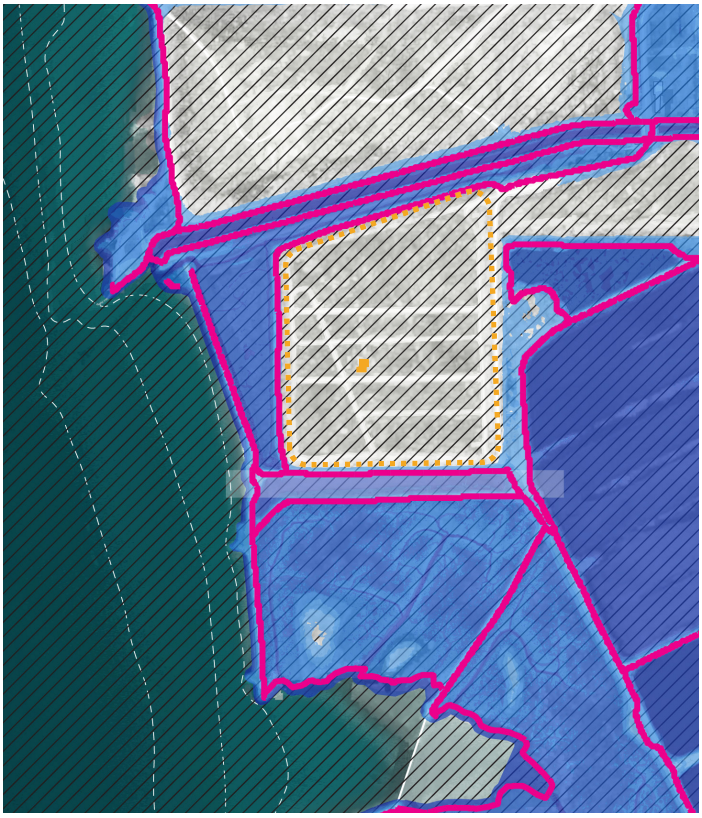
- Minimal impacts

4′ SLR



- W. Winton Ave is inundated

7’ SLR



- Site is severely compromised
- W. Winton Ave is severely inundated
- Access by car and trails is lost

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 3: Regional Park Office

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Relocate the Interpretive Center to the Regional Park Office site

PROS

- Proximity to marshes
- Could be paired with horizontal levee on landfill edge
- Easily accessible from West Winton Ave

CONS

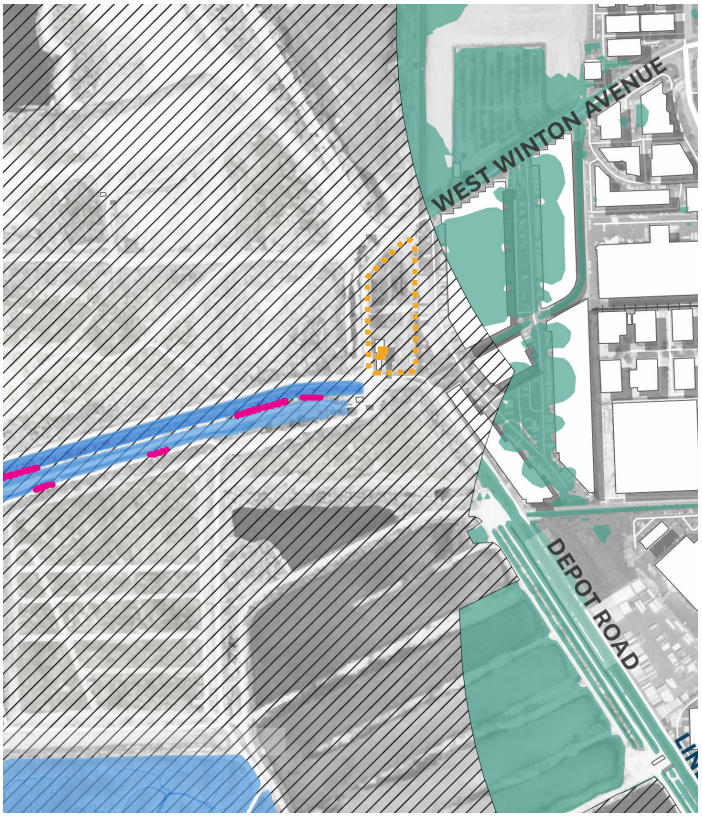
- No true blue water experience
- Access and building are inundated with 4’ SLR
- Transmission lines go through this site, which may present an issue


ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
COGSWELL MARSH
OLIVER SALT PONDS
WEST WINTON AVENUE
CABOT BOULEVARD
INDUSTRIAL BOULEVARD
ARDEN ROAD
MT. EDEN CREEK
EXISTING CONDITION
AERIAL ZOOM IN
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

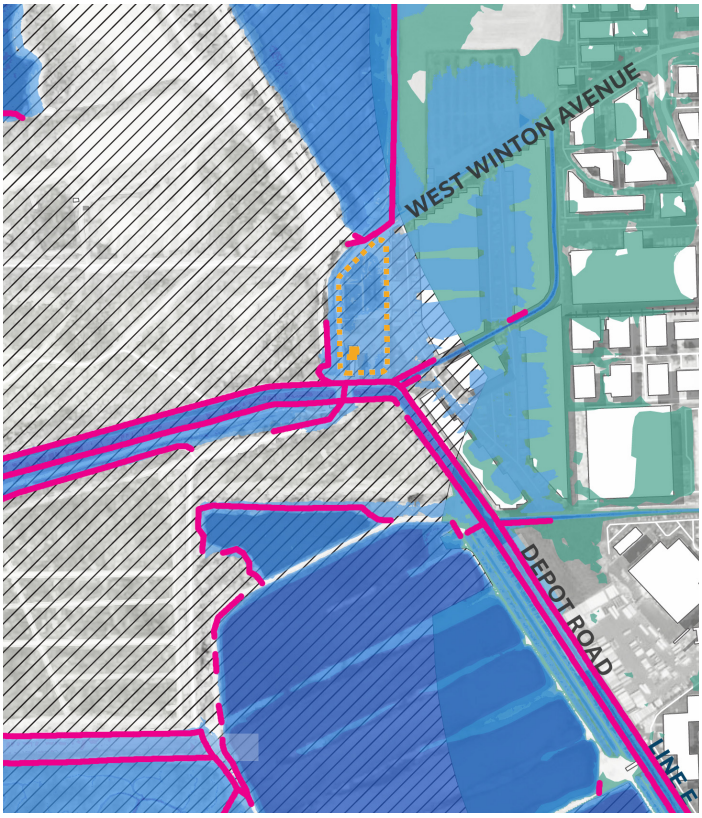
Option 3: Regional Park Office

2′ SLR



- Minimal impacts
- Potential groundwater emergence (no data)

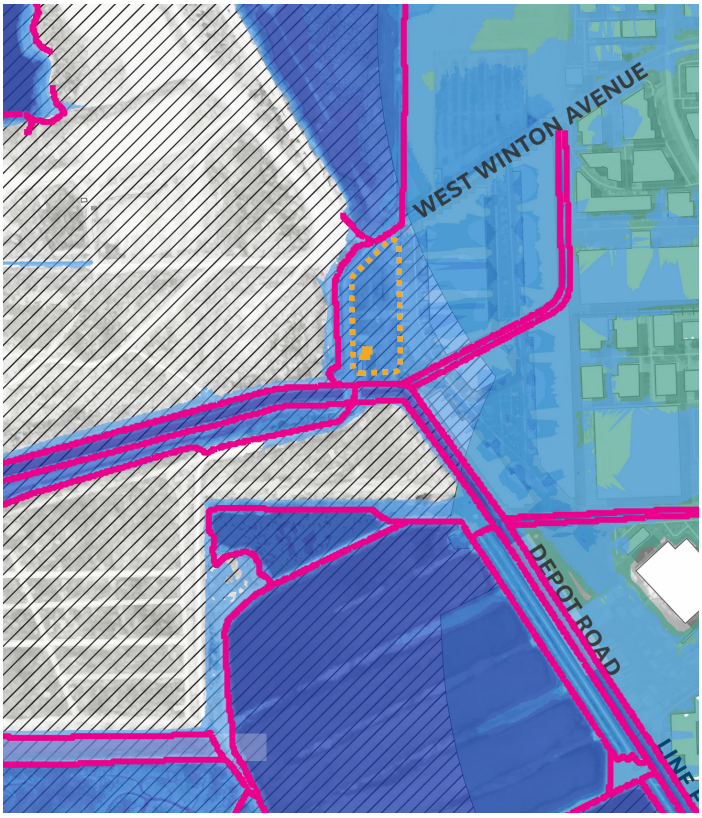
4′ SLR



- Building and access road are inundated

SCAPE

7’ SLR



- Site is severely compromised
- Building is severely inundated
- Access is severely inundated

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 4: San Lorenzo Community Center Park

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Relocate the Interpretive Center to San Lorenzo Community Center Park

PROS

- Potential to pair with marsh migration space pilot project
- Proximity to residential community
- Proximity to Oro Loma Marsh
- Blue water experience with SLR inundation

CONS

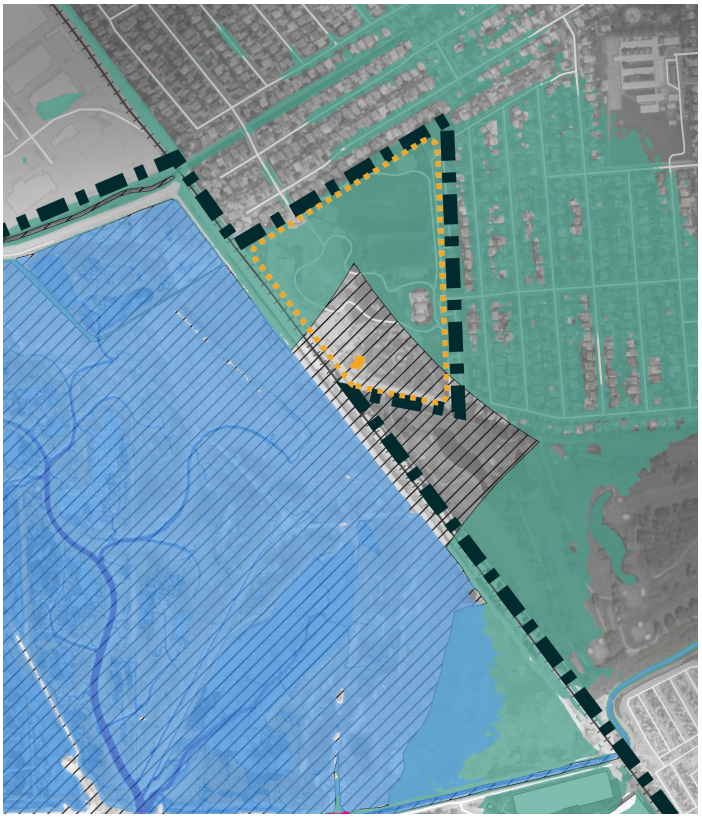
- Inundated with 4’ SLR
- Potential groundwater impacts


ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON AVENUE
AERIAL ZOOM IN
EXISTING CONDITION
H.A.R.D. MARSH
OLIVER SALT PONDS
STATE ROUTE 92
INDUSTRIAL BOULEVARD
ARDEN ROAD
MT. EDEN CREEK
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

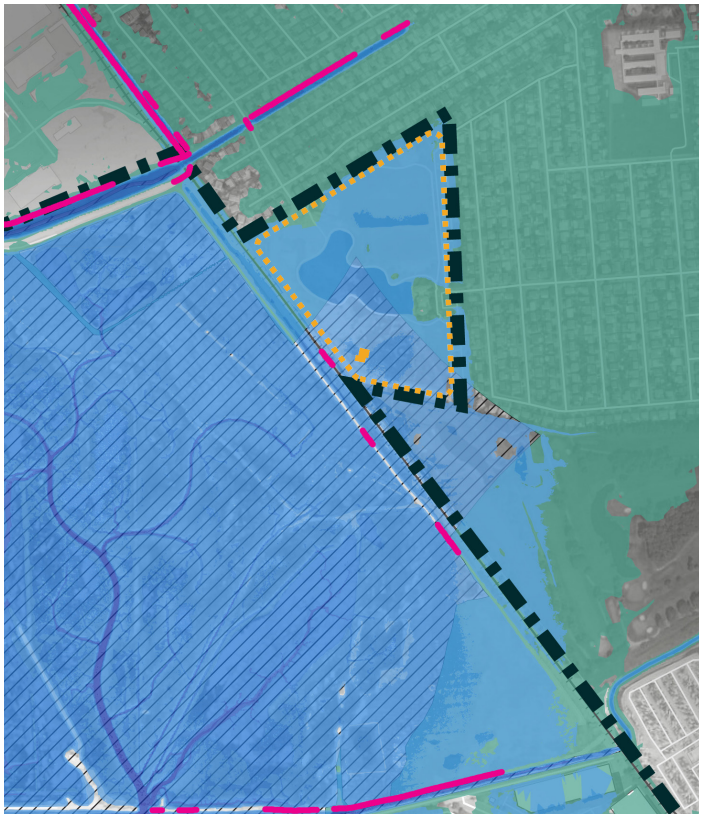
Option 4: San Lorenzo Community Center Park

2’ SLR



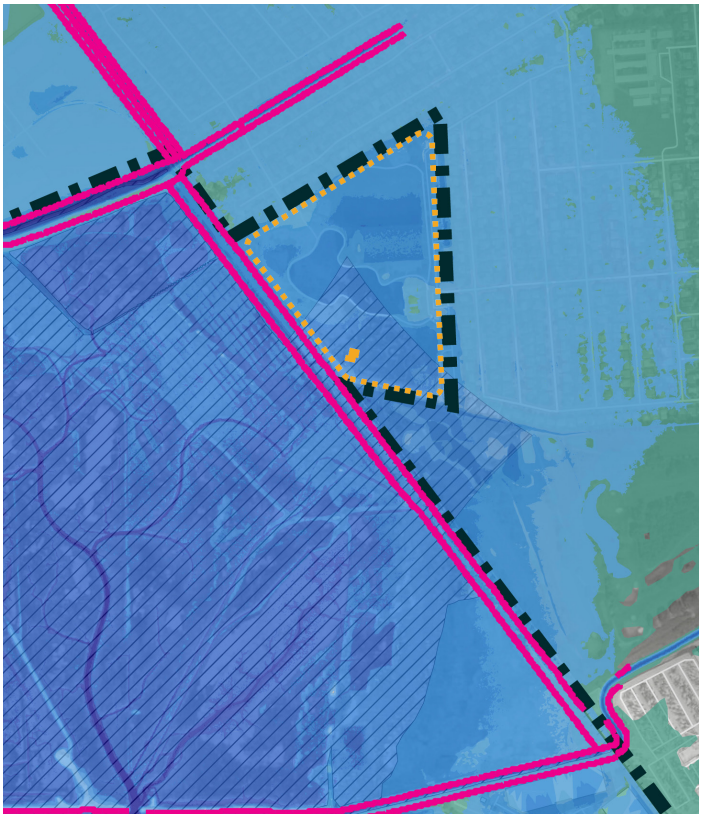
- Potential groundwater impacts (no data)

4’ SLR



- Building is inundated

7’ SLR



- Site is severely compromised
- Building is severely inundated
- All adjacent access is inundated

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 5: Frank's East

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Elevate a portion of Frank's East
- Relocate the Interpretive Center to Frank's East

PROS

- Potential to paired with a horizontal levee on the landfill edge + tidal marsh restoration + Bay Trail realignment
- Easy vehicular access and parking along West Winton Ave

CONS

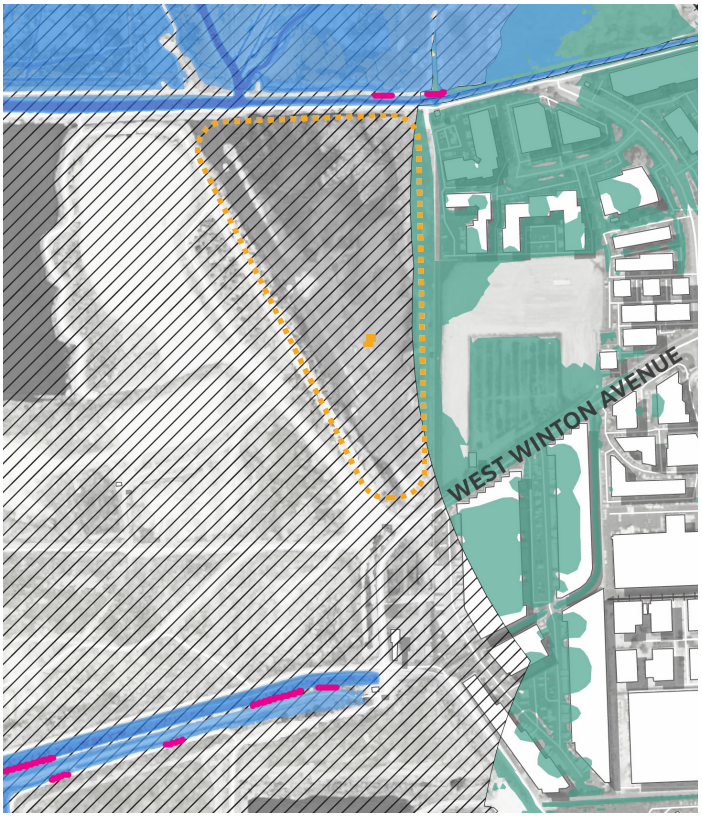
- No parking infrastructure in proximity
- No blue water experience
- Transmission lines go through this site, which may present an issue


ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
WEST WINTON LANDFILL
WEST WINTON AVENUE
WEST WINTON AVENUE
CABOT BOULEVARD
DEPOT ROAD
INDUSTRIAL BOULEVARD
ARDEN ROAD
MT. EDEN CREEK
EXISTING CONDITION
AERIAL ZOOM IN
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

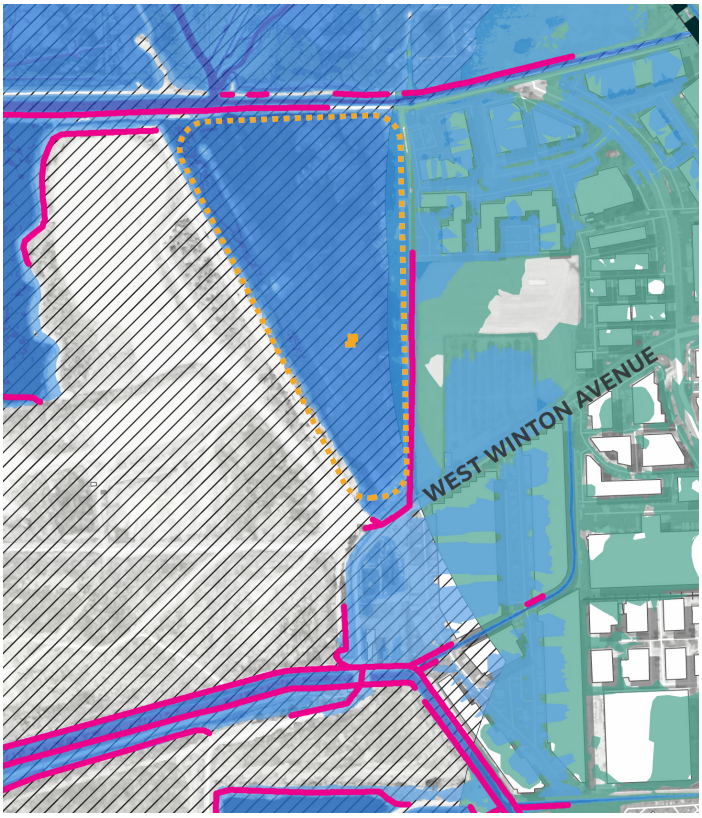
Option 5: Frank's East

2' SLR



- No impacts

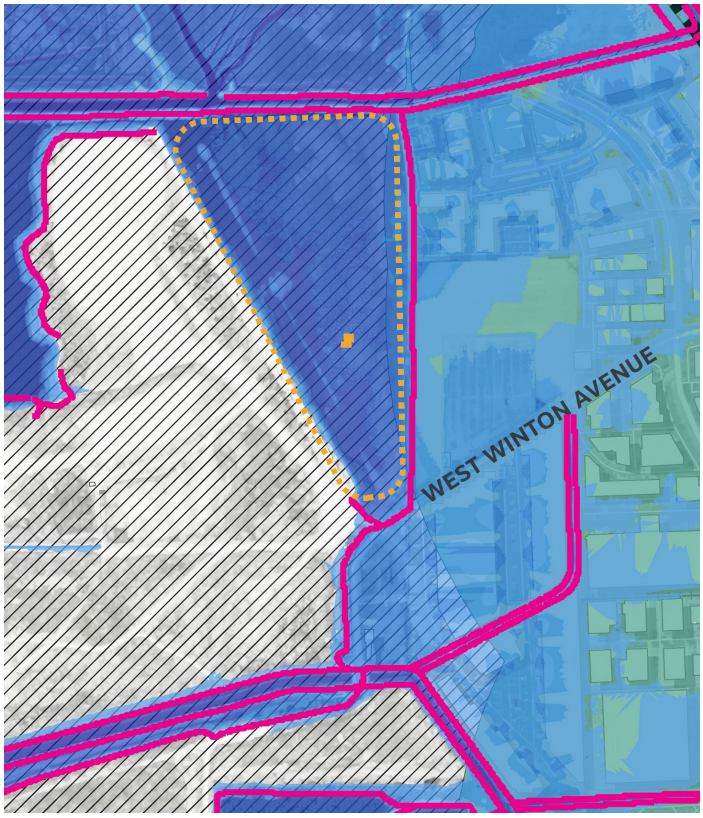
4' SLR



- Building is inundated
- Access is inundated

SCAPE

7’ SLR



- Site is severely compromised
- Building is severely inundated
- Access is inundated

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 6: Eden Landing

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Relocate the Interpretive Center to Eden Landing

PROS

- Blue water experience
- Adjacent to kayak launch and Eden Landing public access

CONS

- Inundated with 2’ SLR
- No immediate public parking

ORO LOMA MARSH

FRANK'S WEST

ALAMEDA COUNTY LANDFILL

WEST WINTON LANDFILL

WEST WINTON

WINTON AVENUE



AERIAL ZOOM IN



EXISTING CONDITION

H.A.R.D. MARSH

OLIVER SALT PONDS

STATE ROUTE 92

ARDEN ROAD

EDEN LANDING

MT. EDEN CREEK

N

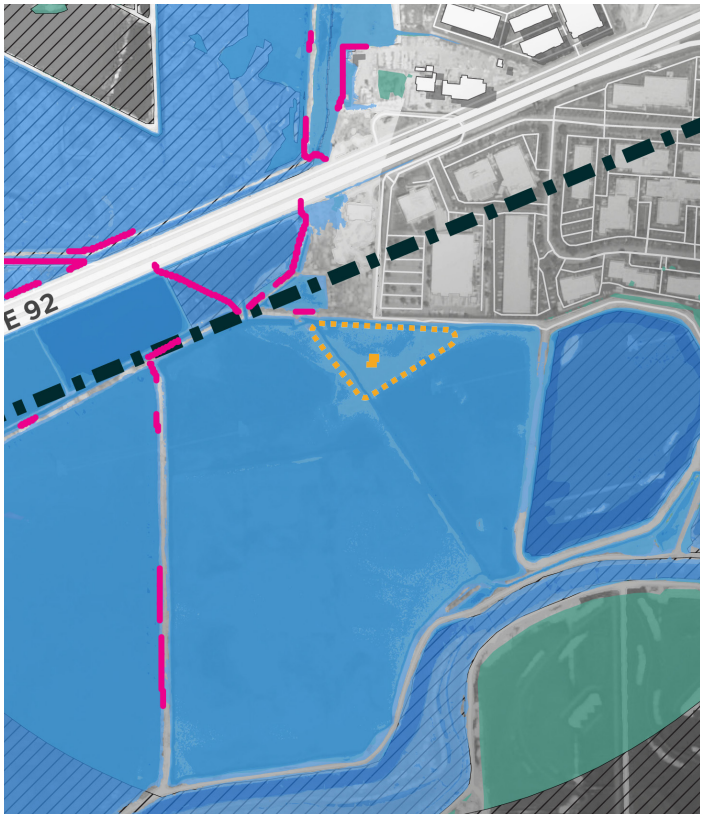
0

0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

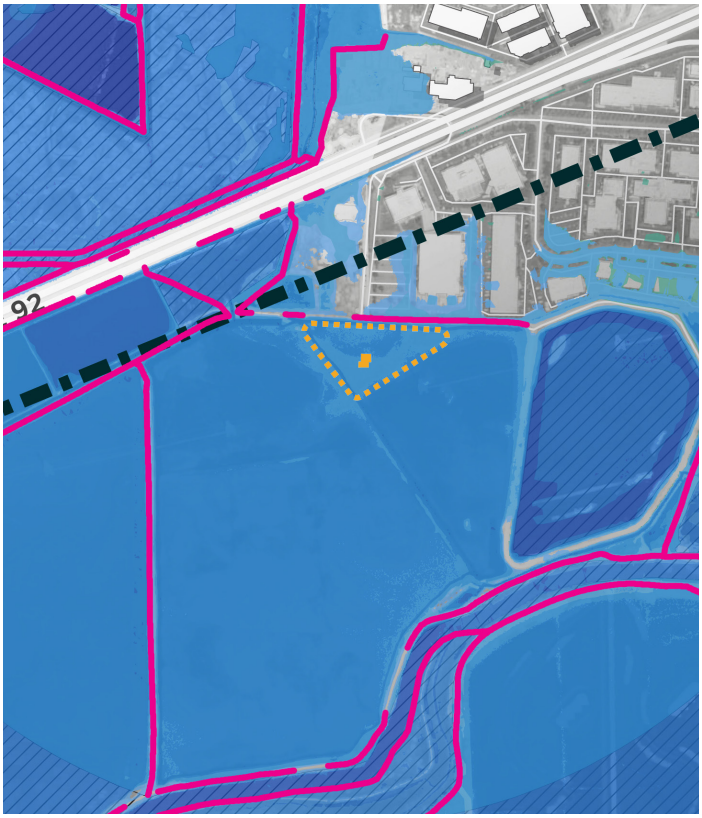
Option 6: Eden Landing

2′ SLR



- Building is inundated

4′ SLR



- Building is inundated
- Bay Trail is inundated

7’ SLR



- Site is severely compromised
- Building is severely inundated
- All access is inundated

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 7: Floating Building / Barge

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Retrofit the Interpretive Center as a floating building or barge

PROS

- Adapts to flooding and SLR
- Blue water experience
- Ability to move to different locations
- Maintain current location and visibility

CONS

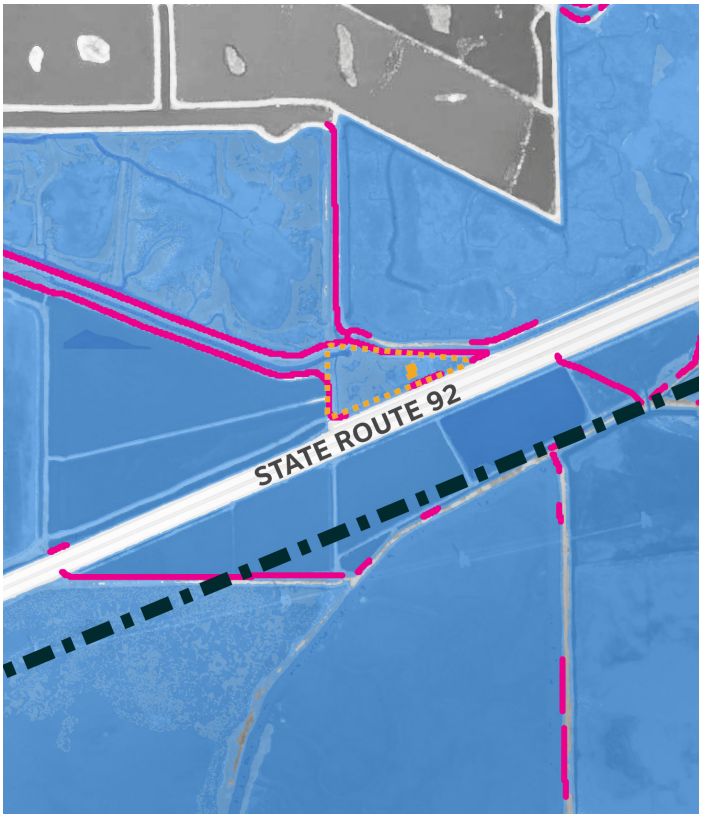
- May be hard to move a barge in shallow water and narrow channel
- All access is inundated with 7’ SLR
- Strong tidal run and wind would prohibit barge movement
- Parking and trail access becomes an issue with SLR


ORO LOMA MARSH
FRANK'S WEST
AERIAL ZOOM IN
EXISTING CONDITION
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
SMHM PRESERVE
OLIVER SALT PONDS
STATE ROUTE 92
INDUSTRIAL BOULEVARD
CLAWITER ROAD
ARDEN ROAD
MT. EDEN CREEK
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

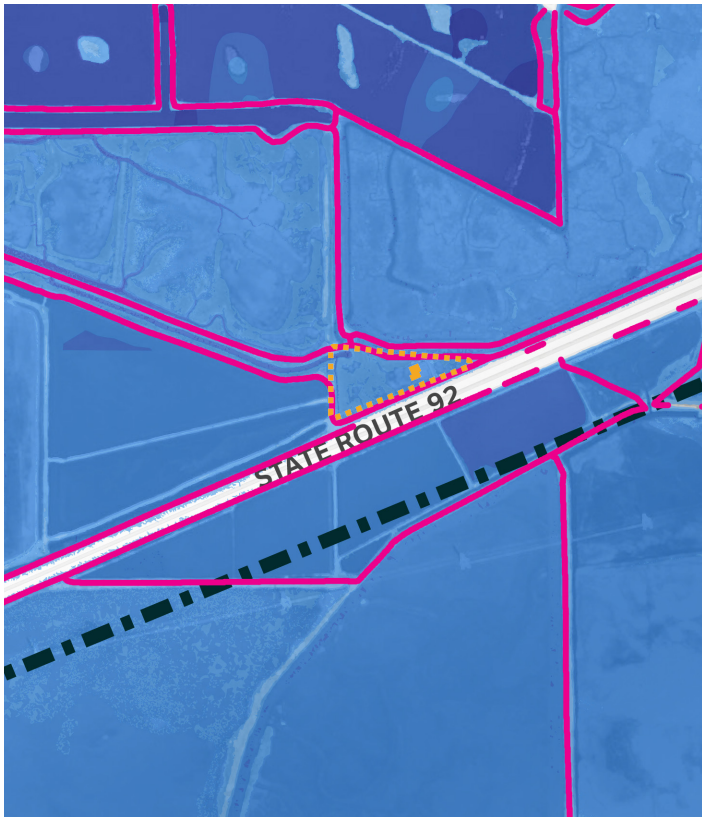
Option 7: Floating Building / Barge

2′ SLR



- Bay Trail access is inundated

4′ SLR



- All trail access is inundated

7′ SLR



- All access, including roads, is severely inundated

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Option 8: SMHM Preserve

OBJECTIVE

Enhance educational opportunities and adapt to SLR.

DESCRIPTION

- Relocate the Interpretive Center to the diked pond adjacent to the SMHM Preserve

PROS

- Potential to pair with wastewater treatment pilot project / horizontal levee
- Potential to pair with trail realignment
- Owned by EBRPD

CONS

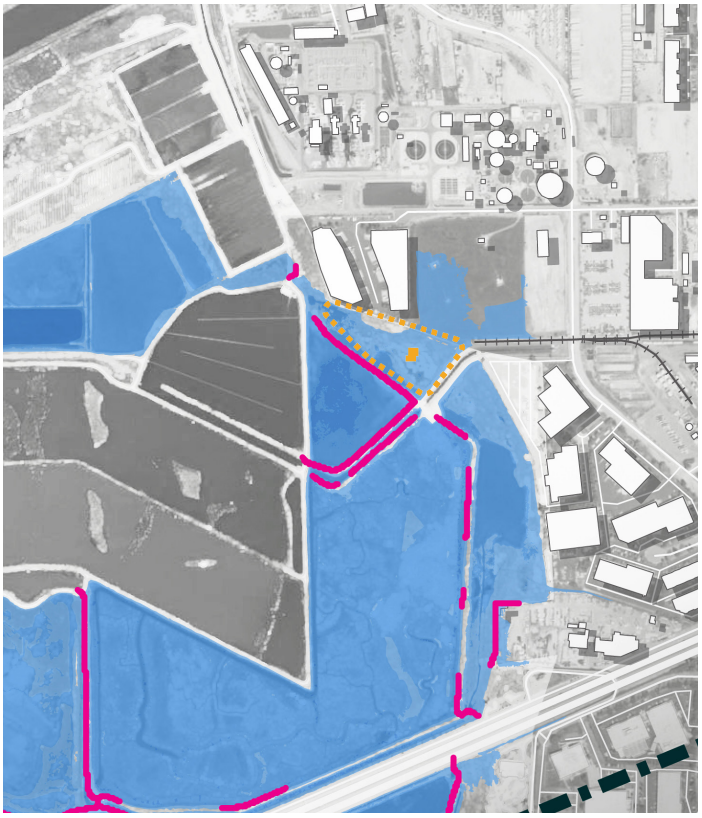
- Site is inundated in all SLR scenarios
- Not easily accessible by car
- No direct blue water experience
- Public access adjacent to wastewater uses is problematic


ORO LOMA MARSH
AERIAL ZOOM IN
EXISTING CONDITION
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
STATE ROUTE 92
ARDEN ROAD
MT. EDEN CREEK
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

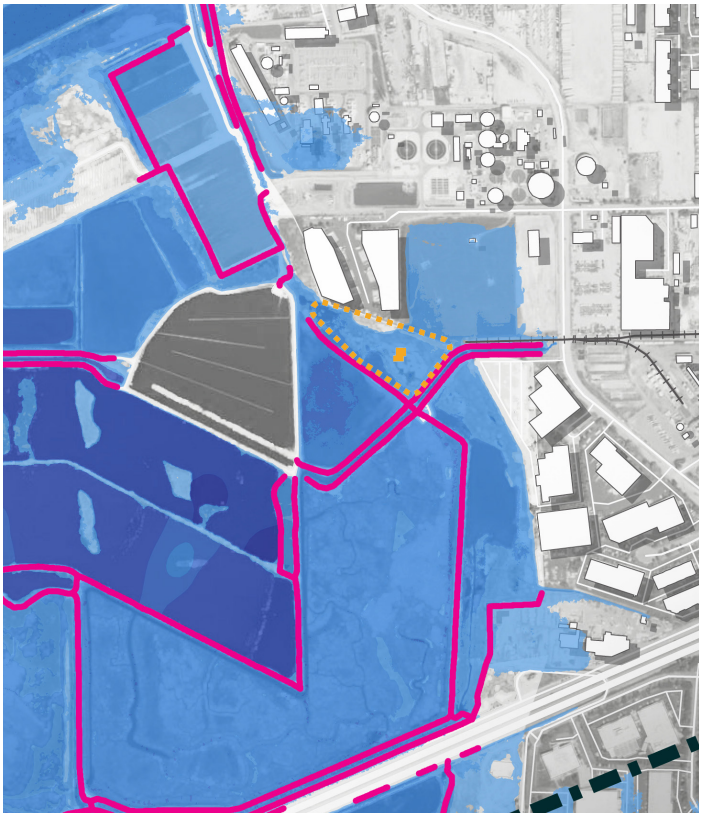
Option 8: SMHM Preserve

2′ SLR



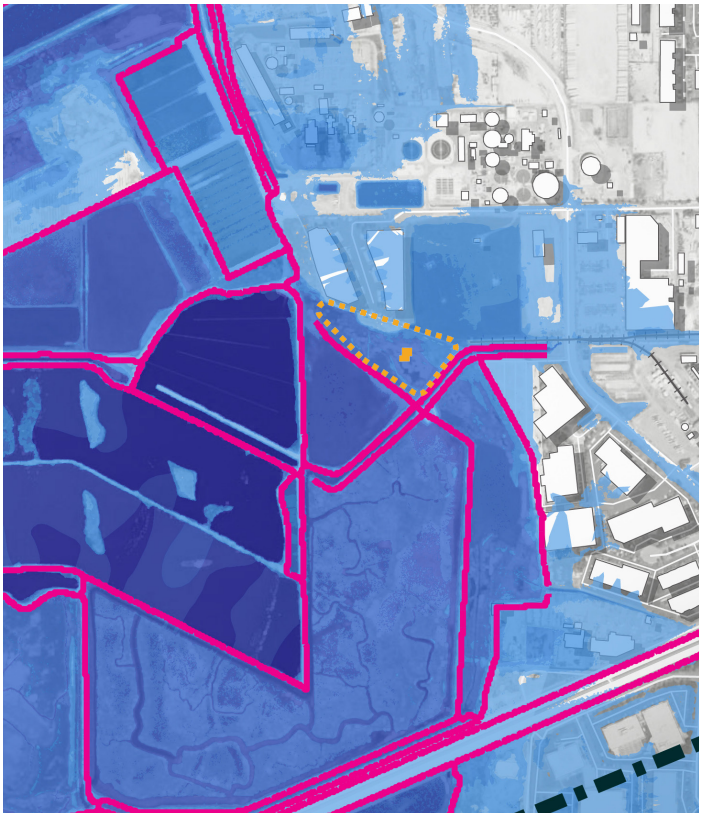
- Site is inundated
- Some access is inundated

4′ SLR



- Site is inundated
- Most access is inundated

7′ SLR



- Site is severely compromised
- All access is severely inundated

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Stakeholder Feedback

GENERAL COMMENTS:

- COH is supportive of any adaptation measure related to the Hayward Shoreline Interpretive Center that's supported by the Hayward Area Recreation and Park District (HARD).
- HARD noted that the key takeaways for the Interpretive Center Relocation include:
  - Locate in proximity to educational opportunities that won't be fully inundated by SLR
  - Locate along the Bay Trail, or maintain the link
  - Parking and access by car is essential
  - Consider the building's visibility, which will increase awareness about the Center
  - HARD has the opportunity to do something that sets the bar and tone for forward-thinking and innovation.
- BCDC indicated that if there was a feasible option to adapt in place, it may be preferable. it is easier to update the permit in its current location, depending on the feasibility of updating/adapting.
- HARD noted that they are currently finishing the final CDs of the San Lorenzo Community Center Park reconstruction.
- HARD noted that it seems like the main concern is access.
- HARD noted that the key is transportation. Everything is going to be inundated and it is so close to the CalTrans highway- tying into those improvements and raising key access points could be a potential path forward.
- HARD suggested a 3-tiered approach to prioritize program first: existing plan and ramifications, costs and programming, then smaller location sites to program the entire region, and lastly existing projects and improvements to address access.
- HARD is in support of the constellation idea of having multiple satellite/mobile locations for programming around the entire shoreline.
- HARD brought up the possibility of mitigation obligations in perpetuity for the HARD Marsh.

OPTION 1 COMMENTS:

- HARD noted that it is hard to address this without knowing what other types of infrastructure improvements are projected.
- HARD noted that a strong pro of this option is the building's visibility- people recognize it and are aware it is there.
- HARD noted that building retrofit may not be recommended if the building is projected to be inundated in the immediate future, which is dependent on the planning time horizon and level of inundation.

OPTION 2 COMMENTS:

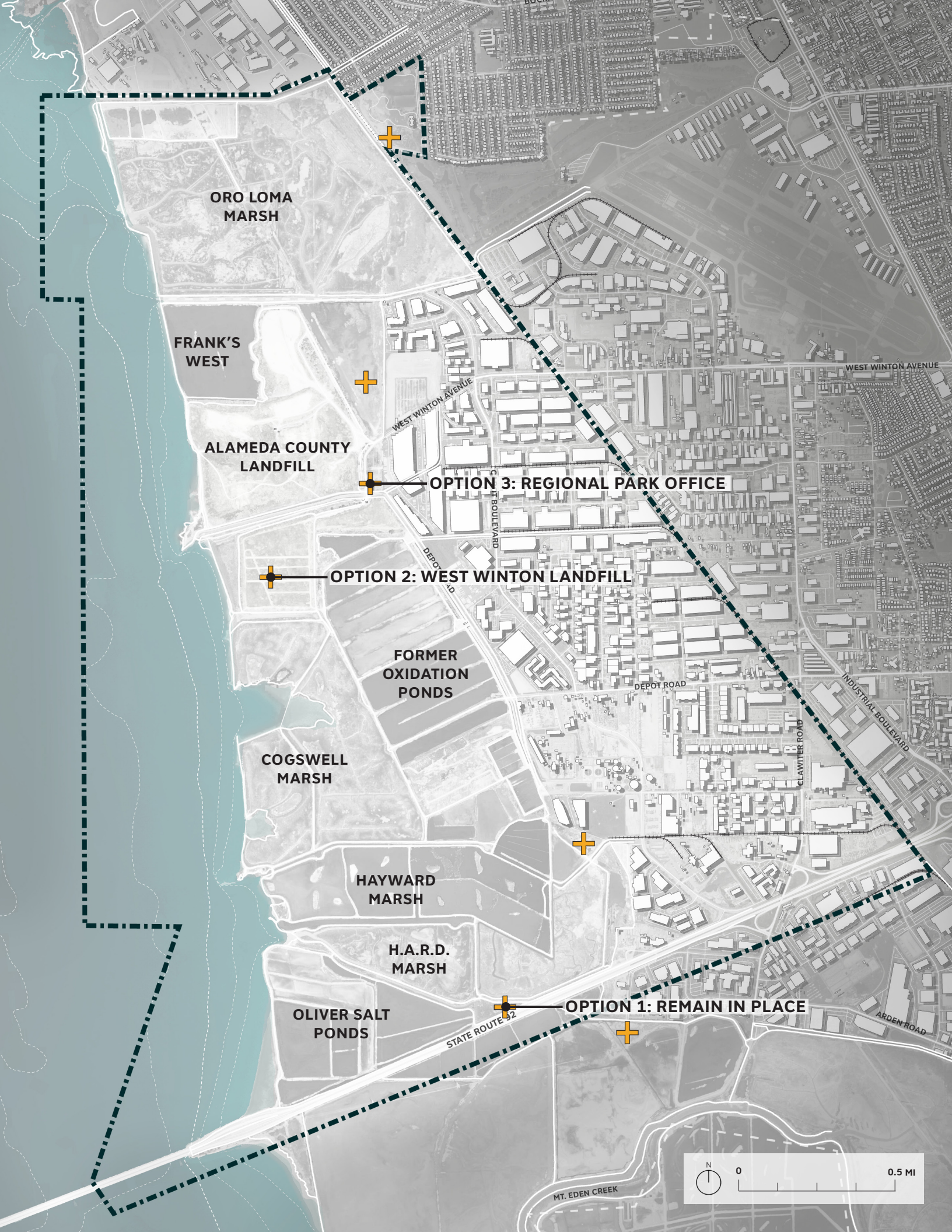
- HARD noted that it was indicated that ACFCD wants to take ownership of this landfill and that they have committed to incorporating a recreational trail. It was agreed that ACFCD would be a good partner and relocation to the landfill could work out.
- HARD questioned driving piles into the landfill. The building will likely require deep piles that will go through the landfill, and any contamination or capping issues may increase the cost.

OPTION 3 COMMENTS:

- HARD noted that this piece of land is owned by EBRPD, but the parking lot is leased out from the COH.
- HARD indicated that the transmission lines that go through this site may present an issue.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
Teal text indicates a response from SCAPE


ORO LOMA MARSH
FRANK'S WEST
ALAMEDA COUNTY LANDFILL
OPTION 3: REGIONAL PARK OFFICE
OPTION 2: WEST WINTON LANDFILL
FORMER OXIDATION PONDS
COGSWELL MARSH
HAYWARD MARSH
H.A.R.D. MARSH
OLIVER SALT PONDS
OPTION 1: REMAIN IN PLACE
WEST WINTON AVENUE
WEST WINTON AVENUE
DEPOT ROAD
DEPOT ROAD
CLAWITER ROAD
INDUSTRIAL BOULEVARD
ARDEN ROAD
STATE ROUTE 92
MT. EDEN CREEK
N
0
0.5 MI

HAYWARD SHORELINE INTERPRETIVE CENTER RELOCATION

Stakeholder Feedback

OPTION 4 COMMENTS:

- HARD noted that in 2015, 2016, and part of 2017, with the reconstruction of the park, the western edge was raised 5.5' to increase resilience to sea level rise.
- HARD noted that the park has invested a lot in dewatering on site and is vulnerable to groundwater impacts today.
- HARD brought up that the railroad would inhibit access to the Interpretive Center.
- HARD agreed that this option should be removed from the report, in response to the site's vulnerability to SLR and groundwater, and access issues.

OPTION 5 COMMENTS:

- HARD noted that this option would have the best vehicular access and parking potential along West Winton Ave.
- HARD indicated that the transmission lines that go through this site may present an issue.

OPTION 6 COMMENTS:

- HARD agreed that this option should be removed from the report, due to the site's vulnerability.

OPTION 7 COMMENTS:

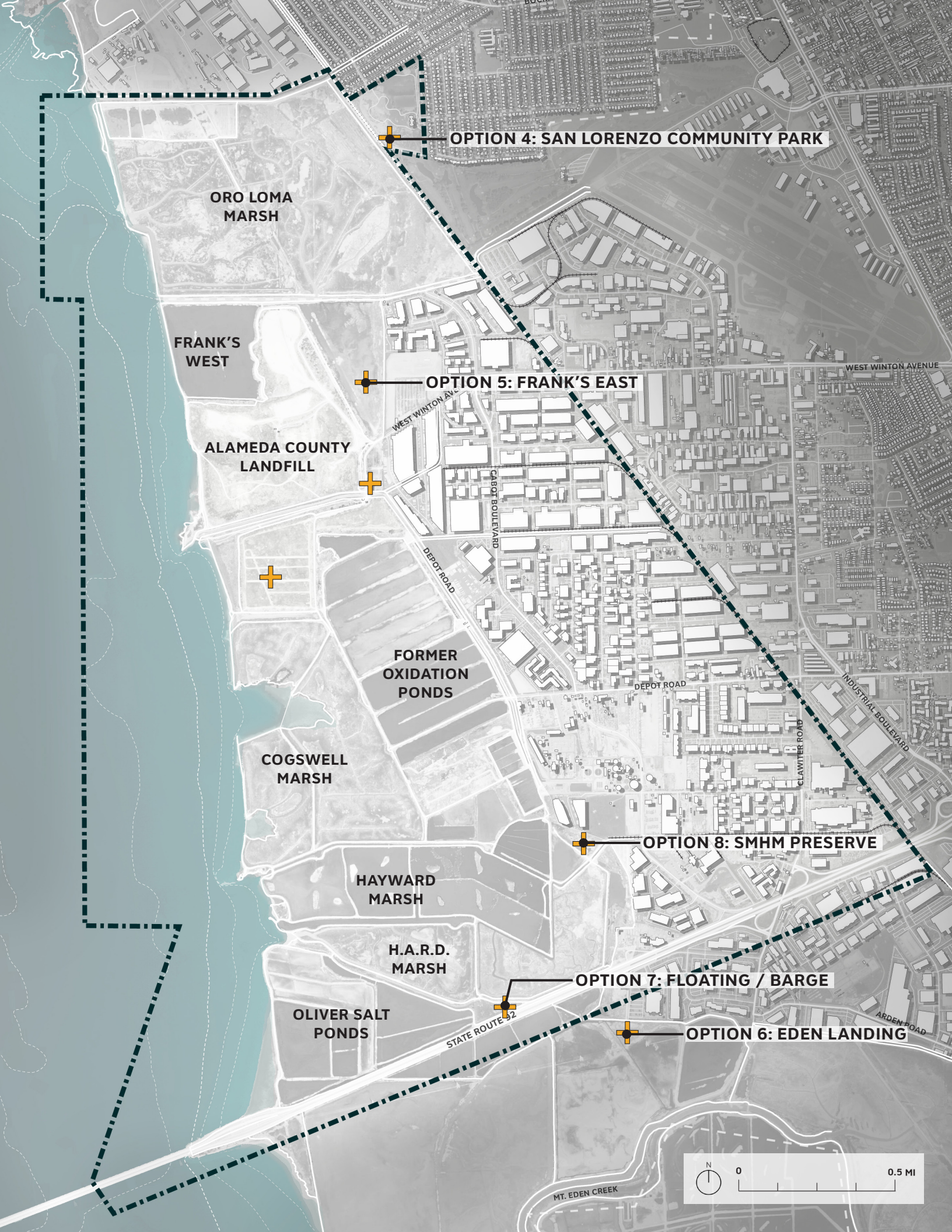
- HARD noted that due to the tidal run and wind, you wouldn't want to take a barge anywhere along this shoreline.
- HARD expressed that this option would maintain visibility, but parking and trail access becomes an issue with SLR.
- HARD agreed that this option is the most viable so far.
- COH asked about ADA regulations and if a barge could comply. Barges can be designed to satisfy ADA accessibility requirements through a floating dock or pier structure.
- BCDC indicated that a barge would be considered permanent fill and would have a larger footprint, which the resource agencies may not favor.
- HARD indicated that the barge is the most innovative idea.

OPTION 8 COMMENTS:

- HARD indicated that this option would locate the Interpretive Center in a diked pond adjacent to Hayward Marsh, and has the potential to pair the Center in proximity to a WWTP adaptation, such as a horizontal levee.

ACRONYMS

EBRPD: East Bay Regional Park District
COH: City of Hayward
HARD: Hayward Area Recreation District
BCDC: Bay Conservation & Development Commission
Teal text indicates a response from SCAPE

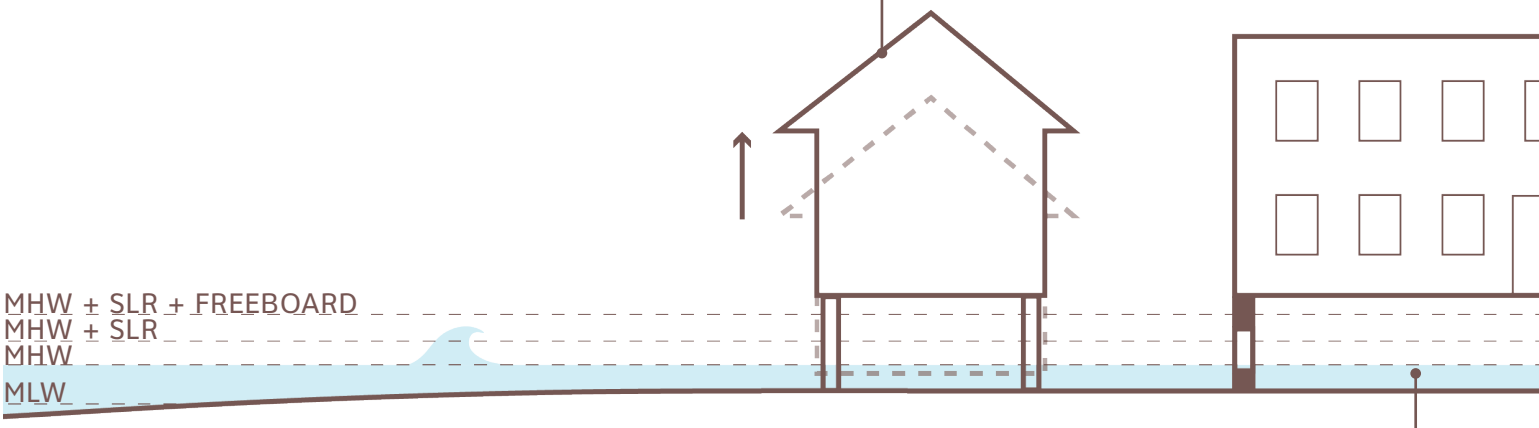

OPTION 4: SAN LORENZO COMMUNITY PARK
ORO LOMA MARSH
FRANK'S WEST
OPTION 5: FRANK'S EAST
WEST WINTON AVENUE
WEST WINTON AV.
ALAMEDA COUNTY LANDFILL
CABOT BOULEVARD
DEPOT ROAD
FORMER OXIDATION PONDS
DEPOT ROAD
INDUSTRIAL BOULEVARD
CLAWITER ROAD
COGSWELL MARSH
OPTION 8: SMHM PRESERVE
HAYWARD MARSH
H.A.R.D. MARSH
OPTION 7: FLOATING / BARGE
OLIVER SALT PONDS
STATE ROUTE 92
ARDEN ROAD
OPTION 6: EDEN LANDING
MT. EDEN CREEK
N
0
0.5 MI

BUILDING SCALE STRATEGIES

Definition

There are many building scale strategies that can be implemented to adapt to sea level rise, from improving standards, such as building codes and removing regulatory impediments, such as zoning height restrictions. The city can also aid businesses and homeowners to assist them with understanding the resilience options available to them and with finding the funding to support those options.

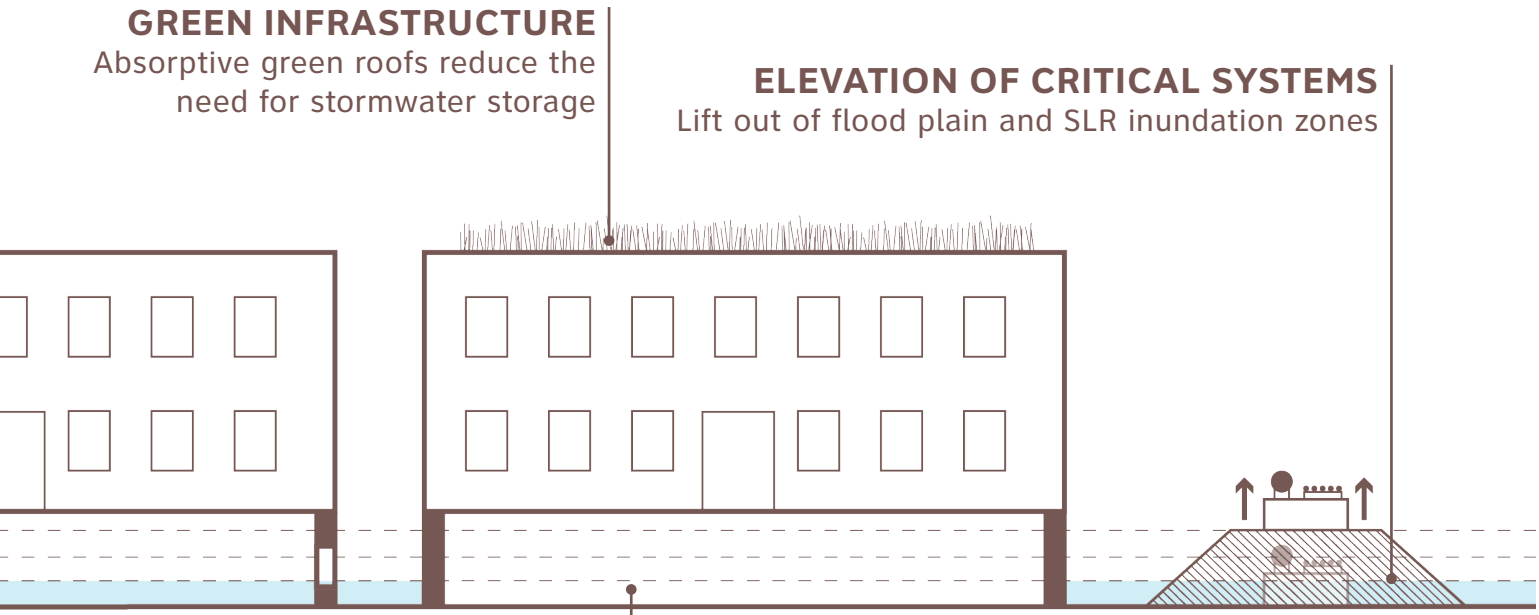
BUILDING ELEVATION
Lifts out of the flood plain and SLR inundation zone



WET FLOODPROOFING
Allows flood water to move into unoccupied areas below the building. Would need to be "mudproof" as well. Also need to raise critical systems (electrical / mechanical)

OBJECTIVE

- Improve design of buildings to increase resiliency to SLR and climate change



BUILDING SCALE STRATEGIES
Precedents

Brooklyn Grange, Rooftop Farm
Industry City, Sunset Park, NY

Size: 250,000 SF
Implementation Timeline: 2010-2019

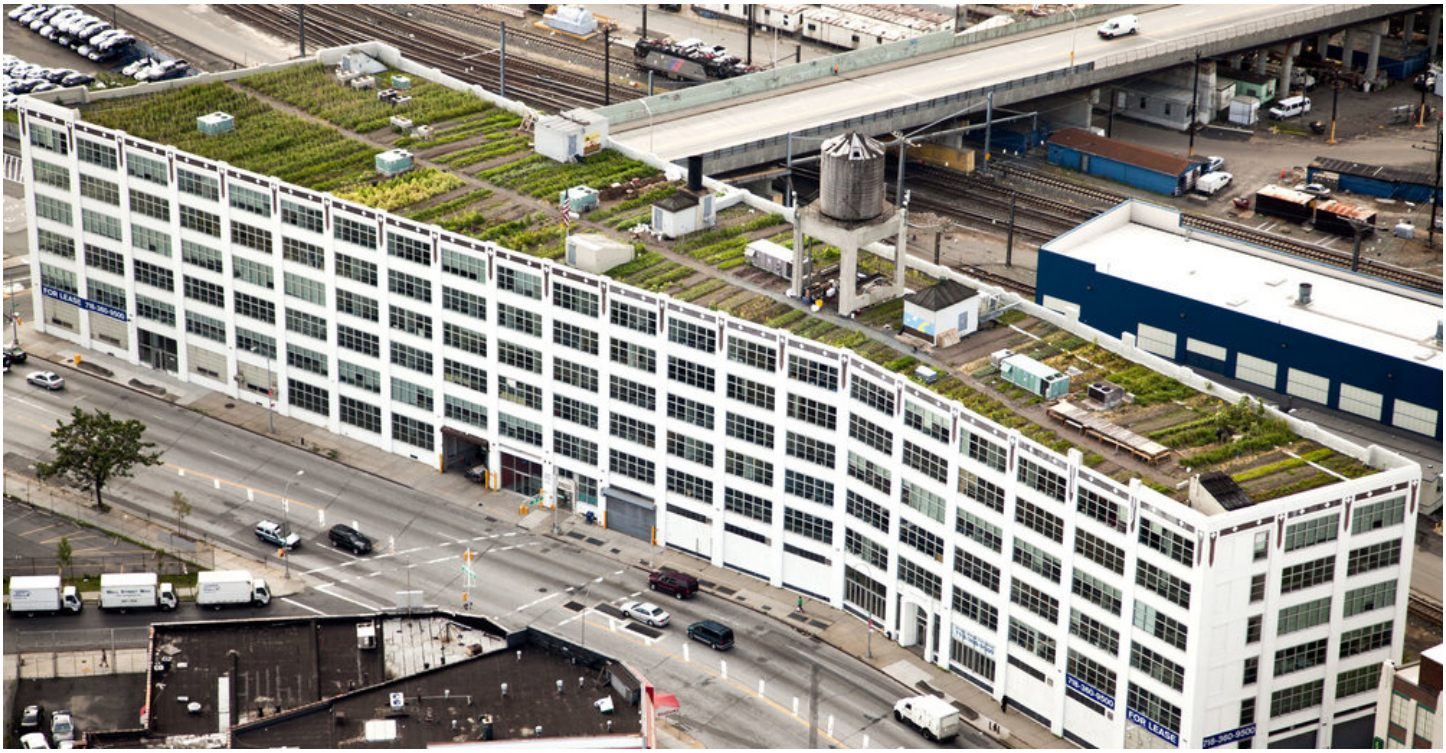
Applicability: Green infrastructure strategies may be implemented in upland watersheds to reduce the need for stormwater storage space near the Baylands.

Description: Brooklyn Grange is composed of three rooftop farms in NYC totaling 5.6 acres with 135,000 square feet of cultivated area, growing over 80,000 pounds of produce each year.

- The green roofs reduce pressure of the city's stormwater sewer system by managing an estimated 2 million gallons of stormwater per year.
- The rooftop farms incorporate habitat for migratory birds and pollinators.
- Buildings work to reduce the urban heat island effect through evapotranspiration, while also reducing the heating and cooling needs of the upper floors of the building.



Brooklyn Navy Yard farm- 1.5 acres



Long Island City farm- 1 acre

BUILDING SCALE STRATEGIES
Precedents

HafenCity
Hamburg, Germany

Size: 593 acres
Cost: Multi-billion dollar project

Applicability: District-wide building standards can help facilitate new resilient development that reduces vulnerabilities with climate change.

Description: To protect them from storm surge, all buildings in HafenCity are built on artificially structured plinths that are compacted to a height of 8-9 meters above sea level. In the interior of HafenCity, the plinths provide ample space for underground carparks, reducing the amount of car parking space required in the streets of the new development.

- Hafen City's location in relation to the main dike of Hamburg leaves it exposed to storm surge
- All streets and bridges are sited at flood-protected levels, at least 7.8-8.5 meters above sea level to prevent flooding
- Alternative motivated by the disadvantages of building dikes
- Building construction on plinths 8-9 meters above sea level
- Allows storm surges to occur without impact
- Construction is mandated to meet "Ecolabel" criteria following methods and resources that lower energy consumption
- Aquarium glass, concrete walls and watertight doors are used to seal ground floors – enhanced with increased trees and ornamentation
- Space beneath raised buildings provides ample room for parking



Hafen City is design to withstand repeated flooding front the Elbe River



Select buildings use aquarium glass to seal ground floors

BUILDING SCALE STRATEGIES

Option 1: Increasing Standards for New Construction

OBJECTIVE

Improve design of buildings to increase resilience to SLR and climate change.

DESCRIPTION

- Review building code and incorporate higher standards of flood protection

PROS

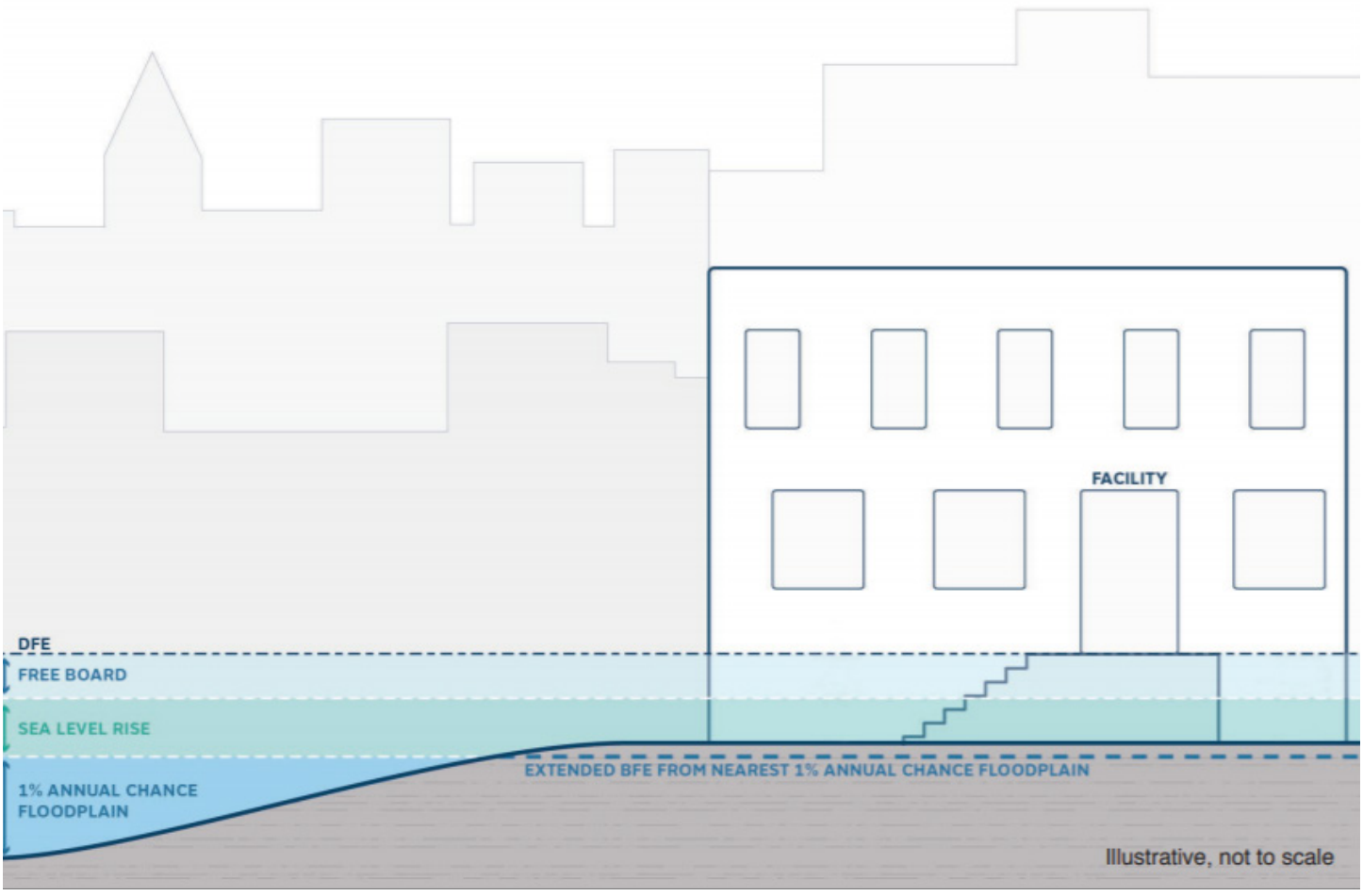
- Reduces risk to future development
- Ensures resilient development
- Savings on flood insurance premiums
- Can be implemented over time as buildings are improved
- Incremental increased costs are low

CONS

- May discourage construction in floodplain
- Older developments are still at risk
- Can conflict with urban design goals (street activation, façade design, etc.)
- May not be appropriate for permanent inundation
- Connectivity to the building would be compromised in floods or with SLR inundation

EXAMPLES

- Increasing freeboard to include SLR projections
- Extending flood-resistant construction requirements to the 500-year floodplain
- Increase storage requirements for hazard materials



BUILDING SCALE STRATEGIES

Option 2: Providing Loans / Grants / Tax Incentives for Implementation

OBJECTIVE

Provide support to help businesses and homeowners adapt to climate change.

DESCRIPTION

- Provide loans, grants, or tax incentives to encourage resilient new construction and retrofits

PROS

- Promotes resilient development
- Funding will ensure more property owners are able to retrofit buildings
- Can be combined with or modeled on CA Water Board brownfield remediation loans/grants and solar tax credits
- Can be structured as competitive grant program to spur innovation (like the NYC RISE program)

CONS

- Requires funding and ongoing program support
- Need to ensure people will take advantage of offerings
- Can be cumbersome to initiate and manage
- May require coordination with state government

EXAMPLES

- Competitive funding for innovative flood mitigation technologies (e.g. NYC rise program)
- Loans/grants modeled on CA water board brownfield remediation loans/grants
- Tax incentives modeled on CA solar tax credit



Deployable flood panels



Sump pumps



Onsite stormwater management

BUILDING SCALE STRATEGIES

Option 3: Technical Support & Education

OBJECTIVE

Improve design of buildings to increase resilience to SLR and climate change.

PROS

- Provides resources to recover from and prepare for future floods and climate risks
- Cost-effective way to prepare residents / property owners for future challenges

CONS

- May require additional staff and funding to coordinate support and education levels
- Requires effective community engagement to ensure participation in programs

EXAMPLES

- Modeled after seismic retrofitting awareness campaigns
- NYC business emergency preparedness risk audits



BUILDING SCALE STRATEGIES

Option 4: Removing Regulatory Impediments

OBJECTIVE

Improve design of buildings to increase resilience to SLR and climate change.

PROS

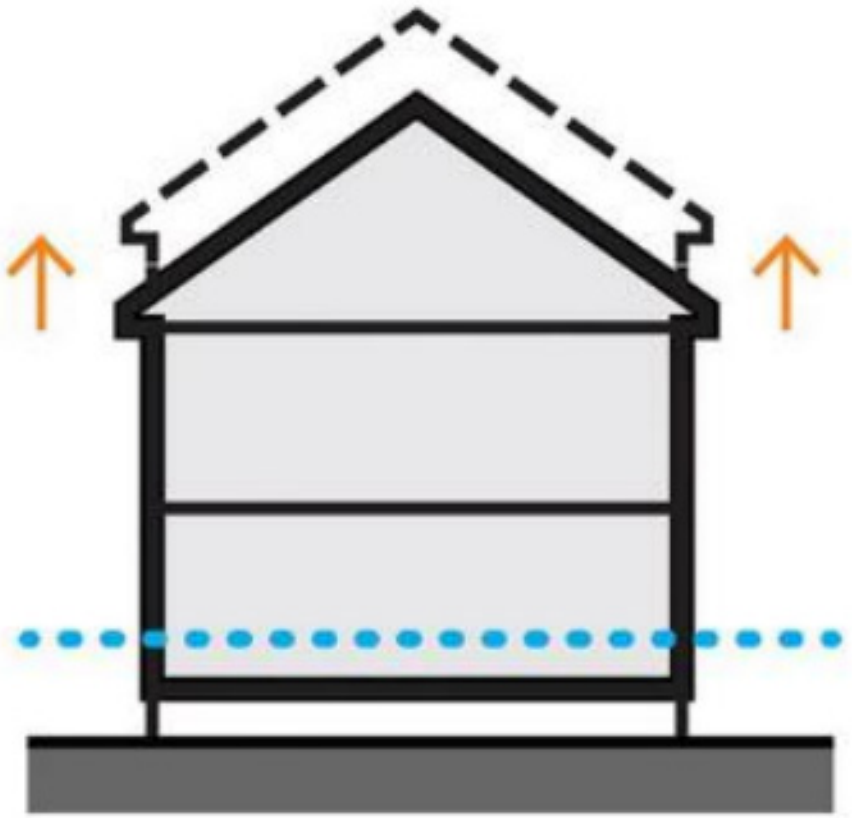
- Provides the structure to allow resilience initiatives to be adopted
- Makes its easier, faster, and more affordable to adopt resilience measures

CONS

- Could require overhaul of existing building or zoning standards
- Could be unintended side effects of removing regulatory impediments

EXAMPLES

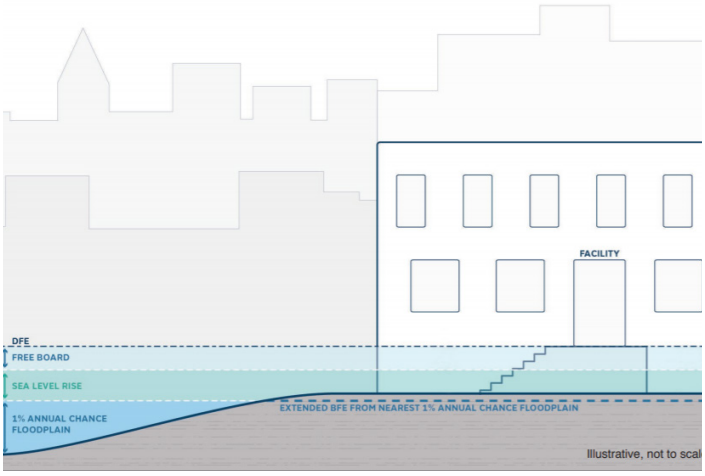
- Zoning height limits
- Permitting requirements and fees



BUILDING SCALE STRATEGIES

Stakeholder Feedback

1: Increasing Standards for New Construction



COMMENTS:

- See General Comments.

2: Providing Loans / Grants / Tax Incentives for Implementation



COMMENTS:

- See General Comments.

GENERAL COMMENTS:

- COH is supportive of all suggested building scale strategies.

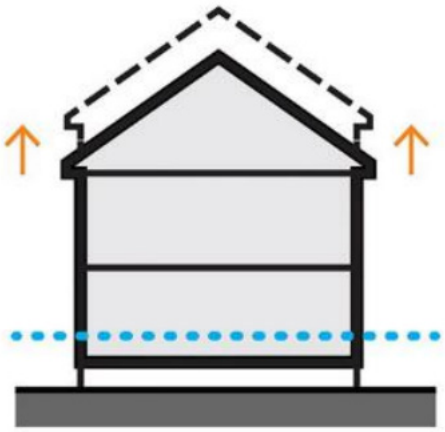
3: Technical Support & Education



COMMENTS:

- See General Comments.

4: Removing Regulatory Impediments



COMMENTS:

- See General Comments.

