SCAPE LANDSCAPE ARCHITECTURE DPC

HAYWARD REGIONAL SHORELINE MASTER PLAN
STAKEHOLDER WORKSHOP #2

OCTOBER 28, 2019

AGENDA

- Since we met last
- Where we are in the process
- Inundation Maps and Conclusions
- Project Goals
- Policy Considerations
- Adaptation Strategies
- Next Steps

SINCE WE MET LAST


THANKS FOR ATTENDING!

SINCE WE MET LAST

- **Completed the background report / Existing Conditions Document**

- **Completed the sea level rise and groundwater emergence maps update**

SITE VISITS

STAKEHOLDER MEETINGS

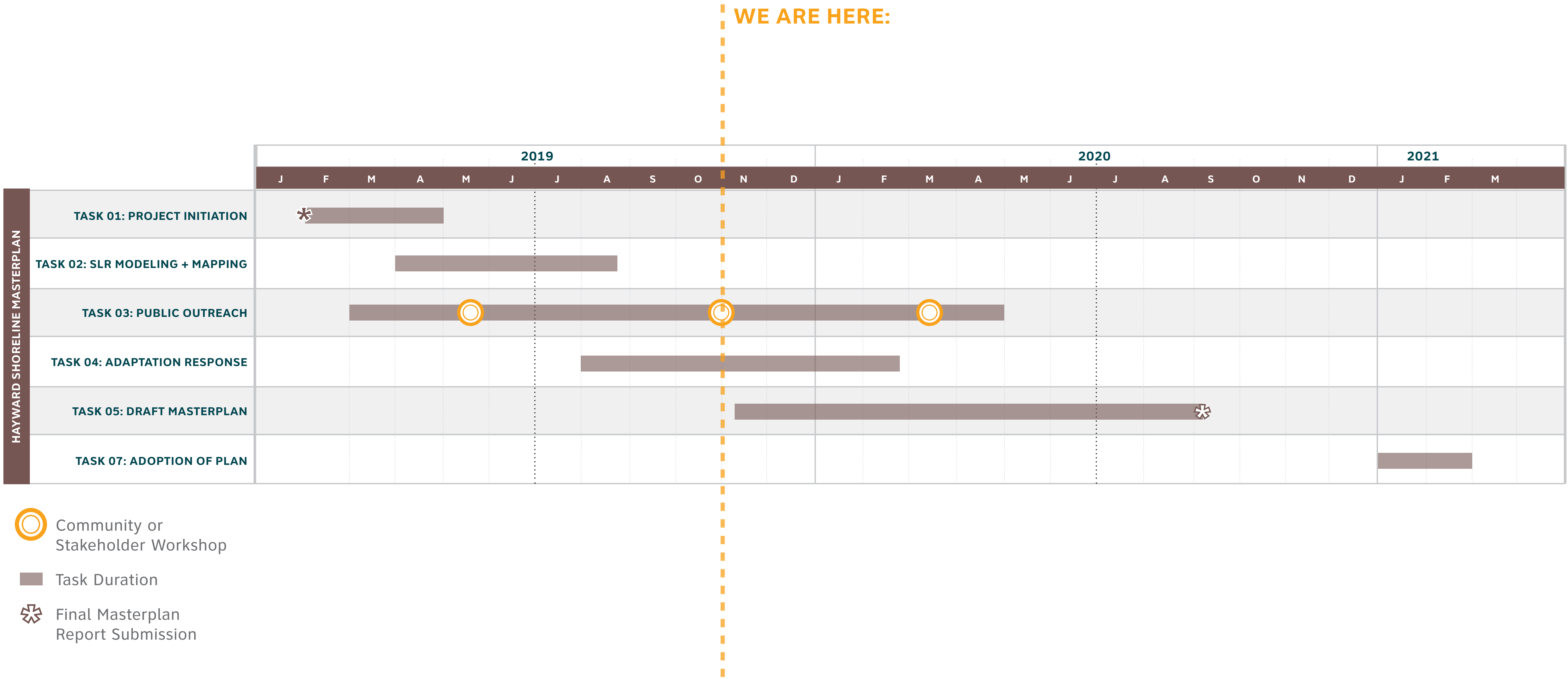
- Hayward Public Works
- Alameda County Flood Control District
- South Bay Salt Ponds
- SFEI
- Bay Trail
- BCDC
- Caltrans

TAC CHARRETTE

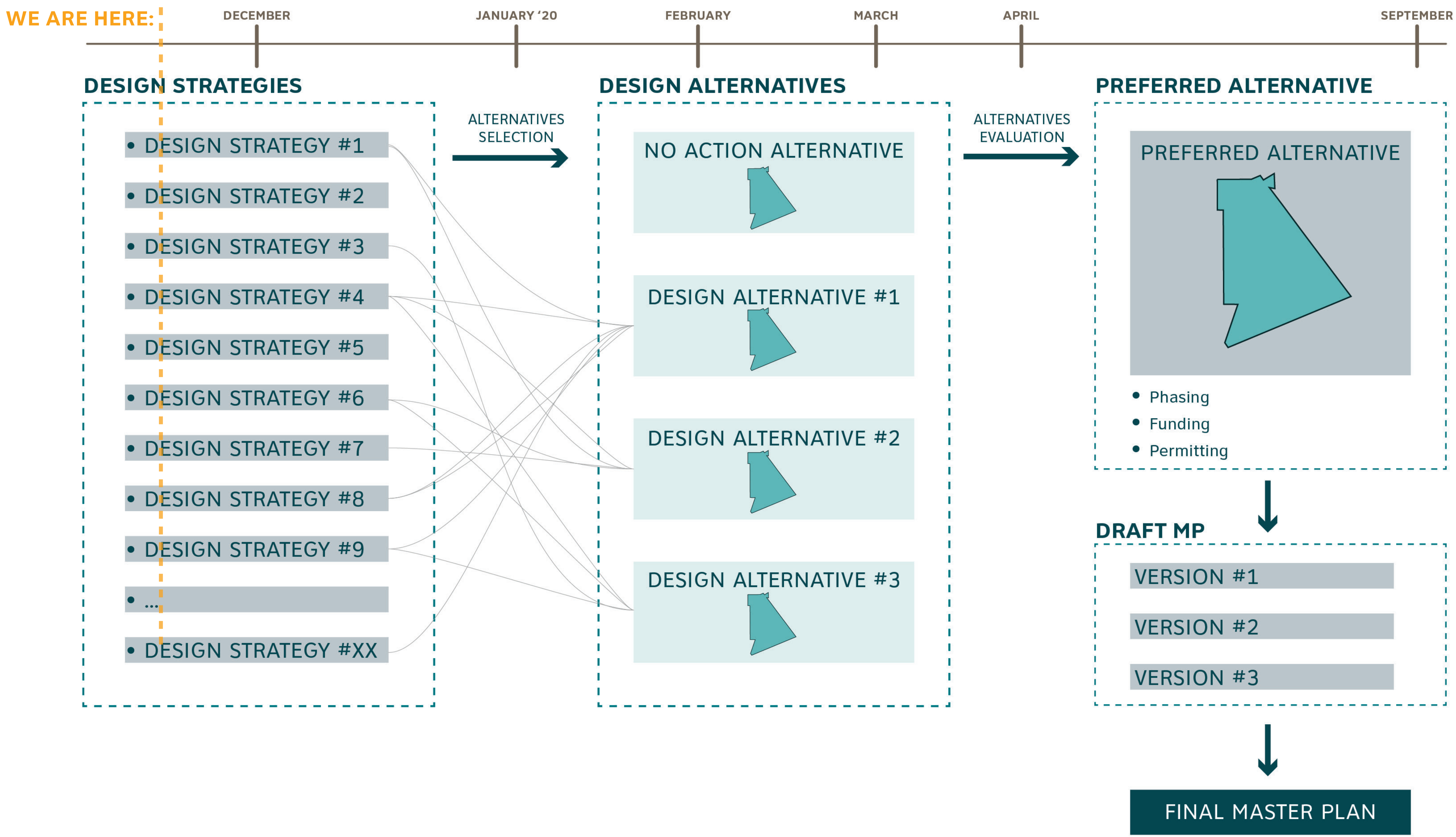

SHORE TOUR

WHERE WE ARE IN THE PROCESS

TIMELINE


WE ARE HERE:
2019
2020
2021
J F M A M J J A S O N D J F M A M J J A S O N D J F M
HAYWARD SHORELINE MASTERPLAN
TASK 01: PROJECT INITIATION
TASK 02: SLR MODELING + MAPPING
TASK 03: PUBLIC OUTREACH
TASK 04: ADAPTATION RESPONSE
TASK 05: DRAFT MASTERPLAN
TASK 07: ADOPTION OF PLAN
Community or Stakeholder Workshop
Task Duration
Final Masterplan Report Submission

NEXT STEPS

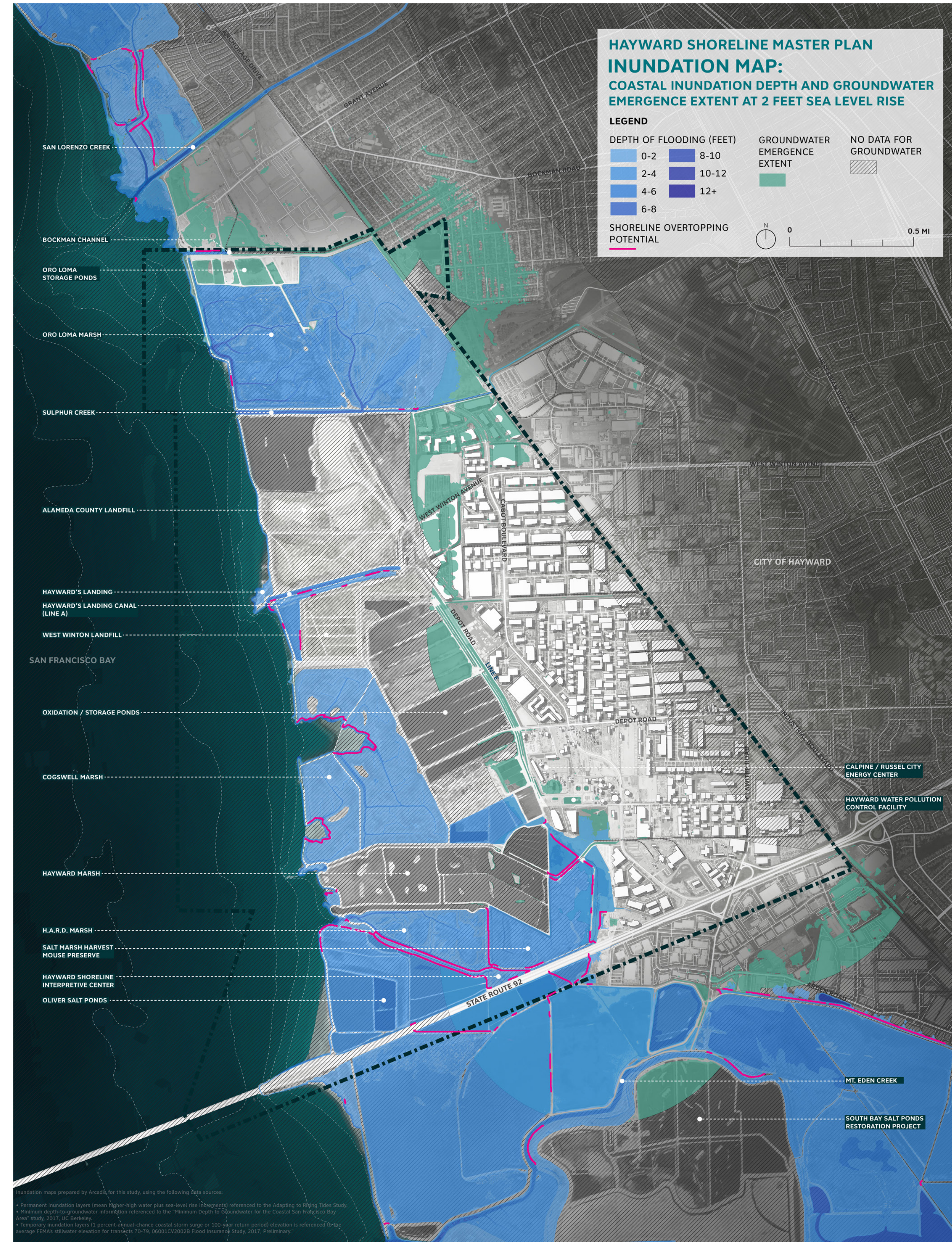

WE ARE HERE:
DECEMBER
JANUARY '20
FEBRUARY
MARCH
APRIL
SEPTEMBER
DESIGN STRATEGIES
DESIGN STRATEGY #1
DESIGN STRATEGY #2
DESIGN STRATEGY #3
DESIGN STRATEGY #4
DESIGN STRATEGY #5
DESIGN STRATEGY #6
DESIGN STRATEGY #7
DESIGN STRATEGY #8
DESIGN STRATEGY #9
...
DESIGN STRATEGY #XX
ALTERNATIVES SELECTION
DESIGN ALTERNATIVES
NO ACTION ALTERNATIVE
DESIGN ALTERNATIVE #1
DESIGN ALTERNATIVE #2
DESIGN ALTERNATIVE #3
ALTERNATIVES EVALUATION
PREFERRED ALTERNATIVE
PREFERRED ALTERNATIVE
Phasing
Funding
Permitting
DRAFT MP
VERSION #1
VERSION #2
VERSION #3
FINAL MASTER PLAN

INUNDATION MAPS

2’ SCENARIO

2’ SCENARIO
SLR AND GROUNDWATER

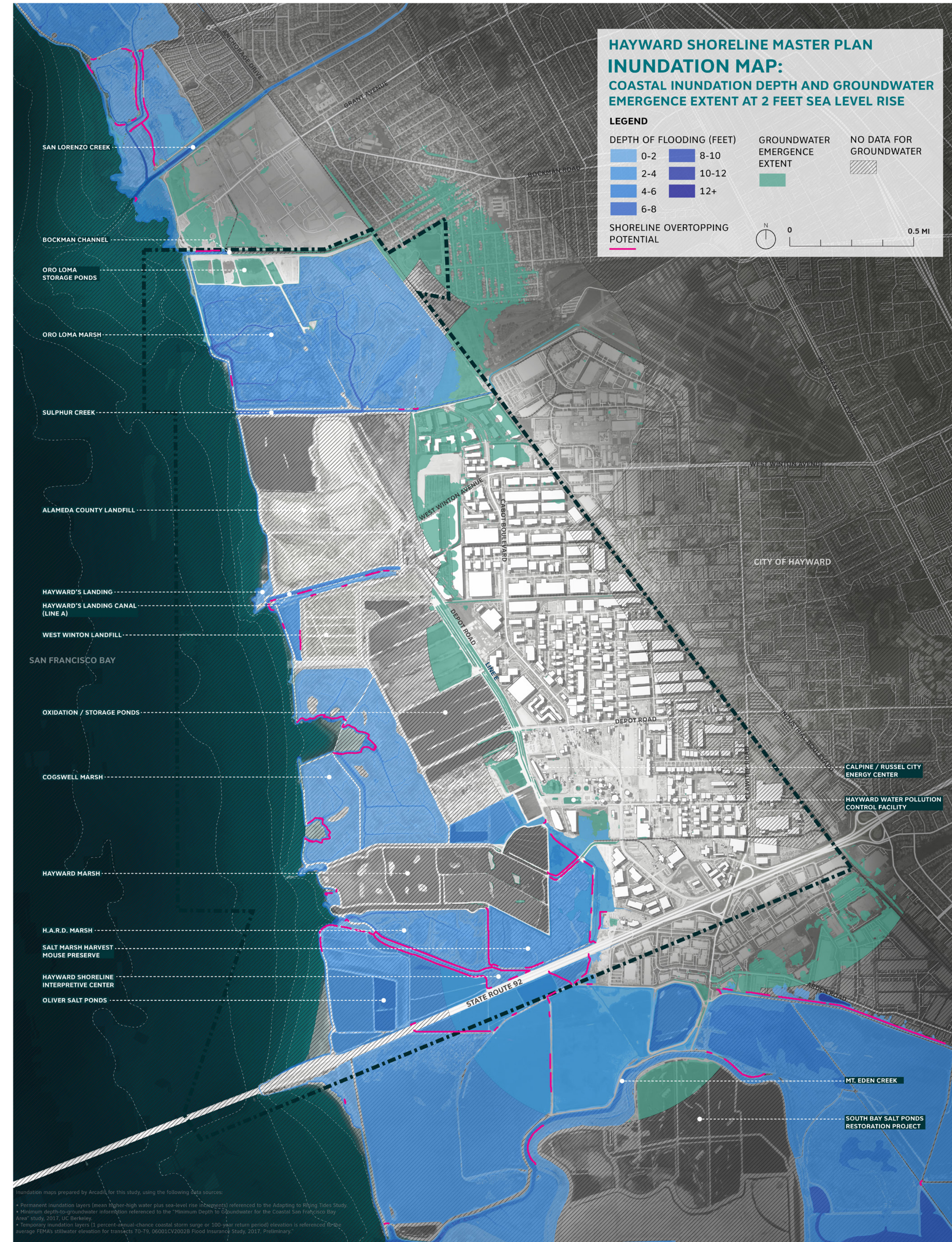
- Northern industrial neighborhoods are impacted by groundwater before SLR inundation.
- SLR impacts tidally influenced natural features and the Oliver Salt Ponds
- SLR impacts to recreational resources, include Bay Trail, Interpretive Center, and access points.
- Areas of groundwater emergence are roughly correlated with areas of 100-year flood risk.



2' SCENARIO

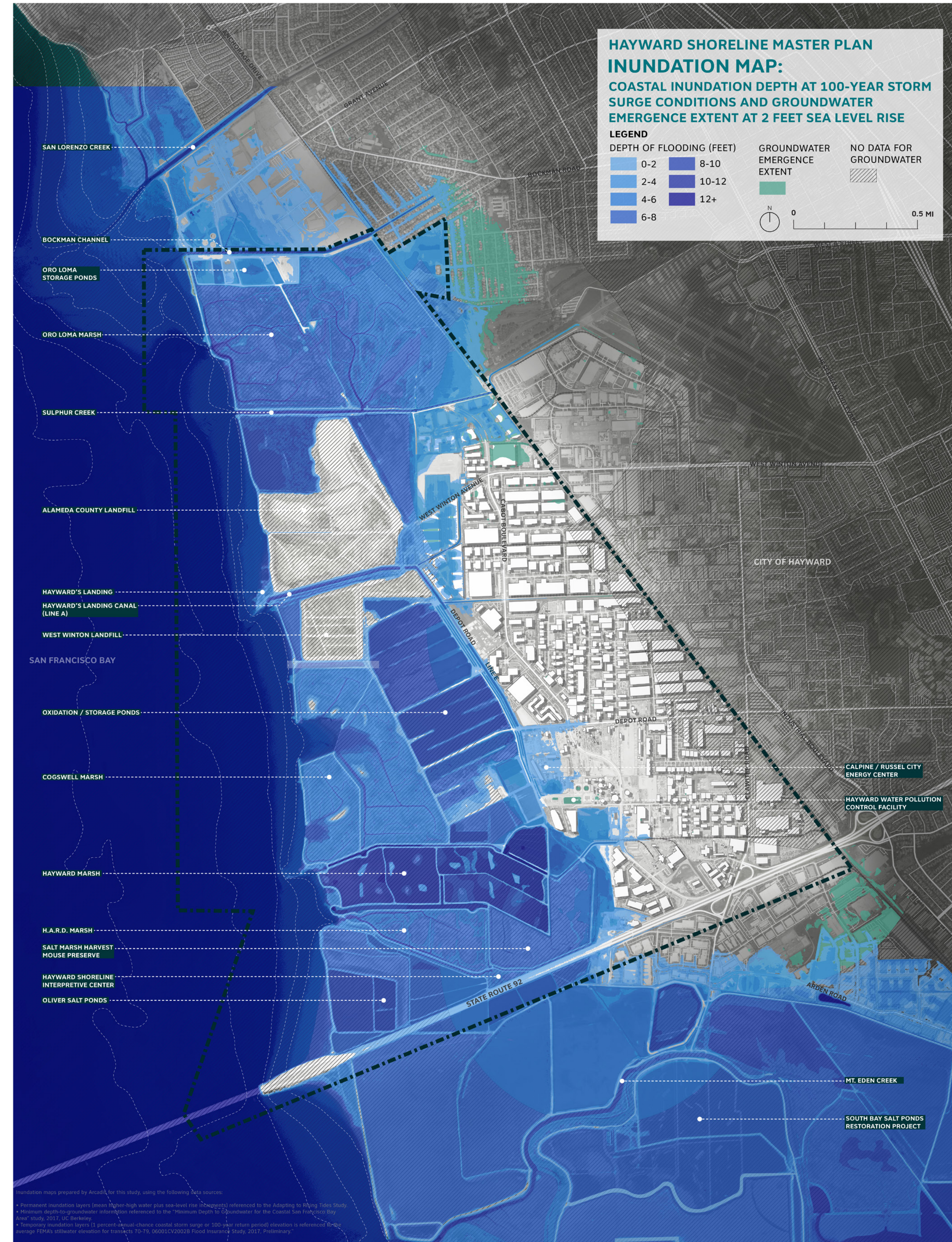
IMPACTED AREAS

- Potential to address SLR impacts with strategic infrastructure improvements.
- Areas impacted by SLR:
  - Oro Loma sludge storage areas
  - Tidally influenced natural features
  - Oliver Salt Ponds
  - West Winton Industrial Park
  - Limited impacts to Bay Trail
  - Access to Interpretive Center
  - Line A flood control channel
- Groundwater emergence impacts:
  - Oro Loma Wastewater Treatment Plant
  - Oxidation ponds
  - Calpine/Russell City Energy Center
  - Northern industrial neighborhoods
  - Line E flood control channel



2' SCENARIO

100 YEAR STORM + SLR AND GROUNDWATER



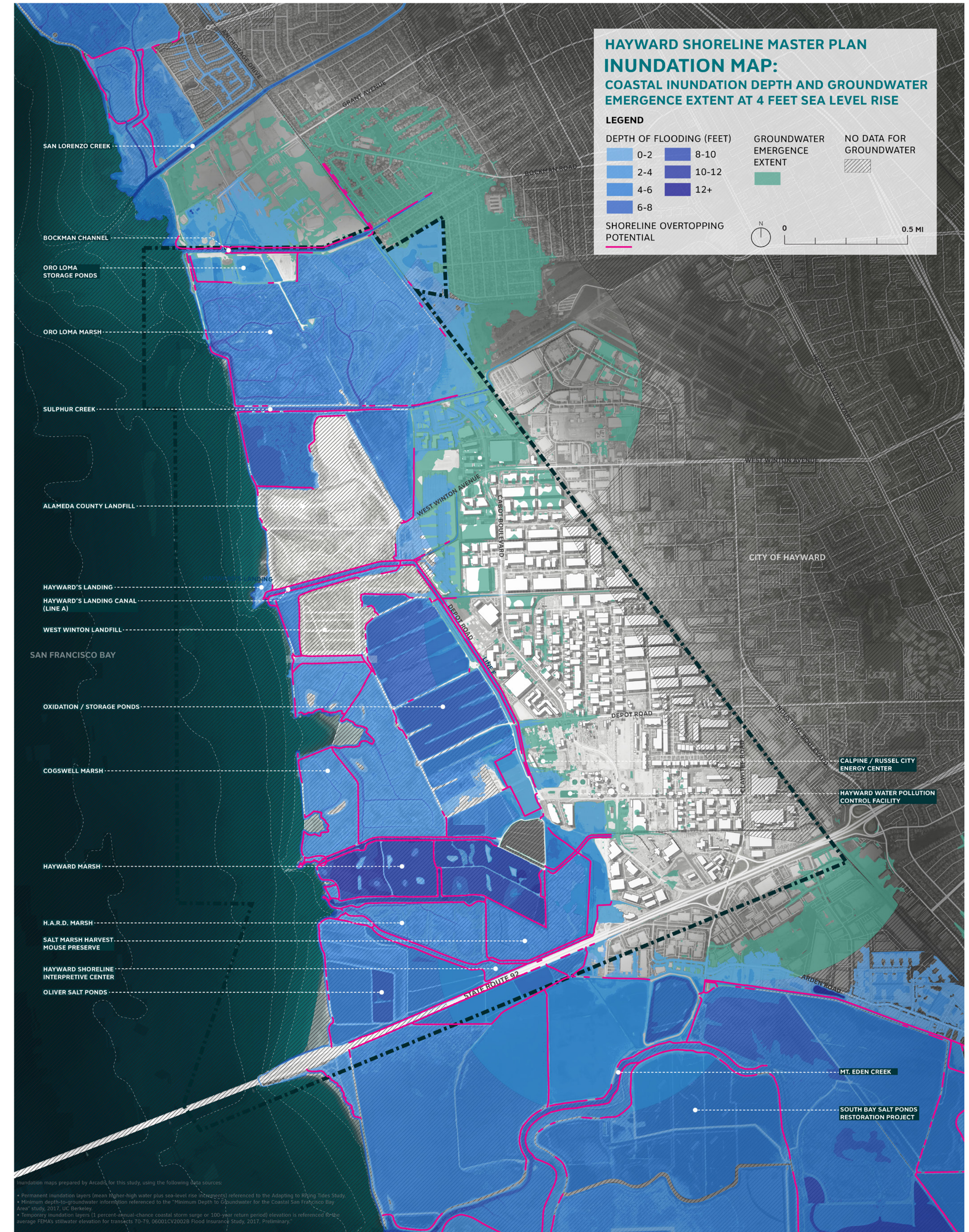
SCAPE

4’ SCENARIO

4’ SCENARIO

SLR AND GROUNDWATER

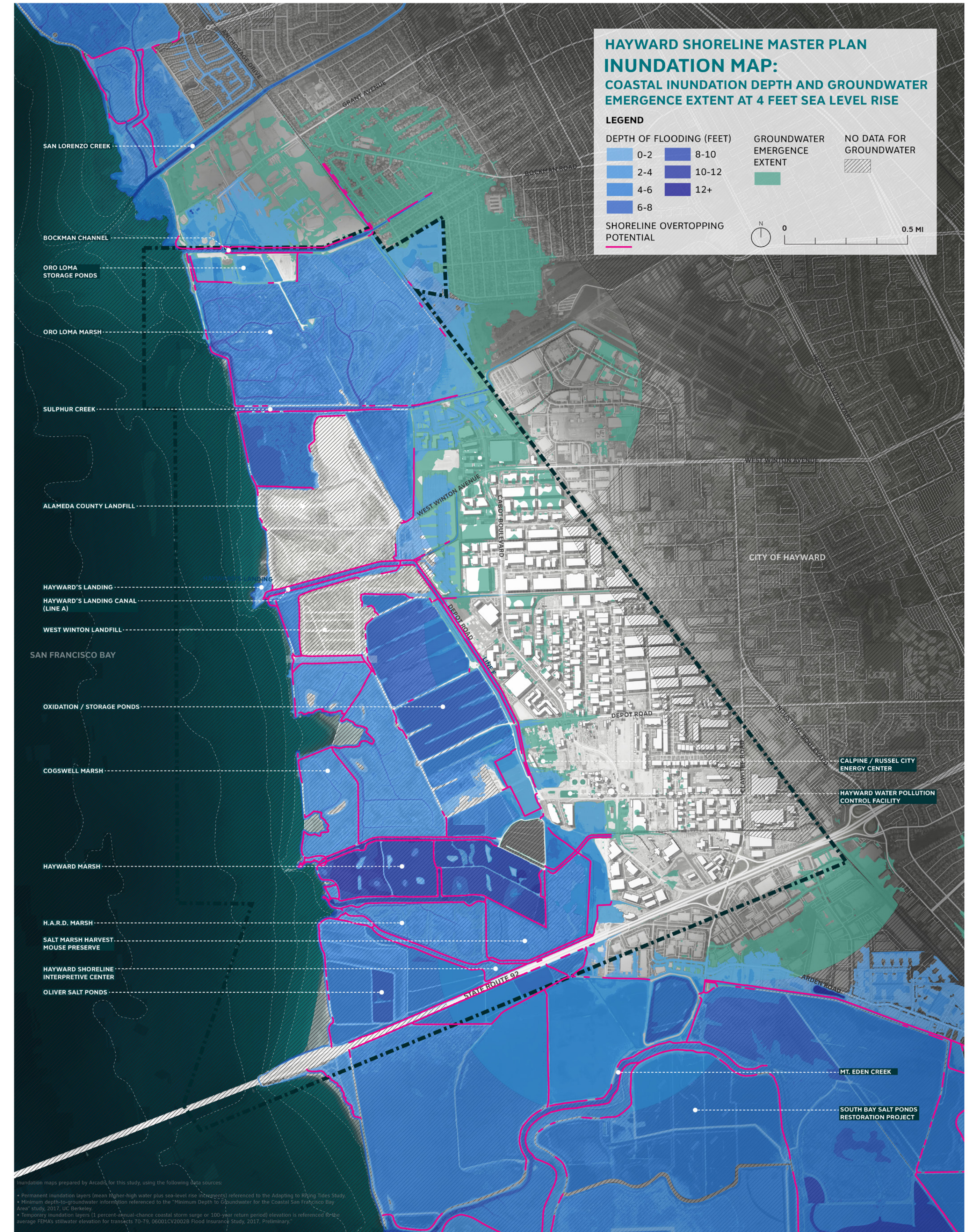
- Many areas impacted by groundwater with 2’ of SLR are now impacted by SLR.
- SLR directly impacts critical infrastructure (San Mateo, Oro Loma, railroad)
- Major SLR impacts to recreational resources include Bay Trail, Interpretive Center, and access points.
- Most natural features are impacted by SLR.
- Areas of groundwater emergence are roughly correlated with areas of 100-year flood risk.



4’ SCENARIO

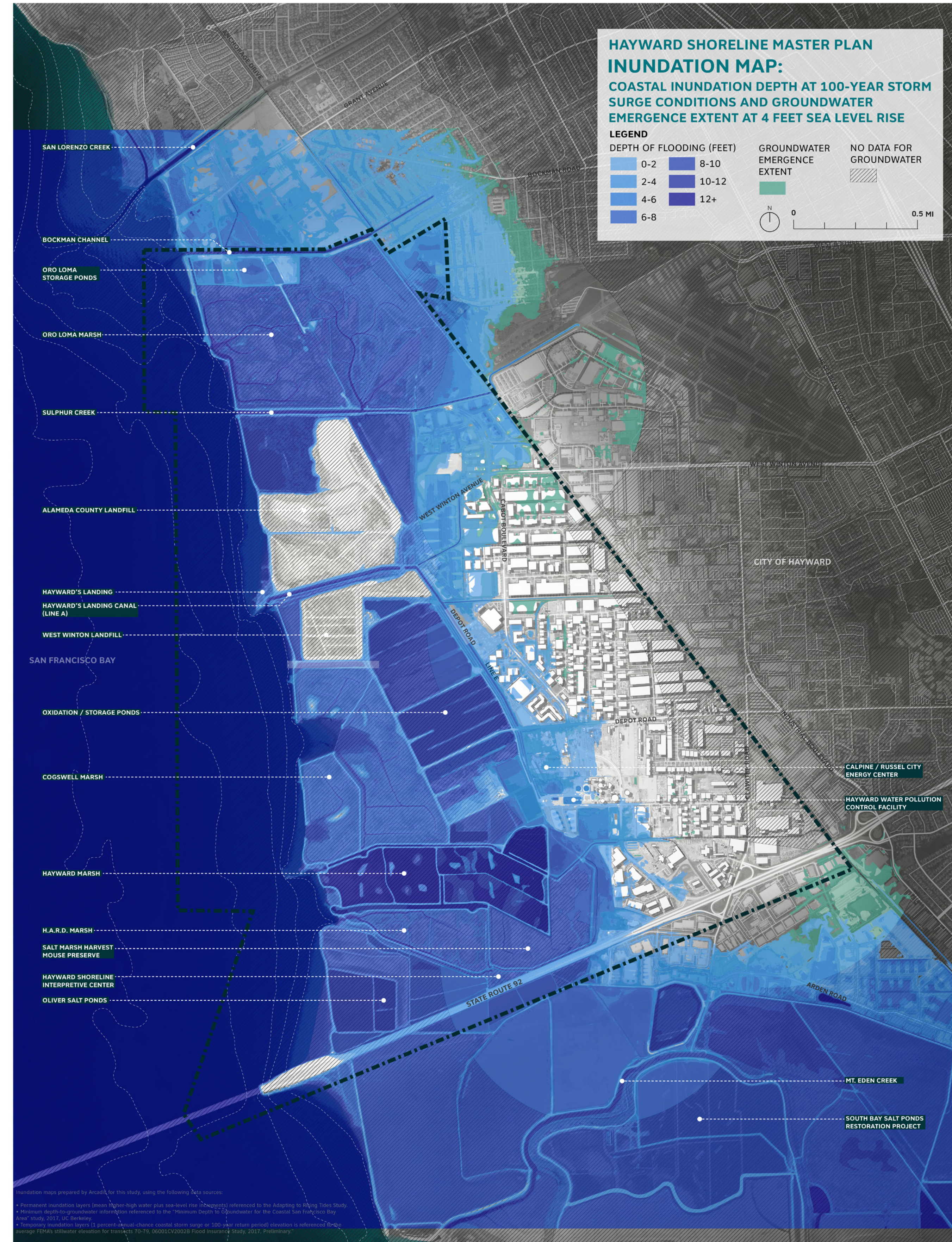
IMPACTED AREAS

- Additional Sea Level Rise Impacts:
  - Oro Loma Wastewater Treatment Plant
  - San Lorenzo Community Center Park
  - Oxidation Ponds
  - Bay Trail
  - San Mateo Bridge approach
- Overtopping contribution to inundation extent:
  - Interpretive Center Building
  - San Lorenzo Park
  - West Winston Industrial Park
  - Calpine/Russell City Energy Center
  - Railroad
  - Sulphur Creek (both sides)
- Additional Groundwater emergence impacts:
  - West Winton Industrial Park
  - Residential areas north of the study area



4' SCENARIO

100 YEAR STORM + SLR AND GROUNDWATER

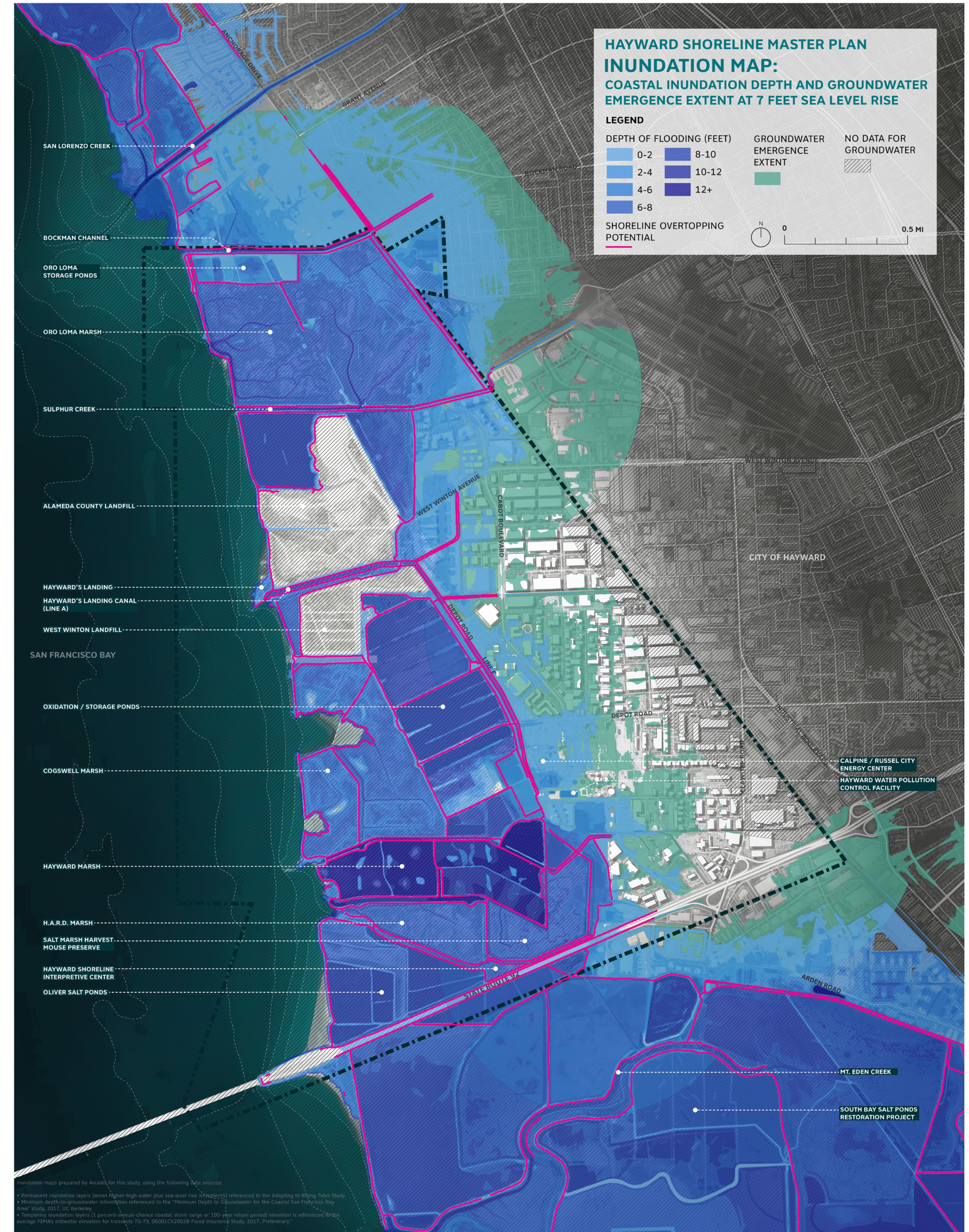


SCAPE

7’ SCENARIO

7′ SCENARIO
SLR AND GROUNDWATER

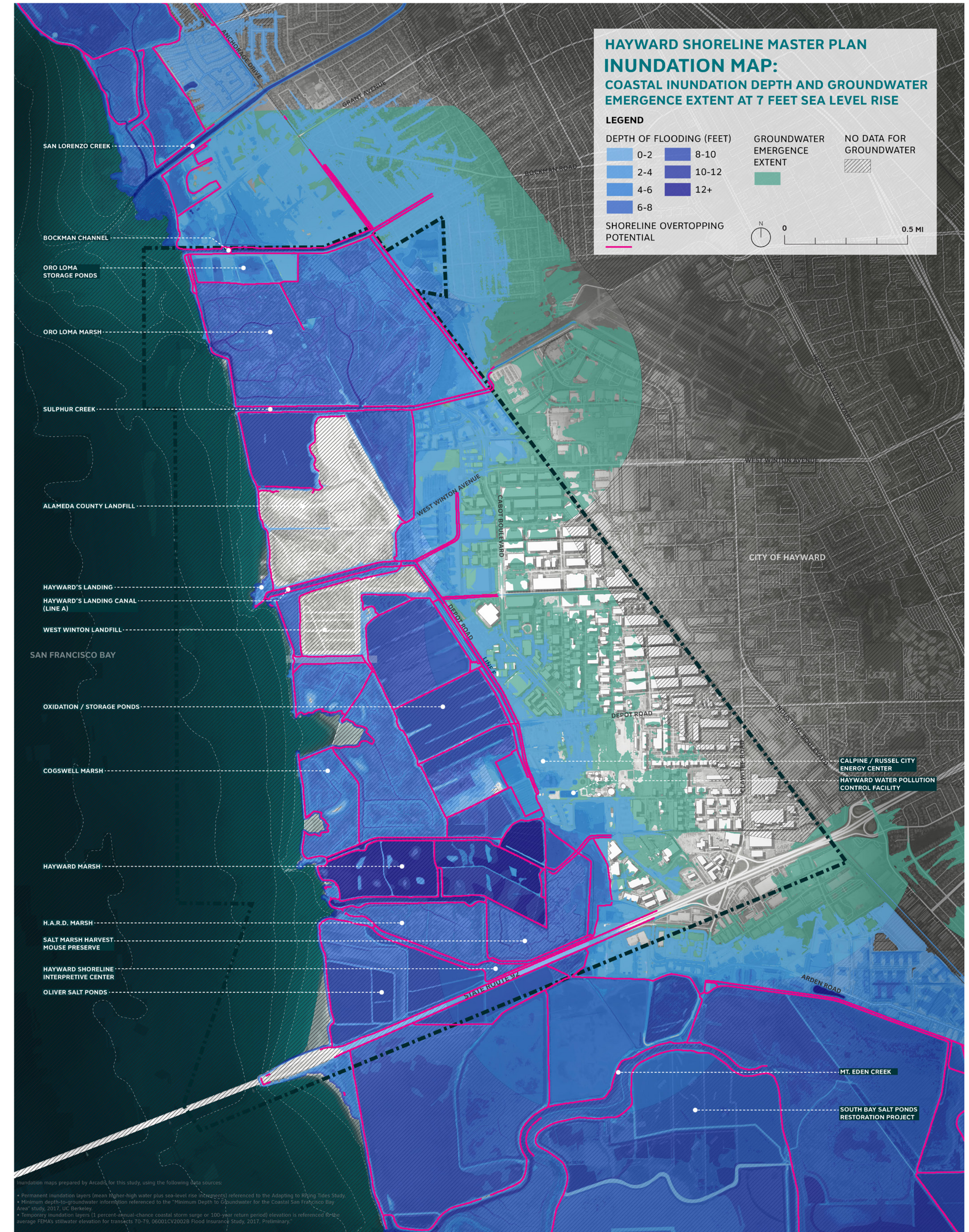
- Almost all critical infrastructure is impacted by SLR
- Major SLR and groundwater impacts to all industrial neighborhoods.
- All stormwater and flood control channels experience significant backups.
- All natural and recreational features experience severe SLR inundation.
- Areas of groundwater emergence are roughly correlated with areas of 100-year flood risk.



7' SCENARIO

IMPACTED AREAS

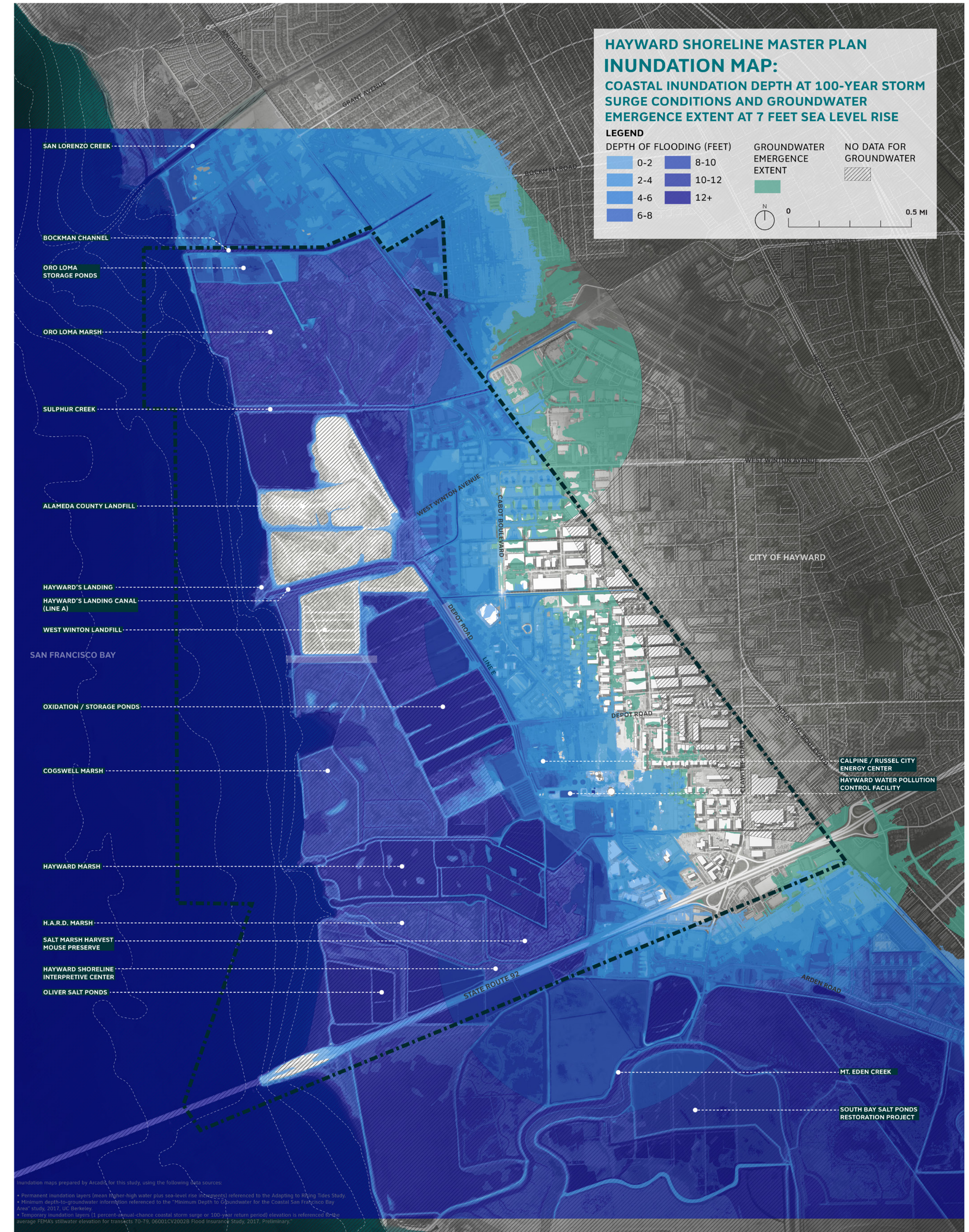
- Additional Sea Level Rise Impacts:
  - Route 92 and bridge approach significantly affected
  - Landfill perimeters inundated
  - Oro Loma Wastewater Treatment Plant
  - Some impacts to Hayward Wastewater Treatment Facility
  - Hayward Marsh
- Overtopping contribution to inundation extent:
  - Observed along most levees and embankments
  - Contributes to inundation on Route 92 brige approach
- Additional Groundwater emergence impacts:
  - Significant impacts to industrial area and neighborhoods
  - Hayward Executive Airport
  - Route 92 interchange



SCAPE

7’ SCENARIO

100 YEAR STORM + SLR AND GROUNDWATER



PROJECT GOALS

CREATE A RESILIENT SHORELINE 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 FROM CLIMATE CHANGE TO ENDANGERED SHORELINE SPECIES

ENHANCE THE SHORELINE ENVIRONMENT TO REDUCE RISK TO CRITICAL INFRASTRUCTURE

- 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 (SAN FRANCISCO BAY TRAIL AND MARSH RESTORATION PROJECTS)

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

KEY POLICY CONSIDERATIONS

- 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.

- There is an extensive permitting process and many regulatory requirements that will likely drive the implementation process.

- 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.

- Innovative approaches to shoreline access may be needed to allow for a full exploration of potential strategies.

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

POLICY MATRIX

AGENCY	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, AND GUIDANCE
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. • Work 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 for, 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. • Member of HASPA	• Owns and manages the HARD marsh, 79-acre, fully tidal marshes comprised of mudflats and low marsh habitats along the Hayward Shoreline, in addition 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, which features exhibits, programs, and activities designed to inspire a sense of appreciation, respect, and stewardship for the bay, its inhabitants, and services they provide.	• Regulations Governing Use of Parks, Recreation Areas, and Facilities[4]
East Bay Regional Park District (EBRPD)	• Regional park district managing 73 parks and over 124,000 acres of space and 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), Hayward Marsh (145-acre fresh and brackish water marsh, 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. EBRD plans to put out a bid for full design in the future. • Operates and manages the SF Bay Trail.	• 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	GENERAL ROLE(S) / MISSION	PLANNING & REGULATORY JURISDICTION / LAND OWNERSHIP RELEVANT TO STUDY AREA AND MASTER PLAN	RELEVANT REGULATIONS, PLANS, POLICIES, AND GUIDANCE
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 • Develops changes to the zoning code to implement land use plans	• General Plan Comprehensive Plan 2040 • Capital Improvement Budget[9] • Economic Development Strategic Plan[10] • Design Guidelines[11] • Neighborhood Plans[12] • 2016 Hayward Local Hazard Mitigation Plan[13]
San Francisco Bay Restoration Regulatory Integration Team (BRRIT)[14]	• Composed of staff from the six state and federal regulatory agencies with jurisdiction over wetlands 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[15]
California Environmental Quality Act (CEQA)	• Broad environmental law with a 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 elevate 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[16]

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

ADAPTATION STRATEGIES & TODAY'S WORKSHOP

ADAPTATION STRATEGIES

- Nature-based strategies
- Engineered strategies
- Non-structural / Policy Strategies

TAC CHARRETTE

APPROACH

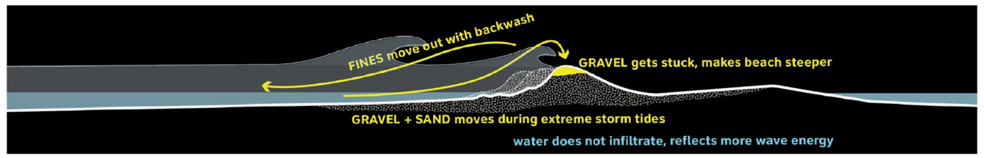
- We are not here to defend any of the adaptation strategies
- The adaptation strategies are intended to spur a discussion
- We need your feedback to inform the strategy selection!

NATURE-BASED STRATEGIES

FINE AND COARSE GRAIN BEACHES

DESIGN STRATEGY REFINEMENT

DESCRIPTION. Coarse or composite estuarine beaches are dynamic features that can 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. They can be placed in front of levees, roads or other vulnerable infrastructure to reduce erosion. Many beaches have habitat benefits to shorebirds.



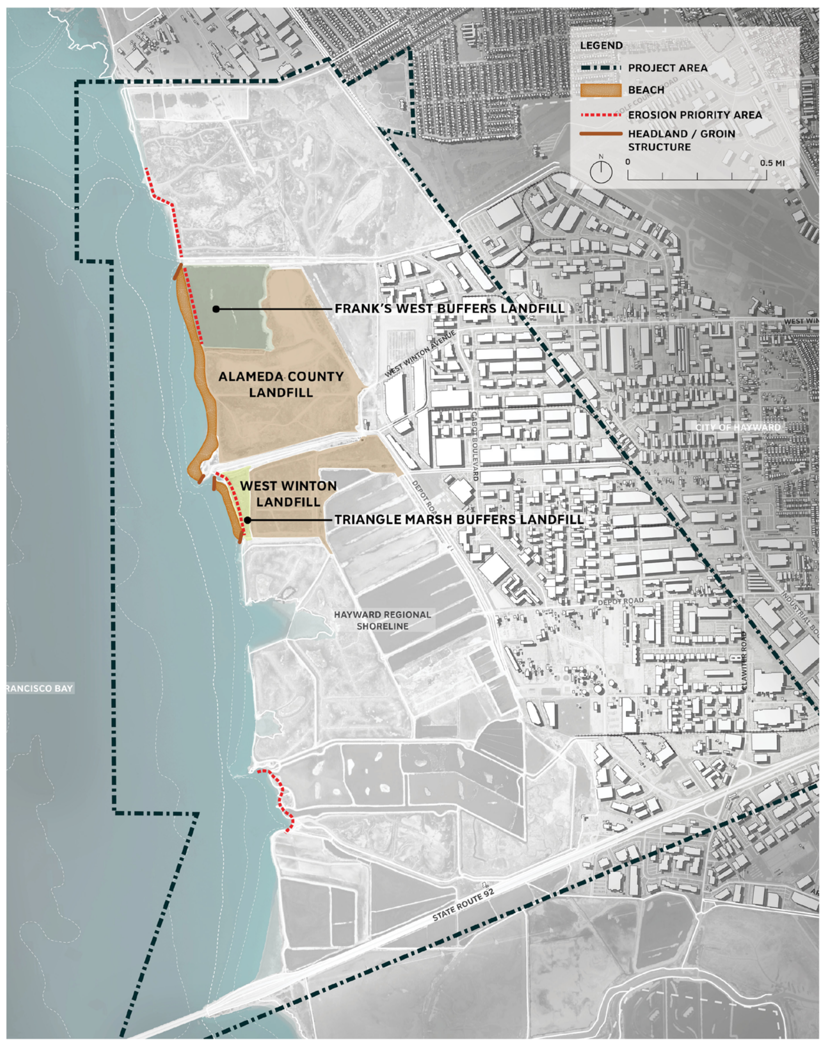
SECTION: Mixed gravel beach, Public Sediment

PRECEDENT: Foster City shell hash beach

PRECEDENT: Arambaru Island Enhancement Project

OPTION 1 BEACHES IN FRONT OF LANDFILLS

ON THE BAY SIDE OF OUTBOARD LEVEES OR BERMS



PROS

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

CONS

- May require artificial replenishment
- Considered fill- permitting challenge

OPTION 2 BEACHES IN FRONT OF EXISTING MARSHES

ON THE BAY SIDE OF ALL MARSH BERMS OR LEVEES

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
- Considered fill- permitting challenge

OPTION 3 BEACHES ALONG ENTIRE SHORELINE

ON THE BAY SIDE OF ALL SHORELINE BERMS OR LEVEES

PROS

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

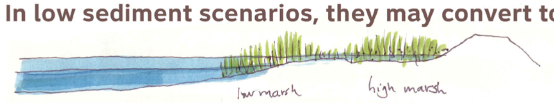
CONS

- May require artificial replenishment- long-term cost
- Could require a lot of material- high initial cost
- Could require multiple groins to hold beaches between channels
- Considered fill- permitting challenge

TIDAL MARSH RESTORATION

DESIGN STRATEGY REFINEMENT

DESCRIPTION. Protecting, maintaining, and restoring tidal marshes and their associated mudflats is critical to maintain flood control and ecosystem services with climate change. 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.



SKETCH: Bay edge marsh

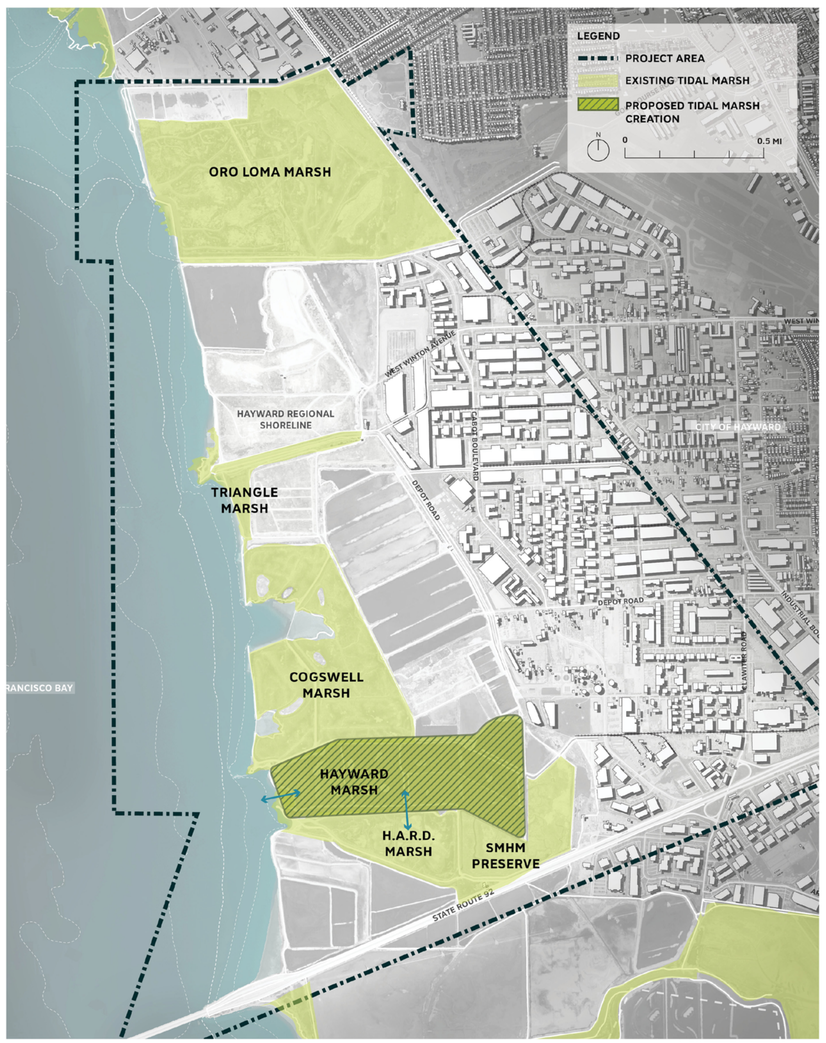
SKETCH: Marsh in diked pond

PRECEDENT: Bair Island Wetland Restoration

PRECEDENT: Sears Point Wetland Restoration

OPTION 1 HAYWARD MARSH RESTORATION

MOST NEAR-TERM PROJECT



PROS

- Hayward marsh is already planned

CONS

- If hayward marsh is restored as a muted marsh, it may not accrete as much sediment as a fully tidal system

OPTION 2 RESTORE BAY-SIDE PONDS TO TIDAL MARSH

PROS

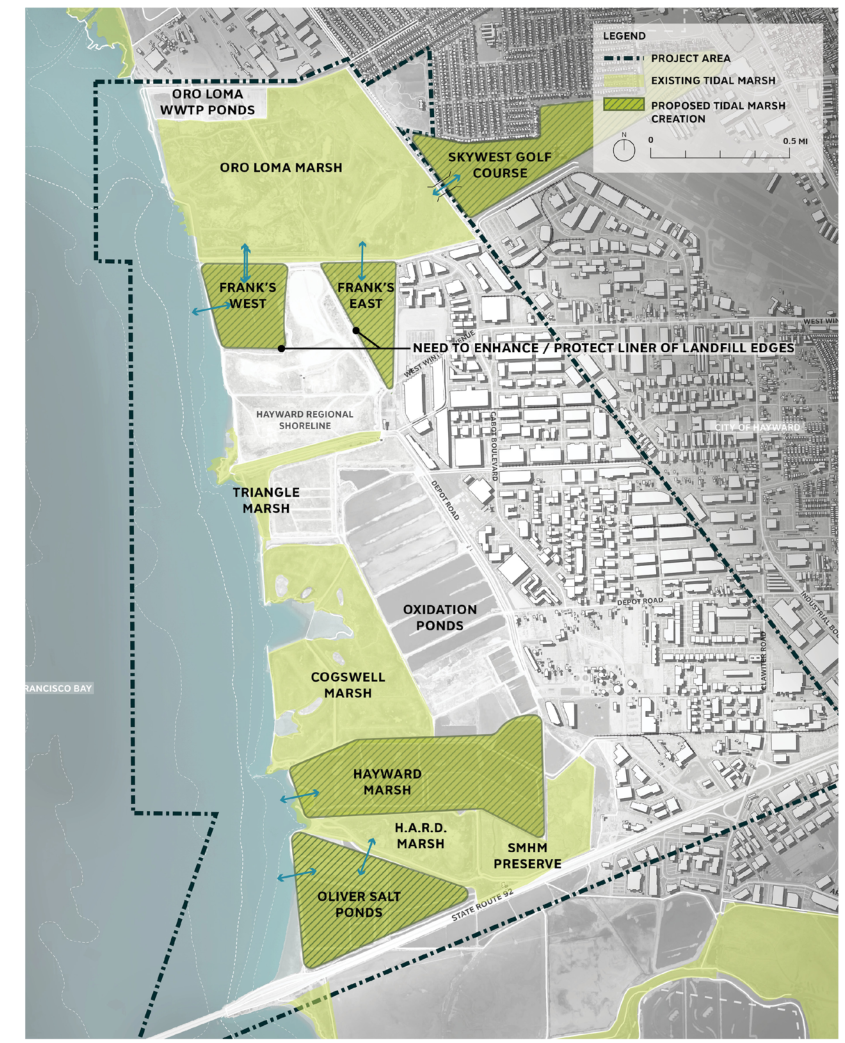
- Marshes at bay edge may be able to accrete more sediment (from bay and fluvial sources)
- Pair with fine sediment augmentation to adapt marshes with slr
- Frank's east and west could help buffer landfill against erosion

CONS

- Lose existing salt pond shorebird habitat- impacts endangered species habitat

OPTION 3 RESTORE ALL DIKED PONDS

MAXIMUM RESTORATION



PROS

- Increased marsh buffer to reduce erosion and buffer shoreline
- Increased habitat benefits
- Larger tracts of connected marsh

CONS

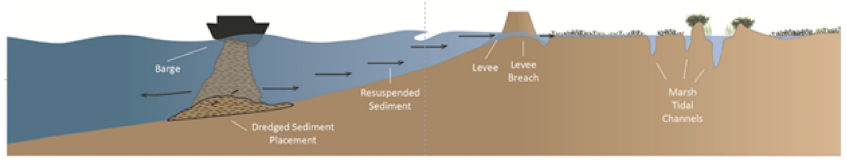
- Lose stormwater detention storage space
- Removes oxidation ponds and uses
- Lose existing salt pond shorebird habitat- impacts endangered species habitat
- Lose oro loma sludge ponds

FINE SEDIMENT AUGMENTATION

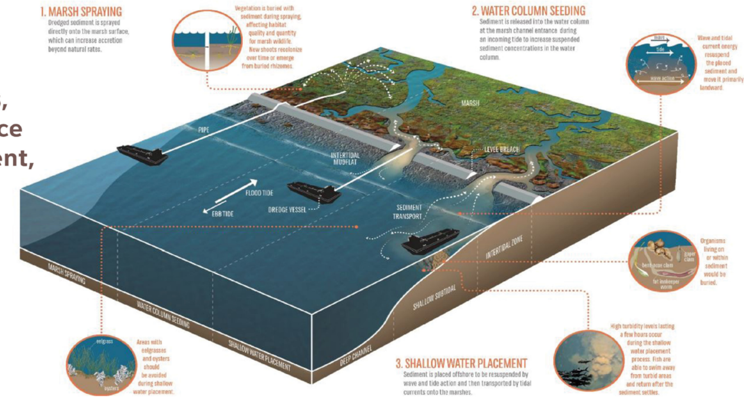
DESIGN STRATEGY REFINEMENT

DESCRIPTION. The direct or indirect placement of fine sediments to increase mudflat elevation relative to the tides. This can help protect and sustain marshes, mudflats, and shorelines when sediment 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

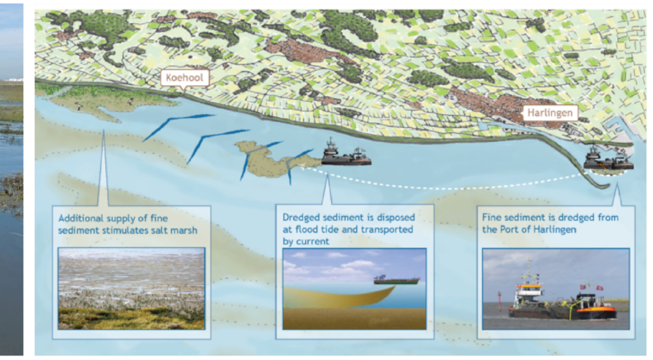


SECTION: Shallow Water Placement
Source: USACE Strategic Placement Report



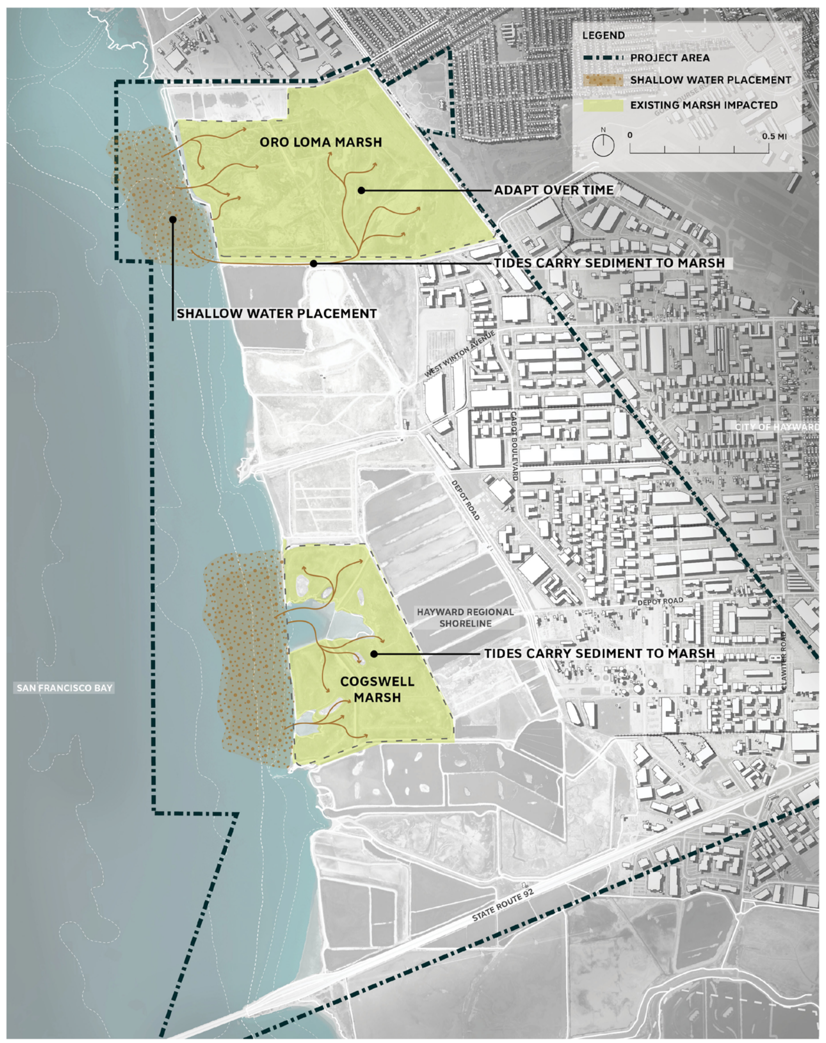
AXON: Mudflat Augmentation Strategies
Source: SFEI, Stantec

PRECEDENT: Seal Beach Sediment Augmentation Project, CA



PRECEDENT: The Mud Motor, Netherlands

OPTION 1 FEED FROM THE BAY



PROS

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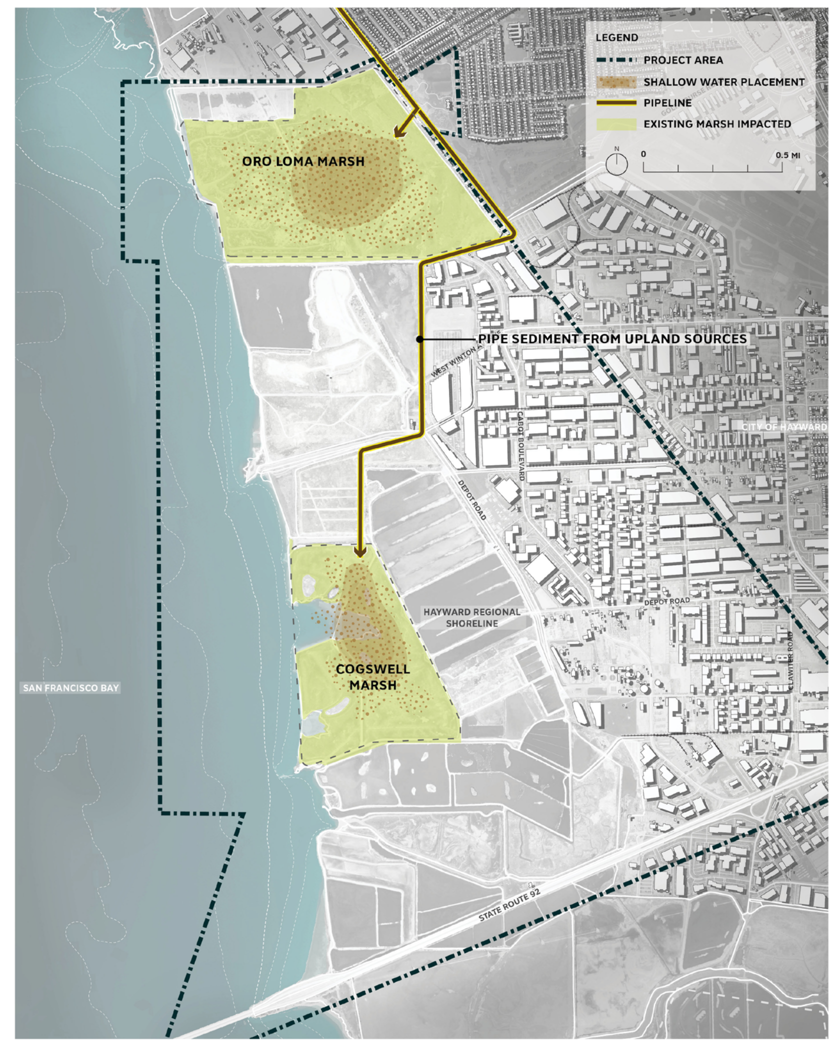
CONS

- Filling the bay- regulatory challenge
- Does not help smaller marshes
- Hard to get material to the mudflat because it is so shallow
- Many unknowns about sediment transport and retention
- Potential negative impacts to existing habitat
-

OPTION 2 NOURISH FROM AN UPLAND PIPELINE



PROS

- Set up infrastructure for sludge delivery over time
- Utilize upland sediment sources
-
-
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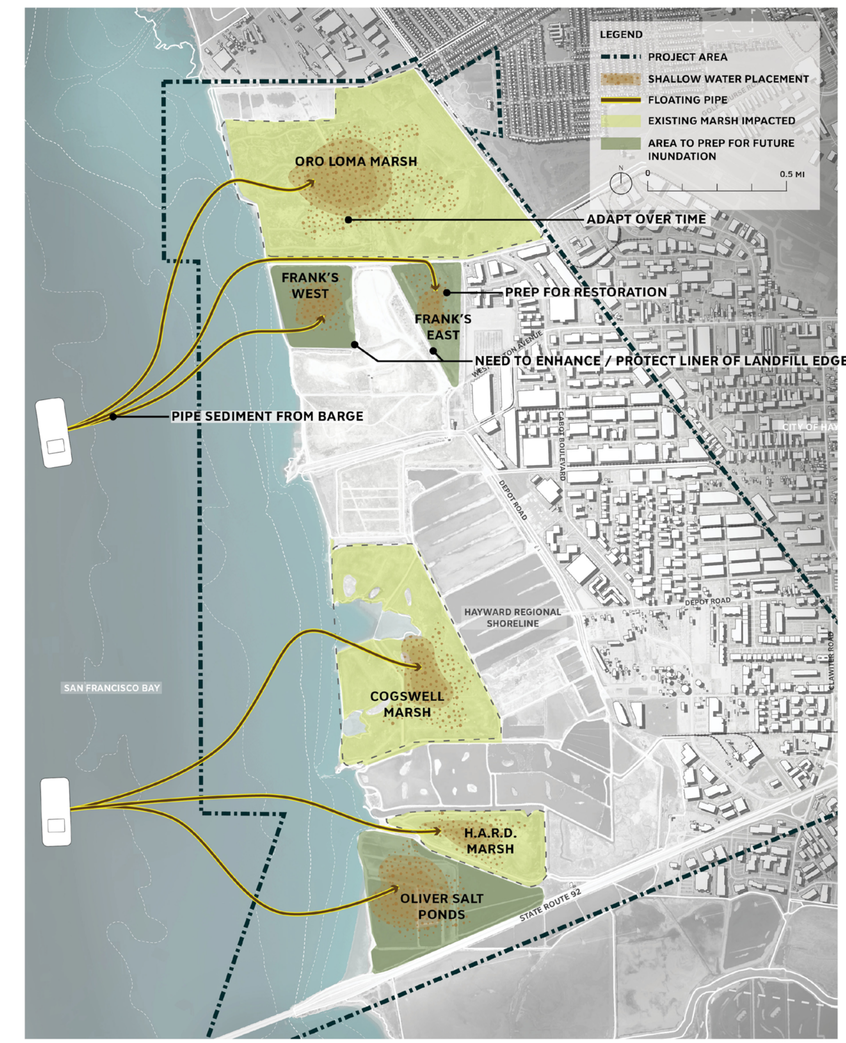
-

CONS

- Filling the bay- regulatory challenge
- Does not help smaller marshes
- Hard to get material to the mudflat because it is so shallow
- Pipeline infrastructure could be costly
- Many unknowns about sediment transport and retention
- Potential negative impacts to existing habitat
-

OPTION 3 BAY SEDIMENT PIPE



PROS

- Proactive approach to prep diked baylands for marsh restoration
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-
-

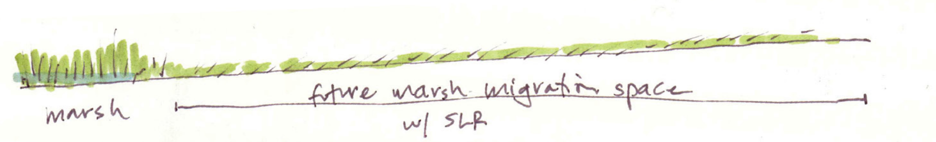
CONS

- Spraying existing marshes disrupts endangered species habitat
- Many unknowns about sediment transport and retention
- Potential negative impacts to existing habitat
-
-
-

MARSH AND MUDFLAT MIGRATION PLANNING

DESIGN STRATEGY REFINEMENT

DESCRIPTION. 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.



SKETCH: section of migration space

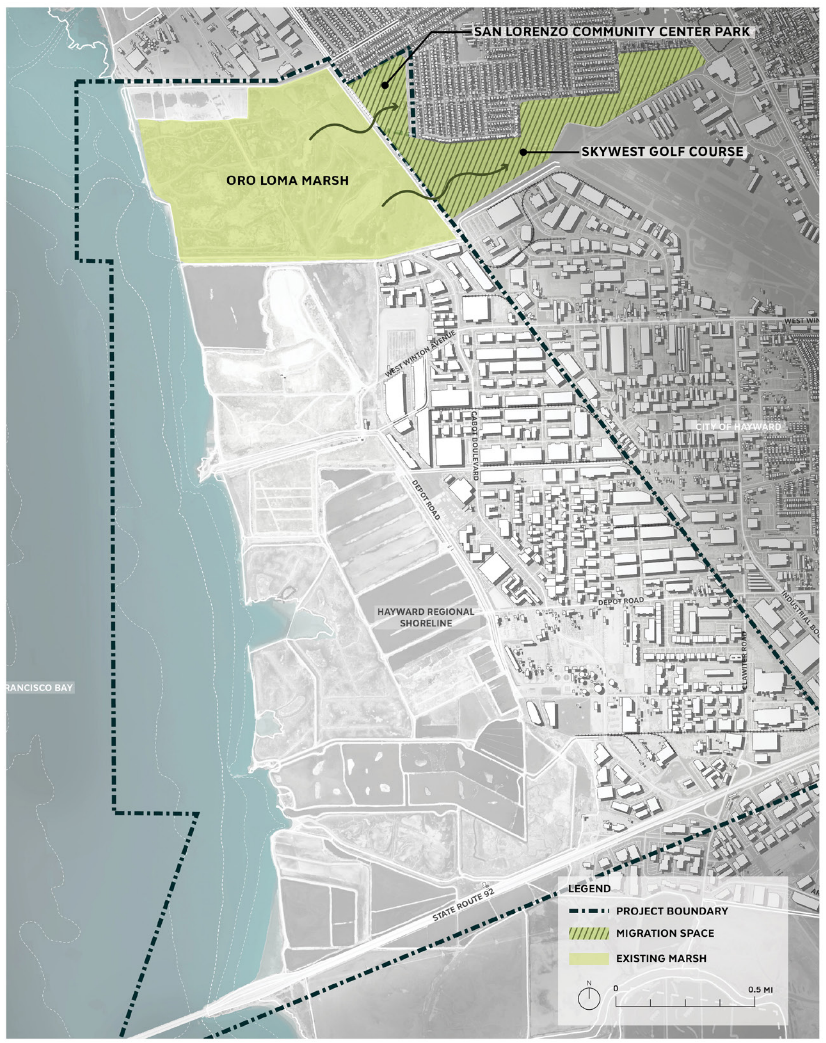
PRECEDENT: North Richmond Shoreline Vision

Hayward Shoreline Mudflat

Hayward Shoreline Marsh

OPTION 1 ORO LOMA MARSH MIGRATION

ALLOW ORO LOMA TO MIGRATE OVER TIME



PROS

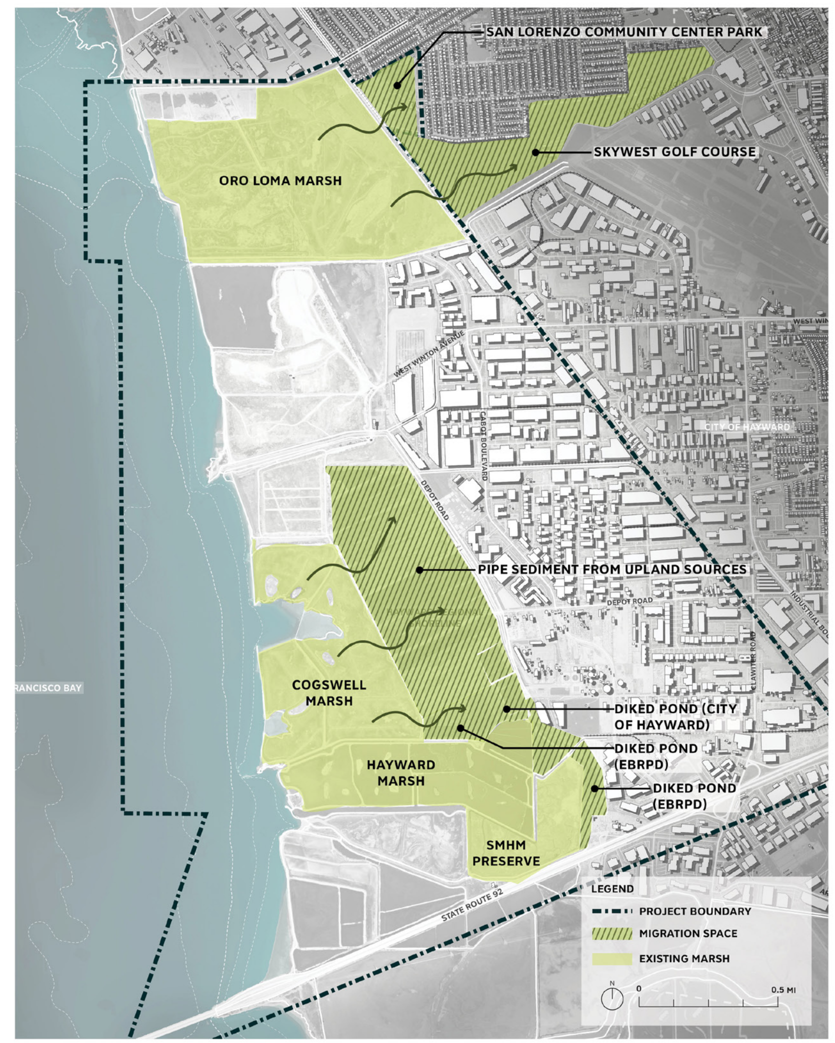
- Large space for migration
- Connect new recreation space to adjacent community
-
-
-
-
-

CONS

- Need to cross railroad through culverts
- Land could require significant prep to facilitate migration- disrupt current uses
-
-
-
-
-

OPTION 2 LARGER MIGRATION POTENTIAL

PRIORITIZE MIGRATION OF EXISTING LARGE MARSHES



PROS

- Two large migration spaces
-
-
-
-

CONS

- Lose stormwater detention capacity at oxidation ponds
- Land could require significant prep to facilitate migration- disrupt current uses
-
-
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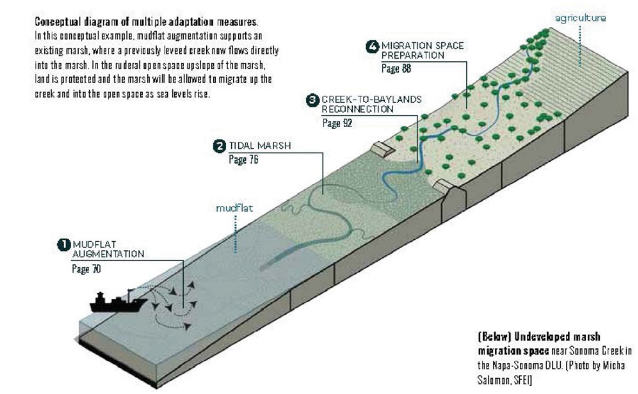
-



AXON: SFEI Adaptation Atlas

PRECEDENT: Undeveloped marsh migration space along Tolay Creek
Source: SFEI, Julie Beagle

PRECEDENT: Undeveloped marsh migration space near Sonoma Creek
Source: SFEI, Micha Salomon

PRECEDENT: Rush Ranch grasslands act as migration space preparation

DIKED POND MANAGEMENT

DESIGN STRATEGY REFINEMENT

DESCRIPTION. Diked baylands are managed as flood retention basins or habitat, and are also used for transmission lines, rail lines, wastewater lines, and other infrastructure. The 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 flood water storage from precipitation-based floods, and/or store groundwater pumped from urban areas. Salt ponds provide critical habitat to endangered species.

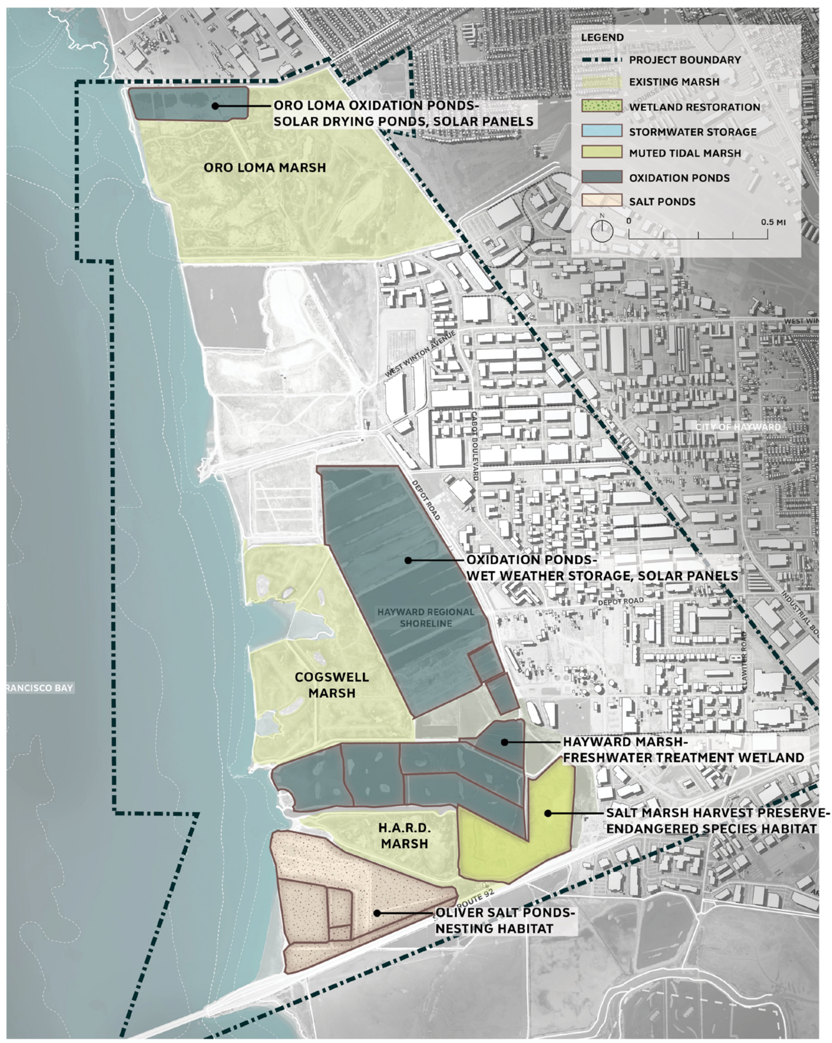
Oliver Salt Ponds, 2019

Frank's East, 2019

Skywest Golf Course, 2017

OPTION 1 NO ACTION

MAINTAIN DIKED PONDS AND THEIR CURRENT USES



PROS

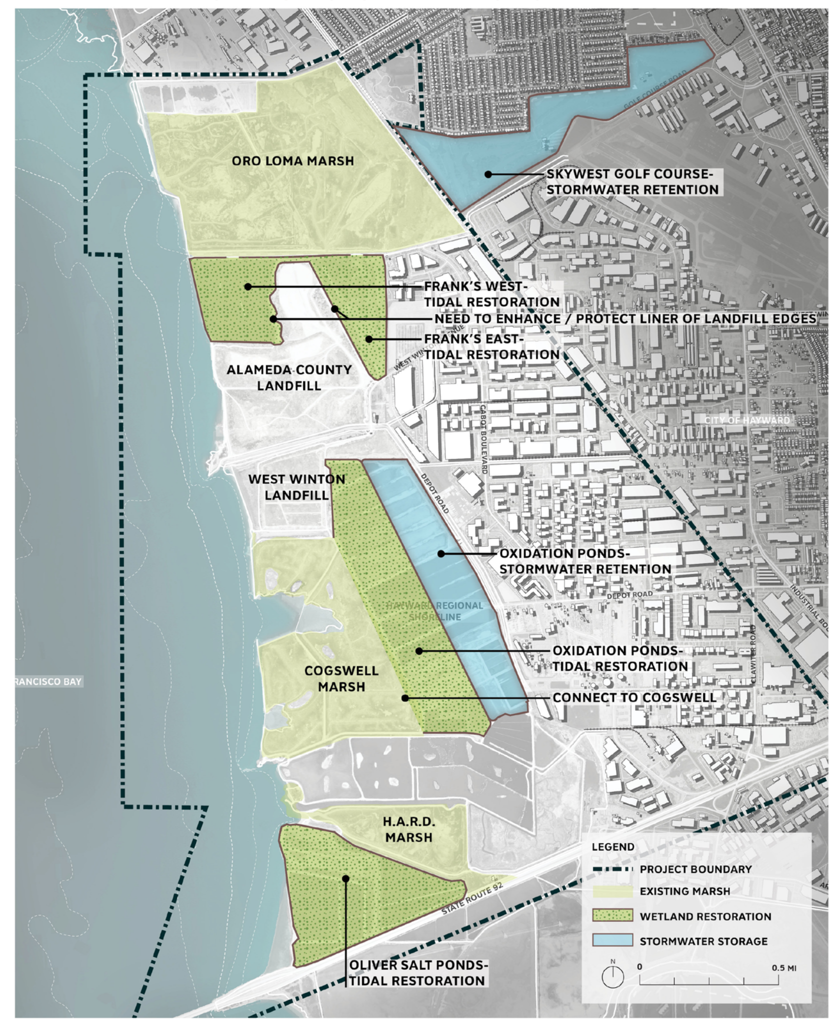
- Maintain current uses and stormwater storage capacity
-
-
-
-
-

CONS

- Costly long-term to maintain uses with sea level rise
-
-
-
-
-
-

OPTION 2 TIDAL RESTORATION + STORMWATER MANAGEMENT

USE INLAND PONDS FOR STORMWATER MANAGEMENT AND RESTORE BAYSIDE PONDS TO TIDAL MARSHES



PROS

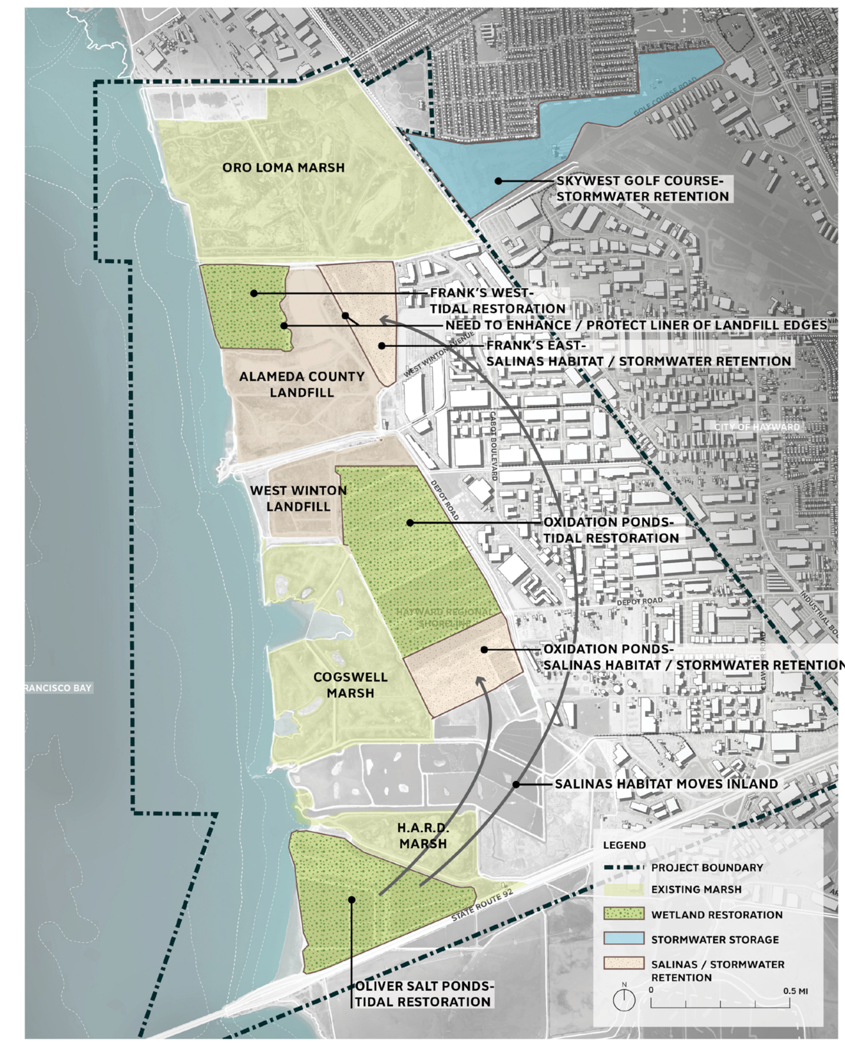
- Increase stormwater detention capacity
- New marsh restoration
- New marshes at bay edge, may accrete and sustain with SLR
-
-
-
-

CONS

- Disrupt shorebird habitat at salt ponds
-
-
-
-
-

OPTION 3 SALINAS SWAP

RESTORE SALINAS INLAND, DOUBLE AS STORMWATER DETENTION



PROS

- Maintain salinas habitat, move inland so it's less vulnerable to sea level rise
-
-
-
-
-

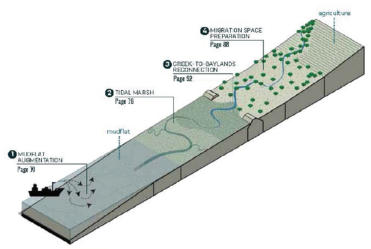
CONS

- Lose existing oxidation pond uses
-
-
-
-
-

TRIBUTARY CONNECTION TO BAYLANDS

DESIGN STRATEGY REFINEMENT

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

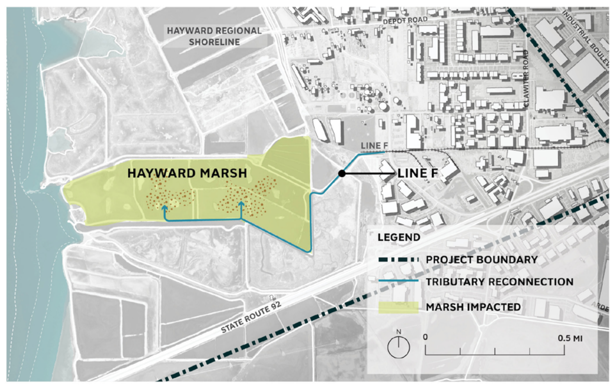


AXON: SFEI Adaptation Atlas

PRECEDENT: Lower Walnut Creek Restoration Project

Bockman Channel, 2019

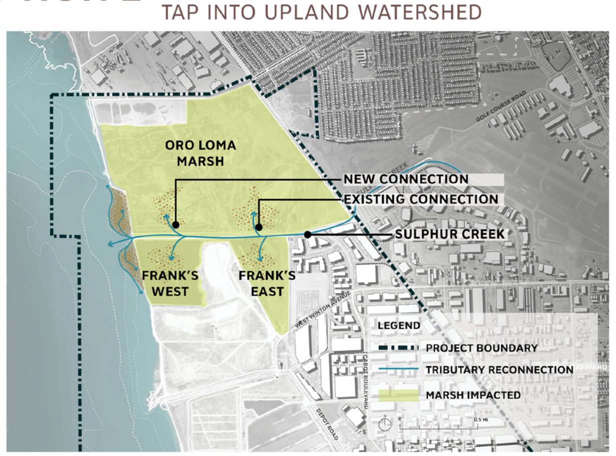
OPTION 1 LINE F
FEED HAYWARD MARSH



PROS
- Slready under consideration with hayward marsh restoration
- help restore salinity gradient
-
-
-
-

CONS
- May not be a large source of sediment for marsh nourishment
-
-
-
-
-

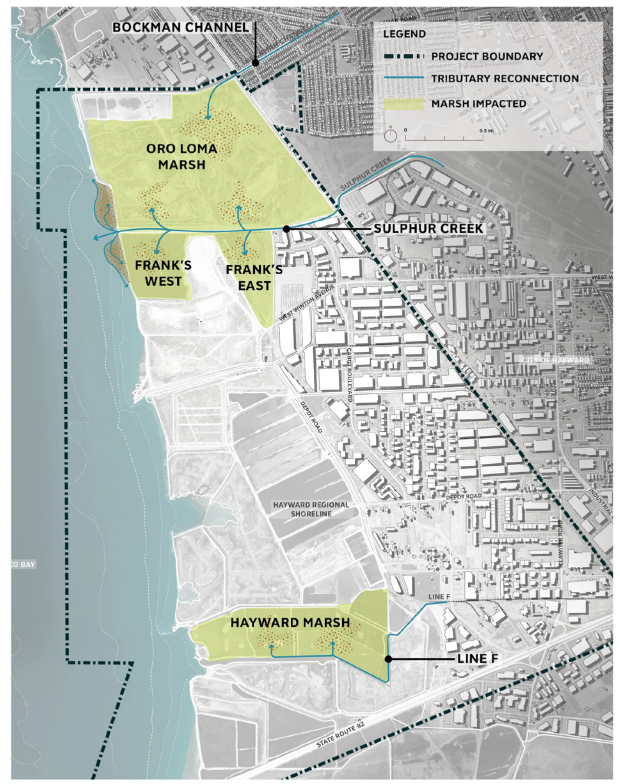
OPTION 2 SULPHUR CREEK
TAP INTO UPLAND WATERSHED



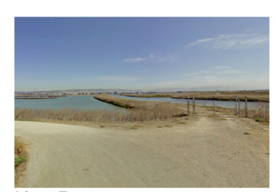
PROS
- Connected to largest upland watershed
- Can potentially be breached into new restoration projects
-
-

CONS
- May impact flood control upstream- need to relocate tide gate
-
-
-

OPTION 3 ALL CHANNELS
RESTORE SALINITY GRADIENTS IN ADJACENT BAYLANDS



PROS
- Connects to most viable upland watersheds
- Potential to nourish a large amount of marsh with sediment
-
-
-
-



Line F

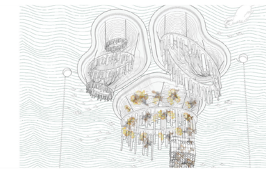
CONS
- May impact flood control upstream- need to relocate tide gate
- Bockman channel has low water quality, may impact marsh negatively
-
-
-
-

Sulphur Creek

REEFS AND LIVING BREAKWATERS

DESIGN STRATEGY REFINEMENT

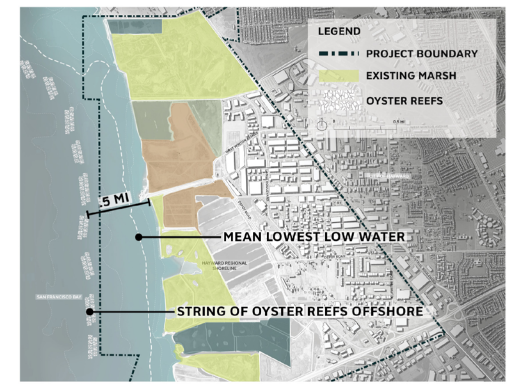
DESCRIPTION. Nearshore reefs made of oyster shell and baycrete (a cement mixture composed mostly of Bay sand and shells) provide hard substrate for shellfish and other aquatic plants and animals. They can reduce wave transmission at lower tidal elevations and stabilize areas in their lee.



PRECEDENT: Floating breakwater, Architectural Ecologies Lab

PRECEDENT: Giant Marsh, Point Pinole

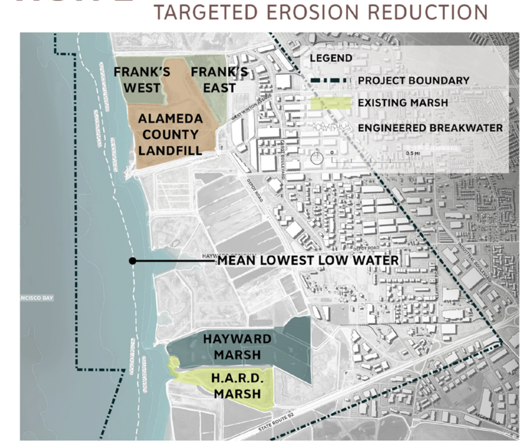
OPTION 1 OFFSHORE OYSTER REEFS
HABITAT BENEFITS AND EROSION REDUCTION



PROS
- Reduce erosion along shoreline
- Provide hard substrate habitat
-
-
-
-

CONS
- Has to be far offshore- may not get as much accretion along shoreline
- May not be stable on bay mud- potential to sink
-
-
-

OPTION 2 ENGINEERED BREAKWATER
TARGETED EROSION REDUCTION



PROS
- Reduce erosion to outboard levees and berms in front of critical infrastructure
-
-
-

CONS
- May not get much accretion along shoreline
- May not be stable on bay mud- potential to sink
- May have negative impacts to habitat
- May be a permitting challenge
-

OPTION 3 FLOATING BREACH BREAKWATERS
REDUCE EROSION AT MARSH BREACHES

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

CONS
- Hard to anchor in bay mud
- Won't reduce erosion during storm surge, only daily tides
- May not get as much accretion along shoreline
-
-
-
-

EELGRASS RESTORATION

DESIGN STRATEGY REFINEMENT

DESCRIPTION. 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.

SKETCH: section

PRECEDENT: Giant Marsh, Point Pinole

OPTION 1 ENHANCE EXISTING BED

PROS
- Eelgrass is already located at the breach, know the conditions facilitate growth
- Eelgrass could help erosion at breaches

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

OPTION 2 PROMOTE AT BREACHES

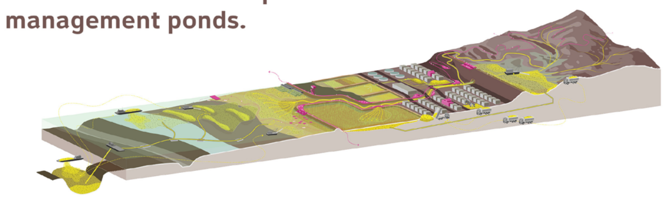
PROS
- Eelgrass could help reduce erosion at breaches

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

UPLAND SEDIMENT STRATEGIES

DESIGN STRATEGY REFINEMENT

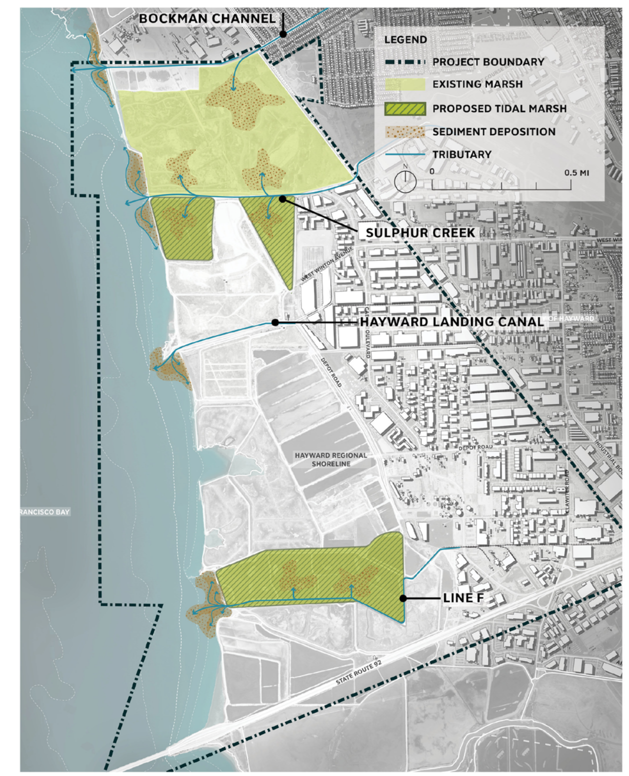
DESCRIPTION. The identification of upland sediment sources, or preparation of areas that will be inundated in the future, can help prepare for future inundation, raise land to marsh plain elevation for restoration, or enhance the landward edge to buffer against increased water inundation. Green infrastructure can help offset the need for diked flood management ponds.



AXON: Public Sediment proposal

Don Castro Dam and Reservoir

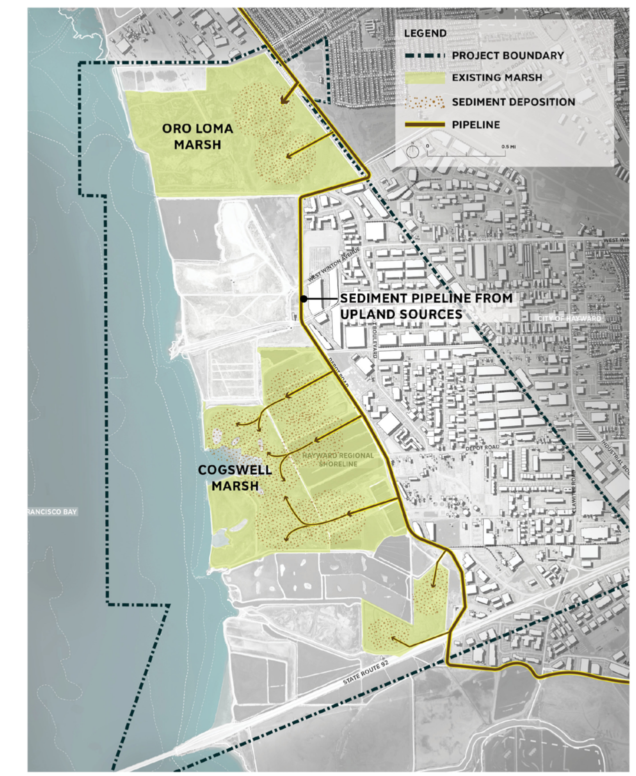
OPTION 1 FLUVIAL SEDIMENT DELIVERY



PROS
- Allow natural processes to deliver sediment to marshes and mudflats
- Formation of mini-deltas

CONS
- Increase of sediment in fluvial channels decreases flood capacity
- Water flows may not be significant enough to distribute sediment

OPTION 2 REGIONAL SEDIMENT DELIVERY



PROS
- Set up infrastructure to deliver sediment over time
- Utilize into upland sediment sources

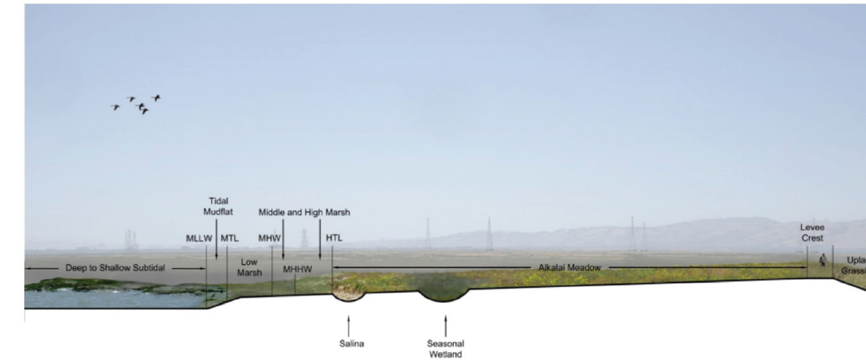
CONS
- May not be the right material
- Pipe infrastructure is costly

ECOTONE LEVEE

DESIGN STRATEGY REFINEMENT

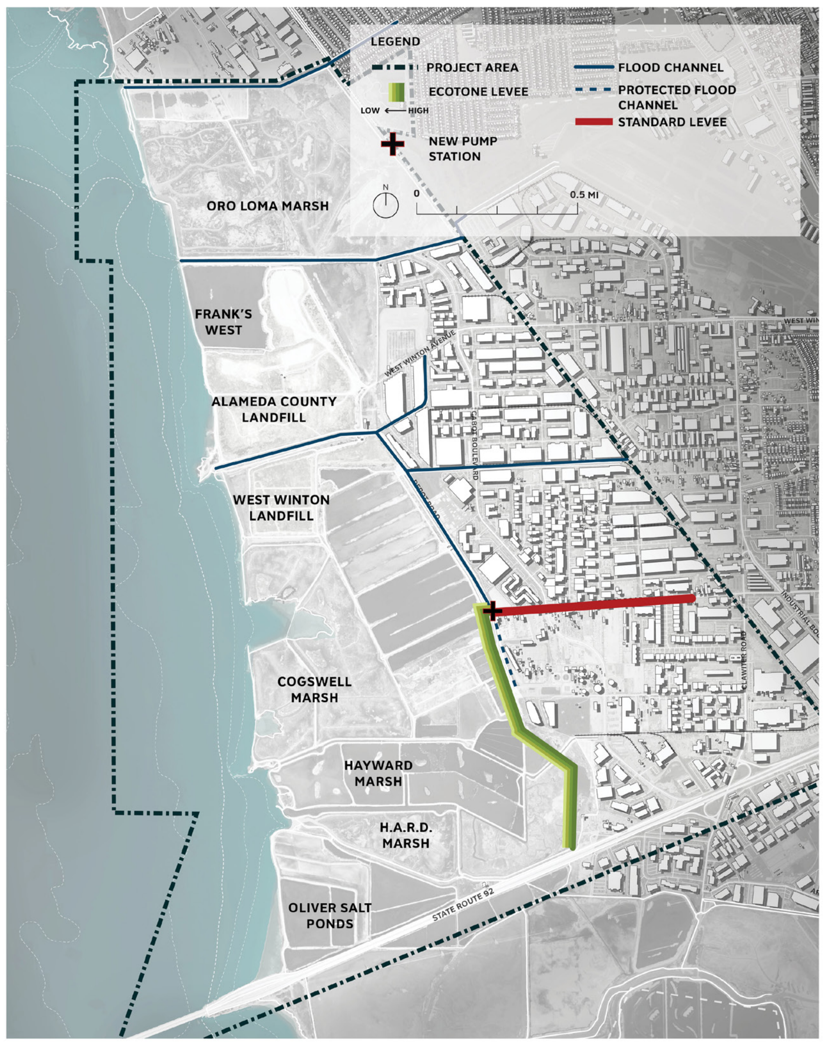
Ecotone levees are vegetated gentle slopes or ramps on the bay side of levee. They can attenuate waves, provide high-tide refuge for marsh wildlife, and allow room for marshes to migrate upslope with sea level rise. Ecotone levees have a larger footprint but can provide many resilience benefits.

TYPICAL ECOTONE SECTION



PRECEDENT: South San Francisco Bay Shoreline Project

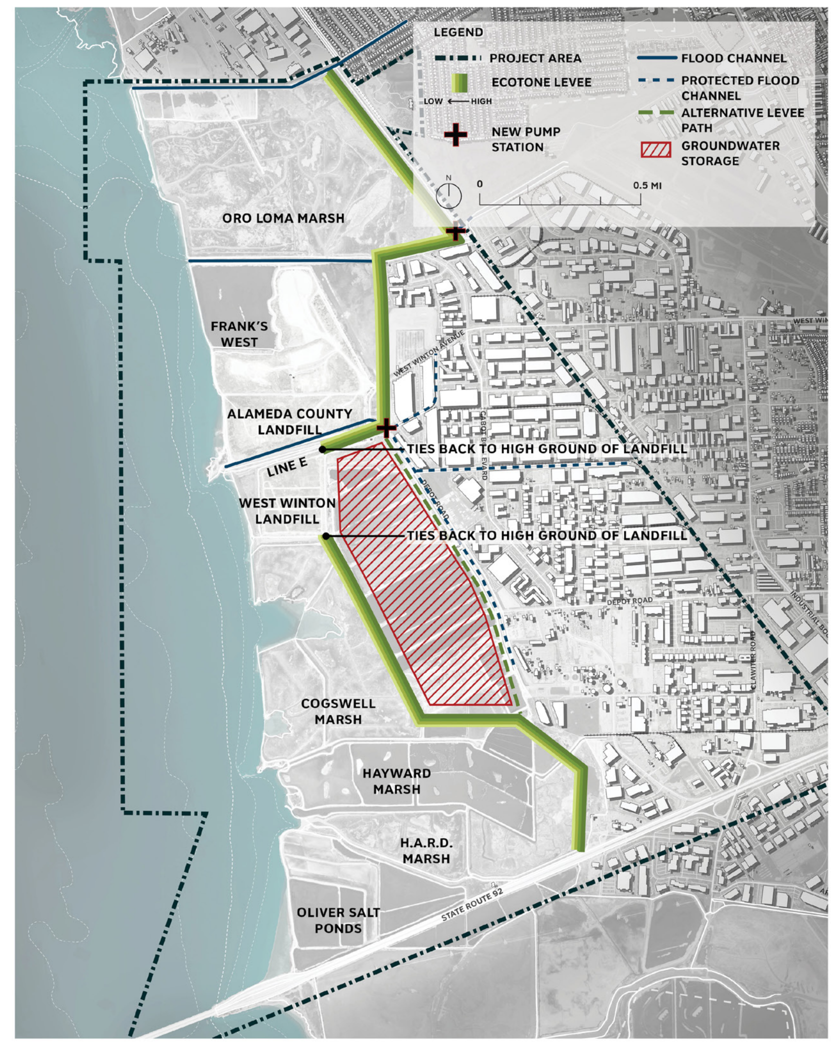
OPTION 1 PROTECT CRITICAL INFRASTRUCTURE



PROS
- Existing tidal connections remain
- Sulphur creek remains in place
- Some water control structures will be preserved (line A)
- Combines well with creating a buffer area for groundwater pooling
- ______
- ______
- ______

CONS
- Only partially protects critical infrastructure
- Hayward marsh not protected
- Sulphur creek not protected
- May require channels to be relocated
- No storage for Hayward WWTP effluent
- ______
- ______
- ______
- ______

OPTION 2 UPLAND LEVEE



PROS
- Preserves oro loma marsh
- Preserves hayward landing
- Provides potential groundwater storage areas in oxidation ponds
- Allows for upland marsh migration
- Attenuates waves, reduce wave run up, prevent overtopping of levee crest
- Low-gradient slope does not need to be constructed from highly engineered levee core
- Reduces erosion

CONS
- Line e unprotected
- Line a to be relocated
- Sulphur creek to be re-routed
- Hayward marsh not protected
- Fema does not certify transition slope levees
- Construction would require filling the bay and modifying shoreline topography - requires multiple permits
- Largely untested

PRECEDENT: Oro Loma Horizontal Levee

PRECEDENT: Deer Island, Marin Independent Journal, 2019

ENGINEERED STRATEGIES

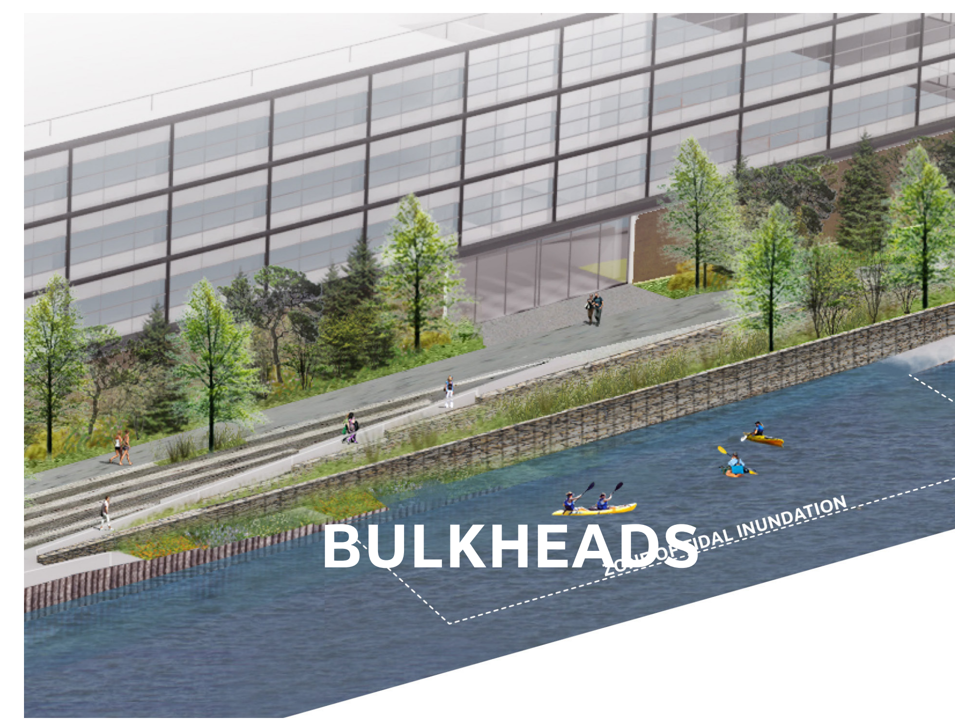

EDGE STABILIZATION AND PROTECTION


REVETMENTS AND RIP RAP


TRANSPORTATION ELEVATION / REALIGNMENT


TIDE GATES AND WATER CONTROL STRUCTURES

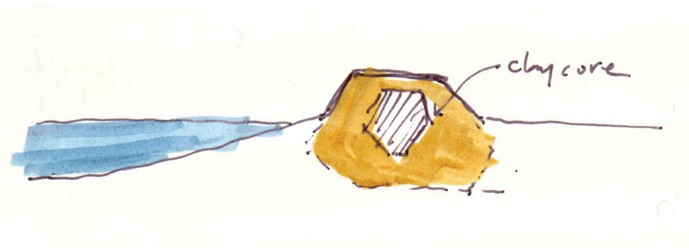

BUILDING ELEVATION


BULKHEADS

LEVEE IMPROVEMENTS

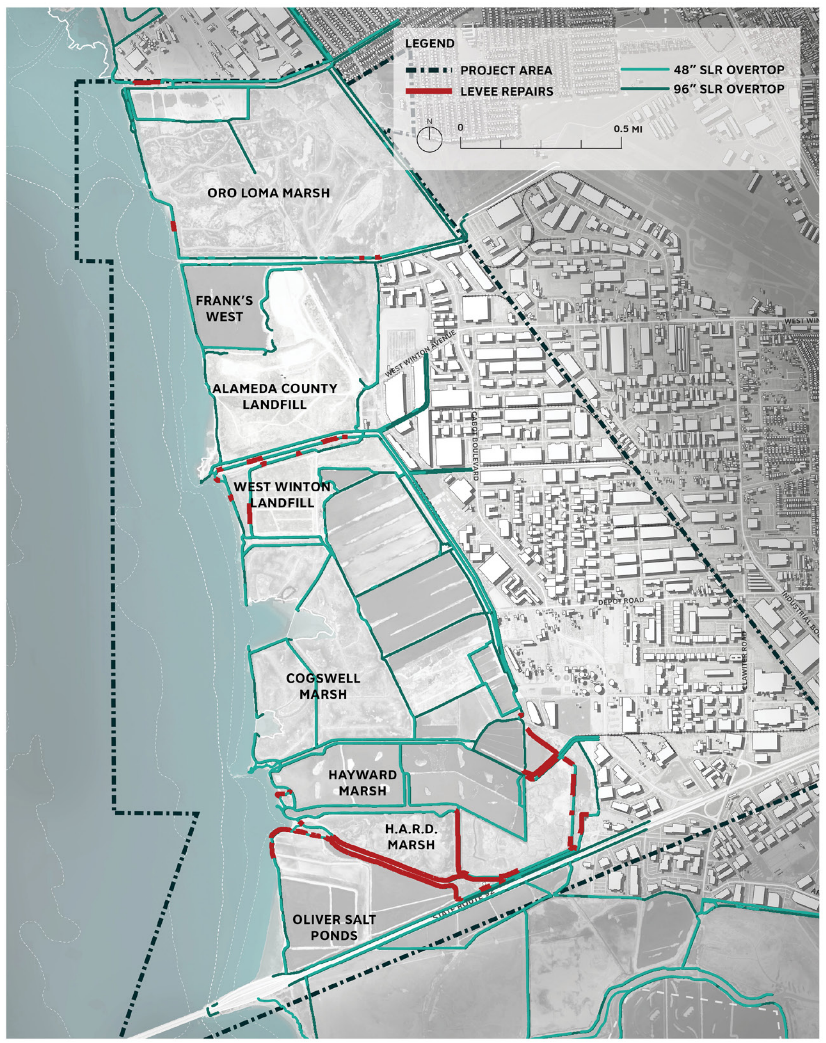
DESIGN STRATEGY REFINEMENT

Existing levees can be modified or improved to increase their resiliency to storms and sea level rise.



SKETCH: IMPROVED LEVEE WITH CLAY CORE

OPTION 1 TARGETED REPAIRS



PROS

- Protects oro loma marsh
- Hayward landing remains intact
- Prevents flooding and erosion
-
-
-
-
-

CONS

- Does not address future storm surge with sea level rise
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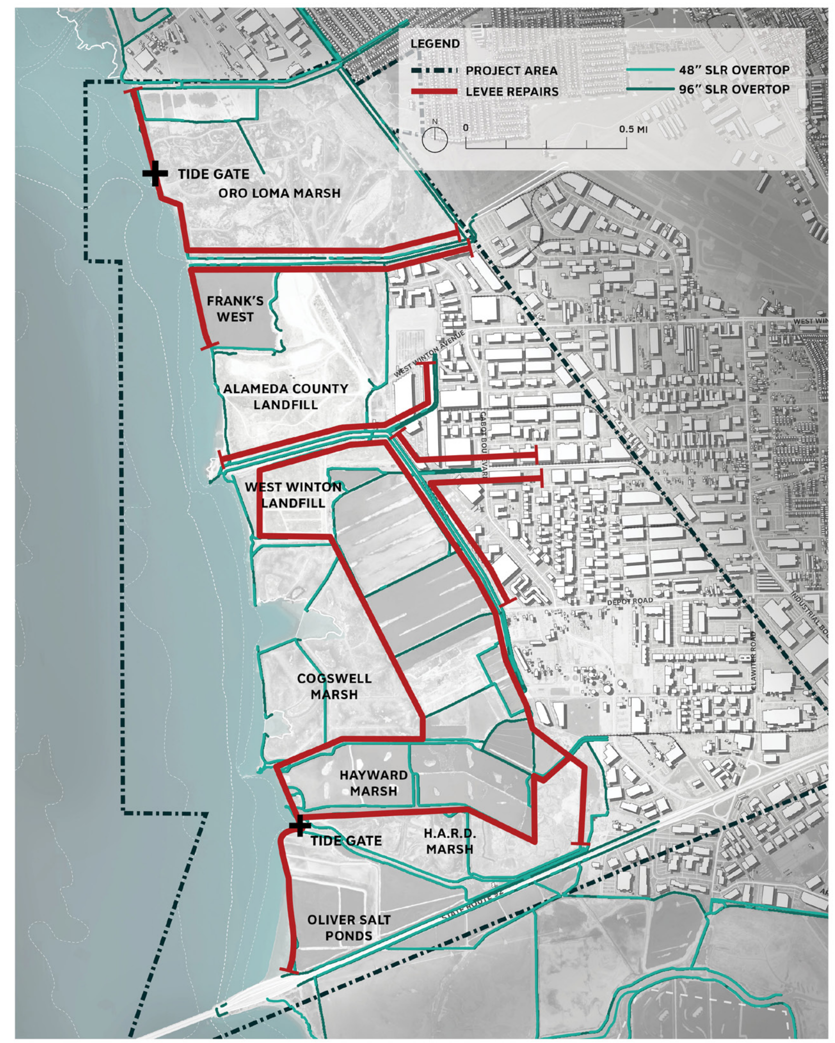
OPTION 2 ADDRESS 4' OF SEA LEVEL RISE

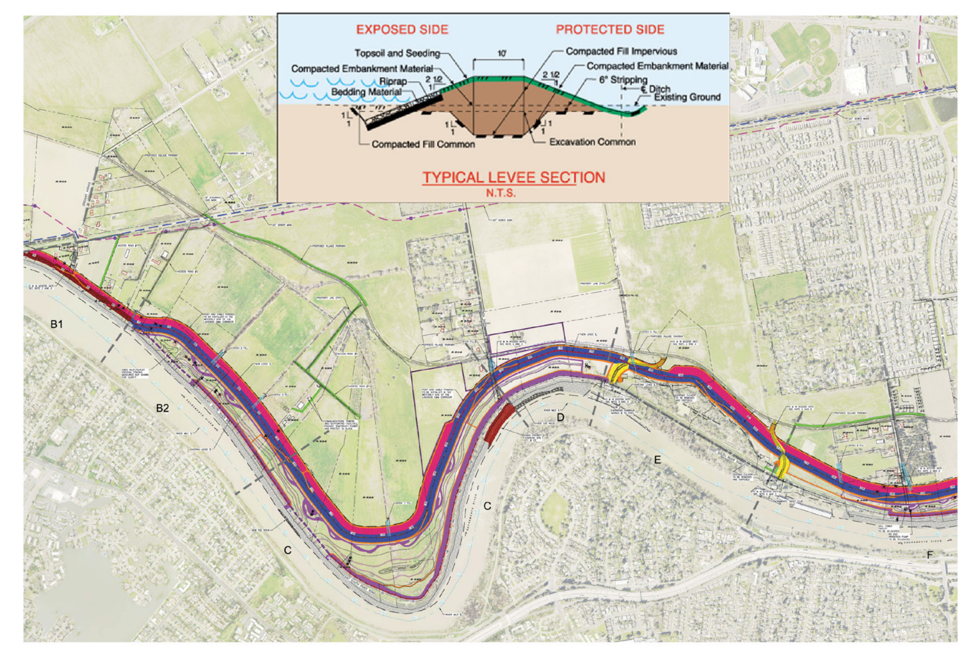


PROS

- Provides full protection to upland communities
- Prevents flooding from sea level rise
- 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
- Removes tidal connection for all marshes
- Could be extremely tall and wide
- May cause displacement of people, infrastructure and wildlife
- Requires demolition of pre-existing structures to raise ground
-



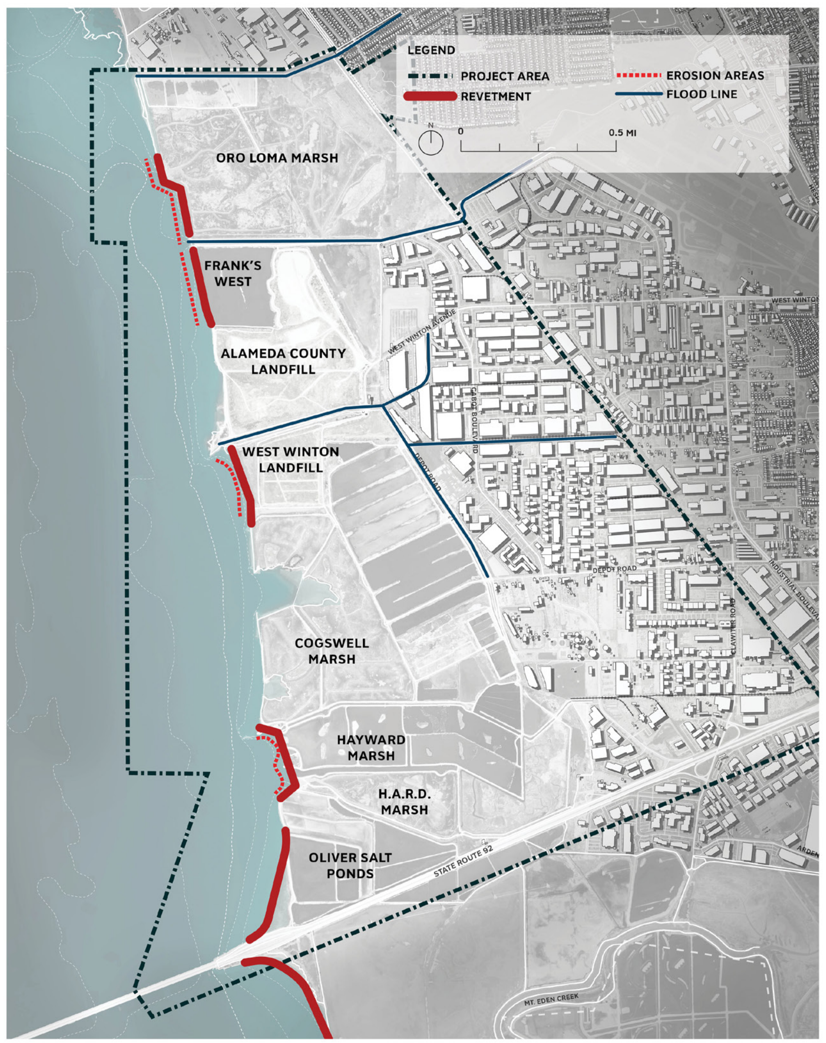
PRECEDENT: SOUTHPORT SACRAMENTO RIVER LEVEE IMPROVEMENT PROJECT, CA

REVETMENTS

DESIGN STRATEGY REFINEMENT

Edge stabilization provides protection along tidal areas to prevent erosion. Bulkheads are vertical retaining structures built to stabilize the existing shorelines and limit shoreline erosion. Seawalls are stone, rock, or concrete structures designed to protect upland areas from coastal flooding, especially in high-wave energy environments. Revetments are hardened structures made of concrete, rocks, wood, or other materials that are placed along waterways to stabilize them against waves and erosion. Riprap, which is made of rock or concrete rubble, is the most common form of shoreline protection revetment structure in San Francisco Bay.

OPTION 1 REVETMENT STABILIZATION

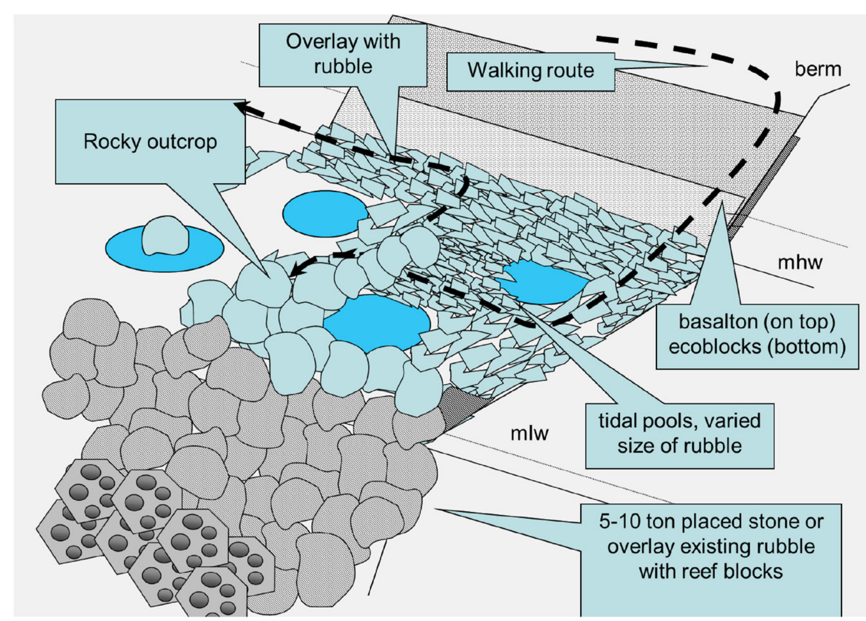


PROS

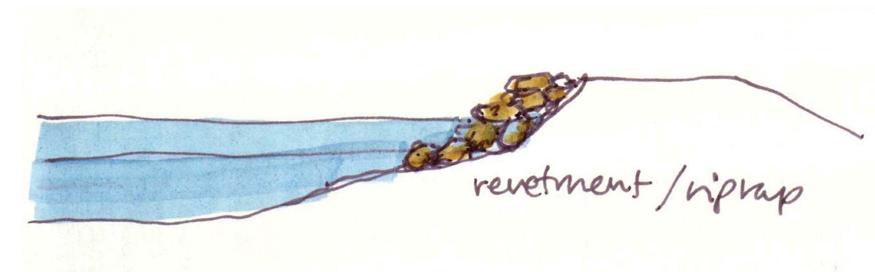
- Preserves oro loma marsh
- Hayward landing remains intact
- Stabilizes landfill edges / erosion control
- More cost-effective than bulkheads or seawalls; requires less engineering
- Can be designed to provide habitat value
- May facilitate water access
- Can incorporate habitat for oysters, shellfish, other species, and plants

CONS

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



PRECEDENT: EASTERN SCHELDT DIKE ENHANCEMENT, THE NETHERLANDS



SKETCH: EDGE STABILIZATION AND EROSION PROTECTION

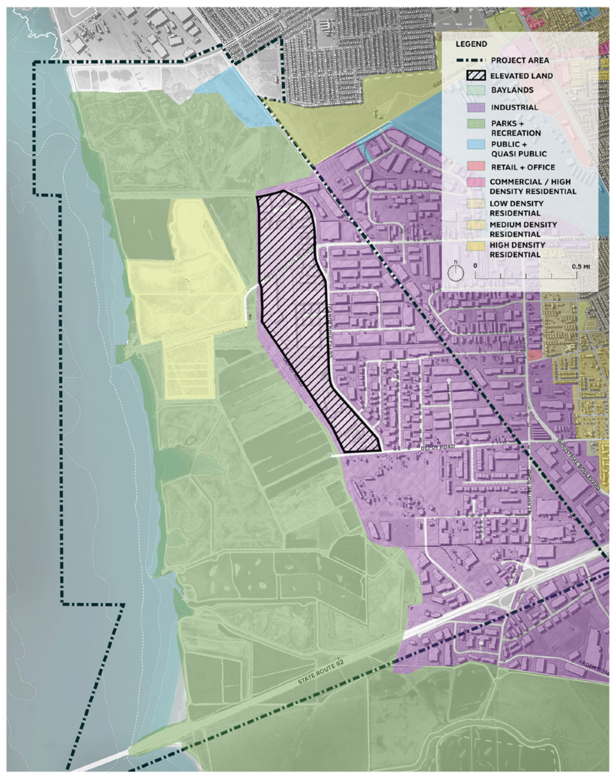
PRECEDENT: EDEN LANDING, UNION CITY, CA

LAND ELEVATION
DESIGN STRATEGY REFINEMENT

Elevating land at the site or district scale above a design flood elevation to lift 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.


PRECEDENT: ARVERNE-BY-THE-SEA

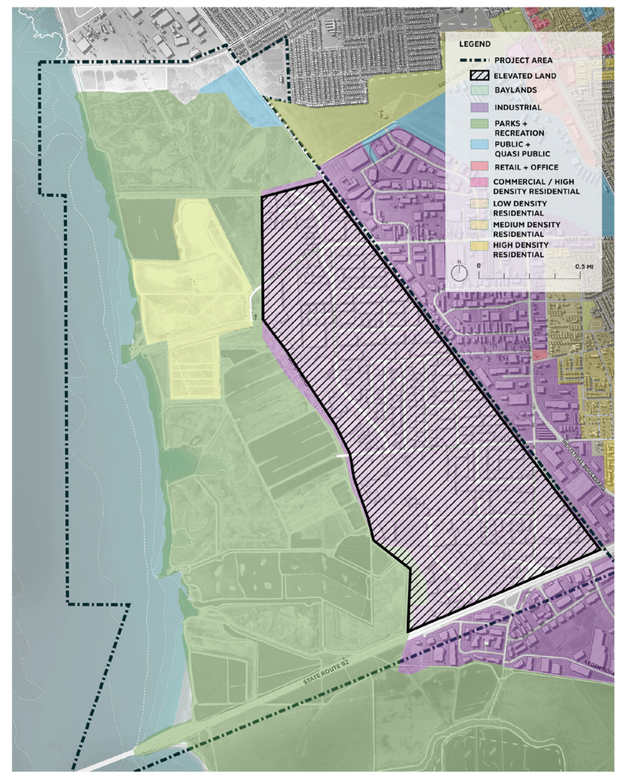
OPTION 1: WEST OF CABOT BOULEVARD



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 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

OPTION 2: INDUSTRIAL NEIGHBORHOOD

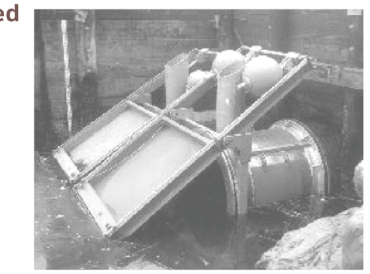


PROS
- Reduces risk of industrial park to flooding and roundwater emergence
- May help remediate brownfields and reduce flood insurance rates

CONS
- Requires complete redevelopment of industrial park, causing significant temporary displacement
- Requires a significant amount of clean dirt or fill
- 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 SLR

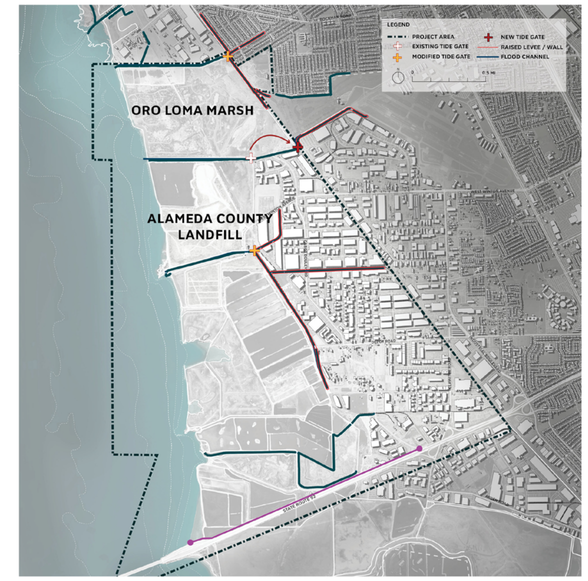
TIDE GATES & WATER CONTROL STRUCTURES
DESIGN STRATEGY REFINEMENT

Tide gates control the movement of water, specifically from a tidewater area and a drained, upland area. Hinged doors at the end of culverts make up the gates and they are controlled by mechanisms that regulate when they open or close.




PRECEDENT: Lower Walnut Creek Restoration Project, CA

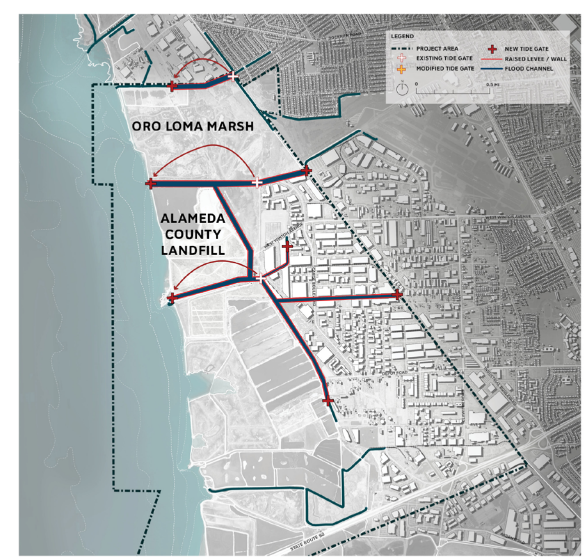
OPTION 1: TIDE GATE RELOCATION



PROS
- Provides tidal connection to frank's east
- Cheaper to locate control structures as close to the line of protection as possible

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

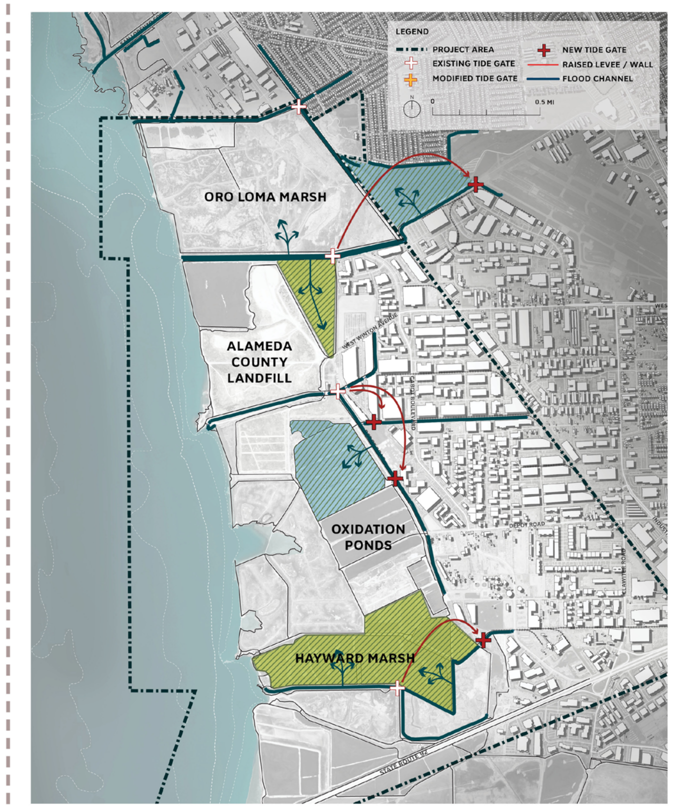
OPTION 2: STORAGE IN FLOOD CHANNELS



PROS
- Improved storage is beneficial

CONS
- Would require pump stations
- Few viable locations for significant storage volumes

OPTION 3: IMPROVING FLOOD CHANNELS



PROS
- Provides further protection from sea level rise
- Minimal impact to channel footprint
- Does not require additional space

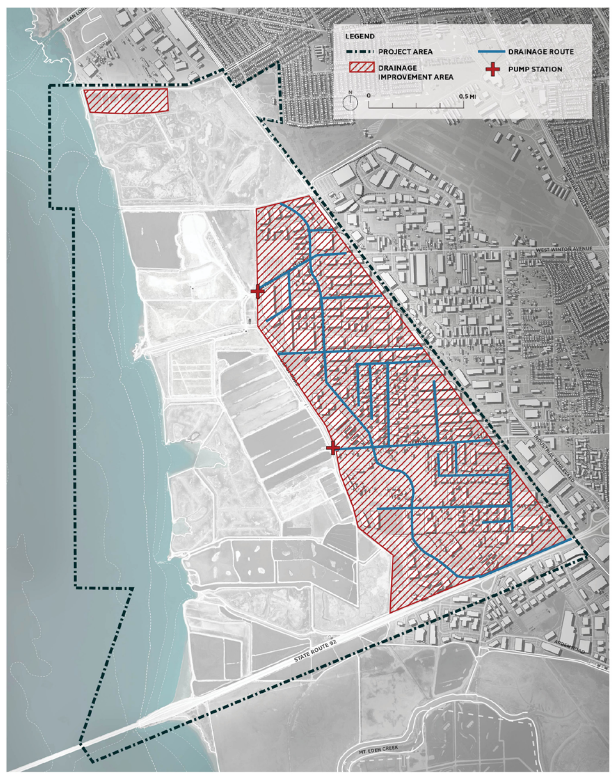
CONS
- Removes visual connection to bay
- May contribute to groundwater ponding
- May exacerbate flooding if water cannot be channeled

GROUNDWATER SOLUTIONS

DESIGN STRATEGY REFINEMENT

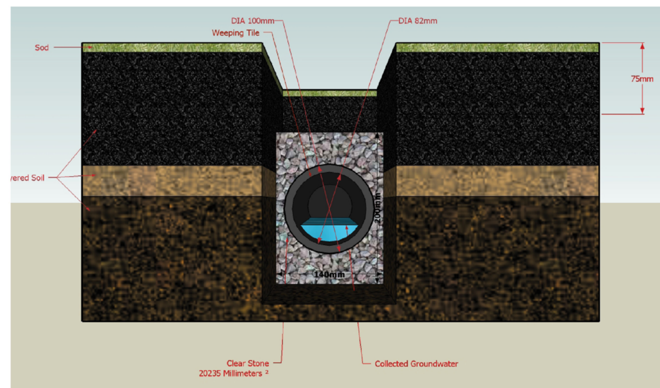
Rising groundwater tables can be addressed through an expanded subsurface drainage network that feeds into trenches/canals that flow to the bay at low tide. Tide gates are needed to prevent influx of high tides. Would require additional inland storage space to manage groundwater storage.

OPTION 1: DRAINAGE + TIDE GATES

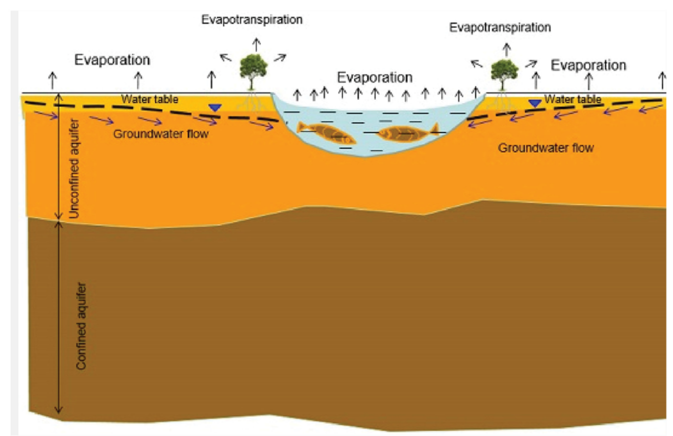


PROS
- Addresses rising groundwater tables
- Good short to medium-term strategy
-
-
-
-

CONS
- Requires additional inland storage space
- 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 it is not a long-term solution
- Requires the creation of a high density system of trenches/ditches and perforated pipelines
-
-



Source: https://en.wikipedia.org/wiki/French_drain



Source: https://www.mdpi.com/2306-5338/3/3/30

WASTEWATER TREATMENT ADAPTATION

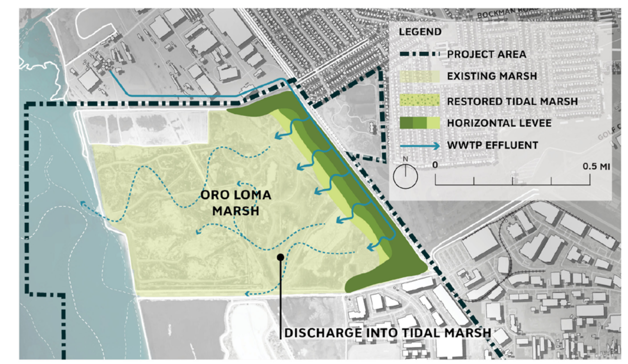
DESIGN STRATEGY REFINEMENT

DESCRIPTION. There is potential to retrofit wastewater treatment plants along the shoreline, which 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.

PRECEDENT: Novato Wastewater Treatment Plant

OPTION 1 ORO LOMA LOCAL DISCHARGE

WWTP EFFLUENT DISCHARGED INTO TIDALLY INFLUENCED ORO LOMA MARSH

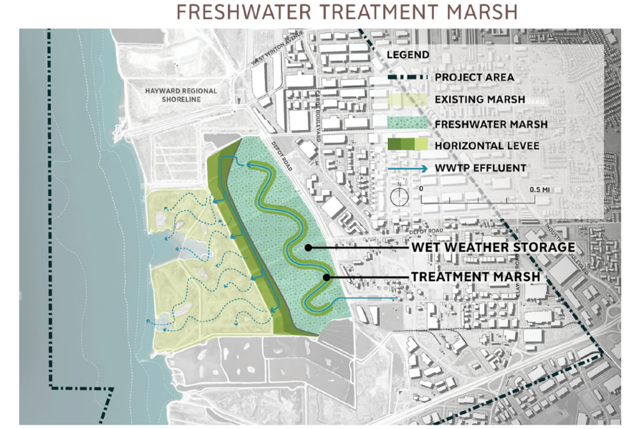


PROS
- Restore salinity gradient to tidal marsh
- Local discharge with EBDA retirement
-
-
-
-
-

CONS
- Not directly connected to the bay
- Need to maintain and raise levee in with sea level rise
- May have negative impacts to oro loma marsh
-
-

OPTION 2 HAYWARD LOCAL DISCHARGE

WWTP EFFLUENT DISCHARGED INTO FRESHWATER TREATMENT MARSH



PROS
- Pair with horizontal levee
-
-
-

CONS
- Not directly connected to the bay
- Need to maintain and raise levee in with sea level rise
-
-

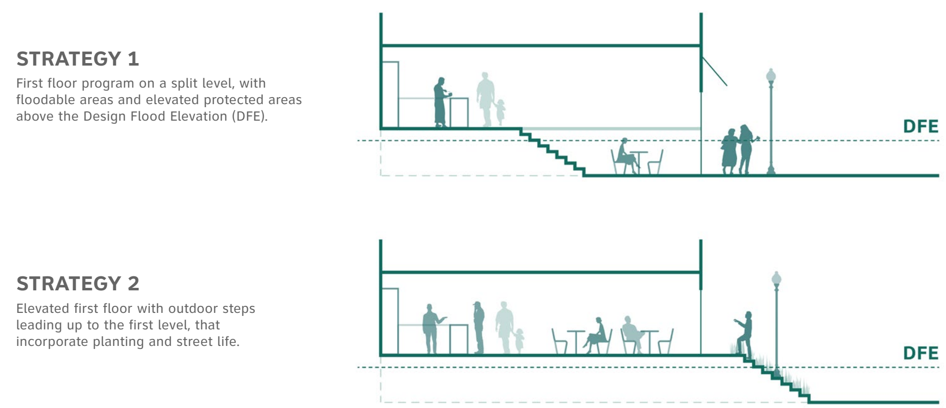
OPTION 3 FULLY TIDAL DISCHARGE

ORO LOMA AND HAYWARD WWTP EFFLUENT DISCHARGED LOCALLY INTO TIDAL MARSHES

PROS
- May be able to discharge from other wwtp's
- 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
-
-
-
-
-

NON-STRUCTURAL / POLICY STRATEGIES



BUILDING AND ZONING CODE CHANGES

MANAGED RETREAT

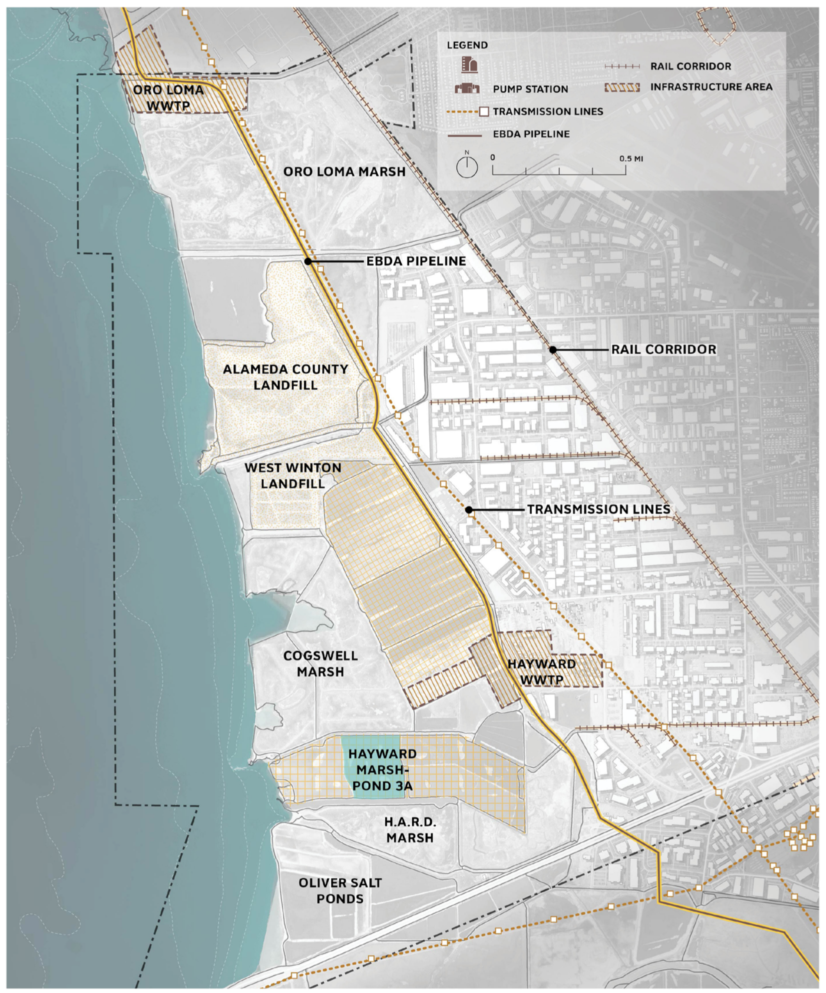
DESIGN STRATEGY REFINEMENT

DESCRIPTION. 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.

PRECEDENT: Surfers Point Managed Retreat, Ventura, CA

PRECEDENT: Ile de Jean Charles

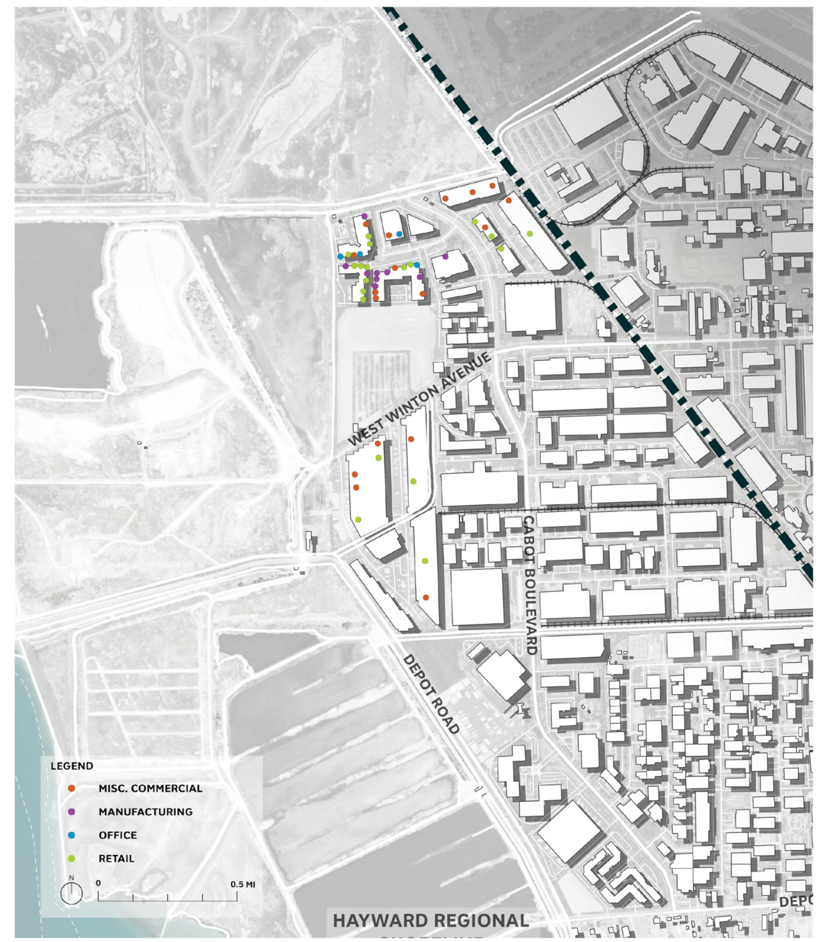
OPTION 1 RELATION OF KEY ASSETS



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
- Lack of available land to move these assets to and may require eminent domain
- Requires multiple-agency coordination and long-term planning

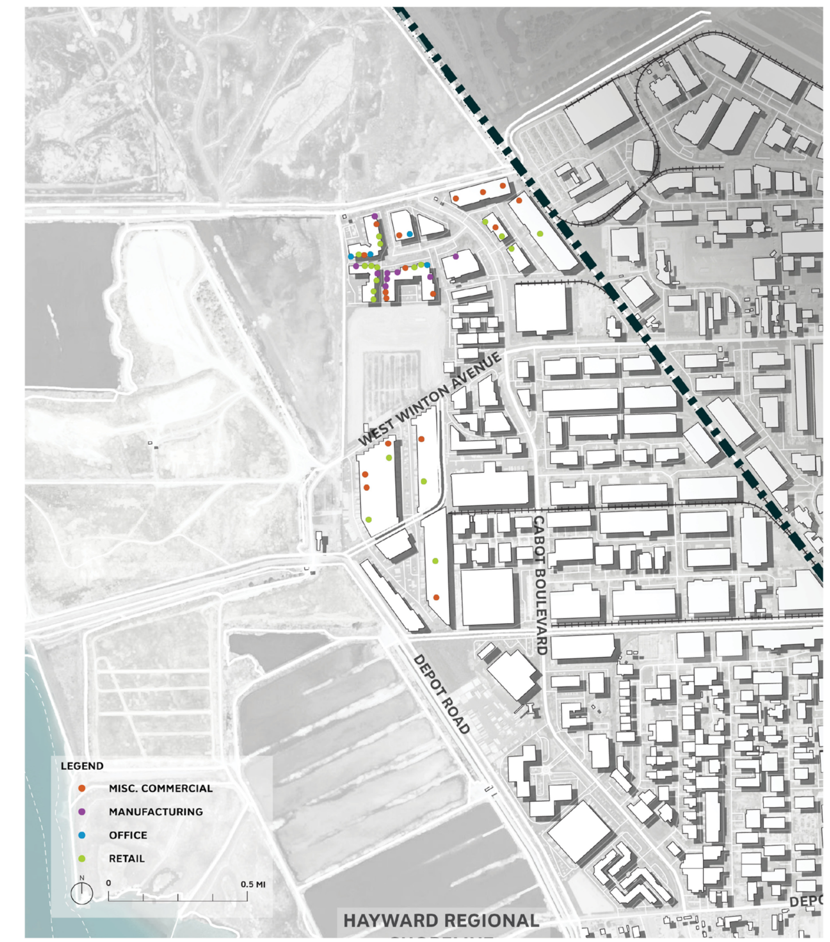
OPTION 2 MANAGED RETREAT OF VULNERABLE NEIGHBORHOODS/ INDUSTRIAL AREAS (4' SLR)



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
- Industrial land use encroaching on other land use further in land
- 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

OPTION 3 LIMITATIONS OF FUNDING AND RESTRICTIONS ON REBUILDING POST-DISASTER



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 integrated into Land Use code

CONS
- Could be placing those who are unable to retreat at a disadvantage
- Displacement
- Legal aspects of restricted development

PUBLIC ACCESS + THE BAY TRAIL

DESIGN STRATEGY REFINEMENT

DESCRIPTION. 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



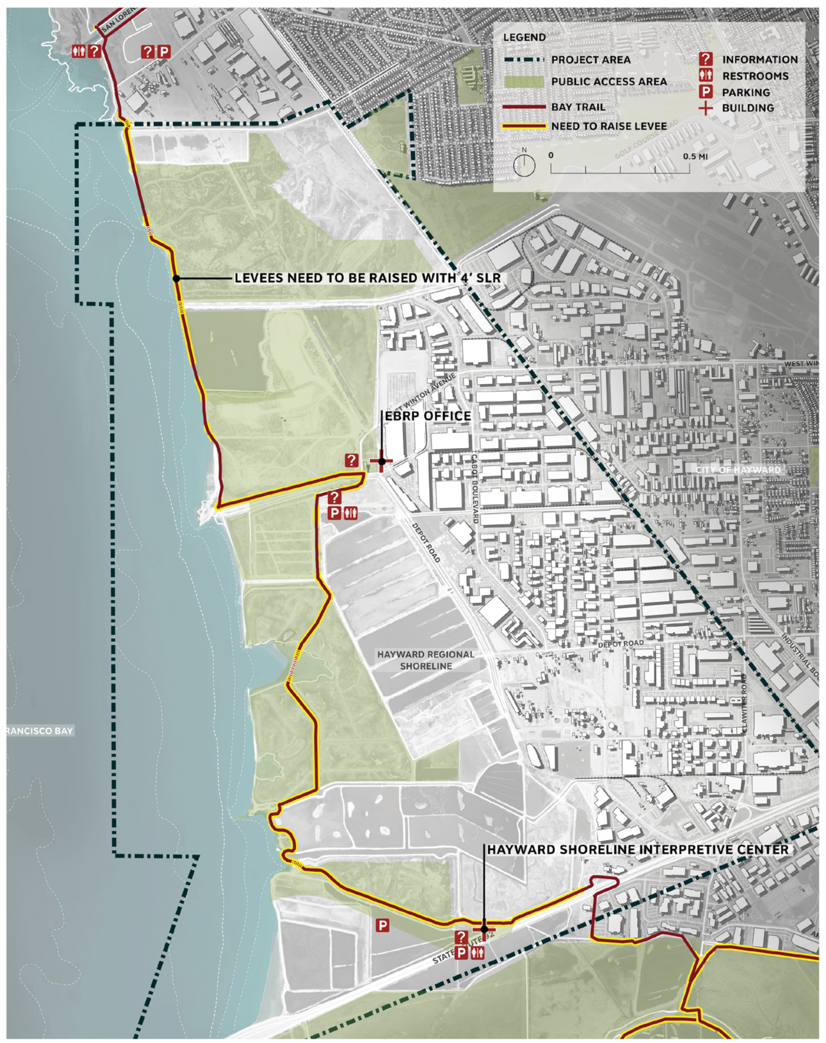
Bay Trail Existing Conditions, 2019


Bay Trail Existing Conditions, 2019

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

OPTION 1 MAINTAIN CURRENT ALIGNMENT OF THE BAY TRAIL

RAISE LEVEES TO ACCOMMODATE 4' SLR



PROS

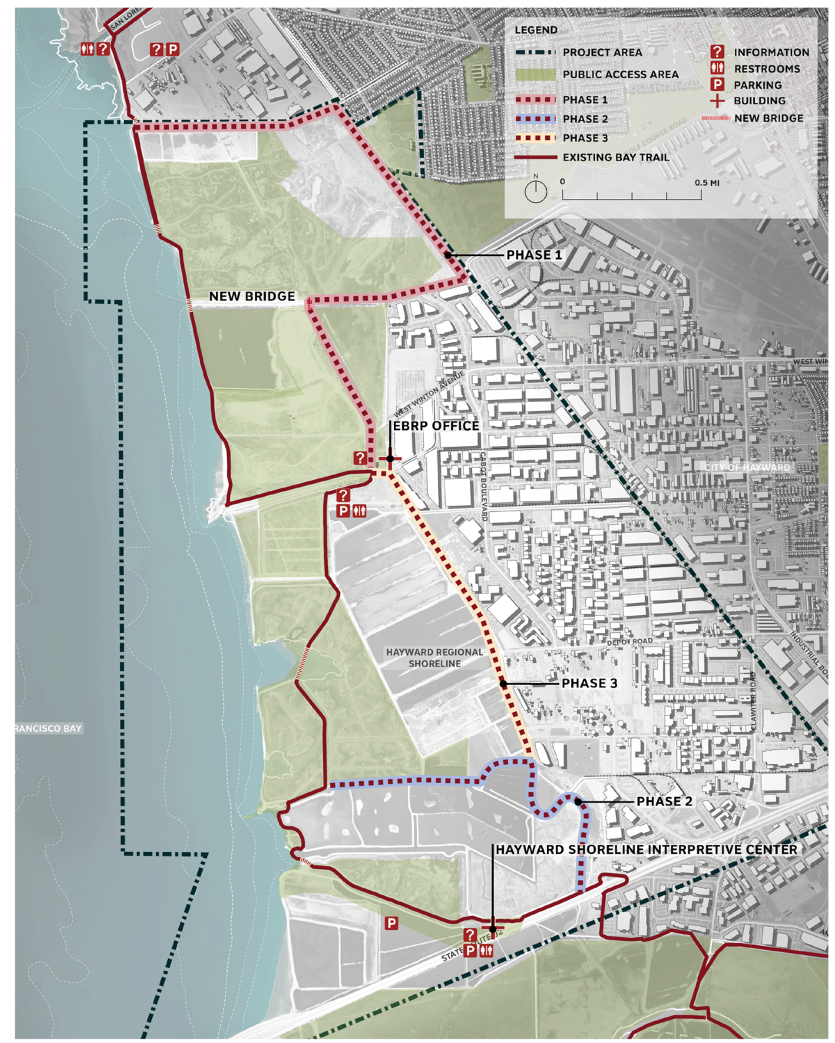
- Diverse bay experience- blue water
- Maintains current alignment which is existing and permitted

CONS

- 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

OPTION 2 ADAPT THE BAY TRAIL OVER TIME

PHASED REALIGNMENT



PROS

- Phased approach may be easier to implement and fund

CONS

- Trail connections at the bay will be vulnerable with SLR

OPTION 3 REALIGN WITH NEW COASTAL PROTECTION INFRASTRUCTURE

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

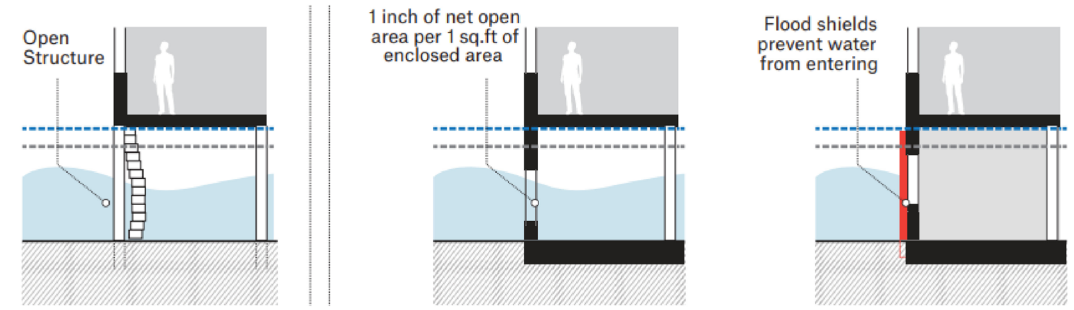
- Bay trail could be far from blue water if the construction occurs before slr inundates

BUILDING SCALE STRATEGIES
DESIGN STRATEGY REFINEMENT

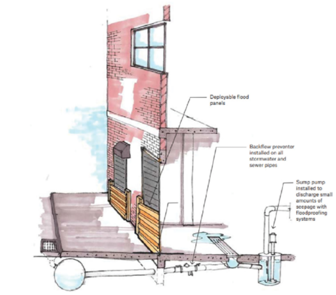
DESCRIPTION. There are many building scale strategies that can be implemented to adapt to sea level rise. From improving standards, such as building codes and removing regulatory impediments, such as zoning height restrictions The City can also aid businesses and homeowners to assist them with understanding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

PHYSICAL STRATEGIES

PRECEDENT: Brooklyn Grange, Rooftop Farm (Industry City, Sunset Park, NY)



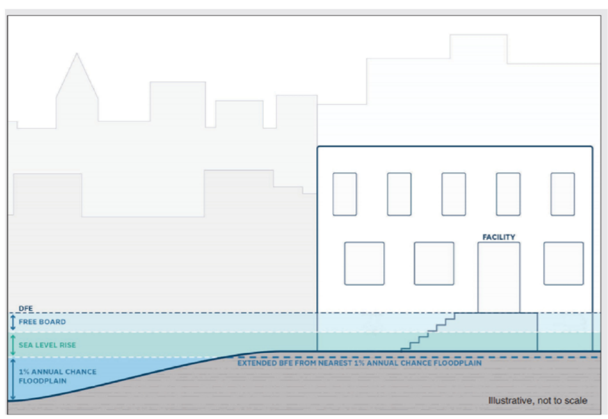
Floodproofing strategies (elevate, wet floodproof, dry floodproof)



On-site pumping, storage

IMPLEMENTATION OPTIONS

OPTION 1 INCREASING STANDARDS FOR NEW CONSTRUCTION



EXAMPLES
- incorporating sea level rise (image above)
- extending requirements to 500-yr floodplain
- storage requirements for hazard materials

PROS
- Reduces risk to future development
- Ensures resilient development
- __________
- __________
- __________
- __________
- __________

CONS
- Could be costly
- Older developments still at risk
- __________
- __________
- __________
- __________
- __________

OPTION 2 PROVIDING LOANS/GRANTS/ TAX INCENTIVES FOR IMPLEMENTATION

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

PROS
- Supports businesses and homeowners before, during, and after an emergency or other disruption
- Funding will allow more vulnerable areas to adopt resilient measures
- __________
- __________
- __________
- __________

CONS
- Requires funding
- Need to ensure people will take advantage of offerings
- __________
- __________
- __________
- __________

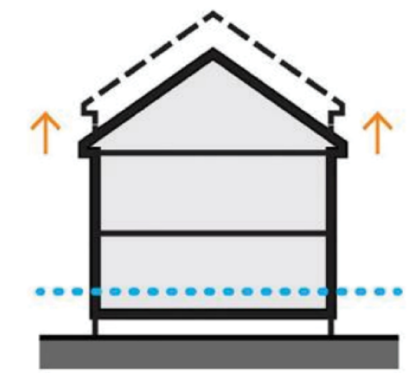
OPTION 3 TECHNICAL SUPPORT & EDUCATION

EXAMPLES
- modeled after seismic retrofitting awareness campaigns
- nyc business emergency preparedness risk audits

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
- __________
- __________
- __________
- __________

OPTION 4 REMOVING REGULATORY IMPEDIMENTS



EXAMPLES
- zoning height limits (image above)
- permitting requirements & fees

PROS
- Provides the structure to allow for 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
- __________
- __________
- __________
- __________

NEXT STEPS

NEXT STEPS

- BACKGROUND REPORT ON EXISTING CONDITIONS
- STAKEHOLDER OUTREACH PLAN

- **SEA LEVEL RISE AND GROUDWATER MAPPING ANALYSIS**
- **ONLINE DISPLAY OF SLR MAPS AND ASSOCIATED RISKS**

- GOALS AND POLICIES
- ADAPTATION STRATEGIES AND IMPLEMENTATION ACTIONS

- SHORELINE MASTER PLAN CONCEPT
- DESIGN ALTERNATIVES
- IDENTIFY FUNDING SOURCES
- MASTER PLAN (DRAFT AND FINAL)

THANK YOU!