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HAYWARD REGIONAL SHORELINE MASTER PLAN

FOR THE HAYWARD AREA SHORELINE PLANNING AGENCY (HASPA)

TASK 1 BACKGROUND REPORT & EXISTING CONDITIONS ANALYSIS

SUBMITTED 06/14/2019
PART OF A JOINT POWERS AGREEMENT
OF COH, HARD AND EBRPD

Tidal channel at Triangle Marsh

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 1 – Project Initiation, the Project Team has prepared an Existing Conditions Inventory 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 broad inventory of existing conditions that will serve as a foundation for the design and development of the Hayward Regional Shoreline Master Plan. During this phase, the Project Team also conducted various community engagement initiatives, including interviewing key local stakeholders and circulating an online survey to receive public feedback.

Document Summary

Existing Conditions Inventory

Ecological Resources:

This section provides an overview of key environmental features and ecological resources along the Hayward Shoreline, and represents the Baylands through a series of axonometric views.

Infrastructure:

This section explores the different infrastructural features within the project area in relation to the threats of flood and sea level rise.

Cultural Resources:

This section provides an overview of the existing historical resources and social infrastructure within the project area.

Connections and Access:

This section provides a high-level survey of the current transportation system, ownership patterns, and land uses.

Demographics:

This section presents an inventory of existing demographic conditions using census data and drawing on environmental justice indexes.

Past Plans and Studies

This is a list of previous plans and studies that were reviewed by the Project Team.

Online Survey and Interviews Summaries

This section provides summaries of both the online survey and the key stakeholder interviews.

Finance Considerations

This section provides a framework to inform the Master Plan process with respect to finance and funding considerations.

Summary of Findings

This section outlines potential design directions for the Master Plan.

Appendices A (attached):

Online Survey and Stakeholder interviews transcripts:

Transcripts of all stakeholder interviews and online survey results conducted as part of the project initiation phase.

Bay tidal mudflats at Cogswell Marsh breach

TABLE OF CONTENTS

INTRODUCTION

PROJECT OVERVIEW

The Master Plan was commissioned by the Hayward Area Shoreline Planning Agency and will serve as a guide to the protection of important assets vulnerable to sea level rise along the Hayward shoreline. Today, the shoreline is home to critical infrastructure such as a wastewater treatment plants, the San Mateo-Hayward Bridge (State Route 92) approach, landfills, and energy facilities. The area also supports Bayland habitat, residential neighborhoods, business parks, and recreational features, including the Bay Trail and the Hayward Shoreline Interpretive Center. The Master Plan will develop various multi-benefit strategies for the shoreline, its existing infrastructure, and the surrounding ecological resources.

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).

SCAPE Landscape Architecture is leading a collaborative Project Team composed of nationally and locally renowned experts in the fields of Landscape Architecture and Urban Design (SCAPE), Planning and Coastal Engineering (ARCADIS), Public Outreach and Communication (Convey), Finance and Funding (re:focus), and Ecological Consulting (San Francisco Estuary Institute).

The Project Team will apply its expertise with a committed set of partners and stakeholders to create a Shoreline Master Plan for the Hayward Area. The process will engage people across a broad social spectrum and explore opportunities to enhance native ecologies, encourage stewardship, and increase resilience along the Hayward Shoreline.

Task 01: Project Initiation

1.3 Meeting with Staff and Consultant Team, Stakeholders List

In collaboration with HASPA, the Project Team will identify and compile a list of key stakeholders for the study area and initiate the project.

1.4 Background Report

The Project Team will develop an online survey tool and conduct individual and small group interviews. Also during this period, the Project Team will develop a summary of existing conditions that will inform the subsequent phases of the project.

1.5 Community Outreach Plan

In collaboration with HASPA, the Project Team will develop a Community Outreach Plan (COP). The plan will outline significant community outreach events and reference various methodologies for engaging the public.

2. Task 02: SLR Modeling Analysis and Mapping

2.1 Model SLR including groundwater and rainfall impacts

Using available information, the Project Team will review existing climate change studies and flood inundation maps produced for the Hayward Regional Shoreline. Based on this review, the Project Team will recommend a sea level rise projection for the Master Plan, and projections will be reviewed by the HASPA team.

For the impacts associated with groundwater, the Project Team will utilize existing work conducted by The San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group (CHARG) and other institutions to understand groundwater level conditions and identify resulting vulnerabilities within the project area.

2.2 Online Display and Sharing

Upon completion of the SLR mapping efforts, the Project Team will work with the City of Hayward GIS staff to identify a preferred level of complexity for the web portal that will be built, and to establish a pathway for storing web content and disseminating new map information.

3. Task 03: Public Outreach

3.1, 3.2, 3.4 Community Workshops

The Project Team, in collaboration with HASPA, will plan, organize, and facilitate three (3) community workshops. Each workshop will be designed with clear objectives to provide meaningful input into the Master Plan and concurrently educate the participants about shoreline resiliency.

3.3 Online Forum

The Project Team will embed graphics – including maps and photographs – into the online tool to continuously inform the public on progress and collect feedback for developed alternatives within the Master Plan.

4. Task 04: Adaptation Responses

4.1 Goals and Policies

Building on content collected through the public engagement process and the sea level rise risk analysis, the Project Team will outline key objectives for the Master Plan and identify potential policy frameworks to support these goals.

4.2 Adaptation Strategies and Implementation Actions

The Project Team will conduct a review of vulnerable areas and facilities to identify any constraints that may limit the implementation of adaptation strategies. For each adaptation strategy, a series of alternative implementation actions will be developed with the range of expected outcomes summarized in an Adaptation Strategies Report.

5. Task 05: Draft Master Plan and Maps

5.1 Develop Shoreline Master Plan Concept

Building on adaptation strategies and public feedback, the Project Team will compile a conceptual Master Plan proposal- continuously testing against goals and policies set in Task 4.1. This plan will be developed in tandem with the HASPA team and continuously reviewed through team work sessions.

5.2 Formulate alternatives

The Project Team will prepare a Preferred Alternative Framework, including policies and implementation actions.

5.3 Master Plan work session

Once a draft Master Plan is developed, the Project Team will lead a working session with HASPA and City of Hayward staff to collaboratively identify weaknesses and opportunities for further development.

5.4, 5.6, 5.7 Draft Master Plan reports

Based on the preferred alternative developed through the planning and outreach process, the Project Team will compile a draft Master Plan report consisting of relevant research, analysis, project goals, policy frameworks, and visual representations of the preferred alternative.

5.5 Potential funding sources

The Project Team will identify specific funding sources for implementation for different components of the Master Plan.

7. Task 07: HASPA adoption of final plan

7.2 Master Plan Hearing

The Project Team will prepare a presentation of the Master Plan and will attend three separate public meetings, one for the City of Hayward, one for HARD Board of Directors, and one for the EBRPD Board of Directors.

Fringe marsh at San Lorenzo Creek

EXISTING CONDITIONS INVENTORY


HAYWARD SHORELINE MASTER PLAN
SAN FRANCISCO BAYLANDS
LEGEND
PROJECT BOUNDARY
STUDY AREA
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3 MI
PIEDMONT
ALAMEDA
OAKLAND
SAN FRANCISCO
ALAMEDA COUNTY
SAN LEANDRO
SAN FRANCISCO BAY
HAYWARD
SAN FRANCISCO INTERNATIONAL AIRPORT
SAN MATEO BRIDGE
UNION CITY
SAN MATEO
FREMONT
NEWARK
REDWOOD CITY
PALO ALTO

STUDY AREA

HAYWARD SHORELINE MASTER PLAN

The Hayward Regional Shoreline Master Plan study area is loosely defined. The northern-most boundary lies just above Lewelling Boulevard in San Lorenzo and the southern boundary is below Alameda Creek in Fremont. This study area is larger than the project area and was chosen to maximize available GIS data resources and provide a regional context for the smaller and more precisely designed project area.

Sources:

1. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)

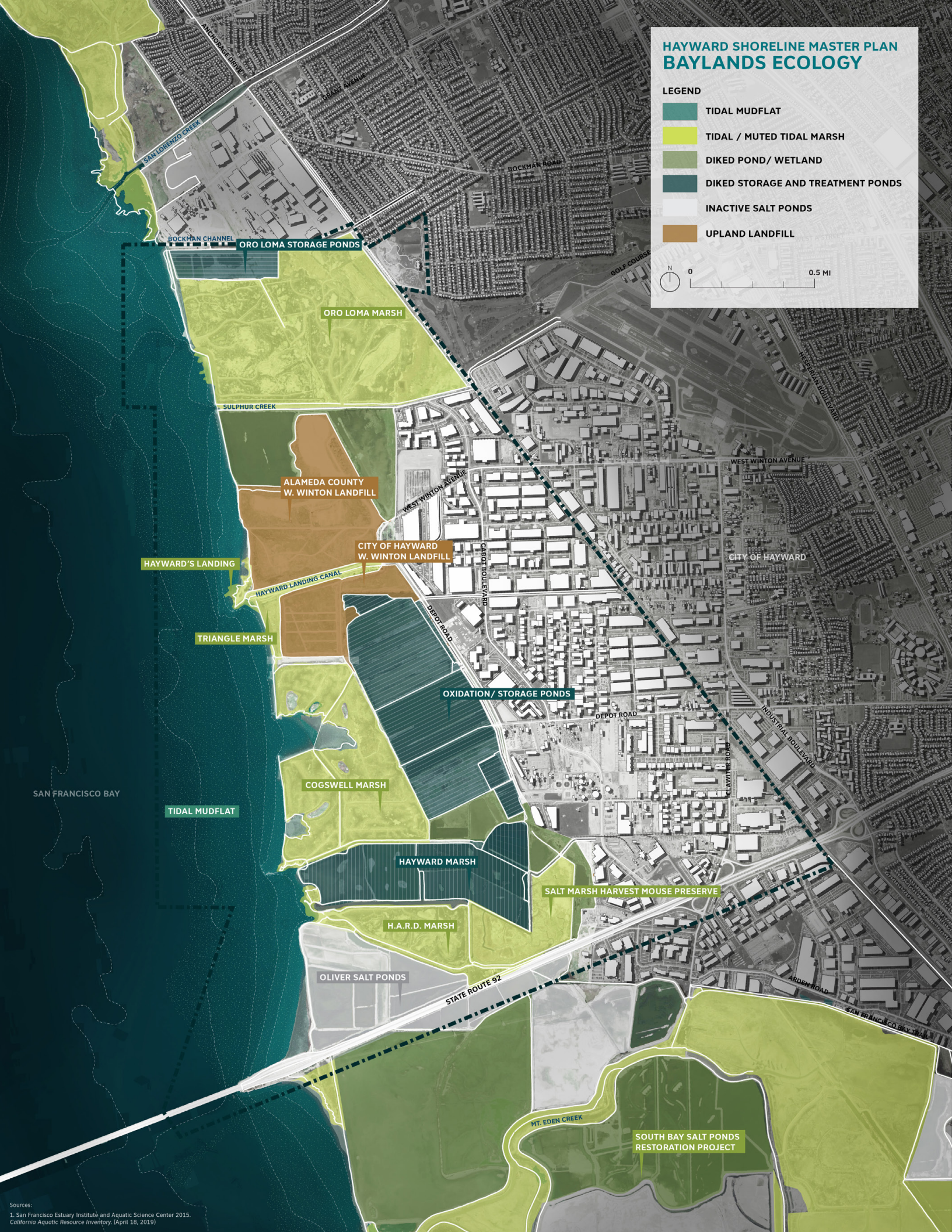
PROJECT AREA

HAYWARD SHORELINE MASTER PLAN

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 extents of the project area are drawn at the rail corridor. In total, the project area covers 6 square miles of various land uses, including open space, urban infrastructure, industrial, and residential.

Former oxidation ponds looking from West Winton Landfill

ECOLOGICAL RESOURCES



Sources:

1. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)

BAYLANDS TODAY

A MOSAIC OF ECOLOGY AND INFRASTRUCTURE

The Hayward Regional Shoreline is a mosaic of bayland environments that supports diverse wildlife habitats and critical urban infrastructure. Formerly a zone of tidal marshes and natural salt ponds, this stretch of shoreline has undergone sequential transformations, resulting in the current mix of restored tidal marshes, inactive industrial salt ponds, filtration marshes, storage ponds, diked wetlands, landfills, solar fields, and biosolids drying beds. Restored tidal marsh is a dominant condition within the Hayward Regional Shoreline Master Plan Project Area. The following includes short descriptions of each tidally influenced marsh.

Oro Loma Marsh is a 364-acre fully tidal marsh restored in 1997. Once diked and degraded wetlands, this area now supports robust habitats, including salt marsh vegetation, seasonal wetlands, high refugia mounds, and tidal flats. The west section of this marsh drains directly into the bay and the east section drains to the bay via Sulpher Creek.

Cogswell Marsh is 250 acres of formerly diked baylands fully restored to tidal marsh in 1980. A reintroduction of bay tidal exchange facilitated the development of a more robust tidal marsh and supported the establishment of federally endangered Salt Marsh Harvest Mouse and Ridgway's Rail populations. Constructed nesting mounds, excavated tidal channels, and invasive species management have also contributed to the success of this ecosystem.

Triangle Marsh is an 8-acre muted tidal marsh system restored in 1990. Robust marsh habitat has developed within the site, but the West Winton Landfill backs onto the site and prevents any further marsh expansion or migration.

HARD Marsh is a 79-acre, fully tidal marsh comprised of mudflats and low marsh habitats. Restoration efforts began in 1986, and currently the marsh does not contain any high ground or islands for wildlife refugia.

Salt Marsh Harvest Mouse Preserve is a 27-acre site of muted tidal marsh managed by East Bay Regional Park District (EBRPD) to maintain habitat for the federally endangered Salt Marsh Harvest Mouse. Currently, there is limited high ground within the site, resulting in the need for combination gates to manage water entering and exiting the system.

Fringe Marshes are established on the outboard side of levees along the shoreline. These areas support unique habitats such as small beaches and rocky intertidal habitat.

Diked baylands still exist within the project area, and most are used to support various infrastructures for the City of Hayward. Hayward Marsh, a 145-acre managed pond system, receives treated wastewater from Union Sanitary's Wastewater Treatment Plant. The system can also store and process excess waste water during wet weather events, when the East Bay Dischargers Authority (EBDA) pipeline infrastructure is at capacity. There is a unique combination of brackish and freshwater conditions, and this area hosts federally endangered species such as the California Least Tern and the Western Snowy Plover. Hayward Marsh is currently being considered for rehabilitation, as there are many infrastructure and habitat quality concerns.

Above Hayward Marsh are former wastewater oxidation ponds currently used for water storage during wet weather events. Immediately south of the ponds and adjacent to biosolids drying fields, is a field of solar panels. In the northern portion of the project area, additional solar panels and biosolid drying fields adjoin the Oro Loma Wastewater Treatment Plant.

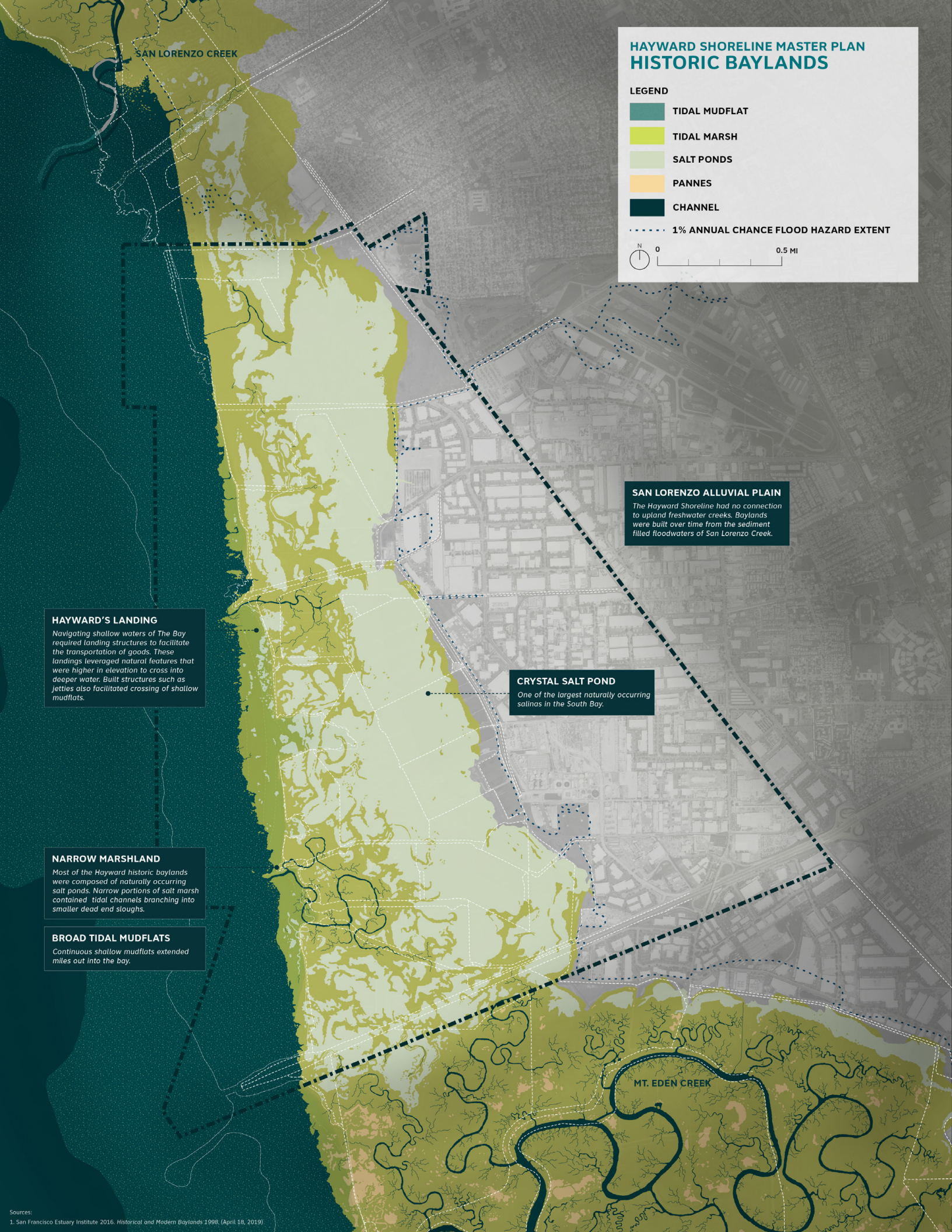
Landfills are concentrated in the center of the project area where tidal baylands were filled with unknown debris and waste. The City of Hayward owned West Winton Landfill was capped and closed in 1974, and current monitoring protocols show no contamination to adjacent baylands. North of the city owned landfill is an Alameda County-owned West Winton Landfill. Conversations with experts led the Project Team to identify this area of the project site most in need of further research due to unknown infrastructure conditions.

Inactive salt ponds and freshwater wetlands are also distributed throughout the site and contribute to habitat diversity. Some areas, such as the Oliver Salt Ponds, are historical resources that also support federally endangered bird species.

Sources:

1. Adapting to Rising Tides, Hayward Resilience Study. January 2015.

2. Phillip Williams and Associates, LTD., Preliminary Study of the Effects of Sea Level Rise on the Resources of the Hayward Shoreline. March 2010.



Sources:
1. San Francisco Estuary Institute 2016. *Historical and Modern Baylands 1998*. (April 18, 2019)

HISTORIC BAYLANDS

MARSHLAND CENTERED AROUND NATURAL SALT PONDS

Historical resources, analyzed by the San Francisco Estuary Institute. were used to understand Hayward's Bayland mosaic prior to rapid development in the late 1800s. Historical tidal marsh, tidal channels, tidal mudflats, and salt ponds were all a part of the Hayward Shoreline Bayland complex and defined a more unique stretch of shoreline in the South Bay. The site consisted of broad and continuous tidal mudflats adjacent to narrow marshland, with small tidal channels branching into smaller dead-end sloughs or expansive ponds. San Lorenzo Creek and Mt. Eden Creek bounded the site and were the main contributors of freshwater flows to the shoreline. Wet meadows and diffused intermittent freshwater sources flowed into the backs of marshes and salinas at a more local scale.

Salinas, expansive natural salt ponds, were the dominant feature along this stretch of the bay and were used to extract abundant natural salt resources through evaporation. The largest and therefore best-known salina was called the Crystal Salt Pond, a feature identified in Hayward's early shoreline surveys. The adjacent map shows the historical extent of this feature in relation to the project area.

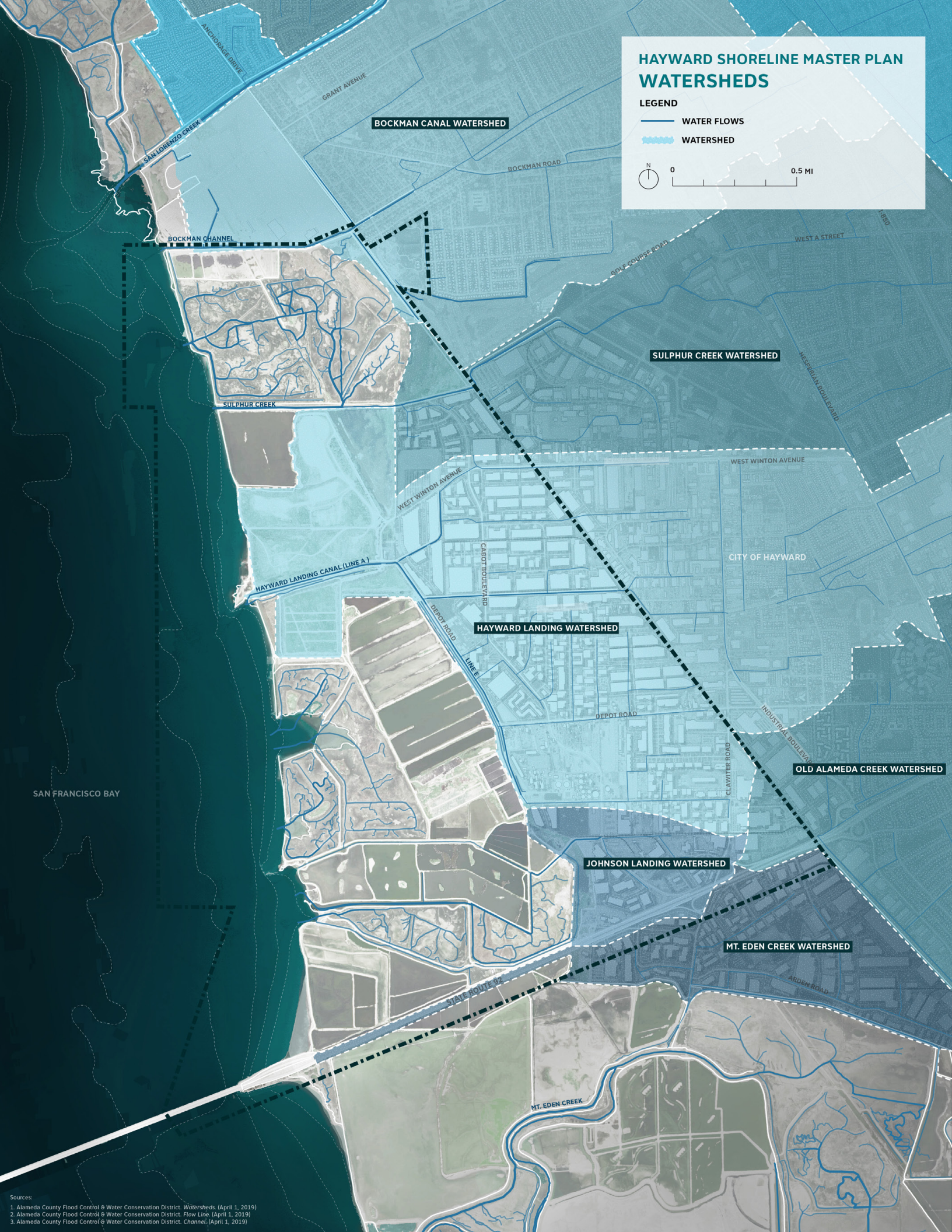
The original Hayward salinas were harvested by indigenous peoples and subsequent Western settlers industrialized the use of these ponds for large-scale, commercial salt production. Salt production drove rapid modifications of marsh resources, and with it the loss of diversity that had characterized the Bay's edge.

Historical map of the Hayward Shoreline.
(US Coast Survey, Mid 1800s.)

Sources:

1. San Francisco Estuary Institute and Oakland Museum of California, Baylands and Creeks of South San Francisco Bay. 2005.

2. San Francisco Estuary Institute, A Geographic History of San Lorenzo Creek Watershed. December 2003.



Sources:

1. Alameda County Flood Control & Water Conservation District. *Watersheds.* (April 1, 2019)
2. Alameda County Flood Control & Water Conservation District. *Flow Line.* (April 1, 2019)
3. Alameda County Flood Control & Water Conservation District. *Channel.* (April 1, 2019)

WATERSHEDS

CONNECTING URBAN RUNOFF TO THE BAY

Hayward is located in the San Lorenzo alluvial plain, and before the region was developed, water would flow from the East Bay hills into tidal creeks and distributary channels. During large storm events, San Lorenzo Creek would flood, spreading sediment-rich waters over large expanses of its floodplain. These deposits of sediment ultimately became the foundation for agricultural production and then the City of Hayward.

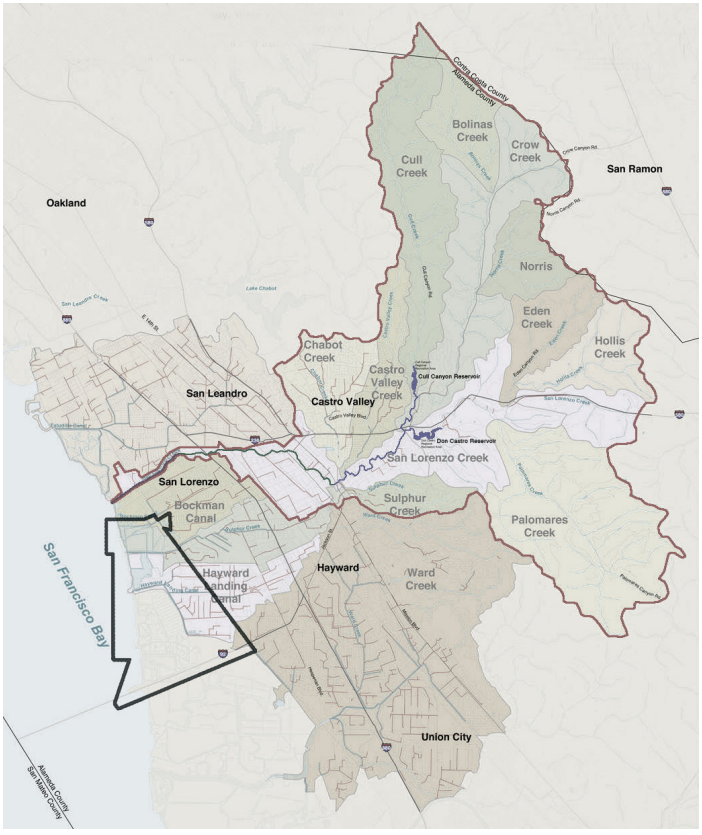
In the 1950s, as the rural region began to develop, flood control infrastructure was built to prevent waters from entering newly urbanized areas, and storm drain networks were used to direct runoff to the Bay. Today, all the watersheds draining to the Hayward shoreline consist entirely of underground culverts and engineered channels. The following paragraphs detail a general condition for each watershed connected to the Bay.

Hayward Landing Watershed: In this 3.4 square mile watershed, water flows from downtown Hayward to San Francisco Bay. Hayward Landing Channel, also known as Line A, is composed of open-air engineered canals that connect urban runoff from storm drains through the Hayward Regional Shoreline.

Sulphur Creek Watershed: Historically, this watershed flowed from the headwaters of Sulphur Creek, but flooding issues led to the diversion of the upper watershed into San Lorenzo Creek. Today, the watershed is 2.4 square miles and flows from downtown Hayward to the San Francisco Bay. Sulphur Creek Engineered Channel, also known as Line K, conveys stormwater runoff through various neighborhoods, industrial parks, and the Hayward Regional Shoreline.

Bockman Canal Watershed: In this 2.7 square mile watershed, water drains from residential neighborhoods through a network of storm drains and out to the Bay through the engineered Bockman Channel.

Expansive impervious surfaces and industrial areas in watersheds adjacent to the Hayward Regional Shoreline.
(SCAPE Site Photos, 2019)



San Lorenzo Creek watershed in realtion to the Hayward Master Plan project area.
(Alameda County Public Works, 2006)

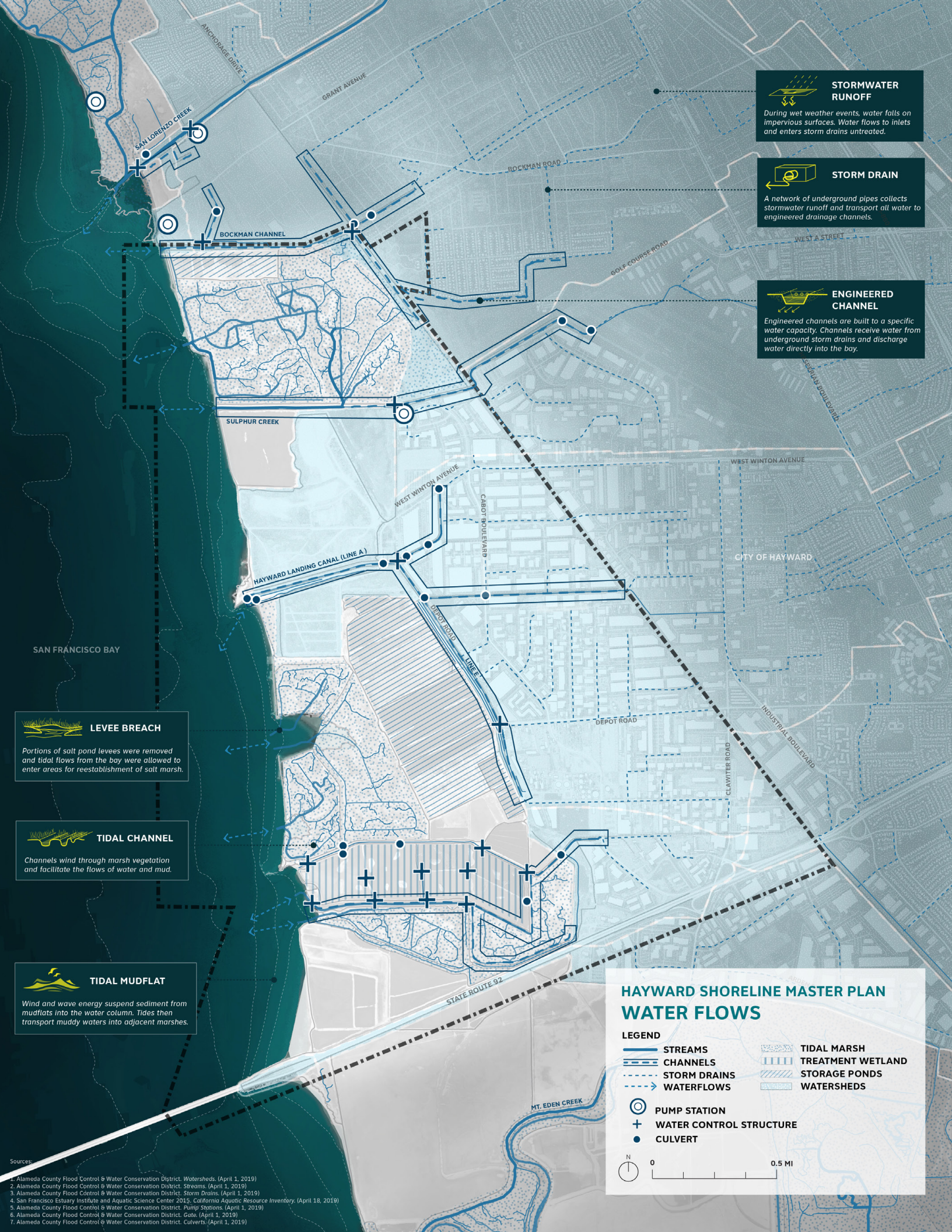
Sources:

1. Alameda County Flood Control and Water Conservation District, Bockman Canal, Sulphur Creek, Hayward Landing Watersheds. 2014.

2. Alameda County Flood Control and Water Conservation District, Interactive Map: Alameda County Watersheds. 2019.

3. San Francisco Estuary Institute, A Geographic History of San Lorenzo Creek Watershed. December 2003.

4. Phillip Williams and Associates, LTD., Preliminary Study of the Effects of Sea Level Rise on the Resources of the Hayward Shoreline. March 2010.



Sources:

1. Alameda County Flood Control & Water Conservation District. *Watersheds.* (April 1, 2019)
2. Alameda County Flood Control & Water Conservation District. *Streams.* (April 1, 2019)
3. Alameda County Flood Control & Water Conservation District. *Storm Drains.* (April 1, 2019)
4. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)
5. Alameda County Flood Control & Water Conservation District. *Pump Stations.* (April 1, 2019)
6. Alameda County Flood Control & Water Conservation District. *Gate.* (April 1, 2019)
7. Alameda County Flood Control & Water Conservation District. *Culverts.* (April 1, 2019)

WATER CONNECTIVITY

A HYBRID SYSTEM OF MANAGED AND UNMANAGED FLOWS

The patterns of water entering, exiting, and circulating within the Hayward Regional shoreline have been repeatedly modified since the mid-1800s. Today, a series of structures, channels, culverts, and pipes control the movement of water to meet operational needs for the City of Hayward and habitat needs for specific baylands. In contrast, many baylands along the Hayward Regional shoreline have been opened to fully tidal waters of the San Francisco Bay.

Using data from Alameda County Flood Control and Water Conservation District and the City of Hayward, the Project Team has highlighted critical infrastructure features throughout the Hayward Regional Shoreline Master Plan Project Area. Short descriptions of each are listed below.

Storm Drains: During wet weather events, urban runoff from industrial, residential, and commercial zones is collected into a network of pipes. These pipes connect directly to various engineered channels that cross the Hayward Regional Shoreline and ultimately discharge water into the Bay.

Engineered Flood Control Channels: Line A, also known as the Hayward Landing Canal, is a major flood control channel within the site. An existing water control structure located at the Bay's edge is needed to limit sediment flows while still allowing for tidal exchange. Line A is also connected to Line E, another tidally influenced engineered flood control channel, which runs parallel to the shoreline. Both collect and convey stormwater runoff from the Hayward Landing Watershed.

Engineered Drainage Channels: Bockman Channel, Sulphur Creek, and Johnson Landing Canal are all engineered channels that cross the Hayward Regional Shoreline to drain collected urban runoff from the City of Hayward. These channels are tidally influenced and discharge directly to the Bay, but upstream water control structures in the form of tide gates and culverts manage the flows of water.

Pump Stations: In low lying flood plain areas, pump stations collect and direct stormwater from urbanized locations. Water is then transferred to the proper flood control bays and channels.

Tidal Baylands: While water flows in some areas within the Hayward Regional Shoreline are controlled through various infrastructures, restoration efforts have allowed for larger portions of the project area to be tidally influenced, with no water management necessary. In these areas, water flows through breached levees into tidal channels and through smaller marsh sloughs.

Residential communities adjacent to the Bockman Channel. (SCAPE Site Photos, 2019)

Water control structure at the end of flood control channel Line A. (SCAPE Site Photos, 2019)

Sources:

1. Alameda County Flood Control and Water Conservation District, Interactive Map: Alameda County Watersheds. 2019.

2. Phillip Williams and Associates, LTD., Preliminary Study of the Effects of Sea Level Rise on the Resources of the Hayward Shoreline. March 2010.

3. Adapting to Rising Tides, Hayward Resilience Study. January 2015.

4. Alameda County Public Works, Pump Station Online Description. https://www.acpwa.org/pas/pump-stations. 2019.

Sources:

1. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)

BAYLAND PROFILE

3D VISUALIZATION

The Hayward Regional Shoreline comprises intricate infrastructures and ecosystems. This mosaic and complexity can be better comprehended when looking at the various relative elevations of the baylands components. To unpack conditions along the site, the Project Team developed representative volumetric drawings as a tool to show how various portions of the shoreline interact with one another. The locations of each of the six axonometric sections are depicted in the adjacent map.

Horizontal Levee at Oro Loma Sanitary District

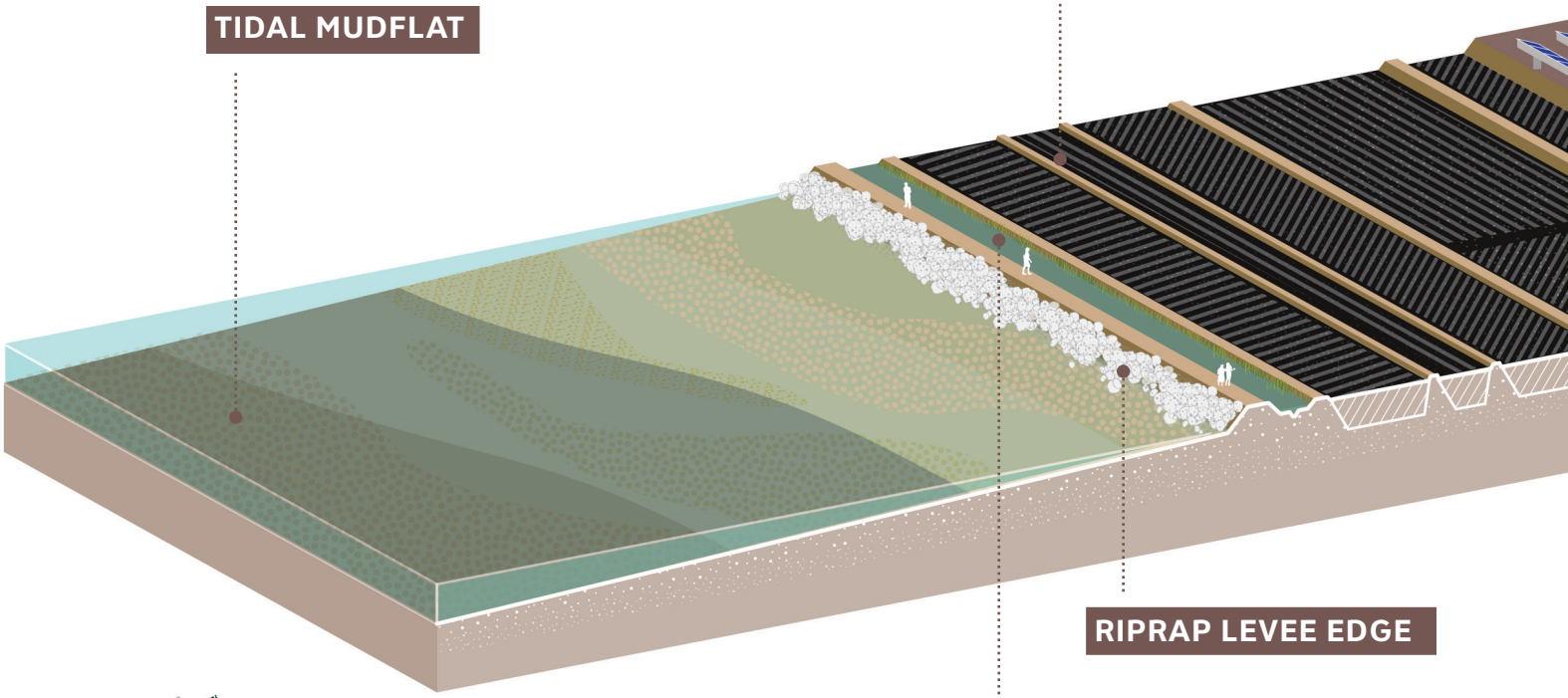
ORO LOMA BAYLAND COMPLEX

CONVERTED BAYLANDS FOR INDUSTRIAL USE AND RESTORATIO

BIOSOLID DRYING BEDS

Used by Oro Loma wastewater treatment facility to air dry processed biosoild material

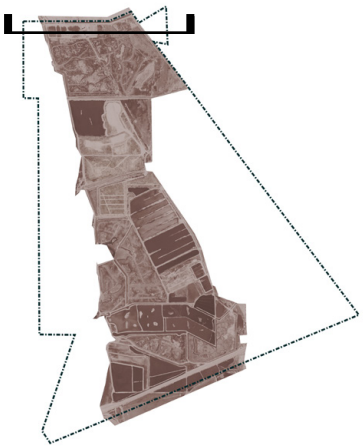
TIDAL MUDFLAT



RIPRAP LEVEE EDGE

TIDAL CHANNEL

Directs bay water into and out of nearby marshes



N

RAIL CORRIDOR

Industrial transportation infrastructure, pipelines, and utility corridor

RESIDENTIAL NEIGHBORHOOD

Low-density, single family post-war housing

ORO LOMA MARSH

Restored tidal marsh behind filled baylands

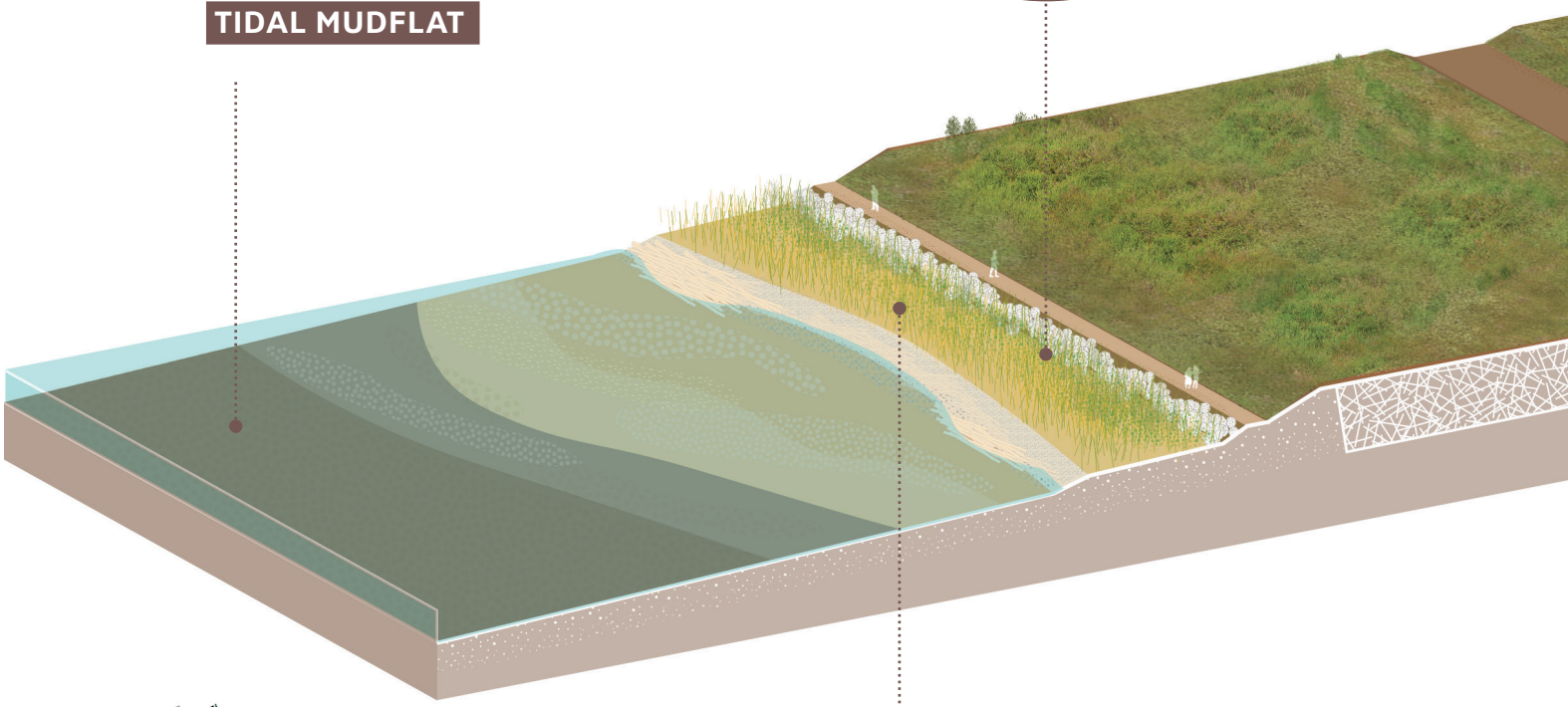
SOLAR PANEL FIELD

Oro Loma Sanitary District energy infrastructure built on former biosolid drying beds

West Winton Landfill looking at Hayward Landing Canal (Line A)

FILLED BAYLANDS

VULNERABLE LANDFILL INFRASTRUCTURE AT THE BAY'S EDGE



TIDAL MUDFLAT

FRINGE MARSH

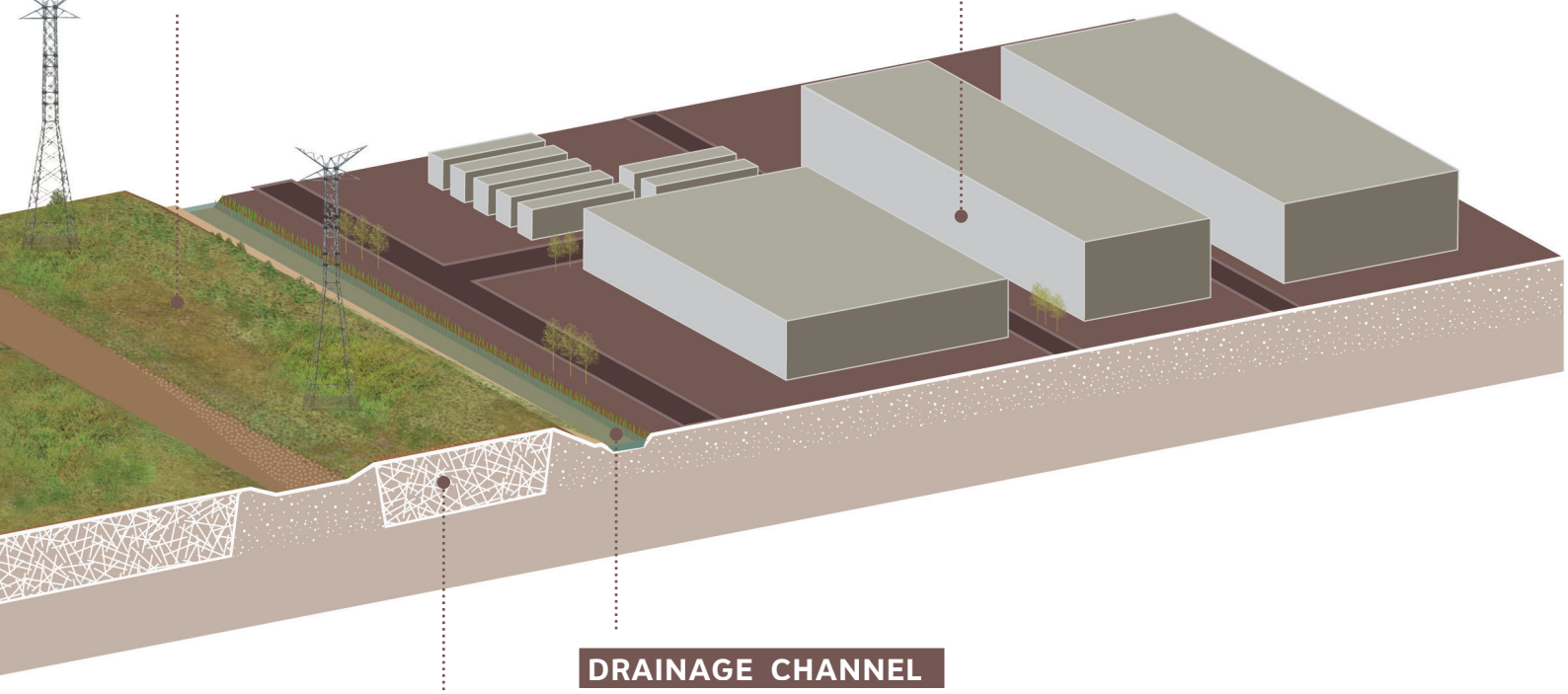
Older marsh condition on outboard side of the levee with unique beach and intertidal habitats

ALAMEDA COUNTY
W. WINTON LANDFILL

This landfill sits directly at the Bay's edge and was not designed to experience inundation or wave action

INDUSTRIAL DEVELOPMENT

Privately-owned industrial buildings and warehouses



DRAINAGE CHANNEL

LANDFILL CONTAINMENT

Unknown condition regarding landfill cap and contents of landfill

West Winton Landfill looking towards Cogswell Marsh

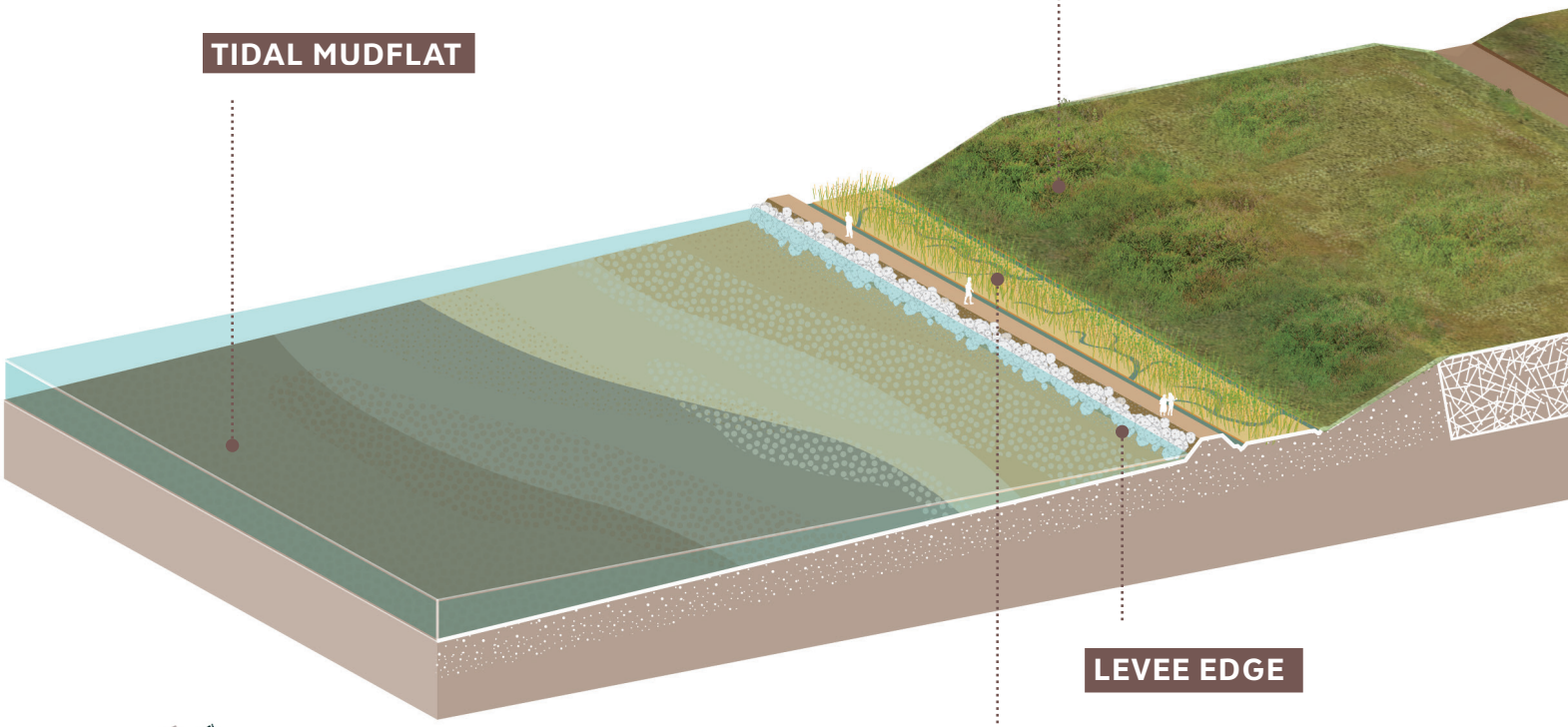
THE BAYLAND SQUEEZE

INFRASTRUCTURE PREVENTING MARSH MIGRATION

CITY OF HAYWARD
W. WINTON LANDFILL

Former landfill closed in 1974. Contents of landfill are unknown and infrastructure is vulnerable to future bay inundation

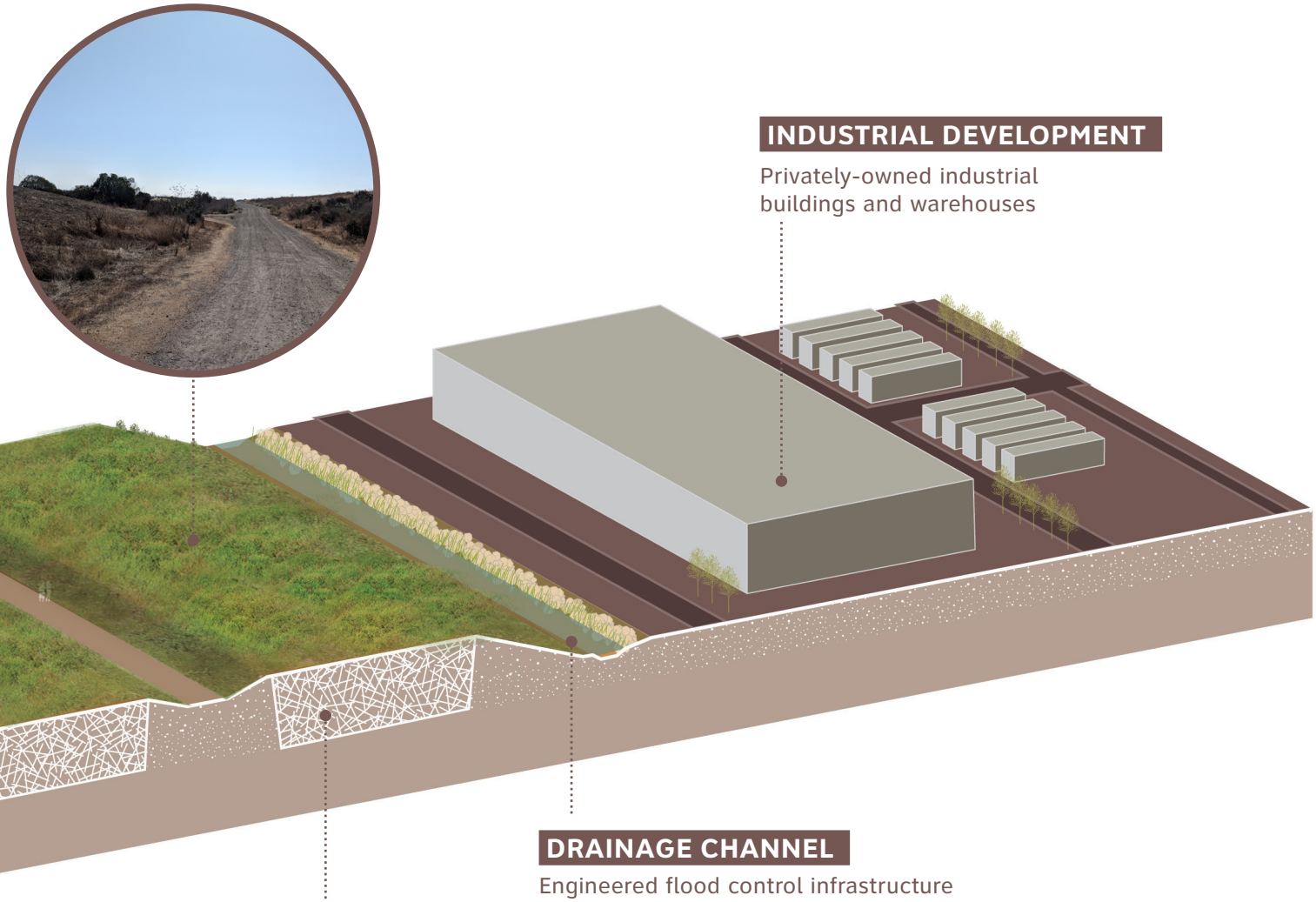
TIDAL MUDFLAT



LEVEE EDGE

TRIANGLE MARSH

Restored tidal marsh with limited migration opportunities due to landfill infrastructure



INDUSTRIAL DEVELOPMENT

Privately-owned industrial buildings and warehouses

DRAINAGE CHANNEL

Engineered flood control infrastructure that is tidally influenced and receives stormwater runoff from urbanized areas

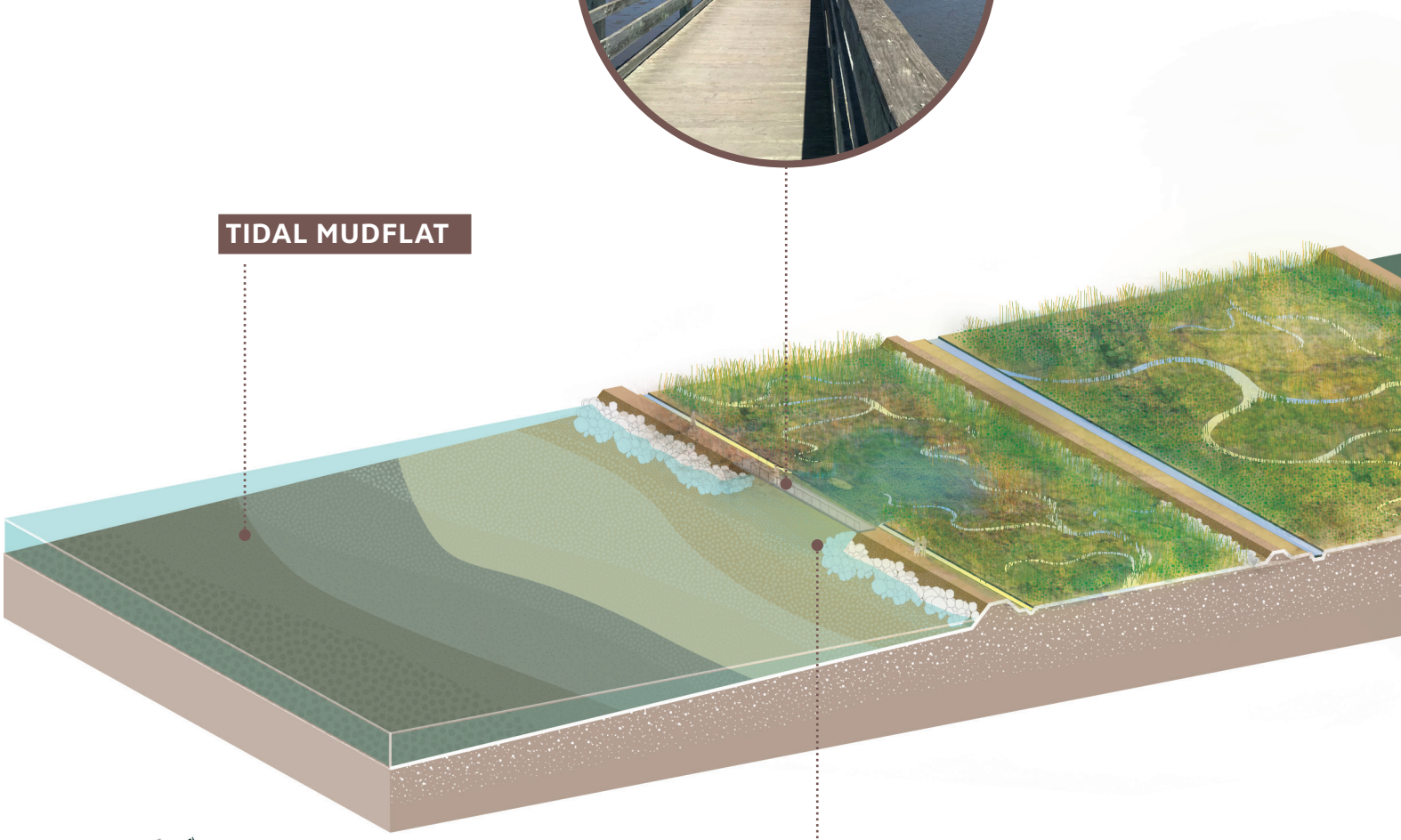
LANDFILL CONTAINMENT

Capped landfill regularly monitored for leaching

Bridge crossing at Cogswell Marsh

BREACHED AND CONTAINED BA

BAYLANDS FOR WATER ABSORPTION AND STORAGE



Outboard levee breached to allow tidal influence into baylands. Due to the breach's wide condition, tidal marsh has seen erosion

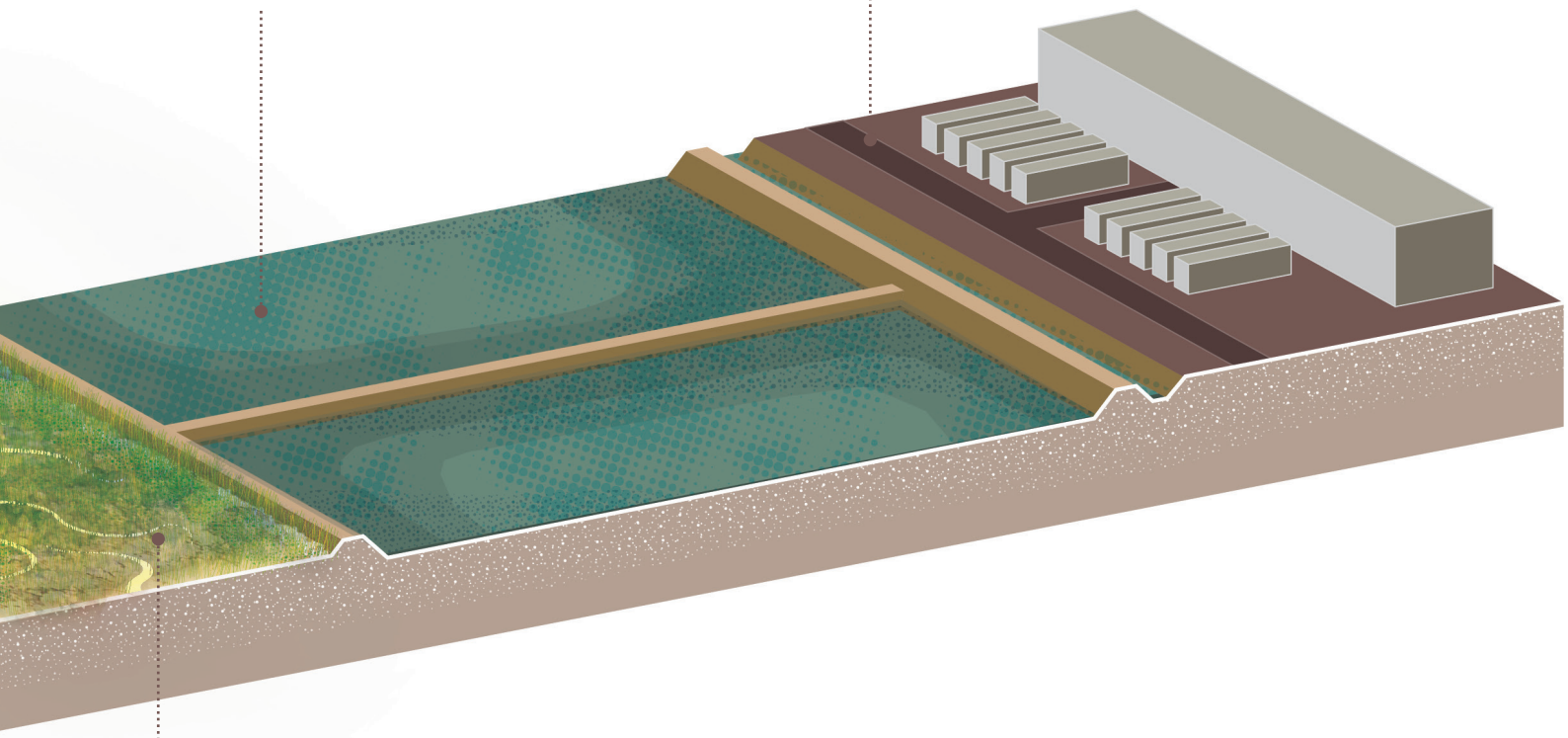
YLANDS

INDUSTRIAL DEVELOPMENT

Large recently built industrial buildings and yards

FORMER OXIDATION PONDS

Shallow ponds used for wastewater overflow during wet weather events



COGSWELL MARSH

Restored tidal marsh that supports endangered species. Mounds with high tide refugia exist in this marsh complex as well

Cogswell marsh levee adjacent to the Bay

TREATMENT MARSH MOSAIC

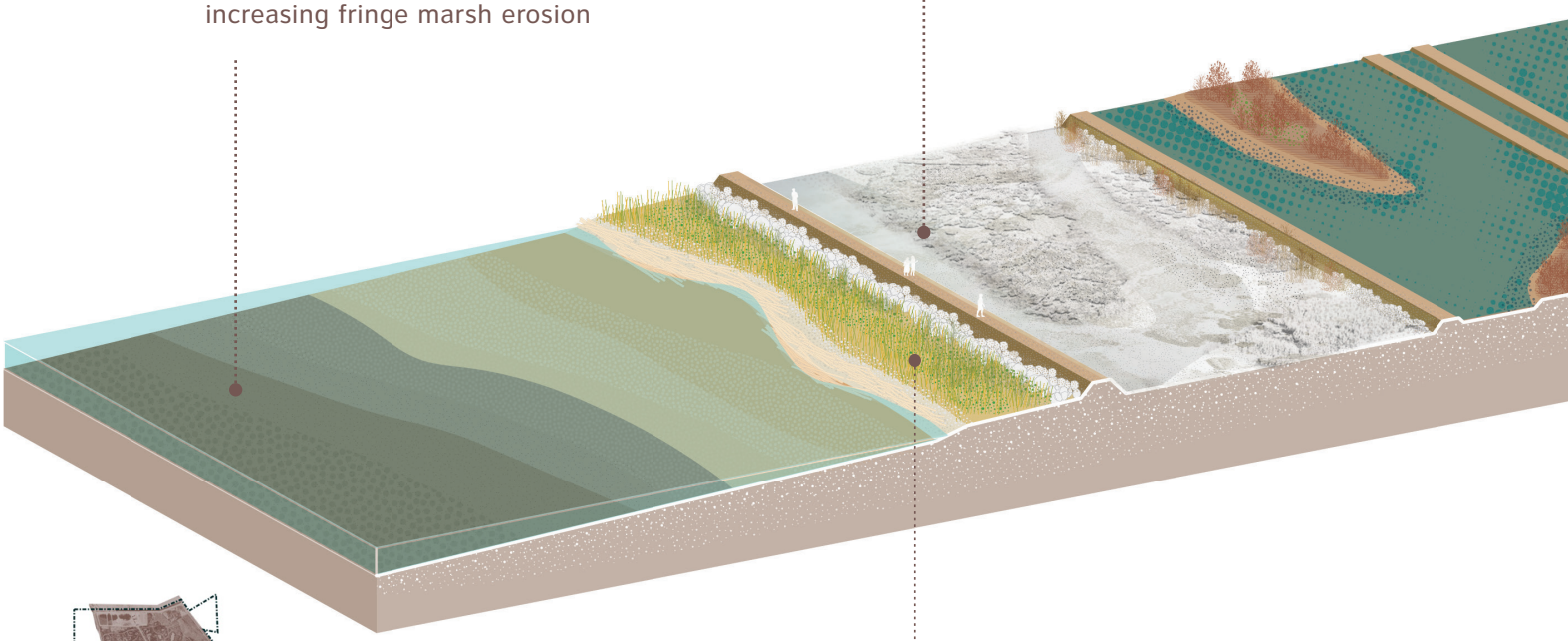
BAYLANDS SUPPORTING WASTEWATER FILTRATION AND ENDAN

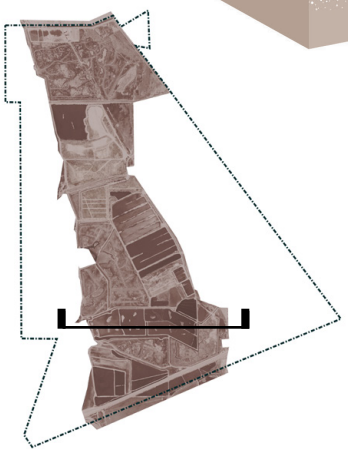
BRACKISH HAYWARD MARSH PONDS

Tide waters are allowed to enter these ponds through water control structure. Mixing of saltwater and freshwater create brackish conditions

TIDAL MUDFLAT

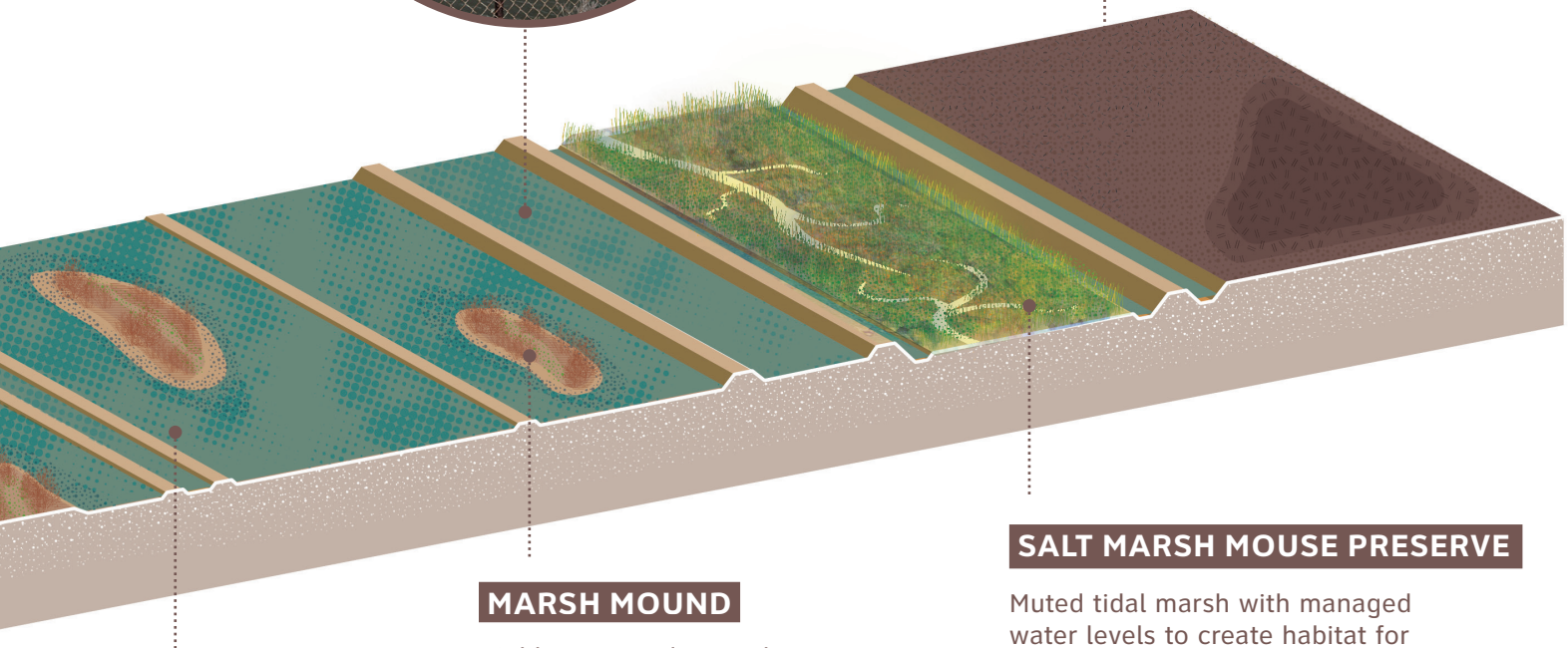
Mudflats are currently lowering, increasing fringe marsh erosion





FRINGE MARSH

NGERED SPECIES



UNDEVELOPED LAND

Intermediary between marshes and adjacent industrial developments

SALT MARSH MOUSE PRESERVE

Muted tidal marsh with managed water levels to create habitat for the Salt Marsh Harvest Mouse

MARSH MOUND

Highly managed mounds to support Least Tern and Snowy Plover habitat

HAYWARD MARSH

Five-basin managed pond system that receives treated wastewater from Union Sanitary District and discharges to the Bay

HARD Marsh looking towards Calpine - Russle City Energy Center

BAYLAND HABITAT GRADIENTS

DIVERSE ECOSYSTEMS AS EDUCATIONAL TOOLS

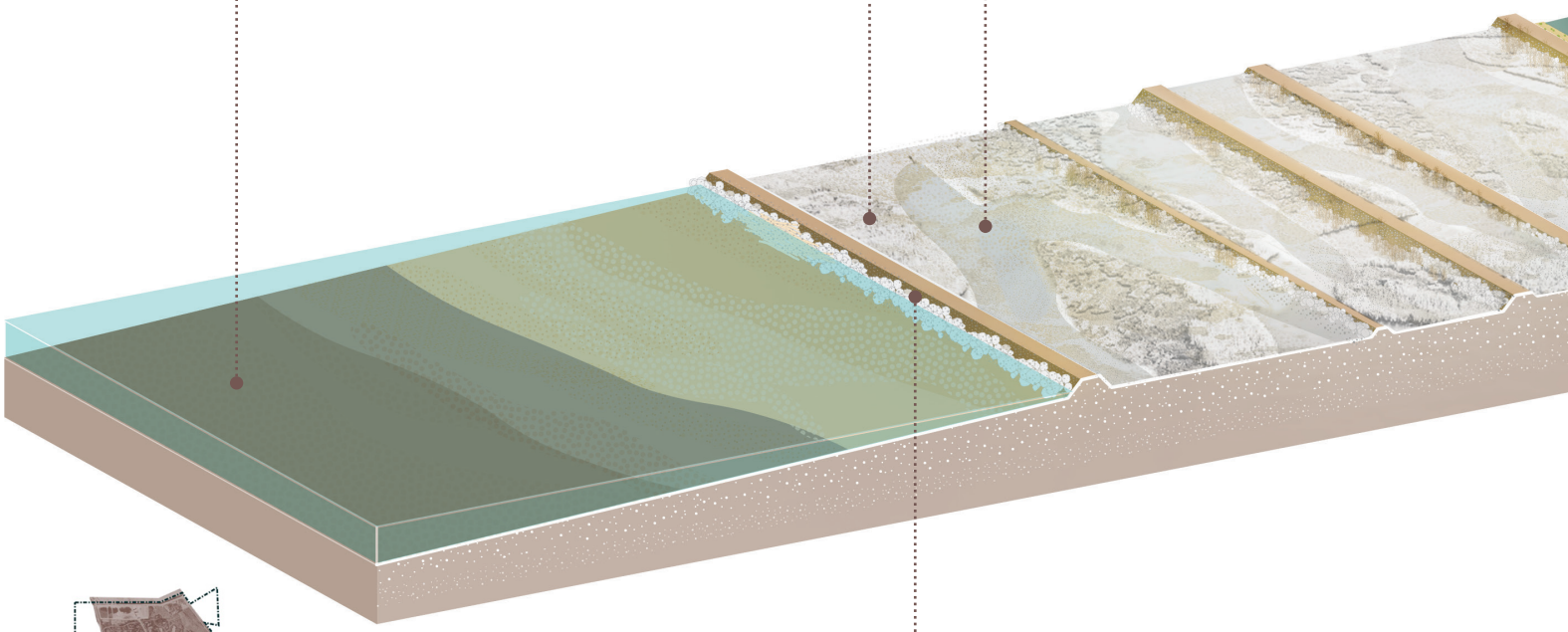
OLIVER SALT PONDS

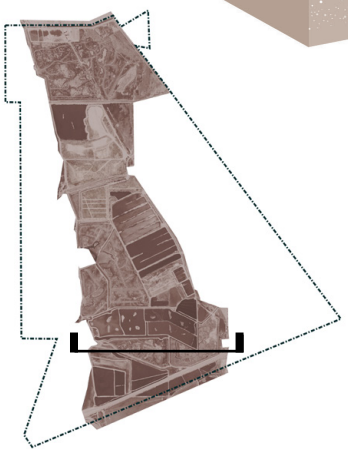
Former commercial salt ponds recently enhanced to provide nesting habitat for Snowy Plovers

ARCHIMEDES SCREW

Historic resources that can be seen from salt pond levees

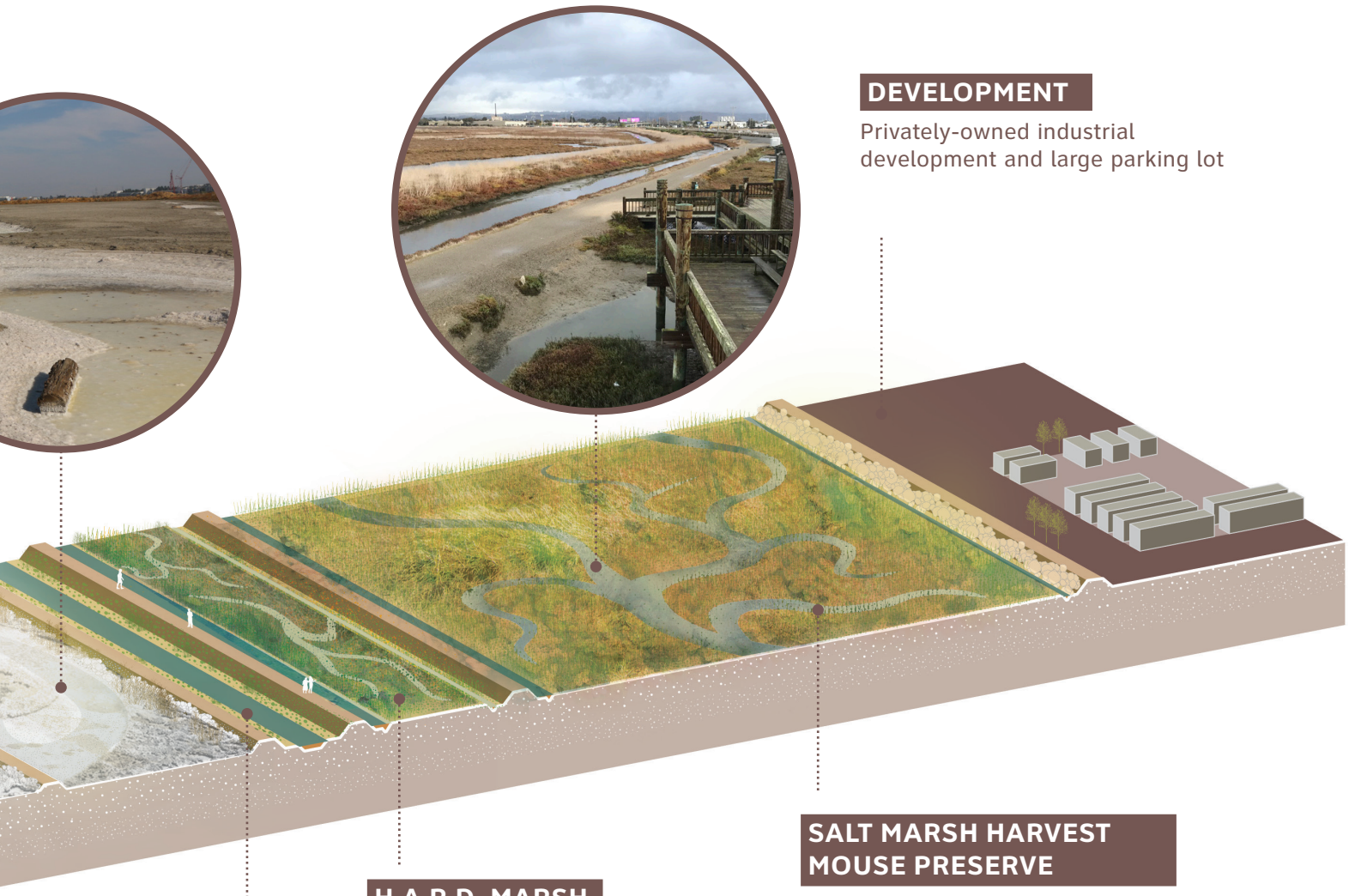
TIDAL MUDFLAT





LEVEE EDGE

Outboard levees were repaired and raised in 2012



DEVELOPMENT

Privately-owned industrial development and large parking lot

SALT MARSH HARVEST MOUSE PRESERVE

H.A.R.D. MARSH

Restored tidal marsh used by the Hayward Shoreline Interpretive Center for education programs

TIDAL CHANNELS

Sources:

1. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)
2. The Cornell Lab of Ornithology. eBird Hotspots Map. *Year-Round, Past Ten Years.* (April 18, 2019)
3. The Cornell Lab of Ornithology. eBird Species Map. *Year-Round, Past Ten Years.* (April 18, 2019)

ENDANGERED SPECIES

DIVERSE HABITATS SUPPORTING WILDLIFE

Since the early 1980s, the marshes along the Hayward Regional Shoreline have been restored to improve habitat value. Oro Loma Marsh, Cogswell Marsh, and HARD Marsh are representative of large systems restored to tidal marsh, and as a result many endangered species now thrive in these areas. Smaller restoration efforts have expanded this work incrementally, further increasing resources for wildlife along the shoreline.

Below are descriptions of various endangered species habitat requirements and supporting habitats along the Hayward Regional Shoreline.

Ridgsway's Rail, *Rallus obsoletus*: These birds nest and feed in tidal salt marshes. The Ridgsway's Rail rarely flies, instead they build nests adjacent to small tidal sloughs for foraging and quick escapes from predators. Ridgsway's Rails also prefer to construct "brood nests" on higher ground to protect their young, so it is essential that marshes contain features with higher elevations. Cogswell Marsh, Oro Loma Marsh, and Triangle Marsh all provide the habitats required by Ridgsway's Rail populations.

California Least Tern, *Sternula anrilarus brownie:* Sandy beaches, berms, and mudflats are typical habitats needed for nesting Least Terns. Vegetative growth is cleared by the tides, and this allows bird colonies to establish themselves. Elevated mounds have been established within Hayward Marsh to support the only Least Tern Colony in the South Bay.

Western Snowy Plover, *Charadrius alexandrinus nivosus:* Snowy Plovers forage in both wet or dry beach conditions, and nest above the high tide line on coastal beaches, dunes, and salt pans; less common habitats are dry salt ponds. Along the Hayward Regional Shoreline, Snowy Plover nests have been observed at the Oliver Salt Ponds as well elevated mounds within Hayward Marsh.

Salt Marsh Harvest Mouse, *Reithrodontomys raviventris:* The Salt Marsh Harvest Mouse lives within dense stands of pickleweed, where it can swim and climb to forage and nest. During high tides, the Salt Marsh Harvest Mouse must retreat to high ground or to mature marsh plant communities with high vegetative structure. Oro Loma Marsh, Cogswell Marsh, Triangle Marsh, and the Salt Marsh Harvest Mouse Preserve are habitats along the Hayward Shoreline that provide the range of marsh elevations needed for these small rodents.

Eelgrass, *Zostera marina:* Intertidal and shallow subtidal areas support the growth of eelgrass at the breach of Cogswell Marsh. Eelgrass populations have been identified at that location, and the Hayward Shoreline presents additional opportunities for future eelgrass restoration.

EBRPD Park Staff on Least Tern nesting site in Hayward Marsh. (Rick Lewis, 2015)

Sources:

1. San Francisco Estuary Institute, Baylands Ecosystem Habitat Goals Science Update. October 2015.

2. Adapting to Rising Tides, Hayward Shoreline Asset Vulnerability and Risk Profile Sheets. March 2015.

3. Adapting to Rising Tides, Existing Conditions and Stressors Report- Structural and Natural Shorelines.

4. EPA, California Clapper Rail: Endangered Species Fact Sheet. February 2010.

Sources:

1. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)

SEDIMENT

THE BUILDING BLOCK OF BAYLANDS

Creek flooding built up Hayward's baylands over centuries. Natural banks were overtopped by floodwaters and allowed sediment to settle on the floodplain. Hayward was a part of the San Lorenzo alluvial plain, but after creek channelization in the mid-1950s, sediment-rich water could no longer reach the baylands.

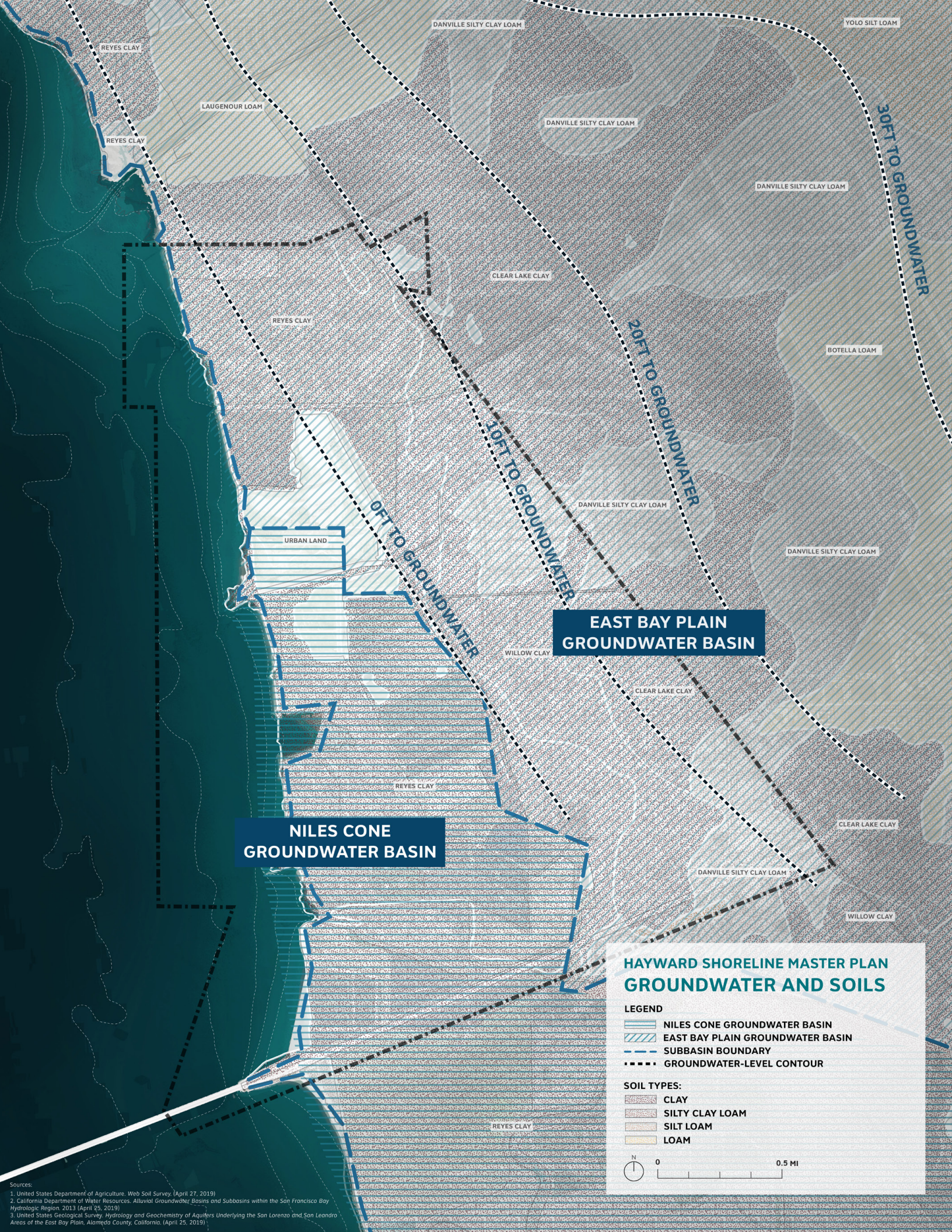
As sea levels rise, the accretion of sediment is critical to bayland survival. Without deposits of this muddy material, tidal marshes and mudflats will not be able to withstand rising water levels, and this will ultimately lead to marsh decline and marsh drowning.

Experts at the Department of California Fish and Wildlife, San Francisco Estuary Institute, and the US Army Corps of Engineers referenced an average sediment accretion rate of 6 mm per year for the baylands, and this number was factored into all sediment calculations. For the South Bay, accretion rates tend to be higher because of increased tributary sediment inputs, water depths, and hydrodynamic flows that hold sediment within the lower portions of the bay. It is important to note that scientists are actively researching sediment accretion in the Bay and data on this topic is subject to change.

The adjacent map looks at two sediment need scenarios for tidal baylands of the Hayward Regional Shoreline: a moderate scenario of three feet of sea level rise by 2100, and a more extreme scenario with seven feet of sea level rise by 2100. From this high-level analysis, results showed that even the more moderate sea level rise scenario outpaces the marsh building process, resulting in extreme sediment deficits.

With climate change, low-sediment or high-sediment conditions differentially impact accretion rates for bayland resources. Because of this, it is crucial to consider sediment sources and their potential to deliver material to the bay.

Mudflats along the Hayward Regional Shoreline contain fine sediments that become suspended in the water column and feed adjacent marshes.
(SCAPE Site Photos, 2019)



HAYWARD SHORELINE MASTER PLAN

GROUNDWATER AND SOILS

LEGEND

- NILES CONE GROUNDWATER BASIN
- EAST BAY PLAIN GROUNDWATER BASIN
- SUBBASIN BOUNDARY
- GROUNDWATER-LEVEL CONTOUR

SOIL TYPES:

- CLAY
- SILTY CLAY LOAM
- SILT LOAM
- LOAM

N

0 — 0.5 MI

Sources:

1. United States Department of Agriculture. *Web Soil Survey.* (April 27, 2019)
2. California Department of Water Resources. *Alluvial Groundwater Basins and Subbasins within the San Francisco Bay Hydrologic Region.* 2013 (April 25, 2019)
3. United States Geological Survey. *Hydrology and Geochemistry of Aquifers Underlying the San Lorenzo and San Leandro Areas of the East Bay Plain, Alameda County, California.* (April 25, 2019)

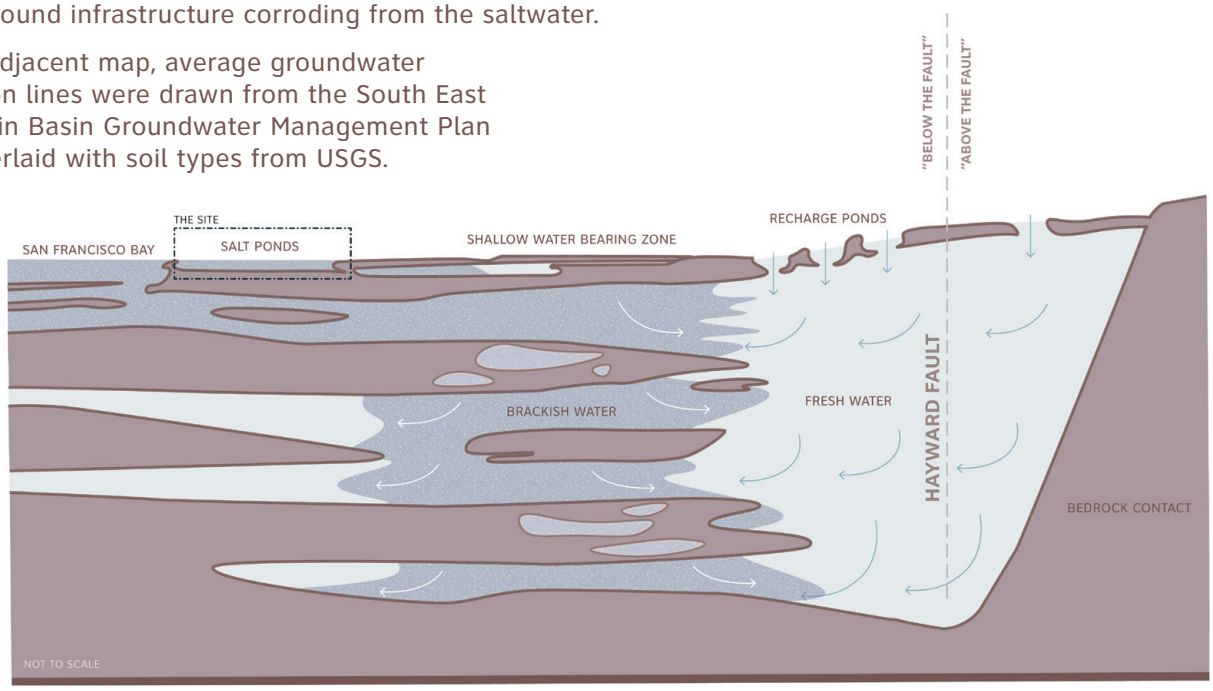
GROUNDWATER

WATER TABLE DEPTHS ALONG HAYWARD SHORELINE

The city of Hayward sits over two groundwater sub-basins: the East Bay Plain and the Niles Cone. Currently, Hayward does not use groundwater for its regular water supply, but the city government serves as a Groundwater Sustainability Agency (GSA). The GSA is a local entity responsible for developing Groundwater Sustainability Plans to manage groundwater resources, addressing issues such as groundwater recharge, saltwater intrusion, and contamination hazards.

There is currently limited information regarding sea level rise impacts on the groundwater table, but preliminary research conducted by academics in the Bay Area shows there may be significant repercussions for urban and suburban developments built above shallow water tables. As rising seas move further inland, saltwater encroaches on underground aquifers. The impacts of sea level rise are therefore exacerbated by what specialist are calling "groundwater rise, "the term for freshwater pushed up through the ground by saltwater intrusion. Some of the potential impacts are water leaching into homes, sewers and toilets backing up, and underground infrastructure corroding from the saltwater.

In the adjacent map, average groundwater elevation lines were drawn from the South East Bay Plain Basin Groundwater Management Plan and overlaid with soil types from USGS.



Groundwater aquifer interactions between freshwater and saltwater represented with reclamation and recharge processes.
(Alameda County Water District, Reliability by Design: Integrated Resources Planning. 2014)

Sources:

1. East Bay Municipal Utility District. South East Bay Plain Basin Groundwater Management Plan. March 2013.

2. USGS. Web Soil Survey. May 2019.

3. City of Hayward, Sustainable Groundwater Management. https://www.hayward-ca.gov/content/sustainable-groundwater-management

Sources:

1. California Department of Conservation. *CGS Information Warehouse: Regulatory*, Landslides. (April 22, 2019)
2. California Department of Conservation. *CGS Information Warehouse: Regulatory*, Liquefaction. (April 22, 2019)
3. California Department of Conservation. *CGS Information Warehouse: Regulatory*, Fault Trace. (April 22, 2019)
4. Association of Bay Area Governments. *Liquefaction Susceptibility Map*. (April 22, 2019)

GEOLOGY

EARTHQUAKE HAZARDS AND LIQUEFACTION

The Hayward Fault runs along the East Bay directly adjacent to densely populated areas including Berkeley, Oakland, Hayward, and Fremont. According to USGS, this condition makes the Hayward Fault the "single most urbanized earthquake fault in the United States." The last major earthquake in the region was on October 21, 1868 at a magnitude of 6.8, with the most intense shaking along a 20-mile stretch of fault between Fremont and San Leandro. Although the region was sparsely populated at the time, impacts were devastating and resulted in significant damage to virtually every built structure in the region.

Researchers at USGS have confirmed that the area is due to receive another high magnitude earthquake within this century, so it is critical for the region to prepare. In particular, an earthquake could cause soils already permeated by encroaching seawater to liquefy. In the adjacent map, USGS fault data and USGS liquefaction hazard zones are represented to show the project area in relation to geologic risks.

Alameda County Courthouse destroyed by the 1868 earthquake.
(Hayward Area Historical Society, 2019)

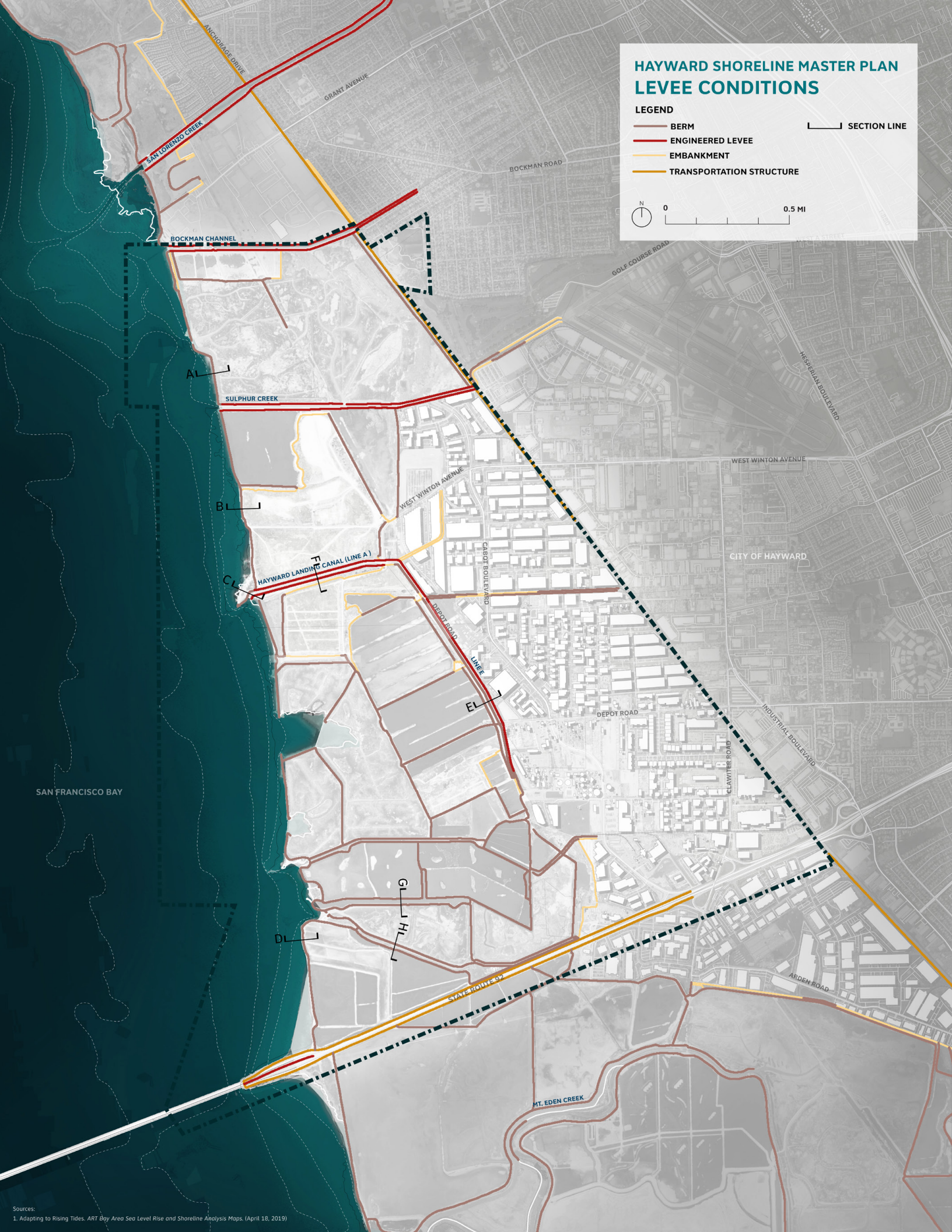
ShakeMaps for the 1868 Hayward Quake.
(USGS, 2008)

Sources:

1. USGS. The Hayward Fault- Is It Due for a Repeat of the Powerful 1868 Earthquake? October 2018.

2. Earth. The Most Dangerous Fault in America. May 2016.

INFRASTRUCTURE



Sources:
1. Adapting to Rising Tides. *ART Bay Area Sea Level Rise and Shoreline Analysis Maps.* (April 18, 2019)

LEVEE TYPES

EXISTING SHORELINE CONDITIONS

Starting in the late 1800s, a network of levees was built to create ponds for commercial salt production along the Hayward shoreline. These structures consisted of compacted bay mud and varied greatly in design characteristics. While today these non-engineered berms provide some buffer to sea level rise and extreme storm events, their foundations are decades old, and were not built to accommodate any flood risk or handle bay conditions compounded by the effects of climate change.

The outboard levees have seen some structural improvement in the form of riprap revetments, but even this infrastructure strengthening does not meet specific design criteria for flood protection. In the Adapting to Rising Tides Hayward Resilience Study, maintenance of shoreline levees is described as "reactive," often delayed until after storm damages occur. The study also notes that shoreline erosion is a common issue along the site, further compounding the poor structural condition of outboard levees.

Inboard levees along the shoreline extend landward into the project area and surround most bayland marsh and pond conditions. Most of these levees are still present as earthen berms with little to no riprap reinforcement.

Although most of the shoreline condition is non-engineered berms, engineered levees have been built for drainage channels and flood control channels. These channels receive stormwater runoff from the City of Hayward and direct those flows across the Hayward Regional Shoreline and out to the Bay.

Image 1: Outboard levee condition composed of construction debris. Image 2: Eroding outboard levee and gravel trail.
(SCAPE Site Photos, 2019)

Inboard levee condition composed of compacted soil with vegetation growing overtop.
(SCAPE Site Photos, 2019)

Sources:

1. Adapting to Rising Tides, Existing Conditions and Stressors Report- Structural and Natural Shorelines. 2015.

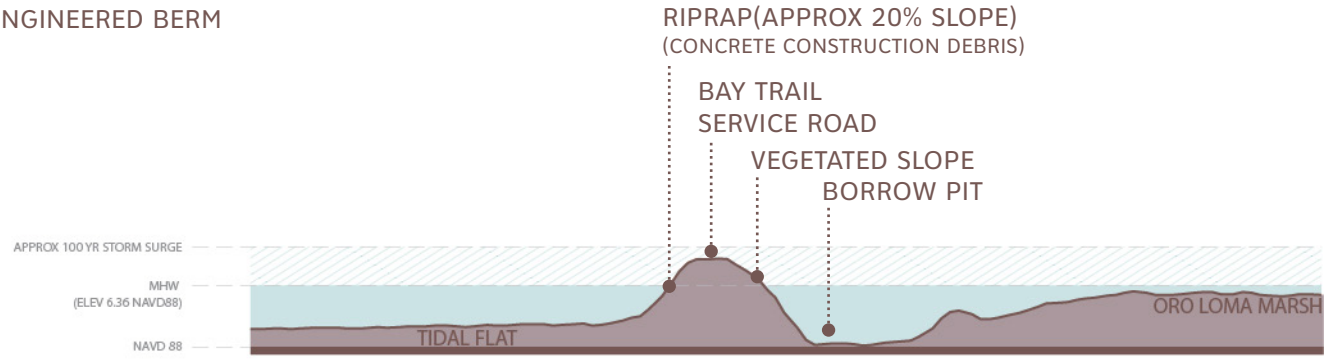
2. Adapting to Rising Tides, Hayward Shoreline Asset Vulnerability and Risk Profile Sheets. March 2015.

3. SFEI, San Francisco Bayshore Inventory, 2016.

OUTBOARD LEVEE CONDITIONS

MARSH

NON-ENGINEERED BERM

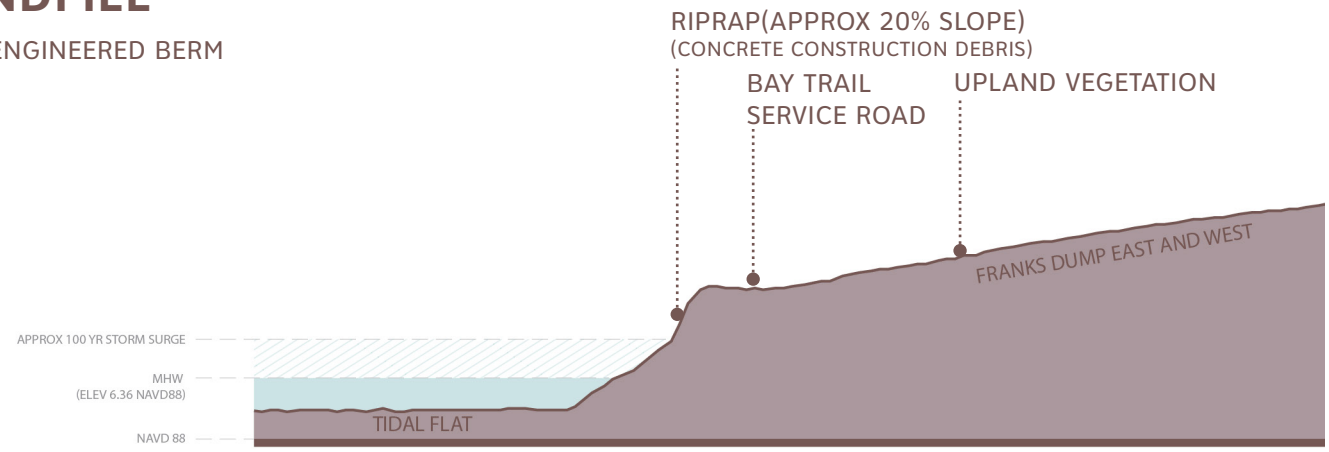


WAVE-EXPOSED SECTION

SURFACE CONDITION

LANDFILL

NON-ENGINEERED BERM

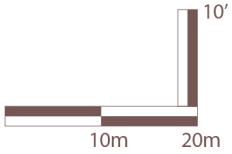


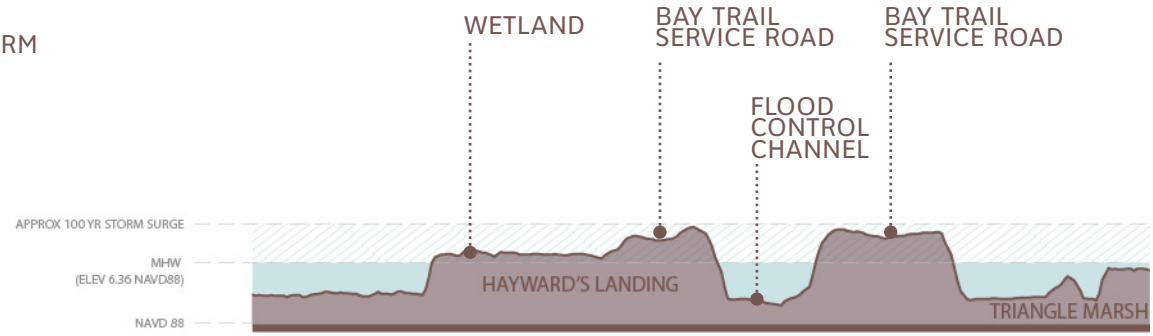
WAVE-EXPOSED SECTION

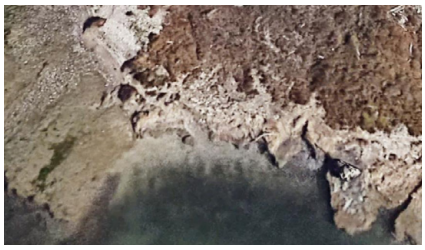
SURFACE CONDITION

LANDING

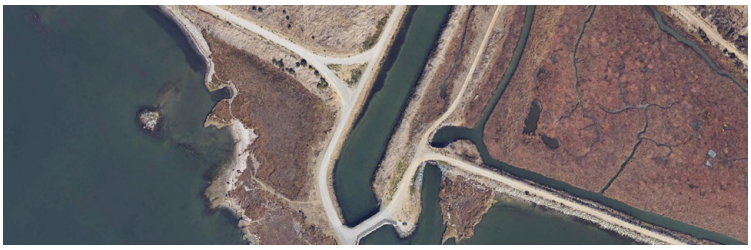
WETLAND
NON-ENGINEERED BERM







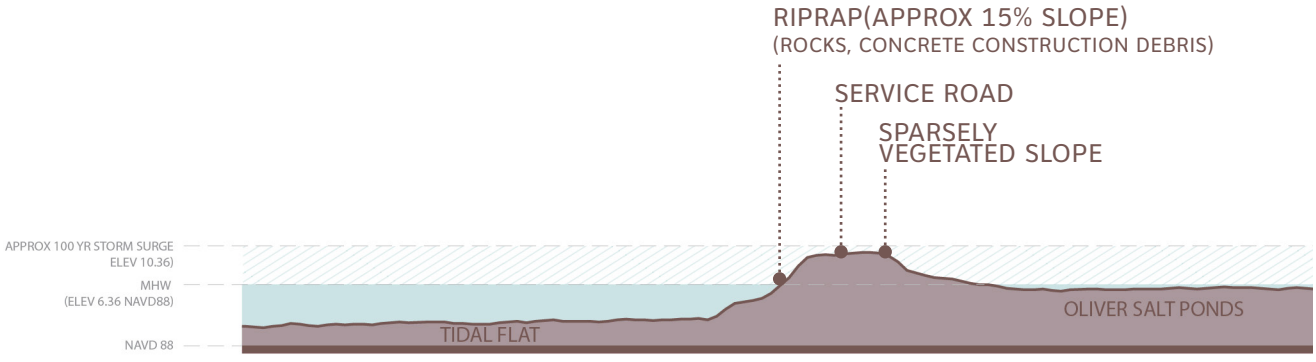
WAVE-EXPOSED SECTION



SURFACE CONDITION

SALT POND

NON-ENGINEERED BERM



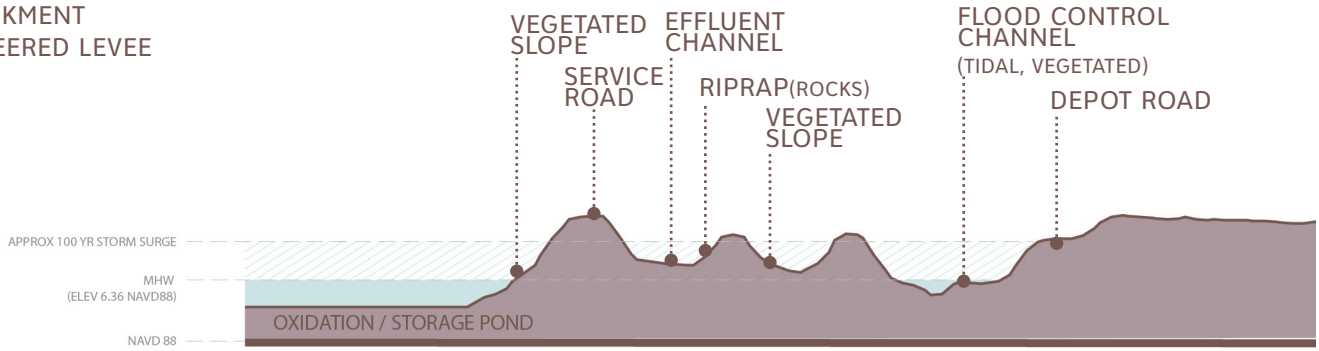
WAVE-EXPOSED SECTION

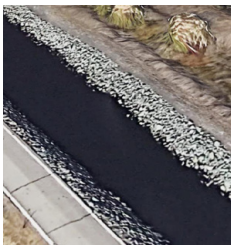
SURFACE CONDITION

INBOARD LEVEE CONDITIONS

FLOOD CONTROL CHANNEL

EMBANKMENT
ENGINEERED LEVEE





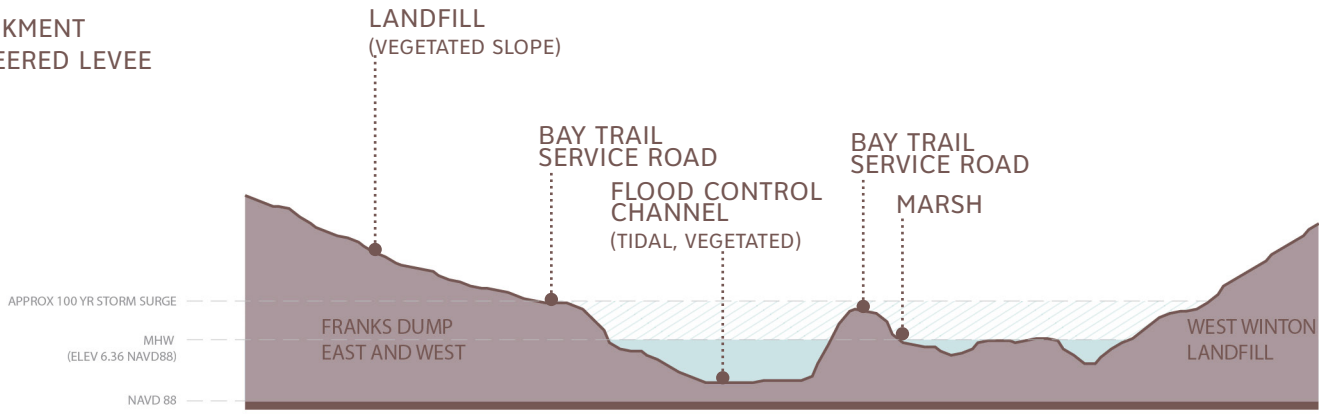
EFFLUENT CHANNEL

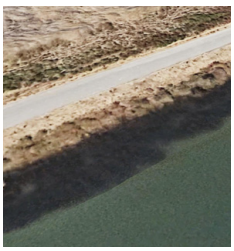
FLOOD CONTROL CHANNEL

SURFACE CONDITION

FLOOD CONTROL CHANNEL

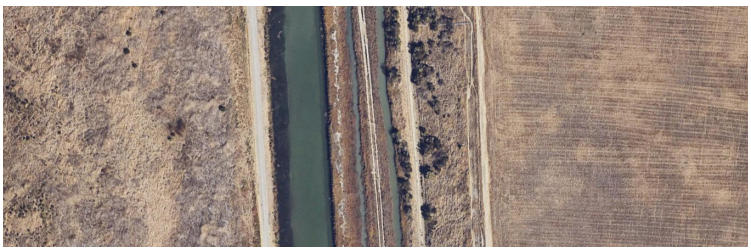
EMBANKMENT
ENGINEERED LEVEE





FLOOD CONTROL CHANNEL

TIDAL CHANNEL

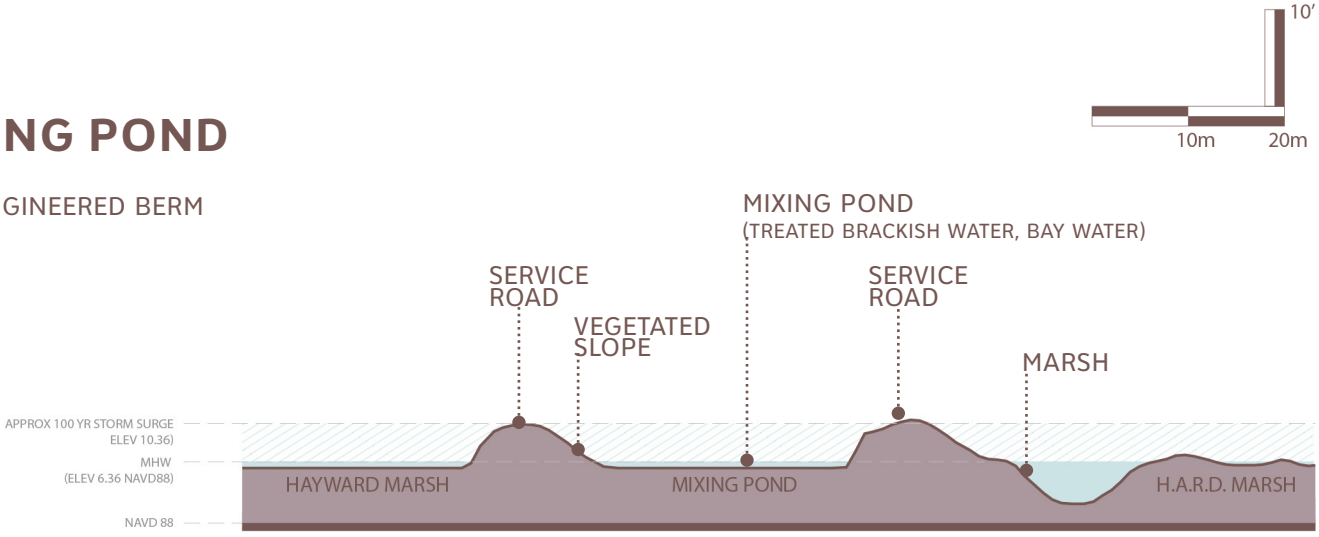


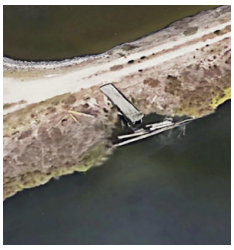
SURFACE CONDITION

SCAPE

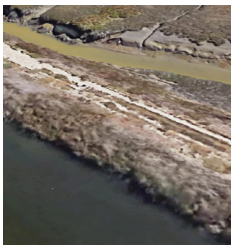
MIXING POND

NON-ENGINEERED BERM

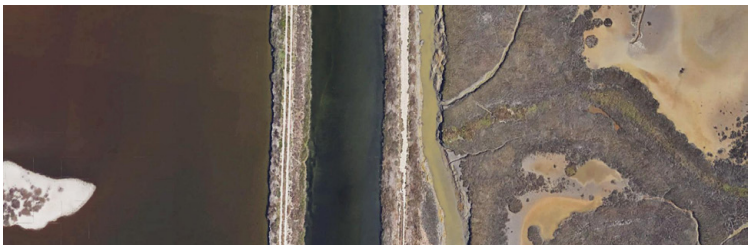




MIXING POND EDGE TOWARD HAYWARD MARSH



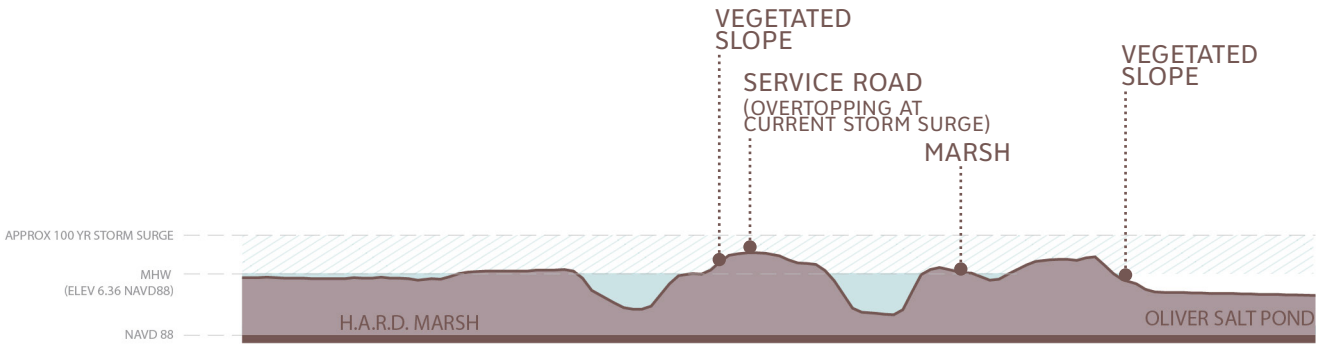
MIXING POND EDGE TOWARD H.A.R.D. MARSH

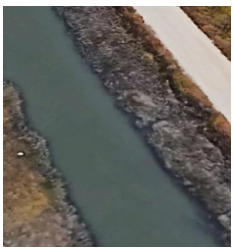


SURFACE CONDITION

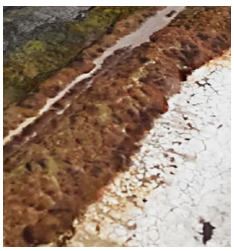
SALT POND

NON-ENGINEERED BERM



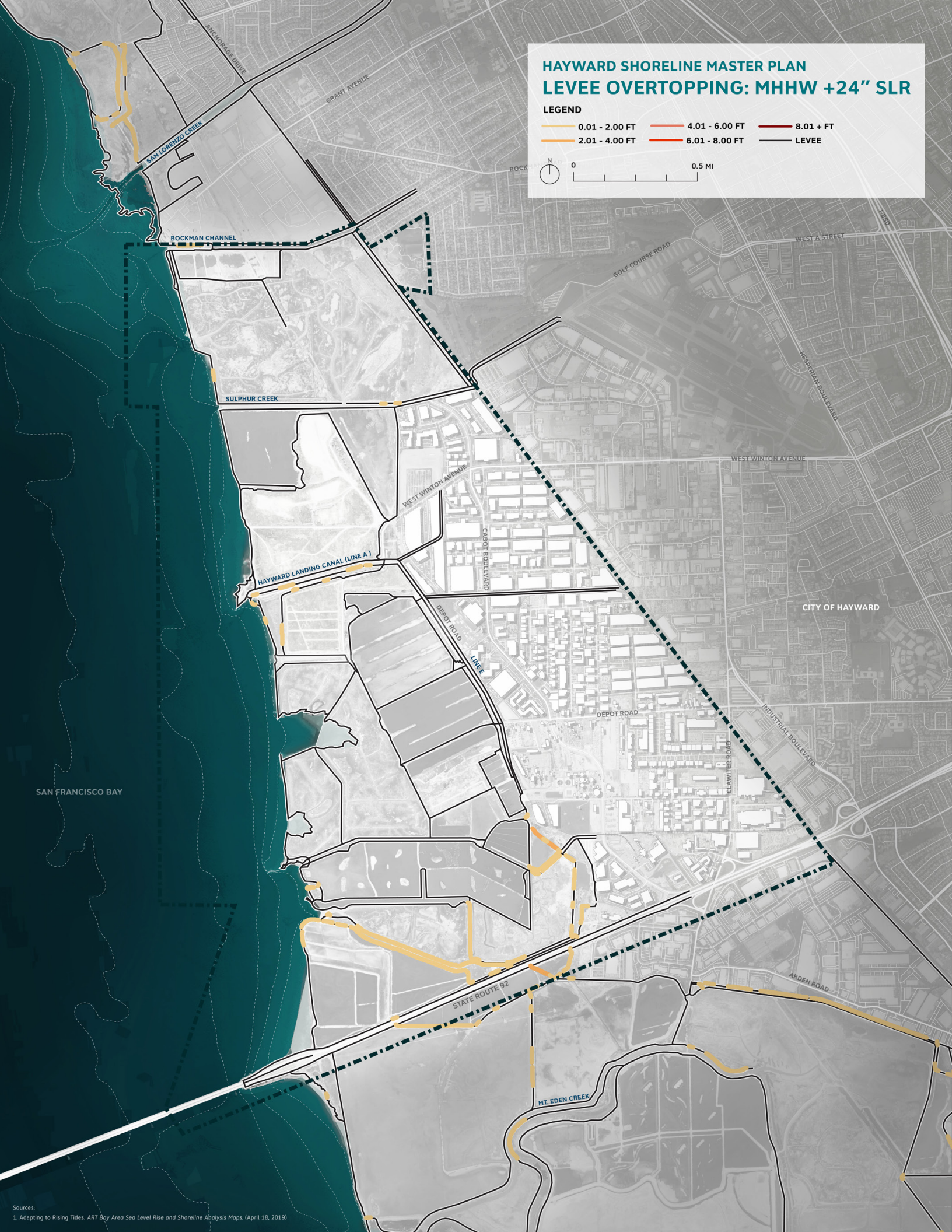


H.A.R.D. MARSH



SALT POND

SURFACE CONDITION



Sources:
1. Adapting to Rising Tides. *ART Bay Area Sea Level Rise and Shoreline Analysis Maps.* (April 18, 2019)

LEVEES AT RISK

OVERTOPPING CONDITIONS ALONG THE SHORELINE

Overtopping is a type of levee failure where the floodwater exceeds the height of the levee. If the landside portion of the levee is not properly reinforced, erosion or undercutting of the structure by overtopping water can lead to collapse or breaching. The sheer force placed on the levee from overtopping can also lead to significant damages from erosion and scour.

Using Adapting to Rising Tides data, the Project Team mapped overtopping of non-engineered berms for the Hayward Regional Shoreline using three scenarios: Mean Higher High Water (MHHW) +24" of Sea Level Rise, MHHW +48" of Sea Level Rise, and MHHW +96" of Sea Level Rise.

MHHW +24" of Sea Level Rise: Minimal overtopping is concentrated around Oliver Salt Ponds and HARD Marsh. The ART 2015 Hayward Resilience Study refers to levee improvements made around the Oliver Salt Ponds, but it is unclear if those improvements would have any impact on reducing overtopping conditions.

MHHW +48" of Sea Level Rise: In this scenario, one to two feet of overtopping submerges most shoreline levees. Higher levels of overtopping occur along inboard levees adjacent to Oliver Salt Ponds and HARD Marsh as well as inboard levees adjacent to the Alameda County-owned landfill. Engineered channels and the approach to State Route 92 also overtop in this scenario, placing critical drainage and transportation infrastructure at risk.

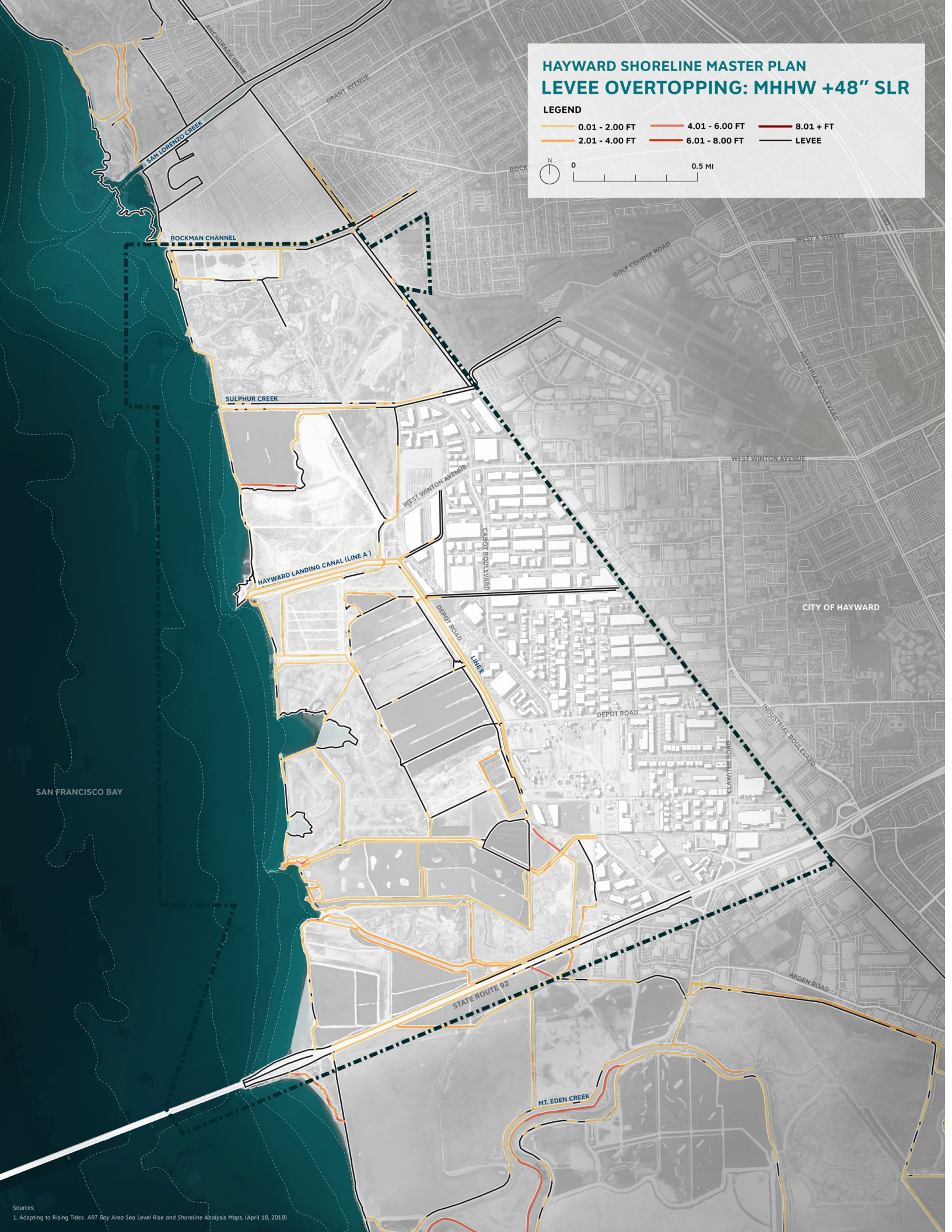
MHHW +96" of Sea Level Rise: Outboard levees in this scenario see two to four feet of overtopping, and the majority of inboard levees see four to six feet of overtopping. With these conditions, more catastrophic failures of levee infrastructure in the form of breaches or liquefaction can be expected. All engineered channels, all landfills, all wastewater treatment zones, and transportation infrastructure are at risk.

Sources:

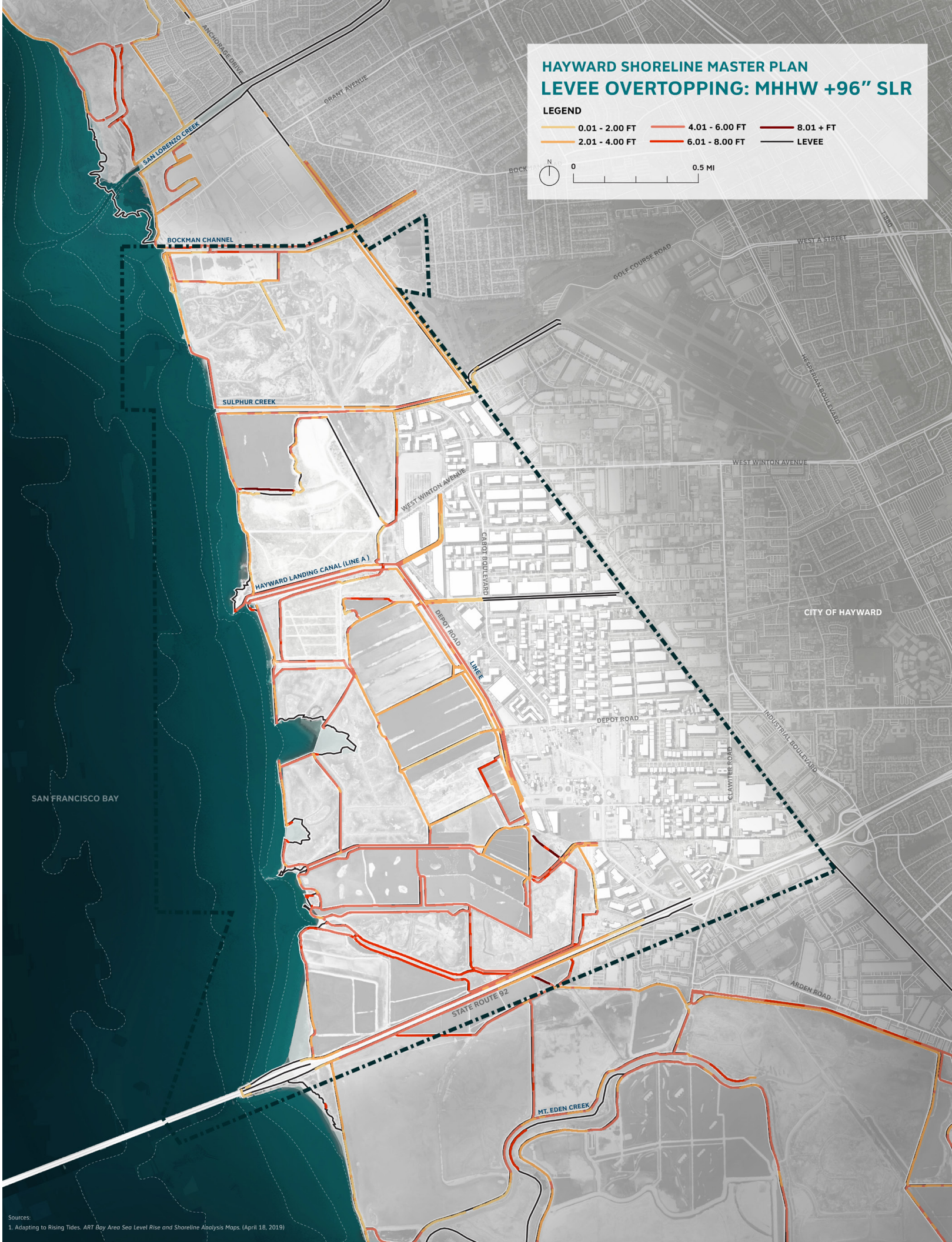
1. Adapting to Rising Tides, Hayward Shoreline Asset Vulnerability and Risk Profile Sheets. March 2015.

2. US Army Corps of Engineers, Levees 101. https://www.usace.army.mil/National-Levee-Safety/About-Levees/Levees-101/ 2019.

3. San Francisco Estuary Institute, San Francisco Bay Shore inventory. 2016.



Sources:
1. Adapting to Rising Tides. *ART Bay Area Sea Level Rise and Shoreline Analysis Maps.* (April 18, 2019)



Sources:
1. Adapting to Rising Tides. *ART Bay Area Sea Level Rise and Shoreline Analysis Maps.* (April 18, 2019)

Sources:

1. City of Hayward. *Power Trainsmission Lines*. (April 1, 2019)
2. Alameda County Flood Control & Water Conservation District. *Pump Stations*. (April 1, 2019)
3. Alameda County Flood Control & Water Conservation District. *Gate*. (April 1, 2019)
4. Alameda County Flood Control & Water Conservation District. *Culverts*. (April 1, 2019)

CRITICAL INFRASTRUCTURE

URBAN ASSETS IN THE BAYLANDS

The city of Hayward depends on infrastructural assets that treat sewage, provide clean water, produce energy, store waste, and support transportation. In the adjacent map, facilities that perform these functions are located within or directly next to the baylands, putting the city's most critical infrastructure at risk as sea levels rise.

Transmission Lines and Utility Corridors: PG&E overhead transmission lines cross the Hayward Regional Shoreline project area. Although the towers are set on concrete bases, sea level rise can potentially pose issues of access for maintaining and repairing the infrastructure. Saltwater corrosion can specifically pose significant risks to infrastructure, resulting in increased operation costs and decreased asset lifetimes. Underground utilities, including the East Bay Dischargers Authority (EBDA) Pipeline and an abandoned Shell Oil jet fuel pipeline, also run through the project area. Sea level rise poses a risk to access roads that maintain these utilities as well.

Landfills: In the center of the Hayward Regional Shoreline, the City owned landfill and the Alameda County owned landfill are located at the edge of the bay. The landfills have been closed and capped, but this waste infrastructure is not built to withstand flooding or wave action. Sea level rise and storm events can pose potential risk of erosion and create a public health and environmental health hazard for the City of Hayward.

Waste Water Treatment Plants and Pump Stations: The Oro Loma Wastewater Treatment Plant and the Hayward Water Pollution Control Facility (WPCF) process sewage from the city of Hayward. Both facilities discharge into the EBDA pipeline, but during storm events WPCF relies on retired oxidation ponds as water storage. Both facilities also use selected baylands as drying beds for biosolids. These assets need proper protection to prevent health and environmental hazards.

EBDA (East Bay Dischargers Authority) Pipeline: Along the East Bay shoreline, EBDA connects 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. Current vulnerabilities include ageing infrastructure, insufficient capacity during wet weather events, damages from rising groundwater, reduced infrastructure access due to rising sea levels, and public health hazards as a result of infrastructure failure.

Solar Fields: Two solar fields have been built within the project area, one in the north adjacent to Oro Loma Wastewater Treatment Plant and one adjacent to the Hayward Treatment Facility. The solar fields are within the extent of the baylands and are currently surrounded by levees. However, many of these levees are in poor condition and could potentially fail with future climate change impacts.

Calpine Russel City Energy Center: This gas-fueled energy facility was built in 2013 and has a life expectancy of 40 years. While this infrastructure is an economic asset to the city of Hayward, many access roads and utilities that support the plant are vulnerable to sea level rise and storm surge conditions.

State Route 92 Bridge Approach: State Route 92 is a regionally significant transportation corridor that connects the East Bay and the Peninsula. The bridge approach to this corridor is surrounded by low lying baylands and currently has stormwater drainage issues. With additional sea level rise, this critical commuter route is at risk of flooding, potentially rendering it impassible if climate change issues are not addressed.

Sources:

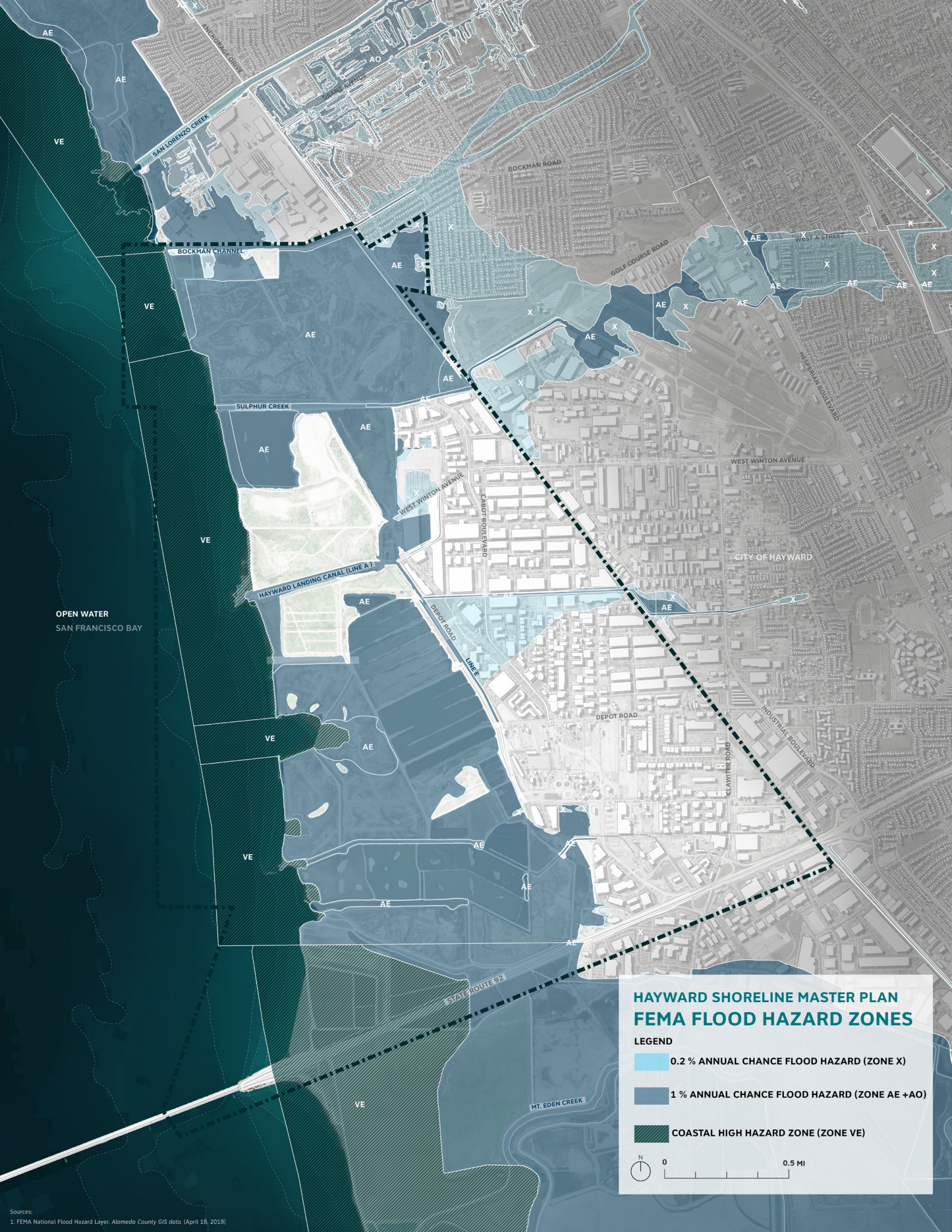
1. Adapting to Rising Tides, Hayward Shoreline Asset Vulnerability and Risk Profile Sheets. March 2015.

Bockman Channel entering the Hayward Regional Shoreline with crossing pipeline infrastructure.
(SCAPE Site Photos, 2019)

State Route 92 approach to the San Mateo Bridge.
(SCAPE Site Photos, 2019)

Calpine Russel City Energy Center adjacent to Hayward Regional Shoreline baylands.
(SCAPE Site Photos, 2019)

Railroad and industrial facilites.
(SCAPE Site Photos, 2019)



HAYWARD SHORELINE MASTER PLAN

FEMA FLOOD HAZARD ZONES

LEGEND

- 0.2 % ANNUAL CHANCE FLOOD HAZARD (ZONE X)
- 1 % ANNUAL CHANCE FLOOD HAZARD (ZONE AE +AO)
- COASTAL HIGH HAZARD ZONE (ZONE VE)

N

0 — 0.5 MI

Sources:

1. FEMA National Flood Hazard Layer. *Alameda County GIS data.* (April 18, 2019)

FEMA FLOOD HAZARD ZONES

HAYWARD COASTAL RISK

Data from the FEMA Flood Hazard Mapping Program was used to create a flood map for the Hayward Regional Shoreline project area. Below are descriptions of various assets along the Hayward Shoreline as they relate to FEMA classification.

Coastal High Hazard Zone (Zone VE) is defined as areas where waves are taller than three feet and fast-moving water can cause extensive damage during a 100-year storm. Along the Hayward Regional Shoreline, this zone typically ends at the outboard levees, but it moves further inland at the start of the Oliver Salt Ponds. State Route 92 Bridge approach is also located within this zone, placing critical infrastructure at high risk.

1% Annual Chance Flood Hazard (Zone AE) is defined as areas flooded by the 100-year storm with wave heights of less than 3 feet. Along the Hayward Regional Shoreline, most tidal and diked baylands are impacted by these conditions. The zone also minimally extends into a few industrial areas and the Hayward Executive Airport.

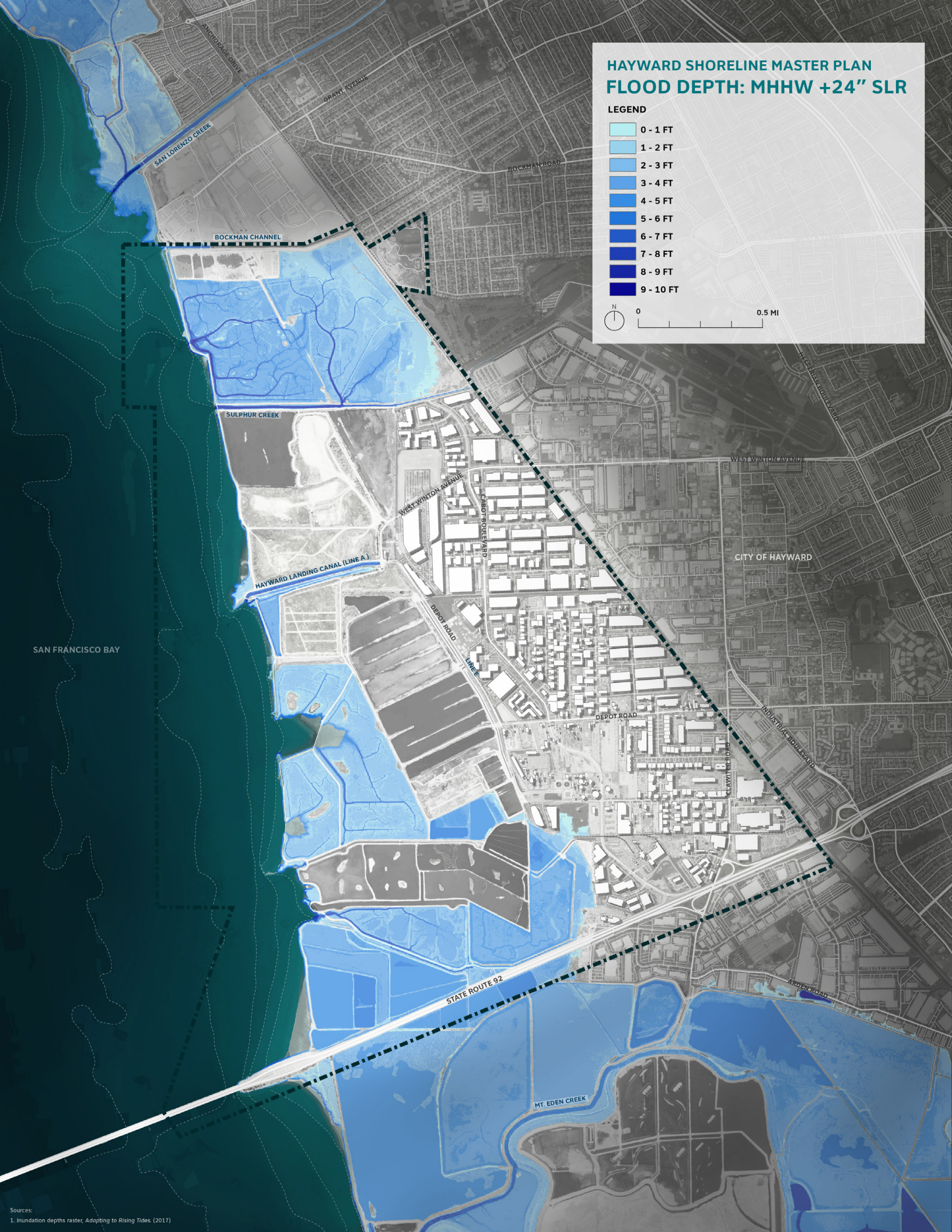
1% Annual Chance Flood Hazard (Zone AO) is defined as areas flooded by the 100-year storm with 1-3 feet of water over sloping ground, usually due to wave overtopping. Areas along the Hayward Regional Shoreline impacted by these conditions include residential communities adjacent to San Lorenzo Creek.

0.2% Annual Chance Flood Hazard (Zone X) is defined as areas impacted by the 500-year storm event. Assets impacted along the Hayward Shoreline include industrial zones adjacent to Line E drainage channel and residential communities above Oro Loma Marsh.

Sources:

1. FEMA, Coastal Hazard and Flood Mapping: A Visual Guide. https://www.fema.gov

2. FEMA, National Flood Insurance Program: Flood Hazard Mapping. https://www.fema.gov



Sources:
1. Inundation depths raster, *Adapting to Rising Tides*. (2017)

INUNDATION DEPTHS

POTENTIAL WATER LEVELS ALONG THE SHORELINE

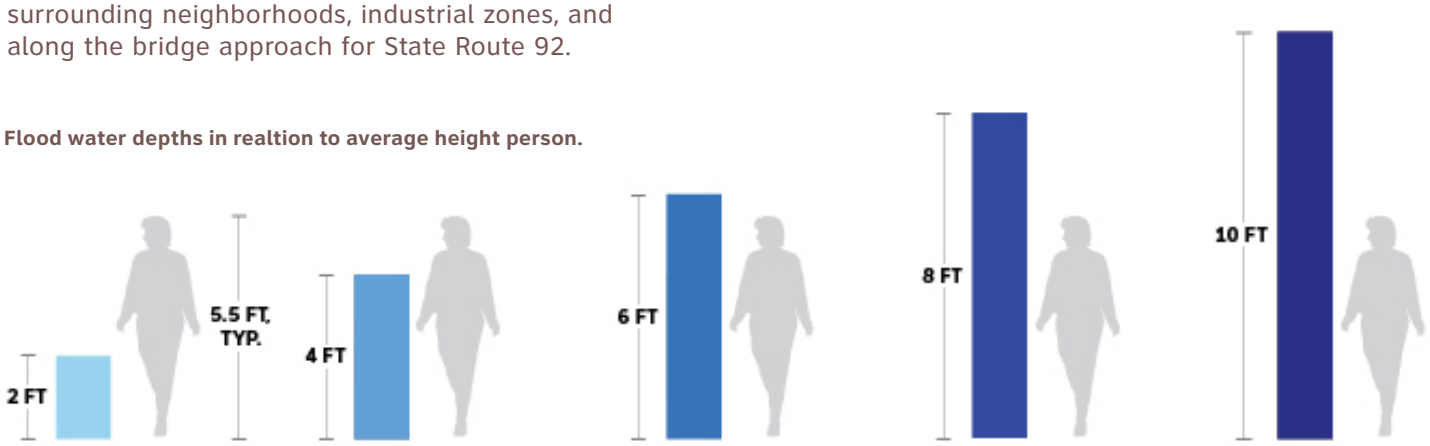
Raster data from Adapting to Rising Tides was used to create depth of flooding maps for the Hayward Regional Shoreline. Three scenarios were evaluated and the following descriptions elaborate on various impacts to the project area.

Flood Depths for MHHW +24" of Sea Level Rise:
In this scenario, all tidally-influenced marshes gain an additional 2 to 3 feet of water depth. If the tidal marshes cannot accrete as sea levels rise, this can lead to downshifting of bayland habitats with the potential for widespread marsh drowning. This scenario also shows water depths of 4 to 5 feet within the Oliver Salt Ponds and increased water depths in the engineered flood control channel Line A.

Flood Depths for MHHW +48" of Sea Level Rise:
Water depths increase to an average of 5 feet over fully tidal baylands and flooding extends further into various diked ponds. The Hayward Treatment Marsh and the former oxidation storage ponds become inundated with water depths ranging from 3 to 6 feet, potentially inhibiting their storage capacity for wastewater treatment facilities. Water depths increase along the Line A flood control channel and extend into Line E running parallel to industrial business zones. Adjacent to the flood control channel, water begins to enter industrial areas with water depths of around 1 to 2 feet.

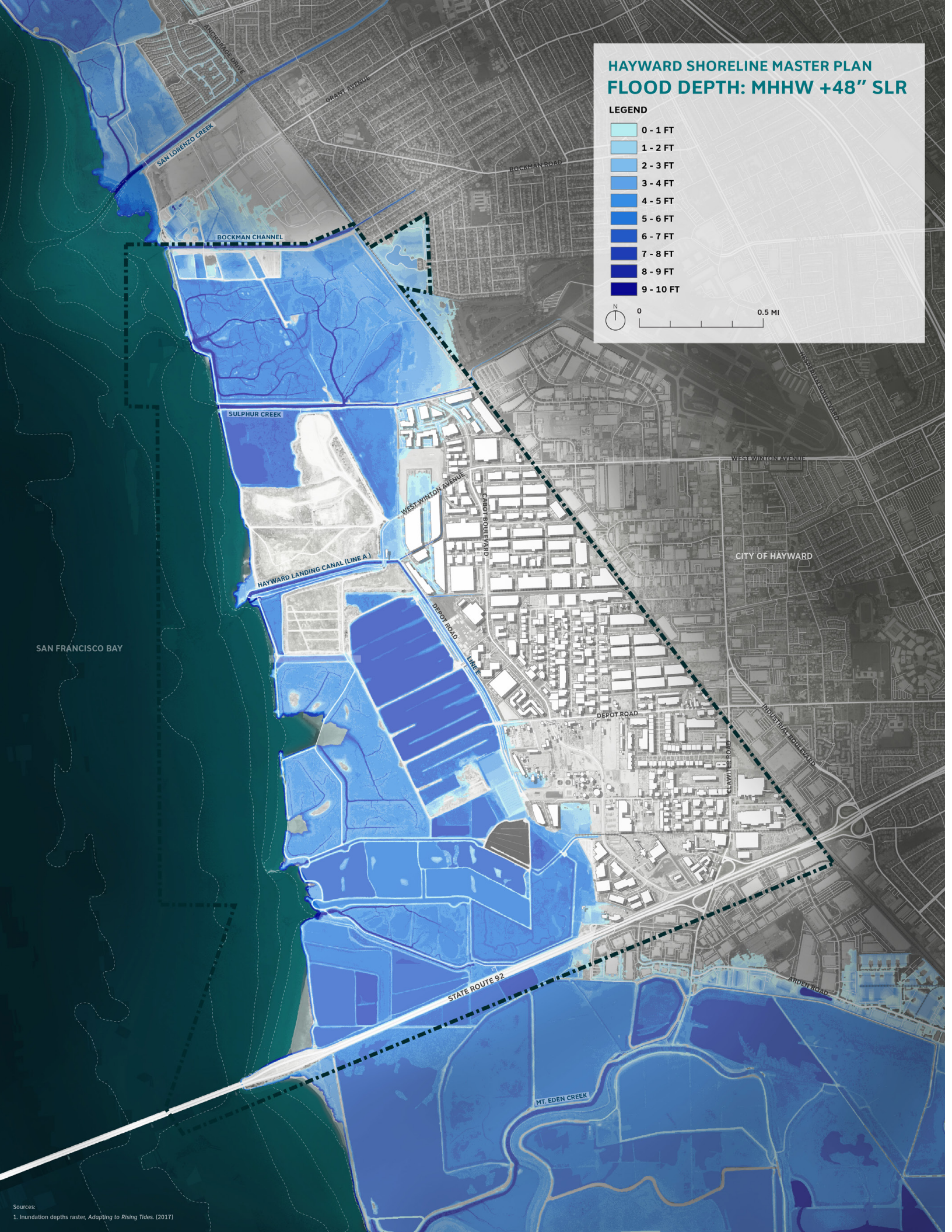
Flood Depths for MHHW +96" of Sea Level Rise:
For the most extreme scenario, all tidal and diked baylands are inundated by 6+ feet of water. While the landfills are not submerged by floodwaters, they are surrounded by flood depths of 4+ feet, which would greatly limit access in the event of an infrastructural failure. A majority of bayland levees are flooded with 3+ feet of water, and flooding extends into surrounding neighborhoods, industrial zones, and along the bridge approach for State Route 92.

Flood water depths in realtion to average height person.

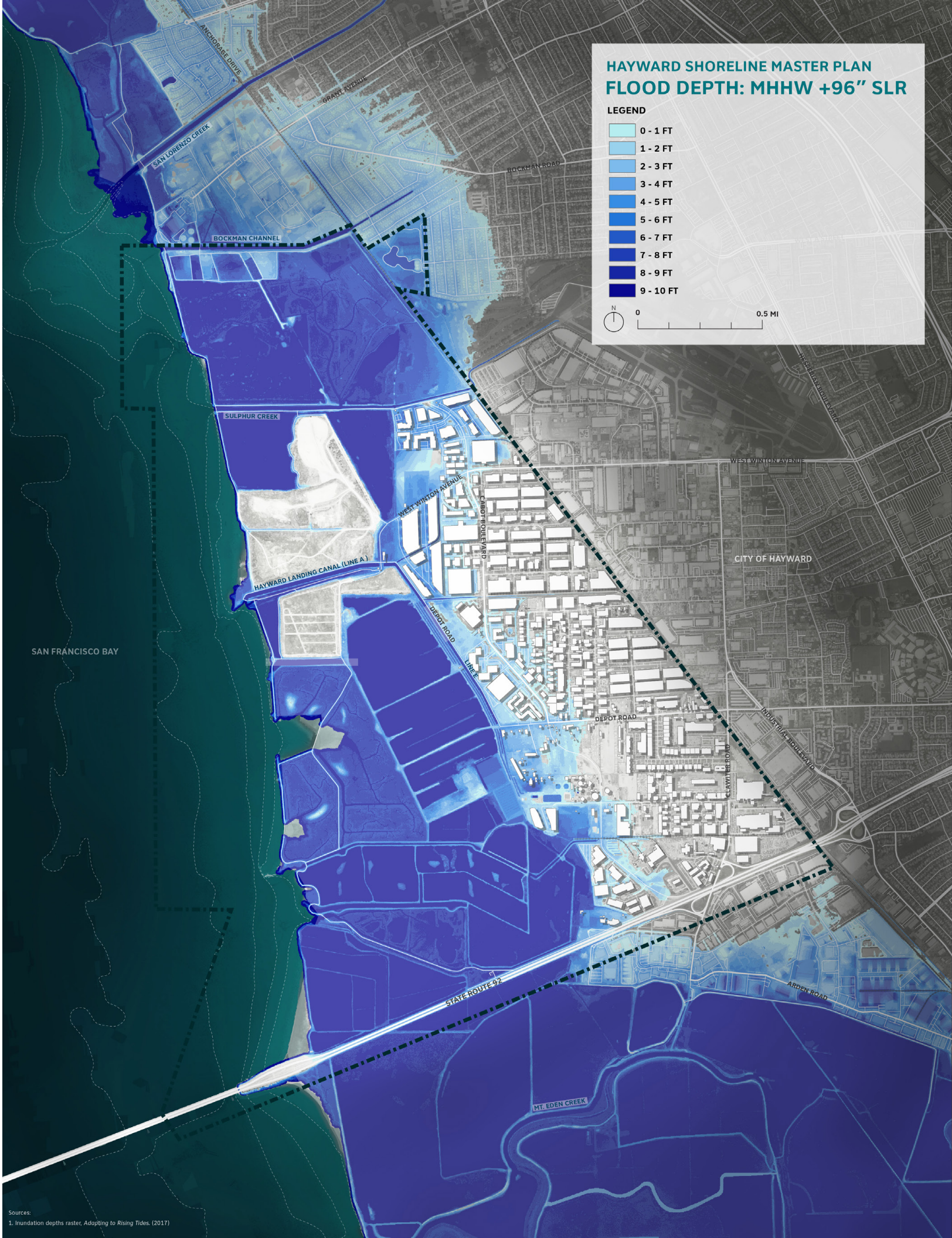


Sources:

1. Adapting to Rising Tides, Sea Level Rise Analysis and Mapping Report. September 2017.

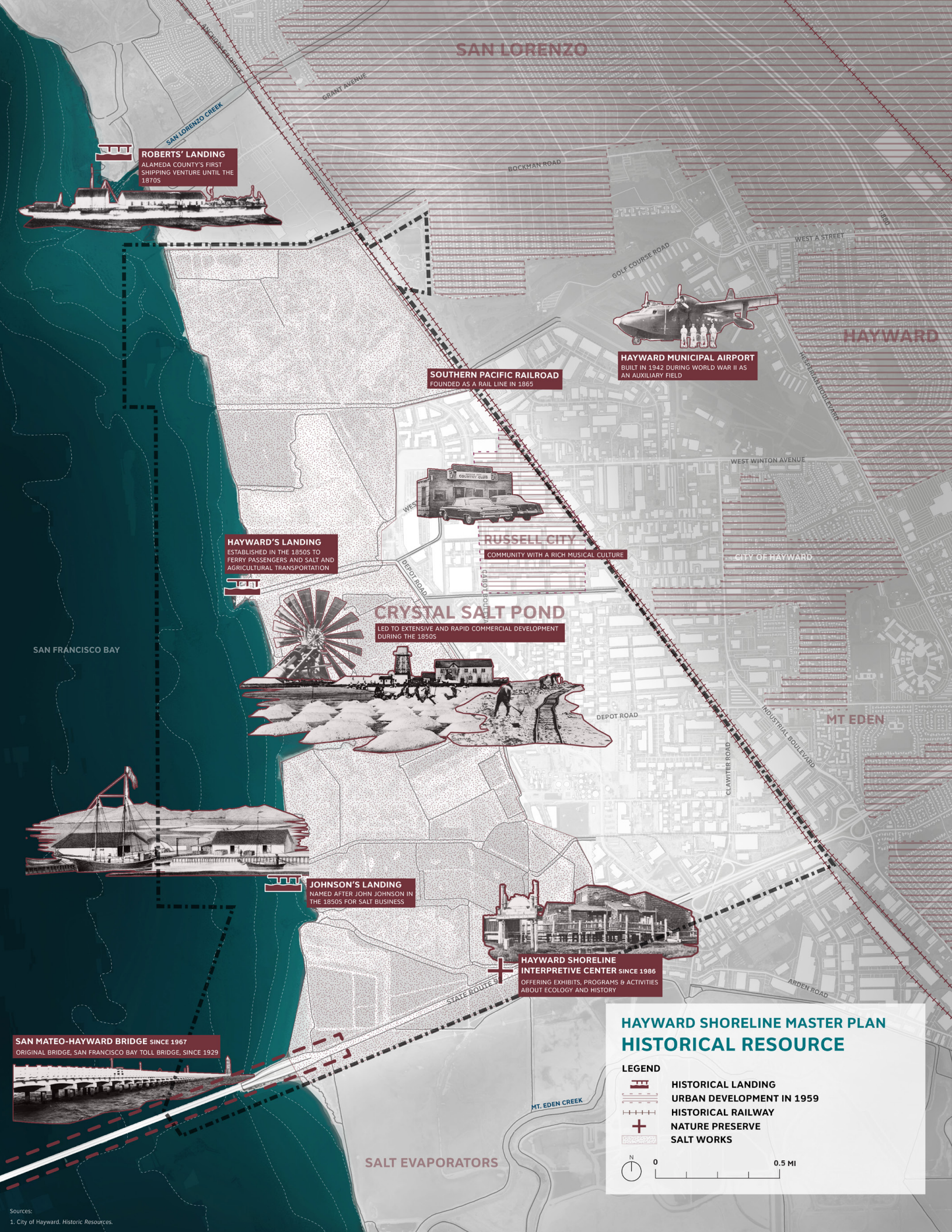


Sources:
1. Inundation depths raster, *Adapting to Rising Tides*. (2017)



Sources:
1. Inundation depths raster, *Adapting to Rising Tides*. (2017)

CULTURAL RESOURCES



Sources:

1. City of Hayward. *Historic Resources.*

HISTORICAL RESOURCES

TRANSFORMATIVE SHORELINE STORIES

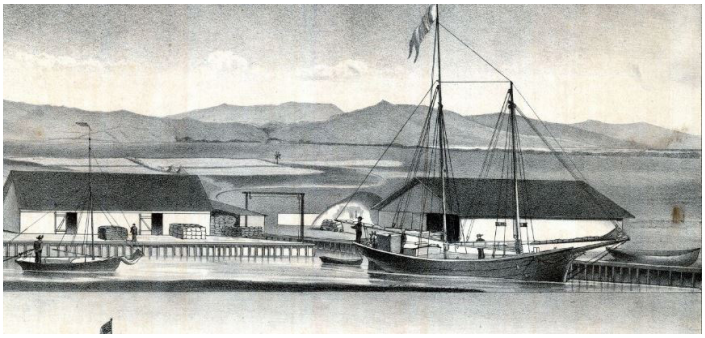
The indigenous Yrgin peoples were first to settle in what is now Hayward, and they used what was later named the Crystal Salt Pond to harvest salt resources for trade. While there were other salt ponds in the South Bay, the Crystal Salt Pond was one of the largest salinas, and it became the foundation for future industrial salt production.

Economic incentives from the salt trade drew additional American settlers, who transformed the baylands into a mosaic of small salt farms to optimize production of the commodity. Most of the salt was transported out of historical landings, facilitating the formation of shipping routes between San Francisco and the South Bay. While none of the landing structures remain along the shoreline today, fringe marshes and drainage channels preserve their names.

As demand for salt increased for other industrial uses, small family-operated salt farms were consolidated into expansive ponds and shaped the landscape mosaic found along the shoreline today. The Oliver Brothers Salt Company and The Leslie Salt Company were two larger businesses in the region, and an historic Archimedes screw pump still exists at the current Oliver Brothers Salt Ponds.

While there were already communities established in the city of Hayward in the early 1900s, rapid urbanization didn't occur until the 1950s. After implementation of the San Lorenzo Creek flood control project, the population of Hayward increased 500% over a 10-year span.

The shoreline today has once again been transformed, thanks to restoration efforts around the South Bay. The Hayward Shoreline Interpretive Center, along with historical societies in Hayward, continue to preserve the history of previous shorelines.



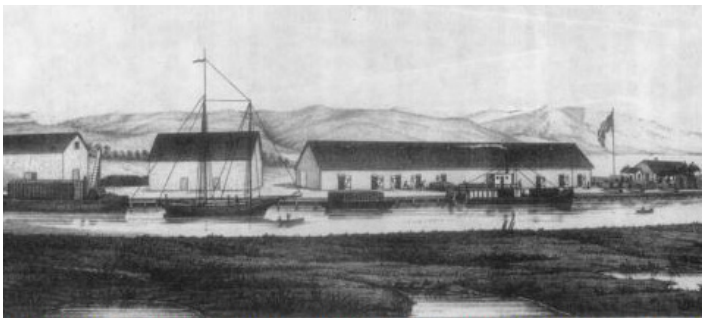


Image 1: Historic Johnson's Landing. Image 2: Historic Roberts Landing.
(SFEI, 2003)

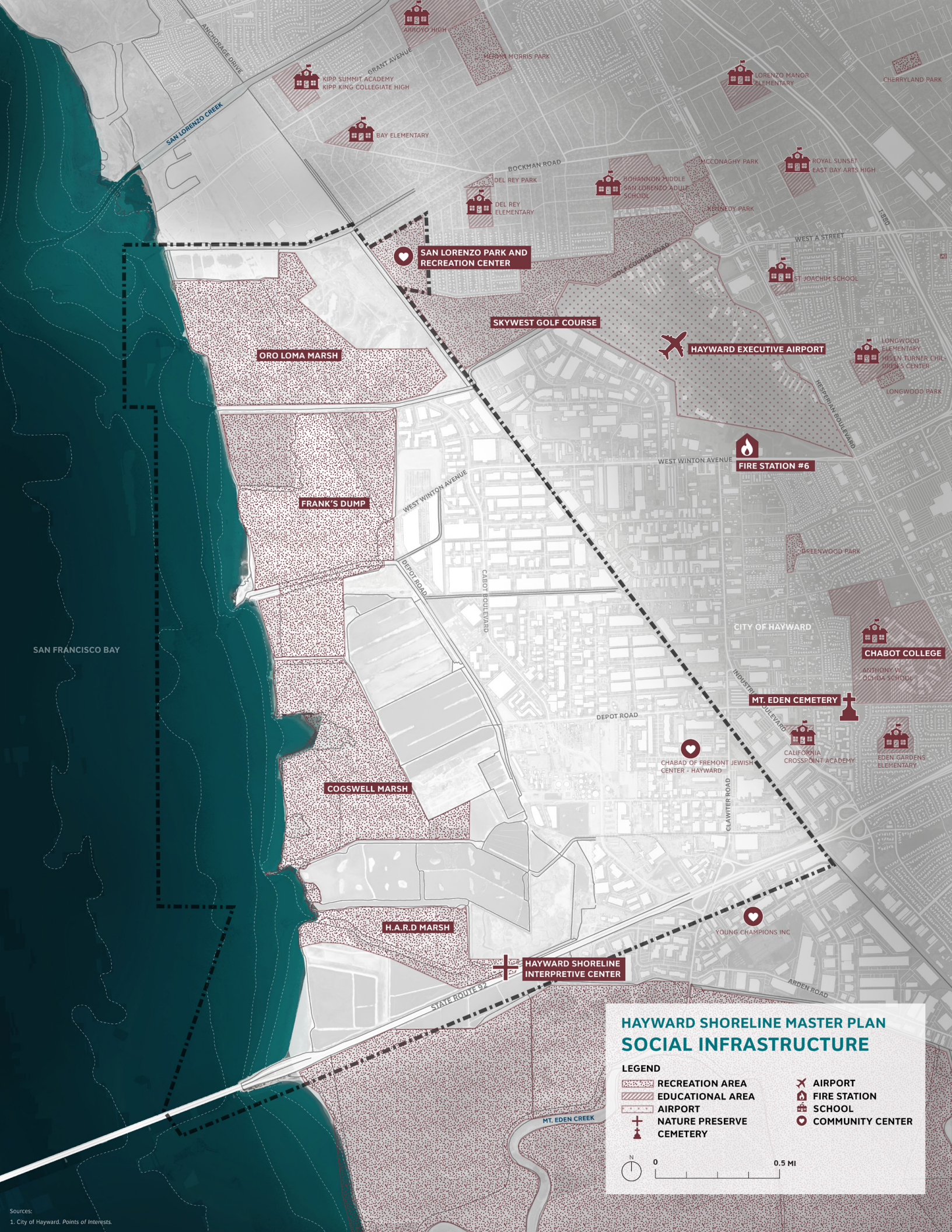
Laborers working at the Oliver Salt Company salt ponds.
(Hayward Area Historical Society)

Sources:

1. San Francisco Estuary Institute, A Geographic History of San Lorenzo Creek Watershed. December 2003.

2. US Fish and Wildlife Service, Identification and Evaluation of the South San Francisco Bay Solar Salt Industry Landscape. March 2009.

3. San Francisco Estuary Institute and Oakland Museum of California, Baylands and Creeks of South San Francisco Bay. 2005.



HAYWARD SHORELINE MASTER PLAN

SOCIAL INFRASTRUCTURE

LEGEND

- RECREATION AREA
- EDUCATIONAL AREA
- AIRPORT
- NATURE PRESERVE
- CEMETERY
- AIRPORT
- FIRE STATION
- SCHOOL
- COMMUNITY CENTER

N

0 — 0.5 MI

Sources:

1. City of Hayward. *Points of Interests.*

SOCIAL INFRASTRUCTURE

COMMUNITY RESOURCES ADJACENT TO THE SHORELINE

Although the Hayward Regional Shoreline is directly adjacent to industrial areas, there are many residential communities less than two miles from the shoreline. Schools, community centers, recreational centers, fire stations, and parks are depicted in the map to illustrate the proximity of this social network to the project area, and ultimately identify potential opportunities to engage the public.

The Hayward Shoreline Interpretive Center, a major community asset for the city of Hayward, is located directly within the baylands. For those visiting the shore, the Interpretive Center serves as a landing point where people can use the facilities and orient themselves to the surrounding public parklands. The Center is also filled with resources to enrich user experience within the baylands, and more formal programs are facilitated by staff to educate the public on stewardship opportunities that can engender a strong appreciation of bayland resources.

Hayward Shoreline Interpretive Center facilities
(Refocus Photography, 2019)

Youth programs facilitated along the Hayward Regional Shoreline.
(Hayward Area Recreation District, 2005)

Sources:
1. Metropolitan Transportation Commission. *Regional Bike Facilities.* (April 18, 2019)
2. Metropolitan Transportation Commission. *San Francisco Bay Trail.* (April 18, 2019)
3. AC Transit. *Bus Route GIS shapefiles.* (April 18, 2019)
4. City of Hayward. *Hayward Bicycle Network.* (April 18, 2019)

RECREATION

USER EXPERIENCE OF THE SHORELINE

The Hayward Regional Shoreline is a 1,700-acre park that offers accessible opportunities for the public to experience various marsh ecosystems at the edge of the bay. Within the park, five miles of trails, including the Bay trail, connect different parts of the shoreline and facilitate recreational activities such as hiking, biking, running, and fishing. Dog walking is allowed but restricted to the northern portion of the park to protect nesting and feeding wildlife.

Many educational programs and events are supported by the Hayward Shoreline Interpretive Center, and these provide opportunities to observe robust wildlife and complex marsh ecosystems. Birding is an especially popular activity and is supported by informal bird walks and avid birders hiking the shoreline. eBird, an online mapping tool developed by Cornell University's Ornithology Lab, allows users to document bird sightings of various species, creating a collective inventory of wildlife in specific locations. The Hayward Regional Shoreline has an extremely high number of recorded bird sightings, making it one of the most active birding locations in the Bay Area.

10 K On the Bay along the Hayward Regional shoreline.
(10k On the Bay, 2018)

Cyclist using the Bay Trail along the Hayward Regional Shoreline.
(SCAPE Site Photos, 2019)

Sources:

1. East Bay Regional Park District, Hayward Regional Shoreline. https://www.ebparks.org/parks/hayward/

2. Cornell University Ornithology Lab, Birding Hotspots. https://ebird.org/hotspots

Sources:
1. Metropolitan Transportation Commission. *Regional Bike Facilities.* (April 18, 2019)
2. Metropolitan Transportation Commission. *San Francisco Bay Trail.* (April 18, 2019)
3. AC Transit. *Bus Route GIS shapefiles.* (April 18, 2019)
4. City of Hayward. *Hayward Bicycle Network.* (April 18, 2019)

A NETWORK OF PARKS

RECREATIONAL AREAS AND PUBLIC ACCESS IN THE SOUTH BAY

The Project Team used California's Protected Areas Database to map the Hayward Masterplan project area in relation to other protected open spaces. This regional network, supported by federal, state, county, and city agencies, provides shoreline public access to adjacent urban communities and connects people to ecological resources of the baylands. Open space types vary greatly, including regional shorelines, regional parks, and ecological reserves that offer large expanses of space where people and wildlife alike can thrive.

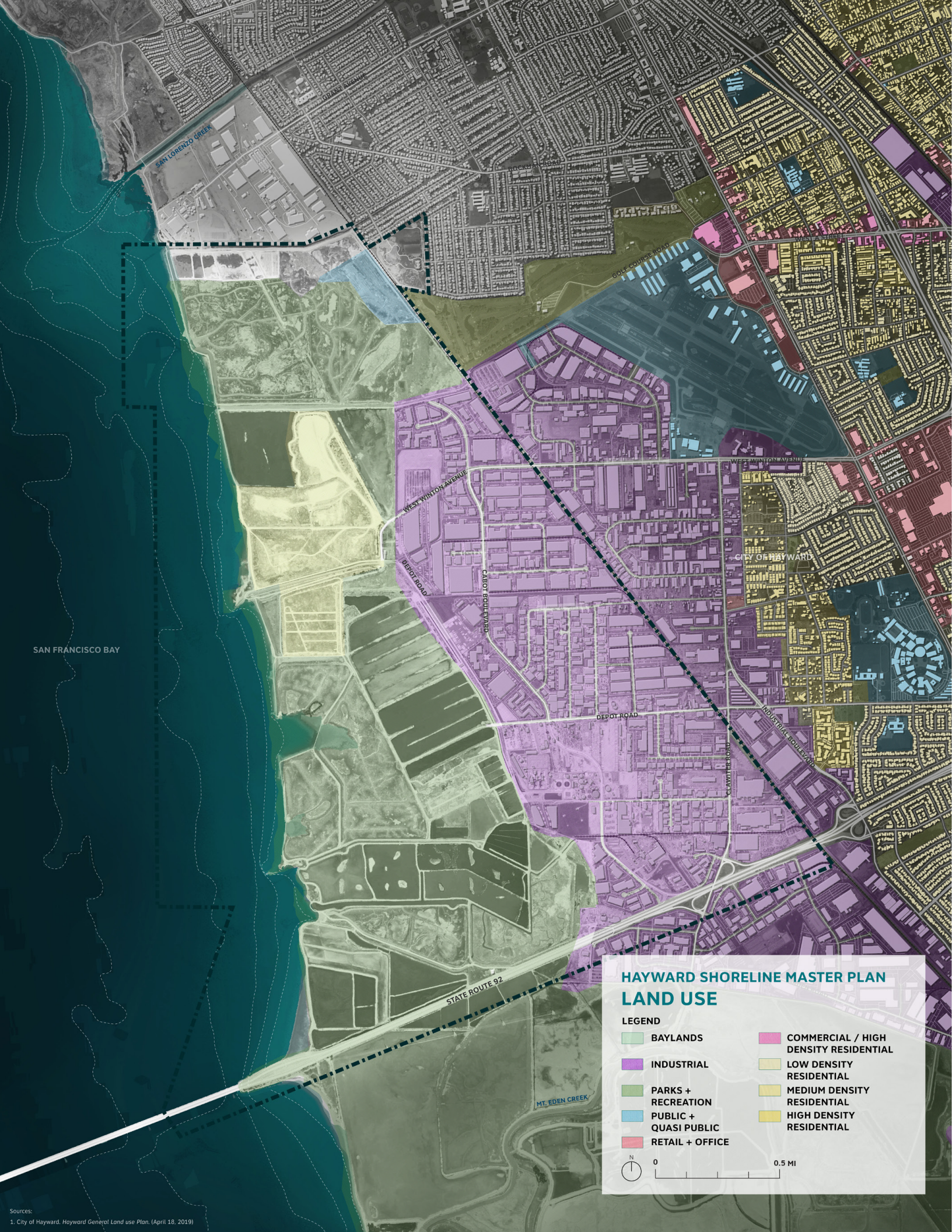
While various entities have ownership over protected areas along the East Bay Shoreline, open access is permitted from Hayward all the way to Warm Springs in Fremont. The San Francisco Bay Trail also serves as a regional connector, providing clear pathways for users and creating diverse shoreline experiences that build community across an expansive area.

Sources:

1. California's Protected Areas, California Protected Areas Database. May 2019.

2. San Francisco Bay Trail. http://baytrail.org/about-the-trail/welcome-to-the-san-francisco-bay-trail/

CONNECTIONS AND ACCESS

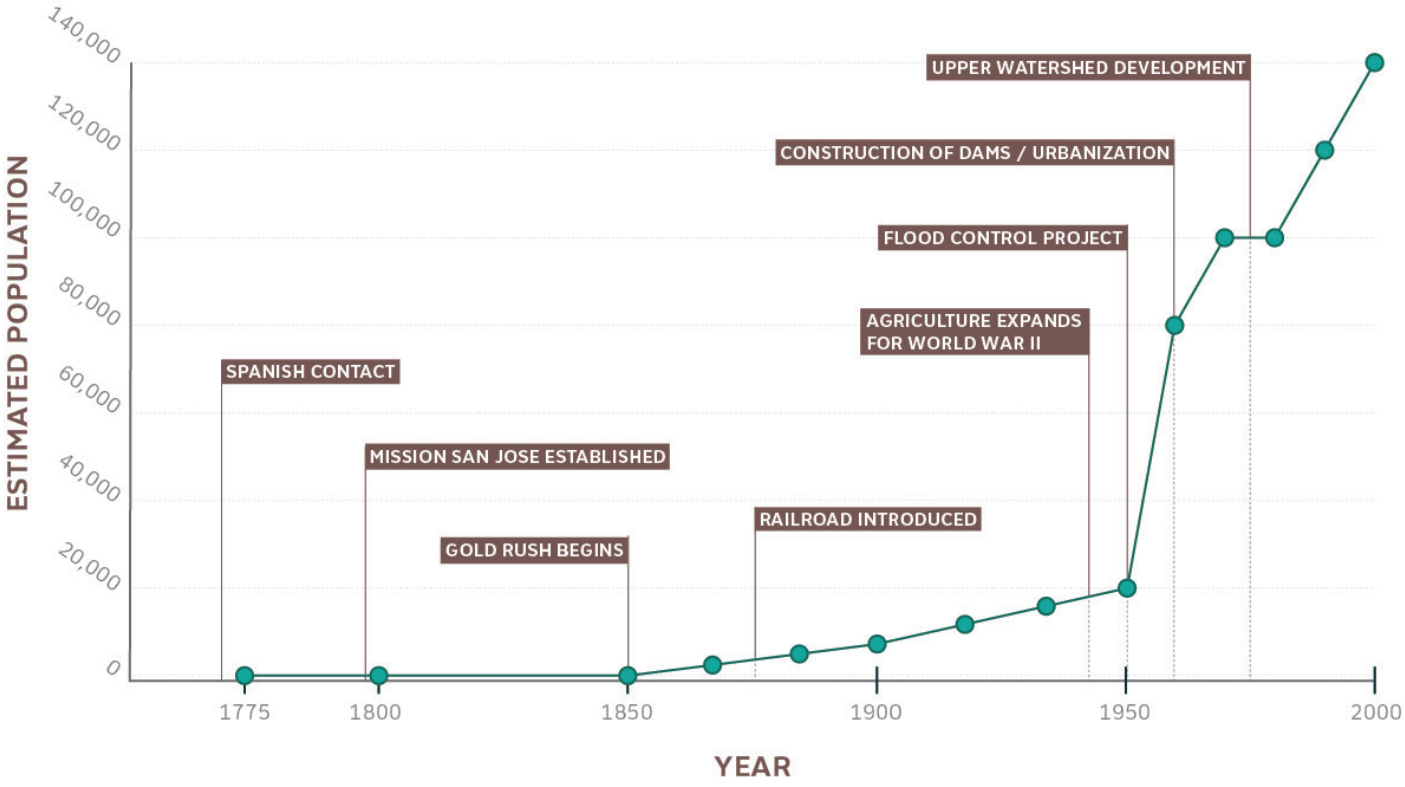


Sources:

1. City of Hayward. *Hayward General Land use Plan.* (April 18, 2019)

LAND USE

Using data from the City of Hayward, a map was created to further illuminate the varied land use conditions throughout the project area. Most of the shoreline abuts a zone of industrial buildings, yards, and warehouses, except for the northern most edge, which is adjacent to a golf course and a post-war residential suburban development of low-rise, single-family detached homes. The large tracts of land and the land use patterns within the project area present an opportunity to leverage funding and develop innovative finance mechanisms for the Hayward Regional Shoreline Master Plan.

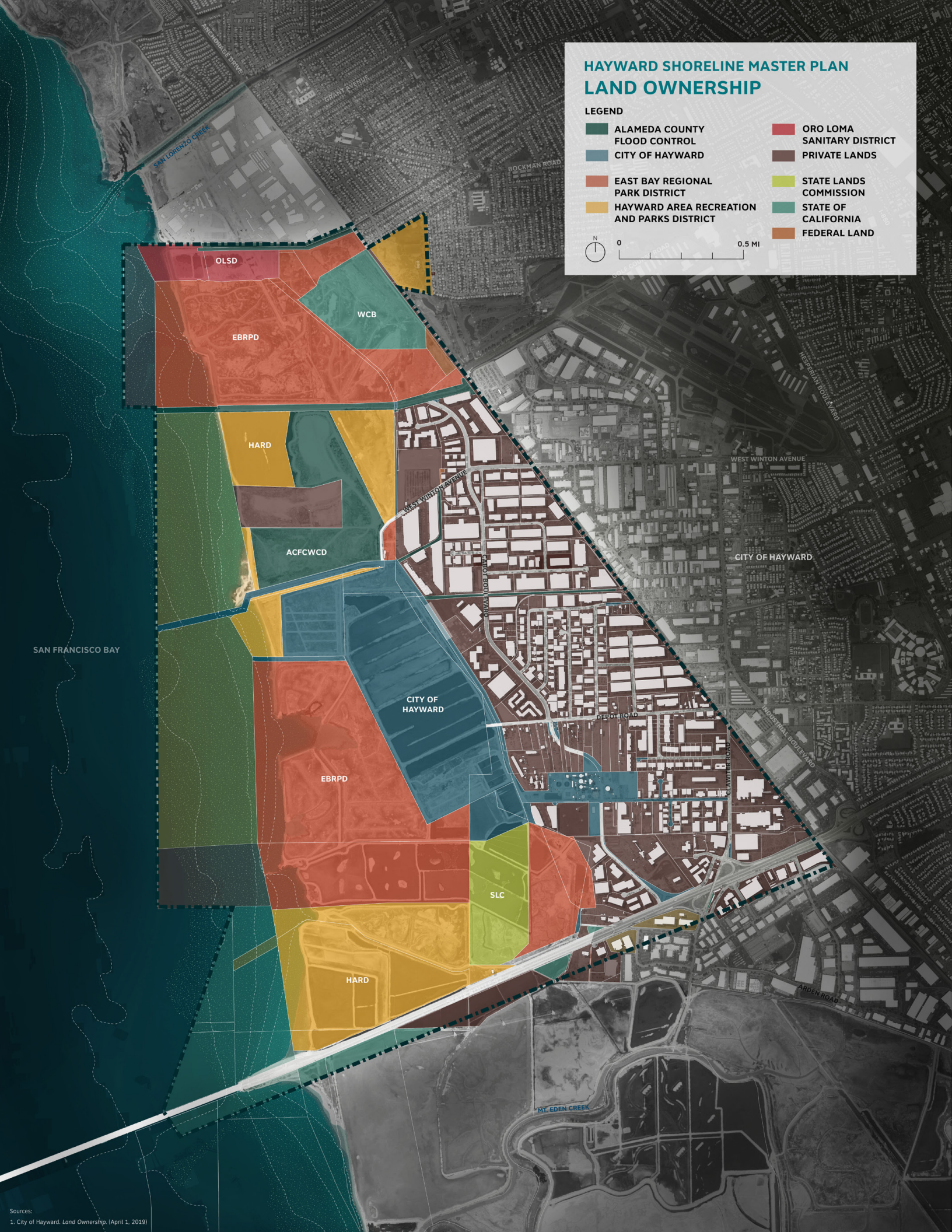


Relationship between land use events and population for the city of Hayward.
(SFEI, A Geographic History of San Lorenzo Watershed, 2014)

Sources:

1. East Bay Regional Park District, Hayward Regional Shoreline. https://www.ebparks.org/parks/hayward/

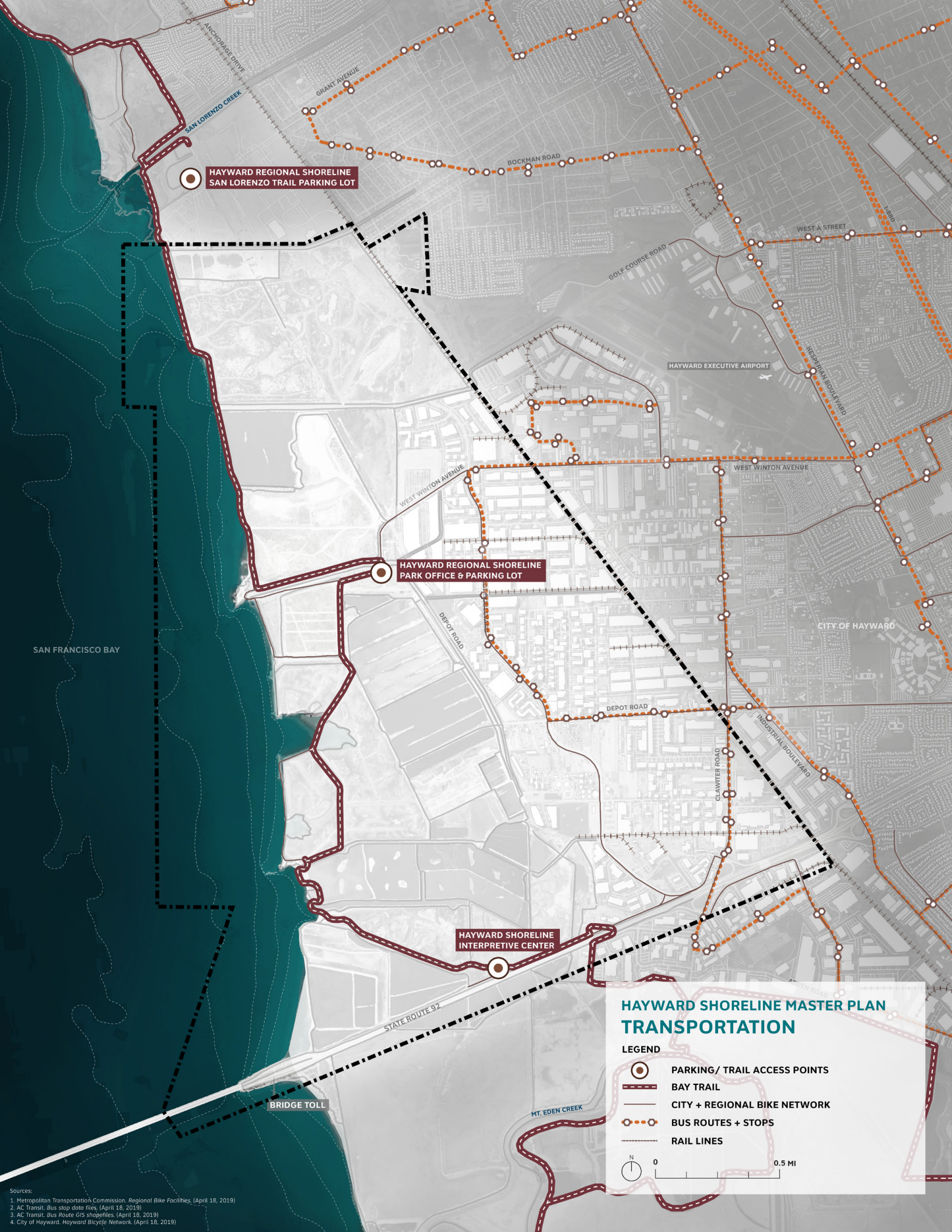
2. Cornell University Ornithology Lab, Birding Hotspots. https://ebird.org/hotspots



Sources:
1. City of Hayward. *Land Ownership.* (April 1, 2019)

OWNERSHIP

Ownership of the baylands is a patchwork of city, county and state entities including CalTrans, HARD, EBRPD, and the City of Hayward. Privately-owned parcels are also within the project area, predominately concentrated within the industrial business zone. To unify an approach for land planning and address the complexity of numerous stakeholder jurisdictions, the City of Hayward, HARD, and EBRPD established the Hayward Area Shoreline Planning Agency (HASPA) in 1970.



HAYWARD SHORELINE MASTER PLAN

TRANSPORTATION

LEGEND

- PARKING/ TRAIL ACCESS POINTS
- BAY TRAIL
- CITY + REGIONAL BIKE NETWORK
- BUS ROUTES + STOPS
- RAIL LINES

N

0 — 0.5 MI

Sources:

1. Metropolitan Transportation Commission. *Regional Bike Facilities.* (April 18, 2019)
2. AC Transit. *Bus stop data files.* (April 18, 2019)
3. AC Transit. *Bus Route GIS shapefiles.* (April 18, 2019)
4. City of Hayward. *Hayward Bicycle Network.* (April 18, 2019)

TRANSPORTATION

Within the project area, public transportation has the potential to facilitate connections between urban developments and the baylands. Bus routes and bus stops provide linkages throughout the City of Hayward, but only one route serves the project area along Cabot Boulevard, limiting direct connections with the Hayward Regional Shoreline.

The Bay Trail, a critical piece of transportation infrastructure, offers walking, hiking, and cycling opportunities throughout the baylands. Numerous regional cycling routes branch off from the Bay Trail and provide additional public access opportunities for adjacent communities.

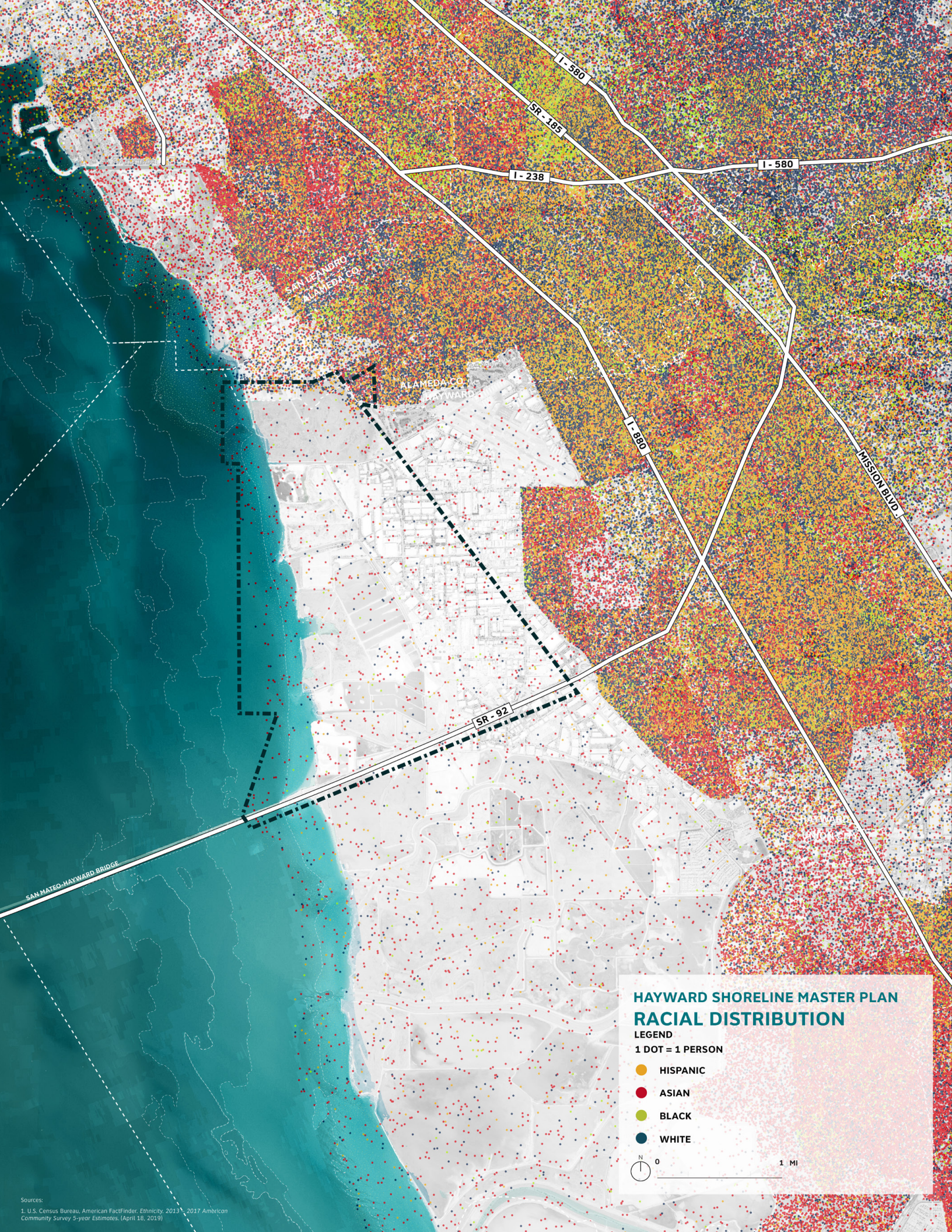
Winton Road, the Hayward Shoreline Interpretive Center, and a staging area near San Lorenzo Creek serve as vehicular access points to the shoreline. While signage demarcates these access opportunities, they tend to be obscured by larger industrial developments that surround the baylands.

Major highways and roads such as State Route 92 serve as critical transportation corridors that link the city of Hayward to other regions of the Bay. These vital connections broaden opportunities to bring people to the shoreline and greatly expanded upon the existing access of the site.

Hiking along the Bay Trail.
(Ronald Horii, 2014)

State Route 92 bridge approach heading toward San Mateo
(CA COT, 2019)

DEMOGRAPHICS



Sources:

1. U.S. Census Bureau, American FactFinder. *Ethnicity. 2013 - 2017 American Community Survey 5-year Estimates.* (April 18, 2019)

RACIAL DISTRIBUTION

A DIVERSE CITY

The 2013-2017 American community survey ranks Hayward as one of the most diverse cities within the State of California. Although Hispanics comprise a majority of the population, the city of Hayward is very ethnically and racially diverse.

Analysis of the census data shows the ethnic composition of Hayward is 62,287 Hispanic residents (40.3%), 39,187 Asian residents (25.4%), 26,470 White residents (17.1%), 16,705 Black residents (10.8%). The most common languages in addition to English in Hayward are Spanish (45,680 speakers), Tagalog (11,288 speakers), and Chinese (6,033 speakers). Compared to other American towns, Hayward has a relative high number of Tagalog, Hindi, and Other Pacific Islander language speakers.

Sources:

1. Datausa.io

2. East Bay tops among California's most diverse places

HAYWARD SHORELINE MASTER PLAN

POPULATION DENSITY

LEGEND

- < 500 PEOPLE / SQUARE MILE
- 500 TO 5,000 PEOPLE / SQUARE MILE
- 5,000 TO 12,000 PEOPLE / SQUARE MILE
- > 12,000 PEOPLE / SQUARE MILE

N

0 1 MI

Sources:

1. U.S. Census Bureau, American FactFinder. *Total Population, 2013 – 2017 American Community Survey 5-year Estimates.* (April 18, 2019)

POPULATION DENSITY

Hayward ranks as the sixth largest city in the Bay Area and is home to a population of 154,507 people. The city spreads over approximately 64 square miles, 30% of which is water. The average population density in Hayward is 2,420 people per square mile, which is slightly higher than Alameda County's density, but lower than the density of the Metro Area as a whole (1,911 per sq mi).

The median property value in Hayward is $404,500, which is 2.71 times lower than the median property value of San Francisco ($1,100,000), and from 2015 to 2016 the median property value in Hayward went from $364,600 to $404,500, a 10.9% increase. The homeownership rate of Hayward is 51%, which is lower than the national average of 63.6%. Hayward residents have an average commute time of 30.8 minutes, and most commuters in the area drive alone. Car ownership in Hayward is approximately the same as the national average, with a mean of 2 cars per household.

The economy of Hayward is specialized in transportation and warehousing, wholesale trade, administration, and waste management services, which employ respectively 1.74, 1.39, and 1.21 times more people than what would be expected in a location of this size. The largest industries in Hayward are healthcare and social assistance, manufacturing, and retail trade. The highest paying industries are utilities ($65,385), professional, scientific, tech services ($61,971), and finance ($51,291).

The median household income in Hayward is $68,138, which is lower than both Alameda County median ($79,831) and the Metro Area median ($85,947).

Poverty status has been determined for 12.5% of the population, a number that is lower than the national average of 14%.

Sources:

1. Datausa.io

2. East Bay tops among California's most diverse places

HAYWARD SHORELINE MASTER PLAN

MEDIAN AGE

LEGEND

- 19-30
- 30-40
- 40-50
- 50-60
- > 60

N 0 1 MI

Sources:

1. U.S. Census Bureau, American FactFinder. *Total Population. 2013 – 2017 American Community Survey 5-year Estimates.* (April 18, 2019)

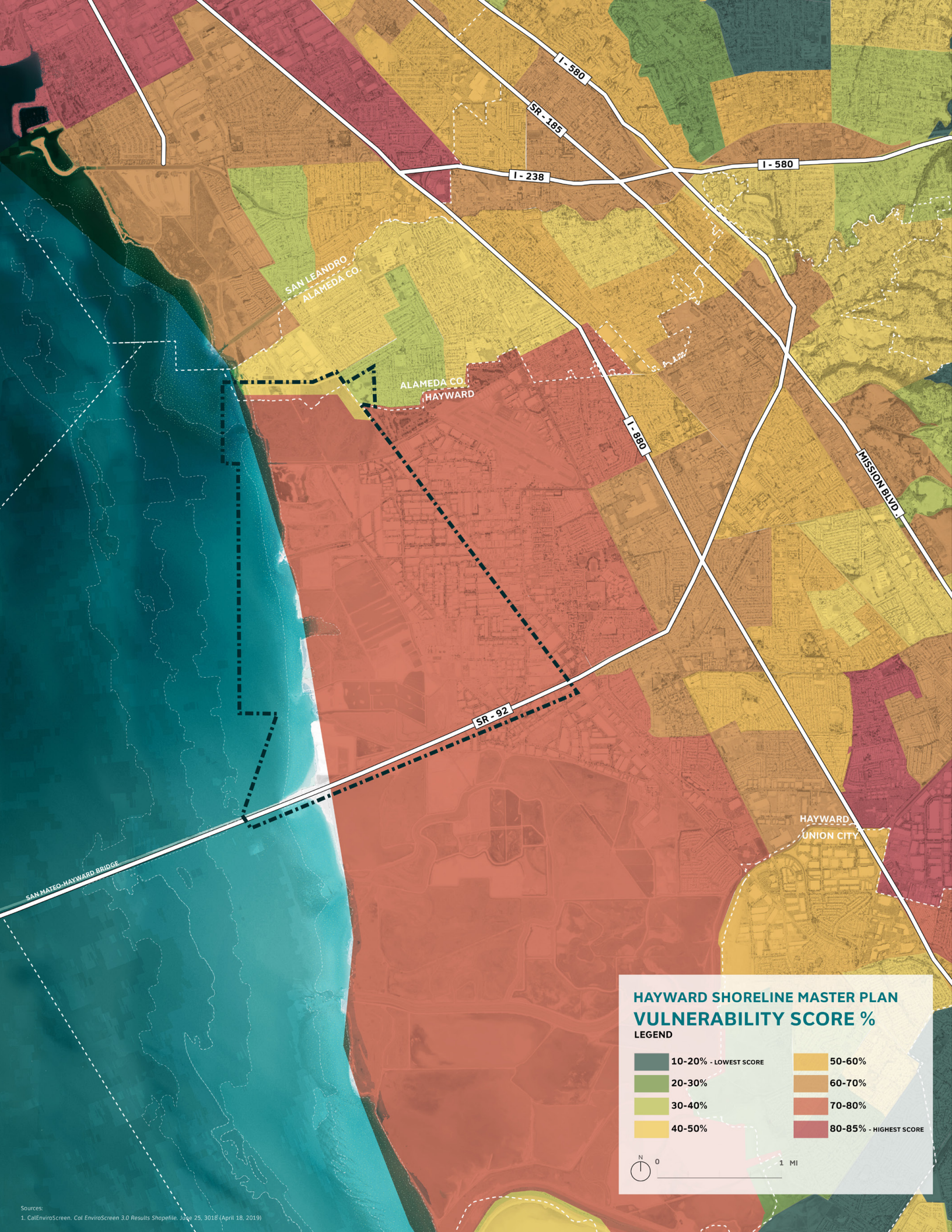
MEDIAN AGE

In 2016, the median age of all people in Hayward was 34.6 years, which is slightly younger than the Calfornia median (36.2), and younger than the national median (37.8). US-born citizens, with a median age of 26.4, were generally younger than immigrant citizens, with a median age of 44.3.

Sources:

1. Datausa.io

2. East Bay tops among California's most diverse places



Sources:

1. CalEnviroScreen. *Cal EnviroScreen 3.0 Results Shapefile.* June 25, 3018 (April 18, 2019)

SOCIAL VULNERABILITIES

The Project Team used the CalEnviroScreen index to evaluate social vulnerabilities in the Hayward area. The CalEnviroScreen is a science-based index that helps identify California communities that are most affected by various sources of pollution and are especially vulnerable to pollution's effects. CalEnviroScreen uses environmental, health, and socioeconomic information to produce a numerical score for each census tract in the state.

A census tract with a high score experiences higher pollution burden and greater vulnerability than census tracts with low scores. CalEnviroScreen ranks census tracts based on data available from state and federal government sources. The numerical model is made up of a suite of 20 statewide indicators of pollution burden and population characteristics associated with increased vulnerability to pollution's health effects. The index uses a weighted scoring system to derive average pollution burden and population characteristics scores for each census tract. The score measures the relative pollution burdens and vulnerabilities in one census tract compared to others and is not a measure of health risk.

Sources:

1. https://oehha.ca.gov/media/downloads/calenviroscreen/fact-sheet/ces30factsheetfinal.pdf

PAST PLANS & STUDIES

PAST PLANS AND STUDIES

- Ackerly, D. J. (2019). San Francisco Bay Area Summary Report. University of California, Berkeley.
- AECOM. (2016). San Francisco Bay Tidal Datums and Extreme Tides Study. San Francisco, CA: AECOM.
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ADAPTING TO RISING TIDES: HAYWARD SHORELINE RESILIENCY STUDY

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

March 2015

Key Words: Vulnerability Assessment, Sea Level Rise, Extreme Tides, Management Challenges, Conceptual Visions

Jurisdiction: State

SUMMARY:

Report summarizing the Hayward Shoreline Resiliency Study conducted as part of the Adapting to Rising Tides program by the San Francisco Bay Conservation and Development Commission (BCDC) in partnership with the National Oceanic and Atmospheric Administration Coastal Services Center (NOAA CSC), ICLEI Local Governments for Sustainability, the Metropolitan Transportation Commission, and California Department of Transportation (Caltrans).

The study assessed vulnerabilities to a range of water levels which represent various scenarios of either sea level rise above MHHW or extreme tides (12, 24, 36, 48, 72 and 96 inches). Includes series of maps of each water level documenting assets vulnerable to either permanent inundation or temporary flooding from extreme tides (1, 5, and 50 yr. tides). Assets highlighted include habitat & wetland complexes (Cogswell and HARD Marshes), the Bay Trail, wastewater treatment facilities, and the approach to the hayward-San Mateo Bridge.

The study identified overarching study area vulnerabilities and potential responses that cut across specific site vulnerabilities and management responsibilities. This includes the need for maintenance and long-term planning for existing shoreline infrastructure; potential widespread consequences of impacts on regionally significant transportation and wastewater infrastructure; at-risk unique shoreline recreation and education facilities; the need for new decision-making and regulatory frameworks to addressing evolving and adaptation needs; and the long-term planning and coordination challenges associated with mid-century sea level rise.

In addition, the study developed three conceptual landscape visions: a traditional levee along Depot Road, a wide horizontal levee that incorporates broader habitat functions, and managed retreat.

ADAPTING TO RISING TIDES: HAYWARD SHORELINE STUDY, APPENDIX A, HAYWARD SHORELINE TECHNICAL MEMO

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

July 2014

Key Words: Vulnerability Assessment, Sea Level Rise, Extreme Tides

Jurisdiction: State

SUMMARY:

Memo summarizing a study on sea level rise exposure analysis and adaptation strategy development conducted as part of a Metropolitan Transportation Commission (MTC) study, produced in tandem with other ongoing work by San Francisco Bay Conservation and Development Commission (BCDC) and Alameda County Flood Control and Water Conservation District (ACFCWCD) to better understand SLR, storm surge, and shoreline vulnerabilities in Alameda County.

The study identified ten key areas of vulnerability grouped into three categories—shoreline inundation areas, critical inundation pathways, and inland inundation areas. Shoreline inundation areas are immediately adjacent to the shoreline and are both the most vulnerable to flooding and permanent inundation. Inland inundation areas are not directly adjacent to the shoreline and require a hydraulic pathway to convey flood waters. Critical inundation pathways connect shoreline inundation areas to the inland inundation areas. Detailed maps, summaries of vulnerabilities, and critical observations are provided for area. The study also identifies the water levels that will flood the eight distinct marsh areas and ponds in the study area.

The memo also identified potential adaptation responses including:

- Cooperative land retreat where an inland berm is constructed, and all lands seaward are repurposed as open space to attenuate waves and diminish erosion and flood risk.
- Maintain the existing shoreline alignment by building up the height (and associated width) of the bayfront berms. Recommended only as a short-term strategy.
- Reinforcing and raising the Bay trail with a levee to provide flood protection. May have impacts to surrounding habitats.
- Constructing an elevated SR 92 causeway and connect the habitat areas to the north and south of SR 92
- Constructing armored embankments adjacent to the SR 92 touchdown, such as rip-rap, sea walls, or levees.

ADAPTING TO RISING TIDES: HAYWARD SHORELINE STUDY, APPENDIX B, HAYWARD ASSET PROFILE SHEETS

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

July 2014

Key Words: Vulnerability Assessment, Sea Level Rise, Extreme Tides

Jurisdiction: State

SUMMARY:

Profiles for each vulnerable asset identified in the Hayward Shoreline Resilience Study. Each profile includes the key issues, vulnerabilities, and consequences

identified for each asset. The profile sheets also identify priority management issues, present proposed adaptation strategies, and identify next steps for

individual agencies and the study area. Includes profiles for:

- BAY TRAIL – portion of regional trail system vulnerable to sea level rise and storm impacts. Owned and maintained by East Bay Regional Parks
- District (EBRPD).
- CITY OF HAYWARD – City will be responsible for impacts to assets it owns and manages, like the water pollution control facility and roads.
- COGSWELL MARSH - 250 acres tidal/low marsh habitat managed by EBRPD. Was once cut off from tidal influence to support commercial salt production, was restored to tidal action in 1980. Sea level rise will increase the depth, duration, and frequency of flooding. Adaptive capacity limited by shortage of sediment and lack of room for inland migration.
- EAST BAY DISCHARGERS AUTHORITY (EBDA) - Provides wastewater disposal for approximately 800,000 people. Treated wastewater is conveyed though a system of pipes and pumps to the Marina Dechlorination Facility prior to being discharged via the Bay Outfall and Diffuser. The EBDA system consists of aging infrastructure and increasing challenges regarding nutrient loading. This system already has limited capacity to discharge wet weather flows, which will be exacerbated by sea level rise and storms. EBDA is investigating replacing the existing system with decentralized alternative treatment and discharge through the local wetlands.
- EDEN LANDING ECOLOGICAL RESERVE – 5,450 acres of tidal marshes and former salt ponds. Owned and managed by the California Coastal Conservancy (CCC) and California Department of Fish and Wildlife (CADFW)
- FLOOD CONTROL (ZONE 4 LINES A AND E) - Lines A and E are the two main flood control channels within the study area. They rely on gravity drainage to discharge rainfall-generated runoff. Operated by Alameda County Flood Control Water Conservation District (ACFCWCD). Tidal action currently extends through the lines to Depot Road. Although they have capacity for today's storms, they do not have capacity for future sea level rise and storms, which could cause flooding along the Bay Trail in commercial and industrial areas. Increased tidal action also reduce capacity for rainfall-generated runoff.
- HARD MARSH - 79 acres of fully tidal low marsh with large interior mudflats managed by the Hayward Area Recreation District (HARD). Sea level rise will increase the depth, duration, and

frequency of flooding. A constrained system with little space for inland migration.

- HAYWARD MARSH - 145-acre, five-basin managed pond system built in 1985 that receives secondary treated wastewater from Union Sanitary District's (USD) Alvarado Wastewater Treatment Plant. East Bay Regional Parks District (EBRPD) owns the marsh and maintains the levees/berms, valves/weirs, channels and islands. Freshwater effluent creates a unique
- brackish pond habitat, and islands provide safe area for
- threatened and endangered birds. EBRPD and USD are currently exploring options to address dredging needs and other management issues.
- HAYWARD SHORELINE INTERPRETIVE CENTER - educational and resource center owned and managed by Hayward Area Recreational District (HARD). Physically vulnerable to sea level rise and storm events, also relies on to vulnerable HARD Marsh for programming.
- HAYWARD WATER POLLUTION CONTROL FACILITY - Wastewater treatment facility owned and managed by the City of Hayward. Includes the Hayward Effluent Pump Station (HEPS) owned by East Bay Dischargers Authority (EBDA) and managed by the City of Hayward. Facility serves 148,800 people and industrial and commercial businesses in the City of Hayward. Facility as well as the oxidation ponds that are used for wet weather flow storage are vulnerable to flooding and sea level rise.
- OLD WEST WINTON LANDFILL - a closed and capped solid waste landfill owned by the City of Hayward. As sea level rises, the cap may be exposed to wave erosion, saltwater intrusion, and standing water that it was not designed to withstand, potentially allowing hazardous materials to enter the Bay.
- OLIVER SALT PONDS - 98 acres of former commercial salt ponds now restored as shorebird and waterfowl habitat, owned by the Hayward Area Recreation District (HARD). Water levels rely on levees and tide gates to manage water, will be compromised by and sea level rise.
- RUSSELL CITY ENERGY CENTER - gas-fueled power plant owned and operated by CalPine. Access roads, water & wastewater service and other utilities vulnerable to sea level rise.
- SALT MARSH HARVEST MOUSE PRESERVE - 27 acre, muted tidal system managed as a habitat preserve by East Bay Regional Parks District (EBRPD). Sea level rise will make controlling water levels more challenging.
- SOLAR PANELS OXIDATION PONDS – Solar panels installed by City of Waterward in former oxidation ponds, providing power to the Hayward Water Pollution Control Facility.
- STATE ROUTE 92 - plaza and eastern approach to the San Mateo-Hayward Bridge, managed by Caltrans. Drainage issues and vulnerable to sea level rise.
- STRUCTURAL SHORELINES - Outboard levees are non-engineered levees, from the 1850s, often strengthened with rip rap revetments, which separate tidal marshes and managed ponds from the Bay. The inboard levee is an engineered levee between the ACFCWCD's Line E flood control channel and Depot Road.
- TRIANGLE MARSH - 8-acre, muted tidal marsh managed by the Hayward Area Recreation District (HARD). Sea level rise will make water level management more challenging, and little space to migrate upland.

ADAPTING TO RISING TIDES: ALAMEDA COUNTY SHORELINE VULNERABILITY ASSESSMENT

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION / ALAMEDA COUNTY FLOOD CONTROL

May 2015

Key Words: Vulnerability Assessment, Sea Level Rise, Extreme Tides

Jurisdiction: State/County

SUMMARY:

This report points out that multiple entities have put their focus and have collaborated on Alameda County to understand, refine, and enhance understanding of climate change related risks, with an emphasis on future sea-level rise and storm surge impacts:

- Alameda County Flood Control and Water Conservation District (ACFCWCD)
- San Francisco Bay Conservation and Development Commission (BCDC)
- Metropolitan Transportation Commission (MTC)
- California Department of Transportation District Number 4 (Caltrans District 4)
- San Francisco Bay Area Rapid Transit (BART)

These organisms have developed a stepwise and systematic approach for investigating shoreline resilience, which include:

1. Use regional SLR and storm surge inundation maps to conduct high-level shoreline assessments.
2. Consult local experts and flag locations where the inundation maps do not represent local of past flood events.
3. Conduct refined shoreline analyses to assess more-detailed vulnerabilities and identify locations where short-term actions would provide benefits.
4. Identify resilience building actions and implementation options that can reduce shoreline vulnerabilities.
5. Investigate the feasibility of resilience building actions.

A Pilot Project funded through a grant with the Federal Highway Administration (FHWA) focuses on developing Step 1 above on a portion of Alameda County (as part of the Adapting to Rising Tides Transportation Vulnerability and Risk Assessment) and was completed in November 2011. From this study it was determined that a more robust shoreline assessment was needed, and therefore Alameda County, in collaboration with BCDC, complemented the additional analyses required to inform the focus area analysis, while also providing an overall enhanced data set for understanding county-wide shoreline vulnerabilities. Alameda County's contributions were funded through the Alameda County Public Works Agency.

As part of this effort, new sea level rise and storm surge inundation maps were created for Alameda County using an innovative approach at the time that allows one map to represent multiple potential future sea level rise and storm surge scenarios. SLR scenarios from 6 to 60 inches were considered, as well as storm surge events from the 1-year extreme tide to the 500-year event. Also, the potential for overtopping was also evaluated. The above approach helped inform when in time, and where, intervention may be required to reduce potential future inland flooding risks. One of the key conclusions is that as sea levels rise past a tipping point, regional solutions require collaboration across board geographic scales. At the time this report was published, two Bay Area wide efforts were in progress to expand the work completed in Alameda County to a regional scale:

- Tidal datums study for the entire San Francisco Bay (U.S. Department of Homeland Security's FEMA)
- Shoreline delineation by type, as part of the Flood Infrastructure Mapping Project (San Francisco Estuary Institute)

ADAPTING TO RISING TIDES: BAY AREA SEA LEVEL RISE ANALYSIS AND MAPPING PROJECT, FINAL REPORT

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION, METROPOLITAN TRANSPORTATION COMMISSION, BAY AREA TOLL AUTHORITY

Sept. 2017

Key Words: Vulnerability Assessment, Sea Level Rise, Extreme Tides

Jurisdiction: State

SUMMARY:

This report describes how earlier projects in certain subareas to map sea level rise inundation (like Alameda County) were conducted at different times and did not include the entire SF Bay Shoreline. As a result, the mapping products were not consistent with each other in terms of source data, methods, degree of stakeholder input, map format, and data structure. This study produced consistent inundation data and mapping products for all nine San Francisco Bay Area counties.

The study created the following tools and data layers:

- 1-meter resolution topographic digital elevation model (DEM)
- SLR inundation maps showing depth and extent of inundation for 10 scenarios
- Shoreline overtopping potential maps for the 10 scenarios
- SLR and extreme tide matrix (showing the 10 scenarios)
- Discussion of key SLR and flooding vulnerabilities

The study also documents sea level rise impacts in each county, high-level discussion of impacts to bridge approaches that may be of interest to Bay Area Toll Authority (BATA) to inform the selection of focus areas for future studies.

HAYWARD 2040 GENERAL PLAN: POLICY DOCUMENT

CITY OF HAYWARD

July 2014

Key Words: Land Use Plan, Policy, Flooding, Sea Level Rise

Jurisdiction: City

SUMMARY:

As required by California State law, Hayward's comprehensive and long-range general plan is a comprehensive planning document that provides the City with a policy framework to guide decision-making related to land use, growth and development, safety, and open space conservation.

The plan contains a Hazard Element with several goals and policies relevant to flooding:

- The City shall coordinate with the Federal Emergency Management Agency (FEMA) to ensure that Federal Insurance Rate Maps correctly depict flood hazards in the City.
- The City shall implement Federal, State, and local requirements related to new construction in flood plain areas to ensure that future flood risks to life and property are minimized.
- The City shall maintain and enforce a Flood Plain Management Ordinance to:
- Promote public health, safety, and general welfare by minimizing public and private losses due to floods,
- Implement the Cobey-Alquist Flood Plain Management Act, and
- Comply with the eligibility requirements of the National Flood Insurance Program.
- The City shall coordinate with the Alameda County Flood Control and Water Conservation District to evaluate the need to expand the capacity of flood control facilities based on changing flood conditions associated with global warming and extreme weather.
- The City shall promote greater public awareness of flooding hazards and promote resources and programs to help property owners protect their homes and businesses from flood damage.

And relevant to sea level rise:

- The City shall monitor information from regional, State, and Federal agencies on rising sea levels in the San Francisco Bay to determine if additional adaptation strategies should be implemented to address flooding hazards.
- The City shall continue to participate in the Adapting to Rising Tides Project to develop adaptation strategies that protect the Hayward shoreline and enhance the community's overall resilience to rising sea levels.
- The City shall coordinate with the Hayward Area Shoreline Planning Agency, the Bay Conservation Development Commission, and other agencies involved in the Adapting to Rising Tides Project to develop and implement a Regional Shore Realignment Master Plan. The Master Plan shall identify:
- A preferred long-term strategy and implementation program to protect the regional shoreline.
- Interim standards to regulate development within potentially affected areas if sea levels rise prior to the construction of shoreline protection projects.
- Potential flood mitigation measures to apply to development projects within potentially affected areas.

The City shall strive to provide updated Flood Insurance Rate Maps that reflect rising sea levels and changing flood conditions.
The City shall require that all new development within areas subject to future flooding as a result of rising sea levels provide future residents and property owners with deed notices upon transfer of title concerning rising sea levels and flooding.

LOCAL HAZARD MITIGATION PLAN

CITY OF HAYWARD

2016

Key Words: Hazard Mitigation, Flooding, Sea Level Rise

Jurisdiction: City

SUMMARY:

This report describes how earlier projects in certain subareas to map sea level rise inundation (like Alameda County) were conducted at different times and did not include the entire SF Bay Shoreline. As a result, the mapping products were not consistent with each other in terms of source data, methods, degree of stakeholder input, map format, and data structure. This study produced consistent inundation data and mapping products for all nine San Francisco Bay Area counties.

The study created the following tools and data layers:

- 1-meter resolution topographic digital elevation model (DEM)
- SLR inundation maps showing depth and extent of inundation for 10 scenarios
- Shoreline overtopping potential maps for the 10 scenarios
- SLR and extreme tide matrix (showing the 10 scenarios)
- Discussion of key SLR and flooding vulnerabilities

The study also documents sea level rise impacts in each county, high-level discussion of impacts to bridge approaches that may be of interest to Bay Area Toll Authority (BATA) to inform the selection of focus areas for future studies.

SAN FRANCISCO BAY TIDAL DATUMS AND EXTREME TIDES STUDY

AECOM

2016

Key Words: Tidal Elevation, Tidal Datums, Water Levels

Jurisdiction: San Francisco Bay

SUMMARY:

This study is the first comprehensive publication of tidal datums and extreme tides for the San Francisco Bay since the USACE presented tidal datums and the "100-year tide" elevation for 53 locations around the bay, in 1984. The study expands on the previous study and presents daily and extreme tidal information for more than 900 locations along the Bay shoreline. The goal of this study is to provide data that support a wide-range of planning efforts around the Bay, particularly as communities seek to understand and begin to adapt to rising sea levels.

This study developed a regional hydrodynamic model of the entire San Francisco Bay to support FEMA's San Francisco Bay Area Coastal Study. The model developed provides simulated tide data at over 8,000 points along the shoreline. Extreme tides were calculated at over 900 locations, capturing the variations in tides, by modeling results for recent time periods (1956-2009 for the South Bay).

CALIFORNIA COASTAL COMMISSION SEA LEVEL RISE POLICY GUIDANCE. INTERPRETIVE GUIDELINES FOR ADDRESSING SEA LEVEL RISE IN LOCAL COASTAL PROGRAMS AND COASTAL DEVELOPMENT PERMITS

CALIFORNIA COASTAL COMMISSION

2018

Key Words: Sea Level Rise, Emission Scenarios, California

Jurisdiction: California

SUMMARY:

Increasing global temperatures are causing significant effects at global, regional, and local scales. Sea level at the San Francisco tide gauge has risen 8 in (20 cm) over the past century, and reports developed by the California Ocean Protection Council (OPC) project that by the year 2100, sea levels may rise by approximately 2.4 to 6.9 feet, with the potential for rapid ice loss to result in an extreme scenario of 10.2 feet of sea level rise.

This document replicates the 2018 OPC set of projections for 12 tide gauges throughout California, which the Coastal Commission recommends using for planning purposes. This document also provides a step-by-step process for addressing SLR and adaptation planning in new and updated Local Coastal Programs.

CLIMATE CHANGE PROJECTIONS OF SEA LEVEL EXTREMES ALONG THE CALIFORNIA COAST

CAYAN, DANIEL; BROMIRSKI, PETER; HAYHOE, KATHARINE; TYREE, MARY; DETTINGER, MICHAEL; FLICK, REINHARD.

2008

Key Words: Sea Level Rise, Climate Change, California

Jurisdiction: California Coast

SUMMARY:

This study investigates the possible influence of SLR and other climate changes on the future statistics of extreme sea levels. To this, they used a model of the combined contributions to hourly sea level of predicted tides and model-simulated weather, climate, and long-term global warming. The study concludes that in the San Francisco Bay estuary, sea level rise effects may be compounded by riverine floods that feed into the northern reaches of the Bay from the Sacramento/San Joaquin Delta.

CLIMATE CHANGE, ATMOSPHERIC RIVERS, AND FLOODS IN CALIFORNIA – A MULTIMODEL ANALYSIS OF STORM FREQUENCY AND MAGNITUDE CHANGES

DETTINGER, MICHAEL

2011

Key Words: Climate Change, Floods, California

Jurisdiction: California

SUMMARY:

This study assesses atmospheric conditions associated with major storms and floods in California, in particular, pineapple express or atmospheric river (AR) storms, in the context of recent projections of 21st Century climate change. Projections indicate that the average intensity of these storms is not likely to increase in most models, although occasional, much-larger-than-historical-range storm intensities are projected to occur under the warming scenarios. The AR storms warm along with the general mean temperatures in the projections analyzed, although not quite as fast. The study concludes by indicating that more analysis is needed to increase understanding and certainties about the potential scenarios described.

SEA-LEVEL RISE AND COASTAL GROUNDWATER INUNDATION AND SHOALING AT SELECT SITES IN CALIFORNIA, USA

HOOVER, DANIEL; ODIGIE, KINGLSEY; SWARZENSKI, PETER; BARNARD, PATRICK

2015

Key Words: Sea Level Rise, Groundwater, California

Jurisdiction: California, Selected Sites

SUMMARY:

This study provides a preliminary assessment of the potential for SLR-driven groundwater inundation and shoaling in select coastal regions of California. The study is focused on three case-studies sites in Arcata, Stinson Beach, and Malibu Lagoon. The study concludes that most of the drier areas along California's coast are unlikely to be affected by SLR-driven emergence or shoaling of fresh groundwater, primarily due to low precipitation and heavy groundwater use that has resulted in lowered groundwater levels. However, groundwater shoaling and emergence may have significant impact in certain settings, for fresh groundwater aquifers. The potentially vulnerable settings identified in the study are Northern California coastal plans, coastal residential communities built on beach sand or sand spits and developed areas around coastal lagoons associated with seasonal streams and berms.

ASSESSMENT OF GROUNDWATER INUNDATION AS A CONSEQUENCE OF SEA-LEVEL RISE

RTOZOLL, KOLJA; FRETCHER, CHARLES

2012

Key Words: Sea Level Rise, Groundwater, Inundation

Jurisdiction: Honolulu, Hawaii

SUMMARY:

Besides marine inundation, it is largely unrecognized that low-lying coastal areas may also be vulnerable to groundwater inundation, which is localized coastal-plain flooding due to a rise of the groundwater table with sea level. This study uses measures of the coastal groundwater elevation and tidal levels in urban Honolulu, Hawaii to estimate the mean water table, which then it was used to assess vulnerability to groundwater inundation from sea-level rise.

A map of areas vulnerable to groundwater inundation was obtained by subtracting the DEM from the estimated regional water table and adding estimates of sea-level rise (SLR). The study indicates that the linear increase in water-table height with SLR is applicable, for example, in freshwater lens aquifers that is directly connected to ocean fluctuations. The correlation found is that 0.6 m (about 2 feet) of potential sea-level rise causes substantial flooding, and 1 m (about 3 feet) sea-level rise inundates 10% of a heavily urbanized coastal zone. One of the key points to consider is that the flooded area including groundwater elevation is more than twice the area of marine inundation alone.

STATE OF CALIFORNIA SEA-LEVEL RISE GUIDANCE: 2018 UPDATE

CALIFORNIA NATURAL RESOURCES AGENCY & CALIFORNIA OCEAN PROTECTION COUNCIL

2018

Key Words: Sea Level Rise, Guidance, California

Jurisdiction: California

SUMMARY:

The increased understanding of sea-level rise projections and polar ice sheet loss warranted an update to the State's sea-level rise guidance document to ensure decisions were based on the best available science. This document provides a science-based methodology for state and local governments to analyze and assess the risks associated with sea-level rise, and to incorporate sea-level rise into their planning, permitting, and investment decisions. The document also provides the State's preferred coastal adaptation approaches.

This Guidance provides a step-wise approach to help decision makers assess risk by evaluating a range of SLR projections and the impacts or consequences associated with these projections. Depending on the finite factors of a proposed project's location and lifespan, decision makers can evaluate the potential impacts and adaptive capacity of the project across a spectrum of SLR projections. This analysis will enable state agencies and local governments to incorporate the latest SLR projections and related hazard information to consider in different types of decisions across California.

This Guidance also describes and provides links to a variety of geospatial and visualization tools to assist decision makers in understanding the impacts

of sea-level rise. The document is accompanied by a library and database of additional resources – hosted on the State Adaptation Clearinghouse and

OPC's website – to help visualize change, access funding opportunities, gather policy and scientific background related to specific jurisdictions, and provide additional support to address a challenge of this nature and magnitude.

CALIFORNIA'S GROUNDWATER UPDATE 2013: A COMPILATION OF ENHANCED CONTENT FOR CALIFORNIA WATER PLAN UPDATE 2013

DEPARTMENT OF WATER RESOURCES

2013

Key Words: Water Resources, Plan, Groundwater

Jurisdiction: California

SUMMARY:

This guidance provides an overview and assessment of the region's groundwater supply and development, groundwater use, monitoring efforts, aquifer conditions, and various management activities. It also identifies challenges and opportunities associated with sustainable groundwater management.

This updated guidance has three primary goals: 1) to expand information about region-specific groundwater conditions and to guide more informed groundwater management actions and policies; 2) improve the quality of groundwater information in future California Water Plan updates to a level that will enable regional water management groups to accurately evaluate their groundwater resources and implement management strategies that can meet local and regional water resources objectives within the context of broader statewide objectives, and 3) identify data gaps and groundwater management challenges that will guide prioritizing of future data collection and funding opportunities relevant to the region. This update is not intended to provide a comprehensive and detailed examination of local groundwater conditions, or be substitute for local studies and analysis.

ONLINE SURVEY & INTERVIEWS SUMMARIES

ONLINE SURVEY SUMMARY

A 23-question survey was conducted on behalf of the Hayward Area Shoreline Planning Agency (HASPA) to assess the public's general understanding of Hayward shoreline, mainly in regard to sea level rise, potential flooding, and participants' feelings, concerns, and predictions regarding these issues. In the spring of 2019, this survey was completed by approximately 900 people throughout the Bay Area, primarily those who live, work, commute through, or recreate at or near the shoreline.

1. **Are you familiar with the Hayward Regional Shoreline that is managed by East Bay Regional Park District and Hayward Area Recreation and Park District?**

   The majority of people surveyed are familiar with the Hayward Regional Shoreline.

2. **What's your association with the project area?**

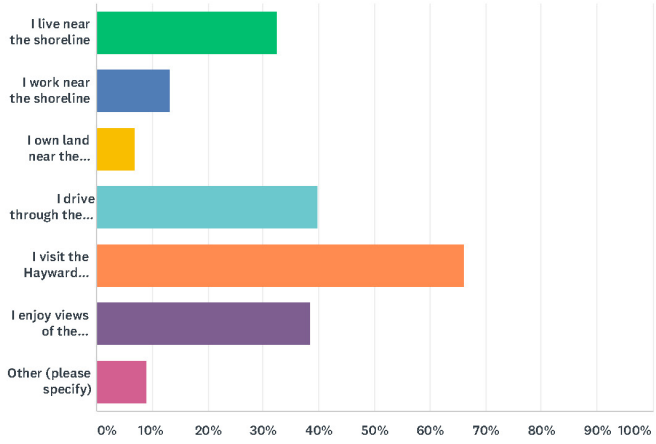
   The majority of those surveyed either drive through the area or enjoy the views of the Shoreline. Approximately two thirds of those surveyed visit the Shoreline and about one third live near the Shoreline. A smaller percentage (about ten percent) specified that they enjoy activities such as birding, cycling, jogging or walking along the Shoreline. A negligible amount of those surveyed stated they'd like to see restaurants built on the area. Some surveyed stated concern for the wetlands and habitats.

3. **Do you live or work near any of the major creeks or channels in the area?**

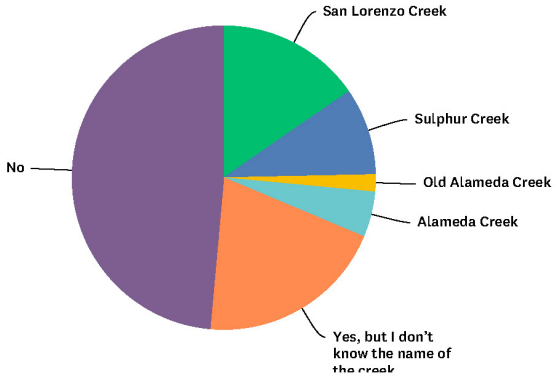
   Approximately half of those surveyed do not live or work near major creeks or channels in the area. About 15% of those surveyed live near San Lorenzo Creek. Almost half of residents who live near a creek or channel do not know the name of that creek or channel. The rest of those surveyed stated they live near Sulphur Creek, Alameda Creek, or Old Alameda Creek (in descending order). A small portion of those surveyed mentioned concerns over climate change, compromised creeks, and rising sea levels.

4. **Have you or anyone close to you ever been personally affected by a flood, either here or elsewhere?**

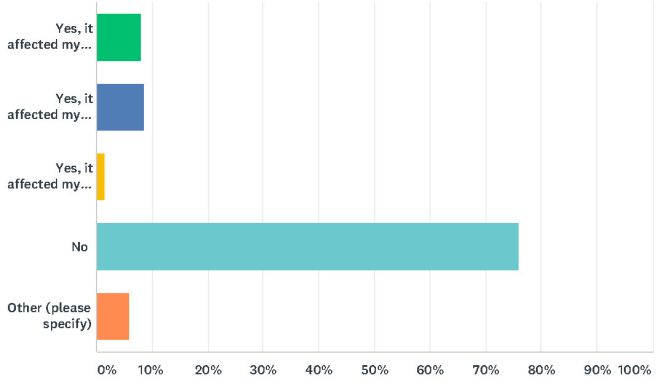
   The vast majority of those surveyed have not been affected by a flood nor do they know anyone personally affected by a flood. A small percentage (less than 10%) were affected a flood that affected their home and transportation, in equal parts.



Question 2 - Online Survey Result



Question 3 - Online Survey Result



Question 4 - Online Survey Result

5. **Do you belong to any environmental, shoreline protection, or shoreline-related recreational groups?**

   The vast majority of those surveyed do not belong to an environmental group or shoreline protection-related group. Of those that are involved in an environmental group, frequently mentioned groups, in descending order, were: The Sierra Club, Save the Bay, Audubon Society, East Bay Regional Parks, and Hayward Shoreline Volunteer Opportunities.

6. **How important is it to be protected against flooding?**

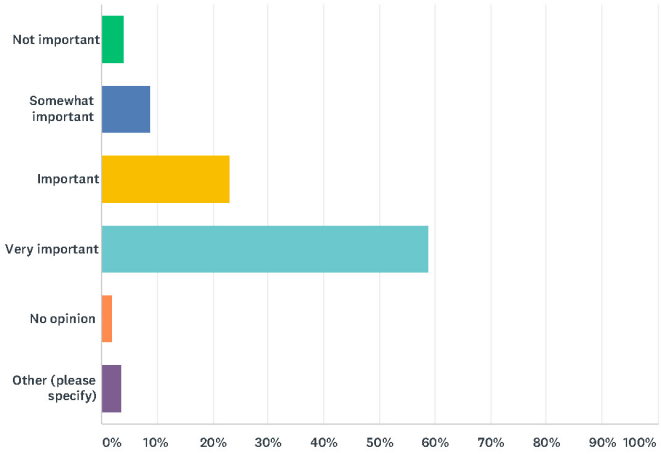
   The majority of those surveyed think it is very important or important to be protected against flooding. A smaller portion (approximately 10%) feel it is not important. A general sentiment with those surveyed was that they were unsure what exactly the term "protected against flooding" implies. Some were concerned around where funding would come from and how, specifically, communities could be protected from flooding.

7. **How important are wetlands and habitats for the health of the San Francisco Bay?**

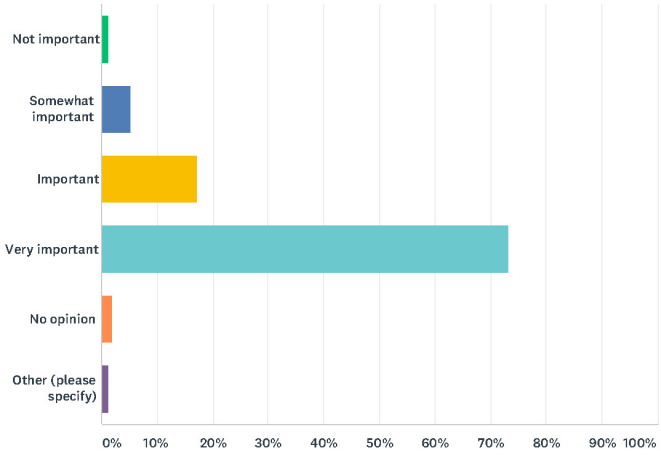
   The vast majority of those surveyed feel wetlands are vital to the health of the Bay. In the comments section of this question, a few people stated people's property should take priority over all else, and that wetlands and other conservation efforts should come in secondary. A small portion of those surveyed are not sure the effects the wetlands have on the environment of the area. A small minority surveyed feel with rising sea level, conservation efforts are hopeless.

8. **How important is it for people to take part in shoreline recreation?**

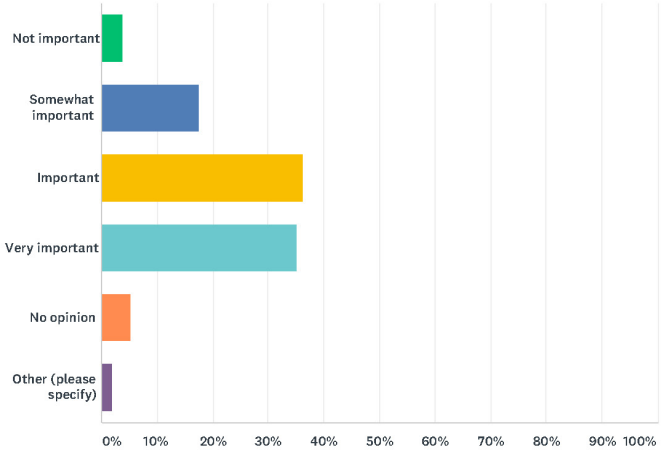
   The majority of those surveyed feel shoreline recreation is important to very important. A large portion surveyed feel recreation is somewhat important, and a small percentage do not feel this is important. In general, people feel shoreline recreation creates a bond with ecological resources and establishes a greater commitment to conservation efforts in the area.



Question 6 - Online Survey Result



Question 7 - Online Survey Result



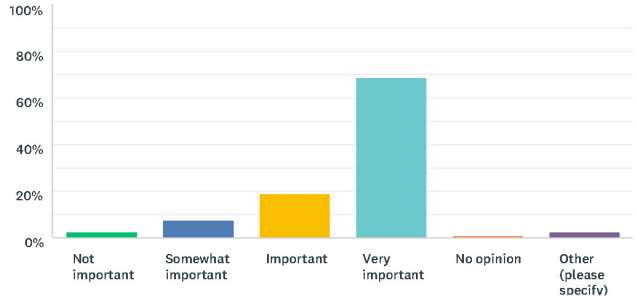
Question 8 - Online Survey Result

9. **How important is it to have uninterrupted shoreline views?**

   Survey participants were divided on the importance of having uninterrupted shoreline views, and responded to the question in nearly equal parts, spanning from "not important" to "very important." A general sentiment was that shoreline views do not perform in any way to alleviate the impacts of climate change. Commenters stressed that access is more important than views.

10. **How important is it to conserve the shoreline's natural environment?**

    The vast majority of those surveyed said that it is very important to conserve the shoreline's natural environment. A very small percentage feel it is not important. A general sentiment among commenters was that shoreline conservation is vital, and some mentioned the idea of compromise around what areas to protect and at what cost, both financial and spatial.



Question 10 - Online Survey Result

11. **What do you think are the most important natural features that help create a healthy environment?**

    The most common answer to the question about factors for a healthy environment was biodiversity, in both native plant species and native animals. Also frequently mentioned were maintaining natural habitats, preserving the wetlands, and having clean water and air. A moderate number of participants stated that restricting human access and keeping out of nature is an important way to create a healthy environment. An even smaller portion felt that saving or maintaining the environment was hopeless.

12. **Are you currently planning any significant construction or development projects?**

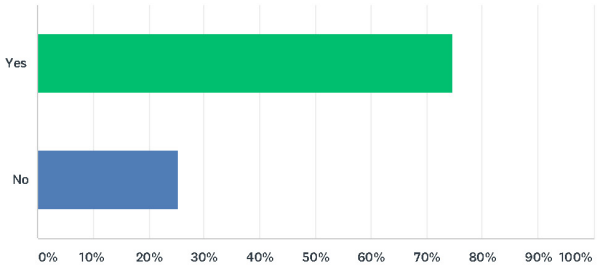
    Almost all participants stated that they are not planning any significant construction or development projects. Of the very small number who are planning construction or development, the Eden Landing project was mentioned several times, and general, smaller repairs to homes and buildings in the area.

13. **Do you have future plans to begin any significant construction or development projects?**

    Almost all participants stated they do not have any construction or development plans in the future. Of the few who do have plans, home repairs and remodels were the primary project listed.

14. Are you aware of rising sea level in the San Francisco Bay?

Approximately 75% of those surveyed are aware of the rising sea level in the San Francisco Bay.



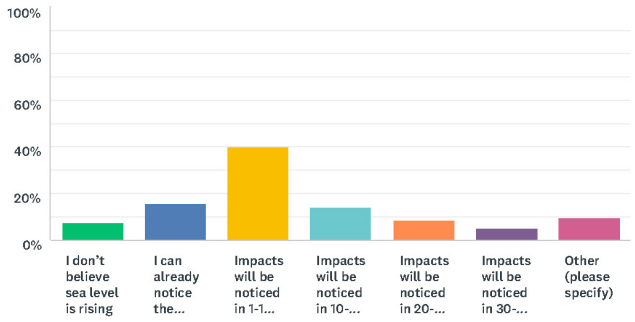
Question 14 - Online Survey Result

15. Related to sea level rise, what types of threats or impacts to property or people do you know about, if any?

The most common concerns around sea level rise in the Bay Area were flooding and erosion. Another concern was loss of habitat for wildlife in the area. Specific concerns were damages to homes and potential loss of shoreline trails and recreation. Some surveyed were concerned but were unsure what the effects of sea level rise will be. A small number of those surveyed felt that any effects of sea level rise will not affect humanity right now, but will affect those in future generations. A very small percentage do not feel global warming is a real threat.

16. When, if ever, do you think there will be a noticeable impact on the Hayward shoreline caused by sea level rise?

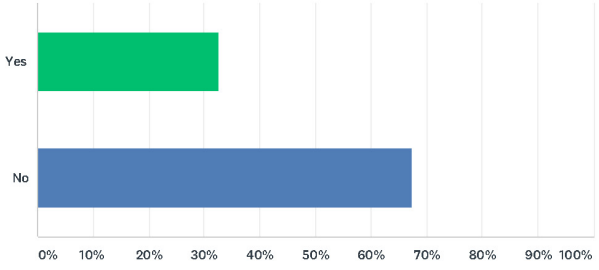
More than one third of those surveyed believe sea level rise will affect the Hayward Shoreline in the next one to ten years. A smaller portion of those surveyed felt that they already notice the effects of sea level rise. About a quarter of those surveyed feel that the impacts on the Hayward Shoreline will be seen in 10-30 years. A small number (10%) of those surveyed are somewhat concerned but do not know what the effects will be. A very small number of those surveyed (about 7%) do not believe in sea level rise.



Question 16 - Online Survey Result

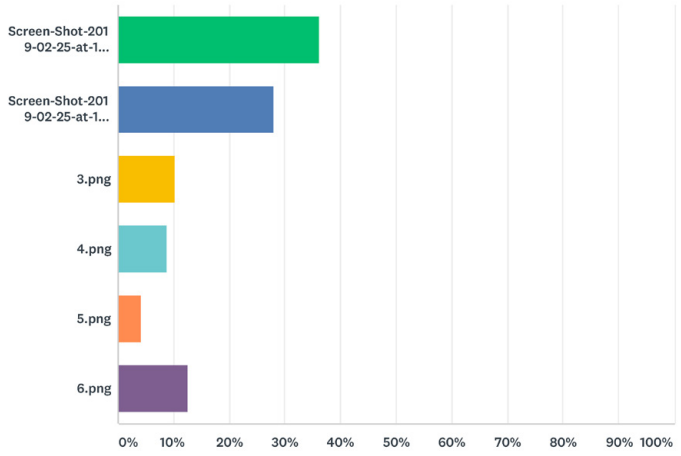
17. Are you aware of any infrastructure in this area (such as levees, tide gates, pump stations) to help reduce flooding?

The majority of those surveyed are not aware of any infrastructure that helps reduce flooding.



Question 17 - Online Survey Result

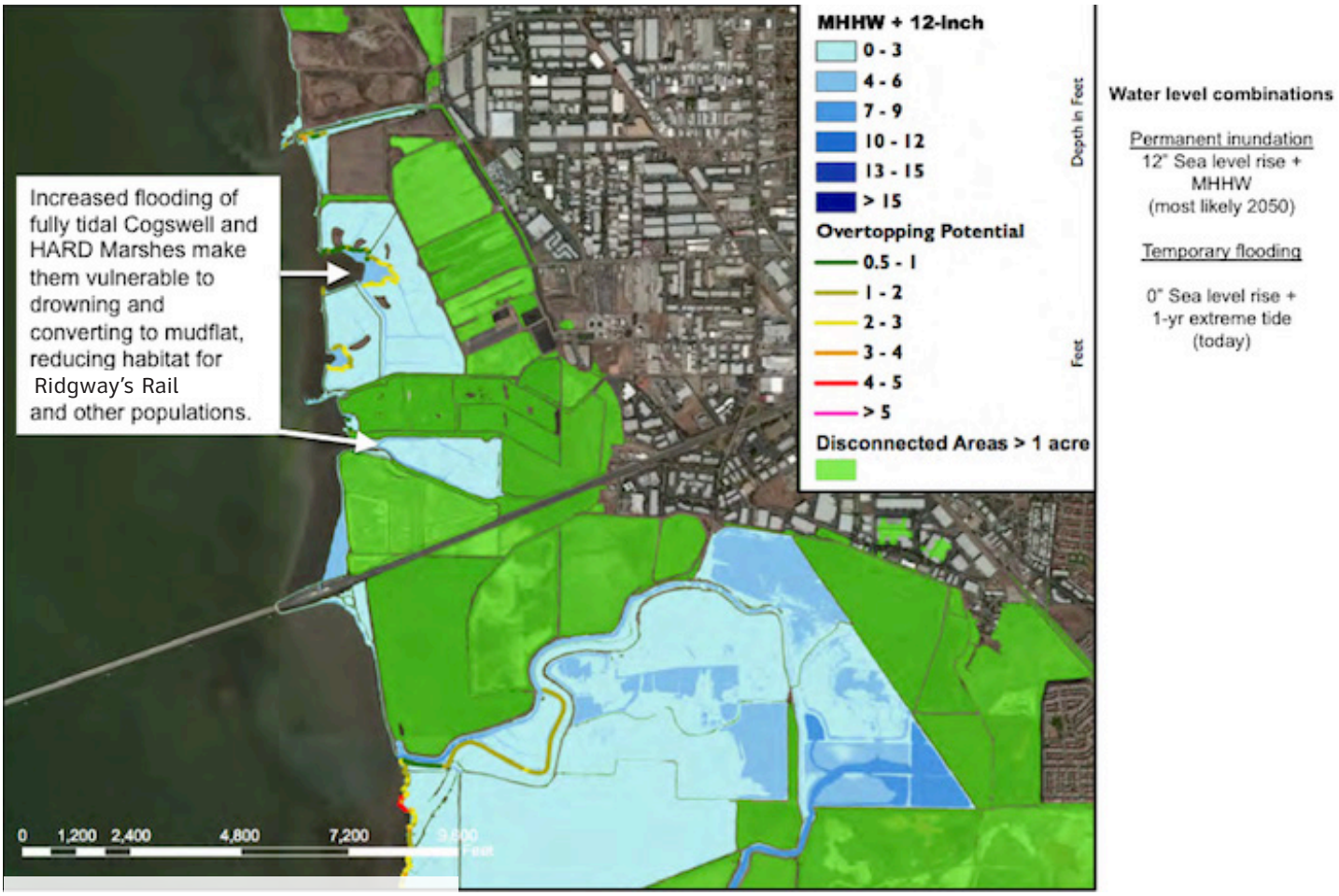
18. Hayward Shoreline Sea Level Rise: The San Francisco Bay Conservation and Development Commission has performed scientific computer modeling of sea level rise as part of its "Adapting to Rising Tides" program. Hypothetically, if nothing else is done to protect against flooding, the following scenarios are possible. Note that the green areas are "disconnected" low lying areas that are protected from flooding by some natural or man-made feature. Blue are flooded areas at various depths of water. Which scenario would become a problem for you?



Question 18 - Online Survey Result

The majority of those surveyed said that scenario one or two would affect them the most.

The most-mentioned concern of those surveyed was flooding and the subsequent loss of homes, Bay Trails, and other recreational activities, along with poor water quality and damage to waste water facilities. Frequently mentioned was loss of habitat and reduction of biodiversity in the area. Also mentioned was the loss of commuter routes and bridge access. A fair number of participants stated that they would feel sad if the scenario came to pass and the situation is generally upsetting.



Scenario 1 - 12" Sea Level Rise + MHHW

SCAPE

19. **The computer modeling shows that at a sea level rise of two feet, most of the Hayward Regional Shoreline will be under half a foot of water if nothing is done to protect the shoreline from flooding. How do you feel about that?**

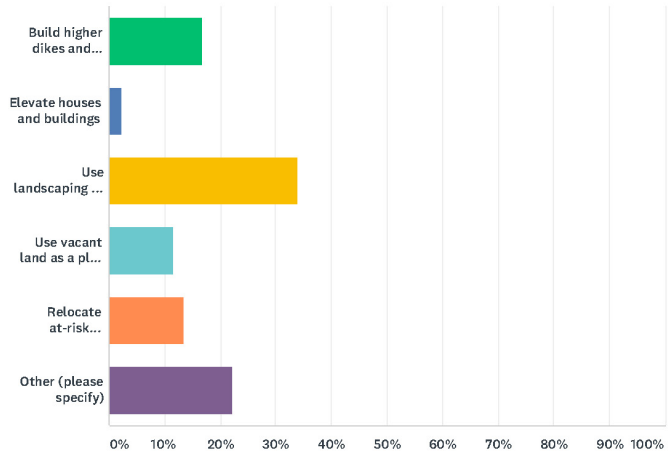
    Almost all those surveyed expressed worry, concern, sadness, and fear over the potential of the Hayward Regional Shoreline being inundated with two feet of water. Some surveyed made strong urges for legislators to act now and asked how community members can help. A very small minority stated that they do not believe this to be true or possible.

20. **What do you think should be done to help reduce the impact of sea level rise?**

    Over one third of participants think that using landscaping would be a good way to help reduce the impact of sea level rise, and a fair amount (nearly 20%) believe building dikes would be helpful. Equal numbers of people believe planners could either relocate at-risk infrastructure to higher ground, or that using vacant land as a place to "store" excess floodwater would be best. A fair number of participants commented that "all of the above" might work and suggest to stop building structures in the wetlands. Policy changes were frequently mentioned in the comments. A minority group feels that sea level rise is not worth fighting and might be a lie.

21. **Would you like to speak with someone about your responses on additional thoughts you might have? If so, please provide your contact information and someone will be in touch.**

    Approximately 100 people would like to have a follow up regarding this survey and left their email and/or phone number.



Question 20 - Online Survey Result

STAKEHOLDER INTERVIEWS SUMMARY

Key stakeholders were interviewed to assess their understanding of sea level rise, flooding and other environmental concerns in the area near the Hayward shoreline. Most of these stakeholders primarily work with agencies whose focus is shoreline preservation, restoration and overall health. All of these stakeholders live, work, commute through, or recreate at or near the Hayward Shoreline. Of the 20 stakeholders contacted, only seven were able to participate in the 15-question interview.

1. **What is your relationship to the shoreline?**

   The majority of stakeholders interviewed care deeply for the overall health of the Hayward shoreline and work for agencies whose goal is to preserve, restore and maintain the shoreline. Some of the stakeholders also use the Hayward shoreline for recreation or volunteer work.

2. **What is your understanding of sea level rise relative to the Hayward shoreline?**

   Stakeholders had a moderate to high level of understanding around issues of sea level rise, but approximately half of stakeholders did not seem to understand the specific impacts on the Hayward shoreline and the surrounding area. All stakeholders expressed concern around the shoreline's health and some expressed uncertainty of the effects of sea level rise in the future.

3. **Do you think your property, or life, will be impacted by sea level rise? If so, where is your affected property or jurisdiction?**

   None of the stakeholders interviewed lived in the area near the Hayward shoreline, but most of them expressed concern for the area regardless. Common concerns were for loss of habitat and wildlife, along with damage to infrastructure due to flooding, primarily to sewage systems.

4. **If your property or neighborhood would experience minor flooding (say 6 inches or less), how frequently would that become a problem for you?**

   None of the stakeholders interviewed live in the area, or in lower levels that could be affected by sea level rise, however about half of interviewees expressed high concern over the potential effects of flooding on industrial salt ponds, transportation, and infrastructure. One interviewee was concerned about the effects the Eden Landing development will have on the marsh, and one interviewee was not concerned, stating that their agency's conservation efforts could accommodate 6 inches or more of flooding.

5. **Are you currently affected by any flood control related issues? For example, FEMA flood insurance, map zone OR intermittent flooding? Do you currently experience flooding to your property?**

   None of the interviewed stakeholders live in an affected area. One interviewee expressed concern again and said they work on a project related to sea level rise impacts.

6. **What would be the consequences to your property if it flooded, either a little or a lot?**

   None of the interviewed stakeholders live in an affected area. However, about half the interviewees took this moment to express high levels of concern for the environmental impacts flooding and sea level rise could have to the area, regardless of whether or not they resided there. Specific areas of concern were: damage to infrastructure, such as the San Mateo Bridge, the sewer system, powerlines and buildings; property damage; trees falling; effects on endangered species and natural habitats (mainly, fish and birds).

7. **Are you currently planning any significant construction or development projects in the vicinity of the shoreline or are you going to be in the future?**

   About half the stakeholders interviewed are planning some sort of restoration project in the near future, including: earth moving, building broader transition zones for the marsh, and expanding the Bay Trail. None of the stakeholders are planning any construction in the area outside of restoration projects.

8. **Do you have any underground facilities on your property that may be affected by high groundwater?**

   An overwhelming majority said they do not have underground facilities. A small percentage expressed concern for existing sewer systems. One interviewee said they have a historic underground well.

9. **How important for the health of the Bay Area community are wetlands and habitats?**

   Every interviewee expressed that the wetlands and habitats are a crucial, vitally important part of the Bay Area. The most frequently mentioned areas of high concern were: ground water health, marshes, creeks, water quality, and wildlife sustainability. Additionally mentioned by several interviewees were: recreation, infrastructure at and near the shoreline, spatial limitations, nutrient recycling, and algae blooms.

10. **How important is it for people to take part in shoreline recreation?**

    Every stakeholder expressed that shoreline recreation is very important, some stating it is "crucial" and "absolutely vital." The majority of stakeholders stressed the importance of education regarding the shoreline and the effects of sea level rise in the area. As one person stated, "The more that people know about the shoreline, the more likely they are to care about it and want to help protect it." This sentiment was brought up several times and within this specific question.

11. **How important are uninterrupted shoreline views to you?**

    About half of interviewees expressed that views are extremely important; about one third felt views were moderately important; a small minority did not feel that views are as important a factor. About half of interviewees expressed that without shoreline views, people are less likely to connect with the Bay and the Hayward Shoreline and therefore less likely to care about it or take any action to learn more about the shoreline.

12. **How important is it to preserve the natural environment of the shoreline? For example, no development of large structures.**

    Every stakeholder interviewed did not support any development on the shoreline and does not want any condos, restaurants or other buildings erected on the shoreline. Some stakeholders mentioned that they do not mind leaving existing structures but do not support any new buildings. About one third of stakeholders stated that their reasoning behind this stance was that the shoreline should have natural edges to allow expansion and movement.

13. **Who is involved in making large-scale decisions about the property within your organization?**

    Most of the stakeholders stated that their organizations had a board or commission of people who team up to make decisions; more than half the interviewees stated their decision-making process is very collaborative. A small portion stated that the Director makes the final decision, but that a team of decision-makers helps inform the Director's decision making.

14. **Are there other people we should be talking to?**

    Suggested organizations to connect with were: Save the Bay; The Ohlone Society (specifically Phil Gordon and Evelyn Cormier); AECOM; East Bay Regional Park District (specifically Mark Taylor or David Halsing); South Bay Ponds Restoration Project; Coastal Conservancy (specifically Amy Hutzel); the San Lorenzo Valley Home Owners Association (Michelle Clowser, mclowser@slvha.com)

15. **What are you expecting from this Master Plan? What would be most useful for you?**

    In general, stakeholders were interested in addressing the issues of erosion, habitat and tidal marsh preservation, and flood control in a sustainable and actionable way. The idea of working with nature (not against it) came up with multiple interviewees. Two interviewees suggested bringing in dredge materials; one suggested banning further building along the shoreline. About a third of interviewees want to address tidal marsh migration and hope the plan will have thoughtful consideration of how climate change is affecting the shoreline.

16. **General Summary Statement:**

    In general, there was some confusion around the goal of the Master Plan and who or what it might be catering to. Throughout the survey, stakeholders frequently expressed concern for the rising tide and tidal marsh migration, especially as it pertains to wildlife, including both plants, fish, and land animals, in the region. Stakeholders hope that the Master Plan will focus on the existing shoreline and ways to help preserve it. Throughout multiple questions, the idea of shoreline education came up, with the thought that if more community members are educated on what and where the shoreline is and how sea level rise is affecting the entire area, then people will be more likely to take ownership and to support efforts to reduce the impacts of climate chance along the Hayward shoreline.

FINANCE CONSIDERATIONS

INCORPORATING FINANCE INTO THE RESILIENCE DESIGN PROCESS

Resilience projects, ranging from coastal protections to flood mitigation solutions, all share one common feature: success is something that doesn't just happen. Sea levels rise, and communities want to avoid flood damages. Unlike traditional revenue-generating projects—toll roads, power systems, or water systems—resilience projects typically do not generate user fees that can be collected (securitized) to finance (payback) project investments. As a result, financing these projects through any source other than general public funds requires a unique approach. The following section outlines four key points in early-stage conceptual and schematic design processes where designers can help unlock new resources for resilience project finance.

1. Find the "biggest losers"

The most common approach to justifying investments in resilience is to characterize aggregate project benefits. While this is an important step in the process, it rarely helps to identify up-front sources of funding or project finance. The simple reason is that the benefits of most resilience projects are diffuse—covering large areas and diverse populations and assets over long-time horizons. As a result, these benefits are difficult to monetize and capture. The first and most important step to unlocking new resources for project finance is to flip the question around and focus on: "Who will lose money if this problem isn't solved, or if a proposed project doesn't go forward?"

The answer to this question can range widely from multinational businesses and water treatment plants to individual homeowners and city agencies. It is important to note that the biggest losers might not be asset-owners. Consider who depends on critical networks (water, power, transportation, telecom), and how their supply chains could also be affected. Creating a robust list of direct (not downstream) beneficiaries is the first step to disaggregating benefits and engaging individuals and entities about their specific financial interests in seeing a project go forward.

Targeting the largest beneficiaries (the biggest potential losers) can help simplify the process of capturing value. For example, working with a single large industrial facility or cluster, or a few major anchor assets may generate enough financial value to support a project at a far lower transaction cost than engaging hundreds of individual homeowners.

2. Prioritize current benefits alongside future benefits

The next step is to further refine the list of direct beneficiaries by asking, "Who is losing money today because of the problem we are trying to solve?" Research from economics to psychology has demonstrated that current benefits almost always take precedence over future benefits. In many cases, future climate impacts are likely to exacerbate current challenges. Rather than trying to persuade stakeholders to shift their focus to future benefits, consider how those benefits can be linked to current pain points. Below are several prompts that can help stakeholders look at their recent and current balance sheets for where improving long-term resilience can also result in near-term savings:

- Have you seen any impacts on your revenues or income as a result of flooding? (e.g. business interruption, saltwater intrusion, or corrosion of equipment)
- Are there any standard (line item) expenses that are increasing or becoming unaffordable because of flooding? (e.g. buying more sandbags, higher pumping costs, higher insurance premiums or deductibles)
- Are you budgeting or setting aside more funds for specific kinds of losses or emergencies? (e.g. more for potential damage clean-up or remediation)
- Have you already invested in site or property level measures to protect against flooding? (e.g. barriers, pumps, changes to drainage, elevation, etc.)

In terms of project finance, identifying these types of potential savings can help make a resilience project look more like an energy efficiency investment, where immediate savings can help payback a protection with even greater future benefits.

3. Draw the boundaries for consolidating beneficiaries

In cases where there are only a few large beneficiaries of a proposed project, or where the value from the largest beneficiaries is insufficient to cover a project funding need or gap, the next step is to consider options for "pooling risk." Risk pools are common insurance tools for providing protection over larger areas at a lower cost of coverage. There are a wide variety of complementary policy and administrative approaches, such as creating special districts or establishing a Geologic Hazard Abatement District (GHAD). The most important contribution to this process at the schematic design stage is determining where the boundaries of any district should be based on project scope and the anticipated improvements in protection and/or value created.

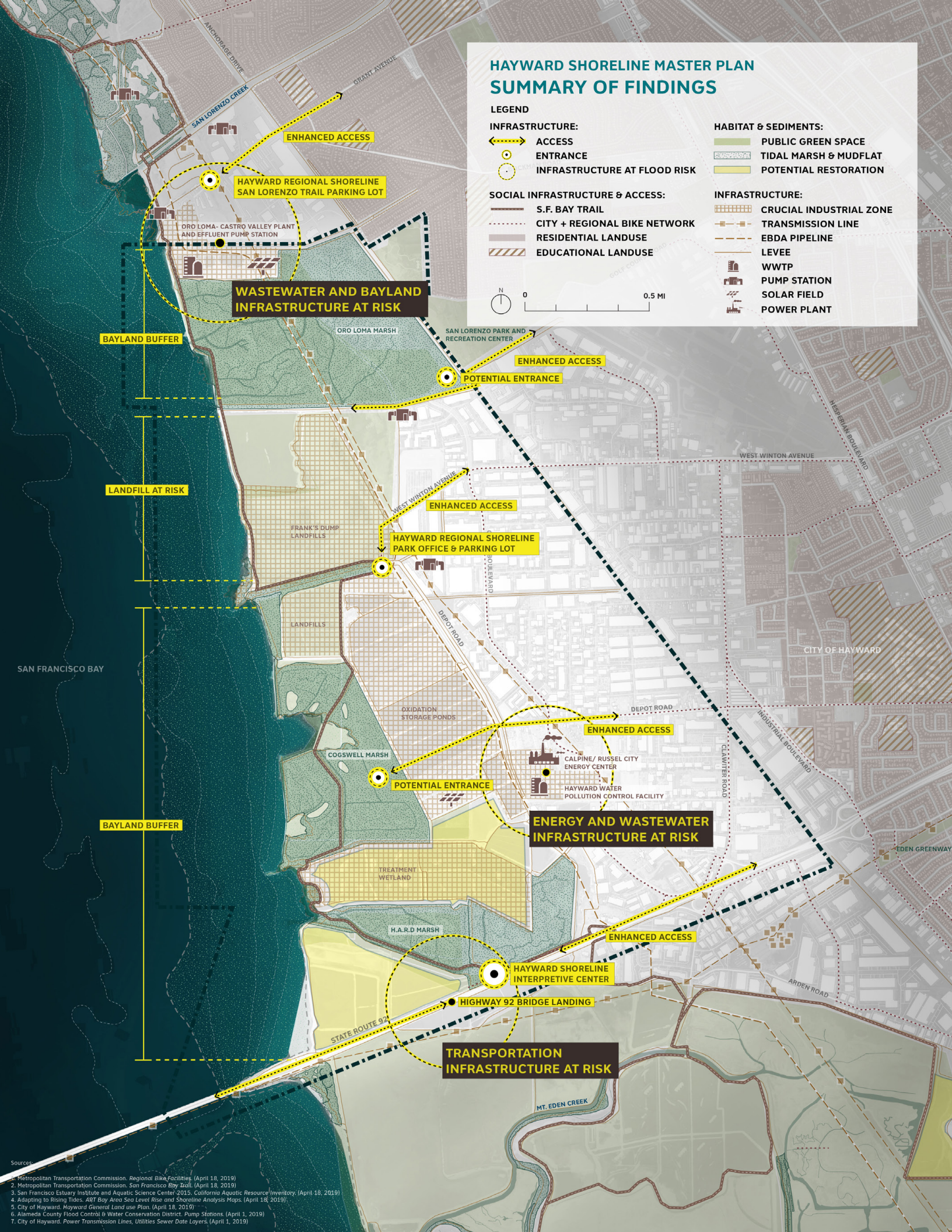
4. Bring finance data and models into the design process

The fourth and final opportunity to integrate finance into the design process is to directly incorporate financial industry models in setting design specifications to maximize the financial value of a project. One example of these types of models is insurance-industry catastrophe models. The advantage of using these models alongside conventional benefit-cost analyses is that investors and insurers already trust the process and are investing billions of dollars based on these analyses. Rather than having to educate diverse investors about new assumptions and uncertainties, using tried and tested models that are already the basis for significant investments can help unlock project capital more quickly and efficiently.

Most of the design decisions that have the biggest impact on the financial viability of a project are made during the earliest design phases of scoping and setting specifications. Taking a structured approach to incorporating financial considerations into the design process from the onset can tap new resources, generate greater financial value, and enable more effective value capture. Doing so does not require designers to become tax or insurance experts, or to understand the ins-and-outs of municipal finance. Instead, the most important things a design team can do are to keep the four basic concepts above front and center in the design process, to maximize the potential for measurably reducing near-term losses and managing long-term risk.

1. https://www.nature.org/content/dam/tnc/nature/en/documents/Coastal_wetlands_and_flood_damage_reduction.pdf

SUMMARY OF FINDINGS



Sources:

1. Metropolitan Transportation Commission. *Regional Bike Facilities.* (April 18, 2019)
2. Metropolitan Transportation Commission. *San Francisco Bay Trail.* (April 18, 2019)
3. San Francisco Estuary Institute and Aquatic Science Center 2015. *California Aquatic Resource Inventory.* (April 18, 2019)
4. Adapting to Rising Tides. *ART Bay Area Sea Level Rise and Shoreline Analysis Maps.* (April 18, 2019)
5. City of Hayward. *Hayward General Land use Plan.* (April 18, 2019)
6. Alameda County Flood Control & Water Conservation District. *Pump Stations.* (April 1, 2019)
7. City of Hayward. *Power Transmission Lines, Utilities Sewer Date Layers.* (April 1, 2019)

SUMMARY OF FINDINGS

MASTER PLAN OPPORTUNITIES

Habiat

The Hayward Shoreline is a mosaic of tidal marshes and mudflats that supports robust habitats and four endangered species including the Ridgway's Rail, California Least Tern, Western Snowy Plover, and the Salt Marsh Harvest Mouse. These ecologies along the shoreline have the potential to buffer vulnerable urban edges from sea level rise and should be considered a valuable resource. The Master Plan is an opportunity to protect, restore, and enhance these dynamic ecologies. The Master Plan can shape the narrative around baylands as a living infrastructure and emphasize their potential to protect shoreline communities from the threat of a changing climate. In order to do so the Regional Shoreline Master Plan will identify opportunities for multi-jurisdictional collaboration to improve existing operations of bayland resources and facilitate an adoption of ecological management goals for the region.

Sediment

Sediment is the building block of the baylands, but sediment futures for the Hayward Regional Shoreline are uncertain. Potential low sediment supply can compound the impacts of sea level rise and result in massive ecological transformations of bayland marshes and mudflats. Without sediment to support the baylands, developed edges along the Hayward Shoreline can potentially face more direct threats from a changing climate. The Master Plan views sediment as a critical resource to the survival of the baylands and will identify sediment strategies to restore sediment delivery to the Bay. The existing water infrastructure will be leveraged to convey sediments from upstream and restore natural processes within the bayland ecosystem.

Recreation and Access

The Hayward Shoreline is part of an expansive open space network along the San Francisco Bay that provides recreational opportunities to a growing population. While the area benefits from existing regional and site level connectivity along the 5 miles of Bay Trail traversing the site, the Master Plan will identify additional access points to enhance user experience between adjacent Hayward communities and the Bay's edge. The Master Plan is also an opportunity to assess the exposure of the existing Bay Trail alignment to sea level rise and propose alternative solutions that will reduce the risk faced by this recreational resource.

Infrastructure

The Hayward Shoreline is home to critical infrastructure that serves the city of Hayward and neighboring communities. Infrastructural assets treat sewage, provide clean water, produce energy, store waste, and support transportation in areas vulnerable to the risks of sea level rise. Within the project area, there are approximately 40 miles of shoreline, 50% of which are non- engineered berms susceptible to erosion and overtopping. If damaged, many of these non-engineered berms will no longer provide critical access routes to utilities and adjacent developments will no longer have a buffer to rising seas. The bridge base of State Route 92 will also be susceptible to flooding and significantly limit access to the 34 million car users that cross this bridge each year.

With this information, the Master Plan will identify adaptation pathways for those infrastructural assets and use a layered approach to explore combinations of nature-based and structural solutions to mitigate the impacts of climate change. The Hayward Shoreline is seen as an opportunity to test hybridized infrastructural solutions to step down risk and increase resilience in the Hayward Region.

Social Infrastructure

In the face of climate change, fostering social resilience for the most vulnerable communities is an absolute necessity. The Master Plan will be developed in close collaboration with local stakeholders and community members to propose an inclusive vision for the Hayward Shoreline Area. Finally, by promoting intergenerational educational programs, the Master Plan establishes opportunities to empower future shoreline stewards.