OAAC ADAPT: Oakland-Alameda Adaptation Projects

Existing Conditions Report

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Prepared For

Oakland-Alameda Adaptation Committee

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Acknowledgements

The preparation of this Existing Conditions Report for the Oakland-Alameda Adaptation Committee has been a collaborative effort. We extend our appreciation to all committee members and partners involved for their contributions, collaborative spirit, valuable feedback, and ongoing commitment to adaptation and resilience efforts in the Oakland-Alameda Subregion.

Disclaimer

This report has been prepared to support ongoing adaptation planning efforts for the Oakland-Alameda Adaptation Committee and is not an exhaustive compilation of data. This document is a work in progress, and findings of this report are subject to change as new information becomes available.

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Acronyms / Abbreviations

Acronym	Signification
AC Transit	Alameda-Contra Costa County Transit
ACFCWCD	Alameda County Flood Control and Water Conservation District
AEP	Annual Exceedance Probability
ART	Adapting to Rising Tides
Bay	San Francisco Bay
Bay Area	San Francisco Bay Area
Bay Bridge	San Francisco–Oakland Bay Bridge
Bay Trail	San Francisco Bay Trail
BCDC	San Francisco Bay Area Conservation and Development Commission
BFI	Bay Farm Island
Caltrans	California Department of Transportation
CBO	Community-based Organization
CDRZ	Community Disaster Resilience Zone
DTSC	Department of Toxic Substance Control
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Parks District
Estuary	San Leandro Bay Estuary
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information Systems
HOA	homeowners' association
MHW	Mean High Water
MHHW	Mean Higher High Water
MTC	Metropolitan Transportation Commission
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
OAAC	Oakland-Alameda Adaptation Committee

OLU	Operational Landscape Unit
OPC	California Ocean Protection Council
PCA	Priority Conservation Area
PDA	Priority Development Area
PPA	Priority Production Area
RSAP	Regional Shoreline Adaptation Plan
RSP	Riprap Slope Protection
ROW	Right-of-Way
SB272	California Senate Bill 272
SDMP	Storm Drain Master Plan
SFEI	San Francisco Estuary Institute
SFHA	Special Flood Hazard Area
SPUR	San Francisco Bay Area Planning and Urban Research Association
SWRCB	State Water Resources Control Board
Subregion	Oakland Alameda Subregion
TPA	Transit Priority Area
USGS	United States Geological Survey
Water Trail	San Francisco Bay Area Water Trail
WSEL	Water Surface Elevation

1 Executive Summary of Key Findings

The Oakland-Alameda Adaptation Committee (OAAC) is a coalition of shoreline communities and stakeholders working to co-create a coordinated and inclusive future-looking action plan and subregional organizational structure to accelerate sea level rise adaptation, protect and restore water quality, recreation, habitat, and promote community resilience. The OAAC is organized around the Oakland-Alameda Subregion (Subregion), stretching from the San Francisco–Oakland Bay Bridge (Bay Bridge) touchdown in the north to Oyster Bay in the south, with an upland boundary based on the potential inland inundation associated with an extreme sea level rise scenario.

This report documents existing conditions and data gaps to support long-term adaptation planning for the entire Subregion with additional detail to support adaptation projects in the Oakland-Alameda Estuary and Bay Farm Island.

1.1 Oakland Alameda Subregion

The Oakland-Alameda Subregion is the San Leandro Operational Land Unit, as defined in the Adaptation Atlas (SFEI and SPUR 2019). It includes the City of Alameda, portions of the City of Oakland, the Port of Oakland, and a small portion of the City of San Leandro.

Hazards: The Subregion is at risk today, due to hazards such as coastal flooding, erosion and waves, emergent groundwater, extreme precipitation and the resulting stormwater, compound flooding, and geologic hazards. Climate change acts as a multiplier for many hazards, which will increase risk if no action is taken. Flooding has significant implications for the people, habitats, and infrastructure within the Subregion.

People: The Subregion is home to 250,000 people from a wide variety of backgrounds, identities, and experiences. The San Francisco Bay Conservation and Development Commission's social vulnerability ranking, Plan Bay Area 2050 Equity Priority Communities, and Federal Emergency Management Agency's Community Disaster Resilience Zone designations provide insight into historic and current inequities within the region. The top three employment industries are transportation and warehousing, health care and social assistance, and public administration.

Habitat: Of the more than 5,000 acres of tidal marsh that used to exist within the Subregion, less than 100 acres remain. Although much of the land within the Subregion is developed, there are some areas of freshwater/saline marsh, annual grassland, and woodland habitats. The Subregion contains a variety of aquatic resources, including primarily subtidal Bay waters, with freshwater streams and ponds (lagoons), playa, tidal flats, and marsh pannes, and tidal marshes.

Sea Level Rise

Based on the best available climate science, California is likely to observe 9 to 12 inches of sea level rise by 2050, and, if sea level rise continues to its current trend, up to 4 feet of sea level rise is possible by 2100. Higher rates of sea level rise could occur if greenhouse gas emissions continue to follow a very high emission scenario, coupled with rapid ice sheet melt and ice sheet disintegration

Built Infrastructure: The Subregion's shoreline is composed of shoreline protection structures, engineered levees, embankments, stretches of natural shoreline, berms, channels, floodwalls, transportation structures, water control structures, and wetlands. Transportation and transit infrastructure includes critical portions of interstate freeways (I-880, I-80) and state routes (SR-260, SR-61); six drawbridges across the San Leandro Channel (four vehicular, two bicycle/pedestrian), accompanied by two proposed new pedestrian bridges; freight rail serving the Northern California Megaregion to connect production and distribution facilities to regional, national, and global markets; seven Bay Area Rapid Transit light rail stations and associated trackway; passenger rail, with service provided by Amtrak, Capitol Corridor, and San Joaquin Transit; four ferry terminals; multiple regional bus routes and stations; and private shuttle services. A series of pipes, channels, lagoons, lakes, ditches, and pump stations provide drainage for the Subregion. The Subregion is home to the Oakland International Airport, Oakland Seaport, Coast Guard Island (federal), and an East Bay Municipal Utility District wastewater treatment plant.

Public Access, Recreation, Parks, and Open Space: There are a variety of networks for pedestrians, bikes, and water access at the regional, sub-regional and municipal scale, including the San Francisco Bay Trail, which when complete will offer a continuous, 500-mile multi-use trail encircling the Bay. Within the Subregion there are currently 45 miles of existing trail and approximately 20 miles of proposed trails. Of the nine San Francisco Bay Area Water Trail officially designated trailheads, at least four are located within the Subregion. The Subregion includes 2,500 acres of parks and open space.

New Developments and Planned Redevelopment: There are many development and redevelopment projects envisioned, planned or under construction in the Subregion. Within Oakland, this includes but is not limited to Brooklyn Basin, Coliseum Area, Middle Harbor Shoreline Park, and Oakland Estuary Park. In Alameda, this includes but is not limited to Alameda Boatworks Green, Alameda Marina, Alameda Point, Corica Park Golf Course, and Encinal Terminals.

Shoreline Contaminants: Contaminants that migrate from upland areas to the Bay have the potential to cause harm to communities and the environment. The State Water Resources Control Board's GeoTracker database includes monitoring well observations that can help identify potentially contaminated sites within the region. The Department of Toxic Substances Control EnviroStor database includes an inventory of potentially contaminated sites, sites under investigation, sites undergoing cleanup, sites in the monitoring phase, and closed sites.

1.2 Oakland-Alameda Estuary

The Oakland-Alameda Estuary Project considers approximately one mile of shoreline on both sides of the channel, the Posey and Webster tubes that connect Oakland and Alameda, as well as the hydrologically-linked inland areas beyond the immediate shoreline.

Physical setting: The existing topography of the shoreline ranges from +8 NAVD to 14+ NAVD and is relatively flat, as are the nearshore areas. Adjacent land uses such as railways, as well as Alameda's ecological and geological history, have influenced the current shoreline and inland elevations. Waves within the Estuary are generally 1-ft high and caused by wake; wind-generated waves are not significant. At present the project area experiences coastal flooding at several locations, including the

Webster/Posey Tubes. Groundwater flooding is also a hazard within the project area, with current data showing that coastal areas, the edges of Lake Merritt and inland areas within Alameda are at particular risk.

Shoreline Conditions: The shoreline along the Oakland-Alameda Estuary project area consists of a variety of retention structures including rock-protected berms and retaining walls. Along some segments, there are pile-supported decks with a variety of land uses on them that overhang the seawall below.

Built Infrastructure: Transportation and transit infrastructure includes critical portions of SR-260, the Posey and Webster Tubes, and a stretch of I-880 in Oakland; freight rail; passenger rail, with service provided by Amtrak, Capitol Corridor and San Joaquin Transit; one ferry terminal; multiple bus routes and stops; and private shuttle services. Drainage for the Oakland-Alameda Estuary project area is provided by a series of pipes, channels, lagoons, ditches and pump stations.

Public Access & Recreation: Both sides of the project area line within a Transit Priority Area. Public transportation includes passenger rail service; one ferry terminal; multiple regional bus routes and stations; and private shuttle services. The project area also contains regional and municipal pedestrian and bike networks as well as one formally designated Water Trail trailhead and a number of other access points to the Bay. The Oakland-Alameda Estuary project shoreline includes four parks on either side of the channel. The San Francisco Bay Trail runs through either side of the channel.

Cultural Resources: Within a 0.25-mile inland buffer of the project shoreline, 30 previously recorded architectural resources were identified, 14 of which appear to be mapped along the actual shoreline, and seven previously recorded archaeological resources within 0.25 mile inland of the shoreline.

New Developments and Planned Redevelopment: There are many development and redevelopment projects envisioned, planned or under construction in the project area. Within Oakland, this includes but is not limited to Oakland's Estuary Park, multiple mixed-use infill projects within the Jack London district and the Oakland-Alameda Access Project. In Alameda, this includes but is not limited to the Sweeney Park Aquatic Center, and the Shipways redevelopment.

1.3 Bay Farm Island

The project area is located within the northwest portion of Bay Farm Island and is ringed by the San Francisco Bay, the San Leandro Channel and the Oakland International Airport.

Physical Setting & Coastal Flood Hazards: The topography of the project area is generally below +20-feet NAVD and is relatively flat. The southwest-facing shoreline of the project area is subject to large, wind-generated waves. Low shoreline elevations at the North Gate pump station, Veterans Court and Doolittle Landfill are subject to coastal flooding. Shallow groundwater is present at Bay Farm Island, though the presence of low-permeable Young Bay Mud supporting the landfill will potentially mitigate some water and groundwater infiltration inside the lagoon and levee system.

Shoreline Conditions: The shoreline of Bay Farm Island consists of a variety of erosion protection structures including rock-protected embankments and vertical bulkheads, with some segments that have pile-supported structures overhanging seawalls below.

Critical Infrastructure: Transportation and transit infrastructure includes critical portions of SR-61, Harbor Bay Parkway, Island Drive, Mecartney Road, Maitland Drive, Aughinbaugh Way and Robert Davey Jr. Drive, as well as the Bay Farm Island Bridge. Critical utility systems within Bay Farm Island include the storm drain system, which includes Bay Farm Island's lagoons; the City of Alameda's sanitary sewer system, which connects wastewater to the EBMUD Wastewater Treatment Plant in Oakland; the potable water system operated by EBMUD; electrical service provided by Municipal Power; natural gas transmission lines; and the citywide fiber optic network. Emergency facilities within Bay Farm Island are limited to the Alameda Fire Station #4.

Public Access and Recreation: The Bay Farm Island project area lies within a Transit Priority Area. Public transportation includes one ferry terminal; multiple regional bus routes and stations; and private shuttle services. The project area also contains regional and municipal pedestrian and bike networks and a number of water access points to the Bay, including a new small craft launch along Doolittle Drive. There is one park located on the project shoreline, and additional parks and open spaces inland, including Tillman Park and Corica Golf Course shoreline includes four parks on either side of the channel. The San Francisco Bay Trail runs along the project shoreline, with a significant gap along Doolittle Drive.

Biological Resources: Though Bay Farm Island is developed and dominated by ornamental landscaping, Bay Farm Island was historically comprised of grasslands and tidal marshes encircled by tidal flats and discontinuous sandy beaches. Eelgrass beds are mapped northwest and west the island. Arrowhead Marsh, part of EBRPD's Martin Luther King, Jr. Regional Shoreline, is the largest remnant tidal marsh; the site provides suitable habitat for several special-status animal species.

Cultural Resources: Background research identified three previously recorded architectural resources within the project area, two of which appear to be mapped along the actual shoreline, and no previously recorded archaeological resources.

New Developments and Planned Redevelopment: There are many development and redevelopment projects envisioned, planned or under construction in the Bay Farm Island project area. This includes but is not limited to Corica Golf Course, the East Bay Greenway, the San Leandro (Lisjan) Greenway, and the SupplyBank.org project on Oakport Street.

1.4 Data Gaps

The following data gaps represent areas for future study and collaboration to support adaptation planning and projects throughout the Subregion.

Public and Community Assets: Additional community-identified assets should be identified within the three project areas. However, this project does not include the scope to complete a full public and community asset analysis. Additional types of public assets to potentially include if data are available:

- Daycare facilities
- Youth centers
- Long-term care facilities and/or assisted living facilities

- Health clinics and/or medical facilities with specialized infrastructure
- Places of worship
- Community gardens

Stormwater Flooding: The City of Oakland is currently working on their storm drainage master plan. There are no readily available reports to illustrate Oaklands existing stormwater flood hazards. The Port of Oakland recently completed a stormwater and tidal flooding study (Port of Oakland 2023a). However, this information was not readily available at the time of this report.

Compound Flooding: Within the project region, stormwater runoff from inland areas is collected via a system of storm drains that either discharge by gravity to the Bay or is pumped to the Bay. The invert elevation of many of the gravity outfalls is such that during extreme high tides they do not function effectively and stormwater runoff backs up into the drain inlets and causes flooding of streets, commercial and residential areas. Increasing sea levels will worsen this situation and result in more frequent flooding. Raising the elevation of the shoreline can mitigate coastal flooding from the Bay but it typically does not benefit areas that are prone to stormwater flooding. This effect of extreme Bay water levels on stormwater induced flooding (otherwise called Compound Flooding) is a significant data gap when it comes to developing Adaptation Strategies.

Transportation and Transit: Detailed information on freight rail facilities & tracks has not yet been obtained or reviewed for incorporation within the Existing Conditions Report.

Critical Infrastructure: The scope of work for the OAAC Adapt projects does not include a comprehensive survey of critical infrastructure or completion of a vulnerability and risk assessment. A comprehensive Vulnerability Assessment for the Subregion should be completed by key stakeholders and/or the OAAC as part of future planning efforts.

Parks and Open Space: The following data gaps remain after compilation of the Existing Conditions Report.

- Detailed data about park usage, including number of households & families served; preliminary usage information from EBRPD is included in report but is limited to MLK Jr. Regional Shoreline in comparison to Oyster Point.
- GIS data for open spaces and parks that are not publicly owned and operated, including additional detail for site types such as:
    - Jack London Square.
    - Middle Harbor Shoreline Park and other Port-operated parks/public spaces.
    - Private golf courses such as Metropolitan Golf Links Course.
    - Community gardens such as City Slicker Farms.
    - POPOs – particularly around marina open spaces.
    - Large retention/detention facilities that function as open space, such as a large pond near Estuary Park in Oakland.
- More current, neighborhood and community driven projects in the subregion such as
    - LCTI: Power the People: MLK Jr. Shoreline Access Study

New Development & Planned Redevelopment: Confirmation of parks and/or public realm projects planned or actively seeking funding within the subregion, particularly near the Oakland-Alameda

Estuary Project Area and Bay Farm Island Project Area. The information in this area represents only a preliminary list of known projects that impact the project area and/or that include an adaptation component.

Shoreline Contaminants: An updated inventory that reflects current conditions should be prepared to identify sites that may not be included within the State Water Resources Control Board or Department of Toxic Substances Control databases.

2 Introduction

This report presents existing condition information collected to support adaptation planning for the Oakland Alameda Subregion, (Subregion), which stretches from the San Francisco–Oakland Bay Bridge (Bay Bridge) touchdown in the north to Oyster Bay in the south, and includes multiple jurisdictions, agencies, and community-based organizations (CBOs) that have an interest in the shoreline within the Subregion, as well as regional and state collaborators (**Error! Reference source not found.**).

The report is intended to serve as a baseline for analysis and adaptation planning as identified in the OAAC Adapt scope of work. It is not a comprehensive or detailed vulnerability or risk assessment or exposure analysis. It presents existing available studies and documents related to coastal and stormwater flooding, sea level rise adaptation, and shoreline improvements or repairs. It includes a summary of existing and future hazards, including coastal flooding, erosion, rising groundwater, and geologic hazards including subsidence and liquefaction. This report also summarizes existing habitats, built infrastructure, public access and recreation, parks and open space, new development, and planned redevelopment, and provides a high-level overview of potentially contaminated areas. Data gaps for future study and consideration are identified based on this initial research.

The existing condition information is presented relative to the geographies for the Oakland-Alameda Adaptation Committee's (OAAC) three adaptation planning projects: the Subregional Adaptation Plan (**Error! Reference source not found.**), Oakland-Alameda Estuary Project (Figure 2-2), and Bay Farm Island Project (Figure 2-3).

- **Subregional Adaptation Plan:** a long-term adaptation plan for the entire Subregion (**Error! Reference source not found.**), with adaptation strategies and preliminary adaptation pathways that can provide collective benefits to coastal communities and wildlife, protect groundwater and ecosystems, restore marsh, upland, and transitional habitat, and enable effective shoreline and wastewater management.
- **Oakland-Alameda Estuary Project:** a near-term adaptation plan to reduce existing and future flood risks along the City of Alameda and Oakland shorelines on either end of the Webster and Posey Tubes. The study area includes the downtown Oakland/Jack London Square shoreline and Alameda's northern shoreline near Marina Village (Figure 2-2).
- **Bay Farm Island Project:** a near-term adaptation plan to reduce existing and future flood risks along the Veterans Court shoreline and at the northern outfall of the Bay Farm Island Lagoon, including replacing/relocating the wooden bicycle/pedestrian bridge (Figure 2-3). This project also includes the development of a long-term adaptation plan for Bay Farm Island's entire

shoreline, not including the Oakland International Airport's coastal levee on the San Francisco Bay (Bay) side. The long-term adaptation plan will be developed in concert with the Subregional Adaptation Plan.

The CMG Team, with support from the City of Alameda, submitted requests for data and information to OAAC members. The data collected to date is organized on SharePoint and presented in Appendix A. As additional data becomes available, it will be added to the data inventory. The geographic information system (GIS) data provided by the East Bay Regional Park District (EBRPD) cannot be shared without a license agreement.

The report is organized as follows:

- Section 1: Executive Summary of Key Findings
- Section 2: Introduction
- Section 3: Oakland-Alameda Subregion
- Section 4: Oakland-Alameda Estuary
- Section 5: Bay Farm Island
- Section 6: References

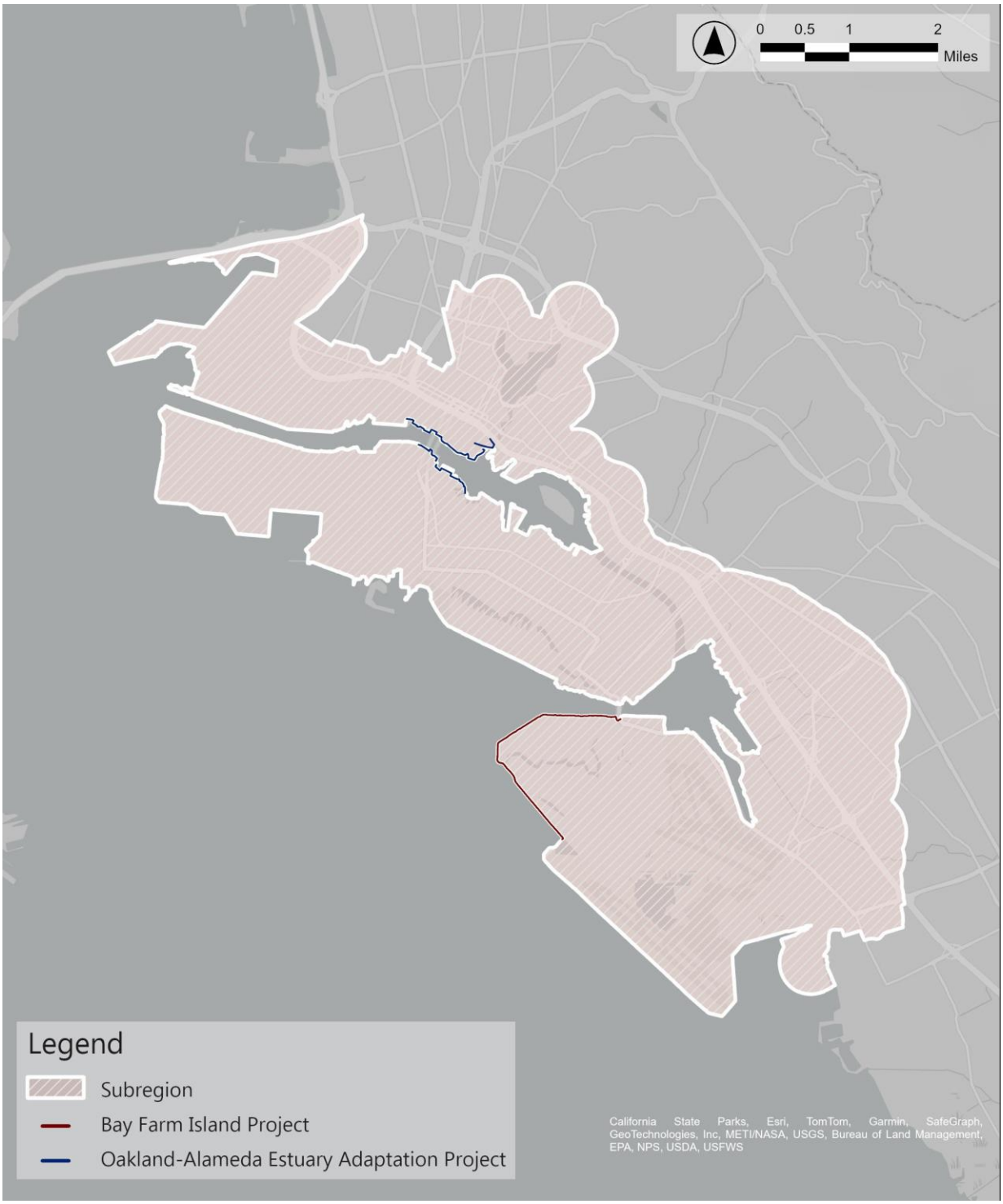


Figure 2-1. Subregional Adaptation Plan Study Area (Oakland-Alameda Subregion)

Source: (SFEI and SPUR 2019; City of Alameda 2023a)

Note: The Subregion corresponds with the San Leandro Operational Land Unit (OLU) defined in the Adaptation Atlas (SFEI and SPUR 2019).

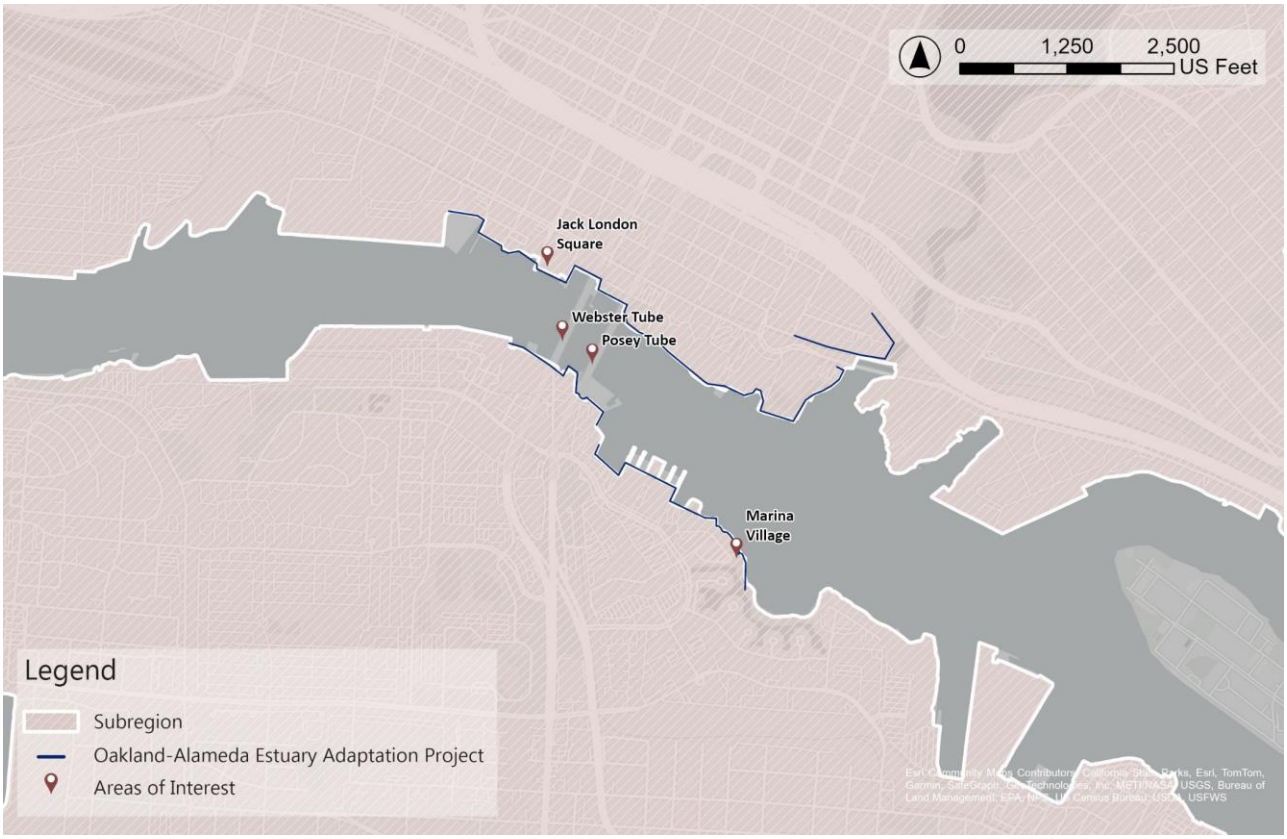


Figure 2-2. Oakland-Alameda Estuary Project Study Area

Source: (SFEI and SPUR 2019; City of Alameda 2023a)

Figure 2-3. Bay Farm Island Near-Term Project Study Area

Source: (SFEI and SPUR 2019; City of Alameda 2023a)

3 Oakland-Alameda Subregion

3.1 Overview of the Oakland-Alameda Subregion and Community Characteristics

The Adaptation Atlas defines the Oakland-Alameda Subregion as the *San Leandro Operational Land Unit* (OLU) (SFEI and SPUR 2019).[1] In the Adaptation Atlas, the San Francisco Bay shoreline and inland communities are divided into 30 OLUs. OLUs are cross-jurisdictional, connected, geographic areas that share common physical characteristics that suggest they would benefit from being managed as a unit (SFEI and SPUR 2019). The San Leandro OLU's northern boundary is the Bay Bridge, and the southern boundary is at the apex of the San Leandro Creek alluvial fan, near Oyster Bay Regional

[1] In the Adaptation Atlas, the Operational Landscape Units (OLU) are named after their dominant creek. In this case, the OLU is named after San Leandro Creek. The San Leandro OLU is called the Oakland-Alameda Subregion for the purposes of OAAC ADAPT project. This is largely driven by potential confusion between the San Leandro OLU and the City of San Leandro, which is located primarily within the San Lorenzo OLU.

Shoreline (**Error! Reference source not found.**). The upland boundary of the OLU is based on potential inland inundation associated with an extreme sea level rise scenario.

3.1.1 Planning and Jurisdiction Boundaries

The Subregion is within the County of Alameda, California, and includes the City of Alameda, portions of the City of Oakland, the Port of Oakland, and a small portion of the City of San Leandro. The Port of Oakland operates the Oakland International Airport and the Oakland Seaport and serves as steward for more than 800 acres of land on waterfront property as California State Tidelands Trust grantees. EBRPD manages multiple shoreline parks and trails throughout the Subregion, including portions of the San Francisco Bay Trail (Bay Trail), a 500-mile network of trails that circle the Bay offering diverse and scenic experiences for pedestrians, joggers, bicyclists, and more (East Bay Regional Parks District 2021; Metropolitan Transportation Commission 2023a)[2].

The California Department of Transportation (Caltrans) owns and maintains multiple state highways that intersect the Subregion, including: Interstate 880, which connects communities along the East Bay from San Jose to Oakland; California State Route 61, which connects Bay Farm Island with the main island (Alameda Island) of Alameda and Oakland; and Route 260, better known as the Webster and Posey Tubes, that links Alameda and downtown Oakland (Figure 3-1).

Two entities serve as floodplain administrators within the Subregion, managing natural and built floodplain infrastructure and helping residents and businesses access the benefits of the FEMA National Flood Insurance Program. The Alameda County Flood Control and Water Conservation District (District) provides flood protection for most of Alameda County. It plans, designs, constructs, and maintains flood control and management systems such as natural creeks, channels, levees, pump stations, dams, and reservoirs (ACFCWCD 2023). The City of Alameda opted to manage flooding separately from ACFCWCD. The City of Alameda Public Works Department serves as the floodplain administrator for the City of Alameda (City of Alameda 2018a).

Coast Guard Island, located in the channel between Alameda and Oakland, is federal property and not open to the public. The artificial island was first formed and used for government purposes in the early 1900s. Base Alameda was established in 2012, supporting Coast Guard activities throughout the West Coast (US Coast Guard 2023). Although Coast Guard Island is within the Subregion, it is outside the scope of this project.

The Subregion is home to a variety of land uses and activities (Figure 3-2). The City of Alameda is largely residential, with pockets of mixed use, commercial, open space, public / institutional, and industrial areas throughout. The portion of Oakland that falls within the Subregion includes industrial areas (the seaport and airport and supporting industries, in addition to pockets east of San Leandro Bay), large commercial areas (downtown Oakland and East Oakland), a variety of uses adjacent to the

[2] More than 350 miles of the San Francisco Bay Trail are complete, with about 150 miles of trail in various stages of planning. The Bay Trail will cross and connect 47 cities, 7 toll bridges, and over 130 parks.

shoreline and up to Lake Merritt (commercial, mixed use, waterfront development, and open spaces), and primarily single-family residential areas further upland.

Plan Bay Area 2050 is a 30-year plan that includes strategies to improve housing affordability, the economy, transportation and the environment for the nine-county San Francisco Bay Area (Bay Area) with equity interwoven throughout (Metropolitan Transportation Commission and Association of Bay Area Governments 2021). Plan Bay Area defines growth geographies for future housing and job growth, including Planned Development Areas (PDAs) near existing job centers or frequent transit, and Priority Production Areas (PPAs) for job growth in industrial middle-wage industries like manufacturing, logistics, and other trades. Nearly the entire shoreline of Oakland outside of the Port of Oakland's jurisdiction is located within PDAs, and a portion of Alameda's shoreline along the San Leandro Channel are located within PDAs (Figure 3-3). The Airport and portions of east Oakland are located within PPAs (Figure 3-4). Plan Bay Area also includes locally nominated areas for the protection of natural habitats and the preservation of open space called Priority Conservation Areas (PCAs) (Figure 3-3). Three PCAs are located within east Oakland. Most of the wetlands in the San Leandro Bay Estuary (Estuary), including Arrowhead Marsh, are already conservation areas managed by EBRPD.

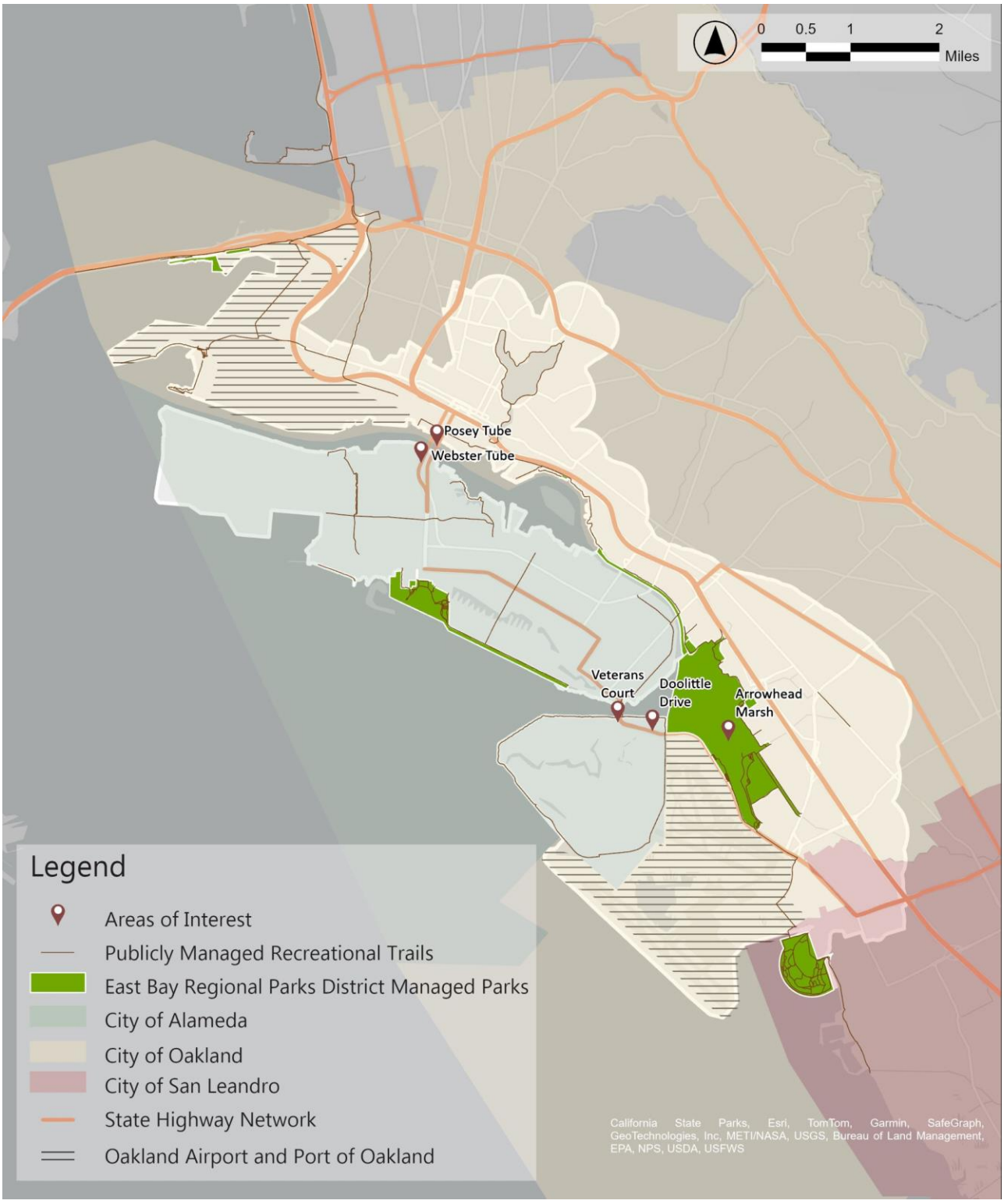


Figure 3-1. Jurisdiction Boundaries

Source: (City of Oakland 2015a; Alameda County Open Data 2022; Caltrans 2022; East Bay Regional Parks District 2023a)

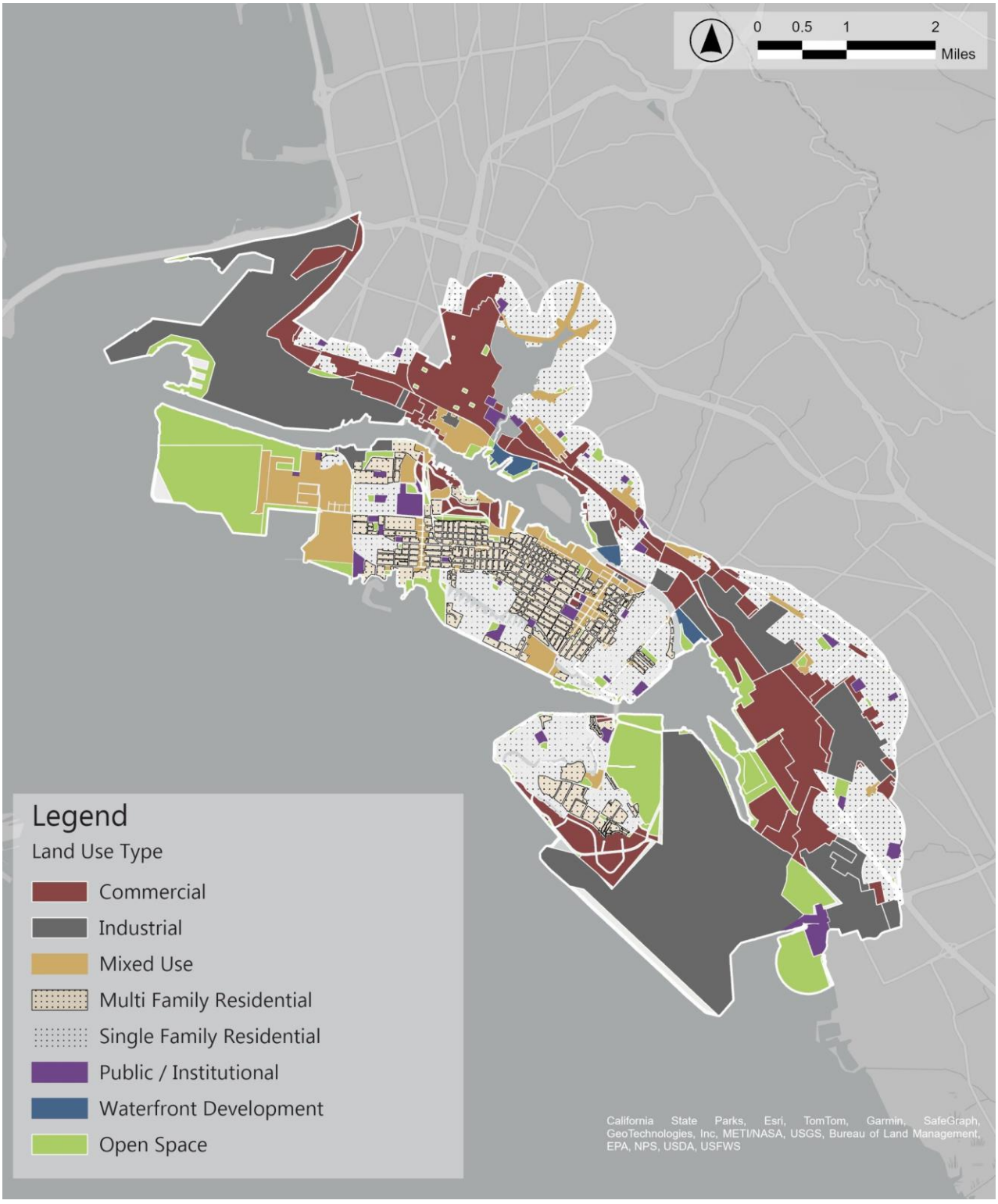


Figure 3-2. Land Use

Source: (City of Oakland 2015a; City of San Leandro 2021; City of Alameda 2023a)

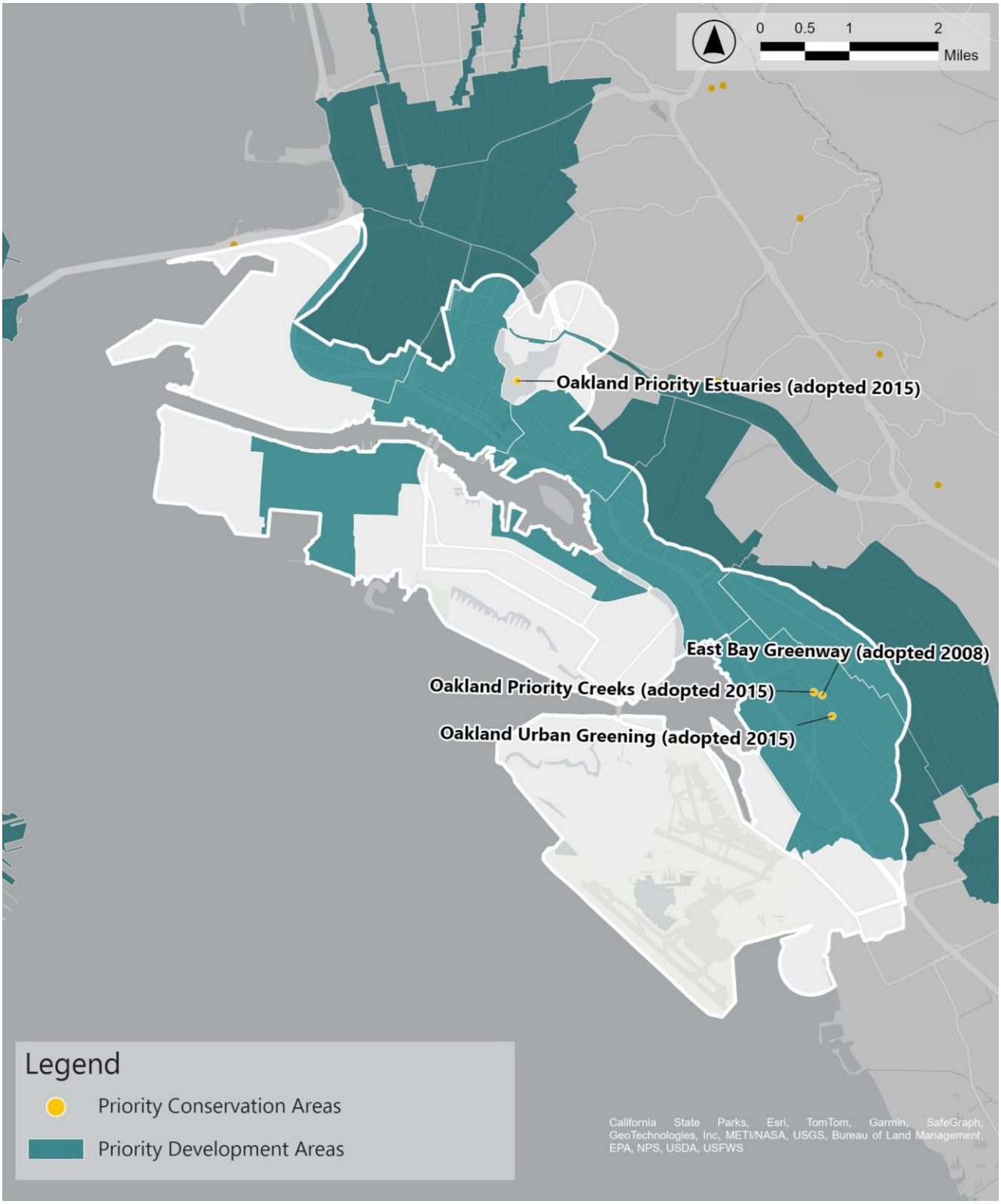


Figure 3-3. Plan Bay Area 2050 Priority Conservation and Development Areas

Source: (Metropolitan Transportation Commission and Association of Bay Area Governments 2021)

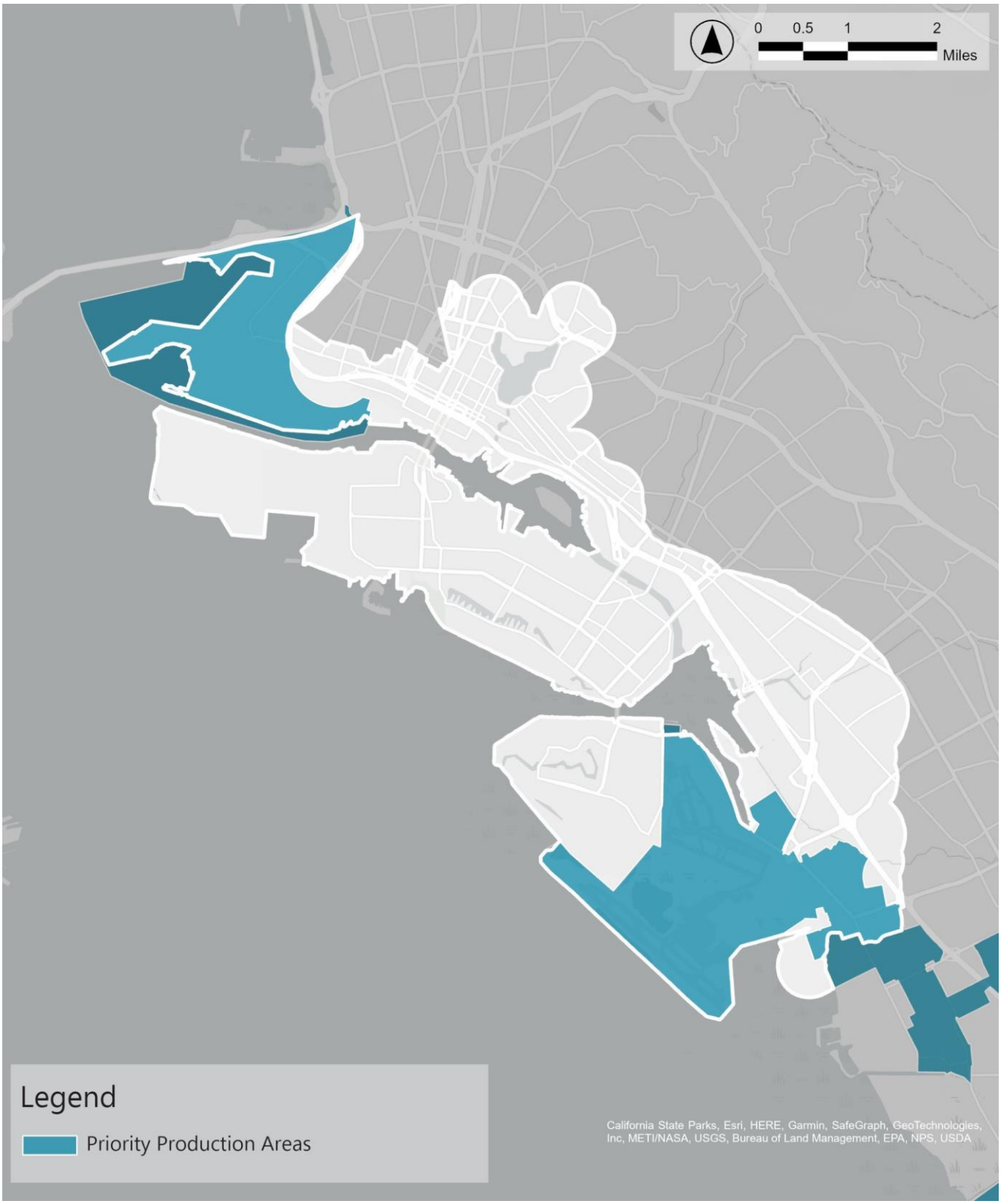


Figure 3-4. Plan Bay Area 2050 Priority Production Areas

Source: (Metropolitan Transportation Commission and Association of Bay Area Governments 2021)

3.1.2 Brief History of the Subregion

The Oakland-Alameda Subregion lies within the territory of xučyun (Huichin), the ancestral and unceded land of the Lisjan (Ohlone) people. The Lisjan are made up of the seven nations that were directly enslaved at Mission San Jose in Fremont, CA and Mission Dolores in San Francisco, CA: Chochenyo (Ohlone), Karkin (Ohlone), Bay Miwok, Plains Miwok, Delta Yokut and Napian (Patwin).

Contrary to many colonial narratives, the San Francisco Bay Area was not an uninhabited, or underpopulated, wilderness prior to the arrival of Spanish soldiers and missionaries (Tending the Wild). Sogorea Te' Land Trust, an urban Indigenous women-led land trust that facilitates the return of Indigenous land to Indigenous people, writes that

> *The Lisjan people have lived in the East Bay since time immemorial. For thousands of years, hundreds of generations, the Lisjan people have lived on the land that is now known as the East Bay in the San Francisco Bay Area. We did not own the land, we belonged to it. Generation after generation, we cultivated reciprocal relationships with the plants and animals we shared this place with and developed beautiful and powerful cultural practices that kept us in balance.*
>
> *The colonization of this land began with the reign of terror inflicted by Spanish soldiers and missionaries who sought to convert all Indigenous people into Catholic subjects of Spain and steal their land. The Missions were plantations, built by slave labor and sustained through brutal physical violence and extractive land practices. The Spanish brought deadly diseases, invasive species and Christian ideology based on human dominion of the natural world with devastating consequences for the Lisjan people and all living beings they shared the land with. (Sogorea Te' Land Trust 2023)*

Lisjan people were removed forcibly from ancestral lands in the Subregion through the Mission Period (1770-1835), causing cataclysmic change that resulted in a large population decline. State-sanctioned genocide followed – Sogora Te' notes that new State of California paid soldiers, ranchers and miners to kill native people, $5 a head and $0.25 an ear – and that

> *Lisjan survivors faced extermination policies of the United States that aimed to eliminate California Indians entirely. In a climate of malicious racial discrimination and state-sponsored vigilante killings, most Lisjan families survived by isolating themselves and concealing their identities. Cultural and spiritual traditions were forced into dormancy or secrecy, and much knowledge perished with the passing of generations.*

Drawn by the discovery of gold at Fort Sutter in 1848, colonial settlers poured into San Francisco and through the Bay Area. By 1852 the City of Oakland was able to incorporate and was officially recognized by the new state in 1854. The new city was bounded by Market Street, 14th Street, the Lake Merritt Channel and the estuary – formerly the San Antonio Creek. Early surveys from 1856 show a landscape dominated by oak groves, interlaced with unpopulated streets in the areas that would become West and Downtown Oakland. Marshland extended north to present-day 5th Street in Oakland, and development was concentrated near the wharves. Settlements of Brooklyn, Clifton and San Antonio were separate settlements, only linked to Oakland by a bridge across Lake Merritt

Channel in 1856. A channel, 5 feet deep at extreme low tide, was cut through the sand bar at its mouth in 1859.

Oakland's growth increased substantially by 1869 when the city became the terminus of the Transcontinental Railroad, bringing

> *both additional population and business prospects to Oakland, including African-American men who sought work as porters, and Chinese immigrants who had helped build the railroad and secured more permanent work and housing in Oakland. Irish, German, and British immigrants, as well as transplanted easterners, comprised the majority of Oakland's non-native population during this period. Later, immigrant populations from southern and eastern Europe and areas of the Pacific Rim were attracted to Oakland's growing economy and the region's offerings.* (Caltrans and ACTC 2021)

Increased industry at the Oakland waterfront drove reclamation efforts in the Estuary, such as the creation of Brooklyn Basin. Lake Merritt, naturally a tidal slough, was damned at 12th Street to create higher real estate values and a more picturesque view (Richter 2008). More industry and commerce created more infrastructural changes to the shoreline, such as the construction of Oakland's long warf, which supported early container service via ferry transit of freight cars across the Bay to San Francisco (City of Oakland 2015a). In 1877, the ship channel in the Estuary was deepened to 20 feet at high tide.

On the Alameda side of the Estuary, settlement was concentrated at three separate locations on the peninsula that would one day become an island, linked by a railroad line and a main road. The city took its name from a Spanish term mean "grove of poplar trees". Much of the peninsula was marshland and shallow bay.

Like Oakland, Alameda's location, plentiful rail and water connections meant that it was well poised to become an industrial center:

> *the Alameda Oil Works, which processed castor, coconut and linseed oils, was established in 1868 and the Pacific Oil Company began production of petroleum products in 1880. These refineries, located south of Pacific Avenue and west of Main Street, were later acquired by the Standard Oil Company, which continued to operate in Alameda until it built a refinery in Richmond in 1903…* (City of Alameda, 2002).

As in Oakland, industry caused significant changes to the shoreline: the first documented filling began in 1890 for the construction of a mole owned by the Southern Pacific Railroad; roads, shipyards, warehouses and other industrial land uses soon followed.

Alameda became an island in 1901, when the Army Corps of Engineers severed the land that connected Oakland to the Alameda peninsula through a Tidal Canal. Historian Deborah Cooper notes that the massive engineering project was named such "because it was supposed create a tidal flow that would scour out the Estuary ship channel and minimize the continual need to dredge. However, the scouring action of the tides has never been effective in keeping the ship channel clear." (Cooper 2008).

Sacred Ohlone sites such as shellmounds were not spared from the intensive development in either city. Sogora Te' notes that

> *Shellmounds are sacred burial sites of the Ohlone and Coast Miwok peoples. They are considered by Ohlone people to be living cemeteries, places of prayer, veneration and connection with the ancestors. "Shellmounds are places where we laid our ancestors to rest," Corrina Gould explains. "We actually buried them in the soil and then covered them with shell and then more soil. As the years and centuries went by, these mounds grew larger and larger. They became monuments to the people that lived here in the Bay Area."*

In 1909, an archeologist named Nels Nelson mapped the 425 distinct shellmound sites.A digitized version of Nelson's 1909 maps produced by Stanford's Spatial History Lab shows seven shellmounds within the Subregion - three listed as fully present in 1909, and four listed as partially present as of 1909. The cartographers of the digital map note that the 1909 map was created as "an act of desperation in the face of rapid change, Nelson's map was hastily made and lacks precision. It is however a stunning reminder of the inhabitiveness of the San Francisco Bay: Thousands of years of native people living and changing the San Francisco Bay" (Allen and Matthew 2022). As with the majority of the shellmounds mapped across the entire Bay Area in 1909, the shellmounds within the Subregion are no longer visible.

More industrial demands continued to change the Estuary: in 1910, the Army Corps of Engineers dredged again to make a wider, more accessible channel for larger ships, eventually reaching a depth of 35 feet deep at low tide in 1939 (Cooper 2008).

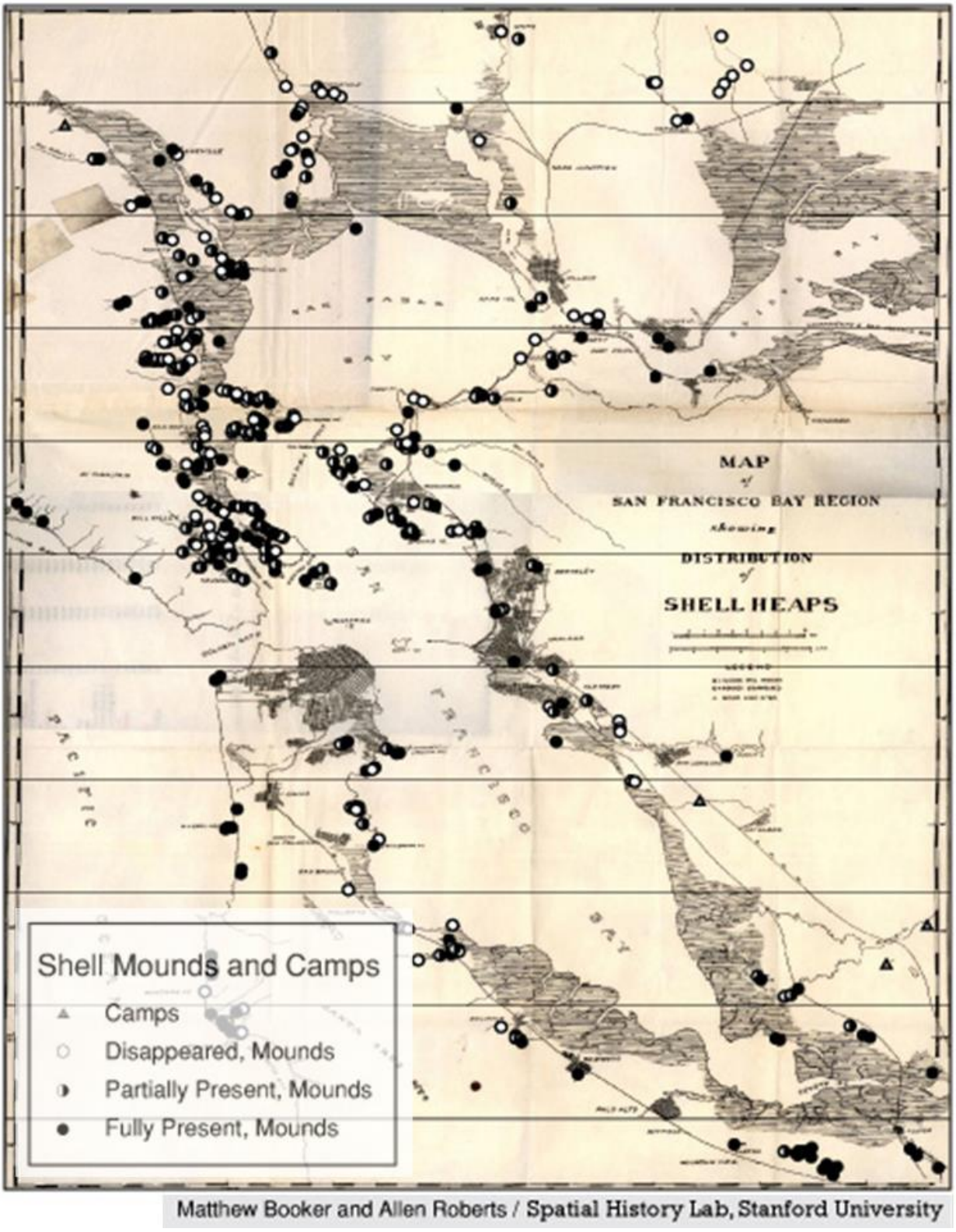


Figure 3-5. Shell Mounds in San Francisco, 1909

Source: (Allen and Matthew 2022)

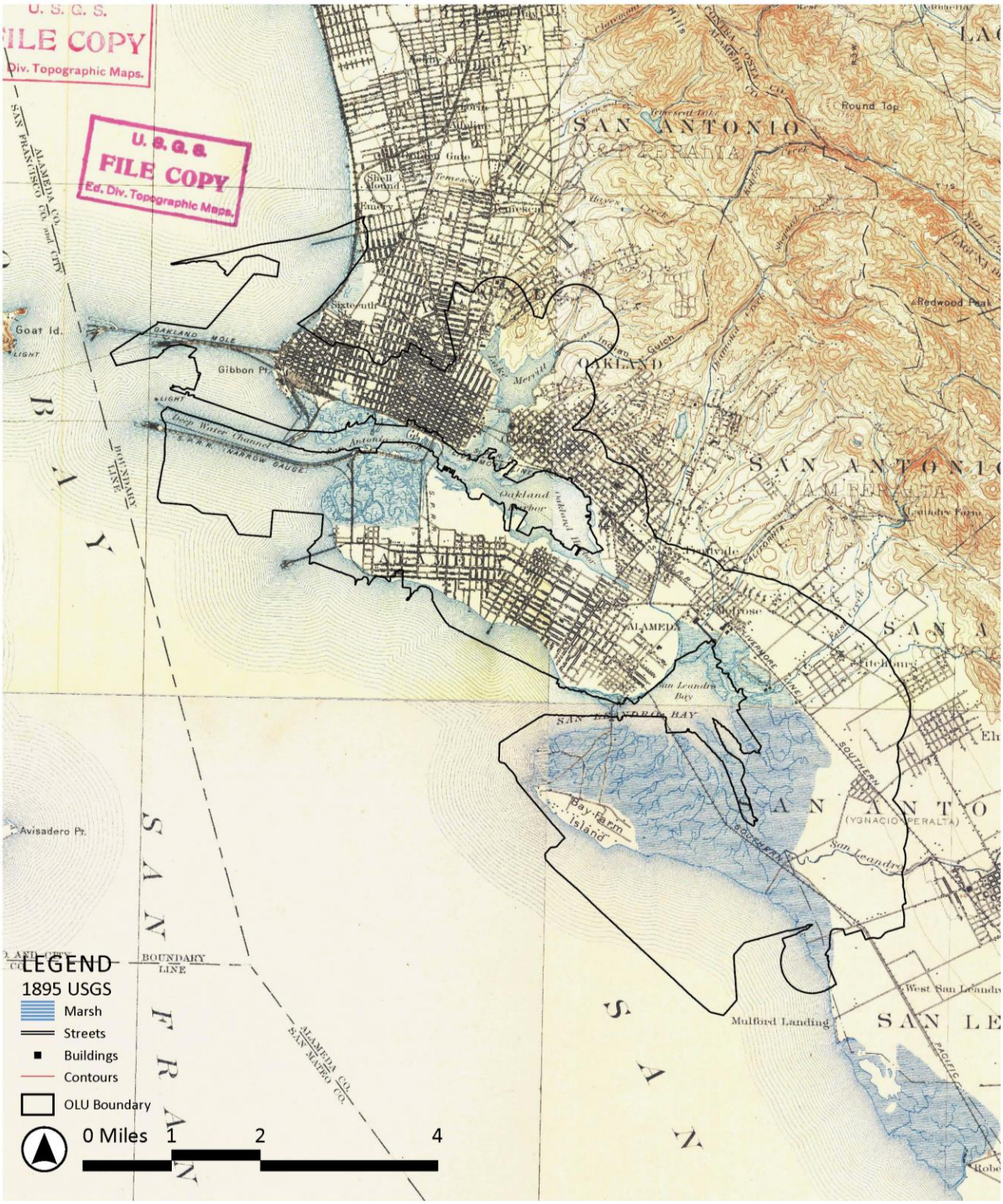


Figure 3-6. Historic Map of Project Area, 1895

Source: (USGS)

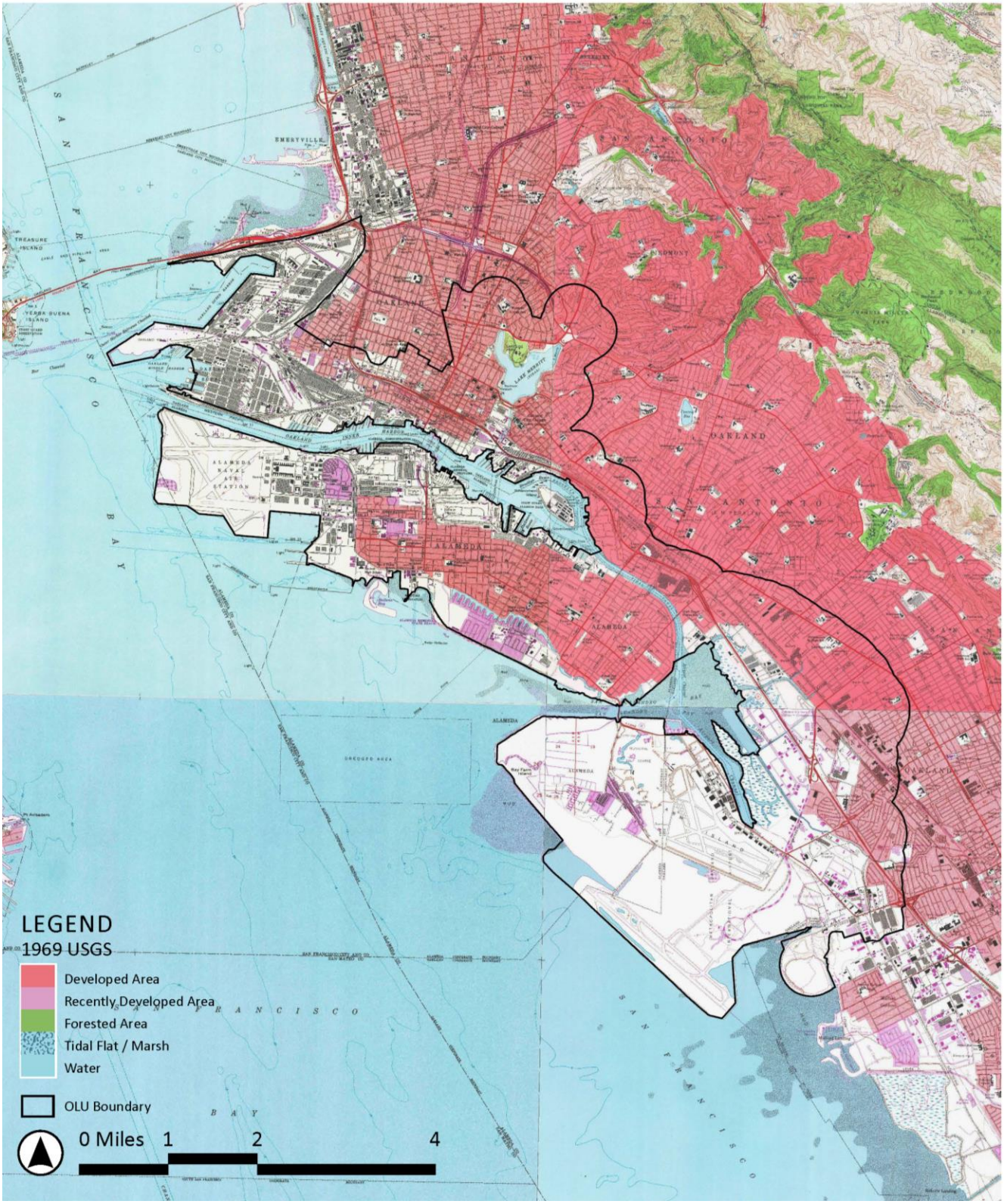


Figure 3-7. Historic Map of Project Area, 1969

Source: (USGS)

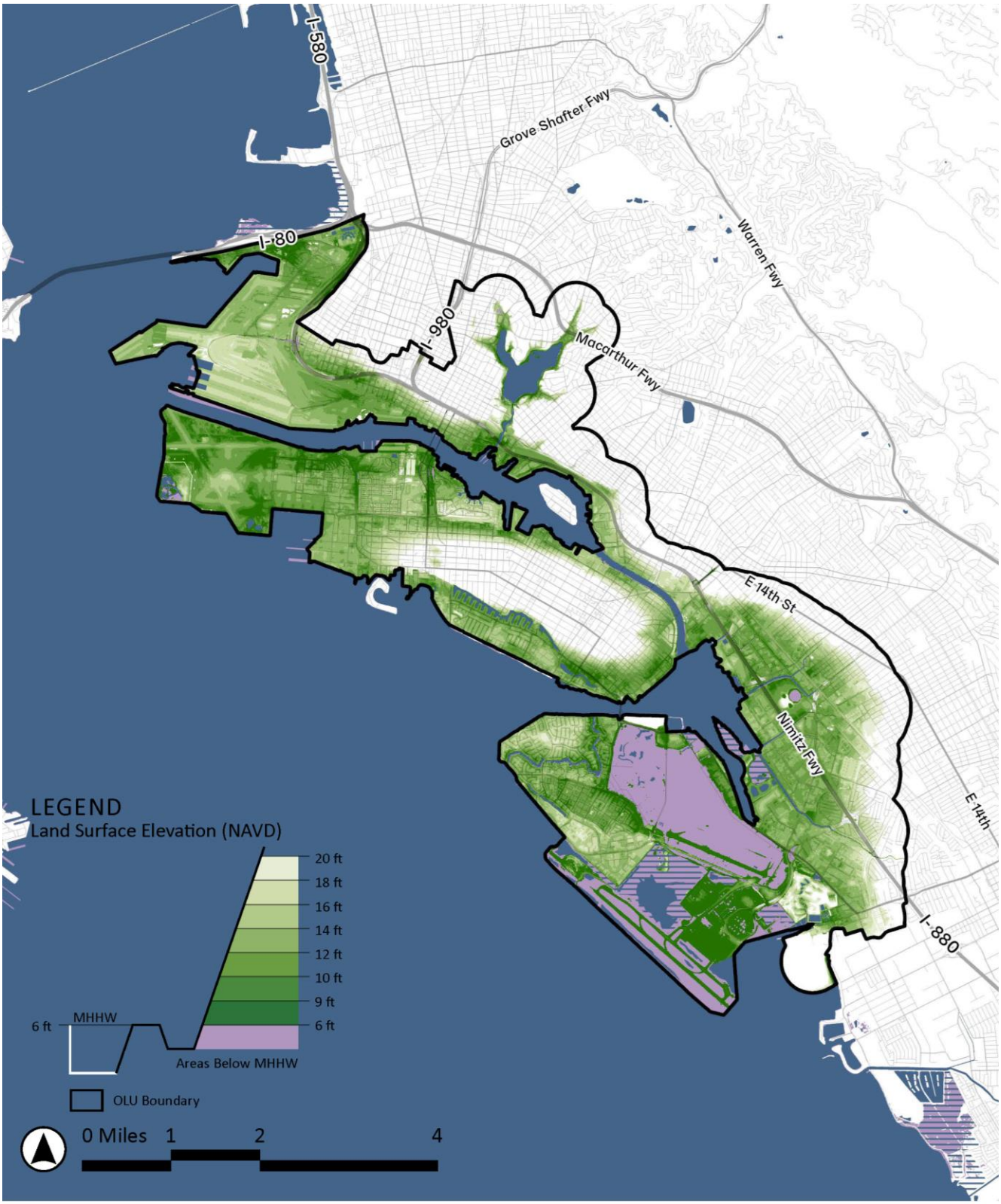


Figure 3-8. Topography

Source: (USGS, NOAA)

3.1.3 Demographics and Environmental Justice Communities

The Subregion is home to about 250,000 people from a wide variety of backgrounds, identities, and experiences. According to the United States Census Bureau's OnTheMap Application[3], 162,426 people work within the Subregion. The top three employment industries are: transportation and warehousing, health care and social assistance, and public administration. Of those who work in the Subregion, 55% identify as White alone with the remaining 45% identifying as non-white. Race is a strong predictor of disparities within the Subregion. Bay Farm Island and Alameda Island are considered medium to high income with median household earnings of about $69,000 – $105,000. The people who live in these affluent communities mostly identify as White or Asian. In contrast, the neighborhoods across the San Leandro Channel, such as the Coliseum/Oakland Airport and Fruitvale/Jingletown neighborhoods have median household earnings of $31,000 – $40,000.

In lower-income areas of the Subregion, there are a higher number of community members who identify as Black or Other/Latinos. In the densely populated and low-income community of Merritt/Clinton/Peralta there is a large concentration of people who identify as Asian. It is important to note that these racial inequalities can be attributed to a long history of inequitable housing practices and redlining policies across the nation. These inequities continue to this day with multigenerational impacts and reduced opportunities for people living and working in these same neighborhoods, which also have higher exposure to pollutants. In addition to housing and income disparities, certain socioeconomic characteristics may determine a population's ability to prepare for, respond to, or recover from a natural hazard.

There are many definitions of environmental justice and underserved communities. The Environmental Protection Agency defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (EPA 2023). FEMA defines underserved populations as "groups that have limited or no access to resources or that are otherwise disenfranchised. These groups may include people who are socioeconomically disadvantaged; people with limited English proficiency; geographically isolated or educationally disenfranchised people; people of color as well as those of ethnic and national origin minorities; women and children; individuals with disabilities and others with access and functional needs; and seniors" (FEMA 2023a).

To help identify underserved communities in the Subregion and ensure environmental justice in the development of the adaptation plans, the San Francisco Bay Conservation and Development Commission's (BCDCs) social vulnerability ranking was used (Figure 3-9). This ranking was developed to better understand community susceptibility to existing and future coastal flooding with sea level rise. Census block groups with high concentrations of characteristics (relative to the nine county Bay Area)

[3] United States Census Bureau OnTheMap: https://onthemap.ces.census.gov/

such as percent people of color, percent single parent families, etc., are flagged as socially vulnerable, with each block group assigned a rank of highest, high, moderate, and low. Block groups designated with the highest social vulnerability have 8 or more indicators in the 70th percentile and/or 6 or more indicators in the 90th percentile. Block groups designated with high social vulnerability have 6-7 indicators in the 70th percentile and/or 4-5 indicators in the 90th percentile. Block groups designated with moderate social vulnerability have 4-5 indicators in 70th percentile and/or 3 indicators in the 90th percentile. Block groups designated with low social vulnerability don't meet any of the criteria above. Those designated with "Not calculated" contained characteristics that were not estimated in the American Community Survey due to low population and other factors leading to low survey response (BCDC 2020).

Plan Bay Area 2050 designates communities that are or have been historically underserved as Equity Priority Communities (EPCs). Similar to BCDC, Plan Bay Area uses community characteristics and demographics within the American Community Survey, such as people of color, low-income, limited English proficiency, people with disabilities, single parent families, and rent burdened. The communities in the Subregion identified by Plan Bay Area with the highest equity priority (Figure 3-10) correspond well with the communities identified by BCDC with the highest social vulnerability (Figure 3-9).

FEMA designates the census tracts most at risk from the effects of natural hazards and climate change as Community Disaster Resilience Zones (CDRZ). FEMA recently designated the first 483 CDRZ in all 50 states. The Subregion has two CDRZ (Figure 3-11), with the Airport and portions of east Oakland are located within a CDRZ.

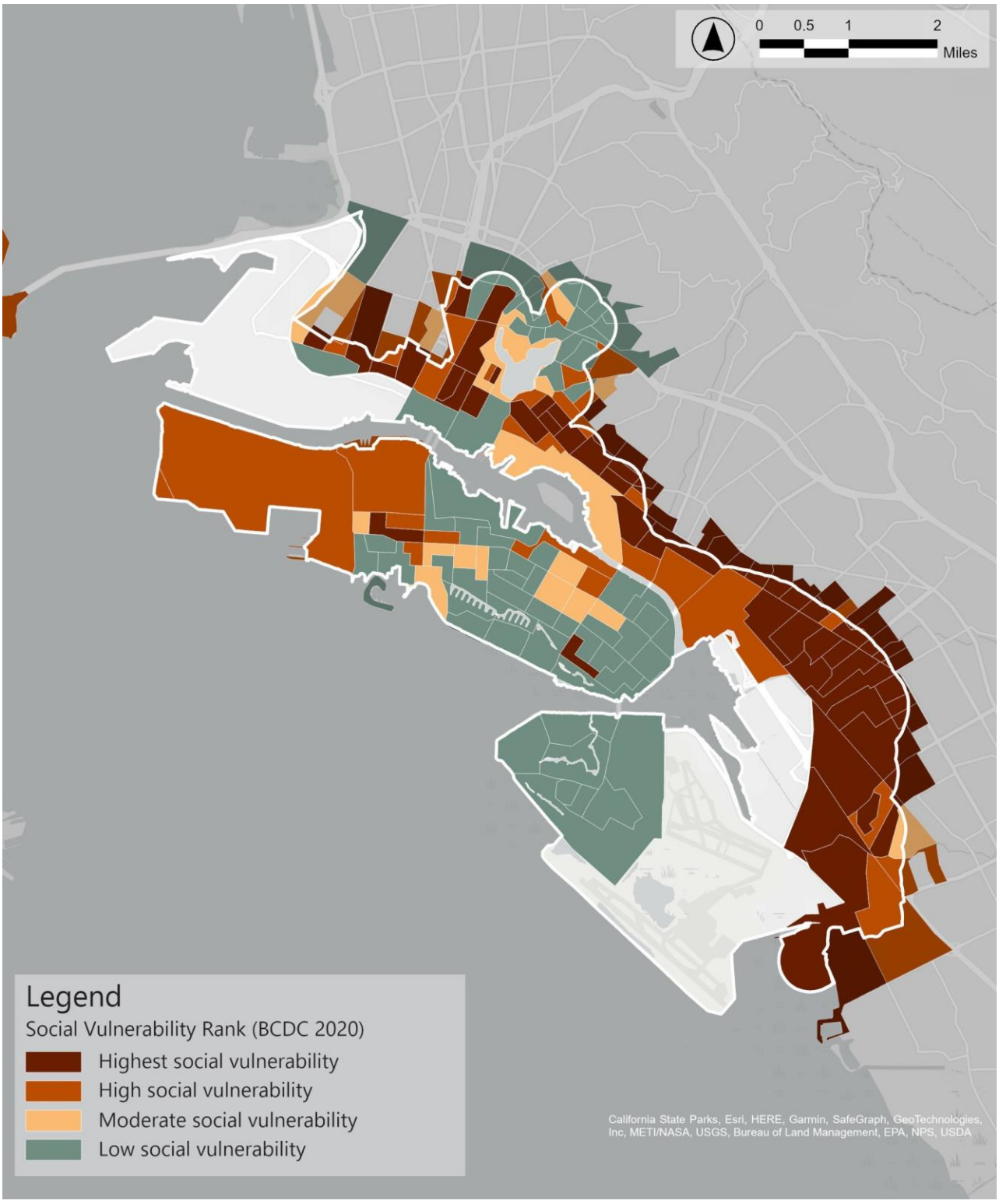


Figure 3-9. Social Vulnerability Rank

Source: (BCDC 2020)

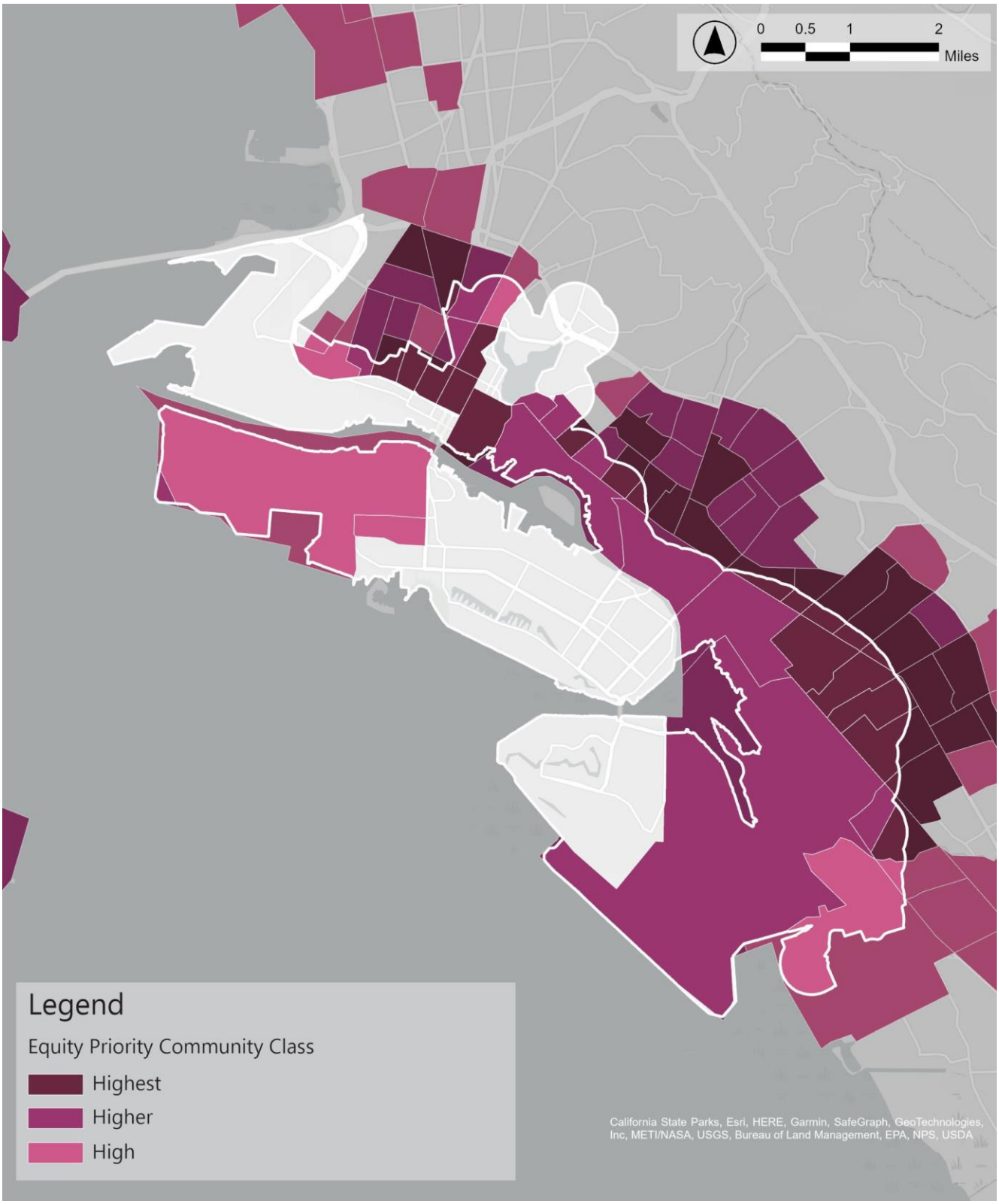


Figure 3-10. Plan Bay Area 2050 Equity Priority Communities

Source: (Metropolitan Transportation Commission and Association of Bay Area Governments 2021)

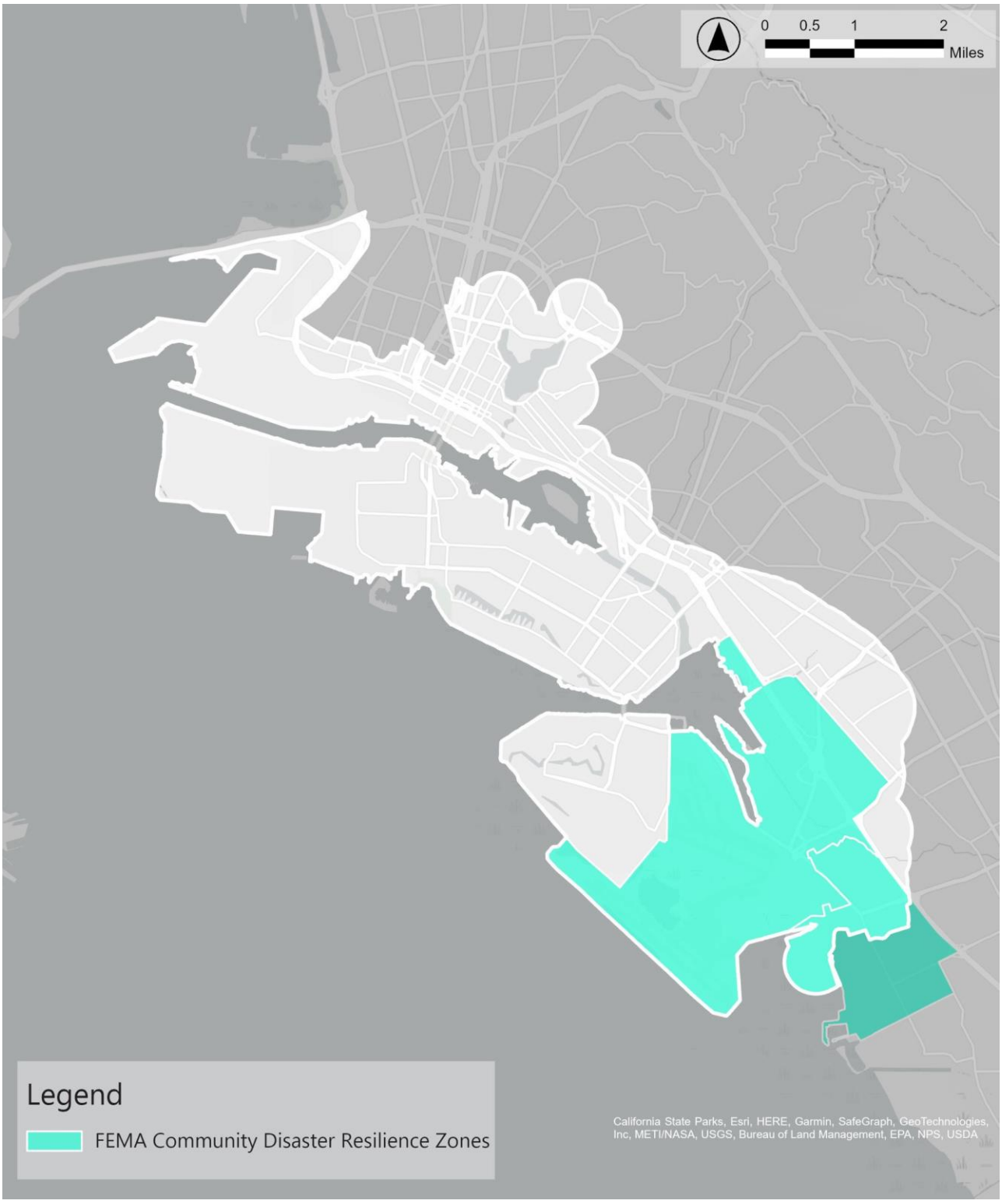


Figure 3-11. FEMA Community Disaster Resilience Zones

Source: (FEMA 2023b)

3.1.4 Public and Community Assets

Public and community assets are assets that improve the quality of life for the community, including assets that are culturally, spiritually, and socially relevant and beloved by community members. Examples include:

- Physical structures or places, such as schools, places of worship, libraries, parks, recreation, and community centers, or social clubs;
- Associations of citizens.
- Ephemeral community event spaces, such as farmers' markets and flea markets.
- Local private, public, and nonprofit institutions or organizations.
- Other medical support services.

Identifying relevant public and community assets typically requires stakeholder engagement and community asset mapping exercises. As the OAAC adaptation planning projects move forward, a more comprehensive list of public and community assets will be identified. For this report, existing planning documents were reviewed to identify a preliminary list of public and community assets.

Existing planning documents reviewed for public & community assets include: the Downtown Oakland Specific Plan (City of Oakland 2019a), Coliseum Area Specific Plan (City of Oakland 2015b), Central Estuary Specific Plan (City of Oakland 2013), Oakland Preliminary Sea Level Rise Road Map (City of Oakland 2017a), Oakland/Alameda Resilience Study (BCDC 2016), East Oakland Neighborhood Initiative (EONI) Community Plan and Asset Maps (EONI 2021), and Oakland Alameda Access Project (Caltrans and ACTC 2021).

A preliminary and by no means exhaustive list of community assets includes:

- Oakland Chinatown.
- Laney College;
- Oakland Museum of California;
- Oakland Public Library;
- Oakland Coliseum;
- College of Alameda;
- East Oakland Sports Center;
- East Oakland Senior Center;
- East Oakland Youth Development Center;
- Martin Luther King Jr. Shoreline Park;
- Robert W. Crown Memorial State Beach;

Public assets that are identified in the City of Alameda and City of Oakland GIS data include hospitals, schools, and clinics. Community-identified assets are not included in the City of Alameda or City of Oakland GIS information.

Data Gap: Additional community-identified assets should be identified within the three project areas. However, this project does not include the scope to complete a full public and community asset analysis. As the work progresses community asset information can be collected and compiled, improving the compilation of missing information. The partner CBOs can also likely identify relevant and meaningful community assets.

Additional types of public assets to potentially include if data are available:

- Daycare facilities;
- Youth centers;
- Long-term care facilities and/or assisted living facilities;
- Health clinics and/or medical facilities with specialized infrastructure;
- Places of worship;
- Community gardens.

3.1.5 Regional and State Guidance and Mandates

The Bay Area has a wealth of sea level rise adaptation planning guidance from the State of California regional agencies such as BCDC. California Senate Bill 272 (SB272), signed by the Governor on October 7, 2023, gives authority to BCDC to set standards or guidelines for how cities should plan for sea level rise. The bill will require cities to submit adaptation plans that meet these new standards to BCDC for approval. BCDC is in the process of developing this guidance through the Bay Adapt Regional Shoreline Adaptation Plan (RSAP). The RSAP Background Research Report (BCDC 2023) provides a summary of resources available at the state and regional level. Only the most relevant resources for OAAC ADAPT are highlighted here.

At the state level, Ocean Protection Council's (OPCs) 2018 State of California Sea-Level Rise Guidance (OPC and CNRA 2018) recommends the best available sea level rise science to assist local and state planning and decision making related to sea level rise and coastal hazards. It includes a summary of best available climate science as relates to sea level rise (at the time of publication), sea level rise projections specific to California, guidance on how to select projections, and recommendations to support planning and design. OPC is in the process of updating its guidance, estimated to be published in early 2024. OPC also published seven Principles for Aligned State Action on sea level rise, supported by numerous state agencies, which provides valuable context for the visioning and early adaptation planning stages (OPC 2020).

In the Bay Area, BCDC's Bay Adapt Joint Platform (BCDC 2021), San Francisco Bay Plan (BCDC 2019), Adapting to Rising Tides[4], and Adaptation Roadmap (BCDC 2022) provide a suite of guides,

[4] BCDC's Adapting to Rising Tides website provides a wealth of resources to support sea level rise vulnerability and risk assessments, adaptation planning, and the related stakeholder and public engagement in the Bay Area: https://www.adaptingtorisingtides.org/.

approaches, tools, and data to support regional and local sea level rise and coastal flood adaptation planning.

SFEI's Adaptation Atlas (SFEI and SPUR 2019) provides an approach focused on nature-based solutions where appropriate for addressing sea level rise adaptation at the OLU scale (Section 3.1). The San Francisco Estuary Blueprint (San Francisco Estuary Partnership 2022), EPRBD Bay Trail Risk Assessment and Adaptation Prioritization (East Bay Regional Parks District 2021), and the Bay Area Habitat Goals Project (Goals Project 2015) all seek to drive regional actions for multi-benefit nature-based projects along the shoreline, including removing barriers to implementation of nature-based approaches, elevating the roles of frontline and underserved communities and Tribes in planning and benefiting from a healthy Bay and Estuary, reducing flood risk through reconnecting and restoring creeks, and increasing the beneficial re-use of dredged sediment.

3.2 Summary of Existing Adaptation Efforts / Plans

Previous and ongoing adaptation planning efforts form the basis of understanding for near- and long-term OAAC ADAPT projects. The following studies are of particular importance to these projects, though they are not an exhaustive list. Refer to Appendix A for the entire Data Inventory and complete list of reference documents.

3.2.1 Subregional Adaptation Plan

- Alameda Climate Action and Resiliency Plan (CARP) (City of Alameda 2019);
- Alameda Climate Adaptation and Hazard Mitigation Plan (City of Alameda 2022a);
- Alameda Point Master Infrastructure Plan (City of Alameda 2020);
- Oakland Preliminary Sea Level Rise Road Map (City of Oakland 2017a);
- City of Oakland 2021-2026 Hazard Mitigation Plan (City of Oakland 2021);
- SFEI Adaptation Pathways: San Leandro Operational Landscape Unit (SFEI 2022a) ;
- San Francisco Bay Trail Risk Assessment & Adaptation Prioritization Plan (East Bay Regional Parks District 2021);
- Port of Oakland Sea Level Rise Assessment (Port of Oakland 2019).

Refer to Appendix A for a complete list of reference documents.

3.2.2 Oakland-Alameda Estuary Project

- Downtown Oakland Specific Plan (City of Oakland 2019a);
- Oakland Estuary Park Renovation & Expansion Project Master Plan (WRT 2023);
- City of Alameda Northern Shoreline Adaptation Project Basis of Design Memorandum (Matthies and Kumar 2021);
- City of Alameda Northern Shoreline Adaptation Project - Interior Drainage Alternatives Memorandum (Schaff and Shick 2021).

Refer to Appendix A for a complete list of reference documents.

3.2.3 Bay Farm Island Project

- Stormwater Management and Tidal Flooding Vulnerability Assessment at the North Field Oakland International Airport: Tidal Flooding Vulnerability Assessment (Port of Oakland 2023a);
- Veterans Court Resiliency Project - Current Concept Options ;
- Bay Farm Island Focus Area (AECOM 2014);
- Bay Farm Island Lagoon Operations Memorandum (Schaaf & Wheeler 2015);
- City of Oakland Drainage Study -- Empire Road and Bernhardt Drive Drainage Areas (City of Oakland 2022a);

Refer to Appendix A for a complete list of reference documents.

3.3 Best Available Climate Science

3.3.1 Temperature

Climate change, driven by increasing greenhouse gas emissions, has caused global temperatures to rise by 1.3 degrees C compared to pre-industrial levels (IPCC 2021; Marvel et al. 2023). Average temperatures in the Bay Area have increased in recent decades, with 106 degrees F recorded as the highest temperature on record in the City of Alameda on Sep 1, 2017. In San Francisco, average annual temperatures increased by 2.9 degrees F between 1970 and 2021 (Figure 3-12). Additionally, average low temperatures have increased by as much as 3.4 degrees F (Figure 3-13). Although the exact temperatures shown for San Francisco vary from temperatures in Alameda and Oakland due to location and topographic changes, the trends presented are applicable to the wider Bay Area. In addition to increasing temperatures, the Bay Area is experiencing longer and hotter heat waves, prolonged droughts, increasing extreme precipitation, and more severe whiplash between period of drought and extreme precipitation (Marvel et al. 2023; White et al. 2023).

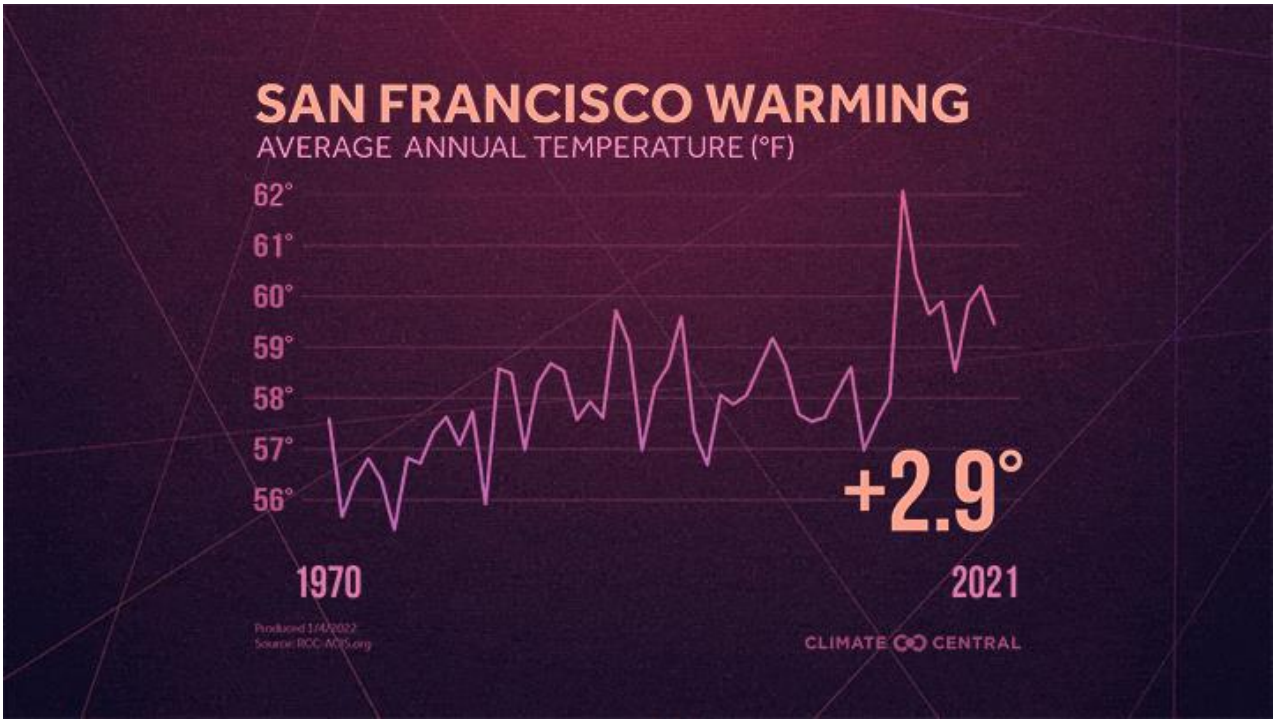


Figure 3-12. Increasing Average Annual Temperature

Source: (Climate Central 2022a)

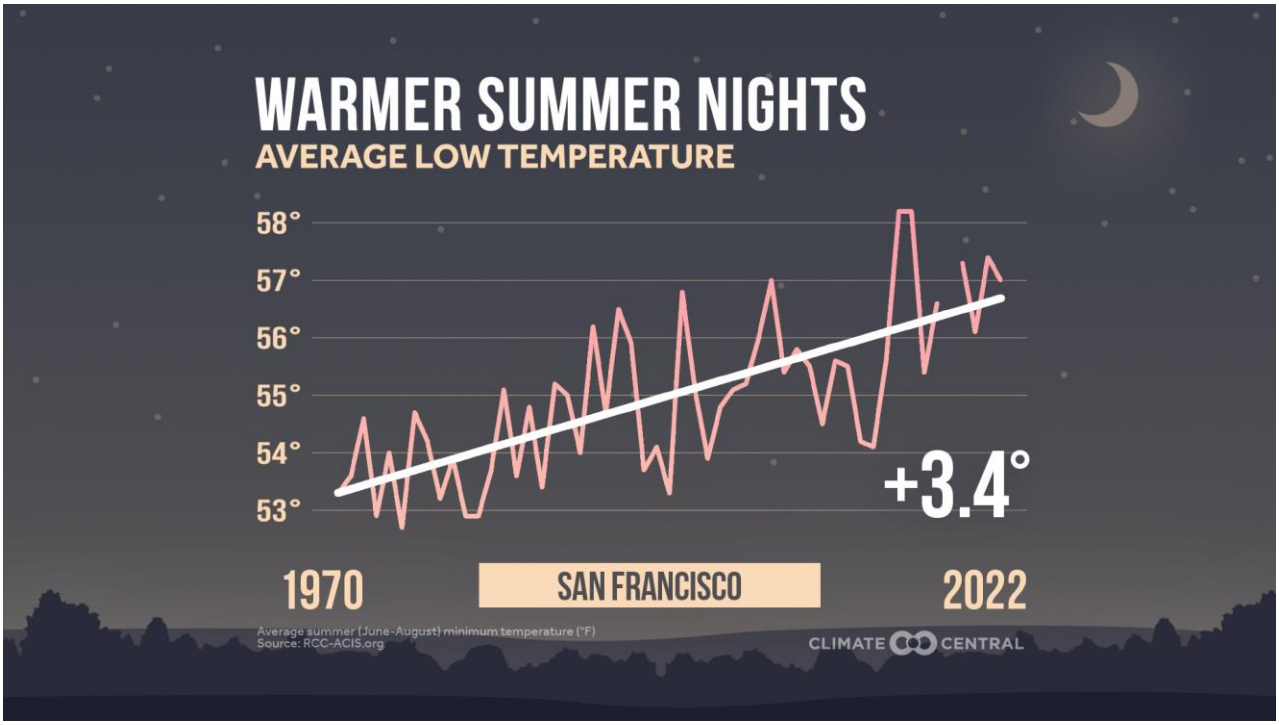


Figure 3-13. Increasing Average Low Temperature

Source: (Climate Central 2022b)

3.3.2 Sea Level Rise

Climate change, including sea level rise, is increasing the severity of flood hazards. Updated sea level rise projections produced by the Federal Interagency Sea Level Rise Task Force suggest that California sea level rise is following the Intermediate curve (Collini et al. 2022; Sweet et al. 2022). Figure 3-14 shows the sea level rise scenarios, along with an observation-based extrapolation of tide gage and satellite observations. This extrapolation is not extended past 2050, as the observed rate of sea level rise is based on past conditions, and with continued greenhouse gas emissions, the rate of sea level rise is likely to continue increasing. By 2050, California is likely to observe 9 to 12 inches of sea level rise. By 2100, if California sea level rise continues to trend along the Intermediate scenario, up to 4 feet of sea level rise is possible (Figure 3-14). OPC is in the process of updating their sea level guidance and is anticipated to adopt Sweet et al. (2022) as best available science.

Higher rates of sea level rise could occur if greenhouse gas emissions continue to follow a very high emission scenario, coupled with rapid ice sheet melt and ice sheet disintegration (Collini et al. 2022; Sweet et al. 2022). The Federal Interagency Sea Level Rise Task Force will update the observation-based trajectories every five years, or as advancements in climate science occur. These updates will provide communities with information on future rates of sea level rise that will help guide climate adaptation decisions and the timing of future flood risk mitigation needs.

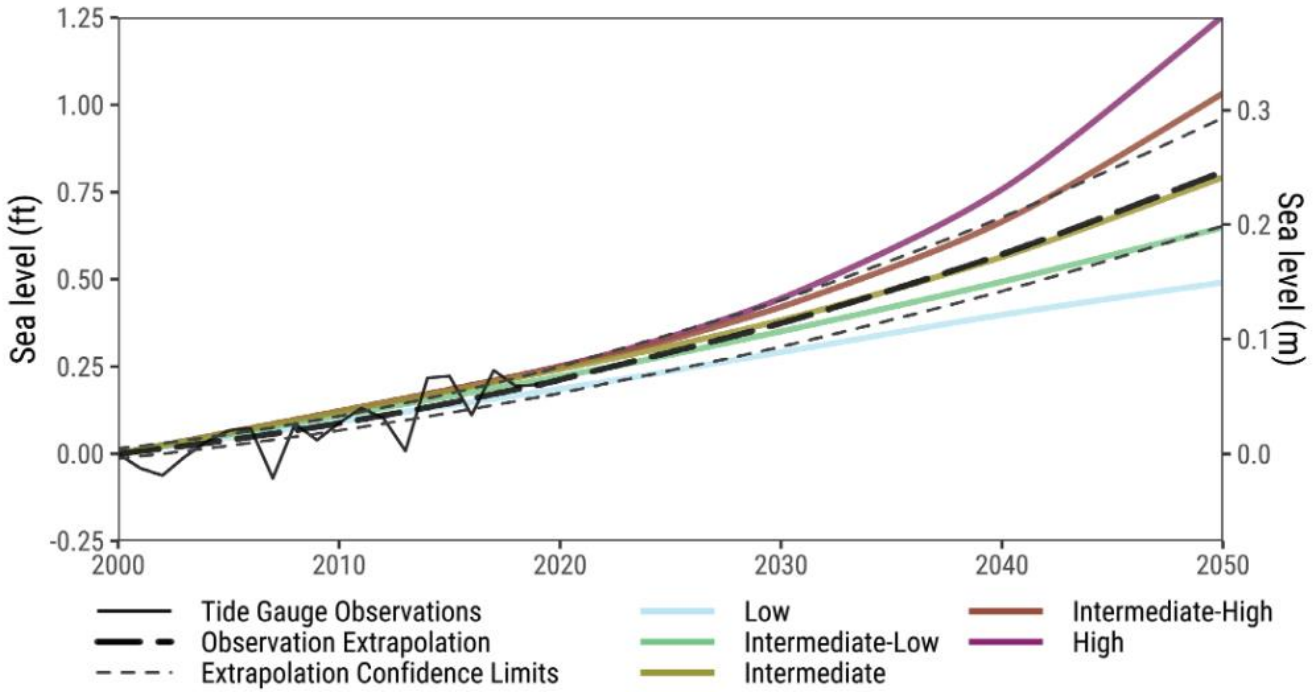


Figure 3-14. Sea Level Rise Observations and Projections

Regional sea level rise scenarios and the observation-based extrapolation for the Southwest Region (California and Southern Oregon). Average annual water levels from tide gauges throughout the region are overlaid for context.

Source: (Collini et al. 2022)

3.3.3 Precipitation

Climate change is driving changes in precipitation intensity and patterns (Leung et al. 2023. As global temperatures rise, the Earth's water cycle intensifies, resulting in heavier rainfall, heightened flooding risks, and variability in precipitation distribution (Tabari 2020). In the Bay Area, extreme precipitation is increasing, with storm total precipitation increasing by up to 37% by the end of the century (Patricola et al. 2022), and shorter duration precipitation (e.g., 1-hour, 3-hour) increasing by up to 67% (Mak et al. 2023a, b).

Traditionally, infrastructure planning and water management have relied on historical data, such as NOAA's Atlas 14, which does not account for the impacts of climate change on precipitation patterns (NOAA 2011). The San Francisco Public Utilities Commission commissioned a regional climate modeling study by Lawrence Berkeley National Laboratory and Pathways Climate Institute to better understand how Bay Area extreme storms may change under a warmer climate (Patricola et al. 2022; Mak et al. 2023a, b). Table 3-1 and Table 3-2 present results from Mak et al. (2023b; 2023a) relative to the San Francisco Downtown weather station. The findings from this study can be applied to an Oakland weather station to better inform the OAAC ADAPT projects. Near the Oakland Airport, at the 13D1001-81B-Donovan Drive weather station, the 5-year, 3 hour and 100-year, 3-hour rainfall intensities are 1.18 inches and 2.18 inches, respectively; and the 5-year, 24-hour and 100-year, 24-hour rainfall depth are 3.0 inches and 5.83 inches, respectively (NOAA 2011).

Table 3-1. Total Rainfall Accumulation and Percent Change from Historical for Short-Term (3-hour) Duration for the San Francisco Downtown Weather Station

	5-year, 3-hour		100-year, 3-hour	
	Inches	% Increase	Inches	% Increase
Historical	1.3	n/a	2.3	n/a
2050	1.5	20%	2.8	26%
2100	2.0	56%	3.8	67%

Source: (Mak et al. 2023a)

Table 3-2. Total Rainfall Accumulation and Percent Change from Historical for Long-Term (24-hour) Duration for the San Francisco Downtown Weather Station

	5-year, 24-hour		100-year, 24-hour	
	Inches	% Increase	Inches	% Increase
Historical	3.0	n/a	5.8	n/a
2050	3.6	17%	7.1	22%
2100	4.3	41%	8.8	51%

Source: (Mak et al. 2023a)

3.4 Hazards

The Subregion experiences coastal, riverine, stormwater, and groundwater flood hazards. Coastal hazards also include wave hazards and wave- and storm-driven erosion. The Subregion is also within a seismic hazard zone with high potential liquefaction risks in the event of an earthquake.

3.4.1 Coastal Water Level Elevations

The coastal water levels in this report are all reported relative to NAVD88. At the Presidio tide gage (Station ID 9414290) near the Golden Gate, 0 feet NAVD88 is only 0.06 feet below the mean lower low water (MLLW) tidal datum associated with the 1983 – 2001 tidal epoch (Figure 3-15). The relationship between the tidal datums and NAVD88 varies throughout the Bay, with MLLW decreasing and mean higher high water (MHHW) increasing to the south, as shown relative to the Alameda tide gage (Station ID 9414750) and Figure 3-16.

Figure 3-17, Figure 3-18, and Figure 3-19 presents the variations in MHHW, 1% annual exceedance probability (AEP) water levels, and 0.2% AEP water levels along the Subregion shoreline. The range in water level elevations from MHHW to the 0.2% AEP water level is relatively small (Table 3-3). Annual king tides, the highest astronomical tides of the year, are about 1+ feet above MHHW, the 10% AEP (10-year) is about 1 foot higher than king tide elevations, and the 1% AEP (100-year) is about 1+ foot above the 10% AEP. Just 12 to 24-inches of sea level rise can increase flood risks in the Bay Area by about factor of 10.

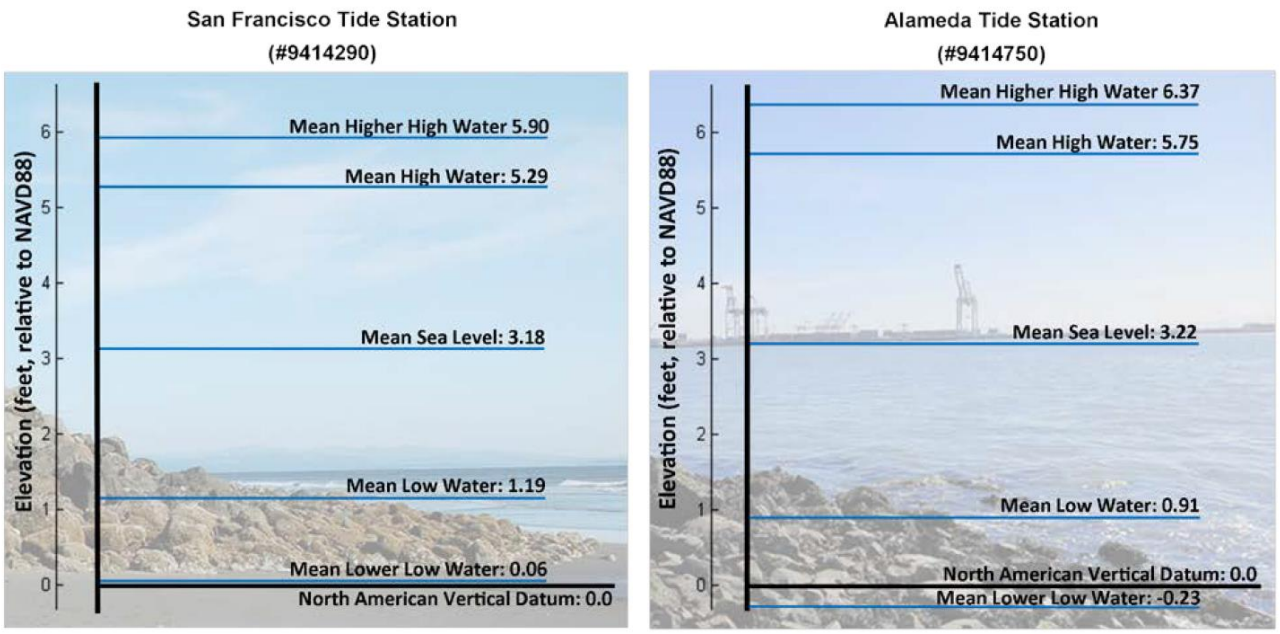


Figure 3-15. Comparison of San Francisco Bay Tidal Datums and NAVD88

Source: (AECOM 2016)

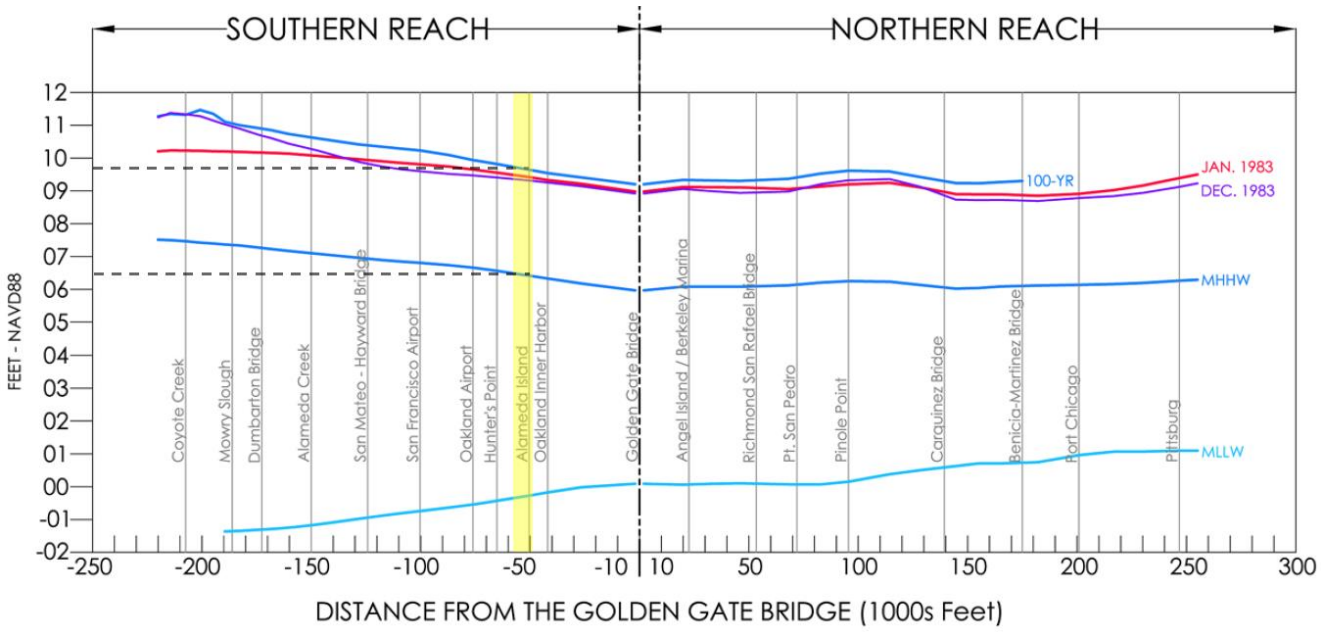


Figure 3-16. Daily and Extreme Tide Elevation Profile in San Francisco Bay

Source: (AECOM 2016)

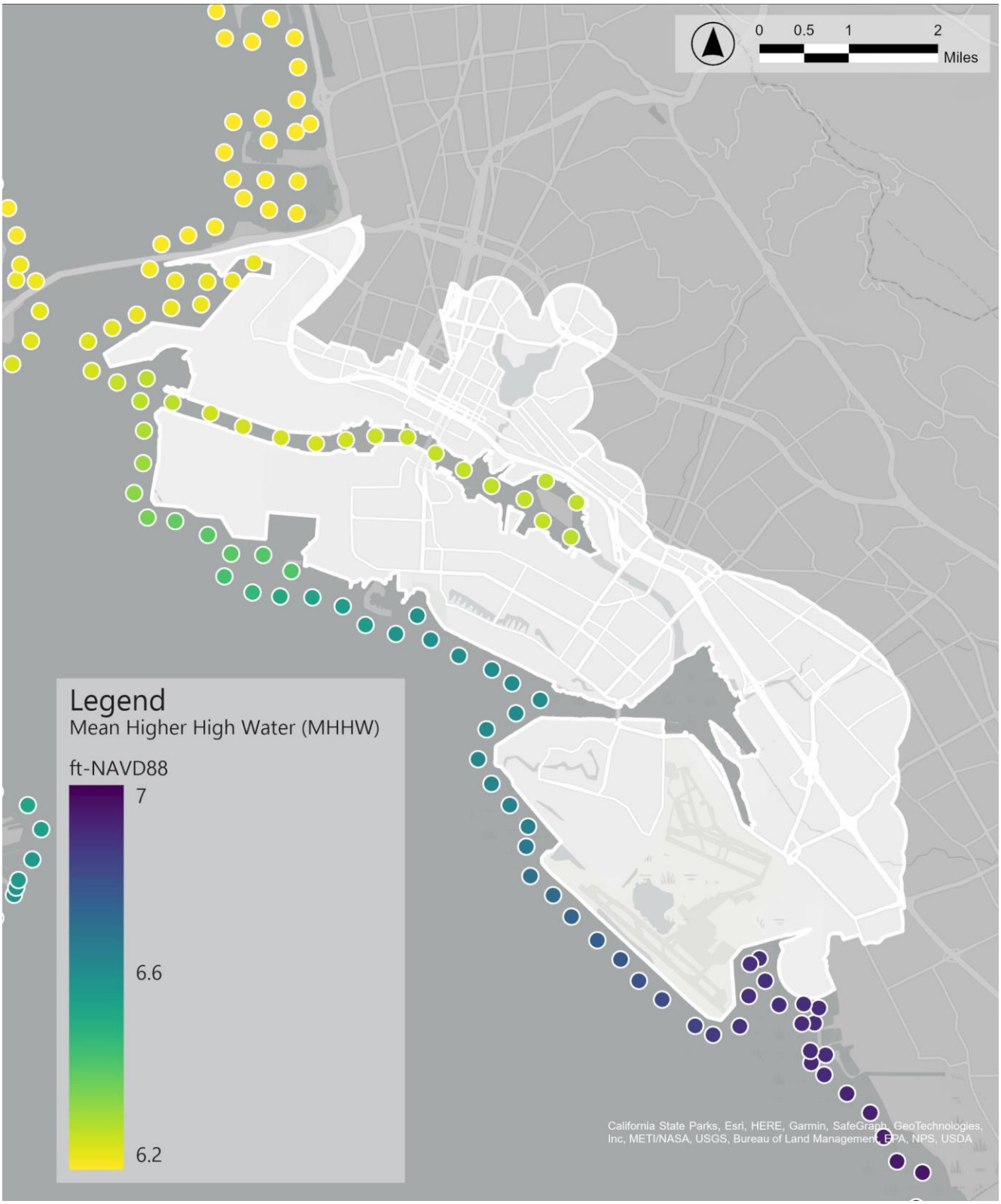


Figure 3-17. Variations in existing Mean Higher High Water

Source: (DHI 2011; AECOM 2016)

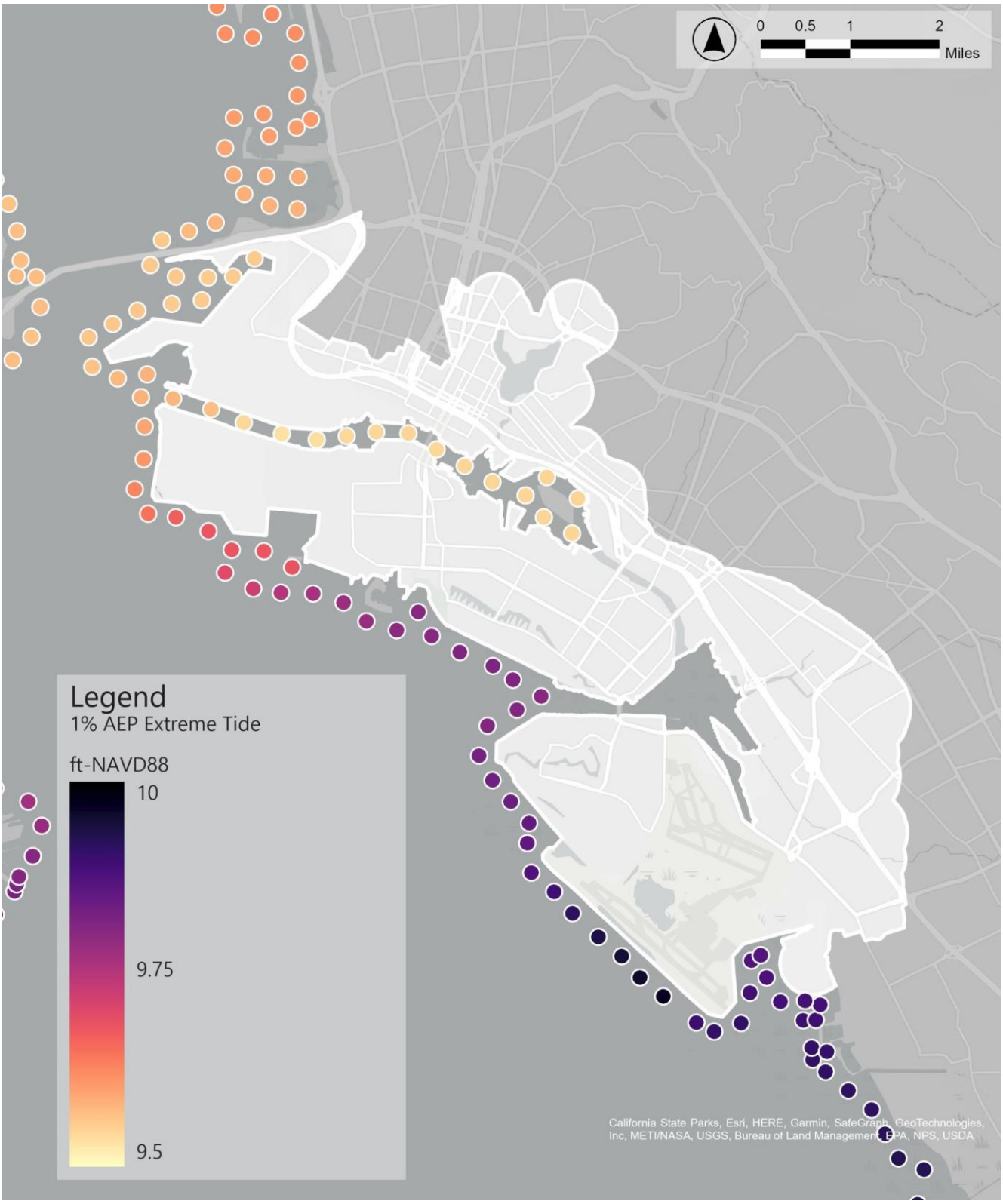


Figure 3-18. Variations in existing 1% AEP Bay Water Level Elevations

Source: (DHI 2011; AECOM 2016)

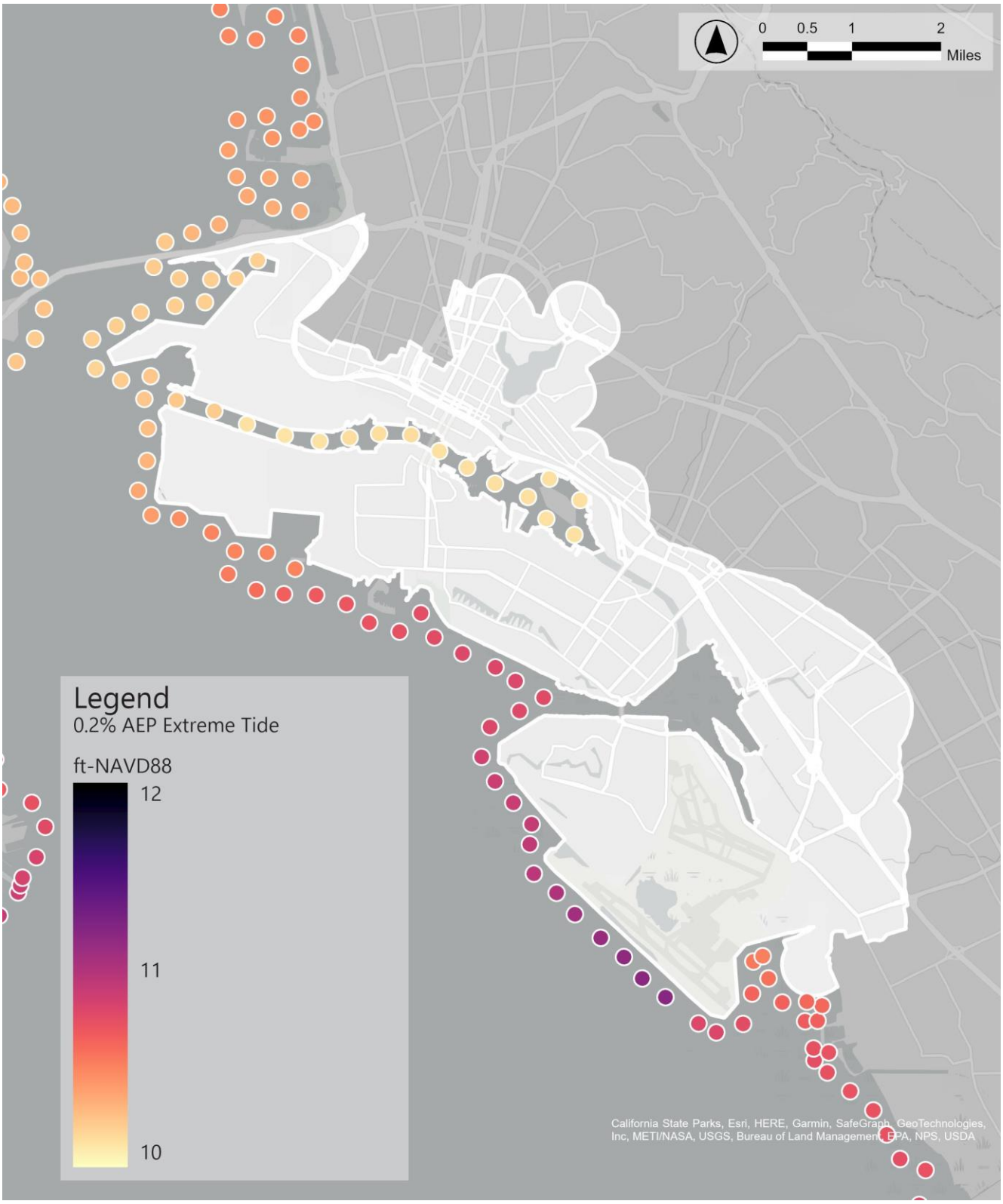


Figure 3-19. Variations in existing 0.2% AEP Bay Water Level Elevations

Source: (DHI 2011; AECOM 2016)

Table 3-3. Water Level Elevations at about the Presidio and Alameda Tide Gauges

Water level elevations were extracted from AECOM (2016) at the points closest to the Presidio and Alameda tide gauges. These values are not intended to imply an exact match with published tide datum information.

Tidal Datum	Presidio (feet)	Alameda (feet)
MLLW	0.05	-0.30
MTL	3.22	3.32
MHHW	5.95	6.42
1-year	7.12	7.68
5-year	7.84	8.36
10-year	8.15	8.65
25-year	8.60	9.07
50-year	8.98	9.43
100-year	9.41	9.82
500-year	10.63	10.90

Source: (AECOM 2016)

3.4.2 Coastal Flooding

When Bay water levels are high enough to overtop the shoreline, inland coastal flooding can occur. This can range from minor, shallow flooding that temporarily disrupts roadways and is a low threat of property damage, to severe flooding with significant threats to property and life (May et al. 2023). Coastal flooding can pose a significant hazard to coastal community homes, businesses, and infrastructure around the world (Petek 2020). To help quantify and reduce the risks associated with coastal flooding, FEMA conducted coastal flood hazard studies for the entire United States coastline population (FEMA 2023c). For the nine Bay Area counties, FEMA completed the San Francisco Bay Area Coastal between 2008 and 2018 (DHI 2011). The updated mapping for Alameda County and the project area became effective on December 21, 2018 (FEMA 2018).

FEMA Flood Insurance Rate Maps (FIRMs) delineate the severity of a flood in terms of recurrence intervals, such as a flood with a 1% or 0.2% chance of occurring in any given year (1% and 0.2% AEP). These recurrence intervals were previously called the 100-year and 500-year flood events, although FEMA moved away from this nomenclature as it can misconstrue the risk. A 100-year flood event can occur more than once in 100 years, and homeowners have about a 26-percent chance (i.e., about one in four) of experiencing a 100-year flood during a 30-year mortgage. Figure 3-21 presents the areas within the Subregion mapped within FEMA's Special Flood Hazard Area (SFHA).

While FEMA FIRMs delineate existing, or historical flood risks, they do not consider climate change. Coastal hazards are increasing due to accelerating sea level rise and changing storm patterns (Sweet et al. 2022; May et al. 2023). Considering future conditions provides a more comprehensive view of long-term coastal hazards in the Subregion and allows us to develop flood risk reduction strategies that consider both past and future flood risks. The Adapting to Rising Tides (ART) program developed integrated Bay Area Sea Level Rise and Shoreline Analysis mapping that can help identify shoreline vulnerabilities (Vandever et al. 2017a). The mapping products capture permanent inundation and temporary flooding impacts from sea level rise scenarios from 0 to 66 inches and extreme high tide events from the 1-year to the 100-year extreme tide, and are available in the ART shoreline flood explorer.[5] Figure 3-22 thru Figure 3-24 present the inundation associated with 24-, 36-, and 48-inches of sea level rise and a 1% AEP extreme tide condition. The figures also highlight where along the shoreline coastal floodwater are overtopping, helping to identify where shoreline flood risk reduction strategies may be needed to mitigate flood risks.

[5] Adapting to Rising Tides Shoreline Flood Explorer: https://explorer.adaptingtorisingtides.org/explorer

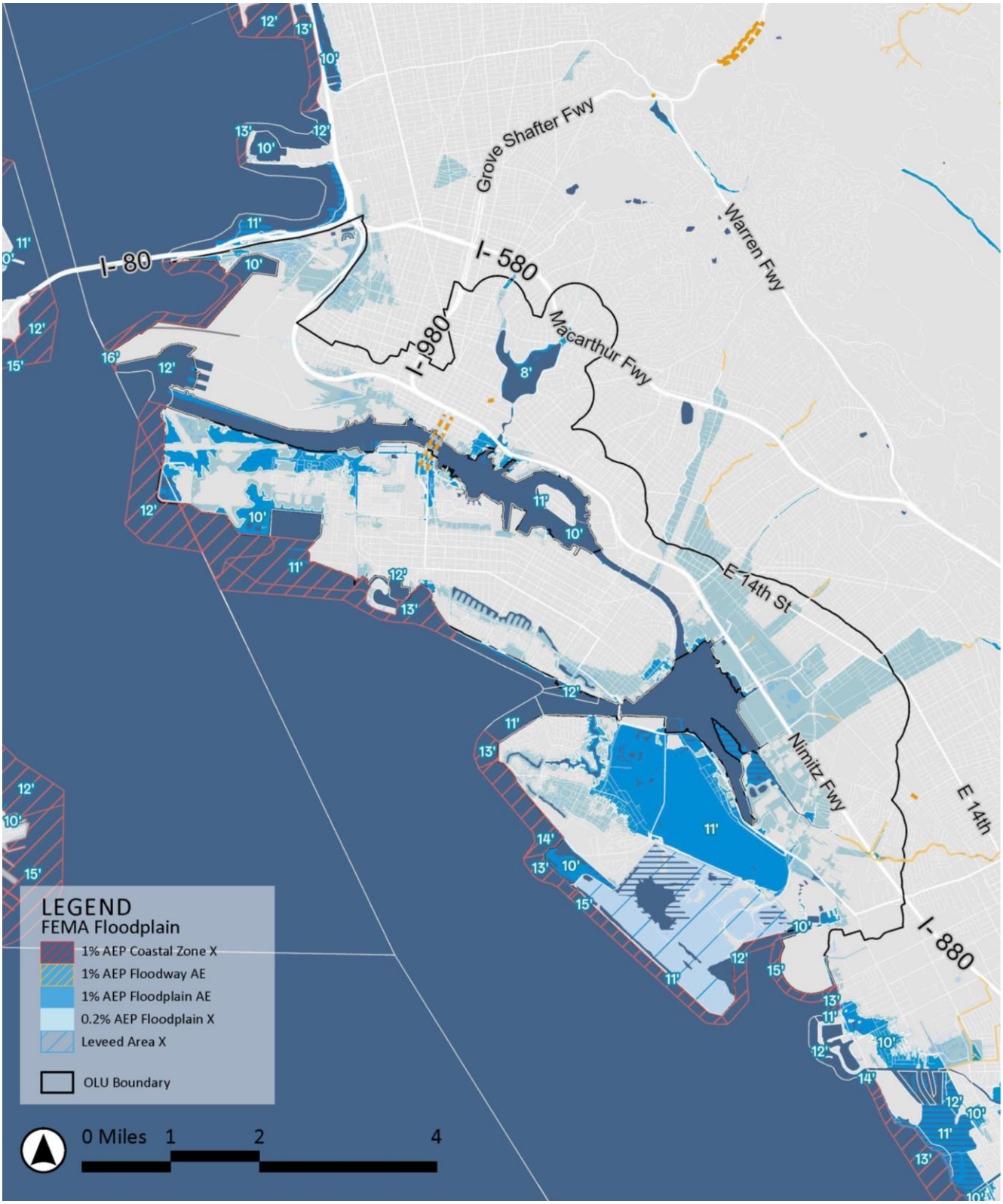


Figure 3-20. FEMA Flood Zones

Source: (FEMA 2018)

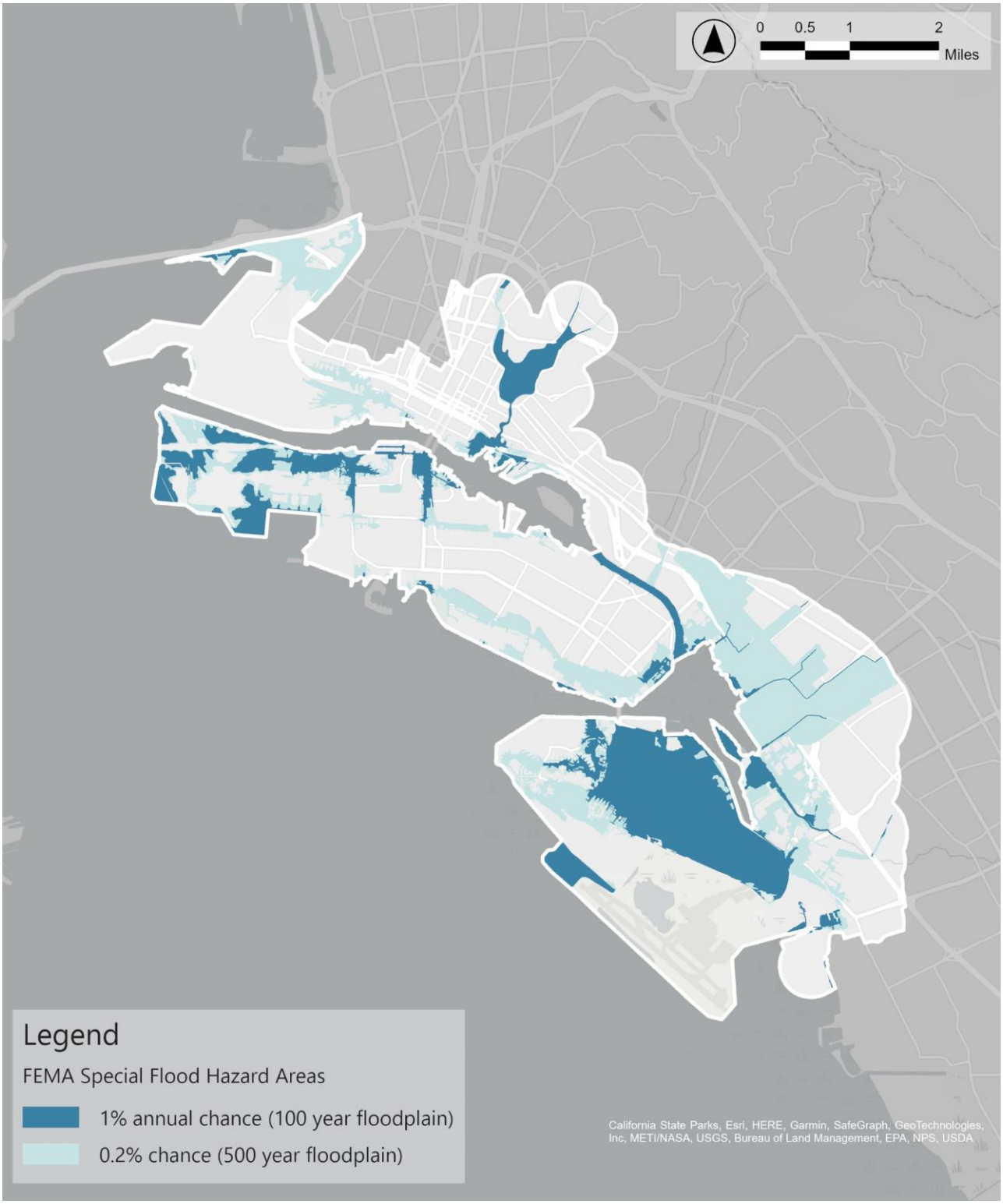


Figure 3-21. FEMA Special Flood Hazard Areas

Source: (FEMA 2023d)

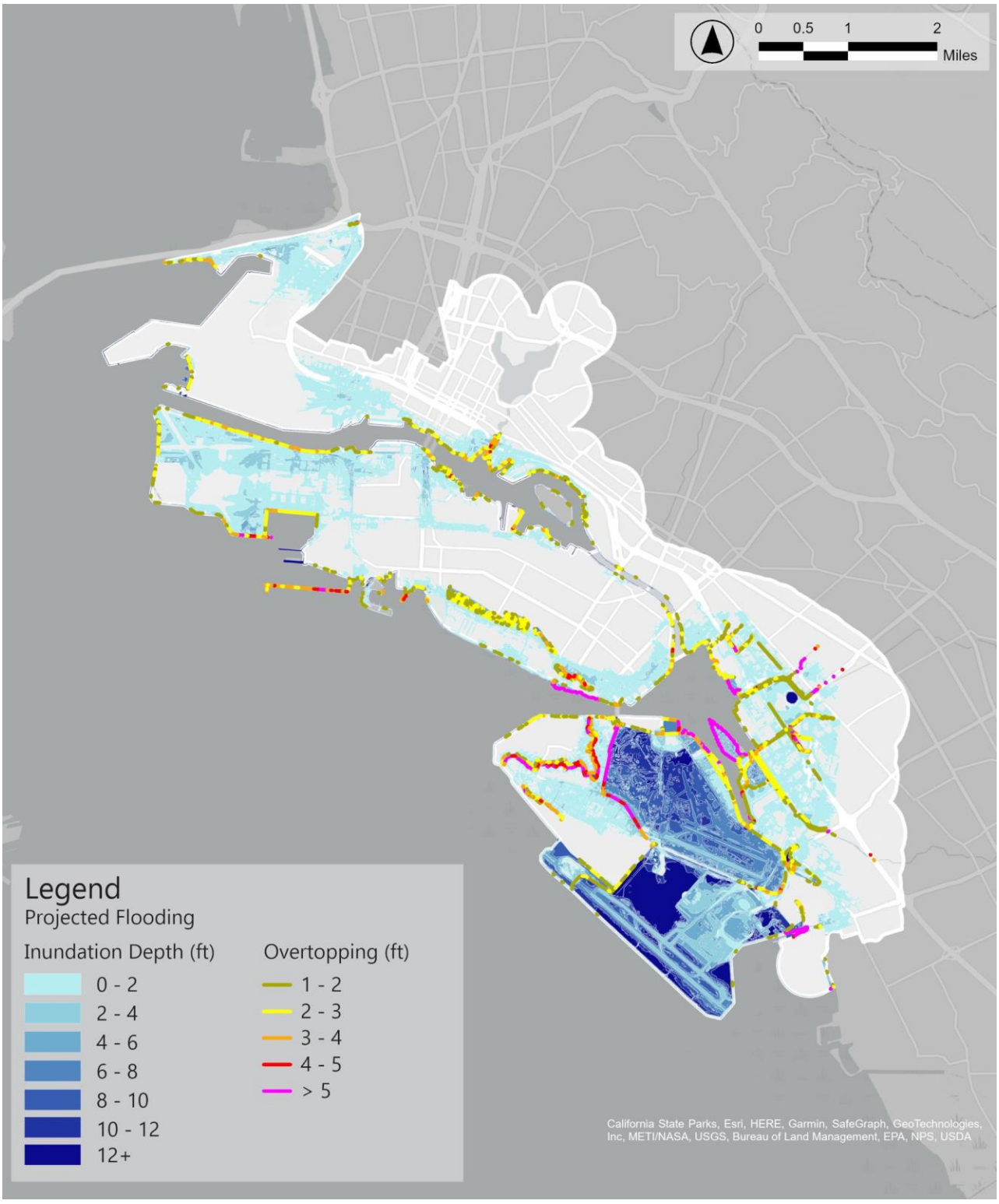


Figure 3-22. 24" Sea Level Rise + 1% AEP Flood

Source: (Vandever et al. 2017b)

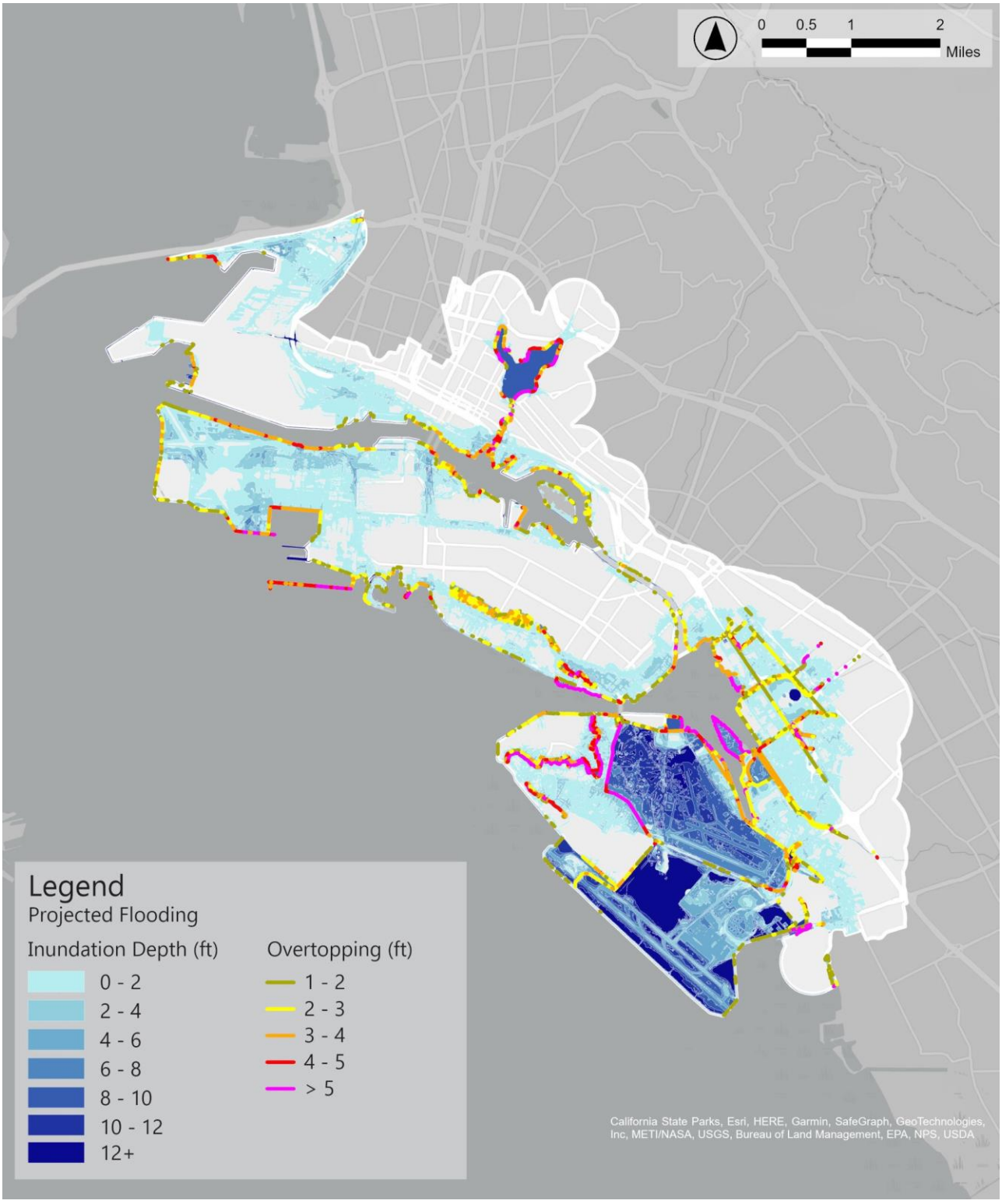


Figure 3-23. 36" Sea Level Rise + 1% AEP Flood

Source: (Vandever et al. 2017b)

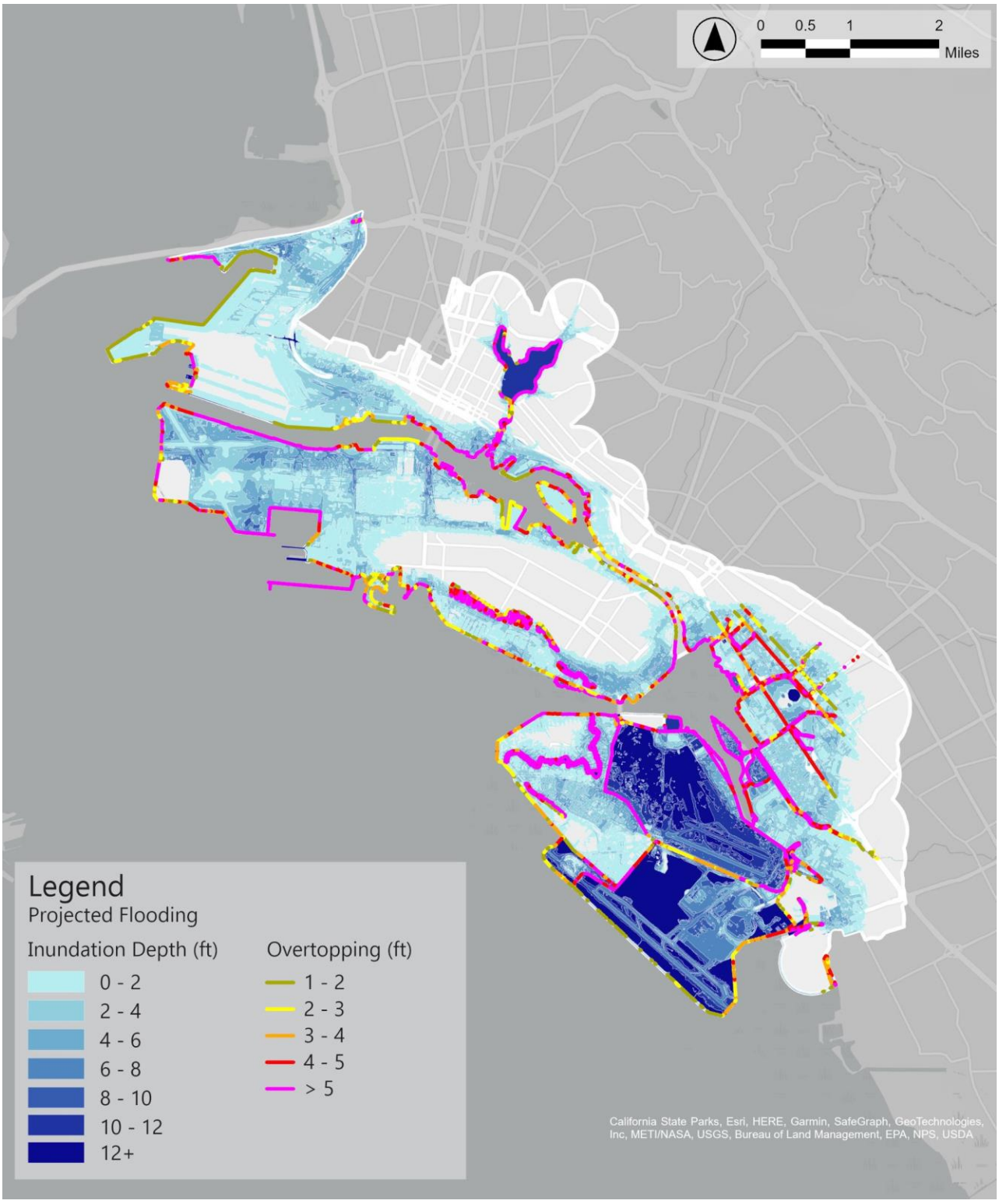


Figure 3-24. 66" Sea Level Rise + 1% AEP Flood

Source: (Vandever et al. 2017b)

3.4.3 Coastal Erosion and Waves

Coastal erosion can be caused by elevated Bay water levels, waves, or a combination of the two. Waves within San Francisco Bay are primarily generated from the friction between the wind and surface water. Wave generation occurs as the wind interacts with the water surface over a sufficient distance (fetch); large waves can only occur when both higher winds and longer fetch are present. Areas with short fetch distances cannot develop large waves even when subject to high winds. Accordingly, wave conditions within the Subregion are highly variable, with Bay-fronting portions (high wind and long fetch) of the Subregion subjected to large waves and Estuary-facing portions of the Subregion (high wind and short fetch) subject to small waves (**Error! Reference source not found.**5). The West/South Bay facing shorelines within the Subregion experience some of the largest wind-driven waves in the Bay, with 1% AEP wave heights of 4 – 5 feet, and wave heights exceeding 5-ft in some locations (**Error! Reference source not found.**).

Low-pressure systems (such as extratropical cyclones) typically result in high wind speeds that directly increase wave size; these storm events also cause elevated water surface elevations (storm surge) that can allow wave action to cause greater levels of damage as waves reach higher ground. Shoreline erosion that occurs at high water levels can jeopardize low-lying shoreline communities, particularly those areas that are levee-protected.

Boat wakes from ship activity can also result in shoreline erosion. Although boat wakes are more prevalent than wind-driven waves, they are generally smaller in height. The riprap revetments designed for Bay Farm Island are governed by large wind-driven generated waves that are the dominant erosion hazard.

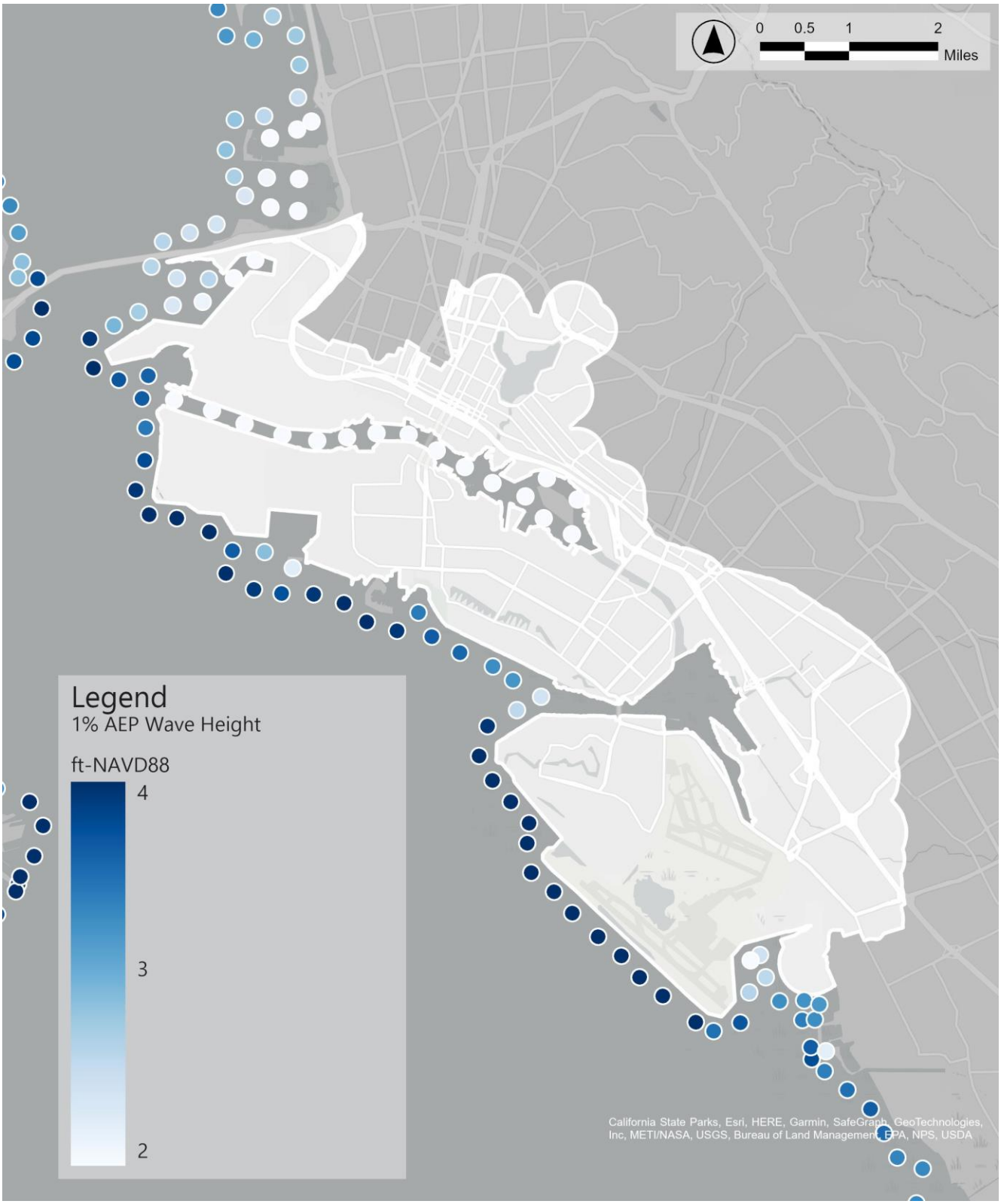


Figure 3-25: Variation in estimated 1% Wave Height

Source: (DHI 2011)

3.4.4 Groundwater

As sea levels rise, groundwater in low-lying coastal communities will also rise (Plane et al. 2019; Befus et al. 2020; May et al. 2023). A rising groundwater table can damage underground infrastructure (May 2020), mobilize soil contaminants (Hill et al. 2023), and increase liquefaction risks during earthquakes (Grant et al. 2021). Pathways and SFEI collaborated with city and county partners to analyze and map the "highest annual" shallow groundwater table and its response to future sea level rise (May et al. 2022).

Figure 3-27 and Figure 3-28 show the projected depth to the groundwater table (below the ground surface) with 24- and 36-inches of sea level rise, respectively. When the groundwater table reaches the ground surface (e.g., depth to groundwater equals 0 feet), groundwater is considered emergent and may present as ponded water on the ground surface. During precipitation events, the groundwater table also rises as precipitation infiltrates the ground surface. During prolonged or consecutive precipitation events, the area above the groundwater table may become saturated by rainwater, creating emergent groundwater conditions and ponding on the ground surface. As the groundwater table rises, the capacity of the soil to retain rainwater will reduce, exacerbating above ground flooding (Rahimi et al. 2020).

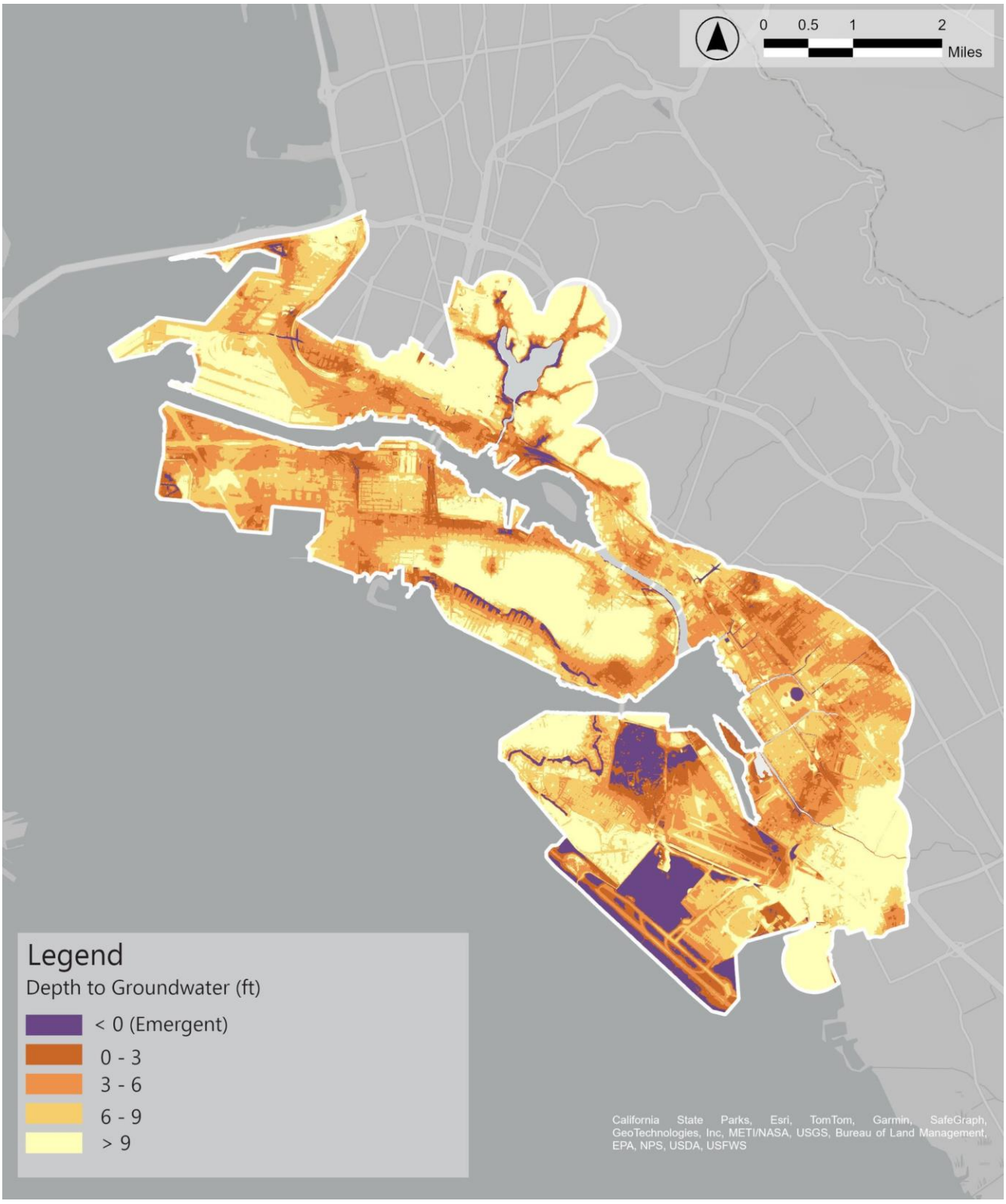


Figure 3-26. Depth to Groundwater (Current Wet-Winter Conditions)

Source: (May et al. 2022)

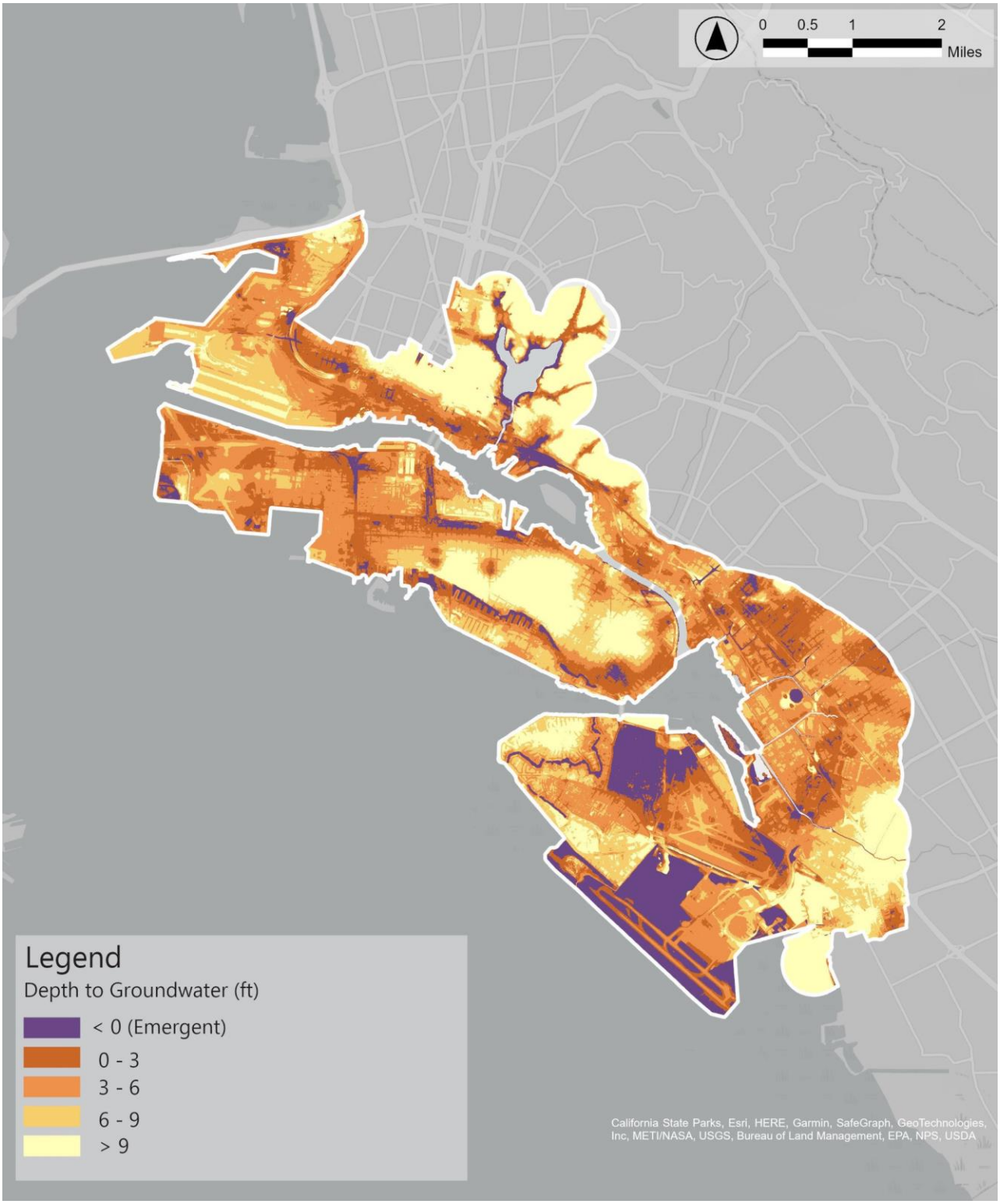


Figure 3-27. Groundwater with 24" Sea Level Rise

Source: (May et al. 2022)

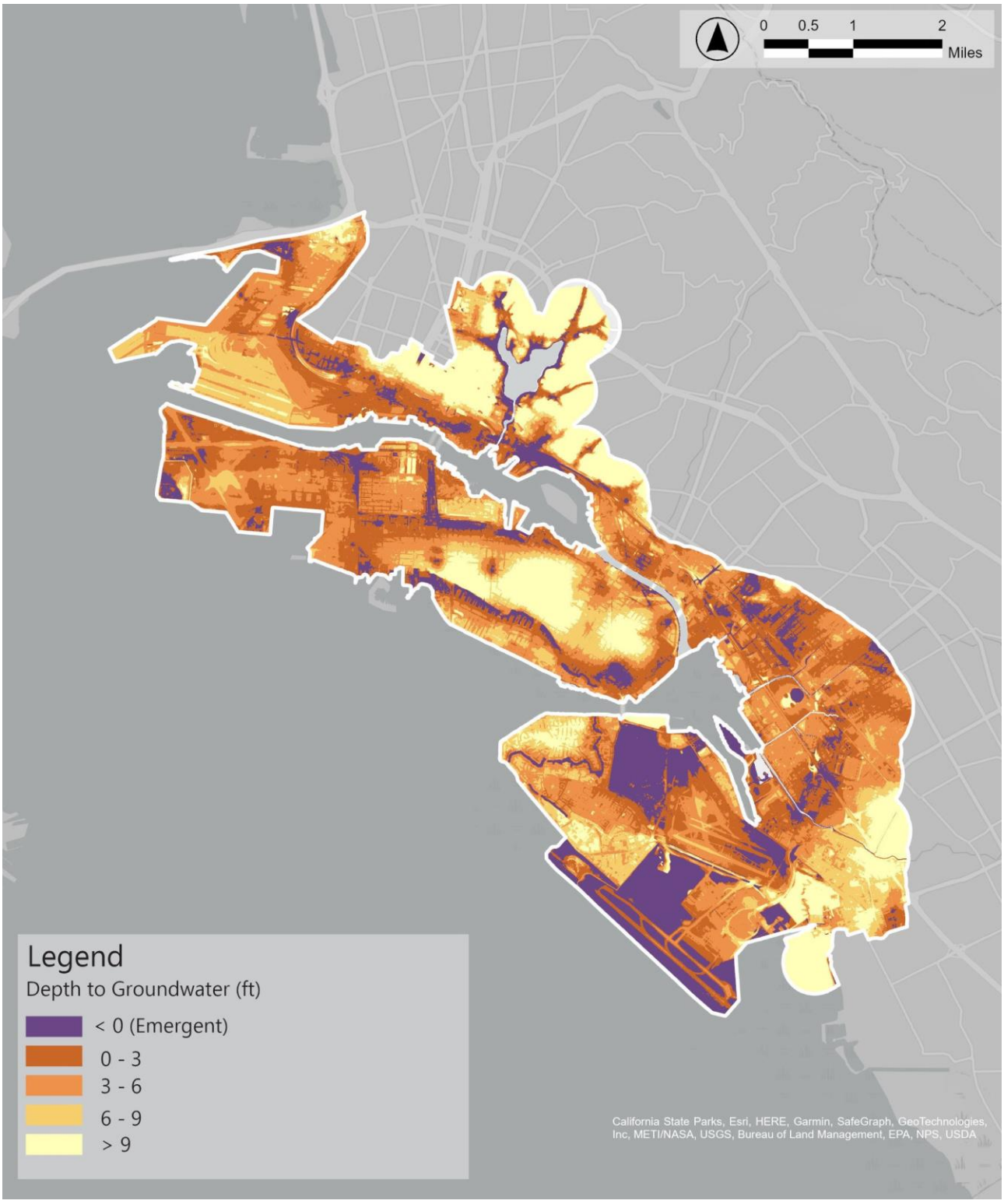


Figure 3-28. Groundwater with 36" Sea Level Rise

Source: (May et al. 2022)

3.4.5 Stormwater Flooding

Stormwater flooding is caused by extreme precipitation, tidal influences, undersized and aging infrastructure, and increased urbanization. As extreme storms increase in frequency and intensity, and sea levels rise in the Bay, stormwater flood hazards will increase (Davtalab et al. 2020; Coutu 2021; Patricola et al. 2022). Within the Subregion, the drainage infrastructure is owned and operated by the City of Oakland, City of Alameda, Port of Oakland, Caltrans, and the Alameda County Flood Control and Water Conservation District.

The City of Alameda Storm Drain Master Plan (SDMP) was prepared in August 2008, and an SDMP for the Port of Oakland SDMP was also prepared. The City of Oakland is currently developing an SDMP. SDMPs identify deficiencies in the current stormwater system. Figure 3-30 and

Figure 3-31 show the existing 10-year flooding depths for Alameda Island and Bay Farm Island. Some areas of the Alameda Island and Bay Farm Island use lagoon systems to help manage stormwater. The water surface in the lagoons can be lowered prior to large storm events, typically 6” to 12”, to provide more stormwater retention capacity in the lagoons. Central Avenue is the ridgeline for the island of Alameda and water flows southerly from there into the lagoon.

Figure 3-29. Sub-Watersheds & Surface Flow

Source: (USGS; NOAA; City of Oakland; City of Alameda; Port of Oakland)

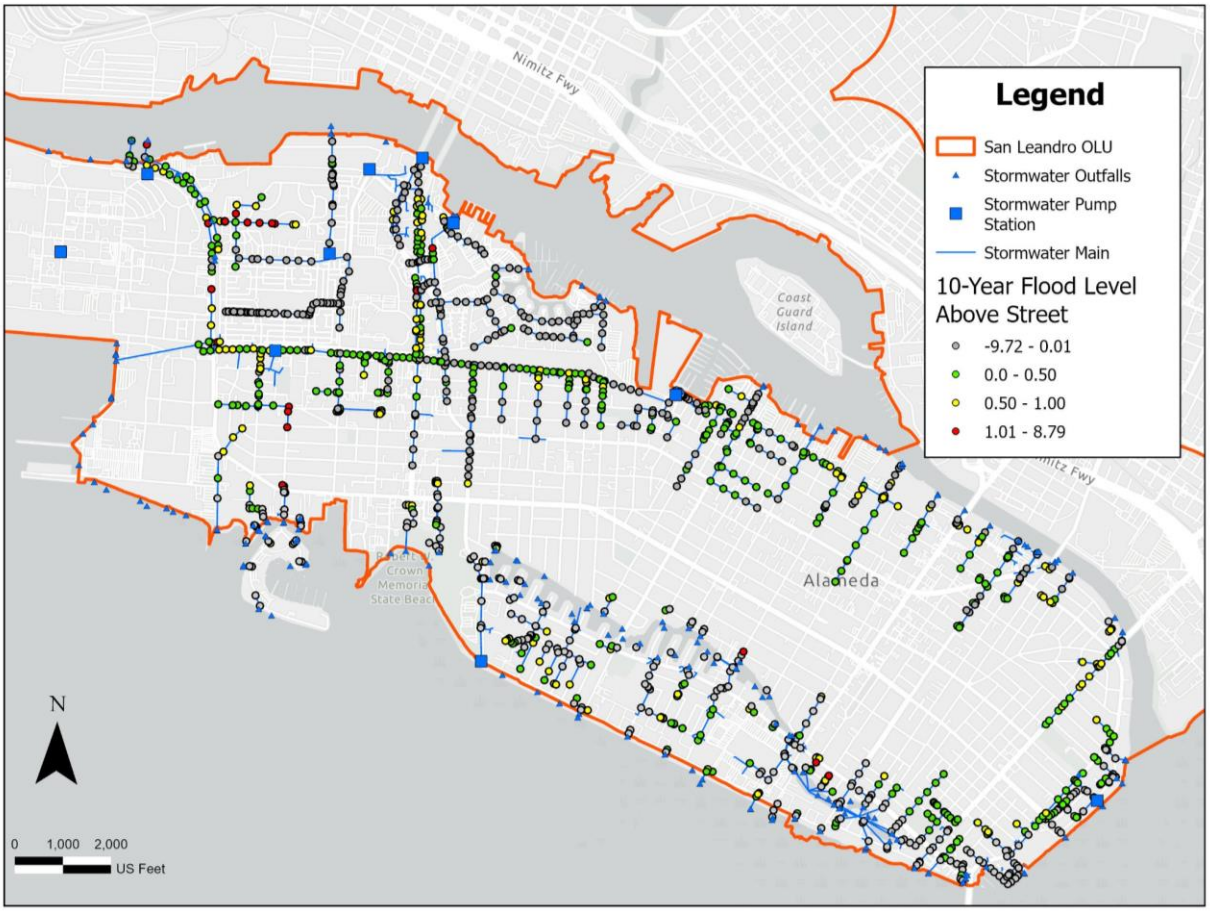


Figure 3-30. City of Alameda (Alameda Island) Existing 10-Year Flooding Depths

Source: (City of Alameda 2008)

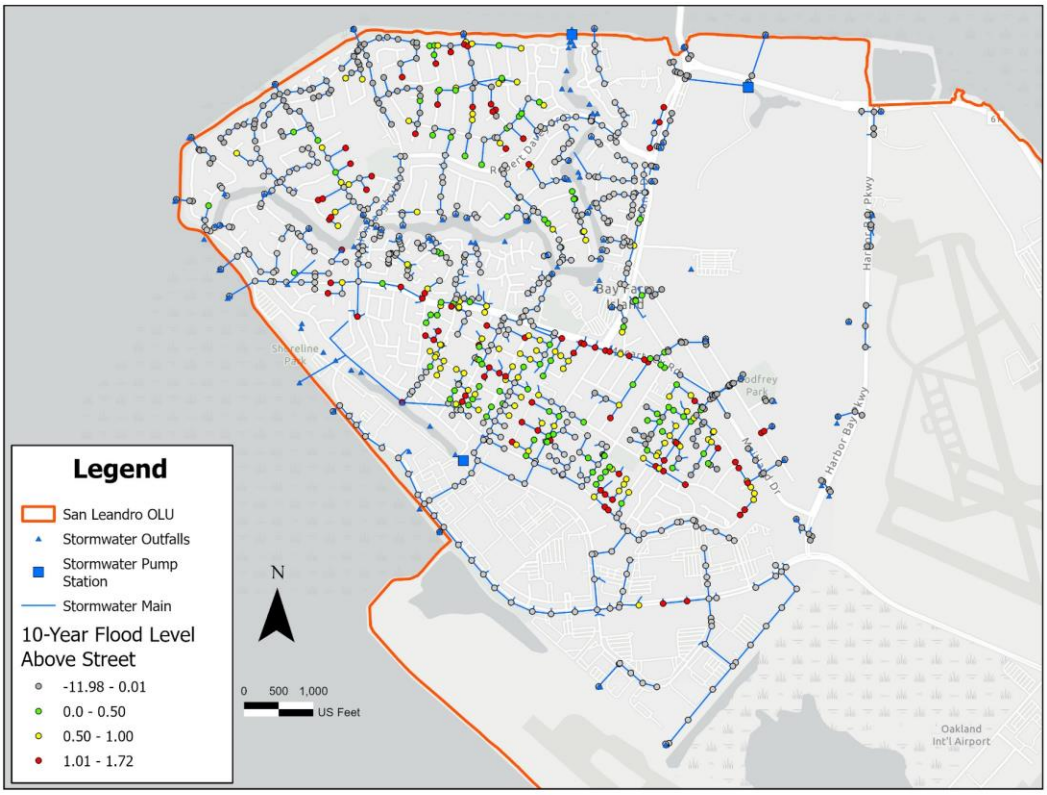


Figure 3-31. City of Alameda (Bay Farm Island) Existing 10-Year Flooding Depths

Source: (City of Alameda 2008)

Data Gap: The City of Oakland is currently working on their storm drainage master plan. There are no readily available reports to illustrate Oaklands existing stormwater flood hazards. Information on stormwater flood hazards on Port of Oakland properties, including the Airport, has not been collected. However, the Port of Oakland recently completed a stormwater and tidal flooding study (Port of Oakland 2023a).

3.4.6 Compound Flooding

Data Gap: Within the project region, stormwater runoff from inland areas is collected via a system of storm drains that either discharge by gravity to the Bay or is pumped to the Bay. The invert elevation of many of the gravity outfalls is such that during extreme high tides they do not function effectively and stormwater runoff backs up into the drain inlets and causes flooding of streets, commercial and residential areas. Increasing sea levels will worsen this situation and result in more frequent flooding. Raising the elevation of the shoreline can mitigate coastal flooding from the Bay but it typically does not benefit areas that are prone to stormwater flooding. This effect of extreme Bay water levels on stormwater induced flooding (otherwise called Compound Flooding) is a significant data gap when it comes to developing Adaptation Strategies.

3.4.7 Geology and Geologic Hazards

3.4.7.1 Regional Geological Setting

The Subregion is located on the east side of the Bay in the Coast Ranges geomorphic province of California. The Coast Ranges are bounded by the Pacific Ocean on the west and the Great Valley on the east and extend from the Oregon border south to the Santa Ynez River near Santa Barbara. San Francisco Bay further subdivides the province into the northern and southern sections. The Coast Ranges are characterized by discontinuous, northwest-trending mountain ranges, ridges, and valleys.

San Francisco Bay is located within a northwest-southeast oriented valley; a structural low between the Berkeley Hills to the east and Santa Cruz Mountains to the west. The structural low formed in the early Quaternary period (about 1-2 million years ago), and since its formation, it has filled with sediment. The Quaternary-age sediments that fill the San Francisco basin unconformably overly Franciscan Complex bedrock and include alternating deposits of marine and non-marine origin. Throughout the Quaternary period, sea level rose and fell in response to changes in climate (i.e., glacial, and interglacial periods). During the interglacial sea level high stands, the San Francisco Bay typically filled with sea water, and deposits within the San Francisco Bay basin were predominantly of marine and estuarine origin during this time. However, during the glacial periods and low sea level stands, the Bay would empty, and deposits during these periods are primarily alluvium derived from the adjacent hills and/or sediment from the inland river systems that drain the Great Valley and Sierra Nevada (i.e., the Sacramento River and San Joaquin River). The geologic units within the area of interest are comprised of these Quaternary-age sedimentary deposits.

Alameda Island was originally a peninsula on the Oakland shoreline. The island was created in 1902 through dredging of a shipping channel on the south side – now known as the Estuary. Most of the southeastern part of the island is underlain by Merritt Sand, a Quaternary-age dune sand. This area is surrounded by artificial fill, which is dredged from the bay and used to reclaim the tidal marshlands on the north and west of the island, and to extend the south shoreline. The approximate northern extent of the Merritt Sand is the current Atlantic Avenue. The northwestern portion of Alameda Island is the home of the former Alameda Naval Air Station, which was constructed by the navy in 1940 and consists of reclaimed tidal marshland.

Bay Farm Island was originally an Ice Age small sand dune, surrounded by marshland, which is located near the west shoreline of the current island, and on the north side of the Oakland International Airport. The original sand dune (Qds) is shown on the geology map of Figure 3-32. Before European settlers arriving to the Bay Area, the local Ohlone Indians used the island as foraging ground for food. The land was used for farming in 1850s, with asparagus being the main crop (Baker, 2014). In 1870s, the marshlands on the north and east side of the island were drained and the land reclaimed for farming and later for development. In 1920s two major development projects, the golf course and the airport that later became Oakland International Airport, further transformed the island toward the current shape. Land reclamation and expansion of Oakland International Airport on the south converted the original island to the current peninsula. As implied by the geologic map of Figure 3-32, most of the current island, including a strip of land along the west shoreline and entire Oakland International Airport is built on artificial fill that is placed on Young Bay Mud. Many areas on Bay Farm Island and Oakland

International Airport are less than 10 feet elevation and are protected from tidal flooding by levees along the island perimeter.

The Doolittle Landfill is located on the northeast tip of the current peninsula. This inactive landfill stopped receiving waste in 1981, closed in 1985, and is currently expected to be developed into an open space park in 2045.

Oakland's low-lying areas comprise the Oakland alluvial plain, surrounded by the Estuary, Bay, and Berkeley/Oakland Hills, contains geologic units like the Temescal Formation, Merritt Sand, and patches of artificial fill. This flat area gently descends from the Berkeley/Oakland Hills towards the west. Spanning about 25 miles north to south and 2 to 7 miles wide, it stretches along its length from east to west.

3.4.7.2 Geological Units

Based on the work by (Graymer 2000) and Rogers and Figuers (1991), major geological units within the project area are as follows:

- Artificial Fill (af): Starting in the mid-19th century, artificial fill was added to the bay shoreline to reclaim land. Artificial fills placed before 1965 are generally not compacted and have high liquefaction potential.
- Alluvial Fan Deposits (Qhaf, Qhaf1): Alluvial Fan Deposits include the alluvial, fluvial, and other Holocene-age sedimentary units of non-marine origin, including Temescal Formation. The unit is primarily comprised of silt and clay but also includes sand and is finer grained than the underlying San Antonio Formation.
- Young Bay Mud: Water saturated estuarine mud, predominantly gray, green, and blue clay and silty clay underlying marshlands and tidal mud flats of San Francisco Bay. Young Bay Mud is soft and compressible and undergoes long-term consolidation settlement when subject to loading.
- Merritt Sand and Dune Sand (Qms, Qds): Fine-grained, very well sorted, well-drained eolian deposits. The Merritt sand outcrops in three large areas in Oakland and Alameda. The Merrit sand is probably time-correlative with Dune Sand, based on similar interfingering with Holocene bay mud and presumably similar depositional environments associated with long-term sea-level fluctuations. The Merrit sand displays different morphology from Dune Sand, however, forming large sheets up to 50 feet thick.
- Marine Terrace Deposits (Qmt): Small outcrops of Pleistocene-age Marine Terrace Deposits are present around Lake Merritt and Lake Merritt Chanel.
- San Antonio Formation (Qpsa): The San Antonio formation is a thick expanse of estuarine and alluvial sediments lying between the older Alameda formation and Young Bay Muds. The San Antonio Formation consists of a layered sequence of non-marine dense to very dense sand with interbedded stiff to very stiff sandy clay and clay. This unit may include Merritt Sand and Posey Sand. The thickness of this formation could be up to 100 feet.
- Old Bay Deposits or Yerba Buena Mud (Qpbm): The Pleistocene-age Old Bay Deposits are also known as Yerba Buena Mud or Old Bay Mud. The Yerba Buena Mud is comprised primarily of a grey marine mud, but a thin (10 to 15 feet thick) sandy, shell-rich zone is commonly found in the middle of the unit. This zone would appear to represent a temporary, slight lowering of sea level with subaerial exposure of the unit.

- Alameda Formation (Qpa): The Alameda Formation unconformably overlays and is comprised of sediment derived from Franciscan Complex bedrock. Little is known about the Alameda Formation since the unit does not outcrop at the ground surface. (Rogers and Figuers 1991) subdivide the unit into an upper and lower unit; the upper portion of the unit is predominantly marine in origin, while the lower portion is non-marine. The unit varies in composition but contains sand, sandy clay, and fine gravel. The thickness of the Alameda Formation ranges from a maximum of over 900 feet near the Oakland Airport to less than 400 feet on the Oakland alluvial plain.
- Franciscan Complex (Kjf): Franciscan Complex rocks presumably underlie the entire area and include more or less sheared and metamorphosed graywacke, shale, mafic volcanic rock, chert, ultramafic rock, limestone, and conglomerate. Highly sheared sandstone and shale forms the matrix of a mélange containing blocks of many rock types, including sandstone, chert, greenstone, blueschist, serpentinite, eclogite, and limestone. Franciscan bedrock is more than 400 feet deep in the project area.

3.4.7.3 Geologic Stratigraphy

Figure 3-32 shows the surficial geologic units in the Subregion. The surficial materials generally consist of Artificial Fill (af), Holocene and Pleistocene-aged Merritt sand (Qms) and Dune Sand (Qds), and Alluvial Fan Deposits (Qhaf) (Graymer 2000). Small areas of Marine Terrace Deposits (Qmt) outcrop around Lake Merrit and Lake Merrit Channel. Subsurface materials generally include varying thickness of Young Bay Mud (Qhbm), Merrit and Posey Sand of San Antonio Formation (Qpsa), Yerba Buena Mud (Qpbm), and older deposits of Alameda Formation (Qpa), underlain by Franciscan bedrock (Kjf).

Figure 3-33 shows a geologic cross section through San Francisco Bay, Alameda, Estuary, and Oakland that is representative of subsurface condition within the project area.

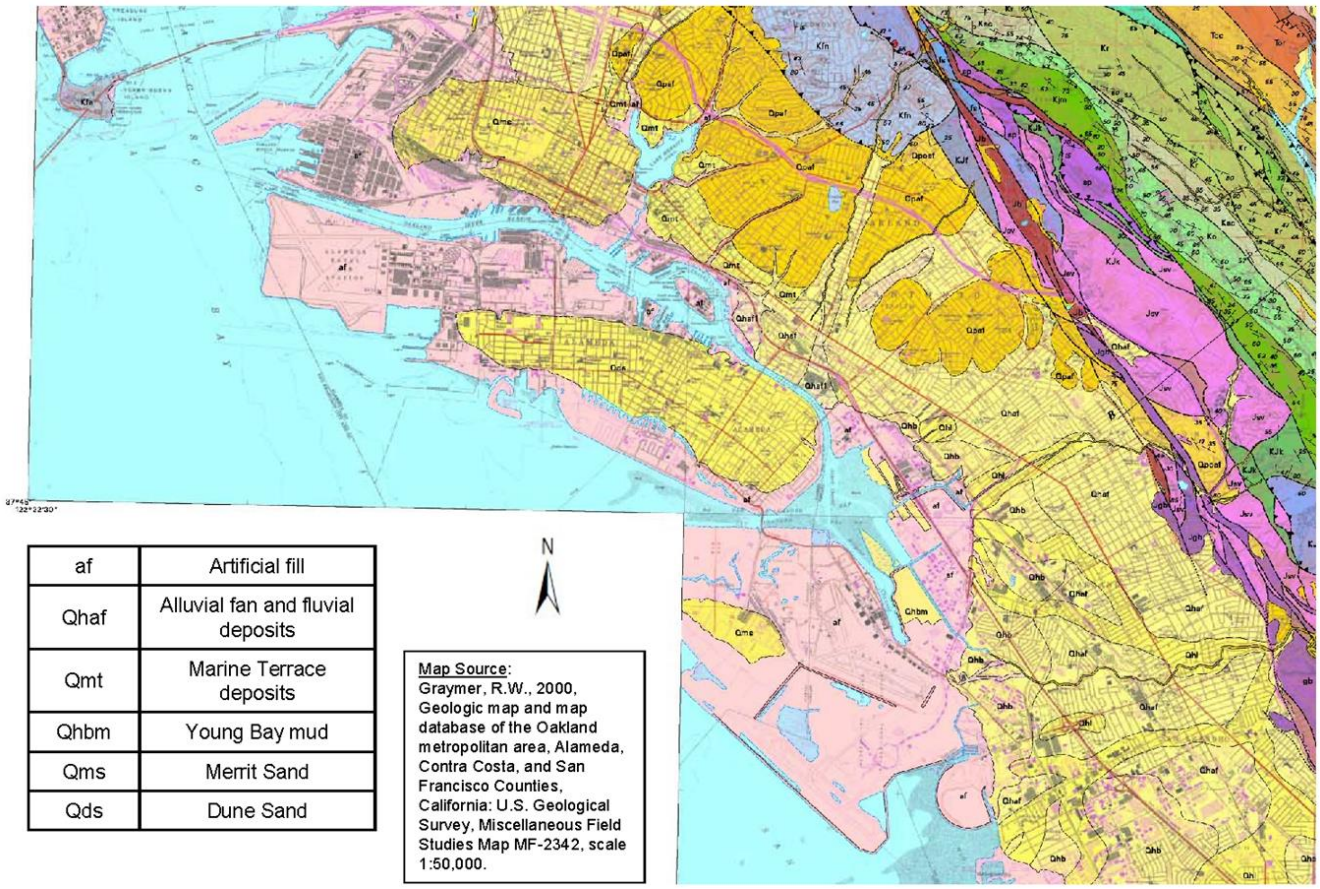


Figure 3-32. Geologic Map

Source: (Graymer 2000)

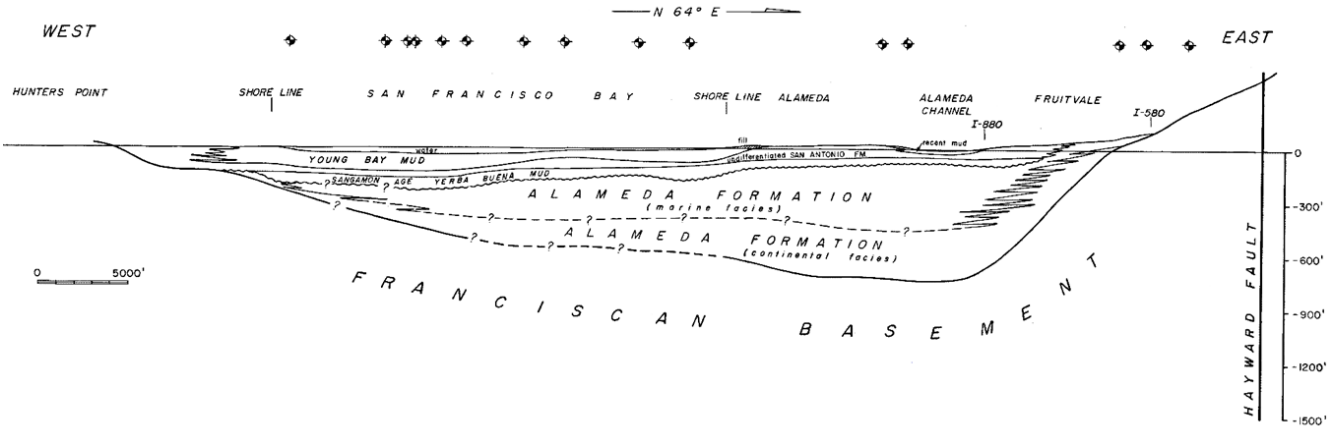


Figure 3-33. Geologic Cross Section

Source: (Rogers and Figuers 1991)

3.4.7.4 Geologic Structure

Positioned between major faults of the San Andreas fault system, the Bay is a structural depression formed by down-warping and subsidence of the structural block in response to activity along individual faults. The San Andreas fault system is a right-lateral, strike-slip fault zone that extends from the Gulf of California north to Cape Mendocino and defines the boundary between the North American Plate to the east and the Pacific Plate to the west. The Pacific plate moves about 35-40 mm per year relative to central California across a broad, approximately 60-mile-wide zone in northern California. Within the San Francisco Bay Area, movement across this plate boundary is distributed across a complex system of primarily northwest-trending, right-lateral, strike-slip faults. Major regional faults of this system include the San Andreas, Hayward, Calaveras, Concord-Green Valley, Mount Diablo Thrust, and Greenville faults. There is also a significant degree of compression across the greater Bay Area, most prominently evident in the faults and associated folds of the Mt. Diablo thrust and fold belt. These thrust faults generally trend west-northwest, are oblique to the strike-slip faults of the San Andreas system, and exhibit a well-defined right-stepping, en echelon geometry.

Historical, ground-rupturing earthquakes have occurred on the nearby Hayward, San Andreas, Calaveras, and Greenville faults. The Hayward-Rodgers Creek and Calaveras faults are considered by the USGS to be the faults most likely to generate a magnitude 6.7 or greater quake in the San Francisco Bay area (Field et al. 2014). Historical earthquake epicenter maps show seismicity generally clustered along the traces of the major fault zones. A summary of active regional faults, maximum earthquakes, slip rates, and fault types is presented in Table 3-4.

Table 3-4. Summary of Regional Faults

Fault	Maximum Earthquake Magnitude (Mw)	Slip Rate (mm/yr)	Fault Type
Hayward	7.3	9	Right lateral strike-slip
Calaveras	6.9	6	Right lateral strike-slip
San Andreas (Peninsula)	8.0	17	Right lateral strike-slip
Concord/Green Valley	6.6	4.3	Right lateral strike-slip
Greenville	6.9	3	Right lateral strike-slip

3.4.7.5 Seismicity

The Subregion is located within a seismically active region. Historical, ground-rupturing earthquakes have occurred on the nearby Hayward, San Andreas, Calaveras, and Greenville faults. Most earthquakes are predominantly right-lateral, strike-slip quakes with varying degrees of minor reverse-oblique motion. A summary of significant historical regional earthquakes in the San Francisco Bay area is presented in Table 3-5.

Table 3-5. Significant Historical Earthquakes in the San Francisco Bay Area

Fault	Year	Approx. Magnitude	Approx. Epicenter Location
Unknown	1836	6.4	Between Monterey and Santa Clara
San Andreas	1838	7.4	Santa Clara
Unknown	1865	6.5	Santa Cruz Mountains
Hayward	1868	6.8	Hayward
Unknown	1892	6.4	Vacaville
Rodgers Creek	1898	6.3	Mare Island
San Andreas	1906	7.8	Daly City
Calaveras	1911	6.5	Morgan Hill
Calaveras	1984	6.2	Morgan Hill
San Andreas Fault System	1989	6.9	Santa Cruz Mountains

3.4.7.6 Geologic Hazards

Earthquake Shaking: Earthquakes are characterized by a moment magnitude, which is a quantitative measure of the strength of the earthquake based on strain energy released during the event. The magnitude is independent of the site but is dependent on several factors including the type and geometry of the causative fault, rock type, and stored energy.

Due to regional proximity to active faults, in the event of a large magnitude earthquake, severe shaking should be anticipated within the project area.

Fault Rupture: No known major faults traverse through the project area. The California Division of Mines and Geology has not identified Alquist-Priolo Fault Zones through the project area. Therefore, the risk of ground surface rupture and related hazards within the project area are expected to be very low.

Landsliding: There are no natural hills within or immediately adjacent to the project area. Consequently, landsliding of natural existing slopes is not a project issue. However, due to low strength of underlying Young Bay Mud and loss of shear strength in liquefied artificial fill. potential for landsliding and lateral spreading exists for artificial fill placed along the shorelines.

Expansive Soils: Expansive soils swell or heave with increases in moisture content and shrink with decreases in moisture content. Montmorillonitic clays are most susceptible to expansion. If expansive soils are subjected to rising groundwater levels, they could undergo volume change and damage existing structures. Expansive soils are present in the San Francisco Bay area, particularly south bay. Expansive soils are present in the study area and could undergo volume change due to sea level rise.

Hydroconsolidation/Collapsible Soils: Natural deposits susceptible to hydroconsolidation/ collapse are typically eolian, alluvial and colluvial Holocene-aged soils in a dry or semiarid environment. Soils that are susceptible to collapse or hydroconsolidation are typically dry, coarse-grained soils with high apparent shear strength and low relative density. While the project area is not known to contain collapsible soils, potential for hydroconsolidation due to sea level rise should be evaluated. Hydroconsolidation and collapsible soils are not anticipated to be a major hazard in the project area.

3.4.7.7 Liquefaction

Liquefaction is a phenomenon whereby saturated granular soils lose their inherent shear strength due to increased pore water pressures, which may be induced by cyclic loading such as that caused by an earthquake. Factors that contribute to liquefaction hazard include loose granular soils with lower fine content, high groundwater level, and high earthquake shaking level. In general liquefaction resistance increases with geologic age. Sediments deposited within the past few thousand years are generally much more susceptible to liquefaction than older Holocene sediments.

Liquefaction potential exists along the project site, particularly where artificial fill is placed below groundwater, and within loose native granular soils. Figure 3-34 shows the liquefaction and earthquake hazard zone map for the project. Based on this figure, large areas within the project site have liquefaction potential. Liquefaction-related ground failure has been extensively observed in project area during the past earthquakes (CGS 2003a, b).

In addition to loss of shear strength, liquefaction could cause large settlements and lateral spreading. Seismically-induced settlement could be between a few inches and more than a foot. The impact of seismically-induced settlement should be considered in design of future adaptation measures.

It should be noted that liquefaction hazard is typically evaluated based on observed groundwater levels. Rising groundwater levels, due to sea level rise for example, could result in expanded liquefaction hazard zones (Grant et al. 2021). In addition, existing liquefaction zones could have larger seismic settlements and more severe lateral spreading due to increased thickness of layers with liquefaction potential.

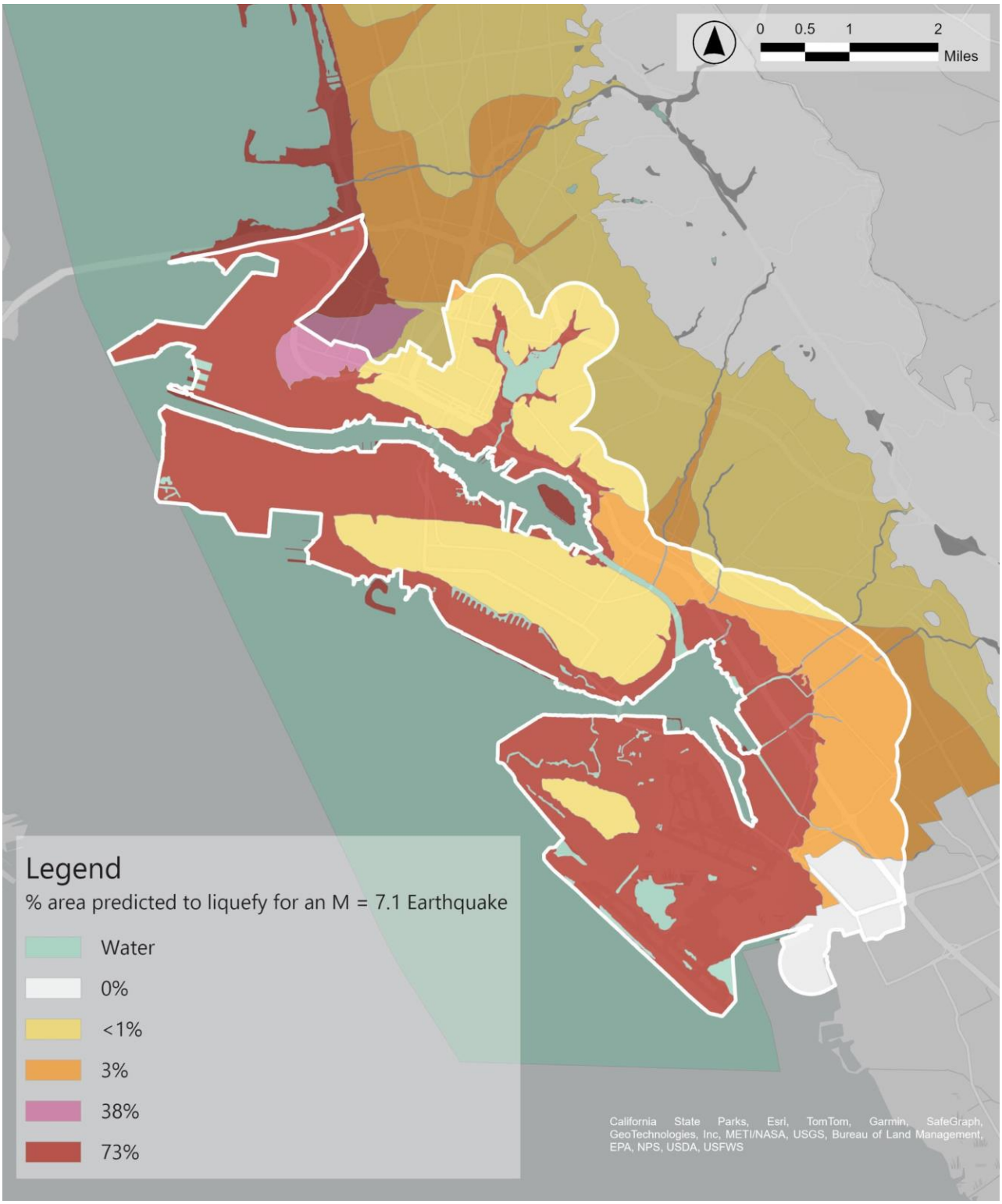


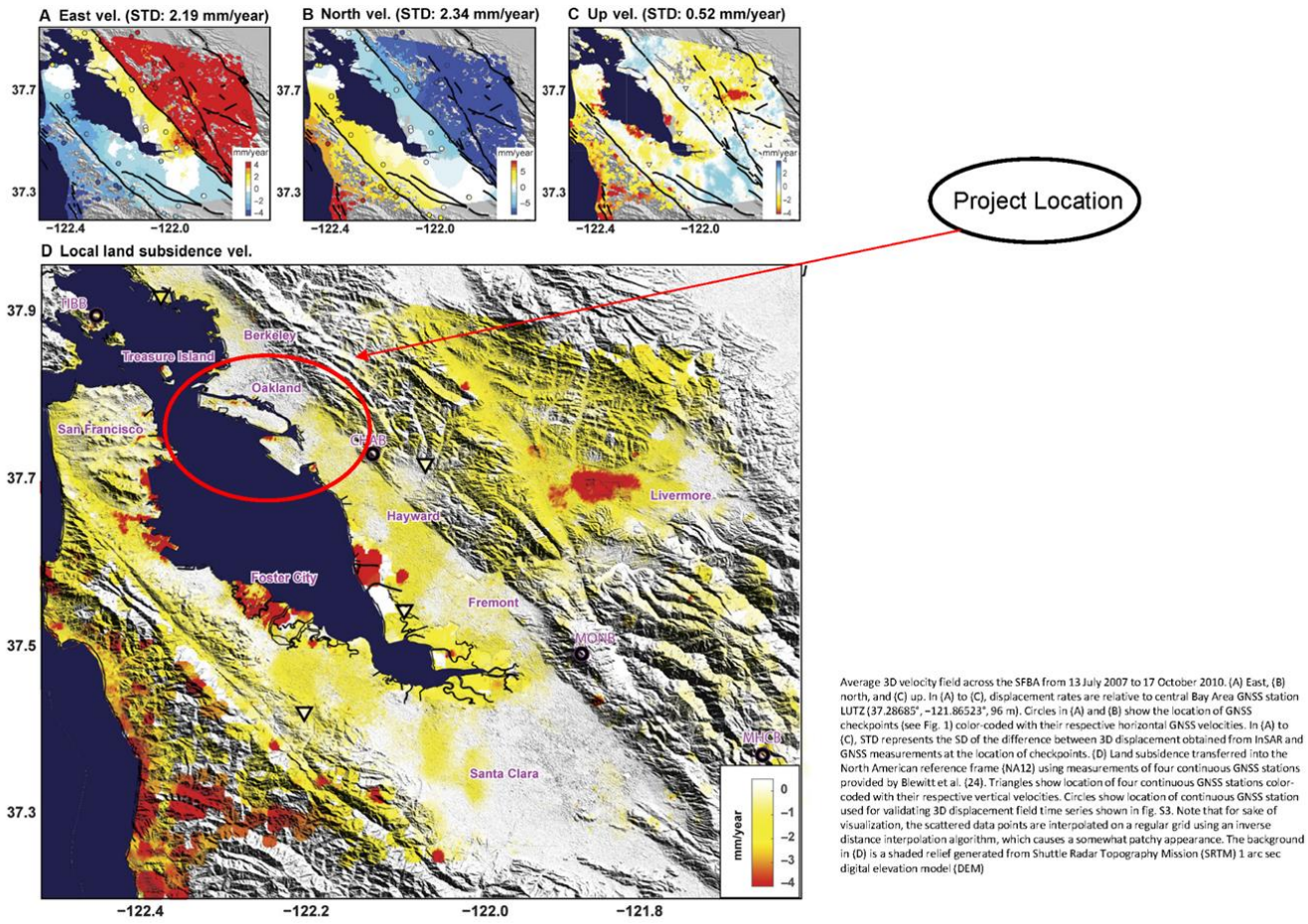
Figure 3-34. Liquefaction

Source : (Holzer et al. 2002)

3.4.7.8 Subsidence

Subsidence refers to the gradual sinking or settling of the ground surface. In the Subregion, subsidence occurs due to a variety of factors, including natural processes such as compaction of sediments, tectonic activity, and the extraction of groundwater or other underground resources. Most of the subsiding soils are located on Quaternary substrates such as Holocene Bay mud deposits or man-made landfills subject to long-term compaction. The USGS map of Areas of Land Subsidence in California shows areas of land subsidence due to groundwater pumping, peat loss, and oil extraction (USGS 2023). This map does not identify an area of subsidence within the boundaries of the Subregion. More detailed subsidence studies, however, show localized areas with significant subsidence, particularly in areas of artificial fill.

For the Holocene Bay mud deposits, it is observed that the rate of subsidence varies for different materials. The most rapid subsidence (≫5 mm/year) was found in areas of anthropogenic landfill overlying thick Bay mud deposits (Shirzaei 2018). Human activities like urban development, land drainage, and construction practices can also contribute to subsidence. In this region, subsidence poses significant geotechnical concerns as it can affect infrastructure stability, exacerbate flooding risks, and potentially impact the structural integrity of buildings and roads. Understanding the causes and patterns of subsidence in the Subregion is important for effective urban planning, land-use management, and ensuring the resilience of critical infrastructure in the face of geological challenges. Figure 3-35 shows the subsidence map for the Bay Area. Sea level rise is unlikely to increase the current rates of land subsidence in the project area, which are mainly due to primary and secondary consolidation of Bay Mud. However, for areas with larger subsidence velocities, the existing rates should be considered in sea level rise mitigation plans.



Average 3D velocity field across the SFBA from 13 July 2007 to 17 October 2010. (A) East, (B) north, and (C) up. In (A) to (C), displacement rates are relative to central Bay Area GNSS station LUTZ (37.28685°, −121.86523°, 96 m). Circles in (A) and (B) show the location of GNSS checkpoints (see Fig. 1) color-coded with their respective horizontal GNSS velocities. In (A) to (C), STD represents the SD of the difference between 3D displacement obtained from InSAR and GNSS measurements at the location of checkpoints. (D) Land subsidence transferred into the North American reference frame (NA12) using measurements of four continuous GNSS stations provided by Blewitt et al. (24). Triangles show location of four continuous GNSS stations color-coded with their respective vertical velocities. Circles show location of continuous GNSS station used for validating 3D displacement field time series shown in fig. S3. Note that for sake of visualization, the scattered data points are interpolated on a regular grid using an inverse distance interpolation algorithm, which causes a somewhat patchy appearance. The background in (D) is a shaded relief generated from Shuttle Radar Topography Mission (SRTM) 1 arc sec digital elevation model (DEM)

Figure 3-35. Local Subsidence Velocity Map

Source: (Shirzaei 2018)

3.4.8 Shoreline Contaminants

There are many contaminants from various sources that have the potential to cause harm to communities and the environment. These contaminants include industrial waste, agricultural runoff, sewage and wastewater, and heavy metals (Natural Resources Defense Council 2023). Pollutants can be released directly into the water from different sources like industrial or sewage treatment facilities. If they are land-based pollutants, they can be carried into coastal waters through rainwater runoff, rivers, and erosion. Contaminants can even be transported through the atmosphere and deposited in coastal areas via rain or dust. In terms of sea level rise, areas with known contamination like former industrial sites or landfills are at risk because flooding in these areas can mobilize contaminants that were previously contained. Additionally, in coastal areas, rising sea levels can lead to saltwater intrusion into groundwater systems which can also potentially remobilize contaminants that were previously stable (Petek 2020; Hill et al. 2023).

The State Water Resources Control Board (SWRCB) has an online information system called 'GeoTracker' that provides access to environmental data from water quality regulatory programs (SWRCB 2022). The GeoTracker database includes monitoring well observations, including depth to

water and contamination concentrations, collected at least twice per year at active sites. To help identify potentially contaminated sites within the Subregion, **Error! Reference source not found.** shows where active monitoring wells are located.

The Department of Toxic Substances Control (DTSC) manages the EnviroStor database that includes an inventory of potentially contaminated sites, sites under investigation, sites undergoing cleanup, sites in the monitoring phase, and closed sites. **Error! Reference source not found.** presents the locations of DTSC's EnviroStor sites. Site types include voluntary cleanup, state response, corrective action, federal superfund, historical, military evaluation, school cleanup, school investigation and tiered permit. The EnviroStor database includes one point location for each site and does not include a polygon delineating the area of the site. However, the EnviroStor database includes reports and information that can be used to better understand the geographic area of the potential soil and/or groundwater contamination. This level of review is beyond the scope of the existing project.

Data Gap: Port of Oakland properties may contain additional contaminated sites not included within the SWRCB or DTSC databases. This is currently an unknown.

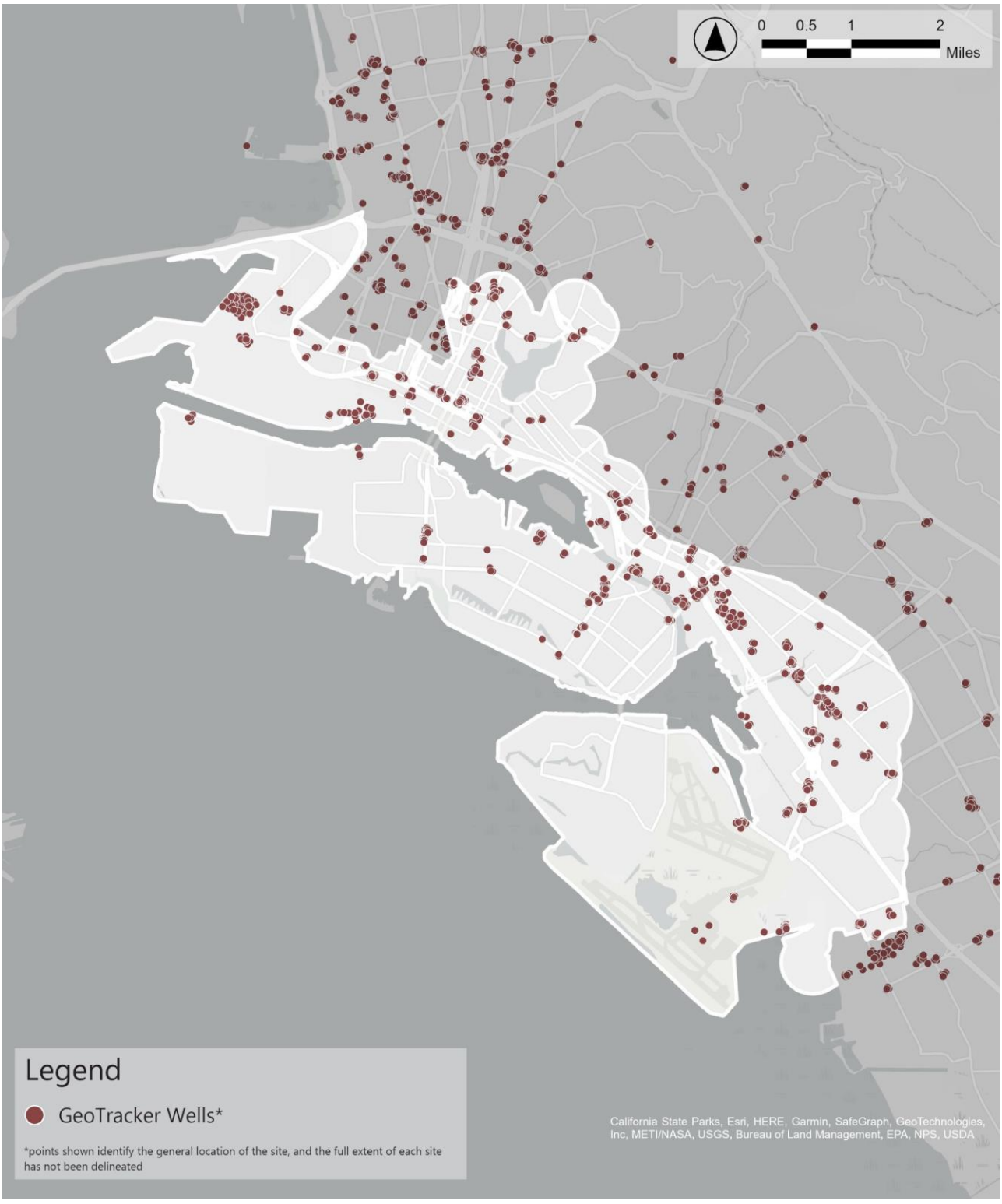


Figure 3-36. Monitoring Wells near Contaminated Sites (SWRCB)

Source: (SWRCB 2022)

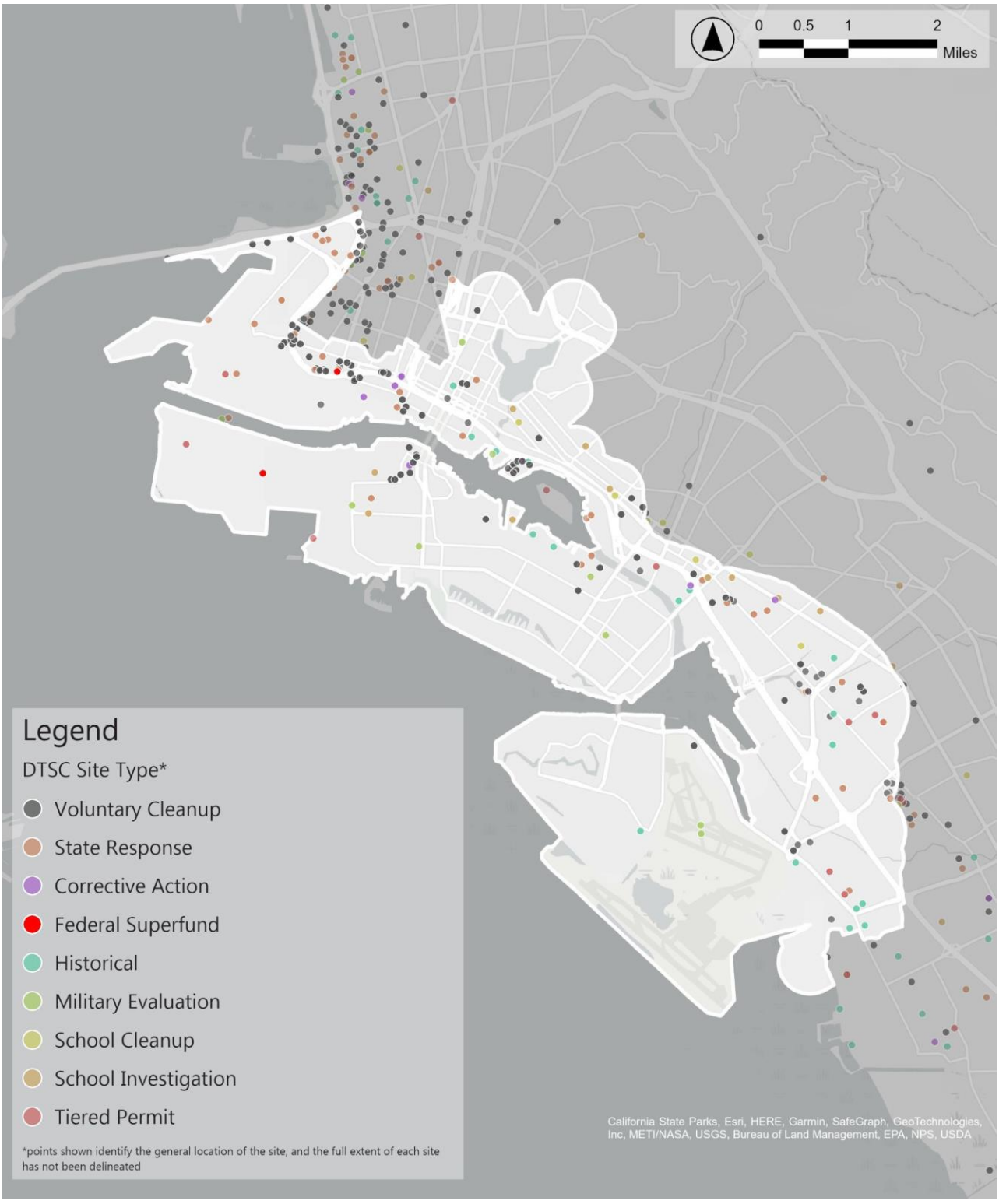


Figure 3-37. Locations of Potentially Contaminated Sites (DTSC)

Source: (DTSC 2023)

3.5 Habitat

3.5.1 Historic Habitat

The project area includes both terrestrial and marine environments. Historically, tidal marshes were extensive throughout much of present-day Bay Farm Island, northwest Alameda, the downtown Oakland shoreline, and in the vicinity of the Oakland Coliseum (see Figure 3-38 below). These marshes were largely surrounded by tidal flat, sandwiching discontinuous narrow strips of sandy beach. Today, the Subregion is highly urbanized. Extensive areas have been built out, particularly near the Port of Oakland, on the western end of Alameda, and surrounding the small island that was previously the extent of Bay Farm Island.

The most distinctive change is a near-total loss of historic marsh habitats. Of the more than 5,000 acres of tidal marsh that used to exist within the primary OLU boundary, less than 100 acres remain. Much of the area's tidal flats have also been lost. Present-day inland water features of this OLU—notably Lake Merritt and small pocket lagoons in the City of Alameda – are largely bound by concrete walls or earthen berms.

3.5.2 Existing Habitat

Various mapping data were obtained to evaluate historical habitat changes and characterize existing conditions of vegetation communities, habitat types, and aquatic resources (SFEI 1998, 2022b; U.S. Forest Service 2018). Although much of the landside Subregion today consists of developed landcover, some areas of freshwater marsh, tidal marsh, annual grassland, and woodland/forest communities are also present. The Subregion contains a variety of aquatic resources, primarily comprised of San Francisco Bay waters, bay flat, marsh, marsh flat and panne, with lagoons and non-tidal (freshwater) wetlands, each supporting a variety of local wildlife.

Within San Francisco Bay, eelgrass and native oyster beds are the two sensitive natural communities which are afforded special attention and protection because of their particular ecological importance. Eelgrass (*Zostera marina*, *Z. pacifica*) beds, which provide important spawning and rearing habitat for fish, are mapped within open waters of the Subregion – concentrated primarily on the southwest side of Alameda Island and west of Shoreline Park on Bay Farm Island (SFEI 2020). In addition to providing refugia for young fish, eelgrass beds stabilize shorelines by dampening wave energy, collecting sediments transported to the shore, and preventing shore erosion. They also improve water quality by collecting and filtering organic matter and sediments. Eelgrass is easily affected by changes in water quality and turbidity. Eelgrass beds are extremely dynamic, expanding and contracting by as much as several hectares per season depending on the quality of the site. Consequently, they serve as an indicator community for the overall health of an estuary.

The Olympia oyster (*Ostrea lurida*), also known as the "native oyster", is native to most of Western North America. This species was a key component of the San Francisco Bay marine ecosystem prior to overharvesting and increased siltation from hydraulic mining in the mid-19th Century which

threatened their extinction.6 The local population is recovering, and native oysters have been observed in various locations in San Francisco Bay since 2000.7 Their presence in rocky intertidal, rocky subtidal, and man-made habitats in Central San Francisco Bay is expected. Within the Subregion, a long-term monitoring site for native oysters is located on the southern shore of Alameda Island at the Encinal Boat ramp. The only other native oyster site documented in the Subregion is located within the Oakland Inner Harbor. Individual oysters are expected throughout the Subregion in rocky intertidal, subtidal habitats such as riprap and piles below wharves; dense quantities that would qualify as oyster beds are not known to the Subregion.

These terrestrial and aquatic habitats were evaluated for their potential to support sensitive plant and animal species. The California Department of Fish and Wildlife (CDFW) Natural Diversity Database (CNDDB),[8] the California Native Plant Society (CNPS) Electronic Inventory,[9] the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC)[10] were queried for records of special-status species[11] within the OLU. Each species documented in the query results was evaluated for their potential presence in the OLU, considering availability of suitable habitat, whether the OLU is within the known species' range, and the location of species' occurrences proximate to the OLU.

6 NOAA. 2008. Habitat Connections, Restoring the Olympia Oyster (*Ostrea conchaphila* = *lurida*). Volume 5, Number 2, 2004. Available at http://www.oyster-restoration.org/reports/OlympiaOysterHabitatConnections.pdf. Accessed March 22, 2011.

7 San Francisco Bay Subtidal Habitat Goals Report: Appendix 7-1. 2010. *ibid*.

8 California Department of Fish and Wildlife, California Natural Diversity Database (CNDDB) Rarefind version 5 query of the Oakland East, Oakland West, San Leandro, Hunters Point USGS 7.5-minute topographic quadrangles, Commercial Version, accessed November 21, 2023.

9 California Native Plant Society (CNPS), Rare Plant Program. 2023. Rare Plant Inventory (online edition, v9.5) query of the Oakland East, Oakland West, San Leandro, Hunters Point USGS 7.5-minute topographic quadrangles. Available at: https://www.rareplants.cnps.org. Accessed November 21, 2023.

10 U.S. Fish and Wildlife Service (USFWS), My Project, IPaC Trust Resource Report and Official Species List of Federally Endangered and Threatened Species that may occur in the San Leandro OLU, accessed November 21, 2023.

11 The term "special-status" species includes those species that are listed and receive specific protection defined in federal (FESA) or state (CESA) endangered species legislation, as well as species not formally listed as Threatened or Endangered, but designated as "Rare" or "Sensitive" based on adopted policies and expertise of state resource agencies or organizations, or local agencies such as counties, cities, and special districts.

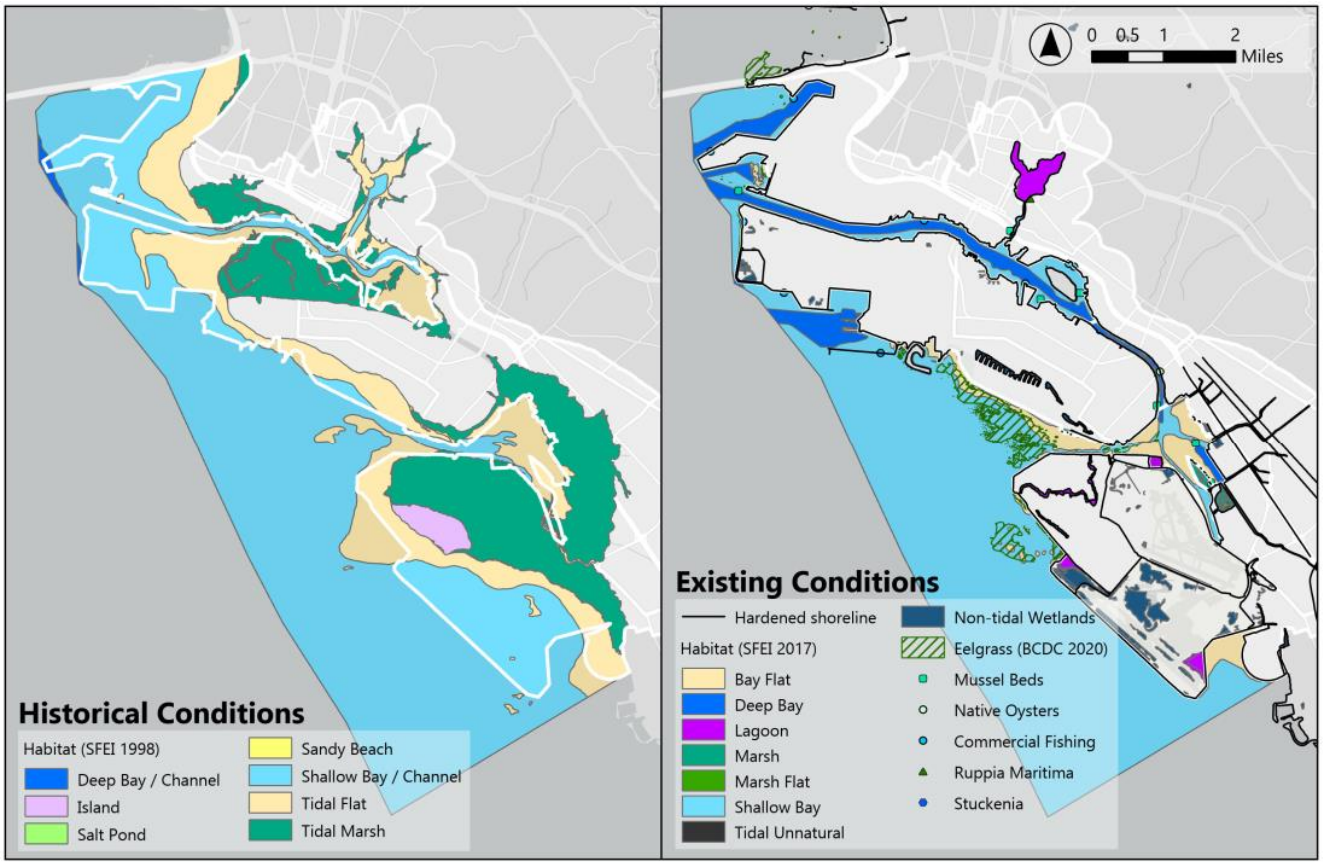


Figure 3-38. Change in Habitat between 1800s and Existing Conditions

Source: (SFEI 1998; SFEI 2017; BCDC 2020)

All special-status plant species were determined to have no[12] or low[13] potential to occur, primarily because the OLU contains limited or no suitable habitat for these species and/or lacks recent records. Of the special-status plant species evaluated, California seablite (*Suaeda californica*; FESA-endangered, California Rare Plant Rank [CRPR] 1B.1[14]) and Point Reyes birds beak (*Chloropyron maritimum* ssp. *palustre*; CRPR 1B.2) were the only species for which suitable habitat remains in the

[12] No Potential = Study area and/or immediate vicinity do not support suitable habitat for a particular species or study area is outside of the species known range.

[13] Low Potential = The study area and/or immediate vicinity only provide limited (low to marginally suitable) habitat or the species' known range is outside of the study area.

[14] California Native Plant Society (CNPS) California Rare Plant Ranks (CRPR):
1A = Presumed extirpated in California; Rare or extinct in other parts of its range.
1B = Rare, threatened, or endangered throughout range; Most species in this rank are endemic to California.
2B = Rare, threatened, or endangered in California but common in other parts of its range.
.1 = Seriously endangered in California
.2 = Fairly endangered in California
.3= Not very threatened in California

OLU. There are no records in CNDDB for California seablite in the OLU. The three CNDDB records for Point Reyes bird's beak within the OLU are identified as possibly extirpated and from the 1990s. Therefore, these plant species were determined to have low potential to occur within the OLU.

Several special-status animals were determined to have a moderate[15] or higher[16] potential (i.e., known presence) to occur in the OLU and are listed below. A full list of species evaluated for their potential to occur in the OLU is available in **Appendix B** along with species descriptions and details on local occurrence.

- Insects
  - Monarch butterfly (*Danaus plexippus*; FESA candidate for listing)
- Fish
  - North American green sturgeon, southern distinct population segment (DPS)(*Acipenser medirostris*; FESA-threatened, CSC)
  - Pacific herring (*Clupea pallasii*; Magnuson-Stevens Fishery Conservation and Management Act [MSFCMA])
  - Steelhead, Central California Coast DPS (*Oncorhynchus mykiss*; FESA-threatened, CSC)
  - Longfin smelt (*Spirinchus thaleichthys*; FESA candidate for listing; CESA-threatened)
- Birds
  - White-tailed kite (*Elanus leucurus*; CDFW fully protected species [CFP])
  - American peregrine falcon *(Falco peregrines anatum*; CFP*)*
  - Brown pelican (*Pelecanus occidentalis* californicus; CFP)
  - California Ridgway's rail (*Rallus obsoletus obsoletus*; FESA, CESA-endangered, CFP)
  - California least tern (*Sternula antillarum browni*; FESA, CESA-endangered, CFP)
  - Cooper's hawk (*Accipiter cooperii*; CDFW watch list)
  - Western burrowing owl (*Athene cunicularia*; CSC)
  - San Francisco common yellowthroat (*Geothlypis trichas sinuous*; CSC)
  - California gull (*Larus californicus*; CDFW watch list)
  - Alameda song sparrow (*Melospiza melodia pusillula*; CSC)
  - Osprey (*Pandion haliaetus*; CDFW watch list)
  - Double-crested cormorant (*Phalacrocorax auritus*; CDFW watch list)

[15] Moderate Potential = The study area and/or immediate vicinity provide low to moderate quality suitable habitat and the study area is within the known species' range.

[16] High Potential = The study area and/or immediate vicinity provide ideal (high quality) habitat conditions and the study area is within the known species' range.

  - Caspian tern (*Hydroprogne caspia*; CDFW watch list)
- Reptiles
  - Western pond turtle (*Actinemys marmorata*; proposed FESA-threatened, CDFW Species of Special Concern [CSC])
- Mammals
  - Salt-marsh harvest mouse (*Reithrodontomys raviventris*; FESA, CESA-endangered, CFP)
  - Pallid bat (*Antrozous pallidus*; CSC)
- Marine Mammals
  - Pacific harbor seal (*Phoca vitulina richardsii*; Marine Mammal Protection Act [MMPA])
  - California sea lion (*Zalophus californianus*; MMPA)

The majority of these special-status animal species are associated with remaining sensitive shoreline and aquatic habitats that were historically abundant within the Subregion. These species may be present within suitable habitat seasonally (e.g., while breeding, wintering, or during migration) or year-round. A large population of California Ridgway's rail is known to inhabit San Leandro Bay at Arrowhead Marsh, MLK New Marsh, and Fan Marsh on Bay Farm Island across Airport Channel from Arrowhead Marsh.[17] California Ridgway's rails are occasionally detected at smaller tidal marshes around San Leandro Bay, including Bay Farm Island and Elsie Roemer Bird Sanctuary on Alameda Island, but the smaller marshes do not consistently support breeding populations.[18] Suitable habitat for salt marsh harvest mouse is present in the tidal marshes of the Subregion, particularly at the larger marshes around San Leandro Bay, including Arrowhead Marsh, MLK New Marsh, Fan Marsh, and Damon Marsh. There are historic records for this species within Arrowhead Marsh (CNDDB occurrence #59).[19] The remaining suitable habitat in the rest of the Subregion, including on Alameda Island and Bay Farm Island, is small and fragmented but still could support populations of salt marsh harvest mouse.[20]

[17] Olofson Environmental, Inc. 2023. California Ridgway's Rail Surveys for the San Francisco Estuary Invasive *Spartina* Project 2023. Report to The State Coastal Conservancy. Prepared by: Olofson Environmental, Inc. December 4, 2023.

[18] Ibid.

[19] California Department of Fish and Wildlife, California Natural Diversity Database (CNDDB) Rarefind version 5 query of the Oakland East, Oakland West, San Leandro, Hunters Point USGS 7.5-minute topographic quadrangles, Commercial Version, accessed November 21, 2023.

[20] Shellhammer, 2000. Salt marsh harvest mouse. 219-288pp. In: Goals Project. 2000. Baylands ecosystem species and community profiles: life histories and environmental requirements of key plants, fish, and wildlife. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. P/R/ Olofson, ed. San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

3.6 Built Infrastructure

3.6.1 Shoreline Infrastructure

The shoreline of Alameda Island and the City of Oakland's shoreline across the San Leandro Channel is comprised mainly of shoreline protection structures (Figure 3-39). Engineered levees, embankments, and natural shoreline make up a large portion of the subregion's remaining shoreline. Other shoreline infrastructure includes berms, channels, floodwalls, transportation structures, water control structures, and wetlands.

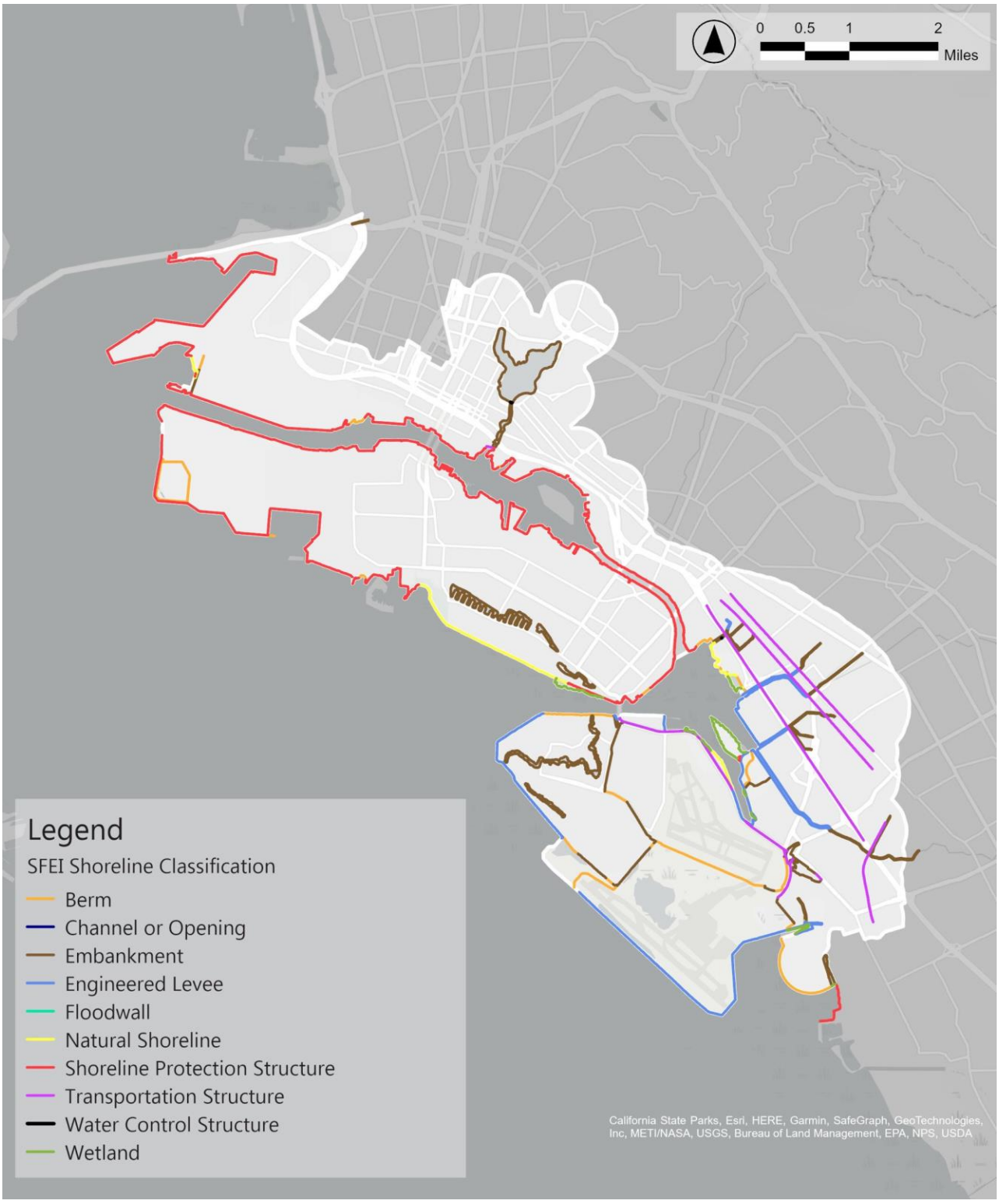


Figure 3-39. Shoreline Infrastructure

Source: (SFEI 2016)

3.6.2 Shoreline Typology & Land Uses

Shoreline typologies inventory conditions across three axes: water use, shoreline type and land use Figure 3-40. There are 13 shoreline types identified within the Estuary project area, and 12 identified land uses. There are 7 water uses documented within the project area. The typology inventories illustrates the complex mosaic of relationships between the existing shoreline conditions, land uses and maritime/water access points.

These typologies were created through desktop research and refined through in-person site visits.

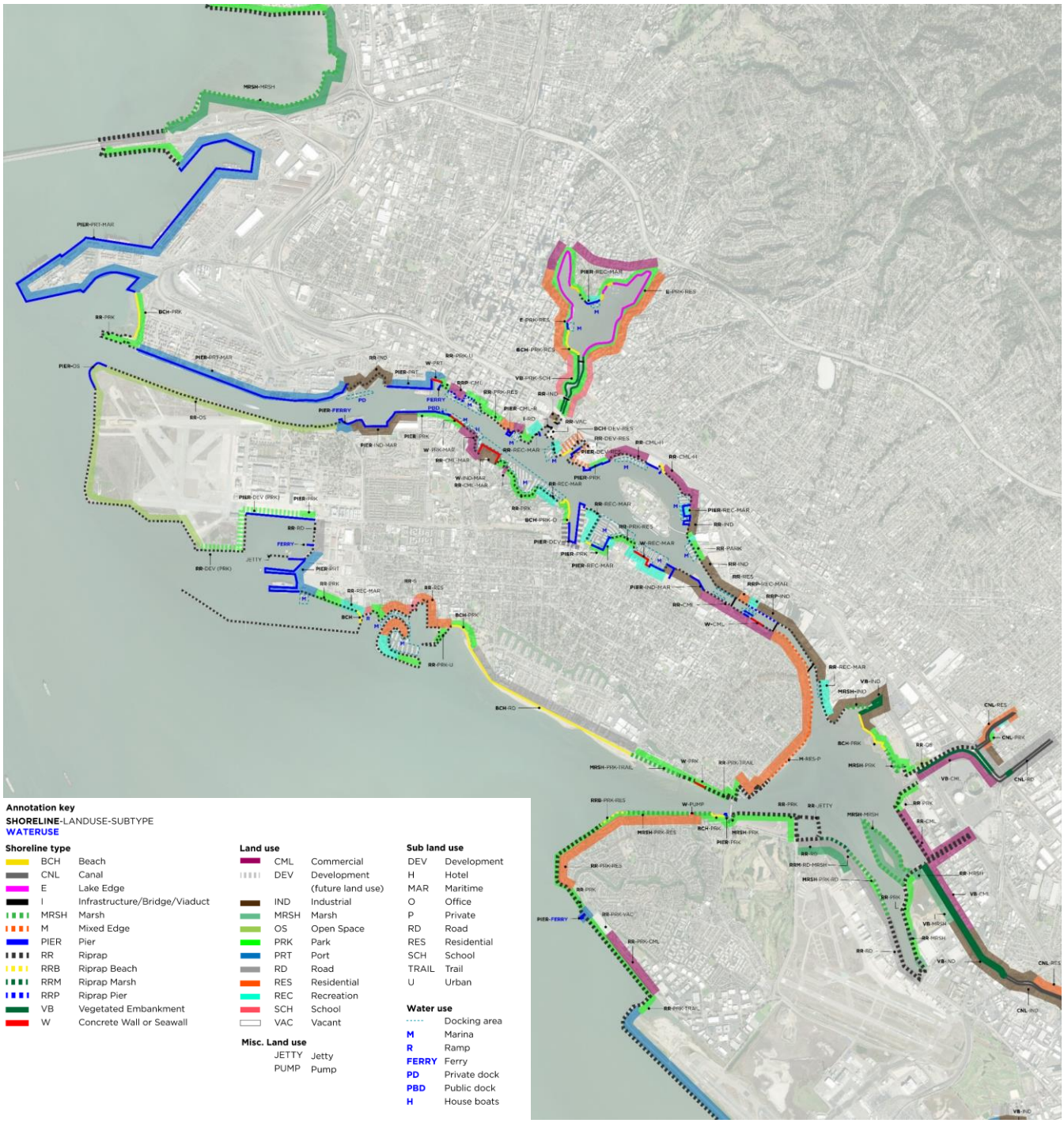


Figure 3-40. Shoreline Typologies

Source: CMG Landscape Architecture

3.6.3 Transportation

3.6.3.1 Interstate Freeways & State Routes

I-880 offers north-south access through Oakland as well as other cities in the East Bay as well as a direct connection to San Francisco via the San Francisco Oakland Bay Bridge (I-80). Within the Subregion, I-880 spans eight lanes and includes the MacArthur Maze, a series of interchanges and offramps at the junction of I-580, I-880, I-980 and SR-24. Local Assessments Section H: San Leandro OLU notes that "from a regional perspective, I-880 provides a critical link for the movement of goods between the Port of Oakland and the Central Valley and averages 25,359 trucks per day. I-880 is also critical for commuter movement between significant residential and commercial areas and job centers, averaging 237,000 vehicles per day." (San Francisco Bay Conservation and Development Commission 2020) Within the Subregion, significant stretches of the freeway rest on a viaduct (elevated bridge-like structure) or retaining walls (Caltrans and ACTC 2021).

The I-880 corridor crossing at Damon Slough has been identified as a critical vulnerability and presents a multitude of challenges related to current and future flooding (BCDC 2016; City of Oakland 2017a). Proposed I-880 adaptation responses include elevating the at-grade stretch of I-880; rerouting I-880 to a less-vulnerable location; and re-routing traffic to other modalities including rail and transit and to other protected roadways such as I-580 (BCDC 2016).

I-80, the Bay Bridge, spans the northern boundary of the Subregion and continues into the northern East Bay Crescent OLU. Though the touchdown of the eastern span of the Bay Bridge is partially within the Subregion, adaptation planning for that asset is outside the scope of this project and is being handled by other agencies. EBRPD is leading a nine-agency effort for a new shoreline park at the touchdown site (SFEI 2022a).

A portion of **I-980** runs within the Subregion. I-980 connects with I-580 as well as SR-24.

SR-260 - the Webster Street & Posey Tubes are underwater tunnels that connect Oakland and Alameda beneath the Oakland Estuary. Traffic into Alameda flows southbound through Webster Street Tube and the Posey Tube handles northbound traffic. Analysis published in 2022 indicates that the tubes serve 60,000 vehicles and 719 trucks per day (SFEI 2022a). The Oakland Alameda Access Project proposes modifications to the Posey Tube exit in Oakland and additional changes to I-880 freeway ramps at Jackson Street (Caltrans and ACTC 2021).

SR-61 – begins in San Leandro to the south and includes a number or City streets. It follows Doolittle Drive on Bay Farm Island, crosses over the Bay Farm Island bridge into Alameda Island, then follows Otis, Broadway, Encinal, Central, Webster, and finally crosses the San Leandro Channel via the Webster and Posey Tubes. Previous studies indicated that SR-61 averages 31,750 vehicles per day, and though a significant portion of the roadway was built prior to 1964, with major upgrades made to the airport-adjacent section in 1982, the pavement is in acceptable condition and is regularly maintained. It provides access for commuters, goods, and emergency response within Alameda Island and between Bay Farm Island and Alameda Island. SR-61 is owned by CalTrans, and portions are operated by the City of Alameda, the City of Oakland, and Caltrans (SFEI 2022a). This roadway is evaluated in more detail for the near-term projects in the Oakland-Alameda Estuary (Section **Error! Reference source not found.**) and Bay Farm Island (Section 5).

3.6.3.2 Bridges

There are six bridges – all drawbridges – that cross the San Leandro Channel: Fruitvale Railroad Bridge, Miller-Sweeney Bridge, Park Street Bridge, and High Street Bridge. The Bay Farm Island Bridge and Bay Farm Island Bicycle Bridge connect Alameda Island and Bay Farm Island. The drawbridges are operated by the Alameda County Public Works Agency, with the Bay Farm Island Bridge operated under agreement with Caltrans, and the Fruitvale Railroad Bridge operated under agreement with the U.S. Army Corps of Engineers. Four of the bridges are exclusively used by vehicular traffic (Miller-Sweeney Bridge, Park Street Bridge, High Street Bridge, Bay Farm Island Bridge); the Bay Farm Island Bicycle Bridge is open exclusively to bicycles and pedestrians. The Fruitvale Railroad Bridge is not currently used for conveyance but can be raised to full height (normal height is maintained at a lower elevation) when necessary.

A bicycle/pedestrian bridge connecting Jack London Square, Downtown Oakland, and Alameda was first proposed in 2009 and is still being studied (HNTB et al. 2021; City of Alameda 2022b) The proposed bridge would increase access for Alameda residents to public transit options such as BART and Amtrak.

Additionally, the City of Alameda's 2021 General Plan proposed a new pedestrian bridge: the Shoreline to Seaview Bridge, connecting Park Street to Bay Farm Island at Seaview Parkway (City of Alameda 2022b). As of January 2024, no feasibility studies had been conducted for this proposal.

3.6.3.3 Rail (freight)

The County of Alameda is one of nineteen counties that make up the Northern California Megaregion, which contains "a robust, multimodal freight network consisting of sports, airports, railroads, and highways that connect regional production and distribution facilities to regional, national, and global markets. These facilities link the Megaregion's economy to international and national trade partners" (MTC Megaregion).

Within the Megaregion, Class I rail service is available via BNSF Railway (BBNSF). Per MTC: "BNSF's rail network originates in the San Francisco Bay and travels southeast through Stockton down to Barstow, where it splits east (through Needles) and west (to the Ports of Los Angeles and Long Beach). Class I rail service is also available through Union Pacific (UP); within the same area, UP "connections between San Jose, San Francisco, Sacramento, and Stockton, allowing freight to continue towards the Pacific Northwest, Midwest, Southwest, and south towards Los Angeles."

The Railport Intermodal Yard at the Port of Oakland, which connects to UP rail service, and the Oakland International Gateway Intermodal Facility at the Port of Oakland, which connects to BNSF rail service, are both significant intermodal facilities that offer rail-to-truck and barge-to-rail (and vice-versa) services.

According to previous studies within the Oakland-Alameda Subregion:

> *"The Union Pacific Railroad (UPRR) is an important heavy freight rail supporting the reliable movement of goods to market across the Bay Area. The rail connects many Bay Area ports and moves goods to areas across the region. UPRR owns the right-of-way for the rail line from Santa Clara county through this OLU and out of the region... UPRR plays a critical connection to and from the Port of Oakland, and runs throughout the OLU including through the Port, Jack London*

Square, and the Coliseum Area." (San Francisco Bay Conservation and Development Commission 2020)

The Port of Oakland is among five major cargo-handling ports in the Northern California Megaregion and houses two of the four key intermodal facilities facilitating truck-to-rail or rail-to-barge services. Specifically, the Railport Intermodal Yard connects to UP rail services, while the Oakland International Gateway offers access to BNSF rail services. The Metropolitan Oakland International Airport (OAK) is also one of six cargo-handling airports in the area. Despite recent employment declines in freight-dependent industries, growth is expected in sectors like construction and trade, fueled by reconstruction after natural disasters such as flooding. Challenges faced by the Megaregion include congestion at the Port of Oakland that is causing relocation of manufacturing to the San Joaquin Valley. This is due to rising land values, which increases trucking distances and congestion, and high land costs in the Bay Area. This pushes warehouse development outward, impacting goods movement efficiency. Opportunities for improvement include implementing a PierPASS program at the Port and developing truck staging areas to enhance freight movement, focusing on regional coordination to support efficient multi-regional trucking and supply chains (MTC 2019).

Data Gap: Detailed information on freight rail facilities & tracks has not yet been obtained or reviewed for incorporation within the Existing Conditions Report.

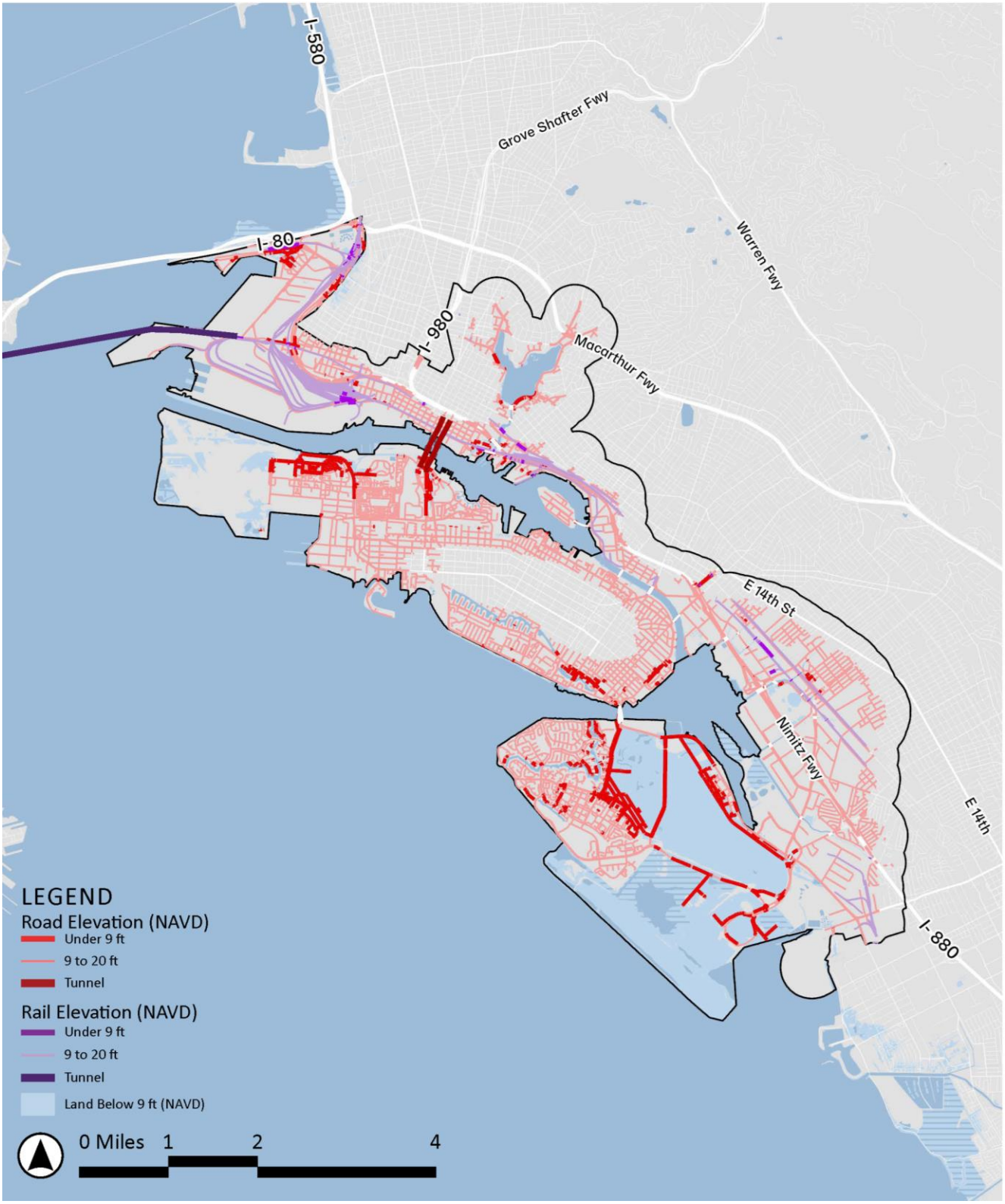


Figure 3-41. Roads & Rail at Risk of Flooding

Source: (USGS; NOAA; US Census TIGER)

3.6.4 Critical Infrastructure

Existing critical infrastructure within the Subregion are those facilities that are essential for life safety and health. Facilities that provide essential services in the Subregion can fall into one of the following categories:

- Major Properties – this category includes important properties in their entirety due to their inherent, necessary function;
- Access – this category includes vehicular access; these facilities are used for private vehicles, commercial vehicles, municipal vehicles, and public transportation;
- Utilities – this includes water, power, sewer, and communications utilities/providers;
- Emergency Facilities – this includes municipal fire, police, hospital/healthcare, and emergency responders.

Data/Analysis Gap: The scope of work for the OAAC Adapt projects does not include a comprehensive survey of critical infrastructure or completion of a vulnerability assessment. A comprehensive Vulnerability Assessment for the Subregion should be completed by key stakeholders and/or the OAAC as part of future planning efforts.

Additional information regarding the vulnerability of critical infrastructure and community facilities and be found in the following studies:

- Alameda Climate Action and Resiliency Plan (CARP)
- Oakland Sea Level Rise Roadmap
- Port of Oakland Sea Level Rise Assessment

3.6.4.1 Major Properties

The **Oakland International Airport** is located within the Subregion. Local Assessments Section H: San Leandro OLU provides this description of Oakland International Airport:

"Oakland International Airport is located approximately 6.5 miles southeast of downtown Oakland on Bay Farm Island. The Airport is owned and operated by the Port of Oakland (Port), which is an autonomous department of the City of Oakland that receives no tax money from the city and funds its own operations. The airport property is organized into two distinct facility areas: South Field and North Field. South Field, the airport area south of Ron Cowan Parkway, is used by commercial airline service and air cargo. North Field, north of Ron Cowan Parkway, is used for general aviation. OAK is classified as a medium-hub commercial airport, carrying 6.4 million passengers in 2017, an 8% increase in enplanements since 2016. Additionally, it is the largest cargo service airport for the region, which handled 1.6 million tons in 2017 and serves as the regional hub for FedEx and has seaport/airport connections to the Port of Oakland. Finally, the airport serves as a lifeline facility to bring in supplies

and personnel in the event of an emergency." (San Francisco Bay Conservation and Development Commission 2020)

The **Port of Oakland** is a deep-water port located within the City of Oakland along the Oakland Alameda Estuary (Figure 3-42). The port occupies about 791 acres across four major terminal areas: the Outer Harbor Terminal Area, the 7th Street Terminal Area, the Middle Harbor Terminal Area and the Inner Harbor Terminal Area (BCDC and NOAA 2012). The Seaport's active container terminals currently include the TraPac Terminal, Ben E. Nutter Terminal, Oakland International Container Terminal, and Matson Terminal. Facilities include berth terminals, at least 32 berths (14 are -50 feet and 9 are -42 feet); 29 active cranes, most of which are electric. There are two intermodal rail yards (Port of Oakland).

Created in 1927, the Port of Oakland is an independent department within the City of Oakland that is governed by its Board of Commissioners. The Port is responsible for 20 miles of property along and funds its own operations (BCDC and NOAA 2012)(Local Assessments Section H: San Leandro OLU).

In 2016, before the global pandemic, the Port of Oakland "was the seventh busiest port in the United States by cargo volume and handled 99 percent of containerized goods moving through Northern California" (Local Assessments Section H: San Leandro OLU).

Additional major properties / essential facilities are noted in Table 3-6.

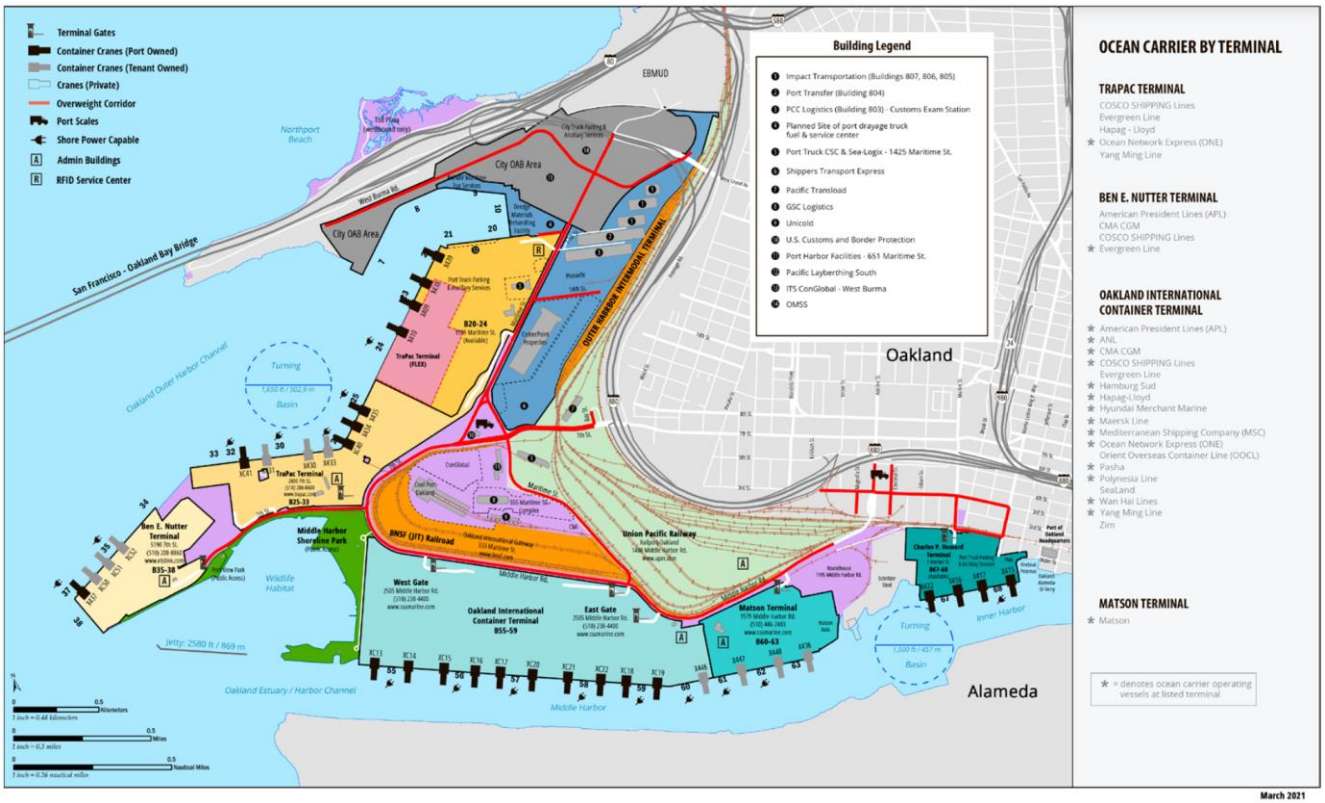


Figure 3-42. Port of Oakland

Source: (Port of Oakland)

Table 3-6. Other Major Properties / Essential Facilities

Name	Owner/Operator	Significance / Need
Coast Guard Island	Coast Guard (Federal)	Life Safety
Wastewater Treatment Plant	East Bay Municipal Utility District	Health

3.6.4.2 Utilities

Storm Drain System and Lagoons

The Subregion is drained by a series of pipes, channels, lagoons, lakes, ditches, and pump stations. Oakland, Alameda, and the Port of Oakland each own and operate the drainage systems within the public right-of-way. There are several outfalls into the estuary from both gravity and pumped systems. Typical interior drainage systems (pipe networks) are designed to a 10-year level-of-service (i.e., to convey a 10-year precipitation event). Channels and pump stations are typically designed to a 100-year level-of-service. The 10- or 100-year design event will vary depending on when the infrastructure was built. Looking ahead, the 10- and 100-year events will change with climate change.

Both the City of Alameda and the Port of Oakland have prepared drainage master plans (City of Alameda 2008; S&W 2017; Port of Oakland 2023). These studies give a macro scale picture of the status of the drainage infrastructure and identify necessary improvements to meet drainage standards. The City of Oakland is currently developing their drainage master plan. Figure 3 43 shows the existing storm drain networks, outfalls, and pumps. The City of Alameda storm drain network is shown in blue, the City of Oakland's is shown in red, and the Port of Oakland's is shown in orange.

Following the completion of the SDMP, Schaaf and Wheeler also completed a more detailed analysis assessing SLR impacts on City of Alameda infrastructure; the completed analysis was added to the original SDMP as the Climate Change Impacts (CCI) Addendum 2009. The CCI Addendum addressed existing climate change research and understanding, as well as the inherent uncertainty of climate change impacts. It also included an analysis of the storm drain system performance with the SDMP CIP during a 10-year design storm with the inclusion of 18-inches of SLR. The Addendum concluded with the improvements required to mitigate the impact of 18-inches of SLR on the CIP storm drain network, but also noted that additional SLR would necessitate further improvements. In 2015, Schaaf and Wheeler prepared a technical memorandum titled "55-Inch Sea Level Rise Study", which added to the existing SDMP (2008) and CCI Addendum (2009) by providing an assessment of the impacts resulting from 55-inches of SLR on City of Alameda infrastructure, and by identifying improvements to prevent flooding (S&W 2015). Figures 3.43 and 3.45

Wastewater / sanitary sewer

Per EBMUD, the cities of Alameda and Oakland and EBMUD own and operate gravity systems, pump stations, and force mains. EBMUD also owns and operates interceptors (large gravity pipes) and force mains. Typically, the city systems discharge EBMUD interceptors. Most of EBMUD's system is gravity flow. Figure 3.46

Potable Water / Fire Water

The East Bay Municipal Utility District (EBMUD) supplies the City of Oakland and City of Alameda potable water systems (also used for the fire water system). The water system within the Subregion is a gravity-flow system within the Central Pressure Zone. The pipe network includes air valves to allow air to enter (vacuum breaker valve) and exit (air release valve), which may include air valves within areas susceptible to flooding; these air valves are typically vented above-ground, but some may be

vented within underground vaults. The water system also includes isolation valves and blow-offs at ground level for maintenance and repair of the pipeline. See Figure 3.47.

Electrical Service

The City of Alameda's electrical service is provided by Alameda Municipal Power (AMP) via PG&E transmission system. The City of Oakland's electrical power is provided by PG&E. The Port of Oakland provides its own electrical power. See Figure 3.48.

Natural Gas

PG&E provides natural gas to the City of Oakland and City of Alameda. Within the central and southern portions of the Subregion, gas transmission lines run generally north-south along I-880, and in the north portion of the Subregion the transmission lines run between I-880 and I-980 and along I-80 and San Pablo Ave. A lateral transmission line crosses the Oakland Estuary into Alameda south of the Posey Tube, and another lateral transmission line serving Bay Farm Island terminates near the east end of the Oakland Airport North Field.

The Port of Oakland provides limited natural gas on a pass-through basis from PG&E. See Figure 3.48.

Other Pipelines

The Kinder Morgan pipeline runs generally north-south parallel to the shoreline through the Subregion from I-80 in the north to 98th Ave in the south, turning west along the southern and western shoreline of Bay Farm Island. The pipeline then crosses San Francisco Bay towards Brisbane Lagoon. See Figure 3.48.

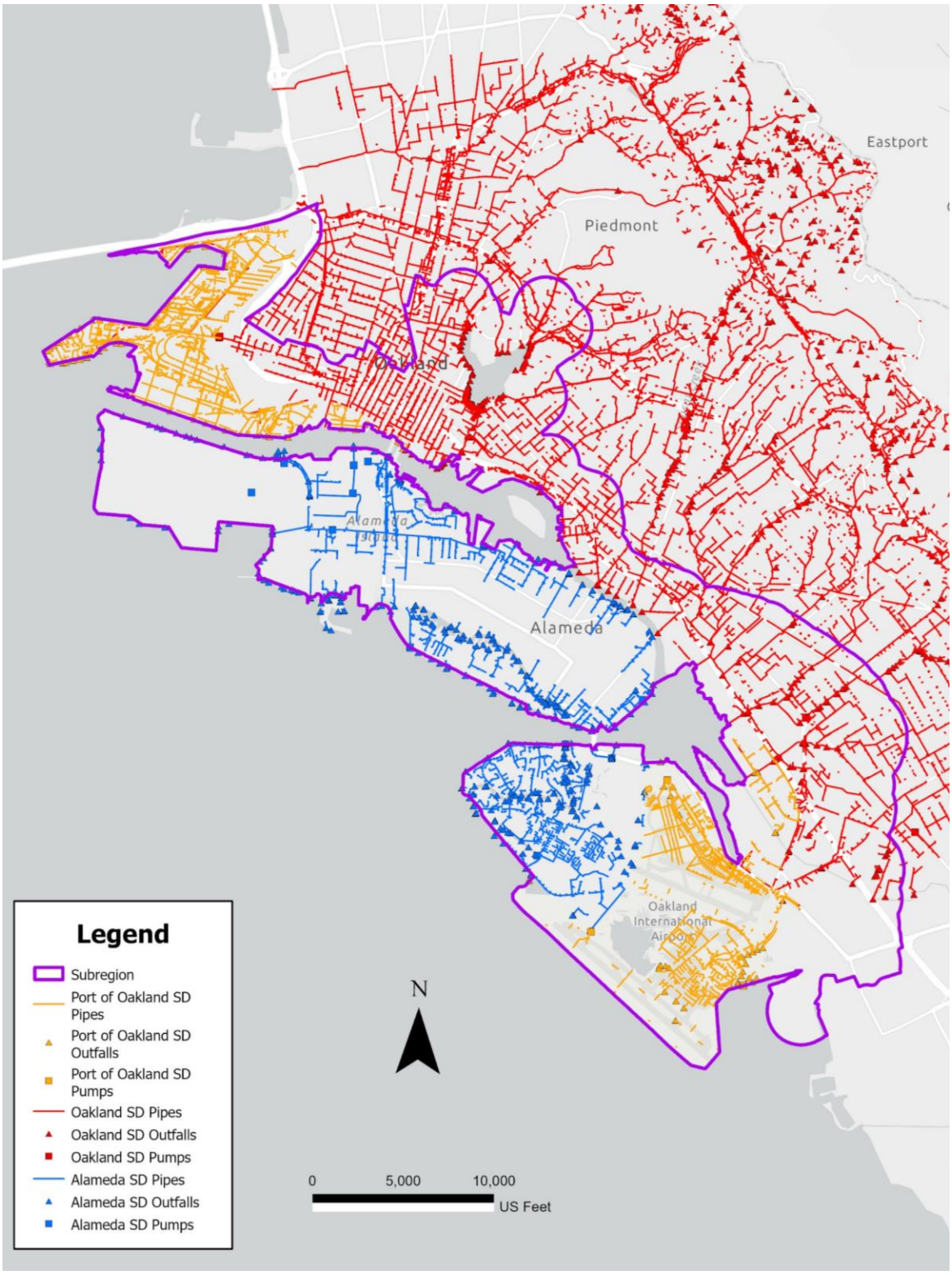


Figure 3-43. City of Alameda, Port of Oakland, and City of Oakland Storm Drain Systems

Source: (Schaaf and Wheeler 2019; Schaaf and Wheeler 2012)

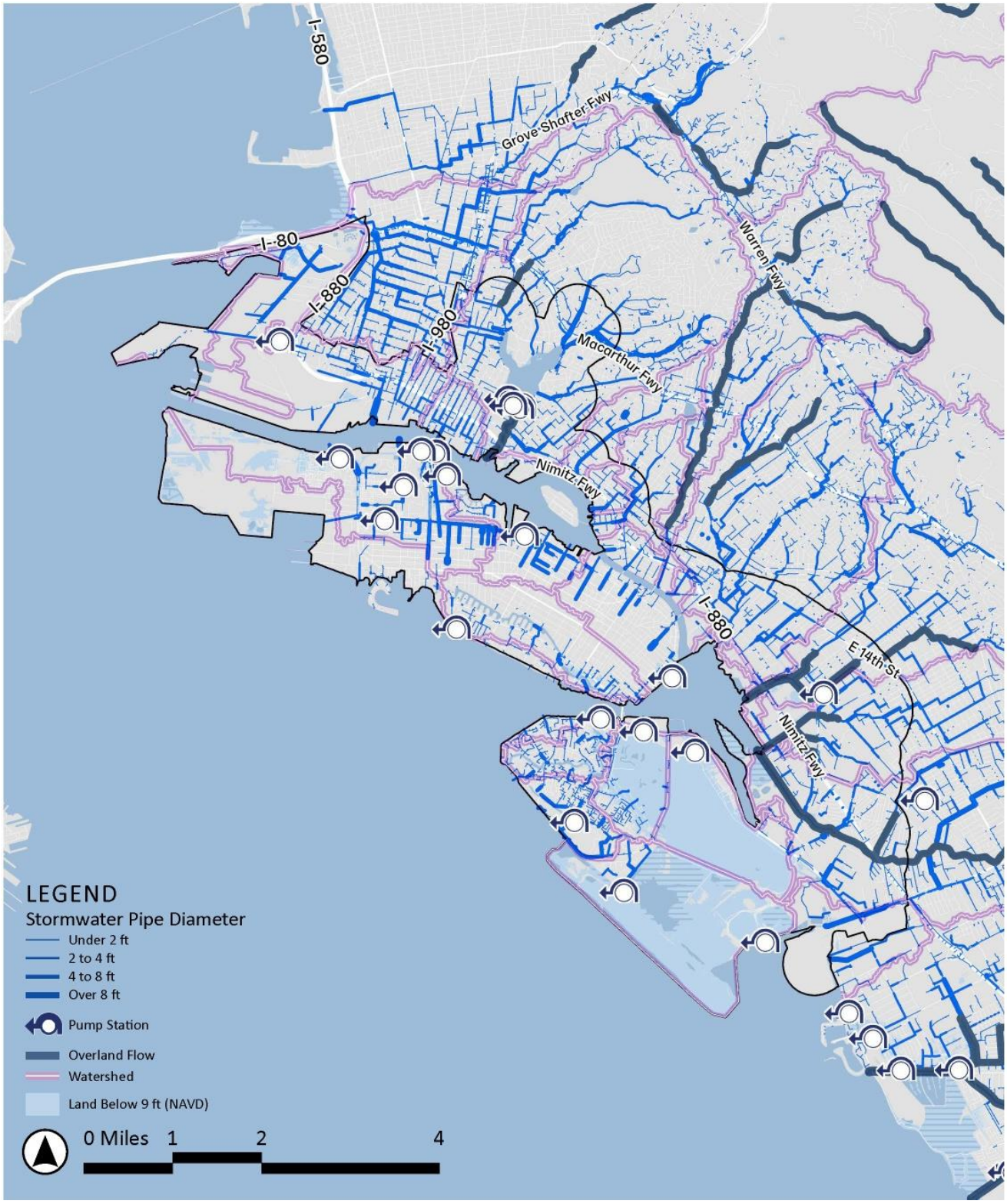


Figure 3-44. Drainage System

Source: (Schaaf and Wheeler 2019; Schaaf and Wheeler 2012)

Figure 3-45. Sewer System

Source: (USGS, NOAA, City of Oakland, City of Alameda, Port of Oakland)

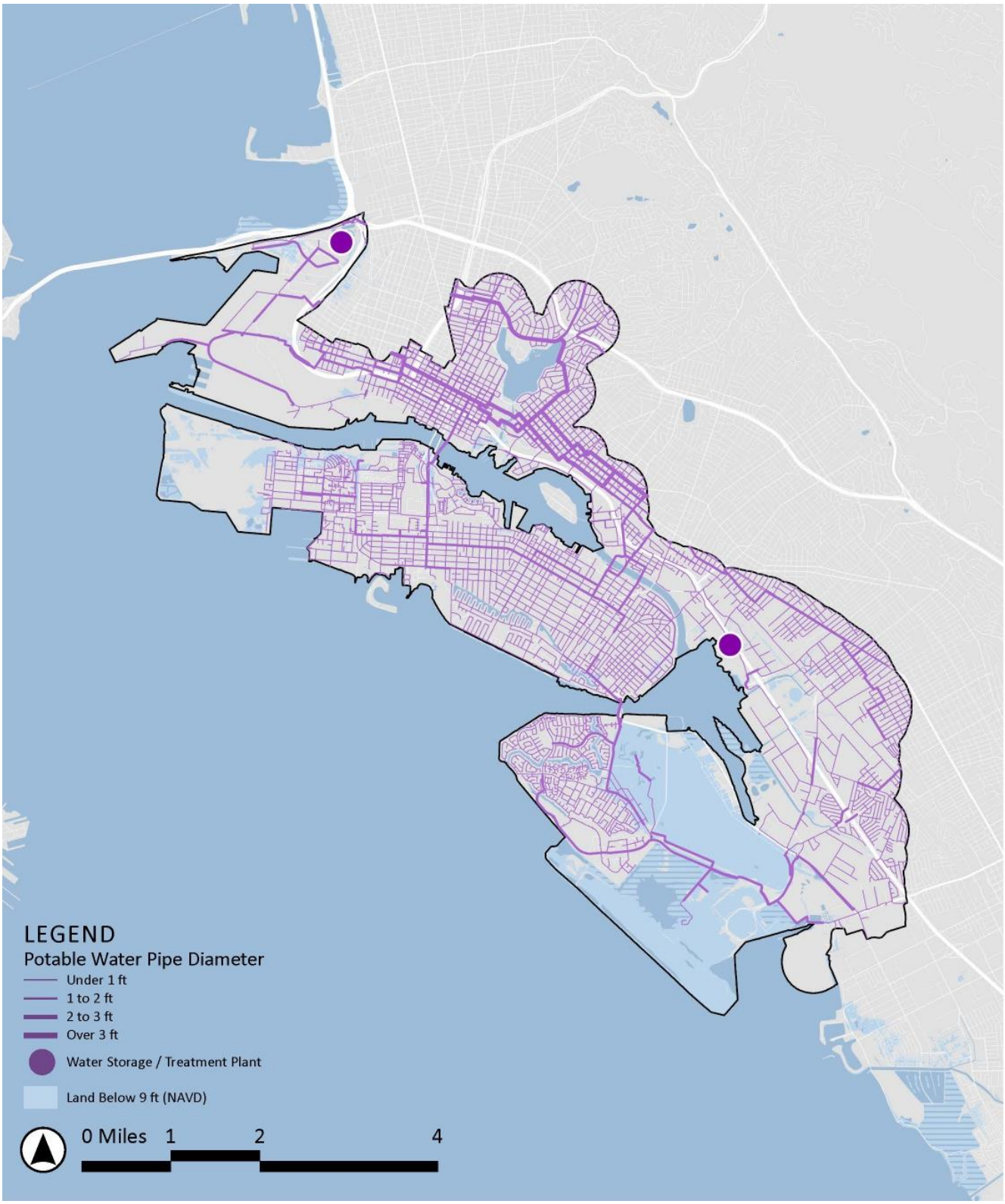


Figure 3-46. Potable Water System

Source: (EBMUD)

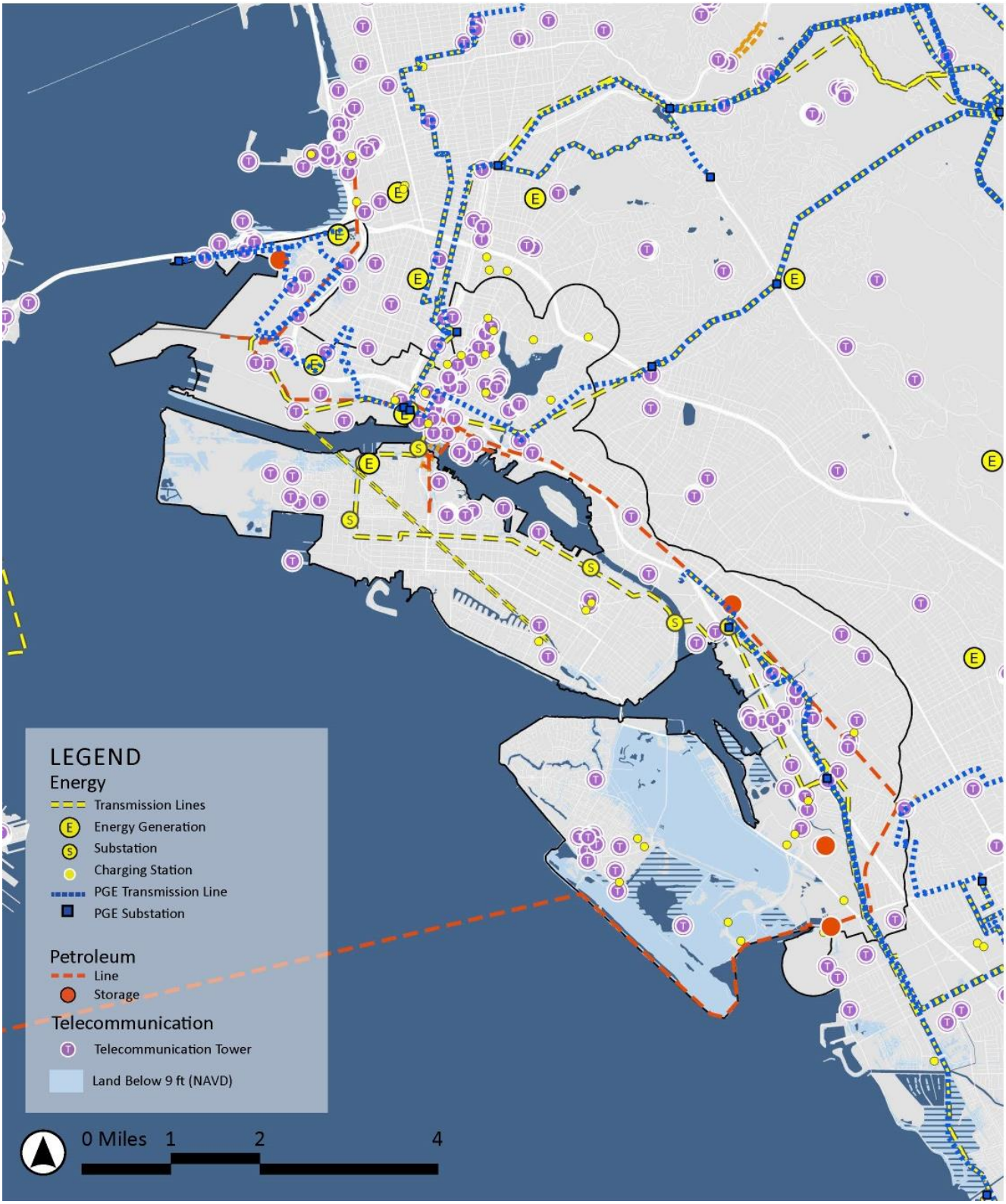


Figure 3-47. Other Utilities

Source: (USGS, Department of Homeland Security, PG&E)

3.6.4.3 Emergency Facilities

- Fire Stations – the Subregion includes a number of fire stations in the City of Oakland and City of Alameda.
- Police Stations – the Subregion includes several stations in the City of Oakland and City of Alameda.
- Emergency Operations – the Subregion includes City facilities for use during emergency situations.

Figure 3-48. Critical Facilities

Source: (USGS)

3.7 Public Access and Recreation

3.7.1 Public Transportation

3.7.1.1 Transit Priority Areas (TPAs)

As part of Plan Bay Area 2050, Transit Priority Area (TPA) is defined as an area within one-half mile of a major transit stop that is existing or planned, if the planned stop is scheduled to be completed within the planning horizon included in a transportation improvement program or applicable regional transportation plan (Metropolitan Transportation Commission and Association of Bay Area Governments 2021).

A Major Transit Stop is a site that contains either an existing rail or bus rapid transit station; a ferry terminal served by either a bus or a rail transit service; or the intersection of two or more major bus routes with a frequency of service interval of 15 minute or less during the morning and afternoon peak commute periods.

Much of the Subregion lies within a TPA, particularly on the Oakland side of the Estuary (Figure 3-49). The two regions on Bay Farm Island are designated as TPAs due to the connections between ferries and bus routes and the multiple forms of transit available at the Oakland Airport.

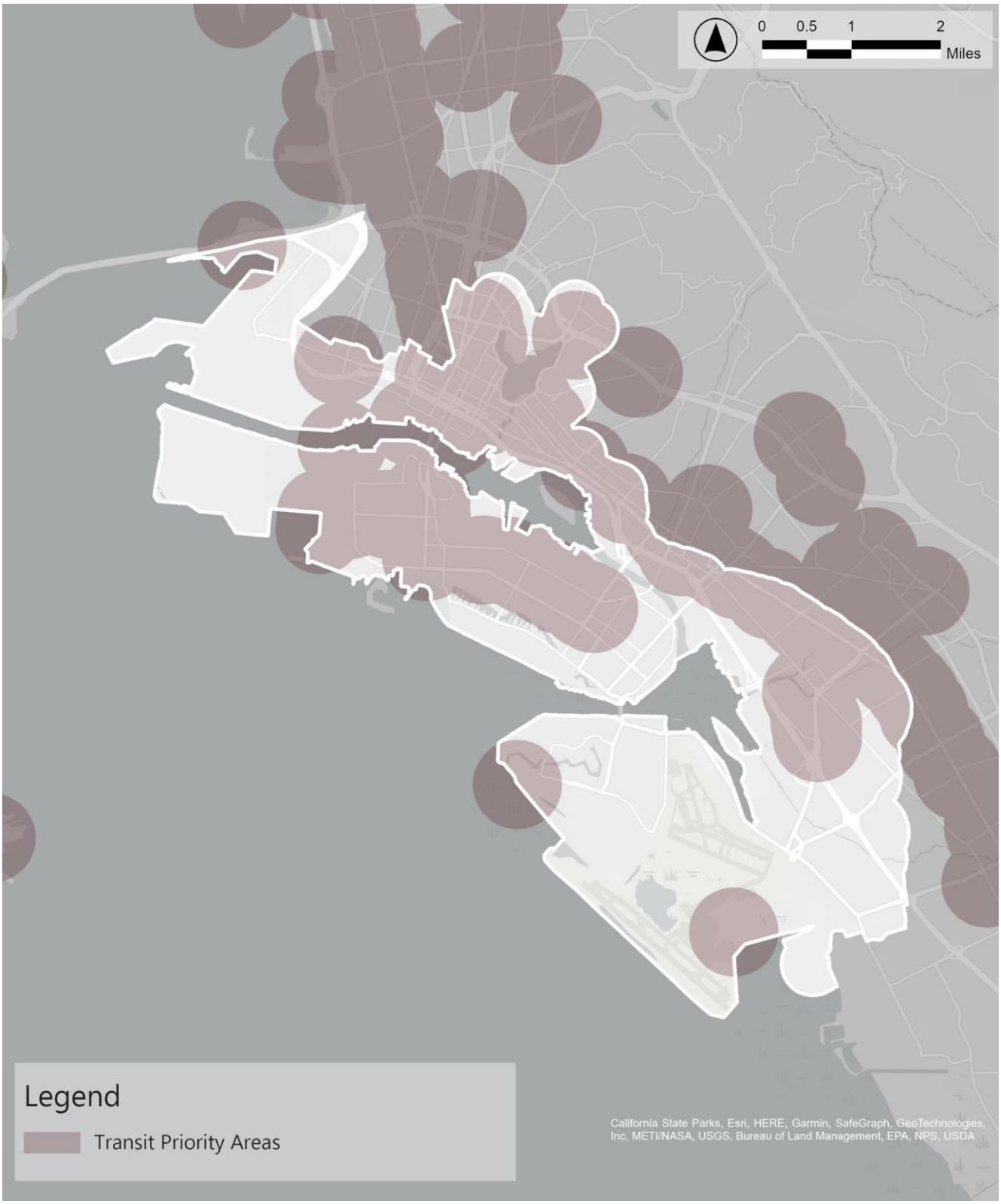


Figure 3-49. Plan Bay Area 2050 Transit Priority Areas

Source: (Metropolitan Transportation Commission and Association of Bay Area Governments 2021)

3.7.1.2 Light Rail

Bay Area Rapid Transit (BART) provides a regional light rail network connects Alameda, Contra Costa, San Francisco, and San Mateo counties. There are seven BART stations within the Subregion: West Oakland; 12th Street/City Center; 19th Street; Lake Merritt; Fruitvale; Coliseum; and Oakland International Airport Station (Figure 3-50**Error! Reference source not found.**). All existing BART stations within the Subregion are located within the City of Oakland. There are currently no BART stations located on Alameda Island, though the City of Alameda's Transportation Choices Plan notes that island residents would welcome a BART station. (City of Alameda 2018b)

3.7.1.3 Passenger Rail

Amtrak, Capitol Corridor, and San Joaquin Transit have passenger rights on the Union Pacific Railroad (UPRR). Amtrak provides service at the Jack London Square Station and Coliseum Station in Oakland. San Joaquin, California Zephyr, and Coast Starlight trains stop at Jack London station, and Capitol Corridor trains stop at the Coliseum Station. The Capitol Corridor service runs between San Jose and Auburn, with fourteen trains per day across the entire service area, and additional trains serving the route stretching between Sacramento and Oakland. The San Joaquin service runs ten trains per day, while the California Zephyr and Coast Starlight lines operate one train per day to Chicago and Seattle, respectively.

3.7.1.4 Ferry Service

San Francisco Bay Ferry Service provides regular passenger services between terminals in Oakland and Alameda to San Francisco, Richmond, South San Francisco, and Vallejo. As of 2023, there are six regular routes with daily service, and five "short hop and pilot routes" that provide quick access between nearby destinations (for instance, service between Alameda and Oakland, and between Pier 41 in San Francisco and downtown San Francisco) and event-based service (service to Oracle Park and the Chase Center on select gamedays). Ferries operated by Bay Ferry reportedly serve over three million passengers each year with a fleet of 15 passenger-only high-speed vessels (WETA 2024a).

There are four ferry terminals within the Subregion: Oakland at Jack London Square; two in Alameda (Main Street Ferry Terminal on the San Leandro Channel, and the Alameda Sea Plane Lagoon Terminal on the western side of the island) and one on Bay Farm Island (Harbor Bay Terminal) (Figure 3-50).

WETA, the Water Emergency Transportation Authority, operates the San Francisco Bay Ferry brand and, as of December 2023, is in the process of creating an updated plan for water-based transportation and emergency response on the San Francisco Bay.

As of early 2024, a new water-based transit option will link Oakland and Alameda. Per the City of Alameda,

> *"A new water shuttle service is coming in late Spring 2024! It's being planned by a partnership of public and private organizations and agencies, including the City of Alameda. It will start as a limited service, with the opportunity to grow over time. Initially the water shuttle will travel between the foot of Fifth Street in Alameda and the foot of Broadway in Oakland. In May 2023, grant funding, matched with private and public funds, was secured for a two-year pilot."*

3.7.1.5 Buses

Alameda-Contra Costa (AC) Transit offers bus transit for thirteen east bay cities and unincorporated areas of Alameda and Contra Costa counties, encompassing a 364-square-mile service area that serves approximately 1.5 million people. As of 2019 there were 158 bus lines served by a fleet of 635 vehicles (Caltrans and ACTC 2021).

There are multiple AC Transit routes within the Subregion as follows:

- **Downtown Oakland**, Broadway is a primary AC Transit route corridor; Webster and Harrison streets, the Tubes, as well as 7th Street, 8th Street, 11th Street and 12th Street also have numerous bus routes (Caltrans and ACTC 2021).
- **Jack London Square**, local bus lines connect to other East Bay communities such as Line 12 (Oakland, Piedmont, Berkeley, and Albany) and Line 72R (Oakland, Emeryville, West Berkeley, Albany, Richmond, and San Pablo)
- **East Oakland**, local bus lines connect the neighborhoods – Sobrante Park/Brookfield Village (Line 45) and Columbian Gardens (Line 98) - to bus rapid transit Tempo (Line 1T) along International Blvd.
- **West Oakland**, several local bus lines converge at the West Oakland BART on 7th Street. The local bus lines in West Oakland connect with Emeryville and Berkeley (Lines 29 and 36) and Fruitvale BART (Lines 14 and 62).
- **Alameda Gateways**, several bus lines run throughout both the main island and Bay Farm Island and head to/from Oakland at three gateway locations: Posey/Webster Tubes, Park Street Bridge and Miller-Sweeney Bridge. Line 51A is the main island's trunk line with the most frequent service and runs through the center of town between Fruitvale BART and downtown Oakland. The Posey/Webster Tubes serve most of the bus lines between Alameda and Oakland including Lines 51A, 96, 19, 20, 851, O and W. The City of Alameda's busiest bus stop is at College of Alameda – Webster Street and Atlantic Avenue – just south of the tube portals.
- **Alameda Estuary**, Line 96 serves West Alameda and Line 19 serves Alameda's Northern Shoreline, and both connect to downtown Oakland BART.

There is one Greyhound bus station at the West Oakland BART station in the Subregion (Greyhound 2024).

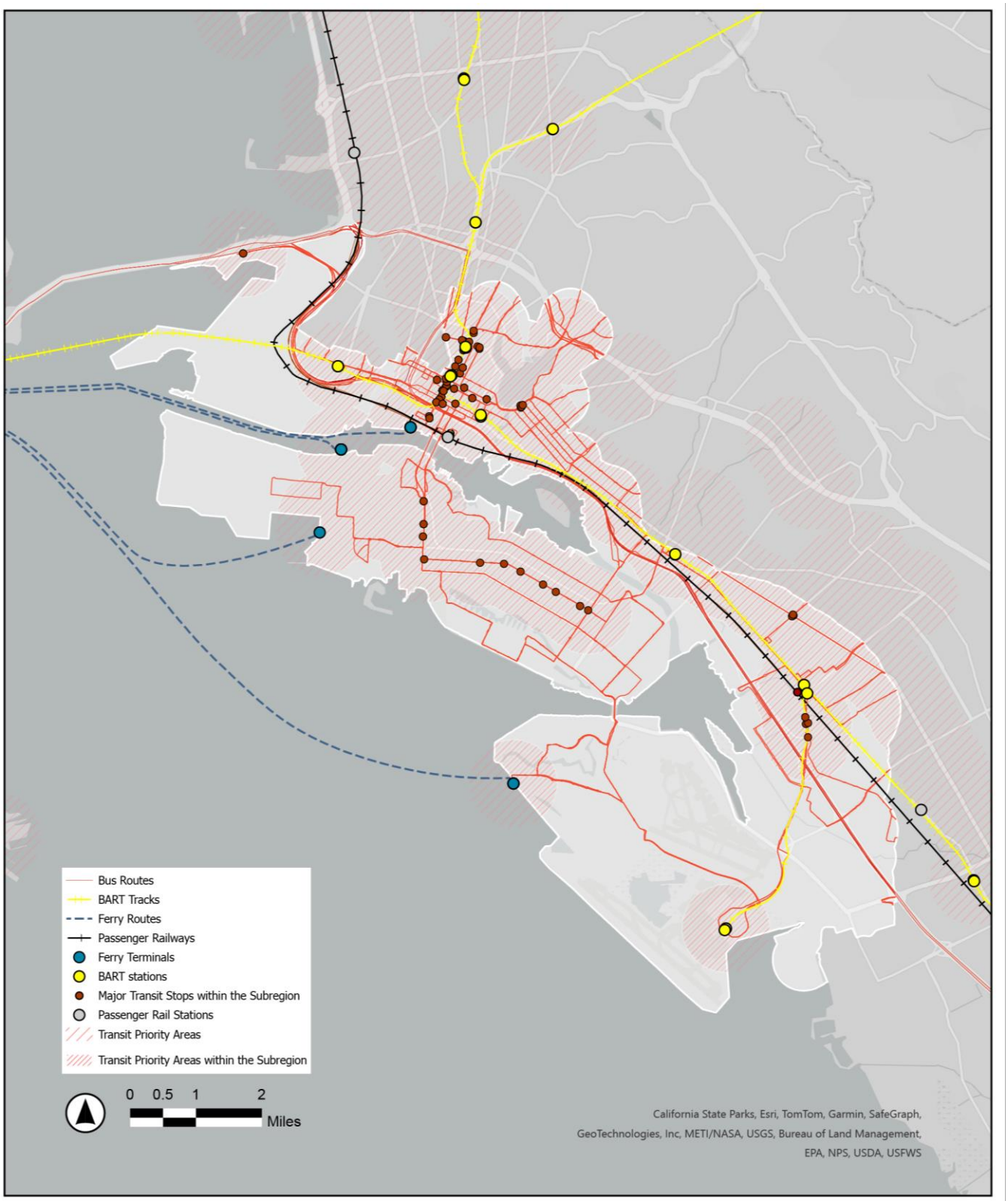


Figure 3-50. Public Transit

Source: (Metropolitan Transportation Commission 2024)

3.7.1.6 Other transit services

Several private shuttle services operate within the City of Alameda, including the Alameda Landing Express, a free, weekday shuttle service that connects Alameda landing at Fifth Street to 12th Street BART Station in Oakland. Alameda's free shuttle service, the Alameda Loop Shuttle, stopped operation in 2022 (City of Alameda 2022c). The Harbor Bay Business Park Shuttle operates on Bay Farm Island, connecting the Coliseum BART station on one end to the Bay Farm Island Ferry along Harbor Bay Parkway & North Loop Road (ALTRANS TMA, Inc.; GS Management Company.).

Within Oakland, the City of Oakland and AC Transit operated the Free Broadway Shuttle (Broadway "B Shuttle"), which ran between Jack London Square to Grand Avenue, with most stops located along Broadway. The shuttle service ran between 7am and 7pm, with extended service past Grand Avenue to 27th Street after 7pm (Caltrans and ACTC 2021). This service was suspended due to the pandemic and it is unclear if and when it will resume operation. (City of Oakland 2024a).

Additionally, there are private airport shuttles that offer services to and from the Oakland International Airport, including door-to-door shuttle services, courtesy shuttles that link the airport to private parking lots and hotels and charter bus services.

3.7.2 Pedestrian & Bicycle Access

There are a variety of networks for pedestrians, bikes, and water access at the regional, sub-regional and municipal scale. Figure 3-51 shows existing, planned, and proposed pedestrian and bike paths within the Subregion. The City of Alameda owns and maintains facilities, trails, and bikelanes for pedestrians and bicyclists, and has planned improvements within the Subregion (City of Alameda 2018b, 2022b). The City of Alameda also maintains portions of the Bay Trail within its jurisdiction.

The City of Oakland recently updated its city-wide bicycle and pedestrian plans (City of Oakland 2017b, 2019b). The plans lay out existing facilities and planned improvements within the Subregion. Of note are the concentration of high-injury corridors and intersections in Oakland within the Subregion, and the significant portions of sidewalk gaps.

3.7.2.1 San Francisco Bay Trail

When complete, the San Francisco Bay Trail will offer a continuous, 500-mile multi-use trail encircling the Bay. At present there are over 350 miles of existing Bay Trail segments in the Bay Area. The Bay Trail Project is a non-profit administered by the Association of Bay Area Governments (ABAG), while local jurisdictions are responsible for individual segments of the Bay Trail.

Within the Subregion there are currently 45 miles of existing trail and approximately 20 miles of proposed (but not planned) trails. The ongoing Bay Trail Gap project identifies many priority gap projects in the Subregion, particularly around the Estuary and Doolittle Drive (Association of Bay Area Governments 2005). MTC and ABAG are in the process of completing a Bay Trail Gap Closure Implementation Plan (BTGCIP), with an estimated completion date in 2024.

Preliminary categorization by the BTGCIP show several highest-priority Bay Trail Gaps within the Subregion.

In Oakland, highest-priority segments include: a stretch along Middle Harbor Road connecting to Middle Harbor Shoreline Park; a small stretch along Embarcadero across from Coast Guard Island; a long stretch of East 7th Street; connections across the High Street Bridge and Fruitvale Bridge; a stretch connecting the northern edge of the Tidewater Aquatic Center under the High Street Bridge; a stretch along Doolittle Drive; and the entrance to the Posey Tube. (Metropolitan Transportation Commission 2022)

In Alameda, highest-priority segments include a stretch along Sentinel Drive to the Alameda Main Street Ferry Terminal; a segment fronting the Shipways property; a segment connecting Shoreline Park to the Wind River POPO; a waterfront-segment to the north of Clement Avenue between Willow Street and Everett Street; a spur trail out to Ballena Vista Point; and a segment connecting Central Avenue to the Encinal Boat Ramp & Encinal Beach. (Metropolitan Transportation Commission 2022)

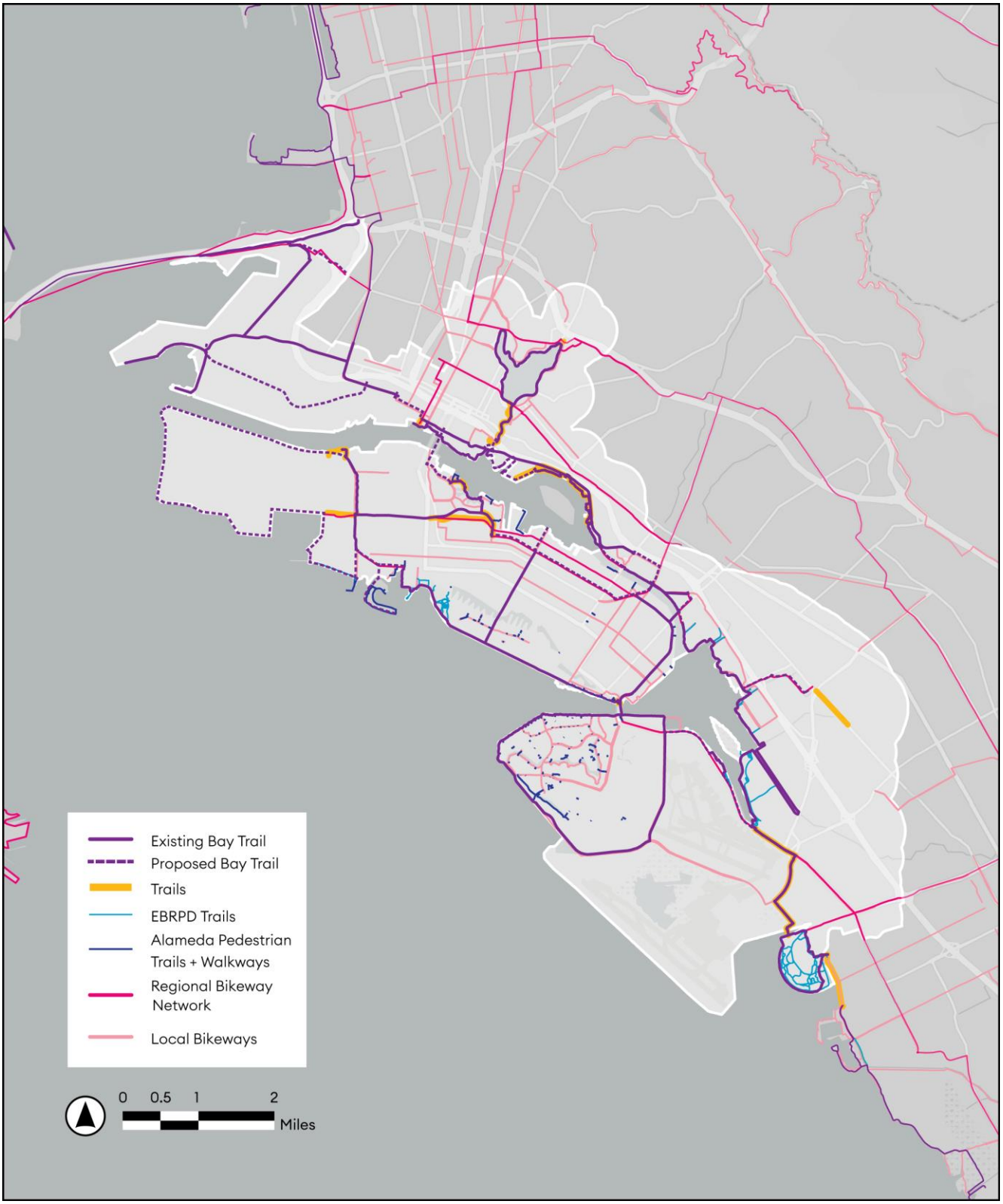


Figure 3-51. Pedestrian and Bicycle Access

Source: (EBRPD, City of Alameda, Metropolitan Transportation Commission 2024)

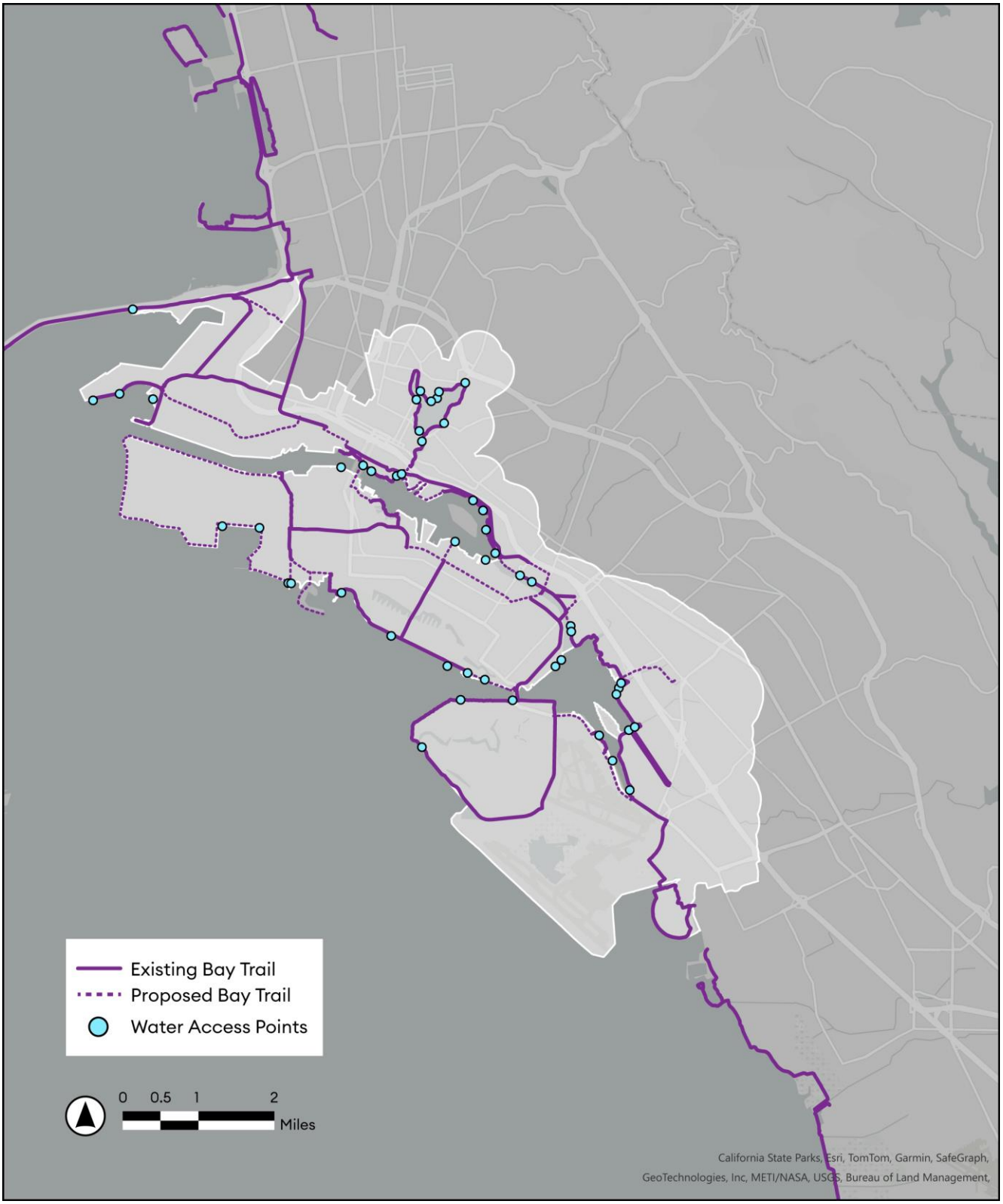


Figure 3-52. Bay Trail Gaps

Source: (Metropolitan Transportation Commission 2024)

3.7.3 Parks and Open Space

There are over 2,500 acres of parks and open space within the Subregion (Figure 3-53). Previous inventories of parks and open space within the Subregion emphasized the relative importance of parks based on their size. From Emeryville to Union City, 22 parks of importance were noted, not including parks under 5 acres as significant resources (BCDC and NOAA 2012); while it is true that larger parks have the capacity to serve more users simultaneously, privileging relative area belies the significance of parks with deep community importance, such as Lincoln Square Park in Oakland. The same report notes that "due to their location within neighborhoods, assessing climate change impacts to pocket parks can easily be folded into future, community-based adaptation planning efforts" (BCDC and NOAA 2012).

However, due to the large size of the subregion and the multitude of parks in the Subregion, an exhaustive description of all parks and open space assets is not provided. Additional research may be necessary to fully inventory all parks and open spaces within the Subregion, particularly informal community spaces that are not easily captured by city databases.

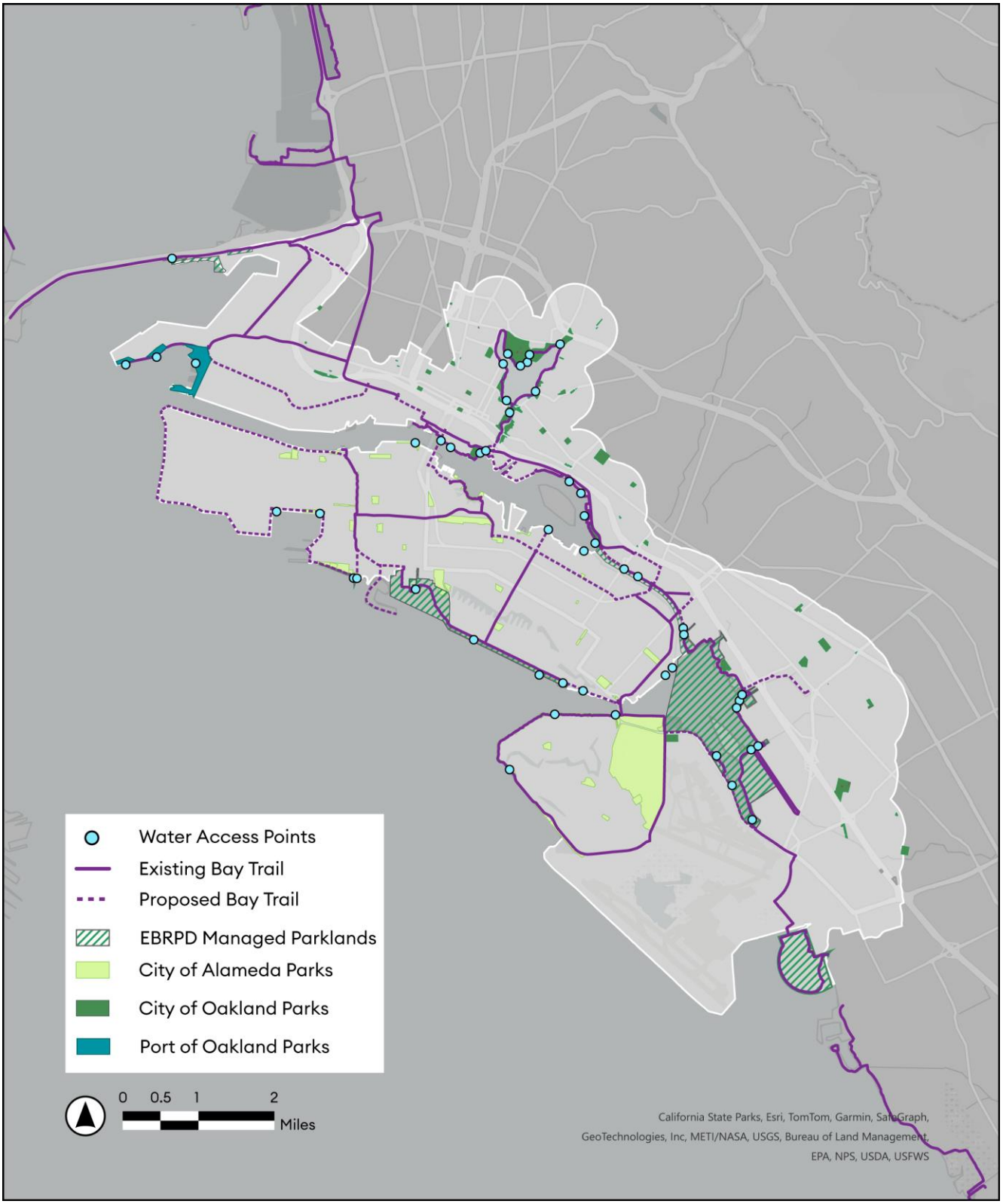


Figure 3-53. Parks and Open Space

Source: (EBRPD, City of Alameda, City of Oakland, Metropolitan Transportation Commission 2024)

3.7.3.1 Oakland Parks

There are approximately 58 parks spread across 470 acres of parks operated by the City of Oakland within the Subregion.

It is important to note that the boundary of the Subregion as it cuts through West Oakland circumvents the inclusion of nearby and critical community assets such as Lowell Park, Raimondi Park and DeFremery Park, which houses the DeFremery Swimming Pool. The boundary of the Subregion as it extends around the western and northern edges of Lake Merritt also includes parks and open spaces that are much farther from the Bay shoreline than parks located in West Oakland that are outside of the Subregion.

Parks within the Oakland side of the Subregion vary in character and size. The City of Oakland classifies parks into different categories by area and numbers of users served (City of Oakland 1996). There are six formal categories of parks within this classification system; GIS data provided by the City of Oakland in 2023 also includes categories for plazas and athletic fields.

Region-serving parks (25 acres or larger) are the largest and broadest serving park typology in Oakland**.** These parks are defined as large recreation areas with diverse natural and built features that have a citywide service area. According to GIS data available in 2023, there are no parks classified as region-serving in the Subregion, though, if combined into a single entity, the various individual parks and recreation amenities surrounding and connected to Lake Merritt would easily fit this classification.

Community Parks (5-20 acres) are large natural and/or landscaped areas with active recreation which usually serve a cluster of neighborhoods within a 0.5-mile radius. There are five parks classified as Community Parks within the Subregion.

- **Estuary Park** (5 Embarcadero, Oakland) is a 7-acre community park adjacent to the Oakland-Alameda Estuary. Amenities include a multi-use field for soccer and other team sports, two public boat launches, picnic areas and a fishing pier. The Park also houses the Jack London Aquatic Center, which offers boat and equipment storage of community programs, rowing and dragon boat clubs and boating programming operated by the Oakland's Department of Parks, Recreation and Youth Development (OPYRD). The Aquatic Center building also serves as a community center and reservable events center, which is available to rent for special events. Estuary Park is undergoing a master-planning and renovation effort (WRT 2023). A portion of t Bay Trail runs through Estuary Park (Metropolitan Transportation Commission 2021).
- **Lake Merritt** is a tidal slough in the center of Oakland. Ringed by a walking path sometimes referred to as the Lake Merritt Trail, the circumference of the lake is 3.4 miles, while the Lake itself covers almost 155 acres (City of Oakland). The lake is the oldest wildlife refuge in North America and is home to large populations of waterbirds as well as migratory birds. There are multiple amenities that surround the lakeshore, including Lakeside Gardens, the Rotary Nature Center, the Lake Merritt Boating Center, and Children's Fairyland. Parks of different sizes are nestled around the perimeter of the park, ranging from mini-parks and special use parks such as the Cleveland Cascade, to the larger Splash Pad Park and Lakeside Park.
- **Peralta Park** is located at the south end of Lake Merritt, between 10th and 12th Streets to the west of the Lake Merritt Channel. It is adjacent to the Henry J. Kaiser Convention Center and the Oakland Museum of California. Major improvements funded by Measure DD improved pedestrian and bicycle connections, and opened the connection between the lake and the

channel (City of Oakland 2014a). The park includes an informal amphitheater and a segment of the Bay Trail.

Neighborhood parks (~2-10 acres) are a scaled-down version of community parks that are typically located within residential areas within walking distance of their primary users. Within the Subregion, neighborhood parks include:

- **Jefferson Square Park**, (618 Jefferson Street, Oakland), is a 1.51-acre neighborhood park that contains a playground, a ballfield, a basketball court, and a fenced dog play area.
- **South Prescott Park** (3rd Street/Chester Avenue, Oakland) is an approximately 4.6-acre neighborhood park that contains a playground and large lawns.
- **Madison Square Park**, (810 Jackson Street, Oakland), is a 1.38-acre neighborhood park that contains lawns, a playground, blacktop play areas, and a labyrinth. Madison Square Park is the site of early morning tai chi and other exercise programs.
- **The Lincoln Square Recreation Center**, (261 11th Street, Oakland), is a part of Lincoln Square Park, a 1.38-acre neighborhood park that includes playgrounds, outdoor basketball courts, chess tables, a small soccer area, and a community garden. The Lincoln Square Recreation Center building contains an indoor gymnasium, community space, and outdoor murals, and averages 2,000 users per day (ESA 2021).
- **Union Point Park,** a 10-acre waterfront park that offers views of the Estuary and nearby marinas, as well as access to the water. The park was developed in 2005 and expanded in 2010. The park's design is intended to encourage flexible use, including passive recreation, sport, and other water-related activities. The Bay Trail runs through this park (City of Oakland 2013).
- **Columbian Gardens Park** (9920 Empire Road)

Active mini-parks & passive mini-parks (<1 acre) are typically located in high density neighborhoods and serve a specific group of people, usually play structures for small children, within 0.125 miles of a neighborhood, while passive mini-parks are small landscaped areas (<1 acre) located adjacent to or in the center of streets. Mini parks within the Subregion include:

- **Fruitvale Bridge Park** (3205 Alameda Ave) Also known as Fruitvale Mini park, this park is located below the Fruitvale Bridge between Oakland and Alameda and offers a view of the drawbridge as well as the Estuary. Facilities include a fishing pier and seating. A portion of the existing Bay Trail runs through the park and ends in a small gap across Fruitvale Avenue (Metropolitan Transportation Commission 2021).
- **66th Avenue Gateway Park** was funded as part of Measure DD. The park was designed to function as "a connection between neighborhoods and the waterfront" and includes a sculpture, native California planting as well as a portion of the Bay Trail (Waterfront Action).

Linear parks protect and provide linear access to a natural feature, such as the shoreline, or provide a connection between two points. Linear parks within the Subregion include:

- **Channel Park (1 10th St)** begins south of Peralta Park, from 10th Street to the I-880 Freeway. This park also referred to as Lake Merritt Channel Park and Estuary Channel Park. The Park runs along the Lake Merritt Channel, through Laney College and Peralta District Administrative Complex. The Channel Park is mostly for passive recreation and includes numerous art

sculptures. It is adjacent to Peralta Park and is separated by the East 10th Street Bridge. The Lake Merritt Trail extends through Channel Park toward the Estuary but falls short of directly connecting to the existing Bay Trail along Embarcadero. The Lake Merritt to Bay Trail Connection Gap Closure Project aims to eliminate this gap and as of 2017 the city had compiled a draft Design Guidelines document for the connection (City of Oakland 2017c).

Special use parks are areas for specialized or single purpose activities and may include city squares that serve an aesthetic function and may also have cultural or historical significance. Special parks within the Subregion include:

- **Chinese Garden Park**, (7th Street & Harrison, Oakland), is a 1.48-acre special use park that includes a community center currently used for childcare, a courtyard garden, and a small pagoda and pavilion. The park also features a Hall of Pioneers and Sun Yat Sen Memorial Hall, which serves as the Hong Lok Senior Center, a drop in-center for seniors ages 55 years and older, and as a general social hall and community garden (City of Oakland 2014a).
- **Lafayette Square Park**, (635 11th Street, Oakland), is a 1.36-acre special use park and designated Oakland Landmark that contains a playground, lawns, tables with built-in chess boards, and picnic areas (City of Oakland 2014a).

Other Public Open Space Areas within the subregion in Oakland include:

- **Jack London Square** is owned by the Port of Oakland and comprises of **"**fifteen square blocks of commercial and recreational activities, including opportunities for dining and shopping, strolling, ferry rides, and special events…" (Port of Oakland 2023). Jack London Square hosts regular events, such as a farmer's market and holiday observances. Franklin D. Roosevelt Fishing Pier is located within Jack London Square, as well as a mini park at Alice Street. Within the district there are restaurants, bars, shops, and private marinas. Publicly accessible amenities include guest berths, plazas, play areas, public restrooms, public seating, and a portion of the Bay Trail. The Oakland Ferry Terminal, also referred to as the Jack London Ferry Terminal, is located at the western edge of the region next to the Howard Terminal site; the Jack London Amtrak Station is located on the eastern region of the area. Jack London Square is within the planning region for the Downtown Oakland Specific Plan as well as the Oakland Alameda Access Project (Caltrans and ACTC 2021).
- **Privately owned, publicly accessible spaces** such as **Township Commons at Brooklyn Basin** in Oakland**.**
- Open spaces and recreational facilities at community college campuses such as the Laney College and other properties owned by the Peralta Community College District.

3.7.3.2 Alameda Parks

The City of Alameda operates 24 parks and recreational facilities that are spread across 580 acres of parkland (City of Alameda 2023b). All of Alameda's parks and public recreation facilities lie within the Subregion and, due to the island's narrow footprint, are never more than a mile away from a shoreline.

Public parks immediately on the shoreline of Alameda include:

- **Bohol Circle Immigrant Park** (2901 5th Street); features & facilities include a playground, restrooms, a picnic area and several types of trails (City of Alameda 2023c). The park was created in 1965 by member of Bohol Circle Inc., the first and oldest Filipino-American organization in the United States. Members pooled money to purchase land for a cultural space supporting recently emigrated Filipino American families.

- **Estuary Park** (201 Mosley Avenue); facilities include athletic fields designed for people of all ages & abilities (City of Alameda 2024a).
- **Shoreline Park** (198 Packet Landing Road)**;** established in 1978, this park is located on Bay Farm Island and provides views of the San Francisco Bay and San Francisco Shoreline. Amenities include restrooms, paved walking trails and rentable picnic spaces (City of Alameda 2024b).
- **Seaplane Lagoon Promenade** (1801 Ferry Point); amenities include picnic areas, restrooms, paved trails for bikes and pedestrians and views of the San Francisco Bay (City of Alameda 2024c).
- **Towata Park** (3315 Bridgeview Isle); a small park at the foot of the Bay Farm Island Bridge with picnic tables (City of Alameda).
- **Alameda Point Multipurpose Field** (1101 West Redline Avenue);
- **Main Street Dog Park** (Main Street next to the Alameda Main Street Ferry Terminal)**;**

Other Public Open Space areas within the subregion in Alameda include:

- Open spaces and recreational facilities at community college campuses such as the **College of Alameda;**
- Open spaces within office parks such as the waterfront business parks along Atlantic Avenue; the open spaces and squares integrated into new housing developments in West Alameda; and squares and open spaces that currently punctuate the Alameda Naval Base and Alameda Point areas;
- **Privately owned, publicly accessible spaces** such as the **Wind River Park in Alameda, and on** a smaller scale, the lawns, and open spaces fronting marinas in Alameda, such as the large lawn at Dock Q;
- **Corica Park Golf Course.**

3.7.3.3 East Bay Regional Parks District

The East Bay Regional Parks District (EBRPD) is responsible for approximately 1200 acres of open space within the Subregion. Significant parks include the following properties.

Robert W. Crown Memorial State includes a 2.5-mile-long beach with approximately 70 acres of sandy beach and sand dunes and open space conducive for swimming, non-motorized boating, windsurfing, picnicking, and fishing. Crown Beach is one of only two sandy beaches in the East Bay that are suitable for swimming and wading and is the longest contiguous stretch of sandy beach in the San Francisco Bay (East Bay Regional Parks District 2015). Though EBRPD operates Crown Beach, the northern section of the park that includes the Crab Cove Visitor Center is owned by California State Park, while the southern reach of the park along Shoreline Drive is owned by the City of Alameda. Neither landowner provides funding for the park, except for a shared cost with the city for annual beach maintenance (East Bay Regional Parks District 2015). Prior vulnerability and risk assessment by EBRPD notes that the shoreline recreation opportunities offered at Crab Cove are unique. At the Crab Cove Visitor's Center, "Naturalists use an accessible tide ramp to introduce visitors to tidal species" while nearby small-craft launches are suitable for kayaks, standup paddle boats, and rowing boats. Crab Cove, a marine reserve, is located at the north end of Crown Beach; the Doug Siden Visitor Center

at Crab Cove offers an aquarium and exhibits as well as other community programming. **The Elsie Roemer Bird Sanctuary** is located at the east end of Crown Memorial State Beach (East Bay Regional Parks District 2023b). EBRPD estimates that visitation at Damon Slough staging area in MLK Shoreline had a low in December 2022 of 2,500 monthly visitors, and a high of 5,000 monthly visitors in April 2023. Visitors have slightly declined since April and are about 3,000 monthly visitors as of November 1, 2023.

The **Martin Luther King, Jr. Regional Shoreline** is a sprawling park that rings San Leandro Bay. The 748 acres of open space are leased from the Port of Oakland (East Bay Regional Parks District 2024a). This shoreline park is a regional amenity and is one of the few sites for waterfront recreation in the area (City of Oakland 2015b). While the area surrounding the park is largely urbanized in character, there are several existing creeks and sloughs (Damon Slough, Elmhurst Creek, East Creek Slough, and San Leandro Creek). Within the Martin Luther King, Jr. Shoreline park is **San Leandro Creek,** which provides important habitat for several wildlife species within the San Leandro Bay. The creek channel is roughly 140 feet wide where it enters San Leandro Bay. The creek is surrounded by business parks and is also hugged by both San Leandro Creek Trail East and West, which are part of the Regional Shoreline. The creek and the surrounding Bay and marshes provide important aquatic, intertidal and marsh habitat used by migratory birds traveling along the Pacific Flyway (City of Oakland 2015b). Other sites within the larger shoreline include **Arrowhead Marsh**, a 50-acre marsh that is part of the Western Hemisphere Shorebird Reserve Network; the **Tidewater Boating Center and Tidewater Staging Area;** and the **Doolittle Pond Wildlife Sanctuary**. **Edgewater Seasonal Wetland**, a restored eight-acre wetland created as a mitigation project by the Port of Oakland, is part of the larger Martin Luther King, Jr. Regional Shoreline as well. This site offers habitat for many marsh-dwelling species, including the federally and state listed endangered Ridgway's Rail (formerly known as the California clapper rail) and the salt-marsh harvest mouse. In 2012, the Port of Oakland transferred this land to the EBRPD for long-term management as a wetland (City of Oakland 2015b).

Oyster Bay Regional Shoreline includes a rolling landscape of berms and turf interspersed with multipurpose trails. The park has been opened in phases; as of 2023, the Bay Trail extends for two uninterrupted miles around the shoreline perimeter and site amenities include bathrooms, a large sculpture, picnic areas, an 18-hole disc golf course and a pollinator-supportive garden aimed at overwintering Monarch butterflies. The park is built on a former landfill that was closed in the early 1970s and continuing development of the park is guided by the Oyster Bay Regional Shoreline Land Use Plan Amendment (2013). A bicycle park area that includes a pump track, jump park, and skills area is in early development stages and requires funding for design and construction (East Bay Regional Parks District 2023c, 2024b). EBRPD estimates that Oyster Bay had 10,000 monthly visits in December 2022, a high of 17,000 visitors in April 2023. And a decline to 12,000 visitors on November 1. So, Oyster Bay has more visitors than MLK Shoreline.

Judge John Sutter Regional Shoreline is in Oakland at the touchdown of the eastern span of the Bay Bridge. The park occupies 22 acres and has sweeping vistas of the San Francisco Bay and skyline (East Bay Regional Parks District). Park amenities include an observation pier and trail, the Bay Bridge Trail, which connects the East Bay to Yerba Buena Island, and the Bridge Yard Building, a reservable venue.

3.7.3.4 Port of Oakland

The Port of Oakland operates the following parks within the Subregion, including:

- **Middle Harbor Shoreline Park in Oakland** is a 38-acre shoreline park. The park boasts more than two miles of paths that wind through the Middle Harbor Basin. The Port notes that the park also houses Oakland's first public beach. Other amenities include an amphitheater, an educational viewing tower and picnic/BBQ areas. Activities such as birdwatching and fishing are encouraged. The park is also the site for an ambitious habitat restoration project that aims to restore around 150-acres of water area to integrate the harbor and park, providing habitat for native species such as the Dungeness crab. The park was the former site of the Oakland Naval Supply Depot, which operated until it was transferred to the Port of Oakland in 1998 (Port of Oakland).
- **Port View Park in Oakland** is a 4.5-acre park offers views of the working Port of Oakland and Seventh Street Terminals as well as views of the San Francisco Bay and skyline. The park was extensively renovated after the 1989 earthquake. Amenities include public access for fishing, walking, picnics, and events; there is a fishing pier, picnic areas, a play area, restrooms, and a viewing area. The park also houses the International Maritime Center, described by the Port as "a nondenominational chapel and recreational facility for visiting seafarers" (Port of Oakland 2023b).

Additionally, through the Tidelands Trust and the Oakland City Charter, the Port of Oakland is given "the responsibility to own, develop and manage lands along the Estuary on behalf of the California State Lands Commission. Through this role, the Port can plan for, permit, and manage development in parts of the Central Estuary governed by the Tidelands Trust. Specifically, the Port acts as the owner of Embarcadero Cove and areas on either side of Embarcadero to the west of Dennison Street. The Port also owns Union Point Park, including the Cryer Site Waterfront Park expansion; these properties are leased to the City of Oakland to provide this park" (City of Oakland 2014a).

3.7.3.5 San Francisco Bay Area Water Trail

The San Francisco Bay Area Water Trail (Water Trail) is a series of launching and landing sites ringing the Bay and its major tributaries, including the Petaluma River, Napa River, and San Joaquin River. These sites, or "trailheads", are geared toward non-motorized small crafts such as kayaks, sailboards, dragon boats and stand-up paddleboards. There are presently 47 sites officially designated as part of the Water Trail; this number is expected to expand as new facilities are created over time.

Out of the nine Water Trail trailheads officially designated in Alameda County, at least four formally designated sites are located within the Subregion: Estuary Park and Tidewater Boating Center are officially designated sites in Oakland; Encinal Beach & Crown Beach are officially designated sites within the City of Alameda. All four sites are heavily utilized by individual users as well as community organizations. Launch types, accessibility and owner/operator vary by site:

- **Oakland's Estuary Park**, and within it, the Jack London Aquatic Center, offers an ADA-compliant low-freeboard dock & ramp, and a high-freeboard dock. Managed by the City of Oakland, the low-freeboard dock is popular with non-motorized small crafts. Community organizations have access to equipment storage through the Aquatic Center.
- **Tidewater Boating Center** in Oakland offers a large low-freeboard dock with ADA access via a gangway. The center offers community amenities such as a boathouse, storage facility and a

training center and is managed by the East Bay Regional Park District. Local organizations and EBRPD utilize the site for programming such as environmental education, school outreach and recreation programs for the general public. This site is considered part of the Martin Luther King, Jr. Regional Shoreline.

- **Encinal Beach & boat launch** in Alameda offers launches from the beach, a cement boat ramp and a seasonally available high-freeboard dock. The San Francisco Bay Water Trail notes that the facilities are popular with the community, particularly non-motorized small craft users, as well as fishers. The path of travel to the beach is paved from the parking lot, but there is no accessible pathway on the beach itself.
- **Crown Beach in Alameda** is managed by the East Bay Regional Parks District. The launch type is beach. Due to its more exposed location and frequent winds, Crown Beach is favored by boardsailors and kiteboarders. It is also used as a trans-bay launch point to San Francisco. The beach itself does not have an accessible path, but East Bay Regional Park District provides free beach wheelchairs.

Additional existing sites with potential Water Trail designation include the upgraded Doolittle Boat Launch along Doolittle Drive, part of the Martin Luther King Jr. Regional Shoreline (East Bay Regional Parks District 2020; Fitzhugh-Craig 2023), as well as the small craft launch at the City of Alameda's Bohol Circle Immigrant Park.

Once built, a small craft launch bundled with marina improvements proposed as part of the Brooklyn Basin Marina Expansion Project (ESA 2022) could become an additional designated Water Trail trailhead.

Data Gaps:

- Detailed data about park usage, including number of households & families served; preliminary usage information from EBRPD is included in report but is limited to MLK Jr. Regional Shoreline in comparison to Oyster Point.
- Additional information about smaller and less visible parks and recreation amenities operated by the Port of Oakland. Currently we do not have GIS information for the parks we do know about (i.e., Middle Harbor Shoreline Park, etc.).
- Maps currently excluding spaces that are not publicly owned and operated - GIS data not available at present.
- Additional detail for site types such as:
  - Private golf courses such as Metropolitan Golf Links Course
  - Community gardens such as City Slicker Farms
  - POPOs – particularly around marina open spaces
  - Large retention/detention facilities that function as open space, such as a large pond near Estuary Park in Oakland
- More current, neighborhood and community driven projects in the subregion such as
  - LCTI: Power the People: MLK Jr. Shoreline Access Study

3.8 New Development and Planned Redevelopment

There are many development and redevelopment projects envisioned, planned or under construction in the Subregion. The following summary attempts to capture the larger projects that may be affected by sea level rise and the near-term and long-term adaptation strategies within the Subregion, and/or whose planned sea level rise adaptation strategies may influence the near- and long-term adaptation strategies developed for the Subregion.

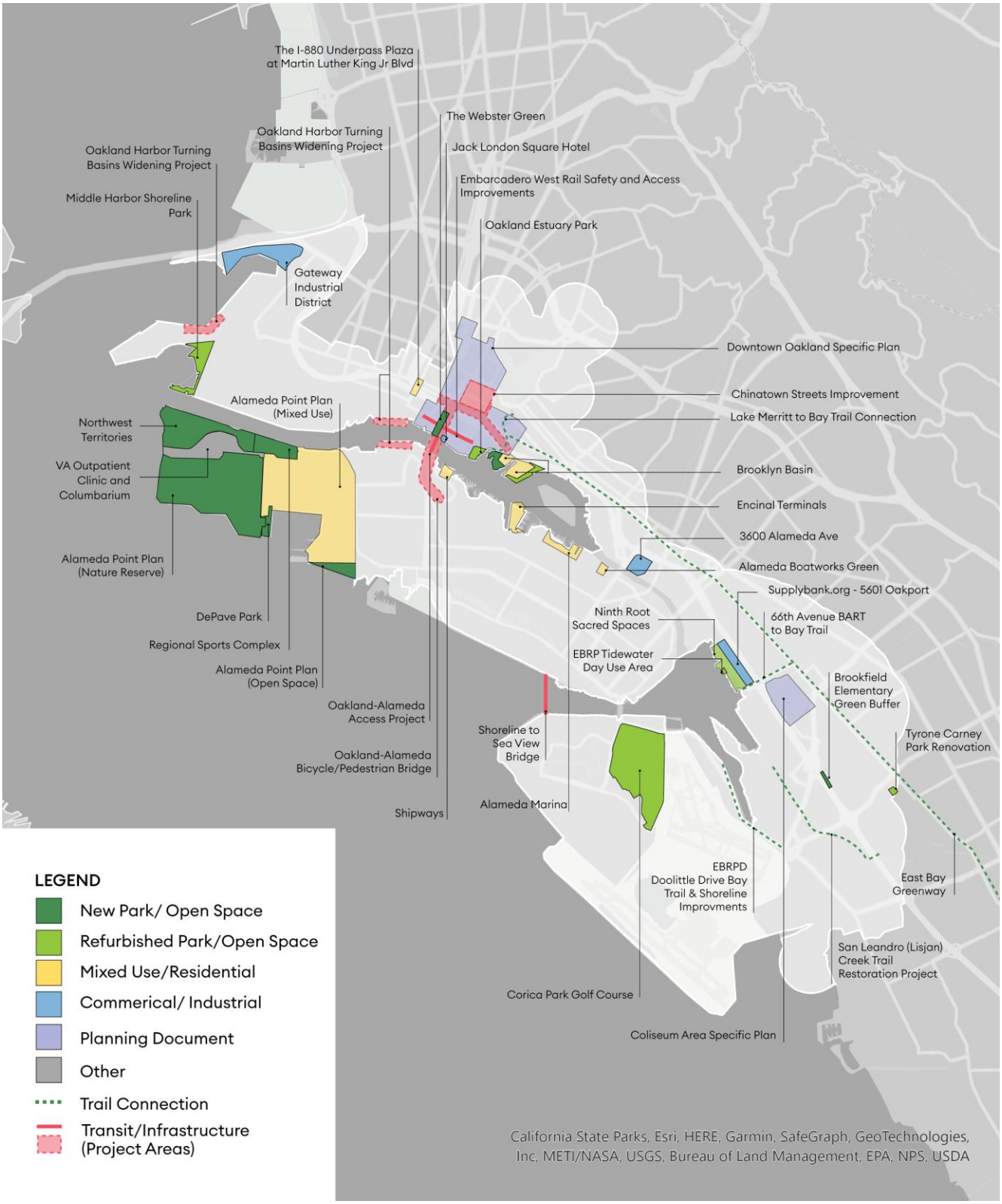


Figure 3-54. New Development and Planned Redevelopment Sites

Source: (City of Alameda; City of Oakland; EBRPD; Port of Oakland; BCDC; SF YIMBY)

3.8.1 Mixed Use & Residential

3.8.1.1 Brooklyn Basin - Oakland

Brooklyn Basin consists of approximately 64 acres of waterfront property, including residential, and commercial development, public space, and an existing wetlands restoration area. Construction began in 2016 and is planned to be built out in four phases over a 17-year period. The project includes two flood-protection strategies: a perimeter protection component along the shoreline; and a requirement for the interior grades of buildings. The shoreline edge is proposed to be 3 feet above the current 100-year water level. The development plan proposes a minimum interior floor elevation of structures to be 3 feet above the current 100-year water level (City of Oakland 2017a).

3.8.1.2 Alameda Marina – Alameda

Alameda Marina (Clement Avenue between Alameda Marina Drive and Willow Street). The Alameda Marina Master Plan was approved by City Council in 2018 to construct a mixed-use development along the Northern Waterfront. The development is proposed to construct approximately 760 housing units and up to 150,000 square feet of commercial uses and waterfront public parks. Most of the project site is located outside of the 100-year FEMA floodplain with small portions of existing grade below elevation 4 and within the floodplain. The master plan includes shoreline improvements to provide long term flood protection along with new waterfront public access. The shoreline will be reconstructed as a revetment, sloped with riprap. Specific areas with limited constraints will be preserved or new seawall/bulkhead will be installed. Public access areas and building foundation elevations are proposed to provide protection against a minimum of 36-inches of sea level rise. Shoreline will be designed to accommodate future adaptive measures to meet potential sea level rise exceeding 36-inches. A new stormwater management system will be constructed, including new outfall structures to the Oakland Estuary. The new system will include measures to improve water quality including bio-filtration planters, bio-filtration basins, infiltration areas, permeable paving, and trash capture devices (Alameda Marina 2018)

3.8.1.3 Alameda Point – – City of Alameda

> *"Alameda Point is considered one of the best remaining development opportunities for large-scale development in the East Bay, with an inspirational setting overlooking the Bay Bridge and the San Francisco skyline. Over 100 businesses, employing more than 1,000 workers, are currently located there, benefiting from the large industrial buildings with adjacent deep-water access. The City is managing the planning and development for Alameda Point—part of the former Naval Air Station Alameda—to create a strong employment and commercial base with a mix of commercial, residential, open space, recreational, and retail uses."* (City of Alameda 2020; Alameda Point Partners 2022)

The Master Infrastructure Plan (MIP) included flood protection requirements to raise elevations within the development area, provide a perimeter flood protection berm surrounding the historic core and managed retreat within proposed open spaces, like De-Pave Park and Northwest Territories (see section 3.8.2 below). The City has created a Community Facilities District for Alameda Point to provide a funding mechanism to support additional adaptation measures should future sea level rise exceed

current projections. The 2020 MIP amendment revised the site grading to align with Alameda's CARP vulnerability assessment, including setting minimum elevations of perimeter protection devices to 8.9 for revetments and headwalls in the Eastern Seaplane Lagoon and West and North Project boundary. The minimum elevation at the Southwest Project Boundary and Existing Piers is 11.9. Requirements for new infrastructure construction have been put in place to minimize potential flooding from rising groundwater (City of Alameda 2020). Additional planned projects at varying stages of development within this area include VA Outpatient Clinic and Columbarium; EBRPD's Northwest Territories Regional Shoreline; City of Alameda's Regional Sports Complex; and City of Alameda's DePave Park.

The planned open spaces at Alameda Point also include a nature reserve – the Least Tern Preservation Area.

3.8.1.4 Shipways – – City of Alameda

Shipways (1100-1250 Marina Village Pkwy).

> *The proposed project encompasses 8.1 acres at 1100-1250 Marina Village Parkway in the city of Alameda. The project would demolish existing historic but defunct shipways structures including existing offices and develop a 292-unit residential apartment complex, associated leasing office and common areas, 497 parking spaces mostly in an internal parking structure, and a 2.5-acre public waterfront park. The waterfront park would include an extensions of the Bay Trail, a kayak launch, and a pier to accommodate a water shuttle, in addition to other public amenities. (City of Alameda 2018c)*

Development plans from 2019 indicate that the residential buildings and parking structures must accommodate up to three feet of sea level rise and meet federal flood insurance requirements (Thomas and Barrera 2019).

3.8.1.5 Encinal Terminals – City of Alameda

Encinal Terminals (1521 Buena Vista Avenue). Transformation of existing 23-acre site into residential mixed-use neighborhood with approximately 4.5 acres of waterfront public space and up to 589 housing units. The elevation of streets, public spaces and building sites to be raised to a minimum elevation of 13.0, to withstand 36-inches of sea level rise. To protect the site from sea level rise above 36 inches, the developer will design and provide a funding mechanism to implement additional protection measures when required. The costs of the adaptive management strategy shall be included in an assessment district, community facilities district, or a Geologic Hazards Abatement District established to fund the maintenance of the Public Trust Lands. These potential adaptive measures would adjust the perimeter of the project site through the construction of seawalls, earthen berms, raised platforms, or storm drain system improvements (North Waterfront Cove LLC 2022).

3.8.1.6 Alameda Boatworks – City of Alameda

Alameda Boatworks Green (2229-2235 Clement Ave) is a residential project. Per the

> *The proposed project would demolish all existing structures and construct approximately 242 housing units on the site, 25 percent of which would be affordable to low-and very low-income households, as well as public open space along the waterfront. The project would include single-family homes and duplexes. All buildings would be three stories tall, with rectangular*

floor plans and building footprints would range from 860 square feet to 2,665 sf of floor area. The development of the site would provide vehicle access through the site through its internal roadway system that would include a network of private roadways. Access points would connect at Clement Avenue and Oak Street. The Oak Street connection would include a full access intersection, aligning with Blanding Avenue. The project proposes to build a small boat marina with ~ 36 berths. The berths would be located along the entire waterfront of the project site. The slip sizes would range from 30 to 50 feet and the average slip length would be 35 feet. There would be no vehicle access to the boat marina or new boat launch location.

Information not found for adaptation planning on this site. The current status of the project is unclear.

3.8.1.7 Additional Planned Projects

There are multiple infill and redevelopment projects planned in the Jack London district in Oakland. Planned projects include the following:

- 419 4th Street, Jack London District, Oakland (YIMBY Team 2023, p. 4)
- 101 East 12th Street, Merritt, Oakland (Nelson 2022)
- 430 Broadway, Jack London District, Oakland (Nelson 2023a)
- 55 Broadway, Jack London District, Oakland (YIMBY Team 2022a)
- 335 3rd Street, Jack London District, Oakland (YIMBY Team 2022b)

3.8.2 Parks & Open Space

3.8.2.1 Middle Harbor Shoreline Park - Oakland

Middle Harbor Shoreline Park is a 38-acre shoreline public park built and operated by the Port of Oakland, encircling Middle Harbor Basin. Originating in 2019, the Master Plan Update focuses on the physical features of the park and propose updates to address changing conditions like sea-level rise, technology, and access. Three alternative designs for the park were presented to the public for input in Spring 2021. The Port reviewed the concepts with BCDC's Design Review Board starting in 2021 and 2022 (Goldzband and Gaffney 2022; Port of Oakland).

The 2019 Port of Oakland Sea Level Rise Assessment includes an assessment of the Middle Harbor Shoreline Park, noting the initial exposure as flooding resulting from 2 feet of sea level rise and the 100-year storm tide in the year 2050, and the point of daily tidal inundation at an increase in the level of mean higher high water of 5.5 feet in 2100. Proposed adaptation strategies included: enhancing the existing dunes; adding a living shoreline south of the park, elevating the street, constructing a seawall, armoring the shoreline along the peninsula of Middle Harbor Shoreline Park (Port of Oakland 2019).

3.8.2.2 Estuary Park - Oakland

Oakland Estuary Park is a seven-acre park located on the Estuary at the mouth of the Lake Merritt Channel. The existing park will expand to eleven acres with the addition of property to the northwest. The Estuary Park Renovation and Expansion Project was proposed beginning in the 1990's; funding through Oakland's Measure DD was approved in 2016; public engagement began on the project in 2018; and the draft Master Plan released in May 2023.

The sea level rise adaptation measures for the park have focused on elevating most of the program areas to the 6-foot City of Oakland elevation (11.7 feet NAVD) to mitigate flooding until approximately 2070. Portions of the park will remain below the 6-foot City of Oakland elevation to conform with existing elevations within the site, including portions of the Bay Trail, the Jack London Aquatic Center building and the existing EBMUD dichlorination facility. The southern shore of the park will be reconstructed as a gravel beach, bracketed on the east and west by rip-rap shore-retention structures. Existing grouted and non-engineered rip-rap shoreline structures will be replaced with engineered rock revetments.

Additional planning is needed to address sea-level rise adaptation for the Jack London Aquatic Center, the northeastern shoreline of the park, adjacent areas of the Bay Trail and boat-launch facilities, which are part of the Water Trail. A longer-term adaptation strategy for a 100-year planning horizon may include elevating critical elements of the park to 13.2 feet NAVD (WRT 2023).

3.8.2.3 Tidewater Day Use Area - Oakland

> *"The Martin Luther King Jr. Regional Shoreline Tidewater Day Use Area is located at the edge of the Oakland Estuary, a site that is already a popular destination for hikers, bicyclists, and rowers. A new 7-acre park expansion will provide a new recreational destination along the Oakland Estuary, with small and large group picnic spaces, a multi-use lawn, restroom facilities and a nature play area for children. A network of pathways will lead visitors through the park to gathering spaces for educational or recreational outings. The park will also serve as a staging area for hikers and bicyclists using the San Francisco Bay Trail and for small-craft boaters using the boat launch for the San Francisco Bay Water Trail." (East Bay Regional Parks District)*

3.8.2.4 Future Brooklyn Basin Parks – Oakland

Includes Shoreline Park (Township Commons Phase & Phase 2), Gateway Park, South Park & Channel Park (ROMA Design Group 2015). Parks will be built out in phases.

3.8.2.5 Northwest Territories – EBRPD

> *"The Park District is planning a new regional shoreline park on the northwest portion of the former Alameda Naval Air Station, also known as Alameda Point. Development of the 158-acre future park - which has a working name of Northwest Territories Regional Shoreline - will occur in phases and include an extension of the San Francisco Bay Trail. The Park District Board of Directors executed a Memorandum of Understanding with the City of Alameda in February of 2020 to cooperate in the development of the future park. A Final Site Plan will be available within two years after the lease is signed. An Interim Bay Trail is planned to be developed first." (East Bay Regional Parks District)*

3.8.2.6 DePave Park – City of Alameda

> *De-Pave Park is a 12-acre urban ecological park in which all existing concrete from a World War II-era runway at Alameda Point, previously Naval Air Station Alameda, will be removed to create tidal wetlands and wildlife habitat. This ecological open space is designed to adapt to sea level rise by inundating over time, creating additional wetlands. A raised boardwalk, accessible to people of all physical abilities, will provide opportunities for viewing shorebirds, waterfowl, and marine mammals in their natural habitat, as will trails and observation areas. This*

park is within walking and biking distance for many low-income residents, including a housing development for seniors and APC for formerly homeless families. Additionally, De-Pave Park is adjacent to VA wetlands that are not accessible to the public but will be viewed from De-Pave Park and provide additional habitat connectivity. De-Pave Park is located on the western edge of Seaplane Lagoon at Alameda Point. (Ott et al. 2023)

3.8.2.7 McKay Master Plan – Crown Beach Expansion – EBRPD

The McKay Master Plan is an expansion of Robert W. Crown Memorial State Beach in Alameda.

> *"The Park District is planning for 3.89 acres of new parkland at Robert W. Crown Memorial State Beach, as well as street improvements along McKay Avenue, in the City of Alameda. The project called the "McKay Master Plan" developed a conceptual plan for the area that provides new recreational amenities and increases shoreline resiliency. The Park District engaged in a multi-year (2020-2022) planning process to develop the McKay Master Plan. In addition to site analysis and design, this process included engaging the public through online surveys and pop-up events at the Park to solicit input on the overall vision for the area and feedback about layout and program. While the McKay Master Plan is intended to provide a long-term vision for the area, implementation of the plan will take place over a number of years. The concept plan is presented in three phases and includes adaptation strategies consistent with anticipated levels of sea-level rise within the time frames associated with each phase. There is currently no timeline for implementation." (East Bay Regional Parks District 2022)*

3.8.2.8 Corica Golf Course – City of Alameda

Corica Park Golf Course. Regrading and drainage improvements - Improvements to grading and drainage at the golf course have been implemented in recent years. Plans submitted by the applicant for most recent grading on the northern portion of the Golf Course have undergone floodplain review and are still in process awaiting resubmittal by applicant.

3.8.2.9 Additional planned projects

- Sweeney Park Aquatic Center – City of Alameda (City of Alameda 2024d)
- Regional Sports Complex – City of Alameda (MIG, Inc 2009)

3.8.3 Trails & Connections

3.8.3.1 Oakland-Alameda Bicycle/Pedestrian Bridge

> *"The Oakland-Alameda Estuary Bridge will create an improved connection for bicyclists and pedestrians moving between the cities of Oakland and Alameda. This connection will replace the substandard and deficient path in the State Route 260 Posey Tube with a world class facility connecting bicyclists and pedestrians to regional transit hubs, local businesses, recreational opportunities, and housing developments on both waterfronts of the Oakland Estuary." (Oakland Alameda Estuary Bridge 2023)*

The project is still in initial stages, and as of early 2024, only general concepts have been developed. Several potential locations are under evaluation. As of January 2023, the project FAQ lists three top location corridors:

> ***Western Corridor*** *provides access to Jack London Square area via Clay St, Washington St, or Broadway. On the Alameda side of the Estuary, the bridge ramping provides access from the intersection of 5th Street and Mitchell Avenue utilizing an existing dedicated right of way preserved for such purpose by the City of Alameda.*
>
> ***Central Corridor*** *provides access from the Bay Trail at Alice Street. This corridor also provides access to the Amtrak grade separated bridge over the Union Pacific Railroad tracks at Alice Street. On the Alameda side of the Estuary, the bridge ramping provides access from City of Alameda owned waterfront property adjacent to the Barnhill Marina.*
>
> ***Eastern Corridor*** *provides access from the City of Oakland waterfront park at the foot of Oak Street. On the Alameda side, access is provided from a City of Alameda waterfront Park and Bay Trail adjacent to Marina Village Parkway. (Bike Walk Alameda 2022)*

Regardless of the final location, the proposed bridge design opens for boat traffic and would require an on-site operator at all times; nearby precedents include the Fruitvale Rail Bridge and the Park Street Bridge. Construction is currently anticipated to begin in 2030, with most of the design work and project funding still to come.

3.8.3.2 *Lake Merritt To Bay Trail Connection*

The Lake Merritt to Bay Trail (LM2BT) Connection closes a major gap between the San Francisco Bay Trail and the regional pedestrian and bicycle transportation network, including the Lake Merritt trail. The project was initiated in 2014 and has selected and refined a location and layout for the bridge.

> *"Starting at the Lake Merritt Channel trail near 7th Street, the S-shaped bridge will thread under the I-880 freeway, and cross Lake Merritt Channel twice before flying over the Union Pacific Railroad tracks and the Embarcadero roadway… The LM2BT project will provide a safe, grade-separated, ADA accessible route that will connect two important trail systems and waterways in Oakland - the Lake Merritt / Channel trails, and the San Francisco Bay Trail system. The project will improve transportation and recreation options for people of all ages and abilities, as well as link neighborhoods and destinations such as transit stations, Jack London Square, Chinatown, Brooklyn Basin, and the Oakland Estuary…" (City of Oakland)*

As of early 2024, the project's website listed anticipated that construction on the project would begin in 2019. The project was reviewed by BCDC in 2019 (City of Oakland et al. 2019).

3.8.3.3 66th Avenue BART to Bay Trail

The 66th Avenue BART to Bay Trail project seeks to create a strong connection between the Martin Luther King Jr. Regional Shoreline for East Oakland residents to access the miles of biking and walking trails and other park resources.

Residents of East Oakland currently have no way to access this destination by foot or on bike. This green space is totally cut off from the low-income neighborhoods of East Oakland by the 880 Freeway, various railroad tracks, and wide swaths of industrial land. The nearest bicycle connection to the Oakland shoreline is on Fruitvale Avenue, and in the 4.2 miles between Fruitvale Avenue and the San Leandro City border, there is one pedestrian/bicycle bridge over the 880, close to 98th Avenue.

The project connects MLK Shoreline at 66th Avenue between San Leandro Street and Oakport Street.

the project will extend west past the entrance to the Oakland Coliseum at Coliseum Way, and over the Caltrans 880 freeway bridge to the entrance of the Shoreline and Bay Trail at the intersection of 66th Ave and Oakport Street. (City of Oakland 2022b)

The project builds upon upcoming projects such as the Coliseum Connections project, which provides a key segment of the East Bay Greenway (Alameda County Public Works Agency 2023).

3.8.3.4 San Leandro (Lisjan) Creek Trail/Greenway

The San Leandro Creek Trail Restoration Project between Hegenberger Road and 105th Avenue will create a 1.2-mile scenic, multi-use trail along the San Leandro Creek in Oakland. When completed, Class 1 trail will give walkers and bikers convenient access to the beautiful San Leandro Creek and provide a safe route for local residents to commute to nearby schools, parks, and the Bay front. This project also includes two new pedestrian bridges and traffic signals at Hegenberger Road and 98th Avenue to provide safe crossing at these busy intersections. (Alameda County Public Works Agency 2023)

3.8.3.5 East Bay Greenway – Oakland

The East Bay Greenway is a proposed regional multi-modal trail that will link East Bay BART stations. The Project will construct bicycle and pedestrian infrastructure that roughly parallels BART between the cities of Oakland, San Leandro, and Hayward. Once completed, the Greenway will link seven BART stations and provide safer transit options.

The first phase of the East Bay Greenway was completed in 2019. The first, half-mile phase connected Coliseum BART at 73rd Avenue to 85th Avenue. The City of Oakland reports that "The project installed a 12-foot-wide shared bicyclist and pedestrian path that parallels San Leandro St, as well as installed lighting, decorative fencing, crosswalks at 71st, 75th and 81st Aves, and an automatic bike/ped counter"

The upcoming Phase II extends the project on San Leandro from 69th Avenue to 75th Avenue (City of Oakland).

3.8.3.6 Shoreline to Sea View Bridge – Alameda, Bay Farm Island

The City of Alameda's 2021 General Plan proposed a new pedestrian bridge: the Shoreline to Seaview Bridge, connecting Park Street to Bay Farm Island at Seaview Parkway (City of Alameda 2022b). As of January 2024, no feasibility studies had been conducted for this proposal.

3.8.4 Commercial/Industrial

3.8.4.1 SupplyBank.org

Located at 5601 Oakport Street, Oakland

> *the five-story multi-purpose facility at 5601 Oakport Street along Oakland's waterfront. The project will create an expansive office building, supply warehouse, and additional structures across the 38.3-acre site. SupplyBank.org, an Oakland non-profit, is overseeing the project and will become its anchor tenant. The five-structure development will include an 85-foot tall office building rising five floors with 160,000 square feet, a 55-foot warehouse spanning 123,000 square feet, a 10,000 square foot workshop to replace the existing East Bay MUD weld shop, a 26,000 square foot rack structure, and a 12,000 square foot storage building. Capping the warehouse will be a rooftop urban farm. The garden will be cultivated in collaboration with local schools. (Nelson 2023b)*

The project site is directly adjacent to the 66th Avenue Gateway Park, Damon Slough and East Creek Slough.

3.8.4.2 3600 Alameda Avenue, Oakland

The 22-acre property is being developed on a speculative basis, with the assumption that the end use will be a distribution warehouse. Planning documents indicate that the structure will be 430,000 square feet, including 30,000 square feet of office area; 254 truck trailers will be accommodated on site, along with stalls for 284 cars and at least 32 bicycles. Demolition will be required for all structures currently standing on the property. Construction is expected to start in 2025 and finish seventeen months later (Nelson 2023c).

3.8.4.3 Jack London Square Hotel, Oakland

The as-yet unnamed hotel on Parcel F3 at the Jack London Square waterfront was approved in 2018 and received additional entitlement extensions due to the Covid-19 pandemic. Planning documents indicate that the structure will be 67-feet tall and comprise 95,960 square feet. Of that area, 87,090 square feet will be used for the hotel space, and 8,870 square feet will be used for a 23-car garage. Current plans show 155 hotel guest rooms. The exterior of the building will connect to the Bay Trail; planned improvements include *"an elevated boardwalk buffered by a garden space and meadow on either side. Cloistered by the gardens and the hotel will be the inner-block pool terrace… The 2.3-acre property is located along the San Francisco Bay Trail, close to Alice Street and the Oakland Jack London transit station…" (Nelson 2023d).*

3.8.5 Transit/Infrastructure

3.8.5.1 Oakland Harbor Turning Basins Widening Project

3.8.5.2 Oakland-Alameda Access Project

Oakland-Alameda Access Project (OAAP) a multi-agency partnership that proposes improvements to local roads and freeway access between the Posey/Webster Tubes that connect Oakland and Alameda.

The project aims to redirect and reduce “freeway-bound traffic within heavily populated pedestrian neighborhoods like Chinatown and construct safe and accessible bicycle and pedestrian facilities that will provide improved connectivity for all modes between Downtown Oakland, Chinatown, the Jack London District and Alameda” (Alameda County Transportation Commission 2024). Project proponents note that the planned improvements include improved bike lanes and pedestrian access through the tunnels themselves; however, bike advocates assert that the planned improvements will do little to improve the conditions that discourage riders from using the crossing as-is (Seibold 2011; Rudick 2016).

3.8.5.3 Embarcadero West Rail Safety and Access Improvements

Embarcadero West Rail Safety and Access Improvements aims to improve multi-modal safety & access along the one-mile city street that currently accommodates trains, motor vehicles and pedestrians without any physical barriers or separation. Planned improvements also aim to reduce freight and passenger rail times by eliminating delays due to vehicles getting stuck on the tracks (City of Oakland 2023). Planned improvements include:

- Reconstruct & upgrade crossings with safety infrastructure such as new railroad and pedestrian crossing arms and equipment, directional signage, pavement delineation, high-visibility crosswalks, bulb-outs, and intersection safety lighting;
- Install fencing for physical separation;
- Construct a multi-use path between Martin Luther King, Jr. Way, and Jefferson Street between Clay & Washington Street;
- Remove on-street parking Clay Street between Embarcadero West and 2nd Street;
- Eliminate left turns across railroad tracks & slowing vehicle speeds through traffic diverters;
- Install new traffic signals with preemption;
- Upgrades to segments perpendicular to rail, including lighting, street regrading, sidewalk widening and ADA improvements.

3.8.6 Other projects

- Oakland Harbor Turning Basins Widening Project (USACE 2023)
- Howard Terminal Redevelopment (ESA 2021; City of Oakland);
- Laney College Facilities & Technology Master Plan Updates (Steinberg et al. 2017);
- VA Alameda Point Multi-Specialty Outpatient Clinic and Columbarium (HDR 2021).

3.8.7 Planning Documents

3.8.7.1 Oakland Downtown Specific Plan

Oakland Downtown Specific Plan (City of Oakland 2019a) was released as a draft in 2019. The Plan proposes several strategies to address the health of the Downtown neighborhood through mobility, community connections and climate resiliency that intersect with adaptation planning efforts for the

Subregion. Proposed Public Realm improvements through the design of parks and public spaces include:

- **The Webster Green:** a linear public greenway between the Estuary Waterfront and I-880 to be constructed over the underground footprint of the Webster Tube. Parcels currently consist of surface parking lots.
- **I-880 Underpass Plaza at Martin Luther King Jr. Blvd:** a proposed park located on Caltrans lots currently used for bus storage and parking. The park would provide safer connections between downtown, Jack London Square and the Estuary.
- **The Green Loop:** a series of improvements to public spaces and active transportation infrastructure to improve connections between neighborhoods, transportation, and amenities.

Resilience Strategies for supporting Community Health goals by expanding climate resilience in the Downtown area:

- Require new developments to install and maintain stormwater detention systems to limit the amount of runoff.
- Require applicants to assess Sea Level Rise vulnerabilities; include shoreline protection measures and adaptation strategies as part of future development projects.
- Prepare a sea level rise strategy for the Plan Area as part of a regional strategy to address rising water levels in the San Francisco Bay, and coordinate with the City's broader climate adaptation efforts.
- Re-evaluate bay and inland flooding potential at key milestones in the specific plan's 20-year implementation horizon, to manage for changing sea level rise projections.

3.8.7.2 Coliseum Area Plan

Coliseum Area includes about 800 acres along I-880 and Hegenberger Road, the Coliseum Specific Plan Area lays out a guiding framework for redeveloping this site with important existing assets into a new urban district (City of Oakland 2015b). The plan explains that sea level rise is expected to affect the development site in various ways: temporary flooding during a storm event, permanent inundation in all conditions, disabling the site stormwater infrastructure system. The plan lays out policy goals for designing flood protection for multiple timelines:

- **Near Term**: Design flood protection for a potential 16-inch sea level rise above current Base Flood Elevation for mid-term planning and design (2050); and design gravity storm drain systems for 16 inches of sea level rise.
- **Mid-Term**: Design an adaptive approach for addressing sea level rise of greater than 18 inches, including incorporation of potential retreat space and setbacks for higher levels of shoreline protection, and design for livable/floodable areas along the shoreline in parks, walkways, and parking lots.
- **Long-Term**: Develop an adaptive management strategy to protect against greater levels of sea level rise of up to 66 inches, plus future storm surge scenarios and consideration of increased magnitude of precipitation events.

The plan includes a suite of adaptation strategies, to be incorporated into the design of future development projects:

- A shoreline protection system to accommodate a mid-term rise in sea level of 16 inches, with development setbacks to allow for further adaptation for higher sea level rise, with space for future storm water lift stations near outfall structures into the Bay and Estuary.
- Incorporation of a seawall along the rail tracks, east of the new Stadium and/or Ballpark sites.
- Inclusion of temporary floodways within parking lots, walkways, and roadways.
- Storm drainage system to be gravity drained for sea level rise up to 16 inches and pumped thereafter. Pumping should be secondary to protection.
- Require that all critical infrastructure sensitive to inundation be located above the 16-inch rise in base flood elevation.
- Design buildings to withstand periodic inundation and prohibit below grade habitable space in inundation zones.
- Construct building pads and vital infrastructure at elevations 36 inches higher than the present day 100-year return period water level in the Bay; add a 6-inch freeboard for finish floor elevations of buildings.
- Consider construction of a protection system, such as a "living levee", along Damon Slough, from its entry into the Plan Area at San Leandro Bay to its upstream confluence at Lion's Creek.

3.8.7.3 Oakland General Plan Update – Oakland 2045 General Plan

The City of Oakland is in the early stages of updating its General Plan. Phase 2 of the update will include updates to: Land Use and Transportation Element (LUTE); Open Space, Conservation and Recreation (OSCAR) Element; and the Infrastructure and Capital Facilities Element. Each Element will have an accompanying Racial Equity Impact Analysis and a corresponding update of the Zoning Code. The City states that goals of Phase 2 include:

> *Build a transportation system where everyone has access to safe and reliable options to get them where they need to go;*
>
> *Create more livable and walkable neighborhoods where folks have access to the things they want and need, like grocery stores, arts & entertainment, retail, libraries, and parks;*
>
> *Develop parks and recreational spaces, focusing on the most underserved neighborhoods, so that everyone can access and enjoy natural spaces;*
>
> *Protect neighborhoods adjacent to freeways, airports and industrial activities from excessive noise;*
>
> *Improve our city's infrastructure, from roads, bridges, and sidewalks to facilities such as public restrooms and fire stations;*
>
> *Identify and work to meet the needs of Oakland's many different, yet interconnected communities. (City of Oakland 2024)*

Phase 2 is scheduled to kick off in early 2024.

3.8.7.4 Additional Oakland Planning Documents

- Central Estuary Specific Plan (City of Oakland 2009, 2013);
- Lake Merritt Station Plan (City of Oakland 2014a);
- West Oakland Specific Plan (City of Oakland 2014b);
- Chinatown Complete Streets Plan (City of Oakland).

3.8.7.5 Data Gaps

Confirmation of parks and/or public realm projects planned or actively seeking funding within the subregion, particularly near the Oakland-Alameda Estuary Project Area and Bay Farm Island Project Area. The information in this area represents only a preliminary list of known projects that impact the project area and/or that include an adaptation component.

4 Oakland-Alameda Estuary

4.1 Overview of project

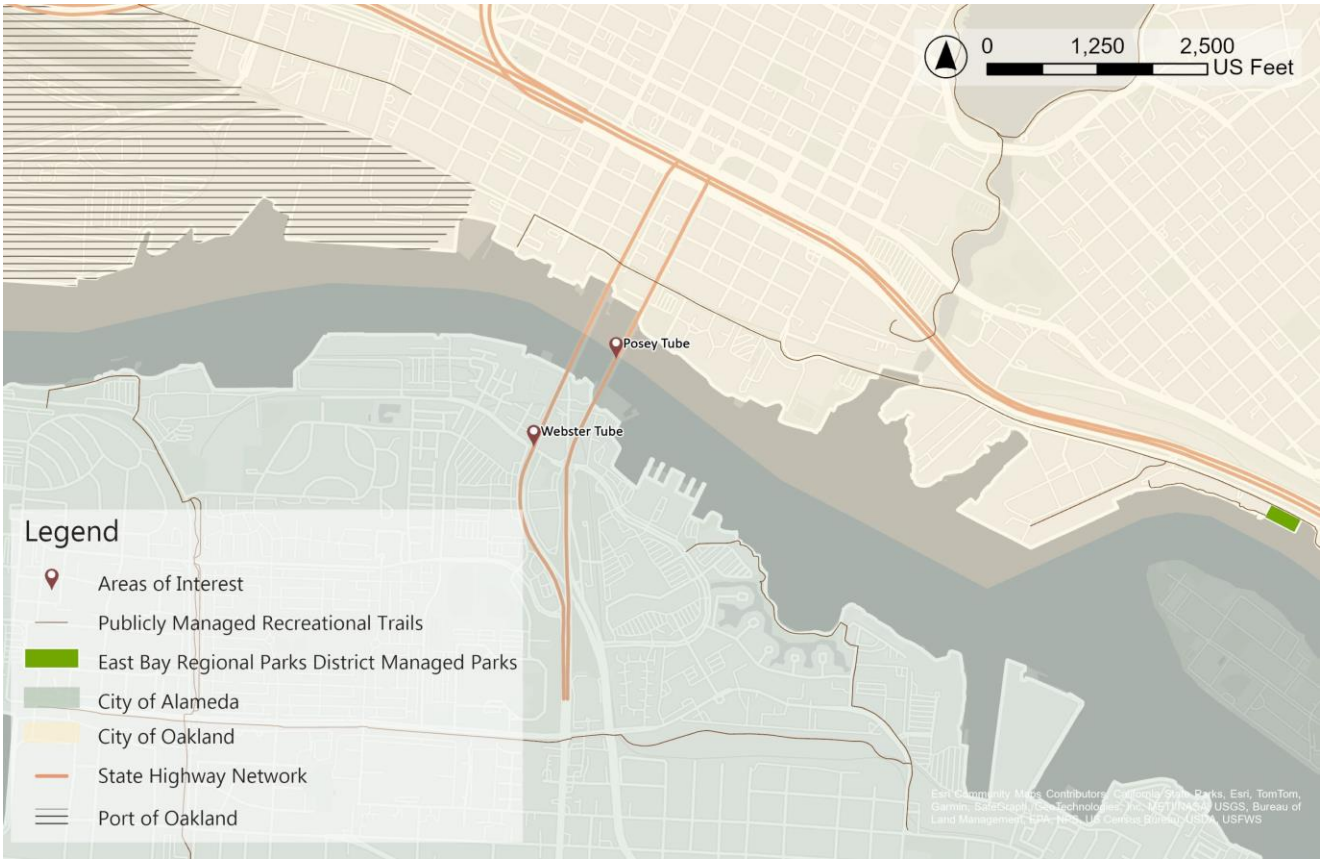


Figure 4-1. Oakland-Alameda Estuary Jurisdiction Boundaries

Source: (City of Oakland 2015a; Alameda County Open Data 2022; Caltrans 2022; East Bay Regional Parks District 2023a)

The Oakland-Alameda Estuary Project is the continuation of previous studies and planning effort, as summarized in the Climate Action and Resiliency Plan (CARP) 2022 Annual Report and 2023 Work Plan:

> *The Estuary Adaptation Project is located in the cities of Alameda and Oakland, near the Posey/Webster Tubes and downtown Oakland and Jack London Square. The Alameda shoreline near the Posey/Webster tubes was identified as a priority flooding location in Alameda's Climate Action and Adaptation Plan*
>
> *…*
>
> *The project will develop a concept in coordination with community members, stakeholders, and the City Councils of Oakland and Alameda to protect both the downtown Oakland shoreline and Alameda's northern shoreline by Marina Village - including the Posey/Webster Tubes, which is Caltrans State Route 260 property, and the San Francisco Bay Trail - from expected sea level rise and to reduce the impacts of flooding.*

4.1.1 Key Stakeholders

- City of Oakland;
- City of Alameda;
- Port of Oakland;
- Jack London Square (CIM Group, Tenants);
- Oakland Ferry Terminal (WETA);
- Caltrans;
- EBMUD.

4.1.2 Land Use

The project area includes a wide range of land uses to a variety of land uses and activities (Figure 3-2). The City of Alameda is mix of commercial, mixed use and residential including marinas and houseboat communities. The City of Oakland is primarily commercial and mixed use with some residential, and includes marinas.

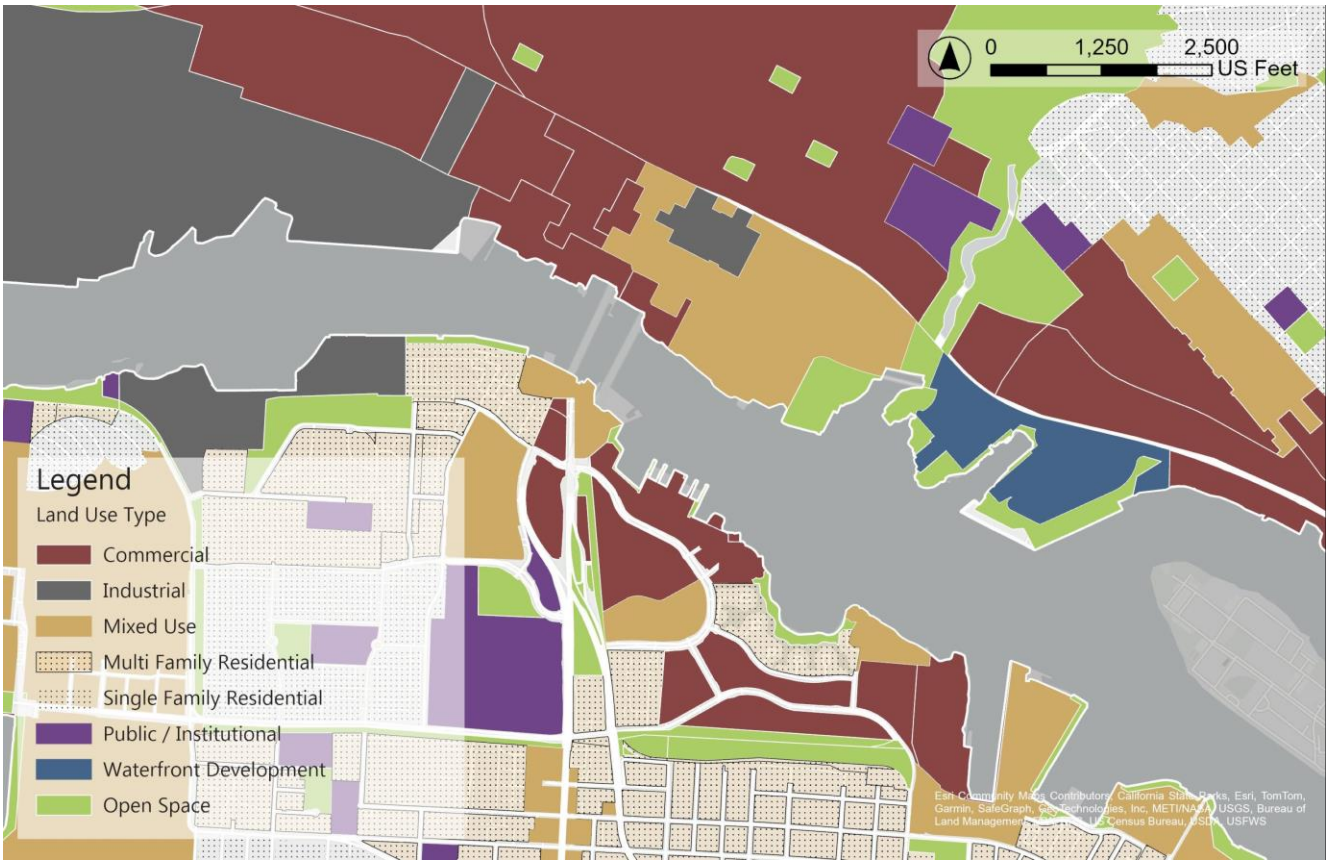


Figure 4-2. Oakland-Alameda Estuary Land Use

Source: (City of Oakland 2015a; City of Alameda 2023a)

4.1.3 Existing Planning Documents & Analysis

Within Oakland, recent planning studies and documents have analyzed existing conditions in this specific project region. Key efforts include:

- City of Alameda Northern Shoreline Adaptation Project Basis of Design Memorandum 05.06.2021 (Matthies and Kumar 2021);
- City of Alameda Northern Shoreline Adaptation Project - Interior Drainage Alternatives Memorandum 10.20.2021 (Schaff and Shick 2021);
- Estuary Crossing Study: Detailed Feasibility and Travel Demand Analysis (2021).

Planning documents and studies considering this particular region of the Oakland-Alameda Estuary include:

- Downtown Oakland Specific Plan – Draft (City of Oakland 2019c);
- Lake Merritt Station Area Plan (City of Oakland 2014a);
- The Estuary Policy Plan (City of Oakland and Port of Oakland 1999);

- Oakland Alameda Access Project (Alameda County Transportation Commission 2024).

4.2 Physical Setting

4.2.1 History

Figure 4-3. Historic Map of Oakland-Alameda Estuary, 1895

Source: (USGS)

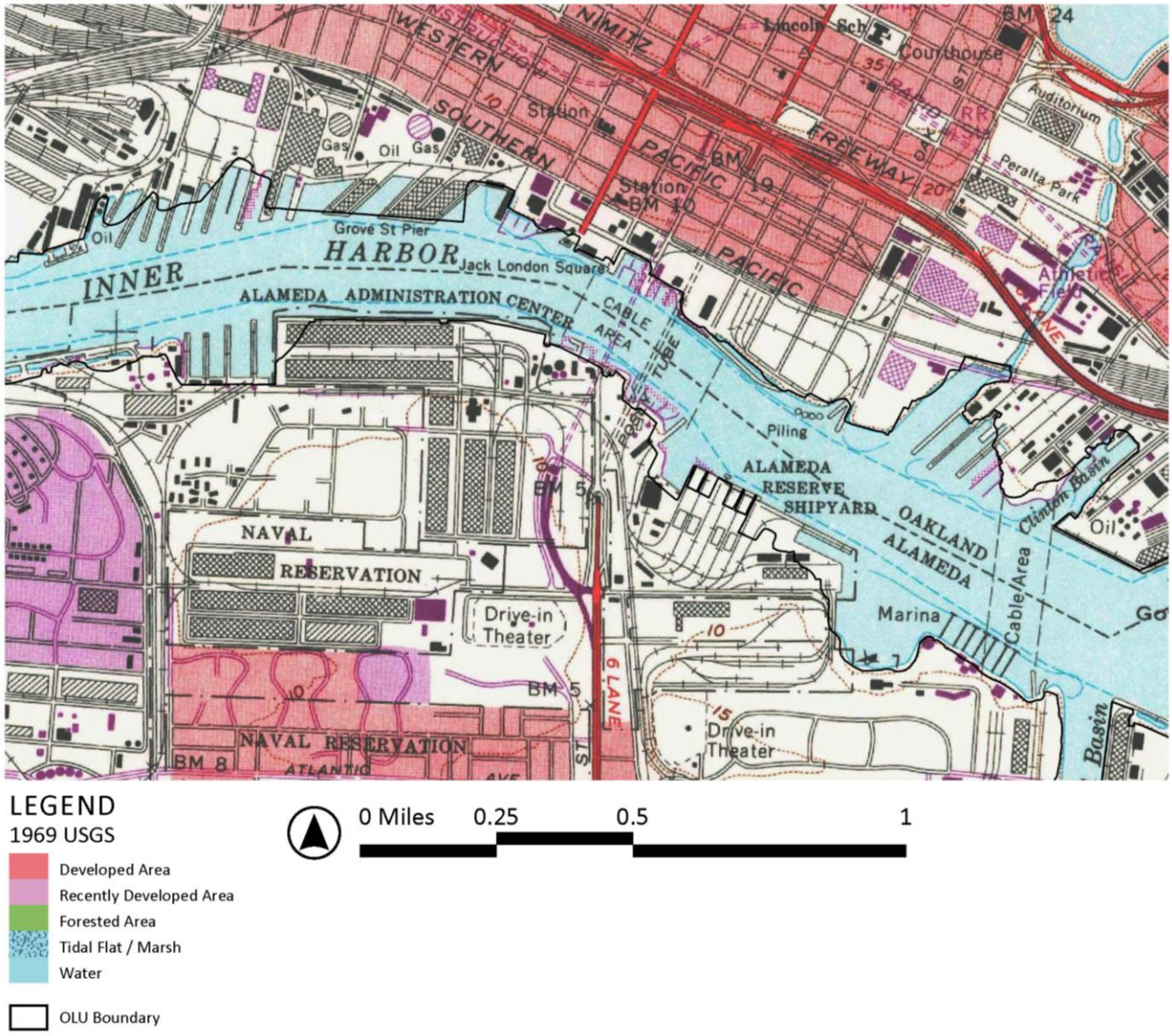


Figure 4-4. Historic Map of Oakland-Alameda Estuary, 1969

Source: (USGS)

4.2.2 Overall

The project area is located on two sides of the Oakland-Alameda Estuary shorelines. Both shorelines are developed, with residential, commercial, and open spaces such as parks occupying the adjacent landside areas. This portion of the Estuary is authorized to a depth of -35' NAVD as shown on the NOAA Navigation Chart shown in Figure 4-5.

The topography of the Oakland-Alameda shoreline is relatively flat, with elevations ranging from +8 NAVD to +14 NAVD. Both the Oakland and Alameda nearshore areas are fairly flat. In Oakland this is due to the presence of the railroad tracks, with elevations increasing east of the railroad tracks; in Alameda this is due to the island being consistently low except where recent development has required raising ground surface elevations. See Figure 4-6 for the overall topography of the Oakland-Alameda project site.

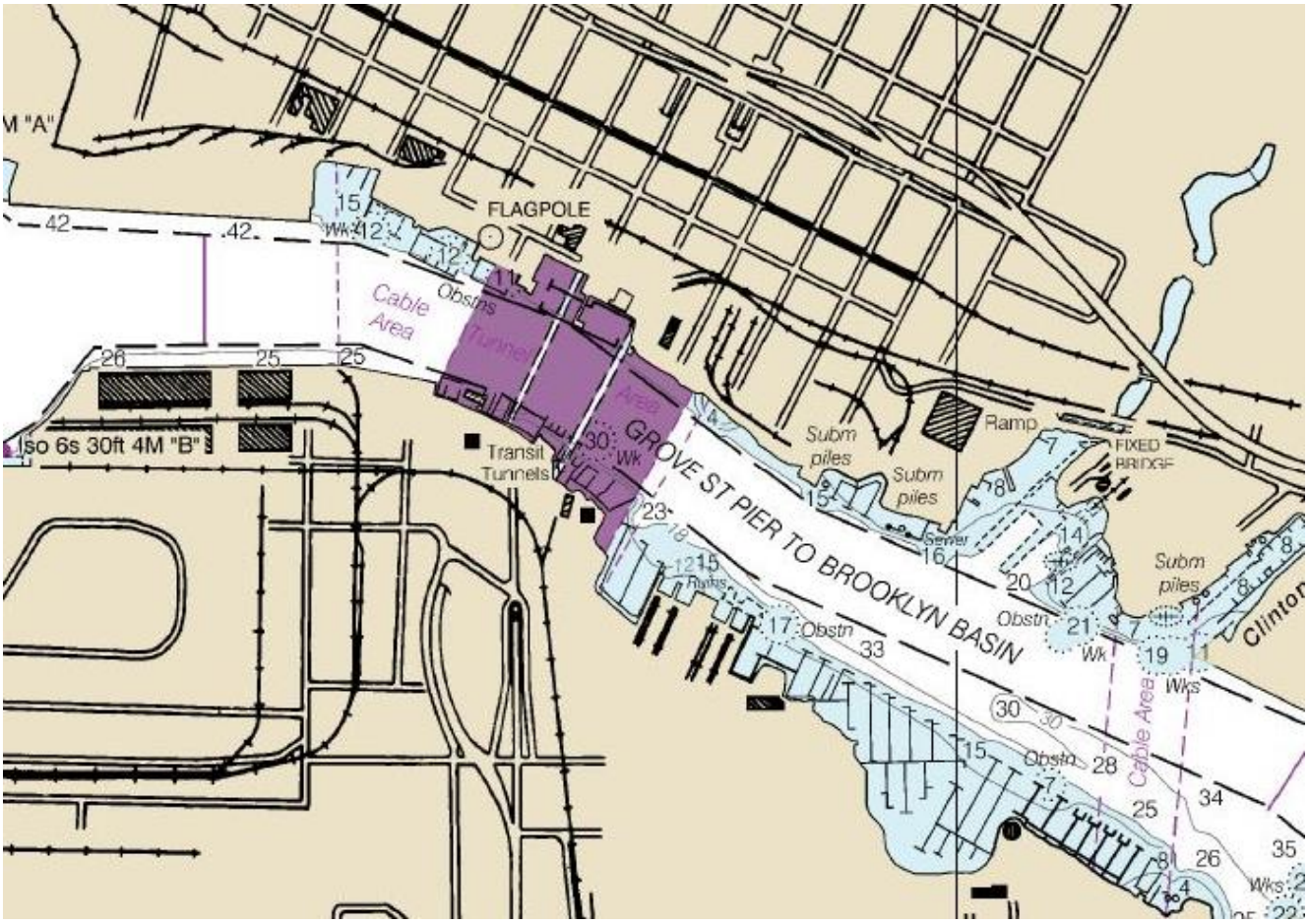


Figure 4-5. Navigation Chart for Oakland-Alameda Estuary Project Area

Source: (NOAA Office of Coast Survey 2023)

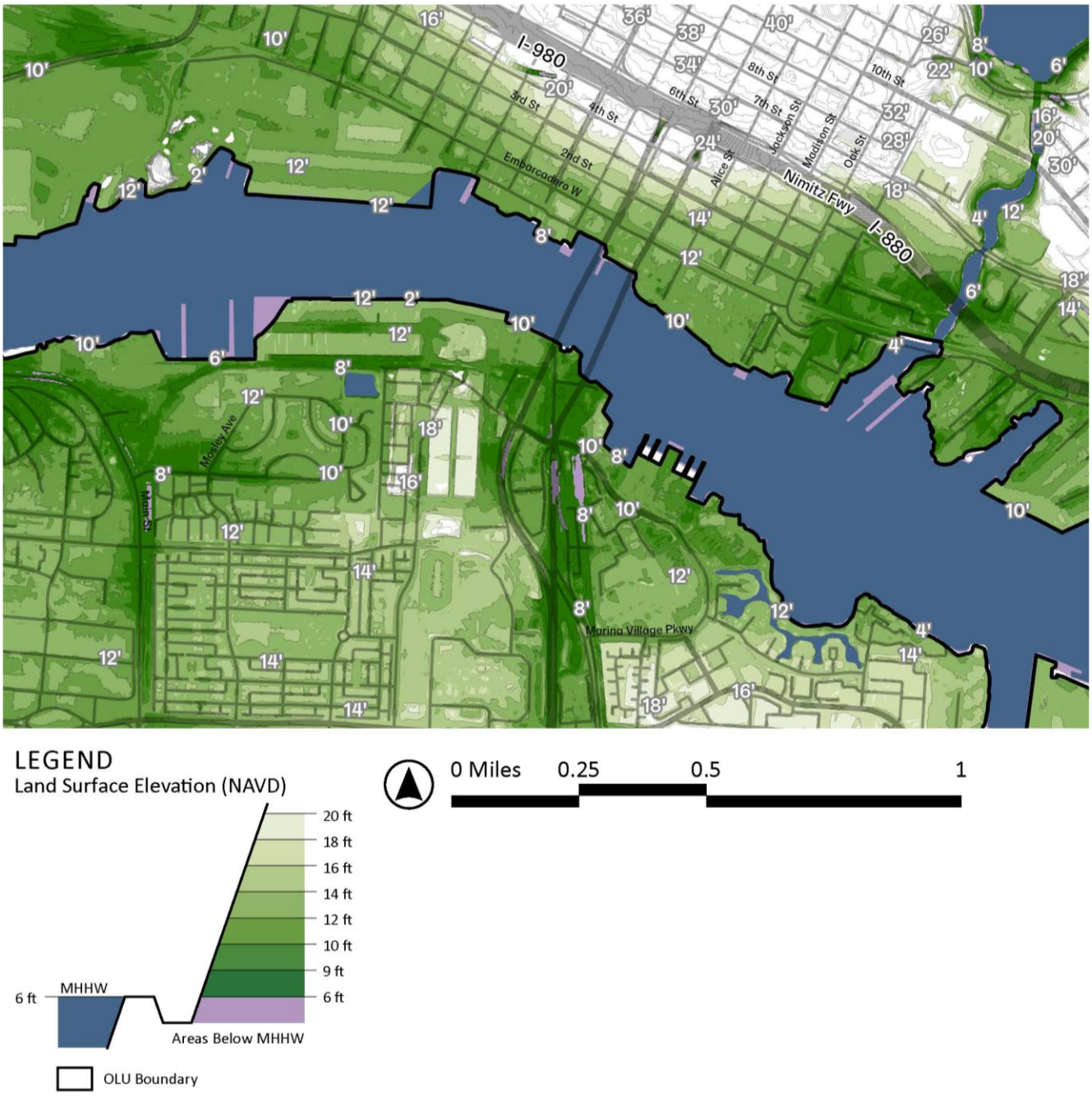


Figure 4-6. Oakland-Alameda Estuary Topography

Source: (NOAA Coastal Lidar, USGS)

4.2.3 Met-ocean Conditions (Tides, Wind, Waves)

Overall wave conditions for the OLU were introduced previously in Section 3.4.3, which described wave size as a function of wind speed. For the Oakland-Alameda Estuary site, wind-generated waves are not significant due to the limited fetch within the Estuary for which wind can interact with the water surface. Waves within the Estuary are generally 1-ft high and are caused by vessel wakes; large vessels traversing the Estuary include Coast Guard vessels, large barges, and ferry vessels.

4.2.4 FEMA Floodplain Mapping

FEMA FIRM Map Number 06001C0067H is presented in Figure 4-7 below, showing the Oakland-Alameda Estuary project area within Zone AE (EL 10) for both Oakland and Alameda. The coastal flooding occurs at the following locations:

Oakland

- North end of Jack London Square – flooding extends a short distance landward, reaching the south side of Embarcadero West.
- Estuary Park – flooding extends landward past Embarcadero West a long distance up Oak Street, reaching I-880. Some flooding extends under I-880 along Lake Merritt Channel.

Alameda

- Webster/Posey Tubes – flooding overtops the shoreline over a long distance and extends a significant distance to the south and west, with some flooding extending to the east along the low-elevation Marina Village Parkway. This flooding jeopardizes the portals for both the Webster and Posey Tubes.
- Alameda Shipways East end – this flooding along the east edge of the Alameda Shipways parcel floods the parking lots to the east and southeast, connecting with the flooded area from the Webster/Posey area.

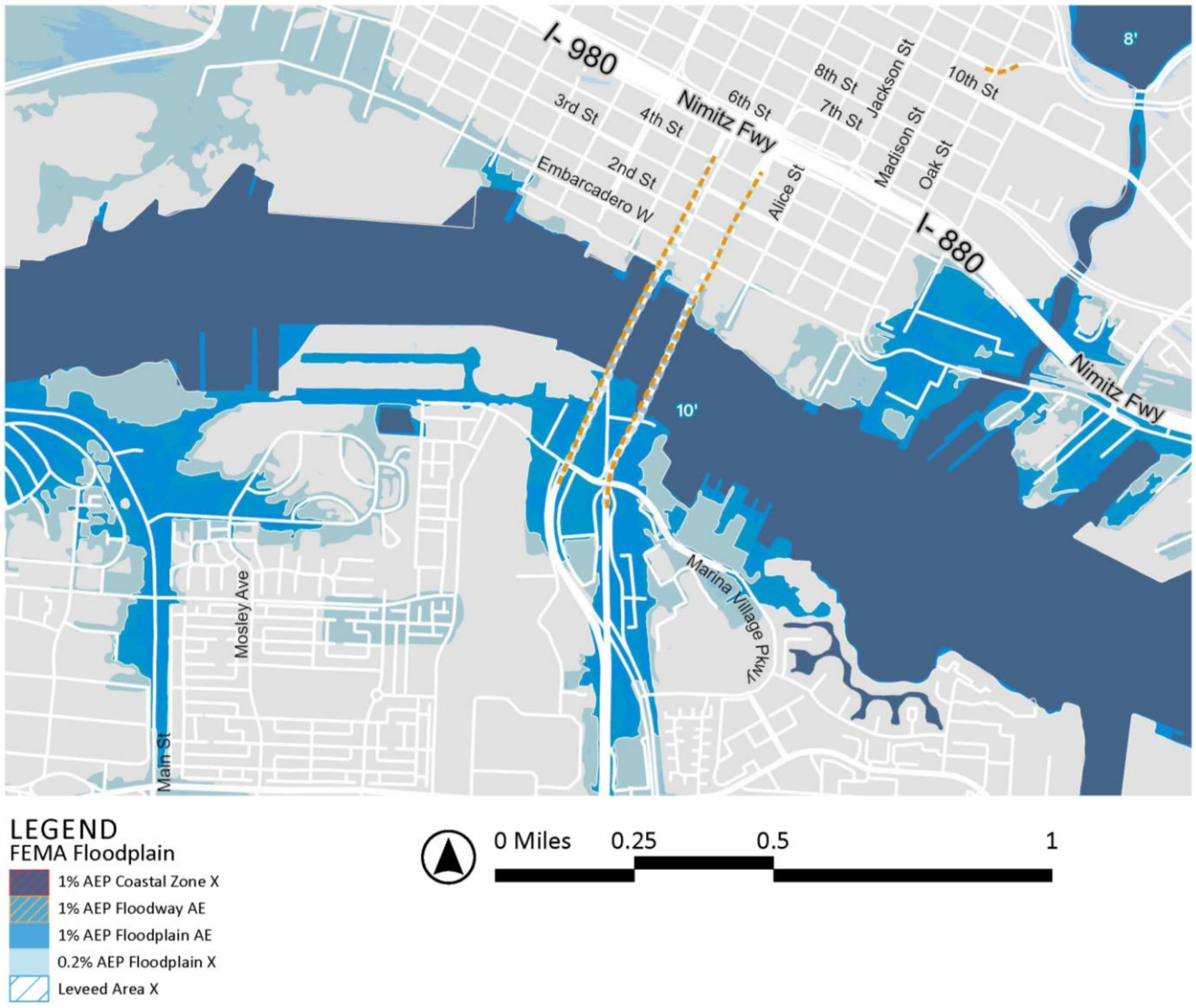


Figure 4-7. FEMA Flood Zones, Oakland-Alameda Estuary Project Area

Source: (FEMA 2018)

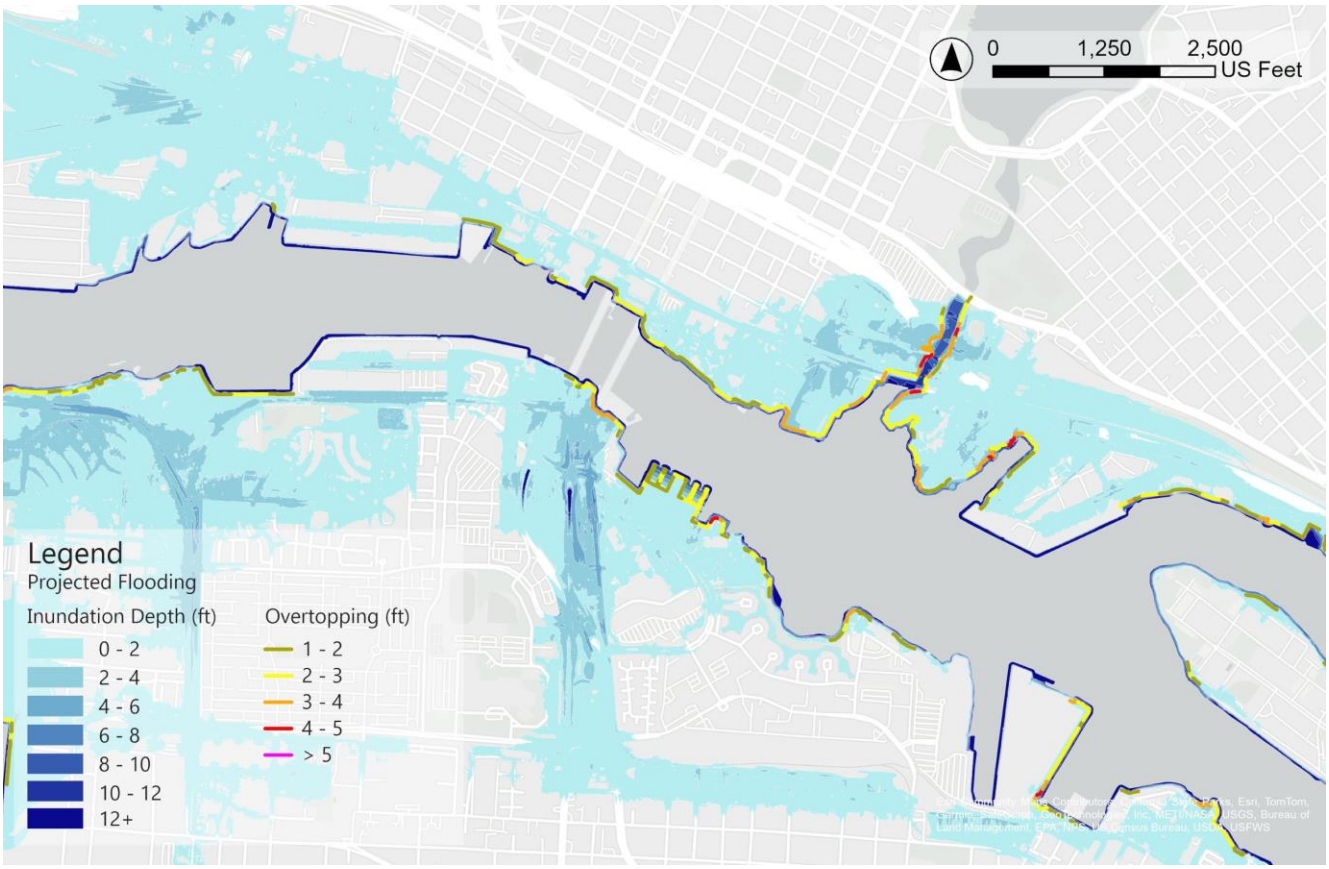


Figure 4-8. 24" Sea Level Rise + 1% AEP Flood for the Oakland-Alameda Estuary Project Site

Source: (Vandever et al. 2017b)

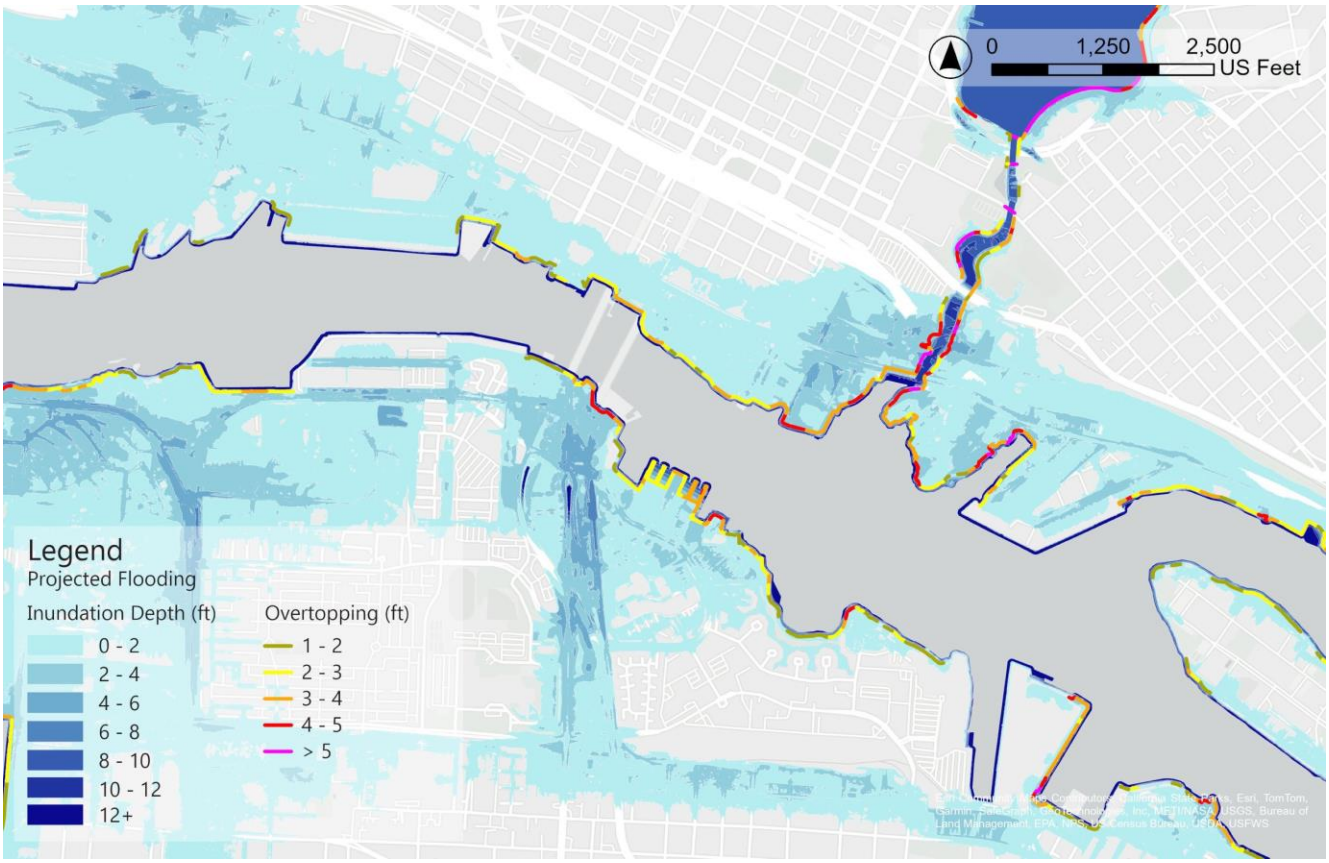


Figure 4-9. 36" Sea Level Rise + 1% AEP Flood for the Oakland-Alameda Estuary Project Site

Source: (Vandever et al. 2017b)

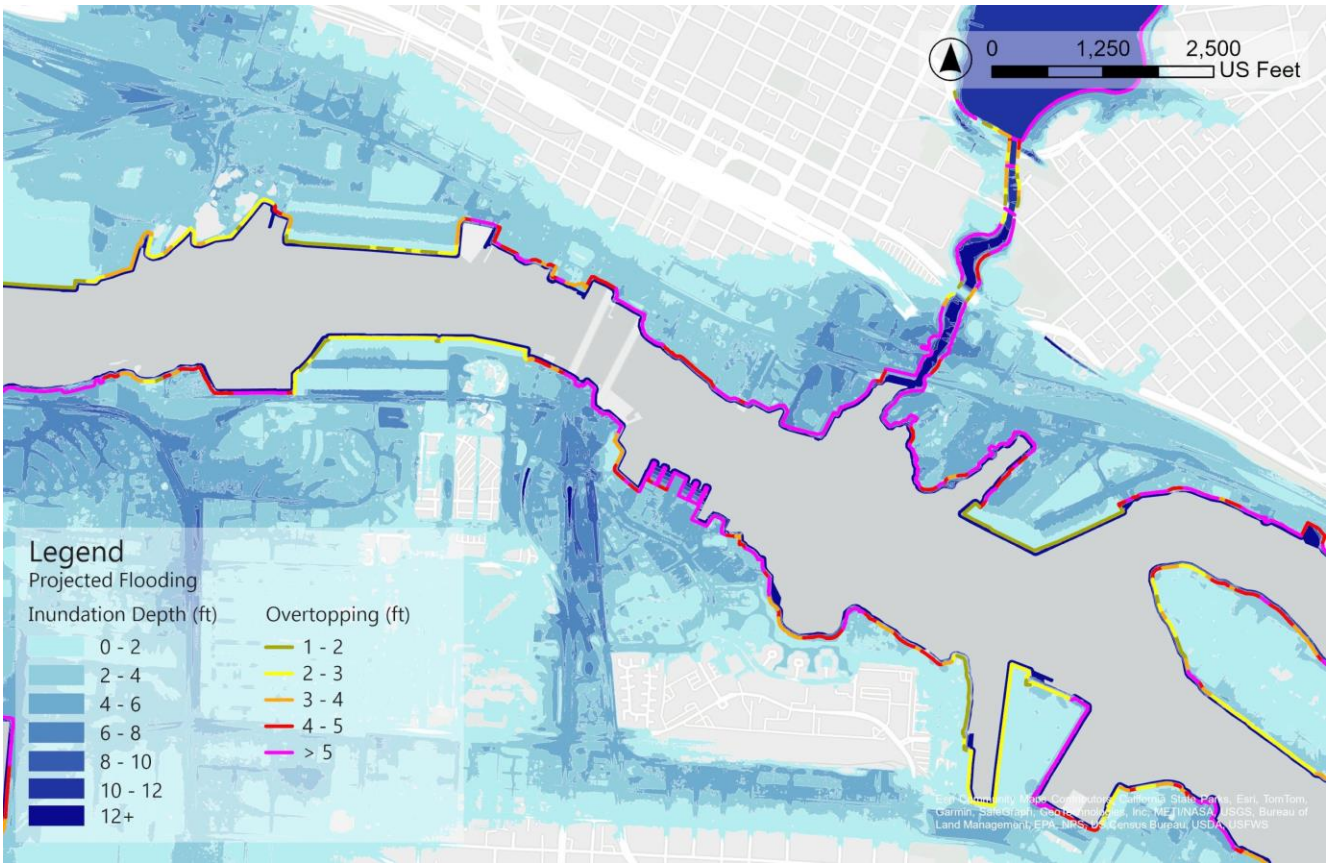


Figure 4-10. 66" Sea Level Rise + 1% AEP Flood for the Oakland-Alameda Estuary Project Site

Source: (Vandever et al. 2017b)

4.2.5 Geology and Geotechnical Conditions

See Section 3.4.7 for geology and geotechnical conditions within the project area.

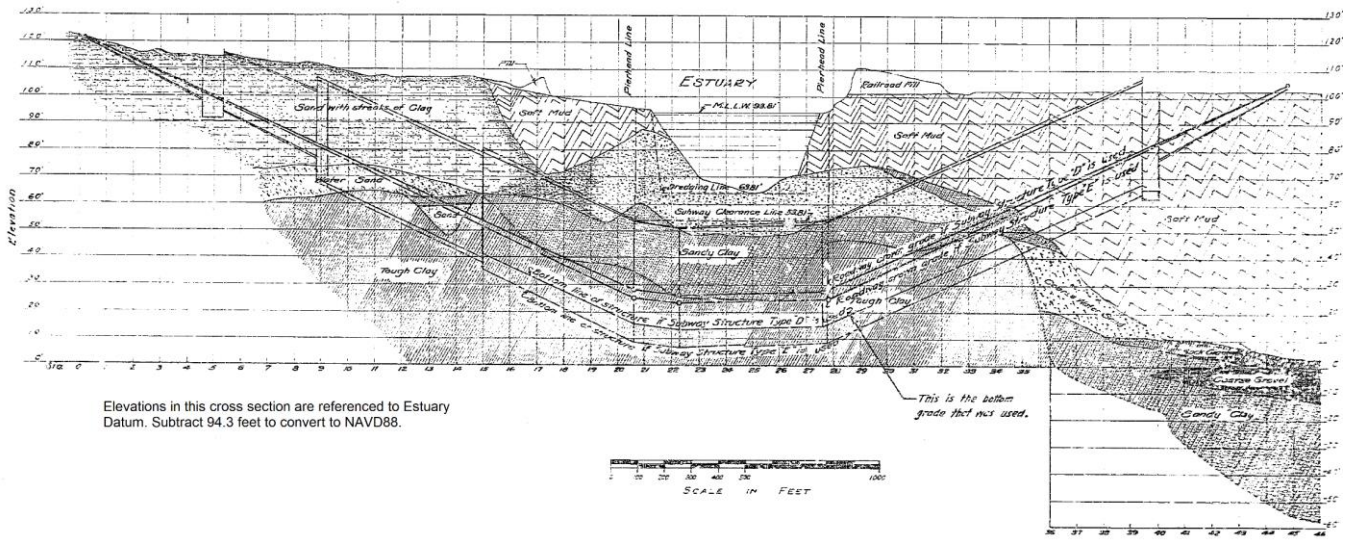


Figure 4-11. Geotechnical Section across Oakland-Alameda Estuary at Posey Tube (looking East)

Source: (Caltrans, Posey Tube As-Built Plans)

4.2.6 Groundwater

Pathways Climate Institute LLC and the San Francisco Estuary Institute (SFEI) carried out a study to understand how rising sea levels might affect groundwater levels in low-lying coastal areas (May et al. 2022). Their work involved analyzing and mapping the “highest annual” shallow groundwater table, with a focus on its response to anticipated sea level rise. This study helps in estimating the existing groundwater elevation in specific areas, such as the Oakland-Alameda Estuary study region (Figure 4-12) and informs us about the potential for shallow groundwater flooding in these coastal communities.

As sea levels rise, the interaction between coastal waters and groundwater systems causes increased pressure on the water table. This suggests that over time, groundwater will gradually rise to the surface in areas with shallow groundwater. The emergence of groundwater at the surface level will likely lead to flooding.

Based on Pathways and SFEI’s groundwater elevation data in Figure 4-12, in the Oakland part of the study region, coastal areas and those along the edge of Lake Merrit will be more susceptible to groundwater flooding as the coast has lower depth to water values than the more inland region. However, in the Alameda portion of the study region, a majority of the region, especially the inland areas, appear to be at a higher risk of being affected by this type of flooding.

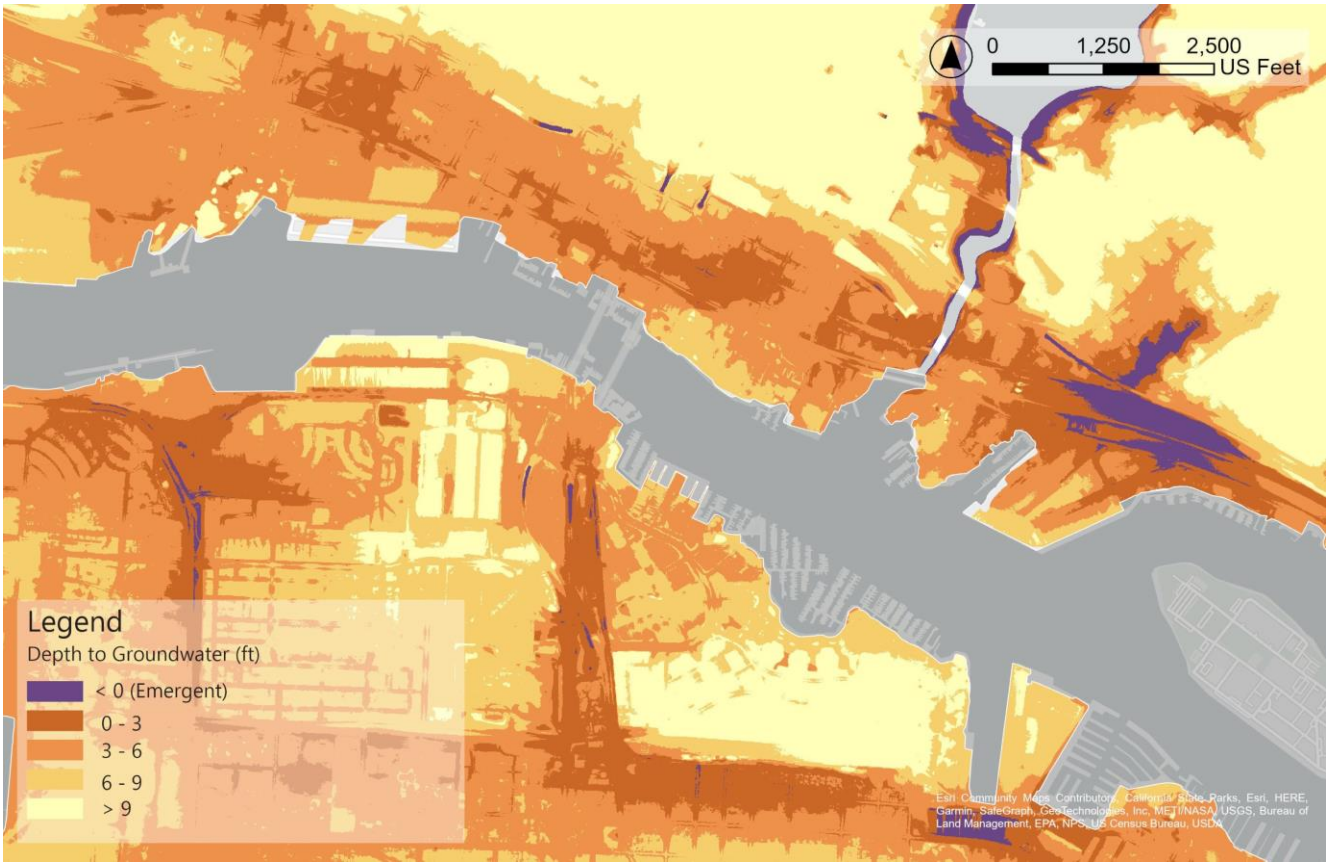


Figure 4-12. Oakland-Alameda Estuary Depth to Groundwater (Current Wet-Winter Conditions)

Source: (May et al. 2022)

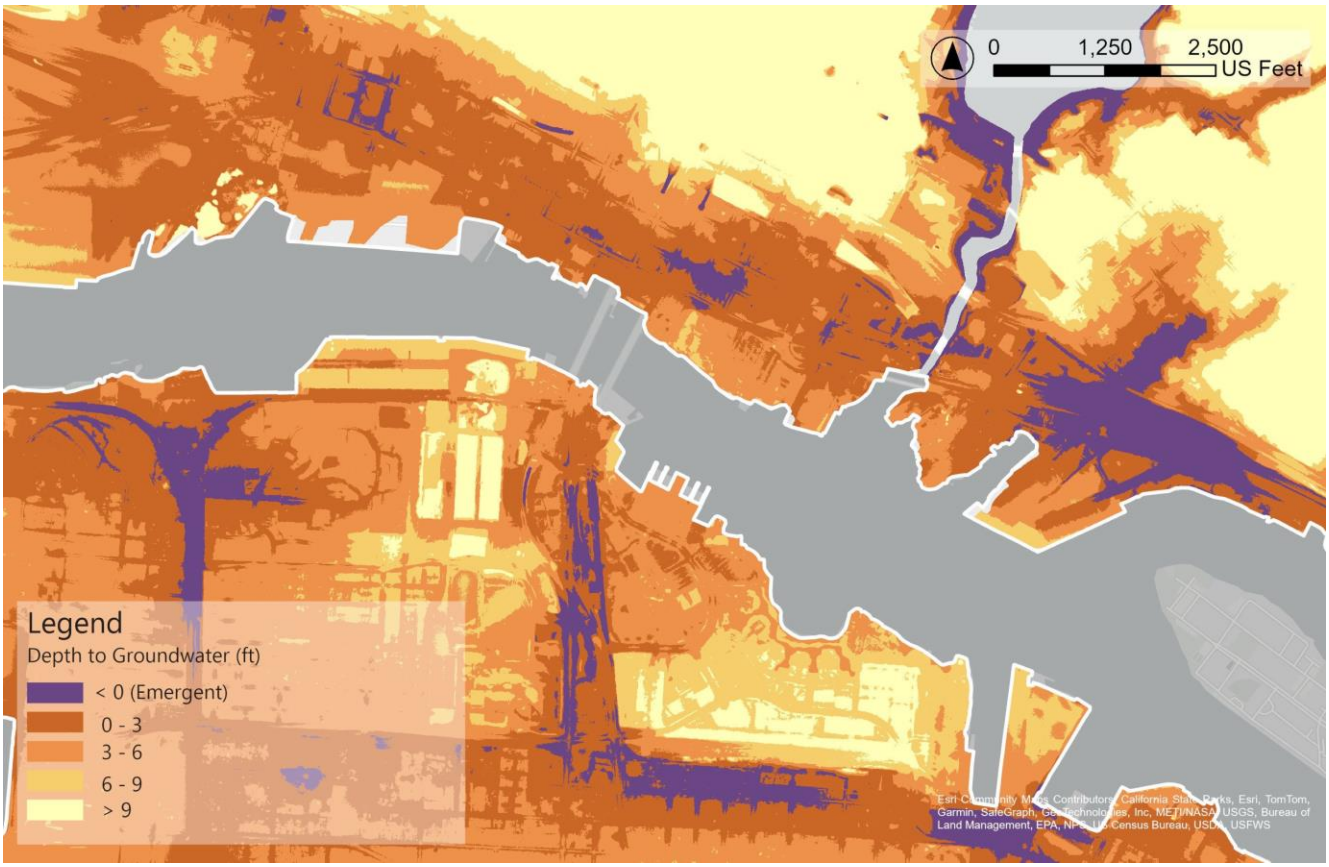


Figure 4-13. Oakland-Alameda Estuary Depth to Groundwater with 24" Sea Level Rise

Source: (May et al. 2022)

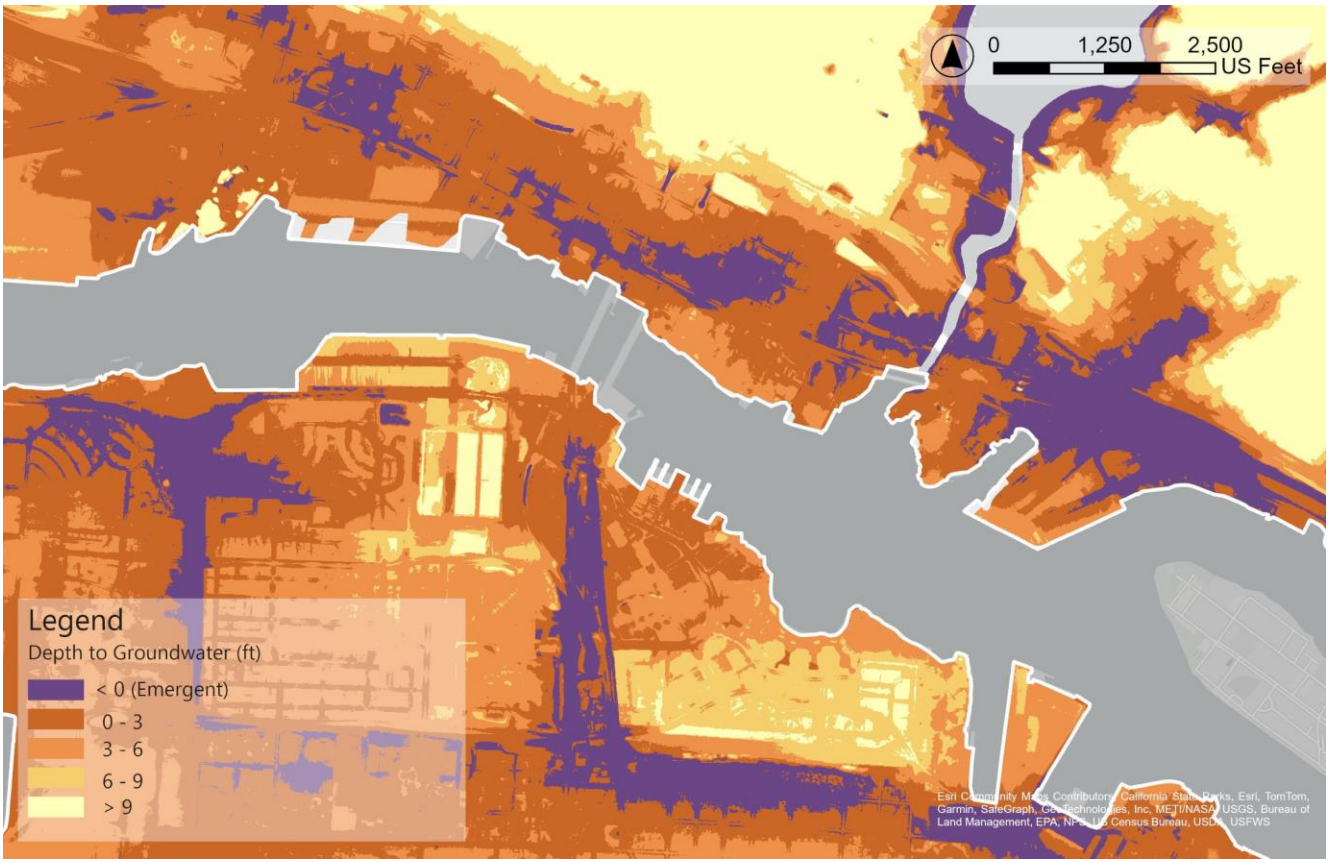


Figure 4-14. Oakland-Alameda Estuary Depth to Groundwater with 36” Sea Level Rise

Source: (May et al. 2022)

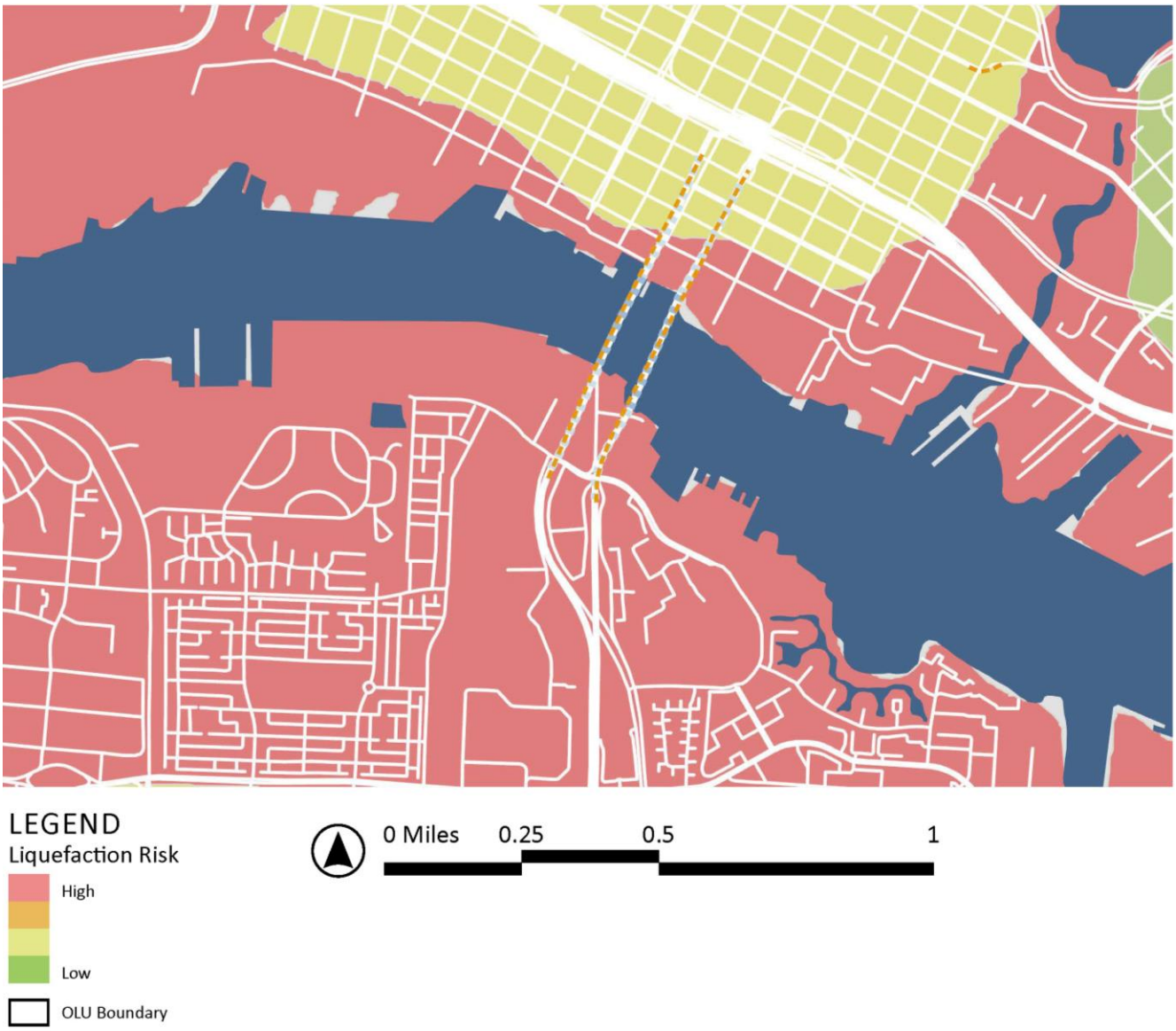


Figure 4-15. Liquefaction Risk

Source: (USGS)

4.3 Shoreline Conditions

4.3.1 Shoreline Conditions

Previous studies have summarized the Oakland/Alameda Estuary shoreline condition, including the 2022 Climate Adaptation and Hazard Mitigation Plan:

> *Alameda's main island is composed mostly of riprap shoreline, and to a lesser extent bulkheads, natural shoreline, and beach.*

…

The engineered structures and natural shorelines that surround Alameda are not FEMA-accredited, and it is unknown how they will behave in the event of a large-scale coastal flooding or earthquake event…. Several shoreline protection projects currently underway have the goal of becoming FEMA accredited.

Within the project boundaries – starting from the north end of Jack London Square (Port of Oakland) property and proceeding east toward Lake Merritt Channel – the Oakland-Alameda Estuary project includes approximately 1.0 miles of shoreline on Alameda and 1.4 miles of shoreline on Oakland. To assist in discussion of specific shoreline segments, the Alameda and Oakland shorelines were divided into reaches; reach designations are described below:

Oakland

- Jack London Square Reach – This reach begins at the east end of the Howard Terminal and extends to Harrison Street. Note that the Jack London Square property ends to the east at Alice Street; this reach ends at Harrison Street due to the entire reach being developed, while the portion between Harrison and Alice has not yet been developed and has significantly more open space similar to the Oakland Central Reach to the east. Approximate reach length: 2810 feet (0.53 mile).
- Oakland Central Reach – This reach continues east from Harrison Street to the start of the Estuary Park property. Approximate reach length: 2190 feet (0.41 mile).
- Estuary Park Reach – This reach covers the Estuary Park property, extending to the northeast along Lake Merritt Chanel under the Embarcadero up to the south bank of I-880. Approximate reach length: 2280 feet (0.43 mile).

Alameda

- Webster Tube Reach – This reach begins at the east end of Bohol Circle Immigrant Park and extends east to the Oakmont of Mariner Point property between the Webster and Posey Tubes. Approximate reach length: 730 feet (0.14 mile).
- Posey Tube Reach – This reach continues east to the north end of the Alameda Shipways property. Approximate reach length: 1670 feet (0.32 mile).
- Alameda Shipways Reach – This reach includes the three sides of the Alameda Shipways property. Approximate reach length: 1480 feet (0.28 mile).
- Marina Village Reach – This reach continues from the Alameda Shipways property to the Marina Village Yacht Harbor office. Approximate reach length: 1340 feet (0.26 mile).

Figure 4-16 shows the five reaches designated for the Oakland-Alameda Estuary Shoreline.

Figure 4-16. Oakland-Alameda Shoreline Reaches

Source: (NOAA Coastal LiDAR)

Existing elevations along the Oakland and Alameda shorelines are presented in Figure 4-17 to Figure 4-19 showing shoreline elevations in plan and profile.

Figure 4-17. Oakland Shoreline Elevations – Plan View

Source: (NOAA Coastal LiDAR)

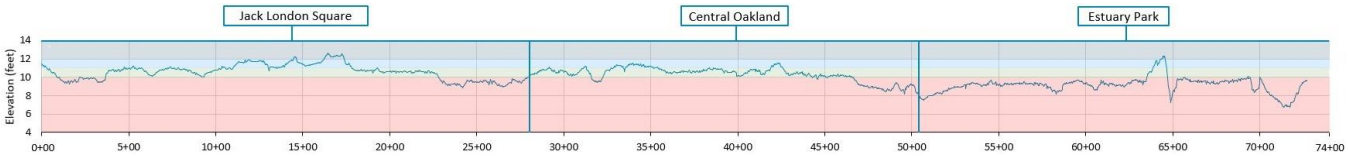


Figure 4-18. Oakland Shoreline Elevation Profile

Source: (NOAA Coastal LiDAR)

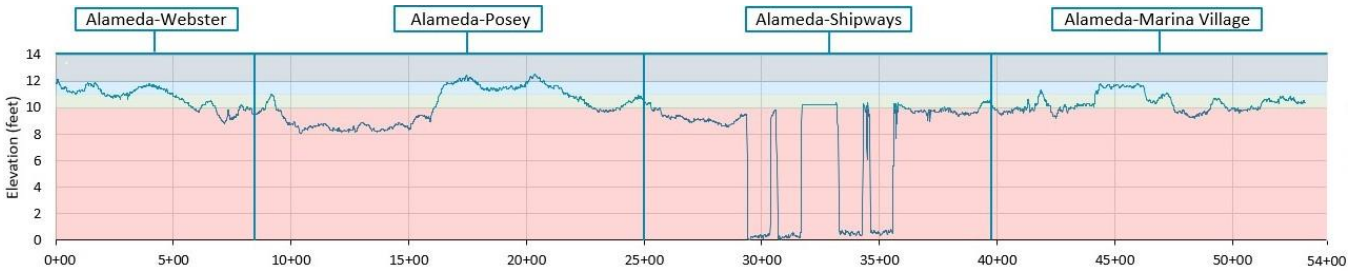


Figure 4-19. Alameda Shoreline Elevation Profile

Source: (NOAA Coastal LiDAR)

4.3.2 Shoreline Description

The Oakland and Alameda shorelines consist of three types of shoreline:

- **Sloped Shoreline** – includes natural unarmored banks and banks protected by riprap rock slope protection (RSP)
- **Vertical Shoreline** – includes seawalls or bulkheads, typically sheetpile walls.
- **Pile-Supported** Structure – typically concrete or timber structures with sloped or vertical shoreline edge beneath.

The majority (67%) of the Oakland shoreline is sloped and armored with RSP, with 27% vertical shoreline and the remaining 6% as pile-supported structure shoreline. Alameda has 45% sloped and armored with RSP, 50% vertical shoreline, and 5% pile-supported structure shoreline.

The Oakland and Alameda shorelines are fronted a number of private marinas for boats and houseboats, public docks, the Oakland Ferry Terminal, and a floating restaurant. The remainder of the shoreline is fronted by open water along the Estuary and Lake Merritt Channel.

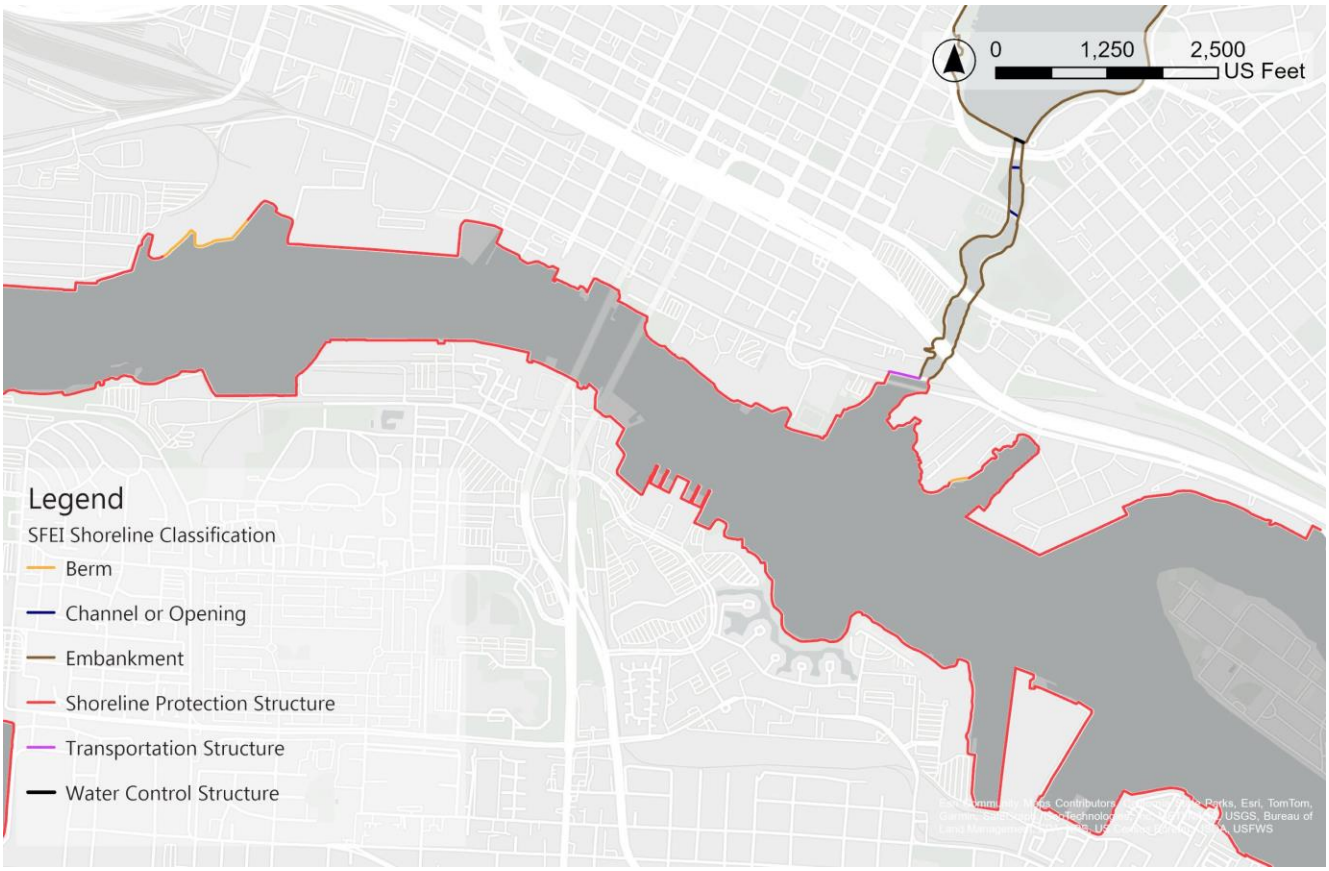


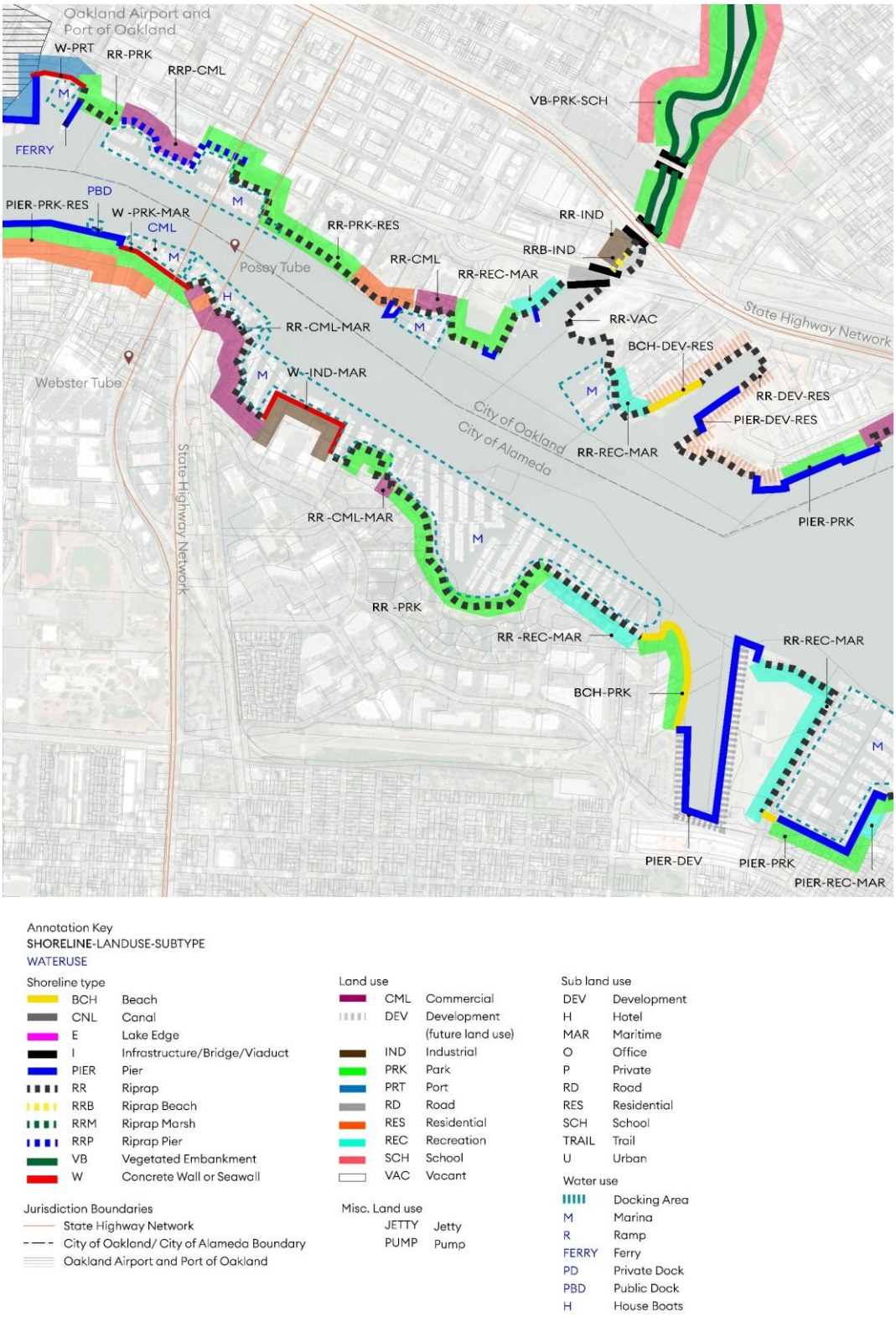
Figure 4-20. Oakland-Alameda Estuary Shoreline Infrastructure

Source: (SFEI 2016)

4.3.3 Shoreline Typologies

Shoreline typologies inventory conditions across three axes: water use, shoreline type and land use Figure 4-21. There are 13 shoreline types identified within the Estuary project area, and 12 identified land uses. There are 7 water uses documented within the project area. The typology illustrates the complex mosaic of relationships between the existing shoreline conditions, land uses and maritime/water access points.

These typologies were created through desktop research and refined through in-person site visits.



Annotation Key
SHORELINE-LANDUSE-SUBTYPE
WATERUSE

Shoreline type

BCH	Beach
CNL	Canal
E	Lake Edge
I	Infrastructure/Bridge/Viaduct
PIER	Pier
RR	Riprap
RRB	Riprap Beach
RRM	Riprap Marsh
RRP	Riprap Pier
VB	Vegetated Embankment
W	Concrete Wall or Seawall

Jurisdiction Boundaries

	State Highway Network
	City of Oakland/ City of Alameda Boundary
	Oakland Airport and Port of Oakland

Land use

CML	Commercial
DEV	Development (future land use)
IND	Industrial
PRK	Park
PRT	Port
RD	Road
RES	Residential
REC	Recreation
SCH	School
VAC	Vacant

Misc. Land use

JETTY	Jetty
PUMP	Pump

Sub land use

DEV	Development
H	Hotel
MAR	Maritime
O	Office
P	Private
RD	Road
RES	Residential
SCH	School
TRAIL	Trail
U	Urban

Water use

	Docking Area
M	Marina
R	Ramp
FERRY	Ferry
PD	Private Dock
PBD	Public Dock
H	House Boats

Figure 4-21. Oakland-Alameda Estuary Shoreline Typology and Land use

Source: (CMG Landscape Architecture)

4.4 Built Infrastructure

4.4.1 Transportation

4.4.1.1 Roadways

Roadways are the primary means of access to and from Alameda, with major roadways including SR61, SR260, and a number of major/arterial roads. The roadways cross the Estuary via three bridges and two tunnels. The bridges are inherently unaffected by floodwater due to their relatively high elevation, but the tunnels (Webster and Posey Tubes) are susceptible to flooding due to their low entrance/exit elevations.

Critical roadways include highways, arterial roadways, transit routes, and trucking routes; these designations delineate roadways by their size, traffic volume, or importance. On the Oakland side of the Estuary, no highways are considered to be affected by the project, but important roadways include Embarcadero West, which runs parallel to the shoreline and adjacent to the railroad tracks; Embarcadero West also marks the south end of arterials Broadway and Oak Street. On the Alameda side, the Webster/Posey tubes (SR-61/SR-260/Webster St) is the only highway in the immediate vicinity of the Oakland-Alameda Estuary project, with Marina Village Parkway, Mitchell Ave, and 5th Ave as other arterial/transit/trucking routes affected by the project.

4.4.1.2 Railroad

The UPRR railway line running along the Oakland Estuary in the City of Oakland is owned by UPRR and is used for freight (UP and BNSF) and passenger trains (Amtrak). The Amtrak service (Capitol Corridor and Coast Starlight) route along the UPRR railway line is among the busiest Amtrak routes in the county; the passenger service provided on the railway, in conjunction with its freight carrying ability, define the railway is a critical component of access within the project site.

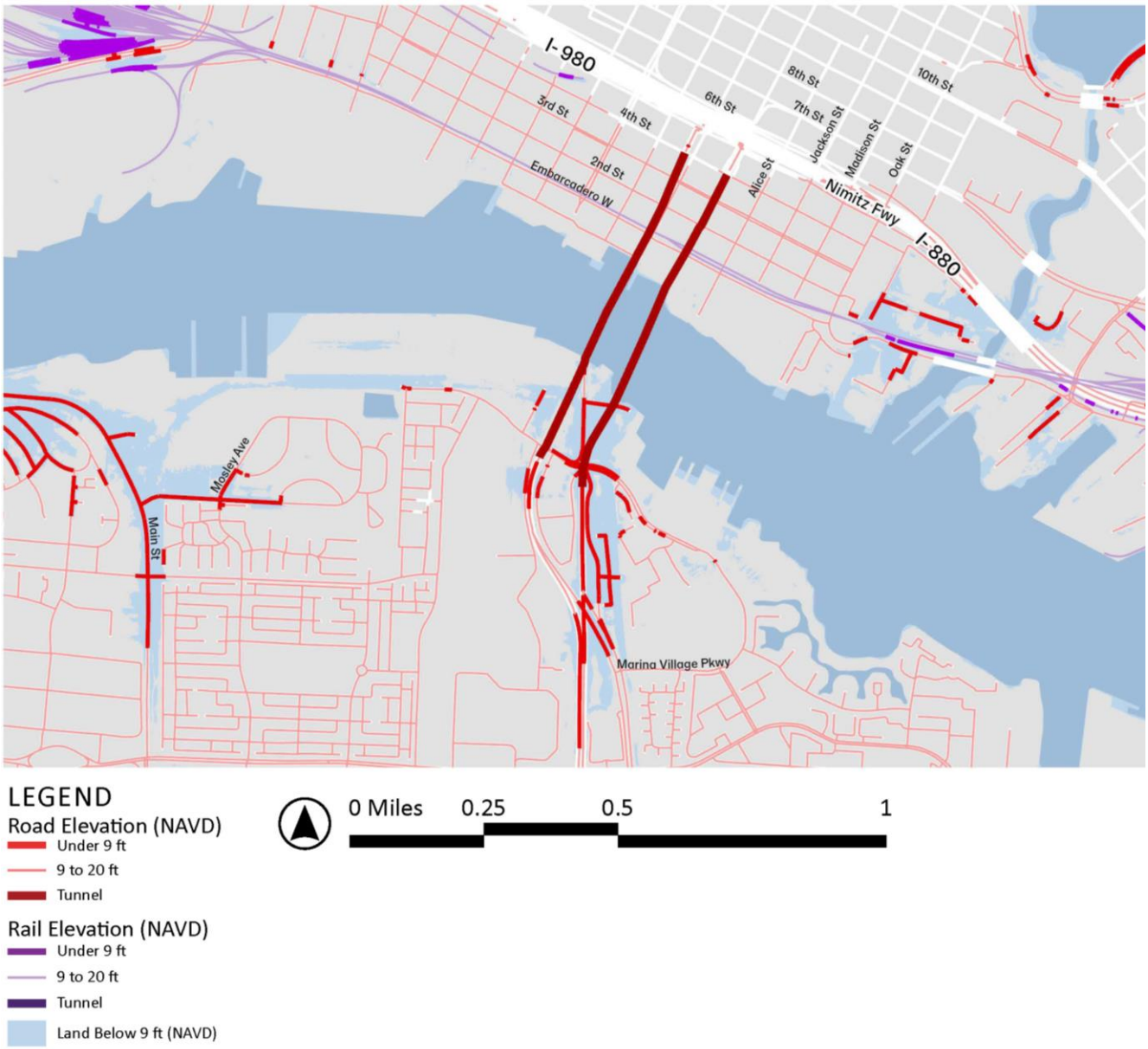


Figure 4-22. Roads & Rail at Risk of Flooding along Oakland-Alameda Estuary

Source: (USGS; NOAA; US Census TIGER)

4.4.2 Critical Infrastructure

Existing critical infrastructure for the purposes of the Oakland-Alameda Estuary project are those facilities that are essential for life safety and health. Accordingly, facilities that provide essential services or access include the following categories:

- Access – vehicle, pedestrian, and bicycle routes
- Utilities – water, power, sewer, communications

- Emergency Facilities – municipal fire, police, and emergency responders

4.4.2.1 Storm Drain System

The City of Alameda and Port of Oakland have developed Storm Drain Master Plans (SDMPs), which identify deficiencies in the existing storm drain system. The SDMP for the City of Oakland is currently in development. The shoreline areas drain via a series of gravity outfalls and pump stations. Tide levels greatly impact the performance of these drainage networks.

Figure 4-2323. Storm Drain Network surrounding Oakland-Alameda Estuary

Source: (Schaff and Wheeler 2019; Schaff and Wheeler 2012)

4.4.2.2 Sanitary Sewer System

The City of Oakland and City of Alameda sanitary sewer systems include gravity-flow piping and lift stations conveying wastewater to EBMUD facilities. EBMUD lift stations, pump stations, force mains, and interceptors (large gravity pipelines) convey sanitary flow to the EBMUD Wastewater Treatment Plant in Oakland.

Figure 4-2424. Sewage System Surrounding Oakland-Alameda Estuary

Source: (USGS, NOAA, City of Oakland, City of Alameda, Port of Oakland)

4.4.2.3 Water Supply

The East Bay Municipal Utility District (EBMUD) supplies the City of Oakland and City of Alameda potable water system (also used for the fire water system). The water system within the Estuary project site is a gravity-flow system within the Central Pressure Zone; no pump stations are used to pressurize the water system. The pipe network includes air valves to allow air to enter (vacuum breaker valve) and exit (air release valve), which may include air valves within areas susceptible to flooding. These air valves are typically vented above-ground; if air valves are vented within an underground vault, the water system may be affected by flooding due to floodwaters preventing proper function of the air valves or contamination of the water supply by floodwaters entering the pipeline. The water system also includes isolation valves and blow-offs at ground level for maintenance and repair of the pipeline; these may be difficult to located and operate if flooded.

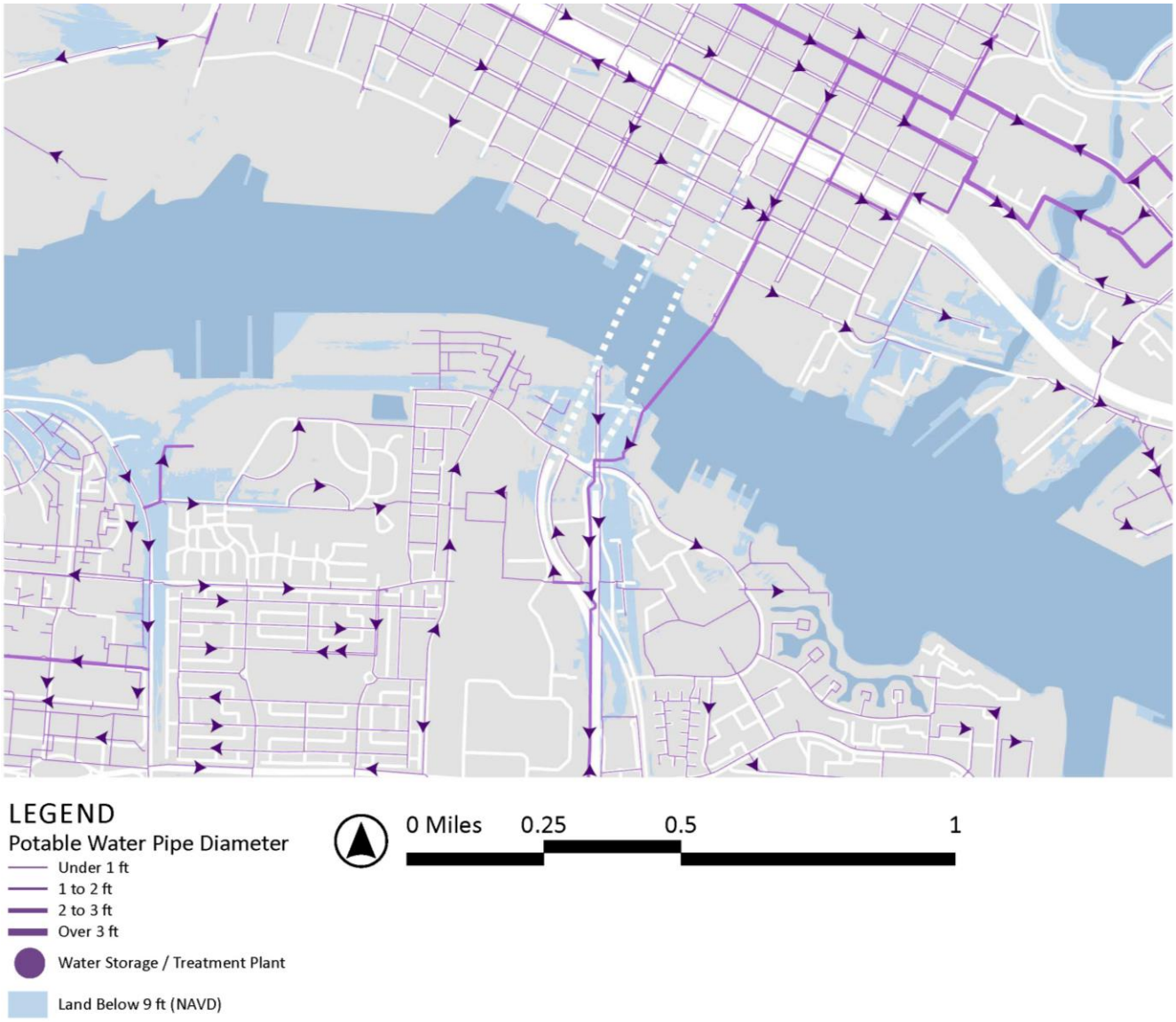


Figure 4-2525. Potable Water System surrounding Oakland-Alameda Estuary

Source: (EBMUD)

4.4.2.4 Electrical Power

On the Alameda side, Alameda Municipal Power (AMP) provides electrical power to Alameda via transmission lines crossing the Estuary at Jack London Square and High Street. Although transmission lines are not directly impacted by potential flooding, AMP's two substations and the NCPA substation (backup/supplemental power) on Alameda Island could potentially be impacted.

On the Oakland side, PGE provides power to the project shoreline area. Similar to AMP, the substations are potentially subject to coastal or stormwater flooding.

4.4.2.5 Natural Gas

Within the Estuary project site, PG&E provides natural gas to the City of Oakland and City of Alameda. Gas transmission lines run generally north-south along I-880, with a lateral transmission line crossing the Oakland Estuary into Alameda south of the Posey Tube.

4.4.2.6 Communications

Although flooding concerns are not likely to impact the various cellular service providers, floodwater could impact the citywide fiber optic network – designated the Municipal Area Network (MAN) – supporting residential, business, and municipal (City) use. The MAN is especially critical to City emergency operations during flooding and other emergency situations. Portions of the MAN are underground and may be susceptible to flooding impacts.

Figure 4-2626. Utilities Surrounding Oakland-Alameda Estuary

Source: (USGS, Department of Homeland Security, PG&E)

4.4.2.7 Emergency Facilities

Within the Oakland-Alameda Estuary project site, three Fire Stations are located: Oakland Fire Station #2, and Alameda Fire Stations #1 and #2. Oakland Fire Station #2 and Alameda Fire Station #2 are both within or adjacent to the current FEMA flood zones and could be directly affected by floodwaters. All three fire stations' operational abilities are hindered by flooded roadways preventing access of firefighting apparatus.

Figure 4-2727. Critical Facilities Adjacent to the Oakland-Alameda Estuary

Source: (USGS)

4.5 Public Access & Recreation

4.5.1 Public Transportation

4.5.1.1 Transit Priority Area (TPA)

The Oakland-Alameda Estuary Project areas on either side of the Estuary are located within Transit Priority Areas. As discussed in Section 3, the MTC designates Transit Priority Areas as "an area within one-half mile of a major transit stop that is existing or planned, if the planned stop is scheduled to be completed within the planning horizon included in a Transportation Improvement Program or applicable regional transportation plan."

Similarly, 'Major Transit Stops' are sites that "contains either an existing rail or bus rapid transit station; a ferry terminal served by either a bus or a rail transit service; or the intersection of two or more major bus routes with a frequency of service interval of 15 minute or less during the morning and afternoon peak commute periods" (MTC).

4.5.1.2 Light Rail

There are no BART stations located in the immediate Oakland-Alameda Estuary Project area. BART tracks run above and underground in this part of the OLU.

However, the Oakland side of the Estuary is included in several larger planning documents related to the development around the Lake Merritt BART station and the broader Downtown Oakland region.

4.5.1.3 Buses

As of early 2024, seven AC Transit lines run through the Oakland-Alameda Estuary project area and utilize the Webster & Posey Tubes – four local lines (19, 20, 51A, and 96); two transbay lines (O & W); and one all-nighter (851).

4.5.1.4 Ferry Service

In Alameda, the Main Street Ferry is adjacent to the Estuary Project. The City of Alameda's Transportation Choices Plan (2018) notes that access to the Main Street Alameda Ferry Terminal is limited; while this terminal lies outside of the project area, ferry users are likely to pass through the project region on their way to the terminal.

On the Oakland side of the project, San Francisco Bay Ferry Service operates a terminal in Jack London Square – the Oakland Ferry Terminal, located at 10 Clay Street. As of early 2024, this terminal offers two regular routes: Oakland & Alameda Route, with daily service to San Francisco, and the South San Francisco Route, with weekday service to and from Oyster Point in South San Francisco. The Alameda Short Hop service route was suspended at the time of writing (WETA 2024b). Additionally, the Oakland Ferry Terminal offers seasonal routes to the Chase Center for Warriors basketball games and to Oracle Park, for Giants baseball games.

Other planned transit services include a new water shuttle service between Oakland and Alameda. Per the City of Alameda,

"A new water shuttle service is coming in late Spring 2024! It's being planned by a partnership of public and private organizations and agencies, including the City of Alameda. It will start as a limited service, with the opportunity to grow over time. Initially the water shuttle will travel between the foot of Fifth Street in Alameda and the foot of Broadway in Oakland. In May 2023, grant funding, matched with private and public funds, was secured for a two-year pilot."

4.5.1.5 Passenger Rail

As detailed in Section 3, the Amtrak Station at Jack London Square serves three passenger lines operated by Amtrak that utilize the Union Pacific Railroad (UPRR): the Capitol Corridor, the San Joaquin and the Coast Starlight. The Capitol Corridor service runs between San Jose and Auburn operates fourteen trains per day roundtrip across the entire service, with additional trains serving the route stretching between Sacramento and San Jose. The San Joaquin service runs ten trains per day in and out of Oakland roundtrip, while the Coast Starlight line operates one train per day.

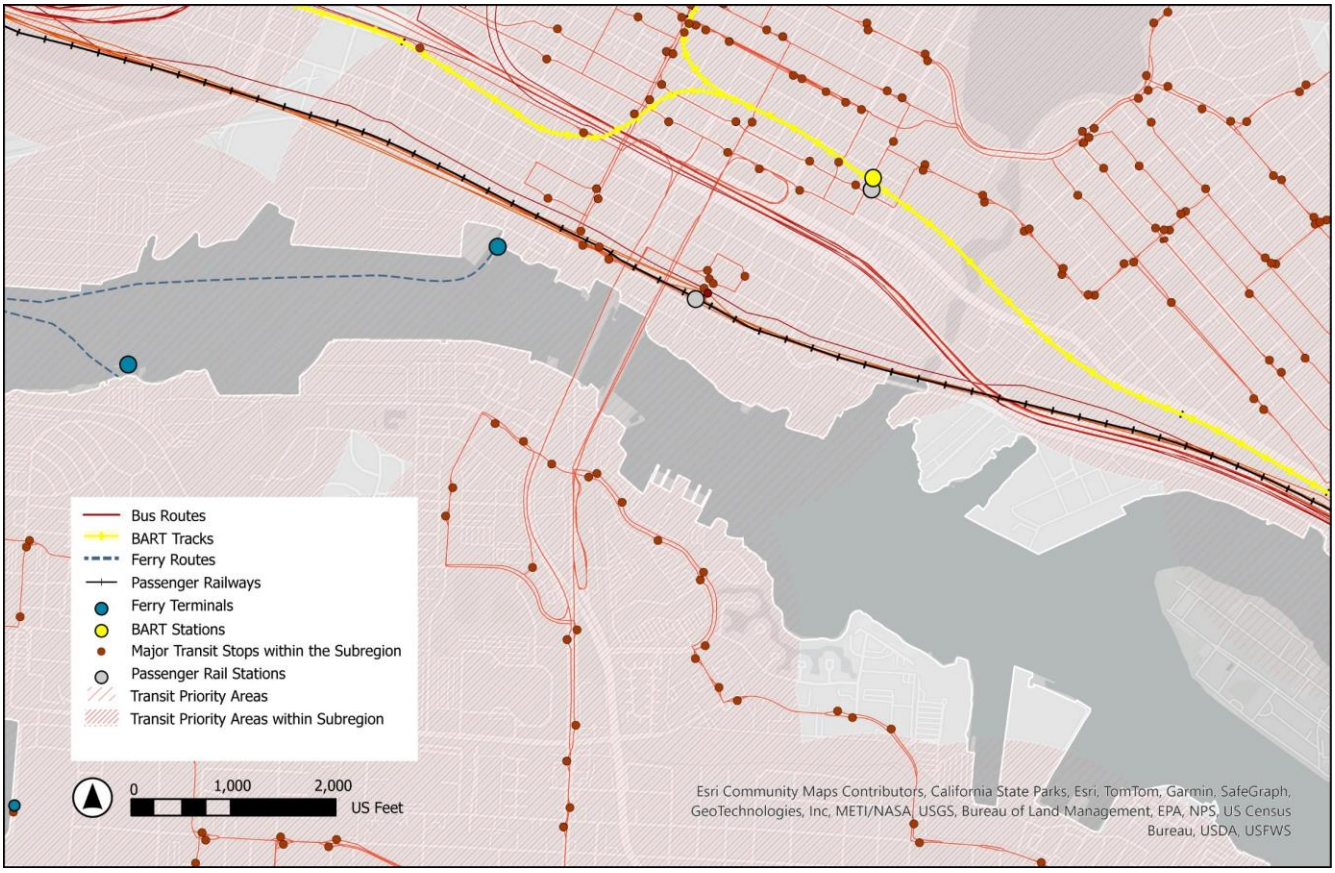


Figure 4-2828. Oakland-Alameda Estuary Public Transit

Source: (Metropolitan Transportation Commission 2024)

4.5.1.6 Other transit services

The Alameda Landing Shuttle is a free, weekday shuttle service that connects Alameda landing at Fifth Street to 12th Street BART Station in Oakland (Vestar 2024). Within Oakland, the City of Oakland and

AC Transit operated the Free Broadway Shuttle (Broadway "B Shuttle"), which ran between Jack London Square to Grand Avenue, with most stops located along Broadway. The shuttle service ran between 7am and 7pm, with extended service past Grand Avenue to 27th Street after 7pm (Caltrans and ACTC 2021). This service was suspended due to the pandemic and it is unclear if and when it will resume operation (City of Oakland 2024a).

4.5.2 Bike & Pedestrian Access

In Downtown Oakland, analysis prepared for the Downtown Oakland Specific Plan found that ramps and wide roadways near the Estuary, such as the Webster/Posey Tubes and the ramps/frontage roads at I-880 and I-980 present major barriers to pedestrians, contributing to a sense of disconnection between various parts of Downtown Oakland. As of 2017, analysis indicated that 36% of Oakland's pedestrian fatalities and injuries occur within 2% of its streets, dubbed the "High Injury Network". Many of these Oakland street segments and intersections are located within the OLU: 7th, 8th, 9th, 12th, 14th Streets, Broadway, Telegraph and Grand Avenues, and the intersections of 12th & Brush, 7th & Harrison, 9th & Madison, and Grand & Lakeside Drives (Toole et al 2017).

Pedestrian and bicycle connectivity between Oakland and Alameda is also limited, particularly at the Webster/Posey tubes. The 36-inch wide, two-way shared-use pathway at the Posey Tube crossing is the only estuary crossing for bicycles and pedestrians (HNTB 2021).

Analysis conducted in 2017 described Downtown Oakland's existing bike network as "relatively dense, but has few continuous, dedicated bike facilities" (Toole et al 2017). As with pedestrians, freeway ramps/frontage roads such as those at I-880 and I-980 present safety challenges. Within the Oakland waterfront segment of the project area, the Bay Trail acts as a Class I Path; several blocks north, there is a Class III - Bike Route on Second Street. Bike parking along the Estuary is limited to bike racks.

4.5.2.1 Bay Trail Access

The Bay Trail runs along either side of the Oakland-Alameda Estuary; on the Oakland side of the Estuary, published maps show a continuous path of access within the project area, while in Alameda, the Bay Trail is interrupted by one gap. Access between each side of the project area is also described as a gap condition. MTC and ABAG are in the process of completing a Bay Trail Gap Closure Implementation Plan (BTGCIP), with an estimated completion date in 2024. Preliminary categorization by the BTGCIP show several highest-priority Bay Trail Gaps within the Oakland-Alameda Estuary Project Area (Metropolitan Transportation Commission 2023b).

On the Oakland side of the Estuary Project Area, the Bay Trail Gap Closure Prioritization Project flags the Oakland-portion of the Posey Tube as a highest-priority gap (Metropolitan Transportation Commission 2022). Pedestrian and bicycle access to and from Alameda to Oakland is physically possible through the Posey Tube; however, the space dedicated to non-motorized access is extremely narrow, particularly for two-way traffic. The Oakland-Alameda Access Project is a multi-agency partnership that proposes improvements to local roads and freeway access between the Posey/Webster Tubes that connect Oakland and Alameda. The project aims to redirect and reduce "freeway-bound traffic within heavily populated pedestrian neighborhoods like Chinatown and construct safe and accessible bicycle and pedestrian facilities that will provide improved connectivity for all modes

between Downtown Oakland, Chinatown, the Jack London District and Alameda." (Alameda County Transportation Commission 2024) Additionally, the Oakland-Alameda Estuary Bridge Project envisions an above-grade crossing for pedestrians and bicycles across this region of the Estuary. If completed, it would likely be eligible for inclusion as part of the Bay Trail (Bike Walk Alameda 2022).

There are no additional Bay Trail Gaps within the Oakland side of the Oakland-Alameda Estuary project area, though there is a high-priority gap flagged in the area adjacent to the project around the Brooklyn Basin shoreline. And though this area immediately on the waterfront is flagged as a gap, the Bay Trail runs in a continuous parallel behind the water along Embarcadero Street until the southern end of Union Point Park (Metropolitan Transportation Commission 2023b).

On the Alameda side of the Estuary Project Area, the Bay Trail runs almost continuously along the water; there is a single, highest-priority gap segment that fronting the Alameda Shipways property (Metropolitan Transportation Commission 2023b). There is another highest-priority gap adjacent to the project area that stretches along Sentinel Drive to the Alameda Main Street Ferry.

4.5.3 Parks & Public Spaces

4.5.3.1 Oakland Parks and Public Spaces

Parks in Oakland directly on the waterfront within the Oakland-Alameda Project Area are:

- **Estuary Park** is a 7-acre community park adjacent to the Oakland-Alameda Estuary. See Section 3 for a more detailed description of the park. As of 2023, Estuary Park is undergoing a master-planning and renovation effort (ESA 2023). An existing dirt/gravel segment of the Bay Trail runs through Estuary Park (Metropolitan Transportation Commission 2021).
- **Channel Park** (1 10th St) begins south of Peralta Park, from 10th Street to the I-880 Freeway. See Section 3 for a more detailed description of the park. Note that Channel Park (also known as Lake Merritt Channel Park) is adjacent to Peralta Park and is separated by the East 10th Street Bridge. The Lake Merritt Trail extends through Channel Park toward the Estuary but falls short of directly connecting to the existing Bay Trail along Embarcadero. The Lake Merritt to Bay Trail Connection Gap Closure Project aims to eliminate this gap and as of 2017 the city had compiled a draft Design Guidelines document for the connection (City of Oakland).

Though not directly adjacent to the shoreline boundary of the project area, Peralta Park is connected to the project site through its adjacency to Channel Park.

Other Public Open Space Areas within the Estuary Project Area in Oakland include**:**

- **Jack London Square** is "fifteen square blocks of commercial and recreational activities, including opportunities for dining and shopping, strolling, ferry rides, and special events…" (Port of Oakland 2023). Jack London Square hosts regular events, such as a farmer's market and holiday observances. Franklin D. Roosevelt Fishing Pier is located within Jack London Square, as well as a mini park at Alice Street. Within the district there are restaurants, bars, shops, and private marinas. Publicly accessible amenities include guest berths, plazas, play areas, public restrooms, public seating, and a portion of the Bay Trail. The Oakland Ferry Terminal, also referred to as the Jack London Ferry Terminal, is located at the western edge of the region next to the Howard Terminal site; the Jack London Amtrak Station is in the eastern region of the area. Jack London Square is within the planning region for the Downtown Oakland Specific Plan as

well as the Oakland Alameda Access Project. The City of Oakland's recently funded Embarcadero West Rail Safety and Access Improvements projects are also adjacent to the Jack London Square region.

4.5.3.2 Alameda Parks and Public Spaces

City of Alameda parks within the Oakland-Alameda Estuary area are:

- **Bohol Circle Immigrant Park** (2901 5th Street). This waterfront park, and the organization behind its creation, has a poignant history: Bohol Circle is the oldest Filipino American organization in the United States. Founded in 1936, the organization started as a mutual-aid group for immigrants, initially organized around the goal of ensuring that the Bay Area Filipino community could obtain respectful and culturally appropriate burials after emigration (City of Alameda 2023). Bohol Circle purchased the land for the park in 1965 and is intended to be "a physical space for Filipino Americans to serve as a cultural and familial mecca for families who recently immigrated to the United States" (City of Alameda 2023). Amenities include BBQ grills, a restroom, picnic areas, a play structure, walking paths and views across the Estuary to Jack London Square.
- **Marina Village Park** (1011 Pacific Marina). Facilities include restrooms and paved walking trails, including an officially designated segment of the Bay Trail (Association of Bay Area Governments 2005; City of Alameda 2024e).
- **Neptune Park** (2000 Webster Street) is inland from the Oakland-Alamea Estuary project shoreline boundary but has been identified as a potential site for stormwater management. The site occupies 3.08 acres. Amenities include paved walking trails, flagpoles and a large open lawn (City of Alameda 2024f).

Additionally, the Jean Sweeney Open Space Park (1925 Sherman Street) is inland from the Oakland-Alameda Estuary project area. The **College of Alameda** campus is also near the Neptune Park wedge.

4.5.3.3 East Bay Regional Parks District & Port of Oakland

The East Bay Regional Parks District and the Port of Oakland do not own or operate any parks or open space in the Oakland-Estuary project area.

4.5.3.4 Water Access

The San Francisco Bay Area Water Trail (Water Trail) is a series of launching and landing sites ringing the Bay and its major tributaries, including the Petaluma River, Napa River, and San Joaquin River. These sites, or "trailheads", are geared toward non-motorized small crafts such as kayaks, sailboards, dragon boats and stand-up paddleboards.

Out of the nine Water Trail trailheads officially designated in Alameda County, one formally designated site is located within the Oakland-Alameda Estuary project area at Estuary Park in Oakland. Oakland's Estuary Park includes the Jack London Aquatic Center, offers an ADA-compliant low-freeboard dock & ramp, and a high-freeboard dock. Managed by the City of Oakland, the low-freeboard dock is popular with non-motorized small crafts. Community organizations have access to equipment storage through the Aquatic Center.

Additional existing sites with potential Water Trail designation within the Oakland-Alameda Estuary project area include the small craft launch at the City of Alameda's Bohol Circle Immigrant Park. Small-

craft launch facilities and direct water access at Jack London Square are also potentially suitable for Water Trail designation.

Once built, a small craft launch bundled with marina improvements proposed as part of the Brooklyn Basin Marina Expansion Project (ESA 2022) could become an additional designated Water Trail trailhead.

Figure 4-29. Oakland-Alameda Estuary Bike and Pedestrian Routes

Source: (City of Alameda, City of Oakland, East Bay Regional Parks District, Metropolitan Transportation Commission 2024)

4.6 Cultural Resources and Biological Resources

In November 2023, ESA staff conducted a cultural resources records search for the project area from the Northwest Information Center (NWIC) at Sonoma State University, Rohnert Park. Geographically, the records search encompassed the shoreline for architectural resources, and the shoreline plus a 0.25-mile buffer inland for archaeological resources.

Background research for this study identified 30 previously recorded architectural resources, 14 of which appear to be mapped along the actual shoreline, and seven previously recorded archaeological resources within 0.25 mile inland of the shoreline. The Oakland shoreline has experienced some level of historic-era development since at least as early as the mid-19th century, with some wharves and associated development present as early as the 1850s, with the overall general location/arrangement

of the shoreline apparent as early as the 1920s. The Alameda shoreline experienced development later than its Oakland counterpart, but its shoreline had its overall general location/arrangement by the 1920s. Given that the current shoreline was established in its current location as a result of historic-era development, and that no pre-contact archaeological resources have been recorded in or adjacent to the project area despite a number of previous studies in the area having included archaeological excavation, the project area appears to have a low sensitivity for pre-contact archaeological resources. In contrast, the significant amount of historic-era development, and presence of several previously recorded historic-era archaeological resources suggests that the project area has a high sensitivity for historic-era archaeological resources. Additionally, a large number of architectural resources have been recorded, many of which are in the shoreline portion and many which appear to have not been evaluated for National Register- or California Register-eligibility. As such, the project area has a high sensitivity for architectural resources.

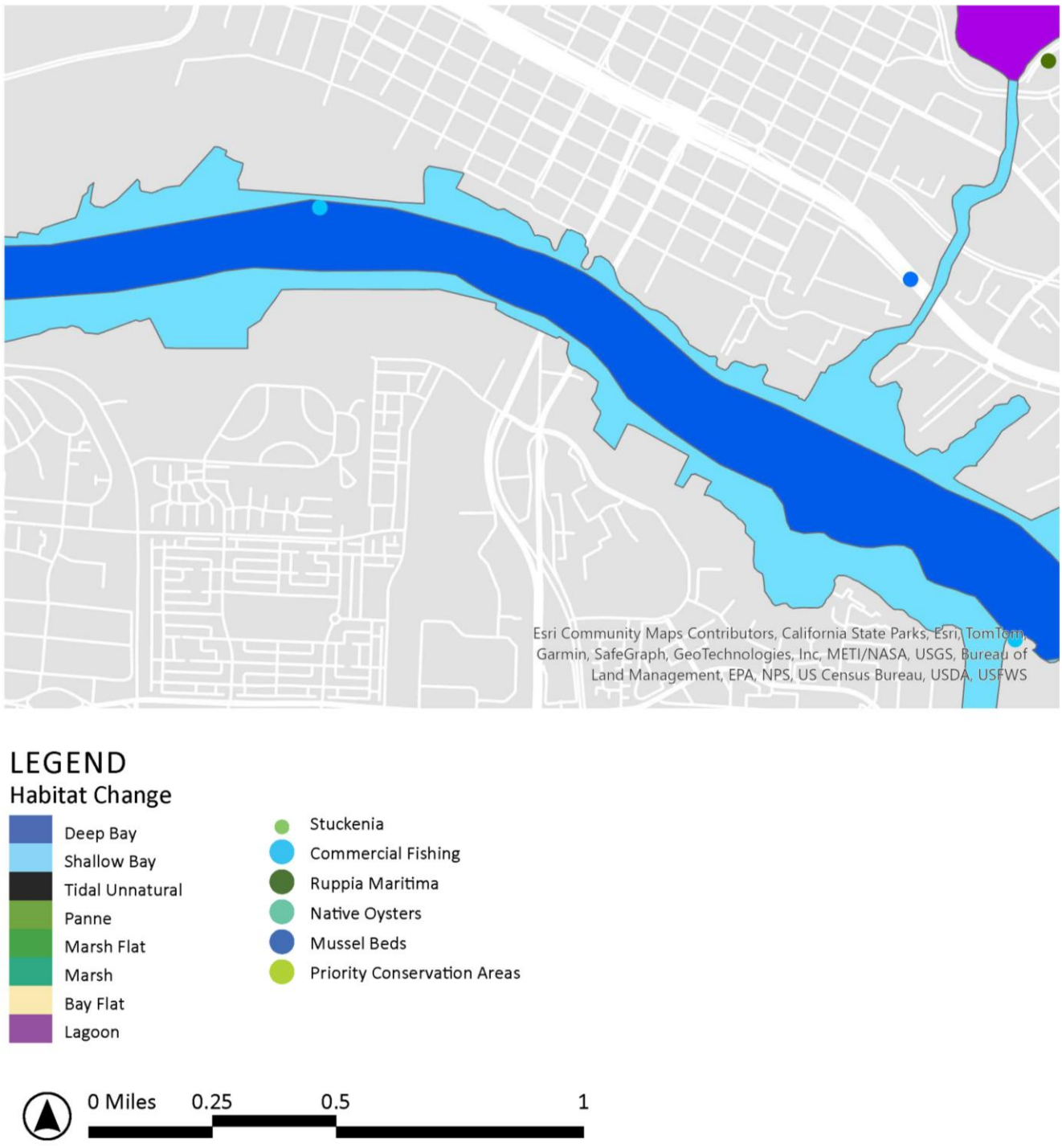


Figure 4-3030. Habitat Change

Source: (ESA, SFEI)

4.7 New Development and Planned Redevelopment

More detailed descriptions of each planned project can be found in Section 3.8.

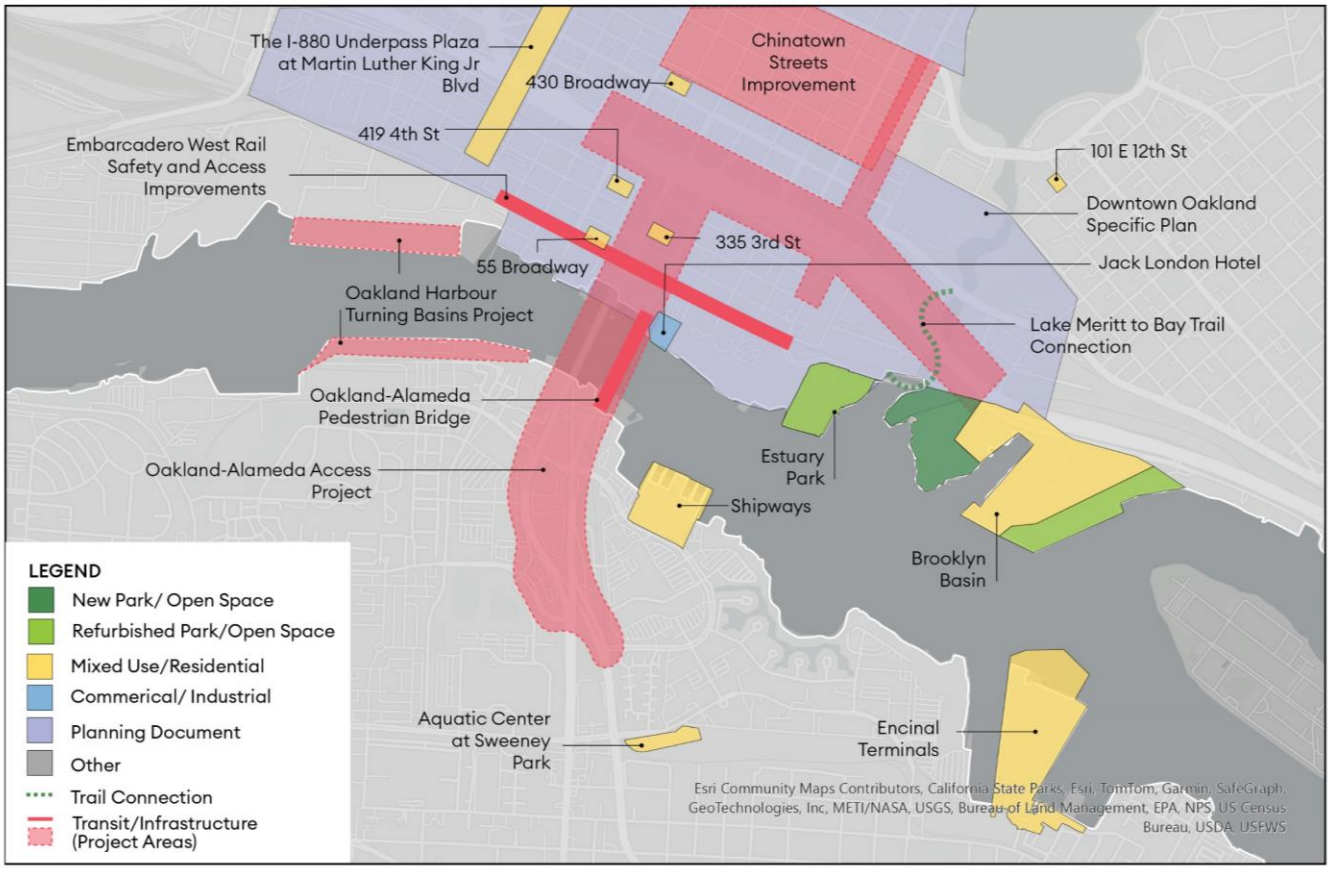


Figure 4-3131. Oakland-Alameda Estuary New Development & Planned Redevelopment

Source: (City of Alameda; City of Oakland; EBRPD; Port of Oakland; BCDC; SF YIMBY)

4.7.1 Mixed Use & Residential Within & Adjacent to Estuary Project Area

- There are multiple infill and redevelopment projects planned in the Jack London district in Oakland. Planned projects include the following:
    - 419 4th Street, Jack London District, Oakland (YIMBY Team 2023, p. 4);
    - 101 East 12th Street, Merritt, Oakland (Nelson 2022);
    - 430 Broadway, Jack London District, Oakland (Nelson 2023a);
    - 55 Broadway, Jack London District, Oakland (YIMBY Team 2022a);
    - 335 3rd Street, Jack London District, Oakland (YIMBY Team 2022b).
- Brooklyn Basin – City of Oakland;
- Shipways – City of Alameda;

- Alameda Point Open Spaces – City of Alameda.

4.7.2 Parks & Open Space Within & Adjacent to Estuary Project Area

- Estuary Park – City of Oakland;
- Sweeney Park Aquatic Center – City of Alameda (City of Alameda);
- Regional Sports Complex – City of Alameda (MIG, Inc 2009);
- Future Brooklyn Basin Parks – City of Oakland;
- Alameda Point Open Spaces – City of Alameda.

4.7.3 Trails & Connections Within the Estuary Project Area

- Oakland-Alameda Bicycle/Pedestrian Bridge;
- Lake Merritt To Bay Trail Connection – City of Oakland;
- East Bay Greenway – City of Oakland.

4.7.4 Commercial/Industrial Projects Within the Estuary Project Area

- Jack London Square Hotel – City of Oakland (Nelson 2023d)

4.7.5 Transit/Infrastructure Projects Within the Estuary Project Area

- Oakland Harbor Turning Basins Widening Project;
- Oakland-Alameda Access Project;
- Embarcadero West Rail Safety and Access Improvements – City of Oakland.

4.7.6 Other Projects within the Estuary Project Area

- Howard Terminal Redevelopment – City of Oakland;
- Laney College Facilities & Technology Master Plan Updates – City of Oakland.

4.7.7 Planning Documents

- Downtown Oakland Specific Plan – City of Oakland;
- Central Estuary Specific Plan – City of Oakland;
- Lake Merritt Station Plan – City of Oakland;
- West Oakland Specific Plan – City of Oakland;
- Chinatown Complete Streets Plan – City of Oakland.

5 Bay Farm Island

Bay Farm Island is at the southern limit of the City of Alameda and is bounded to the south by the Port of Oakland (Oakland Airport) and by San Francisco Bay, San Leandro Channel, and San Leandro Bay to the west, north, and east. Its proximity to Alameda provides an important connection between Alameda and the mainland, providing another access point to and from Alameda. Although Bay Farm Island is a peninsula it is significantly constrained due to the limited access (two roadways) to the City of Oakland to the east. The portion of Bay Farm Island relevant to the project is within the City of Alameda, north and west of the Port of Oakland airport property.

5.1 Overview of project

5.1.1 Project background

The Bay Farm Island is the continuation of previous studies and planning effort, as summarized in the Climate Action and Resiliency Plan (CARP) 2022 Annual Report and 2023 Work Plan:

> *CARP includes two adaptation projects for the northern shoreline of Bay Farm Island (Veterans Court and Lagoon System Outfall) as a first step in the process to work in conjunction with a Doolittle Drive project to protect the airport, golf course, adjacent residential neighborhoods, commercial properties and roadways from flooding and sea level rise.*
>
> *…*
>
> *The project will develop 100% designs for the Veterans Court seawall and Lagoon System 1 outfall and develop a long-term adaptation strategy for the Bay Farm Island shoreline with the long-term goal of removing Bay Farm Island from the FEMA floodplain map. The project also seeks to mitigate the impacts of sea level and groundwater rise and consider liquefaction risk, maintain connectivity to/from Bay Farm Island, maintain and adapt existing public recreation space and the Bay Trail, including the wooden bicycle/pedestrian bridge, implement nature-based solutions, such as submerged aquatic vegetation, horizontal levees, and living seawalls; and provide co-benefits such as enhancing wildlife habitat, attenuating wave energy, accumulating sediment, reducing erosion, sequestering carbon, and buffering ocean acidification.*
>
> *…*
>
> *As part of the Estuary Working Group, the San Leandro Bay/Doolittle Drive Subarea Working Group continues to meet quarterly with the Port of Oakland, Caltrans, East Bay Regional Parks District, City of Oakland, and community groups to coordinate and align adaptation efforts and expedite development of adaptation projects for Doolittle Drive that achieve multiple benefits for all the stakeholders involved. Doolittle Drive is a significant driver of projected sea level rise inundation for Bay Farm Island.*

The Bay Farm Island project includes short-term improvements addressing urgent, specific deficiencies and long-term improvements addressing larger-scale concerns. Short-term projects include

construction of a levee or seawall along Veterans Court and construction of a levee or seawall adjacent to the North Gate Structure at the north end of Lagoon 1. A third short-term project led by Caltrans is planned for the east limit of Doolittle Landfill, crossing over Doolittle Drive. The long-term project, located along the north shoreline from Aughinbaugh Way to Veterans Court, includes flood protection improvements and nature-based solutions and green solutions.

FEMA Flood Maps and independent study by Wood Rodgers indicate that Bay Farm Island project site is susceptible to present-day flooding primarily from three locations: Veterans Court, North Shoreline at the end of Lagoon 1, and the east end of Doolittle Landfill. The flooding is primarily driven by portions of the shoreline with low elevations; each of these shoreline segments corresponds to the short-term projects for which planning is already underway. See Section 5.2.4 for further information about existing flooding concerns as determined by FEMA.

Bay Farm Island is located south of Alameda Island and north of the Port of Oakland property; see Figure 5-1. The project extends from the Port of Oakland property line to the west and northwest shorelines facing San Francisco Bay, and to the north shoreline facing San Leandro Channel.

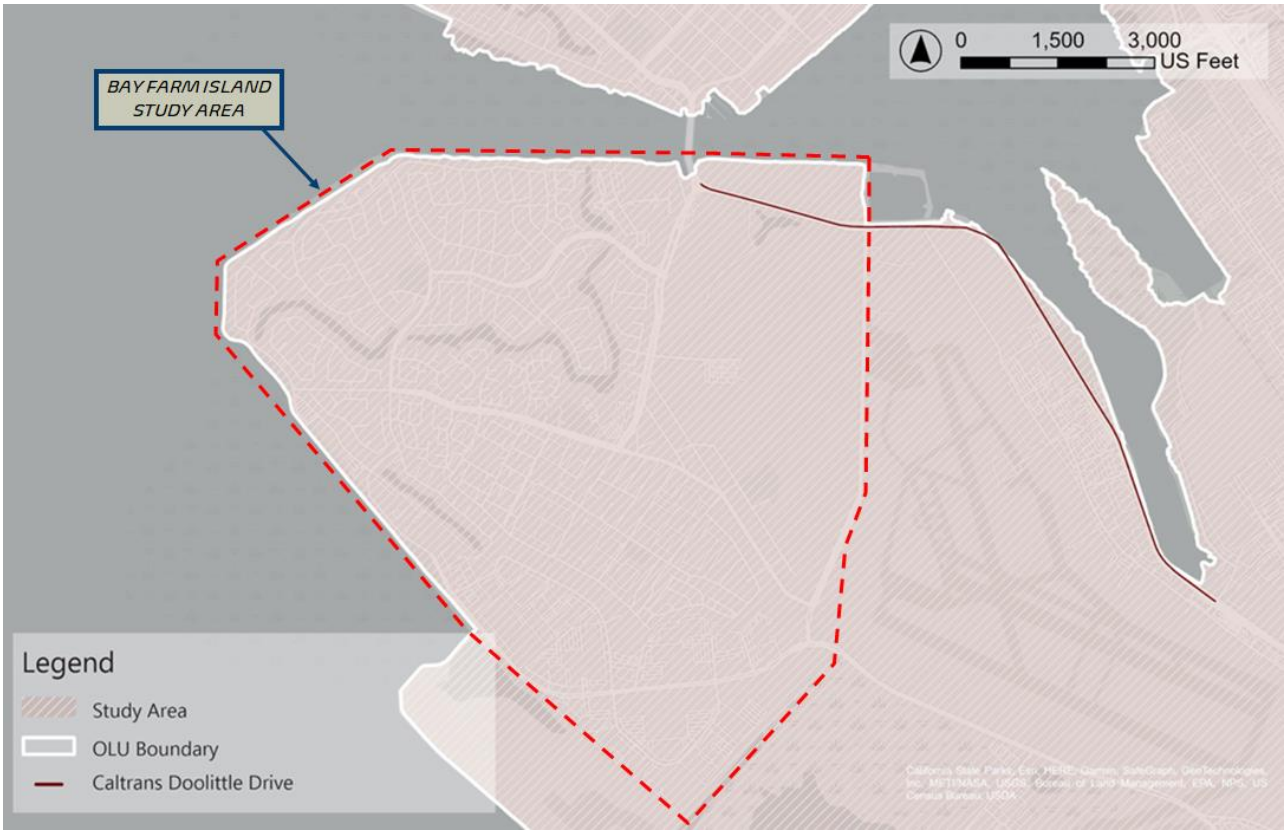


Figure 5-1. Bay Farm Island Study Area

Source: (City of Oakland 2015a; Alameda County Open Data 2022; Caltrans 2022; East Bay Regional Parks District 2023a)

5.1.2 Geological History of Bay Farm Island

The original Bay Farm Island is an Ice Age small sand dune, surrounded by marshland, which is located near the west shoreline of the current island, and on the north side of the Oakland International Airport. The original sand dune (Qds) is shown on the geology map of Figure 3-32. Before European settlers arriving to the Bay Area, the local Ohlone Indians used the island as foraging ground for food. The land was used for farming in 1850s, with asparagus being the main crop (Baker, 2014). In 1870s, the marshlands on the north and east side of the island were drained and the land reclaimed for farming and later for development. In 1920s two major development projects, the golf course and the airport that later became Oakland International Airport, further transformed the island toward the current shape. Land reclamation and expansion of Oakland International Airport on the south converted the original island to the current peninsula. As implied by the geologic map of Figure 3-32 and in Figure 5-2, most of the current island, including a strip of land along the west shoreline and entire Oakland International Airport is built on artificial fill that is placed on Young Bay Mud.

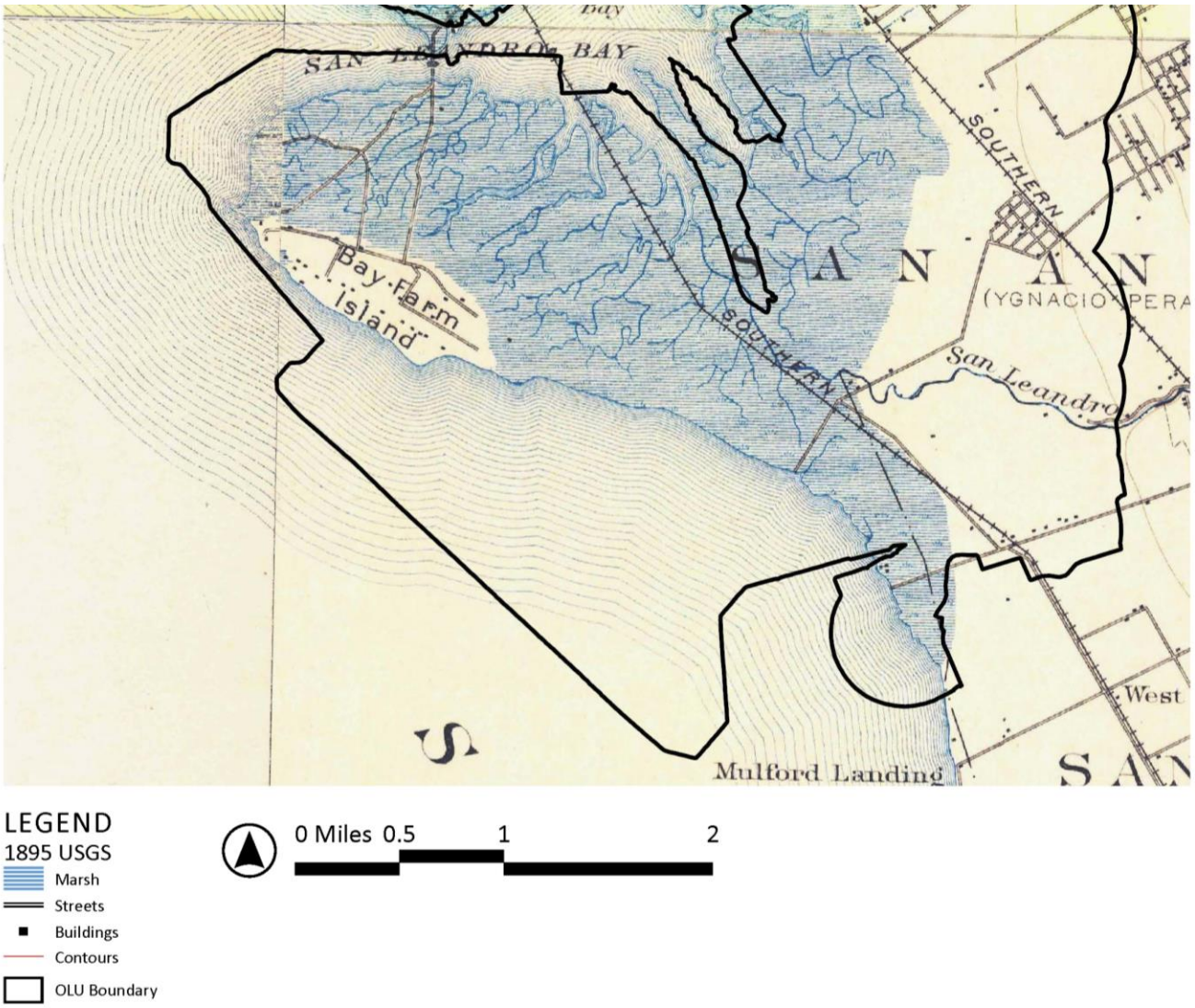


Figure 5-2. Historic Map of Bay Farm Island, 1895

Source: (USGS)

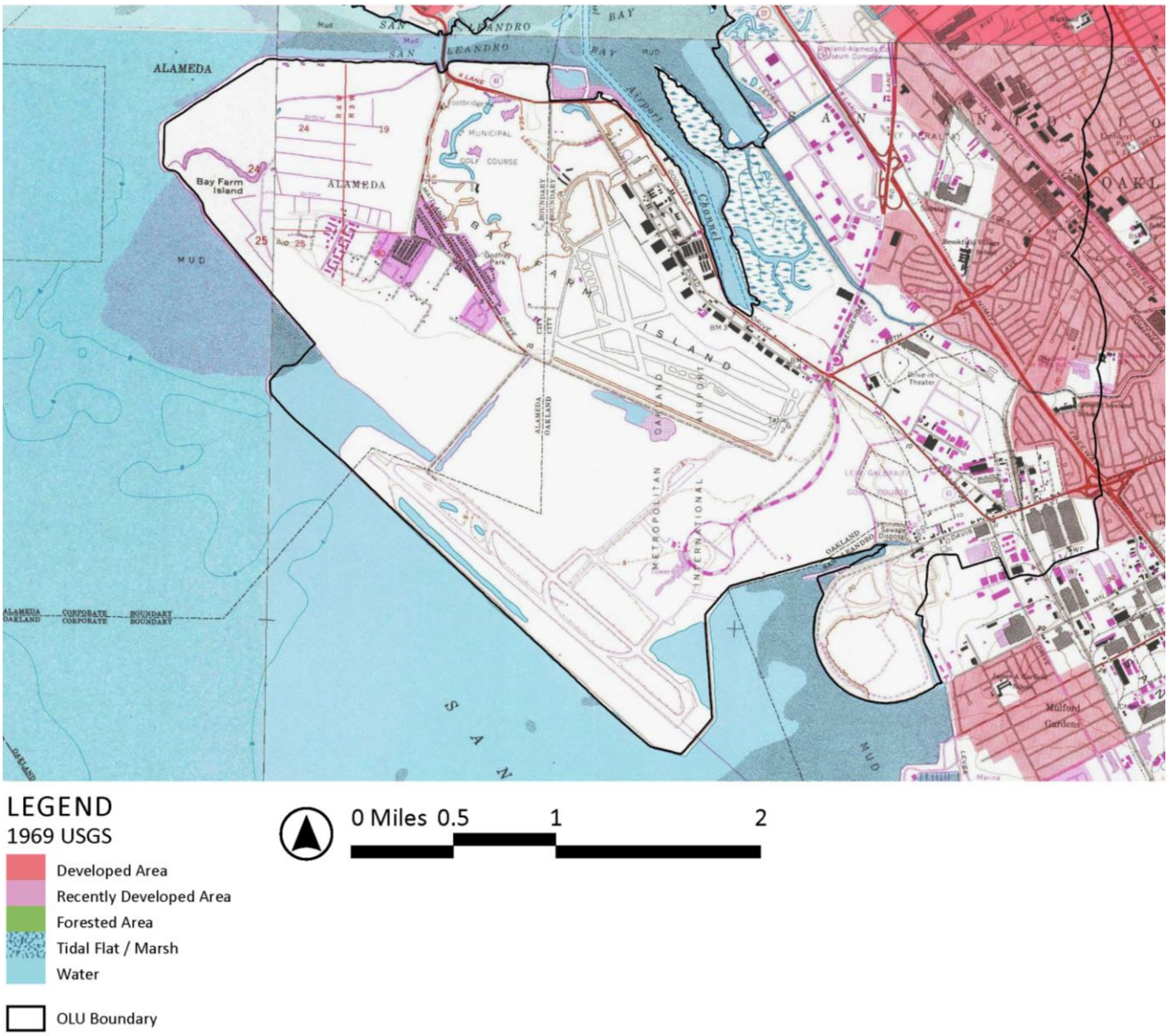


Figure 5-3. Historic Map of Bay Farm Island, 1969

Source: (USGS)

5.1.3 Planning and Jurisdiction

The project area includes four key jurisdictions:

- City of Alameda;
- Port of Oakland;
- Caltrans;
- East Bay Regional Parks District.

Figure 5-4. Bay Farm Island Jurisdiction Boundaries

Source: (City of Oakland 2015a; Alameda County Open Data 2022; Caltrans 2022; East Bay Regional Parks District 2023a)

The project area includes a range of land uses as indicated in Figure 5-5.

Figure 5-5. Bay Farm Island Land Use

Source: (City of Oakland 2015a; City of San Leandro 2021; City of Alameda 2023a)

A range of residential communities, utility providers, businesses, and transportation facilities are also within the project area. Those entities that are particularly affected by the Bay Farm Island flood hazards include:

- Community of Harbor Bay Isle Owners' Association, Inc. (CHBIOA), which coordinates management of (20) Homeowner Associations (Rouse 2024);
- Harbor Bay Ferry Terminal (WETA 2022);
- Harbor Bay Business Park (GS Management Company);
- Recreation Clubs including the Harbor Bay Club.

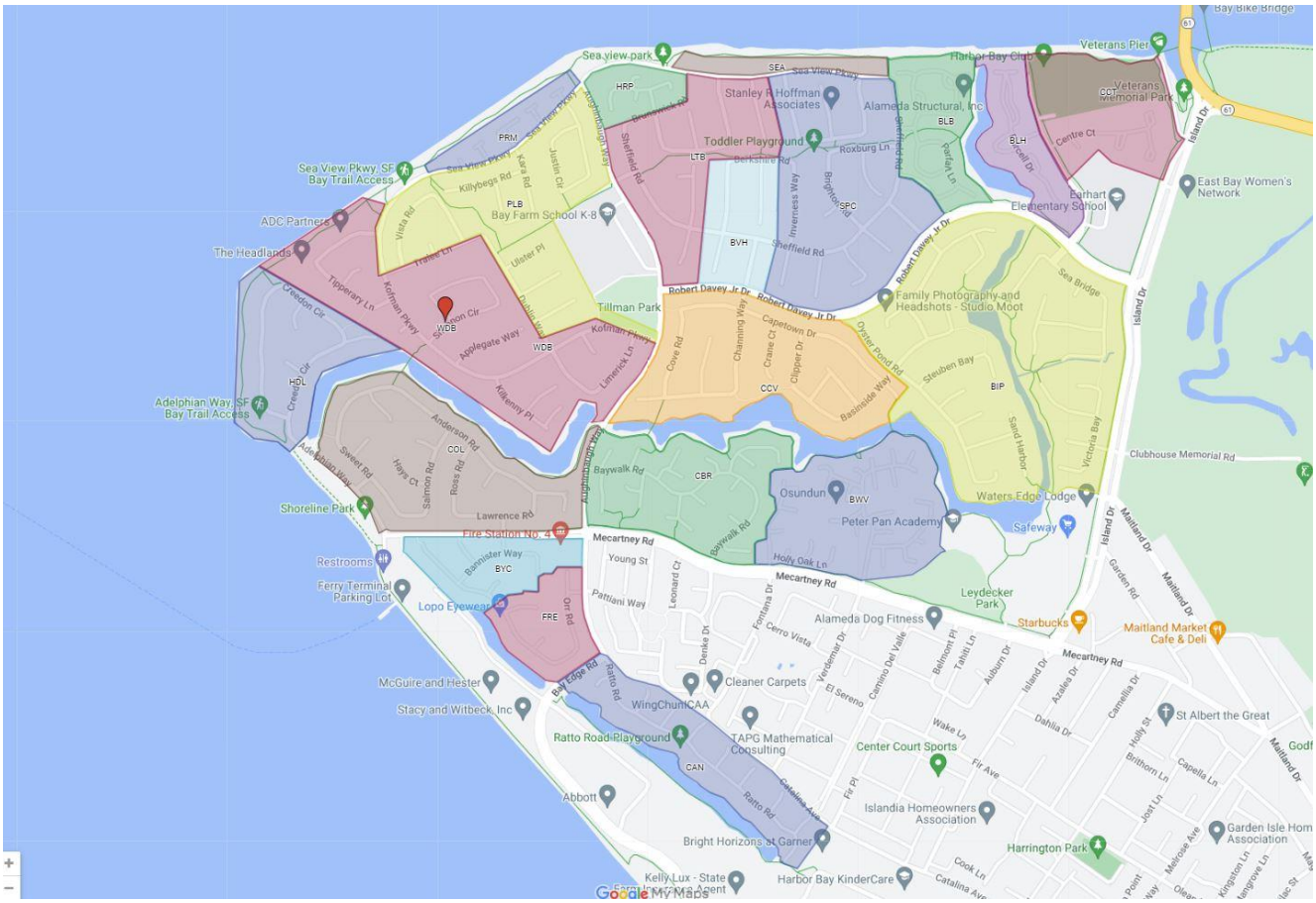


Figure 5-6. Community of Harbor Bay Isle Owners' Association – Association Areas

Source: Harbor Bay Isle Owners Associations

5.2 Physical Setting and Coastal Flood Hazards

5.2.1 Water Depth and Navigable Waters

As described previously, the project area is located within the northwest portion of Bay Farm Island, bordered by San Francisco Bay, San Leandro Channel, and the Port of Oakland. The bay fronting the west and northwest shorelines is relatively shallow; the one exception is deeper water at the ferry terminal which is a recent modification to bay water depths. San Leandro Channel is also shallow, with a deeper channel running parallel to and near the Bay Farm Island north shoreline. The NOAA Navigation Chart 18650 for this area is shown in Figure 5-7.

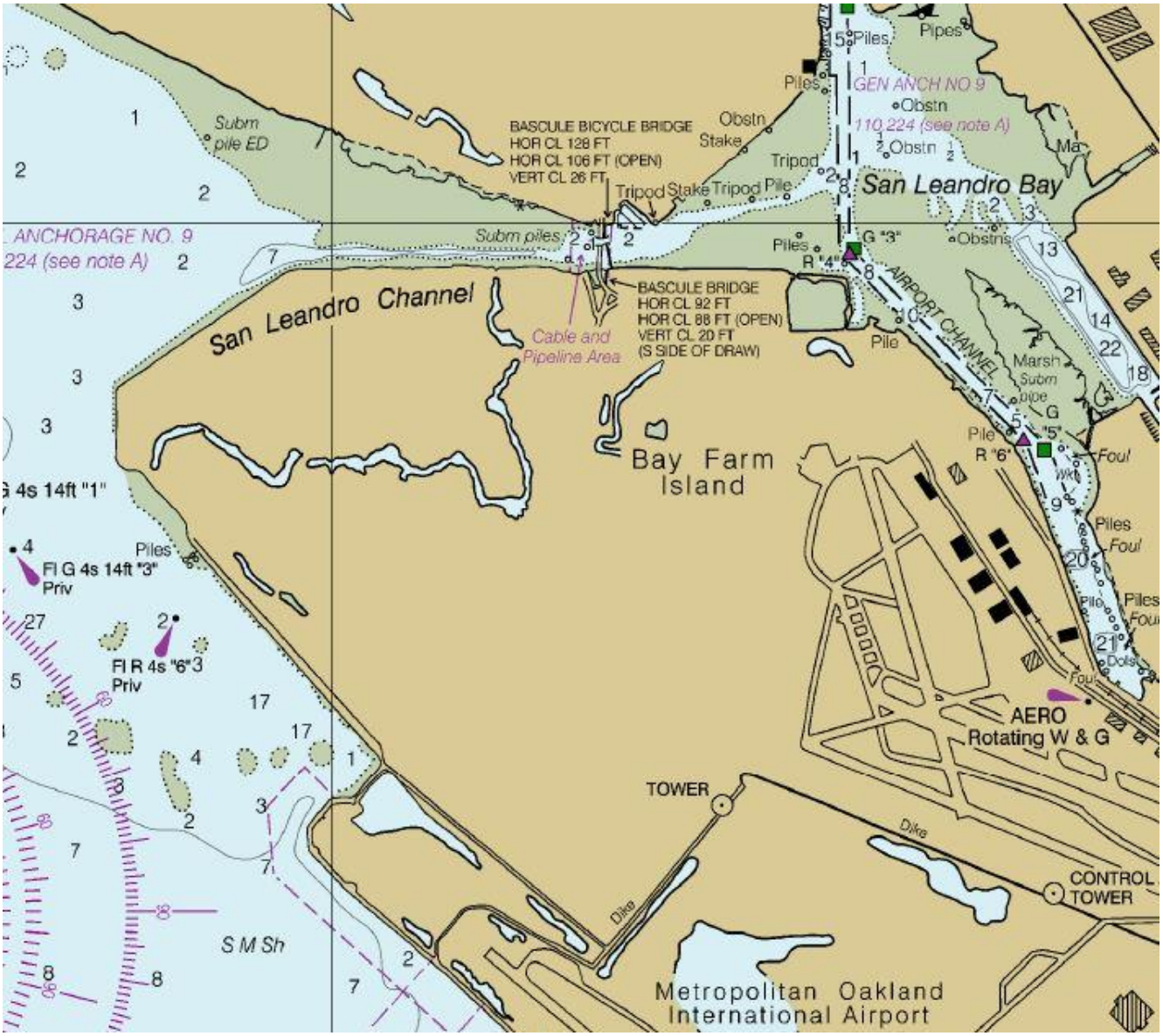


Figure 5-7. Navigation Chart for Bay Farm Island

Source: (NOAA Office of Coast Survey 2023)

5.2.2 Topography

The overall topography of the project site at Bay Farm Island is relatively flat. Elevations are below +20-feet NAVD in the Harbor Bay Isle area south/west of Doolittle Drive (SR61); the highest elevations on Bay Farm Island are at Doolittle Landfill, with elevations over +50-feet NAVD. Low ground elevations along the lagoon edges are at an approximate elevation of +4-feet NAVD, and the lowest elevations occur within the Chuck Corica Golf Course at approximately +2-feet NAVD. See Figure 5-8 for the overall topography of Bay Farm Island.

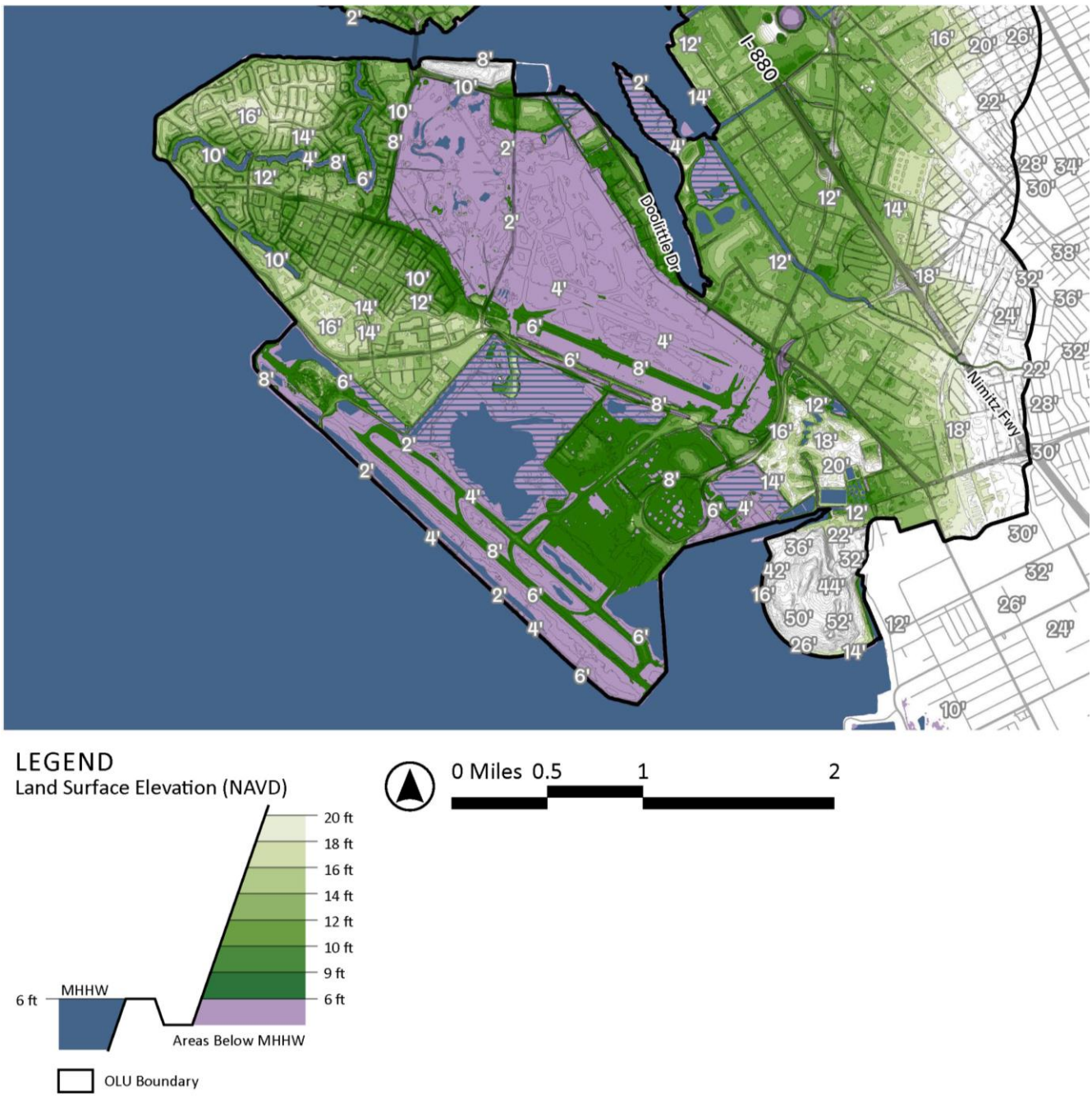


Figure 5-8. Bay Farm Island Topography

Source: (USGS, NOAA Coastal LiDAR)

Data/Analysis Gap: Additional topographic and bathymetric surveys may be required to complete 30% design.

5.2.3 Met-ocean Conditions (Tides, Wind, Waves)

Overall wave conditions for the OLU were introduced previously in Section 3.4.3, which described wave size as a function of wind speed. For the Bay Farm Island project site, the southwest-facing shoreline is subject to some of the largest waves in the Bay. Winds that generate these waves are presented in Figure 5-9, showing the wind rose for annual average wind climate at Alameda, followed by summer and winter wind roses. Although prevailing winds are from the west, high winds originate from both the west and the southeast. High winds from the west act over a relatively short fetch and don't result in high waves. High winds from the southeast act over a longer fetch to the south and result in the high waves that reach Bay Farm Island.

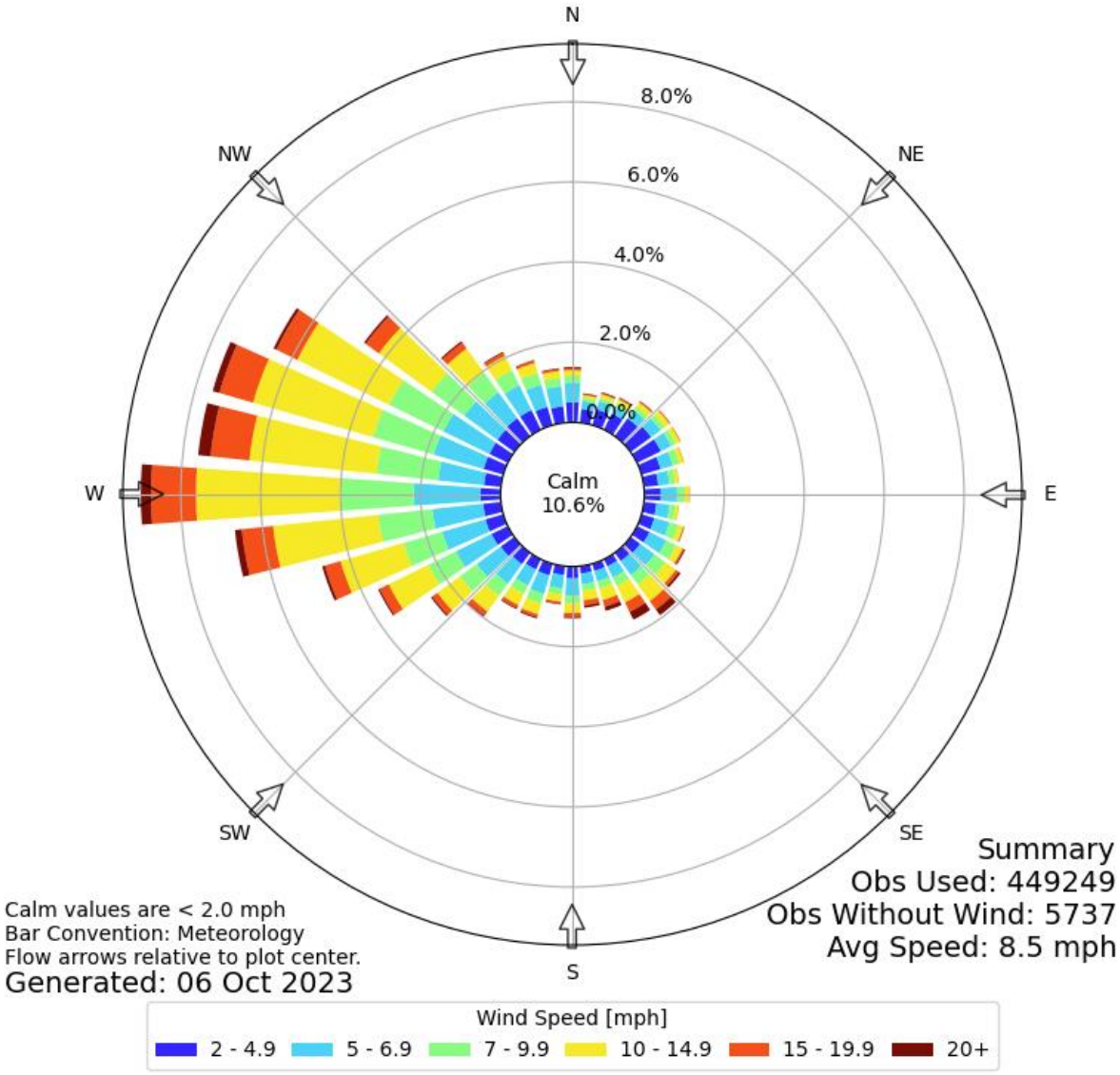


Figure 5-9. Alameda Average Annual Wind Climate

Source: IEM Wind Rose/NOAA Climate.gov

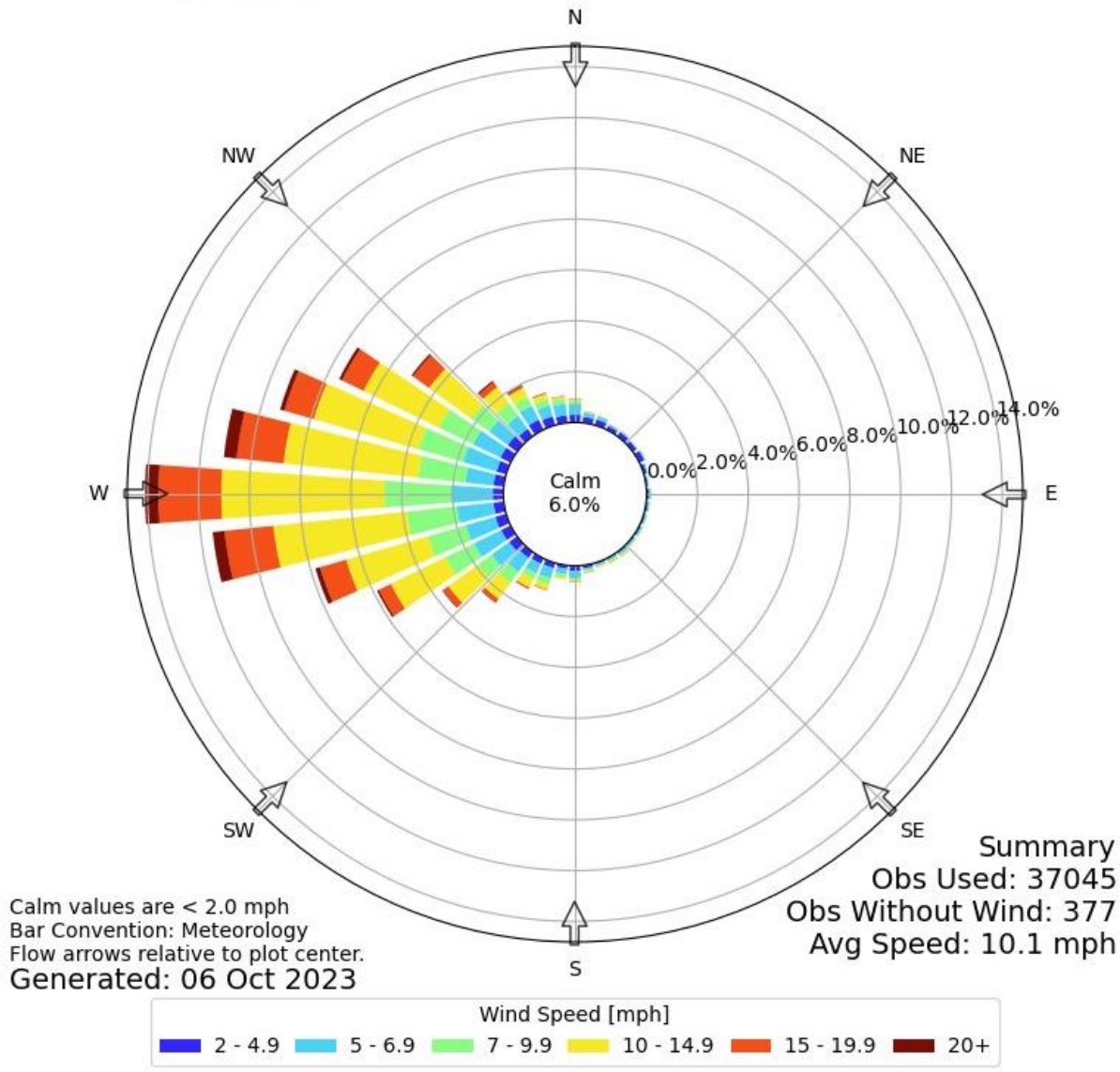


Figure 5-10. Alameda Summer (June) Wind Conditions

Source: IEM Wind Rose/NOAA Climate.gov

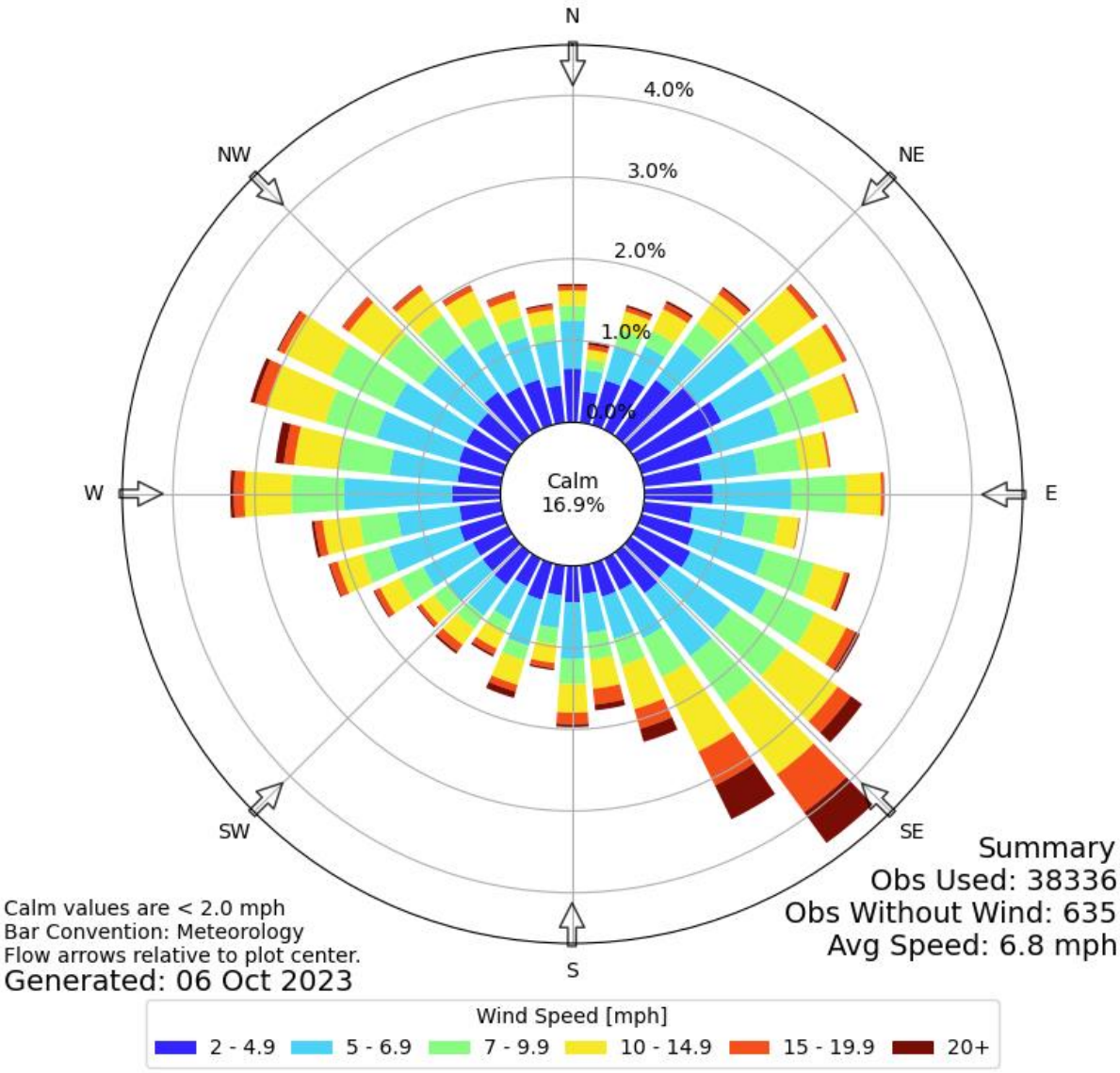


Figure 5-11. Alameda Winter (January) Wind Conditions

Source: IEM Wind Rose/NOAA Climate.gov

5.2.4 FEMA Floodplain Mapping

FEMA's Flood Insurance Rate Maps (FIRM) are based on either 100-yr Stillwater Elevations or Total Water Level where shorelines are subject to significant Wave Runup; for Bay Farm Island five transects were analyzed along its north and west shorelines (49-54), as shown in Figure 5-12.

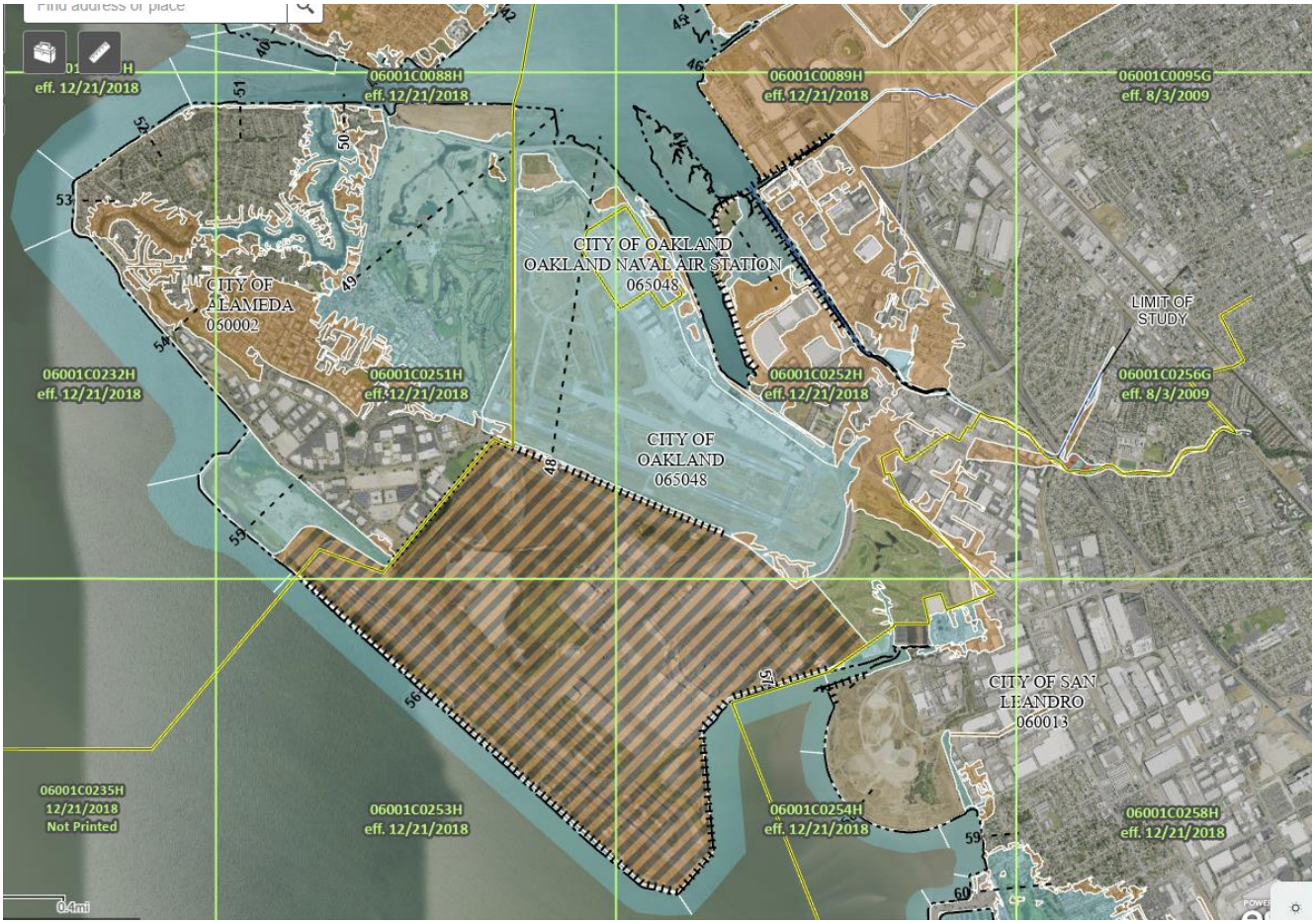


Figure 5-12. FEMA Flood Zones for Bay Farm Island

Source: (FEMA 2023c)

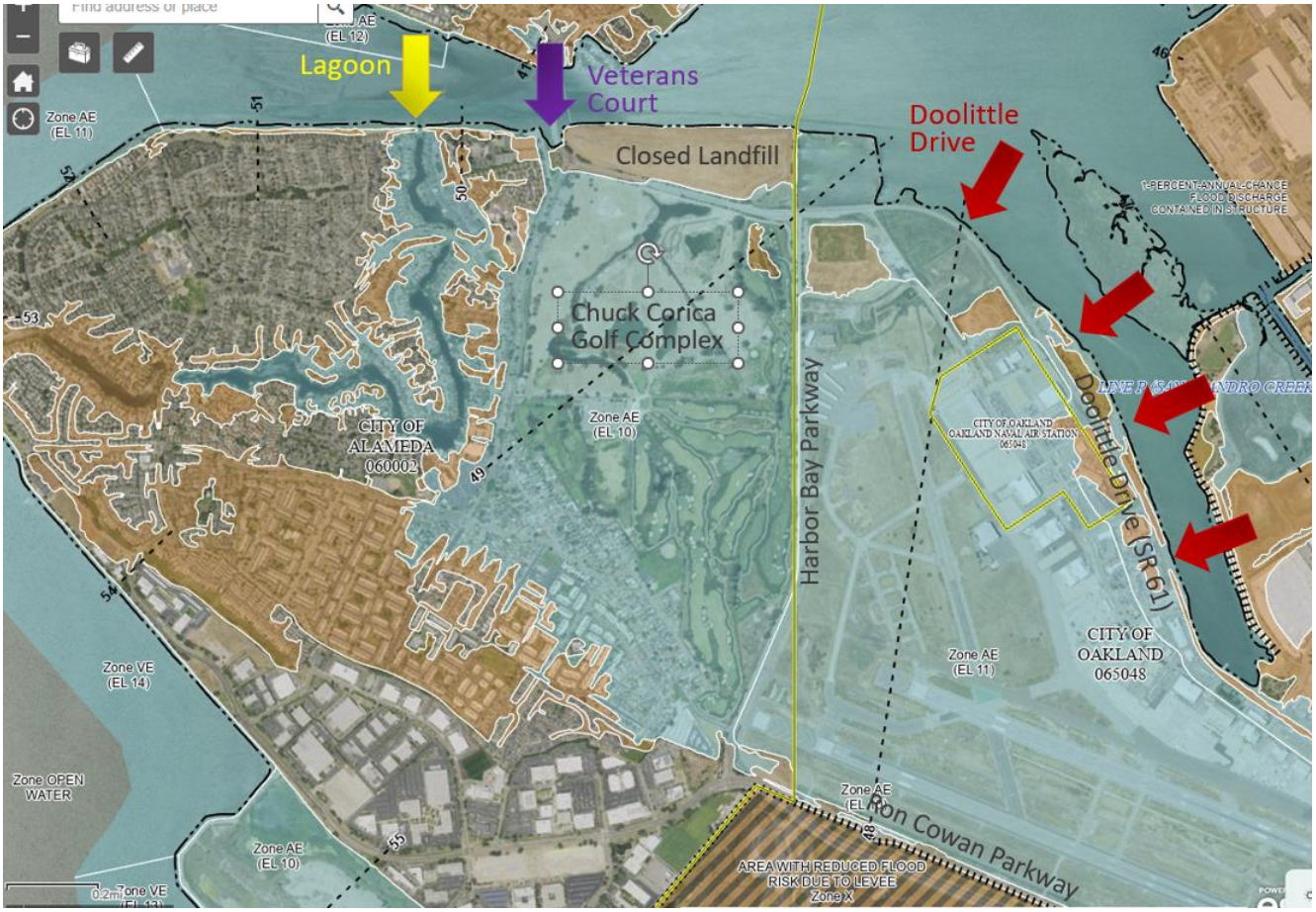


Figure 5-13. Shoreline Overtopping Locations

Source: (FEMA 2023c)

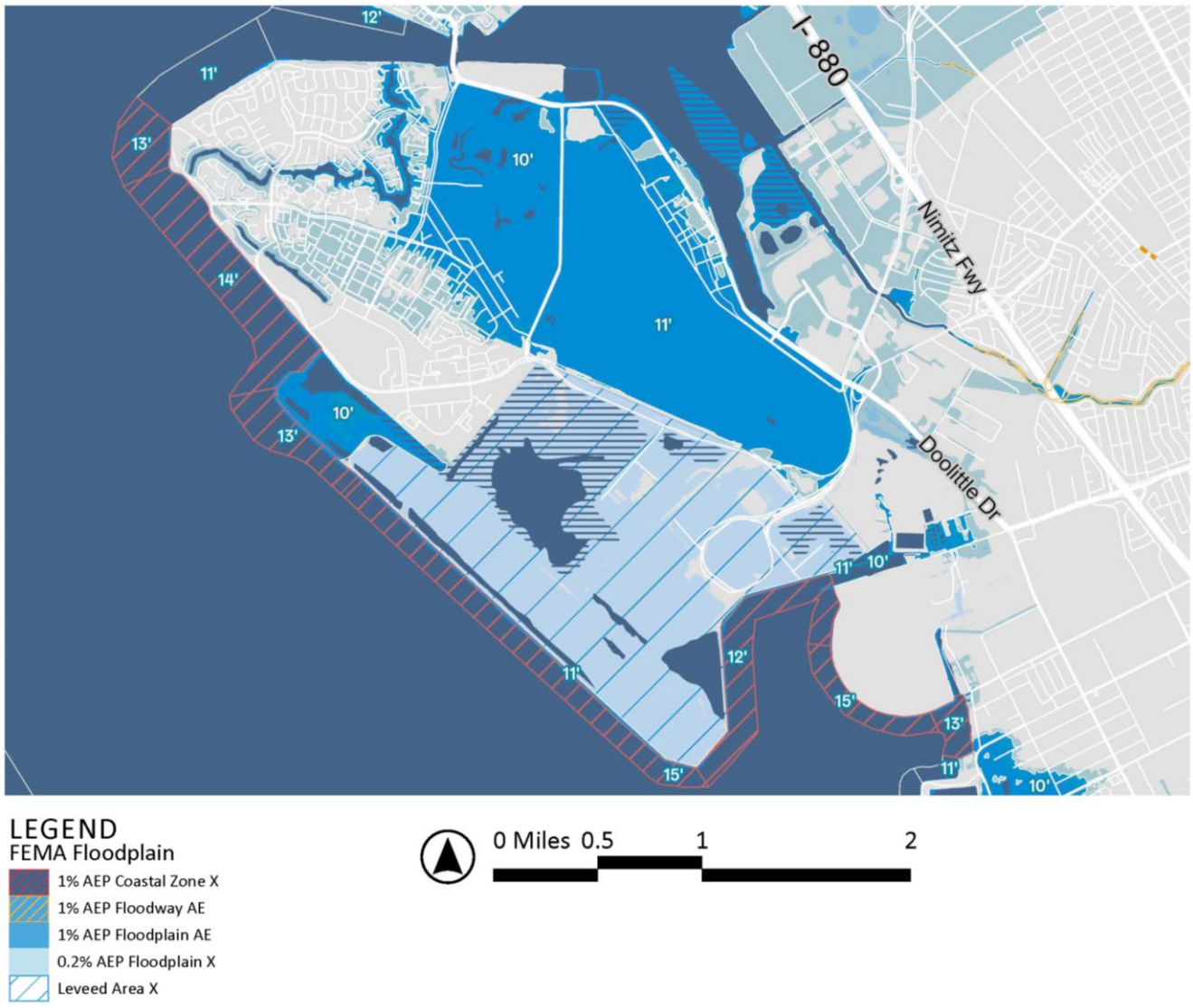


Figure 5-14. FEMA Flood Zones on Bay Farm Island

Source: (FEMA 2018)

Transect	Stillwater Elevation (feet NAVD 88)				Zone	BFE	Note
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance			
49	8.32	9.74	10.04	11.88	AE	10	
50	8.65	9.75	10.07	11.55	AE	10	
51	8.86	9.77	10.22	11.64	AE	10	
52	8.86	9.77	10.22	11.63	AE	11	*
53	8.87	9.78	10.23	11.64	VE	13	*
54	8.9	9.8	10.27	11.71	VE	14	*

* Wave Runup Elevation

Table 5-1. Results of FEMA Flood Insurance Study for Bay Farm Island. Results show Stillwater Elevations governing transects 49-51 (north shoreline) and Wave Runup determining the BFE due to wave runup at transects 52-54 (northwest and west shorelines).

The results of the Flood Insurance Study are presented in the FEMA FIRM for Bay Farm Island, which shows the Bay Farm Island project area bounded by four Zones.

- Zone VE (EL 14) at the southwest facing shoreline north of the airport. This southwest facing shoreline is subject to the largest waves. The land along this shoreline is sufficiently high to prevent coastal flooding.
- Zone VE (EL 13) at the west facing shoreline. This short shoreline segment is subject to slightly smaller waves; the shoreline along this reach is also sufficiently high to prevent coastal flooding.
- Zone AE (EL 1a) at the northwest facing shoreline. This short shoreline segment is subject to smaller waves such that it is not considered as a VE zone. The shoreline along this reach is sufficiently high to prevent coastal flooding.
- Zone AE (EL 10) at the north facing shoreline. This long shoreline segment is generally not subject to significant waves and is governed by stillwater flood elevations. Low shoreline elevations exist at the North Gate pump station, Veterans Court, and the east end of Doolittle Landfill. Floodwaters are shown on the FIRM to enter Bay Farm Island project site at those three locations, joining into a single flooded area extending along Lagoon 1 and over the entire golf course property, with some flooding continuing south past Mecartney Road.

5.2.5 Oakland Airport North Field and Bay Farm Island Flood Hazards

The Airport's North Field and supporting industries remain within the FEMA SFHA. Removing this area from the FEMA SFHA will require addressing multiple areas where coastal floodwaters can overtop the shoreline.

- **SR 61/Doolittle Drive**: SR 61/Doolittle Drive is low-lying along its entire length adjacent to the Airport's North Field and supporting industries. Overtopping can occur at multiple locations along SR 61/Doolittle Drive. Fringing marsh is located on the bayside of SR 61/Doolittle Drive for much of its length within the project area, although a portion is armored with rock revetment. The MLK Jr Shoreline Park, with parking, a kayak/boat launch, and open space is located along SR 61/Doolittle Drive between Langley and Grumman Streets. Mitigation along SR 61/Doolittle Drive to address flooding will require coordination between the Airport, Caltrans, EBRPD and the cities of Oakland and Alameda.
- **Lagoon Northern Shoreline**: At the northern end of the Lagoon on Bay Farm Island within the City of Alameda is where the shoreline and tide gate structure are low spots along the existing shoreline.
- **Veterans Court**: Floodwaters can overtop the shoreline near the touchdown of the Bay Farm Bridge (SR 61), between the closed Alameda landfill and Veterans Court, within the City of Alameda. The shoreline includes an aging seawall, rock riprap, and fringing marsh habitat.

Coastal overtopping along SR 61/Doolittle Drive, and at the Lagoon Shoreline and Veterans Court must all be addressed to mitigate flood risks along SR 61/Doolittle Drive and the Airport. The Port of Oakland, which owns the Airport, completed a two-dimensional hydrodynamic modeling study to better assess stormwater and coastal flood risks and mitigation strategies. The Port determined that, in addition to mitigation elements along SR 61/Doolittle Drive, the Airport would either have to construct a floodwall along much of Harbor Bay Parkway, from Doolittle Drive to Ron Cowan Parkway to address the flood hazards coming from the City of Alameda into the Airport property, or collaborate with the City of Alameda to mitigate the coastal overtopping occurring at the Lagoon Shoreline and Veterans Court (Port of Oakland 2023). An earlier study completed by the San Francisco Bay Conservation and Development Commission (BCDC) as part of the Adapting to Rising Tides program agrees with this finding (AECOM 2014).

The converse of this equation is also true. The City of Alameda can mitigate the flood risks at the Lagoon and Veterans Court low points, but they cannot remove the Bay Farm Island residents who live along the Bay Farm Lagoon from the FEMA SFHA until the flooding along SR 61/Doolittle Drive, which is outside of their jurisdiction, is also mitigated (AECOM 2014).

5.2.6 Coastal Flooding

The following figures are enlargements of coastal flood exposures at different levels of SLR as described in Section 3.4.2.

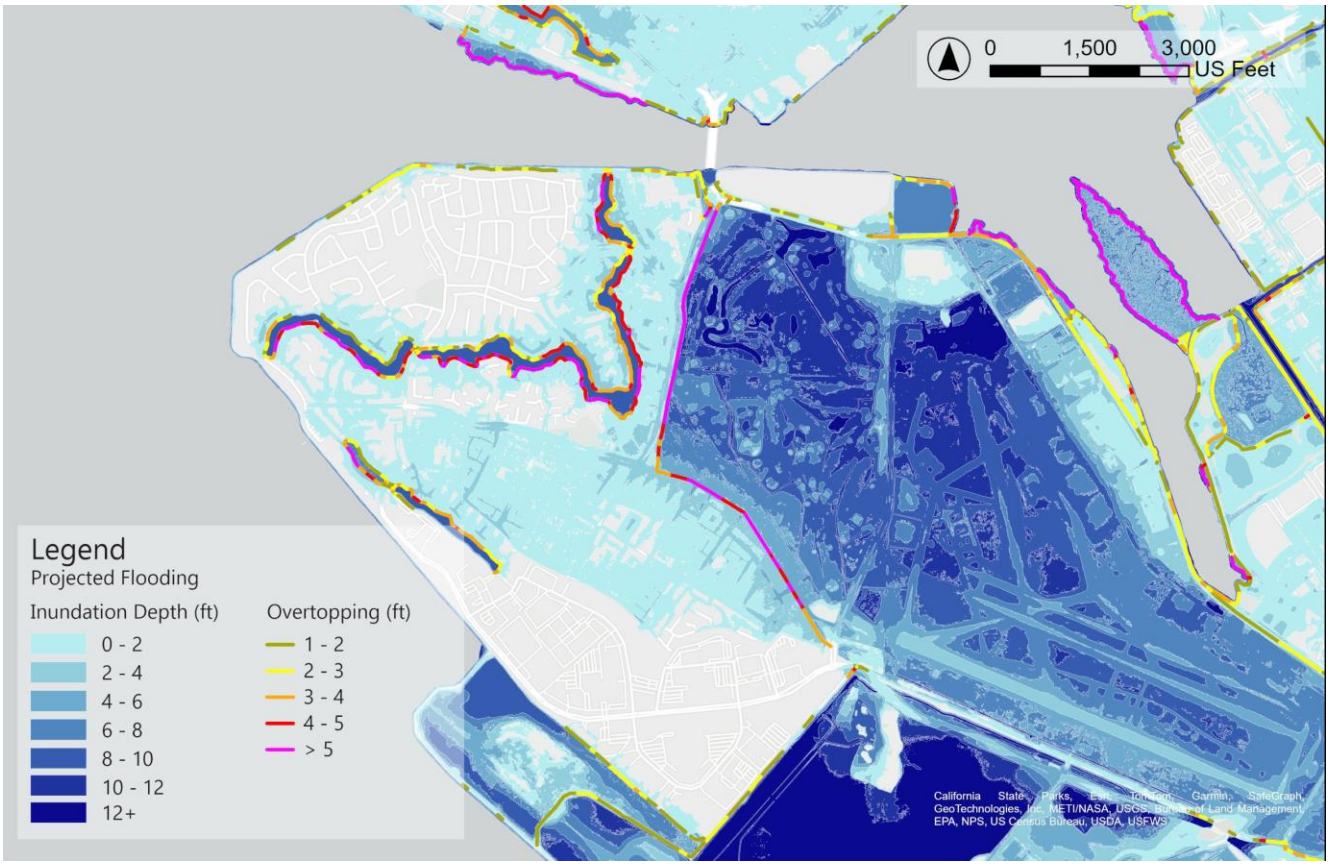


Figure 5-15. 24" Sea Level Rise + 1% AEP Flood for Bay Farm Island

Source: (Vandever et al. 2017b)

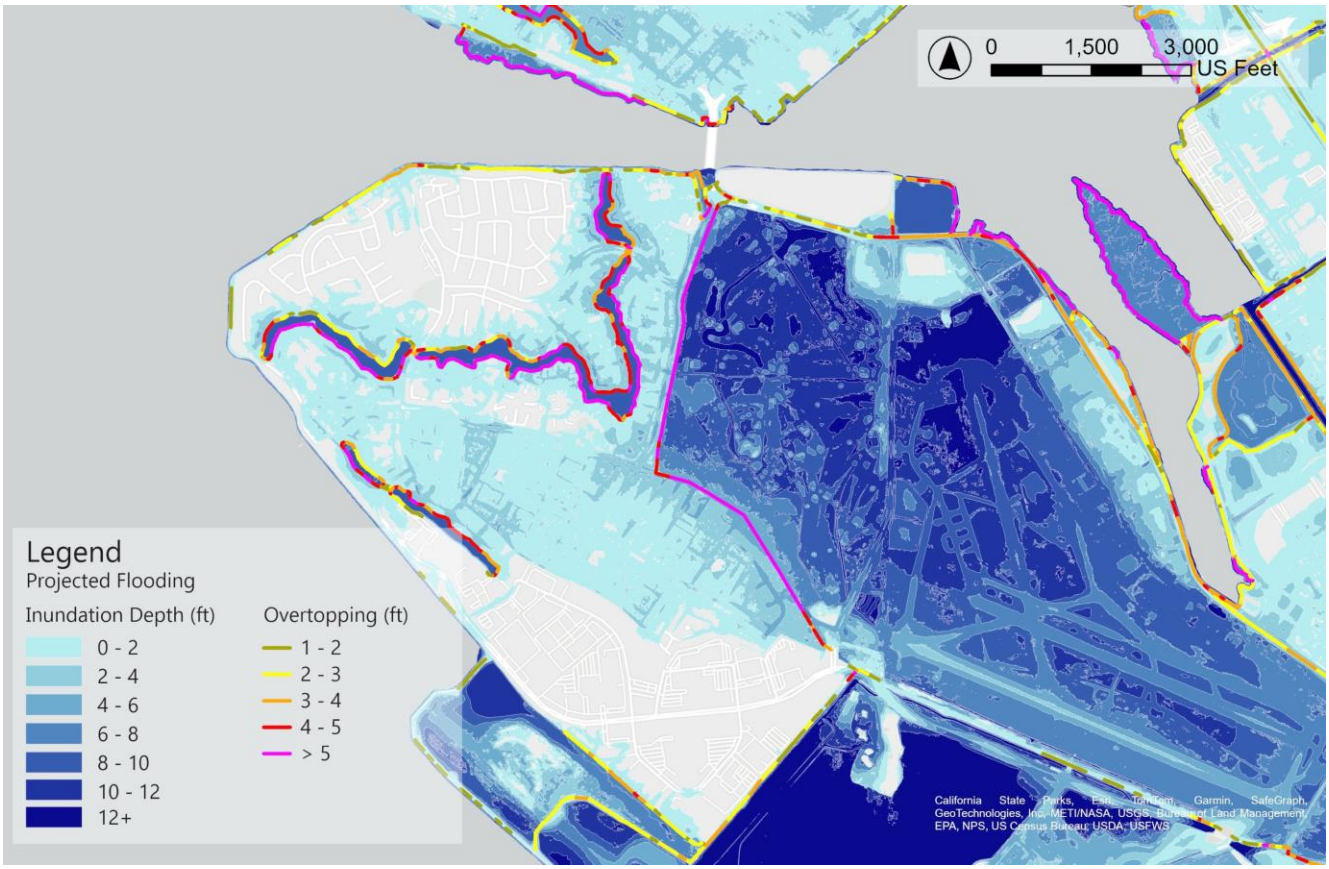


Figure 5-16. 36" Sea Level Rise + 1% AEP Flood for Bay Farm Island

Source: (Vandever et al. 2017b)

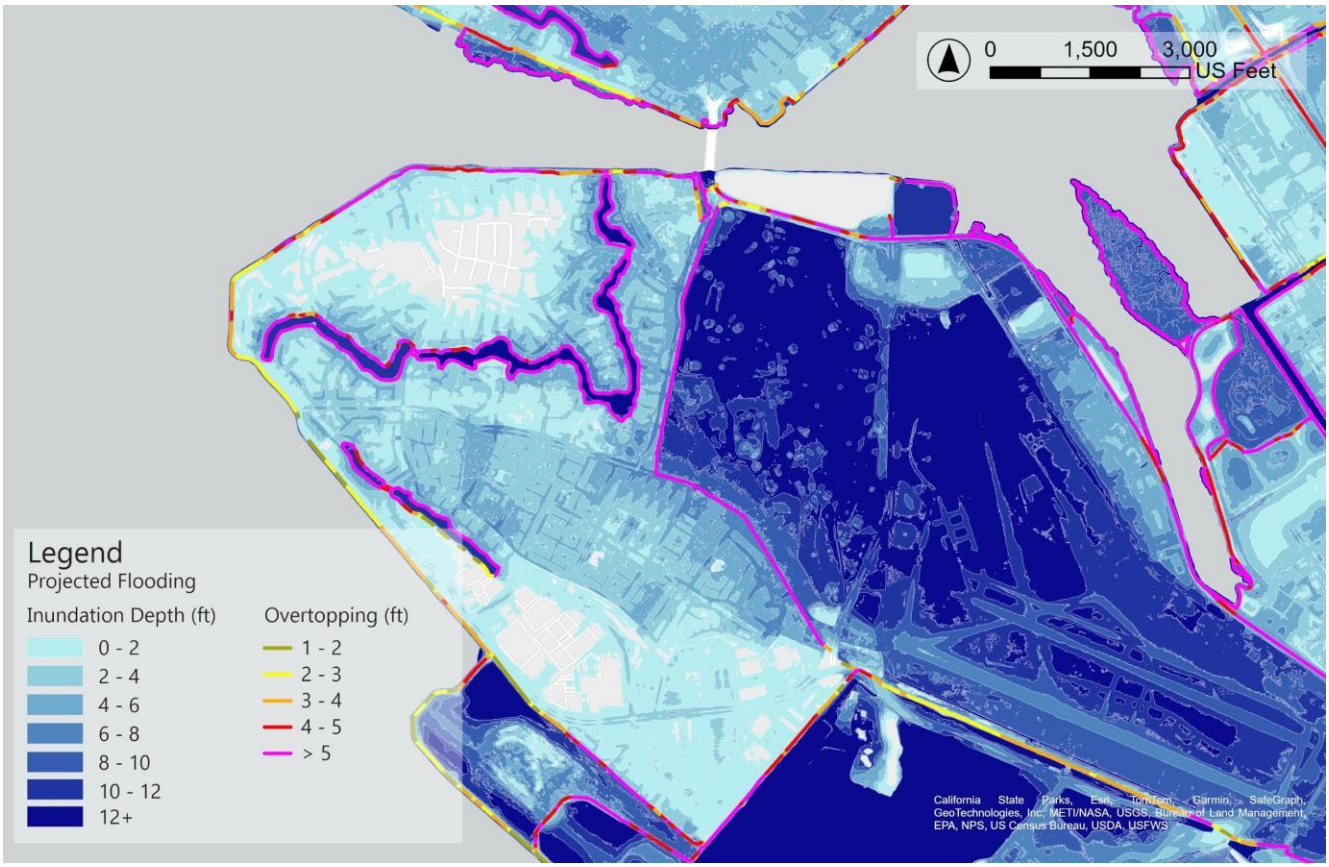


Figure 5-17. 66" Sea Level Rise + 1% AEP Flood for Bay Farm Island

Source: (Vandever et al. 2017b)

5.2.7 Geology & Geotechnical Conditions

General stratigraphy of the project area was discussed in Section 3.4.7. More detailed stratigraphy for the two sites involved in the short-term project was developed using existing geotechnical information.

Veterans Court: The site displays artificial fill that extends to a maximum depth of around 10 feet. Below this fill, the Young Bay Mud unit is identified, featuring a range from very soft to stiff consistency, appearing gray with a fat clay composition. The thickness of the Young Bay Mud unit fluctuates and may extend up to approximately 40 feet. Additionally, a layer of marine shells, approximately 5 feet thick, is encountered roughly 20 feet below the surface. Beneath the Young Bay Mud, there is an irregularly distributed layer of old alluvium extending to a depth of at least 70 feet and potentially further.

Sky View Pkwy: The site exhibits artificial fill extending to a maximum depth of approximately 5 feet. Beneath this fill, the Young Bay Mud unit is present, characterized by a range from very soft to medium stiff, displaying a greenish-gray, fat clay appearance. The thickness of the Young Bay Mud unit varies and can extend up to approximately 30 feet. Below the Young Bay Mud, there exists an irregularly distributed layer of old alluvium. The soil layer rests upon the Posey Formation, which primarily comprises nonmarine deposits consisting mainly of lean clay to silty sand. The thickness of the Posey Sand varies between 0 and 30 feet. Beneath the Posey Formation lies the older Bay Muds, known as

the San Antonio Formation, composed of stiff to very stiff clays. The San Antonio Formation includes very stiff, sandy clay to lean clay layers with intermittent occurrences of silt, clayey sand, and poorly-graded sand lenses.

5.2.7.1 Subsidence

Subsidence in the project area was discussed previously in Section 3.4.7.8. It should be noted that the area near the short-term project on the north tip of the Bay Farm Island is identified on the subsidence velocity map of Figure 3-35 as having subsidence rates of > 4 mm per year.

5.2.8 Groundwater

In general, groundwater in Bay Farm Island is shallow. The reclaimed land forming the majority of the island is protected from tidal flooding by levees along the island perimeter, and pumping is used to lower water levels inside the lagoon system and in Oakland International Airport. Review of monitoring wells from California Statewide Groundwater Elevation Monitoring (CASGEM) identified two monitoring wells on Bay Farm Island, with highest observed elevations of +1.3 feet and –23.4 feet, as shown in Table 5-2. It should be noted that the low groundwater level of -23.4 feet was observed in 1987 and is not representative of the current groundwater elevation in the area. Depth to groundwater levels are also shown on Figure 5-18. It should be noted that the Young Bay Mud layer underlying the artificial fill within majority of the Bay Farm Island has low permeability. While sea level rise could increase infiltration of water and groundwater inside the lagoon and levee system, due to presence of the low permeability mud layer, water levels inside the lagoon and levee system can still be managed with pumping, as long as the levees are raised to appropriate elevations.

Table 5-2. Summary of Monitoring Well Data in Bay Farm Island

Site No.	Well No.	Local Well Designation	Latitude / Longitude	Highest GWE	Ground Surface Elevation	Ground Water Depth	Date
				(ft)	(ft)	(ft)	
1	377369N1222303W001	02S03W19Q001M	37.7369 / -122.2303	1.3	2.7	1.4	4/14/2000
2	377332N1222459W001	02S04W25A001M	37.7332 / -122.2459	-23.4	12.7	36.1	4/22/1987

In low-lying coastal communities, sea level rise poses a significant threat of shallow groundwater flooding. To understand and predict how rising sea levels will impact groundwater levels, Pathways Climate Institute LLC and the San Francisco Estuary Institute undertook a comprehensive study (May et al. 2022). They analyzed and mapped the “highest annual” shallow groundwater table, focusing on its response to future sea level rise. This research enables us to estimate the existing groundwater elevation in specific areas, such as the Bay Farm Island study region(Figure 5-18).

The study's results are derived from the latest available elevation data. However, it is important to note that certain locations within the study area, like the golf course, have undergone recent elevation changes. Based on the data in Figure 5-18, it is evident that the more inland areas of Bay Farm Island are particularly vulnerable to groundwater flooding. This is attributed to the current depth to groundwater in these regions.

As sea levels continue to rise, the depth to water in these inland areas is expected to decrease progressively. This suggests that over time, the groundwater in these regions will gradually rise to the surface. The emergence of groundwater at the surface level is a critical factor that will likely lead to flooding.

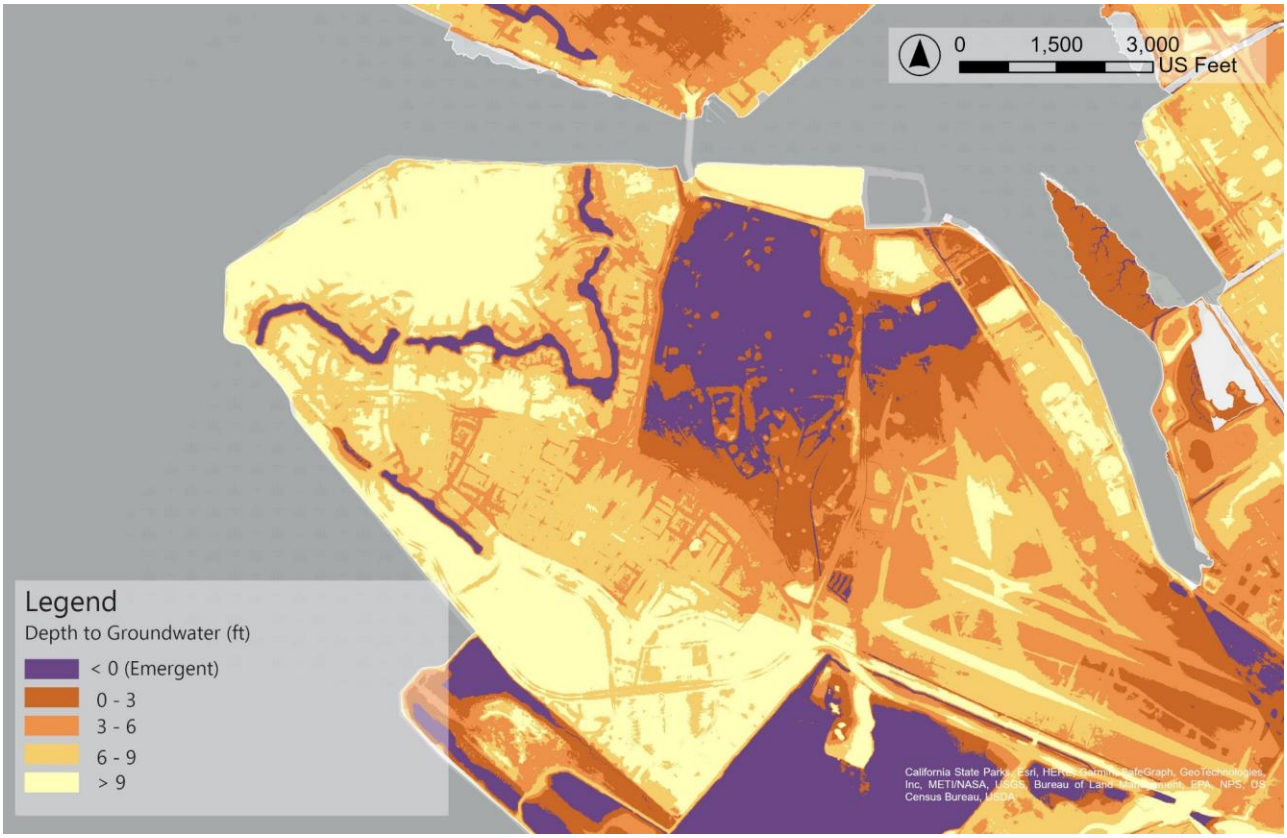


Figure 5-18. Bay Farm Island Depth to Groundwater (Current Wet-Winter Conditions)

Source: (May et al. 2022)

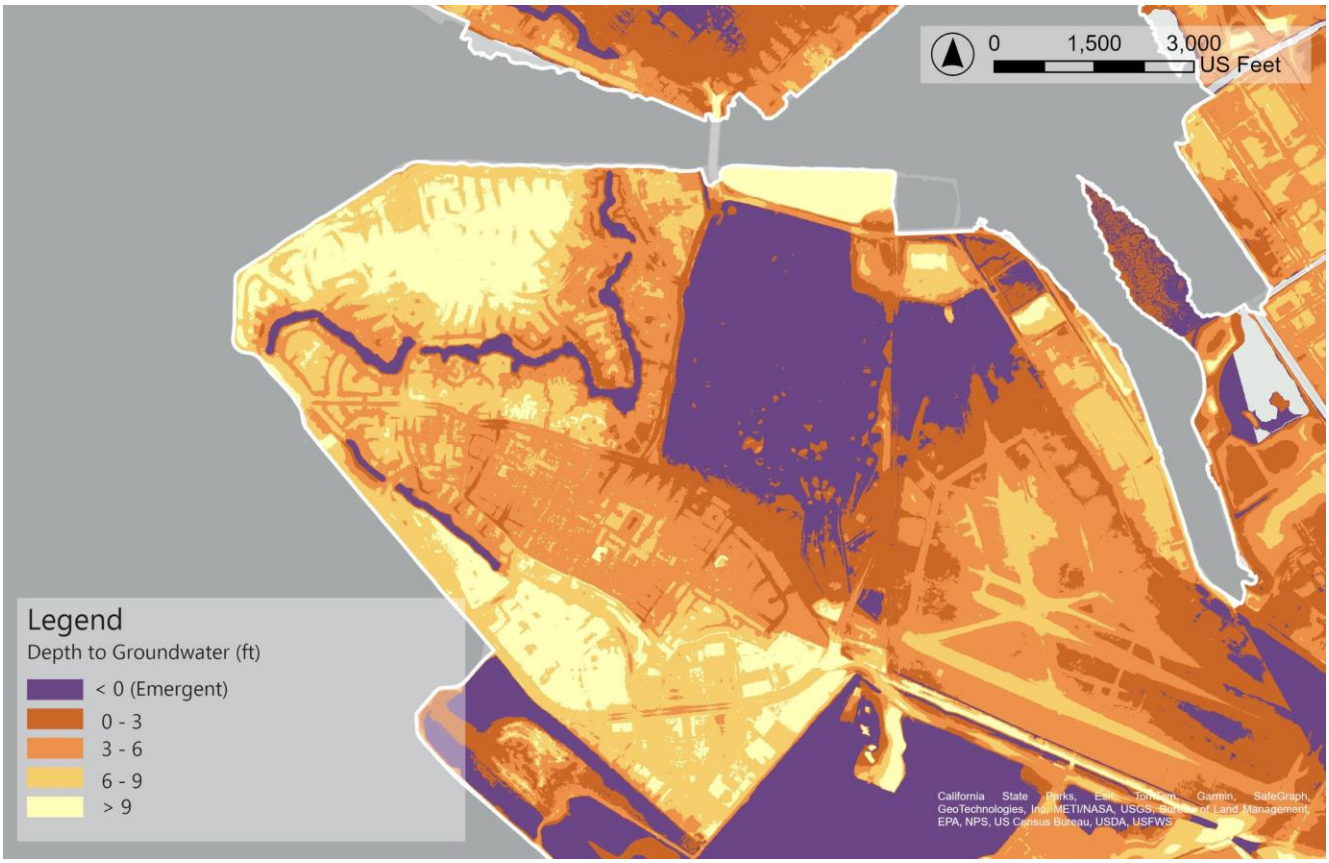


Figure 5-19. Bay Farm Island Depth to Groundwater with 24" Sea Level Rise

Source: (May et al. 2022)

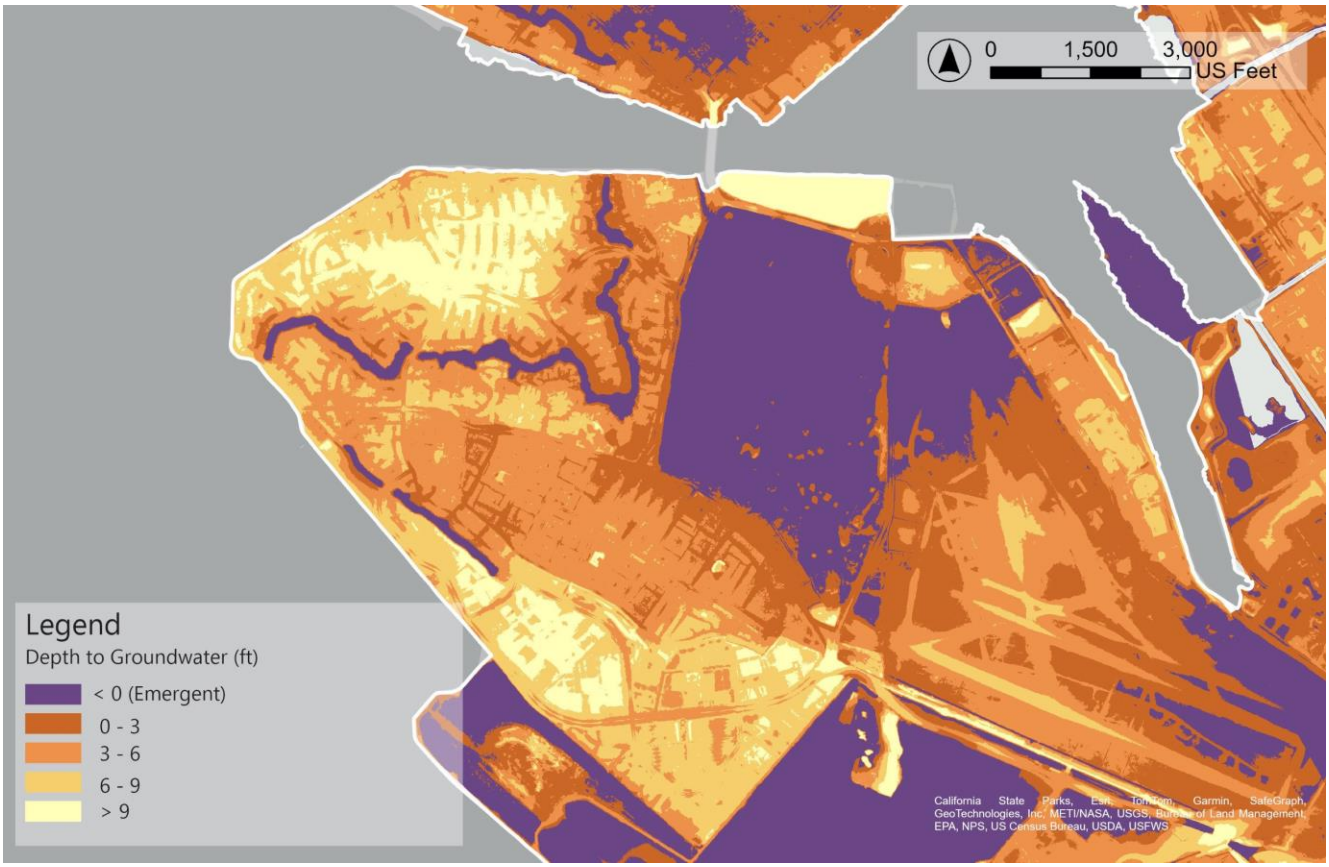


Figure 5-20. Bay Farm Island Depth to Groundwater with 36" Sea Level Rise

Source: (May et al. 2022)

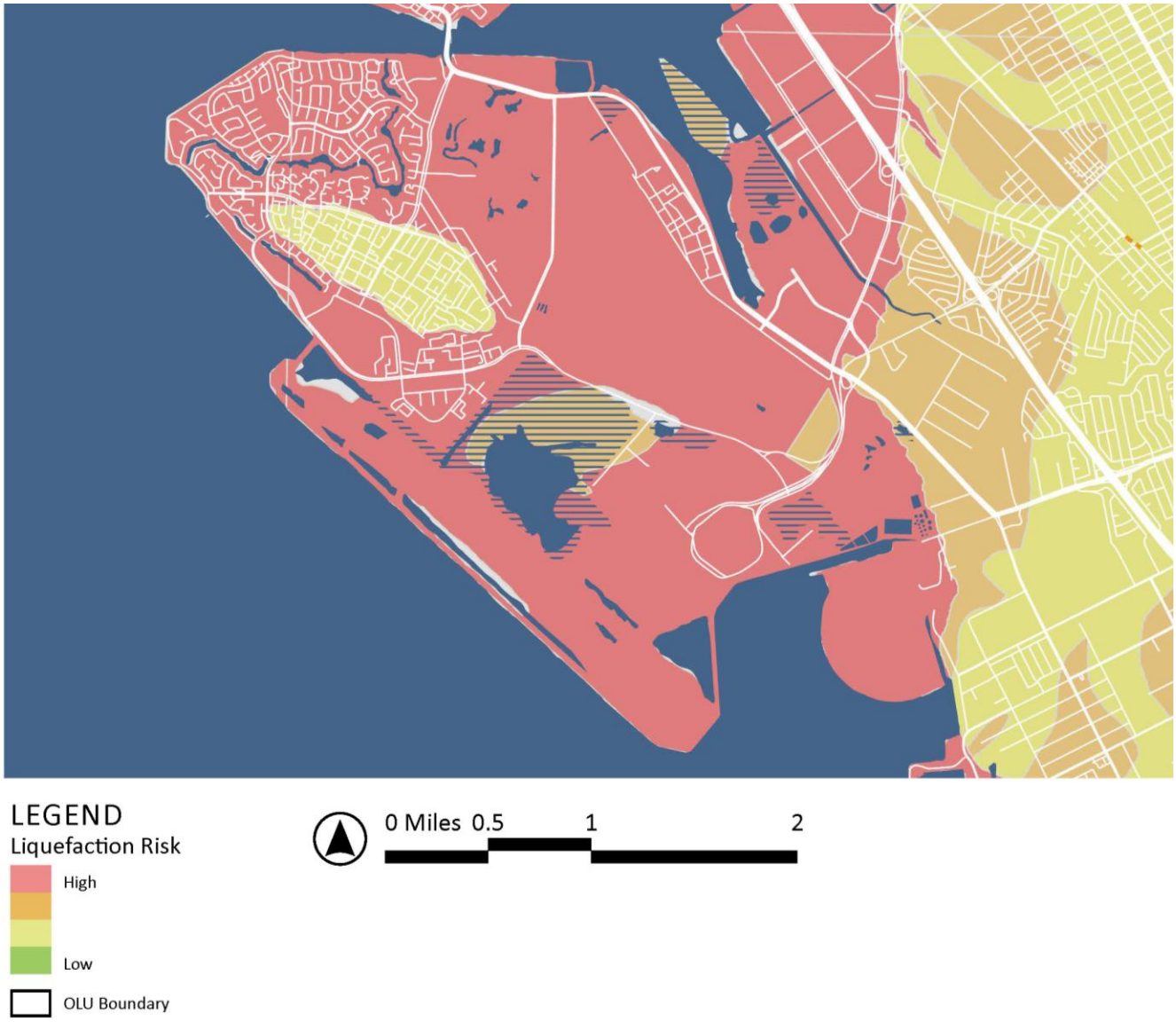


Figure 5-21. Liquefaction Risk

Source: (USGS)

5.3 Shoreline Conditions

Previous studies have summarized the Bay Farm Island shoreline condition, including the 2022 Climate Adaptation and Hazard Mitigation Plan:

> *Bay Farm Island's shoreline is almost exclusively riprap of large diameter, due to the wave action that can be seen coming from the west. Susceptibility of shoreline to wave action has played a large role in determining the shoreline protection level required.*
>
> *In many areas, including the full perimeter of Bay Farm Island, shorelines provide a protective distance between the Bay waters and residential homes, buildings, properties, utilities, and other*

infrastructure. Shorelines also provide a public access area for the public to enjoy the waterfront and many parts of it are designated as the San Francisco Bay Trail.

…

The engineered structures and natural shorelines that surround Alameda are not FEMA-accredited, and it is unknown how they will behave in the event of a large-scale coastal flooding or earthquake event - given development of Alameda in many places (particularly Bay Farm Island) mainly consisted of placing a few feet of sandy fill over the existing young bay mud. Several shoreline protection projects currently underway have the goal of becoming FEMA accredited.

Within the project boundaries – starting from the north end of Port of Oakland property and proceeding clockwise through the Doolittle Landfill – the Bay Farm Island project includes approximately 3.6 miles of existing shoreline. To assist in discussion of specific shoreline segments, the shoreline was divided into reaches corresponding to specific location and/or features; reach designations are described below, proceeding clockwise from the West Shoreline:

- **West Reach** – This reach begins at the northern limit of the Port property and follows the west facing shoreline to the west end of Lagoon 2. This reach is subjected to significant wave action and is armored with rock slope protection. Approximate reach length: 5650 feet (1.07 mile).
- **Northwest Reach** – This reach follows the northwest facing shoreline and ends at Aughinbaugh Way. This reach is subjected to significant wave action and is armored with rock slope protection. Approximate reach length: 4450 feet (0.84 mile).
- **North Reach** – This reach follows the north facing shoreline and ends at the tennis courts. The North Gate pump station and seawall fall within the North Reach, with the seawall previously being identified as a low spot subject to present-day flooding. Previous studies have developed draft plans for a higher seawall or levee to address this deficiency. The majority of this reach is subjected to significant wave action and is armored with rock slope protection; however, wave exposure decreases as you go east. Approximate reach length: 4150 feet (0.79 mile).
- **Veterans Court Reach** – This reach continues along the north facing shoreline and ends at SR61. Previous City studies have developed conceptual plans for improving flood protection by construction of a levee or seawall along Veterans Court. This reach is not subjected to significant wave action, and the small embayment along Veterans Court is the only portion of shoreline that consists of a tidal marsh. Approximate reach length: 800 feet (0.15 mile).
- **Doolittle Landfill Reach** – This reach begins east of Bay Farm Island bridge and passes along the north edge of the Doolittle Landfill; This reach is not subjected to significant wave action and is unarmored. Due to its proximity to SR61 this reach abuts Caltrans right-of-way, and most of this reach is with the landfill footprint. Approximate reach length: 3800 feet (0.72 mile).

Figure 5-22 shows the five reaches designated for the Bay Farm Island Shoreline.

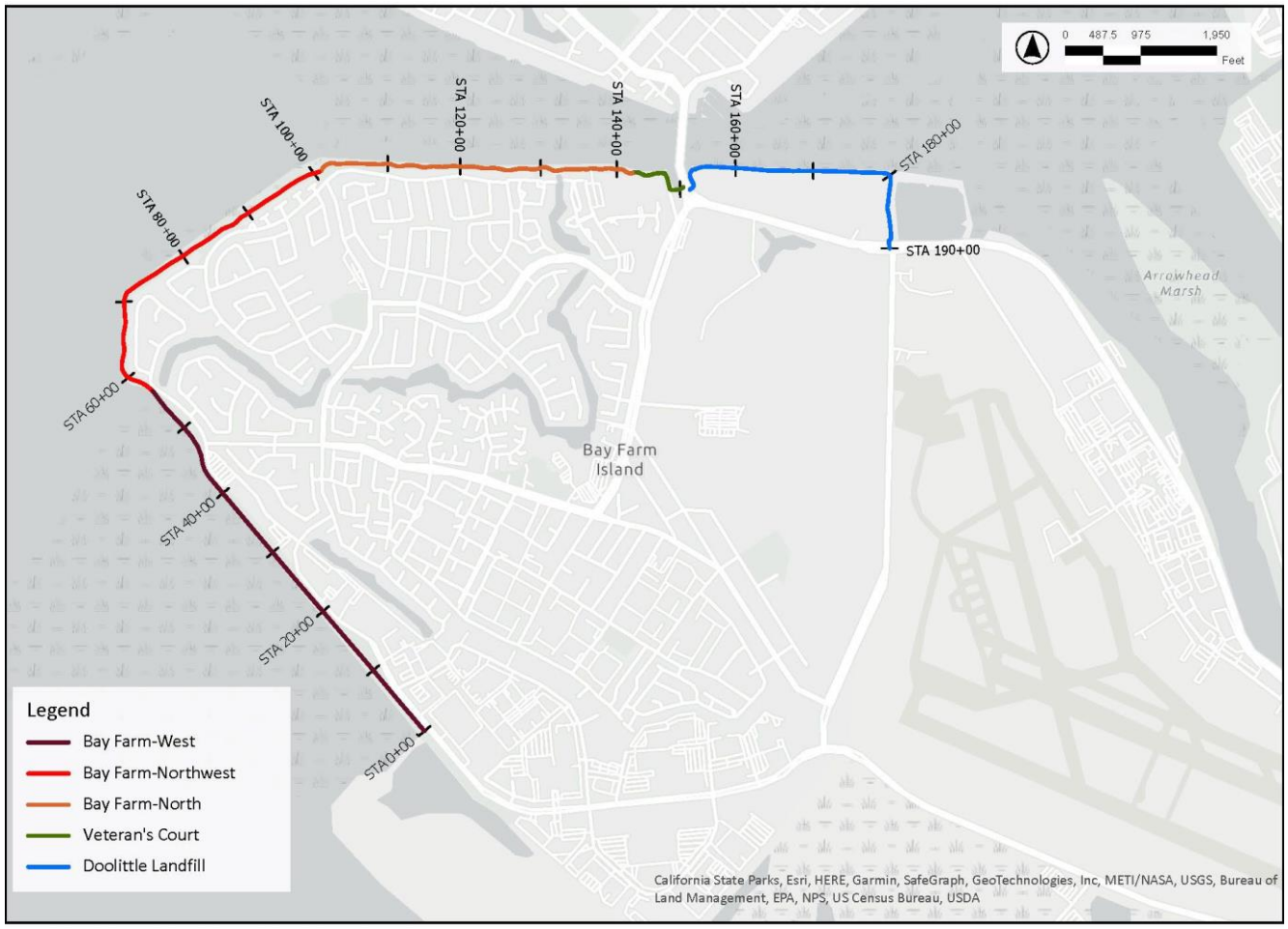


Figure 5-22. Bay Farm Island Shoreline Reaches

Source: (NOAA Coastal LiDAR)

Shoreline elevations along Bay Farm Island are presented in Figure 5-23 to Figure 5-24, showing both plan and profile elevations.

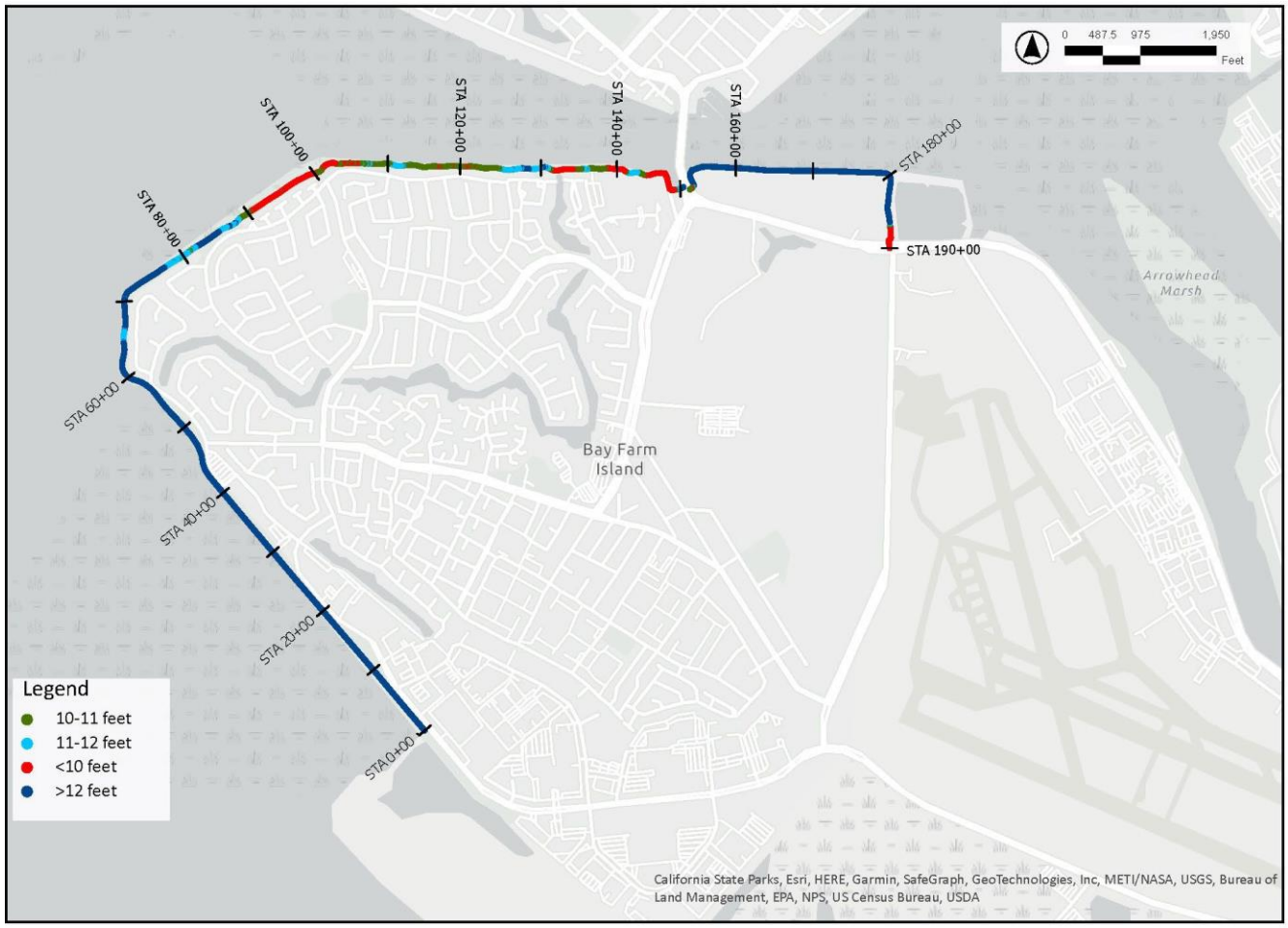


Figure 5-23. Bay Farm Island Shoreline Elevations – Plan View

Source: (NOAA Coastal LiDAR)

Figure 5-24. Bay Farm Island Shoreline Elevation Profile

Source: (NOAA Coastal LiDAR)

5.3.1 Shoreline Description

The Bay Farm shoreline consists of three types of shoreline:

- **Sloped Shoreline** – includes natural unarmored banks and banks protected by riprap rock slope protection (RSP);
- **Vertical Shoreline** – includes seawalls or bulkheads, typically sheetpile walls;
- **Pile-Supported Structure** – typically concrete or timber structures with sloped or vertical shoreline edge beneath.

The shoreline is primarily fronted by open water and mudflats. The West, Northwest, and the western half of the North shoreline reaches are armored with RSP due to high waves, while the Veterans Court and Doolittle Landfill reaches are essentially unarmored due to their sheltered location. Tidal Marsh is generally absent except for the small bay at Veterans Court.

A portion of the shoreline in the vicinity of the Bay Farm Island bridge is fronted by pile-supported bridges (vehicle and pedestrian/bicycle). Small-scale concrete walls/structures and a timber walkway also exist at the end of Veterans Court and at several locations along the north and northwest reaches.

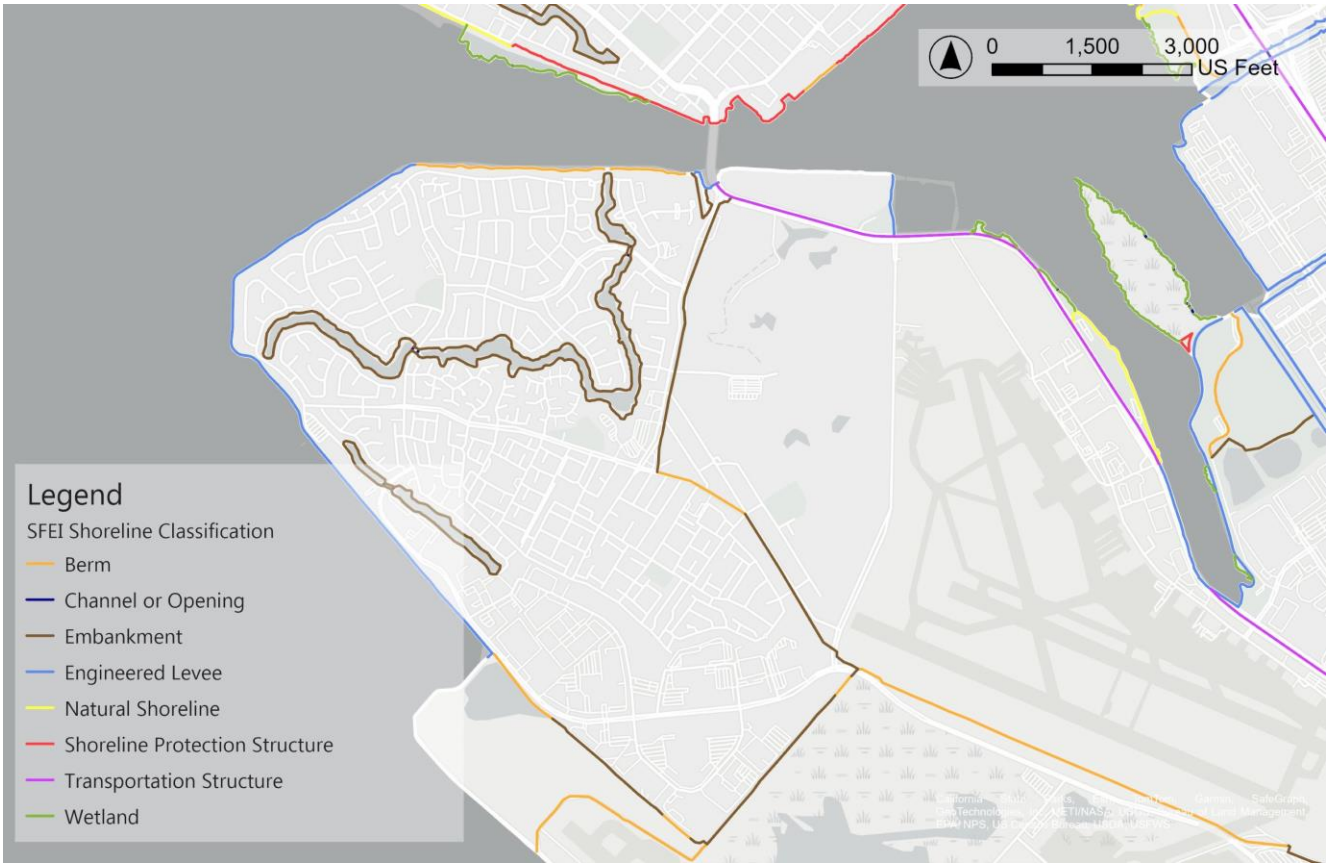


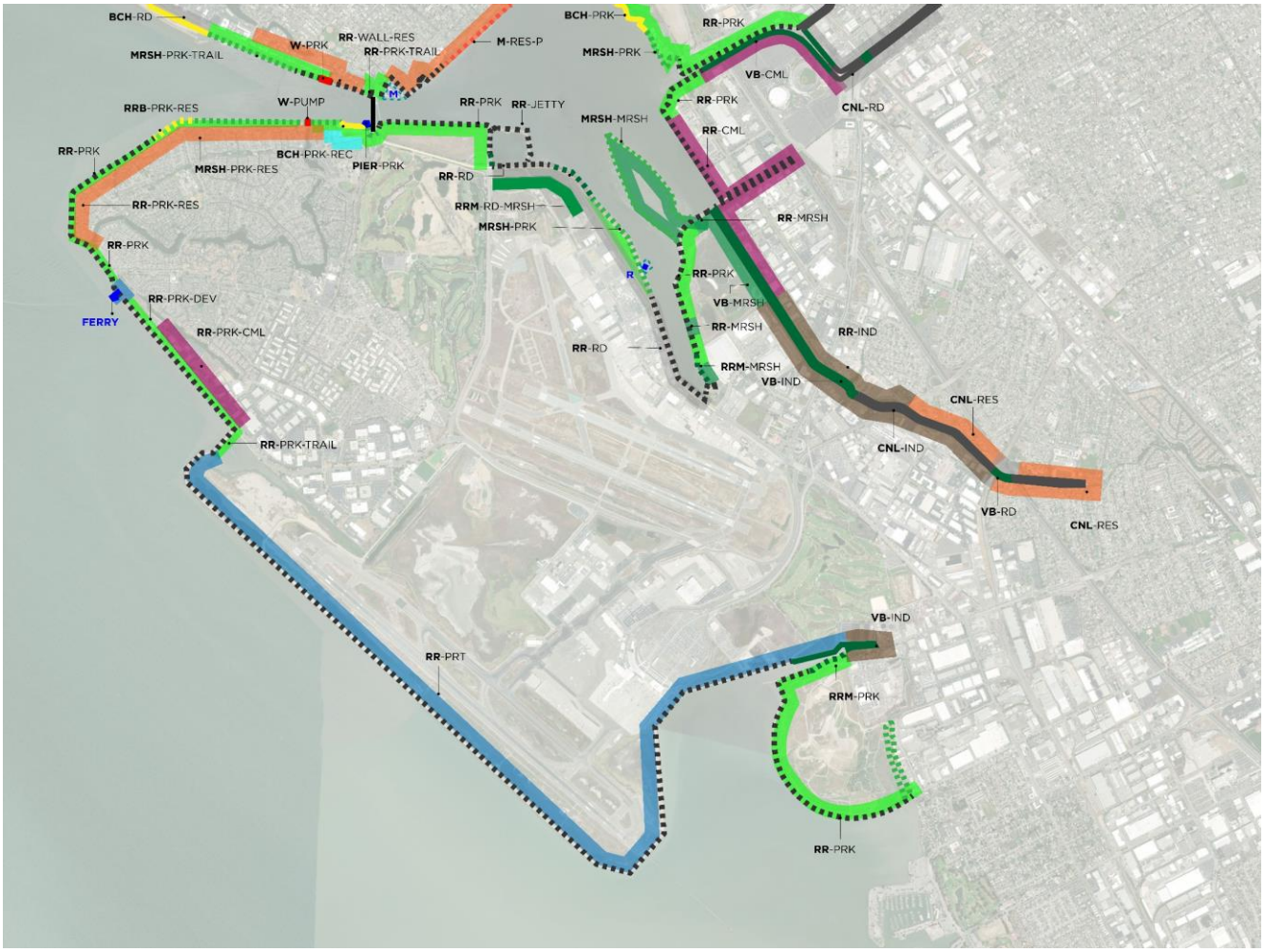
Figure 5-25. Bay Farm Island Shoreline Infrastructure

Source: (SFEI 2016)

5.3.2 Shoreline Typologies

Shoreline typologies inventory conditions across three axes: water use, shoreline type and land use (Figure 5-26) There are 13 shoreline types identified within the Estuary project area, and 12 identified land uses. There are 7 water uses documented within the project area. The typology illustrates the complex mosaic of relationships between the existing shoreline conditions, land uses and maritime/water access points.

These typologies were created through desktop research and refined through in-person site visits.



Annotation key
SHORELINE-LANDUSE-SUBTYPE
WATERUSE

Shoreline type

BCH	Beach
CNL	Canal
E	Lake Edge
I	Infrastructure/Bridge/Viaduct
MRSH	Marsh
M	Mixed Edge
PIER	Pier
RR	Riprap
RRB	Riprap Beach
RRM	Riprap Marsh
RRP	Riprap Pier
VB	Vegetated Embankment
W	Concrete Wall or Seawall

Land use

CML	Commercial
DEV	Development (future land use)
IND	Industrial
MRSH	Marsh
OS	Open Space
PRK	Park
PRT	Port
RD	Road
RES	Residential
REC	Recreation
SCH	School
VAC	Vacant

Misc. Land use

JETTY	Jetty
PUMP	Pump

Sub land use

DEV	Development
H	Hotel
MAR	Maritime
O	Office
P	Private
RD	Road
RES	Residential
SCH	School
TRAIL	Trail
U	Urban

Water use

-----	Docking area
M	Marina
R	Ramp
FERRY	Ferry
PD	Private dock
PBD	Public dock
H	House boats

Figure 5-26. Bay Farm Island Shoreline Typologies

Source: (CMG Landscape Architecture)

5.4 Critical Infrastructure

Existing critical infrastructure for the purposes of the Bay Farm Island project are those facilities that are essential for life safety and health. Accordingly, facilities that provide essential services or access include the following categories:

- Transportation and Transit: vehicle, transit, bike, and pedestrian routes
- Utilities: Stormwater, Sewer, water, power, communications
- Emergency Facilities: municipal fire, police, and emergency responders

Figure 5-27 below graphically depicts the location of critical infrastructure within the Bay Farm Island project site; each of these is described in further detail in the paragraphs that follow.

5.4.1 Roadways

Similar to the Oakland-Alameda Estuary project, critical roadways include highways, arterial roadways, transit routes, and trucking routes; these designations delineate roadways by their size, traffic volume, or importance. For Bay Farm Island these include SR-61 (Doolittle Drive), Harbor Bay Parkway, Island Drive, Mecartney Road, Maitland Drive, Aughinbaugh Way, and Robert Davey Jr. Drive. The only highway on Bay Farm Island, SR-61 connects to SR-112 in San Leandro to the south, runs along the north side of the airport, and crosses San Leandro Channel via the Bay Farm Island Bridge. The bridge is unaffected by floodwater due to its high elevation, but the portion of Doolittle Drive leading up to the bridge is susceptible to flooding due to its low elevation near Harbor Bay Parkway. SR-61 is a lifeline route and therefore the flood risk and vulnerability of the route have been identified as a current risk.

Figure 5-27. Bay Farm Island Lifeline Routes and Major Arterials'

Source: (City of Alameda GIS; Caltrans; Metropolitan Transportation Commission 2024)

Figure 5-28. Bay Farm Island Roads & Rail at Risk of Flooding

Source: (USGS; NOAA; U.S. Census TIGER)

5.4.2 Utilities

5.4.2.1 Storm Drain System and Lagoon Hydrology/Hydraulics

The existing storm drain network for BFI, showing pipes, outfalls, and pumps, is shown in Figure 5-29.

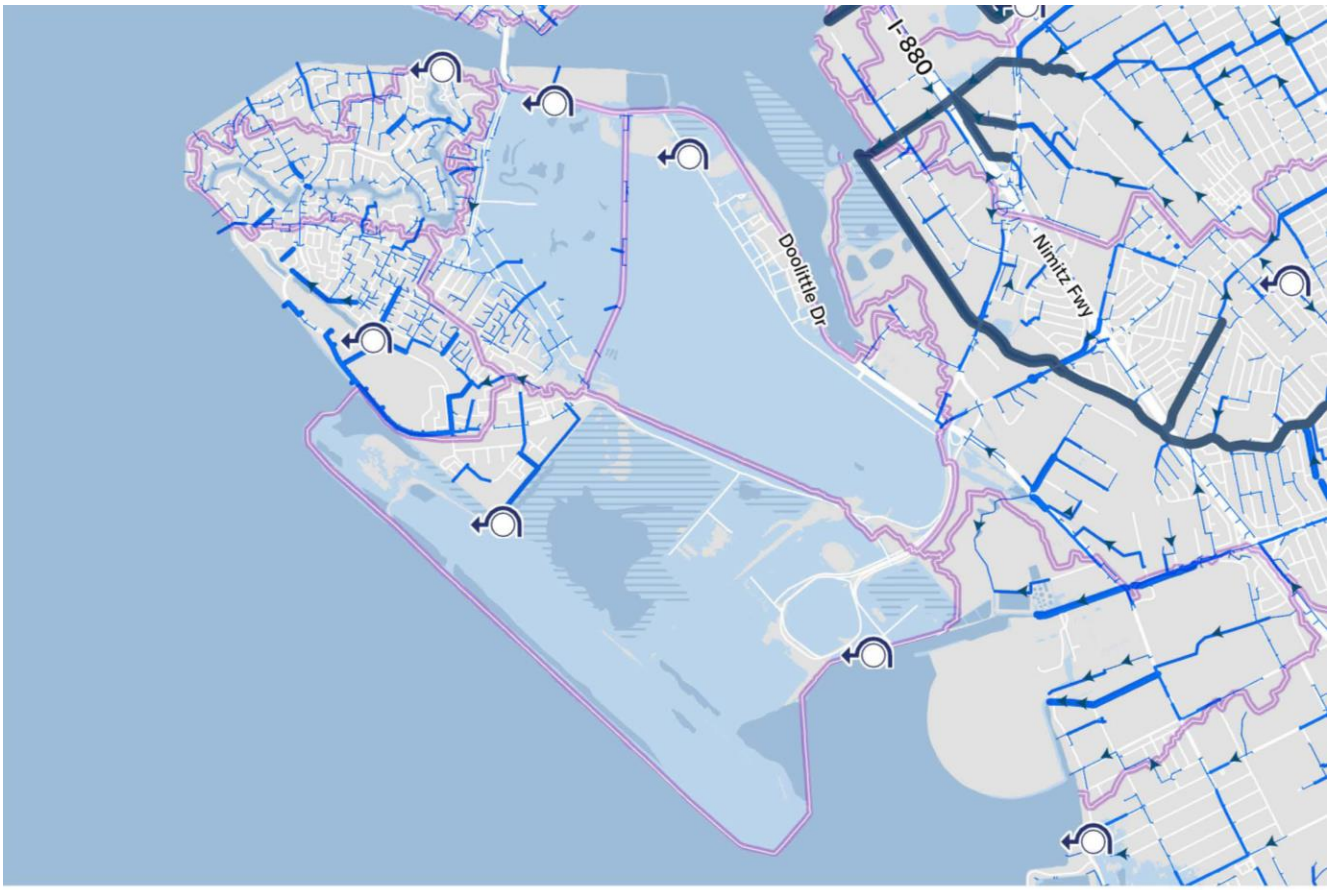


Figure 5-29. Existing Storm Drain System for Bay Farm Island

Source: (Schaff and Wheeler 2019; Schaff and Wheeler 2012)

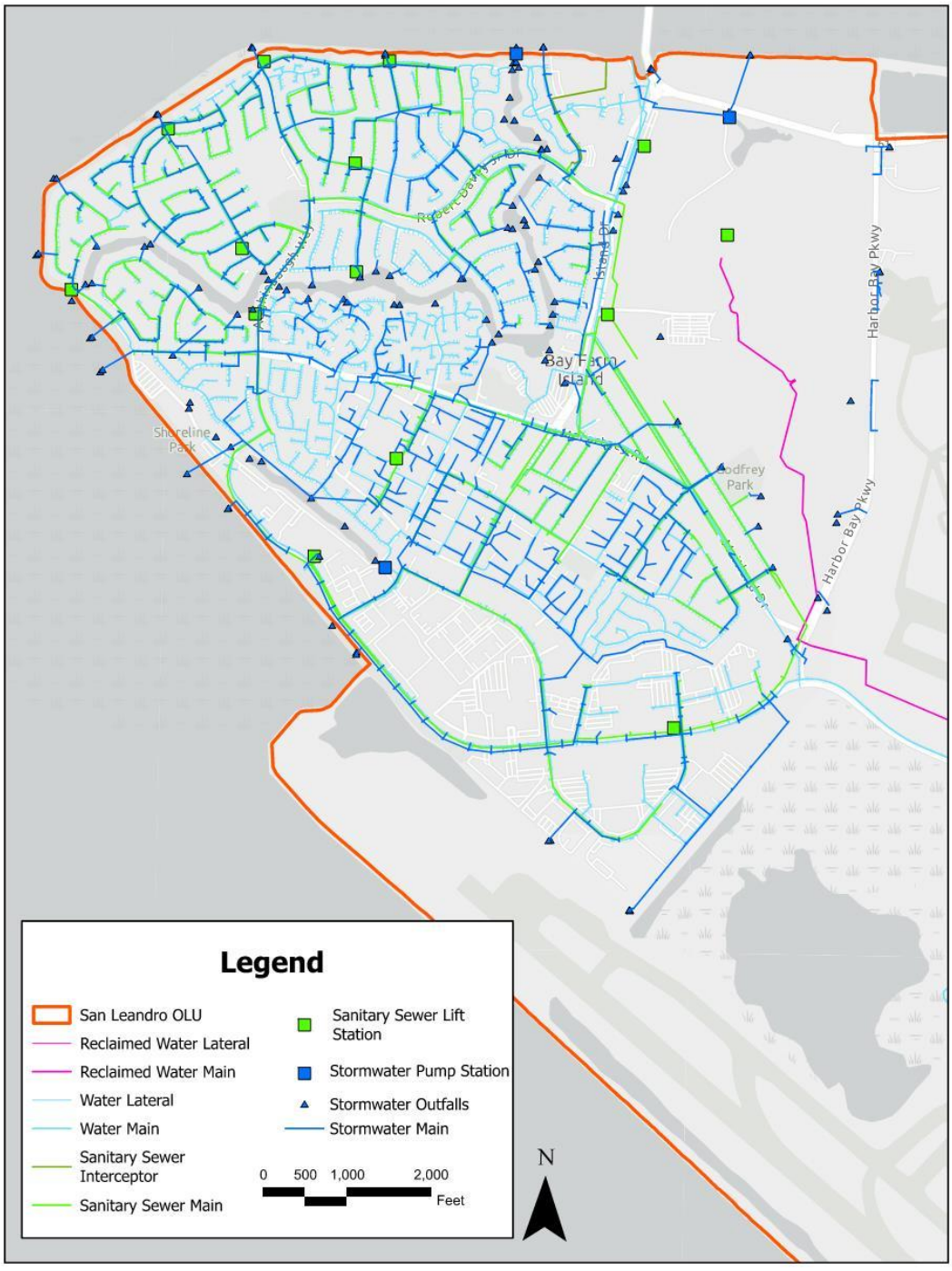


Figure 5-30. Existing Storm Drain & Sanitary Sewer Network for Bay Farm Island

Source: (City of Alameda)

Bay Farm Island has two lagoon systems: System 1 and System 2, the two systems are illustrated in Figure 5-31. The lagoons on Bay Farm Island were created as a part of the development that expanded the original island to its current size.

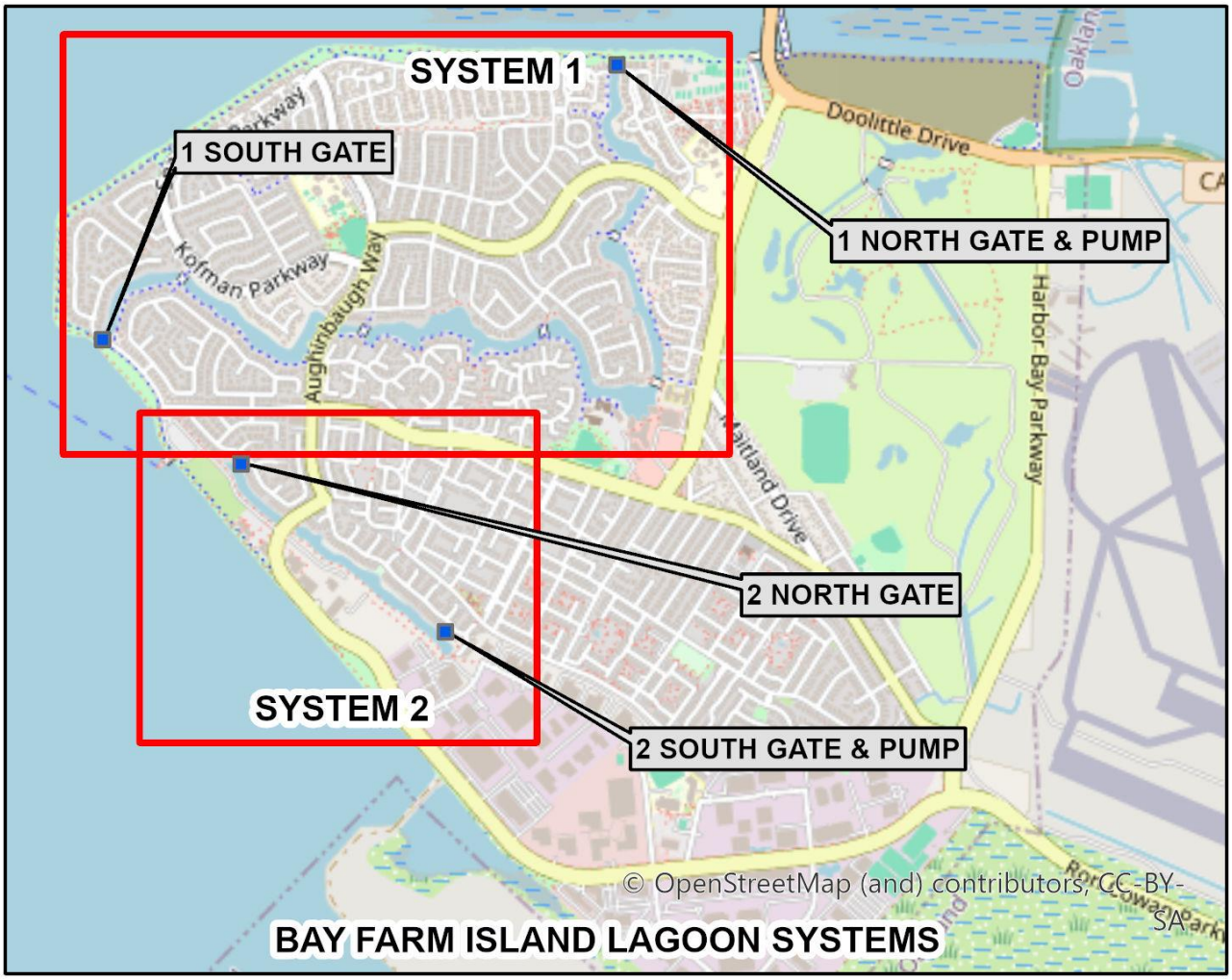


Figure 5-31. Bay Farm Island Lagoon Systems

Source: (Schaaf & Wheeler 2015)

Schaaf and Wheeler previously prepared a memorandum titled *Bay Farm Island Lagoon Operations* dated July 20, 2015 (Schaaf & Wheeler 2015), for the City of Alameda, which discussed the two lagoon systems on Bay Farm Island (BFI) in detail. The lagoons and appurtenances are almost entirely on land owned by the Community of Harbor Bay Isle Owners' Association, Inc., and the Harbor Bay Business Park Association (HOAs), with minor portions owned by the City of Alameda (Shoreline Park, street right-of-ways [ROWs]) and the owners of the Harbor Bay Landing Shopping Center.

The existing BFI System 2 moves water from north to south. The 2 North Gate (intake) utilizes two electronically driven tide gates to draw water through an existing 48-inch storm drainpipe that is connected to the San Francisco Bay on the west side of Bay Farm Island. Water is routed south through

the lagoon system and exists through the 2 South Gate structure via gravity during low tides or the System 2 Pump during high tides. The tide gate and pump both flow to a 48-inch outlet that connects to the existing 60-inch storm drainpipe at a 5% adverse grade. The 60-inch storm drain line drains the system out to the Bay. The outlet for the system sends water into a 5-foot storm drainpipe that discharges to the Bay through a 6-foot outfall.

Lagoon System 1 was built around 1979 and comprises roughly 31 acres in three bodies of water joined together by culverts under the major access roads, Robert Davey Jr Parkway and Aughinbaugh Way. The length of Lagoon System 1 is approximately 11,000 feet. BFI System 1 draws water through an 84-inch intake pipe at the 1 South Gate intake structure and routes it to the 1 North Outlet Gate structure. Water flows out to the San Francisco Bay through an 84-inch outlet during low tides or is pumped out through a 24-inch outfall at high tides at the 1 North Gate outlet structure. The maintenance staff typically maintains one (1) foot of freeboard along the lagoon retaining wall. The lagoons are lowered 6-inches during the winter season, and an additional 6-inches prior to large storm events to provide up to 2-feet of freeboard. When lagoon water levels reach the retaining wall height the pump is turned on to lower the lagoon levels. Elevations from the USGS DEMs (2010) indicate that the lowest point along the retaining walls is approximately 1.5 feet on North American Vertical Datum (NAVD 88), lagoon levels are kept below this elevation. Pressure transducers at three different locations are used as the basis to measure the lagoon levels; that data is then used for opening and closing the tide gates. The pressure transducer locations are shown in Figure 5-32. High lagoon water levels have damaged the retaining walls along the lagoons, primarily near the center of the system by Safeway (As show in Figure 5-32).

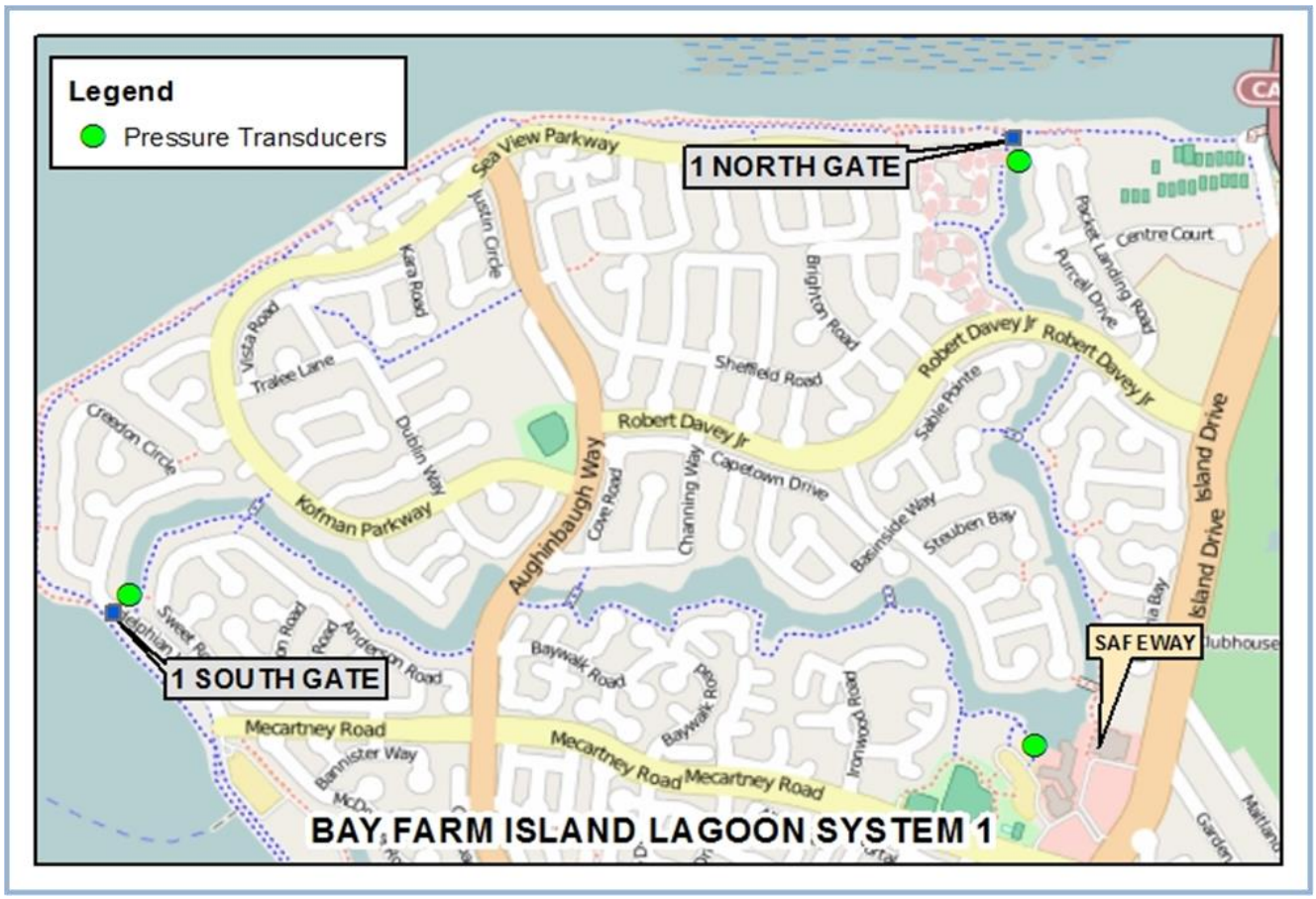


Figure 5-32. Bay Farm Island System 1 - Pressure Transducer Locations

Source: (Schaaf & Wheeler 2015)

The 2015 study identified several improvements to System 1 at an estimated cost, in 2015 dollars, of $5,910,000. Recommended improvements include:

- Updating the Supervisory Control and Data Acquisition (SCADA) infrastructure, including gate sensors;
- Adding a new trash track at North Gate 1;
- Reconstructing San Leandro to prevent flooding from FEMA;
- Raising lagoon perimeter retaining walls at low spots;
- Installing emergency backup power (backup generator);
- Cleaning out large culverts;
- Surveying existing lagoon perimeter retaining wall; walls, and
- Maintaining tides gates and pumps.

5.4.2.2 Sanitary Sewer

The City of Alameda sanitary sewer system includes gravity-flow piping and lift stations conveying wastewater to EBMUD facilities. EBMUD lift stations, pump stations, force mains, and interceptors (large gravity pipelines) convey sanitary flow to the EBMUD Wastewater Treatment Plant in Oakland.

Figure 5-33. Bay Farm Island Sewer System

Source: (USGS; NOAA; City of Alameda; Port of Oakland)

5.4.2.3 Water Supply

The East Bay Municipal Utility District (EBMUD) supplies the City of Alameda potable water system (also used for the fire water system). The water system within the Bay Farm Island project site is a gravity-flow system within the Central Pressure Zone; no pump stations are used to pressurize the water system. The pipe network includes air valves to allow air to enter (vacuum breaker valve) and exit (air release valve), which may include air valves within areas susceptible to flooding. These air valves are typically vented above-ground; if air valves are vented within an underground vault, the water system may be affected by flooding due to floodwaters preventing proper function of the air valves or contamination of the water supply by floodwaters entering the pipeline. The water system also includes isolation valves and blow-offs at ground level for maintenance and repair of the pipeline; these may be difficult to located and operate if flooded.

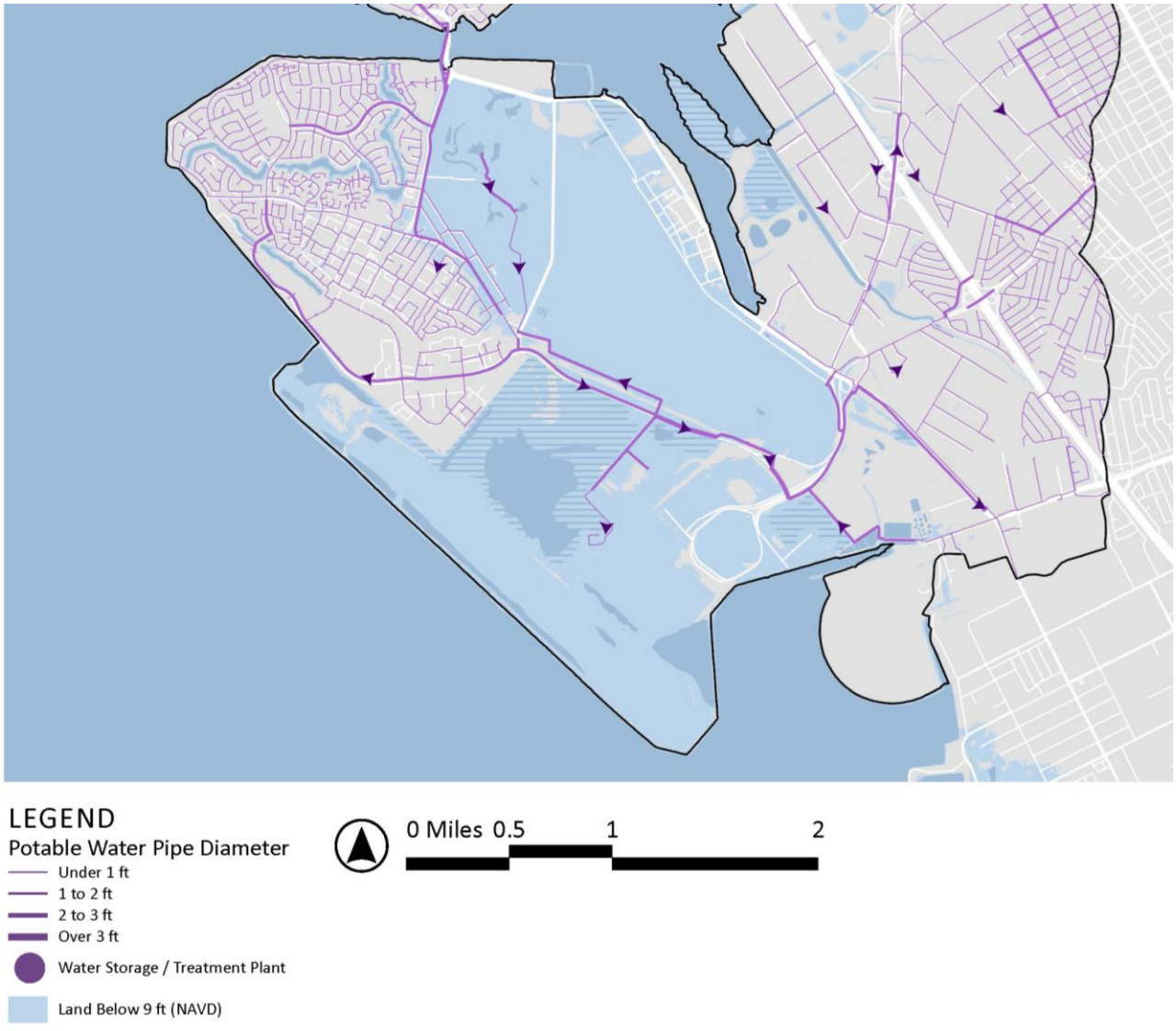


Figure 5-34. Bay Farm Island Potable Water System

Source: (EBMUD)

5.4.2.4 Electrical Power

Alameda Municipal Power (AMP) provides power to the Bay Farm Island project site. Similar to the Oakland-Alameda Estuary site, the substations are potentially subject to coastal or stormwater flooding.

4.4.2.2 Natural Gas

PG&E provides natural gas to the Bay Farm Island project area. The main gas transmission lines are outside the project area; these lines run north-south along I-880, with a lateral transmission line serving Bay Farm Island terminating near the east end of the Oakland Airport North Field.

4.4.2.3 Other Pipelines

The Kinder Morgan pipeline is outside the project area; this pipeline is located east of I-880 and along the southern and western shoreline of Bay Farm Island before crossing San Francisco Bay towards Brisbane Lagoon.

5.4.2.5 Communications

Similar to the Oakland-Alameda Estuary site, flooding concerns are not likely to impact the various cellular service providers, but floodwater could impact the citywide fiber optic network (MAN) which supports residential, business, and municipal (City) use. The MAN is critical to City emergency operations during flooding and other emergency situations. Portions of the MAN are underground and may be susceptible to flooding impacts.

Figure 5-35. Bay Farm Island Utilities

Source: (USGS, Department of Homeland Security; PG&E)

5.4.2 Emergency Facilities

For Bay Farm Island, Alameda Fire Station #4 is the only Fire Department Station, located near the west shoreline inland of the Ferry Terminal.

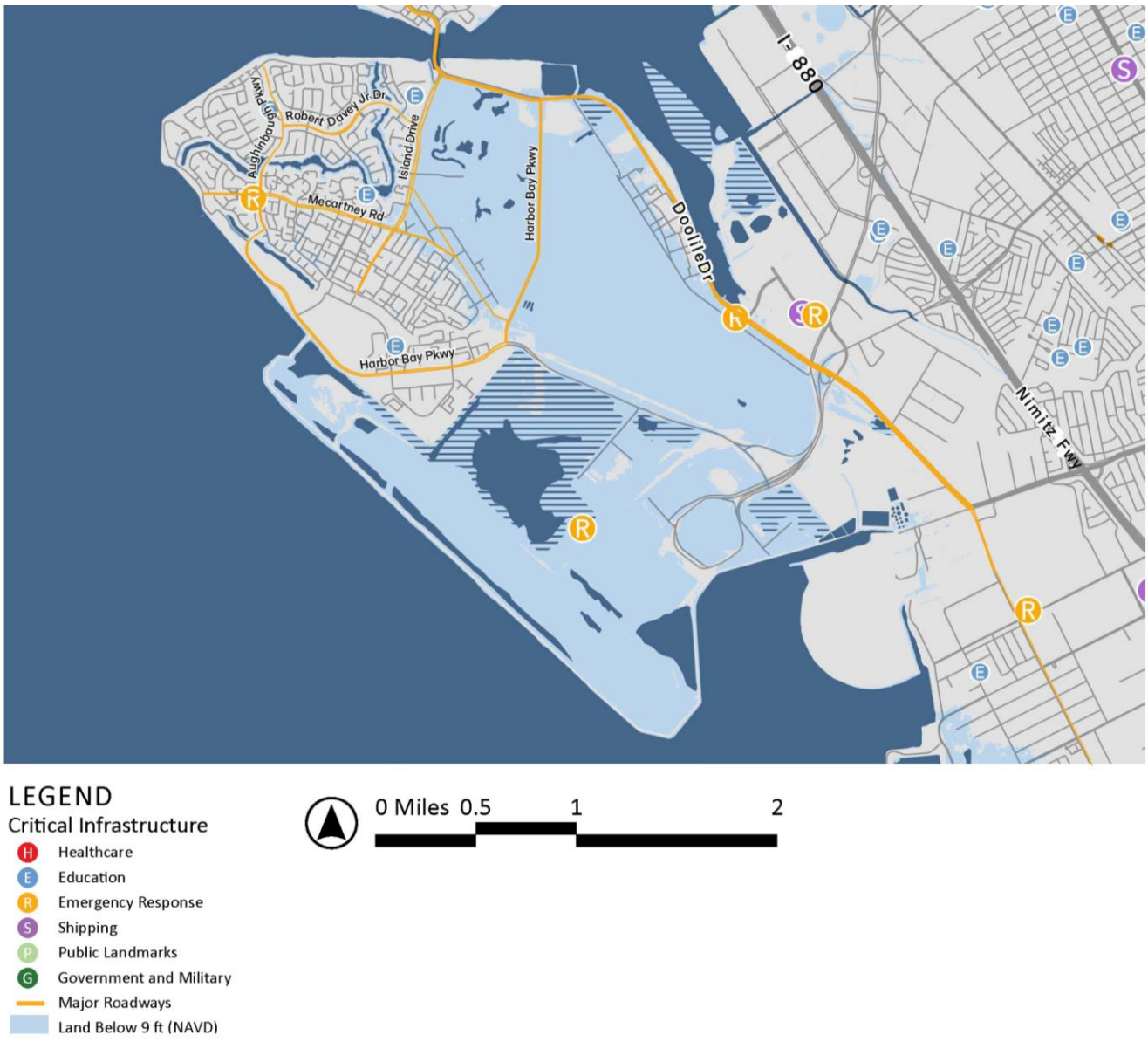


Figure 5-36. Critical Facilities on Bay Farm Island

Source: (USGS)

5.5 Public Access and Recreation

5.5.1 Public Transportation

Much of the Bay Farm Island project area is within a TPA. Transit Priority Area (TPA) is defined as an area within one-half mile of a major transit stop that is existing or planned, if the planned stop is scheduled to be completed within the planning horizon included in a transportation improvement program or applicable regional transportation plan (MTC and ABAG 2021). The two regions on Bay Farm Island are designated as TPAs due to the connections between ferries and bus routes and the multiple forms of transit available at the Oakland Airport.

Bay Area Rapid Transit (BART) provides a regional light rail network within the greater Subregion; however, there are no BART stations within the Bay Farm Island project area. The closest BART stations within the Subregion are the Oakland International Airport Station and the Coliseum Station.

There are no passenger rail stations within the Bay Farm Island project area.

The Harbor Bay Ferry Terminal is located within the Bay Farm Island project area. As of February 2024, the Bay Harbor Ferry Terminal offers weekday service to Downtown San Francisco. Transit time is approximately 25 minutes (WETA 2022).

Additional public transportation within the Bay Farm Island project area includes the Harbor Bay Business Park Shuttle, which connects the Coliseum BART station on one end to the Bay Farm Island Ferry along Harbor Bay Parkway & North Loop Road (ALTRANS TMA, Inc.; GS Management Company.).

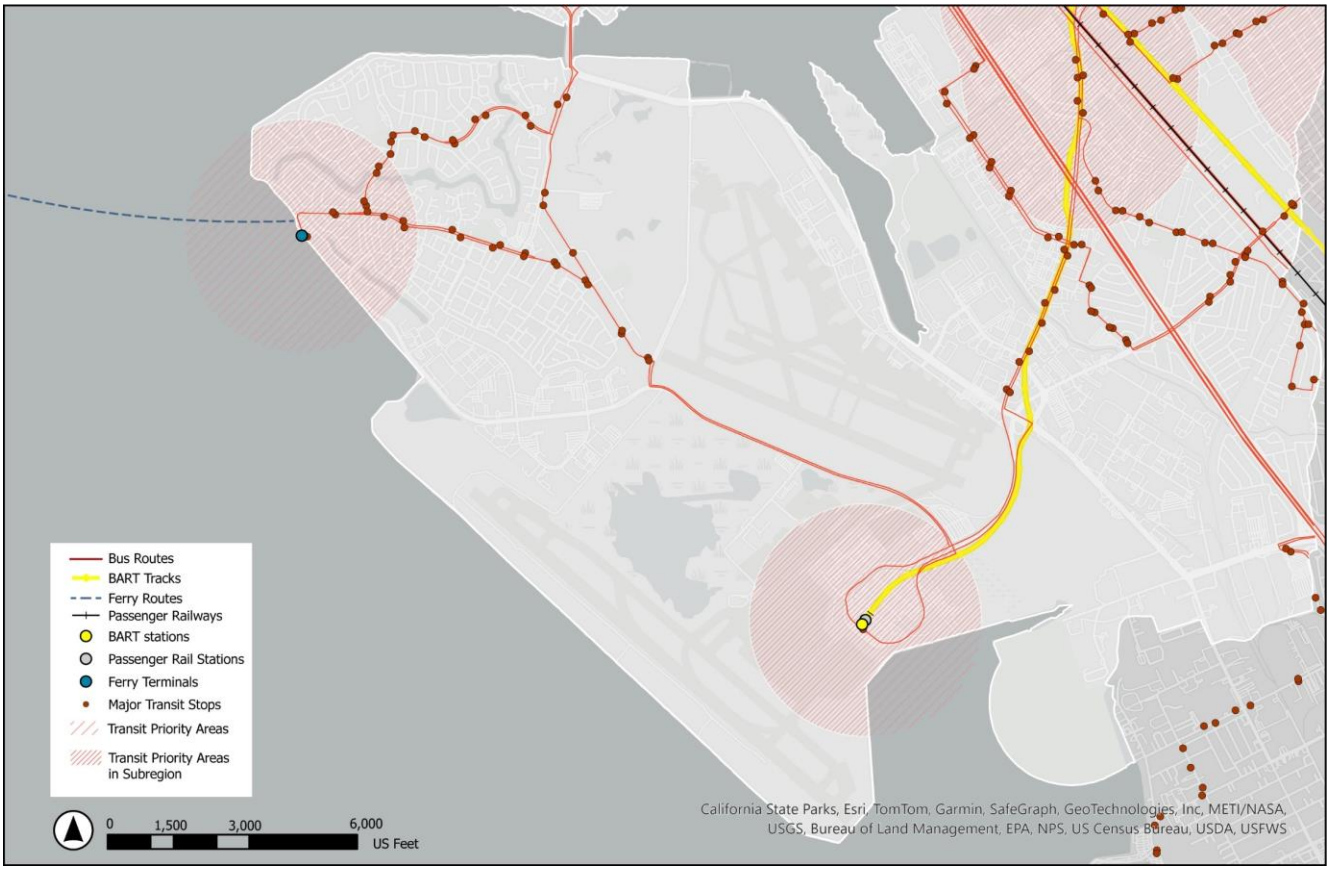


Figure 5-37. Bay Farm Island Public Transportation

Source: (Metropolitan Transportation Commission 2024)

5.5.2 Bicycle & Pedestrian Routes

The San Francisco Bay Trail runs along the outer edge of the Bay Farm Island Project Area. Significant access points can be found at Adelphian Way and at Sea View Way. Additional significant bike and pedestrian infrastructure within the Project Area includes the San Leandro Bay Bike Bridge, which connects Alameda Island to Bay Farm Island parallel to SR-61. This bridge has two touchdowns on Bay Farm Island: one on the eastern side of SR-61, and the other on the western side of SR-61 at Veteran's Pier.

Additional trails and pedestrian pathways include a series of footpaths and trails that follow the edges of several lagoons and connect cul-de-sacs for pedestrians (Figure 5-38).

Additionally, the City of Alameda's 2021 General Plan proposed a new pedestrian bridge: the Shoreline to Seaview Bridge, connecting Park Street to Bay Farm Island at Seaview Parkway (City of Alameda 2022b). As of January 2024, no feasibility studies had been conducted for this proposal.

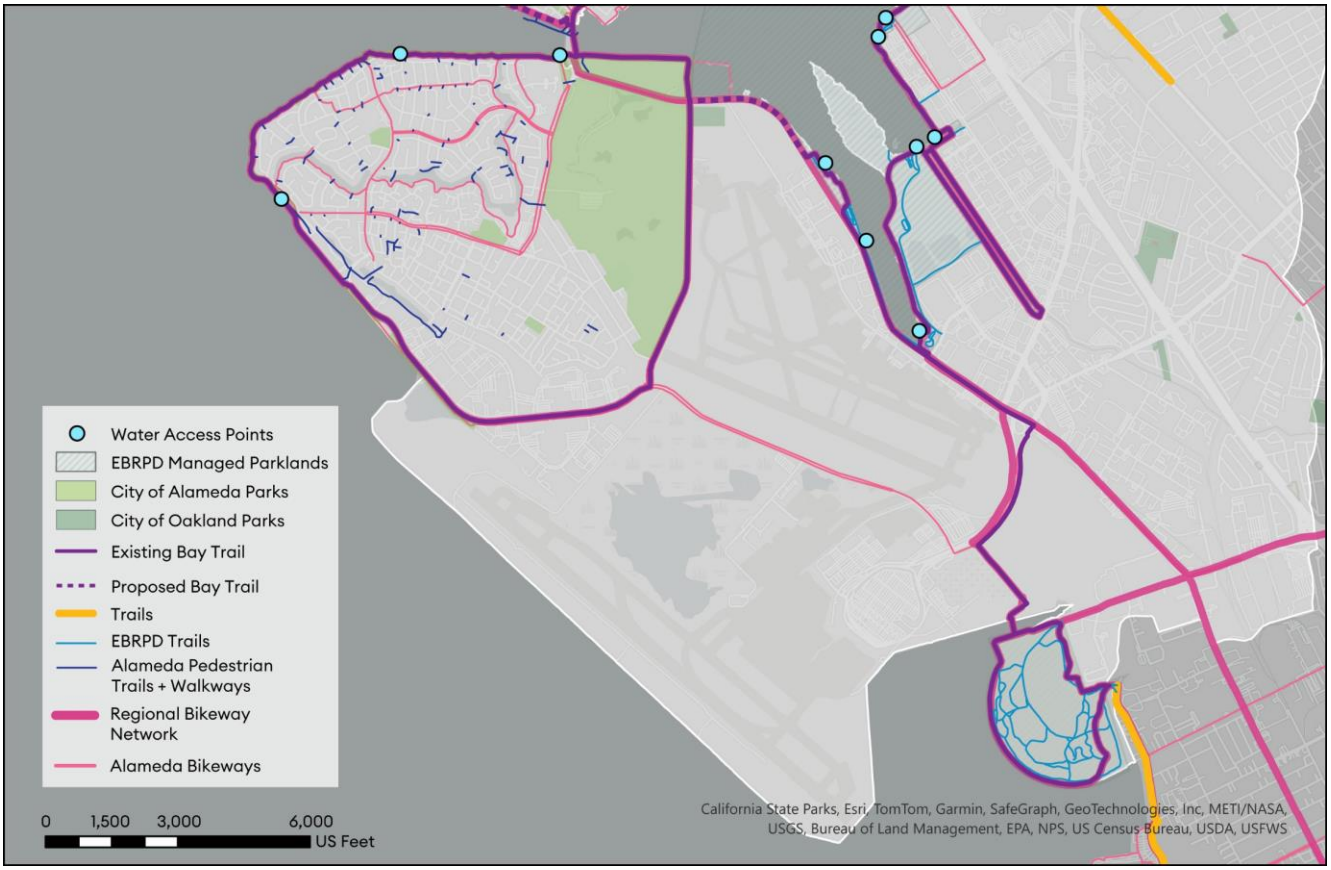


Figure 5-38. Bay Farm Island Bicycle and Pedestrian Routes

Source: (EBRPD; City of Alameda; City of Oakland; Metropolitan Transportation Commission 2024)

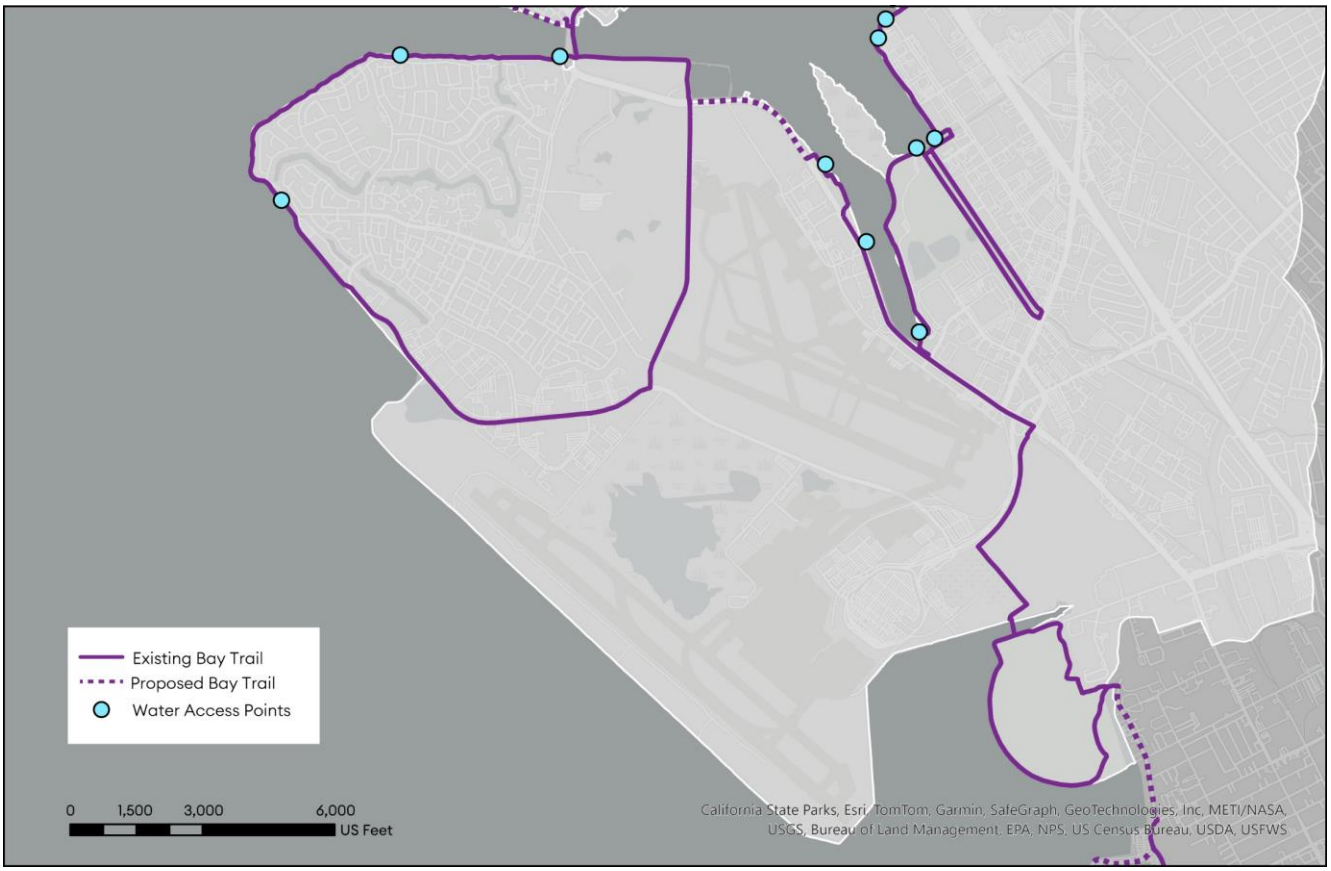


Figure 5-39. Bay Farm Island Existing & Proposed Bay Trail Segments

Source: (Metropolitan Transportation Commission 2024)

5.5.3 Parks & Open Space

Parks and open spaces directly on the waterfront within the Bay Farm Island Project Area are:

> **Shoreline Park** (198 Packet Landing Road)**;** established in 1978, this park is located on Bay Farm Island and provides views of the San Francisco Bay and San Francisco Shoreline. Amenities include restrooms, paved walking trails and rentable picnic spaces (City of Alameda 2024b).

Parks and open spaces adjacent to the in the Bay Farm Island Project Area shoreline are:

> **Tillman Park** (220 Aughinbaugh Way); facilities include athletic fields, picnic areas, playground, recreation center and a restroom (City of Alameda 2024g)
>
> **Corica Golf Course** (1 Clubhouse Memorial Drive) is a municipally owned golf course opened in 1927. The site occupies over 300 acres (Corica Park Golf Course).

Additional public properties with significant open space adjacent to the Bay Farm Island Project Area shoreline include the Bay Farm School and the Earhart Elementary School.

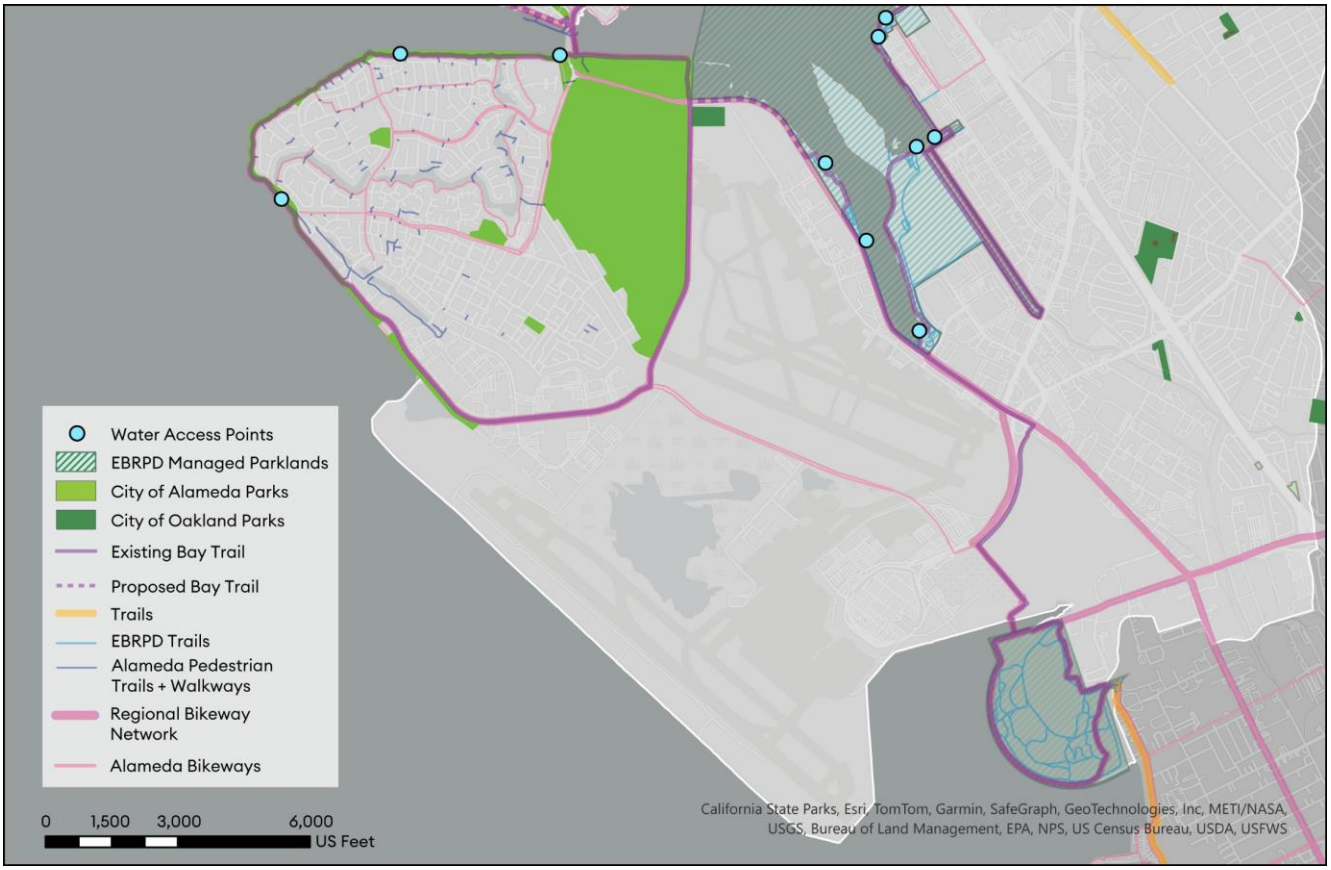


Figure 5-40. Bay Farm Island Parks and Open Spaces

Source: (EBRPD; City of Alameda; City of Oakland; Metropolitan Transportation Commission 2024)

5.6 Biological Resources

As with the greater San Leandro OLU, ESA evaluated historical and existing conditions related to biological resources of Bay Farm Island, which includes both terrestrial and marine environments. Historically, Bay Farm Island was comprised of tidal marshes and grasslands surrounded by tidal flats and discontinuous sandy beaches.[21] Today, much of Bay Farm Island is developed. Annual grassland and ornamental landscaping are the primary naturalized landcover types on the island which include vegetation within the Corica Park Golf Course and Oakland International Airport airfields. A narrow band of tidal marsh borders Fan Marsh (lagoon) and west of the more extensive Arrowhead Marsh within

[21] San Francisco Estuary Institute (SFEI). 1998. "Bay Area EcoAtlas V1.50b4 1998: Geographic Information System of wetland habitats past and present." Accessed December 2023. http://www.sfei.org/content/ecoatlas-version-150b4-1998.

San Leandro Bay.[22] Bay flat habitat border the northeast and south portions of the island.[23] Constructed freshwater ponds or lagoons are also present within the island interior. Eelgrass beds are mapped northwest and west of Bay Farm Island.[24]

The terrestrial and aquatic habitats of Bay Farm Island were evaluated for their potential to support sensitive plant and animal species. ESA examined the query results obtained for the San Leandro OLU from the California Department of Fish and Wildlife (CDFW) Natural Diversity Database (CNDDB), the California Native Plant Society (CNPS) Electronic Inventory, the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) for records of special-status species on Bay Farm Island.

Remnant shoreline marsh, marsh flat and panne, and grassland habitats of Bay Farm Island, provide suitable habitat for the special-status animal species listed below. Each of these species was determined to have a moderate[25] or higher[26] potential (i.e., known presence) to occur at Bay Farm Island or offshore in San Francisco Bay. These species may be present within suitable habitat seasonally (e.g., while breeding, wintering, or during migration) or year-round. Fan Marsh (lagoon) and adjacent tidal marsh, bay flat, marsh flat and panne habitat bordering San Leandro Bay hosts a population of California Ridgway's rail, listed as endangered under both the federal Endangered Species Act and California Endangered Species Act. Note that the only species with potential to occur in the San Leandro Subregion not listed below is western pond turtle. This species was determined to have low[27] potential to occur within Bay Farm Island because of limited, low to marginal quality suitable habitat available and because there are no prior records of this species on the island.

Insects:

- Monarch butterfly (*Danaus plexippus*; FESA candidate for listing)

[22] San Francisco Estuary Institute.02022. California Aquatic Resources Inventory (CARI) version 1.1. Accessed December 2023. Available at: https://www.sfei.org/data/california-aquatic-resource-inventory-cari-version-11-gis-data

[23] Ibid.

[24] San Francisco Estuary Institute, 2020. Eelgrass Survey GIS Data version 2.0, San Francisco Bay (2014). Accessed December 2023. Available at: Eelgrass Data Management and Project Tracking | San Francisco Estuary Institute (sfei.org).

[25] Moderate Potential = The study area and/or immediate vicinity provide low to moderate quality suitable habitat and the study area is within the known species' range.

[26] High Potential = The study area and/or immediate vicinity provide ideal (high quality) habitat conditions and the study area is within the known species' range.

[27] Low Potential = The study area and/or immediate vicinity only provide limited (low to marginally suitable) habitat or the species' known range is outside of the study area.

Fish:

- North American green sturgeon, southern distinct population segment (DPS)(*Acipenser medirostris*; FESA-threatened, CSC)
- Pacific herring (*Clupea pallasii*; Magnuson-Stevens Fishery Conservation and Management Act)
- Steelhead, Central California Coast DPS (*Oncorhynchus mykiss*; FESA-threatened, CSC)
- Longfin smelt (*Spirinchus thaleichthys*; FESA candidate for listing; CESA-threatened)

Birds:

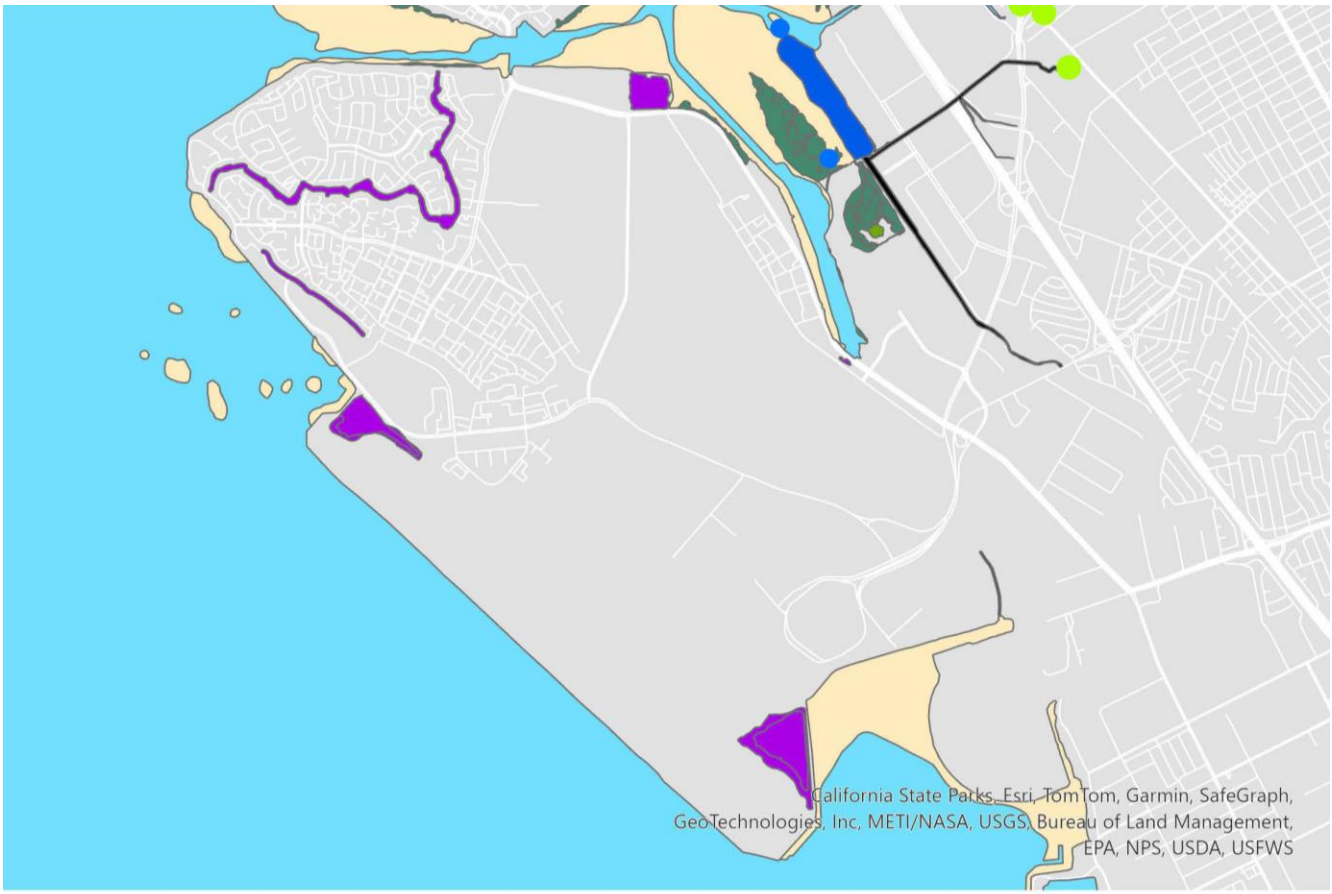
- American peregrine falcon *(Falco peregrines anatum*; CFP*)*
- Brown pelican (*Pelecanus occidentalis* californicus; CFP)
- California Ridgway's rail (*Rallus obsoletus*; FESA, CESA-endangered, CFP)
- California least tern (*Sternula antillarum browni*; FESA, CESA-endangered, CFP)
- Western burrowing owl (*Athene cunicularia*; CSC)
- San Francisco common yellowthroat (*Geothlypis trichas sinuous*; CSC)
- California gull (*Larus californicus*; CDFW watch list)
- Alameda song sparrow (*Melospiza melodia pusillula*; CSC)
- Osprey (*Pandion haliaetus*; CDFW watch list)
- Double-crested cormorant (*Phalacrocorax auritus*; CDFW watch list)
- Caspian tern (*Hydroprogne caspia*; CDFW watch list)

Mammals:

- Salt-marsh harvest mouse (*Reithrodontomys raviventris*; FESA, CESA-endangered, CFP)
- Pallid bat (*Antrozous pallidus*; CSC)

Marine Mammals:

- Pacific harbor seal (*Phoca vitulina richardsii*; Marine Mammal Protection Act [MMPA])
- California sea lion (*Zalophus californianus*; MMPA)



LEGEND

Habitat Change

- Deep Bay
- Shallow Bay
- Tidal Unnatural
- Panne
- Marsh Flat
- Marsh
- Bay Flat
- Lagoon
- Stuckenia
- Commercial Fishing
- Ruppia Maritima
- Native Oysters
- Mussel Beds
- Priority Conservation Areas

0 Miles 0.5 1 2

Figure 5-41. Habitat Change

Source: (ESA, SFEI)

5.7 Cultural Resources

As with the Oakland Alameda Estuary site, ESA staff conducted a cultural resources records search for the Bay Farm Island project area from the Northwest Information Center (NWIC) at Sonoma State University, Rohnert Park.

Background research identified three previously recorded architectural resources within the project area, two of which appear to be mapped along the actual shoreline, and no previously recorded archaeological resources. The western and southern portions of the project area were essentially inundated (bay or marsh) until the mid-20th century, at which point Bay Farm Island was established, along with its levees and associated construction. The other portions of the project area experienced historic-era development earlier. By the 1930s, a bridge had been constructed in the north-central portion of the BFIAP Study Area, levees had been constructed in the same general area as the current shoreline, and Airport Channel had been created. By the 1950s, additional levees had been constructed in the north-center portion of the project area, and the west side of Airport Channel had been developed with wharves and associated features. Given that the current shoreline was established in its current location as a result of historic-era development, and that no pre-contact archaeological resources have been recorded despite a number of previous studies in the area having included archaeological excavation, the project area appears to have a low sensitivity for pre-contact archaeological resources. In contrast, the large amount of historic-era development suggests that the project area has a high sensitivity for historic-era archaeological resources, likely dating to the mid-20th century. Additionally, several architectural resources have been recorded, two of which are in the shoreline portion, and systematic survey does not appear to have been done for the entire project area, though, overall, the more recent and less dense development of Bay Farm Island suggests an overall lower architectural sensitivity than the Oakland-Alameda Estuary project site. As such, Bay Farm Island project area has a moderate sensitivity for architectural resources.

5.8 New Development & Planned Redevelopment

More detailed descriptions of each planned project can be found in Section 3.

5.8.1 Parks & Open Space Within or Adjacent to Bay Farm Island Project Area

- Corica Park Golf Course – City of Alameda.

5.8.2 Trails & Connections Within or Adjacent to Bay Farm Island Project Area

- East Bay Greenway – City of Oakland;
- EBRPD Doolittle Drive Bay Trail & Shoreline Improvements – City of Oakland;
- San Leandro (Lisjan) Creek Greenway – City of Oakland;
- 66th Avenue BART to Bay Trail – City of Oakland;

5.8.3 Commercial/Industrial Projects Within or Adjacent to Bay Farm Island Project Area

- Supplybank.org (Nelson 2023b) – City of Oakland;
- 3600 Alameda Avenue, Oakland (Nelson 2023c) – City of Oakland.

5.8.4 Transit/Infrastructure Projects Within the or Adjacent to Bay Farm Island Project Area

- Shoreline to Sea View Bridge – City of Alameda.

5.8.5 Planning Documents

- Coliseum Area Plan – City of Oakland.

6 Conclusion

The OAAC Adapt Existing Conditions Report is a compilation and review of existing reports and data and is intended to serve as a baseline for analysis and adaptation planning as identified in the OAAC Adapt scope of work. It is not a comprehensive or detailed vulnerability or risk assessment or exposure analysis. As such, the team has included information on key data gaps and identified topics that will require additional scope under current or future adaptation planning. In addition to this summary report, all the background reports, GIS, and other source data, have been compiled in a project library, and a GIS Data Base for the Subregion has been created as a resource to inform ongoing planning. The report is intended as a living document and will be updated as new data and analysis are received and completed.

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