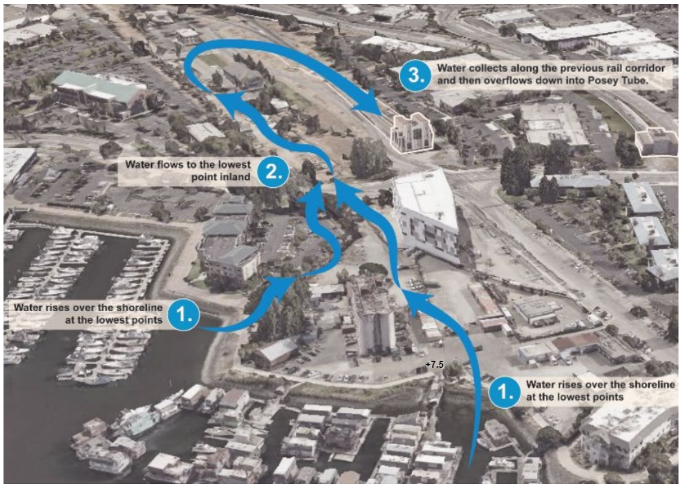

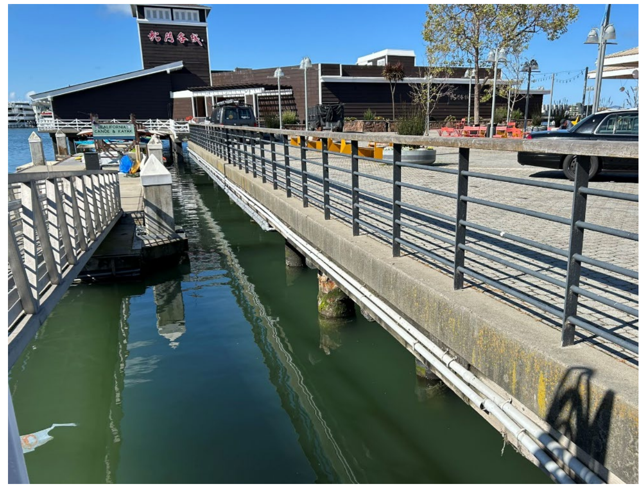

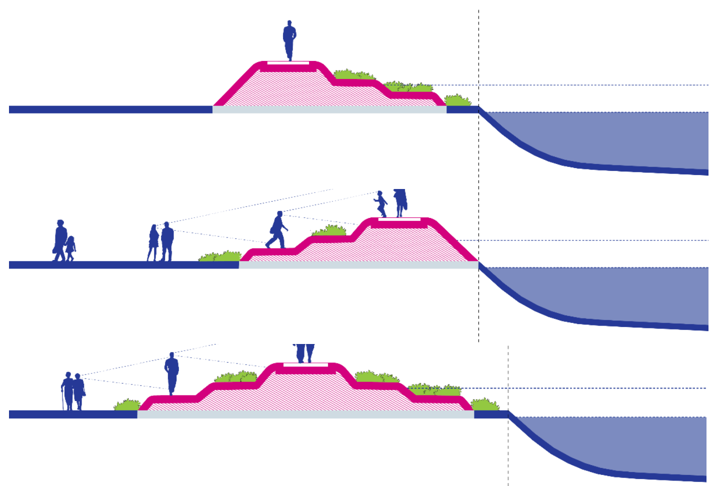

OAAC ADAPT: Oakland-Alameda Adaptation Projects

# Basis of Design & Adaptation Concepts

## Oakland Alameda Estuary

V4

February 28, 2025

## Prepared For

Oakland-Alameda Adaptation Committee

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## Acronyms / Abbreviations

| Acronym | Signification |
|---|---|
| AEP | Annual Exceedance Probability |
| FEMA | Federal Emergency Management Agency |
| GI | Green Infrastructure |
| LID | Low Impact Development |
| MRP | Municipal Regional Permit |
| NAVD | North American Vertical Datum of 1988 |
| NFIP | National Flood Insurance Program |
| NPDES | National Pollutant Discharge Elimination System |
| OAAC | Oakland Alameda Adaptation Committee |
| SDMP | Storm Drain Master Plan |
| SDWA | Safe Drinking Water Act |
| SWL | Still Water Level |
| TWL | Total Water Level |
| UIC | Underground Injection Control |
| WRDA | Water Resources Development Act |

# 1 Introduction

The Oakland Alameda Adaptation Committee ("OAAC") is a coalition of shoreline communities and stakeholders working to accelerate sea level rise adaptation, protect and restore water quality, recreation and habitat, and promote community resilience. OAAC includes jurisdictions, agencies and community-based organizations that have an interest in the Oakland-Alameda shoreline, as well as regional, state and federal collaborators. The primary goal of OAAC is to create inclusive, transformative, and equitable climate-ready communities along the Oakland and Alameda shoreline.

OAAC is collaborating on three funded adaptation projects that seek to address sea level rise vulnerabilities in the cities of Alameda and Oakland. The goal of these projects is to develop conceptual flood protection strategies to address sea level rise induced flooding while also building a long-term framework for future collective action and planning.  The below projects, referred to as the OAAC ADAPT Projects, are funded through 2025:

- Oakland Alameda Subregional Adaptation Plan
- Oakland Alameda Estuary Adaptation Project (this report)
- Bay Farm Island Adaptation Project

The Oakland Alameda Estuary Adaptation Project described in this report is a sea level rise adaptation design concept to address increased coastal, stormwater, and groundwater flooding for a planning horizon defined as *Near-Term.* This Near-term horizon envisions adaptation strategies that would need to be implemented over the next 3 to 10 years, which would address sea level rise induced flooding over the next 35 to 50 years. Some correspond to addressing risk in priority action areas; others are needed to support future decision making. Near-term strategies would address 2' of SLR above the 2000 baseline. The near-term project will include strategies to elevate and adapt low-lying areas of the shoreline combined with green infrastructure such as rain gardens and storm drainage improvements.

The project area, shown on Figure 1-1, encompasses Oakland's shoreline areas between Jack London Square and the Lake Merritt Dam at 7th Street (west bank of the channel only), Alameda's northern shoreline areas between Bohol Circle Immigrant Park and the Marina Village Yacht Harbor, Caltrans' Posey and Webster Tube gateways (State Route 260), and the San Francisco Bay Trail within these reaches.

The adaptation concepts are being prepared in coordination with community members and key stakeholders. Funding is from a Caltrans Sustainable Communities grant and Measure BB, which terminates in February 2025. Design strategies are being developed to a conceptual level under current funding. Design refinement, continued stakeholder engagement, environmental reviews, and design/construction will be done with future funding. The Oakland Alameda Adaptation

Committee (OAAC) is pursuing up to $4 million in federal community project funding and up to $30 million from the federal Water Resources Development Act (WRDA) bill to further the design and initiate implementation of the Oakland Alameda Estuary Adaptation project.

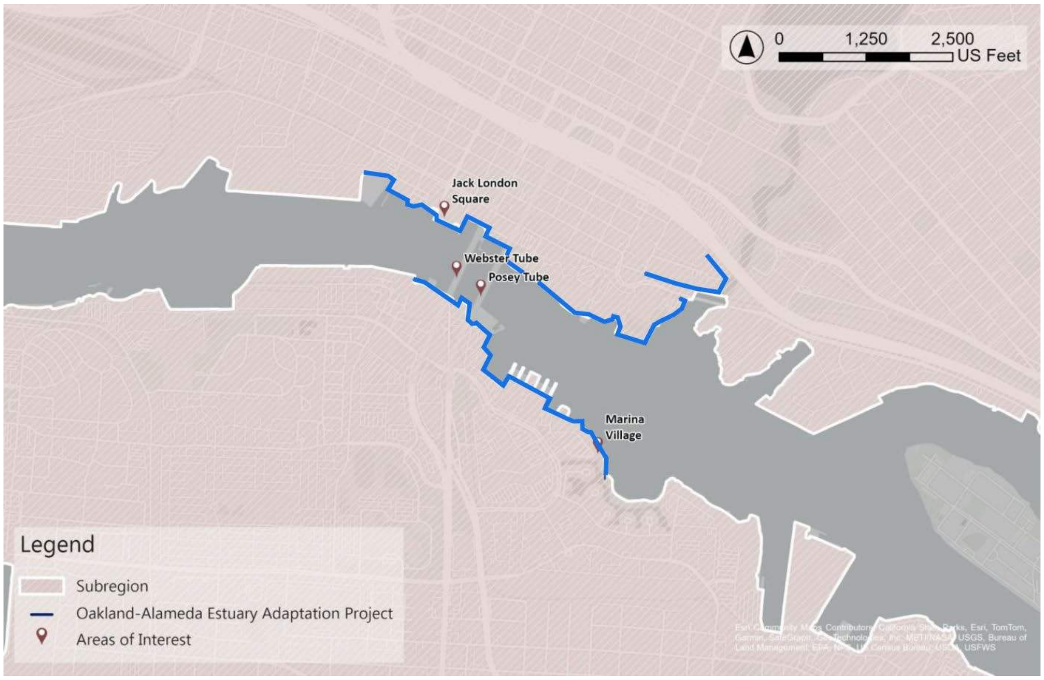



Figure 1-1: Oakland-Alameda Estuary Project Study Area

# 2 Planning Principles

The OAAC ADAPT Planning Principles have been developed in support of the vision and goals established by the OAAC and the OAAC ADAPT Project Charter (see Appendix A).

**OAAC Mission Statement**

> A coalition of shoreline communities and stakeholders coordinating the Oakland Alameda sub-region to accelerate sea level rise adaptation, protect and restore water quality, recreation, and habitat, and promote community resilience.

The equity goals and principles defined in the OAAC and OAAC Adapt Project Charter provide the overarching framework for all the planning and decision making. These planning principles supplement the Charter documents and will guide the physical and policy-based adaptation strategies and evaluation criteria as the project progresses.

The principles are organized into categories consistent with the principles defined in the **Bay Adapt One Bay Vision (Working Draft, March 2024)**, with the intention of ensuring alignment between OAAC planning and BCDC guidance. It is anticipated that these principles may be revisited and revised through future phases of the planning process.

## 2.1 General

- **Sea Level Rise Adaptation Planning Criteria** – Comply with FEMA flood protection criteria for near-term project actions and accommodate 35 to 50 years of projected sea level rise in initial flood mitigation strategies. For higher sea level rise, consider adaptation strategies that can build upon near-term actions.
- **Pathways Approach** - Utilize a Pathways approach to adaptation planning that is site specific and includes measures for monitoring, clearly defined triggers, and a phasing strategy that allows for future adaptations.
- **Multi-benefit** - Embrace a multi-benefit approach that ensures public health and safety, respects natural systems, reduces risk to people, places, and capital through multipurpose design and green infrastructure planning.
- **Equity and Environmental Justice -** Prioritize equity and environmental justice outcomes for vulnerable communities.

## 2.2 Community Health and Wellbeing

- Ensure that adaptation measures **safeguard communities** from the public health consequences of flooding and support healthy environments, public safety, and quality of life (Bay Adapt Draft One Bay Vision).

- Meaningfully engage and **empower communities** in adaptation decision-making processes. (Bay Adapt Draft One Bay Vision)
- Prioritize planning to **address risks** to essential community assets, services including Bay ecosystem services, and cultural resources. (Bay Adapt Draft One Bay Vision)
- Prioritize **economic opportunities** from adaptation in disadvantaged communities through local hire, workforce development, and other community benefits. (Bay Adapt Draft One Bay Vision)

## 2.3 Critical Infrastructure and Services

- Maintain or improve **service continuity** for everyone, by protecting or relocating critical infrastructure while minimizing vulnerabilities of new infrastructure networks to future flooding hazards. (Bay Adapt Draft One Bay Vision)
- Prioritize adaptations that address service deficiencies in **underserved communities**. (Bay Adapt Draft One Bay Vision)

## 2.4 Transportation and Transit

- Adapt local and regional **transportation** systems to ensure safe and reliable connectivity by air, land, and water. (Bay Adapt Draft One Bay Vision)
- Ensure continuity and equitable service in **transit dependent communities**. (Bay Adapt Draft One Bay Vision)
- Promote active, **low emissions mobility** options for environmental and economic benefit. (Bay Adapt Draft One Bay Vision)

## 2.5 Ecosystem Health and Resilience

- Prioritize **nature-based** solutions wherever possible
- Incorporate **habitat connectivity**, sediment management, and whole watershed approaches into shoreline planning and projects. Improve subtidal, intertidal, transitional, and upland ecosystems, to the greatest extent possible.
- Identify and facilitate opportunities for ecosystems to **migrate** landward and seaward to support and enhance natural adaptation processes. (Bay Adapt Draft One Bay Vision)
- Evaluate the environmental benefits and impacts of the adaptation measures as part of the **cost/benefit evaluation** of each.

## 2.6 Public Access, Recreation, and Urban Design

- Provide contiguous and equitable **access** along the waterfront and to the water in support of the San Francisco Bay Trail, the San Francisco Bay Water Trail and other active transportation corridors.

- Prioritize **connecting disadvantaged neighborhoods** to a healthy Bay, creating equitable access for diverse communities. (Bay Adapt Draft One Bay Vision)
- Expand and improve **diverse** varied public access, such as recreation opportunities and water-dependent or culturally significant waterfront uses, through adaptation. (Bay Adapt Draft One Bay Vision)
- Maintain the **physical and visual** relationship between landside communities and the San Francisco Bay, parks, ecological features, and maritime facilities by minimizing the use of tall, vertical walls at the water's edge; and using available landside elevation for gradual adaptation.
- Where appropriate, provide a high-quality **public realm** while adapting the shoreline to address sea level rise, including pedestrian spaces that are accessible for all ages and abilities, active edges, regular access to open space, views of the water and waterfront activities, and clear wayfinding.
- Prioritize adaptation strategies that avoid demolition and maintain the integrity of and access to **historical resources** (districts, buildings, structures, sites, objects listed or eligible for listing in the California Register of Historical Resources), including those associated with local maritime history.
- **Balance** the need for human enjoyment, sustenance, and cultural connection to the Bay with healthy ecosystems. (Bay Adapt Draft One Bay Vision)

## 2.7 Governance, Collaboration, and Finance

- Continue the governance commitments established by OAAC ADAPT to date and consider more formal governance options for future project phases.
- Ensure local and regional governments **collaborate** to address shared flooding risk, identify multi-benefit adaptation opportunities, including nature-based solutions, and avoid adverse flooding impacts to other jurisdictions. (Bay Adapt Draft One Bay Vision)
- Engage with indigenous partners and **community partners** at each step in the planning, implementation, and management of shoreline adaptation projects. (Bay Adapt Draft One Bay Vision)
- Incorporate **multi-benefit design solutions** into projects to best meet community needs and maximize grant funding potential.
- Incorporate **near-term benefits** into long-term planning and design strategies for the communities that will vote on funding the local share of cost.
- Minimize the potential future local share tax impact on the local community, by incorporating project features that benefit stakeholders at **multiple scales**, particularly those on a regional, statewide, or national basis.

## 2.8 Housing, Development, and Land Use

- Adapt existing development **equitably** and plan new and re-development projects to ensure community safety, equity, and Bay ecological health. ((Bay Adapt Draft One Bay Vision)
- Align land use planning with risk mitigation while considering **long-term economic** vitality for all. ((Bay Adapt Draft One Bay Vision)

## 2.9 Groundwater and Shoreline Contamination

- Integrate emerging science on shallow **groundwater rise** into planning and adaptation decisions and identify innovative solutions. ((Bay Adapt Draft One Bay Vision)
- Prioritize remediation of contaminated sites in **Environmental Justice communities**, while minimizing transferring contamination burden. ((Bay Adapt Draft One Bay Vision)

# 3 Overall Approach / Basis of Design

The overall approach to addressing ongoing and future flooding within the project area is to develop adaptation concepts that consider the various sources of flooding, maintain/improve public access opportunities, ensure protection/enhancement of environmental resources, maintain the integrity of cultural resources, and maximize grant funding potential. Key factors considered in developing the concepts are summarized below.

## 3.1 Flood Protection Infrastructure

- Comply with FEMA certification criteria and consider established planning horizons, insurance premiums versus the cost of adaptation strategies, and the benefits of an improved FEMA Community Rating System score.
- Incorporate coastal, stormwater, and groundwater-source flooding independently and collectively
- Accommodate sea level rise in near and long-term scenarios. Time horizons should drive analysis and planning.
- Utilize nature-based solutions for shoreline adaptation and inland green infrastructure to harness natural hydrologic processes. Slow, store, infiltrate, and detain as much stormwater as possible—pump stormwater only when significantly more cost effective or as a temporary measure.
- Develop strategies that can be adapted to higher sea level rise as climate projections evolve, as development patterns change, and as construction methods advance.
- Consider long-term implications of maintenance and management when analyzing adaptation strategies and pathways to implementation.
- Spatially align solutions with a benefit-cost analysis that considers the utility, life cycle, and cultural value of infrastructure.
- Manage water quantity and quality to reduce risk by harmonizing spatial, structural, and ecological criteria.
- Prioritize nature-based solutions and low impact development to the maximum extent practicable.
- Diversify adaptation approaches to increase resilience in the face of the dynamic impacts of coastal, storm, and groundwater flooding.

## 3.2 Urban Design & Public Realm

- Maintain existing connections from adjacent neighborhoods to parks, open spaces, maritime activities, facilities and infrastructure.
- Provide contiguous and equitable access along the waterfront and to the water in support of the San Francisco Bay Trail, the San Francisco Bay Water Trail and other existing recreation corridors.
- Maintain the physical and visual relationship between landside communities and the San Francisco Bay, parks, ecological features, and maritime facilities by minimizing the use of new,

tall, vertical walls at the water's edge; and using available landside elevation for gradual adaptation.

- Provide a high-quality public realm while adapting the shoreline to address sea level rise projections wherever possible. Some elements of a desirable public realm include generous and continuous pedestrian spaces that are accessible for all ages and abilities, active edges, regular access to open space, views of the water and waterfront activities, and clear wayfinding between different zones.
- Provide opportunities for multi-benefit solutions including stormwater planting and ecological enhancements within public open space as much as possible.

## 3.3 Environmental Protection

- Improve subtidal, intertidal, transitional, and upland ecosystems and habitat by incorporating nature-based solutions in all projects, to the greatest extent possible.
- Embrace water as an asset.
- Highlight safety, respect for natural systems, and risk reduction to people, places, and capital through multipurpose design and green infrastructure planning.
- Improve air quality
- Understand the environmental benefits and impacts of the adaptation measures as part of the cost/benefit evaluation of each.

## 3.4 Cultural & Historical

- Prioritize adaptation strategies that maintain the integrity of designated historic districts, structures, sites, and those that have historic and/or cultural merit.
- Prioritize adaptation strategies that maintain integrity and access to structure and sites associated with local maritime history.
- Avoid demolition of a historic resource if possible.
- Utilize design modifications that minimize impacts to historic character-defining features of historic resources (flood adaptation may require more change to a historic property than would typically be acceptable in other historic preservation contexts).
- Conduct tribal consultation on all adaptation measures.

## 3.5 Funding and Financing

- Incorporate multi-benefit solutions into project planning and design in order to maximize grant funding potential.
- Incorporate near-term benefits into long-term planning and design strategies for the communities that will vote on funding the local share of cost.

- To minimize the potential future local share tax impact on the local community, incorporate project features that benefit stakeholders at multiple scales, particularly those on a regional, statewide or national basis.

# 4 Design Criteria and Alternatives Development

The estuary shoreline along Oakland and Alameda, specific reaches for evaluation purposes, and elevations along the shoreline are presented in Figure 4-1 to Figure 4-5.

## 4.1 Flood Protection Infrastructure

One of the most significant goals of the proposed project is to achieve resiliency against flooding, now and into the future. Since flooding can be a result of high Bay water levels, stormwater runoff that cannot be conveyed to the Bay, high groundwater, or a combination of some or all of the above, each flood source needs to be addressed as part of a comprehensive flood protection infrastructure system.

### 4.1.1 Coastal Flooding

This type of flooding is caused by a combination of astronomical high tides and meteorological anomalies that result in storm surges in the Bay. Several options to augment the level of flood protection against coastal flooding have been considered. These include raising the existing shoreline edge or constructing new shoreline structures such as:

- Levee
- Seawall (or Floodwall)
- Hybrid Structure (Berm + Parapet Wall)

Nature-based elements have been included in the analysis, to the maximum extent possible.

### 4.1.2 Stormwater Flooding

Since flood protection improvements along the shoreline would only address coastal flooding from the Bay, separate improvements would be necessary to address stormwater conveyance. Options including green infrastructure (detention basins) and grey infrastructure (conveyance improvements with enhanced pumping capacities) have been considered.

### 4.1.3 Groundwater Flooding

Currently there are several low elevation areas that pond during significant rainfall events, due to a combination of inadequate stormwater conveyance as well as high groundwater table elevation. With future sea level rise, and resulting increase in groundwater elevations, the frequency of flooding will be exacerbated in these low elevation areas. Options, including enhanced stormwater conveyance as well as raising grades have been considered.

A detailed evaluation of each of the above flood source is included in the next section and a Summary of Alternatives developed as part of this study is included in Appendix B (Coastal Flood Protection Alternatives Development).

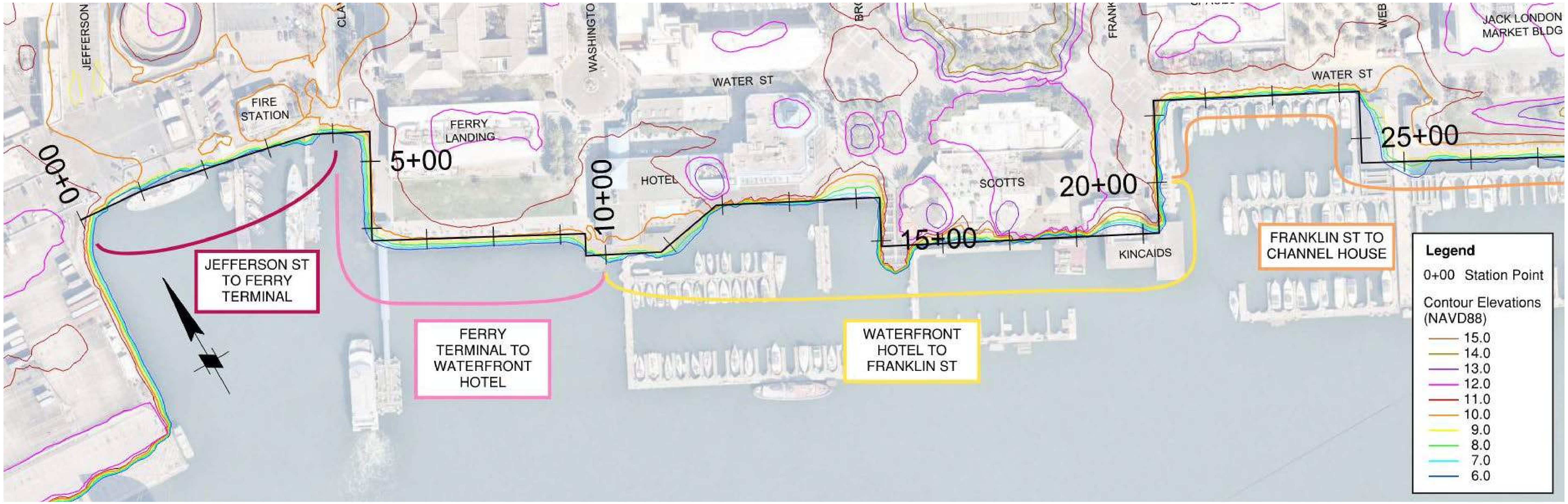



Figure 4-1: Oakland Shoreline (Plate 1 of 3)

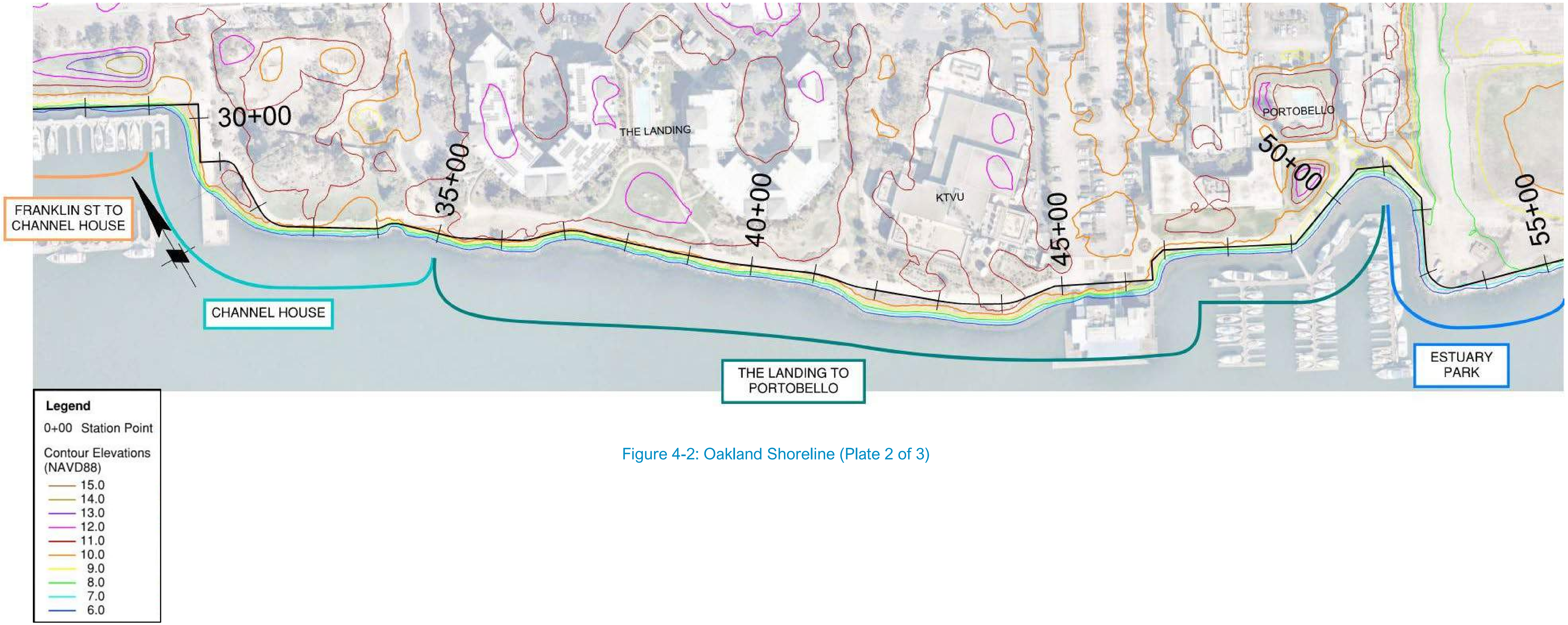



Figure 4-2: Oakland Shoreline (Plate 2 of 3)

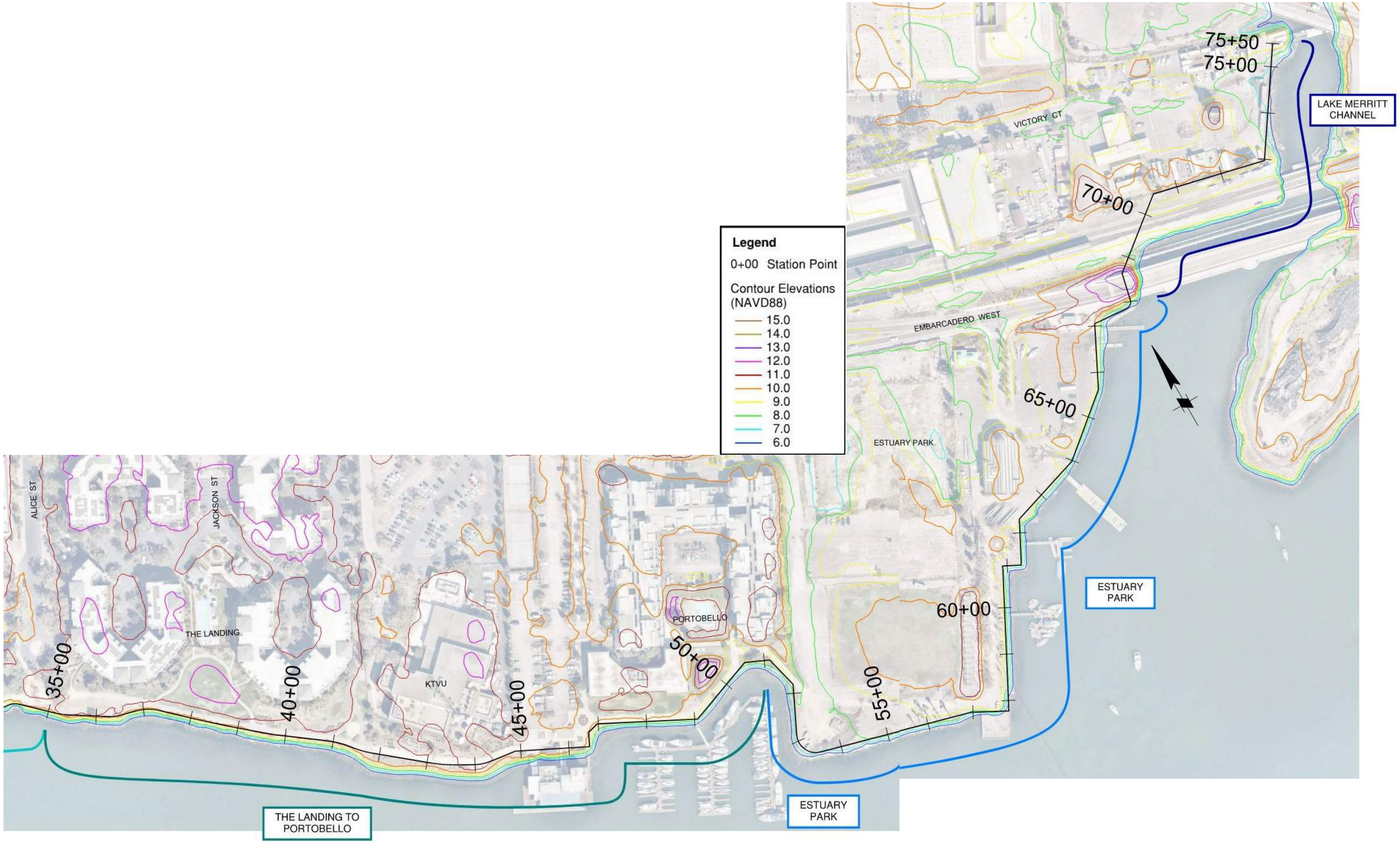



Figure 4-3: Oakland Shoreline (Plate 3 of 3)

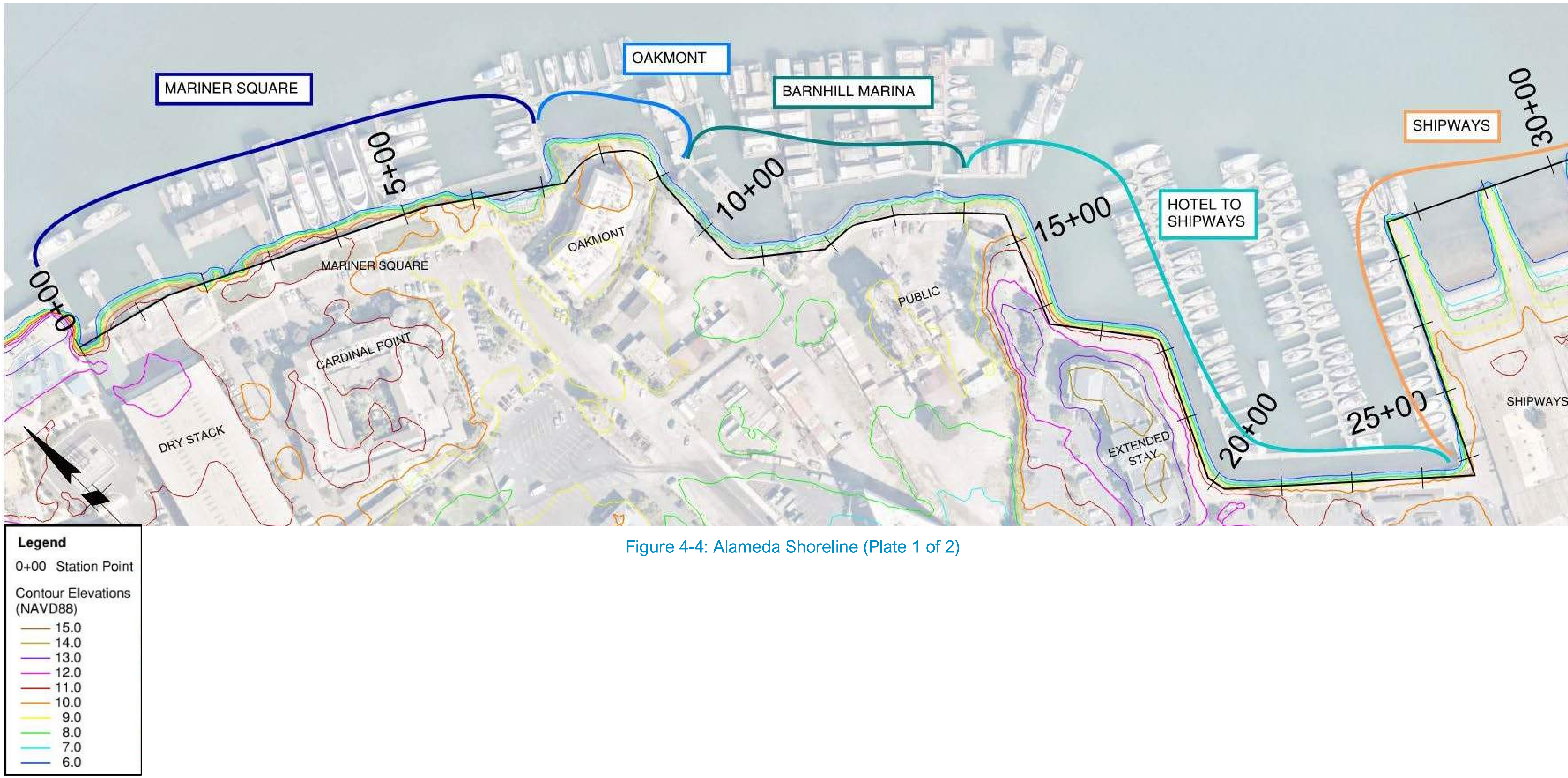



Figure 4-4: Alameda Shoreline (Plate 1 of 2)


Figure 4-5: Alameda Shoreline (Plate 2 of 2)

## 4.2 Coastal Flood Protection

### 4.2.1 Location and Alignment of Coastal Flood Protection Improvements

Given that most of the project reaches have urban developments or recreational access trails of one form or another up to the shoreline, the primary factors that influence the location and alignment of the flood protection feature include:

- Available setback (distance) between the shoreline edge and shore-adjacent land uses
- Type and condition of shoreline structure
- Environmental and Regulatory constraints (minimize filling of the Bay)

It should be noted that adaptation planning for the Jack London Square neighborhood is being undertaken by the Port of Oakland under a separate study. Development plans for Estuary Park are also undergoing redesign at this time by the City of Oakland. The intent of the adaptation concepts proposed as part of this study is to tie into the improvements resulting from these other efforts to provide a continuous level of protection. OAAC Adapt will continue to coordinate with the Port and City of Oakland to ensure that a consistent level of coastal protection and standard of public realm quality is achieved along this stretch of shoreline.

### 4.2.2 Crest Elevation of Coastal Flood Protection Improvements

The primary goals of the coastal flood mitigations are to protect communities in the project area from flooding due to extreme high Bay water levels now and into the future. There is also a strong desire to build improvements to be compliant with the requirements of the National Flood Insurance Program such that the areas would be federally insured. Therefore, the crest elevation is based on a combination of the following:

#### a) Bay Water Levels

The 1% Annual Exceedance Probability (AEP) water level is typically used as a design standard for coastal flood protection. The 1% AEP is an elevation that has a 1% chance of occurring in any given year (sometimes referred to as the 100-year return period water level). It could be the result of tides and storm surge only (known as Stillwater Level, SWL) or the result of tides, storm surge and waves (known as Total Water Level, TWL)

#### b) Sea Level Rise

Allowance for sea level rise based on best available science. A 2-ft projection has been used for near-term improvements (35- to 50-yr life span) and an additional 3-ft has been used for long-term improvements (total of 5-ft through 2100 and beyond).

#### c) FEMA Compliance (where applicable)

If an area is subject to coastal or stormwater induced flooding under what FEMA defines as a *Base Flood Event* (event that has a 1% probability of occurrence in any given year), it is marked as a

Special Flood Hazard Area (SFHA) on insurance rate maps. Communities in these flood-prone areas would typically be subject to purchase of mandatory flood insurance by the applicable jurisdiction (City or County). To protect itself from the Base Flood and not be subject to mandatory flood insurance, a community could implement flood protection measures that are acceptable to FEMA. The Code of Federal Regulations (CFR) 65.10 describes minimum required criteria for such as coastal flood protection system. The criterion specific to crest elevation is Freeboard, which has to be a minimum of 2-ft above SWL or 1-ft above TWL, whichever results in a higher crest.

Resulting minimum crest elevations for the coastal flood improvements are presented in Table 4-1. The table includes three scenarios:

- *Near-Term Strategies*, implemented over the next 3 to 10 years that would provide flood protection for 2' of SLR or a planning horizon of 2060-2075
- *Long-Term Strategies*, implemented over the next 10 to 30 years that would provide flood protection for 5' of SLR or up to 2100 (and possibly beyond)
- *Immediate Strategies* that should be implemented over the next 3 years or so to respond to present-day flooding and 1' of SLR, through about 2050. This scenario applies specifically to project reaches where near-term strategies cannot be implemented in time to address coastal flooding.

Table 4-1: Coastal Flood Protection Improvements

| Scenario ( | 1% AEP (SWL or TWL) | SLR Projection | Levee Freeboard [2] | Levee Crest Elevation [2] |
|---|---|---|---|---|
| Near-Term Strategies (2060-2075) | +9.6' to +10.3' | 2' | Max of 2' above SWL or 1' above TWL | +14' |
| Long-Term Strategies (≥ 2100) | | 5' | | +17' |
| Immediate Strategies (approx. 2050)[1] | | 1' | | +12.5' |

[1] Reaches where near-term improvements cannot be implemented in time to address coastal flooding

[2] Reaches where flood protection levees are necessary

## 4.3 Stormwater Management

Stormwater flooding is caused by inadequate conveyance during extreme precipitation and/or high bay water levels, undersized and/or aging infrastructure, and 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). In order to address these increased flood hazards with potential stormwater management improvements, existing storm drain system capacities were analyzed at a conceptual level for areas where prior studies existed.

The 2008 City of Alameda Storm Drain Master Plan (SDMP) included an analysis for the sub-watershed included within the Near-Term study area. Therefore, as part of developing near-term concepts, the prior analysis was paired with higher future rainfall projections to assess future flood hazards and identify a range of potential flood mitigation strategies.

The City of Oakland is in the process of developing a Storm Drain Master Plan. Once that is complete, a similar study of existing conditions and potential stormwater flood mitigation measures for future higher storm intensities should be performed for the area of Oakland included in the Oakland Alameda Estuary Project.

### 4.3.1 Existing Conditions

The City of Alameda Storm Drain Master Plan (SDMP) was prepared in August 2008 and utilized the 10-year storm event as the basis of design for all improvements. The basic objectives of the master plan were to evaluate existing stormwater drainage conveyance, storage and pumping facilities, and identify capital improvements needed to provide a level of flood protection consistent with the policies of the Federal Emergency Management Agency (FEMA) as administered through the National Flood Insurance Program (NFIP) and City policies, which uses a 100-year design storm target. Recommended improvements to the storm drain network were also summarized in the Storm Drain Master Plan.

Design targets utilized in the SDMP are summarized below.

- Current City of Alameda design storm target: 10-yr rainfall event over a 24-hr period
- Current FEMA design storm target, Alameda: 100-yr rainfall event over a 24-hr period
    - Current drainage system capacity:
        - Pipes – 10-yr rainfall event peak
        - Pumps – 100-yr rainfall event over a 24-hr period
        - Subsurface & surface storage areas: 100-yr rainfall event over a 24-hr period
- Sub-watershed delineation for management strategy: Watersheds are delineated by the pump station or outfall they drain to, and by pipe connectivity.
- Effects of polder condition created by coastal adaptations: Interior drainage will either need to be pumped or re-routed if the coastal adaptation or rising sea levels will prevent existing outfalls from draining effectively.
- Current design criteria for groundwater level: The Alameda Countywide Clean Water Program, C.3 Stormwater Technical Guidance includes design considerations for groundwater for specific treatment measures. For example:
    - For extended detention basins, if there is less than 5-foot separation between the bottom of the facility and the seasonal high groundwater level, or infiltration is not allowed due to other site constraints, an impermeable liner should be placed at the bottom of the facility
    - Additionally, infiltration of stormwater into the ground is not appropriate where there is risk of contamination (e.g. industrial sites, fill sites), or steep slopes, and pretreatment is typically required to maintain the infiltration capacity of the facility, reduce maintenance, and protect groundwater quality.

Flooding depths under a 10-year storm, for the Alameda Northside area included in the SDMP, are shown on Figure 4-6 . Prioritized improvements that would be required to alleviate or minimize flooding for this area, per the SDMP, are shown in Figure 4-7. They include a combination of pipe and pump station capacity improvements.

Per the SDMP, a key component of improving this system is a new 72-inch pipe tying into an existing outfall to San Francisco Bay. This replaced outfall would reduce the demand on the Marina Village Pump Station. The existing system along Ralph Appezzato Parkway would be disconnected near College Avenue, which would then prevent reverse flows in the system. Another disconnect in the system would occur along the railroad easement near Chapin Street, which would isolate the area draining to the Arbor Pump Station. These disconnects would allow the system to operate more effectively and minimize the need for pump station improvements.

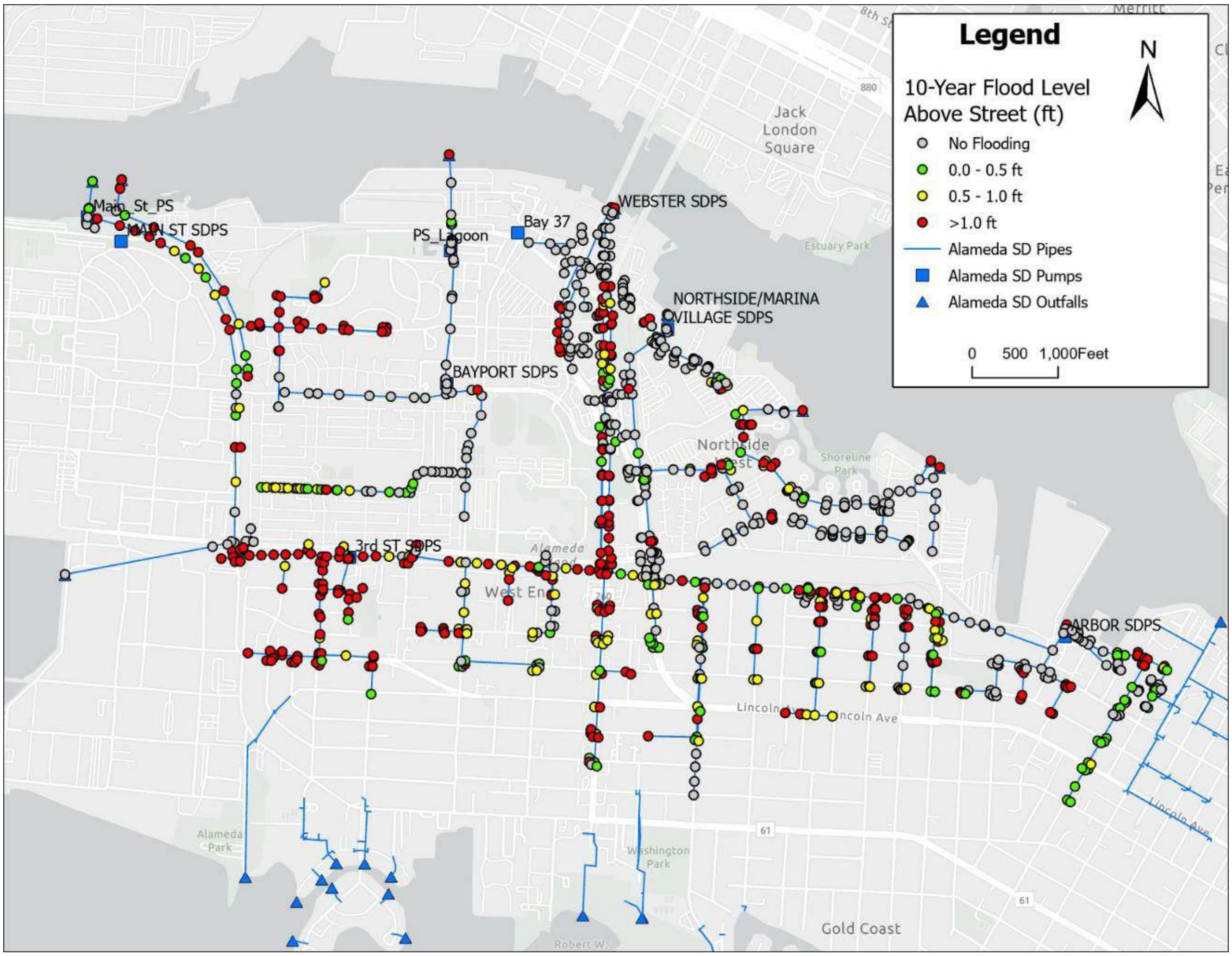



Figure 4-6. City of Alameda (Alameda Island) Existing 10-Year Flooding Depths

Source: (City of Alameda 2008)

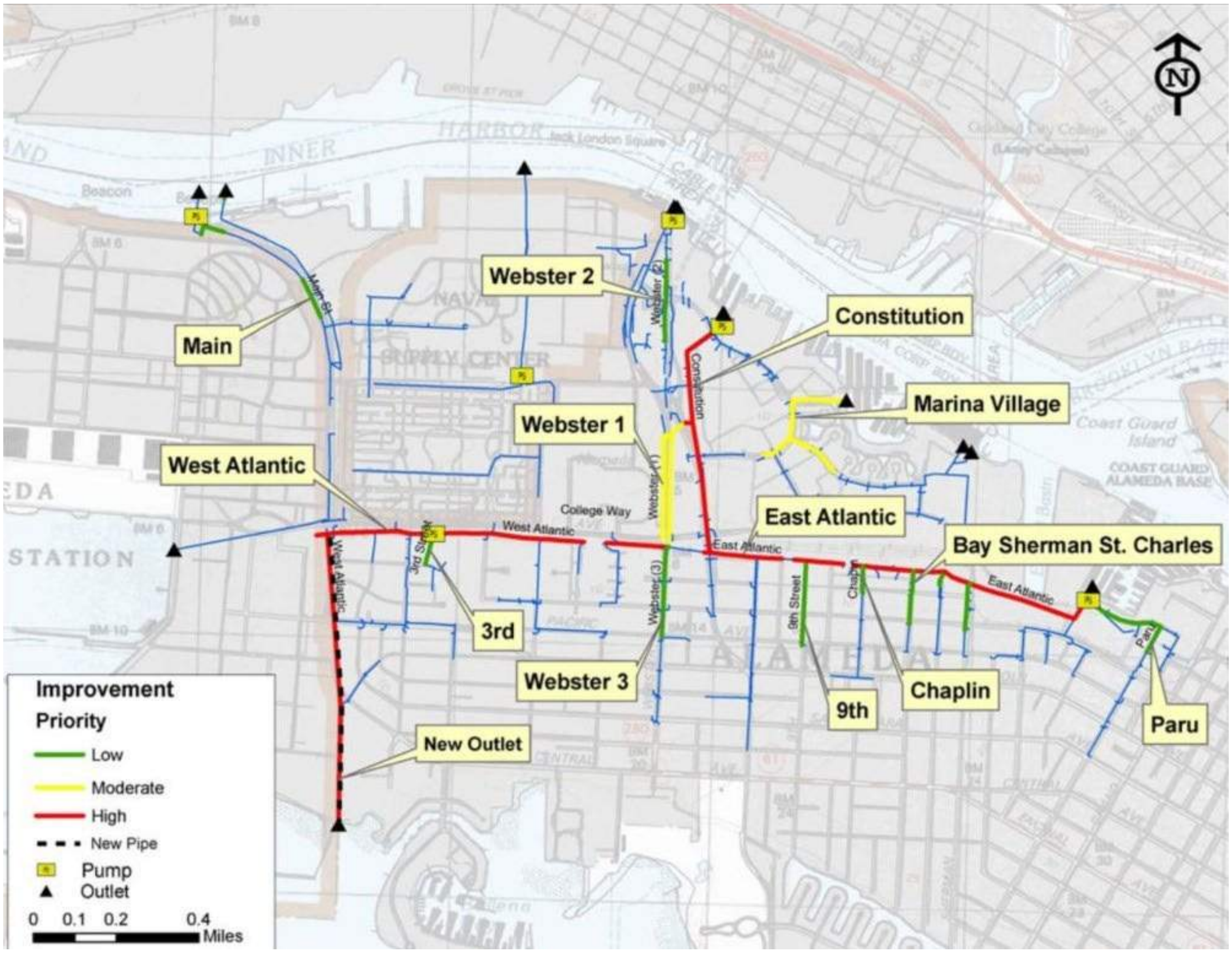



Figure 4-7. City of Alameda (Alameda Island) Existing 10-Year Flooding Depths

Source: (City of Alameda 2008)

The Northside area is served by two pump stations: Webster Street Pump Station and the Northside (Marina Village) Pump Station. The Webster Street Pump Station, located at the northern limit of the Northside sub-area, was constructed in 1947 and has a design capacity of 5,250 gallons per minute (gpm). The pump station consists of three pumps which are controlled by simple pump level controls (bubblers), although only two of the pumps were currently in service at the time the SDMP was prepared in 2008. The pumps are run by electric motors with no backup power supply. There is no trash rack at this pump station. Given the layout of the pump station and surrounding area, construction of a trash rack at this pump station may be unfeasible. The pump station is equipped with a flap gate to prevent backflow into the station. Although located very near the Northside (Marina Village) pump station, Webster Street pump station is not connected by storm drain lines to any other pump stations. At the time of the pump station inspection, there was a noticeable amount of sediment/silt build-up in the wet well. The high priority improvement recommended for this pump station during development of the SDMP was to add on-site standby power generator with automatic transfer switch, while the medium priority improvement recommended for this pump station was to install a self-cleaning trash rack, if feasible.

The Northside (Marina Village) pump station is located at the northern end of the Northside sub-area, just southeast of the Webster Street pump station. The station was constructed in 1984 and has a design capacity of 72,000 GPM. The pump station consists of three pumps which are controlled by simple pump level controls (bubblers). The pumps are run by electric motors with no backup power supply. However, the original station design allows space for a future generator in its own room. Since 1984, tightening emissions standards have tended to increase the size of engine-generator sets. This pump station is equipped with a self-cleaning inlet trash rack and a flap gate that protects the pump station from backflow. The No. 2 pump motor has been recently re-worked, and the No. 3 motor is due for re-working. The high priority improvement recommended for this pump station during development of the SDMP was to install on-site standby power generator with automatic transfer switch, while the medium priority improvement recommended for this pump station was to replace the grating above the vault, which is corroded and deteriorating to install a self-cleaning trash rack, if feasible.

### 4.3.2 Current and Future Rainfall Intensities

A recent study of rainfall intensities for the SF Bay Area suggests an increase in the future due to climate change (Mak et. al. 2023). The study indicates that the 100-year, 24-hour event is projected to increase by about 22% by 2050 and by about 51% by 100. Although these projections have not been adopted by the City or the County, it would be prudent to use these for planning purposes given that other agencies in the SF Bay Area are considering using them (San Francisco in particular). The projections are shown on Table 4-2.

Table 4-2: Projected Changes in Future Rainfall Intensity

| Year | 100-yr, 24-hr |
|---|---|
| 2050 | 22.1% |
| 2060 | 26.8% |
| 2070 | 31.2% |
| 2080 | 36.6% |
| 2090 | 43.7% |
| 2100 | 51.0% |

### 4.3.3 Example Detention Basin Concept to Address Future Flooding, Alameda

As a test case, based on the 2008 SDMP, conceptual locations for detention basins were evaluated to address stormwater flooding and to maintain existing demands on the City's pump stations. The model utilized in the SDMP was converted to MIKE+ and modified to utilize the 100-year, 24-hour event (instead of the 10-year, 24-hour event) to evaluate a subset of the Northside sub watershed area, which is interconnected. The objective was to determine the total water volume above ground (stormwater flooding) for the 100-year, 24-hour event (5.83"). The total water volume above ground was approximately 37 acre-feet in the approximately 800-acre area as shown in Figure 4-8. Therefore, this volume was targeted to mitigate flooding from the 100-year, 24-hour event.

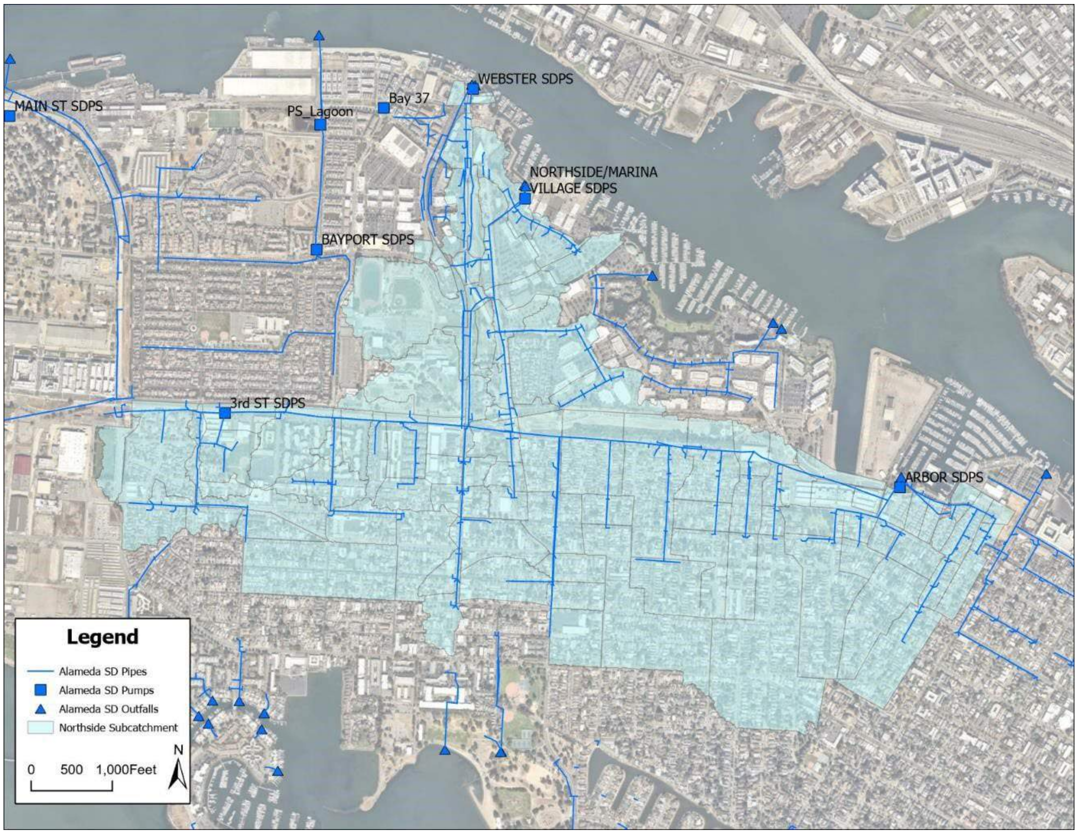



Figure 4-8. Subset of the Northside Sub-Watershed

Subsequently, potential detention areas were chosen based on available open space (absence of buildings or water and sewer infrastructure), ground elevation in relation to the stormwater network (namely lower-lying areas that would require less excavation to convey stormwater from the main to the location), and congruity with the planned future use of the site. The following design criteria were used to evaluate the feasibility of proposed detention areas:

- Property ownership
- Property size
- Excavation depth - the top surface where the basin is proposed must be lower than the ground elevation of the stormwater main, which was estimated as the rim elevation of the closest node or catch basin based on the 2008 stormwater model
- Target storage depth - the depth of the basin must be less than the depth of the stormwater main based on the 2008 stormwater model (to allow for positive drainage from an underdrain back to the stormwater main, assuming the basins would have a low infiltration rate or would require a liner due to high groundwater levels)

- A minimum soil depth of 18", stone depth of 1', with the remaining storage volume to be stored as ponded water on the surface
- Porosity values of 1 were assumed for ponded water, 0.2 for soil, and 0.40 for stone.

Basin parameters, including acreage, storage volumes, approximate ground elevations of the location, stormwater main ground elevations and inverts, and excavation depths are shown in Appendix C.

The general concept for the detention basins is to divert water from the stormwater main during high flows utilizing a water level control structure (for example, and inlet with an internal weir), convey it to the surface of the detention basin via a bubble-up device, where it will be filtered through a minimum of 18" of soil before reaching an underlying layer of stone. The detention basin would also have an overflow device set, for example, 1' to 2' above the top of soil to allow ponding on the surface. Once water reaches the level of the overflow device, it could enter the stone layer through the underdrain, which would function as a distribution pipe in this case (water could also enter the overflow structure from the underdrain). Once the capacity of the detention system has been reached, water would return to the stormwater main through a metered connection (e.g. a pipe with a slow-flow orifice); this pipe would also have a backflow preventer to prevent water from the main backing up in the detention basin. If the detention basin requires an underdrain due to poor infiltration rates, the bottom of the system must be higher than the stormwater main invert to allow for positive drainage from the detention basin back to the stormwater main. A schematic of this concept is shown in Figure 4-9; this would be primarily to detain flood volumes. If the detention systems will be designed to meet C3 requirements for treatment, they should capture the first-flush from adjacent drainage areas and not just overflow volumes. In Figure 4-9, the area below the pipe on the side draining to the detention basin in the water level control structure is shown as filled with concrete so that the excavation for that pipe can be shallower.

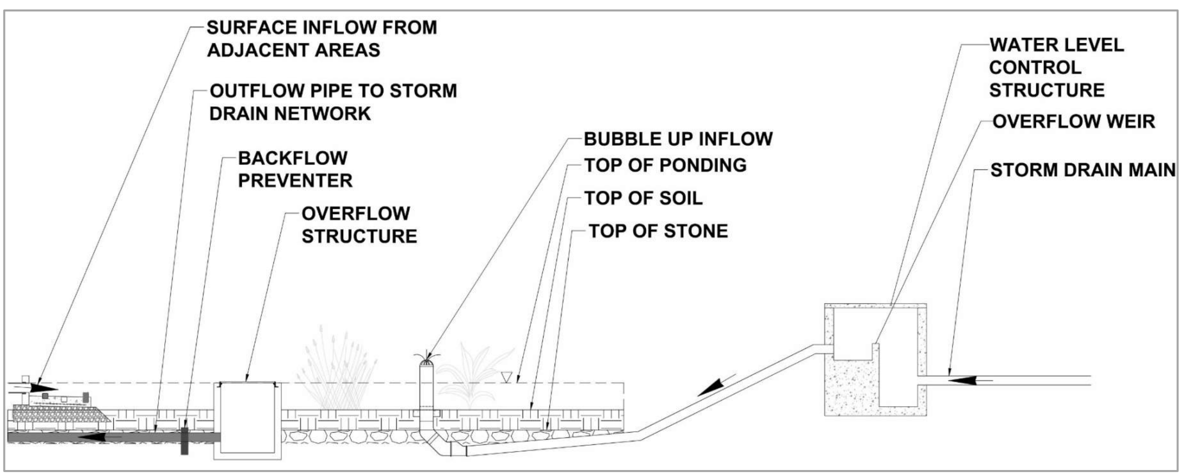



Figure 4-9: Conceptual Green Basin Schematic

### 4.3.4 Water Quality Management Criteria

All improvements will need to meet the National Pollutant Discharge Elimination System (NPDES) Municipal Regional Permit (MRP) in effect at the time of development, including requirements for low-impact development (LID) and trash capture. The City of Alameda Green Infrastructure Plan guides the identification, implementation, tracking, and reporting of green infrastructure (GI) in accordance with the MRP.

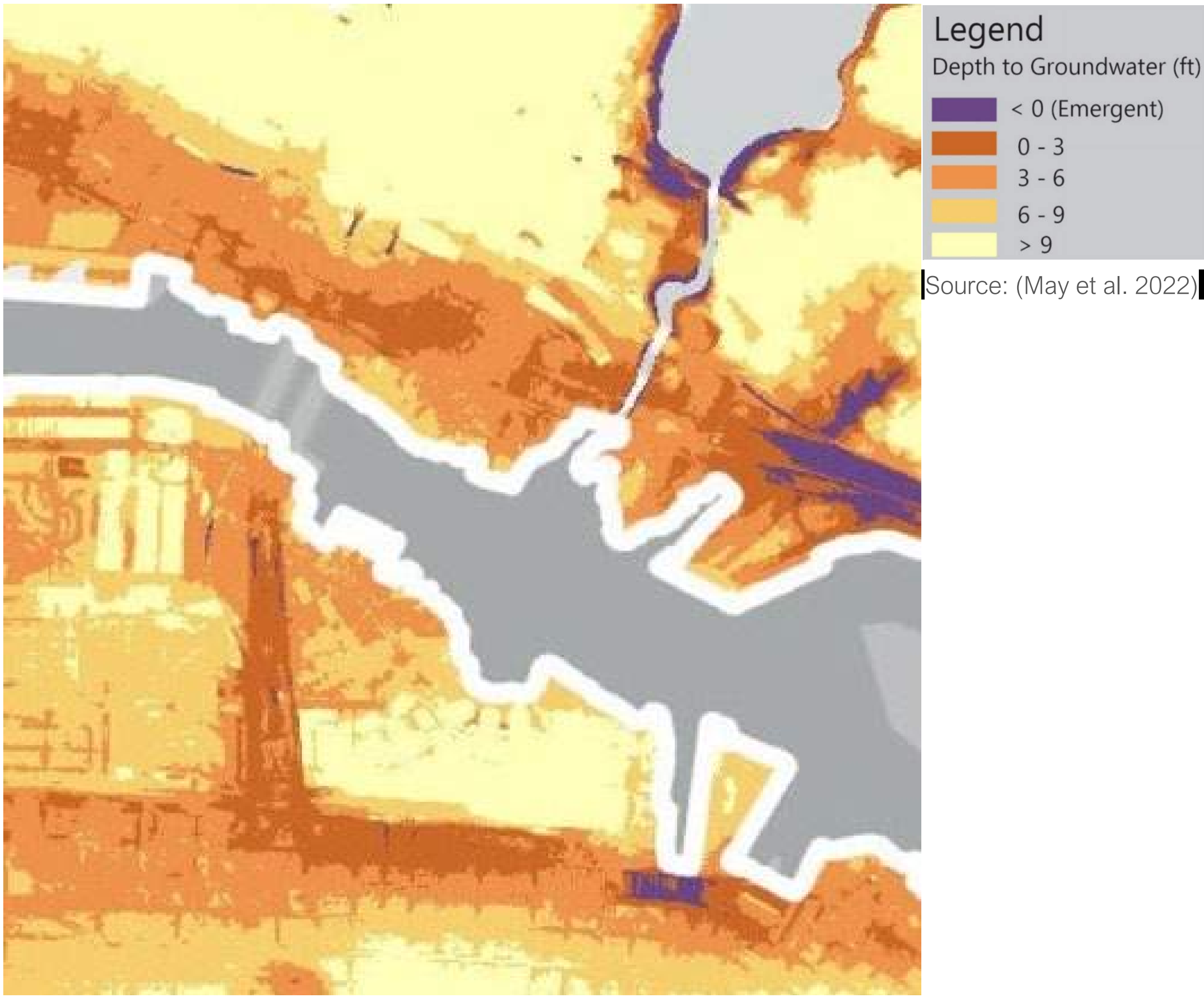
Lining may be required for detention systems where infiltration is not appropriate due to the risk of contamination (e.g. industrial or fill sites with a history of contamination). Pretreatment in detention basins is typically required to maintain the infiltration capacity of the facility, reduce maintenance, and, for infiltrating systems, to protect groundwater quality. If infiltration (no lining) is proposed, to avoid regulation as a Class V injection well, the depth of any trench proposed for infiltration should maintain the required separation from seasonal high groundwater and the depth should be less than the widest surface dimension. For example, stormwater drainage wells (but typically not detention basins since they are wider than they are deep) would be regulated as Class V injection wells per NPDES regulations, under the Safe Drinking Water Act (SDWA) for the Underground Injection Control (UIC) program.

## 4.4 Groundwater Rise Flooding

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). 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). Based on these studies, the current depths to groundwater, and projected depths to groundwater (below the ground surface) with 24-inches and 36-inches of sea level rise, are shown in ,  and .

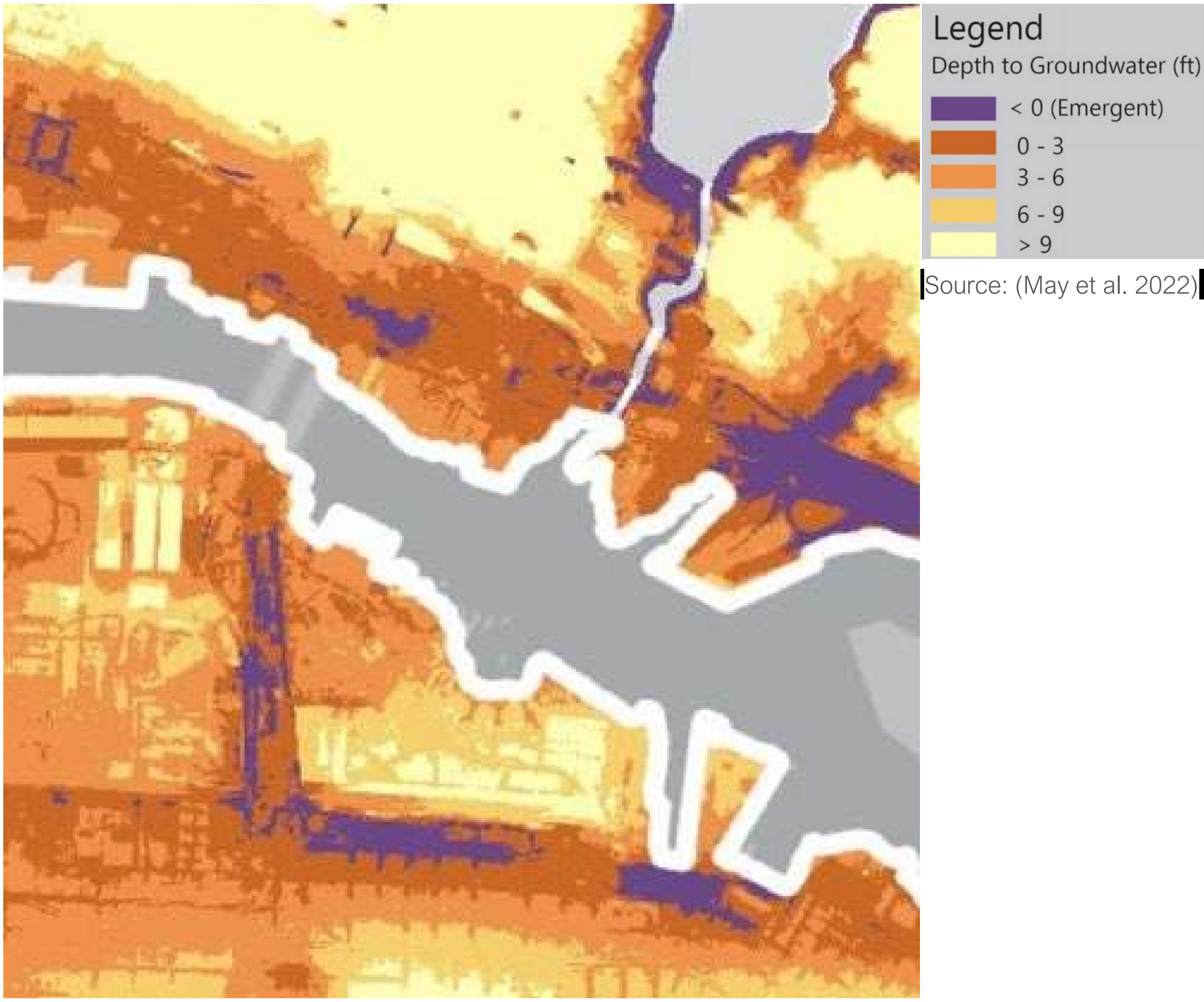
When the groundwater table reaches the ground surface (e.g., depth to groundwater equals 0 feet), groundwater is considered emergent and may present as ponded water on the ground surface. During precipitation events, the groundwater table also rises as precipitation infiltrates the ground surface. During 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). 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). High groundwater will also reduce the capacity of the detention systems. Pumping rates will also need to increase with rising groundwater. If modular storage units are sited in detention areas with high groundwater, buoyancy calculations will need to be performed to ensure they will not float. Naturally present Bay mud may act as an infiltration-limiting layer between the basins and groundwater table, but as sea levels rise, rising groundwater is anticipated to eventually penetrate the layer. For certain areas, lining of basins could be considered.

If there are known contaminants in the upper surface of soils, there may be a potential for increased risk of mobilizing these contaminants with a rise in groundwater elevation. When considering construction of both detention basins and shoreline adaptation interventions, mobilization of these contaminants would have to be addressed either through removal or isolation as appropriate for the location and type of contaminant. Any imported soil will also have to comply with the requirements for general fill as specified by the Regional Water Quality Control Board.



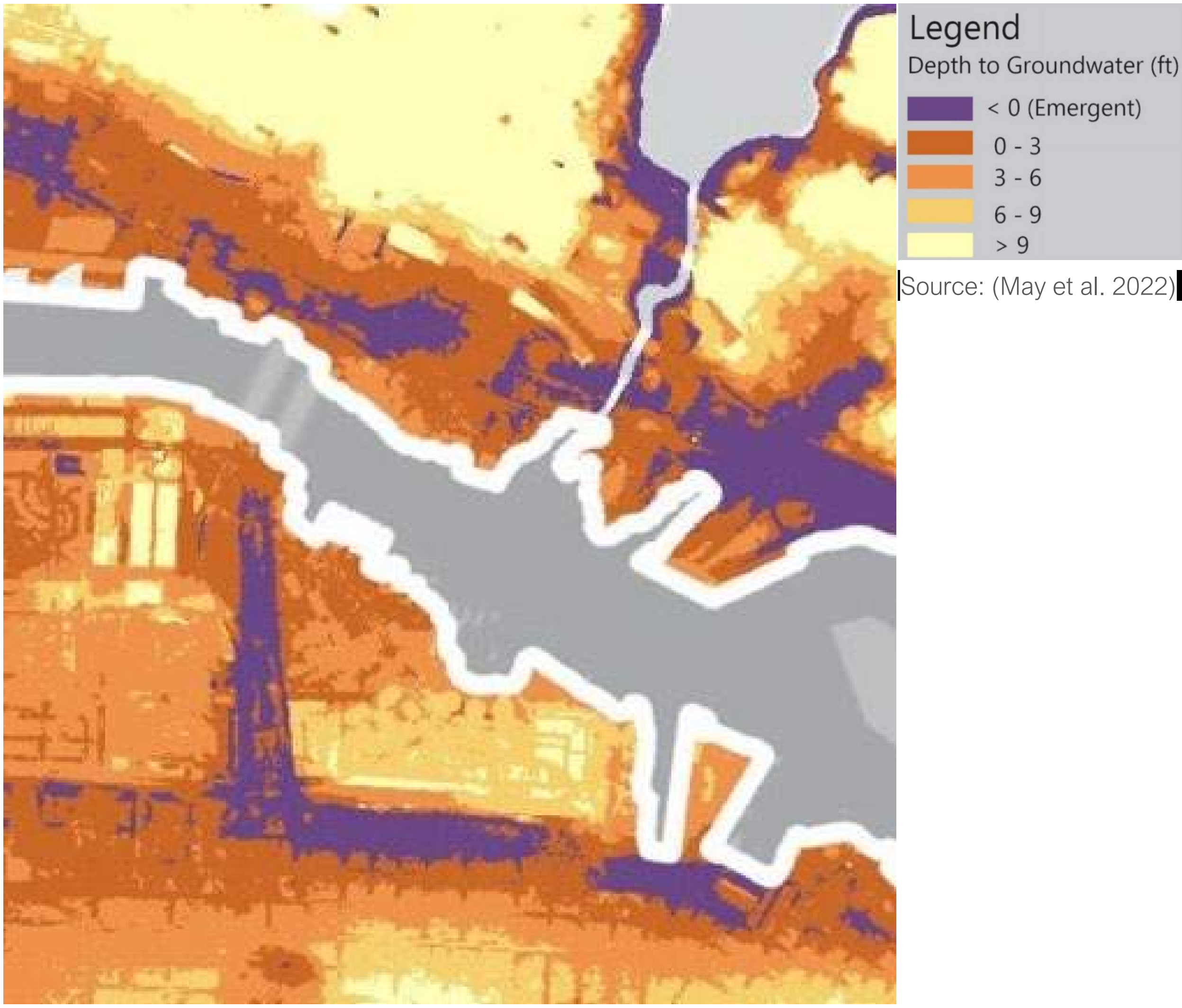

Source: (May et al. 2022) [redacted]

Figure 4-10. Depth to Groundwater (Current Wet-Winter Conditions)




Source: (May et al. 2022) [redacted]

Figure 4-11. Groundwater with 24” Sea Level Rise (Wet-Winter Conditions)




Source: (May et al. 2022) [redacted]

Figure 4-12. Groundwater with 36” Sea Level Rise

## 4.5 Nature Based Shoreline Protection Opportunities

Nature-based approaches are space-constrained within the project area along both sides of the estuary, but some opportunities do exist to incorporate these approaches into future flood protection projects. The goal would be to build in potential to improve the ecological value of raised shoreline segments (both in areas proposing a raised levee and areas proposing a sea wall). A series of sketches are provided in Appendix D that identify type and potential locations for nature-based approaches. Overall, the opportunities fall into a few categories:

- Ecological enhancements to armored shorelines: Armored segments of shoreline could be improved with minor fill placement and plantings. This is an experimental treatment that draws from examples of vegetation growing in cobbles and armor shorelines in Central San Francisco Bay. Some examples exist locally at the southern end of the Marina Village Yacht Harbor Shoreline Park and at the Ballena Bay shoreline in Alameda. This approach should be initiated in small pilot sites using different plant palettes, fill material, and elevations, and expanded over time based on lessons learned.

- **Ecological improvements to sea walls:** where new seawalls or improvements to existing seawalls are proposed, the design could include wall panels that include pre-cast roughness elements at intertidal and sub tidal elevations. This would allow for colonization by aquatic species (oysters, mussels, other invertebrates), which have food web benefits for fish and other species. New seawalls with integrated roughness elements are presumed to have higher likelihood of success, whereas panels added to existing walls are presumed to have lower likelihood of success, since they have a risk of detaching during storms. The design of these elements will learn from the results of the San Francisco Living Seawall Project, and may be refined over time.
- **Shoreline slope improvements:** In several locations along the Oakland shoreline (Estuary Park, the small park near KTVU, the shoreline adjacent to Victory Court and the Laney College parking lot) and Alameda (adjacent to the Marina Village Yacht Harbor), there are areas with space to lay back the existing armored shoreline. In these areas, there is potential to replace the existing armored shoreline with pocket gravel beaches and upland vegetation, or for high tidal benches.

For the reaches shown in the evaluation matrix, ecological net benefits were assumed where the shoreline would be raised in place, in places where opportunities existed to improve the habitat of existing or proposed armor or seawalls. The exception to this was in places where habitat panels were assumed to be additive features (i.e. not pre-cast as part of a new wall structure), since these are less likely to remain in place during storms. These cases were identified as having the need for more study. Also, in places where new seawalls would be constructed bay ward of the existing shoreline edge, the potential habitat impacts from the larger footprint of the structure on existing mudflats may not be balanced by the habitat gains from roughness elements added to the walls. Areas with slope improvements are assumed to have a net benefit since they offer space for a range of habitats. Additional experimental approaches (tide gate at Lake Merritt Channel, restoration of the inlets of the Shipways terminal) are assumed to require further study but could potentially have a benefit.

## 4.6 Public Realm Opportunities

The waterfronts of the Oakland-Alameda Estuary are important public assets, used by residents and visitors every day as places of recreation, exercise, respite and connectivity. The public realm is where people gather and explore when they come to the waterfront, whether biking along the Bay Trail, visiting the Jack London Square farmer's market, or spending time at one of the Estuary's waterfront parks. Many of these areas are vulnerable to flood hazards. Future damage could render parts of the waterfront inaccessible, impact its aesthetic quality, and reduce its function.

For much of the Alameda-Oakland Estuary, the construction of flood defenses will occur within the public realm along the shoreline, transforming our waterfront public spaces. While adaptation is first driven by a need to protect our communities, it is also an opportunity to provide public realm improvements, while also protecting the character and diversity of our existing public shoreline. An adapted shoreline should also support a high-quality public realm, including generous and continuous pedestrian spaces that are accessible for all ages and abilities, active edges that connect to commercial area, regular access to open space, views of the water and waterfront activities, and clear wayfinding between different zones. With these public realm goals in mind, adaptation alternatives development undertaken during this phase of work was informed by the considerations described below.

### 4.6.1 Project Considerations

Development of conceptual alternatives/options for shoreline adaptation are guided by OAAC planning principles, as well as BCDC's One Bay Vision. Alternatives adhere to established standards for accessibility set forth by the Americans with Disabilities Act, Bay Trail Design Guidance, and any other locally applicable design standards.

A detailed summary of Adaptation Alternative public realm impacts and opportunities are provided in the Adaptation Alternatives Evaluation Matrix in Appendix E. Adaptation alternatives for the project area include proposals for flood protection of varying forms including levees, vegetated berms, and floodwalls. The location and height of these structures relative to the existing shoreline varies depending on current shoreline elevations and land use.

The design and placement of flood defense structures should take into account the following high level public realm considerations:

- Construction of flood defenses should maintain the network and quality of waterfront public open space including but not limited to trails (Bay Trail), parks, plazas, waterfront viewpoints and recreational water access points, and multimodal streetscapes at or near the water's edge. Adaptation may also be an opportunity to increase public open space and improve access.
- The adapted shoreline should strive to be accessible to the widest possible set of users across all ages/abilities, and compliance with Title 24, especially the Americans with Disabilities Act (ADA) should be a significant goal of proposed improvements. In some cases, adaptation may offer opportunities to improve access to parts of the shoreline that were previously inaccessible to certain users.
- Adapted public open spaces should be durable, welcoming, and relate to their adjacent context, preserving the diverse urban form that currently characterizes the shoreline.
- Connectivity between adjacent inland neighborhoods and the waterfront should also be maintained or improved, including wayfinding and bike/pedestrian networks. Waterfront redesign for adaptation purposes may also present opportunities to improve Bay Trail connectivity and improve access to Bay Area Water Trail landing sites.
- Shoreline flood defenses have the potential to create visual barriers to the water, impacting views, urban character, and maritime/recreational waterfront access. The use of tall walls (above 3') should be avoided. Where adjacent land uses allow, a more gradual transition to the design flood elevation is recommended. The use of embankments with slopes 3:1 or flatter, low terraces (under 2.5'), and generous space for multiuse paths is recommended in order to ensure a robust and accessible public shoreline. In some cases, regrading of inland space may be recommended in order to maintain a gradual transition between the adapted shoreline and public space.

- The adapted shoreline should balance ecological improvements with public access and public use with the goal of minimizing potential disturbance to sensitive habitats. Certain public uses – such as providing direct access to the water's edge – should only be explored in areas where such uses do not conflict with potential ecological improvements.

The Oakland-Alameda Estuary is a varied stretch of shoreline with a diversity of public realm experiences and varied urban character on each side of the channel. The proposed alternatives take into account local urban form and character as well as spatial constraints and land use adjacencies. Site specific characteristics that have informed the project team's development and assessment of adaptation alternatives are described below. Opportunities for public realm improvement have also been identified.

### 4.6.2 Alameda Northern Shoreline

The Alameda shoreline within the project area begins at Bohol Circle Park to the north and stretches south to Marina Village and Shoreline Park. Some key public realm considerations are as follows:

- Maintain a gradual transition between the shoreline and inland areas. In some locations, existing shoreline grades are so low as to require substantial elevation to reach the prescribed protection elevation of 14.0. Where feasible, grade inland of proposed levees should be elevated to ensure that inland public space maintains clear visual connections to the waterfront.
- Maintain or improve public realm quality at existing waterfront parks within the project area as well as strong connections to Bohol Circle and Shoreline Park.
- Improve connectivity and wayfinding between the waterfront to inland neighborhoods and parks such as Jean Sweeney Park, West Alameda and Alameda Landing
- Adhere to Bay Trail design standards and look for opportunities to improve shoreline continuity of the Bay Trail. Certain areas of the Bay Trail along this stretch of shoreline are too narrow to meet Bay Trail standards. Proposed alternatives seek to create wider, more generous access along the shoreline. The Bay Trail gap between Shipways and Bohol Circle should also be addressed, including opportunities to align the trail along shoreline where feasible. Consider future opportunities to tie into planned Bay Trail extension at Alameda Point (outside current scope of project).
- Improve waterfront recreational access including access to marinas serving maritime industry, recreational and residential uses, water shuttle, and public maritime facilities. Look for opportunities to allow pedestrians to access the water's edge.
- Incorporate green infrastructure into inland areas. Stormwater detention and treatment may be added to existing parks, lawn areas, and right of ways to manage flooding, improve water quality, and create habitat. The qualities of this green infrastructure can help meet the goals of quality public realm, park programming and ecological performance.
- Other Considerations: Explore opportunities for new climate resilient public open space at future development site where space within a development site can more efficiently integrate climate adaptation measures within a high quality public realm.

### 4.6.3 Oakland Shoreline

The Oakland shoreline within the project area begins at the Jack London Square Ferry Terminal and extends into the Lake Merritt Channel and Channel Park. Adaptation planning for the Jack London Square neighborhood is being undertaken by the Port of Oakland under a separate study. Estuary Park is currently undergoing a redesign and renovation effort. Adaptation concepts proposed will tie into grades at Estuary Park to provide a continuous level of protection. OAAC Adapt will continue to coordinate with the Port and City of Oakland to ensure that a consistent level of coastal protection and standard of public realm quality is achieved along this stretch of shoreline.

Some key public realm considerations for the Oakland shoreline are as follows:

- Invest in long-term thinking in Jack London Square in order to maintain public realm function and neighborhood character. While this area has a relatively low near-term flood risk, long term risk may significantly impact the function of this well-loved waterfront public space. Future adaptation efforts should consider the age and condition of buildings, sea level rise vulnerabilities, ferry access, and the urban connection to downtown Oakland.
- Improve public realm quality along the shoreline from Harrison Street south to Estuary Park including the incorporation of nature-based solutions that include ecological improvements balanced with public access and amenities. In these areas, there is potential to replace the existing armored shoreline with pocket gravel beaches and upland vegetation, or for high tidal benches.
- Preserve current level of Bay Trail connectivity and adhere to Bay Trail design standards in areas where adaptation necessitates reconstruction of Bay Trail. Any realignment of the bay trail should maintain the shoreline configuration and avoid moving the trail inland.
- Improve waterfront recreational access including access to marinas, water shuttle, Ferry and public maritime facilities.
- Improve connectivity between Lake Merritt and the waterfront, including public access along the Lake Merritt Channel. Coordinate with future development per the City of Oakland's Downtown Specific Plan.
- Find opportunities to implement green infrastructure such as stormwater detention. Sites to consider include the Lake Merritt Channel, Webster Street, and Oak Street. Coordinate with guidance provided in the City of Oakland Storm Drain Master Plan.

# 5 Evaluation Criteria and Alternatives Analyses

A set of evaluation criteria were developed to objectively assess the performance of each option/alternative and to compare different options for each shoreline segment. Three groups of criteria were developed to assess a range of issues including performance, implementation, impacts, and community/ stakeholder support as described below.

| EVALUATION CRITERIA | SPECIFIC QUESTION |
|---|---|
| **1. Priority Criteria** | |
| - Coastal Flood Protection | Will the option meet FEMA Accreditation requirements? |
| - Adaptability To Long-Term | Can the option be adapted for higher SLR? |
| - Public Realm | What is the Relative Quality of Public Access and Public Realm? |
| - Environmental Impact | Could the option result in adverse environmental impacts in the near term? Consider future environmental benefits associated with this option. |
| - Implementation Costs | What are the relative implementation costs for the option, as compared to the other options for the shoreline segment? |
| - Timeline | Can this option be implemented by about 2035 for near-term projects? |
| **2. Implementation Criteria** | |
| - Property Access | Can the option be implemented within existing right-of-way and/or ownership? |
| - Regulatory / Permitting | What are the regulatory/permitting risks? (Low, Medium, High) |
| - Administrative/O&M | Can the option be implemented without extensive expansion of existing operational or maintenance capacity? |
| **3. Criteria for Selecting Preferred Alternatives and/or Long-Term Planning** | |
| - Stakeholder Support | Is the option supported by multiple stakeholders? |
| - Community Support | Is the option supported by strong community advocates? |
| - Governance | Can the option be implemented under existing governance authorities or policies? |
| - Financing | Can the option be implemented with existing or expected financing sources? |
| - Development Policy | Can the option be implemented under current development policy? |

## 5.1 Alternatives Analyses

To conduct the alternatives assessment, a specific set of qualitative responses were developed for each evaluation criteria described below. This allowed an objective comparison of options against each criterion.

- Positive: An option achieves the desired objective for the criterion. For example, a positive response for public realm implies the measure creates new public space or enhances existing public space such as widening public trails along the shoreline, offering an opportunity for the construction of a new waterfront park, or filling in a previously identified Bay Trail gap.
- Neutral: An option meets the minimum standard but may accomplish it for a limited time or may not be desirable due to a variety of reasons. For example, a 3-ft high parapet wall may accomplish a short-term goal of flood protection, but it creates a vertical barrier that would need significant modifications in the future when shoreline access areas will need to be raised.
- Negative: An option does not meet the minimum standard for that criterion but is still in the mix because it meets other criteria. An example would be that the proposed option removes a public realm asset or negatively impacts physical or visual access to and/or along the shoreline. An alternative with a negative assessment might include a seawall that creates a high visual barrier or an adaptation measure that requires part of the Bay Trail to be moved inland.

The Adaptation Alternatives Evaluation Matrix in Appendix E includes a preliminary assessment of each option based only on the Priority Evaluation Criteria described above, as a first pass. Many of the potential impacts and benefits described above will be determined in later phases of the design process such as materiality and specific park or trail amenities. Design adherence to codes or regulatory standards will be enforced by the relevant agencies and municipalities.

## 5.2 Design Concepts

The adaptation alternatives that were assessed to most closely meet the Project Charter, Planning Principles and the Priority Evaluation Criteria were further refined into design concepts (10% design). These concepts remain preliminary and will require additional study for suitability, feasibility and cost. A graphic summary of the shoreline adaptation and inland stormwater detention design concepts are provided in Appendix F (Design Concepts).

For all the design concepts, it was assumed that existing boardwalks, marina ramps, gangways, and infrastructure will be adapted to the new shoreline elevations. For all reaches, the proposed pedestrian path was assumed to be a 12'-wide asphalt paved path with 3'-wide shoulders on either side.

Implementation of the concepts will need environmental review (CEQA and possibly NEPA if federal funding is obtained) and will need to comply with all applicable regulatory requirements at the time of construction. Additionally, changes should also be considered to local policies governing planning, redevelopment, infrastructure and construction. Policy recommendations included in the City of Alameda's Climate Action and Resiliency Plan and Climate Adaptation and Hazard Mitigation Plan are examples of the kind of policy changes that would be required.

### 5.2.1 Concepts for Alameda Estuary Northern Shoreline

#### a) Shoreline Improvements – Near Term Strategies

A brief description of the type of shoreline improvement for each reach (see Figure 4-4 and Figure 4-5 for reach definitions) is presented below.

Mariner Square to Oakmont

Beginning at the western end of Mariner Square, a new seawall Bayward of the existing seawall with a top elevation of +14' is recommended. The new seawall would consist of precast concrete sheets, with a texture designed to perform as a living seawall. The primary reasons for this alignment and type of seawall are the condition of the existing deteriorated seawall, space constraints on the landside, and the presence of docks on the waterside. Replacing the existing seawall is not possible, and other types of protection such as rock revetments or levees would result in substantial fill in the Bay and relocation of boat docks.

Oakmont

The existing space between the Oakmont Residential building and the shoreline is narrow, leaving insufficient space for a levee and making a seawall the only feasible measure at this location. In order to provide a quality public realm and views over the seawall, the grade between Oakmont and the seawall could be raised to form overlooks and provide access to the adjacent marina.

Oakmont to Hotel

The seawall will transition to a levee with pedestrian path (crest elevation 14.0) as the shoreline widens just east of Oakmont. Access from adjacent upland areas will be provided by accessible ramps and stairs. The water-side levee slope would be at a maximum of 3:1, armored with riprap that is interplanted with appropriate intertidal plants. At the Barnhill Marina site, approximately 27 existing parking spaces will need to be relocated to provide room for the levee. The shoreline widens at the existing public space just northwest of the Extended Stay America Hotel. Here, the levee slope can be sloped more gradually and the levee shifted inland. The levee slope would be enhanced with rocks and logs to retain sediment and provide additional space for intertidal planting and habitat to take hold. The upland side of the levee would be gradually sloped down to existing grade, providing a new park gathering area raised to the crest elevation of the levee. Upland habitat planting would be provided on the inland side of the levee.

Hotel to Shipways

The levee would narrow again from the hotel to the Shipways site. Access from adjacent upland areas will be provided by accessible ramps and stairs. The water-side levee slope would be at a maximum of 3:1, armored with riprap that is interplanted with appropriate intertidal plants. Within the parking lot between the hotel and Shipways site, approximately 20 existing parking spaces will need to be relocated to provide room for the levee. Access from adjacent upland areas will be provided by sloped walks, accessible ramps and stairs. Upland habitat planting would be provided on the inland side of the levee.

Shipways Site

A separate effort is currently underway to redevelop the Shipways site. Through coordination with the OAAC Estuary Project, the redevelopment plans include raising the shoreline and associated path to elevation 14.0. The Oakland-Alameda Estuary project would coordinate with the Shipways redevelopment to seamlessly connect and integrate grade elevations, pathways alignments and access.

Shipways to Marina Village

The commercial buildings between the Shipways site and Shoreline Park are sited very close to the shoreline – within 10 feet – with surface parking between the buildings and Marina Village Parkway. Based on the age of the buildings and after preliminary conversations with the owners of the commercial properties, it is recommended that the parcels be redeveloped at a higher elevation. Where redevelopment is possible, there is more space to raise grade inland as well as at the shoreline, allowing views of the water to be maintained, opportunity for higher quality public space, access and additional space for intertidal habitat along the water. It also allows for the shoreline to be adapted without the construction and cost of a FEMA-certified levee. In this instance, buildings would be removed, and the parcels filled to raise the shoreline to elevation 14.0 and the interior parcels to elevation 13.0 or 14.0, sloping to meet existing grade at Marina Village Parkway.

New structures would then be located outside of BCDC's 100'-wide shoreline band, providing public access to the shoreline along with the addition of upland and intertidal habitat enhancement. The shoreline access path would continue from Shipways within the shoreline band, connecting the upland redevelopment with the shoreline via sloped walks, accessible ramps and stairs. The upland side of the path would integrate upland habitat planting, seating and other public amenities. Locations of existing marinas and shoreline retaining walls would be maintained, including the existing sheet pile wall at Dock Q. Existing marina access would be adapted to higher shoreline elevations.

Nature-based interventions at the shoreline would be implemented based on the amount of space available to regrade between the existing elevation 6.37 (MHHW) and future elevation 14.0. Where most constrained, the shoreline slope would be at a maximum of 3:1, armored with riprap that is interplanted with appropriate intertidal plants. Where more space is available, the more shallow slope of 10:1 would be enhanced with gravel beach, rocks, and logs to retain sediment and provide additional space for intertidal planting and habitat to take hold. The existing park at Dock Q has a sheet pile retaining wall and low elevation area that is already over-topped by high tides. This area would be regraded and planted to support intertidal plan species and provide at picnic gathering area at the highest elevation.

Marina Village to South End

The project area terminates at Shoreline Park, where the existing grade rises to elevation 12.0 and is less susceptible to coastal flooding in the near-term. At the northwest edge of the park, the proposed regrading of the Marina Village commercial area will be integrated with the park elevations and the existing paths that follow the park shoreline and along the north edge of the park to Marina Village Parkway.

### Immediate Term Strategies

*Emergency Coastal Flood Protection at Barnhill Marina and Marina Village Parkway*

This stretch of the shoreline as shown on Figure 5-1 and Figure 5-2 in Alameda is at it's lowest elevation near the Barnhill Marina and Dock Q. These specific locations are at highest risk of shoreline overtopping, allowing coastal floodwaters to flow to lower inland elevations along Mariner Square Drive and Marina Village Parkway, putting the Posey and Webster Tubes at risk of flooding. Recognizing the time required to construct the shoreline protection measures proposed above, immediate term actions can be taken as a temporary emergency measure to mitigate flooding in these specific areas. These measures would not be permanent solutions nor would they be accredited by FEMA. Generally, these measures would consist of providing flood protection to elevation +10.5' with a 2'-3' tall concrete block wall aligned along the back of sidewalk, tying into adjacent elevations of +10.5' or higher. Where streets, walks and driveways cross the sidewalk, temporary deployable flood protection measures could be provided during flood events.

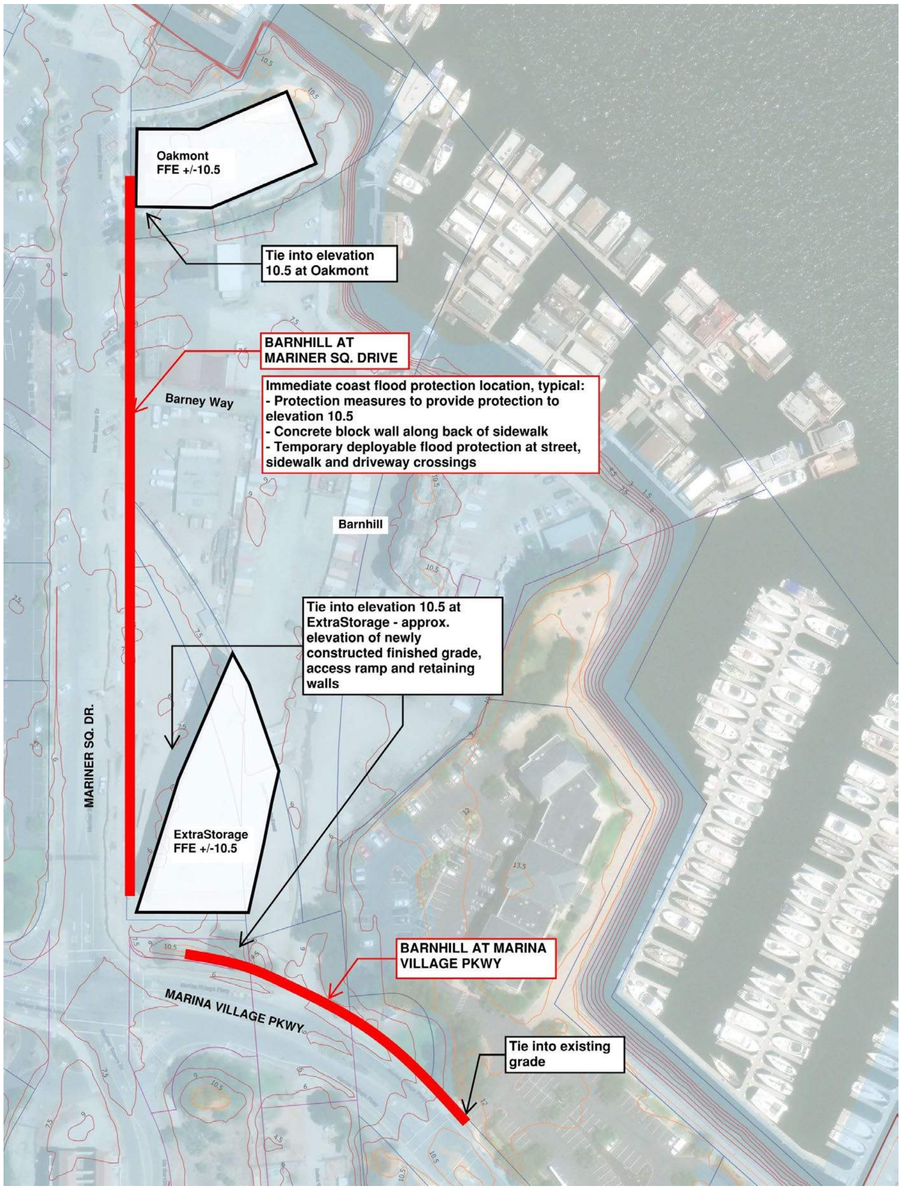



Figure 5-1. Option for Temporary Emergency Coastal Flood Protection at Barnhill Marina

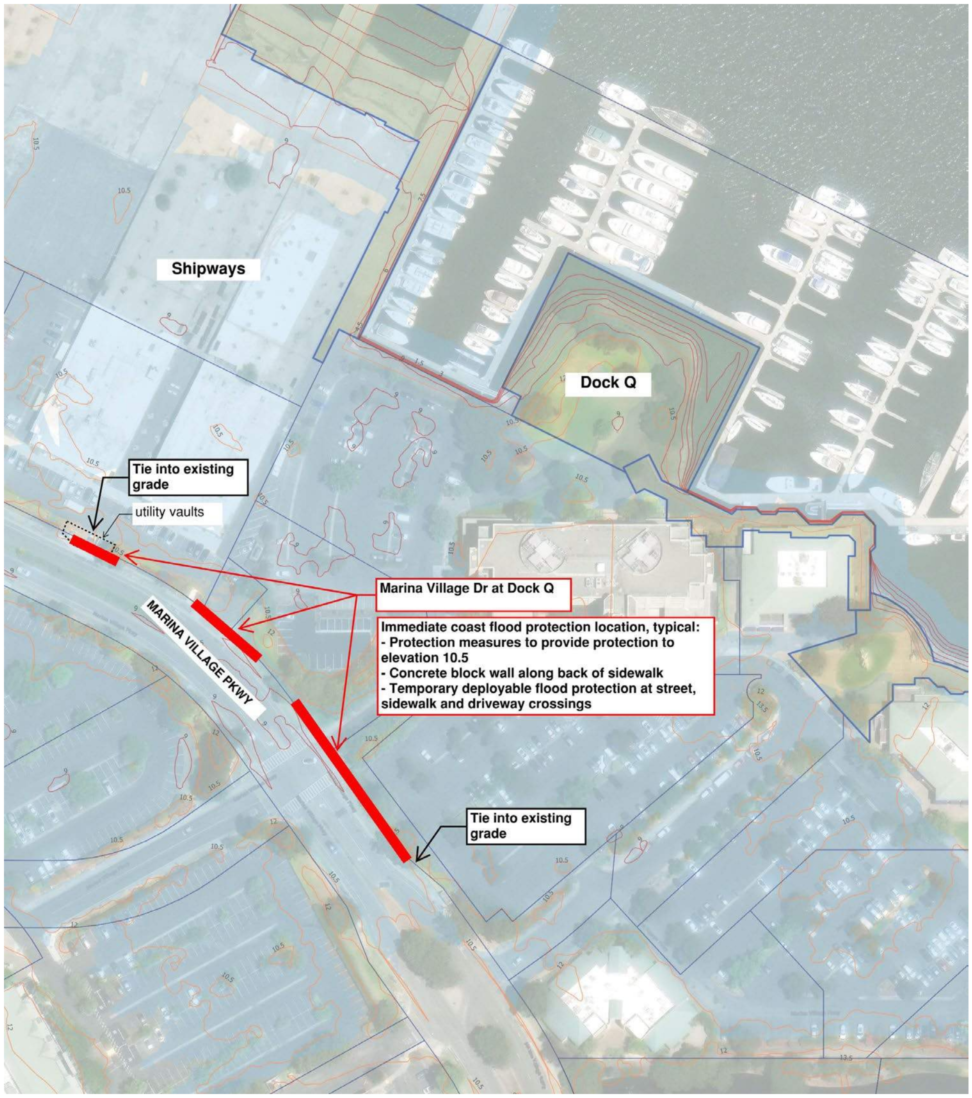



Figure 5-2. Option for Temporary Emergency Coastal Flood Protection at Marina Village Parkway

### b) Alameda Stormwater Detention Areas

As described in Section 4.3.3 and Appendix C, several locations were identified and studied for stormwater detention feasibility, based on land ownership, existing land use (focused on undeveloped areas), and ground elevation in relation to the storm drain network. Refer to Appendix C for details on the conceptual design schematic, potential locations identified and conceptual basin parameters. Refer to Appendix F for additional details for conceptual grading and relationship of the basins to existing conditions and other proposed public space improvements.

All proposed detention basin locations have been analyzed for feasibility at a conceptual level only. Further study of feasibility will be required before confirming the proposed locations and design parameters, including: storm drain elevations, groundwater levels, and location and classifications of existing soil contaminants, and modeling to analyze impacts on the storm drain network.

These detention areas are designed to serve the specific priorities of the public spaces and parks they sit within, whether that is a hard-scaped plaza, a playfield, a garden, or a habitat area within a park (see Appendix F for examples of a variety of large-scale detention gardens in the San Francisco Bay Area). The goals of providing stormwater holding capacity can be synergistic with goals for providing quality public space for humans and habitat benefits for plants, animals and insects. Accompanying interpretive information can educate people about the benefits of detention and the ecology around them.

The largest detention area proposed within this watershed is at Jean Sweeney Park, within the existing open area south of the main path. The proposed vision for the park proposes a natural, forested space with trails for walking and exploration. Through thoughtful grading, path design and plant selection, designing this area for detaining stormwater during heavy storms can be compatible with these park design goals.

Similarly, detention basins at the Neptune Park, Alameda #2 and #3 locations can be designed to provide quality circulation for people through shade trees and habitat gardens.

Partnering with the College of Alameda to build grey or green detention on the campus is an opportunity to take advantage of the available open campus space, improve the campus landscape, as well as potential educational programming partnerships.

In addition to these detention basin locations, the lagoon at Marina Village could provide additional capacity for detention in the storm water system. The HOA currently manages lagoon depths in advance of storm events, but the lagoon is not integrated into the larger Northside SD catchment system. The City could partner with the Marina Village HOA's lagoon management to integrate the lagoon into the larger SD system and utilize the lagoon freeboard to provide additional detention capacity – similar to lagoon management on Bay Farm Island.

### 5.2.2 Concepts for Oakland Estuary Shoreline

A brief description of the type of shoreline improvement for each reach (see Figure 4-1 through Figure 4-3 for reach definitions) is presented below.

#### a) Shoreline Improvements

The Oakland shoreline portion of the Estuary Project area is less susceptible to coastal flooding than the Alameda portion, as the shoreline is at a higher elevation, on average. The areas most at risk of flooding are from Estuary Park up the Lake Merritt Channel to the 7th St Bridge. The elevation of the Union Pacific Rail Bridge and banks of the Channel are particularly low and at risk of coastal flooding.

Jack London Square – Jefferson Street to Alice Street
As described in section 4.6.3, the Port of Oakland's Vulnerability Assessment and Adaptation Plan

is currently studying this portion of the project area in coordination with OAAC. While alternatives for coastal flood protection were considered as part of the project (see Appendix E2), these alternatives were not developed into design concepts.

<u>Oakland (Alice Street to Estuary Park)</u>

Between Alice St and Estuary Park, the design concept expands upon the existing public space at the shoreline, providing additional space for intertidal habitat and maintaining space for people to spend time outside and socialize. A levee with pedestrian path (crest elevation 14.0) is proposed along the shoreline, parallel to the current Bay Trail. Here, the levee slope can be sloped more gradually back from current 6.37 MHHW elevation, and the levee crest and path shifted inland from the current path alignment. The waterside levee slope would be enhanced with rocks and logs to retain sediment and provide additional space for intertidal planting and habitat to take hold. Specific shore areas are flattened to a 10:1 slope to form gravel beaches.

The levee path would include overlooks, seating and other public amenities. The upland side of the levee would be gradually sloped down to existing grade at the existing buildings, providing new gathering areas, like picnic areas, a dog park, and habitat planting. Access from these buildings to the shoreline would be provided via sloped walks, accessible ramps and stairs. Access to the commercial buildings and pier at the former Eve's Waterfront would be provided via accessible ramps and stairs, although coastal flood protection measures for those structures are not being proposed within this design concept. Twelve parking spaces within the parking area between the KTVU and Eve's Waterfront sites would be removed or relocated. The existing path and gate into the Portobello Residential courtyard would need to be relocated. Locations of the existing marinas would be maintained and access would be adapted to higher shoreline elevations.

At each end of this reach, the shoreline levee and path would be integrated with the park elevations and paths within the Port-owned parcel in front of the Channel House to the west and the future design of Estuary Park to the east.

<u>Estuary Park</u>

The Estuary Park Phase 1 and Phase 2 redesign project proposes to elevate the grade of portions of the park to +11.7 and adapting it to higher sea level rise elevations in the future. The JLAC Aquatic Center would also need to be adapted to sea level rise in future planning.

The design concept for this reach of shoreline is to implement the adaptation measures already identified for the Estuary Park project, which is to raise the elevation of protection measures (levees and or mass fill) to at least elevation +12.5. The park will require additional adaptation to higher sea levels to protect inland neighborhoods from coastal flooding along Lake Merritt Channel. That adaptation could include a levee to elevation +14.0 around the perimeter of the park, or raising grade of the entire park to elevation +12.5. In both instances, the grade would need to tie into higher elevations at the Embarcadero Bridge.

Lake Merritt Channel

Two adaptation approaches were considered for the shoreline along Lake Merritt Channel north of the Embarcadero bridge. The first is to construct a Tide Gate across the channel at Embarcadero Bridge, tying it into higher grade along both sides of the channel at the bridge, and adding a pump station.

The second approach is to protect the Union Pacific rail corridor and upland areas of Oakland with elevated flood walls at the rail line (out of the water). Then, levees would be built on both sides of the Lake Merritt Channel up to the exiting 7th St tide gate. This approach would require the support and collaboration with Union Pacific Rail.

Both of these options require additional engineering, hydrological, and ecological studies to assess feasibility and determine a preferred approach.

### b) Oakland Stormwater Detention areas

As described in Section 4.3, the City of Oakland is in the process of developing a Storm Drain Master Plan. Once that is complete, a similar study of existing conditions and potential stormwater flood mitigation measures should be performed for the area of Oakland. As part of this project's study of this area, two locations were identified as potential opportunity sites for stormwater detention areas based on area available within the public right-of-way and locations of existing storm drain lines:

1) Within the footprint of the pedestrian island between Portobello Residential and KTVU buildings (aligned with Oak Street), as shown on Figure 5-3.
2) Within the existing footprint of the existing surface parking area on Webster St, between Water St and 4th St, as shown on Figure 5-4. These areas have already been identified as potential public park space, the Webster Green linear park, within the City of Oakland's Downtown Oakland Specific Plan.

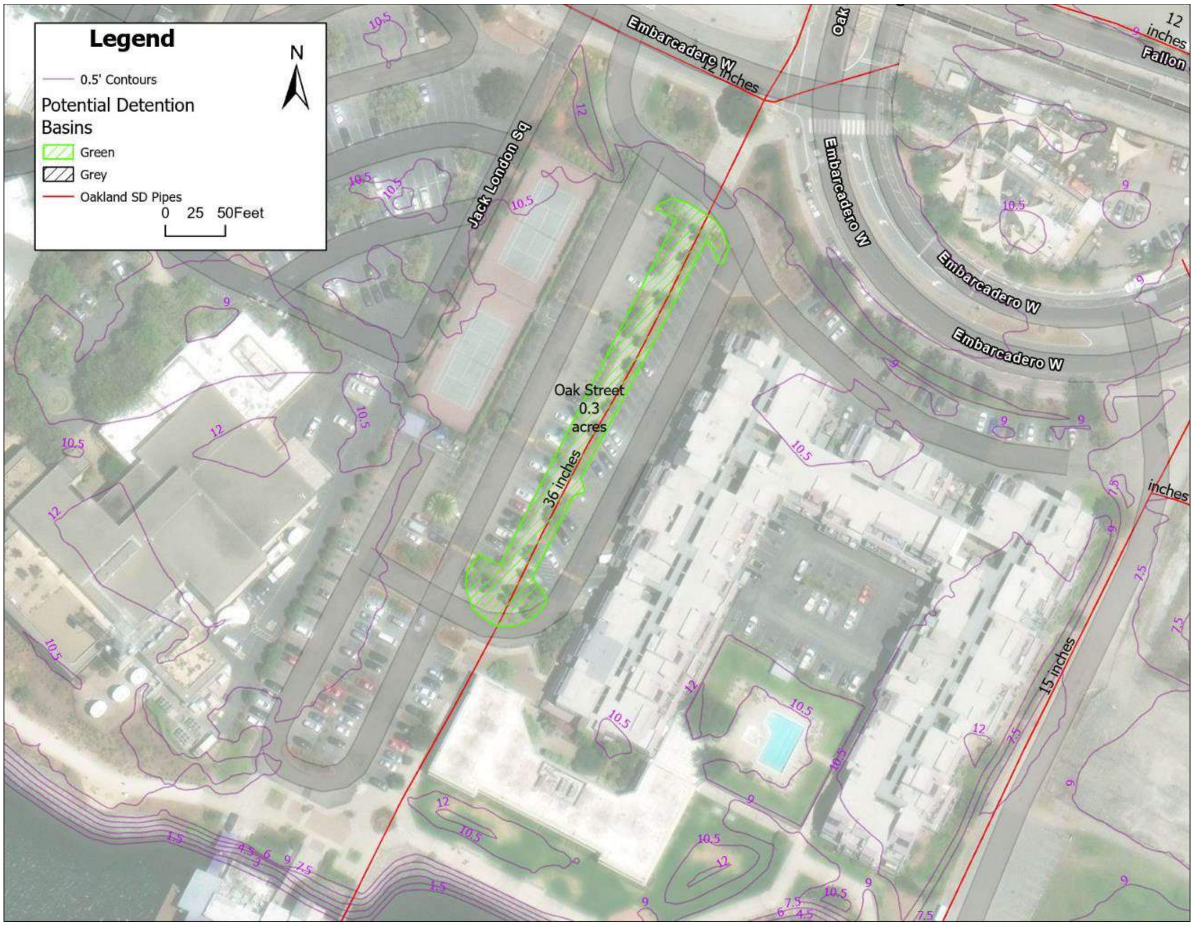


Figure 5-3 Potential future location for stormwater detention at Portobello Residential

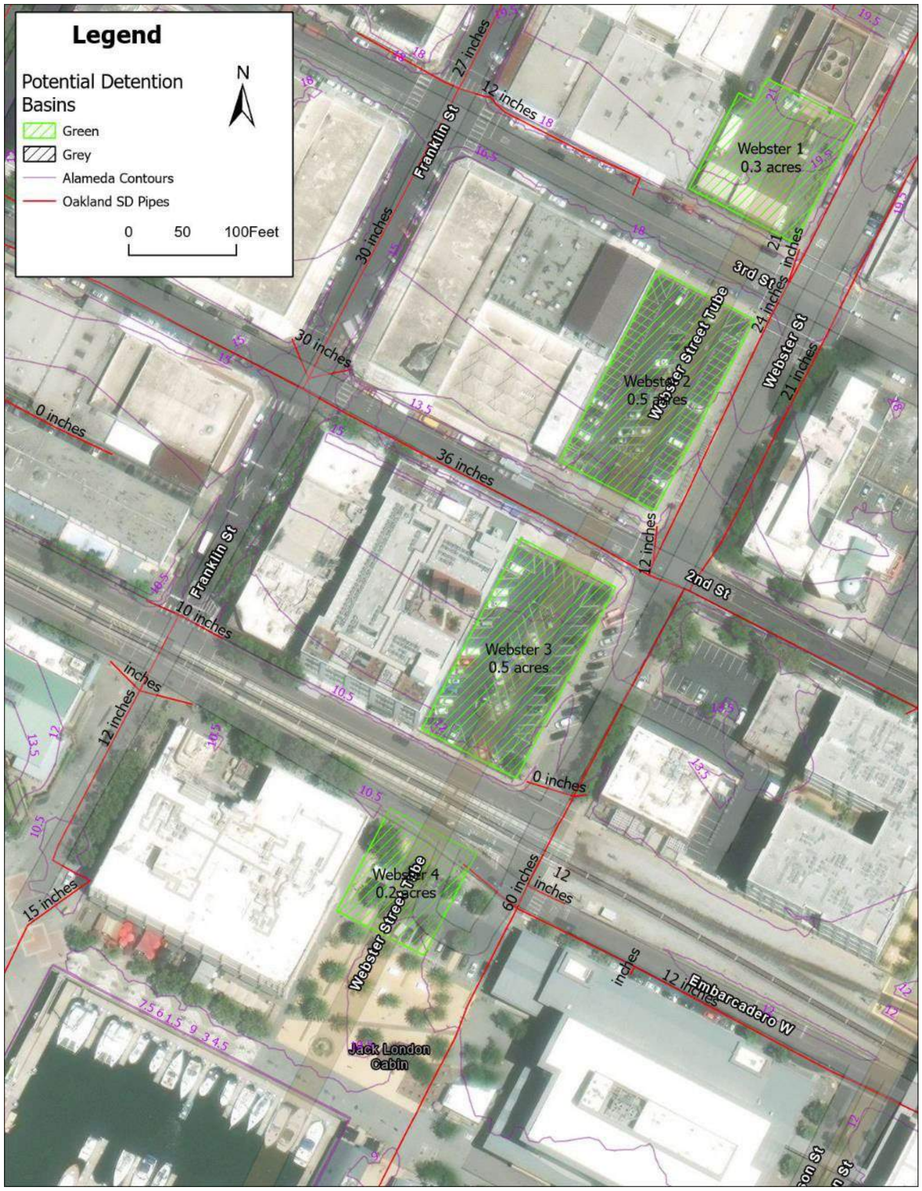



Figure 5-4 Potential future location for stormwater detention in Oakland at Webster Street

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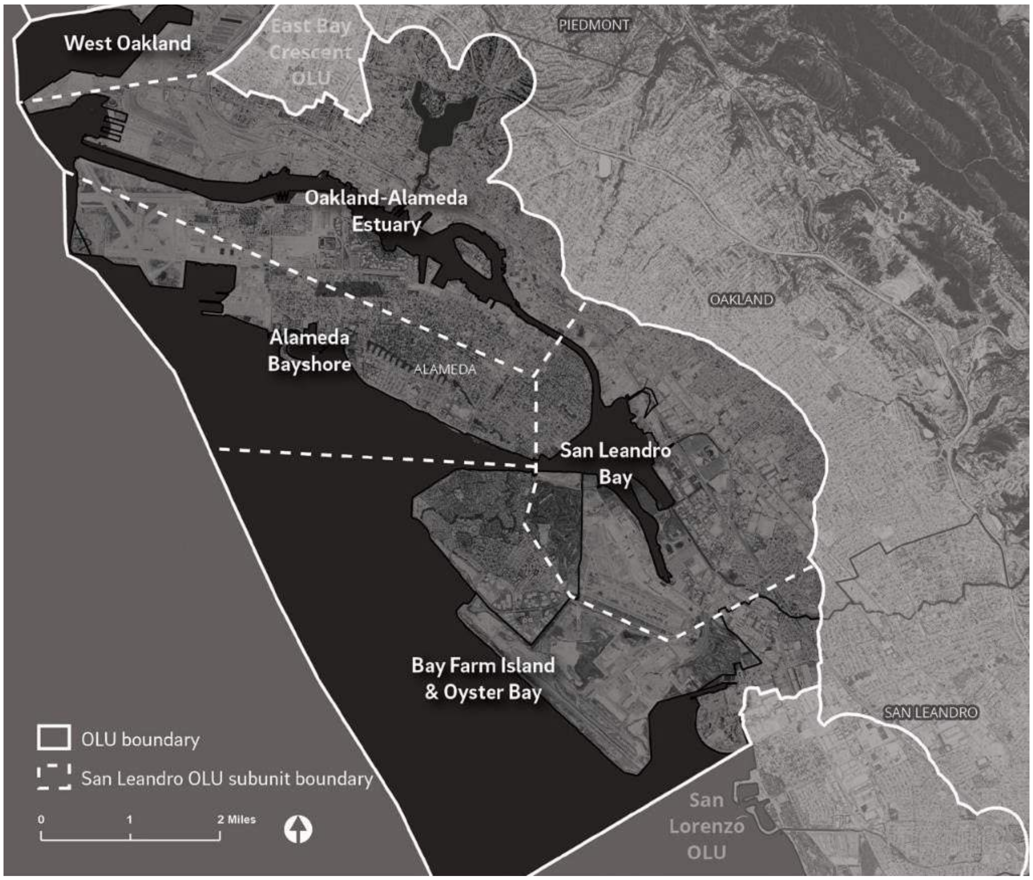
# APPENDIX A: OAAC ADAPT PROJECT CHARTER

# OAAC ADAPT: Oakland-Alameda Adaptation Projects

# Team Charter

Our Team Charter builds upon the San Leandro Bay/Oakland-Alameda Estuary Adaptation Working Group (Working Group), and is organized around the San Leandro OLU, which stretches from the Bay Bridge touchdown in the north to Oyster Bay in the south.  The Project Partners include jurisdictions, agencies, and community-based organizations (CBOs) interested in the shoreline within the OLU, regional and state collaborators, and the CMG consultant team.

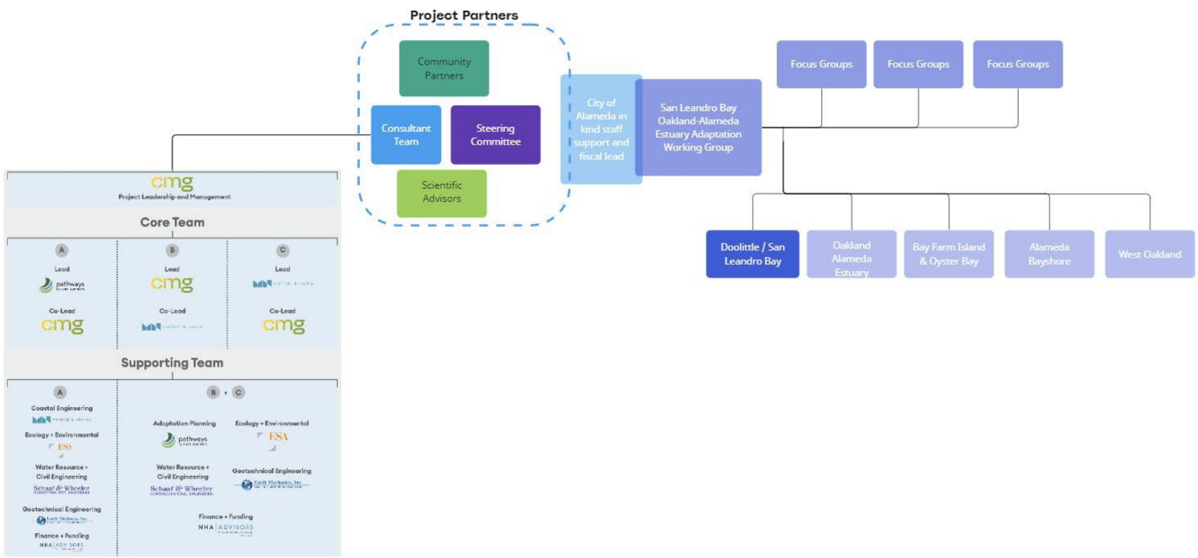
The purpose of the Oakland-Alameda Adaptation Projects (OAAP) Team Charter is to establish the values, agreements, and practices for how we will work together as a diverse coalition of public agencies, non-governmental organizations/community-based organizations, and consultants. The Charter will be reviewed and monitored as we progress through our work together and will be updated as needed.



**Who we are – Roles:**

- **Working Group:** A broad group of state, regional, city, nonprofit/CBOs, and advisors with a charter to guide and advise the Oakland-Alameda Adaptation Project (OAAP Team).
    - Sub Area Groups: Will include working group members and other stakeholders and community organizations to guide and advise the work within specific sub-areas as follows:
        - West Oakland
        - Oakland-Alameda Estuary
        - San Leandro Bay
        - Alameda Bayshore
        - Bay Farm Island & Oyster Bay
    - Focus Groups: Will be organized at key points in the process to address systemic questions and issues such as transportation, public access, environmental justice, nature-based solutions, governance/funding, cultural resources, sediment management, etc.
- **Steering Committee**: A committee of the Working Group to guide the project team.
    - Caltrans
    - City of Alameda
    - City of Oakland
    - Community Action for a Sustainable Alameda (CASA) (also Community Partner)
    - Confederated Villages of Lisjan Nation/Sogorea Té Land Trust (also Community Partner)
    - East Bay Regional Park District
    - Greenbelt Alliance (also Community Partner)
    - Hood Planning Group (also Community Partner)
    - Port of Oakland
    - San Francisco Bay Regional Water Quality Control Board
    - West Oakland Environmental Indicators Project
- **Community Partners:** Community-based organizations to lead the community engagement.
    - CASA
    - Confederated Villages of Lisjan Nation/Sogorea Té Land Trust
    - Greenbelt Alliance
    - Hood Planning Group
    - Ninth Root
    - REAP Climate Center
- **Scientific Advisor**: San Francisco Estuary Institute
- **Consultant Team:**
    - CMG Landscape Architecture

- Pathways Climate Institute
    - Moffatt & Nichol
    - NHA Advisors
    - Schaaf & Wheeler Consulting Civil Engineers
    - ESA
    - Earth Mechanics, Inc.
- **Project Management**:
    - City of Alameda in-kind staff support
    - Community Partners
    - Consultant Team




## Issue Statement

In spring 2023, San Francisco Bay Conservation and Development Commission (BCDC) issued a study that states sea level rise adaptation efforts in the San Francisco Bay Area are expected to cost $110 billion. Alameda County has the highest anticipated costs at $22 billion with several Caltrans highways, Port of Oakland, and the Oakland International Airport. Nevertheless, the region has only committed $5 billion to date in public funds.

Previous government actions in the Oakland-Alameda sub-region have led to negative outcomes for traditionally underrepresented populations such as people of color with redlined neighborhoods that prohibited access to credit or loans. These inequities continue to this day with multigenerational impacts and reduced opportunities for people living and working in these same neighborhoods, which have higher exposures to pollutants, racial inequities, and lower incomes. Climate change is another societal issue that is being added to the mix.

## Our Purpose

The OAAP Team purpose is to realize the overarching goals and specific objectives established by the Working Group for the Oakland Alameda Adaptation Projects and as defined in the OAAP request for proposal and work scope. We are at the beginning of a multi-generational dialogue on climate change that will set the stage for those who continue and follow us. We enter this dialogue with humility and respect; building on the indigenous concept of reciprocity to envision and realize a resilient, equitable, accessible, and regenerative Oakland-Alameda sub-region. We begin with the premise that communities belong to a place.

We understand the importance of developing a long-term vision and plan for the sub-region, while advancing the Oakland-Alameda Estuary and Bay Farm Island Projects to address current and long-term risks. We will develop a framework for governance, define strategies for various levels of sea level rise, groundwater, and storm flooding, and will prioritize co-benefits of equity, public access, open space, and nature-based solutions. This effort must be achieved within a complex regulatory, social, and economic context that only can be navigated through a sophisticated community engagement strategy that informs and empowers the Working Group to drive decisions toward implementation. Furthermore, the community engagement process must ensure that community needs, concerns and perspectives of underserved stakeholders are part of decision making to truly create transformative communities with adaptation as the key motivation. In sum, the process needs to build consensus, inspire action, and establish a clear road map for funding and implementation.

**Shared Values and Goals** (values and goals that will guide our work and our relationships)

- Respect each other.
- Support one another's efforts, share data and information.
- Ensure that vulnerable communities are prioritized in all project work.
- Build capacity for community-based organizations and government organizations to plan and implement adaptation projects.
- Enhance quality of life without contributing to displacement or gentrification.
- Improve bay and riparian ecosystems and habitat by incorporating nature-based solutions in all projects, to the greatest extent possible.
- Improve equity outcomes and environmental justice outcomes for impacted disadvantaged communities with special focus on racial equity. Be attentive to potential unintended adverse impacts of the project recommendations on disadvantaged communities.
- Balance the complexity of planning for long-term uncertainty, near-term needs, and community dialogue to advance consensus around each of the above.
- Community Engagement:
    - Ensure that the engagement process is inclusive, respectful of other community efforts, and represents the diversity of the community,

    - including different demographics, socioeconomic backgrounds, and stakeholders.
    - Provide clear and transparent information about sea level rise, its potential impacts, and the purpose of the engagement process. Prioritize community education to increase awareness and understanding of sea level rise and to help residents make informed decisions.
    - Foster collaboration among different sectors, including government, businesses, non-profits, and community organizations as to inform more holistic solutions.
    - Empower community members by involving them in various phases of the processes. Encourage them to contribute ideas, take ownership of projects, and become advocates for resilience.
    - Address equity and social justice concerns by considering the needs of marginalized communities and protecting vulnerable populations.
- Be visionary and pragmatic.
- Embrace water as an asset.
- Utilize the most current scientific understanding and projections for the regional effects of climate change.
- Highlight safety, respect for natural systems, and risk reduction to people, places, and capital through multipurpose design and green Infrastructure planning.
- Develop a governance framework that focuses to maximize grant funding, both Federal and State; minimize local share grant match requirements that will require an exaction on local taxpayers; utilize the most socially equitable methods possible for funding; and build long-term institutional capacity to pursue additional grant funding.

**Project Goals:** More specific goals to guide the work on each adaptation project, which will be refined as the projects progress.

- Part A: Sub-Regional Goals
    - Protect Oakland-Alameda sub-region from the negative effects of expected sea level, inland flooding, and groundwater rise and liquefaction
    - Identify and develop opportunities for multi-benefit adaptations strategies.
    - Avoid negatively affecting neighboring subregions through protection and adaptation measures.
    - Utilize an adaptation pathways approach to address different SLR thresholds and time horizons. Identify near, mid, and long-term adaptation strategies.
    - Enhance transportation, recreation corridors, bay access, and the San Francisco Bay Trail.
    - Preserve and increase open space where possible.
    - Improve subtidal, intertidal, transitional, and upland habitat with nature-based solutions
    - Improve air quality

- Part B:  Oakland- Alameda Estuary Goals
    - Protect both the downtown Oakland/Jack London Square shoreline and Alameda's northern shoreline near Marina Village from expected sea level rise
    - Reduce the impacts of flooding in the inland areas of the estuary
    - Develop multi-benefit solutions that include urban design and public access improvement for the Oakland waterfront.
    - Develop strategies to maintain marina functions on Alameda waterfront.
    - Identify nature-based solutions where possible.
    - Understand the environmental impacts of the adaptation measures as part of the cost/benefit evaluation of each.
- Part C:  Bay Farm Island Goals
    - Short-term project:
        - Provide FEMA flood protection and ultimately remove property from FEMA 100-year flood zone.
        - Focus on the northern shoreline area of Bay Farm Island; Build consensus on concept design, develop up to 30 percent design drawings and advance the permitting process.
    - Long-term plan:
        - Develop a long-term groundwater and sea level rise adaptation strategy and a design concept equivalent to 10 percent design for the entire Bay Farm Island.
        - Improve subtidal, intertidal, transitional, and upland habitat with nature-based solutions
        - Develop multi-benefit solutions that include urban design and public access

**Opportunities to Realize - Challenges to Manage**

- Co-create an engagement and communications strategy
- Community Engagement – the right amount in the right places at the right time to a broad group of community members with diverse backgrounds and disciplines
- Develop a governance framework and funding plan for the entire project
- Emotional/existential questions and the need to acknowledge grief and loss
- Environmental regulations that take time and money
- Equity and environmental justice, especially racial equity
- Evolving best practices and sea level rise predictions
- Inland work as more complicated than shoreline work
- Inter-jurisdictional complexity and governance (building governance capacity throughout the process)
- Resource/funding constraints, and time/budget constraints for existing grants
- Short-term high priority wins as critical
- Trust building
- Visioning to be visionary and still practical

**Work Process and Communications – Rhythms and Melodies**

- Working Group: Quarterly Meetings
- Steering Committee:  Monthly Meetings
- Project Management:  Bi-weekly Meetings
- Sub-area Groups: Monthly or as needed.
- Focus Groups: As needed.
- Internal Consultant Team Meetings:  Bi-weekly

**Our Promises as a Team**

- Offer direct and timely input, especially raising concerns openly and promptly.
- Be open and receptive to different points of view creating a culture that makes it easy to disagree - and not to "group think" - for overall better results.
- Be candid and specific in our articulation of the desired outcomes, success measures.
- Be agile and work together to address adversity throughout the process.
- Deliver what we promise by the deadlines.

**Consultant Team promises to the Community**

- Bring best practice expertise to engage communities to build capacity and resilience.
- Be receptive and responsive to input, concerns, and requests.
- Be direct and transparent in offering our recommendations and input.
- Practice self-awareness and accountability.
- Work in partnership to achieve goals and sustain community trust.

**Meeting Ground Rules**

- All members will fully and respectively engage with the issue at hand.
- Listen to what others are telling you and take it at face value.
- Every perspective deserves to be heard.
- Be honest and respectful.
- No need to repeat points.
- Take space and make space (Speak up to be heard and allow others to speak).
- Focus on issues, not people.

**Decision Making: Consensus-based Approach**

The OAAP Team shall use the following consensus-based decision-making process.  In consensus-based decision-making, consensus does not always signify that a member or group will agree to a preferred option, rather, a member will accept a proposal that they can "live with" to further the team's agenda. A consensus will be reached by taking a poll. Members can vote either "thumbs up," "thumbs down," or "neutral." The group will strive for full consensus, meaning that for a decision to be approved, all members will vote either "thumbs up" or "neutral." If consensus is not reached, the Working Group, Steering Committee or Sub-area Group will discuss the concerns and amend the decision accordingly.

**Collaboration – Communication Tools**

To support and encourage transparent collaboration, the entire Working Group will have access to these collaboration tools. Contact the CMG Landscape Architecture team if you have questions about accessing these tools or if you need to provide access to additional team members:

- **SharePoint Site:** Oakland-Alameda Adaptation Projects - Project Partners SharePoint Site
    - Project file-sharing
    - All participants who have been made a member of the SharePoint site will have editing permissions. Links to documents on the site are public and can be shared outside of the team.
    - Content:
        - Project Schedule
        - Link to Project Partners Miro Board
        - Meetings and Presentation Exhibits and links
        - Milestone Record Documents
- Miro Board: Oakland-Alameda Adaptation Projects – Project Partners Miro Board
    - Shared space for participatory workshops and meetings between Project Partners.
    - Digital interface for sharing, collaborating, and interacting with graphic materials; recording collaborative meeting activities; and providing a graphic record of previous meetings.
        - Working Group Quarterly Meetings
        - Steering Committee Monthly Meetings
        - Sub-Area and Focus Group meetings
    - Additional boards may be added – links will be shared out
    - All participants with a link to a Miro board will have commenting or editing rights
    - CMG will create new boards for Project Partner teams upon request
- Communication: Outside of meetings, workshops, and collaborative tools above, project communication will be via email

**Charter Tracking:**

Does our work reflect our stated purpose? Are we achieving the goals that we have established? Our team will assess the answers to these questions following key milestones throughout the life of the project. We may elect to revise this charter to ensure we continue to meet the goals of the projects, realizing that they may change over time.

# APPENDIX B: COASTAL FLOOD PROTECTION ALTERNATIVES DEVELOPMENT

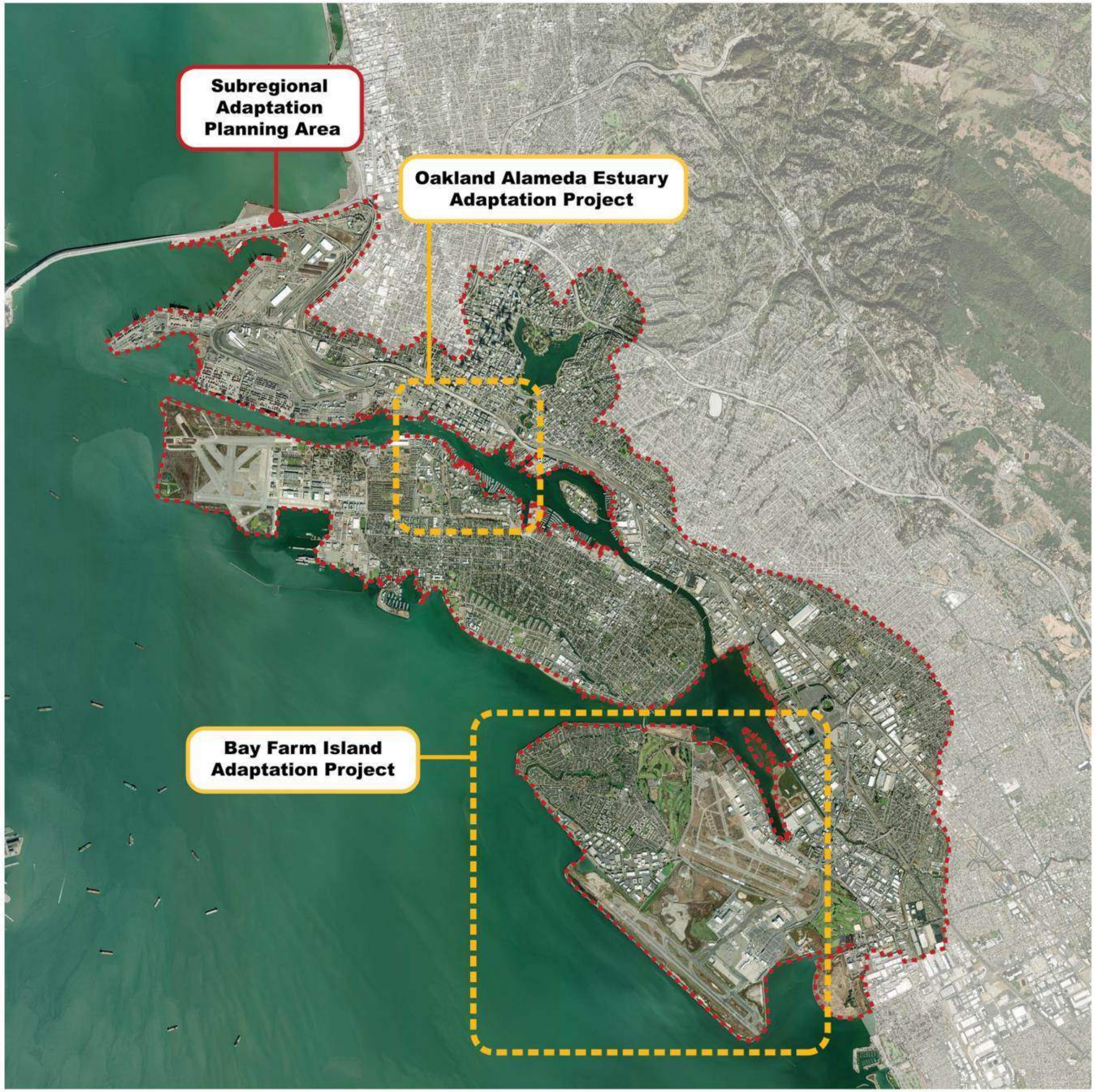
# OAAC Adapt: Oakland-Alameda Estuary Coastal Flood Protection Alternatives Development

# Contents

# Project Overview + Existing Conditions

# OAAC Adapt Projects

- Oakland Alameda Estuary Adaptation Project (near term adaptation)
- Other OAAC Adapt Projects include the **Long-Term Subregional Plan** and the **Bay Farm Island Adaptation Project**



# **Project Area:**
Oakland-Alameda Estuary

# **Project Area:**
Oakland-Alameda Estuary

## ALAMEDA


Bohol Circle


Oakmont Shoreline


View Towards Barnhill Marina


Barnhill Marina


Extended Stay America Hotel


Marina Village

## OAKLAND


Portobello Marina


Embarcadero West / Estuary Bridge

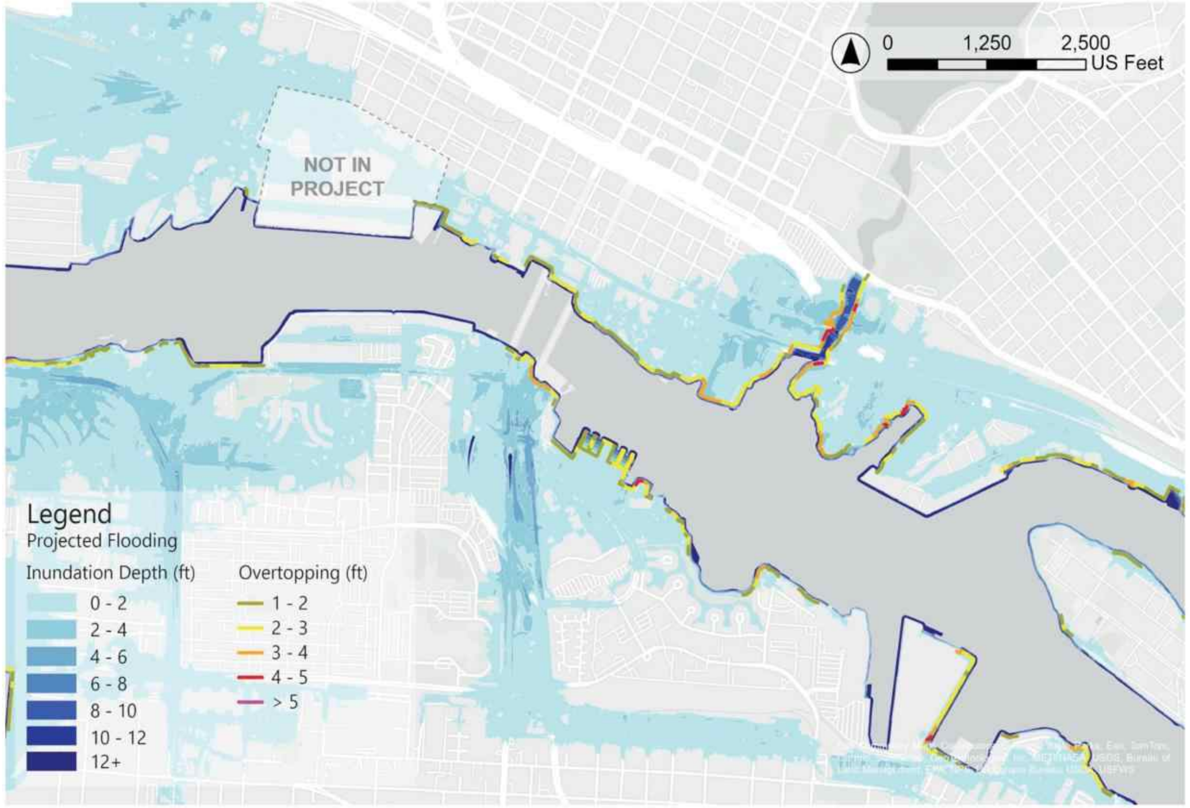

Lake Merritt Channel


Lake Merritt Channel Outlet

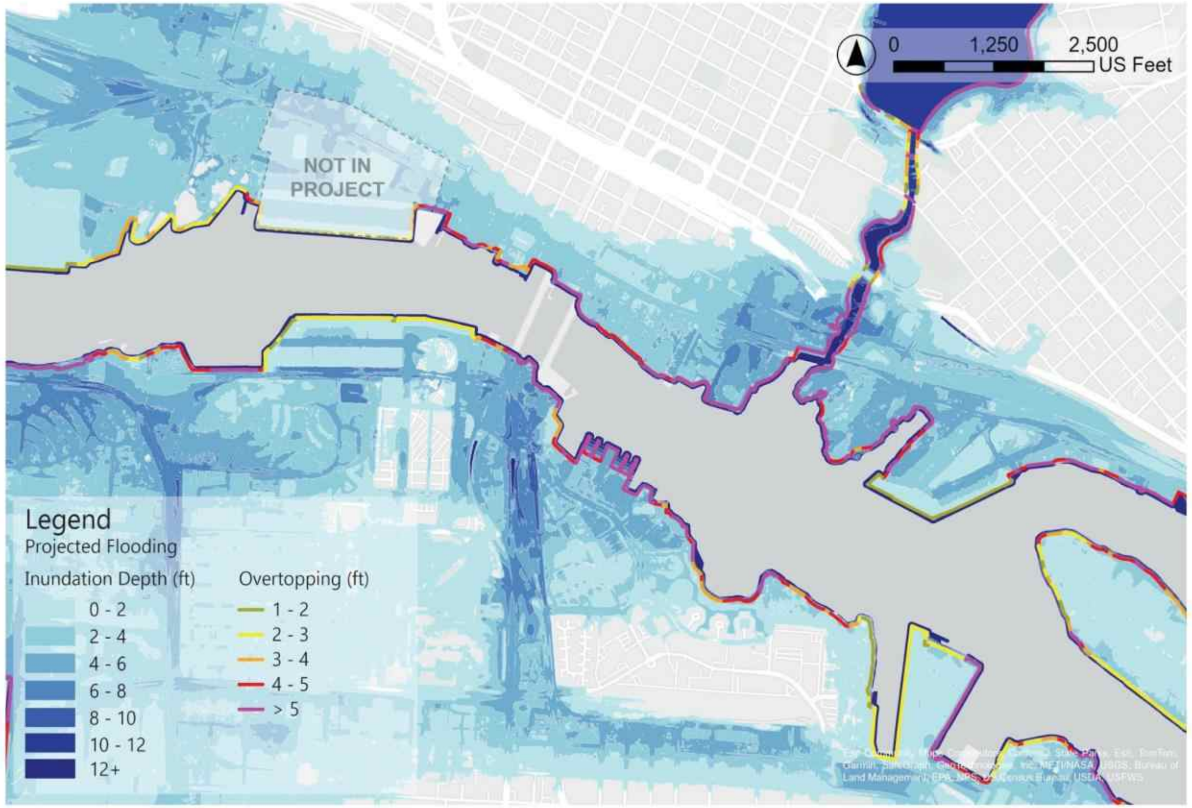

Lawn at the Landing

Jack London Square

# **Projected Sea Level Rise:**
Oakland-Alameda Estuary




100-year coastal flood with 2’ sea level rise




100-year coastal flood with 5.5’ sea level rise

# Sea Level Rise Project Criteria

## Near Term

**2080**
35 to 50-year adaptation project lifespan

**2'** of sea level rise

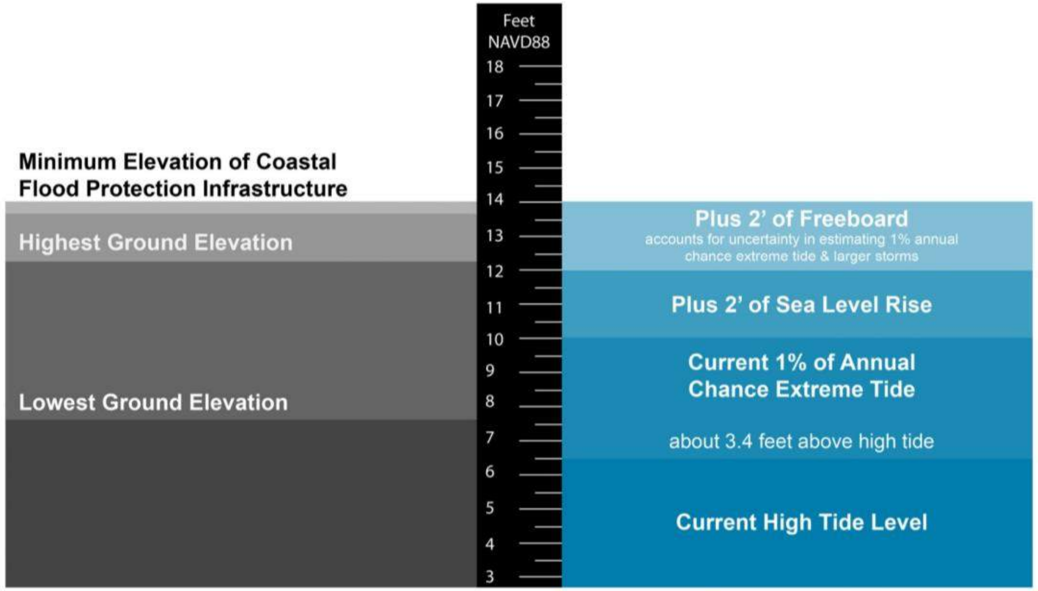
**Protect to elevation +14.0**

## Long Term

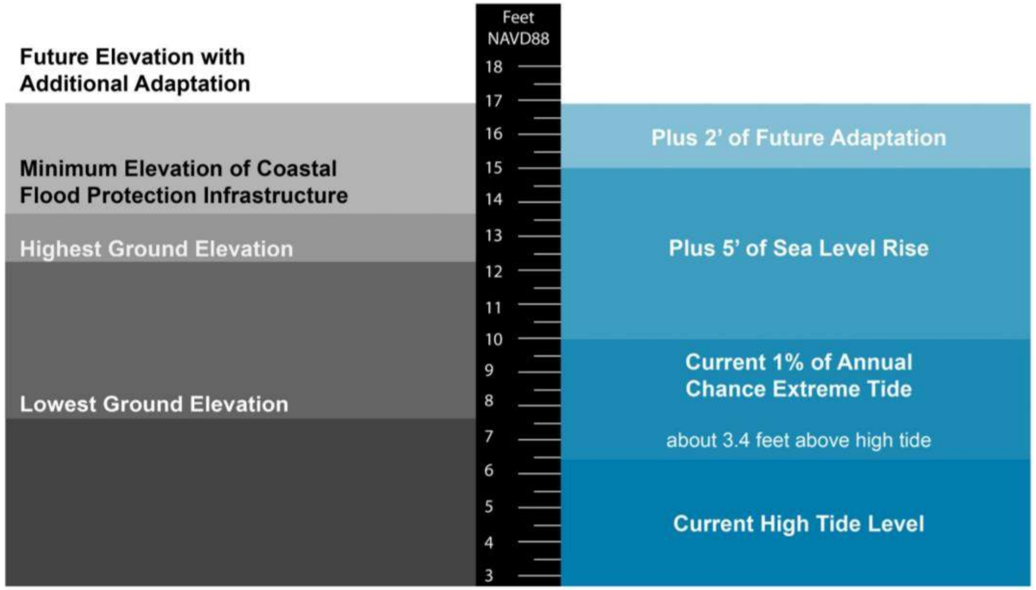
**2100+**
Build upon near term project

**5'** of sea level rise

**Protect to elevation +17.0**



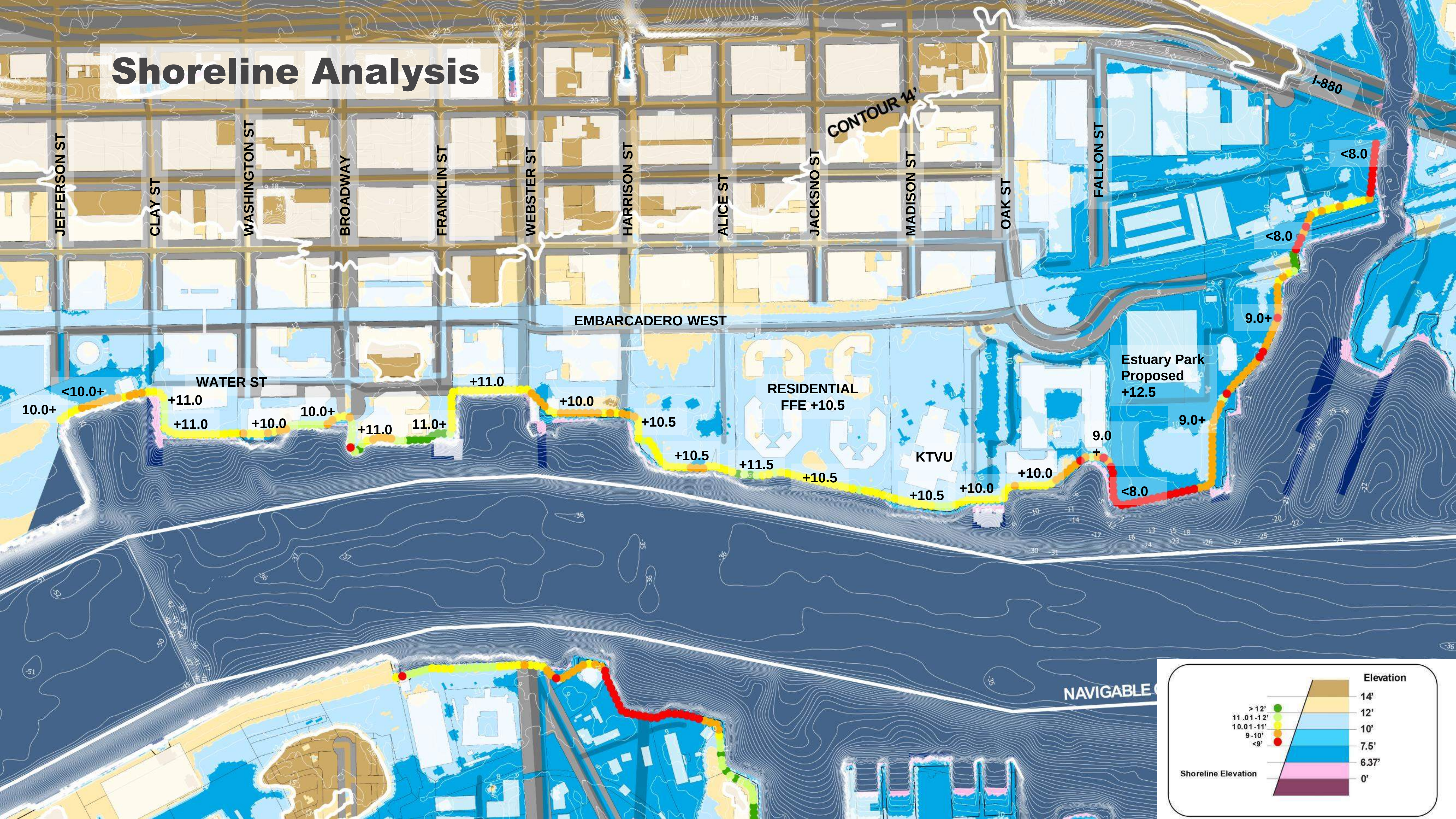

Near Term (2080, 30-50 Year Design Life, 2' of SLR)
Protect to Elevation +14.0




Long Term (2100+, 5' of SLR)
Protect to Elevation +17.0

# Shoreline Analysis

# Shoreline Analysis



# Flooding at Posey & Webster Tubes

# Inland Flooding Analysis
# Stormwater Modeling: Northside of Alameda

- Volume of water currently generated by
- 100-yr, 24-hr storm: 36.6 acre-feet

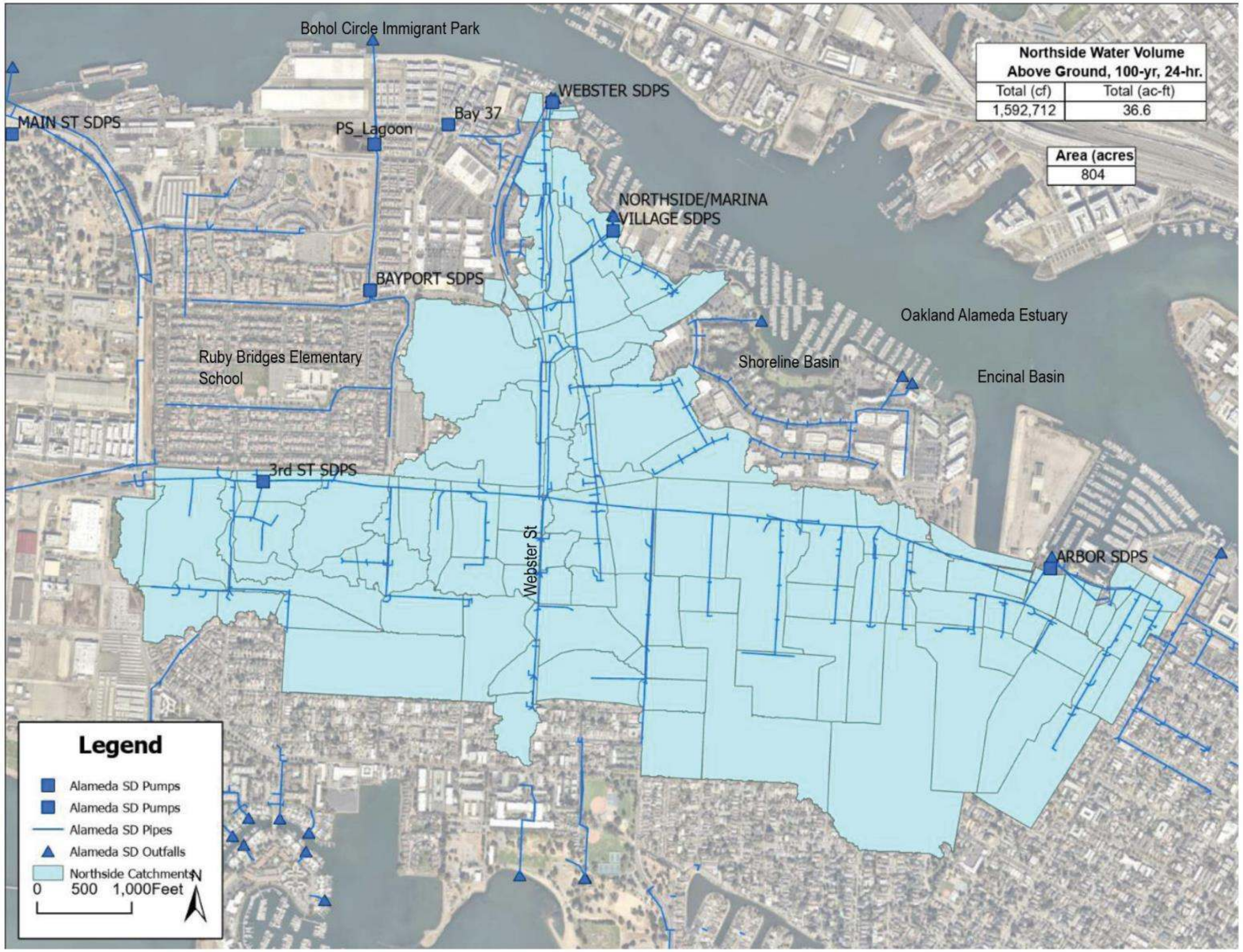
- This is the volume of water that does not fit in Alameda's storm drain system today.

- Near term project includes stormwater detention for today's volume with added capacity for future increases.

**Precipitation % Change**

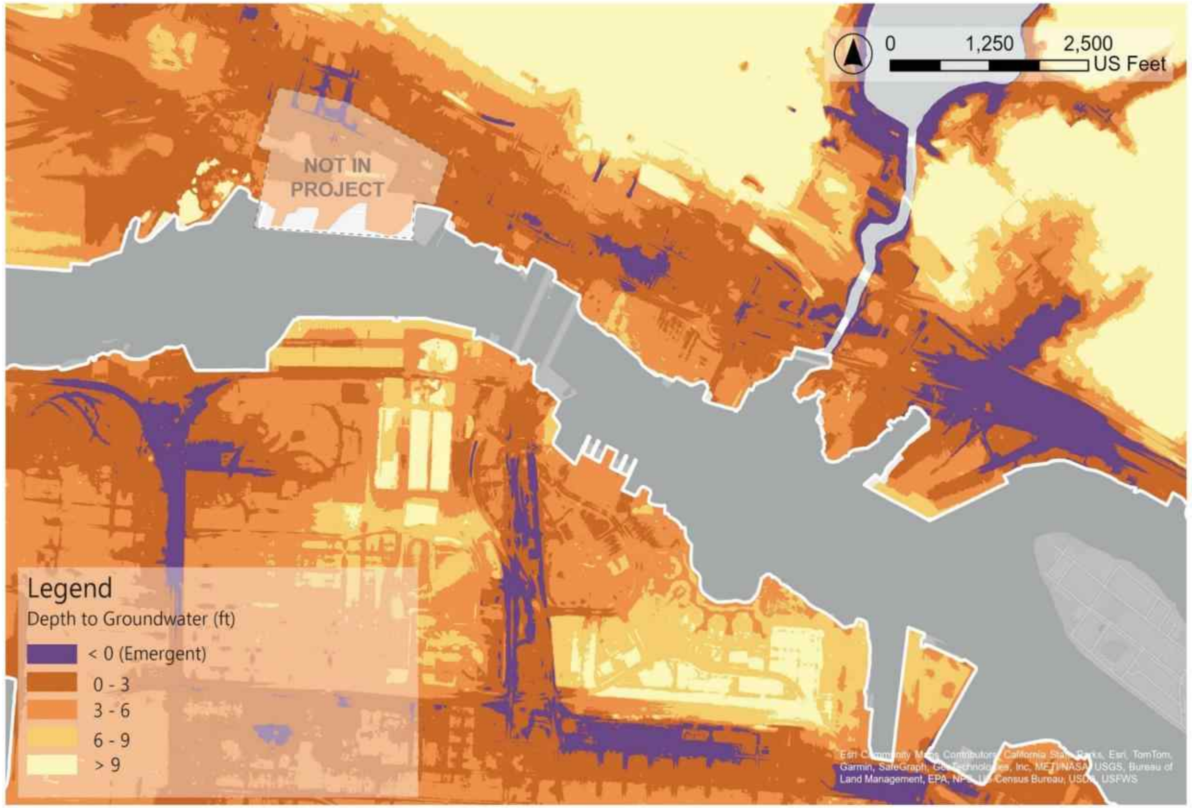
| | | 10-yr | 100-yr |
|---|---|---|---|
| 2050 | 3-hr | 21.6% | 25.8% |
| | 24-hr | 17.9% | 22.1% |
| 2060 | 3-hr | 27.8% | 32.7% |
| | 24-hr | 22.2% | 26.8% |
| 2070 | 3-hr | 33.7% | 39.3% |
| | 24-hr | 25.9% | 31.2% |
| 2080 | 3-hr | 40.7% | 47.1% |
| | 24-hr | 30.7% | 36.6% |
| 2090 | 3-hr | 49.6% | 56.9% |
| | 24-hr | 37.1% | 43.7% |
| 2100 | 3-hr | 59.0% | 67.2% |
| | 24-hr | 43.6% | 51.0% |

**San Francisco Bay Area Domain SSP5-8.5**

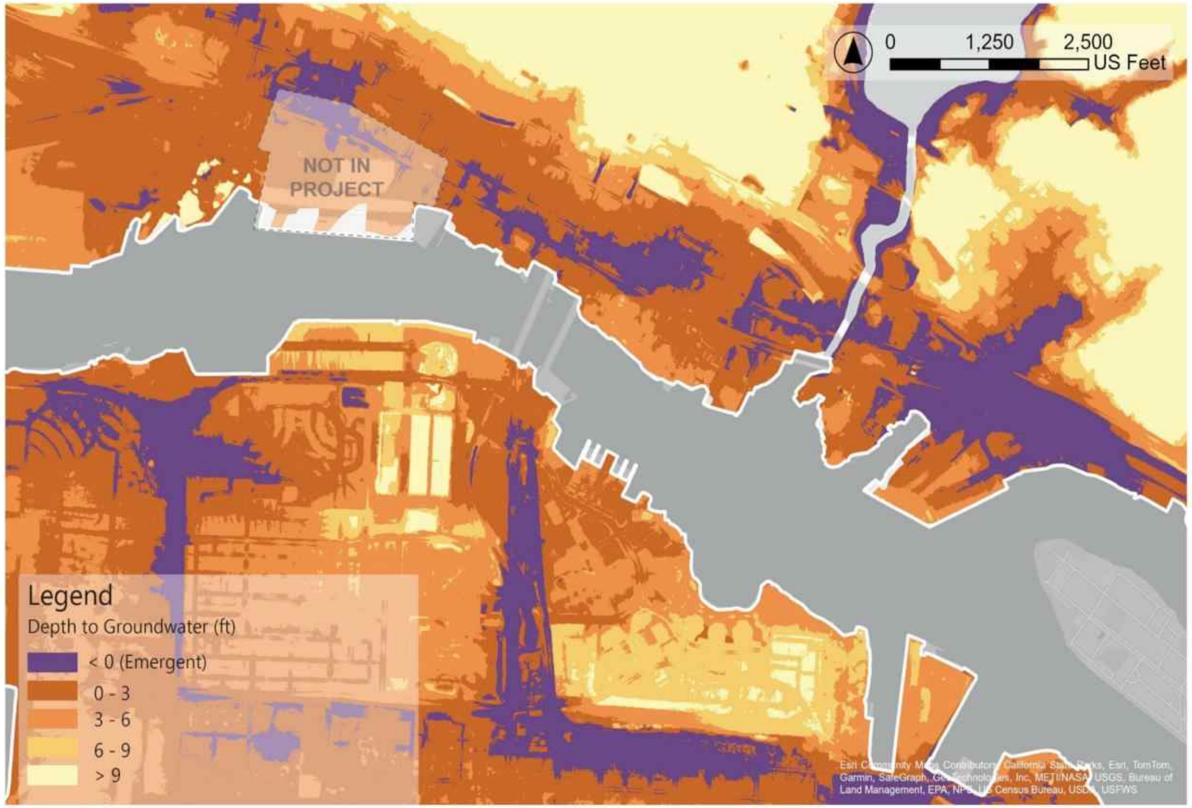


**Projected Depth to Groundwater:**

Oakland-Alameda Estuary

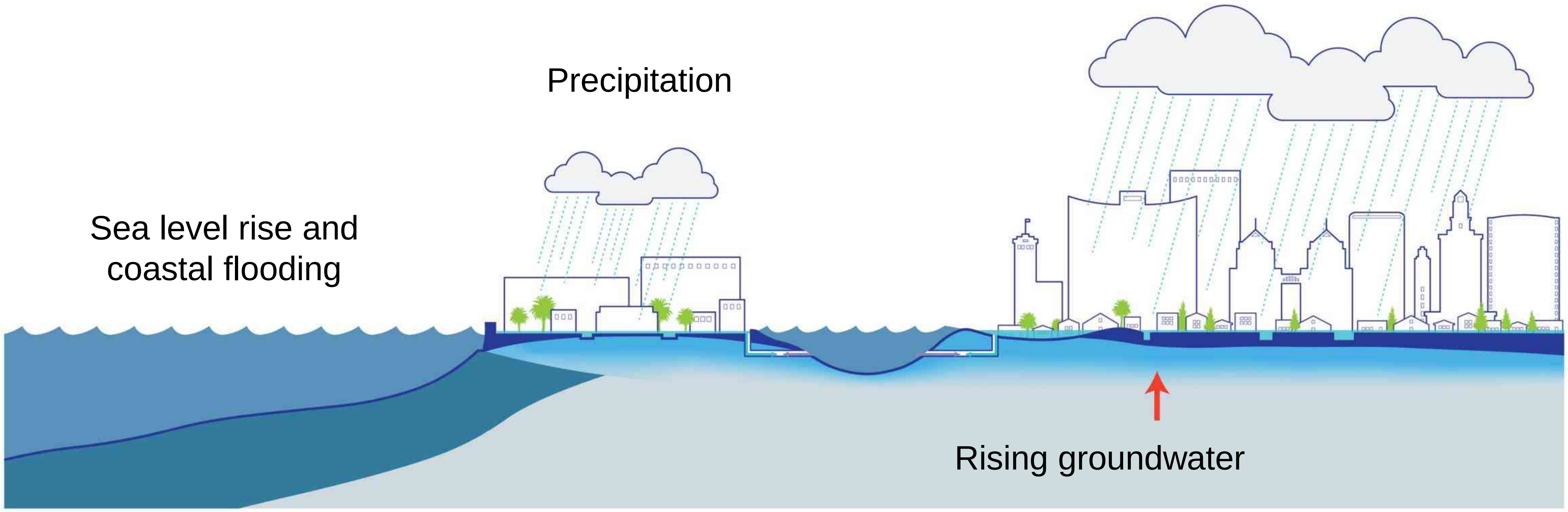



Depth to groundwater with 2’ sea level rise

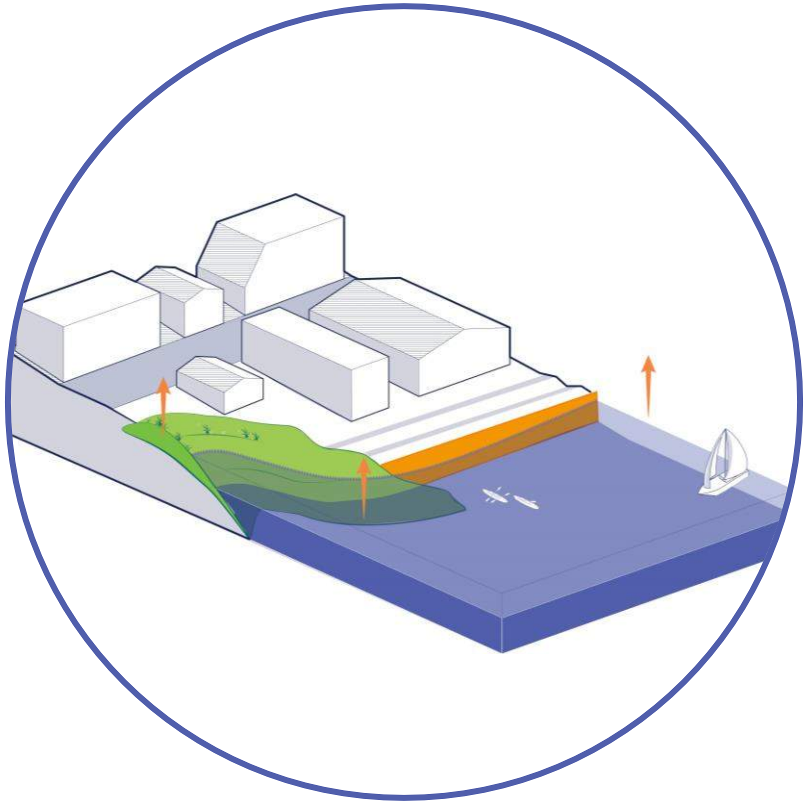



Depth to groundwater with 5.5’ sea level rise

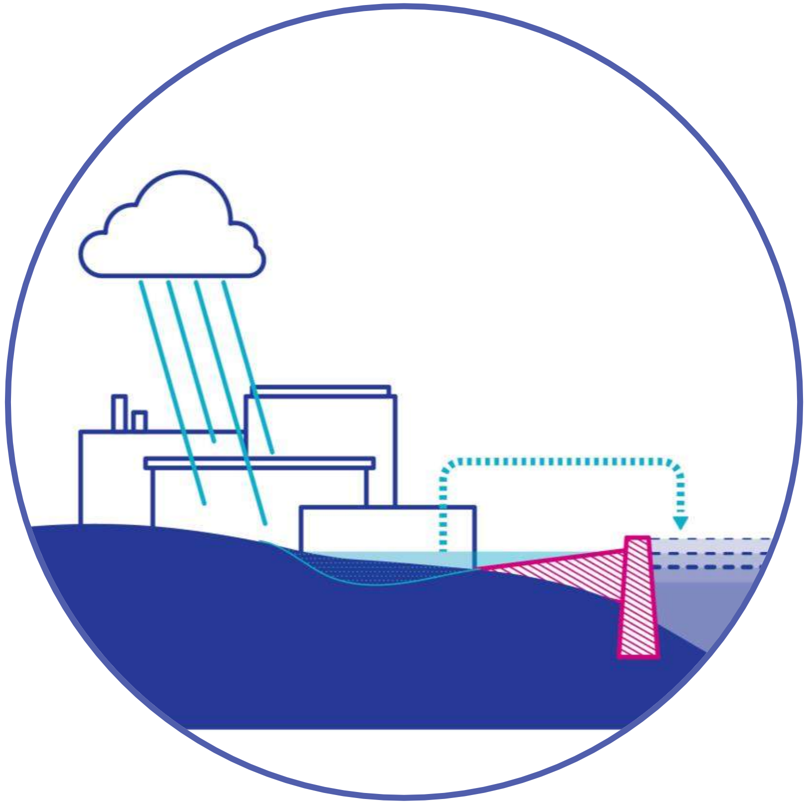
## Combined Flooding:
*A complex problem for adaptation*



# Near Term Adaptation

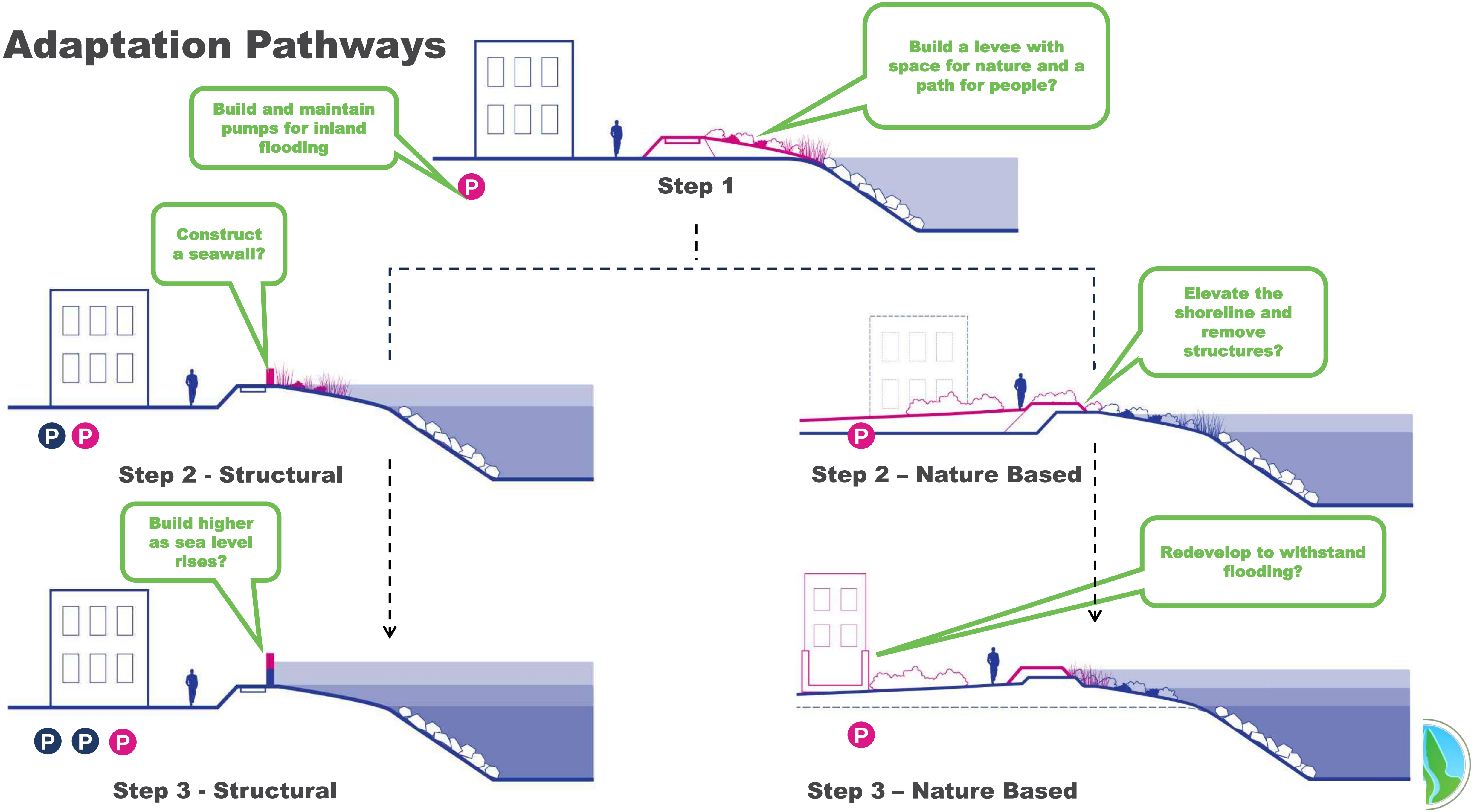


Shoreline elevation to prevent coastal flooding from sea level rise and storm surges

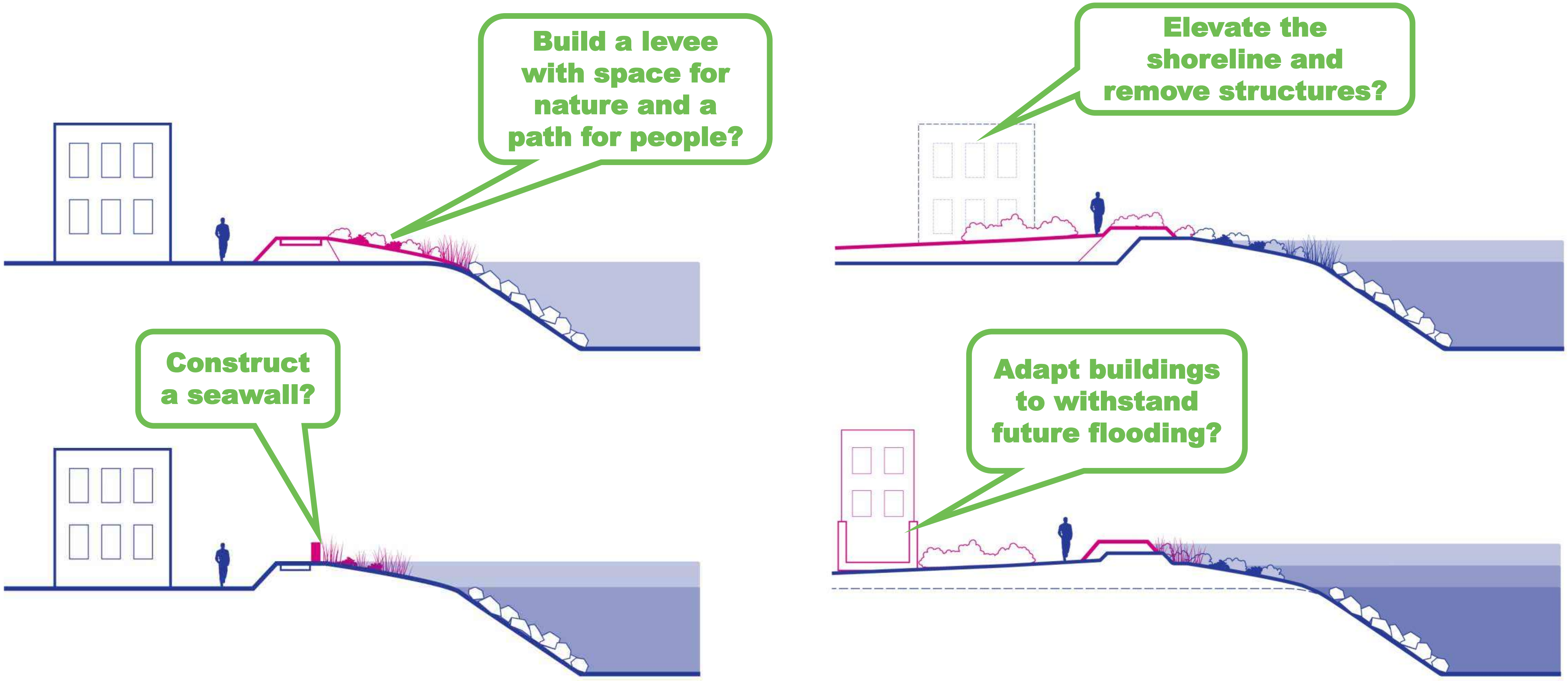


Inland adaptation (green and grey infrastructure) to manage stormwater and groundwater

# Adaptation Pathways

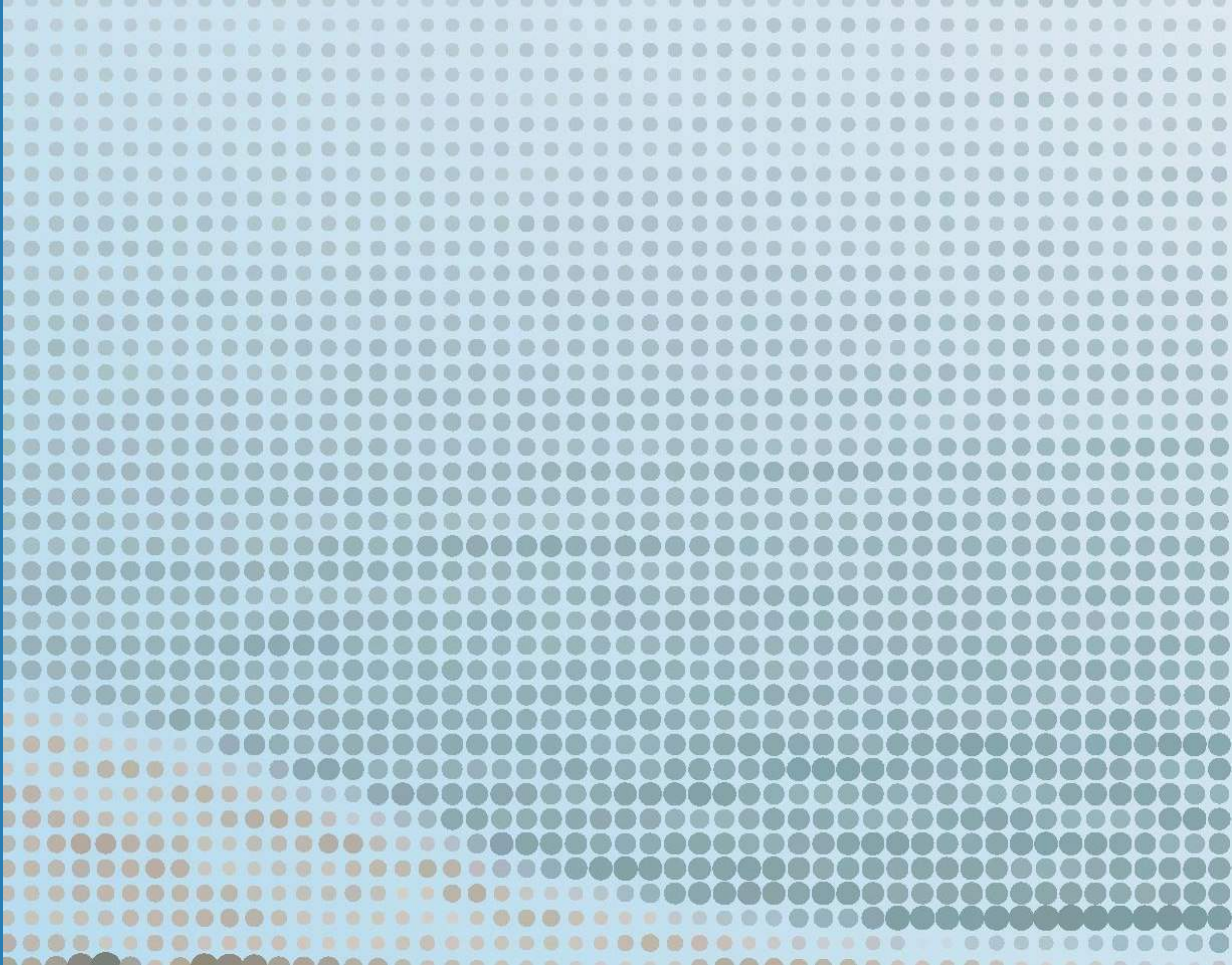


# Adaptation Options

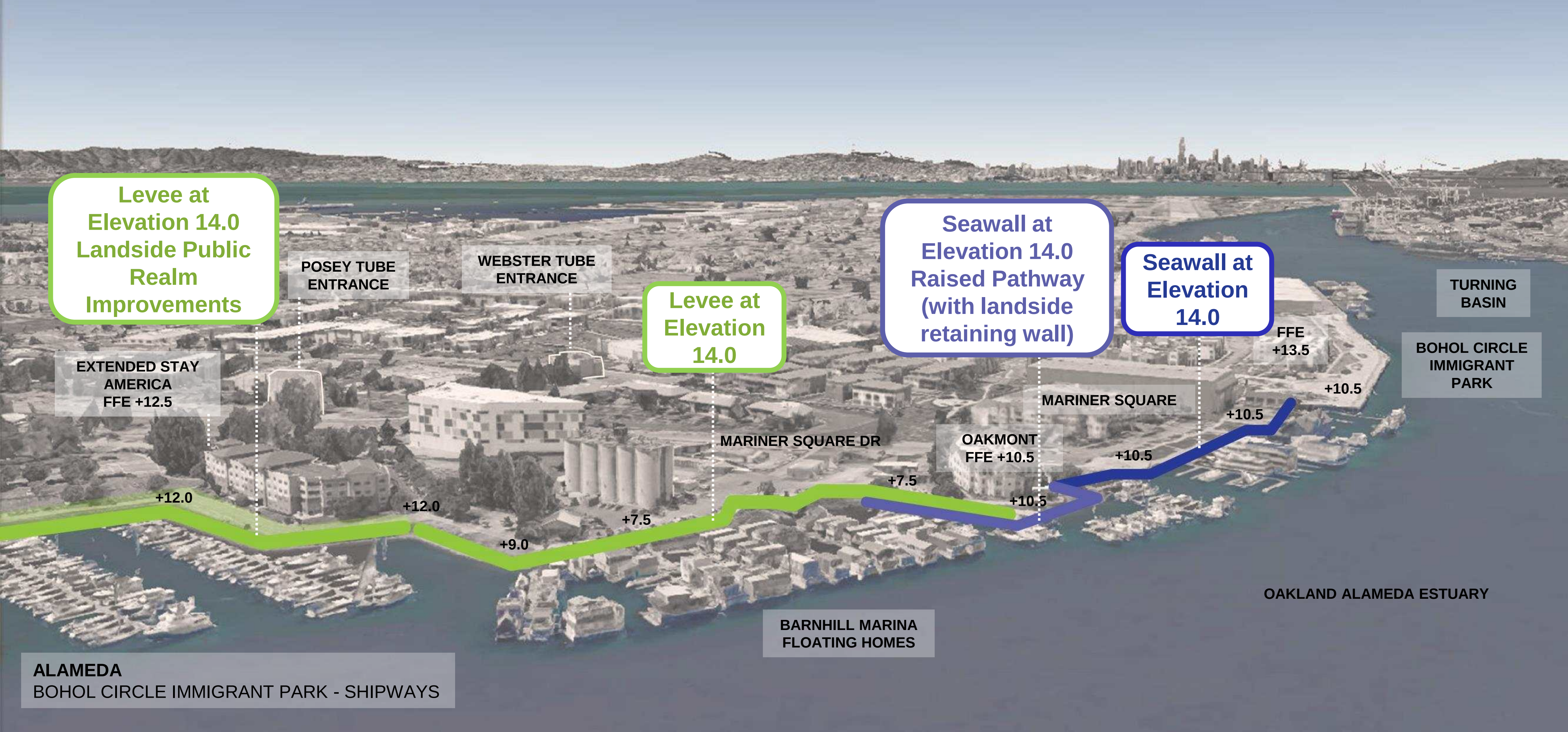


# Alameda Shoreline Adaptation Concepts

*Bohol Circle Immigrant Park to Marina Village*



# Adaptation Concept
## Bohol Circle Immigrant Park to Shipways



# Adaptation Concept: Seawall at Marina Village

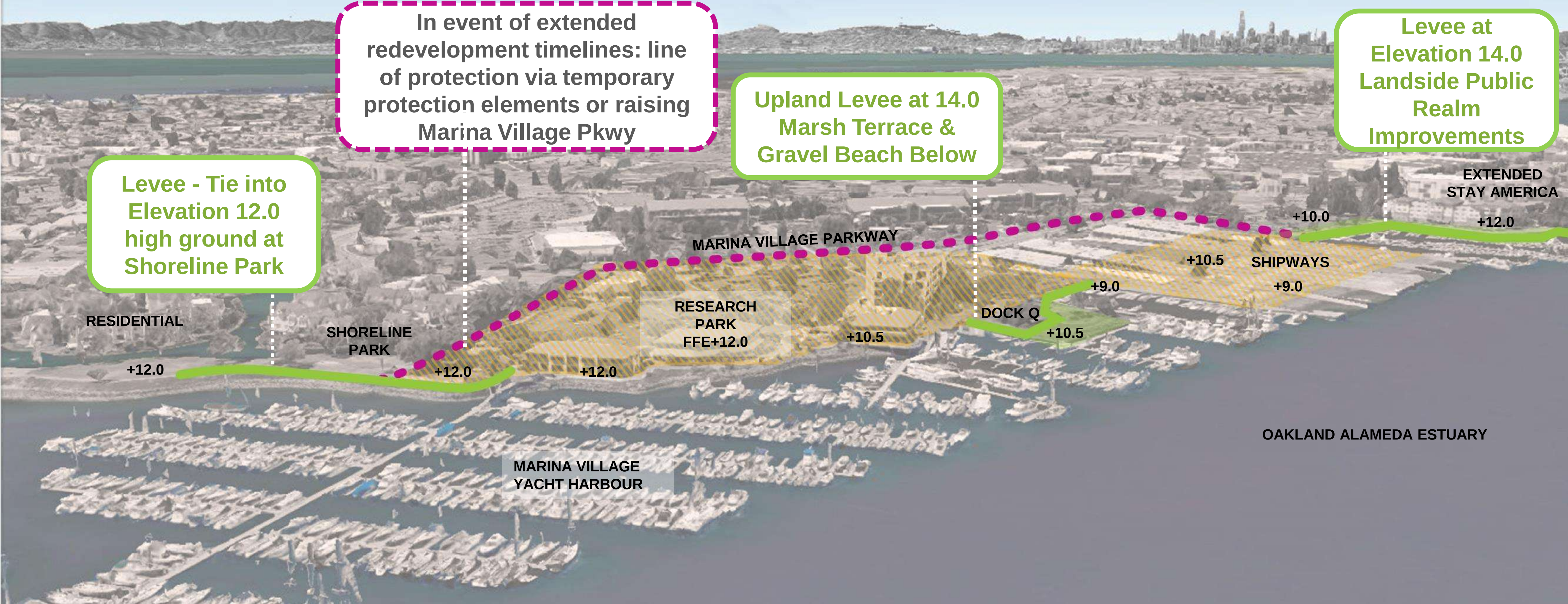
## Shipways to Marina Village

# Adaptation Concept: Redevelopment and Raising Grade

## Shipways to Marina Village

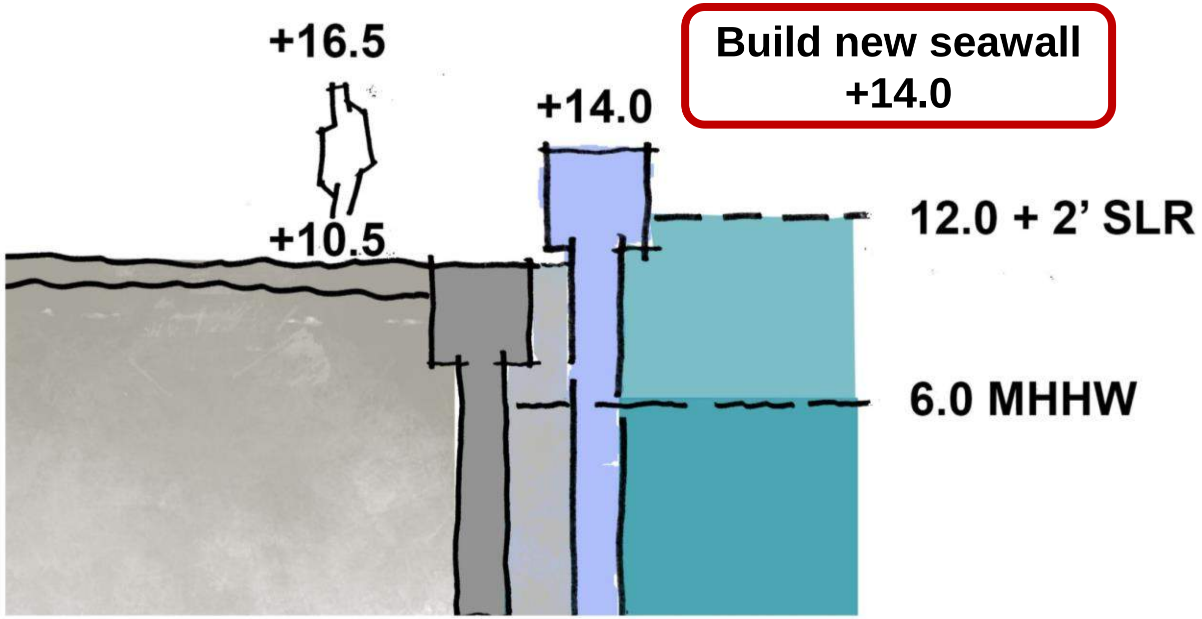
# Adaptation Concept: Upland Protection Prior to Shoreline Redevelopment

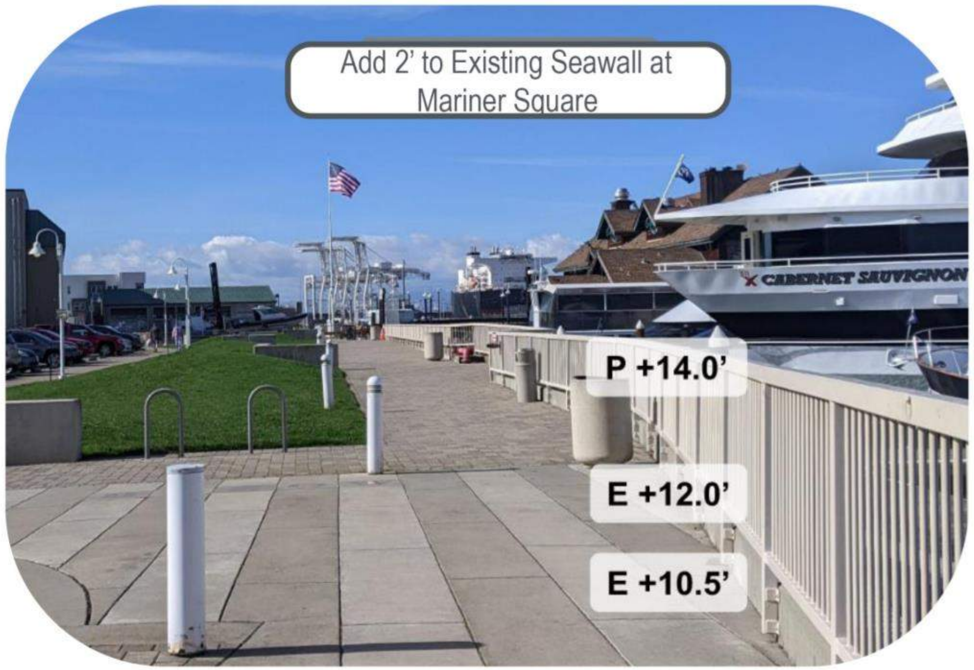
## Shipways to Marina Village



# Alameda Shoreline – Near Term Adaptation

Typical Condition (Bohol Circle to Oakmont; Marina Village Research Park)
Elevated Seawall



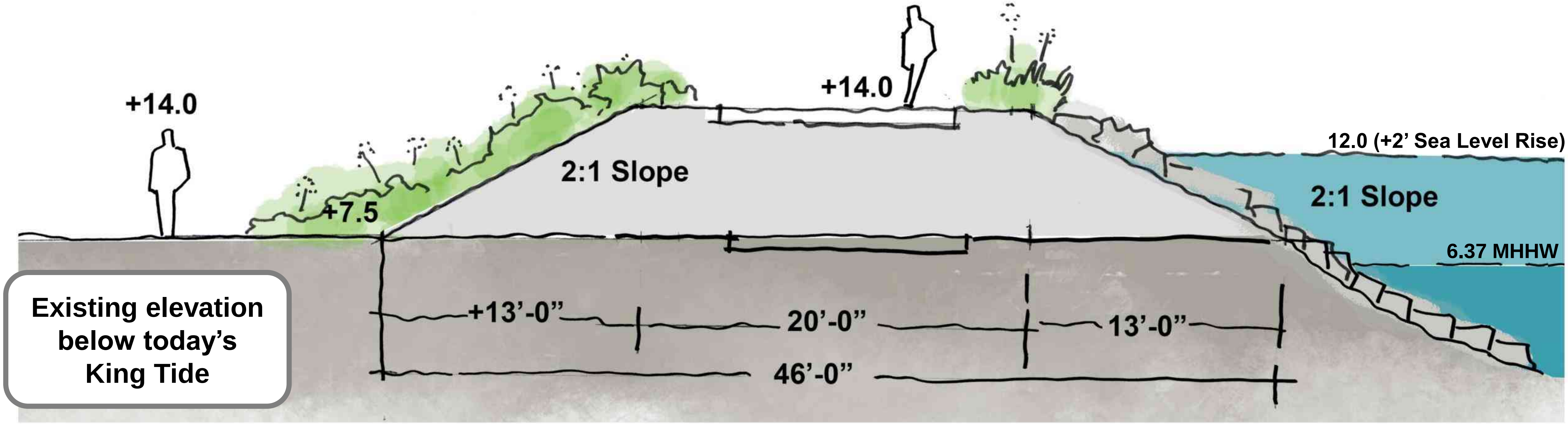



# Alameda Shoreline – Near Term Adaptation

Typical Condition (Barnhill Marina to Shipways)

Shoreline Levee

Build new levee +14.0 with path. Over 6 feet tall relative to adjacent grade.

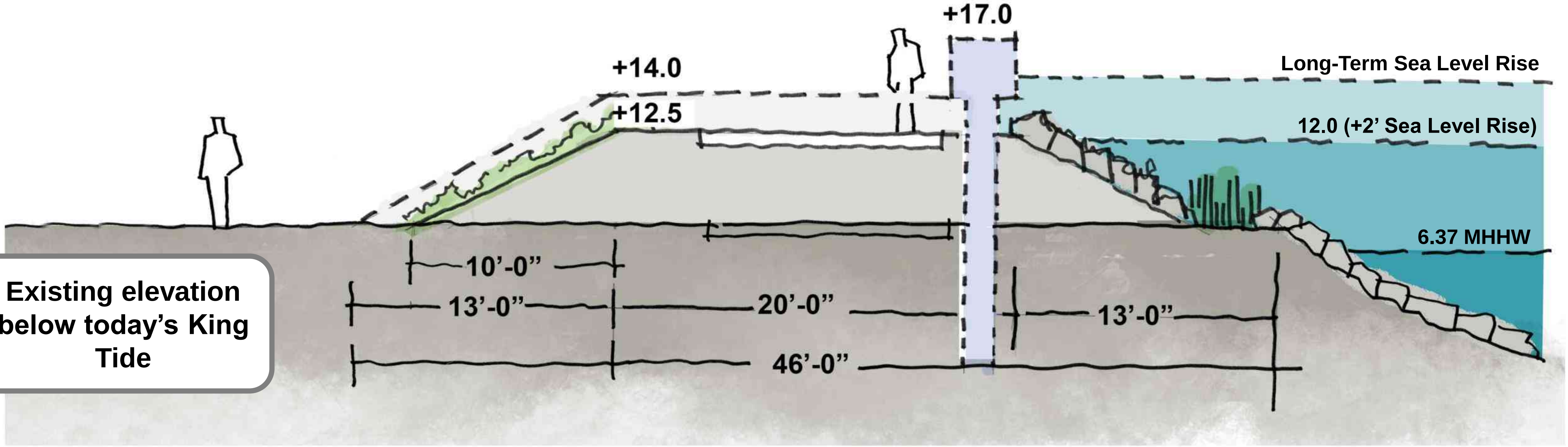



Existing elevation below today's King Tide

# Alameda Shoreline – Long Term Adaptation

Typical Condition (Barnhill Marina to Shipways)
Shoreline Levee with Seawall

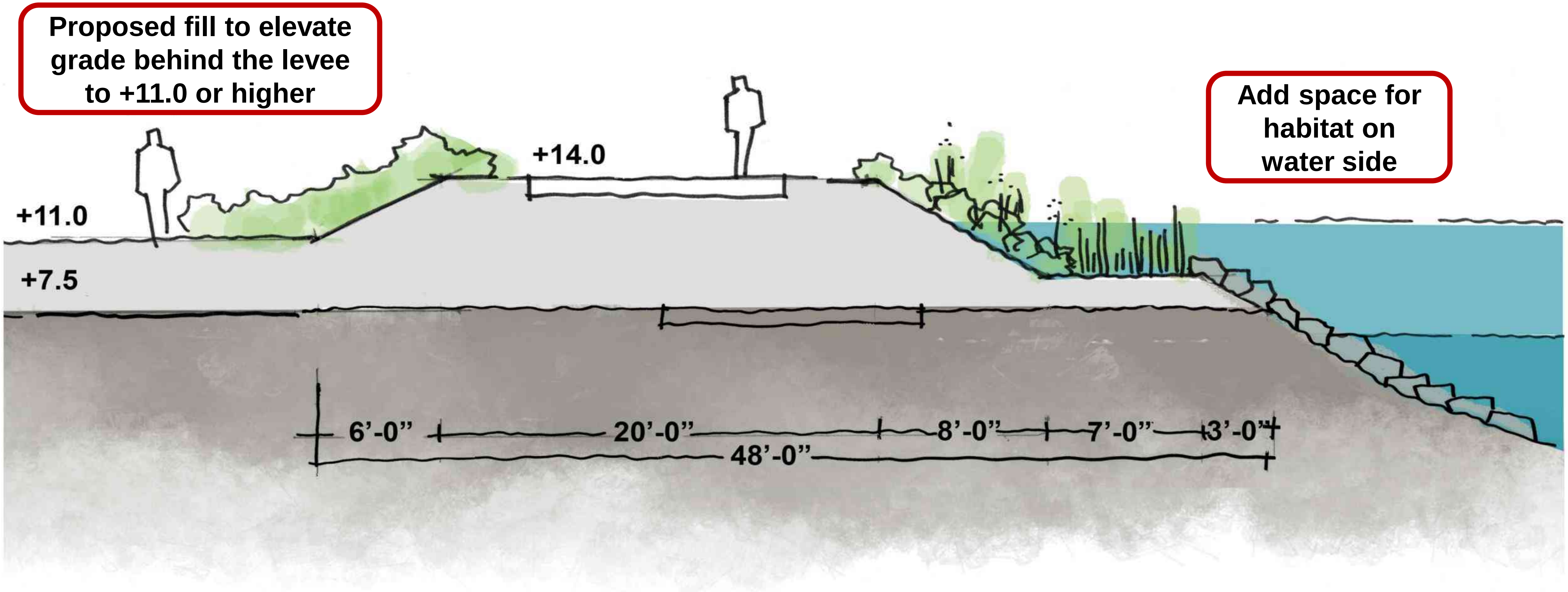
Build levee to +12.5 Near-Term, adapt levee to +14.0, add 3' Seawall Long-Term



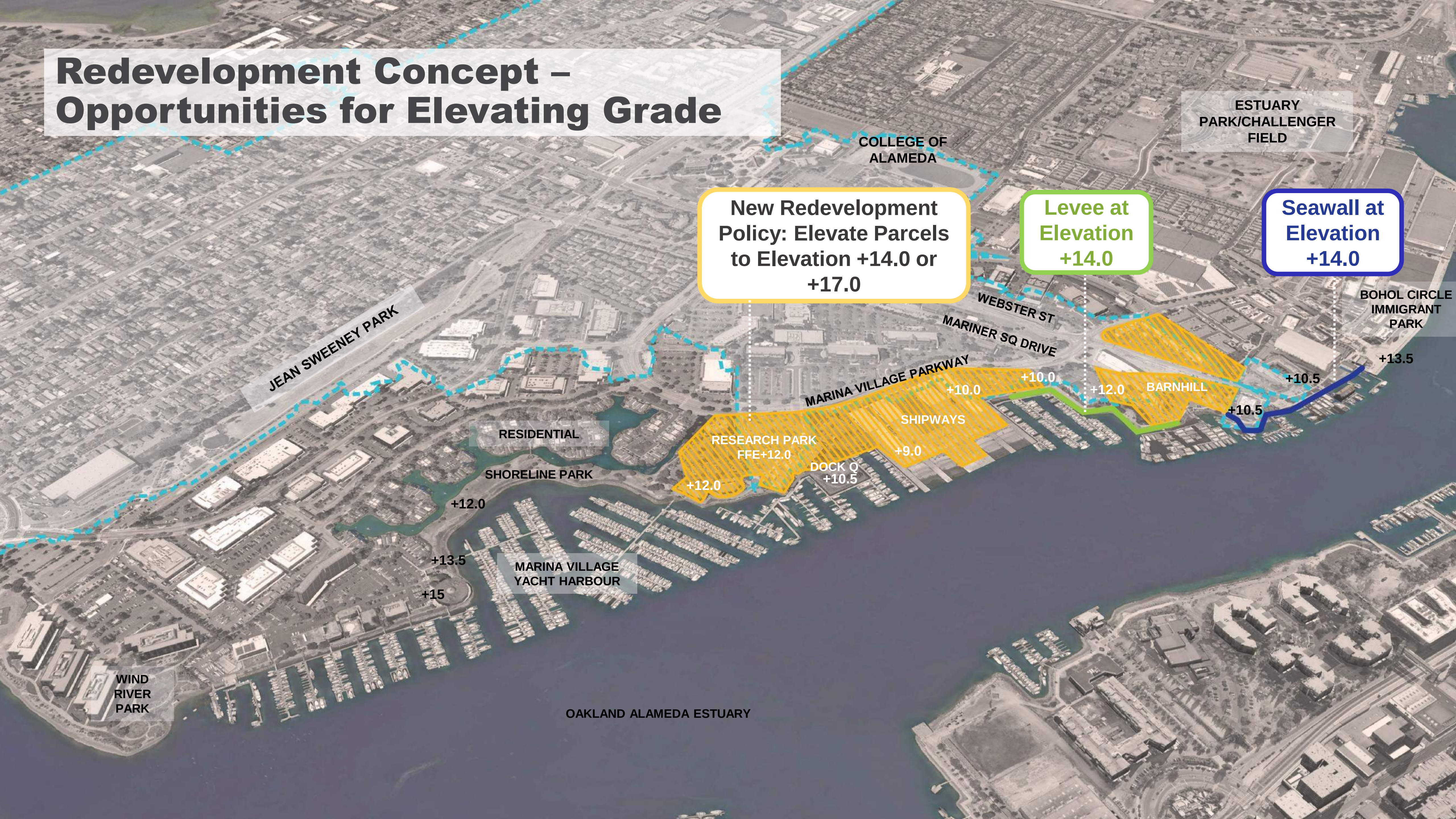

Existing elevation below today's King Tide

# Alameda Shoreline – Near Term Adaptation

Alternative Approach for Redevelopment Sites (Shipways and others)
Shoreline Levee w/ Raised Grade Inland



# Redevelopment Concept – Opportunities for Elevating Grade



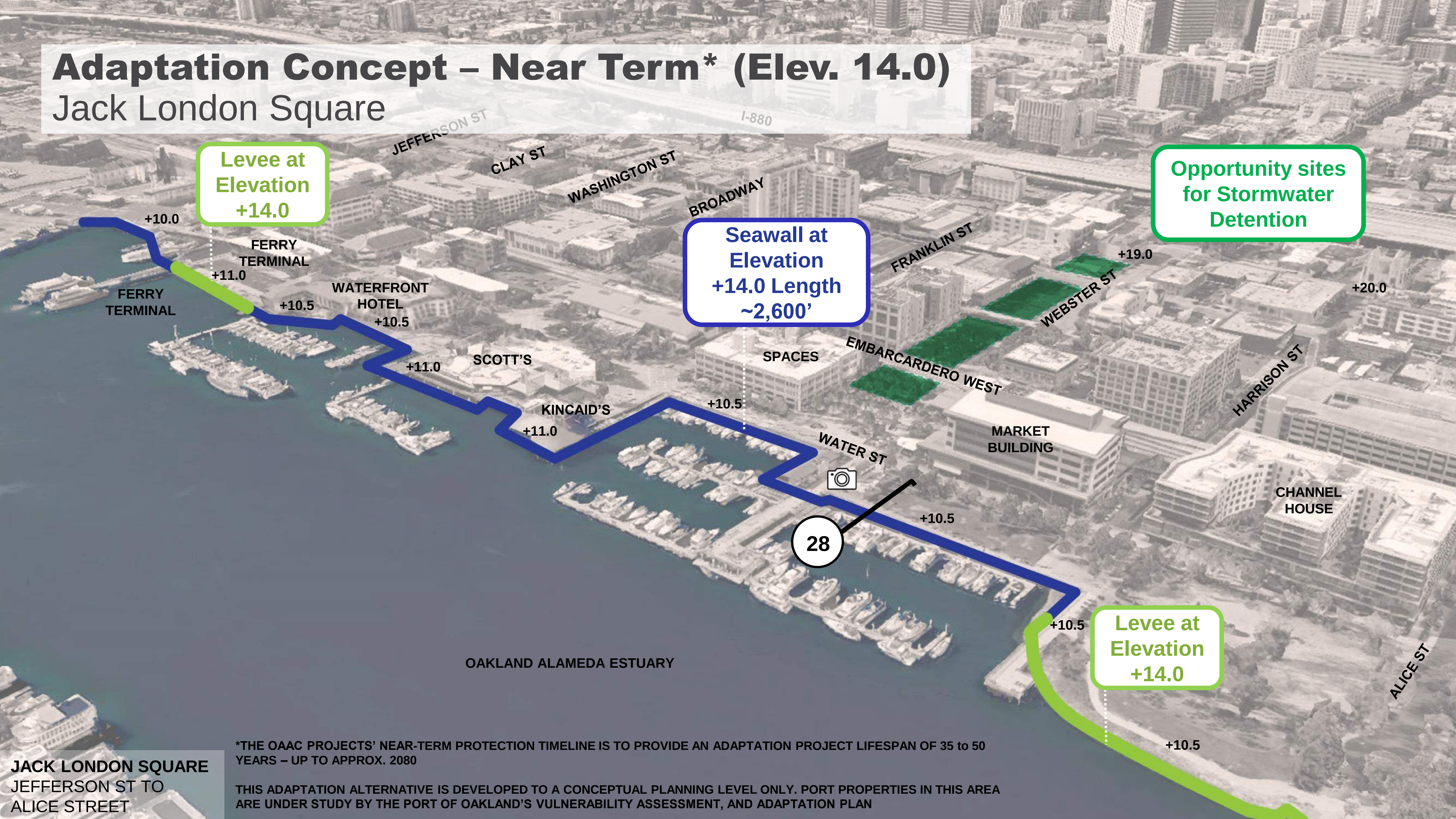
# Oakland Shoreline Adaptation Concepts

*Jefferson Street to Lake Merritt Channel*

# Jack London Square - Port of Oakland Area of Study*


*AREA IS UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Adaptation Concept – Near Term* (Elev. 14.0)
## Jack London Square



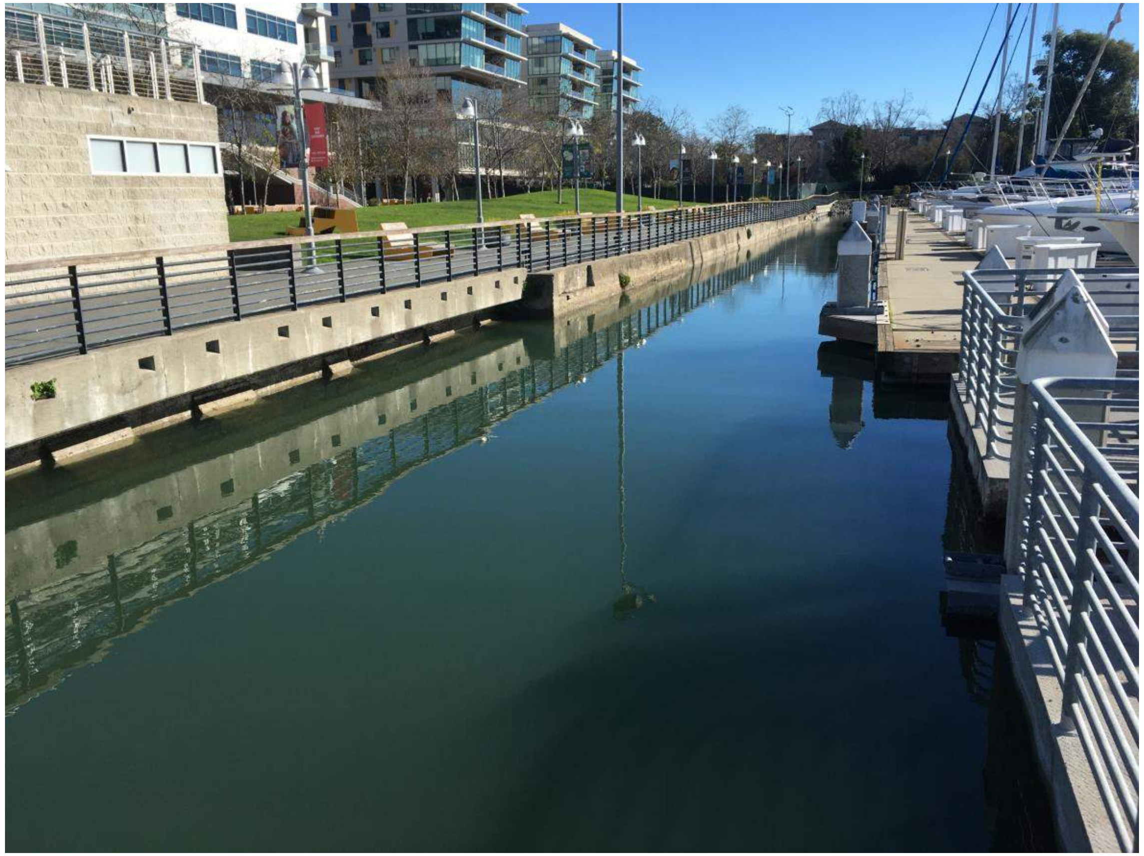

**JACK LONDON SQUARE**
JEFFERSON ST TO
ALICE STREET

*THE OAAC PROJECTS’ NEAR-TERM PROTECTION TIMELINE IS TO PROVIDE AN ADAPTATION PROJECT LIFESPAN OF 35 to 50 YEARS – UP TO APPROX. 2080

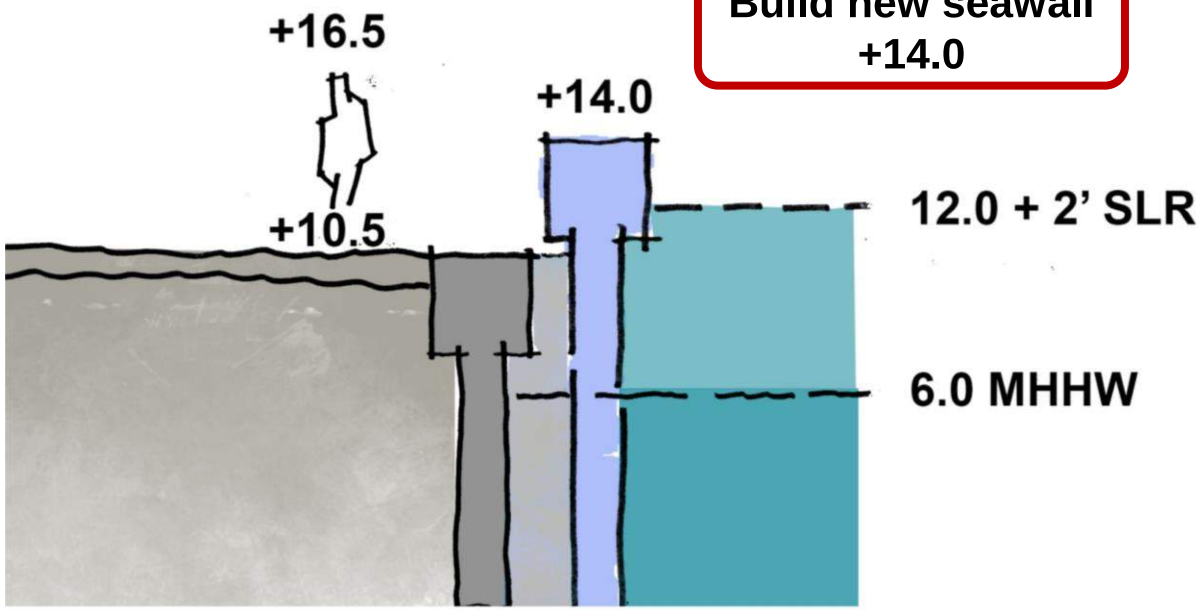
THIS ADAPTATION ALTERNATIVE IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. PORT PROPERTIES IN THIS AREA ARE UNDER STUDY BY THE PORT OF OAKLAND’S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Adaptation Concept – Near Term* (Elev. 14.0)

## Jack London Square
## Elevated Seawall



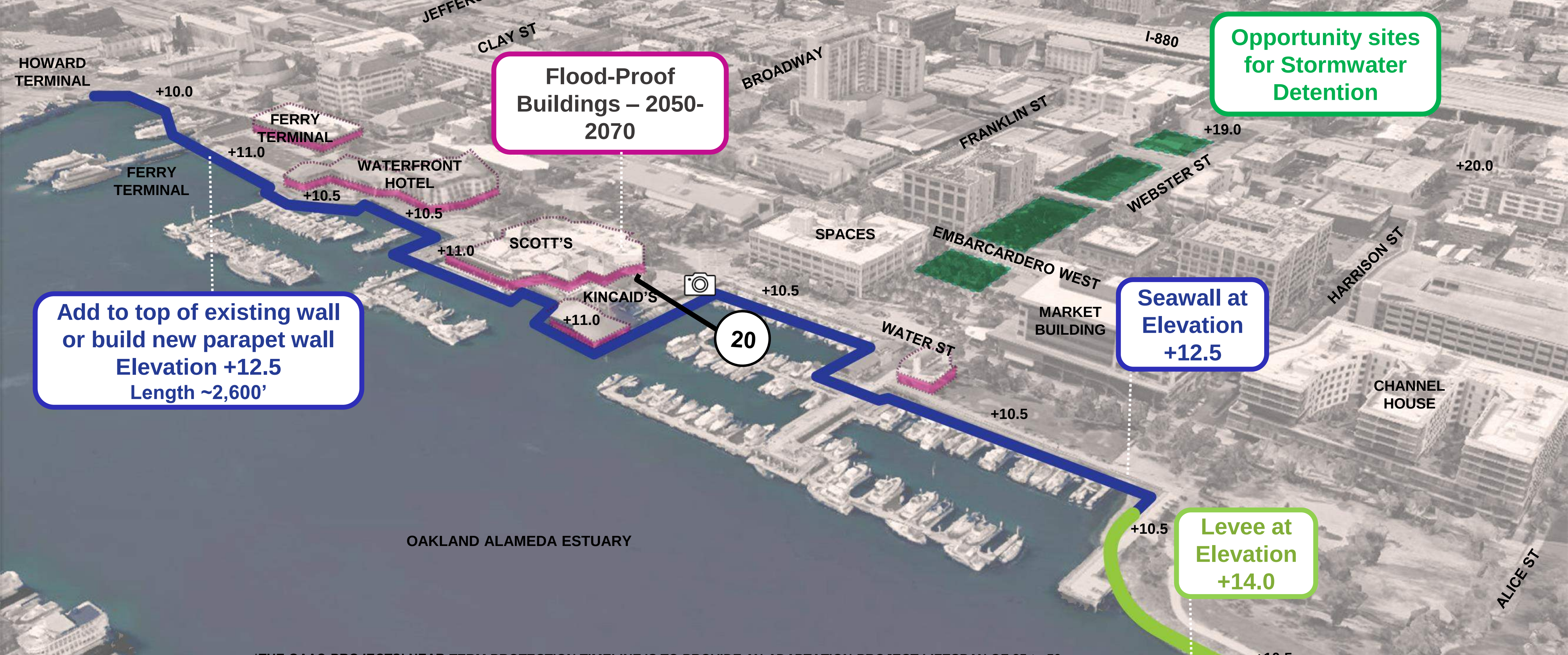
Station 28 – Jack London Market Building




Build new seawall
+14.0

*THIS ADAPTATION CONCEPT IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. AREA IS UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Adaptation Concept – Interim Near Term* (Elev. 12.5)
## Jack London Square



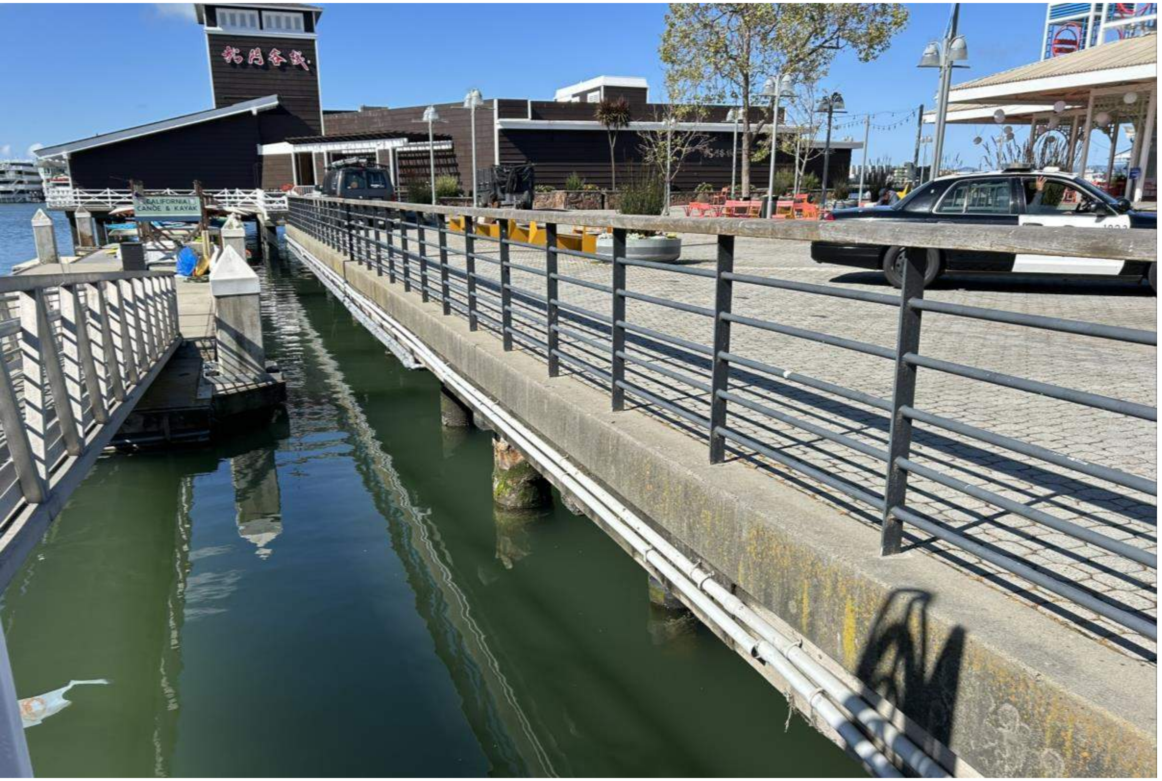

**JACK LONDON SQUARE**
JEFFERSON ST TO
ALICE STREET

*THE OAAC PROJECTS' NEAR-TERM PROTECTION TIMELINE IS TO PROVIDE AN ADAPTATION PROJECT LIFESPAN OF 35 to 50 YEARS – UP TO APPROX. 2080

THIS ADAPTATION ALTERNATIVE IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. PORT PROPERTIES IN THIS AREA ARE UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

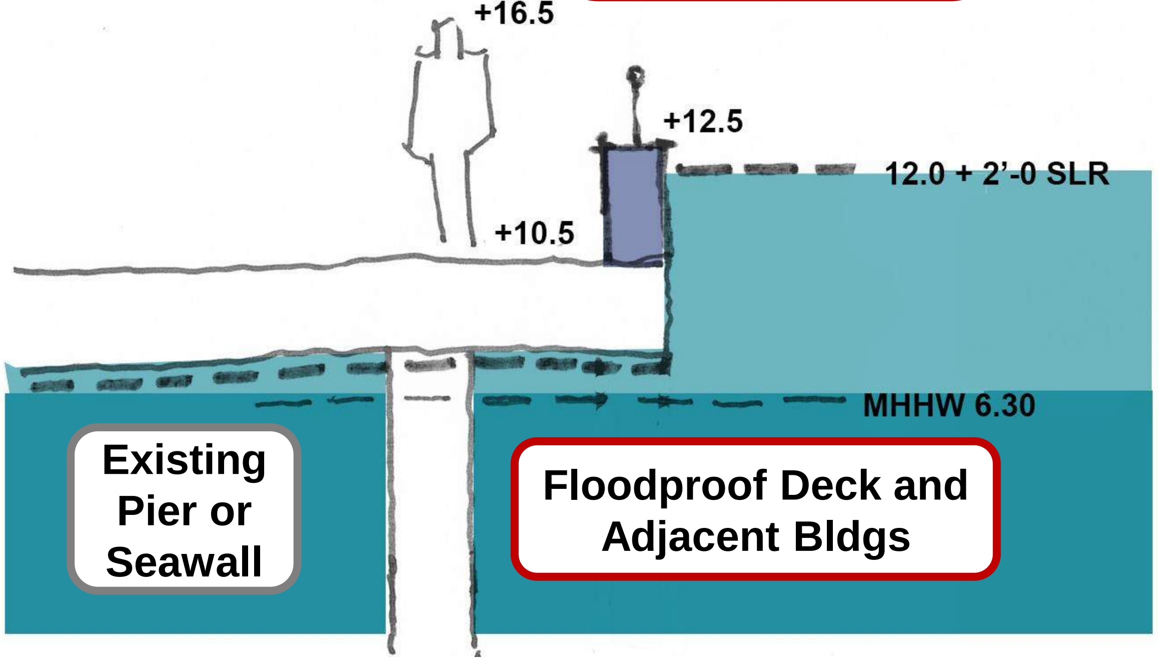
# Adaptation Concept – Interim Near Term* (Elev. 12.5)

## Jack London Square
## Interim Floodwalls & Floodproofing



Station 20 – Jack London Public Dock toward Kincaid's

Add Floodwall to top of Existing Elevation or at Building Face +12.5

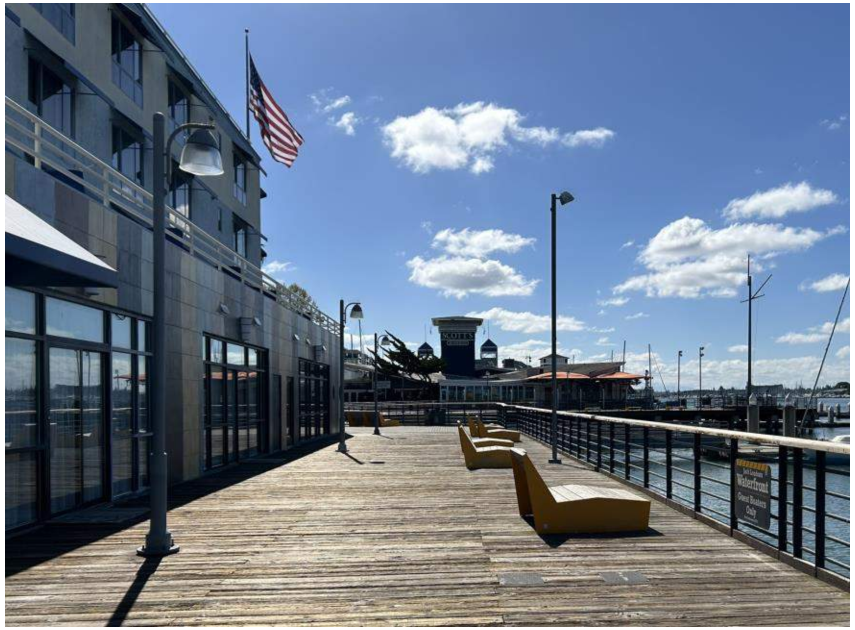



*THIS ADAPTATION CONCEPT IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. AREA IS UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Jack London Site Photos – Edge Conditions

Ferry Lawn

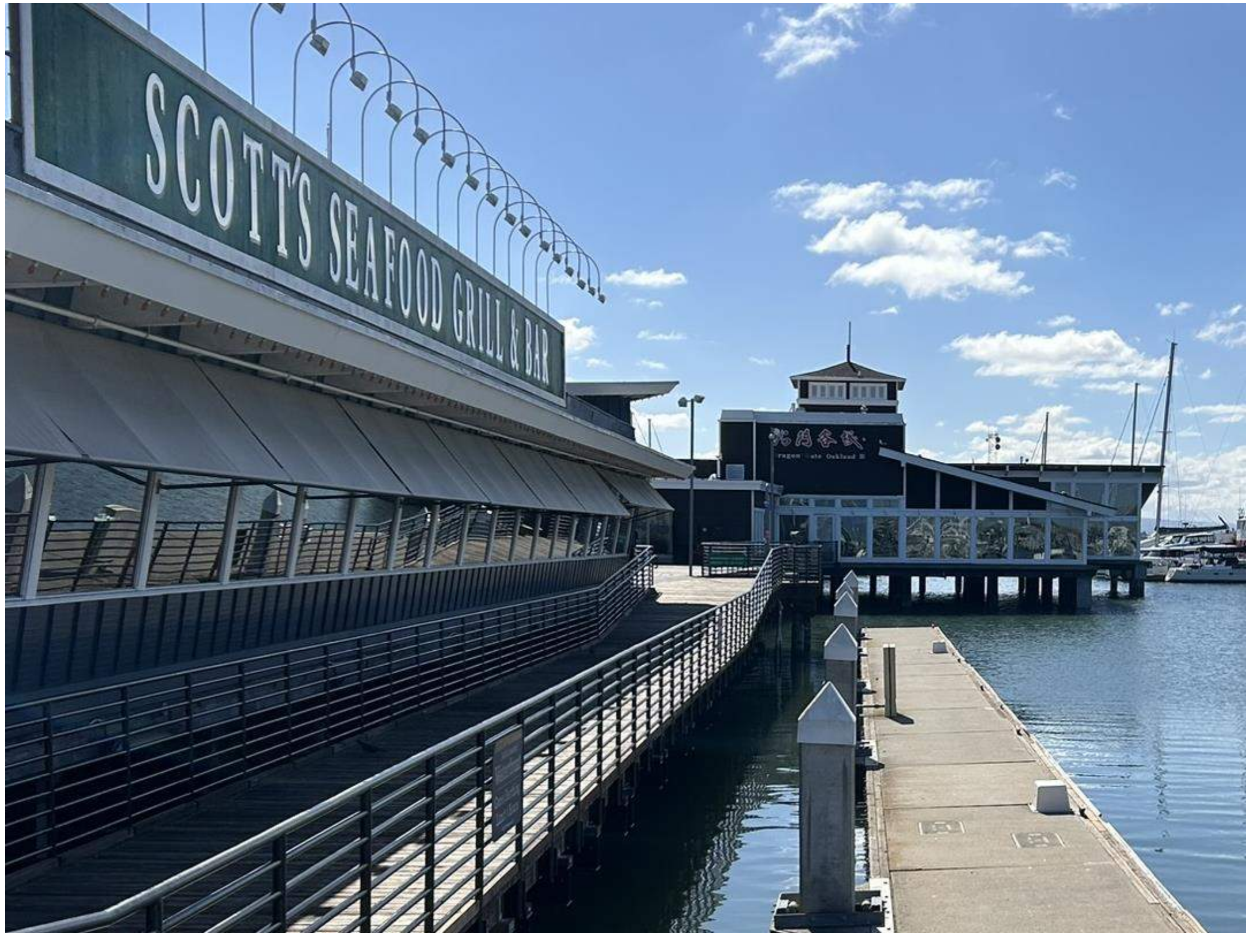
Waterfront Hotel



Waterfront Hotel

# Jack London Site Photos – Edge Conditions

Scott's Seafood – West Edge




Scott's Seafood & Kincaid's Beyond

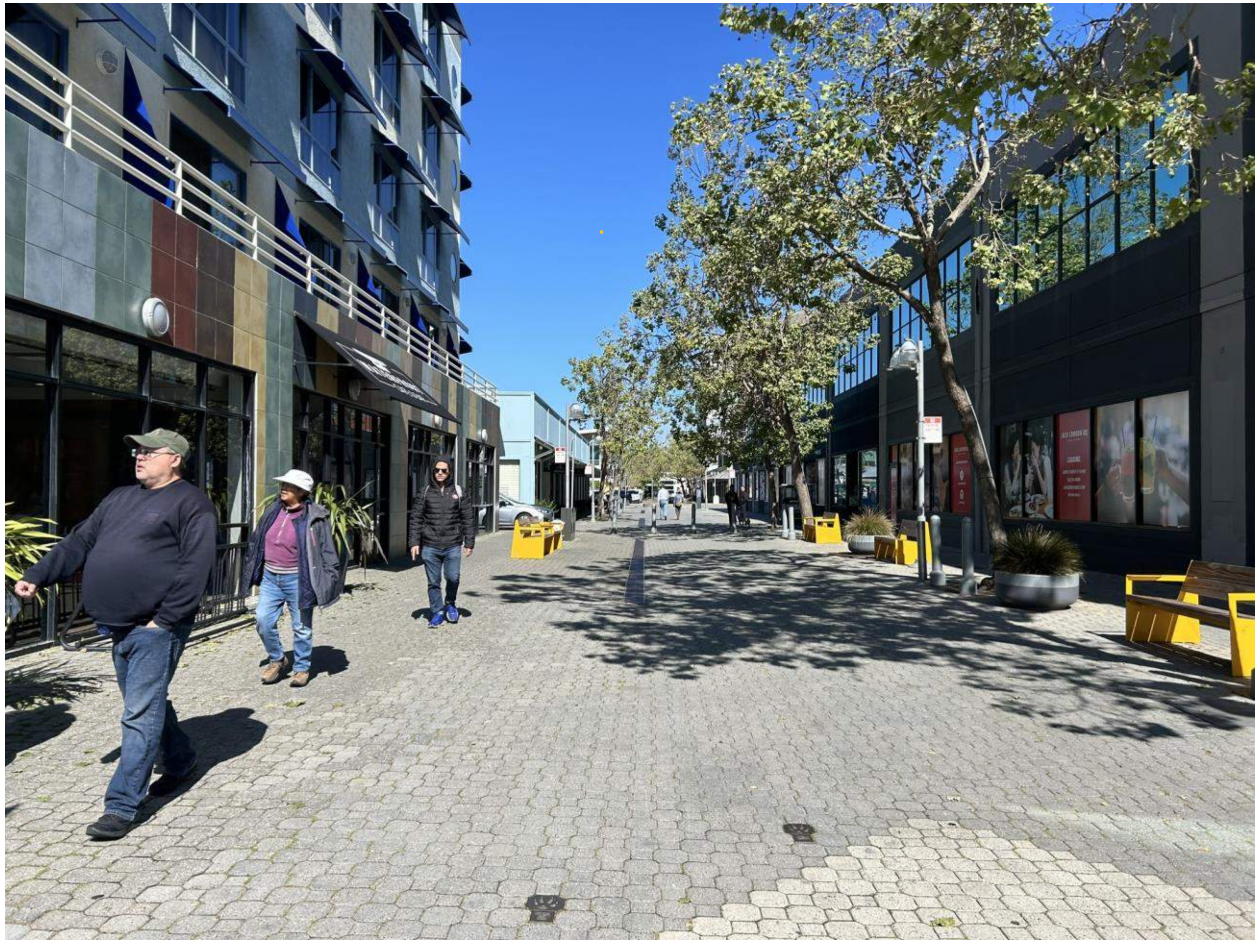
# Adaptation Concept – Water Street Levee & Redevelopment*

## Jack London Square


*THE OAAC PROJECTS' NEAR-TERM PROTECTION TIMELINE IS TO PROVIDE AN ADAPTATION PROJECT LIFESPAN OF 35 to 50 YEARS – UP TO APPROX. 2080

THIS ADAPTATION ALTERNATIVE IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. PORT PROPERTIES IN THIS AREA ARE UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Oakland – Jack London Water Street

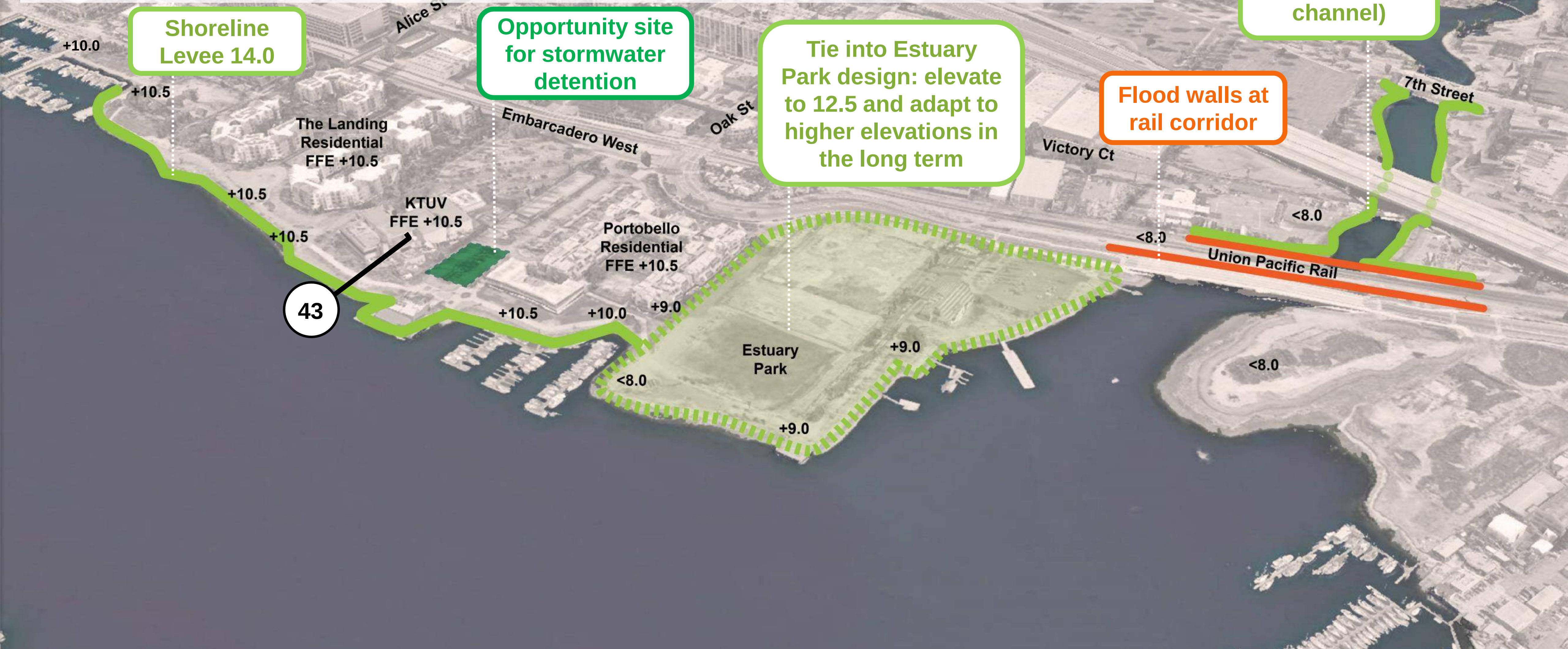


WATER STREET AT BROADWAY


WATER STREET AT FRANKLIN

# Adaptation Concept*

## Alice Street to Lake Merritt Channel
## Shoreline Levee with Public Access and Flood Walls at Channel

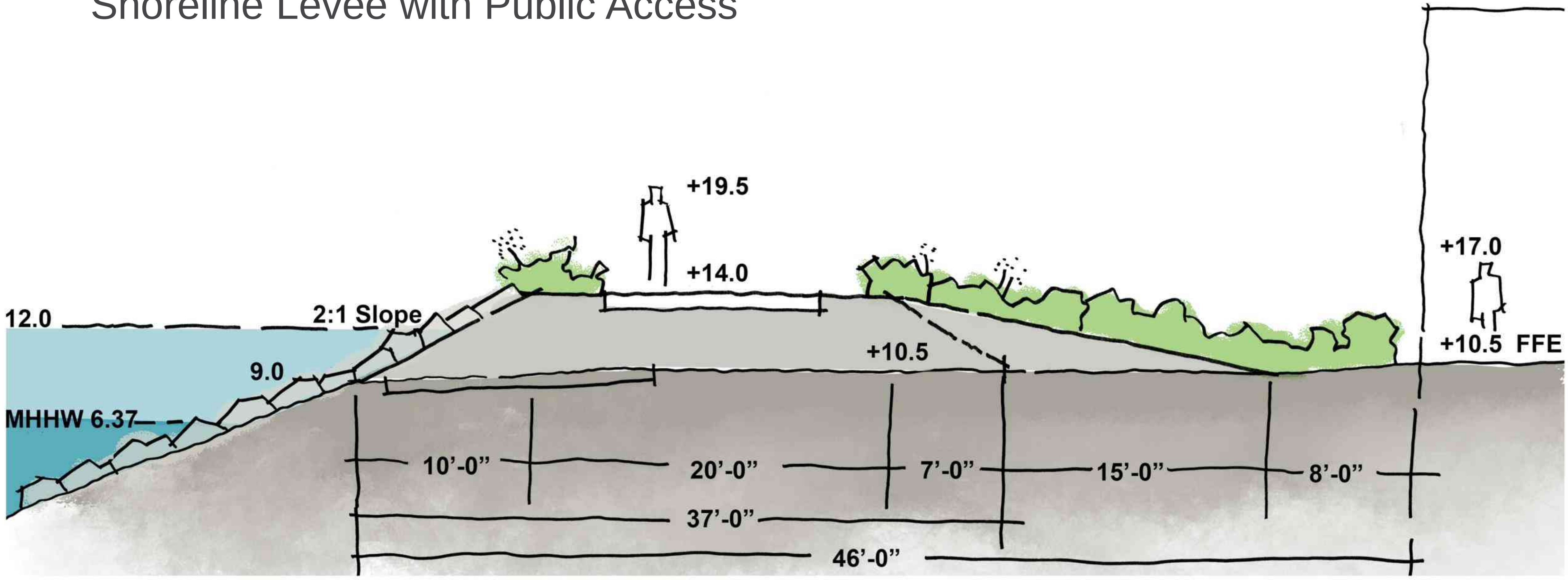



**OAKLAND**
HARRISON STREET TO
LAKE MERRITT CHANNEL

*THIS ADAPTATION ALTERNATIVE IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. PORT PROPERTIES IN THIS AREA ARE UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Oakland Shoreline – Near Term Adaptation

Typical Condition (Alice Street to Lake Merritt Channel)
Shoreline Levee with Public Access



# Adaptation Concept*

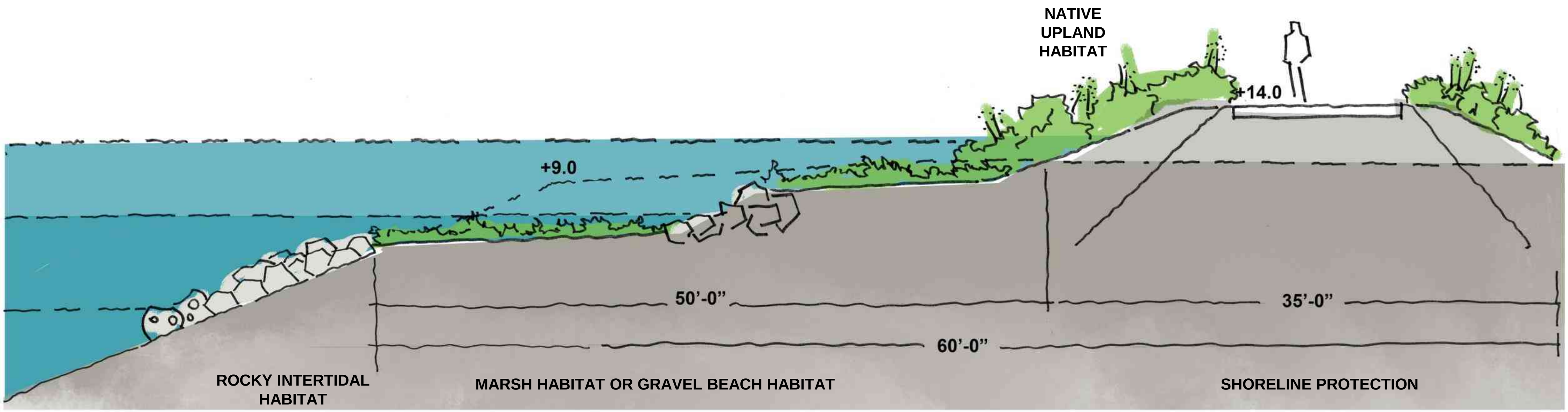
## Alice Street to Lake Merritt Channel
## Shoreline Levee with Habitat Expansion and Tide Gate




*THIS ADAPTATION ALTERNATIVE IS DEVELOPED TO A CONCEPTUAL PLANNING LEVEL ONLY. PORT PROPERTIES IN THIS AREA ARE UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Oakland Shoreline – Near Term Adaptation

Typical Condition (Alice Street to Lake Merritt Channel)
Shoreline Levee with Habitat Expansion




**Station 41 – Lawn Area at The Landing**

# APPENDIX C: DETENTION BASIN PRELIMINARY EVALUATION (ALAMEDA)

# 1 Appendix C: Detention Basin Preliminary Evaluation (Alameda)

Stormwater flooding is caused by extreme precipitation, tidal influences, undersized and aging infrastructure, and 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). The City of Alameda Storm Drain Master Plan (SDMP) was prepared in August 2008. The SDMP identifies deficiencies in the current stormwater system. Figure 1-1 shows the existing 10-year flooding depths for the Alameda Northside area in the SDMP.

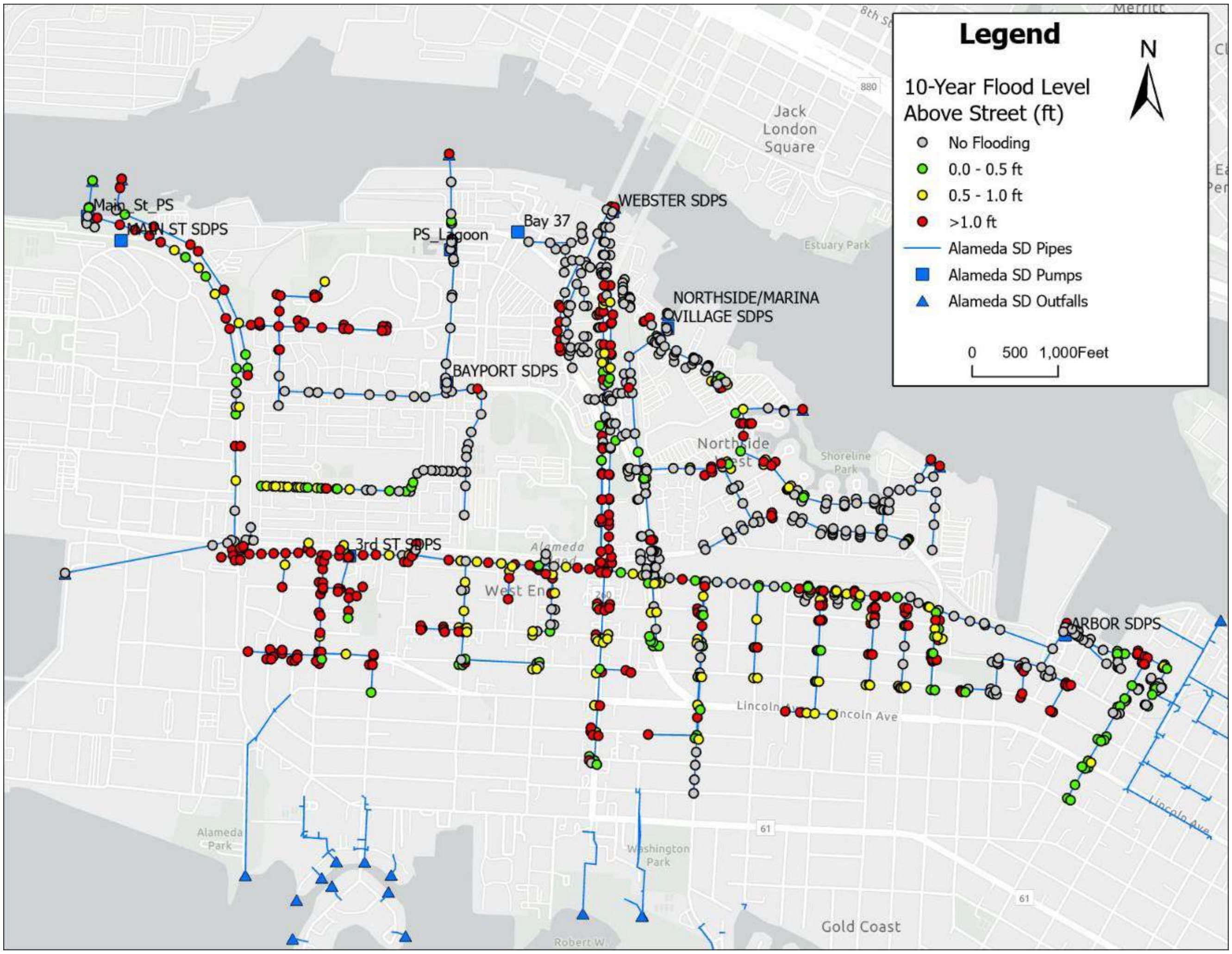



Figure 1-1. City of Alameda (Alameda Island) Existing 10-Year Flooding Depths per 2008 SDMP

Source: (City of Alameda 2008)

Prioritized improvements that are required to alleviate or minimize flooding during a ten-year storm event in the Alameda Northside area per the 2008 SDMP are shown in Figure 1-2, which includes pipe and pump station capacity improvements (at both Arbor and Northside [Marina Village] Pump Stations).

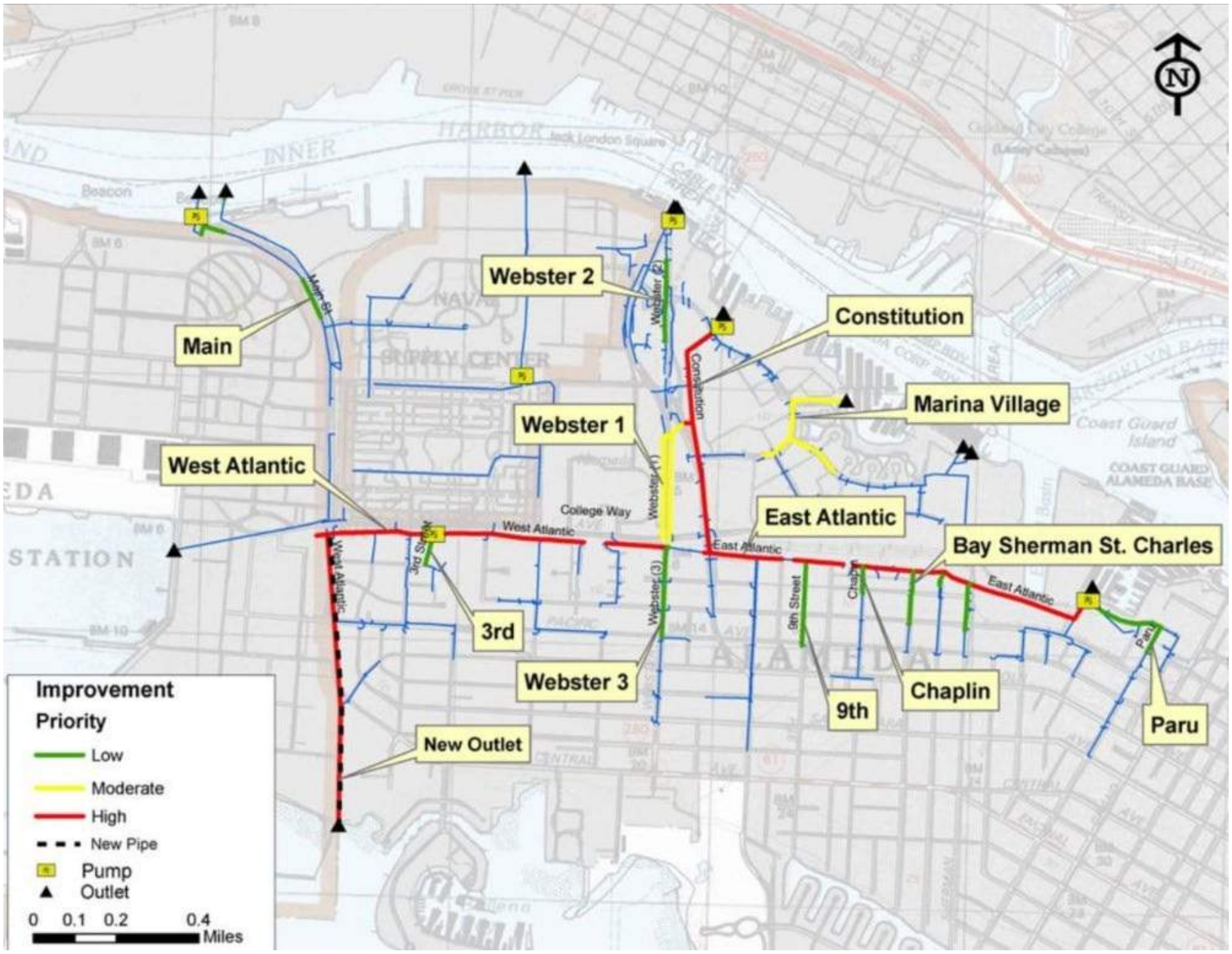



Figure 1-2. City of Alameda (Alameda Island) 10-Year Prioritized Improvements per 2008 SDMP

Source: (City of Alameda 2008)

Per the SDMP, a key component of improving this system is a new 72-inch tying into an existing outfall to the San Francisco Bay. This replaced outfall will reduce the demand on the Marina Village Pump Station. The existing system along Ralph Appezzato Parkway should be disconnected near College Avenue; this will prevent reverse flows in the system. Another disconnect in the system should occur along the railroad easement near Chapin Street; this will isolate the area draining to the Arbor Pump Station. These disconnects will allow the system to operate more effectively and will minimize the need for pump station improvements.

## 1.1 Conceptual Detention Basin Areas

In addition to the improvements to the storm drain network recommended in the SDMP, conceptual locations for stormwater detention basins to reduce flooding and demand on pump stations were evaluated. Areas were chosen based on available open space (lack of buildings or water and sewer infrastructure) and ground elevation in relation to the storm drain network, namely lower-lying areas that would require less excavation to convey stormwater from the main to the location. Conceptual areas identified for stormwater detention are shown in Figure 1-1-3.


Figure 1-1-3. Conceptual Detention Basin Locations

The model utilized in the 2008 SDMP was converted to MIKE+ and modified to evaluate a subset of the Northside area to determine the total water volume above ground for the 100-year, 24-hour event (5.83”). The total water volume above ground was approximately 37 acre-feet in the approximately 800-acre area shown in Figure 1-1-4. Therefore, this volume was targeted to mitigate flooding from the 100-year, 24-hour event.

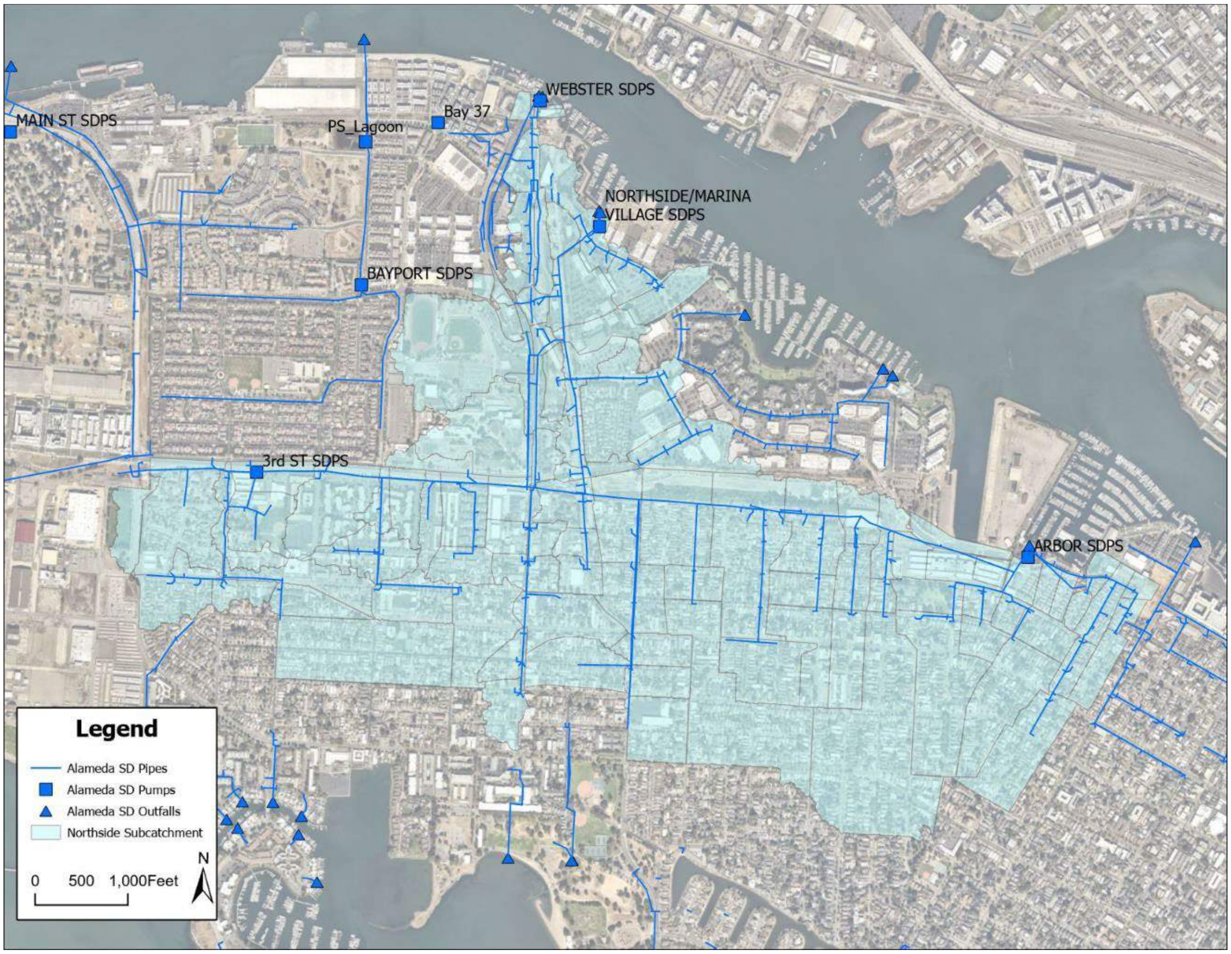



Figure 1-1-4. Subset of Northside Catchment

It is important to note that the total water volume above ground was based on the 100-year, 24-hour event, which is expected to increase by the percentages listed in Table 1-1 – 22% by Year 2050 and 51% by Year 2100.

Table 1-1-1. Precipitation % Change, San Francisco Bay Area Domain (SSP5-8.5)

| Year | 100-yr, 24-hr |
|---|---|
| 2050 | 22.1% |
| 2060 | 26.8% |
| 2070 | 31.2% |

| Year | 100-yr, 24-hr |
|---|---|
| 2080 | 36.6% |
| 2090 | 43.7% |
| 2100 | 51.0% |

Conceptual detention areas were preliminarily identified as either green, where elevations or land use allows, or grey. Green infrastructure (GI) is a nature-based solution that reduces stormwater pollution through a variety of soil-water-plant systems that intercept stormwater, infiltrate a portion into the ground, evapotranspire a portion into the air and, in some cases, release a portion slowly back into the stormwater system. An example rendering of a GI basin is shown in Figure 1-5.

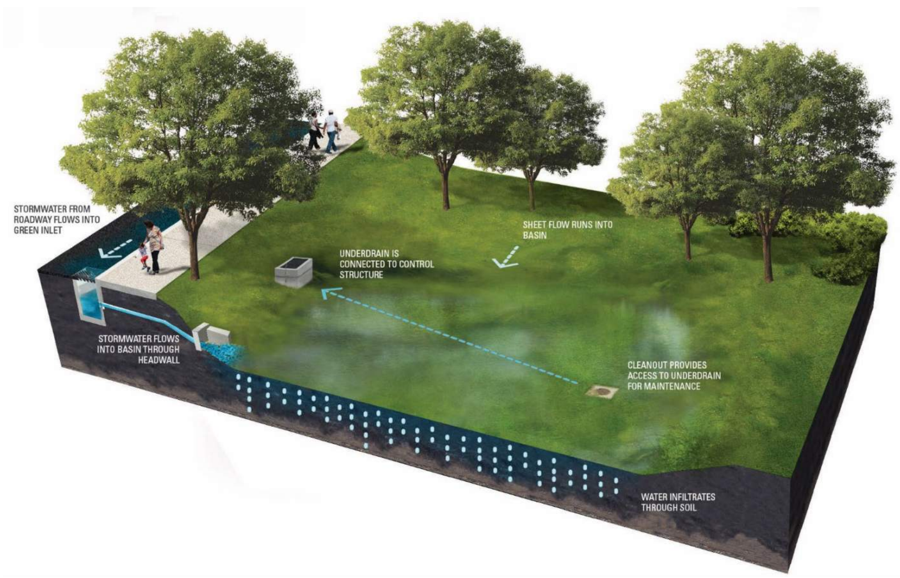



Figure 1-5. Example Rendering of a GI Basin

Source: City of Philadelphia Water Department

Since GI is being proposed to mitigate inland flooding, water would be conveyed from the stormwater main to the basin via a bubble-up device, as an example. Adjacent areas could also be conveyed to the stormwater basin. The basin would allow for water to pond on the surface, and include soil planted with vegetation with stone below. An overflow structure and underdrain with a controlled outlet (e.g. orifice) could be installed to slowly meter flow back to the stormwater network to ensure that the system drains.

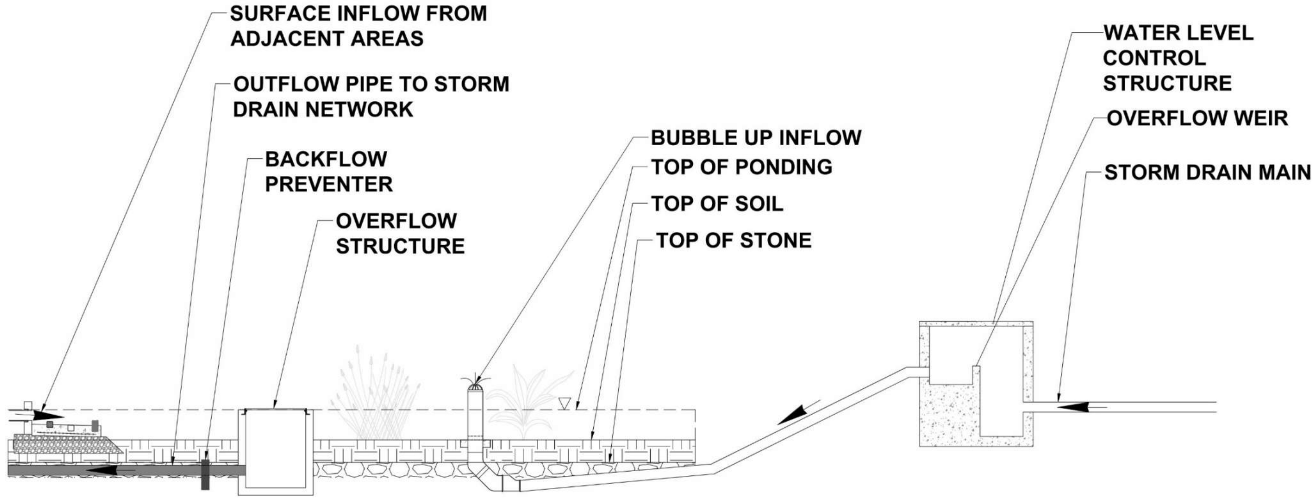



Figure 1-6. Conceptual Green Basin Schematic

Grey stormwater detains stormwater in a subsurface environment using either stone or modular storage. An example of modular storage modules is shown in Figure 1-7, though they can be concrete, arched, and HS-20 traffic-rated depending on the application. An advantage to grey infrastructure is that the surface can continue to be utilized as a parking lot or practice field, for example, and modular storage has a greater storage volume compared to stone (95% of the storage volume compared to 40% of the volume due to void space).

Figure 1-7. Example Modular Storage

Source: Ferguson Waterworks

Stormwater would be conveyed to the grey system using a weir type inlet structure connected to the main. Water from the main would enter the weir structure and flow to the subsurface basin through a pipe. Once the water reaches the height of the weir, it can flow back to the network. The subsurface system could also have an underdrain with a controlled outlet (e.g. orifice) to slowly meter flow back to the stormwater network to ensure that the system drains. The weir structure could also have a device (e.g. orifice along the weir wall) to slowly meter flow to the main to prevent standing water.

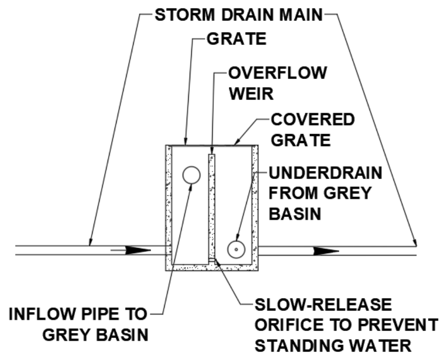



Figure 1-8. Conceptual Grey Basin Inflow

Conceptual basin parameters, including acreage, storage volumes, approximate ground elevations of the location, storm drain main ground elevations and inverts, and excavation depths are shown in Table 1-2. A porosity of 1 was assumed for ponding, 0.2 for soil, and 0.4 for stone. Approximately 132 acre-feet of water could be stored by all the conceptual basins identified, which need to be further vetted for feasibility due to property ownership, land use, etc.

### Table 1-2. Conceptual Basin Parameters

| Location | Type | Area (acres) | Approximate Ground Elevation at Location (ft NAVD88) | Approximate SD Main Ground Elevation at Location (ft NAVD88) | Approximate SD Main Invert Elevation at Location (ft NAVD88) | Target Storage Depth (ft)[(1)] | Adjacent Surface Drainage Area - City (acres) | Adjacent Surface Drainage Area - Non-City (acres) | Total Adjacent Surface Area (acres) | Detention Basin Media | Porosity | Depth (ft) | Excavation Depth (ft)[(2)] | Total Storage Depth (ft) | Storage Volume (acre-ft) | Total Storage Volume (acre-ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jean Sweeney Park | Detention with GI | 5.5 | 17.2 | 17.0 | 10.4 | 5.1 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 2.6 | 7.3 | 5.1 | 14.4 | 18 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 1.7 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 2.2 | |
| Neptune Park | Detention with GI | 2.9 | 8.7 | 8.9 | 2.7 | 4.7 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 2.2 | 6.0 | 4.7 | 6.4 | 8 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.9 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 1.2 | |
| Marina Village Parkway ROW[3] | ROW GI with Detention | 2.0 | Varies | Varies | Varies | 4.5 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 2.0 | Varies | 4.5 | 3.9 | 5 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.6 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 0.8 | |
| City of Alameda ROW[4] | ROW GI with Detention | 0.3 | Varies | Varies | Varies | 4.5 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 2.0 | Varies | 4.5 | 0.6 | 1 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.1 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 0.1 | |
| Alameda #1 | Detention with GI | 1.3 | 7.9 | 6.6 | 2.7 | 2.4 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 0.9 | 5.3 | 2.4 | 1.2 | 2 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.4 | |
| Alameda # 2 and #3 | Detention with GI | 0.8 | 7.8 | 7.3 | 2.0 | 3.8 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 1.3 | 3.9 | 3.8 | 1.0 | 2 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.2 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 0.3 | |
| College of Alameda #1A & #1B | Detention with GI | 4.5 | 10.5 | 10.8 | 2.0 | 7.3 | 0.7 | 0.3 | 1.0 | Ponding | 1.0 | 4.8 | 7.00 | 7.3 | 21.6 | 25 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 1.4 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 1.8 | |
| College of Alameda #2 | Detention with GI | 1.4 | 9.0 | 8.0 | 3.4 | 3.1 | 0.1 | 1.0 | 1.1 | Ponding | 1.0 | 0.6 | 4.08 | 3.1 | 0.8 | 2 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.4 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 0.5 | |
| College of Alameda #3A-#3F | Grey Detention | 15.1 | 15.0 | 11.5 | 2.7 | 7.3 | 2.7 | 17.2 | 19.9 | Modular Storage | 0.95 | 4.0 | 7.49 | 4.0 | 57 | 57 |
| Bay Eagle Park | Detention with GI | 0.6 | 9.0 | 9.9 | 3.7 | 4.7 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 2.2 | 3.76 | 4.7 | 1.3 | 2 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.2 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 0.2 | |
| Parking Lot - Marina Village Parkway | Detention with GI | 1.6 | 9.0 | 10.0 | 5.4 | 3.1 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 0.6 | 2.06 | 3.1 | 1.0 | 2 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.5 | |
| | | | | | | | | | | Stone | 0.4 | 1.0 | | | 0.6 | |
| REAP #1 (to Webster PS) | Detention with GI | 1.2 | 4.5 | 6.9 | 2.7 | 2.7 | Not evaluated | Not evaluated | - | Ponding | 1.0 | 1.7 | 0.32 | 2.7 | 2.0 | 2 |
| | | | | | | | | | | Soil | 0.2 | 1.0 | | | 0.2 | |
| REAP #2 & #3 (to Marina PS) | Detention with GI | 1.5 | 6.0 | 8.2 | -0.8 | 7.5 | Not evaluated | Not evaluated | - | Ponding | 0.6 | 5.0 | 5.31 | 7.5 | 4.5 | 6 |
| | | | | | | | | | | Soil | 0.2 | 1.5 | | | 0.5 | |
| | | | | | | | | | | Stone | 1.0 | 1.0 | | | 1.5 | |
| | | | | | | | | | | | | | | | **Total** | **132** |

Notes:

1. The target storage depth is the storm drain main ground elevation minus the invert, minus 1.5' assuming some loss required to ensure positive drainage to the system, and from the underdrain back to the main.
2. The excavation depth is the approximate ground elevation at the proposed basin location minus the approximate storm drain main ground elevation, plus the storage depth.
3. The Marina Village Parkway ROW is approximately 78' wide. This assumes that the existing street has a crown and GI would be on each side (16' wide although only 14' was assumed for storage, approximately 3,050' long on each side, as 20 separate systems after subtracting for driveways). The average depth is 6' but 4.5' was used assuming losses to ensure positive drainage to/from the system. A 16' width was assumed on each side for GI (32' total), allowing for two 12' travel lanes (24' total), 5' for sidewalks (10' total), and 6' for bike lanes (12' total).
4. Assumes 150 GI measures that are 16' long x 6' wide; actual locations to be determined.

### 1.1.1 Jean Sweeney Park

The conceptual basin area avoids the northwest portion of the park, where a proposed aquatic center will be located. The park is at an approximate elevation of 16’, with elevation increasing to the east. The northern main on Atlantic Avenue should be connected to the park, which is at a ground elevation of approximately 17’, as opposed to the southern main, which is at a ground elevation of approximately 10’.

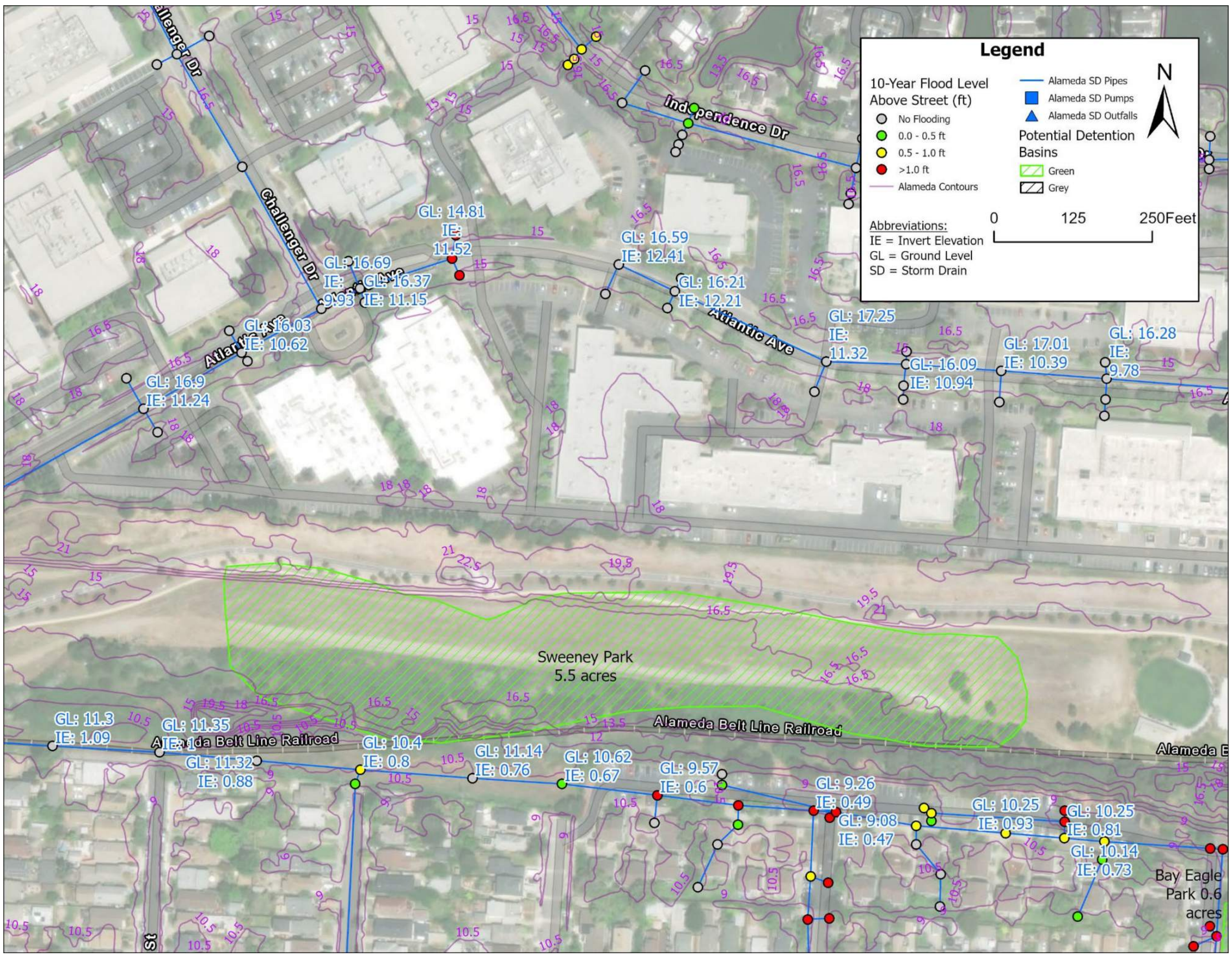



Figure 1-9. Jean Sweeney Park Conceptual Detention Basin

### 1.1.2 Neptune Park

The site ranges in elevation from approximately 7.5’ to 12’ and the adjacent main is at a ground elevation of approximately 9’. The western main on Webster Street should be connected to the park as opposed to the main on Wilma Chan Way based on flood levels identified in the SDMP.

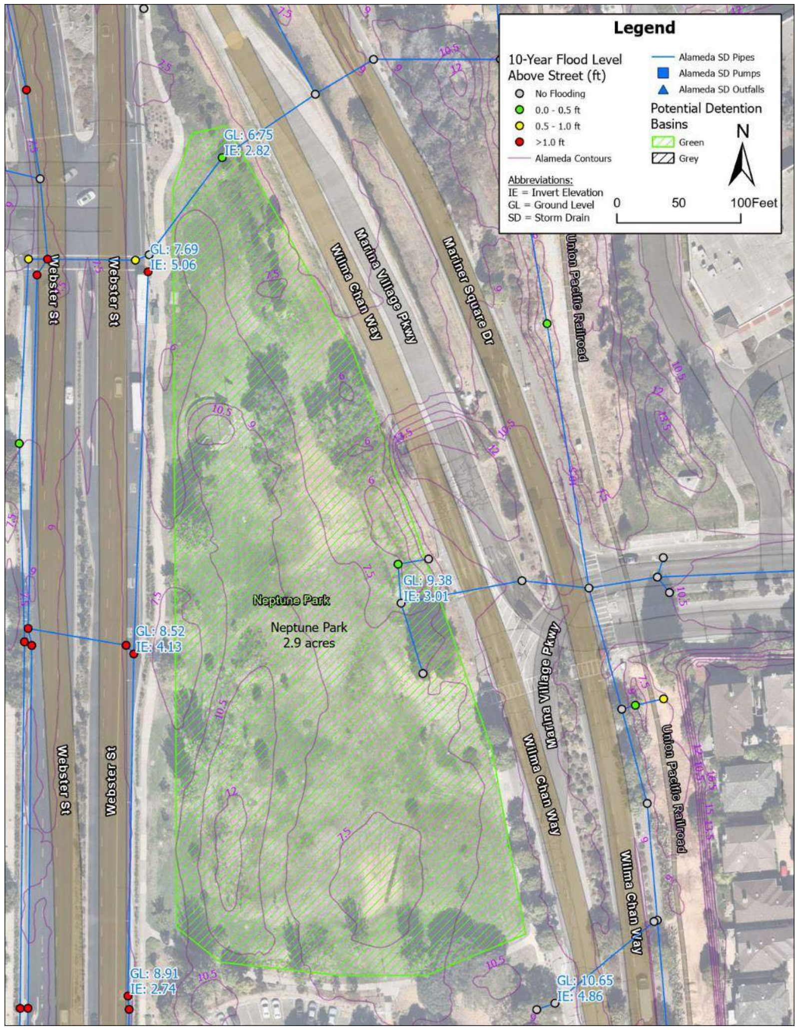



Figure 1-10. Neptune Park Conceptual Detention Basin

### 1.1.3 REAP and City of Alameda

The REAP center is located on land owned by the Union Pacific Railroad. It is a low-lying area; REAP #1 is approximately 4.5’ in elevation. Stormwater runoff from Marina Village Parkway accumulates at the REAP Center. Per conversations with REAP staff, the REAP center manages stormwater on the west side of REAP #1, while stormwater from the east side is pumped by the city to the north side of Marina Village Parkway, where it is eventually conveyed to the Webster Pump Station. REAP #2 and #3 (approximate elevation of 6’) are conveyed to the Marina Village Pump Station. There is an 8” sewer between REAP #1 and #2 areas. The break between Areas #2 and #3 is due to an access road and 12” water main, though they could be hydraulically connected with a culvert. REAP Area #3 also avoids the Marina Village sewer lift station to the south.

Alameda Area #1 could be hydraulically connected to REAP #1. The break between Alameda #2 and #3 is due to a 12" water main, though these areas could be hydraulically connected. A portion of Alameda #2 and #3 is within the Caltrans ROW per the publicly available Caltrans web map service ROW boundary.

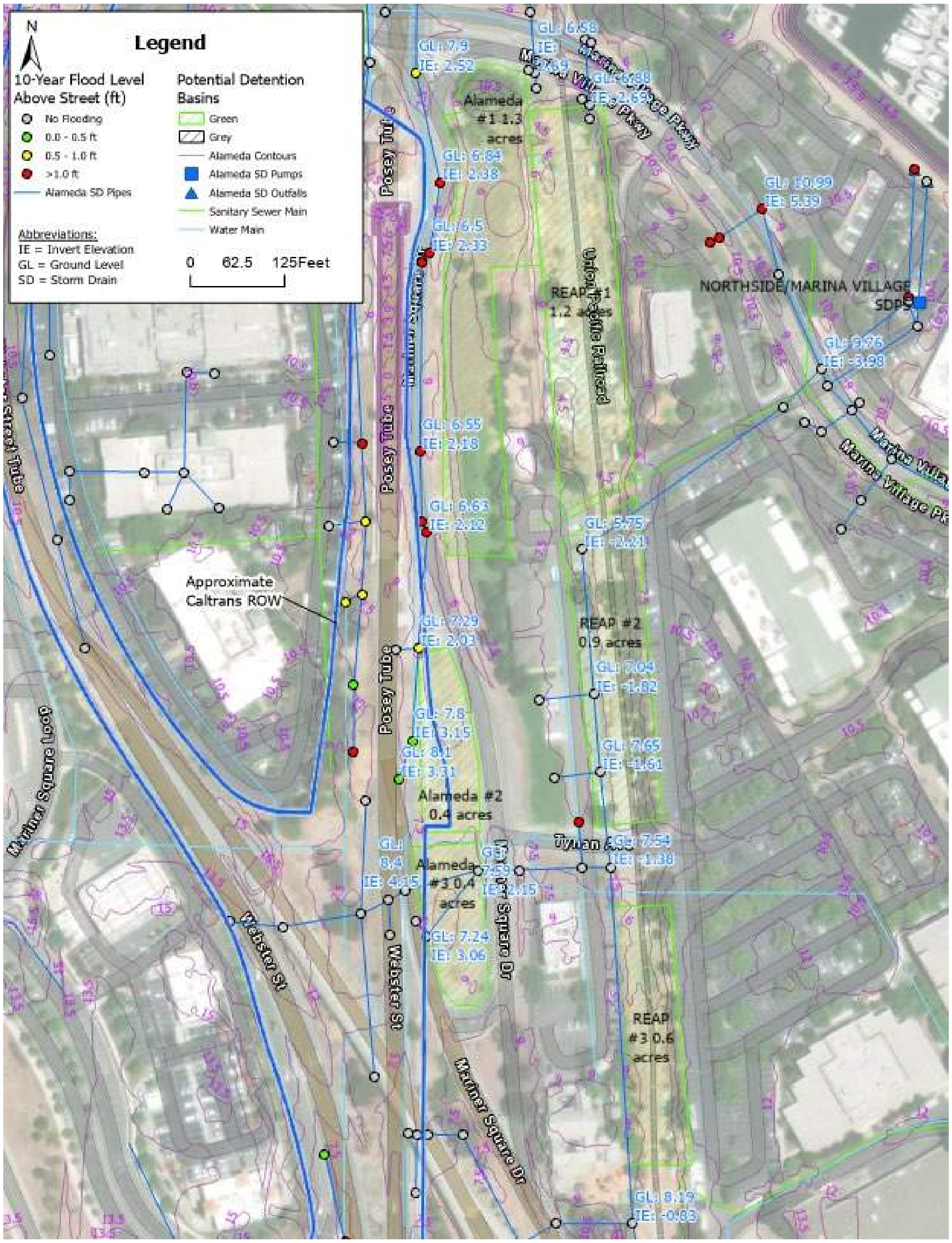



Figure 1-11. REAP and City of Alameda Conceptual Detention Basins

### 1.1.4 College of Alameda

Several areas (parking lots, baseball field, track) were identified on the west and north side of the College of Alameda that could be suitable for grey basins. These areas were identified for grey as opposed to green basins because they are at a higher elevation than the source main on Ralph Appezato Memorial Parkway and could continue to function with their current use as a subsurface system. The grey areas are at an elevation of 13.5' to 15' (NAVD 88) while the ground elevation near the main is approximately 11.5', so approximately 3.5' of over-excavation would be required just to reach the maximum storage depth. The main on Ralph Appezato Memorial Parkway should be connected to the system as opposed to the adjacent main on 5th Street based on flood levels identified in the SDMP. Conceptual green basin areas primarily at elevations of 9' (north) and 10.5' (south) were identified along the eastern side of the College of Alameda, which could either capture stormwater from the main on Ralph Appezato Memorial Parkway, which is higher in elevation than Webster Street, or Webster Street. Runoff from streets adjacent to the detention basins, including city or college campus streets, estimated at approximately 2.1 acres for Areas #1A, 1B, and #2, and 20 acres (including the proposed impervious basin areas) for Areas #3A-3F could be conveyed to the basins. Areas #1A, #1B, and #2 have breaks where utility connections (sewer or water) were observed. Areas could also be combined hydraulically via culverts or check dams to manage elevation changes.

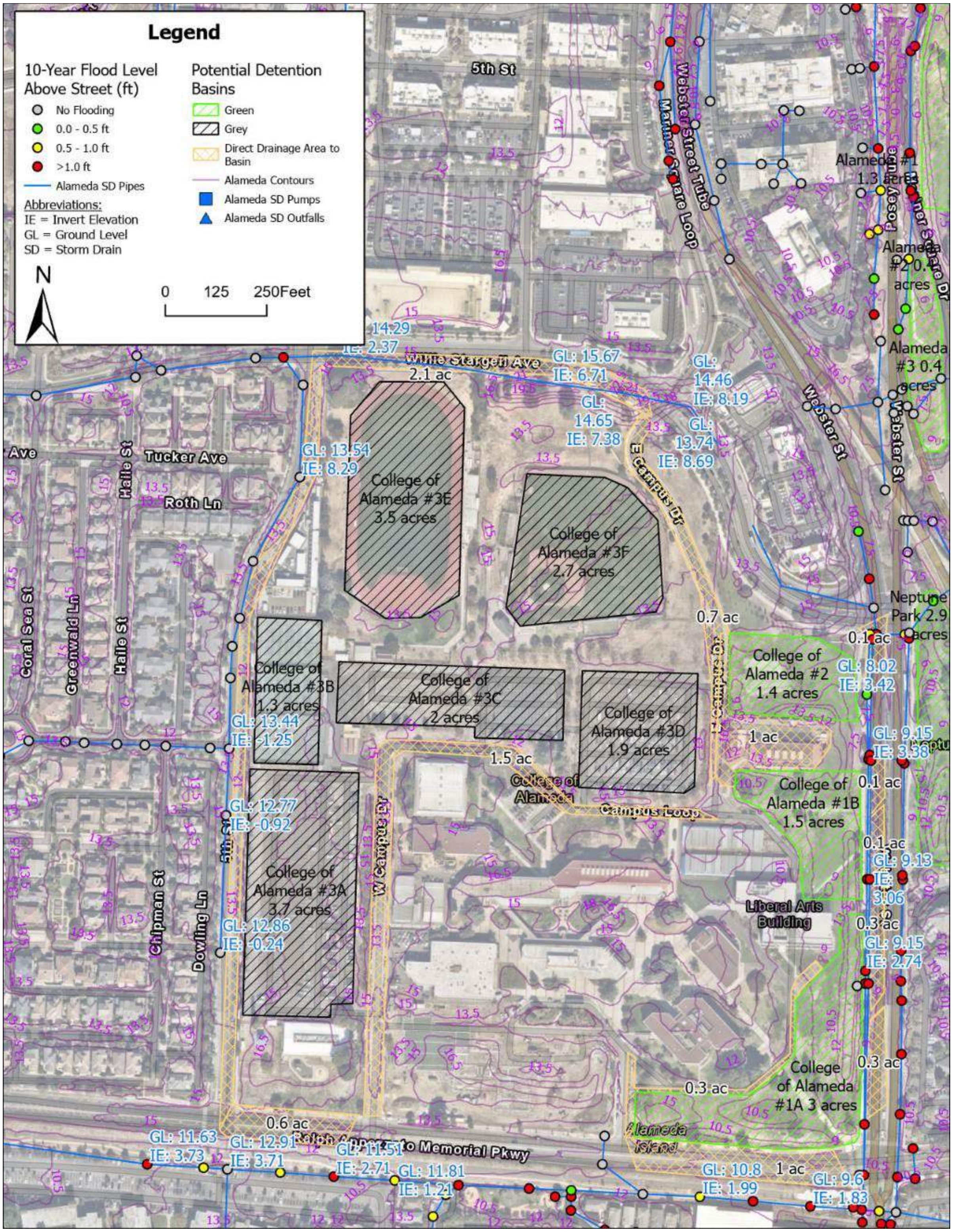



Figure 1-12. College of Alameda Conceptual Detention Basins

## 1.1.5 Bay Eagle Park

This park (assumed to be privately owned) is located south of Jean Sweeney Park. It is at an elevation of approximately 9' compared to 9.5' for the storm drain main.


Figure 1-13. Bay Eagle Park Conceptual Detention Basin

## 1.1.6 Parking Lot Area along Marina Village Parkway

A low-lying (primarily 9' in elevation compared to approximately 10' for the adjacent main) privately owned area was identified in the Marina Village Parkway parking lot for a conceptual basin. It is currently identified as green but could be utilized as a grey basin if the intended future use is also a parking lot.


Figure 1-14. Parking Lot Area along Marina Village Parkway Conceptual Detention Basin

## 1.2 Green Infrastructure in the ROW

The Municipal Regional Permit (C3 requirements) that went into effect July 1, 2023, will be the main impetus for requiring GI in the right-of-way (ROW), as well as on properties that meet the 5,000 square foot (SF) development threshold. Permittees subject to the 5,000 SF threshold are also required to retrofit existing public streets for example, sidewalk or street frontage) and parking lots to treat runoff with low-impact development (LID)/GI measures and meet certain targets for impervious area treated. The threshold was also reduced to 5,000 SF contiguous impervious area for new roads (including sidewalks and bike lanes, adding a traffic lane to an existing road, public works maintenance projects, and even certain trail projects where gravel is considered an impervious surface unless it is constructed like pervious pavement). However, road maintenance and reconstruction projects (including utility trenching greater than eight feet wide) are regulated starting at 1 acre of contiguous impervious surface.

The following resources should be utilized for designing GI in the City of Alameda to comply with C3 requirements:

- Factsheet on new roads and reconstruction/maintenance of roads and parking lots is available at the following link: https://cleanwaterprogram.org/wp-content/uploads/2023/02/C.3-MRP-Changes-Roads-Factsheet-2022-12-07-approved.pdf.
- Alameda Countywide Clean Water Program's C.3 Stormwater Technical Guidance (https://cleanwaterprogram.org/wp-content/uploads/2024/05/C3TG-8.2-compiled-20240519.pdf)
- City of Alameda Green Infrastructure Plan (https://www.alamedaca.gov/files/sharedassets/public/v/1/public-works/key-documents/alameda-gi-plan-with-all-appendicies_-electronic-version_12-3-19.pdf).

#### *1.2.1.1 Marina Village Parkway ROW*

This area was evaluated for large-scale GI assuming that one lane could be used for GI. It is at an approximate elevation of approximately 9' to 10.5' in the north, with elevation increasing to the south to up to 12'. The average depth of the storm drain main in this area is approximately 6'. There is an 8" to 12" water main and an 8" to 15" sanitary sewer main in the south that should be avoided unless relocated. This area outfalls to the Marina Village Storm Drain and Webster Station Pump Station, with an additional outfall near Shoreline Park. The Marina Village Parkway ROW is approximately 78' wide. This assumes that the existing street has a crown and GI would be on each side (16' wide although only 14' was assumed for storage, approximately 3,050' long on each side, as 20 separate systems after subtracting for driveways). The average depth is 6' but 4.5' was used assuming losses to ensure positive drainage to/from the system. A 16' width was assumed on each side for GI (32' total), allowing for two 12' travel lanes (24' total), 5' for sidewalks (10' total), and 6' for bike lanes (12' total).

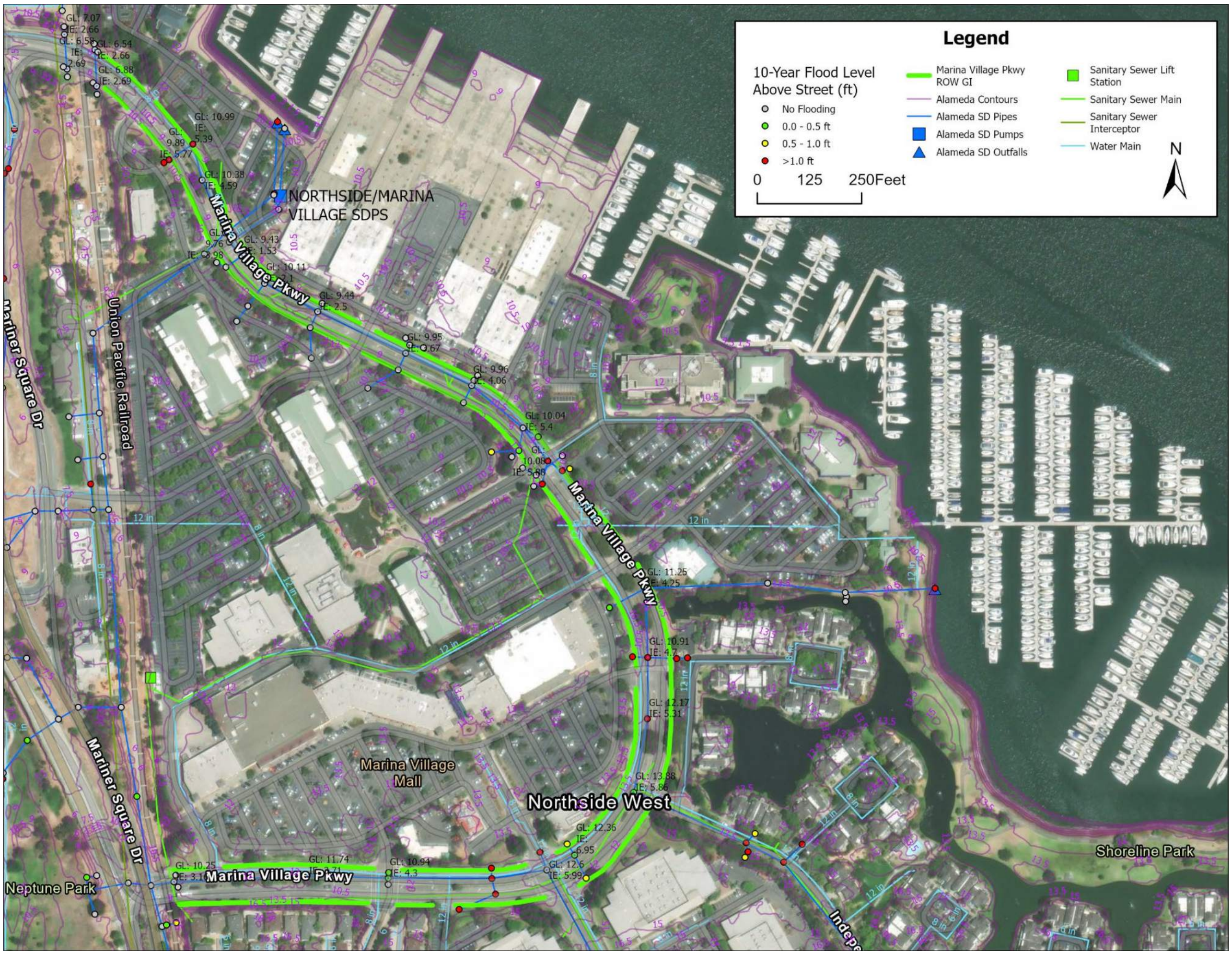



Figure 1-15. Marina Village Parkway ROW GI with Detention

#### *1.2.1.2 City of Alameda ROW*

Assuming 100 bioretention systems, with a width of 6’ and length of 15’, 1’ of ponding, 1.5’ of soil, and 2’ of soil (total depth of 4.5’), would provide approximately 1 acre-feet of storage.

## 1.3 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).

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 1-1-14 shows the proposed detention areas and projected depth to groundwater (below the ground surface) with 36-inches of sea level rise. The following areas proposed for detention are located where depth to groundwater is 3 feet or less: City of Alameda Areas #1, #2, and #3, REAP Areas #1, #2, and #3, Neptune Park, College of Alameda Areas #1A, #1B, and #2, and Bay Eagle Park.

High groundwater will reduce the capacity of the detention systems. Pumping rates will also increase with rising groundwater. If modular storage units are sited in detention areas with high groundwater, buoyancy calculations will need to be performed to ensure they will not float.  Lining of basins could be considered. Naturally present Bay mud may act as an infiltration-limiting layer between the basins and groundwater table, but as sea levels rise, rising groundwater is anticipated to eventually penetrate the layer.

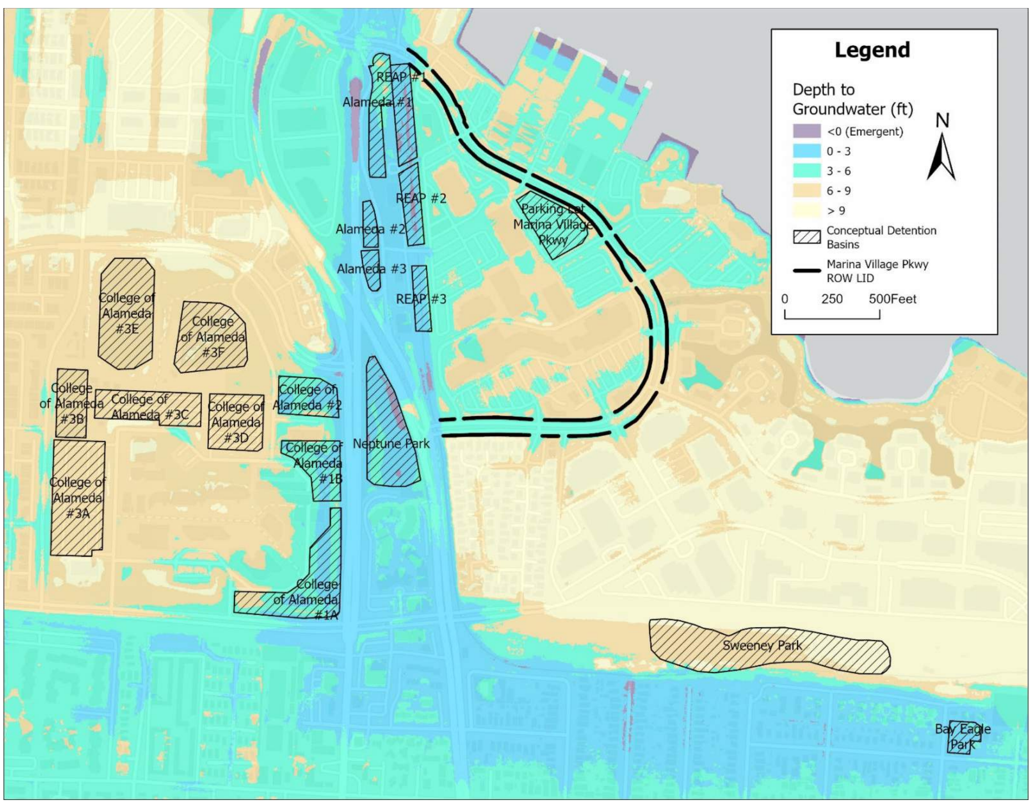


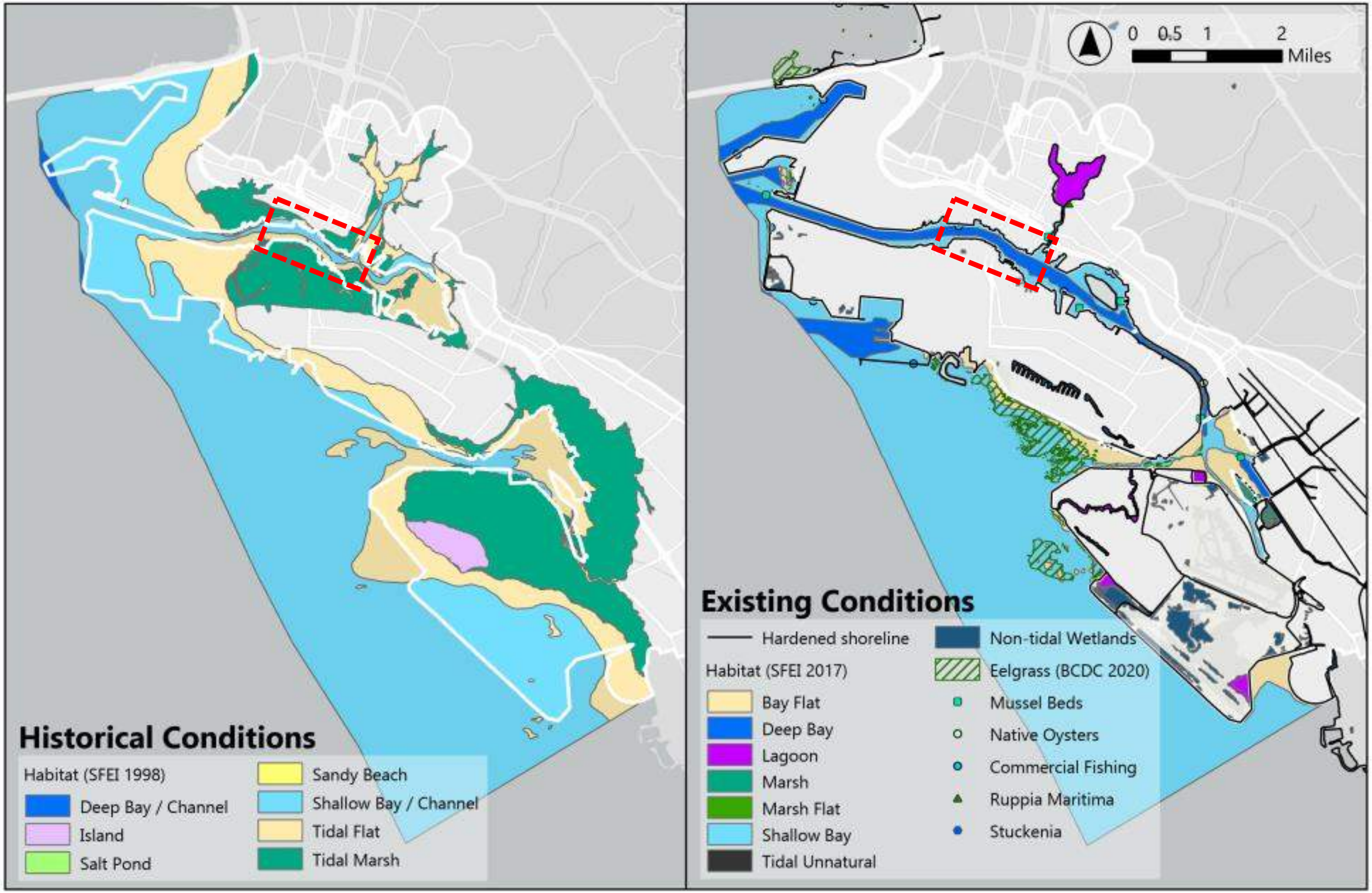

Figure 3-1-16. Shallow Groundwater with 36" Sea Level Rise

Source: (May et al. 2022)

# APPENDIX D: NATURE BASED SHORELINE CONCEPTS

# Nature-Based / Living Shorelines Sources

- Baylands Ecosystem Goals Project
- San Francisco Bay Subtidal Goals Project
- SFEI/SPUR Shoreline Adaptation Atlas
- SFEI San Leandro Bay Shoreline Adaptation 2022
- Regionally Advancing Living Shorelines (in progress)
- EBRPD Risk Assessment and Adaptation Prioritization Plan
- Reference Sites (Heron’s Head, Giant Marsh, SF Seawall (in progress), Estuary Park (in progress))
- Site walks and review of historical shoreline changes



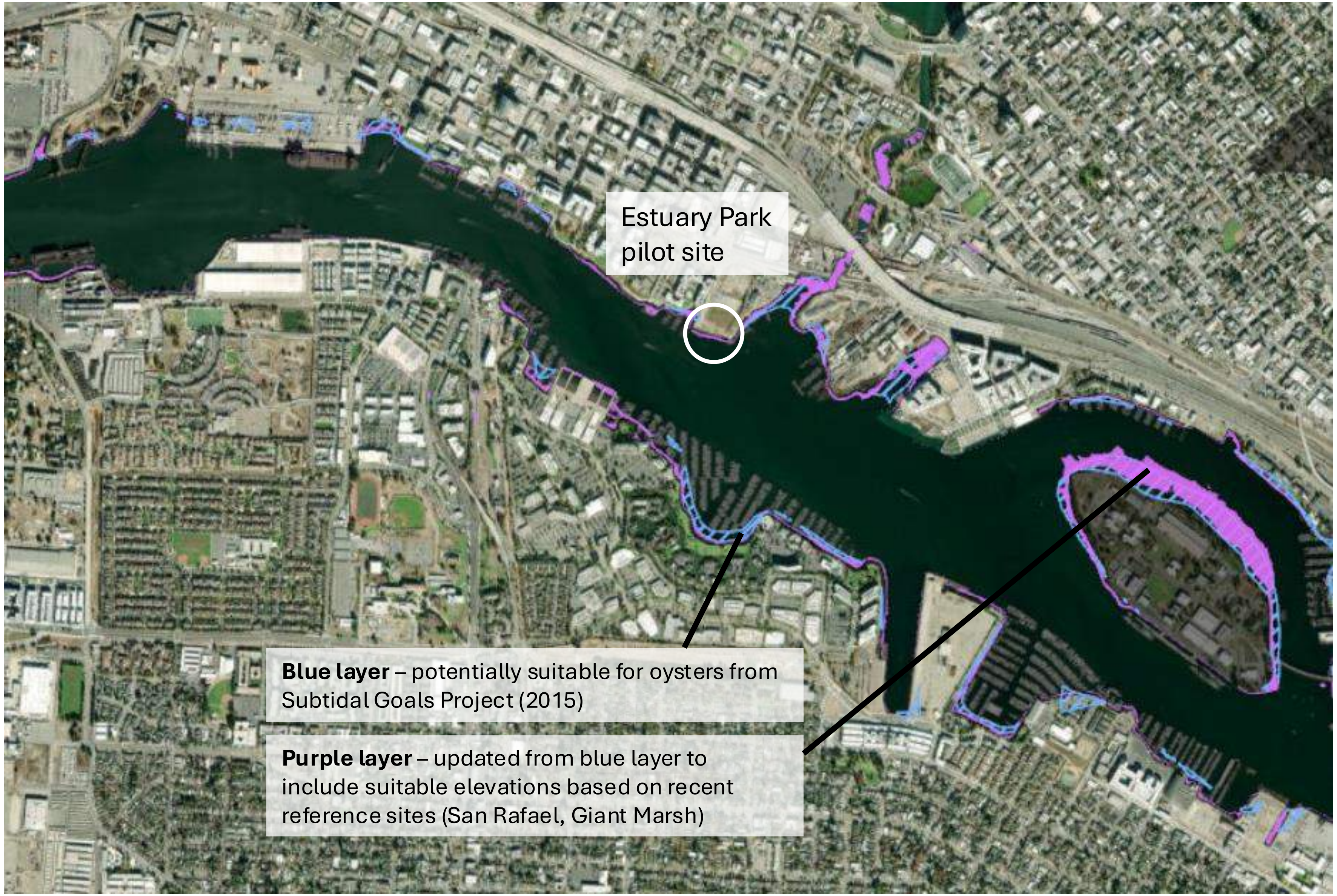
0 0.5 1 2
Miles
Historical Conditions
Habitat (SFEI 1998)
Deep Bay / Channel
Island
Salt Pond
Sandy Beach
Shallow Bay / Channel
Tidal Flat
Tidal Marsh
Existing Conditions
Hardened shoreline
Habitat (SFEI 2017)
Bay Flat
Deep Bay
Lagoon
Marsh
Marsh Flat
Shallow Bay
Tidal Unnatural
Non-tidal Wetlands
Eelgrass (BCDC 2020)
Mussel Beds
Native Oysters
Commercial Fishing
Ruppia Maritima
Stuckenia

## Notes on Oysters

- Blue and purple zones are currently mapped – with purple zone reflecting more recent thinking that oysters can be applied at higher elevations

## Notes on Marshes/Beaches

- Potential for terraces or ecotone slopes will depend on new shoreline alignment.
- Shoreline transition zones are important for biodiversity



## Notes on Eelgrass

- Currently being studied as part of the Estuary Park project.
- If methods there are successful, can be replicated more broadly.

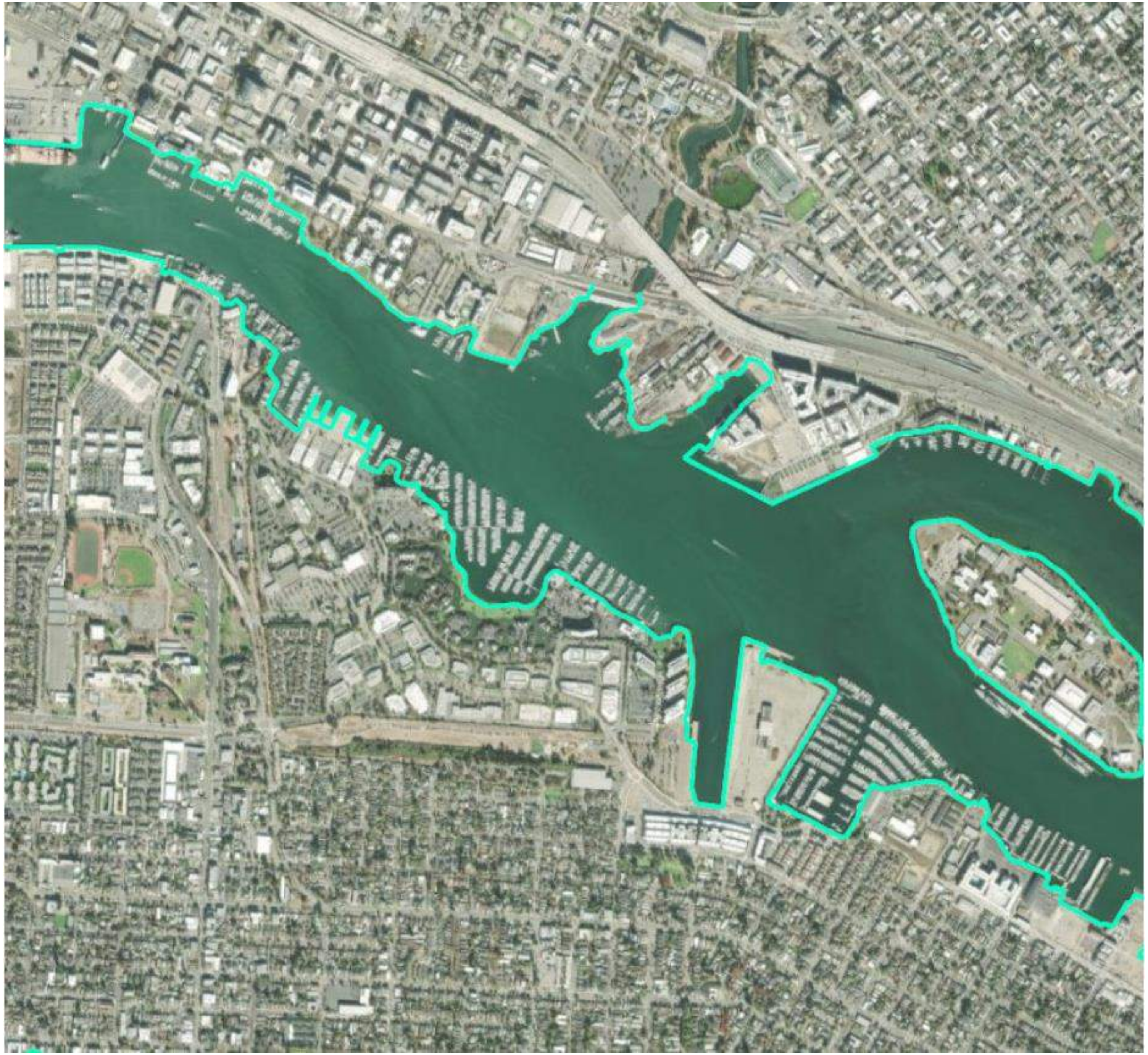

Hybrid Approaches

**Seawalls**

- Living seawalls are potentially feasible wherever vertical seawalls will be present in the intertidal zone
  - Will build on findings from SF Living Seawall and also Estuary Park

**Other approaches**

- Wherever rock armoring is present, there may be opportunities to fill interstitial spaces with cordgrass plantings in the upper intertidal zone.

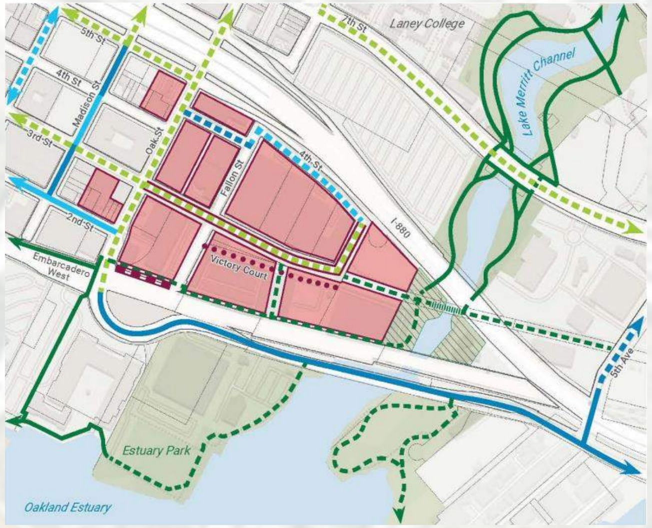



Green-grey infrastructure
(Initial mapping)
Enhanced riprap planting
Oyster panels
Slope/terrace enhancement

## **Potential opportunities for nature-based solutions**
(Lake Merritt channel)

Marsh at Peralta Park created as part of channel widening at 12th Street. Potential marsh enhancement opportunity


Victory Court Development Concept (2023) calls for 60' landscape buffer to Lake Merritt Channel and Estuary Park

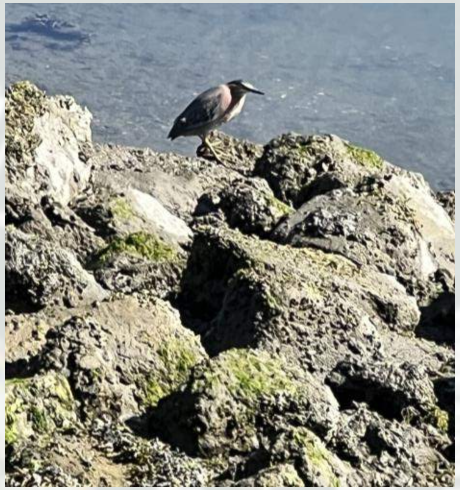



Opportunities to lay back shoreline and/or trail (i.e., reduced space constraints

# Potential opportunities for nature-based solutions
(North shore of Alameda)

Consider removing sheetpile wall

Potential opportunity to lay back shoreline and/or trail (i.e., reduced space constraints) at Shoreline Park, Alameda. This area already contains fucus



# Potential opportunities for nature-based solutions

(Jack London Square area)

Potential opportunity for marsh benches or a pocket beach near/west of KTVU with trail realignment further inland

# APPENDIX E: ADAPTATION ALTERNATIVES EVALUATION MATRIX

**Project B Alternatives Evaluation Matrix - ALAMEDA SHORELINE**

**ALTERNATIVES ELVALUATION**

| | |
|---|---|
| (light orange) | Secondary Preferred |
| (orange) | Primary Preferred |

**EVALUATION CRITERIA: All measures are to be evaluated relative to other measures**

● POSITIVE ○ NEUTRAL ⊗ NEGATIVE ◊ UNDETERMINED (ADDITIONAL ANALYSIS REQUIRED)

| | | | | Adaptation Measure | | Co-Benefits | | Additional Considerations | | Priority Criteria | | | | | | Implementation Criteria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alt #** | **Reach Location (Sta)** | **Existing Elevation** | **Adaptation Elevation** | **Flood Protection Measure** | **Height (ft- above existing grade)** | **Public Realm** | **Nature-Based Solutions** | **Development + Policy Requirement** | **Notes** | **COASTAL FLOOD PROTECTION (FEMA Accreditation & SLR)** | **ADAPTABILITY FOR LONG-TERM** | **PUBLIC REALM Relative Quality of Public Access and Public Realm** | **ENVIRONMENTAL IMPACT Relative Value of Environmental Impact of Measure** | **COST Relative to Other Adaptation Measures ($-$$$$)** | **TIMELINE Can this measure be implemented by about 2035?** | **PROPERTY ACCESS Can the action be accomplished with existing property access and/or ownership** |
| ALA - 01 | Mariner Square Sta 00 - 07 | 10.5 | 14' | Seawall - all new | 3.5 | Regrade pathways to keep visual barrier to less than 3' | textured wall for species recruitment | | Neutral Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ● | ○⊗ | ● | $$$$ | ● | ⊗ |
| ALA - 02 | | | | Raise Existing Seawall | 3.5 | Regrade pathways to keep visual barrier to less than 3' | added habitat panels placed on lower portion | | Neutral Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ⊗ | ○⊗ | ◊ | $$ | ● | ⊗ |
| ALA - 03 | Oakmont Sta 07 - 09 | 9 | 12.5' | Seawall with minimal landside raising (3' visual barrier) | 3.5 | Regrade pathways to keep visual barrier to less than 3' | minor fill and plantings within existing armor slope | | Small amount of fill to raise trail to keep stickup height to about 3', but would be FEMA-compliant until SLR reaches 11" | ●○ | ● | ○ | ● | $$$$ | ● | ⊗ |
| ALA - 04 | | | 14' | Seawall with no landside raising (5' visual barrier) | 5 | 5' tall wall along pathway | minor fill and plantings within existing armor slope | | Wall will have a 5' Stickup (visual barrier) | ● | ● | ⊗ | ● | $$$$ | ● | ⊗ |
| ALA - 05 | | | | Seawall with Raised Landside Pathway (crib) | 5 | Regrade pathways to keep visual barrier to less than 3' | minor fill and plantings within existing armor slope | | Inadequate space for levee, so a crib structure used | ● | ● | ○ | ● | $$$$ | ● | ⊗ |
| ALA - 06 | Barnhill Marina Sta 09 - 14 | 8 | 10.5' | Immediate: Temporary low flood wall and deployable flood protection at Marina Village Parkway at Barnhill; maintain current shoreline elevation (Immediate Step prior to levee construction or redevelopment decision-making) | 1.5 | Maintain existing | none | Immediate Step prior to redevelopment decision-making. | Immediate step to protect Tubes from shoreline over-topping. Additional measures required to meet FEMA requirements and meet SLR criteria | ⊗ | ⊗ | ⊗ | ○ | $ | ● | ● |
| ALA - 07 | | | 12.5' | Seawall with minimal raising of landside pathway (3' visual barrier) | 5 | Existing pathways | minor fill and plantings within existing armor slope | | Modest raising of trail required to keep stickup height to about 3', but would be FEMA-compliant until SLR reaches 11" | ●○ | ● | ○ | ● | $$$$ | ● | ⊗ |
| ALA - 08 | | | 14' | Seawall with raised landside pathway | 6.5 | | minor fill and plantings within new and existing armor slope | | | ● | ● | ○ | ● | $$$$ | ● | ⊗ |
| ALA - 09 | | | | Narrow Berm/Levee (no path at crest) | | no path | minor fill and plantings within new and existing armor slope | | not viable - FEMA certified levee requires path for access | ⊗ | ⊗ | ⊗ | ● | $$$ | ● | ⊗ |
| ALA - 10 | | | | New Levee | | levee public access path | minor fill and plantings within new and existing armor slope | | Bay trail would be at crest but backland parcels would see a 6' tall levee. | ● | ● | ● | ● | $$$ | ● | ⊗ |
| ALA - 11 | | | | Raise Parcels to 12.0 + Shoreline protection 14.0; FFE 12.5 | | widened elevated shoreline park | minor fill and plantings within new and existing armor slope | Redevelopment Policy (parcel owner decides to raise site and/or build levee to continue operating) | Would have to be led by the parcel owner | ● | ● | ● | ● | $ | ⊗ | ⊗ |
| ALA - 12 | | | | Raise Parcels to 14.0; FFE 14.0 | | widened elevated shoreline park | minor fill and plantings within new and existing armor slope | Redevelopment Policy (parcel owner decides to raise site and/or build levee to continue operating) | Would have to be led by the parcel owner | ● | ● | ● | ● | $$$ | ⊗ | ⊗ |

**Project B Alternatives Evaluation Matrix - ALAMEDA SHORELINE**

**ALTERNATIVES ELVALUATION**

Secondary Preferred

Primary Preferred

**EVALUATION CRITERIA: All measures are to be evaluated relative to other measures**

● POSITIVE ○ NEUTRAL ⊗ NEGATIVE ◊ UNDETERMINED (ADDITIONAL ANALYSIS REQUIRED)

| Alt # | Reach Location (Sta) | Existing Elevation | Adaptation Elevation | Adaptation Measure: Flood Protection Measure | Adaptation Measure: Height (ft- above existing grade) | Co-Benefits: Public Realm | Co-Benefits: Nature-Based Solutions | Additional Considerations: Development + Policy Requirement | Additional Considerations: Notes | Priority Criteria: COASTAL FLOOD PROTECTION (FEMA Accreditation & SLR) | Priority Criteria: ADAPTABILITY FOR LONG-TERM | Priority Criteria: PUBLIC REALM Relative Quality of Public Access and Public Realm | Priority Criteria: ENVIRONMENTAL IMPACT Relative Value of Environmental Impact of Measure | Priority Criteria: COST Relative to Other Adaptation Measures ($-$$$$) | Priority Criteria: TIMELINE Can this measure be implemented by about 2035? | Implementation Criteria: PROPERTY ACCESS Can the action be accomplished with existing property access and/or ownership |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALA - 13 | Hotel to Shipways Sta 14 - 24 | | 12.5' | Seawall with minimal landside raising (3' visual barrier) | 1.5 | Existing pathways | minor fill and plantings within new and existing armor slope | | Does not raise the pathway to keep stickup height to about 3', but would be FEMA-compliant until SLR reaches 11" | ● ○ | ● | ○ | ● | $$$$ | ● | ● |
| ALA - 14 | | | 14' | Narrow Berm/Levee (no path at crest) | 3.5 | no path | minor fill and plantings within new and existing armor slope | | not viable - FEMA certified levee requires path for access | ⊗ | ⊗ | ⊗ | ● | $$$ | ● | ● |
| ALA - 15 | | | | Levee [Secondary Preferred] | | levee public access path | minor fill and plantings within new and existing armor slope | | | ● | ● | ○ | ● | $$$ | ● | ⊗ |
| ALA - 16 | | | | Levee with Landside Improvements [Primary Preferred] | | public realm improvements land side | n/a (re: land-side) | | public realm improvements at parking lot? | ● | ● | ● | ○ | $$$ | ● | ⊗ |
| ALA - 17 | Shipways Sta 24 - 38 | 10.5 | 14' | Seawall - align with adjacent shoreline edge (go through the middle) | 3.5 | | | Redevelopment Policy (would be on private property) | | ● | ● | ⊗ | ○ | $$$$ | ⊗ | ⊗ |
| ALA - 18 | | | | Seawall - align with adjacent shoreline edge | | | convert Shipways inlets to wetlands | Redevelopment Policy (would be on private property) | ESA - need to make sure the elevations are feasible for this if no excavation | ● | ● | ○ | ◊ | $$$$ | ⊗ | ⊗ |
| ALA - 19 | | | | Seawall - jog to align seaward with current edge of structures - outer edge of ship ramps | | Redevelopment; include public access near the shoreline | | Redevelopment Policy (would be on private property) | | ● | ● | ○ | ⊗ | $$$$ | ⊗ | ⊗ |
| ALA - 20 | | | | Levee - raise Marina Village Pkwy (if development project does not move forward) [Secondary Preferred] | | levee public access path | convert Shipways inlets to wetlands | If redevelopment project does not move forward | ESA - need to make sure the elevations are feasible for this if no | ● | ● | ○ | ◊ | $$$ | ○ | ● |
| ALA - 21 | | | | Create High Ground: Redevelopment and fill to 14.0 [Primary Preferred] | | Redevelopment; include public access near the shoreline | | Redevelopment Policy (parcel owner decides to raise site and/or build levee for new development) | very good option if developer moves forward with project | ● | ● | ● | ⊗ | $ | ⊗ | ⊗ |
| ALA - 22 | | | | Fill for Park to 14.0 + Wetland restoration | | Redevelop as parkland | convert to wetlands | If owner sells parcel to City | Possible to remove entire structure - historic significance? | ● | ● | ● | ◊ | $$$ | ⊗ | ⊗ |
| ALA - 23 | Dock Q Sta 38-42 | 9-10.5 | 10.5' | Immediate: Temporary low flood wall and deployable flood protection at Marina Village Parkway at Dock Q; maintain current shoreline elevation (Immediate Step prior to redevelopment decision-making) | 1.5 | Maintain existing | none | Immediate Step prior to redevelopment decision-making | Immediate step to protect upland area from shoreline over-topping. Additional measures required to meet FEMA requirements and meet SLR criteria | ⊗ | ⊗ | ⊗ | ○ | $ | ● | ● |
| ALA - 24 | | | 14' | Narrow Berm/Levee (due to space restriction with no path at crest) | 3.5 | no path | added habitat panels placed on lower portion | | not viable - FEMA certified levee requires path for access | ⊗ | ⊗ | ⊗ | ◊ | $$$ | ● | ⊗ |
| ALA - 25 | | | | Levee | | levee public access path | added habitat panels placed on lower portion | | | ● | ● | ○ | ◊ | $$$ | ● | ⊗ |
| ALA - 26 | | | | Upland Levee with Landside Improvements [Primary Preferred] | | levee public access path - upland | remove wall, lay back slope, perched marsh | | | ● | ● | ○ | ● | $$$ | ● | ⊗ |

**Project B Alternatives Evaluation Matrix - ALAMEDA SHORELINE**

**ALTERNATIVES ELVALUATION**

- Secondary Preferred (light orange shading)
- Primary Preferred (dark orange shading)

**EVALUATION CRITERIA: All measures are to be evaluated relative to other measures**

● POSITIVE　○ NEUTRAL　⊗ NEGATIVE　◊ UNDETERMINED (ADDITIONAL ANALYSIS REQUIRED)

| | | | | Adaptation Measure | | Co-Benefits | | Additional Considerations | | Priority Criteria | | | | | | Implementation Criteria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alt # | Reach Location (Sta) | Existing Elevation | Adaptation Elevation | Flood Protection Measure | Height (ft- above existing grade) | Public Realm | Nature-Based Solutions | Development + Policy Requirement | Notes | COASTAL FLOOD PROTECTION (FEMA Accreditation & SLR) | ADAPTABILITY FOR LONG-TERM | PUBLIC REALM Relative Quality of Public Access and Public Realm | ENVIRONMENTAL IMPACT Relative Value of Environmental Impact of Measure | COST Relative to Other Adaptation Measures ($-$$$$) | TIMELINE Can this measure be implemented by about 2035? | PROPERTY ACCESS Can the action be accomplished with existing property access and/or ownership |
| ALA - 27 | Marina Village Sta 42 - 50 | 10.5 | 12.5' | Flood-Proof Marina Village Buildings, maintain current shoreline elevation (Intermediate Step prior to future redevelopment) | 1.5 | Maintain existing | none | Intermediate Step prior to future redevelopment | Portions of the Bay Trail is pile-supported, portions of Trail and buildings are on fill. Concept is to build a parapet wall along the building edge, flood-proof them to address flooding from below the deck. Additional measures required to meet FEMA requirements and meet SLR criteria | ⊗ | ⊗ | ⊗ | ○ | $$$ | ● | ⊗ |
| ALA - 28 | | | | Seawall with minimal landside raising (3' visual barrier) | 2 | | minor fill and plantings within existing armor slope | | Minimal raising of trail to keep stickup height to about 3', but would be FEMA-compliant until SLR reaches 11" Neutral Public Realm in near-term, Negative when adapted to 17.0 in height | ○ ● | ● | ○ ⊗ | ● | $$$$ | ● | ● |
| ALA - 29 | | | 14' | Seawall | 3.5 | existing path | minor fill and plantings within existing armor slope | | existing path very limited Neutral Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ○ | ○ ⊗ | ● | $$$$ | ● | ● |
| ALA - 30 | | | | Narrow Berm/Levee (due to space restriction) + Overwater Baytrail | | Bay Trail on outboard trestle, adaptable to SLR | set back slope, consider smaller armor and ecotone plantings | | not viable - FEMA certified levee requires path for access | ⊗ | ⊗ | ● | ● | $$$ | ● | ⊗ |
| ALA - 31 | | | | Levee - at Marina Village Pkwy (if development project does not move forward) (Secondary Preferred) | | levee public access path | | If redevelopment project does not move forward | | ● | ● | ○ | ◊ | $$$ | ○ | ● |
| ALA - 32 | | | | Create High Ground: Redevelopment and fill to 14.0 (Primary Preferred) | | new section of Bay Trail developed at higher elevation | set back slope, consider smaller armor and ecotone plantings | Redevelopment Policy (parcel owner decides to raise site and/or build levee to continue operating) | | ● | ● | ● | ● | $ | ⊗ | ⊗ |
| ALA - 33 | | | | Fill for Park to 14.0 + Wetland restoration | | Redevelop as parkland and trail access at higher elevation | convert to wetlands | If parcel owner sells parcel to City | | ● | ● | ● | ● | $$$ | ⊗ | ⊗ |
| ALA - 34 | Marina Village - East Sta 50 - 52 | 10.5 | 14' | Narrow Berm/Levee (no path at crest) | 3.5 | | set back slope, consider smaller armor and ecotone plantings | | not viable - FEMA certified levee requires path for access | ⊗ | ● | ⊗ | ● | $$$ | ● | ● |
| ALA - 35 | | | | Upland Levee; connect to elevation 12 high ground (Primary Preferred) | | levee public access path | set back slope, consider smaller armor and ecotone plantings | | Tie Marina Village into existing high ground at Shoreline Park | ● | ● | ○ | ● | $$$ | ● | ● |

**Project B Alternatives Evaluation Matrix - OAKLAND SHORELINE**

**ALTERNATIVES ELVALUATION (Note: Alternatives Oak 01-12 were not evaluated pending Port study)**

Secondary Preferred

Primary Preferred

**EVALUATION CRITERIA: All measures are to be evaluated relative to other measures**

● POSITIVE ○ NEUTRAL ⊗ NEGATIVE ◊ UNDETERMINED (ADDITIONAL ANALYSIS REQUIRED)

| | | | | Adaptation Measure | | Co-Benefits | | Additional Considerations | | Priority Criteria | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alt #** | **Reach Location (Sta)** | **Existing Elevation** | **Adaptation Elevation** | **Flood Protection Measure** | **Height (ft-above existing grade)** | **Public Realm** | **Nature-Based Solutions** | **Development + Policy Requirement** | **Notes** | **COASTAL FLOOD PROTECTION (FEMA Accreditation)** | **ADAPTABILITY TO LONG-TERM** | **PUBLIC REALM Relative Quality of Public Access and Public Realm** | **ENVIRONMENTAL IMPACT Relative Value of Environmental Impact of Measure** | **COST Relative to Other Adaptation Measures ($-$$$$)** | **TIMELINE Can this measure be implemented by about 2035?** |
| Oak - 01 | Jefferson St to Ferry Terminal Sta 00-04 | 9-10.5' | 12.5' | New Seawall in Front | 3.5 | | textured wall for species recruitment | | Not possible to raise existing seawall (poor condition) Netural Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ● | ○ ⊗ | ⊗ | $$$$ | ○ |
| Oak - 02 | Jack London Ferry Terminal to Waterfront Hotel Sta 04-10 | 10.5' | 14' | Floodwall at Promenade Edge | 3.5 | | textured wall for species recruitment | | New wall at existing promenade edge (keep riprap as is) Netural Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ● | ○ ⊗ | ⊗ | $$$ | ● |
| Oak - 03 | | | | Levee within existing park area (includes 75' seawall along Rosenblum building) | | Enhance existing park | minor fill and plantings within existing armor slope; seawall too high for oyster panels if on top of levee | | | ● | ● | ● | ● | $$$ | ● |
| Oak - 04 | Jack London Waterfront Hotel to Franklin St Sta 10 - 20 | 10.5' | 12.5' | Parapet Walls + New Bay Trail + Tactical Flood-proofing of Structures | 2 | New pile-supported Bay Trail | added habitat panels placed on lower portion of wall (existing) | | The Trail and shoreline portion of structures are pile-supported. Concept is to build a parapet wall along the building edge, flood-proof them to address flooding from below the deck, and build a new pile-supported Bay Trail | ○ | ⊗ | ○ | ◊ | $$$$ | ○ |
| Oak - 05 | | | 14' | New Seawall Outboard of Current Edge | 3.5 | | textured wall for species recruitment | | Water in void space below structures would need to be addressed Netural Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ● | ○ ⊗ | ⊗ | $$$$ | ○ |
| Oak - 06 | | | | Levee at Water St; Elevate Hotels & restaurants to higher FFE | | | added habitat panels placed on lower portion of wall (existing) | Redevelopment + Policy Required | When Port lease ends Shifts Bay Trail away from shoreline in near-term, but makes trail more adaptable in long | ● | ● | ⊗ ● | ◊ | $$$ | ⊗ |

**Project B Alternatives Evaluation Matrix - OAKLAND SHORELINE**

**ALTERNATIVES ELVALUATION (Note: Alternatives Oak 01-12 were not evaluated pending Port study)**

Secondary Preferred

Primary Preferred

**EVALUATION CRITERIA: All measures are to be evaluated relative to other measures**

● POSITIVE ○ NEUTRAL ⊗ NEGATIVE ◊ UNDETERMINED (ADDITIONAL ANALYSIS REQUIRED)

| | | | | Adaptation Measure | | Co-Benefits | | Additional Considerations | | Priority Criteria | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alt #** | **Reach Location (Sta)** | **Existing Elevation** | **Adaptation Elevation** | **Flood Protection Measure** | **Height (ft-above existing grade)** | **Public Realm** | **Nature-Based Solutions** | **Development + Policy Requirement** | **Notes** | **COASTAL FLOOD PROTECTION (FEMA Accreditation)** | **ADAPTABILITY TO LONG-TERM** | **PUBLIC REALM Relative Quality of Public Access and Public Realm** | **ENVIRONMENTAL IMPACT Relative Value of Environmental Impact of Measure** | **COST Relative to Other Adaptation Measures ($-$$$$)** | **TIMELINE Can this measure be implemented by about 2035?** |
| Oak - 07 | Jack London Franklin St to Channel House Sta 20-29 | 9-10.5' | 12.5' | Parapet Wall along Promenade Edge. Tactical flood-proofing of buildings until longer-term interventions are planned | 3.5-2.0 | | added habitat panels on lower part of floodwall (existing) | | This reach is a pile-supported deck and in poor conditon. A parapet wall may need new piles or complete re-build | ○ | ⊗ | ○ | ◊ | $$$ | ○ |
| Oak - 08 | | | 14' | New Seawall Outboard of Current Edge + Raise Bay Trail | 3.5-4 | | textured wall for species recruitment | | Netural Public Realm in near-term, Negative when adapted to 17.0 in height | ● | ● | ● ○ | ⊗ | $$$$ | ○ |
| Oak - 09 | | | | Levee along Water St and Market Bldg Park. Raise JLS Marina and Restaurants to higher FFE | | Public realm opportunities at Spaces, Market Bldg | added habitat panels on lower part of floodwall (existing) | Redevelopment + Policy Required | | ● | ● | ● | ◊ | $$$ | ● |
| Oak - 10 | Channel House Sta 29-35 | 10.5' | 14' | Narrow Berm/Levee (no path at crest) | 3.5 | | plantings in existing and new armor | | not viable - FEMA certified levee requires path for access | ⊗ | ⊗ | ⊗ | ○ | $$ | ● |
| Oak - 11 | | | | Levee at current shoreline | | levee access path | plantings in existing and new armor | | | ● | ● | ○ | ○ | $$ | ● |
| Oak - 12 | | | | Fill park and undeveloped hotel parcel and FFE to 14.0, existing bldg FFE remain as current. | | Public realm opportunities at Channel House Park, raise Bay trail to higher elevation | n/a | Redevelopment + Policy Required; Undeveloped hotel parcel FFE requirement | Consider ownership of parking lots and parcels adjacent to Webster St | ● | ● | ● | ○ | $ (By Developer) | ○ |
| Oak - 13 | The Landing to Portobello Residential Sta 35 - 51 | 9-10.5' | 14' | Narrow Berm/Levee (no path at crest) | 3.5-5.0 | | plantings in existing and new armor | | not viable - FEMA certified levee requires path for access | ⊗ | ⊗ | ⊗ | ○ | $$ | ● |
| Oak - 14 | | | | Levee at current shoreline | | levee access path, sloped upland park space | plantings in existing and new armor | | | ● | ● | ○ | ○ | $$$ | ● |
| Oak - 15 | | | | Flatter Levee incorporating NBS | | levee access path | marsh terraces or gravel/cobble beach outboard of levee (~sta 35-43) | | Consider ownership of parking lots and parcels adjacent to Webster St | ● | ● | ● | ● | $$$ | ● |
| Oak - 16 | Estuary Park Sta 51 - 68 | 9-10.5' | 12.5' | High Ground - Implement current Estuary Park design | 3.5 | | coarse beach, eelgrass plantings | | | ○ ● | ● | ○ | ● | $ | ● |
| Oak - 17 | | | 14' | Raise Estuary Park Levee (or New Levee if Estuary Park project not yet constructed) | 5 | | n/a | | | ● | ● | ● | ○ | $$ | ○ |
| Oak - 18 | Lake Merritt Channel Sta 68 - 75 | 8 - 10 | 14' | Rail Bridge Flood Walls & Levee at along Channel - both sides | 4 -6 | levee access path | n/a | | | ⊗ | ⊗ | ○ | ○ | $$$$ | ⊗ |
| Oak - 19 | | | | Rail Bridge Flood Walls & Levee at along Channel - both sides | | Victory Court and Laney College 60' landscape buffer public realm | lay back channel edge for marsh or other NBS space | | | ⊗ | ⊗ | ● | ● | $$$$ | ⊗ |
| Oak - 20 | | | | Tide Gate at Embarcadero West Bridge (build to +17 initially) | | public trail access along channel | n/a | | detention within channel landscape buffer Tidegate should be built to +17 initially | ● | ○ | ● | ◊ | $$$$ | ⊗ |

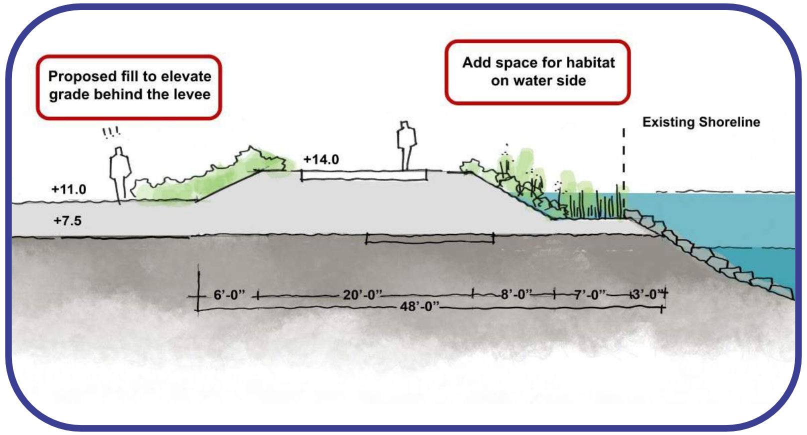
# APPENDIX F: DESIGN CONCEPTS

# OAAC Adapt
## Oakland-Alameda Estuary Near-Term Adaptation
## Design Concept Development
## January 2025

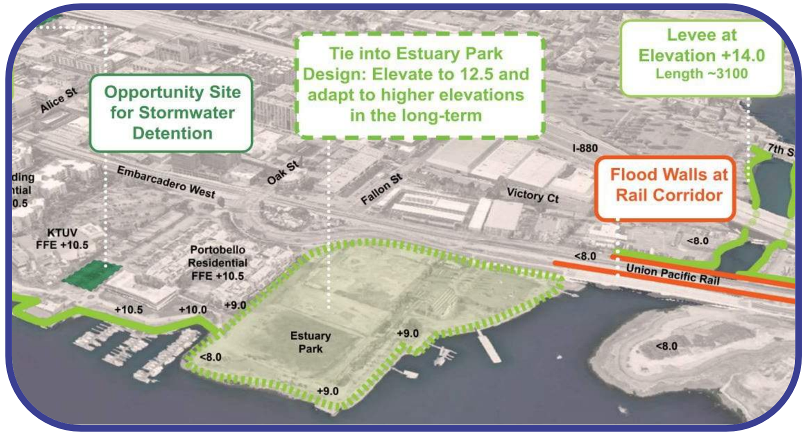
# Developing & Evaluating Alternatives

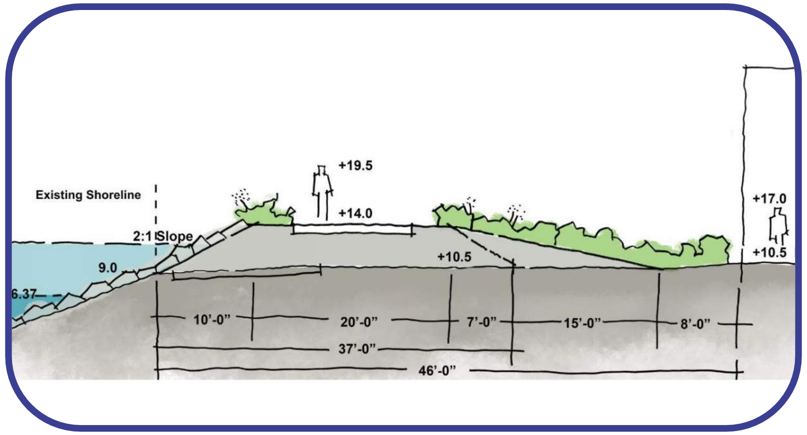
Existing Conditions & Analysis → Develop Alternatives → Evaluate Alternatives → Refine Selected Concepts

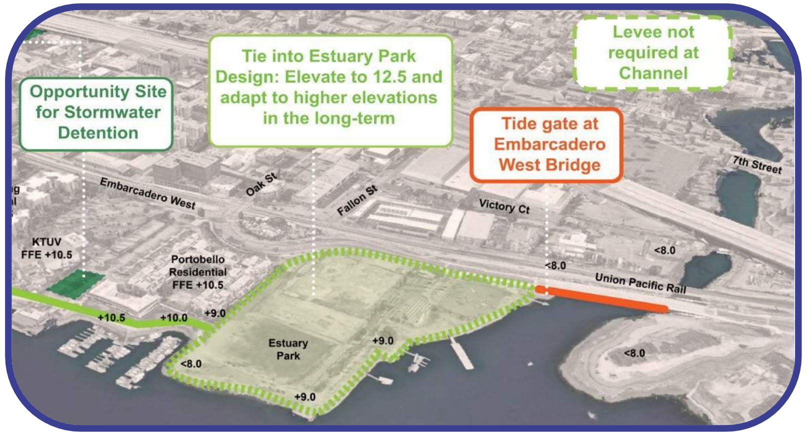
# Over 50 coastal and inland flood adaptation measures were considered for the zones along the Oakland-Alameda Estuary shoreline





Existing Conditions & Analysis → Develop Alternatives → **Evaluate Alternatives** → Selected Concepts

# The Alternatives were assessed relative to the OAAC Project Charter and Project Planning Principles

- Pathways Approach
- Community Health & Wellbeing
- Critical Infrastructure & Services
- Housing, Development, & Land Use
- Multi-benefit
- Governance, Collaboration, & Finance
- Public Access, Recreation, & Urban Design
- Transportation & Transit
- Groundwater & Shoreline Contamination
- Equity & Environmental Justice
- Ecosystem Health & Resilience

Existing Conditions & Analysis → Develop Alternatives → **Evaluate Alternatives** → Selected Concepts

## The Alternatives were assessed relative to each other using the **Priority Evaluation Criteria** developed by the project consultants, community members and agency partners

**COASTAL FLOOD PROTECTION:** Does the Measure provide FEMA Accredited Coastal Flood Protection

**ADAPTABILITY:** Is the Measure Adaptable in the future for Long-Term Flood Protection? (Elev. 17 or greater)

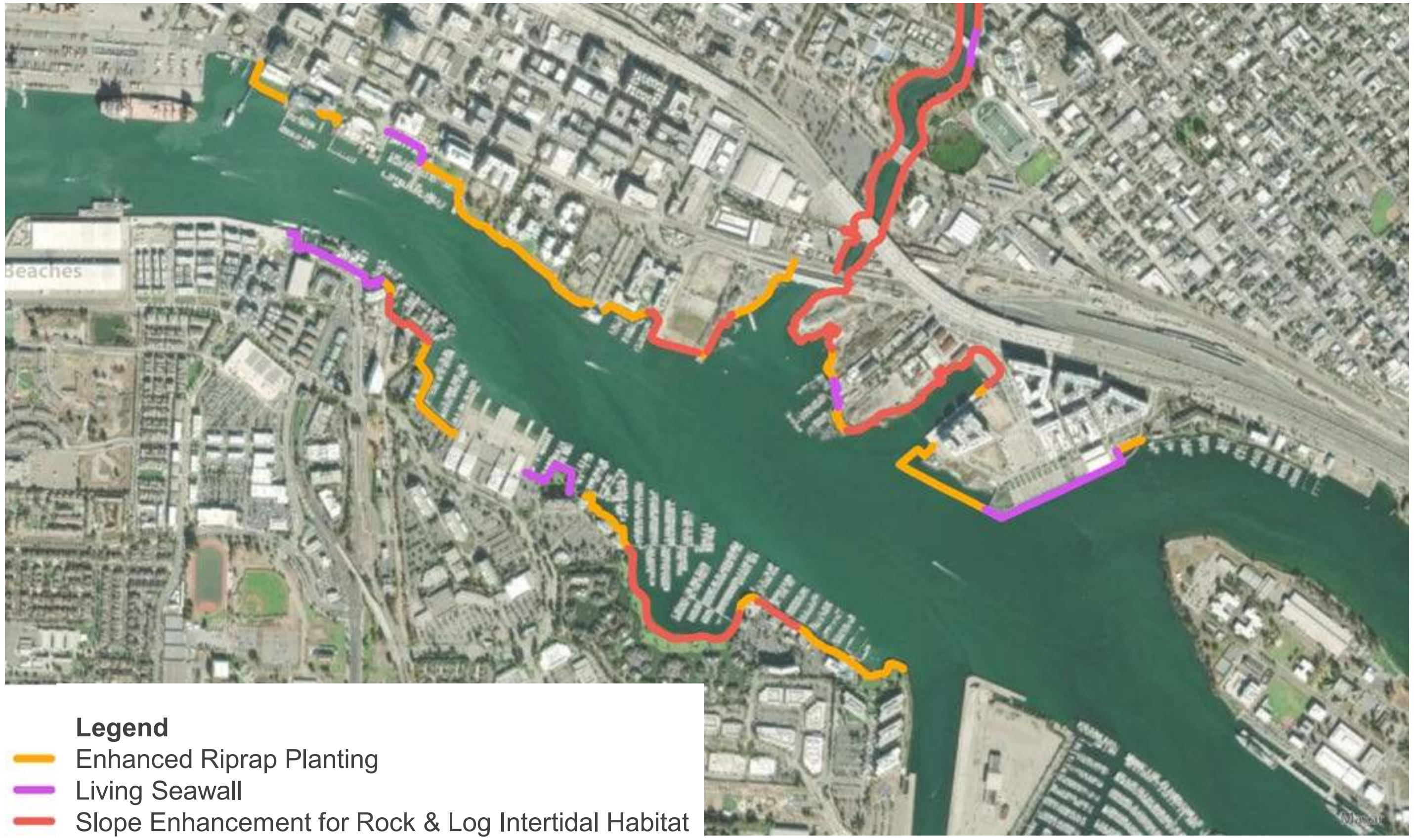
**PUBLIC REALM:** What is the Relative Quality Public Access and Public Space Provided by the Measure

**ENVIRONMENTAL IMPACT:** What is the Relative Value of the Environmental Impact of the Measure. This could be negative or positive benefit.

**COST:** What is the Cost of the Measure Relative to other Measures

**TIMELINE:** Can the measure be implemented by 2035 (within 10 years)

# Potential Natural & Nature-Based Features





*Gravel Beach and Rocky Intertidal Habitat*


*Rock & Log Slope Enhancement*


*Living Seawall*


*Habitat Panels*

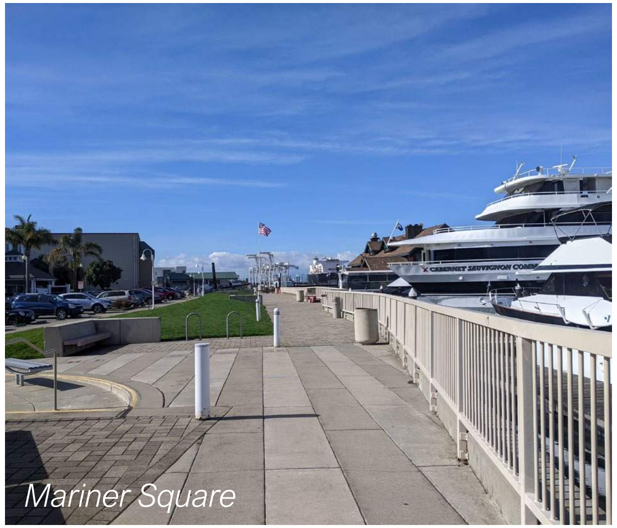

*Constructed Tidepools*


*Cobble Marsh*

# Design Concepts

# Alameda: Mariner Square to Marina Village

# Mariner Square to Marina Village – Existing Site


Mariner Square


Oakmont


Barnhill Marina


Dock Q


Extended Stay America Hotel


Marina Village


Marina Village


Shoreline Park

# Alameda Near Term Adaptation Concept

# Alameda Coastal Flood Protection

MARINER SQUARE TO SHIPWAYS

SHIPWAYS TO MARINA VILLAGE

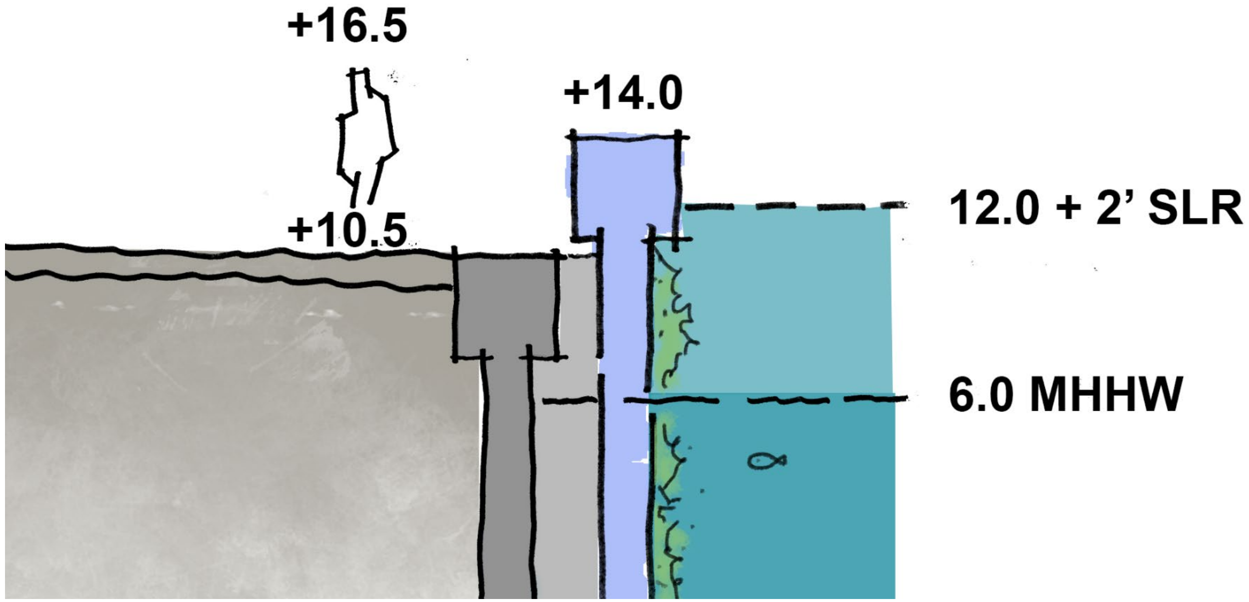
# Alameda Concept Plan – Mariner Square to Shipways


**Finished Floor Elevation

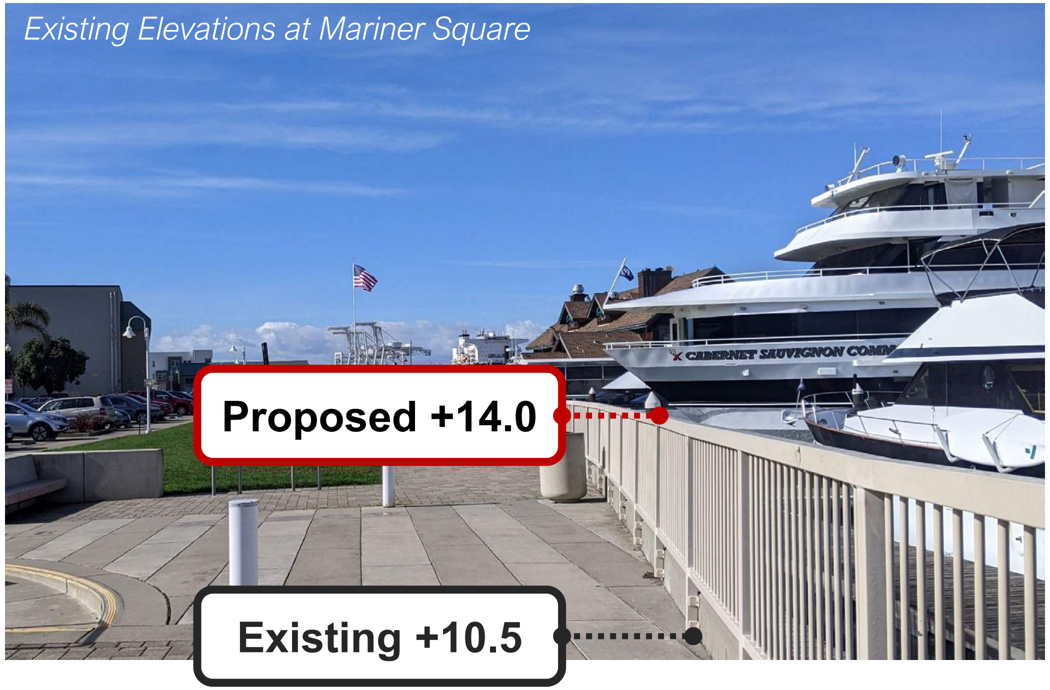
# Alameda Shoreline – Near Term Adaptation

## Elevated Seawall

**Build new Seawall water side of existing wall. Environmental permits and agency coordination required.**

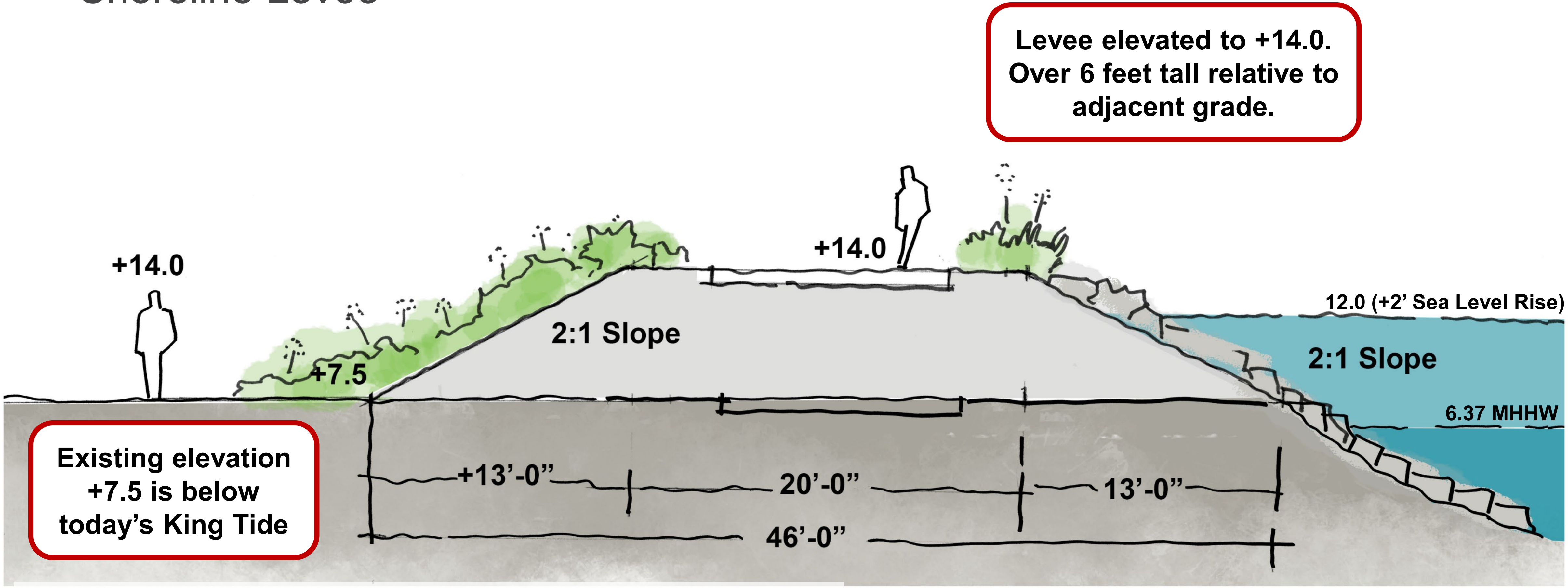



Section 1 – Typical condition at Cardinal Point and Mariner Square Drive



# Alameda Shoreline – Near Term Adaptation

## Shoreline Levee




Section 2 – Typical condition at Barnhill Marina

# Alameda Shoreline

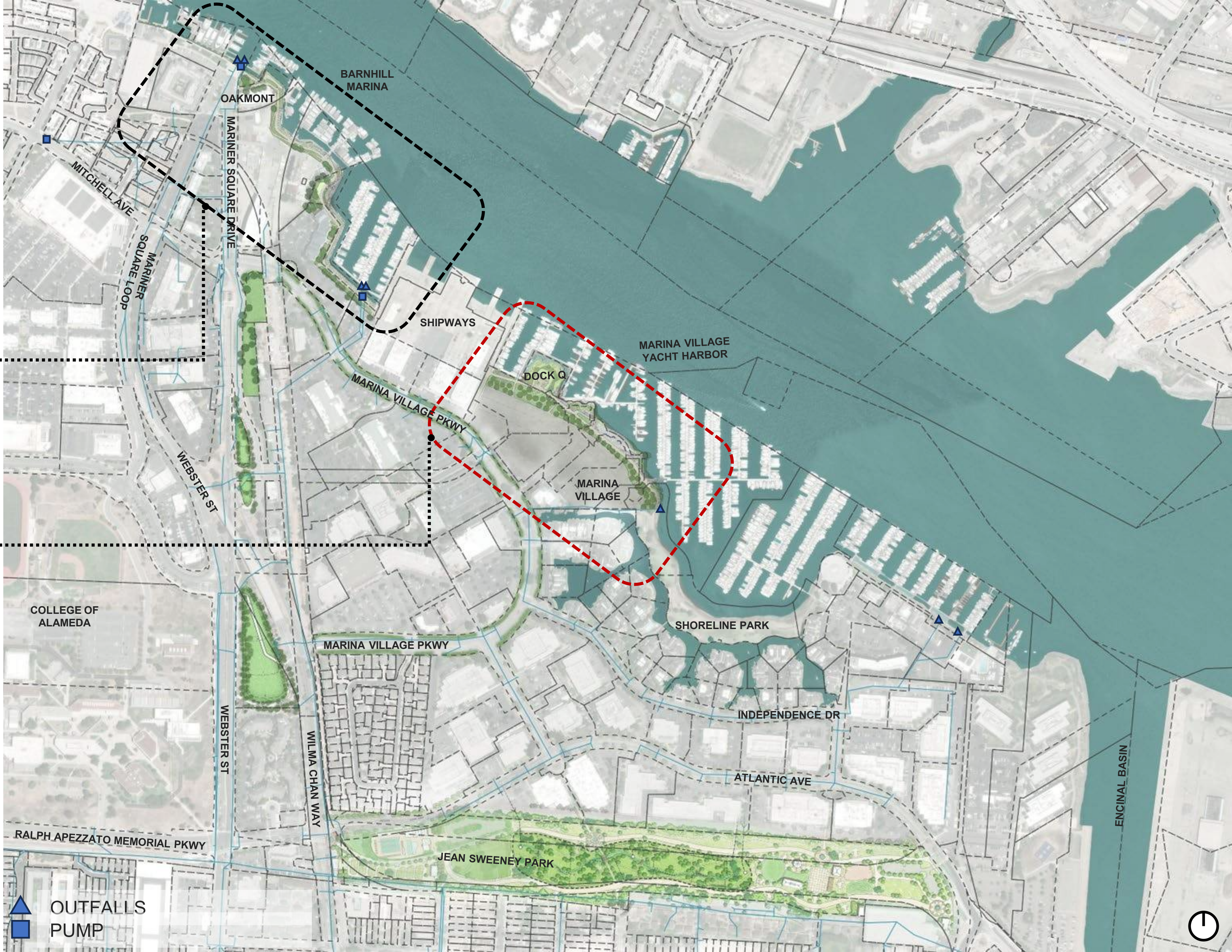

Section 3 - View of shoreline protection and improvements near hotel

# Alameda Near Term Adaptation Concept

# Alameda Coastal Flood Protection

MARINER SQUARE TO SHIPWAYS

SHIPWAYS TO MARINA VILLAGE

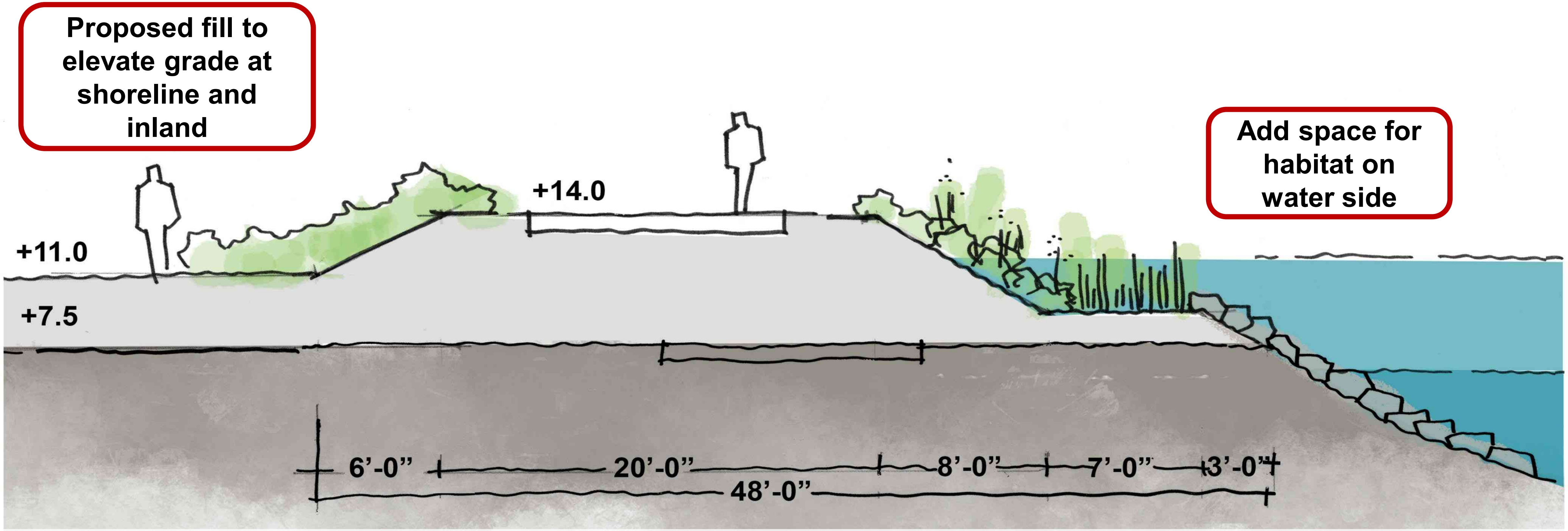


# Alameda Concept Plan – Shipways to Marina Village


***"Finished Floor Elevation" (estimated)

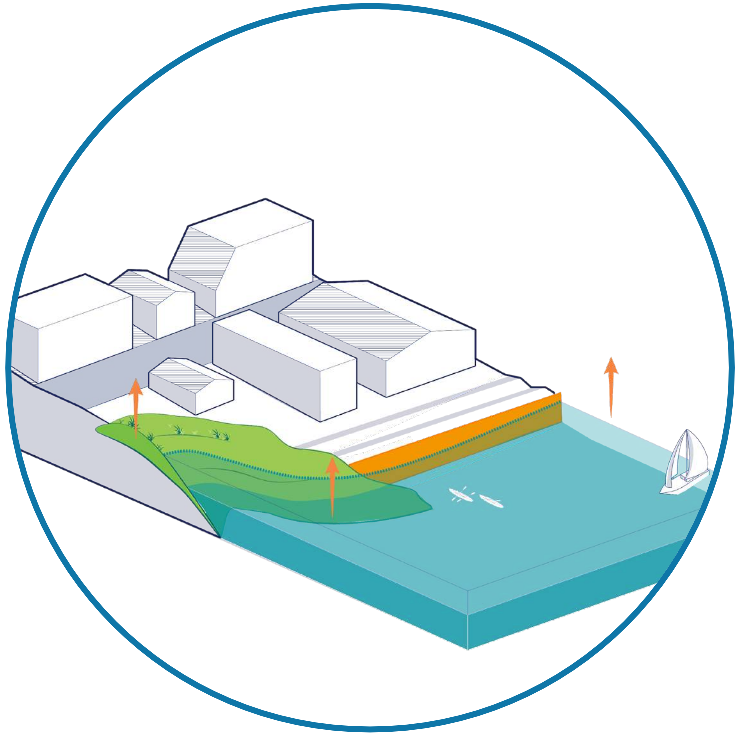
# Alameda Shoreline – Near Term Adaptation

## Raised Grade at Shoreline and Inland

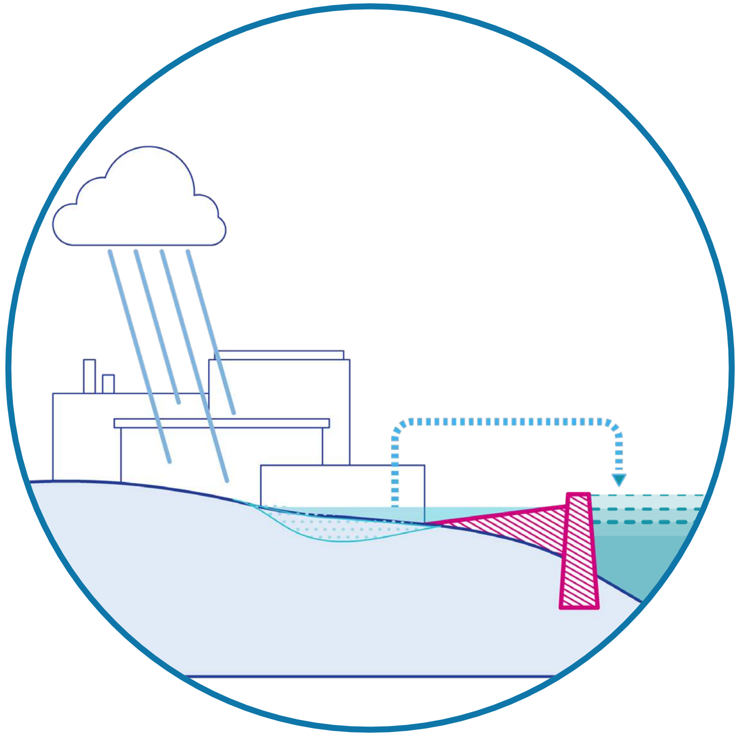



Section 4 – Typical condition at Marina Village

# Alameda Northern Shoreline Inland Flood Protection Concept



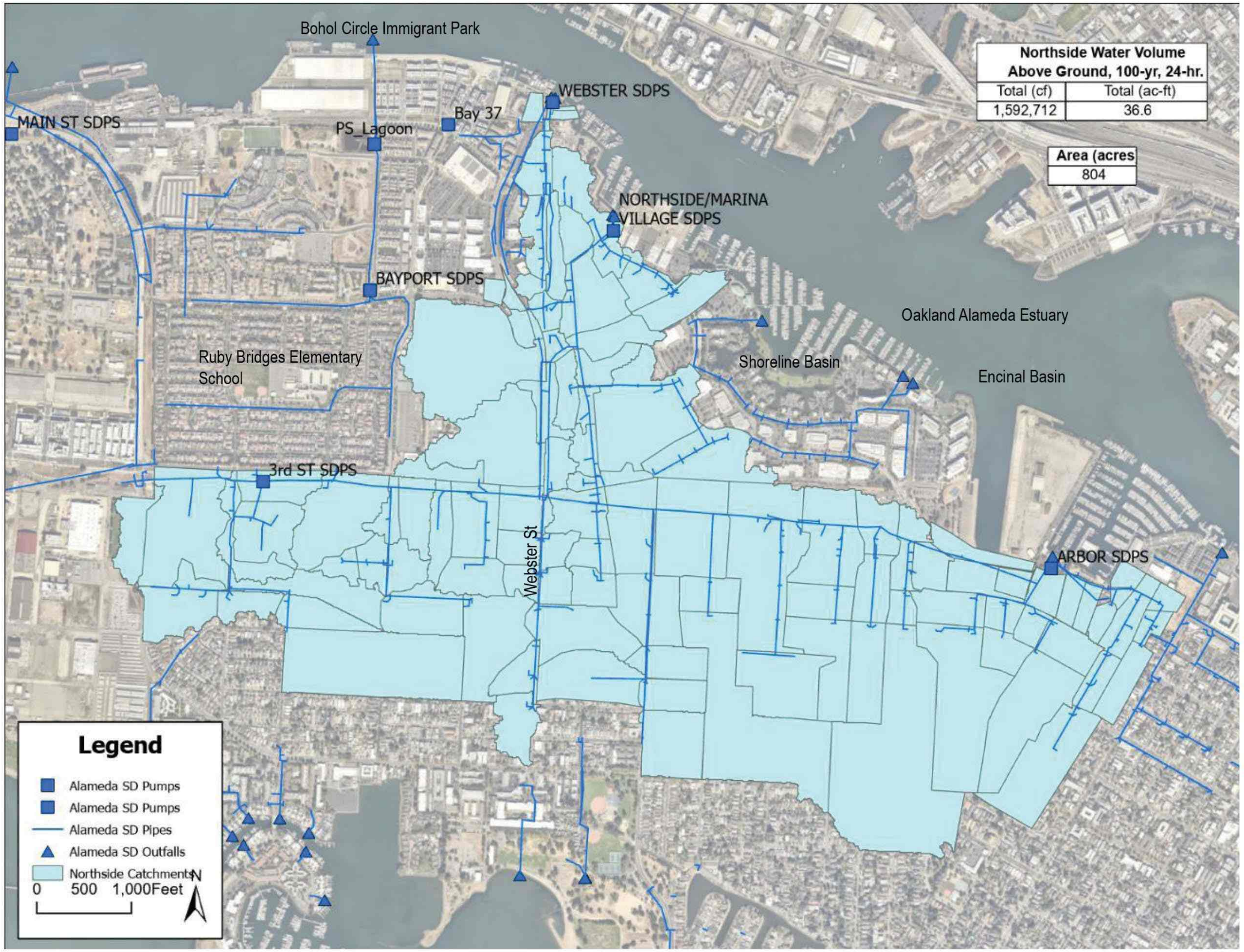
Elevate shoreline to prevent coastal flooding from sea level rise and storm surges



Inland adaptation (green and grey infrastructure) to manage stormwater and groundwater

# Inland Flooding Analysis
# Stormwater Modeling: Northside of Alameda

- Volume of water above ground (stormwater flooding) currently generated by 100-yr, 24-hr storm: 36.6 acre-feet
- This is the volume of water that does not fit in Alameda's storm drain system today.
- Analysis includes stormwater detention for today's volume with added capacity for future increases.




**Estimated Future Precipitation % Increase With Climate Change**

| | | 10-yr | 100-yr |
|---|---|---|---|
| 2050 | 3-hr | 21.6% | 25.8% |
| | 24-hr | 17.9% | 22.1% |
| 2060 | 3-hr | 27.8% | 32.7% |
| | 24-hr | 22.2% | 26.8% |
| 2070 | 3-hr | 33.7% | 39.3% |
| | 24-hr | 25.9% | 31.2% |
| 2080 | 3-hr | 40.7% | 47.1% |
| | 24-hr | 30.7% | 36.6% |
| 2090 | 3-hr | 49.6% | 56.9% |
| | 24-hr | 37.1% | 43.7% |
| 2100 | 3-hr | 59.0% | 67.2% |
| | 24-hr | 43.6% | 51.0% |

**San Francisco Bay Area Domain SSP5-8.5**

# Inland Flooding Conceptual Detention Basin Locations

# Conceptual Stormwater Detention Basin Locations – City of Alameda Land

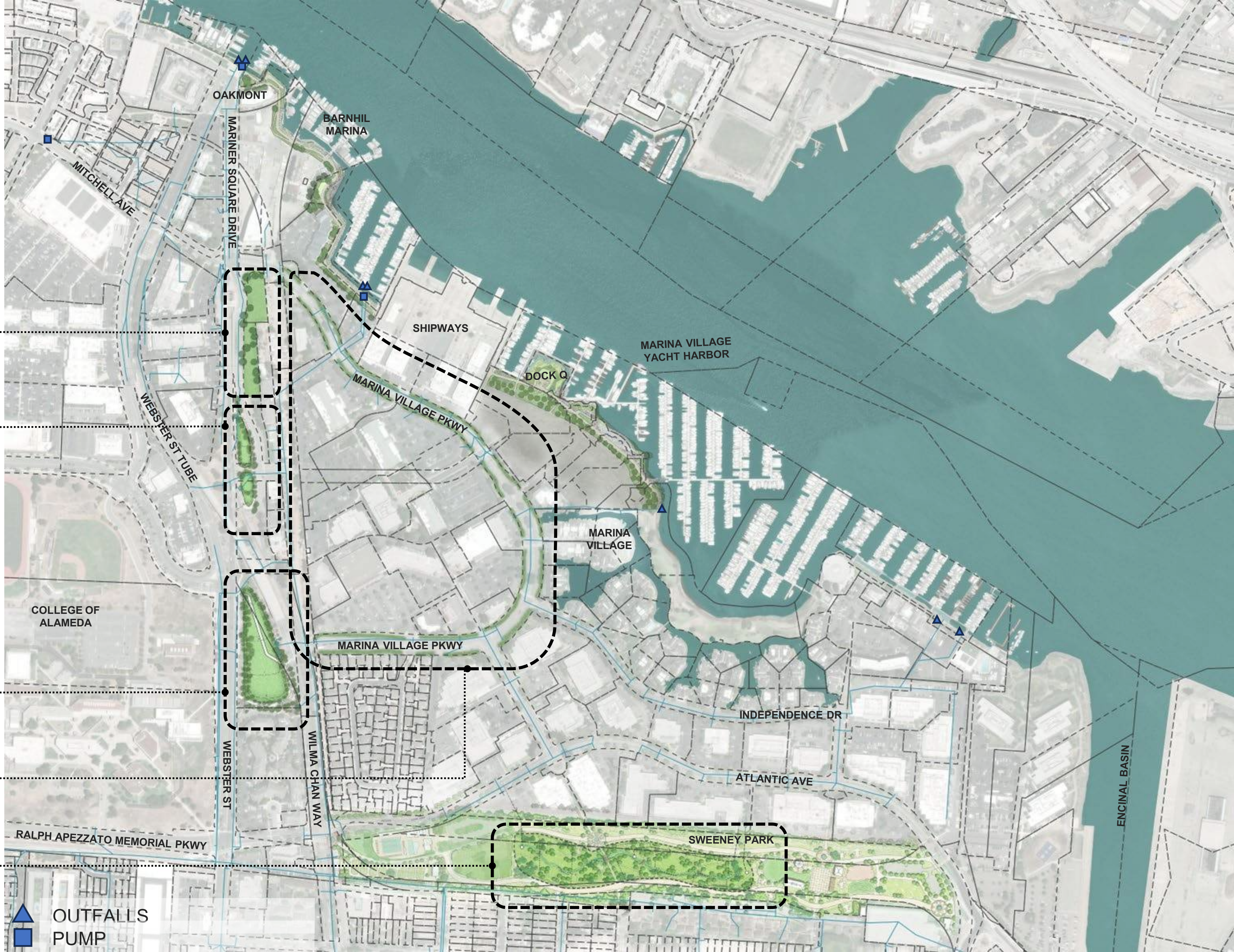
ALAMEDA #1
2 acre-ft

ALAMEDA #2 & #3
2 acre-ft

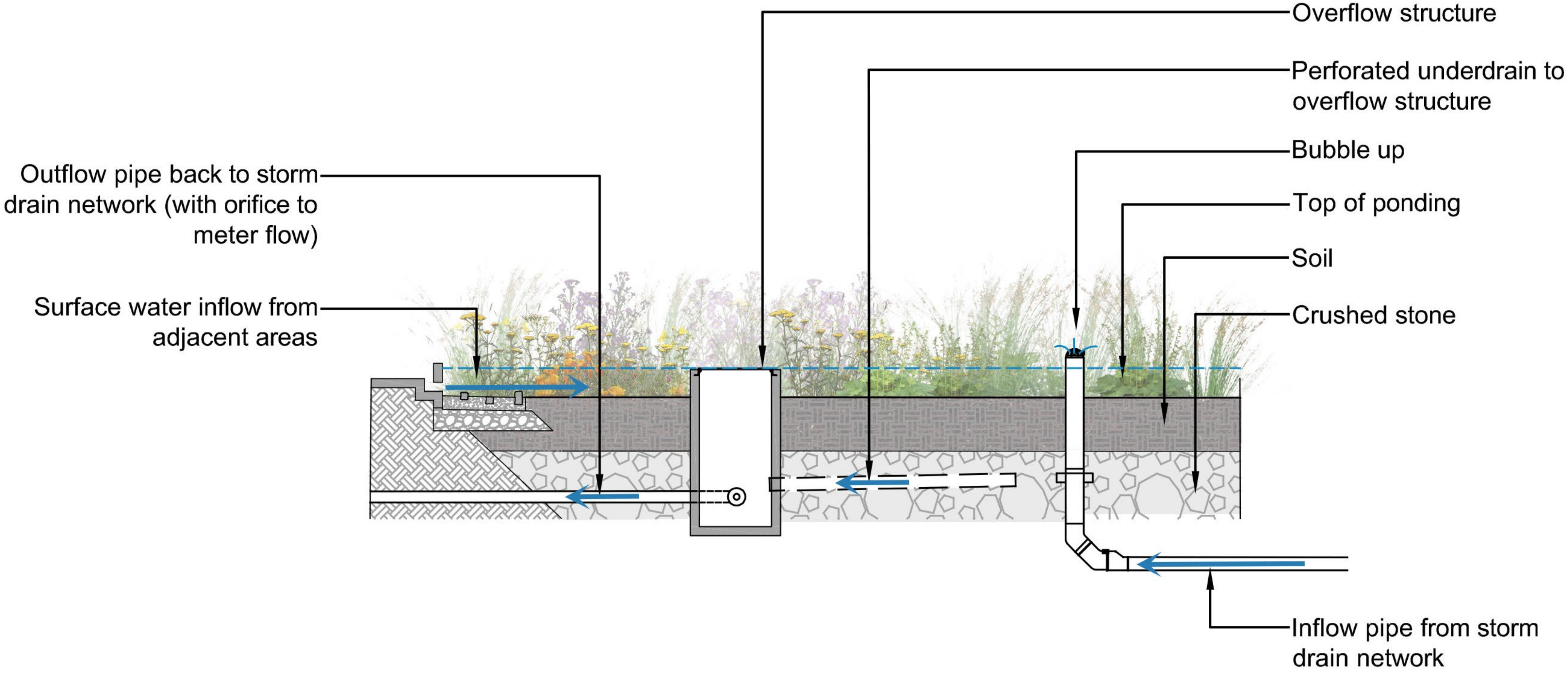
NEPTUNE PARK
8 acre-ft

MARINA VILLAGE PARKWAY RIGHT-OF-WAY
5 acre-ft

JEAN SWEENEY PARK
18 acre-ft

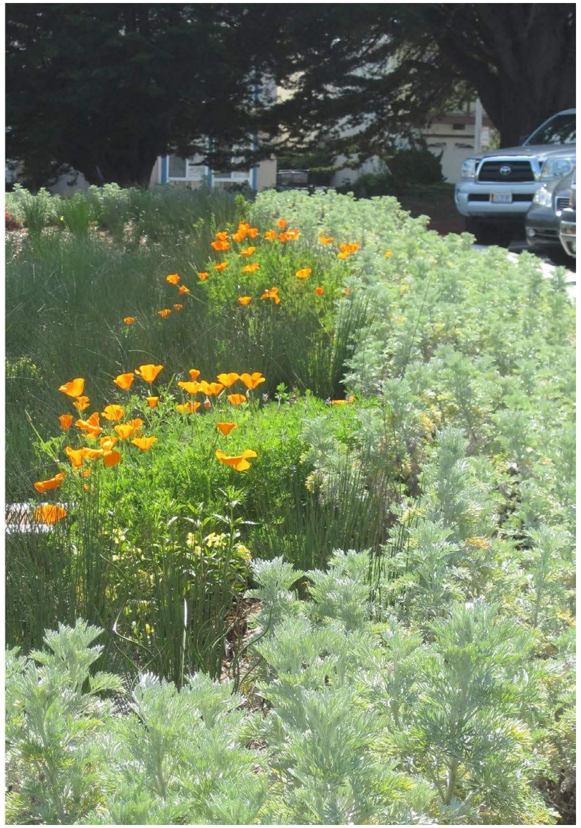


# How the System Would Work



# Green Infrastructure Precedents

Stormwater treatment garden, Serramonte Library



*Stormwater gardens on Yerba Buena Island, San Francisco*

*Stormwater Basin at Fifth and Eucalyptus Street, Alameda*

*Stormwater treatment creek, Civita Community Park, San Diego*

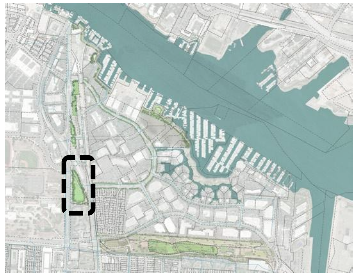
# Conceptual Stormwater Detention Basin Parameters

| Location | Type | Area (acres) | Approximate Ground Elevation at Location (ft NAVD88) | Approximate SD Main Ground Elevation at Location (ft NAVD88) | Approximate SD Main Invert Elevation at Location (ft NAVD88) | Target Storage Depth (ft)[1] | Detention Basin Media | Porosity | Depth (ft) | Excavation Depth (ft)[2] | Total Storage Depth (ft) | Storage Volume (acre-ft) | Total Storage Volume (acre-ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Ponding | 1.0 | 2.6 | | | 14.4 | |
| Jean Sweeney Park | Detention with GI | 5.5 | 17.2 | 17.0 | 10.4 | 5.1 | Soil | 0.2 | 1.5 | 7.3 | 5.1 | 1.7 | 18 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 2.2 | |
| | | | | | | | Ponding | 1.0 | 2.2 | | | 6.4 | |
| Neptune Park | Detention with GI | 2.9 | 8.7 | 8.9 | 2.7 | 4.7 | Soil | 0.2 | 1.5 | 6.0 | 4.7 | 0.9 | 8 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 1.2 | |
| | | | | | | | Ponding | 1.0 | 2.0 | | | 3.9 | |
| Marina Village Parkway ROW[3] | ROW GI with Detention | 2.0 | Varies | Varies | Varies | 4.5 | Soil | 0.2 | 1.5 | Varies | 4.5 | 0.6 | 5 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 0.8 | |
| | | | | | | | Ponding | 1.0 | 2.0 | | | 0.6 | |
| City of Alameda ROW[4] | ROW GI with Detention | 0.3 | Varies | Varies | Varies | 4.5 | Soil | 0.2 | 1.5 | Varies | 4.5 | 0.1 | 1 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 0.1 | |
| Alameda #1 | Detention with GI | 1.3 | 7.9 | 6.6 | 2.7 | 2.4 | Ponding | 1.0 | 0.9 | 5.3 | 2.4 | 1.2 | 2 |
| | | | | | | | Soil | 0.2 | 1.5 | | | 0.4 | |
| | | | | | | | Ponding | 1.0 | 1.3 | | | 1.0 | |
| Alameda # 2 and #3 | Detention with GI | 0.8 | 7.8 | 7.3 | 2.0 | 3.8 | Soil | 0.2 | 1.5 | 3.9 | 3.8 | 0.2 | 2 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 0.3 | |
| | | | | | | | Ponding | 1.0 | 4.8 | | | 21.6 | |
| College of Alameda #1A & #1B | Detention with GI | 4.5 | 10.5 | 10.8 | 2.0 | 7.3 | Soil | 0.2 | 1.5 | 7.00 | 7.3 | 1.4 | 25 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 1.8 | |
| | | | | | | | Ponding | 1.0 | 0.6 | | | 0.8 | |
| College of Alameda #2 | Detention with GI | 1.4 | 9.0 | 8.0 | 3.4 | 3.1 | Soil | 0.2 | 1.5 | 4.08 | 3.1 | 0.4 | 2 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 0.5 | |
| College of Alameda #3A-#3F | Grey Detention | 15.1 | 15.0 | 11.5 | 2.7 | 7.3 | Modular Storage | 0.95 | 4.0 | 7.49 | 4.0 | 57 | 57 |
| | | | | | | | Ponding | 1.0 | 2.2 | | | 1.3 | |
| Bay Eagle Park | Detention with GI | 0.6 | 9.0 | 9.9 | 3.7 | 4.7 | Soil | 0.2 | 1.5 | 3.76 | 4.7 | 0.2 | 2 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 0.2 | |
| | | | | | | | Ponding | 1.0 | 0.6 | | | 1.0 | |
| Parking Lot - Marina Village Parkway | Detention with GI | 1.6 | 9.0 | 10.0 | 5.4 | 3.1 | Soil | 0.2 | 1.5 | 2.06 | 3.1 | 0.5 | 2 |
| | | | | | | | Stone | 0.4 | 1.0 | | | 0.6 | |
| REAP #1 (to Webster PS) | Detention with GI | 1.2 | 4.5 | 6.9 | 2.7 | 2.7 | Ponding | 1.0 | 1.7 | 0.32 | 2.7 | 2.0 | 2 |
| | | | | | | | Soil | 0.2 | 1.0 | | | 0.2 | |
| | | | | | | | Ponding | 0.6 | 5.0 | | | 4.5 | |
| REAP #2 & #3 (to Marina PS) | Detention with GI | 1.5 | 6.0 | 8.2 | -0.8 | 7.5 | Soil | 0.2 | 1.5 | 5.31 | 7.5 | 0.5 | 6 |
| | | | | | | | Stone | 1.0 | 1.0 | | | 1.5 | |
| | | | | | | | | | | | | **Total** | **132** |

**City of Alameda Owned Land 36 acre-ft**

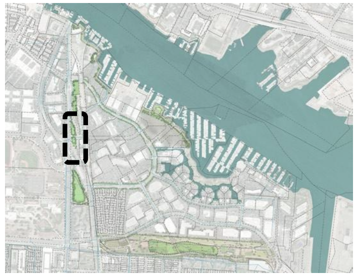
# Alameda Inland Flooding – Detention Basin Concept Plans

Neptune Park

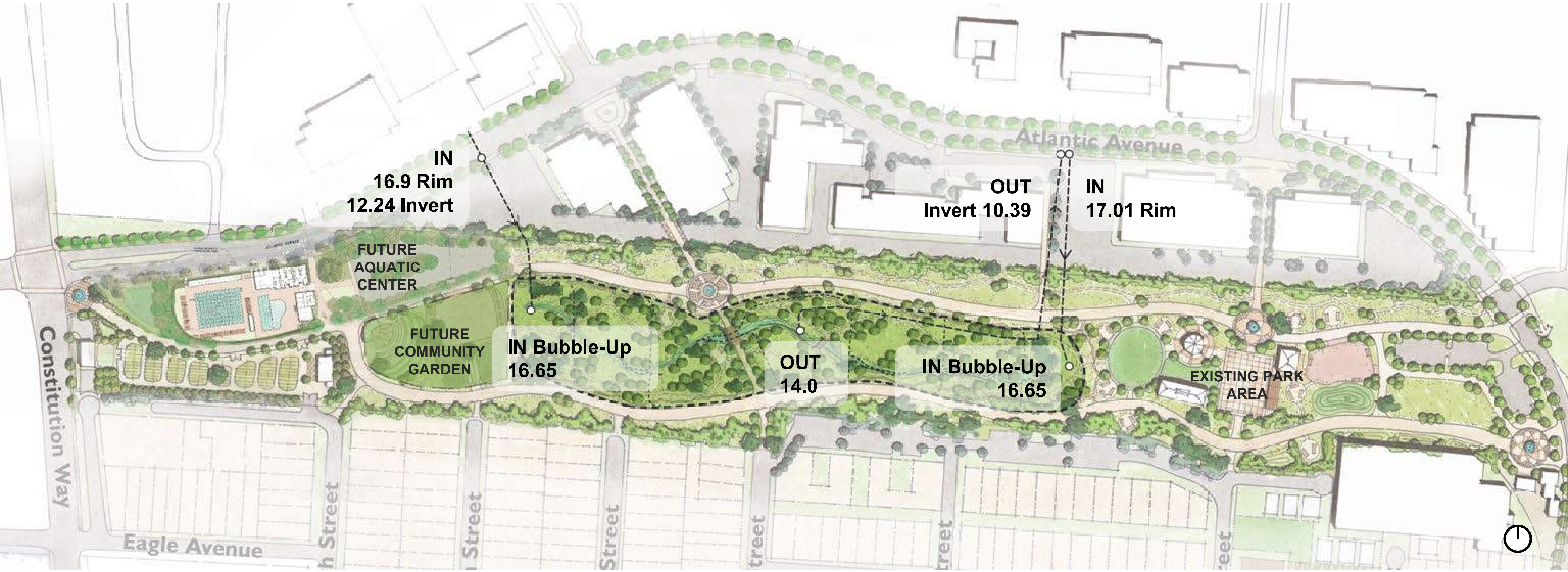



# Alameda Inland Flooding – Detention Basin Concept Plans

## Alameda #2 & #3



# Jean Sweeney Park




Fruit Tree Orchard
Existing Oak Trees
Park Structure
1 Mile Trail & Bike Loop
Fountain
Water & Dry Creek
Foot Bridge
Plaza or Special Paving
Natural Landscape
Lawn Area
Existing Vegetation
Community Garden

# Oakland Coastal Flood Protection Concept

*Alice Street to Lake Merritt Channel*

# Alice Street to Lake Merritt Channel – Existing Site


*The Landing*


*The Landing*


*KTVU*


*Formerly Eve's Waterfront Restaurant*


*Portobello*


*Rail Crossing at Lake Merritt Channel*


*Embarcadero Bridge*


*Estuary Park*

# Jack London Square - Port of Oakland Area of Study*


*AREA IS UNDER STUDY BY THE PORT OF OAKLAND'S VULNERABILITY ASSESSMENT, AND ADAPTATION PLAN

# Oakland Concept Plan

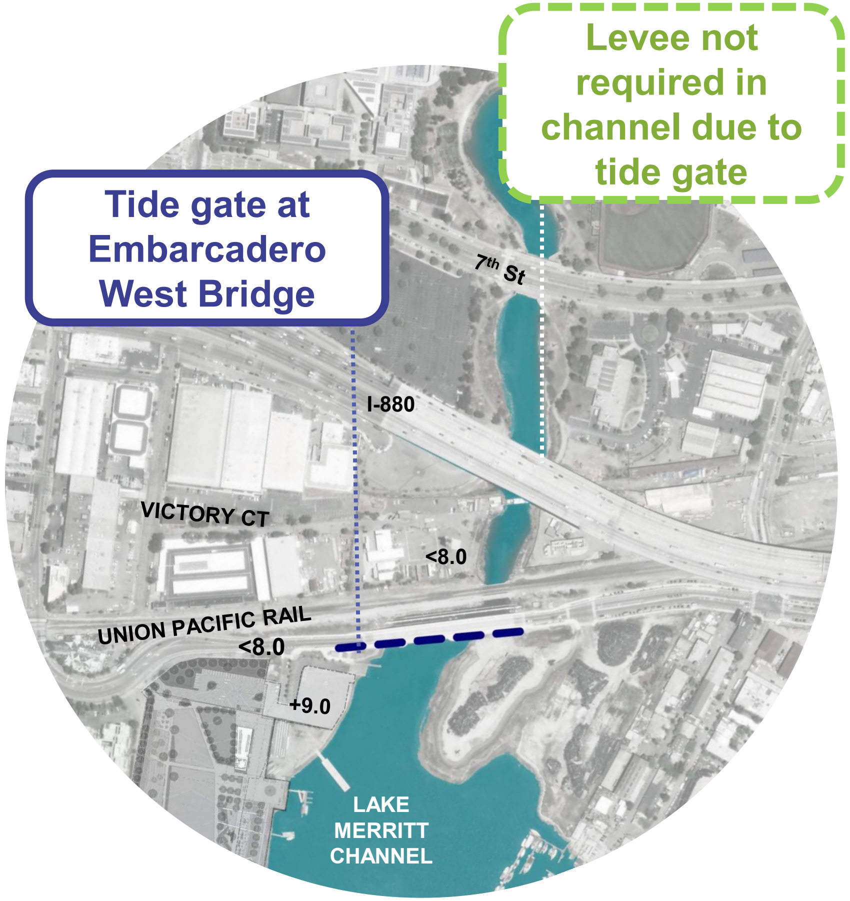

*This adaptation alternative is developed to a conceptual planning level only. Port properties in this area are under study by the Port of Oakland's Vulnerability Assessment, and Adaptation Plan

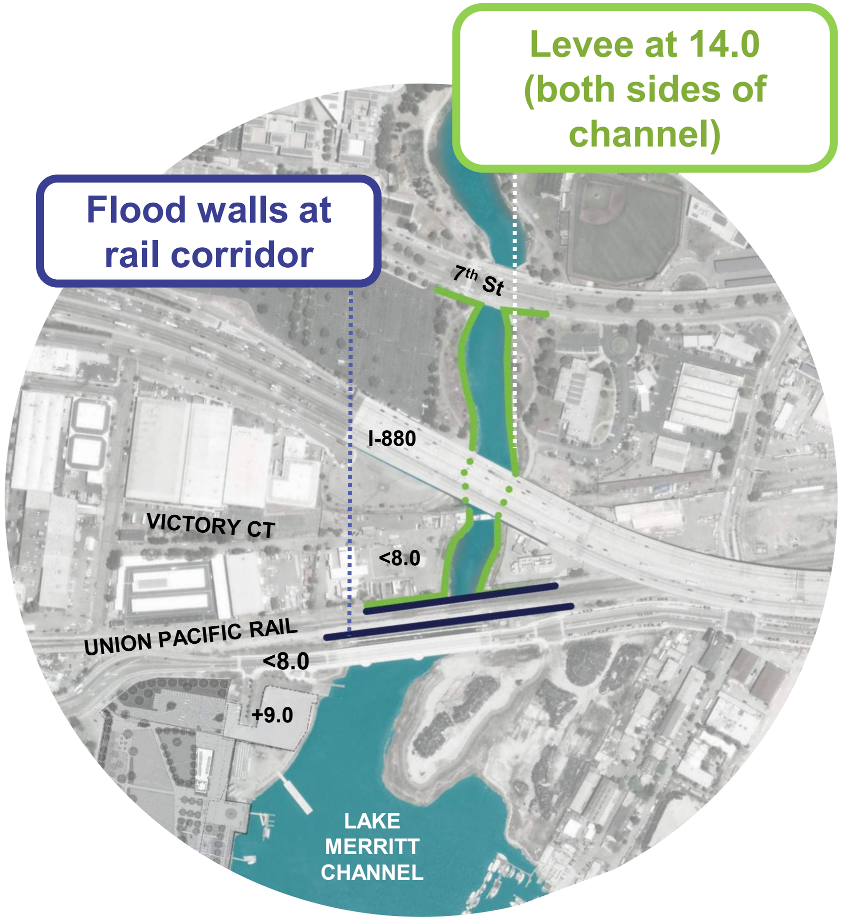
**"Finished Floor Elevation" (estimated)

# Oakland Concept

## Alternative to Tide gate at Lake Merritt Channel: Flood Walls at Union Pacific Rail Bridge





# Oakland Concept Plan – Alice St to Estuary Park


*This adaptation alternative is developed to a conceptual planning level only. Port properties in this area are under study by the Port of Oakland's Vulnerability Assessment, and Adaptation Plan

***"Finished Floor Elevation" (estimated)

# Oakland Shoreline