

**CHAPTER 10**

# OPEN SPACE

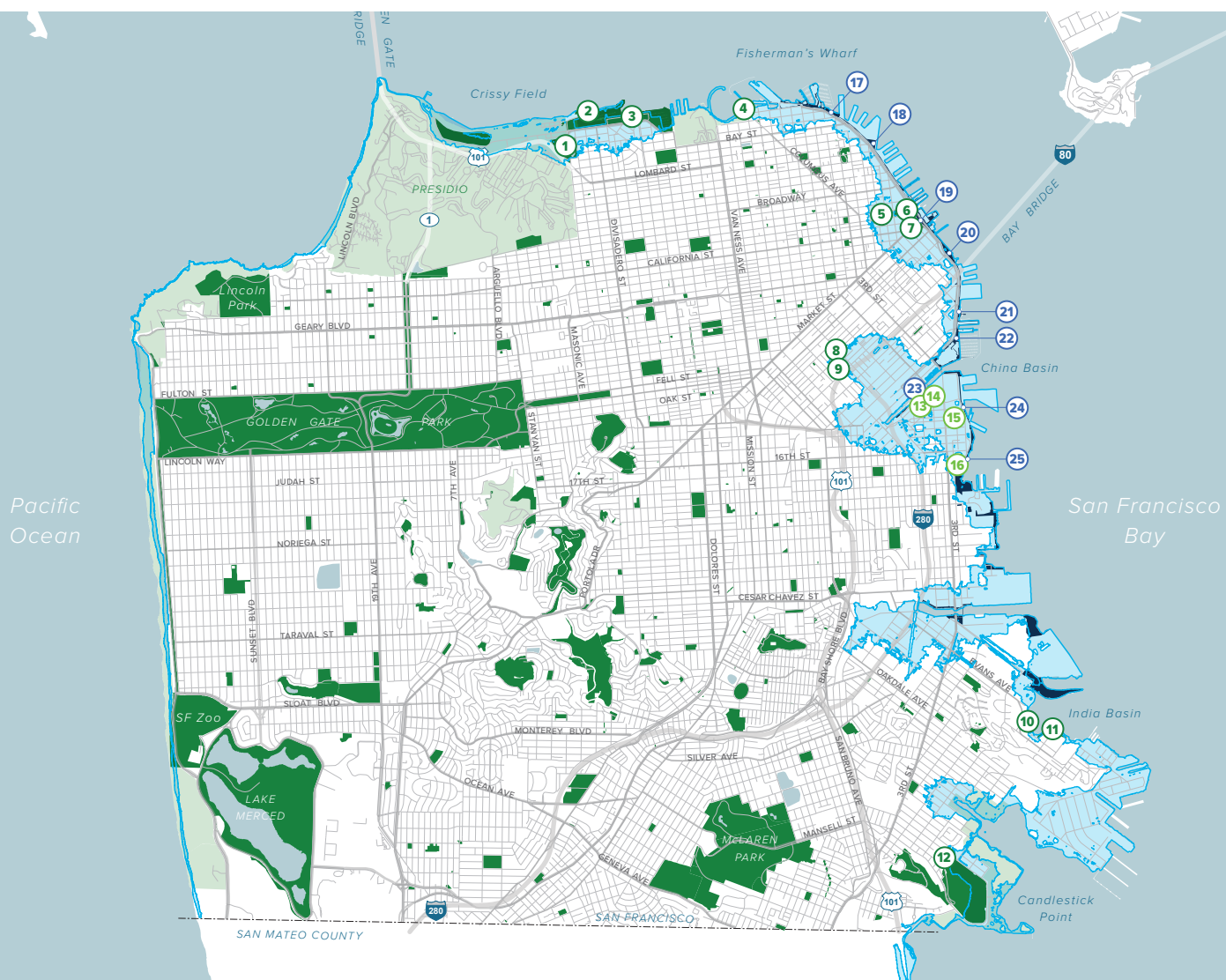
Open spaces preserve the environment for the wellbeing of everyone in our diverse community, and provide community facilities and resources with a variety of programming. The Recreation and Parks Department (RPD) also has initiatives that focus and strengthen the connections to parks and youth and senior programs in disadvantaged communities to ensure park users in every neighborhood across the City have access to clean, safe, and fun parks and programs. These include urban trails, dog play areas, golf courses, marinas, urban agriculture, and natural areas.

Some of the larger parks in San Francisco are owned and managed by other agencies such as the National Park Service (e.g., Presidio, Baker Beach, Ocean Beach, Crissy Field, and San Francisco Maritime National Historical Park and Aquatic Park Historic District), California State Parks (e.g., Candlestick State Recreation Area), and the Office of Community and Infrastructure, (e.g., Yerba Buena Gardens and Mission Creek Park).

The City of San Francisco's parks and open space are managed by several agencies, including RPD, the Port of San Francisco, the Office of Community Investment and Infrastructure, State and Federal agencies, and others (Figure 10.1).

This chapter focuses on the parks, playgrounds, marinas, recreation fields, and trails that are managed by the City and County of San Francisco and that have been identified as potentially vulnerable, by being wholly or partially located in the SLR Vulnerability Zone. The following sections describe these assets and how they may be vulnerable to SLR and coastal flooding, as well as provide information on interdependencies and consequences. Port-owned open spaces are discussed in Chapter 11, *Port of San Francisco*.

Figure 10.1 Parks, Playgrounds, and Recreation Areas within the SLR Vulnerability Zone



San Francisco Parks and Open Space  
 Port of San Francisco Parks and Open Space  
 State and Federal Parks  
 Inundation at 108" Sea Level Rise

0 0.5 1.0 2.0  
Miles



#### RECREATION & PARKS

- ① Palace of Fine Arts
- ② San Francisco Marina Small Craft Harbor
- ③ Marina Green
- ④ Dolphin Club/South End Rowing Club
- ⑤ Maritime Plaza
- ⑥ Sue Bierman Park
- ⑦ Embarcadero Plaza
- ⑧ Gene Friend Recreation Center
- ⑨ Victoria Manalo Draves Park
- ⑩ India Basin Shoreline Park
- ⑪ India Basin Natural Areas
- ⑫ Gilman Playground

#### OCII

- ⑬ Mission Bay Dog Park
- ⑭ Mission Bay Kids' Park
- ⑮ Mission Bay Commons Park
- ⑯ Mission Bay Parks 23 & 24

#### PORT OF SAN FRANCISCO

- ⑰ Public Park (near Pear 39)
- ⑱ Pier 27 (Cruise Ship Terminal)
- ⑲ Harry Bridges Plaza
- ⑳ Rincon Park
- ㉑ Brannan Street Wharf
- ㉒ South Beach Park
- ㉓ Mission Creek Park
- ㉔ Pier 52 Boat Launch
- ㉕ Agua Vista Park
- ⑰ Mission Bay Parks 23 & 24

## 10.1 PARKS, PLAYGROUNDS, AND RECREATIONAL AREAS

Parks, playgrounds, and recreational areas owned and managed by RPD in the SLR Vulnerability Zone are vulnerable to future SLR and coastal storm surge inundation and flooding. The assets are shown on Figure 10.1 and discussed in the sections below.

### 10.1.1 Potentially Vulnerable Assets

The assessment follows San Francisco's shoreline beginning on the Bay shoreline at the intersection of San Francisco with the County of San Mateo and continuing north along the Bay shoreline to the Golden Gate Bridge, and then south along the Westside shoreline to the intersection with the County of San Mateo on the open Pacific shoreline. Recreation and open space assets that are owned and managed by the Port are included in Chapter 11, *Port of San Francisco*.

#### 10.1.1.1 Gilman Playground

Gilman Playground is bounded by Gilman Avenue, Griffith Street, Ingerson Avenue, and Giants Drive in the Candlestick Point area of Bayview. The park is approximately 224,000 square feet and includes playfields, picnic areas, a basketball court, a children's play area, a clubhouse, and restrooms (see Photo 10.1). The clubhouse functions as a community recreation center and includes a community room and kitchen. The site is predominately open space and play areas, with the clubhouse and restrooms situated near Ingerson Avenue. A recent renovation of the children's playground was completed in the summer of 2016.

The open space areas have had drainage problems during heavy rains accompanied by high tides. The fields can remain wet and swampy for extended periods after heavy rain events. Inundation with saltwater could damage the vegetation and affect the growing patterns of the lawns if the soils retain the salt for a prolonged period. Onsite irrigation systems could help mitigate saltwater damage.

The Gilman Playground is first impacted by flooding and inundation under Scenario 7, with 12 percent of the site subject to inundation. By Scenario 10,



Photo 10.1 Gilman Playground. SF Rec Park

approximately 50 percent of the park could be subjected to temporary coastal flooding. To date, the clubhouse and other structural assets at the park have not been adversely affected by flooding.

The clubhouse is an at-grade wood-frame building. Floodwaters could enter the building through doors and other entry pathways, resulting in damage. Temporary flood-protection measures such as sand bags could be used to mitigate damage. The building may contain asbestos, which reduces its ability to be upgraded cost effectively to be more flood resilient. However, the presence of asbestos could also result in more significant damage and contamination if the building is flooded.

Temporary flooding would only have a minor impact on the playground and playground equipment, but access to the facility would be limited during a flood event. Most aspects of the park would recover once floodwaters recede; however, repeated flooding could shorten the lifespan of the playground equipment. During permanent inundation, the park would not be able to perform its primary functions.

RPD has other parks and recreation centers within its portfolio that could provide substitute services during a flood event. However, after-school services would be affected. Parents and children that rely on the park for after-school care may either lose access to this service or require temporary bus service to another location for after-school care.





Photo 10.2 India Basin Shoreline Park. SF Rec Park



Photo 10.3 Kayaks near India Basin Shoreline Park. SF Rec Park

#### 10.1.1.2 India Basin Shoreline Park<sup>1</sup>

India Basin Shoreline Park is an existing 5.6-acre open space located east of Hunters Point Boulevard between Hawes Street to the north and Hudson Avenue to the south. India Basin has one of the few remaining tidal wetlands of the Bay Area and is the only Natural Area<sup>2</sup> within the RPD system that borders the Bay (Photo 10.2). The shoreline areas adjacent to the Bay include tidal salt marsh and upland habitat that provide food and shelter for a variety of shorebirds and foraging habitat for raptors.

The park also has two play structures, a basketball court, landscaping, a portion of the Blue Greenway/ Bay Trail with informal access for kayakers, artwork by local artists and students, barbeque grills, seating areas, a water fountain, and educational signage (Photo 10.3). Two buried ship hulls, the Bay City and the Caroline, are located within the tidal coastline of the India Basin Shoreline Park property.

The shoreline is not engineered (it consists of debris, rip rap, and natural tidal marsh) and is exposed to the Bay's wave climate and subject to some wave-driven erosion. Table 10.1 indicates that the India Basin Park area is 14 percent inundated under Scenario 1;

however, the areas inundated are largely marsh and mudflat areas along the shoreline that are subject to regular tidal inundation today. The inland park areas are not expected to experience regular tidal inundation until Scenario 4.

The park areas have not been disrupted by extreme weather events or flooding to date. The recreational structures are located at a higher elevation than the shoreline open spaces; therefore, the park is expected to regain functional use after temporary flood waters recede with minimal repair other than cleanup. Permanent inundation of the lower-lying areas would impact some the park's current function, but the play areas would likely remain unaffected and the shoreline areas could retain value for bird watching, wildlife habitat, and other connections with nature.

The India Basin Ideas Competition generated ideas to bring this location and the adjacent post-industrial sites together to create a larger park with a resilient marsh shoreline.<sup>3</sup> The project would include features to enhance the future adaptive capacity and overall resilience of the park. With other sites and assets planned nearby, there is some potential redundancy.

<sup>1</sup> Currently, there are two parks at India Basin: India Basin Shoreline Park and India Basin Natural Area. In addition, there is the planned expanded India Basin Open Space, which includes the two parks previously cited plus the area at 900 Innes, with a plan to create a larger 64-acre open space park.

<sup>2</sup> India Basin Shoreline Park is a part of RPD's Natural Areas Program, which aims to preserve, restore, and enhance remnant Natural Areas, and to develop and support community-based site stewardship of these areas. It places a high value in supporting habitat for native plants and wildlife; ecosystem functions such as soil and water retention; and socioeconomic values, as well as being outdoor classrooms and living museums protecting natural heritage.

<sup>3</sup> <http://ibwaterfrontparks.com/#landing>





Photo 10.4 SOMA/Gene Friend Recreation Center. James Watkins

### 10.1.1.3 Gene Friend Recreation Center

The Gene Friend Recreation Center occupies a 1-acre site at the northwest corner of Folsom and 6th Streets in the South of Market area (Photo 10.4). Indoor facilities include a full gymnasium, activity room, weight room, auditorium, badminton and volleyball courts, ping pong, and foosball tables. Outdoor facilities include a basketball court, playground, and open space/lawn area. The facility provides recreational programs and activities for youth and seniors. The facility is also used as a Red Cross emergency evacuation center.

The recreation center is located within the historic Hayes Creek bed, and hydrology and drainage issues could occur as sea levels and the groundwater table rise. The recreation center is not anticipated to be directly inundated until Scenario 10 (Table 10.1). However, the shallow groundwater table is already high and sump pumps are needed in the building to prevent flooding. As sea levels rise, the potential for groundwater flooding will increase.

The building includes mechanical and electrical equipment that is at grade and sensitive to saltwater flooding. The building has at-grade doors and pathways that could allow floodwaters to enter. Sandbags could be used to mitigate flood damage during a temporary flood event. The southernmost structure along 6th Street which houses a multipurpose room, office, and kitchen is most at risk of flooding. The facility is part of a feasibility study and concept design development program that would rehabilitated



Photo 10.5 Victoria Manalo Draves Park. Payton Chung (CC BY 2.0)

or rebuild the recreational center. Current draft plans for the new building include two basketball courts inside the new gym on the south end of the new building.

This is the only public recreation center south of Market, and the center serves a large elderly population and provides services for at-risk youth. There are no nearby RPD assets that could provide the same services and accessibility for the users of this facility.

### 10.1.1.4 Victoria Manalo Draves Park

This recently built 2-acre park, located at Sherman and Folsom Streets, is a new addition to the SOMA neighborhood, adjacent to Bessie Carmichael School (Photo 10.5). The park includes a softball field, basketball court, dual-level playground, picnic area, community garden, and field.

Like the Gene Friend Recreation Center, the park is on the boundary of the SLR Vulnerability Zone and not anticipated to be directly affected by coastal flooding and SLR until Scenario 10 (Table 10.1). The park is located within the South of Market urban area, making it vulnerable to potential flooding if no adaptation measures are implemented along Mission Creek. It is also located within the historic Hayes Creek bed, and hydrology and drainage issues could occur as sea levels and the groundwater table rise.

Most of the park areas could recover after inundation subsides. However, the community garden, and lower-lying grassy areas and park vegetation, may

be impacted from rising groundwater and eventual saltwater inundation. The basketball court and lower playground surfaces could degrade after repeated inundation and require replacement sooner than expected. The park would not function as currently intended with permanent inundation.

Other San Francisco parks could provide similar services and amenities if this park is temporarily impacted; however, there are few alternative recreational spaces in the South of Market area.

#### 9.1.1.5 Embarcadero (formerly Justin Herman) Plaza

Embarcadero Plaza is located in San Francisco's Financial District at the eastern end of Market Street across from the Ferry Building (Photo 10.6). Local vendors and weekly farmers markets utilize the plaza spaces, while local commuters and tourists pass through the thoroughfare between the Embarcadero and Market Street. A hardscape plaza with the Vaillancourt Fountain is situated north of Market Street and bocce ball courts are located to the south. The eastern edge of the plaza is landscaped with lawn and palm trees.

The plaza is adjacent to multiple transit lines, including the San Francisco Bay Ferries, BART, MUNI buses,

Market Street Railway F-line and E-line, and cable cars, all of which have stops nearby or adjacent to the plaza. The plaza is a popular venue for multiple events, including ice skating during the holidays, sport events, protests, concerts, and other large events.

The plaza is located near the Bay shoreline and could be exposed to temporary periodic flooding in the near term (under Scenario 5, see Table 10.1) along the western, hardscape portions both north and south of Market Street. Although function of this site would be impaired during a flood event, it could return to full use with minimal repair and cleanup after initial flood waters recede. More frequent saltwater exposure could impact plants and other assets that are sensitive to saltwater flooding and could lead to faster deterioration and increase maintenance of the hardscape features. Permanent inundation would make this site and the surrounding infrastructure unusable.

Other open-space plazas in the RPD portfolio provide some redundancy for the recreational facilities; however, the gateway character, prominent civic location, and proximity to transit make the Embarcadero Plaza a unique place in the City landscape.



Photo 10.6 Embarcadero (formerly Justin Herman) Plaza. Dennis Jarvis (CC BY-SA 2.0)





Photo 10.7 Sue Bierman (formerly Ferry) Park. TheTokl (CC BY-SA 3.0 DE)



Photo 10.8 Sue Bierman Park Children's Playground. SF Rec Park

### 10.1.1.6 Sue Bierman Park

Sue Bierman Park occupies two City blocks, extending from The Embarcadero on the east to Davis Street on the west, between Washington and Clay Streets (Photos 10.7 and 10.8). Drumm Street bisects the park between Washington and Clay Streets. The park occupies 4.4 acres of land that previously served as on- and off-ramps for the elevated Embarcadero Freeway, which was demolished after being damaged by the 1989 Loma Prieta earthquake.

The park includes a children's playground and lawn areas with trees and walking paths throughout the park. SFPUC owns a small building near the park at the northeast corner of Washington and Drumm Street. RPD uses this building and lot for fuel storage, power equipment, and RPD vehicle parking. If the SFPUC building is damaged during a flood event, it would affect the RPD maintenance activities beyond Sue Bierman Park.

Sue Bierman Park is projected to be 16 percent inundated under Scenario 5 (Table 10.1), with the inundation impacts limited to the eastern parcel until Scenario 7. The western park parcel is located at a slightly higher elevation than the eastern parcel. The eastern parcel presently floods during major storm events and it can take 24 to 48 hours for the water to fully drain. The drainage issues could worsen with SLR and rising groundwater levels.

The park is also popular with a non-native flock of parakeets, which like to roost in the equally

non-native trees of the park. If the trees are negatively impacted by saltwater flooding and rising groundwater, the well-adapted birds are likely to find alternative suitable habitat in the surrounding urban environment.

There are alternative RPD sites nearby that can provide similar recreation opportunities, offering some redundancy should the park be temporarily flooded.

### 10.1.1.7 Palace of Fine Arts

Originally constructed in 1915 as part of the Panama-Pacific International Exhibition, the Palace of Fine Arts is situated generally between Marina Boulevard, Baker Street, Bay Street, and Richardson Avenue (Photo 10.9). It consists of a large open-space area with a landscaped park, footpaths, an artificial lagoon, historic Greco-Roman style rotunda/dome and colonnades, warehouse, and theater. The iconic assembly of buildings is one of the most photographed sites in the City and is featured in numerous film and TV productions. It is also used as a wedding location and popular performance venue. The Palace of Fine Arts is listed (2005) on the National Register of Historic Places.

RPD is currently looking for a long term or permanent tenant to move in and seismically retrofit the building, which could include adaptation strategies to address SLR, rising groundwater levels, and localized flooding. As a temporary measure, sandbags can be placed at the doors of the building to prevent indoor





Photo 10.9 Palace of Fine Arts. Michael Fraley (CC BY 2.0)

flooding. The building also has storm drainage issues. The aging combined sewer system in this location has been clogged in the past, resulting in localized flooding in the rear parking lot.

The historic rotunda and colonnades were originally constructed in 1915 of wood and staff, a mixture of wood and a burlap-type fiber. The structure was intended to be demolished after one year. However, the structure was saved from demolition and was repaired and rehabilitated in the 1930s and 1960s, replacing much of the wood and staff structure with concrete. The most recent restoration and seismic retrofit efforts were completed in 2008. The dome of the historic structure is made from plaster and damage caused by flooding could be permanent.

The Palace of Fine Arts is first inundated under Scenario 6, with 75 percent of the grounds and structures impacted by temporary flooding. However, high groundwater levels and drainage issues are present today, and SLR is likely to exacerbate these issues before overland coastal flooding occurs.

#### 10.1.1.8 Sharp Park & Golf Course

Sharp Park is a golf course in Pacifica that is owned and managed by RPD (see Photo 10.10). It is situated between Milagra and Sweeney Ridges, two regionally significant open spaces managed by the Golden Gate National Recreation Area (GGNRA), and is immediately north of Mori Point, another GGNRA-managed open space to which it has trail connections. The park's natural area encompasses diverse



Photo 10.10 Sharp Park & Golf Course. SF Rec Park

and important habitats, including coastal wetlands (Laguna Salada and Horsestable Pond), coastal scrub, forest, and grasslands. It supports populations of federally listed and protected species such as the California red-legged frog, the rare San Francisco garter snake, and the mission blue butterfly. The park is part of RPD's Natural Areas Program. Sharp Park's other features include an 18-hole golf course and a nationally recognized archery range.

RPD is developing plans for public access improvements along the coastal trail at Sharp Park in the City of Pacifica. The improvements are required as part of RPD's Coastal Development permit for the berm that separates the Sharp Park golf course and the beach at Sharp Park. The permit issued by the California Coastal Commission requires the installation of the two overlook areas, two vertical access ways, interpretive signage, and other trail-related amenities.

The coastal wetlands and coastal shrub habitats located near the open Pacific coast are low-lying and have existing hydrologic connections to the ocean. Temporary flooding is not expected to cause any lasting impacts; however, the wetlands' upward migration to keep pace with SLR may be impeded if there is not enough sediment and they may drown. Generally, the area provides some room for the coastal wetlands to migrate upland, but continued migration would result in a loss of portions of the golf course. Coastal erosion from large wave hazards is also an issue for coastal habitats such as this one. As the sea level rises, larger waves may increasingly erode the shoreline.



### 10.1.2 Exposure Assessment

The exposure of each park was evaluated relative to the 10 SLR scenarios (see Chapter 2). The percentage of each park that could be inundated under each scenario was calculated and is presented in Table 10.1.

### 10.1.3 Consequences

Key consequences that could occur to society and equity, the economy, environment, and governance (see Chapter 3) were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



**KEY ISSUE:** Many of the parks and open spaces providing recreation opportunities and preserving the environment for the wellbeing of the community, especially in already underserved vulnerable communities, would become unavailable to residents and visitors. These park and open-space areas are surrounded by dense urban or industrially use spaces. If temporarily, and eventually

permanently, unavailable due to flooding, most of these spaces will not have room to be relocated to higher ground and could be lost.



**Society and Equity:** Residents could lose shoreline and park and open-space access as well as other recreational opportunities if these areas are damaged or disrupted. These impacts would disproportionately impact vulnerable communities for whom the loss could be considerable, as they may not have the ability take advantage of open space, parks, and/or programs in locations not impacted.



**Environment:** Parks and open spaces often reduce the percentage of impervious surface within a neighborhood, reducing the impacts of urban heat islands and serving as habitat for wildlife species. Coastal flooding would reduce and eventually remove these benefits to the community and environment. At India Basin, the small remaining patches of tidal wetland habitat for threatened and endangered species will be impacted. Storm-event flooding makes these species more vulnerable to predation and can reduce reproductive success if nests are flooded. Downshifting habitat means marshes will be flooded more often, exacerbating

**Table 10.1** Percentage of each RPD Park Inundated with Sea Level Rise

Park	Total Area (acres)	Percent Inundated under Each Sea Level Rise Scenario									
		1	2	3	4	5	6	7	8	9	10
Gilman Playground	5.2	-	-	-	-	-	-	12	24	38	49
India Basin Shoreline Park	11.6	14	19	23	28	30	34	36	38	39	41
Gene Friend Recreation Center	1.0	-	-	-	-	-	-	-	-	-	33
Victoria Manalo Drakes Park	2.5	-	-	-	-	-	-	-	-	-	12
Embarcadero Plaza	4.1	-	-	-	-	22	85	91	95	100	100
Sue Bierman Park	4.3	-	-	-	-	16	39	61	72	80	85
Palace of Fine Arts	19.4	-	-	-	-	-	75	80	86	94	96
Sharp		-	-	-	-	-	-	-	-	-	-

Sharp Park was not included in the exposure assessment because it is located in Pacifica and outside of San Francisco's SLR Vulnerability Zone boundaries.

these population stresses, until conversion of marsh to mudflat results in complete loss of tidal marsh species at this location, assuming there is no accommodation space for inland migration.



**Economy:** Access to open space, recreation areas, programs, and the shoreline provide quality of life for San Francisco residents and visitors and are part of the unique experience of living in or visiting San Francisco. The Embarcadero, Ferry Plaza, and other parks and shoreline areas play an important role in attracting tourists and creating jobs and revenue for the City and its businesses. Temporary and permanent flooding and inundation could negatively affect nearby businesses through direct costs from damages and indirectly from less business. City parks also provide recreation value to residents, help maintain healthy and safe communities, and can increase the property values of

surrounding land, which could also be negatively impacted. In addition, maintenance costs for parks and open spaces could increase and where even possible, substantial funding would be needed to relocate or improve infrastructure due to the high degree of scrutiny and environmental compliance required. These increased costs would potentially be passed on to the taxpayers and park users, creating potential disproportionate impacts across economic brackets.



**Governance:** Although San Francisco's low-lying parks and open spaces in the SLR Vulnerability Zone will all likely be impacted to a similar degree, many of the open spaces are managed by different entities that will need to coordinate to mitigate impacts.



## 10.2 MARINAS AND AQUATIC RECREATION CENTERS

The Port owns and manages the majority of the direct Bay shoreline land use from Herons Head Park to the south and Aquatic Park to the north; however, Aquatic Park is owned and managed by the San Francisco Maritime National Historic Park as part of the National Park Service. The facilities owned and maintained by the Port are described in Chapter 11, Port of San Francisco. RPD manages a selection of marinas, harbors, and aquatic recreation centers that are outside of the Port's authority. These facilities are described below.

### 10.2.1 Potentially Vulnerable Assets

The following marinas and aquatic recreation centers are owned and maintained by RPD and are located within the SLR Vulnerability Zone as shown in Figure 10.2.

#### 10.2.1.1 Marina Small Craft Harbor

The San Francisco Marina is the oldest recreational marina operating in San Francisco and a popular international destination. The San Francisco Marina includes two harbors, West Harbor (Photo 10.11) and East Harbor (Photo 10.12), three park greens (i.e., Little Marina Green, Big Marina Green, and Marina Green Triangle), and several buildings. It is situated along the City's northern waterfront, between Fort Mason on the east and Crissy Field on the west. The entire site consists of about 35 acres, with 727 berths, pump-out stations, and a commercial fuel dock. It also includes a structure with the Harbor Master's Office and public restrooms as well as other buildings (Marina Buildings, discussed below).

Over 500 parking spaces are available to the general public at all times. Approximately 93 parking spaces throughout the Marina Green are striped for the exclusive use of "permitted" harbor tenants whose

**Figure 10.2** Overview Map of Marinas and Aquatic Recreation Centers in the SLR Vulnerability Zone

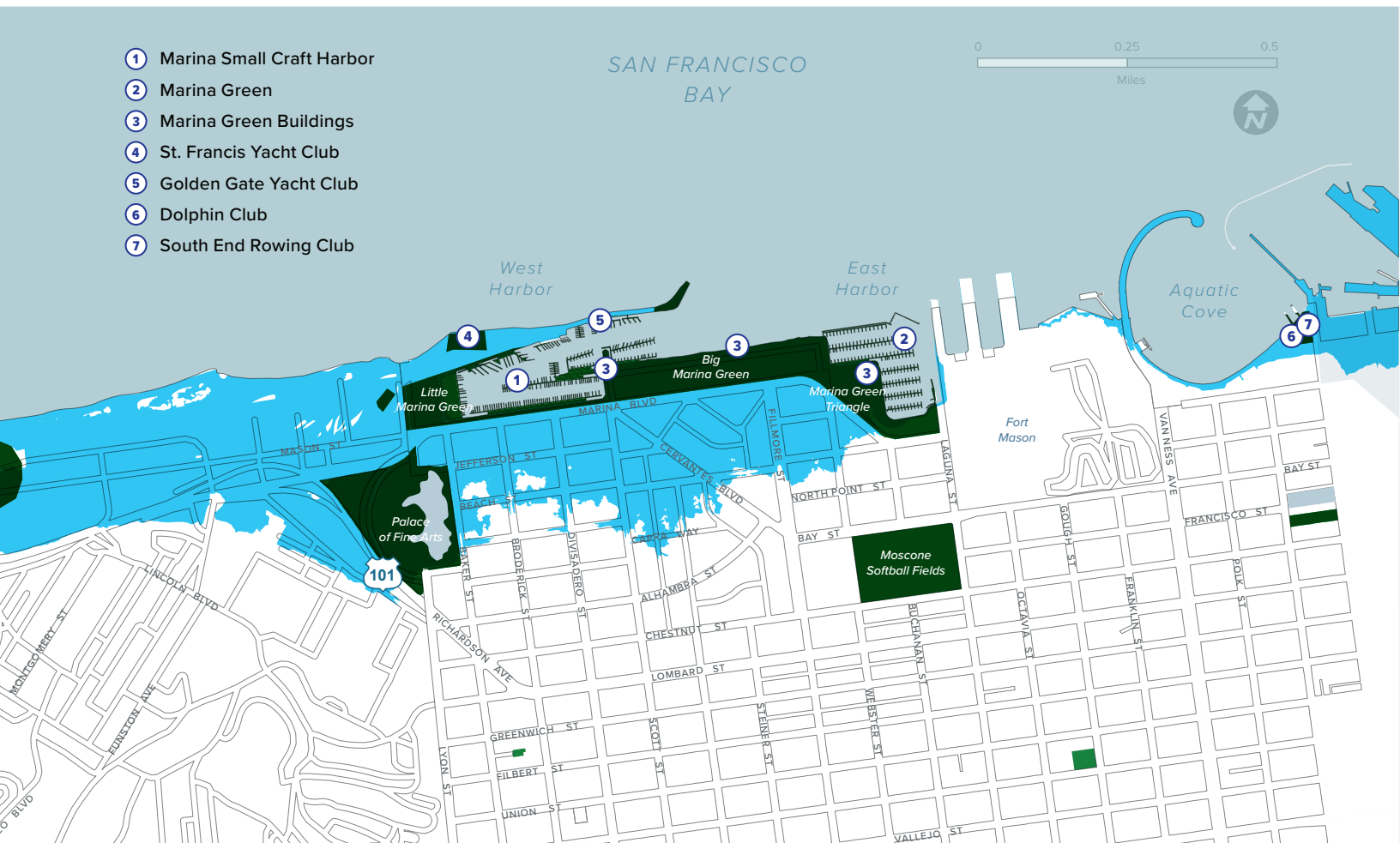






Photo 10.11 Marina Small Craft Harbor (West Harbor) and Little Marina Green.



Photo 10.12 Marina Small Craft Harbor (East Harbor) and Marina Green Triangle.





Photo 10.13 Marina Green. David Jones (CC BY 2.0)

vehicles have 24/7 parking privileges subject to availability. In addition, 74 parking spaces are reserved for boaters on Saturday, Sunday, and official holidays, and available to the general public on weekdays.

The West Harbor, also known as “Yacht Harbor,” is located north of Marina Boulevard, between Baker Street and Scott Street. The East Harbor, also known as “Little Marina” and “Gashouse Cove,” is located north of Marina Boulevard, between Webster and Laguna Street. The West Harbor generally serves public sailboats and motorboats, but also provides berths to fireboats, and other agency boats for critical services, such as Fire Jet Ski’s, U.S. Fish and Wildlife boats, and Homeland Security law enforcement boats.

The marina’s small boat berthing facilities are located behind a locked gate within the marina, with access to the docks via gangways. At-grade utilities, including water and power, are connected to the docks. The main electrical switchgear in the west is at ground level and could fail if exposed to seawater. The power services the docks, street lighting and office / buildings, and the two yacht clubs (discussed below). Fire suppression and storm sewer services are also provided onsite. The historic internal marina seawalls in the west are in poor condition and continue to fail, due to their construction type. The northern marina shoreline adjacent to the west marina also has had failures and heavy erosion due to ship speed and size and amount of traffic type wave action against the northern seawall of the Bay.



Photo 10.14 A building along the Marina Green. James Watkins

Approximately 75 percent of site is subject to tidal, wind, and wave hazards. The West Harbor has more substantial wave protection than does the East Harbor. The Marina Shop’s lower level floods during very high tides, and the floodwater impacts mechanical equipment, including pumps, motors, and valves. At-grade utilities, including water and power, are connected to the docks.

The marina operates at 98 percent occupancy in the West Harbor and 76 percent-percentage occupancy in the east and there are no other nearby public small craft harbor facilities available, thus there are no alternative sites for redundancy. The East Harbor’s planned replacements include gangways to the docks above King Tide level for those that have risk levels of failure and/or wouldn’t be useable. The West Harbor is on pilings, which may be too low to withstand SLR. There are utility systems under the docks that are vulnerable, especially if exposed to storms, high tides, and SLR. In addition, there is a lack of adequate shoreline armoring (e.g., stone rip rap or similar) to reduce wave hazards on the Bayfront side of the marina.

#### 10.2.1.2 Marina Green

Marina Green is a large expanse of predominantly grassy open space on the waterfront, extending from Laguna Street (Fort Mason) on the east to Lyon Street/ Yacht Road (The Presidio) on the west, between Marina Boulevard and San Francisco Bay (Photo 10.13). Footpaths and jogging paths run around the perimeter of Marina Green, along Marina Boulevard





**Photo 10.15** The Naval Degaussing Station in the Marina Green.  
Google Street View

and extend out to the Wave Organ at the end of a jetty past St. Francis Yacht Club.

The lawns at Marina Green are used heavily by neighboring children and schools for athletic practices for children 11 and under. They are also used every Saturday in the fall and spring for microsoccer. There are limited athletic fields in this area and no alternative locations to accommodate the weekday practices. For the Saturday games, there are limited options short of converting baseball fields in the southeast part of the City.

The site has existing drainage issues and the lawns could be damaged by intermittent saltwater flooding. Marina Green hosts major RPD and other public events such as Fleet Week staging, marathons, and the 2013 America's Cup.

#### 10.2.1.3 Marina Green Buildings

Marina Green includes several buildings, including an administration building, restrooms, and other RPD facilities (Photo 10.14). The buildings are not anticipated to be inundated until Scenario 9; however, access issues will likely occur at an earlier scenario due to inundation of the surrounding areas (see Table 9.3). The buildings do not house any critical electrical or mechanical equipment, and the use of the building could resume once floodwaters recede and cleanup is complete. Floodwaters could enter the buildings through doorways, vents, and other openings. Sandbags can be used as a temporary flood protection measure, but no sandbags are currently housed onsite.



**Photo 10.16** St. Francis Yacht Club. Scott Chernis (CC BY 2.0)

Permanent inundation of these facilities would render them inaccessible and unusable. The Naval Degaussing Station, a 720-square-foot clapboard building, is currently being remodeled with a completion date of late 2019 (Photo 10.15). This will be the future marina office; the existing office will then be modified for revenue-generating boater services.

#### 10.2.1.4 St. Francis Yacht Club

St. Francis Yacht Club was founded in 1927 and is located at 700 Marina Boulevard (Photo 10.16). The main building is located directly on the Bay, on a broad spit with a parking lot and vehicular access between the Bay shoreline and the West Harbor. Rip rap is placed along the shoreline directly in front of the yacht club to reduce wave impacts. Much of the shoreline is hardened with either rip rap or concrete.

As sea levels rise and wave hazards increase, the rip rap protection will require improvements to dissipate large wave hazards. Although the structure is not anticipated to be inundated by coastal floodwaters until Scenario 6, the structure is directly adjacent to the rip rap revetment and likely to be damaged under an earlier scenario by wave hazards that exceed the design criteria of the revetment.

Land side transformers southeast of St. Francis Yacht Club are at ground level and serve the yacht clubs and the north side docks north. SLR and king tides in this area would potentially put the transformers underwater. There are other yacht clubs and clubhouses that could provide services if St. Francis Yacht Club is damaged during a storm. However, if St.



Photo 10.17 Golden Gate Yacht Club. Yasuhiro Chatani (CC BY 2.0)

Francis and Golden Gate yacht clubs were damaged at the same time, alternative clubs and clubhouses are many miles away from this location.

#### 10.2.1.5 Golden Gate Yacht Club

Golden Gate Yacht Club was founded in 1939 and is located at 1 Yacht Road in the protected harbor near St. Francis Yacht Club (Photo 10.17). The structure is built on pilings over water and could be inundated by temporary floodwaters as early as Scenario 2. The structure is less exposed to wave hazards than the larger St. Francis Yacht Club; however, wave action is causing erosion issues for the access road/jetty to Golden Gate Yacht Club. There are other yacht clubs and clubhouses that could provide services if Golden Gate Yacht Club is damaged during a storm. However, if Golden Gate and St. Francis yacht clubs were damaged at the same time, alternative clubs and clubhouses are many miles away from this location.

#### 10.2.1.6 Dolphin Club

The Dolphin Club is located at 502 Jefferson Street (Photo 10.18). The building is owned by RPD but managed and leased by the club. Founded in 1877, the club currently has about 1,500 members. They swim in Aquatic Park, row in the Bay, and participate in the annual Escape from Alcatraz Triathlon. The site has boat houses for stowing rowboats and kayaks. The two-story facility has locker rooms, lounge areas, boat building and repair room, and a weight room.

The building is more than a century old, and although well maintained, would likely sustain damage during temporary or permanent inundation. The structure



Photo 10.18 Dolphin Club and South End Rowing Club. Pax Ahimsa Gethen (CC BY-SA 4.0)

is projected to be inundated by temporary coastal flooding under Scenario 3. Some areas of the facility are built on pilings over beach areas. The facilities are being protected from wave hazards by the aquatic pier; however, the pier is deteriorating and will need rehabilitation to maintain protecting the club building.

#### 10.2.1.7 South End Rowing Club

South End Rowing Club, located at 500 Jefferson Street, was founded in 1873 and currently has about 1,300 members (Photo 10.18). Rowing, handball, swimming, and running are the primary club sports. The nearly 150-year-old structure is located directly on the shoreline adjacent to the Dolphin Club. Although well maintained, it would likely sustain damage during temporary or permanent inundation. The structure is projected to be inundated by temporary coastal flooding under Scenario 3. The only alternative location to the Dolphin and South End Rowing Clubs is at Lake Merced, which does not provide the same suite of Bay watercraft opportunities.

### 10.2.2 Exposure Assessment

The exposure of each marina and aquatic recreation center was evaluated relative to the 10 SLR scenarios (see Chapter 2). The percentage off each marina that could be inundated under each scenario was calculated and is presented in Table 10.2. For aquatic recreation structures, exposure under each SLR scenario was assessed as either inundated or not inundated, based on a structure's ground elevation relative to the flood elevation of each SLR scenario, as presented in Table 10.3.

**Table 10.2 Marina and Harbor Exposure with Sea Level Rise**

Name	Total Area (acres)	Percent Inundated under Each Sea Level Rise Scenario									
		1	2	3	4	5	6	7	8	9	10
Marina Small Craft Harbor	30.0	-	-	-	-	-	30	35	36	37	39
Marina Green Three Lawns	27.1	-	-	-	-	-	13	40	52	69	84

**Table 10.3 Aquatic Recreation Exposure with Sea Level Rise**

Name	Percent Inundated under Each Sea Level Rise Scenario									
	1	2	3	4	5	6	7	8	9	10
Marina Green Buildings	-	-	-	-	-	-	-	-	Y	Y
St. Francis Yacht Club	-	-	-	-	-	Y	Y	Y	Y	Y
Golden Gate Yacht Club	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dolphin Club	-	-	Y	Y	Y	Y	Y	Y	Y	Y
South End Rowing Club	-	-	Y	Y	Y	Y	Y	Y	Y	Y

### 10.2.3 Consequences

Key consequences and consequences that could occur to society and equity, the economy, environment, and governance (see Chapter 3) were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



**KEY ISSUE:** The Marina Green and yacht harbors provide key access and unique views of the San Francisco Bay to residents and visitors, and are important for San Francisco's tourism and sailors. The marinas (the physical structures, supporting buildings, and electricity supply) could be damaged and/or become inaccessible due to flooding and secondary hazards, such as wave impacts, creating potentially long-lasting and costly effects. Impacts to some of the historic seawall and shoreline fortifications will become worse, eventually cutting off access to the yacht clubs and marina facilities.



**Society and Equity:** Despite being in a more affluent area of San Francisco, this open space is used for many public and free events and provides prime shoreline access for everyone.



**Environment:** Marinas create, store, and transport hazardous materials such as fuel and motor oil. If these facilities are flooded, hazardous materials may be mobilized and lead to impaired water quality and environmental habitat degradation.



**Economy:** Marinas provide unique shoreline recreation value and direct economic activity through berth rentals and nearby businesses, such as the yacht clubs and neighborhood restaurants. The closure of marinas may impact local economies and tax revenue. Because this area is also used to stage large events of international interest, inaccessibility would also negatively impact revenue from tourism. In addition, maintenance costs could increase and where even possible, substantial funding would be needed to relocate or improve infrastructure due to the high degree of scrutiny and environmental compliance required. These increased costs would potentially be passed on to the taxpayers and marina users, creating potential disproportionate impacts across economic brackets.



**Governance:** RPD owns many of the aquatic recreation sites, with facilities that are leased and managed by other entities. Coordination between these entities will be required to address SLR vulnerabilities and maintain the desired level of service.



## 10.3 TRAILS

In addition to San Francisco's Urban Trails Program,<sup>4</sup> RPD supports trails of regional and national importance. All or portions of these trails are located within the SLR Vulnerability Zone, including the Anza Trail, San Francisco Bay Trail, Blue Greenway, and the Coastal Trail. All of these trails allow residents to escape the City's hectic pace and explore nature within their own neighborhoods and beyond.

### 10.3.1 Potentially Vulnerable Assets

The following trails owned, maintained, or supported by RPD and are located either wholly or partially within the SLRVZ (Figure 10.3).

#### 10.3.1.1 San Francisco Bay Trail

San Francisco Bay Trail is a planned 500-mile walking and bicycling path around the entire San Francisco Bay. Along its course, the trail will link 47 cities through nine counties, providing numerous

connections to local employment hubs, transit, parks and open spaces, schools, and other civic centers (Photos 10.19 and 10.20). As of 2017, more than 300 miles of trail are open, consisting of off-road trails with a mix of surface types, as well as stretches of bike lanes and sidewalks.

For now, gaps separate the open portions. An urban section includes the rail-trail stretch of the trail on the Embarcadero in San Francisco. Here, the trail follows the path of the old State Belt Railroad, which transferred cargo from ships to main line railroads and cars onto ferries for trips across the Bay.<sup>5</sup>

Within San Francisco, there are 14.1 miles of Bay Trail spine and 1.7 miles of Bay Trail spurs. Due to the shoreline nature of the trail location, the trail is subject to inundation by temporary coastal floodwaters and SLR. Impacts to recreation use start in Scenario 2. By Scenario 7, more than 50 percent of the Bay Trail segments are projected to be inundated (Table 10.4).

<sup>4</sup> San Francisco Recreation and Park Department (RPD). Urban Trails Program. Available at <http://sfrecpark.org/parks-open-spaces/urban-trails/>.

<sup>5</sup> Rails-to-Trails Conservancy. TrailLink: San Francisco Bay Trail. Available at <https://www.trailink.com/trail/san-francisco-bay-trail/>.



Photo 10.19 Aerial of the Bay Trail at Herons Head Park, Port of San Francisco

Figure 10.3 Trails within the SLRVZ

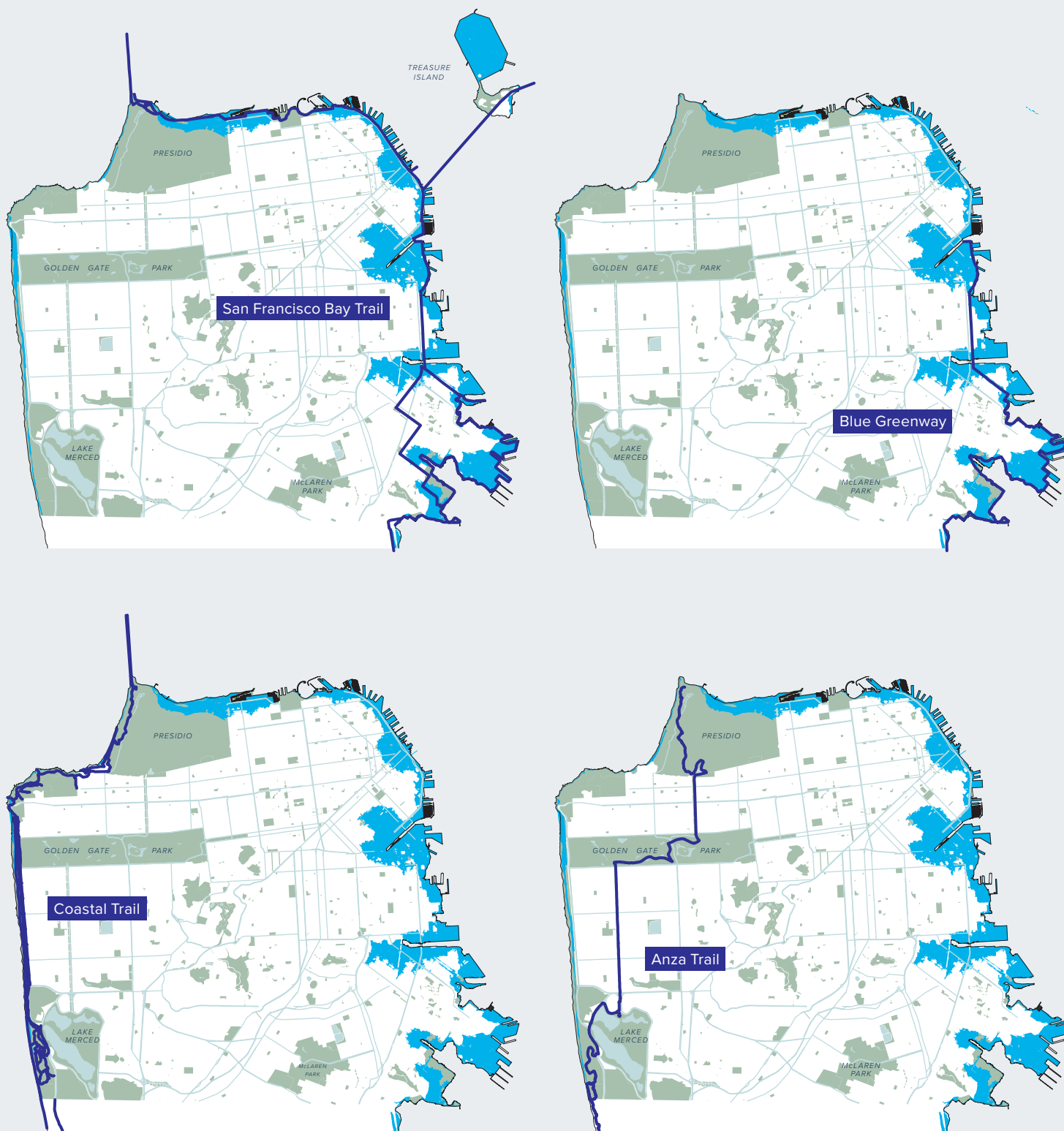






Photo 10.20 Bay Trail at Herons Head Park, Port of San Francisco

A number of connecting trails feed into and spur off from the San Francisco Bay Trail, offering additional opportunities to explore the surrounding communities.

### 10.3.1.2 Blue Greenway (Southern portion of Bay Trail and Bay Area Water Trail)

The Blue Greenway (see Photo 10.21) is the City of San Francisco's project to improve the City's southern portion of the 500-mile, nine-county, regionwide San Francisco Bay Trail, as well as the newly established Bay Area Water Trail and associated waterfront open space system. The alignment of the Blue Greenway generally follows the alignment of the San Francisco Bay Trail and Bay Area Water Trail from Mission Creek on the north to the county line on the south. Like the San Francisco Bay Trail, the projected impacts from temporary coastal inundation and SLR begin early, and by Scenario 7 more than 50 percent of the Blue Greenway trail segments are projected to be inundated (see Table 10.4).

### 10.3.1.3 Coastal Trail

The Coastal Trail in San Francisco is 10.5 miles long, linking tourist attractions along scenic natural and human-made landscapes. The trail connects the Golden Gate Bridge, Fort Point, the Presidio, the Palace of the Legion of Honor, Sutro Heights Park, the historic Cliff House, Golden Gate Park, Ocean Beach, and Fort Funston (Photo 10.22).

Along the westside of San Francisco, the trail along the beach has been closed during high tides and



Photo 10.21 Blue Greenway at Agua Vista Park, Port of San Francisco

some areas are exhibiting erosion. The trail also has seasonal closures when snowy plovers are present. The western snowy plover is currently listed as a threatened species.

The entire length of the Ocean Beach/Fort Funston Shoreline trail (adjacent to the roadway) is projected to be inundated by temporary coastal flooding and SLR by Scenario 5 (see Table 10.4). The trail also includes a bike path within the roadway right-of-way. This pathway is located outside of the SLR Vulnerability Zone, offering potential alternative access. However, this pathway would not provide the same user experience as direct beach access. The planned South Ocean Beach trail would provide coastal access south of Sloat Boulevard through National Park Service connecting trails. Portions of the Coastal Trail along the Great Highway and Baker Beach are also projected to be inundated by coastal floodwaters and SLR.

### 10.3.1.4 Anza Trail

The Juan Bautista de Anza National Historic Trail runs from Nogales, Arizona, to San Francisco. This trail commemorates the path that Lt. Colonel Juan Bautista de Anza used to lead more than 240 men, women, and children on the eve of the American Revolution. It is a legacy to the epic journey they took across the frontier of New Spain to establish a settlement at San Francisco Bay.<sup>6</sup> Only a small segment of the Anza Trail, located along the open Pacific coast near Fort Funston, is located within the SLR Vulnerability Zone (Photo 10.23).

6 Juan Bautista de Anza. Welcome. Available at <http://www.anzahistorictrail.org/>. Accessed August 2018.





Photo 10.22 Coastal Trail in the Presidio. Sergio Ruiz



Photo 10.23 Anza Trail at Fort Funston. Sergio Ruiz

### 10.3.2 Exposure Assessment

The exposure of each trail was evaluated relative to the 10 SLR scenarios (see Chapter 2). The percentage and miles of each trail that could be inundated under each scenario were calculated and are presented in Table 10.4 and Table 10.5, respectively.

### 10.3.3 Consequences

Key consequences that could occur to society and equity, the economy, environment, and governance (see Chapter 3) were evaluated assuming no action is taken to address the impacts associated with SLR or extreme tide flooding. These consequences are listed below. However, several actions are currently planned or in progress to address some of the noted impacts. For a description of the current or planned projects, see Chapter 13, *A Changing Shoreline*.



**KEY ISSUE:** The trails described above provide important public shoreline access, views, and a unique recreation experience across different landscapes, connecting neighborhoods and communities. This public access could become unavailable to residents and visitors. The trail often traverses dense urban or industrially used spaces, having been carved out and fought for over the past decades. If temporarily, and eventually permanently, unavailable due to flooding, some of the trail will not have room to be relocated to higher ground and could be lost.



**Society and Equity:** Residents could lose shoreline access, recreation opportunities, and non-motorized transportation corridors if trails are damaged or closed due to future flooding or erosion. For those with limited mobility or transportation options, the loss of trail segments in their neighborhoods could be significant, reducing the transportation and recreation opportunities provided by these segments.



**Environment:** Trail segments provide nature viewing and environmental education opportunities that may be lost if the trail is flooded or damaged. Damage of the trail can also increase erosion and result in impacts to the natural areas surrounding the damaged trail segments.



**Economy:** Trails provide recreation value and non-motorized transportation options for San Francisco residents and visitors. Proximity to one of the trails is an attractive feature to businesses and residential land uses and can increase the value of adjacent properties. This economic value may be lost if a trail is flooded or inundated.



**Governance:** The trail segments occupy rights-of-way along the shoreline with complex land ownership. Adaptation strategies to address vulnerable trail segments will require cooperation with landowners and other agencies.

**Table 10.4** Trail Exposure with Sea Level Rise (Percent Inundated)

Park	Total Length (mi)	Percent Inundated under Each Sea Level Rise Scenario									
		1	2	3	4	5	6	7	8	9	10
Bay Trail											
Spine	14.1	-	-	4	11	15	44	54	57	62	66
Spur	1.7	1	5	19	29	33	40	45	50	57	65
Blue Greenway	11.9	2	5	11	18	24	49	54	58	63	69
Coastal Trail*						DWL 12	DWL 24	DWL 36	DWL 48		DWL 66
Ocean Beach / Fort Funston Shoreline trail	4.7	-	-	-	-	98	98	98	98	-	98
Great Highway	3.8	-	-	-	-	10	14	18	20	-	22
Baker Beach	0.6	-	-	-	-	91	93	93	93	-	93
China Beach	0.2	-	-	-	-	33	33	33	33	-	40
Anza Trail	12.9	-	-	-	-	2	2	2	2	-	2

\* Exposure along the open Pacific coast shoreline was evaluated using the 100-year dynamic water level (DWL) coupled with SLR. The 100-year DWL considers the influence of wave setup.

**Table 10.5** Trail Exposure with Sea Level Rise (Miles Inundated)

	Total Length (mi)	Percent Inundated under Each Sea Level Rise Scenario									
Park		1	2	3	4	5	6	7	8	9	10
Bay Trail											
Spine	14.1	-	0.1	0.6	1.6	2.2	6.2	7.7	8.0	8.8	9.3
Spur	1.7	-	0.1	0.3	0.5	0.6	0.7	0.8	0.9	1.1	1.1
Blue Greenway	11.9	0.3	0.7	1.3	2.2	2.9	5.6	6.4	7.0	7.5	8.3
Coastal Trail*						DWL 12	DWL 24	DWL 36	DWL 48		DWL 66
Ocean Beach / Fort Funston Shoreline trail	4.7	-	-	-	-	4.6	4.6	4.6	4.6	-	4.6
Great Highway	3.8	-	-	-	-	0.4	0.5	0.7	0.8	-	0.8
Baker Beach	0.6	-	-	-	-	0.5	0.5	0.5	0.5	-	0.5
China Beach	0.2	-	-	-	-	0.1	0.1	0.1	0.1	-	0.1
Anza Trail	12.9	-	-	-	-	0.3	0.3	0.3	0.3	-	0.3





Aerial view of the Embarcadero. Photo by Sergio Ruiz