

Fire Station #27

Fire Station #27 is located at 8501 Pardee Drive, Oakland. It includes accommodations for one officer and 3 crew members, 2 apparatus bay house, 1 triple combination pumper and 1 spare aerial apparatus. The station also has a kitchen and break area for use by the assigned crew. In addition, to firefighting and fire prevention services, the crews provide first aid/emergency medical response. The station was built in 1966 and was retrofitted after the Loma Prieta earthquake. It is owned by the City of Oakland, staffed by the Oakland Fire Department, and managed by the Oakland Public Works Department.

Key Issue Statement

Fire Station #27 is vulnerable to future flooding because the building is at grade and firefighters rely on vulnerable roads to perform their emergency response function. Building resilience into emergency and disaster response will require adaptation on site of the fire station and coordination with transportation agencies to maintain road access.

Vulnerabilities

GOV1: While there are CORE trained residents in the residential area, there isn't an organized, active team.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Provide expanded Communities of Oakland Respond to Emergencies (CORE) trainings, refresher classes, and annual exercises that include flooding preparedness and response (C4.1, Modified)	Education/ outreach	Emergency and Hazard Planning	City of Oakland, Oakland Fire Department, Oakland Police Department	Multi-benefit, Local, Regional

PHYS1: The building is at grade.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Increase inspection and maintenance of infrastructure that that is sensitive to water or salt in areas at risk from sea level rise, storm events, or elevated groundwater levels (C12.2)	Program/ operation	Operations	City of Oakland, Oakland Public Works Department	Do It Yourself, Multi-benefit, Local
Provide incentives or require that Fire Station #27 be retrofitted using waterproof shutters, shields or doors and salt-resistant materials to reduce flood damage (C10.3, Modified)	Program/ operation, Policy Development	Codes and Standards, New Initiative	City of Oakland, Oakland Public Works Department, Alameda County	Do It Yourself, Local, Regional, State, Federal
Waterproof and/or raise the elevation of at-or below-grade electrical and fuel components at the fire station to protect against flooding and allow for continued function during a flood event (T12.6, Modified)	Program/ operation	Capital Planning, Project Design and Planning	Oakland Public Works Department, City of Oakland	Do It Yourself

FUNC1: In order to carry out its function, Fire Station #27 needs vehicle access, which is at grade. Not only is the access important at the station itself, but also between the station and any emergency to which the station is responding. The major streets near Fire Station #27 are Hegenberger Rd. and Doolittle St. (See profile sheets for these assets). The fire station also requires electricity and fuel. Information on the source of electricity is currently unavailable; the station has a fuel storage tank with a capacity of 95 gallons, which is sufficient for 21 hours of operation.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Develop policies or incentives to expand access to auxiliary water and power sources, e.g., on-site power generators with sufficient fuel for several days, portable generators, or pre-negotiated rental or leasing agreements for portable sources (C9.3, Modified)	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	City of Oakland, Oakland Fire Department, Oakland Public Works Department, County of Alameda, ABAG, CalOES	Do It Yourself, Multi-benefit, Local, Regional
Develop policies or incentives to encourage/require emergency response plans and procedures to consider how power, water, and supplies necessary to maintain the function of Fire Station #27 during a flood emergency, will be delivered given that many access routes and transportation modes may also be disrupted (C9.4, Modified)	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	City of Oakland, Oakland Fire Department, Oakland Public Works Department, County of Alameda, ABAG, CalOES	Do It Yourself, Multi-benefit, Local, Regional

(Access – address under Key Planning Issue #1)

Consequences

Society: The fire station responds to fire and other emergencies in the community, benefitting residents and those who work in the area. The station serves a low-income community adjacent to I-80, and responds to emergencies at the airport if needed.

Economy: By protecting the local community, the fire station has an indirect value to the local economy; if it were damaged or otherwise inoperable, it could cause an increase in insurance rates, fire loss, and loss of life.

Environment: The fire station is within a couple of blocks of a wetland, but there are no hazardous materials on site other than diesel carried by apparatus (100 gallons).

Schools Vulnerability and Risk Profile

The Oakland/Alameda Resilience Study area contains 16 schools including elementary through high school, public and private, including portions of the Oakland Unified School District and the Alameda Unified School District. Schools were constructed at various times from 1959 (James Madison Middle School) to 2006 (Oakland Aviation High School). All of the schools have at-grade facilities that could be damaged in a flood event and the schools have varying levels of earthquake safety depending on their construction date and retrofit status. Schools serve children, and this function makes them both difficult and important during disasters and emergency response. Some schools also serve as temporary shelters during disaster response. Schools in OUSD are also overcrowded, so there is limited capacity to reassign students if one school is damaged temporarily or permanently closed.

Key Issue Statement

Schools are vulnerable to sea level rise and storm event impacts because of their physical construction and because of their functions. Schools in the current or future flood plain are vulnerable to flood damage because of their at-grade entrances and equipment. Young children, or limited-mobility or special education students, are particularly difficult to evacuate in the event of an emergency. Schools may not have sufficient staff or transportation to manage an evacuation. Evacuating schools and childcare centers will require careful coordination so that there is adequate supervision of young people and safe locations identified where family members can be reunited. Schools are funded and governed at the local level and may not have adequate resources to improve their buildings or plan for future relocation.

Assets Considered

Oakland Unified School District:

James Madison Middle School
 New Highland/Rise Academy
 Brookfield Elementary
 Oakland Aviation High School
 Lockwood Elementary School
 Esperanza and Stonehurst Elementary

Greenleaf Elementary
 Encompass / Acorn Woodland Academy
 Havenscourt MS / Community United / Futures / Roots / Coliseum HS
 Sobrante Park Elementary
 Rudsdale Continuation School
 Lighthouse Community Charter HS

Alameda Unified School District:

Amelia Earhart Elementary
 Bay Farm Elementary

Private:

Chinese Christian School
 ACTS Christian Academy

Vulnerabilities:

INFO1: Many schools have not been evaluated for earthquake safety, a necessary first step for receiving state funding for earthquake retrofits.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Provide funding and technical assistance to support the evaluation of school facilities for earthquake safety <i>(New)</i>	Program/operation	Emergency and Hazard Planning, New Initiative	ABAG, CalOES, City of Oakland, City of Alameda	Unlocking, Multi-benefit, Regional

GOV1: Public schools constructed before 1978, and private schools constructed before 1986, may not meet current earthquake safety standards.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Bring schools up to current earthquake safety standards through retrofits (<i>New</i>)	Program/operation	Emergency and Hazard Planning, New Initiative	ABAG, CalOES, City of Oakland, OUSD, City of Alameda, AUSD	Multi-benefit, Regional

(See INFO1, PHYS 2.), (Also address in Key Planning Issue #2)

GOV2: There is no central database for the condition of buildings that house charter schools.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Develop and maintain a voluntary database that includes specific information on charter schools related to building safety and emergency response (<i>C1.2, Modified</i>)	Program/operation	Emergency and Hazard Planning, New Initiative	City of Oakland, Oakland Unified School District, private charter school owners	Unlocking, Multi-benefit, Local
Coordinate the information in any existing data repositories using cross-referencing or geo-referencing (<i>C2.2, Modified</i>)	Coordination, Program/operation	New Initiative	City of Oakland, Oakland Unified School District, private charter school owners	Multi-benefit, Local

FUNC1: Schools in the study area are overcrowded. If schools need to close for disaster preparation or response, finding adequate alternative classrooms could be difficult.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Develop contingency plans and procedures to address the need for short-term accommodation and long-term relocation for displaced students in other schools and classrooms (<i>C6.4, Modified</i>)	Program/operation	Emergency and Hazard Planning	City of Oakland, OUSD, City of Alameda, AUSD, private schools	Do It Yourself, Multi-benefit, Local, Regional
Establish mutual aid agreements and initiate or strengthen joint protocols with adjoining school districts for cooperative disaster response (<i>C6.6, Modified</i>)	Coordination, Policy Development	Emergency and Hazard Planning	City of Oakland, OUSD, City of Alameda, AUSD, private schools	Do It Yourself, Multi-benefit, Regional
Reduce dependency on school buildings that are vulnerable to sea level rise by building alternative facilities or by increasing the capacity of existing schools in areas not at risk from sea level rise (<i>C8.3, Modified</i>)	Policy Development	Long-range Planning, Land Use Planning	City of Oakland, OUSD, City of Alameda, AUSD, private schools, Alameda County	Local, Long Lead Time

FUNC2: Schools rely on roads, transit, electricity, water, wastewater, and telecom utilities to function. Even short term disruptions in utility service could disrupt school activities and require school cancellations, e.g., school closures during 12/11/14 storm).

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Develop policies or incentives to encourage/require emergency response plans and procedures to consider how power, water, and food necessary to maintain the function of schools during a flood emergency, will be delivered given that many access routes and transportation modes may also be disrupted. (C9.4, Modified)	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	City of Oakland, OUSD, City of Alameda, AUSD, private schools, Alameda County	Do It Yourself, Multi-benefit, Local, Regional
Develop policies or incentives to encourage/require access to auxiliary water and power sources at schools, e.g., on-site power generators with sufficient fuel for several days, portable generators, or pre-negotiated rental or leasing agreements for portable sources (C9.3, Modified)	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	City of Oakland, OUSD, City of Alameda, AUSD, private schools, Alameda County	Do It Yourself, Multi-benefit, Local, Regional

(Also address in Key Planning Issues #1 and #2)

FUNC3: Schools need teachers and support staff to function. If school staff cannot access the school because of disruptions within or outside the study area, the school cannot operate as intended.

(Access – address under Key Planning Issue #1)

PHYS1: Schools are at-grade and vulnerable to sea level rise and storm event impacts. Due to their construction and use, waterproofing is not practicable.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Conduct vulnerability and risk assessments of individual schools and develop site-specific strategies to reduce service disruptions or closures (C9.1, Modified)	Program/operations	Long-range Planning, New Initiative	City of Oakland, OUSD, City of Alameda, AUSD, private schools	Do It Yourself, Unlocking, Local
Develop policies or incentives to encourage/require at-risk schools to implement changes to facility structures or operations that would reduce potential for disruption or closure due to sea level rise or storm events (C9.2, Modified)	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	City of Oakland, City of Alameda, County of Alameda	Do It Yourself, Local, Regional

(Also address in Key Planning Issue #2)

PHYS2: Public schools constructed prior to 1978 and private schools constructed prior to 1986 may be in building vulnerable to seismic impacts.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Evaluate schools for earthquake safety in order to help obtain funding for retrofits and other earthquake safety measures (<i>new</i>)	Program/operation	Emergency and Hazard Planning, New Initiative	City of Oakland, City of Alameda, OUSD, AUSD	Unlocking, Multi-benefit, Local, Regional

(See INFO1.), (Also address in Key Planning Issue #2)

PHYS3: Schools are at risk during seismic events due to their contents. Unsecured bookcases, furniture and equipment caused four of the deaths in the Northridge earthquake and improved building standards cannot address building contents brought in after inspection. Bracing and other management techniques need to be implemented at both old and new construction buildings.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Provide funding and assistance to schools for bracing and other management techniques that can help reduce risk from building contents during seismic events (<i>new</i>)	Program/operation	Emergency and Hazard Planning, New Initiative	ABAG, CalOES, City of Oakland, City of Alameda	Unlocking, Multi-benefit, Local, Regional

Consequences

Schools provide a critical community function and contribute to the overall well being of the community. They also provide shelter during emergencies for students and community members. Damage to school buildings could result in education disruptions for students and financial burdens for school districts. These effects could be exacerbated in already stressed schools and districts. Oakland Unified School District faces budget shortfalls and overcrowding that seismic or flood damage would exacerbate. Schools that serve low-income, transit-dependent, or linguistically-isolated students are even vulnerable because of the populations they serve. Schools rely on communities for staff, access, funding, and, most importantly, students. If the neighborhoods where students and teachers live are damaged, schools will not be able to fully function.

Hegenberger Road

Hegenberger Road is a six-lane surface street that connects Oakland to Bay Farm Island and the Oakland International Airport. It runs north from Doolittle Dr. under I-880 and past the Coliseum to San Leandro Street, where it bends northeast before turning into Hegenberger Expressway. South of Doolittle Dr., Hegenberger turns into Airport Dr., which leads to Oakland International Airport. Hegenberger Road was originally built in 1960 and is owned and maintained by the City of Oakland’s Public Works Department.

Key Issue Statement

Hegenberger road provides goods and commuter movement between Bay Farm Island and the region. Hegenberger road is vulnerable because of its low elevation and because the City of Oakland owns and maintains the roadway, but not its shoreline protection. If Hegenberger road was damaged or closed due to a flood or seismic event, there could be economic and public safety consequences due to lost access to and from the airport and communities on Bay Farm Island.

Vulnerabilities

GOV1: Part of Hegenberger is protected by dikes and riprap owned by EBRPD as part of the MLK Shoreline (near bridge over San Leandro Channel – dikes/riprap are perpendicular to bridge; if overtopped, water could flood road south and north of bridge). If the road is threatened by overtopping of this shoreline protection, the City of Oakland will need to work with EBRPD to make the necessary improvements. Hegenberger also crosses over Elmhurst Creek.

(Ownership and permitting issues – address under Key Planning Issue #6)

GOV2, PHYS1: Hegenberger Road is co-located with utilities and sewers; if changes to the road were required, the City of Oakland would need to coordinate with public and private utilities such as PG&E and EBMUD.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Expand or form broad public-private partnerships (multi-sector/agency) to guide the planning and implementation of multi-objective transportation improvements and new investments that are resilient to sea level rise and storm events (T2.2)	Coordination	Long-range Planning, New Initiative	ABAG, MTC, Caltrans, BART, Port, AC Transit, County, Cities, CMA, CCJPA, UP, WETA, CBOs, Private Sector	Unlocking, Local, Regional
Work with adjacent communities, regions, and states to develop and jointly implement transportation adaptation strategies that address changes in transportation system condition and use due to sea level rise and storm events (T2.3)	Coordination	New Initiative, Emergency and Hazard Planning	ABAG, BCDC, MTC, Caltrans, BART, Port, AC Transit, County, Cities, CMA, CCJPA, UP, WETA, Adjacent Regions and States	Multi-benefit, Regional, State, Federal, Long Lead Time
Expand or form multi-agency partnerships to facilitate cost-sharing in planning for multi-objective transportation improvements and new investments that avoid or address sea level rise and storm events (T3.1)	Coordination, Policy Development	Long-range Planning, New Initiative	MTC, Caltrans, BART, Port, AC Transit, County, Cities, CMA, CCJPA, UP, WETA	Local, Regional, Long Lead Time

PHYS2: Hegenberger’s Pavement Condition Index ranges from 62-91; areas on the lower end of the range may suffer more extensive damage from a flood event than if it were in good shape.

PHYS3: The road is at grade and the structural integrity of the street itself is sensitive to wave action and susceptible to erosion.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Conduct analyses of critical infrastructure to identify the potential for increased erosion, scour and wear due to increased tide and wave energy (T14.1)	Evaluation	New Initiative, Operations	BART, Caltrans, Port, County, Cities, UP, CCJPA, WETA, CMA	Do It Yourself, Unlocking, Local, Regional

FUNC1: Hegenberger is one of very few roads that connect Bay Farm Island and the airport with the mainland (other roads running from the mainland towards Bay Farm Island feed Doolittle Dr., which intersects with Hegenberger where it merges with 98th Ave and becomes Airport Drive; another alternate route would go through the Island of Alameda and across the Bay Farm Island Bridge onto Doolittle). Therefore, if Hegenberger were not operational due to a climate or seismic impact, access between the mainland and Bay Farm Island / OAK would be nearly cut off. Hegenberger Rd. is also used by public transit agencies for several different routes, which would be cut off or forced to detour if Hegenberger were inoperable.

(Access issues – address under Key Planning Issue #1)

FUNC2: Hegenberger Road is an Oakland Evacuation Route. It cannot serve the function of safely evacuating people if it is not operational due to a climate or seismic event.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Conduct a "hot spot" analysis to identify key routes and nodes critical to traffic flow, assess their vulnerability and risk, and develop actions to improve their resilience to sea level rise and storm events (New)	Evaluation	Long-range Planning, Operations, Emergency and Hazard Planning, New Initiative	ABAG, MTC, Caltrans, AC Transit, County, Cities, CMA	Do It Yourself, Unlocking, Multi-benefit, Local, Regional
Increase the capacity to accommodate re-routed traffic on alternative routes, or build new routes, in areas not at risk from sea level rise and storm events (T5.3)	Program/operation	Long-range Planning, Capital Planning	MTC, Caltrans, AC Transit, County, Cities, CMA	Local, Regional, Long Lead Time

Consequences

Society: Hegenberger Road connects Bay Farm Island and the airport with Oakland and beyond. It carries 18,000 riders per day as well as several transit routes. It may serve transit-dependent communities. It provides access to the airport for travelers and workers (at the airport and related facilities), as well as the movement of cargo and supplies necessary to serve the airport. It is also an Oakland evacuation route and could be used for emergency response. If Hegenberger Road were out of service, it would have a serious effect on travelers and commuters and could disrupt the operation of the airport, as well as the safety of nearby communities.

Economy: Hegenberger Road provides arterial access for commuter movement, goods movement, residents and emergency response between Oakland and Bay Farm Island. It also provides access to the Coliseum. Interruptions to commuters and goods movement could have a local to regional economic effect, and disruption of airport operations could have a national to international effect.

Environment: Hegenberger Road Crosses San Leandro Creek near MLK shoreline, and has part of the Bay Trail on it. Pollutants on the road could wash into the Bay with floodwaters, and construction could threaten habitat and water quality in San Leandro Creek.

Harbor Bay Isle Lagoon System

The Harbor Bay Isle Lagoon is located on the Bay Farm Island peninsula in Alameda, on the east bay shoreline north of the Oakland International Airport. Harbor Bay Isle Lagoon Systems I and II form the major component of the Harbor Bay Isle Master Plan Community, providing open space, wildlife habitat, aesthetic and recreational enjoyment for the residents of the Community. The lagoons also accept storm water drainage from the adjacent developed areas. System I has an intake weir from San Francisco Bay at the west end of the lagoon system and an outfall weir and pump station at San Leandro channel at the north. System II is along the south edge of Bay Farm Island, parallel to the Bay, with an outlet weir and pump station at the southeast end. The lagoons are narrow river-like waterways about 3 miles long. The basic operation of the Lagoon Systems is dependent upon the normal San Francisco Bay tidal action, which through a series of sluice gates at each end of the lagoon, provide a degree of flushing from west to east while maintaining a calibrated water level 2 to 4 inches below the top of the structure. During normal operation, the anticipated average water retention time is approximately four days. When it is necessary to remove some of the lagoon waters while the tides are not favorably low, the pump stations are used. Harbor Bay Isle Community Water Quality Division (HBICWQD) owns and maintains the asset. The City of Alameda Public Works Department provides some major capital improvements for the weir structures and pump stations. Harbor Bay Isle began development in 1978. The area was filled in by 1982, and the lagoons were built simultaneously with tideland reclamation, in 1980.

Key Issue Statement

The Harbor Bay Island Lagoon provides critical stormwater storage for residential areas on the island. The tide gate that protects the lagoon cannot maintain its function during future flood events and will need to be improved or redesigned. The lagoon operates under many different regulatory structures and provides multiple benefits including recreation, habitat, and stormwater management. Improving the resilience of the lagoon will require coordination among user groups and with regulatory agencies.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
If not already done, consolidate management of the interconnected stormwater infrastructure on Bay Farm Island either by creating a single entity or establishing inter-agency agreements to guide capital investment, management, and operations decisions. <i>(U2.2, Modified)</i>	Coordination, Policy Development	Long-range Planning, New Initiative	HBICWQD, City of Alameda	Multi-benefit, Long Lead Time
Establish or strengthen coordination of owners and managers of the interconnected stormwater infrastructure on Bay Farm Island, to articulate and advocate for shared objectives (e.g., reducing runoff through low impact development (LID), addressing wet weather flows), and to develop frameworks for decision-making and funding related to infrastructure maintenance and new investments <i>(U2.3, Modified)</i>	Coordination, Policy Development	Long-range Planning, New Initiative	HBICWQD, City of Alameda	Unlocking, Multi-benefit, Long Lead Time

Vulnerabilities

GOV1: In order to make changes to the asset, a City building permit is required, and the Corps of Engineers and RWQCB have jurisdiction over the lagoons. While BCDC does not have jurisdiction over the lagoons, it has jurisdiction over the Bay into which the lagoons discharge, so if modifications of the outfalls were necessary, a BCDC permit could be required. Since multiple entities have jurisdiction and / or require permits, any changes will require coordination and may take a long time to plan, permit, and implement.

(Permitting and ownership issues – address under Key Planning Issue #6)

PHYS1: System II pump is undersized and takes a while to affect the lagoon elevation. It is recommended for upgrade.

FUNC1: Weirs can be operated manually. In the event that pumping is needed during a power outage, there is a receptacle for a portable generator for System I, but not System II.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Upgrade Lagoon System II to increase resilience to sea level rise and storm events. (1) Ensure that the upgraded System II pump is properly sized to accommodate increasing Bay tidal levels projected to occur over the expected useful life of the pump. (2) Install a receptacle for a portable generator. (U6.2, Modified)	Program/operation	Long-range Planning, Capital Planning, Project Planning and Design	HBICWQD City of Alameda	Do It Yourself, Multi-benefit, Local
Prepare for flooding by pre-positioning emergency power generators and other necessary equipment (e.g., portable pumps, and debris removal equipment) (U3.5, Modified)	Program/operation	Emergency and Hazard Planning, New Initiative	HBICWQD	Do It Yourself, Local
Establish inter-agency mutual aid agreements to provide assistance with inspection and repair of damaged or compromised facilities, and mobile or alternative facilities (e.g., portable pumps, generators) during emergency response and recovery (U2.4, Modified)	Coordination	Long-range Planning, Emergency and Hazard Planning	HBICWQD, City of Alameda, Port	Multi-benefit, Local

FUNC2: The lagoon system is part of a network that includes the stormwater system for Bay Farm Island. A master plan of the storm water system identified several outfalls into the lagoon systems that are undersized and cause flooding in neighborhoods due to backwater conditions and undersized storm drains.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Upgrade the system outfalls to accommodate storm water flows. Add sufficient capacity to accommodate future increases in storm water flows. (U6.2, Modified)	Program/operation	Capital Planning, Project Planning and Design	City of Alameda, HBICWQD	Do It Yourself, Multi-benefit, Local

Consequences

Society: The lagoons provide recreational opportunities to residents, along with storm water storage for water quality treatment. If these systems were damaged, it could cause stormwater management problems and lower the quality of life for local residents.

Economy: The lagoon system is seen as desirable neighborhood element; its damage or loss could potentially hurt home prices, and repairs would need to be financed through assessments and city stormwater fees.

Environment: Problems caused by climate or seismic impact could potentially cause water to overtop, where it could pick up pollutants from surrounding properties; however, these properties are largely residential rather than, e.g., hazardous waste sites. Another possibility is that stormwater stuck in the lagoon due to high Bay water levels could potentially be reduced in quality.

Martin Luther King Jr. Regional Shoreline / Arrowhead Marsh

Martin Luther King Jr. Regional Shoreline is a popular, 717-acre park located along the shoreline around San Leandro Bay from Tidewater Boating Center to Doolittle Pond. It provides a diversity of recreation opportunities, including 3.7 miles of Bay Trail with six bridges, the Tidewater Boating Center with facilities and launches for rowing and paddleboats, a boat launch ramp, the Shoreline Center (meeting facility), 16 acres of grass turf, nine staging areas providing parking, picnic tables and restrooms, a staff office, the Arrowhead Marsh Overlook ramp and boardwalk, interpretive signage, wildlife viewing opportunities, and three marshes – Arrowhead, New, and Damon – which provide habitat for endangered species.

Key Issue Statement

MLK Jr. Regional Shoreline is vulnerable to sea level rise due to its low elevation, especially in Arrowhead Marsh, and its complex relationships with neighboring landowners and partner agencies. In order to preserve public access, recreation, and shoreline habitat around San Leandro Bay, EBRPD and its partners will need to coordinate and proactively plan to adapt to sea level rise.

Vulnerabilities

INFO1: There is a database with the condition and elevation of Bay Trail available to owners and managers. However, this database is not geo-referenced or very high quality. There is no publicly available database with, for example, the owners and managers of Bay Trail segments.

GOV1: MLK Jr. Shoreline and Arrowhead Marsh are owned by the Port of Oakland and managed by EBRPD. Many sections of Bay Trail, managed by EBRPD, are on levees owned by ACFCWCD, with a land use agreement between the agencies. Because of these multiple owners and managers, coordination will be required in order to make changes to adapt to sea level rise.

(Ownership and permitting issues – address under Key Planning Issue #6)

GOV2: Many agencies have regulatory authority over MLK Jr. Shoreline: USACE San Francisco District (Section 404 permit); USFWS and NOAA (Section 7 consultations for the endangered species act); RWQCB (Section 401 certification); some projects require permits from BCDC or a review under CEQA/NEPA. The many agencies involved and permits required means that a lengthy process may be required to make changes to adapt to sea level rise.

(Ownership and permitting issues – address under Key Planning Issue #6)

FUNC1: The Bay Trail connects over 300 miles of trails. If one part of the system is not operational, some of the overall functionality could suffer. In particular, this section is an important north-south commuting corridor both on the mainland and on Bay Farm Island.

(Ownership and permitting issues – address under Key Planning Issue #6)

FUNC2: Arrowhead Marsh is mapped as mid marsh with very little high tide refugia. It is projected to downshift to low marsh by midcentury and to mudflat by end-of-century. The federally endangered clapper rail rely on the high-tide refugia that currently exists; in the future, the marsh may not be able to serve this function for this species and others.

(Environmental value issues – address under Key Planning Issue #5)

FUNC3: Damon Slough seasonal wetlands will be increasingly inundated by rising sea level and over time downshift to marsh habitat. Vertical accretion modeling indicates that Damon Marsh will not keep pace with sea level rise through this century. Its downshifting trajectory depends on the sea level rise rate and sediment supply. The wetlands currently provide habitat for the federally endangered clapper rail. This function could diminish with sea level rise.

(Environmental value issues – address under Key Planning Issue #5)

PHYS1: Although the Bay Trail is paved in MLK Shoreline, some of it is on top of poorly maintained levees that are vulnerable to erosion, which undercuts the trail.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Prioritize resurfacing vulnerable trail segments with erosion-resistant materials (S6.2)	Program/operation	Capital Planning, Project Planning and Design	EBRPD	Do It Yourself, Local, Regional
Prioritize maintenance and repair of barrier-free access to the shoreline and recreation facilities in order to minimize re-routing or closure (S7.1)	Policy Development, Program/operation	Operations	EBRPD	Do It Yourself, Local, Regional
Stockpile materials to create ramps or pathways to maintain safe access for those with limited mobility during and after flooding events (S7.2, Modified)	Program/operation	Operations, Emergency and Hazard Planning	EBRPD	Multi-benefit, Do It Yourself, Local, Regional
Stockpile and use sandbags to minimize flood damage to vulnerable structures (e.g., boat house, meeting space) (New)	Program/operation	Operations, Emergency and Hazard Planning	EBRPD	Multi-benefit, Do It Yourself, Local, Regional
Effectively communicate trail closures, e.g., establish specific notification practices (S7.3)	Education/Outreach	Long-range Planning, Operations, Emergency and Hazard Planning	EBRPD	Do It Yourself, Local, Regional

PHYS2: Some of the levees may have fiber optic cables or tide gates located under, within, or adjacent to them. This could complicate any work necessary to repair or protect against the effects of sea level rise.

Consequences

Society: MLK Jr. Shoreline provides commuting options, recreation, access to the shoreline, and wildlife viewing; these opportunities are free to the public, including several underserved / low-income communities in the vicinity. The shoreline also provides school programs and volunteer programs. If the shoreline is eroded or flooded, or the Bay Trail undercut, these recreational and program opportunities would be lost for the local communities.

Economy: MLK Jr. Shoreline provides \$4.8M in recreation value per year, which would be reduced or lost as sea level rise changes and diminishes shoreline and habitat. It also provides commuting options via the Bay Trail that could be lost or disrupted.

Environment: The Shoreline provides habitat for at least one endangered species, which could be lost due to sea level rise. In addition, various types of ecosystems (high marsh, mid marsh, seasonal wetlands) could be lost as sea level rise causes them to downshift to low marsh and mudflat.

BART Oakland Airport Connector (OAC)

Oakland Airport Connector includes the OAC airport station, the BART Coliseum station, 3.2 miles of guideway and aerial structures, and the wheelhouse. The OAC connects the BART Coliseum station to a new station at the airport, roughly following the course of Hegenberger road. It was built in 2014.

Key Issue Statement

The OAC is vulnerable to direct and indirect sea level rise and storm event impacts. The OAC has sensitive electrical and mechanical equipment at or below-grade that could be damaged by future flooding, especially in the Hegenberger road underpass. OAC is also vulnerable because it relies on OAK and the Coliseum BART station, which have their own vulnerabilities to future flooding. OAC sole function is to provide transportation to and from OAK for travelers and staff. If the OAC is disrupted due to future flooding, there would be economic consequences due to impaired commuter movement and travel.

Vulnerabilities

GOV1: BART owns the OAC, but Dopple-Mayer will manage operations and maintenance, including sump pumps to provide drainage during storm events. The Dopple-Mayer Management Plan is in progress, but is only a 20-year contract and is not incentivized to consider more frequent storm events due to sea level rise. Adaptation may require coordination with Dopple-Mayer, which may be out of the scope of their contract.

(Permitting and ownership issues – address under Key Planning Issue #6)

GOV2: The design of OAC is highly unlikely to have considered sea level rise impacts, as high-level State guidance is not yet routinely applied to project design. The lack of new design standards can potentially jeopardize the useful project lifetime.

PHYS1: A portion of the OAC is in a tunnel below grade and is vulnerable to increased flooding due to storm events and sea level rise. The sump pump in the tunnel was designed to manage current groundwater intrusion or rainfall runoff and will not have the capacity to handle flows during significant flooding events.

PHYS2: The OAC has a diesel emergency generator that is located at grade in the wheelhouse.

PHYS3: The wheelhouse substation is at grade and was not designed to be water or salt tolerant.

PHYS4: The switchgear cabinets at the airport station are at grade and are not designed to be water or salt tolerant.

Adaptation Action <i>If applicable, reference to ART Adaptation Response # that it is taken from.</i>	Type of action	Process	Agencies and organizations involved	Action characterization
Install manual, remote control, or automatic temporary barriers or waterproof closures to protect at- or below-grade critical elements such as station entrances, tunnels, maintenance facilities, asset storage areas, and rail alignments (T7.5)	Program/operation	Capital Planning, Operations, Codes and Standards, Project Planning and Design	UP, Amtrak, Caltrans, CCJPA, Cities, Counties	Do It Yourself, Unlocking, Regional
Construct permanent structures to protect at- or below-grade critical elements such as station entrances, tunnels, maintenance facilities, and asset storage areas (T7.6)	Program/operation	Capital Planning, Operations, Codes and Standards, Project Planning and Design	UP, Amtrak, Caltrans, CCJPA, Cities, Counties	Do It Yourself, Unlocking, Regional
Raise the elevation of at- or below-grade critical elements such as station entrances, maintenance yards, and rail alignments (T7.7)	Program/operation	Capital Planning, Operations, Codes and Standards, Project Planning and Design	UP, Amtrak, Caltrans, CCJPA, Cities, Counties	Do It Yourself, Unlocking, Regional

FUNC1: The OAC extends from the BART Coliseum Station to the Oakland International Airport and relies on existing structural shoreline protection, owned and managed by others. The system of structural shoreline protection was not designed for future storm event water levels that will occur as sea level rises.

(Permitting and ownership issues – address under Key Planning Issue #6)

FUNC2. Flooding of the track that passes through the tunnel would disrupt services of the OAC.

FUNC3: There are no good alternatives to access the airport if the OAC flooded because the local streets and roads that lead to the airport will also be flooded and impassible in particular near the OAC tunnel location.

(Access issues – address under Key Planning Issue #1)

FUNC4: The sole function of the OAC is to provide transit access to the Oakland International Airport. If operations of the airport are disrupted the OAC will not have a purpose.

FUNC5: Access to the OAC relies on the ongoing operation of the Coliseum BART station. Disruption to this station or the adjacent local streets and roads would inhibit passenger access to the OAC.

(Access issues – address under Key Planning Issue #1)

Consequences

Equity: Disruption may inhibit BART's ability to serve transit dependent populations making trips to and from the airport.

Economy: Loss of the OAC will affect BART through loss of revenue and the cost to repair damage to asset. Loss of the OAC will have consequences on the business at the airport and possibly on passenger use of the airport.

Environment: Hazardous materials (diesel in emergency generator) could be released/exposed during flooding. Alternative modes of transportation, such as personal car, may be less environmentally friendly.