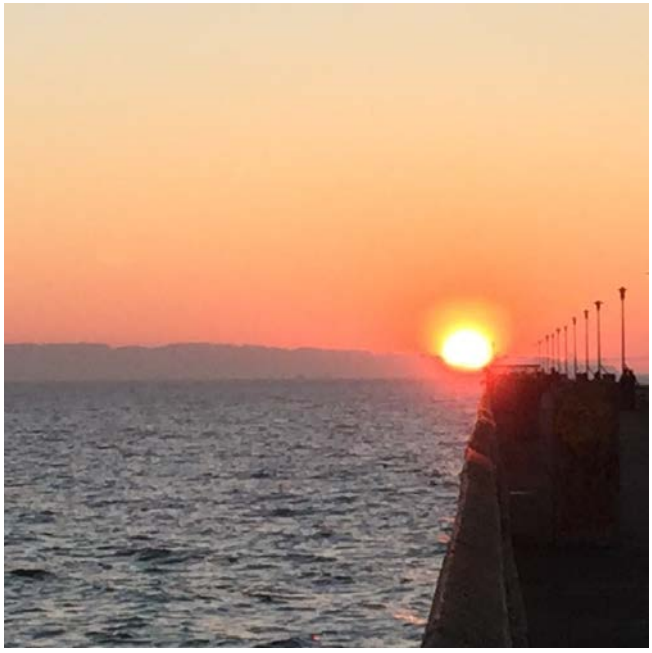


Albany Climate Change Chapter

Four Twenty Seven
Climate Solutions

February 14, 2017

Contents

Executive Summary

Changing climate conditions such as higher temperatures, more intense periods of rainfall, and sea level rise are expected to exacerbate existing challenges that California's cities and counties face. *Senate Bill No. 379 Land Use: general plan: safety element (Jackson)* (SB 379) calls on local governments to incorporate adaptation and resilience strategies into Safety Elements of their General Plans as well as their local hazard mitigation plans. This climate change chapter supports local governments' implementation of SB 379 and builds on the State's *Adaptation Planning Guide*. It describes projected changes in key climate hazards of concern for Albany and the citywide assets that these hazards are likely to affect and presents adaptation options to address these hazards.

The climate hazard assessment and adaptation options are intended to inform the city's efforts to incorporate climate hazards and adaptation strategies into its local hazard mitigation plan, General Plan Safety Element, and other relevant plans such as its climate action plan. In doing so, the content can also assist Albany in meeting requirements to position it for federal funding (e.g., Federal Emergency Management Agency (FEMA)) and to meet voluntary commitments (e.g., Compact of Mayors). The hazards analyzed include inland flooding, sea level rise, changes in temperature and precipitation, flood-induced landslides and wildfire.

Climate change will affect Albany, California

Throughout the remainder of the 21st century, Albany's climate is projected to grow substantially hotter, and precipitation patterns are expected to be less consistent and characterized by more intense rainfall events. Sea level rise is not expected to significantly affect the city's emergency assets, with areas of inundation limited to Albany Bulb, access to Golden Gate Fields and parking facilities along the shoreline. However, inland flooding from a 100-year storm could compromise assets along Codornices Creek and the railway, including portions of the I-580 and I-80 freeways near the border with Richmond and south of Buchanan Street. Figure ES1 summarizes the climate hazards of concern for Albany.

Figure ES1. Climate Hazards and Exposure

Climate Hazard	Exposure[1]	Summary
Inland Flooding	Medium	Significant[2] exposure during 100-year (1 percent annual chance of occurrence) and 500-year (0.2 percent annual chance of occurrence) floods
Sea Level Rise	Medium	Significant exposure of regional resources likely by end of century with a 50-year or 2 percent annual chance storm surge (a combination of permanent and temporary flooding equivalent to 72 inches of sea level rise)
Temperature Change	Medium	Average temperatures projected to increase by 2 to 4 °F and extreme heat by 8 days per year by 2100 (90 °F +)
Precipitation Change	Low	Likely increase in intensity of events, limited change in overall rainfall
Rainfall-Induced Landslides	Low	Some emergency assets located in areas with "few landslides"
Wildfires	Low	No emergency assets located in high fire severity zones

Adaptation can help Albany protect its communities and assets in the face of changing climate conditions

Identifying and incorporating adaptation and resilience measures into a local hazard mitigation plan or other relevant plans will enable Albany to safeguard its communities and its valuable assets from the impacts of a changing climate more effectively. The results of the climate hazard exposure assessment, a review of existing city plans and guidance (such as the Adaptation Planning Guide and Senate Bill 379 draft guidance), and a gap analysis to identify additional strategies informed a set of twenty-four adaptation measures. These options are meant to inform Albany's identification and selection of adaptation measures to integrate into relevant plans and supplement the results of other related planning processes. Figure ES2 lists the measures; more detailed information on the measures can be found in Appendix D.

Figure ES2. Adaptation Options

#	Climate Hazard/Issue Addressed	Exposure	Adaptation Measure

[1] The rankings were determined based on FEMA's Calculated Priority Risk Index framework and optimized for this assessment. (FEMA. (2013). *Local Mitigation Planning Handbook*.) The Index is provided in Appendix B.
[2] Significance was determined by exposure of non-emergency infrastructure and assets that could have large financial or public health impacts as a result of the given climate hazard.

1.	Inland Flooding	Medium	Update flood hazard data
2.	Inland Flooding	Medium	Minimize flood risks for existing development
3.	Inland Flooding	Medium	Avoid and minimize flood risks for new development
4.	Inland Flooding	Medium	Encourage green infrastructure for natural management of stormwater and storm-induced flooding, and preserving and restoring natural features of the watershed for both new and existing development, rather than using engineered structures.
5.	Inland Flooding	Medium	Protect and restore soil health
6.	Inland Flooding	Medium	REGIONAL: Establish cooperative relationships among public agencies with responsibility for flood protection
7.	Sea Level Rise	Medium	Preserve high-hazard areas and public open space
8.	Sea Level Rise	Medium	REGIONAL: Coordinate sea level rise efforts with relevant regional entities as well as other local jurisdictions
9.	Temperature Change	Medium	Decrease urban heat islands through increased tree and vegetation planting and maintenance
10.	Temperature Change	Medium	Promote the use of cool infrastructure
11.	Temperature Change	Medium	Integrate energy assurance actions into citywide planning processes to decrease vulnerability to grid outages during extreme events
12.	Precipitation Change	Low	Manage and conserve groundwater
13.	Precipitation Change	Low	Conserve and reuse water in existing buildings and landscapes
14.	Precipitation Change	Low	Increase the use of local sources of water
15.	Precipitation Change	Low	Build landscapes adapted to California climates and soils
16.	Precipitation Change	Low	Promote food security
17.	Rainfall-Induced Landslides	Low	Avoid and minimize landslide risks for new and existing development
18.	Wildfires	Low	Reduce the exposure of built infrastructure to wildfires
19.	Wildfires	Low	REGIONAL: Establish cooperative working relationships among public agencies with responsibility for fire protection
20.	Public Health	N/A	Identify populations vulnerable to extreme heat
21.	Public Health	N/A	Raise population's awareness of the public health impacts of climate change
22.	Emergency Preparedness	N/A	Ensure an energy assurance plan for city operations during and after disasters
23.	Emergency Preparedness	N/A	Manage hazardous materials to prevent accidents
24.	Emergency Preparedness	N/A	Assess the robustness of the city emergency response and recovery program's consideration of flooding, landslides, sea level rise, and other climate change impacts

1. Introduction

Changing climate conditions such as higher temperatures, more intense periods of rainfall, and sea level rise are expected to exacerbate existing challenges that California's cities and counties face as well as present new opportunities to bolster hazard mitigation and climate action efforts. State legislation seeks to promote the integration of climate change adaptation and resilience into local planning processes. *Assembly Bill No. 2140 General plans: safety element (Hancock)* enables local jurisdictions to adopt a

local hazard mitigation plan with their safety element, facilitating integration of hazard mitigation into General Plans. *Senate Bill No. 379 Land Use: general plan: safety element (Jackson)* (SB 379) calls on local governments to incorporate adaptation and resilience strategies into Safety Elements of their General Plans as well as their local hazard mitigation plans. [3] To support local governments' implementation of SB 379, the Governor's Office of Planning and Research recently issued draft guidelines for integrating climate considerations into Safety Elements. The draft guidelines build on the State's *Adaptation Planning Guide* (2012), emphasize the need for communities to adopt a longer-term perspective in preparing for climate risks, and highlight the importance of identifying linkages and complementarity across different elements of the General Plan as well as other relevant plans.

This climate change chapter was developed as part of an effort by StopWaste, Alameda County's waste authority, to assist five of the County's cities[4], including the City of Albany, respond to SB 379 requirements and promote a consistent approach to incorporating adaptation and resilience into relevant local plans in Alameda County. The chapter's purpose is to describe projected changes in key climate hazards of concern for Albany and the citywide assets that these hazards are likely to affect as well as to present adaptation actions that the city may incorporate into relevant plans to address these hazards.

The content is intended to inform the city's efforts to incorporate climate hazards and adaptation strategies into its local hazard mitigation plan, General Plan Safety Element, and other relevant plans such as its climate action plan. In doing so, the content can also assist Albany in meeting requirements to position it for federal funding (e.g., Federal Emergency Management Agency (FEMA)) and to meet voluntary commitments (e.g., Compact of Mayors). However, the information in this document should be situated in the context of the City's other planning efforts and stakeholder inputs obtained through these other planning processes.

In the remainder of this section, we provide an overview of Albany. Section 2 presents the climate hazard analysis, which helps Albany answer the questions "What climate change effects will a community experience?" (exposure) and "What aspects of a community (people, structures, and functions) will be affected?" (sensitivity) identified in Steps 1 and 2 of the State's *Adaptation Planning Guide.*[5] The climate hazard analysis covers inland flooding, sea level rise, changes in temperature (including extreme heat) and precipitation, and rainfall induced landslides. The analysis includes the probability of occurrence, extent of exposure, and assets affected by key climate hazards in Albany. The methods used to assess the exposure of assets to the climate hazards as well as the data sources for each section are explained in Appendix A.

[3] SB 379 states: "Upon the next revision of a local hazard mitigation plan, adopted in accordance with the federal Disaster Mitigation Act of 2000 (Public Law 106-390), on or after January 1, 2017, or, if a local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022, the safety element shall be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to the city or county."

[4] The five participating cities are Albany, Emeryville, Fremont, Hayward and Piedmont.

[5] Understanding vulnerability also requires an assessment of adaptive capacity, which was outside of the scope of this project, and for which the *Adaptation Planning Guide* describes a process.

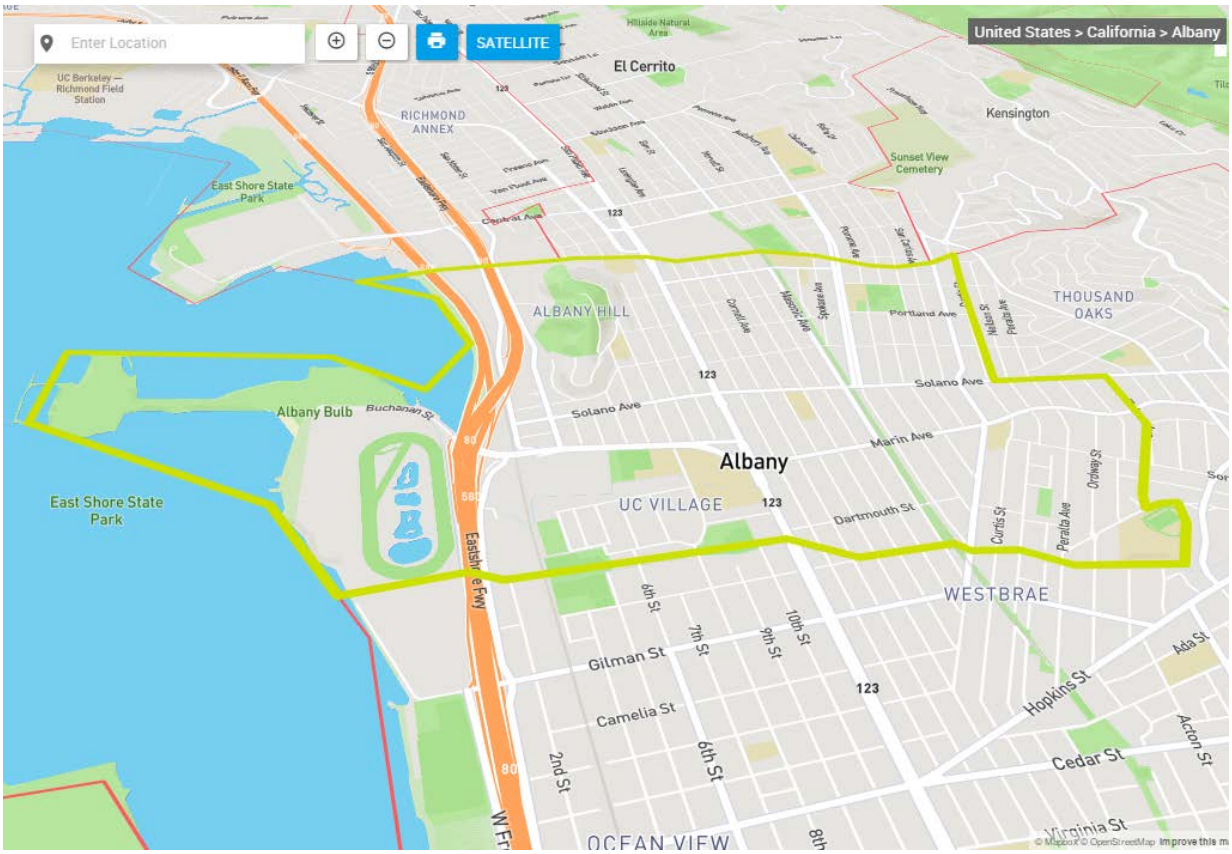
Section 3 is meant to inform Albany's identification and prioritization of potential adaptation actions and provide input to Steps 6 through 9[6] in the *Adaptation Planning Guide*. The adaptation options can be applied to each of the five participating cities and include suggestions for implementing partners, equity considerations, co-benefits and key considerations such as ease of implementation and potential funding sources.

Climate change will affect Albany, California

The City of Albany is a small city of 18,565 situated in the northwestern corner of Alameda County in the San Francisco Bay Area. It is bordered to the south by Berkeley, to the north by El Cerrito, and to the west by the San Francisco Bay. Albany is the sixth most densely populated city in the Bay Area, with 10,905 residents per square mile and much of its development completed before the 1950s. The city has three commercial districts, including the pedestrian-oriented Solano Avenue shopping district, San Pablo Avenue, and Cleveland Avenue and Eastshore Highway along the I-80 corridor, which also includes light industrial businesses. (See Figure 1 for a map of the city.)

Figure 1. Map of Albany

[6] Steps 6 through 9 in the *Adaptation Planning Guide* are: 6) Prioritize adaptive needs – Which impacts require actions to address them?, 7) Identify strategies – Which strategies should be pursued to address adaptation needs?, 8) Evaluate and prioritize – Which strategies should be implemented first? and 9) Phase and implement – How can the strategies be funded, staffed and implemented?



Albany's citywide assets will likely not be critically affected by climate change in the near term. In the long-term, projected temperature increases and the frequency of very hot days will impact a broad set of the city's assets and population.

2. Climate Hazards Analysis

Throughout the remainder of the 21st century, Albany's climate is projected to grow substantially hotter with fluctuations in precipitation patterns characterized by less consistent rainfall patterns and more intense rainfall events. Sea level rise is not expected to significantly affect the city's emergency assets, with areas of inundation limited to Albany Bulb, access to Golden Gate Fields and parking facilities along the shoreline. However, inland flooding from a 100-year storm could compromise assets along Codornices Creek and the railway, including portions of the I-580 and I-80 freeways near the border with Richmond and south of Buchanan Street. Figure 2 summarizes Albany's exposure to each of the hazards examined in this assessment.

Figure 2**.** Climate Hazards and Exposure

Climate Hazard	Exposure[7]	Summary
Inland Flooding	Medium	Significant[8] exposure during 100-year (1 percent annual chance of occurrence) and 500-year (0.2 percent annual chance of occurrence) floods
Sea Level Rise	Medium	Significant exposure of regional resources likely by end of century with a 50-year or 2 percent annual chance storm surge (a combination of permanent and temporary flooding equivalent to 72 inches of sea level rise)
Temperature Change	Medium	Average temperatures projected to increase by 2 to 4 °F and extreme heat by 8 days per year by 2100 (90 °F +)
Precipitation Change	Low	Likely increase in intensity of events, limited change in overall rainfall
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Inland Flooding

Climate change may increase flood risks in Albany

Climate change is expected to exacerbate flooding through storms and more intense periods of rainfall. Albany has a number of assets in historical floodplains, and with more intense precipitation events, the intensity and rate of rainfall-associated flooding events may cause more frequent inundation of citywide assets. Flood events expected to have a 0.2 percent chance of occurring in a given year, or a 500-year recurrence interval, based on historical information may occur more often under changing climate conditions. These changing conditions would translate to a shift in the maps of the 100- and 500-year floodplains.

Albany will potentially face more frequent, severe floods

Based on Flood Insurance Rate Maps (FIRMs) created by FEMA, assets in the 100-year and 500-year floodplains were analyzed for exposure. The 100-year floodplain includes land that has a one percent chance of flooding in a given year and therefore is expected to flood once every 100 years. The 500-year floodplain includes land that has a 0.2 percent chance of flooding in a given year. The floodplain maps are based on historical data and updated about every 10 years. Although they do not currently incorporate climate projections into the floodplain delineations, they provide an accurate depiction of

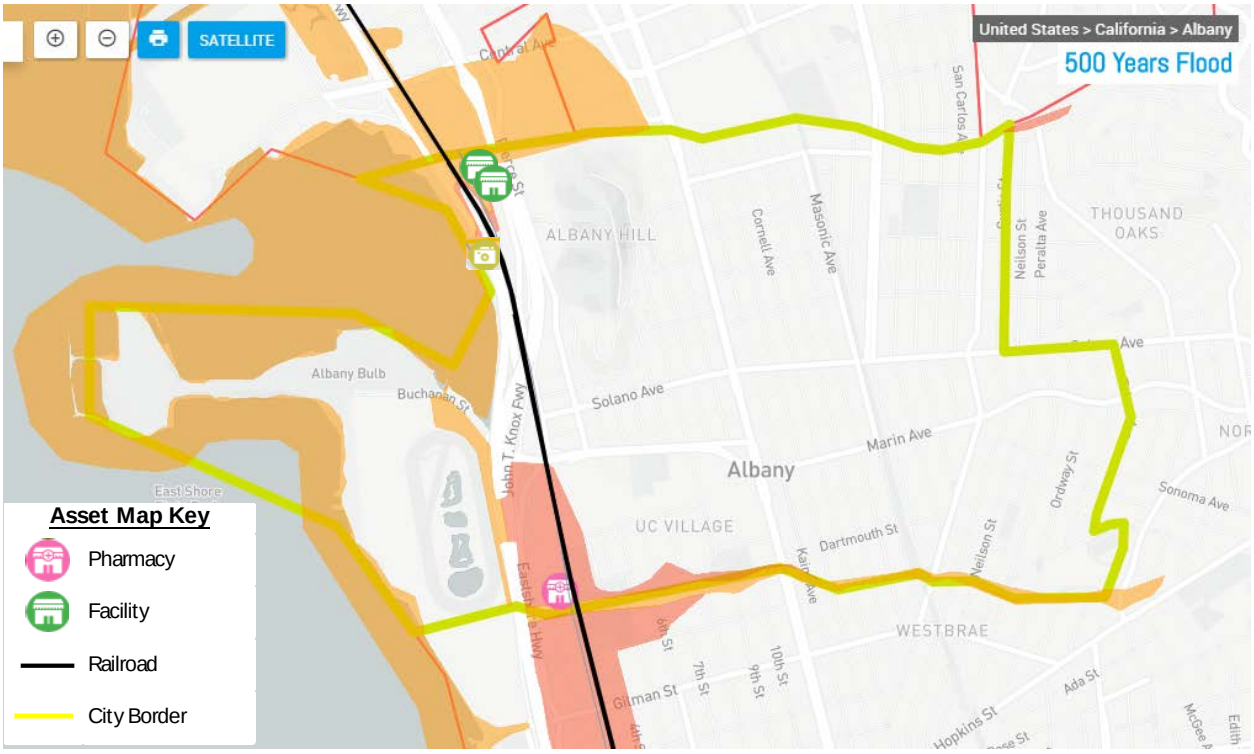
[7] The rankings were determined based on FEMA's Calculated Priority Risk Index framework and optimized for this assessment. (FEMA. (2013). *Local Mitigation Planning Handbook*.) The Index is provided in Appendix B.
[8] Significance was determined by exposure of non-emergency infrastructure and assets that could have large financial or public health impacts as a result of the given climate hazard.

where floodwaters are likely to concentrate, even as the probability of flooding increases and the current estimated recurrence intervals no longer apply due to climate change.

Few citywide assets are exposed to flood risk

According to FEMA flood maps, [9] Albany has a few notable assets located in the 100- and 500-year floodplains (Figure 3). Figure 4 lists the key assets in the 100- and 500-year floodplains. Note that the citywide assets directly addressed in this report are limited to important facilities as determined by the City. Important direct effects of inland flooding may exist for other vital community assets such as business corridors, places of community assembly, and housing, but these are not individually considered here.

Figure 3. Albany Assets in the Current 100- and 500-year Floodplain



Notes: The area shaded in orange is the 100-year floodplain and has a one percent chance of flooding in a given year, and the area shaded in red is the 500-year floodplain and has a 0.2 percent chance of flooding in a given year based on historical data. Source: Albany Local Asset Data, OpenStreet Map, Open Data and FEMA [10] as represented on Vizonomy.

Figure 4. List of Assets in the 100- and 500-year Floodplains

[9] FEMA Flood Insurance Rate Map. 100 Year Floodplain. Alameda County.
[10] FEMA Flood Insurance Rate Map. 100 Year Floodplain. Alameda County.

Asset Type	Area	Impact	100-yr flood	500-yr flood
Highway I-580	Albany Shoreline	H	X	X
Highway I-80	Albany Shoreline	H	X	X
Union Pacific Railroad	Albany Shoreline	H	X	X
Adhesive Factory	Northwest	M	X	X
Albany Maintance Center	Northwest	M	X	X
Albany Bulb and Waterfront	Albany Shoreline	M	X	X
Golden Gate Fields	Albany Shoreline	M	X	X
Pipeline	Albany Shoreline	M	X	X
Target Pharmacy	Codornices Creek	M	X	X
University Village	Codornices Creek	M	X	X
Belmont Village (under construction)	Codornices Creek	M		X
Fielding Field	Codornices Creek	L	X	X
Village Community Garden	Codornices Creek	L		X

Notes: Exposed assets by asset type and level of impact. Throughout this document, the "impact" ranking in the asset tables is based on a high, medium, low scale. High – Critical resources during a disaster or assets that could lead to immediate secondary hazards if damaged. Medium – Important assets or those that could lead to secondary hazards if damaged. Low – Assets that will not compound hazard effects or that are easily replaced. This distinction is based upon reasonable judgement and should be reviewed by local officials for accuracy. Source of asset count: Albany Local Asset Data, OpenStreet Maps, Open Data and AECOM [11] as represented on Vizonomy.

In the 100-year floodplain, flooding is limited to the area along the shoreline, a small section of land north of Albany hill and the area adjacent to Codornices Creek. This level of flooding compromises access to Golden Gate Fields and exposes the Union Pacific railway where it crosses Codornices Creek and in the northwest corner of the city adjacent to the Bay. The Eastshore Freeway (I-80/I-580) is inundated in the northwest as well as for southbound traffic (I-80W/I-580E) between Buchanan Street and the city's southernmost boundary under these conditions. Important structures in the 100-year floodplain include an adhesive factory in northwest Albany, the Albany Maintenance Center, and the pharmacy inside the Target store.

Under 500-year flood conditions, the entire section of railway south of Buchanan Street is inundated and both sides of the I-80/I-580 freeway are in the floodplain. Important assets in the 500-year floodplain include the Eastshore Highway south of Buchanan Street. Flooding along Codornices Creek also begins to affect properties in University Village and possibly Belmont Village.

Although flooding is possible in Albany, emergency assets in the city are located outside the floodplain. A 500-year flood will principally affect transportation networks, potentially limiting access to Golden Gate Fields, the local highway and railways, which would compromise the ability for residents to get around or leave the city, and for resources to be shipped into the area by rail or truck.

[11] AECOM and Brian Fulfrost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

Sea Level Rise

Albany will experience sea level rise due to climate change

Sea levels are rising as a result of higher atmospheric and oceanic temperatures across the globe. The rate of sea level rise is expected to accelerate throughout the century, threatening coastal resources, but projections are complicated by the potential for a substantial acceleration of glacial ice melt resulting in rapid sea level rise, which is not currently accounted for in many global scenarios.[12] The Bay Area is especially exposed to the impacts of sea level rise because of the large number of assets located on the coast. In Albany, the area most exposed to sea level rise is located along the shoreline; however, sea level rise alone is not projected to impact important emergency assets throughout the 21st century.

Sea level rise is a certainty

Sea level rise is occurring and is expected to accelerate throughout the 21st century, but it is uncertain how much and how quickly sea levels will rise in the Bay Area. Considered the best available science, the National Research Council (NRC) identified likely sea level rise estimates for the west coast of the United States.[13] These values are accompanied by ranges of possible sea levels based on low and high emissions scenarios and ice melt scenarios. Figure 5 summarizes the projections applicable to Alameda County: six inches of sea level rise by 2030 (range: 2-12 in), 11 inches by 2050 (range: 5-24 in), and 36 inches by 2100 (range: 17-66 in) relative to the year 2000.

Figure 5. Sea Level Rise Estimates Relative to the Year 2000

Year	Projections	Ranges
2030	6 ± 2 in	2 to 12 in
2050	11 ± 4 in	5 to 24 in
2100	36 ± 10 in	17 to 66 in

Source: NRC [14]

These projections characterize the estimated timeline for permanent increases in water levels. However, these water levels may occur sooner on a temporary basis under a number of different circumstances given the combination of permanent sea level rise and temporary extreme tides resulting from the additive impact of high tides and storm surge. For example, water levels could reach the equivalent of 49 inches of inundation by 2050 in the event of a 50-year storm - a storm that has a two percent chance

[12] M. K. Buchanan, R. E. Kopp, M. Oppenheimer, and C. Tebaldi. (2016). Allowances for evolving coastal flood risk under uncertain local sea-level rise. *Climatic Change* 137, 347-362. doi:10.1007/s10584-016-1664-7.
[13] National Research Council. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report. DOI: 10.17226/13389
[14] National Research Council. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report. DOI: 10.17226/13389

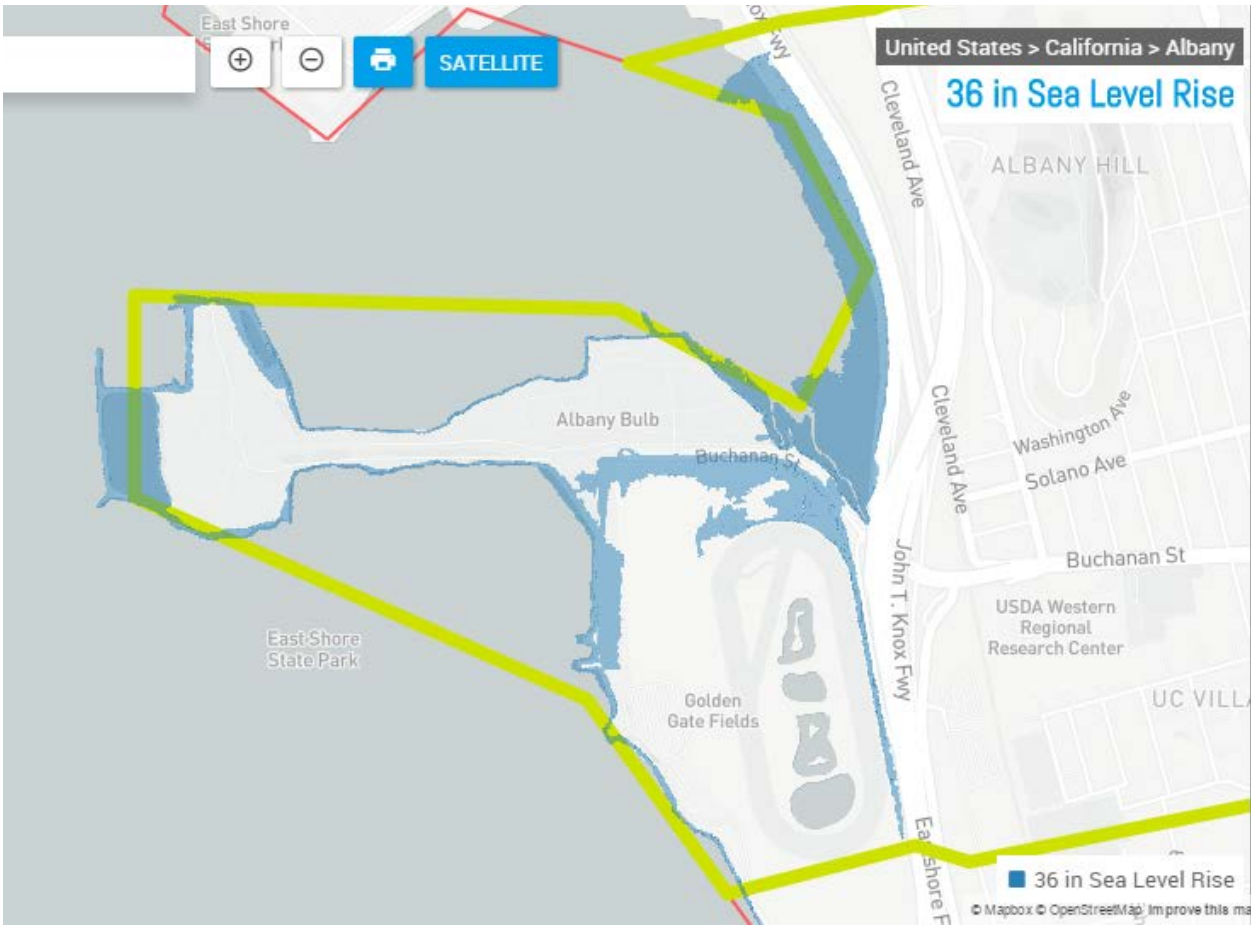
of occurring in a given year - even though that level of sea level rise is not projected to occur by the end of the century.[15]

Sea level rise will mean floods affect more assets over time

Albany's emergency assets are not affected by foreseeable sea level rise or extreme tides throughout the 21st century, but other important city assets are affected. Thirty-six inches of sea level rise is likely by the end of the century and at this level, waters flood the perimeter of Albany Bulb and the Golden Gate Fields parking facilities and road access. See Figure 6 for a map of areas inundated by 36 inches of sea level rise, and Figure 7 for a list of assets exposed to sea level rise. Even in the worst-case scenario of water levels reaching 72 inches in the event of likely sea level rise combined with a 50-year storm, water levels only inundate Buchanan Street along the water and the parking for Golden Gate Fields and Tom Bates Regional Sports Complex, although some small areas of the eastbound I-580 freeway north of Buchanan Street may experience flooding. However, at 96 inches, the commercial and light industrial businesses near Cleveland Avenue and Eastshore Highway are exposed, and Golden Gate Fields is projected to flood completely, compromising important community and economic resources in Albany.

Figure 6**.** Projected Sea Level Rise in Albany by the End of the Century (36 Inches)

[15] AECOM and Brian Fulfrost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.



Notes: The area shaded in blue indicates the area inundated by 36 inches of sea level rise. Source: OpenStreet Maps and AECOM [16] as represented on Vizonomy.

Figure 7**.** List of Assets Exposed to Sea Level Rise Flooding

[16] AECOM and Brian Fulfrost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report.*

Asset Type	Area	Impact	12 in.	24 in.	36 in.	48 in.	72 in.
Highway I-80	Albany Shoreline	H				X	X
Wastewater Treatment Plant	Oakland	H				X	X
Bay Bridge Access	Oakland	H		X	X	X	X
Albany Bulb & Waterfront	Northwest	M			X	X	X
Golden Gate Fields	Albany Shoreline	M				X	X
Buchanan Street	Albany Shoreline	M			X	X	X
I-580E offramp to I-80W	Northwest	M					X
Highway I-580	Oakland	M				X	X
Highway I-880	Oakland	M			X	X	X

Notes: See Figure 4 for an explanation of the asset impact ranking. Source of asset count: Albany Local Asset Data, OpenStreet Maps, Open Data and AECOM [17] as represented on Vizonomy.

Given the unlikely direct impact to Albany's emergency assets from sea level rise, the greater threat may be regional risks from sea level rise. With 48 inches of inundation, which is likely by the end of the century when combined with average yearly storm surge, water begins to threaten westbound access to the Bay Bridge. In the worst-case scenario, with predicted end-of-century sea level rise compounded by glacial melting and/or King Tides and storm surge, there is the possibility that parts of the Bay Area may experience sea level rise related flooding of up to 72 inches or more. At this level, numerous important regional assets are in the projected impact area, including the East Bay Municipal Utility District (EBMUD) wastewater treatment plant, access to the Bay Bridge and the Union Pacific railroad, which would threaten water quality, sewer service, transportation and cargo shipment throughout the area. Flooded areas will also include the I-880 freeway at intervals from Albany to Milpitas, with the most significant inundation occurring in Oakland and San Leandro. This includes projected flooding of the I-880/I-580 interchange. These conditions may likely result by the end of the century from a combination of sea level rise and storm surge, such as 36 inches of sea level rise combined with a 50-year storm surge, or 48 inches of sea level rise combined with a 5-year storm surge. It will be important for Albany to consider the local implications of regional climate impacts, such as delivery of food, water, and resources, access to transportation infrastructure and consequences for public health.

Temperature Changes and Precipitation Events

Climate change may increase temperatures in Albany, but impacts on rainfall are less clear

As greenhouse gas emissions increase, temperatures are expected to increase globally, placing growing stress on human health, water resources, energy systems and other citywide assets. Albany's climate is no exception and temperatures are projected to increase throughout the city with daily maximum temperatures increasing by about 8 °F by the end of the century under the high emissions scenario. The impact of climate change on precipitation events is less clear, but the pattern of precipitation is

[17] AECOM and Brian Fulfrost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

expected to become more variable with extreme events increasing in intensity while projections of annual totals show no clear signal of significant directional change.

Albany may experience higher annual average temperatures and more extreme heat days

Temperature and precipitation projections were provided by Four Twenty Seven using scenarios from the Intergovernmental Panel on Climate Change (IPCC).[18] The Representative Concentration Pathway (RCP) 8.5 is a minimal greenhouse gas mitigation effort and high emissions scenario, resulting in the largest increase in radiative forcing and warming, while RCP 4.5 is considered a moderate mitigation scenario where climate action limits the amount of global emissions. Future temperature rise scenarios vary based on which government policies and commercial and human actions are actually implemented in the coming years and how well these climate change mitigation efforts work cumulatively. While temperatures in Albany are projected to increase under both scenarios, daily average temperatures are projected to increase by about twice as much under the RCP 8.5 (high emissions) scenario than under the RCP 4.5 (lower emissions) scenario by the end of the century (RCP 8.5 leads to a 6.7 to 8.9 °F increase in daily average temperature, compared to a 2.9 to 4.8 °F increase under RCP 4.5).

Temperatures in Albany are projected to be two to four degrees higher

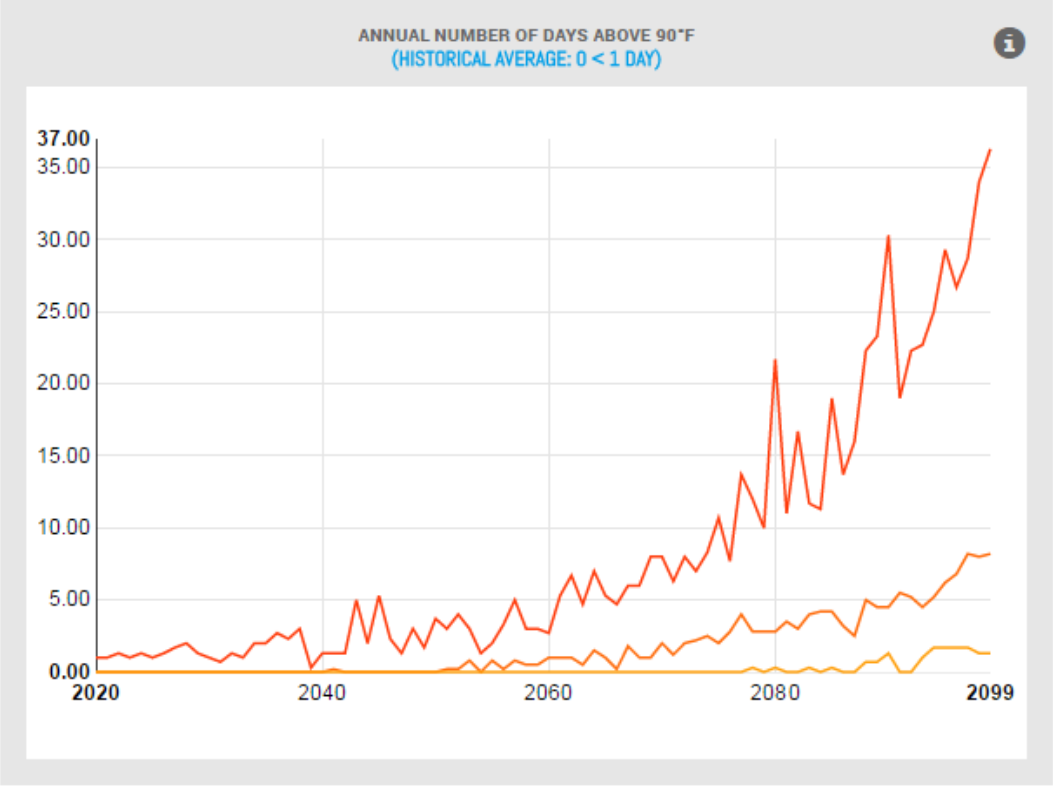
From 1970-2000, Albany experienced a daily average temperature of about 58.3 °F, an average maximum temperature of 66.8 °F and an average minimum temperature of 49.7 °F. Temperature exhibits a clear trend toward warmer average temperatures, which in turn translate to more extreme temperatures. Under RCP 8.5 (a high emissions scenario), daily average temperature will increase between +2.5 °F to +3.6 °F, daily minimum temperatures by +2.5 °F to +3.5 °F, and daily maximum temperatures by +2.6 °F to +4 °F between now and mid-century. Even under RCP 4.5 (a lower emissions scenario), temperature increases are evident and range between an average daily increase of +2.3 °F and +3.2 °F by mid-century. By the end of the century, temperature changes will be substantial, for daily average, minimum, and maximum temperatures with the high-end of the range of RCP 8.5 temperature increase projections suggesting increases from +6.9 °F to +9.2 °F. This means that Albany's average maximum temperature would be comparable to current levels in Vallejo, California at the end of the century. These projections do not indicate seasonal fluctuations, but yearly averages.

Extremely hot days will also become more prevalent in Albany. Historically, Albany averaged less than one day per year when average daily temperatures exceeded 90 °F. However, the occurrence of extremely hot days may rise exponentially after mid-century. In both the low and high emissions scenarios, Albany will likely begin to experience 90 °F days by 2060, with the potential for one 90 °F day per year as soon as 2020. Given the present low occurrence of high heat days in Albany, the city should proactively plan for high heat response in preparation for the increasing recurrence of heat waves. By century's end, the number of days per year above the 90 °F mark could be up to 3 days per year in a low emissions scenario, but as high as 30 days per year in a business-as-usual scenario (although mid-range RCP 8.5 projections indicate this number is closer to 8 days). (See Figure 8.) Higher temperatures will likely increase the magnitude of heat hazards in the city, for instance, heat stroke or exhaustion among

[18] IPCC. (2014). Scenario Process for AR5. Accessed at: http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html

local residents, workers and visitors, or raised demand for power during peak periods which could affect the frequency of outages.

Figure 8. Projected Extreme Heat Days in Albany



Notes: RCP 8.5 projected annual number of days above 90 °F throughout the 21st century. Lines represent low-end (light orange), mid-range (dark orange) and high-end (red) model results. Source: Four Twenty Seven as represented on Vizonomy.

Freeze temperatures in Albany are rare, and the number of very cold days is expected to decrease and minimum temperatures gradually to rise. For both emission scenarios, projections indicate that Albany is not likely to experience freeze after 2040. Under RCP 8.5, it would be unlikely to experience one day below 32 °F after 2083 even according to the most conservative projections.

The impacts of climate change on rainfall are ambiguous

During the historical baseline period, 1970-2000, [19] Albany received approximately 22 inches of rainfall per year. By mid-century, in a high emissions scenario, the percent change in total precipitation varies widely between -0.3 percent and +25.7 percent, indicating that no clear directional change in cumulative precipitation volumes is expected by the end of the century. Under both low and high emissions scenarios, mid-range projections of maximum five-day precipitation totals indicate averages between

[19] Environmental data from 1970-2000 was used as a historical baseline to inform projected future values.

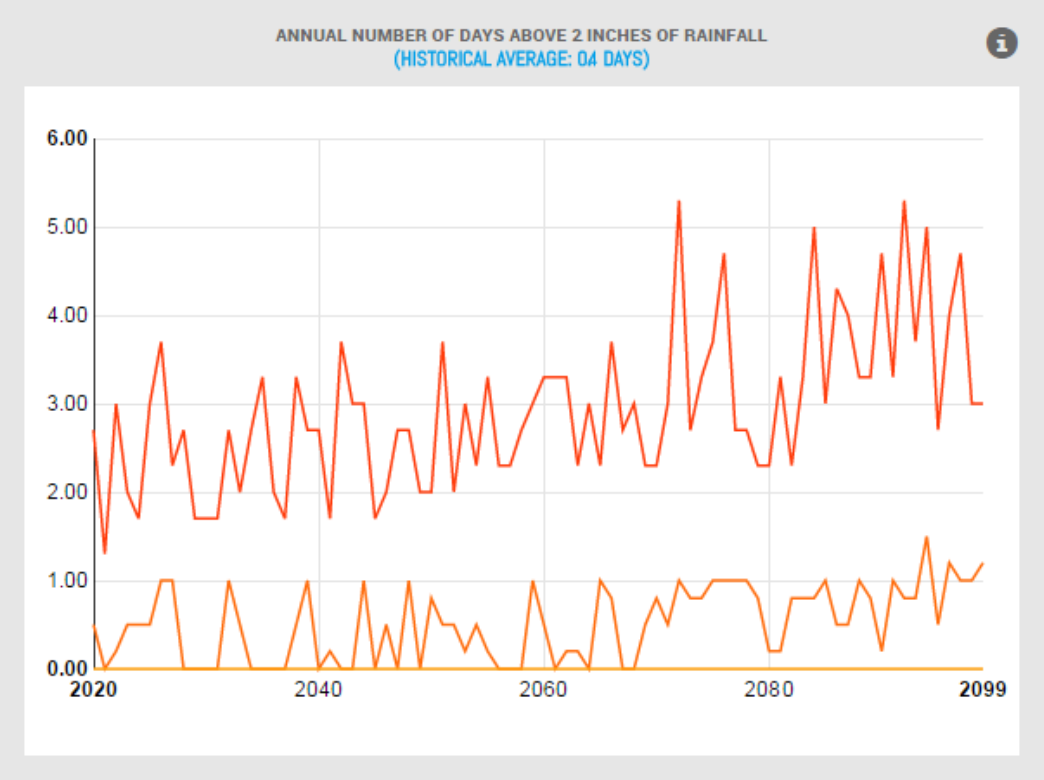
three and five inches of rainfall, consistent with the historical average of four inches. Thus, annual precipitation totals may remain analogous to present conditions.

Projections also indicate that while extreme rainfall events will occur less frequently, these rainfall events may be more intense, resulting in a greater volume of rain within a shorter timeframe. Although the frequency of days per year with more than one inch of rainfall in Albany is not projected to change drastically by the end of the century, there is some indication that two-inch rainfall events may occur once a year, equivalent to a doubling in frequency, by 2075 under a high warming scenario. Figure 9 depicts the projected occurrence of intense rainfall events in Albany between 2020 and 2099.

It is important to note that these extreme rainfall event projections may not account for particularly rare, but increasingly intense events such as atmospheric rivers (i.e., Pineapple Express). Other studies using computational models suggest that climate change will cause the most intense atmospheric river storms hitting California to become much more frequent and last longer by the end of the century.[20]

Figure 9. Projected Occurrence of Intense Rainfall Events in Albany

[20] Shields, C. A., and J. T. Kiehl (2016), Simulating the Pineapple Express in the half degree Community Climate System Model, CCSM4, *Geophysical Research*. Letters, 43, 7767–7773, doi: 10.1002/2016GL069476



Notes: RCP 8.5 projected percent changes in intense precipitation throughout the 21st century. Lines represent low-end (light orange) [21], mid-range (dark orange) and high-end (red) model results. Source: Four Twenty Seven as represented on Vizonomy.

Rainfall Induced Landslides

Climate change may increase the risk of landslides by making flooding more common

As extreme rainfall events increase in intensity the risk of inland flooding increases. Impacts associated with flooding include landslides, subsidence, slippage, creep, or sinkholes. Cities with hilly terrain can experience increased risk of these events, and both landslides and liquefaction during earthquakes are more likely and more severe if the ground is wet or saturated when the shaking occurs. Based on Albany's location and topography, its risk of experiencing landslides is minor.

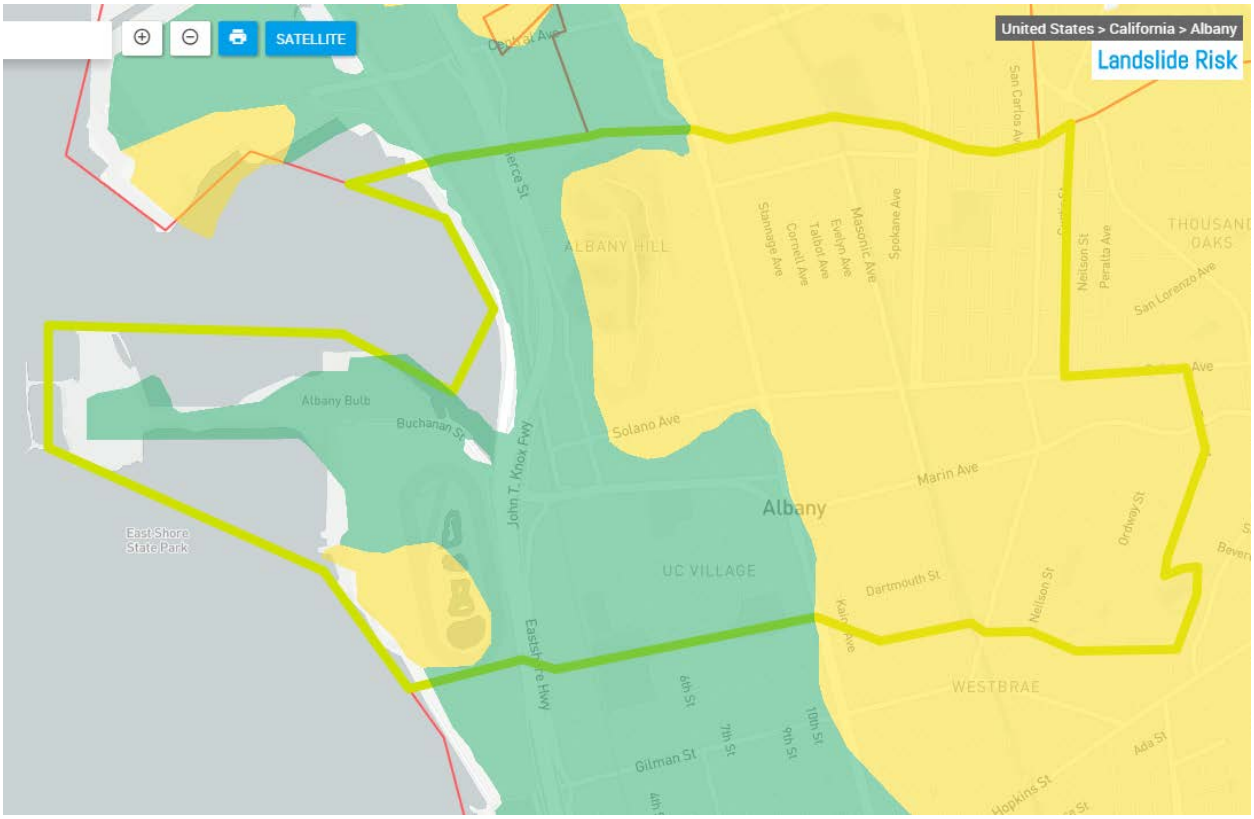
Landslides are considered most likely to occur in and around the places where they have previously taken place. As defined by the United States Geological Survey (USGS), [22] the eastern half of Albany is located in a zone identified as experiencing "few landslides."

[21] In this case, the low-end model results are represented by a flat line at 0.00.
[22] Pike, R.J. (1997). San Francisco Bay Region Landslide Folio Part D. USGS. Accessed at: http://pubs.usgs.gov/of/1997/of97-745/of97-745d.html

Extent of landslide risk areas is likely to be unaffected

The eastern half of the city, Albany Hill and a small area of Golden Gate Fields are at a low-level risk for experiencing a landslide event (see Figure 10). Community assets and local or regional assets east of Albany Hill and San Pablo Avenue are in an area that experience "few landslides," so although unlikely, landslide is possible and should be considered in emergency planning.

Figure 10. Landslide Risk in Albany



Source: Open Data, OpenStreet Map and USGS [23] as represented on Vizonomy.

Wildfires

Climate change may increase wildfire risks

Extreme temperatures and increased variability in rainfall will likely cause dry conditions in California, exacerbating the risk of wildfire throughout the state. Areas with high hazard severity potential in Albany are limited to the park areas in the city.

Francisco Bay Region Landslide Folio Part D. USGS. Accessed at: http://pubs.usgs.gov/of/1997/of97-745/of97-745d.html

Wildfires may become more common or severe

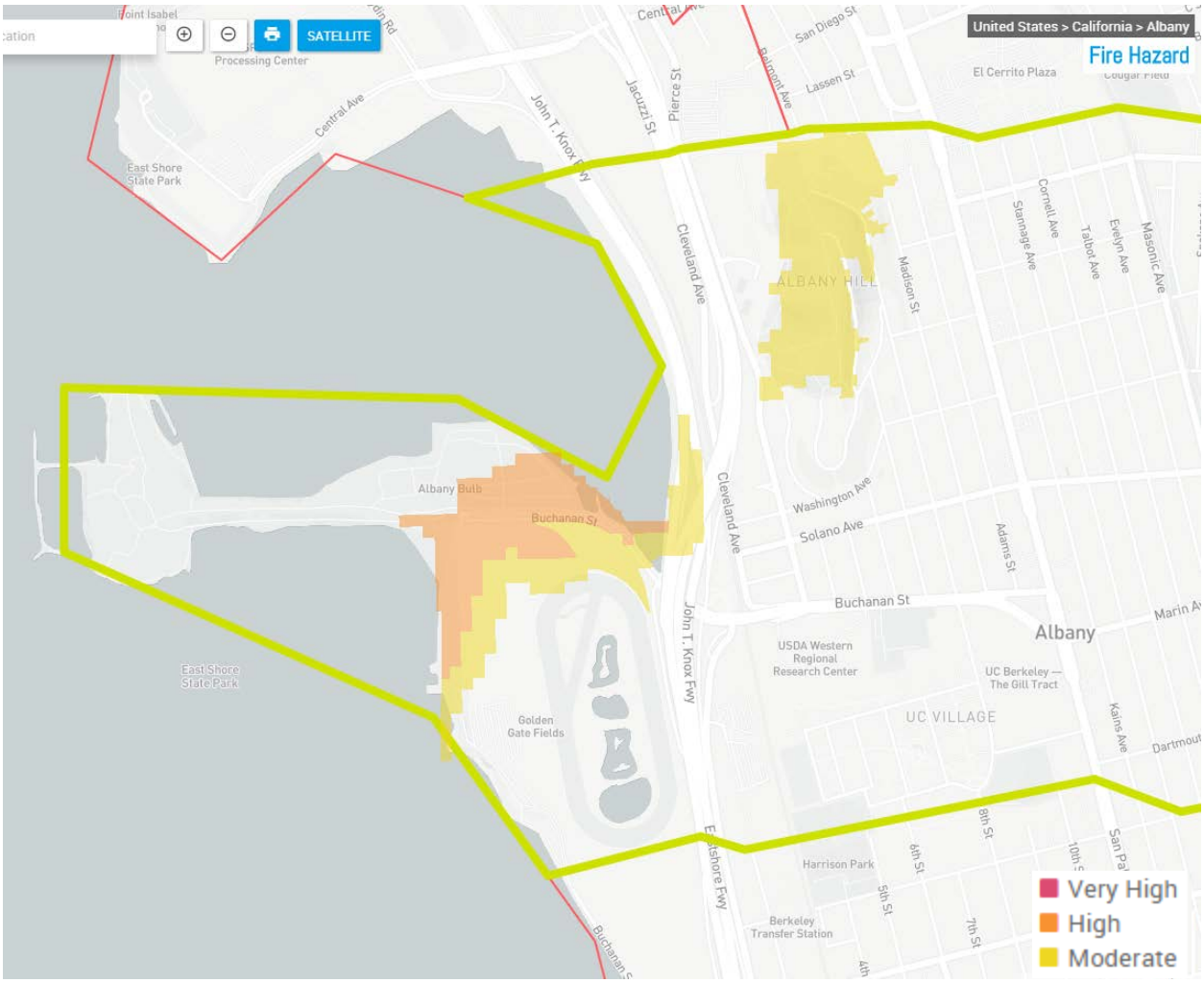
According to the California Department of Forestry and Fire Protection (CAL FIRE) Fire Hazard Severity Zone maps,[24] Albany has small areas with moderate to high wildfire severity zones on Albany Hill and Albany Bulb. Fire hazard severity is a metric of the potential exposure of wildland and urban properties to wildfire based on vegetation, topography, and dangerous fire characteristics. The extent of these zones will therefore depend on land use change, but the occurrence of fire within these zones may increase due to climate change impacts such as more frequent droughts.

Many assets are already exposed to wildfire risk

There is the potential for moderate fire hazard severity throughout Albany Hill and moderate to high fire hazard severity in the eastern portion of Albany Bulb close to the park's entrance. In the event of a fire on Albany Hill, Sutter East Bay Medical Care, and the Children's Center may be at risk due to their close proximity to the park. Golden Gate Fields is also close to the moderate fire hazard severity area in Albany Bulb. This hazard severity area also threatens the area surrounding the freeway just north of Buchanan Street and a wildfire in that area could pose potential danger to passing traffic. See Figure 11 for a map of fire hazard severity zones in Albany.

Figure 11. Fire Hazard Severity Zones in Albany

[24] CalFIRE. Wildland Hazard and Building Codes: Fire Hazard Severity Zone Development. Accessed at: http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_development



Source: Open Data, OpenStreet Map and CalFIRE[25] as represented on Vizonomy.

3. Adaptation Options

As highlighted in the climate hazard analysis in Section 2, Albany is subject to a range of climate hazards, with a number of important citywide assets at risk. Identifying and incorporating adaptation and resilience strategies into its local hazard mitigation plan and other relevant plans will enable Albany to safeguard its communities and these valuable assets from the impacts of a changing climate more effectively. This section presents a set of adaptation goals as well as policies and actions to implement these goals that Albany may draw on to address the climate hazards described in Section 2. These options are meant to inform Albany's identification and selection of adaptation options for integrating into its relevant plans and supplement the results of other relevant planning processes. It is important to

[25] CalFIRE. Wildland Hazard and Building Codes: Fire Hazard Severity Zone Development. Accessed at: http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_development

note that the cities should prioritize these actions based on the severity and relative risk of climate hazards as indicated by their own hazard assessments.

The set of options described in this section is the result of the following process:

- Review of relevant guidance such as the Adaptation Planning Guide and SB 379 draft guidelines,
- Review consolidation of adaptation and resilience related actions from the five participating cities' local hazard mitigation plans, General Plan safety elements, climate action plans, and other relevant plans to identify adaptation and resilience-related actions, [26]
- Prioritization of adaptation and resilience-related actions based on criteria such as hazards addressed, co-benefits and applicability across cities, and
- Assessment of gaps to respond to the priority climate hazards highlighted in the climate hazard analysis and identification of strategies to fill these gaps.

Only the strategies that are relevant to each city are featured in the city-specific climate change chapters, and they are organized under the categories of inland flooding, sea level rise, higher temperatures and extreme heat, changes in precipitation, landslides, fire, and emergency preparedness. The descriptions of the strategies also include suggestions for implementing partners, equity considerations, co-benefits and key considerations such as ease of implementation and potential funding sources. The focus in the write-ups has largely been on non-city government partners to facilitate consideration of other types of partners (e.g., state government, communities, non-governmental organizations, industry partners, businesses).

Inland Flooding

Exposure level – Medium

1. Update flood hazard data
    a. Work with the Federal Emergency Management Agency to integrate sea level rise projections into flood hazard data.
    b. Update floodplain maps to assess risks to new and existing development.

2. Minimize flood risks for existing development
    a. Ensure storm drain inlets are maintained regularly and improve the effectiveness of street sweeping program.

[26] See Appendix C for a list of relevant actions from the Conservation and Sustainability Element and Environmental Hazards Element of Albany's 205 General Plan

b. Provide flood protection assistance to community residents (e.g., technical advice and materials such as sand bags and plastic sheeting), and ensure vulnerable populations have access to these materials at low or no cost.

c. Provide incentives for or require retrofits that use waterproof shutters, shields or doors, basement pumps, and salt-resistant materials to reduce flood damage.

d. Work with the building industry to establish protocols and standards for reducing damages by designing or retrofitting structures to accommodate periodic flooding.

e. Maintain integrity of essential public facilities.

3. Avoid and minimize flood risks for new development

   a. Implement National Flood Insurance Program (NFIP) activities to minimize and avoid development in flood hazard areas.

   b. Implement zoning and subdivision practices through General Plan elements (safety, housing, land use) that restrict development in floodplains.

   c. Ensure that future development is sited, designed, and constructed to minimize risks associated with flooding, landslides, sea level rise, and other natural hazards. Identify appropriate mitigation measures, such as a buffer zone or setback from floodways, if new development is going to be located in flood zones, and use construction measures that reduce safety risks and minimize potential structural damage.

   d. Require 100 percent on-site stormwater management for new development.

4. Encourage green infrastructure for natural management of stormwater and storm-induced flooding, and preserving and restoring natural features of the watershed for both new and existing development, rather than using engineered structures.

   a. Conduct a watershed analysis to determine areas of insufficient capacity in storm drain and natural creek systems and predict impacts of abnormally high rainfall and sea level rise as well as to determine suitable locations for green infrastructure.

   b. Ensure that projects to reduce flooding are compatible with and advance local conservation policies, including restoration and protection of riparian habitat. Protect wildlife through planting and restoration of native habitat.

   c. Maximize use of compost berms, socks and blankets for erosion and sediment control to prevent erosion and contamination of watersheds from heavy rains.

   d. Insert compost requirements into city standards for contractors and department policies (public works, parks, fire departments, etc.).

   e. Protect bare soil with local recycled compost and mulch.

f. Plant trees to intercept rain and build rain gardens, green roofs, and other vegetative stormwater treatment features. Grade surfaces and direct downspouts so that stormwater flows toward vegetated areas.

g. Encourage the use of pervious pavement in new and existing development (e.g., parking lots), including rain gardens, porous pavement and disconnected downspouts to reduce runoff.

5. Protect and restore soil health

    a. Enhance the drought- and flood-resistance of soils in publicly managed lands, including open spaces, and city-owned facilities with compost and mulch.

6. REGIONAL: Establish cooperative relationships among public agencies with responsibility for flood protection

    a. Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.

Sea Level Rise

Exposure level – Medium

7. Preserve high-hazard areas and public open space

    a. Maintain and enhance natural shoreline buffers to protect inland development through mechanisms such as conservation easements and establishment of priority conservation areas.

    b. Ensure that land use and capital improvement decisions for the shoreline area consider long-term sea level projections.

    c. Build a living levee.

8. REGIONAL: Coordinate sea level rise efforts with relevant regional entities as well as other local jurisdictions

    a. Coordinate with Association of Bay Area Governments, San Francisco Bay Conservation and Development Commission, Bay Area Regional Collaborative, and other regional entities to develop relevant, regionally coordinated sea level rise adaptation measures through programs such as Resilient by Design that leverage the results of Adapting to Rising Tides and other programs.

b. Monitor and participate in regional and state-level policy and programmatic development on waterfront protection and rehabilitation.

Higher Temperatures and Extreme Heat

Exposure level – Medium

9. Decrease urban heat islands through increased tree and vegetation planting and maintenance.
    a. Assess existing vegetative cover and plant health throughout the city.
    b. Identify priority areas to expand urban tree and vegetation planting.
    c. Establish a minimum rootable soil volume for trees to support a healthy urban forest. Retrofit tree wells accordingly. Use compost and maintain layer of mulch to create healthy soils for trees and other vegetation.
    d. Plant vegetation and shade trees with substantial canopies and require, where feasible, site design that uses trees and vegetation to shade parking lots, streets and other facilities.
    e. Encourage the preservation of mature trees and vegetation. When preservation is not feasible, require replacement trees and vegetation and ongoing maintenance measures to avoid net loss of plant coverage.
    f. Provide services, education and incentives to encourage the planting and preservation of trees and vegetation on private property.

10. Promote the use of cool infrastructure
    a. Promote the use of “cool-parking” in new parking facilities and existing parking lots undergoing resurfacing by shading parking areas with shade structures and trees, or using light colored paving or other surface treatments.
    b. Promote adoption of cool-roof reach codes for new construction and re-roofing/roofing upgrading.

11. Integrate energy assurance actions into citywide planning processes to decrease vulnerability to grid outages during extreme events
    a. Conduct an assessment to identify the key facilities that support emergency operations, estimate those facilities’ energy supply and demand during emergencies to assess vulnerabilities to power loss, and identify potential actions to mitigate those vulnerabilities and supply alternative power sources (e.g., microgrids).
    b. Develop an action plan (or integrate considerations into an existing plan) to install a reliable energy resource in the form of renewable energy generation, battery storage systems,

smart inverters, energy visualization and control systems, and energy efficient technology at sites with critical energy supply needs.

c. Purchase or engage in power purchase agreements for the installation and deployment of solar plus storage systems. Implement group procurement of microgrid components.

d. Establish or continue to implement reach codes for energy efficiency in new construction and disclosure ordinances for existing residential and commercial buildings to improve building comfort, including in extreme weather conditions, and to reduce energy usage. Encourage passive cooling technologies and discourage new addition of cooling equipment to prevent power outages.

Changes in Precipitation

Exposure level – Low

12. Manage and conserve groundwater

    a. Monitor groundwater elevation and quality. Support the California Statewide Groundwater Elevation Monitoring Act (CASGEM).

    b. Comply with California's Sustainable Ground Water Management Act to develop sustainability plans to prevent overdraft by 2022 and to achieve sustainability by 2040.

    c. Identify priority recharge areas and ensure that land use planners consider the need to protect these areas in land use processes through codes and ordinances.

    d. Determine the location of local aquifers and promote strategies to increase water infiltration over them, such as green infrastructure and pervious paving.

    e. Incentivize the use of compost and mulch in new and existing landscapes and gardens to increase the water holding capacity of soil and increase infiltration.

13. Conserve and reuse water in existing buildings and landscapes

    a. Assess current water usage and available technologies and practices, and set ambitious but feasible water reduction targets at the city level.

    b. Promote and incentivize water efficient landscaping through rebates for lawn conversions with sheet mulch and irrigation repair and upgrades.

    c. Require new construction and major remodels to achieve indoor water efficiency 20 percent above the California Building Standards.

    d. Collaborate with local water agencies to promote indoor water conservation.

    e. Provide incentives and education to promote the use of greywater.

f. Streamline the permit process for greywater systems, and align the permit process with the degree of system risk.

g. Promote greywater use by requiring dual plumbing for greywater from laundry and showers in new developments.

h. Encourage the use of rainwater harvesting facilities, techniques and improvements where appropriate, cost effective, safe and environmentally sustainable.

i. Coordinate with local water agencies to incentivize irrigation audits and advance water recycling programs – including treated wastewater to irrigate parks, golf courses, and roadway landscaping – and to encourage rainwater catchment system-wide and greywater usage in new buildings.

j. Build municipal cisterns.

k. Incentivize and promote the use of compost and mulch in existing landscapes and gardens to create drought resistant soils.

l. Use practices in the Bay-Friendly Landscape Maintenance Manual to maintain city landscapes.

m. Require city landscape maintenance staff to become Bay-Friendly Qualified Professionals.

14. Increase the use of local sources of water

    a. Provide incentives and education on the use of other alternative sources of water, such as greywater, rainwater, air conditioning condensate and foundation drainage.

15. Build landscapes adapted to California climates and soils

    a. Use the Bay-Friendly Landscape Scorecard for all new and renovated public landscape construction and have civic landscapes act as models for water conservation and sustainability for the community.

    b. Fully implement the new California Model WELO for city and permitted new landscapes.

    c. Have city and agency staff involved in landscape design, construction, maintenance or regulation become Bay-Friendly Qualified Professionals.

16. Promote food security

    a. Raise awareness about extending the life of food through food saving and storage strategies that prevent edible food from going to waste.

    b. Support the development of a food rescue infrastructure, and provide information on the availability of food to ensure food access for vulnerable populations.

c. Encourage use of compost in urban agriculture.

d. Promote composting to create a supply for agriculture elsewhere and support crop resilience.

Rainfall Induced Landslides

Exposure level – Low

17. Avoid and minimize landslide risks for new and existing development

    a. Implement zoning and subdivision practices through General Plan elements (safety, housing, land use) that restrict development in landslide risk areas.

    a. Mitigate landslide risks in the hills by improving drainage, reconstructing retaining walls, installing netting and vegetation, avoiding clear cutting, and stabilizing the soil after tree clearing with compost and mulch.

    b. Maximize the use of compost berms, blankets and socks for erosion and sediment control, especially on disturbed soils or post-fire.

Wildfires

Exposure level – Low

18. Reduce the exposure of built infrastructure to wildfires

    a. Discourage new development in the hills where the risk of wildfire is highest and, where feasible, locate new essential public facilities outside of fire hazard zones. Identify appropriate mitigation measures for new development or essential facilities that will be located in fire zones.

    b. Develop defensible space for assets located in wildland-urban interface zones and/or high fire hazard severity zones as designated by CalFIRE.

19. REGIONAL: Establish cooperative working relationships among public agencies with responsibility for fire protection

    a. Identify the appropriate city, state and regional agencies to collaborate with and existing mechanisms that can be leveraged for cooperation and collaboration.

    b. Actively participate in regional efforts to plan, allocate responsibilities and identify funding for fire management efforts, and encourage full consideration of projected climate impacts in all planning processes and partnerships.

Public Health

20. Identify populations vulnerable to extreme heat

    a. Identify populations vulnerable to heat related illness.

    b. Develop targeted outreach materials to raise awareness about heat risks. Ensure that extreme heat preparedness and response information is available in the primary non-English languages spoken in the community.

    c. Provide public cooling centers for these populations. Develop means to raise public awareness of these centers and ensure accessibility for vulnerable populations.

21. Raise population's awareness of the public health impacts of climate change

    d. Develop information dissemination channels for Spare the Air days, including materials specifically targeting vulnerable populations.

    e. Create a plan for disseminating public information about new or more prevalent vector borne diseases.

Emergency Preparedness

22. Ensure an energy assurance plan for city operations during and after disasters (Also see Measure 11: Integrate energy assurance actions into citywide planning processes.)

    a. Estimate critical facilities' (including the emergency operations center) and key community assets' (e.g., schools, the library) energy supply and demand during emergencies to assess facilities' vulnerabilities to power loss.

    b. Work with local gas, electric, cable, water, sewer and other utility providers to maintain and retrofit their facilities and ensure their ability to function or be quickly restored following a climate-related disaster.

    c. Facilitate access to local, decentralized renewable energy.

23. Manage hazardous materials to prevent accidents

    a. Assess the impacts of flooding, landslides, sea level rise, and other climate change impacts on hazardous materials facilities. Develop a strategy to prevent catastrophic releases.

24. Assess the robustness of the city emergency response and recovery program's consideration of flooding, landslides, sea level rise, and other climate change impacts

a. Ensure that emergency response and recovery programs account for changing climate conditions and how new and changing hazards may affect emergency response.

b. Identify emergency response and evacuation access ways and address their vulnerability to flooding, landslides, etc.

Appendix A: Methods and Data Sources

Methods

The Albany climate hazards analysis was conducted using a digital mapping tool called The Vizonomy Climate Risk Platform (Vizonomy). This platform overlays geographical representations of sea level rise and rainfall-induced inland flooding with the location of citywide assets throughout Albany, creating a visual representation of the spatial extent and the number of specific assets that could be affected by each hazard throughout the city. The asset information was collected from open data sources available through various federal agencies, OpenStreet Map and local data provided by the City of Albany and Alameda County. Hazard projections and data were collected from the sources explained in the next section of this appendix. In addition, modeling and graphical representations of projected temperature and precipitation changes throughout the 21st century were provided by Four Twenty Seven.

The spatial evaluation of hazards and assets limited this analysis to the consideration of asset exposure. In order to assess vulnerability to climate change hazards, more information is needed on the sensitivity and adaptive capacity of affected communities and assets. This analysis provides a thorough examination of the city's potential spatial exposure to a variety of climate hazards and is meant to complement further analysis of overall vulnerability and the appropriate adaptive responses.

Data Sources

Inland Flooding

FEMA creates Flood Insurance Rate Maps (FIRMs) as part of the National Flood Insurance Program to determine flood insurance requirements and inform local hazard mitigation actions that address flood risks. FIRMs incorporate statistical information on river flow, storm surge, hydrology and topography in order to delineate 100-year and 500-year floodplains, or areas that will experience floods with a one percent or 0.2 percent chance respectively of being exceeded in a given year. The statistical information and associated maps are based on historical data and do not incorporate climate projections into the floodplain delineations. Nonetheless, they provide an accurate depiction of where floodwaters are likely to concentrate, even if recurrence intervals change.

The hazards assessment was conducted using a digital mapping tool, Vizonomy, which overlaid FEMA FIRMs with the location of citywide assets collected from open data sources, OpenStreet Map and local data provided by the City of Albany in order to assess the impact of floods.

Sea Level RiseThe 2012 National Research Council (NRC) Report *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future* identified likely sea level rise estimates throughout the 21st century for the west coast of the United States based on moderate greenhouse gas emissions and continued acceleration of glacial melt patterns. These values are accompanied by ranges of possible sea levels based on low and high emissions scenarios and ice melt scenarios. The projections applicable to Alameda County are six inches of sea level rise by 2030 (range: 2-12 in), 11 inches by 2050 (range: 5-24 in), and 36 inches by 2100 (range: 17-66 in) relative to the year 2000 (see Figure A1).

Figure A1. Sea Level Rise Estimates Relative to the Year 2000

Year	Projections	Ranges
2030	6 ± 2 in	2 to 12 in
2050	11 ± 4 in*	5 to 24 in
2100	36 ± 10 in	17 to 66 in

Source: NRC [27]

In the report *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment*, these projections inform a sea level rise analysis for Alameda County. Four inundation maps were created which incorporate remote sensing data using light detection and ranging (LiDAR) methods to depict the elevation on natural and hard structures and determine the level of "overtopping" at five-meter resolution. Each map represents a range of scenarios that are possible given different combinations of sea level rise and extreme tides. Extreme tides are caused by the additive impact of unusually high tides, or King Tides, which happen twice per year, and storm surge, which results from the high winds and low atmospheric pressure associated with storm conditions.

The analysis includes maps of water levels increasing by 12 inches, 24 inches, 36 inches and 48 inches over the Mean Higher High Water (MHHW), or the average height of the higher high tide of each day. (Refer to Figure A2). Based on the likely sea level rise projections within climate scenarios, the areas flooded in the map depicting 36 inches of sea level rise are likely to be permanently inundated by 2100. However, this same water level could occur temporarily on an annual basis by mid-century with high tides and storm surge.

Two additional maps of water level increases at 72 and 96 inches illustrate flooding that can potentially take place under circumstances in which sea level rise is combined with higher than projected glacial melt and extreme tides. For example, a 73-inch scale flood is possible with 36 inches of sea level rise and a 50-year extreme tide. A 96-inch scale flood, which would inundate half the city, is possible with 54 inches of sea level rise and a 100-year storm event.

Figure A2. Sea Level Rise and Extreme Tide Matrix (Hydrodynamic Zone 1)

[27] National Research Council. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report. DOI: 10.17226/13389

Table 3-3. Sea Level Rise and Extreme Tide Matrix (Hydrodynamic Zone 1)

Sea Level Rise Scenario	Daily Tide *Permanent Inundation*	Extreme Tide (Storm Surge) *Temporary Flooding*						
	+SLR	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
	Water Level above MHHW (in)							
Existing Conditions	0	14	19	23	27	33	37	42
MHHW + 6 inch	6	20	25	29	33	39	43	48
MHHW +12 inch	12	26	31	35	39	45	49	54
MHHW +18 inch	18	32	37	41	45	51	55	60
MHHW +24 inch	24	38	43	47	51	57	61	66
MHHW +30 inch	30	44	49	53	57	63	67	72
MHHW +36 inch	36	50	55	59	63	69	73	78
MHHW +42 inch	42	56	61	65	69	75	79	84
MHHW +48 inch	48	62	67	71	75	81	85	90
MHHW +54 inch	54	68	73	77	81	87	91	96
MHHW +60 inch	60	74	79	83	87	93	97	102
HYDRODYNAMIC ZONE 1								

Source: Adapting to Rising Tides [28]

The hazards assessment was conducted using Vizonomy, which overlaid the sea level rise maps from the *Adapting to Rising Tides* report with the location of citywide assets collected from open data sources, OpenStreet Map and local data provided by the City of Albany in order to assess the impact of sea level rise related flooding on the city.

Temperature and Precipitation

Temperature and precipitation projections were provided by Four Twenty Seven using an ensemble of 19 global circulation models, statistically downscaled to better represent local conditions. Probabilistic estimates were generated for extreme indicators using Gaussian distribution, with the most likely value falling between the 25th and 75th percentiles. For indicators showing changes to average precipitation and temperature, an envelope-based approach was used by bounding the range of models based on their departure from the historical mean. Temperature and precipitation indicators have been parametrized to show future trends in terms of averages and extremes at the city-level (~12 x 12 km). All future values (2020-2060) were amended with probabilistic estimates and compared to a historical baseline (1970-2000).

The models used scenarios from the IPCC. The RCP 8.5 represents the most minimal greenhouse gas mitigation effort and high emissions, resulting in the largest increase in radiative forcing and warming,

[28] AECOM and Brian Fulfrost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

while RCP 4.5 is considered a moderate greenhouse gas mitigation scenario where climate action limits the amount of global emissions.[29]

Rainfall Induced Landslides

The USGS conducted a survey of landslide risk in the San Francisco Bay Area leading up to the 1997-1998 El Niño event. Today, these maps are used to predict future landslides since these events are generally believed to occur within and around the places where they have previously taken place.[30] Geographic locations are assigned risk based on a five-point scale from surficial deposits (low risk) to mostly landslide (high risk). Areas which have experienced few landslides have a mid-level risk for landslide events.

Wildfires

CAL FIRE produces Fire Hazard Severity Zone maps to determine the potential exposure of wildland and urban properties to wildfire based on vegetation, topography, and dangerous fire characteristics such as crown fire potential and ember production and movement. Fire hazard is a metric for determining physical fire behavior in order to predict the amount of damage a fire in a certain location is likely to cause and is classified as Very High, High or Moderate. The Fire Hazard Severity Zones are based on the evaluation of the likelihood that an area will burn and how, without consideration of the risk for property damage. [31]

[29] IPCC. (2014). Scenario Process for AR5. Accessed at: http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html

[30] Pike, R.J. (1997). San Francisco Bay Region Landslide Folio Part D. USGS. Accessed at: http://pubs.usgs.gov/of/1997/of97-745/of97-745d.html

[31] CalFIRE. Wildland Hazard and Building Codes: Fire Hazard Severity Zone Development. Accessed at: http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_development

Appendix B: Calculated Priority Risk Index

The Calculated Priority Risk Index in Figure B1 is informed by FEMA's guidelines for comparing hazards, as described in the *Local Mitigation Planning Handbook* (2013). The focus here, based on available data, is on the types of assets exposed to a given hazard and the magnitude of the impact. The rankings for types of assets exposed to a given hazard are: low – only assets that will not compound hazard effects or that are replaceable are subject to the hazard, medium – important assets or those that could lead to secondary hazards if damaged are subject to the hazard, and high – critical assets that could lead to immediate secondary hazards if damaged are subject to the hazard. For magnitude, the rankings are: low – no critical assets are affected, medium – some critical assets and/or a large number of important assets are affected, and high – several critical assets are affected.

FEMA defines critical facilities as "all public and private facilities deemed by a community to be essential for the delivery of vital services, protection of special populations, and the provision of other services of importance for that community."[32] This includes emergency response facilities, healthcare facilities, transportation infrastructure, schools, emergency shelters, utilities, communications facilities and other assets important to maintaining the health and safety of city residents.

Figure B1. Calculated Priority Risk Index[33]

Hazard	Types of Assets Exposed to Hazard	Magnitude	Rank
Inland flooding	L	H	M
Sea level rise	M	M	M
Temperature change	M	M	M
Precipitation change	L	L	L
Wildfires	L	M	L
Rainfall Induced Landslides	L	M	L

[32] FEMA. (2007). *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings,* FEMA 543. Accessed at: https://www.fema.gov/media-library/assets/documents/8811

[33] FEMA. (2013). Local Mitigation Planning Handbook.

Appendix C: Relevant Strategies from Albany's Plans

Albany 2035 General Plan

Chapter 7: Conservation and Sustainability Element

Goal CON-1: Protection of Natural Features.
Protect and enhance the natural features that define Albany's environment, including the waterfront, wetlands, creeks, and Albany Hill.

Policies:

Policy CON-1.2: Erosion and Soil Management

Require that construction, grading, retaining walls, infrastructure maintenance, and other earth moving activities use best management practices to reduce erosion, sedimentation, and soil loss.

Policy CON-1.3: Conservation of Albany Hill

Protect and restore natural features, native vegetation, and wildlife on Albany Hill.

Policy CON-1.4: Albany Waterfront

Protect and sustain the Albany waterfront and surrounding wetlands as a natural and cultural resource, a vital ecosystem, a place of scenic beauty, and a defining feature of Albany's physical environment.

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Policy CON-1.6: Respecting Natural Features

Design new development to conserve natural landscape features, such as topography, drainage patterns, and vegetation. Avoid projects which require excessive hillside grading, rerouting of streams and drainage ways, filling of wetlands, and other alterations which compromise natural resources.

Policy CON-1.7: Creek Restoration

Enhance the natural characteristics of Albany's creeks and uncover and restore ("daylight") portions of creeks that have been placed in underground culverts and pipes where feasible.

Policy CON-1.9: Riparian Corridors

Maintain special development regulations for areas within 100 feet of Codornices Creek, Cerrito Creek, and Village Creek which ensure that riparian and littoral habitat is conserved, flood impacts are reduced, and the creeks are enhanced for their aesthetic and ecological value.

Watercourses on private property should be kept free of trash, debris, excessive vegetation, and obstacles to the flow of water.

Policy CON-1.10: Adaptation
Work collaboratively with surrounding jurisdictions and regional agencies on adaptation planning for rising sea level along the Albany shoreline, including any future reuse plans for Golden Gate Fields. Ensure that land use and capital improvement decisions for the shoreline area consider long-term sea level projections.

Implementing actions:

Action CON-1.A: Codornices and Cerrito Creek Restoration Initiatives

Continue collaborative efforts with community organizations, resource agencies, and adjacent cities to restore natural conditions and stabilize banks along Albany's creeks, particularly Codornices and Cerrito Creeks.

Action CON-1.B: Watercourse Combining District

Review the Watercourse Combining District zoning regulations to ensure that they sufficiently protect riparian habitat, reduce erosion and flooding hazards, and mitigate impacts of development on creek ecology. Compliance with all applicable state and federal regulations also shall be required for any project that could potentially impact the city's creeks.

Action CON-1.C: Creeks at UC Village

Work with the University of California and the developers of projects on the UC Village property to maintain undeveloped open space easements along Village Creek and along Codornices Creek, and to plan for the restoration of the creeks as adjacent properties are developed or altered.

Action CON-1.D: Creek Clean-Ups

Support community-led creek clean-ups and restoration efforts, and enforcement of development agreements and approval conditions related to creek clean-up and maintenance.

GOAL CON-2: URBAN FORESTRY AND AGRICULTURE

Expand Albany's urban forest and capacity for local food production.

Policies:

Policy CON-2.1: Trees and the Environment

Recognize the importance of trees and vegetation to improving air and water quality in the City and contributing to local efforts to reduce global climate change.

Policy CON-2.2: Tree Preservation

Encourage the preservation of mature trees during the review of development proposals and subsequent construction projects. Site design and construction plans should identify individual trees and groves of trees and include measures to protect them where feasible. When tree preservation is not feasible, the City may require replacement trees and ongoing maintenance measures to avoid net loss of tree coverage.

Policy CON-2.4: Bay Friendly Landscaping

Encourage and where appropriate require bay-friendly and drought-tolerant landscaping to enhance aesthetics, buffer residences from noise and air pollution, create privacy, reduce wind, and provide habitat.

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Policy CON-2.5: Albany Hill Vegetation Management

Protect the remaining native plant communities on Albany Hill. Vegetation on the Hill should be managed in a way that gradually reduces the extent of the eucalyptus forest and encourages native plants to return.

Policy CON-2.6: Hazardous Trees

Remove trees that threaten human safety due to unstable growth, disease, hazards to life and property, or serious fire danger. In wildland areas such as Albany Hill, remove understory debris and fire ladders to reduce fire hazards and improve trail access.

Implementing Actions:

Action CON-2.A: Street Tree Planting

Continue implementation of a comprehensive street tree planting and maintenance program for Albany streets, including priorities, time schedules, and species selection guidelines. Seek funding through state, federal, and non-profit urban forestry programs to support increased tree planting and maintenance capacity.

Action CON-2.D: Creekside Master Plan

Implementation

Implement the vegetation management prescriptions of the Albany Hill Creekside Master Plan, and periodically update the Plan as conditions change.

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GOAL CON-3: REGIONAL LEADERSHIP IN CLIMATE AND SUSTAINABILITY

Be a regional leader in efforts to reduce the effects of global climate change, improve air quality, and promote sustainable growth.

Policies:

Policy CON-3.2: Climate Change as a

Planning Consideration

Ensure that planning and development decisions consider potential impacts associated with global climate change, including rising sea levels and potential greenhouse gas emissions.

Implementing Actions:

Action CON-3.H: Health Risk Assessments

Require Health Risk Assessments (HRAs) for future development projects resulting in new residential units within 500 feet of the I-80 or I-580 freeways and in other locations where warranted based on Bay Area Quality Management District criteria. HRAs shall be done in accordance with the latest State Office of Environmental Health Hazard Assessment and Bay Area Air Quality Management District guidelines, and shall mitigate impacts to levels deemed acceptable by these agencies.

GOAL CON-4: WATER QUALITY

Maintain and improve water quality in Albany's creeks, shoreline, and off-shore waters

Policies:

Policy CON-4.1: Stormwater Control

Eliminate non-stormwater discharges to the municipal storm sewer, and control potential discharges from spills, dumping, and urban runoff. Activities with the potential to cause or contribute to stormwater pollution shall comply with best management practices, guidelines, or requirements to reduce water quality impacts.

Policy CON-4.3: Low Impact Development

Support the use of pervious pavement, rain gardens, bioswales, cisterns, roof drains directed to pervious areas, and other "low impact development" (LID) measures which capture and filter rainwater and reduce runoff to local creeks and the Bay.

Policy CON-4.4: Municipal Regional Permit

In compliance with the Clean Water Act, participate in the Alameda Countywide Clean Water Program and NPDES Municipal Regional Permit (MRP) to reduce stormwater discharges to local

waterways and San Francisco Bay. In accordance with the MRP, ensure that post-runoff conditions on any development site shall not exceed pre-project rates and durations.

Policy CON-4.5: Watershed-Level Planning

Recognize local watersheds as a logical basis for planning and implementing water quality improvements. Increase awareness of watershed boundaries and the location of creeks and drainage courses in and around Albany.

Implementing Actions:

Action CON-4.B: Stormwater Management Plans

Implement Provision C.3 of the Municipal Resources Permit which requires stormwater management plans, runoff control measures, and stormwater treatment on large development sites.

Action CON-4.C: Alameda Countywide Clean Water Program

Work collaboratively with Alameda County and nearby cities to implement the County Clean Water Program, including water quality monitoring, regulation of construction runoff, cleaning of storm drain inlets, education and outreach, and enforcement of illicit discharge regulations.

GOAL CON-5: BIOLOGICAL RESOURCES

Protect and enhance Albany's plant and animal habitat.

Policies:

Policy CON-5.1: Habitat Protection

Ensure that development decisions, vegetation management plans, and open space plans enhance wildlife diversity, avoid wildlife disruption, and protect the habitat of rare, endangered, and special status species.

Policy CON-5.2: Coordination with State and Federal Resource Agencies

Work with the US Fish and Wildlife Service, the California Department of Fish and Game, the Regional Water Quality Control Board, the Bay Conservation and Development Commission, and other resource agencies to conserve and restore sensitive habitat areas. Refer local projects to these agencies for review and comment as appropriate.

Policy CON-5.4: Albany Mudflats Ecological Reserve

Recognize the environmental value of the Albany Mudflats Ecological Reserve, located west of I-580 and north of Buchanan Street. Protect bird feeding and nesting areas by limiting activities in important habitat areas.

Implementing actions:

Action CON-5.B: Habitat Restoration Plans

Support implementation of state and federal habitat restoration plans which increase the health of San Francisco Bay and bay wetlands.

Chapter 8: Environmental Hazards

GOAL EH-1: HAZARD REDUCTION

Reduce the potential for injury, property damage, and loss of life resulting from earthquakes, landslides, floods, and other natural disasters.

Policies:

Policy EH-1.1: Hazard-Sensitive Planning

Ensure that future development is sited, designed, and constructed to minimize risks associated with earthquakes, flooding, landslides, and other natural hazards. Appropriate mitigation measures should be required to reduce hazard risks.

Policy EH-1.2: Critical Facilities

Ensure that critical public facilities such as City Hall, schools, the police station, and the fire station are designed and maintained in a manner that ensures their resilience and ability to function during and after a natural disaster.

Policy EH-1.4: Soil-Related Hazards

Use best management practices to reduce risks to structures, roads, and utilities associated with erosion, shrink-swell potential, subsidence, and other soil-related hazards.

Policy EH-1.6: Flood Plain Management

Avoid development of structures in the 100-year flood zone. Where no other feasible alternative exists, use construction measures which reduce safety risks and minimize the potential for structure damage.

Policy EH-1.7: Flood Control and

Conservation

Ensure that future projects to reduce flooding are compatible with and advance local conservation policies, including those to restore creeks and protect riparian habitat. Flood control measures should strive for solutions which restore natural features and protect the area extending 100 feet back on each side of creek centerlines, rather than replacing such features with engineered channels.

Policy EH-1.8: Sea Level Rise and Tsunamis

Consider the effects of sea level rise and tsunamis on the long-term safety and viability of structures, utilities, and other improvements built in low-lying areas. Sea level rise should be

considered in any plans for the Albany Neck and Bulb, and plans for any future reuse of Golden Gate Fields. The City should examine potential "worst case scenario" impacts as well as impacts consistent with current predictions and models.

Implementing Actions:

Action EH-1.E: Update of Flood Plain Maps

Work with the Federal Emergency Management Agency to periodically update maps of the 100 and 500 year flood plains. The updates should consider the existing and projected benefits of regional stormwater management efforts.

Action EH-1.F: Building Code Enforcement

Require review of all development and construction proposals by the City of Albany to ensure conformance to current and applicable building code standards.

GOAL EH-2: WILDFIRE PREVENTION

Minimize wildfire hazards on Albany Hill and in other parts of the City where such hazards are present.

Policies

Policy EH-2.1: Vegetation Management

Implement vegetation management and fuel reduction programs in the highest hazard areas on Albany Hill, including areas adjacent to homes and areas of heavy recreational use.

Policy EH-2.2: Collateral Benefits

Maximize opportunities for collateral benefits associated with vegetation management projects, such as habitat restoration, increased security, and enhanced public access.

Policy EH-2.3: Mutual Aid Agreements

Work collaboratively with other jurisdictions to reduce wildfire hazards and respond to wildfire emergencies in the East Bay and elsewhere in California.

Policy EH-2.4: Defensible Space

Ensure that private property owners in areas such as Albany Hill control weeds and other flammable vegetation around their homes in a manner that minimizes the risk of structure fires and threats to nearby properties.

Implementing Actions

Action EH-2.A: Albany Hill Eucalyptus Forest Management

Manage the eucalyptus forest on Albany Hill to reduce the threat of wildfire. Consistent with the Albany Creekside Master Plan, this should include a combination of removing accumulated

ground debris, managing ground cover and shrubs, removing loose or hanging bark, removing the growth of previously cut stumps, removing non-native trees such as acacia where they act as ladder fuels, maintaining the canopy to prevent invasive shrubs, and selectively thinning out denser stands.

Action EH-2.B: Peak Load Water Supply

Work with EBMUD to ensure that peak load water supply and water pressure is sufficient to respond to local fire emergencies.

GOAL EH-4: EMERGENCY PREPAREDNESS

Improve City programs and procedures for emergency preparedness and response.

Policies:

Policy EH-4.1: Response and Recovery

Program

Maintain an active and effective City of Albany emergency response and recovery program that provides direction and identifies responsibilities following a disaster.

Policy EH-4.2: Resident and Business

Preparedness

Develop and expand local efforts to organize and train area residents and employees so they can assist themselves and others during the first 72 hours following an earthquake or major disaster.

Policy EH-4.3: Emergency Operations Center

Maintain a dedicated Emergency Operations Center to serve as the command point for emergency service delivery and communication. As directed by the Emergency Response Plan, identify supplemental sites (such as schools and/or the Library) where emergency services can be delivered and supplies can be stored.

Policy EH-4.4: Utility Resilience

Work with local gas, electric, cable, water, sewer, and other utility providers to maintain and retrofit their facilities and ensure their ability to function or be quickly restored following a disaster.

Policy EH-4.5: Responding to the Needs of a Diverse Community

Ensure that emergency preparedness information is available in the primary non-English languages spoken in Albany, and that preparedness programs recognize the special needs of seniors and persons with disabilities. The City and Fire Department should work with local cultural institutions and special needs service providers to improve preparedness.

Policy EH-4.6: Long-Term Recovery

Incorporate provisions for long-term post-disaster recovery in local emergency preparedness plans. Such provisions should address the period beyond the initial 72 hours following a disaster and should identify strategies for rebuilding, structural repairs, restoration of services, and economic recovery.

Implementing actions:

Action EH-4.A: Updated Emergency

Preparedness Plan

Update and revise Albany's emergency preparedness planning documents, with an emphasis on meeting the needs of all residents, regardless of language, ability, or age. As part of this effort, review current data and information on hazard levels, existing emergency response protocol, and the preparedness plans of major employers in the community. Emergency plans should be consistent with federal Standard Emergency Management System (SEMS) guidelines, and the standards used to determine funding eligibility for emergency planning, relief, and recovery. The business community should be engaged in the Update process.

Action EH-4.B: Upgrades to Critical

Facilities

Continue efforts to upgrade the City's schools and essential service facilities to ensure that they remain functional after a major disaster.

Action EH-4.C: CERT Training

Continue the City of Albany and Albany Fire Department Community Emergency Response Team (CERT) and Albany Local Emergency Response Training (ALERT) training programs for residents.

Action EH-4.D: Emergency Supplies

Regularly acquire, and as needed replace, emergency equipment, supplies, and communication systems, consistent with local emergency response plans.

Action EH-4.E: Drills

Conduct periodic training exercises and disaster drills to test the effectiveness of local emergency response procedures.

2010 Climate Action Plan

Water Conservation Strategy – Celebrate water as an essential community resource.

Objective WC-1: Conserve water in existing buildings/landscapes
Measures:
WC-1.1: encourage residential and commercial users to participate in EBMUD's free water audit program. WC-1.2: Encourage 50% reduction in outdoor potable water usage for existing residential and commercial properties.

Objective WC-2: Conserve water in New Construction/Landscapes
Measures:
WC-2.1: Require new construction and major remodels to achieve indoor water efficiency 20% the California Building Standards Code.
WC-2.2: Require new landscape projects to reduce outdoor potable water use by 50%.

Appendix D: Adaptation Options

Inland Flooding

Exposure level – Medium

Measure 1: Update flood hazard data		
Description: Ensuring that flood hazard data is up to date and takes into account the effects of a changing climate will allow the city to plan appropriately for flood hazards into the future.		
Hazard(s): Floods, changes in precipitation		
Co-benefits: Emergency preparedness		
Equity considerations: Accounting for climate change in flood hazard data will allow the city to properly assess and communicate risks to residents who would otherwise be unaware of their risks for, and therefore unable to plan for, floods.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Work with the Federal Emergency Management Agency to integrate sea level rise projections into flood hazard data.	FEMA, Alameda County Flood Control and Water Conservation District	Comments: FEMA is in the process of completing the San Francisco Bay Area Coastal Study, which will use current conditions to update the flood and wave data for FIRMs. The preliminary Alameda County maps were released in 2015 and the final maps are expected to become effective on March 7, 2017. FEMA has also created Increased Flooding Scenario Maps for the interior shoreline of Alameda County. Based on the San Francisco Bay Area Coastal Study, the maps provide additional information on how the 100-year coastal floodplain may change with 1-foot, 2-foot, and 3-foot increases in Bay water levels. These maps are not regulatory, but are meant to complement the FIRMs, Flood Insurance Study reports and County GIS databases. Timeframe[34]: Short-term Ease of Implementation[35]: High Potential Funding: N/A
Update floodplain maps to assess risks to new and existing development.	Alameda County Flood Control and Water Conservation District	Comments: Use the most up to date FEMA FIRMs for emergency and city planning. Updated maps should influence and be reflected in city plans, zoning, property owner notifications, and other relevant processes. The Increased Flooding Scenario Maps (IFSMs)

[34] The timeframe categories are as follows: short-term is one to three years, mid-term is three to five years, and long-term is six plus years. Potential on-going activities are indicated as such.

[35] The ease of implementation designation is determined by the predicted amount and accessibility of resources needed to complete the action. It considers the need for cross-agency collaboration, building partnerships, securing funding, and planning and implementation and is categorized as either high (easy), medium (moderate) or low (difficult).

		should also be used as resources in all related future planning efforts. In addition to continued communication around existing and updated FIRMS, cities should make information about the IFSMs available to property owners in the city. A communication plan for the IFSMs could be a valuable tool – especially for outreach to property owners and community members who may be impacted by future changes in floodplains. Timeframe: Short-term Ease of Implementation: High Potential Funding: N/A
Resources: FEMA. CCAMP: San Francisco Bay Area Coastal Study. http://www.r9map.org/Pages/San-Francisco-Coastal-Bay-Study.aspx FEMA. San Francisco Bay Area Coastal Study, Alameda, California. http://www.r9map.org/Pages/ProjectDetailsPage.aspx?choLoco=1&choProj=183 USGCRP. After Sandy, Rebuilding Smarter with Science and Technology. 2013. http://www.globalchange.gov/news/after-sandy-rebuilding-smarter-science-and-technology		

Measure 2: Minimize flood risks for existing development		
Description: By engaging commercial and residential property owners in and near the floodplain in proactive efforts to retrofit and protect their property, the city can preempt expensive and dangerous flood damage.		
Hazard(s): Floods, changes in precipitation		
Co-benefits: Emergency management, upgrades to the quality and increases in the value of the built environment		
Equity considerations: Engage the community and incorporate feedback in the development and implementation of these programs to gain buy-in and ensure effective program design. Provide accessible program offerings for various and diverse property types where relevant. Flood damage can have public health consequences, resulting in exposure to increased stress, mold, mildew, sewage and more. Preempting the effects of flooding can improve health outcomes.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Ensure storm drain inlets are maintained regularly and improve the effectiveness of street sweeping program.	Community organizations and non-profit organizations, public works department, Alameda County Flood Control and Water Conservation District	Comments: Oakland's Adopt A Drain program is a successful example of acampaign that helped achieve this goal. These initiatives help to reduce stress on the drainage system and alleviate flood risk, while also engaging communities to increase accountability, community ownership and knowledge of the local storm sewer system. Timeframe: Short-term Ease of Implementation: High Potential Funding: East Bay Municipal Utility District
Provide flood protection assistance to community residents (e.g., technical advice and materials such as sand bags	Emergency management and response, community organizations and non-	Comments: Technical assistance can raise awareness and preparedness for potential flood events. An important initial step will be identifying the populations that are the most

and plastic sheeting), and ensure vulnerable populations have access to these materials at low or no cost.	profit organizations, Alameda County Flood Control and Water Conservation District	vulnerable to floods, based on factors such as living conditions (e.g., quality of housing, homelessness, live alone), health conditions (e.g., diabetes, asthma, physical or mobility disabilities, mental health conditions), and social factors (e.g., children, elderly, populations of color, financially insecure households, low educational attainment, those who cannot speak English). Repetitive loss properties and areas that experience recurring flooding will benefit significantly from the resources provided under this action. Timeframe: Ongoing Ease of Implementation: Medium Potential Funding: California Governor's Office of Emergency Services (CalOES)
Provide incentives for or require retrofits that use waterproof shutters, basement pumps, shields or doors and salt-resistant materials to reduce flood damage.	Home improvement stores, Alameda County Flood Control and Water Conservation District	Comments: The specific characteristics of the city and its building stock will inform the relevant and appropriate actions for the buildings types in the city that are at greatest risk of flooding. Timeframe: Mid-term Ease of Implementation: Low Potential Funding: California Department of Water Resources, CalOES
Work with the building industry to establish protocols and standards for reducing damages by designing or retrofitting structures to accommodate periodic flooding.	Developers and building owners, home-owners associations	Comments: Collaborating with developers and property owners who have experienced past losses can help build support for these efforts. Potential retrofits include onsite stormwater management and elevating electrical equipment. Timeframe: Short-term Ease of Implementation: High Potential Funding: CalOES
Maintain integrity of essential public facilities.	City contractors or staff in charge of facility maintenance, community groups and non-profit organizations,	Comments: Ensure ongoing maintenance, stress the importance of monitoring and evaluation, plan for regular assessment of risk with consideration of the best available science, and pursue sustainable and resilient materials, methods and design for any new facility upgrades or retrofits. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: California Environmental Protection Agency (CalEPA) and other state agencies
Resources: Oakland Adopt A Drain program: http://adoptadrainoakland.com/ FEMA. Building Code Resources. https://www.fema.gov/building-code-resources FEMA. Design Considerations in Floodproofing. https://www.fema.gov/media-library-data/643d07bceee8ade17eef8e11cf7a2abb/P-936_sec2_508.pdf		

The Sustainable Site: The design manual for green infrastructure & low impact development. http://www.foresterpress.com/fps_sustain.html

Measure 3: Avoid and minimize flood risks for new development		
Description: As development continues throughout the city, it will be important to consider future climate risks in order to avoid increasing the risks and costs of flood recovery. Preventing development in the floodplain and requiring that new development near the floodplain is prepared for the reality and risks of its location will ensure the value and resilience of those properties into the future.		
Hazard(s): Floods, changes in precipitation		
Co-benefits: Resilient development, upgrades to the quality and value of the built environment		
Equity considerations: Low income communities that cannot afford resilient housing are disproportionally affected by substandard and poorly located development. In addition, consideration of who is being displaced by future development should also inform how the incentives around these efforts are implemented.		
Actions	**Potential Implementing Partner(s)**	**Key considerations**
Implement National Flood Insurance Program (NFIP) activities to minimize and avoid development in flood hazard areas.	CalOES, local Community Rating System (CRS) communities	Comments: NFIP programs, such as the CRS help communities achieve flood insurance premium reductions for their citizens while also protecting them from flood risks. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: FEMA, CalOES
Implement zoning and subdivision practices through General Plan elements (Safety, Housing, Land Use) that restrict development in floodplains.	Governor's Office of Planning and Research (OPR), city planning and permitting departments	Comments: SB379 includes new requirements to include climate considerations in General Plan Safety Elements. Diverting development away from floodplains, and especially permanent inundation from sea level rise, will promote the resilience of city assets. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: N/A
Ensure that future development is sited, designed, and constructed to minimize risks associated with flooding, landslides, sea level rise, and other natural hazards. Identify appropriate mitigation measures, such as a buffer zone or setback from floodways, if new development is going to be located in flood zones, and use construction measures that reduce safety risks and minimize potential structural damage	Local engineers, construction companies, architects and design firms, The Nature Conservancy and other local conservation groups.	Comments: When preventing development in the floodplain is unfeasible, it will be essential to ensure that structures are built to mitigate the impacts of flood risks. City plans, ordinances and codes are a key tool for implementation of this action. Updating policy to integrate areas projected for inundation by sea level rise is recommended. Easements could also make implementation of this strategy possible, and are most appropriate in targeted, critical areas at the site of or upstream from recurrent flooding. Timeframe: Ongoing/Mid-term Ease of Implementation: Medium Potential Funding: N/A
Require 100% on-site stormwater management for new development.	CalEPA STORMS Program, Bay Area Stormwater Management Agencies	Comments: Updated stormwater management plans and permitting requirements to call for 100% stormwater management will ensure that new and

	Association, Alameda County Clean Water Program	retrofitted development will not add additional load to the stormwater system or negatively impact nearby properties by impacting local runoff patterns. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: CalEPA

Resources:
National Flood Insurance Program. Information for State and Local Officials: https://www.fema.gov/information-state-local-officials
CalEPA STORMS Program: http://www.waterboards.ca.gov/water_issues/programs/stormwater/storms/#
Georgetown Climate Center. Adaptation Clearinghouse. Managed Retreat Strategies. http://www.adaptationclearinghouse.org/resources/managed-retreat-strategies.html
Julian Agyeman, Patrick Devine-Wright, and Julia Prange. 2009. Close to the Edge, down by the River? Joining up Managed Retreat and Place Attachment in a Climate Changed World. *Environment and Planning A* 41:509-513. doi:10.1068/a41301. Full text at: http://julianagyeman.com/2013/04/close-to-the-edge-down-by-the-river-joining-up-managed-retreat-and-place-attachment-in-a-climate-changed-world/

Measure 4: Encourage green infrastructure for natural management of stormwater and storm-induced flooding, and preserving and restoring natural features of the watershed for both new and existing development, rather than using engineered structures

Description: Natural infrastructure can be used as a tool to address flood risk while allowing for flexibility in an uncertain climate future, providing public amenities and preserving the local environment.

Hazard(s): Floods, sea level rise, changing precipitation

Co-benefits: Biodiversity enhancement, natural resource conservation, carbon sequestration, increased public green space, groundwater recharge, urban heat Island effect reduction, erosion control, and pollution reduction

Equity considerations: Green infrastructure should be implemented in the areas that it can be most effective at protecting and empowering communities. Placement should also consider the surrounding communities' vulnerabilities and adaptive capacity to respond to flood events and extreme heat and/or their capacity to maintain the infrastructure.

Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Conduct a watershed analysis to determine areas of insufficient capacity in storm drain and natural creek systems and predict impacts of abnormally high rainfall and sea level rise as well as to determine suitable locations for green infrastructure	Local university experts, East Bay Municipal Utility District, neighboring local governments, Green Plan-IT	Comments: Understanding the capacity and weaknesses of the water management system throughout the city and the region is an important first step to making educated decisions for watershed and stormwater management. Since this analysis will naturally be only useful at a regional scale (the characteristics of other areas of the watershed will impact the areas within city borders), it will be important to coordinate with other regional/local entities and existing efforts. Regional tools, such as Green Plan-IT can inform green infrastructure planning and installation to address watershed issues. Timeframe: Short-term Ease of Implementation: High Potential Funding: California Department of Water Resources

Ensure that projects to reduce flooding are compatible with and advance local conservation policies, including restoration and protection of riparian habitat. Protect wildlife through planting and restoration of native habitat.	Bay Institute, Coastal Conservancy, and other community groups and non-profit organizations	Comments: Green infrastructure presents opportunities to safeguard, restore and enhance habitats. Projects from other parts of the Bay Area, such as the South Bay Salt Pond Restoration Project, offer useful insights and lessons learned. Timeframe: Short-term Ease of Implementation: High Potential Funding: Coastal Conservancy
Maximize use of compost berms, socks and blankets for erosion and sediment control to prevent erosion and contamination of watersheds from heavy rains.	Caltrans, engineers, landscape architects and contractors	Comments: Use compost berms: • Adjacent to creeks or on a site perimeter to filter run off after earthquakes or wildfires • To filter run off on site perimeters after earthquakes or wildfires Use compost socks: • For check dams to slow areas of concentrated flow from stormwater • For slope interruptions to slow run off on steep slopes • For bank stabilization along water ways around storm drains for inlet protection from contaminated run off in storm events and after wildfire or earthquakes Use compost blankets: • For slope (landslide) stabilization on bare or disturbed soils or post wildfires and • To create vegetated filter strips for stormwater control Proper use of compost and mulch can also protect habitat from the impacts of flood and wildfire. This action can be combined with habitat restoration practices to achieve greater ecosystem resilience and faster hazard recovery. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund
Incorporate compost requirements into city standards for contractors and department policies (public works, parks, fire departments, etc.).	Public works departments, fire departments, parks, purchasing, etc.	Comments: Integrating these requirements into city-wide standards will increase effectiveness and uptake. Timeframe: Mid-term Ease of Implementation: High Potential Funding: N/A
Protect bare soil with local recycled compost and mulch.	Local community organizations and non-profit organizations,	Comments: Adopting a city-wide policy to adopt this practice on public lands can help protect public assets. Community

	StopWaste, homeowners associations	organizations can also be influential for implementation of mulching and maintenance of natural infrastructure. Providing education materials and building partnerships to drive community support in strategic locations that are not limited to publicly owned land can help to bring this strategy to scale. Timeframe: Short-term Ease of Implementation: High Potential Funding: California Natural Resources Agency Urban Greening Fund
Plant trees to intercept rain and build rain gardens, green roofs, and other vegetative stormwater treatment features. Grade surfaces and direct downspouts so that stormwater flows toward vegetated areas.	Bay Area Stormwater Management Agencies Association, Alameda County Clean Water Program, Bay Institute, California Landscape Conservation Cooperative, Coastal Conservancy, other community groups, non-profit and non-governmental organizations, East Bay Municipal Utility District, Green Plan-IT	Comments: Pairing these strategies with the other actions recommended here or by other expert organizations (see Potential Implementation Partners and Resources) can help create a robust stormwater management strategy that leverages the power of natural infrastructure while relieving the strain on the sewer system and providing additional greenspace to residents. Creating floodable landscape features or vegetative stormwater management solutions to accommodate storm-induced flooding can protect assets from flood damage. These tools include rain gardens, bioretention ponds and swales, green roofs and others. Tools such as Green Plan-IT can help to locate the areas where these installations can be most effective. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: California Natural Resources Agency Urban Greening Fund, California Landscape Conservation Cooperative, Coastal Conservancy, EPA Clean Water State Revolving Fund
Encourage the use of pervious pavement in new and existing development (e.g., in parking lots), including rain gardens, bioswales, porous pavement and disconnected downspouts to reduce runoff.	Alameda County Clean Water Program, Bay Area Water Management Agencies Association, Green Plan-IT, public works and planning departments	Comments: Pervious surfaces allow water to drain directly into the soil rather than flowing to a storm drain and then to a water treatment plant or directly into local waterbodies. They help prevent pollution and flooding by reducing the load on the stormwater system, especially during intense precipitation, and are therefore an asset in a comprehensive adaptation strategy. Approaches to encouraging the use of pervious surfaces include providing zoning incentives, requiring a certain percentage of groundcover in zoning requirements,

		including porous pavements in good management practices, and removing any zoning provisions that restrict or prohibit the use of porous pavements. The Green Plan-IT tool can help locate where pervious surfaces are needed most and will have the biggest impact on the watershed and/or localized flooding. Results from the tool can be used to direct incentives, program outreach and appropriate solutions or strategies for implementation. Smaller demonstration projects can support these efforts by raising public awareness and acceptance of pervious surfaces. For example, in Chicago, they paved alleyways that tended to flood with porous pavement and clearly labelled them "green alleys" to increase visibility and awareness. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: California Natural Resources Agency Urban Greening Fund

Resources:

Caltrans. Erosion Control Toolkit: Compost. http://www.dot.ca.gov/hq/LandArch/16_la_design/guidance/ec_toolbox/organics/compost_blanket.htm

Coastal Conservancy Climate Ready Program. http://scc.ca.gov/climate-change/climate-ready-program/

Committee for Green Foothills. "'Living Levees': Protecting Against Sea Level Rise by Restoring Wetlands." http://www.greenfoothills.org/living-levees/

David Crohn et al. 2013. Composts as Post-Fire Erosion Control Treatments and Their Effect on Runoff Water Quality. Transactions of the American Society of Agricultural and Biological Engineers, Vol. 56(2): 423-435. http://www.hcd.ca.gov/nationaldisaster/docs/crohn_et_al._2013_trans_asabe.pdf

Green Plan-IT. http://www.sfei.org/projects/greenplan-it#sthash.0TGBjtJO.dpbs

Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center. http://kresge.org/sites/default/files/climate-adaptation-urban-heat.pdf

The Nature Conservancy. Reducing Climate Risks with Natural Infrastructure. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/california/ca-green-vs-gray-report-2.pdf

Measure AA, "San Francisco Bay Clean Water, Pollution Prevention and Habitat Restoration Program." http://sfbayrestore.org/docs/BallotMeasureLanguage.pdf

South Bay Salt Pond Restoration Project. http://www.southbayrestoration.org/

The Sustainable Site. The design manual for green infrastructure & low impact development. http://www.foresterpress.com/fps_sustain.html

Bay Area Stormwater Management Agencies Association. www.bassma.org

Alameda County Clean Water Program. C.3 Technical Guidance, A Handbook for Developers, Builders and Project Applicants. http://cleanwaterprogram.org/resources/resources-development.html

Measure 5: Protect and restore soil health

Description: Soils provide many ecosystems services; they store carbon, filter and breakdown pollutants, store water, and promote plant health and resiliency. Soils are often depleted in the process of development and will be further impacted by climate change, drought, flooding, heat and wildfire. Intentionally restoring soil health can help restore these vital ecosystem services, and help buffer or avoid impacts from climate change.		
Hazard(s): Floods, changes in precipitation, droughts		
Co-benefits: Reduced greenhouse gas emissions carbon capture, increased water retention, reduced stormwater runoff, erosion control		
Equity considerations: Green spaces can help to mitigate the impacts of urban heat islands and support stormwater management. Underserved communities typically have less access to green space, so ensuring the health and maintenance of the green space that does exist is important.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Enhance the drought- and flood-resistance of soils in publicly managed lands, including open spaces, and city-owned facilities with compost and mulch.	East Bay Regional Park District, Bay Are Open Space Council, urban landscape authorities, StopWaste, community organizations, urban agriculture and farm organizations, Office of Environmental Farming and Innovation, Marin Carbon Project, landscape architects and contractors.	Comments: Compost can mitigate the impact of drought on trees, grasslands and crops. Approximately 20,000 gallons of water per acre are retained for each additional 1% of organic material in the soil (depending on soil type). Soil organic matter can hold 20 times its weight in water. Compost also creates healthier plants, by providing key plant nutrients at a rate plants can uptake and by providing antibiotic protection. Compost increases carbon sequestration in the soil and stimulates the growth of more biomass. One inch of compost applied on one acre can avoids emissions of 57 tons of carbon dioxide equivalent or more. It can help bind heavy metals and filter out sediment. The Marin Carbon Project is an effort to implement agricultural practices which help store carbon and enhance ecosystem function. Their research has found that a one-half inch application of compost sequesters 1 ton of carbon dioxide equivalent per acre-year. Exploring how the Project's research could apply to open spaces in Alameda County could provide both adaptation and mitigation benefits. The following are recommended guidelines for the application of compost and mulch: • For new plantings, achieve 5% soil organic matter content by adding compost. (The Model Water Efficient Landscape Ordinance (WELO) requires 4 cubic yards of compost/1,000 sq. ft. of planting area.) Exceptions can be made for plants that need low organic matter such as cactus or for undisturbed native soils.

		• Have a 3-inch layer of coarse mulch. (WELO requirement) Prioritize the use of recycled content materials. Wood and plant material are preferred. Stone and rock mulches heat up soil and deplete natural resources. Synthetic mulches pollute the watershed and should be avoided. • Avoid bare soil. Ensure that soil on roadsides, in median strips, in planting areas is covered with a mulch layer. A University of British Columbia study recently found that woody mulch can reduce NOx emissions from soil by 28% compared to bare soil. • For civic landscapes, top dress irrigated planting beds with compost and maintain a mulch layer. • For all landscape-based stormwater treatment incorporate compost and mulch. In order to achieve scale and impact of compost and mulch efforts to enhance soil throughout the city, it will be valuable to identify priority areas (e.g., forested parklands, shoreline areas, particularly vulnerable neighborhoods) and establish partnerships with waste management authorities and companies to guarantee an adequate supply of compost for urban and open space soils. Timeframe: Ongoing Ease of Implementation: High Potential Funding: Cap and trade funds, Proposition 1, Capitol improvement budgets, Healthy Soils Initiative
Resources: Cal Recycle: http://www.calrecycle.ca.gov/Climate/GrantsLoans/ Caltrans. Erosion Control Toolkit: Compost. http://www.dot.ca.gov/hq/LandArch/16_la_design/guidance/ec_toolbox/organics/compost_blanket.htm Marin Carbon project http://www.marincarbonproject.org/ The Sustainable Site: The design manual for green infrastructure & low impact development. http://www.foresterpress.com/fps_sustain.html		

Measure 6: REGIONAL: Establish cooperative relationships among public agencies with responsibility for flood protection
Description: Since flooding does not always respect city boundaries and often effects Bay area residents on a watershed scale, regional collaboration can help to more effectively and efficiently address flood risk by opening communication channels and providing consistent strategy across local jurisdictions.
Hazard(s): Flood, changes in precipitation
Co-benefits: Regional collaboration, mobilizing inter-agency communication and other cooperative efforts

Equity considerations: Extend invitations to participate in regional efforts to groups that represent a variety of relevant sectors, issue groups and communities.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.	Association of Bay Area Governments, Urban Sustainability Directors Network, ICLEI, Green Cities, StopWaste, Alameda Flood Control and Water Conservation District, CalFIRE, California Department of Parks and Recreation, East Bay Regional Parks District, Pacific Gas & Electric (PG&E), East Bay Municipal Utility District, San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group (CHARG), Bay Area Regional Collaborative, San Francisco Bay Conservation and Development Commission (BCDC), San Francisco Baykeeper, Coastal Conservancy, and other local community groups and non-profit organizations	Comments: This measure is explicitly called for in the SB379 guidelines. In addition, protecting natural infrastructure on a regional level will help reduce the vulnerability of individual cities to flood, and build capacity beyond what a city might be able to achieve on its own. Engaging representatives across cities and agencies in a working group or task force can help to communicate successes, tackle challenges and implement cohesive and practical programs that help to promote regional coordination around the implementation of floodplain development and stormwater management. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: Coastal Conservancy, participating implementing partners
Resources: Bay Area Regional Collaborative. Bay Area Climate Asset Map. 2014. http://bayarearegionalcollaborative.org/pdfs/BACERP_Bay_Area_Climate_Asset_Map_Nov_2014_v2.doc California Governor's Office of Planning and Research. DRAFT Safety Element Section of the General Plan Guidelines.		

Sea Level Rise

Exposure level – Medium

Measure 7: Preserve and protect high-hazard areas and public open space
Description: High-hazard areas include the wetlands that border the San Francisco Bay and act as a buffer between the bay and the development within the cities. Protecting these and other areas that are vulnerable to sea level rise and/or experience repeat exposure will save the city in repair costs and protect citizens from climate hazards.
Hazard(s): Sea level rise, flood, changes in precipitation
Co-benefits: Preservation of community assets, potential reduced costs from flood damages, carbon sequestration

Equity considerations: Vulnerable communities will have the least resources to address damage from and potentially relocate in response to sea level rise. A comprehensive strategy will need to protect all community members.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Maintain and enhance natural shoreline buffers to protect inland development through mechanisms such as conservation easements and establishment of priority conservation areas.	BCDC, CHARG, Bay Area Regional Collaborative, East Bay Regional Parks, California Sea Grant, San Francisco Estuary partnership, San Francisco Bay Restoration Authority	Comments: The 100-year floodplain and the area projected to be inundated by 36 inches of sea level rise should be areas of primary concern. At a minimum, preserving the existing natural buffers will be essential. Timeframe: Short-term/Ongoing Ease of Implementation: High Potential Funding: NOAA, California Sea Grant, Measure AA
Ensure that land use and capital improvement decisions for the shoreline area consider long-term sea level projections.	BCDC, other Bay-area cities or counties pursuing a similar sea level rise strategy	Comments: Update building codes and plans to mandate long-term sea level rise projections. A sample approach could include applying the BCDC sea level rise projections and associated timeline to the expected life of future building development and land use decisions. Also, consider sea level rise projections when updating zoning status and requirements. Timeframe: Mid-term/Ongoing Ease of Implementation: High Potential Funding: N/A
Build a living levee.	Committee for Green Foothills, The Bay Institute, BCDC, California Landscape Conservation Cooperative, Coastal Conservancy, San Francisco Estuary Partnership, San Francisco Bay Restoration Authority, other community groups, non-profit and non-governmental organizations	Comments: Living levees are most appropriate along the Bay where existing wetlands and natural infrastructure may be threatened by sea level rise. Living levees can replace grey infrastructure by building up natural resources to protect vital city assets while maintaining the natural value and function of the Bay. Timeframe: Long-term Ease of Implementation: Low Potential Funding: California Natural Resources Agency Urban Greening Fund, Proposition 1, Bay Area Integrated Regional Water Management funds, California Landscape Conservation Cooperative, Coastal Conservancy, EPA Clean Water State Revolving Fund, Measure AA
Resources: San Francisco Estuary Partnership. The Oro Loma Sanitary District Horizontal Levee Project. http://www.sfestuary.org/oroloma/ and http://oroloma.org/horizontal-levee-project/ BCDC. Adapting to Rising Tides. DOE. Climate Change and the Electricity Sector: Guide for Assessing Vulnerabilities and Developing Resilience Solutions to Sea Level Rise. (2016). http://energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-assessing-vulnerabilities-and-developing		

Brody, Samuel D. and Wesley E. Highfield. 2013. Open space protection and flood mitigation: A national study. *Land Use Policy* 32:89-95. DOI: 10.1016/j.landusepol.2012.10.017

Measure 8: REGIONAL: Coordinate sea level rise efforts with relevant regional entities as well as other local jurisdictions		
Description: Sea level rise is an inherently regional issue and local impacts will be best addressed through regional collaboration and coordination of resources.		
Hazard(s): Sea level rise		
Co-benefits: Regional coordination, mobilizing inter-agency communication and other cooperative efforts		
Equity considerations: Ensure that the voices of vulnerable communities are considered in regional efforts to address sea level rise, ideally through direct involvement of representative community groups.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Coordinate with BCDC, Association of Bay Area Governments, Bay Area Regional Collaborative and other regional entities to develop relevant, regionally coordinated sea level rise adaptation measures through programs such as Resilient by Design that leverage the results of Adapting to Rising Tides and other programs.	BCDC, Association of Bay Area Governments, Bay Area Regional Collaborative, CHARG, the Coastal Conservancy, The Nature Conservancy, and other regional entities	Comments: The San Francisco Bay is at risk from sea level rise, and many existing efforts have begun to assess and craft solutions to the issue. By engaging in or building upon existing efforts, the cities in Alameda County can support further work and build off the momentum of other programs. For instance, CHARG has working groups focused on issues such as adaptation strategies, implementation strategies, and funding. In addition to collaborating with regional agencies, cities can also leverage the experience of other cities and counties that have pursued sea level rise programs and planning, such as San Mateo County. These programs can inform effective and locally-appropriate strategies. Timeframe: Short-term Ease of Implementation: High Potential Funding: BCDC, Resilient by Design
Monitor and participate in regional and state-level policy and programmatic development on waterfront protection and rehabilitation.	Urban Sustainability Directors Network, ICLEI, Green Cities, Alameda County Flood Control and Water Conservation District, CHARG, Bay Area Regional Collaborative, BCDC, Cal FIRE, California Department of Parks and Recreation, East Bay Regional Parks District, East Bay Municipal Utility District, San Francisco Baykeeper, San Francisco Bay Restoration Authority, other local community groups and non-profit organizations	Comments: Active engagement in regional and state-level policy and programmatic development will allow the city to leverage regional knowledge and resources for local protection while communicating specific, tangible community needs to the wider regional conversation around sea level rise. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: Participating implementing partners

Resources: BCDC. Adapting to Rising Tides. http://www.adaptingtorisingtides.org/ Bay Area Regional Collaborative. Bay Area Climate Asset Map (2014): http://bayarearegionalcollaborative.org/pdfs/BACERP_Bay_Area_Climate_Asset_Map_Nov_2014_v2.doc CHARG. http://www.acfloodcontrol.org/SFBayCHARG/ Sea Change San Mateo County. http://seachangesmc.com/

Higher Temperatures and Extreme Heat

Exposure level – Medium

Measure 9: Decrease urban heat islands through increased tree and vegetation planting and maintenance		
Description: Trees and greenspace can significantly reduce urban heat island effects by providing shade and absorbing heat from the surrounding area. Increasing vegetation and tree canopy in urban areas with a large concentration of buildings can reduce extreme heat impacts and decrease the risk of flood by increasing pervious surface.		
Hazard(s): Higher temperatures, extreme heat, droughts		
Co-benefits: Reduced risk for floods with increased pervious surface and greater stormwater capture, improved air quality, cooling of urban infrastructure, increased public green space, increased carbon sequestration, mitigation of drought and heat stress on individual street trees with increased rootable soil volume.		
Equity considerations: Consideration of the equitable distribution of trees across communities will be essential, targeting the areas that are the most vulnerable, underserved and/or will experience the most significant urban heat island impacts.		
Activity	**Potential Implementing Partner(s)**	**Key Considerations**
Assess the existing vegetative cover and plant health throughout the city.	East Bay Regional Park District, Urban ReLeaf, California Urban Forests Council or other community organizations and non-profit organizations	Comments: This is an important first step to understand gaps and vulnerabilities in the existing tree canopy and vegetative cover, and inform future planning and strategy. A comprehensive vegetative cover assessment, such as a biomass index, may be useful for some cities. In general, a tree canopy assessment may be sufficient because trees provide shade and therefore have a substantially larger impact on heat conditions in urban areas than other vegetation. An assessment should consider plant location, health and concentration. Assessing tree health throughout the city is especially important since trees provide substantial benefits. Maintenance of the existing canopy will be more feasible than replacement. Timeframe: Short-term Ease of implementation: Medium Potential funding: East Bay Regional Park District, California ReLeaf network, CalFIRE

Identify priority areas to expand urban tree and vegetation planting.	Urban forestry community organizations and non-profit organizations	Comments: Consider most vulnerable, underserved populations and areas with the least tree cover or green space and/or most urban heat island effect impacts. In addition to setting goals for increases in tree canopy, consider the location-specific benefits of including natural features (parks, streams, marsh areas, etc.) and native vegetation (shrubs, grasses, etc.). As part of a greater urban green space strategy, these different tools can help provide robust and feasible options. Timeframe: Short-term Ease of implementation: High Potential funding: California ReLeaf network
Establish a minimum rootable soil volume for trees to support a healthy urban forest. Retrofit tree wells accordingly. Use compost and maintain layer of mulch to create healthy soils for trees and other vegetation.	Developers; architecture, engineering, landscape architecture and construction firms	Comments: Street trees often are planted in compacted soil, subsoils road base, or rock and/or are bound by concrete. To be healthy and grow to full size, trees need loose, arable soils. Urban trees would benefit from a minimum organic matter of 5% to grow to their full potential. The City of Emeryville requires that all new street trees have the following minimum rootable soil volumes: • Large tree: 1200 sq. ft. • Medium tree: 900 sq. ft. • Small tree: 600 sq. ft. Meeting or exceeding this requirement would help to ensure adequate rootable soil volume. Enhancements to soil volume and quality may be made when retrofitting tree wells to make sidewalk, street or stormwater improvements adjacent to street tree plantings. Tree wells can also be used to intercept and treat stormwater from streets and paved areas but the design should include minimum rootable soil volumes and should avoid soil erosion from the tree well. Supporting actions can also include providing on-going city maintenance of street trees (shifting the responsibility from property owners), and providing discounts on trees and for pick-up of concrete to homeowners. Timeframe: Mid-term Ease of implementation: Medium Potential funding: FEMA, developer fees
Plant vegetation and shade trees with substantial canopies and require, where feasible, site design that uses trees and	California ReLeaf network or other urban forestry organization as a tree maintenance partner	Comments: Selecting appropriate tree and plant species (native, drought resistant, low maintenance) and ensuring provisions for tree and plant maintenance can help to promote sustainability of these efforts.

vegetation to shade parking lots, streets and other facilities.		Timeframe: Mid-term Ease of implementation: Medium Potential funding: Explore options for public/private partnerships to reduce cost of tree planting, California Natural Resources Agency (California Natural Resources Agency) Urban Greening Grant Program, California Natural Resources Agency Environmental Enhancement and Mitigation Grant Program, California ReLeaf grants for non-profit partners, US Department of Agriculture, US Forest Service.
Encourage the preservation of mature trees and vegetation. When preservation is not feasible, require replacement trees and vegetation and ongoing maintenance measures to avoid net loss of plant coverage.	Public communication partner or team	Comments: Mature trees absorb more air pollution, provide more shade and have large inherent financial, social and environmental value. Some areas may have large numbers of co-aging trees that will experience turnover on the same timeline. Creating a tree replacement program to establish a plan for the strategic replacement of aging trees, and providing incentives or passing an ordinance that supports this action can help to address turnover. Timeframe: Ongoing/Long-term Ease of implementation: Medium Potential funding: California ReLeaf network
Provide services, education, and incentives to encourage the planting and preservation of trees and vegetation on private property.	Landscape architects and designers, Master Gardeners, Tree People, Urban ReLeaf, California Conservation Corps, California Landscape Conservation Cooperative and nurseries.	Comments: Examples of incentives or services include providing: on-going tree maintenance (shifting responsibility from property owners), discounts on trees and/or concrete pick-up post-planting for homeowners, and construction or certification benefits for funding green infrastructure, vegetation and trees in public rights of way. Building a network of existing non-profit organizations and community groups to advertise and support these programs can help encourage participation. Timeframe: Mid-term Ease of implementation: Medium Potential funding: California Natural Resources Agency Urban Greening Grant Program, California Natural Resources Agency Environmental Enhancement and Mitigation Grant Program, California ReLeaf grants for non-profit partners, US Department of Agriculture Forest Service.
Resources:		

The Nature Conservancy. 2016. Planting Healthy Air. Available at: https://thought-leadership-production.s3.amazonaws.com/2016/10/28/17/17/50/0615788b-8eaf-4b4f-a02a-8819c68278ef/20160825_PHA_Report_FINAL.pdf

Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center. http://kresge.org/sites/default/files/climate-adaptation-urban-heat.pdf

City of Emeryville Water Efficient Landscape Ordinance. Accessed at DeepRoots web page of municipal codes: http://www.deeproot.com/blog/blog-entries/soil-volume-minimums-organized-by-stateprovince

A list of urban forestry organizations in the Bay Area can be found on the Benicia Tree Foundation website: http://www.beniciatrees.org/about-us/urban-forestry-organizations-bay-area

The Sustainable Site: The design manual for green infrastructure & low impact development. http://www.foresterpress.com/fps_sustain.html

Measure 10: Promote the use of cool infrastructure

Description: Cool infrastructure that reflects light and heat rather than allowing it to absorb into buildings and pavement helps to alleviate urban heat island impacts during high heat days. Examples include white or cool roofs, reflective pavement, green roofs, permeable pavement and more.

Hazard(s): Extreme heat

Co-benefits: Greater energy efficiency, cost savings in building operation

Equity considerations:
Cool infrastructure will have the greatest impact in areas most vulnerable to urban heat island impacts. These impacts may be exacerbated in low income communities where the quality of housing stock tends to be lower and residents generally have less access to public green space. It will be important to focus cool infrastructure installations in areas that have both high urban heat island impact risk and a large population of people living and working there.

Actions	Potential Implementing Partner(s)	Key Considerations
Promote the use of "cool-parking" in new parking facilities and existing parking lots undergoing resurfacing by shading parking areas with shade structures and trees and using light colored paving or other surface treatments.	Contractors and companies that provide resurfacing services, community groups working on these issues (e.g. Climate Resolve), CoolCalifornia.org, Global Cool Cities Alliance	Comments: Shading reduces heat absorption in asphalt by limiting direct exposure to sunlight. Light colored pavement and similar surface treatments reduce heat absorption by increasing the albedo of the pavement to reflect more light and heat. Balance the need for pervious pavement vs. cool parking. Take advantage of opportunities to implement action when resurfacing is taking place by partnering with the companies that provide resurfacing services. They are the first point of contact and can provide advice directly to parking facility owners and decision makers. Timeframe: Short-term Ease of Implementation: Medium Potential Funding: N/A
Promote adoption of cool-roof reach codes for new construction and re-roofing/roofing upgrading.	ICLEI, USDN, Green Cities	Comments: Provide incentives for cool infrastructure, especially on/in affordable housing and within high UHI areas. Timeframe: Mid-term

		Ease of Implementation: Medium Potential Funding: N/A

Resources:
California Climate Action Team. Preparing California for Extreme Heat: Guidelines and Recommendations (2013).
http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf
Global Cool Cities Alliance: http://www.globalcoolcities.org/
Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center. http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Urban-Heat-Toolkit_RD2.pdf
EPA. Heat Island Community Actions Database. https://www.epa.gov/heat-islands/heat-island-community-actions-database
California Code of Regulations. Title 24, Part 6. California Energy Code.
PG&E. Energy-Efficient Cool Roof Rebate, Energy Efficiency Rebates for Multifamily Properties, and Customized Retrofit Incentives.

Measure 11: Integrate energy assurance actions into citywide planning processes to decrease vulnerability to grid outages during extreme events

Description: Energy assurance includes efforts to increase the resilience of a local electricity grid as well as the provision of distributed back-up energy generation to provide power in the event of a grid outage. Grid failure can result from high heat, wind and flooding associated with the impacts of climate change. Important facility types to assure include hospitals, emergency shelter facilities, fire and police stations, stormwater pump stations and other community assets.

Hazard(s): Extreme heat, floods, extreme weather events

Co-benefits: Mitigation (renewable generation and energy storage), earthquake response and recovery

Equity considerations: Prioritize facilities for energy assurance, such as hospitals or urgent care facilities, that serve or are located near vulnerable populations and/or are located in low-lying or high extreme heat risk areas. To fully realize all community potential for increased energy assurance, back up generation should be coupled with increased/expanded energy efficiency as well as promotion of local, renewable sources of energy and residential and commercial solar.

Actions	Potential Implementing Partner(s)	Key Considerations
Conduct an assessment to identify the key facilities that support emergency operations, estimate those facilities' energy supply and demand during emergencies to assess vulnerabilities to power loss, and identify potential actions to mitigate those vulnerabilities and supply alternative power sources (e.g., microgrids).	Target facilities, PG&E (information sharing), California Energy Commission, California Public Utilities Commission, Lawrence Berkeley National Laboratory, Community Choice Energy electricity providers, distributed renewable energy installers, and energy storage companies	Comments: Identification of target facilities for energy assurance projects will depend on the location, climate risk and energy needs of important facilities throughout the city. Additional considerations should include the populations served and the current back-up generation capacity of the facility. The Cities of Berkeley, Oakland, Richmond, San Leandro, Fremont and San Francisco are pursuing microgrid projects with California Energy Commission funding which may be good models for decreasing grid vulnerability. Timeframe: Mid-term Ease of implementation: Medium Potential funding: California Energy Commission, Federal Tax Credit, State Self Generation Incentive program, Department of Energy

Develop an action plan (or integrate considerations into an existing plan) to install a reliable energy resource in the form of renewable energy generation, battery storage systems, smart inverters, energy visualization and control systems, and energy efficient technology at sites with critical energy supply needs.	Target facilities, PG&E, local government partnership programs, Bay Area Regional Energy Network, public sector programs	Comments: Relevant plans to integrate energy assurance considerations into include emergency management and hazard mitigation plans, general plans, climate action plans, climate adaptation plans or resilience strategies. Potential actions to support implementation might include: • Develop a comprehensive financial assessment of the Municipal portfolio of critical assets/emergency facilities and compare pricing scenarios for both a direct purchase of a Microgrid System and a Power Purchase Agreement (PPA). • Conduct asset and facility analysis to determine the ideal assets for micro-grid deployment, the approach to grid interconnection of on-site renewables, and sub-station load management. • Identify facilities where diesel generator back-up typically or already exists and develop specifications to convert to on-site renewable electricity generation with battery storage at those facilities. • Track regulations and partner with utilities and Community Choice Energy providers to expand access to technical assistance and Self Generation Incentive programs. The plan should also consider potential opportunities to increase local grid resilience through the development of Clean Energy Microgrid Communities (see Berkeley Energy Assurance Technology Transformation project in Resources). Timeframe: Mid-term Ease of implementation: High Potential funding: Public-private partnership with target facilities, California Energy Commission grants, California Air Resources Board grants, The California Endowment grants or Program-Related Investments, investor owned utilities, Community Choice Energy electricity providers
Purchase or engage in power purchase agreements for the installation and deployment of solar plus storage systems. Implement group procurement of microgrid components.	Target facilities, PG&E, California Energy Commission, California Public Utilities Commission, Lawrence Berkeley National	Comments: Group procurement is a strategy to systematically bring down the cost of large scale deployment of distributed renewable energy, storage and controls measures. Timeframe: Long-term Ease of implementation: Low

	Laboratory, Community Choice Energy electricity providers, distributed renewable energy installers and energy storage companies	Potential funding: Federal Tax Credit, State Self-Generation Incentive Program, California Energy Commission, Department of Energy
Establish or continue to implement reach codes for energy efficiency in new construction and disclosure ordinances for existing residential and commercial buildings to improve building comfort, including in extreme weather conditions, and to reduce energy usage. Encourage passive cooling technologies and discourage new addition of cooling equipment to prevent power outages.	Relevant city departments, local Chamber of Commerce or relevant business associations, California Energy Commission, California Association of Realtors	Comments: Energy efficiency in buildings increases overall resilience to heat-induced grid outages and public health impacts and allows for energy assurance technologies to provide more effective service, while also providing co-benefits such as decreased cost and reduced greenhouse gas emissions. Similarly, passive cooling techniques, such as solar shading, evaporative and convective cooling, and reflective or radiative roofs, can minimize the use of energy-intensive mechanical cooling with air conditioning and HVAC. Designing or retrofitting buildings to respond to the local climate and the characteristics of the specific location can alleviate grid stress during peak times, avoid outages and lighten load on microgrids or other energy assurance technologies. Timeframe: Ongoing/Long-term Ease of implementation: Medium Potential funding: California Energy Commission grants, California Air Resources Board grants, Energy Efficiency incentive programs
Resources: The City of Berkeley is working with Lawrence Berkeley National Laboratory, with funding from the California Energy Commission, to develop the Berkeley Energy Assurance Technology Transformation (BEAT) project to increase grid resilience. More information at: https://building-microgrid.lbl.gov/projects/berkeley-energy-assurance-transformation The California Endowment. Information on grants and Program-Related Investments: http://www.calendow.org/grants-and-pris/ US Department of Energy. Climate Change and the Electricity Sector: Guide for Climate Change Resilience Planning. (2016). http://energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-climate-change-resilience-planning International Energy Agency. Making the Energy Sector More Resilient to Climate Change. 2015. https://www.iea.org/publications/freepublications/publication/COP21_Resilience_Brochure.pdf Microgrid Knowledge. Community Microgrid: A Guide for Mayors and City Leaders Seeking Clean, Reliable and Locally Controlled Energy. http://www.bostonplans.org/getattachment/5be6cac4-5dbd-42a2-b904-475e95a7782e		

Changes in Precipitation

Exposure level – Low

Measure 12: Manage and conserve groundwater

Description: Groundwater is a critical water resource for California. Preserving local groundwater helps to combat land subsidence and drought.		
Hazard(s): Changes in precipitation, drought		
Co-benefits: Flood prevention		
Equity considerations: Groundwater recharge efforts should be conducted with consideration of the best interest of all communities. Where groundwater management actions can coincide with other water management and green infrastructure efforts, pursuing benefits to vulnerable communities should be considered a priority.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Monitor groundwater elevation and quality. Support the California Statewide Groundwater Elevation Monitoring Act (CASGEM).	Local ground water management agency, Bay Area Integrated Regional Water Management (BAIRWM) group, East Bay Municipal Utility District, State Water Board, California Department of Water Resources	Comments: Understanding the status of groundwater resources in the jurisdiction and region can help inform water use and management decisions. Refer to the South East Bay Plain Basin Ground Management Plan. Timeframe: Ongoing Ease of Implementation: High Potential Funding: California Department of Water Resources Sustainable Groundwater Planning Grant Program
Comply with California's Sustainable Groundwater Management Act to develop sustainability plans to prevent overdraft of groundwater by 2022 and to achieve sustainability by 2040.	Local water and groundwater management agencies	Comments: According to the California Statewide Groundwater Elevation Monitoring Act, groundwater management agencies must be created across California by 2017. By 2020, groundwater basins that are "over-drafted" (meaning more water is being pumped than replenished) must have sustainability plans, and by 2022, all other basins must have such plans. By 2040, all "high and medium priority" basins must achieve sustainability. Timeframe: Mid-Long Term Ease of Implementation: Medium Potential Funding: California Department of Water Resources Sustainable Groundwater Planning Grant Program
Identify priority recharge areas and ensure that land use planners consider the need to protect these areas in land use processes through codes and ordinances.	Bay Area Integrated Regional Water Management (BAIRWM), Alameda Local Agency Formation Commission, Association of Bay Area Governments, East Bay Municipal Utility District	Comments: Priority recharge areas include land that drains into local aquifers and/or is of an appropriate soil type for effective infiltration. Refer to the South East Bay Plain Basin Ground Management Plan. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: California Department of Water Resources Sustainable Groundwater Planning Grant Program
Determine the location of local aquifers and promote strategies to increase water infiltration over them, such as green infrastructure and pervious paving.	BAIRWM, Alameda Local Agency Formation Commission, Association of Bay Area Governments, East Bay Municipal Utility District	Comments: Use the information from the previous action to inform the best location to implement these strategies. For more information, see the pervious surface and green infrastructure measures under overland flooding. Timeframe: Long-term

		Ease of Implementation: Medium Potential Funding: California Department of Water Resources Sustainable Groundwater Planning Grant Program
Incentivize the use of compost and mulch in new and existing landscapes and gardens to increase the water holding capacity of soil and increase infiltration.	East Bay Regional Park District, Bay Area Open Space Council, urban landscape authorities, community organizations, nurseries, compost and mulch vendors, water agencies, Caltrans, ReScape California	Comments: See Measure 5 on improving soil health. Timeframe: Ongoing Ease of Implementation: Medium Potential Funding: Department of Water Resources, water agencies, State Water Board
Resources: Local Government Commission, "Smart Water, Smart Planning: Managing California's Groundwater": https://www.lgc.org/resources/community-design/lpu/oct2016/ South East Bay Plain Basin Ground Management Plan: https://www.ebmud.com/index.php/download_file/force/892/1566/?south-east-bay-plain-basin-groundwater-management-plan-march2013.pdf Sustainable Groundwater Management Act, 2014: http://groundwater.ca.gov/legislation.cfm California Department of Water Resources WELO webpage: http://www.water.ca.gov/wateruseefficiency/landscapeordinance/ California Department of Water Resources Sustainable Groundwater Planning Grant Program webpage: http://www.water.ca.gov/irwm/grants/sgwp/ California Statewide Groundwater Elevation Monitoring (CASGEM) Program. http://www.water.ca.gov/groundwater/casgem/ The California Groundwater Website. http://www.water.ca.gov/cagroundwater/		

Measure 13: Conserve and reuse water in existing buildings/landscapes		
Description: Higher temperatures and changing precipitation patterns, as well as the growing population and increased water demand will place increased pressure on water sources. Water efficiency and saving programs can help reduce water insecurity, both in the short and long-term.		
Hazard(s): Changes in precipitation, droughts		
Co-benefits: Utility cost savings, energy savings, decreased sewer system load		
Equity considerations: In the design of incentives and regulations, consider different uses of water (basic vs. luxury) and ensure that low-income populations are not adversely affected.		
Actions	**Implementing Partner(s)**	**Key considerations**
Assess current water usage and available technologies and practices, and set ambitious but feasible water reduction targets at the city level.	Water efficiency consulting companies, California Department of Water Resources, Alameda County Water District, East Bay Municipal Utility District, Zone 7 Water Agency	Comments: This action represents the starting point for the actions under this measure. The information gathered through this assessment and the associated goals should inform the prioritization and selection of strategies for increased water efficiency and reuse throughout the city. Timeframe: Short term Ease of Implementation: Medium Potential Funding: Water-Energy Grant Program (California Department of Water Resources), Water-SMART Grants (Bureau of Reclamation)

Promote and incentivize water efficient landscaping through rebates for lawn conversions with sheet mulch and irrigation repair and upgrades.	Alameda County Water District, East Bay Municipal Utility District, home and business owners, landscape professionals, ReScape California, Lawntogarden.org	Comments: Promote resources through water agencies and lawntogarden.org. Craft these programs to complement the implementation and enforcement of the city's WELO. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: Water-Energy Grant Program, Water-SMART Grants
Require new construction and major remodels to achieve indoor water efficiency 20 percent above the California Building Standards.	Relevant city departments	Comments: Adjust the specific percent goal based on the city's capacity, water resource use and needs and other existing goals, plans or ordinances. Timeframe: Medium-term Ease of Implementation: Medium Potential Funding: Water-Energy Grant Program, Water-SMART Grants
Collaborate with local water agencies to promote indoor water conservation.	Alameda County Water District, East Bay Municipal Utility District, StopWaste	Comments: Some potential activities include pursuing or expanding a communications strategy for water conservation in residential use and offering incentives for water efficient appliances and fixtures. Leveraging the knowledge, skills and resources of various agencies working toward the same goal can increase the effectiveness of water conservation efforts. Timeframe: Short-term Ease of Implementation: High Potential Funding: N/A
Provide incentives and education to promote the use of greywater.	East Bay Municipal Utility District, Alameda County Water District, Berkeley EcoHouse, Greywater Action, other local water departments with greywater incentive programs (for recommendations and advice)	Comments: East Bay Municipal Utility District currently offers a rebate for the installation of greywater systems. Support and build upon existing rebates and related programs through city-run efforts. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: East Bay Municipal Utility District
Streamline the permit process for greywater systems, and align the permit process with the degree of system risk.	California Water Foundation	Comments: Review and streamline the permitting process for greywater systems, including any disincentives in this or related permitting that may discourage interested developers and property owners from pursuing greywater systems. System risk in this case is defined as the risk of installing and operating the grey water system incorrectly. Systems that connect grey water to landscape irrigation will have less risk of human exposure than internal dual plumbing to toilets. Timeframe: Long-term

		Ease of Implementation: Medium Potential Funding: N/A
Promote greywater use by requiring dual plumbing for greywater from laundry and showers in new developments.	California Water Foundation	Comments: As an additional element to a comprehensive greywater use strategy throughout the city, requiring greywater systems in new development will help the city decrease water use and promote efficiency into the future. Timeframe: Long-term Ease of Implementation: Low Potential Funding: N/A
Encourage the use of rainwater harvesting facilities, techniques and improvements where appropriate, cost effective, safe and environmentally sustainable.	Greywater Action, Wholly H_2O, non-profit organizations and other community organizations	Comments: Rainwater harvesting systems include the rainwater collection system, storage tanks, filtration and processing. The type of filtration and processing required will depend on the target use of the rainwater. It can be used for irrigation, flushing toilets, washing clothes, washing cars, pressure washing, and more. Providing education materials, city-specific guidelines and recommended contractors and retail locations can help promote rainwater catchment installations. Materials and incentives should target multiple sectors and scales of catchment, including residential, small and large commercial, and industrial. Timeframe: Short-term Ease of Implementation: High Potential Funding: Water-SMART grants
Coordinate with local water agencies to incentivize irrigation audits and advance water recycling programs – including treated wastewater to irrigate parks, golf courses, and roadway landscaping – and to encourage rainwater catchment system-wide and greywater usage in new buildings.	East Bay Municipal Utility District, Alameda County Water District, Alameda County Flood Control and Water Conservation District, home and business owners, California Water Foundation, Irrigation Association	Comments: Leverage existing relationships and create new connections to expand the scope of new or existing water recycling and rainwater catchment programs and public communication efforts. Timeframe: Mid-term Ease of Implementation: High Potential Funding: Water-Energy Grant Program, Water-SMART grants
Build municipal cisterns.	East Bay Municipal Utility District, Bay Area Stormwater Management Agencies Association, American Rainwater Catchment Systems Association, Alameda County Flood Control and Water Conservation District	Comments: Municipal cisterns are installed under streets or other municipal facilities and serve multiple functions for stormwater mitigation and flood control, in addition to providing water for landscape irrigation, firefighting and post-earthquake emergency response. Cities should repair existing and install new cisterns to improve coverage for stormwater capture, firefighting and emergency resources. Timeframe: Long-term

		Ease of Implementation: Low Potential Funding: Water-SMART grants
Incentivize and promote the use of compost and mulch in existing landscapes and gardens to create drought resistant soils.	Lawntogarden.org	Comments: In addition to efforts to increase the flood and drought resistance of soils on public lands (see Measure 5), provide information and incentives to residential and commercial landowners to promote compost and mulch use throughout their existing green space. Leverage the available information and programs in the region, such as lawntogarden.org, ReScape California and others. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: StopWaste
Use practices in the Bay-Friendly Landscape Maintenance Manual to maintain city landscapes.	ReScape California	Comments: Minimum landscape practices to include are: • Use climate adapted plant species that use little to no water. • Do not overplant. • Avoid invasive plant species. • Use compost and mulch to create drought resistant soils. • Capture and use or infiltrate and/or filter storm water on site. • Use low water, efficient irrigation systems. • Install a designated landscape water meter or sub-meter. • Use a weather based self-adjusting irrigation controller. • Design and implement lawn replacement plans to convert decorative turf to summer-dry plantings with sheet mulch. • When implementing lawn replacement programs, require sheet mulching. • Use a 1 ½ inch layer of compost in sheet mulch with a minimum total sheet mulch blanket of 4 inches. Timeframe: Mid-term Ease of Implementation: High Potential Funding: N/A
Require city landscape maintenance staff to become Bay-Friendly Qualified Professionals.	ReScape California, StopWaste	Comments: For example, 100 percent of City of Oakland full time staff who manage or maintain landscapes are Bay-Friendly Qualified Professionals. The training includes 24 hours of classes and a final practicum, and is taught by leading experts in stormwater management, soil health, irrigation, plant selection, and more. Timeframe: Mid-term

		Ease of Implementation: Medium Potential Funding: StopWaste

References:

San Francisco Public Utilities Commission. Emergency Firefighting Water System Projects. http://www.sfwater.org/index.aspx?page=468

Department of Water Resources. Save our Water Rebates: http://saveourwaterrebates.com/turf-replacement-rebates.html

EPA. Guidelines for Water Reuse. 2012. https://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf

California Water Foundation. Fact Sheet: Increasing Water Use Efficiency. http://waterfoundation.net/wp-content/uploads/PDF/CWF_WUE_FactSheet_FINAL.pdf

Greywater Action. California Greywater Regulations. http://greywateraction.org/requirements-for-no-permit-systems-in-california/

East Bay Municipal Utility District. Graywater Resources. http://www.ebmud.com/water-and-drought/conservation-and-rebates/residential/rebates/graywater-rebates/graywater-resources/

Bay Area Stormwater Management Agencies Association; www.basmaa.org

Measure 14: Increase the use of local sources of water

Description: Two thirds of the region's water is from the snow pack in the Sierras. By the end of the century the spring snow pack in the Sierras could be reduced by as much as 70 to 90 percent. Increasing capacity to utilize local sources of water, such as greywater, rainwater, air conditioning condensate, and foundation drainage, will help minimize the local impacts of drought by decreasing reliance on shrinking nonlocal resources.

Hazard(s): Changes in precipitation, drought

Co-benefits: Water conservation, fire-fighting water resources

Equity considerations: Local water resource use could be implemented in public facilities, especially those that serve vulnerable or underserved communities that may not have the resources to pursue local water capture and reuse as an adaptive action for personal or community assets.

Actions	Potential Implementing Partner(s)	Key Considerations
Provide incentives and education on the use of alternative sources of water, such as greywater, rainwater, air conditioning condensate and foundation drainage.	San Francisco Public Utilities Commission, architecture firms, developers	Comments: Methods of encouraging local water use include: • Require dual plumbing and greywater use for laundry, toilets, onsite irrigation and showers in new developments. • Provide incentives and education to promote the use of greywater. • Streamline the permit process for greywater systems and align the permit processes with the climate risks for a particular system. Air conditioning condensation can be used for toilet flushing and/or irrigation. Similarly, Low Impact Development and Green Infrastructure infiltrate water on site and reduce need for irrigation, or can facilitate water capture for reuse on site. At the city level, municipal cisterns can help increase resilience. Municipal cisterns can be located under streets or other municipal facilities and serve multiple functions of stormwater mitigation and flood control, landscape irrigation, and an emergency source of water for firefighting and post-earthquake response and recovery.

		Timeframe: Short- to Mid-term Ease of Implementation: Medium Potential Funding: N/A
Resources: Alameda County Local Hazard Mitigation Plan. January 2016. Pg. 4-11. San Francisco Public Utilities Commission (SFPUC). Emergency Firefighting Water System Projects. http://www.sfwater.org/index.aspx?page=468 University of Arizona. On-site Water Collection. http://swes.cals.arizona.edu/environmental_writing/stories/2011/shemanski.html		

Measure 15: Build landscapes adapted to California climates and soils		
Description: About half of urban water use in California is for landscape irrigation. With the appropriate use of native plants and soils, city landscaping can require less water and less maintenance while improving the long-term resilience of local green spaces and soils.		
Hazard(s): Changes in precipitation, drought		
Co-benefits: Water conservation		
Equity considerations: Applying Bay-Friendly Landscape practices to all public facilities and green spaces, with preference for those in areas vulnerable to the effects of floods, sea level rise or drought. Civic landscapes can act as a powerful education tool and model for the community.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Use the Bay-Friendly Landscape Scorecard for all new and renovated public landscape construction and have civic landscapes act as models for water conservation and sustainability for the community.	Rescape California	Comments: Minimum landscape practices to include are: • Use climate resilient plant species that will use little to no water. • Do not overplant. • Avoid invasive plant species. • Use compost and mulch to create drought resistant soils. • Capture and use or infiltrate and/or filter storm water on site. • Use low water, efficient irrigation systems. • Install a designated landscape water meter or sub meter. • Use a weather based self-adjusting irrigation controller. • Design and implement lawn replacement plans to convert decorative turf to summer-dry plantings with sheet mulch. • Require sheet mulching when implementing lawn replacement programs. • Use a 1 ½ inch layer of compost in sheet mulch with a minimum total sheet mulch blanket of 4 inches. Timeframe: Mid-term Ease of Implementation: High Potential Funding: N/A
Fully implement the new California Model WELO	California Department of Water Resources, StopWaste	Comments: The Model Ordinance was updated in 2015 to increase water efficiency standards for new

for city and new permitted landscapes.		and retrofitted landscapes. Best practices include more efficient irrigation systems, greywater usage, onsite storm water capture, and limitations on the proportion of turf cover on landscapes. Local agencies had to adopt the Model WELO by December 1, 2015. Localities with "reasonably necessary' justification for implementing more restrictive requirements due to climate, geology, topography or environmental conditions can do so. Ongoing monitoring and enforcement of the WELO are an essential part of full implementation of the ordinance. Timeframe: Short-term Ease of Implementation: High Potential Funding: California Department of Water Resources
Have city and agency staff involved in landscape design, construction, maintenance or regulation become Bay-Friendly Qualified Professionals.	ReScape California	Comments: For example, 100 percent of City of Oakland full time staff who manage or maintain landscapes are Bay-Friendly Qualified Professionals. The training includes 24 hours of classes and a final practicum and is taught by leading experts in stormwater management, soil health, irrigation, plant selection and more. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: StopWaste
Resources: ReScape California. Resources. http://rescapeca.org/resources/for-community-leaders-landscape-professionals/ California Department of Water Resources. 2015 Updated Model Water Efficient Landscape Ordinance. http://www.water.ca.gov/wateruseefficiency/landscapeordinance/ StopWaste. www.stopwaste.org/welo and www.lawntogarden.org		

Measure 16: Promote food security		
Description: One in six Americans lacks a secure food supply. Droughts and other climate change impacts in California and other agricultural hubs around the world will inevitably place additional strain on agricultural systems, leaving those who already struggle to access sufficient food even more vulnerable.		
Hazard(s): Changes in precipitation, droughts		
Co-benefits: Community engagement, strengthened community wellbeing, public health		
Equity considerations: Food insecurity already effects low income and environmentally vulnerable communities, so building resilience will have an immediate impact on the health and capacity of vulnerable communities in addition to preparing them for future risk.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Raise awareness about extending the life of food through food saving and storage strategies that prevent edible food from going to waste.	Community Food and Justice Coalition, Mandela Marketplace, and other non-profit organizations and community groups	Comments: Up to 40 percent of the food in the United States is not eaten due to waste and inefficiency in the food system. A key element of that system is the food that people buy and do not consumer in their homes. Food saving and storage strategies should focus on food that residents already have in their home in order to maximize the value of purchased goods. To reach the most food

		insecure communities, it will be important to leverage the existing infrastructure of environmental justice and food organizations in the area to promote effective community engagement. Timeframe: Short-term Ease of Implementation: High Potential Funding: US Department of Agriculture National Institute of Food and Agriculture Food Insecurity Nutrition Incentive (FINI) Grant Program and Community Food Projects Competitive Grant Program (CFPCG)
Support the development of a food rescue infrastructure and provide information on the availability of food to ensure food access for vulnerable populations.	Community Food and Justice Coalition, Roots of Change, California Food Policy Council, Bay Area Regional Health Inequities Initiative, and other non-profit organizations and community organizations or groups	Comments: Another strategy for increasing the efficiency of and minimizing waste from food systems is to rescue unattractive or ripe, but still edible food from disposal and make it available to food insecure populations. In addition to building an infrastructure for rescuing food, it will also be important to close the link between food rescue and food delivery and establish a reliable channel for communicating to the public where and when food will be available. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: The California Endowment grants or Program-Related Investments, The Public Health Institute, US Department of Agriculture National Institute of Food and Agriculture FINI and CFPCPG
Encourage the use of compost in urban agriculture.	StopWaste, Mandela Marketplace, CitySlicker Farms, and other non-profit organizations and community groups	Comments: Expanding current compost use is possible through engaging urban farms in the correct and efficient use of compost. Activities that can help implement this action include building partnerships with community groups and providing education, incentives and technical assistance to local urban agricultural operations. Timeframe: Short-term Ease of Implementation: High Potential Funding: CalEPA
Promote composting to create a supply for urban lands and agriculture elsewhere and support crop resilience.	Community Food and Justice Coalition, Roots of Change, and other non-profit organizations and community groups	Comments: Successful implementation of this action will depend on engagement of the public in actively composting their food scraps and other compostable materials. Efforts to increase composting should include local businesses, community groups or centers, restaurants, etc. In addition to outreach, capacity building activities will also be beneficial. Cities can work to develop or strengthen the supply chain from organic material pick-up to processing to compost delivery. An assessment of the existing infrastructure and gaps in access or delivery may help identify the greatest needs and opportunities for improvement in the compost supply chain. Timeframe: Short-term

		Ease of Implementation: Medium Potential Funding: California Department of Food and Agriculture, CalRecycle Greenhouse Gas Reduction Loan Program, CalEPA
Resources: Roots of Change. California Food Policy Council. http://www.rootsofchange.org/projects/california-food-policy-council/ Food and Agriculture Organization of the United Nations. Climate Change and Food Security: Risks and Responses. 2016. http://www.fao.org/3/a-i5188e.pdf National Resources Defense Council. Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill. 2012. https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf California Department of Food and Agriculture. Improving Food Access in California: Report to the California Legislature. 2012. https://www.cdfa.ca.gov/exec/public_affairs/pdf/ImprovingFoodAccessInCalifornia.pdf		

Rainfall Induced Landslides

Exposure level – Low

Measure 17: Avoid and minimize landslide risks for new and existing development		
Description: More intense precipitation events in conjunction with poor development planning could lead to soil instability and landslides in the hills. Updated policies and regulations need to be set in place to ensure that existing and new development are designed accordingly.		
Hazard(s): Landslides, changes in precipitation patterns		
Co-benefits: Reduced risk of flooding downstream, erosion control		
Equity considerations: Property owners and residents will have varying capacity to comply with requirements and/or implement protective measures. It will be important to consider the opportunity to provide technical or financial support to those who might be unable to meet or might be displaced by updated requirements due to a lack of resources.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Implement zoning and subdivision practices through General Plan elements (safety, housing, land use) that restrict development in landslide risk areas.	Alameda County Community Development Agency, Association of Bay Area Governments, Alameda County Flood Control and Water Conservation District	Comments: Projected changes in precipitation indicate increased variability of precipitation events, with implications for the predictability of extreme events. Many high-risk landslide areas are located on public park land. Maintaining park property and natural land in areas susceptible to landslides will help protect from landslide occurrence and limit damage in the event of severe winter weather (such as in 1997-1998). Restricting development or enhancing codes and standards for properties in areas vulnerable to landslides will also help achieve this goal. Timeframe: Long-term Ease of Implementation: Medium Potential Funding: N/A
Mitigate landslide risks in the hills by improving drainage, reconstructing retaining walls,	Alameda County Flood Control and Water Conservation District	Comments: Implementing this action requires a progressive process that includes best practices, routine maintenance,

installing netting and vegetation, avoiding clear cutting, and stabilizing the soil after tree clearing with compost and mulch.		evaluation and targeted repair of problem areas. The goal is to monitor conditions and conscientiously implement practices that maintain low risk levels to avoid compromising sites as they change with development and changes in ownership. Timeframe: Mid-term/Ongoing Ease of Implementation: Medium Potential Funding: California Storm Water Grant Program, California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund
Maximize the use of compost berms, blankets and socks for erosion and sediment control, especially on disturbed soils or post-fire.	California Landscape Conservation Cooperative, fire department, city departments that perform land maintenance, watershed groups, community groups specializing in watershed restoration	Comments: See Measure 4, Action C for example guidelines on the use of compost berms, socks and blankets. Providing education materials and building partnerships to drive community support for installing these solutions in strategic locations that are not limited to publicly owned land can help to bring this strategy to scale. Timeframe: Short-term Ease of Implementation: High Potential Funding: California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund
Resources: United States Geological Survey. Landslides in Alameda County, California. http://geo-nsdi.er.usgs.gov/metadata/open-file/99-504/metadata.faq.html United States Geological Survey. San Francisco Bay Region Landslide Information. http://landslides.usgs.gov/state_local/sanfrancisco.php		

Wildfires

Exposure level – Low

Measure 18: Reduce the exposure of built infrastructure to wildfires		
Description: Increased temperatures and droughts exacerbate the risk of wildfires, threatening public and private assets, the local population, and air quality. Adaptive fire management schemes can help reduce the risk of fires and exposure of people and assets.		
Hazard(s): Fires, increased temperatures, changes in precipitation		
Co-benefits: Maintain health of forested lands, prevent increased flooding and landslide risk		
Equity considerations: Development in the hills is at higher risk of wildfires due to proximity of forested lands. The threat is compounded by development in this area, which can impact watershed hydrology and increase the risk of landslides and flooding in the downstream areas.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**

Discourage new development in the hills where the risk of wildfire is highest and, where feasible, locate new essential public facilities outside of fire hazard zones. Identify appropriate mitigation measures for new development or essential facilities that will be located in fire zones.	Alameda County Community Development Agency	Comments: Current and future land use planning efforts should take into account risk of fire and other hazards, as well as recognizing that development in itself needs to be designed to avoid future risks from fires and other hazards. Coordinating these efforts across city ordinances, plans and permitting will promote a cohesive strategy for avoiding increased investment in high fire risk areas. Timeframe: Ongoing Ease of Implementation: Medium Potential Funding: California Fire Prevention Fund Grants Program
Develop defensible space for assets located in wildland-urban interface zones and/or high fire hazard severity zones as designated by CalFIRE.	Home and business owners, Alameda Tool Lending Library, county and city Fire Department	Comments: Vegetation and fuel clearance and forest management are critical components of fire management schemes. Efforts should be centered on areas where assets and populations are at highest risk - high or very high fire hazard severity zones and wildland-urban interface zones. Timeframe: Ongoing Ease of Implementation: High Potential Funding: California Fire Prevention Fund Grants Program
Resources: CalFIRE Fire Prevention resources. http://calfire.ca.gov/fire_prevention/fire_prevention David Crohn et al. 2013. Composts as Post-Fire Erosion Control Treatments and Their Effect on Runoff Water Quality. Transactions of the American Society of Agricultural and Biological Engineers, Vol. 56(2): 423-435. http://www.hcd.ca.gov/nationaldisaster/docs/crohn_et_al._2013_trans_asabe.pdf		

Measure 19: REGIONAL: Establish cooperative working relationships among public agencies with responsibility for fire protection		
Description: Fire events are not constrained to city boundaries but occur based on environmental and regional factors. Government agencies and other stakeholders can better prepare for climate-induced changes in wildfire conditions by establishing regional partnerships, agreements and plans.		
Hazard(s): Fires, increased temperature, changing precipitation patterns		
Co-benefits: Water quality and quantity, reduced risk of downstream flooding, erosion control		
Equity considerations: Ensure that the voices of vulnerable communities are considered in regional efforts to address wildfire risks, ideally through direct involvement of representative community groups.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Identify the appropriate city, state and regional agencies to collaborate with, and existing mechanisms that can be leveraged for cooperation and collaboration.	CalOES Regional Emergency Operations Center, state and regional fire and rescue coordinators, the State Fire Marshal, and the CalFIRE	Comments: Fire management is a robust field, and climate adaptation efforts will be most effective if they build on existing efforts and regional partnerships. Based on each city's specific fire hazards and institutional capacity, it can determine how best to integrate into regional conversations and planning. Equipping local firefighting experts with climate data and building relationships between fire management

		personnel and climate leads will help to promote longer-term adaptation to climate change effects on fire conditions. Timeframe: Short-term Ease of Implementation: High Potential Funding: N/A
Actively participate in regional efforts to plan, allocate responsibilities and identify funding for fire management efforts, and encourage full consideration of projected climate impacts in all planning processes and partnerships.	CalOES Regional Emergency Operations Center, state and regional fire and rescue coordinators, the State Fire Marshal, and CalFIRE	Comments: Participate in planning efforts, such as updates to the Alameda County Community Wildfire Protection Plan. Since fire impacts are regional, incorporating climate information into fire planning can help maximize the adaptation benefits of coordinating the activities of various agencies, building understanding and identifying resources. Regional planning also has implementation benefits: it allows for firefighters to incorporate pre-fire work into their fire suppression and firefighting strategies during the fire season. Timeframe: Long-term Ease of Implementation: Medium Potential Funding: CalFIRE Fire Prevention Fund
Resources: Draft Alameda County Community Wildfire Protection Plan Update. 2015. http://www.diablofiresafe.org/pdf/2015_Draft_AlCo_CWPP_Update.pdf		

Public Health

Measure 20: Identify populations vulnerable to extreme heat		
Description: In order to assess, prepare for and respond to high heat events, it is critical to understand who and where the most vulnerable people in the city are and create plans to increase capacity and education to address high heat.		
Hazard(s): Extreme heat		
Co-benefits: Public health, emergency response		
Equity considerations: Areas with less green space are more likely to have a significant urban heat island effect, and these places are also more likely to be where low income or disadvantaged populations live. These communities are also the most likely to have limited capacity to adaptively respond to the greater occurrence of high heat events.		
Actions	**Potential Implementing Partner(s)**	**Key Considerations**
Identify populations vulnerable to heat related illnesses.	City public health and emergency management departments, California Department of Public Health, Office of Environmental Health Hazard Assessment, CalOES,	Comments: During high heat events, illnesses such as heart disease, diabetes and heat stroke tend to result in higher rates of hospital admission. Key populations at risk include those that are elderly, socially or linguistically isolated, in poverty, diabetic, or outdoor laborers.

	local social services, local non-governmental organizations	People who live far from emergency room or urgent care facilities and already have preexisting conditions are also be of primary concern. Mapping social connectedness by assessing civic participation, language diversity, and other indicators is a useful tool for understanding vulnerability. The combined effect of high heat with humidity impacts the human body's ability to cool down, and can worsen existing health conditions and lead to a number of heat-related illnesses. Using wet-bulb temperature as a measure for hazard severity can provide a better understanding of projected effects of heat waves. Timeframe: Short-term Ease of Implementation: Medium Potential Funding: Centers for Disease Control and Prevention
Develop targeted outreach materials to raise awareness about heat risks. Ensure that extreme heat preparedness and response information is available in the primary non-English languages spoken in the community.	Local social services, local non-profit organizations	Comments: Linguistically isolated communities can be especially vulnerable to high heat and therefore should be considered in outreach and communications. Timeframe: Short-term Ease of Implementation: High Potential Funding: N/A
Provide public cooling centers for these populations. Develop means to raise public awareness of these centers and ensure accessibility for vulnerable populations.	PG&E, community groups and centers with knowledge of local neighborhood conditions, partners that could provide transportation to cooling centers	Comments: Commercial and publicly owned facilities with air conditioning, such as movie theaters and libraries, have seen higher success in serving community needs in high heat events than government operated cooling centers. They are also generally more accessible by public transportation. Identifying these locations and including them in communication materials will help encourage access during high heat events. Designated cooling centers are a reactive response to high heat days but long-term planning should also emphasize green building and green infrastructure to decrease urban heat island impact and overall heat risk (see Measure 9). Timeframe: Short-term Ease of Implementation: High Potential Funding: US Department of Health and Human Services, US

		Department of Housing and Urban Development

Resources:

Heat & Social Inequity Tool. Four Twenty Seven. http://fourtwentyseven.maps.arcgis.com/apps/MapSeries/index.html?appid=7ac7b8355ee0482d8fdf4a77d4d3e942

EPA. Reducing Urban Heat Islands: Compendium of Strategies. 2008. https://www.epa.gov/heat-islands/heat-island-compendium

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San Francisco's Climate and Health Program: Progress and Lessons Learned. https://www.arb.ca.gov/cc/ab32publichealth/meetings/120512/san%20francisco%20climate%20health%20program%20progress%20lessons%20learned%28scully%29.pdf

Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center. http://kresge.org/sites/default/files/climate-adaptation-urban-heat.pdf

Measure 21: Raise population's awareness of the public health impacts of climate change

Description: Greater awareness of climate change and the impacts it may have on city residents' health, will enable them better to prepare and protect themselves. Also, see Measure 20.

Hazard(s): Wildfires, floods, droughts, sea level rise, extreme temperatures

Co-benefits: Climate change education, public health

Equity considerations: Vulnerable and low-income populations often live in areas that are particularly susceptible to the negative impacts of climate change and should be targeted for climate hazard communications.

Actions	Implementing Partner(s)	Key Considerations
Develop information dissemination channels for Spare the Air days, including materials specifically targeting vulnerable populations.	Non-profit organizations and community groups, Bay Area Air Quality Management District	Comments: Examples include conducting outreach to locations where residents purchase firewood, such as grocery and home improvement stores, and engaging them in communication campaigns. Timeframe: Short-term Ease of Implementation: High Potential Funding: The California Wellness Foundation Advancing Wellness Grant Program
Create a plan for disseminating public information about new or more prevalent vector borne diseases.	Non-profit organizations and community groups, local/regional hospitals	Comments: Build on existing public health communication plans and initiatives to incorporate climate change risks and impacts. As part of the planning process, an exchange between environmental and public health staff and experts about city-specific climate risks and public health can help facilitate more effective planning and implementation. Timeframe: Mid-term Ease of Implementation: High Potential Funding: The California Wellness Foundation Advancing Wellness Grant Program, Public Health Institute

Resources:

Bay Area Air Quality Management District. Spare the Air Program. http://www.sparetheair.org/
World Health Organization. Climate Change and Human Health. Chapter 6: Infectious Diseases. http://www.who.int/globalchange/publications/climatechangechap6.pdf
The California Wellness Foundation. Advancing Wellness Grant Program. http://www.calwellness.org/grants_program/advancing_wellness.php

Emergency Preparedness

Measure 22: Ensure an energy assurance plan for city operations during and after disasters. (Also, see Measure 11: Integrate energy assurance actions into citywide planning processes to decrease vulnerability to grid outages during extreme events.)		
Description: Securing an energy supply following a disaster is a top priority to allow for effective emergency response. Planning energy sources with climate change impacts in mind will increase preparedness to future conditions as well as present threats.		
Hazard(s): Wildfires, floods, increased temperature, changing precipitation patterns		
Co-benefits: Mitigation (renewable energy sources only), emergency preparedness and response		
Equity considerations: Prioritize energy assurance for critical community assets (public, non-profit and private) that serve emergency operations and community needs.		
Actions	**Implementing Partner(s)**	**Key considerations**
Estimate critical facilities' (including the emergency operations center) and key community assets' (e.g. schools, the library) energy supply and demand during emergencies to assess facilities' vulnerabilities to power loss.	Critical facility owners, PG&E, energy assessment consulting firms	Comments: Analyze the overlap between areas highly vulnerable to climate change impacts and those vulnerable to power loss to inform energy assurance needs and the effective installation of decentralized renewable energy. Timeframe: Short-term Ease of Implementation: High Potential Funding: California Energy Commission grants, Lawrence Berkeley National Laboratory, US Department of Energy
Work with local gas, electric, cable, water, sewer and other utility providers to maintain and retrofit their facilities and ensure their ability to function or to be quickly restored following a climate-related disaster.	East Bay Municipal Utility District, PG&E and other utility companies	Comments: Encourage each utility to update their emergency management plans to incorporate climate science and risk data. Timeframe: Long-term Ease of Implementation: Medium Potential Funding: California Energy Commission grants
Facilitate access to local, decentralized renewable energy.	Other local city governments (information sharing), community organizations, Lawrence Berkeley National Laboratory, PG&E	Comments: Assess the possibility of installing a microgrid that can function autonomously from the main grid in case of disruption. Integrate this energy source into emergency planning, and reciprocally, consider emergency response needs in the design of the energy resource. The City of Berkeley is pursuing similar strategies and may be a valuable resource to inform the implementation of local energy systems. Timeframe: Long-term Ease of Implementation: Medium Potential Funding: California Energy

		Commission grants, Lawrence Berkeley National Laboratory, US Department of Energy

Resources:
DOE. Climate Change and the Electricity Sector: Guide for Climate Change Resilience Planning. (2016). http://energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-climate-change-resilience-planning
Berkeley Lab. Microgrids at Berkeley Lab. https://building-microgrid.lbl.gov/
City of Berkeley. Berkeley Resilience Strategy. 2016. http://www.ci.berkeley.ca.us/uploadedFiles/City_Manager/Resilient_Berkeley/Berkeley_Resilience_Strategy_LowRes.pdf

Measure 23: Manage hazardous materials to prevent accidents

Description: Changing climate conditions may compromise the safety and security of existing hazardous materials sites and lead to unforeseen spills and contamination. Incorporating climate risks into hazmat planning and permitting will allow cities to ensure containment into the future.

Hazard(s): Wildfires, floods, sea level rise, landslides

Co-benefits: Public health and safety

Equity considerations: Ensure comprehensive implementation of updated requirements so that all city residents are protected from hazardous materials exposure.

Actions	Implementing Partner(s)	Key Considerations
Assess the impacts of flooding, landslides, sea level rise, and other climate change impacts on hazardous materials facilities. Develop a strategy to prevent catastrophic releases.	Hazardous materials site owners, US EPA, CalEPA, California Department of Toxics Substances Control, Alameda County Department of Environmental Health Certified Unified Program Agency	Comments: Hazardous materials sites must prepare a Risk Management Plan (RMP), which is implemented to prevent or mitigate the release of regulated substances. RMPs that do not account for the projected impacts of climate change, both on the site itself and on containment and treatment processes, pose a risk to public health and safety. Using the information available to the city, while working with county and state partners to assess and communicate the vulnerability of hazardous materials sites, will be an important first step in ensuring preparedness. Integrating climate vulnerability considerations into inspector training and the permitting process for hazardous materials sites will also be important to maintain public safety. Timeframe: Mid-term Ease of Implementation: Medium Potential Funding: CalEPA, US EPA

Resources:
U.S. EPA. Office of Solid Waste and Emergency Response Climate Change Adaptation Implementation Plan. 2014. https://www.epa.gov/sites/production/files/2016-08/documents/oswer-climate-change-adaptation-plan.pdf
Alameda County Environmental Health. Hazardous Materials/Waste Program Website. https://www.acgov.org/aceh/hazard/programs.htm

Measure 24: Assess the robustness of the city emergency response and recovery program's consideration of flooding, landslides, sea level rise, and other climate change impacts

Description: In addition to long-term hazard mitigation planning, climate change will also impact emergency response and recovery through the type, severity and duration of events. Accounting for changing climate conditions in response and recovery planning will help to ensure effective emergency management.		
Hazard(s): Flooding, landslides, sea level rise, wildfires, droughts, extreme heat		
Co-benefits: Emergency preparedness, response and recovery		
Equity considerations: Consider environmental inequity and account for environmental justice in all emergency management planning.		
Actions	**Implementing Partner(s)**	**Key Considerations**
Ensure that emergency response and recovery programs account for changing climate conditions and how new and changing hazards may affect emergency response.	Emergency management planners	Comments: Climate change may affect the kinds of hazards the city will need to be prepared to respond to, as well as shift the timing, duration and severity of existing hazard scenarios. Assess how existing plans address events at the scale projected to occur with climate change and work with emergency management professionals to account for pertinent climate change impacts in emergency response plans and protocol updates. Timeframe: Short-term Ease of Implementation: High Potential Funding: N/A
Identify emergency response and evacuation access ways and address their vulnerability to flooding, landslides, etc.	Emergency management planners and response professionals	Comments: Evaluate planned emergency response access routes, shelters and resources in order to understand how climate change, and sea level rise in particular, will affect the ability to deliver emergency response over time. Share up to date climate data with emergency response departments so they can update and adjust planning accordingly. Timeframe: Mid-term Ease of Implementation: High Potential Funding: CalOES
Resources: California Natural Resources Agency. Safeguarding California: Action Implementation Plans. Emergency Management Sector Plan. http://resources.ca.gov/docs/climate/safeguarding/Emergency%20Services%20Sector%20Plan.pdf		