

Fremont Climate Hazard Assessment & Adaptation Options



Four Twenty Seven
Climate Solutions

February 6, 2017

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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 Fremont 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 Fremont 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, which align with the climate hazards prioritized in the city's [2016 Local Hazard Mitigation Plan](#).

Climate change will affect Fremont, California

Throughout the remainder of the 21st century, Fremont's climate is projected to grow substantially hotter and experience greater variation in precipitation patterns. In addition, rising sea levels threaten to undermine sewer, power and transportation assets located within the city. Fortunately, Fremont's citywide emergency response and community assets are located outside of the areas that are vulnerable to projected rising sea levels. However, the growing likelihood of more intense precipitation events could compromise those assets currently located in the 500-year floodplain. This would be especially true if current wildfire risk is exacerbated by climate change and fire impacts result in increased runoff. Figure ES1 summarizes the climate hazards of concern for Fremont.

Figure ES1. Climate Hazards and Exposure

Climate Hazard	Exposure ¹	Summary
Inland Flooding	High	Significant ² exposure during 100-year storm (1 percent annual chance) and critical ³ exposure during 500-year storm (0.2 percent annual chance)
Sea Level Rise	Medium	Significant exposure likely by end of century with a 50-year or 2 percent annual chance storm (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 3 °F and extreme heat by 36 days per year by 2100 (90 °F +)
Wildfires	Medium	Some emergency assets located in high fire severity zones
Precipitation Change	Low	Likely increase in intensity of events, limited change in overall rainfall
Rainfall-Induced Landslides	Low	No emergency assets located in landslide hazard zones

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

Identifying and incorporating adaptation and resilience measures into its local hazard mitigation plan and other relevant plans will enable Fremont 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 Fremont’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.

ES2. Adaptation Measures

#	Climate Hazard/ Issue Addressed	Exposure	Adaptation Measure
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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 can be found in Appendix B.

² Significance 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.

³ Criticality was determined by the exposure of emergency assets and resources or infrastructure that are “essential for the delivery of vital services, protection of special populations, and the provision of other services of importance for the community.” (FEMA. (2007). *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543.)

1.	Inland Flooding	High	Update flood hazard data
2.	Inland Flooding	High	Minimize flood risks for existing development
3.	Inland Flooding	High	Avoid and minimize flood risks for new development
4.	Inland Flooding	High	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	High	Protect and restore soil health
6.	Inland Flooding	High	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	Medium	Reduce the exposure of built infrastructure to wildfires
19.	Wildfires	Medium	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 plans⁴. 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 cities⁵, including the City of Fremont, 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 Fremont 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 Fremont 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 Fremont. Section 2 presents the climate hazard analysis, which helps Fremont 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*⁶. The climate hazard analysis covers inland flooding, sea level rise, changes in temperature (including extreme heat) and precipitation, and rainfall-induced landslides, which align with the climate hazards prioritized in the city’s [2016 Local Hazard Mitigation Plan](#). The analysis includes the probability

⁴ 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.”

⁵ The five participating cities are Albany, Emeryville, Fremont, Hayward and Piedmont.

⁶ 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.

of occurrence, extent of exposure, and assets affected by key climate hazards in Fremont. 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.

Section 3 is meant to inform Fremont's identification and prioritization of potential adaptation actions and provide input to Steps 6 through 9⁷ 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.

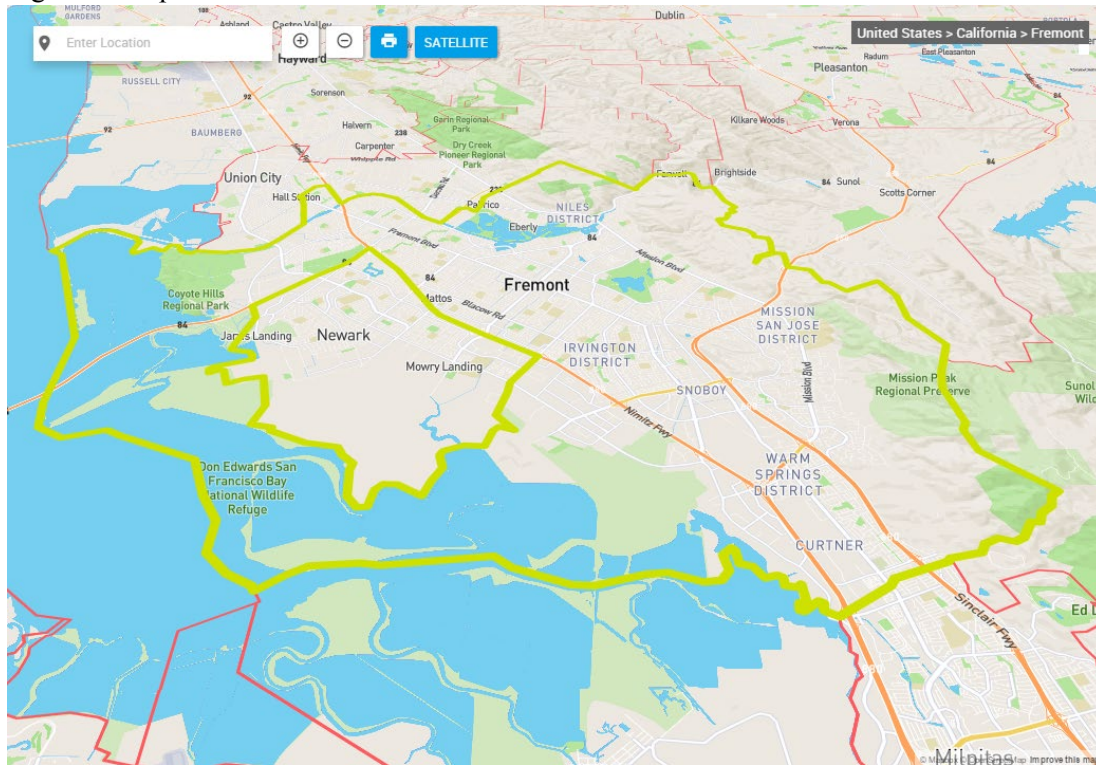
Climate change will affect Fremont, California

Fremont extends from the marshes of the southeastern shores of the San Francisco Bay to the west and into the southern end of the Berkeley Hills to the east, and sits at an average elevation of 56 feet above sea level. (See Figure 1 for a map of the city.)

With a population of about 225,000 people, it is highly urbanized, made up mostly of residential properties with commercial and industrial areas in the southern and western portions of the city. Due to its geographic span from the Bay into the hills, Fremont is susceptible to a variety of climate hazards. Fremont will likely be most affected by a combination of inland flooding and sea level rise in the near term. However, the greatest relative changes in climate will be seen in the long-term, when projected temperature increases and the frequency of very hot days will impact a broader set of the city's assets and population.

⁷ 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?

Figure 1. Map of Fremont



2. Climate Hazards Analysis

Throughout the remainder of the 21st century, Fremont's climate is projected to grow substantially hotter and experience greater variation in precipitation patterns. In addition, rising sea levels threaten to undermine sewer, power and transportation assets located within the city. Fortunately, Fremont's critical emergency response and community assets are located outside of the areas that are vulnerable to projected rising sea levels. However, the growing likelihood of more intense precipitation events could compromise those assets currently located in the 500-year floodplain. This would be especially true if current wildfire risk is exacerbated by climate change and fire impacts result in increased runoff. Figure 2 summarizes Fremont's exposure to each of the hazards examined in this assessment.

Figure 2. Climate Hazards and Exposure

Climate Hazard	Exposure ⁸	Summary
Inland Flooding	High	Significant ⁹ exposure during 100-year storm (1 percent annual chance) and critical ¹⁰ exposure during 500-year storm (0.2 percent annual chance)
Sea Level Rise	Medium	Significant exposure likely by end of century with a 50-year or 2 percent annual chance storm (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 3 °F and extreme heat by 36 days per year by 2100 (90 °F +)
Wildfires	Medium	Some emergency assets located in high fire severity zones
Precipitation Change	Low	Likely increase in intensity of events, limited change in overall rainfall
Rainfall-Induced Landslides	Low	No emergency assets located in landslide hazard zones

Inland Flooding

Climate change may increase flood risks in Fremont

Climate change is expected to exacerbate flooding through storms and more intense periods of rainfall. Many of Fremont’s citywide assets are vulnerable to flooding based on analysis conducted by FEMA,¹¹ including essential emergency response, transportation, power and sewer assets. With more extreme precipitation events, the intensity of rainfall-induced flooding events may cause more flooding of vulnerable 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.

Fremont will potentially face more frequent, severe floods

Flood Insurance Rate Maps (FIRMs) created by FEMA were analyzed to identify hazards posed to assets in the 100-year and 500-year floodplains. The 100-year floodplain includes land that has a one percent

⁸ 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 can be found in Appendix B.

⁹ Significance 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.

¹⁰ Criticality was determined by exposure of emergency assets and resources or infrastructure that are “essential for the delivery of vital services, protection of special populations, and the provision of other services of importance for the community.” (FEMA. (2007). *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings*, FEMA 543.) This assessment refers to “critical” assets as those belonging to the general classes of assets that align with this definition. However, asset-specific classifications of criticality as defined by other city documents and plans take precedence over the discussion of criticality throughout this assessment.

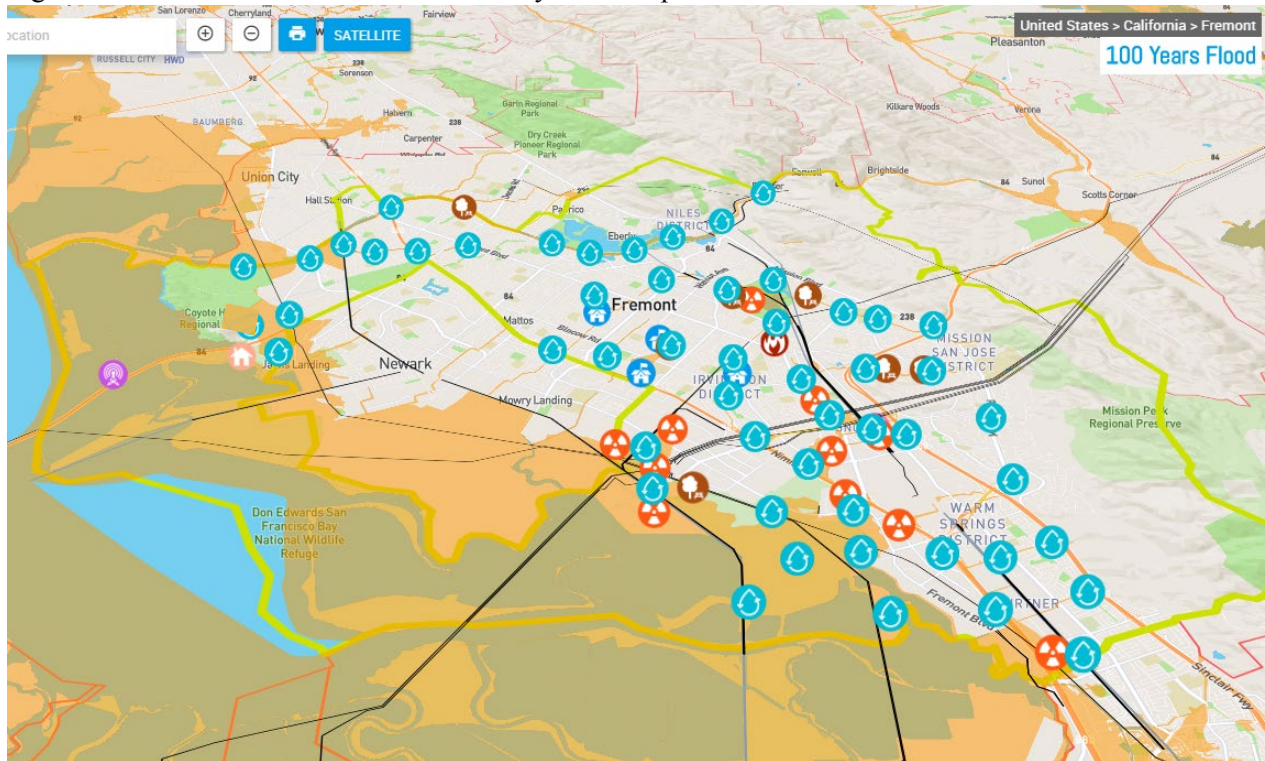
¹¹ FEMA Flood Insurance Rate Map. 100 Year Floodplain. Alameda County.

chance of flooding in a given year and therefore is statistically 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 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.












Many important citywide assets are exposed to flood risks

According to FEMA flood maps, Fremont has multiple citywide assets located in the 100-year (Figures 3 and 4) and 500-year floodplains (Figures 5 and 6). 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 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. Fremont Assets in the Current 100-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 based on historical data. Source: Fremont Local Asset Data, OpenStreet Map, Open Data and FEMA¹² as represented on the Vizonomy Climate Risk Platform (Vizonomy).

Asset Map Key					
	Police Station		City Park		Power Lines
	Fire Station		AM Antenna		Railroad/BART Line
	Storm Drain Lines & Structures		Gas Station		City Border
	Hazmat Facility		School		

¹² FEMA Flood Insurance Rate Map. 100 Year Floodplain. Alameda County.

Figure 4. List of Assets in the 100-Year Floodplain

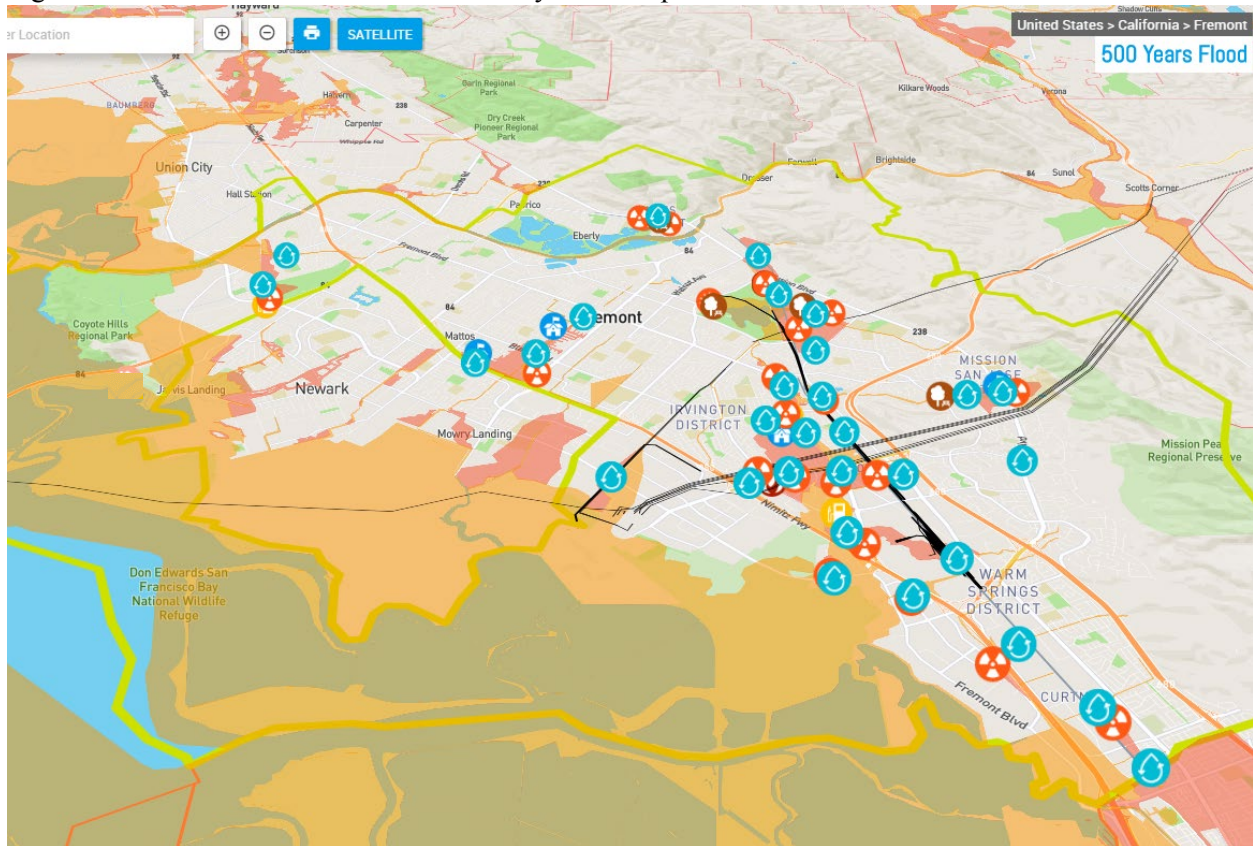
Asset Type	Impact	Number of Assets
Fire Station/EMS	H	1
Police	H	1
Railway (OpenStreet Map)	H	32
Railway (Open Data)	H	22
BART Assets (OpenStreet Map)	H	10
Storm Drains, Structures	H	1145
Storm Drains, Lines	M	1145
Power Lines	M	30
AM Antennas	M	1
Cellular Towers	M	1
Hazmat Facilities	M	67
Pipelines	M	7
Schools	M	4
Pharmacies	L	1
Regional and City Public Parks	L	9
Buildings (Commercial and residential - OpenStreet Map)	L	140
Buildings (Commercial - Fremont)	L	31

Notes: Exposed assets by asset type and level of potential 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 replaceable. This distinction is based upon reasonable judgement and should be reviewed by local officials for accuracy. Source of asset count: Fremont Local Asset Data, OpenStreet Maps, Open Data and AECOM ¹³ as represented on Vizonomy.












Examples of important citywide assets located within the current 100-year floodplain include a fire station and a police station. Over 1,000 storm sewer assets are exposed throughout the city as well, leaving much of Fremont vulnerable to sewer backups. The I-880 freeway may also experience flooding north of the Fremont Boulevard exit, and the railway in the southwest area of the city is expected to flood throughout the Marsh area between Alviso and Newark. In addition, a portion of a PG&E transmission facility, 30 power lines, a pharmacy located within a Walmart, a cellular tower in southern Fremont, an AM radio antenna and 67 hazmat facilities are located in the current 100-year floodplain.

¹³ AECOM and Brian Fulfroft & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

Figure 5. Fremont Assets in the Current 500-year Floodplain



Notes: The area shaded in orange is the 100-year floodplain and the area shaded in red is the 500-year floodplain, which has a 0.2 percent chance of flooding in a given year based on historical data. The assets in the 500-year floodplain are in addition to those depicted in the 100-year floodplain. Source: Fremont Local Asset Data, OpenStreet Map, Open Data and FEMA ¹⁴ as represented on Visonomy.

Asset Map Key					
	Police Station		City Park		Power Lines
	Fire Station		AM Antenna		Railroad/BART Line
	Storm Drain Lines & Structures		Gas Station		City Border
	Hazmat Facility		School		

¹⁴ FEMA Flood Insurance Rate Map. 100 Year Floodplain. Alameda County.

Figure 6. List of Assets in the 500-Year Floodplain

Asset Type	Impact	Number of Assets
Fire Station/EMS	H	2
Railway Station	H	1
Railway (OpenStreet Map)	H	11
Railway (Open Data)	H	39
BART Assets (Open Data)	H	8
Intermodal Terminal Facilities	M	1
Storm Drains, Structures	H	1579
Storm Drains, Lines	M	1579
Power Lines	M	13
Cellular Towers	M	1
Hazmat Facilities	M	119
Power Plants	M	1
Pipelines	M	4
Gas Stations	L	4
Schools	M	6
Colleges and Universities	M	1
Banks	L	3
Restaurants	L	1
Places of Worship	L	1
Regional and City Public Parks	L	6
Buildings (Commercial and residential - OpenStreet Map)	L	232
Buildings (Commercial - Fremont)	L	149

Notes: See Figure 4 for an explanation of the asset impact ranking. The 500-year floodplain asset count does not include the assets in the 100-year floodplain, but the asset counts for increasing levels of sea level rise are cumulative. Source of asset count: Fremont Local Asset Data, OpenStreet Maps, Open Data and AECOM¹⁵ as represented on Vizonomy.

The number of public assets in the 500-year flood plain increases noticeably as flood waters encroach into central Fremont along the waterway extending from Coyote Creek Lagoon and up along Fremont Boulevard. The greatest number of assets exposed to a 500-year flood are located along Fremont Boulevard between the Irvington District and the area north of South Grimmer Boulevard. These include Fire Stations 3 and 7, Harvey Green Elementary, 13 additional power lines, two gas stations, a cellular tower in the Warm Springs District and a truck rail handling/transport facility. The I-880 Freeway north of Fremont Boulevard is also inundated. This area of flooding extends up into Fremont Central Park, affecting the area northeast of the park, including John Gomes Elementary and Fire Station 9. Another gas station is affected just north of Mowry Avenue near the Nimitz Freeway. A 500-year flood may also affect the Mission San Jose District, including the Mission San Jose Elementary School and Ohlone College. Further north, floodwaters could affect Little Flowers Montessori Elementary and a nearby gas

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

station off Ardenwood Boulevard. Cumulatively across these areas, the number of exposed storm drains more than doubles to above 2,000 assets. Additional railways exposed to 500-year flooding include the Niles Railway Station and the Union Pacific lines running through the Warm Springs District up to Niles Station.

Inland flooding critically challenges the City of Fremont by putting emergency response facilities, key arterial roads and highways and a considerable portion of the storm sewer system at risk. As sea level rise encroaches on the marshlands that help protect the city from coastal floods, it will become increasingly essential to minimize the contribution of land use change, site design and impervious cover to water runoff, which may cause flooding to affect a wider area and occur more frequently than historical records indicate.

Sea Level Rise

Fremont 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.¹⁶ 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 Fremont, the assets most at risk from sea level rise include storm drain assets west of I-880, power lines and railways.

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.¹⁷ These values are accompanied by ranges of possible sea levels based on low and high emissions scenarios and ice melt scenarios. Figure 7 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.

¹⁶ 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.

¹⁷ National Research Council. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report. DOI: 10.17226/13389

Figure 7. 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: NRC¹⁸

These projections characterize the estimated timeline for permanent increases in water levels. However, the conditions 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 51 inches of inundation by 2050 in the event of a 50-year storm, or a storm that has a two percent chance of occurring in a given year.¹⁹

Sea level rise will mean floods affect more assets over time

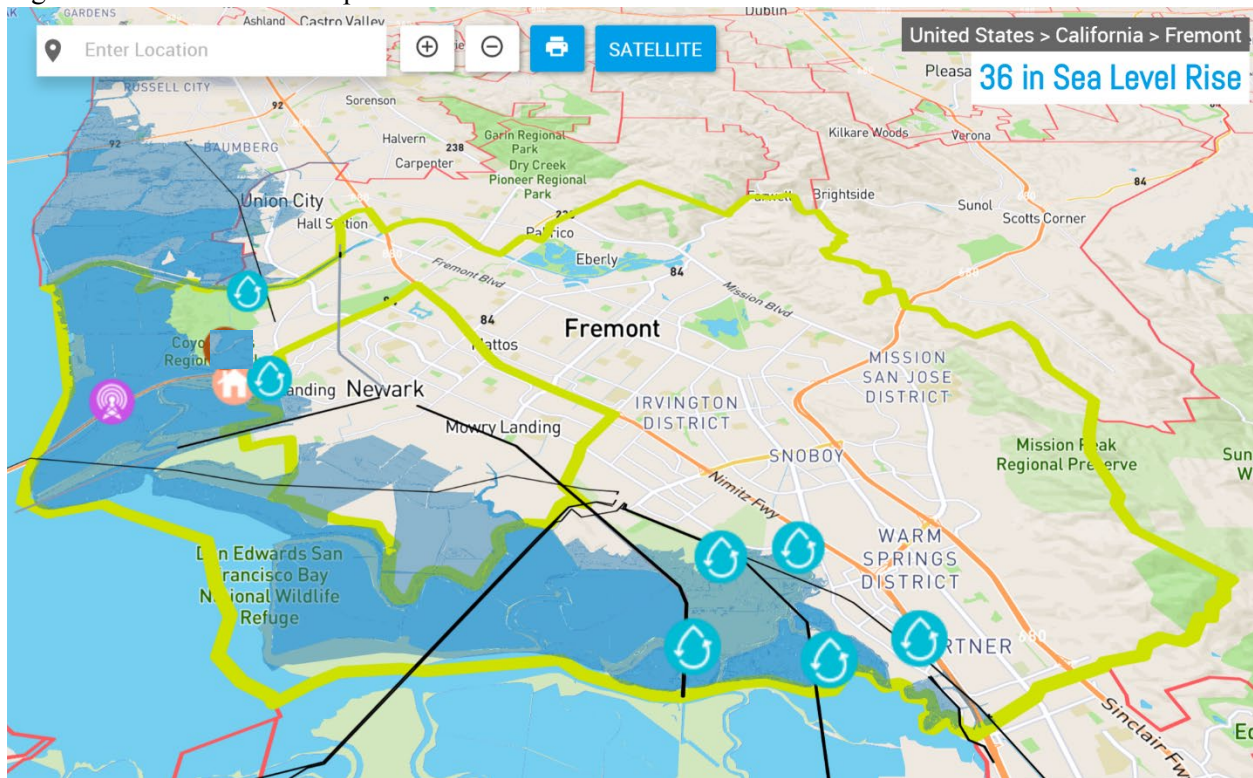
Sea level rise, and the combined effects of periodic King tides and storm surge, is expected to inundate several exposed assets along the shoreline, first flooding marshlands and eventually threatening property and assets in west Fremont.

By mid-century, about 12 inches of sea level rise is projected to permanently inundate the city's marshlands, eroding the city's defense to storm surge and high tides. Assets flooded under these conditions include the Union Pacific railway along the shoreline, five power lines and three storm drains. Exposure levels remain comparable as water levels reach 24 inches, but the number of exposed assets increases as sea level rise reaches 36 inches, which is likely by the end of the century, and possible by mid-century with a five-year extreme tide. With between 24 and 36 inches of sea level rise, flooding of CA-84 could cut off access to the Dumbarton Bridge. I-880 could also begin to flood in South Fremont, near Milpitas, and the number of exposed storm drains increase from four to 48, and exposed buildings increase from two to 32 structures. See Figure 8 for a map of areas inundated by 36 inches of sea level rise, and Figure 9 for a list of exposed assets.












¹⁸ National Research Council. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report. DOI: 10.17226/13389

¹⁹ AECOM and Brian Fulfroft & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

Figure 8. Fremont Assets Exposed to 36 Inches of Sea Level Rise



Notes: The area shaded in blue indicates the area inundated by 36 inches of sea level rise. Source: Fremont Local Asset Data, OpenStreet Maps, Open Data and AECOM²⁰ as represented on Vizonomy.

Asset Map Key					
	Police Station		City Park		Power Lines
	Fire Station		AM Antenna		Railroad/BART Line
	Storm Drain Lines & Structures		Gas Station		City Border
	Hazmat Facility		School		

²⁰ AECOM and Brian Fulfroft & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

Figure 9. List of Assets Exposed to 36 Inches of Sea Level Rise

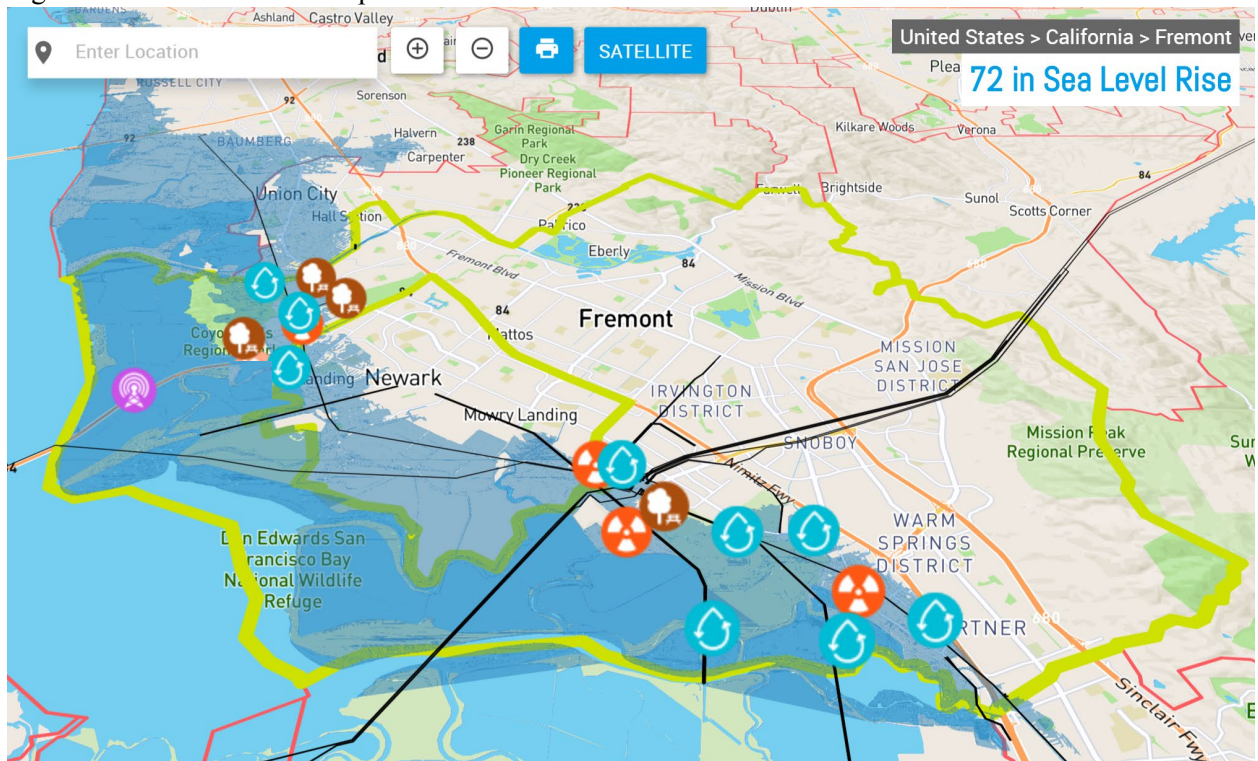
Asset Type	Impact	Number of Assets
Railway (OpenStreet Map)	H	4
Railway (Open Data)	H	5
Storm Drains, Structures	H	48
Storm Drains, Lines	M	48
Power Lines	M	8
AM Antennas	M	1
Hazmat Facilities	M	1
Pipelines	M	1
East Bay Regional Parks	L	2
Buildings (Commercial and residential - OpenStreet Map)	L	32

Notes: See Figure 4 for an explanation of the asset impact ranking. The asset counts for increasing levels of sea level rise are cumulative. Source of asset count: Fremont Local Asset Data, OpenStreet Maps, Open Data and AECOM²¹ as represented on Vizonomy.












The extent of sea level rise exposure continues to grow through the end of the century, if not sooner, depending on the recurrence and additive effect of tides and storm surge. At 48 inches of sea level rise, likely by the end of the century when combined with average yearly storm surge, water threatens a growing number of power line, rail, sewer and hazmat assets. As these resources and facilities are compromised, public health and safety may be at increased risk. Even with 72 inches of sea level rise, emergency service facilities, schools and community resources are outside the area projected to be impacted, despite the fact that many of these assets are located in the 500-year floodplain. One exception is a PG&E transmission facility off Automall Parkway by the Bay, which may be inundated by 72 inches of sea level rise. See Figure 10 for a map of areas inundated by 72 inches of sea level rise, and Figure 11 for a list of exposed assets.

²¹ AECOM and Brian Fulfroost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

Figure 10. Fremont Assets Exposed to 72 Inches of Sea Level Rise



Notes: The area shaded in blue indicates the area inundated by 72 inches of sea level rise. Source: Fremont Local Asset Data, OpenStreet Maps, Open Data and AECOM²² as represented on Vizonomy.

Asset Map Key		
	Police Station	
	Fire Station	
	Storm Drain Lines & Structures	
	Hazmat Facility	
		
		
		

²² AECOM and Brian Fulfrust & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

Figure 11. List of Assets Exposed to 72 Inches of Sea Level Rise

Asset Type	Impact	Number of Assets
Railway (OpenStreet Map)	H	8
Railway (Open Data)	H	8
Storm Drains, Structures	H	833
Storm Drains, Lines	M	833
Power Lines	M	39
AM Antennas	M	1
Hazmat Facilities	M	82
Pipelines	M	2
Regional and City Public Parks	L	5
Buildings (Commercial and residential - OpenStreet Map)	L	142
Buildings (Commercial - Fremont)	L	1

Notes: See Figure 4 for an explanation of the asset impact ranking. The asset counts for increasing levels of sea level rise are cumulative. Source of asset count: Fremont Local Asset Data, OpenStreet Maps, Open Data and AECOM²³ as represented on Vizonomy.

In addition, sea level rise may increase the likelihood of saltwater intrusion in groundwater resources. The Alameda Creek Watershed consists of surfacewater from Alameda Creek and groundwater in Newark Aquifer, Fremont-Centerville Aquifer and Deep Aquifer. Historically, these aquifers have periodically been affected by saltwater intrusion (chloride concentrations greater than 250 parts per million (ppm)) due to changes in the piezometric head of the water table caused by overdraft. Among the aquifers utilized for the city's drinking water, the Newark Aquifer is both hydrologically connected to surface water and in close proximity to future areas of periodic inundation from coastal flooding at the intersection of Alameda Creek and I-880. At this location, surface water connects to the Newark aquifer through clay, and saltwater intrusion is possible when the Bay is subject to surges of saltwater inflow, which may occur more often with sea level rise, potentially affecting the quality of groundwater sourced from the Newark Aquifer.

Temperature Changes and Precipitation Events

Climate change will increase temperatures in Fremont, 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. Fremont's climate is no exception and temperatures are projected to increase. The frequency of days over 90 °F is expected to increase from a baseline average of once a year between 1970 and 2000²⁴ to 37 days per year by end of

²³ AECOM and Brian Fulfroost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

²⁴ Environmental data from 1970-2000 was used as a historical baseline to inform projected future values.

century. The influence of climate change on precipitation events is less clear, but the pattern of precipitation is expected to become more variable with high-intensity events increasing in frequency while projections of annual totals show no clear signal of significant directional change.

Fremont will experience higher annual average temperatures and more extreme heat days

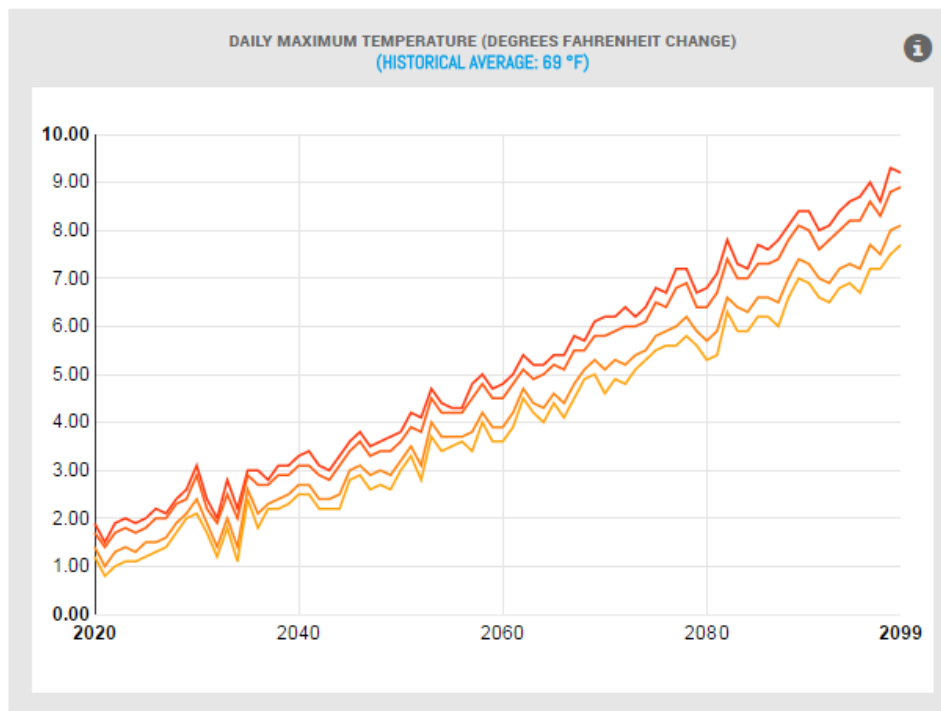
Temperature and precipitation projections were provided by Four Twenty Seven using scenarios from the Intergovernmental Panel on Climate Change (IPCC). The greenhouse gas concentration trajectories adopted by the IPCC for use in modeling and research are called Representative Concentration Pathways (RCPs). 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.²⁵ 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 Fremont 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 7.4 to 8.8 °F increase in daily average temperature, compared to 3.3 to 4.6 °F increase under RCP 4.5).

Temperatures in Fremont will be two to three degrees higher

From 1970-2000, Fremont experienced a daily average temperature of about 58.5 °F, an average maximum temperature of 69 °F and an average minimum temperature of 48 °F. According to climate models, future temperature patterns exhibit a clear trend toward warmer average temperatures, and more common high or even extreme temperature events. Under RCP 8.5 (the high emissions scenario), daily average temperature is projected to increase between 2.7 °F to 3.5 °F, daily minimum temperatures by 2.5 °F to 3.3 °F, and daily maximum temperatures by 3 °F to 3.8 °F between now and mid-century. Even under RCP 4.5 (the lower emissions scenario), temperature increases are anticipated and projections range between an average daily increase of 2.3 °F and 2.9 °F by mid-century. By the end of the century, temperature changes are estimated to 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 7.7 °F to 9.2 °F (Figure 12). These projections do not indicate seasonal fluctuations, but yearly averages.

²⁵ IPCC. (2014). Scenario Process for AR5. Accessed at: http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html

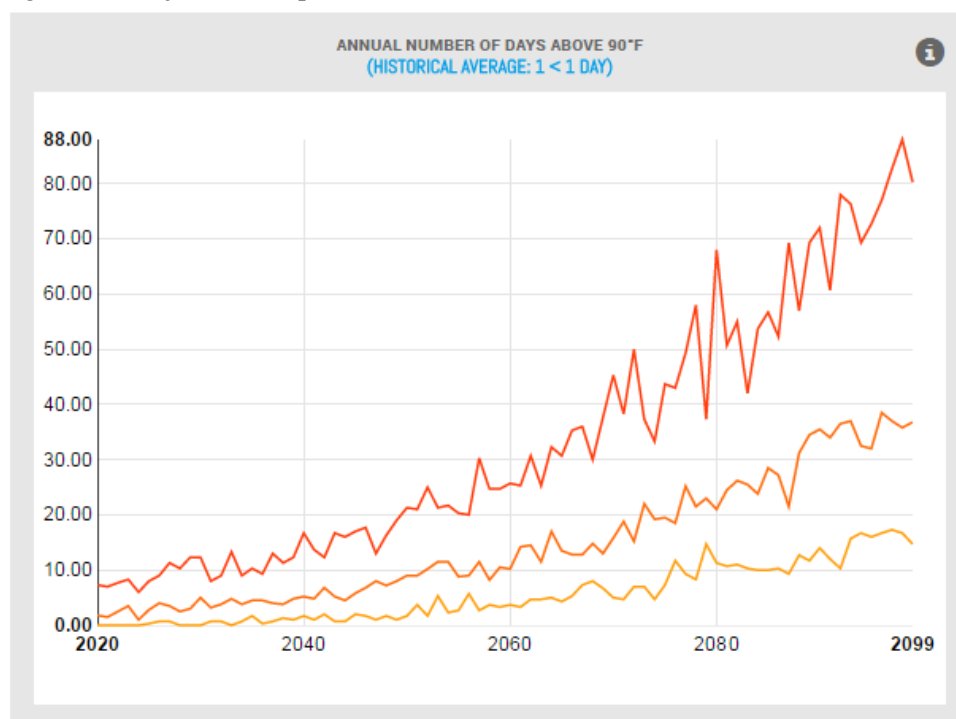
Figure 12. Projected Daily Maximum Temperatures in Fremont



Notes: RCP 8.5 projected °F changes in daily maximum temperature throughout the 21st century. Lines represent the 90th (red), 75th (dark orange), 25th (light orange) and 10th (yellow) percentiles of model results. Source: GCM ensemble as represented on Vizonomy.

The number of extreme heat days are also expected to significantly increase. Historically, Fremont averaged one day per year exceeding 90 °F. The number of hot days is projected to climb more rapidly after mid-century. Under RCP 4.5, Fremont will likely experience one to sixteen days per year over the 90 °F threshold and up to 12 days per year under RCP 8.5 by mid-century. By century's end, the number of days per year above the 90 °F mark could be up to 25 days per year under RCP 4.5 and as high as 88 days per year in an RCP 8.5, business-as-usual scenario (although mid-range RCP 8.5 projections indicate this number is closer to 37 days) (See Figure 13.) Higher temperatures will likely increase the magnitude of heat hazards in the city, for instance, heat stroke or exhaustion among local residents, workers and visitors, or raised demand for power during peak periods which could affect the frequency of outages.

Figure 13. Projected Temperature Extremes in Fremont



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

According to the historical baseline (1970-2000), temperatures in Fremont have dropped below freezing about 7 days per year. Based on climate change scenarios, the number of very cold days is expected to decrease as minimum temperatures are expected to gradually rise. Under RCP 8.5, mid-range projections never reach more than three days per year below freezing after 2020 and drop to zero days per year by 2060. Even under RCP 4.5, it would be unlikely for Fremont to experience more than two days below 32 °F after 2065.

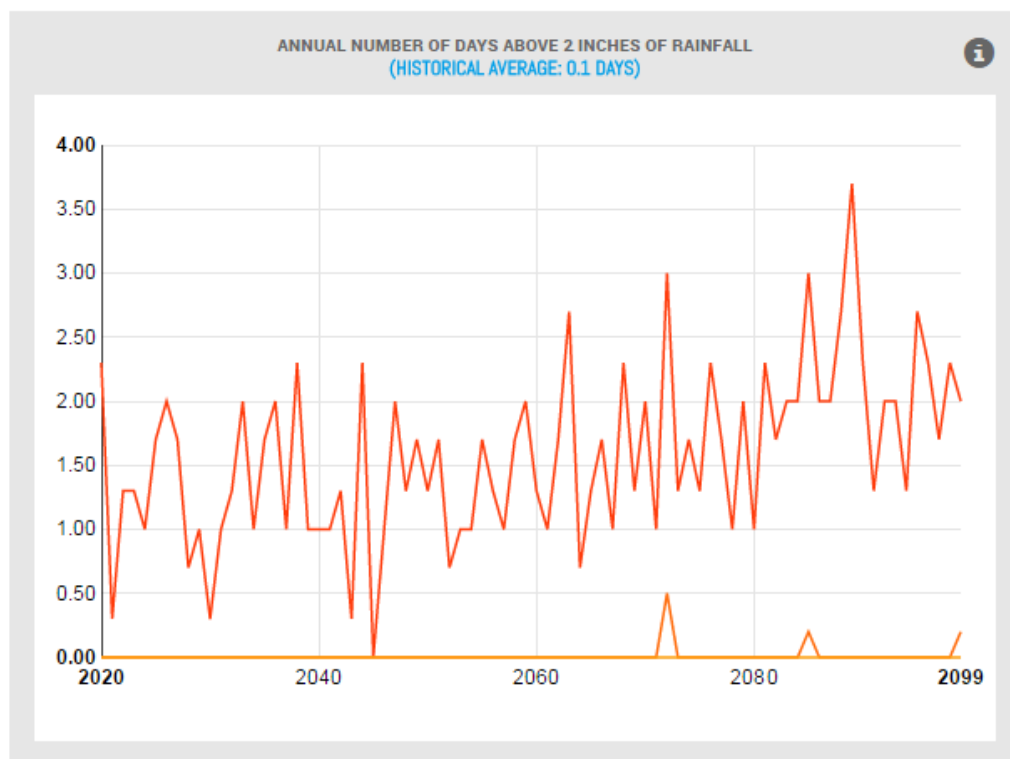
The impacts of climate change on rainfall are ambiguous

During the historical baseline period, 1970-2000, Fremont received approximately 17 inches of rainfall per year. By mid-century, under RCP 8.5 (the high emissions scenario), the percent change in total precipitation varies widely between 39.3 percent less rain and 46.2 percent more rain, indicating that no clear directional change in cumulative precipitation volumes is expected by the end of the century when using this method. Similarly, the frequency of days per year with intense precipitation of more than one or even two inches of rainfall in Fremont is not projected to change drastically by the end of the century.

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.²⁶ The greater variability in extreme precipitation events indicates that when extreme rainfall events occur, they may be shorter, more intense periods of rainfall. Figure 14 depicts the projected occurrence of intense rainfall events in Fremont between 2020 and 2099.

Figure 14. Projected Occurrence of Intense Rainfall Events in Fremont



Notes: RCP 8.5 projected percent changes in intense precipitation throughout the 21st century. Lines represent low-end (light orange)²⁷, mid-range (dark orange) and high-end (red) model results. Source: Global Climate Model (GCM) ensemble as represented on Vizonomy.

Rainfall-Induced Landslides

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

As high-intensity rainfall events increase in frequency the risk of inland flooding increases. Secondary 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. Due to Fremont's location and topography, the risk of experiencing landslides is limited to the area east of

²⁶ 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](https://doi.org/10.1002/2016GL069476)

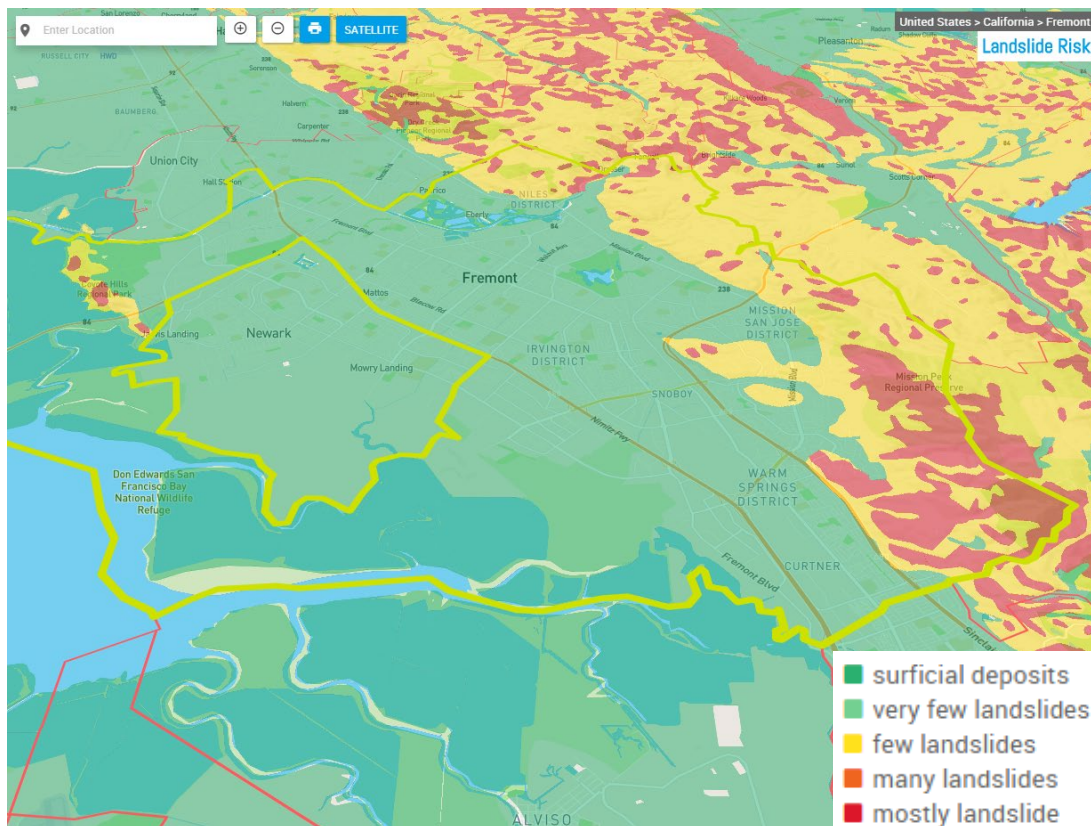
²⁷ In this case, the low-end model results are represented by a flat line at 0.00.

Mission Boulevard in the hills and to Coyote Hills Regional Park on the shoreline. Areas to the north are mainly at a medium level risk for landslide, however Mission Peak Regional Preserve and Coyote Hills Regional Park are subject to high levels of risk, which may be exacerbated by intense precipitation events, earthquakes, and, along the shoreline, sea level rise.

Areas where landslides have already occurred are at greatest risk

As defined by the United States Geological Survey (USGS),²⁸ most of Fremont experiences very few landslides, but the hills to the east and Coyote Hills Regional Park are in zones identified as experiencing “few” to “many landslides.” Landslides are considered to be most likely to occur in and around the places where they have previously taken place. A landslide in 1998 at the Mission Peak Regional Preserve indicates that this area is at an increased risk because landslide probability increases where past events have taken place.²⁹ Figure 15 highlights key areas of Fremont at risk for landslides.

Figure 15. Landslide Risk in and near Fremont



Source: Open Data, OpenStreet Map and USGS³⁰ as represented on Vizonomy.

²⁸ 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>

²⁹ 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>

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>

Extent of landslide risk areas is likely to be unaffected

Fremont is at medium to high risk of experiencing landslide events, with the area east of Mission Boulevard, including the Mission Park Regional Preserve, at the highest risk. An event in this area would primarily affect individual residential water service and the local sewer system, as the primary infrastructure in the area are sewer lines and structures. The Alameda County Water District Mission San Jose Treatment Plant, a hazmat facility, is also in the vicinity and at a medium risk for landslide. Disruptions to this facility, the surrounding sewer system and underground supply pipelines could have negative public health consequences if damaged, potentially exposing the public to raw sewage or other hazardous materials.

Other regions at risk for landslide include the shoreline of Coyote Hills Regional Park, with the area of risk stretching down across CA-84 to Jarvis Landing. Although the areas at high risk are located within the Park and involve limited structures or utilities, a landslide closer to Jarvis Landing could impact CA-84 and access to the Dumbarton Bridge. Throughout the 21st century, sea level rise may increase the risk of landslide in Coyote Hills Regional Park and Jarvis Landing due to the influence of higher water levels on the land.

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. Fremont has large areas that are at risk of high hazard severity in the event of a wildfire, with increased exposure to the northeast of the city where Kilkare Woods has very high hazard severity levels.

Wildfires May Become More Common or Severe

According to the California Department of Forestry and Fire Protection (CAL FIRE) Fire Hazard Severity Zone maps,³¹ Fremont has moderate to high wildfire severity zones in many areas of the city, primarily located in the hills and throughout the parks and property on the shoreline. (See Figure 16.) 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 risks

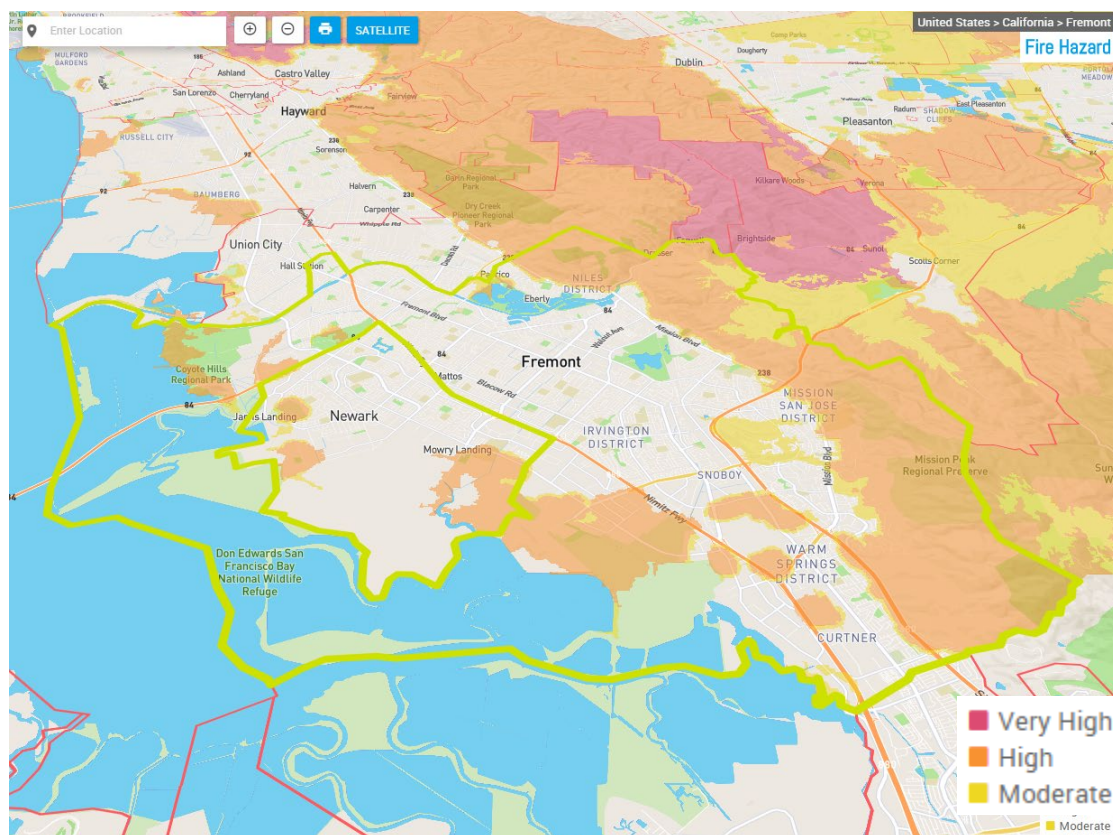
Fire risk in Fremont is concentrated in the hills east of Mission Boulevard and along the coast but also extends further into the city, especially between the Baylands and Mission Peak Regional Preserve in South Fremont. Fremont does not have any very high severity fire zones, but is adjacent to a very high fire hazard severity zone to the northeast.

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

Fire Station 4 is the most vulnerable emergency asset due to its locations in a high fire severity zone. Education assets in designated fire severity zones in Fremont include Forest Park Elementary School, Vallejo Mill Elementary, St. Joseph Elementary, Mission San Jose High, Ohlone College and Northwestern Polytechnic University. Niles Elementary is one city block outside the designated fire hazard zone. In addition, Mission San Jose de Guadalupe and the Dominican Sisters property are in a high fire severity zone.

Communication assets in high fire severity zones include a GTE cell tower and the Fremont Newark Community College FM antenna, both in the hills. At least three other cell towers are close to high hazard severity areas throughout the city. In addition, there is also a large number of hazardous material sites in areas with high fire hazard severity. This is especially true in the high severity areas in the western portion of the city.

Figure 16. Fire Hazard Severity Zones within and near Fremont



Source: Open Data, OpenStreet Map and CalFIRE³² as represented on Vizonomy.

³² 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

3. Adaptation Options

As highlighted in the climate hazard analysis in Section 2, Fremont 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 Fremont 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 Fremont may draw on to address the climate hazards described in Section 2. These options are meant to inform Fremont’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 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 and 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,³³
- 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 – High

1. Update flood hazard data
 - a. Work with the Federal Emergency Management Agency to integrate sea level rise projections into flood hazard data.

³³ See Appendix C for a list of relevant actions from Fremont’s 2016 Local Hazard Mitigation Plan, 2012 Climate Action Plan, and Annex to 2010 Association of Bay Area Governments Local Hazard Mitigation Plan.

- b. Update floodplain maps to assess risks to new and existing development.
- 2. Minimize flood risks for existing development
 - a. Develop a “Maintain-a-Drain” campaign to encourage individuals to keep storm drains in their neighborhood free of debris.
 - 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
- 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. Develop a strategy to convert developed shoreline areas at risk from sea level rise to lower-density uses and/or natural features, and relocate critical assets.
 - d. 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. Support city landscape maintenance staff in becoming 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 – Medium

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. Work with city human services, community services and emergency management departments to 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. Encourage 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 Fremont climate hazards analysis was conducted using a digital mapping tool called The Visonomy Climate Risk Platform (Visonomy). This platform overlays geographical representations of sea level rise, rainfall-induced inland flooding, and landslide with the location of citywide assets throughout Fremont, 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 Fremont 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, yet provide an accurate depiction of where floodwaters are likely to concentrate, even if recurrence intervals change.

Sea Level Rise

The 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 glacial melt patterns. These values are accompanied by ranges of possible sea levels based on low and high emissions scenarios and ice melt scenarios. Figure A1 presents 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 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 ³⁴

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 5-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 the circumstances that sea level rise is combined with higher than projected glacial melt and extreme tides. For example, a 69-inch scale flood is possible with 36 inches of sea level rise and a 25-year extreme tide. A 99-inch scale flood, is possible with 54 inches of sea level rise and a 100-year storm event.

³⁴ National Research Council. (2012). Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Report. DOI: 10.17226/13389

Figure A2. Sea Level Rise and Extreme Tide Matrix

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	15	20	24	28	33	39	45
MHHW + 6 inch	6	21	26	30	34	39	45	51
MHHW +12 inch	12	27	32	36	40	45	51	57
MHHW +18 inch	18	33	38	42	46	51	57	63
MHHW +24 inch	24	39	44	48	52	57	63	69
MHHW +30 inch	30	45	50	54	58	63	69	75
MHHW +36 inch	36	51	56	60	64	69	75	81
MHHW +42 inch	42	57	62	66	70	75	81	87
MHHW +48 inch	48	63	68	72	76	81	87	93
MHHW +54 inch	54	69	74	78	82	87	93	99
MHHW +60 inch	60	75	80	84	88	93	99	105
HYDRODYNAMIC ZONE 4								

Source: *Adapting to Rising Tides* ³⁵

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, while RCP 4.5 is considered a moderate greenhouse gas mitigation scenario where climate action limits the amount of global emissions. ³⁶

³⁵ AECOM and Brian Fulfroost & Associates. (2015). *Adapting to Rising Tides: Alameda County Shoreline Vulnerability Assessment Final Report*.

³⁶ IPCC. (2014). Scenario Process for AR5. Accessed at: http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html

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.³⁷ 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. However, there was no geotechnical survey utilized in the preparation of this data. A Fremont Ordinance requires an appropriate peer review for landslide hazards when development or permit activity occurs in the 11,000 hill parcels.

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.³⁸

³⁷ 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>

³⁸ 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 – citywide 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.”³⁹ 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 Index⁴⁰

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

³⁹ 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>

⁴⁰ FEMA. (2013). *Local Mitigation Planning Handbook*.

Appendix C: Relevant Strategies from Fremont's Plans

2016 Local Hazard Mitigation Plan

Strategy #1

Perform appropriate seismic and fire safety analysis based on current and future use for all City-owned facilities and structures. (Hazards addressed: earthquake, wildfire)

1. Complete analysis of structures supporting critical emergency response and recovery functions, and make recommendations for structural and nonstructural improvements.
2. Prioritize analysis of remaining structures based on occupancy and structure type.
3. Consider the future use of all buildings, and secondary uses those buildings can support in the case of a disaster.

Strategy#2

Strengthen, rehabilitate or replace City facilities and structures, based on the seismic and fire safety analysis, as funding is available. (Hazards: earthquake, wildfire)

1. Use analysis to make recommendations for structural and nonstructural improvements.
2. Integrate unsafe structures into a prioritized program for retrofit or replacement.
3. Seek funding to seismically strengthen or replace additional City buildings in a prioritized order.
4. Periodically assess the need for new or relocated critical facilities including police and fire stations and emergency facilities.
5. Construct resilient facilities and structures that have minimal water and energy needs

Strategy #3

Conduct ongoing training for first responders and City personnel to ensure they have the necessary training and equipment to deal with a hazard (including natural and man-made disaster). (Hazards addressed: Climate change, earthquake, floods, landslide, liquefaction, wildfire)

1. Support an interoperable communications system in case of compromised communications during a natural disaster.
2. Continually train employees on the incident command system and utilizing the Emergency Operations Center (EOC).
3. Periodically assess the need for new training, skills and equipment that will be valuable in responding to an emergency.
4. Consistently use and test equipment in order to provide personnel with adequate gear and communications ability to respond to an emergency.

Strategy #4

Reduce seismic and fire risk in existing development through building and fire code updates and enforcement. (Hazards addressed: earthquake, fire)

1. Update and adopt the Building and Fire Codes with local amendments to incorporate the latest knowledge and design standards to protect people and property against known risks in both structural and non-structural building site components.
2. Maintain Fire Department Efforts to reduce fire risk through: a. Regularly scheduled inspections b. Hazardous material inspections c. Evaluate inspection procedures regularly

3. Maintain fire apparatus access roads for ingress and egress to aide emergency response times and evacuation.

Strategy #5

Explore local legislation to regulate the storage of hazardous materials to be protected from flood zones, rising sea levels and tsunami inundation areas. (Hazards addressed: climate change, earthquake, floods)

1. Continue to assess the potential impact from hazardous materials stored and transported through Fremont.
2. Consult with federal, state and regional patterns to identify legislative best practices in regulating hazardous materials.

Strategy #6

Coordinate disaster preparation and mitigation practices with private sector, public institutions and other public bodies. (Hazards addressed: climate change, earthquake, floods, landslides, liquefaction, wildfire).

1. Support and encourage efforts to plan for and finance disaster-resistance measures undertaken by key lifeline providers (Utility providers, transportation agencies, educational facilities and healthcare facilities): a. Seismic repairs and upgrades b. Disaster preparedness planning c. Collaboration among different agencies and stakeholder d. Implementation of disaster mitigation measures and risk reduction techniques e. Plans for evacuation and reunification of individuals f. Recovery process following a disaster
2. Continue to provide Community Emergency Response Team (CERT) training and Neighborhood Crime Watch Program. As part of the training provide education on how to shut off utilities and prepare for disasters.
3. Maintain an emergency notification system (reverse 9-1-1) to deliver community alerts.
4. Partner with the Association of Bay Area Governments and California Office of Emergency Services to incorporate Fremont's vulnerabilities into regionally managed hazard maps.
5. Seek guidance from CalOES and other local governments on how to best work and educate private sector about business resilience.

Strategy #7

Protect vulnerable water facilities to endure and adequate water supply during emergencies and disaster recovery. (Hazards addressed: earthquake, landslide, liquefaction, wildfire)

1. Coordinate with ACWD to expedite replacement of problem pipelines in neighborhoods with exposure to Wildland-urban interface fire, seismic ground failure and landslides.
2. Coordinate with ACWD to ensure that pipeline replacement projects and upgrades are coordinated prior to street repaving and/or maintenance.
3. On an annual basis, provide a list of critical facilities to ACWD to aid in the prioritization of restoring water service to these facilities.
4. On an ongoing basis, check with SFPUC and State Water Project regarding system upgrades within Fremont, and focus on areas that are susceptible to seismic ground failure, liquefaction and landslides.

Strategy #8

Protect vulnerable electric systems and facilities and build resiliency so disruption to the system is minimized during and following disasters. Ensure adequate redundancy and fuel is available to maintain critical facilities. (Hazards addressed: earthquake, landslide, liquefaction, wildfire)

1. On a continuing basis, provide a list of critical facilities and infrastructure to Pacific Gas and Electric to aid in the prioritization of energy restoration following an energy outage. Make sure PG&E coordinates with other utility providers of water and wastewater (ACWD and USD) to ensure ongoing service can be provided.
2. Identify key City facilities that support emergency operations and estimate the facilities' energy supply and demand to remain operational during an emergency.
3. Prepare the localized energy supply and demand needed for each critical facility, key infrastructure and traffic systems.
4. Identify and develop a plan to have substantial backup power in the form of photovoltaic, generation, battery storage systems, energy efficiency and mobile generators for sites with unmet energy supply sources.
5. On an ongoing basis, check with SFPUC regarding transmission line upgrades within Fremont, and focus on areas that are susceptible to seismic ground failure and landslides.

Strategy #9

Improve the disaster -resistance of the natural gas delivery system to increase public safety and to minimize damage and service disruption following a disaster. (Hazards addressed: earthquake, landslide, liquefaction)

1. Work with the Public Utilities Commission, utilities and oil companies to strengthen, relocate, or otherwise safeguard natural gas and other pipelines where they extend through areas of high liquefaction potential, cross potentially active faults, or traverse potential landslide areas, or areas that may settle differentially during an earthquake.
2. Advocate for the use of automatic shut off valves and remote shut off valves that could be activated in the case of an emergency. Incorporate automatic residential shut off into the building code.
3. As part of the Community Emergency Response Team (CERT), provide education on how to shut off gas lines to private properties.

Strategy #10

Protect vulnerable wastewater facilities to ensure wastewater is treated during emergencies and disaster recovery. (Hazards addressed: earthquake, landslide, liquefaction)

1. Coordinate with USD to expedite replacement of problem pipelines in neighborhoods with exposure to seismic ground failure and landslides.
2. Coordinate with USD to ensure that pipeline replacement projects and upgrades are coordinated prior to street repaving and/or maintenance.
3. Provide a list of critical facilities to USD to aid in the prioritization of restoring wastewater service to these facilities.

Strategy #11

Perform hazard vulnerability assessment analysis for solid waste management facilities utilized by the City. (Hazards addressed: earthquake, floods, landslide, liquefaction)

1. Complete an analysis of facilities supporting the critical disaster debris and solid waste management functions, and make recommendations for structural and nonstructural improvements.
2. Update franchise service agreements to support emergency debris management.
3. Update Fremont's disaster debris management plan, a supplement to the Regional Catastrophic Earthquake Debris Removal Plan.

Strategy #12

Integrate Climate Action Plan goals and actions with the LHMP goals and actions, if determined feasible. (Hazards addressed: climate change)

1. On an annual basis, have the Environmental Sustainability Commission assess the progress on meeting goals established in the Climate Action Plan.
2. Reevaluate results observed thus far, and consider modifying implementable actions to meet those goals, or additional actions to exceed those goals.
3. Following the update to the Climate Action Plan (expected 2017), review and update the Hazard Mitigation Plan to incorporate any goals and actions related to climate vulnerability.
4. Following StopWaste's climate-related hazard assessment, review and update the Hazard Mitigation Plan to incorporate any strategies related to climate and waste vulnerability.

Strategy #13

Integrate climate change research and adaptation planning into City operations and services. (Hazards addressed: climate change)

1. Research and oversee integration of climate change adaptation into City Operations and Services and implement adaptation measures through current operations and services procedures.
2. Maintain the City's participation in the Compact of Mayors, to address climate change by pledging to reduce greenhouse gas emissions, tracking progress and preparing for the impacts of climate change through implementing adaptation measures.
3. Update and Maintain the following elements of the Climate Action Plan: a. Greenhouse Gas Emissions Inventory b. Actions to Reduce GHG Emissions c. Further enhance the use of photovoltaics to power City facilities

Strategy #14

Rehabilitate the City's storm water system to reduce local flooding of nearby streets, utilities and buildings, caused by storm drainage during storms, high tides, sea level rise, seismic events and power outages. (Hazards addressed: climate change, earthquake, floods, landslide, liquefaction)

1. Coordinate with ACFC/WCD to ensure that a hydraulic analysis of watersheds flood capacity is completed.
2. Coordinate with ACFC/WCD to repair and replace pipelines, pump stations and culverts on an ongoing basis.
3. Encourage the use of permeable surfaces to minimize stormwater flow and volume impact; while being mindful of conflicts with mitigating heat island impacts.
4. Encourage water conservation techniques, including the use of local, recycled compost and mulch, that encourage the on-site retention and use of stormwater run-off consistent with Regional Water Quality Control Board policies and requirements.

Strategy #15

Streamline the permitting process to rebuild residential and commercial structures following disasters. (Hazards addressed: climate change, earthquake, floods, landslide, liquefaction, wildfire)

1. Outreach to property owners about the ability to rebuild following a disaster, and clarify the documentation process needed of the current property conditions.
2. For all non-conforming structures that are damaged, impose higher building standards before buildings

are rebuilt under this code.

3. Authorize property owners to hire qualified structural engineers to create building specific post-disaster inspection plans, known as Building Occupancy Resumption Plan (BORP). Allow these engineers to become inspectors in the event of a disaster. This will increase efficiencies and allow more buildings to return to regular use sooner. Regularly review this program to address any changes made to the building code, inspection team and properties covered. Strongly encourage hospitals to engage in this program.
4. Prepare an informational handout for property owners and contractors on steps to rebuild following a disaster.
5. Review and identify improvements to the existing policies, codes and ordinances related to post-disaster recovery, repair and reconstruction.

Strategy #16

Provide outreach activities related to hazard mitigation and disaster preparedness. (Hazards addressed: climate change, earthquake, floods, landslide, liquefaction, wildfire)

1. Provide information on Fremont specific hazards and risk reduction techniques to Fremont organizations, community groups, nonprofits, businesses, vulnerable populations, HOA's, school district and general public. Encourage mitigation activities.
2. Collect and share updated hazard maps with the public.
3. Create printed material, and material on the website to address key elements of the Hazard Mitigation Plan; and, how to better prepare for a disaster.

Strategy #17

Reduce hazard vulnerabilities for non-City owned buildings throughout Fremont. (Hazards addressed: earthquake, floods, landslide, liquefaction, wildfire)

1. Continually update and adopt the California Building Standards Code with local amendments to incorporate the latest knowledge and design standards to protect people and property against known seismic, fire, flood and landslide risks in both structural and non-structural building and site components.
2. Explain building requirements and provide guidance to owners of potentially hazardous structures to facilitate retrofit or replacement.
3. Work with private property owners to prioritize gathering spaces and critical facilities for seismic upgrades.

Strategy #18

Utilize vegetation management to reduce [fire] risks in existing development (Hazards addressed: climate change, wildfire)

1. Increase awareness of vegetation management standards for fire fuel reduction.
2. Maintain Fire Abatement Standards, especially in the hillside and Wildland-Urban Interface areas.
3. Encourage property owners to proactively maintain trees prior to storm season to prevent damage to buildings and/or utility lines.
4. Conduct a baseline tree inventory to have a baseline of existing vegetative conditions.
5. Periodically review CalFire generated maps to understand existing vegetation and evaluate management strategies.
6. Encourage the use of least flammable mulches, such as coarse compost.

Strategy #19

The City's Soft-Story Residential Building Program, Existing Tilt-Up Concrete and Reinforced Masonry Buildings Programs were to be completed by 2008. All known buildings have been retrofitted and removed from the list of buildings out of compliance. If additional buildings are found to be out of compliance, the City will continue to implement the programs. (Hazards addressed: earthquake, floods, landslide, liquefaction)

1. Inform impacted property owners of the requirement to retrofit their building.
2. Work with owners of soft story, tilt-up concrete and reinforced masonry buildings to obtain structural analyses of their buildings and to improve seismic resistance or to remove the buildings and replace them with buildings built to current building and fire codes.

Strategy #20

Continue the City's participation in the National Flood Insurance Program (Hazards addressed: floods)

1. Administer local requests for FEMA map updates and monitor activities.
2. Maintain the Community Rating System rating.
3. Incorporate FEMA guidelines and suggested activities into City plans and procedures for managing flood hazards.

Strategy #21

Establish cooling centers and encourage landscaping improvement to reduce Fremont resident's vulnerability to extreme heat events, severe storms and associated hazards. (Hazards addressed: earthquake, landslide, liquefaction, wildfire)

1. Monitor and support efforts of Association of Bay Area Government, California Energy Commission, Cal-Adapt and California Office of Emergency Services, to forecast the impact of climate change on temperatures and extreme heat events.
2. Integrate extreme heat readiness into City operations and services.
3. Support sufficient soil volumes to create an urban tree cover and the use of vegetation to reduce temperatures and increase air quality.
4. Encourage the use of compost berms, blankets, and socks for erosion and sedimentation control.
5. Support landscape management plans and practices to protect bare soil with local recycled compost and mulch.
6. Continue to implement energy efficiency ordinances for existing residential and commercial buildings to improve building comfort, including in extreme weather conditions, and to reduce energy usage

Strategy # 22

Collaborate with ACWD, local, state, regional and federal partners to increase security of Fremont's water supply from climate change impacts. (Hazards addressed: climate change)

1. Encourage the use of water conservation in the design of new buildings and landscaping.
2. Encourage water recycling and gray water use.
3. Encourage private property owners and public agencies to use sustainable landscaping techniques that require less water.
4. Encourage the use of compost blankets, socks, and berms for erosion control during and after construction.
5. Ensure property owners and the City complies with the State's Water Efficient Landscape Ordinance and Bay Friendly Landscaping Guidelines.

6. As funding permits, retrofit City buildings with low flow water fixtures (such as aerators, low flow toilets, etc.) and drought tolerant landscaping.
7. Consider replacing irrigation controls with weather based irrigation controls.

Strategy #23

Mitigate the impacts of sea level rise in Fremont, by making shoreline and Bay lands facilities more resilient to earthquake, storm and high water elevation hazards in order to maintain functionality and protect inland facilities. Define any associated tsunami hazards and mitigation. (Hazards addressed: climate change, earthquake, floods)

1. Document and explore potential tsunami hazard mitigation measures for Fremont's Baylands areas, and implement if feasible.
2. Monitor and participate in regional, state and federal research on projected sea level rise in the Bay Area region and incorporate findings into future analysis and adaptation measures.
3. Continue to maintain the Baylands as Resource Conservation and Public Open Space

2012 Climate Action Plan

Emission reduction actions and implementation timeline:

GOAL: Reduce greenhouse gas emissions by facilitating transit-oriented development, conducting outreach and educational efforts to promote behavior change, and creating the conditions that support people's ability to make choices which support this goal.

Short term actions: Water

- W-A1 Continue the annual collaboration with the California Youth Energy Services program to conduct residential energy and water audits and to distribute water-saving shower heads and faucet aerators to Fremont households, as replacements for less efficient fixtures. (This action is also listed in the "Energy" Chapter).
- W-C1 Continue to implement the Water Efficient Landscape Ordinance for private development.
- W-C2 Collaborate with Alameda County Water District to implement water conservation and reclamation programs.
- W-P1 Encourage use of on-site recycled water systems, (also known as 'greywater systems' or "laundry to landscape") consistent with all environmental and health and safety regulations and Alameda County Water District policies and requirements.

Medium term actions: Water

- W-C3 Collaborate with Alameda County Water District to adopt a retrofit program to encourage installation of water conservation measures in existing businesses and residences.
- W-C4 Collaborate with Alameda County Water District and Union Sanitary District to support the use of recycled water.
- W-C5 Support development of a process for permitting, registration, and inspection of greywater systems by the City.

- W-C6 Consult with ACWD in developing policies and regulations supporting the use of water conserving strategies, including greywater systems.

Appendix D: Adaptation Options

Inland Flooding

Exposure level – High

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	<p><u>Comments:</u> 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.</p> <p>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.</p> <p><u>Timeframe</u>⁴¹: Short-term</p> <p><u>Ease of Implementation</u>⁴²: High</p> <p><u>Potential Funding</u>: N/A</p>
Update floodplain maps to assess risks to new and existing development.	Alameda County Flood Control and Water Conservation District	<p><u>Comments:</u> 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) should also be used as resources in all related future planning efforts.</p>

⁴¹ 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.

⁴² 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).

		<p>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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> N/A</p>
<p>Resources:</p> <p>FEMA. CCAMP: San Francisco Bay Area Coastal Study. http://www.r9map.org/Pages/San-Francisco-Coastal-Bay-Study.aspx</p> <p>FEMA. San Francisco Bay Area Coastal Study, Alameda, California. http://www.r9map.org/Pages/ProjectDetailsPage.aspx?choLoco=1&choProj=183</p> <p>USGCRP. After Sandy, Rebuilding Smarter with Science and Technology. 2013. http://www.globalchange.gov/news/after-sandy-rebuilding-smarter-science-and-technology</p>		

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
Develop a “Maintain-a-Drain” campaign to encourage individuals to keep storm drains in their neighborhood free of debris.	Community organizations and non-profit organizations, public works department, Alameda County Flood Control and Water Conservation District	<p><u>Comments:</u> Oakland’s Adopt a Drain program is a successful example of this type of campaign. 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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> East Bay Municipal Utility District</p>
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.	Emergency management and response, community organizations and non-profit organizations, Alameda County Flood Control and Water Conservation District	<p><u>Comments:</u> Technical assistance can raise awareness and preparedness for potential flood events. An important initial step will be identifying the populations that are the most 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</p>

		<p>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.</p> <p><u>Timeframe:</u> Ongoing</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> California Governor's Office of Emergency Services (CalOES)</p>
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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Low</p> <p><u>Potential Funding:</u> California Department of Water Resources, CalOES</p>
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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> CalOES</p>
Maintain integrity of essential public facilities.	City contractors or staff in charge of facility maintenance, community groups and non-profit organizations,	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> California Environmental Protection Agency (CalEPA) and other state agencies</p>
<p>Resources:</p> <p>Oakland Adopt A Drain program: http://adoptadrainoakland.com/</p> <p>FEMA. Building Code Resources. https://www.fema.gov/building-code-resources</p> <p>FEMA. Design Considerations in Floodproofing. https://www.fema.gov/media-library-data/643d07bceee8ade17eef8e11cf7a2abb/P-936_sec2_508.pdf</p> <p>The Sustainable Site: The design manual for green infrastructure & low impact development. http://www.foresterpress.com/fps_sustain.html</p>		

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 disproportionately

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	<u>Comments:</u> NFIP programs, such as the CRS help communities achieve flood insurance premium reductions for their citizens while also protecting them from flood risks. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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.	<u>Comments:</u> 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. <u>Timeframe:</u> Ongoing/Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> N/A
Require 100% on-site stormwater management for new development.	CalEPA STORMS Program, Bay Area Stormwater Management Agencies Association, Alameda County Clean Water Program	<u>Comments:</u> Updated stormwater management plans and permitting requirements to call for 100% stormwater management will ensure that new and retrofitted development will not add additional load to the stormwater system or negatively impact nearby properties by impacting local runoff patterns. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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. <i>Environment and Planning A</i> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	<u>Comments:</u> Use compost berms: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • For check dams to slow areas of concentrated flow from stormwater • For slope interruptions to slow run off on steep slopes

		<ul style="list-style-type: none"> For bank stabilization along water ways around storm drains for inlet protection from contaminated run off in storm events and after wildfire or earthquakes <p>Use compost blankets:</p> <ul style="list-style-type: none"> For slope (landslide) stabilization on bare or disturbed soils or post wildfires and To create vegetated filter strips for stormwater control <p>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.</p> <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund</p>
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.	<p><u>Comments:</u> Integrating these requirements into city-wide standards will increase effectiveness and uptake.</p> <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> N/A</p>
Protect bare soil with local recycled compost and mulch.	Local community organizations and non-profit organizations, StopWaste, homeowners associations	<p><u>Comments:</u> Adopting a city-wide policy to adopt this practice on public lands can help protect public assets. Community 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.</p> <p><u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> California Natural Resources Agency Urban Greening Fund</p>
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	<p><u>Comments:</u> 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</p>

	Municipal Utility District, Green Plan-IT	<p>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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> California Natural Resources Agency Urban Greening Fund, California Landscape Conservation Cooperative, Coastal Conservancy, EPA Clean Water State Revolving Fund</p>
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	<p><u>Comments:</u> 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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> California Natural Resources Agency Urban Greening Fund</p>
<p>Resources:</p> <p>Caltrans. Erosion Control Toolkit: Compost. http://www.dot.ca.gov/hq/LandArch/16_la_design/guidance/ec_toolbox/organics/compost_blanket.htm</p> <p>Coastal Conservancy Climate Ready Program. http://scc.ca.gov/climate-change/climate-ready-program/</p> <p>Committee for Green Foothills. “Living Levees”: Protecting Against Sea Level Rise by Restoring Wetlands.”</p>		

<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.0TGbtJO.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 Area 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.	<p>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.</p> <p>Compost increases carbon sequestration in the soil and stimulates the growth of more biomass. One inch of compost applied on one acre can avoid 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</p>

		<p>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.</p> <p>The following are recommended guidelines for the application of compost and mulch:</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <p><u>Timeframe:</u> Ongoing <u>Ease of Implementation:</u> High <u>Potential Funding:</u> Cap and trade funds, Proposition 1, Capitol improvement budgets, Healthy Soils Initiative</p>
<p>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.</p>		

Measure 6: 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	<p><u>Comments:</u> 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.</p> <p>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.</p> <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> Coastal Conservancy, participating implementing partners</p>
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	<u>Comments:</u> 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. <u>Timeframe:</u> Short-term/Ongoing <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-term/Ongoing <u>Ease of Implementation:</u> High <u>Potential Funding:</u> N/A
Develop a strategy to convert developed shoreline areas at risk from sea level rise to lower-density uses and/or natural features, and relocate critical assets.	HazMat site owners and operators, PG&E, East Bay Municipal Utility District, other asset owners	<u>Comments:</u> This can include creating a transition plan to account for the relocation of critical resources located in the projected floodplain for sea level rise. Include hazardous materials sites, key electric grid infrastructure and other key city assets. Planning for relocation should account for the life of the asset and the projected sea level rise that corresponds with that expected timeframe. Assets that are expected to serve local communities through the end of the century (hazmat control, energy transmission, sewer, etc.) should account for the “likely” scenario of 36 inches of sea level rise at a minimum. By identifying these assets and developing a transition strategy and schedule, the City and its partners will be able to adapt incrementally. <u>Timeframe:</u> Short-term plan development, long-term implementation <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> DOE, Ocean Protection Council (OPC) Local Coastal Program Sea-level Rise Grant Program

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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Long-term</p> <p><u>Ease of Implementation:</u> Low</p> <p><u>Potential Funding:</u> 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</p>
<p>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. <i>Land Use Policy</i> 32:89-95. DOI: 10.1016/j.landusepol.2012.10.017</p>		

Measure 8: 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	<p><u>Comments:</u> 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</p>

		<p>inform effective and locally-appropriate strategies.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> BCDC, Resilient by Design</p>
Monitor and participate in regional and state-level policy and programmatic development on waterfront protection and rehabilitation.	<p>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</p>	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> Participating implementing partners</p>
<p>Resources:</p> <p>BCDC. Adapting to Rising Tides. http://www.adaptingtorisingtides.org/</p> <p>Bay Area Regional Collaborative. Bay Area Climate Asset Map (2014): http://bayarearegionalcollaborative.org/pdfs/BACERP_Bay_Area_Climate_Asset_Map_Nov_2014_v2.doc</p> <p>CHARG. http://www.acfloodcontrol.org/SFBayCHARG/</p> <p>Sea Change San Mateo County. http://seachangesmc.com/</p>		

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	<u>Comments:</u> 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

		<p>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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of implementation:</u> Medium</p> <p><u>Potential funding:</u> East Bay Regional Park District, California ReLeaf network, CalFIRE</p>
Identify priority areas to expand urban tree and vegetation planting.	Urban forestry community organizations and non-profit organizations	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of implementation:</u> High</p> <p><u>Potential funding:</u> California ReLeaf network</p>
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	<p><u>Comments:</u> 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:</p> <ul style="list-style-type: none"> • Large tree: 1200 sq. ft. • Medium tree: 900 sq. ft. • Small tree: 600 sq. ft. <p>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</p>

		<p>(shifting the responsibility from property owners), and providing discounts on trees and for pick-up of concrete to homeowners.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of implementation:</u> Medium</p> <p><u>Potential funding:</u> FEMA, developer fees</p>
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.	California ReLeaf network or other urban forestry organization as a tree maintenance partner	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of implementation:</u> Medium</p> <p><u>Potential funding:</u> 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.</p>
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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Ongoing/Long-term</p> <p><u>Ease of implementation:</u> Medium</p> <p><u>Potential funding:</u> California ReLeaf network</p>
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.	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of implementation:</u> Medium</p> <p><u>Potential funding:</u> California Natural Resources Agency Urban Greening Grant Program, California Natural Resources Agency Environmental Enhancement and Mitigation</p>

		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.

		<u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-term <u>Ease of implementation:</u> Medium <u>Potential funding:</u> 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	Target facilities, PG&E, local government partnership programs,	<u>Comments:</u> Relevant plans to integrate energy assurance considerations into include emergency management and hazard mitigation

<p>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.</p>	<p>Bay Area Regional Energy Network, public sector programs</p>	<p>plans, general plans, climate action plans, climate adaptation plans or resilience strategies. Potential actions to support implementation might include:</p> <ul style="list-style-type: none"> • 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. <p>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).</p> <p><u>Timeframe:</u> Mid-term <u>Ease of implementation:</u> High <u>Potential funding:</u> 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</p>
<p>Purchase or engage in power purchase agreements for the installation and deployment of solar plus storage systems. Implement group procurement of microgrid components.</p>	<p>Target facilities, PG&E, California Energy Commission, California Public Utilities Commission, Lawrence Berkeley National Laboratory, Community Choice Energy electricity providers, distributed renewable energy installers and energy storage companies</p>	<p><u>Comments:</u> Group procurement is a strategy to systematically bring down the cost of large scale deployment of distributed renewable energy, storage and controls measures.</p> <p><u>Timeframe:</u> Long-term <u>Ease of implementation:</u> Low <u>Potential funding:</u> Federal Tax Credit, State Self-Generation Incentive Program, California Energy Commission, Department of Energy</p>

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	<p><u>Comments:</u> 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.</p> <p>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.</p> <p><u>Timeframe:</u> Ongoing/Long-term</p> <p><u>Ease of implementation:</u> Medium</p> <p><u>Potential funding:</u> California Energy Commission grants, California Air Resources Board grants, Energy Efficiency incentive programs</p>
<p>Resources:</p> <p>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</p> <p>The California Endowment. Information on grants and Program-Related Investments: http://www.calendow.org/grants-and-pris/</p> <p>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</p> <p>International Energy Agency. Making the Energy Sector More Resilient to Climate Change. 2015. https://www.iea.org/publications/freepublications/publication/COP21_Resilience_Brochure.pdf</p> <p>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</p>		

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	Local ground water	<u>Comments:</u> Understanding the status of

and quality. Support the California Statewide Groundwater Elevation Monitoring Act (CASGEM).	management agency, Bay Area Integrated Regional Water Management (BAIRWM) group, East Bay Municipal Utility District, State Water Board, California Department of Water Resources	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. <u>Timeframe:</u> Ongoing <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-Long Term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Long-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> See Measure 5 on improving soil health. <u>Timeframe:</u> Ongoing <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Short term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> Promote resources through water agencies and lawntogarden.org. Craft these programs to complement the implementation and enforcement of the city's WELO. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> Adjust the specific percent goal based on the city's capacity, water resource use and needs and other existing goals, plans or ordinances. <u>Timeframe:</u> Medium-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> Some potential activities include pursuing or expanding a communications strategy for water conservation in residential

		<p>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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> N/A</p>
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)	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> East Bay Municipal Utility District</p>
Streamline the permit process for greywater systems, and align the permit process with the degree of system risk.	California Water Foundation	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Long-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> N/A</p>
Promote greywater use by requiring dual plumbing for greywater from laundry and showers in new developments.	California Water Foundation	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Long-term</p> <p><u>Ease of Implementation:</u> Low</p> <p><u>Potential Funding:</u> N/A</p>
Encourage the use of rainwater harvesting facilities, techniques and improvements where appropriate, cost effective, safe and environmentally sustainable.	Greywater Action, Wholly H ₂ O, non-profit organizations and other community organizations	<p><u>Comments:</u> 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,</p>

		<p>small and large commercial, and industrial.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> Water-SMART grants</p>
<p>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.</p>	<p>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</p>	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> Water-Energy Grant Program, Water-SMART grants</p>
<p>Build municipal cisterns.</p>	<p>East Bay Municipal Utility District, Bay Area Stormwater Management Agencies Association, American Rainwater Catchment Systems Association, Alameda County Flood Control and Water Conservation District</p>	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Long-term</p> <p><u>Ease of Implementation:</u> Low</p> <p><u>Potential Funding:</u> Water-SMART grants</p>
<p>Incentivize and promote the use of compost and mulch in existing landscapes and gardens to create drought resistant soils.</p>	<p>Lawntogarden.org</p>	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> StopWaste</p>
<p>Use practices in the Bay-Friendly Landscape Maintenance Manual to maintain city landscapes.</p>	<p>ReScape California</p>	<p><u>Comments:</u> Minimum landscape practices to include are:</p> <ul style="list-style-type: none"> • 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.

		<ul style="list-style-type: none"> • 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. <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> N/A</p>
Support city landscape maintenance staff in becoming Bay-Friendly Qualified Professionals.	ReScape California, StopWaste	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> StopWaste</p>
<p>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</p>		

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	San Francisco Public Utilities Commission, architecture firms, developers	<p><u>Comments:</u> Methods of encouraging local water use include:</p> <ul style="list-style-type: none"> • Require dual plumbing and greywater use for

water, such as greywater, rainwater, air conditioning condensate and foundation drainage.		<p>laundry, toilets, onsite irrigation and showers in new developments.</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <p><u>Timeframe:</u> Short- to Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> N/A</p>
<p>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</p>		

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	<p><u>Comments:</u> Minimum landscape practices to include are:</p> <ul style="list-style-type: none"> • 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

		<p>sub meter.</p> <ul style="list-style-type: none"> • 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. <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> N/A</p>
Fully implement the new California Model WELO for city and new permitted landscapes.	California Department of Water Resources, StopWaste	<p><u>Comments:</u> The Model Ordinance was updated in 2015 to increase water efficiency standards for new 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.</p> <p><u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> California Department of Water Resources</p>
Have city and agency staff involved in landscape design, construction, maintenance or regulation become Bay-Friendly Qualified Professionals.	ReScape California	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> StopWaste</p>
<p>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</p>		

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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> 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)</p>
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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Mid-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> 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</p>
Encourage the use of compost in urban agriculture.	StopWaste, Mandela Marketplace, CitySlicker Farms, and other non-profit organizations and community groups	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> CalEPA</p>
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	<p><u>Comments:</u> 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</p>

		<p>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.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> California Department of Food and Agriculture, CalRecycle Greenhouse Gas Reduction Loan Program, CalEPA</p>
<p>Resources:</p> <p>Roots of Change. California Food Policy Council. http://www.rootsofchange.org/projects/california-food-policy-council/</p> <p>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</p> <p>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</p> <p>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</p>		

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	<p><u>Comments:</u> 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.</p> <p><u>Timeframe:</u> Long-term</p> <p><u>Ease of Implementation:</u> Medium</p>

		Potential Funding: N/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.	Alameda County Flood Control and Water Conservation District	Comments: Implementing this action requires a progressive process that includes best practices, routine maintenance, 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-nstdi.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 – Medium

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	Alameda County Community Development Agency	Comments: Current and future land use planning efforts should take into account risk

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.		of fire and other hazards, as well as recognize that development 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. <u>Timeframe:</u> Ongoing <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Ongoing <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> N/A
Actively participate in	CalOES Regional	<u>Comments:</u> Participate in planning efforts, such as

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.	Emergency Operations Center, state and regional fire and rescue coordinators, the State Fire Marshal, and CalFIRE	<p>updates to the Alameda County Community Wildfire Protection Plan.</p> <p>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.</p> <p><u>Timeframe:</u> Long-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> CalFIRE Fire Prevention Fund</p>
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
Work with city human services, community services and emergency management departments to 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, local social services, local non-governmental organizations	<p><u>Comments:</u> 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. 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.</p> <p>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</p>

		<p>a better understanding of projected effects of heat waves.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> Medium</p> <p><u>Potential Funding:</u> Centers for Disease Control and Prevention</p>
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	<p><u>Comments:</u> Linguistically isolated communities can be especially vulnerable to high heat and therefore should be considered in outreach and communications.</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> N/A</p>
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	<p><u>Comments:</u> 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.</p> <p>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).</p> <p><u>Timeframe:</u> Short-term</p> <p><u>Ease of Implementation:</u> High</p> <p><u>Potential Funding:</u> US Department of Health and Human Services, US Department of Housing and Urban Development</p>

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>
 Hamilton, Billy and Christina L. Erikson. Urban Heat Islands and Social Work: Opportunities for Intervention. *Advances in Social Work* Vol. 13 No. 2 (Summer 2012), 420-430.
 Georgetown Climate Center. Federal Funding Compendium for Urban Heat Adaptation. 2013.
<http://www.georgetownclimate.org/files/report/Federal%20Funding%20Compendium%20for%20Urban%20Heat%20Adaptation.pdf>
 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	<u>Comments:</u> Examples include conducting outreach to locations where residents purchase firewood, such as grocery and home improvement stores, and engaging them in communication campaigns. <u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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	Critical facility owners, PG&E, energy assessment consulting firms	<u>Comments:</u> 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.

demand during emergencies to assess facilities' vulnerabilities to power loss.		<u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> California Energy Commission grants, Lawrence Berkeley National Laboratory, US Department of Energy
Encourage 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	<u>Comments:</u> Encourage each utility to update their emergency management plans to incorporate climate science and risk data. <u>Timeframe:</u> Long-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Long-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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

	Certified Unified Program Agency	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. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> Medium <u>Potential Funding:</u> 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	<u>Comments:</u> 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. <u>Timeframe:</u> Short-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> N/A
Identify emergency response and evacuation access ways and address their vulnerability to flooding, landslides, etc.	Emergency management planners and response professionals	<u>Comments:</u> 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. <u>Timeframe:</u> Mid-term <u>Ease of Implementation:</u> High <u>Potential Funding:</u> 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		