Appendix X Fullerton Safety Element Supplement

The following document is intended to support the City's ongoing compliance with California Government Code 65302 (g) requirements requiring update to the General Plan Safety Element. In addition to this document, the City has prepared a Climate Adaptation Vulnerability Assessment (Attachment A) and a series of updated Goals, Policies, and Actions that have been incorporated into the General Plan.

The following link provides access to this document: LINK

5-15-2024

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Fullerton Safety Element Supplement

Emergency Preparedness/Evacuation

The ability to anticipate, evaluate, and mitigate potential risks posed by natural and human-caused hazards is paramount to a city's longevity. Although this element specifically addresses natural and human-caused hazards, emergency preparedness involves many more considerations beyond identifying them. The Emergency Preparedness section consolidates and briefly describes the City of Fullerton's hazard prevention and response strategies.

Police Service

The Fullerton Police Department is comprised of two divisions: an Operations Division and a Support Services Division. Within the department, officers and civilians manage the daily tasks necessary to operate and provide a high level of service to the citizens of Fullerton. With approximately 180 employees (approximately 70% sworn positions), the Fullerton Police Department manages close to 50,000 calls for service annually.

Fire Service

Fire protection and emergency service for the city is provided by the Fullerton Fire Department (FFD). Services provided include fire protection, emergency response, medical aid, fire prevention and inspections, hazardous materials control, and community education programs. The department has approximately 80 full-time employees spread amongst 3 divisions: Administration, Prevention, and Operations. Operating from six stations throughout the city, the FFD covers an area of approximately 22.5 square miles.

These facilities, in conjunction with Police facilities, provide adequate emergency/disaster response capabilities for the City. *Exhibit 15: Police and Fire Protection Facilities,* found in the Public Safety Tables and Exhibits chapter of the Fullerton Plan, depicts the locations of these facilities in Fullerton. The FFD is responsible for community outreach and education regarding fire awareness and prevention information. This information focuses on at-risk populations, especially those portions of the population located within fire-prone areas.

Emergency Management

Emergency management is provided by the Office of Emergency Management (OEM), led by the Emergency Manager. OEM is tasked with helping our community and City organizations anticipate hazards and vulnerabilities and take measures to better plan and prepare for natural and human-caused disasters. OEM ensures City employees, residents, and businesses are prepared for disasters. The OEM is also responsible for the oversight and management of disaster and preparedness grants, the Community Emergency Response Team (CERT) and Radio Amateur Civil Emergency Services (RACES) volunteer programs, community outreach and engagement, training, and ensuring the City is meeting local, state, and federal requirements.

Preparedness

The Emergency Operations Plan (EOP) is primarily responsible for informing the City's emergency management strategies. The EOP incorporates detailed response plans for emergency events such as fires, earthquakes, floods, pandemics, and terrorist activities. These strategies are typically organized under four categories: mitigation, preparedness, response, and recovery. Preparedness activities ensure City Departments are adequately trained and prepared

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for future hazard events. City preparedness activities focus on ensuring the City's Emergency Operations Center (EOC) is adequately supplied and staffed by trained personnel in the event of an emergency.

Response

Emergency response activities typically focus on actions necessary to save lives and prevent further property damage during an emergency/disaster. Many of these activities are conducted in tandem with the Fullerton Police and Fire Departments' standard emergency response procedures. To guide response activities, the City will rely on the EOP and work closely with volunteer organizations such as CERT, which helps orchestrate internal and external communications, logistics, and assistance during large-scale emergencies. If City resources become overwhelmed, the City will request support through the Operational Area using automatic aid and mutual aid agreements currently in place with the State, County, and neighboring jurisdictions. However, the City recognizes that mutual aid resources depend on availability and may be limited during a large regional incident. Therefore, consideration for strengthening self-sufficiency is a priority.

Recovery

Recovery activities typically occur after an emergency/disaster event. These activities focus on reestablishing services to any impacted areas, repairing and/or reconstructing damaged buildings and infrastructure, and aiding residents and businesses with permitting and approvals of building plans as part of the reconstruction process. Depending on the scale and type of incident, recovery could occur in specific community locations and/or require specialized expertise to address the issues created. Cleanup of hazardous wastes shall be considered part of the recovery from a major disaster event (fire, flood, landslide, or earthquake).

Mitigation

The EOP, in conjunction with the Fullerton Local Hazard Mitigation Plan, identifies and assesses the natural and human-caused hazards that threaten the City and recommends proactive policy and procedural actions that reduce the risks associated with these hazards. This preemptive planning is intended to decrease the probability of emergency situations and minimize the effects should one occur. The Local Hazard Mitigation Plan (LHMP) was developed in accordance with the Disaster Mitigation Act of 2000 (DMA 2000) and followed FEMA's Local Hazard Mitigation Plan guidance. The LHMP incorporates a process where hazards are identified and profiled, the people and facilities at risk are analyzed, and mitigation actions are developed to reduce or eliminate hazard risk. Implementing these mitigation actions, which include short- and long-term strategies, involves planning, policy changes, programs, projects, and other activities.

As part of the City's preparedness initiatives, an evacuation analysis has been prepared that identifies the routes used for evacuation purposes. ***Exhibit 1*** depicts the potential evacuation routes that could be used during a hazard event. These roadways are intended to meet evacuation needs; however, the City recognizes that some constraints may affect evacuation, namely narrow roadways, bridges, and railroad crossings. These locations may be vulnerable if failure or blockage occurs. ***Exhibit 2*** identifies constrained roadways (single ingress/egress conditions) and parcels that use these roadways (constrained parcels). These constrained locations are required to be identified by California Government Code Section 65302(g)(5) [SB99]. The mapping depicts both constrained access parcels (identified in orange), which are parcel groups of more than 30 individual parcels located on a constrained roadway. The map also depicts parcel groups of concern (identified in green), which are groups of between 20-29 individual parcels located along a constrained roadway. These parcel groups of concern are identified because of the potential to become constrained access parcels should new development or

redevelopment (construction of additional dwelling units, subdivision, etc.) occur in these areas. In the event of a natural hazard or other emergency, these areas of constrained access can potentially become much more difficult to evacuate should it become necessary.

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Exhibit 1- Potential Evacuation Routes in Fullerton

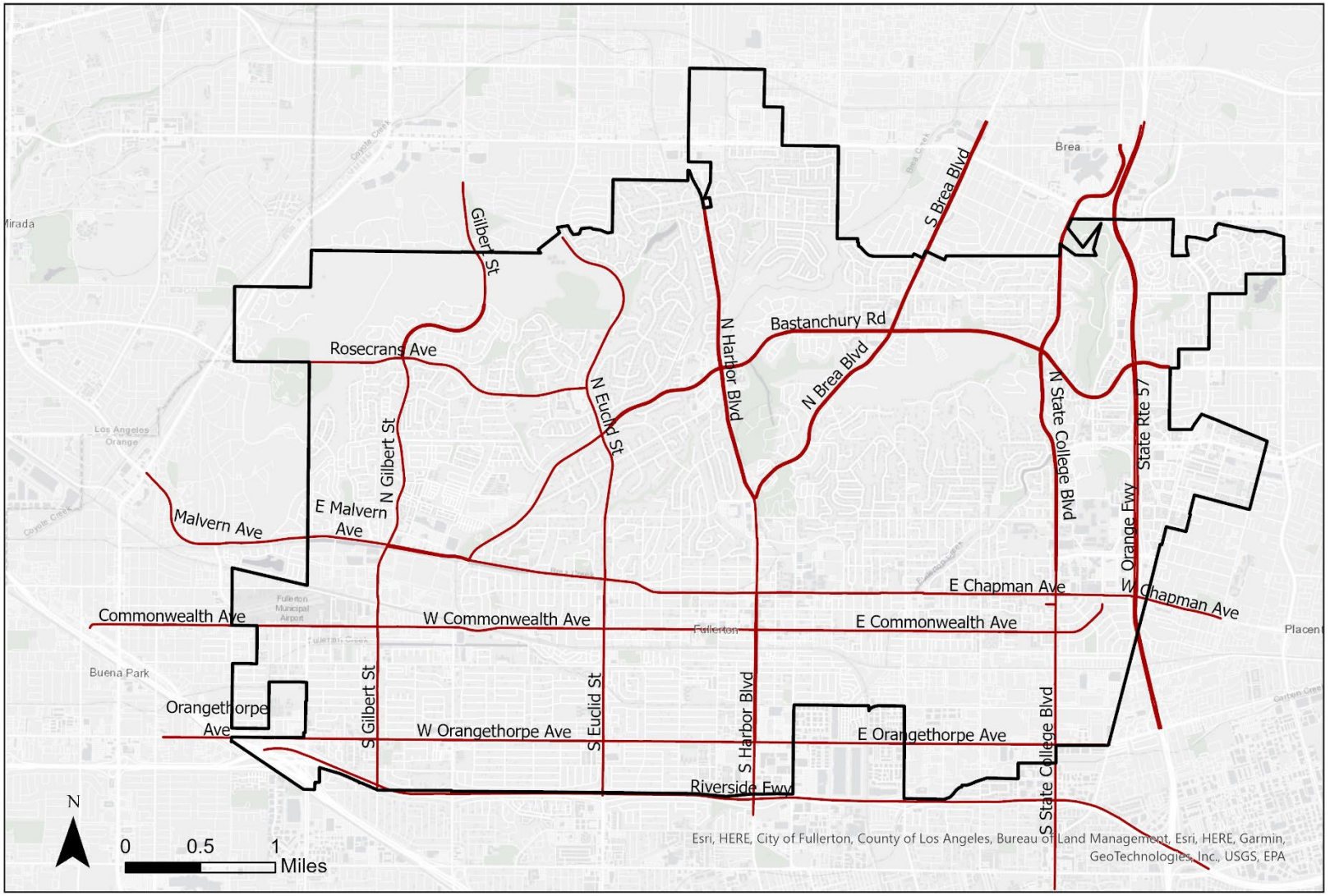

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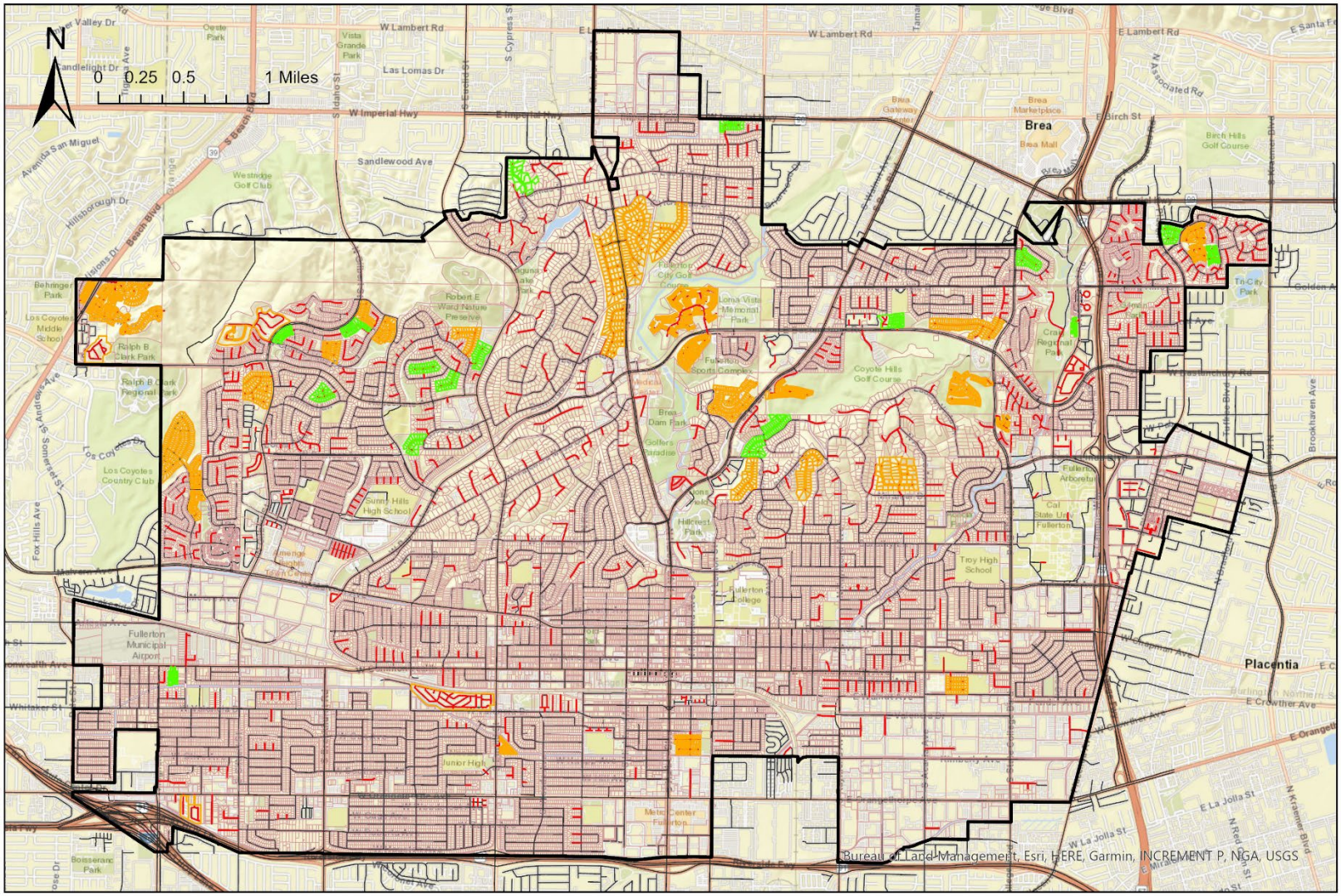
Exhibit 2 – Constrained Roadways, Constrained Access Parcels, and Parcels of Concern



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Seismic Hazards: Fault Rupture, Seismic Shaking, Liquefaction

Seismic Hazards

Southern California is a seismically active region that experiences earthquakes regularly. Fullerton is prone to seismic hazards due to its location and proximity to active earthquake faults. Seismic hazards that can potentially affect the city are characterized as follows:

Fault Rupture

The Earth is covered in tectonic plates, which are large sections of the Earth's crust constantly shifting and moving closer together, further apart, or past one another. The movement of two plates past one another frequently causes friction, resulting in plates that "stick." When this occurs, the same forces that push the plates past each other are now concentrated in certain areas. In time, friction can no longer hold the plates together, and the plates suddenly shift, releasing a massive build-up of energy (i.e., earthquake). This rapid movement and release of energy can cause the Earth to fracture and displace the land around it, resulting in an earthquake fault. Some faults are buried beneath the surface, while others are located on the surface of the Earth. Surface rupture of a fault is especially dangerous if structures are built on top of the fault or infrastructure crosses the fault, as fault movement could damage these facilities. If a surface rupture occurs, the movement could break pipelines and damage roads and bridges, rendering them useless after the event. Areas of known surface rupture hazard in California are identified in Alquist-Priolo Special Study Zones. Fullerton has no Alquist-Priolo Special Study Zones within the city, reducing the concern associated with surface rupture.

Seismic Shaking

Seismic shaking is the recognizable movement caused by the energy released from an earthquake. The same mechanism that creates a surface rupture is also responsible for seismic shaking and can produce an equally devastating effect. Earthquakes may occur without surface rupture, which can still cause significant damage to buildings and other structures. Infrastructure such as roads, railways, pipelines, and power lines are also susceptible to damage and pose additional safety concerns. Unlike surface rupture, seismic shaking consequences are not restricted to the area immediately surrounding the fault. Energy resonating through the ground can travel hundreds of miles and simultaneously cause damage in many locations. The closer to the earthquake's source (epicenter), the stronger the shaking will be. Seismic shaking is of particular concern for the City due to the proximity to active faults that can generate significant earthquakes. The Puente Hills Fault is the closest fault to the city and is capable of generating a magnitude 6.7 to 7.5+ earthquake that could potentially damage buildings and infrastructure. Other notable faults include the San Andreas, Newport-Inglewood, and Whittier Fault zones. *Exhibit 26: Earthquake Hazards* in the Fullerton Plan (Page 207) depicts the locations of the local and regional faults in and near the city.

Liquefaction

Liquefaction is a phenomenon that occurs when intense vibrations from an earthquake cause saturated soil to lose stability and act more like a liquid than a solid. This poses significant problems for buildings and other structures in areas where liquefaction can occur, as the ground may give way under the weight of the structure and its foundation. In addition, underground structures are vulnerable to liquefaction. Most of the City lies within a low liquefaction risk zone; however, the Coyote Creek Floodplain in the northwest section of Fullerton contains areas susceptible to liquefaction based on the presence of saturated, loose sandy soils at depths less than 40 feet. ***Exhibit 3*** depicts the areas of the city potentially susceptible to liquefaction. Although the Carbon Creek alluvial fan is composed of loose, sandy material, susceptibility is considered low since groundwater is deeper than 50 feet below the surface. Since liquefaction occurs in areas

with saturated soils, areas of liquefaction with slopes are also known to trigger events known as "deep-seated landslides," which are landslides that occur when water accumulates in the soil underneath the slope's surface. The areas of West Coyote Hills and East Coyote Hills are susceptible to deep-seated landslides. ***Exhibit 4*** depicts the areas of the city potentially susceptible to landslides.

Exhibit 3 – Areas of Liquefaction Potential in Fullerton

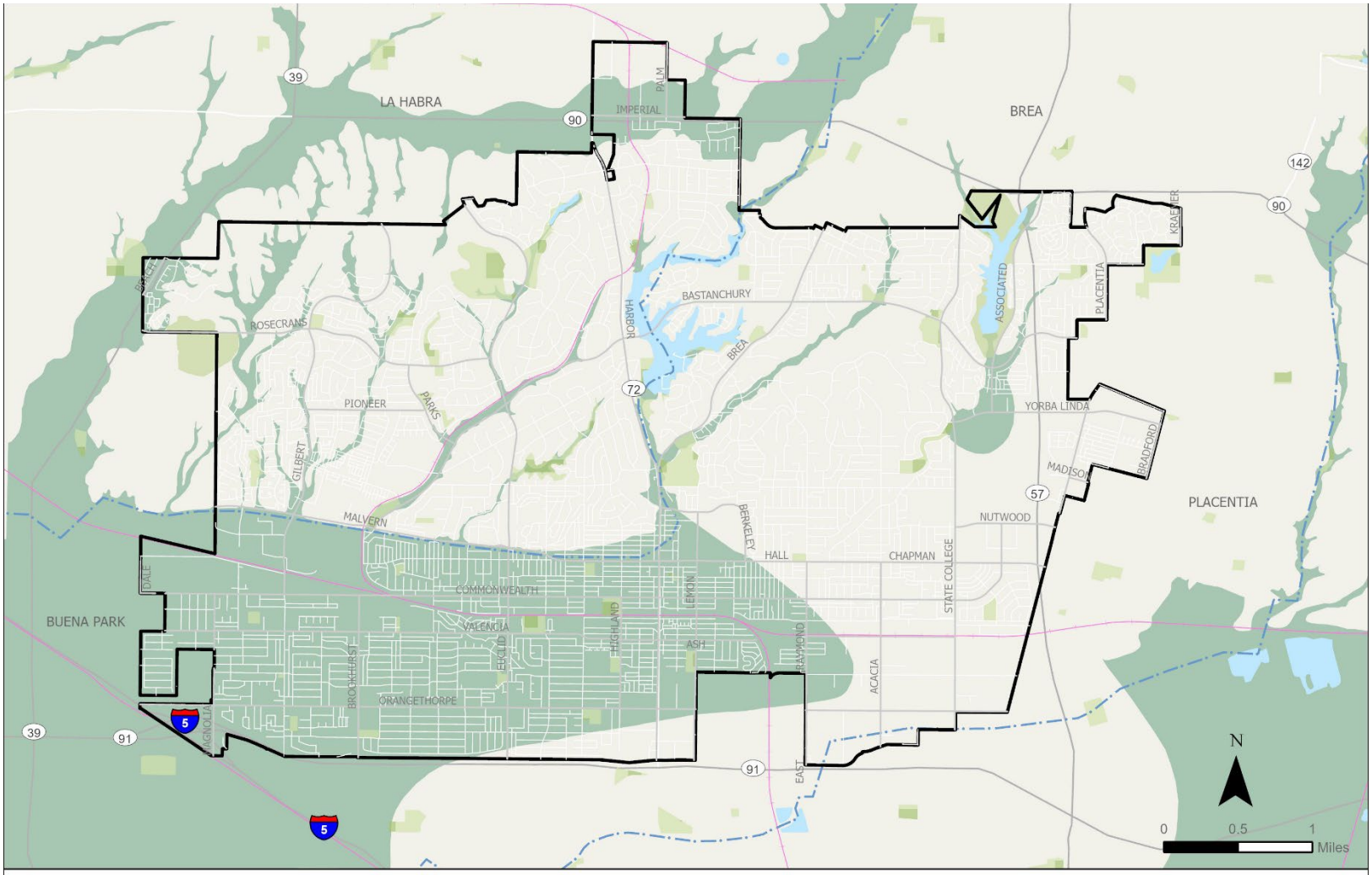

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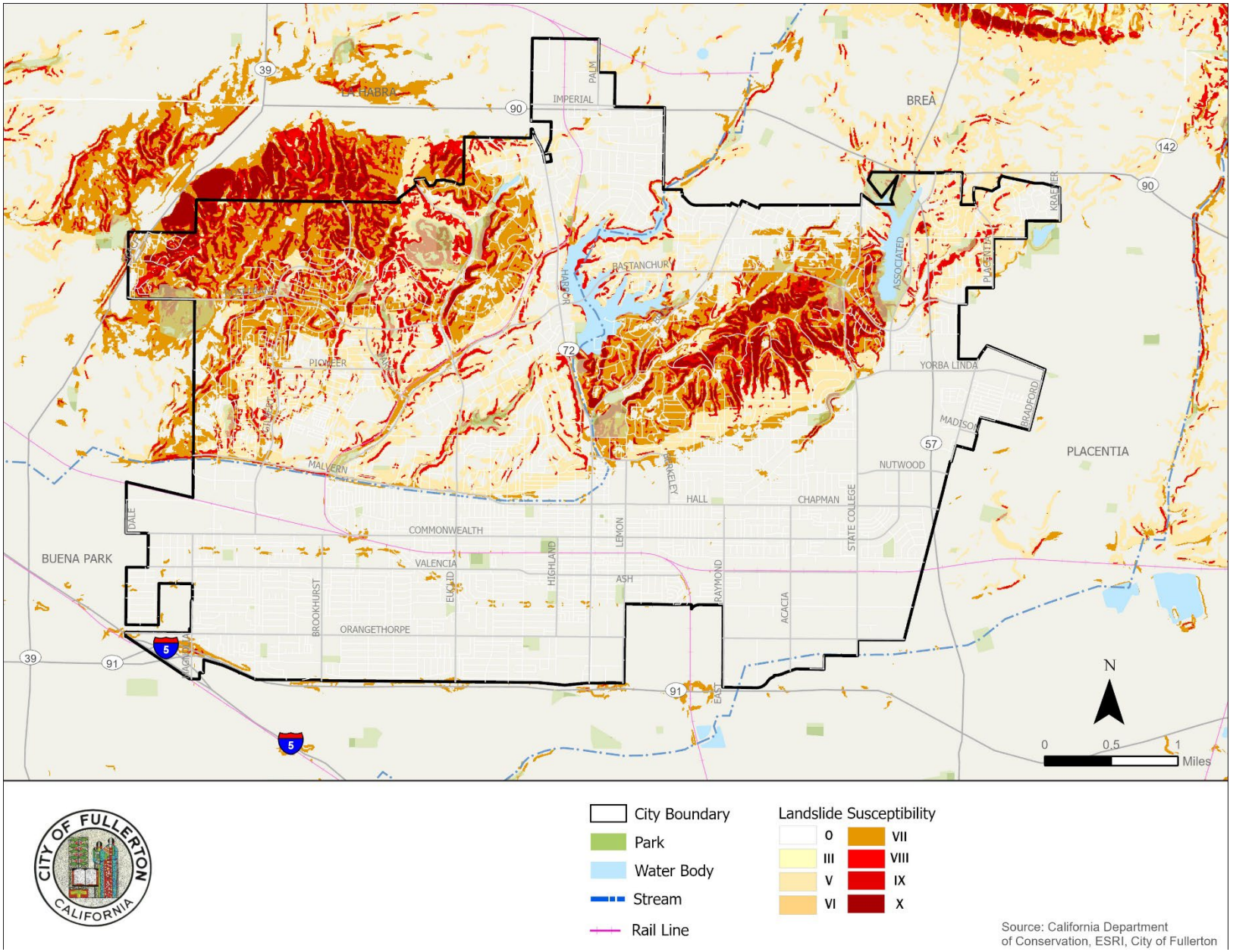
Exhibit 4 – Areas of Deep-Seated Landslide Potential in Fullerton



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Fire Hazards

Wildfires

The most common type of natural hazard in California is wildfire, which can quickly burn large areas of undeveloped or natural land. They often begin as smaller fires caused by lightning strikes, downed power lines, mechanical equipment use, or unattended campfires but may rapidly expand in size if conditions are dry and/or windy. The recent trend toward more prolonged periods of drought increases the likelihood of a wildfire. Typically, wildfires pose minimal threat to people and buildings in urban areas, but increasing human encroachment and development into natural areas increases the likelihood of bodily harm or structural damage. This encroachment occurs in areas called the wildland-urban interface (WUI), which is considered an area within a fire hazard severity zone, as defined by the California Department of Forestry and Fire Protection (CAL FIRE).

Significant wildfires have occurred in Orange County and neighboring communities in the past and pose a significant threat to people and property. Based on the current Fire Hazard Severity Zones mapping prepared by the CAL FIRE *Fire and Resource Assessment Program* (FRAP), the city's northwest area is identified within a Very High Fire Hazard Severity Zone. These areas are depicted in ***Exhibit 5.*** Properties located here and in some other smaller areas are susceptible to the threat of wildfires as they are located near open space areas and hillsides containing dense vegetation. These areas are located within the Local Responsibility Area (LRA), which is under the Fullerton Fire Department's (FFD) authority. The City has no State Responsibility Areas (SRA) or Federal Responsibility Areas (FRA), which fall under the authority of CAL FIRE and the U.S. Forest Service, respectively. However, the FFD does have multiple mutual aid agreements with neighboring jurisdictions in place, and the call for aid during large wildfires has been answered by the FFD throughout California. The most recent wildfires to affect the city occurred on October 30, 2019, including a brush fire near the Brea Dam, which was contained quickly. Later that same day, the Castlewood Fire broke out on the northeast corner of Castlewood Dr and Gilbert; approximately eleven acres were consumed before the fire was contained. ***Exhibit 6*** identifies the WUI areas and the locations of historic fires in Fullerton and the surrounding area.

Current and future development in the areas identified with fire hazard potential should be guided by prevention requirements, such as fire-resistant building construction and materials, adequate space between structures, available water supply, fire-resistant plant materials, quality of year-round firefighting service, available evacuation routes, access routes level enough for fire equipment use, and the creation and maintenance of fire breaks especially in areas of increased fire hazard.

Urban Fires

The possibility of an urban fire confronts every city. Many urban fires begin as isolated incidents caused by faulty electrical appliances, cooking mishaps, improper storage of chemicals, or industrial malfunction but can spread to other buildings if conditions permit. Many factors contribute to an urban fire's severity and extent, but modern building codes and practices have helped reduce their effects. Despite these improvements, it is important to acknowledge the risks associated with fires in urban areas. No matter its size, any fire can be fatal or cause severe harm to people and damage buildings and other structures.

Exhibit 5 – Fire Hazard Severity Zones in Fullerton

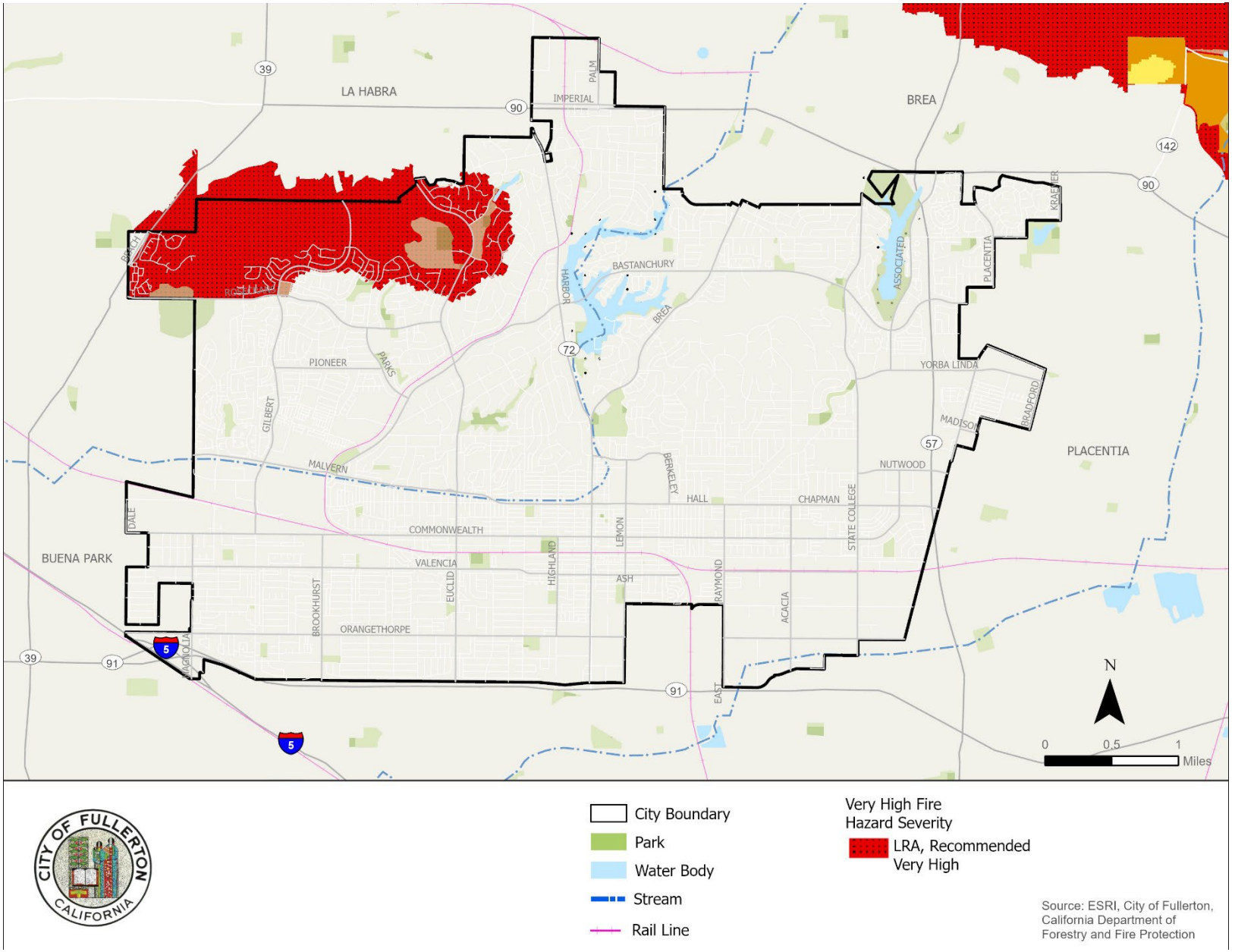

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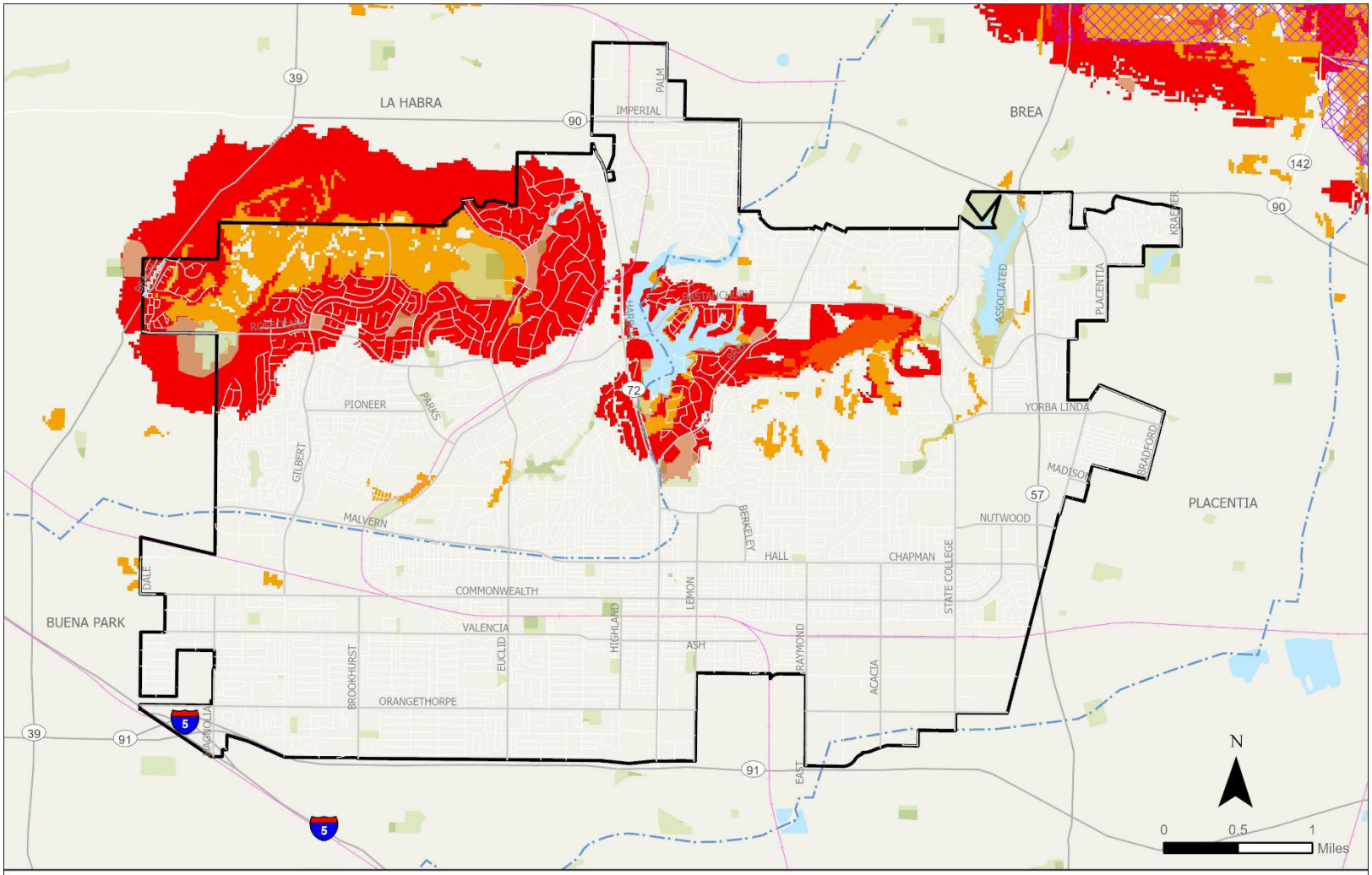
Exhibit 6 – Wildland Urban Interface in Fullerton



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Drought

A drought is a long period during which precipitation levels are significantly below normal. The most common effect is that plants dry out and become more susceptible to agricultural pests or diseases. An abundance of dry plant matter may also increase the risk of wildfires or cause fires to be more intense. In severe cases, droughts can affect urban areas. A significant drought can lead to water shortages, which may force local water suppliers to institute mandatory restrictions on nonessential water use. In extreme cases, there may be insufficient water to meet basic health and hygienic needs, requiring communities to find alternative water supplies. Since many communities receive their water from far-away sources, such as the Sierra Nevada or Colorado River, it is common in California to experience "long-distance droughts," where precipitation levels may be normal in the community itself but low at the source of the community's water. Droughts are large-scale events, so drought risks and conditions are generally equal across all of Fullerton.

Water Service

Fullerton is a retail water supplier that provides water to its residents and other customers using the imported potable water supply obtained from its regional wholesaler, Metropolitan Water District of Southern California (MET), and local groundwater from the Orange County Groundwater Basin (OC Basin), which is managed by the Orange County Water District (OCWD). The City meets all its demands with a combination of imported water and local groundwater. The City works with two primary agencies, MET and OCWD, to ensure a safe and reliable water supply that will continue serving the community in drought and shortage periods.

The city's main water source is groundwater from the Orange County Groundwater Basin. Even under the assumption of a drought over the next five years, MET's 2020 UWMP concludes a surplus of water supplies would be available to all its Member Agencies, including the City. The City has a purchase agreement with MET that allows it to purchase significantly more MET water should the need arise. MET's 2020 UWMP concludes that they can meet full service demands of their member agencies starting 2025 through 2045 during normal years, single dry year, and multiple dry years. Consequently, the City is projected to meet full service demands through 2045 for the same scenarios.

Severe Weather: Heat, Wind, Rain

Extreme Heat

An extreme heat event is a day when temperatures reach levels that are significantly higher than normal. In California, extreme heat has been defined as any day when the maximum temperature surpasses 98 percent of all prior historic high temperatures for the area, using the time between April and October from 1961 to 1990 as the baseline. Extreme heat events differ from region to region based on the area's climate. An extreme heat event in the Central Coast area of California will likely have a lower threshold than an extreme heat event in the Central Valley. A succession of extreme heat events is generally called a heat wave.

Windstorm

Wind is simply the movement of air caused by differences in atmospheric temperature. High-pressure air will naturally move to areas of low air pressure. Usually, the distance between these high- and low-pressure zones is far. However, these low- and high-pressure zones may occasionally be near one another. When this happens, air will flow dramatically, creating high-speed winds. When winds are fast enough, they can cause property damage to homes, public facilities, utilities, and other infrastructure. They can also uproot or topple mature trees or pick up debris and send it careening through the air. This debris can injure or even kill bystanders who

may find themselves stranded outside. High-speed winds can also deposit this debris in the middle of rights-of-way, such as roads, freeways, and railways, blocking exit routes for would-be evacuees or impeding access to first responders trying to reach wounded people.

Rainstorm

During severe weather events such as strong storms, rain can fall at such a high rate that it cannot drain away fast enough. The resulting heavy rain can cause flooding, leading to inundation and potential damage to buildings, road networks, public areas, utilities, and other critical pieces of infrastructure. In California, heavy rainfall events are often short, intense bursts of rain, but heavy rain can sometimes persist for multiple days.

Flood

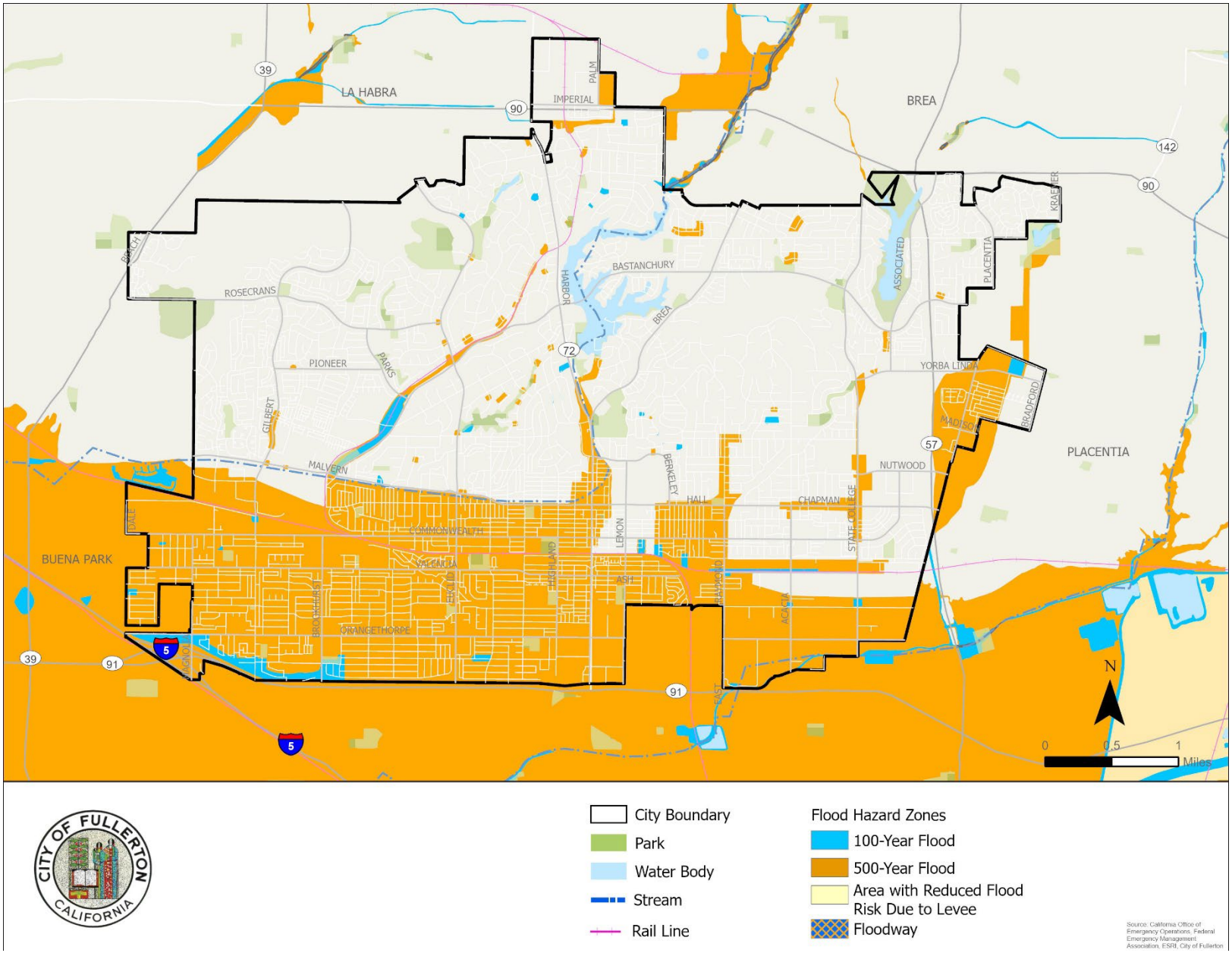
Heavy rains in Fullerton generally occur during the winter season when El Niño weather conditions or atmospheric rivers bring rain from other parts of the world to Southern California. Severe or prolonged heavy rain can lead to flooding in the city, particularly in areas with high amounts of pavement and other impervious surfaces. Floods are measured by their likelihood of occurrence. A 100-year flood has a 1 in 100 chance of occurring during any given year, while a 500-year flood has a 1 in 500 chance. Fullerton has 100- and 500-year floodplains designated and mapped by FEMA as flood zones. These FEMA flood zones are displayed in ***Exhibit 7***.

Dam Failure

A dam failure occurs when a dam holding back the water of a reservoir can no longer control the collection of the water. A dam failure could result from a dam breach in which a section of the dam disintegrates, allowing the reservoir's waters to escape. A flood caused by a dam breach can move swiftly and be very powerful. Other hazardous situations, such as a major flash flood or strong earthquake, can trigger a dam failure, especially if the dam is aging or deteriorating. A mechanical malfunction can also cause a dam failure if the dam is not maintained or operated correctly. When assessing dam failure hazards, it is assumed that impacts occur based on a full reservoir.

Dam inundation maps show areas downstream that would be inundated by water from an unintentional release of water from a dam's reservoir. Five dams potentially threaten Fullerton: Fullerton Dam, Prado Dam, Carbon Canyon Dam, Orange County Reservoir, and Brea Dam. The areas at risk of inundation are located primarily in the southern areas of the city, along the eastern border and from the center of the city, and they all flow toward the southern edge of the city limits. These areas are depicted in *Exhibit 29 Dam Inundation Risks* in The Fullerton Plan (page 213).

Exhibit 7- FEMA Identified Flood Zones in Fullerton



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Geologic Hazards: Landslide/Mudflows, Subsidence

Although seismic events like earthquakes often trigger geologic hazards, this is not always the case. Therefore, understanding and preparing for these hazards as standalone events is equally important.

Landslides and Mudslides

A landslide is the movement of earth material down slopes and areas of steep topography. Although earthquakes often cause them, landslides can occur when a sloped surface can no longer support the material contained within or sitting above it. The sheer weight of the material can cause instability or can be rendered unstable by other events, such as heavy rain. When rain causes a slope to fail, the movement of earth materials is typically referred to as a mudslide.

Both landslides and mudslides can move with great force and pose a significant danger to buildings and other structures. In some circumstances, these events may cause bodily harm if bystanders cannot move out of their path in time. Anticipating the risk of landslides in the areas identified in ***Exhibit 4*** will be essential for protecting the community members who reside there. Due to the sloping topography, there is the potential for landslides in the steeper portions of the East and West Coyote Hills area. Even these areas, however, are designated as having a moderately low risk of landslides due to seismic conditions and a low likelihood of a landslide under other conditions.

Subsidence

Subsidence occurs when the ground level decreases as if the surface is sinking. Subsidence can either be sudden (as in a sinkhole) or happen gradually over time. It can be caused by mining, groundwater pumping, or fossil fuel extraction, creating empty underground spaces that can collapse and cause the soil above to drop. Erosion, natural cave collapses, and seismic activity can also cause subsidence. The City has identified that the most likely locations for subsidence in Fullerton are the northern and central portions of the city. Other sections of the city are potentially subject to subsidence in the event of a major earthquake (Mw 5.0 or greater); however, Fullerton does not have a history of seismically induced subsidence.

Hazardous Materials Release

Natural hazards are not the only threat to a community's safety. Human-caused dangers, such as various hazardous materials and wastes, are often found throughout a community and can pose significant risks. Some of these materials may be transported through the City via SR-57, SR-90, SR-91, and I-5. Generally speaking, hazardous materials are identified as toxic, flammable, explosive, corrosive, infectious, radioactive, or a combination of these characteristics. Hazardous wastes are categorized similarly but are identified separately from materials because they no longer serve a meaningful use.

In the Community

Although common household chemicals pose little threat to the community, hazardous materials and wastes used by businesses and industries present greater risks. Mechanical dealerships, repair shops, gasoline and diesel fuel stations, and dry cleaners are examples of businesses that regularly use and store chemicals or other hazardous materials. Pipelines and tanks within the city also transport and store chemicals that could pose a risk if a failure occurs. These releases are anticipated to be isolated to properties where storage occurs. Releases also tend to involve transporting raw materials and their byproducts by pipeline, rail, or truck. Regulation of the use,

storage, and transportation of hazardous materials and wastes rests on state and federal agencies; however, cities play a large role in minimizing the risks and impacts of exposure through careful planning and preparation. The city's primary risk to hazardous material spills comes from the various highways, a railroad right of way, the airport, the active oil wells in East Coyote Hills, and a major natural gas transmission pipeline that passes through the community and allows for the transport of potentially harmful chemicals and materials into and out of Fullerton.

In the Home

Exposure to hazardous materials is not uncommon, as many household cleaning products contain chemicals that can harm both humans and the environment. However, proper use can largely avoid the health risks associated with these hazardous materials. Properly storing household cleaning products and other common hazardous materials, such as those used in automotive and home repair, is also an important component of responsible management. Following the manufacturer's instructions on the packaging and keeping products out of the reach of children are two simple steps that can help reduce the risk of exposure.

Air Pollution

Air pollutants are substances in the atmosphere that affect our health. They include smoke, particles, and gases from human-made and natural sources. People generate air pollution in many ways — through the cars they drive, the stoves they cook on, and the fuel burned to produce heat and electricity. Air pollution from these sources may harm our hearts or lungs and reduce disease resistance. Air pollutants may cause diseases, especially those in the respiratory system. When certain air pollutants are breathed in, the airways to the lungs can become irritated. Continued exposure to air pollution may also cause a decrease in lung function. This is especially a problem in children whose lungs are still growing.

Climate Related Hazards

Although climate change is not a hazard, variations in environmental conditions can impact some of the natural hazards affecting Fullerton. Projections of future conditions include increased temperatures, increased extreme heat days, changes in precipitation, more prolonged droughts, and changes in the size and frequency of wildfire incidents. *Table 1* identifies the current/historical conditions and projected future conditions associated with climate change that could occur in Fullerton. Additional details regarding potential climate change effects are located in the City of Fullerton Climate Vulnerability Assessment (Attachment A).

Table 1: Potential Climate Change Effects for Fullerton

Historic/ Current Conditions	Future Conditions
Annual Mean Temperature (1961-1990)	Annual Mean Temperature (2070-2099)
76.4° F	81.5 ° to 84.5° F
Extreme Heat Days (98.6° F)	Extreme Heat Days (2070-2099)
4 days per year (observed)	13 to 27 days per year
Annual Mean Precipitation	Annual Mean Precipitation (2070-2099)
13.8 inches (observed)	13.2 to 13.6inches
Annual Average Area Burned	Annual Average Area Burned (2070-2099)
65.4 acres	11.4 to 12.7 acres
Source: https://cal-adapt.org/tools/local-climate-change-snapshot	

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Temperature

Increasing temperatures associated with climate change can act as a hazard multiplier. By the end of the century, annual mean temperatures are projected to increase between 5.1 and 8.1 degrees, impacting city residents and businesses. These increases are also anticipated to increase the number of extreme heat days from two days to between 13-27 days per year. These potential temperature increases may impact residents living in poorly insulated structures or structures that do not have air conditioning. For residents living in these structures, temperatures above 85 may cause discomfort. By the end of the century, the number of days over this temperature threshold could be nearly six times more than the city typically experiences.

While climate change is projected to exacerbate many of the hazards already affecting the city, many of these hazards may interact with each other. Increased temperatures can affect both water supplies and vegetation growth. With drier conditions, vegetation growth may be reduced, which can reduce wildfire vulnerability; however, if dry conditions persist for long periods, the reduced vegetation may be drier than normal. These two conditions may change the wildfire risks within and around the city or cause areas that have not burned historically to be at greater risk of ignition.

Precipitation

While temperatures are anticipated to increase in the coming decades, climate change projections suggest that annual mean precipitation may decrease slightly. While an annual decrease is projected, it is anticipated that future rain events may be more intense than what is currently experienced within the city, which could increase flooding. With changes in future precipitation, it is expected that changes to local vegetation may also occur, which could impact drainages and increase the need for slope stabilization management, wildfire management activities, and drainage infrastructure in some areas.

Increased rainfall could increase the amount of flooding within the community or introduce flooding into areas that have not experienced flooding before. The city could also experience increased landslides/mudslides with greater and more intense precipitation. Extreme precipitation events could destabilize hillsides, bluffs, and drainages, resulting in more erosion along drainage courses and landslides/mudslides. This could especially be true in areas where vegetation has been reduced or impacted by drought conditions.

With future temperature increases coupled with relatively similar precipitation amounts experienced today, future wildfire impact is projected to decrease by the end of the century. This projection is based on the overall reduction in small and moderate precipitation events instead of large or extreme events, suggesting that vegetation growth will experience an overall reduction. A reduction in vegetation could reduce future wildfire vulnerability due to reduced fuel loads and changes in fuel types and densities. Based on the historical fires, the city has experienced an annual average of 65.4 acres burned (total acreage burned divided by the number of years analyzed), which is projected to decrease to 12.7 acres or less by the end of the century.

Attachment A – Climate Adaptation Vulnerability Assessment

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CITY OF FULLERTON

CLIMATE VULNERABILITY ASSESSMENT & ADAPTATION FRAMEWORK

Prepared for

City of Fullerton Department of Planning and Zoning

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Prepared by

Atlas Planning Solutions

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This document includes the following chapters:

Chapter 1 – Introduction

This chapter describes climate adaptation planning and the applicable State requirements as they relate to this Vulnerability Assessment and Adaptation Framework.

Chapter 2 – Community Profile

This chapter provides a description of the City of Fullerton's general environment and demographics. Special emphasis is made to discuss climate vulnerable populations.

Chapter 3 – Vulnerability Assessment

This chapter includes forecasts of each of the five climate-related hazards. It also maps where those hazards are most likely to affect the City of Fullerton.

This chapter evaluates the City's current capacity to address the five climate-related hazards. This includes an assessment of the City's current policies and programs and how they address the ability to respond to hazard events.

Chapter 4 – Adaptation Framework: Recommendations to Improve Resilience

This chapter includes potential strategies and policy recommendations to increase the City's ability to adapt to hazards and meet the needs of its vulnerable communities.

The City of Fullerton's Climate Vulnerability Assessment and Adaptation Framework is intended to inform the community about climate hazard exposure, sensitivity, and capacity to adapt to projected changes to the climate. The data collected and analyzed within this assessment represent a snapshot in time as of the date of this document and should be used as a guide, not a final determinant. Data collected from external, publicly available sources will have varying degrees of uncertainty and may contain some nonconformities, defects, inaccuracies, or errors that existed from the primary source. Although reasonable effort is made to present accurate information, the City of Fullerton makes no guarantee or warranty with respect to the information provided. The City, its employees, officers, content providers, affiliates, or other representatives are not liable for damages of any kind (including, without limitation, lost profits, direct, indirect, compensatory, consequential, exemplary, special, incidental, or punitive damages) arising out of your use of, your inability to use, or the content of this document, whether or not we have been advised of the possibility of such damages.

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EXECUTIVE SUMMARY

The City of Fullerton (City) recognizes that climate conditions are changing and will have profound effects on the community, ecosystem, and economy. Climate change may be a global phenomenon, but the impacts are felt locally. If greenhouse gas emissions continue at current levels globally, the City's average temperatures are expected to warm by 5-9° F by the end of the century, potentially leading to extreme heat events and drought and exacerbating wildfire conditions.

The City is addressing greenhouse gas emissions reductions through Green Projects to meet the City's Climate Action Plan goals. These sustainability initiatives outline actions the City and partners will take to reduce greenhouse gas emissions. In a parallel effort, the City is evaluating climate vulnerabilities and planning climate adaptation strategies to help the economy and environment, as well as the health of its residents, become more resilient. The City recognizes that the hazards influenced by climate change will not affect all residents and assets evenly, as vulnerability depends on existing stressors, potential climate impacts, and existing adaptive capacity. In creating this assessment and adaptation framework, the existing exposure and adaptive capacity were considered in evaluating climate vulnerability.

The vulnerability assessment revealed the following hazards have, and will continue, to impact the region:

- Wildfire risk to forests, affecting wildlife, natural areas, recreation, and public health
- Flooding that displaces residents, damages critical infrastructure, and disrupts the economy
- Extreme heat events that cause public health emergencies for vulnerable populations
- Drought that limits water supply and can exacerbate wildfire and landslide conditions

Additionally, all climate-induced hazards have the potential to:

- Risk lives, property, and homes
- Increase mental health impacts and associated trauma
- Overburden emergency services
- Overburdened infrastructure (e.g., electrical blackouts and damage to electrical infrastructure)
- Increase utility and insurance costs
- Overburden non-profit organizations from the increasing demand for services
- Limit outdoor recreation, potentially lowering revenue from tourism

Preparing for the impacts of climate change requires significant investment in time and resources across the region, including emergency services, infrastructure improvements, and expanded social and environmental programs. New, bold, and adaptable approaches to how people live, move, and manage vital resources are needed. Assessing climate vulnerabilities and developing an adaptation framework is the first step towards greater climate resilience for the City of Fullerton.

CHAPTER 1. INTRODUCTION

According to the State of California's Legislative Analyst's Office:

"Addressing the widespread impacts of climate change represents a significant challenge for the State. A changing climate presents California with five key climate hazards: (1) higher temperatures and extreme heat events, (2) more severe wildfires, (3) more frequent and intense droughts, (4) flooding due to extreme precipitation events, and (5) coastal flooding and erosion from sea-level rise. These hazards will threaten public health, safety, and well-being—including from life-threatening events, damage to public and private property and infrastructure, and impaired natural resources."[1]

To address the potential impacts from these hazardous events on the community, the City is expanding upon its climate action and hazard mitigation planning efforts to: 1) focus on climate change adaptation by understanding the community's vulnerabilities to climate hazards; and 2) explore strategies to reduce the vulnerability to projected climate change effects, increase the local capacity to adapt, and build resilience.

Note the data, policies, guidance, and regulations discussed herein may become out of date over time as climate change and hazard data is updated and new policies, guidance, and regulations pertaining to climate change hazards are released.

Regulatory Drivers and Guidance for Climate Adaptation Planning

The report includes a Climate Vulnerability Assessment and Adaptation Framework, which will be incorporated into the City's General Plan Safety Element, in compliance with SB 379, Government Code section 65302(g)(4)[2] and the Office of Planning & Research's (OPR) General Plan Guidelines. According to SB 379, General Plan Safety Elements must address climate change vulnerability, adaptation strategies, and emergency response strategies. SB 379 states:

"This bill would, upon the next revision of a local hazard mitigation plan on or after January 1, 2017, or, if the local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022, require the Safety Element to be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to that City or city. The bill would require the update to include a set of goals, policies, and objectives based on a Vulnerability Assessment, identifying the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts, and specified information from federal, State, regional, and local agencies."

As specified in Government Code section 65302(g)(4)(A) Vulnerability Assessments must identify the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts, utilizing federal, state, regional, and local climate vulnerability documentation such as the California Adaptation Planning Guide and the Cal-Adapt climate tool created by the California Energy Commission (CEC) and University of California, Berkeley Geospatial Innovation Facility. Other sources of information include data from local agencies regarding their adaptive capacity and historical data on natural events and hazards. Per Government Code section 65302(g)(4)(B), adaptation policies, goals, and objectives are to be developed based on findings from the Vulnerability Assessment.

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[1] Legislative Analyst's Office (LAO). 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed December 11, 2023.

[2] SB 379 was enacted to integrate climate change adaptation into California's general plan process.

Additionally, Government Code section 65302(g)(4)(C) requires jurisdictions to create a set of feasible implementation measures to reduce climate change impacts on new or proposed land uses.

AB 162 (2007) Gov Code 65302(g)(2)

AB 162 requires that, upon the next revision of the housing element on or after January 1, 2009, cities and counties address flood hazards and safety in the land use, conservation, safety, and housing elements of their general plans.

SB 1241 (2012) Gov Code 65302(g)(3)

SB 1241 revised the Safety Element requirements to require all cities and counties whose planning area is within the State responsibility area (SRA) or very high fire hazard severity zones (VHFHSZs), as defined by California Department of Forestry and Fire Protection (CAL FIRE), to address and incorporate specific information regarding wildfire hazards and risk, and policies and programs to address and reduce unreasonable risks associated with wildfire. Upon the next revision of the Housing Element on or after January 1, 2014, the bill requires those cities and counties to review and update the Safety Element to consider the advice in the Office of Planning and Research's most recent publication of "Fire Hazard Planning, General Plan Technical Advice Series" as well as: information regarding fire hazards, a set of goals, policies, and objectives based on identified fire hazards, and a set of feasible implementation measures designed to carry out those goals, policies, and objectives.

SB 1000 (2016) Gov Code 65302(h)

SB 1000 stipulates those cities and counties with Disadvantaged Communities, as defined by SB 1000 in Government Code Section 65302(h), incorporate environmental justice policies in their general plans through either a stand-alone element, or by integrating relevant goals, policies, and objectives throughout other elements. The bill requires cities and counties to identify Disadvantaged Communities (as defined in SB 1000), include policies and objectives to reduce unique or compounded health risks in Disadvantaged Communities, promote civic engagement in the public decision-making process, and address the needs of Disadvantaged Communities. Compliance with SB 1000 is triggered when two or more elements in a general plan are revised after January 1, 2018.

SB 1035 (2018) Gov Code 65302(g)(5)

SB 1035 requires regular updates to the Safety Element chapter of the General Plan. The latest information regarding flood and fire hazards must be included and climate change adaptation and resilience must be addressed as part of the update. After 2022, Safety Elements must be updated upon each revision of the housing element or local hazard mitigation plan, but no less often than once every 8 years. Housing element revisions are typically on 4–8-year cycles and LHMP revisions are on 5-year cycles.

SB 99 (2019) Gov Code 65302(g)(5)

SB 99 requires that, upon the next revision of the housing element on or after January 1, 2020, the Safety Element must be updated to include information identifying residential developments in hazard areas that do not have at least two emergency evacuation routes (i.e., points of ingress and egress).

AB 747 (2019) Gov Code 65302.15

AB 747 requires that, upon the next revision of a LHMP on or after January 1, 2022, or beginning on or before January 1, 2022, if a local jurisdiction has not adopted a LHMP, the Safety Element must be reviewed and updated as necessary to identify evacuation routes and their Capacity, safety, and

viability under a range of emergency scenarios. If a LHMP, emergency operations plan, or other document that fulfills commensurate goals and objectives, a local agency may use that information in the Safety Element to comply with this requirement by summarizing and incorporating by reference such a plan or other document into the Safety Element.

Consistent with Government Code 65302(g)(4)(A), the following Vulnerability Assessment and adaptation framework also takes guidance from:

California's Fourth Climate Assessment (2018)

California Natural Resources Agency (CNRA), OPR, and CEC prepared California's Fourth Climate Assessment in 2018. The Climate Assessment was designed to present findings in the context of existing climate science, including strategies to adapt to climate impacts and key research gaps needed to spur additional progress on safeguarding California from climate change.

Safeguarding California Plan (2018)

CNRA released an update to the Safeguarding California Plan in 2018, providing a roadmap for State government action to build climate resiliency. The Safeguarding California Plan presents overarching strategies and outlines ongoing actions and cost-effective and achievable next steps to make California more resilient to climate change.

California Adaptation Planning Guide (2020)

The California Office of Emergency Services (Cal OES) released the second version of the Adaptation Planning Guide in 2020 - APG 2.0 - which includes updated guidance, an increased focus on equity and outreach, and best practices. The APG is designed to help local government, regional entities, and climate organizations incorporate best practices and current science and research into their adaptation plans.[3]

California Office of Planning and Research Fire Hazard Planning Technical Advisory (2022)

The goal of the technical advisory is to provide a robust planning framework for addressing fire hazards, reducing risk, and increasing resilience across California's diverse communities and landscapes.

LOCAL AND REGIONAL CLIMATE PLANNING

Historical climate or climate-related assessments evaluated under this effort include:

- Fullerton Local Hazard Mitigation Plan (2020)
- Orange County County-Wide Community Wildfire Protection Plan (2017)
- California's Fourth Climate Change Assessment (2018)
- California Governor's Office of Emergency Services State Hazard Mitigation Plan (2023)
- Federal Emergency Management Administration National Risk Index (2023)

Methodology and Planning Process

[3] California Governor's Office of Emergency Services (Cal OES). California Adaptation Planning Guide. June 2020.

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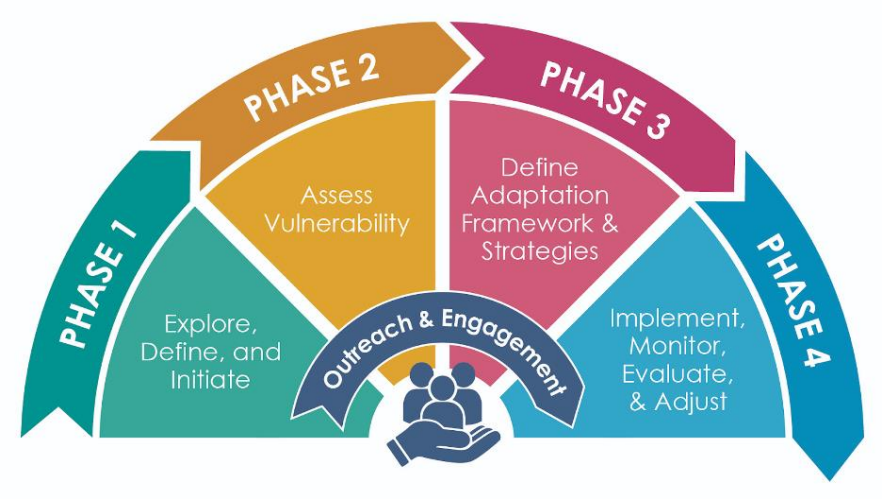
The APG 2.0 provides a four-step process that communities can use to plan for climate change. The APG is designed to be flexible and guide communities in adaptation planning.



Source: California Governor's Office of Emergency Services, 2020.

Phases of the Adaptation Planning Process include:

- Phase 1, Explore, Define, and Initiate:

  This phase includes scoping the process and project, such as identifying the potential climate change effects and important physical, social, and natural assets in the community.

- Phase 2, Assess Vulnerability:

  This phase includes analysis of exposure to, sensitivity of, and adaptive Capacity to respond to climate effect to determine physical and social vulnerability.

- Phase 3, Define Adaptation Framework and Strategies:

  This phase focuses on creating an adaptation framework and developing adaptation strategies based on the results of the Vulnerability Assessment. The adaptation strategies are the community's potential response to the Vulnerability Assessment.

- Phase 4, Implement, Monitor, Evaluate, and Adjust:

  In this phase, the adaptation framework is implemented, consistently monitored and evaluated, and adjusted based on continual learning, feedback, and triggers.

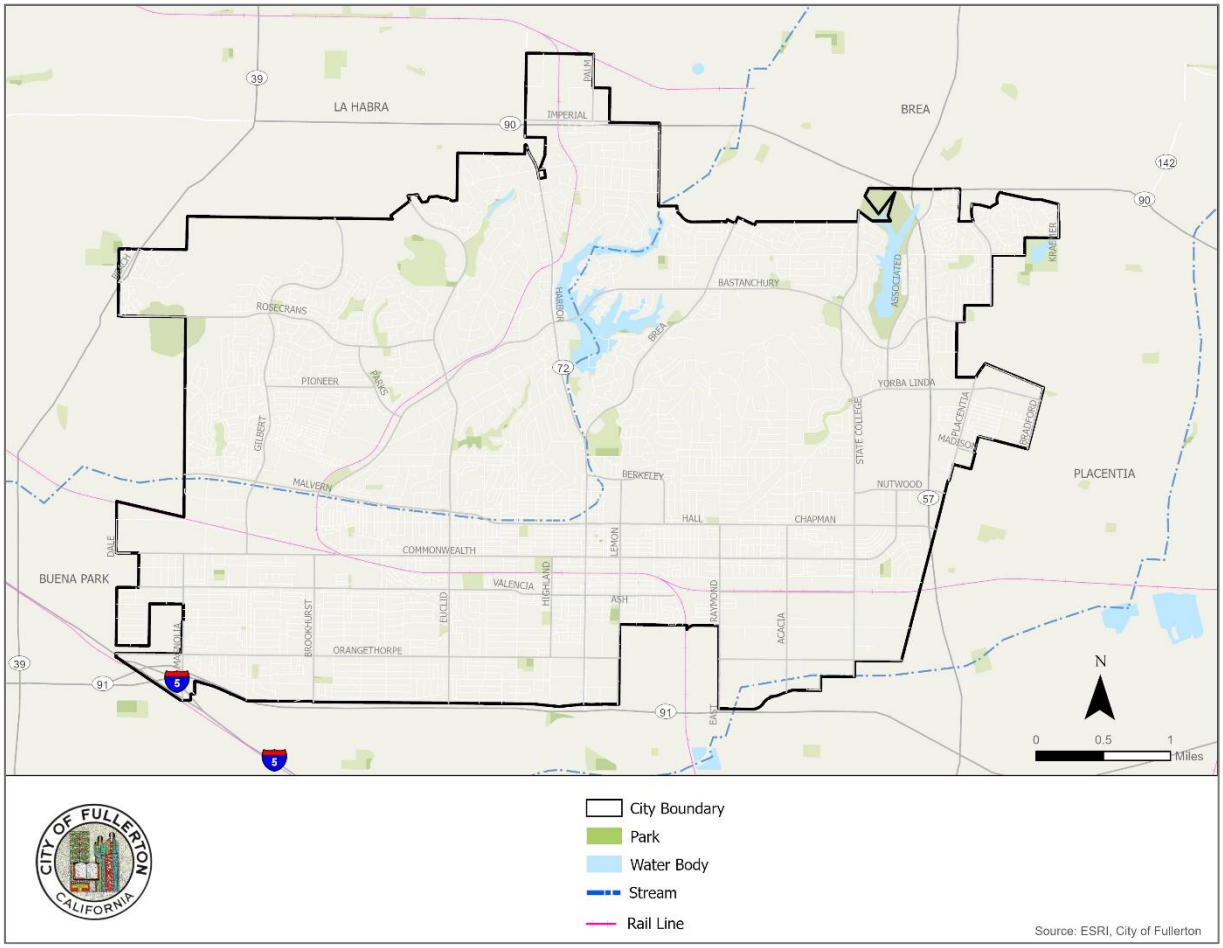
The purpose of this report is to document Step 1 through Step 3. The Vulnerability Assessment and development of adaptation measures follows the approach recommended by APG 2.0.

The Vulnerability Assessment identifies projected climate change exposures for the City at mid- to late-century timeframes. In addition to identifying the City's exposure to the effects of climate change, the Vulnerability Assessment evaluates the sensitivity of key population groups and major community elements to climate change and associated hazards.

CHAPTER 2. COMMUNITY PROFILE

The region is characterized by a Mediterranean climate with hot, dry summers and cool, wet winters. This famously pleasant climate influences all aspects of life in the LA region. Countless ecosystems thrive throughout the region's coasts, mountains, and interior landscapes. Substantial agricultural production occurs here, taking advantage of the bountiful sunshine and generally warm temperatures. Snow-based water from the Sierra Nevada (and Colorado Rockies) have, to date, largely satisfied the region's huge residential, industrial, agricultural, and ecological freshwater demands. A complex web of generation and transmission systems has also provided enough energy to power to the region's vast population.[4]

Figure 2-1: City of Fullerton



[4] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

Table 2-1: Demographics displays the population characteristics in the City.[5] 48.5 percent of the households have a household income of greater than $100,000 per year, with 16.3 percent of households having an income of more than $200,000 per year. A higher income tends to correlate with a greater ability to adapt to climate change (e.g., have and afford air conditioning). However, 11.2 percent of the population is living below poverty (based on national-level data) and almost one-third of the population is over the age of 65. An additional concern for emergency response planning (e.g., evacuation in case of flooding) is that 21.2 percent of households have at least one person living with a disability.

Table 2-1: Demographics

	City of Fullerton	Orange County
Total Population**	144,363	3,212,746
Percent of residents that are children (less than 10 years old)*	10.6%	10.4%
Percent of households that have people 65+ years old*	28.2%	30.7%
Percentage of households with at least one person living with a disability*	21.2%	20.3%
Median age**	36.3	38.0
Total households**	48,739	1,088,611
Median household income**	$96,047	$105,327
Percent of rental households**	49.7%	42.8%
Percent of household income below poverty level*	11.2%	9.6%

Source: *US Census Bureau, ACS 2017 – 2021, **ESRI Forecasts 2023 based on US Census Bureau 2020 Summary File 1

Vulnerable Communities

Compared to the region, the City's population is younger by a little more than 1.5 years (see Table 2-1: Demographics). While percentage of the population under age 5 or aged 65 years and older is similar between the City and region (see Table 2-2: Age Distribution Comparison) illustrating that the City's vulnerable population (considering age only) is similar to the region.

Table 2-2: Age Distribution Comparison

	City of Fullerton	Orange County
Under 5	5.1%	5.5%
5 - 14	11.3%	12.2%
15 - 24	15.9%	13.2%
25 - 34	16.1%	14.8%
35 - 44	12.7%	13.6%
45 - 54	12.1%	12.5%
55 - 64	11.6%	12.1%
Over 65	15.4%	16.0%

Source: ESRI Forecasts 2023 based on US Census Bureau 2020 Summary File 1

In California, the percentage of persons of retirement age (i.e., 65 years and older) are expected to grow more than twice as fast as the total population, and this growth will vary by region. This means

[5] Data for vulnerable populations was extracted from a combination of US Census Bureau American Community Survey 2017 – 2021 estimates and ESRI's Business Analyst 2023 forecasts. Data sources have been noted in each demographic table.

that people are living longer, and the aging population is increasing. This trend is also evident in the City, where the population aged 65 years and older grew by 32 percent from 2010 to 2022.[6]

The racial and ethnic composition of a population may affect housing needs because of cultural preferences associated with different racial/ethnic groups. Cultural influences may reflect preference for a specific type of housing and household structure. Research has shown that number and share of Americans living in multigenerational family households have continued to rise. In 2016, a record 64 million people, or 20 percent of the U.S. population, lived with multiple generations under one roof.

Figure 2-2: Population Age 65 and Older – City of Fullerton

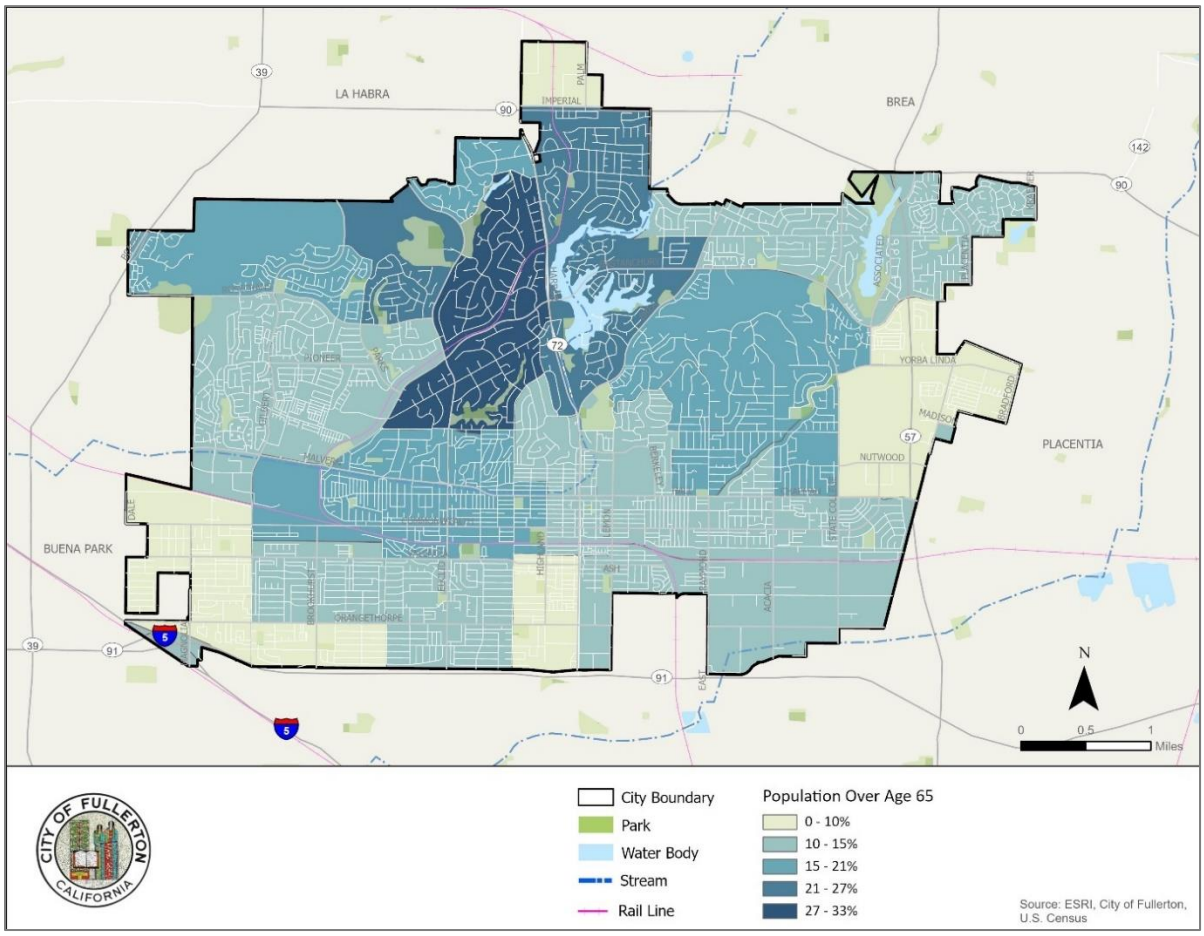


Table 2-3: Race and Ethnicity and Figure 2-3: Communities of Color in City of Fullerton illustrate that the ethnic distribution of the City's population was predominantly people identifying as White Alone or Asian Alone with the combined cohorts representing two-thirds of the total. The City differs from the entire region in the proportion of people identifying as Asian Alone and White Alone, with a greater proportion of people identifying as Asian Alone and a smaller proportion identifying as White Alone. Approximately 39.4 percent of the City's total population was of Hispanic origin compared to 35.2 percent for the region.

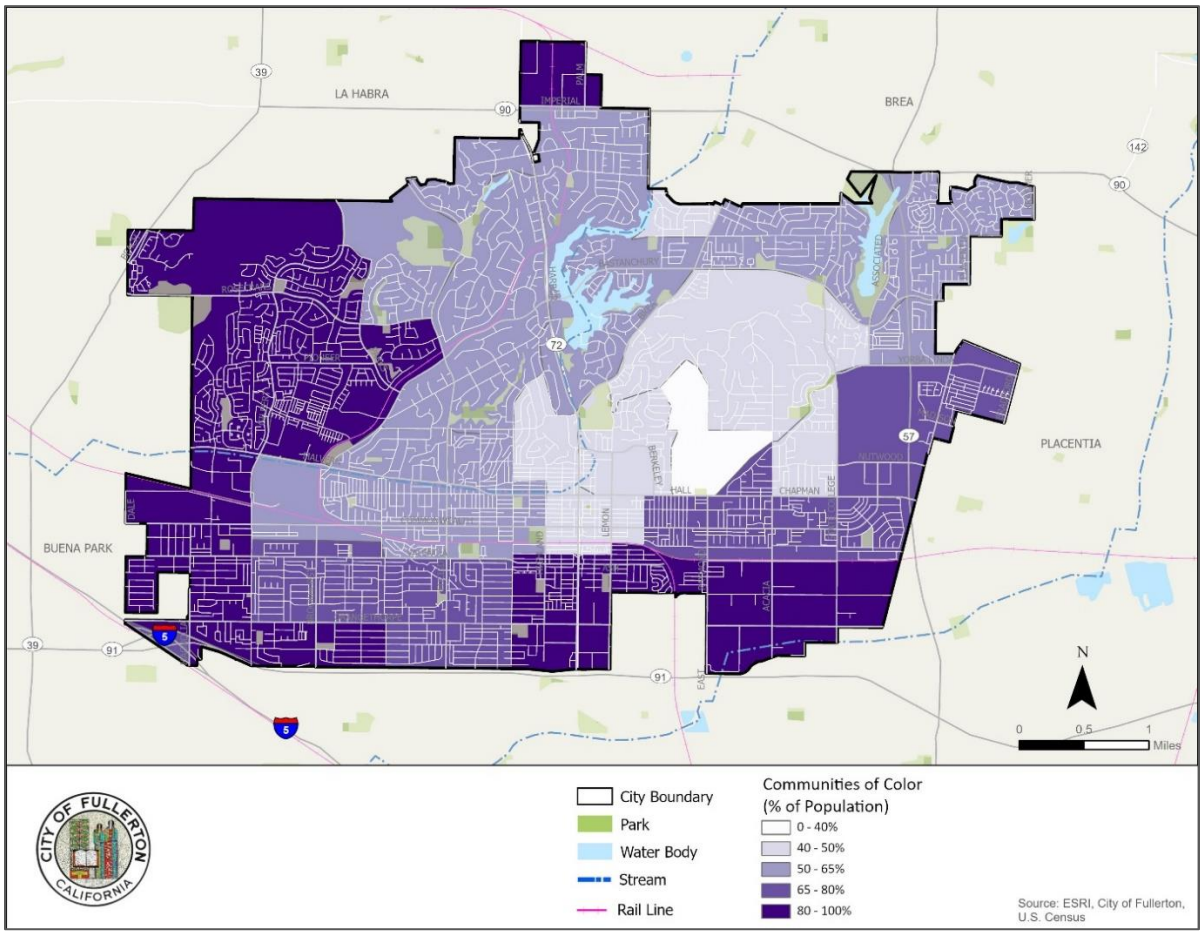
[6] ESRI Forecasts 2023 based on US Census Bureau 2020 Summary File 1

Table 2-3: Race and Ethnicity

	City of Fullerton	Orange County
White Alone	34.5%	41.5%
Black Alone	2.3%	1.7%
American Indian Alone	1.3%	1.2%
Asian Alone	27.2%	23.1%
Pacific Islander Alone	0.2%	0.3%
Some Other Race Alone	19.2%	17.8%
Two or More Races	15.2%	14.4%
Hispanic Origin (Any Race)	39.4%	35.2%

Source: ESRI Forecasts 2023 based on US Census Bureau 2020 Summary File 1

Figure 2-3: Communities of Color in City of Fullerton



The Fullerton community is diverse with multiple languages spoken. As shown in **Table 2-4: English Proficiency and Languages Spoken at Home Among Residents 5 Years and Older – City of Fullerton**, the majority of residents aged 5 years and older are fluent in English; however, 7.6 percent of the population identify as not able to speak English "very well" or "well". There are potential ramifications to vulnerability if emergency preparedness and climate resiliency programs do not provide information or services in languages besides English.

Table 2-4: English Proficiency and Languages Spoken at Home Among Residents 5 Years and Older – City of Fullerton

	Number of Speakers	Percent Not Fluent in English
English Only	73,501	-
Spanish	32,222	18.6%
Other Indo-European Languages (excluding English and Spanish)	4,116	6.6%
Asian and Pacific Island Languages	22,072	23.0%
Other Languages	1,577	20.0%

Note: Percentage values rounded to nearest tenth decimal.

Source: US Census Bureau, American Community Survey 2017 - 2021, ESRI 2023

2.1 VULNERABLE POPULATIONS

Climate change disproportionately affects those with existing disadvantages. Low-income communities and communities of color often live in areas with conditions that expose them to more severe hazards, such as higher temperatures and worse air quality. These communities also have fewer financial resources to adapt to these hazards. For instance, low-income populations are already disproportionately burdened by energy bills and may reduce air conditioning usage out of concerns about cost. People with chronic medical conditions are often more physiologically susceptible to negative health impacts from extreme heat and poor air quality, and those with mobility issues are particularly at risk. These risk factors are often present in older adults, who are more likely to have a limited income, chronic health conditions, and mobility limitations, and are more likely to experience social isolation.[7]

Factors such as age, physical and mental condition, socioeconomic status, access to key services (e.g., public or private transportation), and other factors affect the ability of people to prepare for and protect themselves and their property from a climate-related event. Even though hazard events may impact all parts of the City with equal severity, individuals may experience the effects differently.

Social Vulnerability

Social Vulnerability is broadly defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social Vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards.

FEMA's National Risk Index provides Social Vulnerability scores and ratings that represent the relative level of a community's social vulnerability compared to all other communities at the same level. A community's Social Vulnerability score measures its national rank or percentile. A higher Social Vulnerability score results in a higher Risk Index score as shown in **Figure 2-4: National Risk Index: Social Vulnerability**.[8]

[7] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

[8] Federal Emergency Management Administration. 2023. National Risk Index. https://hazards.fema.gov/nri/social-vulnerability. Accessed April 25, 2023.

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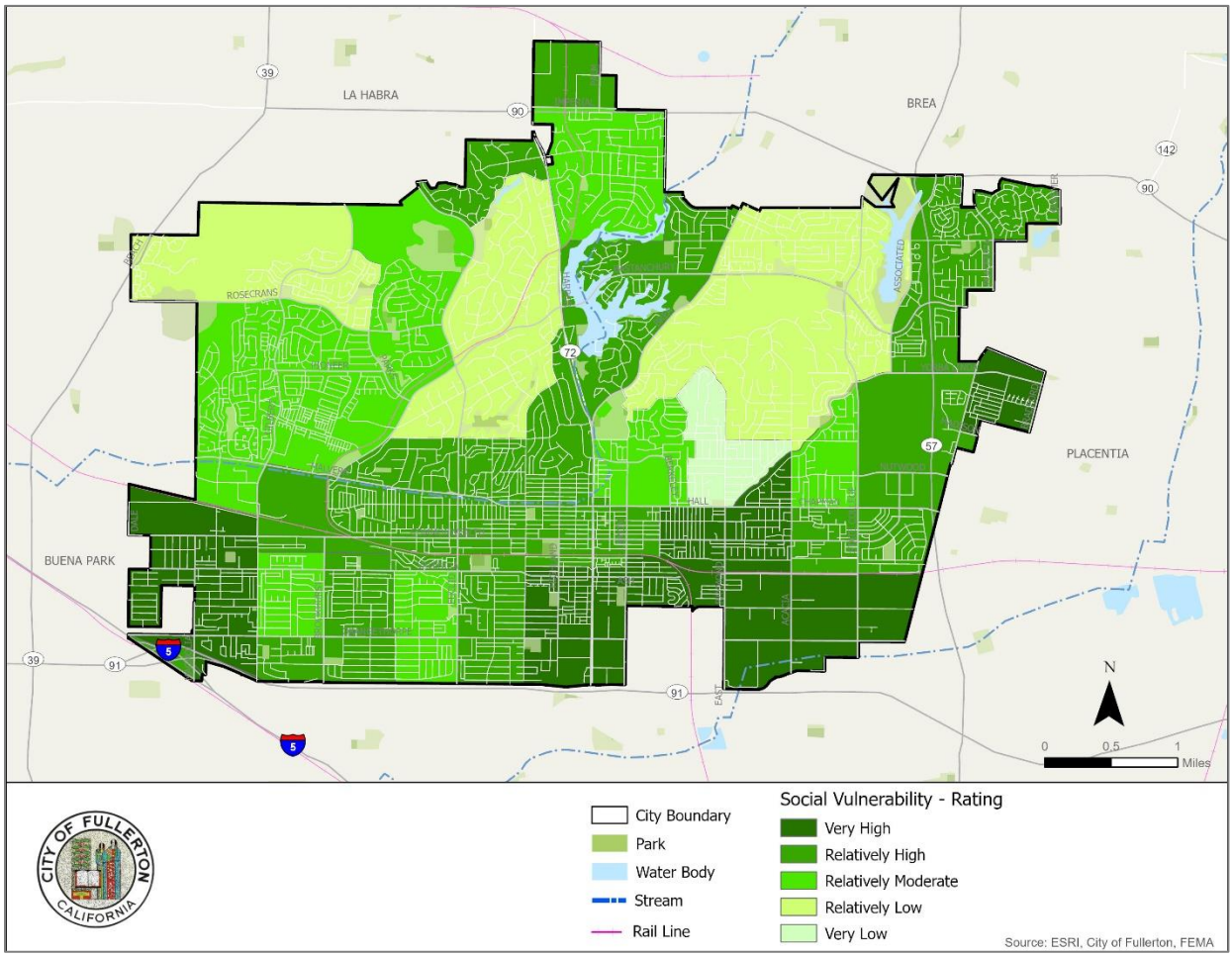
Compared to all census tracts in the State, tracts in the southern portions of the City have a higher social vulnerability rating, meaning the population in these areas have higher vulnerability – with a lower ability to adapt and respond to natural hazards.

Figure 2-4: National Risk Index: Social Vulnerability Rating



Unhoused Population

People experiencing homelessness are highly susceptible to impacts from direct and indirect climate effects including extreme heat events, air pollution from wildfires, and precipitation-driven or coastal flooding. Factors contributing to the rise in people experiencing homelessness include the general lack of housing affordable to lower-income people, increases in the number of people whose incomes fall below the poverty level, reductions in public subsidies, the de-institutionalization of those with mental illness, and increasing substance abuse issues. According to the Orange County Point-In-Time Report on Homelessness, in 2022 there were 272 people experiencing sheltered or unsheltered homelessness in the City, with 74.3 percent unsheltered. The City saw a 34.4 percent decrease in unsheltered homelessness between 2019 and 2022. While the data regarding socio-demographics was not parsed out by geography (therefore the information released was not specific to cities), in the region 66.4 percent of unsheltered individuals identified as White and 6.2 percent identified as Black or African American, whereas the City's general population was 34.5 percent and 2.3 percent, respectively. Of

specific concern to climate vulnerability, 32.2 percent of unsheltered respondents reported having a physical disability and 9.8 percent were ages 62 or older.[9]

The Fullerton Police Department's Homeless Liaison Officer (HLO) Unit is comprised of multiple officers dedicated to assisting the homeless population in Fullerton. Utilizing partnerships with various organizations including Orange County Mental Health, the HLO Unit's mission is to provide homeless individuals with opportunities to get off the streets and into permanent housing. Some of the organizations we are partnered with include the Fullerton Navigation Center (run by Illumination Foundation), Placentia Navigation Center (run by PATH), Buena Park Navigation Center (run by Mercy House), and the Anaheim Bridges Shelter (run by Mercy House).[10]

In Orange County, homelessness is addressed regionally by the Orange County Continuum of Care (COC), an umbrella organization that brings together government agencies and community-based nonprofit organizations in a coordinated effort to meet the urgent needs of people experiencing homelessness or who are in imminent danger of experiencing homelessness.[11]

Orange County currently has several existing programs to assist individuals experiencing homelessness. The County also provides interim housing (e.g., including the Yale Navigation Center and Bridges at Kraemer Place), emergency shelters, and transitional housing. Finally, the County addresses homelessness through special initiatives such as CalWORKS, a program to assist families with children who are currently homeless or at risk of homelessness.[12]

2.2 MAJOR COMMUNITY ELEMENTS

The identification of assets potentially affected by climate change related events are as follows:

Essential Services

Fire and Emergency Services

The Fullerton Fire Department is led by the Fire Chief and supported by the Deputy Chief of Operations and Deputy Chief of Administration and Fire Marshal. The operations division includes emergency dispatch, emergency medical services (e.g., firefighter/paramedic program, EMS paramedic training, paramedic subscription program, and ambulance transportation), the Office of Emergency Services, MetroNet Fire, and is responsible for training. The Fire Department has six stations located throughout the city.

[9] County of Orange. 2022. Point-In-Time Report on Homelessness.
[10] Fullerton, City of. 2023. Homeless Liaison Officer (HLO) Unit. https://www.cityoffullerton.com/government/departments/police/police-services/homeless-outreach. Accessed December 20, 2023.
[11] County of Orange. 2023. Continuum of Care. https://ceo.ocgov.com/care-coordination/homeless-services/2023-continuum-care. Accessed December 9, 2023.
[12] County of Orange. 2023. Homeless Services. https://www.ocgov.com/residents/health/homeless-services. Accessed December 9, 2023.

The Fullerton Fire Department also provides prevention resources (e.g., plan check services and hazardous materials services, weed abatement, and fireworks education) and emergency management services.[13]

Police Services

The Fullerton Police Department (FPD) is led by the Chief of Police and supported by Captains and Area Commanders. FPD has Specialized Units ranging from investigation to gang suppression; traffic enforcement and community relations to engage with the community. With a compliment of approximately 180 employees, 125 sworn and 55 civilian positions, the Fullerton Police Department handles close to 50,000 calls for service annually.[14]

Transportation Systems

A system of major and primary arterial highways provides vehicular circulation throughout the city. The east-west highways providing access to/from and through the city are Imperial Highway (State Route 90), Bastanchury Road, Malvern/Chapman Avenue, Commonwealth Avenue, and Orangethorpe Avenue. Similarly, Beach Boulevard (State Route 39), Euclid Street, Harbor/Brea Boulevard, State College Boulevard, and Placentia Avenue provide the north-south highways. The Orange Freeway (State Route 57) runs along Fullerton's eastern border and the Riverside Freeway (State Route 91) runs along the southern border of Fullerton, and the Santa Ana Freeway (Interstate 5) runs near the southwest city limits. In the event of an emergency, most community members would likely evacuate in either direction along any of these arterial highways. If any of these routes become inaccessible, the other roadways and local streets could easily become congested. Use of the roadway system as evacuation routes will be based on the incident occurring and areas of the city impacted.

The Orange County Transportation Authority runs bus lines that connect Fullerton with cities in Los Angeles and Orange Counties. Fullerton's rail station in the downtown area is served by Metrolink commuter trains, Amtrak's Pacific Surfliner route, and the long-distance Southwest Chief Amtrak train. Freight rail service is provided by BNSF Railroad and Union Pacific Railroad. The nearest airports with commercial service are John Wayne International Airport and Long Beach Airport. The Fullerton Municipal Airport serves general aviation aircraft.[15]

Lifeline Utility systems

Infrastructure plays a vital role in mitigating the effects of hazard events. When infrastructure fails, it can exacerbate the extent of certain hazards or create complications for rescue workers trying to reach victims. For example, fallen utility poles due to high winds or seismic activity, can obstruct roadways and prevent emergency vehicles from reaching affected areas. Brief descriptions of major infrastructure in the City that may be affected by climate-related hazards are as follows:

Electricity

Fullerton receives its electricity from Southern California Edison, which is one of California's four major investor-owned utility companies and the largest electrical supplier in the state. Southern California

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[13] Fullerton, City of. 2023. Fire Department. https://www.cityoffullerton.com/government/departments/fire. Accessed December 20, 2023.

[14] Fullerton, City of. 2023. Fullerton Police. https://www.cityoffullerton.com/government/departments/police/about-fpd. Accessed December 20, 2023.

[15] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

Edison sources electricity from power plants throughout California and neighboring states and delivers it through a network of large-scale power lines and substations. The one registered commercial power plant in the city is the CSUF Trigeneration natural gas plant on the CSUF campus. There are also a number of noncommercial plants in Fullerton, including the CSUF State College solar photovoltaic plant, a natural gas plant on the Kimberly-Clark campus in southeastern Fullerton, and a number of small-scale solar panel installations. Fullerton has seven power substations: the Norweld, Gilbert, Sunnyhills, Basta, Fullerton, Paper, and Titans Substations. Southern California Edison operates all of these substations. There are also a number of nearby substations outside the city that are operated by Southern California Edison or by other providers. The major transmission lines in Fullerton run along Walnut Avenue, Orangethorpe Avenue, and Imperial Highway (State Route 90) and connect Fullerton to substations outside of the city. While these are not all of the transmission lines running through the City, these external connections provide Fullerton with some redundancies against power outages in the event that individual power lies are damaged, although damage to a substation or more widespread damage to power lines could result in a greater loss of power.[16]

Natural Gas and Oil

Natural gas service in Fullerton is provided by the Southern California Gas Company. There is one major transmission line running along S Placentia Avenue as well as a high-pressure distribution line with branches running along Brookhurst Street, W Valencia Drive, S Placentia Avenue, and Nutwood Avenue. No other large pipelines are present. Various facilities in neighboring Placentia, Anaheim, Brea, and other surrounding communities help to keep the natural gas flowing safely and reliably. Oil pipelines run through the neighboring cities of Buena Park and Brea; however no major transmission lines run through the City. Damage to transmission lines in Fullerton or to facilities in surrounding communities could impact services in Fullerton.[17]

Water Supply

Most of Fullerton's water is groundwater supplied by the Orange County Water District; the remaining water is imported from the State Water Project and Colorado River and is supplied to Fullerton through regional agencies. According to Fullerton's 2015 Urban Water Management Plan, the City maintains 15 storage reservoirs with a capacity of 69.5 million gallons. With a daily water demand of 223 gallons per capita per day (GPCD) and using the City's 2015 population of 138,976 people, the City has enough reserves to supply the community's needs for roughly two days. This assumes no restrictions are enacted or that GPCD does not decrease. The City maintains connection to a regional pipeline network that allows it to receive water from other Orange County water suppliers in the event of short-term emergencies. Wastewater service in the community is supplied by the Orange County Sanitation District (OCSD).The City operates miles of sewer lines and pump stations that collect wastewater from buildings and facilities in Fullerton and conveys it to regional wastewater treatment facilities. The nearest wastewater treatment facility is the OCSD Plant in Fountain Valley.[18]

Stormwater Management

Orange County manages stormwater through the National Pollutant Discharge Elimination System (NPDES), which in California is overseen by Regional Water Quality Control Boards (RWQCBs). The Santa Ana RWQCB (Region 8) includes the City of Fullerton. The Water Quality Control Plan for the

[16] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

[17] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

[18] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

Santa Ana River Basin (Basin Plan) contains the Region Board's policies for managing the Region's water quality. The Basin Plan includes the water quality standards (water quality objectives, beneficial uses, and anti-degradation policy) for the Region, regionally important water quality management and improvement initiatives, policies and practices for implementing water quality standards, and implementation plans. The Clean Water Act requires review of water quality management plans every three years, and the California Water Code, basin plans are reviewed periodically for areas where improvements or updates are needed.

The Basin Plan for the Santa Ana Region includes the upper and lower Santa Ana River watersheds, the San Jacinto River watershed, and several other small drainage areas. The Santa Ana Region covers parts of southwestern San Bernardino County, western Riverside County, and northwestern Orange County. The Basin Plan establishes water quality standards for the ground and surface waters of the region. The Basin Plan includes an implementation plan describing the actions by the Regional Board and others that are necessary to achieve and maintain the water quality standards.[19,20]

Hazardous Materials

The threat that hazardous materials pose to human health depends on the type of material, frequency, and duration of exposure, and whether chemicals are inhaled, penetrate skin, or are ingested, among other factors. Exposure to hazardous materials can result in short- or long-term effects, including major damage to organs and systems in the body, or death. Hazardous waste is any material with properties that make it dangerous or potentially harmful to human health or the environment. Hazardous materials can also cause health risks if they contaminate soil, groundwater, and air, potentially posing a threat long after the initial release.

Hazardous materials can cause damage to physical assets in the City if they are released into the environment. Corrosive hazardous materials can damage the exteriors of any buildings or structures designated as a critical facility or facility of concern by the City. Flammable hazardous materials can potentially start fires and may cause any nearby critical facilities to flashover. Sites that are closer to the origin for the release of the hazardous materials are more threatened than those that are farther away.

The Cities of Anaheim and Huntington Beach have entered into a Joint Powers Agreement (JPA) to form the Orange County-City Hazardous Materials Emergency Response Authority (OCCHMERA). Anaheim and Huntington Beach provide 2 hazardous materials response teams, which in turn, provide hazmat emergency service for Subscribing Cities, including Fullerton.[21]

Passage of SB 1082 in 1993 required consolidation of State-mandated hazardous waste and hazardous materials management programs within a single Unified Program, to be administered by a Certified Unified Program Agency (CUPA). These programs are:

- Hazardous Waste Generator Program
- Tiered Permitting Program
- Hazardous Materials Business Plan (HMBP)

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[19] County of Orange Public Works. 2023. Regional Stormwater Program. https://ocerws.ocpublicworks.com/service-areas/oc-environmental-resources/oc-watersheds/regional-stormwater-program. Accessed December 12. 2023

[20] California, State of Water Boards. Santa Ana River Basin Plan. https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan. Accessed December 12, 2023.

[21] Fullerton, City of. 2023. Orange County-City Hazardous Materials Emergency Response Authority (OCCHMERA). https://www.cityoffullerton.com/government/departments/fire/prevention/occhmera. Accessed December 20, 2023.

- Aboveground Storage Tank Program
- Underground Storage Tank Program (UST)
- California Accidental Release Program (CalARP)

County and City Fire Agencies within Orange County have joined in partnership with the CUPA as Participating Agencies (PAs). In most Orange County cities, the Environmental Health Division administers all programs, with the exception of La Habra, Fullerton, Huntington Beach, Orange and Fountain Valley in which case the local Fire Agencies are responsible for the Hazardous Materials and Business Emergency Plan Programs. The Fire Agencies in the cities of Orange and Fullerton also administer the Underground Storage Tank Program and LA County Fire administers the CalARP and HMD/BEP programs for the City of La Habra.[22]

Fullerton Adaptive Capacity to Climate-Related Hazards

Fullerton has implemented programs or partnered with external agencies to prepare for, respond to, and help the community recover from human-caused and natural hazards, including those that are climate related. The following programs improve the overall adaptive capacity of the City:

AlertOC

AlertOC is Orange County's official emergency alert and warning system. Information provided by AlertOC in addition to local, State, and Federal alert and warning systems provides the most up-to-date information on emergencies and disasters happening in Orange County.[23]

AB 38 Gov Code 1102.19

As of July 1, 2021, a seller of a property that is in a high or very high fire hazard severity zone as identified by the Director of Forestry and Fire Protection must provide to the buyer documentation stating that the property is in compliance with local vegetation management ordinances.[24]

Community Emergency Response Team (CERT) Program

In the event of an area wide disaster, critical infrastructure and emergency services will be impacted. The Community Emergency Response Team (CERT) academy trains residents to prepare for and respond to life-threatening events in their community. CERT members can mobilize neighborhood resources, deliver immediate assistance to victims, organize emergency communications and provide support to first responders.[25]

Fullerton Local Hazard Mitigation Plan (2020)

The 2020 LHMP includes goals to decrease the risks associated with the hazards, including:

- Reduce and isolate threats to public safety and property in Fullerton.
- Maintain government operations and provisions of essential services to residents and stakeholders during and after a hazard event.

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[22] County of Orange Health Care Agency. CUPA. https://www.ochealthinfo.com/about-hca/public-health-services/environmental-health-division/hazardous-materials. Accessed December 20, 2023.
[23] AlertOC. 2023. https://www.ocgov.com/about-county/emergency. Accessed December 10, 2023.
[24] State of California. 2019. AB38, Wood. Fire safety: low-cost retrofits: regional Capacity review: wildfire mitigation. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB38. Accessed December 3, 2023.
[25] Fullerton, City of. 2023. https://www.cityoffullerton.com/government/departments/fire/emergency-management/certAccessed December 10, 2023.

- Protect the natural environment through responsible stewardship of air, water, and open spaces in Fullerton.
- Promote resiliency and climate action in Fullerton through resilient infrastructure, responsive governance, and vibrant civic participation.
- Partner with surrounding local, regional, state, and federal jurisdictions in hazard mitigation efforts.[26]

[26] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

CHAPTER 3. VULNERABILITY ASSESSMENT

Addressing the widespread impacts of climate change represents a significant challenge for the State. A changing climate presents California with five key climate hazards: (1) higher temperatures and extreme heat events, (2) more severe wildfires, (3) more frequent and intense droughts, (4) flooding due to extreme precipitation events and coastal flooding and erosion from sea-level rise, and (5) increased potential for geologic (landslides) and seismic (earthquake-induced liquefaction) hazards. These hazards will threaten public health, safety, and well-being—including from life-threatening events, damage to public and private property and infrastructure, and impaired natural resources.[27]

Notable examples of climate impacts in Fullerton and the broader Orange County include:

- Across the region, average maximum temperatures are projected to increase around 4-5 degrees °F by the mid-century, and 5-8 degrees °F by the late century.
- Despite small changes in average precipitation, dry and wet extremes are both expected to increase. By the late-21st century, the wettest day of the year is expected to increase across most of the region, with some locations experiencing 25-30 percent increases under RCP8.5. Increased frequency and severity of atmospheric river events are also projected to occur for this region.
- Projections indicate that wildfire may increase over southern California, but there remains uncertainty in quantifying future changes of burned area over the region.[28]

Following State guidance, this report provides an assessment of the City's vulnerabilities to climate change. It identifies and describes the climate hazards and other climate effects that may affect the City in the future. The Vulnerability Assessment follows the process outlined in Phase 2 of APG 2.0 and is composed of the following three steps:

- Exposure: The purpose of this step is to characterize the City's exposure to current and projected climate hazards. Existing hazards that can be worsened by the effects of climate change are identified and described, based on historical data, including the City's Local Hazard Mitigation Plan (LHMP) adopted in 2020. Climate data are used to develop projections for how existing hazards are expected to change by mid- and late century from future climate change.
- Sensitivity: This step will characterize potential future climate impacts to community populations and assets. Using historical data and research from regional and State reports on climate impacts, this step explores how sensitive vulnerable populations and assets may be affected by the projected impacts of climate change hazards.
- Adaptive Capacity: The purpose of this step is to characterize the City's current capability to cope with the projected impacts from climate hazards to vulnerable populations and assets. The adaptive capacity of the City to adapt to each of the identified climate impacts is determined through a review of existing plans and programs.

[27] California Legislative Analyst's Office (LAO). 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed December 1, 2023.
[28] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

RPC 2 (b)(iv)

3.1 EXISTING HAZARDS

Orange County has a history of major hazard events. Presidential disaster declarations are typically issued for hazard events that cause more damage than State and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. The following table illustrates examples of past hazard events:

Table 3-1: FEMA-Declared Disasters in Orange County

Name of Event	FEMA Disaster Number*	Date
Bond Fire	FM-5383	2021
Blue Ridge Fire	FM-5381	2021
Silverado Fire	FM-5830	2021
California Covid-19 Emergency	DR-4482	2020
Wildfires (Holy Fire)	FM-5268	2018
Canyon 2 Fire	DR-4344	2018
Canyon Fire	FM-5213	2017
Severe Winter Storms, Flooding, and Mudslides	DR-4305	2017
Severe Winter Storms, Flooding, And Debris And Mud Flows	DR-1952	2011
Freeway Complex Fire	FM-2792	2008
Wildfires	DR-1810	2008
Santiago Fire	FM-2737	2007
241 Fire	FM-2863	2007
Wildfires, Flooding, Mud Flows, And Debris Flows	DR-1731	2007

* DR = Disaster Declaration; EM = Emergency Declaration; FM = Fire Management; FS = Fire Suppression

Source: FEMA, 2023

3.2 ANALYZING CLIMATE CHANGE

The effects of projected climate change include changes in temperature and precipitation contributing to hazards such as extreme heat events, drought, wildfires (and associated decreases in air quality), flooding associated with large precipitation events, landslides, and coastal flooding and inundation resulting from sea level rise. It is important to note that hazardous events may result from isolated changes, or a combination of changes, in temperature and precipitation.

To assess the potential direct and indirect effects from climate change, APG 2.0 recommends using Cal-Adapt, a global climate simulation model data. Cal-Adapt addresses uncertainty surrounding potential GHG emissions with the use of Representative Concentration Pathways (RCP). The RCPs in this Vulnerability Assessment rely upon two future emissions scenarios: RCP 4.5 and RCP 8.5. RCP 4.5 represents a medium emissions scenario of GHG emissions and assumes emissions will rise, then even out near the middle of the century, and decrease to below 1990 levels by the end of the 21st century.

RPC 2 (b)(iv)

RCP 8.5 is a high emissions scenario where GHG emissions continue to increase through the end of the 21st century.[29]

Cal-Adapt also includes ten global climate models, downscaled to local and regional resolution using the Localized Constructed Analogs statistical technique. Four of these models were selected by California's Climate Action Team Research Working Group as priority models for research contributing to California's Fourth Climate Change Assessment. Projected future climate from these four models can be described as producing:

- A warm/dry simulation (HadGEM2-ES),
- A cooler/wetter simulation (CNRM-CM5),
- An average simulation (CanESM2), and
- A dynamic simulation with greater variability (MIROC5).

3.2.1 IMPACTS OF CLIMATE CHANGE

The projected outcomes of climate change include increases or decreases in temperature and precipitation as they relate to the frequency, duration, and intensity of changes. Combined, these changes in the historical patterns of temperature and precipitation contribute to changes in the frequency, duration, and intensity of climate hazard events such as extreme heat events, drought, wildfires (and associated decreases in air quality), flooding associated with large precipitation events, landslides, and coastal flooding and inundation resulting from sea level rise.

3.2.1.1 CHANGES IN TEMPERATURE

Observations over the past century indicate that temperature has increased across southern California. Based on 1896-2015 temperature records for the California South Coast NOAA Climate Division, which encompasses Orange County, there were significant trends in annual average, maximum, and minimum temperature around 0.16°C per decade.[30]

According to Cal-Adapt, the historic, observed annual average maximum temperature (1961-1990) for the City was 76.4°F, and the historic, observed annual average minimum temperature was 52.3°F.[31] As shown in **Table 3-2: Projected Change in Annual Average Temperature:** City of Fullerton, both are projected to increase by mid-century and further increase by the end of the century.

The increase in minimum temperatures over time should also be considered as it can have a substantial impact on the community and the economy. Higher minimum temperatures equate to warmer nights that may impact those susceptible to heat effects.

[29] Bedsworth et al. 2018. Statewide Summary Report. California's Fourth Climate Change Assessment. Publication number: SUMCCCA4-2018-013.
[30] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.
[31] California Energy Commission. 2023. CalAdapt. Local Climate Change Snapshot for Fullerton: Annual Average Maximum and Minimum Temperature. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed November 19, 2023.

Table 3-2: Projected Change in Annual Average Temperature: City of Fullerton

Annual Average Temperature	Historic Annual Average Temperature (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
Maximum	76.4°F	80.4°F	81.5°F	81.3°F	84.5°F
Minimum	52.3°F	55.9°F	57.0°F	56.9°F	60.1°F
°F = degrees Fahrenheit					

California Energy Commission. 2023. CalAdapt. Local Climate Change Snapshot for City of Fullerton: Annual Average Maximum and Minimum Temperature. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed November 1, 2023.

3.2.1.2 CHANGES IN PRECIPITATION

Precipitation over the region is highly variable from year to year and only about five storms each year make up 50 percent of the annual precipitation total. Natural climate variability phenomena, such as the El Niño-Southern Oscillation, can influence the amount of precipitation that the region receives, but there are no clear trends in historical precipitation for this region. Despite small changes in average precipitation, dry and wet extremes are both expected to increase in the future. By the late-21st century, the wettest day of the year is expected to increase across most of the region, with some locations experiencing 25-30 percent increases under RCP8.5. Extreme precipitation often arrives via "atmospheric rivers," and possible changes to these and other extreme storms are discussed further in the subsequent section. Extremely dry years are also projected to increase over southern California, potentially a doubling or more in frequency by the late-21st century.[32]

Annual Average Precipitation Levels

According to Cal-Adapt, annual projected precipitation levels in the City are expected to experience minimal to no change by the end of the century. **Table 3-3: Projected Change in Annual Average Precipitation: City of Fullerton** identifies estimated annual average precipitation levels. The results of these projections suggest that during average years at mid-century, precipitation levels will be similar to conditions currently experienced within the City, with a potential increase in average annual rain at the end of the century under the RCP 8.5 scenario.

Table 3-3: Projected Change in Annual Average Precipitation: City of Fullerton

Average Annual Precipitation	Historic Annual Average Precipitation (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	13.6 Inches	13.2 Inches	13.6 Inches	13.3 Inches	13.2 Inches

CalAdapt. Local Climate Change Snapshot for Fullerton: Annual Average Precipitation. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed November 1, 2023.

This Vulnerability Assessment addresses relevant natural hazards for the City influenced by a changing climate and includes Extreme heat events, drought, wildfire and smoke, flooding, landslides and liquefaction. Swings in extreme weather, such as extremely dry and hot conditions followed by extremely wet conditions and back again, can also exacerbate wildfires and flooding for certain land uses.

[32] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

Mental Health

The impacts from climate change such as fires and floods can have acute mental health impacts. As reported in the State's 4th Climate Change Assessment, there are potential links between extreme weather events and anxiety and depression, post-traumatic stress disorder, and suicide.[33]

3.2.1.3 EXTREME HEAT EVENTS

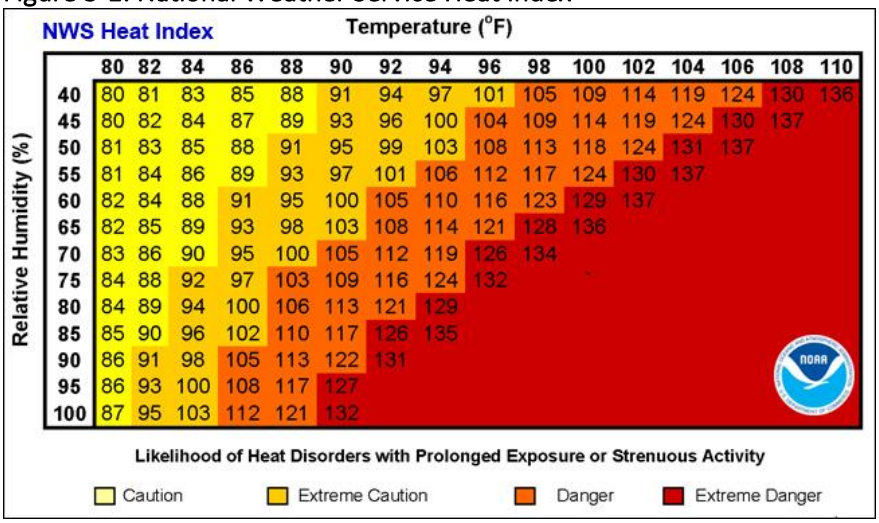
Extreme heat events are a period when temperatures are abnormally high relative to a designated location's normal temperature range. Extreme heat events are one of the leading weather-related causes of death in the United States from 1999 through 2009, extreme heat exposure caused more than 7,800 deaths.[34] There are generally three types of extreme heat events:

- Extreme Heat Days: a day during which the maximum temperature surpasses 98 percent of all historic high temperatures for the area, using the time between April and October from 1961 to 1990 as the baseline.
- Warm Nights: a day between April and October when the minimum temperature exceeds 98 percent of all historic minimum daytime temperatures observed between 1961 and 1990.
- Extreme Heatwaves: a successive series of extreme heat days and warm nights where extreme temperatures do not abate. While no universally accepted minimum length of time for a heatwave event exists, Cal-Adapt considers 4 successive extreme heat days and warm nights to be the minimum threshold for an extreme heatwave.

Extreme heat events will feel different from region to region since different areas have different historic high temperatures. For example, an extreme heat day on the coast will feel different than an extreme heat day in the high desert. This is because humidity plays a factor in the perceived heat that people feel. Humid conditions will make a day feel hotter than non-humid conditions, even though the temperature may be the same. The difference between the perceived temperature and the actual temperature is known as the "heat index." To illustrate the effect of the heat index, a 90°F day with 50 percent humidity feels like 95°F, whereas a 90°F day with 90 percent humidity feels like 122°F. **Figure 3-1: National Weather Service Heat Index** shows the National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service (NWS) Heat Index.[35]

[33] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.
[34] United States Global Change Research Program, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. A. Crimmins, J. Balbus, J. L. Gamble, C. B. Beard, J. E. Bell, D. Dodgen, R. J. Eisen, N. Fann, M. D. Hawkins, S. C. Herring, L. Jantarasami, D. M. Mills, S. Saha, M. C. Sarofim, J. Trtanj, and L. Ziska, Eds.
[35] National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service Heat Index. https://www.weather.gov/safety/heat-index. Accessed November 30, 2023.

Figure 3-1: National Weather Service Heat Index



Source: National Oceanic and Atmospheric Administration National Weather Service Heat Index.

Historical Extreme Heat Events

Local data for Fullerton is generally available using the National Weather Service Cooperative Network station at Fullerton Municipal Airport. The data indicates that the average maximum temperature for the area from all years between 1991 and 2020 is 86.7°F, occurring in the month of August.[36] Significant historic extreme heat events include:

- October 24, 2017. Daily temperature records were set for all weather monitoring stations in the Orange County including Fullerton at 107°F.[37]
- September 22, 2021. A heatwave across California set records including temperatures reaching 105°F in Orange County[38].
- September 22, 2022. A heatwave across California set records including temperatures reaching 110°F in Fullerton[39].
- August 27, 2023. South California reached 100°F plus degrees including areas of inland Orange County.[40]

Unusually hot days and multi-day heatwaves are a natural part of day-to-day variation in weather. As the Earth's climate warms, however, hotter-than-usual days and nights are becoming more common, and heatwaves are expected to become more frequent and intense. Increases in these extreme heat events can lead to more heat-related illnesses and deaths, especially if people and communities do not take steps to adapt.[41]

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[36] Western Regional Climate Center. 2023. Fullerton Municipal Airport, California. https://wrcc.dri.edu. Accessed December 8, 2023.

[37] Henson, Bob. 2017. Record-melting Fall Heat Wave Bakes Southern California. www.wunderground.com. Accessed December 1, 2023.

[38] Los Angeles Daily News. Triple-Digit Heat Wave Continues in Southern California. Accessed December 1, 2023.

[39] Daily Titan. Heat waves: What students should know. Accessed December 1, 2023.

[40] Darwish, Mona. 2023. Heat Wave Blasts Southern California. Los Angeles Times. August 27.

[41] Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana. 2016. Chapter 2: Temperature-related death and illness. In: The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program.

VULNERABILITY TO EXTREME HEAT EVENTS

Exposure

More frequent, larger magnitude, and longer duration heatwaves are already emerging as an important aspect of climate change in the Orange County.[42]

Annual mean maximum temperature could increase by 4.1°F by 2100 (see **Table 3-2: Projected Change in Annual Average Temperature: City of Fullerton**.[43] As illustrated in **Table 3-4: Projected Change in Number of Extreme Heat Days: City of Fullerton (98.6°F)** the annual number of extreme heat days (over 98.6°F, the 98th percentile) in the City could increase up to 17 days by 2100 under the high emissions scenario.[44]

Table 3-4: Projected Change in Number of Extreme Heat Days: City of Fullerton (98.6°F)

Number of Extreme Heat Days*	Historic Annual Average Extreme Heat Days (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	2	10	13	12	27

*Number of days in a year when daily maximum temperature is above a threshold temperature of 98.6 °F. Note: Threshold temperature used in this tool is location specific. It is defined as the 98th percentile value of historical daily maximum/minimum temperatures (from 1961–1990, between April and October) observed at a location.

However, when evaluating temperatures 85°F and above, the annual number of extreme heat days in the City could double by mid-century under the medium emissions scenario and more by end of century under the high emissions scenario. **Table 3-5: Projected Change in Number of Extreme Heat Days: City of Fullerton (85°F)**

Table 3-5: Projected Change in Number of Extreme Heat Days: City of Fullerton (85°F)

Number of Extreme Heat Days*	Historic Annual Average Extreme Heat Days (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	71	128	149	142	183

*Number of days in a year when daily maximum temperature is above a threshold temperature of 85 °F. Note: Threshold temperature used in this tool is location specific.

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Fullerton: Extreme Heat Days. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed December 1, 2023.

42 Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.
[43]California Energy Commission. 2022. CalAdapt. Local Climate Change Snapshot for Fullerton: Annual Average Maximum Temperature. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed December 1, 2023.
[44]California Energy Commission. 2022. CalAdapt. Local Climate Change Snapshot for Fullerton: Extreme Heat Days. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed December 1, 2023.

Warm Nights

Warm night temperatures affect the ability of a community and its residents to effectively cool down from extreme heat days. If temperatures remain higher than normal during the night, the compounding impacts from high daytime temperatures can be highly detrimental to public health.

According to Cal-Adapt, a warm night event in the City is a night when the evening temperature exceeds 67.9°F. **Table 3-6: Projected Change in Number of Warm Nights: City of Fullerton** identifies the projected average number of warm nights that would occur each year under the RCP 4.5 and RCP 8.5 scenarios. By 2100, an average of 75 warm nights (RCP 8.5) could be experienced compared to current conditions of 7 days annually based on observed historical conditions. Based on these projections, the City can anticipate increased demand towards the end of the century - for overnight cooling centers and calls for service from vulnerable populations, which are expected to be disproportionately impacted by extreme heat conditions.

Table 3-6: Projected Change in Number of Warm Nights: City of Fullerton

Average Annual Number of Warm Nights*	Historic Annual Average Warm Nights (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	7	26	37	35	75

*Number of days in a year when daily minimum temperature is above a threshold temperature of 67.9 °F.
Note: Threshold temperature used in this tool is location specific. It is defined as the 98th percentile value of historical daily maximum/minimum temperatures (from 1961–1990, between April and October) observed at a location.

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Fullerton: Warm Nights. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed November 1, 2023.

Sensitivity: Major Community Elements

The impacts of extreme heat events will be most severely felt in highly developed areas of the City that are intensely paved and surrounded by buildings constructed of dark (heat absorbing) materials without the cooling benefits of tree shade. Compared with rural communities, urbanized areas can experience higher temperatures, greater pollution, and more negative health effects, especially during summer months. This phenomenon is known as the Urban Heat Island Effect (UHIE). Urban heat islands are created by a combination of heat-absorptive surfaces (e.g., dark pavement and roofing), heat-generating activities (e.g., automobile engines and industrial generators), and the absence of "green spaces" (vegetative surfaces that provide evaporative cooling). During extreme heat days and heatwaves, asphalt and darker surfaces reduce nighttime cooling as these surface types retain more heat to be released at night. The UHIE is known to intensify extreme heat days and heatwaves.

Transportation Systems

High temperatures increase the risk of pavement deterioration, depending on the paving materials and the traffic load of a given road.[45,46] The type of pavement used is typically based on historical

[45] Daniel, J.S., J.M. Jacobs, E. Douglas, R.B. Mallick, and K. Hayhoe. 2014. Impact of climate change on pavement performance: Preliminary lessons learned through the Infrastructure and Climate Network (IC Net). dot:10.1061/9780784413326.001.
[46] Rowan, E., C. Evans, M. Riley-Gilbert, R. Hyman, R. Kafalenos, B. Beucler, B. Rodehorst, A. Choate, and P. Schultz. 2013. Assessing the sensitivity of transportation assets to extreme weather events and climate change. Transportation Research Record: Journal of the Transportation Research Board 2326(1):16—23. doi:10.3141/2326-03.

climate conditions; the increasing occurrence of frequent and prolonged extreme heat outside of historical norms will present challenges to the roadway system.[47] Extreme heat may also cause pavement heave and damage to transportation infrastructure and functioning.[48] Extreme heat is also problematic for rail systems, as railroad tracks exposed to high temperatures are at risk of warping or buckling.[49]

Lifeline Utility Systems

As heatwaves worsen, energy systems will need to adapt to help communities cope with rising temperatures. Access to air conditioning will be vital for vulnerable populations, even life saving for the elderly, young children, and those with pre-existing health conditions. However, increased cooling needs for both air conditioning and refrigeration will place significant stress on the power system during periods of extreme heat. And if that power comes from fossil fuel-fired power plants, there may also be an increase in soot, smog, and other forms of air pollution with associated public health consequences.[50] Impacts on electricity resources from climate hazards can include stress and physical damage to the electricity generation, transmission, and distribution system.

Transmission facilities face increasing climate change-related risks because of increased frequency of wildfires, severe wind, and extreme heat. Extreme heat and drought can add stress to transmission systems, resulting in system failure. Electrical infrastructure may fail due to increased electrical loads and stress from longer periods of increased operation. A 2011 study found that just one extra day with temperatures above 90°F increases annual household energy use by 0.4 percent.[51]

Higher temperatures can reduce the water supply in California from reduced precipitation and snowpack and earlier snowmelt.[52]

Renewable energy and electricity storage technologies can add flexibility to the electricity grid. Together with microgrids, renewables can support increased grid resilience and reliability in the face of extreme weather. Electricity storage also has the potential to replace fossil fuel-fired "peaking" power plants, which are called upon in times of high demand for electricity such as during extreme heat events.[53]

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[47] Holsinger, H. 2017. Preparing for change. FITWA-HRT-17-002. Public Roads 80(4). McLean, VA: Office of Research, Development, and Technology, Federal High Administration. https://highways.dot.gov/public-roads/januaryfebruary-2017/preparing-change. Accessed November 11, 2022.

[48] Guo Y, Gasparrini A, Li S, Sera F, Vicedo-Cabrera AM, de Sousa Zanotti Stagliorio Coelho M, et al. (2018) Quantifying excess deaths related to heatwaves under climate change scenarios: A multicountry time series modelling study. PLoS Med 15(7): e1002629.

[49] Magill, B. 2014. "Sun kinks" in railways join the list of climate change's toll. Scientific American, June 2. www.scientificamerican.com/article/sun-links-in-railways-Join-the-list-of-climate-change-s-toll. Accessed Novemer 11, 2022.

[50] Abel, D.W., T. Holloway, M. Harkey, P. Meter, D. Ahl, V.S. Limaye, and J.A. Patz. 2018. Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. PLOS Medicine 15(7):1—27.dot:10.1371/journal.pmed.1002599.

[51] Deschênes, Olivier and Michael Greenstone. 2011. Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US. American Economic Journal: Applied Economics Vol. 3 No. 4 October 2011

[52] U.S. Environmental Protection Agency. 2016. What Climate Change Means for California. https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ca.pdf

[53] Abel, D.W., T. Holloway, M. Harkey, P. Meter, D. Ahl, V.S. Limaye, and J.A. Patz. 2018. Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. PLOS Medicine 15(7):1—27. dot:10.1371/journal.pmed.1002599.

Economic Elements

Laborers in weather-exposed industries such as construction and agriculture are the most prone to extreme heat impacts, even if they work fewer hours when it is hotter. Workers are less productive when it is hotter out.[54] Exposure to high temperatures may affect worker safety by increasing rates of workplace injuries[55] and it may also affect the performance and productivity of workers.[56] Higher temperatures tend to reduce growth in many industries that involve substantial indoor work, including retail, services, and finance. A 1°F increase in the average summer temperature is associated with a reduction in the annual growth rate of state-level economic output of 0.15 to 0.25 percentage points, and rising temperatures could reduce U.S. economic growth by up to one-third over the next century.[57]

The increase in electricity usage on hot days stresses electric grids right when people depend on them most, as seen in California during recent heatwaves. Blackouts can be quite costly for the economy, as inventories of food and other goods can be spoiled, and many businesses either must run generators or shut down. For instance, the 2019 California blackouts cost an estimated $10 billion due to business closures.[58]

Natural Resource Areas

Extreme temperatures — as opposed to warmer average temperatures — are the catalyst for a growing number of extinctions. In 2002, researchers looked at 538 plant and animal species at 581 sites around the world that had been previously surveyed. The goal was to understand what aspects of climate change were the most serious threat to biodiversity. They found that 44 percent of the species at the sites had gone locally extinct, and that the culprit was an increase in the temperature of the hottest days of the year.[59]

Birds suffer more than other animals as they are diurnal (active in the day) and exposed to the hottest part of the day. Small mammals live underground and are generally nocturnal (active at night). A recent study found that the number of areas that native bumblebees occupy has plummeted 46 percent in North America and 17 percent in Europe compared to surveys taken from 1901 to 1974. Those bee-less areas were also places with a high degree of climate variation, especially higher temperatures. The study concluded that climate change--specifically hotter and more frequent extremes in temperatures--is related to the growing risk of extinction that animals are facing around the world.[60]

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[54] Lemione, Derek. 2021. 4 ways extreme heat hurts the economy. Cornell University Alliance for Science. August 3. https://allianceforscience.cornell.edu/blog/2021/08/4-ways-extreme-heat-hurts-the-economy. Accessed May 6, 2022.
[55] Park, J., Pankratz, N., & Behrer, A. (2021). Temperature, Workplace Safety, and Labor Market Inequality. IZA Discussion Paper No. 14560
[56] Cui, W., Cao, G., Park, J. H., Ouyang, Q., & Zhu, Y. 2013. Influence of indoor air temperature on human thermal comfort, motivation and performance. Building and environment, 68, 114-122.
[57] Colacito, Riccardo; Bridget Hoffmann, Toan Phan. 2018. Temperature and Growth: A Panel Analysis of the United States. Journal of Money, Credit, and Banking. December 3. https://doi.org/10.1111/jmcb.12574. Accessed May 6, 2022.
[58] Wara, Michael. 2019. Impacts of Wildfire on Electric Grid Reliability. Senate Energy and Natural Resources Committee Testimony. December 19.
[59] Roman-Palacios, Cristian and John J Wiens. 2020. Recent responses to climate change reveal the drivers of species extinction and survival. Proceedings of the National Academy of Sciences. February 10. https://doi.org/10.1073/pnas.1913007117
[60] Soroye, Peter. Tim Newbold, Jeremy Kerr. 2020. Climate change contributes to widespread declines among bumble bees across continents. Science. February 7. Pp. 685-688. DOI: 10.1126/science.aax8591.

Water stress induced mortality processes such as hydraulic failure or carbon starvation are caused by extreme heat (and drought). Many trees operate at or near their tolerance limit for water stress and may not be able to acclimate to keep pace with the changing climate.[61]

Climatic changes alter the range, biogeography, and growth of microbes and the vectors of food, water, and vector-borne illnesses. This includes the changes in aquatic environments that could increase harmful algal blooms and lead to increases in foodborne and waterborne illnesses.[62]

Sensitivity: Vulnerable Populations

Increased temperatures manifested as heatwaves and sustained high-heat days directly harm human health through heat-related illnesses (mild heat stress to fatal heat stroke) and the exacerbation of pre-existing conditions in the medically fragile, chronically ill, and vulnerable. Increased heat also intensifies the photochemical reactions that produce smog and ground level ozone and fine particulates (PM2.5), which contribute to and exacerbate respiratory disease in children and adults. Increased heat and carbon dioxide enhance the growth of plants that produce pollen, which are associated with allergies.[63]

Higher temperatures and extreme heat can lead to heat cramps, heat exhaustion, heat stroke, respiratory illness, and increase the risk of heat-related mortality and expansion of vector-borne disease.[64]

Whereas a heat event can be relatively harmless for those with a reliable means of staying hydrated and cool, it can be deadly for others. Young children, the elderly, or people suffering from serious medical conditions are physiologically more vulnerable to heatstroke. Some senior citizens also take medicines that can make it harder for their bodies to maintain a safe internal temperature, creating an additional threat from extreme heat events. Young children may not be aware of the signs of dehydration or ways of protecting themselves from heatstroke.

Extreme heat can cause urban surface areas to become 50 to 90°F Fahrenheit warmer than the air temperature. Extreme heat is present at all hours of the day and the night but is most intense during the day and in the summer. Due to changes in the sun's intensity, its magnitude varies with seasons. Surface heat contributes to human discomfort during the day and an increase in energy demand for air conditioning.[65]

Sudden spikes in heat can catch people by surprise. Stores can rapidly sell out of fans, air-conditioning units, or drinking water during a heatwave. Lower-income households or those with limited mobility may be unable to acquire enough insulation or cooling devices without significant advance preparations. This can be further compounded by the threat of Public Safety Power Shutoff events. During these events, extreme heat impacts may affect larger portions of the City and populations that would not be considered as vulnerable under normal circumstances.

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[61] Williams I N, Torn M S, Riley W J and Wehner M F 2014 Impacts of climate extremes on gross primary production under global warming Environ. Res. Lett

[62] California Department of Public Health. 2017. Climate Change and Health Profile Report Santa Clara County.

[63] Maizlish N, English D, Chan J, Dervin K, English P. Climate Change and Health Profile Report: Santa Clara County. Sacramento, CA: Office of Health Equity, California Department of Public Health; 2017.

[64] Southern California Association of Governments. 2020. Extreme Heat & Public Health Report. September.

[65] Southern California Association of Governments. 2020. Extreme Heat & Public Health Report. September.

While the general population may be less vulnerable to extreme heat events, people have unique and individual thresholds. Extreme heat events including heatwaves can lead to illness and death, particularly among older adults, the very young, and other vulnerable populations. People experiencing homelessness are at a high risk of health complications during heatwaves, especially if they are unsheltered.

Adaptive Capacity

Current research indicates that most people can adapt biologically and physically to incremental increases in average normal temperatures. Children, pregnant women, and older adults are more susceptible to adverse effects because they are less able to regulate their body temperatures. Other at-risk groups include individuals working outdoors, the socially isolated, and those with incomes below the federal poverty level, as well as communities of color. Continuous exposure to increased heat over time will impact how individuals are able to work and play both now and in the future.[66]

Regulation and Planning

Fullerton has addressed extreme heat in planning and research documents such as the Local Hazard Mitigation Plan, including a mitigation action to "Evaluate the long-term capacity of designated cooling centers and shelters in the City to provide sufficient relief from extreme heat. Assess the need to expand services as the frequency, length, and severity of future heatwaves potentially change as a result of climate change.

State of California: HeatReadyCA

The State of California provides resources and information to help you stay safe, cool and connected include developing a plan, understand warning signs, and provide cooling center location services.[67]

City of Fullerton: Heat Awareness and Cooling Center Information

Fullerton also provides Heat Awareness and Cooling Center Information that provides the protocol for three stages of readiness actions that include a Readiness Phase - Heat Advisory, Heat Alert Phase – Excessive Heat Watch, and Heat Alert Phase – Excessive Heat Warning. The protocols provide direction as to when the Heat Advisory or Heat Alerts are issued following a set criteria and use of standard indices and include the necessary actions such as monitoring, communication, and notifications.

Cooling Centers

To provide respite from extreme heat, Fullerton provides two cooling centers at the Fullerton Community Center at 340 W. Commonwealth and the Fullerton Main Library at 353 Commonwealth Avenue. There are also cooling centers located throughout the region to support vulnerable individuals and families.[68]

Aging Adults Excessive Heat Resources

The Orange County Office of Aging provides excessive heat resources to older adults and persons with health problems to stay safe during extreme heat.[69]

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[66] National Institute of Heath, National Institute of Environmental Health Sciences. 2022. *Temperature-related Death and Illness*. https://www.niehs.nih.gov/research/programs/climatechange/health_impacts/heat/index.cfm#footnote1 Accessed April 7, 2022.

[67] State of California. Office of Community Partnerships and Strategic Communications. 2023. Heat Ready California. Accessed December 21, 2023.

[68] County of Orange. 2023. Cooling Centers. https://ocgov.com/cooling-centers. Accessed December 21, 2023.

[69] County of Orange. 2023. Excessive Heat. https://www.officeonaging.ocgov.com/resources/excessive-heat. Accessed December 21, 2023.

3.2.1.4 DROUGHT + WATER SUPPLY

Increasing temperatures and changes in precipitation may lead to intensified drought conditions. Warmer temperatures contribute to more frequent and intense droughts by leading to a decline in and faster melting of winter snowpack, greater rates of evaporation, and drier soils. These conditions decrease the amount of spring and early summer snowmelt runoff upon which the State historically has depended for its annual water supply, while they increase the demand for irrigation water in both agricultural and urban settings. The period of 2012 through 2015 represents the State's four driest consecutive years on record in terms of Statewide precipitation, and 2021 was the third-driest single year.

Drought may lead to water-related problems. When rainfall is less than normal for weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth of water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought.[70]

As a result, droughts have widespread impacts across the State, including mandatory water use restrictions, reductions in agricultural crop production, and over-pumping of groundwater, which damages infrastructure from land sinking and dries up and degrades domestic well habitats.[71]

Historical Drought Events

- The 2007–2011 California drought marked the beginning of increased restrictions on State Water Project (SWP) pumping from the Bay-Delta due to environmental considerations. In April 2007, Metropolitan Water District of Southern California (MWD) announced that it would implement shortage-related actions consistent with its Water Surplus and Drought Management Plan (WSDMP).
- In January 2014, Governor Brown proclaimed a state of emergency throughout California, calling for increased conservation across the State. In response to the Governor's drought declaration and call for conservation, the Water Authority activated its WSDMP for the second time since its adoption in 2006, declaring in February 2014 a regional drought response Stage I, Voluntary Supply Management. On April 2, 2017, Governor Brown lifted the drought emergency.[72]
- On April 21, May 10, and July 8, 2021, Governor Newsom issued proclamations that a state of emergency exists in a total of 50 counties due to severe drought conditions and directed State agencies to take immediate action to preserve critical water supplies, mitigate the effects of drought, and ensure the protection of health, safety, and the environment. On October 19, 2021, Governor Newsom signed a proclamation extending the drought emergency Statewide and further urging Californians to reduce their water use.
- On January 4, 2022, the State Water Resources Board passed Resolution No. 2022-0002 adopting an emergency regulation to supplement voluntary water conservation.[73]

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[70] United States Geological Survey. 2022. California Water Sciences Center. California Drought. https://ca.water.usgs.gov/california-drought/what-is-drought.html. Accessed December 12, 2023.

[71] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed December 11, 2023.

[72] United States Geological Survey. 2022. California Water Sciences Center. California Drought. Comparisons. 2012-2016 California Drought: Historical Perspectives. https://ca.water.usgs.gov/california-drought/california-drought-comparisons.html. Accessed December 13, 2023.

[73] California Department of Water Resources. 2022. Resolution no. 2022-0002 to adopt an emergency regulation to supplement voluntary water conservation. January 4.

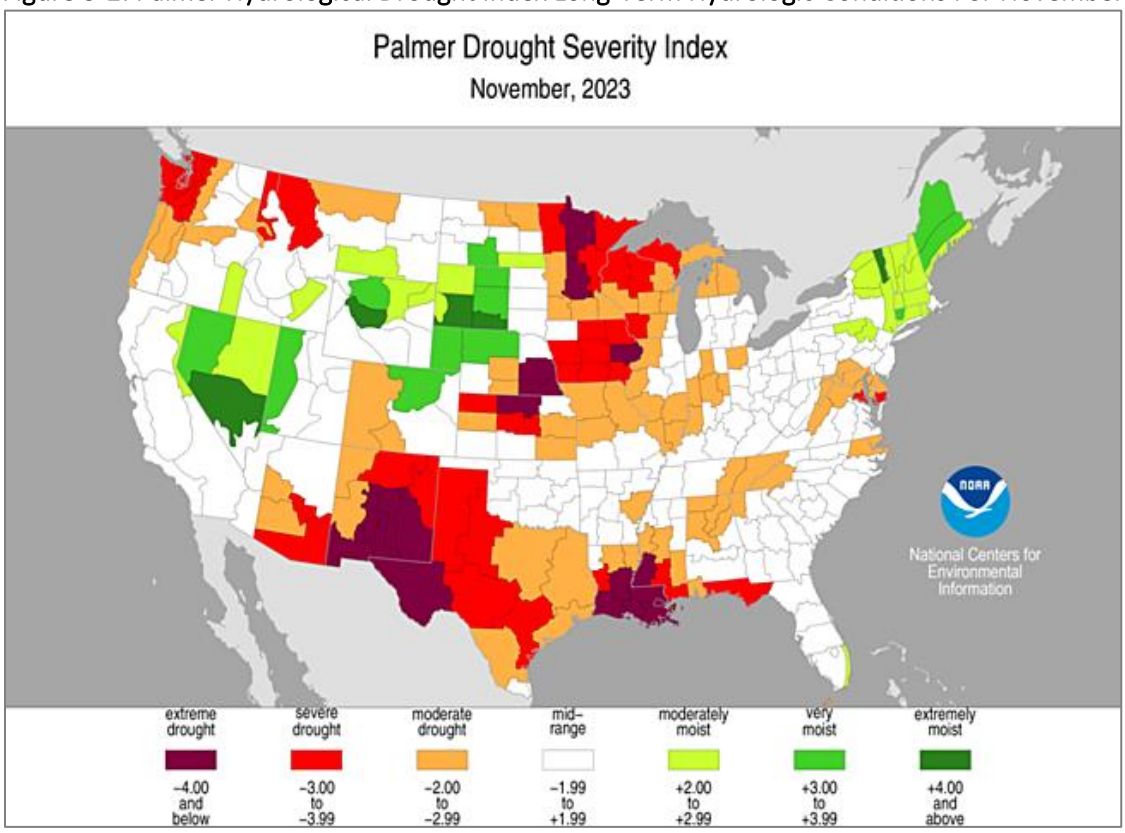
- Excessive rainfall and flooding in late December 2022 and early January 2023 alleviated some of the drought conditions. Governor Newsom officially eased drought restrictions in March 2023. As of November 2023, the City was not considered to be in a state of drought.[74]

MONITORING DROUGHT

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations. The Palmer Drought Index measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month depends on current weather plus the cumulative weather of previous months. Figure 3-2: Palmer Hydrological Drought Index Long-Term Hydrologic Conditions For November 2023 shows this index for November 2023.

As the climate continues to change, many historically dry areas like ours are likely to experience less precipitation and increased risk of prolonged droughts, erratic and unseasonal rainfall patterns, flash floods and surface runoff, topsoil erosion, decline in forest canopy, depletion of groundwater supplies, land subsidence, increased dependence on expensive imported water supplies, and subsequent impacts on human health, economy and more. Droughts are among the most expensive weather-related disasters in the world, affecting ecosystems, agriculture, and human society.

Figure 3-2: Palmer Hydrological Drought Index Long-Term Hydrologic Conditions For November 2023



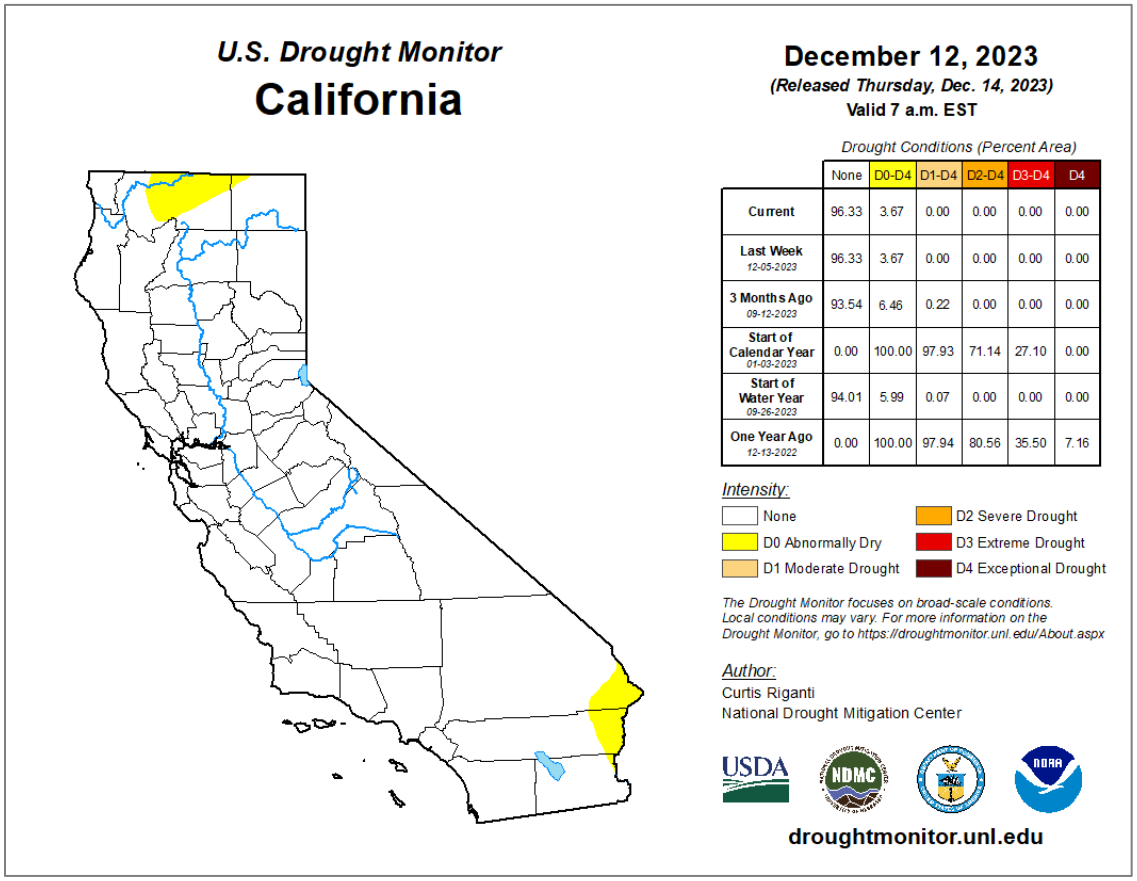
Source: National Oceanic and Atmospheric Administration. Palmer Drought Severity Index. https://www.ncei.noaa.gov/access/monitoring/historical-palmers/. Accessed December 14, 2023.

[74] Office of Governor. 2023. https://www.gov.ca.gov/2023/03/24/governor-newsom-eases-drought-restrictions/

The Palmer Drought Severity Index (PDSI) uses monthly temperature and precipitation data to calculate a simple soil water balance. The index is a relative measure that typically ranges from -4 (extremely dry) to +4 (extremely wet) and represents how soil moisture availability differs from that expected for a given place and time of year. The PDSI includes a "memory" component that considers past conditions and persistence of soil moisture surplus or deficit.[75]

While the entire State of California was in severe to extreme drought in the fall of 2022, storms in early 2023 brought much needed precipitation and snowpack that has reduced the impact of the drought. The November 2023 PDSI illustrates the State and Fullerton as having dramatically improved drought conditions with a “mid-range” ranking. The December 12, 2023, Drought Monitor map for California (**Figure 3-3: Drought Monitor)** shows that localized drought conditions as “none” in the City.

Figure 3-3: Drought Monitor



The Drought Monitor is a joint effort of the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture, and the National Drought Mitigation Center at the University of Nebraska-Lincoln. A map is released each week with drought conditions across the country, indexing everything from groundwater storage to river levels.

Source: National Drought Mitigation Center — University of Nebraska-Lincoln. https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?CA. Accessed December 12, 2023.

[75] Carolinas Precipitation Patterns & Probabilities. 2023. https://www.cisa.sc.edu/atlas/glossary.html. Accessed December 20, 2023.

VULNERABILITY TO DROUGHT

Exposure

As shown **Table 3-3: Change in Annual Average Precipitation: City of Fullerton** under both the medium and high emissions scenarios, the City is not expected to experience significant changes in average precipitation. California, and by extension the City, has been experiencing prolonged periods of drought over the last decade. Recent research suggests that extended drought occurrence (a "mega-drought") could become more pervasive in future decades. An extended drought scenario is predicted for all of California from 2025 to 2075 under the HadGEM2-ES simulation and high emissions scenario. The extended drought scenario is based on the average annual precipitation between 1961 and 1990 of 13.9 inches. Under the projected drought scenario between 2051 and 2070, Fullerton's precipitation would decrease by 3.9 inches from the 1961-1990 baseline and the variability in annual precipitation would be between 3.0 and 29.3 inches for the HadGEM 2-ES model.[76]

Drought and Flooding

According to climate forecasters at NASA, the future of fresh water will be full of extremes in the frequency and magnitude of floods and droughts. Droughts will pose serious challenges to the safety, health, and food and water supplies of plants, and animals and humans in some regions. Forecasts must now focus on predicting where it rains, but also how much, and how frequently heavy rain falls versus light rain. Rainfall amount impacts soils saturation and how high streams and rivers rise, which then changes their capacity to hold more in the event of another storm. Drier conditions from extended drought can exacerbate flooding conditions.[77]

Sensitivity: Major Community Elements

Drought will continue to be a foreseeable event in the future of California, including the City of Fullerton. Since most droughts are almost entirely contingent on global weather phenomena, which vary from year to year, it is impossible to predict either the frequency or severity of future drought events in the City. Droughts that result from infrastructure failure are equally impossible to predict since the circumstances that lead to infrastructure failure are unique to each situation.

As vegetation changes because of drought conditions, the animal species that depend on certain plant communities for food supply and habitat may be affected. The projected increase in the duration of droughts through the end of the century may threaten ecosystems as species become weak due to limited access to water and become susceptible to disease, pest, and decay.[78]

An indirect hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. Millions of board feet of timber have been lost, and in many cases, erosion has

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[76] California Energy Commission. Cal-Adapt. 2022. Extended Drought Scenarios, Precipitation by Water Year for Fullerton. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed November 1, 2023.
[77] National Aeronautics and Space Administration. 2019. Earth's Freshwater Future: Extremes of Flood and Drought. https://climate.nasa.gov/news/2881/earths-freshwater-future-extremes-of-flood-and-drought/. Accessed November 1, 2023.
[78] California Natural Resources agency, Governor's Office of Planning and Research, and California Energy Commission. 2019. California's Fourth Climate Change Assessment; San Diego Region Report. Available: https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-009_SanDiego_ADA.pdf. Accessed December 1, 2023.

occurred, has caused serious damage to aquatic life, irrigation, and power production due to heavy silting of streams, reservoirs, and rivers.

Drought is also often accompanied by extreme heat, exposing people to the risk of sunstroke, heat cramps and heat exhaustion. Pets and farmed animals are also vulnerable to heat-related injuries. Crops, already susceptible from drier conditions, can become even more vulnerable to extreme heat events as well.

Lifeline Utility Systems

Climate change is also expected to increase the average temperature and cause more frequent and prolonged heatwaves in California. During these events, water supplies may be diverted for cooling functions in the City. Hotter temperatures may also lead to increased surface water evaporation which could lead to greater water consumption. If a drought were to occur during a future heatwave, it could place the water supply under strain due to increased consumption potentially in combination with reduced supply.

From a regional perspective, warmer overall temperatures in California are anticipated to lead to a reduction in Statewide water supplies. Much of California's water comes from melted snow in the high sierra. In April 2022, the Sierra snowpack was in decline, at 38 percent of the Statewide average. The snowpack was the lowest it had been since 2015 and registered the sixth lowest April measurement in State history. In January 2023, storms in the Sierra Nevada more than doubled the snowpack for a normal January and surpassed the April annual average.[79] Water experts from the California Department of Water Resources were reluctant to signal too much optimism given that in the winter of 2021 California snowpacks accumulated to above-average levels through December, only to see January, February, and March of 2022 register as the driest on record.[80]

Economic Elements

Drought causes the most significant economic impacts on industries that use or depend on water for their business — most notably, agriculture and related sectors (forestry, fisheries, and waterborne activities). In addition to losses in crop yields and livestock production, drought is associated with increased insect infestations, plant diseases, and wind erosion. As the general drying of the landscape occurs in a drought, there can be a dramatic shift from high moisture to low moisture, prompting nuisance pests to migrate earlier in the year and in a more concentrated manner.[81] And for certain insects that thrive in warm, dry weather, like grasshoppers, populations increase dramatically. Left unaddressed, grasshoppers could cause agricultural damage so severe that beef and crop prices would go up.[82] Drought can lead to reduced income for farmers and reduced business for retailers and others who provide goods and services to farmers. This can lead to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue. Prices for food, energy, and other products may also increase as supplies decrease. Additionally, removal of dead trees can be costly and challenging, which can add to the financial impacts of drought.

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[79] California Department of Water Resources. 2023. Snow Water Equivalents. January 20.
[80] Sternfield, Marc. 2023. California snowpack soars to nearly 200% of normal. KTLA. https://ktla.com/news/local-news/california-snowpack-200-percent-normal/. Accessed December 21, 2023.
[81] Schellman, Anne. 2015. California drought may be causing shifts in pest invasion behavior. UC Division of Agriculture and Natural Resources. https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=19008. Accessed December 21, 2023.
[82] Brown, Matthew. 2021. Forget cicadas. Drought-stricken West is getting plagued by voracious grasshoppers. Los Angeles Times. June 24.

No structures will be directly affected by drought conditions, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

The water sector is central to public health and the economy. Water utilities ensure a reliable supply of clean water to communities and ecosystems and contribute significantly to the resilience of many other sectors, including agriculture, energy, and manufacturing. Drought can result in impacts to water utility operations, including:

- Loss of water pressure and water supply
- Poor water quality that may require additional treatment to meet drinking water standards
- Inability to access alternative and supplementary water sources because of high demand by and competition from other users
- Increased customer demand
- Increased costs and reduced revenues related to responding to drought impacts.

Prolonged droughts could add stress to the City's water supplies, potentially putting more stress on existing groundwater resources within the region. Climate change is projected to cause an increase in the frequency and intensity of extreme precipitation events, which includes droughts as well as intensive flooding. Additionally, hotter temperatures are expected to increase demand for water supply for landscape maintenance in urban areas. Fullerton's natural areas in the Coyote Hills are likely to be at risk of being negatively impacted by more frequent and severe droughts in the future.[83]

Natural Resource Areas

Climate change threatens biodiversity, as urban development has left species with limited room to migrate. Drier soils may impact the ability of plant species to survive in their native habitats, and riverine ecosystems may experience decreasing populations of aquatic species. Climate change is likely to exacerbate the spread of invasive species and plant diseases that threaten ecosystem health. Aquatic ecosystems may see a decrease in surface water quality, which would place stress on aquatic life and could result in the spread of invasive species. Climate related ecosystem vulnerabilities may lead to habitat fragmentation, which would impede species migration and threaten the connectivity of regional ecosystems.

When a drought occurs, the existing pressures on the ecosystem's natural water supplies are amplified. If the ecosystem's water needs are not considered in water allocation decisions, then this already vulnerable ecosystem may be pushed beyond the threshold at which it can recover. The ecosystem will begin to function differently, leading to a loss in the critical services it once provided humans—such as purifying water and air, preventing erosion, and providing recreation opportunities.[84] An exceptionally severe drought could dramatically reduce the amount of water available for landscaping in the City and deprive trees of the irrigation they require for their survival.

Lack of moisture, already at a severe level in California due to a current multi-year drought and decades of fuel accumulation from historical forestry and fire suppression practices, increases the risk of wildfires.

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[83] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

[84] National Integrated Drought Information Systems. Ecosystems. https://www.drought.gov/sectors/ecosystems. Accessed December 5, 2023.

Tree mortality is a key secondary impact of drought. Drought can affect a tree's ability to generate pitch, which it uses to defend itself against infestation by insects such as the bark beetle. Prolonged periods of drought, such as the one just experienced by the State of California, can cause extensive damage to trees. Since May 2016, the U.S. Forest Service has identified 36 million new dead trees, bringing the total estimate of dead trees in California to 62 million. These impacts are not instantaneous, and sometimes are not felt by communities for many years following a drought. Any tree has the potential to be infested by pests that could result in the tree's death. This means all areas of the City that are landscaped with trees could experience tree mortality. These areas include parks, landscaped parkways and street medians, schools, as well as private homes.

Sensitivity: Vulnerable Populations

The entire population of the City is vulnerable to drought. Drought can affect people's health and safety, including health problems related to low water flows, poor water quality, or dust. Droughts can also lead to loss of human life. In addition to fire-related injuries, local and regional transport of smoke, ash, and fine particles increases respiratory and cardiovascular risks. Drought may increase exposure to health hazards including wildfires, dust storms, extreme heat events, flash flooding, degraded water quality, and reduced water quantity. Other possible impacts include recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and hygiene; compromised food and nutrition; and increased incidence of illness and disease.

Adaptive Capacity

Fullerton has addressed drought in planning documents such as their LHMP and the Fullerton Urban Water Management Plan. Orange County has regulations and programs in place that are beneficial during drought events by limiting further potential public health impacts.

Orange County

Orange County Water District

The District manages and protects the Orange County Groundwater Basin (Basin), which provides 85% of the water supply to 2.5 million people in north and central Orange County, including Fullerton. The Basin holds water from a variety of sources, including Santa Ana River flows, stormwater, imported water, and recycled water. They get the remaining 15 percent from imported supplies brought in by the Metropolitan Water District of Southern California (MWD) and served through its local subsidiary member agency, the Municipal Water District of Orange County (MWDOC).

Since the previous drought from 2012-2016, OCWD has worked hard to substantially refill our groundwater basin. At this time, the Basin can provide water for two consecutive years at current pumping levels even if drought conditions persist.

The District has increased water recycling at the Groundwater Replenishment System (GWRS), which produces 130 million gallons of water a day, enough to serve nearly one million people. In early 2023, a final expansion of the facility was completed, recycling 100% of local reclaimable wastewater flows, thereby maximizing water recycling efforts in the region.[85]

Santa Ana Watershed Project Authority

[85] Orange County Water District. 2023. Drought in California. https://www.ocwd.com/learning-center/drought/. Accessed December 21, 2023.

The Santa Ana Watershed Project Authority (SAWPA), of which the District is a member, has launched a weather modification pilot program to increase precipitation through the use of cloud seeding. The process works by releasing particles of silver iodide into clouds, which increases the chances of droplet condensation.[86]

Fullerton

Fullerton 2020 Urban Water Management Plan

This 2020 Urban Water Management Plan (UWMP) provides an assessment of the present and future water supply sources and demands within the City's service area. It presents an update to the 2015 UWMP on the City's water resource needs, water use efficiency programs, water reliability assessment and strategies to mitigate water shortage conditions. It also presents a new 2020 Water Shortage Contingency Plan (WSCP) designed to prepare for and respond to water shortages. This 2020 UWMP contains all elements to meet compliance of the new requirements of the UWMP Act of 1983 as amended since 2015.

Fullerton Ordinance No. 3299: Water Supply Shortage Conservation Plan

Establishes water management requirements necessary to conserve water, enable effective water supply planning, assure reasonable and beneficial use of water, prevent waste of water, prevent unreasonable use of water, prevent unreasonable method of use of water within the City in order to assure adequate supplies of water to meet the needs of the public and further the public health, safety and welfare, recognizing that water is a scarce natural resource that requires careful management not only in times of drought but at all times.

Establishes six levels of Water Shortage Levels most often triggered due to drought conditions to provide defined response actions to implement during times of declared water shortage or declared water shortage emergency with increasing restrictions on water use in response to worsening drought or emergency conditions and decreasing supplies.

Fullerton Landscape Ordinance 15.50.110

The purpose of the Fullerton Landscape Ordinance is to establish standards for the provision of landscaping within the City of Fullerton while promoting conservation and the efficient use of water, prevention of erosion, protection from fire, and restoration of natural systems.[87]

3.2.1.5 WILDFIRE + SMOKE

According to the State's Fourth Climate Change Assessment, by 2100, the frequency of extreme wildfires burning over 25,000 acres could increase by nearly 50 percent.[88] As with other climate hazards, the State already is beginning to experience an increase in severe wildfires. Most of California's largest and most destructive wildfires have occurred in recent decades. This pattern has been particularly notable in the last few years, which have seen some of the worst wildfires in the

[86] Santa Ana Watershed Project Authority. 2023. Weather Modification (Cloud Seeding) in the Santa Ana River Watershed. https://sawpa.gov/santa-ana-river-watershed-weather-modification. Accessed December 21, 2023.
[87] Fullerton Landscape Ordinance. https://codelibrary.amlegal.com/codes/fullerton/latest/fullerton_ca/0-0-0-24090. Accessed December 21, 2023.
[88] State of California Climate Adaptation Strategy. 2023. https://climateresilience.ca.gov/overview/impacts.html. Accessed December 7, 2023.

State's recorded history. Five of the twenty most destructive wildfires in the state's history occurred in 2020 alone, with an additional two in 2021.[89]

Wildfire in southern California is influenced by a multitude of factors: a dry and warm Mediterranean climate with periodic episodes of Santa Ana winds and droughts, the type and spatial distribution of vegetation (along with dead/ dry vegetation caused by pests), varying topography, large urban-wildland interfaces, past fire suppression attempts, and human activities. Hot and dry conditions, combined with offshore winds in autumn create high risk conditions that rapidly spread fires. Fire ignitions in California are primarily due to human activity, and the dry fuels and climate contribute to higher risk of rapid-fire spread Future projections using statistical models indicate that southern California may experience a larger number of wildfires and burned area by the mid-21st century under RCP8.5. Overall burned area is projected to increase over 60 percent for Santa Ana-based fires and over 75 percent for non-Santa Ana fires.[90,91]

Not only do high-severity wildfires take lives and level homes, public facilities, and community infrastructure, but they also destroy fish and wildlife habitats. Moreover, intense wildfires can also impair air quality throughout the State.

Historical Wildfire Events

Orange County has experienced large and destructive fires. These include:

- 2007 - The Santiago Fire was a wildfire located near Santiago Canyon where twelve homes were destroyed.
- 2017 - Canyon 2 Fire, was a wildfire that burned in the Anaheim Hills area of the city of Anaheim setting fire to several homes. In total, about 16,570 were ordered to evacuate their homes.
- 2018 - Holy Fire was a wildfire that burned in the Cleveland National Forest in Orange and Riverside Counties, California. The blaze burned 23,136 acres and destroyed 18 buildings.
- 2020 **-** Bond Fire. A wildfire burned 6,686 acres (2,706 ha) in the Santiago Canyon area of Orange County, California in December 2020. The fire caused evacuations of 25,000 residents and injured 2 firefighters.
- 2020 - The Silverado Fire was a wildfire that burned in October and November 2020 in southern Orange County, California northeast of Irvine.

VULNERABILITY TO WILDFIRE

Climate change will result in changes in precipitation patterns, increased temperature, and drought conditions. Wetter months may lead to increased vegetative growth, while following periods of drought will allow for the vegetative growth to dry up, creating greater amounts of fuel for fires.

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[89] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed December 11, 2023.
[90] Ackerly, David, Andrew Jones, Mark Stacey, Bruce Riordan. (University of California, Berkeley). 2018. San Francisco Bay Area Summary Report. California's Fourth Climate Change Assessment. Publication number: CCCA4-SUM-2018-005.
[91] Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles). 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

Climate change will also worsen existing severe wind events, which fuel the spread and intensity of wildfires.

Exposure

Wildfires begin in natural, undeveloped land. Wildfires sometimes ignite due to natural circumstances, such as intense heat combined with masses of dead vegetation, or lightning strikes. Dry vegetation is highly combustible when the weather is hot and dry. Fires can also ignite under windy conditions from the friction caused by vegetation rubbing together. Humans can also start wildfires, either intentionally or unintentionally. A downed power line in a wind event, for example, could catch the surrounding landscaping or buildings on fire, or an unextinguished cigarette tossed into dry grass may ignite and cause a wildfire. Sometimes humans intentionally burn wild landscapes, often for land management purposes.

Topography can play a role in influencing the speed and direction of a wildfire. Because heat rises, fires move faster uphill, so a steep slope can make a fire spread faster. Thus, fires are a greater risk in mountainous areas.[92]

Traditionally, fire season in Southern California lasts from May through September. However, over the past 15 years Orange County has experienced some of its most devastating wildfires between October and April [e.g., Santiago Fire and the Freeway Complex Fire.) An analysis of fires with known start dates recorded in the County show:

- Most fires occurred between June and November.
- Approximately 60 percent of all fires were ignited from June through September but accounted for only 26 percent of the area that burned.
- In contrast, 17 percent of all fires occurred in October/November and consumed 61 percent of the land burned between 1940 and 2008.
- Although most ignitions take place between June-September, ignitions in October tend to be larger.[93]

Wildland Fire vs. Wildland-Urban Interface Fires

Fire science distinguishes between two types of wildfires: “wildland” fires, which burn predominately in undeveloped areas, and “wildland-urban Interface” (WUI) fires. This distinction is important because mitigation, damage, and actions related to the two types may differ significantly.

Wildland fires that burn in natural settings with little or no development are part of a natural ecological cycle and may be beneficial to the landscape if they burn within the historic range of variability for fire size and intensity. Many species are adapted to California's natural fire regimes and flourish after a low or mixed severity burn. These fires also enhance ecosystem function by creating landscapes that have more variation, are more resilient to other disturbances, and are better able to withstand extremes in precipitation. The wildland fire may result in secondary negative impacts in the form of air pollution, soil erosion (resulting in siltation of streams and lakes), or mudslides, though these impacts tend to be far less than would occur following high severity fires in areas of historic fire suppression. However, unless these fires or their related secondary impacts occur in or near

[92] Fullerton, City of. Local Hazard Mitigation Plan. 2020.
[93] Orange County County-Wide Community Wildfire Protection Plan. 2017.

developed areas they are rarely classified as disasters because they do not affect people or the built environment.

The WUI is characterized by the intersection of the natural and the built environments and has been defined as "the area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels" (Society of American Foresters). The WUI can be configured in many ways including a classic "interface" (e.g., a community that abuts a National Forest at a distinct boundary), an "intermix" (e.g., vegetative fuels distributed between buildings throughout a subdivision between buildings), or an "occlusion" (e.g., a community that completely surrounds a designated open space area).

WUI fires represent an increasingly significant concern for the State of California. California has a chronic and destructive WUI fire history with significant losses of life, structures, infrastructure, agriculture, and businesses. Even relatively small-acreage WUI fires may result in disastrous damage. Most local governments that have submitted Local Hazard Mitigation Plans (LHMPs) have identified fire and WUI fires as specific hazards.[94]

Fire Hazard Severity Zones

Wildfires are not measured on a specific scale and are usually classified by size (e.g., acres burned) or impact (e.g., buildings destroyed or damaged, injuries or deaths, cost of damage, etc.). The risk of wildfire is classified on a three-tier scale of fire hazard severity zones (FHSZs): very high, high, and moderate. These classes do not correspond to a specific risk or intensity of fire but are qualitative terms that consider many factors. Fire-prone areas are also classified by the agency responsible for fire protection. Federal Responsibility Areas (FRAs) fall to federal agencies such as the US Forest Service, the Bureau of Land Management, and the National Park Service. State Responsibility Areas (SRAs) fall to CAL FIRE, and Local Responsibility Areas (LRAs) fall to local governments.

CAL FIRE data was used to identify Very High Fire Hazard Severity Zones (VHFHSZ) in the City that are included in the LRA (See Figure 3-4: Fire Hazard Severity Zones). Development within these zones is regulated through the Uniform Building Code and Uniform Fire Code. State Minimum Fire Safe Regulations apply to all of the SRA (regardless of risk) and local VHFHSZ. Building code requirements apply to all of the WUI, regardless of whether in LRA or SRA. Requirements imposed as part of the development review process include fire lanes, fuel modification zones, fire retardant building materials, smoke detectors and automatic sprinkler systems, depending on the size and type of development.

Climate models have difficulty projecting exactly where and how fires will burn as the frequency, severity and impacts of wildfire are sensitive to climate change as well as other factors, such as development patterns and pest infestations. Instead, climate models estimate increased risk from wildfires. As shown in Table 3-7: Modeled Annual Area Burned – City of Fullerton, The amount of area within the City at risk of wildfire is projected to decrease substantially by the end of the century (depending on scenario) compared with the historic baseline.

[94] California Governor's Office of Emergency Services. 2023 State Hazard Mitigation Plan.

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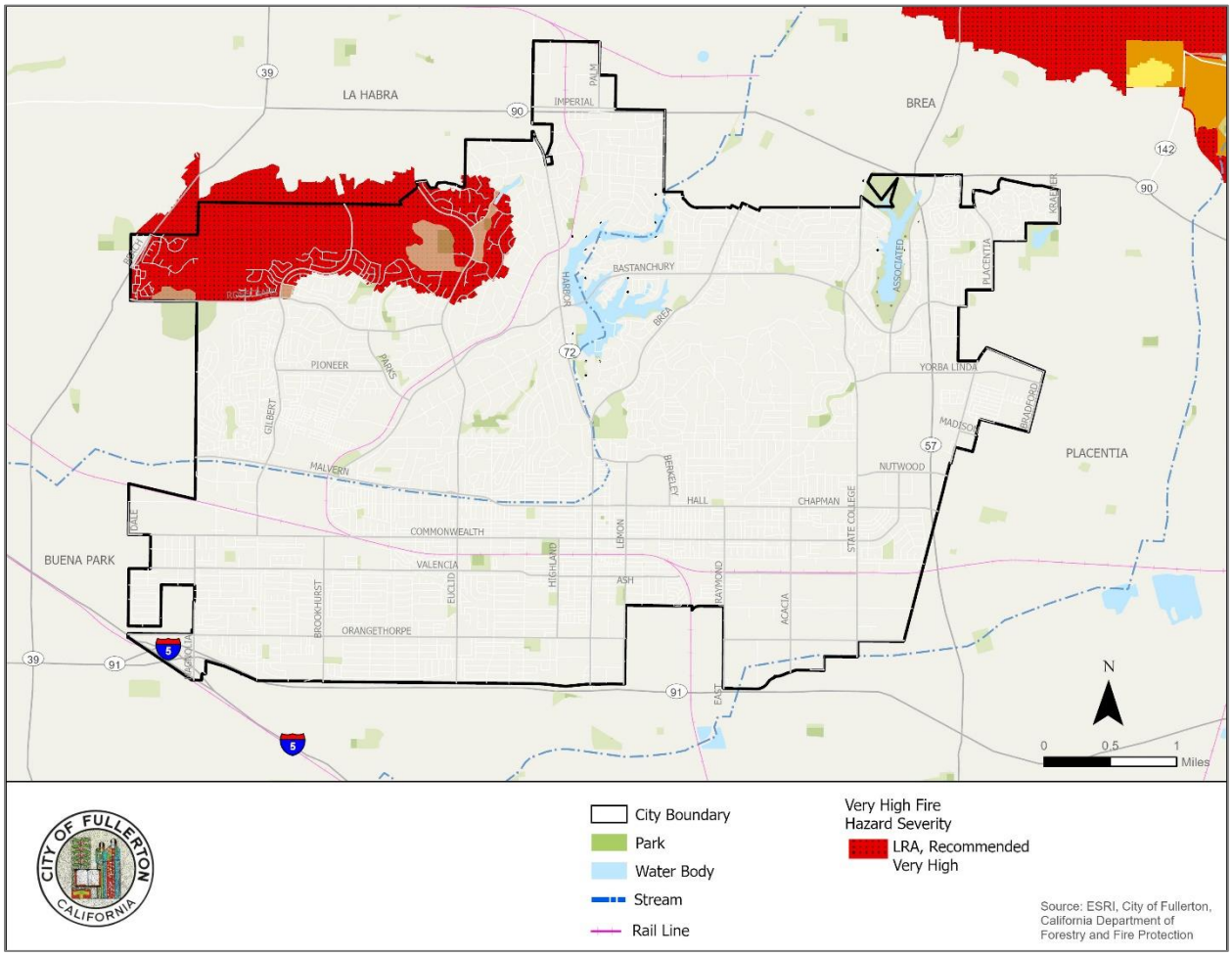
Figure 3-4: Fire Hazard Severity Zones



Source: Office of the State Fire Marshall. 2023. Fire Hazard Severity Zones (FHSZ). https://osfm.fire.ca.gov/divisions/community-wildfire-preparedness-and-mitigation/wildfire-preparedness/fire-hazard-severity-zones/#explorefhsz. Accessed November 2023.

Table 3-7: Modeled Annual Area Burned – City of Fullerton

Baseline (hectares) (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
	Mid-Century	End-Century	Mid-Century	End-Century
65.4	14.2	12.7	11.1	11.4

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for City of Fullerton: Wildfire: Modeled Annual Area Burned. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed December 9, 2023.

The Annual Average Area Burned can help inform the City if wildfire activity is likely to increase in the study area. These projections are most robust for the Sierra Nevada given model inputs. Much of California can expect an increased risk of wildfire, with a wildfire season that starts earlier, runs longer, and features more extreme fire events.

Based on the RCP 8.5 scenario, the annual average of area burned if forecast to decrease by over 50 acres by the end of the century. While all of Fullerton is potentially at risk of some type of fire hazard. Since 90 percent of the City's land is currently built-out, mostly with wooden-frame construction, the potential for wildfires to emerge at any location in the city is more limited.

According to **Table 3-8: Fire Hazard Severity Zone: Vulnerable Populations**, residents living in the VHFHSZ have demographic characteristics dissimilar to the remainder of the City. The median age is 10 years older than in the City as a whole. These are unique challenges for the City, as 33.2 percent of households in the Fire Hazard Severity Zone have at least one individual aged 65 years and older. Additionally, 10.5 percent of households have at least one person living with a disability. Challenges that these populations face include potential inability to access emergency supplies, evacuate, or receive and understand emergency information. The effects of climate change hazards can result in infrastructure disruptions including power outages. Such events could result in additional health hazards for the elderly or persons with disabilities who rely on power to sustain medical equipment or assistive technology.

Table 3-8: Fire Hazard Severity Zone: Vulnerable Populations

	VHFHSZ	City of Fullerton
Total Population[1]	4,458	144,363
Percent of residents who are children (less than 10 years old)[2]	7.8%	10.6%
Percent of households that have people 65+ years old[1]	33.2%	28.2%
Percentage of households with at least one person living with a disability[1]	10.5%	21.2%
Median age[2]	46.4	36.3
Total households[1]	1,568	48,739
Median household income[2]	$159,104	$96,047
Percent of rental households[2]	24.3%	49.7%
Percent of household income below poverty level[1]	2.2%	11.2%

Source: US Census Bureau, ACS 2017 - 2021[1], US Census Bureau 2020 Summary File 1, ESRI Forecasts 2023[2]

Wildland Urban Interface

This Vulnerability Assessment evaluates housing density and wildfire hazard attributes (FHSZ) in an effort to capture Wildland Urban Interface (WUI). **Figure 3-5: Wildland Urban Interface** displays the overall pattern of WUI development for the City and compares counties in terms of development patterns. Three WUI classes are mapped:

1. Wildland Urban Interface — dense housing adjacent to vegetation that can burn in a wildfire;
2. Wildland Urban Intermix — housing development interspersed in an area dominated by wildland vegetation subject to wildfire; and
3. Wildfire Influence Zone — wildfire susceptible vegetation up to 1.5 miles from Wildland Urban Interface or Wildland Urban Intermix.

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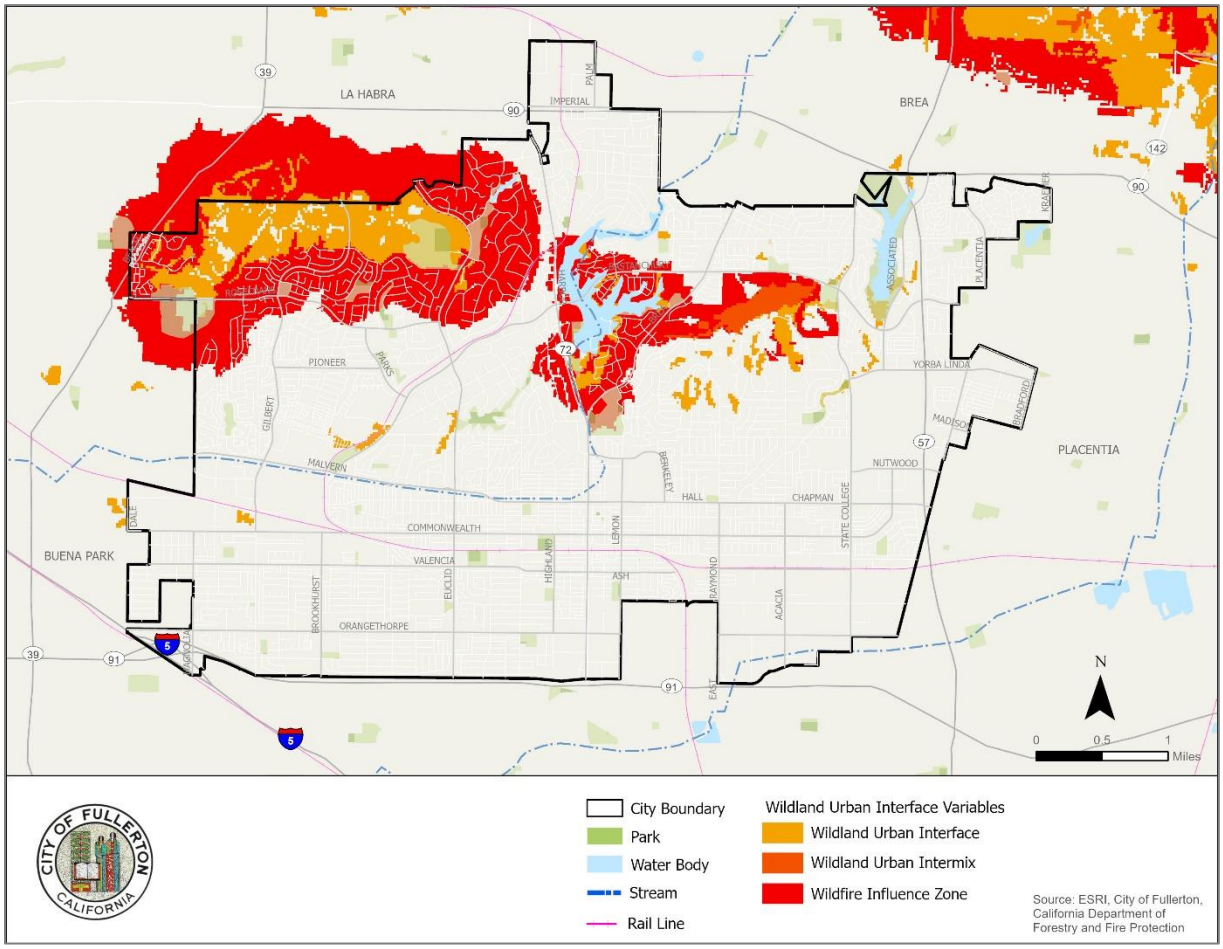
Figure 3-5: Wildland Urban Interface



Note: The WUI dataset is not refined through a field review process; it is not suited for WUI designations for individual houses or neighborhoods.

Table 3-9: Wildland Urban Interface: Vulnerable Populations	WUI	City of Fullerton
Total Population[1]	10,351	144,363
Percent of residents that are children (less than 10 years)[2]	7.9%	10.6%
Percent of households that have people 65+ years[1]	45.9%	28.2%
Percentage of households with at least one person living with a disability[1]	20.9%	21.2%
Median age[2]	49.6	36.3
Total households[1]	3,651	48,739
Median household income[2]	$152,565	$96,047
Percent of rental households[2]	21.3%	49.7%
Percent of household income below poverty level[1]	2.8%	11.2%

Source: US Census Bureau, ACS 2017 - 2021[1], US Census Bureau 2020 Summary File 1, ESRI Forecasts 2023[2]

According to **Table 3-9: Wildland Urban Interface: Vulnerable Populations**, residents living in the Wildland Urban Interface have demographic characteristics similar to the Very High Fire Hazard Severity Zones as shown in **Table 3-8: Fire Hazard Severity Zone: Vulnerable Populations**, and therefore the City's concern would also be similar.

Sensitivity: Major Community Elements

The major fire hazard scenarios of concern to protection agencies are residential fires that start in the home with potential to spread to outlying areas and neighboring structures, and wildfires in natural areas that may pose a threat to life and property. The major limitations upon firefighting capabilities within the rural areas are limited accessibility, long travel distances and response times, and water supply limitations. As described in the 2020 LHMP, there are approximately 44 key facilities located within a Fire Hazard Severity Zone (FHSZ). The majority of these are water pumps or sewage facilities, creating a significant risk to the city's water infrastructure. Water pumps can fail if they lose power during a fire, hampering firefighting efforts. Additionally, excessive water use from firefighting efforts can lower water pressure in pipes and raise the risk of contamination. Lower water pressure can cause non-potable water to backflow or make it easier for contaminants to be drawn in.

As shown in **Table 3-10: Key Facilities Threatened by Wildfire**, there are a number of medical-related facilities, such as assisted living and nursing facilities, in the wildfire hazard zone. In the event of a wildfire, these facilities may require specialized evacuation to ensure the safety of their occupants due to the high vulnerability of the persons living in these facilities.

Table 3-10: Key Facilities Threatened by Wildfire

Facility Type	Moderate Fire Hazard Severity Zone	High Fire Hazard Severity Zone	Very High Fire Hazard Severity Zone	Total
Emergency Gathering Areas	0	1	1	2
Medical	1	2	2	5
Municipal Government	0	0	1	1
Transportation	2	0	1	3
Water and Sewage	3	4	26	33
Total	**6**	**7**	**31**	**44**

Source: Fullerton LHMP 2020

Transportation Systems

Wildfire could damage roads in several ways. Unsafe conditions and damage could lead to road closures. Difficulties may arise with simultaneous evacuation and fire response due to roads that are narrow, steep, or have a dead end. Typical asphalt mixtures could ignite or melt/excessively soften. Debris from fires and subsequent landslides could block roads.[95,96] Most major roads have sidewalks

[95] Carvel, R., & Torero, J. (2006). The Contribution of Asphalt Road Surfaces to Fire Risk in Tunnel Fires: Preliminary Findings. Proceedings of the International Conference on Risk and Fire Engineering for Tunnels, Stations, and Linked Underground Spaces (pp. 83-87). Hong Kong: Tunnel Management International.

[96] Cannon, S., & DeGraff, J. (2009). The Increasing Wildfire and Post-Fire Debris-Flow Threat in Western USA, and Implications for Consequences of Climate Change. In K. Sassa, & P. Canuti, Landslides -

that create a small defensible space as well as development of the surrounding areas. Roads can be damaged by increased traffic of heavy vehicles, and vehicles that exceed weight limits, used during emergency response or recovery efforts. Costs associated with transportation infrastructure losses include repair costs, clean-up costs, and costs related to service disruptions.[97]

Lifeline Utility Systems

Additionally, wildfire can cause direct and indirect damage to electrical infrastructure. Direct exposure to fire can sever transmission lines, and heat and smoke can affect transmission capacity. Other impacts of climate change also threaten electricity infrastructure, including wildfires that can destroy poles and towers carrying transmission lines.[98] Additionally, downed powerlines can cause wildfires.[99]

Wildfire events can physically damage water infrastructure including pipes, water meters, dams, spillways, and other structures and equipment. Costs associated with water infrastructure losses include repair costs, clean-up costs, and costs related to service disruptions. Mitigation actions specifically to reduce water infrastructure losses primarily include infrastructure hardening and defensible space. Water infrastructure damage can also cause contamination of drinking water supplies that can pose a risk to public health.[100] Wildfires can damage or destroy gas, electric, and telecommunications infrastructure including poles, towers, lines, pipes, and other physical assets.[101]

Economic Elements

Wildfire can lead to the loss of buildings and infrastructure that may need to be repaired from damage or replaced if destroyed. Additional economic losses include the value of private property or inventory that is damaged along with a home, costs associated with temporary accommodation or service disruptions, and costs related to toxic material and debris cleanup. When infrastructure losses cause service disruptions, the costs can be borne by customers and communities far from the perimeter of the wildfire.[102]

Natural Resource Areas

Because of historical forest management trends over the past century, increased temperatures, and more frequent drought, California wildfires are characteristically hotter and more intense as compared to naturally occurring fire regimes. As such, soil structure and moisture retention are damaged,

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Disaster Risk Reduction (pp. 177-190). Verlag Berlin Heidelberg: Springer.

[97] Feo, Teresa J., Amber J. Mace, Sarah E. Brady, and Brie Lindsey. 2020. The Costs of Wildfire in California An Independent Review of Scientific and Technical Information. California Council on Science and Technology. ISBN Number: 978-1-930117-66-2.

[98] Davis, M., and S. Clemmer. 2014. Power failure: How climate change puts our Electricity at risk—and what we can do. Cambridge, MA: Union of Concerned Scientists. https://www.ucsusa.org/sites/default/files/2019-10/Power-Failure-How-Climate-Change-Puts-Our-Electricity-at-Risk-and-What-We-Can-Do.pdf. Accessed December 11, 2023.

[99] Gonzales, Richard. 2018. PG&E Power Lines Blamed for Northern California Wildfires. National Public Radio. June 8. https://www.npr.org/2018/06/08/618444388/pg-e-power-lines-blamed-for-northern-california-wildfires. Accessed December 3, 2023.

[100] Feo, Teresa J., Amber J. Mace, Sarah E. Brady, and Brie Lindsey. 2020. The Costs of Wildfire in California An Independent Review of Scientific and Technical Information. California Council on Science and Technology. ISBN Number: 978-1-930117-66-2.

[101] California Governor's Office of Emergency Services (Cal OES) 2018. California State Hazard Mitigation Plan.https://www.caloes.ca.gov/HazardMitigationSite/Documents/002-2018%20SHMP_FINAL_ ENTIRE%20PLAN.pdf

[102] Feo, Teresa J., Amber J. Mace, Sarah E. Brady, and Brie Lindsey. 2020. The Costs of Wildfire in California An Independent Review of Scientific and Technical Information. California Council on Science and Technology. ISBN Number: 978-1-930117-66-2.

leading to increased susceptibility to erosion or landscapes. If the City's foothills become covered with dry, overgrown vegetation because of drought conditions, extreme heat events and high winds will increase the threat of wildfires.

Beyond direct damage to physical property and harmful effects on public safety, wildfires also result in secondary impacts: a major consequence of wildfires is post-fire flooding and debris flow. Wildfires can burn away ground cover and vegetation across the landscape, leaving soil exposed and easily erodible by precipitation. In other cases, fires can cause soil surfaces to harden. Instead of the rain soaking into the soil, rainwater and melted snow can rush across these hardened surfaces, gaining enough power to erode loose sediments.[103]

Wildfires could alter hydrology by changing vegetation, increasing runoff, and resulting in more sediment that could block drainage and damage structures.[104] The wildfires are unlikely to directly burn and/or damage outfalls themselves due to construction materials and placement near bodies of water.

Conservation areas and open space in the City provide crucial ecosystem services such as the provisioning of clean air and water and climate regulation. If conservation areas are damaged, endangered species could be at increased risk to species survival. If habitats of sensitive species are subject to frequent disturbance or destruction, resources may be needed to conserve these species.

Sensitivity: Vulnerable Populations

Wildfires are a major public health concern as they can cause immediate health impacts through burns, injuries, and heat stress. However, a wildfire can influence the health outcomes of an area larger than the burn area because the associated smoke can travel long distances and worsen the air quality for extended periods. Wildfires can be a significant contributor to air pollution in both urban and rural areas and have the potential to significantly impact public health through particulates and volatile organic compounds in smoke plumes. Wildfires are a major source of particulate matter, which is an air pollutant that increases one's risk for respiratory illnesses, cardiovascular disease, negative birth outcomes, and premature death.[105] Wildfire smoke contains numerous primary and secondary pollutants, including particulates, polycyclic aromatic hydrocarbons, carbon monoxide, aldehydes, organic compounds, gases, and inorganic materials with toxicological hazard potentials.[106] Wildfire smoke also increases exposure to ground level ozone and toxic chemicals (e.g., pesticides, plastics, and paints) released from burned buildings and other man-made materials. Individuals sheltering in place are also at risk of exposure to hazardous air quality because wildfire smoke penetrates homes, particularly older homes.[107] Beyond these immediate health impacts, the stress, displacement, and

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[103] United States Geological Survey. 2017. Increases in Wildfire-Caused Erosion Could Impact Water in the West. https://www.usgs.gov/news/national-news-release/increases-wildfire-caused-erosion-could-impact-water-supply-and-2. September 17. Accessed November 23, 2023.

[104] U.S. DOT. 2018. Transportation Climate Change Sensitivity Matrix. U.S. Department of Transportation. Retrieved from https://toolkit.climate.gov/tool/transportation-climate-change-sensitivity-matrix

[105] Bell, J.E., S.C. Herring, L. Jantarasami, C. Adrianopoli, K. Benedict, K. Conlon, V. Escobar, J. Hess, J. Luvall, C.P. Garcia-Pando, D. Quattrochi, J. Runkle, and C.J. Schreck, III, 2016: Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 99–128.

[106] Künzli, N. et al. 2006. Health effects of the 2003 Southern California wildfires on children. Am J Respir Crit Care Med. 174:1221-8.

[107] Rudolph, L., Harrison, C., Buckley, L. & North, S. (2018). Climate Change, Health, and Equity: A Guide for Local Health Departments. Oakland, CA and Washington D.C., Public Health Institute and American Public Health Association.

loss of home and community from wildfires can cause significant mental health impacts, such as anxiety, depression, and post-traumatic stress disorder.[108]

Outside of the property owners directly impacted by a wildfire event, wildfires can also impact seniors and persons with disabilities. During hazard events such as wildfires, flooding, or extreme storms, the elderly and other vulnerable populations, such as persons with disabilities, may require additional assistance to adequately respond. These groups may have limited mobility, be immuno-compromised, and/or not receive notifications regarding current conditions and evacuation requirements. For example, a senior who lives alone may not be aware that a wildfire is burning close to their residence and that they have been ordered to evacuate if those notifications were sent in manner that does not reach them. Persons with disabilities may require special mobility devices or caregiver assistance to go outside, which may not arrive as quickly as needed.

Vulnerable populations with an increased threat level to wildfire and smoke include lower-incomes, renters, the unhoused, and seasonal agricultural workers. These groups may not possess enough financial resources to purchase and operate air purifiers or rebuild their homes or search for new homes in the aftermath of a fire. The unhoused and seasonal agricultural workers have an additional risk as they are less likely to receive notification of this or other disasters because of a lack of access to information or technology or emergency notifications are not provided in a language they understand.

Adaptive Capacity

The City has addressed wildfire in planning documents such as the 2020 LHMP. The State of California also has regulations and programs in place that are beneficial during wildfires by limiting further potential public health impacts as further described below:

In similar acknowledgement of the escalating risk of wildfire, the State of California also issued several documents to assist in wildfire planning and preparation, detailed in the following sections.

Statewide Hazard Mitigation Plan

The State of California Multi-Hazard Mitigation Plan, revised in 2023, considers wildfire along with floods and earthquakes to be the three primary hazards faced by California.[109]. The document notes the importance of SB 1241, which was passed in 2012 and mandates wildfire planning responsibilities by local agencies through requirements regarding:

1. Wildfire updates to General Plans;
2. Mandatory findings for subdivision approvals in SRAs and VHFHSZs; and
3. California Environmental Quality Act (CEQA) checklist updates for wildfire safety.

Fullerton Fire Department

The Fire Prevention Division conducts ongoing inspections for the purpose of life safety, reduction in property loss, weed and rubbish abatement, and the enforcement of federal, state and local fire regulations. The Emergency Management Division offers a variety of programs to help the community be prepared for fire, including the use of AlertOC, providing guidance of building a disaster preparedness kit, and preparing for a power outage.

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[108] Hanigan, Ivan C., Colin D. Butler, Philip N. Kokic, and Michael F. Hutchinson. 2012. "Suicide and Drought in New South Wales, Australia, 1970–2007." Proceedings of the National Academy of Sciences of the United States of America 109 (35): 13950–55.

[109] California Governor's Office of Emergency Services. 2023 State Hazard Mitigation Plan. 2023

3.2.1.6 FLOODING

A flood occurs when land that does not normally have bodies of water becomes suddenly inundated with water. Flooding can occur after periods of heavy rainfall, whether it occurs as a single extreme episode or as a series of storms. When heavy rainfall hits an area where the ground is already saturated, the risk of flooding is high. In developed areas, the presence of pavement and other impervious surfaces means that the ground is less able to absorb water. As a result, rainwater must be carried away in storm channels or waterways. Drainages and stream courses may flood their banks and shores if their capacity is exceeded by rainwater.

Floods pose several threats to communities and public safety. Flooding can cause property damage, destroy homes, and carry away vehicles or other large debris. Topsoil and vegetation can be swept away by floodwaters, leading to erosion. Floodwater may impede the movement of victims fleeing a flood or of first responders attempting to reach people in need of help.

Climate models predict that California will experience less frequent but more intense storm patterns in the coming decades. The State's precipitation is expected to fall more frequently as rain rather than snow, compared to historical trends. Additionally, earlier and faster spring snowmelt--caused by higher temperatures--will cause the State's streams and rivers to swell more in some years. Scientists suggest the combination of these factors could lead to a 50 percent increase in runoff in future years, challenging the capacity of the State's existing reservoirs, canals, levees, and other flood control systems, and increasing the risk of inland flooding. Floods cause significant risk to human life, and damage roads, buildings, and other infrastructure.[110]

FLOODING

Increases in temperature and precipitation can lead to extreme precipitation events that could lead to flooding in the City. In the context of climate change for the City, this Vulnerability Assessment evaluated two types of climate-related floods: riverine and surface flooding caused by precipitation-driven events. The following describes the types of floods within each category.

Riverine and Surface Flooding from Precipitation-Driven Events

- Inland flooding occurs when moderate precipitation accumulates over several days, intense precipitation falls over a brief period, or river overflows because of an ice or debris jam or dam or levee failure.
- A flash flood is caused by heavy or excessive rainfall in a brief period, generally less than six hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through riverbeds, urban streets, or mountain canyons. They can occur within minutes or a few hours of excessive rainfall.

The following analyses describe riverine and surface flooding vulnerabilities resulting from projected climate change for the City.

Riverine and Surface Flooding from Precipitation Events

For the City, projections show only a slight change in average annual rainfall through the end of the century (Table 3-3: Projected Change in Annual Average Precipitation: City of Fullerton). Globally, climate change is anticipated to lead to more variability in the intensity of rainfall events from year to

[110] State of California, Legislative Analyst's Office. 2022. Budget and Policy Post. Climate Change Impacts Across California Crosscutting Issues. April 5, 2022. https://lao.ca.gov/Publications/Report/4575. Accessed December 11, 2023.

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year and longer transitions between droughts and deluges.[111] Historically, the City has experienced an average of three extreme precipitation events[112] per year between 1960 and 1990. Under the medium emissions scenario, the City is expected to experience an average of four extreme precipitation events per year through the end of the century. Under the high emissions scenario, the City is expected to experience an average of five extreme precipitation events per year by the late century.[113]

The City has experienced flooding during heavy rainfall events. While the forecasted changes in Maximum 1-Day Precipitation — the greatest amount of daily rain or snow (over a 24-hour period) for each year — are not anticipated to substantially differ from historic records (see **Table 3-11: Projected Change in Maximum 1-Day Precipitation: City of Fullerton**), flooding can still occur. Impacts from flooding caused by the largest precipitation-driven events should not be dramatically different than what the community currently experiences, and adaptation solutions to address the flooding should be lasting.

Table 3-11: Projected Change in Maximum 1-Day Precipitation: City of Fullerton

Maximum 1-Day Precipitation (Inches)	Historic Maximum 1-Day Precipitation (1961 - 1990)	Medium Emissions (RCP 4.5)		High Emissions (RCP 8.5)	
		Mid-Century	End-Century	Mid-Century	End-Century
	1.575	1.657	1.721	1.705	1.779

Source: California Energy Commission. CalAdapt. Local Climate Change Snapshot for Fullerton: Maximum 1-Day Precipitation. https://cal-adapt.org/tools/local-climate-change-snapshot. Accessed November 1, 2023.

Historical Riverine and Surface Flooding Events

- In March 2003, 3 to 7 inches of rain fell on Southern California, causing region-wide flooding. Water reached depths of up to three feet on some roadways, causing over 1,000 vehicle collisions.
- In January 2010, a strong storm delivered by the jet stream caused urban flooding throughout Southern California. A medical facility in nearby Santa Ana saw its roof cave in due to the heavy rain.
- In 2014 heavy rains affecting most of Southern California caused flooding on a section of Bastanchury Road that was nearly a foot deep. Nearby weather stations reported that more than an inch of rain had fallen in a span of three hours.
- In September 2015, flooding of roadways caused severe traffic congestion across Southern California, including Orange County. In the City of Los Angeles, 7,300 people lost power for most of the day, and there more than 500 traffic collisions across the entire region as a result of the road conditions.[114]

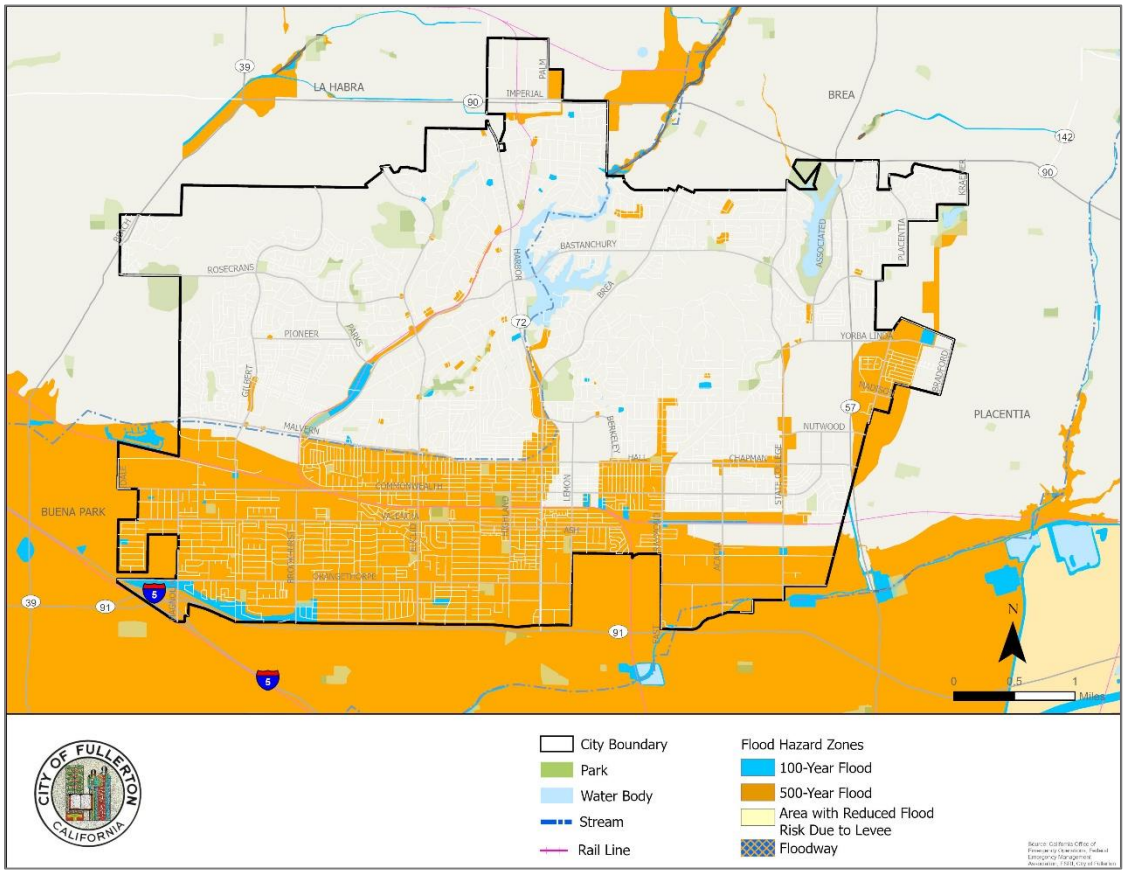
Exposure

With climate change, the future is likely to be different from the past, with most models projecting more intense, but possibly less frequent, rainstorms. **Figure 3-6: Flood Hazard Zones** shows the mapped flood hazard zones for 100-year and 500-year flood (the 500-year floodplain is land that is covered in water during a flood event that has a 0.2 percent chance of being equaled or exceeded

[111] Swain, D. L. (2018). Increasing precipitation volatility in twenty-first-century California. Nature Climate Change.
[112] Extreme Precipitation events are successive days in which the 2-day rainfall total is above a threshold of 1 inch.
[113] California Energy Commission. Cal-Adapt Extreme Precipitation Events Tool. Available: https://cal-adapt.org/tools/extremeprecipitation/. Accessed December 11, 2023.
[114] Fullerton, City of. 2020. Local Hazard Mitigation Plan.

each year) events in the City. Approximately 1 percent of the City is within the 100-year flood plain (0.3 square miles), whereas almost 32 percent is in the 500-year flood plain (7.14 square miles). Of special concern are the areas in the southern portion of the City, also identified as vulnerable communities according to FEMA's Social Vulnerability Rating. These areas are within the 100-year and 500-year zones, and therefore highly susceptible to future flooding events.

Figure 3-6: Flood Hazard Zones



Sensitivity: Community Elements

If enough precipitation were to fall exceeding the storm drain infrastructure design capacity in the City, physical assets can expect to be inundated. Electronic or mechanical equipment on the ground could become waterlogged and nonfunctional. Emergency services may also be impacted.

AS the 2020 LMHP notes, flooding from a 100-year or 500-year storm event will primarily affect the southern section of the city, where the terrain is relatively flat. In the event of a major storm, runoff will flow rapidly to southern Fullerton from the higher-elevation northern areas of the city. Whereas a 100-year flood threatens just 2 critical facilities, a 500-year flood threatens 102 key facilities, among these are Fullerton City Hall and Community Center. Table 3-12: Key Facilities at Risk of Flooding shows the key facilities threatened by flooding in the City. Any facilities inundated with floodwaters are likely to experience power outages if the flood disrupts nearby electrical power grids. Computers and other electronic equipment stored on the ground would become inoperable and destroyed. Streets would become flooded and motorists as well as emergency personnel may not be able to reach their destinations.

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Table 3-12: Key Facilities at Risk of Flooding

	100-Year Flood		500-Year Flood	
Facility Type	Critical Facility	Facility of Concern	Critical Facility	Facility of Concern
Community Services	0	0	1	6
Education	0	0	18	0
Energy	0	0	0	2
Medical	0	0	0	0
Museum	0	0	0	5
Municipal Government	0	0	0	2
Transportation	0	0	0	49
Utility	0	0	0	2
Water and Sewage	0	2	0	12
Total	**0**	**2**	**24**	**78**

Source: Fullerton LHMP 2020

Lifeline Utility Systems

Disruptions to communications (including fiber optic cables, data centers, and communications towers) impact all aspects of residents' lives, from simple services to the complex and interdependent regional economy. Water damaged fiber optic lines can lead to disruptions in communications, which can be catastrophic during a disaster when communication is most essential. Flooded data centers could cause widespread damage to equipment, loss of data, and/or disruption of web-based services that use local data centers for hosting. Flood water can damage equipment at the base of communication towers and can even topple the towers if the water flow is fast enough, causing further damage to nearby homes and businesses.

Flood damage to energy infrastructure would mean interruptions in electricity supply and potentially blackouts. Public health and safety could be affected due to the temporary loss of power and community-wide disruption of transportation networks, businesses, homes, and daily life. Prolonged loss of grid power could result in backup systems for critical facilities being depleted, resulting in disruption of operations to hospitals and fire and police stations and threatening public health and safety.

Economic Elements

Renovations of commercial buildings may be necessary in areas of significant flooding, disrupting associated services. The tourism industry may also be affected by major flood events, as popular vacation areas tend to overlap with flood hazard zones.

Health Materials

Reentering and cleaning homes and buildings also presents hazards. Flooded buildings can pose significant health hazards to people entering them. Electrical power systems can become hazardous. Gas leaks can trigger fire and explosions. Flood debris—such as broken bottles, wood, stones, and walls—may cause injuries to those cleaning damaged buildings. Containers of hazardous chemicals may be buried under flood debris. Hazardous dust and mold can circulate through a building and be inhaled by those engaged in cleanup and restoration.

According to the 2020 Fullerton Local Hazard Mitigation Plan, In Fullerton the 100-year floodplain is not a contiguous area but consists instead of various pockets across the city. These include a residential area northeast of the intersection of I-5 and SR-91, a swath of land abutting Bastanchury Road between Parks Road and W Malvern Avenue, and other small pockets throughout the Coyote Hills. In contrast, the 500-year floodplain covers a large section of Fullerton. Most of the city south of Malvern Avenue and Chapman Avenue, a multifamily neighborhood across SR-57 from California State University, Fullerton (CSUF), and sections of Harbor Boulevard south of the Brea Dam are included in the 500-year floodplain category.[115]

Natural Resource Areas

Flooding events are projected to become more frequent and severe and can create significant ecosystem damage, compromising wildlife habitat from impacts such as erosion or sedimentation.

Sensitivity: Vulnerable Populations

Age and disability can affect the ability of individuals to prepare for a flood and to move safely before, during, or after a flood. Individuals 65 years and older are more likely to experience difficulties during flooding, as well as with preparing and responding to rapidly changing environments. As little as 6 inches of floodwater can make sidewalks, streets, and pathways difficult to navigate; the elderly may find withstanding such circumstances especially challenging. When public health infrastructure or services are affected by flooding or erosion, the elderly are more likely to be affected by a lack of services than other age groups and may be more physically compromised in seeking services. Floods and their aftermath present numerous threats to public health and safety:

- Unsafe food—Floodwaters contain disease-causing bacteria, dirt, oil, human and animal waste, and farm and industrial chemicals which can contaminate agricultural fields.
- Contaminated drinking and washing water and poor sanitation—Flooding impairs clean water sources with pollutants. The pollutants also saturate into the groundwater which may put people at risk by drinking contaminated water. Flooded wastewater treatment plants can be overloaded, resulting in backflows of raw sewage. Private wells can be contaminated by floodwater. Private sewage systems can become a cause of bacteria spread if they overflow.
- Floods provide new breeding grounds for mosquitoes in wet areas and stagnant pools.
- Mold and mildew — Flooding can cause the growth of mold and mildew in structures. Excessive exposure to mold and mildew can cause flood victims—especially those with allergies and asthma—to contract upper respiratory diseases.
- Carbon monoxide poisoning—In the event of power outages following floods, built-up carbon monoxide from natural gas appliances can poison people and animals.
- Mental stress – Experiencing a devastating flood can cause a long-term mental impact.[116]

[115] Fullerton, City of. Local Hazard Mitigation Plan. 2020.
[116] County of Santa Clara. Local Hazard Mitigation Plan. 2017.

Table 3-13: Vulnerable Populations: Flood Zones	100 Year Flood Zone	500 Year Flood Zone	100 + 500 Year Flood Zones	City of Fullerton
Total Population[1]	1,279	62,381	63,660	144,363
Percent of residents that are children (less than 10 years old)[2]	9.2%	12.9%	12.4%	10.6%
Percent of households that have people 65+ years old[1]	17.4%	23.1%	22.9%	28.2%
Percentage of households with at least one person living with a disability[1]	22.4%	24.8%	24.7%	21.2%
Median age[2]	33.6	33.7	33.7	36.3
Total households[1]	578	20,109	20,687	48,739
Median household income[2]	$62,591	$80,882	$80,344	$96,047
Percent of rental households[2]	76.8%	61.0%	61.5%	49.7%
Percent of household income below	13.9%	13.8%	13.8%	11.2%

Source: US Census Bureau, ACS 2017 - 2021[1], US Census Bureau 2020 Summary File 1, ESRI Forecasts 2023[2]

Adaptive Capacity

The City has addressed flooding in planning documents such as the 2020 LHMP.

3.2.1.7 GEOLOGIC AND SEISMIC HAZARDS

In the context of climate change vulnerability, increased liquefaction (seismic) and heightened possibility of landslide (geologic) events are a concern. Both hazards are an indirect effect of increased precipitation and rising groundwater because soil must be saturated with water for liquefaction or landslides to occur. Both hazards can be triggered by seismic events such as earthquakes. Specifically:

- Liquefaction occurs when seismic energy shakes an area with low-density, fine grain soil, like sand or silt, which is also saturated with water. When the shaking motion reaches these areas, it can cause these loosely packed soils to suddenly compact, making the waterlogged sediment behave more like a liquid than solid ground.
- Landslides occur when earth on slopes becomes destabilized, typically after heavy rains, when the precipitation saturates the soil and makes it less stable, or when significant erosion from rainfall destabilizes the ground. Slopes that have recently burned face a greater risk from rain-induced landslides, as the fires burn the trees, brush, and other vegetation that help stabilize the earth.

Seismic Activity

Changes in the climate do not have a direct effect on seismic activity. However, seismic events such as an earthquake can cause liquefaction and landslides which are made worse by other conditions caused by climate change.[117] California is seismically active because of movement of the North American

[117] Liquefaction occurs when seismic energy shakes an area with low-density, fine grain soil, like sand or silt, which is also saturated with water. When the shaking motion reaches these areas, it can cause these loosely packed soils to suddenly compact, making the waterlogged sediment behave more like a liquid than solid ground. During liquefaction events, the liquified soil can lose most of its stability which can cause damage to buildings and infrastructure built upon it. In severe

Plate, east of the San Andreas Fault, and the Pacific Plate to the west, which includes the State's coastal communities. The transform (parallel) movement of these tectonic plates against one another creates stresses that build as the rocks are gradually deformed. The rock deformation, or strain, is stored in the rocks as elastic strain energy. When the strength of the rock is exceeded, rupture occurs along a fault.

There are several smaller fault lines that pass through or lie underneath Fullerton. The Puente Hills Blind Thrust System runs north-south through Fullerton. Sections of the Elysian Park and Yorba Linda fault lines pass through Fullerton's southwestern and southeastern areas, respectively. The Coyote Hills faults, a series of smaller, shorter faults, run through northern sections of Fullerton. One of these fault segments, located just north of the City, is located within an Alquist-Priolo Special Study zone.

In addition to these local faults, there are six major regional faults that could potentially impact Fullerton:

- The closest point to the Whittier-Elsinore Fault is 1.6 miles northeast of Fullerton.
- The closest point to the Newport-Inglewood Fault is 9.8 miles southwest of Fullerton.
- The closest point of the Sierra Madre/San Fernando Fault is approximately 14 miles north of Fullerton.
- The Palos Verdes Hills Fault is 20 miles southwest of Fullerton at its closest point.
- The San Jacinto Fault is 36 miles east.
- The San Andreas fault, the dominant fault system in Southern California, is 37 miles northeast of Fullerton at its closest point.

Local geology and groundwater conditions, as well as historical events, all influence which areas are susceptible to liquefaction. The Coyote Creek Floodplain in the northwest section of Fullerton contains an abundance of saturated, loose sandy soils at depths less than 40 feet. These sediment layers have the potential to liquefy in the event of an earthquake, causing this area to have a high liquefaction susceptibility. Although the Carbon Creek alluvial fan is composed of loose, sandy material, there is a low susceptibility because groundwater is relatively far below the surface. Since liquefaction occurs in areas with highly water saturated soil, areas of liquefaction with slopes are also known to trigger events known as "deep-seated landslides" which are landslides that occur when water accumulates in the soil underneath the slope's surface. The areas of West Coyote Hills and East Coyote Hills have a susceptibility to deep-seated landslide. [118]

Historical Earthquake, Landslide, and Liquefaction Events

- July 8, 1986. North Palms Springs Earthquake. The shock occurred in a complex setting along the San Andreas Fault Zone where it bisects San Gorgonio Mountain and San Jacinto Peak at the San Gorgonio Pass and was the first in a series of three earthquakes that affected southern California and the northern Owens Valley in July 1986. Between 29 and 40 people were injured, and financial losses were estimated to be in the range of $4.5–6 million.
- January 17, 1994. Northridge Earthquake. The earthquake struck in the San Fernando Valley about 20 miles (32 km) northwest of downtown Los Angeles. The death toll was 57, with more than 9,000 injured. In addition, property damage was estimated to be $13–50 billion (equivalent to $24–93 billion in 2021).

cases, some buildings may completely collapse. Pipelines or other utility lines running through a liquefaction zone can be breached during an event, potentially leading to flooding or release of hazardous materials.

[118] Fullerton, City of. Local Hazard Mitigation Plan. 2020.

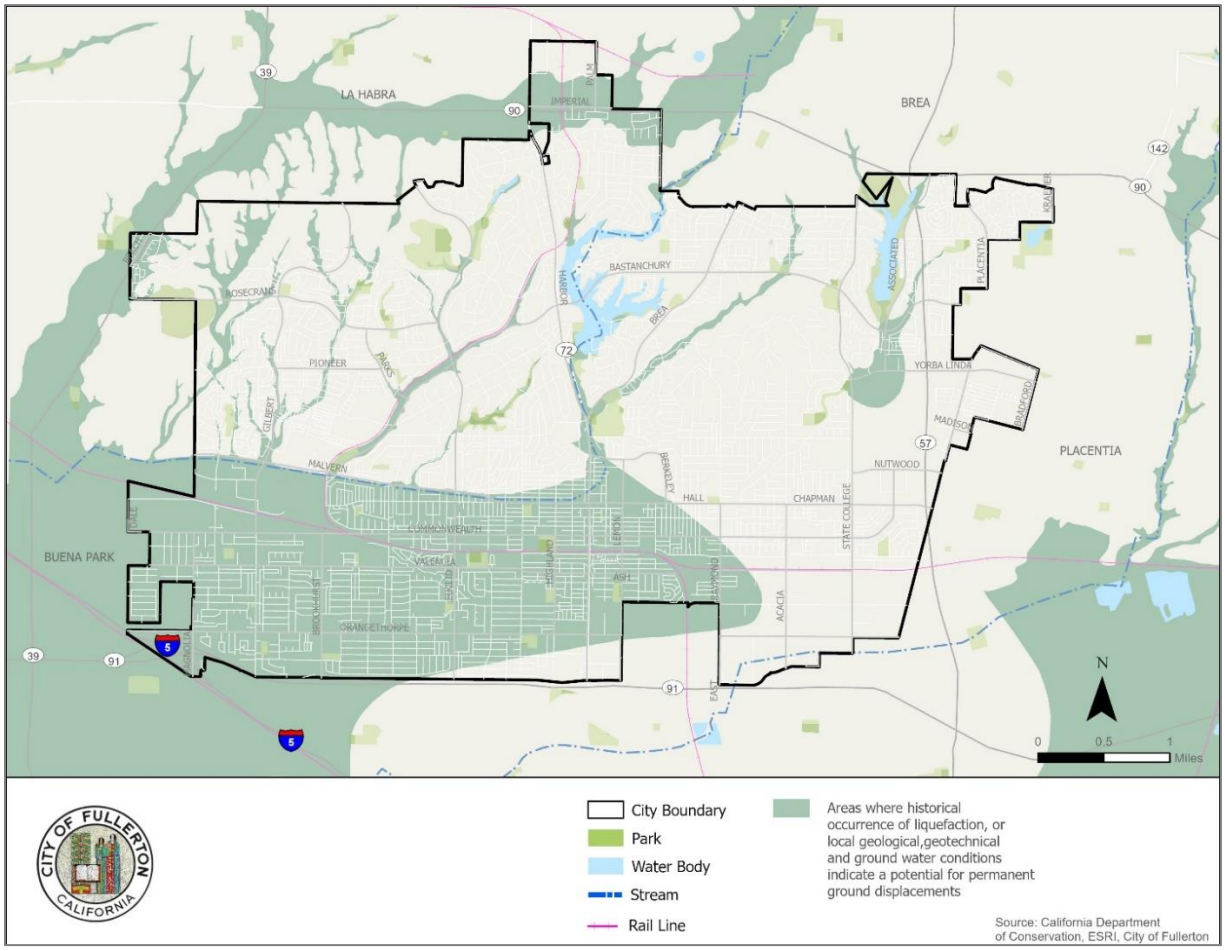
- March 28, 2014. La Habra Earthquake. The La Habra earthquake was caused by oblique thrust faulting on the Coyote Hills segment of the Puente Hills Thrust Fault System. The Puente Hills Fault is a blind thrust fault that runs north and west from Orange County to Los Angeles. The earthquake caused a total of $10.8 million in damage in Orange County, with approximately $1.5 million in Fullerton.[119] Thirteen water mains broke in Fullerton, forcing roughly 70 families to be displaced from their homes after they were declared temporarily uninhabitable.[120]

VULNERABILITY

Exposure

Figure 3-7: Liquefaction Susceptibility highlights areas with potential for liquefaction. The underlying dataset combine existing liquefaction areas from local maps and the National Earthquake Hazards Reduction Program which rates soils from hard to soft and known hydric soils from the United States Department of Agriculture Soil Survey to identify the potential areas where liquefaction may occur.

Figure 3-7: Liquefaction Susceptibility



[119] Fullerton Observer. Mid-April 2014. North Fullerton Earthquake Damage. www.fullertonobserver.com

[120] National Geophysical Data Center /World Data Service (NGDC/WDS) (1972), Significant Earthquake Database (Data Set), National Geophysical Data Center, NOAA, doi:10.7289/V5TD9V7K.

Table 3-14: Liquefaction Susceptibility – Vulnerable Populations compares the population within the High and Very High liquefaction hazard zones within the entire City population. Of special concern to the City is that almost 26.2 percent of households have at least one person aged 65 and over in addition to 26.1 percent of households with at least one person living with a disability. While the data may represent the same households, the number of individuals within the High and Very High liquefaction susceptibility zones should be of special concern for the City when preparing for emergency events including evacuation.

Table 3-14: Liquefaction Susceptibility – Vulnerable Populations	High and Very High Liquefaction	City of Fullerton
Total Population[1]	61,836	144,363
Percent of residents that are children (less than 10 years old)[2]	12.3%	10.6%
Percent of households that have people 65+ years old[1]	26.2%	28.2%
Percentage of households with at least one person living with a disability[1]	26.1%	21.2%
Median age[2]	34.1	36.3
Total households[1]	19,257	48,739
Median household income[2]	$86,574	$96,047
Percent of rental households[2]	54.8%	49.7%
Percent of household income below poverty level[1]	14.0%	11.2%

Source: US Census Bureau, ACS 2017 - 2021[1], US Census Bureau 2020 Summary File 1, ESRI Forecasts 2023[2]

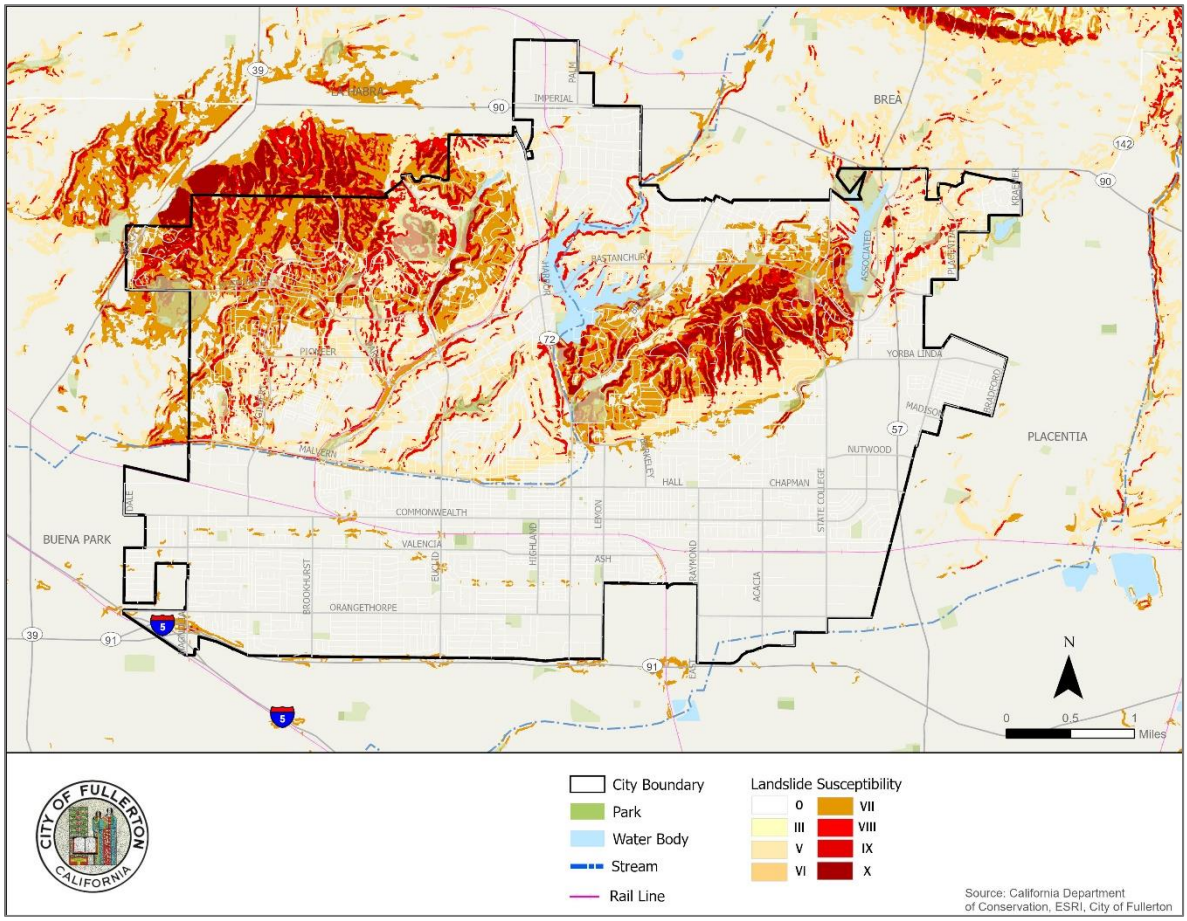
Landslides

Landslides occur when earth on slopes becomes destabilized, typically after heavy rains, when the precipitation saturates the soil and makes it less stable, or when significant erosion from rainfall destabilizes the ground. Slopes that have recently burned face a greater risk from rain-induced landslides as the fires burn the trees, brush, and other vegetation that help stabilize the earth. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 33 percent.
- A history of landslide activity or movement during the last 10,000 years.
- Stream or wave activity, which has caused erosion, undercut a bank, or cut into a bank to cause the surrounding land to be unstable.
- The presence of an alluvial fan (a triangle-shaped deposit of gravel, sand, and even smaller pieces of sediment, such as silt) indicates vulnerability to the flow of debris or sediments.
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Earthquakes may also be a source of landslides as the shaking can destabilize already loosened soils. There is the potential for landslides in the steeper portions of the foothills of the City. These areas are characterized with steep topography and geologic units that can become unstable. Figure 3-8: Earthquake Induced Landslide Zone identifies the areas of the City that are considered vulnerable to seismic induced landslides.

Figure 3-8: Earthquake Induced Landslide Zone



Sensitivity: Major Community Elements

Liquefaction and Landslides

As climate change is anticipated to change the usual precipitation patterns in Southern California, including the City, periods of both rain and drought are anticipated to become more intense and frequent. Therefore, climate change could, depending on the circumstances, increase the future risk of liquefaction in the region.

Critical Facilities and Infrastructure

During liquefaction events, the liquified soil can lose its stability which can cause damage to buildings and infrastructure built upon it. In severe cases, buildings may completely collapse. **(See Figure 3-7: Liquefaction Zones and Figure 3-8: Earthquake Induced Landslide Zone).**

- Roads—Access to major roads is crucial after a disaster event. Services and mobility may be disrupted during and following a liquefaction event. Sidewalks, roadways, and pipelines may become fractured and disjointed because of the liquefying soils. Roads and sidewalks may be usable in some form, but a severe liquefaction event may render them impassible until they are repaired. Landslides may block roadways causing long-term disruptions to the roadway network, infrastructure systems and City capabilities.

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- Bridges — Earthquake shaking, liquefaction and landslides can significantly damage bridges, which often provide the only access to some neighborhoods. Since soft soil regions generally follow floodplain boundaries, those bridges that cross water courses are considered vulnerable. Key factors in the degree of vulnerability are the facility's age and type of construction and soil classification at the bridge support structure, which indicate the standards to which the facility was built.
- Water and sewer infrastructure — Water and sewer infrastructure would likely suffer considerable damage in the event of an earthquake. This factor is difficult to analyze based on the vast amount of infrastructure in City and because water and sewer infrastructure are usually linear easements. Without further analysis of individual system components, it should be assumed that these systems are exposed to breakage and failure. Distribution systems with older brittle pipes are vulnerable to shaking and liquefaction.
- Power Lines — Power lines are generally elevated above steep slopes but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and rip down the lines.

According to the 2020 LHMP, a significant section of the lower southwest section of the city would be affected by liquefaction, potentially impacting 109 key facilities. As shown in Table 3-15: Key Facilities Threatened by Liquefaction, a seismic event could cause liquefaction that damages bridges, education facilities, utility infrastructure, and several other critical facilities and facilities of concern.

Table 3-15: Key Facilities Threatened by Liquefaction

Facility Type	Critical Facility	Facility of Concern	Total
Community Services	4	1	5
Education	0	14	14
Energy	2	0	2
Emergency Gathering Areas	3	0	3
Medical	0	7	7
Museum	1	0	1
Municipal Government	7	0	7
Transportation	54	0	54
Utility	1	0	1
Water and Sewage	15	0	15
Total	**87**	**22**	**109**

Source: Fullerton LHMP 2020

Hazardous Materials

Hazardous materials, including chemicals used as byproducts of industrial activities, natural gas and oil pipeline ruptures could be a significant threat to human and environmental health if they are not properly stored, managed, and contained. Oil and natural gas lines could rupture, exposing flammable or toxic chemicals. A short section of the Crimson Pipeline carries crude oil cuts through the northeast corner of Fullerton. In addition, several oil pipelines carrying crude oil and refined product run through La Habra, Brea, Anaheim, and Buena Park. SoCalGas also runs a subterranean natural gas pipeline through the middle of the city that nearly divides northern and southern Fullerton in half. Although pipeline failures are low-frequency events, they can have disastrous consequences. Ruptures could lead to fires and explosions that cause serious injuries or fatalities as well as environmental

contamination of waterways. Oil and gasoline could contaminate groundwater and lead to costly and multiyear cleanup efforts if released into waterways.

In addition, records from the Department of Toxic Substances Control have found harmful levels of toxic chemicals that have leached into the soil as a result of industrial activities. These chemicals can leach into the soil and potentially contaminate groundwater aquifers.[121]

Economic Elements

Homes, schools, and public facilities may be damaged and would likely be rendered unsafe for occupancy if they experience any leaning or structural damage resulting from the liquefaction or landslides. In addition to potentially causing significant injuries or fatalities, this can cause economic harm and create a need for long-term emergency sheltering and temporary housing until these buildings can be reconstructed.

In consideration of future degradation of structures, the City will want to monitor the quality of older housing stock to ensure it is still safe in a liquefaction event. The U. S. Department of Housing and Urban Development may consider units substandard if they were built before 1940. An estimated 46.8 percent of housing units within the City (approximately 49,000) were built before 1940. The median year structures were built was 1969.[122]

Natural Resource Areas

Earthquake-induced landslides in landslide-prone areas can significantly damage surrounding habitat. It is also possible for streams to be rerouted after an earthquake. Rerouting can change the water quality, possibly damaging habitat and feeding areas. There is a possibility that streams fed by groundwater wells will dry up because of changes in underlying geology. Landslides could affect sensitive ecological areas around the community, causing localized harm to the region's ecosystem, although widespread impacts are unlikely.

Sensitivity: Vulnerable Populations

Seismic shaking and fault rupture pose a significant threat to populations living or working near structures that are not retrofitted to withstand seismic activity. This could include lower-income households who are unable to afford the cost of seismically retrofitting their homes or renters living in substandard housing. Senior citizens (especially those living alone) and lower-income households could have more difficulty recovering from a seismic event that causes significant damage to their home. Households with residents aged 65 and older or have a disability, as there may exist challenges with mobility that may affect evacuation and response to a catastrophic event.

Adaptive Capacity

The City has addressed liquefaction and landslide events in planning documents such as Fullerton Local Hazard Mitigation Plan and other agency programs. Additionally, City plan check engineers utilize a City-wide GIS tool – the California Geological Survey's Earthquake Zones of Required Investigation - that is a standard practice in line with the California Building code.[123]

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[121] Fullerton, City of. Local Hazard Mitigation Plan. 2020.

[122] U.S. Census Bureau. American Community Survey. 2022 ACS 1-Year Estimates.

[123] Correspondence with Taylor Samuelson, Senior Administrative Analyst City of Fullerton on January 31, 2024.

CHAPTER 4. CLIMATE ADAPTATION FRAMEWORK

Preparing the City of Fullerton for the impacts of climate change requires significant investment in time and resources across all parts of the community, including businesses, health, emergency services, government, schools, infrastructure, culture, and natural resources. This chapter provides a list of general strategies and supporting actions the City of Fullerton can consider for future climate adaptation and resilience efforts. Actions are divided into climate hazard sections (and include a "City-wide" section), like the body of the Vulnerability Assessment as follows:

- Citywide
- Extreme Heat Events
- Drought
- Wildfire
- Flooding
- Liquefaction/Landslide

Development of climate adaptation strategies considered the following:

PLANNING AND COLLABORATION

The complexity and interconnectedness of climate change requires a significant investment in community engagement and education to increase awareness and resilience. In addition, land use, geography, and transportation network infrastructure necessitate comprehensive and multi-jurisdictional adaptation approaches and solutions in partnership with local, regional, and State partners. Programs that educate and inform residents, visitors, businesses, and local decision-makers can empower individuals to take actions to reduce risk for themselves. Programs that seek to bring community members together can create lasting connectivity among neighbors who can plan together to get out of harm's way.

HEALTHY COMMUNITIES

Climate change can affect the health of residents, workers, and tourists. Impacts include respiratory impacts from smoke, heat-related illnesses, increasing allergies and asthma, food-borne and water-borne illnesses, and mental health impacts from extreme events. More frequent and severe storms, floods, heat waves, wildfires, and other extreme events create additional stresses to healthcare systems, employees, and infrastructure. Maintaining and improving physical and mental health should be a top priority.

As climate-related hazards are expected to worsen in coming decades, the community will need to increase their preparation, response, recovery, and mitigation efforts. The intent is to strengthen safety nets by expanding and strengthening community preparedness and resilience through collaboration, education, and lasting partnerships that emphasize community well-being.

CLIMATE EQUITY

As discussed in the Vulnerability Assessment, Climate change does not affect all residents evenly. Climate hazards can disproportionately affect vulnerable populations that may have a more challenging

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time responding to hazard events because of age, language barriers, income, housing, or other characteristics. To address these differences, climate adaptation actions were developed to address the specific needs of those most vulnerable to hazards.

EMERGENCY PREPAREDNESS

Emergency preparedness requires proactive planning, strong communication, and reliable and clear sources of information available through multiple channels. To minimize the impact of potential disasters for community members, the City plays a key role in making sure residents and visitors have the correct information about what to do and where to go in the event of a disaster. Individuals also have a responsibility in emergency preparedness, and should stay informed, prepare emergency kits, and otherwise take precautions to minimize risk to themselves and their families. In addition, clear evacuation protocols, planning, and practice are crucial factors for community preparedness.

Future planning efforts should focus on regional connectivity and communication, engaging the right regional partners in evacuation planning, optimizing the City and Orange County evacuation protocols, and identifying key potential challenges in regional evacuations.

RESILIENT BUILDINGS

Fullerton development includes a mix of buildings, including master-planned communities and neighborhoods of single- and multi-family homes, along with commercial and industrial buildings. Upgrades to business and residential structures to reduce fire-, flood-, geologic-, and seismic-related vulnerability can be combined with efforts to increase energy efficiency and reduce greenhouse gas emissions. Both objectives lead to meaningful climate action that saves money and improves quality of life for residents and promotes a sustainable economy.

RESILIENT INFRASTRUCTURE

Implementation and management of City infrastructure will determine how well it can protect residents and accommodate or mitigate future climate and extreme weather impacts. As the City does not directly own or operate all the critical infrastructure (e.g., electricity, water, or telecommunications), it must work directly with those companies, agencies, and organizations to enhance the resilience of those systems. Continuous investment in transportation infrastructure may be needed to facilitate mobility throughout the City in both everyday life and during an emergency.

RESILIENT ECOSYSTEMS

Natural systems provide valuable functions to both residents and visitors in the form of ecosystem services (water storage, etc.) within watersheds and open spaces. Natural lands and open space are increasingly being affected by climate change and will need to be managed for continued natural function.

Notes on the Evaluation and Implementation of Climate Adaptation Actions

As part of the adaptation assessment process, potentially relevant adaptation actions were collected through research of Fullerton planning documents (e.g., Local Hazard Mitigation Plan), other climate adaptation plans in the State of California, and from communities across the country. These actions were modified specifically for Fullerton and should be updated accordingly as adaptation planning and implementation processes progress.

Actions listed can be complementary, directly dependent on the implementation of another action (before or after), implemented in conjunction (or sequentially) with other actions, or mutually exclusive of one another.

Citywide Actions (CW)

CW-1: Prioritize climate change adaptation planning

- Continue to update the climate vulnerability assessment and Local Hazard Mitigation Plan (LHMP) as required by regulation to comprehensively plan for current and future natural and human-caused hazards within the City.
- Integrate climate science and projected climate-related impacts in all City planning documents, policies, programs, and ordinances as they are reviewed or updated.
- Provide training for staff about the impacts of climate hazards as part of the Risk Management functions of the City.
- Continue to integrate mitigation actions from the current LHMP into major capital improvement projects planning and development, including the potential relocation of critical facilities.

CW-2: Partner with surrounding local, regional, State, and Federal partners to support social and economic resilience

- Coordinate with Orange County so mitigation actions in both the County's and Fullerton's hazard mitigation plans can lead to a more regionally unified hazard mitigation strategy.
- Coordinate with surrounding municipalities and Orange County to enhance evacuation and emergency management protocols, agreements, and processes.
- Provide residents, businesses, and neighborhood organizations evacuation procedures and shelter-in-place guidelines to increase community resilience.
- Coordinate with regional health care facilities to ensure effective care for all City residents and visitors during an emergency.
- Create a rapid response plan from among Fullerton's and Orange County's first responders to secure hospital, nursing and assisted living facilities located within high hazard zones.

CW-3: Maintain City operations for community resilience

- Install backup generators at key critical facilities (City Hall, Fire Stations, Police Stations, water pumps, etc.) in the event of power loss during an emergency. Install portable generators in City-owned water facilities.
- Maintain at least one emergency power-generating station in all critical facilities that the City could use as an emergency public assembly area, such as City Hall, Fullerton Public Library, and any others that the City may so designate in the future.
- Continue to designate, maintain, and promote to the community use of City Parks and Recreation facilities as emergency shelters.

CW-4: Strengthen community resilience through collaboration and education

- Work with local community organizations to develop a climate change education outreach program focused on residents, especially environmental justice, LatinX, and other community organizations as they identify gaps in vulnerable community resilience planning and further engage vulnerable community members.
- Expand participation in the Fullerton Community Emergency Response Team (CERT) program for residents and businesses.
- Evaluate and enhance existing preparedness and evacuation programs to better educate, inform, and engage the public about emergency preparedness in the case of a disaster.
- Identify gaps in current communication pathways to effectively notify the community of impending hazards (e.g., AlertOC, Fullerton School District website and Blackboard Connect).

CW-5: Collaborate with local businesses on economic and community resilience

- Work with local businesses and organizations to conduct regular workplace emergency preparedness drills, create or update disaster recovery plans, and ensure adequate evacuation planning is conducted.
- Develop agreements with hotels to designate them as Red Cross facilities in case of an emergency.

CW-6: Collaborate with school districts to develop emergency preparedness programs

- Explore agreements with local school districts so that school facilities can act as evacuation sites during major emergencies.
- Identify opportunities to use school facilities as evacuation centers, cooling centers, and charging stations, during extreme heat or severe weather events.

CW-7: Coordinate with regional and local transportation and transit agencies to ensure continued access and movement in the event of an emergency.

- Coordinate with Caltrans and Orange County Transit Authority to assess the vulnerability of transportation infrastructure and primary evacuation routes to hazardous climate-related events.
- Develop smart transportation demand management systems to respond to increased volumes of traffic during an evacuation.

CW-8: Coordinate with regional utilities to enhance the preparedness, protection, and resilience of water, energy, and telecommunications infrastructure.

- Coordinate with regional utilities to assess the vulnerability of critical infrastructure to hazardous climate-related events and harden as necessary to reduce risk of breach.

Extreme Heat Events (EH)

EH-1: Prepare the community for extreme heat events

- Work with regional and local health agencies to evaluate extreme heat warning thresholds and protocols and incorporate enhanced extreme heat preparedness into local operations.
- Establish a City-wide Heat Alert Program (HAP) when weather forecasts predict heat waves or extreme heat days.
- Educate vulnerable community members and their caregivers (e.g., aging, elderly, ill) to detect signs and symptoms of, and to prevent heat-related illness. Emphasize the importance of immediate medical assistance for heat-related illness.

EH-2: Develop facilities and resources to reduce the effects from extreme heat events

- Expand number of publicly operated cooling centers based on the need of vulnerable populations.
- Collaborate with local businesses and institutions to provide a “Cool Zone” area network (i.e., cooling centers).
- Develop a tree and shade master plan with a particular focus on climate resilient tree species.

Drought (D)

D-1: Collaborate with agency partners to prepare for future drought conditions

- Collaborate with Orange County Water District and Federal, State, and local agencies to explore alternative sources and improve groundwater supplies, including groundwater recharge.

D-2: Develop and implement City-wide efforts to increase drought resilience

- Continue to update and implement the Fullerton Water Shortage Contingency Plan.
- Launch a pilot program with smart water meters to track water usage in commercial and industrial properties across the City.
- Promote nature-based methods and BMPs (e.g., bioswales, natural ground cover) through the City's stormwater program.
- Continue to plan for, and respond to, incidents of tree mortality; drought resilience of public landscapes; and pest management concerns.

D-3: Promote community water conservation measures

- Support Orange County Water District in education and outreach efforts focused on water conservation measures (e.g., water reuse, water use, and irrigation efficiency) for City residents.
- Encourage drought tolerant native landscaping, low-flow water fixtures, and apply daytime watering restrictions (as necessary) on properties throughout the city to reduce water consumption.

Wildfire (WF)

WF-1: Collaborate with regional partners to reduce the impacts from wildfire

- Create and routinely update a Community Wildfire Protection Plan for fire prone areas within the city.
- Promote and implement the Orange County Vegetation Management program to reduce wildfire risk.

WF-2: Implement actions to reduce flammable materials in wildfire zones

- Update the Community Forest Master Plan, incorporating drought strategies and wildfire vulnerabilities into the planning framework.
- Remove highly flammable vegetation in fire prone areas and replant with fire-adapted specimens.
- Create a hillside weed abatement pilot program using goats or other livestock to reduce fuel loads in fire-prone areas.
- Plant fire-resistant, drought-tolerant groundcover on slopes, inclines, and hillsides to reduce runoff and erosion during heavy rainfall.

WF-3: Educate the community about wildfire for improved public safety and resilience

- Expand the fire hazard prevention awareness campaign to residents in the fire prone areas.
- Support regional partners (e.g., Orange County Fire Authority's Ready, Set, Go Program) in their efforts to educate residents about defensible space, vegetation management, and home hardening efforts.

Flood (F)

F-1: Coordinate with relevant agencies to better plan and prepare emergency services required for flooding events.

- Monitor stormwater management infrastructure and identify changes in flooding patterns and locations related to changing climatic conditions.

F-2: Develop or update long-term public works plans for critical facilities to address current and future flood risk.

- Require that future transportation infrastructure projects consider current and future flood risk and align the projected lifespan of the project with best available science.
- Explore and implement Low Impact Development (LID) standards for new development to reduce the amount of stormwater runoff.
- Draft an ecosystem restoration plan and upgrade of drainage systems in Gilman Park and other similar areas in Fullerton.

F-3: Educate the community about flooding for improved public safety and resilience

- Implement an outreach program to increase the public awareness of flooding, stormwater management, and drought management issues and techniques for residents to mitigate those challenges on their property, including availability of flood insurance.
- Partner with Orange County Public Works to proactively disseminate information from the "H2OC Stormwater Program" to educate home and small business owners on regulations and highlight the role that engaged residents can play to assist with community-based stormwater management.

F-4: Ensure resilience and long-term functionality of stormwater and sewer systems.

- Update the City's Drainage Area Master Plan on a regular basis to incorporate new data and/or address emerging issues.
- Conduct comprehensive visual and functional test monitoring and asset condition assessment. Model potential impacts to utility infrastructure under future flooding scenarios.
- Conduct frequent cleanings of storm drain intakes, especially before and during the rainy season.
- Create areas with permeable pavements and/or catchwater systems as an interim solution to flood control channel expansion.

Liquefaction and Landslide (L)

L-1: Coordinate with local and regional partners to prepare and respond to liquefaction and landslide events

- Coordinate with Orange County Water District on subsidence monitoring in areas of active groundwater extraction and develop strategies based on the amount and severity of subsidence occurring.
- Improve local understanding of the threat of a major earthquake by conducting a city-wide scenario modeling potential loss of life and injuries, destroyed and damaged structures, and interruptions to key services.

L-2: Educate the community about seismic and geologic events for improved public safety and resilience

- Provide information to the community to prepare for, and recover from, a seismic or geologic event.
- Promote retrofit of key community facilities not owned by the City.

L-3: Design facilities to be resilient to seismic and geologic events

- Regularly update an inventory of buildings within the City that may be seismically vulnerable (adobe brick, unreinforced masonry, etc.)
- To the extent feasible, construct all new and significantly retrofitted City-owned facilities to remain operational in the event of a major earthquake.
- In coordination with Caltrans, update facilities condition assessments for bridges along evacuation routes to identify bridges that need seismic retrofitting.
- Build retaining walls, install shotcrete, and drape catch-fall nets on slopes or areas where landslides are likely to occur on public property.
- Install water runoff catchment troughs to channelize and divert rainwater away from hillsides on public property.