Appendix D:
Climate Adaptation and Resilience Report for City of Folsom

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Introduction

The effects of climate change are already occurring at global and regional scales and will continue to worsen existing hazards in the City of Folsom (hereafter referred to as "city"). The primary effects of climate change include increased temperatures and changes in precipitation patterns. These impacts are expected to heighten and exacerbate risks posed by secondary climate effects, including extreme heat events, wildfire, drought, flooding, and large storms. While many of these hazards have existed historically in the city, the frequency and intensity of many of these hazards is projected to increase because of global climate change.

This Climate Adaptation and Resilience Report (report) serves as a climate change vulnerability assessment, which is intended to inform the development of adaptation strategies by analyzing the city's exposure to existing hazards, sensitivity to these hazards, potential climate-related impacts from these hazards, and the City of Folsom government's (City) existing capacity to prepare and adapt for these impacts, known as adaptive capacity. This report is intended to accompany a set of adaptation strategies that will be incorporated into the Safety Element of the City of Folsom 2035 General Plan. Both the vulnerability assessment and the adaptation strategies are intended to help the City prepare for the impacts of climate change and remain consistent with Government Code Section 65302, as amended by Senate Bill (SB) 379, which requires jurisdictions in California to assess and prepare for climate change as part of their next Safety Element update.

Climate Change Background

Greenhouse gas (GHG) emissions are responsible for causing climate change. The largest source of GHG emissions from human activities is the burning fossil fuels for electricity, heat, and transportation. The combustion of fossil fuels, among other human activities, since the Industrial Revolution in the 19th century has introduced GHGs into the atmosphere at an increasingly accelerated pace, intensifying the greenhouse effect and leading to a trend of unnatural warming of the Earth's climate, known as global climate change or global warming. Climate change has more recently become a priority issue on an international, national, and local scale as recent climate data reveal more extreme weather patterns, increased average global temperatures, and the rapid melting of the Earth's Artic and Antarctic poles and glaciers.

The global average temperature is expected to increase by 3.7 degrees Celsius (°C) (6.7 to 8.6 degrees Fahrenheit [°F]) by the end of the century unless additional efforts to reduce GHG emissions are made (IPCC 2014). Depending on future GHG emissions, average annual maximum daily temperatures in California are projected to increase between 4.4 and 5.8°F by 2050 and by 5.6 to 8.8°F by 2100 (OPR, CEC, and CNRA 2018a). The state and the city have already begun to experience extreme weather effects, the frequency and intensity of which have been worsened by climate change (OPR, CEC, and CNRA 2018a). Extreme weather effects such as volatility in precipitation, increased average temperatures, and increased frequency of extreme heat events have led to increases in the frequency and intensity of human health and safety hazards such as wildfires, droughts, and changes in the available water supply.

Regulatory Setting and Guidance Documents

This section provides a summary of the relevant regulations and guidance documents and resources that were used to help develop the vulnerability assessment and adaptation strategies included in this report.

SENATE BILL 379

According to SB 379, general plan safety elements must address climate change vulnerability, adaptation strategies, and emergency response strategy. Upon adoption of SB 379, Government Code Section 65302 was updated to include the following additions:

> Section 65302 (g) (4) Upon the next revision of a local hazard mitigation plan, adopted in accordance with the federal Disaster Mitigation Act of 2000 (Public Law 106-390), on or after January 1, 2017, or, if a local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022, the safety element shall be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to the city or county. This review shall consider advice provided in the Office of Planning and Research's General Plan Guidelines and shall include all of the following:
>
> (A) (i) A vulnerability assessment that identifies the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts, including, but not limited to, an assessment of how climate change may affect the risks addressed pursuant to paragraphs (2) and (3).
>
> (ii) Information that may be available from federal, state, regional, and local agencies that will assist in developing the vulnerability assessment and the adaptation policies and strategies required pursuant to subparagraph (B), including, but not limited to, all of the following:
>
> (I) Information from the internet-based Cal-Adapt tool.
>
> (II) Information from the most recent version of the California Adaptation Planning Guide.
>
> (III) Information from local agencies on the types of assets, resources, and populations that will be sensitive to various climate change exposures.
>
> (IV) Information from local agencies on their current ability to deal with the impacts of climate change.
>
> (V) Historical data on natural events and hazards, including locally prepared maps of areas subject to previous risk, areas that are vulnerable, and sites that have been repeatedly damaged.
>
> (VI) Existing and planned development in identified at-risk areas, including structures, roads, utilities, and essential public facilities.
>
> (VII) Federal, state, regional, and local agencies with responsibility for the protection of public health and safety and the environment, including special districts and local offices of emergency services.
>
> (B) A set of adaptation and resilience goals, policies, and objectives based on the information specified in subparagraph (A) for the protection of the community.
>
> (C) A set of feasible implementation measures designed to carry out the goals, policies, and objectives identified pursuant to subparagraph (B) including, but not limited to, all of the following:
>
> (i) Feasible methods to avoid or minimize climate change impacts associated with new uses of land.
>
> (ii) The location, when feasible, of new essential public facilities outside of at-risk areas, including, but not limited to, hospitals and health care facilities, emergency shelters, emergency command centers, and emergency communications facilities, or identifying construction methods or other methods to minimize damage if these facilities are located in at-risk areas.
>
> (iii) The designation of adequate and feasible infrastructure located in an at-risk area.
>
> (iv) Guidelines for working cooperatively with relevant local, regional, state, and federal agencies.

(v) The identification of natural infrastructure that may be used in adaptation projects, where feasible. Where feasible, the plan shall use existing natural features and ecosystem processes, or the restoration of natural features and ecosystem processes, when developing alternatives for consideration. For purposes of this clause, "natural infrastructure" means using natural ecological systems or processes to reduce vulnerability to climate change related hazards, or other related climate change effects, while increasing the long-term adaptive capacity of coastal and inland areas by perpetuating or restoring ecosystem services. This includes, but is not limited to, the conservation, preservation, or sustainable management of any form of aquatic or terrestrial vegetated open space, such as beaches, dunes, tidal marshes, reefs, seagrass, parks, rain gardens, and urban tree canopies. It also includes systems and practices that use or mimic natural processes, such as permeable pavements, bioswales, and other engineered systems, such as levees that are combined with restored natural systems, to provide clean water, conserve ecosystem values and functions, and provide a wide array of benefits to people and wildlife.

(D) (i) If a city or county has adopted the local hazard mitigation plan, or other climate adaptation plan or document that fulfills commensurate goals and objectives and contains the information required pursuant to this paragraph, separate from the general plan, an attachment of, or reference to, the local hazard mitigation plan or other climate adaptation plan or document.

(ii) Cities or counties that have an adopted hazard mitigation plan, or other climate adaptation plan or document that substantially complies with this section, or have substantially equivalent provisions to this subdivision in their general plans, may use that information in the safety element to comply with this subdivision, and shall summarize and incorporate by reference into the safety element the other general plan provisions, climate adaptation plan or document, specifically showing how each requirement of this subdivision has been met.

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. Adaptation policies, goals, and objectives are to be developed based on findings from the vulnerability assessment. Additionally, jurisdictions are required to create a set of feasible implementation measures to reduce climate change impacts on new or proposed land uses. Lastly, jurisdictions that have adopted a climate adaptation plan (CAP) separate from the General Plan may reference that document to comply with SB 379 requirements.

CALIFORNIA ADAPTATION PLANNING GUIDE

The California Office of Emergency Services (CalOES) and California Natural Resource Agency (CNRA) prepared the first Adaptation Planning Guide (APG), most recently updated in June 2020, to provide communities with vulnerability assessment and adaptation planning guidance. The APG includes a step-by-step process that communities may use to help plan for the impacts of climate change. The APG provides a framework for communities to identify potential climate change effects and important physical, social, and natural assets; create adaptation strategies to address climate change impacts; and develop a monitoring and implementation framework for climate change adaptation. The APG served as the formal guidance document for preparation of this report (CalOES 2020).

CALIFORNIA'S FOURTH CLIMATE CHANGE ASSESSMENT AND SACRAMENTO VALLEY REGION REPORT

CNRA, Governor's Office of Planning and Research (OPR), and California Energy Commission (CEC) prepared *California's Fourth Climate Change Assessment* (Climate Assessment) in 2018 (OPR, CEC, and CNRA 2018a). The Climate Assessment was designed to address critical information gaps that decisionmakers at the state, regional, and local levels need to close to protect and build the resilience of people, infrastructure, and natural systems to climate change-related hazards. The Climate Assessment is referenced throughout this report to provide background information and evidence of regional climate change impacts. The Climate Assessment includes regional reports that provide information on the climate change impacts that will affect specific regions throughout the state. Information from *California's Fourth Climate Change Assessment Report: Sacramento Valley Region Report* (Sacramento Valley Report) is included throughout the report and was used to assess the various potential climate change effects that are projected to impact the city and Sacramento County (county) (OPR, CEC, and CNRA 2018b).

CITY OF FOLSOM AND REGIONAL PLANNING EFFORTS

In addition to State adaptation efforts, the City and supporting agencies have developed planning documents focused on local and regional adaptation to climate change hazards. These planning documents analyze existing hazards and include strategies or guidelines to mitigate their severity. Resources considered in the development of this vulnerability assessment include:

- the County's Local Hazard Mitigation Plan (LHMP) (Sacramento County 2017a),
- the City's Annex to the LHMP (City LHMP Annex) (Sacramento County 2017b),
- the City's General Plan and supporting documents,
- the City's Emergency Operations Plan (EOP) (City of Folsom 2020a),
- the City's Evacuation Plan (City of Folsom 2020b),
- the City's Community Wildfire Protection Plan (CWPP) (City of Folsom 2011),
- the City's Urban Water Management Plan (City of Folsom 2015), and
- the Sacramento County Draft Climate Action Plan (Sacramento County 2021).

Vulnerability Assessment

This section provides a comprehensive assessment of the city's vulnerabilities to climate change. It identifies and characterizes the climate change effects and other related hazards that are anticipated to impact the city. The vulnerability assessment follows the process outlined in the APG and is composed of the following four steps:

1. **Exposure:** The purpose of this step is to understand existing hazards within the city and how changes in climate variables (e.g., average temperature, precipitation) are projected to affect these hazards. Existing hazards that can be worsened by the effects of climate change are identified and described, based on historical data from sources such as the LHMP. Climate projection data is used to develop projections for how existing hazards are expected to change by near-term (2021-2050), midterm (2035-2064), and long-term (2070-2099) timescales.
2. **Sensitivity and Potential Impacts**: This step compiles a list of population groups and community assets that are sensitive to localized climate change effects. Climate-related hazards (e.g., flooding, wildfire) are generally projected to increase in severity, with the potential for climate change to generate new impacts that communities have not experienced historically. Using historical data, research from regional and statewide reports on climate impacts, this step seeks to understand how sensitive populations and assets may be affected by climate change.
3. **Adaptive Capacity**: The City, partner agencies, and organizations within the County have already taken steps to build resilience and protect sensitive populations and assets from existing hazards. The purpose of this step is to characterize the City's and involved stakeholders' current ability to address future climate impacts, referred to as adaptive capacity. The ability of the City to adapt to each of the identified climate impacts is determined through a review of existing plans, policies, and programs.

4. **Vulnerability Scoring**: Lastly, this step determines the City's priority climate vulnerabilities through a vulnerability scoring process. Vulnerability scores are based on several factors, including: the severity of projected climate exposures, the sensitivity of certain population groups and assets to the anticipated climate effects, and whether sufficient adaptive capacity exists to manage future climate impacts.

The vulnerability assessment helps the City understand which climate vulnerabilities are most urgent and should be prioritized during the adaptation strategy development phase, outlined in Section 3, "Adaptation Framework and Strategies," as well as during strategy implementation.

Exposure

This section includes the exposure analysis, relying primarily on existing planning documents and resources to understand the City's current hazard and uses climate modeling data to identify how these hazards will change in the future.

The city is located in Sacramento County approximately 25 miles east of the City of Sacramento. U.S. Highway 50 runs east-west through the city and serves as the main regional connector roadway for residents and visitors. The city includes three Regional Transit Authority light rail stations, connecting it to downtown Sacramento with connections to other areas in the Sacramento region. The city is located directly south of Folsom Lake, which is created by the Folsom Dam. Folsom Dam was built in 1955 by the U.S. Army Corps of Engineers and is operated by U.S. Bureau of Reclamation. The city's elevation is approximately 350 feet above sea level.

The city's climate consists of mild winters and Mediterranean summers similar to other areas of Sacramento County. The average daily temperatures in the city range from 37 to 60°F degrees in the winter months to between 53 and 94°F in the summer and fall months. Annual average rainfall in the city is 23 inches, which occurs primarily in November through March.

EXISTING HAZARDS

The City's LHMP Annex and the City's General Plan provide a comprehensive understanding of natural and manmade hazards that historically have threatened the city, including those that may be exacerbated by climate change. These plans evaluate several hazards that are influenced by climate, including wildfire, extreme weather, flooding, and drought. The following sections discuss these existing hazards as evaluated by the County, drawing from other reports and documents as needed.

Wildfire

Wildfire behavior is dependent on several factors that, when identified and assessed, can help determine future wildfire characteristics. The three factors listed below contribute significantly to wildfire behavior and can be used to identify wildfire hazard areas:

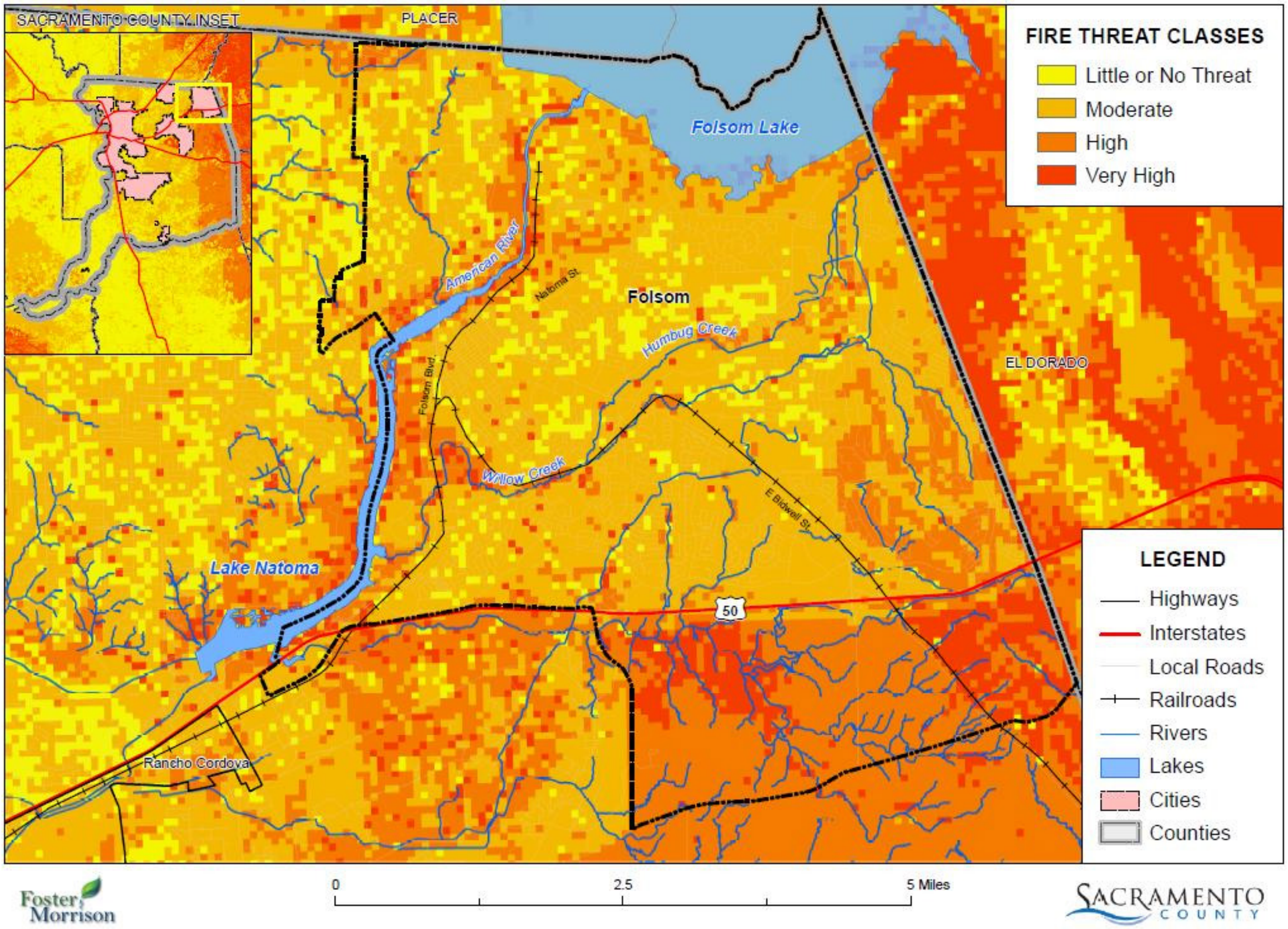
- **Topography**: An area's terrain and land slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases because heat from a fire tends to rise through convection. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.
- **Fuel**: Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and can include dead tree leaves, twigs, and branches of dead, standing trees; live trees; brush; and cured grasses. Buildings and other structures, such as homes and other associated combustibles, are also considered a fuel source.
- **Weather**: Components such as temperature, relative humidity, wind, and occurrence of lightning affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires, creating a situation where fuel will ignite more readily and burn more intensely. Thus, during periods of

drought, the threat of wildfire increases. Wind is one of the most significant weather factors in the spread of wildfires. The greater a wind, the faster a fire will spread and the more intense it will be.

The California Department of Forestry and Fire Protection (CAL FIRE) maps areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZ), are represented as Very High, High, or Moderate. The classification of a zone as a Moderate, High, or Very High FHSZ is based on a combination of how a fire would behave and the probability that flames and embers would threaten buildings. Wildfire risk is also determined by several factors, such as wind speeds, drought conditions, available wildfire fuel (i.e., dry vegetation), past wildfire suppression activity, and expanding wildland-urban interface (WUI) (i.e., places in and around forests, grasslands, shrub lands, and other natural areas) (Westerling 2018). Impacts from grass and brushfires in the City could result in evacuations of portions of the City as well as loss of property and impacts to critical facilities.

Based on data included in the CWPP and the City's LHMP Annex shown in Figure D-1, the majority of the city is located in areas designated as moderate to high fire threat. Given the city's location and urban setting, there is relatively low risk of impacts from wildfires relative to areas northeast of the city in El Dorado County; however, the city is at increased threat of grass and brushfires. Although the majority of the city's developed areas are at lower fire risk, the city does include a few key areas classified as high or very high fire threat, specifically in the American River and Lake Natoma Recreation areas, which are managed by the State of California Parks and Recreation Department (California State Parks). As a recreation area, there are limited roadways within these areas, making fire equipment access difficult. Other areas with increased risk of impacts in the WUI along the American River include Willow Creek and Folsom Powerhouse recreation areas, as well as the Negro Bar Recreation area. While threatened by fire risk along the American River and in southeastern portions of the city, residents are also at risk from health impacts from poor air quality associated with wildfire smoke. Poor air quality can be generated in the city from wildfires occurring throughout northern California as has been experienced in recent years.

FIGURE D-1: CITY OF FOLSOM FIRE THREAT ZONES



Source: Sacramento County 2017b

Extreme Heat

Extreme heat days and heat waves are the most lethal type of weather-related event in the United States. The warmest months in the city typically occur in the summer months from June through August. Using data from Cal-Adapt and for the purposes of this report, the extreme heat threshold for the city is 104°F, meaning 98 percent of all recorded temperatures in this period (1961-1990) were below 104°F. Historically, the city has experienced an average of four extreme heat days per year. Heat wave events are characterized as periods of sustained extreme heat and are defined by Cal-Adapt as four or more consecutive extreme heat days. Historically, there has been less than one heat wave event in the city per year with only, on average, two consecutive days per year above 104°F. Table 1 includes historic monthly temperatures at the closest weather station to the city. Although not located directly in the city, new record daily high temperatures were set at the Sacramento Executive Airport, the weather station nearest to the city, in August (112°F) and September (109°F) 2020 (NOAA 2020). The previous record for August (110°F) was set in 1996, and the previous record for September (108°F) was set in 1950 (NOAA 2020).

Table 1: Historic Monthly Temperatures in the City of Folsom

Month	Temperature	Date	Month	Temperature	Date
January	74°F	1/12/2009	July	114°F	7/13/1972
February	76°F	2/19/1964	August	112°F	8/16/2020
March	88°F	3/26/1988	September	109°F	9/6/2020
April	95°F	4/30/1996	October	104°F	10/02/2001
May	105°F	5/28/1984	November	87°F	11/01/1960
June	115°F	6/15/1961	December	72°F	12/28/1967

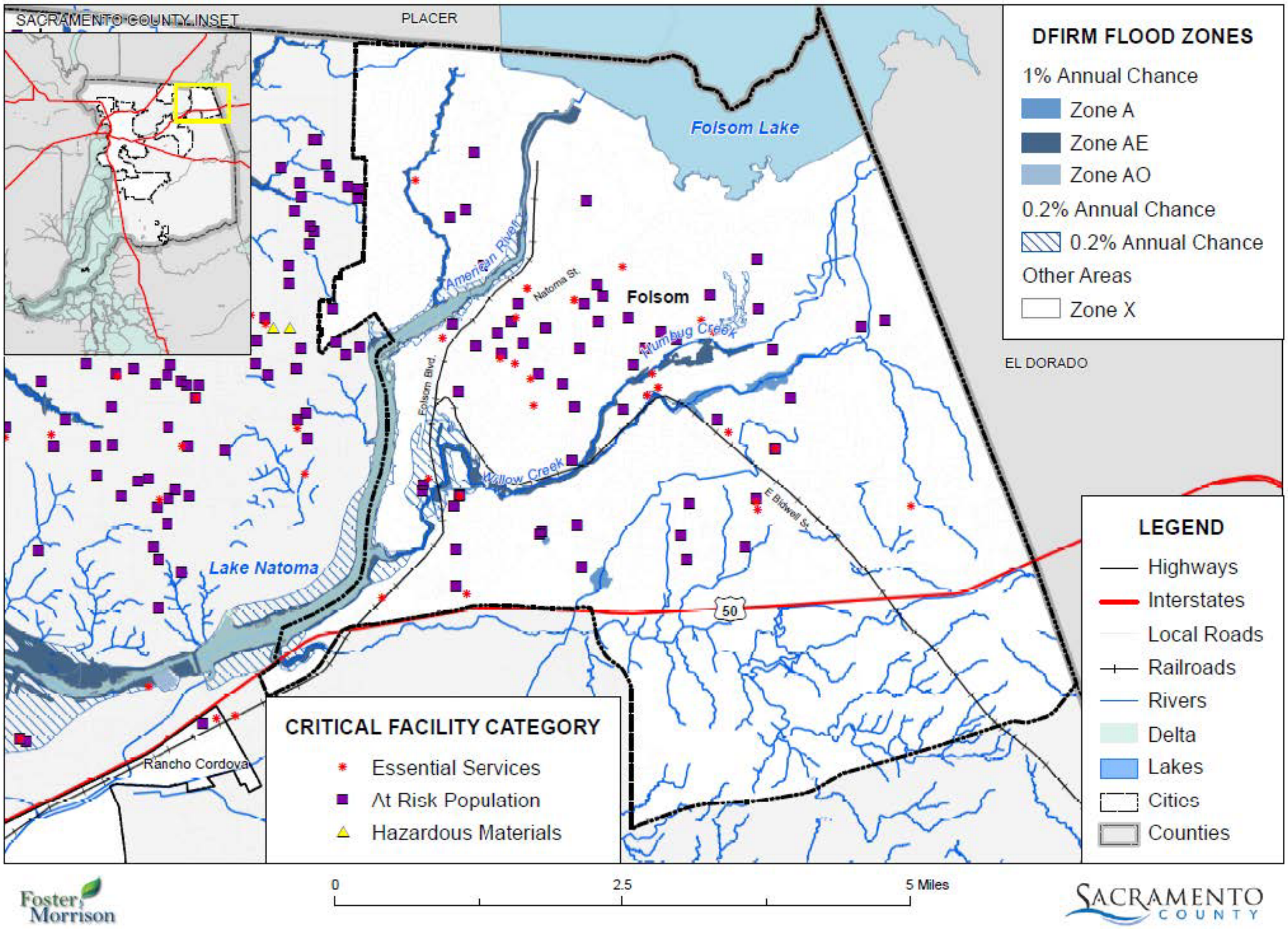
Note: Temperatures recorded at Western Regional Climate Center, Federal Aviation Administration Sacramento Executive Airport Station.

Source: Sacramento County 2017, NOAA 2020

Flooding

The city is traversed by several smaller waterways which generally run northeast to southwest through the city. Larger waterways include the American River, which runs through the northern portion of the city and along the southwest boundary of the city, as well as Humbug Creek and Willow Creek, which run into the American River at the southwest boundary of the city. These waterways are at risk from both riverine flooding and localized stormwater flood events. As shown in Figure D-2, the areas immediately surrounding Humbug Creek, Willow Creek, and the American River are located in the Federal Emergency Management Agency 100- or 500-year floodplain. Historically, the Sacramento region has been subject to several large flooding events including more recent events in 1995 and 2016/2017. According to analysis conducted in the City's LHMP Annex, there is a total population of 216 residents with dwelling units located in the 100-year floodplain and 198 residents located in the 500-year floodplain. Critical facilities that provide critical services during emergency events such as fire stations, police stations, and government facilities as well the location of vulnerable populations such as day care centers, schools, and elderly care facilities are all identified in the City's LHMP annex. The city does not have any critical facilities located in the 100-year floodplain and includes 5 critical facilities located in the 500-year floodplain. These facilities include the Children's Creative Learning Center, the Inn at Lake Natoma, the Folsom Crescent School, the Glenn Regional Transit Light Rail Stop, and the Folsom Sierra Endoscopy Center. Located adjacent to the Folsom Dam, the city is also at risk to impacts from dam inundation. Approximately 40,000 residents are at risk from dam inundation, in which mass evacuations of larger portions would be required. The City, in conjunction with FEMA, has recently completed updated hydrology and hydraulic analysis as well as updated flood mapping for Humbug Creek, Willow Creek, Hinkle Creek and Alder Creek and are expected to be published in Fall of 2021. However, as of the publishing of this report, these maps have not been published.

FIGURE D-2: CRITICAL FACILITIES AND FLOOD ZONES IN THE CITY OF FOLSOM



Source: Sacramento County 2017b

Drought

As noted in the City's LHMP Annex, drought is unique in its characteristics compared to other natural hazards in that it is not a distinct event and more characteristically has a slow onset and can last for several years. The City relies primarily on Folsom Lake, located directly north of city, for its potable water supply. Folsom Lake receives and controls water supplies within the American River watershed, an area of approximately 1,875 square miles to the north and east of the reservoir. While the city does not typically use their total apportioned annual water supply, drought scenarios, when they do occur, can affect both the city and the larger Sacramento region. From 2012 to 2015, the city experienced a prolonged drought period along with majority of communities in California. During this period, Folsom Lake reached historic low water levels. As noted in the City's LHMP Annex, the City has achieved significant reductions in water consumption in recent years due to State conservation mandates, more efficient plumbing standards, water system optimization improvements including repairs, improvements and replacements of existing water transmission and distribution facilities. As the city's population continues to grow, water demand will increase and could exacerbate future drought conditions when they do occur.

CLIMATE CHANGE EFFECTS

Climate change effects are categorized as primary (direct) and secondary (indirect). Primary effects are those that are caused by the initial impacts of increased GHG emissions, from which secondary effects result. The primary climate change effects analyzed for the city include changes in average annual temperature and precipitation. The secondary effects, which can occur because of individual changes or a combination of changes in the primary effects, include wildfire, extreme heat, extreme precipitation and flooding, and drought regimes, as well as reduced snowpack.

Though the precise extent of future climate change effects is uncertain, historical climate data and forecasted GHG emissions can be used to project climate change effects through near-term (2021-2050), midterm (2035-2064), and long-term (2070-2099) timescales. The time periods are established as 30-year time intervals to gather accurate data on average changes in the climate, which is typically measured over 30-year time periods or longer. This results in overlap among some time periods. Due to annual fluctuations in climate variables, climate data on shorter time periods may be less accurate and not reflect long-term averages (NOAA 2018). To assess potential effects from climate change, the APG recommends using Cal-Adapt, a tool developed by the CEC and the University of California, Berkeley Geospatial Innovation Facility that uses global climate simulation model data to identify how climate change might affect various geographies in California. Cal-Adapt addresses the uncertainty in future GHG emissions by using Representative Concentration Pathways (RCPs) developed by the Intergovernmental Panel on Climate Change (IPCC). These RCPs depict two different future emissions scenarios. RCP 4.5 represents a lower emissions scenario in which GHG emissions continue to rise through 2040 and then decrease to below 1990 levels by the end of the century. RCP 8.5 represents a high emissions scenario, or business-as-usual (BAU) scenario, where GHG emissions continue to increase through the end of the century. As recommended by the APG, this vulnerability assessment evaluates near-term and midterm climate change effects and their associated impacts under the high emissions scenario, as this takes a conservative approach and assumes worst-case scenario. Additionally, changes in climate variables during these timescales are similar under both the low and high emissions scenarios. Because long-term global GHG emissions trends are less certain and climate impacts vary more considerably between scenarios, a discussion of both the low and high emissions scenarios is included for the long-term timescale (OPR, CEC, and CNRA 2018a).

Cal-Adapt downscales global climate models to local and regional resolutions using the Localized Constructed Analogs statistical technique. Four of the models included have been selected by California's Climate Action Team Research Working Group as priority models for research contributing to the Climate Assessment. To analyze climate projections for the city, the average of the downscaled data provided by these four models was used. The boundaries of the study area for this analysis are the geographic boundaries of the city.

Primary Climate Change Effects

Increased Temperatures

According to Cal-Adapt, the historic (1961-1990) average annual maximum temperature for the city is 74.2°F, and the historic average annual minimum temperature is 49.1°F. As shown in Table 2, both are projected to increase throughout the century. The average annual maximum temperature in the city is projected to increase to 78.4°F in the near-term and 79.3°F in the midterm under the high emissions scenario. The average annual maximum temperature is projected to increase to 79.5°F and 82.9°F in the long-term under the low and high emissions scenarios, respectively. The average annual minimum temperature in the city is projected to increase to 52.9°F in the near-term and 53.7°F in the midterm under the high emissions scenario, and the long-term average annual minimum temperature is projected to increase to 53.8°F and 53.8°F under the low and high emissions scenarios, respectively (CEC 2021a). Increased temperatures in the city will influence secondary climate effects, including extreme heat events and wildfire risk.

Table 2: Changes in Average Annual Temperature in the City of Folsom					
Average Annual Temperature (°F)	**Historic Average Annual Temperature (1961-1990)**	**Near-Term (2021-2050)**	**Midterm (2035-2064)**	**Long-Term (2070-2099)**	
				Low Emissions	**High Emissions**
Maximum Temperature	74.2	78.4	79.3	80.3	83.3
Minimum Temperature	49.1	52.9	53.7	54.4	57.8

Notes: °F = degrees Fahrenheit.

Source: CEC 2021a.

Changes in Precipitation Patterns

As shown in Table 3, the historic average annual precipitation in the city is 23.4 inches. The average annual precipitation in the city is projected increase to 25.3 inches in the near-term and 25.6 inches in the midterm under the high emissions scenario. Average annual precipitation is projected to be 25.1 inches under the low emissions scenario and 27.1 inches under the high emissions scenario in the long-term (CEC 2021a).

Table 3: Changes in Average Annual Precipitation in the City of Folsom					
Average Annual Precipitation	**Historic Average Annual Precipitation (1961-1990)**	**Near-Term High Emissions (2021-2050)**	**Midterm High Emissions (2035-2064)**	**Long-Term (2070-2099)**	
				Low Emissions	**High Emissions**
Average Annual Precipitation (inches)	23.4	25.3	25.6	25.1	27.1

Source: CEC 2021a.

While average annual precipitation in the city is projected to trend upward in future years, the key finding for this climate effect is that precipitation patterns are expected to become more volatile, with more intense storm events with increased precipitation over short periods. As noted in the Fourth Climate Change Assessment Sacramento Valley Report, although annual precipitation is anticipated to increase in the region, California's climate oscillates between extremely dry and extremely wet periods with annual precipitation varying widely from year to year. Climate change is anticipated to exacerbate these seasonal extremes with dry periods becoming dryer and wet periods becoming wetter (OPR, CEC, and CNRA 2018a). As a result, the frequency and severity of large storm events are anticipated to increase as well. These oscillations between extremely dry and extremely wet periods, which have occurred historically in the state, are anticipated to become more severe with rapid shifts from dry to wet periods known as "whiplash events" (Swain et al. 2016). Precipitation patterns will affect secondary climate effects including drought, extreme precipitation and flooding, and wildfire.

Secondary Climate Change Effects

Increased Wildfire Risk in the Sacramento Valley

Wildfire risk is determined by several factors, such as wind speeds, drought conditions, available wildfire fuel (i.e., dry vegetation), past wildfire suppression activity, and expanding wildland-urban interface (WUI) (i.e., the zone of transition between unoccupied land and human development) (Westerling 2018). Climate change effects, including increased temperatures and changes to precipitation patterns, will exacerbate many of the factors that contribute to wildfire risk. Increased variability in precipitation may lead to wetter winters and increased vegetative growth in the spring, and longer and hotter summer periods will lead to the drying of vegetative growth and ultimately result in a greater amount of fuel for fires. This has already been seen across the state in recent years, with the area burned by wildfires increasing in parallel with rising air temperatures (OEHHA 2018).

These factors, combined with intense wind conditions, cause fires to spread rapidly and irregularly, making it difficult to predict fires' paths and effectively deploy fire suppression forces.

Relative humidity is also an important fire-related weather factor; as humidity levels drop, the dry air causes vegetation moisture levels to decrease, which consequently increases the likelihood that plant material will ignite and burn. With an increase in hotter and drier landscapes, humidity levels may continue to drop and result in higher fuel levels, increasing the risk of wildfire (Schwartz et al., 2015).

Cal-Adapt provides projections for future annual mean hectares burned within the Sacramento Valley region, as defined in the California Fourth Assessment Report, when wildfires do occur. Because the city is not directly threatened by large-scale wildfires but is likely to be impacted by regional effects such as wildfire smoke, this analysis focuses on the Sacramento Valley region. As shown in Table 4, the total area burned annually by wildfire within the Sacramento Valley region is expected increase from the historic (1961-1990) annual average of 20,956 hectares to 23,942 hectares in the near-term and increase further in the midterm to 28,759 hectares. In the long-term, average annual area burned in the region is projected to increase to 31,670 hectares and to 41,784 hectares under the low and high emissions scenarios, respectively (CEC 2021b).

Table 4: Changes in Annual Average Area Burned in the Sacramento Valley Region

Average Annual Area Burned	Historic Modeled1 Average Annual Area Burned (1961-1990)	Near-Term (2021-2050)	Midterm (2035-2064)	Long-Term (2070-2099)	
				Low Emissions	High Emissions
Average Annual Area Burned (hectares)	20,956	23,942	28,759	31,670	41,784

[1] Observed historical average annual area burned data was not available from Cal-Adapt; the modeled historical average annual area burned data under the low emissions scenario was available and used as proxy data.

Source: CEC 2021b.

Increased Frequency of Extreme Heat Events

The Cal-Adapt tool provides estimates of future instances of extreme heat events. Extreme heat events include extreme heat days and heat waves. Cal-Adapt defines an extreme heat day as a day when the daily maximum temperature exceeds the 98th historical percentile of daily maximum temperatures based on observed data from 1961–1990 between April and October. Heat wave events are characterized as periods of sustained extreme heat and are defined by Cal-Adapt as four or more consecutive extreme heat days.

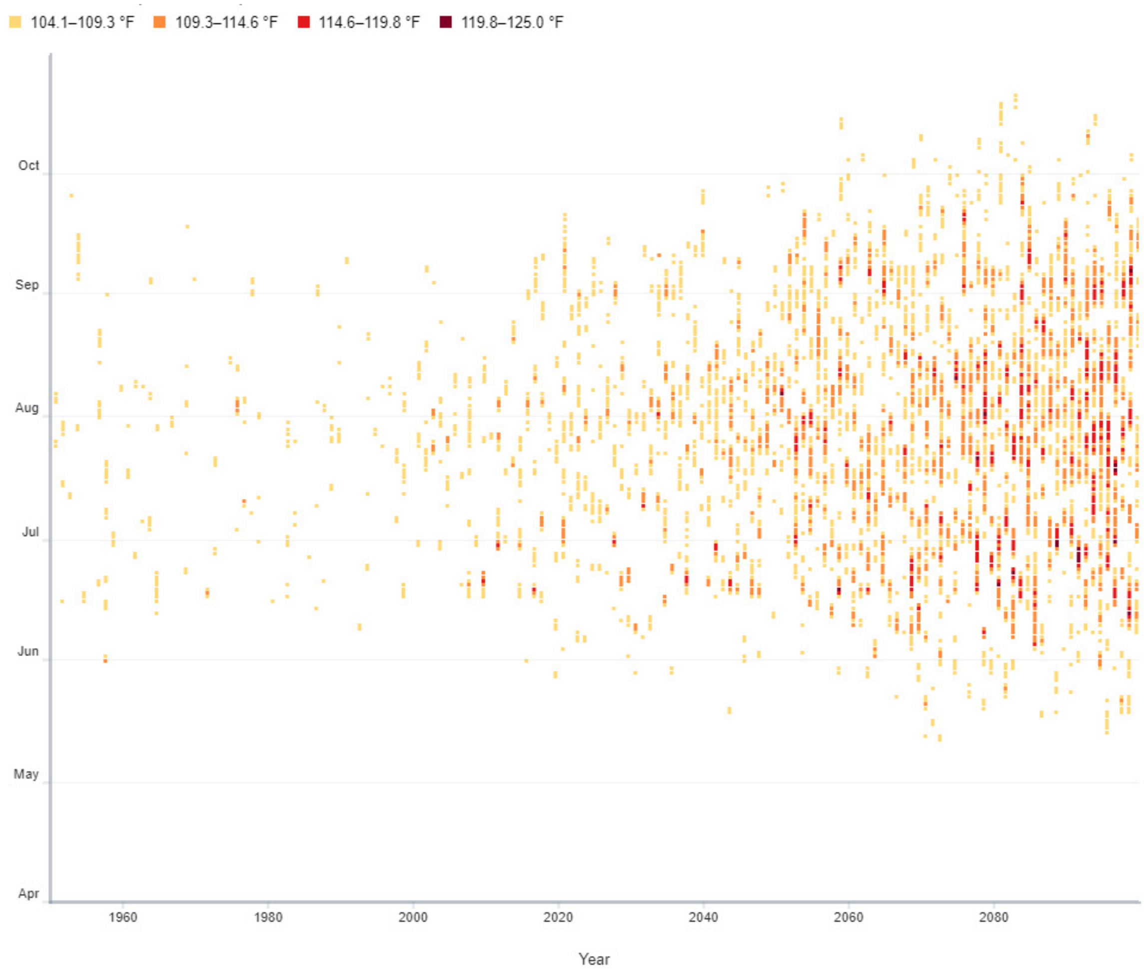
The extreme heat threshold for the city is 104.1°F, meaning 98 percent of all recorded temperatures in this period were below 104.1°F. Historically (1961-1990), the city experienced an average of four extreme heat days per year. As a result of rising temperatures from climate change, the city is projected to experience up to 21 extreme heats days annually in the near-term and 30 extreme heat days annually in the midterm under the high emissions scenario. In the long-term, the city is projected to experience up to 33 extreme heat days annually under the low emissions scenario and 52 extreme heat days annually under the high emissions scenario (CEC 2021c). As shown in Table 5 and Figure D-3, the number of extreme heat days is already increasing from historic averages and will continue to increase through the long-term.

Table 5: Changes in Extreme Heat Events in the City of Folsom					
Annual Averages	**Historic Annual Averages (1961-1990)**	**Near-Term High Emissions (2021-2050)**	**Midterm High Emissions (2035-2064)**	**Long-Term (2070-2099)**	
				Low Emissions	**High Emissions**
Number of Extreme Heat Days	4	21	30	33	52
Number of Heat Waves	0.2	3	4.6	5.1	9.2
Number of Days in Longest Stretch of Consecutive Extreme Heat Days	2.2	7.8	9.9	10.3	17.4

Notes: Extreme Heat Day = Annual maximum temperature above 104.1°F, Heat Wave = Four or more consecutive Extreme Heat Days.

Source: CEC 2021c.

FIGURE D-3: CHANGE IN ANNUAL EXTREME HEAT DAYS THROUGH 2099 – HIGH-EMISSIONS SCENARIO



Source: CEC 2021c.

While heat waves have historically been infrequent in the city, with a historical average of less than one heat wave annually, climate change is expected to increase the frequency of heat waves within the city. Under the high emissions scenario, the city is projected to experience an average of three heat waves per year in the near-term and 3.6 heatwaves per year in the midterm. The city is projected to experience approximately 5 heatwaves per year and 9 heat waves per year in the long-term under the low and high emissions scenarios, respectively.

The average number of days in the longest stretch of consecutive extreme heat days per year is also projected to increase substantially. Historically, the longest stretch of consecutive extreme heat days lasted for an average duration of approximately two-and-a-half days. The longest stretch of consecutive extreme heat days is projected to increase to an average of 7.8 days in the near-term and 9.9 days in the midterm under the high emissions scenario. In the long-term, the duration is projected to increase to an average of 10.3 days under the low emissions scenario and 17.4 days under the high emissions scenario (CEC 2021c). The timing of extreme days between April and October is also projected to shift with extreme heat days occurring earlier and later in this period rather than concentrated in late summer and early fall period. Figure D-3 displays the changes in timing of extreme heat days through 2099 under the high emissions scenario.

As temperatures continue to rise from climate change, the frequency, intensity, and duration of extreme heat days and heat waves will increase in the Sacramento Valley, which will increase risks to public health and safety. The health impacts associated with extreme heat, including heat stroke, heat exhaustion, and dehydration, as well as implications from cardiovascular and respiratory diseases, are particularly likely to be exacerbated by climate change (OPR, CEC, and CNRA 2018b; Sheridan et al. 2012).

Changes in Extreme Precipitation Events (100-year Storm Event)

Based on California's location next to the Pacific Ocean, the state is exposed to the atmospheric river (AR) phenomenon, a narrow corridor of concentrated moisture in the atmosphere. California is subject to precipitation from an AR that transports water vapor from as far south as Hawaii to the state. The presence of the AR contributes to the frequency of "wet years" in the state, when there is an above-average number of AR storms and above-average annual precipitation. While research indicates that the frequency of large storms events does increase in these wet years, the most severe flooding from ARs may not be in wet years (Swain et al. 2018). The largest flooding impacts are caused by persistent storm sequences on sub-seasonal timescales (i.e., short time periods, typically 2 weeks to 3 months), which bring a significant fraction of annual average precipitation over a brief period. These are storms events like the Great Flood events of 1861–1862 which caused widespread damage throughout northern California (Swain et al. 2016). Based on current climate modeling, the frequency of these large storm sequences over short timeframes is projected to increase noticeably under the RCP 8.5 scenario. It is estimated that a storm similar in magnitude to the Great Flood events is more likely than not to occur at least once between 2018 and 2060 (Swain et al. 2018). A storm of this size would likely compromise large portions of the flood control systems in the Sacramento and the Central Valleys (Swain et al. 2018).

As discussed in the Sacramento Valley Report, changes in precipitation patterns in northern California are anticipated to affect the Sacramento Valley region as well as adjacent regional watersheds which affect the Sacramento Valley (OPR et al. 2018b). Projected shifts include increases in the intensity of large storms events, which could compromise the performance of the Sacramento Valley and Central Valley flood management systems (Pierce et al. 2018). Given the city's proximity to the American River, it is important to understand how precipitation changes in regions affecting the American River and its tributaries may affect the city including Folsom Lake and Folsom Dam. The regional exposure analysis provides a snapshot of projected changes in precipitation in two key Integrated Regional Water Management (IRWM) regions, regional boundaries established by the California Department of Water Resources (DWR), that affect the American River. The two IRWM regions included in the analysis are listed in Table 6. Major waterways in these two IRWM regions include the Yuba River, Bear River, American River, and the Cosumnes River, as well as portions of their tributaries.

As shown in Table 6, under the low emissions scenario, annual precipitation in the two IRWM regions increases between 8 and 12 percent in the near-term period. During the midterm and long-term periods, the change in annual precipitation remain relatively the same with a 9 to 10 percent increase between the historic baseline and 2099 under the low emissions scenario. Under the high emissions scenario, annual precipitation in the two IRWM regions increases between 9 and 10 percent in the midterm period and continues to increase through the long-term period, resulting in an approximately 19 percent increase over historic levels by the end of the century. It is important to note that because the projected precipitation changes under the low and high emissions scenarios are relatively the same through the midterm period at the regional level, these changes will occur with a higher degree of likelihood, regardless of what trends occur in global emissions reductions by the end of the near-term period (2040).

Table 6: Regional Annual Precipitation Changes (Historic to 2099)

IRWM Region	Historic (1961–1990)	Emission Scenario	Change in Annual Mean Precipitation (Inches)					
			Near Term (2020–2050)	Percent Change (Historic to 2050)	Midterm (2040–2070)	Percent Change (Historic to 2070)	Long Term (2070–2099)	Percent Change (Historic to 2099)
Cosumnes, American, Bear, Yuba, Sacramento	51.5	Low	56.3	8%	56.2	9%	56.0	9%
		High	55.5	7%	56.2	9%	61.2	19%
American	20.6	Low	23.3	12%	22.7	10%	22.7	10%
		High	22.5	8%	22.6	10%	24.6	19%

Notes: IRWM = Integrated Regional Water Management.

Source: CEC 2021a

Droughts and Water Supply

The city and larger Sacramento region are expected to experience slight overall increases in average annual precipitation in the long-term. However, projections show the Sacramento region will experience increased variability and volatility in precipitation events, such as droughts. California has a highly variable climate that is susceptible to prolonged periods of drought, and recent research suggests that extended drought occurrence (a "mega-drought") could become more pervasive in future decades (CEC 2021d).

Cal-Adapt uses data to model an extended drought scenario for all of California from 2051 to 2070. For this analysis, the extended drought scenario is based on the average annual precipitation over 20 years under a high emissions scenario. This analysis includes an extended drought scenario for El Dorado County rather than just the boundaries of the City. As the City's primary water supply, Folsom Lake relies on precipitation and snowpack runoff from tributaries in the watersheds surrounding Folsom Lake including tributaries in El Dorado County (i.e., the north fork and south fork of the American River). El Dorado County's observed historical (1961-1990) average annual rainfall accumulation is 43.6 inches. Under the anticipated drought scenario between 2051 and 2070, El Dorado County's average annual rainfall accumulation would decrease to 37.9 inches (CEC 2021d). The city and the Sacramento region are predicted to experience extended drought periods due to climate change, which may result in stress on reliable local water supply. This effect will not only result in water shortages for the city, but also for other jurisdictions across the state that rely on water supply from the region.

The city's primary water supply consists of surface water from Folsom Lake that originates as rainfall and runoff from snowpack in the northern Sierra Nevada mountains and the surrounding foothills. Due to increases in climate variability and rising temperatures, the state has already seen signs of decreased snowmelt in Northern California. Annual snowpack in the Sierra Nevada is expected to decline by as much as 33 percent by mid-century and 66 percent by the end of the century, relative to historic baseline snowpack (OPR, CEC, and CRNA 2018b). Further, rising temperatures have caused snowpack to melt faster and earlier in the year. These changes in snowmelt timing and streamflow availability will challenge local and regional water supply availability (OPR, CEC, and CRNA 2018a). Inadequate rainfall and reduced snowpack will result in decreased runoff to the reservoirs that supply water to the city, which will lead to less available water and more frequent water shortages.

Sensitivity and Potential Impacts

The varying effects of climate change will impact the city and its residents differently, such that some population groups and physical assets will be affected more severely than others. Key populations and assets identified in the city are organized into the following overarching categories: populations, built environment, and community functions. These categories are described in more detail below.

The climate change effects analyzed in this section include increased temperatures and extreme heat, increased wildfire risk, increased extreme precipitation events and flooding, drought, water supply, and reduced snowpack. Climate change effects at the local scale are inherently uncertain, but the potential ways in which climate change could impact specific populations and community assets within the city are identified and discussed (CalEMA and CNRA 2012:23).

POPULATIONS

While all persons in the city are anticipated to experience impacts of climate change at some level, some populations are more vulnerable to climate impacts due to a variety of factors. Vulnerable populations are those that are more likely to be affected or impacted more severely to climate-related hazards when they do occur due to factors such as health challenges or disabilities, location, living or working conditions, income level, historical and/or current marginalization, and limited access to resources. These factors, among others, can lead to increased susceptibility to and disproportionate harm from climate change impacts and can impact the ability to recover from impacts.

Vulnerable populations in the city include individuals experiencing homelessness, individuals with disabilities, senior citizens, youth, low-income households, and residents experiencing linguistic isolation (i.e., non-English-speaking people). Though certain vulnerable populations represent only a small percentage of the city's total population, it is important to plan for all groups that, for one reason or another, lack available resources or capacity to react or adapt to climate change impacts themselves.

BUILT ENVIRONMENT

The built environment in the city consists of a set of buildings and infrastructure that are essential to the health and welfare of residents and visitors and are especially important during and proceeding climate-related hazard events. This includes residential and commercial buildings; critical facilities (i.e., hospitals and medical facilities, fire departments, emergency shelters, schools, senior centers); transportation infrastructure (i.e., roadways, bridges, rail lines); and utility infrastructure (i.e., energy, communications, and water and wastewater). Many of these assets are considered high-potential loss facilities and infrastructure, where damage would have large environmental, economic, or public safety consequences.

The resilience of the city's built environment to climate change is critically important to overall community resilience and well-being, as well as preventing cascading impacts from disasters. Coupled with increased use and aging infrastructure, infrastructure assets may be highly sensitive to climate-related hazards including extreme heat, wildfire, and extreme storms. These hazards may adversely affect the reliability, accessibility, and lifespan and maintenance costs of roads, facilities, utilities, and equipment. Maintaining and adapting infrastructure to reduce risks to climate-related impacts is crucial to emergency response and safety during hazard events.

COMMUNITY FUNCTIONS

Community functions are the resources and assets, operations, economic sectors, and services that are created or influenced by the interaction between populations and the built environment and allow day-to-day activities to continue in the city. The priority community functions that have been identified include tourism and recreation; transportation and mobility; ecological function; public health and emergency services; and energy delivery and other utility operations. Increases in the frequency and/or severity of climate-related hazards will cause environmental, economic, and social impacts across these community functions, which are crucial to the integrity and resilience of the city.

INCREASED TEMPERATURES AND EXTREME HEAT

Under the high emissions scenario, the average annual maximum temperature in the city is projected to rise approximately 4ºF in the near-term and 5ºF in the midterm. In the long-term, the average annual maximum temperature is projected to increase by approximately 5ºF or 7ºF under the low and high emissions scenarios, respectively. Increased temperatures will lead to secondary climate change impacts including increases in the frequency, intensity, and duration of extreme heat events and wildfires in the city. As discussed in the climate change effects exposure analysis, the average number of extreme heat days and heat waves are projected to increase substantially in the midterm and in the long-term, and the projected average annual area burned by wildfire is expected to increase in the near-term and continue to rise through the end of the century (CEC 2021c; CEC 2021b).

Populations

Higher frequency of extreme heat conditions can cause serious public health impacts, such as heat stroke and dehydration, as well as indirect effects such as worsened air quality from increased ozone formation and particulate matter generation (CalEMA and CNRA 2012:3).

As aging impairs muscle strength, coordination, cognitive ability, the immune system, and the regulation of body temperature, people aged 65 and older are especially vulnerable to the health-related impacts of extreme heat and are more likely to experience respiratory and/or cardiovascular health complications than younger individuals (OPR, CEC, and CNRA 2018a). The median age of city residents is over 40 years old, 11 years older than the statewide average, and approximately 10 percent of residents are over 65 years old (U.S. Census Bureau 2019a). Extreme heat events may also lead to stress on electricity transmission systems, resulting in system failure. Such events could result in additional health hazards for the elderly or other persons with disabilities who rely on power to sustain medical equipment/assistive technology use. Approximately 4 percent of individuals below the age of 65 in the city have a disability (U.S. Census Bureau 2019b). Similarly, children are also at elevated risk to heat-related climate hazards, particularly the risks posed by reduced air quality. Individuals experiencing homelessness in the city are particularly vulnerable to extreme heat due to a lack of adequate protection from the sun and access to air conditioning. Increased exposure to extreme heat may exacerbate the risks of heat-related hazards described above.

Built Environment

Rising temperatures and extended periods of extreme heat will result in impacts to buildings and facilities throughout the city. Increases in nighttime temperatures (i.e., average minimum temperatures) can have a large effect on facility cooling needs because buildings and houses are not able to cool down after high daytime temperatures. High temperatures also decrease the efficiency of power transmission lines, while demand for electricity simultaneously goes up as operation of air conditioners and cooling equipment increases. One of the major effects of climate change on the city's transportation system from extreme heat is the reduction in the overall lifespan of transportation infrastructure. Increased average temperatures and extreme heat on roadways and trails can result in the degradation of pavement. These effects can increase roadway hazards, such as potholes and roadway cracks, and lower the overall lifespan of roadway infrastructure (OPR, CEC, and CNRA 2018b).

Community Functions

As temperatures increase and heat waves occur more frequently, the city is likely to experience potential public health impacts and demand for emergency services. Impacts on the City's roadway network and degradation of roadways could result in increased traffic congestion and secondary impacts on the City including loss of productivity and potential impacts on businesses in the city. Heat wave events in the city will result in increased stress on the electricity grid which may lead to the increased frequency of brownouts or blackouts, causing disruptions to normal city functions and economic impacts on businesses. Extreme heat days and heat wave events may also limit opportunities for recreation opportunities at Folsom Lake and recreation areas with the city, resulting in secondary impacts on tourism-supporting businesses in the community. Finally, prolonged heat waves can also prevent barriers for individuals working outdoors, including construction workers, to complete work. The increased prevalence of heat wave events could result in impacts on timing and costs for large-scale infrastructure projects as well residential and nonresidential building construction.

INCREASED WILDFIRE RISK

Increased temperatures and changes in precipitation patterns associated with climate change will lead to reduced moisture content in vegetation and soils during dry years. These conditions are expected to increase the amount of area burned by wildfires that will occur predominantly outside of the city boundaries but may have secondary impacts on the city from wildfire smoke, disruptions to transportation behavior, or the increased prevalence of Public Safety Power Shutoffs (PSPS).

Populations

Although the city is not at risk from the direct impacts of wildfires, the city's location within the Sacramento Valley makes it susceptible to impacts of smoke from wildfires in the Sierra Nevada mountains and the coastal mountain ranges of northern California. Community public health factors that can increase the impacts of wildfire smoke include the prevalence of asthma in children and adults; chronic obstructive pulmonary disease; hypertension; diabetes; obesity; and percent of population 65 years of age and older. Additionally, socioeconomic characteristics such as poverty rates, educational achievement, and unemployment rates have all been linked to the increased prevalence of underlying health conditions including depression, obesity, hypertension, and diabetes, making populations in the city with these characteristics more vulnerable to wildfire smoke impacts (Kivimäki et al. 2020). Exposure to wildfire smoke, particularly exposure by vulnerable populations, can result in worsening of respiratory symptoms, increased rates of cardiorespiratory emergency visits, hospitalizations, and even death (Rappold et al. 2017). Increased annual average temperatures and the subsequent increase in the frequency and severity of wildfires in northern California are anticipated to result in impacts from wildfire smoke on the city's population and vulnerable populations in particular (OPR, CEC, and CNRA 2018b).

Specific populations including linguistically isolated households, senior citizens, and individuals with disabilities or those experiencing homelessness are particularly vulnerable during evacuation events, if wildfire evacuations were to occur in the city. Impacts affecting these populations include inability to access or receive and/or understand warning messages and evacuation notices, limited ability to evacuate due to lack of mobility, limited situational understanding from cognitive conditions, and reliance on medication or treatment devices. Wildfires in the larger Sacramento region can also result in secondary impacts affecting populations. A major consequence of wildfires is post-fire flooding and debris flow. The risk of floods and debris flows after fires increases due to vegetation loss and soil exposur These flows are a risk to life because they can occur with little warning and can exert great force on objects in their path.

Built Environment

Regional wildfires threaten energy generation and transmission infrastructure and have the capacity to damage facilities, create maintenance costs, and reduce transmission line efficiency (CAL FIRE 2020). Grid-supplied as well as locally generated electricity, which is the primary source of power for residences in the city, is provided by the Sacramento Municipal Utilities District (SMUD). Regional communications infrastructure can also be affected by wildfires, which is often located in remote locations, such as mountaintops, resulting in significant threat from wildfire. Regional wildfires may also generate impacts on transportation behavior in the city during emergency evacuation events. This could include potential route diversion and increases in traffic congestion due to road closures from wildfire impacts or post-wildfire runoff or landslide affected roadways. While fire causes relatively insignificant direct impact on roads and highways, cracking and degradation of pavement is not uncommon.

Community Functions

Due to a number of recent large-scale wildfires in Northern California caused by electricity infrastructure exposed to extreme heat and high-winds, utilities have begun to implement PSPS to avoid wildfire risk. PSPS events can result in communities experiencing no electricity for multiple days and prevent individuals from using prescribed medications and treatments that rely on electricity or refrigeration. PSPS events can also result in impacts to commerce and economic losses, particularly for businesses that rely on refrigeration such as grocery stores. Hazards such as landslides, wildfires, and flooding can also affect underground natural gas pipelines, exposing and/or damaging these pipelines. The damage resulting from climate change-related hazards on electricity and natural gas infrastructure can have a greater impact on disadvantaged populations, particularly communities that are low-income or individuals who have limited mobility or lack the financial means to make repairs to their property.

Major wildfires often result in the damage to transportation infrastructure and/or closure of roadways. Combined with reduced visibility from wildfire smoke, this leads to a disruption in normal transportation networks and accessibility. Congestion that starts during a mass evacuation can lead to additional traffic management problems, which can result in delays to emergency response, evacuation, and logistical support.

INCREASED EXTREME PRECIPITATION AND FLOODING

The average number of annual extreme precipitation events in the city and in the Sacramento Valley region are projected to increase. Additionally, variability and volatility in severe storms are expected to increase as a result of primary climate change effects (i.e., changes in temperature and precipitation regimes). Increases in the frequency and severity of flooding events when they do occur could have serious ramifications as the Sacramento Valley region is already relatively vulnerable to large-scale flooding events.

Populations

Increases in the magnitudes and frequency of flood events will adversely affect populations in the city through both direct impacts and several secondary hazards. Electrical equipment impacted by flood waters can result in fires, creating further threats to public safety. Hazardous materials can also get into floodways, causing health concerns and polluted water supplies. Although all residents and visitors of the city will be sensitive to severe storms and flooding, vulnerable population groups will likely face disproportionate negative impacts. In addition to lacking adequate shelter and protection form storm events, individuals experiencing homelessness may have limited access to warning messages and other pertinent information from the City or Sacramento County. Senior citizens and individuals with disabilities may face these challenges and are likely to have limited mobility and ability to react to and prepare for these events.

Built Environment

Increases in the magnitude and frequency of flood events pose significant risk to the city's buildings, critical facilities, transportation infrastructure, utility infrastructure, and essential services. Electrical infrastructure may be inundated, disrupting service to residences and critical facilities as well as further challenging public safety infrastructure such as traffic signals. Additionally, underground electrical infrastructure is considered more vulnerable to flooding as prolonged periods of inundations inhibit repairs.

Damage to transportation infrastructure from severe floods is likely to occur as well. Flood conditions, such as those cause by increased magnitude of peak stream flows in winter, may damage roads near perennial streams. Roads, bridges, and culverts are susceptible to increased runoff during storm events, especially following a wildfire, causing failures due to washouts, plugging, overtopping, stream diversion, and scour. Transportation infrastructure near streams and floodplains will be especially vulnerable.

Community Functions

Flooding may have economic impacts on businesses and public agency budgets in other ways. Increased direct and indirect costs associated with flood mitigation services, clean-up operations, and maintenance and replacement of damaged structures and infrastructure could put considerable strain on local and regional government budgets. If floods cause sustained closures of major roadways, access to major tourism and recreation destinations and activities in the city could be limited. Events such as these would interrupt business cycles and cause revenue loss for businesses and the City, affecting the City's ability to provide basic services to residents and visitors.

The potential for floods to damage roads creates considerable risk to emergency services. The need for emergency response may be required during or immediately after a significant flooding event, and this response could be inhibited by damaged roads. However, these impacts can also persist, especially if funding for maintenance and repair is limited. This risk may be exacerbated if floods result in electric power outages or other impacts to energy resources.

DROUGHT AND WATER SUPPLY

Increased average temperatures and a compressed rate of snowmelt in the northern Sierra Nevada region, along with inadequate precipitation during the typically rainy season, have previously affected surface water supplies for Folsom Lake and have had secondary impacts on the region and city's water supply. With high volatility in annual precipitation and snowpack projected to decline over 50 percent by the end of the century, the American River Basin is likely to experience less annual runoff into Folsom Reservoir.

Populations

In the event of a severe and sustained drought lasting multiple years, Folsom Lake's water supply could be severely affected and result in the need for increased water conservation efforts to be implemented by jurisdictions in the Sacramento region. City residents may be encouraged to reduce household water demand, which may limit certain activities such as landscape irrigation. Actions taken by the City in drought scenarios are included in the City's Urban Water Management Plan (UWMP) and discussed further in Section 1.6.2. A long-term drought scenario would likely not result in increased water costs for residents.

Built Environment

While increasingly frequent and prolonged droughts directly threaten residents of the city, the built environment will not experience substantial direct impacts associated with this climate-related hazard. However, these conditions have the potential to cause secondary impacts. Heavy rainfall or snowfall during drought conditions can cause intense flooding, debris flows, landslides, and mudslides, which pose risks to the city's built environment.

Community Functions

Droughts create cascading effects on community functions that may worsen in the future. The associated risks include adverse impacts on timber harvesting, reduction in native habitat and overall ecological function, increased forest fuels for wildfire, and economic consequences associated with decreases in tourism and recreation. More intense future droughts affecting the region could result in decreasing recreation opportunities on and surrounding Folsom Lake. Decreased recreation could have a direct impact on city business revenue from pass through visitors. Increased episodes of drought and increased water demand could result in water shortages for the region, endangering residents and ecological systems (e.g., flood control or sensitive habitat, recreational areas).

SUMMARY OF SENSITIVITY AND POTENTIAL IMPACTS

Based on guidance from the APG, potential impacts from each climate change effect are rated on a qualitative scale comprised of Low, Medium, and High ratings. A description of each qualitative rating for potential impacts is provided in Table 7.

Table 7: Potential Impact Scoring

Score	Potential Impact Scoring Description
Low	Impact is unlikely based on projected exposure; would result in minor consequences to public health, safety, and/or other metrics of concern.
Medium	Impact is somewhat likely based on projected exposure; would result in some consequences to public health, safety, and/or other metrics of concern.
High	Impact is highly likely based on projected exposure; would result in substantial consequences to public health, safety, and/or other metrics of concern.

Source: CalOES 2020.

The climate change effects anticipated to impact the city are ranked in Table 8 for a potential impact score. This evaluation is based on the exposure analysis and analysis of sensitivities and impacts throughout Section 2.2.

Table 8: Potential Impact Summary

Climate Change Effect	Potential Impact Rating
Increased Temperatures and Extreme Heat	High
Increased Extreme Precipitation and Flooding	High
Drought, Water Supply, and Reduced Snowpack	Medium
Increased Wildfire Risk	Medium

Source: Ascent Environmental 2021.

Adaptive Capacity

The third step in the vulnerability assessment process is to evaluate the adaptive capacity of the populations, built environment, and community functions to address the impacts of climate change. Adaptive capacity, analyzed in this section, refers to a community's current and future ability to address climate-related impacts. A review of the City's existing policies, plans, programs, and resources, as well as those from relevant regional and State agencies and organizations, provides an assessment of the City's current ability to reduce vulnerability to hazards and adapt to climate change over the long-term. However, these efforts do not comprehensively identify all of strategies and actions that will need to be implemented by the City and other agencies to adequately address the full scope and magnitude of potential climate change impacts. Climate change will increase the frequency and severity of climate-related hazards in the future, requiring updates to emergency response and land use planning, new policies and programs, and new strategic partnerships. The following section summarizes current State and regional planning efforts that address climate-related hazards.

EXISTING STATE AND REGIONAL PLANNING EFFORTS

California Department of Transportation

The Climate Change Branch in the California Department of Transportation (Caltrans) Division of Transportation Planning is responsible for overseeing the development, coordination, and implementation of climate change policies in all aspects of the Department's decision making. In 2013, Caltrans completed its first report intended to help reduce GHG emissions and adapt the State's transportation system to prepare for the impacts of climate change (Caltrans 2013), which includes a series of strategies to reduce the risk from various climate change impacts, including increasingly intense precipitation events.

Strategies outlined in the report include using vegetation to prevent erosion along roadways, assessing and resizing culverts to accommodate increased precipitation, coordinating with local jurisdictions regarding route closures as well as pursing individual projects included in the Caltrans District Vulnerability Assessments. In 2019, Caltrans completed the District 3 Vulnerability Assessment which provides an overview of potential climate impacts to the district's portion of the State Highway System. The District 3 Vulnerability Assessment is part of a larger adaptation process undertaken by Caltrans to assess risk to Caltrans assets in the district and prioritize adaptation strategies from various climate impacts. The District 3 Vulnerability Assessment includes projected climate change exposure from precipitation change, flooding, temperature change, wildfire, storm surge, and sea level rise.

Sacramento Area Council of Governments

The Sacramento Area Council of Governments (SACOG) is the Metropolitan Planning Organization (MPO) for the six-county Sacramento region including the 22 cities within El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties. SACOG develops the region's long-range transportation plan which guides transportation and land use planning in the region. In 2015, SACOG adopted the *Sacramento Region Transportation Climate Adaptation Plan* to address how potential climate change impacts affect the region's transportation infrastructure. The plan highlights key impacts from climate change that could occur on the Sacramento region's transportation system in the future as well as a guiding action plan for future adaptation planning and implementation.

Sacramento County and Sacramento Office of Emergency Services

Sacramento County completed a vulnerability assessment in 2015 that assessed the projected changes associated with climate change in the County (including the City of Folsom), including impacts from changes in precipitation patterns and increased flooding. The assessment highlighted the unique vulnerabilities of Sacramento County to climate change including projected increases in the frequency, intensity, and duration of extreme storm events as well as projected regional temperature increases leading to earlier and more rapid melting of the Sierra Nevada snowpack and subsequent increases in flow rate of surface waters in Sacramento County (Sacramento County 2017a).

The Sacramento County Office of Emergency Services (Sacramento OES) provides support and resources for emergency preparedness through its Sacramento Ready Program and operates the county's Emergency Alerts Notification System. Sacramento, Yolo, and Placer County residents can use the Citizen Opt-In portal to receive critical and time sensitive alerts regarding flooding, levee failures, severe weather, disaster events, unexpected road closures, missing persons, and evacuations of buildings or neighborhoods in specific geographic locations. Sacramento OES coordinates with police and fire departments in the incorporated cities in the County for emergency planning and response purposes. Sacramento OES also develops and updates planning documents including the County's *Evacuation Plan*, *Emergency Operations Plan*, *Mass Care and Shelter Plan,* and the County's LHMP. Sacramento County, along with the City, is currently in the process of updating the City's Local Hazard Mitigation Plan. The 2021 Local Hazard Mitigation plan is expected to be complete by September 2021 and will include a section specifically on climate change.

EXISTING LOCAL PLANNING EFFORTS

Emergency Operations Plan and Evacuation Route Plan

The EOP is designed to address the City's planned response to significant emergency situations. The EOP provides an overview of operational concepts relating to various emergencies to provide a system for the effective management of emergency situations through an emergency management organization and define the overall responsibilities for all agencies and individuals, public and private, having a role in emergency preparedness, response, recovery, and/or mitigation in the city. It facilitates coordination of planning efforts of the various emergency staff and service elements utilizing the National Incident Management System and the

Standardized Emergency Management System. The objective of this plan is to incorporate and coordinate all of the City's facilities and personnel into an efficient organization capable of responding to any emergency.

Appendix 1 of the EOP includes the City's Evacuation Plan, adopted in 2020, which provides guidance for the evacuation and movement of people during any disaster, or any type of major call/critical incident, that may be encountered in the city. As noted in the Evacuation Plan, the overall objectives of evacuation operations are:

- Expedite movement of persons from hazardous areas.
- Control evacuation traffic.
- Provide transportation for those without vehicles and for those with special needs (language barriers, physical/mental disability, elderly, etc.).
- Provide perimeter control and security for evacuated areas.
- Provide a controlled area from which evacuation will take place, and prevent entry by unauthorized persons.
- Maintain law and order in the evacuation area.

The Evacuation Plan includes analysis and detailed mapping to identify designated roadways for evacuation routes for neighborhoods, titled Evacuation Zones in the plan, throughout the city as well as the location and capacity for evacuation centers and shelters. As part of the EOP, the Evacuation Plan also includes emergency operations procedures for City personnel to follow during emergency evacuation events.

City of Folsom Community Wildfire Protection Plan

The City's CWPP (City of Folsom 2011) was developed in collaboration with the Folsom Fire Department, CAL FIRE, and U.S. Bureau of Reclamation. The Plan was developed to help the City and partner agencies protect human life and reduce the loss of property, critical infrastructure, and natural resources from the impacts of wildfires. The Plan includes an analysis of the wildfire risk experienced by the city and includes a priority set of actions to be taken by the City, residents, and business owners to reduce the severity of wildfire impacts. The main strategy themes included in the Plan include increasing collaboration between stakeholders and relevant agencies, reducing wildfire risk in the WUI, creating and maintaining defensible spaces for structures and properties, and coordinating evacuation protocols to implement when wildfires do occur.

City of Folsom Urban Water Management Plan

The City's UWMP, adopted in 2016, provides a framework for water planning to minimize the negative effects of potential water shortages and provides useful information to the public about the City and its water management programs. The UWMP is also a comprehensive water planning document which describes existing and future supply reliability, forecasts future demands, presents demand management progress, and identifies local and regional cooperative efforts to meet projected water use. Chapter 6 of the UWMP includes a Water Shortage Contingency Plan which includes protocols and strategies to help the City reduce overall water use in a long-term drought scenario. In May 2021, the City released the public draft version of the 2020 Urban Water Management Plan, which includes a new standalone more robust Water Shortage Contingency Plan to address water use in a long-term drought scenario including compliance and enforcement actions available to administer water demand reductions.

Adaptive Capacity Scoring

Based on a combination of the adaptation initiatives outlined in these documents and additional adaptive efforts that have been pursued, the City's adaptive capacity for each climate change effect can be rated Low, Medium, or High. High adaptive capacity indicates that sufficient measures are already in place to address the points of sensitivity and impacts associated with climate change, while a low rating indicates a community is unprepared and requires major changes to address hazards (CalEMA and CNRA 2012:26). Adaptive capacity ratings are described in Table 9.

Table 9: Adaptive Capacity Scoring

Score	Adaptive Capacity Scoring Description
Low	The community lacks capability to manage climate impact; major changes would be required.
Medium	The community has some capacity to manage climate impact; some changes would be required.
High	The community has high capacity to manage climate impact; minimal to no changes are required.

Source: CalOES 2020.

The following sections, organized by climate change effect, describe the current adaptive efforts that have been implemented to address climate-related hazards. These evaluations serve to analyze and ultimately score adaptive capacity related to each climate change effect.

ADAPTIVE CAPACITY BY HAZARD

Increased Temperatures and Extreme Heat

Adaptive Capacity Rating: Low

The City does not generate its own electricity and may not be in a position to protect vulnerable populations (aside from opening cooling centers) from the impacts that will be caused by rising temperatures and a drastic increase in the number of extreme heat events. As rising temperatures and extreme heat lead to more frequent electricity outages, the lack of backup power sources for residents and business will expose more residents to risk of health impacts associated with extreme heat. While the LHMP does include extreme heat as a hazard, relevant information is limited. Impacts associated with increases in temperatures and extreme heat events are the largest potential impact for the city. This means that although the City may be adequately prepared to address extreme heat events currently, the vulnerabilities faced by the city including impacts to youth, seniors, and homeless populations as well as impacts on energy demand and services are likely to exceed to City's current capacity.

For these reasons, the adaptive capacity ranking for increased temperatures and extreme heat is Low.

Increased Wildfire Risk

Adaptive Capacity Rating: High

The County, State and regional agencies, and other partners are implementing a diverse array of policies and programs that address the design of structures, fire safety, community preparedness, and emergency response, decreasing the city's overall vulnerability to the threat of wildfire. However, as the threat of wildfire increases both locally and regionally, the City, in coordination with federal, state, and local agencies, will need to continue to adapt to projected impacts from wildfire. While the city is at relatively low risk from direct wildfire impacts, the affects from regional wildfires on the city through secondary impacts such as wildfire smoke and regional transportation route disruptions will continue to affect the city. Because these impacts have been increasing in intensity and severity in recent years and are somewhat novel, the city will need to make minimal changes to expand its capacity to address these types of impacts.

For these reasons, the adaptive capacity associated with wildfire is high.

Increased Extreme Precipitation and Flooding

Adaptive Capacity Rating: Medium

The City has adequately assessed its flood risk through the LHMP and other planning documents. The City and stakeholders have developed, adopted, and enforced several policies and programs that will serve to mitigate impacts from increasingly frequent floods in the future. While the city's populations and assets are not severely threatened by floods as identified in the LHMP, the City, Sacramento County and other regional and local agencies can continue to implement policies and programs that reduce the risks associated with significant flooding events. As noted in Section 2.1.2, the risk of a large-scale storm event similar to the Great Flood events of 1861–1862 is more likely than not occur at least once by 2060. This means that although the City is adequately prepared to address flooding events currently, an event such as this would result in widescale impacts on the city and potentially affect Folsom Dam.

Therefore, the adaptive capacity associated with increased extreme precipitation and flooding is medium.

Drought and Water Supply

Adaptive Capacity Rating: Medium

The City understands that a reliable water supply is essential. The City's UWMP will assist in building resilience to future drought conditions. However, given the city's reliance on Folsom Lake as the primary water supply increases the vulnerability of regional drought impacts when they do occur. The city is still somewhat vulnerable to these climate-related hazards, particularly in terms of the economic and related impacts (irrigation of recreation fields, constraints on future housing development) of generally dryer conditions, interannual precipitation variability, and reduced snowpack. These climate change effects will pose risks to tourism-related businesses that rely on pass-by visitors to Folsom Lake and the surrounding recreation areas when long-term droughts do occur.

Based on the reasons stated above, the adaptive capacity ranking for drought, water supply, and reduced snowpack is medium.

SUMMARY OF ADAPTIVE CAPACITY

Like the sensitivity and potential impacts analysis, the adaptive capacity ratings of each climate change effect will help the City understand priority areas where there are gaps in preparing for and adapting to climate change. Table 10 summarizes the City's adaptive capacity regarding each climate change effect.

Table 10: Adaptive Capacity Summary

Climate Change Effect	Adaptive Capacity Rating
Increased Temperatures and Extreme Heat	Low
Increased Wildfire Risk	High
Increased Extreme Precipitation and Flooding	Medium
Drought, Water Supply, and Reduced Snowpack	Medium

Source: Ascent Environmental 2021.

Vulnerability Scoring

The final step in the vulnerability assessment is to characterize the vulnerability to each climate change effect. The city's vulnerability to each identified impact is assessed based on the magnitude of risk to and potential impacts on populations, the built environment, and community functions while considering the current adaptive capacity in place to mitigate for these impacts. Based on the ratings of potential impacts and adaptive capacity, an overall vulnerability score can be determined for each climate change effect. This scoring can help the City understand which effects pose the greatest threats and should be prioritized in future planning efforts. Table 11 presents the rubric used to determine overall vulnerability scores based on the ratings for potential impacts and adaptive capacity.

Table 11: Potential Impact Summary

Vulnerability Score				
Adaptive Capacity	Low	3	4	5
	Medium	2	3	4
	High	1	2	3
		Low	Medium	High
		Potential Impacts		

Source: CalOES 2020; adapted by Ascent Environmental in 2021.

Vulnerability scoring for each climate change effect identified and evaluated in Sections 1.5.4 through 1.5.7 is included in Table 12 below. The table shows that increased temperatures and extreme heat is assigned a vulnerability rating of 5 and therefore should be a high priority for the City. Impacts from increased precipitation and flooding as well as water supply are both assigned a vulnerability score of 3. These climate change effects are likely to have significant impacts on the city's populations, built environment, and community functions in the near-term, and although a variety of adaptive efforts related to both climate change effects are in place and underway, the magnitude of the risks posed by these hazards contributes to high vulnerability in the city. Increased wildfire risk is characterized as having a vulnerability rating of 2. This climate change effect will likely have lower priority impacts on the city and is currently being addressed adequately based on existing conditions, but additional adaptation and resilience planning will be required in the future to mitigate impacts and protect the city.

Table 12: Vulnerability Scoring Summary

Climate Change Effect	Vulnerability Score		
	Adaptive Capacity	Potential Impact	Vulnerability
Increased Temperatures and Extreme Heat	Low	High	5
Increased Extreme Precipitation and Flooding	Medium	High	4
Drought and Water Supply	Medium	Medium	3
Increased Wildfire Risk	High	Medium	2

Source: CalOES 2020; adapted by Ascent Environmental in 2021.

Conclusion

The City, regional and State agencies, and other stakeholder groups have already implemented a variety of initiatives to address climate change in the city through existing policies, programs, and actions. As climate change continues to exacerbate risks and impacts from heat waves, wildfires, flooding, and drought, it is critical that the City continues to develop and implement adaptation strategies to plan for and mitigate these risks. This includes but is not limited to an update to the City's Safety and Noise Element to address and prepare for the impacts of climate change.

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