VULNERABILITY ASSESSMENT: RESILIENCY, CLIMATE ADAPTATION, AND WILDFIRE

September 28, 2021

Introduction

Climate change is a long-term shift in average weather patterns that are typical in local, regional, and global climates. Climate adaption is the process of adjusting to climate change in order to moderate its potential impacts. This Vulnerability Assessment addresses climate-related issues by addressing wildfire, local resiliency, and adaptive issues.

The greenhouse gas (GHG) emissions we generate are the leading cause of climate change. The level of gases in our atmosphere has soared since the beginning of the 21st century. The burning of fossil fuels—coal, oil, and gas—for electricity, heat, and transportation is the primary source of human-generated emissions. These activities have had a broad range of observed effects that have made weather patterns less predictable. Climate change has been linked to more frequent and more intense weather events such as hurricanes, floods, winter storms, and heatwaves. Curbing dangerous climate change requires very deep cuts in emissions and implementing climate adaptation strategies.

California law requires that a General Plan's safety element be reviewed and updated, as necessary, to address climate adaptation and resiliency strategies applicable to that city or county. This requires preparing a vulnerability assessment identifying the risks that climate change poses to the local geographic areas at risk from climate change impacts. The vulnerability assessment follows the process outlined in the California Adaptation Planning Guide 2.0 (released in 2020) and is composed of the following four steps:

1. **Exposure:** Provides an overview of existing hazards within the city and how these hazards will change because of climate change. Climate projection data from the Cal-Adapt[1] tool are used to understand how these changes will occur by mid-and late-century.
2. **Sensitivity and Potential Impacts:** Discusses the potential impacts climate change will have on various populations and critical assets.
3. **Adaptive Capacity:** Assesses the City of Monrovia's and partner agencies' ability to cope with climate impacts. This is determined by a review of existing plans, policies, and programs.
4. **Vulnerability Scoring:** Scores potential impacts and adaptive capacity for reach population and asset at risk for each climate change-related effect identified in Step 2.

The information gathered from the vulnerability assessment is then used to develop a set of goals, policies, and objectives for climate adaptation. However, compliance with State laws is only part of the picture. Responding to the potential impacts of climate change is critical to assuring the city remains prepared to address a range of potential impacts including extreme heat days, severe rainstorms, possible droughts, and wildfires.

Exposure

The Vulnerability Assessment Exposure provides an overview of communities' risk to projected climate hazards to understand what the potential impacts might be.

[1] The Cal-Adapt tool is a publicly available tool that provides data and insights on how climate change might affect California at the local level. The tool was developed by UC Berkeley's Geospatial Innovation Facility and utilizes data gathered from California's scientific community. This assessment utilizes data accessed from the Cal-Adapt website in May 2021.

Direct changes to the local climate include average temperature and annual precipitation, which can be categorized as primary impacts. Secondary impacts are those associated with these direct changes such as heatwaves, intense rainstorms, landslides, droughts, and wildfires. As part of this vulnerability assessment, it is necessary to understand the following:

- Past major natural hazard events
- Differences between current conditions and those projected for the middle and end of the 21st century
- The pace at which these changes are projected to occur
- The scale of the area that these changes are projected to occur

The data used to understand the points listed above are sourced from the State's Cal-Adapt[2] tool and the City of Monrovia's 2017 Local Hazard Mitigation Plan (LHMP).

Past Major Natural Hazard Events

Previous major climate-related events dating back to 1980 have included fires and landslides. Table 1 summarizes the major fire events dating from 1980 to 2020.

Table 1: Major Historic Natural Hazard Events in Monrovia and Nearby Communities

Event	Data	Location	Damages
Stable Fire	November 1980	Bradbury	57 structures destroyed.
Curve Fire	September 2002	Azusa Canyon	72 structures destroyed.
Station Fire	August 2009	Angeles National Forest, La Cañada-Flintridge	209 structures destroyed; 2 fatalities
Madison Fire 170 acres	April 2013		No structures lost.
San Gabriel Complex (Fish & Reservoir) Fire 5,399 acres	June/July 2016	Azusa Canyon	No structures lost.
Ranch Fire (also known as Mountain Cove fire)	August 2020	Azusa Canyon	4,237 acres No structures lost.
Bobcat Fire	September 2020	Angeles National Forest, from north of Monrovia to Juniper Hills	170 structures destroyed.

Source: Los Angeles Almanac, Wildfires in Los Angeles County, 2021.
City of Monrovia, Local Hazard Mitigation Plan, 2017.

[2] Cal-Adapt Tool accessed May 2021.

Projected Climate Change Effects

Each tool in Cal-Adapt uses two greenhouse gas and climate scenarios in California's 4th Climate Assessment. The two scenarios are called Representative Concentration Pathways (RCPs):

- **RCP 4.5.** A "medium" emissions scenario that models a future where greenhouse gas emissions (GHG) peak around 2040 and then decline to lower than 1990 levels by the end of the century. This moderate scenario assumes that society will make significant strides in the reduction of greenhouse gas emissions.

- **RCP 8.5.** A "business as usual" scenario where emissions continue to rise strongly through 2050 and plateau around 2100.

This assessment uses data modeled for both the RCP 4.5 and RCP 8.5 scenarios. While the best available data is used in these models, climate change projections involve inherent uncertainty. This uncertainty is largely derived from the fact that climate projections depend on future greenhouse gas emission scenarios and that different climate change models result in differing outcomes or impacts. The different scenarios also indicate the level of risk involved when developing climate adaptation strategies. The medium emissions scenario would require less aggressive strategies due to progress towards emissions reduction and the business-as-usual scenario would require more aggressive strategies due to a continuance in rising emissions.

These projections can be compared to the modeled historical baseline from 1961-1990 as provided by Cal-Adapt. A *modeled* historical baseline is used rather than observed historical data to provide an apples-to-apples comparison to the *modeled* RCP scenarios. Cal-Adapt uses the historical period of 1961-1990 since GHG emissions began accelerating in the middle of the 20th century and the tool uses data from National Oceanic and Atmospheric Administration's (NOAA) Annual Greenhouse Gas Index (AGGI). The AGGI compares GHG emissions each year to their influence in 1990, which is the year that countries that signed the U.N. Kyoto Protocol agreed to use as a benchmark for their efforts to reduce emissions.

Changes in Annual Precipitation

California's climate varies between wet and dry years. Research suggests that for much of the state, wet years will become wetter and the dry years will become drier. While California does not see the average annual precipitation changing significantly in the next 50-75 years, precipitation will likely be delivered in more intense storms and within a shorter wet season. The modeled historical baseline for annual precipitation in Monrovia ranges between 23.0 - 28.8 inches. Table 2 summarizes the changes in annual precipitation under each of the emissions scenarios.

Table 2: Projected changes in annual precipitation

	Change from baseline	30-year average	30-year Range
Baseline (1961-1990)			
Modeled historical	-	26.3 inches	23.0 - 28.8 inches
Mid-Century (2035-2064)			
Medium Emissions	-0.9 inches	25.4 inches	19.4 - 33.7 inches
High Emissions	-0.7 inches	25.6 inches	19.5 - 34.2 inches
End-Century (2070-2099)			
Medium Emissions	-0.2 inches	26.1 inches	19.0 - 31.5 inches
High Emissions	-0.7 inches	25.6 inches	16.6 - 37.0 inches

Monrovia could expect to see very dry or wet years. Exceptionally dry years could lead to drought conditions and wet years could lead to more significant landslide or flooding events.

Increased Temperatures

Overall temperatures are projected to rise in California during the 21st century. In Monrovia, the historical annual average maximum temperature ranges from 76.3 - 77.1°F, with an average of 76.7°F. Extreme heat days, which are days when the daily maximum temperature is above the threshold temperature of 99.1°F, have a historical average of four days. Tables 3 and 4 summarize the changes in annual average temperatures and extreme heat days under each of the emissions scenarios.

Table 3: Projected changes in average maximum temperature

	Change from baseline	30-year average	30-year Range
Baseline (1961-1990)			
Modeled historical	-	76.7 °F	76.3 - 77.1 °F
Mid-Century (2035-2064)			
Medium Emissions	+4.6 °F	81.3 °F	78.9 - 83.8 °F
High Emissions	+5.5 °F	82.2 °F	79.7 - 84.3 °F
End-Century (2070-2099)			
Medium Emissions	+5.7 °F	82.4 °F	80.3 - 85.4 °F
High Emissions	+8.9 °F	85.6 °F	82.7 - 89.3 °F

Table 4: Projected changes in extreme heat days

	Change from baseline	30-year average	30-year Range
Baseline (1961-1990)			
Modeled historical	-	4 days	3 - 5 days
Mid-Century (2035-2064)			
Medium Emissions	+17 days	21 days	13 - 46 days
High Emissions	+22 days	26 days	17 - 51 days
End-Century (2070-2099)			
Medium Emissions	+23 days	27 days	18 - 64 days
High Emissions	+46 days	50 days	34 - 99 days

These significant increases in temperatures can have dangerous impacts, such as more frequent and prolonged heatwaves, wildfires, and droughts.

Wildfires

Heatwaves combined with drought and Santa Ana wind conditions can increase the likelihood and severity of wildfires. Monrovia is particularly susceptible to wildfire as it is located in the foothills, which are areas that are generally covered with dry and dense vegetation. Fire records maintained by the Los Angeles County Fire Department indicate that large portions of the San Gabriel Mountain's foothill area have been subject to wildland fires of 100 to 500 acres. The major fire threat exists in the steeper slopes of the San Gabriel Mountains to the north and their potential to sweep into the hillsides and residential foothill developments. The Bobcat and Station fires, which have occurred in the past decade and have been recorded as some of the largest wildfires in California history, attest to the extensive damage that can take place from wildfires.

Where and how wildfire activity will occur is difficult to project due to the uncertainty of influencing factors, such as development patterns and pest infestations. However, the Cal-Adapt tool does provide a high-level assessment of the likeliness of an increase in wildfire activity. The tool uses a statistical model based on historical data of climate, vegetation, population density, and fire history. The table below summarizes these projections retrieved from the Cal-Adapt tool in September 2021.

Table 5: Projected wildfire activity

	Change from baseline	30-year average	30-year Range
Baseline (1961-1990)			
Medium Emissions	-	308.3 acres	299.9 – 313.7 acres
High Emissions	-	297.7 acres	288.7 – 306.2 acres
Mid-Century (2035-2064)			
Medium Emissions	+63.3 acres	371.6 acres	328.9 – 392.2 acres
High Emissions	+100.3 acres	398.0 acres	371.6 – 419.8 acres
End-Century (2070-2099)			
Medium Emissions	+88.1 acres	396.4 acres	367.7 - 425.5 acres
High Emissions	+116.1 acres	413.8 acres	380.0 - 440.0 acres

Droughts

Drought is characterized as a period of unusually persistent dry weather that continues long enough to cause serious problems such as regional water supply shortages. One dry year does not normally constitute a drought in California but serves as a reminder of the need to plan for droughts. Drought is a gradual phenomenon that occurs slowly over a multi-year period. Research suggests that extended drought occurrences could become more pervasive in future decades. The modeled historical baseline shows that the maximum length of a dry spell ranges from 112 - 135 days in Monrovia. These are expected to increase by seven to fifteen days by the middle and end of the century (see Table 6).

Table 6: Projected maximum lengths of dry spell period

	Change from baseline	30-year average	30-year Range
Baseline (1961-1990)			
Modeled Historical	-	124 days	112 - 135 days
Mid-Century (2035-2064)			
Medium Emissions	+7 days	131 days	108 - 154 days
High Emissions	+8 days	132 days	106 - 155 days
End-Century (2070-2099)			
Medium Emissions	+7 days	131 days	114 - 150 days
High Emissions	+15 days	139 days	100 - 175 days

Sensitivity and Potential Climate Change Impacts

Climate change effects will impact some population groups and assets more severely than others. The sections below identify what key populations and assets are likely to be more sensitive to the impacts of climate change-related effects.

Heatwaves

Severe heatwaves can affect sensitive populations such as elderly residents, lower-income populations who cannot afford air conditioning systems or potential price surges for water and electricity, and homeless individuals without access to cooling centers. These weather events can cause severe symptoms, such as heat exhaustion, heat stroke, and severe dehydration, and sometimes even death. People with chronic diseases are at greater risk of complications and death during a heatwave. Those with disabilities could also face difficulty accessing resources to stay cool and hydrated.

Extreme heat events can put a strain on the electrical supply, transmission, and distribution systems, which in turn increase the risk of very costly and disruptive blackouts. Disruptions to the power grid will almost always result in disruptions in one or more other infrastructures, especially in urban systems, triggering serious cross-sector cascading infrastructure system failures in some locations, at least for short periods. Though a widespread and prolonged power failure has not affected Monrovia, the potential damage because of one would negatively impact services provided to residents and businesses, the function of City government, and the residents' quality of life. Small power outages may impact these; however, the community is prepared to respond and maintain if there is fuel for generators, infrastructure in place to protect vital services, and people who can implement emergency power plans.

Water supply can also become overburdened during extreme heat events due to increased demand and reductions in the natural replenishments of local water storage facilities. A warming climate reduces the Sierra snowpack and causes an earlier spring runoff, which could result in reduced water storage capacity. Additionally, California regularly experiences drought conditions that impact local water supplies. Monrovia receives its water supply from the Main San Gabriel Basin and has seen historic lows due to the most recent 5-year drought that began in 2011. Despite near-average rainfall between 2019-2020, local stormwater capture and recharge was only 78% of the average.[3] The exceptionally dry ground has been absorbing stormwater runoff instead of flowing into local storage facilities. However, water conservation and management strategies have been improving water supply. Water use has decreased by 30% since 2006, which has helped stave off water shortages.

Safety Element Considerations

The following are issues that should be addressed in the Safety Element:

- **Strain on utilities.** As mentioned, extreme heat events cause an increased demand for water and power. The City should ensure there are policies in place to be able to effectively manage electrical supply to mitigate any potential blackouts and impacts to critical infrastructure. Incorporating water conservation and management policies is also critical to minimizing strains on the water supply system.
- **Access to cooling centers and devices**. The City of Monrovia has a few programs in place to ensure vulnerable residents have access to safe places during a heatwave event. The City should consider incorporating this type of policy into the Safety Element.

[3] Main San Gabriel Basin Water Master, 2019-2020 Annual Report, 2020.

- **Heat reduction**. The City should consider zoning code and building design strategies to reduce the heat island effect. These could be in the form of green or cool roofs, cool pavements, tree canopy, etc.

Wildfires

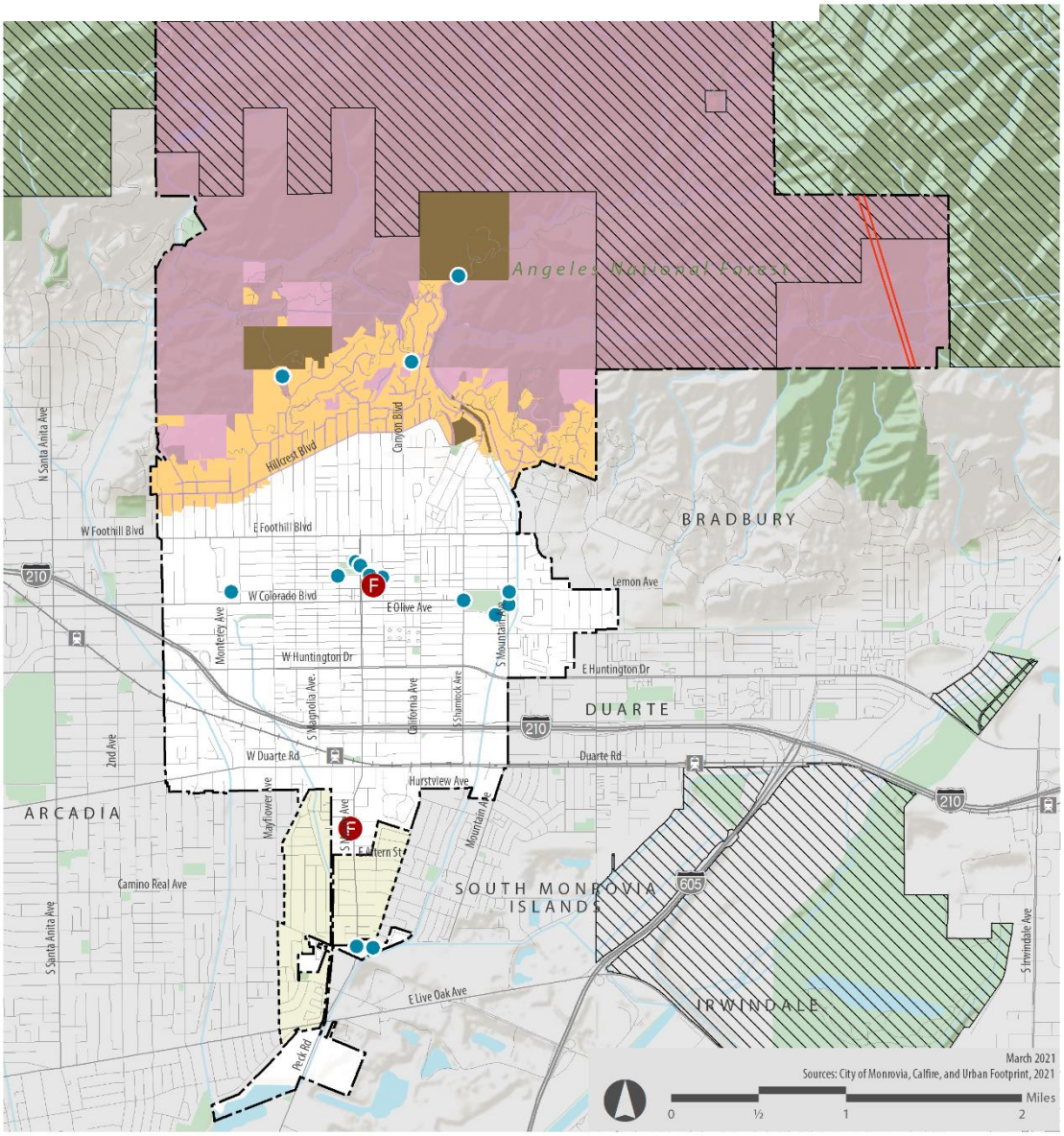
Monrovia has been listed by CalFire as a "Community at risk from Wildfire." The extensive wildland interface with the United States Department of Agriculture forest land at its northern border makes the City susceptible to the effects of any fire that originates in the northern reaches. The greatest fire danger to Monrovia is from Wild Land Urban Interface (WUI), where homes are in close proximity to the 30-50 year brush growth.

Wildfires also place stress on other critical assets within the city. Roadways are at risk of physical damage and/or closure, which could impact the effectiveness of evacuation routes and emergency service access. In Monrovia, evacuation routes are concentrated in the northern part of the City, which could cause traffic congestion and emergency response issues. Water supply is a vulnerable asset as there is likely to be an increase in demand for water for wildfire fire suppression and resident needs. The 2017 LHMP provides a list of several critical facilities that should remain functioning in the event of a disaster and is summarized in Table 7. Figure 1 shows wildfire severity zones and the location of critical assets and facilities within the City.

Table 7: Critical Facilities List

Facility Name	Description	Address
City Hall		415 South Ivy Street
City Hall Annex		200 Lime Avenue
Police Station		140 East Lime Street
Police Evidence Room		
Fire Station #1		141 East Lemon Avenue
Fire Station #2		2055 South Myrtle Avenue
Fire Station #2 Storage Building		
Fire Station #3		600 Cloverleaf Drive
Library		321 South Myrtle Avenue
Community Center		119 West Palm Avenue
Community Center	EIC Container	119 West Palm Avenue
City Yard	Main Building	600 South Mountain Avenue
City Yard	Garage	600 South Mountain Avenue
Recreation Park	Museum	742 Lemon Avenue
Recreation Park	Museum Storage, Garage	742 Lemon Avenue
Recreation Park	Restroom #2-5, Tennis Courts	742 Lemon Avenue
Boy's and Girl's Club		600 South Shamrock Avenue
Canyon Park Facilities & Reservoir		1200 North Canyon Boulevard
Well Pumphouse #4		2610 South California Avenue
Well Pumphouse #5		2620 South California Avenue
Booster 404, 4-5		601 North Cloverleaf Drive
Myrtle Water Yard	No. 1-3 Booster Bldg. Pumphouse	2655 South Myrtle Avenue
Myrtle Water Yard Well	Storage Shed	2655 South Myrtle Avenue
Mountain Avenue Reservoir	Pumphouse #2	510 South Mountain Avenue
Ridgeside Reservoir & Electrical Panel	Boosters 2-1, 2-2, 2-3, 2-4	715 Ridgeside Drive
Telephone System		Citywide System
May Wilcox Facility	Recreation Park	843 East Olive Avenue

Figure 1: Areas at risk of wildfire hazards



Development, Infrastructure, and Criticial Facilities within Wildfire Risk Zones

- Non-Residential Land Uses
- Residential Land Uses
- Electrical Transmission Lines
- Critical Facilities

Wildfire Hazards: Severity Risk Zones

- Very High
- Federal Responsiblity Areas (FRA)
- Fire Stations

Base Map Features

- City of Monrovia Boundary
- Sphere of Influence
- Metro Rail line and Stations
- Major Streets
- Parks and Open Space
- Waterbodies

All fire hazard severity zones within City of Monrovia limits are within the City of Monrovia Local Responsibility Area for fire emergency response. All other fire hazard severity zones illustrated in this map are within the State Responsibility or other Local Responsibility Areas.

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Monrovia Focused General Plan Update

Wildfire Hazards: At Risk Areas

Wildfire smoke is another hazard associated with wildfires. Smoke releases high concentrations of particulate matter and carbon monoxide. Other air pollutants, such as acrolein, benzene, and formaldehyde, are present in smoke, but in much lower concentrations than particulate matter and carbon monoxide. The effects of smoke range from eye and respiratory tract irritation to more serious disorders, including reduced lung function, bronchitis, exacerbation of asthma, and premature death. These effects can be more severe for sensitive populations, such as those with respiratory illnesses and other chronic diseases, the elderly, and children.

Other populations at risk of experiencing the impacts of wildfire, specifically wildfire smoke, include low-income communities and/or communities of color who have historically lived or worked in areas with greater exposure to pollution burdens. The City of Monrovia contains one census tract that qualifies as a "disadvantaged community" (also referred to as an environmental justice community in the City's General Plan) according to the California Environmental Protection Agency's CalEnviroScreen 3.0 tool. The State defines a disadvantaged community as a community that is disproportionately burdened by multiple sources of pollution and with population characteristics that make them more sensitive to pollution. This census tract, located within Old Town Monrovia, is exposed to poor air quality due to surrounding industrial uses and freeways. Toxins released from wildfire smoke could exacerbate existing pollution burdens in this community.

Safety Element Considerations

The City's previous Safety Element contains several goals and policies relating to fire prevention. The following are additional issues that should be considered in the Safety Element:

- **Evacuation routes.** Ensure that evacuation routes are consistently updated and exist for all areas of the City and a map of evacuation routes should be included in the Safety Element. Evacuation routes should be reviewed to determine if they are of sufficient width to facilitate rapid evacuation. If they are not, General Plan policy should put forth operational programs to address necessary right-of-way. Such programs may include no parking zones during "Red Flag" alerts or during voluntary and mandatory evacuation orders.
- **Development extending into the Wild Land Urban Interface**. One of the factors that affect wildfire activity and severity is development patterns that extend into brush growth. The Safety Element should consider additional methods for fire protection and prevention associated with new land uses and new development at the edges of current development.
- **Coordination between all fire protection services and resources.** Several agencies provide additional support to the Monrovia Fire Department for fire services. It is critical to continue to ensure there is efficient and consistent messaging and coordination between all responsible agencies.
- **Ensure emergency services and facilities can meet future demand.** As the frequency and intensity of wildfires are projected to increase, it is crucial to ensure that emergency services and facilities (medical facilities, emergency shelters, etc.) have the capacity to meet future demand. The Safety Element should consider coordinating with appropriate agencies on any potential expansions needed to accommodate increased hazard events associated with changing climatic conditions.
- **Protective measures against wildfire smoke impacts.** Wildfire smoke contains high concentrations of harmful toxins. The Safety Element should consider protective measures that

minimize the impacts of wildfire, such as promoting better building filtration systems, air quality alerts and forecasts, and outreach efforts to educate residents about the wildfire smoke impacts. Special consideration should also be given to vulnerable populations such as the elderly, those with existing lung conditions, and low-income communities.

Drought

As the climate continues to warm, there will be a tighter squeeze on water supplies. Rising surface temperatures also imply greater moisture loss in vegetation and on the ground surface. These conditions can put stress on existing water supply and water storage facilities.

Drought can also cause respiratory illnesses since there is no rainwater available to flush out airborne pollutants. This could have severe effects on those with respiratory illnesses or other disabilities. Additionally, low-income populations and communities of color are potentially more likely to experience water shortages during periods of drought as they may already lack access to potable drinking water or are unlikely to afford any price surges caused by increased demand for water. In Monrovia, this could pose additional stressors on the environmental justice community since it has existing exposure to groundwater contaminants. See the Environmental Justice Element of the City's General Plan for more information.

Safety Element Considerations

Water conservation. The Safety Element should address issues related to water conservation to ensure that supplies are not exhausted during periods of drought.

Flooding

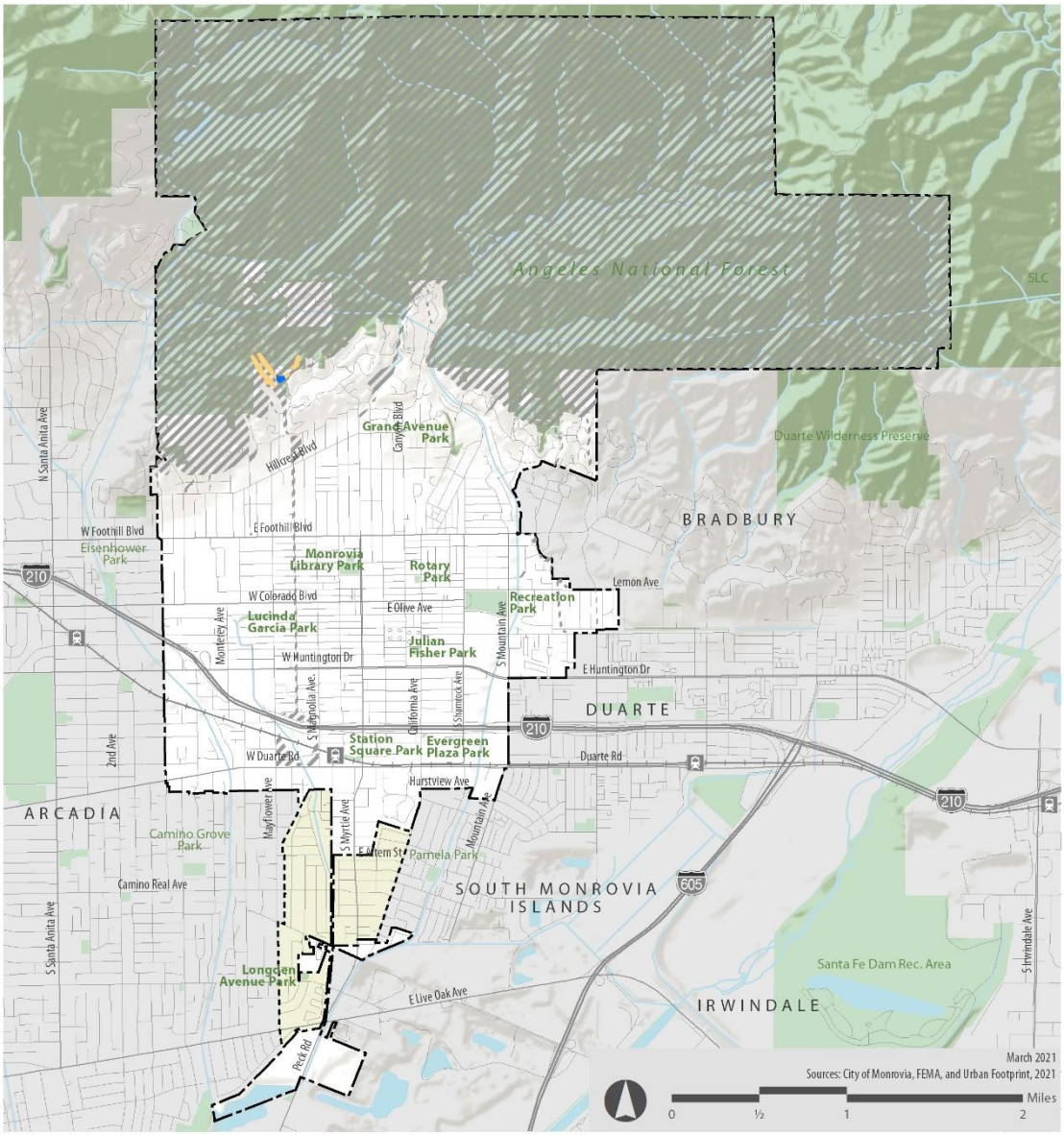
The Federal Emergency Management Agency (FEMA) has placed the City of Monrovia in Zone D, which is an area of possible but undetermined flood hazard. Property owners in Monrovia have not been required to purchase flood insurance in this zone, nor is it required to implement any floodplain management regulations. Figure 2 illustrates areas of the City in the 500-year Flood Zone, which only occurs in one specific spot in the foothills between Cloverleaf Drive and Hidden Valley Avenue. The 500-year Flood Zone means that there is a 0.2% annual chance of a flood hazard.

Monrovia is located in an area that has a potential for flooding due to surface water runoff from the San Gabriel Mountains to the immediate north. However, with the appropriate flood control measures, potential flooding can be avoided. The flooding potential can be successfully cycled through the Los Angeles County Flood Control District system. In addition to the infrastructure drainage system, other facilities maintain public safety during potential flood events. These facilities include the Sawpit Wash, Santa Anita Wash, two temporary debris basins in the Buena Vista Canyon, and three settling basins. The City of Monrovia has also installed a storm drain in the Hidden Valley area. Altogether these facilities provide the City with adequate flood control.

Safety Element Considerations

The City has several policies in the previous Safety Element relating to flood control systems, because of this and of minimal flooding hazards, no additional measures are needed.

Figure 2: Areas at risk of flooding hazards



FEMA Flood Risk Zones

- No Data Available
- 0.2% Annual Chance Flood Hazard (500-Year Flood Zone)

Development and Infrastructure within FEMA Flood Risk Zones

- Residential Land Uses

Base Map Features

- City of Monrovia Boundary
- Sphere of Influence
- Metro Rail line and Stations
- Major Streets
- Parks and Open Space
- Waterbodies

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Monrovia Housing Element Update

FEMA Flood Zones: At Risk Areas

Landslides

Landslides are a natural geologic process that can be caused by earthquakes, subterranean water flow, and rainfall. However, climate change can also exacerbate the problem through the combination of extremely dry and wet periods. Wildfires that have occurred on hills covered with shrubland plants are often a precursor to debris flows in burned-out canyons. The extreme heat of a wildfire can create a soil condition in which the earth becomes impervious to water. Landslides are then more likely to occur during periods of heavy rainfall. Areas along the hillside and steep slopes can experience more dangerous conditions as debris movements can be more rapid.

Location at risks from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills;
- Steep road-cuts or excavations;
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels;
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons; and
- Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire.

Figure 3 shows landslide-prone areas and critical assets located within these areas. According to the Monrovia Hillside Study by Leighton and Associates, many landslides of various sizes and types have been mapped within the Monrovia foothills. Most of the landslides are primarily in the steep northern area, which is underlain by granite bedrock. Structures backed up to the steep slopes of the mountains from Foothill Blvd north are at the greatest risk. Roads in steep terrain or with high side banks can act as chutes from debris and mud coming downhill and landing on their surfaces. Most structures at risk in Monrovia are privately owned.

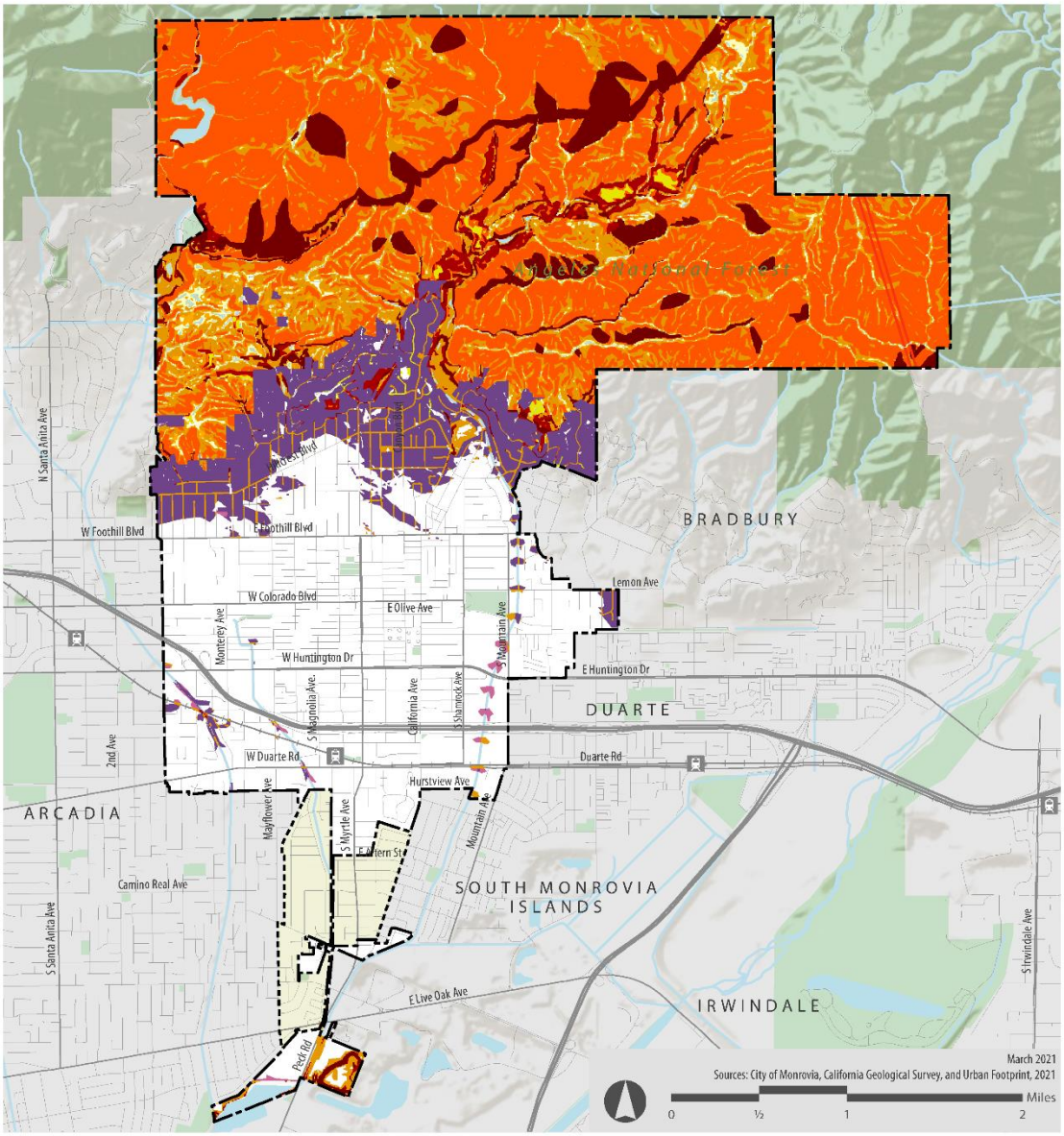
The effect of any landslide cannot be pre-determined; however, such events do involve the loss of, and damage to property, supplies, materials, and equipment. Loss of life may occur when people fail to heed warnings or to take the advice offered regarding precautionary evacuation. Persons caught in areas that become inundated can present difficult rescue problems and can anticipate personal hardship and discomfort until their situation can be addressed. The loss of utilities, including telephone service, and the serious reduction of vehicle accessibility should be expected.

Safety Element Considerations

While the City has placed development standards for structures in areas prone to landslides, other preventive measures could be put in place, particularly after a wildfire event.

Increased risk for landslide after wildfire events. Landslides are more likely to occur during heavy rainstorms in areas impacted by wildfires. The Safety Element should address preventive measures that can be implemented after the occurrence of a wildfire event.

Figure 3: Landslide Prone Areas Map



Landslide Suseptibility Hazards: Risk Zone Classes (low to high)

III
V
VI
VII
VIII
IX
X

Development and Infrastructure within Wildfire Risk Zones

Non-Residential Land Uses
Residential Land Uses
Electric Transmission Lines
Microwave Towers

Base Map Features

City of Monrovia Boundary
Sphere of Influence
Metro Rail line and Stations
Major Streets
Parks and Open Space
Waterbodies

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Monrovia Focused General Plan Update

Deep-Seated Landslide Susceptibility Hazards: At Risk Areas

Adaptive Capacity

The City and regional agencies have developed policies, plans, and programs to moderate the potential damages caused by climate change and/or natural hazards. The following sections summarize documents that outline existing efforts to manage climate impacts.

Existing Plans and Reports

Monrovia General Plan

The City's General Plan provides a long-term vision and policy guidance for future development of the community. Actions taken, laws enacted, and agreements made by the City must be consistent with the policies of the General Plan. State law requires the General Plan to be comprised of eight chapters: land use, circulation, housing, noise, safety, open space, conservation, and environmental justice. Currently, the General Plan does not contain specific climate change adaptation and resilience goals or policies. However, the Safety Element, which was last updated in 2002, addresses hazards and identifies policies implemented by the City to reduce the risks to residents and physical assets. Many of these hazards are natural hazards that could be exacerbated by climate change, therefore the policies listed provide a base understanding of the City's capacity to address future climate change effects. For example, the Safety Element includes policies for development standards for residential buildings and structures located in wildfire and landslide-prone areas. The Safety Element also provides an assessment of the City's emergency preparedness procedures and capacity.

Local Hazard Mitigation Plan

The City's Local Hazard Mitigation Plan (LHMP), which was last updated in 2017, provides a framework for the identification and coordination of Hazard Mitigation strategies developed in the City of Monrovia with other plans, especially those developed by City departments, agencies, and organizations as well as those developed to file for federal disaster assistance. The LHMP provides an assessment of risk and vulnerability associated with hazards such as wildfire/structure fire, earthquake/liquefaction, rain-induced landslide, drought, and emerging climate change risks. Climate change itself is not listed as a hazard but the impacts of climate change on existing hazards are generally discussed.

Urban Forest Management Plan

The City developed an Urban Forest Management Plan, which is contained within its Hillside Wilderness Preserve Resource Management Plan. The goals of the Urban Forest Management Plan are to protect natural resources, provide outdoor and nature education, and address fire safety and passive recreation. The Fire Safety Chapter of the Plan identifies fire risk within the Hillside Wilderness and Hillside Recreation areas of the City and various fire management strategies. These strategies manage fuel sources, call for the development of a Community Wildfire Protection Plan, and provide guidelines for new development projects within high-risk zones and emergency preparedness procedures.

Community Wildfire Protection Plan

The Community Wildfire Protection Plan (CWPP) is a living document aimed at protecting life safety, homes, and infrastructure adjacent to and surrounding Monrovia's natural hillside. The CWPP evaluates risk and hazards and sets forth actions that the community can undertake to reduce the risk of wildfire

and/or minimize damage if a wildfire occurs. The CWPP Action Plan contains a climate adaptation strategy that calls for the brush inspection program to promote year-round resident compliance with defensible space requirements. This strategy recommends more regular brush inspections and brush removal.

Monrovia Urban Water Management Plan

An Urban Water Management Plan is required by State law for every urban water supplier to provide long-term resource planning to ensure adequate water supplies are available for meeting existing and future demand. The City of Monrovia is classified as an urban water supplier because it serves more than 3,000 customers through individual metered accounts and supplies more than 3,000 acre-feet of water annually to its customers for municipal purposes. The plan is required to be updated at least every five years and was last updated by the City in 2020.

California's Fourth Climate Change Assessment Los Angeles County Summary Report

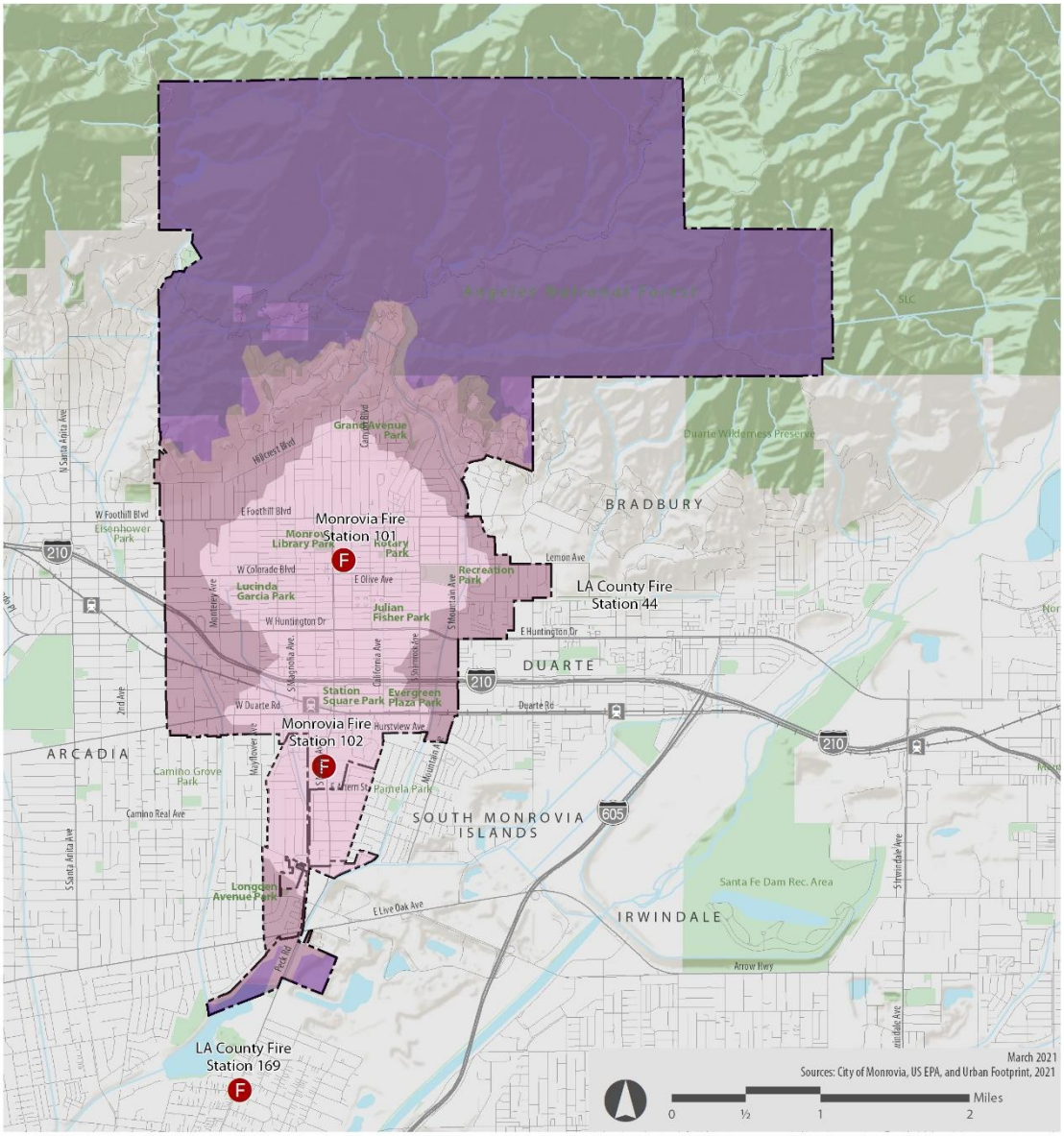
The Los Angeles County Regional Summary Report, prepared in 2018, is one of a series of 12 climate vulnerability assessments in California that provide an overview of climate science, climate adaption strategies, and key research gaps needed to safeguard the region from climate change. The Summary Report breaks down regional vulnerability by land use, infrastructure and services, and communities.

Responsible Agencies

Monrovia is reliant on several critical services and agencies for hazard mitigation and public safety. This section of the assessment assists in determining the adaptive capacity to adapt to climate impacts based on existing policies, plans, and/or programs.

- **Fire Services.** Fire service is provided by the Monrovia Fire Department. It provides fire protection, hazardous materials response, disaster preparedness, and emergency medical response. The Fire Department has two fire stations; one is located in the northern part of the City and the other in the southern portion (see Figure 4). The Monrovia Fire Department also receives resource assistance from various local fire services. The City of Glendale Fire Department coordinates fire response assistance to nine communities including Monrovia, Arcadia, San Marino, Sierra Madre, Monterey Park, Pasadena, South Pasadena, Glendale, and Burbank. The United States Forest Service, Los Angeles County Fire Department, and the cities of Arcadia, Sierra Madre, and El Monte also provide fire-fighting assistance to the City of Monrovia through a Cooperation Fire Protection Agreement and are referred to as the Foothill Fire Departments.
- **Law Enforcement.** Law enforcement services are provided by the Monrovia Police Department and have one centrally located station (Figure 5). The Monrovia Police Department also provides mutual aid to thirteen cities: Arcadia, Azusa, Baldwin Park, Claremont, Covina, El Monte, Irwindale, La Verne, Pomona, San Marino, Sierra Madre, and West Covina.

Figure 4: Fire Station Location and Service Areas



Fire Station Service Areas

- Within One-Mile Driving Distance
- Within Two-Mile Driving Distance
- Two Miles or More Driving Distance
- Fire Stations

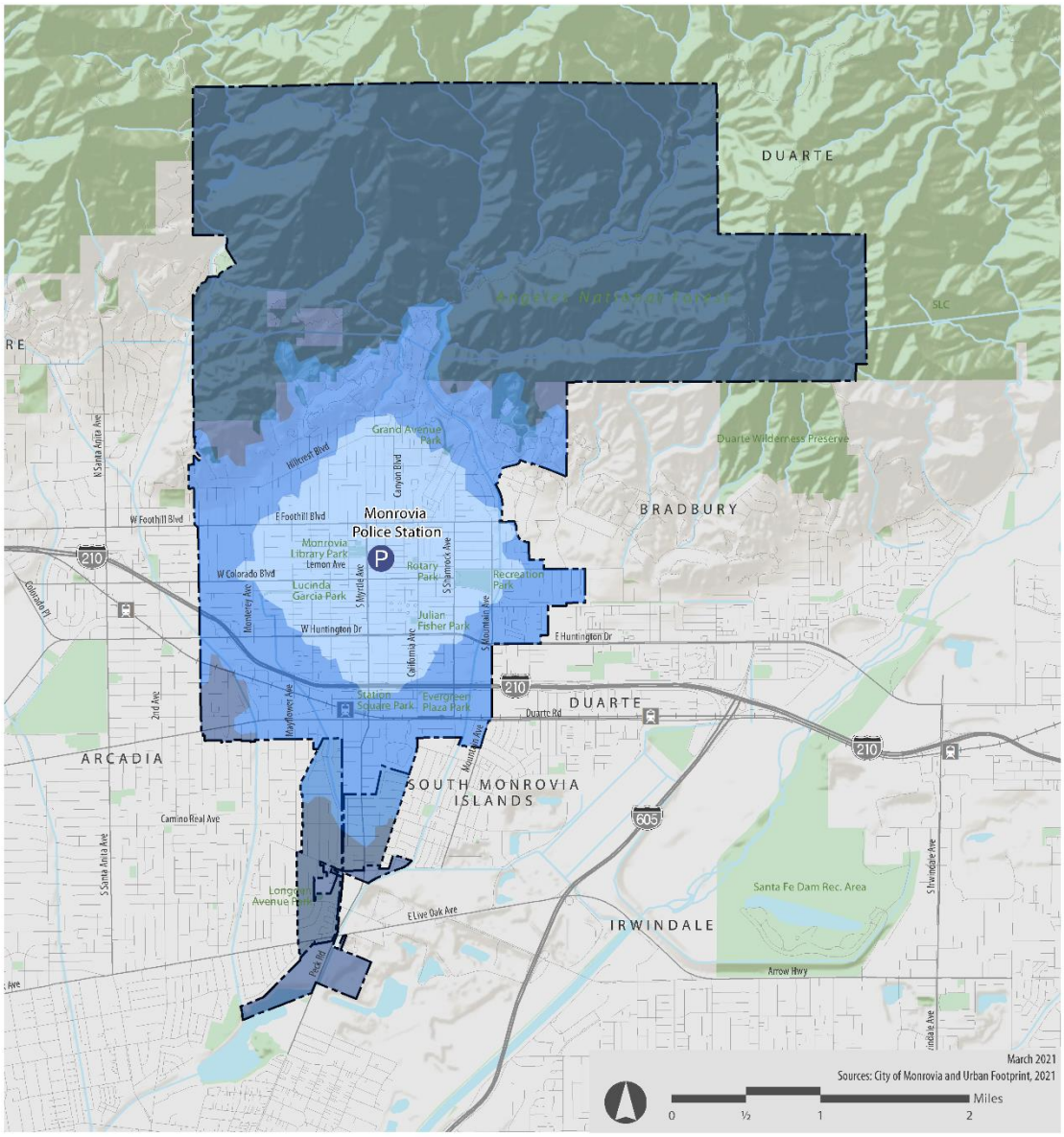
Base Map Features

- City of Monrovia Boundary
- Sphere of Influence
- Metro Rail line and Stations
- Major Streets
- Parks and Open Space
- Waterbodies

Monrovia Housing Element Update

Fire Station Service Areas

Figure 5: Police Station Location and Service Areas



Police Station Service Areas

- Within One-Mile Driving Distance
- Within Two-Mile Driving Distance
- Two Miles or More Driving Distance
- Police Stations

Base Map Features

- City of Monrovia Boundary
- Sphere of Influence
- Metro Rail line and Stations
- Major Streets
- Parks and Open Space
- Waterbodies

Monrovia Housing Element Update

Police Station Service Areas

Vulnerability Scoring

This section identifies priority climate vulnerabilities based on a scoring system. The vulnerability scores are based on the combination of potential impact and adaptive capacity. Potential impact measures the likeliness and significance of a potential climate change impact. Adaptive capacity measures the City's ability to be able to address a potential climate change impact. The scoring process is qualitative and uses the California Adaption Planning Guide (APG) guidance. Table 8 summarizes the scoring rubric used to prioritize vulnerabilities.

Table 8: Potential Impact and Adaptive Capacity Scoring Rubric

Score	Potential Impact	Adaptive Capacity
Low	Impact is unlikely based on projected exposure; would result in minor consequences to public health, safety, and/or other metrics of concern.	The population or asset lacks capacity to manage climate impact; major changes would be required.
Medium	Impact is somewhat likely based on projected exposure; would result in some consequences to public health, safety, and/or other metrics of concern.	The population or asset has some capacity to manage climate impact; some changes would be required.
High	Impact is highly likely based on projected exposure; consequences to public health, safety, and/or other metrics of concern	The population or asset has high capacity to manage climate impact; minimal to no changes are required.

Table 9 is used to determine the overall vulnerability scores based on the potential impact and adaptive capacity score. Table 9 essentially quantifies the low, medium, and high scores listed in the scoring rubric from Table 8.

Table 9: Vulnerability Score Matrix

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

Table 10 provides a description of each vulnerability for various populations and assets at risk of experiencing climate change-related impacts within the City. The scores presented in Table 10 help identify the most pressing issues requiring adaptation action. The scores can range from one to five, with one being a low priority and 5 being a high priority. Generally, a high priority risk is one where the potential climate change impact is high and the City's current capacity to address the impact requires enhanced interventions to meet projected climatic conditions. Overall, the City's priorities revolve around primary and secondary impacts from increases in the frequency and intensity of wildfires, such as wildfire smoke, infrastructure impacts, and landslides.

Table 10: Vulnerability Scoring

Vulnerability Description	Potential Impact	Adaptive Capacity	Vulnerability Scoring
Increased human health risk (heat-related illnesses, poor air quality, worsening of existing health conditions, etc.)	High	Medium	4
Reduced water supply availability due to extended drought periods	High	Medium	4
Increased exposure of people to landslides	Medium	Medium	3
Increased exposure of people to wildfires	High	Medium	4
Limited ability to prepare for climate events and to respond and evacuate	Low	High	1
Increased risk of residence damage due to landslides	Medium	High	2
Increased risk of residence damage due to wildfires	High	Medium	4
Increased risk of roadway damage due to landslides	Medium	High	2
Increased risk of roadway damage due to wildfires	High	Low	5
Increased energy system stress during droughts and extreme heat events	High	Low	5
Risk of physical damage to energy system from wildfires	High	Medium	4
Risk of physical damage to energy systems from landslides	High	Medium	4
Increase in water demand	High	Medium	4
Reduction in available water supply	High	Medium	4
Increased demand for emergency response services	High	High	3
Increased demand for emergency facilities (e.g. hospitals, cooling centers, telecommunication systems, and evacuation centers)	High	High	3
Increased risk of damage to emergency facilities	Low	High	1

Note: See Table 9 for Vulnerability Scoring