DRAFT

Local Hazard Mitigation Plan

May 5, 2021

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PREFACE

Impacts from hazards are a challenge to jurisdictions, its leaders, and its citizens. After catastrophic disaster events communities can experience power outages, loss of telecommunications and water service, limited access to fuel, and closed roadways in addition to significant damage to buildings, mass injuries, and loss of life. Depending on the magnitude of the event, recovery from these events can take weeks, months, and in some instances, years. The goal of many communities is to reduce the potential impacts thus shortening the recovery time. In emergency management, this is generally called mitigation.

Mitigation is defined by the Department of Homeland Security (DHS)-Federal Emergency Management Agency (FEMA) as "*any action taken to reduce and/or eliminate the long-term risk to human life and property from natural hazards*." Mitigation is one of the primary phases of the Disaster Cycle and is the only phase specifically dedicated to breaking the cycle of damage. The goal of mitigation is to build resiliency within the community; enabling a more efficient and effective response to and recovery from disasters.

To assist communities become more resilient to hazards, FEMA developed a program and guidance around the creation of Local Hazard Mitigation Plans (LHMPs). LHMPs promote a comprehensive planning process, requiring an assessment of local capabilities against impacts from hazards in order to identify potential projects and/or strategies.

With an approved and adopted LHMP, cities, counties, and special districts are eligible for Federal Hazard Mitigation Assistance (HMA) grants offered through FEMA: Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC; formerly Pre-Disaster Mitigation- PDM), and Flood Management Assistance (FMA). The HMA grants are a great source of funding to help implement local mitigation actions identified in the LHMPs.

Because the LHMP must include information to meet federal requirements and guidance it includes information not traditionally found in other planning documents. This can lead to a large, cumbersome document, making it difficult to easily access specific information. In an attempt to ensure the LHMP contains all required information and is user-friendly; it has been organized as follows:

Chapter 1: ***Introduction***- provides information on the purpose of the plan, outlines the scope of the work, and presents the adoption process and authority.

Chapter 2: ***Planning Process***- provides information on the methodology used to prepare the LHMP, including a list of the Planning Team members and the public outreach efforts.

Chapter 3: ***Community Profile***- provides background information on the City, ensuring all Planning Team members have a common understanding of the dynamics within the community.

Chapter 4: ***Capability Assessment***- provides information on the current mitigation efforts by the City, including department roles and responsibilities, existing plans/programs/codes, and available funding.

Chapter 5: ***Hazard Assessment***- provides information on hazards within the City and assesses the priority of each hazard.

Chapter 6: ***Vulnerability Assessment***- provides information on the potential impacts, through exposure and loss (damage) estimates for each hazard within the City.

Chapter 7: ***Mitigation Strategies***- provides information on the actions/projects the City is proposing to address the vulnerabilities to the high-risk hazards within the City.

Chapter 8: ***Plan Administration***- provides information on how the City intends to keep the LHMP current, incorporate it into other efforts, and share it with the public.

1 INTRODUCTION

The Local Hazard Mitigation Plan (LHMP) is a "*living document*" that should be reviewed, monitored, and revised to reflect changing conditions and new information. As required, the LHMP must be updated every five (5) years to remain in compliance with regulations to receive Federal Hazard Mitigation Assistance (HMA) grants. The City of Redlands has had several approved and adopted LHMPs, the latest being in 2015. This LHMP is an update to the 2015 City of Redlands LHMP.

1.1 PURPOSE OF THE PLAN

The purpose of this plan is to establish the five (5) year mitigation strategy to reduce and/or eliminate impacts from hazards within the City of Redlands.

1.2 SCOPE OF THE PLAN

The scope of this plan is to: 1) assess relevant existing conditions and capabilities within the City; 2) identify potential hazards and their impacts within the City; and 3) propose mitigation actions to address the impacts to the high-priority hazards within the City. In support of the above scope, this plan will implement and document a comprehensive planning process, present actions to maintain and integrate the LHMP with other City plans, and establish methods to continuously inform and educate the public on hazards and potential actions that can be taken to reduce and/or eliminate impacts.

1.3 HAZARD MITIGATION PLANNING DIRECTIVE

In 2000, the Federal Emergency Management Agency (FEMA) adopted revisions to Title 44 of the Code of Federal Regulations (44 CFR). This revision is known as "Disaster Mitigation Act (DMA) 2000". Section 322 (a-d) of DMA 2000 requires that local governments, as a condition of receiving federal disaster mitigation funds, have an approved and adopted Hazard Mitigation Plan (HMP) that describes the process for assessing hazards, risks and vulnerabilities, identifying and prioritizing mitigation actions, and engaging/soliciting input from the community (public), key stakeholders, and adjacent jurisdictions/agencies.

1.4 PROMULGATION AUTHORITY

The City Council is the legislative body of the City of Redlands. It decides policy for the municipal government, enacts laws, and oversees all activities of the City. The City Council also serves as the governing body of the City of Redlands Redevelopment Agency. The promulgation authority is vested in the members of the City Council. A list of the members of Redlands City Council include:

Mayor	Paul Barich	***Council Member***	Paul Foster
Mayor Pro Tem	Eddie Tejada	***Council Member***	Denise Davis
		Council Member	Jenna Guzman-Lowery

1.5 LOCAL HAZARD MITIGATION PLAN ADOPTION

The update of the City of Redlands LHMP was reviewed and adopted by the City Council on DATE under Resolution RESOLUTION NUMBER. A copy of the Resolution is in **Appendix 1**.

2 PLANNING PROCESS

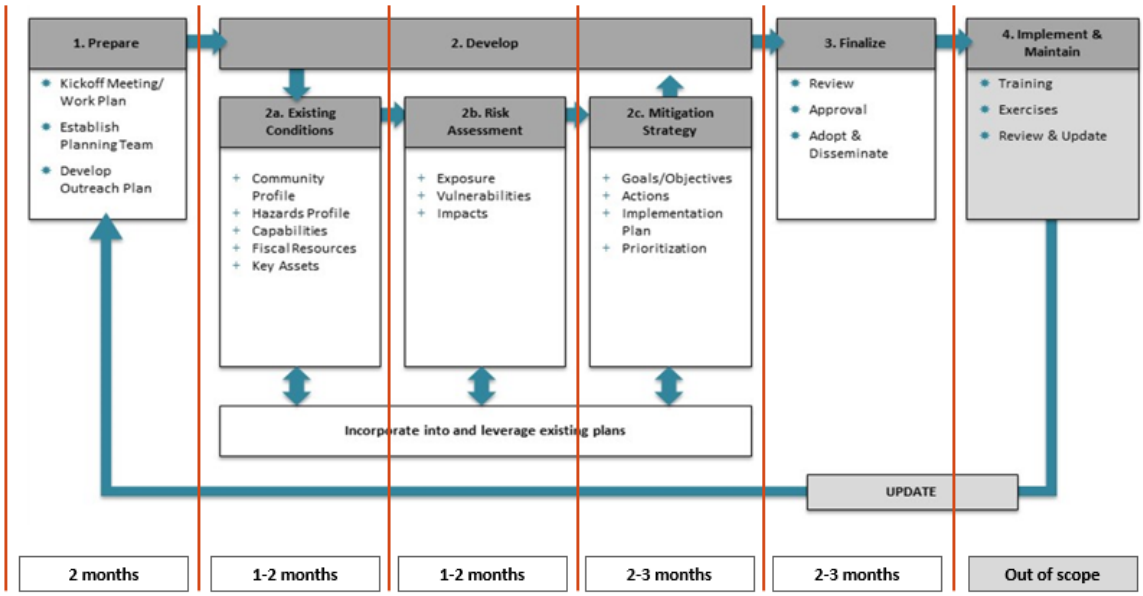
2.1 OVERVIEW

This section demonstrates the methodology used by the City of Redlands to develop the LHMP. FEMA's LHMP development guidance outlines recommended actions, emphasizing involving the "*whole community*" in the planning process. The whole community concept promotes the inclusion of not only emergency managers but other City department representatives (e.g., zoning, floodplain management, public works, community, and economic development), as well as, outside partners (e.g., surrounding counties/cities, special districts, lifelines companies, businesses leaders) to participate in the LHMP effort. The concept also includes outreach to the general public to bring awareness to community hazards and the planning effort. Soliciting and considering input from diverse interests is essential to building a comprehensive plan and gaining community-wide support for the plan.

2.2 METHODOLOGY AND TIMELINE

To complete the update of LHMP, the City of Redlands incorporated a three (3) phase planning process: 1) Prepare; 2) Develop; and, 3) Finalize (**Figure 2.1**). Phase 2- Develop, has three (3) sub-phases that establish the current conditions, determine the risk and vulnerabilities, and identifies strategies and projects. In addition to the phases, Figure 1 also depicts the timeline to complete the project. While this methodology is in alignment with the FEMA guidance, sequence and naming of phases were adjusted to better suit the City of Redlands' needs.

Figure 2.1- Planning Methodology



Under the *Prepare* phase general project tasks were completed. This included conducting an Administrative Kickoff meeting with the consultant, validation of the Planning Team, an identification of the Public Outreach effort, and a Kickoff meeting with the Planning Team.

As mentioned, the *Develop* phase had three (3) sub-phases. During the Existing Conditions sub-phase, the Planning Team confirmed current City mitigation capabilities, including identification of departments supporting mitigation, current governance guiding mitigation efforts, identification of fiscal resource availability to possibly support mitigation, discussion of key assets, and identification and description of local hazards within the City. Under the Risk Assessment sub-phase, the Planning Team reviewed exposure and impacts of hazards within the City; and prioritized hazards. The final sub-phase, Mitigation Strategies, had the Planning Team discuss previous mitigation efforts, identify and prioritize new mitigation projects, and develop an implementation plan for each project.

Throughout the *Develop* Phase, plans and other documents, both internal and external, were also analyzed and leveraged to ensure decisions were based on the best available information and that proposed actions were compatible with other efforts. And conversely, efforts were made to encourage results from the LHMP planning process were considered and incorporated into other planning efforts.

The last phase of the planning process methodology was *Finalize*. During this phase the Planning Team reviewed and provided additional comments on the complete LHMP before being forwarded to the California Governor's Office of Emergency Services (Cal OES) and FEMA. This phase also included addressing both Cal OES and FEMA comments, and working with the City Council to adopt the LHMP.

During the planning process, draft LHMP sections (i.e., Capabilities, Hazards, Vulnerability, Mitigation Strategies) were disseminated for review and comment as the Planning Team moved through each phase and sub-phase. This helped the Planning Teams focus their review on the subject matter at hand and enforced the relationship between the phases. At the end of the planning process, another review cycle was provided, this time with all draft sections under one cover.

2.3 PLANNING TEAM

Building on the whole community concept, a Planning Team was established to assist with the updating of the City of Redlands LHMP. The primary goal of the Planning Team is to help define and identify the strategies within the LHMP. The Planning Team was led by representatives from the City of Redlands Fire Department. The City of Redlands Fire Department representatives took on the responsibilities of Project Manager and facilitated and coordinated Planning Team activates. Additionally, the City of Redlands Fire Department hired a consultant to provide technical support through the process and preparation of the final LHMP.

2.3.1 MEMBERS

The Planning Team was comprised of subject matter experts from a range of areas affected by the LHMP or could provide great benefit to the team. Keeping the Planning Team to a manageable number of members while ensuring that all perspectives are captured and/or included in the process is challenging. To balance this, the Planning Team members were urged to act as liaisons to community groups with whom they regularly interact with; exchanging thoughts on the LHMP with other groups in the community. Planning Team member were encouraged to communicate the direction and status of the planning effort to their outside members and in return they were expected to bring outside perspectives to the Planning Team. The City of Redlands took great efforts to engage and include as many Planning Team members as possible. A list of the Planning Team members can be found in **Appendix 2**.

2.3.2 MEETINGS

There were a series of meetings held with the Planning Team. Each meeting had a primary focus and provided an opportunity to discuss/review information and exchange ideas. Below is a list of the Planning Team meetings (**Table 2.1**) and Planning Team member attendance at each meeting can be found in **Appendix 3**:

Table 2.1- Planning Team Meetings

Date	Purpose of the Meeting
Jun 16, 2020	Project Kickoff- Discussed: Goal/Objectives of LHMPs, Type of Information Needed, Role of the Planning Team, LHMP Update Process, Public Outreach Effort, and Project Timeline
Aug 18, 2020	Prepare- Discussed: 1) relationship between EOPs and LHMPs, 2) FEMA Review Tool, 3) 2015 LHMP sections- Community Profile, Capabilities, Key Assets, and Hazards. Solicit feedback on draft LHMP sections
Sep 21, 2020	Existing Conditions- Discuss: 1) Key Assets, and 2) Hazards (Identification). Solicit feedback on draft LHMP sections
Oct 19, 2020	Existing Conditions- Discuss: 1) Key Assets, and 2) Hazards (Priority). Solicit feedback on draft LHMP sections
Nov 16, 2020	Existing Conditions- Discuss: 1) Hazards (Profiles, Priority). Solicit feedback on draft LHMP sections
Jan 14, 2021	Risk Assessment- Review of Hazard 1) Exposure, 2) Impacts, and 3) Prioritization. Solicit feedback on draft LHMP sections
Mar 16, 2021	Mitigation Strategies- Review of 1) Previous Projects, 2) Previous Goals/Objectives, and 3) Identification of New Projects
Apr 07, 2021	Mitigation Strategies- Discussion of 1) New Projects, and 2) Project Implementation Plan
DATE TBD	Draft Plan- Review of draft LHMP; including Public Comments
DATE TBD	*Draft Plan*- Review of Cal OES/FEMA Comments on draft LHMP

2.4 COMMUNITY STAKEHOLDER INVOLVEMENT

2.4.1 RECURRING COORDINATION

The City of Redlands attends and coordinates several meetings with community stakeholders. A large number of these stakeholder meetings are organized by San Bernardino County Fire Department Office of Emergency Services (OES). The San Bernardino County Fire Department OES leads the San Bernardino Operational Area (OA) efforts. It's role as lead is to support local governments response and recovery operations. The San Bernardino County Fire Department OES also encourages coordination across local governments and community stakeholders. Some of these efforts include:

- San Bernardino County OA Stakeholder Group- meetings focused on maintaining, coordinating, and updating the OA Multi-hazard LHMP and the individual city LHMPs
- Critical Route Planning Committee- has a committee that develops and validates countywide routes and alternate routes for use in evacuating residents from a disaster area while simultaneously allowing first responders' access into a disaster area without congestion and gridlock.
- California Governor's Office of Emergency Services Annual Exercise- coordinates the OA's participation in the exercise. The purpose for participation is to better prepare for regional, catastrophic events, ensuring an effective multi-agency/multi-jurisdictional response.

The City of Redlands also meets quarterly with the Voluntary Organizations Active in Disasters (VOAD) group. The San Bernardino County chapter of the VOAD group is a community network of non-partisan membership organizations that serves as the forum to share knowledge and resources to help communities prepare for and recover from disasters. Further, VOAD fosters efficient delivery of available member resources to persons with unmet needs affected by disaster.

At the local-level, the City of Redlands meets with faith-based organizations monthly. This group coordinates all faith-based organizations in the City of Redlands. The group supports positive interfaith relationships, enhance non-violent attitudes & behavior, support peace & promote goodwill in the Redlands Community. During Disasters this group supports the city not only in having volunteers, but also in being the emotional and religious support.

2.4.2 Stakeholder Mitigation Related Planning Resources

To ensure consistency within the region, the Planning Team reviewed the state HMP and several LHMPs from surrounding jurisdictions. This list included:

- State of California Hazard Mitigation Plan
- San Bernardino County Multi-Jurisdictional Hazard Mitigation Plan
- Yucaipa, City of
- Loma Linda, City of
- Colton, City of
- Riverside County Multi-Jurisdictional Hazard Mitigation Plan
- Calimesa, City of

While not technically considered a mitigation plan, the Planning Team also reviewed available Emergency Operations Plans (EOPs) and the General Plan Safety Elements from the jurisdictions above. The value of reviewing EOPs is to understand how the City of Redlands and other communities within the region will respond to events and the type of equipment and facilities they will be reliant upon. Gaining this perspective, the Planning Team was able to incorporate these considerations into its LHMP. Although there is a concerted effort to incorporate LHMP information into the General Plan Safety Elements, that is not always the case. A review of the Safety Elements can provide additional insight into hazards within the community and present a closer tie to community-wide goals and objectives.

2.5 Public Outreach

For the purposes of the LHMP, the public is defined as any person within the jurisdiction or adjacent areas, not part of the Planning Team, not acting in an official capacity of a recognized form or level of government. There were two (2) different Public Outreach campaigns used during the City of Redlands LHMP update process: the first informing the community of the efforts to update to the LHMP and the second educating the community of hazards and mitigation actions. Below is a summary of the campaigns:

2.5.1 LHMP Awareness Campaign

This campaign presents the strategy of how the City of Redlands engaged the public during the LHMP update process. A significant piece of the FEMA's LHMP guidance is to ensure the "*whole community*" is involved. A significant element of FEMA's "*whole community*" concept is the general public.

The public outreach strategy worked in conjunction with LHMP planning process and timeline. As the Planning Team completed critical milestones, key information was disseminated to the public for consideration and input. Because of the pandemic (COVID), there were limited options and opportunities to reach out to the public. All public outreach efforts were done virtually. The City of Redlands held two (2) public meetings: one (1) at the start of the project; and, one (1) at the end of the project. In between, there were a series of status update provided through the city website, keeping the general public aware of the progress and status of the project.

This outreach strategy shared information about the project kickoff, hazards and potential impacts within the community, current mitigation capabilities, and proposed mitigation actions. The information was shared through presentations, status updates, and handout materials, through meetings, social media platforms (Facebook, Twitter, Instagram, LinkedIn, Nextdoor), media (print, broadcast), and other announcements.

For the update process, the City of Redlands leveraged the existing City Disaster Council to engage the public. The Disaster Council holds regular, ongoing meetings with the public and its purpose was in alignment with the LHMP efforts. On October 8, 2020, the City of Redlands issued a press release, via email and the city website, announcing the LHMP as an agenda item for the Disaster Council. The Disaster Council agenda is also disseminated to registered users and the general public.

A second Public Outreach meeting was held on April 26, 2021, to provide an overview of the draft LHMP. The presentation informed the community of the LHMP planning process and the hazards included in the LHMP. The presentation presented an overview of the chapters in the LHMP, highlighting the proposed mitigation actions; inviting the public to review and submit comments on the draft LHMP.

Attendance at the Public Outreach meetings were good considering the challenges from the COVID-19 pandemic and competing priorities. In addition to the COVID-19 pandemic, the community has faced challenges brought on by regional wildfires. During the Public Outreach meetings, a few comments were received. Since the draft LHMP was not available for viewing yet, the comments were requesting clarification of the presentation material. Comments received related to the draft LHMP included XXX. All public comments were shared with the Planning Team; and revisions were incorporated into the LHMP where appropriate. The public announcements and presentations for both meetings can be found in **Appendix 4**.

2.5.2 MITIGATION AWARENESS CAMPAIGN

Over past few years, the City of Redlands established both regular meetings and ad hoc meetings/events to educate and exchange information on mitigation within the city. The regular meetings involve the re-establishment of the Disaster Council. The Disaster Council consist of existing groups that support a strong team merging sectors of the community including elected officials, emergency management, first responders, volunteer services, major industry and commercial, healthcare and education. The Disaster Council meets quarterly. Ad hoc meeting/events consist of events run by the city or others that may provide opportunities to share and exchange information about mitigation. The City organized and/or participated in a number of initiatives to inform the public of hazards in the community and discussed possible mitigation actions. The City sponsors and staff information booths at local events, encourages

Community Emergency Response Team (CERT) training, and participates in several regular community-based stakeholder and public meetings. The CERT training helps the City educate citizens about hazards and train citizens to be self-sufficient following a major disaster, while staffing information booths provide City staff with the opportunity to provide literature and handouts pertaining to mitigation strategies and emergency and disaster preparedness. The City has also used surveys in the past to determine the level of knowledge local citizens already have about potential disasters and assess areas of vulnerability to various types of disasters. The City also leverages its social media platforms (Facebook, Twitter, Instagram, LinkedIn, Nextdoor), media (print, broadcast), and other general public announcements to disseminate vital information about hazards in the community, relevant programs being undertaken to safeguard the public from the effects of hazards, and actions the public can take to prepare themselves for events.

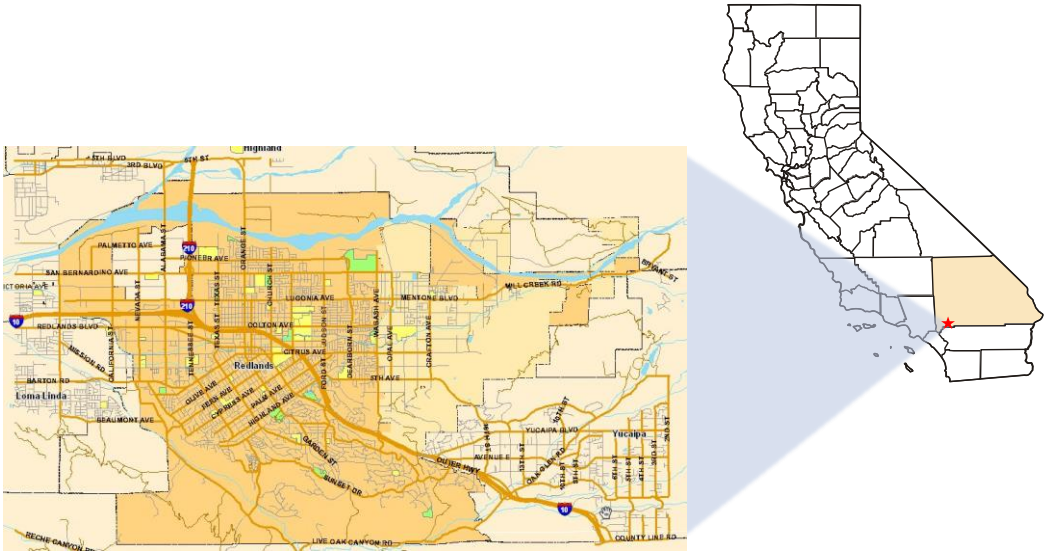
3 COMMUNITY PROFILE

The purpose of this section is to present an overview of the City of Redlands, providing the Planning Team with a common understanding of the existing conditions and perspective on select aspects within the community. Gaining a common understanding of the existing conditions provides the basis on which the Planning Team can assess the impacts of hazards, as well as, identify needed mitigation actions.

3.1 LOCATION

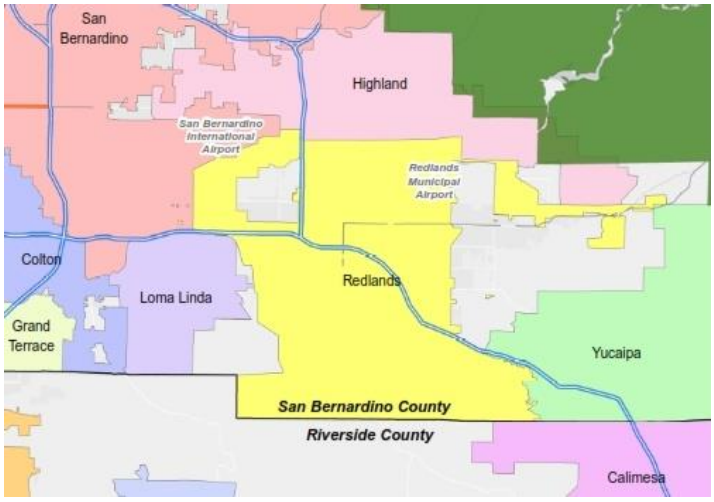
The City of Redlands is located at the base of the San Bernardino Mountains in southwestern San Bernardino County, eight (8) miles east of the City of San Bernardino, sixty-three (63) miles east of the Los Angeles metropolitan area, and one-hundred- ten (110) miles north of San Diego (**Figure 3.1**). The City of Redlands planning area covers approximately 46 square miles. The planning area covers the City of Redlands (approximately 37.5 square miles), the City's Sphere of Influence (SOI), and an unincorporated County island (referred to as the "Donut Hole). The SOI is represented in light gold (east of the City of Redlands) and the Donut Hole in tan (northwest portion of the City of Redlands) on Figure 3.1.

Figure 3.1- City of Redlands



The City is bordered by other local jurisdictions (**Figure 3.2**). The County of San Bernardino has jurisdiction over the unincorporated land within the City (aka the Donut Hole) and land around the SOI. The City of San Bernardino shares a border with Redlands along Mountain View Avenue north of Interstate-10; the City of Loma Linda shares a border with the City of Redlands and the SOI on the west; the City of Yucaipa shares a border with the City on the east side; the City of Highland shares a border with the City in the north; and the City of Calimesa shares a border with the City in the south.

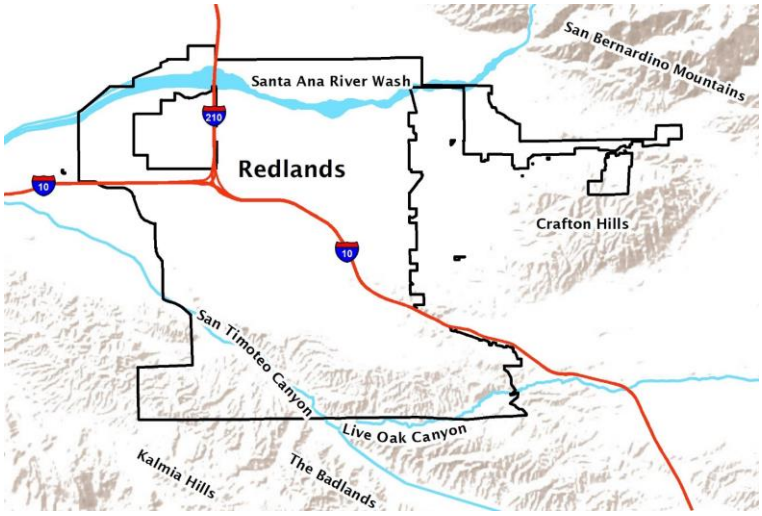
Figure 3.2- Surrounding Jurisdictions to the City of Redlands



3.2 GEOGRAPHY

The City is located in what is known as the East Valley Corridor of the Inland Empire. Surrounding physical features include the San Bernardino Mountains (11,503 feet in elevation) and the Santa Ana River (and/or wash) located on the valley floor at the base of San Bernardino Mountains to the north, the Crafton Hills (3,297 feet in elevation) to the east, and San Timoteo Canyon, the Badlands Mountain range- 2,520 feet, the Kalmia Hills- 2,405 feet and Live Oak Canyon (at base of the San Timoteo Badlands Mountain range) to the south (**Figure 3.3**). Interstate 10 (I-10) freeway which bisects the City east to west, stretches from the Pacific Ocean to Atlantic Ocean; and courses through the major cities of Los Angeles, Phoenix, San Antonio, Houston, Baton Rouge, Mobile, and Jacksonville. The City is also served by State Route 210 which intersects with I-10 Freeway close to the west City limit.

Figure 3.3- Physical Features Around the City of Redlands



There are two (2) principal streams that drain into the City of Redlands, each of presents identifiable flood hazards at peak flows:

- **Santa Ana River/Mill Creek**- The Santa Ana River/Mill Creek emerges from its mountain canyon 5 miles northeast of Redlands, spreads out in shallow, braided channels more than a 1.5-mile-wide

wash, mantled with fluvial debris. In 1965, 1966, 1969, 1976, 1980, 1992, 1993, and 1995 the flood waters from the upper regions of the Santa Ana River/Mill Creek were responsible for extensive damage to Orange Street and Alabama Street, ranging from washouts from five to six-foot high flood waters, to extensive, permanent damages from uncontrollable runoff from the upper regions of the San Bernardino mountains.

- **Mission Zanja,** *also known as Mill Creek Zanja and Mission Storm Drain*- The Mission Zanja was constructed for water supply in 1819. Diverting water from Mill Creek, the Zanja carried water for 12 miles to support the San Bernardino Assistance and surrounding farms and ranches. Today, as it traverses an east/west direction, the Zanja drains major portions of the City through various storm drain systems. During significant storm periods, the Zanja poses a serious threat to the community, and is presently being studied by the U. S. Army Corps of Engineers to determine if Corps funding might be available for design and construction of facilities to remove the flood hazard. The Mission Zanja, from the 2800 block of Mentone Boulevard to the west edge of Sylvan Park, is a designated landmark, and part of the National Register of Historic Places.

3.3 HISTORY

Once part of the Spanish Mission lands, Redlands was incorporated in 1888 following an influx of wealthy easterners and mid westerners. Early settlers brought their cultures, traditions and treasures, adding to the City's reputation as a cultural and educational community. Agriculture prospered with the navel orange and many citrus groves still surround Redlands today. More than a hundred years ago the seed which became the city of Redlands was planted by two young Easterners who shared a dream of an idyllic agricultural and residential community.

Redlands was the shared dream of Frank E. Brown, a civil engineer and Yale graduate, and E. G. Judson, a New York stock broker, who met in Southern California in late 1870's. Naming their Redlands colony for the color of the adobe soil, the two busily laid out a city, brought water from the mountains to the community, introduced the newly discovered Washington navel orange, and recruited settlers. It wasn't long before Redlands proudly proclaimed itself the Navel Orange Capital of the World.

One group of early settlers called itself the Chicago Colony and created what is now the downtown business district. They named the principal shopping street for State Street in Chicago.

In 1889, twins Alfred H. and Albert K. Smiley came to Redlands, and the town was changed forever. The Smiley brothers, well-known educators and resort owners from New York, established a tradition of philanthropy with their donation of the A.K. Smiley public library and park in 1889. Two decades later, the Clarence G. Whites gave the Prosellis at the Redlands Bowl, and Robert Watchorns built the Lincoln Shrine next to the library. These and many others built a city that was known as the "Jewel of the Inland Empire."

The interval from 1920-1930 was another period of growth and prosperity, largely due to the citrus industry. The town's other "industry," the University of Redlands, expanded as well and a general increase in population occurred. Another regional contributor was the establishment of Norton Air Force Base, which remained an active military facility until 1994. Because of Redlands' historic and cultural heritage, the City attracted many commissioned military personnel as residents. The closure of Norton Air Force Base, coupled with a declining economy beginning in 1990, had a negative impact on the City's economic stability.

3.4 CLIMATE

Redlands' climate is typical of Southern California inland areas. Residents of the City experience mild winters, low annual rainfall, and prolonged, dry summers. (**Table 3.1**)

Table 3.1- Average Temperature and Precipitation in Redlands

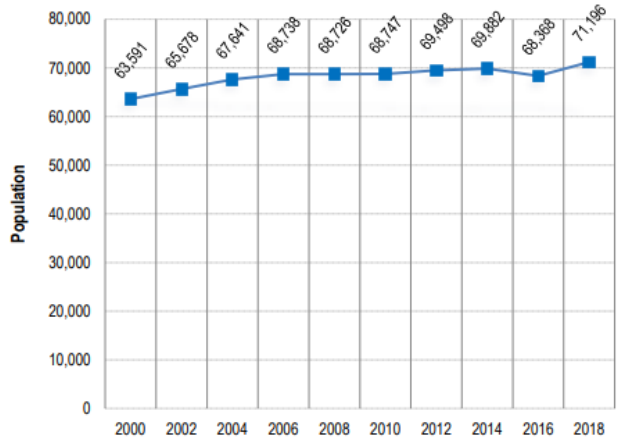
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max Ave Temp (F)	64.7	66.1	69.1	73.7	78.5	86.7	94.5	94.2	90.1	81.0	72.7	65.8	**78.1**
Min Ave Temp (F)	39.3	41.3	43.6	46.8	51.1	55.2	60.3	60.6	57.6	51.2	44.0	39.6	**49.2**
Precipitation (in.)	2.72	2.66	2.29	1.18	0.48	0.11	0.06	0.15	0.29	0.69	1.13	1.80	**13.55**

3.5 DEMOGRAPHICS

According to the U.S. Census Bureau 2019 estimate, the total population of San Bernardino County is approximately 2,171,600 people. Most of the County's population is in the valley areas located in the southwestern portion of the County. The County's population has grown by approximately 121,690 people (6.4%) since the 2010 population of 2,040,910 persons. This rate of growth was relatively slower than the population growth in three neighboring Southern California counties (Riverside County with 11.3%, San Diego County with 7.7%, and Kern County with 6.6%), but much higher than the next three other counties in (Los Angeles County with 2.88%, Ventura County with 3.13%, and Orange County 5.62%).

The population in City of Redlands is estimated to be 71,513 (US Census, 2019 estimate), slightly up from the 2018 estimate of 71,196. The City of Redlands 2019 population estimate represents approximately 3.3% of the population residing within San Bernardino County. The City of Redlands population has increased approximately 12% since 2000; lower than the population growth in the San Bernardino County (27.2%) over the same period. The historical population estimates for the City of Redlands are shown in **Figure 3.4**.

Figure 3.4- Historical Population Estimates for the City of Redlands, 2000-2018



Source: California Department of Finance, E-5, 2000-2018

Below are some additional relevant population statistics from the 2019 U.S. Census estimate for the City of Redlands:

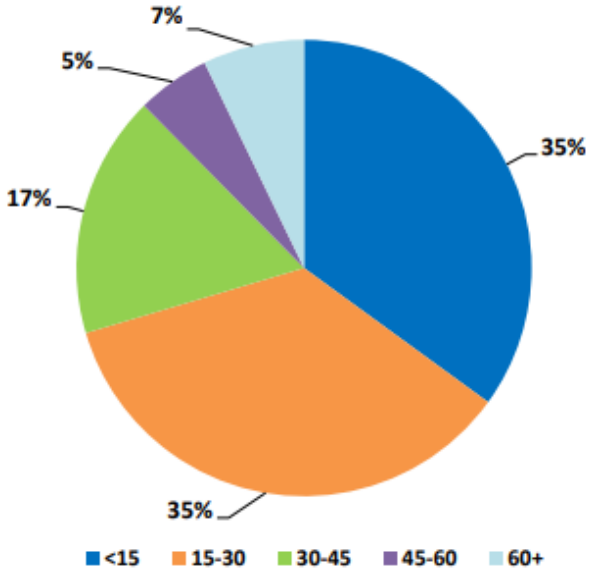
- 22.9% under 18 years old
- 15.4% over the age 65
- 61.7% between the ages of 18 and 65
- 25.5% reported speaking a language other than English at home
- 88.9% over the age of 25 are high school graduates
- 38.6% have attained a Bachelor's Degree or higher
- 6.9% over the age of 65 with a disability
- $72,523 median household income
- 13.6% living below the poverty level

In addition to the above information, the Planning Team reviewed information from Southern California Association of Government (SCAG). In 2008, SCAG initiated the Local Profiles which provided a variety of demographic, economic, education, housing, and transportation information about each member jurisdiction and are updated every two years. The SCAG region includes six counties (Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura) and 191 incorporated cities. In addition, the SCAG region is a major hub of global economic activity, representing the 16th largest economy in the world, and is considered the nation's gateway for international trade with two of the largest ports in the nation. Below is some information from the SCAG Local Profile for the City of Redlands (2019):

- 26,973 Housing Units in the City of Redlands (or 3.7% of San Bernardino County)
- 57.5% own their homes, and 42.5% rent
- Mean drive time to work in the City of Redlands is 22.8 minutes (compared to 30.9 minutes for San Bernardino County)

According to the US Census American Community Survey (2017), 70% of the City of Redlands population commute over 45 minutes to work (**Figure 3.5**)

Figure 3.5- Travel Time to Work (minutes) City of Redlands



3.6 ECONOMY

According to the SCAG report, the total number of jobs in the City of Redlands is 41,610 (or 5.4% of jobs located in San Bernardino County). The total number of jobs in the City of Redlands reflects a 2.5% decrease (1,049 jobs) from 2007 (**Figure 3.6**). A more detailed breakdown of the jobs in the City of Redlands is depicted in **Figure 3.7**. Below is a summary of some of the larger losses in job sectors since 2007:

- Manufacturing: 1,204 jobs in 2017(a 40.4% decrease)
- Construction: 1,619 jobs in 2017 (a 42.3% decrease)
- Retail: 4,621 jobs in 2017(a 17.7% decrease)
- Professional/Management: 4,510 jobs in 2017 (a 56.7% decrease)

Figure 3.6- Total Number of Jobs in the City of Redlands- 2007-2017

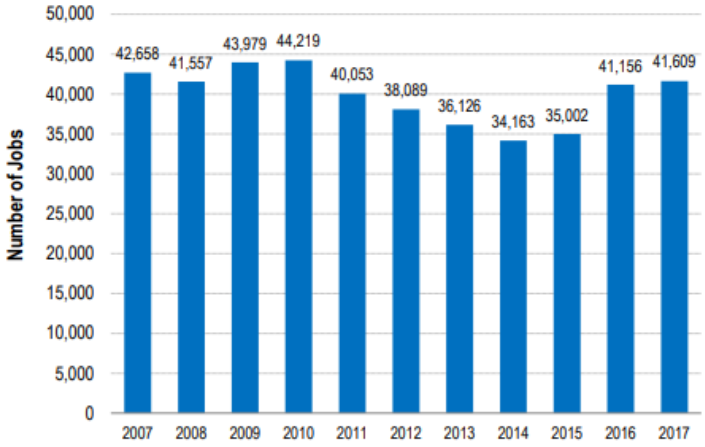
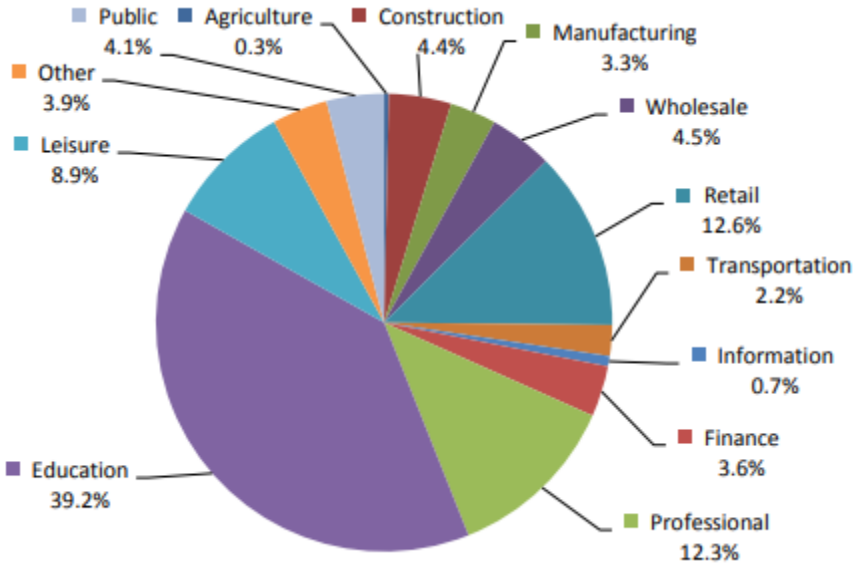


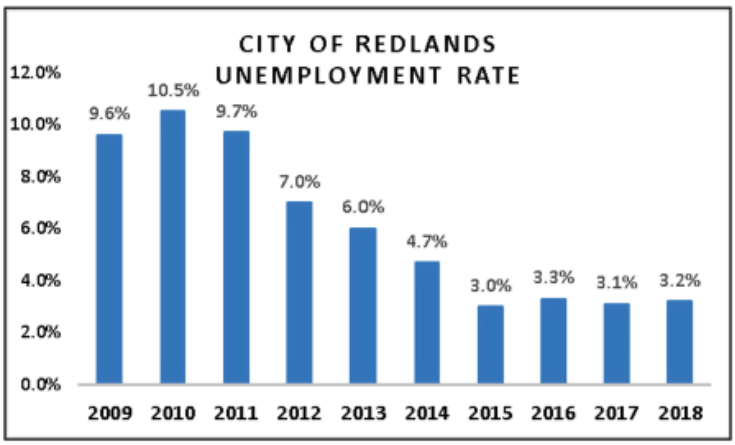
Figure 3.7- Total Number of Jobs in the City of Redlands- 2007-2017



As presented in the Comprehensive Annual Financial Report, The City of Redlands' economy is based largely in the service and trade sectors (health care, retail trade, technology, and education) and light

manufacturing. Since 2007-2008, the vacancy rate for industrial and manufacturing space has declined significantly as the City expanded its manufacturing and industrial base. This growth has added to the relative stability of the unemployment rate over the years since the 2007-2009 economic recession. During that time the unemployment rate rose to a high in 2010 of 10.5%, declining in the following years to reach 3.2% by 2018 (**Figure 3.8**).

Figure 3.8- Unemployment Rate, City of Redlands



3.6.1 MAJOR EMPLOYERS IN REDLANDS AND SURROUNDING VICINITY

Major industries with headquarters or divisions located within the City's boundaries (or in close proximity) include computer technology manufacturers, electrical controls, several financial and insurance institutions, and educational institutions. Within the "Donut Hole"- the unincorporated 1,100-acre island of parcels, located in the northwestern portion of the city, a number of large warehouse distribution centers were developed over the past several, alongside a variety of retail establishments. Major employers in the City and the Donut Hole are presented in **Table 3.2**.

Table 3.2- Major Employers

Employer	Number of Employees	
	City	Donut Hole
Environmental Systems Research Institute (ESRI)	2,650	
Redlands Unified School District	2,108	
Redlands Community Hospital	1,600	
Beaver Medical Group	1,022	
Burlington Coat Factory		806
University of Redlands	593	
Amazon Fulfillment Center		500
Citrus Plaza Shopping Center		250-500*
Mountain Grove Shopping Center		250-500*
City of Redlands	467	
Target		400
Loma Linda University	374	
Caddo Hardware		280
Amazon Fulfillment Center	250	
Walmart	230	

Kohls		225
Garner Holt Productions, Inc.	100-200*	
JCPenney		150
Redlands Christian Schools	100-150*	
Becton Dickson Distribution		100

**- Denotes an estimate of the number of employees*

3.7 LAND USE

Land Use in the City of Redlands is guided by the General Plan, Zoning Laws, and Municipal Building Codes. The Land Use element of the General Plan supports opportunities to create a cohesive and attractive image for each district and neighborhood. The City of Redland's Land Use Plan includes three related parts: 1) description of allowed land uses; 2) overlay districts; and 3) the location of allowed land use. **Table 3.3** provides a summary of the permitted Land Uses and the maximum density.

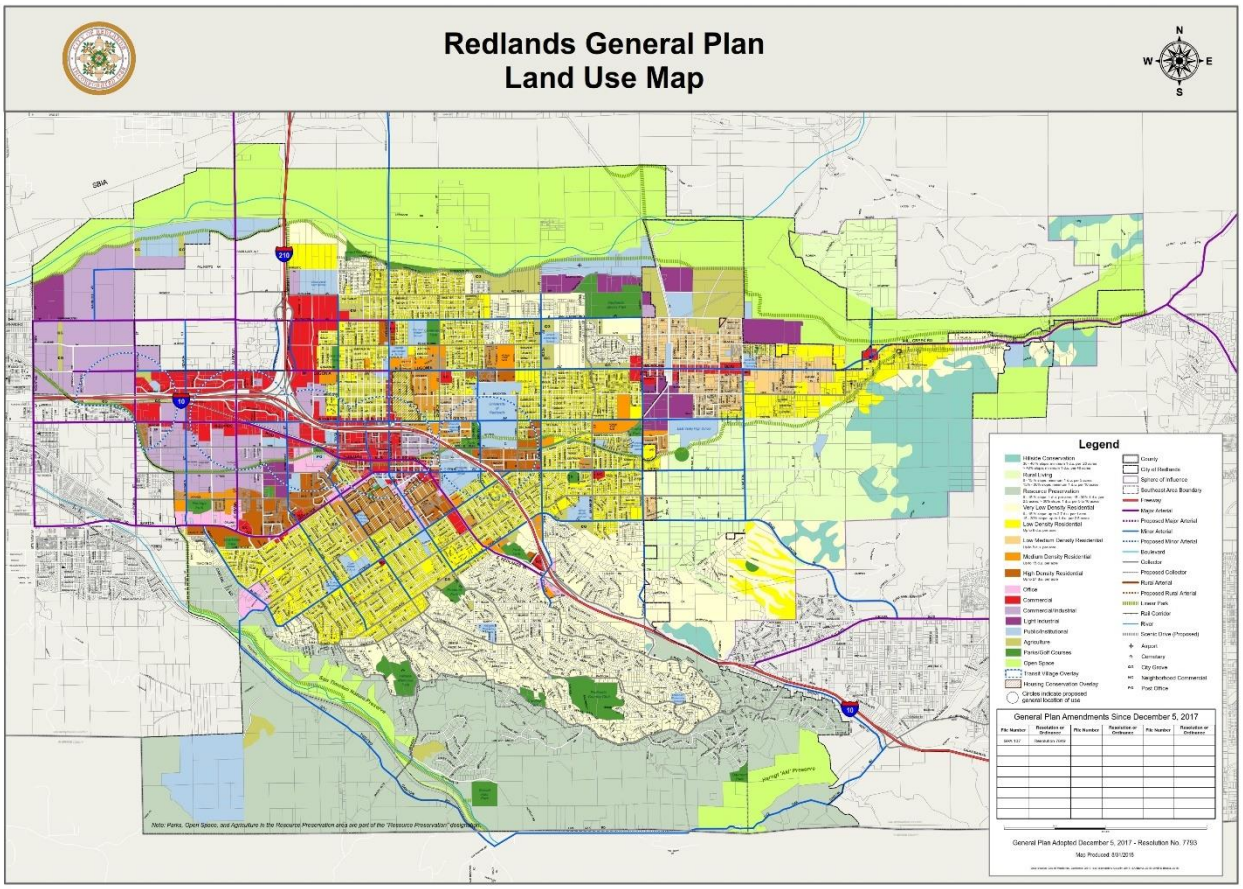
Table 3.3- Land Use Categories

Land Use	Maximum Density
Residential	
Rural Living (RL)	*1dwelling unit/gross acre*
Single Residential (RS)	*6.1 dwelling unit/gross acre*
Multiple Residential (RM)	*8.7 dwelling unit/gross acre*
Multiple Residential (RM-24)	*20-24 dwelling units/gross acre*
Commercial	
Neighborhood Commercial (CN)	*0.50 Floor to Area Ratio*
General Commercial (CG)	*1.0 Floor to Area Ratio*
Service Commercial (CS)	*1.2 Floor to Area Ratio*
Commercial Industrial (IC)	*1.0 Floor to Area Ratio*
Other Land Uses	
Institutional (IN)	*0.8 Floor to Area Ratio*
Floodway (FW)	*None*
Parks (P)	*0.25 Floor to Area Ratio*
Open Space (OS and OS-PD)	*None*
Planned Development (PD)	*Various*

3.7.1 POTENTIAL LAND USE

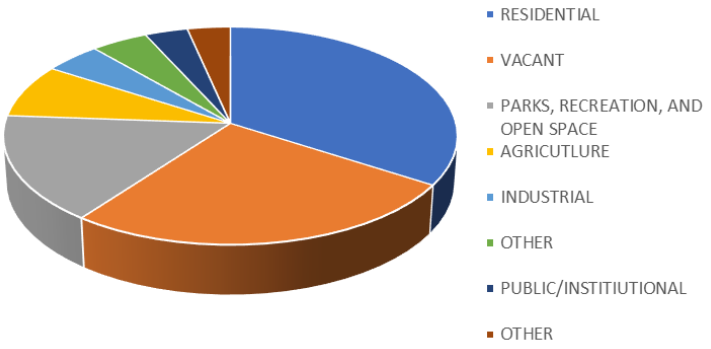
The Land Use in the City of Redlands consists of the following categories: Agriculture; Commercial; Industrial; Office; Residential; Public/Institutional; Vacant; Parks; Open Space, and Recreational; and other (airport, utilities, parking lots, and water). As presented in the City of Redlands General Plan, the proposed distribution of the land uses within the City limits can be seen in **Figure 3.9**.

Figure 3.9. General Plan Land Use Map



According to the City of Redlands General Plan, the breakdown of Land Use in the Planning Area (**Figure 3.10**) includes: Residential (30%); Vacant (23%); Parks, Recreation, and Open Space (14%); Agriculture (7%); Industrial (4%); Other (4%), Public/Institutional (3%); and Commercial (3%).

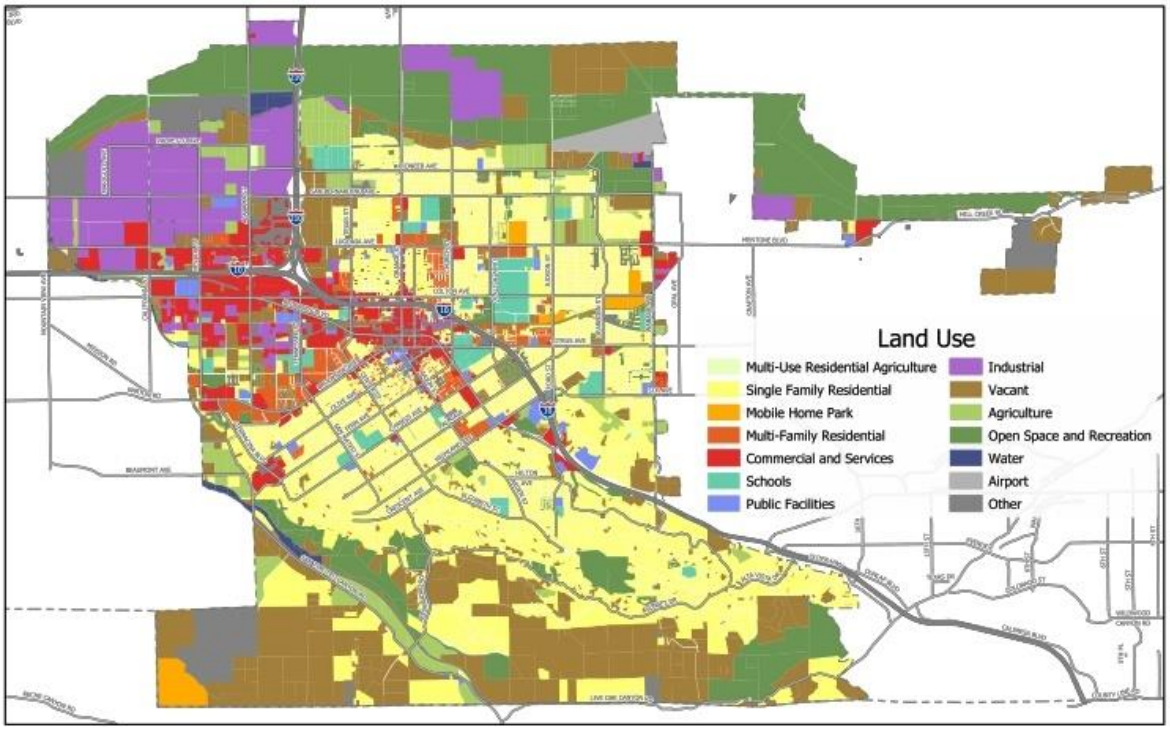
Figure 3.10- Land Use Distribution



3.7.2 EXISTING LAND USE

While the General Plan Land Use illustrates potential buildout of the City, **Figure3.11** depicts the current, existing Land Use within the city.

Figure 3.11- Existing Land Use Map



The LHMP, also leveraged information from the FEMA-sponsored San Bernardino County Essential Facilities Risk Assessment (*SBEFRA*) project. The *SBEFRA* project improved Hazus model default data to better reflect what was currently "on-the-ground" and use it for flood and earthquake loss estimation analysis (damage) and exposure assessment for wildfire. **Table 3.6** presents the "*improved*" Hazus data for City of Redlands.

Table 3.6- Improved Hazus Default Data- City of Redlands

Building Stock	Building Count	Building Replacement Value ($1,000)	Contents Replacement Value ($1,000)	Building Sq. Ft. (1,000 Sq. Ft.)
Residential	19,661	$4,586,535	$2,293,253	39,193
Commercial	790	$2,000,690	$2,077,158	20,969
Industrial	116	$154,116	$231,174	2,020
Other	524	$449,264	$219,703	2,817
TOTAL	**21,091**	**$7,190,605**	**$4,821,288**	**64,998**
Concrete	223	$572,025		
Mfg Housing	1,039	$47,818		
Precast Concrete	99	$388,399		
Reinforced Masonry	398	$617,472		
Steel	142	$264,195		
URM	59	$73,705		
Wood Frame (Other)	990	$1,406,583		
Wood Frame (SFR)	18,141	$3,820,407		
TOTAL	**21,091**	**$7,190,605**		

3.7.3 DEVELOPMENT TRENDS

Limited incremental growth has occurred within the City of Redlands since the adopted 2015 LHMP. All development occurring over the past few years was constructed in accordance with all local land use, building codes, zoning, and environmental requirements, and applicable State and Federal regulations. Because of the limited growth and rigorous project review over the past five (5) years, there have been no changes to the community's vulnerability.

Because much of the City of Redlands has already been developed, no significant growth is anticipated over the next five (5) years. Projected development is expected to be for small infill and redevelopment projects, not of any significant scale. Many of these sites are concentrated in the East Valley Corridor and Transit Village areas. The City has prepared Specific Plan for both of these areas to ensure measured and safe development.

According to the 2035 General Plan, the projected population at buildout in the City of Redlands is 79,013 persons, with an additional 14,611 persons in the Sphere of Influence (SOI) outside the city's current boundaries. Buildout projections in the 2035 General Plan only factor in the potential maximums based on Land Use and Zoning designations; it does not consider other factors that may limit growth (e.g., downturn in the economy, building material shortages, etc.). At full build-out by year 2035, the General Plan suggests that there may be the following additional types of development: 4,703 new residential structures (2,676 in the City and 2,027 in the SOI); up to 3,135,379 square feet of additional commercial development; up to 300,704 square feet of additional office development, up to 2,943,653 square feet of commercial/industrial development; up to 1,599,503 square feet of additional industrial development; and up to 115,815 square feet of additional public/institutional development. The new 2035 General Plan generally encourages new development to occur on infill lots in core areas of the city (e.g., the Transit Villages Concept), thereby trying to avoid unrestrained expansion or sprawl around the city's periphery (such as new residential subdivisions in hillside, open space, and high fire hazard areas).

Whether the projections are realized or not, all future development proposed for the City of Redlands will continue to be reviewed to ensure compliance with all relevant land use and zoning regulations, building codes and fire codes, and environmental and engineering standards. Additionally, the LHMP will be referenced during the review of proposed development projects to assess exposure (or risk) to community hazards. The LHMP will also serve as a reference for any suggested mitigation measures to reduce and/or eliminate risk from those hazards.

3.8 KEY ASSETS

A subset of the general building stock are key buildings the City will rely on when responding to and recovering from disaster events. Because of the role and importance of these facilities, the City needs to ensure the facilities are maintained and will be functional during and after disasters. Also, part of these key assets are systems and equipment used to perform certain functions and/or operations. The list of key assets includes, but are not limited to: Police Stations, Fire Stations, City Hall, Water facilities, Hospitals/Medical facilities, airports, Community Centers, Corporate Maintenance Yards, Library and, Schools. A list of Key Assets can be found in **Appendix 5**.

4 CAPABILITY ASSESSMENT

The purpose of this section is to capture the different resources available to the City of Redlands in support of mitigation. In an effort to efficiently demonstrate these resources, the section has been organized by: Personnel Resource; Mitigation Governance Resources; Technical Resources; and, Fiscal Resources.

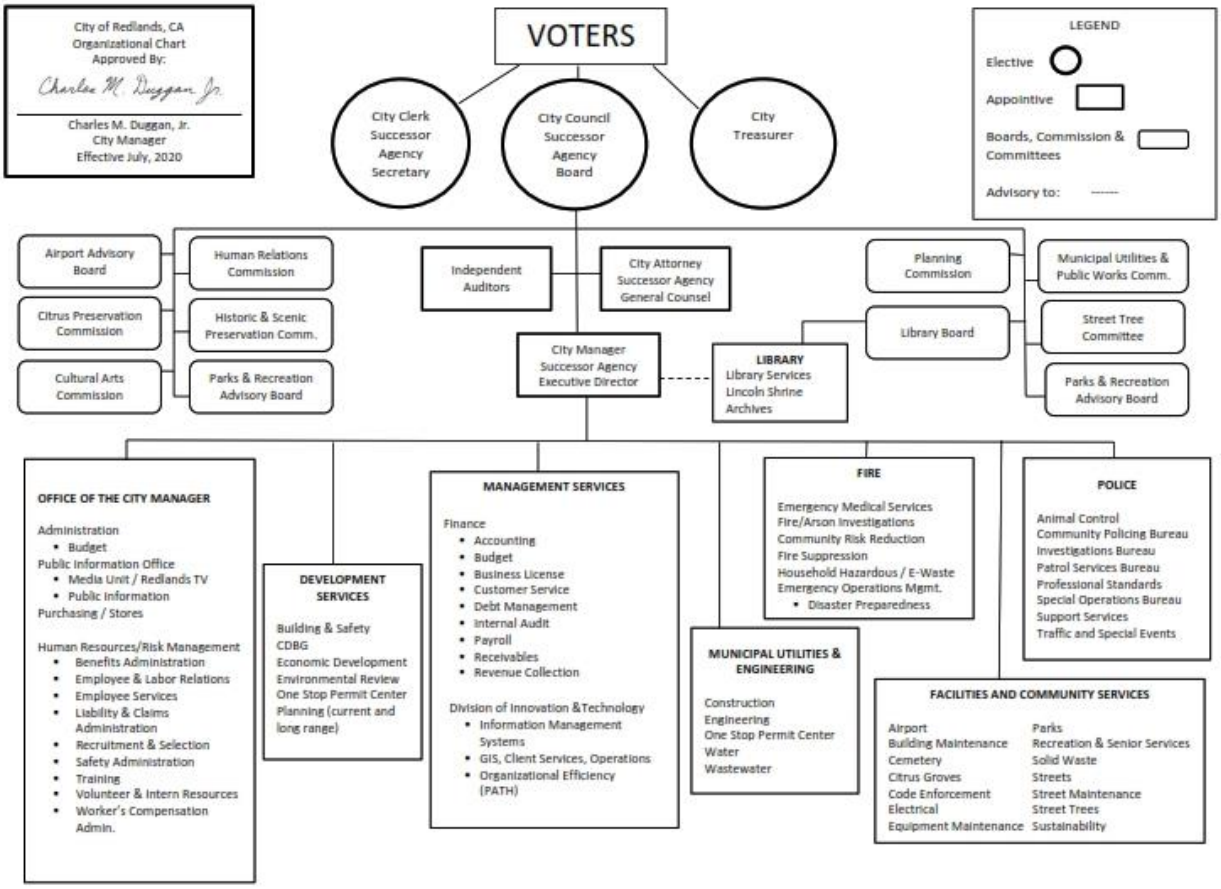
4.1 PERSONNEL RESOURCES

This sub section demonstrates the City of Redlands capability to dedicate and/or assign, long-term or short-term, workforce to mitigation efforts. There are four (4) primary ways the City of Redlands can provide personnel resources: directly from the City of Redlands government workforce; through Contracts, through Volunteer organizations; through Mutual Aid; and, through Partnerships.

4.1.1 GOVERNMENT

The City of Redlands is a full service, general law city. The major services provided include: Police, Fire, Water, Wastewater, Solid Waste, Engineering, Public Works and Community Development. The City is governed by a five-member City Council, who also chair several Boards, Committees, and Commissions. The City Council is support by the City Clerk's Office, the City Treasurer, and the City Manager. The City Manager oversees the Office of the City Manager staff, Development Services, Management Services, Municipal Utilities & Engineering, Fire, Facilities and Community Services, and Police. The organization structure of the City of Redlands is depicted in **Figure 4.1**.

Figure 4.1- City of Redlands Organizational Structure



While each City department plays a role with regard to emergency Preparedness and Response, not all have a role in Mitigation. The City of Redlands has an established Emergency Management Organization under the Office of the City Manager. The Emergency Management Organization is headed by the Emergency Services Chief, who manages and/or coordinates all activities related to disaster planning, response, recovery and mitigation (Ord. 2639 § 1, 2006: Ord. 2485 § 3, 2002). The Emergency Operations Manager works for the Emergency Services Chief and is also supported by the Emergency Management Organization. The Emergency Operations Manager's focus under Mitigation is to identifying, analyzing potential hazards and recommending appropriate countermeasures. Below is a summary of the City departments and their role:

- **Office of the City Manager**- The Office of the City Manager oversees the city departments and administers the day-to-day operations of the city. The Office of The City Manager is responsible for maintaining and updating the City's Administrative Policies and Procedures (CAPP) Manual. The policies and procedures contained within CAPP Manual reflect not only the City's values as an employer, but also convey the standards that the City has for its employee. Emergency Management, the Public Information Office and Purchasing are also part of the Office of the City Manager.
    - *Public Information Office*- The Public Information Officer (PIO) is responsible for the regular dissemination of public information about the City of Redlands to the media. The PIO hosts press conferences, writes press releases and articles for publication in magazines and newsletters and helps coordinate public events. The Public Information Officer also oversees

the City's Government Access cable TV channels 3 (Spectrum customers) and 35 (Verizon customers). The Public Information Office includes the Redlands TV video unit, which produces original programming regarding municipal services for Redlands TV

- *Purchasing*- City of Redlands Purchasing Division serves as the central acquisition point for equipment and services. The Central Warehouse provides all types of commodities to all City departments. The Division is the sole authority for the purchase of supplies, services or equipment. This division also handles items declared as surplus for redistribution, sale or disposal per the City Municipal Code.

- **Development Services**- The Development Services Department provides quality service to customers through professionalism, integrity and the efficient use of resources. The Department endeavors to enhance and protect the urban and natural environment of the city helping to ensure that Redlands remains an ideal place to live and work. Functional divisions include: Building and Safety; Economic Development; and, Planning.
  - *Building & Safety*- conducts building inspections, plan review and permit processing
  - *Economic Development*- business attraction and retention, workforce development and tourism promotion
  - *Planning*- land development, application review, general plan, specific plan, long-range planning and historic preservation) as well as the administration of the Community Development Block Grant (CDBG) Program
- **Management Services**- The Management Services/Finance Department is comprised of the divisions of Finance, Revenue, Utility Billing Customer Service, Geographic Information Systems (GIS) and Innovation & Technology
  - *Finance Division- performs the functions of administration, accounting and budgeting, payroll, accounts payable and accounts receivable. Other responsibilities of the division include administration of all City related debts/bonds, preparation of regular financial analysis, responsibility for the annual budget process and spending oversight, performance of periodic internal audits of City operations, as well as coordination of the City's annual audit and preparation of all related reports as required by law.*
  - *Revenue- responsible for the collection of all fees, taxes and penalties owed to the city, safekeeping of the funds invested, and deposited in various financial institutions.*
  - *Utility Billing Customer Service- provides accurate and timely billing for water, wastewater, solid waste, street cleaning and household hazardous waste services. In addition to providing billing services, the Customer Service Division is a cross-functional team that provides assistance to customers for information on their utility bill.*
  - *Innovation & Technology*- includes both the Information Technology (IT) and Geographic Information Systems (GIS)
- **Municipal Utilities & Engineering**- is organized into several divisions which include capital improvement engineering services, land development engineering, water and wastewater operations and maintenance and utility administration. Municipal Utilities & Engineering (MUED) plans, designs and constructs Redlands' physical infrastructure for the residents and businesses in the City, making it a desirable place to live, work, and visit. MUED is responsible for delivering the following services to the City's residents and businesses:
  - *Utility Operations: water production and distribution; non-potable water distribution; and wastewater collection, treatment, and disposal*
  - *Engineering review and inspection of development proposals for compliance with State and City codes, standards, and other governmental requirements relating to land subdivisions, grading, drainage, and improvements within the City right-of-way*

- *Management, rehabilitation, and replacement of infrastructure such as water mains, sewer mains, storm drains, streets, and traffic signals to provide reliable service to the community*
- *Development and construction of new public facilities to protect and enhance Redlands' livability*
- *Floodplain Management- administrators of the National Flood Insurance Program (NFIP)*

- **Fire**- mission is to provide a safe, professional and courteous team that strives to exceed the expectations of the community and our organization. This mission requires our members to be part of a capable, aggressive, all-risk fire department that is focused on "Preserving the Past and Protecting the Future" of those we serve. The Fire Suppression & Operations Division of the Fire Department is responsible for putting out fires, emergency rescues and medical emergency response.
  - *Hazardous Materials Response Team*- consists of eighteen (18) active members, with ten (10) members trained to the "Specialist" Level, and eight (8) members trained to the "Technician" Level. All trained personnel are also members of the San Bernardino County Inter-Agency Hazardous Materials Response Team, and respond countywide, through a countywide mutual aid agreement. Personnel maintain their skills by attending monthly training sessions. Redlands is covered by the LEPC for California Region VI (CA05), located in Hemet. The City is a member of a Countywide Hazardous Materials Response Team. As a part of this, all City of Redlands Fire Department field employees are trained in Hazardous Materials First Responder Certifications. The Countywide team would provide a response if the level of hazard were above the certified level of City Staff. From there, the County Hazardous Materials response team would provide for the evacuation, mitigation and facilitation of cleanup efforts in the event of an accidental release of hazardous materials.
  - *Community Risk Reduction*- Operating under the direction of the Fire Chief, and guided by the California Fire Code (CFC), the goal of the Fire Prevention Division is to safeguard the community from fire through programs ensuring adherence to fire regulations, public education, and mitigation.
  - *Emergency Management*- Emergency Management in the City of Redlands is coordinated within the Fire Department. Emergency Management is the framework for which companies, communities, and organizations respond to natural and man-made disasters and acts of terrorism
- **Facilities and Community Services**- ensures residents, businesses and visitors enjoy City services and facilities including parks, recreation and senior services, trees, City-owned groves, solid waste removal and recycling, code enforcement, the maintenance of our street lights, traffic signals and streets as well as oversight of the Downtown area, Redlands Municipal Airport and Hillside Memorial Park Cemetery. All services and support are coordinated under comprehensive Green Initiatives.
  - Citrus Division- The City's citrus operation operates as an enterprise fund. The revenue received from the harvesting of the crops is used to continue the care of maintenance of the groves. The City of Redlands owns 21 citrus groves throughout the City totaling 184 acres. They include Valencia Oranges, Navel Oranges, Ruby Star Grapefruit, and Rio Grapefruit
  - *Code Enforcement*- The Code Enforcement Division is dedicated to enhancing the quality of life for the residents of Redlands by enforcing local Building, Zoning and Public Nuisance Ordinances. This Division is responsible for enforcing codes which address public health and safety issues, including regulations related to rubbish, garbage, specific nuisances, removal of vegetation, zoning, housing, dangerous buildings, and inoperable and unlicensed vehicles on

private property. Enforcement actions are taken in response to requests for action received from residents.

- *Solid Waste & Recycling Services*- currently services over 20,000 customers for solid waste, green waste, food waste, and recycling services. The Solid Waste Division is seeking new technologies and services which will not only preserve our environment, but provide more efficient and economical collection, recycling, and disposal of waste materials, while meeting all health, safety, and regulatory requirements. In addition to this service, the Division also provides roll-off services for the entire City of Redlands.
- *Streets & Lights Division*- provides general maintenance and repair of 314 miles of street, 90 miles of storm drains, 72 City-owned traffic signals, approximately 5,000 City-owned street lights and routine street sweeping services on public roadways within the City
- *Street Trees*- maintains approximately 53,875 tree sites located within the City's right-of-way. The Trees Division, in partnership with the Redlands Street Tree Committee, is dedicated to the continued enhancement, maintenance, and care of this living asset.
- *Building Maintenance Division*- performs both routine maintenance and emergency service for all City-owned facilities. The Division consists of three (3) full-time and one (1) part time positions and provides a wide range of building maintenance functions maintenance services to approximately 385,000 square feet of City facilities. The Division also administers contracts for various vendors to provide ongoing and/or specialized maintenance services.

- **Police**- dedicated to bolstering the public's trust through accountability to high standards of performance, ethics, transparency, and professional conduct. Strives to serve the community in a fair and just manner.
  - *Community Services Bureau*- reaches out to the residential and business communities to establish and maintain cooperative relationships that keep the City of Redlands a safe and enjoyable community
  - *Traffic Safety Unit*- focuses on Traffic Education, Moving Violations, and Parking Citations. The Patrol Services Bureau is comprised of Patrol, Custody, and the Field Training and Evaluation Program
  - *Special Services Bureau*- is comprised of the following specialized units: Investigations Unit, Multiple Enforcement Team (MET), Street Enforcement Team (SET), Crisis Negotiations Team, K-9 Unit, and the Special Weapons and Tactics (SWAT) Team
  - *Support Services Bureau*- offers a wide variety of services that provide a vital link between the community and public safety personnel within the Police Department and other law enforcement agencies

4.1.2 CONTRACTORS

The City of Redlands is able to hire contract employee. A contract employee is an individual retained by the City for a predetermined time and price. Benefits of hiring contract employees include:

- Ability to hire workers for short-term projects, on an as-needed basis
- Ability to hire highly skilled individuals for which there is no one in-house qualifications
  - *usually little to no downtime as noticed with onboarding new staff*
- Lower overhead operating costs
  - *do not need to pay taxes (social security, workers compensation) or provide benefits (unemployment, health, sick leave, vacation time, retirement or profit sharing)*
  - *usually do not need to provide office space or equipment*

Disadvantages of hiring contract employees include:

- May work for several employers simultaneously and may not be available when needed
- Integrating with City staff can be difficult because of remote working and unfamiliar with city organization and resources

4.1.3 VOLUNTEERS

The City of Redlands has the ability to leverage volunteer workers. A volunteer worker generally means anyone who agrees to work for free, California labor laws narrow in on a more specific definition of a volunteer. According to California Labor Code Section 1720.4, which defines volunteering in California labor law, an individual must perform services freely and without coercion for a civic, humanitarian or charitable purpose to be considered a volunteer. To legally volunteer, an individual must offer her services to a public agency or nonprofit organization. Businesses may not legally utilize volunteers.

California labor law permits the extension workers' compensation to volunteers during their time in service. Workers' compensation is a type of insurance that covers employees in the event of industrial accidents or occupational injury. Often, public agencies will grant volunteers insurance protection under workers' compensation to help encourage volunteering and avoid the potential for lawsuits. In order to be deemed an employee for workers' compensation, the organization -- whether public or private -- usually must declare a volunteer as such prior to an injury incident. Under the law, this declaration should be in writing through a resolution of the governing body of the organization or agency, such as its board of directors.

Unpaid internships are another volunteer opportunity the City can leverage, however, some criteria must be meet. California Labor Relations Department has provided some clarification regarding unpaid internships. Unpaid internships are a type of volunteering that is intended to provide educational opportunities -- and in some cases, school credit -- for volunteers. As of April 2010, the California Labor Relations Department applies six criteria based on federal law when determining the legality of an unpaid internship: 1) the experience must resemble those of vocational schools, 2) the experience is primarily for the benefit of the intern, 3) the intern does not displace a regular employee, 4) the intern's services provide no immediate advantage to the employer, 5) the intern is not entitled to a job at the end of his internship, and 6) both the employer and intern have a mutual understanding that no compensation is expected for the internship.

4.1.4 MUTUAL AID

The City of Redlands has several mutual aid agreements; most focused on emergency management. An emergency management mutual aid agreement defines and formalizes the arrangement to lend assistance across jurisdictional boundaries in situations that exhausted internal resources or there is a need for increased capabilities. Some of the City of Redlands mutual aid agreements are with the state of California. This enables the state to either request or fulfill requests for mutual aid from one region to another; enabling locals to maintain readiness in their region.

4.1.5 PARTNERSHIPS

The City of Redlands has the ability to enter into partnerships with surrounding cities and counties, and outside agencies, special districts, and companies. Partnerships are an arrangement where parties agree to cooperate to advance their mutual interests. In most cases partnerships are done through a

Memorandum of Understanding (MOU) outlining the scope of work, the mission, and roles and responsibilities.

4.2 Mitigation Governance Resources

There are a variety of governance directly related to or influence mitigation efforts. This governance generally falls under: 1) Laws, Regulations, Codes, and Ordinances; 2) Plans, Studies, and Reports; and, 3) Programs. While the intent is to capture City-level information, there are some state-level and/or county-level information that has direct implications on the City. To ensure there is a comprehensive list of governance, relevant state-level and/or county-level information is also captured.

4.2.1 Laws, Regulations, Codes, and Ordinances

Title: Senate Bill (SB) 379
Sponsor: State of California, Senate
Description: In 2017, the California State Senate approved Senate Bill (SB) 379 which requires the General Plan's Safety Element to address climate adaptation and resilience strategies. This must be done after the next revision to the Local Hazard Mitigation Plan (LHMP) or by January 2022 if the city/county does not have a LHMP. If the jurisdiction has an approved and adopted LHMP it can be summarized and incorporated by reference into the Safety Element.

Title: Assembly Bill (SB) 477
Sponsor: State of California, Assembly
Description: In 2019, the California State Assembly approved Assembly Bill (AB) 477. AB 477 requires local jurisdictions (cities/counties) to include representatives from the access and functional needs population in the next update of the Emergency Plan. The primary focus areas include, but are not limited to: emergency communications, emergency evacuations, and emergency sheltering.

Title: Assemble Bill (AB) 2140
Sponsor: State of California, Assembly
Description: In 2006, the California State Assembly approved Assembly Bill (AB) 2140. AB 2140 enables the state of California to provide greater than 75% of the eligible state share if a local jurisdiction (city/county) has an approved and adopted LHMP as part of the General Plan's Safety Element.

Title: California Building Codes
Sponsor: State of California
Description: The City abides by and is governed by California 2010 Building Codes adopted in February 2014, including sections on electric, plumbing, mechanical, green, and residential requirements, standards and regulations.

Title: San Bernardino County Building Codes
Sponsor: San Bernardino County
Description: An amendment to Title 6 of the County of San Bernardino Building Code to adopt by reference the 2010 Editions of the California Building Standards Codes became effective on January 2011.

Title: California Zoning Ordinance
Sponsor: State of California
Description: The City has adopted a Zoning Ordinances as part of the General Plan process. These ordinances regulate land use and map the official land use and hazard overlay districts, to include safety hazard and environmental protection areas.

Title: Model Water Efficient Landscape Ordinance
Sponsor: State of California
Description: Over the years, the State of California has been promoting water conservation for all new development within the State. In a drought-prone California, where approximately 60 percent of all residential water is used in landscape applications, California lawmakers have adopted such legislation as Assembly Bill (AB) 325 (1990), AB 2717 (2004), and AB 1881 (2006) that outline, and in some instances mandate, the practice of water conservation in landscape applications. As part of AB 325, the Department of Water Resources (DWR) prepare and promote the State's first Model Water Efficient Landscape Ordinance (MWELO). In 2006, State lawmakers adopted AB 1881, which gave guidelines and timelines for revision of the State's MWELO and mandated that every city, county, or other agency within the State of California adopt the State's revised MWELO, or be in compliance with it through their own ordinance, by January 2010. San Bernardino County has adopted and revise Development Code Chapter 83.10 which sets forth landscaping and irrigation standards within the unincorporated areas of the County.

Title: Emergency Planning and Community Right-to-Know Act
Sponsor: State of California
Description: The Emergency Planning and Community Right-to-Know Act (EPCRA) was created to help communities plan for emergencies involving hazardous substances. EPCRA has four (4) major provisions: one (1) deals with emergency planning and three (3) deal with chemical reporting. EPCRA local emergency planning requirements (Sections 301 to 303) stipulate that every community in the United States must be part of a comprehensive emergency response plan. Facilities are required to participate in the planning process. State Emergency Response Commissions (SERCs) oversee the implementation of EPCRA requirements in each state.

Title: Hazard Mitigation Plan Ordinance
Sponsor: City of Redlands
Description: The City of Redlands has adopted Ordinances 2639 and 2485 that require the emergency services chief to be responsible for the development and update of the City of Redlands Emergency Multi-hazard Functional Plan and Hazard Mitigation Plan. Emergency Multi-hazard Functional Plan shall provide for the effective mobilization of all of the resources of the City, both public and private, to meet any condition constituting a local emergency, state of emergency, or state of war emergency. Both plans shall take effect upon adoption by resolution of the city council. (Ord. 2639 § 3, 2006: Ord. 2485 § 4 [5], 2002). The City of Redlands Title 2 – Administration and Personnel Chapter 2.52.150 – Emergency Organization Ordinance 2639).

4.2.2 Plans, Reports, Studies

Title: General Plan and Environmental Impact Report
Sponsor: City of Redlands
Description: All cities and counties in California are required to adopt a General Plan that lays out major policy goals. The General Plan includes elements, which are sections that address a variety of important topics. The element most closely related to Mitigation is the Safety and Hazardous Waste Element, which focuses on natural, technological, and other human caused hazards. The aim of the Safety and Hazardous Waste Element is to reduce the potential risk of death, injury, property damage, and economic and social dislocation resulting from fires, floods, earthquakes, landslides, and other hazards. The Safety and Hazardous Waste Element identifies all significant hazards and risks in a community and defines policies to mitigate and respond to those risks. In addition to ensuring that the General Plan incorporates information from the LHMP in to the Safety Element, the General Plan is also reviewed while producing the LHMP to ensure goals, objectives, and mitigation actions are compatible and in sync with each other.

Title: Emergency Operations Plan
Sponsor: City of Redlands
Description: all-hazard plan describing how the City will organize and respond to incidents. It is based on and is compatible with the laws, regulations, plans, and policies listed above. The Emergency Operations Plan (EOP) also addresses the integration and coordination of resources and activities with other Governmental Agencies, Special Districts, and private-sector partners.

Title: Transit Villages Specific Plan
Sponsor: City of Redlands
Description: This Specific Plan provides a "*road map*" for the growth and change for the plan area until the year 2040. It is comprised of unique and customized standards that enable the City to shape or reshape its streets and public spaces and property owners to develop or redevelop their properties according to the vision of the Specific Plan. The Specific Plan area is generally bound to the west by Kansas Street, Redlands Boulevard, Alabama Street, and Tennessee Street; to the north by the I-10 Freeway, Colton Avenue, and Sylvan Boulevard; to the east by Judson Street; and the south by Citrus Avenue, Central Avenue, Redlands Boulevard, Olive Avenue, Brookside Avenues, Ash Street, Pine Avenue, Tennessee Street, and State Street.

Title: Drainage Master Plan
Sponsor: City of Redlands
Description: The Master Plan of Storm Drainage covers the City and adjacent areas that are tributary to the major regional flood control facilities that traverse through the City. The City of Redlands has a long history of flooding during moderate to severe storm events. One of the main causes for flooding is the lack of conveyance capacity in the historical channel of Mission Zanja (Zanja). The Zanja, formerly known as the Mill Creek Zanja, is a surface channel that flows from the Crafton Hills area, west to 9th Street, near downtown Redlands, where it transitions into a box culvert. The Zanja was built by the natives in 1819 as a water-supply, irrigation ditch, pulling flows from Mill Creek. Due to extensive flooding and development, the diversion of flow from Mill Creek was blocked. Nonetheless, the Zanja was never improved to convey local storm flows and the drainage area tributary to the 9th Street storm drain still produces flows that far exceed the capacity of the box culvert, causing extensive flooding through the downtown area.

Title: Strategic Plan: 2014-2017
Sponsor: City of Redlands
Description: Utilizing the City Council's five (5) priority focus areas of Fiscal Accountability, Economic Development, Infrastructure, Land Resource Management, Safety and Community Services, the Strategic Plan highlights activities and accomplishments that City staff will complete in the coming three years.

Title: Existing Conditions Report
Sponsor: City of Redlands
Description: Part of the General Plan. Used to provide background information and technical analysis to inform the planning process. The report describes Redlands' planning context and delves into the topics of land use and development; growth management; demographics and economics; community design; transportation and circulation; parks, recreation, and open space; historic resources; biological resources; hazards; public utilities and services; and noise.

Title: Downtown Specific Plan
Sponsor: City of Redlands
Description: The plan's primary goal is to support the economic vitality of Downtown Redlands, and it seeks to facilitate the development of financial, technical, professional and research-development offices and services Downtown, supported by retail, restaurants, entertainment, and cultural activities. Downtown Specific Plan covers a larger area, including residential and civic areas in south Downtown. The

plan also has a new emphasis on mixed-use and transit-oriented development, including guidelines to ensure compatibility with historic buildings. The plan identifies districts and corridors, and provides direction for vehicle and pedestrian circulation, and pedestrian-oriented street design.

Title: East Valley Corridor Specific Plan
Sponsor: City of Redlands
Description: aims to strengthen the local economy, attract major businesses, and result in the orderly and aesthetic development of industrial, commercial, and residential areas in the East Valley Corridor Specific Plan (EVCSP) plan area. The EVCSP plan area is composed of 4,350 acres adjacent to I-10 and I-210, and includes portions of the City of Redlands and the City of Loma Linda, as well as unincorporated area under jurisdiction of San Bernardino County (the "Donut Hole") surrounded by the City of Redlands.

Title: Community Sustainability Plan
Sponsor: City of Redlands
Description: intended as a conceptual framework for sustainability policy related to water conservation, green buildings, waste reduction, climate friendly purchasing, renewable energy, carbon emissions, and land use.

Title: Economic Development Action Plan
Sponsor: City of Redlands
Description: identifies strategies to attract businesses to Redlands, retain and expand existing businesses, develop a skilled workforce, and market Redlands to visitors.

Title: Redlands Municipal Airport Master Plan
Sponsor: City of Redlands
Description: Plan in order to preserve investment in the airport, reflect community needs, attract airport tenants and users, preserve the environment, strengthen the economy, and ensure safety.

Title: Climate Action Plan
Sponsor: City of Redlands
Description: demonstrate how the City will comply with State of California's Green House Gas (GHG) emission reduction standards. As a Qualified GHG Reduction Strategy, the CAP will also enable streamlined environmental review of future development projects, in accordance with the California Environmental Quality Act (CEQA)

Title: San Bernardino County Desert Area Groundwater Inventory and Atlas
Sponsor: San Bernardino County Fire Department OES
Description: The San Bernardino County Desert Area Groundwater Inventory (DGI) and Atlas includes a database providing locational and water depth information for specific regions of the County that currently do not have a groundwater inventory. This DGI and Atlas provides information applicable for flood mitigation or ground water availability for usage during severe drought. The location and water depth in the inventory are important for an earthquake hazard analysis, if liquefaction potential exists. California Department of Water Resources will give priority to local agencies with adopted groundwater management plans (SB1938 compliant), and which demonstrate collaboration with other local agencies in managing groundwater basins. County's groundwater management ordinance satisfies this requirement.

Title: Drainage Studies
Sponsor: San Bernardino County Public Works-Solid Waste Management Division
Description: Drainage studies including review of upstream properties, site drainage area, potential upstream development, and site-specific development will help to mitigate damage from future storm events. San Bernardino County owns landfill sites, transfer stations and closed disposal sites where

combined site property totals several hundred acres. Landfills and disposal site properties include acreage that has been constructed to design grades and may include improved drainage systems. Also, within most landfill and disposal site properties there are many acres of property that remain in its natural state including native vegetation and natural grades. During severe weather events both engineered areas and undisturbed areas are subject to erosion from storm run-off. The erosion can range from minor to severe depending on the storm event and amount of precipitation. Most sites where engineered drainage systems are in place hold up well experiencing only minor erosion and debris flow. However, during major storm events, runoff from native and unimproved areas carrying solids and debris flow may compromise downstream drainage systems and overwhelm system facilities.

Title: Mass Care and Shelter Plan Concept of Operations
Sponsor: San Bernardino County Fire Department OES/ American Red Cross
Description: Outlines the framework of a new one-stop shelter concept, Shelter Operations Compound (SHOC). It combines a shelter, a Local Assistance Center (LAC) and a Non- LAC Unit in one easy location. Residents can access public information and referral services through the LAC, and then take a short walk to the Non-LAC Unit for communication, postal services, and other private organizations/business at little to no cost. The ConOps also helped to sync local resources, encourage local self-sufficiency, foster partnership between public and private agencies, and serve as a reference document for the region.

Title: Water Conservation Plan
Sponsor: City of Redlands
Description: Chapter 13.06 of the Redlands Municipal Code (RMC), provides guidance on how to reduce the nonessential use of water to conserve city water supplies, thereby minimizing the effect of a shortage of water supplies on city users. The water conservation plan here established is to: 1) protect the health, safety, and welfare of the citizens and property owners of the city; 2) assure the maximum beneficial use of city water supplies; and, 3) attempt to provide sufficient water supplies to meet the basic needs of human consumption, sanitation and fire protection.

4.2.3 PROGRAMS

The City of Redlands currently has the following mitigation programs to address the top Hazards which are Flood, Wildfire, Earthquakes, Drought and Hazardous Material.

Title: Flood Programs
Sponsor: City of Redlands
Description: The City has implemented the Flood Control, ADA Ramps, Sidewalks, Trees and Parks (FAST) Program to inform the City of Redlands residents of funding needs for critical infrastructure and to solicit residents' input regarding the preparation of a possible ballot measure to provide revenue to meet those needs. Community Outreach is done through CERT, Market night and Safety Fairs. There are also Pamphlets provided to residence on flood insurance, and flood preparedness. Redlands has committed to a variety of mitigation measures that will progressively lower flood insurance premiums for those residents whose properties are located within the floodplain and require the added level of insurance protection provided through the National Flood Insurance Program (NFIP). The City of Redlands has participated with the NFIP since 10/01/2007 and is a class 9. The City of Redlands sends out notifications to residents upon receipt of FEMA Letter of Map Revisions (LOMR) Letters. Residents that reside in flood prone zones are provided brochures about the NFIP. Public notices are published in the San Bernardino County Sun newspaper, Federal Register and Flood Hazard Mapping website. Our continued compliance include: community outreach, LOMR notifications, Flood Insurance brochure and provide FEMA Mapping tools and provide tools on City of Redlands website.

Title: Wildfire Program
Sponsor: City of Redlands
Description: The City has an on-going Vegetation Management and Weed Abatement Program to manage weeds and brush and provided the defensible space (100-foot clearance) for areas prone to wildfire due to high vegetation area.

Title: Earthquake/Geologic Hazard Program
Sponsor: City of Redlands
Description: Since 1982, the City of Redlands has participated in long term recovery programs for earthquakes, wildfires and floods. This program provides continued stability to sustain and continue infrastructure services.

Title: Drought Program
Sponsor: City of Redlands
Description: The City of Redlands is in the process of updating Ordinance 2151 Water Conservation Plan to address drought. The plan will implement a plan to conserve city water supplies, thereby minimizing the effect of a shortage of water supplies on city users.

Title: Hazardous Materials Program
Sponsor: City of Redlands
Description: The City of Redlands in coordination with the County of San Bernardino is providing an outreach program to limit the negative impacts associated with inappropriate discard of hazardous material into the environment. This outreach program will provide community awareness of how to dispose of the hazardous material. The outreach material will be provided at emergency preparedness fairs and fire safety fairs.

Title: Mass Care and Shelter Trailer/Cache Program
Sponsor: City of Redlands
Description: To increase Mass Care and Shelter capability of the county, grants from 2008-2009 Homeland Security Grant Program (HSGP) and 2009 Riverside Regional Urban Area Security Initiative (UASI) funded the Mass Care and Shelter Trailer/Cache Program. In December 2012, the program will have procured 36 trailers/caches equipped with mass care and shelter supplies, strategically placed throughout the County and ready for rapid deployment. It is expected to serve over 7,200 residents. In addition to enhancing the comfort levels of shelter residents, the program will produce standardized documents and protocols for procuring and maintaining Mass Care and Shelter trailers/caches. The City of Redlands obtained one of the 200 person trailers in December 2013.

Title: Disaster Council
Sponsor: City of Redlands
Description: In October 2013, the City of Redlands re-implemented its Disaster Council. The meetings are Chaired by the Mayor and Co-Chaired by the City Manager. Disaster Council meetings provide for communication and coordination between the public and private sectors in the City in analyzing and developing plans, projects, policies, and procedures for emergency operations.

Title: Community Emergency Response Team (CERT)
Sponsor: City of Redlands
Description: The City of Redlands recently re-implemented CERT training in October 2013. This three-day course will provide the citizens of Redlands the much-needed training to prepare in an event of emergency or a disaster. Currently, the city has 150 people trained in personal preparedness.

Title: Emergency Communications Group
Sponsor: City of Redlands

Description: This group is responsible for redundant emergency communications and provides supplemental communication assistance to City agencies in the event of a disaster, emergency, or other designated event. The Federal Communications Commission (FCC) in Part 97, Sub-part E of the Commission's Rules provide for the Radio Amateur Civil Emergency Service (RACES). The purpose of RACES is to provide communication support to government during periods of local, regional or national emergency.

4.3 TECHNICAL RESOURCES

4.3.1 PROFICIENCIES AND EXPERTISE

The City of Redlands has many proficiencies and expertise that can be leveraged in support of mitigation efforts. In addition to public safety and fire suppression capabilities, the City has access to staff with skills in Engineering/Construction, Planning, Environmental, Project/Grant Management, Economic Development, Debris Removal, HazMat Response, and Water resources.

4.3.2 TECHNOLOGY

As with many jurisdictions, the City of Redlands has been increasing its technology capabilities. This includes providing secure platforms to store and access information, means of ensuring continuity of government, and general technical support. A significant capability available to support mitigation efforts is the establishment of the Geographic Information Systems (GIS) group. GIS is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. By relating seemingly unrelated data, GIS can help individuals and organizations better understand spatial patterns and relationships. The GIS group is able to analyze and generate reports of critical data (land use, built environment, natural environment), able to demonstrate potential ramifications of actions or events, and generate graphic representation of results.

4.3.3 COMMUNICATIONS

The City of Redlands has several platforms to communicate with staff, surrounding jurisdictions, and the general public. In addition to the standard methods (telephone/cell phones, emails), the has inoperable communication capabilities (radio communications and satellite communications). In addition to the above, 2-way communications platforms, there are several "push" platforms that can be used. These consist of television, broadcast radio, websites, and social media (Facebook, Twitter, Instagram, Nextdoor).

The City of Redlands Emergency Notification System will communicate emergency and other urgent messages to residents and community members within Redlands. The system uses both text and voice messages to keep residents and community members in Redlands informed in case of emergencies that affect areas in which they live or work. With this information, residents and businesses can make arrangements to help ensure the safety of family members, employees, pets, and property in the event of fires, floods, earthquakes, or other types of disasters. In the event of an emergency, residents and community members will receive a message with the latest information and safety instructions. The system is programmed to know whether or not the message has been delivered to a person, recorded to voicemail, or was not delivered due to a telephone system error. The system will continue to attempt to deliver its message until the message is successfully delivered to a person, or until the message expires.

The system utilizes the area's 9-1-1 database, provided by the local telephone company, and thus is able to contact land-line telephones whether listed or unlisted.

4.4 FISCAL RESOURCES

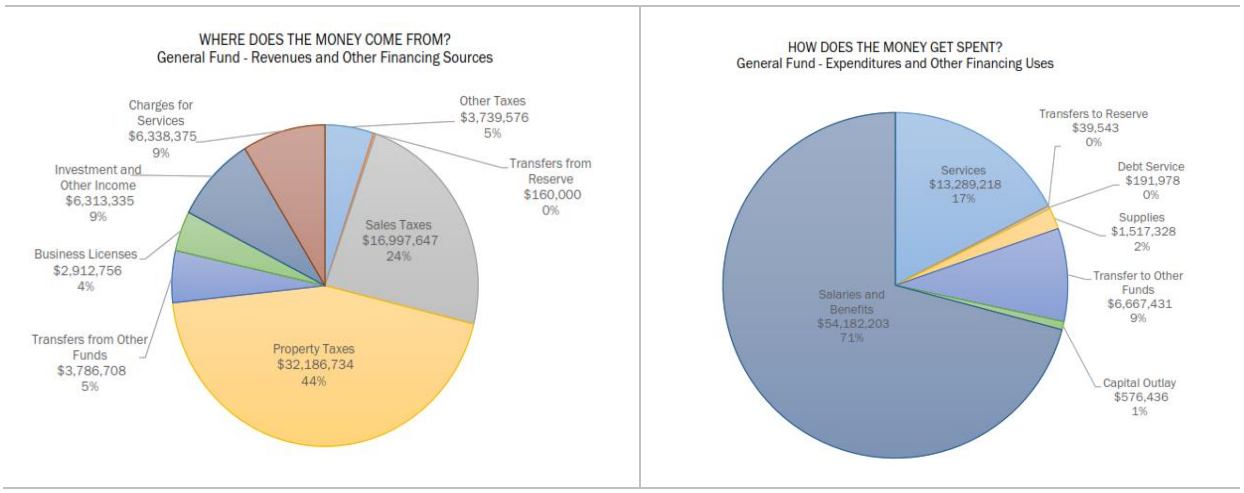
The financial resources of the City of Redlands are allocated to and accounted for in various funds based upon the purposes for which the funds are to be spent and the means by which spending activities are controlled. The varies funds include: Governmental Funds; Proprietary Funds; and, Fiduciary Funds.

- **Governmental Funds-** used for most of city governmental functions. There are four (4) types of Governmental Funds: General Fund; Special Fund; Debt Services Fund; and, Capital Project Funds.
  - *General Fund- the operating fund used to account for all activities, expect those requires to be accounted for in another fund*
  - *Special Fund- used for proceeds of specific revenue sources that are restricted to expenditures of special purposes*
  - *Debt Services Fund- used for accumulation of resources and the payment of principal, interest and related costs of general long-0term debt*
  - *Capital Project Funds- used for resources for the acquisition or construction of major capital facilities*
- **Proprietary Funds**- used for government's business-type activities. These funds recover the cost of providing services through fees and charges on those who use their services. There are two (2) types of Proprietary Funds: Enterprise Funds, and, Internal Services Funds.
  - *Enterprise Funds- used for services provided primarily to external customers and legal requirements or management policy required services, including capital, be fully recovered through fees and charges*
  - *Internal Services Funds- used for services provided to other funds, departments, or agencies of the government. Costs are allocated to the benefitting funds in the form of fees and charges in order to recover the full cost of providing services*
- **Fiduciary Funds**- used for assets held in a trustee or agency capacity for outside parties, including individuals, private organizations and other government.

4.4.1 GOVERNMENT FUND

The primary account under the Government Fund is the General Fund. Reallocation of the General Fund is the main source of funds the City can access to implement mitigation projects. The following figure from the Comprehensive Annual Financial Report (CARF) illustrate where the City of Redlands General Funds come from and how the General Fund money is spent (**Figure 4.2**).

Figure 4.2- City of Redlands General Fund Allocation



According to the CARF, by the end of June 2019, the total fund balance reported for the general fund was $39,647,517, an increase of $3.9 million, or 10.9%, from the prior year fund balance of $35,734,630. As a measure of the General Fund's liquidity, it can be useful to compare the total fund balance to total fund expenditures, which indicates that fund balance is 59.3% of general fund expenditures, however only $17,654,773 of the $39.6 million fund balance is unassigned. The unassigned fund balance of $17.7 million, together with the $8.3 million fund balance committed to stabilization arrangement (contingencies), is the only portion of fund balance readily available for spending and represents 39.1% of general fund expenditures. Total general fund expenditures this year were $66.3 million, which is 4.9% greater than the prior year amount of $63.3 million, and total General Fund revenues was $72.6 million, or 5.8% greater than the prior year amount of $68.6 million.

4.4.2 Proprietary and Fiduciary Funds

Other means to implementing mitigation projects is the utilization of Proprietary and Fiduciary Funds. While there are a variety of options that the City may be able to access under these funds, the primary funds will be those secured through project grants, such as the FEMA Hazard Mitigation Assistance (HMA) programs- Hazard Mitigation Grant Program- HMGP, Flood Mitigation Assistance- FMA, or Building Resilient Infrastructure and Communities- BRIC (formerly, the Pre-Disaster Mitigation- PDM program). Currently, other than the grant to fund the update of this LHMP, the City has not received any FEMA HMA grants over the past five (5) years.

5 HAZARD ASSESSMENT

5.1 OVERVIEW

The purpose of this section is to capture the approach used by the City of Redlands LHMP Planning Team to identify and prioritize (screen) hazards in its community. This is an important step to ensure all potential hazards are considered and relevant hazards ranked as to the greatest concern within the community.

This section also presents relevant information (profiles) on each hazard in the community. The "*Hazard Profiles*" provide a description of the hazard, the location and/or extent of the hazard within the community, the history of the hazard within the community, the probability of the hazard occurring in the community, and a discussion of any considerations needed due to changing conditions (i.e., climate). This information was referenced when prioritizing hazards.

5.2 HAZARD IDENTIFICATION

The Planning Team went through an extensive effort to identify all of the hazards present in the community. The Planning Team started with the list of hazards in the City of Redlands 2015 LHMP and augment the list as necessary. This augmentation considered both adding and removing of hazards to create a list of all potential hazards in the community. The Planning Team utilized several external resources to ensure they were considering all potential hazards. These resources included the State of California HMP (2018), the San Bernardino County OA LHMP (2017), and several other surrounding community LHMPs (i.e., Colton, Loma Linda, Yucaipa). This helped the Planning Team understand statewide, countywide, and surrounding area hazard concerns. Each hazard identified in the external resources were reviewed and considered by the Planning Team. After careful review and consideration, the Planning Team identified the following hazards for inclusion in the City of Redlands LHMP update:

- Aircraft Accident/Incident
- Civil Disturbance
- Dam Breach
- Drought
- Earthquake
- Energy Shortage/Power Outage
- Extreme Temperature
- Flood
- Hazardous Material Accident
- Infectious Disease
- Infestation
- Landslide
- Technology Disruption
- Terrorism
- Train Accident/Incident
- Wildfire
- Windstorm

As a note, no hazards from the City of Redlands 2015 LHMP were removed, however, the Planning Team added four (4) new hazards: *aircraft accident/incident*, *civil disturbance, technology disruption,* and *train*

accident/incident. It is also important to note that the Planning Team did revise the name and description of some hazards to provide more clarity and understanding of the hazard. This step also led to separating and creating distinct individual hazards (i.e., Power Outage/Excessive Heat). The changes to the hazard descriptions and other relevant hazard information are captured under sub section 5.4- *Hazard Profiles*.

5.3 HAZARD SCREENING AND PRIORITIZATION

After the list of hazards was identified, the Planning Team went through a process to prioritized (screened) the hazards to determine which hazards created the greatest concern in the community. The Planning Team utilized the same non-numerical ranking system that was implemented during the last update to the City of Redlands LHMP. This process consists of generating a qualitative ranking, High, Medium, or Low rating for: 1) *Probability*; and, 2) *Impact* from each hazard. As part of this process, the following criteria (definitions) were applied:

- **Probability**

  High: (Highly Likely/Likely) There may or may not have been historic occurrences of the hazard in the community or region but experts feel that it is likely that the hazard will occur in the community. Citizens feel that there is a likelihood of occurrence.

  Medium: (Possible) There may or may not have been a historic occurrence of the hazard in the community or region but experts feel that it is possible that the hazard could occur in the community. Citizens may feel that there is a likelihood of occurrence.

  Low: (Unlikely) There have been no historic occurrences of the hazard in the community or region and both experts and citizens agree that it is highly unlikely that the hazard will occur in the community.

- **Impact**

  High: (Catastrophic/Critical) Both experts and citizens feel that the consequences will be significant in terms of building damage and loss of life.

  Medium: (Limited, but not insignificant) Consequences are thought to be modest in terms of building damage and loss of life, limited either in geographic extent or magnitude.

  Low: (Negligible) Consequences are thought to be minimal in terms of building damage and loss of life, limited either in geographic extent or magnitude.

After each hazard was ranked using the above criteria, the results were displayed in a graph to assist the Planning Team validate the results (**Figure 5.1**). The Planning Team determined all hazards falling within the gray-colored boxes were Tier I priority hazards, those within the blue-colored boxes were Tier II priority hazards, and those within the white-colored boxes were Tier III priority hazards. The higher priority hazards (Tier I and Tier II), reflect those hazards the Planning Team determined the community should focus on over the next five (5) years. This does not mean that the community will not address the lower priority hazards. It means if resources are limited (i.e., funding, staffing), the primary focus will be on the higher priority hazards.

Figure 5.1- Hazard Prioritization Matrix

		Impact		
		High	**Medium**	**Low**
Probability	**High**	• Energy Shortage/Power Outage	• Wildfire • Windstorm	
	Medium	• Earthquake • Flood • Infectious Disease	• Aircraft Accident/Incident • HazMat Accident • Civil Disturbance • Landslide • Train Accident/Incident	• Drought • Infestation • Extreme Temperature
	Low	• Technology Disruption	• Terrorism • Dam Breach	

5.4 HAZARD PROFILES

The Hazard Profiles include the incorporation of all new information, material, and reports to better help the Planning Team and the community understand the hazard. The hazards are organized alphabetically by the priority screening ranking (i.e., Tier I, Tier II, and Tier III). The hazards assessed by the Planning Team are summarized below:

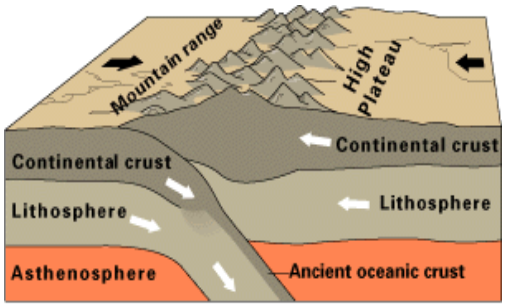
5.4.1 TIER I

The hazards, in alphabetical order, under Tier I include: Earthquake; Energy Shortage/Power Outage; Flood; Infectious Disease; Wildfire; and, Windstorm

5.4.1.1 EARTHQUAKE

- **Ranking-** *Probability*- Medium; *Impact*- High
- **Description**

An earthquake is caused by a release of strain within or along the edge of the Earth's tectonic plates, producing ground motion, surface fault rupture, and secondary hazards such as ground failure. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth as the huge plates that form the Earth's surface move slowly over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free causing the ground to shake. Most earthquakes occur at the boundaries where the plates meet; however, some earthquakes occur in the middle of plates.

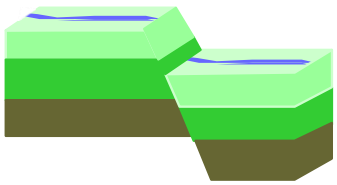


Continental-continental convergence

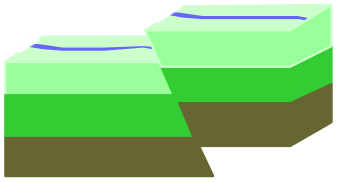
The severity of the shaking increases with the amount of energy released, decreases with distance from the causative fault or epicenter, and is amplified by soft soils. After just a few seconds, earthquakes can

cause massive damage and extensive casualties. A fault is a fracture between blocks of the earth's crust where either side moves relative to the other along a parallel plane to the fracture.

There are three (3) different types of earthquake faults: 1) Normal, 2) Thrust; and, 3) Strike-slip. Normal fault and Thrust faults are examples of dip-slip faults. Dip-slip faults are slanted fractures where the blocks mostly shift vertically. If the earth above an inclined fault moves down, the fault is called a normal fault, but when the rock above the fault moves up, the fault is called a reverse (or trust) fault. Thrust faults have a reverse fault with a dip of 45° or less.

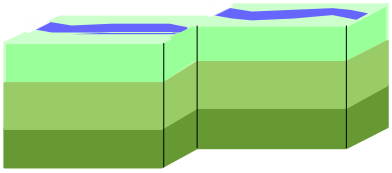


Normal Fault



Thrust Fault

Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observer's perspective, if the opposite block looking across the fault moves to the right, the slip style is called a right lateral fault; if the block moves left, the shift is called a left lateral fault.



Strike-slip Fault

The effect of an earthquake on various locations throughout the felt area is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction of property. The scale currently used in the United States is the Modified Mercalli Intensity (MMI) Scale (**Table 5.1**). It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale is composed of increasing levels of intensity designated by Roman numerals that range from imperceptible shaking (MMI I) to catastrophic destruction (MMI X). It does not have a mathematical basis; instead, it is an empirical scale based on observed effects.

Table 5.1- Modified Mercalli Intensity (MMI) Scale

Intensity	Shaking	Description
I	Not Felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop

VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent

However, most people are familiar with the Richter scale, a method of rating earthquakes based on the amplitude of seismic waves - an indirect measure of energy released (**Table 5.2**). The Richter scale is logarithmic. Each one-point increase corresponds to a 10-fold increase in the amplitude of the seismic shock waves and a 32-fold increase in energy released. For example, an earthquake registering magnitude 7.0 on the Richter scale releases over 1,000 times more energy than an earthquake registering magnitude 5.0. It should be noted that while an earthquake may have many intensity values across the impacted area, there is just one Richter magnitude associated with each event.

Table 5.2 Richter Scale

Magnitude	Earthquake Effects
0-1.9	*Micro*- Not felt by people
2.0-2.9	*Minor*- Felt by few people
3.0-3.9	*Minor*- Felt by some people, inside objective can be seen shaking
4.0-4.9	*Light*- Felt by most people, inside object shake and fall
5.0-5.9	*Moderate*- Felt by everyone, damage and possible collapse of unreinforced buildings
6.0-6.9	*Strong*- Felt by everyone, widespread shaking/damage, some buildings collapse
7.0-7.9	*Major*- Felt by everyone, widespread shaking/damage, many buildings collapse
8.0 or greater	*Great*- Felt by everyone, widespread shaking/damage, most buildings collapse

Ground shaking and ground deformation (i.e., surface fault rupture, landslides, and liquefaction) are the specific hazards associated with earthquakes. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, magnitude, and the type of earthquake.

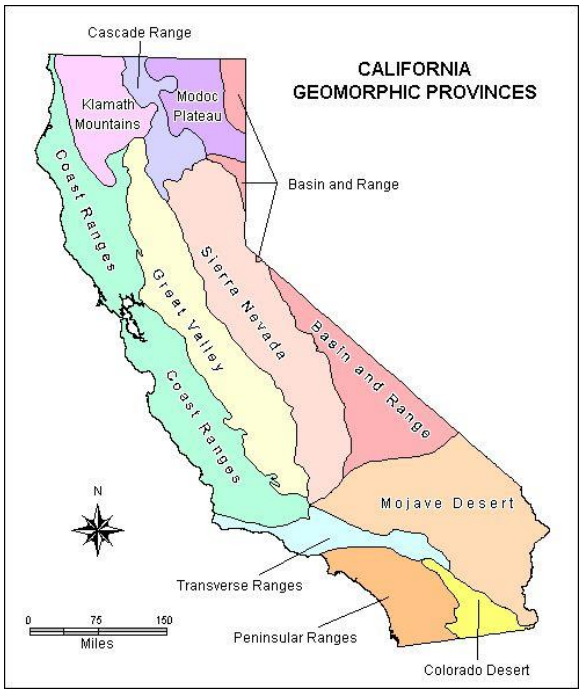
- *Ground Shaking*- Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, distance from the epicenter (where the earthquake originates), and local soil conditions. Soils and soft sedimentary rocks near the earth's surface can amplify earthquake ground shaking. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk. Amplification can also occur in areas with deep sediment filled basins and on

ridge tops. Peak Ground Acceleration (PGA) is a measure of the strength of ground shaking. Larger PGAs result in greater damage to structures. PGA is used to depict the risk of damage from future earthquakes by showing earthquake ground motions that have a specified probability (10%, 5%, or 2%) of being exceeded in 50 years return period. These values are often used for reference in construction design, and in assessing relative hazards when making economic and safety decisions.

- *Surface Fault Rupture*- As previously mentioned, the sudden sliding of one part of the earth's crust past another releases the vast store of elastic energy in the rocks as an earthquake. The resulting fracture is known as a fault, while the sliding movement of earth on either side of a fault is called fault rupture. Fault rupture generally begins below the ground surface at the earthquake hypocenter, typically between three and ten miles below the ground surface in California. If an earthquake is large enough, the fault rupture will reach the ground surface (referred to as "surface fault rupture"), wreaking havoc on structures built across its path. Structures built across the fault are a risk of significant damage from surface fault rupture. In California, the 1972 Alquist-Priola Earthquake Fault Zoning Act prohibits the siting of most structures for human occupancy across traces of active faults that constitute a potential hazard to structures from surface faulting. Recent large earthquakes in Turkey and Taiwan have shown that few structures built across the surface traces of faults can withstand the large displacements that may occur during an earthquake.
- *Landslides*- Earthquake-induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Many communities in Southern California have a high likelihood of encountering such risks, especially in areas with steep slopes. (NOTE: while mentioned here, landslides are covered under a separate hazards)
- *Liquefaction*- Liquefaction is the phenomenon that occurs when ground shaking causes loose, saturated soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop on gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength occurs when the soil supporting structures liquefy, causing the structures to settle, resulting in damage and, in some cases, collapse.

- **Location and Extent**

As noted by the California Geological Survey, California is divided into eleven (11) geomorphic provinces. California's geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. Each region displays unique, defining features based on geology, faults, topographic relief and climate. These geomorphic provinces are remarkably diverse. They provide spectacular vistas and unique opportunities to learn about earth's geologic processes and history. These geomorphic provinces each have the potential to create significant earthquakes and associated hazards. The City of Redlands is located in a high seismic activity zone in the Transverse Range geologic province. The Transverse Ranges are an east-west trending series of steep mountain ranges and valleys. The east-west structure of the Transverse Ranges is oblique to the normal northwest trend of coastal California, hence the name "Transverse." The province extends offshore to include San Miguel, Santa Rosa, and Santa Cruz islands. Its eastern extension, the San Bernardino Mountains, has been displaced to the south along the San Andreas Fault. Intense north-south compression is squeezing the Transverse Ranges. As a result, this is one of the most rapidly rising regions on earth. Great thicknesses of Cenozoic petroleum-rich sedimentary rocks have been folded and faulted, making this one of the important oil-producing areas in the United States.



The more significant faults within the region include the San Andreas Fault, the San Jacinto Fault, and the Crafton Hills Fault Zone. The City of Redlands is geographically located between active traces of the San Andreas Fault located to the northeast of the City, and the San Jacinto Fault located to the southwest of the City, with the Crafton Hills Fault Zone located southeastern of the city (**Figure 5.2**). The San Jacinto Fault forms the southwestern boundary of the San Bernardino Valley and intersects the City of Redlands at its southwest corner. The fault zone extends approximately 120 miles in distance from its point of origin in the San Bernardino Valley at the San Andreas Fault. The formation of this juncture exists within the geographical location of the Devore Pass. The southernmost section of the zone travels northwest of El Centro. The San Bernardino segment of the San Andreas Fault is located to the east of the City of Redlands. This 50 km segment is considered to be "*the currently active segment of the San Andreas fault system to the northwest of Gorgonio Pass*". The Crafton Hills Fault Zone is a series of normal faults, each about 10 km in length or less, located just to the east of the City of Redlands, between the San Jacinto and San Andreas Faults.

Figure 5.2- Earthquake Fault Zones in the Vicinity of the City of Redlands

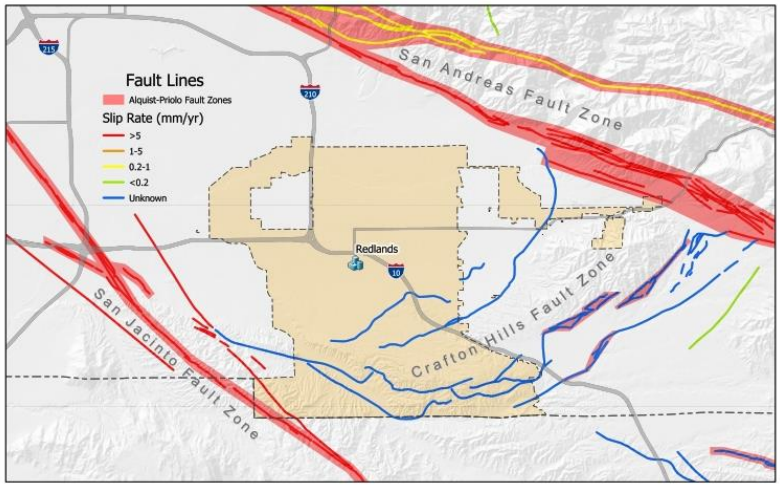
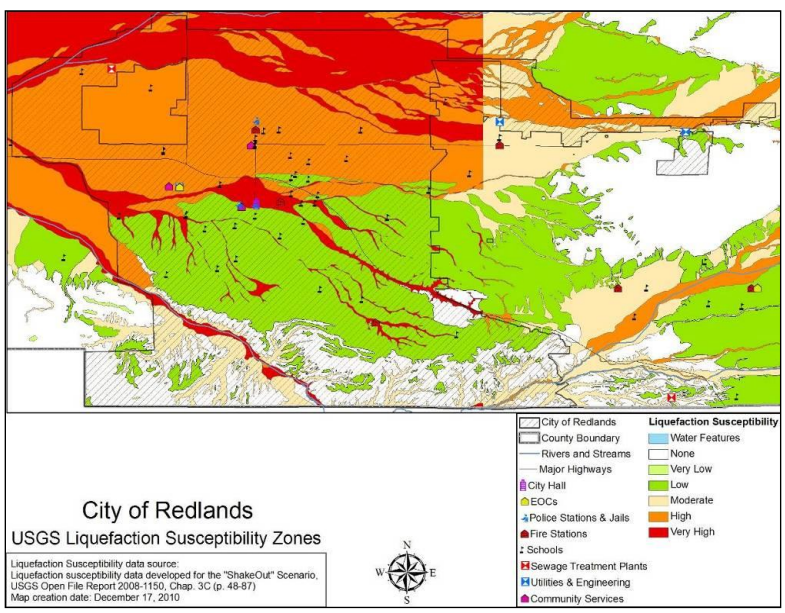


Figure 5.3 depicting the liquefaction susceptibility areas in the vicinity of the City of Redlands. There are considerable areas of Very High and High liquefaction susceptibility in areas of sandy soil associated with the Santa Ana River, the Mission Zanja, and San Timoteo Creek, but the City of Redlands is located within an area of Low landslide susceptibility.

Figure 5.3- Liquefaction Susceptibility in the Vicinity of the City of Redlands



- **History**

There are 45 states and territories in the United States at “moderate” to “very high” risk from earthquakes, and they are located in every region of the country. California experiences the most frequent damaging earthquakes; however, Alaska experiences the greatest number of large earthquakes—most located in uninhabited areas. The largest earthquakes felt in the United States were along the New Madrid Fault in Missouri, where a three-month long series of quakes from 1811 to 1812 included three quakes

larger than a magnitude of 8 on the Richter scale. These earthquakes were felt over the entire Eastern United States, with Missouri, Tennessee, Kentucky, Indiana, Illinois, Ohio, Alabama, Arkansas, and Mississippi experiencing the strongest ground shaking.

Historical and geological records show that California has a long history of seismic events (a list of significant earthquakes can be found in **Appendix 5**). In California, movement between the North American and the Pacific tectonic plates manifest primarily along a region known as the San Andreas Fault system. Experts believe the San Andreas Fault is capable of producing an earthquake of magnitude 8.0+ over the next few years. The San Andreas Fault is considered the "*Master Fault*" because it has frequent (geologically speaking), large earthquakes, and it controls the seismic hazard in southern California. Faults in the San Andreas Fault zone that passes through Los Angeles County are part of the very active southern segment. This segment includes historically active, active, potentially active, and inactive faults.

Southern California area has experienced several earthquakes, two very large earthquakes, the Fort Tejon in 1857 (M7.9) and the Owens Valley in 1872 (M7.6) are evidence of the tremendously damaging potential of earthquakes in Southern California. The Fort Tejon earthquake surface rupture broke the portions of the central and southern segments of the San Andreas Fault system (Cholame, Carrizo, and Mojave segments), resulting in displacements of as much as 27 feet (9 meters) along the rupture zone. These fault segments are thought to have an incident recurrence interval of between 104 and 296 years. The most recent significant earthquake event affecting the region was the Northridge Earthquake. At 4:31 A.M. on Monday, January 17, 1994, a very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures. Effects of the earthquake were felt north into Ventura County, south in Orange County, and east into Riverside and San Bernardino Counties.

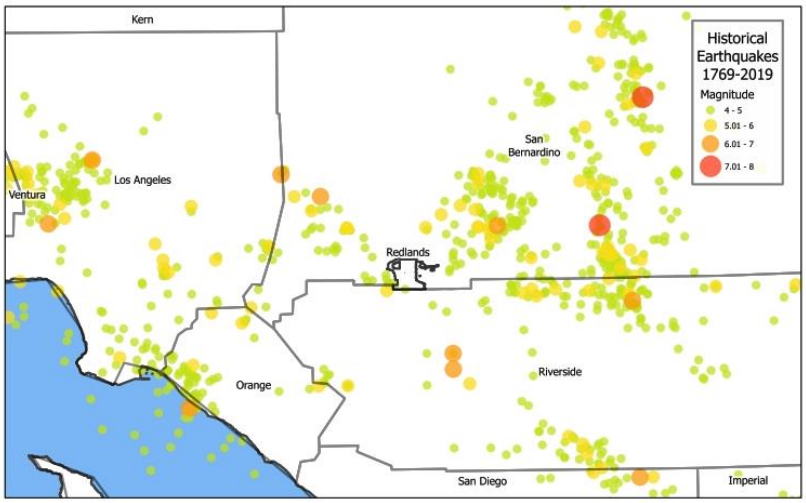
In June of 1992, the M7.3 Landers Earthquake ruptured 85 km (53 miles) along a series of faults in a roughly contiguous fault system, including the Johnson Valley, Landers, Homestead Valley, Emerson and Camp Rock faults. Strong shaking was felt in the City of Redlands. The largest aftershock of the Landers earthquake was the M6.4 Big Bear Earthquake, which caused damage and landslides in the Big Bear area. Declared as Disaster FEMA-947-DR CA, these earthquakes resulted in structural damage to many residential dwellings in Redlands, including chimneys and foundation slippage. Other significant earthquake events in the region included:

- *Newport-Inglewood Earthquake, 6.4m (1933)- 120 deaths, over $50 million in damage*
- *San Fernando (Sylmar) Earthquake, 6.5m (1971)- 65 deaths, over $500 million in damage*
- *Whittier Narrows Earthquake 5.9m (1987)- 8 deaths, over $358 million in damage*
- *Sierra Madre Earthquake 5.8m (1991)- 2 deaths, over $40 million in damage*
- *Chino Hills Earthquake 5.4m (2008)- no casualties and only minor damage*
- *City of Los Angeles Earthquake 4.7m (2009)- no casualties and minor to moderate damage*
- *El Mayor Cucapah Earthquake 7.2m (2010)- major damages to the area and Imperial County*
- *Calimesa 4.1m (2011)- no casualties and minor to moderate damage*
- *La Habra Earthquake 5.1m (2014)- no casualties and minor to moderate damage*
- *Fontana Earthquake 4.4m (2014)- no casualties and minor to moderate damage*
- *Running Springs 4.6m (2014)- no casualties and minor to moderate damage*
- *Fontana 4.2m (2015)- no casualties and minor to moderate damage*

- *Big Bear Lake 4.0m (2015)- no casualties and minor to moderate damage*
- *Muscoy 4.4m (2015)- no casualties and minor to moderate damage*
- *Banning 4.4m (2016)- no casualties and minor to moderate damage*
- *Cabazon 4.5m (2017)- no casualties and minor to moderate damage*
- *Big Bear 3.5m (2018)- no casualties and minor to moderate damage*
- *Trona (2019)- no casualties and minor to moderate damage*
- *Ridgecrest 7.1m (2019)- no casualties and minor to moderate damage*

Figure 5.4 displays historical epicenters of historical earthquakes located in southern California since 1568.

Figure 5.4- Historical Earthquakes in Southern California since 1568



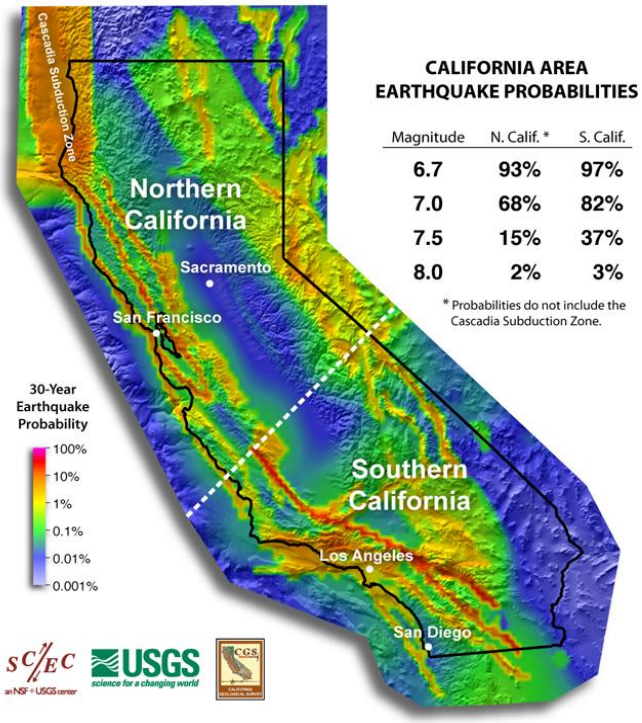
- **Probability**

Earthquakes strike suddenly, without warning. Earthquakes can occur at any time of the year and at any time of the day or night. On a yearly basis, 70 to 75 damaging earthquakes occur throughout the world. Recent estimates of expected annualized earthquake loss for the U.S. totals $5.3 billion per year, with 66% ($3.5 billion) concentrated within the State of California, and $397 million in Riverside and San Bernardino Counties (FEMA, 2008[1]).

The probability of a significant (M6.7 or greater) earthquake occurring in Southern California in the next 30 years has been estimated to be 97% by the 2007 California Working Group on Earthquake Probability, as shown in **Figure 5.5**. California Area 30-Year Earthquake Probabilities. (USGS Open-File Report 2007-1437)

Figure 5.5- California Area 30-Year Earthquake Probabilities

[1] "HAZUS®MH Estimated Annualized Earthquake Losses for the United States", FEMA 366, April, 2008.



- **Climate Change Considerations**

To date, no credible evidence has been provided that links climate to earthquakes. However, climate and weather does play a significant role in the response and recovery from earthquakes. Effects from climate change could create cascading complications and impacts.

5.4.1.2 ENERGY SHORTAGE/POWER OUTAGE

- **Ranking**- *Probability*- High; *Impact*- High
- **Description**

For the purposes of this LHMP, Energy Shortage/Power Outage hazards are confined to rolling blackouts or brownouts and Public Safety Power Shutdown (PSPS) events. While some accidents can cause energy shortage/power outage, they are usually smaller, localized events and are not part of this assessment. Additionally, Energy Shortage/Power Outage hazards can be consequences from other events. These energy shortage/power outage consequences are discussed under the primary hazard event (high winds, wildfire, earthquake). A brownout is a partial, temporary reduction in total system capacity, while a blackout is a complete interruption in power. A brownout is caused by high electricity demand that is near or above a utility's production capacity. When this occurs, the utility may reduce the flow of electricity to certain areas to prevent a blackout. The state of California has also implemented "Flex Alerts" to bring awareness to times in which supply and demand of power could become an issue. A blackout is a large-scale service interruption that can happen as a result of severe weather or equipment failure at power plants. There are several factors that can play into energy shortage/power outage: 1) increased demand within the city; and, 2) increased demand elsewhere. Because Southern California Edison is part of the

western power grid, increases in other parts in the west region could curtail the energy available to the City.

PSPS events are initiated by power utility companies and are implemented in response to severe weather events. The purpose is to mitigate the increased fire risk during "red flag" weather conditions. Red flag weather conditions include: high winds, low humidity, and high temperatures. By shutting off power, the utility companies are ensuring that electrical equipment, which can arc and spark, during severe events, will not exacerbate or start a fire.

- **Location and Extent**

An Energy Shortage/Power Outage events can occur throughout the entire city.

- **History**

Southern California has experienced a population growth over the years. This coupled with changes to daily life styles (heavier reliance on power) and changing weather patterns have contributed to a higher demand for power over recent years. Because of this, the City of Redlands, like other parts of California, have had energy shortage/power outage events related to the failure of the statewide or regional systems not being able to meet demand. The Energy Shortage/Power Outage events usually occur during the warmer summer months and have lasted for a few hours and in some cases days. Recently, the City has experienced several Energy Shortage/Power Outage events due to the power company's implementing PSPS events in response to Red Flag weather conditions. Similar to the power outage during the summer months, these PSPS energy shortage/power outage are relativity short in duration.

- **Probability**

There are no studies that predict the probability of Energy Shortage/Power Outage events; however, it is expected that there is a higher probability of events occurring during the warmer summer months and during Red Flag (high temperatures, low humidity, high wind) events.

- **Climate Change Considerations**

Climate can play a significant role in Energy Shortage/Power Outage events. As temperatures rise due to changing conditions, it will have significant impacts on energy supply and demand. Additionally, changing climate conditions can create more Red Flag events, causing the power companies to consider to turn off power to lessen the potential fire threat.

5.4.1.3 FLOOD

- **Ranking-** *Probability*- Medium; *Impact*- High
- **Description**

A flood is a temporary condition (short-duration or long-duration) of partial or complete inundation on land that is normally dry. This condition is generally caused by precipitation (i.e., rainfall). Several factors determine the severity of floods, including rainfall intensity and duration, antecedent moisture conditions, surface permeability, and geographic characteristics of the watershed such as shape and slope. Other causes of flooding can include a ruptured dam or levee, rapid ice or snow melting in the mountains, under-engineered infrastructure, or even a poorly placed beaver dam can overwhelm a river or channel and send

water spreading over adjacent land or floodplains. According to FEMA, there are several different types of floods and under some there are subtypes. The flooding types and subtypes include:

- *Riverine Flooding*- River/Stream Overbank Flooding, Flash Floods, Dam and Levee Failure, Alluvia Fans, Ice Jam Flooding, Moveable Bed Streams
- *Urban Drainage*- Drainage system capacity deficiencies
- *Ground Failures*- Mud flood and Mud flows, Subsidence, Liquefaction
  (*NOTE: while mentioned here, mud flows are covered under landslide hazards and Subsidence and Liquefaction hazards are covered under earthquake hazards*)
- *Fluctuating Lake Levels*- Increase volume caused by rain, snowmelt, and other runoffs
- *Coastal Flooding and Erosion- Storm Surge*

In California, some of the more common types of flooding fall under Riverine Flooding (i.e., flash flooding), Urban Flooding, and Coastal Flooding (i.e., storm surge). Floods can take several hours to days to develop. A flash flood is a flood occurring in a watershed where the time of travel of the peak of flow from one end of the watershed to the other is less than six hours. Coastal flooding occurs when storms produce large ocean waves that sweep across coastlines making landfall. The following flood characterization designates the amount of time for response:

- *Flood Watch*- a flood is possible in the area. Advanced warning
- *Flood Warning*- flooding is already occurring or will occur soon in the area. Advanced warning
- *Flash Flood Watch*- a flash flood is possible in the area. Little-to-no advanced warning
- *Flash Flood Warning*- flooding is already occurring or will occur soon in the area. Little-to-no advanced warning

- **Location and Extent**

The geographical location, climate, and topography of the City of Redlands make the city prone to flooding. In Redlands, floods usually occur during the winter "*wet*" season, the time of year with the highest precipitation totals or heavy rainfalls. During significant rainfall years, the season is characterized by high intensity rainfalls and rapid runoffs or discharge. These storm events have: inundate streams; flooded areas; create debris flows (i.e., sediment, rock, dead trees) that have plug culverts and damage bridges/overpasses; and/or, eroded or scared the landscape. The common type of flooding in the City of Redlands is:

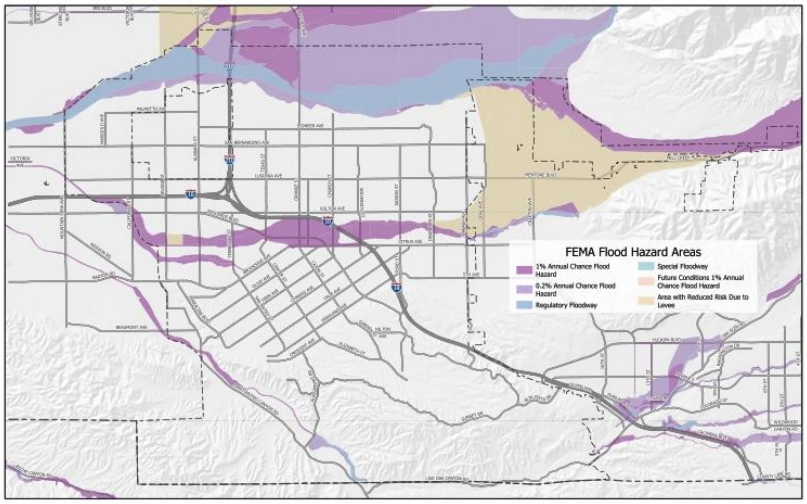
- *Alluvial Fan*- Alluvial fan flooding occurs in the steep arid or semiarid mountains found throughout California. Alluvial fans are fan-shaped deposits of eroded rock and soil carried out of mountains and into valley floors by landslides, mudslides, mudflows, and surface runoff. At the beginning of the valley, alluvial fans are steep and narrow with boulders and other coarse material. The deposited material becomes increasingly fine as the gradient decreases and the material, mainly gravels, sand and mud, spreads. When rain falls, runoff from the canyon walls flows as a high-velocity sheet that channels into rivulets, and then to natural drainage courses. The rapidly moving water often carries large boulders and other material from the watershed depositing them into runoff channels, blocking the flow of water. Floodwater then spills out onto the fan, with each event finding a new channel that

soon fills up with deposits and overflows. Flooding in alluvial fans often can cause greater damage than clear-water flooding.

- *Flash Flood*- A flash flood is a rapid flooding of low-lying areas, rivers and streams that is caused by the intense rainfall associated with a thunderstorm, or multiple thunderstorms. Flash floods also occur when a man-made structure, such as a dam, collapses. Flash flooding occurs when the ground under a storm becomes saturated with water so quickly that it cannot be absorbed. The runoff collects in low-lying areas and flows rapidly downhill. As a result, anything in its path is suddenly in rising water. A typical flash flood begins with a slow-moving thunderstorm. This usually takes longer to move out of the affected areas and causes the area to endure a greater amount of rainfall for a longer period of time. In addition, a thunderstorm may pass over an affected area repeatedly, dumping even more rainfall. A large amount of rainfall in a short time can result in flash flood conditions, as can a dam failure or other sudden spill. The National Weather Service's definition of a flash flood is a flood occurring in a watershed where the time of travel of the peak of flow from one end of the watershed to the other is less than six hours.
- *Urban Drainage*- The heavy rainfall associated with these storm systems contributes to urban flooding in a number of ways. Primarily, heavy rainfall will often overwhelm the capacity of the conventional drainage system made up of storm drains, catch basins, sewers, and additional natural mechanisms for storm-water management. These systems typically cannot handle more than one or two inches of rainfall per hour before they begin to backup and overflow. This amount is further diminished if the storm drains, and other components of the storm-water management system, have not been adequately maintained, are clogged with debris such as trash or natural waste, or are old and in a state of disrepair. Heavy rainfall, combined with storm-water runoff, can cause local waterways to rise and overflow their banks.

Four (4) streams drain Redlands, each of which represents a potential flood hazard at peak flows; 1) the Santa Ana River/Mill Creek (located at the northern edge of the City), 2) the Mission Zanja (also known as Mill Creek Zanja and Mission Storm Drain), 3) San Timoteo Creek and 4) Live Oak Creek. The Santa Ana River/Mill Creek emerges from its mountain canyon 5 miles northeast of Redlands, spreads out in shallow, braided channels more than a 1.5-mile-wide wash, mantled with fluvial debris. The Mission Zanja (in the southwest part of the City) was constructed for water supply in 1819. Diverting water from Mill Creek, the Zanja carried water for 12 miles to support the San Bernardino Assistance and surrounding farms and ranches. Today, as it traverses an east/west direction, the Zanja drains major portions of the City through various storm drain systems. Taking into account these features and other factors, FEMA has developed Flood Hazard Maps. The most common flood hazard map is the Federal Emergency Management Agency (FEMA) 100-year flood zone map (**Figure 5.6**). The 100-year flood zone map depicts areas within the City of Redlands that may be prone to flooding.

Figure 5.6- FEMA Flood Hazard Areas for the City of Redlands



The flood hazard zones depicted on the map are derived from FEMA Flood Insurance Rate Maps (FIRM) and indicate the probability of flooding happening over a given period of time. FEMA National Flood Insurance Program (NFIP) produces FIRMs. The FIRM identifies potential flood risk in geographic areas. The FIRMs are the official map of a community on which FEMA has delineated both the special flood hazard areas and the risk premium zones applicable to the community. Historically, FIRMs were produced on paper; however, over recent years FEMA has begun the process of creating digital versions- *DFIRM*. Because of the volume of area, not all FIRMs have been digitized. Due to the limited detail and large scale of the base maps used for most FIRMs, much interpolation between contour lines is done in mapping the floodplain boundaries. This is why you may find discrepancies when actual ground elevations are surveyed: the maps are just the best available graphic representations of the Base Flood Elevations (BFEs). Definitions of flood zone designations are provided in **Table 5.3**.

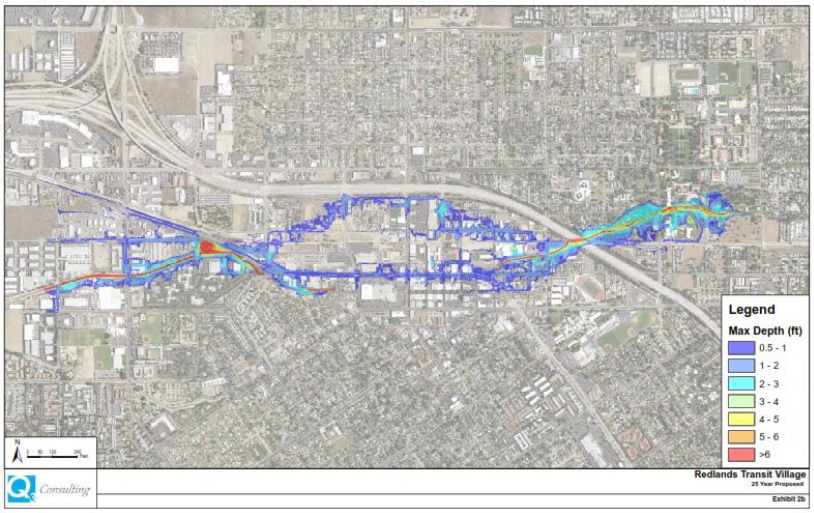
Table 5.3- FEMA Flood Zone Designations

Risk Level	Flood Zone	Description
High	A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
	AE	The base floodplain where base flood elevations are provided.
	AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
	AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
Moderate to Low	X (Shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods.
	X (Unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.
Undetermined	D	Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

The City of Redlands has also conducted focused flood studies in the area; the majority of which are for the downtown area. The most recent work was done to augment the Redlands Master Plan of Drainage, to better understand the extents of flooding under the proposed Transit village Specific Plan project. Redlands Master Plan of Drainage utilized the Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) to identify flooding potential in the downtown area. Inputs into the model included the then-planned Opal Basin. Because the Opal Basin was not realized and there was a need to expand the downtown area under the Redlands Master Plan of Drainage, another EPA SWMM was run. The results of the expanded EPA SWMM run for downtown Redlands is depicted in **Figure 5.7** and **Figure 5.8**.

Figure 5.7- Redlands Transit Village- 100-year Proposed

Figure 5.8- Redlands Transit Village- 25-year Proposed



- **History**

While not always a significant event, floods inundate portions of the City of Redlands almost every year. In 1965, 1966, 1969, 1976, 1980, 1992, 1993, and 1995 the flood waters from the upper regions of the Santa Ana River/Mill Creek were responsible for extensive damage to Orange Street and Alabama Street, ranging from washouts from five to six-foot high flood waters, to extensive, permanent damages from uncontrollable runoff from the upper regions of the San Bernardino mountains. The following information, provides a summary of the historic significant flooding events in the City of Redlands.

- *FEMA 1952-DR-CA*- (January 2011) The City of Redlands sustained more than 600,000 in damages costs associated with Emergency Protection and debris removal. The amounts included salaries, benefits, overtime and other professional and special contractual services for repairs and maintenance supplies. Several repairs of damages in various locations in the amount of $282, 050; $7,870 for repairs of damages on Bond Avenue, Fern Avenue, and Brookside Avenue; $4,000 with for geologic evaluations services; $10,722 for restriping San Timoteo Road from Alessandro Road to Fern Street; $12, 585 for emergency street sweeping of San Timoteo Canyon; and $6,487 for surfacing of damaged playground at Jennie Davis Park.

- *FEMA 1884-DR-CA*- (March 2010) The City of Redlands sustained a significant amount of damage due to the heavy rains and associated flooding.
- *FEMA 1577-DR-CA*- (December 27, 2004) The City of Redlands sustained over $40,000 in damages were sustained as a result of the storm.
- *FEMA 1203-DR-CA*- (February 1998) Redlands experienced a continuing series of storms. On February 27 and 28, 1998, the strongest storm created a 2-day event that resulted in considerable damage and private property loss.
- *FEMA 1046-DR-CA*- (March 1995) The second storm series resulted in more than $12,000 in damage. The most significant damage, however, was the loss of the temporary emergency crossings at Orange and Alabama Streets. Warm tropical rain, coupled with an extreme snowmelt, created severe flooding conditions in the Santa Ana River. Mud, debris, and boulders swept away both roads, which were replaced in 1993 (FEMA 979) at a cost of $570,000.
- *FEMA 979-DR-CA*- (January 1993) Produced the most significant damage to the City of Redlands in recent history. Recurrent flooding during the months of December through March resulted in an over saturation of soil which promoted long-term effects of storm waters in the City and region. Tropical rains melted a heavy snow pack at the higher elevations, producing increased flood activity. With approximately $6.5 Million in damages, but no loss of life, these storms finally claimed both the Alabama Street and Orange Street bridges. The Mission Zanja again produced flooding along its banks at Sylvan Blvd. and Judson Street, resulting in channel improvements at that intersection. Partial collapse of the Zanja occurred again in Sylvan Park. Landslides crushed the Monkey Face Falls waterline, which provides water to residents of Mountain Home Village. One additional water line, serving sparse residences north of the Santa Ana River, was washed out. Repair was affected in October 1993, following subsidence of the Santa Ana River. Several city-owned buildings sustained water damage, including the Smiley Library, which is on the National Register of Historic Places. Landslides occurred in the San Timoteo/Live Oak Canyon area, resulting in road closures for a portion of the three-month Declaration period.
- *FEMA 935-DR-CA*- (February 1992) significant flooding occurred as a result of major storm systems moving through Southern California. The three-day storm system produced most of the 14.96 rainfalls for 1991-92. Historically, the Santa Ana River and Mission Zanja were the cause of the most significant damages, and due to extensive build out of the southeast area, storm runoff produced increased flooding of the Country Club area. Most significantly, water run-off from the populated Country Club area traversed a private elementary school as well as Ford Street and developed subdivisions to the north. School property was damaged as a result of flood waters flowing through the school's parking lot and only street entrance, resulting in a lawsuit against the City. The Bear Valley Pipeline, generally located in Mill Creek near Greenspot Road and Florida Street, sustained damage to approximately 400 feet of steel pipe and supports. There was no loss of life or public property.
- *February 1980 Floods*- produced a mirror image of prior floods, as extensive damage again occurred as a result of rising storm waters and runoff from the upper regions of the Santa Ana River. The Santa Ana River at Alabama Street changed course and completely washed out the road in two locations, plugged existing culverts, eroded shoulders at various locations, scoured the existing A.C. pavement and washed out the existing pipe on the north end of the river. Minor erosion damage occurred on various City streets and some private property. The

Zanja experienced collapse between Redlands Boulevard and State Street near Kendall Drive, as well as in a portion of the channel in Sylvan Park.

- *September 1976 Flood*- an intense local thunderstorm dropped most of its precipitation in a 20-30-minute period. At one spot, 3 ½ inches of rain fell during this time. This heavy rain produced an extremely high rate of runoff, which quickly exceeded the capacity of local drainage systems. Major overflows occurred on the eastern edge of Redlands' downtown business district, flooding the area and depositing mud up to three feet deep. Damages to houses, businesses, roads, and flood control facilities reached $2 million. Mission Zanja overflowed again in 1978, depositing water up to 30 inches deep in some places.
- *Flood of January 1969*- The storms and floods caused the deaths of at least 13 persons. "An intense downpour on January 25, 1969, climaxed a nine-day period of heavy precipitation. From 10 to 20 inches of rain fell in the lowlands, from 25 to more than 50 inches in the mountains. Emergency crews prevented large property damage with sandbagging and other emergency work. Flooding could have been worse, but the ground was not saturated prior to the storms, so water was able to percolate into the ground.
- *February 1969 Flood*- Occurred one month after the January storm series hit. Since the ground was by then saturated, property damage was more severe. The runoff from the storms resulted in the greatest flood of record on many streams in the upper Santa Ana River basin. Flooding from Mission Zanja deposited debris on streets, eroded road shoulders and parts of the Zanja's rock and mortar channel, washed out the bridge at New Jersey Street, damaged several residences, and inundated four citrus packing plans and several commercial businesses. Estimated damages were $304,000." (US Army Corps of Engineers, LA District, Information Bulletin, July 1984.) Flood damages in San Bernardino County from both floods were more than $54,000,000. Damages to residential property in the County were widespread. Damages in the Cucamonga area were particularly heavy: hundreds of people were forced to leave their homes – some for as long as 3 months. Damages to businesses and industrial property in San Bernardino County also were great. Agricultural losses were very severe. Flood damaged sewer lines and sewage-treatment plants posed a threat to the lives and health of many residents of San Bernardino County.
- *OEP-233-DR*- (December 1966) a series of three storms swept through San Bernardino County. December recorded the fourth most severe rainfall period in 76 years of San Bernardino rainfall history with a near-record 4.23. Nearly one-half mile of Alabama Street was washed out during flows up to five feet deep. Violent flows from the Santa Ana River also severely eroded the north levee protecting the Redlands Sewage Treatment Plant. The Zanja again overflowed east of Wabash Avenue, poured through an orange grove and flooded the Crafton School Yard. The University area, as well as the Central Business District, was layered with tons of mud and debris. The north approach to the Kansas Street Bridge was washed away, and flows undercut the abutment, dropping the north end of the bridge about two feet. The bridges at both Iowa and New Jersey Streets suffered similar damages.
- *OEP-211-DR*- (November 1965) a series of five storm periods, ranging from light to severe, inflicted extensive damage in the region. The most severe of these storms occurred between November 20 and 25, when 11 deaths (6 in San Bernardino County) were attributed to the storms. Property damage estimates greater than $11 million were recorded. Within Redlands' jurisdiction, Alabama Street suffered extensive damage due to flood waters from the upper regions of the Santa Ana River/Mill Creek. Resultant flows put the Redlands Sewage

Treatment Plan out of operation, took the city's largest water reservoir off line and produced significant damage throughout the northern portion of Redlands and its Central Business District. The Mission Zanja Creek, which flows through Redlands from a controlled diversion of Mill Creek for irrigation purposes, produced significant levels of mud and debris deposits, and flooded homes along Sylvan Boulevard. Water carried tons of mud from construction-bared slopes along Palo Alto Drive across Country Club Drive and through the storm drain channel, which bisects the golf course. Many intersections throughout the City were flooded, with gutters filled to overflowing with heavy runoff. Floodwater from the overflow of the Zanja flooded the basement of the Crafton Elementary School.

- *November 1965 Flood*- a damaging general storm occurred throughout Southern California, following on the heels of a smaller general storm, which occurred about a week earlier. The antecedent rainfall conditions from the earlier storm left watersheds with a residual moisture content in the soils thus contributing to the accelerated runoff that occurred as a result of the intense precipitation. Above freezing temperatures in the mountain areas further contributed to increased runoff. Major flood-producing waters emanated from the highest watersheds in the 10,000-foot ranges. The storm has been placed in the category of a small flood likely to recur every 5-15 years. Mill Creek flow was of about a 15-year frequency, the Santa Ana Canyon flow about a 5-year frequency, and Cucamonga Creek somewhat greater that a 10-year frequency.
- *August 1965 Flood*- In what was called an “electrifying” flash flood, muddy water cascaded destructively through the City’s streets. The muddy runoff overtaxed the capacities of storm drains and spewed across streets and highways into low-lying areas. Water swept into the basements of the Crafton and Kingsbury schools and flowed through the lobby of Provident Federal Savings at Orange and State and into the basement where the vaults were flooded. Two youths were rescued after they were swept 1 ¾ miles along a storm drain system, portions of which are buried pipe extending through downtown Redlands.
- *April 1965 Flood*- During this flood event, fast-moving water spilled out of the debris-choked channel in numerous spots, creating a serious flood hazard to low-lying homes between Dearborn and University Streets. City officials generally blamed poor maintenance of the Zanja for the flood. One house at Lincoln and Laramie Streets was partially flooded while foot-deep water swirled through the yards of many homes along the Zanja. Small bridges used for access from Sylvan Boulevard to homes on the other side were under water, but withstood the pressure.

- **Probability**

Flooding tends to occur in the summer and early fall because of the monsoon and is typified by increased humidity and high summer temperatures. The County of San Bernardino Flood Control District initiated a report following the floods of January and February 1969, which summed up the repetition of flood damage in Redlands and vicinity. It stated that "*A review of the occurrence of past floods of serious magnitude in San Bernardino Valley shows that one may be expected on the average of every 20 to 21 years. 'Great floods' have been recorded for the years 1825, 1862, 1867, 1884, 1891, 1916, 1938, 1969 and 1993. Available records indicated that the greatest of these by far was the flood of January 1862. If the reconstructed data for that storm is reasonably accurate, it would have been approximately a once-in-350-years flood!*"

The standard measure for flooding is the "*100-year flood*", a benchmark used by the FEMA to establish a standard of flood control in communities throughout the country. The 100-year flood is also referred to as the "regulatory" or "base" flood. The term 100-year flood is often incorrectly used and can be misleading. The correct designation is "*the 1% annual chance flood*", meaning there is a 1% chance that a flood of that intensity and elevation will occur in any given year, not that the flood will occur once every hundred years.

The 100-year Flood map of the City of Redlands is shown in Figure 1 under the Flood Location and Extent subsection. As defined by FEMA, Zone A, AE, AE Floodway, AH, and AO (lighter shades of blue) indicate a 1% annual chance of flooding; while Zone Shaded X (dark blue) indicates a 0.2% of annual chance of flooding. Complete definitions of flood zone designations are provided in Table 1 under the Flood Location and Extent subsection.

- **Climate Change Considerations**

Climate change acts as an amplifier to flood hazards. Extreme weather events have become more frequent over the past 40 to 50 years and this trend is projected to continue. Rising sea levels and shifting weather patterns (temperate, winds) are expected to have a significant impact on rainfall frequency, intensity and distribution; which in turn will have a significant impact on the frequency of flood occurrences. Additionally, warmer weather patterns increase snowmelt, which in turn produces more runoff to the lower elevations.

5.4.1.4 INFECTIOUS DISEASE

- **Ranking-** *Probability*- Medium; *Impact*- High
- **Description**

Infectious Disease is a broad term used to describe illness caused by a specific type of bacterium, parasite, virus, or fungus organisms. Below is a brief overview of the main infectious disease types:

- *Bacterial Infections*- Responsible for a variety of diseases from strep throat to meningitis and tuberculosis.
- *Fungal Infections*- There are roughly 300 types of fungi known to cause infectious disease. Common types include ringworm, blastomycosis, histoplasmosis, and pneumocystis pneumonia.
- *Parasitic Infections*- Responsible for a variety of diseases including malaria, Chagas disease, and toxocariasis.
- *Viral Infections*- Responsible for a variety of diseases including the common cold, influenza, mononucleosis, smallpox, and HIV/AIDS.

These organisms can be transmitted:

- *Person-to-person (e.g., measles, mumps, meningococcal disease, tuberculosis)*
- *By consuming contaminated food or water, also known as foodborne (e.g.: salmonella, E.coli, botulinum toxin)*
- *Through animal bites (i.e., mosquito, ticks, fleas) also known as vector-borne (e.g.: West Nile virus, dengue, Zika, malaria).*

Newly emerging infectious diseases include Ebola, Zika, Severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), avian influenza. The current pandemic (COVID-19) is linked to the SARS virus. The SARS coronavirus (SARS-CoV) is a virus identified in 2003. SARS-CoV is thought to be an animal virus from an as-yet-uncertain animal reservoir, perhaps bats, that spread to other animals (civet cats) and first infected humans in the Guangdong province of southern China in 2002. In 2019, in Wuhan China a new coronavirus was discovered. The coronavirus is closely related to the SARS coronavirus. The new virus goes by both COVID-19, standing for coronavirus disease 2019, and SARS CoV-2. Additional detail about the impacts of the COVID 19 can be found under the History section.

Also, of concern are the threats of potential biological terrorism (bioterrorism), the intentional release or spread of disease (or toxins). Bioterrorism, also known as biological warfare, is not new and has been used for centuries. As early as 600 BC, military leaders have implemented practices to poison water supplies and infect citizens/soldiers to gain strategic advantages in their efforts to conquer territories. Today there have been occurrences are both at the large scale (by military) and small scale (by terrorist organizations or individuals). No matter the purpose, the release of organisms could have devastating effects on an international, national, state, or local level if it is a highly infectious disease.

Infectious disease emergencies are incidents caused by these organisms, with the potential for significant illness or death in the population. The impact of infectious disease emergencies can also the local economy through loss of production and costs of treating or preventing spread of the disease. The ability to recover from an infectious disease emergency will depend on:

- *The type of biological agent (organism)*
- *The availability of prophylaxis (i.e., vaccine) for responders and the public*
- *The scale of the current and ongoing exposure*
- *The mode of transmission and whether transmission can be interrupted*
- *Whether the event is affecting critical infrastructure such as transportation, law enforcement, health care, and the medical and food supply chains.*

There are three (3) common levels (or categories) of infectious disease emergencies: Outbreaks, Epidemics, and Pandemics.

- *Outbreak*- when there are more cases than would be normally expected, often suddenly, of an infectious disease in a community or facility.
- *Epidemic*- when there are more cases than would be normally expected of an infectious disease, often suddenly, in a population of a large geographic area.
- *Pandemic*- refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

Outbreaks, epidemics, or pandemics can occur when a new virus emerges to which the population has little immunity. Public Health measures are used to control outbreaks, epidemics, or pandemics of infectious diseases, and are especially important for diseases with high morbidity or mortality and limited medical prophylaxis and/or rapid treatment. Public Health measures to control disease include:

- *Isolation and quarantine of persons or products, and legal closure of food establishments*
- *Control of contaminated food through recall of product*
- *Control of contaminated water through "Do Not Use", "Do Not Drink" or "Boil Water" orders*

- *Vector control spraying to target animals, bugs, and/or inspects*

- **Location and Extent**

An infectious disease incident can occur throughout the entire city any time during year.

- **History**

Infectious diseases have been of concern for many years. It is only recently, because of COVID-19 that the potential risk has been heightened. As sited by the Centers for Disease Control and Prevention (CDC), the 20th century saw three (3) pandemics, the most notable of which was the 1918 Spanish influenza pandemic that was responsible for 20 million deaths throughout the world. The pandemics are now known to represent three (3) different antigenic subtypes of influenza A virus: H1N1 (in 1918), H2N2 (Asian Influenza in 1957), and H3N2 (Hong Kong Influenza in 1968). Not classified as true pandemics are three (3) notable epidemics: a pseudo pandemic in 1947 with low death rates, an epidemic in 1977 that was a pandemic in children, and an abortive epidemic of swine influenza in 1976 that was feared to have pandemic potential. Major influenza epidemics show no predictable periodicity or pattern, and all differ from one another. Evidence suggests that true pandemics with changes in hemagglutinin subtypes arise from genetic reassortment with animal influenza A viruses.

Currently, the world is dealing with the effects of COVID-19. According to the CDC, COVID-19 was first identified in Wuhan, China, in December 2019. Although most people who have COVID-19 have mild symptoms, COVID-19 can also cause severe illness and even death. Some groups, including older adults and people who have certain underlying medical conditions, are at increased risk of severe illness. Because it is a new virus, scientists are learning more each day. New cases of and death rates from COVID-19 are rising globally each day. Potential vaccines are being tested but to date, there is no known cure.

Locally, the City of Redlands has been impacted by COVID-19 both from an economic standpoint, as well as its citizen impacted by the virus. Other infectious disease events include the 2009 H1N1, 2003 Avian Flu, 2015-17 Zika, 2014-16 West African Ebola; 2015 West Nile, 2013 large scale Tuberculosis, 2004 botulism Type A, 2003 West Nile, and the 2020 Hepatitis A outbreak.

- **Probability**

There is an annual risk of experiencing an infectious disease outbreak in the City of Redlands. While there is a continued threat from a novel influenza virus the potential threat of outbreaks and epidemics have been increased due expanding global trade and accessible national and international travel. Infectious disease outbreaks and epidemics occur on an ongoing basis.

Aside from the City of Redlands currently dealing with the effects from COVID-19, annual outbreaks of the seasonal flu usually occur during the late fall through early spring. Most people have natural immunity, and a seasonal flu vaccine is generally available. According to the CDC, in a typical year, approximately 5 to 20 percent of the population gets the seasonal flu and flu-related deaths range from 3,300 to 48,600 (average 23,600).

Bird flu (H5N1) is an influenza A virus subtype that is highly contagious among birds; although rare, some human infections with the Bird flu virus have occurred. Most confirmed cases have occurred in Asia, Africa,

the Pacific, Europe and the Near East. According to the CDC, there are currently no confirmed human cases of Bird flu infections but it remains a serious concern with the potential to cause a deadly pandemic.

Swine flu (H1N1) was first detected in the United States in April 2009. This virus was a unique combination of influenza virus genes never previously identified in either animals or people. The Swine flu virus caused more illness in young people and pregnant women than is usual for prior flu seasons, and was declared a Worldwide Pandemic by the World Health Organization.

- **Climate Change Considerations**

While many vector-borne diseases, such as malaria, yellow fever, dengue, and murine typhus, are rarely seen in the United States, the United States are susceptible to these vector-borne diseases. Many vector-borne diseases are climate sensitive and ecological shifts associated with climate change are expected to impact the distribution and incidences of these diseases. Changes in temperature and precipitation directly affect vector born disease transmission through pathogen-host interaction, and indirectly through ecosystem changes and species composition. As temperatures increases vectors can spread into new areas that were previously too cold. For example, two (2) mosquito vectors that carry malaria are now found at the U.S.-Mexico border.

5.4.1.5 WILDFIRE

- **Ranking-** *Probability*- High; *Impact*- High
- **Description**

Wildfires can be started by natural and mad-made causes. There are three (3) different classes of wild land or wildfires: 1) surface; 2) ground; and, 3) crown. A "Surface fire" is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A "Ground fire"; usually started by lightning, are fed by subterranean roots, and smolder on or below the forest floor. A "Crown fire" spread rapidly by wind and move quickly by jumping along the tops of trees. Wildfires can be classified as either a wildland fire or a wildland-urban interface (WUI) fire. Wildland fires involve situations where a fire occurs in an area that is relatively undeveloped except for the possible existence of basic infrastructure such as roads and power lines. A WUI fire includes situations in which a wildland fire enters an area that is developed with structures and other human developments. In WUI fires, the fire is fueled by both naturally occurring vegetation and the urban structural elements themselves. According to the National Fire Plan issued by the U.S. Departments of Agriculture and Interior, the wildland-urban interface is defined as "*…the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.*"

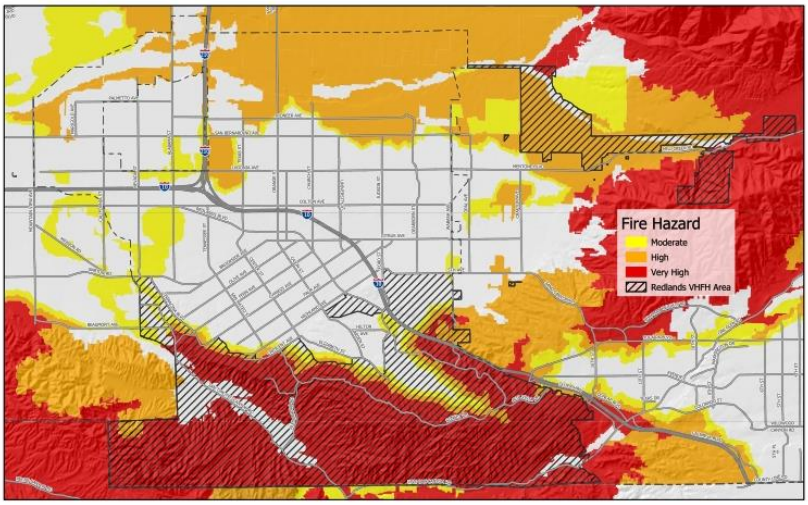
The WUI fire can be subdivided into three (3) categories (NWUIFPP, 1998): 1) classic wildland-urban interface; 2) the mixed wildland-urban interface; and, 3) the occluded wildland-urban interface. The *classic wildland-urban interface* exists where well-defined urban and suburban development presses up against open expanses of wildland areas. The *mixed wildland-urban interface* is characterized by isolated homes, subdivisions, and small communities situated predominantly in wildland settings. The *occluded wildland- urban interface* exists where islands of wildland vegetation occur inside a largely urbanized area. Generally, many of the areas at risk within the City of Redlands fall into the classic wildland-urban interface category.

Certain conditions must be present for a wildfire hazard to occur; a large source of fuel must be present, the weather must be conducive (generally hot, dry, and windy), and fire suppression sources must not be able to easily suppress and control the fire. The cause of a majority of wildfires is human-induced or lightning; however, once burning, wildfire behavior is based on three (3) primary factors: 1) fuel; 2) topography; and, weather. Fuel will affect the potential size and behavior of a wildfire depending on the amount present, its burning qualities (e.g., level of moisture), and its horizontal and vertical continuity. Topography affects the movement of air, and thus the fire, over the ground surface. The terrain can also change the speed at which the fire travels, and the ability of firefighters to reach and extinguish the fire. Weather as manifested in temperature, humidity and wind (both short and long term) affect the probability, severity, and duration of wildfires. Other factors that create concern are drought conditions and development (the build environment). Drought conditions bring on contributing concerns in that it can lead to relatively drier conditions and leave reservoirs and water tables lower; thus, creating hotter fires and less water to fight the fires. The expansion of the built environment into previously unoccupied areas introduces more people to the hazard and in some cases make response actions more challenging.

- **Location and Extent**

The climate, topography, and vegetation in Redlands is conducive to annual wildfire events. California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (CDF-FRAP) was established and mandated to map areas of significant fire hazards based on fuels (vegetation), terrain, weather, and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZ), define the application of various mitigation strategies to reduce risk associated with wildland fires. CDF-FRAP developed data that displays the relative risk to areas of significant population density from wildfire. This data is created by intersecting residential housing unit density with proximate fire threat, to give a relative measure of potential loss of structures and threats to public safety from wildfire. The maps below show the "very high" Fire Hazard Severity Zones located in Redlands for state and local responsibility areas (**Figure 5.9**).

Figure 5.9- Fire Hazard Severity Zones- City of Redlands



Due to a combination of topography, weather, and fuel, and exacerbated by potentially high winds and limited access, the southern portion of the City of Redlands is highly susceptible to wildland fire hazards. The slopes of San Timoteo and Live Oak canyons, the Badlands to the south, and the Crafton Hills to the east are not only difficult for firefighters and their equipment to reach, but the hill's steepness and configuration can result in the rapid upslope spread of fire.

Limited rainfall, low humidity, and seasonal high temperatures continue to contribute to the desiccation of the grasses and chaparral which cover the foothills, providing prime fuel for intense burns. Although some of the canyons are shielded from the direct impact of the powerful, dry Santa Ana winds, their occurrence generally aggravates the fire hazard. In addition, the presence of human activities in or near a wildland area dramatically increases the risk of a major fire due to careless smokers, illegal campfires, and other related risks. As noted above, the canyon areas located at the southwest of the City (and the surrounding areas) are the zones of highest hazard.

- **History**

Historically, fires in the City of Redlands have started in either San Timoteo or Live Oak Canyon and burn from a western to easterly direction, driven by prevailing winds and topography. **Figure 5.10** depicts the location of significant wildfires since 1950 in the City of Redlands, while **Table 5.4** shows the year and acres of reported wildfires in the City of Redlands since 2000.

Figure 5.10- Fire History for the City of Redlands and Vicinity, 1950-2020

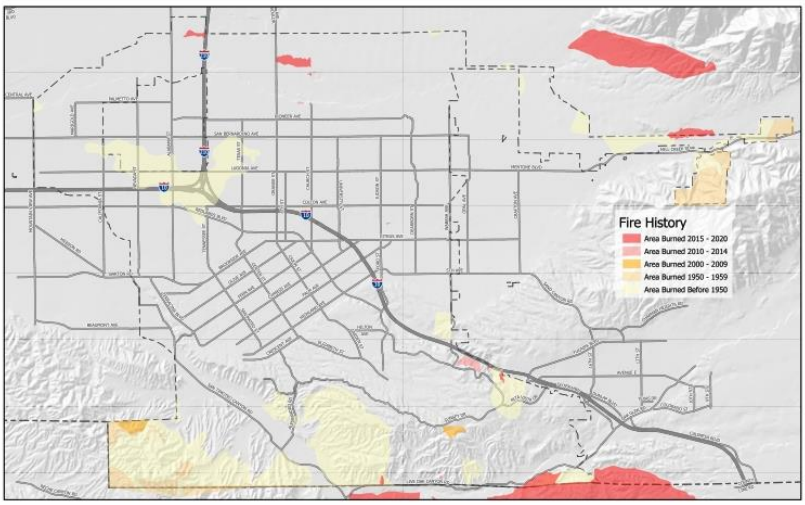


Table 5.4- Recent Fires Occurring in the Vicinity of the City of Redlands, 2000-2020

Name	Acres	Year
Reche	1,798	2001
Locust	1,899	2003
Mill Creek	173	2004
Hatchery	200	2005
Edgemont	521	2006
Garnet	119	2008

Helen Fire	22	2009
Helen Spot Fire	0	2009
River Fire	1	2010
30376 Live Oak Canyon Road	2	2011
Florida	67	2011
Greenspot	57	2012
Live Oak	73	2013
Mill	534	2013
Wabash Fire	24	2013
Orange Blossom Trail	0.3	2017
Palmer	3,872	2017
Wash Fire	11	2017
Outer Highway 10	4	2018
Freeway	1	2019
Live	3	2019
Sandalwood	1,005	2019
El Dorado	22,744	2020
Mentone Fire	41	2020
Orange Fire	1	2020
Orange Fire	37	2020

- *Reche/Redlands Fires*- This wind-driven fire originated in Riverside County, in an area known as Reche Canyon. The fire burned northeast over a period of approximately 2 hours, entering San Bernardino County and threatening residents in the area of San Timoteo Canyon and Pilgrim Road. We were notified by Riverside County that the fire was moving into our county and expected to burn into San Timoteo Canyon. They requested us to assemble engines for structure protection along Pilgrim Road in San Timoteo Canyon. The fire was diverted away from these structures because of backfiring operations, air support and hand crews into San Timoteo. Overall, the fire damaged approximately 700 acres by containment.

- *Compost Fire*- This fire occurred within the High Fire Hazard Area of the City of Redlands. This area is subject to a great deal of commuter and transient activity between counties. Fire was located at 1901 Alessandro Road, and caused by illegal dumping of organic materials within the San Timoteo Canyon. Chemical reaction resulted in spontaneous combustion of the compost heap at Sunset Hills Kennels. A unified command was established, including numerous Strike Teams, Hand Crews, Fixed Wing Aircraft, Helicopters and Manpower. The fire consumed 140 acres, and resulted in one firefighter injury.

- *Canyon Fire*- Sparking from railroad train traffic ignited this vegetation fire, which started adjacent to the Southern Pacific tracks north of San Timoteo Canyon Road and west of Alessandro Road. The high temperature was 99 degrees, with humidity at 24%. The fire was one-quarter acre in size, with medium fuel and moderate rate of spread. Winds were out of the west and steady, at 10 miles per hour. Limited access and erratic winds increased the spread of the fire, which spotted along the base of the hills, west of Smiley Ridge. The fire spread north, up the west slope of the Smiley Ridge subdivision. Winds increased, causing a spot fire in the flats east of Alessandro, adjacent to Sunset Hills Ranch. Increased erratic winds caused another spot fire to occur north of the first, now in heavier brush. Incoming resources attempted a hose lay up the flanks, but terrain and weather conditions advanced the spot out of reach. Due to topography and weather conditions, additional resources were ordered. Due

to the fire's potential, a unified command was established and structure groups assigned. Aircraft dropped on all flanks of the fire, and dozers cut lines on two divisions. Hand crews were also placed on all Divisions to facilitate a line between the burned and unburned areas. The fire was 50% contained around midnight and 70% contained by 0600 hours on 9/10/96. The fire consumed 250 acres, with no loss of structures. Effective suppression tactics, ignition resistant construction requirements, residential sprinklers, and fuel modification allowed this fire to move eastward with no structure loss or damage. The fire then presented the potential of structure loss in older existing neighborhoods where these types of fuel modification had not been conditioned 15-20 years previous. This posed a threat for conflagration potential, and this is where the Fire Department would like to address hazard mitigation through grant implementation for existing property owners. Costs shown in damage figures are strictly related to overhead, manpower and equipment.

- **Probability**

The majority of work done to estimate the probability of wildfire occurrence has been around identifying the potential areas for wildfire to occur. As previously mentioned, vegetation, weather, and topography were the significant elements in identifying areas of potential threat to wildfire occurrences. The area south and east of the city of Redlands is marked by mountains, foothills, and canyons are covered in susceptible vegetation. A large amount of the native vegetation in the Redlands area is commonly called chaparral, it is a dense and scrubby bush that has evolved to persist in a fire-prone habitat. Chaparral plants will eventually age and die; however, they will not be replaced by new growth until a fire rejuvenates the area. Chamise, manzanita and ceanothus are all examples of chaparral which are quite common in the Redlands area. The City of Redlands climate, with its warm and dry summers, contributes to low relative humidity and low fuel moistures. When combined with high fuel loading, the potential for a catastrophic wildfire event is significant. Three (3) weather conditions specific to Redlands that may cause the ignition and/or impact the behavior of wildfires are as follows:

- *Thunderstorms and the associated lightning are a significant source of fire starts, and usually occurs mid to late summer*
- *High winds can become steady up to 20 mph and gust up to 30-40 mph throughout the year but are most likely to exacerbate wildland fires during the months of August through October when dry vegetation conditions are generally present*
- *Hot, dry conditions most commonly occur in August and September*

This knowledge and understanding are a key driver in the methodology of the CDF-FRAP program. According the CDF, the FRAP "very high" Fire Hazard Severity Zone maps are based on data and models of, potential fuels over a 30- to 50-year time horizon and their associated expected fire behavior and expected burn probabilities to quantify the likelihood and nature of vegetation fore exposure to buildings. This indicates a very high likelihood of wildfire occurrence in the area. As such, Redlands is susceptible to annual wildfire risk. An aspect of wildfires that needs greater consideration within the City of Redlands is man-made caused wildfires. Over the past few years, the City has noticed an increase in the number of wildfires started by arsonists, illegal homeless encampments, and improper use of fireworks. All of these factors have increased the probability of wildfires in the City.

- **Climate Change Considerations**

Climate change plays a significant role in wildfire hazards. The changing conditions from wet to dry can create more fuel; the increased possibility of high winds increase risk and present a challenge, and drought conditions could hinder ability to contain fires. Large wildfires also have several indirect effects beyond those of a smaller, local fire. These may include air quality and health issues, road closures, business closures, and other forms of losses. Furthermore, large wildfires increase the threat of other disasters such as landslide and flooding.

5.4.1.6 WINDSTORM

- **Ranking-** *Probability*- High; *Impact*- Medium
- **Description**

Winds are often referred to according to their strength, and the direction from which they are blowing. Wind is caused by the difference in pressure from one point on the earth's surface to another. Wind is created by air moving from the area of "*higher*" pressure to the area of "*lower*" pressure; the difference in pressure over a certain distance, determines the strength of the wind. Air does not move directly from the point of highest pressure to the point of lowest pressure. The earth's rotation affects the air flow by deflecting it to the right. This effect is called the Coriolis Effect. In the Northern Hemisphere, this causes air to flow clockwise around high-pressure areas and counter-clockwise around low-pressure areas.

Winds are categorized by types and each type is associated with wind speeds: breeze (<0-31 mph), gale (32-65 mph), storm (66-72 mph), and hurricane (73-139> mph). Within each category are sub classifications with differential names depending on geographic location (i.e., tropical depression, tropical storm/cyclone) and/or categories (i.e., category 3 hurricane). Damage from winds account for half of all severe reports in the lower 48 states and is more common than damage from tornadoes. Winds are also measured using the Beaufort Scale. The Beaufort Scale categories winds by wind speed, using Force categories between 0-12 to measure speed and summarize descriptions (**Table 5.5**).

Table 5.5- Beaufort Scale

Category (Force)	Speed (MPH)	Description
0	0-1	Calm. Smoke rises vertically and the sea is flat.
1	1-3	Light air. The direction of the wind is shown by drifting smoke, but not wind vanes.
2	4-7	Light breeze. Wind is felt on the face, leaves rustle, and wind vanes move. Small wavelets appear on the ocean, but do not break
3	8-12	Gentle breeze. Leaves and small twigs are in motion, and light flags extend. Larg3 wavelets appear on the ocean and crests begin to break.
4	13-18	Moderate breeze. Dust and loose paper become airborne, and small branches move. Small waves appear on the ocean.
5	19-24	Fresh breeze. Small trees begin to sway and moderate waves appear.
6	25-31	Strong breeze. Large branches are in motion, and holding an umbrella becomes difficult. Large waves begin to form.
7	32-38	Near gale. Whole trees are in motion, and walking against the wind can be hard. Foam from breaking waves is blown in streaks.
8	39-46	Gale. Walking is difficult and twigs break off trees.

9	47-54	Severe gale. There is slight structural damage, and the crests of waves begin to topple.
10	55-63	Storm. Trees are uprooted and there is considerable damage to structures. Very high waves form in long, overhanging crests.
11	63-72	Violent storm. There is widespread structural damage, exceptionally high waves form, and the ocean is completely covered in foam.
12	>73	Hurricane. There is devastating structural damage. On the ocean, the air is filled with foam and spray.

For the purposes of the LHMP, windstorms include both 1) cyclonic winds and 2) significant straight-line, with little-to-no precipitation.

Cyclonic winds are the wind which swirl counter-clockwise in the northern hemisphere or clockwise in the southern hemisphere. The biggest differences between hurricanes and tornadoes are how big they are and how long they last. Hurricanes are typically hundreds of miles in diameter, with high winds and heavy rains over the entire region. Hurricanes can last for days or even weeks. Tornadoes usually last no more than a few minutes.

- *Hurricane*- A rotating low-pressure weather system (storm) that has organized thunderstorms but no fronts (a boundary separating two air masses of different densities. Hurricanes originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico, the eastern North Pacific Ocean, and, less frequently, the central North Pacific Ocean. Hurricanes develop in stages; working their way up to hurricane status:
  - *Tropical Wave*- A low-pressure trough moving generally westward with the trade winds.
  - *Tropical Disturbance*- An organized area of thunderstorms that usually forms in the tropics. Typically, they maintain their identity for 24 hours and are accompanied by heavy rains and gusty winds.
  - *Tropical Cyclone*- A generic term for any organized low pressure that develops over tropical and sometimes sub-tropical waters. Tropical depressions, tropical storms, and hurricanes are all example of tropical cyclones.
  - *Tropical Depression*- An organized area of low pressure in which sustained winds are 38 mph or less.
  - *Tropical Storm*- A tropical cyclone with maximum sustained wind speeds that range from 39 to 73 mph.
  - *Hurricane*- A tropical cyclone with sustained winds of at least 74 mph.

After the storm reaches Hurricane status, the Saffir-Simpson Hurricane Wind Scale is used to categorizes hurricanes by sustained wind speeds (**Table 5.6**).

Table 5.6- Saffir-Simpson Hurricane Wind Scale

Category	Wind Speed	Description
1	74-95	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days
2	96-110	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days

		to weeks.
3	111-129	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes
4	130-156	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months
5	>156	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months

- *Tornado*- A tornado is a rapidly (violent) rotating column of air that is in contact with both the surface of the Earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. Tornadoes come in many shapes and sizes, and are often visible in the form of a condensation funnel originating from the base of a cumulonimbus cloud, with a cloud of rotating debris and dust beneath it. Most tornadoes have wind speeds less than 110 miles per hour, are about 250 feet across, and travel a few miles before dissipating. The most violent tornadoes are capable of tremendous destruction with wind speeds of up to 300 mph. They can destroy large buildings, uproot trees and throw vehicles hundreds of yards. They can also drive straw into trees. Damage paths can be in excess of one mile wide to 50 miles long.

  Most tornadoes form from thunderstorms. They need warm, moist air from the Gulf of Mexico and cool, dry air from Canada. When these two air masses meet, they create instability in the atmosphere. A change in wind direction and an increase in wind speed with increasing height creates an invisible, horizontal spinning effect in the lower atmosphere. Rising air within the updraft tilts the rotating air from horizontal to vertical. An area of rotation, 2-6 miles wide, now extends through much of the storm. Most strong and violent tornadoes form within this area of strong rotation. Tornadoes are measured by the Fujita Tornado Scale (**Table 5.7**) which classifies tornadoes by intensity categories, based on the maximum winds occurring within the funnel.

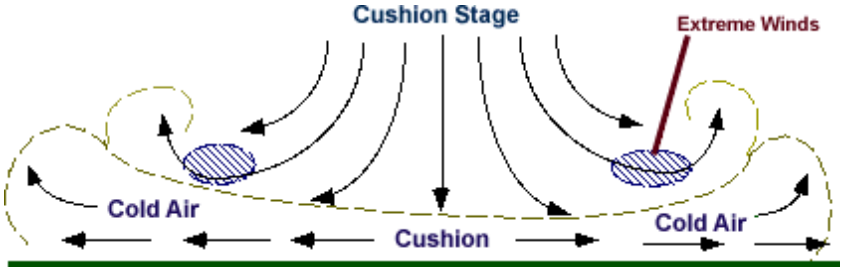
Table 5.7- Fujita Tornado Scale

Category	Wind Speed	Description
F0	40-72 miles per hour	Gale Tornado. Light Damage: Some damage to chimneys; breaks twigs and branches off trees; pushes over shallow-rooted trees; damages signboards; some windows broken; hurricane wind speed begins at 73 miles per hour.
F1	73-112 miles per hour	Moderate Tornado. Moderate Damage: Peels surfaces off roofs; mobile homes pushed off foundations or overturned; outbuildings demolished; moving autos pushed off the roads; trees snapped or broken.
F2	113-157 miles per hour	Significant Tornado. Considerable Damage: Roofs torn off frame houses; mobile homes demolished; frame houses with weak foundations lifted and moved; boxcars pushed over; large trees

		snapped or uprooted; light-object missiles generated.
F3	158-206 miles per hour	Severe Tornado. Severe Damage: Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forests uprooted; heavy cars lifted off the ground and thrown; weak pavement blown off roads.
F4	207-260 miles per hour	Devastating Tornado. Devastating Damage: Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and disintegrated; large missiles generated; trees in forest uprooted and carried some distance away.
F5	261-318 miles per hour	Incredible Tornado. Incredible Damage: Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 300 feet (100 meters); trees debarked; incredible phenomena will occur.
F6-12	>319 miles per hour	The maximum wind speeds of tornadoes are not expected to reach the F6 wind speeds.

Straight-line winds are common with the gust front of a thunderstorm or originate with a downburst from a thunderstorm. The winds can gust to 130 mph and winds of 58 mph or more and can last for more than twenty minutes. Straight-line wind events are most common during the spring when instability is highest and weather fronts routinely cross the country. These storms have wind speeds capable of reaching up to 100 mph, capable of producing a path of damage extending for hundreds of miles. Terms and characteristics of damaging straight-line wind events include:

- *Derecho*- Derechos, Spanish for "straight", are a widespread, long-lived, straight-line wind storm event that is associated with a land-based, fast-moving group of severe thunderstorms. Derechos can cause hurricane-force winds, tornadoes, heavy rains, and flash floods. A warm-weather phenomenon, derechos occur mostly in summer, especially during June, July, and August.
- *Updrafts/Downdraft*- Localized regions of warm or cool air will exhibit vertical movement (updrafts/downdrafts). Updrafts are small-scale current of rising air, often within a cloud. A mass of warm air will typically be less dense than the surrounding region, and so will rise until it reaches air that is either warmer or less dense than itself. The converse will occur for a mass of cool air, and is known as subsidence. This movement of large volumes of air, especially when regions of hot, wet air rise, can create large clouds, and is the central source of thunderstorms. Drafts can also be conceived by low or high-pressure regions. A low-pressure region will attract air from the surrounding area, which will move towards the center and then rise, creating an updraft. A high-pressure region will then attract air from the surrounding area, which will move towards the center and sink, spawning a downdraft.
- *Downburst*- Strong, downdraft winds flowing out of a thunderstorm cell. A downburst is a straight- direction surface wind in excess of 39 miles per hour caused by a small-scale, strong downdraft from the base of convective thundershowers and thunderstorms. Downbursts of

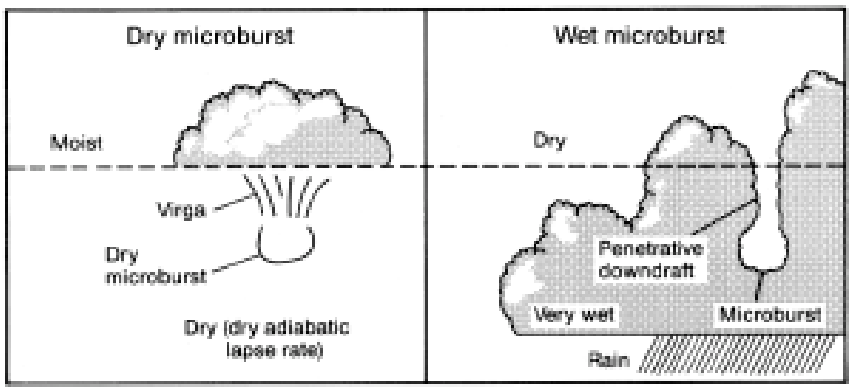


all sizes descend from the upper regions of severe thunderstorms when the air accelerates downward through either exceptionally strong evaporative cooling or by very heavy rain, which drags dry air down with it. When the rapidly descending air strikes the ground, it spreads outward in all directions, like a fast-running faucet stream hitting the bottom of the sink.

There are two (2) sub-categories of downbursts: the larger macrobursts and small microbursts.

Macroburst- Macrobursts are downbursts with winds up to 117 miles per hour which spread across a path greater than 2.5 miles wide at the surface and which last from 5 to 30 minutes.

Microburst- Microbursts are strong, damaging winds which strike the ground and often give the impression a tornado has struck. They frequently occur during intense thunderstorms. The origin of a microburst is downward moving air from a thunderstorm's core. But unlike a tornado, they affect only a rather small area, less than 2.5 miles in diameter from the initial point of downdraft impact. An intense microburst can result in damaging winds near 170 miles per hour and often lasts for less than five minutes. There are two (2) types of microburst windstorms: dry and wet.



- *Gust Front*- A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- *Haboob*- Haboobs, Arabic for blasting/drifting, is a type of intense dust storm carried on an atmospheric gravity current (i.e., thunderstorm), also known as a weather front. When a thunderstorm collapses, and begins to release precipitation, wind directions reverse, gusting outward from the storm and generally gusting the strongest in the direction of the storm's travel. Haboobs occur regularly in arid regions throughout the world.

In Southern California, Santa Ana winds are considered a windstorm event. Santa Ana winds are katabatic winds- Greek for *"flowing downhill"*. These winds occur below the passes and canyons of the coastal ranges of Southern California and in the Los Angeles basin. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon (the canyon from which it derives its name). Santa Ana winds are strong, extremely dry (low humidity) down-slope winds that originate from cool, dry high pressure air masses in the Great Basin region (the high plateau east of the Sierra Mountains and west of the Rocky Mountains,

including most of Nevada and Utah) and affect Southern California. These winds come up, over, and are pulled southward down the eastern side of the Sierra Nevadas and into the Southern California region. The air warms as it descends toward the California coast at the rate of 5 degrees Fahrenheit per 1000 feet due to compressional heating. Thus, compressional heating provides the primary source of warming. The air is dry since it originated in the desert, and it dries out even more as it is heated.

Forecasters at the National Weather Service offices in Oxnard and San Diego usually place speed minimums on these winds and reserve the use of "*Santa Ana*" for winds greater than 25 knots. These winds accelerate to speeds of 35 knots as they move through canyons and passes, with gusts to 50 or even 60 knots. Santa Ana winds can happen anytime during the year but are most prevalent in the autumn and winter months. The most significant hazard associated with Santa Ana winds is an increased wildfire danger, but Santa Ana winds can also cause downed trees and power lines, and property damage, as well as causing potentially hazardous conditions for RV's, semi-trailers, aircraft and boaters.

- **Location and Extent**

Although tornadoes and hurricanes are rare, the entire City of Redlands is susceptible to various types of windstorms.

- **History**

As mentioned, tornadoes and hurricanes are rare in the area but the City of Redlands has experienced significant straight-line winds events. The events range in strength of wind and duration but they all have similar impacts; downed trees and powerlines, injuries, and minor structural damage.

- **Probability**

The City of Redlands is at risk of windstorms at any given time during the calendar year. However, as previously mentioned they are more prevalent in the autumn and winter months. Santa Ana winds, which commonly occur between October and February, and can, reach speeds of more than 100 miles per hour. Tornadoes and/or Hurricanes occur infrequently in California, which has a statewide average of just 5 tornadoes/hurricanes a year. This is significantly less than states located in the US' "*tornado alley*", which can experience as many as 50–100 tornadoes per year or along the southern Atlantic US/Gulf of Mexico region which can experience twelve (12) named storms, six (6) hurricanes, and three (3) major hurricanes each year**.** In addition, most California tornadoes and hurricanes are considered "weak"; the historical average occurrence rate of Strong – Violent events in California is zero.

- **Climate Change Considerations**

Climate change will play a significant role with windstorm events. The changing conditions are expected to cause a significant amplification to many existing conditions. Because of this, climate change might impact the frequency and intensity of windstorms. Climate change, although still being studied, could have an effect on high- and low-pressure zones. High- and low-pressure zones are created by many factors, but many are related to uneven heating of the earth's surface by the sun. Many of the factors that go into the heating of the earth's surface, but many may be impacted by Climate change (i.e., type of vegetation in areas impact ability to absorb heat, amount of snow cover which reflects heat). In addition to altering and possibly increasing frequency of significant winds in the area. This indicates that the City of Redlands could experience a greater number of windstorm events in the future.

5.4.2 TIER II

The hazards, in alphabetical order, under Tier 1I include: Aircraft Accident/Incident; Civil Disturbance; Drought; Hazardous Material Accident; Infestation; Landslide; Technology Disruption; and, Train Accident/Incident.

5.4.2.1 AIRCRAFT ACCIDENT/INCIDENT

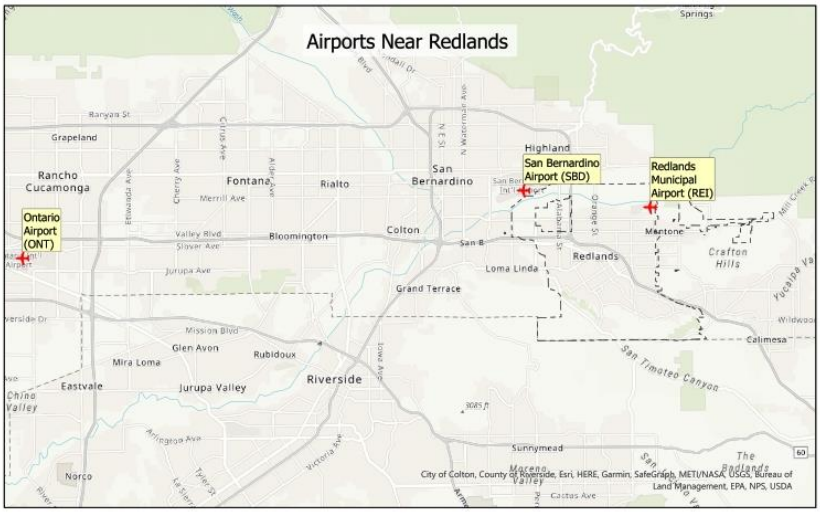
- **Ranking-** *Probability*- Medium; *Impact*- Medium
- **Description**

Aircraft Accidents/Incidents can occur "*in-flight*" or "*on ground*", that either cause death and injuries or cause substantial damage to an aircraft and/or airport facilities. This can include fatalities or injuries as a result of: 1) being in the aircraft, 2) direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or 3) direct exposure to jet blast (with excepts). Damages includes accidents/incidents that affect the structural strength, performance or flight characteristics of the aircraft and/or airport requiring major repair or replacement and incidents where the aircraft is missing or is completely inaccessible. For purposes of this LHMP, the definition of "aircraft accident" does not include "unmanned aircraft accident,".

- **Location and Extent**

Since 1947, the Redlands Municipal Airport (REI) has been serving the area's aviation community. Redlands Municipal Airport is a 180-acre facility with a 4,570 foot long by 75-foot-wide runway serving approximately 240 based aircraft. In addition to the Redlands Municipal Airport, the Ontario International Airport (ONT) and the San Bernardino International Airport (SBD) are in close proximity to the City of Redlands. **Figure 5.11** depicts the location of the three (3) local airports in the general area of the City of Redlands.

Figure 5.11- Airports Around the City of Redlands



In addition to the local airports, there are four (4) large commercial airports operating in the region. The City of Redlands is transected by the flight pattern from LAX, ONT, SBD, and March Air Reserve Base.

- **History**

The City of Redlands has suffered several accidents/incidents in the past. **Table 5.8** provides an overview of the events that have occurred since 2008, according to the National Transportation Safety Board (NTSB) Case Analysis and Reporting Online (CAROL) Query Tool. All reported aircraft accidents involved small craft, aircraft.

Table 5.8- Aircraft Accidents Since 2008

Accidents	Total	Dates
Incidents	8	
Incident Injury Type		
Fatal	*3*	*Jun 2020, Feb 2010, Sep 2009*
Serious	*1*	*Sep 2011*
Minor	*1*	*Mar 2015*
None	*3*	*May 2015, Jul 2013, Sep 2011*

- **Probability**

The possibility of an aircraft accident/incident occurring in the City of Redlands will continue to exist due to the location (and existing use) of the Redlands Municipal Airport, SBD, ONT, and March Air Reserve Base. It is worth to note, that the Redlands Municipal Airport also supports the US Forest Service and Cal FIRE NOT heliports during fire seasons. Based on historic events and known increase safety standards, it is anticipated that future accidents/incidents will be minimal to extremely remote. The risk to the City of Redlands associated with these types of accidents/incidents is similar to other general aviation airports in southern California.

- **Climate Change Considerations**

While there are many devices that monitor and/or track weather conditions, it is expected that changing conditions are going to impact air travel. From the simplest of impacts from temperatures altering takeoffs and landing, to increase in rains and winds altering flight patterns, changes in our environment could increase the likelihood of an aircraft accidents/incidents.

5.4.2.2 CIVIL DISTURBANCE

- **Ranking-** *Probability*- Medium; *Impact*- Medium
- **Description**

Civil Disturbance is a term generally used to describe disorderly conduct or a breakdown of orderly society by a large group of people. Civil Disturbance can range from a form of protest against major socio-political problems to riots.

- **Location and Extent**

Civil Disturbance can occur in any part of the City of Redlands. However, it is generally located within larger, more concentrated, commercial areas.

- **History**

No significant historical incidents to report to date. However, there have been a few small incidents that have occurred due to recent social and political movements.

- **Probability**

There are no studies that predict the probability of civil disturbance occurrences.

- **Climate Change Considerations**

While there is no direct linkage between climate change and civil disturbances, there could be indirect linkages. As climate change impacts are either felt or perceived to be felt it could ignite passions within people to demonstrate against possible causes or enablers.

5.4.2.3 DROUGHT

- **Ranking-** *Probability*- Medium; *Impact*- Low
- **Description**

Drought can best be thought of as a condition of water shortage for a particular user in a particular location. Drought is a gradual phenomenon and generally are not signified by one or two dry years. California's extensive system of water supply infrastructure (reservoirs, groundwater basins, and interregional conveyance facilities) generally mitigates the effects of short-term dry periods for most water users. However, drought conditions are present when a region receives below-average precipitation, resulting in prolonged shortages in its water supply, whether its water supply is provided by atmospheric, surface, or ground water means. A drought can last for months or years, or may be declared after as few as 15 days.

Drought is not a purely physical phenomenon, but rather an interplay between natural water availability and human demands for water supply. The precise definition of drought is made complex owing to political considerations, but there are generally four (4) types of conditions that are referred to as drought:

- *Meteorological drought is brought about when there is a prolonged period with less than average precipitation.*
- *Agricultural drought is brought about when there is insufficient moisture for average crop or range production. This condition can arise, even in times of average precipitation, owing to soil conditions or agricultural techniques.*
- *Hydrologic drought is brought about when the water reserves available in sources such as aquifers, lakes, and reservoirs fall below the statistical average. This condition can arise, even in times of average (or above average) precipitation, when increased usage of water diminishes the reserves.*
- *Socioeconomic drought associates the supply and demand of water services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall.*

The U.S. Drought Monitor, established in 1999, is a weekly map of drought conditions produced jointly by the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture, and the National Drought Mitigation Center at the University of Nebraska-Lincoln. The map is based on measurements of climatic, hydrologic and soil conditions as well as reported impacts and observations from more than 350 contributors around the country. Droughts are generally categorized into five (5) categories: D1) Abnormally Dry, D2) Moderate Drought; D3) Severe Drought; D4) Extreme Drought; and, D5) Exceptional Drought. There are many considerations that are factored into the determining the

drought status; these include consideration of status on the: Palmer Drought Severity Index; CPC Soil Moisture Model; USGS Weekly Streamflow; Standardized Precipitation Index; and Objective Drought Indicator Blends.

- **Location and Extent**

The entire City of Redlands is subject to drought conditions and water shortages.

- **History**

It was only recently that the State of California emerged from a proclaimed a State of Emergency due to extremely dry conditions. The longest duration of drought (D1-D4) in California lasted 376 weeks beginning on December 27, 2011 and ending on March 5, 2019. The most intense period of drought occurred 2014 and 2017, where at its peak over 50% of the land in California was under Exceptional Drought (D4) conditions. The City of Redlands has experienced several droughts, most recently during the statewide drought from 2011-2019.

- **Probability**

In any given year, California and the City of Redlands can be subject to drought conditions and water shortages. This is especially true since much of the water is provided by outside resources, resources that a shared with others. It is also important to note the droughts do not happened over night, they are a slow buildup of conditions. On average, seventy-five percent (75%) of the state's annual precipitation occurs in the "wet season"- *November thru March*. December, January, and February generally see the most precipitation but there have been many early and late season storms that bring in a substantial amount of precipitation. One of the best ways to predict drought conditions is to study the status of the El Niño Southern Oscillation (ENSO) patterns. In California. ENSO is a periodic shifting of ocean atmosphere conditions in the tropical Pacific that ranges from El Niño (warm phase) to neutral to La Niña (cold phase). La Niña conditions tend to favor a drier outlook for Southern California; while the El Niño conditions favor stronger, and wetter storms.

- **Climate Change Considerations**

Climate change has the potential to make drought events more common in the West, including California. Extreme heat creates conditions more conducive for evaporation of moisture from the ground, thereby increasing the possibility of drought. A warming planet could lead to earlier melting of winter snow packs, leaving lower stream flows and drier conditions in the late spring and summer. Snow packs are important in terms of providing water storage and ensuring adequate supply in the summer, when water is most needed. Changing precipitation distribution and intensity have the potential to cause more of the precipitation that does fall to run-off rather than be stored. The result of these processes is an increased potential for more frequent and more severe periods of drought.

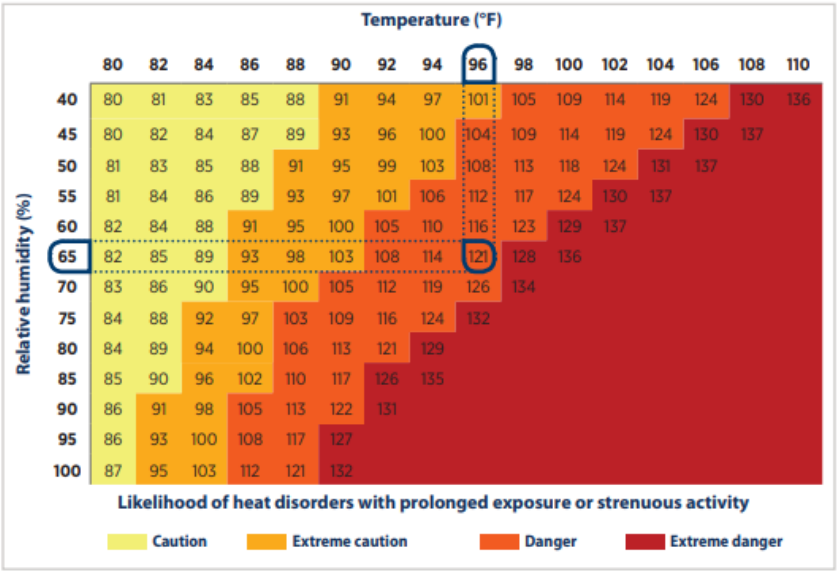
5.4.2.4 EXTREME TEMPERATURES

- **Ranking-** *Probability*- Medium; *Impact*- Low
- **Description**

For the purposes of the LHMP, Extreme Temperatures include both 1) extreme heat and 2) freezing weather conditions.

Extreme Heat conditions, according to the EPA and CDC, is defined as weather that is much hotter and more humid than average for a particular time and place. The heat index is a measure of how hot it feels when relative humidity is factored in with the actual air temperature (**Figure 5.12**). Relative humidity is the percentage of moisture in the air compared with the maximum amount of moisture the air can hold. Humidity is an important factor in how hot it feels because when humidity is high, water doesn't evaporate as easily, so it's harder for your body to cool off by sweating.

Figure 5.12- NOAA's National Weather Service Heat Index



Relative humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Extreme heat is not just a nuisance; it kills hundreds of Americans every year and causes many more to become seriously ill. Measures to prevent illness are generally common sense, including staying cool indoors, keeping hydrated, limiting physical activity, and monitoring those at highest risk.

Freeze conditions are noted when there are sustained temperatures below freezing (32F). Prolonged freezing temperatures can pose a risk to vulnerable populations, particularly if combined with power outages. When combined with precipitation, ice can form on roadways, trees, and power lines creating secondary hazard conditions. Extreme cold can result in significant damage to homes and businesses (e.g., from burst pipes), and can cause significant health problems, such as hypothermia and frostbite. Agriculture and livestock are subject to damage and life loss, and may cause economic impacts as well. The NOAA provides three (3) different categories of actions for freeze events: advisory, watch, and warning.

- *Frost Advisory* is issued when the minimum temperature is forecast to be 33 to 36 degrees on clear and calm nights during the growing season.
- *Freeze Watch* is issued when there is a potential for significant, widespread freezing temperatures within the next 24–36 hours.
- *Freeze Warning* is issued when significant, widespread freezing temperatures are expected.

- **Location and Extent**

The entire city is subject to Extreme Heat and/or Freeze conditions. While, this will affect humans, a significant impact would be felt on livestock and agriculture. The City of Redlands also has several agriculture growers that produce citrus and other crops.

- **History**

The City of Redlands experiences extreme temperatures on an annual basis. In most instances, the events are short in duration and do not create significant impacts on the community. Some of the minor events do require the City to take action including dissemination of Public Service Announcements, checking in with vulnerable populations (elderly, homeless), and opening and/or coordinate with others to open heating and/or cooling centers. Some of the more significant extreme weather events in the region include:

- *In 2010 an extreme heat event occurred in impacting the Southeastern Desert Region.*
- *In 2007 an extreme cold event damaged citrus, row, field and nursery crops county-wide, including agriculture.*
- *In 2006, San Bernardino County experienced an extreme heat event affecting the Valley communities.*

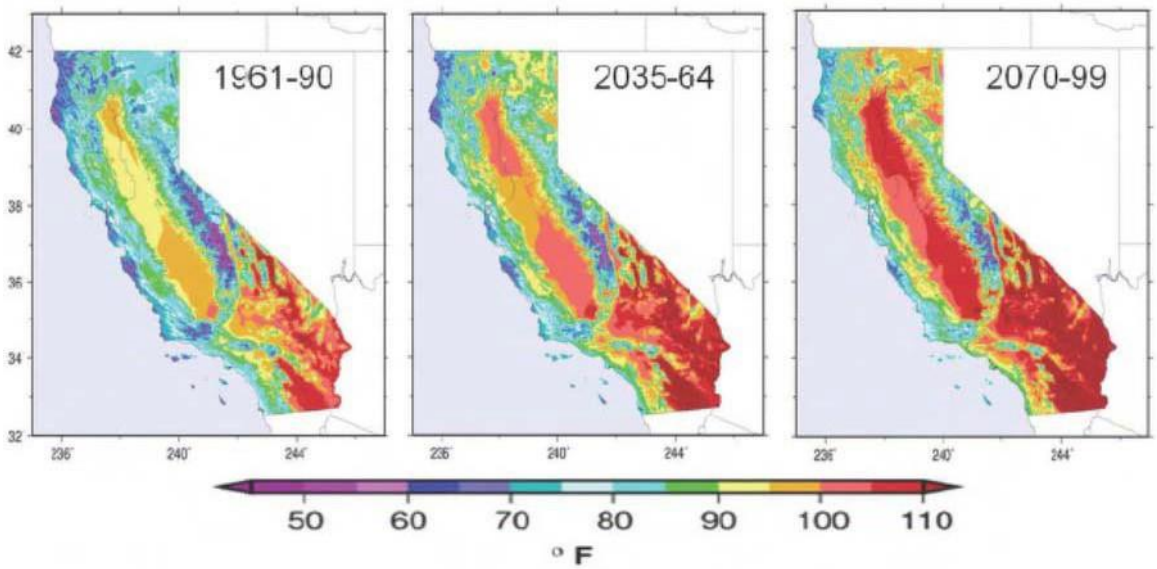
- **Probability**

In any given year the City could experience Extreme Heat or Freeze events.

- **Climate Change Considerations**

Climate plays a significant role in Excessive Heat and Freeze events. As temperatures rise and fall due to changing conditions, Californians will face greater possibility of Extreme Heat or Freeze events. Depending on the model and the study referenced, freezing spells are likely to increase and/or decrease in frequency as climate conditions change. By mid-century, extreme heat events in urban centers could cause two to three times more heat-related deaths than occur today. By 2100, The California Energy Commission is projecting hotter temperatures are expected throughout the state, with an increase of 3 to 5.5°F under the lower emissions scenario and 8 to 10.5°F under the higher emissions scenario (**Figure 5.13**).

Figure 5.13- Comparison between Historic and Projected Temperature



According to the EPA and CDC, the chances are increasing that an Extreme Heat or Freeze event could happen where you live because, the average temperatures are rising, both in the United States and around the world:

- *Globally, the annual average temperature has been rising since the beginning of the 20th century, and temperatures are expected to continue to rise through the end of this century.*
- *Worldwide, 15 of the 16 warmest years on record have occurred since 2000, with the exception of 1998*

5.4.2.5 HAZARDOUS MATERIAL ACCIDENT

- **Ranking**- *Probability*- Medium; *Impact*- Medium
- **Description**

Hazardous materials are used and/or created in manufacturing, agriculture, service industries (e.g., gas stations, dry cleaners), and health care facilities. Several household products such as cleaning supplies and paint are also considered hazardous materials. These chemicals and hazardous materials may be corrosive or otherwise damaging over time. The US Department of Transportation (US DOT) classifies hazard chemicals/materials into the following classification system:

- *Class 1*- Explosives
- *Class 2*- Flammable, non-flammable, and poisonous gases
- *Class 3*- Flammable liquids
- *Class 4*- Flammable, spontaneously combustible, and dangerous when wet solids
- *Class 5*- Oxidizers and organic peroxides
- *Class 6*- Toxic (poisonous) substances
- *Class 7*- Radioactive materials
- *Class 8*- Corrosive substances
- *Class 9*- Miscellaneous dangerous goods/hazardous materials and articles

The release of these chemicals and/or materials into a community can have devastating effects. A hazardous materials release could also result in public health risks, fires, and/or explosions. Contamination may be carried out of the immediate area of the incident by people, vehicles, wind, and water. Weather conditions can increase the size and intensity of the Hazardous Materials Release. Typography, such as hills and canyons, can increase the size of the release or make it more difficult to contain. There are several types of hazardous materials releases:

- *Fixed-Site Releases*- releases involving the production and manufacturing, handling, and storage of a hazardous product at a single facility as well as any releases that may occur at a designated hazardous waste disposal site.
- *Transportation-Related Releases*- Includes releases that occur while the hazardous material is in transit from one facility to another or en route to be disposed of at a designated hazardous waste disposal site (e.g., on highways, railways, airports, or in pipelines).
- *Intentional Releases*- includes criminal acts and acts of terrorism in which a hazardous material is used to intentionally cause injuries and/or fatalities, damage the environment and/or property, or advance a political or social agenda.

- **Location and Extent**

As outlined above, hazardous materials can be found throughout the community. The location and identity of facilities that store hazardous materials must be reported to local and federal governments as required by the Emergency Planning and Community Right-to-Know Act (EPCRA). Many facilities have their own hazardous materials guides and response plans, including transportation companies who transport hazardous materials. The release of hazardous materials into the environment can cause a multitude of problems. Although these incidents can happen almost anywhere, certain areas of Redlands are at higher risk, such as near roadways that are frequently used to transport hazardous materials and locations with industrial facilities that use, store, and/or dispose of such materials. Areas crossed by railways, waterways, airways, and pipelines also have increased potential for mishaps. **Table 5.9** provides a list of sites within the City of Redlands.

Table 5.9- Registered Hazardous Chemical Sites in the City of Redlands

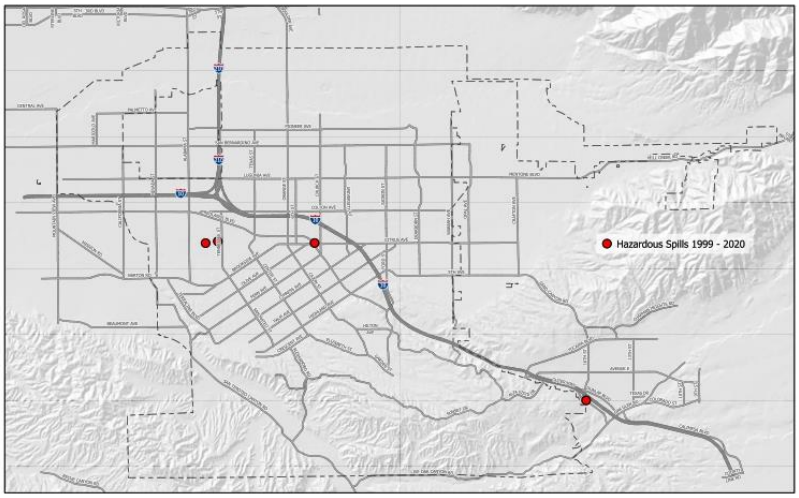
Site/Facility Name	Location
Crafton-Redlands area	Bunker hill groundwater sub-basin
Edison/Redlands II (Redlands Boulevard) MGP	501-525 w. Redlands Boulevard at Kendall
Jorco Chemical Company	32185 east outer Highway 10
Judson Street Elementary School	Judson Street/Pennsylvania Avenue
Layne Christensen Redlands property	1675 West Park Avenue
Lockheed Propulsion Corporation	1500 Crafton Avenue
New High School No.3	Texas Street/w. Pioneer Avenue
QA Processor Service	302 Alabama Street, ste8
Redlands Airport	1745 Sessums Drive
Redlands Community Day School	Alabama Street/West Park Avenue
Redlands Early Education Center	1712 West Park Avenue
Redlands Farming Company	780 West San Bernardino Avenue
SoCal gas/Redlands I (State Street.) MGP	State Street at Redlands Boulevard
Teledyne Battery Products	840 W Brockton Avenue

- **History**

A significant hazardous materials events in San Bernardino County included the February 1996 train derailment in the Cajon Pass. A 49-car Burlington Northern-Santa Fe freight train en route from Barstow, California, to Los Angeles, derailed near Cajon Junction, killing the conductor and a trainman, and seriously injuring the engineer. The derailment resulted in a rail car pile-up which included five cars containing hazardous materials. The train ignited, and continued to burn for several days, requiring immediate closure of I-15, extended closure of SR-138, and a secondary closure of I-15 three days later due to the potential explosion of a tank car containing butyl acrylate. In addition to the train crew casualties, 32 people suffered minor injuries (21 police officers, 8 California Transportation Department personnel, and 3 civilians). According to the National Transportation Safety Board (NTSB), the total economic cost of the incident reached almost $9.5 million, including equipment, environmental and other costs.

Within the City of Redlands, the Fire Department has the responsibility for responding to hazardous materials incidents. The City of Redlands Fire Department has responded to a series of hazardous material incidents over the years. While most are routine in natural and do not require significant resources, there have been a handful of incidents that have required greater response and recovery coordination/effort. **Figure 5.14** depicts the location of the more significant hazardous material incidents within the City of Redlands between 1999-2020.

Figure 5.14- Hazardous Material Spills City of Redlands (1999-2020)



- **Probability**

The release of chemicals and hazardous materials can occur throughout the entire city on any given day. Incidences can occur during production, storage, transportation, and/or during use or disposal of materials. Communities can be at risk if a chemical is used unsafely or released in harmful amounts into the environment. Hazardous materials can cause death, serious injury, long lasting health effects, and damage to buildings, the environment, homes, and other property.

- **Climate Change Considerations**

While there is little evidence to link climate change increase occurrences of chemical and hazardous material releases, weather plays a significant factor in certain aspects of chemical and hazardous material releases. Changing conditions can create more mishaps and accidents with production, storage,

transportation, use, and disposal of chemicals and hazardous materials. Additionally, changing conditions could impact the response and recovery efforts after releases.

5.4.2.6 INFESTATION

- **Ranking-** *Probability*- Medium; *Impact*- Low
- **Description**

Agricultural pests and disease infestation occur when an undesirable organism inhabits an area in a manner that causes serious harm to agriculture crops, livestock or poultry, and wild land vegetation or animals. Countless insects and diseases live on, in, and around plants and animals in all environments. Most are harmless, while some can cause significant damage and loss. Under some conditions, insects and diseases that have been relatively harmless can become hazardous. For example, severe drought conditions can weaken trees and make them more susceptible to destruction from insect attacks than they would be under normal conditions.

- **Location and Extent**

The City of Redlands has several agriculture crops (orange groves) but limited commercial livestock or poultry. However, the City of Redlands, much like most cities have areas and vegetation susceptible to infestations. Impacts to local plants happen throughout the entire city. Impacts on wildland vegetation or animals generally happened in interface areas along edges of the community (i.e., Crafton Foothills, Live Oak Canyon, Sam Timoteo Canyon, San Bernardino Mountains). The location of the groves is depicted on **Figure 5.15**.

Figure 5.15- Citrus Groves

XXX waiting for graphic XXX

- **History**

As mentioned, the city is vulnerability to insect infestation. Infestations of Mediterranean Fruit Fly, Oriental Fruit Fly, Gypsy Moth, Glassy-winged Sharpshooter, Asian Citrus Psyllid, and Light-Brown Apple Moth have all occurred in the last 30 years; however, there are not detailed records to list each event. Diseases such as Chrysanthemum White Rust and Pierce's Disease of Grapes have caused significant losses to local plants and impacts on wildland vegetation or animals.

Emergencies related to insect infestation have impacted San Bernardino County and its local jurisdictions in the last decade, including an increased fire risk due to Bark Beetle infestation of trees in 2003, and mosquito-borne West Nile Virus in 2007. Since 2002, the Bark Beetle infestation has required removal of 99,500 acres of affected trees in the San Bernardino National Forest, as well as on private lands, at a cost of $4 million in grants and matching funds. However, both the Bark Beetle and West Nile Virus infestations are under control and did not seriously impact the City of Redlands. Additionally, while future infestation issues are possible, the impact on the City of Redlands is generally expected to be limited and no major impact to the community.

- **Probability**

Due to its interaction with the global economy, its mild Mediterranean climate, and its diversified agricultural and native landscape, the City of Redlands can experience impacts from agricultural pests and diseases annually.

- **Climate Change Considerations**

Continued climate change is likely to alter the abundance and types of pests, lengthen pests' breeding season, and increase pathogen growth rates. For example, the pink bollworm, a common pest of cotton crops, is currently a problem only in southern desert valleys because it cannot survive winter frosts elsewhere in the state. However, if winter temperatures rise 3 to 4.5°F, the pink bollworm's range would likely expand northward, which could lead to substantial economic and ecological consequences for the state.

Temperature is not the only climatic influence on pests. For example, some insects are unable to cope in extreme drought, while others cannot survive in extremely wet conditions. Furthermore, while warming speeds up the lifecycles of many insects, suggesting that pest problems could increase, some insects may grow more slowly as elevated carbon dioxide levels decrease the protein content of the leaves on which they feed (California Climate Change Center 2006).

5.4.2.7 LANDSLIDE

- **Ranking**- *Probability*- Medium; *Impact*- Medium
- **Description**

Landslides can be defined as the movement of a mass of rock, debris, or earth down an incline. According to the USGS, the term "*landslide*" encompasses five (5) modes of slope movement: falls, topples, slides, spreads, and flows.

- *Falls are masses of soil or rock that dislodge from steep slopes and free-fall, bounce, or roll downslope.*
- *Topples move by the forward pivoting of a mass around an axis below the displaced mass.*
- *Spreads (lateral) commonly induced by liquefaction of material in an earthquake, move by horizontal extension and shear or tensile fractures.*
- *Slides displace masses of material along one or more discrete planes.*
  - In "rotational" sliding, the slide plane is curved and the mass rotates backwards around an axis parallel to the slope;
  - In "translational" sliding, the failure surface is more or less planar and the mass moves parallel to the ground surface.
- *Flows mobilize as a deforming, viscous mass without a discrete failure plane.*

Landslides can be caused by natural processes or by man-made activities. Landslides occurs when down-slope forces (gravity) exceed the resistance (strength) of the earth materials. Landslides can be initiated by rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. Two (2) of the more common types of landslides include:

- *Mudflows*- defined as flows or rivers of liquid mud down a hillside on the surface of normally dry land. They occur when water saturates the ground, usually following long and heavy rain

falls, or rapid snow melt. Mud forms and flows down slope if there is no ground cover such as brush or trees to hold the soil in place.

- *Debris Flow*- defined when water begins to wash material from a slope or when water sheets off of a newly burned stretch of land. Chaparral land is especially susceptible to debris flows after a fire. The flow will pick up speed and debris as it descends the slope. As the system gradually picks up speed it takes on the characteristics of a basic river system, carrying everything in its path along with it.

Fast-moving (or rapidly-moving) landslides present the greatest risk to human life, and people living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Debris-flows can travel down a hillside with speeds up to 200 miles per hour (though more commonly, 30-50 miles per hour), depending on the slope angle and type of earth and debris in the flow.

Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage but are less likely to result in serious human injuries. Slow-moving slides include rotational slides, where sliding material moves along a curved surface, and translational slides, where movement occurs along a flat surface. These slides are generally slow-moving and can be deep. Slumps are small rotational slides that are generally shallow.

The size of a landslide usually depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of rock and soil; the length, width, and depth of the area affected; frequency of occurrence; and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics.

Many landslides are difficult to mitigate, particularly in areas of large historic movement with weak underlying geologic materials. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they, along with climate, create landslide hazards. Proper planning cannot completely eliminate the threat of landslides to the safety of people, property, and infrastructure; however, without proper planning, landslide hazards will be even more common and more destructive.

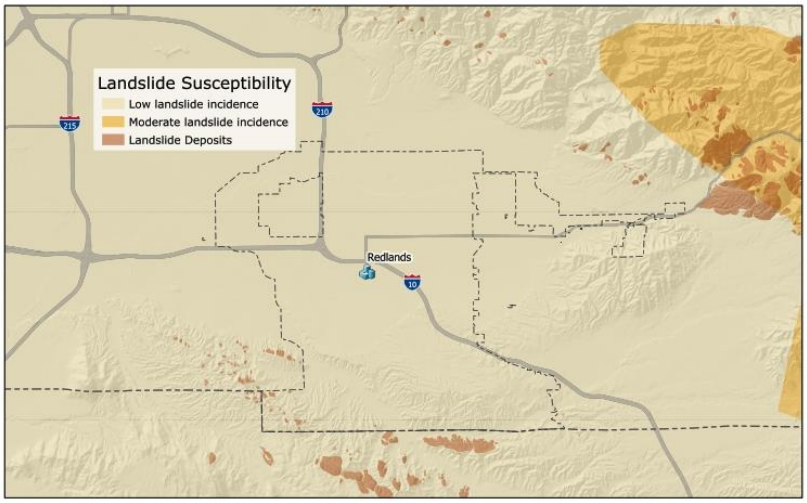
- **Location and Extent**

The California Geological Survey is in the process of recording and mapping historical and potential landslides in the state. The location and extent of landslides are extremely difficult to predict and are usually based on historical event and/or soil type and topography. Landslides have the potential to occur in 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*
- *Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire.*

Figure 5.16 depicts the location around the City of Redlands of low landslide incidence on the USGS' Landslide Incidence and Susceptibility in the Conterminous United States map (Overview map, 2001), which shows areas of landslides and areas susceptible to future land sliding (defined to include most types of gravitational mass movement such as rock falls, debris flows, and the failure of engineered soil materials).

Figure 5.16- Landslide Incidence in the Vicinity of the City of Redlands



- **History**

Historically, the majority of landslides in Redlands have been a secondary hazard to other hazards (i.e., earthquakes, floods); there have been no known previous occurrences of landslides documented in the City of Redlands.

- **Probability**

Landslides are a common hazard in California. Weathering and the decomposition of geologic materials produce conditions conducive to landslides, and human activity further exacerbates many landslide problems. It is difficult to estimate the probability of occurrence for landslide as no landslide susceptibility maps have been prepared for Redlands. However, recently there has been increased probability for mud flows and debris flows due to wildfire events in the area.

- **Climate Change Considerations**

Climate change can increase the probability, frequency, and/or intensity of landslides. Changes in precipitation, specifically the increased frequency of intense precipitation, can result in significant water run-off, which may cause landslides. Additionally, increase in wildfire hazards will result in loss of hillside vegetation. The loss of hillside vegetation will increase the likelihood of debris and mudflows. This could result in landslides occurring in areas not previously identified.

5.4.2.8 TECHNOLOGY DISRUPTION

- **Ranking-** *Probability*- Low; *Impact*- High

- **Description**

Technology disruption includes both deliberate (cyber-attacks) or accidental (equipment failure or human error) actions that can cause the loss of use of technology and/or data. A cyber threat/attack is a circumstance or event that has or indicates the potential to exploit technology vulnerabilities and to adversely impact organizational operations, organizational assets (including information and information systems), individuals, other organizations, or society. Critical infrastructure, such as utilities and telecommunications, are also potential targets. Cyber threats/attacks are most easily described as either external threats (where attacks originate outside of established networks) or internal/insider threats (where attacks originate from users who have existing access to an internal network). Examples of cyber threats/attacks include: malware and hacking, phishing, denial of service attacks, ransomware, and state-sponsored hacking. Any one of these threats, if initiated, and successful, can produce a cyber-attack that has major implications throughout the organization. Recent report produced by Verizon (2020) analyzes 32,002 security incidents and 3,950 confirmed breaches from 81 global contributors from 81 countries and indicate the following trends:

- *86% of data breaches for financial gain - up from 71% in 2019*
- *Cloud-based data under attack – web application attacks double to 43%*
- *67% of breaches caused by credential theft, errors and social attacks*
- *Clearly identified cyber-breach pathways enable a "Defender Advantage" in the fight against cyber-crime*
- *On-going patching successful - fewer than 1 in 20 breaches exploit vulnerabilities*
- *37% of credential theft breaches used stolen or weak credentials*
- *25% involved phishing*
- *Human error accounted for 22%*

- **Location and Extent**

Technology disruptions can happen anywhere within the City but will generally be targeted towards larger corporations or government organizations.

- **History**

While there have been several smaller cyber threats and hacking, none have reached a level of significance. However, the frequency of cyber-attacks on public and private sector organizations in general, continues to rise.

- **Probability**

The probability of technology disruptions is on the rise globally, national, and locally. The probability of occurrence of cyber threats is rapidly increasing, especially with increased reliance on the Internet and cloud-based computing. However, cyber security threats/attacks will generally be targeted towards larger corporations or state/national governments which are not located within the county.

Local governments are increasingly being targeted by cyber criminals on the basis that they have fewer resources to defend themselves. Unlike natural hazards, where there is historical data, and some predictive modeling can occur, cyber-attacks are an emerging hazard, which are more challenging to anticipate

- **Climate Change Considerations**

While there is little evidence to link climate change to increase in occurrences of cyber security threats/attacks, the target could be related to persons/groups with issues with individuals or companies they perceive to have effect on the climate (i.e., greenhouse gas producers) within the community. And much like terrorism, depending on the consequence of the cyber-attack, it could hinder the response and recovery efforts.

5.4.2.9 TRAIN ACCIDENT/INCIDENT

- **Ranking-** *Probability*- Low; *Impact*- Medium
- **Description**

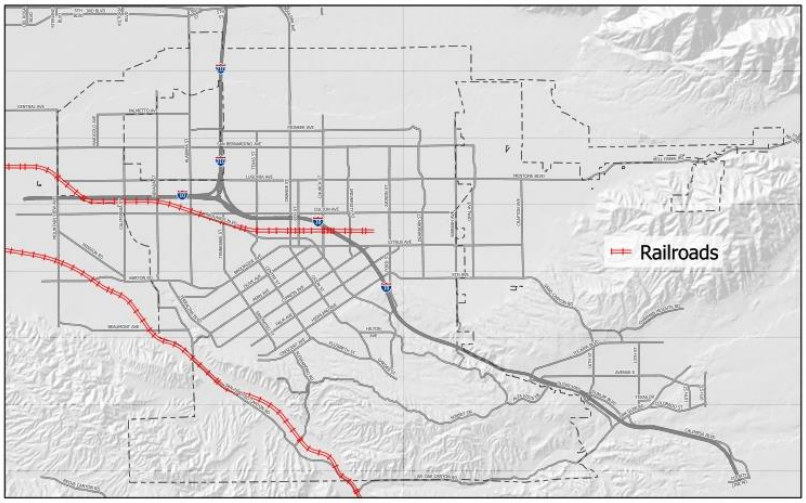
Train derailments are defined as any accidents involving public or private trains carrying passengers or cargo along the rail corridor. Cargo commodities include such things as hazardous materials, fuel (including oil), agriculture, meats, and non-consumables (*NOTE: hazardous materials incident are covered under a separate hazard*). Train derailments, like other transportation accidents, are less likely to lead to a state or federal disaster declaration, than other hazards previously and afore mentioned.

- **Location and Extent**

Trains running through the City of Redlands carry both commuters and commodities (**Figure 5.17**). However, San Bernardino County is currently in the final stages of extending the Metrolink line to the City of Redlands. This will increase the frequency of trips and volume of riders/passengers, thus increasing the potential for commuter-related train incidents.

Train accidents are generally localized, and the incidents result in limited impacts at the community level. However, if there are volatile or flammable substances on the train and the train is in a highly populated or densely forested area, death, injuries, and damage to homes, infrastructure, and the environment, including forest fires can occur.

Figure 5.17- Rail Lines in Vicinity of the City of Redlands



- **History**

There have been no historical train derailments incidents within the City of Redlands.

- **Probability**

Train accidents can occur anytime during the year. Because of current plans to extend the commuter rail into the City of Redlands, it is expected that the provability of an incident/accident will increase.

- **Climate Change Considerations**

Weather conditions have been known to play a significant role in some train derailments globally. While current train operations anticipate and plan for current and future weather conditions, sudden changes to weather conditions and weather patterns can affect the safe movement of trains. Additionally, climate change could impact response and recovery operations.

5.4.3 TIER III

The hazard under Tier III includes Dam Breach and Terrorism.

5.4.3.1 DAM BREACH

- **Ranking-** *Probability*- Low; *Impact*- Medium
- **Description**

Because of California's seasonal and climatic conditions, water storage is critical. Dams and reservoirs help reserve (store) the water necessary for agriculture, hydroelectric power, recreational activities, environmental protection, and a stable drinking water supply. They are also critical tools in flood and debris control. Based on the function, dams can be classified as: storage dam, diversion dam, detention dam, debris dam, or coffer dam. In addition to the classifications there are several types of dams:

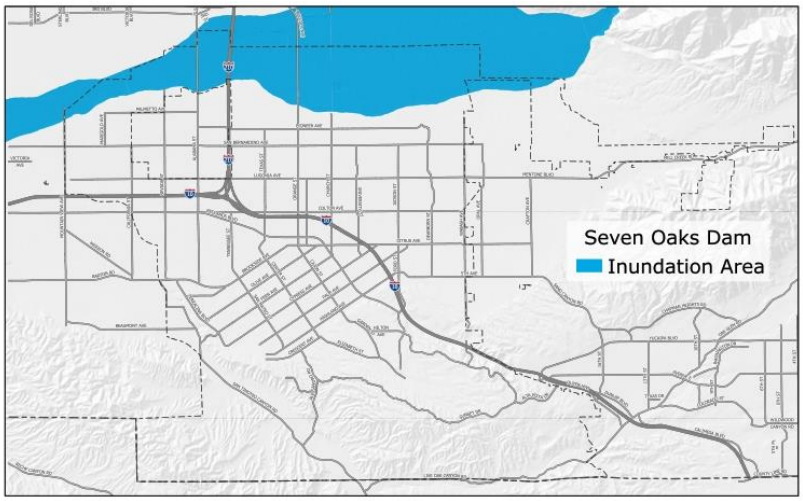
- *Gravity Dams- concrete, rubber masonry*
- *Embankment Dams- earth or rock*
- *Arch/Multiple Arch Dams- concrete*
- *Buttress Dams- concrete, timber, steel*

Along with their many benefits, dams and reservoirs present formidable consequences if not properly designed, built, and maintained. Failures to dams and reservoir are generally due to old age, poor design/construction, lack of maintenance, structural damage, improper siting, landslides flowing into a reservoir, or terrorist actions. Structural damage is often a result of a flood, erosion, or earthquake. A catastrophic dam/reservoir failure could inundate the area downstream. The degree of flood impact is dependent upon topography, vegetation, duration and intensity of rainfall with consequent storm water runoff. The force of the water is large enough to carry boulders, trees, automobiles, and even houses along a destructive path downstream. Another factor in dam/reservoir failures is heavy or increased precipitation, especially in very short periods of time. This increase in rainfall can crested dams, weaken structures, and erode supports. The potential for casualties, environmental damage, and economic loss is great. Damage to electric generating facilities and transmission lines could impact life support systems in communities outside the immediate hazard area.

- **Location and Extent**

As shown in **Figure 5.18**, the northernmost portions of the City of Redlands, along the Santa Ana River margin, are located within the potential dam inundation area for Seven Oaks Dam as mapped by San Bernardino County ISD/GIS as part of the San Bernardino County General Plan. Construction of this modern dam by the U.S. Army Corps of Engineers was completed in 1999. Designed for flood control, its location near the San Andreas Fault resulted in the dam's being designed to resist earthquake damage for events as large as a M8 earthquake.

Figure 5.18- Dam Inundation Areas in the City of Redlands



- **History**

The State of California and the federal government have a rigorous Dam Safety Program. This is a proactive program that ensure proper planning in the event of failure but also sets standards for dam design and maintenance. Because of this, many potential issues have been addressed and/or resolved. Within the City of Redlands, no significant dam failures have occurred.

- **Probability**

Dam failure events are infrequent and usually coincide with the events that cause them, such as earthquakes, landslides, excessive rainfall and snowmelt. These impacts can also be exacerbated by aging or poor maintenance of the structures. There is a "residual risk" associated with dams; residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of occurrence of any type of dam failure event is considered to be low in today's regulatory and dam safety oversight environment.

- **Climate Change Considerations**

Increased rainfall from changing climate conditions could present a risk to dams and reservoirs in area if volume of runoff is greater than the dam's capacity. This could cause the County to release stored water into the downstream water courses in order to ensure the integrity of the dam.

5.4.3.2 TERRORISM

- **Ranking-** *Probability*- Low; *Impact*- Medium
- **Description**

Terrorism has become an undeniable reality throughout the United States. The term terrorism refers to intentional, criminal malicious acts. There is no single, universally accepted definition of terrorism, and it can be interpreted in many ways. Terrorism is defined in the Code of Federal Regulations as "...t*he unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.*" (28 CFR, Section 0.85). For the purposes of this plan, terrorism refers to the use of weapons of mass destruction, including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and cyber terrorism. Many of these incidents can be a well-planned, coordinated attacks with multiple suspects, or the result of a lone individual on a rampage. Conventional Attacks/Active Shooter incidents are generally considered a lone individual incident; some are considered "homegrown violent extremists" inspired by foreign terrorist groups.

- **Location and Extent**

Terrorism can occur throughout the entire city but due to terrorisms' intended purpose to cause the greatest amount of destruction it would most likely happen in more populous areas (high value, visually recognized targets) where more devastation, fear, and chaos will ensue.

- **History**

The City and surrounding area have experienced several terrorism (Active Shooter) events. In March of 2016, the police responded to a single shooter incident at Office Depot. There was one (1) minor injury reported. In April of 2017, there was also a shooting at North Park Elementary, part of the Redlands Unified School District. The shooting was an apparent murder–suicide and an act of domestic violence. Three people died from their wounds and another student was wounded and hospitalized. However, the most significant Active Shooter event in the area occurred December of 2015 at the Inland Regional Center in San Bernardino. Fourteen (14) people were killed and 22 others were seriously injured. The pursuit to capture the shooters lead the police to the City of Redlands. The shooters were killed in a shootout, which also left two (2) officers injured.

- **Probability**

All City businesses and facilities are perceived as a soft target; however, due to the intended purpose of terrorism, it would most likely happen in more populous urban areas where more devastation (and fear) will ensue.

- **Climate Change Considerations**

While there is little evidence to link climate change increasing occurrences of terrorism. However, depending on the type of attack, it could intensify the incident (i.e., Improvised Explosive Device- *IED* during high wind event), and hinder the response and recovery efforts (i.e., evacuation during flooding).

6 VULNERABILITY ASSESSMENT

6.1 OVERVIEW

The purpose of this section is to estimate the potential vulnerability (impacts) of hazards within the City of Redlands. While an emphasis will be on the built environment (residential, non-residential, critical facilities, etc.), the economy, and the general population; other areas may be considered (i.e., lifelines, environment). The focus of this section will be on Tier I hazards. As presented in Section 5.0- Hazard Assessment, the Planning Team ranked hazards into tiers: Tier I, Tier II, and Tier III hazards. Understanding potential impacts (damage and losses) is essential to decision-making at all levels of government, providing a basis for developing mitigation plans and policies, emergency preparedness and response and recovery planning. To accomplish this, two (2) different approaches were used:

Scientific Loss Estimation Modeling

The scientific loss estimation modeling efforts included the utilization of the FEMA Hazus model. Hazus is a nationally applicable standardized methodology that estimates potential losses from floods, earthquakes, hurricane winds and tsunamis. Hazus uses state-of-the-art Geographic Information Systems (GIS) software to map hazard data and estimate potential *physical damage* to residential, commercial, schools, critical facilities, and infrastructure; *economic loss*, including lost jobs, business interruptions, repair, and reconstruction cost; and, *social impacts*, including estimating shelter requirements, displaces households, and population exposure to the hazard.

Hazus standard configuration allows for "*out-of-the-box*" regional or community-wide loss assessment using default (Level 1) building inventory databases, aggregated to the census tract (for earthquakes) or census block (for floods) level. Hazus also allows for the replacement of the default data with data that better reflects the area. In 2009, FEMA sponsored a project to leverage and improve San Bernardino County Assessor data for general building stock and utilize it in Hazus for county-level flood and earthquake analysis (San Bernardino County Essential Facilities Risk Assessment- *SBEFRA*). The SBEFRA project incorporated enhanced flood data from information on the FEMA updated (2008) Digital Flood Insurance Rate Map (DFIRM). The results of the SBEFRA project were leveraged and incorporated into this plan.

Exposure Assessment

Because scientific loss estimation models are not available for all types of hazards, a different approach was used on some hazards to identify potential impacts; exposure assessments. There are two (2) kinds of exposure assessment: 1) when there a hazard exposure area (or footprint); and, 2) when an exposure area (footprint) does not exist.

A hazard exposure footprint enables you to determine areas in the planning area where you are either "*in*" or "out" of the hazard (i.e., wildfire). With this footprint, the Planning Team was able to determine elements within the hazard area and conduct a qualitative assessment of the potential impact. For those hazards where an exposure footprint does not exist (i.e., infectious disease, energy shortage/power outage), the assessment is done for the entire planning area/City. Neither approach

provides an estimate potential damage but provides an understanding of the exposure and as such, the potential loss during events. Types of elements that were considered during the exposure assessment were general building stock, populations, lifeline infrastructure, economy, and the environment. **Table 6.1** provides a summary of relevant building stock from Hazus, population, and economy information presented in *Section 3.0- Community Profile*. This information provides a reference point which can be used to assess the potential impacts from the hazard.

Table 6.1- Summary of Building Stock, Population, and Economy within the City of Redlands

BUILDING STOCK	Building Count	Building Replacement Value ($1,000)	Contents Replacement Value ($1,000)	Building Sq. Ft. (1,000 Sq. Ft.)
Residential	19,661	$4,586,535	$2,293,253	39,193
Commercial	790	$2,000,690	$2,077,158	20,969
Industrial	116	$154,116	$231,174	2,020
Other	524	$449,264	$219,703	2,817
TOTAL	**21,091**	**$7,190,605**	**$4,821,288**	**64,998**
Concrete	223	$572,025		
Mfg Housing	1,039	$47,818		
Precast Concrete	99	$388,399		
Reinforced Masonry	398	$617,472		
Steel	142	$264,195		
URM	59	$73,705		
Wood Frame (Other)	990	$1,406,583		
Wood Frame (SFR)	18,141	$3,820,407		
TOTAL	**21,091**	**$7,190,605**		
POPULATION	**Citizens**	**% of Population**		
Under 18	16,304	22.9%		
Between 18-65	43,928	61.7%		
Over 65	11,964	15.4%		
TOTAL	**71,196**	**100%**		
ECONOMY	**Jobs**	**% of Economy**		
Education	16,311	39.20%		
Retail	5,243	12.60%		
Professional	5,118	12.30%		
Leisure	3,703	8.90%		
Wholesale	1,872	4.50%		
Construction	1,831	4.40%		
Public	1,706	4.10%		
Other	1,623	3.90%		
Finance	1,498	3.60%		
Manufacturing	1,373	3.30%		
Transportation	915	2.20%		
Information	291	0.70%		

Agriculture	125	0.30%		
TOTAL	**41,609**	**100%**		

Additionally, the FEMA-funded SBEFRA project also did an exposure assessment of facilities deemed critical under the project (i.e., police stations, fire stations, emergency operations centers, schools). The SBEFRA project did a damage assessment of critical facilities for Earthquake and an exposure assessment of critical facilities for Flood and Wildfire.

6.2 TIER I HAZARDS

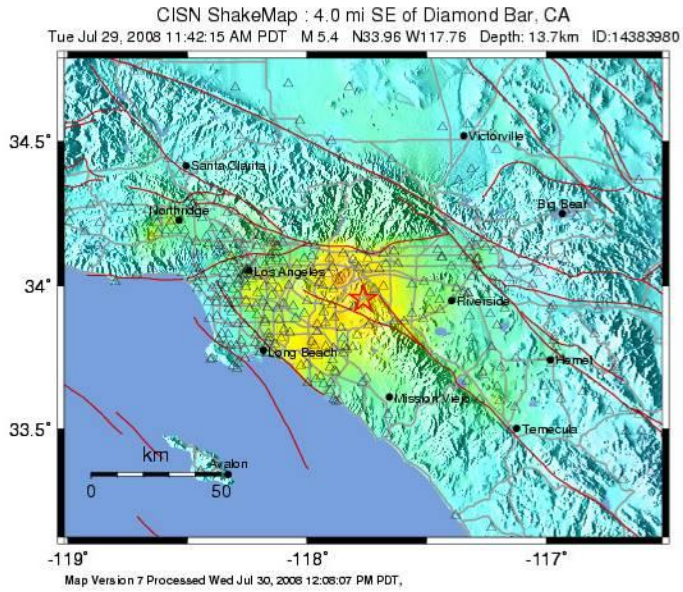
6.2.1 EARTHQUAKE

To understand the vulnerability to Earthquakes in the City of Redlands, a scientific loss estimation model was used. The City of Redlands leveraged the Hazus assessment and critical facilities exposure assessment conducted under the SBEFRA Project. The Planning Team ranked this hazard as a HIGH impact during the hazard prioritization process.

6.2.1.1 HAZUS ASSESSMENT

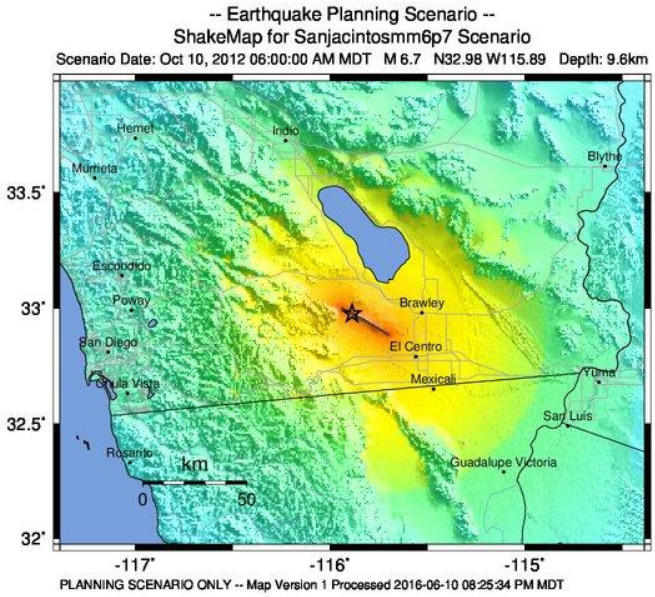
The SBEFRA Project looked at three (3) earthquake scenarios: the M7.8 Shakeout Scenario, a M6.7 San Jacinto scenario earthquake, and a M6.7 Chino Hills Scenario earthquake (**Figure 6.1**, **Figure 6.2**, and **Figure 6.3**). A summary of the Hazus results is presented in **Table 6.2**. It should be noted that the casualty figures reported are not direct Hazus outputs; they are estimates in more medically-meaningful categories derived from Hazus outputs using a "calibration" methodology developed using historic injury data from the 1994 Northridge and other California earthquakes (Seligson & Shoaf, 2003). The method was also recently applied for the San Andreas "ShakeOut" Scenario developed by the USGS and others for the 2008 Golden Guardian statewide disaster exercise (Jones et al., 2008). Also as noted previously, Hazus estimates earthquake impacts at the census tract level. Accordingly, building count totals may differ from totals reported in the flood risk assessment**,** which were developed at the census block level.

Figure 6.1- ShakeOut Scenario (M7.8)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Figure 6.2- San Jacinto Scenario (M6.7)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.1	0.5	2.4	6.7	13	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	11	22	43	83	>160
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Wald, et al.; 1999

Figure 6.3- Chino Hills Scenario (M6.7)

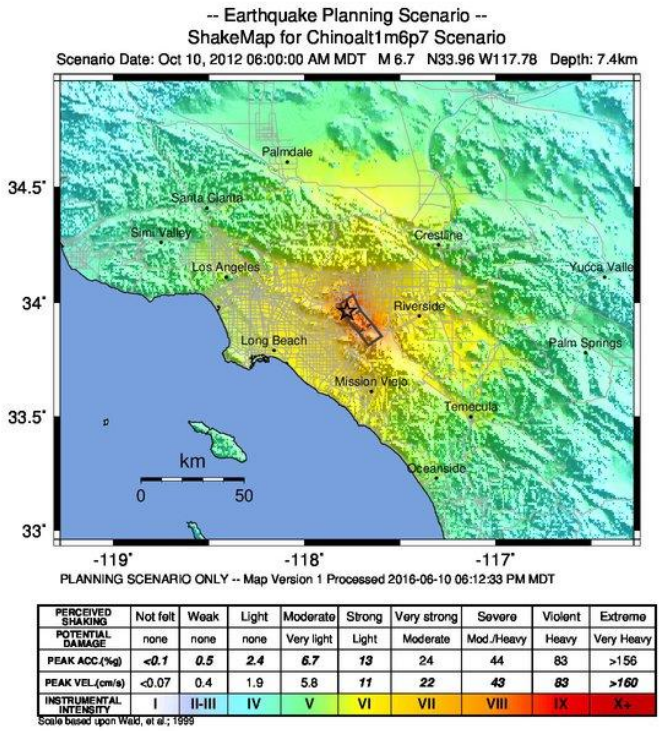


Table 6.2- Estimated Earthquake Impacts for the City of Redlands (Hazus)

		Earthquake Scenario		
		M7.8 ShakeOut	**M6.7 San Jacinto**	**M6.7 Chino Hills**
Direct Economic Losses for Buildings ($1,000)				
	Total Building Exposure Value	**7,190,605**		
Capital Stock	Cost of Structural Damage	245,830	48,248	1,022
	Cost of Non-Structural Damage	858,890	190,323	10,548
	Total Building Damage (Str. + Non-Str.)	1,104,721	238,572	11,570
	Building Loss Ratio %	15.4%	3.3%	0.2%
	Cost of Contents Damage	324,650	80,134	6,038
	Inventory Loss	13,510	3,066	280
Income	Relocation Loss	121,663	29,579	277
	Capital-Related Loss	56,578	10,669	119
	Rental Income Loss	77,740	16,676	259
	Wage Losses	79,015	16,096	164
	Total Direct Economic Loss (% of County Damage)	**1,777,877** (8.2%)	**394,792** (7.8%)	**18,706** (0.6%)
Casualties				
Day Casualties (2PM)	**Fatalities**	**26**	**1**	**0**
	Trauma injuries	7	0	0
	Other (non-trauma) hospitalized injuries	47	0	0
	Total Hospitalized Injuries	**54**	**0**	**0**
	Injuries requiring Emergency Dept Visits	963	69	1
	Injuries treated on an Outpatient basis	1,632	133	2
	Total Injuries	**2,675**	**203**	**3**
	Hospital visits requiring EMS transport	78	3	0
Night Casualties (2AM)	**Fatalities**	**7**	**0**	**0**
	Trauma injuries	2	0	0
	Other (non-trauma) hospitalized injuries	13	0	0
	Total Hospitalized Injuries	**15**	**0**	**0**
	Injuries requiring Emergency Depart Visits	615	65	2

		Earthquake Scenario		
		M7.8 ShakeOut	M6.7 San Jacinto	M6.7 Chino Hills
	Injuries treated on an Outpatient basis	1,117	133	4
	Total Injuries	**1,754**	**198**	**6**
	Hospital visits requiring EMS transport	39	2	0
Shelter				
	Number of Displaced Households	2,728	728	2
	Number of People Requiring Short-term Shelter	938	229	1
Debris (thousands of tons)				
	Brick, Wood & Other (Light) Debris	175	39	1
	Concrete & Steel (Heavy) Debris	452	54	1
Building Damage Count by General Building Type				
Concrete	None	20	61	217
	Slight	39	80	6
	Moderate	44	69	0
	Extensive	41	13	0
	Complete	78	1	0
	Total	**223**	**223**	**223**
Manuf. Housing	None	0	11	714
	Slight	0	86	263
	Moderate	1	521	62
	Extensive	17	391	0
	Complete	1,022	29	0
	Total	**1,039**	**1,039**	**1,039**
Precast Concrete	None	22	30	94
	Slight	43	45	5
	Moderate	31	23	0
	Extensive	3	1	0
	Complete	0	0	0
	Total	**99**	**99**	**99**
Reinforced Masonry	None	97	178	390
	Slight	112	135	7
	Moderate	107	75	1
	Extensive	42	10	0
	Complete	40	0	0
	Total	**398**	**398**	**398**
Steel	None	6	34	138
	Slight	14	53	4
	Moderate	39	49	0
	Extensive	43	6	0
	Complete	40	0	0
	Total	**142**	**142**	**142**
Unreinforced Masonry	None	1	5	48
	Slight	3	13	10
	Moderate	6	25	2
	Extensive	4	14	0
	Complete	44	2	0
	Total	**59**	**59**	**59**
Wood Frame (Other)	None	188	374	970
	Slight	320	435	19
	Moderate	176	168	0
	Extensive	111	12	0
	Complete	195	1	0
	Total	**990**	**990**	**990**
Woo d Fram	None	6,691	9,534	17,778
	Slight	8,987	7,653	357

		Earthquake Scenario		
		M7.8 ShakeOut	M6.7 San Jacinto	M6.7 Chino Hills
	Moderate	2,267	884	6
	Extensive	190	59	0
	Complete	7	11	0
	Total	**18,141**	**18,141**	**18,141**
ALL BUILDING TYPES	None	7,026	10,226	20,349
	Slight	9,519	8,499	671
	Moderate	2,671	1,814	71
	Extensive	451	506	0
	Complete	1,425	45	0
	Total	**21,091**	**21,091**	**21,091**

6.2.1.2 CRITICAL FACILITIES EXPOSURE ASSESSMENT

Damage and functionality of critical facilities identified in the FEMA-funded SBEFRA project were estimated for the earthquake scenarios identified above using HAZUS. Results are presented in **Table 6.3.** As shown, three of the four fire stations existing in 2009 are expected to be less than 50% functional in a M7.8 earthquake on the San Andreas fault (ShakeOut scenario), although physical damage is likely to be considered Moderate or less (none of the stations are have probabilities of experiencing moderate or greater damage exceeding 50%). In this same event, the EOC is expected to have functionality between 50-75%, while the Redlands Police Department is expected to have less than 50% functionality and its probability of being in the Moderate or greater damage state exceeds 50%. The Police Department is also expected to have less than 50% functionality in the M6.7 San Jacinto earthquake scenario.

Table 6.3- Estimated Essential Facility Earthquake Impacts (Hazus)

		Earthquake Scenario		
		M7.8 ShakeOut	M6.7 San Jacinto	M6.7 Chino Hills
Fire Stations	**Redlands Fire Department**			
	Total Number of Buildings	**4**		
	Damage			
	# Blgs with >50% Probability of Moderate or Greater Damage	0	0	0
	# Blgs with >50% Probability of Complete Damage	0	0	0
	Functionality			
	Functionality < 50 % on Day 1	3	0	0
	Functionality 50 - 75% on Day 1	1	4	0
	Functionality >75% Day 1	0	0	4
EOCs	**City of Redlands**			
	Total Number of Buildings	**1**		
	Damage			
	# Blgs with >50% Probability of Moderate or Greater Damage	0	0	0
	# Blgs with >50% Probability of Complete Damage	0	0	0
	Functionality			
	Functionality < 50 % on Day 1	0	0	0
	Functionality 50 - 75% on Day 1	1	0	0
	Functionality >75% Day 1	0	1	1

		Earthquake Scenario		
		M7.8 ShakeOut	M6.7 San Jacinto	M6.7 Chino Hills
Police Station	**Redlands Police Department**			
	Total Number of Buildings	**1**		
	Damage			
	# Blgs with >50% Probability of Moderate or Greater Damage	1	0	0
	# Blgs with >50% Probability of Complete Damage	0	0	0
	Functionality			
	Functionality < 50 % on Day 1	1	1	0
	Functionality 50 - 75% on Day 1	0	0	0
	Functionality >75% Day 1	0	0	1

Under the FEMA-funded SBEFRA project, the earthquake exposure analysis also included an assessment of Liquefaction Susceptibility Zones. The analysis identified several facilities in High and Very High Liquefaction Susceptibility zones:

- Three (3) Fire Station (FS 262, FS 263, and FS 264)
- Emergency Operations Center
- Four (4) Police Department (Community Policing Station, Animal Control, Redlands Community Senior Center, Police Annex)
- Two (2) Municipal Utility facility (Corporate Yard)
- City Hall

Because the school district participated in the FEMA-funded SBEFRA project, it was possible to develop damage and functionality estimates for the Redlands Unified School District's (District or RUSD) facilities in each of the three scenario earthquakes. An overall summary of the District's performance, in terms of damage and functionality on the day of the earthquake, is given in **Table 6.4**

Table 6.4- Estimated Earthquake Impacts for the Redlands Unified School District Summary (Hazus)

	Earthquake Scenario		
	M7.8 ShakeOut	M6.7 San Jacinto	M6.7 Chino Hills
Total Number of Buildings	**592**		
Damage			
# Buildings with >50% Probability of Moderate or Greater Damage	79	18	0
# Buildings with >50% Probability of Complete Damage	17	0	0
Functionality			
Functionality < 50 % on Day 1	519	101	0
Functionality 50 - 75% on Day 1	73	448	1
Functionality >75% Day 1	0	43	591

As shown in Table 6.4, 79 buildings have a high likelihood (>50% probability) of experiencing Moderate or greater damage in the M7.8 ShakeOut Scenario earthquake on the San Andreas Fault; 17 of these are likely (have >50% probability) to suffer Complete damage. These 79 buildings are located on 19 different campuses (*see* Table 6). The campuses with the most buildings in this category are Redlands High School (29) and Clement Middle School (10). In the San Jacinto scenario earthquake, there are 18 buildings on 9 campuses likely to experience Moderate or greater damage.

Overall, 519 of the 592 buildings are expected to have initial functionality of less than 50% on Day 1 following the M7.8 ShakeOut scenario earthquake; these buildings are spread across virtually all facility locations (*see* Table 6) number decrease to 101 buildings on 16 campuses with less than 50% functionality

following a M6.7 San Jacinto scenario earthquake, with no buildings expected to have less than 50% functionality following a M6.7 Chino Hills scenario earthquake.

Damage information for each campus in the two earthquake events shown to cause potential damage (the M7.8 ShakeOut Scenario and the M6.7 San Jacinto Scenario earthquakes) is given in **Table 6.5**, while **Table 6.6** provides campus level functionality estimates for all three events.

Table 6.5- Estimated Earthquake Damage- Redlands Unified School District (Hazus)

Name	# of Bldgs.	M7.8 ShakeOut		M6.7 San Jacinto
		>50% Probability of Moderate Damage	>50% Probability of Complete Damage	>50% Probability of Moderate Damage
Arroyo Verde Elem.	24	0	0	0
Beattie Middle	8	0	0	0
Bryn Mawr Elem.	26	0	0	0
Central Admin./Enrollment Center	3	1	0	0
Clement Middle	35	10	0	0
Cope Middle	42	0	0	0
Crafton Elem.	21	7	1	1
Cram Elem.	27	1	0	0
District Office-North	4	1	0	0
District Office-South	9	1	1	1
Fallsvale Elem.	3	0	0	0
Franklin Elem.	7	5	0	0
Highland Grove Elem.	6	0	0	0
Judson & Brown	9	0	0	0
Kimberly Elem.	21	0	0	0
Kingsbury Elem.	12	1	0	1
Lugonia Elem.	19	4	0	0
Mariposa Elem.	16	0	0	0
McKinley Elem.	12	2	2	2
Mentone Elem.	26	1	0	0
Mission Elem.	11	3	2	2
Moore Middle	25	1	0	0
Orangewood High	19	4	3	3
Redlands East Valley High	83	1	0	0
Redlands High	83	29	5	5
Smiley Elem.	11	0	0	0
Supply Center	5	3	2	2
Transportation	3	1	1	1
Victoria Elem.	22	3	0	0
Total	**592**	**79**	**17**	**18**

Table 6.6- Estimated Post-Earthquake Functionality, Redlands Unified School District (Hazus)

Name	# of Bldgs	M7.8 ShakeOut		M6.7 San Jacinto Fault			M6.7 Chino Hills Fault	
		<50%	50-75%	<50%	50-75%	>75%	50-75%	>75%
Arroyo Verde Elem.	24	24	0	0	22	2	0	24
Beattie Middle	8	8	0	0	8	0	0	8
Bryn Mawr Elem.	26	0	26	26	0	0	0	26
Central Admin/Enrollment Center	3	3	0	1	2	0	0	3
Clement Middle	35	35	0	0	35	0	0	35
Cope Middle	42	23	19	11	31	0	0	42
Crafton Elem.	21	21	0	1	20	0	0	21
Cram Elem.	27	27	0	0	1	26	0	27

District Office-North	4	4	0	0	4	0	0	4
District Office-South	9	9	0	1	8	0	0	9
Fallsvale Elem.	3	3	0	0	0	3	0	3
Franklin Elem.	7	7	0	0	7	0	0	7
Highland Grove Elem.	6	6	0	0	6	0	0	6
Judson & Brown	9	9	0	0	9	0	0	9
Kimberly Elem.	21	6	15	0	21	0	0	21
Kingsbury Elem.	12	12	0	5	7	0	0	12
Lugonia Elem.	19	19	0	0	19	0	0	19
Mariposa Elem.	16	5	11	0	16	0	0	16
McKinley Elem.	12	12	0	3	9	0	0	12
Mentone Elem.	26	26	0	0	26	0	0	26
Mission Elem.	11	11	0	3	8	0	0	11
Moore Middle	25	25	0	1	24	0	0	25
Orangewood High	19	19	0	4	15	0	0	19
Redlands East Valley High	83	83	0	1	70	12	0	83
Redlands High	83	83	0	8	75	0	0	83
Smiley Elem.	11	9	2	11	0	0	0	11
Supply Center	5	5	0	2	3	0	0	5
Transportation	3	3	0	1	2	0	1	2
Victoria Elem.	22	22	0	22	0	0	0	22
Total	**592**	**519**	**73**	**101**	**448**	**43**	**1**	**591**

The FEMA-funded SBEFRA project also assessed Liquefaction Susceptibility risk for the RUSD facilities. The assessment found:

- Fifty-three (53) buildings in the Moderate zone (Arroyo Verde Elementary, Fallsvale Elementary, and Mentone Elementary)
- Two hundred-nineteen (219) buildings in the High zone (Central Admin./Enrollment Center, Clement Middle, District Office-North, District Office-South, Judson & Brown Elem., Lugonia Elem., Mission Elem., Orangewood High, Redlands East Valley High, Supply Center, Victoria Elem
- One-hundred (100) buildings in the Very High zone (Beattie Middle, Highland Grove Elem., Redlands High, Transportation

6.2.2 ENERGY SHORTAGE/POWER OUTAGE

To understand the vulnerability to Power Outage in the City of Redlands, an exposure assessment was used. Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. A power outage could have a considerable impact on the population, built environment, lifeline infrastructure, and the economy. The Planning Team ranked this hazard as a HIGH impact during the hazard prioritization process.

- *Population*- Our communities have become more reliant on power for gadgets and appliances to perform basic daily activities. This loss of power will not only be an inconvenience but could become a life-threatening experience. Many citizens rely on power to operate medical machinery to survive (i.e., oxygen tanks, dialysis machines).
- *Built Environment*- Power outages have a significant impact on buildings. While in most cases it will not damage the structure, the loss of power will impact the buildings functionality. This includes loss of: lighting, HVAC, electrical outlets, communications, and elevators in taller buildings.
- *Lifeline Infrastructure*- Because of interdependencies, the loss of power can impact several other lifeline systems (i.e., water, telecommunications, natural gas, fuel). While there are backup

systems for some aspects of the system, depending on the length of time, many systems will loss functionality or be required to shut down for safety.

- *Economy*- If lifeline systems shutdown and/or fail, there are rippling effects on the economy as there is an inability to provided services and/or move merchandise. Additionally, implementation of temporary mitigation actions could impact operating budgets.

While a power outage can vary in size and length of time, in the City of Redlands, it is expected to be smaller and of limited time.

6.2.3 FLOOD

To understand the flood vulnerability in the City of Redlands, a scientific loss estimation model was used and an exposure assessment was performed. The City of Redlands leverage the Hazus assessment and critical facilities exposure assessment that was conducted as part of the SBEFRA Project and conducted an exposure assessment of its list key assets, general building stock, and population against flood hazard zones. While the Hazus model and the exposure assessment does a good job of estimating damage and potential injuries from the damage, it does not consider challenges from illegal encampments within the watershed and along the riverbeds. These encampments have created an increased concern and extra work for city officials during potential flood events. This vulnerability needs to be better understood and analyzed; and actions taken to help reduce and/or eliminate potential future risk from flooding.

Another aspect that is not part of the Hazus model and the exposure assessment is the National Flood Insurance Program (NFIP). As previously mentioned, the City of Redlands is a NFIP participating community and takes an active role in floodplain management. An important part of its role is to understand and address reoccurring losses, particularly with regards to NFIP claims. A recent check of repetitive and severe repetitive loss properties conducted by FEMA Region IX's NFIP Unit indicates that there are no repetitive or severe repetitive loss properties in the City of Redlands.

The Planning Team ranked this hazard as a HIGH impact during the hazard prioritization process.

6.2.3.1 HAZUS ASSESSMENT

Under the SBEFRA Project, three (3) flood scenarios were analyzed: a 100-year flood, a 100-year flood without levee protection, and a 500-year flood. **Table 6.7** provides the Hazus losses estimated for the County in each of these scenarios.

Table 6.7- Regional Flood Impacts to San Bernardino County (Hazus)

	Regional Risk Assessment Results	Flood Scenario		
		100-year	100-year*	500-year
Regional Risk	Economic loss due to building damage ($B)	0.46	1.6	2.7
	Total building-related direct economic loss ($B)	1.4	5.4	8.6
	# of buildings in the Complete Damage State	345	350	1,105
	Total # Displaced Households	14,828	52,856	86,062
	Total # people needing short-term shelter	32,095	138,991	231,452
	Debris Generated (million tons)	0.1	0.23	0.37

**- 100-year Flood without levee protection*

Unfortunately, the County results can't be disaggregated to individual City-level using publicly-available information. However, the City of Redlands represents 4% of the values of the entire County. Making a simplifying assumption of a uniform distribution of flood risk across the County, the City of Redlands could be expected to suffer as much as:

- $18 million in economic loss due to building damage in a 100-year flood
- $64 million in a 100-year flood event without levee protection
- $108 million in a 500-year flood event
- Have 14 buildings in Complete Damage State during the 100-year event and 44 buildings in Complete Damage State during the 500-year event
- Have 593 displaced households during a 100-year event with levee protection (2,114 households without levee protection); and 3,442 households displaced during a 500-year event
- Of the displaced household, the city can expect 5,560 people needing shelter during a 100-year event with levee protection (1,284 people without levee protection); and 9,258 people during a 500-year event

The SBEFRA project also produced facility-level flood risk assessment results for the 100-year, 100-year without levee protection, and 500-year flood scenarios for the identified essential facilities (Emergency Operations Centers-*EOC*, Police Stations, Fire Stations). The City of Redlands' existing fire stations, police station and EOC were all determined to be functional in each of the three (3) flood scenarios.

To determine a more robust estimate of the potential flood risk faced by the City of Redlands, a quantitative assessment of exposure to flooding was also performed. The improved census-block level general building stock data generated by the SBEFRA project was overlain onto maps of flood hazard (FEMA's National Flood Hazard Layer) to quantify the amount of the building inventory that falls within each hazard zone. The results of this overlay are provided in **Table 6.8**.

Table 6.8- Redlands Building Inventory Exposure to Flood Hazards

Building Inventory Data by General Occupancy	Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance (100-year) Flood				Other flood areas		Other Areas		
	Zone A	Zone AE	Zone AH	Zone AO	Zone X (Shaded)	Zone X Protected by Levee	Zone D	Zone X (Unshaded)	TOTAL
Building Replacement Value ($1,000)									
Residential	3,316	0	0	72,993	0	23,917	59,597	4,329,967	4,489,790
Commercial	26,136	0	0	250,414	575	16,444	4,946	1,256,213	1,554,728
Industrial	19,010	0	0	18,101	0	6,370	0	92,749	136,230
Other	7,159	0	0	13,473	0	9,224	0	405,384	435,240
Total	**55,621**	**0**	**0**	**354,981**	**575**	**55,955**	**64,543**	**6,084,313**	**6,615,988**
% of Total	**1%**	**0%**	**0%**	**5%**	**0.01%**	**1%**	**1%**	**92%**	**100%**
Contents Replacement Value ($1,000)									
Residential	1,658	0	0	36,494	0	11,958	29,798	2,164,974	2,244,882
Commercial	26,136	0	0	250,414	575	16,444	4,946	1,332,681	1,631,196

Industrial	28,515	0	0	27,152	0	9,555	0	139,124	204,346
Other	10,738	0	0	13,371	0	1,538	0	182,862	208,509
Total	**67,047**	**0**	**0**	**327,431**	**575**	**39,495**	**34,744**	**3,819,641**	**4,288,933**
% of Total	**2%**	**0%**	**0%**	**8%**	**0.01%**	**1%**	**1%**	**89%**	**100%**
Building Square Footage (1,000 Sq. Ft.)									
Residential	31	0	0	722	0	227	530	36,978	38,488
Commercial	237	0	0	2,196	4	124	60	13,011	15,633
Industrial	252	0	0	240	0	85	0	1,210	1,788
Other	15	0	0	105	0	70	0	2,548	2,738
Total	**535**	**0**	**0**	**3,264**	**4**	**506**	**590**	**53,748**	**58,647**
% of Total	**1%**	**0%**	**0%**	**6%**	**0.01%**	**1%**	**1%**	**92%**	**100%**
Building Count									
Residential	27	0	0	376	0	149	324	18,611	19,487
Commercial	8	0	0	174	1	8	8	509	708
Industrial	2	0	0	25	0	2	0	67	96
Other	2	0	0	12	0	21	0	480	515
Total	**39**	**0**	**0**	**587**	**1**	**180**	**332**	**19,667**	**20,806**
% of Total	**0.2%**	**0%**	**0%**	**3%**	**0.005%**	**1%**	**2%**	**95%**	**100%**

Notes: *Special Flood Zone Areas are defined in the Hazard Assessment section under Flood*

As shown in the Table 6.8, most of the city's buildings are located outside of mapped areas subject to flooding (i.e., Zone X). However, $410 million (6%) of the City's building value (3.2% of the buildings by count) is subject to inundation by the 1% Annual Chance (100-year) Flood. Should these buildings suffer flood losses on the order of 12–16% (e.g., the expected range of damage possible for: a two-story home with no basement, a typical retail store, a typical office, or a typical industrial facility, each with two feet of flood water, as modeled by the Hazus software's damage function library), building damage could reach $50–65 million dollars, significantly more than was estimated from countywide loss estimates assuming uniform risk.

Further, while most of the building value at risk in the 100-year floodplain is commercial development (67%), more than 400 residential buildings are also exposed. Very little inventory (<1%) is exposed to the 500-year flood hazard (Zone X (Shaded)—0.2% Annual chance (500yr) Flood), and just 1% is located in areas of levee protection for the 100-year flood (Zone X Protected by Levee—Areas protected from the 1% annual chance flood).

It should be noted that the totals in this Table 6.8 will vary slightly from those presented in Community Profile sections, because it was developed by identifying individual census blocks falling within the boundaries of each hazard zone, and will therefore produce a more refined overlay assessment than a similar analysis conducted using census tract data. The table in the Community Profile section was developed from census tract data.

6.2.3.2 Critical Facilities Exposure Assessment

Under the FEMA-funded SBEFRA project, a flood exposure analysis of the critical facilities was performed. The analysis identified one (1) Fire station (Fire Station 261) and eighty-eight (88) RUSD buildings (Redlands High School, Supply Center) in Zone AO; and one-hundred-thirty (130) RUSD buildings and one (1) Municipal Utility facility (Hinkley Surface Water Treatment Plant) in Zone X. The other critical facilities were all located in Zone X (Unshaded).

6.2.4 Infectious Disease

To understand the vulnerability to Infectious Disease in the City of Redlands, an exposure assessment was used. Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. The city, as well as the state, country, and the world, are vulnerable to infectious disease caused by either newly emerging or existing diseases spread person to person, through a vector, or through food. A significant infectious disease outbreak, epidemic, and/or pandemic could impact a large portion of the population, create challenges on the built environment, overburden essential public services, and effect the economy. The Planning Team ranked this hazard as a HIGH impact during the hazard prioritization process.

- *Population/Environment*- Populations (or other living organisms) are hardest hit during Infectious Disease events. As observed during the COVID pandemic, exposure to infectious diseases can range from mild conditions to fatalities; each having a significant impact on services provided. Another consideration is addressing the challenges and needs of vulnerable populations (elderly, homeless).
- *Built Environment*- Depending on the type of infectious disease event, impact to buildings may include increased use of equipment (i.e., HVAC, water) and adaptive reuse of space. Additionally, it could also include deferred maintenance to equipment if employees and vendors are unavailable.
- *Economy*- Infectious Disease events can have a significant impact on the economy. While outbreaks and some epidemics may be less impactful, larger epidemics and pandemics can be devastating. This can range from loss of livestock to loss of business due to limited shoppers, employees, and/or tenants.

County Public Health departments develop and exercise response plans related to infectious disease outbreaks, epidemics, and pandemics. Plans are developed through the coordination efforts of partner agencies to establish a solid foundation for improved coordination and intervention by all participants. The plans, however, are focused on public health-related issues and actions. They lack response efforts needed for recovery of the economy and other aspects.

The City of Redlands, as the rest of the world, is currently going through a pandemic with the Coronavirus (COVID-19). Because of the nature of the infectious disease and the duration gain control over the pandemic, there have been significant impact on the local population and the economy. This has led to closure of local schools and businesses, surge in hospital visits, loss of lives, and loss of jobs.

6.2.5 Wildfire

To understand the vulnerability to Wildfire in the City of Redlands, an exposure assessment was used. Because there is a hazard exposure area (or footprint), the Planning Team assessed potential impacts

against the building stock, population, and key assets within the hazard footprint. The California Department of Forestry and Fire Protection's (Cal FIRE) has created and maintains the Fire Hazard Severity Zones maps. These maps, part of the Fire and Resource Assessment Program (FRAP), look at both State Responsibility Areas (SRA) and Local Responsibility Areas (LRA).

The City of Redlands leverage the exposure assessment of the general building stock and the critical facilities conducted as part of the SBEFRA Project against Fire Hazard Severity Zones. While there is good exposure information to leverage, some considerations should be given to addressing man-made ignitions. This includes the use (or inappropriate use) of fireworks, deliberate ignitions of fires, and the use of fires in homeless encampments. The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.

6.2.5.1 General Building Stock Exposure Assessment

For this effort, the improved census-block level building data generated by the SBEFRA project was overlain onto Cal FIRE Fire Hazard Severity Zone maps to quantify the amount of the building inventory that falls within each hazard zone. The results of this overlay are provided in **Table 6.9**. It should be noted that mapped fire hazard severity zones affecting the City are all within LRA. The totals in the table (e.g., total building exposure value, total building square footage, etc.) were derived from census "block" data and will vary slightly from those presented in other tables which were developed from census "tract" data.

Table 6.9- City of Redlands Building Inventory Exposure to Cal FIRE Hazard Zones

Building Inventory Data by General Occupancy	Cal Fire—Fire Hazard Severity Zones					
	Very High	High	Moderate	Non-wildland/ Non-urban	Urban Unzoned	Total
Building Count						
Residential	1,688	870	1,367	379	15,183	19,487
Commercial	24	4	89	22	569	708
Industrial	0	0	33	2	61	96
Other	17	4	8	16	470	515
Total	**1,729**	**878**	**1,497**	**419**	**16,283**	**20,806**
% of Total	8%	4%	7%	2%	78%	100%
Building Square Footage (1,000 Sq. Ft.)						
Residential	4,456	1,904	2,987	701	28,440	38,488
Commercial	217	207	1,503	6,533	7,173	15,633
Industrial	0	0	696	26	1,066	1,788
Other	59	13	33	79	2,555	2,738
Total	**4,732**	**2,124**	**5,219**	**7,338**	**39,234**	**58,647**
% of Total	8%	4%	9%	13%	67%	100%
Building Replacement Value ($1,000)						
Residential	611,516	242,849	365,552	54,011	3,215,862	4,489,790
Commercial	28,447	17,177	173,989	515,605	819,510	1,554,728
Industrial	0	0	52,426	2,170	81,634	136,230
Other	8,845	1,413	5,181	12,938	406,863	435,240
Total	**648,808**	**261,439**	**597,148**	**584,724**	**4,523,869**	**6,615,988**
% of Total	10%	4%	9%	9%	68%	100%
Contents Replacement Value ($1,000)						

Residential	305,758	121,425	182,778	27,006	1,607,915	2,244,882
Commercial	30,827	17,177	187,873	515,605	879,714	1,631,196
Industrial	0	0	78,640	3,255	122,451	204,346
Other	2,873	1,413	3,957	2,748	197,518	208,509
Total	**339,458**	**140,015**	**453,248**	**548,614**	**2,807,598**	**4,288,933**
% of Total	8%	3%	11%	13%	65%	100%

As shown in the Table 6.9, most of the city's buildings (80% of buildings, 77% of building value) are located outside of mapped wildfire hazard areas (i.e., are located in "non-wildland/non-urban" or "urban unzoned" areas). However, 10% of the City's building value is located in the area of Very High Fire Hazard Severity, with an additional 4% located in High Severity, and 9% in Moderate Severity. Most of the exposure to these fire hazard severity zones is residential construction; 1688, 870 and 1367 residential buildings are located in the Very High, High and Moderate Zones respectively, valued at more than $611 million, $242 million, and $365 million.

6.2.5.2 CRITICAL FACILITIES EXPOSURE ASSESSMENT

Under the FEMA-funded SBEFRA project, a wildfire exposure analysis of the critical facilities was performed. The analysis of the Federal and Local Responsibly Area Fire Hazard Severity Zones identified:

- One (1) Fire Station (Fire Station 262) in the Moderate Local Responsibly Area Fire Hazard Severity Zone
- Two (2) Municipal Utility facilities (Henry Tate Water Treatment Plant, Hinkley Surface Water Treatment Plant) and one-hundred-forty-eight (148) RUSD buildings (Arroyo Verde Elementary., Beattie Middle, Highland Grove Elementary., Mariposa Elementary., Mission Elementary., Redlands East Valley High) in the High Local Responsibly Area Fire Hazard Severity Zone
- Twenty-seven (27) RUSD buildings (Cram Elementary) in the Very High Local Responsibly Area Fire Hazard Severity Zone
- Three (3) RUSD buildings (Fallsvale Elementary) in the Very High Federal Responsibly Area Fire Hazard Severity Zone

6.2.6 WINDSTORM

To understand the vulnerability to Windstorms in the City of Redlands, an exposure assessment was used. Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. Windstorm events have become more frequent, longer lasting, and are more severe/intense than before. Windstorms have the capability of being of long or short duration. While longer duration events can have significant impact on the population, built environment, lifeline infrastructure, environment, and/or the economy; shorter duration events can be just as damaging if the winds are powerful. Windstorm events could also trigger other hazards. For example, prolonged periods of high winds, could damage power lines; creating power outages and/or wildfires. The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.

- *Population*- While rare, windstorms have been responsible for injuries and loss of life. High winds have been known to knock people down and cause significant injuries, especially with the elderly. Collapsed structures and flying debris carried along by extreme winds can directly contribute to injuries and loss of life. This is particularly true for falling limbs or branches, or entire trees during wind events. Falling trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Rising population growth and new infrastructure in the region

creates a higher probability for damage to occur from windstorms as more life and property are exposed to risk.

- *Built Environment*- Both residential and commercial structures are susceptible to damage. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift suction forces that pull building components and surfaces outward. With extreme wind forces, the roof or entire building can fail, causing considerable. Windstorms can also collapse or damage roads, bridges, traffic signals, streetlights, and other facilities. During periods of extremely strong winds, major roads and highways can be temporarily closed to personal, commercial (high profile trucks), and recreational vehicle traffic. Roads blocked by may also have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.
- *Lifelines*- Historically, falling trees and other flying debris have been the major cause of power outages in the region. Windstorms such as strong microbursts and Santa Ana Wind conditions can cause flying debris and downed utility lines. Winds can also knock out or cause damage to telecommunications equipment (cell towers and/or antennas). Many lifeline systems rely on telecommunication systems to manage and monitor systems.
- *Economy*- Windstorms can result in direct damage and indirect consequences (interrupted services) to the local economy. Direct impacts include loss of business; while secondary (indirect) impacts include damage to buildings, personnel, and other vital equipment.
- *Environment*- During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds. In some instances, this lose could include some older, more historical (or sentimental) trees in the area or involve several trees, changing the characteristic of the area.

6.3 TIER II AND TIER III HAZARDS

As mentioned, this section is focused on Tier I hazards. However, because there are no loss estimation models for the hazards in Tier II and Tier III and the only vulnerability assessment that can be performed is an exposure assessment; the Planning Team decided to include an overview of the vulnerabilities of the Tier II and Tier III hazards. Below is a summary of the assessment:

6.3.1 TIER II HAZARDS

- *Aircraft Accident/Incident*- To understand the vulnerability to Aircraft Accidents/Incidents in the City of Redlands, an exposure assessment was used. Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. An Aircraft Accident/Incident, depending on the size of the aircraft and the location of the incident, could have a considerable impact on the population (loss of life from the accident), buildings (damage to structures from debris), economy (shut down of areas to recover), and the environment (fire following, loss of vegetation/habitats, reconfiguration of landscape). The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.
- *Civil Disturbance*- To understand the vulnerability to Civil Disturbance in the City of Redlands, an exposure assessment was used. Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. Southern California is a frequent site of demonstrations due to its high profile and presence of significant government functions and buildings. It is conceivable that a demonstration or movement could turn to violence and begin spreading into neighboring communities. While the City of Redlands does not have a history of civil disturbances, it has a high profile in the area. Civil disturbance can vary in size and length of time, however, in the City of Redlands, it is expected to be smaller and of limited time. A civil disturbance, depending on the cause and effect, could have a considerable impact on the population (injuries, fatalities), built environment (destruction to property), lifeline infrastructure (damage to equipment), economy (disruption to normal business), and the environment (destruction to property). The Planning Team ranked this hazard as a HIGH impact during the hazard prioritization process.
- *Drought*- Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. A drought event could have a considerable impact on the population (injuries, fatalities), lifeline infrastructure (damage to equipment), economy (disruption to normal business), and the environment (destruction to landscape). The Planning Team ranked this hazard as a LOW impact during the hazard prioritization process.
- *Extreme Temperatures*- Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. An Extreme Temperature event could have a considerable impact on the population, built environment, lifeline infrastructure, economy, and the environment. Exposure to extreme heat can result in illness (such as heat stroke or heat exhaustion) or death for those at greatest risk, including: infants and children up to four years of age; people who overexert during work or exercise; people 65 years of age or older; people who are ill or on certain medications; the homeless population; and, people who are overweight. Extreme temperatures can cause equipment to become overburden and possible fail. Depending on the type of equipment impacted, it could over heat structures, create electric al overloads, and warp (or melt) pieces. If lifeline systems shutdown and/or fail, there are rippling effects on the economy as there is an inability to provided services and/or move merchandise. Additionally, extreme temperatures may require implementation of mitigation actions that

impact operating budgets. Extreme temperatures could noticeably impact water supplies and vegetation/landscape. The Planning Team ranked this hazard as a LOW impact during the hazard prioritization process.

- *Hazardous Material Accident*- Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. A chemical/hazardous materials spill, depending on the cause and effect, could have a considerable impact on the population (injuries, fatalities), built environment (destruction to property), lifeline infrastructure (damage to equipment), economy (disruption to normal business), and the environment (destruction to property). The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.
- *Infestation*- Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. An infestation event could have a considerable impact on the population (injuries, fatalities), economy (disruption to normal business), and the environment (destruction to landscape/crops). The Planning Team ranked this hazard as a LOW impact during the hazard prioritization process.
- *Landslide*- Because there is a hazard exposure area (or footprint), the Planning Team assessed potential impacts against the building stock, population, and key assets within and around the hazard footprint. The current hazard footprint (*see* Figure 5.16, under Hazard Profile) is located in in areas with very little development and population. However, a landslide event could potentially impact people who may be in the area (injuries, fatalities), damage some property and lifeline infrastructure systems and equipment, disrupt the economy, and damage the environment. The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.
- *Technology Disruption*- Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. A cybersecurity even depending on the cause and effect, could have a considerable impact on the population (injuries, fatalities), built environment (destruction to property), lifeline infrastructure (damage to equipment), and economy (disruption to normal business). The Planning Team ranked this hazard as a HIGH impact during the hazard prioritization process.
- *Train Accident/Incident*- Because there is a hazard exposure area (or footprint), the Planning Team assessed potential impacts against the building stock, population, and key assets within and around the hazard footprint. A train derailment event could have a considerable impact on the population (injuries, fatalities), built environment (destruction to property), lifeline infrastructure (damage to equipment), economy (disruption to normal business), and the environment (reconfiguration of landscape). The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.

6.3.2 TIER III HAZARDS

- *Dam Breach*- Because there is a hazard exposure area (or footprint), the Planning Team assessed potential impacts against the building stock, population, and key assets within the hazard footprint. The current hazard footprint (*see* Figure 5.12, under Hazard Profile) is located in an area with very little development and population. However, a dam breach could potentially impact people who may be in the area (injuries, fatalities), damage some property and lifeline infrastructure systems and equipment, disrupt the economy, and damage the environment. The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.

- *Terrorism*- Because there is not a hazard exposure area (or footprint), the Planning Team considered potential impacts within the entire City. A terrorism event, depending on the cause and effect, could have a considerable impact on the population (injuries, fatalities), built environment (destruction to property), lifeline infrastructure (damage to equipment), economy (disruption to normal business), and the environment (reconfiguration of landscape). The Planning Team ranked this hazard as a MEDIUM impact during the hazard prioritization process.

7 MITIGATION STRATEGY

7.1 OVERVIEW

The mitigation strategy for the City of Redlands is based on informed assumptions, recognizing both mitigation challenges and opportunities, with the ultimate mission of creating a disaster resistant and sustainable community for the future. The mitigation strategy is derived from an in-depth understanding of possible deficiencies between potential vulnerabilities and existing capabilities, with the mitigation objectives in mind. The mitigation strategy built upon the previous mitigation actions identified in the City of Redlands 2015 LHMP and was expanded to consider current needs.

7.2 MITIGATION GOALS AND OBJECTIVES

To better assist with the identification of mitigation measures, mitigation goals and objectives were developed. The mitigation goals and objectives support the City's mitigation mission to create a disaster resistant and sustainable community. Well defined goals and objectives help focus efforts and ensure progress toward the mitigation mission. The mitigation goal and objectives were used by the Planning Team as a starting point prior to identifying mitigation measures. The goals and objectives include:

- **GOAL 1: Minimize Life Loss and Injuries**
  - Objective 1.1 Improve understanding of the hazards (location, vulnerability, and measures needed).
  - Objective 1.2 Exchange information about hazards, vulnerabilities, and mitigation measures with all levels of governments, private sector, and the public.
  - Objective 1.3 Ensure that all facilities meet current applicable regulations, standards, and ordinances designed to protect life safety.
  - Objective 1.4 Identify and modify high risk structures to meet life safety standards.
  - Objective 1.5 Improve emergency communications and public warning systems.
  - Objective 1.6 Develop policies and procedures to better serve disadvantaged and vulnerable populations.
- **GOAL 2: Minimize Damage to Structures, Property, and Equipment**
  - Objective 2.1 Encourage new development to occur in locations that avoid or minimize exposure to hazards.
  - Objective 2.2 Develop and adopt enhanced land use, design, and construction policies designed to reduce property loss to hazards.
  - Objective 2.3 Incorporate mitigation into repairs, major alterations, new development, and redevelopment projects in areas subject to substantial life safety risks.
  - Objective 2.4 Ensure that all facilities meet current applicable codes, standards, and ordinances, encourage incorporation of mitigation measures for all structures.
  - Objective 2.5 Encourage non-structural retrofitting on elements and equipment within facilities.
- **GOAL 3: Protect the Environment**
  - Objective 3.1 Implement mitigation and watershed protection strategies that reduce loss of wildlife, habitat, and water.
  - Objective 3.2 Implement mitigation and protection strategies that reduce loss of cultural, historic and environmental resources.
  - Objective 3.3 Enhance, rehabilitate, and protect natural systems and environmental resources.

Objective 3.4 Encourage balance between natural resource management and land use planning.

- **GOAL 4: Promote Public Awareness of Hazards**

  Objective 4.1 Develop and implement strategies to bring a greater understanding of the risks associated with hazards, individual preparedness activities, and the benefits of hazard mitigation.

  Objective 4.2 Develop and implement strategies to bring a greater understanding of mitigation, disaster preparedness, and recovery programs.

  Objective 4.3 Establish and maintain partnerships between all levels of local government, the private sector, the business community, community groups, and institutions of higher learning that exchange information on hazards and the benefits of mitigation measures.

- **GOAL 5: Improve Emergency Management Capability**

  Objective 5.1 Identify the need for, and acquire, any special emergency management equipment to enhance response capabilities for specific hazards.

  Objective 5.2 Develop and maintain emergency plans (Response, Recovery, Preparedness, Prevention, Mitigation)

  Objective 5.3 Establish and maintain emergency management systems and facilities

  Objective 5.4 Develop and maintain Public-Private Partnerships

  Objective 5.5 Develop and maintain Memorandums of Understanding/Mutual Aid Agreements

  Objective 5.6 Develop, maintain, and share essential data (demographics, hazards, buildings, resources, personnel)

  Objective 5.7 Develop, maintain, and implement emergency management training curriculum

  Objective 5.8 Design and implement disaster response exercises (tabletop, functional, full-scale)

- **GOAL 6: Ensure Continuity of Government and Operations**

  Objective 6.1 Develop, maintain, and exercise Business Continuity Plans; ensuring compatibility with emergency management plans.

  Objective 6.2 Ensure reliability for vital communications

  Objective 6.3 Protect vital records

  Objective 6.4 Protect essential Information Technology equipment and systems

  Objective 6.5 Promote resiliency of essential functions to minimize economic loss/disruption

  Objective 6.6 Maintain list of Key Assets and ensure their functionality after hazard events

  Objective 6.7 Maintain a list of essential personnel and vendors with contact information

  Objective 6.8 Identify and acquire any necessary equipment to maintain functionality

7.3 Progress Implementing Mitigation Measures

As part of the LHMP update process, the Planning Team reviewed the mitigation actions included in the previous plan. The review included identifying the status of the mitigation action (Completed, Not Started, In Progress, or No Longer Needed). Those mitigation actions that were determined to be On Going where placed under the Mitigation Governance section of Capabilities Assessment chapter. For all mitigation actions listed as Not Started, the Planning Team discussed whether or not the mitigation action was still needed. Additionally, descriptions of the needed mitigation actions were reviewed and revised to reflect current conditions. **Table 7-1** indicates the status of each of the mitigation measures from the previous plan.

Table 7-1. Status of Previous Mitigation Measures

Mitigation Measure	Hazard	Status
Mission Zanja- improve drainage	Flood	Not Started
Reservoir Canyon- improve drainage	Flood	Not Started
Downtown- improve drainage	Flood	Not Started
South City- improve drainage	Flood	Not Started
North City- improve drainage	Flood	Not Started
Water Conservation Plan- develop and implement	Drought	Not Started
Vegetation Reduction- abatement program	Wildfire	Ongoing program
Vegetation Management- inspection program	Wildfire	Ongoing program
Fire Resistant Community- outreach and education	Wildfire	Not Started
Household Hazardous Waste- Reduction Program	Hazardous Material	Ongoing program
County Hazardous Materials Responders	Hazardous Material	Not Started
Self-contained Breathing Apparatus- equipment purchase	Hazardous Material	Complete
Education and Outreach- structural retrofitting	Earthquake	Not Started
Structural Retrofitting- City-owned buildings	Earthquake	Not Started
Drought Emergency Plan	Drought	Not Started
Public Outreach, Emergency Notification System, and database of Unreinforced Masonry buildings	Earthquake	Not Started
Emergency Circulation Master Plan	Hazardous Material	Not Started

7.4 Mitigation Measure Prioritization

The Planning Team used the STAPLEE Criteria (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) to evaluate the feasibility of each of the mitigation measures being considered for inclusion in the LHMP update. The STAPLEE process helped the Planning Team understand possible challenges that could hinder the ability to implement the mitigation measure. The STAPLEE criteria as includes the following considerations:

- **Social**
  - *Is the proposed action socially acceptable to the community?*
  - *Are there equity issues involved that would mean that one segment of the community is treated unfairly?*
  - *Will the action cause social disruption?*
- **Technical**
  - *Will the proposed action work?*
  - *Will it create more problems than it solves?*
  - *Does it solve a problem or only a symptom?*
  - *Is it the most useful action in light of other community goals?*
- **Administrative**
  - *Can the community implement the action?*
  - *Is there someone to coordinate and lead the effort?*
  - *Is there sufficient funding, staff, and technical support available?*
  - *Are there ongoing administrative requirements that need to be met?*
- **Political**
  - *Is the action politically acceptable?*
  - *Is there public support both to implement and to maintain the project?*
- **Legal**
  - *Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?*

- *Are there legal side effects? Could the activity be construed as a taking?*
- *Is the proposed action allowed by the general plan, or must the general plan be amended to allow the proposed action?*
- *Will the community be liable for action or lack of action?*
- *Will the activity be challenged?*

- **Economic**
  - *What are the costs and benefits of this action?*
  - *Do the benefits exceed the costs?*
  - *Are initial, maintenance, and administrative costs taken into account?*
  - *Has funding been secured for the proposed action? If not, what are the potential sources (public, non-profit, and private)?*
  - *How will this action affect the fiscal capability of the community?*
  - *What burden will this action place on the tax base or local economy?*
  - *What are the budget and revenue effects of this activity?*
  - *Does the action contribute to other community goals, such as capital improvements or economic development?*
  - *What benefits will the action provide?*
- **Environmental**
  - *How will the action affect the environment?*
  - *Will the action need environmental regulatory approvals?*
  - *Will it meet local and state regulatory requirements?*
  - *Are endangered or threatened species likely to be affected?*

Each proposed mitigation measure was assessed and given a score between 1–5 where 5 is favorable/beneficial (or NO major issues/opposition) and 1 is unfavorable/not beneficial (or major issues/opposition) for each of the STAPLEE criteria. The scores were then totaled and a final score was established for each mitigation measure. A relative comparison of mitigation measures helps understand which mitigation measure may have the greatest potential for implementation. However, the Planning Team recognized that this ranking does not (and should not) preclude the City from funding mitigation actions lower on the list first, especially if funding is available.

7.5 Mitigation Measures

The focus of the mitigation measures was on the "high" priority (Tier I) hazards (Earthquake, Energy Shortage/Power Outage, Flood, Infectious Disease, Wildfire, and Windstorm); however, some mitigation measures do address other hazards or cut across all hazards. Mitigation measures were identified by assessing the effectiveness of current capabilities (existing plans, policies, and programs) against the expected impacts (vulnerabilities). **Table 7-2** represents the proposed mitigation measures identified by the Planning Team.

Table 7-2. Proposed Mitigation Actions

Mitigation Action	Hazard	Goal
Create and maintain a Key Asset Database	Multi	1, 2, 5, 6
Develop and maintain Emergency Circulation (Traffic) Plan(s); acquire necessary equipment to support implementation	Multi	1, 4, 5, 6

Mitigation Action	Hazard	Goal
Develop and maintain Memorandums of Understanding (MOUs) and Public-Private Partnerships in support of emergency management and business continuity	Multi	1, 2, 3, 4, 5, 6
Develop and maintain Business Continuity Plan(s), emphasize loss of technology (Tech Down) situation	Multi	1, 2, 3, 4, 5, 6
Develop and maintain an Emergency Public Communications Plan; acquire necessary equipment and maintain systems to support implementation	Multi	1, 4, 5, 6
Develop and maintain an Energy Strategic Plan; acquire necessary equipment to support implementation	Multi	1, 2, 3, 4, 5, 6
Develop and maintain a Hazards Public Outreach Program; acquire necessary material/equipment/systems to support implementation	Multi	1, 2, 3, 4, 5, 6
Update and maintain an Emergency Operations Plan (EOP); acquire necessary equipment/systems to support implementation	Multi	1, 4, 5, 6
Develop a Policy to Incorporate Hazard Risk into other plans and development efforts	Multi	1, 2, 3, 4, 5, 6
Develop and/or incorporate Emergency Management Training and Exercise Program into existing training and exercise programs	Multi	1, 2, 3, 4, 5, 6
Conduct an Assessment of City-owned Lifeline infrastructure; acquire equipment and materials as need to support implementation. Projects could include: pipeline replacement, adding security systems, retrofit of existing facilities/equipment, incorporating backup generators, and other upgrades and improvements.	Multi	2,3,5,6
Participate and continue support of the OA Stakeholder Group	Multi	1,3,4,5,6
Establish and maintain the Hazard Mitigation Planning Team	Multi	1,2,3,4,5,6
Conduct an Assessment of City-owned Facilities; perform Structural and Non-structural Retrofits as needed	Multi	1,2,4,6
Develop a Building Condition Assessment Report for typical of building construction types in the City; develop a program to support structural and non-structural retrofitting	Multi	1,2,4,6
Develop and maintain a Vegetation Management Plan	Multi	1,2,3,4
Increase coordination with Lifeline Stakeholders to better understand their improvement, mitigation, and resiliency efforts	Multi	1, 2, 5, 6
Develop protocols and ensure appropriate personnel are signed up and receive Earthquake Notifications from USGS	Earthquake	1,2, 3, 4, 5, 6
Coordinate with Southern California Edison Emergency Management	Energy Shortage/ Power Outage	
Continue support of the County Floodplain Management Plan	Flood	4, 5, 6
Formalize and expand the role of the Floodplain Manager/NFIP Coordinator	Flood	1, 2, 3, 4
Conduct drainage improvements on Mission Zanja	Flood	1, 2, 3
Conduct drainage improvements on Reservoir Canyon	Flood	1, 2, 3
Conduct drainage improvements in Downtown	Flood	1, 2, 3
Conduct drainage improvements in South City	Flood	1, 2, 3
Conduct drainage improvements in North City	Flood	1, 2, 3

Mitigation Action	Hazard	Goal
Develop, maintain, and disseminate an Infectious Disease Response Plan; acquire equipment, supplies, and other material as needed to support role	Infectious Disease	1, 4, 5, 6
Ensure Fire Resistant Materials are incorporated into existing building modifications and/or future development	Wildfire	1, 2, 4, 6
Incorporate Defensive Space Standards in existing and future building designs	Wildfire	1, 2, 4, 6
Coordinate with San Bernardino International and Ontario International Airport's Emergency Management Division	Aircraft Accident/Incident	1, 2, 4, 5
Coordinate with the County, surrounding local cities, and the regional Fusion Center	Civil Disturbance	1, 2, 4, 5, 6
Coordinate with Ca Department of Water Resources	Dam Breach	1, 2, 3, 4
Coordinate with State and local Governments; acquire equipment, supplies, and other material as needed to support role	Drought	1, 2, 3, 4, 5, 6
Develop and maintain a Water Conservation Plan; implement recommendations	Drought	1, 2, 3, 4
Develop and maintain a Drought Emergency Plan; acquire equipment, supplies, and other material as needed to support role	Drought	1, 2, 3, 4, 5, 6
Coordinate with State of California local Governments; acquire equipment, supplies, and other material as needed to support role	Extreme Temperatures	1, 2, 3, 4, 5, 6
Develop and maintain an Extreme Temperature Emergency Plan; acquire equipment, supplies, and other material as needed to support implementation	Extreme Temperatures	1, 2, 3, 4, 5
Formalize, maintain, and promote the Hazardous Materials Program; acquire necessary equipment, material, and supplies needed to support implementation	Hazardous Material Accident	1, 2, 3, 4, 5
Enforce and support annual Training and Exercises	Hazardous Material Accident	1, 2, 3, 4, 5
Coordinate with local citrus growers; acquire equipment, supplies, and other material as needed to support role	Infestation	2, 3, 4, 5
Work with State and County officials; acquire equipment, supplies, and other material as needed to support role	Infestation	2, 3, 4, 5
Develop and maintain a Technology Master Plan; acquire equipment as needed to support implementation	Technology Disruption	1, 2, 4, 5, 6
Develop and maintain IT Incident Response Plans; implement recommendations	Technology Disruption	1, 2, 4, 5, 6
Coordinate with NTSB, Regional Association of governments, and County Transportation Department; acquire equipment, supplies, and other material as needed to support role	Train Accident	1, 4, 5
Coordinate with the County, surrounding local cities, and the regional Fusion Center; acquire equipment, supplies, and other material as needed to support role	Terrorism	1, 2, 3, 4, 5, 6

The Planning Team made assessments to determine if plans, policies, and/or programs needed to be expanded and/or improved; and whether those changes would support reducing the hazard. Any recommended changes to plans, policies, and programs are reflective in Table 7.2. It is also worth to note,

that consideration was also given to needed plans, policies, and programs. They too are also included in Table 7.2.

7.6 Mitigation Measure Implementation Plan

The following table (**Table 7-3**) reflects the implementation plan for each mitigation measure. The implementation plan identifies the lead department responsible for the action, the estimated cost, potential funding source to support the action, and the proposed timeframe for completion.

Table 7-3. Mitigation Measure- Implementation Plan

Mitigation Action	Lead	Cost	Timeframe	Funding	Score
Create and maintain a Key Asset Database	Emergency Services	<$100,000	< 1 year	General Fund	35
Develop and maintain Emergency Circulation (Traffic) Plan(s); acquire necessary equipment to support implementation	Police / Facilities and Community Services	<$100,000	1-3 years	General Fund/ HMA	31
Develop and maintain Memorandums of Understanding (MOUs) and Public-Private Partnerships in support of emergency management and business continuity	Various	<$100,000	1-3 years	General Fund	33
Develop and maintain Business Continuity Plan(s), emphasize loss of technology (Tech Down) situation	Various	$100,000-$300,000	1-3 years	General Fund/HMA	32
Develop and maintain an Emergency Public Communications Plan; acquire necessary equipment and maintain systems to support implementation	Emergency Services / Management Services	<$100,000	< 1 year	General Fund/HMA	32
Develop and maintain an Energy Strategic Plan; acquire necessary equipment to support implementation	Municipal Utilities & Engineering	<$100,000	1-3 years	General Fund/HMA	28
Develop and maintain a Hazards Public Outreach Program; acquire necessary material/equipment/systems to support implementation	Emergency Services	<$100,000	< 1 year	General Fund/HMA	33
Update and maintain an Emergency Operations Plan (EOP); acquire necessary equipment/systems to support implementation	Emergency Services	<$100,000	< 1 year	General Fund/HMA	35
Develop a Policy to Incorporate Hazard Risk into other plans and development efforts	Office of City Manager	<$100,000	< 1 year	General Fund	31
Develop and/or incorporate Emergency Management Training and Exercise Program into existing training and exercise programs	Emergency Services	$100,000-$300,00	1-3 years	General Fund/HMA	30

Mitigation Action	Lead	Cost	Timeframe	Funding	Score
Conduct an Assessment of City-owned Lifeline infrastructure; acquire equipment and materials as need to support implementation	Municipal Utilities & Engineering	$500,000-$1,000,00	3-5 years	General Fund/HMA	29
Participate and continue support of the OA Stakeholder Group	Emergency Services	<$100,000	<1 year	General Fund/HMA	35
Establish and maintain the Hazard Mitigation Planning Team	Emergency Services	<$100,000	<1 year	General Fund/HMA	35
Conduct an Assessment of City-owned Facilities; perform Structural and Non-structural Retrofits as needed	Municipal Utilities & Engineering	$500,000-$1,000,000	3-5 years	General Fund/HMA	29
Develop a Building Condition Assessment Report for typical of building construction types in the City; develop a program to support structural and non-structural retrofitting	Municipal Utilities & Engineering	$100,000-$300,000	1-3 years	General Fund/HMA	29
Develop and maintain a Vegetation Management Plan	Facilities and Community Services	<$100,000	1-3 years	General Fund/HMA	29
Increase coordination with Lifeline Stakeholders to better understand their improvement, mitigation, and resiliency efforts	Various	>$100,000	1-3 years	General Fund	34
Develop protocols and ensure appropriate personnel are signed up and receive Earthquake Notifications from USGS	Emergency Services	<$100,000	< 1 year	General Fund/ HMA	26
Coordinate with Southern California Edison Emergency Management	Municipal Utilities & Engineering	<$100,000	< 1 year	General Fund/ HMA	34
Continue support of the County Floodplain Management Plan	Municipal Utilities & Engineering	<$100,000	< 1 year	General Fund/ HMA	31
Formalize and expand the role of the Floodplain Manager/NFIP Coordinator	Municipal Utilities & Engineering	<$100,000	< 1 year	General Fund/ HMA	32
Conduct drainage improvements on Mission Zanja	Municipal Utilities & Engineering	$300,000-$500,000	3-5 years	General Fund/ HMA	26
Conduct drainage improvements on Reservoir Canyon	Municipal Utilities & Engineering	$300,000-$500,000	3-5 years	General Fund/ HMA	26
Conduct drainage improvements in Downtown	Municipal Utilities & Engineering	$300,000-$500,000	3-5 years	General Fund/ HMA	26
Conduct drainage improvements in South City	Municipal Utilities & Engineering	$300,000-$500,000	3-5 years	General Fund/ HMA	26

Mitigation Action	Lead	Cost	Timeframe	Funding	Score
Conduct drainage improvements in North City	Municipal Utilities & Engineering	$300,000-$500,000	3-5 years	General Fund/ HMA	26
Develop, maintain, and disseminate an Infectious Disease Response Plan; acquire equipment, supplies, and other material as needed to support role	Emergency Services	<$100,000	1-3 years	General Fund/ HMA	29
Ensure Fire Resistant Materials are incorporated into existing building modifications and/or future development	Fire	$100,000-$300,000	1-3 years	General Fund/ HMA	32
Incorporate Defensive Space Standards in existing and future building designs	Fire/Development Services	$100,000-$300,000	1-3 years	General Fund/ HMA	32
Coordinate with San Bernardino International and Ontario International Airport's Emergency Management Division	Facilitates and Community Services	<$100,000	<1 year	General Fund	35
Coordinate with the County, surrounding local cities, and the regional Fusion Center	Police	<$100,000	<1 year	General Fund	35
Coordinate with Ca Department of Water Resources	Municipal Utilities & Engineering	<$100,000	<1 year	General Fund	28
Coordinate with State and local Governments; acquire equipment, supplies, and other material as needed to support role	Emergency Services / Municipal Utilities & Engineering	$100,000-$300,000	1-3 Years	General Fund/EMPG	30
Develop and maintain a Water Conservation Plan; implement recommendations	Municipal Utilities & Engineering	$100,000-$300,000	<1 year	General Fund	29
Develop and maintain a Drought Emergency Plan; acquire equipment, supplies, and other material as needed to support role	Emergency Services / Municipal Utilities & Engineering	$100,000-$300,000	<1 year	General Fund	29
Coordinate with State of California local Governments; acquire equipment, supplies, and other material as needed to support role	Emergency Services	$100,000-$300,000	<1 year	General Fund	29
Develop and maintain an Extreme Temperature Emergency Plan; acquire equipment, supplies, and other material as needed to support implementation	Emergency Services	$100,000-$300,000	<1 year	General Fund	29

Mitigation Action	Lead	Cost	Timeframe	Funding	Score
Formalize, maintain, and promote the Hazardous Materials Program; acquire necessary equipment, material, and supplies needed to support implementation	Fire	$100,000-$300,000	<1 year	General Fund	33
Enforce and support annual Training and Exercises	Fire / Emergency Services	$100,000-$300,000	1-3 years	General Fund/HMA	33
Coordinate with local citrus growers; acquire equipment, supplies, and other material as needed to support role	Facilities and Community Services	<$100,000	<1 year	General Fund	29
Work with State and County officials; acquire equipment, supplies, and other material as needed to support role	Facilities and Community Services	$100,000-$300,000	<1 year	General Fund	29
Develop and maintain a Technology Master Plan; acquire equipment as needed to support implementation	Management Services	$100,000-$300,000	1-3 Years	General Fund	31
Develop and maintain IT Incident Response Plans; implement recommendations	Management Services	$100,000-$300,000	1-3 Years	General Fund	31
Coordinate with NTSB, Regional Association of governments, and County Transportation Department; acquire equipment, supplies, and other material as needed to support role	Facilities and Community Services	<$100,000	<1 year	General Fund	33
Coordinate with the County, surrounding local cities, and the regional Fusion Center; acquire equipment, supplies, and other material as needed to support role	Police	$300,000-$500,000	1-3 Years	General Fund / EMPG	32

8 PLAN MAINTENANCE

8.1 MONITORING, EVALUATING AND UPDATING THE PLAN

The City of Redlands Fire Department Emergency Management Division take the lead and will monitor the LHMP on an annual basis. City of Redlands Fire Department Emergency Management Division will work with the Hazard Mitigation Planning Team to review and evaluate the LHMP. The annual review will include; not limited to:

- Status on progress towards implementing mitigation measures
- The need for additional and/or removal of mitigation measures
- Adjustments to the mitigation measure and/or implementation plan
- Addition to the Goals and/or objectives
- Revisions to the Hazard Profiles, primarily focused on description, history, location

The City will also visit the LHMP after significant hazard events; ensuring Lesson Learned and other vital information is captured for incorporation into future LHMP updates.

8.2 INCORPORATION INTO OTHER PLANNING EFFORTS

The City of Redlands is aware of the hazards that face its community, as historic incidents prove that disasters are a common occurrence in this area. The City will continue to strive toward protecting the life, property and economy of the city. As other plans are developed, the LHMP will leveraged and incorporated where appropriate.

The City of Redlands is also considering incorporating and/or leveraging the information from the LHMP into the General Plan, City of Redlands Municipal Codes, Capital Improvement Plans, and other plans that benefit from a better understanding of hazards and potential mitigation measures that should be considered. The City of Redlands supports an all-hazard approach, encouraging information sharing between City Departments to incorporate into plans (i.e., General Plan, Master Drainage Plan, Emergency Operations Plan, Capital Improvement Plan). Once approved by FEMA, the LHMP will be provided to all City Departments for reference. Additional plans may include:

- Emergency Operation Plan
- Water System Emergency Response Plan
- Water Conservation Management Plan (Title 13 – 13.06.010)
- Fire Protection Master Plan (Title 15, Section 15.20.580)
- Spill Prevention Control & Countermeasure Plan
- Storm Water Pollution Prevention Plan (Title 3 3.48.020 and 3.56.020)
- Business Emergency Contingency Plan
- Sewer Capital Improvement (Title 3 – 3.44.020)
- Vegetation Management (Title 15, Section 15.20.560)
- Wildland-Urban Interface Fire Area (Title 15, Section 15.20.550)
- Earthquake – Hazardous Building (Title 15, Section 15.52.020)

Additionally, the LHMP will be utilized to assess future development in accordance with the General Plan. In addition to reviewing future development against relevant land use and zoning regulations, building codes and fire codes, and environmental and engineering standards, it will also be reviewed against the

LHMP. Proposed development projects will be assessed to determine exposure (or risk) to community hazards. The LHMP will also serve as a reference for suggested mitigation measures to reduce and/or eliminate risk from those hazards.

8.3 Continued Stakeholder and Public Involvement

As mentioned under Section 2.4 and 2.5, the City of Redlands will organize and/or participate in a variety of meetings/events to share and exchange information about mitigation with stakeholders and the public. The City will use its social media platforms and when, appropriate, leverage stakeholder and community social media platforms to announce the meetings/events. The City will also continue to provide public forms with our quarterly Disaster Council which gives the public and local emergency managers the opportunity to collaborate and coordinate prior to an emergency occurring.

8.4 Point of Contact

Comments or suggestions regarding this plan may be submitted to:

Fire Department; Emergency Management
35 Cajon Street, Suite 12
Redlands, Ca 92373
(909) 798-7600 / XXX@cityofredlands.org

Appendix 1 Adoption Resolution

Appendix 2 Planning Team Members

Agency	Department	Staff	Position
City of Redlands	Airport	Shaffer, Carl	Airport Supervisor
City of Redlands	City Manager's Office	Baker, Carl	Public Information Officer
City of Redlands	City Manager's Office	McConnell, Janice	Assistant City Manager
City of Redlands	Development Services	Esparza, Cruz	Economic Development Manager
City of Redlands	Development Services	Foote, Brian	Planning Director
City of Redlands	Facilities and Community Services	Sullivan, Tim	Assistant Director
City of Redlands	Finance	Jenner, Farrah	Assistant Finance Director
City of Redlands	Fire	Anderson, Vincent	Fire Marshal
City of Redlands	Fire	Crews, Carly	EMS Coordinator
City of Redlands	Fire	Martinez, Esther	Emergency Operations Specialist
City of Redlands	Fire	Reyes, Bruni	Management Analyst
City of Redlands	Fire	Sessler, Rich	Deputy Chief
City of Redlands	Human Resources	Ng, Tommi	Assistant Director
City of Redlands	Innovation and Technology	Resh, Tom	GIS Supervisor/Web Administrator
City of Redlands	Innovation and Technology	Sanchez, Sandra	Information Technology
City of Redlands	Library	McCue, Don	Director
City of Redlands	Municipal Utilities and Engineering	Watson, Kevin	Operations Manager
City of Redlands	Planning	Lin, Catherine	Principal Planner
City of Redlands	Police	Reiss, Mike	Deputy Chief
City of Redlands	Police	Tolber, Rachel	Commander
City of Redlands	Purchasing	Abramovitz, Dana	Manager
Amazon		Morales, Linda	
Amazon		Notthingham, Greg	
American Red Cross	San Bernardino County	Anderson, Robert	Disaster Program Manager
Arrowhead Christian Academy		Bell, Nrian	Upper school Principal
Assemblyman James Ramos		Leyva, Jessie	Field Representative
CA Public Utilities Commission		Windbigler, Sandy	Business and Community Outreach
CALFire		Ahmad, Abdul	Division Chief
CALFire		Malinowski, Grant	Chief
Cal Trans		Sadler, Jason	
California Governor's Office of Emergency Services		Brown, Sonia	Senior Emergency Services Coordinator
California Highway Patrol		Seldon, Rod	Captain
Carollo		Deslauriers, Sarah	
Carollo		Roquebert, Vincent	
Carollo		Sobeck, Dave	Senior Vice President

Church of Jesus Christ Latter Day Saints		Cannon, Judy	Redlands Area Interfaith Council
City of Highland		Daniely, David	Administrative Analyst
City of Loma Linda		Kendal, Shannon	Joint Emergency Services Coordinator
City of Moreno Valley		Bricker, Zuzzette	Emergency Manager
City of San Bernardino		Oldendorf, Nick	Emergency Manager/ Sergeant
City of Yucaipa		O'Connell, Sherrie	Emergency Services Coordinator
Com Center		Franke, Tim	Com Center Supervisor
ESRI		Abushanab, Dan	CIO
ESRI		Berry, Don	Operations Manager
ESRI		Kelling, Daniel	Physical Security and Safety
ESRI		Nowlin, Chris	
Jonbe Care Retirement Community		Elshof, Richard	
Loma Linda Hospital		Ngo, Ehren	Emergency Operations Manager
Metrolink		Rodriguez, Richard	Emergency Manager
Montessori in Redlands		Camarillo, Ellen	Safety Coordinator
North Redlands Visioning Committee		Saucedo, Mario	
Office of Representative Pete Aguilar		Lewis, Curt	Grant Program Director
Office of Senator Mike Morrell		Bogh, Madison	Field Representative
Office of Senator Mike Morrell		Cornejo-Reynoso, Pacal	Field Representative
Omni Trans		Erwin, Barbara	Safety, Security, and Regulatory Compliance Manager
Packinghouse Christian Academy		Conner. Michelle	Safety Coordinator
Plymouth Village Retirement Community		Michaels, Julie	Executive Director
Redlands Adventist Academy		York, Glynda	Safety Coordinator
Redlands Bowl Summer Music Festival		Noerr, Beverly	Executive Director
Redlands Chamber of Commerce		Alvarez, Christopher	Executive Director

Redlands Christian Center		Wallace, Don	Redlands Area Interfaith Council
Redlands Community Hospital		Olmos, Melissa	Emergency Management Coordinator
Redlands Historical Society		Nelda, Stuck	
Redlands Unified School District		Arrellano, Mauricio	Superintendent
Redlands Unified School District		Mackamul-Covey, Carianne	
Redlands Unified School District		Morse, Ken	Coordinator of Operations and Facility Planning
Rochford Foundation		Timothy, Ellen	
San Bernardino County		Congjuico, Ashley	Medical Emergency Planning Specialist
San Bernardino County		Cruz, Carrie	Emergency Services Officer
San Bernardino County		Ramirez, Michael	Emergency Services Supervisor Officer
San Bernardino County School Districts		Marmolejo, Daniel	Safety Manager/ Intergovernmental Relations
Simpler Life		Snedaker, Bob	Owner
Southern California Gas		Scott, Kristine	Public Affairs Manager
Southern California Edison		Cloud, Mark	Government Affairs Representative
United States Post Office		Andrews, Janet	National Preparedness Specialist
University of Redlands		Abbey, Leonette	Project Management Coordinator
University of Redlands		Rogers, Michelle	Vice President Administration
University of Redlands		Talbott, Jeff	Director of Public Safety
University of Redlands		Walsh, John	Chaplain
Valley Preparatory School		Black, John	School Principal
Valley Preparatory School		Schutz, Derrick	Assistant Head of School

Appendix 3 Planning Team Member Meeting Attendance Matrix

Appendix 4 Public Outreach Announcements

Appendix 5 Key Assets

The City of Redlands has identified the following key building assets (**Table APP1**). Table3.6 captures the Redlands Unified School District by campus; however, there are several permanent and temporary structures on each campus. **Table APP2** depicts the number of permanent and temporary structures on each campus.

Table APP1 Key Building Assets

Facility Name	Address	Year Built	Bldg. Sq. Ft	Structure Type	Replacement Cost
Fire Station 261	525 E. Citrus Ave.	2001	4,200	Wood Frame	$1.98M
Fire Station 262	1716 Garden St.	1969	2,500	Wood Frame	$1.18M
Fire Station 263	10 W. Pennsylvania Ave.	1985	3,000	Wood Frame	$1.42M
Fire Station 264					
Police Dispatch	1270 W. Park Ave	1984	8,800	Wood Frame	$4.16M
Emergency Operations Center	1270 West Park Ave	1985	6,200	Concrete Block/ Reinforced Masonry	$3.0M
Police Annex	30 Cajon Street		20,000		
Animal Control	504 N. Kansas St.		750		
Joslyn Senior Center	21 Grant St.		8,700		
Community Center	111 W. Lugonia Ave.		27,500		
Corporate Yard, including HAZMAT Storage	1270 W. Park Ave		67,400		$3.4M
Henry Tate Water Treatment Plant	3050 Mill Creek Rd., Mentone		N/A		$20.0M
Hinkley Surface Water Treatment Plant	1604 Crafton Ave.		26,614		$20.0M
Highland Ave. Water Complex	Highland Ave.		N/A		$30.0M
Redlands Wastewater Treatment Facility	1950 N. Nevada St.		N/A		
City Hall	35 Cajon Street		20,054		$7.82M
Redlands Municipal Airport	1745 Sessums Dr	Various	Various	Wood and Metal Framed	$103M
San Bernardino International Airport	1601 E 3rd St #100		1,329 acres		
A.K. Smiley Library	125 W Vine St	1898	64,000		$40M
Contemporary Club	173 S Eureka St		4,000		$6M
Power Plant- Redlands	2492 W San Bernardino Ave	1893			$2B
Lincoln Shrine	125 W Vine St	1932	3800		$8M
Agate Ave. Reservoir	Agate Ave & Salerno Ave				
Arroyo Reservoir	Arroyo Crest & Smiley Heights Dr				
Country Club Reservoirs	Country Club Dr & Verde				

	Vista Dr				
Crafton College Reservoir	Crafton Hills Ridge Cir				
Dearborn Reservoir	500 N Dearborn St				
Fifth Ave. Reservoir	Valencia Dr & King St				
Highland Avenue Reservoir	Parkford Dr & Marshall St				
Margarita Reservoir	Margarita Dr & Marilyn ln				
Mill Creek Reservoir	3040 Mill Creek Rd				
Sand Canyon Reservoir	Campus Dr & Sand Canyon Rd				
Smiley Heights Reservoir	Smiley Heights Dr & Calle de Las Palmas				
South Ave. Reservoir	Sunset Dr & Felisa Ct				
Sunset Reservoir	13198 Helen Ct				
Texas Grove Reservoir	1660 Texas St				
Texas Street Site Reservoir	1321 Texas St				
Ward Way Reservoir	1369 Fairview ln				
Water Quality Lab	1950 Nevada St				
Julian Way Effluent Valve (Tate)	3050 Mill Creek Rd				
Ward Way Valve	2594 Mill Creek Rd				
Well 38	11143 Nevada St				
24" Highline Transmission Pipeline	Various				
Zone 1570 Piping/water distribution system	Various				
Zone 1750 Piping/water distribution system	Various				
Zone 1900 Piping/water distribution system	Various				
University of Redlands					
Kaiser Permanente Redlands Medical	1301 California Street				
Redlands Community Hospital	350 Terracina Boulevard				
ESRI	380 New York Street	1969			
Beaver Medical Group	2 West Fern Avenue				
Arroyo Verde Elementary School)	7701 Church Street, Highland, CA 92346	1989-1990	50,911		7,564.68*
Beattie Middle School	7800 Orange St., Highland CA, 92346	2004	92,310		26,053.12*
Bryn Mawr Elementary School	11680 Whittier Ave., Loma Linda CA, 92354	1990	63,605		10,806.60*
Citrus Valley High School	800 West Pioneer Ave., Redlands, CA, 92374	2009	N/A		N/A
Clement Middle School	501 East Pennsylvania Ave., Redlands CA, 92374	1961 1964	133,124		20,428.36*
Cope Middle School	1000 West Cypress Ave., Redlands CA, 92373	1956-1957	160,739		25,046.61*
Crafton Elementary School	311 North Wabash Ave., Redlands CA, 92374	1936-1965	69,931		9,224.26*
Cram Elementary School	29700 Water St., Highland CA, 92346	1997	52,814		7,696.27*

Franklin Elementary School	850 East Colton Ave., Redlands CA, 92374	1955 1969	70,450		11,455.98*
Highland Grove Elementary School	7700 Orange St., Highland CA, 92346	2005	46,549		11,375.73*
Judson & Brown Elementary School	1401 E Pennsylvania Ave., Redlands CA, 92374	2006	42,344		13,216.96*
Kimberly Elementary School	301 West South Ave., Redlands CA, 92373	1956-1963	74,670		9,357.75*
Kingsbury Elementary School	600 Cajon St., Redlands CA, 92373	1968	62,205		8,618.97*
Lugonia Elementary School	202 East Pennsylvania Ave., Redlands CA, 92374	1955 1963	58,856		9,258.99*
Mariposa Elementary School	30800 Palo Alto Dr., Redlands CA, 92373	1964	56,613		7,664.47*
McKinley Elementary School	645 West Olive Ave., Redlands CA, 92373	1938 1966	52,529		8,222.37*
Mentone Elementary School	1320 Crafton Ave., Mentone CA, 92359	1949	43,566		6,651.36*
Mission Elementary School	10568 California Street, Redlands, CA 92374	1938, 1965 1970	62,341		11,004.51*
Moore Middle School	1550 East Highland Ave., Redlands CA, 92374	1965	144,730		22,765.39*
Orangewood High School (Continuation)	515 Texas St., Redlands CA, 92374	1940, 1955, 1990 1992	42,142		5,845.34*
Redlands East Valley High School	31000 East Colton Ave., Redlands CA, 92374	1995	326,895		55,068.16*
Redlands High School	840 East Citrus Ave., Redlands CA, 92374	1928 1970	393,384		64,529.62*
Smiley Elementary School	1210 West Cypress Ave., Redlands CA, 92373	1952, 1963 1980	68,896		9,502.79*
Victoria Elementary School	1505 Richardson St., San Bernardino CA, 92408	1949 1967	49,264		7,027.26*
Central Administration/ Enrollment Center	7 West Delaware St, Redlands, CA 92374	1970 1991	11,830		1,744.39*
District Office -North	20 West Lugonia Ave., Redlands, CA 92346	1970	30,213		5,793.59*
District Office - South	25 West Lugonia St., Redlands, CA 92346	1937 1992	13,979		2,699.90*
Supply Center	250 Church Street, Redlands, CA 92374	1973	37,192		3,744.82*
Transportation	956 East Citrus Ave., Redlands, CA 92374	1929	6,670		527.12*

*- Replacement Value ($1,000)

Table APP2 Number of Structures on Redlands Unified School District Campuses

Name	# of Buildings	
	Permanent	Portable
Arroyo Verde Elementary School	24	11
Beattie Middle School	8	3
Bryn Mawr Elementary School	26	11
Citrus Valley High School	N/A	N/A
Clement Middle School	35	25
Cope Middle School	42	24
Crafton Elementary School	21	12
Cram Elementary School	27	19
Franklin Elementary School	7	2
Highland Grove Elementary School	6	0
Judson & Brown Elementary School	9	0
Kimberly Elementary School	21	13
Kingsbury Elementary School	12	6
Lugonia Elementary School	19	7
Mariposa Elementary School	16	10
McKinley Elementary School	12	6
Mentone Elementary School	26	19
Mission Elementary School	11	6
Moore Middle School	25	15
Orangewood High School (Continuation)	19	8
Redlands East Valley High School	83	69
Redlands High School	83	48
Smiley Elementary School	11	1
Victoria Elementary School	22	12
Central Administration/ Enrollment Center	3	0
District Office -North	4	3
District Office - South	9	5
Supply Center	5	2
Transportation	3	1
TOTAL	**592**	**338**

Appendix 6 List of Significant Earthquakes in California Since 1700

Date	Magnitude	Name, Location, or Region Affected	Loss of Life and Property
1700, Jan. 26	9.0	Offshore, somewhere between Cape Mendocino and Canada	Limited data available, magnitude is an estimate. Shook northern California, Oregon, Washington, and southern British Columbia; caused tsunami damage to villages in Japan and western US
1857, Jan 9	7.9	Great Fort Tejon earthquake	1 dead; damage from Monterey to San Bernardino County
1906, Apr 18	7.8	Great 1906 San Francisco Earthquake and Fire	3,000 dead; $524 million in property damage (includes damage from fire)
1838, Jun	7.4	San Francisco to San Juan Bautista	Limited data available, magnitude is an estimate. Damage to San Francisco and Santa Clara
1872, Mar 26	7.4	Owens Valley	27 dead; 56 injured; $250,000 in property damage
1980, Nov 8	7.4	West of Eureka	6 injured; $2 million in property damage
1812, Dec 8	7.3	Wrightwood	Limited data available, magnitude is an estimate. 40 dead at San Juan Capistrano
1892, Feb 24	7.3	Laguna Salida, Baja California	Damage to San Diego and Imperial Valley
1922, Jan 31	7.3	Offshore, about 70 mi W of Eureka	
1952, Jul 21	7.3	Kern County earthquake	12 dead; $60 million in property damage
1954, Dec 16	7.3	Fairview Peak, near Fallon, NV	
1992, Jun 28	7.3	Landers	1 dead; 402 injured; $91.1 million in property damage
1923, Jan 22	7.2	Off Cape Mendocino	Destructive in Humboldt County; strongly felt in Reno
1932, Dec 21	7.2	Cedar Mountain, near Gabbs, NV	
1992, Apr 25	7.2	Petrolia	356 injured; $48.3 million in property damage
1812, Dec 21	7.1	Los Angeles, Ventura, Santa Barbara	Limited data available, magnitude is an estimate. 1 dead
1927, Nov 4	7.1	40 km west of Lompoc	Damage in Santa Barbara and San Luis Obispo counties
1954, Dec 16	7.1	Dixie Valley, near Fallon, NV	
1868, Oct 21	7.0	Hayward Fault	30 dead; $350,000 in property damage
1899, Apr 16	7.0	Offshore, about 80 miles west of Eureka	
1934, Dec 31	7.0	In Mexico, about 100 miles SE of El Centro	
1940, May 19	7.0	Imperial Valley	9 dead; $6 million in property damage
1991, Aug 17	7.0	Offshore, about 100 miles NW of Eureka	Preceded by two quakes (M 6.3 and 6.2) on Aug. 16 and 17
1994, Sep 1	7.0	Offshore, about 70 miles W of Cape Mendocino	
1873, Nov 23	6.9	Crescent City region	Damage in California-Oregon border area
1989, Oct 17	6.9	Loma Prieta	63 dead; 3,737 injured; $6 billion in property damage

1872, Mar 26	6.8	Owens Valley	Aftershock of previous entry
1872, Apr 11	6.8	Owens Valley	Aftershock of March 26, 1872 quake
1890, Feb 9	6.8	San Jacinto fault?	Little damage
1918, Apr 21	6.8	San Jacinto	1 dead; several injuries; $200,000 in property damage
1925, Jun 29	6.8	Santa Barbara	13 dead; $8 million in property damage
1954, Jul 6	6.8	Rainbow Mountain, near Fallon, NV	
1999, Oct 16	7.1	Bullion Mountains (Hector Mine)	Minimal injuries and damage due to sparse population in affected area
1954, Aug 24	6.8	Rainbow Mountain, near Fallon, NV	
1976, Nov 26	6.8	Offshore, about 100 mi WNW of Eureka	
1898, Apr 15	6.7	Fort Bragg - Mendocino	Limited data available, magnitude is an estimate. Damage from Fort Bragg to Mendocino; 3 houses collapsed; landslides reported
1899, Dec 25	6.7	San Jacinto and Hemet	6 dead; $50,000 in property damage
1994, Jan 17	6.7	Northridge	57 dead; more than 9,000 injured; about $40 billion in property damage
1892, Apr 19	6.6	Vacaville	1 dead; $225,000 in property damage
1915, Nov 21	6.6	In Mexico, about 60 miles S of El Centro	
1941, Feb 9	6.6	Offshore, about 65 miles W of Eureka	
1954, Dec 21	6.6	East of Arcata	1 dead; several injured; $2.1 million in property damage
1968, Apr 8	6.6	Borrego Mountain	
1971, Feb 9	6.6	San Fernando	65 dead; more than 2,000 injured; $505 million in losses
1987, Nov 24	6.6	Superstition Hills	part of above damage
1992, Apr 26	6.6	Petrolia	Aftershock of the Apr. 25 quake
1992, Apr 26	6.6	Petrolia	Another aftershock of Apr. 25 quake
1852, Nov 29	6.5	Near Fort Yuma, Arizona	Limited data available, magnitude is an estimate.
1860, Mar 15	6.5	Carson City	Limited data available, magnitude is an estimate.
1865, Oct 8	6.5	Santa Cruz Mountains	$0.5 million in property damage
1918, Jul 15	6.5	Offshore, about 40 W of Eureka	
1934, Jul 6	6.5	Offshore, about 100 mi WNW of Eureka	
1934, Dec 30	6.5	In Mexico, about 40 miles S of El Centro	
1947, Apr 10	6.5	East of Yermo	
1956, Feb 9	6.5	In Mexico, about 80 miles SW of El Centro	
1979, Oct 15	6.5	Imperial Valley	9 injured; $30 million in property damage
1992, June 28	6.5	Big Bear	Included with Landers losses, above
2003, Dec 22	6.5	San Simeon	

1836, Jun 10	6.4	Near San Juan Bautista	Limited data available, magnitude is estimate. Older reports reported quake as possibly larger and centered near Oakland
1898, Mar 31	6.4	Mare Island	$350,000 in property damage
1991, Jul 12	6.6	Offshore west of Crescent City	
1899, Jul 22	6.4	Wrightwood	Chimneys knocked down; landslides reported
1911, Jul 1	6.4	Morgan Hill area	
1933, Mar 11	6.4	Long Beach	115 dead; $40 million in property damage
1942, Oct 21	6.4	About 25 miles W of Westmoreland	
1983, May 2	6.4	Coalinga	
1986, Jul 21	6.4	Chalfant Valley	
1800, Nov 22	6.3	San Diego/San Juan Capistrano region	Limited data available, magnitude is an estimate. Damaged adobe walls of missions in San Diego and San Juan Capistrano
1922, Mar 10	6.3	Parkfield	
1995, Feb 19	6.3	Offshore, about 70 miles W of Cape Mendocino	
1980, May 25	6.2	Mammoth Lakes	
1984, Apr 24	6.2	Morgan Hill	$8 million in property damage
1908, Nov 4	6.0	SW of Death Valley	
1948, Dec 4	6.0	East of Yermo	
1980, May 25	6.0	Mammoth Lakes	
1987, Oct 1	6.0	Whittier Narrows	8 dead; $358 million in property damage to 10,500 homes and businesses

Appendix 7 XX