Albuquerque/Bernalillo County Hazard Mitigation Plan

Public Review Draft

March 2021

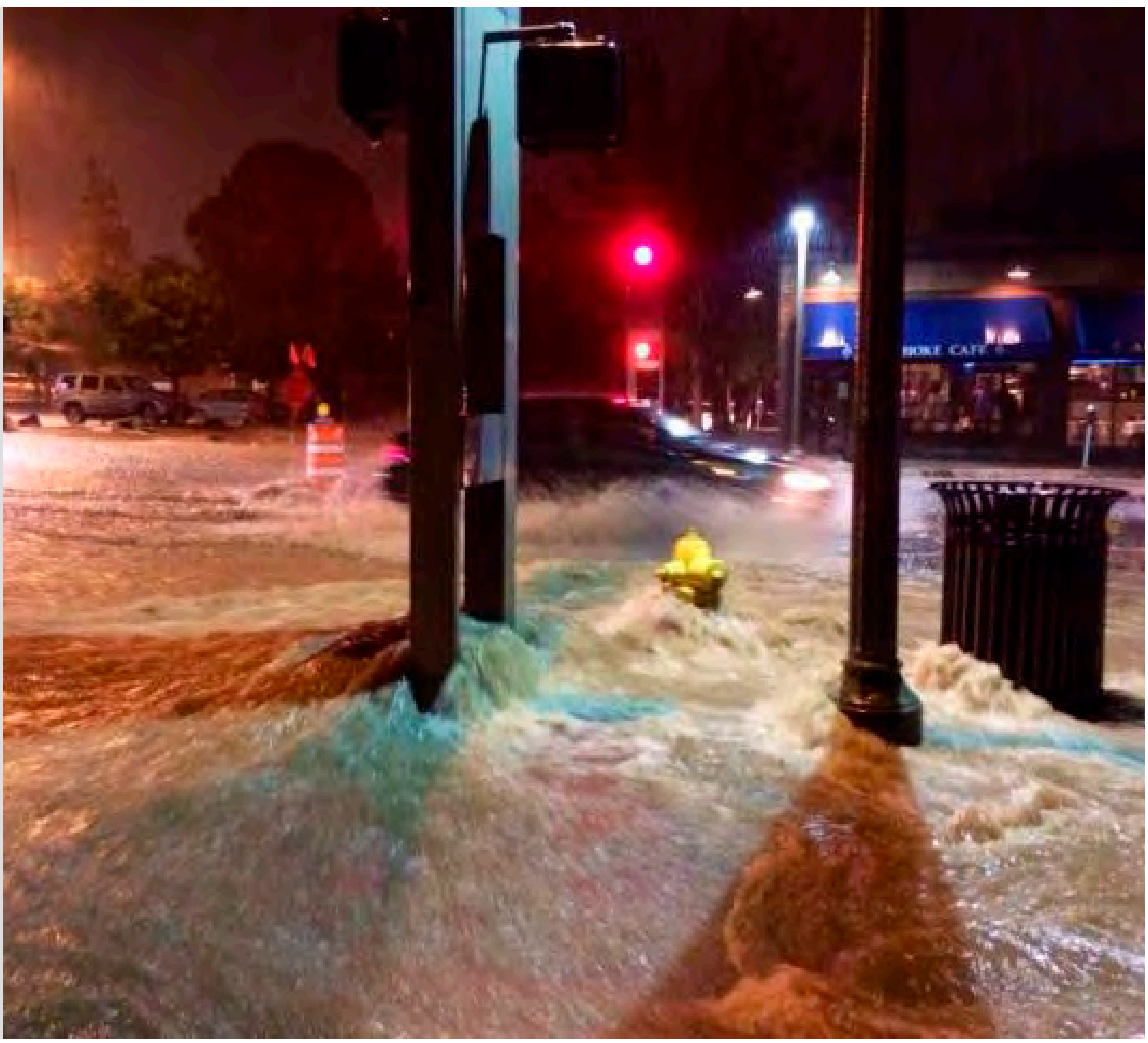


Table of Contents

1 Introduction

Disaster Mitigation Act (DMA) Requirement §201.1(b):
The purpose of mitigation planning is for State, local, and Indian tribal governments to identify the natural hazards that impact them, to identify actions and activities to reduce any losses from those hazards, and to establish a coordinated process to implement the plan, taking advantage of a wide range of resources.

This section provides a general introduction to the 2020 Albuquerque/Bernalillo County Hazard Mitigation Plan. This plan was originally adopted in 2007, revised in 2015, and underwent another comprehensive update in 2020 pursuant to the requirements of the Disaster Mitigation Act of 2000 (DMA, Public Law 106-390) and associated implementing regulations.

1.1 Executive Summary

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from disasters or hazard events. Studies have found that hazard mitigation is extremely cost-effective, with every dollar spent on mitigation saving an average of $6 in avoided future losses. The participating jurisdictions developed this hazard mitigation plan to reduce future losses from natural and human-caused hazards.

This plan was also developed to maintain the participating jurisdictions' eligibility for certain federal disaster assistance, specifically the Federal Emergency Management Agency's (FEMA), Hazard Mitigation Assistance (HMA) grants including the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), and Building Resilient Infrastructure and Communities (BRIC) grant program.

The 2020 Albuquerque/Bernalillo County Hazard Mitigation Plan is a multi-jurisdictional plan that includes the following communities and districts:

- Bernalillo County
- City of Albuquerque
- Village of Los Ranchos de Albuquerque
- Village of Tijeras
- Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA)
- Middle Rio Grande Conservancy District (MRGCD)
- Albuquerque Bernalillo County Water Utility Authority (ABCWA)

The Plan analyzes the natural and human-caused hazards that present the greatest threat to the planning area and develops a mitigation strategy to protect lives and property and reduce losses from those hazards. This plan will serve as a blueprint for coordinating and implementing hazard mitigation policies, programs, and projects in the planning area. While disasters cannot always be prevented, their impacts can be lessened and sometimes avoided altogether if appropriate measures are taken before they occur. By reducing risk from known hazards, communities will save lives and property and minimize the social, economic, and environmental disruptions that commonly follow hazardous events.

This Plan is divided into seven sections:

Chapter 1 Introduction provides an overview of the plan, including its vision, scope, background, and relevant authorities.

Chapter 2 Community Profile describes the planning area and participating jurisdictions, including updated information on demographics, social vulnerability, and changes in development since the 2015 Plan.

Chapter 3 Planning Process describes the planning process used to conduct the 2020 update. This update was conducted with a high degree of public participation. A broad range of public and private stakeholders, including agencies, local businesses, nonprofits, and other interested parties were invited to participate in the development of the 2020 Plan. Stakeholder involvement was encouraged through staff and planning team invitations to agencies and individuals to actively participate in local planning meetings and to interact with the planning materials and surveys posted on the project website. Public input was sought throughout the planning process by conducting online surveys and an open public meeting advertised through social media networks, community bulletins, email distribution lists, and jurisdictional websites. The final plan was reviewed by the State of New Mexico Division of Homeland Security and Emergency Management (DHSEM), approved by the Federal Emergency Management Agency (FEMA), and formally adopted by the governing bodies of all participating jurisdictions.

Chapter 4 Hazard Identification and Risk Assessment builds on available historical data from past hazard occurrences, establishes detailed profiles for each hazard, and analysis risk based on the frequency of occurrence, spatial extent, and potential impact of each hazard. Because risk varies across the planning area, risk rankings were developed for each jurisdiction. The best available information on the impacts of climate change were taken into account for each hazard. The risk assessment helps communities identify and prioritize mitigation actions to pursue and implement, helping them to focus their efforts on those hazards of greatest concern. In all, the Plan profiles eleven natural and five human-caused hazards with the potential to impact the planning area. Those hazards and their significance by jurisdiction are shown in Table 1-1.

Table 1-1 Overall Hazard Rankings by Jurisdiction

Hazard	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
Active Threat	Medium	High	Low	Low	Low	Low	Low
Cyber Threat	High	Medium	Low	Low	Low	High	High
Dam Failure	Low	Medium	Medium	Low	High	High	Low
Drought	High	Medium	High	Medium	NA	High	High
Earthquake	Medium	Medium	High	Medium	High	Medium	Medium
Extreme Heat	High	Medium	Medium	Low	NA	Medium	Medium
Flood	Medium	High	High	High	High	High	High
Hazmat Release	Medium	Medium	Low	Low	Low	Low	Low
High Wind	High	High	Medium	Medium	NA	Medium	Medium
Landslide	Medium	Medium	Low	Medium	Medium	Low	Medium
Land Subsidence	Medium	Low	Low	Low	Medium	Low	Low
Pandemic	High	High	Medium	Medium	Medium	High	High
Severe Winter Storm	Medium	Low	High	High	NA	Low	Medium
Thunderstorm	Medium	Medium	Medium	Medium	High	High	Medium
Tornado	Low	Low	Low	Low	NA	Low	Low
Wildfire	High	High	High	High	Low	High	High

Frequency of Occurrence: Highly Likely: Near 100% probability in next year. Likely: Between 10 and 100% probability in next year or at least one chance in ten years. Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years. Unlikely: Less than 1% probability in next 100 years.	**Potential Severity:** Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.
Spatial Extent: Limited: Less than 10% of planning area Significant: 10-50% of planning area Extensive: 50-100% of planning area	**Significance** Low: minimal potential impact Medium: moderate potential impact High: widespread potential impact

Chapter 5 Capability Assessment evaluates programs and policies currently in use by the jurisdictions to reduce hazard impacts or that could be used to implement hazard mitigation activities. The section also identifies opportunities for enhancement.

Chapter 6 Mitigation Goals, Measures, and Actions describes what the jurisdictions will do to reduce their vulnerability to the hazards identified in Chapter 4, and to increase their mitigation capabilities described in Section 5. It presents the updates goals of the mitigation program and details a broad range of targeted mitigation actions to reduce losses from hazard events. This section also describes progress the jurisdictions have made in implementing mitigation activities since the 2015 Plan.

Chapter 7 Plan Implementation and Maintenance details how the plan will be implemented, monitored, evaluated, and updated, as well as how the mitigation program will be integrated into other planning mechanisms.

1.2 Vision and Purpose of the Plan

FEMA Definition of Hazard Mitigation:

"Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards."

The primary purpose of hazard mitigation planning is to organize people and resources to produce long-term and recurring benefits that help break the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that the investments made before a hazard event will significantly reduce the demand for post-event assistance by lessening the need for emergency response, repair, recovery, and reconstruction. Both the localized events that temporarily disrupt normal functioning as well as the larger events that receive Presidential disaster declarations will be addressed. Adopting mitigation practices will enable the jurisdictions to re-establish themselves in the wake of a larger disaster event, becoming more resilient with less disruption to services and businesses.

The benefits of mitigation planning go beyond solely reducing hazard vulnerability. Related measures emanating from a mitigation plan such as preserving open space, protecting vital infrastructure, designing sustainable buildings, maintaining environmental health, and protecting critical facilities meet other important community objectives including public safety, natural resource protection, and business development. It is important that any mitigation planning process be integrated with other local planning efforts like comprehensive plans, and any proposed mitigation strategies must take into account other existing goals or initiatives that will help complement or hinder their future implementation. All information in this HMP is for planning and risk management information purposes only.

In summary, the purpose of the Albuquerque/Bernalillo County Hazard Mitigation Plan is to:

- Break the cycle of repetitive natural hazards
- Protect life, safety and property by reducing the potential for future damages and economic losses that result from hazards
- Make the planning area a safer place to work, visit, and live
- Restore and preserve the area's natural and recreational resources
- Help the jurisdictions thrive economically
- Support preservation of hazard prone natural areas
- Reduce future vulnerability by guiding development and redevelopment
- Avoid interruptions caused by hazards
- Qualify for mitigation grant funding in both the pre-disaster and post-disaster environment
- Document coordination efforts with other stakeholders in the hazard mitigation effort
- Speed recovery following disaster events
- Develop broad based community support for hazard mitigation
- Record successful hazard mitigation projects and programs
- Demonstrate a firm commitment to hazard mitigation principles
- Comply with state and federal legislative requirements for hazard mitigation plans

The Albuquerque/Bernalillo County Mitigation Plan is a living document, and as such will be reviewed and updated as necessary in order to evaluate the progress made on the risk reduction actions identified through the planning process. The Plan will also be reviewed when new hazards are identified or when large hazard events occur that may require new mitigation priorities in the planning area. An update is required every five years in order to maintain compliance with the DMA 2000.

1.3 Plan Scope

Each year in the United States, disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters, because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are determined, prioritized, and implemented. A congressionally mandated independent study assessing future savings from mitigation activities determined that mitigation activities are highly cost effective; on average, each dollar spent on mitigation saves society an average of $6 in avoided future losses in addition to saving lives and preventing injuries (Natural Hazard Mitigation Saves: 2017 Interim Report).

As noted above, this multi-jurisdictional plan includes the following participating jurisdictions:

- Bernalillo County
- City of Albuquerque
- Village of Los Ranchos de Albuquerque
- Village of Tijeras
- Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA)

- Middle Rio Grande Conservancy District (MRGCD)
- Albuquerque Bernalillo County Water Utility Authority (ABCWA)

The term "planning area" is issued in this Plan to refer to physical extent of Bernalillo County, its incorporated and unincorporated municipalities, and those portions of the participating jurisdictions that fall within Bernalillo County. For purposes of this plan, parcel and critical infrastructure for Kirtland Air Force Base and tribal lands were excluded from analysis.

1.4 Authority

This Plan has been developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans:

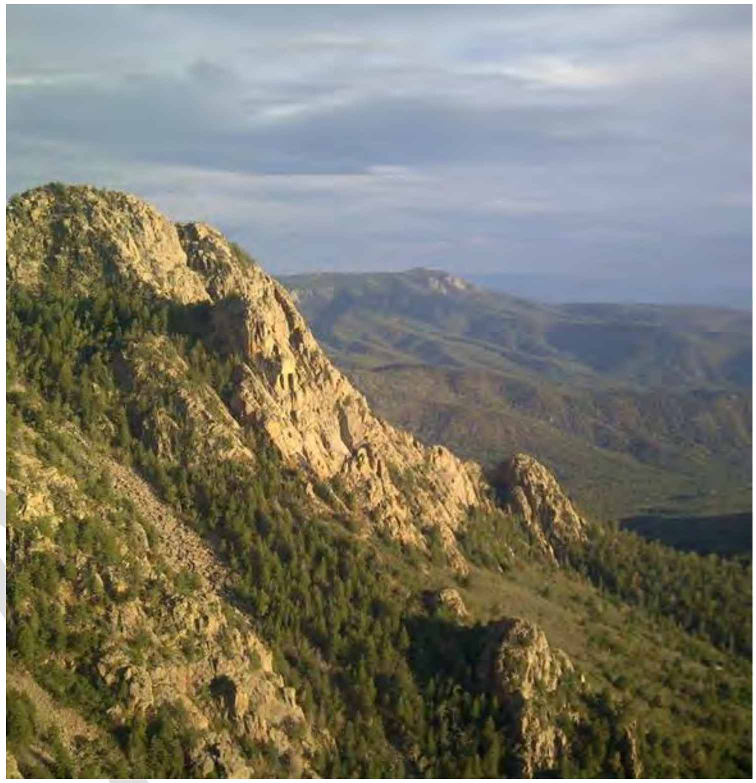
- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act (DMA) of 2000 (P.L. 106-390)
- Current Local Mitigation Planning requirements found in 44 CFR Part 201.6

This Plan shall be routinely monitored and revised to maintain compliance with the above provisions, rules and legislation, as detailed further in Chapter 7 of this plan.

2 Community Profiles

This section gives and overview of the planning area and participating jurisdictions. For a discussion of each jurisdiction's capabilities to mitigate against hazards, see Chapter 5.

2.1 Geography

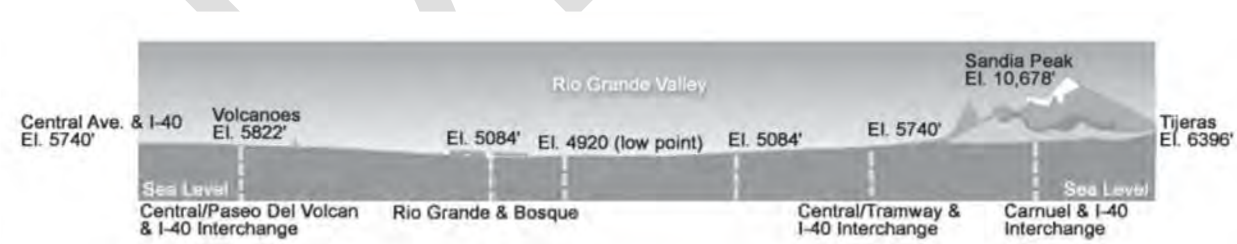


Bernalillo County is located in central New Mexico and covers nearly 1,200 square miles. The County stretches from the mountains in the eastern portion of the county, to the high desert grasslands above the Rio Grande Valley on the western edge. Elevation ranges from 10,678' at Sandia Peak to 4,920' in the Rio Grande Valley.

Natural features of the County include the massive Sandia, Manzanitas, and Manzano Mountains to the east and south; the fertile Rio Grande Valley with its lush Bosque which bisects the County, and the mesa uplands and escarpment to the west. The County includes three distinct environmental regions: 1) the forested uplands of the mountains; 2) the semi-arid and flat mesas that flank the Rio Grande Valley; and 3) the wooded greenbelt of the Rio Grande Valley itself. The Valley has two distinct areas: the North Valley and South Valley. At the far western boundary is an ancient lava flow which forms an escarpment (cliff) where it meets the mesa.

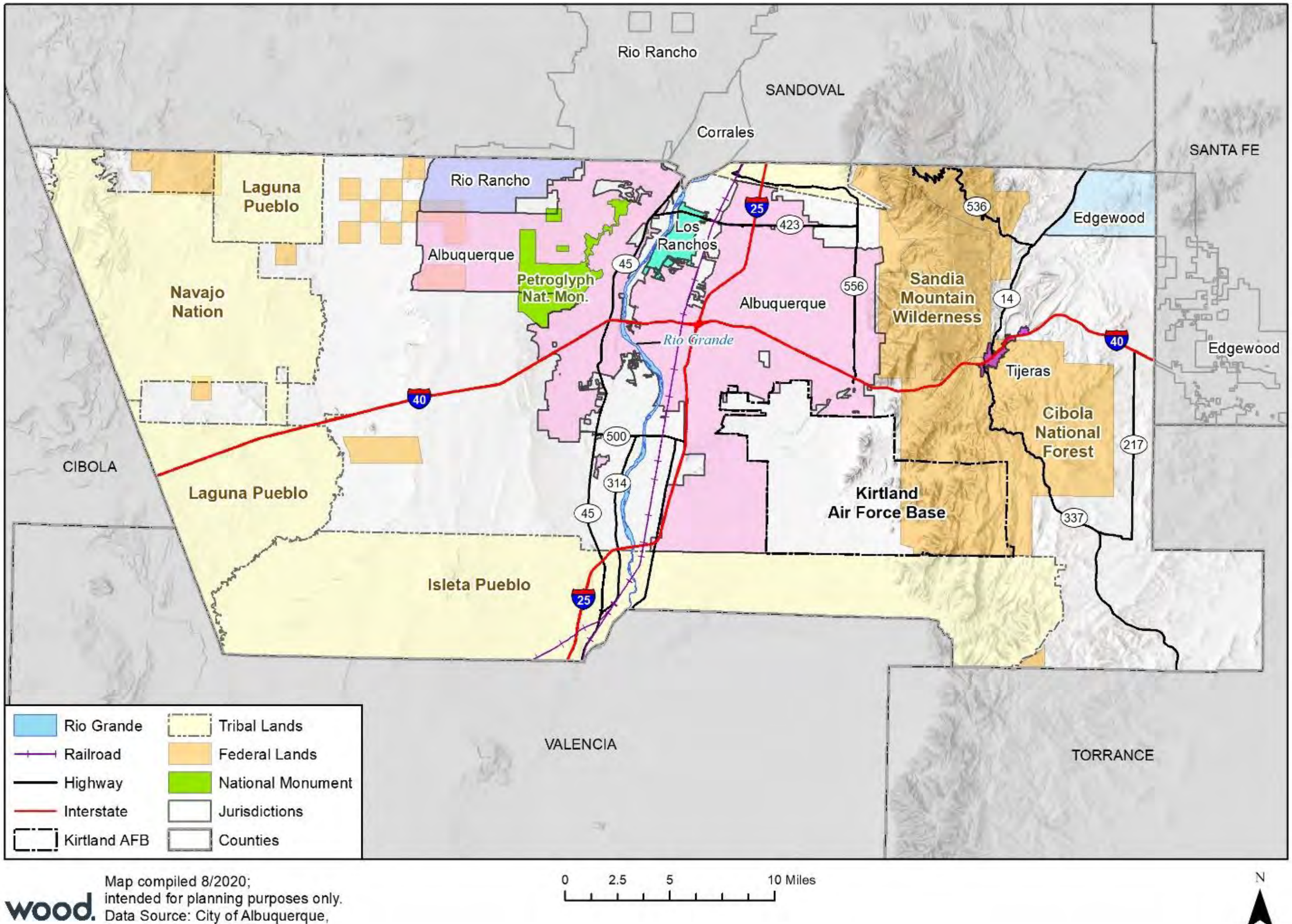
The East Mountain area overall encompasses 316 square miles of eastern Bernalillo County. Cibola National Forest makes up a large portion of the western and southern portion of the East Mountain Area.

Figure 2-1 Cross-section of Bernalillo County, NM



Source: Albuquerque-Bernalillo County Comprehensive Plan 2013

Figure 2-2 Bernalillo County



wood. Map compiled 8/2020; intended for planning purposes only. Data Source: City of Albuquerque, Bernalillo County, RGIS

2.2 History

The Albuquerque area and Bernalillo County has one of the longest histories of human habitation in North America, first being visited by nomadic hunters and then eventually settled by pueblo tribes in an area known as Rio Abajo (valley). European exploration and settlement occurred in the mid-16th Century. Settlements occurred primarily along the fertile river floodplain where it was most suitable for raising livestock and agriculture. In addition, the proximity to the Camino Real route traveling to and from Mexico (New Spain), subsequent stage lines, and eventually the railroad made settlement in Bernalillo County a logical occurrence.

Bernalillo County and Albuquerque have evolved as the major metropolitan area in New Mexico as well as a historically rural and agricultural county with a rich natural and cultural heritage. This precious heritage, along with beautiful landscapes has made the area a desirable place to live for centuries. The County and its municipalities have expressed a strong desire to preserve and protect its unique heritage and lands as witnessed by the 254 properties on the National and State Historic Register (Refer to Chapter 4, section 4.2.4 Asset Summary for more information on historic and cultural properties).

2.3 Transportation Systems and Infrastructure

The planning area is located at the intersection of Interstate 25 and Interstate 40. I-25 serves north and south travelers, and I-40 serves east and west travelers. The County is also intersected by a few designated Scenic Byways. El Camino Real (meaning Royal Road or King's Highway) served as the main road for the Spanish caravans for over three hundred years and originally extended 1,150 miles from Mexico City to Santa Fe. Historic Route 66 travels through Bernalillo County as New Mexico 333, paralleling I-40 in certain areas, and becomes Central Avenue in the Nob Hill neighborhood of Albuquerque.

Albuquerque's International Sunport airport serves local, regional, national, and international airlines as well as air cargo service providers. Double Eagle II Airport on the west side of the City, handles general aviation services.

The railroad is the initial reason Albuquerque grew so rapidly at the turn of the 20th Century. However, now the majority of the transcontinental east-west cargo passes well south of Albuquerque. The Burlington Northern Santa Fe Railroad serves freight traffic in the Albuquerque metro area. Amtrak also maintains a station in downtown Albuquerque. The Rail Runner Express provides commuter rails service between Albuquerque and Santa Fe.

The water and wastewater utility is jointly operated by the Albuquerque Bernalillo County Water Utility Authority (ABCWUA). Most of Albuquerque's water is drawn from an underground aquifer and has adopted a plan for water management that includes the use of river water, recycled water, ground water from both shallow and deep aquifers. The City owns 48,200 acre-feet of water from the San Juan- Chama Diversion Project in Northern New Mexico which supplements the groundwater supply. For wastewater, the Water Utility Authority currently operates a wastewater collection system and reclamation plant. The Southside Water Reclamation Plan recycles about 200 million gallons of water each year and has plans to pipe treated effluent to irrigate major landscaped areas and public golf courses.

Additional information on critical facilities including transportation and infrastructure can be found in Section 4.2.3.

2.4 Communities

There are three incorporated municipalities wholly located in Bernalillo County:

- City of Albuquerque

- Village of Los Ranchos de Albuquerque
- Village of Tijeras

Combined, these municipalities include approximately 84% of the total population of the County with most of the population in Albuquerque, the State's largest city. The County also has two communities that are only partially located in Bernalillo. The City of Rio Rancho is primarily located in Sandoval County, but has a small portion within Bernalillo County. The Town of Edgewood is primarily located in Santa Fe County but has a small area within Bernalillo County.

Although the incorporated municipalities contain most of the major commercial centers, some commercial and industrial development occurs in the unincorporated villages and communities in the county, especially in the East Mountains area. The following are the unincorporated areas in the County:

- Chilili
- Juan Tomas
- Escobosa
- Ponderosa Pine
- Cedro
- San Antonio
- Sandia Park
- Cedar Crest
- Sedillo
- Carnuel

2.5 Tribal Lands

Bernalillo County contains tribal lands for three Pueblos: Isleta Pueblo extends across most of the southern boundary of the county, Sandia Pueblo is on the north side of the county, and Laguna Pueblo has lands on the west side of the County. Sandia, Isleta, and Laguna Pueblos all have major casinos located in Bernalillo County but virtually no residential population within the County. To'hajiilee, a non-contiguous chapter of the Navajo Nation, has approximately 1,649 residents in the northwestern part of the County. For all three Pueblos and To'hajiilee, their seats of government are located in adjoining counties. The tribes are part of the Plan's coordination efforts but are not participating jurisdictions of this plan update.

2.6 Bernalillo County

2.6.1 Bernalillo County Demographics

This section was updated using data from the U.S. Census Bureau's 2014-2018 American Community Survey (ACS) 5-Year estimates.

As of 2018, the U.S. Census Bureau estimated Bernalillo County's total population at 677,692 people. This constitutes a 0.9% increase in population since 2014, and a 2.3% increase (662,564 persons) since the 2010 census. Table 2-1 show several key demographic and social characteristics of Bernalillo County, how those characteristics have changed over the last five years, and how those characteristics compare to the rest of the state and nation.

Table 2-1 Bernalillo County Demographic and Social Characteristics, 2014-2018

Bernalillo County	2014	2018	% Change
Population	671,429	677,692	0.9%
Median Age	36.3	37.3	2.8%
Total Housing Units	286,270	292,439	2.2%
Housing Occupancy Rate	92.1%	90.8%	-1.4%
% of Housing Units with no Vehicles Available	6.4%	6.6%	3.1%
Median Home Value	$185,500	$194,300	4.7%

Bernalillo County	2014	2018	% Change
Unemployment	8.7%	6.3%	-27.6%
Mean Travel Time to Work (minutes)	21.7	22.2	2.3%
Median Household Income	$48,390	$51,643	6.7%
Per Capita Income	$26,916	$29,415	9.3%
% of Individuals Below Poverty Level	18.6%	17.4%	-6.5%
% Without Health Insurance	15.8%	9.2%	-41.8%
# of Households	263,719	265,657	0.7%
Average Household Size	2.5	2.5	0.4%
% of Population Over 25 with high school diploma	87.8%	88.8%	1.1%
% of Population Over 25 with bachelor's degree or higher	14.4%	33.9%	135.4%
% with Disability	12.7%	13.5%	6.3%
% Speak English less than "very well"	8.5%	7.8%	-8.2%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-2 County Demographic and Social Characteristics Compared to the State and Nation

Demographic & Social Characteristics (as of 2018)	County	New Mexico	U.S.
Median Age	37.3	37.5	37.9
Housing Occupancy Rate	90.8%	83.2%	87.8%
% of Housing Units with no Vehicles Available	6.6%	5.8%	8.7%
Median Home Value	$194,300	$166,800	$204,900
Unemployment	6.3%	7.2%	5.9%
Mean Travel Time to Work (minutes)	22.2	22.1	26.6
Median Household Income	$51,643	$48,059	$60,293
Per Capita Income	$29,415	$26,085	$32,621
% of Individuals Below Poverty Level	17.4%	20.0%	14.1%
% Without Health Insurance	9.2%	10.7%	9.4%
Average Household Size	2.50	2.64	2.63
% of Population Over 25 with high school diploma	88.8%	85.3%	87.7%
% of Population Over 25 with bachelor's degree or higher	14.4%	27.1%	31.5%
% with Disability	12.7%	15.1%	12.6%
% Speak English less than "very well"	8.5%	8.9%	8.5%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-3 and Figure 2-3 break down the demographics of the County by sex, race, and age.

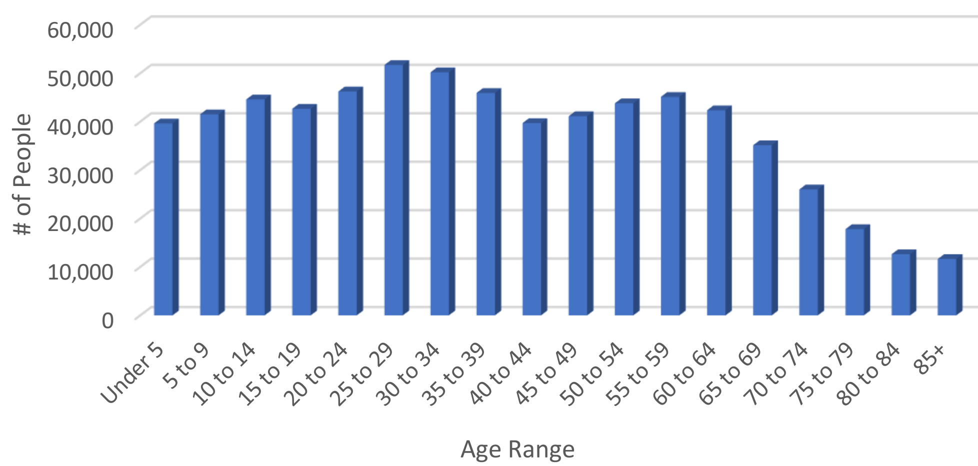
Table 2-3 County Demographics by Race and Sex

Bernalillo County	Population	%
Total Population	677,692	
Male	332,271	49.0%
Female	345,421	51.0%

Bernalillo County	Population	%
White, not Hispanic	264,358	39.0%
Hispanic or Latino	337,627	49.8%
Black	16,622	2.5%
Asian	16,782	2.5%
American Indian and Alaska Native	27,949	4.1%
Native Hawaiian and Other Pacific Islander	379	0.1%
Some other race	1,900	0.3%
Two or more races	12,075	1.8%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Figure 2-3 Bernalillo County Population by Age



Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Housing Characteristics

The table below presents the 2014-2018 ACS estimates of housing units in the county.

Table 2-4 Types and Total Amounts of Housing Units in Bernalillo County

Type of Housing Units	Total	Percentage
Total housing units	292,439	
1-unit detached	189,870	64.9%
1-unit attached	14,879	5.1%
2 units	5,086	1.7%
3 or 4 units	16,066	5.5%
5 to 9 units	11,837	4.0%
10 to 19 units	13,263	4.5%
20 or more units	24,285	8.3%
Mobile home	16,831	5.8%
Boat, RV, van, etc.	322	0.11%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

According to the American Community Survey, in 2018 Bernalillo County had 292,439 total housing units, of which 265,657 (90.8%) were occupied. Of the occupied units, 62.8% of the occupied housing units are owner-occupied and 37.2% renter-occupied. More than half the total housing units (51%) were built in 1980 or later, and the remaining 49% were built between 1939 and 1979. Of the occupied housing units, 81% of residents have been in their current housing for ten or more years. Over half of residents (61%) have been in their current housing for eight years or less. Only 6.6% of occupied housing units have no vehicles available for private use, which is slightly above the state average (5.8%) but well below the national average (8.7% respectively).

2.6.2 Bernalillo County Economy

According to data from the U.S. Bureau of Economic Analysis, Bernalillo County's Gross Domestic Product (GDP) in 2018 was $33,852,532. This constitutes 36% of the State's economy and ranks Bernalillo 1st among New Mexico Counties in terms of GDP. The County's GDP has grown by an average of 2% annually since 2015, which makes it the 10th fastest growing County economy in New Mexico.

The civilian workforce in Bernalillo County, defined as all employed residents 16 years or older, was 338,148 (63.2%) in 2018. Table 2-5 lists the major employers in Bernalillo County.

Table 2-5 Major Employers in Bernalillo County

Name of Employer	Number of Employees	Industry/Comments
Albuquerque Public Schools	14,480	Education industry. Has approximately 96,000 students. (Albuquerque Public School system includes Bernalillo County, Village of Tijeras, Los Ranchos de Albuquerque, and the City of Albuquerque)
University of New Mexico (Including UNM Hospital)	14,300	Education and health industries. Has approximately 34,700 students.
Sandia National Laboratories	9,957	Science and technology industries. Located within KAFB in the City of Albuquerque. It is a multi-program lab primarily conducting national defense research and development (R&D), energy and environment projects.
Kirtland Air Force Base (KAFB)	8,666	KAFB occupies a large area on the south side of the county, employs over 23,000, and is home to the Air Force Laboratory.
Presbyterian Hospital	7,369	Health care industry.
City of Albuquerque	6,680	Government industry.
State of New Mexico	5,910	Government industry.
Lovelace Health Systems	3,700	Health care industry.
Bernalillo County	2,450	Government industry.
Intel Corporation	2,300	Science and technology industry.
Central New Mexico Community College (CNM)	1,770	Education industry. Has approximately 35,000 students.

Source: ABC Comprehensive Plan, 2017

The median household income in 2018 was $51,643 an 8% increase since 2015; this is above the statewide average of $48,059. Per capita income increased similarly during this period, from $29,415 to $26,765 (9%). Figure 2-4 shows the breakdown of households earning different income levels in the County as of 2018.

Figure 2-4 Income Distribution in Bernalillo County

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

2.6.3 Bernalillo County Governing Body

Bernalillo County is represented by five elected officials and five county Commissioners. The Assessor, Clerk, Probate Judge, Sheriff, Treasurer, are elected county-wide and the Commissioners by districts. A County Manager oversees 25 other departments that range from Animal Regulation to Zoning.

The Mid-Region Council of Governments (MRCOG) provides services to a consortium of local governments including Bernalillo County. It coordinates transportation and infrastructure planning, employment, demographic and housing statistics, and resource management.

2.7 City of Albuquerque

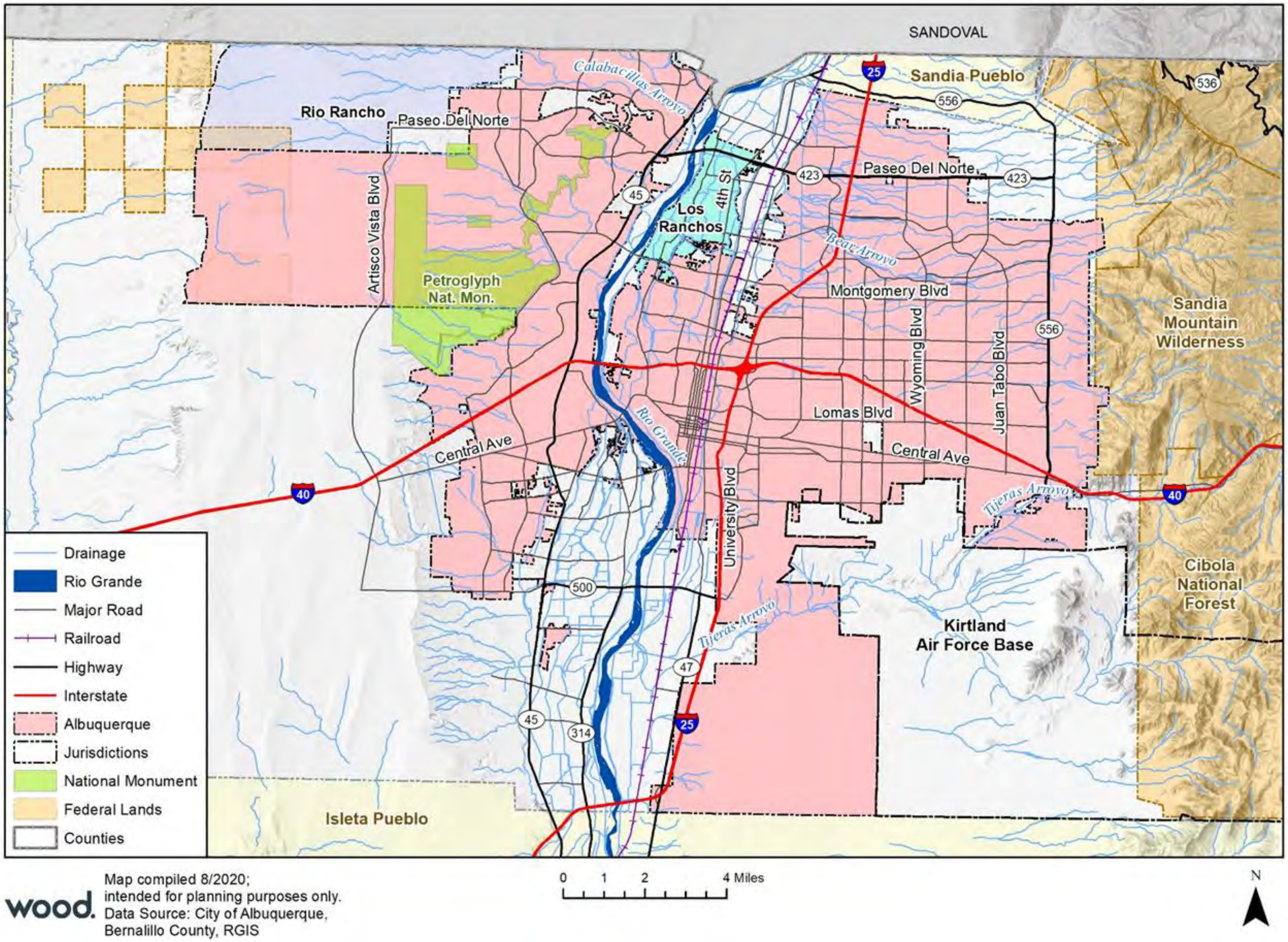
The City of Albuquerque (CABQ) is New Mexico's largest City and is located in central Bernalillo County. The City of Albuquerque was founded in 1706 by the Spanish and is a city rich in history and tradition. Albuquerque was incorporated in 1891 during the development of railroad infrastructure into New Mexico. The presence of a transcontinental railroad in Albuquerque caused the population to grow and surpass Santa Fe as the largest city in the New Mexico Territory by 1900.

In 1926, the federal government officially designated Route 66, which runs through the center of Albuquerque, and the area continued its reputation as a commercial and transportation hub within the Southwest. It also served as a servicing point for early transcontinental air service. The area is the commercial and financial center of New Mexico and continued to grow in the second half of the 20th Century due to national defense activities and an attractive climate.

Albuquerque is located centrally within Bernalillo County and includes Albuquerque International Sunport. The biggest event hosted by Albuquerque each year is the International Balloon Fiesta held each October; this nine-day event can attract over 100,000 spectators at any given time.

Figure 2-5 shows the Albuquerque city limits.

Figure 2-5 City of Albuquerque



2.7.1 City of Albuquerque Demographics

As of 2018, the U.S. Census Bureau estimated the City of Albuquerque's total population at 559,202 persons. This constitutes a 1% increase in population since 2014 and a 2.4% increase (545,852 persons) since the 2010 census. Table 2-6 and Table 2-7 show several key demographic and social characteristics of the City of Albuquerque, and how those characteristics have changed over the last five years, and how those characteristics compare to the rest of the county and state.

Table 2-6 City of Albuquerque Demographic and Social Characteristics, 2014-2018

Albuquerque	2014	2018	% Change
Population	553,576	559,202	1.0%
Median Age	35.6	36.6	2.8%
Total Housing Units	240,961	244,382	1.4%
Housing Occupancy Rate	92.5%	91.1%	-1.5%
% of Housing Units with no Vehicles Available	6.90%	7.3%	5.8%
Median Home Value	$185,100	$193,000	4.3%
Unemployment	8.5%	6.3%	-25.9%
Mean Travel Time to Work (minutes)	21.2	21.6	1.9%
Median Household Income	$47,413	$51,128	7.8%
Per Capita Income	$26,876	$29,210	8.7%
% of Individuals Below Poverty Level	18.5%	17.6%	-4.9%
% Without Health Insurance	15.2%	8.9%	-41.4%
# of Households	222,868	222,748	-0.1%
Average Household Size	2.5	2.48	0.8%
% of Population Over 25 with high school diploma	88.9%	89.7%	0.9%
% of Population Over 25 with bachelor's degree or higher	33.2%	34.7%	4.5%
% with Disability	12.7%	13.2%	3.9%
% Speak English less than "very well"	7.9%	7.3%	-7.6%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-7 Albuquerque Demographic and Social Characteristics Compared to the County and State

Demographic & Social Characteristics (as of 2018)	Albuquerque	County	New Mexico
Median Age	36.6	37.3	37.5
Housing Occupancy Rate	91.1%	90.8%	83.2%
% of Housing Units with no Vehicles Available	7.3%	6.6%	5.8%
Median Home Value	$193,000	$194,300	$166,800
Unemployment	6.3%	6.3%	7.2%
Mean Travel Time to Work (minutes)	21.6	22.2	22.1
Median Household Income	$51,128	$51,643	$48,059
Per Capita Income	$29,210	$29,415	$26,085
% of Individuals Below Poverty Level	17.6%	17.4%	20.0%

Demographic & Social Characteristics (as of 2018)	Albuquerque	County	New Mexico
% Without Health Insurance	8.9%	9.2%	10.7%
Average Household Size	2.46	2.5	2.6
% of Population Over 25 with high school diploma	89.7%	88.8%	85.3%
% of Population Over 25 with bachelor's degree or higher	33.2%	14.4%	27.1%
% with Disability	12.7%	12.7%	15.1%
% Speak English less than "very well"	7.9%	8.5%	8.9%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

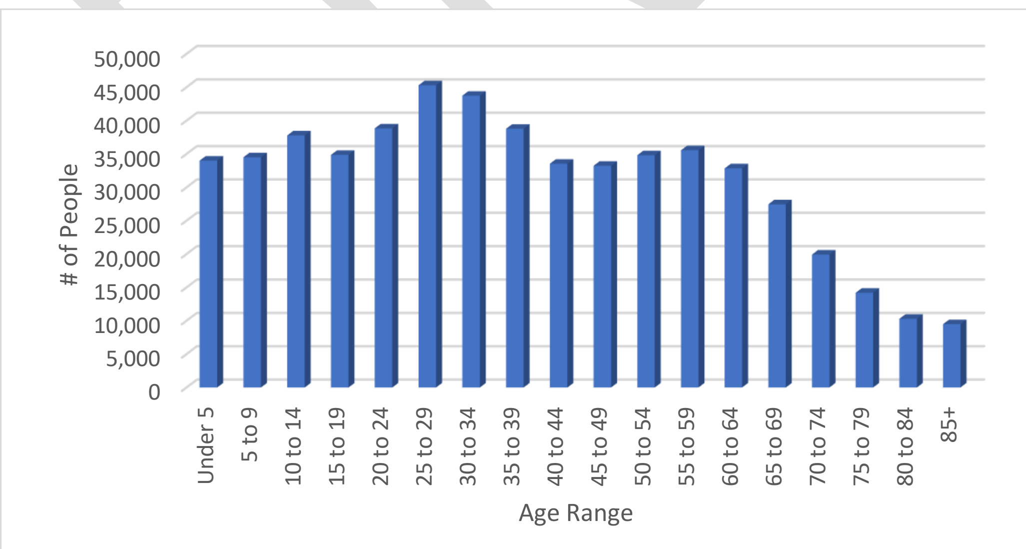
Table 2-8 and Figure 2-6 break down the demographics of the City by sex, race, and age.

Table 2-8 Albuquerque Demographics by Race and Sex

Albuquerque	Population	Percentage
Total Population	559,202	
Male	272,840	48.8%
Female	286,362	51.2%
White, not Hispanic	220,123	39.4%
Hispanic or Latino	272,814	48.8%
Black	15,399	2.8%
Asian	15,244	2.7%
American Indian and Alaska Native	22,208	4.0%
Native Hawaiian and Other Pacific Islander	319	0.1%
Some other race	1,666	0.3%
Two or more races	10,429	1.9%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Figure 2-6 Albuquerque Population by Age



Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Housing Characteristics

The table below presents the 2014-2018 ACS estimates of housing units in the City.

Table 2-9 Types and Total Amounts of Housing Units in the City of Albuquerque

Type of Housing Units	Total	Percentage
Total housing units	244,382	
1-unit detached	153,083	62.6%
1-unit attached	13,302	5.4%
2 units	4,581	1.9%
3 or 4 units	15,647	6.4%
5 to 9 units	11,317	4.6%
10 to 19 units	12,880	5.3%
20 or more units	23,897	9.8%
Mobile home	9,380	3.8%
Boat, RV, van, etc.	295	0.1%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

According to the American Community Survey, in 2018 the City of Albuquerque had 244,382 total housing units, of which 222,748 (91.1%) were occupied. Of the occupied units, 59.6% of the occupied housing units are owner-occupied and 40.4% renter-occupied. Nearly half the total housing units (49%) were built in 1979 or earlier and more than half (51%) were built in 1980 or later. Of occupied housing units, 60% of residents moved into their current housing between 2010 and 2018, while 30% of residents moved in between 1990 and 2009 and 9.9% in 1989 or earlier. Only 7.5% of occupied housing units have no vehicles available for private use, which is above the state average (5.8%) but below the national average of 8.7% respectively.

2.7.2 City of Albuquerque Economy

The civilian workforce in the City of Albuquerque, defined as all employed residents 16 years or older, was 283,224 in 2018. The breakdown of workers by class of work is shown in Table 2-10, while Table 2-11 shows the breakdown by industry.

Table 2-10 Civilian Employed Population in Albuquerque by Class of Work

Class of Worker	2014	2018	% Change
Civilian employed population 16 years and over	259,900	265,504	2%
Private wage and salary workers	192,679	199,776	4%
Government workers	53,336	51,562	-3%
Self-employed in own not incorporated business workers	13,415	13,827	3%
Unpaid family workers	470	339	-28%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-11 Civilian Employed Population in Albuquerque by Industry

Industry	2014	2018	% Change
Civilian employed population 16 years and over	259,900	265,504	2%
Agriculture, forestry, fishing and hunting, and mining	2,351	2,332	-1%
Construction	15,051	14,907	-1%

Industry	2014	2018	% Change
Manufacturing	13,933	10,967	-21%
Wholesale trade	6,242	5,554	-11%
Retail trade	29,104	30,565	5%
Transportation and warehousing, and utilities	8,536	8,324	-2%
Information	5,513	5,577	1%
Finance and insurance, and real estate and rental and leasing	13,955	14,487	4%
Professional, scientific, and management, and administrative and waste management services	36,564	40,353	10%
Educational services, and health care and social assistance	68,581	70,812	3%
Arts, entertainment, and recreation, and accommodation and food services	29,555	31,074	5%
Other services, except public administration	13,045	14,014	7%
Public administration	17,470	16,538	-5%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

The median household income in 2018 was $51,128 a 9% increase since 2015; this is above the statewide average of $48,059. Per capita income increased similarly during this period, from $26,683 to $29,210 (9%). Figure 2-7 shows the breakdown of households earning different income levels in the City as of 2018.

Figure 2-7 City of Albuquerque Income Distribution

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

2.7.3 City of Albuquerque Governing Body

The City of Albuquerque has an elected Mayor and nine City Council members. Among the many departments, (the City employs 8,500 people) the City government has an environmental planning commission, and a planning department.

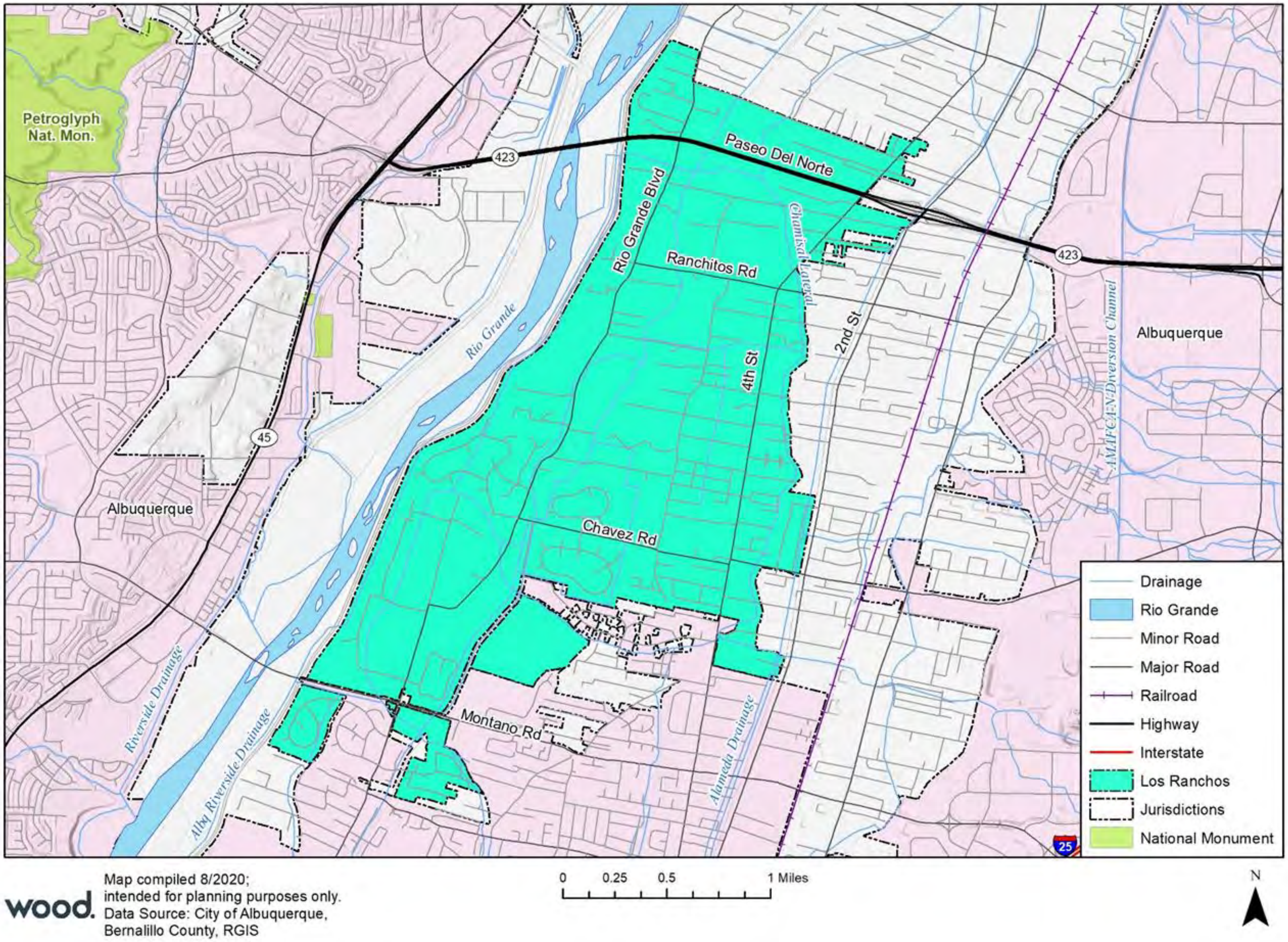
2.8 Village of Los Ranchos de Albuquerque

The Village of Los Ranchos de Albuquerque (commonly referred to as Los Ranchos) is located in the North Valley of Bernalillo County. The village is semi-rural and is comprised of just over 4 square miles.

Los Ranchos is a primarily residential community with a main street commercial corridor. The Village also hosts the Los Ranchos Growers' Market from May to November and the Lavender in the Village festival.

Figure 2-8 shows the Village of Los Ranchos de Albuquerque boundaries.

Figure 2-8 Village of Los Ranchos de Albuquerque



2.8.1 Village of Los Ranchos de Albuquerque Demographics

This section was updated using data from the U.S. Census Bureau's 2014-2018 American Community Survey (ACS) 5-Year estimates.

As of 2018, the U.S. Census Bureau estimated the Village of Los Ranchos' total population at 6,131 persons. This constitutes a 0.9% increase in population since 2014 and a 1.8% increase (6,024 persons) since the 2010 census. Table 2-12 and Table 2-13 show several key demographic and social characteristics of Los Ranchos, how those characteristics have changed over the last five years, and how those characteristics compare to the rest of the state and nation.

Table 2-12 Village of Los Ranchos Demographic and Social Characteristics, 2014-2018

Los Ranchos	2014	2018	% Change
Population	6,074	6,131	0.9%
Median Age	50.2	50.3	0.2%
Total Housing Units	3,020	2,966	-1.8%
Housing Occupancy Rate	91.3%	88.7%	-2.8%
% of Housing Units with no Vehicles Available	6.8%	6.8%	0.0%
Median Home Value	$380,100	$420,600	10.7%
Unemployment	3.5%	3.0%	-14.3%
Mean Travel Time to Work (minutes)	19.9	20.2	1.5%
Median Household Income	$57,850	$62,214	7.5%
Per Capita Income	$43,828	$53,744	22.6%
% of Individuals Below Poverty Level	10.2%	14.1%	38.2%
% Without Health Insurance	11.1%	3.5%	-68.5%
# of Households	2,756	2,632	-4.5%
Average Household Size	2.2	2.3	5.5%
% of Population Over 25 with high school diploma	95.2%	92.9%	-2.4%
% of Population Over 25 with bachelor's degree or higher	45.3%	45.7%	0.9%
% with Disability	15.0%	12.0%	-20.0%
% Speak English less than "very well"	3.6%	3.3%	-8.3%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-13 Village of Los Ranchos Demographic and Social Characteristics Compared to the County and State

Demographic & Social Characteristics (as of 2018)	Los Ranchos	County	New Mexico
Median Age	50.3	37.3	37.5
Housing Occupancy Rate	88.7%	90.8%	83.2%
% of Housing Units with no Vehicles Available	6.8%	6.6%	5.8%
Median Home Value	$420,600	$194,300	$166,800
Unemployment	3.0%	6.3%	7.2%
Mean Travel Time to Work (minutes)	20.2	22.2	22.1
Median Household Income	$62,214	$51,643	$48,059

Demographic & Social Characteristics (as of 2018)	Los Ranchos	County	New Mexico
Per Capita Income	$53,744	$29,415	$26,085
% of Individuals Below Poverty Level	14.1%	17.4%	20.0%
% Without Health Insurance	3.5%	9.2%	10.7%
Average Household Size	2.2	2.5	2.6
% of Population Over 25 with high school diploma	92.9%	88.8%	85.3%
% of Population Over 25 with bachelor's degree or higher	45.3%	14.4%	27.1%
% with Disability	15.0%	12.7%	15.1%
% Speak English less than "very well"	3.6%	8.5%	8.9%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

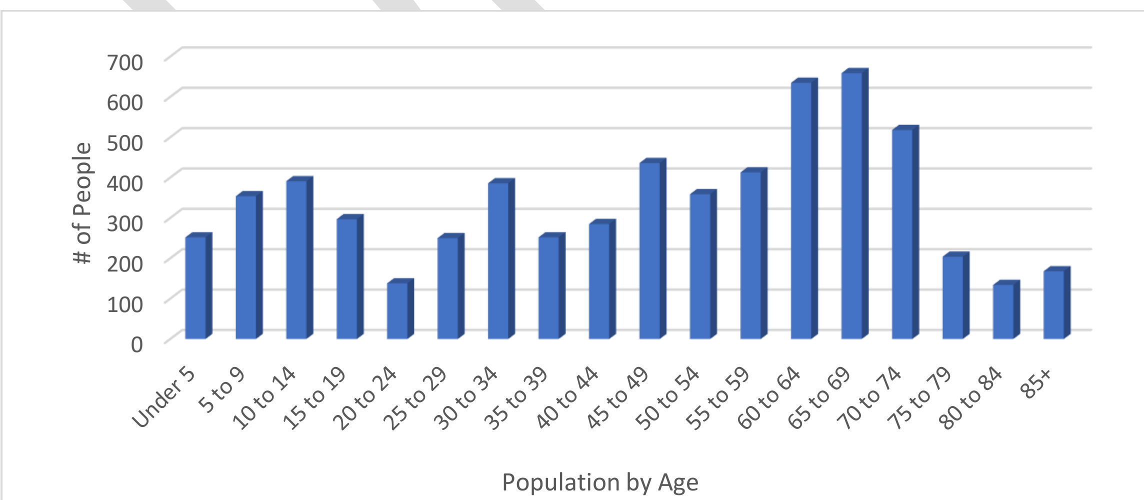
Table 2-14 and Figure 2-9 break down the demographics of the Village by sex, race, and age.

Table 2-14 Los Ranchos Demographics by Race and Sex

Los Ranchos	Population	Percent
Total Population	6,131	
Male	2,754	44.9%
Female	3,377	55.1%
White, not Hispanic	3,245	52.9%
Hispanic or Latino	3,453	56.3%
Black	2	0.0%
Asian	64	1.0%
American Indian and Alaska Native	0	0.0%
Native Hawaiian and Other Pacific Islander	0	0.0%
Some other race	107	1.7%
Two or more races	35	0.6%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Figure 2-9 Los Ranchos Population by Age



Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Housing Characteristics

The table below presents the 2014-2018 ACS estimates of housing units in Los Ranchos.

Table 2-15 Types and Total Amounts of Housing Units in Los Ranchos

Type of Housing Units	Total	Percentage
Total housing units	2,966	
1-unit detached	2,263	76.3%
1-unit attached	121	4.1%
2 units	36	1.2%
3 or 4 units	51	1.7%
5 to 9 units	115	3.9%
10 to 19 units	91	3.1%
20 or more units	154	5.2%
Mobile home	135	4.6%
Boat, RV, van, etc.	0	0.0%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

According to the American Community Survey, in 2018 the Village of Los Ranchos had 2,966 total housing units, of which 2,632 (88.7%) were occupied. Of the occupied units, 70% of the occupied housing units are owner-occupied and 30% are renter-occupied. Nearly half the total housing units (46%) were built in the past 38 years and more than half (55%) were built in 1979 or earlier. Of occupied housing units, 40.1% of residents moved into their current housing between 2010 and 2018, while 38.3% of residents moved in between 1990 and 2009 and 21.4% in 1989 or earlier. Only 6.8% of occupied housing units have no vehicles available for private use, which is above the state average (5.8%) but below the national average of 8.7% respectively.

2.8.2 Village of Los Ranchos de Albuquerque Economy

The civilian workforce in the Village of Los Ranchos was 2,859 in 2018. The breakdown of workers by class of work is shown in Table 2-16 while Table 2-17 shows the breakdown by industry.

Table 2-16 Civilian Employed Population in Los Ranchos by Class of Work

Class of Worker	2014	2018	% Change
Civilian employed population 16 years and over	2,737	2,774	1%
Private wage and salary workers	1,841	1,945	6%
Government workers	650	612	-6%
Self-employed in own not incorporated business workers	246	217	-12%
Unpaid family workers	0	0	0%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-17 Civilian Employed Population in Los Ranchos by Industry

Industry	2014	2018	% Change
Civilian employed population 16 years and over	2,737	2,774	1%
Agriculture, forestry, fishing and hunting, and mining	43	21	-51%
Construction	160	142	-11%
Manufacturing	320	177	-45%

Industry	2014	2018	% Change
Wholesale trade	26	55	112%
Retail trade	197	405	106%
Transportation and warehousing, and utilities	20	36	80%
Information	92	73	-21%
Finance and insurance, and real estate and rental and leasing	108	300	178%
Professional, scientific, and management, and administrative and waste management services	437	306	-30%
Educational services, and health care and social assistance	604	771	28%
Arts, entertainment, and recreation, and accommodation and food services	256	182	-29%
Other services, except public administration	115	130	13%
Public administration	359	176	-51%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

The median household income in 2018 was $62,214 an 0.2% decrease since 2015; despite the decrease this is above the statewide average of $48,059. Per capita income increased during this period, from $47,680 to $53,744 (13%). Figure 2-10 shows the breakdown of households earning different income levels in the Village as of 2018.

Figure 2-10 Village of Los Ranchos' Income Distribution

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

2.8.3 Village of Los Ranchos de Albuquerque Governing Body

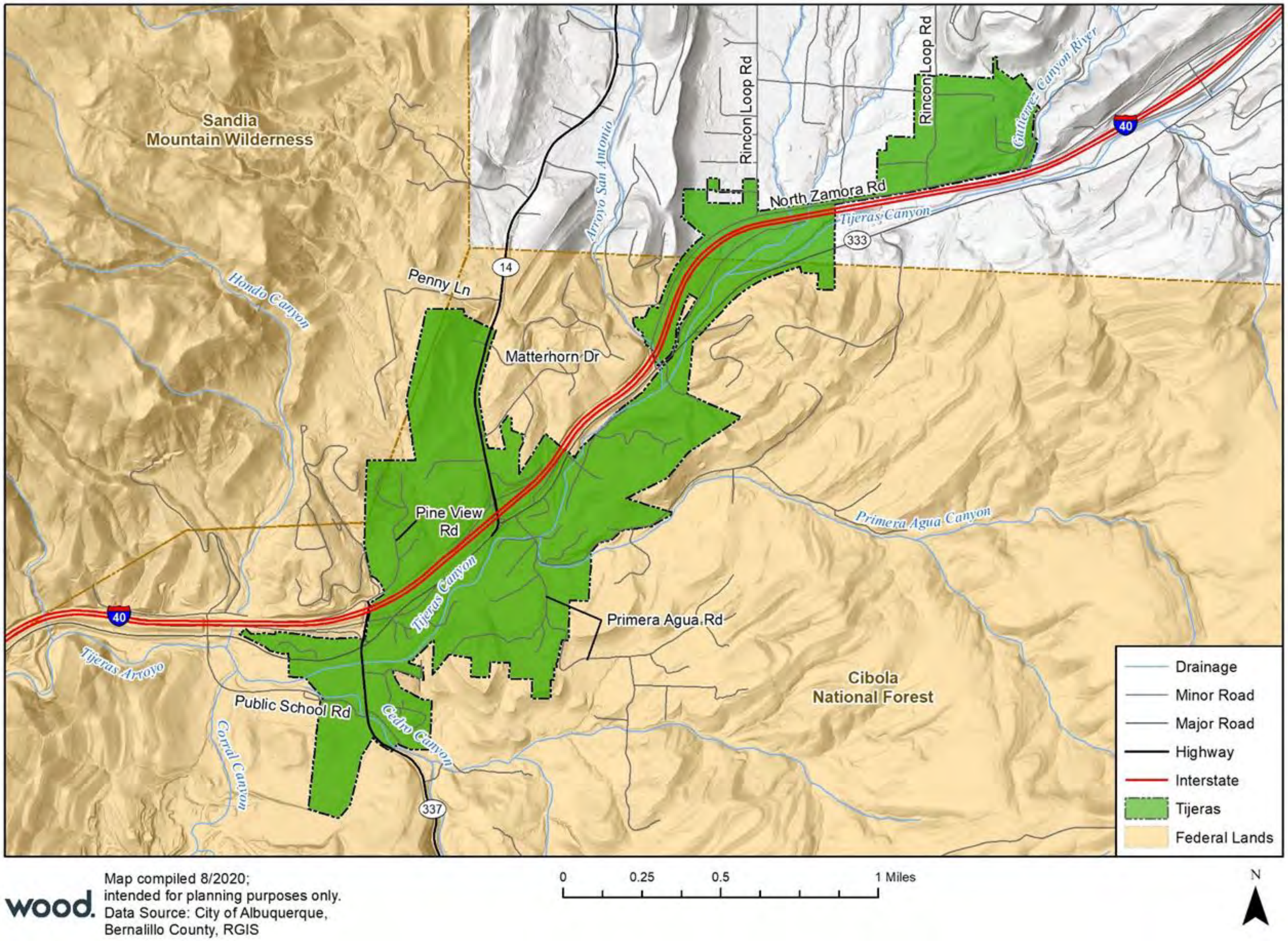
The governing body for the Village of Los Ranchos' consists of a Mayor and four-member Board of Trustees, who serve staggered four-year terms. The Village also has a Planning and Zoning Commission with seven positions of residents appointed by the Mayor to review and act on matters of planning, platting and zoning using both the Master Plan and the Village Zoning Ordinance to guide them.

2.9 Village of Tijeras

The Village of Tijeras is the only incorporated municipality within the East Mountain Area. The Interstate-40 corridor splits the area into two sub-regions. Historic Route 66 (also referred to as State Highway 333) traverses the area and is still emotionally (if not physically) the core roadway for local residents in an east-west direction (East Mountain Area Plan, Bernalillo County 1992).

Figure 2-11 shows the Village of Tijeras boundaries.

Figure 2-11 Village of Tijeras



2.9.1 Village of Tijeras Demographics

This section was updated using data from the U.S. Census Bureau's 2014-2018 American Community Survey (ACS) 5-Year estimates.

As of 2018, the U.S. Census Bureau estimated the Village of Tijeras' total population at 655 persons. This constitutes a 56.7% increase in population since 2014 and a 21.1% increase (541 persons) since the 2010 census. Table 2-18 and Table 2-19 show several key demographic and social characteristics of Bernalillo County, how those characteristics have changed over the last five years, and how those characteristics compare to the rest of the state and nation.

Table 2-18 Village of Tijeras Demographic and Social Characteristics, 2014-2018

Tijeras	2014	2018	% Change
Population	418	655	56.7%
Median Age	50.0	41.6	-16.8%
Total Housing Units	194	297	53.1%
Housing Occupancy Rate	75.3%	83.5%	10.9%
% of Housing Units with no Vehicles Available	3.4%	2.0%	-41.2%
Median Home Value	$215,000	$172,300	-19.9%
Unemployment	10.8%	0.0%	-100.0%
Mean Travel Time to Work (minutes)	23.9	26.7	11.7%
Median Household Income	$65,417	$71,250	8.9%
Per Capita Income	$36,234	$31,832	-12.1%
% of Individuals Below Poverty Level	7.4%	5.0%	-32.4%
% Without Health Insurance	19.3%	9.5%	-50.8%
# of Households	146	248	69.9%
Average Household Size	2.9	2.6	-7.7%
% of Population Over 25 with high school diploma	87.5%	91.8%	4.9%
% of Population Over 25 with bachelor's degree or higher	26.9%	27.7%	3.0%
% with Disability	20.8%	9.5%	-54.3%
% Speak English less than "very well"	2.8%	0.3%	-89.3%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Table 2-19 Village of Tijeras Demographic and Social Characteristics Compared to the County and State

Demographic & Social Characteristics (as of 2018)	Tijeras	County	New Mexico
Median Age	41.6	37.3	37.5
Housing Occupancy Rate	83.5%	90.8%	83.2%
% of Housing Units with no Vehicles Available	2.0%	6.6%	5.8%
Median Home Value	$172,300	$194,300	$166,800
Unemployment	0.0%	6.3%	7.2%
Mean Travel Time to Work (minutes)	26.7	22.2	22.1
Median Household Income	$71,250	$51,643	$48,059

Demographic & Social Characteristics (as of 2018)	Tijeras	County	New Mexico
Per Capita Income	$31,832	$29,415	$26,085
% of Individuals Below Poverty Level	5.0%	17.4%	20.0%
% Without Health Insurance	9.5%	9.2%	10.7%
Average Household Size	2.9	2.5	2.6
% of Population Over 25 with high school diploma	91.8%	88.8%	85.3%
% of Population Over 25 with bachelor's degree or higher	26.9%	14.4%	27.1%
% with Disability	20.8%	12.7%	15.1%
% Speak English less than "very well"	2.8%	8.5%	8.9%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

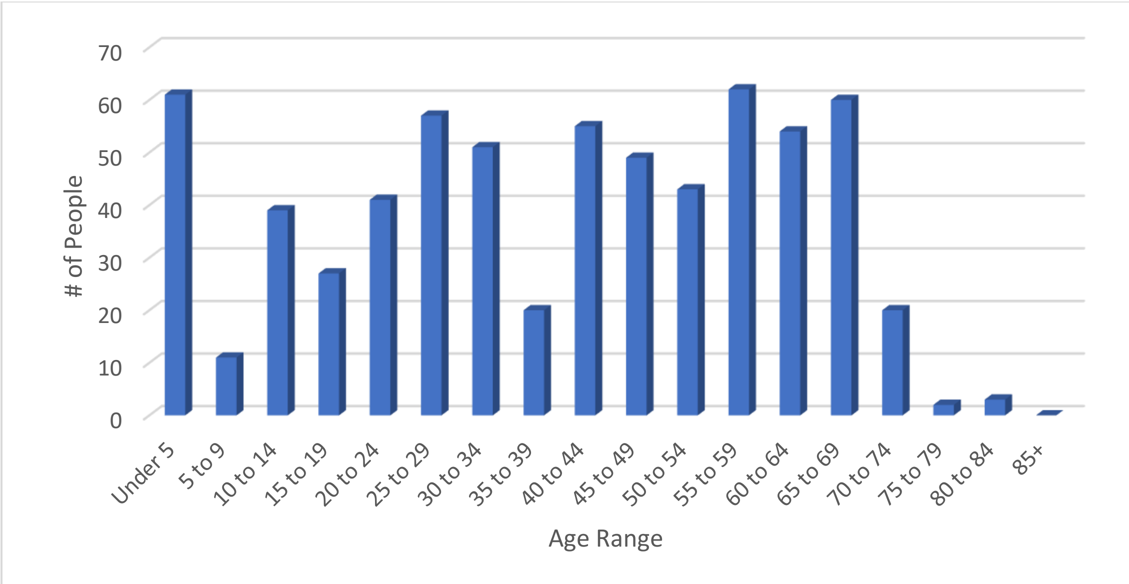
Table 2-20 and Figure 2-12 break down the demographics of the Village by sex, race, and age.

Table 2-20 Village of Tijeras Demographics by Race and Sex

Tijeras	Population	Percent
Total Population	655	
Male	346	52.8%
Female	309	47.2%
White, not Hispanic	308	47.0%
Hispanic or Latino	323	49.3%
Black	0	0.0%
Asian	0	0.0%
American Indian and Alaska Native	0	0.0%
Native Hawaiian and Other Pacific Islander	0	0.0%
Some other race	0	0.0%
Two or more races	15	2.3%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Figure 2-12 Village of Tijeras Population by Age



Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

Housing Characteristics

The table below presents the 2014-2018 ACS estimates of housing units in the Village of Tijeras.

Table 2-21 Types and Total Amounts of Housing Units in the Village of Tijeras

Type of Housing Units	Total	Percentage
Total housing units	297	
1-unit detached	261	87.9%
1-unit attached	0	0.0%
2 units	0	0.0%
3 or 4 units	17	5.7%
5 to 9 units	0	0.0%
10 to 19 units	0	0.0%
20 or more units	0	0.0%
Mobile home	19	6.4%
Boat, RV, van, etc.	0	0.0%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

According to the American Community Survey, in 2018 the Village of Tijeras had 297 total housing units, of which 248 (83.5%) were occupied. Of the occupied units, 68.5% of the occupied housing units are owner-occupied and 31.5% are renter-occupied. According to the ACS data, 100% of the housing built in Tijeras was constructed before 2010. Of occupied housing units, 62% of residents moved into their current housing between 1990 and 2009, while 38% of residents moved in between 2010 and 2018, and 25.4% in 1989 or earlier. Only 2% of occupied housing units have no vehicles available for private use, which is below both the state average (5.8%) and the national average of 8.7% respectively.

2.9.2 Village of Tijeras Economy

The civilian workforce in the Village of Tijeras was 329 in 2018. The breakdown of workers by class of work is shown in Table 2-22 while Table 2-23 shows the breakdown by industry.

Table 2-22 Civilian Employed Population in Tijeras by Class of Work

Class of Worker	2014	2018	% Change
Civilian employed population 16 years and over	219	329	50%
Private wage and salary workers	137	250	82%
Government workers	78	57	-27%
Self-employed in own not incorporated business workers	4	22	450%
Unpaid family workers	0	0	0%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

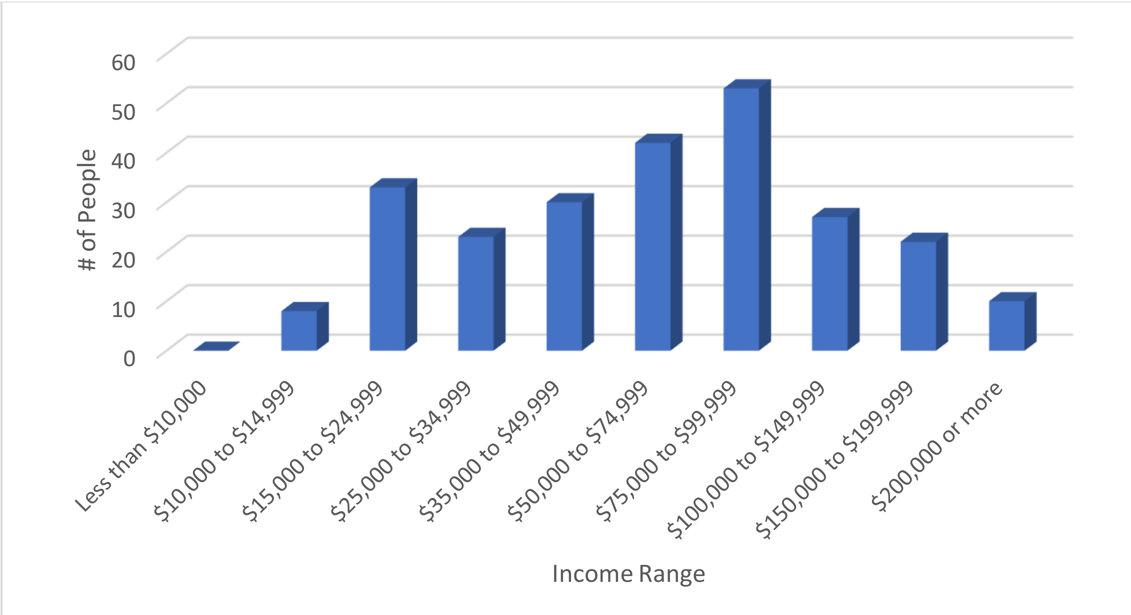
Table 2-23 Civilian Employed Population in Tijeras by Industry

Industry	2014	2018	% Change
Civilian employed population 16 years and over	219	329	50%
Agriculture, forestry, fishing and hunting, and mining	0	0	0%
Construction	16	25	56%
Manufacturing	15	14	-7%
Wholesale trade	15	9	-40%
Retail trade	9	44	389%
Transportation and warehousing, and utilities	16	0	-100%
Information	3	0	-100%
Finance and insurance, and real estate and rental and leasing	2	56	2700%
Professional, scientific, and management, and administrative and waste management services	28	53	89%
Educational services, and health care and social assistance	62	78	26%
Arts, entertainment, recreation, accommodation and food services	22	15	-32%
Other services, except public administration	8	20	150%
Public administration	23	15	-35%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

The median household income in 2018 was $71,250 a 1.1% decrease since 2015; despite the decrease in the past five years, this is still above the statewide average of $48,059. Per capita income also decreased during this period, from $36,054 to $31,832 (-12%).Figure 2-13 shows the breakdown of households earning different income levels in the Village of Tijeras as of 2018.

Figure 2-13 Village of Tijeras Income Distribution



Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2014-2018

2.9.3 Village of Tijeras Governing Body

The Village of Tijeras is governed by a Mayor and Village Council. There are five Planning and Zoning Commissioners that review development applications in the Village.

2.10 Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA)

The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) was created in 1963 by the New Mexico Legislature with specific responsibility for flooding problems in greater Albuquerque. AMAFCA's purpose is to prevent injury or loss of life, and to eliminate or minimize property damage. AMAFCA does this by building and maintaining flood control structures throughout the Albuquerque area. The District is governed by a five-member Board of Directors.

AMAFCA maintains the following types of structures in Bernalillo County:

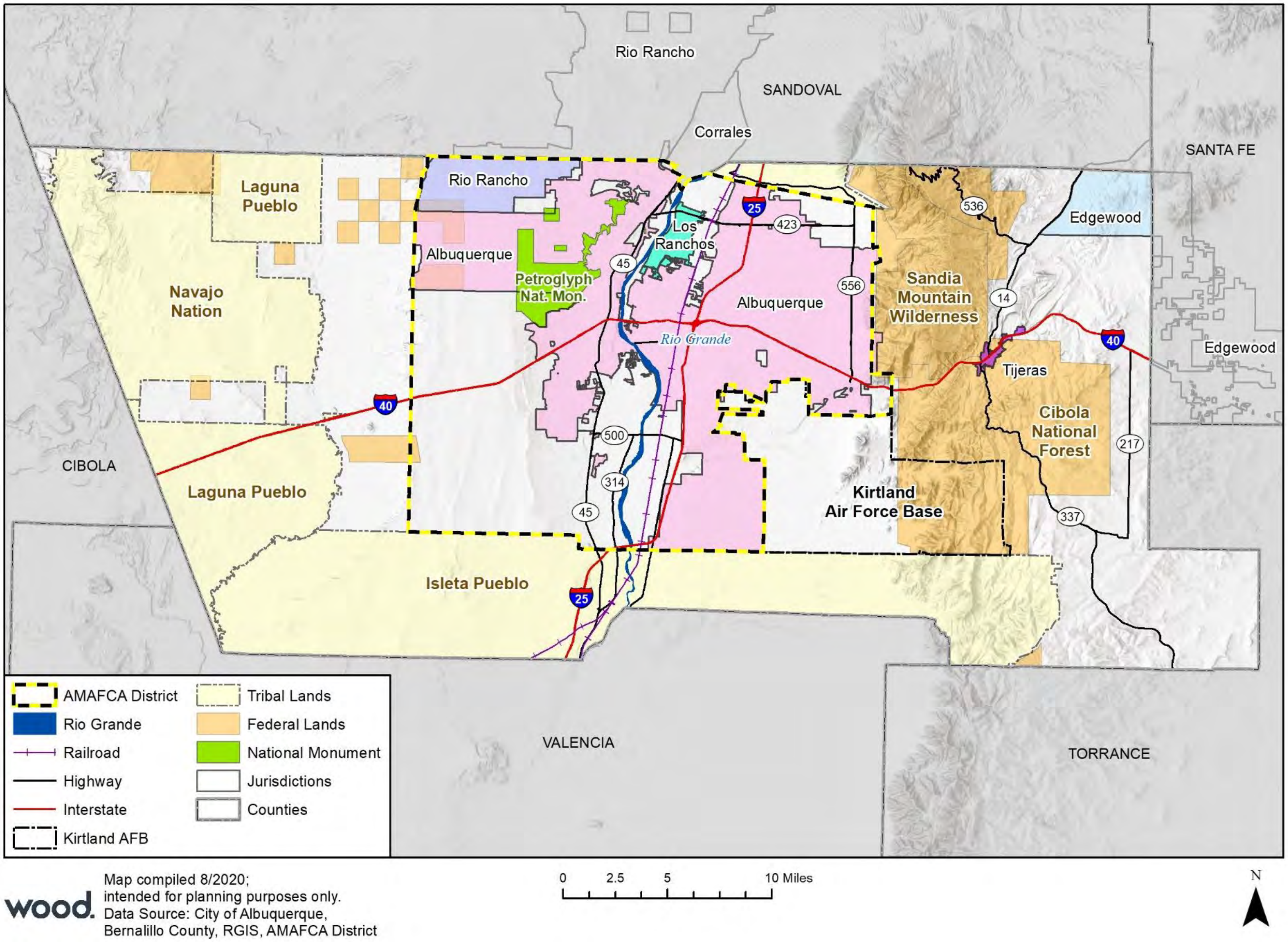
- **Flood Control Structures** - Traditional flood control measures focus on protection of existing development through construction of dams (to hold water back) and channels (to divert or confine flows). AMAFCA maintains many but other agencies are also involved with their own structures.
- **North and South Diversion Channels** - The first mission of AMAFCA was to be the local sponsor for construction of two very large federally-funded projects, the North and South Diversion Channels, which were built by the Army Corps of Engineers. The North Diversion Channel drains Northeast Albuquerque and can carry 44,000 cubic feet of water per second at its outlet. The smaller South Diversion Channel protects the Southeast Valley by intercepting flows from Southeast Albuquerque and the Tijeras Arroyo. AMAFCA today is still responsible for these two main flood control structures.
- **Traditional Channels** - The North and South Diversion Channels are examples of traditional channels. The North Diversion Channel is a concrete-lined arroyo, and the South Diversion Channel is mostly made of dirt. Both arroyos move floodwater to the river.
- **Non-Traditional Channels** - The Calabacillas Arroyo is one example of a non-traditional channel built by AMAFCA. Soil-cement, made from a combination of local soil and cement, mimics the look of a

natural arroyo while providing greater erosion protection than that of a plain dirt arroyo. The Calabacillas Arroyo also incorporates artwork elements into the design of the arroyo walls, in the section between Coors Boulevard and the Rio Grande.

- **Dams and Levees** - A typical AMAFCA dam contains a principal spillway, which is a pipe under the dam, and an emergency spillway, which is the large channel around the side or over the top of the dam that acts as a safety valve. Dams and other types of detention basins collect floodwater and release it slowly to prevent downstream damage. AMAFCA dams are capable of fully detaining the one percent (100-year) storm. A storm greater than that, however, could flow through the emergency spillway, and cause some downstream flooding. A levee is like a dam but confines water along a waterway such as a river. Levees protect a significant portion of the planning area and are discussed in more detail in Section 4.5.

Figure 2-14 shows the location of the district's boundary within Bernalillo County.

Figure 2-14 Albuquerque Metropolitan Arroyo Flood Control Authority District Boundary



2.11 Middle Rio Grande Conservancy District (MRGCD)

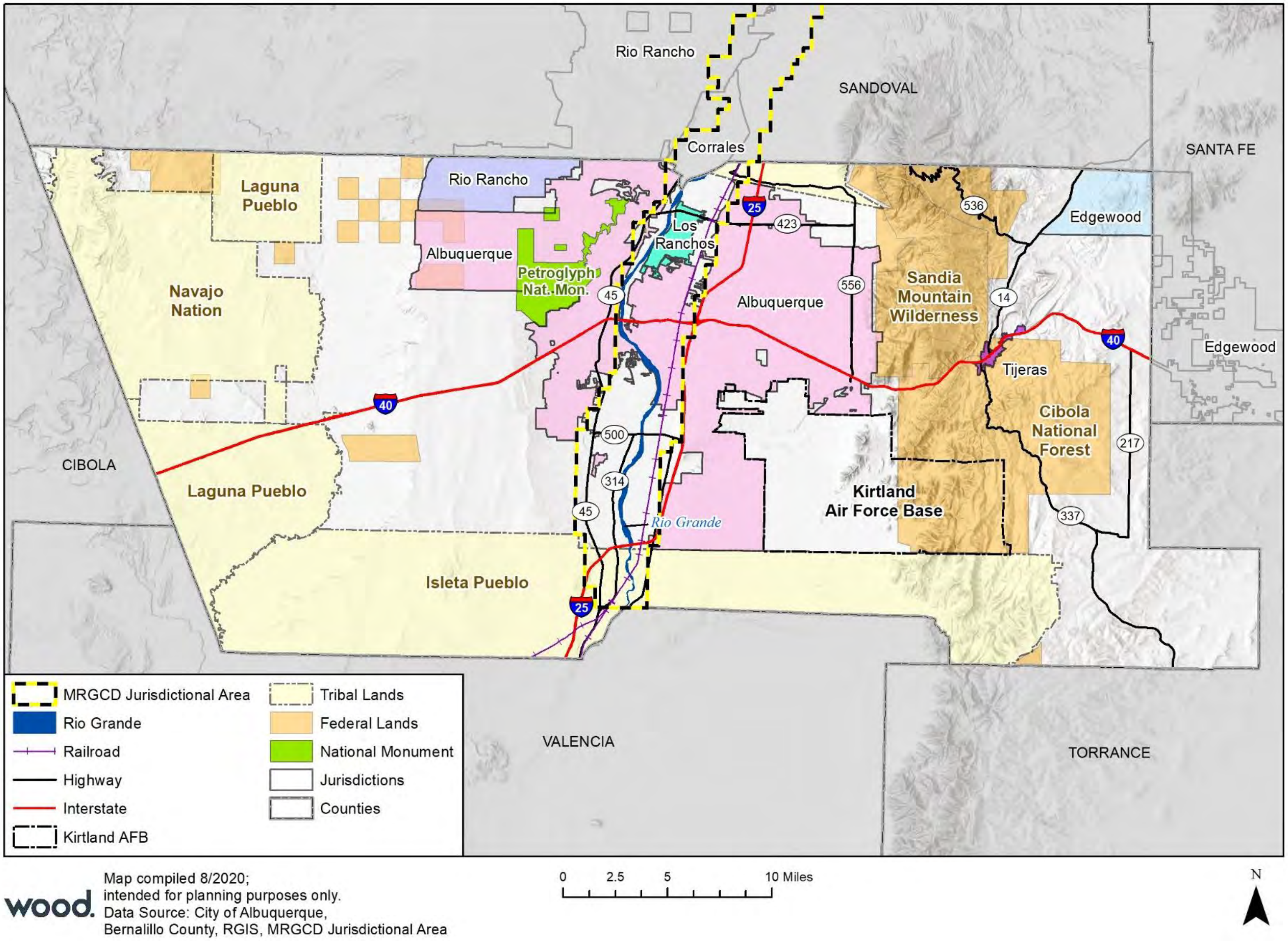
The Middle Rio Grande Conservancy District (MRGCD) was created in 1925 to provide flood protection from the Rio Grande and is responsible for maintaining and operating a network of acequias (shared irrigation) or conservancy ditches that carry water from the Rio Grande to farmland on either side of the river. MRGCD taxes property that is within the irrigation district along the Rio Grande.

The District is governed by a Board of Directors with seven positions. There are twelve departments within District:

- Accounting
- Assessments
- Biology & Planning
- Engineering
- Equipment Repair & Transportation
- General Office
- Human Resources
- Hydrology
- Information Systems
- Mapping/GIS
- Purchasing
- Records

Figure 2-15 shows the District's jurisdictional area.

Figure 2-15 Middle Rio Grande Conservancy District Jurisdictional Area



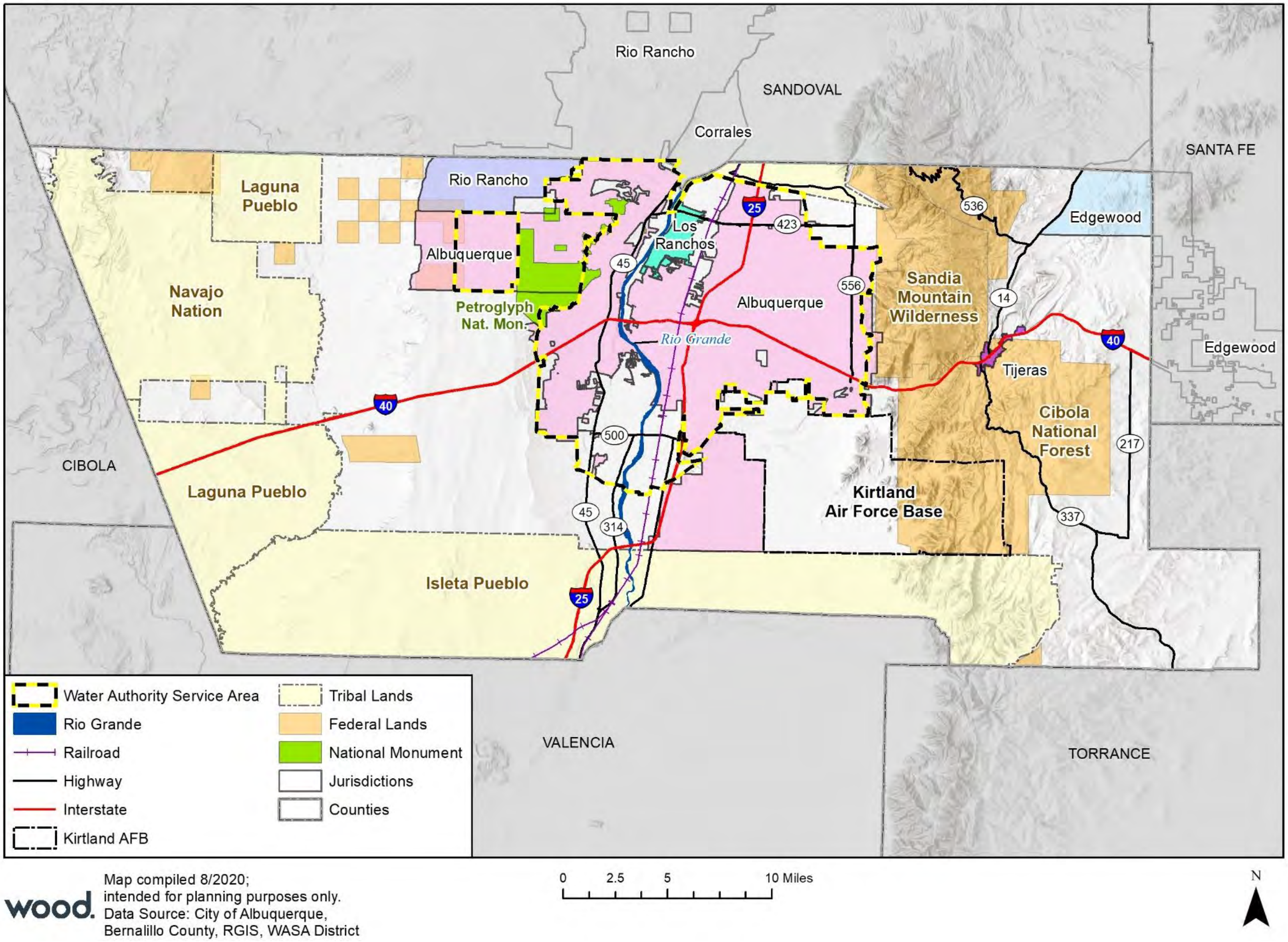
2.12 Albuquerque Bernalillo County Water Utility Authority (ABCWUA)

The Albuquerque Bernalillo County Water Utility Authority (ABCWUA) was established in June 2003 through State Law NMS 1978§72-1-10 and gained statutory powers to provide public water and wastewater utilities in 2005. The District entered into an operations and maintenance agreement with the City of Albuquerque and Bernalillo County in December 2003, reaching an agreement to continue day-to-day management of the water utility. The ABCWUA fully transitioned to administering public water and wastewater utility in July 2007.

The ABCWU district is considered the largest water utility in the state with an operating budget of over $170 million, over 3,000 miles of water supply pipes, and more than 2,400 miles of sewer collector pipes supporting 606,780 water users in the Albuquerque area (ABCWA). The district is governed by a Governing Board made of eight-members; three Albuquerque City Councilors, three Bernalillo County Commissioners, the Mayor of Albuquerque and a non-voting member from the Village of Los Ranchos.

Figure 2-16 shows the ABWUA service area boundary.

Figure 2-16 Albuquerque Bernalillo County Water Utility Authority



Map compiled 8/2020; intended for planning purposes only. Data Source: City of Albuquerque, Bernalillo County, RGIS, WASA District

2.13 Social Vulnerability

Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human caused threats, such as toxic chemical spills. Social vulnerability considerations were included in this plan update to identify areas across the planning area that might be more vulnerable to hazard impacts based on a number of factors.

The Center for Disease Control and Prevention (CDC) has developed a social vulnerability index (SoVI) as a way to measure the resilience of communities when confronted by external stresses such as natural or human-caused disasters or disease outbreaks. The SoVI is broken down to the census tract level and provides insight into particularly vulnerable populations to assist emergency planners and public health officials identify communities more likely to require additional support before, during, and after a hazardous event. The SoVI index combines four main themes of vulnerability, which are in turn broken down into subcategories for a total of 15 vulnerability factors. Table 2-24 displays those 15 factors and shows how Bernalillo County compares to other counties in New Mexico and nationally. The rankings show the percentage of counties that Bernalillo County is more vulnerable than, i.e. – high numbers are worse.

Table 2-24 Social Vulnerability in Bernalillo County

Theme	Variable	Ranking Compared to New Mexico Counties	Ranking Compared to US Counties	Vulnerability
Socioeconomic status		**19%**	**52%**	**Above Average**
	Below poverty	29%	67%	Above Average
	Unemployment	39%	64%	Above Average
	Income	10%	28%	Below Average
	No high school diploma	25%	43%	Below Average
Household composition and disability		**9%**	**36%**	**Below Average**
	Age 65 or older	22%	23%	Low
	Age 17 or younger	44%	50%	Below Average
	Disability	16%	30%	Below Average
	Single-parent households	63%	80%	High
Minority status and language		**63%**	**94%**	**High**
	Minority	59%	93%	High
	Speaking English "less than well"	63%	89%	High
Housing and transportation		**50%**	**66%**	**Above Average**
	Multiunit structures	100%	92%	High
	Mobile homes	3%	27%	Below Average
	Crowding	50%	71%	Above Average
	No vehicle	66%	63%	Above Average
	Group quarters	25%	26%	Below Average
Overall Social Vulnerability		**29%**	**68%**	**Above Average**

Source: U.S. CDC https://svi.cdc.gov (using data from U.S. Census Bureau American Community Survey, 2014-2018)

Bernalillo County's social vulnerability is above average overall compared to the rest of the United States, and high compared to the rest of New Mexico:

- Socioeconomic vulnerability is generally above average, but the County is below average in terms on income and people without a high school diploma.
- Bernalillo County has a low percentage of elderly and below average of people with disabilities. However, it has a high percentage of children and single-parent households.

- Bernalillo County has a high percentage of racial minorities, who historically are hardest hit by disasters, as well as people who speak English "less than well," complicating disaster communications.
- A high percentage of Bernalillo County residents live in multi-unit structures, or in housing units with more people than rooms, which can complicate evacuations.

Figure 2-17 through Figure 2-21 display SoVI data for Bernalillo County by census tract. Based on this data, the areas with the highest level of social vulnerability are located in south-central portions of Bernalillo County, the western portion of the unincorporated county, and areas along Interstate 25 in the City of Albuquerque.

Additional information on the CDC's Social Vulnerability Index can be found at https://svi.cdc.gov.

Figure 2-17 Overall Social Vulnerability in Bernalillo County

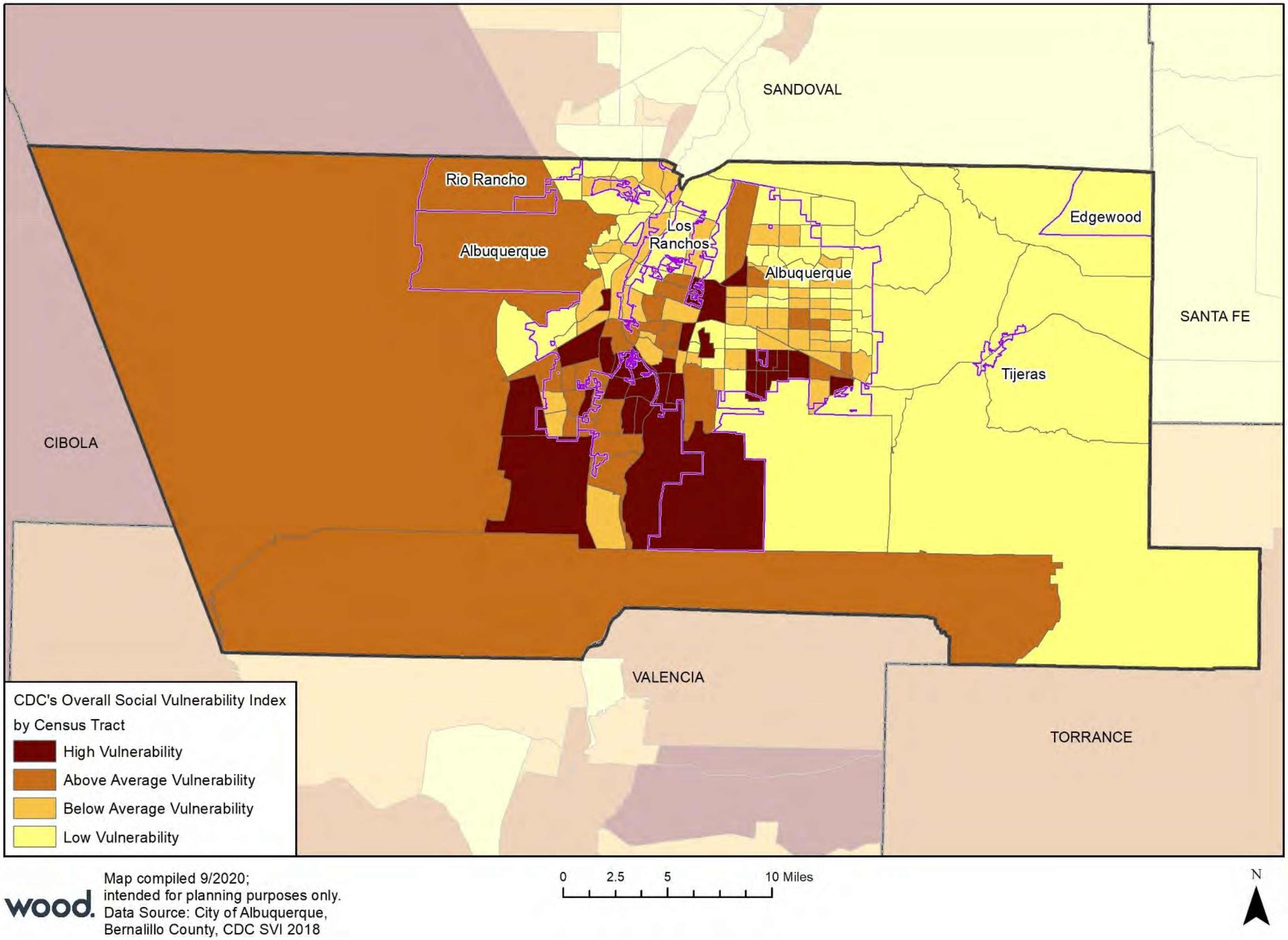


Figure 2-18 Social Vulnerability in Bernalillo County – Socioeconomic Status

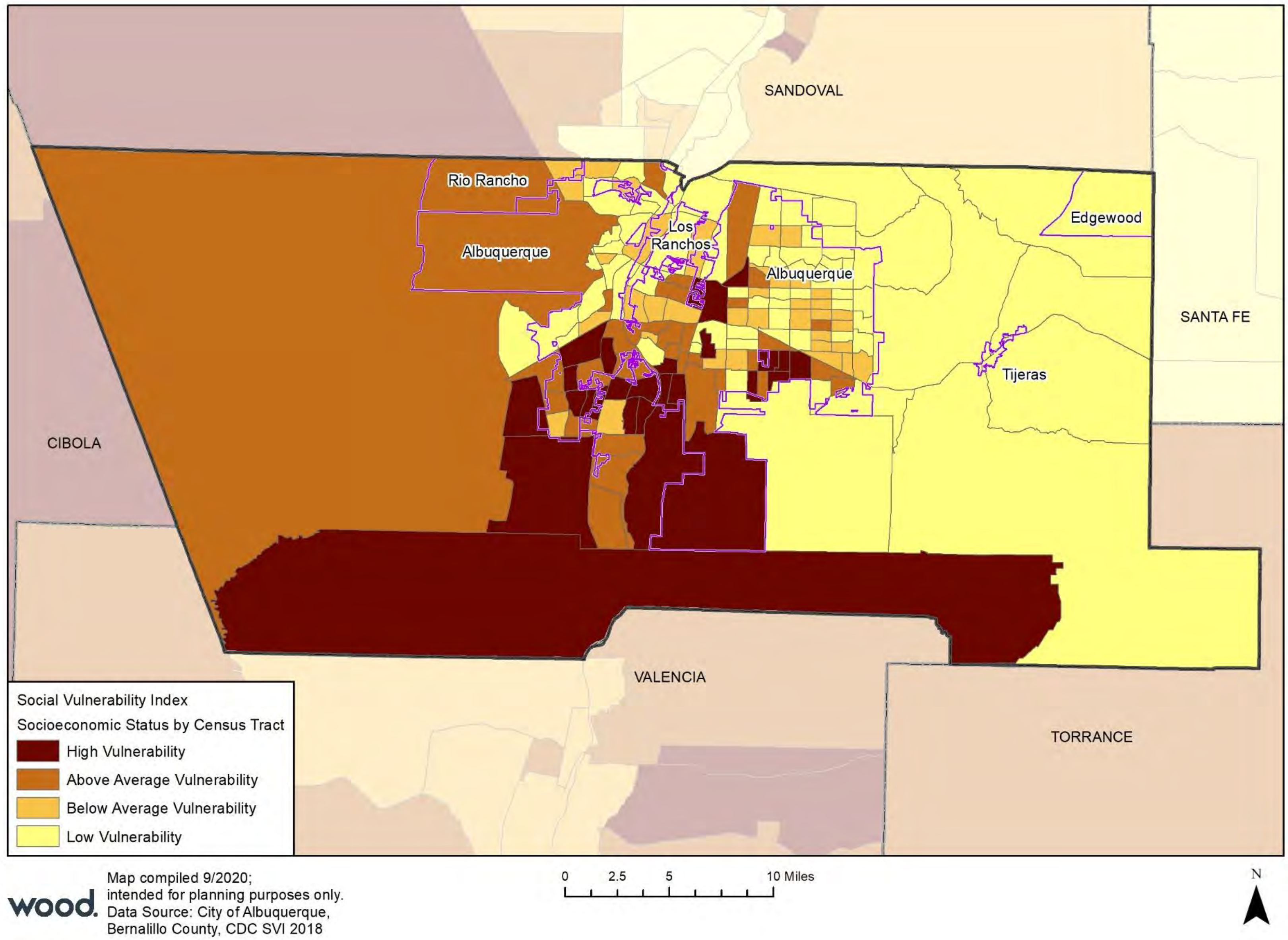


Figure 2-19 Social Vulnerability in Bernalillo County – Household Composition and Disability

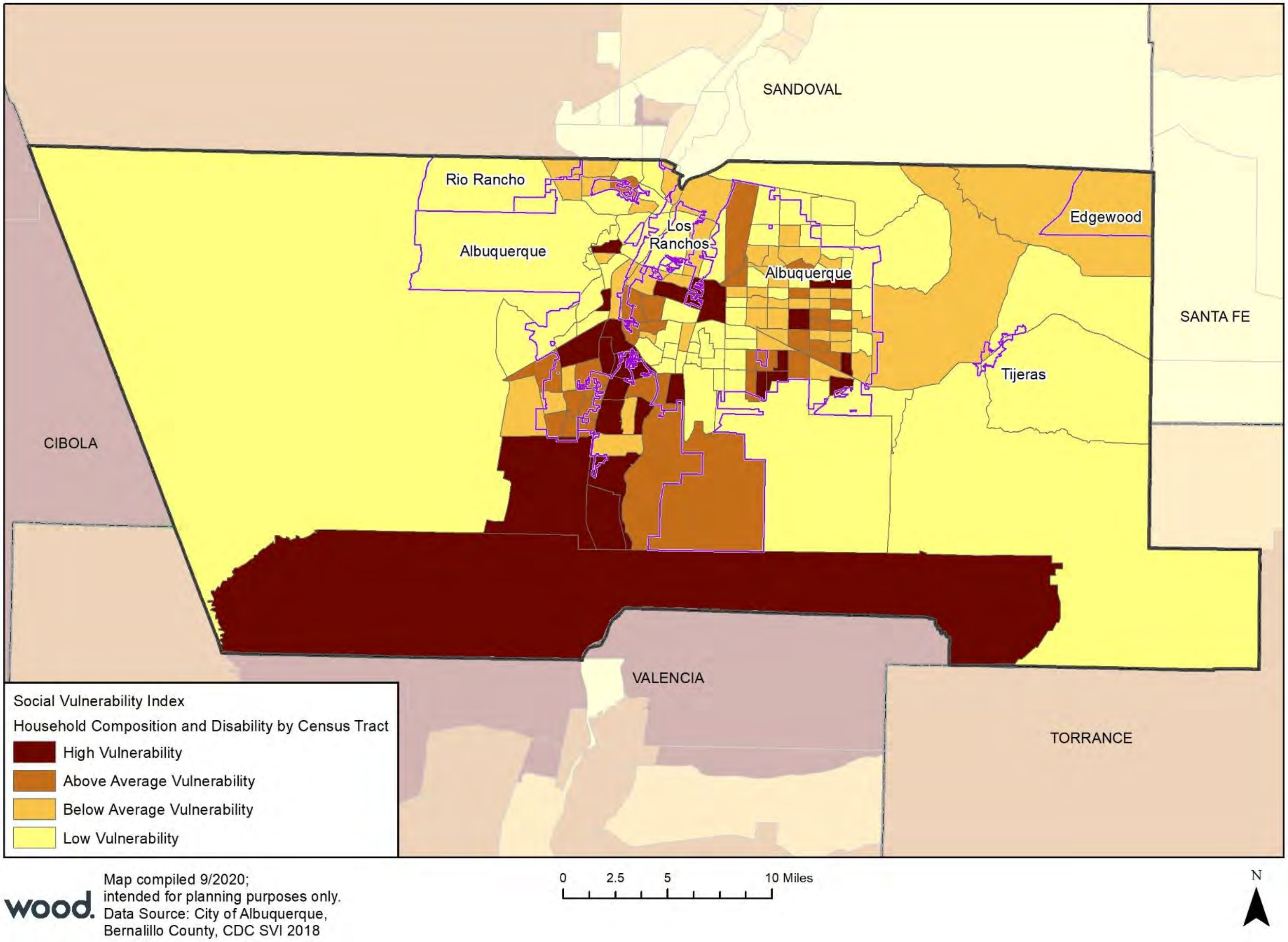


Figure 2-20 Social Vulnerability in Bernalillo County - Minority and Language Status

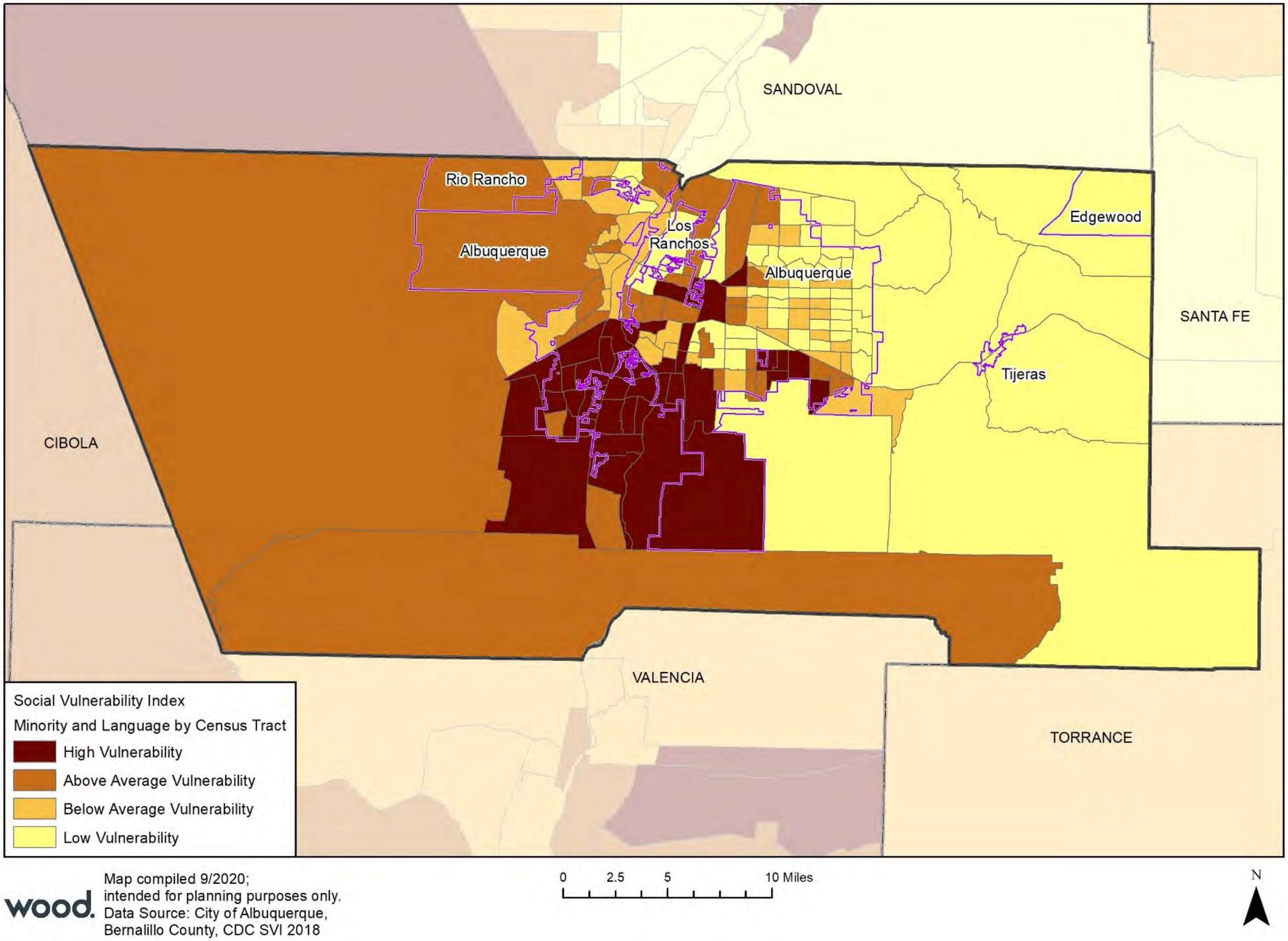
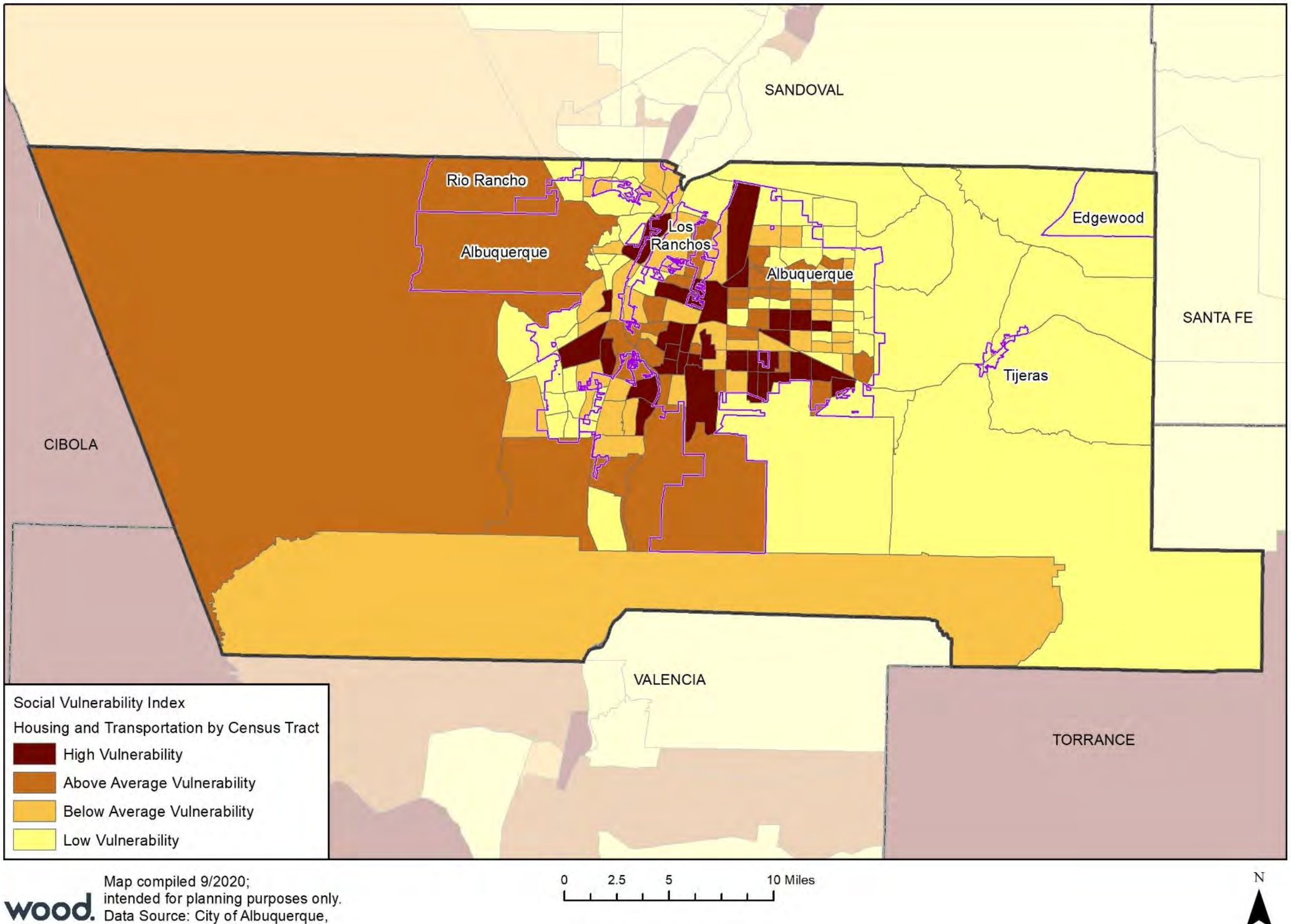


Figure 2-21 Social Vulnerability in Bernalillo County - Housing and Transportation



wood. Map compiled 9/2020; intended for planning purposes only. Data Source: City of Albuquerque, Bernalillo County, CDC SVI 2018

2.14 Future Development Trends

The Albuquerque metropolitan area is primarily land locked due to boundaries with Pueblos, other jurisdictions, and federal and state lands. as well as topographic constraints in the unincorporated areas, due to natural features such as the Rio Grande Valley, Mountain Ranges, and volcanic escarpment (ABC 2017). These development constraints have led to increased infill development within the City and low density in previously undeveloped areas of unincorporated Bernalillo. The Planning Team noted that in recent years development has occurred in the floodplain fringe and near arroyos that were previously undeveloped. New large developments have also occurred to the west of City of Albuquerque in the past five years. According to the Planning Team, the increased development has caused a strain on existing undersized infrastructure leading to increased concerns of stormwater capacity and flooding. The Village of Los Ranchos noted that residential development in the village in built out but there continues to be potential for commercial development and redevelopment.

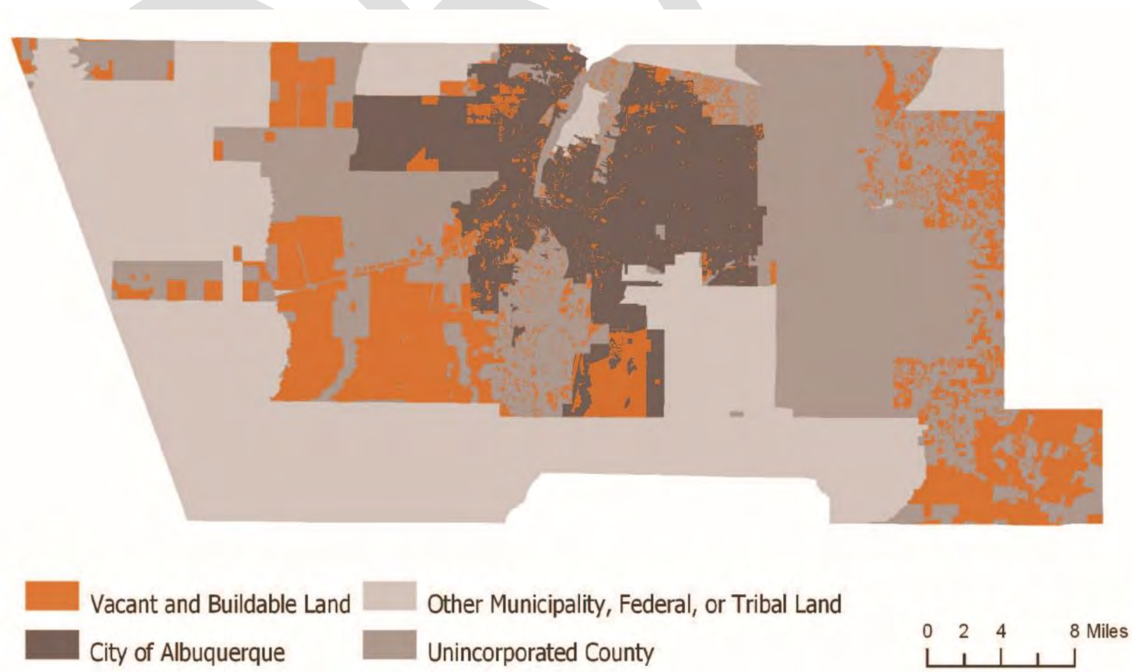
The following table and figure from the Albuquerque/Bernalillo County Comprehensive Plan (2017) break down the amount of developable land remaining in the area.

Figure 2-22 Developed and Vacant Land in City of Albuquerque and Bernalillo County

	DEVELOPED SQ. MI. (APPROX)	VACANT SQ. MI. (APPROX)	TOTAL DEVELOPABLE LAND SQ. MI. (APPROX)	TOTAL UNDEVELOPABLE LAND SQ. MI. (APPROX)
Albuquerque	89	24	113	76
Unincorporated Bernalillo County*	120	160	280	259

* Unincorporated Bernalillo County includes Federal Lands, such as Cibola National Forest, the Petroglyph National Monument, and the Reserve Area. It does not include Kirtland Air Force Base, tribal lands, or other municipalities
Source: Albuquerque/Bernalillo County Comprehensive Plan, 2017

Figure 2-23 Location of Vacant Land in City of Albuquerque and Bernalillo County



Source: Albuquerque/Bernalillo County Comprehensive Plan, 2017 and Mid-Region Metropolitan Planning Organization (MRMPO)

3 Planning Process

DMA Requirements §201.6(b) and §201.6(c)(1):
An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: *An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;* *An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and non-profit interests to be involved in the planning process; and* *Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.* *[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

3.1 Background on Mitigation Planning in the Albuquerque/Bernalillo County Area

The primary purpose of the 2020 Albuquerque/Bernalillo County Hazard Mitigation Plan (HMP) is to reduce or eliminate long-term risk to people and property from natural and human-caused hazards and their effects on the Albuquerque/Bernalillo County planning area.

Recognizing the importance of hazard mitigation planning, Bernalillo County and the City of Albuquerque developed a Hazard Mitigation Plan in 2007. In 2015 they were joined by the Village of Los Ranchos de Albuquerque, the Village of Tijeras, and the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) to update the Plan. Additional details on those previous planning efforts can be referenced in the 2007 and 2015 Plans.

The Hazard Mitigation Plan (HMP) underwent a comprehensive update in 2020. Two additional special districts participated in the 2020 planning process: the Middle Rio Grande Conservancy District (MRGCD) and the Albuquerque Bernalillo County Water Utility Authority (ABCWA). The planning process followed during this update was similar to that used in the previous plan development and was based on input from a multi-jurisdictional Hazard Mitigation Planning Committee (HMPC). A consultant, Wood Environment & Infrastructure Solutions, Inc (Wood) was procured to assist with the update in 2020. The plan update process is described further in this section and documented in Appendix B.

3.2 What's New in the Plan Update

DMA Requirements §201.6(d)(3):
A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

The updated HMP complies with Federal Emergency Management Agency (FEMA) guidance for Local Hazard Mitigation Plans. The update followed the requirements noted in the Disaster Mitigation Act (DMA) of 2000 and FEMA's 2013 Local Hazard Mitigation Planning Handbook.

This multi-jurisdictional, multi-hazard mitigation plan update involved a comprehensive review and update of each section of the 2015 plan and includes an assessment of the participating jurisdictions' success in evaluating, monitoring, and implementing the mitigation strategy outlined in the 2015 Plan. The process followed to review and revise the chapters of the plan during the 2020 update is detailed in Table 3-1. All sections of the plan were reviewed and updated to reflect new data and methodologies on hazards and risk, risk analysis processes, capabilities, participating jurisdictions and stakeholders, and mitigation strategies. The plan was also revised to reflect changes in development, including using the latest version of the assessor's office data as the basis for identifying overall and hazard exposure for developed parcels by County and jurisdiction. Only the information and data still valid from the 2015 plan was carried forward as applicable to this plan update.

As noted above, one significant addition to the 2020 planning process is the inclusion of two additional participating jurisdictions: The Middle Rio Grande Conservancy District (MRCGD) and The Albuquerque Bernalillo County Water Authority (ABCWUA).

Table 3-1 2020 Plan Update Summary of Changes by Chapter

2015 Plan Section	Update Review and Analysis	2020 Plan Section
1 Introduction	• Updated information to be 2020 relevant. • Moved demographic, social and economic data, including results of any recent annexation or new development into (new) 2 Community Profile	1 Introduction
	• New chapter in 2020.	2 Community Profile
2 Planning Process	• Moved into Chapter 3. • Described and documented the planning process for the 2020 update, including coordination among agencies and integration with other planning efforts. • Described changes in participation. • Described 2020 public participation process.	3 Planning Process
3 Hazards Identification	• Combined with analysis and risk assessment into Chapter 4. • Revisited 2015 hazards list and added human-caused hazards. • Reviewed hazards from current NM State Hazard Mitigation Plan for consistency. • Updated list of disaster declarations to include 2015-2020 data. • Added potential consequences of climate change within each hazard profile. • Updated Asset Summary including historic and cultural resources.	4 Hazard Identification and Risk Assessment
4 Hazards Analysis and Risk Assessment	• Combined with Hazard Identification (previously Chapter 3). • Incorporated new hazard studies since 2015 and/or CWPPs/wildfire risk mapping. • Updated critical facilities data from the 2015 plan. • Updated development and land use trends to include Census data, state, county, and local data sources. • Using 2020 Assessor's data, updated current property values. • Estimated flood losses using the latest flood hazard mapping and building counts and values. • Updated NFIP data and Repetitive Loss structure data from the previous plan. • Incorporated new hazard loss estimates since 2015, as applicable.	4 Hazard Identification and Risk Assessment

2015 Plan Section	Update Review and Analysis	2020 Plan Section
	• Examined changes in growth and development; especially changes in the context of hazard-prone areas and how the changes may affect loss estimates and vulnerability. • Updated information regarding specific vulnerabilities to hazards, including maps and tables of specific assets at risk, specific critical facilities at risk, and specific populations at risk. • Conducted a HAZUS-MH Level I earthquake vulnerability analysis. • Updated information regarding specific vulnerabilities to hazards, including maps and tables of specific assets at risk, specific critical facilities at risk, and specific populations at risk. • Updated maps in plan where appropriate.	
	• New in Chapter in 2020. Previously located in Implementation Strategy. • Updated capability assessment using information from Wood develop and distributed Data Collection Guide • Reviewed mitigation capabilities and update to reflect current capabilities. • Indicated projects that have been implemented that may reduce previously identified vulnerabilities. • Described how 2015 plan was integrated into other plans and programs	5 Capability Assessment
5 Mitigation Strategy Goals, Measures, and Actions	• Moved to new Chapter 6. • Updated based on the results of the updated risk assessment, completed mitigation actions, and implementation obstacles and opportunities over the last five years. • Described changes in goals and the addition of an objective. • Reviewed mitigation actions from the 2015 plan and develop a status report for each; identified if action has been completed, deleted, or deferred. • Identified and detailed new mitigation actions not captured in the previous plan. • Identified projects that have been submitted for funding and those that will be likely candidates for this funding. • Created a consolidated mitigation actions table to represent all jurisdictions existing and new actions.	6 Mitigation Strategy
6 Plan Implementation Strategy	• Moved into and combined with Chapter 7. •	7 Plan Implementation and Maintenance
7 Plan Maintenance	• Reviewed and updated procedures for monitoring, evaluating, and updating the plan. • Revised to reflect current methods. • Revised to note opportunities for integration in future planning efforts. • Identified additional criteria for plan monitoring and maintenance.	7 Plan Implementation and Maintenance
Appendices	• Appendix A: Meeting Documentation – renamed Planning Process, updated to document 2020 planning process. • Appendix B: Plan Review Tool - Removed	Appendix A: Planning Team

2015 Plan Section	Update Review and Analysis	2020 Plan Section
	• Appendix C: AMAFCA Map Showing Drainage Facility Responsibilities in Albuquerque Area – Removed • Added Emergency Management Accreditation Program (EMAP) Crosswalk.	Appendix B Planning Process Documentation Appendix C: Adoption Resolutions Appendix D: EMAP Crosswalk Appendix E: Mitigation Action Worksheets Appendix F: Available Dam Inundation Maps (not for public release)

3.3 Local Government Participation

DMA Requirements §201.6(a)(3):
Multi-jurisdictional plans may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.

Every incorporated municipality and special district in the planning area was invited to participate in the 2020 Hazard Mitigation Plan update. The Disaster Mitigation Act requires that each jurisdiction participate in the planning process and officially adopt the multi-jurisdictional hazard mitigation plan in order to be eligible for FEMA Hazard Mitigation Assistance grants. The jurisdictions that chose to participate in the planning process and development of the plan or its update were required to meet strict plan participation requirements defined at the beginning of the process, which included the following:

- Designate a representative to serve on the HMPC
- Participate in HMPC meetings
- Complete and return updates on Mitigation Actions since 2015 to Wood
- Identify new mitigation actions for the plan
- Review and comment on plan drafts
- Inform the public, local officials, and other interested parties about the planning process and provide opportunity for them to comment on the plan
- Formally adopt the mitigation plan and re-adopt every 5 years

Bernalillo County, the Village of Los Ranchos de Albuquerque, Village of Tijeras, Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), Middle Rio Grande Conservancy District (MRGCD), Albuquerque Bernalillo County Water Utility Authority (ABCWA) committed to participating in the plan update, and met all of these participation requirements. In most cases, the representative for each jurisdiction brought together a planning team to help collect data, identify mitigation actions and review implementation strategies. Appendix A shows the attendance of representatives at each HMPC meeting; sign-in sheets are included in Appendix B Planning Process Documentation.

3.4 The 10-Step Planning Process

DMA Requirements §201.6(b):
An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: *(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.* *(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.* *(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.*

Wood and the HMPC worked together to establish the framework and process for this planning effort using FEMA's Local Multi-Hazard Mitigation Planning Guidance (2013). The guidance and this plan are structured around FEMA's original four-phase process:

1. Organize resources
2. Assess risks
3. Develop the mitigation plan
4. Implement the plan and monitor progress

Into this four-phase process, Wood integrated a more detailed 9-step process laid out in the 2013 Local Mitigation Planning Handbook, along with the 10-step planning process used for FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. Thus, the modified 10-step process used for this plan meets the funding eligibility requirements of the Hazard Mitigation Assistance grants (including Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities grant, High Hazard Potential Dam grant, Flood Mitigation Assistance grant, Repetitive Loss and Severe Repetitive Loss grants), Community Rating System, and the flood control projects authorized by the U.S. Army Corps of Engineers (USACE). Table 3-2 shows how the modified 10-step process fits into FEMA's four-phase process.

Table 3-2 Mitigation Planning Process Used to Develop the Plan

FEMA's 4-Phase DMA Process	Modified 10-Step CRS Process	FEMA Local Mitigation Planning Handbook Tasks
1) Organize Resources		
201.6(c)(1)	1) Organize the Planning Effort	1: Determine the planning area and resources
201.6(b)(1)	2) Involve the Public	2: Build the planning team - 44 CFR 201.6 (C)(1)
201.6(b)(2) and (3)	3) Coordinate with Other Departments and Agencies	3: Create an outreach strategy - 44 CFR 201.6(b)(1)
		4: Review community capabilities - 44 CFR 201.6 (b)(2)&(3)
2) Assess Risks		
201.6(c)(2)(i)	4) Identify the Hazards	5: Conduct a risk assessment - 44 CFR 201.6 (C)(2)(i) 44 CFR 201.6(C)(2)(ii)&(iii)
201.6(c)(2)(ii)	5) Assess the Risks	
3) Develop the Mitigation Plan		
201.6(c)(3)(i)	6) Set Goals	

FEMA's 4-Phase DMA Process	Modified 10-Step CRS Process	FEMA Local Mitigation Planning Handbook Tasks
201.6(c)(3)(ii)	7) Review Possible Activities	6: Develop a mitigation strategy - 44 CFR 201.6(c)(3)(i); 44 CFR 201(c)(3)(ii) and 44 CFR 201.6(c)(3)(iii)
201.6(c)(3)(iii)	8) Draft an Action Plan	
4) Implement the Plan and Monitor Progress		
201.6(c)(5)	9) Adopt the Plan	7: Review and adopt the plan
201.6(c)(4)	10) Implement, Evaluate, and Revise the Plan	8: Keep the plan current
		9: Create a safe and resilient community - 44 CFR 201.6(c)(4)

3.4.1 Phase 1 Organize the Resource

Step 1: Organize the Planning Effort

This section describes the planning process used during the 2020 update. The original planning process effort is well documented and can be referenced in the 2015 plan. The City of Albuquerque Emergency Manager took the lead on coordinating and reconvening the HMPC, identifying the key county, municipal, and other local government and initial stakeholder representatives. An email invitation was sent to them with a request to participate as a member of the HMPC and to attend a kickoff meeting. Representatives from the following City, County, municipal departments and special districts participated on the HMPC and the update of the plan. A complete list of participants and their titles can be found in Appendix A.

City of Albuquerque

- Office of Emergency Management
- Planning
  - AGIS Division
  - Building Safety Division
- Fire Rescue
- Economic Development
- Parks & Recreation
- Cultural Services
- Police
- Risk Management
- Animal Welfare
- Municipal Development
- Transit

Bernalillo County

- Office of Emergency Management
- Public Works
- Planning and Development Services
- Sheriff
- Fire Rescue
- Public Works/Technical Services
- Health Protection
- Fleet and Facilities
- GIS

Village of Los Ranchos de Albuquerque

- Mayor's Office
- Office of Emergency Management
- Public Facilities
- Planning & Zoning

Village of Tijeras

- Fire
- Clerk's Office

Albuquerque Metropolitan Arroyo Flood Control Authority (AMFACA)

- GIS Manager
- Development Review Engineer
- Field Engineer

Middle Rio Grande Conservancy District

- Chief Executive Office
- Planner

Albuquerque/Bernalillo County Water Authority

- Risk Manager
- Safety Manager

The City of Albuquerque Office of Emergency Management emailed letters of invitation to each meeting to county, municipal, district, state, and other stakeholder representatives. This list is included in Appendix B. Stakeholder participation was significant during the 2020 update; stakeholders are listed in subsection Step 3: Coordinate with Other Departments and Agencies.

A Hazard Mitigation Planning Committee (HMPC) was created including representatives from each participating jurisdiction, County and municipal departments, and other local, state, and federal organizations responsible for making decisions in the plan and agreeing upon the final contents. Kickoff meeting attendees discussed potential participants and made decisions about additional stakeholders to invite to participate on the HMPC.

The HMPC contributed to this planning process by:

- Providing facilities for meetings,
- Attending meetings,
- Collecting data,
- Managing administrative details,
- Making decisions on plan process and content,
- Submitting mitigation action implementation worksheets,
- Reviewing and editing drafts, and
- Coordinating and assisting with public involvement and plan adoptions.

During the plan update process, the HMPC communicated with a combination of online webinars, phone interviews, and email correspondence. Three planning meetings with the HMPC was held during the plan's development between July 2020 and October 2020. The meeting schedule and topics are listed in the following table; all 10 planning process steps were covered in these four meetings. All meetings were held virtually as webinars due to social distancing requirements associated with the ongoing COVID-19 pandemic. The sign-in sheets and agendas for each of the meetings are included in Appendix B.

Table 3-3 Schedule of HMPC Meetings

Meeting	Topic	Date
Kickoff Meeting	• Introduction to DMA and the planning process. Identification of hazards impacting Albuquerque/Bernalillo County. • Organize resources: the role of the planning team, planning for public involvement, and coordinating with other agencies and stakeholders.	July 22, 2020
HMPC #2	• Review online survey and other public involvement strategies. • Review/discussion of Risk Assessment (Assess the Hazard) • Review/discussion of Vulnerability Assessment (Assess the Problem) • Discuss/update mitigation goals • Solicit comments and feedback from the Planning Team	September 22, 2020

Meeting	Topic	Date
HMPC #3	• Review/discussion of Risk and Vulnerability Assessment • Discuss/develop mitigation strategies • Review Draft Plan • Update maintenance and implementation procedures • Solicit comments and feedback from the Planning Team	October 20, 2020

HMPC Meeting #1 – Kickoff Webinar

During the kickoff webinar, Wood presented information on the scope and purpose of the plan update, participation requirements of HMPC, and the proposed project work plan and schedule. Fifty-two participants attended the kickoff webinar. Plans for public involvement (Step 2) and coordination with other agencies and departments (Step 3) were discussed. Wood also introduced the hazard identification requirements and data. The HMPC discussed past events and impacts and future probability for each of the hazards required by FEMA for consideration in a local hazard mitigation plan. Each jurisdiction provided updates through a data collection workbook created by Wood and mitigation action trackers or provided information directly to Wood for incorporation into the plan update.

HMPC Meeting #2 – Risk Assessment Update

On September 22, 2020, the HMPC convened virtually to review and discuss the results of the risk and vulnerability assessment update. Twenty-seven members of the Planning Team and stakeholders were present for the discussion. Wood presented preliminary risk assessment results for natural and human-caused hazards. The group went through each hazard together and discussed the results as well as shared any local insight to inform the HIRA update. The Planning Team discussed the addition of including human-caused hazards to the Hazard Mitigation Plan, a new addition to the 2020 planning process. A survey was developed by Wood and shared with the Planning Team after the meeting, that asked the members to rank each hazard for their jurisdiction and asked to rank the human-caused hazards that should be included in the plan update. The survey also asked the Planning Team to review the 2015 mitigation goals and determine if they were still valid, comprehensive, and reflect current priorities and updated risk assessments. The Planning Team made several revisions, to include adding a goal specifically addressing the importance of life-safety and expanding the existing goals to include human-caused hazards. Revisions to the goals can be found in Chapter 6 Mitigation Strategy. Refer to the meeting summary in Appendix B for notes related to each hazard discussed and results from the post meeting survey.

HMPC Meeting #3 – Mitigation Strategy

The Planning Team convened virtually on October 20, 2020 with 29 people participating to discuss updating the mitigation action plan from 2015 and finalize the goals and objectives for this planning process. The group reviewed the public survey results and noted the differences between hazard ratings for the jurisdictions and the public's perception of risks to the various hazards. The human-caused hazards discussed in the second meeting were revisited and the group reached a consensus on which human-caused hazards to include in the 2020 plan update. The group discussed the criteria for mitigation action selection and prioritization using a worksheet provided by Wood (refer to Appendix B). The meeting ended with a review of the next steps and planning process schedule. Wood provided the Planning Team with a link to an online form to submit new mitigation actions. During the Planning Team review of the full plan, each member was provided a handout on prioritizing new mitigation actions and asked to focus on prioritizing each new mitigation action for their jurisdiction.

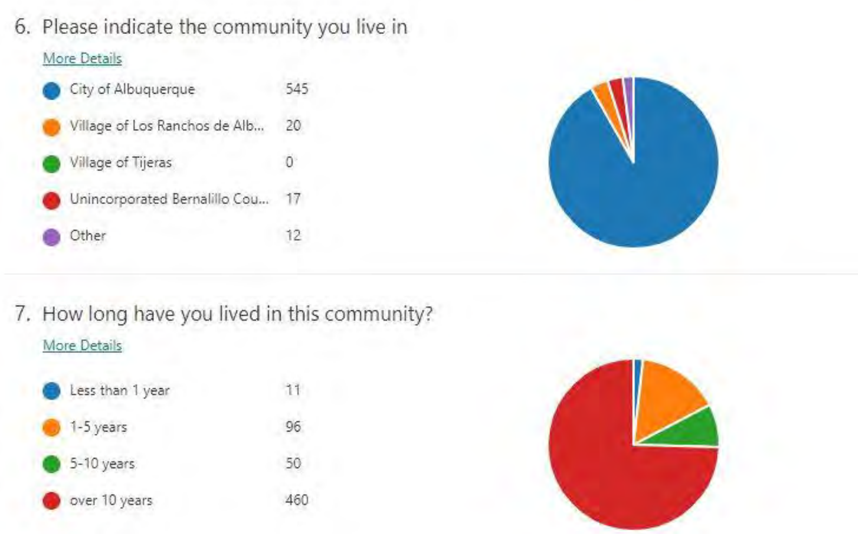
Step 2: Involve the Public

At the kickoff meeting, the HMPC discussed options for soliciting public input on the mitigation plan and developed an outreach strategy by consensus. The fact that the process was conducted during the COVID-19 pandemic, with attendant restrictions on public gatherings, made it difficult to use many traditional outreach methods such as in-person public gatherings or discussion at other forums. The Planning Team adapted by leveraging virtual meetings and other online messaging, which in many cases resulted in greater public attendance and involvement than more traditional face-to-face meetings.

Online Public Survey

During the plan update's initial drafting stage, an online public survey was used to gather public input to the Planning Team. The survey, created in both English and Spanish, provided an opportunity for public input during the planning process, prior to finalization of the plan update. The survey gathered public feedback on concerns about hazards and input on mitigation strategies to reduce their impacts. The survey was released on August 3, 2020 and closed on September 30, 2020. The Planning Team provided links to the public survey by distributing it using social media, email, and posting the link on websites.

Figure 3-1 Sample of Public Survey Responses



Six hundred and twenty-nine people filled out the survey online (624 English responses and 5 Spanish responses). Results showed that the public perceives the most significant hazards to be wildfire, spring/summer storm, winter storm and flood. Question 4 of the survey asked the public's opinion on what mitigation actions that should have the highest priority in the updated hazard mitigation plan; wildfire fuels treatment projects, water conservation, improve reliability of communication systems, generators for critical facilities, forest health/watershed protection, critical facilities protection, and public education and awareness were cited as the most popular mitigation actions. This information was shared with the Planning Team during the update of the mitigation strategy to consider when evaluating hazard rankings and as a source of potential mitigation ideas. A summary of all the survey data and documentation of the public feedback can be found in Appendix B.

Public Workshop

In addition to the online survey, a public workshop was held during the planning process to inform the public and receive input on hazards and the planning process. The public workshop was held virtually due to social distancing requirements associated with the ongoing COVID-19 pandemic.

The public workshop was held on November 19, 2020 through Zoom. The intent of the first was to introduce the public to the hazard mitigation planning process for the Albuquerque/Bernalillo County's Plan Update as well as answer any questions and gather public input to be integrated into the plan update. In addition, it was an opportunity to help staff identify risks, hazards and vulnerabilities from the public's perspective. In total thirteen individuals participated in the virtual workshop. Members of the public were able to submit comments verbally or via the chat function, however no public comments were submitted. A recording of the meeting was subsequently posted on the City of Albuquerque's YouTube channel, where it has been viewed an additional 30 times as of January 1, 2021.

Public Review Period

The public was also given an opportunity to provide input on a draft of the complete plan prior to its submittal to the State and FEMA. The plan draft was provided for review and comment on the City and County websites from xx to xx, 2020. (Due to the ongoing COVID-19 pandemic, hard copy plans were not made available for comment.) The jurisdictions announced the availability of the draft plan and the public comment period through social and traditional media announcements. Copies of these notices are provided in Appendix B. An online form to collect comments was posted with the plan, and is also included in Appendix B. The Planning Team received ___ comments from the public that helped to inform the Planning Team on the public's perception of hazard mitigation and hazards in their community.

Step 3: Coordinate with Other Departments and Agencies

There are numerous organizations whose goals and interests' interface with hazard mitigation in Albuquerque and Bernalillo County. Coordination with these organizations and other community planning efforts is vital to the success of this plan update. The City of Albuquerque Office of Emergency Management invited other local, state, and federal agencies to the kickoff meeting to learn about and participate in the hazard mitigation planning initiative. Many of the agencies participated throughout the planning process in meetings described in Step 1: Organize the Planning Effort. In addition, the HMPC developed a list of neighboring communities and local and regional agencies involved in hazard mitigation activities, as well as other interested parties to keep informed on the plan update process.

Stakeholders included local and regional agencies involved in hazard mitigation activities and those with the authority to regulate development. The neighboring counties of Santa Fe, Sandoval, Torrance, Valencia, and Cibola Counties were also invited to participate, either by attending meetings or reviewing draft documents. Stakeholders could participate in various ways, either by contributing input at Planning Team meetings, being aware of planning activities through an email group, providing information to support the effort, or reviewing and commenting on the draft plan. Representatives from the following agencies and organizations were invited to participate as stakeholders in the process; an asterisk indicates they attended Planning Team meetings.

Other Government and Stakeholder Representatives

- Edgewood Soil & Water Conservation District*
- State of New Mexico – Office of the State Engineer/Dam Safety*
- NOAA/NWS*
- State of New Mexico Department of Homeland Security and Emergency Management*
- U.S. Army Corps of Engineers
- Mid-Region Council of Governments

Incorporation of Existing Plans and Other Information

Coordination and synchronization with other community planning mechanisms and efforts is vital to the success of mitigation planning. To have a thorough evaluation of hazard mitigation practices already in place, appropriate planning procedures should also identify and review existing plans, policies, regulations, codes, tools, and other actions that help to reduce a community's risk and vulnerability from hazards. The participating jurisdictions use a variety of mechanisms to guide growth and development. Integrating existing planning efforts, mitigation policies, and action strategies into this plan establishes a credible, comprehensive document that weaves the common threads of a community's values together. The development and update of this plan involved a comprehensive review of existing jurisdiction plans, studies, reports, and initiatives related to hazards or hazard mitigation. A high-level summary of the key plans, studies and reports is summarized in the table below. Information on how they informed the update are noted and incorporated where applicable.

Table 3-4 Summary of Review of Key Plans, Studies and Reports

Plan, Study, Report Name	How Plan Informed HMP Update
Albuquerque/Bernalillo County Hazard Mitigation Plan (2015)	Provided background information on the County including some information related to jurisdictions. Informed the Community Profile in Chapter 2 and Chapter 4 Risk Assessment.
Albuquerque/Bernalillo County Comprehensive Plan (2017)	Provided background information on the County and the City of Albuquerque. Informed the Community Profile in Chapter 2 and the Asset Summary in Chapter 4.
State of New Mexico Hazard Mitigation Plan (2018)	Informed the HIRA (Chapter 4) with risk information specific to Bernalillo County and hazard profile information for each of the hazards. Used as a reference in the development and review of mitigation goals.
Bernalillo County Flood Insurance Study (2016)	Reviewed for information on past floods and flood problems and flood depths to inform risk assessment (Chapter 4)
Los Ranchos 2035 Master Plan and Appendix	Each plan and planning process informs the other reflecting community priorities. This iterative process has been used on each subsequent plan dating back to the year 2000.
East Mountain Community Wildfire Protection Plan (CWPP) (2015)	Evaluated for wildfire risk assessment background information, including wildfire hazard mapping and rating, and mitigation project ideas.
2020 New Mexico Forest Action Plan	Provided information on wildfire hazard including, statewide wildfire history, post-wildfire hazards, and potential impacts of climate change
AMAFCA 2020 Project Schedule	Informed the Community Profile section. Provided an understanding of planned and ongoing projects scheduled for AMAFCA.
Stormwater Management Program (SWMP) for AMAFCA (2020)	Provided background information to the Community Profile section. Informed flood section in the risk assessment.
Middle Rio Grande Bosque CWPP – Appendix A Base Maps (2007)	Informed the wildfire risk and vulnerability assessment in Chapter 4 Risk Assessment.
Resolution 2020-11 AMAFCA Drainage Policy	Informed the Capability Assessment, providing and understanding of existing policies in place for the district as they relate to hazards.
East Mountain Area Plan (2006)	Provided background information on the East Mountain area and the Village of Tijeras.
Final Risk Assessment Report for Albuquerque Bernalillo County Water Utility Authority	Informed the risk assessment for ABCWUA assets.
Upper Tijeras Creek Watershed-Based Plan (2020 Draft)	Informed the flood risk assessment for the East Mountain area and the Village of Tijeras.

Other technical data, reports and studies were reviewed and considered during the collection of data to support Planning Steps 4 and 5, which included the hazard identification, vulnerability assessment, and capability assessment. Information from the following agencies and groups were reviewed in the development and update of this plan. Specific references relied on in the development of this plan are also sourced throughout the document as appropriate and can be found in Appendix x References.

3.4.2 Phase 2 Assess Risk

Step 4: Identify the Hazards

Wood led the HMPC in a review of the hazards identified in the 2015 plan and discussed other hazards that have impacted or could impact the planning area, to include documenting recent events. The HMPC refined the list of hazards to make it more relevant to the planning area. The profile of each of these hazards was then developed and updated in 2020 with information from the HMPC and additional sources. Web resources, existing reports and plans, and existing GIS layers were used to compile information about past hazard events and determine the location, previous occurrences, probability of future occurrences, and magnitude/severity of each hazard. Information on the methodology and resources used to identify and profile hazards is provided in Chapter 4.

Step 5: Assess the Risks

After profiling the hazards that could affect the planning area, the HMPC collected information to describe the likely impacts of future hazard events on the participating jurisdictions. This step included two parts: a vulnerability assessment and a capability assessment.

Vulnerability Assessment—Participating jurisdictions inventoried their assets at risk to natural and human-caused hazards—overall and in the identified hazard areas. These assets included total number and value of structures; critical facilities and infrastructure; natural, historic, and cultural assets; and economic assets. The HMPC also analyzed development trends in hazard areas. The County's Digital Flood Insurance Rate Map (DFIRM) was used to refine the estimated flood losses during the update, where available for the NFIP participating communities.

Capability Assessment—This assessment consisted of identifying the existing mitigation capabilities of participating jurisdictions. This involved collecting information about existing government programs, policies, regulations, ordinances, and plans that mitigate or could be used to mitigate risk to disasters. Participating jurisdictions collected information on their regulatory, administrative, fiscal, and technical capabilities, as well as ongoing initiatives related to interagency coordination and public outreach. Refer to Chapter 5 Capability Assessment for the results of the existing capabilities as well as the jurisdictions' identified opportunities for enhancing capabilities.

A more detailed description of the risk assessment process and the results is included in Chapter 4 Risk Assessment.

3.4.3 Phase 3 Develop the Mitigation Plan

Step 6: Set Goals

Wood facilitated a brainstorming and discussion session with the Planning Team during their second meeting to review and update the goals for the overall hazard mitigation plan update. The Planning Team discussed definitions and examples of goals, objectives, and actions and considered the goals of the state hazard mitigation plan and other relevant local plans when forming their own goals and objectives. The Planning Team were provided a survey after the meeting to review the goals more closely and provide recommendations on revisions. The Team determined that the goals should be revised to include adding a goal specifically addressing the importance of life-safety and expanding the existing goals to include human-caused hazards. The group discussed the ideas and came to consensus on the final goals for the multi-jurisdictional plan update, which are further discussed in Chapter 6.

Step 7: Review the Possible Activities

The Planning Team identified mitigation actions at their third meeting. The group was presented with six different categories of mitigation actions and example actions for each identified hazard. Planning Team members were encouraged to brainstorm actions to address the plan's goals. The Planning Team then reviewed potential mitigation alternatives and identified new actions by hazard and jurisdiction to ensure that all the plan's hazards were addressed, and that all participating jurisdictions had at least one new mitigation action.

The Planning Team discussed criteria for narrowing down and prioritizing the identified actions. The group approved the STAPLEE criteria, which assesses the Social, Technical, Administrative, Political, Legal, Economic, and Environmental implications of each action. Each member used these criteria to determine their highest priority projects. Projects were then sorted into high, medium, or low priority based upon the feedback received from each Planning Team member. This process is described in more detail in Chapter 6 Mitigation Strategy.

Each participating jurisdiction was responsible for submitting at least one new mitigation action specific to their jurisdiction, in addition to providing input on the progress made on actions identified in the 2015 Plan.

Step 8: Draft the Plan

The first complete draft of the updated Plan was developed and submitted to the Planning Team for review in November 2020. Once the Planning Team's comments were incorporated, a complete draft of the plan was made available for review and comment by the public and other agencies and interested stakeholders, as discussed above under Step 2 Involve the Public. This review period was from x xx – x, xx. Methods for inviting interested parties and the public to review and comment on the plan were discussed in Steps 2 and 3, and materials are provided in Appendix B.

Step 9: Adopt the Plan

To secure buy-in and officially implement the plan, the governing bodies of each participating jurisdiction adopted the plan. Scanned copies of resolutions of adoption are included in Appendix C Adoption Resolutions.

Step 10: Implement, Evaluate, and Revise the Plan

The true worth of any mitigation plan is in the effectiveness of its implementation. Up to this point in the plan update process, all of the HMPC's efforts have been directed at researching data, coordinating input from participating entities, and updating and developing appropriate mitigation actions. Each recommended action includes key descriptors, such as hazard(s) addressed, lead manager and priority, to help initiate implementation. An overall implementation strategy is described in Chapter 7 Plan Implementation and Monitoring, which also addresses how the previous plan was implemented and evaluated.

Finally, there are numerous organizations within the planning area whose goals and interests' interface with hazard mitigation. Coordination with these other planning efforts, as addressed in Planning Step 3, is paramount to the ongoing success of this plan and of mitigation in Albuquerque/Bernalillo County and is addressed further in Chapter 7. A plan update and maintenance schedule and a strategy for continued public involvement are also included in Chapter 7.

4 Hazard Identification and Risk Assessment

DMA Requirement §201.6(c)(2):
[The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

This section describes the Hazard Identification and Risk Assessment undertaken by the participating jurisdictions and special districts. The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction's potential risk to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This risk assessment builds upon the methodology described in the 2013 FEMA Local Mitigation Planning Handbook, which recommends a four-step process for conducting a risk assessment:

1. Describe Hazards
2. Identify Community Assets
3. Analyze Risks
4. Summarize Vulnerability

A key step in preventing disaster losses is developing a comprehensive understanding of the hazards that pose risks to its communities. The following terms facilitate comparisons between communities and can be found throughout the Plan.

- Hazard: Event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, other types of harm or loss
- Risk: Product of a hazard's likelihood of occurrence and its consequences to society; the estimated impact that a hazard would have on people, services, facilities, and structures in a community
- Vulnerability: Degree of susceptibility to physical injury, harm, damage, or economic loss; depends on an asset's construction, contents, and economic value of its functions

In essence, the risk assessment evaluates potential loss from hazards by assessing the vulnerability of the planning area's population, built environment, critical facilities, and other assets. Environmental and social impacts are also taken into consideration wherever possible. Data collected through this process has been incorporated into the following subsections:

4.1: Hazard Identification – Identifies the hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.

4.2: Asset Summary – Describes the methodology for inventorying assets as the basis for determining vulnerability of the planning area to the identified hazards.

4.3 to 4.14: Hazard Profiles – Discusses the threat to the planning area and describes previous occurrences of hazard events and the likelihood of future occurrences. It also includes a vulnerability assessment considering property, critical facilities, and historic/cultural/natural assets at risk, as well as possible effects to the economy and future development trends.

4.15: Risk Assessment Summary – Summarizes risk assessment information from the 12 hazard profiles.

4.1 Hazard Identification

In 2018, the New Mexico Department of Homeland Security and Emergency Management (DHSEM) updated the State Hazard Mitigation Plan and identified 14 natural hazards which had the greatest impact on the State:

- Dam Failure
- Drought
- Earthquake
- Extreme Heat
- Expansive Soils
- Flood/Flash Floods
- High Wind
- Landslide
- Land Subsidence
- Severe Winter Storms
- Thunderstorms (including Lightning and Hail)
- Tornadoes
- Volcanoes
- Wildland/Wildland-Urban Interface Fire

This Plan uses the State's hazard identification as a basis to analyze the impacts of these 14 natural hazards. The HMPT carefully screened each hazard with the goal of refining the list to reflect the hazards that pose the greatest risk to the jurisdictions represented in this Plan. Twelve natural hazards were selected for inclusion in the 2015 Plan, based on the historical record and expertise of the HMPT members, as having the greatest potential for significant impact on the participating jurisdictions.

A few hazards listed in the State Hazard Mitigation Plan were excluded from additional consideration as they present little to no risk to the planning area. Hazards that were dropped from further profiling and evaluation are:

- ***Volcano*** - Most volcanism that occurred near Bernalillo County took place more than 1 million years ago; the youngest volcanic deposits are tens of thousands of years old. New Mexico's numerous volcanoes are considered dormant, but not extinct. The 2018 State Plan a 1% probability of a volcanic eruption in New Mexico in the next 100 years, and therefore the probability of volcanic eruption is considered Highly Unlikely. Given the very low probability of occurring and the lack of previous occurrences, this hazard was not deemed a significant threat to the planning area and is not addressed further in the Plan.
- ***Expansive Soils*** - Due the low frequency of this hazard and its minor potential impact, it is considered a nuisance and is not addressed in the rest of the Plan.

The planning team reviewed the 12 natural hazards from the 2015 Plan and verified that they are still of the most concern to the planning area. The planning team also reviewed several human-caused hazards for possible inclusion during the 2020 update. After reviewing the potential risks from each of these hazards along with the potential mitigation benefits, the planning team determined the following four hazards pose a significant threat to the planning area:

- Active Threat
- Cyber Threat
- Hazardous Materials
- Pandemic/Public Health

These, along with the 12 natural hazards identified above, are profiled in Sections 4.3 through 4.18 below, including detailed descriptions and analyses.

4.1.1 Major Emergency and Disaster Declarations

Complementing the Hazards Analysis and Risk Assessment Section is a review of the past major disaster declarations that impacted Bernalillo County and the participating jurisdictions. Major disasters are declared by the President of the United States when the magnitude of a disaster event is of such severity and magnitude that effective response is beyond the capabilities of the State and the local governments. In these situations, eligible applicants may apply for a wide range of federal disaster assistance that include funds for public assistance, individual assistance, and hazard mitigation assistance.

From 1954 through 2020, Bernalillo County has received eleven federal declarations, including three emergency declarations (EM), four major disaster declarations (DR), and four fire management declarations (FM). This does not include all state or local emergency declarations issued for localized disaster events that did not warrant a presidential or federal emergency declaration.

Table 4-1 Federal Emergency and Disaster Declarations in Bernalillo County (1954 – 2020)

Event	Declaration Date	Declaration Number
New Mexico Fire	5/10/2000 5/13/2000	FEMA-EM-3154 FEMA-DR-1329
New Mexico Atrisco (Bosque) Fire	6/25/2003	FEMA-FM-2472
Severe Storms and Flooding	4/29/2004	FEMA-DR-1514
Hurricane Katrina Evacuation	9/7/2005	FEMA-EM-3229
Malpais Fire	6/15/2006	FEMA-FM-2644
White Fire	4/3/2011	FEMA-FM-2880
Severe Storms and Flooding	9/30/2013	FEMA-DR-4148
Dog Head Fire	6/16/2016	FEMA-FM_5127
COVID-19 Pandemic	3/13/2020 4/5/2020	FEMA-EM-3460 FEMA-DR-4529

Source: Federal Emergency Management Agency

4.1.2 Climate Change Considerations Summary

Climate includes patterns of temperature, precipitation, humidity, wind, and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. The term climate change refers to changes over a long period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts are likely to include the following:

- Snow cover losses will continue, and declining snowpack will affect snow-dependent water supplies and stream flow levels around the world.
- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase.
- More extreme precipitation is likely, increasing the risk of flooding.
- The world's average temperature is expected to increase.

In 2018, the U.S. Global Change Research Program released the Fourth National Climate Assessment (NCA4), the authoritative and comprehensive report on climate change and its impacts in the United States. Not only does the report confirm that climate change continues to affect Americans in every region of the U.S., but the report also identifies increased heat, drought, insect outbreaks, wildfire, and flooding as key climate-related concerns for the southwest region of the U.S, which includes New Mexico.

Recent warming in the southwest region is among the most rapid in the nation and is significantly greater than the global average; the period from 1950 to 2018 has been hotter than any comparable long period in at least 600 years. Summer temperatures across the state are expected to increase more than winter temperatures and projections suggest that typical summer months will be as warm as or warmer than the hottest 10% of summers that occurred between 1950 and 1999.

Projected increases in temperatures in the southwest region are also projected to increase the probability of natural events such as wildfires, drought, and summer precipitation. These temperature changes have great potential to directly affect public health through increased risk of heat stress. They may also affect infrastructure through increased risk of disruptions of electric power generation. Water supplies are vulnerable to impacts of higher temperatures. While water supplies generally change year-to-year due to variabilities in water use and precipitation, higher temperatures are projected to increase evapotranspiration, reducing the effectiveness of precipitation in replenishing surface water and soil moisture. This will have direct impacts on crop yields and productivity of key regional crops and livestock, representing a major risk for the agricultural industry and food security nationwide.

The impacts of climate change already pose a threat to people and property in the southwest region of the United States, including Bernalillo County. Together, these impacts represent a slow-onset disaster that is likely to manifest and change over time. Current projections predict even more rapid changes in the near future, which are likely to affect many of the natural hazards that Bernalillo County has historically dealt with. This is particularly true for drought, flooding, wildfire, and extreme temperature hazards. The nature of erosion/land subsidence and public health hazards are also likely to evolve in intensity and character due to a changing regional climate. For these reasons, the hazard identification and risk assessment for the 2020 Bernalillo County Hazard Mitigation Plan update takes climate change into consideration when evaluating the frequency, intensity, and distribution of hazards within the County. Because many impacts of climate-related hazards cross county boundaries, some of the discussion looks at impacts on a regional scale. As climate science evolves, future mitigation plan updates may consider including climate change projections in the risk rankings and vulnerability assessments of the hazards included in the Plan.

4.1.3 Methodology

Several sources of data were used to profile, describe, and analyze the hazards.

1. Experience, input and knowledge from the Planning Team as captured in site visits, meetings, and surveys
2. The 2018 New Mexico State Hazard Mitigation Plan
3. The National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Information (NCEI)
4. Studies, data, and reports by the United States Geological Survey (USGS), U.S. Army Corps of Engineers (USACE), and other federal agencies
5. Existing local plans and data
6. Resources published on the Internet with relevant information.

Each hazard profile is organized in the following manner:

- ***Description*** – General overview of the hazard
- ***Past Occurrences*** – List and description of previous recorded events .
- ***Location*** – Specific areas in the planning area that may be affected and the extent.
- ***Magnitude/Severity*** – The range of intensity the planning area is likely to experience.
- ***Climate Change Considerations*** – The known or potential impacts of climate change on the hazard.
- ***Probability of Future Events*** – The likelihood or frequency of the hazard occurring annually
- ***Vulnerability Assessment*** – Quantifies the potential impacts of the hazard on:
  - People (including vulnerable populations)
  - General Property
  - Critical Facilities and Infrastructure
  - Economy
  - Historic, Cultural, and Natural Resources
  - Future Development
- **Jurisdictional Differences** – Describes how the risk varies across the different jurisdictions on the plannign area

- **Risk Summary** – Summarizes the threat, vulnerabilites, and risk of the hazard.

4.1.4 Hazard Rankings

Based on the analysis described above, each jurisdiction ranked each hazard in terms of its geographic area, probability of future occurrence, magnitude/severity, and overall significance. Public concern was also considered via input at public meetings and an online survey. These rankings are summarized in Table 4-2, and detailed by jurisdiction in tables Table 4-3 through Table 4-9.

Table 4-2 Overall Hazard Rankings by Jurisdiction

Hazard	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
Active Threat	Medium	High	Low	Low	Low	Low	Low
Cyber Threat	High	Medium	Low	Low	Low	High	High
Dam Failure	Low	Medium	Medium	Low	High	High	Low
Drought	High	Medium	High	Medium	NA	High	High
Earthquake	Medium	Medium	High	Medium	High	Medium	Medium
Extreme Heat	High	Medium	Medium	Low	NA	Medium	Medium
Flood	Medium	High	High	High	High	High	High
Hazmat Release	Medium	Medium	Low	Low	Low	Low	Low
High Wind	High	High	Medium	Medium	NA	Medium	Medium
Landslide	Medium	Medium	Low	Medium	Medium	Low	Medium
Land Subsidence	Medium	Low	Low	Low	Medium	Low	Low
Pandemic	High	High	Medium	Medium	Medium	High	High
Severe Winter Storm	Medium	Low	High	High	NA	Low	Medium
Thunderstorm	Medium	Medium	Medium	Medium	High	High	Medium
Tornado	Low	Low	Low	Low	NA	Low	Low
Wildfire	High	High	High	High	Low	High	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-3 Bernalillo County Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Likely	Limited	Significant	Medium
Cyber Threat	Likely	Limited	Significant	High
Dam Failure	Unlikely	Limited	Critical	Low
Drought	Highly Likely	Extensive	Significant	High
Earthquake	Unlikely	Extensive	Critical	Medium
Extreme Heat	Likely	Significant	Negligible	High
Flood	Highly Likely	Extensive	Significant	Medium
Hazmat Release	Likely	Significant	Significant	Medium
High Wind	Highly Likely	Extensive	Significant	High
Landslide	Likely	Significant	Significant	Medium
Land Subsidence	Unlikely	Extensive	Negligible	Medium
Pandemic	Occasional	Extensive	Critical	High
Severe Winter Storm	Likely	Significant	Significant	Medium
Thunderstorm	Highly Likely	Significant	Significant	Medium
Tornado	Unlikely	Limited	Significant	Low
Wildfire	Highly Likely	Extensive	Catastrophic	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-4 City of Albuquerque Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Highly Likely	Significant	Critical	High
Cyber Threat	Likely	Limited	Negligible	Medium
Dam Failure	Unlikely	Significant	Critical	Medium
Drought	Likely	Extensive	Critical	Medium
Earthquake	Unlikely	Extensive	Catastrophic	Medium
Extreme Heat	Likely	Extensive	Negligible	Medium
Flood	Occasional	Significant	Significant	High
Hazmat Release	Likely	Limited	Significant	Medium
High Wind	Highly Likely	Significant	Significant	High
Landslide	Occasional	Limited	Significant	Medium
Land Subsidence	Unlikely	Limited	Negligible	Low
Pandemic	Occasional	Extensive	Critical	High
Severe Winter Storm	Likely	Limited	Negligible	Low
Thunderstorm	Highly Likely	Extensive	Negligible	Medium
Tornado	Unlikely	Limited	Critical	Low
Wildfire	Highly Likely	Significant	Significant	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-5 Village of Los Ranchos de Albuquerque Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Occasional	Limited	Significant	Low
Cyber Threat	Occasional	Limited	Negligible	Low
Dam Failure	Unlikely	Significant	Critical	Medium
Drought	Likely	Extensive	Significant	High
Earthquake	Unlikely	Extensive	Catastrophic	High
Extreme Heat	Likely	Significant	Negligible	Medium
Flood	Highly Likely	Extensive	Critical	High
Hazmat Release	Occasional	Limited	Significant	Low
High Wind	Highly Likely	Extensive	Significant	Medium
Landslide	Unlikely	Limited	Negligible	Low
Land Subsidence	Unlikely	Extensive	Negligible	Low
Pandemic	Occasional	Extensive	Significant	Medium
Severe Winter Storm	Likely	Extensive	Critical	High
Thunderstorm	Highly Likely	Significant	Significant	Medium
Tornado	Unlikely	Limited	Significant	Low
Wildfire	Highly Likely	Significant	Catastrophic	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-6 Village of Tijeras Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Occasional	Limited	Significant	Low
Cyber Threat	Occasional	Limited	Negligible	Low
Dam Failure	Unlikely	Limited	Critical	Low
Drought	Likely	Extensive	Negligible	Medium
Earthquake	Unlikely	Significant	Critical	Medium
Extreme Heat	Occasional	Significant	Negligible	Low
Flood	Highly Likely	Significant	Critical	High
Hazmat Release	Occasional	Limited	Significant	Low
High Wind	Highly Likely	Extensive	Significant	Medium
Landslide	Likely	Significant	Critical	Medium
Land Subsidence	Unlikely	Significant	Negligible	Low
Pandemic	Occasional	Extensive	Significant	Medium
Severe Winter Storm	Likely	Extensive	Critical	High
Thunderstorm	Highly Likely	Significant	Significant	Medium
Tornado	Unlikely	Significant	Significant	Low
Wildfire	Highly Likely	Extensive	Catastrophic	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-7 AMAFCA Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Occasional	Limited	Negligible	Low
Cyber Threat	Occasional	Significant	Significant	Low
Dam Failure	Unlikely	Significant	Catastrophic	High
Drought	NA	NA	NA	NA
Earthquake	Unlikely	Extensive	Catastrophic	High
Extreme Heat	NA	NA	NA	NA
Flood	Highly Likely	Extensive	Critical	High
Hazmat Release	Occasional	Limited	Negligible	Low
High Wind	NA	NA	NA	NA
Landslide	Unlikely	Limited	Critical	Medium
Land Subsidence	Unlikely	Limited	Critical	Medium
Pandemic	Occasional	Extensive	Critical	Medium
Severe Winter Storm	NA	NA	NA	NA
Thunderstorm	Highly Likely	Extensive	Critical	High
Tornado	NA	NA	NA	NA
Wildfire	Occasional	Limited	Negligible	Low

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-8 MRGCD Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Occasional	Limited	Significant	Low
Cyber Threat	Likely	Limited	Significant	High
Dam Failure	Unlikely	Extensive	Critical	High
Drought	Likely	Extensive	Significant	High
Earthquake	Unlikely	Extensive	Critical	Medium
Extreme Heat	Occasional	Significant	Significant	Medium
Flood	Highly Likely	Significant	Significant	High
Hazmat Release	Occasional	Limited	Significant	Low
High Wind	Highly Likely	Extensive	Significant	Medium
Landslide	Unlikely	Limited	Negligible	Low
Land Subsidence	Unlikely	Limited	Negligible	Low
Pandemic	Occasional	Extensive	Critical	High
Severe Winter Storm	Likely	Significant	Negligible	Low
Thunderstorm	Highly Likely	Extensive	Critical	High
Tornado	Unlikely	Limited	Significant	Low
Wildfire	Highly Likely	Extensive	Catastrophic	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Table 4-9 ABCWUA Hazard Rankings

Hazard	Frequency	Spatial Extent	Severity	Overall Significance
Active Threat	Occasional	Limited	Significant	Low
Cyber Threat	Likely	Limited	Significant	High
Dam Failure	Unlikely	Limited	Critical	Low
Drought	Likely	Extensive	Significant	High
Earthquake	Unlikely	Extensive	Critical	Medium
Extreme Heat	Occasional	Significant	Negligible	Medium
Flood	Highly Likely	Extensive	Critical	High
Hazmat Release	Occasional	Limited	Significant	Low
High Wind	Highly Likely	Extensive	Significant	Medium
Landslide	Unlikely	Limited	Significant	Medium
Land Subsidence	Unlikely	Limited	Negligible	Low
Pandemic	Occasional	Extensive	Critical	High
Severe Winter Storm	Likely	Significant	Negligible	Medium
Thunderstorm	Highly Likely	Significant	Significant	Medium
Tornado	Unlikely	Limited	Significant	Low
Wildfire	Highly Likely	Significant	Significant	High

Frequency of Occurrence:
Highly Likely: Near 100% probability in next year.
Likely: Between 10 and 100% probability in next year or at least one chance in ten years.
Occasional: Between 1 and 10% probability in next year or at least one chance in next 100 years.
Unlikely: Less than 1% probability in next 100 years.

Spatial Extent:
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Potential Severity:
Catastrophic: Multiple deaths, complete shutdown of facilities for 30 days or more, more than 50% of property is severely damaged
Critical: Multiple severe injuries, complete shutdown of facilities for at least 2 weeks, more than 25% of property is severely damaged
Significant: Some injuries, complete shutdown of critical facilities for more than one week, more than 10 percent of property is severely damaged
Negligible: Minor injuries, minimal quality-of-life impact, shutdown of critical facilities and services for 24 hours or less, less than 10 percent of property is severely damaged.

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

4.2 Asset Summary

This vulnerability assessment attempts to quantify assets at risk to further define populations, properties, and critical facilities at risk to hazards identified in this plan. The methods of analysis vary by hazard type and data available. Data to support the vulnerability assessment was collected and compiled from a variety of sources:

- GIS data (spatial data such as hazard threats, base layers like hydrology, boundaries, roads, etc. assessor's data),
- Written descriptions of inventory and risks provided by participating jurisdictions and the Planning Team,
- Existing plans, studies, and reports with relevant information,
- Information provided by Planning Team members.

This section assesses the population, structures, critical facilities and infrastructure, and other important assets in the planning area as an initial consideration of risk to hazards identified in this plan. It begins with an inventory of people and buildings (total exposure) in the planning area to provide a baseline for evaluating vulnerability by hazard. For purposes of this plan, parcel and critical infrastructure for Kirtland Air Force Base and tribal lands were excluded from analysis.

4.2.1 People

Population estimates were calculated for hazards with a geospatial component and for which data was available for GIS-based parcel analysis. These were based on dividing the total Census population estimates from the 2018 American Community Survey by the total number of residential parcels to get an average number of people per parcel for each jurisdiction. Average population per residential parcel was calculated as 3.23 for Albuquerque, 3.14 for Los Rancho, 3.41 for Tijeras, and 3.53 for unincorporated Bernalillo County. This value was then multiplied by the number of residential parcels that overlap with a hazard layer to get an estimate of the population exposed to that hazard. For more details on economic assets, development trends, and other population and demographic information refer to Chapter 2 Community Profile.

4.2.2 General Property

General property exposure to hazards is based on a combination of parcel layers from the City of Albuquerque and Bernalillo County. The containing data consisted of assessor information such as total number of parcels and improvement values for commercial, residential, and vacant land parcel types by jurisdiction found in Section 4.2. Note that only those parcels with improvements (values greater than $0) were used for analysis. Non-developed or non-improved parcels were excluded for the purposes of conducting the vulnerability assessment.

Counts and values are based on the latest county assessor's data (as of August 3, 2020) and building footprints which were provided in GIS by Albuquerque and Bernalillo County Assessor's offices. Content values were estimated as a percent of the improvement value based on parcel type: 50% of the improvement value for residential structures, and 100% for commercial and vacant parcels. These percentage calculations are based on standard FEMA HAZUS methodologies. Finally, Table 4-10 shows the total number of buildings, property types and their improvement and content values by jurisdiction.

Table 4-10 Improved Parcel Exposure Values by Jurisdiction

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Albuquerque	Commercial	10,697	15,512	$7,819,394,465	$7,819,394,465	$15,638,788,930
	Residential	172,905	189,022	$26,866,422,807	$13,433,211,404	$40,299,634,211
	Vacant	1,277	1,407	$111,046,726	$111,046,726	$222,093,452
	Total	**184,879**	**205,941**	**$34,796,863,998**	**$21,363,652,595**	**$56,160,516,593**
Los Ranchos	Commercial	156	294	$76,314,517	$76,314,517	$152,629,034
	Residential	1,951	2,951	$640,053,103	$320,026,552	$960,079,655
	Vacant	50	56	$451,200	$451,200	$902,400
	Total	**2,157**	**3,301**	**$716,818,820**	**$396,792,269**	**$1,113,611,089**
Tijeras	Commercial	30	48	$11,728,729	$11,728,729	$23,457,458
	Residential	192	269	$22,709,075	$11,354,538	$34,063,613
	Vacant	7	9	$38,600	$38,600	$77,200
	Total	**229**	**326**	**$34,476,404**	**$23,121,867**	**$57,598,271**
Unincorporated	Commercial	1,575	3,191	$990,953,869	$990,953,869	$1,981,907,738
	Residential	31,674	44,692	$5,370,471,479	$2,685,235,740	$8,055,707,219
	Vacant	1,367	1,611	$93,193,350	$93,193,350	$186,386,700
	Total	**34,616**	**49,494**	**$6,454,618,698**	**$3,769,382,959**	**$10,224,001,657**
	Grand Total	**221,881**	**259,062**	**$42,002,777,920**	**$25,552,949,688**	**$67,555,727,608**

Source: Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-11 summarizes the same information as above, but this time by parcel type. The below information indicates that 93% of parcels are residential in nature and 7% are non-residential (Commercial and Vacant). The Total Values of parcels available for assessment is over $67 billion including both improvement values and content values. A total of 221,881 parcels were summed up for this exposure summary.

Table 4-11 Improved Parcel Exposure Values by Parcel Type

Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value
Commercial	12,458	19,045	$8,898,391,580	$8,898,391,580	$17,796,783,160
Residential	206,722	236,934	$32,899,656,464	$16,449,828,232	$49,349,484,696
Vacant	2,701	3,083	$204,729,876	$204,729,876	$409,459,752
Total	**221,881**	**259,062**	**$42,002,777,920**	**$25,552,949,688**	**$67,555,727,608**

Source: Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

For those vulnerability analyses to follow in Section 4.2 Hazard Analysis and Risk Assessment, the total parcels exposed to the hazards available in geospatial format were obtained by overlaying the hazard threat layers with the building footprint layer performing a spatial join to the parcel in GIS to have a complete building count and improved values at risk. The following hazards have vulnerability summaries at the parcel level, due to the availability of hazard data for the geospatial overlay analysis: Flood, Landslide, Land Subsidence, and Wildfire. Earthquake vulnerability also includes damage and loss estimates to general property based on the HAZUS-derived information (see Section 4.3.4 Earthquake for details).

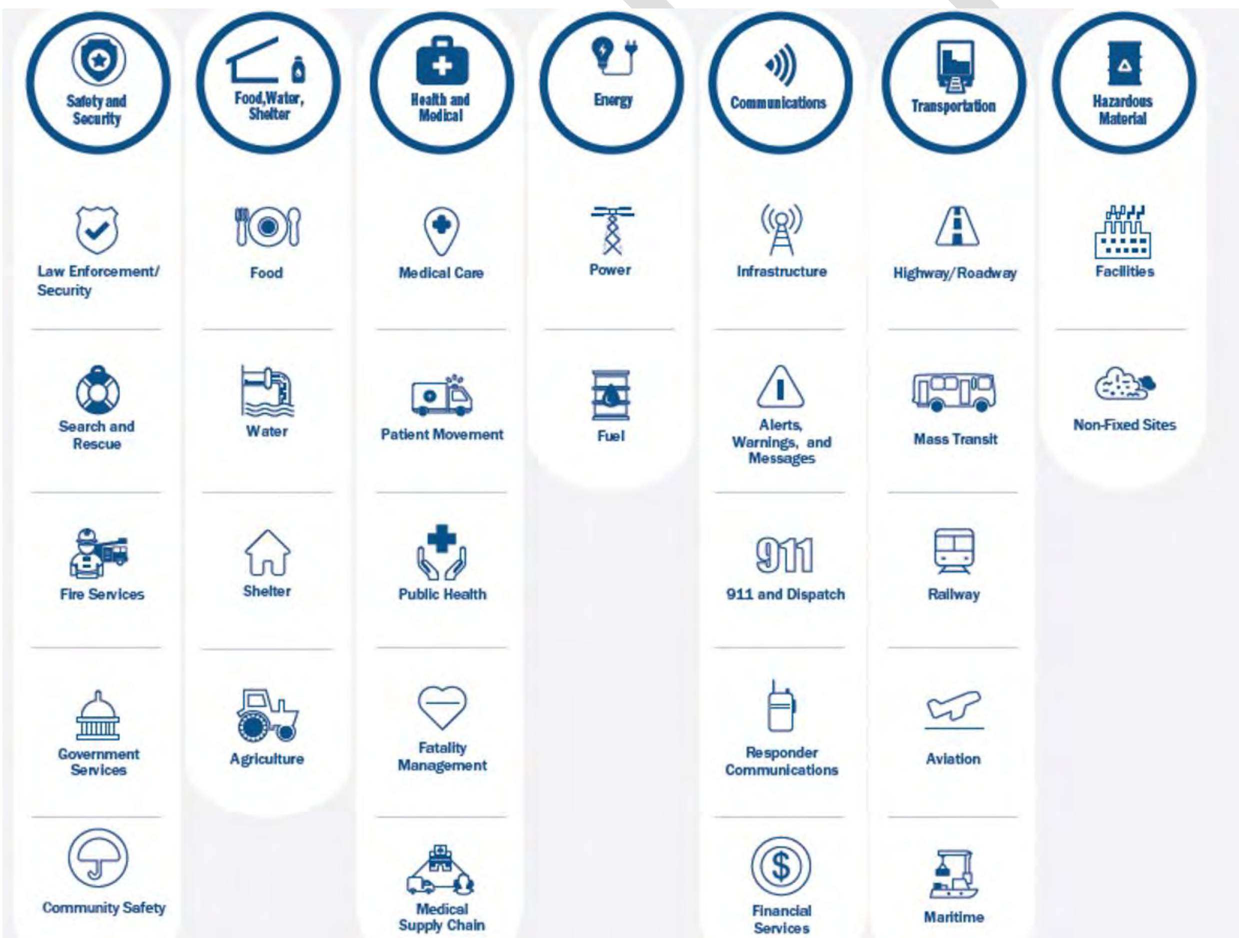
4.2.3 Critical Facilities and Infrastructure

A critical facility may be defined as one that is essential in providing utility or direction either during the response to an emergency or during the recovery operation.

FEMA lifeline categories, shown in Figure 4-1, are the U.S. Department of Homeland Security's recommended way to standardize the classification of critical facilities and infrastructure which provide indispensable service, operation, or function to a community. A lifeline is defined as providing indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security. These categorizations are particularly useful as they:

- Enable effort consolidations between government and other organizations (e.g. infrastructure owners and operators)
- Enable integration of preparedness efforts among plans; easier identification of unmet critical facility needs
- Refine sources and products to enhance awareness, capability gaps, and progress towards stabilization
- Enhance communication amongst critical entities, while enabling complex interdependencies between government assets
- Highlight lifeline related priority areas regarding general operations as well as response efforts.

Figure 4-1 FEMA Community Lifeline Categories



Source: FEMA

Error! Reference source not found. summarizes the inventory of critical facilities by jurisdiction. This data was provided by the City of Albuquerque, Bernalillo County Assessor's Office, NMWRAP, and the

Homeland Infrastructure Foundation-Level Data (HIFLD) database. Table 4-12 breaks down those facilities by jurisdiction and FEMA Lifeline Type. The locations of these facilities are displayed in Figure 4-2.

Specific information on facilities, names, and other key details by participating communities may be accessed by permission of the jurisdiction or infrastructure owner.

Table 4-12 Critical Facilities and Infrastructure by Jurisdiction and FEMA Lifeline

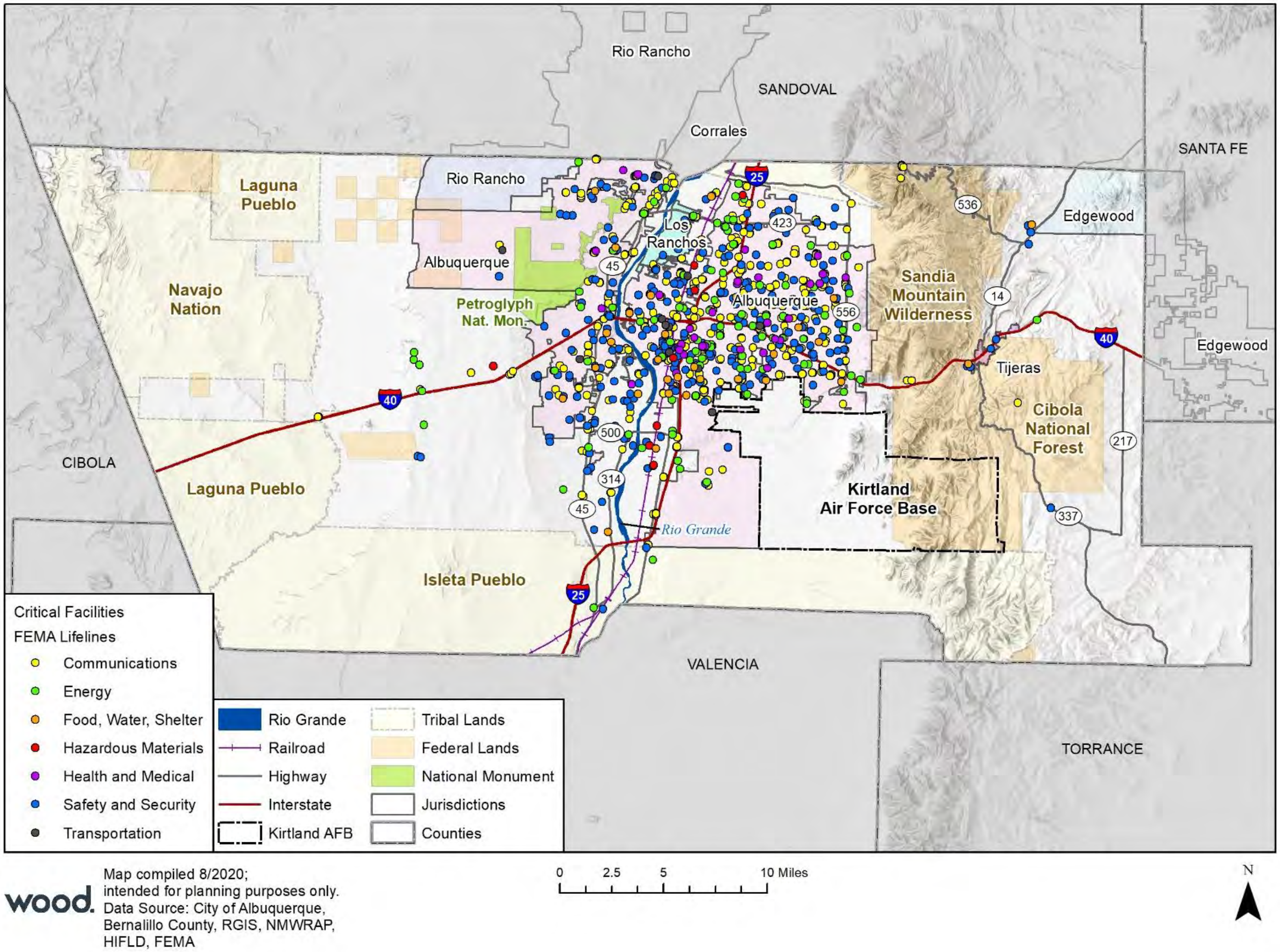
Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	480	75	23	2	34	200	11	**825**
Los Ranchos	6	1				6		**13**
Tijeras						1		**1**
Unincorporated	84	17	7	7	1	48		**164**
Total	**570**	**93**	**30**	**9**	**35**	**255**	**11**	**1,003**

Source: Albuquerque and Bernalillo County Assessor's Office, NMWRAP, HIFLD, Wood analysis.

Additional critical facilities identified by the Village of Tijeras but not reflected in the above analysis include two Safety and Security facilities (Fire Department and Village Hall), one Energy facility (PNM substation), and five Food, Water, and Shelter facilities (three wells, two tanks).

Critical facilities located in areas at risk of hazards are discussed in the Vulnerability Assessment section of each hazard profile.

Figure 4-2 Critical Facilities in Albuquerque and Bernalillo County



4.2.4 Historic, Cultural, and Natural Resources

Assessing the vulnerability of the planning area to disasters also involves inventorying the natural, historic, and cultural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are likely to be impacted by a disaster, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.
- The rules and laws for reconstruction, restoration, rehabilitation, and/or replacement are often specific for these types of designated resources (e.g. under the NEPA and Section 106 of the National Historic Preservation Act).
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.

Historic and Cultural Resources

A historic property not only includes buildings or other types of structures such as bridges and dams but can also refer to prehistoric or Native American sites, roads, byways, historic landscapes, and such other features. Given the history of the region, there are a high number of these types of historic properties in the planning area.

Historic properties and cultural resources are also valuable economic assets that increase property values and attract businesses and tourists, and their preservation is often an important catalyst for economic development. Some key information on historic assets and properties in the planning area was obtained from the National Register of Historic Places (NRHP). The NRHP database is the Nation's official list of cultural resources worthy of preservation, and the NRHP overall is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service (NPS), which is part of the U.S. Department of the Interior. The NRHP database lists 151 resources listed on the National Register located in the County as summarized in Table 4-13.

In addition to the National Register the New Mexico Historic Preservation Division of the Department of

Table 4-13 Historic and Cultural Resources in the National Register of Historic Places

Location	# of Sites
Alameda	1
Albuquerque	143
Albuquerque Mountain	1
Isleta Pueblo	1
Los Ranchos	1
San Antonito	1
Tijeras	3
Total	**151**

Source: NPS NRHP and New Mexico Dept. of Cultural Affairs

Cultural Affairs also maintains the State Register of Cultural Properties, the official list of historic properties worthy of designation in New Mexico. According to the State Register of Cultural Properties database, 106 properties are listed on both the National and State Historic Registers. Of these properties

96 are only listed on the State Register. The complete list of NRHP sites in the planning area can be found in Appendix X.

It should be noted that as defined by the National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, in the event that the property is to be altered or has been altered as the result of a major federal action, the property must be evaluated under the guidelines set forth by NEPA and the NHPA regarding this key age period. In addition, by law under the NHPA, "members of the public have a voice when federal actions will affect properties that qualify for the National Register of Historic Places, the nation's official list of historic properties" (A Citizen's Guide to Section 106 Review, 2016). Structural mitigation projects are considered alterations for the purpose of these NEPA/NHPA regulations, if regarding historical properties and places.

Natural Resources

Natural resources are important to include in benefit-cost analyses for future projects and may be used to leverage additional funding for projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetland areas protects sensitive habitat as well as attenuates and stores floodwaters. The Albuquerque and Bernalillo County 2017 Comprehensive Plan lists the follow the natural and cultural landscapes as important to the community and defining characteristics of the area.

- **Volcano Mesa** – A 3,532 acres-areas surrounded on three sides by the Petroglyph National Monument and Major Public Open Space and small portion of the of the National Monument. From east to west the area extends from the Northwest Mesa escarpment to the City' s Major Open Space surrounding five dormant volcanoes.
- **Arroyos** – Streambeds that are dry most of the time. The arroyos in Albuquerque and Bernalillo County have been historically important cultural asset for Native American communities connecting ceremonial sites to Pueblo villages that were along the Rio Grande. The Boca Negra/Mariposa arroyos make up a 21 square-mile watershed bounded by the Calabacillas Arroyo basin on the north and the San Antonio arroyo basin on the south. Other arroyos east of the Rio Grande including the Bear Canyon form natural corridors through the City of Albuquerque.
- **Sandia Mountains** – One of the most distinctive natural features in the area. Both a natural and cultural asset. The Mountains contain important shrines and area important to the Pueblo beliefs. The City of Albuquerque has overlay regulations to preserve views along corridors of the mountains.
- **Bosque** – The longest forest corridor in a City in the country (Albuquerque/Bernalillo County 2017). Includes the Rio Grande, surrounding cottonwood forest, state park land, trail and natural habitat. The Bosque is a unique natural and cultural landscape that have been inhabited by Pueblo people for thousands of years.
- **Tijeras Arroyo** – Lying east of the Rio Grande and City of Albuquerque, Tijeras Arroyo has historically provided water to land grant communities in the East Mountains and creates a creates a natural corridor through the Village of Tijeras and surrounding communities.

Endangered Species

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (endangered and threatened species) in the planning area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Candidate species are a third category of plants and animals at risk, but these have been proposed as endangered or threatened but are not currently listed.

According to the U.S. Fish and Wildlife Service (USFW) Environmental Conservation Online System (ECOS), there are six federally endangered, threatened, or candidate/proposed/under/other status review species in Bernalillo County (as of November 2020). These are listed in Table 4-14.

Table 4-14 Endangered Species in Bernalillo County

Group	Common Name	Scientific Name	Status
Birds	Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened
Birds	Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered
Birds	Sprague's pipit	*Anthus spragueii*	Resolved Taxon
Birds	Mexican spotted owl	*Strix occidentalis lucida*	Threatened
Fishes	Rio Grande Silvery Minnow	*Hybognathus amarus*	Endangered
Mammals	New Mexico jumping mouse	*Zapus hudsonius luteus*	Endangered

Source: U.S. Fish & Wildlife Service Environmental Conservation Online System

4.3 Active Threat

4.3.1 Description

An active threat can encompass a variety of malicious acts including explosive attacks, conventional firearm attacks, explosives, or even chemical/biological/ radiological/nuclear (CBRN) attacks. Typically, an active threat is a very short-lived incident meant to inflict as many casualties as possible, although recovery from an incident can last days or even months.

The Department of Homeland Security defines an active shooter as "an individual actively engaged in killing or attempted to kill people in a confined and populated area; in most cases, active shooters use firearms(s) and there is no pattern or method to their selection of victims…situations are unpredictable and evolve quickly...and are often over within 10 to 15 minutes." However, the presence or suspected presence of secondary devices can lengthen the duration of the event until the attack site is determined to be clear. Although this definition focuses on an active shooter, the elements remain the same for most active threat situations.

A terrorist attack is an attack by terrorist groups or individuals against civilians. Another term sometimes used for these types of incidents is "violent extremist attacks." These may involve:

- Coordinated tactical assaults by multiple attackers, such as the 2008 attacks on Mumbai, India;
- Sniping attacks from a distance, as with the 2014 Pennsylvania State Police barracks attack;
- Use of explosives, such as the 2013 Boston Marathon bombing;
- Arson, as in the multiple abortion clinic fires in Albuquerque in the 1990s.

While many terrorist attacks can also be described as active threat incidents, the term also includes non-politically motivated incidents such as recent tragic incidents at schools, places of worship, and workplaces; these attacks are also sometimes called mass shootings. Active threats most often use firearms and/or explosives, although vehicle and knife attacks are also common. The motivations for committing such acts range from retribution for a perceived injustice; to acts of violence against racial minorities, LGBTQ persons, or others; to promoting a specific social or political goal. Typically, active shooters are not interested in taking hostages or attaining material gain, and frequently are not even interested in their own survival. Unlike organized terrorist attacks, most active shooter incidents are carried out by one or two individuals.

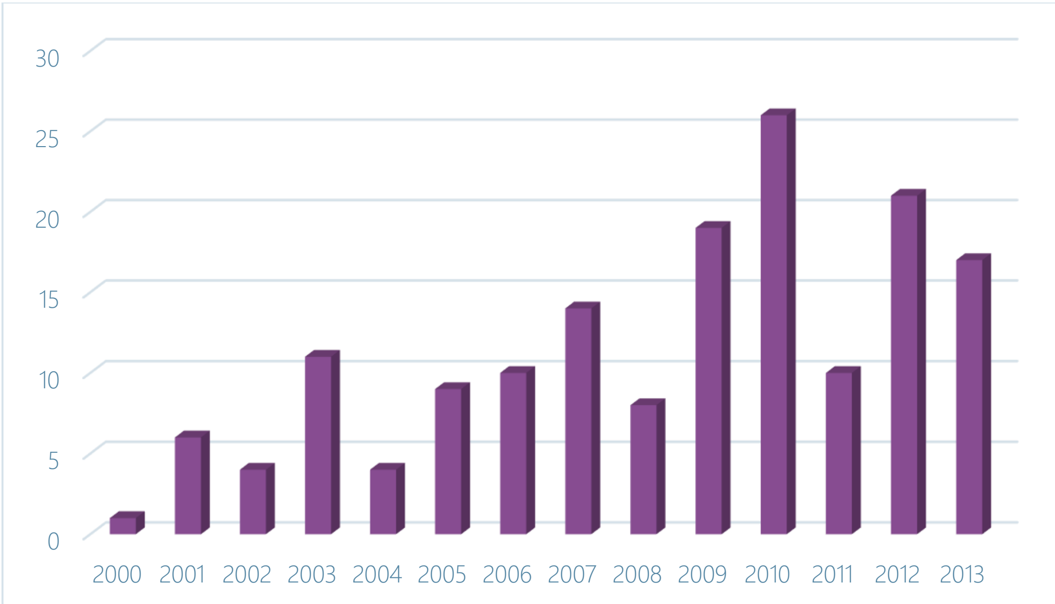
For the purposes of this hazard profile, normal law enforcement incidents such as barricaded suspects, hostage negotiations, high-risk warrant searches, bomb threats, and other criminal activities are not included.

Active threat incidents can happen anywhere and generally take place with little or no warning. Duration is dependent on the parameters of the incident; while the incidents themselves are usually relatively short, residual impacts on the community can be long-lasting.

4.3.2 Past Occurrences

Although there is much uncertainty and debate around exactly what constitutes an active shooter incident, a 2014 FBI study reported that the frequency of attacks has increased sharply in recent years, from an average of 6.4 incidents per year during the period 2000-2007, to 16.4 per year during 2008-2014.

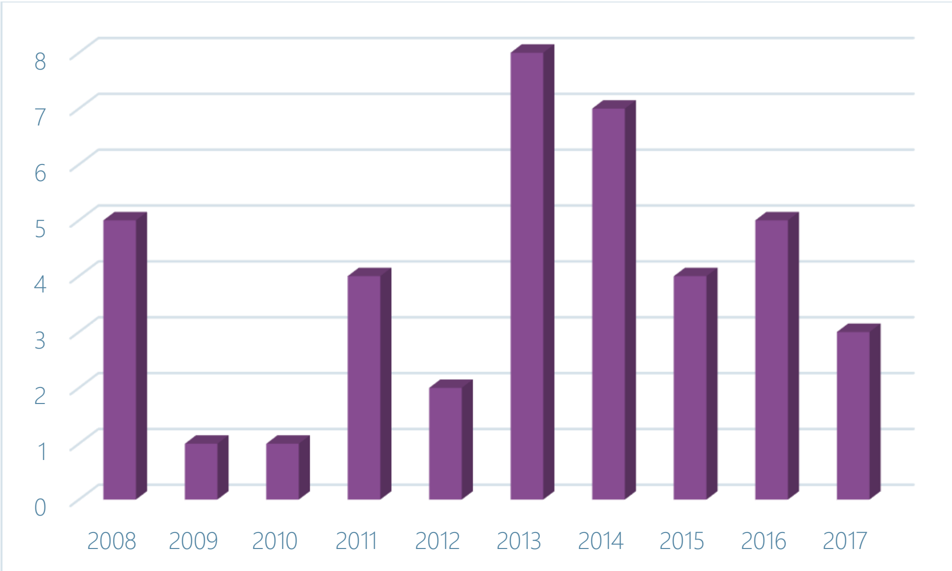
Figure 4-3 Active Shooter Incidents in the U.S. 2000-2013



Source: FBI, A Study of Active Shooter Incidents in the United States Between 2000 and 2013

School violence is sometimes considered as a subset of active shooter incidents (although not all school incidents involve the use of firearms). The U.S. Secret Service conducted a study of incidents of "targeted school violence" in the U.S. from 2008 to 2017, which they defined as "any incident in which (i) a current or recently former K-12 school student (ii) purposefully used a weapon (iii) to cause physical injury to, or the death of, at least one other student and/or school employee (iv) in or on the immediate property of the school (v) while targeting in advance one or more specific and/or random student(s) and/or employee(s)." The study excluded spontaneous incidents that resulted from unplanned fights or were tied to other criminal acts such as gang violence or drug trafficking. The Secret Service study found 41 incidents that met the criteria from 2008 to 2017, an average of 4 per year. As with active shooter incidents, the number of incidents has increased. From 2008 through 2012, the nation saw an average of 2.6 incidents per year; from 2013 through 2017, that number had risen to 5.4 per year. 61% of attacks used firearms, while 39% used knives. In the 41 attacks, 98 victims were harmed, including 79 injured and 19 killed; averaging out to 1.9 persons injured and 0.5 killed per incident.

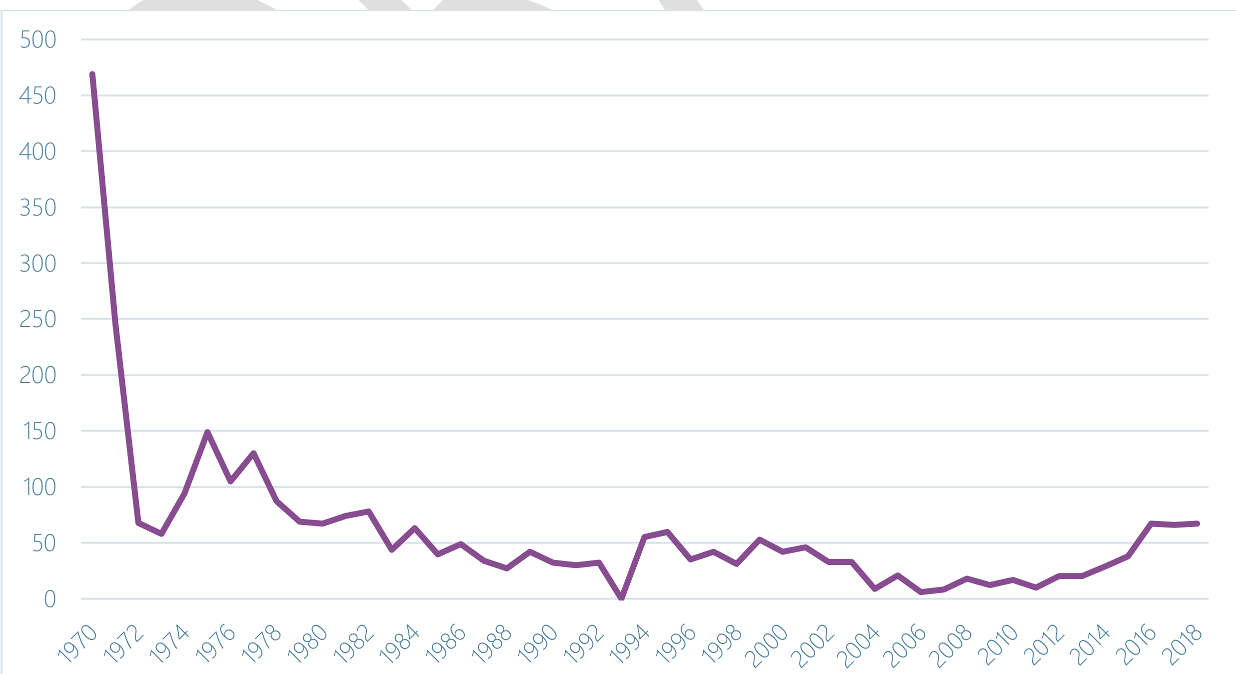
Figure 4-4 Incidents of Targeted School Violence in the US 2008-2017



Source: U.S. Secret Service Analysis of Targeted School Violence, 2019

Turning to terrorism specifically, the Global Terrorism Database (GTD) catalogues more than 190,000 terrorist attacks dating back to 1970. GTD data shows that despite public perception the number of terrorist attacks on US soil has in fact decreased over the last 50 years. From an average of 147.5 incidents per year in the 1970s, the frequency of attacks declined to 51.8 per year in the 1980s, then to 37.0 per year in the 1990s, and to 22.8 per year in the 2000s. An increase in attacks from 2015 through 2018 (the most recent year the GTD has analyzed) brought that average back up to 39.6 incidents per year for 2011 through 2018, but this is still well below the frequency seen in the 70s and 80s.

Figure 4-5 Terrorist Attacks in the U.S. 1970-2018



Source: Study of Terrorism and Responses to Terrorism (START) Global Terrorism Database (GTD) https://www.start.umd.edu/gtd/

A 2017 U.S. Government Accountability Office report "Countering Violent Extremism" found that of 85 violent extremist incidents resulting in death in the U.S. since September 12, 2001, right wing groups were responsible for 73% of attacks while radical Islamist groups were responsible for 27%.

Table 4-15 lists active threat and terrorism attacks that have occurred in New Mexico in the last 25 years. Note that this list includes several arson incidents, which are not always included in the definition of active threats but are included here to paint a clearer picture of the type of incidents the state has seen in the past. While only five of these twelve incidents occurred in the planning area, most of them had impacts that were felt statewide.

Table 4-15 Active Threat/Terrorism Incidents in New Mexico, 1995-2019

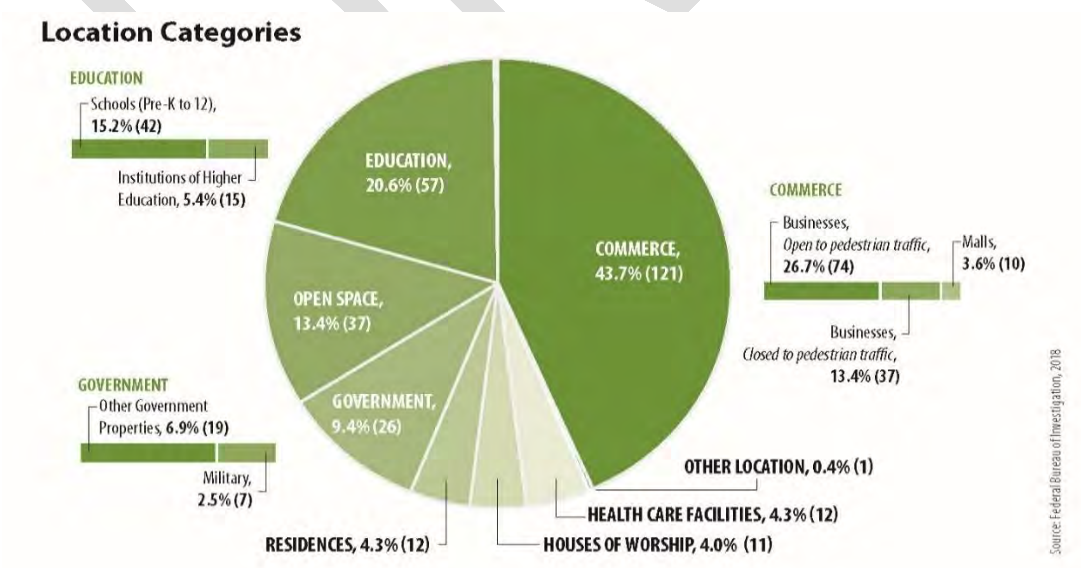
Incident	Injuries/Fatalities
2017 Aztec High School, Aztec	0 / 3
2017 Clovis Library, Clovis	4 / 2
2016 Project Defending Life office arson, Albuquerque	0 / 0
2015 Holy Cross Catholic Church Bombing, Las Cruces	0 / 0
2014 Islamic Center of New Mexico Bombing, Albuquerque	0 / 0
2014 Berrendo Middle School, Roswell	3 / 0
2013 South Valley Homicides, Bernalillo	0 / 5
2010 Delisle Triple Murder, Las Cruces	0 / 3
2003 ELF Restaurant Arsons, Albuquerque	0 / 0
1999 Pipe Bombing of Forest Guardians Office, Santa Fe	0 / 0
1998 Oso Complex Fire Arson, Jemez Mountains	0 / 0
1995-99 Multiple Abortion Clinic Fires, Albuquerque	0 / 0

Source: Global Terrorism Database https://www.start.umd.edu/gtd/, News media, HMPC

4.3.3 Location

Active threats can happen anywhere in the planning area. While the trend in active threats has been to target high population areas, soft target venues, businesses, and schools, incidents across New Mexico and the nation show they can happen anywhere, as shown in Figure 4-6.

Figure 4-6 277 Active Shooter Incidents in the U.S., 2000-2018



Source: FBI, 2018

4.3.4 Magnitude/Severity

Active threats can be measured in multiple ways including length of incident, casualties, and number of perpetrators. According to a U.S Department of Justice (DOJ) study of active shooter incidents, the extent of this hazard is:

- Number of incidents: 11.4 annually
- Casualties: Ranges from 1-32 fatalities, and 1-70 casualties (wounded and killed)
- Incident length: Averages 12 minutes

Although an active threat may only directly impact one specific piece of infrastructure (i.e. a school, theater, or concert venue), it indirectly impacts the community in many ways. Ongoing closures for investigation, local and national media logistics, VIP visits, mental health concerns, and aversions to similar infrastructure and subsequent impacts to businesses can manifest after an active threat. The psychological impact of these types of incidents is often even worse than the direct impacts and can continue to affect a community for years.

Looking at terrorist attacks since 1970, most years the U.S. experiences fewer than 25 causalities per year, and only 10 years (20%) saw more than 100 injuries or fatalities nationally. Since 2002, the U.S. has averaged 125 injuries or fatalities per year due to terrorism, although that number is skewed by a handful of deadly attacks, such as the 2013 Boston Marathon Bombing (3 dead, 264 injured) and the 2017 concert shooting Las Vegas, Nevada (59 dead, 851 wounded.

4.3.5 Climate Change Considerations

There are no known impacts of climate change on this hazard.

4.3.6 Probability of Future Occurrence

The probability of occurrence for an active threat can be difficult to quantify, largely due to different definitions of what constitutes an active threat. The DOJ study reported an average of 11.4 active shooter incidents per year. The 2014 FBI report estimated 16.4 incidents per year. While either number is tragic, a strictly mathematical analysis might conclude that averaging 16.4 active shooter incidents nationally across 3,142 counties (or county-equivalents), there is roughly a 0.5% chance of an incident occurring in any given county in any given year, all other things being equal. However, the fact that the planning area has experienced five such incidents in the last 25 years suggests the effective probability is significantly greater, perhaps as high as 20%.

4.3.7 Vulnerability Assessment

People

Most terrorist attacks are primarily intended to kill and injure as many people as possible. Physical harm from a firearms attack or explosive device is not completely dependent on location, but risk is greater in areas where higher numbers of people gather. If a biological or chemical agent were released indoors, it could result in exposure to a high concentration of pathogens, whereas an outdoors release could affect many more people but probably at a lower dose. Symptoms of illness from a biological or chemical attack could go undetected for days or even weeks. Local healthcare workers may observe a pattern of unusual illness or early warning monitoring systems may detect airborne pathogens. People could also be affected by an attack on food and water supply. In addition to impacts on physical health, any terrorist attack would likely cause significant stress and anxiety.

Similarly, most active shooters primarily target people, attempting to kill or injure large numbers of individuals. The number of injuries and fatalities are highly variable, dependent on many factors surrounding the attack including the location, the number of type of weapons used, the shooter's skill with weapons, the amount of people at the location, and law enforcement response time. Statistics indicate an average of 6.5 casualties per active shooter incident. Psychological effects of the incident on not only victims and responders, but also the general public, may last for years.

General Property

The potential for damage to property is highly dependent on the type of attack. Terrorist attacks involving explosives or other CBRNE weapons, may damage buildings and infrastructure, but for most attacks, impacts are localized to the target of the attack.

Active shooter incidents rarely result in significant property damage. However, active threats can close down property, facilities, and infrastructure for days or even months for investigation or rehabilitation of the site.

Critical Facilities and Infrastructure

Terrorists often target critical infrastructure, and attacks using explosives or other CBRNE weapons can potentially have devastating impacts.

While active shooter incidents rarely cause major property damage directly, indirect effects can be significant, such as the loss of critical facilities for days or weeks due to crime scene concerns.

Government Services

Active threats directed at a government facility or critical infrastructure could significantly interrupt delivery of essential services or continuity of operations. Active threats affecting general property or businesses are less likely to interrupt delivery of government services, although lower-priority incidents are likely to see an increased response time. Delivery of services at government facilities may be impacted if a shelter in place/lockdown/lockout is implemented.

Responders may be the target of secondary attacks meant to exploit the response system.

Public confidence in the government is directly related to its ability to respond to an active threat.

Economy

As noted above, over 45% of active shooter incidents in the FBI study took place at a commercial establishment. Nonetheless, most active shooter incidents have minimal impacts on the broader economy beyond the individual business affected. This can vary based on the location of the incident; an incident at a mall for example could cause temporary business interruption and closures due to crime scene investigation.

Direct economic impacts from most active shooter attacks are minimal. However, indirect costs can be substantial, including:

- Responder costs, including overtime, equipment, resource expenditure, etc.
- Facility damage
- Loss of revenue
- Legal fees
- Mental health/other healthcare related costs
- VIP visits/security
- Policy/legislative changes to increase security

Some statistics from active threats show the different costs, including rebuilding costs. San Bernardino "had to pay $4 million for the response…Connecticut gave the city of Newtown $50 million just for the costs of rebuilding…the costs from the 1999 shooting at Columbine High School came to roughly $50 million." (Delgadillo, 2018)

Historic, Cultural and Natural Resources

Most active shooter attacks do not cause widespread damage to the environment. Atypical attacks utilizing CBRN materials could significantly impact the environment. Unless an attacker targets a hazardous materials site (fixed facility or rail), or infrastructure such as wastewater or water purification sites, it is unlikely to result in significant impacts to the environment.

Future Land Use and Development

Active threats have happened all across the United States and the world. Changes in development based on lessons learned have resulted in additional security at critical infrastructure, collaboration during construction with security professionals, and better training.

4.3.8 Jurisdictional Differences

Active Threat	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Likely	Limited	Significant	Medium
Albuquerque	Highly Likely	Significant	Critical	High
Los Ranchos	Occasional	Limited	Significant	Low
Tijeras	Occasional	Limited	Significant	Low
AMAFCA	Occasional	Limited	Negligible	Low
MRGCD	Occasional	Limited	Significant	Low
ABCWUA	Occasional	Limited	Significant	Low

While it is difficult to predict where and when active threats will occur, they may be more likely to occur in the City of Albuquerque and Bernalillo County due to the greater number of high-visibility targets in those jurisdictions.

4.3.9 Risk Summary

- While the number of terrorist attacks on U.S. soil has been declining since the 1970s, active shooter incidents and school violence have risen in recent years.
- Effects on people: The primary aim of most active shooters is to injure and kill as many people as possible.
- Effects on property: Active shooter incidents rarely cause significant property damage.
- Effects on economy: Most active shooter incidents have minimal impacts on the economy.
- Effects on critical facilities and infrastructure: Crime scene concerns can lead to the loss of use of critical facilities for days or weeks.
- Related Hazards: Cyber Incident, Hazardous Materials

4.4 Cyber Threat

4.4.1 Description

A cyber attack can be defined as a deliberate exploitation of computer systems, technology-dependent enterprises, and networks. Cyber-attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that, "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks. Cyber threats can take many forms, including:

- <u>Phishing attacks</u>: Phishing attacks are fraudulent communications that appear to come from legitimate sources. Phishing attacks typically come through email but may come through text messages as well. Phishing may also be considered a type of social engineering meant to exploit employees into paying fake invoices, providing passwords, or sending sensitive information.
- <u>Malware attacks</u>: Malware is malicious code that may infect a computer system. Malware typically gains a foothold when a user visits an unsafe site, downloads untrusted software, or may be downloaded in conjunction with a phishing attack. Malware can remain undetected for years and spread across an entire network.
- <u>Distributed Denial of Service (DDoS) attack</u>: Perhaps the most common type of cyber attack, a DDoS attack seeks to overwhelm a network and causes it to either be inaccessible or shut down. A DDoS typically uses other infected systems and internet connected devices to "request" information from a specific network or server that is not configured or powerful enough to handle the traffic.
- <u>Data breach</u>: Hackers gaining access to large amounts of personal, sensitive, or confidential information has become increasingly common in recent years. In addition to networked systems, data breaches can occur due to the mishandling of external drives.
- <u>Ransomware</u>: Ransomware typically blocks access to a jurisdiction's/agency's/ business' data by encrypting it. Perpetrators will ask for a ransom to provide the security key and decrypt the data, although many ransomware victims never get their data back even after paying the ransom. Ransomware attacks against state and local government systems have risen dramatically in recent years.
- <u>Critical Infrastructure/SCADA System attack</u>: There have been recent critical infrastructure Supervisory Control and Data Acquisition (SCADA) system attacks aimed at taking down lifelines such as power plants and wastewater facilities. These attacks typically combine a form of phishing, malware, or other social engineering mechanisms to gain access to the system.

4.4.2 Past Occurrences

The cybersecurity firm Symantec reports there were a total of 1,209 data breaches worldwide in 2016. While the number of breaches has remained relatively steady, the average number of identities stolen has increased to almost one million per incident. The report also found that one in every 131 emails contained malware, and the company's software blocked an average of 229,000 web attacks every day.

The Privacy Rights Clearinghouse, a nonprofit organization based in San Diego, maintains a timeline of 9,741 data breaches resulting from computer hacking incidents in the United States from 2005-2019. The database lists 11 data breaches against systems located in New Mexico, including 4 specifically identified as targeting servers in the planning area (Table 4-16). However, attacks happening outside of the county and state can also impact local businesses, personal identifiable information, and credit card information, so it is difficult to know how many of those affected Bernalillo County residents.

Table 4-16 Major Cyber Attacks Impacting New Mexico, 2005-2020

Date Reported	Target	Total Records	Description
3/30/2012	Eclipse AeroSpace	0	A hacker or hackers accessed and posted Eclipse AeroSpace database information online. The leaked information included email addresses, usernames, names, and passwords.
5/13/2012	University of New Mexico	81	A hacker or hackers accessed and posted sensitive information from the University of New Mexico's electrical and computer engineering department. Usernames, emails, and encrypted passwords were exposed.
9/12/2012	UNM Health Sciences Center	2365	Location of breached information: Hacking/IT Incident Business associate present: No
5/17/2017	UNM Foundation	0	In mid-April 2017, we discovered that an unauthorized individual had gained access to our network through an account with our security services provider. This unauthorized individual may have had access to certain systems that contained personal information of our donors. While our investigation is ongoing, we are providing this notice out of an abundance of caution to alert you to the incident because information about you was available through the affected system. Information that may have been available includes names, contact information, donation amount and the checking and routing information displayed on your donation checks. While this information should not typically be sufficient to grant access to your accounts with your financial institutions, we place a high priority on the confidentiality of our donor information, and wanted to alert you to this incident so that you may be vigilant against phishing attempts or other fraudulent requests, and monitor your accounts for any suspicious activity.

Source: Privacy Rights Clearinghouse https://privacyrights.org/

A 2017 study found ransomware payments over a two-year period totaled more than $16 million. Even if a victim is perfectly prepared with full offline data backups, recovery from a sophisticated ransomware attack typically costs far more than the demanded ransom. However, according to a 2016 study by Kaspersky Lab, roughly one in five ransomware victims who pay their attackers never recover their data.

Recent years have seen an increase in ransomware attacks, particularly against local government systems. The City of Atlanta was hit by a major ransomware attack in 2018, recovery from which wound up costing a reported $2.6 million, significantly more than the $52,000 ransom demand. A similar attack against the City of Baltimore in 2019 affected the city government's email, voicemail, property tax portal, water bill, and parking ticket payment systems, and delayed more than 1,000 pending home sales. In March 2019, Orange County, North Carolina was attacked with a ransomware virus, causing slowdowns and service problems at key public offices such as the Register of Deeds, the Sheriff's Office, and county libraries. The attack impacted a variety of county services, including disrupting the county's capability to process real estate closings, issue marriage licenses, process fees or permits, process housing vouchers, and verify tax bills.

A large, sophisticated malware attack, known as Olympic Destroyer, was launched against the 2018 Winter Olympics in PyeongChang, South Korea. The attack initially took down servers, email, Wi-Fi, and ticketing systems, which could have severely disrupted the games. Fortunately, the organizing committee had a robust cybersecurity group that was able to quickly restore most functions.

4.4.3 Location

Cyber-attacks can and have occurred in every location regardless of geography, demographics, and security posture. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the state can still impact people, businesses, and institutions within the county. The entire planning area is susceptible to cyber-attacks.

4.4.4 Magnitude/Severity

There is no universally accepted scale to explain the severity of cyber-attacks. The strength of a DDoS attack is often explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, the October 21, 2016 Dyn attack, peaked at 1.2 terabytes per second and impacted some of the internet's most popular sites to include Amazon, Netflix, PayPal, Twitter, and several news organizations.

Data breaches are often described in terms of the number of records or identities exposed. The largest data breach ever reported occurred in August 2013, when hackers gained access to all three billion Yahoo accounts. The hacking incidents associated with Albuquerque in the Privacy Rights Clearinghouse database (Table 4-16) range from 0 records to just over 2,000 records.

Ransomware attacks are typically described in terms of the amount of ransom requested, or by the amount of time and money spent to recover from the attack. One report from cybersecurity firm Emsisoft estimates the average successful ransomware attack costs $81 million and can take 287 days to recover from.

4.4.5 Climate Change Considerations

There are no known impacts of climate change on cyber attacks.

4.4.6 Probability of Future Occurrence

Small-scale cyber attacks such as DDoS attacks occur daily, but most have negligible impacts at the local or regional level. Data breaches are also extremely common, but again most have only minor impacts on government services.

Perhaps of greatest concern are ransomware attacks, which are becoming increasingly common. It is difficult to calculate the odds of one of the participating jurisdictions being hit with a successful ransomware attack in any given year, but it remains a possibility.

The possibility of a larger disruption affecting systems within the county is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Major attacks specifically targeting systems or infrastructure in the county cannot be ruled out.

4.4.7 Vulnerability Assessment

The impact of a cyber-attack can vary depending on the type of attack and the intent of the malicious actor. Though a cyber disruption can have limited impacts within a system's own operations, it may cause cascading impacts.

People

Injuries or fatalities from cyber attacks would generally only be possible from a major cyber terrorist attack against critical infrastructure. More likely impacts to the public are financial losses and an inability to access systems such as public websites and permitting sites. Indirect impacts could include interruptions to traffic control systems or other infrastructure.

Data breaches and subsequent identify thefts can have huge impacts on the public. The Internet Crime Complaint Center (IC3) estimates that identity theft alone resulted in $2.7 billion in losses to businesses and $149 million in losses to individuals.

Cyber-attacks can interfere with emergency response communications, access to mobile data terminals, and access to critical preplans and response documents.

According to the Cyber & Infrastructure Security Agency, cyber risks to 9-1-1 systems can have "severe impacts, including loss of life or property; job disruption for affected network users; and financial costs for the misuse of data and subsequent resolution." CISA also compiled a recent list of attacks on 9-1-1 systems including a DDoS in Arizona, unauthorized access with stolen credentials in Canada, a network outage in New York, and a ransomware attack in Baltimore.

General Property

The vast majority of cyber attacks affect only data and computer systems. However, sophisticated attacks have occurred against the SCADA systems of critical infrastructure, which could potentially result in system failures on a scale equal with natural disasters. Facilities and infrastructure such as the electrical grid could become unusable. A cyber attack took down the power grid in Ukraine in 2015, leaving over 230,000 people without power. The 2003 Northeast Blackout, while not the result of a cyber attack, caused 11 deaths and an estimated $6 billion in economic loss.

Critical Facilities and Infrastructure

Agencies that rely on electronic backup of critical files are vulnerable. The delivery of services can be impacted since governments rely, to a great extent, upon electronic delivery of services. An attack could raise questions regarding the security of using electronic systems for government services.

While the vast majority of cyber attacks affect only data and computer systems, sophisticated attacks against utilities and infrastructure sites have occurred. Such attacks typically target the Supervisory Control and Data Acquisition (SCADA) systems of critical infrastructure, which can potentially result in system failures on a scale equal with natural disasters. Facilities and infrastructure, such as the electrical grid, could become unusable as a result of a cyber attack.

Government Services

The delivery of services can be impacted since governments rely to a great extent upon electronic delivery of services. Most agencies rely on server backups, electronic backups, and remote options for Continuity of Operations/Continuity of Government. Many departments in the participating jurisdictions have the option to move to a paper method including permitting, DMV services, payments to and from the county, and payroll. However, access to documents on the network, OneDrive access, and other operations that require collaboration across the county will be significantly impacted.

Loss of government servers due to a cyber attack could affect the ability of responders to do their jobs.

Public confidence in the government will likely suffer if systems such as permitting, DMV, voting, or public websites are down for a prolonged amount of time. An attack could raise questions regarding the security of using electronic systems for government services.

Economy

Economic impacts from a cyber attack can be debilitating. The cyber attack in 2018 that took down the City of Atlanta cost at least $2.5 million in contractor costs and an estimated $9.5 million additional funds to bring everything back online. The attack in Atlanta took "more than a third of the 424 software programs offline" and recovery lasted more than 6 months. The 2018 cyber attack on the Colorado Department of Transportation (CDOT) cost an estimated $1.5 million. None of these statistics take into account the economic losses to businesses and ongoing IT configuration to mitigate from a future cyber-attack.

Historic, Cultural and Natural Resources

The vast majority of cyber incidents have little to no impact on historic, cultural or natural resources. A major cyber terrorism attack could potentially impact the environment by triggering a release of a hazardous materials, or by causing an accident involving hazardous materials by disrupting traffic-control devices.

Future Land Use and Development

Changes in development have no impact to the threat, vulnerability, and consequences of a cyber attack. Cyber attacks can and have targeted small and large jurisdictions, multi-billion dollar companies, small mom-and-pop shops, and individual citizens. The decentralized nature of the internet and data centers means that the cyber threat is shared by all, regardless of new construction and changes in development.

4.4.8 Jurisdictional Differences

Cyber Threat	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Likely	Limited	Significant	High
Albuquerque	Likely	Limited	Negligible	Medium
Los Ranchos	Occasional	Limited	Negligible	Low
Tijeras	Occasional	Limited	Negligible	Low
AMAFCA	Occasional	Significant	Significant	Low
MRGCD	Likely	Limited	Significant	High
ABCWUA	Likely	Limited	Significant	High

While it is difficult to predict where and when cyber threats will occur, the threat may be higher to Bernalillo County, MRGCD, and ABCWUA due to the nature and vulnerability of their assets.

4.4.9 Risk Summary

- Most data breaches and hacking incidents only impact a few individuals or businesses at a time and have minimal broader impact.
- Ransomware attacks, particularly against state and local governments, have increased significantly in recent years and could have major impacts on services.
- Major cyber attacks against infrastructure and systems are also happening with more frequency worldwide, but there is no data to suggest that the participating jurisdictions are likely to be targeted.
- Effects on people: Cyber attacks can impact personal data and accounts. Injuries or fatalities could potentially result from a major cyber terrorist attacks against critical infrastructure.
- Effects on property: Short of a major cyber terrorist attacks against critical infrastructure, property damage from cyber attacks is typically limited to computer systems.

- Effects on economy: Could greatly affect the economy. In an electronic-based commerce society, any disruption to daily activities can have disastrous impacts to the economy. It is difficult to measure the true extent of the impact.
- Effects on critical facilities and infrastructure: Sabotage of utilities and infrastructure from a major cyber terrorist attacks could potentially result in system failures that damage property on a scale equal with natural disasters. Facilities and infrastructure could become unusable as a result of a major cyber-attack.
- Related hazards: Terrorism, Dam Failure/Incident, and Hazardous Materials incident.

4.5 Dam Failure

4.5.1 Description

This section refers to the failure of large dams that are operated for hydropower, navigation or large-scale flood control and impound large pools of water. Dam failures occur when the structural stability of a dam gives way and results in a large release of water downstream that typically causes a high degree of damage to any nearby structures or infrastructure.

Hydrologic or structural deficiencies are the primary cause of dam failure, but the safety of the structure can be influenced by reservoir operations. Hydrologic deficiencies result from the following:

- Inadequate spillway capacity
- Excessive runoff after heavy precipitation
- Large waves generated from landslides into the reservoir
- Sudden inflow from upstream dam failures

Structural deficiencies may be a result of the following:

- Seepage through the embankment
- Piping along internal conduits
- Erosion
- Cracking
- Sliding
- Overturning
- Rodent tunneling
- Landslides hitting the dam
- Other weaknesses in the structure

When a dam failure occurs due to structural deficiencies, the subsequent flooding is characterized by a sudden rise in stream level, much like a flash flood from a thunderstorm. Dam failures can occur at any time; however, the risk of structural failure is increased during the monsoon season, through July and August, because of increased precipitation and the runoff of melting mountain snow.

Dam failure can occur when a dam is overtopped when a spillway can no longer manage the excess flows. Overtopping is especially dangerous for an earthen dam because the down rush of water will erode the dam face and could breach the dam.

4.5.2 Past Occurrences

No known dam incidents and/or failures involving notable property damage have occurred in Bernalillo County according to the Association of State Dam Safety Officials. The 2018 State HMP reports that one dam failure occurred in Bernalillo County at the Renaissance Detention Basin in 1987. No other dam incident notifications were reported in the planning area since 1890.

4.5.3 Location

The USACE National Inventory of Dams (NID) was queried for high hazard dams in Bernalillo County. (See Section 4.5.4 for hazard potential categories.) These are listed below in Table 4-17. Twenty seven High Hazard Potential dams are located within Bernalillo County; nine other high hazard potential dams are located upstream in Sandoval County, including Cochiti and Jemez Dams. Most of the high hazard dams in the County are designed as flood detention dams and are typically dry. The majority of the dams are owned by AMAFCA and exist for flood control purposes.

Table 4-17 High Hazard Dams in Bernalillo County

Dam Name	Maximum Storage (AF)	Normal Storage	Max Discharge (CFS)	Year Built
Amole Arroyo Detention Dam	582	0	22,969	1979
Amole Del Norte Detention Dam*	101.82	0	7096	1997
Arroyo Del Oso Detention Dam*	840	0	36,500	1956
Black Arroyo Detention Dam	486	0	21,428	1992
Boca Negra Detention Dam	241	0	37,816	2014
Borrega Detention Dam	169	0	15,432	2001
Don Felipe Detention Dam	525	0	18,500	1989
Embudo Dam*	340	0	16,840	1979
Hubbell Lake Detention Dam	620	0	20,050	1979
John Robert Dam	659	0	23,600	1976
Kinney Dam	200	0	30,019	1995
Ladera Dam No. 10	66.04	0	889	1976
Ladera Dam No. 12	99.65	0	52,568	1976
Ladera Dam No. 14	134.4	0	19,351	1976
Ladera Dam No. 15	1,128.35	0	11,515	1976
Las Ventanas Detention Dam	323	0	17,590	1999
Mariposa Dam (CABQ owned)	670	0	4,500	1983
Mccoy Detention Dam	365	0	15,382	1991
North Domingo Baca Dam	325	0	20,065	1982
Piedras Marcadas Detention Dam	649	0	28,240	1984
Pino Dam	890	0	32,282	1979
Raymac Detention Dam	249.9	0	12,445	1989
Settled Water Storage Dam No. 1 (not AMAFCA)	173	147	0	2007
South Domingo Baca Dam	720	0	28,700	1979
Swinburne Dam	1630	0	50,700	1991
Tohajiilee**	0	0	0	0
Westgate Detention Dam	920	0	46360	1976

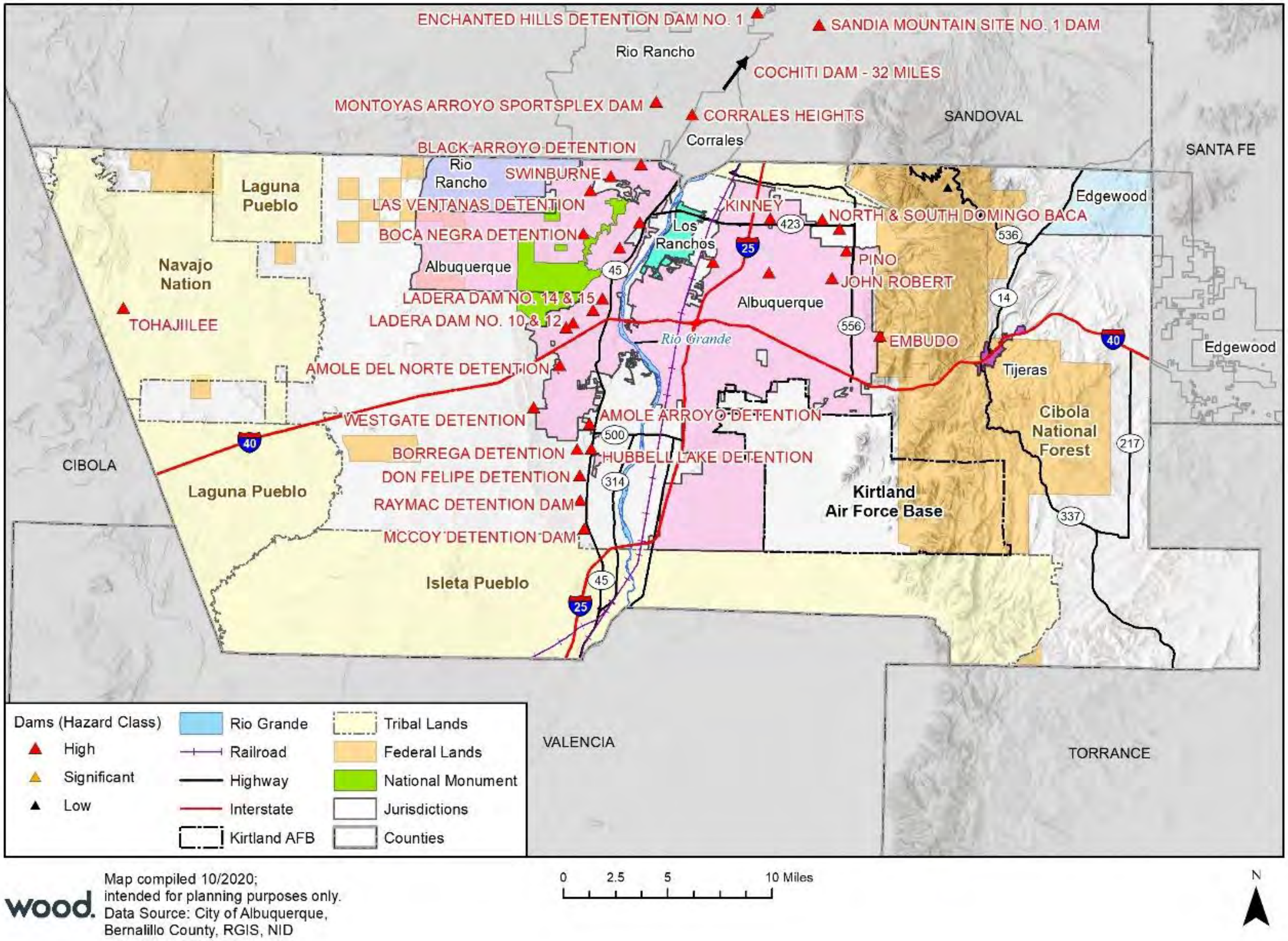
Source: New Mexico NID 2019; All dams owned by AMAFCA except: * City of Albuquerque owned, ** BIA owned

Table 4-18 High Hazard Dams in Sandoval County with Potential to Impact Bernalillo County

Dam Name	Maximum Storage (AF)	Normal Storage	Max Discharge (CFS)	Year Built
Cochiti Lake	722,000	50,130	136,360	1975
Corrales Heights Dam	107	0	1,695	1973
Enchanted Hills Detention Dam No. 1	154.6	0	4,368	2002
Jemez Canyon Dam	264,700	2,9712	319,300	1953
Montoyas Arroyo Sportsplex Dam	316	0	102,500	2007
San Francisco	0	145	0	0
Sandia Mountain Site No. 1 Dam	383	0	21,190	1955
Santa Ana	0	560	0	1960
Water Tank	0	0	0	0

Source: NID 2019

Figure 4-7 High Hazard Dams in and near Bernalillo County



Larger dams managed by the USACE and outside of Bernalillo County that could impact it in the unlikely event of a dam failure. These are noted in the table above. Notable dams are Cochiti and Jemez Canyon, which are described further below:

Cochiti Dam on the Rio Grande in Sandoval County is a large dam that created Cochiti Lake (50,000 acre-feet) and is maintained by the USACE. According to the 2018 State Hazard Mitigation Plan the dam is located near Pueblo de Cochiti, approximately 50 miles upstream from Albuquerque, New Mexico. The project consists of an earthfill dam about 5.4 miles long with a maximum height of 251 feet above streambed. The project extends generally in an east-west line across the Rio Grande to a point about 2 miles east of the Rio Grande and then southward across the Santa Fe River. The project controls floodwaters from an 11,695 square mile drainage area. According to Army Corps of Engineers inundation maps from April 1982, the following could occur:

Table 4-19 Cochiti Dam Inundation

Distance	Time	Location
1.7	0:15	Cochiti Pueblo
4.2	0:30	Pena Blanca
7.7	1:15	Santo Domingo Pueblo
8.5	1:30	
16	2:30	San Felipe Pueblo
19.4	2:45	Algodones Power Plant
27.7	4:45	Rt. 44
28.5	5:45	Bernalillo
33.5	7:00	Sandia Pueblo
39.1	10:15	Alameda Bridge
46	18:45	I-40
58.7	30:00	I-25 Bridge
61.9	32:00	Isleta Pueblo

Jemez Canyon Dam on the Jemez River, a tributary of the Rio Grande, is located on the Santa Ana Pueblo in Sandoval County upstream of Albuquerque. It created the Jemez Canyon Lake (with 1,414 water acres) and is maintained by the USACE. The dam is about 2 miles upstream of the confluence of the Jemez River and the Rio Grande, about 5 miles northwest of Bernalillo, New Mexico. The project consists of an earthfill dam 780 feet long with a maximum height of 146.6 feet above streambed, an off-channel uncontrolled saddle spillway 400 feet wide and a 13-foot diameter gated outlet in the left abutment. According to Army Corps of Engineers inundation maps from 1982, the following flooding could occur:

Table 4-20 Jemez Canyon Dam Inundation

Distance	Hours	Location
2.8	0:30	
5.7	0:30	Algodones Power Plant
7.1	2:00	Rt. 44
8.1	2:30	Bernalillo
12.8	4:30	Sandia Pueblo
18.5	10:00	Alameda Bridge
25.8	21:45	I-40
29.1	28:15	Barelas Bridge
38.1	36:45	I-25
41.3	41:45	Isleta Pueblo

Distance	Hours	Location
49.2	51:45	Rt. 49
60.2	66:15	Rt. 6

USACE dam inundation maps for Cochiti Dam and Jemez Dam were not available during this plan update cycle. The maps will be reviewed and analyzed, as available, in the next planning cycle.

4.5.4 Magnitude/Severity

The NID utilizes 4 categories to indicate the potential hazard to the downstream area resulting from failure including: Low, Significant, High, and Undetermined.

- High Hazard Potential – dams for which failure or disoperation would probably cause a loss of life.
- Significant Hazard Potential – dams where failure results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns.
- Low Hazard Potential – dams where failure results in no probable loss of human life and low economic and/or environmental losses (typically limited to the owner's property).
- Undetermined – dams that have not yet been adequately assessed.

Note that the hazard potential ratings do not reflect the likelihood of dam failure, merely the consequences if a failure did occur. While a dam failure is considered unlikely, given the presence of high hazard potential dams in the planning area, the magnitude of impacts could include loss of life and extensive property damage.

The Association of State Dam Safety Officials indicates that, in the absence of a formal inundation map, for dams with a maximum storage capacity of 100,000 acre-feet or more High hazard dams, downstream development within five miles are considered to be at risk to potential dam failure hazards. For dams with a maximum storage capacity between 10,000 and 100,000 acre-feet or Significant hazard dams, downstream development within three miles are considered at risk to potential dam failure hazards. For dams with a maximum storage capacity of less than 10,000 acre-feet, or Low hazard dams, downstream developments within one mile are considered at risk to potential dam failure hazards.

4.5.5 Climate Change Considerations

Based on the 2018 State HMP there has not been a definitive link between long-term, changing weather patterns and an increase or decrease in the frequency or severity of dam failures or incidents in New Mexico. A 2018 Colorado-New Mexico Regional Extreme Precipitation Study looked at considering climate change in the estimation of extreme precipitation for dam safety. The study suggests that Probable Maximum Precipitation (PMP) estimates used for design of dams may not account for higher volumes of precipitable water (PW) in a future warmer atmosphere. With a potential for more extreme precipitation events as a result of climate change, this could result in large inflows to reservoirs, potentially exceeding the design capacity.

4.5.6 Probability of Future Events

The State studied the risk of dam failure in its 2018 Plan and determined the probability of each Preparedness Area experiencing future dam failure based on historical data provided by local authorities. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. In the multi-county Preparedness Area #5, there is a 2% chance of a dam incident in any given year, and a less than 1% chance of a high hazard dam failure, thus the probability of a future event is classified as "Unlikely".

4.5.7 Vulnerability Assessment

People

Persons located downstream of a dam are at risk of a dam failure, though the level of risk can be tempered by topography, amount of water in the reservoir, and time of day of the breach. The populations most at-risk are directly downstream of the dams and reservoirs which could cause inundation.

General Property

While the chance of dam failure is low, a dam failure could impact in the planning area while affecting a more limited spatial extent (areas near the waterways downstream from the dam). The flood waters would be swift moving and could sweep structures off their foundation. A dam failure incident could result in loss of life due to the lack of warning and swift flow of water. The impact of dam failure is not fully known without comprehensive dam inundation studies.

Critical Facilities and Infrastructure

A total dam failure could cause catastrophic impacts to areas downstream along the Rio Grande River which includes critical infrastructure and lifelines. The greatest risk would be to roads and bridges that could be vulnerable to washouts that further complicate emergency response and recovery. Levees may also be compromised.

Government Services

Short-term accessibility issues may limit staffs' abilities to perform routine duties or report to work locations, and delivery of services may be affected. Damage to facilities/personnel in incident area may require temporary relocation of some operations. Regulatory waivers may be needed locally. Fulfillment of some contracts may be difficult.

Responders in flooded areas at the time of incident or assisting in evacuations could be at risk. Impacts to transportation corridors and communications lines could affect first responders' ability to effectively respond.

Public confidence in government may be challenged by the public if planning, response, and recovery are not timely and effective, regardless of the dam owner.

Economy

Depending on the circumstances and location of the breach, dam failure can have significant impacts on the economy. Waters can flood and ruin buildings, and wash out culverts, roads, bridges and other transportation systems and essential infrastructure providing to the economy directly or indirectly. Due to the potential for inundation in the downtown area, a dam failure could have long term economic impacts on local businesses and affect the tourism industry.

Historic, Cultural and Natural Resources

Water could erode topsoil, cover the environment with debris, and affect parks and other open spaces within the planning area. Dam failure has the potential to inundate some of the historic and cultural resources within the planning area.

Future Land Use and Development

In the case of a dam failure, inundation would likely follow some existing FEMA mapped floodplains, which contains development restrictions for the 1% annual chance floods, but it could exceed those floodplains.

Jurisdictional Differences

Those jurisdictions located adjacent to the Rio Grande have a higher likelihood of being impacted from one of the many dams in Sandoval County or further north in the Rio Grande watershed. This includes areas of the unincorporated county, portions of the City of Albuquerque, and Los Ranchos in particular.

4.5.8 Jurisdictional Differences

Dam Failure	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Unlikely	Limited	Critical	Low
Albuquerque	Unlikely	Significant	Critical	Medium
Los Ranchos	Unlikely	Significant	Critical	Medium
Tijeras	Unlikely	Limited	Critical	Low
AMAFCA	Unlikely	Significant	Catastrophic	High
MRGCD	Unlikely	Extensive	Critical	High
ABCWUA	Unlikely	Limited	Critical	Low

The unincorporated County, Village of Tijeras, and ABCWUA have fewer areas and facilities at risk of dam inundation, resulting in lower risk. The risk is higher for AMAFCA and MRGCD due to greater exposure and the nature of their assets exposed.

4.5.9 Risk Summary

Dam failure is a concern in central New Mexico area due to the presence of several dams. This hazard may be overlooked during times of drought. Due to data limitations related to mapped dam inundation zones in the planning area, it is not entirely clear what the impacts of a dam failure would be. Therefore, an initial step towards mitigating the risk would be a dam failure inundation map and study, which has been added as an action item.

- 27 High Hazard Potential dams are located within Bernalillo County; 9 other High Hazard Potential dams are located upstream in Sandoval County, including Cochiti and Jemez dams, and many others in northern New Mexico could affect the Rio Grande.
- Most of the High Hazard dams in the County are designed as flood detention dams and are typically dry.
- The probability of dam failure is remote and considered to be “unlikely” in terms of frequency classification.
- Related Hazards: flood

4.6 Drought

4.6.1 Description

A drought is a period of prolonged dryness that contributes to depletion of water supplies, both underground and on the surface. Drought is a natural climatic condition caused by an extended period of less than normal rainfall in a broad geographic area. High temperatures, high winds, and low humidity exacerbate drought conditions. Human demands and actions can also exacerbate the impacts of drought.

Droughts can be defined by a variety of criteria and are generally characterized in the following four categories, as defined by the National Drought Mitigation Center (NDMC):

- A ***meteorological*** drought refers to a period of less than average precipitation defined by the degree of dryness and the duration of the dry period.
- A ***hydrological*** drought refers to when precipitation shortfalls begin to affect surface and subsurface water supplies. Hydrological droughts typically lag behind meteorological drought because it takes longer for precipitation deficiencies to be apparent in soil moisture, streamflow, groundwater, and other parts of the hydrological system.
- An ***agricultural*** drought refers to the effects of a meteorological or hydrological drought in terms of soil moisture, actual and potential evapotranspiration, reduced groundwater, and other factors related to plant life. Agricultural drought definitions account for the variable susceptibility of crops at different stages of development.
- A ***socioeconomic*** drought occurs when meteorological, hydrological, or agricultural drought impacts the supply and demand of water-dependent goods, thus potentially affecting public health and economic activity.

Each of the above definitions of drought can be measured on different scales and scopes and by a variety of metrics, such as precipitation, soil moisture, streamflow, and surface water and groundwater levels. Additionally, each definition can provide a different point of view or understanding of drought severity and impacts. Several unique indices have been developed to describe drought and measure its severity. It is important to understand that each of these indices measures drought as it occurs but does not predict future drought conditions.

The **Palmer Drought Severity Index** (PDSI) devised in 1965, was the first drought indicator to assess moisture status comprehensively. The PDSI uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for unirrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief.

The **Standardized Precipitation Index** (SPI), like the PDSI, index is negative for drought, and positive for wet conditions. However, the SPI is a probability index that considers only precipitation.

The **U.S. Drought Monitor** provides a summary of drought conditions across the United States and Puerto Rico. Often described as a blend of art and science, the Drought Monitor map is updated weekly by combining a variety of data-based drought indices and indicators as well as local expert input into a single composite drought indicator.

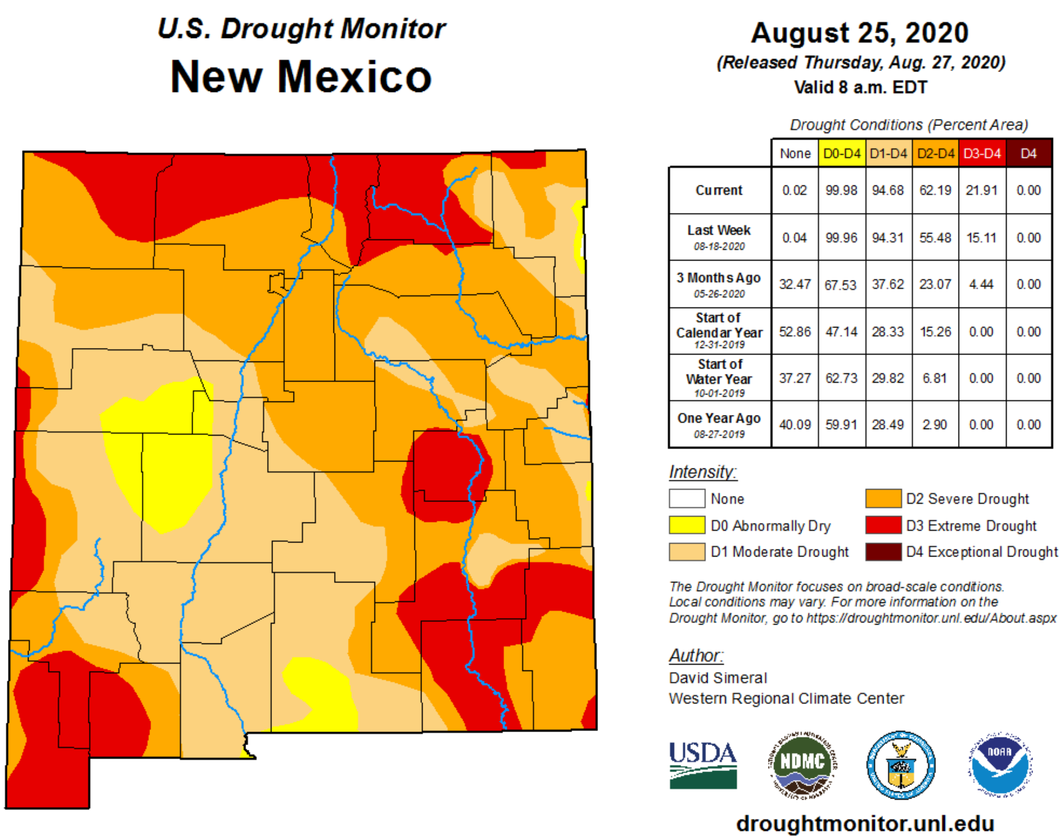
4.6.2 Past Occurrences

In the last 120 years, New Mexico has suffered five devastating periods of drought: 1900-1910, 1931-1941, 1942-1956, 1974-1979, and 2011-2014. This most recent major drought led the Governor of New Mexico to declare a Drought State of Emergency on May 15, 2012, which convened the New Mexico Drought Task Force, led by the State Engineer, to determine ways the State can prepare for and mitigate the effects of the drought. During the 2011-2014 drought, all of Bernalillo County reached D5 (Exceptional Drought) conditions for 11 consecutive weeks in 2013, with part of the County remaining in D5 conditions for an additional 9 weeks. This drought was considered by the NWS to be the State's most severe period of drought since the 1950s. (https://www.abqjournal.com/192344/drought-is-worst-since-the-1950s.html).

According to a review of significant past drought events in the 2018 State of New Mexico Hazard Mitigation Plan, the U.S. Department of Agriculture designated Bernalillo County as a disaster area due to drought in January 2015 and Summer 2013. Additionally, Bernalillo County received USDA Secretarial Drought Declarations in 2012 and 2018.

Figure 4-8 shows the U.S. Drought Monitor map as of August 2020, illustrating the regional nature of drought. At this time, all of New Mexico was in various stages of drought, with primarily D1 conditions in Albuquerque and portions of Bernalillo County experiencing a range from D0 to D2 conditions.

Figure 4-8 U.S Drought Monitor, New Mexico (as of August 25, 2020)



Source: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?NM accessed August 2020

The U.S. Drought Monitor maintains weekly records of drought conditions by county. Table 4-21 presents the number of weeks that any portion of Bernalillo County spent in drought by intensity over the period from 2000 to 2020, for which the Drought Monitor has records for 1,044 weeks. Each week is attributed to the most severe drought category present in the County for that week.

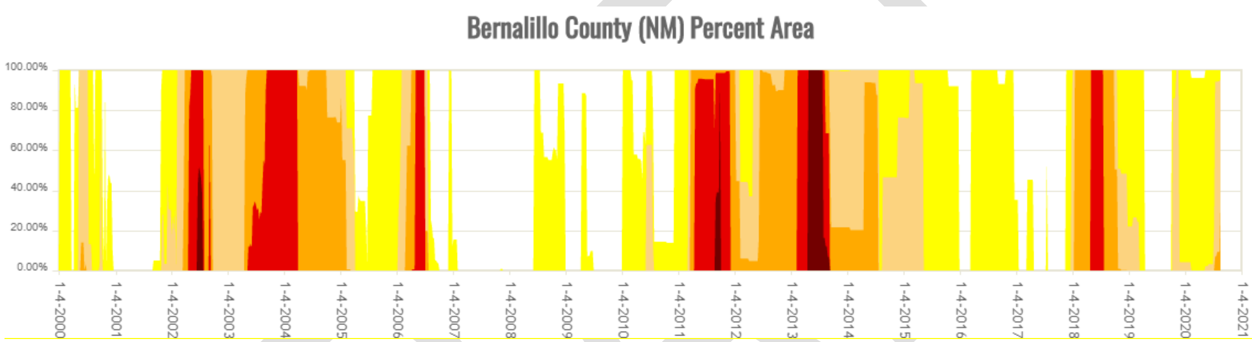
Table 4-21 Weeks in Drought, 2000-2020

Weeks in Drought						% of time in Severe Drought or Worse
Total	D0	D1	D2	D3	D4	
811	293	145	225	118	30	35.7%

Source: U.S. Drought Monitor History

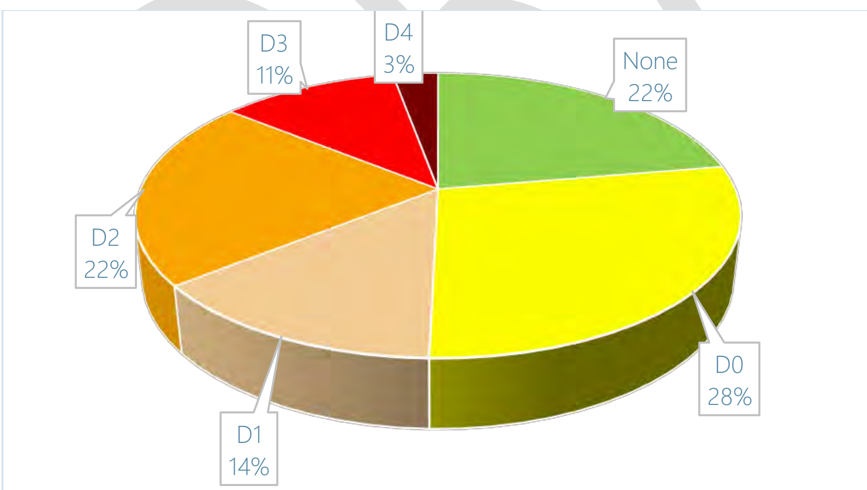
Per these records, during the 1,044-week period from January 2000 to January 2020, all or portions of Bernalillo County spent 811 weeks (78% of the time period) in some level of drought, defined as Abnormally Dry (D0) or worse conditions. This period includes 225 weeks of Severe Drought (D2), 118 weeks of Extreme Drought (D3), and 30 weeks of Exceptional Drought (D4). Figure 4-9 illustrates the historical periods where the county was considered in some level of drought condition and Figure 4-10 illustrates the total proportion of time spent in drought by severity. The color key shown in Figure 4-8 above indicates the intensity of the drought.

Figure 4-9 U.S. Drought Monitor Historical Records, Bernalillo County, 2000-2021



Source: U.S. Drought Monitor

Figure 4-10 Percentage of Weeks in Drought, 2000-2020



Source: U.S. Drought Monitor

4.6.3 Location

Drought is generally a broad geographic hazard that is not tied to site specific topographic and geologic features like flooding. The climate in the planning area is arid with less than an inch of rain typically falling each month from November through June, and a monsoon effect from June through October when most rainfall occurs. Per records from the Western Regional Climate Center, the Rio Grande Valley of New Mexico averages around 10 inches of rainfall a year, and Albuquerque averages 9.6 inches of rainfall a year. The East Mountain area of Bernalillo County can receive up to 23 inches of rain per year according to the Bernalillo County Water Conservation Development Standards and Guidelines. This normally small and concentrated annual precipitation causes extended periods of low flow in the State's rivers and streams. Any measurable decrease in precipitation rates can create drought conditions in a relatively short time. The entire planning area may experience all levels of drought.

4.6.4 Magnitude/Severity

The National Weather Service (NWS) and the United States Department of Agriculture (USDA) collaborate with academic institutions to categorize drought. Taking input from these entities and local sources, the National Drought Mitigation Center (NDMC) through the U.S. Drought Monitor website issues a weekly drought severity assessment by combining a variety of data-based drought indices and indicators and local expert input into a single composite drought indicator.

Figure 4-11 details the classifications used by the U.S. Drought Monitor and Figure 4-12**Error! Reference source not found.** details possible impacts specific to New Mexico. A category of D2 (severe) on the U.S. Drought Monitor Scale can typically result in dust storms, more frequent and severe wildfire, decreases in well water, and significant crop and livestock impacts.

Figure 4-11 U.S. Drought Monitor Classifications

			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Source: U.S. Drought Monitor

Figure 4-12 Possible Impacts by U.S. Drought Monitor Category in New Mexico

Category	Impact
D0	Soil moisture is low
	Fire danger increases
D1	Livestock need supplemental feed and water
	Burn bans and firework restrictions begin
D2	Pasture yield is limited; producers sell livestock
	Irrigated crops are stunted; dryland crops are brown
	Dust storms occur
	Abundance and magnitude of wildfires may increase; fuel mitigation practices are in effect
	Wildlife feeding patterns change
	Well water decreases
D3	Livestock are suffering; producers are selling herds; feed costs are high; emergency CRP grazing is authorized; crop yields are low
	Fire danger is extreme
	Irrigation allotments decrease
	Vegetation and native trees are dying
D4	Federal lands begin to close for fire precautions; burn bans increase
	Bears encroach on developed areas; migratory birds change patterns
	No surface water is left for agriculture, farmers use private wells
	Rio Grande and other large rivers are dry

Source: U.S. Drought Monitor

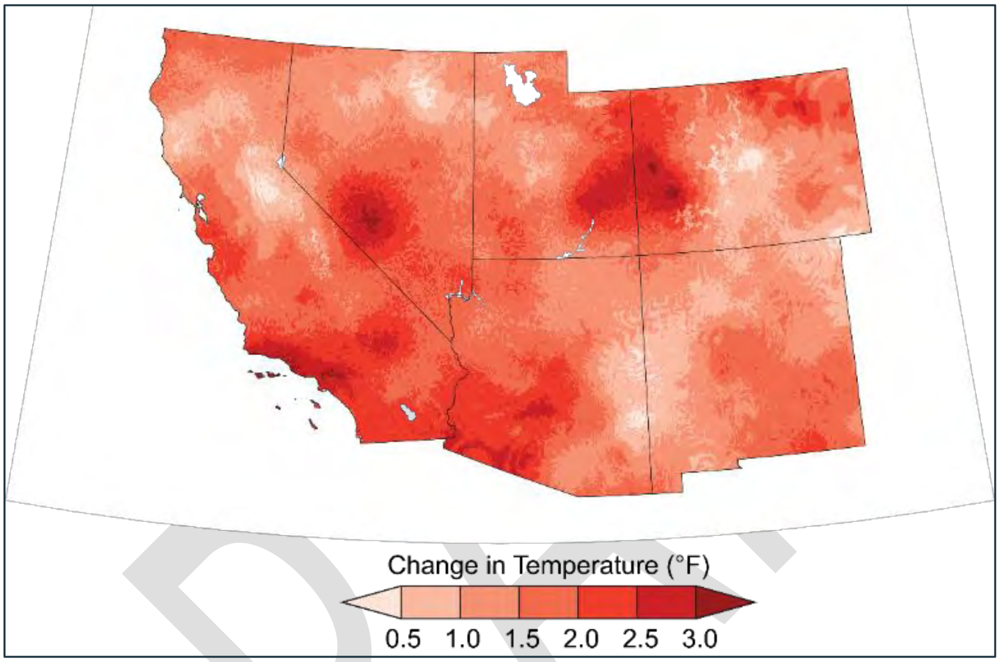
Albuquerque and Bernalillo County can experience any category of drought on the U.S. Drought Monitor scale. When the majority of Bernalillo County is in a D2 (severe drought) rating, the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) will issue a Drought Advisory to educate the public about the drought conditions and to encourage voluntary water conservation. If the Drought Advisory is not effective at meeting water use goals, the ABCWUA Board may adopt additional measures. (2012 ABCWUA Drought Management Strategy, accessed August 2014, http://www.abcwua.org/uploads/files/Your%20Drinking%20Water/dms2012.pdf)

Drought has a slow speed of onset and a long duration compared to other hazards. Droughts can last multiple years and can do more damage the longer they persist. The length of the recovery period is a function of the intensity of the drought, its length, and the quantity of precipitation received as the drought ends. Due to the variety of indices for tracking drought, there is typically significant time to issue hazard warnings. Drought warnings can be regularly updated and allow for response to escalate depending on the severity of conditions.

4.6.5 Climate Change Considerations

Climate change is expected to bring more frequent and severe droughts to the Southwest because of rising temperatures and changes in precipitation patterns. Per the Fourth National Climate Assessment, average temperatures have increased across the Southwest and will likely continue to rise. Figure 4-13 shows the difference between the 1986-2016 average temperature and the 1901-1960 average temperature. This trend toward higher temperatures is expected to cause more frequent and severe droughts in the Southwest as well as drier future conditions and an increased risk of megadroughts—dry periods lasting 10 years or more. Additionally, current models project decreases in snowpack, less snow and more rain, shorter snowfall seasons, and earlier runoff, all of which may increase the probability of future water shortages (Gonzalez et al., 2018).

Figure 4-13 Change in Average Temperature Across the Southwest, 1901-1960 to 1986-2016



Source: Fourth National Climate Assessment

4.6.6 Probability of Future Events

In an arid region such as Bernalillo County, the probability of recurring droughts with moderate to exceptional severity is likely. Droughts can last from one season to over 40 years and should be expected at any time.

As noted above under past occurrences, historical drought occurrence and intensity data reported by the U.S. Drought Monitor indicates that over the 1,044-week period from January 2000 through December 2019 Bernalillo County experienced 373 weeks of Severe Drought or worse conditions. If future occurrences continue to follow this trend, Bernalillo County has a 36% chance of experiencing severe drought conditions in any given week. Short duration droughts are likely, but longer periods of intense drought are less common. Considered on the level of annual probability, Bernalillo County experienced Severe Drought or worse conditions during 12 of the 20 years during this period, which equates to a 60% annual chance of severe drought conditions. As noted above, climate change may drive increased probability of drought in the future.

4.6.7 Vulnerability Assessment

The National Drought Mitigation Center (NDMC), located at the University of Nebraska in Lincoln, provides a clearinghouse for information on the effects of drought based on reports from media, observers, impact records, and other sources.

According to the NDMC's Drought Impact Reporter, during the 20-year period from January 2000 through December 2019, 96 drought reports were recorded for the State of New Mexico, 111 were recorded for Bernalillo County, and 11 were reported to affect the City of Albuquerque. Table 4-22 summarizes the number of impacts reported by category. Note that the Drought Impact Reporter assigns multiple impact categories to each report, so there is some duplication between categories.

Table 4-22 NDMC Drought Impact Reporter, 2000-2020

Impact Category	City of Albuquerque # of Impacts	Bernalillo County # of Impacts
Agriculture	2	22
Business & Industry	2	3
Fire	1	39
Plants & Wildlife	1	38
Relief, Response & Restrictions	5	56
Society & Public Health	3	17
Tourism & Recreation	2	9
Water Supply & Quality	7	37
Total Impacts	**23**	**221**

Source: National Drought Mitigation Center Drought Impact Reporter (https://droughtreporter.unl.edu/map/)

People

Drought is unlikely to cause direct physical injury but can result in health problems related to low water flows and poor water quality. Increases in dust and reductions in air quality because of drought can also affect public health. Mental health issues may also arise from drought, especially for those dependent on reliable water supply for their livelihood. Drought affects the entire community by placing a higher demand on the present water supply systems. In extreme cases, individuals may experience dry wells, and drought may cause conflict over water shortages. A particularly long or severe drought could require water restrictions. Individuals with private well water may also face impacts, including drinking water turbidity, change in water color or odor, and wells running dry. People employed in water-dependent industries may face decreased incomes or unemployment.

Per the New Mexico Drought Task Force, urban and agricultural water users who rely on reservoirs and wells that are not dependent on high rates of aquifer recharge are the last to feel the effects of drought. East Mountain area wells show measurable and increased decline during drought and some individual wells may become unusable.

General Property

Drought does not have a direct impact on buildings; however, indirect impacts may result from an increase in dust. Developed areas may experience damages to landscaping if water use restrictions are put in place, however these losses are not considered significant.

According to the 2017 USDA Census of Agriculture, there are 1,248 farm operations in Bernalillo County covering 221,495 acres, the majority of which is pastureland. The total market value of these farm operations is $9,317,000, with roughly $4.8 million in crops and $4.5 million in livestock. The USDA Risk Management Agency (RMA) maintains a database of crop insurance claims across the country by location and cause of loss. No losses were reported for Bernalillo County between 2007-2019; however, only nine farm operations in Bernalillo County reported having crop insurance according to the 2017 Census of Agriculture, so it is possible that uninsured losses were incurred.

Critical Facilities and Infrastructure

Severe to exceptional droughts can have significant consequences for water supply (drinking water and agriculture uses), water quality, firefighting, and navigation and recreation. Additionally, a higher demand on the water system infrastructure can lead to disruption of service due to line breakage.

The effect on local government infrastructure is the same as for the general public, and a drought may interrupt the normal operation of government in some places. For example, facilities dependent on wells may lose water supply.

Government Services

Drought may require disaster declarations, aid programs, water restrictions, and/or fire restrictions. These needs could impact funding or administrative resources for other regular operations or may necessitate changes to existing operating procedures.

Water utilities are likely to face the greatest challenges to continuity of operations and delivery of services, especially during long-term widespread droughts, where opportunities for resource-sharing are limited. Water suppliers may need to change water rates, set usage restrictions, adjust to changes in demand, address water line damage or repairs due to drought stress, account for changes in water quality, and seek alternative water supplies. Should a public water system be severely affected, the cost of shipping in outside water could total into the millions of dollars.

The impact to first responders from drought events is likely to be similar to impacts on the general public.

Public confidence may be affected because of the drought response process. Water usage restrictions and potential penalties for violations of these restrictions can cause frustration with government. Meetings to discuss drought, efforts to create community drought plans, and public service announcements and education efforts may affect public confidence. Elevated stress levels may result from these processes as well as from demand for higher water rates, cancellation of fundraising events, cancellation/alteration of festivals or holiday traditions, stockpiling water, and/or protests.

Economy

When a drought begins, agriculture is usually the first industry affected because of its heavy dependence on stored moisture in the soil. Soil moisture can be rapidly depleted during extended dry periods. Dryland farming and ranching are most at risk from drought. Agricultural impacts may include decreased land prices, unemployment from declines in production, and increased importation of food. Impact on agricultural activities can be seen even during a short-term drought. Water uses depending on in-stream flows, such as irrigated farms; aquatic, wetland, and riparian environmental communities; and recreational uses are at high risk.

Other industries that may be affected by drought include businesses in landscaping, recreation and tourism, and public utilities. For example, during the 2013 drought, employment declined at nearby ski areas. Additionally, water conservation efforts left the local water utility short of revenue and forced to consider rate hikes.

Historic, Cultural and Natural Resources

Droughts create conditions that increase wildfires risk, both by increasing fuel loads and fire susceptibility and by reducing water supply for fire control. Drought also creates conditions for increased wind erosion and dust storms.

Local wildlife and vegetation may suffer from drought. Animal habitat and food supply can dwindle causing species die-off.

Future Land Use and Development

Drought limits the amount of growth that can be expected for the County and its municipalities due to the lack of recharge of the already finite water supply. Bernalillo County's population is not growing, nor is significant growth expected in the coming years. If growth does occur, drought vulnerability would likely be impacted, as public water demand impacts water levels and can exacerbate drought.

4.6.8 Jurisdictional Differences

Drought	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Highly Likely	Extensive	Significant	High
Albuquerque	Likely	Extensive	Critical	Medium
Los Ranchos	Likely	Extensive	Significant	High
Tijeras	Likely	Extensive	Negligible	Medium
AMAFCA	NA	NA	NA	NA
MRGCD	Likely	Extensive	Significant	High
ABCWUA	Likely	Extensive	Significant	High

Since AMAFCA facilities are generally dry and designed to accommodate different level flood events, drought is not expected to have any impact on the facilities. The severity of drought to the City of Albuquerque and Village of Tijeras is lower than the rest of the planning area.

4.6.9 Risk Summary

- In New Mexico, drought conditions are often the norm rather than the exception. In most cases, the dry weather conditions that cause droughts will need to persist for months or even years before it becomes clear that drought conditions exist. It is also difficult in an arid state like New Mexico to verify when an affected area has actually recovered from a drought. Many drought events are followed by years of average or slightly below average rainfall that do not restore surface water and/or groundwater levels to pre-drought conditions. More accurate monitoring of groundwater levels in critical aquifers would help to establish base conditions and to assess levels of recovery from a drought and this is already being implemented at some wells in the network. There are also data limitations in determining the available quantity and quality of groundwater.
- Mitigation management for drought is a proactive process. The best practices include early assessment, public education, and water conservation programs. Identifying the first phases of the drought and reacting with water conservation at the earliest time will help to mitigate drought later in the disaster. At the State level, the Governor's Drought Task Force Monitoring Working Group monitors the drought situation and can help determine best practices for mitigating the drought effects.
- Related hazards: Wildfire, Extreme Heat

4.7 Earthquake

4.7.1 Description

Earthquakes result from sudden ground motion or trembling caused by a release of strain accumulated within or along the edge of the earth's crustal plates. Earthquakes occur most frequently in the boundaries between the great crustal plates that form the earth's outer shell. As these plates move, stress accumulates. Eventually, when faults along or near plate boundaries slip abruptly, an earthquake occurs. Earthquakes can also occur in active rift zones, like the Rio Grande Rift zone in Albuquerque, and in volcanic zones like at Socorro Fracture Zone (creating the Socorro Seismic Anomaly).

The severity of an earthquake depends on the amount of energy released from the fault or epicenter of the earthquake. The severity is described in terms of magnitude and intensity. **Magnitude** characterizes the total energy released, while **intensity** subjectively describes effects at a particular place. While a given earthquake has only one magnitude, its intensity will vary throughout the affected region.

Although earthquakes in the U.S. have caused less economic loss annually than other hazards like flood, they have the potential to cause great and immediate losses, especially near the epicenter. Within one to two minutes, an earthquake can devastate a city through ground shaking, surface-fault ruptures, and ground failures. Seismic hazards often trigger other devastating events, such as landslides, fires, and damage to dams and levees. Earthquakes can even trigger volcanic eruptions or cause tsunamis in coastal areas.

The most significant area of seismic activity in the state is located in the Rio Grande River Valley, centered in Socorro. This area is particularly active because it is at the intersection of the Rio Grande Rift Zone and the Socorro Fracture Zone. This area also has a magma body beneath it.

The largest recorded seismic event in New Mexico history occurred in Socorro in 1906. The effects of this event were felt from El Paso, Texas to Las Vegas, New Mexico; however, little damage was reported and there were no fatalities. This event would have been felt in Bernalillo County, approximately 25 miles north of Socorro.

4.7.2 Past Occurrences

Bernalillo County is more vulnerable to earthquakes than many areas of the state.

Several of the strongest New Mexico earthquakes recorded in the 2018 State Plan (earthquakes over 4.5 on the Richter Scale) have occurred in Bernalillo County or are close enough in proximity to be felt throughout the planning area. The following earthquakes occurred centered in Albuquerque based on a search of the USGS Earthquake Catalog (https://earthquake.usgs.gov/earthquakes/search/):

- January 4, 1971: M 4.7
- November 28, 1970: M 4.5

The closest additional noteworthy and larger New Mexico earthquakes outside the county located from 30 to approximately 150 miles away include:

- 1869; Socorro; Magnitude 5.2
- From 1895 to 1906, eight earthquakes in Socorro ranging from 4.5 to 5.8
- September 7, 1893; Belen; Magnitude 5.2
- May 28, 1918; Los Cerrillos; Magnitude 5.5
- December 22, 1935; Belen; Magnitude 4.5
- August 3, 1955; Dulce; Magnitude 4.5

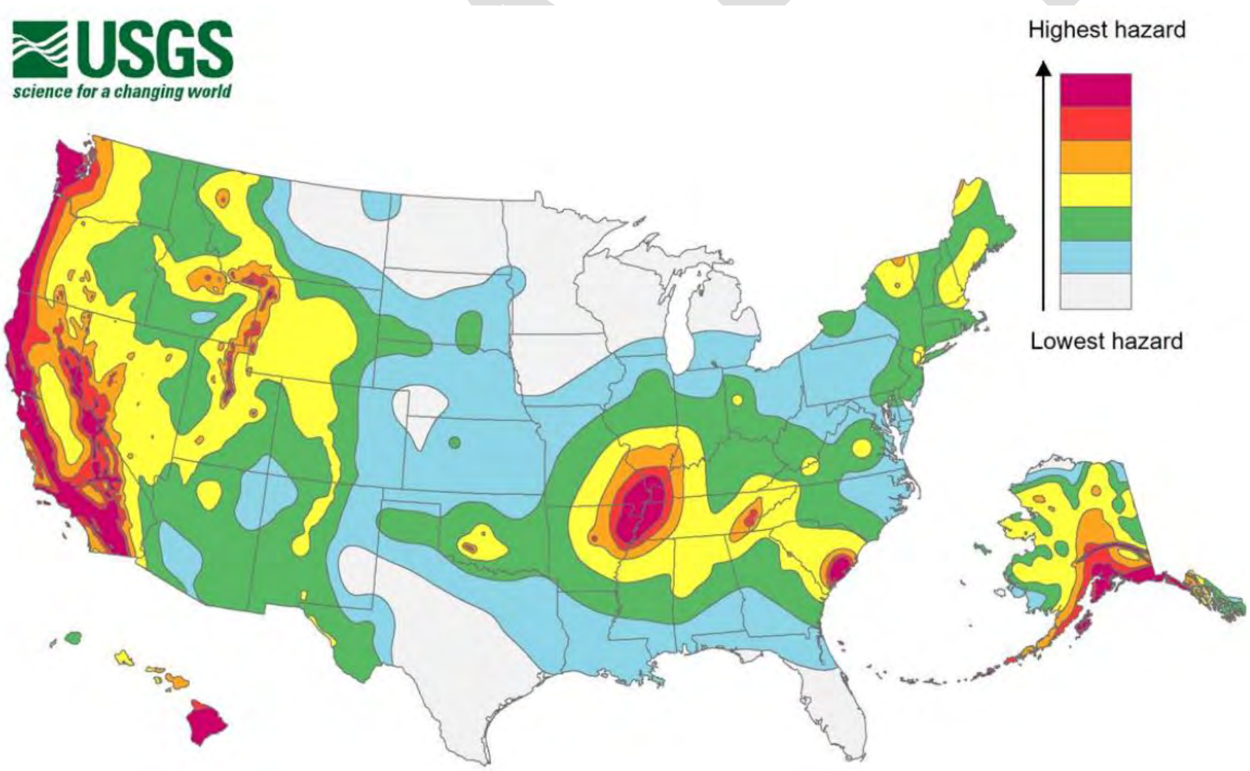
- July 3, 1961; Socorro; Magnitude 4.5
- January 23, 1966; Dulce; Magnitude 4.8

While earthquakes are possible in Bernalillo County, the potential of a damaging one occurring is fairly small. Additionally, of the earthquakes that have occurred in New Mexico since 1869, none have produced significant damage to property or injury to the population. Although there will always be the potential of an earthquake occurring in Bernalillo County, it is not presently anticipated that one of significant magnitude will occur. Historically, no infrastructure of Bernalillo County, or any of the participating jurisdictions have been impacted by earthquakes.

4.7.3 Location

Though not nearly as intense or as numerous as in some other parts of the world, earthquakes have occurred in New Mexico. In the last 115 years, New Mexico has experienced earthquakes with an estimated magnitude as high as 6.5 (1906). In 1935 and 1966, earthquakes with a magnitude of 5.5 caused damage to homes and schools. A seismic event would generally affect the planning area similarly as the effects are widespread. Figure 4-14 below depicts seismic risk across the state. It shows a low to moderate risk (yellow area on the map) in the central part of the state including Bernalillo County. The spatial extent of a potential earthquake would be large. Areas in blue are at the lowest risk.

Figure 4-14 National Seismic Hazard Map – 2% in 50 years Probability of Exceedance



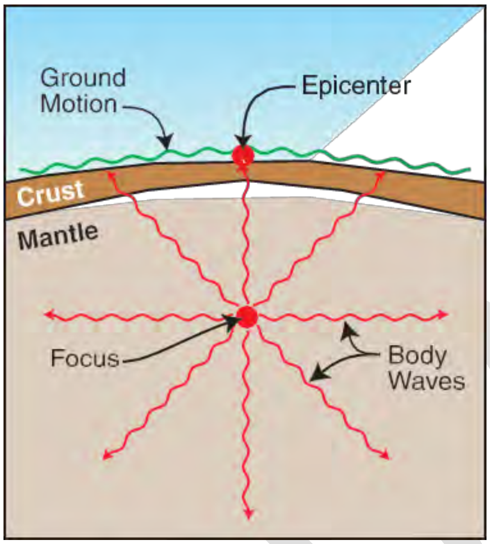
Source: USGS, https://www.usgs.gov/media/images/2018-long-term-national-seismic-hazard-map

4.7.4 Magnitude/Severity

The Richter scale is a logarithmic magnitude scale that defines magnitude in terms of the motion that would be measured by a standard type of seismograph. On the Richter scale, magnitude is expressed in whole numbers and decimals. The scale is logarithmic, meaning that for every increase of 1.0 on the Richter scale, the energy released by the earthquake increases 10-fold. In more qualitative terms, an earthquake of 5.0 is a moderate event, 6.0 is a strong event, 7.0 is a major earthquake, and 8.0 or higher is catastrophic.

The Moment Magnitude Scale is the current scale used to quantify the magnitude or strength of the seismic energy released by an earthquake. The effect of an earthquake on the earth's surface is called the intensity. In the U.S., the most commonly used intensity scale is the Modified Mercalli Intensity Scale (MMI).

Figure 4-15 Definition Sketch for Earthquake



Source: Understanding Your Risks – FEMA Publication 386-2, page 2-16.

Another way to express earthquake severity is through peak ground acceleration (PGA) which compares the rate at which the ground surface accelerates due to an earthquake's force with the rate of acceleration experienced by a falling object due to gravity (g). PGA measures the strength of ground movements in this manner. Although the specific damages caused by different magnitudes of earthquakes are listed in the table below Table 4-23, generally when the PGA exceeds 15%, significant damage will occur. Table 4-23 also shows the relationship between PGA, magnitude, and intensity. (For the most accurate picture of risk, locational variables such as the distance from the epicenter and depth of the epicenter would need to be factored in as well.)

Table 4-23 Earthquake Magnitude/Intensity Comparison

PGA (% g)	Magnitude (Richter)	Intensity (MMI)	Description
<0.17	1.0 - 3.0	I	I. Not felt except by a very few under especially favorable conditions.
0.17 - 1.4	3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. 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.

PGA (% g)	Magnitude (Richter)	Intensity (MMI)	Description
1.4 - 9.2	4.0 - 4.9	IV - V	IV. 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. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 - 34	5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. 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.
34 - 124	6.0 - 6.9	VII - IX	VIII. 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. 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.
>124	7.0 and higher	VIII or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: Wald, D., et al., 1999, "Relationship between Peak Ground Acceleration, Peak Ground Motion, and Modified Mercalli Intensity in California," Earthquake Spectra, v. 15, p. 557 – 564.
USGS Magnitude/Intensity Comparison http://earthquake.usgs.gov/learn/topics/mag_vs_int.php Accessed July 2014.

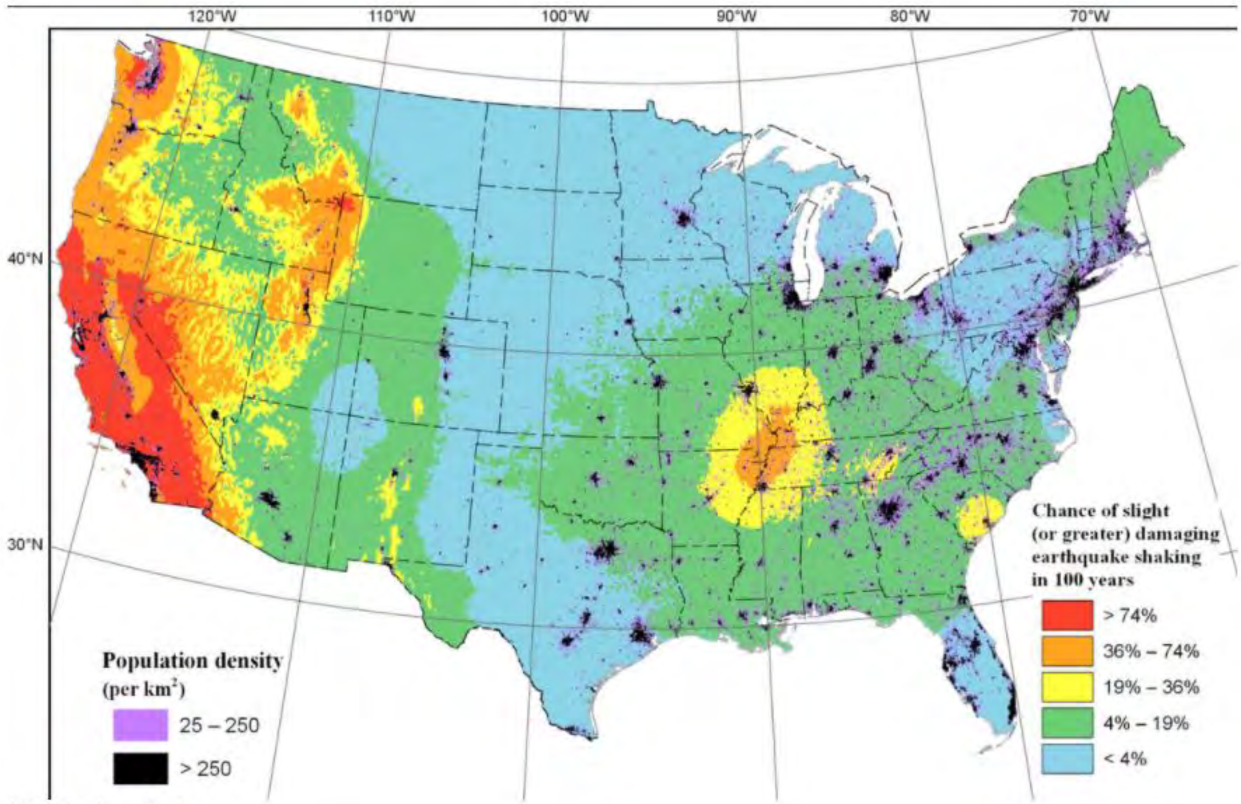
4.7.5 Climate Change Considerations

Climate change is not expected at this time to have any impacts on geological hazards such as earthquakes. There is potential for increased heat and reduced soil moisture to contribute to the instability of regional soils. In theory, these subtle changes to the surface of the earth could affect the damage profile of local earthquake events in the future. However, it is unlikely that earthquake events in will be affected by climate change in a measurable way.

4.7.6 Probability of Future Events

Given the relatively rare past occurrence and moderate risk in magnitude of earthquakes to the planning area, the probability of a future event is "Unlikely". However, earthquakes are nearly impossible to predict and the consequences can be devastating. The map below shows a 2018 chance-of-damage map for 100 years developed by the USGS with population density superimposed; Bernalillo County is mostly in the 19%-36% category.

National Seismic Hazard Map – Chance of Damaging Earthquake Shaking in 100 Years



Source: USGS https://www.usgs.gov/media/images/2018-nshm-chance-shaking-image

4.7.7 Vulnerability Assessment

The most appropriate risk assessment methodology for seismic hazards involves scenario modeling using FEMA's HAZUS loss estimation software. HAZUS is a regional earthquake loss estimation model developed by FEMA and the National Institute of Building Science. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake loss at a regional scale. HAZUS is a very useful planning tool because it provides a standard method for estimating earthquake damage, loss of function of infrastructure, and casualties, among many other factors. There are three levels of HAZUS analysis, from Level 1, which uses the default FEMA-derived datasets and damage functions, to Level 3, which uses independently compiled and accurately verified structure and infrastructure inventories and damage functions.

Utilizing HAZUS 4.2, FEMA's loss estimation and hazard modeling software, a Level 1 earthquake loss analyses was conducted for Bernalillo County as part of the 2020 plan update, based on an inventory database compiled at a national level aggregated to Census Tracts. As with any model there are uncertainties, and the results should be considered approximate for planning purposes.

To evaluate potential losses associated with earthquake activity in the planning area, a HAZUS 2,500-year probabilistic scenario was run for the entire County. The methodology utilizes probabilistic seismic hazard contour maps developed by the U.S. Geological Survey (USGS). The 2,500-year return period analyzes ground shaking estimates from the various seismic sources in the area with a 2 percent probability of being exceeded in 50 years. It is not based on a single magnitude event but is representative of strong levels of ground shaking.

People

Casualties: Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related injuries result from collapsing walls, flying glass, and falling objects as a result of the ground shaking, or people trying to move more than a few feet during the shaking. HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four severity levels that describe the extent of the injuries. The levels are described as follows:

- Severity Level 1: Injuries will require medical attention, but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening.
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is at its maximum. The 2:00 PM estimate considers that the educational, commercial, and industrial sector loads are at their maximum. The 5:00 PM represents peak commute time. The model shows that the 2:00 PM would result in the most casualties. Most of these would be minor injuries (2,376 Level 1 and 561 Level 2), and 83 hospitalization (Level 3) and 160 fatalities (Level 4) are estimated.

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates that approximately 6,119 households will be displaced due to the earthquake, and 4,035 people will seek temporary shelter in public shelters.

General Property

There are an estimated 241,000 buildings in the County with a total building replacement value (excluding contents) of $64 Billion. In terms of building construction types found in the HAZUS region, wood frame construction makes up 65% of the building inventory.

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents.

The categories of damages defined by HAZUS are:

- Slight damage includes diagonal hairline fractures on most shear wall surfaces and hairline cracks on most infill walls.
- Moderate damage includes cracks on most walls and failure of some shear walls.
- Extensive damage means that most shear wall surfaces in the structure have reached or exceeded their capacity exhibited by large, through-the-wall diagonal cracks.
- Complete damage means that the structure has collapsed or is in danger of collapse.

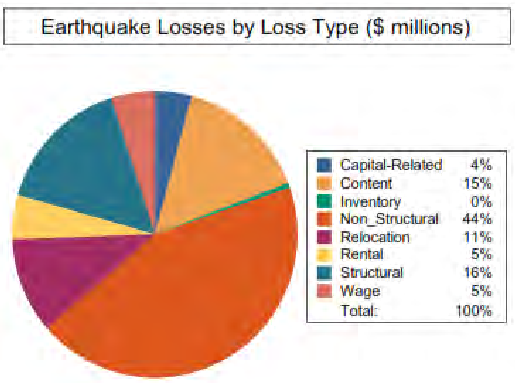
HAZUS estimates that about 59,546 buildings will be at least moderately damaged. This is over 25% of the total number of buildings in the County. There are 2,729 buildings that will be damaged beyond repair. Most of the damage modeled as extensive and complete is associated with unreinforced masonry buildings.

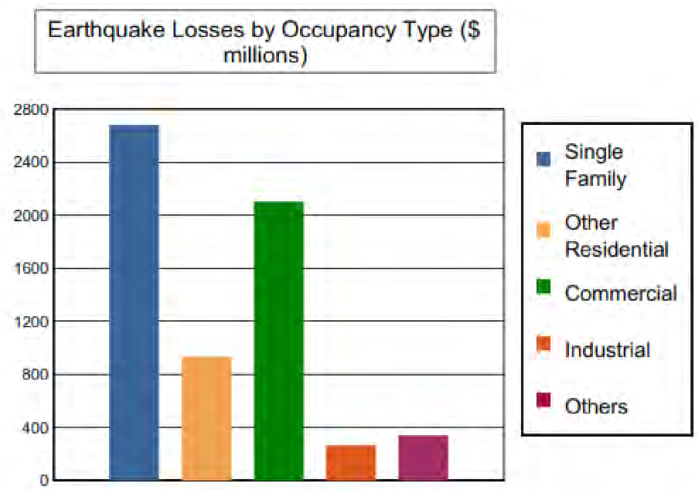
The total building-related losses were $6.3 billion, with detail shown in Table 4-24. By far, the largest loss was sustained by the residential occupancies which made up over 57% of the total loss.

Table 4-24 Building Related Economic Loss Estimates in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	19.7748	270.7511	7.2452	15.2635	313.0346
	Capital-Related	0.0000	8.4247	244.5809	4.3114	3.3445	260.6615
	Rental	94.7437	65.7151	140.0947	2.8189	9.8450	313.2174
	Relocation	335.8477	57.2987	215.1249	16.4589	60.1335	684.8637
	Subtotal	**430.5914**	**151.2133**	**870.5516**	**30.8344**	**88.5865**	**1571.7772**
Capital Stock Losses							
	Structural	469.9300	126.4936	292.8152	45.7366	55.5150	990.4904
	Non_Structural	1361.6156	534.9430	640.7570	108.7897	135.7573	2,781.8626
	Content	418.3016	121.7806	289.2481	67.9235	60.1198	957.3736
	Inventory	0.0000	0.0000	7.9520	11.8631	0.3986	20.2137
	Subtotal	**2249.8472**	**783.2172**	**1230.7723**	**234.3129**	**251.7907**	**4749.9403**
	Total	**2680.44**	**934.43**	**2101.32**	**265.15**	**340.38**	**6321.72**

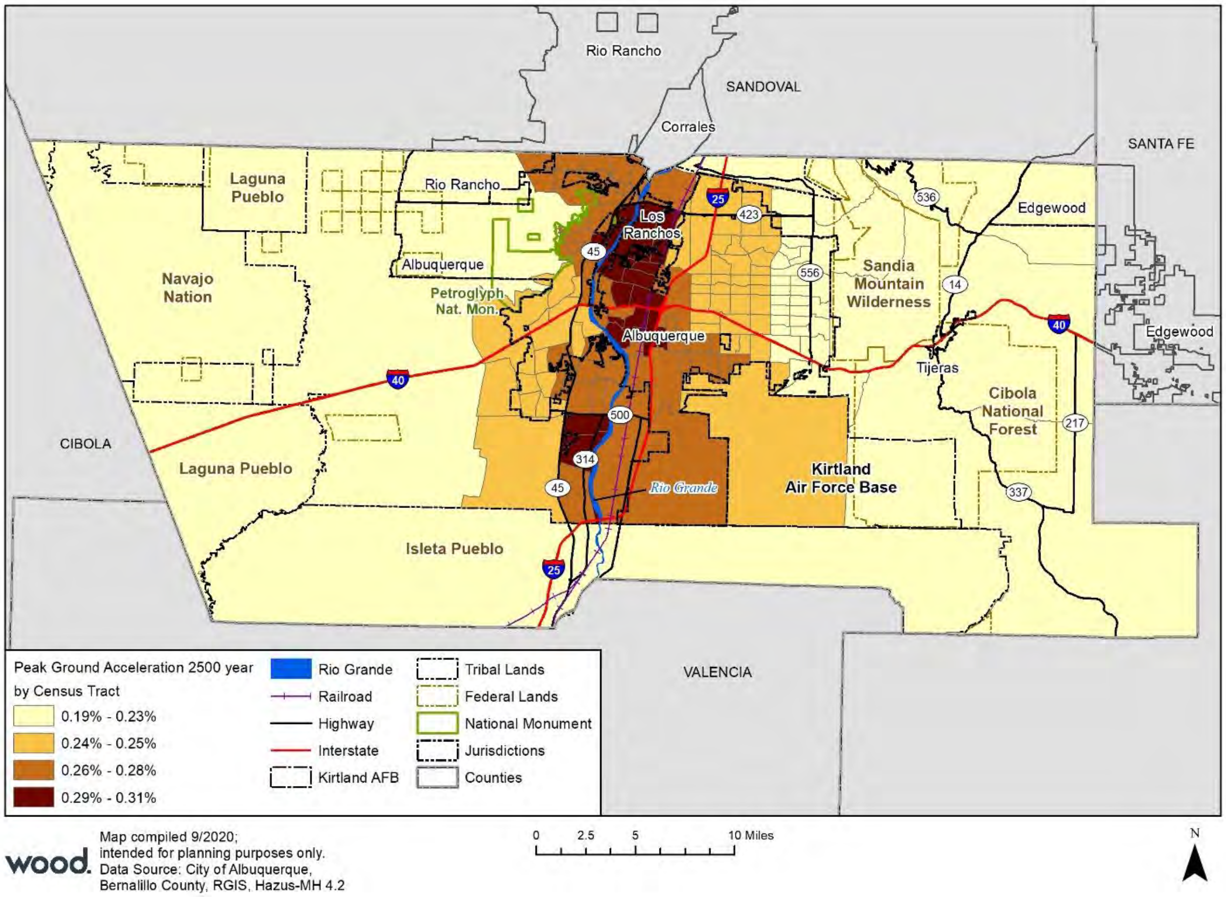
Figure 4-16 Earthquake Losses by Type





The following map depicts the ground shaking levels at the census tracts in the planning area.

Figure 4-17 2500 Year Probabilistic Peak Ground Acceleration by Census Tract



Critical Facilities and Infrastructure

Critical Facility Inventory: HAZUS breaks critical facilities into two groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites. Earthquakes could impact AMAFCA facilities by buckling and cracking channelized arroyos/diversion channels and causing structural damage to levees and dams.

Essential Facility Damage: The model estimates the region had 2,020 hospital beds total, and due to the earthquake only 526 (26%) would be available for use. After one week 49% of the beds will be back in service. The model predicted there would be at least moderate damage to 8 hospitals, 65 schools, 3 police, 9 fire stations, and 1 EOC.

Transportation Systems Inventory: Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are 7 transportation systems that include highways, railways, light rail, bus, ports, ferry, and airports. The transportation systems inventory includes over 418 miles of highways and 297 bridges. The model estimated approximately $25 million in damage to transportation systems, mostly to bridges and road segments.

Utility Lifeline Systems Inventory: There are 6 utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power, and communications. The replacement value of the utility lifeline systems combined is estimated to be $687 Million, and related economic losses to these systems would be around $32 Million, with the largest losses to potable water, wastewater and electrical power systems.

Government Services

Damage to government facilities and infrastructure from a major earthquake would likely interrupt or delay the ability of local governments to delivery of services and could require temporary relocation of some operations. Regulatory waivers may be needed locally. Fulfillment of some contracts may be difficult.

Responders will initially experience similar impacts as the general public. However, in the aftermath of a major earthquake responders would likely be put in very hazardous circumstances as they attempt to save lives, protect property, and deliver essential services.

Public confidence in government may be challenged by the public if planning, response, and recovery are not timely and effective.

Economy

The total economic loss estimated for the earthquake modelled above is $6.3 billion, which includes building and lifeline related losses based on the County's available inventory. Twenty five percent ($1.5 billion) of the losses are estimated to result from business interruption.

Historic, Cultural and Natural Resources

Earthquake effects on the environment, natural resources, and historic and cultural assets would likely be minor. The biggest impact would likely be on the older historic properties constructed with unreinforced masonry. Unreinforced masonry and adobe structures built before current building codes are more susceptible to damage than other types of structures built to seismic-resistant codes.

Future Land Use and Development

Future development built in accordance with modern building codes should be less susceptible to earthquake damage. The City of Albuquerque requires designation of the seismic zone category for all commercial permits with structural implications and the 2015 International Building Code (IBC), International Residential Code (IRC), and International Existing Building Code (IEBC) have been adopted. For example, when submitting a permit to the Albuquerque Planning Department Building Safety Division for new construction or a change in occupancy, the applicant must adhere to the seismic zone and an engineer has to determine appropriate seismic category according to the function of buildings, use and types of soil and build to 2015 IBC requirements accordingly.

4.7.8 Jurisdictional Differences

Earthquake	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Unlikely	Extensive	Critical	Medium
Albuquerque	Unlikely	Extensive	Catastrophic	Medium
Los Ranchos	Unlikely	Extensive	Catastrophic	High
Tijeras	Unlikely	Significant	Critical	Medium
AMAFCA	Unlikely	Extensive	Catastrophic	High
MRGCD	Unlikely	Extensive	Critical	Medium
ABCWUA	Unlikely	Extensive	Critical	Medium

HAZUS does not break out loss by jurisdiction, but areas in Bernalillo County with high population densities and large numbers of structures and critical facilities are expected to experience greater damage and loss from an earthquake event, particularly the City of Albuquerque. Communities located in the central part of the County will experience the greatest level of shaking and may experience differential impacts from an earthquake event if transportation or utility infrastructure is damaged and prevents communities from responding or evacuating. The impact is likely to be less in the East Mountains and the Village of Tijeras. Due to the nature of AMAFCA's assets, the potential severity of an earthquake is higher.

4.7.9 Risk Summary

Earthquakes with epicenters in or near Bernalillo County have been detected in the past, although they have historically been small, and damage has been relatively minor. The overall significance of earthquakes is Medium due to low probability but the potential for high economic losses.

- A large earthquake occurring in or near the County could result in injuries, property damage, and disruption of normal government, community services and activities, and economic and business activity.
- The HAZUS 2,500-year probabilistic scenario modeling of strong ground shaking estimates approximately $6.3 B in total economic damages, and significant casualties and sheltering needs. Economic losses to utility lifeline systems would be around $32 million, with the largest losses to water, wastewater and electrical power systems.
- Earthquakes can cause many cascading effects such as fires, dam incidents, hazardous materials spills, landslide and debris flows, utility disruptions, and transportation emergencies.
- Related hazards: Landslide, Dam Failure, Subsidence.

4.8 Extreme Heat

4.8.1 Description

Extreme heat is typically defined as temperatures that hover 10 degrees or more above the average high temperature for the region and that last for an extended period of time. Humid conditions may also add to the discomfort of high temperatures. Health risks from extreme heat can include heat cramps, heat fainting, heat exhaustion, and heat stroke.

According to the National Weather Service, heat is the leading weather-related killer in the United States and kills hundreds of people every year, primarily during prolonged heat waves in large cities that rarely experience hot weather. While extreme temperatures threaten human health, they typically do not cause significant damage to the built environment. The elderly and the ill are most at-risk, along with those who exercise outdoors in hot, humid weather.

Extreme heat can exacerbate the frequency, severity, and impacts of drought, as discussed on Section 4.4.

4.8.2 Past Occurrences

The 2018 State Plan reports that that in New Mexico, at elevations at or below 5,000 feet, individual day-time temperatures often exceed 100°F during the summer months. However, during July, the warmest month, temperatures range from slightly above 90°F in the lower elevations to 70°F in the higher elevations.

NCEI data lists four reported episodes of extreme heat between 2000-2020 resulting in two deaths and one injury, all involving young children left unattended in vehicles. These events are detailed below:

July 14, 2010 – A 2-year-old died after being left in a hot car for almost four hours at Southwestern Indian Polytechnic Institute. By noon MST, the outside air temperature was 93 degrees which may have resulted in temperatures exceeding 135˚F in the vehicle.

August 6, 2012 – An Albuquerque toddler died after being left inside a car for at least 8 hours. The boy was found Monday afternoon inside the car and was pronounced dead later at the hospital. High temperature recorded at the Albuquerque International Sunport was 93 ˚F.

June 10, 2013 – A seven-month-old boy was in critical condition after being left inside a hot car for more than two hours during the afternoon of Monday, June 10th. Temperatures around the city at the time of the incident were in the upper 90s to low 100s. Albuquerque Sunport recorded a maximum temperature of 99˚F, which tied the record maximum temperature for the date last observed in 1981.

June 20, 2017 – High temperatures across the Albuquerque Metro area ranged from 100 to 106 degrees on four consecutive days. The hottest temperature at the Albuquerque Sunport reached 103 degrees on June 22nd. A record high minimum temperature of 76˚F was set on June 22nd, breaking the previous record of 74˚F from 2015.

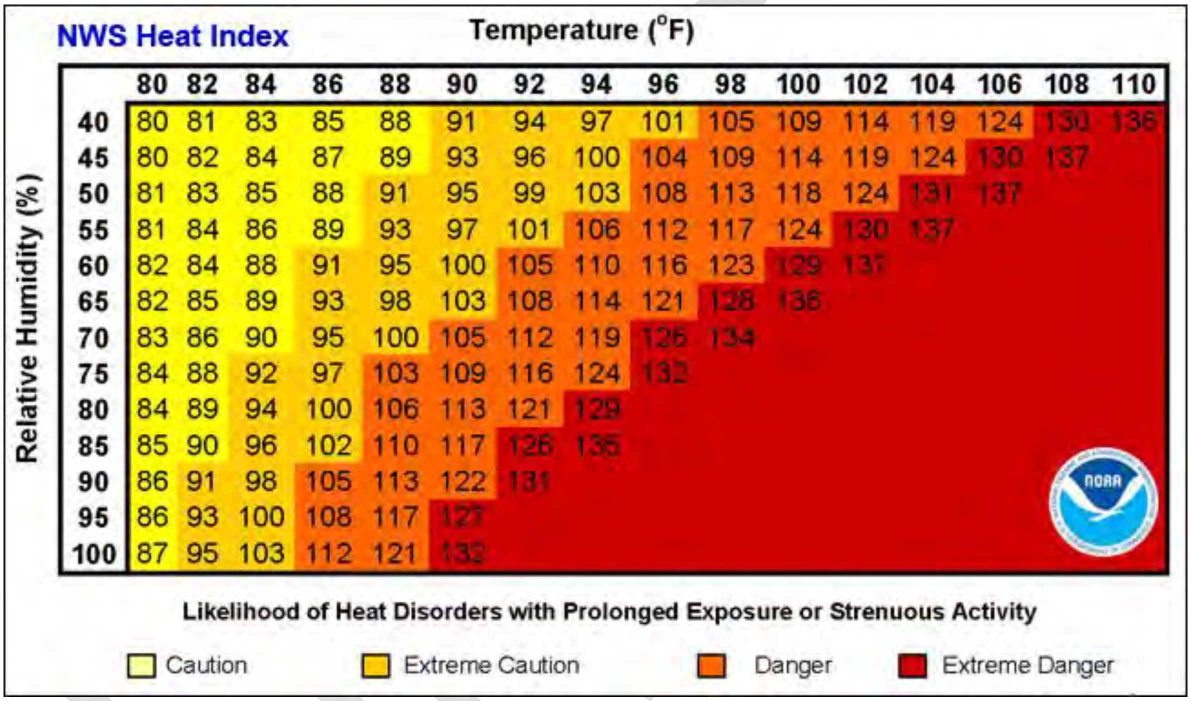
4.8.3 Location

Extreme heat is regional in nature, and the entire planning area is equally subject to extreme heat. However, more heavily urbanized areas can experience pockets of heightened temperatures due to surfaces such as roads and roofs absorbing and retaining heat and becoming hotter than the surrounding air temperature. This process is known as the urban heat island effect. Trees and vegetation can mitigate this effect and lower surface and air temperatures by providing shade and through evapotranspiration. For example, per the EPA, shaded surfaces may be 20–45°F cooler than the peak temperatures of unshaded materials. Evapotranspiration, alone or in combination with shading, can help reduce peak summer temperatures by 2–9°F. Therefore, neighborhoods with street trees and buildings shaded by trees or vines may be less susceptible to heat.

4.8.4 Magnitude/Severity

Heat conditions are a product of ambient air temperature and relative humidity. Humidity increases the feeling of heat as measured by heat index. The Heat Index, shown in **Error! Reference source not found.**, can be used to gauge the severity of heat conditions. The shaded zone above 105°F corresponds to a heat index that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

Figure 4-18 Heat Index



NWS Heat Index

Temperature (°F)

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										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: National Weather Service

The National Weather Service Heat Index provides a measure of the extent of typical health impacts of exposure to heat, summarized in Table 4-25. During these conditions, the human body has difficulty cooling through the normal method of the evaporation of perspiration, and health risks rise.

Table 4-25 Typical Health Impacts of Extreme Heat by Heat Index

Heat Index	Disorder
80-90° F	Fatigue possible with prolonged exposure and/or physical activity
90-105° F	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105-130° F	Heatstroke/sunstroke highly likely with continued exposure

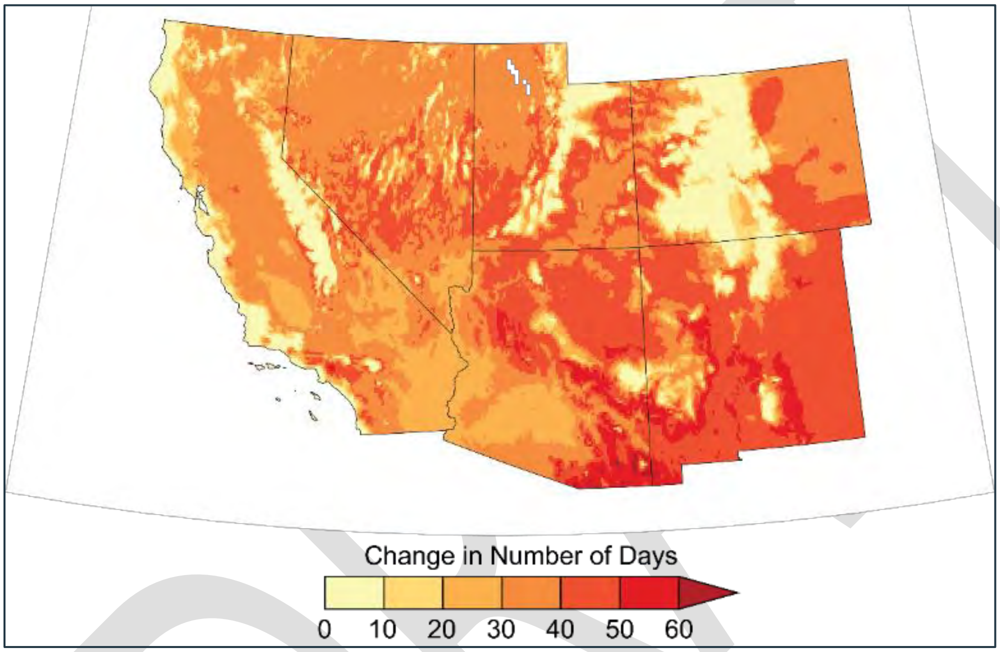
Source: National Weather Service Heat Index Program, www.weather.gov/os/heat/index.shtml

Although lower relative humidity contributes to a lower overall heat index, excessively dry and hot weather can also be dangerous. These conditions can cause dust storms and low visibility and can contribute to more severe drought as well as dangerous fire conditions. Additionally, direct sun exposure can increase heat index values by up to 15°F. Any extended period with temperatures above 90°F can be hazardous and cause for concern; however, the participating jurisdictions consider the overall impact of heat to be minor.

4.8.5 Climate Change Considerations

Extreme heat is expected to become more frequent in the Southwest. Figure 4-19 shows projected increases in extreme heat as an increase in the number of days per year when the temperature exceeds 90°F by the period 2036-2065 compared to the period 1976-2005. According to these projections, under the higher emissions scenario (RCP8.5), the number of days of extreme heat could increase in the Albuquerque Metro Area by as much as 40 to 50 days.

Figure 4-19 Projected Increases in Extreme Heat

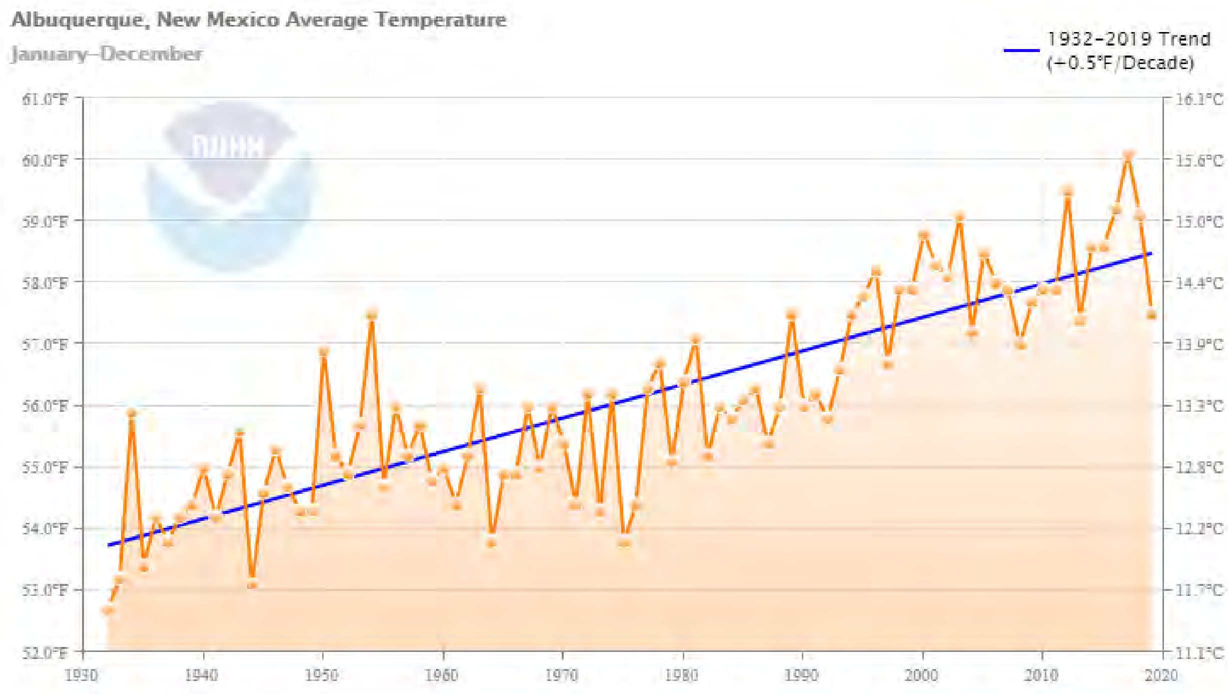


Source: Fourth National Climate Assessment *Based on higher emission scenario RCP8.5

4.8.6 Probability of Future Events

Error! Reference source not found. shows the trend in average annual temperature from 1930 to 2020.

Figure 4-20 Average Annual Temperature, City of Albuquerque 1930-2020



Source: NOAA Climate at a Glance

Based on NCEI records of heat from 2000 to 2020, there is a 20 percent annual probability of a significant heat event resulting in injury or death. Given the trends in average temperature showing an increase of approximately 0.5˚F per decade, extreme heat may become more likely in the future. Based on past events, current trends, and climate change projections, the probability of extreme heat occurring in the future is likely, defined as a 10-50% annual chance of extreme heat.

4.8.7 Vulnerability Assessment

People

Impacts on public health are a primary concern during extreme heat events. Heat stroke is the most serious heat-related disorder. It occurs when the body becomes unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. This condition can cause death or permanent disability if emergency treatment is not given.

Extreme heat presents a considerable safety risk to Bernalillo County's vulnerable populations. Heat casualties are usually caused by a lack of adequate air conditioning or heat exhaustion. The most vulnerable populations to heat are the elderly or infirmed, who frequently live on low fixed incomes and cannot afford to run air conditioning on a regular basis. The elderly may also be isolated with no immediate family or friends to look out for their well-being. Young children are also extremely vulnerable to heat, particularly when left unattended in the elements or in cars.

General Property

Buildings, infrastructure, and critical facilities are not considered vulnerable as the impact on these facilities would be minor with no disruption of services. Therefore, any estimated property losses are anticipated to be minimal across the area.

Critical Facilities and Infrastructure

Prolonged heat exposure can have significant impacts on infrastructure. Prolonged high heat exposure increases the potential of pavement deterioration, as well as railroad warping or buckling. High heat also puts a strain on energy systems and consumption, as air conditioners and swamp coolers are run at a higher rate and for longer. Extreme heat can also reduce transmission capacity over electric systems.

Government Services

Extended power outages resulting from extreme heat affect the delivery of government services in the absence of backup power sources. During an extended extreme heat event, the public would expect alerts and warnings as well as cooling shelters from the government.

Responders are as vulnerable to the effects of extreme heat as the general population and may receive increased calls during extended periods of extreme heat.

Economy

Extreme heat could cause short-term economic impacts such as direct and indirect losses due to temporary sheltering. Elevated demand for energy sources will increase individuals' cooling costs and may also affect rates. Long-term effects include potential lasting impacts on agriculture and energy sectors.

Historic, Cultural and Natural Resources

Similar to drought, extreme heat can have direct health impacts on plants, wildlife, and livestock. Heat may result in shrinking food supplies and damage to habitats. Increased stress on endangered species could cause extinction. Reduced food supply can also drive wildlife into greater proximity with humans.

Future Land Use and Development

Future development in urban areas could affect the frequency of extreme heat events due to the potential to increase urban heat island effects. Buildings are not usually directly impacted by extreme heat; therefore, new development will not necessarily increase extreme heat risk. However, population growth associated with new development would raise the overall population exposure and potentially increase the strain on existing utility infrastructure unless sufficient concurrent utility expansions are made.

The use of resilient design and construction, such as green buildings that require less energy to cool, use of good insulation on pipes and electric wirings, and smart design of walkways, parking structures, pedestrian zones, and landscaping to minimize exposure to extreme heat may help reduce vulnerability of the built environment and the individuals who use it.

4.8.8 Jurisdictional Differences

Extreme Heat	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Likely	Significant	Negligible	High
Albuquerque	Likely	Extensive	Negligible	Medium
Los Ranchos	Likely	Significant	Negligible	Medium
Tijeras	Occasional	Significant	Negligible	Low
AMAFCA	NA	NA	NA	NA
MRGCD	Occasional	Significant	Significant	Medium
ABCWUA	Occasional	Significant	Negligible	Medium

As noted under the Location subheading, more heavily urbanized areas, such as Albuquerque and Los Ranchos can experience impacts of urban heat island effect compared the less dense and more vegetated areas of the county. The East Mountain area is significantly less vulnerable to extreme heat.

The types of flood control and water quality facilities within AMAFCA's jurisdiction are not susceptible to this hazard.

4.8.9 Risk Summary

- The main focus of mitigation for extreme heat is to activate shelters in Bernalillo County during times of extreme heat to serve as public cooling centers. During extreme heat episodes, the elderly should seek shelter in air-conditioned spaces.
- Albuquerque and Los Ranchos are more susceptible due to urban heat island effects.
- Green infrastructure, planning and zoning, and urban forestry considerations can help mitigate extreme heat impacts.
- Related hazards: Drought

4.9 Flood

4.9.1 Description

Floods involve inundation of normally dry land or other areas. Floods can cause substantial damage to structures, landscapes, and utilities, as well as cause life safety issues. Certain related health hazards are also common to flood events. Standing water and wet materials in structures can become breeding grounds for microorganisms such as bacteria, mold, and viruses. This can cause disease, trigger allergic reactions, and damage materials long after the flood. When flood waters contain sewage or decaying animal carcasses, infectious disease becomes a concern. Direct impacts to populations such as drowning can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts.

The three types of flooding are of the most concern in the planning area are flash flooding, stormwater drainage, and riverine flooding.

Flash flood. A flash flood is a very dynamic event in which a large volume of water moves through an area at high velocity in a very short time. This type of flooding can be very difficult to predict and can occur with little or no warning. In many cases flash floods can move through an area miles away from where rain has occurred, thereby increasing the danger to persons within the flood's path.

Flash floods are created as a result of rainfall. As rainwater runs into small channels, it begins to collect. As these channels merge together, the amount of water increases and picks up speed and force. This collection of water becomes a wall of water that can wash vegetation, structures, and other debris along with it. This debris then increases the amount of force available and increases its destructive power. In addition to the amount of water that creates a flash flood, other factors also affect the dynamics of this type of flood including slope, width, and vegetation that is in place along the banks of the water course. The slope that a flash flood traverses has a definite relation to the overall speed in which the water will travel. The steeper the incline, the faster the water will travel. The incline on which the water moves affects the width of the flooding area.

Generally, the faster the water moves, the narrower the channel will be created, since the water digs the channel deeper as it flows. When the water flows on a shallower slope, the water tends to spread out more, which can decrease its potential to cause mass damage. However, it must still be considered dangerous.

Finally, the type of vegetation located along the flood's path can prevent further erosion of the channel banks. A structure that lies along a flood channel that has no surrounding vegetation is at risk of having its foundation undercut, which can cause structural damage, or in some cases, a building's complete collapse. The hazard and risk from flash floods are greatly increased in areas downstream from lands that have recently experienced wildfire (see Section 4.18 for more detail).

Stormwater Drainage. As rain falls on any given area, some of the water will be absorbed into the ground. However, the water that is not absorbed or ponded on site will run off. Depending on the area's flatness and the presence of a storm drainage system, this water can create localized flooding. Since the water will flow to the lowest possible location, these areas become temporary holding ponds. The water then evaporates back into the atmosphere, is absorbed back into the earth, or is physically removed using pumps or other equipment. Depending on the angle of the slope, passing storm waters develop a tremendous amount of force. In such instances these waters can damage structures, push debris in front of them much like a flash flood, and cause soil erosion.

Riverine Flooding. The Rio Grande flows southward through the center of Bernalillo County, with the land rising on both sides of the river and forming mesas at elevations above 5,000 feet. To the east, the Sandia and Manzano Mountains rise to a maximum elevation of 10,678 feet and parallel the Rio Grande. The valley and mesa areas are arid, with an average annual precipitation near 8 inches. In the mountains, average precipitation ranges from 15 to 30 inches, generally increasing with elevation. The climate is classified as arid continental, characterized by fairly hot summers, mild winters, and short, temperate spring and fall seasons. Approximately half of the precipitation falls as summer rains during brief, but often intense, thunderstorms. Winter precipitation falls as either rain or snow and is caused by frontal activity associated with storms moving across the country from the Pacific Ocean.

Although the Rio Grande River is protected by a levee system, some deteriorated conditions throughout the system have left areas of Bernalillo County susceptible to flooding. The river flow is also controlled by dams upstream. The amount of water flowing through a river at any given time determines the river's depth. When a higher than normal amount of water finds its way into a river or stream, the height of the water relative to its path increases. When this occurs, the river will overflow its normal banks and flood the surrounding area to the water's present height. The height of the river's banks determines how far out a flood will spread. This type of flooding, like flash flooding, will begin at some point above where the flooding occurs. In the Bosque along the Rio Grande, jetty jacks have been installed to capture debris. The jetty jacks can also be a hindrance to fire-fighting operations.

In Bernalillo County, there are seasonal differences in the causes of floods. In the winter and early spring (February to April), major flooding has occurred because of heavy rainfall on dense snowpack throughout contributing watersheds. During most winters, the snowpack is generally moderate and associated flooding is infrequent. Summer floods are more frequent and generally are the result of summer thunderstorms that deposit large quantities of rainfall over a short period of time, causing localized flooding. Flash floods peak during the Southwest Monsoon (or "North American Monsoon") season of July and August.

Flash floods are more likely to occur in places with steep slopes and narrow stream valleys, and along small tributary streams. In urban areas, parking lots and other impervious surfaces that shed water rapidly contribute to flash floods. In rugged, hilly, and steep terrain, the high-velocity flows and short warning time make flash floods hazardous and very destructive. In the arid environments of the southwest, steep topography, sparse vegetation, and infrequent precipitation in the form of intense thunderstorms typify the flash flood hazard areas.

Erosion can play a large role in flash floods. Extensive erosion damage can occur with major flooding. Erosion results in access disruption, road closures, driving hazards, drainage facility damage and blockage, and sedimentation. Erosion can occur rapidly during a storm event or can occur over time due to minor storms or breaks in water lines. Accelerated soil erosion has created problems ranging from loss of productive agricultural soil to displacement of human structures to sediment buildup in water reservoirs. Water erosion is one of the most common geologic phenomena. The detachment and transportation of soil particles by water can cause sheet erosion, rill erosion, or gully erosion. Sheet erosion occurs with soil being removed in a uniform manner across the surface but is often accompanied by tiny channels cut into the surface creating rill erosion. Where the volume of runoff water is more concentrated, larger channels or gullies may occur within the landscape, creating gully erosion. Rill and gully erosion can cause serious land use problems. Storm events in New Mexico can result in flash floods which also creates serious rill and gully erosion.

Incorporated and unincorporated areas of Bernalillo County were re-studied in 2012; further re-studies resulted in a revised FIRM and Flood Insurance Study (FIS) in 2016. The resulting updated FIRM maps have an effective date of 11/04/2016.

4.9.2 Past Occurrences

According to the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI), there have been 78 reported flood events in Bernalillo County from July 10, 1996 (the earliest recordings of floods in the County in the Storm Events Database) through July 26, 2018 in Table 4-26. Additional reported flooding events are shown in Table 4-27.

Table 4-26 NCEI Reported Flood Events

Location	Date	Event Type	Property Damage
Albuquerque	7/10/1996	Flash Flood	0
Tijeras	7/10/1996	Flash Flood	$35,000
Albuquerque	7/28/1997	Flash Flood	$100,000
Albuquerque	7/25/1998	Flash Flood	$30,000
Albuquerque	6/16/1999	Flash Flood	$1,200,000
Albuquerque	8/2/1999	Flash Flood	0
Albuquerque	8/2/1999	Flash Flood	0
Tijeras	8/8/1999	Flash Flood	0
Albuquerque	7/20/2002	Flash Flood	0
Albuquerque	7/12/2004	Flash Flood	0
Albuquerque	8/4/2004	Flash Flood	0
ABQ Airport	7/17/2005	Flash Flood	0
Albuquerque	8/13/2005	Flash Flood	0
Albuquerque	7/8/2006	Flash Flood	0
Albuquerque	7/31/2006	Flash Flood	$100,000
Albuquerque	8/6/2006	Flash Flood	0
Albuquerque	8/6/2006	Flash Flood	0
Albuquerque	8/13/2006	Flash Flood	0
Albuquerque	8/18/2006	Flash Flood	0
Albuquerque	7/31/2007	Flash Flood	$4,000
Hahn	7/19/2008	Flash Flood	$500
Hahn	7/21/2008	Flash Flood	$2,000
ABQ Airport	7/22/2008	Flash Flood	$20,000
Albuquerque	8/4/2008	Flash Flood	$1,000
Albuquerque	8/4/2008	Flash Flood	$500

Location	Date	Event Type	Property Damage
Hahn	8/8/2008	Flash Flood	$300,000
Adobe Acres	8/16/2008	Flash Flood	$50,000
Carnuel	7/21/2009	Flash Flood	$2,000
Albuquerque	9/9/2009	Flash Flood	$1,000
Carnuel	7/24/2010	Flash Flood	$1,000
Albuquerque	7/28/2010	Flash Flood	$4,000
Carnuel	7/28/2010	Flash Flood	$1,000
ABQ Airport	7/31/2010	Flash Flood	$5,000
Carnuel	9/22/2010	Flash Flood	0
Albuquerque	7/24/2012	Flash Flood	$2,000
Paradise Hills	7/8/2013	Flash Flood	$20,000
ABQ International Airport	7/8/2013	Flash Flood	$50,000
Double Eagle II Airport	7/14/2013	Flash Flood	0
Carnuel	7/19/2013	Flash Flood	$10,000
Albuquerque	7/19/2013	Flash Flood	$1,000
Kirtland AFB	7/19/2013	Flash Flood	0
Escabosa	7/20/2013	Flash Flood	0
Albuquerque	7/25/2013	Flash Flood	0
ABQ International Airport	7/26/2013	Flash Flood	0
Paradise Hills	7/26/2013	Flash Flood	0
Albuquerque	7/26/2013	Flash Flood	$50,000
Albuquerque	7/26/2013	Flash Flood	$2,600,000
Albuquerque	7/26/2013	Flash Flood	$10,000
Paradise Hills	7/26/2013	Flash Flood	$5,000
Sandia Park	8/9/2013	Flash Flood	0
Bernalillo County	9/1/2013	Flash Flood	$5,000
Bernalillo County	9/14/2013	Flash Flood	$60,000
ABQ International Airport	7/8/2013	Flash Flood	$50,000.00
Paradise Hills	7/8/2013	Flash Flood	$20,000
Double Eagle II Airport	7/14/2013	Flash Flood	0
Carnuel	7/19/2013	Flash Flood	$10,000
Albuquerque	7/19/2013	Flash Flood	$1,000
Kirtland AFB	7/19/2013	Flash Flood	$0
Escabosa	7/20/2013	Flash Flood	$0
Albuquerque	7/26/2013	Flash Flood	$60,000
Paradise Hills	7/26/2013	Flash Flood	$5,000
ABQ International Airport	7/26/213	Flash Flood	$0
Sandia Park	8/9/2013	Flash Flood	$0
Double Eagle II Airport	7/8/2014	Flash Flood	$0
Albuquerque	7/16/2014	Flash Flood	$0
ABQ International Airport	7/16/2014	Flash Flood	$200,000
Albuquerque	7/27/2014	Flash Flood	$0
ABQ International Airport	7/29/2014	Flash Flood	$2,000
Albuquerque	8/1/2014	Flash Flood	$1,090,000
Escabosa	7/2/2015	Flash Flood	$0
Albuquerque	9/22/2015	Flash Flood	$500,000
Chillili	7/25/2016	Flash Flood	$50,000
Albuquerque	7/30/2016	Flash Flood	$10,000
Kirtland AFB	7/30/2016	Flash Flood	$50,000
Chillili	8/3/2016	Flash Flood	$0

Location	Date	Event Type	Property Damage
Carnuel	8/4/2016	Flash Flood	$10,000
Albuquerque	7/17/2017	Flash Flood	$0
Albuquerque	7/26/2018	Flash Flood	$50,000
		Total	**$6,778,000**

Source: NCEI Storm Events Database

Table 4-27 Additional Reported Flood Events

Date	Location	Type of Impact	Estimated Losses
2006	COA Embudo Channel near Moon NE	concrete channel failure	$10,000*
2006	Embudo/I-40 Channel NMDOT	concrete channel failure	$500,000*
2006	COA Hahn Arroyo	concrete channel failure	$45,000*
2006	COA Embudo Channel near Moon NE	concrete channel failure	$75,000*
2006	Calabacillas Arroyo near Eagle Ranch	extreme erosion	$20,000*
2006	Calabacillas Arroyo near Eagle Ranch	pipe failure	$10,000*
2006	Calabacillas Arroyo McMahon private	extreme erosion	$8,000*
2006	Broadway Pump Station COA	force main failure	$1,600,000*
2006	Calabacillas Arroyo - Caliche Hills	extreme erosion	$20,000*
2006	Pino Arroyo Tanoan private	extreme erosion	$30,000*
August 2006	Tijeras Arroyo @ Los Picaros Road	extreme erosion	$25,000*
2007	North Pino Arroyo	concrete channel failure	$5,000*
2007	Raymac Dam Road	extreme erosion	$10,000*
July 2007	COA Embudo Channel near Moon NE	concrete channel failure	$100,000*
2008	Gun Club Ditch (MRGCD)	sediment/overtopping	$5,000*
August 2008	COA Embudito Channel	concrete channel failure	$5,000*
6/23/09	Embudo/North Diversion Channel	rescue	none
2009	Embudo/North Diversion Channel	drowning	loss of life
7/28/10	Embudo Arroyo near Morningside	rescue	none
9/23/10	Embudo /North Diversion Channel	drowning	loss of life
7/24/11	Embudo/North Diversion Channel	rescue	none
7/2/13	Embudo Channel near Moon	concrete channel failure	$50,000*
July 2013	NMDOT I-40/Embudo Channel	concrete channel failure	$100,000*
2013	Calabacillas Arroyo - Caliche Hills	extreme erosion	$10,000*
2013	Calabacillas Arroyo near Blacks	extreme erosion	$30,000*
2013 & 2014	closed South Broadway landfill	Mass wasting (slope failure/slumping)	n/a
July 2014	Gun Club Ditch (MRGCD)	overtopping	$5,000*

Source: AMAFCA and HMPT. * - estimates only

On September 22, 2015 a series of storms hit the Albuquerque metro area through the afternoon, causing lots of street flooding and uprooting a few trees. One person died as a result of strong flows within the arroyo channels despite best rescue efforts.

At the early part of the 2014 monsoon season, there was a heavy rainfall event that led to flash flooding in downtown Albuquerque on August 1st and a State Emergency Declaration. A Presidential Disaster Declaration in 2013, DR-4148, for severe weather with flooding and high winds from July 23-28 included Bernalillo County. Intense heavy rainfall from thunderstorms moving over the west side of Albuquerque forced mudslides up to 3 feet deep into the backyards of several homes along the Petroglyph National Monument. Some of this mud and water entered a few homes in the area. Roads were also reported as covered in mud. Record high wind gusts were recorded at 89 mph in the Albuquerque area and the sustained wind speed at the time was 64 mph. More than 30,000 homes lost power due to downed trees. Widespread tree and structural damage along with flooding resulted in over 3 million dollars in damages throughout the declared area.

In September 2013, there was flooding in North Albuquerque Acres and the East Mountain area. Types of damages reported were damage to yards/landscaping and one home with minor flooding due to poor lot development. Other reported flooding included a breached stock tank, and damage to yards, livestock, and propane tanks in the Juan Tomas Canyon Arroyo. There was also one reported flood rescue along the Juan Tomas Canyon Arroyo. Other reported flooded includes properties flooded west of the Sandia Pueblo at the railroad tracks.

In July of 2009, flooding was reported in the Carnuel area with one home flooded, most likely due to poor lot development. Heavy sediment removal from this flood was required from yards and roads. In July 2008, flooding in the South Broadway area impacted businesses in the area and damaged railroad tracks. Heavy sediment removal from roadways was required.

Downtown Albuquerque received some significant flooding in August 2006 when a series of thunderstorms hit the city on August 13, 2006. Flooding damaged several homes in two communities, including Barelas. The primary cause of this flooding was due to storm drainage system pumps being inoperable during the thunderstorm (Downey 2014). Other areas that were flooded include North Albuquerque Acres and South Valley where homes, yards and roads were reported as flooded. One loss of life was reported.

In April 2004, $3.8 million in damages occurred when a flash flood caused massive sewer line breaks near downtown Albuquerque. Flood waters also deposited 4,500 cubic yards of sand and gravel in the City's wastewater treatment plant, damaging equipment.

Figure 4-21 Flooding along the Osuna Bike Notch on July 26th, 2013

Source: Photo Courtesy of Kevin Troutman of the Albuquerque Metro Arroyo and Flood Control Authority (http://www.srh.noaa.gov/abq/?n=july2012vsjuly2013abqprecip Accessed June 2014)

4.9.3 Location

The Rio Grande passes through the City of Albuquerque in the form of an "S". The areas known locally as the North and South Valleys, nestle in the hollows of the "S" formation, one east and the other west of the river. The valley contains a long, narrow flood plain that has been extensively modified by agriculture and development. The Bosque (the woodland along the river) provides a riparian wildlife habitat and a natural greenbelt area.

The lower lying valley has been subject to flooding from two sources: the Rio Grande, and from storm water run-off on the higher mesas flanking the valley. The valley has also been subject to sheet flows and widespread flooding in its lowest lying areas from water carried by arroyos. The spread of urbanization across the east mesa created extensive impermeable surfaces. Storm water run-off from localized weather events would often exceed the capacity of arroyos to carry the water from the Sandia Mountain foothills across the mesa to the valley. Entering the valley, the arroyos diffused into broad alluvial fans on the valley floor where water ponded. The construction of the North and South Diversion Channels, networked with the arroyos, has provided a level of protection thorough the conveyance of storm run-off to the Rio Grande in an efficient manner.

Flooding within the unincorporated areas of Bernalillo County occurs most often during late summer as a result of intense short-duration thunderstorms. The resulting peak flows can be large but usually produce relatively small volumes of water. Historically, flooding in the Albuquerque area can be divided into two categories: flooding from the Rio Grande and runoff generated from local thunderstorms.

Flooding from the Rio Grande can be from rapid snowmelt induced by warm rains or from widespread thunderstorms. Floodwaters from the Rio Grande can also block irrigation and drainage ditches with sediment, increasing the flood potential. Before the 1930s, flooding from the river had been widespread within the North and South Valley areas of the City. The present flood potential in the City of Albuquerque from the Rio Grande is much less than historical data may suggest because of a levee system built in the 1930's as well as several flood control structures built upstream of the City.

Other flooding within the City of Albuquerque can result from brief, intense thunderstorms causing substantial localized flash flooding and serious sedimentation and erosion problems. The Sandia Mountains, east of Albuquerque, have steep bedrock outcrops, which have high runoff potential. Flow runoff paths are unpredictable at the base of the mountains as the runoff spreads onto several alluvial fans. Continued development on the East Mesa at the base of the mountains and on the alluvial areas complicates the flow patterns and increases the potential for flood damage.

Flooding on the West Mesa can also result from intense thunderstorms, and the area has serious sedimentation and erosion problems. The area contains mostly fine sands and silts with minimal ground cover, which is highly prone to erosion. Flood flows can pond behind ditch levees and in low spots, depositing large quantities of sediment, or the floodwaters can flow into irrigation ditches, filling the ditches with sediment and causing the banks to be overtopped.

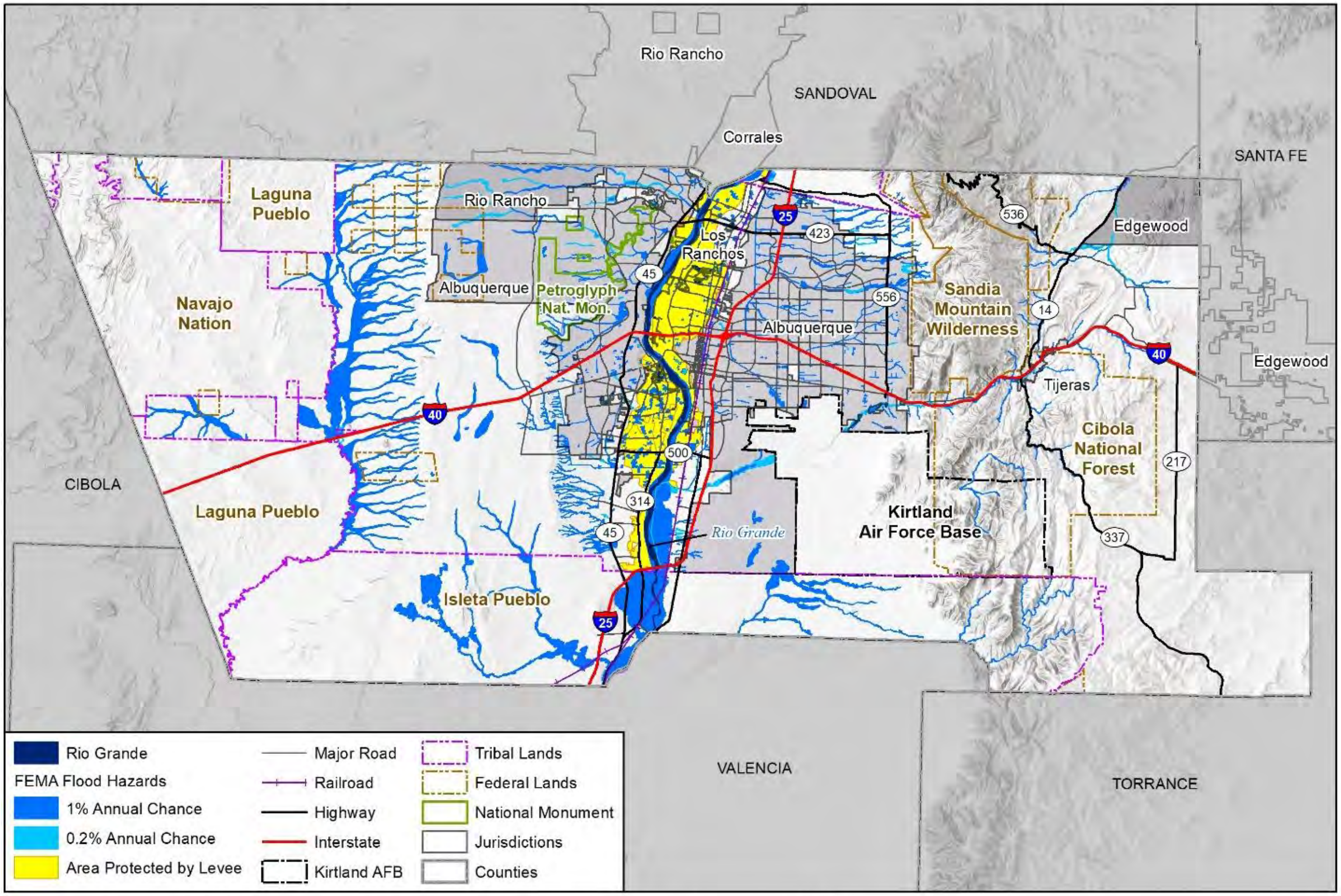
The low-lying valley areas along the Rio Grande are also subject to flooding from runoff from the east and west uplands. Residential and commercial development, channel levees, and irrigation embankments have obstructed the natural outfalls to the river and increased the flood hazards in many areas. Floodwaters flow rapidly into the valley areas and then spread into ponding areas because of the flat slopes and limited outlets to the river.

The areas with the greatest vulnerability are concentrated in the older neighborhoods of the City and along the Rio Grande. For example, downtown Albuquerque has some of the lowest elevations in the City and requires pumping stations to lift stormwater out of the area and towards the river. Several areas in the County that are near the river have inadequate storm sewer capacity to handle flows from large storm events. The City is also concerned about localized flooding that crosses City jurisdiction onto Kirtland Air Force Base near Zuni and Wyoming SE.

The Village of Tijeras has experienced localized flooding along the Tijeras Arroyo. The Village of Los Ranchos de Albuquerque identified several areas subject to flooding including: Garduno Road west of 4th Street, Ranchitos Road west of 4th Street, and Ortega Road west of 4th Street.

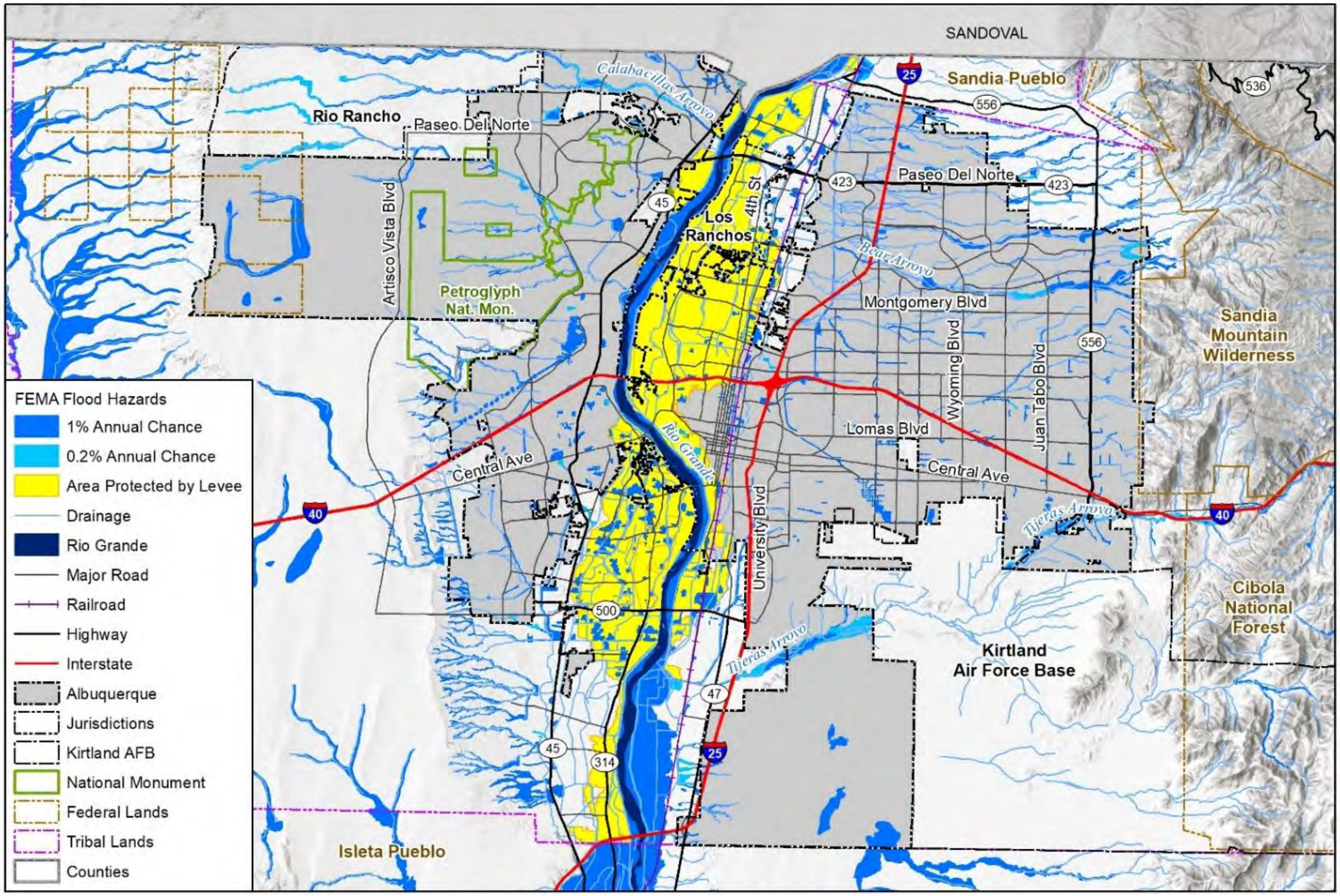
Figure 4-22 to Figure 4-25 show the locations of FEMA mapped flood zones in the County.

Figure 4-22 Flood Zones for Bernalillo County



Map compiled 8/2020; intended for planning purposes only. Data Source: City of Albuquerque, Bernalillo County, RGIS, FEMA NFHL 12/23/2019

Figure 4-23 Flood Zones for Albuquerque and Central Bernalillo County



wood.
Map compiled 8/2020; intended for planning purposes only.
Data Source: City of Albuquerque, Bernalillo County, RGIS, FEMA NFHL 12/23/2019

Figure 4-24 Flood Zones Los Ranchos

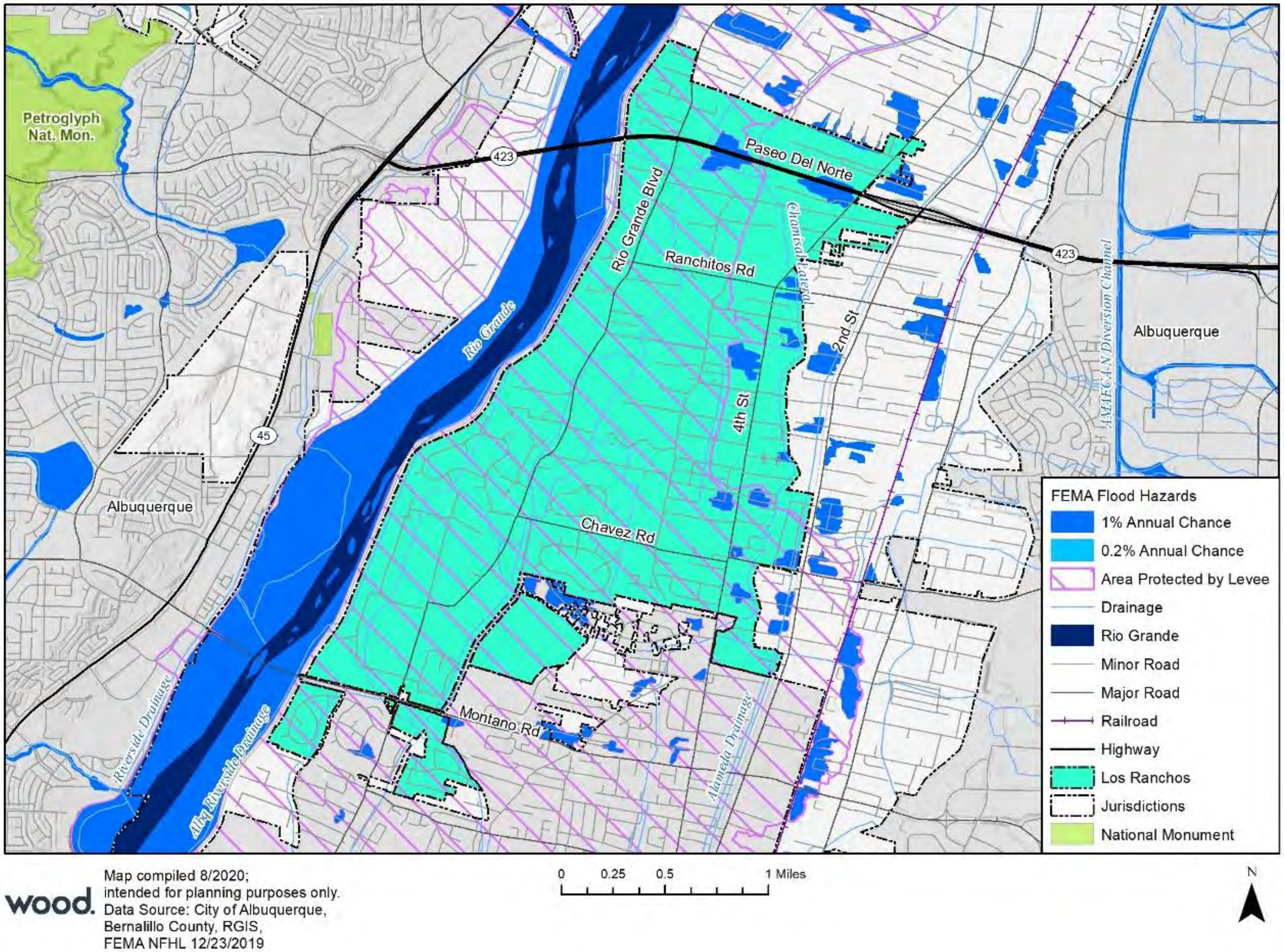
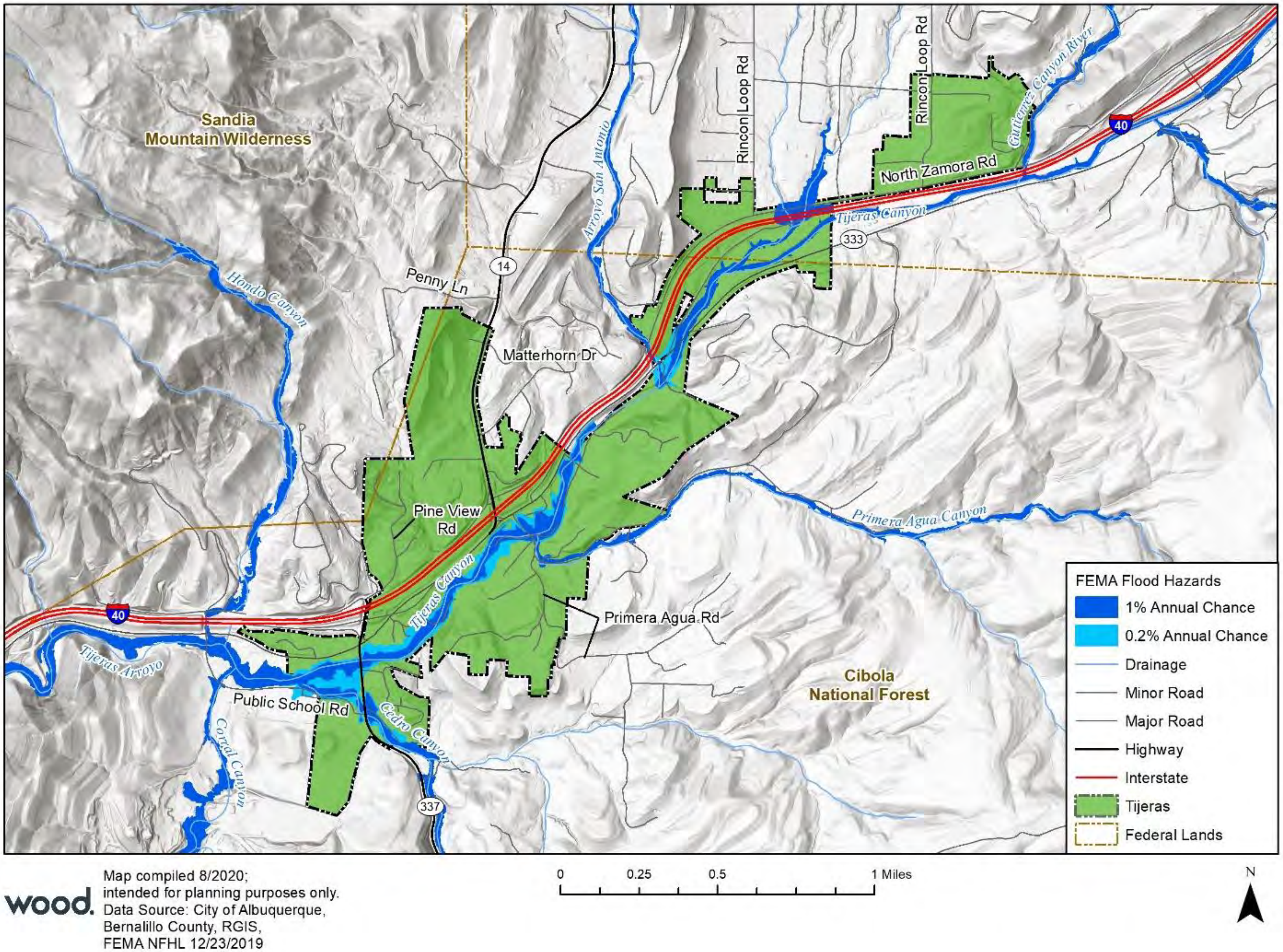


Figure 4-25 Flood Zones Tijeras



4.9.4 Magnitude/Severity

As shown in the Past Occurrences section, the damages to flooding have ranged from $500 to $1.6 million. While the more typical flood event may be more localized in nature and well under $1 million in damages, it is possible for larger type events. A truly catastrophic flood event caused by several days of heavy rainfall during the monsoon season or a Pacific hurricane that moved inland over Bernalillo County which resulted in both flash flooding and riverine flooding during could cause multi-million damages as well as severe economic disruption. In a larger event, it could be expected that homes in the 100-year floodplain would receive several feet of flooding, that roads were washed out or covered in sedimentation, drainage systems would be overwhelmed and back up, and that businesses could be closed for several days to weeks.

To establish the potential extent of flooding, in terms of flood depth, in Bernalillo County and its municipalities, the Flood Insurance Study dated November 4, 2016 was studied. Table 4-28 displays the range of potential flood depths within the 100-year Floodplain (Base Flood Elevation) for many waterways.

Table 4-28 Potential Flood Depth Range within the 100-Year Floodplain

Jurisdiction	Waterway	BFE Depth Range
Albuquerque/County	Arroyo A-B	12-18 inches
Albuquerque/County	Arroyo A-C	3-12 feet
Albuquerque/County	Arroyo B-A	9-12 inches
Albuquerque/County	Arroyo B-B	18-24 inches
Albuquerque/County	Arroyo B-C	11-14 inches
Albuquerque	Arroyo de Las Calabacillas	3-17.5 feet
Albuquerque	Bear Arroyo Tributary	5-9 feet
County	Borrega Arroyo	6-26 inches
County	Double Eagle II Channel	1-5 feet
County	Frost Arroyo	3-14.5 feet
Albuquerque	Ladera Diversion Channel	0.5-4 feet
Albuquerque	Mirehaven Arroyo A	0.3-3.5 feet
Albuquerque	Mirehaven Arroyo B	1-2.5 feet
Albuquerque/County	Mirehaven Arroyo C	1.5-3 feet
County	Rio Grande	3.5-10.5 feet
County	Rio Puerco	19.5-23 feet
County	San Pedro Canyon Arroyo	8.5-15 feet
County	San Pedro Creek	3-9.5 feet
County	Shamrock Channel/Tributary 2	1-8 feet
Albuquerque/County/Tijeras	Tijeras Arroyo	2.5-21.5 feet
Albuquerque	Unser Channel	0.5-5 feet
Albuquerque	West I-40 Diversion Channel	2-5 feet
Albuquerque/County	Arroyo A-B	12-18 inches
Albuquerque/County	Arroyo A-C	3-12 feet
Albuquerque/County	Arroyo B-A	9-12 inches
Albuquerque/County	Arroyo B-B	18-24 inches
Albuquerque/County	Arroyo B-C	11-14 inches
Albuquerque	Arroyo de Las Calabacillas	3-17.5 feet
Albuquerque	Bear Arroyo Tributary	5-9 feet

Jurisdiction	Waterway	BFE Depth Range
County	Borrega Arroyo	6-26 inches
County	Double Eagle II Channel	1-5 feet
County	Frost Arroyo	3-14.5 feet
Albuquerque/County/Tijeras	Tijeras Arroyo	2.5-21.5 feet
Albuquerque	Unser Channel	0.5-5 feet
Albuquerque	West I-40 Diversion Channel	2-5 feet

Source: AMAFCA, FEMA FIS Revised 10/4/2016

4.9.5 Climate Change Considerations

Climate projections across the United States have shown that while total annual precipitation will likely decrease in the Southwest region, the heaviest annual rainfall events will become more intense. Extreme precipitation, one of the controlling factors in flood statistics, is observed to have generally increased and is projected to continue to do so across the United States in a warming atmosphere. As a result, damaging flood events have the potential to increase with climate change. (Climate Science Special Report, Fourth National Climate Assessment 2017, https://science2017.globalchange.gov/chapter/8/) Also, with wildfires already being a problem in New Mexico, increasing periods of drought and lack of precipitation are expected to exacerbate conditions for fires to occur, and in turn worsen the potential for runoff and flooding associated with burned areas.

4.9.6 Probability of Future Events

Flooding occurs on a regular basis throughout the planning area and can be expected to continue. The impact of these events will depend on their location and specific circumstances. A "100-year flood" is the flood elevation (or depth) that has a 1% chance of being equaled or exceeded each year. The "500-year flood" is the flood elevation or depth that has a 0.2% chance of being equaled or exceeded each year, respectively. Based on historical data, flooding events less severe than a 100-year flood and those outside of the 100-year floodplain occur frequently in the planning area during periods of heavy rains. The State Hazard Mitigation plan made efforts to determine a probability of occurrence for riverine flooding and flash flooding; Bernalillo County falls in Preparedness Area 5. The State determined Preparedness Area 5 has a 57 percent chance of flooding and 100 percent flash flooding occurring in a given year, based on NCEI data. Bernalillo County and all participating jurisdictions rank the future probability of floods as Highly Likely.

4.9.7 Vulnerability Assessment

GIS was used to analyze risk to buildings, population and critical facilities during the 2020 update, utilizing the FEMA effective map products available in the National Flood Hazard Layer. The parcel layer was used as the basis for the inventory of developed parcels. The County's parcel layer and associated assessor's building improvement valuation data were used as the basis for the value of improvements. Building locations were based on a building footprints layer. The results are discussed below.

People

Population counts of those living in the flood hazard area were generated by analyzing tax assessor building locations of residential structure locations that intersect with the SFHA. Total estimates were derived by multiplying the number of residential properties exposed to the SFHA by the average household size by the respective community. Through this approach, an estimated 8,469 residents live within the 100-year floodplain, an additional 1,508 within the 500-year floodplain, and 77,942 within SFHA areas protected by certified levees throughout the County. The majority of population at risk reside in the unincorporated areas and the City of Albuquerque.

General Property

Tabular results of the overlay analysis area are shown in Table 4-29 and Table 4-30 and are grouped by flood zone and the parcel's property type. Property type refers to the land use of the parcel and includes commercial, residential (condominium, mobile home, single family), and vacant. Contents values were estimated as a percentage of building value based on their property type, using FEMA/HAZUS estimated content replacement values. This includes 100% of the structure value for commercial structures, 50% for residential structures and 0% for vacant structures. A loss estimate analysis was also performed, generally based on flood depth-damage relationships developed by the Corp of Engineers. An average depth-damage of 25% was applied to the total value to estimate flood loss. This is generally equivalent to the damage associated when buildings are inundated with a two-foot-deep flood.

According to the GIS analysis conducted for this plan update, there are 3,981 structures at risk that could be impacted by a 1% annual chance flood event with an estimated $360 million in potential losses. A 0.2% annual chance flood would add an additional 656 structures to the total at risk to flooding; the majority of which are residential parcel types. A further 32,568 structures are located in areas that could potentially be impacted by a levee failure, with an estimated $6.6 billion in potential losses. The unincorporated areas, followed by Albuquerque and Los Ranchos, have the most buildings at risk. This analysis does not account for flood losses that may occur outside of mapped flood hazard areas. Levees protect a substantial amount of built environment from flooding from the 1% annual chance flood, primarily in Albuquerque, the unincorporated areas, and Los Ranchos as summarized in Table 4-31. Should levees be overtopped or fail the impacts could be significant to catastrophic, depending on the magnitude of the incident.

Table 4-29 Improved Properties at Risk to FEMA 1% Annual Chance Flood Hazard by Property Type

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Estimated Loss	Population
Albuquerque	Commercial	157	211	$261,928,601	$261,928,601	$523,857,202	$130,964,301	
	Residential	616	735	$180,214,316	$90,107,158	$270,321,474	$67,580,369	1,992
	Vacant	32	33	$1,136,660	$1,136,660	$2,273,320	$568,330	
	Total	**805**	**979**	**$443,279,577**	**$353,172,419**	**$796,451,996**	**$199,112,999**	**1,992**
Los Ranchos	Commercial	14	23	$2,726,600	$2,726,600	$5,453,200	$1,363,300	
	Residential	75	139	$16,514,509	$8,257,255	$24,771,764	$6,192,941	236
	Vacant	2	2	$4,100	$4,100	$8,200	$2,050	
	Total	**91**	**164**	**$19,245,209**	**$10,987,955**	**$30,233,164**	**$7,558,291**	**236**
Tijeras	Commercial	3	3	$313,600	$313,600	$627,200	$156,800	
	Residential	12	14	$1,298,003	$649,002	$1,947,005	$486,751	41
	Vacant	1	1	$3,100	$3,100	$6,200	$1,550	
	Total	**16**	**18**	**$1,614,703**	**$965,702**	**$2,580,405**	**$645,101**	**41**
Unincorporated	Commercial	127	233	$112,511,323	$112,511,323	$225,022,646	$56,255,662	
	Residential	1,758	2,486	$252,258,017	$126,129,009	$378,387,026	$94,596,756	6,200
	Vacant	87	101	$3,726,486	$3,726,486	$7,452,972	$1,863,243	
	Total	**1,972**	**2,820**	**$368,495,826**	**$242,366,818**	**$610,862,644**	**$152,715,661**	**6,200**
	Grand Total	**2,884**	**3,981**	**$832,635,315**	**$607,492,893**	**$1,440,128,208**	**$360,032,052**	**8,469**

Table 4-30 Improved Properties at Risk to FEMA 0.2% Annual Chance Flood Hazard by Property Type

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Estimated Loss	Population
Albuquerque	Commercial	8	8	$11,747,500	$11,747,500	$23,495,000	$5,873,750	
	Residential	352	474	$122,661,666	$61,330,833	$183,992,499	$45,998,125	1,138
	Total	**360**	**482**	**$134,409,166**	**$73,078,333**	**$207,487,499**	**$51,871,875**	**1,138**
Tijeras	Commercial	3	3	$504,300	$504,300	$1,008,600	$252,150	
	Residential	7	8	$574,081	$287,041	$861,122	$215,280	24
	Vacant	1	1	$4,300	$4,300	$8,600	$2,150	
	Total	**11**	**12**	**$1,082,681**	**$795,641**	**$1,878,322**	**$469,580**	**24**

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Estimated Loss	Population
Unincorporated	Commercial	14	18	$8,810,516	$8,810,516	$17,621,032	$4,405,258	
	Residential	98	119	$16,952,001	$8,476,001	$25,428,002	$6,357,000	346
	Vacant	21	25	$170,300	$170,300	$340,600	$85,150	
	Total	**133**	**162**	**$25,932,817**	**$17,456,817**	**$43,389,634**	**$10,847,408**	**346**
	Grand Total	**504**	**656**	**$161,424,664**	**$91,330,790**	**$252,755,454**	**$63,188,864**	**1,508**

Table 4-31 Improved Properties at Risk to FEMA Area Protected by Levee Flood Hazard by Property Type

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	866	1,297	$452,592,032	$452,592,032	$905,184,064	
	Residential	12,655	14,754	$1,865,152,808	$932,576,404	$2,797,729,212	40,928
	Vacant	227	242	$13,763,916	$13,763,916	$27,527,832	
	Total	**13,748**	**16,293**	**$2,331,508,756**	**$1,398,932,352**	**$3,730,441,108**	**40,928**
Los Ranchos	Commercial	64	128	$56,461,603	$56,461,603	$112,923,206	
	Residential	1,502	2,224	$540,688,541	$270,344,271	$811,032,812	4,720
	Vacant	35	39	$370,200	$370,200	$740,400	
	Total	**1,601**	**2,391**	**$597,520,344**	**$327,176,074**	**$924,696,418**	**4,720**
Unincorporated	Commercial	390	718	$218,156,379	$218,156,379	$436,312,758	
	Residential	9,157	12,837	$1,016,128,958	$508,064,479	$1,524,193,437	32,294
	Vacant	282	329	$3,104,795	$3,104,795	$6,209,590	
	Total	**9,829**	**13,884**	**$1,237,390,132**	**$729,325,653**	**$1,966,715,785**	**32,294**
	Grand Total	**25,178**	**32,568**	**$4,166,419,232**	**$2,455,434,079**	**$6,621,853,311**	**77,942**

Flood Insurance Policy Analysis and Repetitive Losses

Data from the National Flood Insurance Program shows that $1,426,541 in flood loss claims have been paid out in Bernalillo County and its jurisdictions since 1978. 75% of those losses were in the City of Albuquerque, 17% in the unincorporated County, and 7% in the Village of Los Ranchos.

NFIP Policy Counts and Loss Claims Summary

Community	Total Policy Count	Total Coverage (in Thousands)	Total Losses	Total Dollars Paid
Albuquerque	699	$198,639,700	118	$1,081,724
Los Ranchos	62	$18,143,100	2	$100,024
Tijeras	3	$168,000	0	$0
Unincorporated	746	$168,007,200	52	$244,793
Total	**1,510**	**$348,958,000**	**172**	**$1,426,541**

A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. As of September 2020, there were a total of seven repetitive loss properties: six within the City of Albuquerque, and one within the unincorporated areas of the County. This represents an increase five properties from 2015 NFIP statistics for the City. These properties suffered 11 repetitive losses since 1978, totaling $84,374 in payments.

Severe repetitive loss properties (SRL) are those for which the program has either made at least four payments for buildings and/or contents of more than $5,000 or at least two building- only payments that exceeded the value of the property. As of September 2020, there were no severe repetitive loss (SRL) structures located within the County.

Additional details on the jurisdictions' participation in the National Flood Insurance Program and the Community Rating System can be found in Section 5.1.2 of the Capability Assessment and Section 6.2.1 of the Mitigation Strategy.

Critical Facilities and Infrastructure

Critical infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters. Floods can severely disrupt normal operations, especially when there is a loss of power. This can affect the operations of critical facilities, which affects response times. Loss of power also puts the public at risk. Downed power lines pose a serious hazard and should always be treated as if they are still energized. When a building loses power during a flood, electricity should be turned off and not used until the wiring can be inspected, to avoid risk of electrocution or fire. Damage to electrical equipment can also result from exposure to flood waters contaminated with chemicals, sewage, oil, and other debris.

The critical facility exposure analysis indicates that there is a total of 26 critical facilities in the County within the mapped FEMA 1% Annual Chance flood zone. The majority of these are communications facilities. The tables below summarize the results of the critical facility flood exposure analysis. There are 106 facilities in the Area Protected by Levee zone. Only one critical facility, a communications site, is located in the 0.2 % Annual Chance flood zone.

Table 4-32 Critical Facilities within the 1% Annual Chance Flood Zone

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	8	1	1			2		**12**
Los Ranchos	2	1						**3**
Tijeras								**0**
Unincorporated	4	2	2	1		2		**11**
Total	**14**	**4**	**3**	**1**	**0**	**4**	**0**	**26**

Table 4-33 Critical Facilities within the Area Protected by Levee Zone

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	36	3	3		1	23	2	**68**
Los Ranchos	2					2		**4**
Tijeras								**0**
Unincorporated	15	2	1	1	1	14		**34**
Total	**53**	**5**	**4**	**1**	**2**	**39**	**2**	**106**

According to HMPC members representing ABCWA, the Rio Grande River poses the greatest to risk to ABCWA facilities and infrastructure. Specifically, three of their structures – the Water Reclamation Facility, Lift Station and River Diversion Structure – are partially or completely located within the 1% annual chance flood zone. While the majority of the Water Reclamation Facility site is protected by levees, there are areas within the site that are within the Special Flood Hazard Area being at or below the base flood elevation of 4,927 feet. The HMPC noted that half of the site where one of their lift stations is also subject to 1% annual chance flood zones, The Rio Grande Diversion Structure is within the 1% annual chance flood zone and is unlikely to provide reliable diversion operations during a 100-year flood event.

Government Services

Publicly owned facilities are a key component of daily life for all citizens of the county. Public buildings are of particular importance during flood events because they house critical assets for government response and recovery activities. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Loss of power and communications can be expected. Drinking water and wastewater treatment facilities may be temporarily out of operation.

Flooding can have various impacts to responders in terms of response time and the personal safety of first responders. Flooded roadways are a common occurrence throughout the planning area and can block emergency vehicles from crossing certain areas, delaying response times. Flood events can often result in motorists needing to be rescued from stalled vehicles in flooded roadways. These type of recuses can often be dangerous for the first responders due to potentially polluted waters as well as swift currents.

Public confidence in government may be hindered if warnings and alerts prior to the flood event are not communicated effectively. Local governments' ability to respond and recover may be questioned and challenged by the public if planning, response, and recovery is not timely and effective, particularly in areas that have repeated flooding.

Economy

Flooding can have a major economic impact on the economy, including indirect losses such as business interruption, lost wages, reduced tourism and visitation, and other downtime costs. Flooding often coincides with the summer tourism months and may hence impact, directly or indirectly (such as from the negative perception of potential danger to his hazard), the revenues of tourist agencies, hotel bookings, outdoor activity companies, and other such businesses in the commercial and industrial sectors.

Historic, Cultural and Natural Resources

There are significant historic, cultural, and natural resources and assets located throughout the County (e.g., trails and natural spaces, lakes). Natural areas within the floodplain often benefit from periodic flooding as a naturally recurring phenomenon. These natural areas often reduce flood impacts by allowing absorption and infiltration of floodwaters. Natural resources are generally resistant to flooding except where natural landscapes and soil compositions have been altered for human development or after periods of previous disasters such as drought and fire. Wetlands, for example, exist because of natural flooding incidents. Areas that are no longer wetlands may suffer from oversaturation of water, as will areas that are particularly impacted by drought. Areas which may have recently suffered from wildfire damage may erode because of flooding, which can permanently alter an ecological system.

In terms of natural resources, vulnerability from flash flood events is greatly increased in areas downstream from a recent wildfire event. Any future wildfires in the higher elevation parts of Bernalillo County (including both the Sandias and Manzanos) will significantly impact the hydrology of the affected watersheds. The burning of forestlands causes a virtually impervious surface due to the destruction of forest floor vegetation, burned tree material like sap, and the ash itself. Rainfall simply runs off this hardened surface, known as 'hydrophobic' soils, and there is very little ground absorption of the water. The resulting diminished water storage and steep slope of higher elevation areas will create high quantity and velocity flows. Another issue related to flood risk after fire is that with mountainsides denuded of protective vegetation, rainfall events also cause severe erosion resulting in debris flows and can damage water control facilities which will quickly become full of sediment. All jurisdictions in Bernalillo County are at equal risk from the threat of increased water flows and debris flow downstream of a burn area because all jurisdictions include vulnerable areas downstream from high elevations.

Future Land Use and Development

Development in 1% flood hazard areas is regulated through compliance with the NFIP by the County and the municipalities. Flash flooding resulting from the summer monsoon thunderstorms can result in swift waters flowing through commercial areas like downtown as occurred in July/August 2014, stormwater drainage overflow, or overtopping arroyos and spilling over into the surrounding neighborhood. Longer term rainfall events may result in riverine flooding in the Rio Grande with possible levee overtopping. AMAFCA facilities are planned and constructed to carry a design flood event but there are some events that may exceed the design capacity and damage the arroyos through scour and erosion. Extreme flood events could also affect dams and levees causing breaches. However, the primary purpose of AMAFCA facilities is to protect surrounding development from flooding so the PRI will show how AMAFCA protects other development.

4.9.8 Jurisdictional Differences

Flood	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Highly Likely	Extensive	Significant	Medium
Albuquerque	Occasional	Significant	Significant	High
Los Ranchos	Highly Likely	Extensive	Critical	High
Tijeras	Highly Likely	Significant	Critical	High
AMAFCA	Highly Likely	Extensive	Critical	High
MRGCD	Highly Likely	Significant	Significant	High
ABCWUA	Highly Likely	Extensive	Critical	High

Based on the GIS and NFIP policy analysis, the largest number of buildings and population at risk are in the unincorporated areas, followed by Albuquerque and Los Ranchos. Refer to Table 4-29 through Table 4-31 for more specifics on the expected losses by jurisdiction.

4.9.9 Risk Summary

Flooding is a significant hazard for all participating jurisdictions. Heavy rains during the typical monsoon season could result in homes and businesses flooding, damaging the sensitive economy of Bernalillo County. Flash flooding and impassable egress routes are primary public safety concerns during flood events.

- According to the GIS analysis, there are 3,981 structures at risk to a 1% annual chance flood event with an estimated $360 million in potential losses.
- A 0.2% annual chance flood would add an additional 656 structures to the total at risk to flooding; the majority of which are residential parcel types.
- Extensive levees provide protection from Rio Grande flooding, but overtopping or other levee failure could result in extensive damages.
- NFIP statistics indicate a total of 6 repetitive loss properties in the City of Albuquerque, and 1 in the unincorporated county; an increase of 6 overall from 2015.
- The critical facility exposure analysis indicates that there is a total of 26 critical facilities in the County within the mapped FEMA 1% Annual Chance flood zone of which the majority of these are communications facilities.
- Stormwater improvements have helped reduce damage to new and existing development.
- Related hazards: Dam failure, Wildfire

4.10 Hazardous Materials Release

4.10.1 Description

A hazardous material (or Hazmat) is any material or group of materials that can cause harm to people, property, or the environment when released. Such releases are typically accidental as a result of equipment failure or personal error and can occur at a fixed location or while in transport.

The U.S. Department of Transportation divides hazardous materials into the following classes:

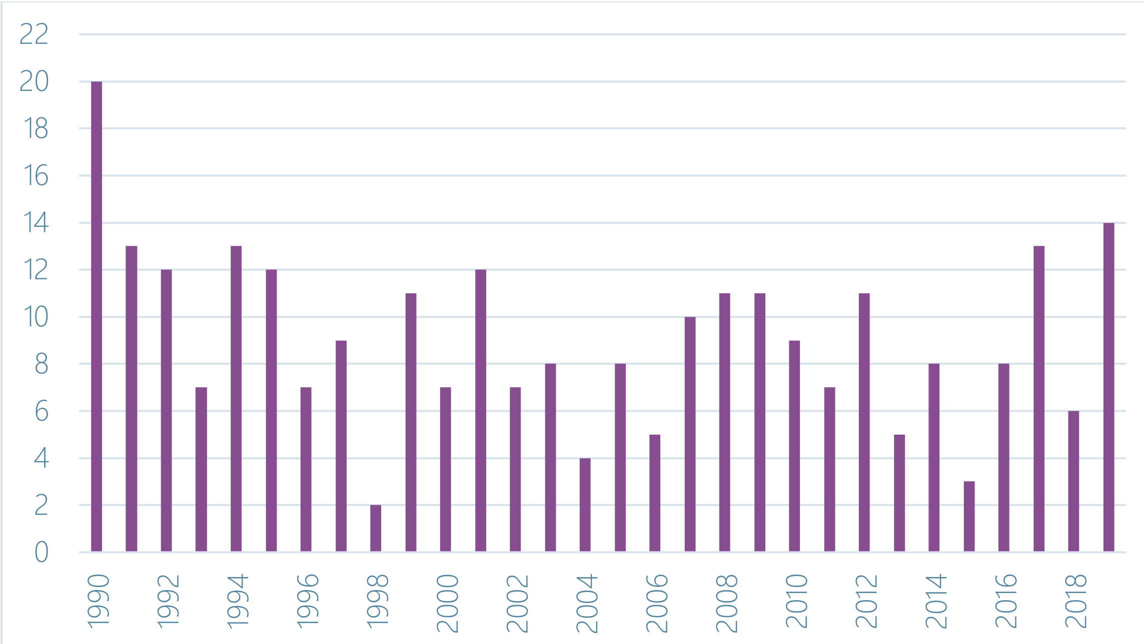
- Explosives
- Compressed gases: flammable, non-flammable compressed, poisonous
- Flammable & combustible liquids
- Flammable solids: spontaneously combustible, dangerous when wet
- Oxidizers and organic peroxides
- Toxic materials: poisonous material, infectious agents
- Radioactive material
- Corrosive material: destruction of human skin, corrodes steel

The U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) all have responsibilities relating to the transportation, storage, and use of hazardous materials and waste. The Right to Know Network maintained by the U.S. Coast Guard's National Response Center (NRC) is a primary source of information on the use and storage of hazardous materials, as well as data regarding spills and releases.

4.10.2 Past Occurrences

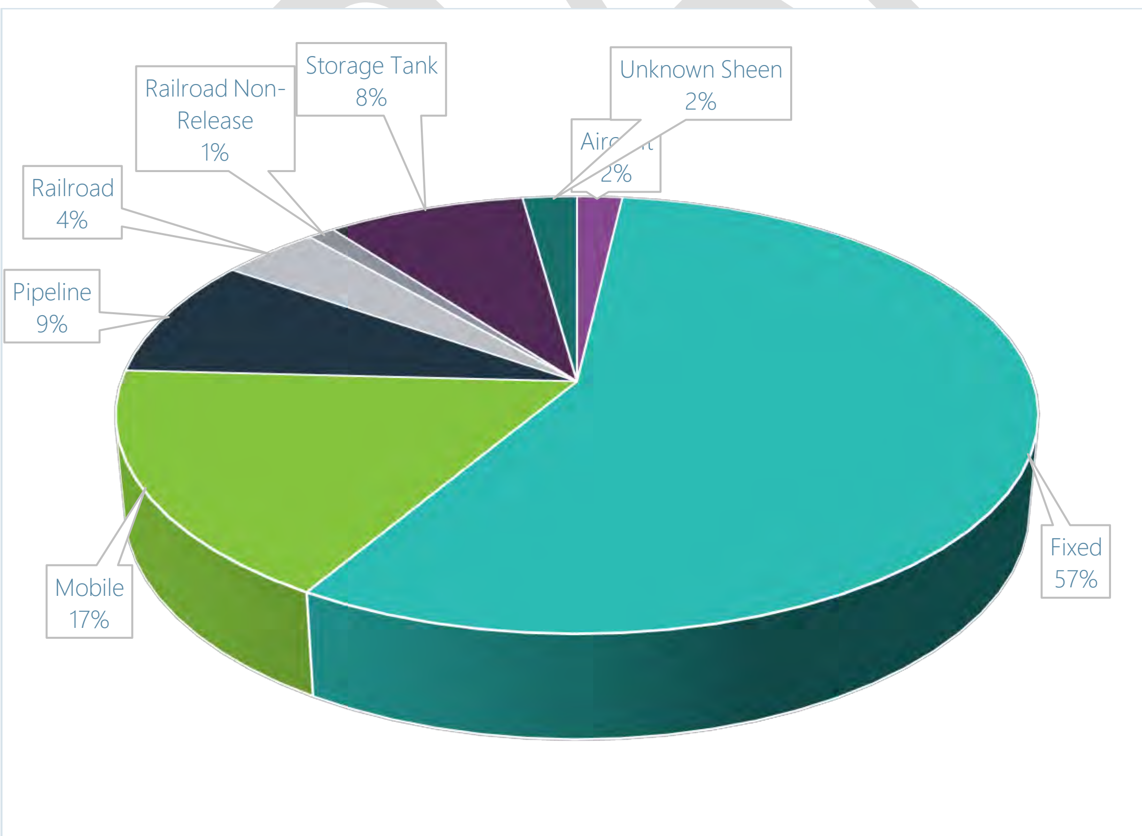
Hazardous materials incidents occur regularly in the planning area. Statistics from the National Response Center (NRC) list 272 hazardous materials incidents reported in Bernalillo County 1990 through 2019. This number almost certainly excludes a number of very small spills that were not reported to the NRC. As shown in Figure 4-26, the number of reported incidents has declined slightly over the last 30 years, with an average of 11 incidents per year during the 1990s, and 8 per year during the 2000s and 2010s.

Figure 4-26 Hazardous Materials Incidents in Bernalillo County by Year, 1990-2019



As shown in Figure 4-27, hazardous material incidents in Bernalillo County are most common at fixed sites; only 24% of incidents occur during transportation.

Figure 4-27 Hazardous Materials Incidents in Bernalillo County by Type, 1990-2019



Of these 272 reported incidents listed in the NRC data from 1990 through 2019, only 44 (16%) resulted in any reported injuries, fatalities, evacuations, or property damage. Those 4 incidents are listed as resulting in 5 fatalities, 22 injuries (15 requiring hospitalization), 16 evacuations (a total of 888 people) and $975,000 in property damages. Averaging these numbers out over 30 years gives annualized rates of 1.5 damaging hazmat incident per year, 1 fatality every 6 years, 0.73 injuries per year, one evacuation every other year, and $32,500 in property damage per year. However, it is important to note that the NRC counts all injuries or damages resulting from an accident where hazardous materials were involved, whether or not the injuries or damages were caused by exposure to the hazardous substance; closer analysis shows that all of the listed fatalities and a majority of the injuries and property damages were from the physical impacts of the accident that caused the release, rather from exposure to hazardous materials themselves.

4.10.3 Location

Hazmat incidents can occur at fixed facilities or during transportation, as discussed below. Overall, the greatest risk is in areas adjacent to hazardous materials facilities or major transportation routes. However, depending on the type and quantity of spills and the medium affected, the geographic coverage could become large, particularly if a material was released into a stream or waterway.

Of the 272 incidents in the NRC database, 259 (95%) are reported as occurring in or near the City of Albuquerque, with 2 incidents reported in or near the Village of Los Ranchos and 2 in or near the Village of Tijeras.

Generally, with a fixed facility, the hazards are pre-identified. The U.S. Emergency Planning and Community Right-to-Know Act (EPCRA) requires industries to report on the storage, use, and releases of hazardous substances to federal, state, and local governments. Facilities in New Mexico must submit an emergency and hazardous chemical inventory form (Tier II form) to the New Mexico Department of Homeland Security and Emergency Management (DHSEM). Tier II forms provide state and local officials and the public with information on the general hazard types and locations of hazardous chemicals present at facilities during the previous calendar year. The inventory forms require basic facility identification information, employee contact information for both emergencies and non-emergencies, and information about chemicals stored or used at the facility.

The EPA also requires facilities containing certain extremely hazardous substances to generate Risk Management Plans (RMPs) and resubmit these plans every five years. As of November 1, 2020, there are nine RMP facilities located in the planning area. There are no significant releases or incidents resulting in deaths or injuries associated with any of these RMP sites. These sites are shown on Figure 4-27 in the Asset Summary Section. As shown in that map, the majority of these sites are located along the rail line or one of the Interstate highways. Seven of the sites are in the unincorporated county; the other two are in Albuquerque.

4.10.4 Magnitude/Severity

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. Hazards can occur during production, manufacturing, storage, transportation, use, or disposal. Impacts from hazardous materials releases can include:

- Fatalities
- Injury
- Evacuations
- Property damage

- Animal fatalities (livestock, fish & wildlife)
- Air pollution
- Surface or ground water pollution/contamination
- Interruption of commerce and transportation

Numerous factors influence the impacts of a hazardous materials release, including the type and quantity of material, location of release, method of release, weather conditions, and time of day. This makes it difficult to predict precise impacts. The impact to life and property from any given release depends primarily on:

- The type and quantity of material released.
- The human act(s) or unintended event(s) necessary to cause the hazard to occur.
- The length of time the hazard is present in the area.
- The tendency of a hazard, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space.
- Characteristics of the location and its physical environment that can either magnify or reduce the effects of a hazard.

The release or spill of hazardous materials can also require different emergency responses depending on the amount, type, and location of the spill incident.

The impacts of major hazardous materials incidents are potentially catastrophic, causing multiple deaths, property damage, and/or interruption of essential facilities and service for more than 72 hours. However, historically the impact of hazardous materials incidents in the planning area have been limited. As noted previously, the area experiences an average of 1 fatality every 6 years, 0.73 injuries per year, one evacuation every 2 years, and $32,500 in property damage per year associated with hazardous materials incidents. However, that majority of those deaths and injuries result from the accident that caused the release, rather than from exposure to the hazardous material itself.

4.10.5 Climate Change Considerations

There are no known effects of climate change on hazardous material incidents.

4.10.6 Probability of Future Occurrence

It is almost certain that the planning area will experience a hazardous material incident in any given year. Since 2000, Bernalillo County has averaged 8 hazardous materials incidents per year, with 1.5 incidents per year resulting in injuries, fatalities, damage, or evacuations.

4.10.7 Vulnerability Assessment

People

Hazardous materials incidents impact on people is highly dependent on the location of the incident, but can cause injuries, hospitalizations, and even fatalities to people nearby. The most likely routes are inhalation, absorption, and ingestion. A toxic spill or a release of an airborne chemical near a populated area can lead to significant evacuations and have a high potential for loss of life. People living near hazardous facilities and along transportation routes may be at a higher risk of exposure, particularly those living or working downstream and downwind from such facilities.

Vulnerable populations can be more severely impacted by hazardous materials incidents. People with existing health risks or compromised immune systems could be severely affected by releases of even relatively low-impact materials. Low income families may be more likely to live in industrial areas or near hazardous materials routes. Individuals with disabilities may need more time to evacuate, so evacuation notices will need to be issued as soon as feasible, and communicated by multiple, inclusive methods.

General Property

The impact of most fixed facility incidents is typically localized to the property where the incident occurs. The impact of small spills during transportation may also be limited to the extent of the spill and remediated if needed. Cleanup from major spills can be lengthy and expensive.

Critical Facilities and Infrastructure

Impacts on critical facilities are similarly most often limited to the area or facility where they occurred, such as at a transit station, airport, fire station, hospital, or railroad. However, they can cause long-term traffic delays and road closures resulting in major delays in the movement of goods and services. These impacts can spread beyond the planning area to affect neighboring counties, or vice-versa. While cleanup costs from major spills can be significant, they do not typically cause significant long-term impacts to critical facilities.

The critical facilities tables under the other hazard sections list include Risk Management Plan (RMP) facilities located in mapped hazard areas, to include one in a 0.2% floodplain, and eight in areas identified as at risk of collapsible soils.

Government Services

The vast majority of hazardous materials incidents have minimal impacts on continuity of operations beyond short-term road closures. However, a large spill or a particularly hazardous substance can take weeks or even months to clean up.

Hazardous Materials incidents can have a more significant impact to responders, particularly those responders conducting initial size-up operations and those conducting scene entry, mitigation, and clean-up operations. This qualitative assessment is based on the likelihood of lower levels of personal protective equipment donned by initial responders, the handling and proximity of mitigation responders and clean-up technicians.

Nationally, recent large hazardous materials incidents such as the 2013 fertilizer plant explosion in West, Texas, and several railway fuel oil explosions in 2013-2015 affected confidence in government's ability to prevent or protect people from those types of disasters. Typically, the impact to public confidence is minimal so long as the government acts appropriately by sharing timely and accurate information, follows mitigation procedures focused on, in this order, life safety, incident stabilization, property protection, and environmental protection. Additionally, the government is responsible for ensuring proper resolution by reviewing remediation reports in the event of spill involving mitigation actions. Issues such as long-term closures of major Interstates may cause frustration from the public. These impacts can be mitigated by following proper messaging and cleanup procedures.

Economy

The primary economic impact of hazardous material incidents results from lost business, delayed deliveries, property damage, and potential contamination. The economic impacts of major road closures alone can range from $2,000 to $250,000. Large and publicized hazardous material-related events can deter tourists and recreationists and could potentially discourage residents and businesses. Regionally, economic effects from major transportation corridor closures can be significant.

Even small incidents have cleanup and disposal costs, and for a larger scale incident, these could be extensive and protracted. Evacuations can disrupt home and business activities. Large-scale incidents can easily reach $1 million or more in direct damages, with clean-ups that can last for years.

Historic, Cultural and Natural Resources

In many instances of hazardous materials releases, the environment is the most significantly affected component of the system consisting of people, property, and the environment. Environmental impact often includes water quality, air quality, and soil contamination. Again, the impact to the environment is scale dependent and ranges from minimal and temporary such as a small chemical spill on a roadway to catastrophic and permanent. Widespread effects can occur when materials contaminate the groundwater and eventually the municipal water supply, or they migrate to a major waterway or aquifer. Impacts on wildlife and natural resources can also be significant.

Future Land Use and Development

Increased development in the planning area increases not only the number of people potentially exposed to hazardous materials incidents, but also increases the number of shipments which can translate into more releases. Development along major transportation routes and RMP facilities should be closely monitored.

4.10.8 Jurisdictional Differences

Hazmat Release	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Likely	Significant	Significant	Medium
Albuquerque	Likely	Limited	Significant	Medium
Los Ranchos	Occasional	Limited	Significant	Low
Tijeras	Occasional	Limited	Significant	Low
AMAFCA	Occasional	Limited	Negligible	Low
MRGCD	Occasional	Limited	Significant	Low
ABCWUA	Occasional	Limited	Significant	Low

The likelihood of a hazardous materials release, as well as the potential impacts of such a release, are highest in the City of Albuquerque and in Bernalillo County along the major transportation routes.

4.10.9 Risk Summary

- For the past 20 years, the planning area has averaged eight hazardous materials incidents per year.
- Roughly 75% of these incidents were at fixed facility sites.
- The vast majority result in few injuries, but a major spill of a highly toxic chemical could potentially kill or injure hundreds of people.
- There are 9 sites classified as Risk Management Plan facilities.
- Related Hazards: Cyber Incident, Dam Failure, Earthquake, Flood, Severe Thunderstorms, and Wildfire

4.11 High Wind

4.11.1 Description

Wind is defined as the motion of air relative to the earth's surface, and the hazard of high wind is commonly associated with severe thunderstorm winds, severe winter storms (exceeding 58 mph) and tornadoes. High winds can also occur in the absence of other definable hazard conditions, events often referred to as simply "windstorms." High wind events might occur over large, widespread areas or in a very limited, localized area. They can occur suddenly without warning, at any time of the day or night.

Typically, high winds occur when large air masses of varying temperatures meet. High winds, often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Rapidly rising warm moist air serves as the "engine" for severe thunderstorms, tornadoes, and other windstorm events. These storms can occur singularly, in lines or in clusters. They can move through an area very quickly or linger for several hours. Severe winds associated with thunderstorm events are also discussed under the Thunderstorm profile (section 4.1.2) and severe winds associated with winter storms area discussed under the Severe Winter Storm profile (section 4.11).

High wind events due to seasonal processes are frequent across northern and central New Mexico. High winds in the planning area generally fall into two categories, easterly high wind events and westerly high wind events. Topography is an important feature in the formation of the different types of wind. Westerly winds are associated with dynamic weather events while easterly winds are associated with local topographical features and are often observed from the winter to spring seasons during the late afternoon to early evening hours. Easterly high wind events are the most common type of high wind in the County and can occur during any time of day, often during fall and spring seasons. There are three types of east high wind events that impact Bernalillo County:

- **Gap Winds** – Most common type of east wind. A gap wind, also known as a canyon wind, results when wind is channeled through Tijeras Canyon. Gap winds are formed when surface pressure to the east of the Sandia and Manzano mountains is greater than the pressure to the west and is accompanied by different air mass on either side of the mountains. Wind speeds are strongest at the canyon mouths. Areas west of the canyon receive the strongest winds. Gap winds are most likely to occur in spring, summer and fall months and are less frequent during the winter months. Summer thunderstorms often result in strong easterly winds.
- **Spill Over Winds** – Occur when cold air to the east has a sufficient depth to "spill over" the Sandia and Manzano mountains, instead of being restricted to the passes and canyons. Spill over winds can reach 30 to 50 mph and can result in significant damages. During winter months, a major winter storm in combination with spill over winds can lead to blizzard-like conditions. The duration of this type of easterly wind can range from 12 to 48 hours.
- **Mountain Wave Induced Winds** – This type of wind event is most common on the east side of the mountain ranges. The wave is set up by strong westerly winds across a mountain range. A subset of spill over winds type, mountain wave winds have exceptionally strong winds the reach the surface. Erratic wind pattern with the possibility of damaging winds in some areas while no winds in other areas. Mountain wave induced winds are relatively infrequent but have the potentially to cause severe property damages.

4.11.2 Past Occurrences

High wind most often occurs during the months of April and May, followed by the months of March and June.

Between December 2009 and May 2019, the NCEI Storm Events Database reported 87 high wind events impacting Bernalillo County and the Albuquerque metropolitan area. These events resulted in a total of $5,141,200 in property damages and $2,000 in crop damages. No casualties are recorded in the database during this time period. The following table shows the high wind events recorded by NCEI that resulted in damages to properties:

Table 4-34 High Wind Events Resulting in Impacts, 2009-2019

Date	Magnitude (mph)	Property Damage		Date	Magnitude (mph)	Property Damage
3/26/2010	59	$200		3/23/2013	58	$2,000
4/29/2010	99	$5,000		6/18/2013	60	$500
5/10/2010	64	$500		6/20/2013	64	$10,000
6/19/2010	59	$400,000		2/19/2014	83	$3,000
6/23/2010	70	$10,000		4/26/2014	61	$8,000
3/7/2011	59	$10,000		10/15/2015	66	$50,000
12/1/2011	87	$4,500,000		5/6/2016	58	$5,000
3/8/2012	68	$500		3/15/2018	58	$1,000
3/18/2012	66	$40,000		3/18/2018	64	$10,000
4/14/2012	60	$500		4/19/2018	64	$10,000
4/26/2012	58	$70,000		3/13/2019	64	$5,000
					Total	**$5,141,200**

Source: NCEI Storm Events Database

The highest wind speed recorded in the database is 99 mph (86 knots) on April 29, 2010, which resulted in $5,000 in property damages.

One of the most severe high wind events in Bernalillo County occurred on December 1st, 2011, when a powerful cold front plunged south and west across the eastern plains of New Mexico and spilled over the top of the Central Mountains into the Rio Grande Valley. Wind gusts between 60 and 90 mph caused widespread damage to roofs and power lines around Albuquerque, Socorro and even as far as Grants. Sustained winds between 40 and 55 mph and gusts between 60 and 90 mph were common across the planning area with numerous reports of roof damage, downed power lines, evaporative coolers blown off roofs, tree limbs snapped, and trees toppled over. Over $4.5 million in damages were reported.

Additional events not recorded in the NCEI Storm Events Database include:

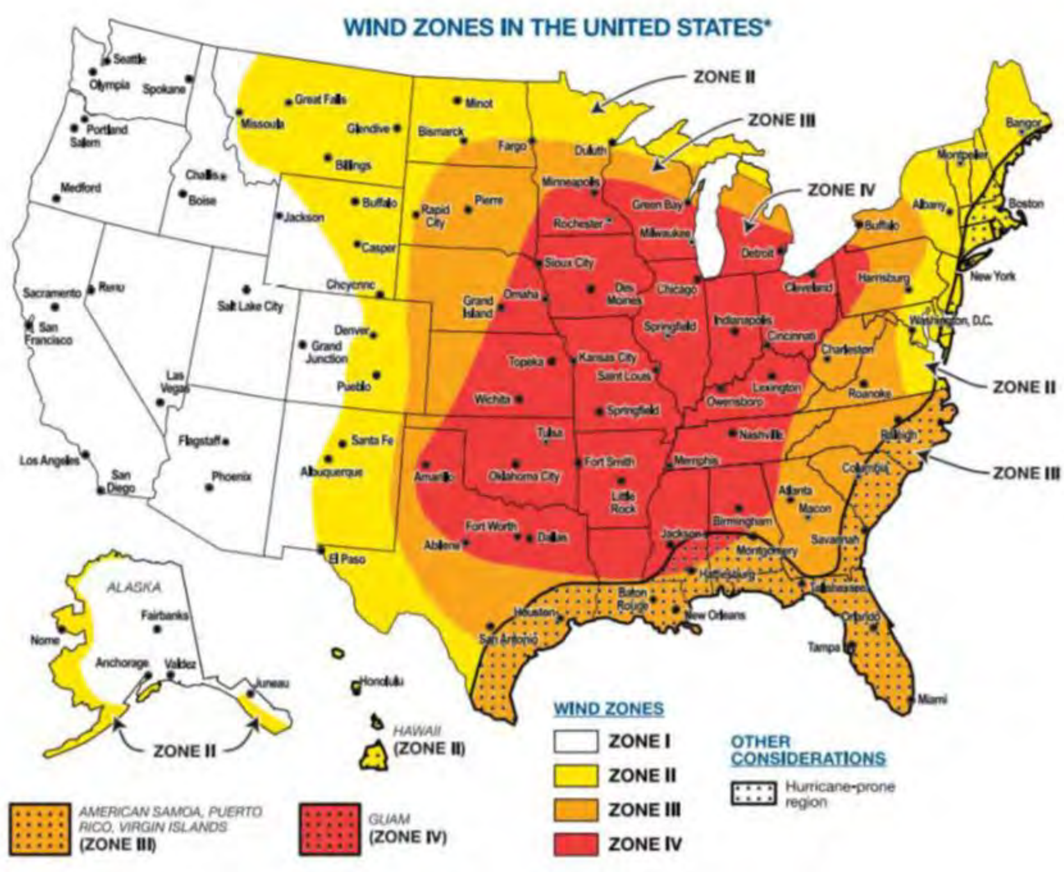
- **December 1977:** A mountain wave-induced wind event. Surface winds with gusts between 50 – 70 mph reported at the airport in Albuquerque. Reports around the Albuquerque metro area included a peak wind of 71 mph at the airport, 97 mph at the base of the Sandia Tramway and gusts between 80-90 mph at Coronado Airport.
- **March – April 1993:** Windstorms/Dust storms. Numerous days with high winds and blowing dust. Albuquerque Airport recorded a peak gust of 80 mph, Sandia Peak a gust of 106 mph.
- **December 2018:** A strong winter storm struck the planning region accompanied by 50-60 mph winds. No damages were reported.
- **July 27, 2013:** A windstorm compared by Albuquerque Mayor Berry to "a category one hurricane" pummeled Albuquerque and the surrounding area. 30,000 households lost power, although it is not clear how many of those outages were due to the winds or due to accompanying lightning strikes.
- **September 8th-9th, 2020:** During the 2020 planning process, an easterly gap wind event took place in the planning area, with winds peaking at over 70 mph at Albuquerque Sunport. The winds caused several downed trees and powerlines, leaving more than 15,000 people without power the following

morning. According to the NWS Albuquerque Weather Forecast Office, this was the strongest gap wind event (71 mph) since 1987.

4.11.3 Location

High winds are a hazard that generally has a large geographic impact, being caused by larger scale storms like thunderstorms and winter storms. The planning area experiences high wind frequently, based on seasonal meteorological patterns and local topographical conditions. All areas of the County are vulnerable to high winds, although local topography plays a significant role in how wind affects a particular area. Figure 4-28 depicts wind zones for the United States, and shows that the planning area falls into Zone II, which is characterized by damaging winds of up to 160 mph. Wind can affect any area of the County, but is worse along the Rio Grande Valley. Wind gusts on Interstate 25, which runs parallel to the Rio Grande through most of the County, can make travel more difficult.

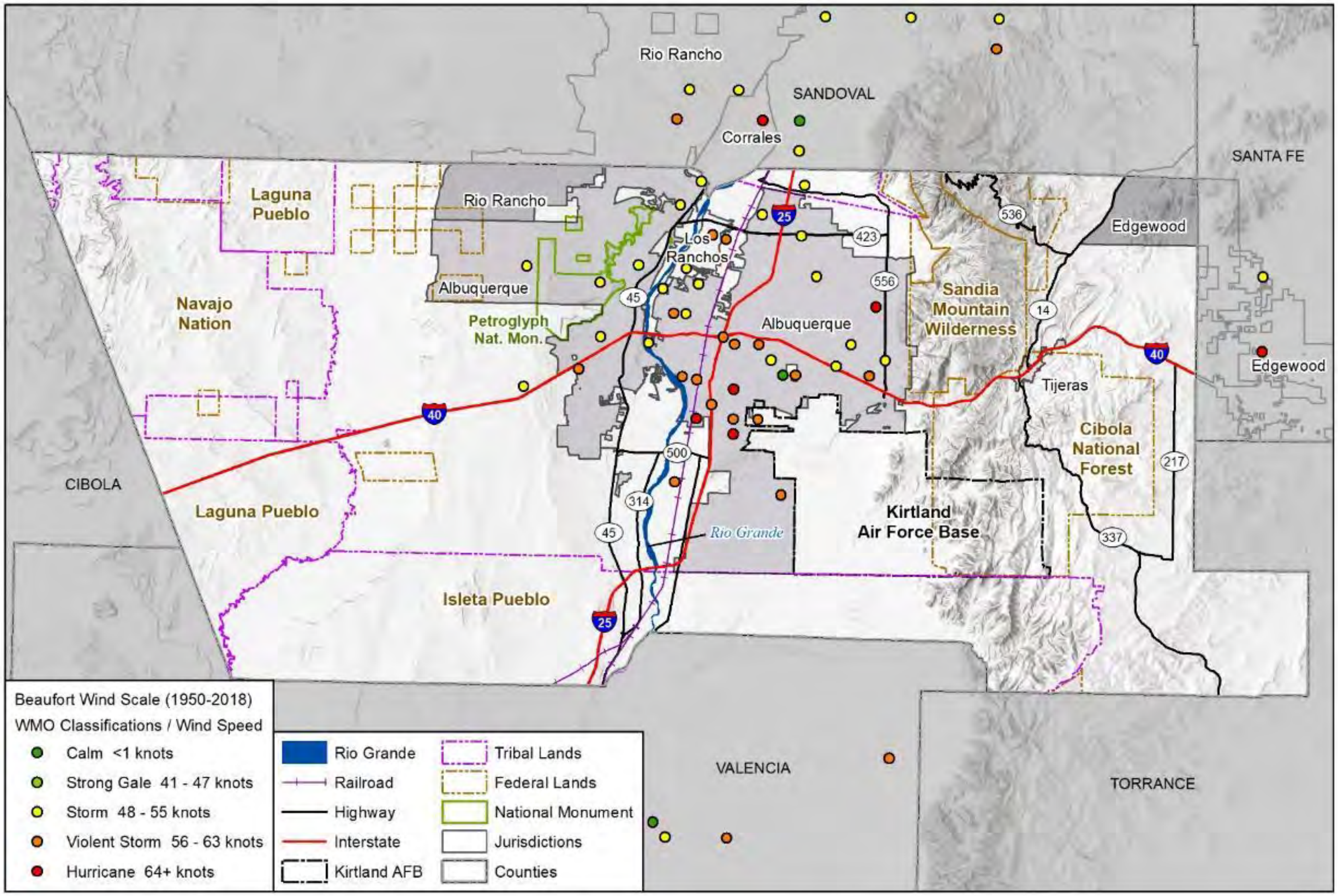
Figure 4-28 Wind Zones of the United States



Source: 2018 State Plan (originally from Taking Shelter from the Storm, FEMA P-320, Fourth Edition, 2014)

Figure 4-29 shows the starting point of past wind events in the planning area.

Figure 4-29 Past High Wind Events in Bernalillo County, 1955-2018



wood. Map compiled 8/2020; intended for planning purposes only. Data Source: City of Albuquerque, Bernalillo County, RGIS, NOAA, National Weather Service SVRGIS 2019

4.11.4 Magnitude/Severity

High winds of any type can result in damaged property and endanger the safety of people and animals come from a variety of sources. The Beaufort Wind Scale in Table 4-35 shows the specific effects that various wind speed has on land. The entire planning area can experience all 12 Beaufort wind categories.

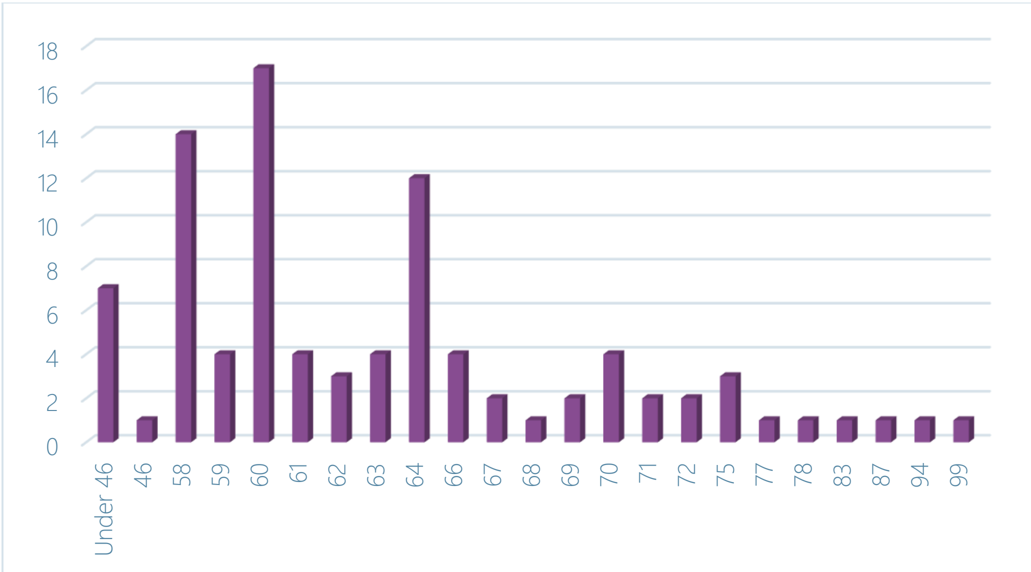
Table 4-35 Beaufort Wind Scale

Beaufort Number	Description	Windspeed (MPH)	Land Conditions
0	Calm	<1	Calm. Smoke rises vertically.
1	Light air	1 – 3	Wind motion visible in smoke.
2	Light breeze	3 – 7	Wind felt on exposed skin. Leaves rustle.
3	Gentle breeze	8 – 12	Leaves and smaller twigs in constant motion.
4	Moderate breeze	13 – 17	Dust and loose paper raised. Small branches begin to move.
5	Fresh breeze	18 – 24	Branches of a moderate size move. Small trees begin to sway.
6	Strong breeze	25 – 30	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.
7	High wind, Moderate gale, Near gale	31 – 38	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	Gale, Fresh gale	39 – 46	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9	Strong gale	47 – 54	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	Storm, Whole gale	55 – 63	Trees are broken off or uprooted, saplings bent and deformed. Poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	Violent storm	64 – 72	Widespread vegetation damage. Many roofing surfaces are damaged; asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	Hurricane	≥ 73	Very widespread damage to vegetation. Some windows may break; mobile homes and poorly constructed sheds and barns are damaged. Debris may be hurled about.

Source: National Oceanographic and Atmospheric Association, http://www.spc.noaa.gov/faq/tornado/beaufort.html

The National Weather Service Albuquerque Weather Forecast Office issues high wind warning when winds are expected to have sustained speeds of 40 mph or greater and/or instantaneous gusts of 58 mph or higher. The following table summarizes the magnitude of past high wind events in the planning area from 1959 through 2018 as recorded in the NCEI Storm Events Database. The highest recorded wind event in Bernalillo County was 99 mph, while the most frequently recorded wind speed is 64 mph.

Figure 4-36 Summary of Magnitudes of Past High Wind Events in Bernalillo County



Source: NCEI Storm Events Database

4.11.5 Climate Change Considerations

According to the best data available at the time of this plan update, the future impacts of climate change on severe wind events are unclear.

4.11.6 Probability of Future Events

The 2018 State Plan gives a 100% probability of occurrence for Preparedness Area 5. Given that 87 damaging high wind events have been recorded in Bernalillo County in the past ten years, the planning area can expect to experience several such events per year. The probability of a future event is Highly Likely.

4.11.7 Vulnerability Assessment

People

Some community members are vulnerable to the indirect impacts of high winds, particularly the loss of electrical power. These populations include the elderly or disabled, especially those with medical needs and treatments dependent on electricity. Nursing homes, community-based residential facilities, and other special needs housing facilities are also vulnerable if electrical outages are prolonged, since backup power generally operates only minimal functions for a short time.

General Property

General damages can be both direct and indirect. Direct damage refers to what the wind event physically destroys. Indirect damage focuses on additional costs, damages and losses from secondary hazards spawned by the event. Depending on the magnitude of the wind events as well as its path, a high wind event can cause significant damages to property. Older homes, which were often built under less strict building codes, suffer increased vulnerability to wind over time. Mobile homes, which are most often occupied by low-income, socially vulnerable residents, are the most dangerous places during a windstorm. Between December 2009 and May 2019, the NCEI Storm Events Database reported 21 high wind events that resulted in a total of $5,141,200 in property damages. Construction practices and building codes can help maximize the resistance of the structures to damage.

Critical Facilities and Infrastructure

High wind events often lead to downed power lines causing a disruption of power. They also have the potential to cause highway closures and disruptions to emergency communications capabilities. Because of the unpredictability of wind events' strength and path, most critical infrastructure that is above ground is equally exposed to the storm's impacts.

Government Services

Most structures, including the county's critical facilities, should be able to withstand and provide adequate protection from severe wind. Those facilities with back-up generators should be fully equipped to handle a severe wind should the power go out.

The impact of high wind on responders is similar to that of the general public.

To maintain public confidence, jurisdictions must continue to adhere to building codes and to facilitate new development that is built to the highest design standards to account for heavy winds.

Economy

High winds can impact exposed critical infrastructure; depending on the impact and the function, this could cause a short-term economic disruption. The most common problems associated with high winds are utility disruptions from downed power lines, which can have significant economic impact on businesses.

Historic, Cultural and Natural Resources

High winds can cause sporadic damage to the natural environment such as uprooting trees.

Future Land Use and Development

As the planning area increases in population, the number of people and housing developments exposed to high wind increases. However, adherence to current building codes, coupled with proper education on building techniques and the use of sturdy building materials, attached foundations, and other structural techniques, can minimize property vulnerabilities. New mobile homes can increase the planning area's vulnerability to high wind events unless they are securely anchored.

4.11.8 Jurisdictional Differences

High Wind	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Highly Likely	Extensive	Significant	High
Albuquerque	Highly Likely	Significant	Significant	High
Los Ranchos	Highly Likely	Extensive	Significant	Medium
Tijeras	Highly Likely	Extensive	Significant	Medium
AMAFCA	NA	NA	NA	NA
MRGCD	Highly Likely	Extensive	Significant	Medium
ABCWUA	Highly Likely	Extensive	Significant	Medium

High wind events can impact any area within the planning area. Based on the past occurrences discussed in Section 4.11.2 a majority of the recorded high wind events reported between 1955 and 2018 took place within the City of Albuquerque.

4.11.9 Risk Summary

- Easterly high wind events are the most common type of high wind in the planning area.
- High wind events occur most often during the fall and spring months and can occur at any time of day.
- 87 high wind events have been recorded in Bernalillo County between December 2009 and May 2019, resulting in $5,141,200 property damages and $2,000 in crop damages.
- The probability of future high wind events is highly likely.
- Vulnerable populations are at greater higher risk of power outages from wind events.
- Related Hazards: Thunderstorm, Winter Storm, Tornado, Wildfire, Drought

4.12 Landslide

4.12.1 Description

The term landslide describes the downward and outward movement of slope-forming materials (e.g., dirt, trees, and rocks) under the force of gravity. The term covers a broad array of events, including mudflows, mudslides, debris flows, rock falls, rockslides, debris avalanches, debris slides, and earth flows. Rockslides and rockfalls are types of landslides that consist of rocks or boulders moving or falling down a slope. Several natural and human factors may contribute to landslides. Landslides are defined by two factors: type of movement (e.g. slides, falls, flows, topples) and type of material (e.g. rock, earth, soil, debris).

The principal natural factors are topography, geology, and precipitation—either periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Significant landslide susceptibility exists on the margins of major uplift areas and near deeply incised river channels where slopes are steep and unconsolidated materials are present. Other elements that determine slope stability are vegetative cover and slope aspect.

The principal human activities that can contribute to slope failure are altering the slope gradient, increasing the soil water content, and removing vegetative cover (e.g., mining and the construction of highways, buildings, and railroads).

4.12.2 Past Occurrences

There is limited information on previous landslide events in New Mexico. Per the 2018 State Plan and other past research, no records of past landslides have been found for Bernalillo County. However, as reported by the Planning Team, landslides can occur in the mountainous areas near the Sandia Mountain Wilderness, Cibola National Forest, and in the eastern portion of Bernalillo County around Tijeras. As discussed in the flood hazard profile, in July 2014 heavy rainfall from thunderstorms moving over the west side of Albuquerque forced mudslides up to 3 feet deep into the backyards of several homes near Petroglyph National Monument. The USGS U.S. Landslide inventory (https://www.usgs.gov/natural-hazards/landslide-hazards/maps) notes this event, and another debris flow event that occurred on September 14, 2013 that affected a home in Albuquerque, No previous occurrences of debris flow or avalanches are listed in the NCEI database for Bernalillo County.

4.12.3 Location

Figure 4-30 displays the Landslide susceptibility classes in Bernalillo County. Landslide susceptibility data are derived from logistic regression modeling of topographic, climatic, and geologic parameters. A set of six logistic regression models relating topographic, climatic, and geologic variables to deep-seated landslide susceptibility were created (Cikoski and Koning 2017). The final models were merged across gradational boundaries, then classified into 4 susceptibility classes as shown in Figure 4-30, based on the distribution of model probabilities occurring in known landslide areas.

Figure 4-31 displays the rockfall susceptibility classes for Bernalillo County. Rockfall susceptibility data are derived from digital elevation models (DEMs) to calculate slopes. Using these calculated slopes and known mapped rockfalls, three susceptibility classes were calculated. Slopes that are over 17° that are mean-less-one standard deviation of maximum slopes in proximity of 300 meters of mapped rockfalls. These areas of likely susceptibility contain ledges or cliff that could generate rockfalls and slopes steep enough to allow rockfall transport over various distances. Potentially susceptibility rockfall areas include slopes that are generally 8-17°, contain small ledges with limited rockfall and short transport paths.

Unlikely susceptibility includes slopes that are <8° and unlikely to generate or transport rockfalls. For further detailed explanation, see Koning and Mansell 2017.

Both maps show high susceptibility for landslides and rockfalls in western/northwestern and eastern portions of the county near Sandia Crest. These areas include I-40 east of Albuquerque, along with Highways 14, 337, and 536 in the eastern portion of the County. There is also high susceptibility near the Petroglyph National Monument.

The risk of landslides is generally greater in the mountainous steep-sloped part of Bernalillo County where it can damage roads and culverts and act as a dam across streams and tributaries. The spatial extent is limited. Landslide deposit and naturally occurring rockfalls are shown in Figure 4-31 and Figure 4-32. Both landslide deposits and naturally occurring rockfall events are in the Sandia Mountain Wilderness area. There are also landslide deposits in the far western portion of the county in the Navajo Nation.

Figure 4-30 Landslide Susceptibility Classes in Bernalillo County

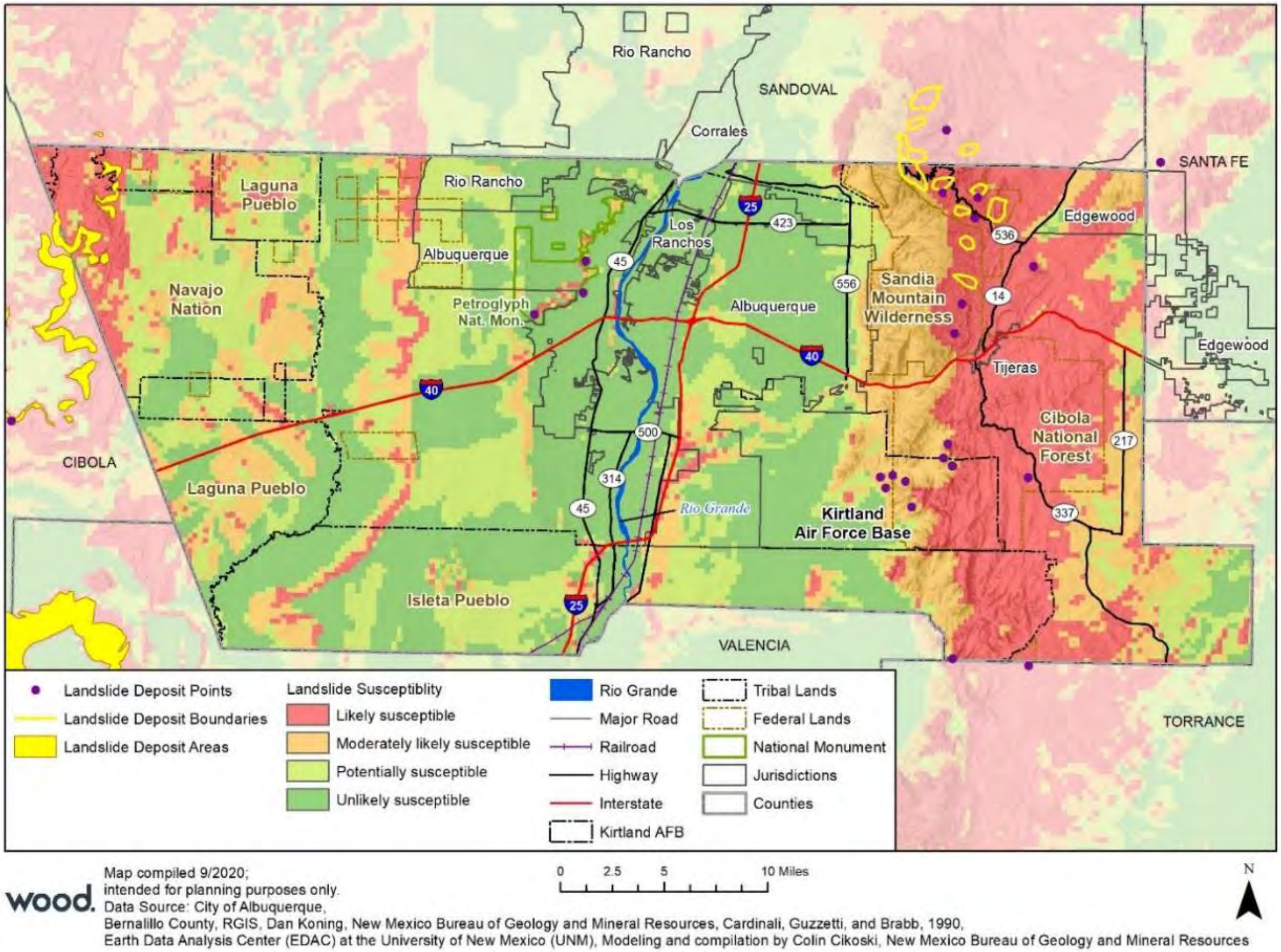
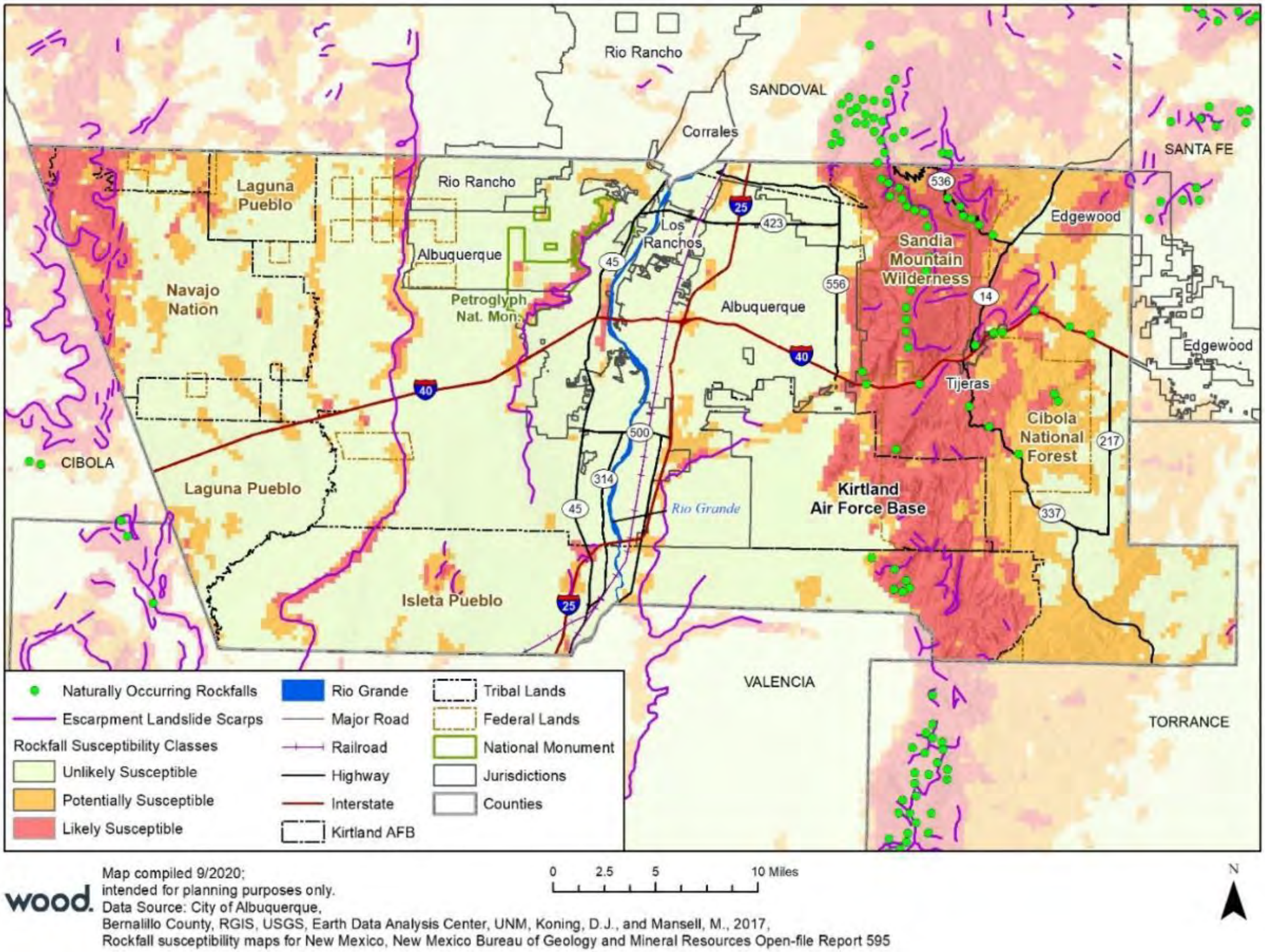


Figure 4-31 Rockfall Susceptibility Classes in Bernalillo County



4.12.4 Magnitude/Severity

Landslides and rockfalls often come with minimal to no warning. The duration of an event is quick, in the range of seconds to minutes, but the effects can last up to a day or two if blocking a roadway or knocking out power. Common problems associated with landslides and rockfalls include the loss of utilities or immobility. Loss of life is rare but can occur during landslides or rockfalls. Immobility can occur when roads become impassable due to landslides or rockfalls. Interruption or loss of power lines or transportation pathways can occur.

Landslides can be classified using the Alexander Scale, shown in Table 4-37. The scale is predicated on landslide debris impacting the built environment. Based on the history the highest extent level expected within the planning area is level 5 (Very Serious), but this is likely to be isolated to limited areas in where maintenance is limited and wooden buildings, roofs, or porches are collapsed or disconnected from foundations.

Table 4-37 Alexander Scale for Landslide Scale Damage

Level	Damage	Description
0	None	Building is intact
1	Negligible	Hairline cracks in walls or structural members; no distortion of structure or detachment of external architectural details
2	Light	Buildings continue to be habitable; repair not urgent. Settlement of foundations, distortion of structure, and inclination of walls are not sufficient to compromise overall stability.
3	Moderate	Walls out of perpendicular by one or two degrees, or there has been substantial cracking in structural members, or the foundations have settled during differential subsidence of at least 6 inches; building requires evacuation and rapid attention to ensure its continued life.
4	Serious	Walls out of perpendicular by several degrees; open cracks in walls; fracture of structural members; fragmentation of masonry; differential settlement of at least 10 inches compromising foundations; floors may be inclined by one or two degrees or ruined by heave. Internal partition walls will need to be replaced; door and window frames are too distorted to use; occupants must be evacuated, and major repairs carried out.
5	Very Serious	Walls out of plumb by five or six degrees; structure grossly distorted; differential settlement has seriously cracked floors and walls or caused major rotation or slewing of the building [wooden buildings are detached completely from their foundations]. Partition walls and brick infill will have at least partly collapsed; roofs may have partially collapsed; outhouses, porches, and patios may have been damaged more seriously than the principal structure itself. Occupants will need to be re-housed on a long-term basis, and rehabilitation of the building will probably not be feasible.
6	Partial Collapse	Requires immediate evacuation of the occupants and the cordoning off of the site to prevent accidents with falling masonry.
7	Total Collapse	Requires clearance of the site.

The severity of landslides or rockslides depends on the amount of material (soil, debris, or rocks) moves and where it stops moving (e.g. on roadway). Although the extent of the hazard is geographically small, the severity of landslides and rockfalls can be critical with potential to cause severe injuries, shutdown transportation corridors to critical infrastructure, and damage property.

4.12.5 Climate Change Considerations

Most of New Mexico has warmed at least one degree (F) in the past century. The effects of future climate change may include rising temperatures, intensified drought events, and increased susceptibility to invasive species. These factors also contribute to increase to increased risk of wildfires, which can destabilize soil on steep slopes increasing landslide risk.

Climate projections across the United States have shown that while total annual precipitation will likely decrease in the Southwest region, the heaviest annual rainfall events will become more intense. More frequent high-magnitude precipitation events would cause more frequent debris flows and landslides across the State. Also, the severity of debris flows would correlate to the intensity of these precipitation events. Sustained periods of higher-than-normal moisture could possibly result in more rockfall and deep-seated landslide events according to the 2018 state plan.

4.12.6 Probability of Future Events

Despite a lack of data on past events, the probability of future occurrences of rockfall and landslide events in the planning area is estimated to be likely. Many areas in the eastern portion of the County are prone to these types of hazard events due to their proximity to landslide deposits, naturally occurring rockfall events, their location at the base or top of steep slopes and drainage basins, or their location on infill or steep slope cuts. Moreover, increasing development and population in the County, particularly in mountainous areas, is likely to increasing numbers of structures and people exposed to future landslide and rockfall events.

4.12.7 Vulnerability Assessment

People

Exposure of people to landslide hazards is generally low. People who travel along roadways or highways in the north western and eastern portions of the county are potentially exposed because these areas are occasionally susceptible to landslides and rockfalls due to steep slopes and potential for heavy rain. Although there have been rockfall events that resulted in fatalities in 1988 and 1991 between Taos and Española, there have been no landslides or rockfall events in Bernalillo County reported to have caused loss of life, injuries, or major property damage.

General Property

Table 4-38 shows there are 9,469 buildings on 6,687 parcels in areas likely susceptible to landslides. Most are in the unincorporated portions of the County, followed by Albuquerque and Tijeras. The estimated value of these buildings is over $1.9 billion. This analysis is a planning level exposure analysis; site-specific analyses would be needed to refine loss estimates and further refine potential risk to individual structures.

Table 4-38 Improved Properties Potentially at Risk to Landslide

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	10	45	$31,574,449	$31,574,449	$63,148,898	
	Residential	543	659	$95,949,757	$47,974,879	$143,924,636	1,756
	Vacant	1	5	$20,813	$20,813	$41,626	
	Total	**554**	**709**	**$127,545,019**	**$79,570,141**	**$207,115,160**	**1,756**
Tijeras	Commercial	30	53	$11,728,729	$11,728,729	$23,457,458	
	Residential	192	291	$22,709,075	$11,354,538	$34,063,613	655
	Vacant	7	9	$38,600	$38,600	$77,200	
	Total	**229**	**353**	**$34,476,404**	**$23,121,867**	**$57,598,271**	**655**
Unincorporated	Commercial	119	266	$41,808,766	$41,808,766	$83,617,532	
	Residential	5,476	7,782	$1,072,178,658	$536,089,329	$1,608,267,987	19,312
	Vacant	309	359	$2,088,040	$2,088,040	$4,176,080	
	Total	**5,904**	**8,407**	**$1,116,075,464**	**$579,986,135**	**$1,696,061,599**	**19,312**
	Grand Total	**6,687**	**9,469**	**$1,278,096,887**	**$682,678,142**	**$1,960,775,029**	**21,723**

Source: New Mexico Bureau of Geology & Mineral Resources, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-39 shows there are 7,586 buildings on 5,606 parcels in areas likely susceptible to rockfall. Unlike landslide, the majority of these structures are in Albuquerque, followed by the unincorporated areas and the Village of Tijeras. The improved value of the buildings is over $1 billion with the total value over $1.6 billion. This analysis is a planning level exposure analysis; site-specific analyses would be needed to refine loss estimates and further refine potential risk to individual structures.

Table 4-39. Improved Properties Potentially at Risk to Rockfall

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	42	109	$78,758,433	$78,758,433	$157,516,866	
	Residential	3,611	4,614	$646,807,889	$323,403,945	$970,211,834	11,679
	Vacant	12	18	$81,113	$81,113	$162,226	
	Total	**3,665**	**4,741**	**$725,647,435**	**$402,243,491**	**$1,127,890,926**	**11,679**
Tijeras	Commercial	24	42	$10,382,429	$10,382,429	$20,764,858	
	Residential	132	191	$15,180,570	$7,590,285	$22,770,855	450
	Vacant	6	8	$36,700	$36,700	$73,400	
	Total	**162**	**241**	**$25,599,699**	**$18,009,414**	**$43,609,113**	**450**
Unincorporated	Commercial	84	170	$30,376,151	$30,376,151	$60,752,302	
	Residential	1,600	2,328	$286,140,648	$143,070,324	$429,210,972	5,643
	Vacant	95	106	$564,240	$564,240	$1,128,480	
	Total	**1,779**	**2,604**	**$317,081,039**	**$174,010,715**	**$491,091,754**	**5,643**
	Grand Total	**5,606**	**7,586**	**$1,068,328,173**	**$594,263,620**	**$1,662,591,793**	**17,772**

Source: New Mexico Bureau of Geology & Mineral Resources, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Critical Facilities and Infrastructure

Landslides and rockfalls affect certain parts of the planning area, mostly areas that have steep slopes including some areas near roadways or critical infrastructure. The transportation corridors that have steep slopes and could potentially be affect are in the northeast and southeast portions of the County, including NM-165, NM-536, and NM-337, Although damage or losses to transportation corridors and structures are typically minimal, there can be impacts with lost time, maintenance costs, and tourism.

The critical facility exposure analysis estimates that there are 17 critical facilities in areas of likely landslide susceptibility and 21 facilities in areas of likely rockfall susceptibility, as shown in Table 4-40 and Table 4-41. An additional 137 critical facilities are in areas of potential to moderate landslide susceptibility, and 982 are located in areas of potential to moderate rockfall susceptibility. This analysis is a planning level exposure analysis; site-specific analyses would be needed to refine loss estimates and further refine potential risk to individual structures.

Table 4-40 Critical Facilities with Likely Landslide Susceptibility

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	1					1		**2**
Los Ranchos								**0**
Tijeras						1		**1**
Unincorporated	4	2	1			7		**14**
Total	**5**	**2**	**1**	**0**	**0**	**9**	**0**	**17**

Source: New Mexico Bureau of Geology & Mineral Resources, Albuquerque and Bernalillo County Assessor's Office, NMWRAP, HIFLD, Wood analysis.

Table 4-41 Critical Facilities with Likely Rockfall Susceptibility

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	3	1	1			4		**9**
Los Ranchos								**0**
Tijeras						1		**1**
Unincorporated	7		1			3		**11**
Total	**10**	**1**	**2**	**0**	**0**	**8**	**0**	**21**

Source: New Mexico Bureau of Geology & Mineral Resources, Albuquerque and Bernalillo County Assessor's Office, NMWRAP, HIFLD, Wood analysis.

Government Services

Aside from possible damage to government facilities, the impact of landslides and rockslides on government services or public confidence in government is minimal. The vulnerability of responders to landslide and rockslide events is similar to that of the general public.

Economy

Economic impact of landslides/rockfalls is typically short term. Short term impacts on the economy include potential minutes to hours delays in commerce and tourism.

Historic, Cultural and Natural Resources

Landslides/rockslides are a natural environmental process. Environmental impacts include the removal of vegetation, soil, and rock. As shown in **Error! Reference source not found.** and Figure 4-32, the Petroglyph National Monument is in an area that has a likely susceptibility of landslides and rockfalls.

Future Land Use and Development

Landslides in Bernalillo County generally pose a low risk to life and property because the landslide and rockfall likely susceptible areas are relatively small and lie outside the more densely populated areas of Albuquerque. As the planning area increases in population, future development should consider avoiding mapped landslide deposits and likely landslide / rockfall susceptibility areas as shown in Figure 4-30 and Figure 4-31.

Future land development inside and stemming out from Albuquerque should also consider proximity to arroyos. A landslide could undermine arroyos in higher elevation areas near future development areas and create debris flows in these arroyos causing other issues such as flooding as discussed in Section 4.9.7

4.12.8 Jurisdictional Differences

Landslide	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Likely	Significant	Significant	Medium
Albuquerque	Occasional	Limited	Significant	Medium
Los Ranchos	Unlikely	Limited	Negligible	Low
Tijeras	Likely	Significant	Critical	Medium
AMAFCA	Unlikely	Limited	Significant	Medium
MRGCD	Unlikely	Limited	Negligible	Low
ABCWUA	Unlikely	Limited	Significant	Medium

All participating jurisdictions in Bernalillo County, except for Los Ranchos, are susceptible to impacts of landslides because they include or are directly adjacent to steeper terrain.

4.12.9 Risk Summary

The eastern portion of the county is likely susceptible to the impacts of landslides and rockfalls, especially in areas of steep slopes during high precipitation events in spring or summer.

- There have been no landslides or rockfall events in the planning area that have caused loss of life, injuries, or major property damage.
- The County actively monitors conditions along the Rio Grande for potential landslides.
- There are landslide deposits and naturally occurring rockfall events in the Sandia Mountain Wilderness.
- The Petroglyph National Monument is an area that has a likely susceptibility of rockfall and landslides.
- Recently available statewide landslide data informed an enhanced vulnerability assessment during the update of this plan. The total value of properties in areas of likely susceptibility to landslides and rockfalls within Bernalillo County is over $1.9 billion and $1.6 billion, respectively, not including utilities or roadways.

- Mitigation of smaller landslides or rock falls can be accomplished with mesh or cable nets, barriers, and fences, or catchment areas. These designed structures can stop, control, reduce or provide a safe location for landslides/rock falls.
- Related hazards: spring/summer storms, earthquakes, wildfires.

4.13 Land Subsidence

4.13.1 Description

Land subsidence describes any depressions, cracks, and/or sinkholes in the earth's surface which can threaten people and property. Causes of subsidence include, but are not limited to, the removal or reduction of sub-surface fluids (water, oil, gas, etc.), mine subsidence, and hydro compaction. Of these causes, hydro-compaction, and mine subsidence manifest as localized events, while fluid removal may occur either locally or regionally.

Subsidence is caused by a diverse set of natural processes and human activities that include the mining of coal, metallic ores, limestone, salt, and sulfur; the withdrawal of groundwater, petroleum, and geothermal fluids; dewatering of organic soils; the wetting of dry, low-density deposits known as hydro compaction; dissolution of underground strata; natural sediment compaction; liquefaction; and crustal deformation.

Collapsible Soil

Collapsible soil is a related hazard that can quickly settle or collapse the ground, causing damage to manmade structures. The most common type of collapsible soil is hydrocompactive soil, which occurs in semi-arid to arid climates and consists of low density and low moisture content soil. The soil grains in these areas are not compacted tightly together but rather stacked loosely. These soils are considered strong while in a dry state. However, when moisture is introduced the stacked soil grains can collapse causing ground surface subsidence or settlement.

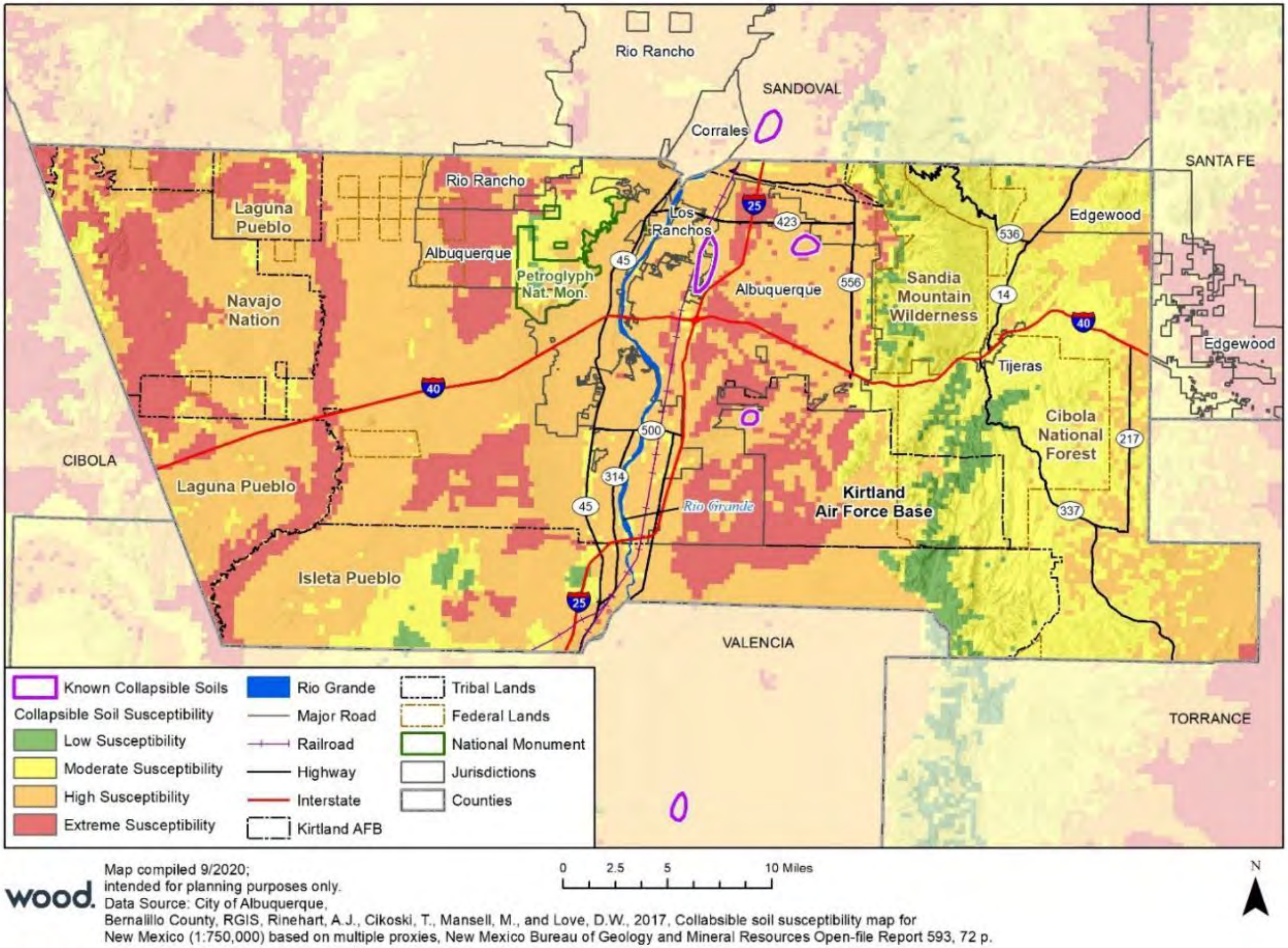
4.13.2 Past Occurrences

There are known collapsible soil locations in the plan area as shown in Figure 4-32, but there are no recorded events involving collapsible soils, subsidence, or sinkholes causing damage in the planning area. There are likely a number of minor events that have gone unreported. While sinkholes are secondary hazards related to land subsidence, there was a 2008 sinkhole event in Carlsbad and was directly linked to mining, but no known underground mining related sinkholes have occurred in Bernalillo County. There are mines in the county as discussed below.

4.13.3 Location

Figure 4-32 shows locations within Bernalillo County that have been identified as being susceptible to collapsible soils. The susceptibility results included known collapsible features and multiple correlative and qualitative proxies including climate, soil texture and taxonomy, depth-to-water, vegetation and land use, and landforms (Rinehart *et al* 2017). Although not all of these proxies were consistently available across the State and each came with its own data resolution, the total susceptibility was calculated by balancing correlation between hydro compaction susceptibility and proxy data along with the quality and reliability of the proxies. For further explanation, see Rinehart *et al* 2017. Areas with extreme susceptibility for collapsible soils range from central to the western parts of the planning area.

Figure 4-32 Collapsible Soil Susceptibility in Bernalillo County



4.13.4 Magnitude/Severity

Data on extent of land subsidence are extremely limited according to the 2018 New Mexico State HMP. As a result, severity can only be determined based on a few occurrences. Land subsidence generally affects localized areas but can affect the region if it damages transportation corridors.

Land subsidence can occur rapidly due to sinkholes, the collapse of underground mines, or during an earthquake. Subsidence can also take place slowly, becoming evident over many years. Soils that tend to collapse and settle are those characterized by low-density materials that shrink in volume when they become wet and/or are subjected to weight from development. Subsidence events, depending on their location, can pose significant risks to health, safety, and local agricultural economies and interruption to transportation, and other services. Collapsible soil, like land subsidence, generally affects localized areas but can affect the region if it affects transportation corridors.

According to the 2018 State plan, land subsidence due to hydrocompactive soils has been identified and verified across New Mexico, affecting roads, residences, water lines and sewer lines. These include regions in the planning area such as in the Tanoan Communities in Albuquerque, along the western flank of the Rio Grande valley in Albuquerque, and in Tijeras Canyon in Albuquerque.

According to the New Mexico Mining and Minerals Division, there are 48 mine registrations and permits in Bernalillo County (EMNRD Mining and Minerals Division 2020). As mining is associated with mine subsidence and sinkholes, it is important to know these locations. Although the number of abandoned mines in Bernalillo County is unknown, it is estimated there are over 15,000 abandoned mine features in the State of New Mexico (EMNRD Mining and Minerals Division 2020).

4.13.5 Climate Change Considerations

Changing weather patterns and climate could affect land subsidence in New Mexico. Areas with collapsible soils that already have structures built on them may be more likely to subside due to greater focused run-off with increased precipitation magnitude and intensity. New Mexico will likely see an increased incidence of subsidence from groundwater withdrawal as climate changes. As the climate warms, increases in irrigation and water use will lead to greater reliance on groundwater reserves, likely lowering groundwater levels below historical levels. When groundwater levels drop, the likelihood of subsidence increases.

4.13.6 Probability of Future Events

No records of past subsidence have been found for Bernalillo County. The 2018 State Plan does not report any land subsidence or sinkhole issues in the planning area. Based on the known collapsible soil locations around the planning area, it is possible that collapsible soils will continue occasionally. Collapsible soils potential to occur increases when water is added to drier soils as development extends out to the valley margins and foothills beyond the well-watered and irrigated valleys with compact soils. Overall, the probability of significant land subsidence occurring in the future is occasional.

4.13.7 Vulnerability Assessment

People

Collapsible soils and moderately expansive soils intersect with many of the more populated jurisdictions such as Albuquerque. However, the relatively slow onset of most expansive and collapsible soil events makes them unlikely to cause injuries. There are no known deaths or injuries in the planning area from these types of events.

General Property

Although damage or losses to transportation corridors and structures are typically minimal, there can be impacts with mitigation and maintenance costs, lost time, and minor structural damage.

Damages to property due to erosion and deposition are usually classified as cosmetic, functional, or structural. Cosmetic damages refer to slight problems where only the physical appearance of a structure is affected (e.g., cracking in plaster or drywall). Functional damage refers to situations where the use of a structure has been impacted due to subsidence. Structural damages include situations where entire foundations require replacement due to subsidence-caused cracking of supporting walls and footings.

This analysis is a planning level exposure analysis; site-specific analyses would be needed to refine loss estimates and further refine potential risk to individual structures. However, only 18% of Bernalillo County has Extreme Risk to collapsible soil susceptibility, of which is generally outside of the high density population area of Albuquerque (Figure 4-32).There are 42,889 buildings on 29,081 parcels in Albuquerque, Los Ranchos, and unincorporated areas identified as being at extreme susceptibility to collapsible soils (Table 4-42). The potential losses associated with these facilities is estimated at $11.5 billion. The known collapsible soil locations, as shown in Figure 4-32, are in the high susceptibility area for collapsing soils and are within or just outside of Albuquerque.

Table 4-42 Improved Properties at Risk to Extreme Susceptibility (18% of County) Collapsible Soil by Property Type

Jurisdiction	Property Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	3,623	5,457	$2,586,351,344	$2,586,351,344	$5,172,702,688	
	Residential	24,415	36,166	$4,047,371,368	$2,023,685,684	$6,071,057,052	78,962
	Vacant	386	456	$10,261,756	$10,261,756	$20,523,512	
	Total	**28,424**	**42,079**	**$6,643,984,468**	**$4,620,298,784**	**$11,264,283,252**	**78,962**
Los Ranchos	Commercial	1	1	$245,100	$245,100	$490,200	
	Residential	26	27	$18,657,941	$9,328,971	$27,986,912	82
	Total	**27**	**28**	**$18,903,041**	**$9,574,071**	**$28,477,112**	**82**
Unincorporated	Commercial	27	42	$18,500,600	$18,500,600	$37,001,200	
	Residential	574	699	$177,949,695	$88,974,848	$266,924,543	2,024
	Vacant	29	41	$1,087,200	$1,087,200	$2,174,400	
	Total	**630**	**782**	**$197,537,495**	**$108,562,648**	**$306,100,143**	**2,024**
	Grand Total	**29,081**	**42,889**	**$6,860,425,004**	**$4,738,435,502**	**$11,598,860,506**	**81,068**

Source: New Mexico Bureau of Geology & Mineral Resources, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

While the above analysis shows large numbers of people and property potentially at risk of land subsidence, the lack of reported damages from subsidence combined with the slow onset of subsidence indicates the actual risk is lower than this data might suggest.

Critical Facilities and Infrastructure

The critical facility exposure analysis identified 188 critical facilities located in areas at extreme susceptibility to collapsible soils, as shown in Table 4-43. This analysis is a planning level exposure analysis; site-specific analyses would be needed to refine loss estimates and further refine potential risk to individual structures.

Table 4-43 Critical Facilities with High-to-Extreme Collapsible Soil Susceptibility

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	474	72	23	2	33	193	11	**808**
Los Ranchos	6	1				6		**13**
Tijeras								**0**
Unincorporated	62	13	5	6	1	39		**126**
Total	**542**	**86**	**28**	**8**	**34**	**238**	**11**	**947**

Source: New Mexico Bureau of Geology & Mineral Resources, Albuquerque and Bernalillo County Assessor's Office, NMWRAP, HIFLD, Wood analysis.

Government Services

Aside from possible damage to government facilities, the impact of subsidence on government services or public confidence in government is minimal. Impacts on responders are unlikely.

Economy

The economic cost of subsidence and collapsible soils is typically minor in the short term, although over time they can add up to significant impacts.

Historic, Cultural and Natural Resources

Subsidence and collapsible soils are a natural environmental process that can be influenced by human activities. Nonetheless they have the potential to alter the landscape and cause damages to historic and cultural resources.

Future Land Use and Development

Local land subsidence will continue as more water is pumped for irrigation and as more development such as roads and buildings extend into new regions. For hydrocompactive soils, better building ordinances and special care for all surface and subsurface water sources is essential. This includes better testing of the subsurface before construction.

Only 18% of the county is rated as extreme susceptibility for collapsible soils and includes over 42,000 structures with a total value of over $11.5 billion. However, based on historic records, Bernalillo County only has a few collapsible soil locations. And although studies by the USGS suggest that vulnerability to subsidence could increase if groundwater pumping becomes non-sustainable, subsidence and collapsible soil impacts would likely be minor such as disrupting roads, water lines, sewer lines, or aesthetic damages to residences.

One mitigation effort is educating communities about the effects of land subsidence and the risks mining brings to the community. As discussed above, there are currently 48 mine registrations and permits in Bernalillo County (EMNRD Mining and Minerals Division 2020). While sinkholes are secondary hazards related to land subsidence, there most recent New Mexico sinkhole event occurred in Carlsbad in 2008 and was directly linked to mining, but no underground mining related sinkholes have known occurred in Bernalillo County.

4.13.8 Jurisdictional Differences

Land Subsidence	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Unlikely	Extensive	Negligible	Medium
Albuquerque	Unlikely	Limited	Negligible	Low
Los Ranchos	Unlikely	Extensive	Negligible	Low
Tijeras	Unlikely	Significant	Negligible	Low
AMAFCA	Unlikely	Limited	Critical	Medium
MRGCD	Unlikely	Limited	Negligible	Low
ABCWUA	Unlikely	Limited	Negligible	Low

The risk of land subsidence is slightly higher in western Bernalillo County, and lowest in the east mountains and Village of Tijeras. For AMAFCA facilities, this could be mean a sinkhole underneath part of an arroyo creating the need for repair.

4.13.9 Risk Summary

There are no damaging subsidence events reported in the planning area.

- 18% of the planning area has extreme collapsible soil susceptibility based on statewide mapping and includes over 42,000 structures with a total value of over $11.5 billion.
- There are three areas of known collapsible soils in Albuquerque.
- Based on known collapsible locations, land subsidence in the future will occur occasionally.
- The spatial extent and severity of subsidence including collapsible soils are limited.
- There are 48 mine registrations and permits in Bernalillo County, although the number of abandoned mines in Bernalillo County is unknown, it is estimated there are over 15,000 abandoned mine features in the State of New Mexico.
- Increases in irrigation and water use will lead to greater reliance on groundwater reserves and when groundwater levels drop, the likelihood of subsidence increases.
- Subsidence and collapsible soil impacts would likely be minor such as disrupting roads, water lines, sewer lines, or aesthetic damages to residences.
- Related hazards: earthquake, wildfire, spring/summer storms, floods.

4.14 Pandemic/Public Health Emergency

4.14.1 Description

A public health emergency is defined as an emergency need for healthcare and medical services to respond to a disaster, significant outbreak of an infectious disease, bioterrorist attack or other significant or catastrophic event. Public health emergencies can occur as primary events by themselves, or they may be secondary to another disaster or emergency, such as tornado, flood, or hazardous material incident.

Public health emergencies have the potential to cause serious illness and death, especially among those who have compromised immune systems due to age or underlying medical conditions. There are several contagious and infectious diseases present in the planning area that could constitute a public health risk.

A pandemic can be defined as a disease that attacks a large population across great geographic distances. Pandemics are larger than epidemics in terms of geographic area and number of people affected. Epidemics tend to occur seasonally and affect much smaller areas. Pandemics, on the other hand, are most often caused by new subtypes of viruses or bacteria for which humans have little or no natural resistance. Consequently, pandemics typically result in more deaths, social disruption, and economic loss than epidemics.

There are three conditions that trigger a pandemic declaration:

1. A new virus subtype must emerge that has not previously circulated in humans (and therefore there is no pre-existing immunity),
2. This new subtype must be able to cause disease in humans, and
3. The virus must be easily transmissible from human to human.

As of October 2020, Bernalillo County, the nation, and the world are dealing with the COVID-19 pandemic, confirming that pandemic is a key public health hazard in the planning area. This hazard risk assessment includes an analysis of pandemic risk across Bernalillo County and an analysis of the impacts of the hazards profiled in this plan on public health.

Unlike seasonal flu, an influenza pandemic has much greater potential for loss of life and significant social disruption due to higher rates of transmission and more severe health impacts. The COVID-19 virus has a much higher rate of transmission than the seasonal flu, primarily by airborne transmission of droplets/bodily fluid. Common symptoms include fever, cough, fatigue, shortness of breath or breathing difficulties, and loss of smell and taste. While most people have mild symptoms, some people develop acute respiratory distress syndrome with roughly one in five requiring hospitalization and a fatality rate of approximately 1%. A key challenge in containing the spread has been the fact that it can be transmitted by people who are asymptomatic.

According to the U.S. Centers for Disease Control and Prevention (CDC) and the New Mexico Department of Health, there are several resources the County can focus on in the event of a pandemic, which include:

- Infection Prevention and Control
- Securing medical resources
- Laboratory testing/capacity
- Community Mitigation
- Surveillance and Data Analytics
- Contact Tracing

4.14.2 Past Occurrences

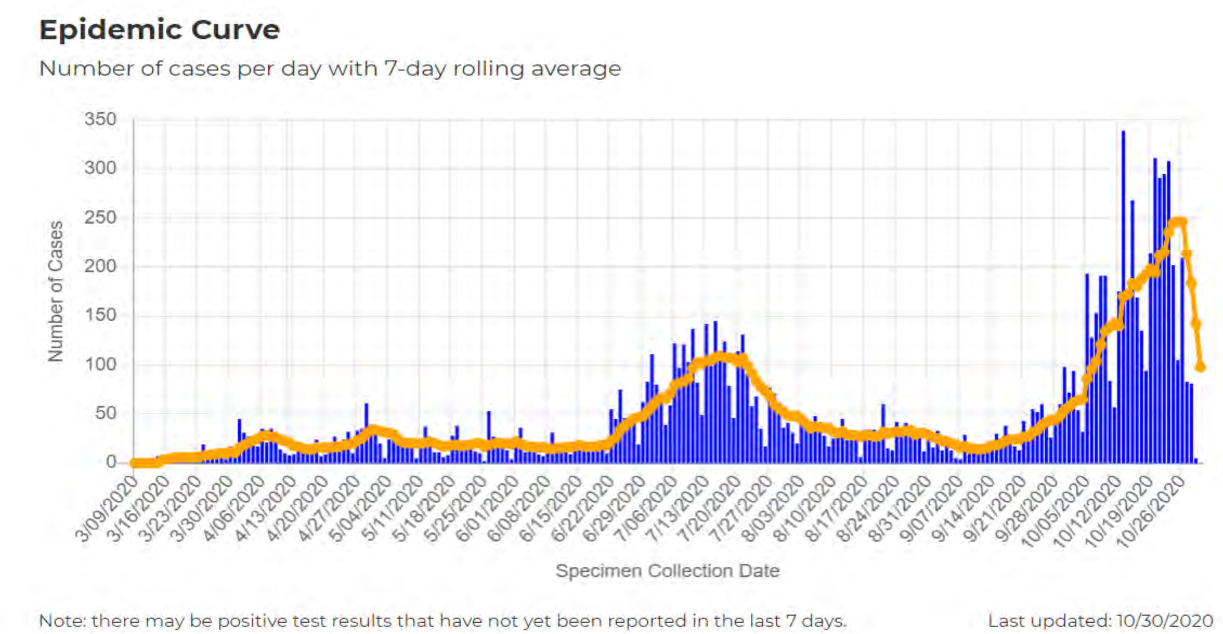
The New Mexico Department of Health publishes epidemiology reports for various diseases. One of the most prominent diseases that affects New Mexico every year is influenza. In the 2018-2019 season, there two waves of influenza from two strains of the virus and was the longest season in 10 years.

Pandemics

Since the early 1900s, five lethal pandemics have swept the globe:

- **1918-1919 Spanish Flu**: The Spanish Flu was the most severe pandemic in recent history. The number of deaths was estimated to be 50-100 million worldwide and 675,000 in the United States. Its primary victims were mostly young, healthy adults. At one point, more than 10 percent of the American workforce was bedridden.
- **1957-1958 Asian Flu**: The 1957 Asian Flu pandemic killed 1-2 million people worldwide, including about 70,000 people in the United States, mostly the elderly and chronically ill. Fortunately, the virus was quickly identified, and vaccine production began in May 1957.
- **1968-1969 H3N2 Hong Kong Flu**: The 1968 Hong Kong Flu pandemic killed 34,000 Americans. Again, the elderly were more severely affected. This pandemic peaked during school holidays in December, limiting student-related infections, which may have kept the number of infections down. Also, people infected by the Asian Flu ten years earlier may have gained some resistance to the new virus.
- **2009-2010 H1N1 Swine Flu**: This influenza pandemic emerged from Mexico in early 2009 and was declared a public health emergency in the U.S. on April 26. By June, approximately 18,000 cases had been reported in the U.S. and the virus had spread to 74 countries. Most cases were fairly mild, with symptoms similar to the seasonal flu, but there were cases of severe disease requiring hospitalization and a number of deaths. The CDC estimates that 43-89 million people were infected worldwide, with an estimated 8,870 to 18,300 H1N1 related deaths, including 12,469 deaths in the United States.
- **2020-Ongoing COVID-19**: The COVID-19 or novel coronavirus pandemic began in December 2019 and was declared a pandemic in March of 2020. As of November 5th, 2020, 49 million cases have been reported around the world with over 1.2 million deaths, including 9.8 million cases and 236,000 deaths in the United States. Bernalillo County has seen 12,828 cases, resulting in 225 deaths. The pandemic is expected to last through the remainder of 2020 and into 2021.

Figure 4-33 COVID-19 Epidemic Curve, Bernalillo County, October 30, 2020



Source: New Mexico Department Of Health

While it did not reach pandemic proportions, the planning area was impacted by an outbreak of Hepatitis A from November 2018 through June 2020. This outbreak was part of a national outbreak of Hepatitis A among persons experiencing homelessness and injection and non-injection drug users. Along with routine monitoring of cases in Albuquerque area, the City of ABQ Environmental Health Department (EHD) partnered with NM Department of Health and other local agencies to assist with providing information to restaurants, the general public, and educating/assisting businesses that had positive workers. In addition to state and federal partners, EHD coordinated with other City departments to facilitate vaccination events for specific groups of City employees that needed Hepatitis A vaccination. Overall, New Mexico experienced 168 total cases, 127 hospitalization, and 2 deaths.

4.14.3 Location

Pandemics occur not only on a county or state level, but on a national and global scale. The current COVID-19 pandemic has affected all counties in New Mexico. It is likely that most communities in Bernalillo County would be affected, either directly or by secondary impacts. More highly-populated areas may be affected sooner and may experience higher infection rates.

4.14.4 Magnitude/Severity

The magnitude of a public health emergency will range significantly depending on the transmissivity and mortality rate of the virus. Pandemic influenza is more easily transmitted from person-to-person but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time.

Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus could spread around the globe within hours. Under such conditions, there may be very little time to counties, states, and countries to prepare. Most experts believe we will have just one to six months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the United States. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make influenza pandemic unlike any other public health emergency or community disaster. Pandemics typically last for several months to 1-2 years.

As described by the World Health Organization (WHO), the Pandemic Intervals Framework (PIF) is a six-phased approach to defining the progression of a pandemic. This framework is used to guide pandemic planning and provides recommendations for risk assessment, decision-making, and action. These intervals provide a common method to describe pandemic activity which can inform public health actions. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response.

The six-phase approach was designed for the easy incorporation of recommendations into existing national and local preparedness and response plans. Phases 1 through 3 correlate with preparedness in the pre-pandemic interval, including capacity development and response planning activities, while Phases 4 through 6 signal the need for response and mitigation efforts during the pandemic interval. Phase 6 was reached in the County during the 2020 COVID outbreak.

Pre-Pandemic Interval

- Phase 1 is the natural state in which influenza viruses circulate continuously among animals but do not affect humans.
- Phase 2 involves cases of animal influenza that have circulated among domesticated or wild animals and have caused specific cases of infection among humans.
- Phase 3 represents the mutation of the animal influenza virus in humans so that it can be transmitted to other humans under certain circumstances (usually very close contact between individuals). At this point, small clusters of infection have occurred.

Pandemic Interval

- Phase 4 involves community-wide outbreaks as the virus continues to mutate and become more easily transmitted between people (for example, transmission through the air).
- Phase 5 represents human-to-human transmission of the virus in at least two countries.
- Phase 6 is the pandemic phase, characterized by community-level influenza outbreaks.

4.14.5 Climate Change Considerations

Additional research is needed to determine the effects of climate change on the frequency and duration of epidemics and pandemics. Climate change may influence vector-borne disease prevalence, although the direction of the effects (increased or decreased incidence) will be location- and disease-specific. The intensity and extent of certain diseases is projected to increase. Climate change threatens to increase the spread of infectious diseases because changing heat, rain, and humidity levels allow disease carrying vectors and pathogens to come into closer contact with humans. If New Mexico's climate becomes warmer, mosquito populations could swell, making the region more favorable for disease transmission. Warmer weather could also play a role in elevated seasonal deer mouse populations. Disadvantaged populations such as people with compromised health and the economically disadvantaged are expected to bear a greater burden as a result of their reduced access to medical care and limited resources for adaptation strategies.

Ongoing efforts to reduce greenhouse gas emissions and adapt to a changing climate, may help to reduce the impacts of climate change on pandemics.

4.14.6 Probability of Future Events

Even before the COVID-19 pandemic began, most public health experts considered another major pandemic to be inevitable. However, there is no definite way to predict when the next pandemic might happen. Some indicators will be present, but not every new virus turns into a pandemic. Based on the five pandemics that have affected the United States in roughly the last 100 years, a pandemic occurs on average roughly every 20 years.

Based on historical incidents from 2013 through 2017, Bernalillo County experiences approximately 13 deaths per 100,000 people from influenza and pneumonia each year.

4.14.7 Vulnerability Assessment

Preparing for, responding to, and recovering from a pandemic requires a strategy that includes a holistic suite of public health activities designed to lessen the impact on morbidity and mortality. These activities include education, vaccination, prophylaxis, isolation/quarantine, a robust contact tracing program, and the closure of public facilities. In addition, clear, concise communication with the public and with other agencies remains a critical component, as does the ability of the involved agencies to achieve collaboration and coordination. By their very nature, most pandemics, once started, will not be stopped until they have run their course. This course can be shortened and weakened by a number of factors, with vaccination being the most effective method for protecting the population. Pandemic plans describe strategies of preparedness, response, and recovery to attempt to decrease illnesses and deaths during the pandemic period to manageable levels (i.e., that do not overwhelm the critical infrastructures of the State), and to promote community resiliency and rapid recovery.

People

Pandemics have the ability to affect large segments of the population for long periods of time. The number of hospitalizations and deaths will depend on the virulence of the virus. Risk groups cannot be predicted with certainty; the elderly, people with underlying medical conditions, and young children are usually at higher risk, but as discussed above this is not always true for all influenza strains. People without health coverage or access to good medical care are also likely to be more adversely affected. Mental health of the public could also be impacted depending on the length of the event and public health guidance on prevention.

As noted under Previous Occurrences, the COVID-19 pandemic has resulted in 49 million cases worldwide as of November 5, 2020, with over 1.2 million deaths. The U.S. has seen 9.8 million cases with 236,000 deaths. Bernalillo County has seen 12,828 cases, resulting in 225 deaths. In addition to the direct impacts, the pandemic has completely disrupted life for many people. Most large gatherings have had to be cancelled, and many schools have closed. Sheltering in place and social distancing have been highly encouraged and, in some places, mandated, leaving some individuals isolated for months.

General Property

For the most part, property itself is not generally impacted by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. Additionally, traditional sheltering facilities including homeless shelters or facilities stood up to support displaced persons due to an evacuation or other reason due to a simultaneous disaster occurring cannot be done in a congregate setting. This requires additional planning considerations or use of facilities that allow for non-congregate shelter settings which may require an approval of a request to FEMA for non-congregate sheltering, and may have an increased cost (such as the use of individual hotel rooms) as opposed to traditional congregate sheltering facilities.

Critical Facilities and Infrastructure

Hospitals and morgues will be heavily affected and may be overwhelmed. Other critical facilities and infrastructure are not directly affected by a pandemic but may have difficulty maintaining operations and maintenance activities due to a significantly decreased workforce. Schools may be forced to close.

Government Services

Medical staff can become overburdened with hundreds of additional cases on top of their normal workload. All other responders will be impacted in similar proportions to the general public, thereby reducing available responders. Adverse impacts are expected to be severe for unprotected personnel and uncertain for trained and protected personnel, depending on the nature of the incident.

The COVID-19 pandemic has had severe impacts on healthcare workers and other responders. The difficulty of trying to protect themselves and their families while still doing their jobs was exacerbated initially by shortages of personal protective equipment (PPE). The mental health impacts on responders and healthcare workers have not been fully quantified but are likely to have impacts for months if not years to come.

Other responders will be impacted similarly to the general public, although the nature of their jobs may make social distancing more difficult which could potentially lead to higher infection rates, thereby reducing available responders.

Unscheduled sick leave from a large portion of the workforce could result in loss of productivity and delivery of services. Even without large numbers of infected workers, social distancing requirements and workplace closures can have a major impact on the government's ability to deliver services, as seen during the COVID-19 pandemic. As residents are quarantined due to the pandemic, as seen during the COVID-19 pandemic the demand for deliveries of essential goods will also increase.

Ability to respond and recover may be questioned and challenged if planning, response, and recovery are not timely and effective. Help from the federal government and from other states would likely be limited, as all personnel would be deployed throughout the country already. While the federal government would do what they can, communities would have to rely on their own resources for a much longer period of time as compared to other disasters. It is expected that the government will work towards a solution that will end the pandemic, typically by helping to distribute vaccines and antiviral agents. Continual public messaging and outreach is vital.

Economy

In a normal year, lost productivity due to illness costs U.S. employers an estimated $530 billion. During a pandemic, that figure would likely be considerably high and could trigger a recession or even a depression. Local economy and finances may be adversely affected, possibly for an extended period of time. Unscheduled sick leave from a large portion of the workforce could result in millions, even billions, of dollars lost in productivity. Business restrictions due to social distancing requirements can also be significant. In a normal year, lost productivity due to illness costs U.S. employers an estimated $530 billion. During a pandemic, that figure would likely be considerably high and could trigger a reception or even a depression.

The economic impact of the COVID-19 pandemic and associated closures has been significant, triggering a recession and high unemployment; the unemployment rate jumped for 4.4% in March of 2020 to 14.7% in April and stayed in the double-digits through most of the summer. Some studies estimate that 1 in 5 renters are at risk of eviction. The stock market suffered major losses in the early days of the pandemic. The restaurant, retail, and oil and gas industries have been particularly hard hit, with numerous businesses closing or filing for bankruptcy. And among household with children, food insecurity – defined as when a household does not have sufficient food for its members to maintain healthy and active lives and lacks the resources to obtain more food – has more than doubled from 14% in 2018 to 32% in July 2020.

FluWorkLoss 1.0 is a tool developed by the CDC to estimate the potential economic impact of pandemic influenza on a community in terms of the number of workdays lost. Days missed from work cost both employees in lost wages, and employers in work not completed. Table 4-44 shows the total estimated number of days lost from work in Bernalillo County due to a four-week long influenza pandemic with a 25% clinical attack rate. The available workdays are calculated as a product of the total population in the working age group (Census 2019), the employment rate of Bernalillo County (Census 2019), and five workdays in a week. Results are estimated based on three scenarios: a mild, best-case scenario; a most likely scenario, and a more severe worst-case scenario.

Table 4-44 Total Workdays Lost (Pandemic Influenza)

Scenario	Workdays Lost
Minimum Loss Scenario	336,163
Most Likely Scenario	283,522
Maximum Loss Scenario	418,325

Source: FluWorkLoss 1.0, CDC

The number of workdays lost includes days lost for both self-care and care of sick family members and shows the County could lose hundreds of thousands of workdays in a month. Moreover, these estimates do not include workdays lost due to secondary impacts such as social distancing and the closure of schools and businesses.

Historic, Cultural and Natural Resources

Impacts to these resources are typically minimal. However, reduced tourism during outbreaks could lead to additional economic impacts.

Future Land Use and Development

Population growth and development contribute to pandemic exposure. Future development in and around Bernalillo County has the potential to change how infectious diseases spread through the community and impact human health in both the short and long term. New development may increase the number of people and facilities exposed to public health hazards and greater population concentrations (often found in special needs facilities and businesses) put more people at risk. During a disease outbreak those in the immediate isolation area would have little to no warning, whereas the population further away in the dispersion path may have some time to prepare and mitigate against disease depending on the hazard, its transmission, and public notification.

4.14.8 Jurisdictional Differences

Pandemic	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Occasional	Extensive	Critical	High
Albuquerque	Occasional	Extensive	Critical	High
Los Ranchos	Occasional	Extensive	Significant	Medium
Tijeras	Occasional	Extensive	Significant	Medium
AMAFCA	Occasional	Extensive	Critical	Medium
MRGCD	Occasional	Extensive	Critical	High
ABCWUA	Occasional	Extensive	Critical	High

Public health emergencies have the potential to occur anywhere in the planning area. However, specific communities or areas may experience higher rates of transmission or be higher risk, due to the following factors:

- Age groups – Colleges/universities with large young adult populations may be hotspots or have a higher incidence rate than other communities; this may increase the risk in the City of Albuquerque which includes the University of New Mexico campus. Conversely, elderly communities or neighborhoods may be at higher risk for pandemics; the Village of Los Ranchos has a significantly higher percentage of people aged 65 years or older (27% compared to 15% for the County as a whole), which could increase their vulnerability.
- Low income communities – Vulnerable populations such as lower income areas within the County may be at higher risk for pandemics in terms of access to medical care or PPE. As discussed in Section 2.13 Social Vulnerability, this sort of socioeconomic vulnerability is higher in south Albuquerque and in the western County.
- Urban density – High density urban areas may experience higher cases counts and faster transmission rates for viruses, especially in public gathering spaces, compared to suburban or remote areas within the County. This could increase the City of Albuquerque's vulnerability.

4.14.9 Risk Summary

- Pandemics affecting the U.S. occur roughly once every 20 years but cannot be reliably predicted.
- Effects on people will vary, but as much as 30% of the population could become ill, and 10% may need to be hospitalized.
- Effects on property are typically minimal, although quarantines could result in short-term closures. Critical facilities may have difficulty maintaining operations due to staffing shortages.
- Lost productivity due to illness and potential business closures could potentially have severe economic impacts. Social distancing requirements and fear of public gatherings could significantly reduce in-person commerce.
- Ongoing mitigation activities should focus on disease prevention, especially during flu season. This includes, but is not limited to, pre-season community outreach campaigns to educate the public about risks and available support; establishing convenient vaccination centers; reaching out to vulnerable populations and care givers; and issuing advisories and warnings.
- Related Hazards: None

4.15 Severe Winter Storms

4.15.1 Description

Winter storms in New Mexico generally begin as low-pressure systems that move through the state following the jet stream. These systems are usually generated in the Pacific Ocean and move eastward across California, Nevada, Arizona, and Utah before reaching New Mexico, if strong enough. Severe winter storms may bring bursts of heavy snow, accumulating three to six inches in short periods or one to two feet in 12 to 24 hours. Blizzard conditions can develop with winds over 35-mph. Freezing rain and drizzle can create a coating of ice that is hazardous to walk or drive on. Unusually heavy ice accumulations can damage trees, power lines and other utilities, and buildings.

Table 4-45 provides descriptions of the various types and impacts of winter storms that are consistent with NWS approved definitions found in the 2018 State Plan:

Table 4-45 Types of Winter Storms

Storm Type	Description
Heavy Snowstorm / Snowfall	Accumulations of 6 inches or more in a 12-hour period, or 8 inches or more in a 24-hour period. The most common effects are traffic accidents; interruptions in power supply and communications; and the failure of inadequately designed and/or maintained roofing systems.
Sleet / Sleet Storm	Significant accumulations of solid grains or pellets of ice that form from the freezing of raindrops or partially melted snowflakes. While this ice does not cling to surfaces, it causes slippery surfaces, posing hazards to pedestrians and motorists.
Ice Storm	Significant accumulations of rain or drizzle freezing on exposed objects (trees, power lines, roadways), causing slippery surfaces and damage from the weight of ice accumulation.
Blizzard	Wind velocity of 35 mph or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile, prevailing over an extended period of time.
Severe Blizzard	Wind velocity of 45 mph or more, temperatures of 10 degrees Fahrenheit or lower, a high density of blowing snow with visibility frequently measured in inches, prevailing over an extended period of time.
Wind Chill	An apparent temperature that describes the combined effect of wind and low air temperatures on exposed skin
Freezing drizzle/ freezing rain	The effect of drizzle or rain freezing upon impact on objects that have a temperature of 32° F or below

Source: 2018 State of New Mexico Mitigation Plan

The 2018 New Mexico State Plan lists the likely severe winter storm scenario for areas below 7,500 feet as 4 to 5 inches of snowfall.

According to the public survey conducted as part of the 2020 planning process, severe winter storms are a moderate concern to residents of the planning area. This is likely because while winter weather hazards are common, severe winter storms rarely occur in the area and tend to be short lived when winter storm events do occur. Generally, when such a storm hits, it may cause some traffic slow-down, but it rarely causes major transportation routes to be closed for more than a day. This situation creates more of an inconvenience than a hazard. During winter storms, heavy/wet snowfall can create a risk to flat-roofed residential structures, but the damage is generally limited. Heavy snowfall in Bernalillo County is infrequent and tends to melt off quickly before major impacts.

4.15.2 Past Occurrences

A review of NOAA's National Centers for Environmental Information (NCEI), Storm Events Database show six heavy snow events were reported for Bernalillo County from January 1, 1996 through December 31, 2019. The following narrative from the NCEI and other sources summarizes each event:

- **December 27, 1997 -** A series of heavy snow events produced totals of 15 to 30 inches across eastern and central New Mexico just before Christmas. Numerous roads and highways across eastern New Mexico including sections of I-40 between Albuquerque and Santa Rosa were closed, stranding hundreds of Christmas travelers. Winds gusting 60-70 mph were also reported across eastern Albuquerque on the 19th and the 22nd as the upper level storm brought strong east winds over the top of the nearby Sandia and Manzano Mountains. One 69-year-old man died from exposure in eastern Bernalillo County near the Village of Tijeras, after he left his vehicle which had become stuck in a snowdrift.
- **December 2006** –A storm spinning over New Mexico for nearly 36 hours dumped up to 36 inches of snow, stranding New Mexicans in their homes and forcing the closure of roads across the state. Most highways including I-25 and I-40 were closed for extended periods. The National Guard preformed training missions to airlift supplies to trapped residents and hay to stranded livestock for five days afterward. Eighteen counties reported storm related damages, as snow remained on the ground until January 12. The Governor issued a State Declaration of Emergency.
- **February 2, 2011** - A powerful storm and arctic cold front combined to bring fresh snow cover to nearly all of northern and central New Mexico on the 1st and 2nd, as well as extremely cold, record setting minimum temperatures. This resulted in dangerously low wind chill values over many areas. This storm, known as the "Big Freeze", had the coldest temperatures in the state in 40 years. The storm affected several power grids in west Texas that impacted the pumps that supply natural gas to the pipelines in New Mexico. The resulting high demand due to the cold and lack of supply created a huge pressure drop in the system forcing the New Mexico Gas Company to shut down the natural gas supply to 11 communities across the state affecting 32,000 homes and businesses. The supply was fully re-established on February 8, 2011.
- **November 23, 2013** - Storm total snowfall amounts of 8 to 10 inches were reported across this area. Severe driving conditions and numerous accidents were reported.
- **December 5, 2013** – Storm total snowfall accumulations of roughly 2 to 7 inches were reported. Several traffic accidents were reported in the Albuquerque Foothills where the highest amounts were reported. This was the greatest 24 hour snowfall in several years for many reporting stations in the metro area.
- **February 3, 2014** - Heavy bursts of snowfall reported that accumulated very quickly late in the evening on the 3rd. Areas from Rio Rancho to Placitas and much of the Albuquerque east side picked up 2 to 6 inches. Hazardous travel conditions were noted around Rio Rancho with numerous accidents.
- **December 6, 2015** – The 2015 historic blizzard, brought heavy snow throughout the State of New Mexico. Heavy snow was accompanied by high winds (60-80 mph) producing snow drifts of 6-10 feet in eastern New Mexico. Interstate 40 from Albuquerque to Amarillo was closed. Over 400 motorists were stranded across the eastern plains. An estimated 30,000 to 50,000 livestock in the state perished due to the blizzard conditions.
- **January 1-2, 2019** – The Albuquerque area received 2"-7" of snow, followed by the coldest temperatures recorded in the City since 2013. 40 schools suffered burst water pipes. Total property damages are estimated at $500,000.
- **February 22-23, 2019** – The Albuquerque area received 2"-7" of snow, including 3.6" at Albuquerque Sunport, which broke the previous record from 1979.

The Storm Events Database collects information on each event from a variety of sources including but not limited to, county, state and federal emergency management officials, newspaper clipping services, the insurance industry, and the general project. A review of the Storm Events Database for events in Bernalillo County also showed 63 records related to heavy snow, blizzard, extreme cold/wind chill, winter storm and winter weather events. The following table summarizes the events recorded in the NCEI database.

Table 4-46 NCEI Severe Winter Storm Events Reported for the Albuquerque Metropolitan Area, October 2, 2009- February 22, 2019

Event Type	Location	# of Events	Property Damage ($)	Deaths
Blizzard	Sandia/Manzano Mountains (Zone)	3	0	0
Extreme Cold/Wind Chill	Sandia/Manzano Mountains (Zone)	1	0	0
	Albuquerque Metro Area (Zone)	1	0	0
Heavy Snow	Sandia/Manzano Mountains (Zone)	32	0	0
	Albuquerque Metro Area (Zone)	17	$505,000	1
Winter Storm	Sandia/Manzano Mountains (Zone)	3	0	0
	Albuquerque Metro Area (Zone)	2	0	0
Winter Weather	Sandia/Manzano Mountains (Zone)	3	0	0
	Albuquerque Metro Area (Zone)	1	$100,000	0
	Total	**63**	**$605,000**	**1**

Source: NCEI, Storm Events Database

4.15.3 Location

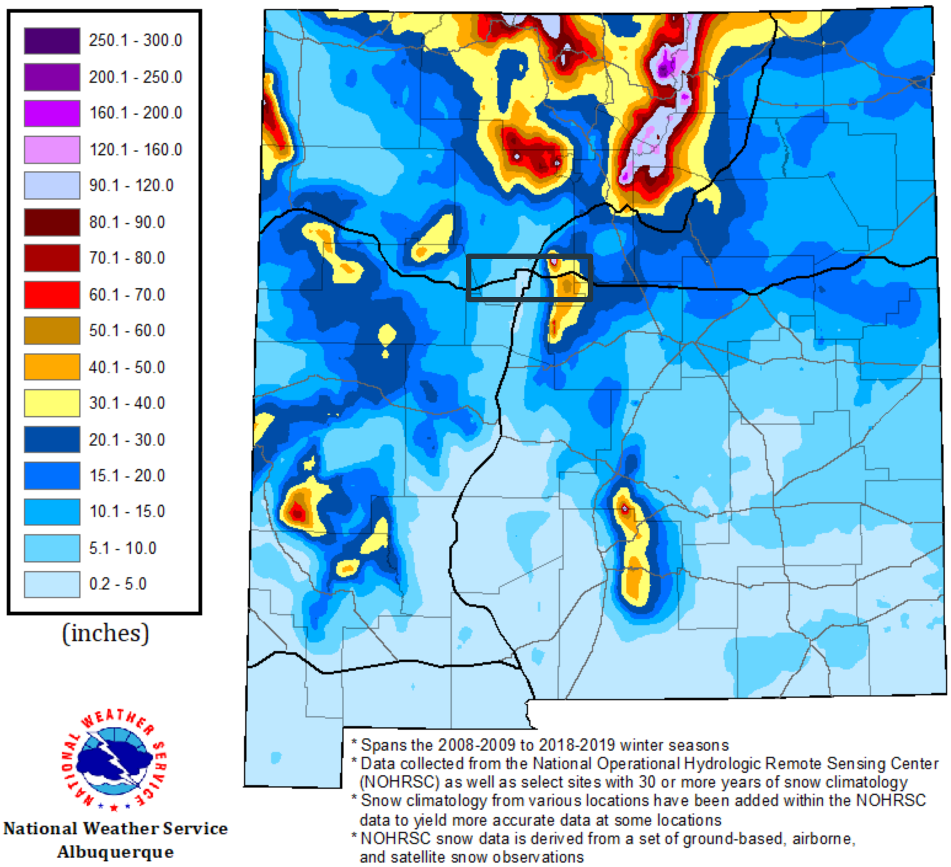
The complex terrain of New Mexico, ranging from the eastern plains, to the high mountains across the northern and western regions, to the Rio Grande Valley, creates weather systems that change quickly over relatively short distances. The weather may be relatively mild and sunny along the Rio Grande Valley with near blizzard conditions found across the high plains east of the central mountain chain.

Severe winter storms are generally large enough to affect the entire planning area. Historically, winter storms in the planning area are rare. The most severe conditions would typically include very little snowfall (1-2 inches) but would result in extreme wind chills. Refer to the Magnitude/Severity subsection below for more information related to wind chill in the planning area.

4.15.4 Magnitude/Severity

Figure 4-34 from the National Weather Service (NWS) Albuquerque Weather Forecast Office, show annual snowfall amounts across New Mexico. The snowfall map was developed by NWS using analysis from the National Operational Hydrological Remote Sensing Center averaging the 2008-2009 to 2018-2019 winter seasons and then added several data points from airports and cooperative observer stations to make the analysis more representative 30-year climatology from 1981 to 2010.

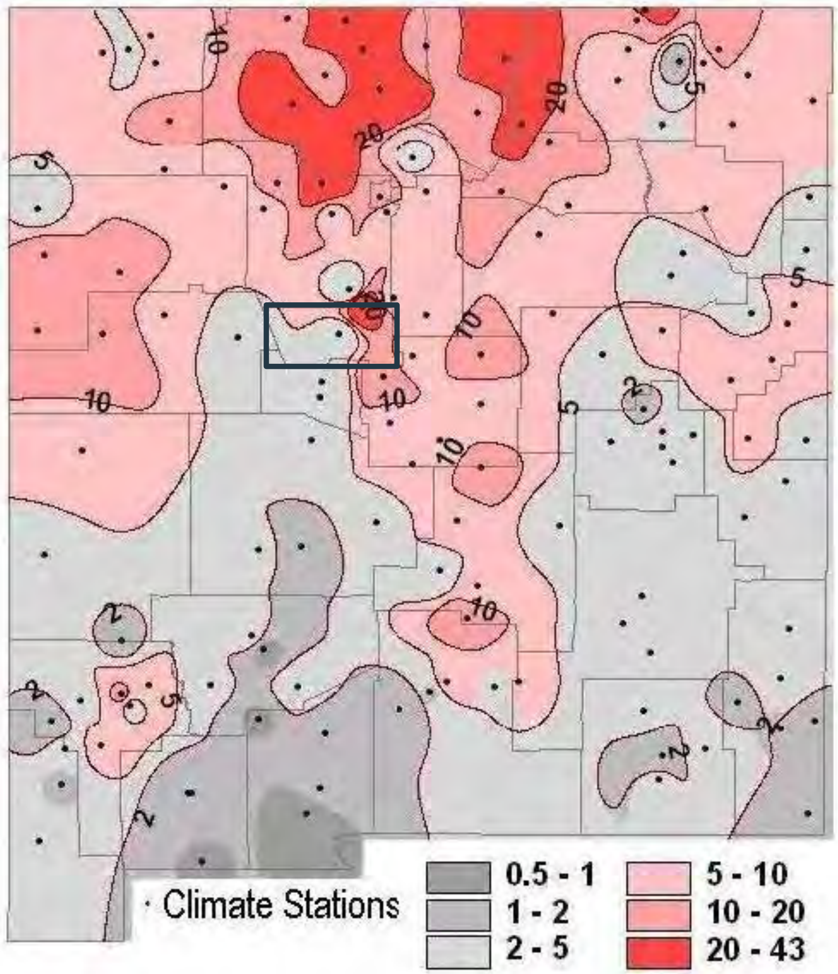
Figure 4-34 Average Annual Snowfall in State of New Mexico



Source: NWS Albuquerque Weather Forecast Office *Black square represents the general location of Bernalillo County.

Figure 4-35 from the 2018 State of New Mexico Hazard Mitigation Plan, shows the statewide average annual number of days with snowfall greater than one inch. The central and western portions of the county average between 2 to 5 days, while the more mountains eastern portion of the county averages between 5 to 20 inches.

Figure 4-35 Average Annual Number of Days with Snowfall >1.0 inch



Source: State of New Mexico Hazard Mitigation Plan 2018 *Black square represents the general location of Bernalillo County.

Table 4-47 contains winter weather summaries from the Albuquerque International Sunport, COOP Station number 290234 with a period of record of January 1, 1897 and June 10, 2016.

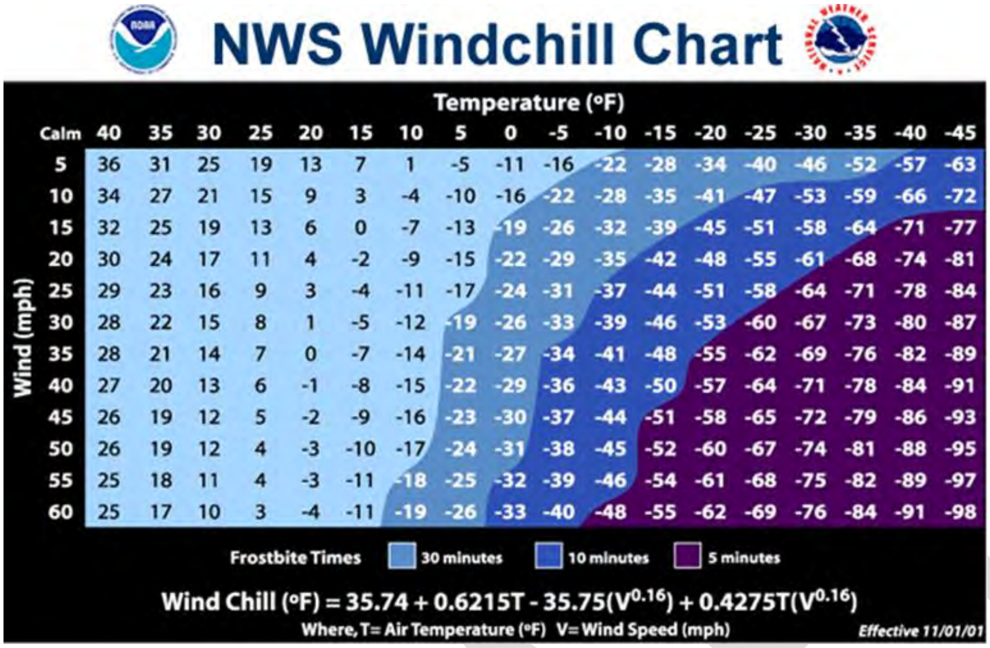
Table 4-47 Bernalillo County Winter Weather Summary in Inches

Average Annual Snowfall	Snowiest Month/Average Snowfall	Highest Daily Snowfall	Highest Monthly Snowfall	Highest Seasonal Snowfall	Winter Average Minimum Temp.	Lowest Minimum Temp.	# of Days <32°F
9.6	Dec./2.4	0.96 12/16/2010	20.8 Dec. 2006	34.3 1973	37.3°F	-17°F 2/25/1986	3.9

Source: Western Regional Climate Center, www.wrcc.dri.edu/ *Winter Months; December, January, February *Period of Record: 1/1/1897 – 6/10/2016

Wind chills play the most significant role in Bernalillo County's severe winter weather since the welfare of residents is directly related to wind chill. Wind chill is the combination of wind and temperature that serves as an estimate of how cold it actually feels to exposed human skin. Local officials throughout the planning area consider wind chill values below -10˚F to be extremely dangerous to the population although hypothermia can occur at higher temperatures and cause death. Local officials encourage citizens to heed the warning and take extra precautions. The following figure gives a range of physical intensities from winter storms along with the potential effect (NOAA).

Figure 4-36 National Weather Service Windchill Chart



NWS Windchill Chart

Temperature (°F)

Wind (mph) \ Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes / 10 minutes / 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: National Weather Service

Overall, severe winter storm impacts could be critical with the potential for heavy snow and extreme cold events as defined by the National Weather Service and as described in Table 4-45 above. Snow removal costs can impact budgets significantly. High snow loads also cause damage to buildings and roofs. Most property damages with winter storms are related to the heavy snow loads and vehicle accidents. The highest risk will be to travelers that attempt to drive during adverse conditions. People can also become isolated from essential services in their homes and vehicles. Economic impacts occur because of power outages and road closures, leaving residents and visitors stranded as well as interrupting the transport of supplies and services into the area for an extended period. A winter storm can escalate, creating life threatening situations when emergency response is limited by severe winter conditions. Extreme cold associated with a severe winter storm can lead to frozen pipes as well as physical risks of hypothermia and the threat of physical overexertion that may lead to heart attacks or strokes.

4.15.5 Climate Change Considerations

Climate change studies have shown an increased variability in weather patterns across New Mexico. Including fewer predictive winters and a greater proportion of precipitation as rain instead of snow (Union of Concerned Scientists 2016). The Fourth National Climate Assessment (2018) projects shorter snowfall seasons and decreases in snowpack due to earlier snowmelt. These changes in winter precipitation in addition to the projected higher temperatures year-around in New Mexico will lead to increases in the risk of other hazards including drought and wildfires. The potential also exists for more extreme events due to wide variations in the jet stream.

4.15.6 Probability of Future Events

The following table shows the frequency of snowfall events in the planning area in the past three decades. The table breaks down the number of days with snowfall events 1-inch or greater, 2-inches or greater, 4-inches or greater, and 6-inches or greater at various locations in the planning area. In the past 29 years, the frequency of snow events has been decreasing across the county.

Table 4-48 Frequency of Snowfall Events by Number of Days

	≥1" of snow			≥ 2" of snow			≥ 4" of snow			≥ 6" of snow		
Location	2011-2019	2001-2010	1991-2000	2011-2019	2001-2010	1991-2000	2011-2019	2001-2010	1991-2000	2011-2019	2001-2010	1991-2000
ABQ Sunport	19	17	33	8	9	15	1	4	2	0	1	1
ABQ Foothills	34	90	97	24	40	59	9	9	19	3	4	5
ABQ Valley	16	22	30	9	11	19	1	6	3	1	2	1

Source: Adapted from National Weather Service Albuquerque Weather Forecast Office, https://www.weather.gov/abq/prepwinterwxclimo

Winter storm events in Bernalillo County are typically short-lived resulting in a few inches of snowfall. The 2018 State Plan reports the probability of winter weather hazards including extreme cold/wind chill, freezing fog, heavy snow, and winter storm for each Preparedness Area. The following of probabilities of occurrence is state for Preparedness Area #5. Note, Preparedness Area #5 includes Bernalillo, Sandoval, Torrance, and Valencia Counites, as well as Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia Pueblos.

- Extreme Cold/Wind Chill = 40%
- Freezing Fog = 10%
- Heavy Snow = 100%
- Winter Storm = 40%

Given these approximate frequencies of each winter weather hazard, the probability of a future severe winter storm event to the entire planning area is Likely.

4.15.7 Vulnerability Assessment

The entire planning area is vulnerable to severe winter storms with wind and light snow or ice. The severity of winter storms may vary from mild impacts to an extremely dangerous storm that can bring wind, snow and ice that can both create whiteout conditions, safety hazards, and impacts to structures and infrastructure. While higher elevations may be more accustomed to colder temperatures, severe winter storms generally impact the planning area with equal severity. Severe winter storms with over 5 inches of snow have occurred in the past and will likely occur again in the future.

People

The threat to public safety is typically the greatest concern when it comes to impacts of winter storms. While virtually all aspects of the population are vulnerable to the potential indirect impacts of a winter storm, others may be more vulnerable, such as the elderly, particularly if there is a loss of electrical power or gas. The weight of heavy continued snowfall and/or ice accumulating on power lines often brings them to the ground causing service disruptions for thousands of customers, as was seen on December 26, 2015.

Cold and extreme cold temperatures are partially responsible for the one recorded causality in the NCEI Storm Events Database after a stranded driver in eastern Bernalillo County left their vehicle and became exposed to the cold temperatures. Infants, elderly and the homeless population are most vulnerable to the impacts of extreme cold. Exposure to extreme cold can cause frostbite or hypothermia and, in some cases, even death.

The region can experience high winds and drifting snow during winter storms that can occasionally isolate individuals and entire communities and lead to serious damage to infrastructure. Travelers on I-25 in the central portions of the planning area can become isolated and visitors can become stranded, requiring search and rescue assistance and shelter provisions.

The impacts of winter weather on vulnerable populations can be more severe. As noted above, senior citizens in particular are much more vulnerable to cold temperatures and slipping on ice can lead to severe injuries. People with disabilities or those who rely on home health care may be at increased risk if travel becomes difficult.

General Property

Structural losses to buildings are possible and structural damage from winter storms. Older buildings are more at risk, as are buildings with large flat rooftops (often found in public buildings such as schools). A building's vulnerability is influenced both by architecture and type of construction material and should be assessed on a building-by-building basis. According to the NCEI Storm Events Database, in the past eight years heavy snow and winter weather have resulted in $605,000 in property damages within the Albuquerque Metropolitan Area.

Critical Facilities and Infrastructure

Roads are especially susceptible to the effects of a winter storm, which can temporarily hinder transportation and require resources for snow removal. I-25 and I-40 cross the County, and closure of either highway could leave travelers isolated from emergency services. One important part of mitigating severe weather is forecasting and warning so people can prepare. Communities can prepare for winter storms by advising people to stay home or to use caution if they must go out, stocking sand and salt to improve road conditions, and recommending that people stock up on food, water, batteries, and other supplies.

As noted under the people section, heavy snow accumulation may also lead to downed power lines, not only causing disruption to customers but also have potentially negative impacts on critical facilities in the county which may have cascading impacts on the County governments ability to operate. Winter weather hazards also have the potential to overwhelm local capabilities to handle disruptions to emergency services, traffic, communications, and electric power when snow and ice-laden branches fall across power lines and interrupt service.

Government Services

Blizzards, heavy snow, ice storms and extreme low temperatures can have limited impacts to the continuity of operations throughout the planning area. Events such as power loss and poor road conditions can interrupt daily services such as delivery services and staff being able to perform their normal job functions.

The impact to responders can be extensive during a severe winter storm. Operations can include rescue missions for stranded motorists, medic responses to motor vehicle accidents, and transportation of citizens to warming shelters and medical facilities. Responders are often subjected to the harsh elements of winter storms such as exposure to extreme low temperatures, high winds, and extensive snow for long periods of time.

During extreme winter weather events the public will expect notifications as early as possible and updated frequently as events unfold. The local government agencies will enact winter weather operations such as extensive plowing operations and the opening of warming shelters.

Economy

Closure of major roads including I-25 in of the planning area during winter storms could temporarily isolate portions of the planning area. Depending on the length of the closure it could also hinder the local economy and the movement of goods through the county. Other economic impacts could occur if livestock suffer from severe cold and lack feed. An extended power outage after a winter storm event could impact local businesses, hindering the local economy. A heavy snow event on December 26, 2015 that impacted the entirety of central New Mexico including the Albuquerque Metropolitan Area resulted in motorists being stranded along Interstate 40 after it was shut down for 36 hours and 14,2000 residences in eastern New Mexico to be without power for several hours (NCEI). According to the Storm Events Database, the Department of Agriculture reported 12,000 adult milking cows were lost in the winter storm as well as between 30,000 and 50,000 young livestock.

Historic, Cultural and Natural Resources

Natural resources may be damaged by the severe winter weather, including broken trees and death of wildlife. Unseasonable storms may damage or kill plants and wildlife, which may impact natural food chains until the next growing seasons. Most of these impacts are typically short-term. As noted previously, older, historic buildings could potentially be more vulnerable to roof and structural damage from heavy snow. Heritage Farm, BioPark as well as the Bosque ecosystem in Albuquerque are important assets to Bernalillo community and particularly are vulnerable to freezing temperatures and heavy snow that can lead to damages to important natural vegetation as well as livestock.

Future Land Use and Development

Future buildings that conform to local building codes should be able to withstand snow loads from severe winter storms. Given building and population trends in the planning area (Refer to Chapter 2, Section 2.14), it is not anticipated that more persons will be exposed to the winter storm hazard in the future.

4.15.8 Jurisdictional Differences

Severe Winter Storms	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Likely	Significant	Significant	Medium
Albuquerque	Likely	Limited	Negligible	Low
Los Ranchos	Likely	Extensive	Critical	High
Tijeras	Likely	Extensive	Critical	High
AMAFCA	NA	NA	NA	NA
MRGCD	Likely	Significant	Negligible	Low
ABCWUA	Likely	Significant	Negligible	Medium

While severe winter storm events can take place anywhere within the planning area, the magnitude of the event and resulting impacts will vary by area. The east mountains frequently experience higher snowfall counts compared to the areas in the west mesa. AMAFCA facilities are not significantly affected by winter storms.

4.15.9 Risk Summary

- Severe winter storms have been and will continue to be a threat to the economic and social well-being of the planning area. Disruptions of emergency and other essential services are the main threats to the people and property.
- There is a likely probability of future occurrences of severe winter storms in the planning area.

- Future development should take into consideration the effects of winter storms, including excessive snow loading on roofs. Piping that is not insulated or protected can burst, causing damage.
- Related Hazards: High Wind

4.16 Thunderstorms

4.16.1 Description

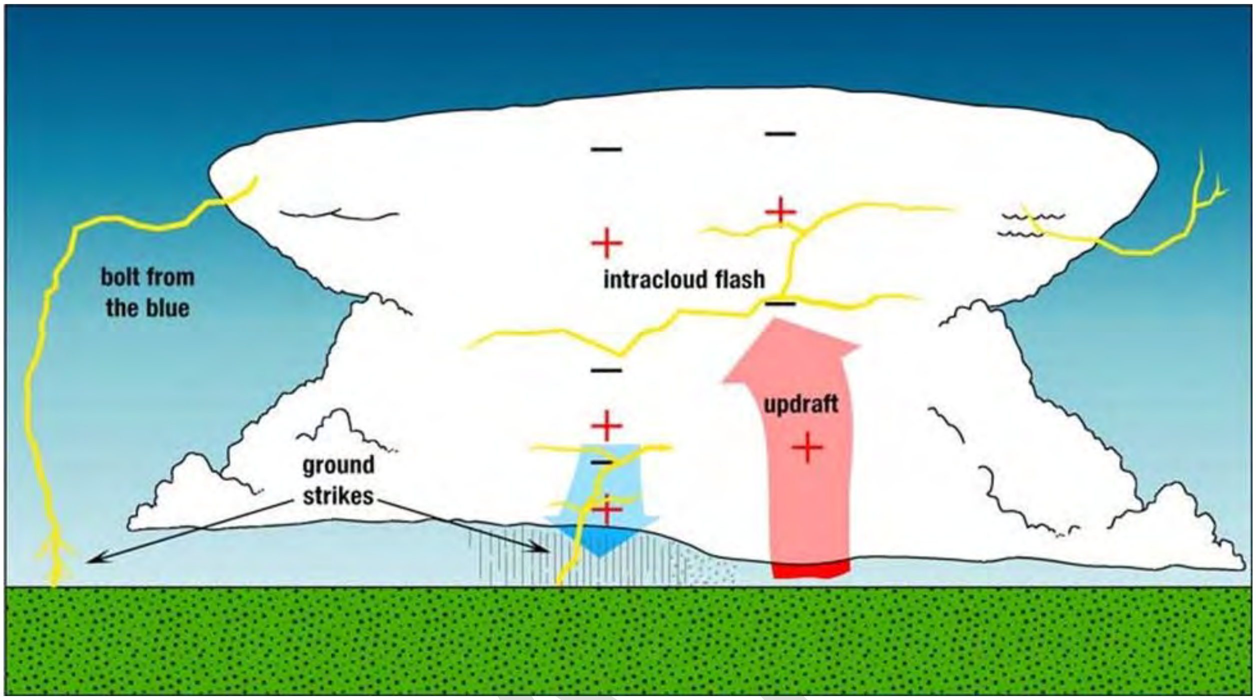
Thunderstorms are generally produced when dry and cool air converges with warm moist air. Large cold fronts moving through areas of warm moist air can produce long lines of thunderstorms cells. Thunderstorms are responsible for much of the severe weather across New Mexico, particularly during the North American Monsoon season in the summer. Thunderstorms are a frequent occurrence in July and August, especially over the northwest and north central mountains of New Mexico.

Thunderstorms are characterized by high winds, heavy rain, hail, lightning, and, on rare occasions, tornados. The National Weather Service defines a severe thunderstorm as a thunderstorm with any of the following attributes: downbursts with winds of 58 miles (50 knots) per hour or greater (often with gusts of 74 miles per hour or greater), hail 0.75 of an inch in diameter or greater, or a tornado. Because high rainfall impacts are covered in the Flood section (4.3), and high winds and tornadoes have their own sections in this plan (4.8 and 4.9 respectively), this section primarily focuses on hail and lightning.

The 2018 State Plan describes lightning as "a sudden and violent discharge of electricity, usually from within a thunderstorm, due to a difference in electrical charges. Lightning is a flow of electrical current from cloud to cloud or cloud to ground" (State of New Mexico 2018). Thunderstorms and lightning are usually (but not always) accompanied by rain. Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat (see Figure 4-37). Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

Figure 4-37 Cloud to Ground Lightning



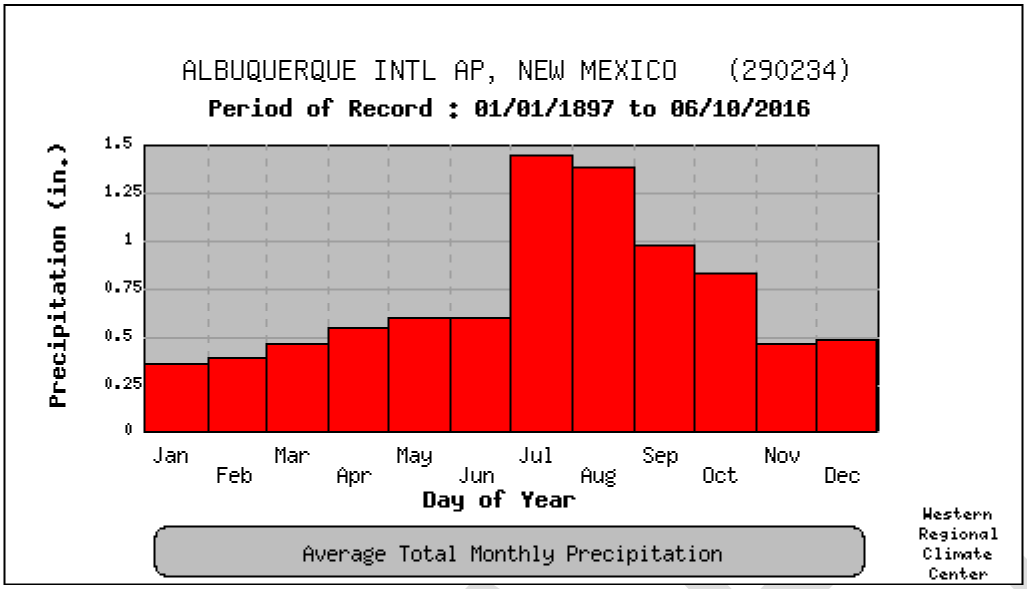
Source: National Weather Service

Hail is described as the movement of water droplets up and down inside the cloud, through cold, where the droplets freeze and then warmer temperatures. Layers of ice can be added to the frozen droplets which can become quite large, sometimes round or oval shaped and sometimes irregularly shaped. The frozen droplets of various sizes finally fall to the ground as hail. Hail sizes can range from pea-sized to softball-sized. The 2018 State Plan states that severe hailstorms most commonly occur in May, followed by June, July, and April.

4.16.2 Past Occurrences

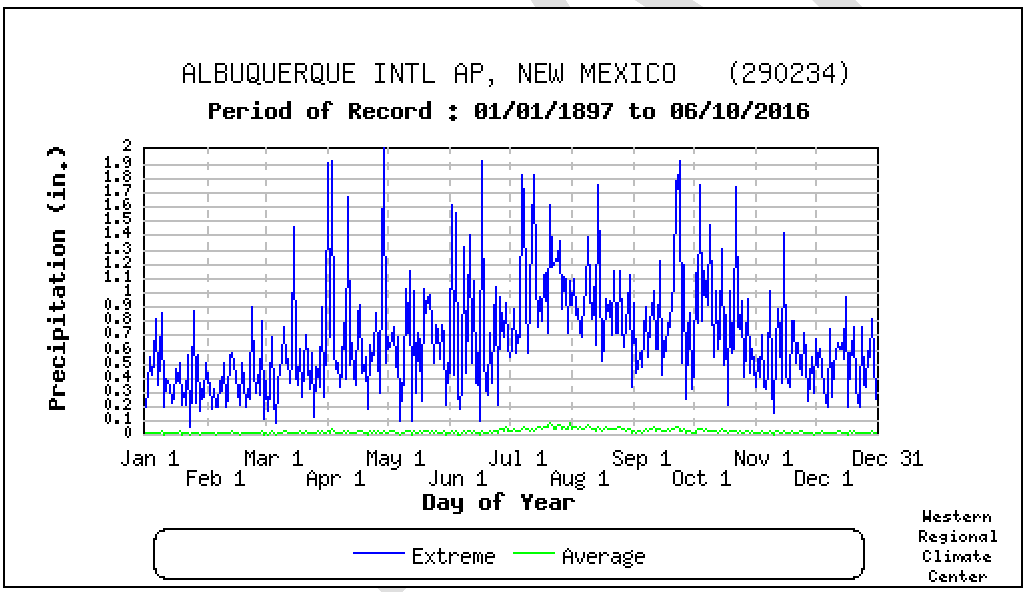
Summer begins with warm, and often dry, conditions in June across the planning area, followed by a 2-month rainy season. Often referred to as monsoon season, July and August brings predictable afternoon thunderstorms. However, the annual total precipitation fluctuates considerably from year to year and the monsoon can start as early as mid-June. Average monthly precipitation totals for the Albuquerque Sunport weather station, are shown in Figure 4-38. Precipitation extremes for the same station are shown in Figure 4-39.

Figure 4-38 Monthly Average Total Precipitation Recorded at Albuquerque International Airport, January 1897-June 2016



Source: Western Regional Climate Center

Figure 4-39 Daily Precipitation Average and Extremes, Albuquerque International Airport, January 1897 – June 2016



Source: Western Regional Climate Center

NOAA's National Center for Environmental Information (NCEI) Storm Events Database records 190 severe thunderstorm events for Bernalillo County between 1957 and 2019. (The search included hail, heavy rain, lightning, and thunderstorm wind.) Of these events 46 resulted in $13,575,500 in property damages, no crop damages are reported for any to the events recorded. Hail and thunderstorm wind were the most commonly recorded thunderstorm hazards. Hail has caused the most property damages in the past 62 years, while lightning has caused more causalities. The following table summarizes the recorded events.

Table 4-49 Severe Thunderstorm Events, 1957-2019*

Event Type	# of Events	Property Damage	Deaths	Injuries
Hail	82	$10,517,000	0	1
Lightning	11	$90,500	1	10
Heavy Rain	15	$1,324,000	1	9
Thunderstorm Wind	82	$1,644,000	1	9
Total	**190**	**$13,575,500**	**3**	**29**

Source: NCEI Storm Events Database *Note: The Database only has recorded events for lightning and heavy rain from 1996-2018

Figure 4-41 shows the location of past hail events between 1955 and 2018. The most damaging hail event recorded in the NCEI Database occurred on October 2, 2010 in the Cedar Crest community. The narrative for the event states hail up to 2-inches in diameter fell and caused damages to trees, roofs and windows of buildings, and windshields across the area, resulting in $6,016,000 in property damages. According to the National Weather Service, the number of severe hail reports across the state of New Mexico has greatly increased over past decades, as shown in Table 4-50.

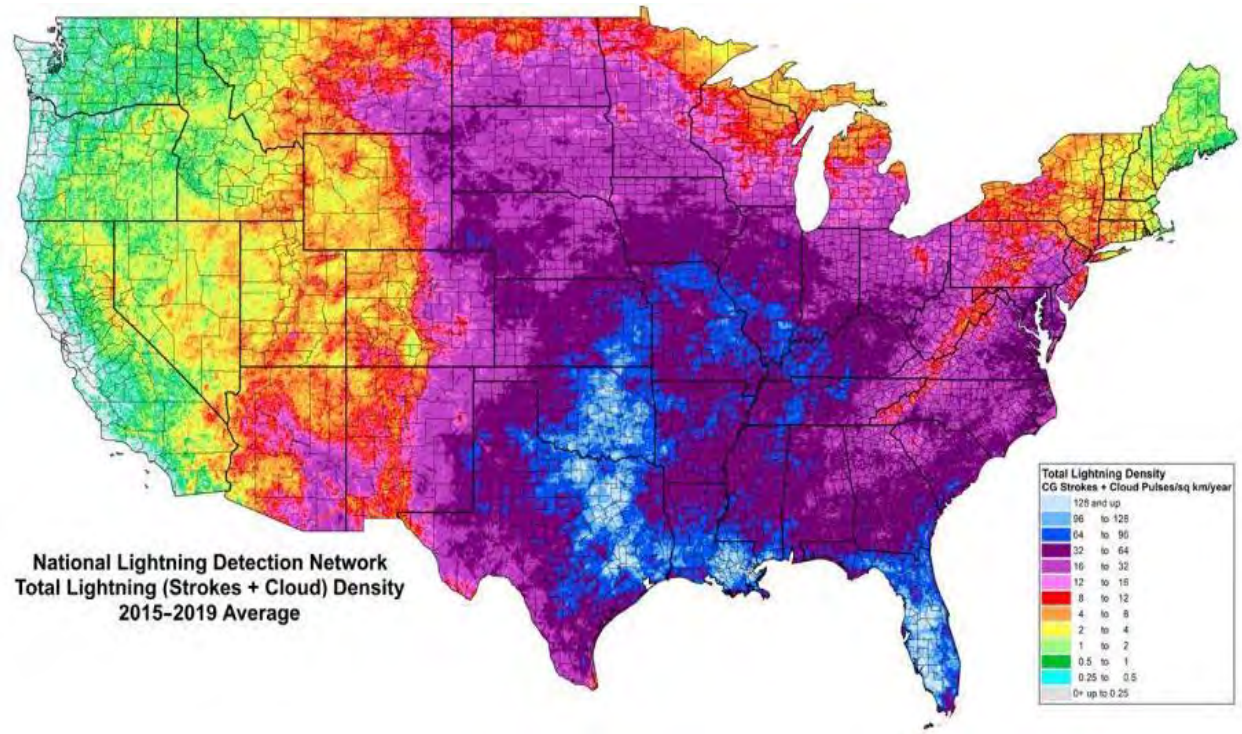
Table 4-50 Average Severe Hail Reports Per Year

Time Period	# of Reports
1955-1979	11
1980-2009	99
2009-2019	168

Source: NWS Albuquerque Weather Forcast Office

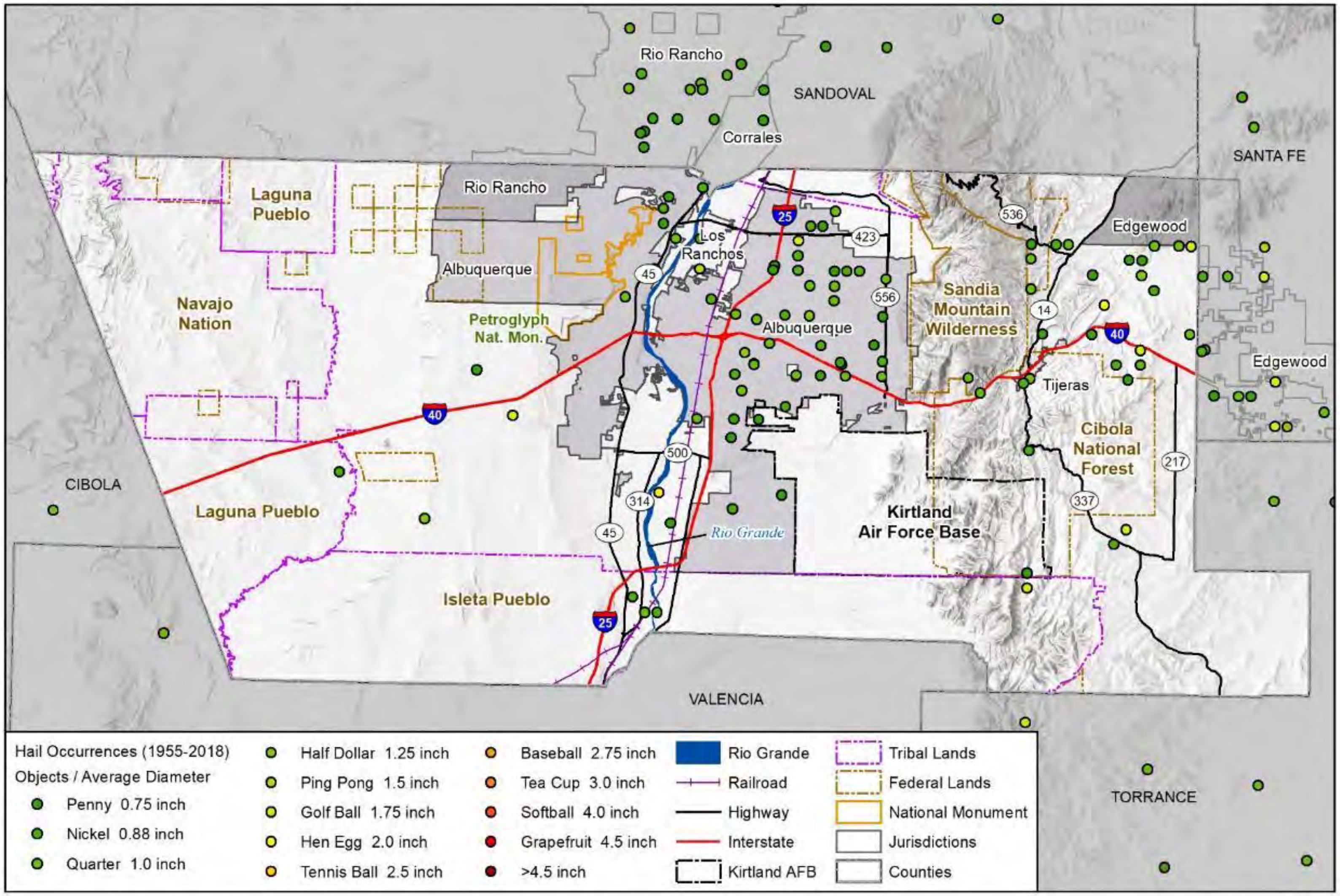
The State of New Mexico ranked 12th in total lightning counts in 2019 with 5,124,315. (For comparison, Texas ranked 1st with 47,397,975 in the same year.) Figure 4-40 shows the average U.S. total lightning density (cloud-to-ground strokes + cloud pulse/sq. km/year) between 2015 and 2019. In that same time period 1,084,890,070 lightning events were detected on the National Lightning Detection Network (Vaisala 2020). According to Figure 4-40, Bernalillo County experienced an average lightning density between 2 to 8 flashes/sq. km/year.

Figure 4-40 Average U.S. Total Lightning Density, 2015-2019



Source: Vaisala Annual Lightning Report, 2019

Figure 4-41 Historical Hail Events in Bernalillo County, 1955-2018



wood. Map compiled 8/2020; intended for planning purposes only. Data Source: City of Albuquerque, Bernalillo County, RGIS, NOAA, National Weather Service SVRGIS 2019

4.16.3 Location

All areas of Bernalillo County are susceptible to thunderstorms, although local topography, such as elevation and land contours, plays a significant role in how weather affects a particular area. Thunderstorms can be either localized or widespread, so their impact can vary depending on the size, strength and speed of the storm. At the time of storm occurrence, one neighborhood may experience severe damage while another nearby escapes with minimal impact. Large-scale thunderstorms with multiple lightning strikes, hail and thunderstorm wind would create the most impact over a wide area.

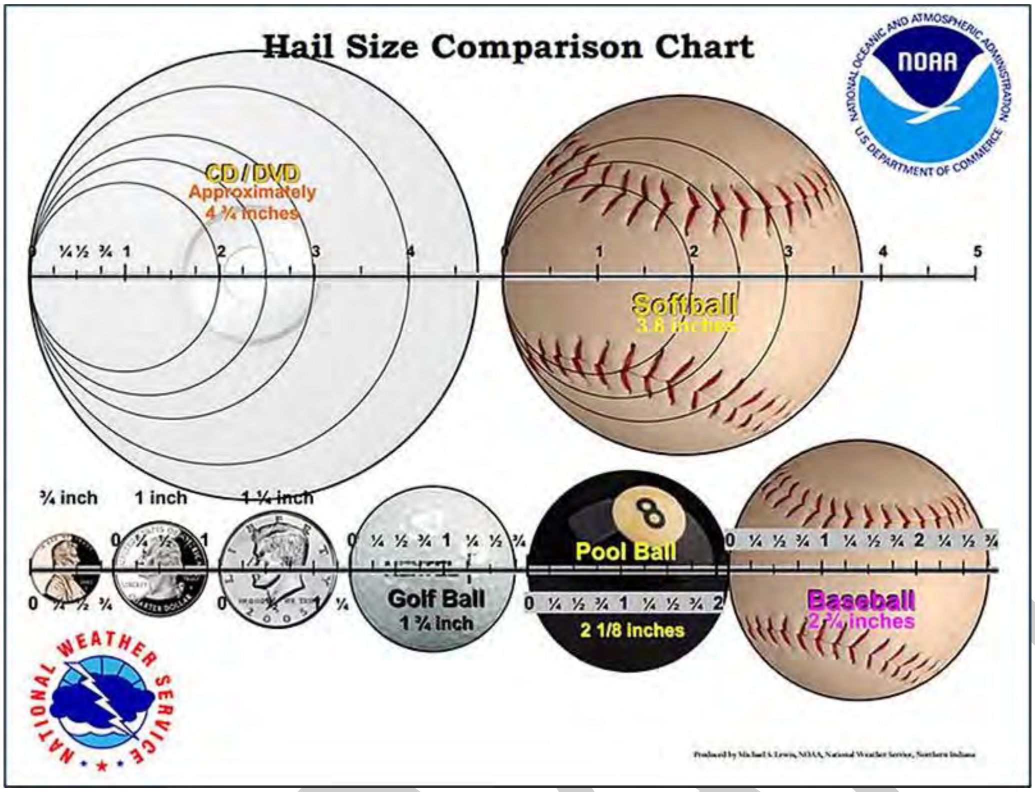
The complex terrain of New Mexico, ranging from the eastern plains to the high mountains across the northern and western regions to the Rio Grande Valley, creates weather regimes that change quickly over relatively short distances. The mountainous areas of the state experience more thunderstorms compared to the other areas in the state, but the storms tend to be less severe and create smaller hail. According to the 2018 State Plan, counites in the central and western areas of the State experience damaging hail events at least 2 times a year.

4.16.4 Magnitude/Severity

As noted previously, the National Weather Service defines a severe thunderstorm as a thunderstorm with any of the following attributes: downbursts with winds of 58 miles (50 knots) per hour or greater (often with gusts of 74 miles per hour or greater), hail 0.75 of an inch in diameter or greater, or a tornado. The severity of severe thunderstorms that involve heavy rain, high wind, and/or hail can be measured by hail sizes and wind speeds. The NWS classifies hail by diameter size, compared to everyday objects to help relay scope and severity to the population. Figure 4-42 below shows the hailstone measurements utilized by the NWS.

There is no clear distinction between storms that do and do not produce hailstones. Nearly all severe thunderstorms probably produce hail aloft, though it may melt before reaching the ground. Multi-cell thunderstorms produce many hailstones, but not usually the largest hailstones. In the life cycle of the multi-cell thunderstorm, the mature stage is relatively short so there is not much time for growth of the hailstone. Supercell thunderstorms have sustained updrafts that support large hail formation by repeatedly lifting the hailstones into the very cold air at the top of the thunderstorm cloud. In general, golf ball sized hail or larger is associated with supercells, but non-supercell storms are also capable of producing golf ball size hail.

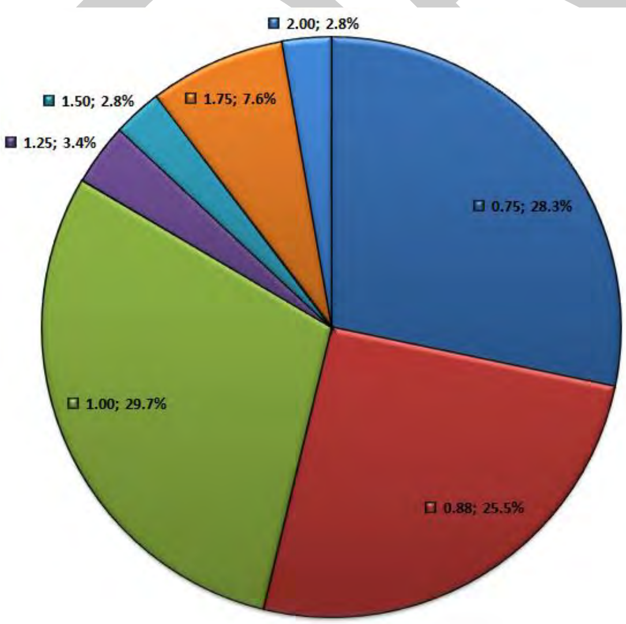
Figure 4-42 Hail Measurements



Source: National Weather Service

The most common hail size recorded in the Storm Event Database is 1-inch or hail the size of a quarter. Figure 4-43 shows the breakdown of the various sizes of hail that have fallen in Bernalillo County between 1955 and 2019.

Figure 4-43 Bernalillo County Hail Reports, By Size, 1955-2019



Source: National Weather Service, Albuquerque Weather Forecast Office

The table below combines the NOAA and TORRO hailstorm intensity scales as a way of describing the size of hail based on the intensity and diameter of the hail. NOAA data indicates that the majority of hail events in the planning area since 1950 produced hail less than 1 inch in diameter (H0 – H2). Officials of each participating jurisdiction consider all thunderstorm events which contain hail to be severe events and warrant evasive actions due to the unpredictable nature of such storms.

Table 4-51 Hailstorm Intensity Scale

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, $J\text{-}m^2$	Description	Typical Damage Impacts
H0	Hard Hail	5	0-20	Pea	No damage
H1	Potentially Damaging	5-15	>20	Mothball	Slight general damage to plants, crops
H2	Significant	10-20	>100	Marble, Grape	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	>300	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	>500	Pigeon's Egg> Squash Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	>800	Golf Ball> Pullet's Egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60		Hen's Egg	Bodywork of grounded aircraft dented brick walls pitted
H7	Destructive	50-75		Tennis Ball> Cricket Ball	Severe roof damage, risk of serious injuries
H8	Destructive	60-90		Large Orange> Softball	(Severest recorded in the British Isles) Severe
H9	Super Hailstorms	75-100		Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100		Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: NOAA and TORRO

Lightning is measured by the Lightning Activity Level (LAL) scale, created by the NWS to define lightning activity into a specific categorical scale. The LAL is a common parameter that is part of fire weather forecasts nationwide. Bernalillo County is at risk to experience lightning in any of these categories. The LAL is reproduced in Table 4-52.

Table 4-52 Lightning Activity Level Scale

Lightning Activity Level	
LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five-minute period.
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five-minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five-minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five-minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning.

Source: National Weather Service

Lightning can occur anywhere in the planning area, and it is not possible to identify specific hazard areas. Data is not available to identify specific structures at risk. Data on average annual losses is limited but based on NCEI records $90,500 in lightning-related damages occurred between 1996 and 2018. One of the most serious risks associated with lightning is its potential to cause wildland fires. For specific details on loss and vulnerability associated with wildland fires, please see the wildland fire vulnerability discussion.

4.16.5 Climate Change Considerations

As average temperatures increase over time, this generally will result in higher extreme temperatures and more warming in the atmosphere. The additional heat in the atmosphere could result in more frequent extreme weather events. Lightning specifically tends to occur with warmer temperatures as heat energy fuels storm clouds. A study published in the Journal of Science in November of 2014 showed the possibility of a 12% increase of lightning events for every degree of warming. On average the United States experiences 20 million lightning strikes with the possibility of 30 million lightning strikes over the continental U.S. by 2100 (Scientific American 2014). Overall, the impacts of changing climate on the frequency and severity of lightning events is still uncertain.

4.16.6 Probability of Future Events

Bernalillo County experiences thunderstorms with hail and/or lightning on a fairly frequent basis. The 2018 State Plan lists the following of probabilities of occurrence for Preparedness Area #5 for hail, lightning, heavy rain and thunderstorm wind.

- Hail = 100%
- Thunderstorm Wind = 100%
- Lightning = 29%
- Heavy Rain = 34%

NCEI records show 190 thunderstorm events recorded from 1957 through 2019, an average of 3 per year. Thunderstorms that produce lightning and hail severe enough to threaten safety and property are less common but should still be considered Likely.

4.16.7 Vulnerability Assessment

All assets located in the planning area can be considered at risk from thunderstorm hazards. This includes all of the County's population, and all buildings and infrastructure within the planning area. Damages primarily occur as a result of hail, lightning strikes and thunderstorm winds.

People

Exposure is the greatest danger to people from severe thunderstorms. People can be hit by lightning, pelted by hail, and caught in rising waters due to heavy rain. Past thunderstorm events in the County have caused 3 deaths and 29 injuries. Most injuries were caused by lightning events.

Aspects of the population who rely on constant, uninterrupted electrical supplies may have a greater, indirect vulnerability to lightning. Elderly or disabled people, especially those with home health care services, often rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, residential facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. If they do not have a back-up power source, rural residents and agricultural operations reliant on electricity for heating, cooling, and water supplies are also especially vulnerable to power outages. According to the data obtained from emPower.com, a website maintained by the U.S. Department of Health and Human Services, 9% of the Medicare beneficiaries in the County (10,225 of 117,255 beneficiaries) rely on medical equipment that requires electricity in order to live independently.

The impacts of thunderstorms on other vulnerable populations can also be more severe. Low income families are more likely to live in poorly constructed homes that are more likely to be damaged, and are more likely to be uninsured or underinsured, making it more difficult for them to recover from hail or lightning events. Individuals with disabilities may need more assistance after a major storm, especially if transportation or utility services are disrupted. Severe weather warnings must use methods that reach vision or hearing impaired people and those with limited English proficiency.

General Property

Severe thunderstorm events in Bernalillo County are seasonal events that are most likely to occur in the summer months, especially during the Monsoon season. Vulnerability to the effects of thunderstorms on buildings is dependent on the age of the building (including what building codes were in effect at the time it was built), type of construction, and how well the structure has been maintained. Lightning and hail in particular can cause damage to buildings, communications systems, power lines, and electrical systems. Lightning strikes cause intense but localized damage. Structural fires, localized damage to buildings, damage to electrical powerlines and communications outages are typical consequences of a lightning strike.

Critical Facilities and Infrastructure

All of the planning area's critical facilities are vulnerable to potential disruption of services and transportation systems as well as disruptions to emergency communications capabilities. Electric and communications services are particularly vulnerable to disruption.

Economy

Economic impact of a severe thunderstorm is typically short term, although it can be significant. Lightning events can cause power outages and fires. Generally, long-term economic impacts center more around hazards that cascade from a severe thunderstorm, such as flooding, or wildfires ignited by lightning. As noted in the Previous Occurrences subsection above, between 1957 and 2019, hail, lightning, thunderstorm wind and heavy rain in Bernalillo County led to over $13 million property damages.

Historic, Cultural and Natural Resources

Severe thunderstorms are a natural environmental process. Environmental impacts include the sparking of potentially destructive wildfires by lightning and localized flattening of plants by thunderstorm wind.

Future Land Use and Development

New critical facilities such as communication towers should be built to withstand heavy rain, hail, wind, and lightning damage. Future development projects should consider severe thunderstorm hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Development trends in the County are not expected to increase overall vulnerability to the hazard, but all development will be affected by severe thunderstorm events and any population growth will increase potential exposure to hazards such as severe thunderstorms.

4.16.8 Jurisdictional Differences

Thunderstorms	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Highly Likely	Significant	Significant	Medium
Albuquerque	Highly Likely	Extensive	Negligible	Medium
Los Ranchos	Highly Likely	Significant	Significant	Medium
Tijeras	Highly Likely	Significant	Significant	Medium
AMAFCA	Highly Likely	Extensive	Critical	High
MRGCD	Highly Likely	Extensive	Critical	High
ABCWUA	Highly Likely	Significant	Significant	Medium

While a majority of past hail events have taken place in the City of Albuquerque the entire planning area can experience thunderstorm events. AMAFCA and MRGCD assets are more vulnerable to thunderstorm impacts, increasing the risk for those jurisdictions.

4.16.9 Risk Summary

- Severe thunderstorms can include hail, lightning, thunderstorm and heavy rain.
- 190 severe thunderstorm events have been reported in the County since 1957, an average of 3 per year.
- Hail and thunderstorm wind are the most frequently recorded events.
- Hail is the most damaging hazard; resulting in $10,517,000 in property damages since 1957. Lightning has caused the most injuries (10) since 1996.
- Vulnerable populations are at risk of losing electricity due to a severe thunderstorm event. 9% of Medicare beneficiaries in the County rely on equipment that is electricity dependent.
- Related Hazards: High Wind, Tornado, Flood, Wildfire

4.17 Tornado

4.17.1 Description

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes and other tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally range from 40 to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and can cause extreme destruction and turning normally harmless objects into deadly missiles.

Statewide New Mexico averages 10 tornadoes a year, although historically most been weak and short-lived events. Tornadoes are most likely to occur during the months of March through May and can occur at any time of day but are more likely to form in the late afternoon and early evening.

4.17.2 Past Occurrences

The NCEI Storm Events Database has 16 records of tornado events in Bernalillo County from May 1957 through July 2016. In this 59-year time period, tornado events caused $277,590 in property damages. The most damaging event took place on September 20, 1985 and resulted in $250,000 in damages. The NCEI does not report any casualties from past tornado events, the 2018 State Plan does note a tornado event west of Albuquerque in October 1974 that did cause a fatality.

Historically, tornadoes in the planning area have been relatively minor, but even F1 tornadoes can still produce dangerous winds up to 112 mph. High winds can cause damage to buildings (tearing shingles from roofs, tearing awnings, collapsing structures, etc.). The maximum tornado magnitude recorded in the Storm Events Database for the planning area was an F1 with no associated property damages or injuries. There have been no recorded tornado events causing direct impacts to Bernalillo County since 1987.

The following table show the past tornado events that have cause property damages in Bernalillo County.

Table 4-53 Summary of Magnitudes of Past Tornado Events in Bernalillo County

Date	Magnitude	Property Damage
10/19/1957	F0	$30
5/31/1965	F1	$30
3/27/1970	F0	$30
9/20/1985	F0	$250,000
4/12/1987	F0	$25,000
6/29/1987	F0	$2,500
	Total	**$277,590**

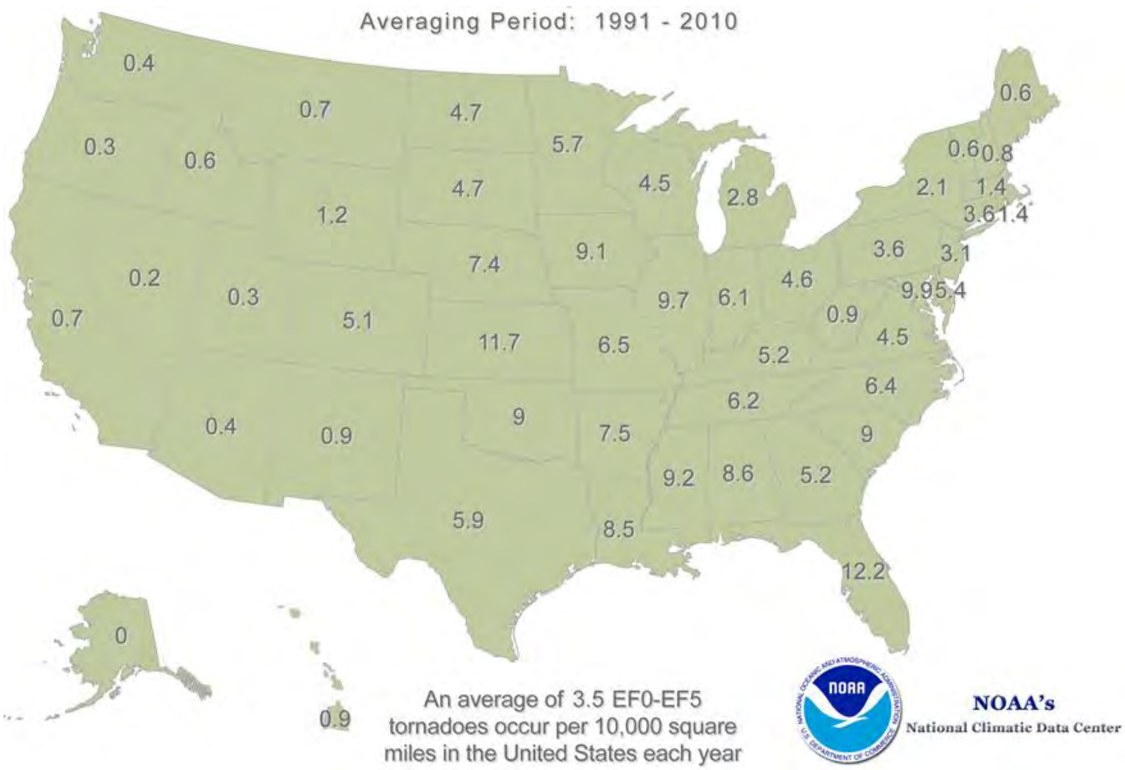
Source: NCEI Storm Events Database

4.17.3 Location

According to the NOAA Storm Prediction Center (SPC), the highest concentration of tornadoes in the United States has been in Oklahoma, Texas, Kansas, and Florida respectively. The Great Plains region of the Central United States favors the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"). Figure 4-45 shows the average annual number of EF0-EF5 tornadoes in the United States based on the number of recorded tornadoes per 10,000 square miles between 1991 and 2010. New Mexico averages 0.9 tornadoes per 10,000 square miles each year, indicating a low risk for the rest of New Mexico (including Bernalillo County).

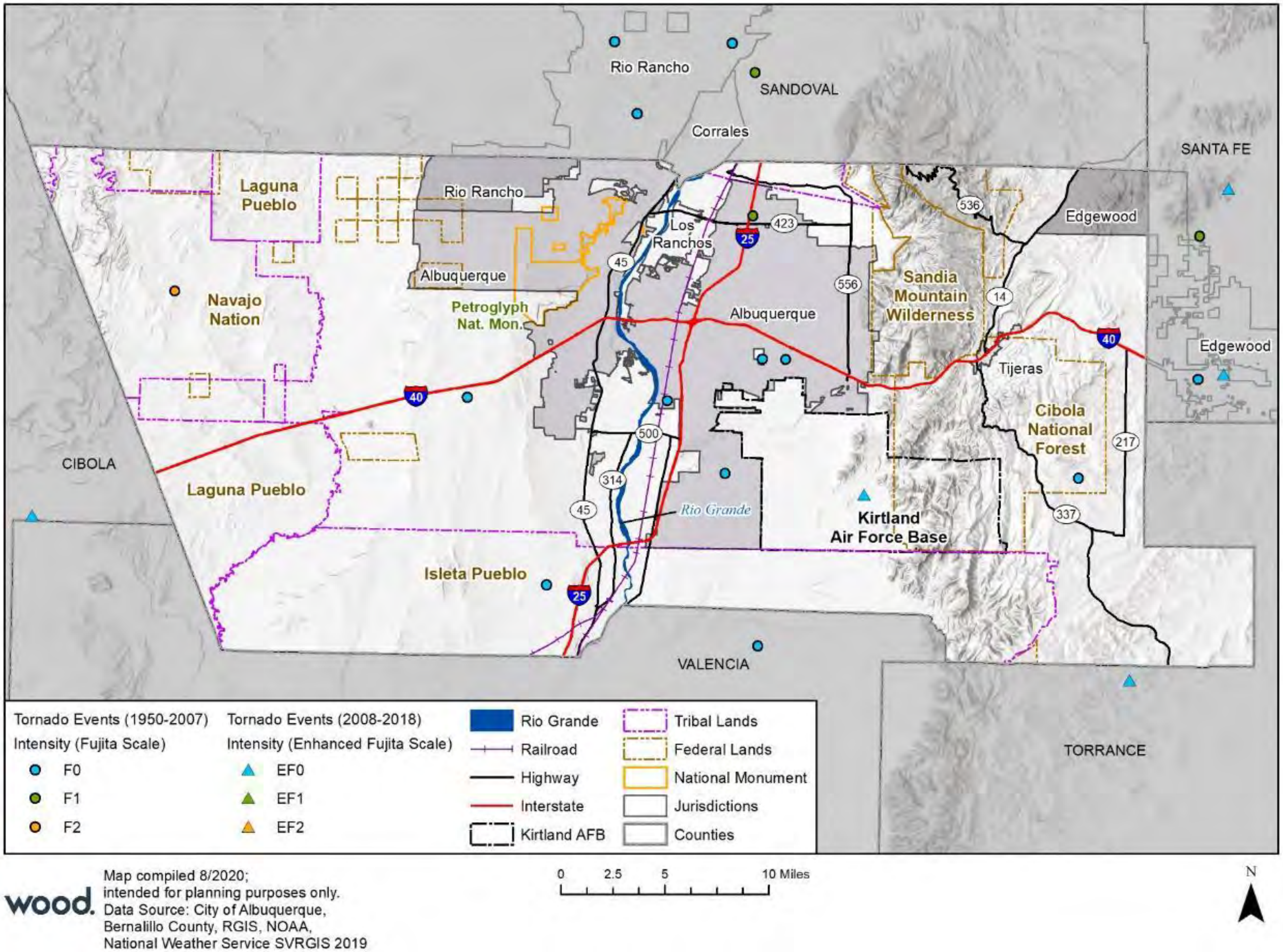
While the entire planning area is subject to the threat of tornadoes, the planning area's lower elevations are at a slightly greater risk as well as densely populated areas. The spatial extent of a tornado is small. Refer to Figure 4-45 for the location of past tornado events in the planning area.

Figure 4-44 Average Annual Number of EF0-EF5 Tornadoes Per 10,000 Sq. Miles, 1991-2010



Source: NOAA National Climatic Data Center

Figure 4-45 Past Tornado Events in Bernalillo County, 1955-2018



4.17.4 Magnitude/Severity

Tornadoes can cause damage to property and loss of life. While most tornado property damage is caused by violent winds, the majority of injuries and deaths generally result from flying debris. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response.

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale, with F0 being the least intense and F6 being the most intense. The Fujita Scale (seen in the table below) was used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.

Table 4-54 Fujita Tornado Damage Scale (Old)

Fujita (F) Scale	Intensity Phrase	Wind Speed (mph)
F0	Gale tornado	40-72
F1	Moderate tornado	73-112
F2	Significant tornado	113-157
F3	Severe tornado	158-206
F4	Devastating tornado	207-260
F5	Incredible tornado	261-318
F6	Inconceivable tornado	319-379

Source: NOAA

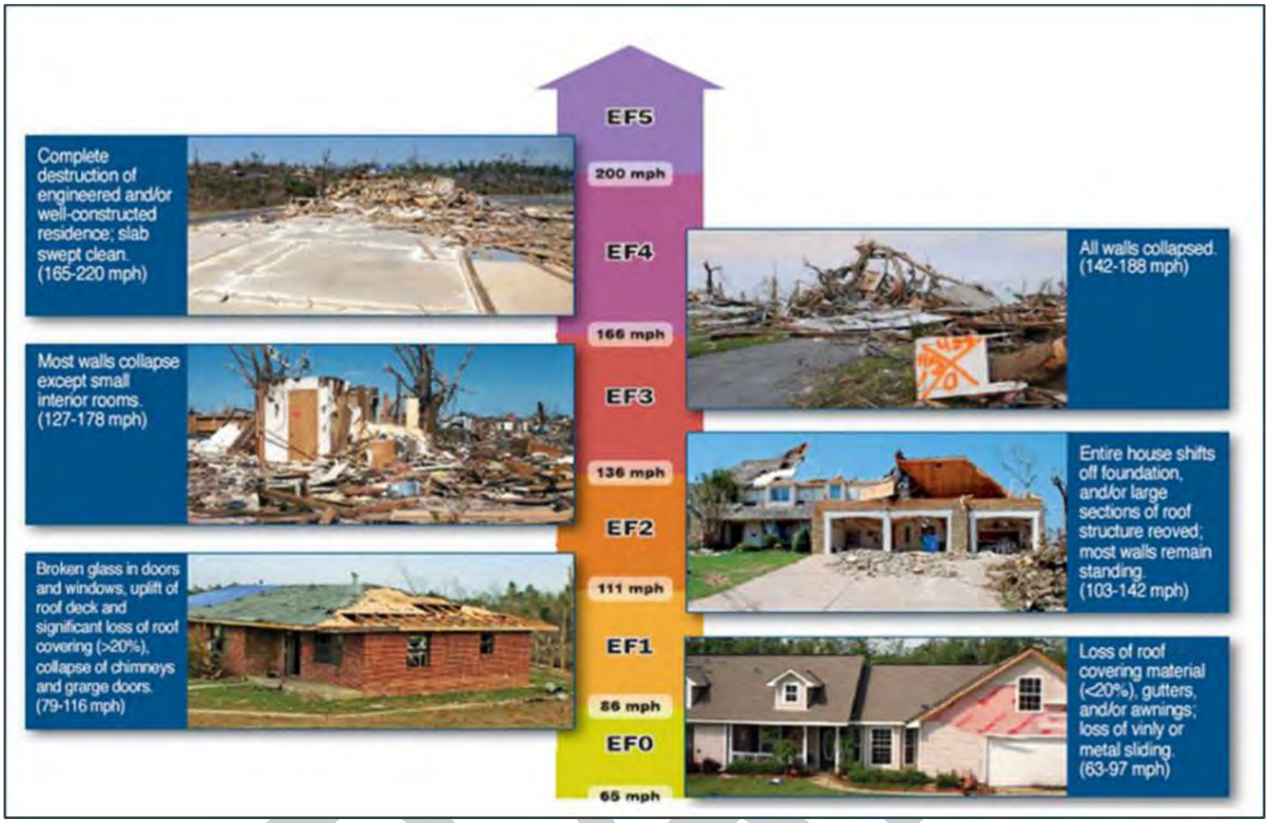
This scale was revised in 2007 and the Enhanced Fujita scale is now used. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table 4-55 shows the wind speeds associated with the Enhanced Fujita Scale ratings and Figure 4-46 illustrates the potential damage at each EF scale.

Table 4-55 Enhanced Fujita (EF) Tornado Scale

Enhanced Fujita (EF) Scale	Wind Speed Estimate (mph)	Potential Damage
EF0	65-85	Light damage:
EF1	86-110	Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF2	111-135	Moderate damage:
EF3	136-165	Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF4	166-200	Considerable damage:
EF5	Over 200	Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.

Source: NOAA

Figure 4-46 Potential Impact and Damage from a Tornado



Source: FEMA

Table 4-56 summarizes the magnitude of past tornado events as recorded in the NCEI Storm Events Database. There have been 13 tornado events with a recorded magnitude since 1957 in Bernalillo County. The greatest magnitude tornado recorded in the county is an F1. The most frequent recorded magnitude of past tornado events is F0 tornadoes.

Table 4-56 Magnitudes of Past Tornado Events in Bernalillo County

Magnitude	# of Events
F0	10
F1	1
EF0	2
Total	**13**

Source: NCEI Storm Events Database

4.17.5 Climate Change Considerations

There presently is not enough data or research to quantify the magnitude of change that climate change may have related to tornado frequency and intensity. NASA's Earth Observatory has conducted studies which aim to understand the interaction between climate change and tornadoes. Based on these studies meteorologists are unsure why some thunderstorms generate tornadoes and others don't, beyond knowing that they require a certain type of wind shear. Tornadoes spawn from approximately one percent of thunderstorms, usually supercell thunderstorms that are in a wind shear environment that promotes rotation. Some studies show a potential for a decrease in wind shear in mid-latitude areas. Because of uncertainty with the influence of climate change on tornadoes, future updates to the mitigation plan should include the latest research on how the tornado hazard frequency and severity could change. The level of significance of this hazard should be revisited over time.

4.17.6 Probability of Future Events

The 2018 State Plan gives Preparedness Area 5 a 64% probability of future occurrence of tornado events. Given there have been 16 tornadoes recorded in Bernalillo County in the last 59 years, the planning area can expect to see one tornado every 3-4 years. Most tornadoes will likely be EF0 or EF1.

4.17.7 Vulnerability Assessment

People

Community members are vulnerable to damaging wind and tornado events. Over the last 59 years there has been 1 death and no injuries reported in Bernalillo County from tornado events. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population.

However, there are also segments of the population that are especially exposed to the indirect impacts of tornadoes, particularly the loss of electrical power. According to the data obtained from emPower.com, a website maintained by the U.S. Department of Health and Human Services, 9% of the Medicare beneficiaries in the County (10,225 of 117,255 beneficiaries) rely on medical equipment that requires electricity in order to live independently. These populations include the elderly or disabled, especially those with medical needs and treatments dependent on electricity. Nursing homes, community-based residential facilities, and other special needs housing facilities are also vulnerable if electrical outages are prolonged, since backup power generally operates only minimal functions for a short time.

General Property

Property damages can be both direct and indirect. Direct damage refers to what the wind event physically destroys. Indirect damage focuses on additional costs, damages and losses from secondary hazards spawned by the event. Depending on the size of the tornado and its path, a tornado is capable of damaging and/or destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage. It should also be noted that few homes in Bernalillo County have basements, removing a normal "safe space" for shelter if tornadoes do occur. Mobile homes in particular are vulnerable and can be pushed off foundations or overturned. Due to the potential of a stronger tornado, the impact would be considered critical.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a large tornado could put tremendous strain on a community.

Historically, damaging tornadoes in the County have caused $277,590 worth of property damage from May 1957 through July 2016, which averages to $21,353 per tornado or $4,700 per year. According to data derived from the NWS, property damages included damage to homes, roofs, fences, windows, carports, outbuildings and tree damages. NCEI does not record any reported damage to crops.

Critical Facilities and Infrastructure

Because of the unpredictability of wind events' strength and path, most critical infrastructure that is above ground is equally exposed to the storm's impacts. Due to the random nature of these hazards, a more specific risk assessment was not able to be conducted. Possible losses to critical infrastructure include:

- Electric power disruption
- Communication disruption
- Water and fuel shortages
- Road closures
- Damaged infrastructure components, such as sewer lift stations and treatment plants
- Damage to homes, structures, and shelters

Government Services

Most structures, including critical facilities, should be able to withstand and provide adequate protection from severe wind and tornados. Those facilities with back-up generators should be fully equipped to handle a tornado events should the power go out.

In the event of a tornado there may be localized impacts to response personnel. Impacts to transportation corridors and communications lines affect first responders' ability to respond effectively.

To maintain public confidence, jurisdictions must continue to adhere to building codes and to facilitate new development that is built to the highest design standards to account for tornado winds.

Economy

Economic impacts are dependent on the size and path of the tornado. A tornado with a path through the county could potentially have tremendous economic impacts, including loss of business, transportation system impacts and rebuilding costs. These impacts will be felt more strongly by individuals who lack the means to rebuild or relocate.

Historic, Cultural and Natural Resources

Tornadoes can cause damage to the natural environment, uprooting trees and other debris; there is historical precedent for this in the city. This is seldom permanent, however, and the environment will return to its original state in time. Historic buildings built prior to modern building codes could potentially be more vulnerable to roof and structural damage from a tornado event.

Future Land Use and Development

Increased population leads to more people and housing developments potentially exposed. Adherence to current building codes, coupled with proper education on building techniques and the use of sturdy building materials, attached foundations, and other structural techniques may minimize the property vulnerabilities. Public shelters at parks and open spaces may help reduce the impacts of tornadoes and damaging wind events on the recreational populations exposed to storms.

4.17.8 Jurisdictional Differences

Tornado	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Unlikely	Limited	Significant	Low
Albuquerque	Unlikely	Limited	Critical	Low
Los Ranchos	Unlikely	Limited	Significant	Low
Tijeras	Unlikely	Significant	Significant	Low
AMAFCA	NA	NA	NA	NA
MRGCD	Unlikely	Limited	Significant	Low
ABCWUA	Unlikely	Limited	Significant	Low

The entire planning area is subject to the possibility of tornadoes. Areas with lower elevations have a slightly greater risk compared to the east mountains. The City of Albuquerque and other more densely populated areas also have a greater risk due to the greater exposure of people and property.

4.17.9 Risk Summary

- 13 tornado events have occurred in the planning area in the past 59 years, an average of one every 3-4 years.
- All recorded tornadoes in the planning area have been relatively weak, EF1 or less. The 13 recorded tornadoes caused $277,590 in property damages, an average of $21,353 per event.
- Tornadoes mainly occur during the late fall and early spring and can occur during any time of day.
- Specific impacts and vulnerabilities are difficult to predict due to the random nature of tornadoes, but a lower likelihood of occurrence suggests the overall significance is low.
- Related Hazards: Thunderstorm, High Wind

4.18 Wildfires

4.18.1 Description

A wildfire is an uncontrolled fire spreading through vegetative fuels, threatening and possibly consuming structures and other community assets. Wildfires are unwanted and unplanned fires that result from natural ignition, unauthorized human-caused fire, or escaped prescribed fire. Wildfires can begin unnoticed in remote areas and can spread quickly, creating dense smoke that may be seen for miles.

A **wildland-urban interface (WUI)** fire is a wildfire occurring in areas where structures and other human developments meet or intermingle with wildland vegetation-fuels. Fires in the WUI are a specific concern because they directly pose risks to human lives, property, structures, and critical infrastructure more so than the other types of wildland fires. Even relatively small acreage fires can result in disastrous damages.

Wildfires can occur any time of the day and any month, but peak fire season in New Mexico is between March and July (New Mexico DHSEM 2018). Fire conditions arise from a combination of high temperatures, low moisture content in the air and fuel, accumulation of vegetation, and high winds. In New Mexico, periodic prolonged droughts lead to higher wildfire risk. To exacerbate the wildfire risk problem is windblown dry air (typical of New Mexico). This dry wind creates a 'hairdryer' effect and further dries out vegetation making it more combustible.

After a fire starts, it can burn as three different burn types: surface, ground, and crown fire, or as a combination of all three. A surface burn consumes the ground cover and is limited to the surface, a ground fire burns roots and plants beneath the soil, and a crown fire burns the tops of trees and vegetation (Cohen 2003).

Generally, there are three major factors that sustain wildfires and allow for predictions of a given area's potential to burn: fuel, topography, and weather.

- **Fuel** – The material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree needles and leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Also considered a fuel source are man-made structures and other associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for fire spread. Fuel is the only factor that is under human control.
- **Topography** – An area's terrain and land slopes affect its susceptibility to wildfire spread. Fire intensities and rates of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The natural arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes. Terrain factors influencing fire behavior cannot be modified. Fires often run rapidly up steep slopes and are often pushed up or down canyons by daily cycles of wind direction.
- **Weather** – Components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out the fuels that feed wildfire, creating a situation where fuel will more readily ignite and burn more intensely.

4.18.2 Past Occurrences

There have been numerous wildfires within and in the vicinity of the planning area. Past wildfire events were compiled through the USGS, Federal Wildland Fire Occurrence database and the New Mexico Wildfire Risk Assessment Portal (NMWRAP). This data lists 653 recorded wildfires from 1970 through 2016, burning a total of 27,887 acres. This averages to 14.2 wildfires per year, 42.7 acres per wildfire event, and

606.3 acres per year. Of these events, 38 burned at least 10 acres, a majority of which occurred on federal land. Five of the fires since 2000 have led to a Federal Disaster declaration, refer to Table 4-1.

Of the 653 fires that have occurred since 1970, 75% (492) were human caused and 25% (153) were natural caused, likely from lightning events, the remainder of events were categorized as "miscellaneous" (0.3%) and "unknown" (0.5%). Table 4-57 summarizes past wildfire occurrences by year.

Table 4-57 Summary of Wildfires in Bernalillo County by Year

Year	Count of Wildfire Events	Total Acres Burned	Year	Count of Wildfire Events	Total Acres Burned
1970	1	50	1996	9	101.3
1971	2	121	1997	9	170.9
1972	3	61	1998	17	74.8
1974	3	536	1999	15	71.4
1980	3	0.3	2000	26	21.7
1981	4	30.3	2001	37	58.5
1982	4	3.3	2002	34	106.9
1983	4	3.2	2003	19	219.5
1984	12	269.1	2004	14	57.9
1985	4	81.1	2005	30	35.8
1986	9	32.1	2006	33	434.95
1987	7	53.1	2007	18	2443.7
1988	7	2.3	2008	27	611
1989	19	785	2009	19	560.8
1990	11	51.1	2010	22	27.7
1991	17	331.5	2011	40	96.3
1992	12	151.9	2012	26	63.6
1993	17	86	2013	25	47.8
1994	12	233.6	2014	25	544.6
1995	18	1218.4	2016	22	10.9
			Total	**653**	**27,887.35**

Source: USFS, NMWRAP

The State HMP highlights significant wildfires directly or indirectly impacting Bernalillo County since 2003:

- ***June 2003*** - Fireworks ignited the Bosque Fire in Albuquerque, which burned hundreds of acres and destroyed one home. The threat to surrounding residences, businesses, and infrastructure was very high, response costs and losses were approximately $1 million.
- ***November 19, 2007*** – A small human caused wildfire which began in the southern Manzano Mountains early in the morning on the 19th grew to around 7000 acres early on the 21st. Three residences and four outbuildings were destroyed. Nearly 100 people were evacuated prior to Thanksgiving Day in the villages of Punta de Agua and Manzano. Cost was $500K.
- ***April 30, 2008*** - A human caused fire turned into a large wildfire during several days of strong winds. Very dry conditions were present prior to the wildfire due to a lack of precipitation in the preceding weeks. The Trigo Wildfire began on the west slopes of the Manzano Mountains and was initially

spread by southwest wind gusts to 35 mph. The fire reached Osha Peak during the evening of April 16th. On the 20th, the fire spread rapidly northeast due to 40 mph winds. It entered flatter terrain on the east side of the Manzanos, and by April 21st, 3750 acres had been burned including nine homes, nine outbuildings and two recreational vehicles. The 4800 acre fire was 95 percent contained by April 29th but was fanned by strong southwest winds of 40 to 50 mph on the 30th, forcing the evacuation of Sufi and Apple Mountain Campgrounds and the Sherwood Forest subdivision, west of Torreon. Over 50 additional homes and one communications tower were damaged or destroyed, mainly in the Sherwood Forest area as the fire grew to more than 11,000 acres. The fire continued to be uncontained into the month of May. Cost was $8.5 Million

- ***June 23, 2008*** - Lightning started a wildfire in heavy timber on the east side of the Manzano Mountains, not far from the area of the Trigo Wildfire, which had burned earlier in the spring. Over 5000 acres were consumed before the fire was contained June 30th. The Big Springs Wildfire consumed 5478 acres on the east slopes of the Manzano Mountains about 3 to 6 miles west northwest of Tajique. Six homes and ten outbuildings were destroyed in the fire in the Apache Canyon area. Property damage was $1 Million.

- ***June 16, 2011*** - The Swallow Wildfire quickly engulfed 9 homes amidst breezy, hot and very dry conditions. This human caused fire, named the Swallow Fire for starting on Swallow Drive, burned 10 acres of land in a wooded Ruidoso neighborhood. Nine homes were lost to the blaze. Total Property damage was $3.5 Million.
- ***June 26, 2011*** - Hot, dry and windy conditions allowed this human caused fire in the Bosque to quickly destroy a few residences and outbuildings. The 346 Fire, located 5 miles south of Belen in the Bosque, burned 262 acres over a five day period. The fire destroyed 3 residences and 7 outbuildings, and also damaged another 3 residences and 7 outbuildings. Total property damage was $700K.
- ***June 20, 2012*** - The Romero Fire burned 360 acres.
- **June 14-21, 2016** – The Dog Head Fire started in Torrance County, and on June 15 crossed over into Bernalillo County. In total, 17,912 acres were burned.

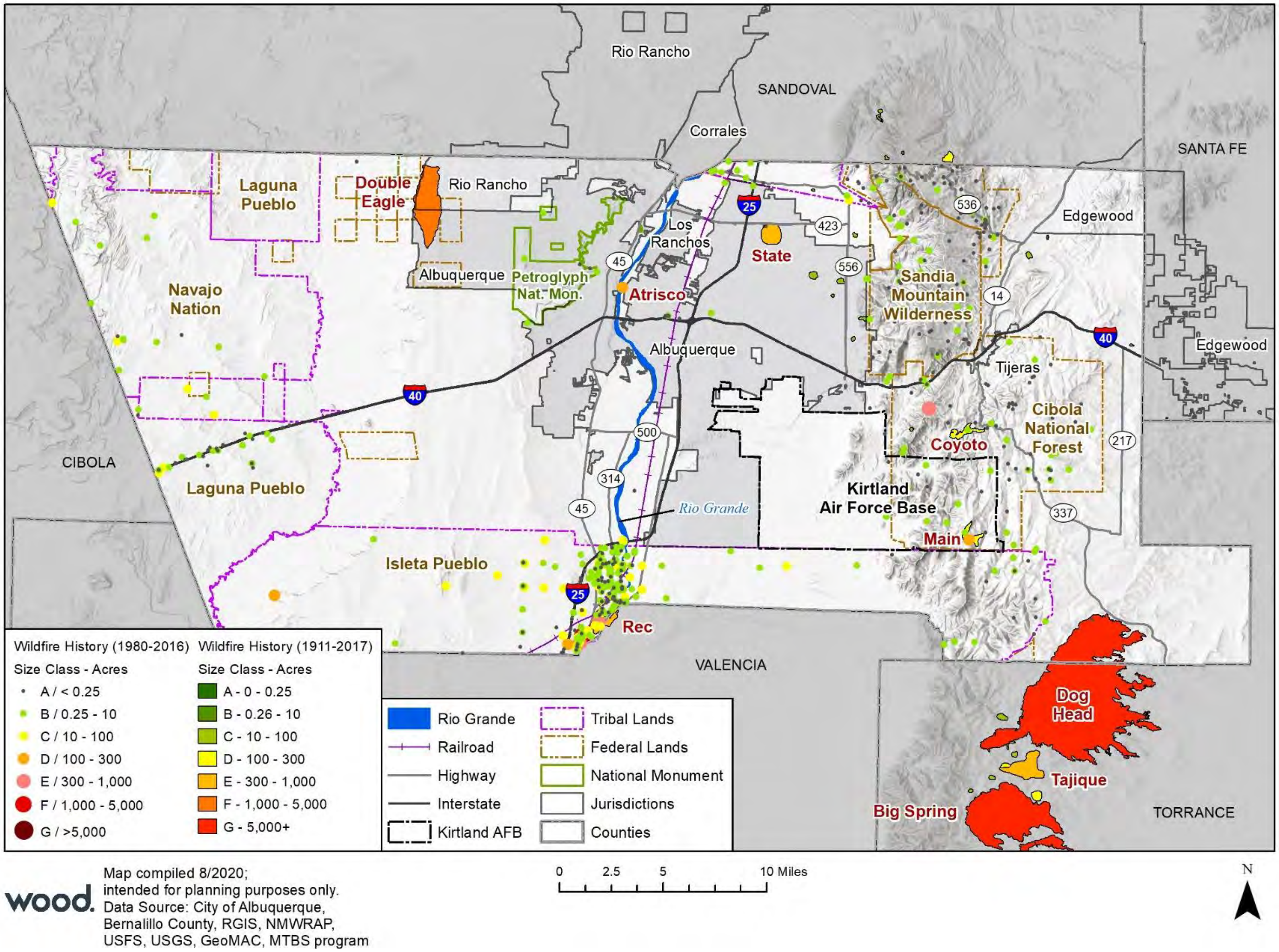
In addition to events noted above, the NCEI Storm Events Database lists two additional events in 2018 and 2019.

- ***May 15, 2018*** – A brush fire started in the Albuquerque Foothills near the Elena Gallegos Picnic Area and spread to seven acres. Roughly 20 homes were evacuated, 10 homes were threatened, and three homes suffered minor exterior burn damage.

- ***March 3, 2019*** – The first destructive wildfire of the 2019 season broke out along the Rio Grande near the Rio Communities during the late afternoon. The fire initially started on the west bank of the Rio Grande near Los Chavez then spread across the river to over 100 acres. The fire destroyed at least two homes, seven outbuildings, six recreational vehicles. Two fire fighters were injured. Property damages are estimated to be $500,000.

The following map shows the location of past wildfire events within Bernalillo County.

Figure 4-47 Bernalillo County Wildfire History 1911-2017



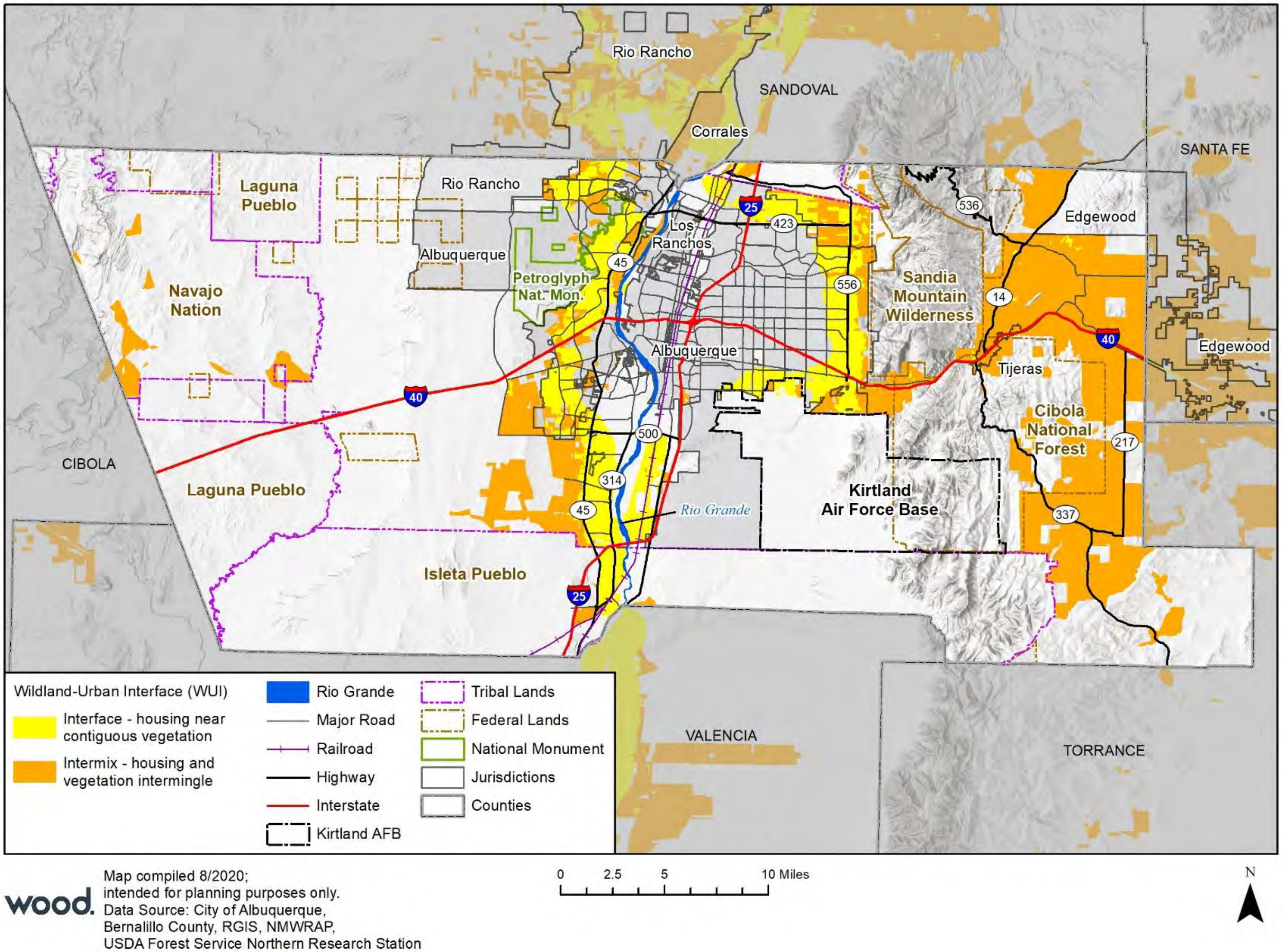
4.18.3 Location

The area of greatest concern for wildfire risk is the 'wildland-urban interface (WUI), which is the area where development is close to or within a boundary of natural terrain and fuel, where high potential for wildland fires exist. This area is where the potential for wildfire to directly impact people and property is the highest. Communities are able to establish the definition and boundary of their local WUI, and the boundaries often help in meeting local management needs. WUI areas can include both public and private land and can help improve local access to funding sources.

Traditional settlement patterns in New Mexico began with concentrated development of homes and farms along the river and within the Bosque. In the past 30 years, development has accelerated in the East Mountains. Wildland-urban interface areas of Bernalillo County, where urban areas meet the natural environment in both the East Mountains and Bosque, contain tree densities that are several times greater than what is considered to be a healthy forest, with thick stands of stunted trees and large accumulations of fuels. The higher than normal tree densities and accumulation of fuels present a significant continued threat of a wildfire to structures located in the wildland-urban interface area.

More recently, wildfires have become a key component of the Bosque ecosystem, as the natural hydrologic regime has been altered and invasive species have become more common throughout the area. Treatments to fuels in these Bosque areas contribute to decreasing the likelihood of wildfire's negative impacts on communities in the planning area. Continued preventive activities are needed however to further reduce the negative impacts that wildland fire can have on communities and community members living in the Wildland-Urban Interface (WUI), the area where houses meet or intermingle with undeveloped wildland vegetation. The WUI area is a focal area for human-environment conflicts such as wildland fires, habitat fragmentation, invasive species, and biodiversity decline. Figure 4-48 shows WUI areas within Bernalillo County. The WUI layer was provided by NMWRAP, and was created by SILVIS Lab, Department of Forest Ecology and Management and the University of Wisconsin-Madison. Using geographic information systems (GIS), we integrated U.S. Census and USGS National Land Cover Data, to map the Federal Register definition of WUI.

Figure 4-48 Bernalillo County Wildlife Urban Interface (WUI)



Areas especially vulnerable are the western slopes of the East Mountains, and the cottonwood Bosque along the Rio Grande. Wildfires in Bernalillo County can also occur in the grasslands of the western portion of the County, known locally as the West Mesa. In addition, some of the heavily forested areas in the eastern part of the County are located on steep slopes, which aid in the spread of fires and add to the difficulty of fighting a wildfire.

4.18.4 Magnitude/Severity

Several factors contribute to the increased risk of catastrophic fires in the planning area:

- Increased tree density and decreased grass and forb (broad-leaved herbs that grow in fields, prairies, or meadows) cover.
- Past forest fire suppression practices and livestock overgrazing that resulted in the unnaturally heavy accumulation of live and dead vegetation and led to "doghair" thickets of ponderosa pine trees in the Sandia Mountains.
- Fire suppression in the Bosque for many years has resulted in a high fuel load of dry, dead, and dying vegetation.
- Early logging activity in different regions that creates artificial fuel breaks, alters the local microclimate, and modifies forest composition and age structure.
- The Bark Beetle outbreak in Southwest is highly visible in the East Mountains, and greatly increases the risk of wildfire. Populations of several native bark beetle species are increasing dramatically due to several years of extended drought. Many trees are extremely stressed from the drought and are highly susceptible to bark beetle attack. The resulting outbreak has killed millions of ponderosa pine and pinion trees in Arizona and New Mexico. Due to the continued drought and the widespread extent of the bark beetle outbreak, there is little or nothing that can be done on a large scale to prevent the mortality of these trees. Once a stand of pinion trees has been killed as a result of the bark beetle infestation and the trees drop their needles, the intensity of a potential fire is lessened because there is less fuel to burn.
- Drought in the Southwest region of the United States has greatly affected vegetation in Bernalillo County and greatly contributes to the increased risk of wildfire.

The NMWRAP Wildfire Risk Assessment Report for Bernalillo County lists the following incorporated and unincorporated communities as being at medium-to-high risk of wildfire. All of the high risk communities are located in the East Mountains and covered under the East Mountain Community Wildfire Protection Plan. The 2003 New Mexico Legislature created the New Mexico Fire Planning Task Force to identify the state's Wildland Urban Interface (WUI) areas most vulnerable to wildland fires, and to develop standards for building codes and ordinances to reduce the threat of wildland fires to those communities. It should be noted that the communities listed within a CWPP are by no means a complete list of areas at risk from wildland fire. Each CWPP has made a concerted effort to list all the communities within their plan's boundaries. The Communities at Risk Subcommittee recognizes that some communities in the state of New Mexico are not currently listed in a CWPP. The NM-FPTF encourages all communities within New Mexico to be in a CWPP.

Table 4-58 NMWRAP Wildfire Risk Assessment – Communities at Risk in Bernalillo County

Community Name	Rating
Canyon Estates	High Risk
Tijeras	High Risk
Casa Loma	High Risk
Primera Agua	High Risk
San Antonio	High Risk

Community Name	Rating
Canoncito	High Risk
Cedar Crest	High Risk
Forest Park	High Risk
Sandia Park	High Risk
Rincon	High Risk
Cedro	High Risk
El Tablazon	High Risk
El Refugio	High Risk
Ponderosa Pine	High Risk
Los Pinos	High Risk
Sandia Knolls	High Risk
Dennis Chavez Estates	High Risk
Ponderosa	High Risk
Chilili Land Grant	High Risk
Albuquerque	Medium Risk
Los Ranchos de Albuquerque	Medium Risk
Carnuel	Medium Risk
Zamora	Medium Risk
San Antonito	Medium Risk
Juan Tomas	Medium Risk
Sedillo	Medium Risk
Miera	Medium Risk
Yrisarri	Medium Risk
Escabosa	Medium Risk
Frost (historical)	Medium Risk
Alley Place	Medium Risk
Barton	Medium Risk

Source: NMWRAP Wildfire Risk Assessment Report for Bernalillo County 2020, nmwrap.org

The Keetch-Bryam Drought Index (KBDI) was developed specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground.

The KBDI (see Table 4-59) attempts to measure the amount of precipitation necessary to return the soil to full field capacity. It is a closed system ranging from 0 to 800 units and represents a moisture regime from 0 to 8 inches of water through the soil layer. At 8 inches of water, the KBDI assumes saturation. Zero is the point of no moisture deficiency and 800 is the maximum drought that is possible. At any point along the scale, the index number indicates the amount of net rainfall that is required to reduce the index to zero, or saturation.

The inputs for KBDI are weather station latitude, mean annual precipitation, maximum dry bulb temperature, and the last 24 hours of rainfall. KDBI levels and its relationship to expected fire potential are reflected in the following table:

Table 4-59 Keetch-Byram Drought Index Range Categories

Keetch-Byram Drought Index Fire Rating System	
0 – 200	Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.

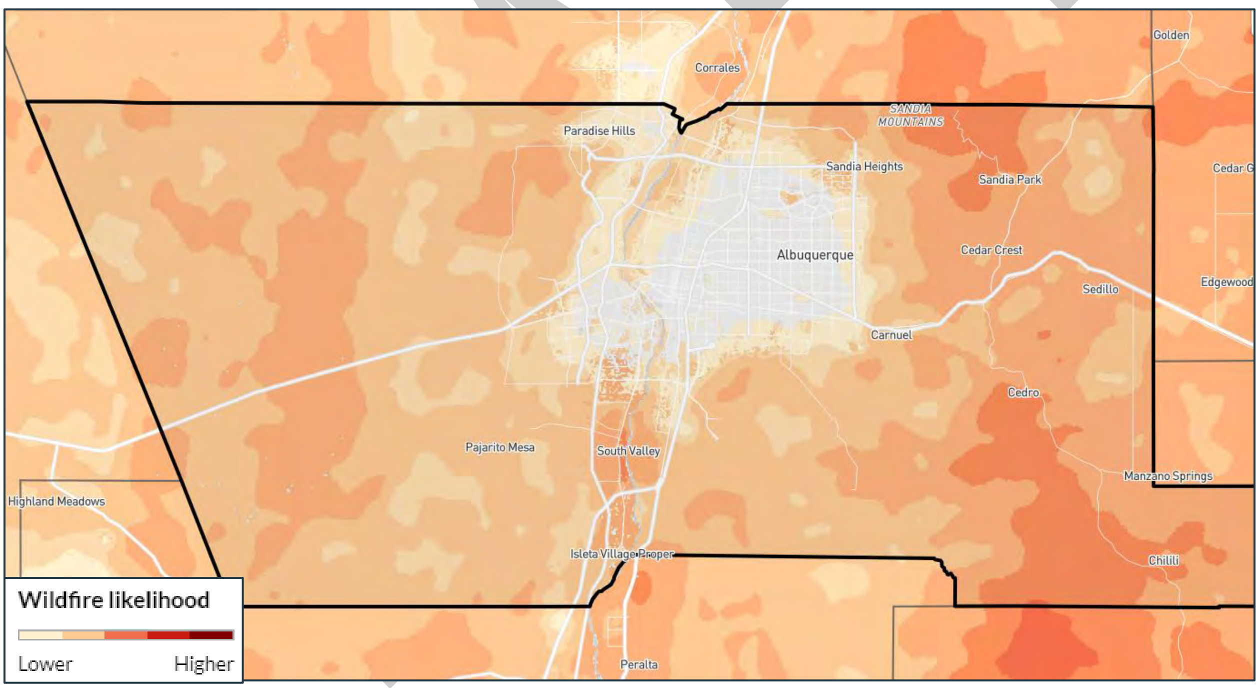
Keetch-Byram Drought Index Fire Rating System	
200 – 400	Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possible through the night.
400 – 600	Fire Intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.
600-800	Fires will burn to mineral soils. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity.

Source: from Keetch-Byram Drought Index narrative at: http://www.wfas.net/index.php/keetch-byram-index- moisture--drought-49

Typical conditions in the planning area from September through December usually center on the 200-400 rating while January through August are usually drier months and, depending on fuel and moisture, usually will rate in the 400-600 range. During extreme dry and drought times – typically in the months of May, June, and July – the County may be rated at 600-800.

Figure 4-49 is a spatial representation of wildfire likelihood across the County depicted from the USDA Wildfire Risk to Communities interactive map. The USDA data shows that Bernalillo County's wildfire risk is among the lowest of the 33 New Mexico counties.

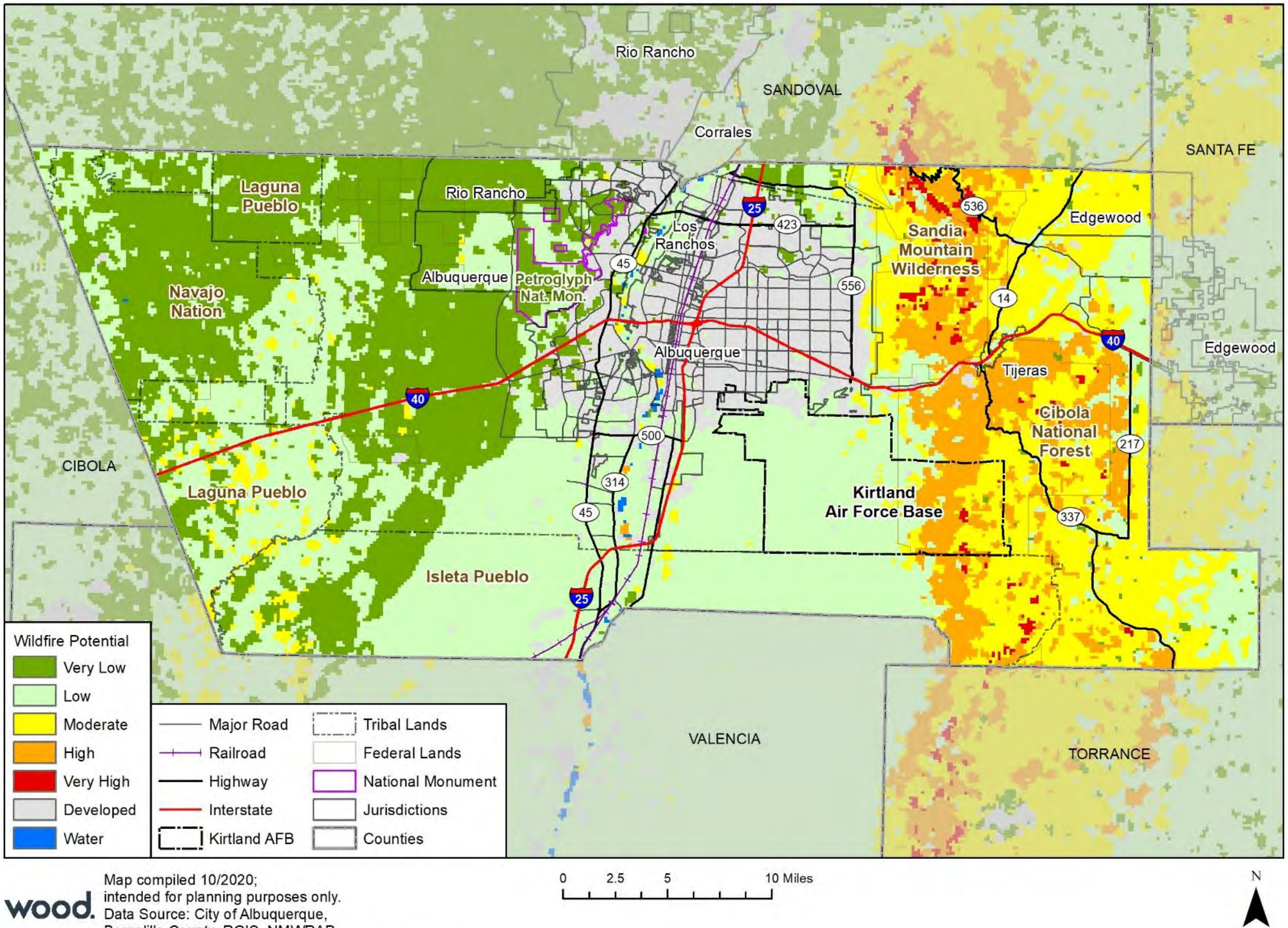
Figure 4-49 Bernalillo County Wildlife Likelihood



Source: USDA Wildfire Risk to Communities https://wildfirerisk.org

Figure 4-50 is a spatial representation of Wildfire Potential for Bernalillo County. The purpose of the wildfire hazard potential map was to depict the relative potential for wildfire that would be difficult for suppression resources to contain. Spatial estimates of wildfire likelihood and intensity generated in 2014 with the Large Fire Simulation system (FSim) for the national interagency Fire Program Analysis system (FPA), as well as spatial fuels and vegetation data from LANDFIRE 2010 and point locations of fire occurrence from FPA (ca. 1992 – 2012). With these datasets as inputs, an index of wildfire hazard potential for all of the conterminous United States at 270 meter resolution. The final wildfire hazard potential map has five classes of very low, low, moderate, high, and very high. On its own, the layer is not an explicit map of wildfire threat or risk, but when paired with spatial data depicting highly valued resources and assets such as structures or powerlines, it can approximate relative wildfire risk to those specific resources and assets. The wildfire hazard potential layer is also not a forecast or wildfire outlook for any particular season it is instead intended for long-term strategic fuels management.

Figure 4-50 Bernalillo County Wildfire Potential



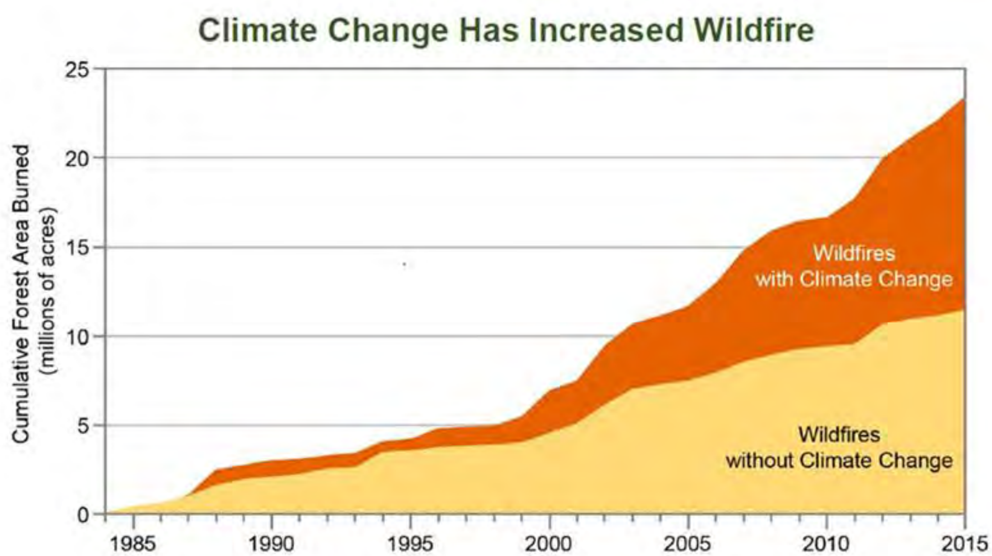
wood.

Map compiled 10/2020;
intended for planning purposes only.
Data Source: City of Albuquerque,
Bernalillo County, RGIS, NMWRAP,
USDA Forest Service, Fire Modeling Institute (FMI),
Missoula Fire Sciences Laboratory

4.18.5 Climate Change Considerations

The effects of climate change can already be seen in the Southwest region of the United States; including rising temperatures, intensified drought events, and increased susceptibility to invasive species. According to the Fourth National Climate Assessment (2018), wildfires have burned twice as many acres across the western United States between 1985 and 2015 than would have burned had climate change not been occurring. Climate change is also creating a year-round wildfire season.

Figure 4-51 Climate Change and Wildfire Events



Source: Fourth National Climate Change Assessment, 2018

4.18.6 Probability of Future Events

As noted above under Past Occurrences, Bernalillo County has experienced 653 recorded wildfires from 1970 to 2016, 94 of which burned at least 10 acres. Fires of 10 acres or more occurred in 32 of the 46 years on record. Based on this historical record, wildfire is highly likely to occur in any given year. It is important to note that over 70% of recent past wildfires in Bernalillo County have been human-caused. Ultimately, the occurrence of future wildfire events will strongly depend on patterns of human activity and events are more likely to occur in wildfire-prone areas experiencing new or additional development.

4.18.7 Vulnerability Assessment

Potential exposure to wildfire was estimated using the Bernalillo County Wildland Urban Interface (WUI) data, as firefighting costs in WUI areas are a major concern (USDA 2015). The table below defines in more detail the WUI areas and their vegetative content coverage percentages.

Based on the table and descriptions, the WUI zones data where wildland vegetation was greater than 50% in the Intermix was used for the following parcel and critical facility analyses. Within the WUI Intermix zones where wildland vegetation was >50%, three categories of WUI zones were relevant to the planning area: Low Density Intermix, Medium Density Intermix, and High Density Intermix. The highest concern WUI Intermix area is the High Density Intermix, which is sporadically found across the county as displayed in Figure 4-48.

Table 4-60 WUI and Vegetated Classes and Definitions

Area	Description
WUI Areas	
Intermix	Areas with ≥6.18 houses per km^2 and ≥50 percent cover of wildland vegetation.
Interface	Areas with ≥6.18 houses per km^2 and <50 percent cover of vegetation located <2.4 km of an area ≥5 km^2 in size that is ≥75 percent vegetated.
Non-WUI Vegetated Areas	
No Housing	Areas with ≥50 percent cover of wildland vegetation and no houses (e.g., protected areas, steep slopes, mountain tops).
Very Low Housing Density	Areas with ≥50 percent cover of wildland vegetation and <6.18 houses per km^2 (e.g., dispersed rural housing outside neighborhoods).
Non-Vegetated or Agriculture Areas	
Low and Very Low Housing Density	Areas with <50 percent cover of wildland vegetation and <49.42 houses per km^2 (e.g., agricultural lands and pasturelands).
Medium and High Housing Density	Areas with <50 percent cover of wildland vegetation and ≥49.42 houses per km^2 (e.g., urban and suburban areas, which may have vegetation but not dense vegetation).

Source: USDA Forest Service - The 2010 Wildland-Urban Interface of the Conterminous United States, 2010. Available at https://www.fs.fed.us/nrs/pubs/rmap/rmap_nrs8.pdf

People

In addition to the potential for fatalities, wildfire and the resulting diminished air quality pose health risks. Exposure to wildfire smoke can cause serious health problems within a community, including asthma attacks and pneumonia, and can worsen chronic heart and lung diseases. Vulnerable populations include children, the elderly, and people with respiratory problems or heart disease. Even healthy otherwise healthy individuals may experience minor symptoms, such as sore throats and itchy eyes.

The last column of Table 4-61 and Table 4-62 below summarizes the number of people at risk to wildfire in the analyzed WUI Intermix and Interface zones. The City of Albuquerque has the greatest number of residential properties in the WUI interface with the most potential population exposure (220,046), followed by unincorporated areas of the County (31,430 people). In term of potential population exposure in the WUI Intermix the unincorporated areas of the County have the greatest number of potential population exposure (35,764) followed by the City of Albuquerque (33,134). Overall, the county has an estimated 321,066 potential people exposed in these WUI interface and intermix zones.

In addition to the WUI parcel analysis, parcel analysis on wildfire probability was also conducted. Based on this GIS analysis, 211,958 persons are potentially exposed to moderate to very high probability of a wildfire event. Of those persons, 186,832 are potentially exposed to very high probability of a wildfire event, a majority located in the City of Albuquerque followed by the unincorporated areas of the county. Refer to Table 4-61 through Table 4-66 below.

General Property

Any flammable materials are vulnerable during a wildfire, including structures and personal property. The vulnerability of general property increases as the distance of the property to wildfire-prone areas decreases and is particularly high for structures located in the WUI. These structures receive an even higher level of vulnerability if the properties surrounding them are not properly mitigated for fire, using techniques include such as using non-flammable materials and ignition-resistant construction, leaving appropriate spaces between buildings and vegetation, landscaping with non-flammable materials (such as decorative rock or stone), and clearing of underbrush and trees. If a wildland fire were to cross completely into an urban zone, the damage could be extensive and there would likely be a higher exposure of property and homes themselves become fuel in extreme fire weather conditions.

As noted above WUI areas were overlaid with the parcel data in GIS to estimate potential parcels exposed as well as their values, based on the methodology described under this vulnerability section introduction as well as Section 4.2 Asset Summary. Results of the spatial analysis are summarized, by WUI zone as well as jurisdiction, in Table 4-61 and Table 4-62. This analysis indicates that 79,147 and 21,389 parcels are located in the WUI interface and intermix zones, a majority of which for both zones are residential parcels. The breakdown of parcels and values found in WUI zones is summarized based on parcel type in the following tables. The exposure values for wildfire can be considered equivalent to loss estimates, as typically the entire structure and contents are consumed by wildfires. It would be extremely rare, however, for a wildfire to affect all the at-risk communities simultaneously. While not recorded in the tables below, the HMPC added that there has been an increase in homeless persons living in the Bosque.

Table 4-61 Improved Properties at Risk to WUI Interface by Property Type

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	1,293	2,068	$775,563,357	$775,563,357	$1,551,126,714	
	Residential	68,038	72,831	$10,632,847,944	$5,316,423,972	$15,949,271,916	220,046
	Vacant	188	207	$2,822,900	$2,822,900	$5,645,800	
	Total	**69,519**	**75,106**	**$11,411,234,201**	**$6,094,810,229**	**$17,506,044,430**	**220,046**
Tijeras	Commercial	20	35	$4,515,700	$4,515,700	$9,031,400	
	Residential	33	42	$3,008,663	$1,504,332	$4,512,995	113
	Vacant	3	3	$9,100	$9,100	$18,200	
	Total	**56**	**80**	**$7,533,463**	**$6,029,132**	**$13,562,595**	**113**
Unincorporated	Commercial	338	806	$213,920,547	$213,920,547	$427,841,094	
	Residential	8,912	12,364	$1,602,537,509	$801,268,755	$2,403,806,264	31,430
	Vacant	322	409	$3,066,309	$3,066,309	$6,132,618	
	Total	**9,572**	**13,579**	**$1,819,524,365**	**$1,018,255,611**	**$2,837,779,976**	**31,430**
	Grand Total	**79,147**	**88,765**	**$13,238,292,029**	**$7,119,094,971**	**$20,357,387,000**	**251,588**

Source: NMWRAP, USDA Forest Service Northern Research Station, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-62 Improved Properties at Risk to WUI Intermix by Property Type

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	137	257	$249,334,710	$249,334,710	$498,669,420	
	Residential	10,245	10,546	$2,133,311,770	$1,066,655,885	$3,199,967,655	33,134
	Vacant	18	19	$792,600	$792,600	$1,585,200	
	Total	**10,400**	**10,822**	**$2,383,439,080**	**$1,316,783,195**	**$3,700,222,275**	**33,134**
Los Ranchos	Residential	12	21	$15,443,519	$7,721,760	$23,165,279	38
	Total	**12**	**21**	**$15,443,519**	**$7,721,760**	**$23,165,279**	**38**
Tijeras	Commercial	9	12	$7,048,829	$7,048,829	$14,097,658	
	Residential	159	227	$19,700,412	$9,850,206	$29,550,618	542
	Vacant	4	6	$29,500	$29,500	$59,000	
	Total	**172**	**245**	**$26,778,741**	**$16,928,535**	**$43,707,276**	**542**
Unincorporated	Commercial	158	293	$170,271,307	$170,271,307	$340,542,614	
	Residential	10,141	14,024	$2,279,687,248	$1,139,843,624	$3,419,530,872	35,764

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
	Vacant	506	578	$77,518,843	$77,518,843	$155,037,686	
	Total	**10,805**	**14,895**	**$2,527,477,398**	**$1,387,633,774**	**$3,915,111,172**	**35,764**
Grand Total		**21,389**	**25,983**	**$4,953,138,738**	**$2,729,067,264**	**$7,682,206,002**	**69,478**

Source: NMWRAP, USDA Forest Service Northern Research Station, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

The results of the wildfire WUI analysis shown above in Table 4-63, Table 4-64, Table 4-65, and Table 4-66 indicate that $20 billion in property value and 88,765 structures are located in the WUI Interface while $43 million and 245 structures are in the WUI Intermix.

The results of the wildfire potential analysis shown below in Table 4-63, Table 4-64, Table 4-65, and Table 4-66 indicate that $16 billion in property value and 57,770 structures are located in areas of very high wildfire potential.

Table 4-63 Improved Properties at Risk to Very High Wildfire Potential by Property Type

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	669	669	$624,913,061	$624,913,061	$1,249,826,122	
	Residential	34,157	34,157	$5,824,116,921	$2,912,058,461	$8,736,175,382	110,469
	Vacant	23	23	$915,900	$915,900	$1,831,800	
	Total	**34,849**	**34,849**	**$6,449,945,882**	**$3,537,887,422**	**$9,987,833,304**	**110,469**
Tijeras	Commercial	29	29	$11,532,929	$11,532,929	$23,065,858	
	Residential	184	184	$21,936,190	$10,968,095	$32,904,285	628
	Vacant	2	2	$28,700	$28,700	$57,400	
	Total	**215**	**215**	**$33,497,819**	**$22,529,724**	**$56,027,543**	**628**
Unincorporated	Commercial	720	720	$522,626,372	$522,626,372	$1,045,252,744	
	Residential	21,475	21,475	$3,778,425,553	$1,889,212,777	$5,667,638,330	75,735
	Vacant	511	511	$79,817,426	$79,817,426	$159,634,852	
	Total	**22,706**	**22,706**	**$4,380,869,351**	**$2,491,656,575**	**$6,872,525,926**	**75,735**
Grand Total		**57,770**	**57,770**	**$10,864,313,052**	**$6,052,073,720**	**$16,916,386,772**	**186,832**

Source: NMWRAP, USDA Forest Service, Fire Modeling Institute, Missoula Fire Sciences Laboratory, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-64 Improved Properties at Risk to High Wildfire Potential by Property Type

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	137	257	$249,334,710	$249,334,710	$498,669,420	
	Residential	10,245	10,546	$2,133,311,770	$1,066,655,885	$3,199,967,655	33,134
	Vacant	18	19	$792,600	$792,600	$1,585,200	
	Total	**10,400**	**10,822**	**$2,383,439,080**	**$1,316,783,195**	**$3,700,222,275**	**33,134**
Los Ranchos	Residential	12	21	$15,443,519	$7,721,760	$23,165,279	38
	Total	**12**	**21**	**$15,443,519**	**$7,721,760**	**$23,165,279**	**38**
Tijeras	Commercial	9	12	$7,048,829	$7,048,829	$14,097,658	
	Residential	159	227	$19,700,412	$9,850,206	$29,550,618	542
	Vacant	4	6	$29,500	$29,500	$59,000	

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
	Total	**172**	**245**	**$26,778,741**	**$16,928,535**	**$43,707,276**	**542**
Unincorporated	Commercial	158	293	$170,271,307	$170,271,307	$340,542,614	
	Residential	10,141	14,024	$2,279,687,248	$1,139,843,624	$3,419,530,872	35,764
	Vacant	506	578	$77,518,843	$77,518,843	$155,037,686	
	Total	**10,805**	**14,895**	**$2,527,477,398**	**$1,387,633,774**	**$3,915,111,172**	**35,764**
	Grand Total	**21,389**	**25,983**	**$4,953,138,738**	**$2,729,067,264**	**$7,682,206,002**	**69,478**

Source: NMWRAP, USDA Forest Service, Fire Modeling Institute, Missoula Fire Sciences Laboratory, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-65 Improved Properties at Risk to Moderate Wildfire Potential by Property Type

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	26	41	$69,878,078	$69,878,078	$139,756,156	
	Residential	892	1,083	$198,408,850	$99,204,425	$297,613,275	2,885
	Vacant	2	2	$228,300	$228,300	$456,600	
	Total	**920**	**1,126**	**$268,515,228**	**$169,310,803**	**$437,826,031**	**2,885**
Los Ranchos	Residential	3	7	$2,245,703	$1,122,852	$3,368,555	9
	Total	**3**	**7**	**$2,245,703**	**$1,122,852**	**$3,368,555**	**9**
Tijeras	Commercial	6	7	$5,051,500	$5,051,500	$10,103,000	
	Residential	139	208	$16,436,587	$8,218,294	$24,654,881	474
	Vacant	6	6	$14,200	$14,200	$28,400	
	Total	**151**	**221**	**$21,502,287**	**$13,283,994**	**$34,786,281**	**474**
Unincorporated	Commercial	85	164	$21,404,541	$21,404,541	$42,809,082	
	Residential	4,691	6,531	$950,325,286	$475,162,643	$1,425,487,929	16,544
	Vacant	278	318	$2,416,188	$2,416,188	$4,832,376	
	Total	**5,054**	**7,013**	**$974,146,015**	**$498,983,372**	**$1,473,129,387**	**16,544**
	Grand Total	**6,128**	**8,367**	**$1,266,409,233**	**$682,701,020**	**$1,949,110,253**	**19,912**

Source: NMWRAP, USDA Forest Service, Fire Modeling Institute, Missoula Fire Sciences Laboratory, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-66 Improved Properties at Risk to Low Wildfire Potential by Property Type

Jurisdiction	Parcel Type	Improved Parcels	Building Count	Improved Value	Content Value	Total Value	Population
Albuquerque	Commercial	259	431	$427,076,483	$427,076,483	$854,152,966	
	Residential	11,101	12,605	$2,068,413,786	$1,034,206,893	$3,102,620,679	40,767
	Vacant	44	72	$4,018,360	$4,018,360	$8,036,720	
	Total	**11,404**	**13,108**	**$2,499,508,629**	**$1,465,301,736**	**$3,964,810,365**	**40,767**
Unincorporated	Commercial	39	91	$183,613,157	$183,613,157	$367,226,314	
	Residential	708	1,069	$203,635,273	$101,817,637	$305,452,910	3,770
	Vacant	28	33	$331,500	$331,500	$663,000	
	Total	**775**	**1,193**	**$387,579,930**	**$285,762,294**	**$673,342,224**	**3,770**
	Grand Total	**12,179**	**14,301**	**$2,887,088,559**	**$1,751,064,030**	**$4,638,152,589**	**44,537**

Source: NMWRAP, USDA Forest Service, Fire Modeling Institute, Missoula Fire Sciences Laboratory, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Critical Facilities and Infrastructure

The following tables show the results from the GIS analysis to identify facilities at increased risk from a wildfire. In total there are 207 critical facilities within the WUI interface and 38 are located within the WUI intermix. The most common types of facilities are communications (144) followed by safety and security (56). The following tables shows the critical facilities within the WUI interface and intermix.

Table 4-67 Critical Facilities with WUI Interface Wildfire Risk

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	105	8	2		8	41	1	**165**
Los Ranchos								**0**
Tijeras								**0**
Unincorporated	20	2	3	3		14		**42**
Total	**125**	**10**	**5**	**3**	**8**	**55**	**1**	**207**

Source: NMWRAP, USDA Forest Service Northern Research Station, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

Table 4-68 Critical Facilities with WUI Intermix Wildfire Risk

Jurisdiction	Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	10	1				6		**17**
Los Ranchos								**0**
Tijeras						1		**1**
Unincorporated	9	1	2			8		**20**
Total	**19**	**2**	**2**	**0**	**0**	**15**	**0**	**38**

Source: NMWRAP, USDA Forest Service Northern Research Station, Albuquerque and Bernalillo County Assessor's Office, Wood analysis.

The following table summarizes the exposure data of critical facilities to potential wildfire risk by showing the number of critical facilities located within each wildfire risk category, categories by FEMA Lifeline. The communications Lifeline is most often listed in the wildfire risk categories. Only Bernalillo County has critical facilities located in very high and high wildfire risk categories. Overall, 176 critical facilities are located in wildfire risk of very high to very low categories.

Table 4-69 Wildfire Risk for Critical Facilities

Jurisdiction		Communications	Energy	Food, Water, Shelter	Hazardous Materials	Health and Medical	Safety and Security	Transportation	Total
Albuquerque	Moderate	4	1				1		**6**
	Low	26	7	2		1	17		**53**
	Very Low	15	3				9	1	**28**
Los Ranchos	Low	2					3		**5**
Tijeras	(None)								**0**
Unincorporated	Very High	2							**2**
	High	4					2		**6**
	Moderate	2	1	1			3		**7**
	Low	25	6	3		1	13		**48**
	Very Low	9	6		1		5		**21**
Total		**89**	**24**	**6**	**1**	**2**	**53**	**1**	**176**

Source: NMWRAP, USDA Forest Service, Fire Modeling Institute, Missoula Fire Sciences Laboratory, Albuquerque and Bernalillo County Assessor's Office, HIFLD, Wood analysis.

In addition to the critical facilities analysis it should be noted that AMAFCA dry dams could potentially be directly impacted by wildfires, but the damages would be minimal. While AMAFCA facilities are designed for these type events, a wildfire in areas upstream of AMAFCA facilities like arroyos and dams could lead to massive sedimentation and debris blockage from floods and resulting debris flows occurring in fire burn areas.

Government Services

In addition to the potential loss of government buildings and critical facilities (including radio towers), wildfires can result in power interruptions and impact the availability of resources over an extended response. The expense of responding to fires (equipment, personnel, supplies, etc.) can have a significant impact on state and local government budgets.

Wildfire-related duties such as evacuation, suppression, law enforcement, and damage assessment can cause significant danger to response personnel.

The public holds high expectations of government capabilities for warning, public information, and response and recovery activities related to wildfires. Timely communication of property damage assessments is crucial to maintaining public confidence.

Economy

Fires can extensively impact the economy of an affected area, including agricultural, recreation and tourism industries, and water resources. Businesses in affected areas can be impacted due to evacuation, lack of utility service, or through destruction of property.

Historic, Cultural and Natural Resources

The most common catastrophic wildfires are usually in forested areas where the fuel load is high. Potential consequences of wildfires include severe erosion and the silting of streambeds and reservoirs, which causes damage to the watershed and flooding due to a loss of ground cover. The major concern caused by wildfires has historically been focused on the Bosque along the Rio Grande River, a vital natural resource to the County and State. Fire is a natural part of forest growth cycles but can also cause cascading threats to natural resources. After wildfires, the risk of floods and debris flows increases due to the exposure of bare ground and the loss of vegetation. Secondary effects of wildfires also include erosion, landslides, introduction of invasive species, and changes in water quality.

Future Land Use and Development

Future development is an important factor to consider in the context of wildfire mitigation because development and population growth can contribute to increased exposure of people and property to wildfire. By identifying areas with significant potential for population growth and/or future development in high-risk areas, communities can identify areas of mitigation interest and reduce hazard risks associated with increased exposure.

As development expands into wildland areas in previously underdeveloped areas west of the City of Albuquerque and in unincorporated Bernalillo County (Refer to Chapter 2), people and property are increasingly at risk from wildfire. Wildfire mitigation in the wildland-urban interface has primarily been the responsibility of property owners who choose to build and live in vulnerable zones. In practice, successful wildfire mitigation strategies can be quite involved. The most important aspect of successful suppression is disruption of the continuity of fuels, achieved by creating breaks or defensible areas. For interface fires, where homes and other structures fill the space, fuel reduction is best accomplished before the fires begin. Bernalillo County does have land use codes in place that specifically deal with construction in the WUI. Some of these codes include and/or focus on mandatory mitigation measures

4.18.8 Jurisdictional Differences

Wildfires	Frequency	Spatial Extent	Severity	Overall Risk
Bernalillo County	Highly Likely	Extensive	Catastrophic	High
Albuquerque	Highly Likely	Significant	Significant	High
Los Ranchos	Highly Likely	Significant	Catastrophic	High
Tijeras	Highly Likely	Extensive	Catastrophic	High
AMAFCA	Occasional	Limited	Negligible	Low
MRGCD	Highly Likely	Extensive	Significant	High
ABCWUA	Highly Likely	Significant	Catastrophic	High

While wildfire events can occur anywhere in Bernalillo County, the East Mountains and Bosque along the Rio Grande are particularly vulnerable to wildfire events. The communities located in the East Mountains are considered to be high risk communities. Their risk is analyzed at the community level in the East Mountain Community Wildfire Protection Plan. The Bosque is an important natural resource for Bernalillo County and the State of New Mexico. Recently the natural area has been impacted by invasive species increasing its vulnerability to wildfire events. AMAFCA assets are less affected by wildfire, reducing their vulnerability.

4.18.9 Risk Summary

- Bernalillo County has experienced 653 wildfire events between 1970 and 2016, averaging 42.7 acres per event. 38 of the fires burned at least 10 acres.
- 75% of those fires were human caused and 25% were natural caused.
- Since 2000, five fires have resulted in a Federal Disaster Declaration.
- 211,958 persons are potentially exposed to moderate to very high probability of wildfire risk.

- 57,700 structures worth $16 billion in property value located in areas of very high probability wildfire risk.
- There are 207 critical facilities located in the WUI interface.
- Bernalillo County is the only jurisdiction with critical facilities located in areas of high to very high probability of wildfire risk.

5 Capability Assessment

The capability and resource assessment examines the jurisdictions' ability to implement and manage the comprehensive mitigation strategy laid out in this Plan. The strengths, weaknesses, and resources of the participating jurisdictions and agencies are identified here as a means for evaluating and maintaining effective and appropriate management of the hazard mitigation program.

The information included in the capability assessment was gathered primarily from Planning Team members and other representatives of the participating jurisdictions and agencies. The 2020 update process afforded the participating jurisdictions an opportunity to review their capabilities and how those capabilities have changed since the previous plan. Additionally, in summarizing their current capabilities and identifying gaps, plan participants also considered their ability to expand or improve upon existing policies and programs as potential new mitigation strategies. Chapter 6 Mitigation Strategy includes mitigation actions aimed at improving community capability to reduce hazard risk and vulnerability.

Together, the capabilities outlined in this plan highlight both strengths and areas of improvement that the county and its local jurisdictions should consider as they work to mitigate hazard impacts, reduce risk to life and property, and build a disaster resilient community.

5.1 Planning and Regulatory Capabilities

Table 5-1 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the planning area. For each of the profiled hazards, several ordinances, regulations, plans, and programs were identified in various communities. These are listed here to serve as a reference for related planning efforts.

Table 5-1 Planning and Regulatory Capabilities

Capability	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
Comprehensive Plan	Yes	Yes	Yes	Yes	No	No	Yes[2]
Zoning ordinance	Yes	Yes	Yes	Yes	No	No	No
Subdivision ordinance	Yes	Yes	Yes	Yes	No[1]	No	Yes
Growth management ordinance	Yes	Yes	No	No	No	No	No
Floodplain ordinance	Yes	Yes	Yes	Yes	Yes	No	No
Other special purpose ordinance (stormwater, steep slope, wildfire)	Yes	Yes	Yes	No	No	No	No
Building codes	IBC 2009	IBC 2015	IBC 2009	No	No	No	No
Fire department ISO rating	Yes (varies)	Class 1	No[1]	No	No	No	No
Erosion or sediment control program	Yes	Yes	No	No	Yes	No	No
Stormwater management program	Yes	Yes	Yes	No	Yes	No	No
Site plan review requirements	Yes	Yes	Yes	Yes	No[1]	No	Yes
Capital improvements plan	Yes	Yes	Yes	Yes	Yes	No	Yes
Economic development plan	Yes	Yes	No[3]	No	No	No	No

Capability	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
Local emergency operations plan	Yes	Yes	Yes	No	Yes	Yes	Yes
Flood insurance study or other engineering study for streams	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Elevation certificates (for floodplain development)	Yes	Yes	Yes	No	No	No	No
Impact Fees Ordinance	Yes	Yes	No	No	No	No	Yes
IT COOP & Recovery Plans	No	Yes	Yes	No	No	No	Yes

Notes: 1 – Provided by Bernalillo County. 2- ABCWUA- has a 100-year plan to supply water for the metropolitan area. 3 – Revitalization plans for specific areas/neighborhoods.

5.1.1 Land Use Planning and Codes

Local land use plans and building codes are tremendous tools for evaluating local policies related to hazard mitigation and risk reduction. Additionally, comprehensive master plans, capital improvement plans, stormwater plans and zoning ordinances all present opportunities for enhanced local capabilities. The Albuquerque/Bernalillo County Comprehensive Plan was updated in 2017. The Comprehensive Plan has a Resiliency and Sustainability element that references the 2015 Hazard Mitigation Plan and acknowledges flooding, wildfire, drought, and extreme heat as natural hazards of concern, as well as the potential implications of climate change for the region.

Building codes are one tool that communities use to enhance public safety. For example, they can increase structural integrity, mitigate structure fires, and provide benefits in relation to natural hazard avoidance.

The table above shows that most participating jurisdictions have a comprehensive or general plan to guide growth and development, along with zoning ordinances. Most have also adopted recent building codes.

Successful efforts at eliminating or reducing the consequences of future hazard events cannot occur without controlling and evaluating the growth of new development within known hazardous areas. For each investment considered by the jurisdictions like construction or renovation of infrastructure and facilities, hazard mitigation should be considered. Proposed new development should be evaluated against identified hazard-prone areas to limit construction in known hazard- prone areas such as floodplains.

In addition, planning staffs should ensure that all comprehensive land use plans that are developed based on the community's predicted growth patterns consider both hazard locations and the mitigating action plans to eliminate or reduce them. To accomplish this, the planning staff and the mitigation team should collaborate during the revision and updating of future comprehensive plans. Melding these two efforts would help steer growth away from identified hazard locations, wherever possible, and avoid increasing the potential damage risk they represent. When the hazard locations cannot be avoided, building codes and zoning codes can be utilized to minimize the danger.

Additional actions may also be developed by the cooperative works of the planning staffs and the mitigation planning team during the revision and updating process of the comprehensive plans. Projects identified in this manner should be included in future plan updates.

5.1.2 National Flood Insurance Program Participation

The National Flood Insurance Program (NFIP) is a highly effective way for communities to reduce and manage their flood risk. Bernalillo County, the City of Albuquerque, and the Villages of Los Ranchos and Tijeras have all been mapped for flood hazards and participate fully in the NFIP. (As special districts, AMAFCA, MRGCD, and ABCWUA are not eligible for NFIP participation.) Details of participation status from the NFIP's Community Information System can be found in Table 5-2 below. Table 5-3 breaks down the number of policies and claims of damage by type of structure, showing that 90% of the properties insured and 83% of claims paid are for single-family residential properties. 6% of the properties insured and 11% of claims paid are for non-residential properties.

Table 5-2 National Flood Insurance Participation by Jurisdiction

Community	Date Joined	Current Map Date	Study Underway?	Policies in Force	Insurance in Force	# of Paid Losses	Total Losses Paid
Bernalillo County	9/15/1983	11/4/2016	Yes	736	$168,007,200	52	$244,793
Albuquerque	10/14/1983	11/4/2016	Yes	699	$198,639,700	118	$1,081,724
Los Ranchos	1/3/1983	8/16/2012	Yes	62	$18,143,100	2	$100,024
Tijeras	1/6/1983	8/16/2012	Yes	3	$168,000	0	$0
			Total	**1,510**	**$348,958,000**	**172**	**$1,426,541**

Source: FEMA Community Information System, September 2020

Table 5-3 NFIP Policy and Claims Data by Structure Type

	Single Family		2-4 Family		Other Residential		Non Residential	
Community	# of Policies	# of Losses	# of Policies	# of Losses	# of Policies	# of Losses	# of Policies	# of Losses
Bernalillo County	720	45	2	0	0	0	24	7
Albuquerque	580	96	10	2	46	8	63	12
Los Ranchos	61	2	0	0	0	0	1	0
Tijeras	2	0	0	0	0	0	1	0
Total	**1,363**	**143**	**12**	**2**	**46**	**8**	**89**	**19**

Source: FEMA Community Information System, September 2020

See section 4.9.7 for analysis of insured losses and repetitive losses from flooding. See also Section 6.2.1 for the participating jurisdictions' commitment to continue participation in the NFIP.

5.1.3 Community Rating System (CRS) Participation

The Community Rating System (CRS) is a voluntary program for NFIP participating communities. The goals of the CRS are to reduce flood damages to insurable property, to strengthen and support the insurance aspects of the NFIP, and to encourage a comprehensive approach to floodplain management. The CRS provides incentives in the form of insurance premium discounts to communities that go above and beyond the minimum floodplain management requirements and develop extra measures to reduce flood risk. There are 10 CRS classes that determine the insurance premium discount for policy holders, which range from 5% to a maximum of 45%.

Bernalillo County and the City of Albuquerque both currently participate in the CRS, as shown in Table 5-4. The County is currently rated at Class 8, which gives a 10% rate reduction to NFIP policy holders in the unincorporated areas. The City of Albuquerque has a rating of Class 7, giving its policyholders a 15% discount. Between them, their participation saves property owners more than $94,000 every year.

Table 5-4 Current CRS Participation and Summary Information

Community	Current Rating	Policies	Total Premiums	Discount	Current Annual Savings
Bernalillo County	8	736	$533,101	10%	$52,746
Albuquerque	7	699	$429,313	15%	$41,471

Source: FEMA Community Information System, September 2020

Table 5-5 shows the benefits of improving their CRS rating for Bernalillo County and the City of Albuquerque, as well as the potential benefits of joining the program for The Villages of Los Ranchos and Tijeras.

Table 5-5 Potential Benefits of CRS Ratings by Jurisdiction

Community	Class 9 Annual Savings	Class 8 Annual Savings	Class 7 Annual Savings	Class 6 Annual Savings	Class 5 Annual Savings	Class 4 Annual Savings	Class 3 Annual Savings	Class 2 Annual Savings	Class 1 Annual Savings
Bernalillo County	$26,839	$52,746	$78,651	$105,491	$131,397	$157,303	$183,209	$209,115	$235,021
Albuquerque	$14,624	$28,048	$41,471	$56,096	$69,519	$82,943	$96,366	$109,790	$123,213
Los Ranchos	$1,013	$2,025	$3,038	$4,050	$5,063	$6,076	$7,088	$8,101	$9,113
Tijeras	$94	$187	$281	$374	$468	$562	$655	$749	$842

Source: FEMA Community Information System, September 2020

5.2 Administrative and Technical Capabilities

Mitigation is an interdisciplinary effort that requires collaboration across numerous departments and individuals. Existing administrative and technical resources in the participating jurisdictions are summarized in Table 5-6. Per this assessment, the county is well-staffed and equipped to assess and mitigate hazards, and to manage exposure through land management and building requirements.

Table 5-6 Administrative and Technical Capabilities

Capability	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
Planner/engineer with knowledge of land development/land management practices	Yes	Yes	Yes	No	Yes	Yes	Yes
Engineer/professional trained in construction practices related to buildings and/or infrastructure	Yes	Yes	No[1]	No	Yes	Yes	Yes
Planner/engineer/scientist with an understanding of natural hazards	Yes	Yes	No	No	Yes	Yes	Yes
Personnel skilled in GIS	Yes	Yes	Yes	No	Yes	Yes	Yes
Full time building official	Yes	Yes	No[1]	No	No	No	No
Floodplain manager	Yes	Yes	Yes	Yes	No	No	No
Emergency manager	Yes	Yes	Yes	No	No	No	Yes[2]
Grant writer	Yes	Yes	No	Yes	No	No	No
GIS Data Resources	Yes	Yes	No[1]	No	Yes	Yes	Yes
Warning Systems/Services	Yes	Yes	No[1]	No	No	Yes	Yes[3]

Capability	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
TS/ Stormwater Quality Manager	Yes	Yes	No	No	No	No	No
Water Conservation Manager	Yes	No	No	No	No	No	Yes
ROW Manager	No	Yes	No	No	Yes	No	No

Notes: 1 – Provided by Bernalillo County. 2- Incident commander assigned as needed to respond to specific situations. Additional training in emergency management is being sought. 3- Systems maintained for detecting security intrusion.

5.3 Financial Capabilities

Table 5-7 Financial Capabilities

Capability	Bernalillo County	Albuquerque	Los Ranchos	Tijeras	AMAFCA	MRGCD	ABCWUA
Community Development Block Grants	Yes	Yes[1]	No	Yes	Yes	No	No
Capital improvements project funding	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority to levy taxes for specific purposes	Yes	Yes	Yes	Yes	Yes	Yes	No
Fees for water, sewer, gas, or electric services	No	Yes	No	Yes	No	Yes	Yes
Impact fees for new development	Yes	Yes	No	No	Yes	No	Yes
Incur debt through general obligation bonds	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incur debt through special tax bonds	Yes	Yes	Yes	Yes	No	No	Unknown
Incur debt through private activities	Yes	Yes	No	No	Yes	Yes	No
Withhold spending in hazard prone areas	Yes	Yes	Yes	Yes	No	No	No

Notes: 1 –Projects must serve lower to moderate income areas.

5.4 Public Education and Outreach

The jurisdictions engage in a wide variety of public education and outreach capabilities, to include:

- The City of Albuquerque is certified as a StormReady community by the National Weather Service, and Bernalillo County is in the process of achieving certification.
- Albuquerque's High Desert Neighborhood is certified as a Firewise community. The County teaches components of the Firewise program but is not certified.
- Bernalillo County conducts a water conservation program that includes instructions on low-water plumbing fixtures and rainwater harvesting for irrigation.
- Albuquerque Community Emergency Response Team (CERT) Program
- Albuquerque OEM Personal Emergency Preparedness Workshops/Training
- Bernalillo County and the City of Albuquerque provide a Flood Map Information Service to lenders, insurance agents, mortgage companies, and the general public. The City of Albuquerque mails out flyers on flood safety for all homes that are within the floodplain.
- Albuquerque Fire Rescue outreach programs include:
  - School fire drills and fire extinguisher drills.
  - Ready! Set! Go! Preparing for Wildfire

  - Life Saver- 2,913 people trained, City Employees- 1865, civilians-1048
  - HEART- Home Engagement and Alternative Response Team
  - CPR
  - Fall protection awareness
  - Fall prevention program
  - Harm reduction training
  - Red Cross smoke detector outreach
  - Car seat training
  - Youth Fire Prevention
  - Confined Space Awareness

- Albuquerque Fire Rescue conducts all-hazards assessments of City facilities, using scenarios such as a Bosque fire, a severe weather incident, a hazardous materials release, or an active shooter incident. AFR applies those scenarios to the buildings' plans, and safety and security features to identify any gaps and offer recommendations to fill those gaps. To date AFR has completed 110 of these assessments, covering a population of 51,048.
- The Village of Los Ranchos de Albuquerque participates in the Middle Rio Grande Stormwater Quality Management Team.
- The Village of Los Ranchos de Albuquerque regularly publishes stormwater articles and fire safety articles in the community magazine.
- AMAFCA outreach programs include:
  - Storm Water Surveys
  - Regional MS4 Permit Educational Work
  - Storm Team
  - Ditch Safety Program
  - Bosque Ecosystem Monitoring Program
- The MRGCD participates with other local agencies in Bernalillo County in a "Ditch the Ditches" Campaign which targets young people with safety messages about swimming and playing in irrigation ditches and arroyos.
- The MRGCD participates on an illegal dumping task force with eleven other agencies in Bernalillo County.
- The Bosque School and UNM house the Bosque Ecosystem Monitoring Program, which uses students to conduct long term ecological monitoring in the bosque, including information on flooding, droughts and wildfires.

5.5 Opportunities for Enhancement

Based on the capability assessment, the jurisdictions have several existing mechanisms in place to mitigate hazards, including numerous planning tools and many available funding mechanisms. There are also opportunities for them to expand or improve on their capability to further protect their communities. As can be seen from the previous tables, the County and City of Albuquerque have a wide range of capabilities that may not be available in the villages and districts; the County and City could explore expanding intergovernmental agreements to share mitigation resources with the smaller jurisdictions.

Other opportunities include the continuation of incorporating updated risk information into comprehensive plan updates and ensuring risk information is taken into consideration in land use code updates and during the development review process. See Section 7.3 for additional information on ways mitigation can be incorporated into other mechanisms.

Another opportunity to reduce flood losses would be for the County and/or City of Albuquerque to increase their CRS ratings; as shown in Table 5-5 above, the savings to policy holders from increasing one rating level equates to roughly $25,000 per year for Bernalillo County and $12,000 per year for the City of Albuquerque. The Villages of Los Ranchos and Tijeras could also consider joining the CRS program, although the direct financial benefits for them doing so are relatively low due to the small number of policies; roughly $1,000 per year per class for Los Ranchos less than $100 per year per class for Tijeras.

Bernalillo County has identified a number of other possible areas to enhance their mitigation capabilities, such as:

- Improving traffic incident management and the ability to redirect traffic.
- Organizing and training teams among County staff needed during an emergency.
- Portable/fixed helicopter dip site systems within the east mountains.
- Expanding on community outreach, including education components of the above initiatives.

The Middle Rio Grande Conservancy District (MRGCD) has several possible areas to enhance their mitigation capabilities, such as:

- Update to the MRGCD's Emergency Management Plan and designating an Emergency plan manager/administrator.
- Continued development of the MRGCD's Conservation Program and options for water capture and storage to address and stabilize water supply and delivery with climate change and drought.
- Additional staff and possibly equipment to develop BMPs and rehabilitation/maintenance of riverside drains and levees for recertification and improved performance
- Developing protocols for secondary access to MRGCD facilities to address downed trees, ditch breaks or other emergencies where inadequate right of way and access exists.

6 Mitigation Goals, Measures, and Actions

DMA Requirement §201.6(c)(3):
[The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section shall include: *(i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.* *(ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.* *(iii) An action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

The preparation of goals, measures, and actions to address the risks defined in Chapter 4 is the culmination of the mitigation plan. The implementation of these measures will lead to the reduction of risk, reduced losses, and ultimately a higher quality of life for the residents of the planning area. This section of the Plan provides the blueprint for the participating jurisdictions to become less vulnerable to natural hazards. It is based on the consensus of the Planning Team and local stakeholder feedback, along with the findings of the Hazard Identification and Risk Assessment. This section consists of the following subsections:

- Mitigation Goals
- Progress on Previous Mitigation Plan Actions
- Identification and Prioritization of Mitigation Actions
- Mitigation Action Plan

The intent of the mitigation strategy is to provide the participating jurisdictions with the tools for future mitigation policy and project administration, along with a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature. The development of the strategy included a thorough review of natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to help the participating jurisdictions achieve compatible economic, environmental, and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to establish priorities assigned to specific departments or individuals responsible for their implementation. Potential funding sources are identified when possible and identified projects were assumed to be realistically achievable over the coming five years.

- Mitigation goals are general guidelines that explain what the county wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results.
- Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date. The inclusion of mitigation objectives is optional.
- Mitigation actions provide more detailed descriptions of specific work tasks to help the county and its municipalities achieve prescribed goals and objectives.

Based on participation from the Planning Team, the mitigation strategy from the 2015 Hazard Mitigation Plan was modified and updated. Completed actions were noted and deleted. New actions have been added to address particular hazards facing the participating jurisdictions, and the consensus achieved in how to address those actions.

6.1 Mitigation Goals

The mitigation goals reflect the aspirations of the participating jurisdictions to provide a safe environment in the planning area while preserving historic and cultural sites, the natural environment, and a quality of life. The goals formulation process is linked to the risk and vulnerability findings. The resulting mitigation actions are the specific measures needed to meet the goals.

Mitigation Goals of the 2020 Albuquerque/Bernalillo County Hazard Mitigation Plan:

1. Protect lives and reduce injury.
2. Make the County and its municipalities safer from natural and human-caused hazards.
3. Reduce the amount of property damage and economic impacts, both public and private, from all hazards.
4. Enhance the collaborative process with federal, state and local agencies to mitigate all hazards in the planning area.
5. Make the County, its municipalities, and special districts more resilient by shortening the recovery time after a hazard event.
6. Encourage the development and implementation of long-term, cost-effective, and environmentally sound mitigation projects.
7. Increase public awareness and understanding of risks and strategies for mitigation to protect lives and reduce injury.

The Planning Team reviewed the goals included in the 2015 Plan, and made several revisions, to include adding a goal specifically addressing the importance of life-safety, expanding the existing goals to include human-caused hazards and made them broad enough to include other special districts new to the 2020 planning process. The previous goals from the 2015 plan are listed below to show continuity and give a sense of how the area's strategy has changed over time.

Mitigation Goals from the 2015 Hazard Mitigation Plan:

I. Make the County and its municipalities safer from natural hazards
II. Reduce the damage to historical/cultural sites and natural resources from natural hazards
III. Reduce property damages caused by natural hazards
IV. Make the county, its municipalities, and AMAFCA more resilient by shortening the recovery time after a natural hazard event
V. Increase the capability of the County, its municipalities, and AMAFCA to mitigate natural hazards
VI. Enhance the collaborative process with federal, state and local agencies to mitigate natural hazards in the planning area
VII. Increase awareness and understanding of risks and opportunities for mitigation among residents

The 2015 Plan did not include mitigation objectives. After discussion, the Planning Team decided not to include mitigation objectives in the 2020 Plan. The prioritization criteria listed in Section 6.3 below can be regarded as objectives for implementing the mitigation goals.

6.2 Progress on Previous Mitigation Plan Actions

The 2015 Plan identified several mitigation actions, which the jurisdictions have been successful in implementing to work steadily towards meeting their mitigation goals and objectives. During the 2020 plan update process, the Planning Team reviewed the mitigation actions in the 2015 Plan and updated their status based on input from the responsible agency for each action, describing which actions had been completed, which were either in progress or not yet started, and if any should be deleted as no longer relevant of achievable.

The 2015 Plan contained a total of 76 mitigation actions. Of those, 10 actions were reported as having been completed. These actions are listed in Table 6-1 below. Overall, the high number of actions that have been completed is a sign of the effectiveness of the jurisdictions' hazard mitigation program and that the planning area is steadily working towards the goals of this plan.

Table 6-1 Completed Mitigation Actions from the 2015 HMP

Jurisdiction	Mitigation Action	Hazards
Bernalillo County	Storm Drain Projects: McCoy Dam, Raymac, & Tower Road	Flood
Bernalillo County, Albuquerque, AMAFCA	Pond 187 and 187A Construction and Outfall	Flood
Albuquerque	10th Street Storm Drain	Flood
Albuquerque	Continue thinning and fuel reduction projects in Bosque	Wildfire
Albuquerque	Review and update existing building codes for earthquakes	Earthquake
Albuquerque	Stover Street Storm Drain	Flood
Albuquerque, AMAFCA	Calabacillas Grade Control Structures 1a, 6a, and 7a	Flood
Albuquerque, AMAFCA	Kirtland Air Force Base (KAFB) South Detention Basin Study and Project	Flood
Albuquerque, AMAFCA	West I-40 Diversion Channel	Flood
Village of Los Ranchos	Install Generators at Critical Facilities	Flood, Drought, Severe Winter Storms, High Wind, Thunderstorm, Earthquake, Dam Failure, Tornado
Village of Tijeras	Explore Feasibility of Insulating Water Pipes on Exterior of Public Buildings.	Severe Winter Storm
Village of Tijeras	Evaluate Methods for Protecting Public Buildings from Lightning Strike Damage.	Thunderstorm
Village of Tijeras	Secure additional sources of water for emergency use.	Wildfire

Other mitigation activities completed by the participating jurisdictions since 2015 include:

- FEMA Flood Insurance Rate Maps (FIRM) for Bernalillo County and the City of Albuquerque were updated in 2016.
- A pre-wildfire evaluation identifying potential post-wildfire debris-flow hazards for the Sandia and Manzano Mountains and surrounding areas.
- Bernalillo County: on-going stormwater drainage improvements to protect homes, streets, and public facilities from flood impacts, often removing large portions of neighborhoods from the floodplain.
- Los Ranchos: 4th Street improvements to reduce losses during severe storms.
- AMAFCA has developed and updated site EAPs, conducted flood fighting workshops, drainage policy implementation, and various project schedule and capital improvements tasks.
- MRCGD completed a study plan for Bernalillo-to-Belen levee rehabilitation completed; the project includes the Mountainview section of levees in SE Valley of Bernalillo County.

- MRGCD completed critical repairs and stabilization to the Corrales siphon and the El Vado dam, which are outside the planning area but play a critical role the District's water supply and delivery.

6.2.1 NFIP Continued Compliance

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against the ravages of flooding. Recognizing the importance of the National Flood Insurance Program (NFIP) in mitigating flood losses, Bernalillo County, Albuquerque, Los Ranchos, and Tijeras are all participants in the NFIP in good standing. These communities will emphasize continued compliance with the NFIP and will continue to make every effort to remain in good standing with NFIP. This includes continuing to comply with the NFIP's standards for updating and adopting floodplain maps and maintaining and updating the floodplain zoning ordinance.

Bernalillo County and Albuquerque will also continue to participate in the Community Rating System (CRS), going above and beyond the requirements of the NFIP as further evidence of continued compliance.

AMAFCA, MRGCD, and ABCWUA are not municipalities and therefore do not participate in the NFIP.

Other details related to NFIP participation are discussed in Section 5.1.2 and in the flood vulnerability discussion in Section 4.7.

Bernalillo County currently mitigates risks due to flooding using the following methods.

1. Restricts development within the identified Special Flood Hazard Areas shown on the current FEMA Flood Insurance Rate Map (FIRM) for Bernalillo County.
2. Performs an annual outreach to real estate agents, mortgage companies and the general public to let them know where they can find flood risk information.
3. Provides a flood risk information service on the Bernalillo County web site and through the Floodplain Administrators office available to anyone.
4. Adopted a higher elevation standard than the minimum FEMA requirement for construction within flood zones.
5. Participates with local agencies on the development of regional Drainage Management Plans that direct development away from flood prone areas and provides guidance on what drainage infrastructure is needed to provide protection for existing development.
6. Has a Capital Improvements Program to provide funding for flood protection activities.

The participating jurisdictions use the FIRMs developed for the NFIP to identify high flood risk areas. In general, these maps are updated when new development occurs or when FEMA reviews the community for changes that would require new mapping; the most recent update was in 2016. Nevertheless, there remain some flood zones that need to be revisited, or where approximate methods were used to develop the flood zones rather than detailed methods. The County has discussed conducting additional studies and map revisions in the East Mountain area, but progress is limited by cost. Similarly, the City of Albuquerque has identified a number of areas where the revisions are needed. Individual property owners are able to remap their property by following the FEMA process at their own expense.

6.3 Identification and Prioritization of Mitigation Actions

The natural and human-caused hazards identified in Chapter 4 Risk Assessment were evaluated to identify and prioritize mitigation actions to support the mitigation goals and objectives described above.

6.3.1 Identification of New Mitigation Actions

The Planning Team considered the following categories of mitigation actions, as defined in FEMA's 2013 Local Mitigation Planning Handbook:

- **Plans and regulations:** These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.
- **Structure and infrastructure projects:** These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- **Natural systems protection:** These are actions that minimize damage and losses and preserve or restore the functions of natural systems.
- **Education and awareness:** These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.

The Planning Team also considered the following categories as defined in the Community Rating System:

- **Prevention:** Administrative or regulatory actions or processes that influence the way land and buildings are developed and built.
- **Property protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or remove them from the hazard area.
- **Structural:** Actions that involve the construction of structures to reduce the impact of a hazard.
- **Natural resource protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems.
- **Emergency services:** Actions that protect people and property during and immediately after a disaster or hazard event.
- **Public information/education and awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.

At planning meeting #3, the Planning Team was provided with handouts describing the categories and listing examples of potential mitigation actions for each category, as well as for the identified hazards. FEMA's 2013 document Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards was also referenced and shared with the Planning Team. Attendees were then asked to submit mitigation action ideas via an online survey. Action submissions included details describing how the actions will be implemented and administered, to include cost estimates, potential funding sources, and estimated timeline for completion. Each action was required to be tied to one or more of the goals.

Actions were compared against identified hazards to ensure that the plan contains a comprehensive range of mitigation actions and projects for each of the highest risk hazards, with an emphasis on new and existing buildings and infrastructure. While the Planning Team focused primarily on developing mitigation actions in the categories described above, some jurisdictions identified actions that do not fall into one of the above categories and which may be better defined as planning or preparedness actions. Some of these actions were nonetheless included in the plan, as the jurisdiction felt they were important actions to reduce losses from future disasters even if they do not meet the strict definition of mitigation.

A total of 82 new actions were submitted. These new actions, along with the continuing actions carried over from the 2015 Plan, form the 2020 mitigation action plan as summarized in Table 6-2 and detailed in

Table 6-3. Note that many of the 76 mitigation actions in the 2015 Plan were assigned to multiple jurisdictions; the Planning Team decided to split those actions apart to make them easier to track, therefore the number of 2015 actions shown below exceeds 76.

Table 6-2 Mitigation Actions Summary by Jurisdiction

Jurisdiction	# of Actions in 2015 HMP	# of Actions Completed	# of Actions Deleted	# of Actions Continued	# of New Actions	Total 2020 Actions
Bernalillo County	32	2	2	28	7	**35**
Albuquerque	37	8	13	16	6	**22**
Los Ranchos	35	1	3	31	3	**34**
Tijeras	33	3	1	29	3	**32**
AMAFCA	24	4	0	20	49	**69**
MRGCD	0	0	0	0	10	**10**
ABCWUA	0	0	0	0	31	**31**
Total	**161**	**18**	**19**	**124**	**109**	**233**

6.3.2 Prioritization

After the Planning Team had developed new mitigation actions as described above, those new actions were consolidated into lists by jurisdiction for prioritization. Continuing actions from the 2015 Plan were also included in the list so they could be re-prioritized relative to the new actions.

The Planning Team was provided with several decision-making tools, including FEMA's recommended prioritization criteria, STAPLEE, to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE stands for the following:

- **Social:** Does the measure treat people fairly? (e.g., different groups, different generations) Does it consider social equity, disadvantaged communities, or vulnerable populations?
- **Technical:** Will it work? (Is the action technically feasible? Does it solve the problem?)
- **Administrative:** Is there capacity to implement and manage the project? (adequate staffing, funding, and other capabilities to implement the project?)
- **Political:** Who are the stakeholders? Did they get to participate? Will there be adequate political and public support for the project?
- **Legal:** Does the jurisdiction have the legal authority to implement the action? Is it legal? Are there liability implications?
- **Economic:** Is the action cost-beneficial? Is there funding available? Will the action contribute to the local economy?
- **Environmental:** Does the action comply with environmental regulations? Will there be negative environmental consequences from the action?

In accordance with the Disaster Mitigation Act requirements, an emphasis was placed on the importance of a benefit-cost analysis in determining action priority. Other criteria used to assist in evaluating the benefit-cost of a mitigation action included:

- Does the action address hazards or areas with the highest risk?
- Does the action protect lives?
- Does the action protect infrastructure, community assets or critical facilities?
- Does the action meet multiple goals?

- What will the action cost?
- What is the timing of available funding?

The above criteria were used to prioritize actions in an iterative process over the course of the plan update process. At the start of the process, participating jurisdictions were asked to validate or update the status and priority of their continuing actions from the 2015 Plan. When submitting new mitigation actions, planning team members were asked to prioritize those as well. Finally, once all new and continuing actions had been collated into a draft mitigation action plan, jurisdictions were asked to verify or update the priorities of each action compared to their other actions based on the above criteria.

6.4 Mitigation Action Plan

The 2020 Albuquerque/Bernalillo County Mitigation Action Plan lists the actions developed and prioritized as described above, to include continuing actions from the 2015 Plan. The action plan details how the participating jurisdictions will reduce the vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. The action plan summarizes who is responsible for implementing each of the prioritized actions as well as when and how the actions will be implemented. All actions are tied to specific goals to ensure alignment with the Plan's overall mitigation strategy. Over time the implementation of these projects will be tracked as a measure of demonstrated progress on meeting the plan's goals.

Many of these mitigation actions are intended to reduce impacts to new development. These actions include those that promote wise development and hazard avoidance, such as building code, mapping, and zoning improvements, and continued enforcement of floodplain development regulations.

The mitigation action for all participating jurisdictions are listed in Table 6-3 below. Actions carried over from the 2015 plans have been given new item numbers for simplicity, but their previous item numbers are also included for reference. As discussed in Section 6.2, the priorities of each action were reviewed to updated to reflect changes since 2015.

Table 6-3 2020 Hazard Mitigation Actions

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
				Bernalillo County				
B1	**Install generators at critical facilities.** this project would allow for fixed diesel powered generators be installed at critical facilities to ensure continuity of emergency services to the public during high hazard events.	Flood, Drought, Severe Winter Storms, High Wind, Thunderstorm, Earthquake, Dam Failure, Tornado	5	Medium	County OEM	Under $500,000; County budget, NM DOT, FEMA grants	Ongoing	In progress. The majority of fire stations and other critical facilities do have generators. Also have disconnects installed at community centers to allow for a portable generator.
B2	**Multi-hazard public education program.** Educate residents on natural hazard threats, impacts, mitigation opportunities, and advanced preparations to make in advance of events. Print materials will be developed and distributed at local government buildings and public libraries. Include the Los Ranchos Citizen Corps Program as part of this effort.	Dam Failure, Drought, Extreme Heat, Flood, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorm, Tornado, Wildfire	7	Low	County OEM, County Commissioners	Under $100,000; County budget, FEMA grants	Ongoing	Annual Implementation. Roads generates a trifold that provides information about being prepared for winter weather and possible evacuations in the East mountains. Would like to expand to include residential preparedness. TS provides a trifold with PNM billing, to advertise flood hazard awareness.
B3	**County-wide stormready program.** Continue to expand the StormReady program, and any other related programs, to enable preparedness and mitigation for the impacts of severe weather through better planning, education, and awareness. Program shall be county-wide and include participation at the local community level.	Tornadoes, Floods, Thunderstorm	4	Low	County OEM	$50, 000; General Budget	2021	In progress. Storm Ready application has been submitted.
B4	**Bernalillo County drainage projects.** Stormwater projects to address the following areas: • Alameda Outfall – to address potential GI/LID retrofit features, including retrofit of existing outfall infrastructure and possible realignment. • Browning Culvert Crossings – To provide safe access during flood events to North Albuquerque Acres	Flood	2	High	County Public Works, AMAFCA	Ober $500,000; General Funds - Bonds	2025	In progress. Browning is in design AMAFCA preforming a study and will be delayed by 3 months. Barcelona completed Phase I,II and in design for IIb and III New Project to list Alameda Outfall: the preliminary conceptual design evaluation has been completed. Conceptual design evaluation for retrofit of the Alameda Outfall to

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	• Barcelona Storm Drain – To reduce roadway flooding and localized flooding along Barcelona Road							address potential GI/LID retrofit features, including retrofit of existing outfall infrastructure and possible realignment.
B5	**Valle de Oro site plan.** This project is for the preparation of a drainage comprehensive plan and feasibility study for the Valle de Oro Site Plan	Flood	6	High	County Public Works, AMAFCA, CABQ, Kirtland Air Force Base, Pueblo of Sandia, Los Ranchos, MRGCD, NMDOT, US Fish and Wildlife	$100,000; County budget, AMAFCA, CABQ, Village of Los Ranchos, US Fish and Wildlife	2025	In progress. Currently in construction
B6	**Well safety education program.** Local Emergency Managers will work with the New Mexico Department of Health to provide educational information for residents of the county's unincorporated areas on avoiding water well contamination due to flooding. Materials will include methods for well decontamination after flood events. Some notification for County residents is already in place. Attach educational information to County permits and website. Additional information is to include abandoned well sites and list on website. The County also will fill all abandoned wells for community safety. The Health Department can help address waterborne disease. Materials should be multi-lingual.	Flood	1	Medium	County OEM, County Health Department, New Mexico Environment Department, State Engineer's Office, New Mexico Department of Health	Minimal; Staff time	Ongoing	Annual Implementation. Filling of wells may increase budget
B7	**Flood insurance awareness program.** A public awareness program will provide the unprotected property owners throughout the planning area with information concerning their risk and available insurance. Informational materials should be multi-lingual.	Flood	7	Low	County Floodplain Manager	Minimal; Staff time	Ongoing	Annual Implementation. Active and ongoing
B8	**Drainage ditch improvements and maintenance.** Continue cleaning and repairing drainage ditches, arroyos and culverts to increase or maintain capacity. Continuing implementing maintenance plans.	Flood	5	Medium	County Public Works	FEMA	Ongoing	Annual Implementation. Active and ongoing

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
B9	**Wildfire public education and outreach activities.** Develop comprehensive education process that includes Fire safety education/prevention and organize community cleanups in high fuel areas. Some efforts are currently in process with the County offering biannual green waste days at County owned facilities and monthly fire prevention classes.	Wildfire	6	Low	County OEM	USFS; County and Municipal Budgets	Ongoing	Annual Implementation. O&M coordinates with Zoning to do 15 community clean ups and have 2 free green waste events at the EMTS annually
B 10	**Bury power lines.** Bury all power lines in Bernalillo County to reduce the incident of a downed tree hitting a power line or ice affecting lines. New development in the City is required to bury power lines (except high voltage lines).	Wildfire, Severe winter storms, thunderstorms, high wind	3	Mediu m	County Public Works, PNM	Over $500,000; County CIP budget, utility companies	Unknown	In progress. Costs are high. Public Safety would like to continue this goal and use grant funding.
B 11	**Water conservation programs.** Continue and expand existing County and City water conservation programs to encourage and provide incentives for residents to use water-saving landscaping techniques. Promote City Water Awareness Programs/Water Audits and County Water Conservation Plan, Ordinance and Guidelines. Employ municipal and county, subdivision, and building regulations to promote water conservation. Implement aggressive program to repair leaks in existing municipal water system. Implement drought emergency plan to: implement residential, business and watering restrictions, water use violation fees, and a drought emergency surcharge for excessive water usage.	Drought	6	High	County Public Works, ABCWUA	Under $50,000; (Part of Water Conservation Program)	Ongoing	Annual Implementation. BC just updated the water conservation plan this year to expand incentive programs and promote conservation and planned workshops. Scheduled for review on five-year recurring basis.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
B 12	**Repair water leaks.** Continue to implement aggressive program to repair leaks in existing municipal water system, including lines to homes. Due to the recurrent and persistent drought, value of water as an asset is rising. Water leakage not only wastes water but can also contribute to subsidence and sinkholes.	Drought, Land Subsidence	6	High	Engineering & Planning; ABCWUA	Under $500,000; County budget, NM DOT, FEMA grants	Ongoing	Annual Implementation. County initiatives - we identify and implement water conservation activities at County facilities with a goal of 10 projects per year annually working with Land Management and with Facilities (one of our performance measures) annually. Just this last month we implemented a water audit at the Vista Grande center to identify excessive use per Facility request/concern with billings
B 13	**Drought indicator/early warning system.** Promote and expand a system that detects levels of soil moisture and stream/river levels to determine when conditions are trending toward a drought. Develop comprehensive education process that includes drought education. Some warning is available from USDA.	Drought	7	Mediu m	County OEM	Under $100,000; NRCS, USDA	Ongoing	Annual Implementation. Expand to include working with multiple organizations
B 14	**Earthquake awareness.** Although earthquakes are rare in Bernalillo County, earthquakes should be included in other disaster information literature and programs already in place. Information should include what to do before, during, and after an earthquake. Part of the education effort will be on the dangers of how an earthquake may affect AMAFCA facilities and what the public should be aware of if high rains occur after a flood event in relation to damaged AMAFCA facilities.	Earthquake	7	Low	County OEM	Minimal; Staff time	Ongoing	Annual Implementation.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
B 15	**Review and update existing building codes for earthquakes.** Building codes are the first line of defense against earthquake damage. Adopt new building codes, as necessary, to ensure adequacy in respect to potential earthquake risk. AMAFCA to evaluate its facilities for vulnerability to earthquakes.	Earthquake	3	Low	County Building, Planning, and Zoning Department/ Building Official	Under $50,000; County budget	2025	In progress. The building codes have a seismic design category (earthquake) and the building engineer for the project will design the building to those codes. International Code Council (ICCsafe.org) is the code book everyone uses to design for an earthquake design. Currently the state has adopted the 2015 ICC codes and will adopt newer codes on a six year cycle. Next code to be adopted will be the 2021 ICC family of codes.
B 16	**Earthquake technical assistance for homeowners.** Conduct Technical Assistance Visits to help homeowners implement non-structural earthquake retrofits of their home. Work with homeowners to conduct inexpensive, non-structural retrofitting such: as securing appliances, bookcases, cabinet drawers and doors to prevent tipping/opening during an earthquake; securing pictures and framed art to walls; securing hanging fixtures to the ceiling, and applying safety film to glass windows and doors.	Earthquake	7	Low	County OEM	$500/home; HUD funds, FEMA grants, Homeowner	2025	Not started. EOC has not been conducting this
B 17	**Public education effort for winterizing measures.** Develop and provide educational information to local residents on insulating pipes to reduce damage from winter storms. Find ready-made brochures to distribute.	Severe Winter Storm	7	Mediu m	County OEM	under $100,000; HUD funds if needed	Ongoing	Annual Implementation. Can have listed on website
B 18	**Tree trimming to protect power lines.** Trim trees along roadways to prevent interference with power lines during high winds and winter storms. The Public Service Company of New Mexico (PNM) does this through a contract. Public education needs to be a component of the project, to aid in identifying what is owner responsibility, vs. PNM or Bernalillo responsibility.	Severe Winter Storm, High Winds. Utility Disruption	3	Mediu m	County Forestry Department, PNM	Under $500,000; capital improvements budget	Ongoing	Annual Implementation.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
B 19	**Lightning safety program for Bernalillo County residents.** Raise awareness among Bernalillo County residents of dangers of lightning and what to do in a lightning storm. Obtain ready-made guides and brochures from sources like FEMA. Draft a Plan for lightning safety at outdoor events where large crowds of people are expected to gather.	Thunderstorms	7	Medium	County OEM	Minimal; Staff time	Ongoing	In progress. Continue with this project. Signage at local parks update to include
B 20	**Protect public buildings from lightning strike damage.** Install a surge protector system for protecting electronic equipment from direct lightning strikes. Severe weather plan to take the extra step of disconnecting especially sensitive equipment.	Thunderstorms	6	Medium	County OEM	Under $500,000; capital improvements budget	Ongoing	Annual Implementation. EOC and IT has implemented surge protectors and we have lightning protection on our building facilities per code
B 21	**Reduce vulnerability of structures to severe weather and hailstorms.** As public buildings are constructed or renovated, use hail-resistant metal roofing. County has high percentage of manufactured homes and a number of historic critical facilities. Identify specific vulnerabilities and distribute information about how to strengthen their ability to resist high wind events and hailstorms.	Thunderstorms	6	Low	County Building Section; City of Albuquerque Building Inspection Section; Village of Los Ranchos Planning Department	$80,000; capital improvements budget, Mitigation grants	TBD	In progress. During design of new projects, we meet building code requirements. Currently we do not have a grant established to mitigate this.
B 22	**Residential safe room rebate program.** Implement program to encourage individuals to construct safe rooms at residential homes by implementing a safe room rebate program to reimburse a portion of the construction costs.	Tornados, High Winds	7	Low	County OEM	Under $500,000; FEMA grants	TBD	Not started.
B 23	**Dam failure warning system.** Coordinate with other communities and dam operators to develop a gauge and communication system that would provide warning in event of a dam failure. The City and AMAFCA are working with AFD to evaluate systems for arroyo flooding.	Dam Failure	7	Low	County OEM	Under $500,000; FEMA grants, USGS	TBD	Not started. Public Outreach / education regarding downstream risks
B 24	**Activate Shelter Plan to Set up a Public Cooling Centers.** Activate and set up cooling centers in well-known centrally located public facilities that will serve as a shelter to vulnerable populations (particularly the elderly and families with infants and toddlers) during periods of	Extreme Heat	6	Medium	County OEM	Under $500,000; HUD, FEMA grants	Ongoing	In progress. Parks and Rec shelters

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	extreme heat following the existing procedures from Annex J of the Emergency Operations Plan (EOP). Work with NM Department of Health-BHEM Vulnerable Populations Coordinator for specifics on addressing vulnerable populations.							
B 25	**Conduct fan drive to prepare for periods of extreme heat.** Collect and distribute fans to most vulnerable citizens (generally the elderly) during periods of extreme heat. Develop a list of vulnerable citizens ahead of any extreme heat.	Extreme Heat	1	Low	County OEM	Volunteer time and efforts; Local donations	Ongoing	Annual Implementation. Senior and social services /EOC
B 26	**Anchor slope mesh over areas prone to landslides that threaten infrastructure and critical facilities.** Areas within Bernalillo County are vulnerable to landslides due to slope erosion. Anchor heavy-gauge metal slope mesh over areas prone to landslides along transportation routes and near critical facilities in areas of high vulnerability.	Landslide	6	Low	County OEM, County Public Works	$100,000; County budget	2021	Not started. PW no movement on this issue
B 27	**Multi-jurisdiction storm water management plans.** Investigate the feasibility and buy-in for regional stormwater management planning approach. Establish committee and coordinate with neighboring communities to establish better water management planning. Evaluate linkage to MS4 Permit Issuance (90th Percentile Storm Retention Requirement).	Flood	4	High	County public works, planning department	Under $500,000; County budget, State Grants	2021	Annual Implementation. Should be integrated within MS4 EPA Permit Constraints. Committee may already exist via Memorandum of Understandings with AMAMAFCA.
B 28	**Old Coors ponding area.** This project is to construct a ponding area that will provide flood mitigation near the corner of Old Coors and Coors.	Flood	6	High	County Public Works, AMAFCA, MRGCD, NMDOT	$600,000; County budget, AMAFCA	2021	Not started. No progress has been done on this project
B 29	**Helicopter Dipping sites.** 7,000 gal dip tanks placed at four locations within the county. A portable / transportable convertible-top tank and water storage system designed with the constant and flexible needs of dynamic air operations for quick access to a water source for fire suppression. Increased water capacity in East mountains will increase firefighting capabilities in a high- risk area.	Wildfire	3	Medium	Bernalillo County	$180,000; USFS, State Forestry, State Fire Fund, HMGP	2025	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
B 30	**COOP updates.** Update continuity of operations plans	Pandemic/ Public Health	5	High	County OEM	$150,000; FEMA Technical Assistance funds	2022	New in 2020
B 31	**Hazardous materials transport routes.** Work with local LEPC, industry and government agencies to develop a route for hazardous materials transport routes, and alternate access routes, to be transported around the city rather than through the city.	Hazmat release	6	Mediu m	County LEPC, OEM	Under $50,000; County budget, staff time	2023	New in 2020
B 32	**Alvarado construction security plan.** Install secured and controlled entries to County buildings. Alvarado square will have designated safe rooms on each floor; items in rooms include panic buttons, first aid kits, and phones.	Active Threat	1	High	County Security Manager	Over $500,000; Capital outlay	2021	New in 2020
B 33	**Alvarado security plan.** Armed Security on site with extensive annual training for response.	Active Threat	1	High	County Security Manager	$1,000,000; County General Fund	2021	New in 2020
B 34	**Bernalillo County Illegal Dumping Task Force education and outreach.** Develop education and outreach materials and messaging for illegal dumping.	Hazmat Release; Pandemic/ Public Health	1. 2. 4. 6. 7. 3.	High	County, MRGCD, City of Albuquerque, AMAFCA and 7 other agencies	$10,000 - $100,000; Department budgets, grants	2026	New in 2020
B 35	**Dam Inundation mapping.** Conduct a study on dam inundation mapping and data. Identified as a data deficiency during this planning effort. Mapping will aid in planning and provide advance notice to homeowners in flood zones. Educational resources will be provided to residence and businesses in inundation zones.	Dam failure	1, 2, 3, 4, 5, 6, 7	Mediu m	Bernalillo County GIS	Unknown	TBD	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
				City of Albuquerque				
A 1	**Increase warning capabilities.** Increase number of sirens and radios/televisions with warning capabilities, in public buildings, parks, and recreational areas to announce alerts from the Emergency Alert System and National Weather Radio for the public. Alert the public of potential severe weather including wind, tornado, Thunderstorm or other severe weather.	High Wind, Tornado, Thunderstorm, Flood	1, 2, 4, 5, 6, 7	Medium	Albuquerque OEM	$40,000; City budget, grants	Ongoing	In Progress. Increased number of National Weather Radios in public buildings.
A 2	**Multi-hazard public education program.** Educate residents on natural hazard threats, impacts, mitigation opportunities, and advanced preparations to make in advance of events. Print materials will be developed and distributed at local government buildings and public libraries. Include the Los Ranchos Citizen Corps Program as part of this effort.	Flood, Wildfire, Drought, Severe Winter Storms, High Wind, Thunderstorm, Land Subsidence Extreme Heat, Dam Failure, Tornado	1, 2, 7	High	Albuquerque OEM	Under $100,000; City budget, FEMA grants	Ongoing	In Progress.
A 3	**South Broadway pond expansion.** This project will increase the capacity of the South Broadway Pond, thus mitigating the flooding that occurred repeatedly during 2006, 2013 and 2014.	Flood	1, 2, 3, 5, 6	Medium	Public Works	$2,938,000; City funds, State Grants, FEMA grants	2023	In Progress.
A 4	**Drainage comprehensive and feasibility studies.** This project is for the preparation of plans and feasibility studies to do the following: • Gibson-San Mateo Flood Plain Restudy ($100,000) • Glenrio (Loma Hermosa) Feasibility Study ($450,000) • North Camino Arroyo Drainage Management Plan ($200,000) • North Valley Drainage Management Plan ($500,000) • Upper Snow Vista Channel Improvements Study ($100,000)	Flood	1,2,3,4, 5,6	High	CABQ, Bernalillo County, Pueblo of Sandia, Los Ranchos, MRGCD, NMDOT, US Fish and Wildlife	Over $500,000; AMAFCA, CABQ, Bernalillo County, Village of Los Ranchos, US Fish and Wildlife	2022-2023	In Progress. AMAFCA will continue working on this project.
A 5	**Flood insurance awareness program.** A public awareness program will provide the unprotected property owners throughout the planning area with information concerning their risk and	Flood	1, 2, 3, 4, 7	Low	County and local Floodplain Managers, City of Albuquerque	Under $100,000; City budget	2021	Annual Implementation.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	available insurance. Informational materials should be multi-lingual.				Planning Department			
A 6	**Multi-jurisdiction storm water management plans.** Investigate the feasibility and buy-in for regional stormwater management planning approach. Establish committee and coordinate with neighboring communities to establish better water management planning. Evaluate linkage to MS4 Permit Issuance (90th Percentile Storm Retention Requirement).	Flood	4, 6	High	County and local public works and planning departments	Under $100,000; City budget, State Grants	2021	In Progress. Should be integrated within MS4 EPA Permit Constraints. Committee may already exist via Memorandum of Understandings with AMAFCA.
A 7	**Drainage channel improvements and maintenance.** Continue cleaning and repairing drainage channels, arroyos and culverts to increase or maintain capacity. Continuing implementing maintenance plans.	Flood	1, 2, 3, 4, 6	High	Local and county public works departments	$100-500K; FEMA grants	2021	In Progress. Ongoing Action
A 8	**Wildfire public education and outreach activities.** Develop comprehensive education process that includes Fire safety education/prevention and organize community cleanups in high fuel areas. Some efforts are currently in process with the County offering biannual green waste days at County owned facilities and monthly fire prevention classes.	Wildfire	1, 2, 3, 5, 6, 7	High	Fire & Rescue; Open Space	Under $100,000; USFS, city budget	2023	Annual Implementation. Continue thinning and fueling reduction projects in Bosque. Projects completed include New Mexico State Forestry Fuel Wood Reduction Project at Central Ave. NW Bosque and New Mexico State Forestry Bosque School Fuelwood Reduction Project. MRGCD also funded NM State Forestry for Bosque Fuel wood reduction over three seasons south of Cesar Chavez, eastside of the river for the “Bosque Healing Project.” NMSF also completed fuel wood reduction at Alameda Bridge crossing over the Bosque. USACE completed their Middle Rio Grande Restoration Project to include non-native species removal/fuelwood reduction. The DHSEM Grant for fuelwood reduction in the vicinity of Tingley Beach is in progress.
A 9	**Participate in State's biomass fuels program to dispose of tree thinning debris.** Thinning projects create an overabundance of debris for disposal. Using the debris as a biomass fuel source should be studied as an effective and	Wildfire	1, 2, 3, 4, 5, 6	High	City Open Space Division, State Forestry Division	$65,000; Rio Grande Water Fund, USFS, NM State Forestry, State Fire Fund,	2022	In Progress. The City of Albuquerque Open Space Division in partnership with the State Forestry Division is currently working on a number of fuel thinning projects in the Bosque and East

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	cost effective solution for disposal. Evaluate possible sale of firewood from thinning projects.					HMGP Technical Assistance funds		Mountains. Need to work with the Rio Grande Water Trust and some studies may already be available.
A 10	**Earthquake awareness campaign.** Although earthquakes are rare in Bernalillo County, earthquakes should be included in other disaster information literature and programs already in place. Information should include what to do before, during, and after an earthquake. Part of the education effort will be on the dangers of how an earthquake may affect AMAFCA facilities and what the public should be aware of if high rains occur after a flood event in relation to damaged AMAFCA facilities.	Earthquake	1, 2, 3, 7	Medium	City OEM	Minimal; FEMA Earthquake Program, General Fund	2021	In Progress.
A 11	**Prepare public education effort for winterizing measures.** Provide educational information to local residents on insulating pipes to reduce damage from winter storms. Find ready-made brochures to distribute.	Severe Winter Storm	2, 3, 6, 7	High	City OEM	Under $100,000; HUD if funds are needed	2021	In Progress.
A 12	**Tree trimming to protect power lines.** Trim trees along roadways to prevent interference with power lines during high winds and winter storms. The Public Service Company of New Mexico (PNM) does this through a contract. Public education needs to be a component of the project.	Severe Winter Storm, High Winds	1, 2, 3, 5, 7	Medium	City Forestry Department, PNM	Under $100,000; Capital improvements plans	2023	In Progress. Ongoing Action
A 13	**Reduce vulnerability of structures to severe weather and hailstorms.** As public buildings are constructed or renovated, use hail-resistant metal roofing. County has high percentage of manufactured homes and a number of historic critical facilities. Identify specific vulnerabilities and distribute information about how to strengthen their ability to resist high wind events and hailstorms.	Thunderstorms	1, 2, 3, 4, 5, 6	Low	City Building Inspection Section	$80,000; Capital improvements budget, Mitigation Grants	2025	In Progress. With the adoption of the new codes, public building design is more resistant to high wind events and hailstorms.
A 14	**Tornado warning system.** Purchase and install a tornado warning system	Tornados	1, 2, 7	Low	City OEM	Under $500K; FEMA grants	2023-2025	In Progress.
A 15	**Mapping of dam & levee failure inundation areas.** Map potential dam failure inundation area. The City and AMAFCA will coordinate with the USACE and the NM Dam Safety Bureau (part	Dam Failure	1, 2, 3, 4	Medium	City OEM	$100-500K; FEMA Risk MAP	2023-2025	In Progress.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	of OSE) on preparing Emergency Action Plans for jurisdictional dams. Part of this effort will include evaluating options for mapping dam inundation areas where this has not yet occurred.							
A 16	**Map known landslide areas and debris flow run-out zones.** USGS produced landslide maps approximately 20 years ago based on aerial photographs of steep regions throughout New Mexico. There is a need to produce landslide maps in digital format based on this mapping for the use of individual counties and municipalities. The Department of Transportation also has landslide information that is used for design and maintenance priorities. This information, as well as reported landslide areas, could enhance the accuracy of the USGS product and produce beneficial information for Bernalillo County and its jurisdictions.	Landslide	6	Medium	City GIS	Under $500K; City budget, USGS, DOT, HMGP, BRIC	2025	Not Started
A 17	**Lifeline resilience assessment.** Analyze the resilience of the City of Albuquerque's community lifelines as part of a broader effort to assess and enhance the City's resilience to ongoing and potential future threats and stressors. The assessment process would allow for quantification of system risk and resilience in order to enhance the region's ability to rapidly stabilize and restore community lifelines in catastrophes. The final report would provide insight into the most pressing threats/stressors on the Albuquerque MSA's community lifelines, which could be used to inform management to leverage funding for those lifelines that are most impacted.	Earthquake, Wildfire, Flood, Severe Winter Storm, Active Threat	1, 2, 3, 4, 5	Medium	City OEM, UNM Resilience Institute, Sandia National Laboratories	$100-500K; State Grants, FEMA grants	2023-2025	New for 2020
A 18	**Reduce Albuquerque's vulnerability to extreme heat events.** a) Monitor and support regional and State-level efforts to forecast the impact of climate change on temperatures and incidence of extreme heat events in Albuquerque and the region, and integrate extreme heat event readiness, focusing on the	Extreme Heat	1, 2, 3, 4, 6	Medium	City OEM	Under $500K; City budget, Urban Sustainability Directors Network grants, Air Quality Control Board and USDOE	2025	New for 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	most vulnerable populations impacted and improving access to resources, into City operations and services. b) Continue to create and maintain shading by maintaining the health of existing trees and sustaining municipal tree planting with a focus on efforts in areas where there are fewer trees. c) Continue to implement energy efficiency ordinances for existing residential and commercial buildings to improve building comfort, including in extreme heat conditions, and to reduce energy use. d) Encourage cooling strategies for the built environment through voluntary programs to mitigate the urban heat island effect. This can include strategies like green roofs, cool roofs, and cool pavements, increased vegetation, as well as electric heat pumps and natural ventilation which can provide cooling to buildings in an extreme heat event.							
A 19	**Upgrade the ABQ Alert mass notification system.** Upgrade the ABQ ALERT mass notification system to send emergency alerts and other non-urgent messages to Albuquerque residents using a variety of communication channels and to integrate FEMA's Integrated Public Alert & Warning System (IPAWS).	Dam Failure, Earthquake, Extreme Heat, Flood, High Wind, Landslide, Severe Winter Storm, Thunderstorm, Tornado, Wildfire, Active Threat, Hazmat Release	1, 2, 6, 7	High	City OEM	$60,000; FEMA grants	2021-2022	New for 2020
A 20	**Pandemic influenza plan.** Develop a pandemic influenza plan to provide a guide for the City of Albuquerque on how to respond before, during, and after a pandemic situation.	Pandemic	1, 2, 3, 4, 5	High	City OEM	Under $500K; State Grants, FEMA	2022-2023	New for 2020
A 21	**Pandemic influenza plan training and tabletop exercise.** Conduct training with key City personnel and relevant stakeholders in order to review key elements of the pandemic	Pandemic	1, 2, 3, 4, 5	High	City OEM	Under $500K; State Grants, FEMA	2022-2023	New for 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	influenza plan and Department COOPs. Then conduct Tabletop Exercise with key City personnel and relevant stakeholders in order to test the effectiveness of the plans.							
A 22	**Repair water line leaks.** Work with ABCWUA to implement aggressive program to repair leaks in existing municipal water system, including lines to homes. Due to the recurrent and persistent drought, value of water as an asset is rising. Water leakage not only wastes water but can also contribute to subsidence and sinkholes.	Drought, Land Subsidence	1,2,3,6	High	City Public Works, ABCWUA	Under $500,000; Local municipal funds	2021	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
				Village of Los Ranchos de Albuquerque				
L 1	**Increase warning capabilities.** Increase number of sirens and radios/televisions with warning capabilities, in public buildings, parks, and recreational areas to announce alerts from the Emergency Alert System and National Weather Radio for the public. Alert the public of potential severe weather including wind, tornado, hailstorms or other severe weather.	High Wind, Tornado, Thunderstorm, Flooding	1	Medium	Bernalillo County Office of Emergency Management Fire Department, VLR Emergency Manager	$40,000; Local budgets, FEMA	2022	Not Started
L 2	**Multi-hazard public education program.** Educate residents on natural hazard threats, impacts, mitigation opportunities, and advanced preparations to make in advance of events. Print materials will be developed and distributed at local government buildings and public libraries. Include the Los Ranchos Citizen Corps Program as part of this effort.	Flood, Wildfire, Drought, Land Subsidence, Earthquake, Severe Winter Storms, High Wind, Thunderstorm, Extreme Heat, Dam Failure, Tornado	7	High	Emergency manager	Under $100,000; Village budget, FEMA grants	Ongoing	Annual Implementation. Physical brochures available at Village Hall, Emergency Management social media account, Los Ranchos Citizen Corps information table at seasonal Growers' Market
L 3	**Fix North 4th Street NW drainage problems.** This project is to address drainage issues on North 4th Street NW, especially at Garduno Road, Ranchitos Road, and Ortega Road.	Flood	3, 6	High	Public works	over $500,000; Village budget	2026	In progress with 4th Street Revitalization Project.
L 4	**Flood insurance awareness program.** A public awareness program will provide the unprotected property owners throughout the planning area with information concerning their risk and available insurance. Informational materials should be multi-lingual.	Flood	3, 7	High	Floodplain Manager	Minimal; Village budget	Ongoing	In progress/On-going. Informational brochures available at Village Hall, Los Ranchos Citizen Corps information table at seasonal Growers' Market.
L 5	**Multi-jurisdiction storm water management plans.** Investigate the feasibility and buy-in for regional stormwater management planning approach. Establish committee and coordinate with neighboring communities to establish better water management planning. Evaluate linkage to MS4 Permit Issuance (90th Percentile Storm Retention Requirement).	Flood	4	High	Public works, Planning department	Under $100,000; Village budget, State & FEMA Grants	2022	In progress with 4th St Revitalization Project

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
L 6	**Drainage ditch improvements and maintenance.** Continue cleaning and repairing drainage ditches, arroyos and culverts to increase or maintain capacity. Continuing implementing maintenance plans.	Flood	3, 6	High	Public works	Under $500,000; State & FEMA Grants	Ongoing	Annual Implementation. We have one catchment chamber we maintain annually.
L 7	**Wildfire public education and outreach activities.** Develop comprehensive education process that includes Fire safety education/prevention and organize community cleanups in high fuel areas. Some efforts are currently in process with the County offering biannual green waste days at County owned facilities and monthly fire prevention classes.	Wildfire	1, 2, 3, 7	High	Emergency manager	Under $100,000; USFS; Village budget	2024	Ongoing. Emergency Management social media account, Los Ranchos Citizen Corps information table at seasonal Growers' Market
L 8	**Bury power lines.** Bury all power lines in Bernalillo County to reduce the incident of a downed tree hitting a power line or ice affecting lines. New development in the City is required to bury power lines (except high voltage lines).	Wildfire, Severe Winter Storms, Thunderstorms, High Wind	1, 2, 3	Medium	PNM	Over $500,000; CIP, Utility companies	2025	Not started.
L 9	**Increase water storage capacity for fire suppression in the Bosque.** Study needed on best way to increase water availability for fire suppression in the Bosque by increasing capability for water storage via new wells or dry hydrants. Increased water capacity in Bosque will increase firefighting capabilities in a high- risk area.	Wildfire	1 ,2, 3	High	Albuquerque Bernalillo County Water Utility Authority/ Water Resources Division, AMAFCA (potentially through its dams)	$40,000; USFS, State Forestry, State Fire Fund, HMGP	2023	Not started. For new wells, an agreement on water environmental rights will need to be obtained. Additionally, water rights issues for well will need to be resolved.
L 10	**Participate in State's biomass fuels program to dispose of tree thinning debris.** Thinning projects create an overabundance of debris for disposal. Using the debris as a biomass fuel source should be studied as an effective and cost effective solution for disposal. Evaluate possible sale of firewood from thinning projects.	Wildfire	4, 6	High	City of Albuquerque Open Space Division, New Mexico State Parks	$65,000; Rio Grande Water Fund, USFS, State Forestry, State Fire Fund, HMGP	2023	Not started. Need to work with the Rio Grande Water Trust and some studies may already be available.
L 11	**Water conservation programs.** Continue and expand existing County and City water conservation programs to encourage and provide incentives for residents to use water-saving landscaping techniques. Promote City Water Awareness Programs/Water Audits and County Water Conservation Plan, Ordinance and	Drought	4, 6	High	Albuquerque Bernalillo County Water Authority	Under $50,000; Village budget	2022	Not started. Village could adopt water conservation ordinance; we have related water management ordinance

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	Guidelines. Employ municipal and county, subdivision, and building regulations to promote water conservation. Implement aggressive program to repair leaks in existing municipal water system. Implement drought emergency plan to: implement residential, business and watering restrictions, water use violation fees, and a drought emergency surcharge for excessive water usage.							
L 12	**Repair leaks in existing municipal water system.** Due to the recurrent and persistent drought, value of water as an asset is rising. Water leakage not only wastes water but can also contribute to subsidence and sinkholes.	Drought, Land Subsidence	2, 3, 6	High	Albuquerque Bernalillo County Water Utility Authority/ Engineering & Planning	Under $100,000; Village budget	2022	Not started. Need to work with other water associations and private homeowners. Need to determine if subsidence was caused by groundwater withdrawal.
L 13	**Participate in the State drought management plan work group.** Currently no Village representatives are participating in the Plan. The Village should identify a staff member to participate. The Work Group shall be composed of city, county and village officials who will participate in the creation and implementation of the State Drought Management Plan through attendance at planning meetings. Increased knowledge of village officials in State Drought Management Plan will facilitate a comprehensive response to drought.	Drought	4	High	Village of Los Ranchos de Albuquerque	Minimal; Staff time	Ongoing	Annual Implementation. Emergency Manager, Village staff, and members of the Los Ranchos Citizen Corps are regular participants.
L 14	**Review and update existing building codes for earthquakes.** Building codes are the first line of defense against earthquake damage. Adopt new building codes, as necessary, to ensure adequacy in respect to potential earthquake risk. AMAFCA to evaluate its facilities for vulnerability to earthquakes.	Earthquake	1, 2, 3	Low	Planning Department/ Building Official	Minimal; Staff time	2022	Not started. Village has JPA with Bernalillo County and both follow IBC. If BC adopts building codes (IBC) that involve higher standards for earthquakes, it might automatically be adopted for the Village.
L 15	**Prepare public education effort for winterizing measures.** Provide educational information to local residents on insulating pipes to reduce damage from winter storms. Find ready-made brochures to distribute.	Severe Winter Storm	7	High	Emergency manager	Under $100,000; HUD if funds are needed	2022	Not started. Los Ranchos Citizen Corps information table at seasonal Growers' Market.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
L 16	**Tree trimming to protect power lines.** Trim trees along roadways to prevent interference with power lines during high winds and winter storms. The Public Service Company of New Mexico (PNM) does this through a contract. Public education needs to be a component of the project.	Severe Winter Storm, High Winds	1, 2, 3	High	Forestry Department, PNM	Under $500,000; capital improvements budget	Ongoing	Annual Implementation.
L 17	**Explore feasibility of insulating water pipes on exterior of public buildings.** Insulating the pipes can reduce incidences of pipes bursting and causing interior water damage and loss of water in public buildings. Also consider insulation for unheated spaces.	Severe Winter Storm	3	Low	Emergency manager	Under $500,000; capital improvements budget	Ongoing	Annual Implementation.
L 18	**Establish lightning safety program.** Raise awareness among Bernalillo County residents of dangers of lightning and what to do in a lightning storm. Obtain ready-made guides and brochures from sources like FEMA. Draft a Plan for lightning safety at outdoor events where large crowds of people are expected to gather.	Thunderstorms	7	Mediu m	Emergency manager	Minimal; Staff time	2024	Not started. Los Ranchos Citizen Corps information table at seasonal Growers' Market.
L 19	**Evaluate methods for protecting public buildings from lightning strike damage.** Install a surge protector system for protecting electronic equipment from direct lightning strikes. Severe weather plan to take the extra step of disconnecting especially sensitive equipment.	Thunderstorms	3	Mediu m	Emergency manager	Under $500,000; capital improvements budget	2024	Not started.
L 20	**Reduce vulnerability of structures to severe weather and hailstorms.** As public buildings are constructed or renovated, use hail-resistant metal roofing. County has high percentage of manufactured homes and a number of historic critical facilities. Identify specific vulnerabilities and distribute information about how to strengthen their ability to resist high wind events and hailstorms.	Thunderstorms	3	Mediu m	Planning Department	$80,000; capital improvements plans, Mitigation grants	Ongoing	Annual Implementation. Implemented when public buildings constructed or renovated.
L 21	**Residential safe room rebate program.** Implement program to encourage individuals to construct safe rooms at residential homes by implementing a safe room rebate program to reimburse a portion of the construction costs.	Tornados, High Winds	1	Low	Emergency manager	Under $500,000; FEMA grants	2026	Not started.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
L 22	**Tornado warning system.** Purchase and install a tornado warning system	Tornados	1, 2	Low	Emergency manager	Under $500,000; FEMA grants	2026	Not started. In cooperation with Bernalillo County and CABQ
L 23	**Dam & levee failure warning system.** Coordinate with other communities and dam operators to develop a gauge and communication system that would provide warning in event of a dam failure. The City and AMAFCA are working with AFD to evaluate systems for arroyo flooding.	Dam Failure	1, 7	High	Emergency manager	Under $500,000; FEMA grants; USGS funding	2026	Not started.
L 24	**Mapping of dam & levee failure inundation areas.** Map potential dam failure inundation area. The City and AMAFCA will coordinate with the USACE and the NM Dam Safety Bureau (part of OSE) on preparing Emergency Action Plans for jurisdictional dams. Part of this effort will include evaluating options for mapping dam inundation areas where this has not yet occurred.	Dam Failure	1, 7	High	Emergency manager	Under $500,000; FEMA Risk Map	2026	Not started.
L 25	**Activate shelter plan to set up a public cooling centers.** Activate and set up cooling centers in well-known centrally located public facilities that will serve as a shelter to vulnerable populations (particularly the elderly and families with infants and toddlers) during periods of extreme heat following the existing procedures from Annex J of the Emergency Operations Plan (EOP). Work with NM Department of Health-BHEM Vulnerable Populations Coordinator for specifics on addressing vulnerable populations.	Extreme Heat	1, 2	Medium	Emergency manager	Under $500,000; FEMA grants; HUD	2024	Not started.
L 26	**Conduct fan drive to prepare for periods of extreme heat.** Collect and distribute fans to most vulnerable citizens (generally the elderly) during periods of extreme heat. Develop a list of vulnerable citizens ahead of any extreme heat.	Extreme Heat	1, 7	Low	Emergency manager	Volunteer time and efforts; Local donations	2025	Not started.
L 27	**Map known landslide areas and debris flow run-out zones.** USGS produced landslide maps approximately 20 years ago based on aerial photographs of steep regions throughout New Mexico. There is a need to produce landslide maps in digital format based on this mapping for the use of individual counties and	Landslide	1, 2, 3	Low	Bernalillo County, CABQ, USGS, assistance from State of New Mexico	Under $100,000; Village budget, USGS, DOT, HMGP, PDM	2024	Not started. Village relies on other agencies (MRCOG).

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	municipalities. The Department of Transportation also has landslide information that is used for design and maintenance priorities. This information, as well as reported landslide areas, should enhance the accuracy of the USGS product and produce beneficial information for the Village.							
L 28	**Anchor slope mesh over areas prone to landslides that threaten infrastructure and critical facilities.** Areas within Bernalillo County are vulnerable to landslides due to slope erosion. Anchor heavy-gauge metal slope mesh over areas prone to landslides along transportation routes and near critical facilities in areas of high vulnerability.	Landslide	1, 2, 3	Low	Emergency Manager, Public Works	$100,000; Village budget	2022	Not started.
L 29	**Continue efforts to create Firewise Communities.** Utilize the Village newsletter to educate the public on information pertaining to maintaining defensible space around their homes as well as clearing all debris from rooftops. Provide information to the public on evacuation routes and procedures. Circulate wildfire safety and prevention materials.	Wildfire	7	Medium	Village of Los Ranchos de Albuquerque (District 12)	$1,500; Village budget	2023	Not started.
L 30	**Storm drain projects -- various locations.** Storm Drain improvements, extensions, enhancement and repairs at various locations including: Benavides Storm Drain Extension ($391,000), Black Mesa (Don Felipe Dam) Storm Drain ($4,803,000), Black Mesa (McCoy Dam) Storm Drain ($3,541,000), Black Mesa (Raymac) Storm Drain ($2,746,000), Bobby Foster Storm Drain ($4,715,000), North Fourth Street ($2,999,000), North Johniece Storm Drain ($3,764,000), South Johniece Storm Drain ($632,000), Tower Road Storm Drain ($1,520,000)	Flood	2, 3	High	Public Works	Over $500,000; AMAFCA, Bernalillo County, Village CIP	2026	In Progress
L 31	**Drainage comprehensive and feasibility studies.** This project is for the preparation of plans and feasibility studies to do the following: Gibson-San Mateo Flood Plain Restudy ($100,000), Glenrio (Loma Hermosa) Feasibility Study ($450,000), North Camino Arroyo	Flood	2, 3	High	Public Works	Over $500,000; AMAFCA, Bernalillo County, Village CIP	2024	In Progress

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	Drainage Management Plan ($200,000), North Valley Drainage Management Plan ($500,000), Upper Snow Vista Channel Improvements Study ($100,000), Valle de Oro Site Plan ($100,000).							
L 32	**Levee failure tabletop.** Coordinate Tabletop Exercise on Flooding Due to Levee Failure. Coordinate tabletop exercise with stakeholder agencies in the Middle Rio Grande Valley on flooding due to levee failure. The levees were installed years ago, and their structural integrity may have been worsened over time. The benefit to conducting this exercise would be to spur interjurisdictional/interagency action to mitigate the potential scenario that the levees fail in a flood, possibly leading to reinforcement of the levees or filling in existing gaps.	Dam Failure; Flood	1. 2. 3. 4	Mediu m	Emergency Manager, Mayor	Minimal; Staff time	2023	New in 2020
L 33	**Adopt water conservation ordinance.** Supplement the Village's Water Management ordinance with a Water Conservation ordinance in response to existing drought conditions and the increased likelihood of severe drought due to climate change. The benefits would be better water use in the municipality and the ability enforce minimum standards beyond encouraging water conservation.	Drought	7	Mediu m	Planning Department	$10,000; Village budget	2024	New in 2020
L 34	**Require buried utilities in new development.** Require new development to bury utilities to decrease the likelihood of downed lines, especially given the bosque canopy in the municipality. The benefits would be a smaller chance of utility disruption and less potential conflict between the lines and the trees.	High Wind; Thunderstorms; Utility Disruption	1. 2. 3.	Mediu m	Planning Department	Minimal; Staff time	2024	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
				Village of Tijeras				
T 1	**Well safety education program.** Local Emergency Manager will work with the New Mexico Department of Health to provide educational information for residents of the county's unincorporated areas on avoiding water well contamination due to flooding. Materials will include methods for well decontamination after flood events. Some notification for County residents is already in place. Attach educational information to County permits and website. The Health Department can help address waterborne disease. Materials should be multi-lingual.	Flood	1,2,3,5, 7	Medium	Emergency Management, Bernalillo County Health Department, New Mexico Environment Department, New Mexico State Engineer's Office, New Mexico Department of Health	Low; Local budgets	Ongoing	In Progress. Will continue to collaborate with the county and other key stakeholders.
T 2	**Flood insurance awareness program.** A public awareness program will provide the unprotected property owners throughout the planning area with information concerning their risk and available insurance. Informational materials should be multi-lingual.	Flood	2,3,4,6, 7	High	County and local Floodplain Managers, City of Albuquerque Planning Department	Low; Local budgets	Ongoing	Not Started. Will create a schedule and curriculum for the annual public awareness program that the local floodplain manager can follow every year.
T 3	**Multi-jurisdiction storm water management plans.** Investigate the feasibility and buy-in for regional stormwater management planning approach. Establish committee and coordinate with neighboring communities to establish better water management planning. Evaluate linkage to MS4 Permit Issuance (90th Percentile Storm Retention Requirement).	Flood	1,2,3,5, 6	High	County and local public works and planning departments	Low; Local municipal funds, New Mexico State Grants	2024	Annual Implementation. Will continue to collaborate with the county and other key stakeholders.
T 4	**Drainage ditch improvements and maintenance.** Continue cleaning and repairing drainage ditches, arroyos and culverts to increase or maintain capacity. Continuing implementing maintenance plans.	Flood	2,3,5,6	High	Local and county public works departments	Medium, FEMA grants	Ongoing	Annual Implementation. Ongoing maintenance, repair, and replacement of draining features and culverts when necessary and funding allows.
T 5	**Flood control projects stabilization of arroyos.** Study of stabilizing arroyos within Village of Tijeras. Study to identify additional areas where low-water crossings should be engineered and mitigated. Install fabric baskets.	Flood	2,3,5,6	High	NMDOT MAP	$400,000; HMDOT	2024	Not started. Will include in future funding applications.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
T 6	**Bury power lines.** Bury all power lines in Tijeras to reduce the incident of a downed tree hitting a power line or ice affecting lines. New development in the City is required to bury power lines (except high voltage lines).	Wildfire, Severe winter storms, thunderstorms, high wind, tornado	1,2,3,5, 6	Low	Municipal utilities, PNM	High; Work with utility companies and Incorporate into capital improvements	2024	Not started. Will engage PNM in conversations as they provide all power to the area.
T 7	**Participate in State's program to use biomass fuels as a way to dispose of tree thinning debris in the Bosque and East Mountain areas.** Thinning projects create an overabundance of debris for disposal. Using the debris as a biomass fuel source should be studied as an effective and cost effective solution for disposal. Evaluate possible sale of firewood from thinning projects.	Wildfire	2,3,4,6	High	City of Albuquerque Open Space Division, New Mexico State Parks	$65,000; Rio Grande Water Fund, USFS, NM State Forestry, New Mexico State Fire Fund, Hazard Mitigation Grant Program Technical Assistance funds	2023	In progress. Currently collaborating with Ciudad Soil and Water Conservation District, Talking Talons, and other nonprofits to collaborate on thinning projects in the Tijeras Creek and in neighborhoods throughout the Village, will connect with appropriate agencies.
T 8	**Water conservation programs for residential, commercial, and industrial users.** Continue and expand existing County and City water conservation programs to encourage and provide incentives for residents to use water-saving landscaping techniques. Promote City Water Awareness Programs/Water Audits and County Water Conservation Plan, Ordinance and Guidelines. Employ municipal and county, subdivision, and building regulations to promote water conservation. Implement aggressive program to repair leaks in existing municipal water system. Implement drought emergency plan to: implement residential, business and watering restrictions, water use violation fees, and a drought emergency surcharge for excessive water usage.	Drought	2,3,5,6, 7	High	Albuquerque Bernalillo County Water Authority	Low; Local budgets	Ongoing	In progress. Village Council recently approved a list of water conservation products that, upon proof of purchase, can be credited to water customer's accounts, conducted first water audit in 7 years and 2020, training staff to help conduct future water audits, and more aggressive leak detection monitoring.
T 9	**Repair leaks in water system.** Continue to implement aggressive program to repair leaks in existing municipal water system, including lines to homes. Due to the recurrent and persistent drought, value of water as an asset is rising. Water leakage not only wastes water but can also contribute to subsidence and sinkholes.	Drought, Land Subsidence	2,3,5,6	High	Albuquerque Bernalillo County Water Utility Authority/Engineering & Planning	Low; Local budgets	Ongoing	Annual Implementation. Monthly and as needed leak monitoring actively occurring, with future plans to utilize a greater number of reports to promote leak detection.
T 10	**Promote and expand drought indicator/early warning system.** Promote and expand a system that detects levels of soil moisture and	Drought	2,3,5,6	Medium	Local emergency management	Low; NRCS, USDA	2023	Not started. Will reengage with key stakeholders.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	stream/river levels to determine when conditions are trending toward a drought. Some warning is available from USDA.							
T 11	**Earthquake awareness.** Although earthquakes are rare in Bernalillo County, earthquakes should be included in other disaster information literature and programs already in place. Information should include what to do before, during, and after an earthquake.	Earthquake	1,2,3,5, 7	Mediu m	Emergency Manager	Minimal; FEMA Earthquake Program, General Fund	2024	Not started. Will include as apart of flood insurance awareness program.
T 12	**Review and update existing building codes for earthquakes.** Building codes are the first line of defense against earthquake damage. Adopt new building codes, as necessary, to ensure adequacy in respect to potential earthquake risk. AMAFCA to evaluate its facilities for vulnerability to earthquakes.	Earthquake	1,2,3,5	Low	Building Official	Low; Local budgets	2024	Not started. Will encourage county building code updates.
T 13	**Earthquake technical assistance for homeowners.** Conduct Technical Assistance Visits to help homeowners implement non-structural earthquake retrofits of their home. Work with homeowners to conduct inexpensive, non-structural retrofitting such: as securing appliances, bookcases, cabinet drawers and doors to prevent tipping/opening during an earthquake; securing pictures and framed art to walls; securing hanging fixtures to the ceiling, and applying safety film to glass windows and doors.	Earthquake	1,2,3,5, 7	Low	Emergency Manager	$500/per home or less; HUD funds, FEMA, Homeowner	2023	Not started. Will reengage with key stakeholders.
T 14	**Public education effort for winterizing measures.** Provide educational information to local residents on insulating pipes to reduce damage from winter storms. Find ready-made brochures to distribute.	Severe Winter Storm	1,2,3,5, 7	High	Emergency Manager	Low; HUD funds	Ongoing	Annual Implementation. Ongoing communication with residents each winter about winterizing measures.
T 15	**Tree trimming to protect power lines.** Trim trees along roadways to prevent interference with power lines during high winds and winter storms. The Public Service Company of New Mexico (PNM) does this through a contract. Public education needs to be a component of the project.	Severe Winter Storm, High Winds	1,2,3,5, 6,7	Mediu m	Forestry Department, PNM	Low to Medium; capital improvement budget	Ongoing	Annual Implementation. Active maintenance of roadway tree trimming projects.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
T 16	**Establish lightning safety program for Bernalillo County residents.** Raise awareness among Bernalillo County residents of dangers of lightning and what to do in a lightning storm. Obtain ready-made guides and brochures from sources like FEMA. Draft a Plan for lightning safety at outdoor events where large crowds of people are expected to gather.	Thunderstorms	1,2,3,6, 7	Mediu m	Emergency Manager	Minimal; staff time.	2022	Not started. Will reengage with county and key stakeholders.
T 17	**Reduce vulnerability of structures to severe weather and hailstorms.** As public buildings are constructed or renovated, use hail-resistant metal roofing. County has high percentage of manufactured homes and a number of historic critical facilities. Identify specific vulnerabilities and distribute information about how to strengthen their ability to resist high wind events and hailstorms.	High wind, Thunderstorms	2,3,5,6	Low	Planning Department	80000; capital improvements funds, FEMA grants	Ongoing	Not started. No construction since 2015 plan, will implement going forward.
T 18	**Residential safe room rebate program.** Implement program to encourage individuals to construct safe rooms at residential homes by implementing a safe room rebate program to reimburse a portion of the construction costs.	Tornados, High Winds	1,2,3,5, 7	Low	Emergency Manager	Medium; FEMA grants	2024	Not started. Will coordinate with key stakeholders.
T 19	**Tornado warning system.** Purchase and install a tornado warning system	Tornados	1,2,3,5, 7	Low	Emergency Manager	Medium; FEMA grants	2024	Not started. Will coordinate with City of Albuquerque and other stakeholders
T 20	**Dam failure warning system.** Coordinate with other communities and dam operators to develop a gauge and communication system that would provide warning in event of a dam failure. The City and AMAFCA are working with AFD to evaluate systems for arroyo flooding.	Dam Failure	1,2,3,5, 7	Low	Emergency Manager	Medium; FEMA grants, USGS	2024	Not started. Will coordinate with key stakeholders.
T 21	**Map potential dam failure inundation area.** The City and AMAFCA will coordinate with the USACE and the NM Dam Safety Bureau (part of OSE) on preparing Emergency Action Plans for jurisdictional dams. Part of this effort will include evaluating options for mapping dam inundation areas where this has not yet occurred.	Dam Failure	1,2,3,4, 5,6	Mediu m	Emergency Manager	Medium; FEMA RiskMAP	2024	Not started. Will coordinate with key stakeholders.
T 22	**Conduct fan drive to prepare for periods of extreme heat.** Collect and distribute fans to most vulnerable citizens (generally the elderly)	Extreme Heat	1,2,3,4, 5,6,7	Low	Emergency Manager	Volunteer time and efforts; local donations	Ongoing	Not started. Will coordinate with key stakeholders.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	during periods of extreme heat. Develop a list of vulnerable citizens ahead of any extreme heat.							
T 23	**Map known landslide areas and debris flow run-out zones.** USGS produced landslide maps approximately 20 years ago based on aerial photographs of steep regions throughout New Mexico. There is a need to produce landslide maps in digital format based on this mapping for the use of individual counties and municipalities. The Department of Transportation also has landslide information that is used for design and maintenance priorities. This information, as well as reported landslide areas, should enhance the accuracy of the USGS product and produce beneficial information for Bernalillo County and its jurisdictions.	Landslide	1,2,3,4, 5,6	Medium	Bernalillo County, CABQ, USGS, assistance from State of New Mexico	Low to medium; State and local budget possibly from current staff and resources, USGS, DOT, FEMA	2024	Not started. Will coordinate with key stakeholders.
T 24	**Anchor slope mesh over areas prone to landslides that threaten infrastructure and critical facilities.** Areas within Bernalillo County are vulnerable to landslides due to slope erosion. Anchor heavy-gauge metal slope mesh over areas prone to landslides along transportation routes and near critical facilities in areas of high vulnerability.	Landslide	1,2,3,4, 5,6	Low	Emergency Manager, Public Works Department	$100,000; general fund	Ongoing	In Progress. Currently engaged in slope stabilization and erosion mitigation projects to protect roadways.
T 25	**Continue efforts to create Firewise Communities.** Continue efforts to create Firewise Community in Tijeras including education to the public on information pertaining to maintaining defensible space around their homes as well as clearing all debris from rooftops.	Wildfire	1,2,3,4, 5,6,7	Low	Village of Tijeras	Minimal; village budget	2022	Not started. Will include in public hazard awareness efforts.
T 26	**Increase warning capabilities.** Increase number of sirens and radios/televisions with warning capabilities, in public buildings, parks, and recreational areas to announce alerts from the Emergency Alert System and National Weather Radio for the public. Alert the public of potential severe weather including wind, tornado, hailstorms or other severe weather.	High Wind, Tornado, Thunderstorm, Flooding	1,2,3,5, 7	Medium	Tijeras Fire Chief	~$40,000; Local budgets, FEMA	2024	Not started. Will engage with City of Albuquerque, Bernalillo County, and other stakeholders.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
T 27	**Install generators at critical facilities.** This project would allow for fixed diesel powered generators be installed at critical facilities to ensure continuity of emergency services to the public during high hazard events.	Flood, Drought, Severe Winter Storms, High Wind, Thunderstorm, Earthquake, Dam Failure, Tornado	2,3,5	Mediu m	Emergency Manager	Medium; Local budget, NMDOT, FEMA	2024	Not started. Planning to install backup generators at all municipal wells
T 28	**Multi-hazard public education program.** Educate residents on natural hazard threats, impacts, mitigation opportunities, and advanced preparations to make in advance of events. Print materials will be developed and distributed at local government buildings and public libraries. Include the Los Ranchos Citizen Corps Program as part of this effort.	Flood, Wildfire, Drought, Land Subsidence, Severe Winter Storms, High Wind, Thunderstorm, Extreme Heat, Dam Failure, Tornado	1,2,3,4, 5,7	High	Emergency Manager	Low; Local budgets, FEMA	2022	Not started. Planning to engage in ongoing public awareness efforts related to multiple hazards
T 29	**Wildfire public education and outreach activities.** Develop comprehensive education process that includes Fire safety education/prevention and organize community cleanups in high fuel areas. Some efforts are currently in process with the County offering biannual green waste days at County owned facilities and monthly fire prevention classes.	Wildfire	1,2,3,4, 5,7	Mediu m	Emergency Manager	Low; USFS; Village budget	2022	Not started. Will include in public hazard awareness efforts
T 30	**Disaster preparedness plan.** Develop disaster preparedness plan for all possible human and natural hazards identified in this plan	Active threat, cyber threat, dam failure, drought, earthquake, extreme heat, flood, hazmat release, high wind, landslide, land subsidence, pandemic, severe winter storm, thunderstorm,	1, 2, 3, 4,5,6, 7	Low	Village of Tijeras	Low to medium; Village staff time	2022	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
		tornado, wildfire						
T 31	**Bernalillo County illegal dumping task force education and outreach.** Develop education and outreach materials and messaging for illegal dumping.	Hazmat Release; Pandemic	1. 2. 4. 6. 7. 3.	High	Village of Tijeras, County, MRGCD, City of Albuquerque, AMAFCA and 7 other agencies	$10,000 - $100,000; Department budgets, grants	2026	New in 2020
T 32	**Maintenance building construction.** Demolish existing maintenance building and construct new maintenance building for storage of roads department, water department, and fire department gear and vehicles. The Village's ability to maintain its assets and conduct mitigation projects is currently hampered by its limited capacity to store supplies and equipment for the roads department, water department, and fire department. The new building will provide adequate space for equipment and supplies for conducting mitigation work, as well as routine maintenance and response to hazard events.	Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hazmat Release, High Wind, Landslide, Land Subsidence, Severe Winter Storm, Thunderstorm, Tornado, Wildfire	1,2,3,4, 5,6,7	High	Village of Tijeras	$750,000. We have secured $200,000 of capital outlay so far for the project. Other possible funding sources would be state and FEMA grants.	2022	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
				AMAFCA				
F 1	**AMAFCA miscellaneous projects.** Miscellaneous concrete repairs, access control, and minor modifications to existing conveyance, detention, and stormwater quality facilities as identified in an on-going inspection program.	Flood, Landslide, Land Subsidence	1,2,3,4, 5,6	High	AMAFCA	$1,800,000; AMAFCA budget	2021	Annual Implementation.
F 2	**Amole dam gravity outlet.** This project consists of constructing a primary spillway gravity outfall pipe from the Amole Dam east through Navajo Elementary School and into the Isleta Drain. It will assist drainage at the school and remove a floodplain on the school.	Flood	1,2,3,4, 5,6	High	AMAFCA, MRGCD, USACE, APS, Bernalillo County	$671,000; USACE, AMAFCA	2018	In Progress. Portions of the infrastructure have been installed.
F 3	**Barr main canal improvements.** This project consists of widening and deepening the existing irrigation channels to create a drainage system which will have a series of inline detention ponds.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County, MRGCD	$4,792,000; Bernalillo County, AMAFCA, MRGCD	2021	In Progress. AMAFCA is in the design stage for these improvements.
F 4	**Calabacillas Arroyo bank monitoring and enhancement (reaches 1-4).** This project's primary focus is to evaluate and enhance the bank protection and grade control structures on the Calabacillas Arroyo to provide erosion protection.	Flood	1,2,3,4, 5,6	High	AMAFCA, CABQ	Over $1 million; AMAFCA budget	2021	In Progress. Study is in progress.
F 5	**Don Felipe/ Raymac miscellaneous projects, drainage management plan and right of way acquisition.** This project is to install master planned drainage facilities in the Don Felipe Dam/Raymac Dam Watershed Drainage Management Plan. This project is to also acquire right of way for corridors for the outfalls of two proposed ponding areas.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County	$1,500,000; AMAFCA, Bernalillo County	2018	In Progress. AMAFCA will continue working on this project.
F 6	**Drainage comprehensive and feasibility studies.** This project is for the preparation of plans and feasibility studies to do the following: • Gibson-San Mateo Flood Plain Restudy ($100,000) • Glenrio (Loma Hermosa) Feasibility Study ($450,000) • North Camino Arroyo Drainage Management Plan ($200,000) • North Valley Drainage Management Plan	Flood	1,2,3,4, 5,6	High	AFCA, CABQ, Kirtland Air Force Base, Bernalillo County, Pueblo of Sandia, Los Ranchos, MRGCD, NMDOT, US Fish and Wildlife	High; AMAFCA, CABQ, Bernalillo County, Village of Los Ranchos, US Fish and Wildlife	2019	In Progress. Plan development is ongoing.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	($500,000) • Upper Snow Vista Channel Improvements Study ($100,000)							
F 7	**Guac detention basin phase I.** This project is to provide additional detention volume (around 500 acre- feet) in the Guac-Amole Detention Dam system for a drainage area of nearly 18 square miles.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County, CABQ	$1,173,000; AMAFCA budget	2017	In Progress. Engineering work is underway.
F 8	**Hamilton Dam stormwater detention basin.** This project is to construct a dam between Glendale and Florence west of Eubank to control and maintain flows in the El Camino Arroyo. The proposed dam will hold 104 acre-feet of stormwater to reduce downstream flow rates.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County, USACE, Office of State Engineer (OSE)	$8,656,000; AMAFCA budget	2021	In Progress. Coordination with neighborhood property owners continues.
F 9	**Mid Valley Drainage management plan and implementation components.** This project is to install master planned drainage facilities identified in the Mid Valley Drainage Management Plan including purchase of right of way.	Flood	1,2,3,4, 5,6	High	AMAFCA, CABQ	$7,000,000; AMAFCA budget, CABQ	2021	In Progress. AMAFCA will continue to support its partner entities.
F 10	**North Camino inlet improvements, channel extension, and North Camino/El Camino arroyos earthen berm.** This project is to reconfigure and possibly relocate the North Camino inlet to reduce waves that may overtop the channel. This project will also include completing the North Camino Channel from the existing channel near San Mateo to the inlet into the North Diversion Channel. The project also includes construction of an earthen berm to prevent runoff from flowing into either the North Camino Arroyo or the El Camino Arroyo from the other watershed.	Flood	1,2,3,4, 5,6	High	AMAFCA, USACE, CABQ, Pueblo of Sandia	High; AMAFCA, CABQ, Pueblo of Sandia	2017	In Progress. Discussions with Sandia Pueblo are continuing.
F 11	**North geologic window dam detention basin.** This project is to design a proposed detention basin west of the North Geologic Window as identified in the Boca Negra Drainage Management Plan. It will be designed to hold 173 acre-feet of storage and will control flows in the Boca Negra Arroyo.	Flood	1,2,3,4, 5,6	High	AMAFCA, National Park Service, OSE	$4,084,000; AMAFCA	2019-2021	In Progress. Design and study work are ongoing.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
F 12	**Northwest mesa miscellaneous drainage projects.** This project is to install master planned drainage facilities in the West I-40 Drainage Management Plan and the Boca Negra DMP to control runoff.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County, CABQ	$1,000,000; AMAFCA, Bernalillo County, CABQ	2019-2021	In Progress. Studies are underway.
F 13	**South diversion channel freeboard improvements.** This project will construct 2-foot sill walls along the west side of the South Diversion Channel which will help contain the 500-year flood water surface plus wave action.	Flood	1,2,3,4, 5,6	High	AMAFCA, CABQ, University of New Mexico (UNM)	$419,000; AMAFCA, CABQ, UNM	2017	In Progress. AMAFCA is still studying this issue.
F 14	**Southwest mesa miscellaneous drainage projects.** This project is to install master planned drainage facilities identified in the Don Felipe Dam, Raymac Dam, and McCoy Dam Drainage Management Plans to ensure downstream facilities function correctly.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County	$500,000; AMAFCA, Bernalillo County	2021	In Progress. AMAFCA will continue working on this project.
F 15	**Valle de Oro Bosque outfall and drainage/ water quality infrastructure.** This project is to provide a stormwater conveyance outfall through the Valle de Oro Urban Wildlife Refuge. This project also includes the design and construction of infrastructure to convey stormwater runoff from the area east of Second Street and detain approximately 48 acre-feet of runoff. This project will help reduce flooding in the southeast valley.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County, MRGCD, FWS, SLO, BOR	$5,000,000; AMAFCA, Bernalillo County, FWS, SLO, BOR	2019-2021	In Progress. Design phase.
F 16	**Multi-jurisdiction storm water management plans.** Investigate the feasibility and buy-in for regional stormwater management planning approach. Establish committee and coordinate with neighboring communities to establish better water management planning. Evaluate linkage to MS4 Permit Issuance (90th Percentile Storm Retention Requirement).	Flood	1,2,3,4, 5,6,7	High	County and local public works and planning departments	Low; municipal budgets, grants	2017	In Progress. Multijurisdictional effort will continue.
F 17	**Explore options for mapping of dam failure inundation areas.** Map potential dam failure inundation area. The City and AMAFCA will coordinate with the USACE and the NM Dam Safety Bureau (part of OSE) on preparing Emergency Action Plans for jurisdictional dams. Part of this effort will include evaluating options	Dam Failure	1,2,3,4, 5,6	Medium	Local Emergency Managers	Medium; FEMA Risk MAP	2019-2021	In Progress. AMAFCA will continue to develop these as part of Emergency Action Plans.

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	for mapping dam inundation areas where this has not yet occurred.							
F 18	**Prepare emergency action plans (EAPs) for several AMAFCA dams.** Prepare EAPs, a plan that identifies potential emergency conditions at a dam and outlines the procedures to follow to minimize property damage and loss of life, at the following dams: • John B. Robert and Arroyo del Oso Dams ($100,000) • Ladera Dams 0-15 ($250,000) • North Domingo Baca and Kinney Dams ($50,000) • South Domingo Baca Dam ($50,000) • Westgate, Amole and Hubbell Dams ($200,000)	Dam Failure	1,2,3,4, 5,6	High	AMAFCA, CABQ, OSE, Bernalillo County	Medium; AMAFCA, CABQ for John B. Robert and Arroyo del Oso Dams	2025	In Progress. AMAFCA continues to develop EAPs.
F 19	**Pino dam emergency spillway modifications.** For Pino Dam, which is presently an earthen dam, either construct a secondary emergency spillway on the west or south side of the dam and/or add erosion resistant structural elements to the primary emergency spillway. Either proposal must be approved by the Office of the State Engineer.	Dam Failure	1,2,3,4, 5,6	High	AMAFCA, OSE	$3,726,000; AMAFCA	2021	In Progress. Study phase.
F 20	**Southeast Valley drainage management plan projects implementation and right of way acquisition.** This project is to construct various projects that can alleviate local drainage problems as identified in the Southeast Valley Drainage Management and Storm Water Quality Plan. This project is also to include the acquisition of drainage right of way for ponding and/or conveyance of stormwater generated within the Southeast Valley and Mesa del Sol bluff area.	Flood	1,2,3,4, 5,6	High	AMAFCA, Bernalillo County, CABQ, MRGCD, BOR, USACE	$2,000,000; AMAFCA, Bernalillo County, Private sources	2021	In Progress. Projects are being evaluated.
F 21	**Stormwater discharge into MRGCD drains.** Municipal and County stormwater discharge into MRGCD drains. Cooperate as a participating agency in flood control/stormwater management projects that involve MRGCD facilities.	Dam Failure; Drought; Flood; Thunderstorms	1. 2. 3. 4. 6. 7.	Mediu m	AMAFCA; Bernalillo County MRGCD; Albuquerque	Over $1,000,000; CIP, Dept. budgets, grants	2026	New in 2020

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F 22	**Alameda drain hydraulic study.** The Restudy of the Drainage Management Plan (DMP) for the Alameda Drain will identify hydraulic deficiencies of the Alameda Drain in order to focus future studies and design efforts toward optimizing the existing drainage system. This restudy of the Alameda Drain is the first phase of a multi-phase project that will provide the technical data needed to utilize the Drain to the maximum practical extent. A Hydraulic Study will identify locations where inefficiencies or "choke points" are and allow future efforts to be focused on those locations. This update will also identify new drainage facilities that have been constructed since the DMP was first completed and provide a good inventory of all storm drain and irrigation connections.	Flood, Thunderstorm	1,2,3,4, 5,6	High	COA, BC, AMAFCA, VLR	$400,000; local budgets	2023-2025	New in 2020
F 23	**AMAFCA telemetry.** The flood control system telemetry project will provide automated data reporting for AMAFCA facilities. The installation of automated telemetry for AMAFCA facilities will be especially beneficial in the event of inclement weather as it will enhance AMAFCA's ability to observe flood control system conditions remotely; allowing for focused observation by AMAFCA staff concerning the amount and quality of water moving through the system. The telemetry project will report details about the depth of water at the location, possible environmental reporting such as rainfall rate, select water quality parameters, and may include video reporting.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$800,000; local budgets	2023-2025	New in 2020
F 24	**Amole arroyo modification.** A redirection of the Amole Arroyo directly into the Hubbell Channel instead of the Amole Dam will assist in the potential lack-of-capacity issues in Amole Dam. This redirection will allow for greater overall system capacity between the Amole and Hubbell Dams.	Flood, Thunderstorm, Dam Failure	1,2,3,4, 5,6	High	AMAFCA	$950,000; local budgets	2023-2025	New in 2020
F 25	**Barelas pump station outfall swq improvements.** Stormwater quality	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA	$419,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	improvements will be made to the Barelas Pump Station at the discharge pipes in the Bosque. The improvements to the system will help to satisfy the EPA stormwater quality improvement permit requirements for the Rio Grande. This project will concentrate on making improvements in the Bosque outfall basin to attain additional floatable and solids settling. Meandering, unlined channels from the basin will be constructed through the Bosque.							
F 26	**Black Mesa P.S. outfall upgrade.** Master planned storm drain facilities identified in the Southwest Valley Flood Reduction Feasibility Project will be installed to remove floodplain on the valley floor. In addition to widening Middle Rio Grande Conservancy District Drains and rebuilding the Black Mesa Pump Station and force main, the project will utilize in-line storage in the Los Padillas Drain. The Isleta Drain will collect runoff and convey it to the Rio Grande. Best Management Practices will be used to enhance storm water quality. The capacity of the Black Mesa Pond on Malpais Road will be increased to 115 acre-feet to accept overflow runoff from the Los Padillas and Isleta Drains to avoid overwhelming facilities within the Isleta Reservation. The pump and force main must be sized for flows of 50 cubic feet per second.	Flood, Thunderstorm	1,2,3,4, 5,6	High	BC, AMAFCA	$1,014,000; local budgets	2023-2025	New in 2020
F 27	**Browning drainage Anaheim to Modesto.** Bernalillo County is improving drainage along Browning Street. This area is immediately upstream of the South Domingo Baca Dam, an AMAFCA facility. These improvements will provide better drainage to the dam and improve local flood protection. The installation of large diameter culverts where Browning crosses two different arroyos will allow the public who travel on a road safety from inundation with storm runoff, sediment and debris from moderate storms	Flood, Thunderstorm	1,2,3,4, 5,6	High	BC, AMAFCA	$1,014,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
F 28	**Calabacillas access ramp.** The Calabacillas Arroyo is a naturalized channel, providing an open space corridor through the northwest portion of Albuquerque. The channel is stabilized using soil cement and rip rap for both grade control and bank protection. An access ramp from Eagle Ranch Road was constructed during the 1990's. After a series of strong storms in 2006, the bottom portion of the ramp was protected with basalt rip rap. This has forced the flow path onto the opposing bank causing increased erosion. The project will steepen and hard line the slope to realign the access ramp and remove the flow restriction at this location.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$130,000; local budgets	2023-2025	New in 2020
F 29	**Calabacillas facility plan above swinburne dam.** The Upper Calabacillas Facility Plan will evaluate the Calabacillas Arroyo from the south edge of Swinburne Dam, to the northern edge of the AMAFCA jurisdiction. The goal of the plan will be to evaluate the existing grade control structures, evaluate the risks for lateral and vertical erosion, and identify any possible areas for enhancing storm water quality.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, SSCAFCA	$250,000; local budgets	2023-2025	New in 2020
F 30	**Calabacillas flow and sediment control.** The grade control structures below Swinburne Dam are sized for the design outflow of the dam. To ensure that the peak outflow is not impacted by higher than normal inflow, a flow control structure may be needed on the main branch of the Calabacillas Arroyo to restrict higher flows. The lower flows through the system would not be impacted. The design of this structure would have a sediment retention aspect to improve stormwater quality.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, SSCAFCA	$2,310,000; local budgets	2023-2025	New in 2020
F 31	**Calabacillas GCS 3a1 and bank protection.** The Calabacillas Arroyo is a unique arroyo in the region. To maintain a natural look, numerous grade control structures were constructed along the arroyo to allow development and provide flood protection. Calabacillas Grade Control Structure 3a1 was identified in the Calabacillas	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA	$1,323,000; local budgets	2023-2025	New in 2020

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	Arroyo Facility Plan as a needed structure to provide vertical and lateral erosion control of the Calabacillas Arroyo. The additional bank protection will assist in lateral erosion control as well.							
F 32	**Calabacillas/Corrales SWQ facility.** The Calabacillas-Corrales stormwater quality facility will be constructed adjacent to the Corrales Main Canal, near the Calabacillas Arroyo. The facility will trap trash and debris at the existing overflow structure where storm water is separated from the irrigation water. The treated water is then discharged to the Rio Grande at the Calabacillas Arroyo outfall.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$1,406,000; local budgets	2023-2025	New in 2020
F 33	**Candelaria WQ lining.** The Candelaria Water Quality Structure was built in 2011. The facility diverts lower flows from the Candelaria channel into a water quality pond. The pond has a plastic liner under a soil top to protect the North Diversion Channel. Routine maintenance can damage the liner, which is difficult to repair or replace. The project will line the existing pond with concrete to provide a stable working platform for equipment and allow greater mechanization of the maintenance activities.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$1,270,000; local budgets	2023-2025	New in 2020
F 34	**Chamisa pond expansion.** The expansion of the Chamisa Pond will provide additional storage of diverted runoff from the Upper Piedras Marcadas watershed and maximize the use of the Lyon Blvd storm drain system. The diverted runoff will reduce flow to the Piedras Marcadas Dam, which is near capacity. The Chamisa Pond will be modified to reduce sediment and trash resulting in improvements in stormwater quality.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, Private	$729,000; local budgets	2023-2025	New in 2020
F 35	**Corrales main diversion.** This project will install an automated gate structure in the Corrales Main Canal at the Calabacillas siphon that will close and divert irrigation water out of the Canal into the Bosque using existing infrastructure when the Piedras Marcadas dam is discharging. The gate will open again once the dam ceases	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$800,000; local budgets	2023-2025	New in 2020

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	discharging to the Canal. This will generate additional capacity in Piedras Marcadas Dam by removing the manual gate and associated holding time.							
F 36	**D5 dam.** Dam D5 is a proposed detention basin in the upper Ladera Dam 5 watershed on the Dam 5 Arroyo. This facility will control flows in the arroyo downstream in order to maintain and protect existing drainage facilities and other infrastructure. The 300 acre-feet of storm water and sediment detention will lower peak flows in the arroyo and provide additional downstream capacity within existing structures.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, Private	$4,225,000; local budgets	2023-2025	New in 2020
F 37	**Dallas surge pond.** A surge pond near the Dallas Storm Drain will provide temporary storage for stormwater that periodically overwhelms the drainage system. Adding this relief provides the capacity needed to prevent water from traveling past the existing infrastructure in moderate sized rain events. This structure will be coordinated within the redevelopment of the adjacent block.	Flood, Thunderstorm	1,2,3,4, 5,6	High	COA, AMAFCA	$400,000; local budgets	2023-2025	New in 2020
F 38	**Gibson/San Mateo flood plain restudy.** A comprehensive study of the upland watershed and storm drain network capacity in a residential neighborhood near the San Mateo/Gibson intersection in southeast Albuquerque is needed to determine the existing floodplain. The current available floodplain analysis may not be accurate due to development downstream of and within the affected neighborhood, and upstream on Kirtland Air Force Base. This study will determine locations of floodplain and drainage issues and provide data for the development of future projects to address these problems.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA	$100,000; local budgets	2023-2025	New in 2020
F 39	**Gibson-San Mateo regional drainage facility.** A 30-acre-foot detention pond near Eastern and Alvarado will relieve the surcharging of the Campus Wash storm drain system and allow for the removal of floodplain between San Mateo and San Pedro, north of Gibson. The project will	Flood, Thunderstorm	1,2,3,4, 5,6	High	COA, AMAFCA	$1,200,000; local budgets	2023-2025	New in 2020

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	include additional storm drain in Gibson to convey runoff to the drainage facility.							
F 40	**Glendale storm drain.** The storm drain will be constructed in Glendale Avenue from the proposed Hamilton Dam near Eubank Boulevard to the El Camino sediment pond near Barstow Street. The storm drain will provide flooding relief for approximately 200 properties along Glendale Avenue and allow for the removal of floodplain in the area. The storm drain may also be used as a conveyance for other regional storm drainage projects in the area.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$2,377,000; local budgets	2023-2025	New in 2020
F 41	**Grantline WQ lining.** The Grantline Water Quality Structure was built in 2011. The facility diverts lower flows from the Grantline channel into a water quality pond. The pond has a plastic liner under a soil top to protect the North Diversion Channel. Routine maintenance can damage the liner, which is difficult to repair or replace. The project will line the existing pond with concrete to provide a stable working platform for equipment and allow greater mechanization of the maintenance activities.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$635,000; local budgets	2023-2025	New in 2020
F 42	**Hubbell dam expansion.** The Hubbell Dam will be expanded by constructing an embankment around the perimeter of the agricultural field north of the existing facility. The agricultural use of the field will continue to be utilized. This will provide the needed stormwater detention capacity in the Amole/Hubbell Dam system facilities.	Flood, Thunderstorm, Dam Failure	1,2,3,4, 5,6	High	AMAFCA	$3,086,000; local budgets	2023-2025	New in 2020
F 43	**Karsten area restudy.** The Karsten Area Restudy will determine where flooding and drainage issues occur in the South Broadway area near Karsten road. The capacities of the current storm drains and drainage infrastructure will be analyzed to make recommendations for future facilities including those for water quality improvement.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$100,000; local budgets	2023-2025	New in 2020
F 44	**Ladera dam 1 upgrade.** Ladera Dam 1 is an existing detention basin at the top of the Ladera	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$1,037,000; local budgets	2023-2025	New in 2020

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	Dam System. This facility is the second in a series of 16 dams that provide flood protection in western Albuquerque. To accommodate the additional runoff from development, Dam 1 will be expanded. This expansion will provide additional storm water and sediment detention and will lower peak flows in the arroyo and provide additional downstream capacity using existing structures.							
F 45	**Ladera dam 5 diversion.** Ladera Dam 5 is an existing detention basin just west of Arroyo Vista Blvd. It is the sixth in a series of 16 dams that provide flood protection in western Albuquerque. To accommodate the additional runoff from development, water from Ladera Dam 5 will be diverted from the Ladera watershed into the West I-40 watershed. This diversion will provide additional storm water capacity within the system create downstream capacity within the existing structures.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$1,651,000; local budgets	2023-2025	New in 2020
F 46	**Las Ventanas dam WQ upgrades.** The upgrades for this project will incorporate Best Management Practices to enhance stormwater quality for flows entering the Las Ventanas Dam, improving the quality of stormwater released to the river and providing compliance with the EPA MS4 permit. This project will reduce maintenance costs by concentrating trash and debris at prescribed locations. Two channel inlets and three storm drain inlets will be retrofitted with debris fences to capture floatables and debris.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$425,000; local budgets	2023-2025	New in 2020
F 47	**Max's inlet storm water quality upgrade.** Max's Inlet into the South Diversion Channel receives a large quantity of sediment from the upland watershed, creating a deep sediment plug at the base of the inlet, within the flow path of the channel. A sediment control facility will reduce maintenance and control sediment before it goes into the South Diversion Channel and ultimately the Rio Grande.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$745,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
F 48	**McCoy diversion channel A.** The project will construct a diversion channel to collect flows from north and west of the dam. This will prevent these flows from bypassing the dam and inundating the valley floor. It will allow for the removal of existing residential areas from FEMA floodplains.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$4,053,000; local budgets	2023-2025	New in 2020
F 49	**McEwen pond GI/LID improvements.** United States Geological Survey will monitor stormwater quality pre- and post-installation of Green Infrastructure (GI) and Low Impact Development (LID) structural features in the pond. The purpose of this pilot project is to sample stormwater before and after processing in the pond to evaluate the performance of GI best management practices relative to stormwater quality.	Flood, Thunderstorm	1,2,3,4, 5,6	High	BC, AMAFCA	$100,000; local budgets	2023-2025	New in 2020
F 50	**Miscellaneous real estate acquisition.** During the design of some projects, additional real estate is required to reduce the cost of construction or expand a project to provide additional flood protection. The real estate acquisition can be in the form of real property, temporary construction easements, or permanent drainage or maintenance easements. Real estate acquisition is also done to support projects derived from drainage management plans or other planning documents. Market conditions, site constraints, and availability are considered when developing a plan for real estate acquisitions.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$900,000; local budgets	2023-2025	New in 2020
F 51	**NAA-Sandia Heights floodplain study.** The North Albuquerque Acres/Sandia Heights Floodplain Study will reevaluate the floodplains delineated in the area. Advances in hydraulic modeling coupled with more accurate hydrologic data can provide a more accurate floodplain delineation. This revised floodplain will represent a more accurate model of reality and possibly release some restrictions on development.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, BC	$200,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
F 52	**NDC overlay.** The North Diversion Channel (NDC) drains 94 square miles of northeast Albuquerque and is the largest man-made concrete channel in Albuquerque. The NDC is now over 50 years old. To extend the life of the channel, AMAFCA has started applying a concrete overlay across the bottom of the channel. Various upstream sources provide constant trickle water that keeps the bottom wet. The new overlay includes a gentle slope across the bottom to force the trickle water to one side, further extending the lifespan of the concrete.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$6,000,000; local budgets	2023-2025	New in 2020
F 53	**North diversion channel/indian school WQ pond.** The North Diversion Channel (NDC) transports approximately one third of the urban metropolitan area runoff to the Rio Grande. The location provides treatment for one of the larger untreated watersheds to the NDC. The project will construct a diversion wall and basin that will trap trash and sediment in an easily maintained structure. The wall will be designed so the channel continues to provide flood protection. The debris basin will significantly reduce manual trash removal in the downstream areas and provide compliance with the EPA MS4 permit.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$3,850,000; local budgets	2023-2025	New in 2020
F 54	**Ortega-Garduno storm drain.** The project includes storm drain infrastructure in 4th Street north of Paseo Del Norte and on adjacent side. Water is then directed to existing infrastructure in and around Paseo del Norte. The goal of the project is to reduce the extent of FEMA floodplain and alleviate local drainage issues in the area.	Flood, Thunderstorm	1,2,3,4, 5,6	High	BC, AMAFCA	$2,587,000; local budgets	2023-2025	New in 2020
F 55	**Paradise west dam.** This large detention facility near del Oeste Blvd will control flows in the West Branch of the Calabacillas Arroyo to historic rates, provide for reduction in sediment transport, and be designed for possible multi-use opportunities. Construction of the facility will	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$1,187,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	allow for upstream development without impacting existing downstream infrastructure.							
F 56	**Post fire sediment risk assessment.** Recent large wildfires in the western United States have shown there is a potential for large scale sediment transport for several years after a fire. AMAFCA has four large dams and several miles of channel that have a forested upper watershed. These facilities may be at risk in a post-fire environment. An assessment of the potential impacts will allow AMAFCA to mobilize the necessary resources to ensure that the flood control function of these facilities is preserved until the upland area has fully stabilized.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$200,000; local budgets	2023-2025	New in 2020
F 57	**S Pino bank monitoring & enhancement.** The South Pino Arroyo is an arroyo that mimics a natural channel in the northeast portion of Albuquerque. Grade control structures and bank protection are applied to these types of arroyos to prevent lateral erosion or vertical degradation issues, while maintaining a natural appearance. Bank protection and grade control structures may be built in the South Pino Arroyo if it begins to migrate outside of the designated erosion limits.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$200,000; local budgets	2023-2025	New in 2020
F 58	**SDC access project.** The South Diversion Channel Access Project will provide better access to the South Diversion Channel, Geneiva's Arroyo drop structure, and future water quality facilities. Access to the South Diversion Channel from Gibson Boulevard is problematic due to the proximity of the I-25 on and off ramps and two concrete side inlets that receive drainage from Gibson Boulevard. The project will modify the side inlets and install drive pads and maintenance roads.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$150,000; local budgets	2023-2025	New in 2020
F 59	**South diversion channel outfall water quality.** Constructing a stormwater quality facility near the South Diversion Channel outfall to the Rio Grande will remove sediment and debris from stormwater before it can reach the river. This	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$1,134,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	project will include the construction of a diversion from the main channel into storm water quality pond with a ported riser. Stormwater quality will be enhanced by the removal of sediment and floatables. Discharge from this pond will either be rerouted back into the South Diversion Channel or the local irrigation lateral.							
F 60	**Swinburne dam regional WQ & sediment facility.** Design and entitlement of a water quality pond within the confluence of the two major arroyos entering the dam will create a "dam within a dam." A pond capable of holding "first flush" flows and sediment/debris will make removals easier, less expensive, and allow the remaining area within the dam to be cleaner and better utilized. The project will incorporate Best Management Practices to enhance stormwater quality for flows coming into the Swinburne Dam from the west and main branches of the Calabacillas Arroyo, thus improving the quality of stormwater reaching the river and providing compliance with the EPA MS4 permit. This project will be designed to reduce maintenance costs by concentrating trash and debris at discrete locations while allowing the rest of the facility to be "trash-free."	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$3,200,000; local budgets	2023-2025	New in 2020
F 61	**Tijeras GCS 245+70.** The Tijeras Arroyo is a large water course in southern Albuquerque. The Tijeras Arroyo Facility Plan identified several grade control structures that were needed to provide vertical control of the arroyo. Tijeras Grade Control Structure (GCS) 245+70 is one such structure, located just to the east of University Blvd. The cost for previous grade control structures constructed throughout the AMAFCA jurisdiction have been split between the adjacent landowners and AMAFCA. This grade control structure will also provide channel stability near the University Blvd. bridge.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA, Private	$3,000,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
F 62	**Tijeras GCS 383+84.** The Tijeras Arroyo is a large water course that bisects Kirtland Air Force Base. The Tijeras Arroyo Facility Plan identified several grade control structures that were needed to provide vertical control of the arroyo. Tijeras Grade Control Structure (GCS) 383+84 is one such structure located on the western boundary of the Air Force Base. Cost sharing with the Air Force will not only provide the required erosion control for the area, but also provide necessary security measures along the area of the water crossing.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, KAFB	$4,000,000; local budgets	2023-2025	New in 2020
F 63	**Tijeras GCS 637+20.** The Tijeras Arroyo is a large water course that bisects Kirtland Air Force Base. The Tijeras Arroyo Facility Plan identified several grade control structures that were needed to provide vertical control of the arroyo. Tijeras Grade Control Structure (GCS) 637+20 is one such structure located on the northern boundary of the Air Force Base. Cost sharing with the Air Force will not only provide the required erosion control for the area, but also provide necessary security measures along the area of the water crossing.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, KAFB	$6,000,000; local budgets	2023-2025	New in 2020
F 64	**UPM pond.** The future development of the Upper Piedras Marcadas watershed will produce runoff quantities that will exceed the capacity of the existing storm drain in Paseo del Norte Boulevard. A 20-acre-foot detention pond will be constructed to safely discharge runoff to prescribed rate and provide enhanced water quality. The design will take into account near surface basalt outcrops.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA	$3,945,000; local budgets	2023-2025	New in 2020
F 65	**Upper Bear tributary storm water quality facility.** Regional flood control and stormwater quality improvements on the Upper Bear Tributary will increase the efficiency of the storm drainage system in the Bear Arroyo Watershed utilizing a regional Best Management Practice structure to collect trash and debris, reduce peak runoff flows as well as enhance stormwater	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA	$400,000; local budgets	2023-2025	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	quality before discharging into the North Diversion Channel and ultimately into the Rio Grande. A secondary water quality benefit will be for the aquifer storage and recovery project given the proximity to the Bear Arroyo direct injection site.							
F 66	**West Branch Calabacillas (Quail Ranch) dam.** This detention facility in the Upper West Branch Calabacillas Watershed will control flows in the West Branch of the Calabacillas Arroyo to historic rates, provide for reduction in sediment transport, and be designed for possible multi-use opportunities. Construction of the facility will allow for upstream development without impacting existing downstream infrastructure. This facility will also allow for reduced sizing of downstream detention facilities.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$4,680,000; local budgets	2023-2025	New in 2020
F 67	**Zuni-Dallas pond.** A surge pond near the intersection of Zuni Road and Dallas Street will provide temporary storage for stormwater within the Dallas Storm Drain system. Adding this relief provides the capacity needed to prevent water from traveling past the existing infrastructure in moderate sized rain events. Construction of this upper watershed facility will allow for reduced facility needs downstream and allow for development along the Central Blvd. corridor.	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA, COA	$2,000,000; local budgets	2023-2025	New in 2020
F 68	**NDC inlet project.** The North Diversion Channel (NDC) drains 94 square miles of northeast Albuquerque and is the largest man-made concrete channel in Albuquerque. The NDC is now over 50 years old. Many of the inlets into the channel are showing signs of deterioration and need replacing. AMAFCA is continuing to replace and monitor the inlets	Flood, Thunderstorm	1,2,3,4, 5,6	High	AMAFCA	$2,000,000; local budgets	2023-2025	New in 2020
F 69	**Monument monitoring.** AMAFCA surveys monument markers on its jurisdictional dams to measure subsidence, and conducts repairs as needed. Individual dams are surveyed once every five years.	Landslide, Land Subsidence	1,2,3,4, 5,6	High	AMAFCA	$25,000; AMAFCA	Annual	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
MRGCD								
M 1	**On-line water scheduling for irrigators.** Developing an online system for irrigators to schedule which allows greater public transparency, tracing priority for water delivery and reduces communications load for Irrigation System Operators.	Drought; Extreme Heat	3. 5. 6.	High	MRGCD	$100,000 - $1,000,000; Dept. budget and grants	2022	New in 2020
M 2	**Water efficiency improvement projects.** Construct 75 constant head weirs and 60 turnouts (long-crested constant head weirs, metered turnouts, properly sized turnouts) per year to maximize water delivery efficiency in our system in drought conditions. Allows for more storage in our reservoir El Vado Dam.	Drought; Extreme Heat	3. 5. 6.	High	MRGCD NRCS, Bernalillo County Water Conservation, Bernalillo County Extension	Over $1,000,000; Dept. budget, grants, CIP	2026	New in 2020
M 3	**Signage for public safety at water facilities.** Signage for MRGCD ditch and drain facilities that include warnings of flood and public safety risk to reduce injuries and liability.	Dam Failure; Flood; Thunderstorms	1. 2. 4. 7.	High	MRGCD Bernalillo County, AMAFCA, City of Albuquerque	$10,000 - $100,000; Dept. budgets, grants	2023	New in 2020
M 4	**Wildland urban interface treatments.** Thinning trees along flood control levees and riverside drains adjacent to the Rio Grande riparian forest to protect adjacent private lands and the bosque habitat and improve the integrity and function of the flood control levees.	Dam Failure; Drought; Flood; High Wind; Wildfire	1. 2. 3. 4. 5. 6. 7.	High	MRGCD City of Albuquerque; Bernalillo County	$100,000 - $1,000,000; Dept. Budget, grants	2026	New in 2020
M 5	**Non-native and invasive species treatment and removal.** Treatment of non-native and invasive species in the Rio Grande bosque - 4500 acres.	Drought; High Wind; Thunderstorms; Wildfire	1. 2. 3. 4. 5. 6. 7.	High	MRGCD; City of Albuquerque U.S. Army Corps of Engineers	Over $1,000,000; Dept. Budget, grants	2026	New in 2020
M 6	**Thinning of tree canopy on irrigation facilities and interior drains.** Assessment and removal of high risk trees and reducing stand densities.	Drought; Flood; High Wind; Thunderstorms; Wildfire; Winter Storms	1. 2. 3. 4. 5. 6. 7.	High	MRGCD; City of Albuquerque and Bernalillo County (Fire Depts. and Parks and Rec.), Soil and Water Conservation Districts	Over $1,000,000; Dept. budget, CIP, grants	2026	New in 2020
M 7	**Subsidence mitigation.** Work with the County and State to identify areas vulnerable to or where land subsidence has occurred within the MRGCD. Develop and implement a plan for	Land Subsidence	1,2,3,4, 6,7	Low	MRGCD, Bernalillo County, NM Bureau of Geology	$10,000- $100,000; Dept. budgets grants, staff time.	2026	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	protecting facilities and evaluating ground and surface water irrigation in those areas.							
M 8	**Levee evaluations.** Complete structural evaluations of Albuquerque levee system for earthquake resistance/predicted damages and conduct repairs/improvements where needed.	Earthquakes	1,2,3,4, 5,7	Mediu m	MRGCD, U.S. Army Corps of Engineers	$100,000 - $1,000,000; Dept. budgets, grants, CIP	2026	New in 2020
M 9	**Public education program.** Participate in a multi-jurisdictional, multi hazard public education program to increase public awareness of hazards beyond the Ditch and Arroyo Safety Program	Flood, high wind, thunderstorms, wildfire, utility disruption, land subsidence, earthquakes, winter storms, extreme heat.	1,2,3,4, 5,6,7	Mediu m	MRGCD, Bernalillo County, City of Albuquerque, AMAFCA, Village of Los Ranchos, Village of Tijeras, Army Corps of Engineers	$10,000 - $100,000; Staff time, Dept. budgets, grants	2023	New in 2020
M 10	**Emergency management plan update.** Update the MRGCD's Emergency Management Plan to address any hazards in the HMP not currently addressed.	Dam Failure, Earthquakes, Extreme Heat, Flood, High Wind, Land Subsidence, Thunderstorms, Wildfire, Winter Storms	1,3,4,5, 6	Mediu m	MRGCD	$0 - $10,000; Staff time, Dept. budgets	2023	New in 2020

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
				ABCWUA				
W 1	**Water conservation programs for residential, commercial, and industrial users.** Continue and expand water conservation programs to encourage reductions and provide incentives for residents to use water-efficient landscaping techniques. Promote Water Conservation Plan, Water Waste Ordinance and Rebates. Implement drought emergency plan to include public education, additional incentives, augmented watering compliance for outdoor water waste, and drought surcharges.	Drought	2,3,5,6, 7	High	**ABCWUA Water Resource Division**	Low; ABCWUA budget for Water Conservation Program, Rate fees	Ongoing	New in 2020. Included in the commodity there is a charge per unit that is dedicated to the Water Resources Management Program in Fund 621 to fund the Water Conservation Program and other Water Resources management activities.
W 2	**Repair leaks in existing municipal water system including lines to homes.** Due to the recurrent and persistent drought, value of water as an asset is rising. Water leakage not only wastes water but can also contribute to subsidence and sinkholes.	Drought, Land Subsidence	2,3,6,	High	**ABCWUA Engineering & Planning**	Low to medium; local municipal funds	2022	New in 2020. ABCWUA has active Leak Detection (LD) program focused on detecting leaks via manual acoustic LD surveys, smart acoustic LD nodes on WLs/meters, and smart hydrant LD nodes. By 3rd Quarter FY21, remote acoustic nodes will be relocated to new areas where 2018/2019 WL break data indicates greater opportunity to detect additional leaks.
W 3	**Expand existing projects to use treated effluent for non-potable uses.** City of Albuquerque and Bernalillo County already use treated effluent to irrigate golf course and limited number of city parks. Existing programs can be expanded and thereby reduce current use of potable water.	Drought	2,3,4,6	Mediu m	**ABCWUA Compliance Division**; City of Albuquerque and Bernalillo County Public Works departments	$250,000; Office of State Engineer, State legislative funds, FEMA grants	2022	New in 2020.
W 4	**Reduce vulnerability of structures to high winds and hail.** Identify specific vulnerabilities and distribute information about how to strengthen buildings to resist high wind events and hailstorms. As public buildings are constructed, ABCWUA is using hail-resistant roofing.	High Wind, Thunderstorms	1,2,3,	Low	**ABCWUA Field/ Plant Division**, Bernalillo County Building Section; CABQ Building Inspection Section; Village of Los Ranchos Planning Department	Unknown cost; CIP budget, FEMA grants	2025	New in 2020.
W 5	**Reduce vulnerability of structures to lightning.** Install surge protector systems for	Thunderstorms, Lightning	1,2,3,	Low	**ABCWUA Field/ Plant Division**,	Unknown cost;	2025	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	protecting electronic equipment from direct lightning strikes. Ensure severe weather plans specify the disconnecting especially sensitive equipment.				Bernalillo County Building Section; CABQ Building Inspection Section; Village of Los Ranchos Planning Department	CIP budget, FEMA grants		
W 6	**Review and update existing building codes for earthquakes.** Building codes are the first line of defense against earthquake damage. Adopt new building codes, as necessary, to ensure adequacy in respect to potential earthquake risk. Water Authority recently purchased new customer service building and meets all new building code requirements.	Earthquake	1,2,3,4, 5,6	Low	**ABCWUA Operations Division**, Bernalillo County/ CABQ Building, Planning, and Zoning Department/ Building Official	Low; Local budgets	2025	New in 2020.
W 7	**Map known landslide areas and debris flow run-out zones.** Work with other jurisdictions and insurance carriers to further evaluate hazards: USGS produced landslide maps approximately 20 years ago based on aerial photographs of steep regions throughout New Mexico. There is a need to produce landslide maps in digital format based on this mapping for the use of individual counties and municipalities. NMDOT also has landslide information that is used for design and maintenance priorities. This information, as well as reported landslide areas, should enhance the accuracy of the USGS product and produce beneficial information. ABCWUA does not have facilities on steep slopes.	Landslide	1,2,3,4, 5,6	Medium	**ABCWUA GIS Staff**	Unknown cost; CIP budget, FEMA grants	2026	New in 2020.
W 8	**Install additional cameras and motion detection capability at diversion dam.** Add two CCTV cameras with motion detection capability to view the Diversion Dam and Dam intake structure	Dam Failure	1,2,3,4	Medium	**ABCWUA Water Resources Division,** AMAFCA	Unknown cost; CIP budget, FEMA grants	2025	New in 2020.
W 9	**Evaluate options for dam failure warning system.** Coordinate with other communities and dam operators to develop a gauge and	Dam Failure	1,2,3,4	Medium	**ABCWUA Field/ Plant and Planning**	Unknown cost; CIP budget, FEMA grants	2025	New in 2020. The City and AMAFCA are working with AFD to evaluate systems for arroyo flooding.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	communication system that would provide warning in event of a dam failure.				**Divisions;** Local Emergency Managers			
W 10	**Flood insurance awareness program.** Work with Local Emergency Managers who can provide educational information for county and city residents. Partner with other local jurisdictions to develop and implement hazard mitigation strategies to include working with insurance carriers.	Flood	1,2,3,6, 7	Low	**ABCWUA Risk Management Division;** Local Emergency Managers, Local and county public works departments	Staff Time	2025	New in 2020.
W 11	**Tornado educational & awareness**- Review and update existing emergency response plans**.** Work with other local emergency managers to ensure Water Authority's integrated emergency response plan is updated for Tornados	Tornado	1,2,3,4	Low	**ABCWUA Risk Management Division;** Local Emergency Managers	Staff Time	2025	New in 2020.
W 12	**Cooling centers.** Identify and designate cooling centers in well-known centrally located Water Authority facilities to be used during periods of extreme heat. Ensure designated centers have adequate cooling capacity, and upgrade if needed. Install generator connections to ensure uninterrupted function during a power outage.	Extreme Heat	1,2,7	Low	**ABCWUA Field/ Plant and Operations Divisions;** Local Emergency Managers	Unknown; CIP funds, HUD, FEMA grants	2023	New in 2020.
W 13	**Conduct fan drive to prepare for periods of extreme heat.** Collect and distribute fans to most vulnerable citizens (generally the elderly) during periods of extreme heat. Develop a list of vulnerable citizens ahead of any extreme heat.	Extreme Heat	1,2,4,7	Low	**ABCWUA Field/ Plant and Operations Divisions;** Local Emergency Managers	Minimal;	2023	New in 2020.
W 14	**Increase water storage capacity for fire suppression in the Bosque.** Identify and implement ways to increase water availability for fire suppression in the Bosque by increasing capability for water storage via new wells or dry hydrants. Increased water capacity in Bosque will increase firefighting capabilities in a high- risk area.	Wildfire	1 ,2, 3	High	**ABCWUA Water Resources Division,** AMAFCA, CABQ, State of NM	$40,000; USFS, State Forestry, State Fire Fund, HMGP	2023	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
W 15	**Implementation of pandemic COOP planning.** Due to recent COVID-19 Pandemic Water Authority implemented a Pandemic COOP plan to ensure continuity of critical public health services	Pandemic	1,2,3,5	High	**ABCWUA Risk Management Division**	Low; staff time	Ongoing	New in 2020.
W 16	**Comprehensive information technology security plan.** Due to recent rise of national cyber threats and public sector exposure ABCWUA has implemented policies that are aligned with the standards, guidelines, and best practices of the National Institute of Standards and Technology (NIST) Cybersecurity Framework	Cyber Threat	2,3,4,5	High	**ABCWUA IT Division**	Medium to High; Local budgets	2021	New in 2020.
W 17	**Water authority final security plan.** Begin implementing Phase 1 of the Water Authority's Final Security Plan based on vulnerability assessments that were performed to reduce physical security risks with a goal of completing hardware countermeasures selected for adoption. Update the Water Authority's Emergency Response Plan by the end of the 4th Quarter of FY20. Complete the AWWA risk and resilience certificate program to demonstrate compliance with America's Water Infrastructure Act of 2018.	Active Threat	1,2,3,4, 5	High	**ABCWUA Risk Management Division**	Medium to High; Local budgets	2023	New in 2020.
W 18	**Review and update existing emergency response plans.** Work with other local emergency managers to ensure Water Authority's integrated emergency response plan is updated	Active Threat, Cyber Threat, Dam Failure, Drought, Earthquake, Extreme Heat, Flood, Hazmat, High Wind, Landslide, Land Subsidence, Pandemic, Severe Winter Storm, Thunderstorm, Tornado, Wildfire	1,2,3,4, 5	Low	**ABCWUA Risk Management Division**, Municipal OEMs	Staff Time	2023	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
W 19	**Conduct updated dam failure analysis and implement recommended improvements.** A Dam break analysis was conducted in 2004 by an outside engineering firm to determine potential for flood inundation of embankment failures which was determined as minor. An updated analysis needs to be completed to assess what progress has been made since 2004 and what new vulnerabilities have emerged. Recommended changes and improvements will be budgeted and implemented as funding is made available.	Dam Failure, Flood	1,2,3,4, 5,6	Medium	**ABCWUA Risk Management Division, Municipal OEMs**	Staff Time FEMA Grants	Complete analysis by 2022; complete improvements by 2025	New 2021
W 20	**Maintain ground water reserve to limit subsidence.** One of the goals in ABCWUA's 2016 Water Resources Management Strategy "Water 2120: Securing our Water Future" is to establish and maintain a groundwater reserve. Maintaining ground water reserve is critical to limiting and managing subsidence.	Land Subsidence	2,3,6	Low	**ABCWUA Field/ Plant and Operations Divisions**	Unknown cost; CIP budget, FEMA grants	Ongoing	New 2020
W 21	**Adherence to building codes.** Including measures such as structural bracing. ABCWUA continues to rehab priority facilities on a priority basis. CIP planning will need to further evaluate other facilities and projects	High Wind	1,2,3,	Low	**ABCWUA Field/ Plant Division**, Bernalillo County Building Section; CABQ Building Inspection Section; Village of Los Ranchos Planning Department	Unknown cost; CIP budget, FEMA grants	2025	New in 2020.
W 22	**Lightning awareness brochures.** Develop and distribute a brochure on lightning protection and distribute to critical infrastructure sites and internal employees. Work with municipalities to promote lightning awareness and outreach programs	Thunderstorms Lightening	1,2,3,	Low	**ABCWUA Field/ Plant Division**, Bernalillo County Building Section; CABQ Building Inspection Section; Village of Los Ranchos Planning Department	Unknown cost; CIP budget, FEMA grants	2025	New in 2020.
W 23	**Review and update existing building codes for earthquakes.** In 2015, ABCWUA improved	Earthquake	1,2,3,4	Low	**ABCWUA Operations**	Unknown cost;	2025	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	and rehabilitated the College Arsenic Treatment Facility to provide retrofit, design and construction upgrades for seismic bracing purposes. ABCWUA needs further planning for evaluating other facility locations.				**Division**, Bernalillo County/ CABQ Building, Planning, and Zoning Department/ Building Official	CIP budget, FEMA grants		
W 24	**Install new fire hydrants in the Bosque area.** Conduct a study to strategically map out new locations of fire hydrants where the capabilities of fire suppression are insufficient for the Bosque area, and then install those hydrants.	Wildfire	1 ,2, 3	High	**ABCWUA Water Resources Division,** AMAFCA, CABQ, State of NM	$40,000; USFS, State Forestry, State Fire Fund, HMGP	2023	New in 2020.
W 25	**Review and update existing emergency response plans to address high winds.** Plan and implement work sessions with other local emergency managers to ensure Water Authority's integrated emergency response plans addresses high wind to include educational training for WUA staff.	High Wind	1,2,3	Low	**ABCWUA Risk Management Division, Municipal OEMs**	Unknown cost; CIP budget, FEMA grants	2023	New in 2020
W 26	**Implement site-specific risk reduction measures in high risk landslide areas.** Work with other jurisdictions, CIP engineering teams, and Contractors to implement recommended mitigation actions. Install monitoring tools and/or procedures where appropriate to assess movement and recurrent landslide activity.	Landslides	1,2,3	Low	**ABCWUA Risk Management Division, Municipal OEMs**	Unknown cost; CIP budget, FEMA grants	2023	New in 2020
W 27	**Protect utility lines at ABCWUA properties-** ABCWUA to utilize groundskeeper contractor to maintain tree pruning and other vegetation growth maintenance at ABCWUA properties.	Severe Winter Storm	1,2,3	Low	**ABCWUA Operations Division**	Unknown cost; CIP budget, FEMA grants	2025	New in 2020.
W 28	**Winter weather awareness and communication-** ABCWUA to develop and plan communication system (informacast) to better communicate and train employees about inclement weather.	Severe Winter Storm	1,2,3	Low	**ABCWUA Public Information & Communications**	Unknown cost; FEMA grants	2025	New in 2020.
W 29	**Thunderstorm hail awareness program.** Work with Local Emergency Managers who can provide educational information for county and city residents. Partner with other local jurisdictions to develop and implement hazard	Thunderstorm Hail	1,2,3,	Low	**ABCWUA Risk Management Division;** Local Emergency Managers, Local and county public	Staff Time	2025	New in 2020.

ID	Project Description & Benefits	Hazards	Goals	Priority	Lead/Supporting Agencies	Estimated Costs & Possible Funding	Timeline	Status/Implementation Notes
	mitigation strategies to include working with insurance carriers.				works departments			
W 30	**Adherence to building codes and Wind Resistant Techniques.** Including measures such as structural bracing. CIP planning will need to further evaluate Building Projects to promote engineering measures and construction compliance for build design measures to minimize damage.	Tornado	1,2,3	Low	**ABCWUA Operations Division**, Bernalillo County/ CABQ Building, Planning, and Zoning Department/ Building Official	Unknown cost; CIP budget, FEMA grants	2025	New in 2020.
W 31	**Implement recommendations of the 2007 Vulnerability Assessment Master Plan.** ABCWUA completed a Vulnerability Assessment Master Plan in 2007, which made 51 specific recommendations "to secure the Utility's water and wastewater facilities from malevolent acts." Many of these actions have been completed, however due to budget and staffing limitations, some recommendations have yet to be implemented.	Active Threat	1,2,3,4, 5	Low	**ABCWUA Water reclamation & Operations Divisions**	Unknown cost;	2025	New in 2020.

7 Plan Implementation and Maintenance

DMA Requirement §201.6(c)(4):
[The plan shall include a] plan maintenance process that includes: *(i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.* *(ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.* *(iii) Discussion on how the community will continue public participation in the plan maintenance process.*

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This chapter provides an overview of the strategy for plan implementation and maintenance, and outlines the method and schedule for monitoring, evaluating, and updating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to ensure continued public involvement in mitigation planning.

7.1 Implementing the Plan

Once adopted, the plan faces the truest test of its worth: implementation. While this plan contains many worthwhile actions, the participating jurisdictions will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

Implementation will be accomplished by adhering to the schedules identified for each mitigation action in Table 6-3 in Chapter 6 Mitigation Strategy, and through pervasive efforts to network and highlight the multi-objective, win-win benefits of each project to the jurisdictions and their stakeholders. These efforts include the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community.

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. Implementation will be accomplished through the routine actions of monitoring agendas, as well as attending meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

Simultaneously to these efforts, it is important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the costlier recommended actions. This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements, should grants be pursued; this will help ensure participating jurisdictions are in a position to capitalize on the opportunity when funding becomes available. Funding opportunities to be monitored include special pre- and post-disaster funds, budgeted funds, state and federal earmarked funds, and other grant programs, including those that can serve or support multi-objective applications.

7.1.1 Implementation and Maintenance of the 2015 Plan

In general, the jurisdictions have made considerable progress on the implementation of the plan and reducing their vulnerability to hazards. The 2015 Plan included a process for implementation and maintenance of the plan, which was generally followed. The 2015 Plan stated that the Planning Team would meet annually to review progress on mitigation actions, assess how effective those actions have been in mitigating losses, and how well the Plan's goals and objectives are being met. The Planning Team would also monitor how elements of this Plan were being incorporated in into other planning mechanisms. Unfortunately, due to competing priorities this did not happen during the past five years.

The status of mitigation actions and success stories are captured in Chapter 6. The 2015 Plan also identified a number of strategies that the participating jurisdictions could use to integrate the plan into other planning mechanisms and processes. These strategies and the extent to which they were implemented are shown in Table 7-1.

Table 7-1 Strategies from 2015 HMP for Integrating Hazard Mitigation into Other Planning Mechanisms

Existing Plans	Responsible Agency	Role of Planning Team	2020 Status
CABQ Comprehensive Land Use Plan	CABQ	HMPT will work with city planners to participate in update meetings and incorporate mitigation through comments and recommendations.	The City of Albuquerque and Bernalillo County developed a joint Comprehensive Plan, adopted in 2017, that references the 2015 Hazard Mitigation Plan and includes information on natural hazards of concern including, flooding, wildfire, drought, and extreme heat as well as climate change.
Los Ranchos 2020 Master Plan	Los Ranchos	HMPT will work with local community planners to participate in update meetings and incorporate mitigation through comments and recommendations.	Updated to 2035 Master Plan adopted November 2019; plan references HMP in Section 11 Community Facilities & Services. Next plan update review anticipated for 2024, full plan update not expected until 2035.
2010 Bernalillo County Emergency Operations Plan	Bern Co OEM	The Bern Co Emergency Manager (a member of HMPT) is on the EOP planning committee. They will work to incorporate HMP goals and objectives into the county EOP update currently under development.	Currently being updated estimated date of completion is Nov 2021
2013 Bridge Boulevard Corridor Redevelopment Plan	Bern Co	If updated in the future, HMPT will address at that time	Phase 1 currently in construction. Phase2 Design completed waiting for construction. Phase 3 awaiting design.
Amended 2011 Isleta Boulevard and Village Centers Sector Development Plan Volume I	Bern Co	If updated in the future, HMPT will address at that time	Section from goff to bridge has been constructed and completed. We continue to move forward with plan completion
2012 Los Duranes Neighborhood Plan	CABQ/Bern Co	If updated in the future, HMPT will address at that time	Rescinded in 2018 when the City adopted the Integrated Development Ordinance
2006 East Mountain Area Plan	CABQ/Bern Co	If updated in the future, HMPT will address at that time	Plan is still current; currently no initiative to update.

Existing Plans	Responsible Agency	Role of Planning Team	2020 Status
2007 Tijeras Canyon/Carnuel Plan	Bern Co	If updated in the future, HMPT will address at that time	Plan is still current; currently no initiative to update.
2011 Update of East Mountain Community Wildfire Protection Plan (CWPP)	East Mountain Interagency Fire Protection Association	HMPT will coordinate with the County Manager and Fire Chief to participate in update meetings as they relate to hazard mitigation activities and wildfire risk information. The HMPT, as needed, will incorporate mitigation through comments and recommendations.	Completed in 2015.
AMAFCA Fiscal Year 2014 Project Schedule	AMAFCA	HMPT, which includes AMAFCA, will become familiar with proposed projects and provide comments to incorporate mitigation as needed. The HMPT will consider AMAFCA hazard mitigation projects into future updates of the HMP.	Project schedule updated biannually and developed/coordinated with local agency partners.

7.1.2 Role of the Planning Team in Implementation and Maintenance

With adoption of this plan the participating jurisdictions will be tasked with plan implementation and maintenance. This will be accomplished by keeping the Planning Team active throughout the lifecycle of the plan. The participating jurisdictions agree to:

- Act as a forum for hazard mitigation issues,
- Disseminate hazard mitigation ideas and activities to all participants,
- Pursue the implementation of high-priority, low/no-cost recommended actions,
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters,
- Maintain a monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists,
- Monitor and assist in implementation and update of this plan,
- Report on plan progress and recommended changes to the County Commissioners, City/Village Councils, governing boards, and other partners, and
- Inform and solicit input from the public.

Other duties include reviewing and promoting mitigation proposals, providing technical assistance in implementing mitigation codes and ordinances, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the county and jurisdiction websites, in the local newspaper, and on social media. Unincorporated communities and special districts not participating in this plan will be integrated into mitigation implementation wherever possible.

7.2 Plan Maintenance

The Albuquerque/Bernalillo County Hazard Mitigation Plan is a living document that may be adjusted or updated as conditions change, actions progress, or new information becomes available. This section describes the method and schedule the participating jurisdictions will follow for monitoring, evaluating, and updating the Plan over the next five years. All participating jurisdictions will follow the process and schedule described below.

7.2.1 Monitoring

Monitoring refers to tracking the implementation of the plan over time. Bernalillo County OEM and the City of Albuquerque OEM will be responsible for reaching out to lead and supporting agencies identified in the Mitigation Actions table for status on those mitigation actions and will coordinate with Planning Team members in the first quarter of each year to identify and track any significant changes in their agencies' mitigation efforts.

Bernalillo County OEM and the City of Albuquerque OEM will use the following process to track progress, note changes in vulnerabilities, and consider changes in priorities as a result of project implementation:

- A representative from the responsible entity identified in each mitigation action will be responsible for tracking and reporting to the Planning Team when project status changes. The representative will provide input on whether the project as implemented meets the defined goals and is likely to be successful in reducing vulnerabilities.
- If the project does not meet identified goals and objectives, the Planning Team may select alternative projects for implementation.
- Projects that were not ranked high priority but were identified as potential mitigation strategies will be reviewed periodically to determine feasibility of future implementation.
- New mitigation projects identified will require an individual assigned to be responsible for defining the project scope, implementing the project, monitoring success of the project.
- Mitigation activities not identified as actions in this plan will also be tracked to ensure a comprehensive hazard mitigation program, and to assist with future updates.

7.2.2 Evaluation

Evaluating refers to assessing the effectiveness of the plan at achieving its stated purpose and goals. Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan, such as:

- Decreased vulnerability because of implementing recommended actions,
- Increased vulnerability because of failed or ineffective mitigation actions, and/or
- Increased vulnerability because of new development (and/or annexation).

The Planning Team will meet annually to evaluate the implementation of the plan and consider any changes in priorities that may be warranted. The annual evaluation will not only include an investigation of whether mitigation actions were completed, but also an assessment of how effective those actions were in mitigating losses. A review of the qualitative and quantitative benefits (or avoided losses) of mitigation activities will support this assessment. Results of the evaluation will then be compared to the goals and objectives established in the plan and decisions will be made regarding whether actions should be discontinued or modified in any way in light of new developments in the community. Progress will be documented by the Planning Team for use in the next plan update. Finally, the Planning Team will monitor and incorporate elements of this Plan into other planning mechanisms.

Bernalillo County OEM and the City of Albuquerque OEM will coordinate with all participating jurisdictions to facilitate an effective maintenance and implementation process. Completed projects will be evaluated to determine how they have reduced vulnerability. Changes will be made to the plan to accommodate for projects that have failed or are not considered feasible after a review for their consistency with established criteria, the time frame, priorities, and/or funding resources.

7.2.3 Updates

The Albuquerque/Bernalillo County Hazard Mitigation Plan will be reviewed and revised at least every five years in accordance with the DMA 2000 requirements and latest FEMA and DHSEM hazard mitigation planning guidance. Updates to this plan will consider:

- Has the nature or magnitude of hazards affecting the planning area changed?
- Are there new hazards that have the potential to impact the planning area?
- Have growth and development changed the planning area's vulnerabilities?
- Do the identified goals and actions still address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional local resources be committed to address identified hazards?

The updated plan will document success stories where mitigation efforts have proven effective, as well as areas where mitigation actions were not effective, and will include re-adoption by all participating entities following State/FEMA approval.

Any interested party wishing for an update of this Plan sooner than the regular 5-year update will submit such a request to Bernalillo County OEM and Albuquerque OEM for consideration. OEM will evaluate all such requests and bring them to the full Planning Team for consideration.

7.3 Incorporation into Other Planning Mechanisms and Existing Programs

Another important implementation mechanism that is highly effective and low-cost is the incorporation of the hazard mitigation plan recommendations and their underlying principles into other jurisdictional plans and mechanisms. Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. The mitigation plan can be considered as the hub of a wheel with spokes radiating out to other related planning mechanisms that will build from the information and recommendations contained herein. Properly implemented, the HMP should serve as one of the foundational documents of the jurisdictions' emergency management programs, since everything emergency management does should relate back in one way or another to the hazards the jurisdiction faces.

As stated in Section 7.1 above, implementation through existing plans and/or programs is recommended wherever possible. Based on this Plan's capability assessment and progress made on mitigation actions noted in Chapter 6, the participating jurisdictions continue to implement policies and programs to reduce losses to life and property from natural and human-caused hazards. The Planning Team will be responsible for integrating the data, goals and objectives, and other elements of this Plan into other plans, as appropriate.

The following sections provides some guidance on how the jurisdictions may use the updated HMP to inform and improve other plans, procedures, and programs.

7.3.1 Comprehensive Plans

Integrating hazard mitigation into the jurisdiction's comprehensive or general plan is considered a best practice by both FEMA and the American Planning Association.

The Albuquerque/Bernalillo County Comprehensive Plan was last updated in 2017, and included hazards information from the 2015 HMP, which is cited as a supporting document to the Comprehensive Plan. In 2017, the updated Comprehensive Plan proposed working with each of the 12 City Community Planning Areas (CPAs) on a 5-year cycle to create an action plan. City staff work with key stakeholders in each of the 12 City CPAs to assess development, demographic, and health trends; identify important character elements in neighborhoods and special places; and gather information on key issues and opportunities that would impact the quality of life for community members. This information will feed recommendations for actions that the City or other agencies can take to meet CPA goals and priorities. The City of Albuquerque and Bernalillo County OEMs will work with their Planning Departments to ensure that hazards data and mitigation goals inform the next Comprehensive Plan update, including the CPA assessment process (https://cpa.abc-zone.com/).

Los Ranchos' Master Plan was updated in 2019 and references the 2015 HMP as a supplemental plan in the community's long-range planning efforts. Los Ranchos OEM will work with the Planning and Zoning Department to ensure that hazards data and mitigation goals inform the next Master Plan update.

7.3.2 Threat and Hazard Identification and Risk Assessment (THIRA)

The City of Albuquerque and Bernalillo County have completed a County-wide Threat and Hazard Identification and Risk Assessment (THIRA). CPG201 Threat and Hazard Identification and Risk Assessment (THIRA) establishes Step 1 as "Identify the Threats and Hazards of Concern" and lists HIRAs and HMPs as possible sources of threat/hazard information.

The criteria for selecting which Threats/Hazards are "of concern" are defined as:

- Factor #1: Likelihood of a Threat or Hazard Affecting a Community
- Factor #2: The Impacts of a Threat or Hazard

Each natural and human-caused hazard profiled in the HIRA (Chapter 4) contains a section analyzing the probability of future events, which provides a data-driven answer to Factor #1. Similarly, the vulnerability assessment section of the hazard profiles address what impacts can realistically be expected from both routine and extreme events of each hazard, which specifically addresses Factor #2.

Step 2 of CPG 201 is to "Give the Threats and Hazards Context" by creating a scenario for each hazard of concern, with specifics like time of day, area, and magnitude of the event, which are then used to establish capability targets for each of the 32 core capabilities. All the hazards profiled in the HIRA contain detailed information to ensure the hazard scenarios are plausible. For some hazards, such as flood or earthquake, detailed GIS and HAZUS modeling runs have been done that can easily be incorporated as THIRA scenarios. Other hazards include details on the most extreme historical events on record that can quickly be updated to modern scenarios.

7.3.3 Response Plans

All participating jurisdictions have local emergency operations plans (EOP). While the EOP is an all hazards document, it also contains hazard-specific information and concerns. Hazard information from this HMP update will be incorporated into the next EOP update. At a minimum, all high significance hazards identified in this Plan should be addressed in future EOP updates.

Several other operational or functional response plans are also influenced by information contained in the HMP. These plans include but are not limited to:

- **Damage Assessment Plan:** A review of the vulnerability and estimated losses detailed in the hazard profiles can help identify what areas to initially prioritize following a hazard event. Similarly, a review of Section 4.2 Asset Summary can help identify what critical facilities need to be assessed following a hazard event.

- **Debris Management Plan:** HAZUS runs conducted for earthquake scenarios include an estimate of how many tons of debris would likely be generated by those scenarios. These estimates can be used as bounding limits for how much and what type of debris generation is likely to be required, as well as what areas are most likely to see heavy debris generations.
- **Evacuation & Sheltering Plan:** A review of the vulnerability and estimated losses detailed in the hazard profiles can help identify what areas are more likely to need evacuation in different hazard scenarios. The Community Profiles in Chapter 2 can help identify not only how many people would potentially be impacted by disasters, but how many are likely to need assistance with transportation, special medical or sheltering needs, etc. This review can also help evaluate the impacts of multiple or cascading hazards, so that evacuees are not relocated into an area that puts them at risk from other hazards.

7.3.4 Recovery Plan

The risk and vulnerability data in the HMP should help inform the post-disaster recovery planning process, especially by ensuring that the recovery elements of those plans fully take into account the dangers posed by other hazards, rather than focusing exclusively on the most recent hazard event. The HMP in turn will be revisited during recovery to help identify opportunities to incorporate mitigation in the recovery and rebuilding process, including maximizing FEMA PA (including Section 406 mitigation funding) and HMGP funding where applicable.

The FEMA publication “Pre-Disaster Recovery Planning Guide for State Governments” notes:

“…much of the research involved in the development of mitigation plans can be used to inform the pre-disaster recovery planning effort.

“The pre-disaster recovery planning process will benefit from and build upon hazard mitigation as:

- The mitigation planning process identifies local hazards, risks, exposures, and vulnerabilities;
- Implementation of mitigation policies and strategies will reduce the likelihood or degree of disaster-related damage, decreasing demand on resources post-disaster;
- The process will identify potential solutions to future anticipated community problems; and
- Mitigation activities will increase public awareness of the need for disaster preparedness.

“Pre-disaster recovery planning efforts also increase resilience by:

- Establishing partnerships, organizational structures, communication resources, and access to resources that promote a more rapid and inclusive recovery process;
- Describing how hazard mitigation will underlie all considerations for reinvestment;
- Laying out a process for implementation of activities that will increase resilience; and
- Increasing awareness of resilience as an important consideration in all community activities.”

The City of Albuquerque has a Recovery Plan that was last updated in December 2019. It includes the list of hazards from the 2016 HMP, and establishes mitigation as a Recovery Support Function with pre- and post-disaster tasks to “define actions during the recovery period that help prevent repeated future losses and reduce the City’s vulnerability to threats and hazards.”

7.3.5 Continuity of Operations Plans (COOP)

Many local government departments and agencies are required to maintain a Continuity of Operations Plan (COOP) that details that agency's critical functions and how they will protect those functions in order to continue to provide essential services during a disaster or interruption. By defining and describing the hazards facing the County, including frequency and severity, the HIRA informs agency COOP plans by giving context to what types of disasters of interruptions are most likely to occur. Critical facilities and assets located in hazard areas in Section 4.2 should be prioritized for COOP planning.

7.3.6 Training and Exercise Plan

Training on hazard mitigation principles and procedures should be included in the jurisdictions' training and exercise planning. Any training and exercise needs identified in the Capabilities Assessment (Chapter 5) and Mitigation Strategy (Chapter 6) should also be included in the jurisdictions' training and exercise planning.

7.3.7 Public Awareness and Education Programs

The jurisdictions' ongoing public education and outreach efforts should reflect the hazards and vulnerabilities described in this Plan. In addition to preparing for disasters, public education should include ways in which the public can reduce their vulnerability to natural and human caused hazards. Furthermore, mitigation activities and success stories should be communicated to the public to show the benefits of effective mitigation planning.

7.3.8 Critical Infrastructure Protection Plan

Critical facilities and assets identified in Section 4.2 should be included in Critical Infrastructure Protection Planning (CIPP), with prioritization given to assets located in hazard-prone areas. Hazardous materials facilities in particular should be viewed both as critical assets in need of protection, and as potential hazards in their own right.

7.3.9 Capital Improvements Plan

Many of the mitigation actions listed in the Mitigation Strategy (Section 6.4) came from the jurisdictions' Capital Improvements Plans, and thus have already been identified for funding. Other high-dollar actions listed or identified in the future can also be added to the Capital Improvements Plan to ensure that hazard mitigation projects continue to receive funding. The prioritization of actions listed in Table 6-3, while not binding on capital improvement planning, can be used to inform the prioritization of those actions. Even projects for which the jurisdictions intend to seek grant funding may also need to be addressed in the Capital Improvements Plan, given that most mitigation grants require significant local matching funds.

Prior and current mitigation planning has and will continue to inform Village of Los Ranchos Capital Improvement Planning.

7.3.10 Sustainability Plans

Sustainability is a separate area of concern from hazard mitigation, but there are areas where the two fields overlap and influence one another positively or negatively.

Sustainability plans should be reviewed to identify where there may be synergy between sustainability and mitigation/resiliency. For example, sustainability efforts aimed at increasing jurisdictions' adaptability to climate change can also make them more resilient to drought and severe weather. Increasing the percentage of food obtained locally could make the jurisdictions more resilient to supply-chain interruptions or the impacts of disasters in other states. Adding more trees and grass to urban areas to reduce the heat island effect could help mitigate the impact of extreme weather events, as well as reducing flood risk by increasing the number of permeable surfaces. This may help raise the priority of some sustainability efforts, as well as suggest complimentary mitigation efforts.

It is equally important to identify areas where sustainability efforts may work to reduce the jurisdictions' resilience to hazards. For example, a sustainability goal of promoting use of public transit and reducing private car ownership could potentially make it harder to evacuate the public during a disaster if public transit is damaged and offline (as was observed during Hurricane Sandy). Similarly, reduced production of solid waste could lead to a reduction in the number of public resources such as dump trucks, which means that in a disaster those resources would not be available for debris removal and similar tasks. The intent of this review is not to say that sustainability goals should not be pursued, but rather to identify areas of concern that should be considered during implementation of these goals. For example, evacuation plans may need to be revised to reflect a larger percentage of families without cars; or contracts may need to be put in place to obtain additional dump trucks in a disaster.

7.4 Continued Public Involvement

Continued public involvement is also imperative to the overall success of the Plan's implementation. The adopting jurisdictions will post the updated HMP on their websites for reference and will use it to help inform their ongoing public education and outreach program. The completion of mitigation actions that reduce the community's vulnerability can be shared with the public through forums like the Local Emergency Planning Committee (LEPC), public meetings, and through social media. This helps keep the concept of hazard mitigation alive and helps show the public that their government officials are working to keep them safe.

The update process provides an opportunity to publicize success stories from the Plan implementation and seek additional public comment. When the Planning Team reconvenes for the five-year plan update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the plan. The plan maintenance and update process will include continued public and stakeholder involvement and input through participation in designated committee meetings, surveys, web postings, and press releases to local media.