Bernalillo County/City of Albuquerque/ Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA)/Village of Los Ranchos de Albuquerque/Village of Tijeras Hazard Mitigation Plan

FIRST DRAFT PLAN
August 2014

Prepared --by Bernalillo County, the City of Albuquerque, AMAFCA, the Village of Los Ranchos de Albuquerque, and the Village of Tijeras

Technical Assistance provided by URS Corporation of Albuquerque, NM & Germantown, MD

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Reviewers, please NOTE:

The attached document is a <u>Draft</u>: This document is intended to be a working document for local and public review. We anticipate comments and encourage your feedback on all aspects of the report. The deliverable at this stage:

- May includes certain sections that require additional data, addition of limited missing data in tables, appendices, etc.
- Includes a few citations that have yet to be found.
- Has not received a technical edit. Writing should be generally unified, but may still need smoothing in terms of style and voice.
- Depending on the comments received from local officials and the public, there may be another iteration of this level of report.

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Acronym List

CABQ	City of Albuquerque
AMAFCA	Albuquerque Metropolitan Arroyo Flood Control Authority
BOR	Bureau of Reclamation
CDBG	Community Development Block Grant
CEDS	Comprehensive Economic Development Strategy
cfs	cubic feet per second
DEM	Digital Elevation Model
DMA2000	Disaster Mitigation Act 2000
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information Systems
HMP	Hazard Mitigation Plan
HMPT	Hazard Mitigation Planning Team
HUD	US Department of Housing and Urban Development
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Services
QA/QC	Quality Assurance and Quality Control
SOW	Scope of Work
THIRA	Threat and Hazard Identification and Risk Assessment
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USFS	United States Forest Service
WSEL	Water Surface Elevation

PLACEHOLDER

For Bernalillo County/City of Albuquerque/ AMAFCA / Village of Los Ranchos de Albuquerque/Village of Tijeras

Adoption Resolution

(Once the Plan is 'Approvable' by FEMA Region VI, the Plan shall be formally adopted and the adoption resolutions provided.)

1 Introduction

This section provides a general introduction to the Bernalillo County Hazard Mitigation Plan Update. The Bernalillo County Hazard Mitigation Plan was originally developed, adopted and approved in 2007. This document contains the Bernalillo County's Hazard Mitigation Plan Update incorporating a number of revisions and refinements to the original plan content. This Plan analyzes the 12 natural hazards presenting the greatest threat to the planning area. Two additional hazards identified in the state plan were reviewed but were excluded from additional consideration as they present little to no risk to the planning area. Each of the five participating jurisdictions reviewed the hazards, independently ranking their relevance to the participating municipality. The Plan Update includes a detailed characterization of relevant natural hazards in Bernalillo County; a risk assessment that describes potential losses to physical assets, people and operations; a set of goals, objectives, and actions that will guide the county and participation jurisdiction's mitigation program in coming years; and a detailed strategy for implementation and monitoring results.

Bernalillo County has made great strides in reducing potential disasters such as flooding, wildfires, and drought. **Section 5.2**, "Previous Mitigation Action Update", demonstrates that the County and its municipalities not only implemented an impressive amount of actions from the previous plan update, but also undertook additional actions beyond those listed in the Plan. Both the County and its incorporated municipalities have adopted ordinances, land use regulations and building codes that are effective policies for mitigating hazards. Zoning regulations prevent construction in hazard-prone areas such as floodplains, and building codes ensure that new buildings are constructed to withstand severe weather and earthquakes. Participation in the National Flood Insurance Program (NFIP) for the County and its municipalities, and the Community Rating System (CRS) program for the County and the City of Albuquerque helps identify areas prone to flooding and to reduce potential damage caused by flooding. Many agencies and departments have some responsibility in mitigating hazards but most of the effort is done piecemeal, i.e., there is not a coordinated effort to address hazards in a comprehensive fashion. This Plan outlines a strategy for a coordinated effort across jurisdictional and departmental lines.

In 2000, the U.S. Congress passed the Disaster Mitigation Act (DMA2000) which encourages local, tribal, and state pre-disaster planning and requires local mitigation plans as a condition of receiving Hazard Mitigation Grant Program (HMGP) project grants. As an incentive to create mitigation plans, the Federal Emergency Management Agency (FEMA) makes grants available to fund local and state mitigation planning efforts such as this one. With funding from the New Mexico Department of Homeland Security and Emergency Management (NMDHSEM), the Bernalillo County / City of Albuquerque Mitigation Planning Team, composed of county and municipal officials, prepared this *Bernalillo County / City of Albuquerque / AMAFCA / Village of Los Ranchos / Village of Tijeras Hazard Mitigation Plan, New Mexico.* The Plan is the result of

months of work to develop a multi-jurisdictional, multi-hazard mitigation plan that will guide the County toward greater disaster resiliency.

This Hazard Mitigation Plan update focuses on the hazards with the highest potential for causing damage to buildings and other physical assets, injuries and fatalities to the residents of Bernalillo County and disruption of government and business operations in the area. These hazards include High wind, severe thunderstorms (including hail and lightning), floods, wildland fire, drought, severe winter storms, extreme heat, earthquake, and tornadoes. Additional hazards, identified in the State of New Mexico Mitigation Plan are also discussed.

This section consists of the following subsections:

- Vision and Purpose of the Plan
- Bernalillo County Community Description and Geography
- Scope
- Authority
- Summary of Plan Contents

1.1 Vision and Purpose of the Plan

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 Bernalillo County to re-establish itself in the wake of a larger disaster event, becoming more resilient with less disruption to services and businesses.

FEMA Definition of Hazard Mitigation:

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

An emphasis was placed on wildfire, high wind events, thunderstorms (including lightning and hail), and flood, as these are considered to pose the greatest threat to the planning area. Six other natural hazards that are part of the 2013 State of New Mexico Hazard Mitigation Plan were considered to pose a lower risk to the planning area are also profiled in this update.

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 the comprehensive plans of the County and its municipalities, 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 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 county a safer place to work, visit, and live
- Restore and preserve Bernalillo County's natural and recreational resources
- Help the county 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

From FEMA March 2009 Comprehensive Planning Guide (CPG-101):

"Planning has a proven ability to influence events before they occur and is an indispensable contribution to unity of effort"

The 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.

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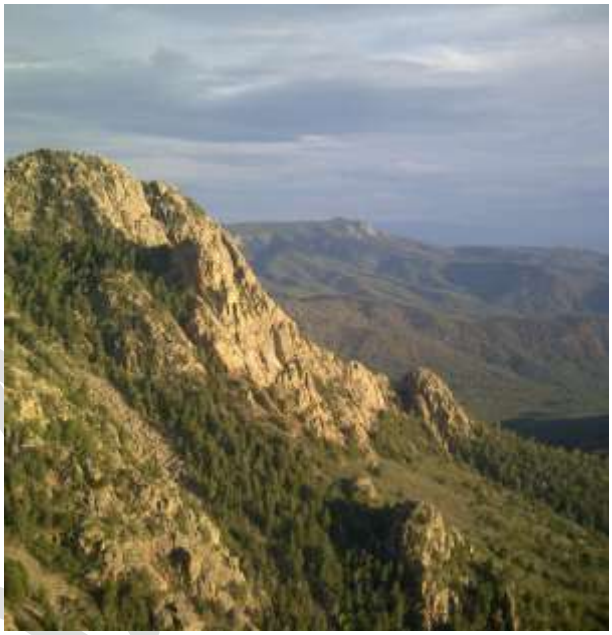
1.2 Bernalillo County Planning Area: History, Demographics, and Geography

Bernalillo County

Bernalillo County is located in central New Mexico, and stretches from the Sandia Mountains in the eastern portion of the county, to the high desert grasslands above the Rio Grande Valley on the western edge. The County consists of an area of nearly 1200 square miles and a population of over 662,564 according to the 2010 US Census. This represents an increase of just over 105,000 people from 2000 (19 percent) with most of the growth in the City of Albuquerque (97,000 people). The number of housing units in the region grew by 45,160[1]. The unincorporated portion of the County had a 2010 population of 110,147, a 7.5% increase from its 2000 population of 102,505.



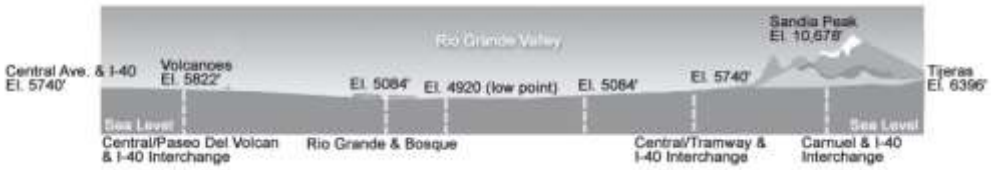
Bernalillo County is represented by five elected officials and five county Commissioners. The Assessor, Clerk, Probate Judge, Sheriff, Treasurer, are elected county-wide and the Commissioners by districts. A County Manager oversees 25 other departments that range from Animal Regulation to Zoning. The County is bordered by Sandoval County to the north, Torrance and Santa Fe Counties to the east, Cibola County to the west, and Valencia County to the south.

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. Elevations in Bernalillo County range from 10,678 at Sandia Peak to 4,920 in the Rio Grande Valley. 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 Rio Grande Valley itself which is a wooded greenbelt. The Valley has two distinct areas: the North Valley and South

[1] Mid-Region Councils of Government website, http://www.mrcog-nm.gov/region-a-people Accessed June 2014

Valley. At the far western boundary is an ancient lava flow which forms an escarpment (cliff) where it meets the mesa.

Figure 1.1: Cross-section of Bernalillo County, NM



Source: Albuquerque-Bernalillo County Comprehensive Plan 2013

The County has three municipalities (Albuquerque, Los Ranchos de Albuquerque, and Tijeras) and a number of unincorporated villages and communities, especially in the East Mountains area (the eastern part of the County on the eastern slope of the Sandias) including Chilili, Juan Tomas, Escobosa, Ponderosa Pine, Cedro, San Antonio, Sandia Park, Cedar Crest, Sedillo, and Carnuel. The East Mountain area overall encompasses 316 square miles of eastern Bernalillo County. The western and southern portion of the East Mountain Area is primarily under control of the Cibola National Forest.

It also includes a flood control authority, the Albuquerque Metropolitan Arroyo Flood Control District (AMAFCA), that manages the primary drainage system. Part of the county's area are Native American tribes including the Isleta Pueblo (south and also into Valencia County), Laguna Pueblo and the To'Hajilee chapter of the Navajo Nation (to the west), and part of the Sandia Pueblo (to the north) which is primarily in Sandoval County. The tribes and the National Forest will be part of the Plan's coordination efforts and are not part of the participating jurisdictions. Tribes generally prepare separate hazard mitigation plans.

The Bernalillo County and Albuquerque area is 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 flood plain 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 has 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, and presence of Albuquerque has made the County a desirable place to live for centuries. In the last decade, the County increased its population by 7.5% (from 2000 to 2010). Most of this growth can be seen in increased housing (residential) and businesses (commercial), and the reduction in farm land. The various types of land uses

(commercial, residential, industrial, ~~agricultural~~and agricultural, etc.) make up the character of Bernalillo County. However, despite the rapid growth, the County and its municipalities have expressed a strong desire to preserve and protect its unique heritage and lands as witnessed by the 140 properties on the National Historic Register.

The County is 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 Interstate-40 in certain areas, and becomes Central Avenue in the Nob Hill neighborhood of Albuquerque.

Three municipalities have been incorporated to date: the City of Albuquerque (1891), the Village of Los Ranchos de Albuquerque (1958), and the Village of Tijeras (1973). Combined, these municipalities include approximately 83% of the total population of the County with most of the population in Albuquerque, the state's largest city. Although the municipalities, especially Albuquerque contain most of the major commercial centers in the County, some commercial and industrial development occurs in the unincorporated county areas. 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.

Figure 1.2: Bernalillo County, NM

Source: Bernalillo County GIS https://www.bernco.gov/Download-GIS-Maps/ Accessed June 2014

Overall, the Albuquerque metropolitan area is growing at a rate of 1 to 2 percent a year for a projected 7.2 percent over a 5-year timeframe[2].

City of Albuquerque

The City of Albuquerque (CABQ) is the state's largest City and is located within Bernalillo County. In 2010, it had a population of 545,852, a 21.7% increase from its 2000 population of 448,607. It 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. 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. (http://www.abq.org/) 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 to the south). 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

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 with just over 4 square miles and a population of approximately 6,024, an 18.3% increase from its 2000 population of 5,092. The governing body consists of a Mayor and Board of Trustees (four) and they serve 4-year terms, the trustee terms are staggered. There are seven Planning and Zoning Commissioners, appointed by the Mayor and approved by the Board of Trustees.

Los Ranchos hosts the Los Ranchos Growers' Market from May to November and the Lavender in the Village festival. Los Ranchos is a popular tourist area with several nearby wineries.

[2] http://www.abq.org/demographics.aspx Accessed August 2014

Village of Tijeras

The Village of Tijeras is the only incorporated municipality within the East Mountain Area. In 2010, it had a population of 541, a 14.1% increase from its 2000 population of 474. The Village of Tijeras has a draft zoning map with accompanying regulations, and a development policy plan. The Interstate-40 corridor splits the area into two ~~subregions~~sub regions. Historic Route 66 (know 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).

Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA)

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. AMAFCA was not a participating jurisdiction in the previous Plan but because of its core mission of flood protection, it was a logical choice for addition in the Plan update. AMAFCA may also consider applying for future FEMA mitigation grants and its participation in the development of this Plan will help position it for future grant consideration.

AMAFCA maintains the following types of structures in Bernalillo County (a map of the location of the structures is better accessed at the following site: http://www.amafca.org/documents/Maintenance_Map_2014web.pdf):

- **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.

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

Tribal Lands

Bernalillo County contains tribal lands for three Pueblos: Islеta 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, Islеta, and Laguna Pueblos all have major casinos located in Bernalillo County but virtually no residential population within the County. To'hajiillee, 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 generally will produce their own mitigation plans or participate in planning efforts where their seats of government are located.

Table 1.1 - Major Institutions and Infrastructure in the Bernalillo County/City of Albuquerque area

Type of Institution / Infrastructure	*Description of Infrastructure/Institution*

Vehicular	Bernalillo County and the City of Albuquerque are 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
Airports	Albuquerque's International Sunport 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, handle general aviation services
Rail Transportation Routes	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.
Water/ Wastewater	The water and wastewater utility is jointly operated by the Albuquerque Bernalillo County Water Utility Authority (the Authority). Albuquerque's water is currently 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 also owns 48,200 acre-feet of water from the San Juan-Chama Diversion Project in Northern New Mexico, to provide water for future development. 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.
Albuquerque Public Schools	Has approximately 90,000 students
University of New Mexico	Has approximately 34,700 students
Central New Mexico Community College	The institution formerly known as the Albuquerque Technical and Vocational Institute has approximately 35,000 students
Kirtland Air Force Base (KAFB)	KAFB occupies a large area on the south side of the county, employs over 23,000, and is home to the Air Force Laboratory.
Sandia National Laboratories	Employs over 8,000 people in Albuquerque and is located within KAFB. It is a multi-program lab primarily conducting national defense

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	research and development (R&D), energy and environment projects.

1.3 Plan Scope

The planning process included five major elements (see **Table 1.1**) that were completed over the course of approximately XXX months starting in February 2014. The completion of each of these planning elements contributed to the overall Hazard Mitigation Plan. These elements make up several sections of the Plan as described in detail in **Section 1.5:** ***Summary of Plan Contents***. The overall purpose of mitigation planning is to document the best risk information possible so that it can be used to establish a sustainable on-going process that results in actions to lower the risk. Due to the large scope of mitigating the risk from natural hazards, the Plan helps the county and participating jurisdictions establish both short-term and long-term goals.

Table 1.2: Hazard Mitigation Planning Phases
Phase 1. Planning Process including Pre-Kickoff and Kickoff Meetings
Phase 2. Hazard Identification, Analysis and Risk Assessment
Phase 3. Mitigation Strategy including Capability Assessment, Assessment of Alternative Hazard Mitigation Measures, and Implementation Strategy
Phase 4. Plan Monitoring, Evaluation, and Updating
Phase 5. Plan Adoption

In developing this Plan, URS followed the most up-to-date FEMA guidance available, the March 2013 Local Mitigation Planning Handbook, and the most current State Mitigation Plan that was available, the September 2013 State of New Mexico Natural Hazards Mitigation Plan.

1.4 Authority

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

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- 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 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.

1.5 Summary of Plan Contents

The remaining contents of this Plan are designed and organized to be reader-friendly and functional. **Section 2: *Planning Process*** (Phase 1), provides a complete narrative description of the process used to prepare the Plan. This includes identification of the planning process participants and descriptions of the meetings. Documentation of the process is in **Appendix A** which includes meeting attendance records, meeting minutes and other results of planning meetings.

The Hazards Identification, Analysis, and Risk Assessment phase (Phase 2) is presented in two sections - **Section 3: *Hazard Identification*** and **Section 4: *Hazards Analysis and Risk Assessment*.** **Section 3** identifies the natural hazards addressed in this Plan (the 14 from the 2013 State of New Mexico Hazard Mitigation Plan). **Section 4** outlines the county's risk from these hazards.

The Risk Assessment provides a record of available historical data from past hazard occurrences and detailed hazard profiles which included general probabilities of recurrence, the spatial extent of the hazard, and its potential impact. The risk assessment serves a critical function as the county and participating jurisdictions seek to determine the most appropriate mitigation actions to pursue and implement – enabling them to prioritize and focus efforts on those hazards of greatest concern and those structures or planning areas facing the greatest risk(s).

The ***Mitigation Strategy*** (Phase 3), consists of two sections – **Section 5**: ***Mitigation Goals, Objectives and Actions***, where mitigation actions to address vulnerabilities identified in **Section 4** are placed, and **Section 6**: ***Implementation Plan*** which includes a capability assessment. The capability assessment describes the regulations and policies in the planning area relevant to addressing the identified hazards. The mitigation actions provide specific implementation mechanisms and target completion dates. The actions are prioritized to help focus future efforts. Together, these sections are designed to make the Plan both strategic (through the identification of long-term goals) but also functional through the identification of short-term and immediate actions that will guide day-to-day decision-making and project implementation.

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In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program, regulatory, and policy mitigation alternatives. These types of actions can also help achieve other economic, social and environmental goals. Each action was evaluated for its appropriateness for the planning area.

Plan Maintenance Procedures (Phase 4), found in **Section 7**, includes the measures that the county and participating jurisdictions will take to ensure the Plan's continuous long-term implementation. These procedures provide a framework to keep the plan current, dynamic, and effective so that over time that becomes integrated into the routine decision making process. The procedures also describe how the Plan will be regularly evaluated and updated to remain a current and meaningful planning document and meet FEMA requirements.

For Phase 5, **Plan Adoption**, a resolution for adoption of this Plan will be placed right after the Table of Contents once the Plan has been 'approved pending adoption' by FEMA and each participating jurisdiction passes a resolution.

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2 Planning Process

While the hazard mitigation plan update is the final product, it is the planning process, where community resources are organized to best minimize or manage those risks, which is the true legacy of this effort.

This section consists of the following subsections:

- Hazard Mitigation Planning Team
- Data Collection
- Meetings
- Public Involvement and Outreach
- The State Hazard Mitigation Plan
- Agency and Organization Coordination
- Future Development Trends

2.1 Hazard Mitigation Planning Team (HMPT)

On January 9th, 2014, Bernalillo County entered into a contractual agreement with the consulting firm URS Group, Inc. (URS) for assistance in the preparation of the Bernalillo County Hazard Mitigation Plan Update. Participating jurisdictions include Bernalillo County, the City of Albuquerque, the Village of Los Ranchos, the Village of Tijeras, and AMAFCA. The funds for the contract were from a hazard mitigation planning grant approved by the Federal Emergency Management Agency (FEMA) and the State of New Mexico Department of Homeland Security and Emergency Management (DHSEM). The planning lead from Bernalillo County is Ms. Kelli Murtagh, Bernalillo County Homeland Security and Emergency Management Coordinator. The lead from CABQ is Mr. Roger Ebner, the Director of Emergency Management for the city.

URS was led by an experienced professional hazard mitigation planner, Mr. Lawrence Frank, who has a Master's Degree in Land Use and Environmental Planning and is Certified Floodplain Manager (CFM); with assistance from another experience professional mitigation planner, Ms. Rhonda Murphy, CFM, and was managed by Mr. Jim DeAngelo, an experienced project manager leading the Albuquerque office Hazard Mitigation Team. URS and the participating jurisdictions followed the hazard mitigation planning steps, activities and process outlined in 44 CFR Part 201.6 and FEMA's Local Mitigation Planning Handbook to develop this Plan. The completed Mitigation Plan Review Tool in **Appendix B** provides the location of where each requirement is met within the Plan.

The HMPT consists of the following members from a wide range of departments, representing each participating jurisdiction:

Table 2.1: Bernalillo County HMPT

Name	Title
Kelli Murtagh	Bernalillo County Emergency Manager
Roger Ebner	City of Albuquerque Office of Emergency Management Director
Gary Surad	Bernalillo County Deputy Emergency Manager
Fred Hogan	City of Albuquerque Planning Official
David Downey	City of Albuquerque Fire Department
Vic Padilla	City of Albuquerque Fire Department
Peter Ennen	City of Albuquerque DFAS/Risk
Gary Jones	City of Albuquerque EOC Officer
Lois Blocker	City of Albuquerque Building Inspector
Greg Smith	City of Albuquerque Municipal Development (DMD)
Wilfred Gallegos	City of Albuquerque DMD Deputy Director
Land Clark	City of Albuquerque Chief Building Official (Building Safety)
Kaitlin Greenberg	City of Albuquerque EHD (EPI Specialist)
Hal Senke	City of Albuquerque EHD
Bill McCarty	Albuquerque Bernalillo County Water Utility Authority
Evelyn Chacon	Bernalillo County OHSEM
Donna Hernandez	Bernalillo County OHSEM
Frank Barka	Bernalillo County Fire Department
Jarvis Middleton	Bernalillo County Public Works
Kurt Wagener	AMAFCA Field Engineer
Bryan Wolfe	City of Albuquerque Planning
M. Conrad	City of Albuquerque Planning
Curtis Cherne	City of Albuquerque Planning
Christopher Romero	City of Albuquerque Animal Welfare Dept (AWD) Field Supervisor
Joel Craig	City of Albuquerque AWD Operations Manager
Doug Walton	Albuquerque Police Department Homeland Security
Bill Slauson	City of Albuquerque Police Department
Kevin Daggett	City of Albuquerque Storm Drainage Manager
Fred Montano	Albuquerque Public Schools (APS)
Van Lewis	Albuquerque Public Schools (APS)
Jenn Daniel	Bernalillo County Health and Social Services
Veronica Espinosa	Bernalillo County Risk Fiscal Officer
Kevin Kinzie	Bernalillo County Risk Management
Elizabeth Eastman	City of Albuquerque EPI Specialist
Don Briggs	Bernalillo County Floodplain Administrator
	Village of Tijeras
Jeff Phillips	Village of Los Ranchos
Kevin Dodge	New Mexico DHSEM Mitigation Specialist
Navida Johnson	New Mexico DHSEM Mitigation Intern
Sandra Simonson	FEMA Region VI Mitigation Division

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The HMPT is leading the hazard mitigation effort for the planning area and will continue the planning process past approval into implementation and then a future update.

2.2 Data Collection – Existing Plans and Programs

The HMPT and URS were diligent in collecting best available and updated data during the 2014 hazard mitigation planning process. The following plans, studies and reports were evaluated for opportunities to integrate information related to hazard mitigation and incorporated into this planning process where appropriate:

- ***Amended Through 2013 Albuquerque/Bernalillo County Comprehensive Land Use Plan*** - The Plan provided good information about existing resources, land uses and development in CABQ and the county, as well as goals and objectives for future development. The plan includes recommended actions to limit development on steep slopes, create open space along arroyos and ditches, use drought tolerant landscaping, and use natural drainage and infiltration facilities to irrigate parks, golf courses, and open spaces. For rural areas, it includes a policy to carefully control development in floodplains and valley areas including mapping low density zoning districts in environmentally sensitive areas. It also includes helping maintaining a City/County major open space acquisition fund, a Capital Implementation Program, policy to encourage maximum absorption of precipitation, and maintain emergency preparedness capabilities.
- **Los Ranchos 2020 Master Plan –** This plan available on-line at http://www.hdts.net/losranchosnm/los-ranchos-2020-master-plan/index.html emphasizes maintaining the character of the village including low density lots.
- ***2010 Bernalillo County Emergency Operations Plan*** – The EOP included hazard-specific appendices, a concept of operations section for mitigation, a damage assessment subsection, a Long-Term Community Recovery subsection and annex, and descriptions of critical infrastructure and facilities. The Plan also includes a Natural and Cultural Resources and Historic Properties annex (annexes and most hazard-specific appendices not available with the EOP document available on-line).
- ***2013 State of New Mexico Natural Hazard Mitigation Plan Update*** - A summary of the latest update of the State Mitigation Plan was used to inform this Plan is summarized in **Section 2.5**.
- ***2012 Albuquerque Bernalillo County Water Utility Authority Water Resources Management Strategy Implementation Drought Management Strategy***- Includes conditions for issuing Drought Advisories and Drought Emergencies to reduce water use in droughts.

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- ***2013-2022 CABQ Decade Plan for Capital Improvements*** – Includes 10-year plan for funding of infrastructure and facilities including plans to fund and implement multiple storm drainage projects.
- ***2010-2020 City of Albuquerque and Bernalillo County Facility Plan (adopted in 2011/2012) –*** Plan for siting new electric power transmission and generation facilities in the future. Gives special consideration to potential conflicts with Special Flood Hazard Areas (p. 5). Also provides listing of proposed electric facility projects through 2020 (Table 5; pdf p.42)
- ***2009 Bernalillo County /International Sunport (major airport) Station Area Sector Development Plan –*** Developed "to guide quality development in an area that is semi-rural and industrial in nature and to provide a mixture of use more suitable for the area surrounding the International Sunport Rail Station".
- ***Vulnerability Assessment of Downtown Albuquerque (2012) –*** This document provides an assessment of vulnerability in downtown Albuquerque through a study of the history of disasters, interviews with key emergency management personnel, and critical infrastructure identification. Three recommendations in the assessment to improve disaster planning and minimizing the effects of disasters are:
    - Evaluate of earthquake vulnerability using FEMA's Hazus program
    - Implement an emergency notification system that targets specific regions or groups in the city
    - Contact NMDHSEM for assistance in the creation of a disaster recovery plan for CABQ.
- **Sector Development/Neighborhood/Corridor Development Plans include:**
    - ***2013 Bridge Boulevard Corridor Redevelopment Plan –*** Encourages sustainable development practices including drought-resistant vegetation and stormwater drainage (surface runoff directed to landscaped areas). Infrastructure Development Zones (IDZs) are quasi-municipal corporations allowed for commercial or residential development that can be used also for improvements to drainage and flood control systems.
    - **Amended 2011 Isleta Boulevard and Village Centers Sector Development Plan Volume I –** This plan for parts of the South Valley includes design overlay zones in plan include simple and effective low-impact stormwater drainage approaches and techniques.
    - **2012 Los Duranes Neighborhood Plan (Sector Development) –** A neighborhood in both CABQ and the County that includes area near the Rio Grande that were subject to regular flooding until dams, drains and levees were constructed to control flooding. The area is protected by the Rio Grande levee and is subject to stormwater flooding. The plan includes use of water harvesting areas in available green and pervious spaces. Some fire control measures suggested in comments section. Includes implementation strategies to preserve open space,

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important in the Rio Grande area. It also includes strategies to preserve the acequia system.

- **2006 East Mountain Area Plan –** Includes policies to address water conservation and drought. Applications for subdivision development must include a fire mitigation plan. Fire-resistant materials are encouraged for development in forested areas. Seeks to establish construction guidelines for water conservation measures and possible wastewater re-use. Encourages preservation of arroyos and streams and requires these to be placed on maps. Requires an overall drainage management plan to be prepared.
- **2007 Tijeras Canyon/Carnuel Plan –** The policies in this plan include large-lots to maintain the character's area and mentions the desire of residents to restore the Tijeras Creek. Tijeras Arroyo and some tributaries are included in FEMA FIRMs.

- ***2011 Update of East Mountain Community Wildfire Protection Plan* (CWPP)** – Evaluated plan for wildfire risk assessment background information, including wildfire hazard mapping and rating, and mitigation project ideas including fuel reduction, encourage defensible space, and encourage Firewise Community participation. Captured appropriate information and project ideas for this plan.
- ***2002 Bernalillo County Wildland Urban Interface Area Inventory Assessment* –** The assessment document evaluates 42 areas identified by the Bernalillo County Fire Department as Wildland Urban Interface areas. In each area, a hazard rating was assigned based on observed conditions of terrain, water availability, quality of defensible space, building construction, vegetative fuels, access, and distance to fire apparatus.
- ***CABQ THIRA*** – Includes a hypothetical scenario involving a large-scale flood event. Included in **Appendix C**.
- ***AMAFCA Floodfighting Annex* –** Also provided in **Appendix D**.

2.3 Meetings

The members of the HMPT were solicited for their voluntary participation in the development of the Plan. An equal opportunity was given to all planning area residents to participate in the process through public announcements /notifications. HMPT meetings were open to the public and all attendees were encouraged to participate in exercises and discussions. All meeting materials were available online prior to a scheduled meeting. It was the goal of this Plan to have a committee that represented a broad spectrum of community stakeholders, including representatives from city government, emergency response organizations, health care, private businessmen, and local environmental agencies.

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The HMPT met several times during the course of preparing this plan. The meetings described below are the formal ones for this planning process. Documentation for these meetings is located in **Appendix A**.

February 27, 2014 Kickoff Meeting – The Kickoff Meeting was the first formal planning meeting after Bernalillo County officially contracted with URS to prepare the plan. Kelli Murtagh of Bernalillo County and Roger Ebner of CABQ opened the meeting and introduced Jim DeAngelo as a contractor with URS to assist in completion of the plan update. Mr. DeAngelo facilitated this meeting which was attended by 33 members of the HMPT. Mr. DeAngelo discussed the overall planning process including the data collection process, hazard identification, risk assessment and the mitigation strategies. Emphasis was given to linking the risk assessment to the mitigation strategy. Ms. Murtagh and Mr. Ebner provided URS with information on where to get documents that captured important planning information from the county and participating jurisdictions. Sandra Simonson and Cheryl Copeland, FEMA Region VI Hazard Mitigation Planners, attended the meeting. A Hazard Mitigation Planning Survey was completed by HMPT members during the meeting. Both Bernalillo County and the City of Albuquerque post meeting materials to their respective websites to keep the public informed.

June 19, 2014 Risk Assessment Meeting – The Risk Assessment Meeting was the second formal planning meeting in the planning process. This meeting was facilitated by URS (Jim DeAngelo and Lawrence Frank) and attended by 20 members of the HMPT and interested parties. Mr. DeAngelo opened the presentation with an overview of the meeting purpose and the identified hazards to review. The presentation provided the status of the hazard profiles developed to date, with emphasis on the more significant hazards posing a threat the planning area. The statuses of all mitigation actions identified in the 2007 Plan were reviewed for the update. Actions that were not implemented since the 2007 Plan were discussed and reviewed for relevancy. A range of mitigation actions were discussed for each relevant hazard. The public survey was discussed. Meeting participants were asked to complete a survey form at the end of the presentation. Completed surveys were collected at the end of the meeting. Mr. Frank and Mr. DeAngelo closed the meeting with a brief review of the project schedule.

August 21, 2014 Final Meeting and Public Meeting [UPCOMING] –It is expected that the HMPT will review the projects, determine basic prioritization and fill in gaps. It is expected that the HMPT will also decide how many times they will meet in the future once the Plan is approved. A follow-up meeting for the public will be held afterwards.

2.4 Public Involvement and Outreach

The HMPT pursued a number of avenues for notifying Bernalillo County residents of this planning initiative. The planning team met several times during the course of preparing this plan, as detailed in the previous section. HMPT meetings had a wide variety of representation and all attendees were encouraged to participate in exercises and discussions.

A public survey was developed to increase public input. This survey was posted electronically on the ~~c~~County and CABQ website before the August 21st HMPT meeting, which also had a public meeting following it, and was also distributed in paper format at public meeting. It was available for 3-4 weeks on-line and the public was notified through websites, ads in neighborhood newspapers, xxx and xxx. ____ surveys were submitted to the planning team. The public input was useful as a gauge on the perception of risk to the different hazards and for mitigation action ideas. A summary of the survey results is located in **Appendix A**.

2.5 The State Hazard Mitigation Plan and Mitigation Program

The State of New Mexico finalized its hazard mitigation plan update during the development of this Plan. The updated State Plan was a critical document to review for this Plan and a valuable resource for risk assessment background information. The State Plan was reviewed for information on natural hazards and mitigation project ideas so the Bernalillo County's Plan was consistent with State information.

The State Hazard Mitigation Plan states that the goal of mitigation is the following:

> "…is to save lives, reduce injuries, property damage and recovery times. Mitigation can reduce the enormous cost of disasters to property owners and all levels of government. In addition, mitigation can protect critical facilities, reduce exposure to liability and minimize community disruption. Preparedness, response, and recovery measures support the concept of mitigation and may directly support identified mitigation actions."

The Bernalillo County Plan addressed 12 natural hazards covered in the State Plan. Not all hazards in the State Plan have a significant impact in the planning area; if a hazard has a very low probability of occurring and/or has negligible impact (and therefore is considered a nuisance), this is noted in **Section 4**.

The Local Plan Integration section of the State Plan lists four hazards as the most significant in the state:

- Floods
- Wildfires
- Drought

- Thunderstorms

The State Plan divides New Mexico into five preparedness areas. Bernalillo County is included in Preparedness Area #5, along with Sandoval, Valencia, Torrance, and Socorro Counties. In State Preparedness Area #5, three hazards were ranked as the highest priority:

- Floods/Flash Floods
- Severe Winter Storms
- Wildfire

The State's mitigation goals were also reviewed and are closely aligned with Bernalillo County's goals:

- Reduce the number of injuries due to natural hazards
- Reduce the number of fatalities from natural hazards
- Reduce the amount of property damage, both public and private, from natural hazards
- Reduce the number of necessary evacuations
- Shorten recovery times for both community function and the natural environment after natural hazard events
- Improve communication, collaboration and integration among State, tribal and local emergency management agencies
- Increase awareness and understanding of risk and opportunities for mitigation among the citizens and elected officials of New Mexico

The State Plan was reviewed for mitigation action best practices and types of mitigation actions appropriate for Bernalillo County. The State has been a valuable partner of Bernalillo County and provided technical assistance during the development of this Plan.

2.6 Agency and Organization Coordination

From the beginning of the planning process until the final drafting of this Plan, Bernalillo County has actively coordinated with state and federal agencies to discuss and evaluate risk reduction activities. Both the State and FEMA have participated in most of the Bernalillo County HMP plan meetings. The development of this Plan included consideration of several other plans listed in **Section 2.2** and vital contributions from DHSEM and FEMA.

2.7 Future Development Trends

The HMPT examined Bernalillo County's existing limits, urban services boundary, and capital improvement program to determine areas of future growth and expansion. The team also

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examined the City of Albuquerque/Bernalillo County Comprehensive, amended through 2013, as well as other plans available from each participating jurisdiction.

Areas of future development include XXX.

3 Hazards Identification

In 2013, the NMDHSEM updated its State Hazard Mitigation Plan and identified 14 natural hazards which had the greatest impact on the State:

Table 3.1 Hazards Identified in State Plan

Hazard Category	Hazard Type
Atmospheric	Extreme Heat High Wind Thunderstorm (Hail/Lightning) Tornado Severe Winter Storms
Hydrologic	Drought Flood
Geologic	Earthquake Expansive Soils Land Subsidence Volcano Landslide
Other	Wildland/Urban Interface Fire Dam Failure

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. All hazard-specific information and analysis for profiled hazards is provided in **Section 4**. Several

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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 evaluation are summarized as follows:

- **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[3]. The 2013 State Plan states that there are no estimates of future occurrence of volcanic activity in New Mexico in the near future. New Mexico's numerous volcanoes are considered dormant, but not extinct. The State Plan reports an extremely low probability of a volcano in the next 10 years (.01%) 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.

All hazard-specific information and analysis is provided in **Section 4**.

3.1 Major and National Emergency 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.[4]

Since 1954, Bernalillo County received four presidential or emergency disaster declarations for flood and wildfire as listed in **Table 3.2.** Please note that this listing does not include all state or local emergency declarations issued for localized disaster events that did not warrant a presidential or federal emergency declaration.

[3] Kues, Barry S., and Callender, John, F., 1986, Geologic History, Contribution to New Mexico in Maps, edited by Jerry L. Williams: University of New Mexico Press.)
4 For more information on the disaster declaration process and federal disaster assistance, see http://www.fema.gov/disasters Accessed October 2013

Table 3.2: Four Presidential and Emergency Disaster Declarations in Bernalillo County (1954 – July 31, 2014)

Event	Declaration Date	Declaration Number
New Mexico Fire (Emergency Declaration)	05/10/2000	FEMA-3154-EM
New Mexico Wildfire	05/13/2000	FEMA-1329-DR
Severe Storms and Flooding	04/29/2004	FEMA-1514-DR
Severe Storms and Flooding	09/30/2013	FEMA-4148-DR

Source: Federal Emergency Management Agency

4 Hazards Analysis and Risk Assessment

In this section of the Plan, the HMPT reviewed the 14 natural hazards identified in the State HMP. Each hazard was reviewed for its potential to impact the planning area. 12 hazards were selected based on the historical record and expertise of the HMPT members, as having the greatest potential for significant impact on Bernalillo County and the participating jurisdictions. These hazards are profiled including a detailed description and analysis of each one. For each hazard type, the Plan describes the locations that can be affected, the potential severity, and previous occurrences of the hazard in Bernalillo County. This information is used to estimate the probability of an occurrence of the hazard in any given year. The plan describes the impact of each hazard and the planning areas vulnerability to it. Two hazards, Volcano and Land Subsidence, were determined to be insignificant to the planning area, posing little to no threat. These hazards were not addressed further in the Plan.

4.1 Methodology

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

1. Experience, input and knowledge from the HMPT as captured in site visits, meetings, and surveys
2. Existing local plans and data
3. The National Climactic Data Center (NCDC) information

4. The September 2013 New Mexico State Hazard Mitigation Plan.
5. Studies, data, and reports by USACE and other federal agencies
6. The FEMA 2014 Disaster Declaration database on the FEMA.gov website
7. Resources published on the Internet with relevant information. These sources are referenced in footnotes.

Each hazard profile is organized in the following manner:

- *Overview* – General description of the hazard
- *Location and Spatial Extent* – Specific areas in Bernalillo County that may be affected and the extent. Any available maps displaying risk are shown.
- *Previous Occurrences* – List and description of past events where available.
- *Probability and Extent of Future Events* – Establishes the likelihood of the hazard occurring annually and extent of damages if it occurred (severity)
- *Vulnerability and Impact* – The level of impact currently and on future development
- *Conclusions* – Includes summary statements about the hazard, any mitigation accomplishments, and establishes link to Mitigation Actions in **Section 5**.

In each hazard profile, hazards are assigned varying degrees of risk in five categories probability, impact, spatial extent, warning time, and duration) as shown in **Table 4.1**.

	Table 4.1: Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Highly Unlikely	Probability so remote close to 0% annual probability	0	40%
	Unlikely	Less than 1% annual probability	1	
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 50% annual probability	3	
	Highly Likely	Between 50 to 100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	20%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than 1 week.	3	

	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self explanatory	1	10%
	12 to 24 hours	Self explanatory	2	
	6 to 12 hours	Self explanatory	3	
	Less than 6 hours	Self explanatory	4	
Duration	Less than 6 hours	Self explanatory	1	10%
	Less than 24 hours	Self explanatory	2	
	Less than 1 week	Self explanatory	3	
	More than 1 week	Self explanatory	4	

At the end of this section is a summary of the vulnerability of Bernalillo County, and the participating jurisdictions to the 12 identified natural hazards using the evaluation of each hazard with the categories from **Table 4.1**. Each jurisdiction independently evaluated the degree of risk posed by each hazard specific to their community.

4.2 Flood

4.2.1 Overview

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.[5]

[5] Flood Insurance Study, Bernalillo County, 2011; http://www.riskmap6.com/documents/Meeting_228/bernalillo_nm_fis_tables1.pdf

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Three types of flooding appear to be of the most concern in the planning area: flash flooding, storm water 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 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.

Storm 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 River runs through Bernalillo County. Though 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. When it rains, it can cause flooding along its path. 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~~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 as a result of heavy rainfall on dense snow pack throughout contributing watersheds. During most winters, the snow pack 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.

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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. The resulting updated FIRM maps have an effective date of XX/XX/2012.

4.2.2 Location and Spatial Extent

The Rio Grande passes through the city of Albuquerque in the form of an "S". The areas, locally known 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 is most likely to occur 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.

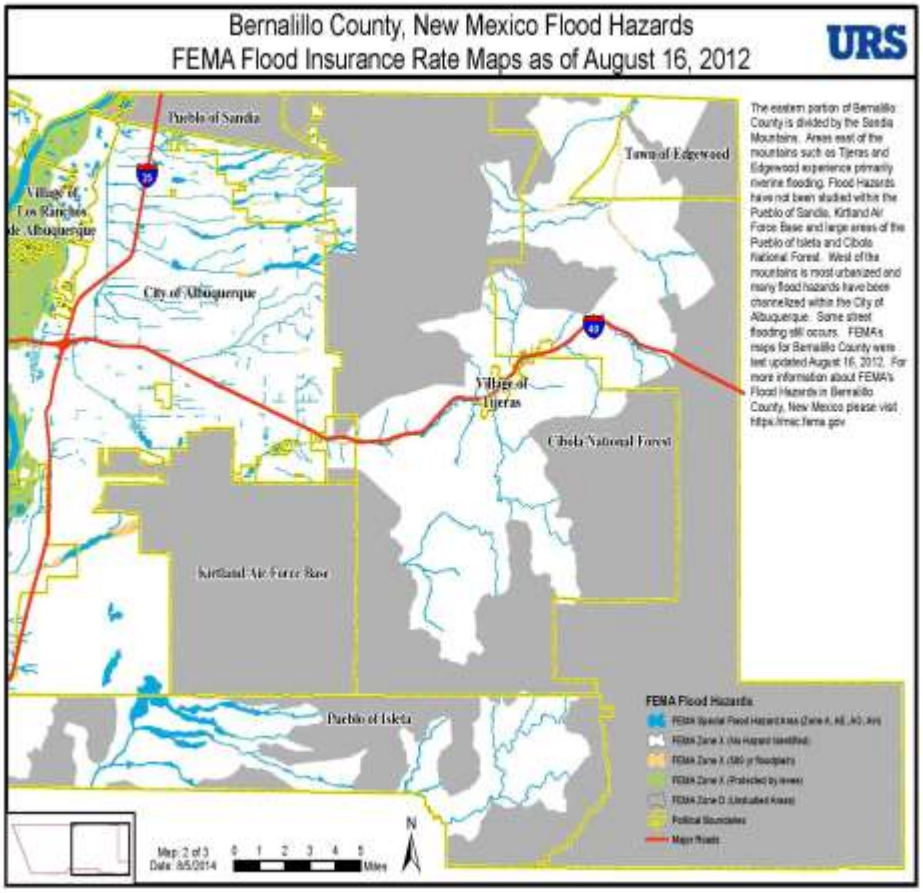
The low-lying valley areas along the Rio Grande are also subject to flooding from runoff from the east and west uplands. Residential and commercial development, channel levees, and irrigation embankments have obstructed the natural outfalls to the river and increased the flood hazards in many areas. 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. There are no records of repetitive losses for properties in the 100- year floodplain, but some areas have been identified as having chronic flooding problems. 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.

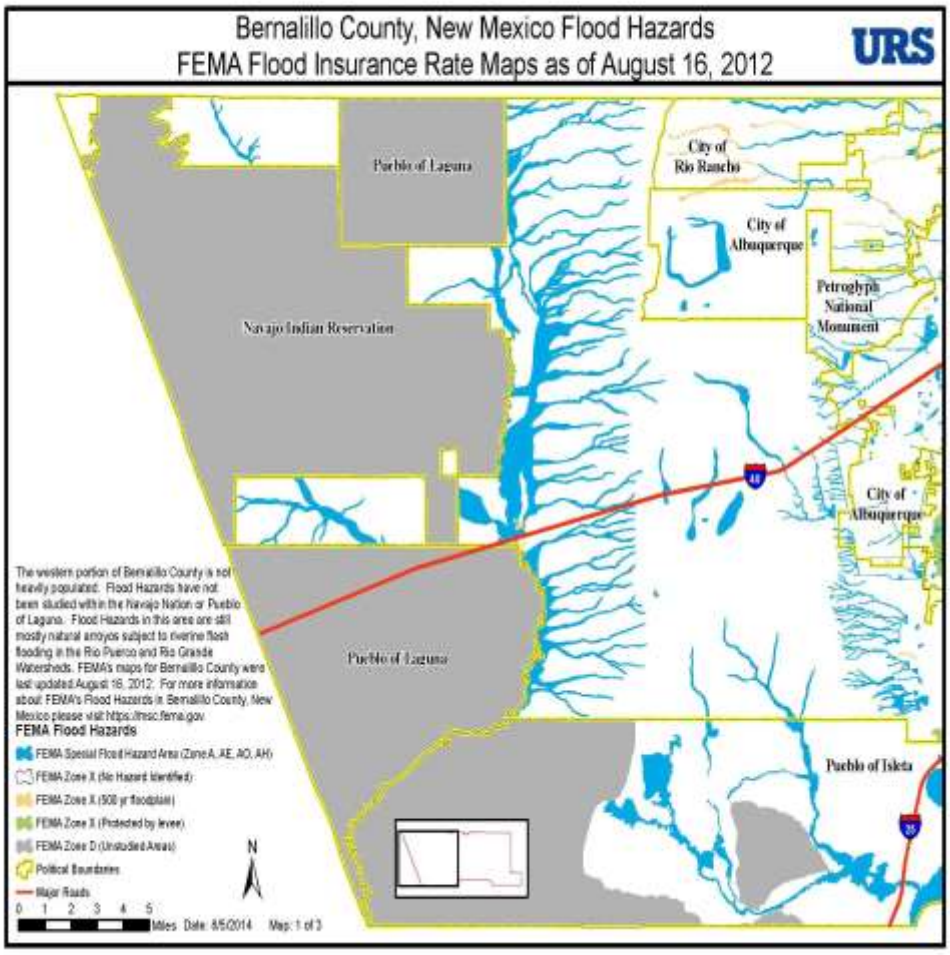
The Village of Tijeras has experienced localized flooding along the Tijeras Arroyo. The Village of Los Ranchos de Albuquerque identified several areas subject to flooding including: Garduno Road west of 4th Street, Ranchitos Road west of 4th Street, and Ortega Road west of 4th Street. **Figures 4.1 to 4.3** show the locations of FEMA mapped flood zones in the County.

Figure 4.1: Flood Zones for Eastern Bernalillo County, 2013



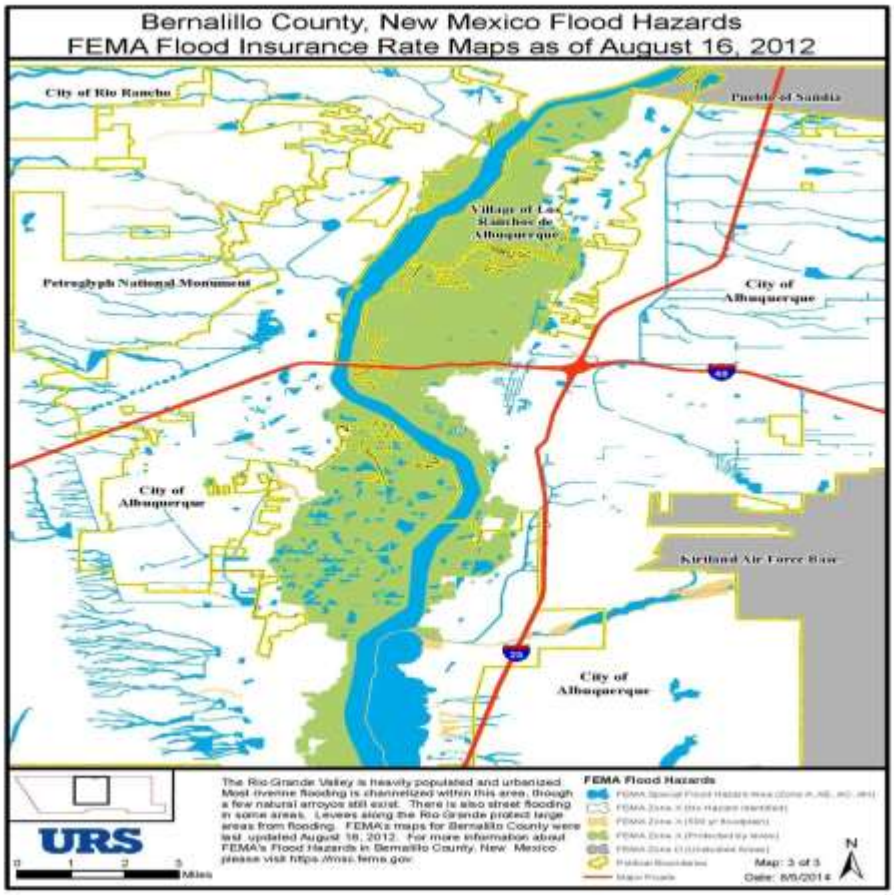
Source: FEMA / URS

Figure 4.2: Flood Zones for Western Bernalillo County, 2013



Source: FEMA / URS

Figure 4.3: Flood Zones for Central Bernalillo County, 2013



Source: FEMA / URS

4.2.3 Previous Occurrences

According to the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC), there have been 52 reported flood events in Bernalillo County from January 1, 1994 (the earliest recordings of floods in the County in the Storm Events Database) through July 1, 2014 in **Table 4.2**. AMAFCA reported flooding events as shown in **Table 4.3**.

Table 4.2: NCDC Reported Flood Events

Location	Date	Event Type	Property Damage
Bernalillo County	09/14/2013	Flash Flood	$60,000
Bernalillo County	09/01/2013	Flash Flood	$5,000
Carnuel	07/19/2013	Flash Flood	$10,000
ABQ International Airport	07/26/2013	Flash Flood	0
Double Eagle II Airport	07/14/2013	Flash Flood	0
Paradise Hills	07/08/2013	Flash Flood	$20,000
Escabosa	07/20/2013	Flash Flood	0
Paradise Hills	07/26/2013	Flash Flood	0
Sandia Park	08/09/2013	Flash Flood	0
Albuquerque	07/26/2013	Flash Flood	$50,000
ABQ International Airport	07/08/2013	Flash Flood	$50,000
Albuquerque	07/25/2013	Flash Flood	0
Albuquerque	07/26/2013	Flash Flood	0
Albuquerque	07/19/2013	Flash Flood	$1,000
Kirtland AFB	07/19/2013	Flash Flood	0
Albuquerque	07/26/2013	Flash Flood	$10,000
Paradise Hills	07/26/2013	Flash Flood	$5,000
Albuquerque	07/24/2012	Flash Flood	$2,000
ABQ Airport	07/31/2010	Flash Flood	$5,000
Albuquerque	07/28/2010	Flash Flood	$4,000

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Carnuel	07/24/2010	Flash Flood	$1,000
Carnuel	07/28/2010	Flash Flood	$1,000
Carnuel	09/22/2010	Flash Flood	0
Albuquerque	09/09/2009	Flash Flood	$1,000
Carnuel	07/21/2009	Flash Flood	$2,000
Albuquerque	08/04/2008	Flash Flood	$1,000
Albuquerque	08/04/2008	Flash Flood	$500
Adobe Acres	08/16/2008	Flash Flood	$50,000
Hahn	08/08/2008	Flash Flood	$300,000
ABQ Airport	07/22/2008	Flash Flood	$20,000
Hahn	07/21/2008	Flash Flood	$2,000
Hahn	07/19/2008	Flash Flood	$500
Albuquerque	07/31/2007	Flash Flood	$4,000
Albuquerque	08/18/2006	Flash Flood	0
Albuquerque	08/13/2006	Flash Flood	0
Albuquerque	08/06/2006	Flash Flood	0
Albuquerque	08/06/2006	Flash Flood	0
Albuquerque	07/08/2006	Flash Flood	0
Albuquerque	07/31/2006	Flash Flood	$100,000
Albuquerque	08/13/2005	Flash Flood	0
ABQ Airport	07/17/2005	Flash Flood	0
Albuquerque	07/12/2004	Flash Flood	0
Albuquerque	08/04/2004	Flash Flood	0
Albuquerque	07/20/2002	Flash Flood	0
Albuquerque	08/02/1999	Flash Flood	0
Albuquerque	08/02/1999	Flash Flood	0
Tijeras	08/08/1999	Flash Flood	0
Albuquerque	06/16/1999	Flash Flood	$1,200,000
Albuquerque	07/25/1998	Flash Flood	$30,000
Albuquerque	07/28/1997	Flash Flood	$100,000

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Albuquerque	07/10/1996	Flash Flood	0
Tijeras	07/10/1996	Flash Flood	$35,000

Source: NCDC at http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=35%2CNEW+MEXICO – Accessed June 2014

Table 4.3: 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 Embuditio 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*

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July 2014	Gun Club Ditch (MRGCD)	overtopping	$5,000*

* - estimates only

Source: AMAFCA

At the early part of the 2014 monsoon season, there has been a heavy rainfall event that led to flash flooding in downtown Albuquerque on August 1st. A recent 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 (NAA) 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[6]. Other areas that were flooded in August 2006 include NAA and South Valley where homes, yards and roads were reported as flooded. One loss of life was reported in August 2006.

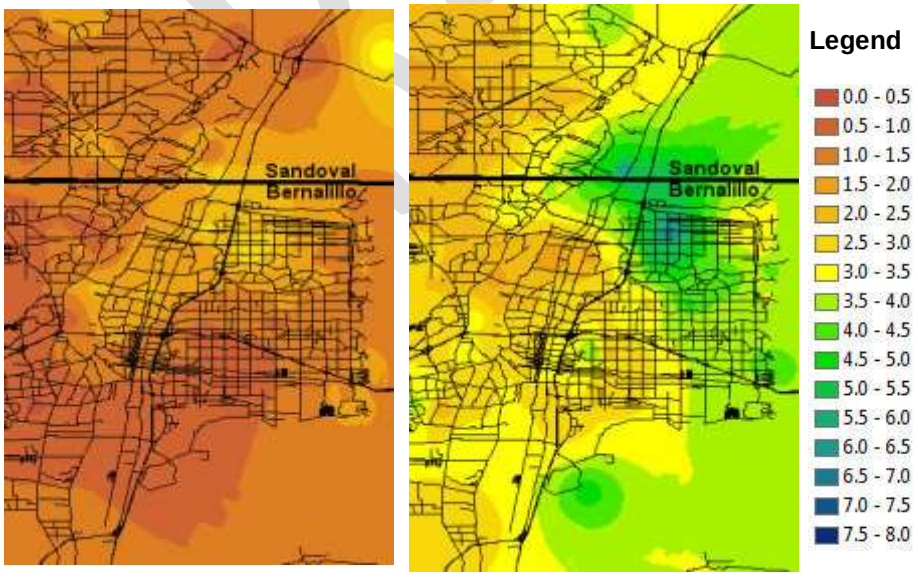
In April 2004, $3.8 million in damages occurred when a flash flood caused massive sewer line breaks near downtown Albuquerque. Flood waters also deposited 4,500 cubic yards of sand and gravel in the City's wastewater treatment plant, damaging equipment.

[6] David Downey, *Vulnerability Assessment of Albuquerque*, p.22. Accessed June 2014.

Figure 4.4: 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)*

Figure 4.5: July 2012 rainfall (on left) versus July 2013 rainfall (on right) which caused flooding. Precipitation (rainfall listed in inches in the legend)



Source: Albuquerque July Rainfall at http://www.srh.noaa.gov/abq/?n=july2012vsjuly2013abqprecip Accessed June 2014

4.2.4 Probability and Extent of Future Events

To establish the potential extent of flooding in Bernalillo County and its municipalities, the Flood Insurance Study dated August 16, 2012 was studied. **Table 4.4** is the range of potential flood depths within the 100-year Floodplain (Base Flood Elevation) for many waterways.

Table 4.4: 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	San Pedro Canyon Arroyo	8.5-15 feet
County	Frost Arroyo	3-14.5 feet
County	Rio Grande	3.5-10.5 feet
County	Rio Puerco	19.5-23 feet
County	San Pedro Creek	3-9.5 feet
Albuquerque/County/Tijeras	Tijeras Arroyo	2.5-21.5 feet

Source: AMAFCA[doublecheck source]

Flooding occurs on a regular basis in Bernalillo County and can be expected to continue. The impact of these events will depend on their location and the specific circumstances existing at the time. Bernalillo County and all participating jurisdictions rank the future probability of floods as "**Highly Likely**".

4.2.5 Vulnerability and Impact

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.

As shown in the two tables from **Section 4.2.3**, 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 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.

Flooding, especially during the monsoon season, has the potential to become a regional disaster which would dramatically stretch local and state resources to respond to events. In a regional flood event, fewer flood response and recovery assets would be available to the County and its municipalities. Flooding will cause an increase in the demands placed on first response capabilities and increase delays in providing normal service to the community. The current US Census provides information that Bernalillo County has 286,134 housing units at a median value of $190,200.00.

4.2.6 Conclusion

Flooding is a significant concern for all four 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 concerns during flood events.

4.3 Wildland Fire/Wildland-Urban Interface (Wildfire)

4.3.1 Overview

A wildfire is an uncontrolled fire spreading through vegetative fuels, threatening and possibly consuming structures and other community assets. Wildfires can begin unnoticed in wild areas and can spread quickly, creating dense smoke that may be seen for miles. A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. A wildland urban interface fire is a wildfire in an area where structures and other human development meet or intermingle with wildland or vegetative fuels.

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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. It can also be 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[7].

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 following WUI map (**Figure 4.6**) shows the housing density for the planning area:

Figure 4.6: New Mexico Wildland Interface 2000

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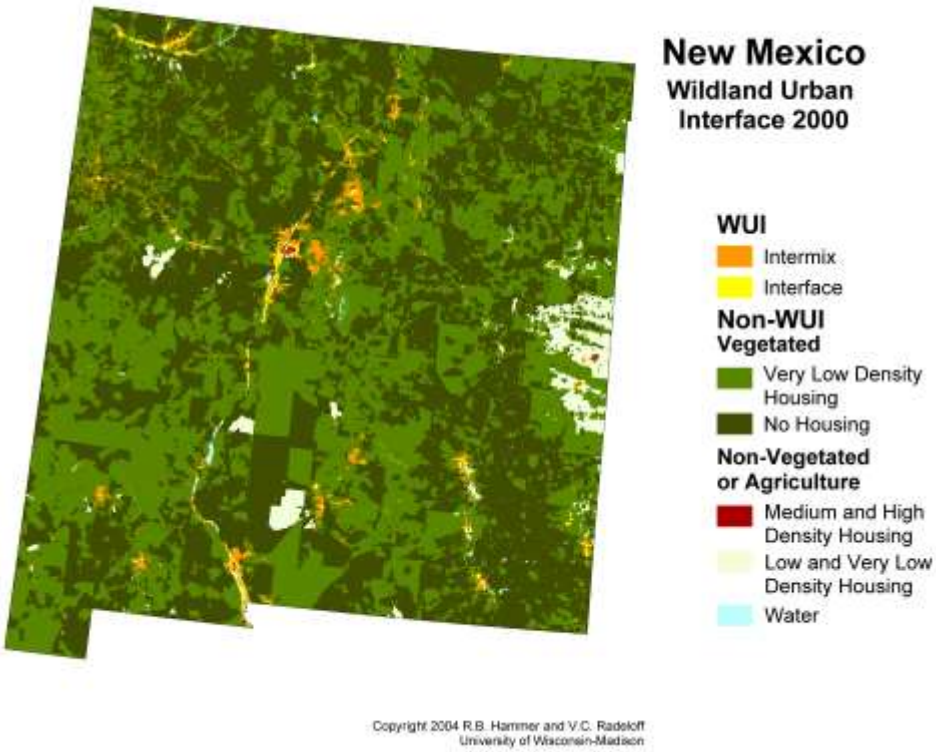
[7] Cohen, Jerry, 2003. *The Impact of Fire on Ecosystem*, University of Texas



Source: http://silvis.forest.wisc.edu/old/Library/WUI_state_download.php?state=New%20Mexico&abrev=NM, *Accessed April 2014*

4.3.2 Location and Spatial Extent

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 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 4.5: 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.
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 Accessed July 2014

Typical conditions in the planning area from September through December usually centers 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.

Due to the arid climate, current drought conditions, and degraded timber stands, the probability of catastrophic wildfire occurrence is extremely high in Bernalillo County. Areas especially vulnerable are the western slopes of the Sandia Mountains in the eastern portion of the county (referred to as 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.

Wildland fire is historically an intermediate disturbance in riparian forests of the southwestern United States and not part of a semi-annual disturbance regime, like flooding. 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 Bernalillo County wildland urban interface (WUI). 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 WUI.

Table 4.6: WIldland Interface Rating (2002 – most recent available)

Number of Areas	*Hazard Rating Assigned*	*Acreage*
12	Moderate	87,160
28	High	91,345
2	Extreme	1,280
Total Acres		179,785

Source: 2002 Bernalillo County Wildland Urban Interface Assessment

Several factors contribute to the increased risk of catastrophic fires in the Southwest, and Bernalillo County in particular:

- 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 have 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.

Traditional settlement patterns in New Mexico began with concentrated development of homes and farms along the river and within the Bosque. In the past 25 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.

4.3.3 Previous Occurrences

New Mexico State Forestry provided information of wildfire incidents in Bernalillo County from 1996 to June 2005.

Table 4.7: Bernalillo County Wildfire Incidents

Year	Number of Fires	Acres Burned
1996	29	401.43
1996	18	82.15
1996	16	72.25
1999	27	249.70
2000*	44	1866.65
2001	36	170.55
2002	76	197.58
2003	39	65.96
2004	38	75.55
2005	19	22.88

Source: New Mexico Forestry Department / check NCDC

The state HMP highlights additional significant wildfires directly or indirectly impacting Bernalillo County in the last decade:

- **June, 2003** - Fireworks ignited the Bosque Fire in Albuquerque, which burned hundreds of acres. 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 4 outbuildings were destroyed. Nearly 100 people

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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 were 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 23, 2010** - Thunderstorms were the result of a back door cold front which slid through the eastern plains of New Mexico during the day. Initially, thunderstorms brought hail and gusty winds across southeast New Mexico. Then later, the thunderstorms evolved into a cluster which slowly moved east into Texas. This cluster of storms brought rainfall amounts of up to 2 inches in one hour's time across the east. Later that night, the front pushed through the gaps of the central mountain chain resulting in east winds topping 60 mph. Tree damage was noted across much of Albuquerque. A 2-acre fire resulted in damage of the Cumbres and Toltec Scenic Railroad by the Lobato Trestle. The fire, which was approximately 5 miles north-northeast of Chama near the Colorado border, destroyed the wooden ties that support the rail bed. As a result, the railroad had to halt train operations through the area. The cause of the fire remains unknown, though arson and natural causes have been ruled out. 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

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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.

4.3.4 Probability and Extent of Future Events

The potential for wildfire is present throughout Bernalillo County. The location where a wildfire occurs becomes the overriding concern. The major concern caused by wildfires has historically been focused around the bosque along the Rio Grande River.

The probability of another wildfire in Bernalillo County, is "**Highly Likely**".

4.3.5 Vulnerability Assessment and Impact

Two older studies were analyzed for this report to determine a baseline of the minimal wildfire threat for the planning area including the Wildland-Urban Interface (WU/) Area Inventory Assessment and the Bosque Wildfire Risk Assessment Report and City of Albuquerque Bosque Wildland-Urban Interface Fire Run book. The WU/ Area Inventory Assessment was created by the Bernalillo County Fire Department and the New Mexico State Forestry division and published in 2002. The Bosque Wildfire Risk Assessment Report was developed by the Albuquerque Fire Department, Albuquerque Open Space, Albuquerque Public Works Division, and the Bernalillo County Assessor's Office and published in 2004.

According to the WUI Assessment, there are 179,785 acres located in areas vulnerable to fire damages in all areas of the County. This report indicates an estimated 1,082 residential structures located in the bosque WUI. With a median home value of $190,200, these homes have an estimated total value in excess of $205,000,000. The total value of critical infrastructure at risk from wildfires in the Bosque can be based upon estimates of potential losses from commercial assets, residential property values, and critical -infrastructure. The value of commercial assets and critical facilities is more challenging, as the value is not available or as consistent as it is for residential structural values.

The two major fires in the Rio Grande Bosque in 2003 demonstrated that wildfires are a significant threat to the citizens, structures, infrastructure, and natural resources within the County. In the Bosque WUI, there are over 1,500 residential structures with a reported total value of over 150 million dollars. The East Mountain area and the Village of Tijeras also face a threat from wildfires. The County has identified 22 areas in the East Mountains and one area in the Village of Tijeras that have a High or Extremely High rating for potential wildfires.

4.3.6 Conclusions

Bernalillo County is clearly aware of its fire risk, specifically near the river bosque areas. Effective land use restrictions along the bosque have lessened the impacts of wildfire in the planning area and the County and its municipalities are active in their fuel reduction activities.

4.4 Drought

4.4.1 Overview

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 limited rainfall (less than normal) in a broad geographic area. High temperatures, high winds, and low humidity exacerbate drought conditions. Human demands and actions also exacerbate drought-related impacts.

Droughts are often categorized as meteorologic, hydrologic, agricultural, or socioeconomic:

- A meteorologic drought is defined by a period of less than average or normal precipitation.
- A hydrologic drought occurs when a meteorologic drought begins to affect surface and subsurface water supplies.

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- An agricultural drought refers to the effects of a meteorologic or hydrologic drought in terms of soil moisture and its relation to plant life, usually crops.
- A socioeconomic drought is when the water shortages affect public health and economic activity including agriculture.

The National Weather Service (NWS) and the United States Department of Agriculture (USDA)'s collaborate with academic institutions to categorize drought. Taking input from these entities and local sources, the National Drought Mitigation Center (NDMC) through the US Drought Monitor website issues a state by state weekly drought severity assessment using these categories shown in increasing intensity from top to bottom:

- **D0** – Abnormally dry
- **D1** – Drought - Moderate
- **D2** – Drought - Severe
- **D3** – Drought - Extreme
- **D4** – Drought - Exceptional

Droughts do the worst damage when they are prolonged and in New Mexico this is possible over multiple years like the droughts of the 1950s and the multi-year drought still in effect as of June 2014. While drought is a cyclical process, a growing population in New Mexico and threat from wildfire as a result of dry conditions make it a significant hazard.

4.4.2 Location and Spatial Extent

Droughts are common in New Mexico and Bernalillo County. Drought is generally a broad geographic hazard that is not tied to site specific topographic and geologic features like flooding. The Rio Grande Valley of New Mexico averages around 10 inches of rainfall a year[8]. The climate in the Bernalillo County area is arid with January, May and November typically the driest months. In addition, due to the monsoon effect, most of the precipitation occurs from July to September annually. This normally small and concentrated annual precipitation causes extended periods of low flow in the State's rivers and streams. Any measurable decrease in

[8] From the Western Regional Climate Center at http://www.wrcc.dri.edu/narratives/newmexico/ Accessed August 2014

precipitation rates can create drought conditions in a relatively short time. The entire county is at risk from all levels of drought.

When the majority of Bernalillo County is in a D2 (severe drought) rating on the drought monitor scale, 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.[9]

4.4.3 Previous Occurrences

In the last 115 years, New Mexico has suffered four devastating periods of drought; 1900-1910, 1931-1941, 1942-1956, and 1974-1979. Other periods of drought include short-duration droughts in New Mexico in 1996[10] and 2008 (specific to northern New Mexico), and a severe drought that affected the State and the rest of the western US in 2002-2003.

As seen in **Figure 4.4**, as of June 2014, a U.S. Drought Monitor map shows that all of New Mexico was in various stages of drought severity which had generally lessened considerably from May 2013. This drought had also been in effect in 2012 when the Governor of New Mexico declared a Drought State of Emergency on May 15, 2012. This drought declaration 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.

Due to the fact that in May 2013, 44.14% of the state was at the highest level of drought intensity (Exceptional), and 81.68% was either Exceptional or Extreme (the second highest level), the drought that continues through 2014 is considered by some federal meteorologists as the worst one since the 1950s drought[11]. Bernalillo County, as of June 2014, is located primarily within a Severe level of drought.

Figure 4.7: New Mexico Drought Map (as of June 17, 2014)

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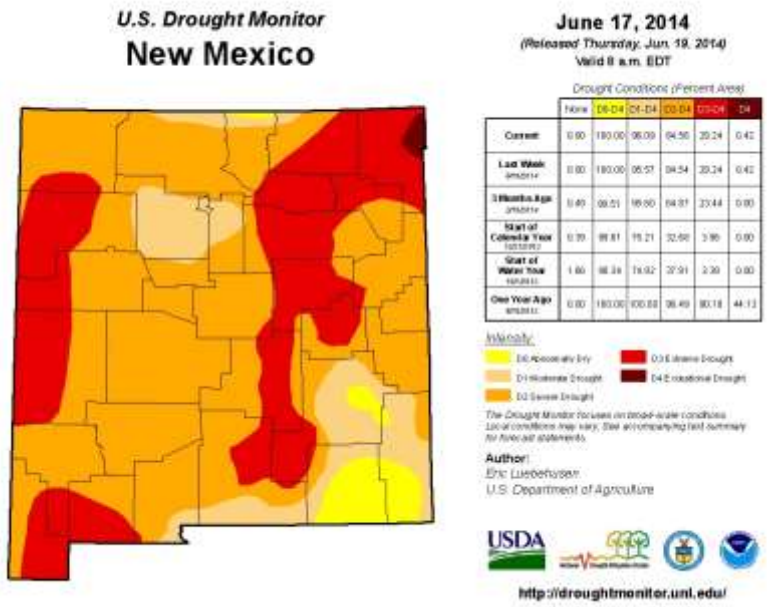
[9] 2012 ABCWUA Drought Management Strategy, http://www.abcwua.org/uploads/files/Your%20Drinking%20Water/dms2012.pdf, Accessed August 2014
[10] New Mexico Drought Task Force , May 2002
[11] http://www.abqjournal.com/192344/news/drought-is-worst-since-the-1950s.html Accessed July 2014



Source: http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?NM *Accessed July 2014*

4.4.4 Probability and Extent of Future Events

In an arid region such as Bernalillo County, the probability of recurring droughts with moderate to exceptional severity is "**Likely**". The drought would likely affect the entire county. Droughts can last from one season to over 40 years and should be expected at any time. 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. The NWS Climate Prediction Center website shows that in the short-term (June 19, 2014 – September 30, 2014), the drought remains but may improve for the planning area. There is scientific evidence suggesting that prolonged periods of drought are increasingly likely in the future in the planning area[12].

[12] *Long Term Trends and their Implications for Emergency Management* from http://www.fema.gov/pdf/about/programs/oppa/climate_change_paper.pdf Accessed July 2014

4.4.5 Vulnerability and Impact

When severe to exceptional droughts occur, they have significant consequences for water supply (drinking water and agriculture uses), water quality, fighting forest fires, and navigation and recreation. When a drought begins, agriculture is usually first to be 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. Impact on these activities can be seen 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. 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[13].

Drought affects the entire county and is a hazard that cannot be eliminated. In addition, drought is cyclic and will always be a potential problem. The effect on the county/city/village government infrastructure is the same as for the general public and poses no specific danger to the normal operation of government.

Drought affects the entire community by placing a higher demand on the present water supply systems. Drought also 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. Additionally, a higher demand on the water system infrastructure can lead to disruption of service due to line breakage.

It is extremely difficult to estimate the amount of dollar damages from a drought because of the slow-moving nature of droughts and the lack of direct immediate impacts. The 2013 State Plan reports on page 51 that from 2003-2012, the costs of droughts were $500,000, state wide. For the planning area, drought impacts cattle-grazing, other agricultural activities, the tourist economy, and reduced charge to the aquifer. Droughts in Bernalillo County leaves exposed soils susceptible to erosion, and flash flooding. A particularly long spell of drought could mean water restrictions. Using Table 2.18 found in the 2013 State Plan and applying it to the county's assets, **Table 4.8** of this Plan lists specific potential impacts of drought to the county:

Table 4.8: Potential Impacts from the Drought

Subject	Potential Impacts
HEALTH and SAFETY of the PUBLIC	Increased number of wildfires; Health problems related to low water flows and poor water quality; Health problems related to dust

[13] New Mexico Drought Task Force,2002

HEALTH and SAFETY of RESPONDERS	Increased wildfire risk coupled with limited water supply makes it more challenging for responders to fight fires and puts responders at greater risk
ENVIRONMENT	Animal habitat and food supply can dwindle causing species die-off; poor soil quality; loss of wetlands; increased soil erosion; migration of wildlife
ECONOMIC CONDITION	Decreased tourism; Crop loss; Decreased land prices; Unemployment from drought-related declines in production; Increased importation of food; Rural population loss
PUBLIC CONFIDENCE	Reduced incomes; Fewer recreational activities; Increase in food costs due to loss of crops and livestock; Loss of aesthetic values; Loss of cultural sites

4.4.6 Conclusions

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. 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.

4.5 Earthquake

4.5.1 Overview

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

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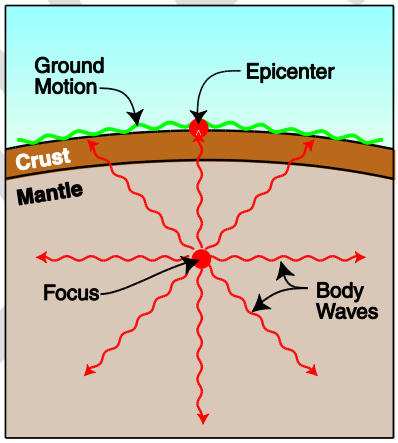
frequently in the boundaries between the great crustal plates that form the earth's outer shell. As these plates move, stress accumulates. Eventually, when faults along or near plate boundaries slip abruptly, an earthquake occurs.

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, and intensity subjectively describes effects at a particular place. While an earthquake has only one magnitude, its intensity varies throughout the affected region.

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. 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 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 4.8: 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. PGA measures the

strength of ground movements in this manner. Although the specific damages caused by different magnitudes of earthquakes are listed in **Table 4.9**, generally when the PGA exceeds 15, significant damage will occur. **Table 4.9** also shows the relationship between PGA, magnitude, and intensity (to get 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 4.9: 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.
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 2013.

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 and is centered in Socorro, New Mexico. Eight seismic events have occurred there between 1869 and 1992. The largest recorded seismic event in New Mexico 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.

Present structural building code requirements in New Mexico do not consider the possibility of seismic events. In addition, due to the low historic occurrence of seismic events in Bernalillo County, it has not been considered necessary to take specific mitigation measures to address them at this time.

4.5.2 Location and Spatial Extent

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 110 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 in 1935 and 1966, causing damage to homes and schools. A seismic event would generally have the same magnitude across the County similarly as the effects are wide-spread.

Figure 4.9 below depicts seismic risk across the nation. It shows a low to moderate risk (green and yellow areas on the map) in central New Mexico which includes Bernalillo County. The spatial extent of a potential earthquake would be large.

Figure 4.9: Earthquake Risk in the United States

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Source: USGS, http://earthquake.usgs.gov/hazards/products/

4.5.3 Previous Occurrences

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

Several of the strongest New Mexico earthquakes recorded in the 2013 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. In 1931 and 1947, 4.5 Magnitude earthquakes occurred centered in Albuquerque. 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 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.

4.5.4 Probability and Extent of Future Events

Given the rare past occurrence and moderate risk in magnitude of earthquakes to the County and its municipalities, the probability of a future event is "**Unlikely**". However, earthquakes are nearly impossible to predict and the consequences can be devastating.

4.5.5 Vulnerability and Impact

Earthquakes with epicenters in or near Bernalillo County have been detected in the past, although they have been small and damage has been relatively minor. The 2013 State of New Mexico Plan includes Bernalillo County in Preparedness Area #5, the central part of the State comprised of Sandoval, Bernalillo, Valencia, Torrance, and Socorro Counties. The State Plan shows that the maximum probable earthquake in this Area would have a magnitude of 7.5 on the Richter scale and an epicenter in Albuquerque. This type of event would cause significant damage in the planning area.

The potential impact from the State's maximum probable earthquake is critical with most buildings and bridges destroyed. Due to the lack of warning and the peril of falling objects in an earthquake, there would also likely be moderate to severe injuries to Bernalillo County residents including a few deaths.

The HMPT would need to study the structures in the planning area—their age, condition, and construction type—to rate their relative vulnerability. 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 plan updates should consider more study of the earthquake risk.

4.5.6 Conclusions

Damage from earthquakes can be mitigated for existing buildings by structural retrofits and non-structural retrofits for interior contents that can be damaged by a fall (e.g., computer) or can cause harm by falling (e.g., bookshelves). Structures erected before standard building codes, such as un-reinforced adobe and masonry buildings, are typically vulnerable to earthquake damage. Structural retrofits are generally very expensive whereas non-structural can be relatively inexpensive.

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More detailed information on other structures in Bernalillo County is required to identify those that are highly vulnerable. The City of Albuquerque requires designation of the seismic zone category for all commercial permits with structural implications and the 2009 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 2009 IBC requirements accordingly.

4.6 Severe Winter Storms

4.6.1 Overview

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 4.10 provides descriptions of the various types and impacts of winter storms that are consistent with NWS approved definitions found in the 2013 State Plan:

Table 4.10: 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

The 2013 State Plan lists the likely severe winter storm scenarios for New Mexico:

- 4 or more inches of snowfall below 7,500 feet
- 6 or more inches of snowfall above 7,500 feet in a 12 hour period
- 6 or more inches of snowfall below 7,500 feet
- 9 inches of snowfall above 7,500 feet in a 24-hour period

Severe winter storms are not of major concern to the citizens of Bernalillo County because they only rarely occur in the county and do not cause a major problem throughout the area. 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. Snowfall in Bernalillo County is infrequent and it melts off quickly.

4.6.2 Location and Spatial Extent

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.

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. Local officials encourage citizens to heed the warning and take extra precautions. 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 degrees to be extremely dangerous to the population although hypothermia can occur at higher temperatures and cause death. The following table gives a range of physical intensities from winter storms along with the potential effect[14]:

Table 4.11: National Weather Service Windchill Chart

NWS Windchill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
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

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

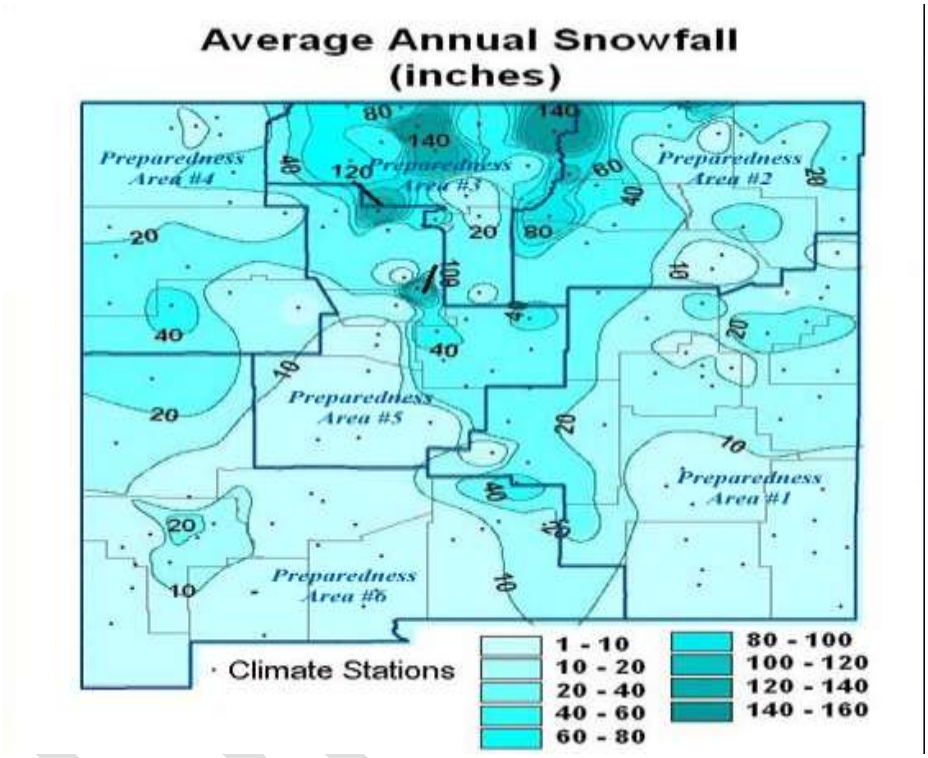
Where, T= Air Temperature (°F) V= Wind Speed (mph) Effective 11/01/01

Source: National Weather Service

Figures 4.10 and **4.11** from SRH of NOAA show annual snowfall amounts across New Mexico[15]:

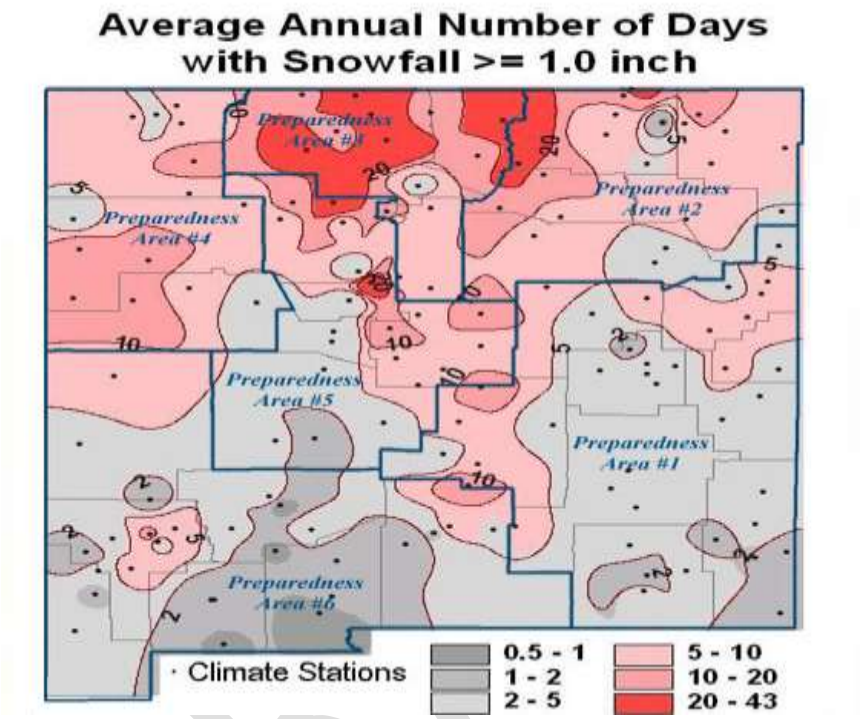
[14] http://www.nws.noaa.gov/os/windchill/index.shtml, Accessed July 2014
[15] Source: http://www.srh.noaa.gov/abq/?n=prepwinterwxclimo, Accessed July 2014

Figure 4.10: Average Annual Snowfall in New Mexico



Source: NOAA Southern Region Headquarters (SRH)

Figure 4.11: Average Annual Number of Days With Snowfall in New Mexico



Source: NOAA Southern Region Headquarters (SRH)

4.6.3 Previous Occurrences

Five heavy snow events were reported for Bernalillo County from January 1, 1996 through June 30, 2014. The following narrative from the NCDC and other sources summarizes each event:

- **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 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. Sergeant Robert Baron with Sandoval County who was responding to a weather-related traffic incident early on the

5th was struck by another car and later died from his injuries on the 6th despite significant efforts by paramedics.

- **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.
- **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[16].
- **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 forced the closure of roads across the state. Most highways including I-25 and I-40 were closed for extensive 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.

4.6.4 Probability and Extent of Future Events

The 2013 State Plan reports a probability of 1.2% annual chance that heavy snowfall or extreme cold/wind chill events will occur in Preparedness Area #5. Given this approximate frequency, the probability of a future severe winter storm event to the entire planning area is "**Possible**". Winter storm events in Bernalillo County are typically short-lived resulting in a few inches of snowfall.

4.6.5 Vulnerability and Impact

The entire county 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, hazardous to safety,

[16] David W. Downey, Vulnerability Assessment of Albuquerque, p.22. Accessed June 2014.

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and impacts to structures and infrastructure. A severe winter storm in Bernalillo County would have the following types of impacts:

- 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;
- cause school and business closures, as well as disruptions in transportation systems, electric power, telecommunications, and emergency services;
- Residents potentially running out of basic supplies, including food and fuel;
- livestock suffer from severe cold and lack of feed; and
- in extreme cases, building roof systems fail due to snow loading.

Severe Winter Storms with over 5 inches of snow have occurred in the past and will occur again in the future. However, given the infrequent recurrence of the extreme cold events and the relatively minor losses associated with this type of event, the overall vulnerability is considered to be low.

4.6.6 Conclusions

Severe winter storms have been and will continue to be a threat to the economic and social well-being of Bernalillo County. Disruptions of emergency and other essential services are the main threats to the people and property.

One important part of mitigating severe weather is forecasting and warning so people can prepare. Communities can prepare for winter storms by stocking sand and salt to improve road conditions, advising people to stay home or to use caution if they must go out, and recommending that people stock up on food, water, batteries, and other supplies.

Future Development should take into consideration the effects of winter storms, including excessive snow loading on roofs. Interior piping that is not insulated or protected can burst causing damage.

4.7 Thunderstorm (including Lightning / Hail)

4.7.1 Overview

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. The

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thunderstorm season in New Mexico is well defined, from early July to September. 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. Due the fact that high rainfall impacts are covered in the "Flood" section (**4.2**) and that both 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.

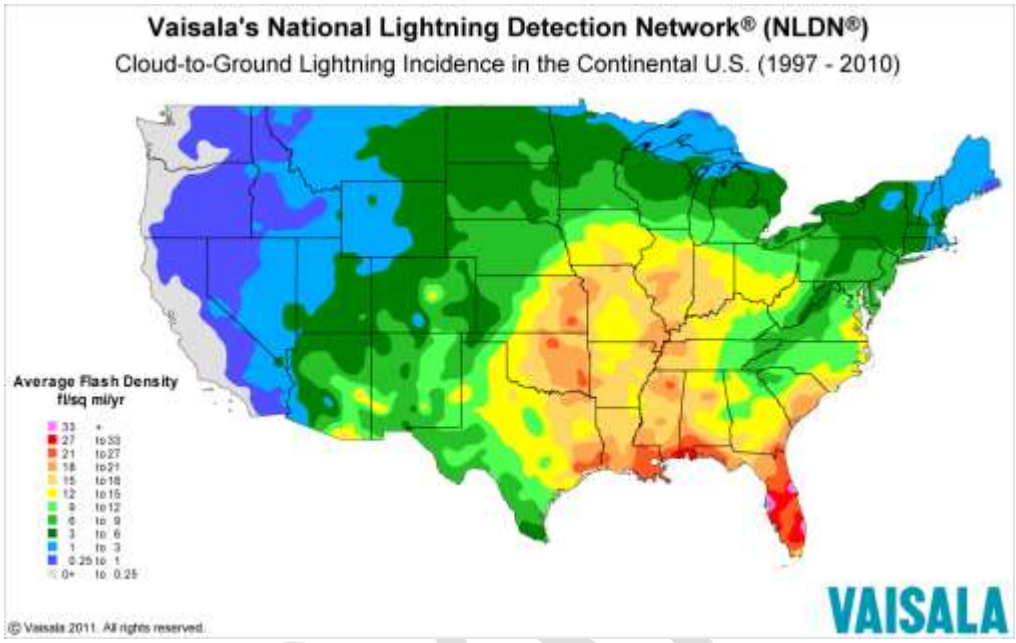
The 2013 State Plan describes lightning as "a sudden and violent discharge of electricity, usually from within a thunderstorm, due to a difference in electrical charges. Lightning is a flow of electrical current from cloud to cloud or cloud to ground." Hail is described as the movement of water droplets 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 the size of a softball. The 2013 State Plan states that severe hailstorms most commonly occur in May, followed by June, July and April.

4.7.2 Location and Spatial Extent

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, located nearby, escapes with minimal impact. Large-scale thunderstorms with multiple lightning strikes, hail and high wind would create the most impact over a wide area.

The Vaisala map below shows a flash density of 6-9 flashes/square mile/year for the majority of the planning area and a flash density of 3 to 6 flashes in a small portion of the county. Specific records are not kept at the local level. Officials of each participating jurisdiction consider all thunderstorm events which contain lightning to be severe events and warrant evasive actions.

Figure 4.12: Flash Density Map



Source: Vaisala

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. Thunderstorms in Bernalillo County may directly only affect a small portion of it. The spatial extent of thunderstorms is small.

4.7.3 Previous Occurrences

The NOAA Southern Region Headquarters website shows that May (879 events) and June (1,014) have had the most hail events in New Mexico from 1955 to 2012[17].

In the central New Mexico region, the 2013 State Plan reports that there were 90 hail events in Bernalillo County from 1955 to 2012. By comparison, the counties experiencing the highest number of hail events during this timeframe are Eddy (383) and Lea (369). The 2013 State Plan reports that of the hail events that affected Preparedness Area #5, including Bernalillo County, $8.8 million of property damage and $20,000 of crop damage occurred.

[17] http://www.srh.noaa.gov/abq/?n=prephazards Accessed July 2014

4.7.4 Probability and Extent of Future Events

Bernalillo County experiences thunderstorms with hail and/or lightning on a fairly frequent basis. The 2013 State Plan reports that New Mexico ranks sixth in the nation in lightning fatalities with 0.55 deaths per million people annually. The State ranks 22nd in lightning frequency overall. While typical thunderstorms can be expected almost 100% annually, thunderstorms that are capable of producing lightning and hail severe enough to threaten safety and property are considered "**Likely**".

4.7.5 Vulnerability and Impact

Vulnerability to the effects of thunderstorms on buildings is dependent on the age of the building (and what building codes were in effect at the time it was built), type of construction, and condition of the structure (how well the structure has been maintained). All of the planning areas critical facilities are vulnerable to potential disruption of services and transportation systems as well as disruptions to emergency communications capabilities. Electric and telephone services are particularly vulnerable to disruption.

The most probable impact of a thunderstorm in Bernalillo County is lightning. Other impacts of thunderstorms, flood and wildfire ignition, are addressed in **Sections 4.2** and **4.3** respectively. The potential impacts of hail and lightning to Bernalillo County are:

- local capabilities to handle disruptions to emergency services, traffic, communications, and electric power are overwhelmed;
- hail causes damage to property (particularly crops, roof systems of building, and vehicles);
- lightning strikes a person or animal causing severe injury or death;
- lightning directly strikes a building causing damage or strikes a tree that falls on a building, person, animal or vehicle.
- lightning strikes ignite a wildfire that threatens the safety of people and destroy property; and,
- lightning causes a power surge in a building's electrical system that damages the system and/or electronic equipment plugged into the system.

4.7.6 Conclusions

One important part of mitigating severe weather is forecasting and warning so people can prepare. Communities can be notified of approaching severe thunderstorms and take action to seek shelter or get out of the path of the storm. Important community structures and critical

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facilities should have their electric and roof systems evaluated for vulnerability to hail and lightning. Electronic systems should be unplugged once warning of a thunderstorm has been issued.

4.8 High Wind

4.8.1 Overview

High winds that damage property and endanger the safety of people and animals come from a variety of sources. High winds in New Mexico are usually generated by severe thunderstorms and severe winter storms. Bernalillo County is Wind Speed Zone II, experiencing wind speeds up to 160 mph (see **Figure 4.13**).

Wind is defined by FEMA's Multi-Hazard Identification and Risk Assessment as "the motion of air relative to the earth's surface." A microburst is a strong, localized thunderstorm downdraft which, when it strikes the surface, produces winds affecting an area less than 2.5 miles across. A microburst according to the US Weather Service "is a small area of rapidly descending air beneath a thunderstorm. When the descending air hits the ground, it quickly spreads out in all directions, causing very strong, strait-line winds." A microburst forms "inside a thunderstorm, [when] water vapor condenses into raindrops, which then fall to the ground. When these raindrops fall through the air, they start to evaporate. The evaporation cools the air, causing it to become denser than the air around it. This rain-cooled air, along with the falling raindrops, accelerates downwards; it is this down-rushing air that eventually hits the ground … causing the damaging straight-line winds."

High winds are considered hazards when the winds cause direct damage to crops, buildings or infrastructure through impacts to the buildings themselves or causing debris or trees to crash into the asset creating damage. Flying debris in high winds can also cause injuries to people and animals.

4.8.2 Location and Spatial Extent

High winds are a hazard that generally has a large geographic impact being caused by larger scale storms, like thunderstorms and winter storms. Bernalillo County's location in wind speed zone II means a fairly low possibility of extreme wind speeds up to 160 mph. Wind can affect any area of the county, but is worse along the Rio Grande valley where the incorporated jurisdictions are located. Wind gusts on Interstate 25, which runs parallel to the Rio Grande through most of the county, can make travel more difficult.

Figure 4.13: Wind Zones of the United States

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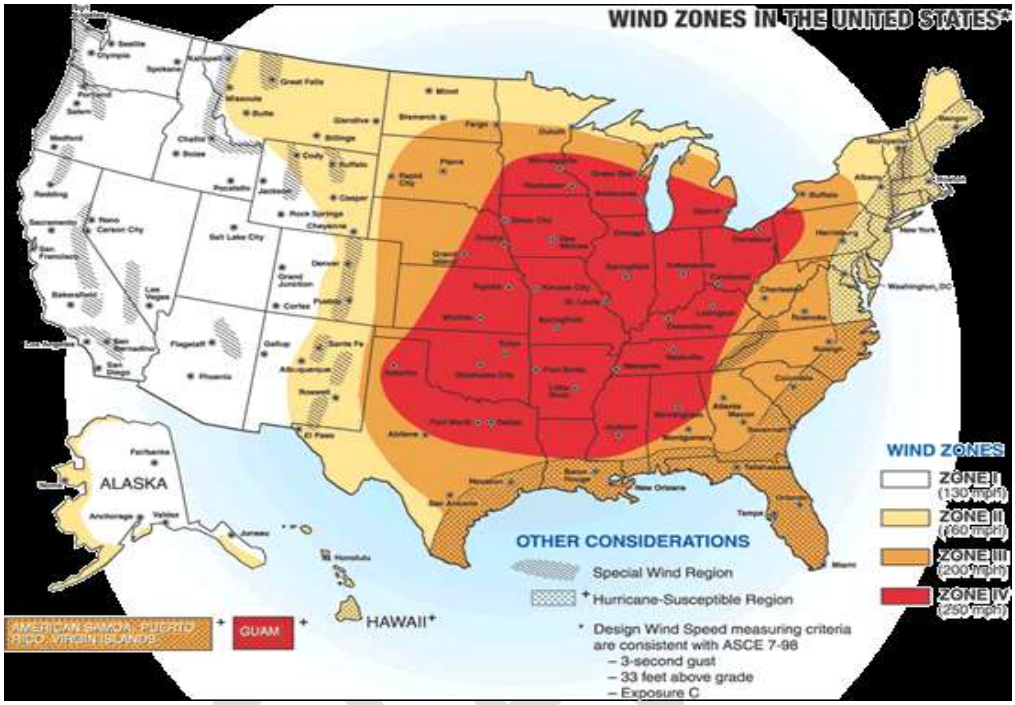

Source: 2013 State Plan (originally from ASCE 7-10)

4.8.3 Previous Occurrences

Between January 1, 1950 and July 1, 2014, the National Climatic Data Center (NCDC) reported 63 thunderstorm wind events impacting Bernalillo County with an average of $19,777 in property damage per event. During the same reporting period, 86 high wind events were reported for the planning area with an average of $64,140 in property damage per event.

One of the worst severe weather events in Bernalillo County occurred in December 2011. A powerful cold front plunged south and west across the eastern plains of New Mexico on the 1st 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 Grants. Sustained winds between 40 and 55 mph and gusts between 60 and 90 mph were common across the Albuquerque Metro 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.

The 2013 State Plan reports that Preparedness Area #5, including Bernalillo County, has had 28 high/strong wind events that have cumulatively caused $5.2 million in property damage from January 1, 2006 through December 1, 2012.

4.8.4 Probability and Extent of Future Events

Given the fairly frequent occurrence of high wind in Bernalillo County, the probability of a future event is "**Likely**".

4.8.5 Vulnerability and Impact

Bernalillo County 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. Compared to the hurricane-prone southeastern U.S. coast, the vulnerability is not as high.

The likely impacts of high winds in Bernalillo County would be damage to manufactured homes, disruption of power and telephone services, highway closures, and disruptions to emergency communications capabilities. Additional future studies should focus on the vulnerability of key public facilities to high wind.

4.8.6 Conclusions

Mitigation opportunities for high wind in Bernalillo County include the current adoption of the 2009 International Building Code (IBC), International Residential Code (IRC), and International Existing Building Code (IEBC). The 2009 IBC design criteria for high wind is 90 mph for a 3 second gust for new commercial construction or a change in occupancy. For existing residential structures, the most effective mitigation actions focus on the most vulnerable structures, particularly manufactured and mobile homes. These structures can be inspected for adequate tie-downs and retrofitted if necessary. Bernalillo County should examine its critical facilities for wind retrofits first. Subsequent updates to this Plan will explore this further.

4.9 Tornado

4.9.1 Overview

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

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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 are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Each year, an average of over 800 tornadoes are reported nationwide, resulting in an average of 80 deaths and 1,500 injuries[18] . While 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. Most tornadoes are a few dozen yards wide and touch down briefly. Even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

The destruction caused by tornadoes ranges from light to incredible depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction such as residential homes (particularly mobile homes). The Enhanced Fujita Scale for Tornadoes was developed to measure tornado strength and associated damages (see **Table 4.12**).

Table 4.12: Enhanced Fujita Scale for Tornadoes

EF-Scale Number	Intensity Phrase	3 Second Gust (MPH)	Type of Damage Done
EF0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	SIGNIFICANT	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	SEVERE	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	INCREDIBLE	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized

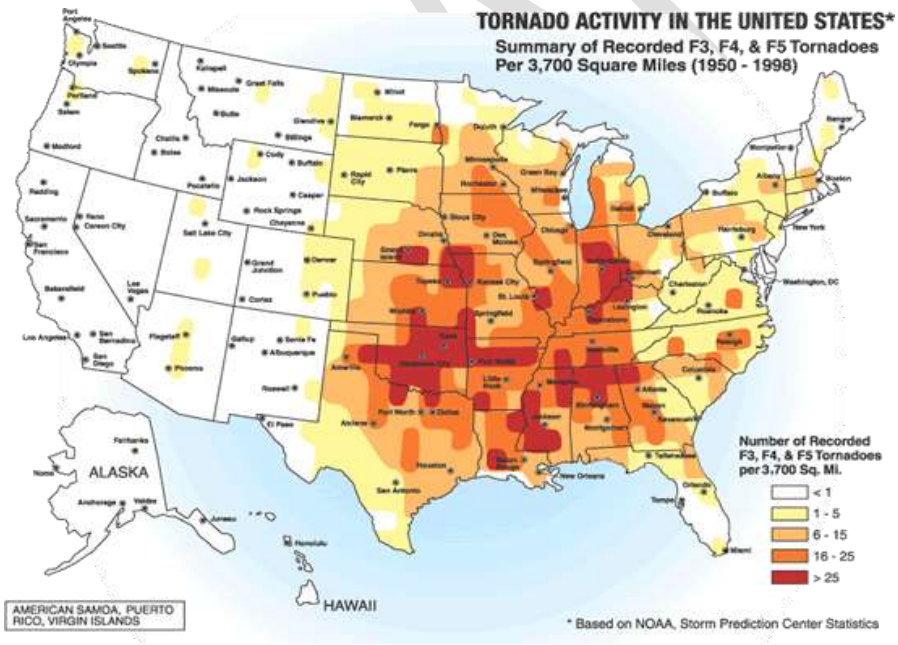
[18] NOAA, 2007 information

			missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

4.9.2 Location and Spatial Extent

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 4.14** shows tornado activity in the United States based on the number of recorded tornadoes per 1,000 square miles. Only small parts of eastern New Mexico have more than 1 tornado reported for 1,000 square miles 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. The spatial extent of a tornado is small.

Figure 4.14: Tornado Activity in the United States



Source :FEMA (http://www.fema.gov/safe-rooms/tornado-activity-united-states)

4.9.3 Previous Occurrences

There was 12 tornado events reported in Bernalillo County from January 1950 through June 2014, according to the NOAA. The maximum tornado magnitude was recorded as an EF1 with no associated property damages or injuries. The New Mexico State Plan indicates the same data for Preparedness Area 5, which includes Bernalillo County through 2013.

4.9.4 Probability and Extent of Future Events

Given the relatively rare occurrence of tornadoes in Bernalillo County, the probability of a future event is "**Unlikely**". If a tornado did occur, it will most likely be an EF0 or EF1, the weakest types.

4.9.5 Vulnerability and Impact

While the magnitude and location of tornadoes are unpredictable, the strongest tornado to have occurred in the planning area in the past 60 years was classified as low intensity (F1), with no reported damages. However, Bernalillo a County would be vulnerable to a direct strike by even a low intensity tornado. The impact of a future EF-0 or EF-1 tornado in Bernalillo County would include damage to trees, roofs, chimneys, sign boards, gutters, windows, and siding. Mobile homes may be pushed off foundations or overturned. Due to the potential of a stronger tornado, the impact would be considered critical.

4.9.6 Conclusions

The potentially strong winds of a tornado and random location make it a difficult hazard to mitigate. Most tornado mitigation activities across the nation focus on life safety. Safe rooms, both community and individual ones, are common mitigation actions to protect people in a tornado event.

4.10 Dam Failure

4.10.1 Overview

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

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- 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 (i.e., when it overflows). Overtopping is especially dangerous for an earthen dam because the down rush of water will erode the dam face and could breach the dam.

4.10.2 Location and Spatial Extent

The USACE National Inventory of Dams (NID) lists 47 dams in Bernalillo County. In addition, the New Mexico Dam Safety Program in the Office of State Engineer (OSE) maintains a list also. The hazard potential classification is listed below and the ranking of each jurisdictional/non-~~jurisdicational~~jurisdictional dam in Bernalillo County is listed below in **Table 4.13**.

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The NID utilizes 4 categories to indicate the potential hazard to the downstream area resulting from failure including: Low, Significant, High, and Undetermined. The NID Data Dictionary[19] defines these categories. Dams assigned the "high hazard potential" classification are those for which failure or disoperation would probably cause a loss of life. Dams assigned the "significant hazard potential" classification are those 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. Dams assigned the "low hazard potential" classification are those where failure results in no probable loss of human life and low economic and/or environmental losses (typically limited to the owner's property).

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 or "high" hazard dams, downstream development within five miles were 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 were considered to be at risk to potential dam failure hazards. For dams with a maximum storage capacity of less than 10,000 acre-feet, downstream ~~development within one mile were~~developments within one mile were considered to be at risk to potential dam failure hazards.

All dams owned by the USACE, as federally owned dams, are required to have completed Emergency Action Plans (EAPs). These EAPs include inundation maps as well as lists of critical facilities that may be threatened by the dams. Copies of the EAPs are located at the Bernalillo County Emergency Manager's Office. **Table 4.13** list dams located within Bernalillo County as provided by the New Mexico Dam OSE. The hazard potential classification ranges from low to high to significant based on dams are rated as low or significant hazard. This list overlaps with the NID list.

Table 4.13: Dams in Bernalillo County

Dam Name	Maximum Storage (AF)	Hazard Potential	Year Built	Juris-dictional (Y/N)
Ladera Dam No. 12	99.65	High	1976	Y
John Robert Dam	659	High	1976	Y
Settled Water Storage Dam No. 1	173	High	2005	Y
Manzano Mesa Detention Basin	38	Significant	2000	N

[19] NID Data Dictionary, 2013: http://geo.usace.army.mil/pgis/NID2009.downloadFile?InFileName=NID_DataDictionary2013.pdf, accessed July 21, 2014

Albuquerque Inflatable Diversion Dam	51.2	Low	2006	N
Kinney Dam	200	High	1995	Y
Ladera Dam No. 10	66.04	HIgh	1976	Y
Tohajilee	Unav	Unav	Unav	Unav
Westgate Detention Dam	920	High	1976	Y
Piedra Lisa Detention Dam	47	High	1982	N
Swinburne Dam	1630	High	1991	Y
North Domingo Baca Dam	325	High	1982	Y
Bridge Blvd Detention Basin	15.65	High	1986	N
Renaissance Detention Basin	29	High	1987	N
North/South Coors Detention Dam	78	High	1988	N
Amole Del Norte Detention Dam	101.81	High	1997	Y
Ladera Dam No. 7	29.78	High	1976	N
Raymac Detention Dam	249.9	High	1989	Y
Sunport Blvd Detention Dam	10	Significant	1997	N
Ladera Dam No. 3	55.82	Low	1976	N
Sandia Peak Phase 2 Pond	20	Low	1986	Y
Ladera Dam No. 14	134.4	High	1976	Y
Piedras Marcadas Detention Dam	649	High	1984	Y
Amole Arroyo Detention Dam	582	High	1979	Y
Black Arroyo Detention Dam	486	High	1992	Y
Embudo Dam	340	High	1979	Y
West Detention Dam	105	High	2005	N
McCoy Detention Dam	365	High	1991	Y
Ladera Dam No. 9	30.57	HIgh	1976	N
Ladera Dam No. 8	49.14	High	1976	N
Hubbell Lake Detention Dam	620	High	1979	Y
Borrega Detention Dam	169	High	2001	Y
Las Ventanas Detention Dam	323	High	1999	Y
Ladera Dam No. 15	1128.34	High	1976	Y
Tower/Sage Park Detention Dam	106	High	2001	N
South Domingo Baca Dam	720	High	1979	Y

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Ladera Dam No. 13	51.45	High	1976	Y
Don Felipe Detention Dam	525	High	1989	Y
Ladera Dam No. 11	36.17	High	1976	Y
Ladera Dam No. 5	52.7	Low	1976	N
Menaul Detention Dam	98	High	1994	N
Mariposa Dam	670	High	1983	Y
Arroyo Del Oso Detention Dam	840	High	1856	Y
Kirtland AFB Detention Dam	95	High	1985	N
Pino Dam	890	High	1979	Y
Ladera Dam No. 6	40.71	High	1976	N
Griegos Detention Dam	73.66	High	2002	N
Boca Negra Detention Dam	n/a	High	2014	Y
98th Street Surge Pond Dam	56.2	High	2008	N
Claremont Detention	150	Low	1994	N
Highland Detention	32	Low	1986	N
Ladera Dam No. 1	48.5	Low	1976	N
Ladera Dam No. 2	40.5	Low	1976	N
Ladera Dam No. 4	31.8	Low	1976	N
Odelia Park Dam	58	Low	1984	N
South Broadway Detention Basin	11	Low	1990	N
Special Assessment District 212 Detention Dam	20	Low	1985	N

Source :New Mexico OSE

4.10.3 Previous 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 2013 State Plan 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.

4.10.4 Probability and Extent of Future Events

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The State studied the risk of dam failure in its 2013 Plan and determined the probability of each Preparedness Area experiencing future dam failure, the probability or chance of occurrence was calculated 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 dam failure in any given year.

There is a low probability of occurrence of dam failure in Bernalillo County and the probability of a future event is "**Unlikely**".

4.10.5 Vulnerability and Impact

During periods of drought, communities along river systems are generally not as vulnerable to dam failure because of lower water levels behind the dam. While the chance of dam failure is low, a dam failure could have a significant impact in the planning area. The flood waters would be swift moving and would likely sweep structures off their foundation. A dam failure incident would likely result in a loss of life due to the lack of warning, swift flow of water, and the significant spatial extent of the impact.

4.10.6 Conclusions

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

4.11 Extreme Heat

4.11.1 Overview, Previous Occurrences, Location, Probability and Severity

Extreme heat is 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 include heat cramps, heat fainting, heat exhaustion, and heat stroke. According to the National Weather Service, heat is one the leading weather-related killer in the United States and kills hundreds of

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people every year[20]. However, most deaths are attributed to prolonged heat waves in large cities that rarely experience hot weather. It is important to note however that 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.

The 2013 State Plan reports that that in New Mexico, at elevations 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. The danger of extreme heat is gauged by using the Extreme Heat Index in **Figure 4.15**. The Heat Index, as seen below, displays the relative danger in regards to Air Temperature and Relative Humidity.

Figure 4.15: Extreme 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	113	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	117	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										

Caution | Extreme Caution | Danger | Extreme Danger

Source: http://www.nc-climate.ncsu.edu/images/climate/heat_index.jpg

[20] http://www.nws.noaa.gov/os/heat/index.shtml#heatindex Accessed July 2014

The 2013 State Plan reports that there have been 2 extreme heat events in Preparedness Area #5. There have been two reported deaths as a result of these events. Both deaths were young children left unattended in vehicles.

Bernalillo County considers any extended period with temperatures above 90 degrees to be hazardous and cause for concern. The entire planning area is equally subject to extreme heat. The probability of extreme heat occurring in the future is "**Likely**". The spatial extent of the damage is negligible.

4.11.2 Vulnerability and Conclusions

While extreme heat events will occur again in the future, Bernalillo County's existing buildings, infrastructure, and critical facilities are not considered vulnerable and therefore any estimated property losses are anticipated to be minimal across the area. Extreme heat does however present a considerable safety risk to Bernalillo County's vulnerable populations. Heat casualties are usually caused by lack of adequate air conditioning or heat exhaustion. The most vulnerable population to heat casualties are the elderly or infirmed, who frequently live on low fixed incomes, and cannot afford to run air-conditioning on a regular basis, may experience power outages, and may 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.

During extreme heat episodes, the elderly should seek shelter in air-conditioned spaces. Due to the lack of mitigation options for extreme heat, this hazard is considered a nuisance and will not be addressed in the rest of the Plan except for an action to designate a cooling center for Bernalillo County during times of extreme heat and an education program on the dangers of extreme heat and children. If future conditions or events warrant further investigation, a future update to this Plan will address it.

4.12 Landslide

4.12.1 Overview

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, rock slides, debris avalanches, debris slides, and earth flows. Several natural and human factors may contribute to landslides. 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

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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 are some of those activities)

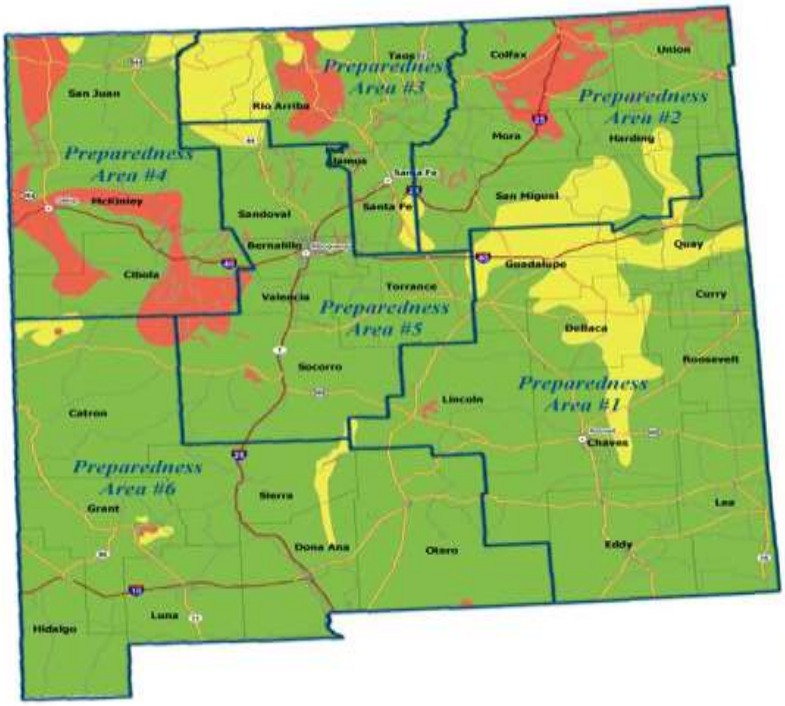
4.12.2 Location and Spatial Extent

In 1997, the U.S. Geological Survey (USGS) published a national map to illustrate landslide risk areas. The map combines past incidents with a measure of "susceptibility", defined as the "probable degree of response of rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation." **Figure 4.16** displays the USGS landslide map for the State of New Mexico (from 2013 State Plan)[21]. The map indicates that the majority of the planning area, is shown as having had less than 1.5% of its land area affected by movement of soils on slopes (no planning period is identified). The map shows that some small portions of the planning area along the Rio Grande River and a small section of the northeast portion of the county near Sandia Crest having high susceptibility.

The risk of landslides is generally greater in the mountainous steep-sloped part of Bernalillo County where it can damage roads and culverts and also act as a dam across streams and tributaries. The extent of the hazard is geographically small. The spatial extent is moderate.

Figure 4.16: Landslide Hazard Areas in New Mexico

[21] Source: http://landslides.usgs.gov/html_files/landslides/nationalmap/



Source: 2013 State Plan

For **Figure 4.16**, Green = Low (less than 1.5% of area); Yellow = Moderate (between 1.5 -15 % of area); Red = High (more than 15% of area). Bernalillo County is in the green area and is considered low risk.

4.12.3 Previous Occurrences

In referencing the NCDC, no previous occurrences are listed in the database. There is little information capturing previous landslide events in New Mexico, specifically at the county level. Per the 2013 State Plan and other past research, no records of past landslides have been found for Bernalillo County. However, as reported by the HMPT, landslides can occur along the Rio Grande and in the mountainous areas near the Sandia Crest.

4.12.4 Probability and Extent of Future Events

The 2013 State Plan shows a 3% annual probability of landslides in Preparedness Area #5. The probability of an annual chance of a landslide is generally "**Possible**".

4.12.5 Vulnerability and Future Impacts

Landslides in Bernalillo County generally pose a low risk to life and property because the landslide susceptibility areas are relatively small and generally lie outside the populated area. Impacts to the Rio Grande could become critical if the river becomes blocked and water is dammed behind it. This can result in water buildup and potential flooding upstream.

4.12.6 Conclusions

The county actively monitors conditions along the Rio Grande for potential landslides. To prevent the most severe impacts of landslides, the planning area must monitor potential landslide areas and be ready to respond.

4.13 Land Subsidence

4.13.1 Overview, Spatial Extent, Previous Occurrences, and Probability

Land subsidence, the loss of surface elevation due to the removal of subsurface support, ranges from broad, regional lowering of the land surface to localized collapse. Land subsidence can occur slowly and continuously over time or abruptly, such as in the sudden formation of sinkholes. A sinkhole can be defined as a subsidence feature that can form rapidly and is characterized by a distinct break in the land surface and the downward movement of surface material into the resulting hole or cavity.

Subsidence is caused by a diverse set of human activities and natural processes 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 hydrocompaction; dissolution of underground strata; natural sediment compaction; liquefaction; and crustal deformation.

No records of past subsidence have been found for Bernalillo County. The 2013 State Plan does not report any land subsidence or sinkhole issues in the planning area. The probability of land subsidence occurring in the future is "**Unlikely**". The spatial extent of the damage is likely to be negligible.

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4.13.2 Vulnerability, Impact, and Conclusions

Based on historic records, Bernalillo County does not appear to be vulnerable to subsidence. Any impact would be minor. Therefore the hazard is considered a nuisance and is **not addressed further** in the rest of the Plan. If future conditions or events warrant further investigation, a future update to this Plan will address it.

4.14 Summary of Vulnerability

The findings presented in **Section 4** were developed using the best available data and methods that provide an approximation of hazard risk. These approximations should be used to understand relative hazard risk. However, uncertainties are inherent in risk assessment methodology, arising in part from incomplete scientific knowledge concerning specific hazards and their effects on the built environment and from generalities that are necessary to provide a comprehensive analysis and overview of hazard risk for large planning areas.

The preparers of this Plan's hazard risk assessment relied heavily on historical data, stakeholder input, and professional and experienced judgment regarding projected hazard impacts. The preparers also considered the findings in other relevant plans, studies, and technical reports.

To draw some meaningful planning conclusions on hazard risk for Bernalillo County, the results of the combined risk assessment process were used to generate hazard profiles according to a "Priority Risk Index" (PRI). The purpose of the PRI, described further below, is to categorize and prioritize the 12 identified hazards for Bernalillo County and the participating jurisdictions as high, moderate, or low risk (see **Table 4.11**).

Priority Risk Index

The prioritization and categorization of identified hazards for the planning area is based principally on the Priority Risk Index (PRI), a tool used to measure the degree of risk for identified hazards in a particular planning area. The PRI is used to assist the HMPT in gaining consensus on the determination of those hazards that pose the most significant threat to Bernalillo County based on a variety of factors. The PRI is by no means scientific, but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in Bernalillo County based on standardized criteria. The hazard profiles developed earlier in this section allows for the prioritization of high hazard risks for mitigation planning purposes.

The numerical PRI results allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and

duration) which occurred in the **Section 4** hazard profiles. Each degree of risk was assigned a value (1 to 4) and a weighting factor, as summarized in **Table 4.1**. To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor.

The sum of all five categories is the final PRI value using this example equation:

PRI VALUE = [(PROBABILITY x .40) + (IMPACT x .20) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

Using the weighting scheme used by Bernalillo County, the highest possible PRI value is 4.0. **Tables 4.14 through 4.18** summarize the degree of risk assigned to each category for all identified hazards (note AMAFCA has water control structures in its jurisdiction so not all identified hazards are applicable). The PRI Score for each hazard is in the last column on the right.

	Table 4.14 Category/Degree of Risk for Bernalillo County					
	Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	***PRI Score***
Flood	Highly Likely	Critical	Moderate	Less than 6 Hours	Less than 24 Hours	**3.4**
Wildfire	Highly Likely	Limited	Moderate	12 to 24 Hours	Less than 24 Hours	**3.0**
Drought	Likely	Limited	Large	More than 24 Hours	More than 1 Week	**2.9**
Earthquake	Unlikely	Catastrophic	Large	6 to 12 Hours	Less than 6 Hours	**2.4**
Severe Winter Storms	Possible	Limited	Large	More than 24 Hours	Less than 24 Hours	**2.4**
Thunderstorm	Likely	Minor	Small	More than 24 Hours	Less than 6 Hours	**2.0**
High Wind	Likely	Minor	Small	12 to 24 Hours	Less than 6 Hours	**2.1**
Tornado	Unlikely	Limited	Small	6 to 12 Hours	Less than 6 Hours	**1.6**
Dam Failure	Unlikely	Critical	Small	12 to 24 Hours	Less than 24 Hours	**1.8**
Extreme Heat	Likely	Minor	Moderate	More than 24 Hours	Less than 1 Week	**2.4**
Landslide	Possible	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.9**
Land Subsidence	Unlikely	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.5**

	Table 4.15 Category/Degree of Risk for City of Albuquerque					
	Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	***PRI Score***
Flood	Highly Likely	Critical	Moderate	Less than 6 Hours	Less than 24 Hours	**3.4**
Wildfire	Highly Likely	Limited	Moderate	12 to 24 Hours	Less than 24 Hours	**3.0**
Drought	Likely	Limited	Large	More than 24 Hours	More than 1 Week	**2.9**
Earthquake	Unlikely	Catastrophic	Large	6 to 12 Hours	Less than 6 Hours	**2.4**

	Table 4.15 Category/Degree of Risk for City of Albuquerque					
	Probability	Impact	Spatial Extent	Warning Time	Duration	*PRI Score*
Severe Winter Storms	Possible	Limited	Large	More than 24 Hours	Less than 24 Hours	**2.4**
Thunderstorm	Likely	Minor	Small	More than 24 Hours	Less than 6 Hours	**2.0**
High Wind	Likely	Minor	Small	12 to 24 Hours	Less than 6 Hours	**2.1**
Tornado	Unlikely	Limited	Small	6 to 12 Hours	Less than 6 Hours	**1.6**
Dam Failure	Unlikely	Critical	Small	12 to 24 Hours	Less than 24 Hours	**1.8**
Extreme Heat	Likely	Minor	Moderate	More than 24 Hours	Less than 1 Week	**2.4**
Landslide	Possible	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.9**
Land Subsidence	Unlikely	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.5**

	Table 4.16 Category/Degree of Risk for AMAFCA					
	Probability	Impact	Spatial Extent	Warning Time	Duration	*PRI Score*
Flood	Highly Likely	Critical	Moderate	Less than 6 Hours	Less than 24 Hours	**3.4**
Wildfire	Highly Likely	Limited	Moderate	12 to 24 Hours	Less than 24 Hours	**3.0**
Drought	Likely	Limited	Large	More than 24 Hours	More than 1 Week	**2.9**
Earthquake	Unlikely	Catastrophic	Large	6 to 12 Hours	Less than 6 Hours	**2.4**
Dam Failure	Unlikely	Critical	Small	12 to 24 Hours	Less than 24 Hours	**1.8**
Landslide	Possible	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.9**
Land Subsidence	Unlikely	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.5**

	Table 4.17 Category/Degree of Risk for Village of Tijeras					
	Probability	Impact	Spatial Extent	Warning Time	Duration	*PRI Score*
Flood	Highly Likely	Critical	Moderate	Less than 6 Hours	Less than 24 Hours	**3.4**
Wildfire	Highly Likely	Limited	Moderate	12 to 24 Hours	Less than 24 Hours	**3.0**
Drought	Likely	Limited	Large	More than 24 Hours	More than 1 Week	**2.9**
Earthquake	Unlikely	Catastrophic	Large	6 to 12 Hours	Less than 6 Hours	**2.4**
Severe Winter Storms	Possible	Limited	Large	More than 24 Hours	Less than 24 Hours	**2.4**
Thunderstorm	Likely	Minor	Small	More than 24 Hours	Less than 6 Hours	**2.0**
High Wind	Likely	Minor	Small	12 to 24 Hours	Less than 6 Hours	**2.1**
Tornado	Unlikely	Limited	Small	6 to 12 Hours	Less than 6 Hours	**1.6**
Dam Failure	Unlikely	Critical	Small	12 to 24 Hours	Less than 24 Hours	**1.8**
Extreme Heat	Likely	Minor	Moderate	More than 24 Hours	Less than 1 Week	**2.4**

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	Table 4.17 Category/Degree of Risk for Village of Tijeras					
	Probability	Impact	Spatial Extent	Warning Time	Duration	*PRI Score*
Landslide	Possible	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.9**
Land Subsidence	Unlikely	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.5**

	Table 4.18 Category/Degree of Risk for Village of Los Ranchos					
	Probability	Impact	Spatial Extent	Warning Time	Duration	*PRI Score*
Flood	Highly Likely	Critical	Moderate	Less than 6 Hours	Less than 24 Hours	**3.4**
Wildfire	Highly Likely	Limited	Moderate	12 to 24 Hours	Less than 24 Hours	**3.0**
Drought	Likely	Limited	Large	More than 24 Hours	More than 1 Week	**2.9**
Earthquake	Unlikely	Catastrophic	Large	6 to 12 Hours	Less than 6 Hours	**2.4**
Severe Winter Storms	Possible	Limited	Large	More than 24 Hours	Less than 24 Hours	**2.4**
Thunderstorm	Likely	Minor	Small	More than 24 Hours	Less than 6 Hours	**2.0**
High Wind	Likely	Minor	Small	12 to 24 Hours	Less than 6 Hours	**2.1**
Tornado	Unlikely	Limited	Small	6 to 12 Hours	Less than 6 Hours	**1.6**
Dam Failure	Unlikely	Critical	Small	12 to 24 Hours	Less than 24 Hours	**1.8**
Extreme Heat	Likely	Minor	Moderate	More than 24 Hours	Less than 1 Week	**2.4**
Landslide	Highly Unlikely	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.1**
Land Subsidence	Unlikely	Limited	Small	Less than 6 Hours	Less than 6 Hours	**1.5**

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Table 4.19 shows the 12 natural hazards categorized by hazard risk:

- ***High*** – PRI score over 2.5
- ***Moderate*** – PRI score between 1.6 and 2.5
- ***Low*** – PRI score 1.5 or below

Table 4.19 – Hazards organized by Risk

Hazard Risk	Hazard Type
High	Flood Wildfire Drought

	Severe Winter Storms
Moderate	High Wind Thunderstorm Earthquake Extreme Heat
Low	Landslide Land Subsidence Dam Failure Tornado

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5 Mitigation Goals, Measures, and Actions

The preparation of goal, measures and actions to address the risk defined in **Section 4** is the culmination of the mitigation plan. The implementation of these measures will lead to the fulfillment of risk reduction and ultimately, a higher quality of life for the citizens of Bernalillo County.

5.1 Mitigation Measures

5.1.1 Hazard Mitigation Goals

The mitigation goals reflect the aspirations of the Bernalillo County HMPT to provide a safe environment in the planning area while preserving 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. The mitigation goals of Bernalillo County are:

I. Make the county and its municipalities safer from natural hazards
II. Reduce the damage to 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

5.1.2 NFIP Participation and 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.

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The Flood Insurance Rate Maps (FIRMs) were recently updated and became effective as of August 16, 2012. As of June 2014, Bernalillo County and all participating jurisdictions, except AMAFCA, are participants in the NFIP and are in good standing[22]. AMAFCA is not a municipality and therefore does not participating in the NFIP.

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 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.

Bernalillo County participates in the National Flood Insurance Program (NFIP) and uses 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. Some of the flood zones in Bernalillo County have not been revisited since their initial mapping in 1983. There are also many areas where approximate methods were used to develop the flood zones rather than detailed methods. Portions of the East Mountain area have never been mapped and development has occurred in this area, potentially at high risk.

The maps need to be updated in these areas: north and south valley, south west escarpment, North Albuquerque Acres and Sandia Heights. New mapping is needed along the large arroyos south of I-40 that flow east towards Edgewood in the East Mountain area.

Both Bernalillo County and the City of Albuquerque participate in the NFIP Community Rating System (CRS), which is an incentive program for communities to go beyond minimum NFIP requirements. Both Bernalillo County and CABQ are at Class 8 which means flood insurance

[22] http://www.fema.gov/cis/NM.pdf Accessed June 2014

policyholders with properties in the Special Flood Hazard Area (SFHA) receive a 10 percent discount on premiums and policyholders with properties not in the SFHA receive a five percent discount.

(Need NFIP policy #'s, claims data and rep loss property data for all jurisdictions here if possible)

Bernalillo County and all participating jurisdictions will continue to ensure compliance in the NFIP through action items identified in this Plan.

5.2 Previous Mitigation Action Plan Update

Below is a listing of the actions from the 2007 Plan and their current status.

1) *Wildland Urban Interface (WUI) Code for entire County*

Description: The WUI Code shall apply to the construction, alteration, movement, repair, maintenance, and use of any building, structure or premises within the WUI areas of the County. The objective of this code is to establish minimum regulations consistent with nationally recognized good practices for safeguarding of life and property. Regulations in this code are intended to mitigate the risk to life and structures from the intrusion of fire. The purpose of the rules is to prohibit wildland exposures from spreading to adjacent structures and vice versa. Certain requirements may not be applicable depending on the type of construction and the hazard rating. The Fire Chief or the code may allow alternative materials or methods as long as they meet the intent of the WUI Code.

Cost: City / County administrative costs.
Jurisdictions: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras
Responsible Agency: Bernalillo County and City of Albuquerque Fire Departments and Planning and Zoning for all jurisdictions
Funding Sources: Self-funded
Timeline: 3 -6 Months
Cost-Benefit Analysis: Regulations in this code are intended to mitigate the risk to life and structures from the intrusion of fire.

Status: *Complete. Adoption of the 2009 Fire Code by the City of Albuquerque includes NFPA 1 Chapter 17 Wildland Urban Interface and NFPA 1144 Protection of Life and Property from Wildfire.*

2) ***Continue training fire fighters in advanced Wildland firefighting techniques to respond and control wildfires***

Description: Bernalillo County has developed comprehensive firefighting techniques to respond to wildfire type situations that require on-going training of fire-fighting personnel:
Cost: On-going.
Jurisdictions: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County Fire Department/Training Commander
Funding Sources: County/General Fund
Timeline: 12 months and on-going
Cost-Benefit Analysis: Comprehensive firefighting techniques for wildfire will lead to increased safety of fire fighters and rapid response.

Status: *Completed*

3) ***Integrated Wildland Resource Group***

Description: Develop a program to integrate planning and training efforts for local emergency response for wildfire. The group will function as a platform for sharing lessons learned and strategies for an integrated city/county/volunteer response to wildfires..

Cost: $25,000
Jurisdictions: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras Fire Departments
Responsible Agency: Bernalillo County Fire Department/Training Commander and Office of Emergency Management ; City of Albuquerque Fire Department/Training Commander; City of Albuquerque Wildland Fire Task Force; Village of Tijeras Fire Department/Fire Chief; Village of Los Ranchos de Albuquerque Fire Department/Fire Chief
Funding Sources: General budget
Timeline: 6 months
Cost-Benefit Analysis: Integrated planning will lead to faster and more efficient response to wildfire.

Status: *Completed*

4) ***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***

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Description: Part 1 - Identify facilities with large venues and evaluate appropriate warning systems. Part 2 - Create building codes to increase number of warning sirens..

Cost: $40,000
Jurisdictions: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras Offices
Responsible Agency: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras Fire Departments and Offices of the Emergency Managers/Bernalillo County EOC Manager; Albuquerque EOC Manager; Los Ranchos de Albuquerque Fire Chief; Tijeras Fire Chief
Funding Sources: General Budget
Timeline: 12 months
Cost-Benefit Analysis:
Hail damage from recent storm could total more than 40 million dollars. Early warning systems could have enabled people to get vehicles under protected areas.

Status: *Albuquerque Fire Department in collaboration with CABQ OEM has worked towards a public announcement system at Balloon Fiesta Park during special events which can be used as an Emergency Alert System including weather related incidents.*

5) *Develop and implement a county-wide StormReady Program*

Description: Develop a StormReady program to enable preparedness 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.

Cost: $50,000
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County and City of Albuquerque Emergency Services/EOG Manager
Funding Sources: General Budget
Timeline: 12 Months.
Cost-Benefit Analysis:
Cost is minimal compared to recent annual storm damage in Bernalillo County.
Flash flood event in April 2004 cost 3.8 million dollars.

Status: *Not completed and this action will be carried forward.*

6) *Create a State Drought Management Plan Work Group*

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Description: Convene a work group of city, county, and village officials to participate in the creation and implementation of the State Drought Management Plan by identifying staff to attend meetings.

Cost: Salary and travel costs for meetings
Jurisdictions: Bernalillo County
Responsible Agency: Village of Tijeras
Funding Sources: General budget
Timeline: 12 Months; on-going
Cost-Benefit Analysis: Increased knowledge of staff in drought management will facilitate a comprehensive response to drought.

Status: *No progress as this action is better suited for a State agency and will not be carried forward.*

7) *Create a Wellhead Protection Awareness Program*

Description: Create a program to be implemented through the neighborhood associations to educate communities about wellhead protection. Target communities with domestic wells.

Cost: Project cost estimated at $25,000
Jurisdictions: Bernalillo County
Responsible Agency: Albuquerque Bernalillo County Water Authority/Water Resources Division Leader
Funding Sources: EPA
Timeline: approximately 12 months
Cost-Benefit Analysis: Small cost to help protect the area's major source of potable water. Cost is equal to purchasing eight acre-feet of water rights.

Status*: Village of Tijeras reports that a wellhead protection awareness program has been created.*

8) *Create and maintain defensible space around all critical facilities and structures, including housing, administrative, and other structures*

Description: Biopark and Interstate-40 area over the Bosque most at risk.
Cost: Project cost estimated at:

- Hazardous fuels reduction $1500-3000 per acre
- Herbicide $500-800 per acre
- 5-year restoration $6000 per acre
- Continued monitoring $2200 year per acre

Jurisdictions: Bernalillo County and City of Albuquerque, and Office of Cultural Affairs (Hispanic Center), Village of Los Ranchos de Albuquerque, and Village of Tijeras
Responsible Agency: City of Albuquerque Open Space Division and Middle Rio Grande Conservancy
Funding Sources: USACE
Timeline: 12 months and on-going
Cost-Benefit Analysis: Value of assets at-risk total more than 250 million dollars.

Status: *Operations and Maintenance (O&M) has been assessing our bridges and removing vegetation as needed to prevent wildland fire damage. (Note: Some grasses and small brush are needed for erosion control.). Continuing to maintain a reduced fuel load within the Bosque (between levees). The Albuquerque Fire Department is using the Ready, Set, Go campaign in collaboration with Firewise Community Program to educate the citizens and neighborhood associations in and around identified WUI areas of the City of Albuquerque the importance of wildland fire preparedness, defensible space, and fuel reduction. Defensible space has been created around the Village of Tijeras buildings.*

9) *Further investigations to examine the vulnerability of structures to severe weather and hailstorms.*

Description: 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.

Cost: Project cost estimated at $80,000.
Jurisdictions: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Responsible Agency: Bernalillo County Building Section; City of Albuquerque Building Inspection Section; Village of Los Ranchos de Albuquerque Planning Department
Funding Sources: Bernalillo County, Pre-Disaster Mitigation Assistance funds administered by NMOEM, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline: Within 24 months of adoption of Plan
Cost-Benefit Analysis: Recent damage due to hailstorms estimated at 40 million dollars.

Status: *Not completed and this action will be carried forward.*

10) *Expand existing projects to use treated effluent for non-potable uses.*

Description: 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.

Cost: Project cost estimated at $250,000
Jurisdictions: City of Albuquerque and Bernalillo County
Responsible Agency: City of Albuquerque and Bernalillo County Public Works departments
Funding Sources: Office of State Engineer, State legislative funds, Pre-Disaster Mitigation Assistance funds administered by NMOEM, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline: 12 Months
Cost-Benefit Analysis: New water sources cost more than $6,000/acre-foot of water . Each acre-foot of water typically serves three households. Re-use of treated effluent equals cost of adding 125 new households.

Status: *Not completed and this action will be carried forward.*

11) *Create water conservation programs for residential, commercial and industrial users*

Description: Expand City water conservation programs to encourage and provide incentives for residents to use water-saving landscaping techniques. Expand City Water Awareness Programs and Water Audits to all parts of County. 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.

Cost: Part of City Water Conservation Program
Jurisdictions: Bernalillo County I City of Albuquerque
Responsible Agency: Albuquerque Bernalillo County Water Authority
Funding Sources: ~~Self funding~~Self-funding by the Albuquerque Bernalillo County Water Authority
Timeline: 12 Months; On-going
Cost-Benefit Analysis: Increased knowledge of staff in water conservation methods will facilitate a comprehensive response to drought.

Status: *Albuquerque Fire Department in collaboration with ABCWUA has developed a water conservation program while testing hydrants to limit the wasted water during the annual hydrant inspections. This has saved hundreds of thousands of gallons of waste water yearly.*

12) *Increase awareness of potential for earthquakes in Bernalillo County*

Description: 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.

Cost: Staff time and printing costs
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County Office of Emergency Management
Funding Sources: General fund
Timeline: 12 months
Cost-Benefit Analysis: Increased awareness of potential earthquakes will protect lives and property.

Status: *The City of Albuquerque requires designation of the seismic zone category for all commercial permits with structural implications.*

13) *Review and update existing building codes for earthquakes*

Description: 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.

Cost: Minimal
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County Building, Planning, and Zoning Department/Building Official
Timeline: 12 months
Cost-Benefit Analysis: Updated building codes will minimize damage to structures and protect lives in the event of an earthquake.

Status: *Adoption of the 2009 International Building Code (IBC), International Residential Code (IRC), and International Existing Building Code (IEBC) by CBAQ.*

14) *Conduct Technical Assistance Visits to help homeowners implement non-structural earthquake retrofits of their home*

Description: Work with home owners 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.

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Cost: $500/per home or less
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County Office of Emergency Management; Bernalillo County Zoning, Building & Planning/Building Inspector
Funding Sources: Homeowner
Timeline: 12 months
Cost-Benefit Analysis: Non-structural retrofits are an inexpensive means of mitigating property damage and personal damage due to the effects of earthquakes.

Status: *Not completed and this action will be carried forward.*

15) *Map areas vulnerable to landslides and land subsidence and input into GIS*

Description: Areas of eastern Bernalillo County are susceptible to landslides. The northeast quadrant of the City of Albuquerque is vulnerable to land subsidence due to ground water pumping. Mapping vulnerable areas will enable planners when developing land-use zoning maps and guide mitigation activities for landslide/land subsidence hazards.

Cost: City/County Administrative Costs
Jurisdictions: Bernalillo County and City of Albuquerque
Responsible Agency: Bernalillo County and City of Albuquerque Planning, Zoning, and Mapping
Funding Sources: City/County government budgets
Timeline: Within 12 months of adoption of Plan
Cost-Benefit Analysis: This project will identify the areas vulnerable to landslides and land subsidence and decrease, if not eliminate, this hazard as future development of the County and City of Albuquerque continues.

Status: *Not completed and this action will be carried forward.*

16) *Anchor slope mesh over areas prone to landslides that threaten infrastructure and critical facilities*

Description: 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.

Cost: Project cost estimated at $100,000
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County Office of Emergency Management/Emergency Manager and Bernalillo County Public Works Department

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Funding Sources: General Fund
Timeline: 12 months
Cost-Benefit Analysis: Protection of transportation routes and critical facilities will minimize damage and protect lives in the event of a landslide.

Status: *Not completed and this action will be carried forward.*

17) *Implement aggressive program to repair leaks in existing municipal water system , including lines to homes*

Description: Due to the on-going drought, value of water as an asset is rising. Water leakage not only wastes water, but can also contribute to subsidence and sinkholes.

Cost: Costs will be on a project by project basis
Jurisdictions: Bernalillo County
Responsible Agency: Albuquerque Bernalillo County Water Utility Authority/Engineering & Planning
Timeline: 12 months
Cost-Benefit Analysis: An aggressive program to repair leaks in municipal water systems will increase water conservation and protect against infrastructure damage.

Status: *Albuquerque Fire Department in collaboration with ABCWUA has developed a water conservation program while testing hydrants to limit the wasted water during the annual hydrant inspections. This has saved hundreds of thousands of gallons of waste water yearly.*

18) *Increase water storage capacity for fire suppression in the Bosque*

Description: 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.

Cost: Project cost estimated at $40,000
Jurisdictions: Bernalillo County
Responsible Agency: Albuquerque Bernalillo County Water Utility Authority/ Water Resources Division
Funding Sources: USFS, NM State Forestry, New Mexico State Fire Fund, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline: Within 18 months of adoption of Plan
Cost-Benefit Analysis: Increased water capacity in Bosque will increase fire fighting capabilities in a high- risk area.

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Status: *Not completed and this action will be carried forward.*

19) ***Continue thinning and fuel reduction projects in Bosque***

Description: Continue Middle Rio Grande Bosque Initiative, Middle Rio Grande Bosque Restoration, and Bosque Ecosystem Revitalization Programs. Through these programs dead and downed trees and non-native plants are cleared out of areas within the Bosque. This keeps fire from spreading vertically to the upperstory; preserves native plants such as cottonwoods and willows and improves wildlife habitat.

Cost: Project cost estimated at $80 M total, $3M City of Albuquerque, $8M USACE, $10M per year Federal funding per year for 10 years; Hazardous fuels reduction $1500-3000 per acre; Herbicide $500-800 per acre; 5-year restoration $6000 per acre; Continued monitoring $2200 year per acre
Jurisdictions: Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque
Responsible Agency: USACE, City of Albuquerque, Bernalillo County, Albuquerque Fire Department, Middle Rio Grande Conservancy District
Funding Sources: Federal, City of Albuquerque, State
Timeline: 12 Months; On-going
Cost-Benefit Analysis: Value of residential assets at-risk in the Bosque area due to wildfire total more than 150 million dollars. Thinning will help reduce the threat of catastrophic fires.

Status: *Bernalillo County became an Open Space Partner with the Bosque Ecological Management Program, which provides data not only for fuel loads but for effective thinning strategies that provide for long term sustainable biosystems versus continually dying invasive species that increase fuel loads.*

20) ***Remove jetty jacks from along the Rio Grande in targeted high-risk areas to aid first responder access to the Bosque during wildfires***

Description: Continue Middle Rio Grande Bosque Initiative, Middle Rio Grande Bosque Restoration and Bosque Ecosystem Revitalization Programs are currently working to improve

conditions in Middle Rio Grande Bosque. Non-functional jetty jack fields often have a build-up of vegetation and contribute to wildfire fuel loads. Removal of non-functional jacks improves access to the Bosque and reduces wildfire fuel loads.

Cost: Project cost estimated at $1,100,000.00 for removal
Jurisdictions: City of Albuquerque (in coordination with Bernalillo County)
Responsible Agency: USACE, City of Albuquerque, Bernalillo County, Albuquerque Fire Department, Middle Rio Grande Conservancy District
Funding Sources: United States Army Corps of Engineers
Timeline: 12 months
Cost-Benefit Analysis: Value of residential assets at-risk in the Bosque area due to wildfire total more than 150 million dollars. Quicker response to fires can contain them before they become major wildfire events.

Status: *The Bureau of Reclamation Bosque Restoration project removed some jetty jacks along the Rio Grande.*

21) *Participate in State's program to use bio mass fuels as a way to dispose of tree thinning debris in the Bosque and East Mountain areas*

Description: Thinning projects create an ~~over abundance~~overabundance of debris for disposal. Using the debris as a bio mass fuel source should be studied as an effective and cost effective solution for disposal.

Cost: Project cost estimated at $65,000
Jurisdictions: City of Albuquerque Open Space Division, New Mexico State Parks
Responsible Agency: City of Albuquerque Open Space Division, New Mexico State Parks
Funding Sources: USFS, NM State Forestry, New Mexico State Fire Fund, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline: 24 months from adoption of Plan
Cost-Benefit Analysis: Disposal costs for slash average $8.00/cubic yard. Bio-fuel could be means to eliminate disposal costs and create additional fuel source.

Status: *Not completed and this action will be carried forward.*

22) *Develop mitigation strategies for known roads and buildings in flood areas in Bernalillo County*

Description: Fund and construct drainage improvements in areas of City of Albuquerque and unincorporated areas of Bernalillo County that are subject to chronic flooding including:

- Broadway Boulevard near Lomas Avenue
- Streets near City of Albuquerque Zoo
- Areas in South Valley

Cost: Costs to be defined after further study and engineering
Jurisdictions: Bernalillo County and City of Albuquerque
Responsible Agency: City of Albuquerque and Bernalillo County Public Works/Technical Services Division
Funding Sources: Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM, AMAFCA
Timeline: Within 36 months of adoption of Plan
Cost-Benefit Analysis: Albuquerque Zoo has assets valued at more than 234 million dollars. Each identified area is in densely developed part of County. One hundred year flood could cause millions of dollars of damage.

Status: *A South East Valley Master Drainage Plan has been prepared to provide development guidelines and propose infrastructure to reduce the impacts of flooding in the South East Valley and the Mountainview Neighborhood. O&M has refurbished the pumping trucks used for pumping water after storm events.*

23) *Improve access into the bosque and to identified East Mountain areas for emergency response*

Description: Several areas of limited access were identified in the Wildland-Urban Interface Assessment. Improved access can be completed by building bridges across conservancy ditches and roads in the bosque. Several areas of limited access were identified in the Wildland-Urban Interface Assessment. Access can be improved by upgrading bridges and roads in the East Mountain areas

Cost: $150,000/ bridge and Improving road access: average of $100,000/mile. New bridges: $200,000 each
Jurisdictions: Bernalillo County
Responsible Agency: Bernalillo County Fire Department and Public Works
Funding Sources: USFS, NM State Forestry, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline: 12 Months
Cost-Benefit Analysis: Improved access will save lives by providing evacuation routes and protect property by allowing access by emergency vehicles.

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Status: *Bernalillo County has aggressively increased its paved vs. unpaved road mileage going from 113 miles out of 300 to 169 of 300 miles in the rural east mountain wildland urban interface since 2006, improving the resiliency of the roadway to flood damage and providing for all weather access. The cost in 2014 dollars is $17million invested.*

24) *Update first floor elevation certificates and incorporate them into City of Albuquerque GIS system*

Description: City currently has parcel data but does not have accurate information concerning elevations within the floodplain. This project will help improve the city's rating in the National Flood Insurance Program's (NFIP) Community Rating System (CRS). The CRS is a voluntary incentive program that encourages communities to implement floodplain management activities that exceed the minimum NFIP requirement, and results in discounted flood insurance premium rates that reflect the reduction of flood risk.

Cost: Project cost estimated at $50,000
Jurisdictions: City of Albuquerque
Responsible Agency: City of Albuquerque
Timeline: 12 Months; On-going
Cost-Benefit Analysis: City has over one billion ~~dollar's worth~~dollars' worth of assets in defined 100 year flood zones.

Status: *First floor Elevation Certificates were updated and installed into AGIS in April of 2014. as reported by CABQ Hydrology Section.*

25) *Create monitoring system to track land subsidence due to groundwater depletion in the northeast quadrant of the City of Albuquerque*

Description: The northeast quadrant of the City has experience subsidence due to groundwater pumping. Create a system to monitor groundwater levels and stop pumping when the water level drops low enough to increase the risk of land subsidence.

Cost: Project cost estimated at $150,000
Jurisdictions: City of Albuquerque
Responsible Agency: Albuquerque Bernalillo County Water Utility Authority
Funding Sources: City of Albuquerque general budget
Timeline: 24 months from adoption of Plan
Cost-Benefit Analysis: The northeast quadrant is the largest geographical and most populous area of the city. The effects of not having a system to monitor groundwater pumping could cause millions of dollars of damage.

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Status: *Not completed and this action will be carried forward.*

26) ***Create Firewise Communities through the National Wildland-Urban Interface Fire Program in the Village of Los Ranchos de Albuquerque***

Description: 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. We will circulate wildfire safety and prevention materials.

Cost: Project cost estimated at $1,500
Jurisdictions: Village of Los Ranchos de Albuquerque
Responsible Agency: Village of Los Ranchos de Albuquerque (District 12)
Funding Source: General Fund
Timeline: 12 Months; On-going
Cost-Benefit Analysis: Firewise Communities are eligible for lower insurance rates.

Status: *No progress has been made on this activity and it will be carried forward.*

27) ***Select a village official to participate in the State Drought Management Plan Work Group***

Description: 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.

Cost: Salary and travel costs
Jurisdictions: Village of Los Ranchos de Albuquerque
Responsible Agency: Village of Los Ranchos de Albuquerque
Timeline: 12 months
Cost-Benefit Analysis: Increased knowledge of village officials in State Drought Management Plan will facilitate a comprehensive response to drought.

Status: *No progress has been made on this activity and it will be carried forward***.**

28) ***Implement Los Ranchos de Albuquerque Incident Action Plan (IAP)***

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Description: The purpose of the Los Ranchos de Albuquerque Incident Action Plan (IAP) is to provide a pre-planned coordinated mechanism to establish a safe, efficient, and organized inter- agency response and unified incident command system in the event of a large wildfire occurring within the Village of Los Ranchos de Albuquerque area.

The six primary agencies responsible for the implementation plan include the Village of Los Ranchos de Albuquerque Fire Department-, Village of Tijeras Fire Department, Bernalillo County Fire Department, City of Albuquerque Fire Department, New Mexico State Forestry, and the USDA Forest Service, Cibola National Forest. The IAP will include incident support locations and facilities, radio plan, contact phone list, dispatch, evacuation plan, jurisdiction, wildland command and will specify minimum training levels for responders and advanced training requirements as specified with the National Wildland Coordinating Group (NWCG).

Cost: Printing, estimated at less than $500
Jurisdictions: Village of Los Ranchos de Albuquerque
Responsible Agency: Village of Los Ranchos de Albuquerque (District 12)
Funding Sources: Within current budget
Timeline: 6 – 12 months
Cost-Benefit Analysis: The Los Ranchos de Albuquerque Incident Action Plan (IAP) will provide a pre- planned coordinated mechanism to establish a safe, efficient, and organized inter- agency response and unified incident command system in the event of a large wildfire occurring within the Village of Los Ranchos de Albuquerque area.

Status: *Progress on wildfire specific planning but no event specific IAP:*

- *2008 Resolution adopting National Incident Management System (NIMS)*
- *2008 Emergency Management Ordinance*
- *2011 Emergency Operations Plan*

29) *Continue efforts as a Firewise Community through the National Wildland/Urban Interface Fire Program to educate the community in defensible space*

Description: 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.

Cost: Minimal
Jurisdictions: Village of Tijeras
Responsible Agency: Village of Tijeras
Funding Sources: General Fund

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Timeline: 12 months
Cost-Benefit Analysis: Firewise Communities are eligible for lower insurance rates.

Status: *Not completed and this action will be carried forward.*

30) ***Create a program for green waste disposal at transfer stations to encourage tree thinning by facilitating disposal of debris.***

Description: Provide area for residents to dispose of tree trimming debris to help protect against wildfire.

Cost: Minimal
Jurisdictions: Village of Tijeras
Responsible Agency: Village of Tijeras
Funding Sources: General Fund
Timeline: 12 months
Cost-Benefit Analysis: Low cost way to encourage residents' participation in this fuel reduction activity.

Status: *Village of Tijeras has clean-up days to support this activity.*

31) ***Secure additional sources of water for emergency use.***

Description: Community water supply limited by present storage capacity; impacts ability to suppress wildland-urban fires.

Cost: Project cost estimated at $250,000
Jurisdictions: Village of Tijeras
Responsible Agency: Village of Tijeras
Funding Sources: New development impact fees, Office of State Engineer
Timeline: 12 months
Cost-Benefit Analysis: Increased community water supply will increase ability to suppress wildfires.

Status: *Additional sources of water have not yet been secured for emergency use.*

32) ***Flood Control Projects: Arroyo Crossing Points***

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Description: Create a structural arroyo crossing at Primera Agua Bridge, Cresencino Project, and Camino de Constancia

Cost: Project cost estimated at $400,000 for each crossing ($1,200,000 total)
Jurisdictions: Village of Tijeras
Responsible Agency: New Mexico Department of Transportation (NMDOT) Municipal Arterial Project (MAP)
Funding Sources: NMDOT
Timeline: 6 Months; On-going
Cost-Benefit Analysis: Assets at risk for flooding in Tijeras total more than 2 million dollars.

Status: *Village of Tijeras reports as completed*

33) ***Flood Control Projects Stabilization of Arroyos***

Description: 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.

Cost: Project cost estimated at $400,000
Jurisdictions: Village of Tijeras
Responsible Agency: NMDOT MAP
Funding Sources: NMDOT
Timeline: 6 months; ongoing
Cost-Benefit Analysis: Assets at risk for flooding in Tijeras total more than 2 million dollars.

Status: *Village of Tijeras reports as not completed and this action will be carried forward.*

34) ***Hire a Floodplain Manager for the Village***

Description: Hire a Floodplain Manager (position can be part time) to enforce and manage existing floodplain ordinance. Floodplain Manager should have ASFPM certification.

Cost: Project cost estimated for part-time position at $15,000
Jurisdictions: Village of Tijeras
Responsible Agency: Village of Tijeras
Funding Sources: General Fund
Timeline: 12 Months; On-going
Cost-Benefit Analysis: Assets at risk for flooding in Tijeras total more than 2 million dollars.

Status: *The Village of Tijeras maintains a certified floodplain manager.*

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35) ***Participate in State's program to use bio mass fuels as a way to dispose of tree thinning debris in the Village of Tijeras.***

Description: Thinning projects create an ~~over abundance~~overabundance of debris for disposal. Forest residues from fire mitigation activities can be turned into power instead of being burned in the woods. Using the debris as a bio mass fuel source should be studied.

Cost: Project cost estimated at $65,000
Jurisdictions: Village of Tijeras
Responsible Agency: Village of Tijeras
Funding Sources: USFS, NM State Forestry, New Mexico State Fire Fund, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline: 24 months after adoption of Plan
Cost-Benefit Analysis: Disposal costs for slash average $8.00/cubic yard. Bio-fuel could be means to eliminate disposal costs and create additional fuel source.

Status: *The Village of Tijeras will have a green waste day.*

Other Mitigation Actions Completed by Bernalillo County and its participating jurisdictions since 2007:

- STORM Team "Ditch the Ditches" program – Public awareness: by CABQ, Bernalillo County and AMAFCA
- Bernalillo County Public Works requested that FEMA map flood prone areas in the East Mountains. Partially completed with the new 2012 Flood Insurance Rate Maps.
- Bernalillo County Public Works implemented new higher standards for development within flood prone areas. Developed a cooperative outreach program with the City of Albuquerque to help constituents determine their flood risk (web and flyers). Elevation Certificates are now available electronically on the County web site. Participated in the Community Rating System (CRS) and received a Class 8 rating in 2013. Received training in implementation and documentation for the new 2013 CRS program.
- Bernalillo County Public Works started implementation of the South Valley Flood Damage Reduction Project in conjunction with the Corps of Engineers, Middle Rio Grande Conservancy District, and the Albuquerque Metropolitan Arroyo Flood Control Authority. We participated in the reconstruction of the South West Levee along the Rio Grande. The County implemented remapping of old flood zones to provide accurate flood risk data to constituents.
- AMAFCA conducted a flood fighting workshop on May 11/12, 2011 which including elected officials, emergency managers, maintenance personnel, emergency responders at Albuquerque Convention Center and hands-on training at South Diversion Channel.

- AMAFCA accepted the Operations and Maintenance Manual for Dams.
- AMAFCA started preparation of Emergency Action Plans for its jurisdictional dams and accepted the Emergency Action Plans for Dams – Volume I.
- AMAFCA submitted Emergency Action Plans for the Pino Dam and Boca Negra Dam – Volume II to Office of the State Engineer (Dam Safety Bureau).
- AMAFCA developed and accepted the Hazard Specific Flood Incident Annex by AMAFCA, City of Albuquerque and Bernalillo County.
- AMAFCA exercised the Emergency Action Plan for Dams in Bernalillo County.
- AMAFCA exercised the Hazard Specific Flood Incident Annex for the City of Albuquerque.
- The State of New Mexico will participate in the FEMA 'Great Shakeout' for the first time in 2014.
- Los Ranchos has worked with EPA on improving its storm water quality.

Projects Not Implemented and Not Carried Forward to 2014 Plan

Due to limited resources and need to focus on hazards more likely to have an impact on Bernalillo County, the two following action items from the 2007 Plan were not carried forward:

- "Create a volcano awareness program to educate citizens on the potential dangers of the Albuquerque Volcanic Fields."
- "Map areas vulnerable to volcanic explosion and assign a high/medium/low risk value."

5.3 Mitigation Action Plan

The mitigation actions and strategies in this section address, to the extent possible, the risk from the hazards described in **Section 4**. The actions and strategies also address areas where additional coordination with other agencies and organizations could benefit Bernalillo County goals to reduce risk. The actions and strategies are the specific measures to help meet the goals of **Section 5.1.1** and include estimated timeframes for completion. Where a specific dollar estimate was not available, a range of costs was used:

- **High** – Over $500,000
- **Medium** - $100,000 to $499,000
- **Low** – $5,000 to $100,000
- **Minimal** – Less than $5,000

The actions were prioritized using a basic format to encourage immediate action (see **Table 5.1**). Flood projects originally receiving a "High" prioritization were also reviewed with STAPLEE criteria considerations (See **Section 6.2.1.** for criteria). The pass/fail results of the STAPLEE

evaluation for these types of projects are listed in **Sections 5.3.1** for project undergoing the evaluation.

Table 5.1: Prioritization Categories

Category	Timeframe	Comments
High	Begin within 1 year from Plan adoption	Top organizational priority and is generally a well-detailed project idea. Protects population, resource or property at high risk. Uses feasible methods, techniques or technology.
Medium	2-3 years from Plan adoption	A good idea that needs more information or is an action that addresses a moderate hazard.
Low	3-5 years from Plan adoption	An idea that needs a lot more information or will take a lot of preliminary action to build support.

Multiple funding sources have been identified (see **Section 6.1.**) for suitability. The priority for each action is at the bottom of each action box. When a proposed project mitigates multiple hazards, this is noted.

5.3.1 Mitigation Actions and Projects

Increase Warning Capabilities	
Project Description/Comments:	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, hail storms or other severe weather.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras Offices
Hazard(s) Addressed:	High Wind, Tornado, Hail Storms, Flash Flooding
Responsible Organization:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque and Village of Tijeras Fire Departments and Offices of the Emergency Managers/Bernalillo County EOC Manager; Albuquerque EOC

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	Manager; Los Ranchos de Albuquerque Fire Chief; Tijeras Fire Chief
Estimated Costs:	Medium (~$40,000)
Possible Funding Sources:	Local budgets, FEMA
Timeline for Implementation:	Within 12 months of Plan adoption
Cost-Benefit Review	Due to relatively low cost and life safety benefits, the overall benefits are anticipated to outweigh costs
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Install Generators at Critical Facilities	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Flood, Drought, Severe Winter Storms, High Wind, Thunderstorm, Earthquake, Dam Failure, Tornado
Responsible Organization:	Local Emergency Management Divisions
Estimated Costs:	Medium
Possible Funding Sources:	Local budgets, New Mexico Department of Transportation, FEMA
Timeline for Implementation:	Within 2 to 3 years of Plan adoption
Cost-Benefit Review	Life safety benefits expected to outweigh the relatively low costs
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Multi-hazard Public Education Program	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Flood, Wildfire, Drought, Severe Winter Storms, High Wind, Thunderstorm, Earthquake, Extreme Heat, Dam Failure, Tornado
Responsible Organization:	Local Emergency Management Divisions
Estimated Costs:	Low
Possible Funding Sources:	Local budgets, FEMA

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Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Life safety benefits expected to outweigh the low costs
STAPLEE+C Review	No concerns raised
Priority	**High**

Develop and implement a county-wide StormReady Program	
Project Description/Comments:	Develop a StormReady program to enable preparedness 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.
Jurisdiction:	Bernalillo County
Hazard(s) Addressed:	Tornadoes, Floods, Lightning
Responsible Organization:	Bernalillo County Homeland Security and Emergency Management and City of Albuquerque Emergency Management
Estimated Costs:	$50,000
Possible Funding Sources:	General Budget
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Life safety and economic benefits expected to outweigh the costs. Cost is minimal compared to recent annual storm damage in Bernalillo County . Flash flood event in April 2004 cost 3.8 million dollars.
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Specific Drainage Project – Need specific project from AMAFCA or other jurisidictions	
Project Description/Comments:	
Jurisdiction:	
Hazard(s) Addressed:	Flood
Responsible Organization:	
Estimated Costs:	High
Possible Funding Sources:	USACE, General Funds, New Mexico State Legislature, State Department of Transportation, FEMA
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Life safety, environmental, and economic benefits expected to outweigh the costs
STAPLEE+C Review	No concerns raised
Priority	**High**

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Specific Drainage Project – Need specific project from AMAFCA or other jurisidictions	
Project Description/Comments:	xxxxxx – Any Specific Drainages for County, City and AMAFCA?.
Jurisdiction:	Bernalillo County
Hazard(s) Addressed:	Flood
Responsible Organization:	xxxx
Estimated Costs:	High
Possible Funding Sources:	New Mexico State Legislature, State Department of Transportation, General, FEMA
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Life safety and economic benefits expected to outweigh the costs
STAPLEE+C Review	No concerns raised
Priority	**High**

Well Safety Education Program	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Flood
Responsible Organization:	Valencia County Emergency Management, Valencia County Health Department, New Mexico State Engineer's Office
Estimated Costs:	Low
Possible Funding Sources:	Local budgets
Timeline for Implementation:	Within 2 to 3 years of Plan adoption
Cost-Benefit Review	Due to low cost, the benefits are anticipated to outweigh costs
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Flood Insurance Awareness Program	
Project Description/Comments:	A public awareness program will provide the unprotected property owners throughout the planning area with information concerning their risk and

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	available insurance.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Flood
Responsible Organization:	County and local Floodplain Managers
Estimated Costs:	Low
Possible Funding Sources:	Local budgets
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Due to low cost, the benefits are anticipated to outweigh costs
STAPLEE+C Review	No concerns raised
Priority	**High**

Multi-Jurisdiction Storm Water Management Plans	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras, AMAFCA
Hazard(s) Addressed:	Flood
Responsible Organization:	County and local public works and planning departments
Estimated Costs:	Low
Possible Funding Sources:	Local municipal funds, New Mexico State Grants
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Due to low cost, the benefits are anticipated to outweigh costs
STAPLEE+C Review	No concerns raised
Priority	**High**

Drainage Ditch Improvements and Maintenance	
Project Description/Comments:	Clean and repair drainage ditches and culverts to increase or maintain capacity. Develop and implement a maintenance plan.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras, AMAFCA
Hazard(s) Addressed:	Flood
Responsible Organization:	Local and county public works departments
Estimated Costs:	Medium
Possible Funding Sources:	FEMA
Timeline for Implementation:	Within one year of Plan adoption

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Cost-Benefit Review	Due to the repetitive losses, the benefits are anticipated to outweigh costs
STAPLEE+C Review	No concerns raised
Priority	**High**

Flood Control Projects Stabilization of Arroyos	
Project Description/Comments:	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.
Jurisdiction:	Village of Tijeras
Hazard(s) Addressed:	Flood
Responsible Organization:	NMDOT MAP
Estimated Costs:	High- Project cost originally estimated at $400,000
Possible Funding Sources:	NMDOT
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Assets at risk for flooding in Tijeras total more than 2 million dollars.
STAPLEE+C Review	No concerns raised
Priority	**High**

Continue thinning and fuel reduction projects in Bosque	
Project Description/Comments:	Continue Middle Rio Grande Bosque Initiative, Middle Rio Grande Bosque Restoration, and Bosque Ecosystem Revitalization Programs. Through these programs dead and downed trees and non-native plants are cleared out of areas within the Bosque. This keeps fire from spreading vertically to the upper story; preserves native plants such as cottonwoods and willows and improves wildlife habitat.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque
Hazard(s) Addressed:	Wildfire
Responsible Organization:	USACE, City of Albuquerque, Bernalillo County, Albuquerque Fire Department, Middle Rio Grande Conservancy District
Estimated Costs:	Low
Possible Funding Sources:	Municipal Budgets
Timeline for Implementation:	Some planning efforts on-going. Implement within one year of Plan adoption.
Cost-Benefit Review	Due to risk of wildfire in the area, and the low cost, the benefits are anticipated to outweigh costs
Priority	**High**

Implement Wildfire Public Education and Outreach Activities	
Project Description/Comments:	Develop comprehensive education process that includes Fire safety education/prevention and organize community cleanups in high fuel areas

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Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Wildfire
Responsible Organization:	Local emergency managers
Estimated Costs:	Low
Possible Funding Sources:	USFS; County and Municipal Budgets
Timeline for Implementation:	Within two to three years of Plan adoption
Cost-Benefit Review	Due to low cost of awareness programs, the benefits are anticipated to outweigh costs
Priority	**Medium**

Bury Power Lines	
Project Description/Comments:	Bury all power lines in Bernalillo County to reduce the incident of a downed tree hitting a power line
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Wildfire, Severe winter storms, thunderstorms, high wind
Responsible Organization:	Municipal utilities
Estimated Costs:	High
Possible Funding Sources:	Work with utility companies and Incorporate into capital improvements plans
Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Costs are high; individual BCA would need to be run
Priority	**Low**

Increase water storage capacity for fire suppression in the Bosque	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County
Hazard(s) Addressed:	Wildfire
Responsible Organization:	Albuquerque Bernalillo County Water Utility Authority/ Water Resources Division
Estimated Costs:	Low - Project cost estimated at $40,000
Possible Funding Sources:	USFS, NM State Forestry, New Mexico State Fire Fund, Hazard Mitigation Grant Program Technical Assistance funds administered by NMDHSEM
Timeline for Implementation:	Within one to two years of Plan adoption
Cost-Benefit Review	Increased water capacity in Bosque will increase fire fighting capabilities in

	a high- risk area.
STAPLEE+C Review	No concerns raised
Priority	**High**

Participate in State's program to use bio mass fuels as a way to dispose of tree thinning debris in the Bosque and East Mountain areas	
Project Description/Comments:	Thinning projects create an overabundance of debris for disposal. Using the debris as a bio mass fuel source should be studied as an effective and cost effective solution for disposal.
Jurisdiction:	City of Albuquerque Open Space Division, New Mexico State Parks
Hazard(s) Addressed:	Wildfire
Responsible Organization:	City of Albuquerque Open Space Division, New Mexico State Parks
Estimated Costs:	Low - Project cost estimated at $65,000
Possible Funding Sources:	USFS, NM State Forestry, New Mexico State Fire Fund, Hazard Mitigation Grant Program Technical Assistance funds administered by NMDHSEM
Timeline for Implementation:	Within one to two years of Plan adoption
Cost-Benefit Review	Disposal costs for slash average $8.00/cubic yard. Bio-fuel could be means to eliminate disposal costs and create additional fuel source.
STAPLEE+C Review	No concerns raised
Priority	**High**

Continue and expand water conservation programs for residential, commercial and industrial users	
Project Description/Comments:	Continue and expand City water conservation programs to encourage and provide incentives for residents to use water-saving landscaping techniques. Expand City Water Awareness Programs and Water Audits to all parts of County. 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.
Jurisdiction:	Bernalillo County, City of Albuquerque
Hazard(s) Addressed:	Drought
Responsible Organization:	Albuquerque Bernalillo County Water Authority
Estimated Costs:	Low (Part of City Water Conservation Program)
Possible Funding Sources:	Local municipal funds
Timeline for Implementation:	Within one year of Plan adoption

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Cost-Benefit Review	Due to low cost, the benefits are anticipated to outweigh costs
Priority	**High**

Continue to implement aggressive program to repair leaks in existing municipal water system , including lines to homes	
Project Description/Comments:	Due to the on-going drought, value of water as an asset is rising. Water leakage not only wastes water, but can also contribute to subsidence and sinkholes.
Jurisdiction:	Bernalillo County
Hazard(s) Addressed:	Drought, Land Subsidence
Responsible Organization:	Albuquerque Bernalillo County Water Utility Authority/Engineering & Planning
Estimated Costs:	Low
Possible Funding Sources:	Local municipal funds
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Due to low cost, the benefits are anticipated to outweigh costs
Priority	**High**

Expand existing projects to use treated effluent for non-potable uses.	
Project Description/Comments:	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.
Jurisdiction:	City of Albuquerque and Bernalillo County
Hazard(s) Addressed:	Drought
Responsible Organization:	City of Albuquerque and Bernalillo County Public Works departments
Estimated Costs:	High - Project cost estimated at $250,000
Possible Funding Sources:	Office of State Engineer, State legislative funds, Pre-Disaster Mitigation Assistance funds administered by NMOEM, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Economic benefits expected to outweigh the costs. New water sources cost more than $6,000/acre-foot of water. Each acre-foot of water typically serves three households. Re-use of treated effluent equals cost of adding 125 new households.
STAPLEE+C Review	No concerns raised
Priority	**Medium**

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Select a village official to participate in the State Drought Management Plan Work Group	
Project Description/Comments:	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. Consider adding representatives from Bernalillo County, CABQ and the Village of Tijeras.
Jurisdiction:	Village of Los Ranchos de Albuquerque
Hazard(s) Addressed:	Drought
Responsible Organization:	Village of Los Ranchos de Albuquerque
Estimated Costs:	Minimal
Possible Funding Sources:	Staff time
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Increased knowledge of village officials in State Drought Management Plan will facilitate a comprehensive response to drought.
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Establish Drought Indicator/Early Warning System	
Project Description/Comments:	Establish a system that detects levels of soil moisture and stream/river levels to determine when conditions are trending toward a drought
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Drought
Responsible Organization:	Local emergency management
Estimated Costs:	Low
Possible Funding Sources:	NRCS, USDA
Timeline for Implementation:	Within two to three years of Plan adoption
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Medium**

Increase awareness of potential for earthquakes in Bernalillo County	
Project Description/Comments:	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.
	Bernalillo County, City of Albuquerque, Village of Los Ranchos de

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Jurisdiction:	Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Earthquake
Responsible Organization:	Bernalillo County Office of Homeland Security and Emergency Management; City of Albuquerque Office of Emergency Management
Estimated Costs:	Minimal
Possible Funding Sources:	FEMA Earthquake Program, General Fund
Timeline for Implementation:	Within 12 months of Plan adoption
Cost-Benefit Review	Due to low cost of awareness programs, the benefits are anticipated to outweigh costs
Priority	**Medium**

Review and update existing building codes for earthquakes	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque; Village of Tijeras
Hazard(s) Addressed:	Earthquake
Responsible Organization:	Bernalillo County Building, Planning, and Zoning Department/Building Official
Estimated Costs:	Low
Possible Funding Sources:	Local budgets
Timeline for Implementation:	Within 12 months of Plan adoption
Cost-Benefit Review	Relative low costs for review and consideration so the benefits are anticipated to outweigh costs
Priority	**Medium**

Conduct Technical Assistance Visits to help homeowners implement non-structural earthquake retrofits of their home	
Project Description/Comments:	Work with home owners 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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Earthquake
Responsible Organization:	Local Emergency Managers
Estimated Costs:	$500/per home or less
Possible Funding Sources:	HUD funds, FEMA, Homeowner

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Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Non-structural retrofits are an inexpensive means of mitigating property damage and personal damage due to the effects of earthquakes.
Priority	**Low**

Prepare Public Education Effort for Winterizing Measures	
Project Description/Comments:	Provide educational information to local residents on insulating pipes to reduce damage from winter storms. Find ready-made brochures to distribute.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Severe Winter Storm
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Low
Possible Funding Sources:	HUD if funds are needed
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Due to low cost of awareness programs, the benefits are anticipated to outweigh costs
Priority	**High**

Implement Tree Trimming to Protect Power Lines	
Project Description/Comments:	Trim trees along roadways to prevent interference with power lines during high winds and winter storms
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Severe Winter Storm, High Winds
Responsible Organization:	Local Forestry Department
Estimated Costs:	Low to Medium
Possible Funding Sources:	Incorporate into capital improvements plans
Timeline for Implementation:	Within two to three years of Plan adoption
Cost-Benefit Review	Due to multiple benefits from tree-trimming, benefits expected to outweigh costs
Priority	**Medium**

Explore Feasibility of Insulating Water Pipes on Exterior of Public Buildings	
Project Description/Comments:	Insulating the pipes can reduce incidences of pipes bursting and causing interior water damage and loss of water in public buildings
	Bernalillo County, City of Albuquerque, Village of Los Ranchos de

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Jurisdiction:	Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Severe Winter Storm
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Medium
Possible Funding Sources:	Incorporate into capital improvements plans
Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Low**

Establish Lightning Safety Program for Bernalillo County Residents	
Project Description/Comments:	Raise awareness among Valencia County residents of dangers of lightning and what to do in a lightning storm. Obtain ready-made guides and brochures from sources like FEMA
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Thunderstorms
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Minimal
Possible Funding Sources:	Some staff time needed
Timeline for Implementation:	Within two to three years of Plan adoption
Cost-Benefit Review	Due to low cost of awareness programs, the benefits are anticipated to outweigh costs
Priority	**Medium**

Evaluate Methods for Protecting Public Buildings from Lightning Strike Damage	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Thunderstorms
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Low to Medium
Possible Funding Sources:	Incorporate into capital improvements plans
Timeline for Implementation:	Within two to three years of Plan adoption
Cost-Benefit Review	Due to high cost of data loss and relative low cost of project, the benefits are anticipated to outweigh the costs
Priority	**Medium**

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Further investigations to examine the vulnerability of structures to severe weather and hailstorms	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Thunderstorms
Responsible Organization:	Bernalillo County Building Section; City of Albuquerque Building Inspection Section; Village of Los Ranchos de Albuquerque Planning Department
Estimated Costs:	Low to Medium / $80,000
Possible Funding Sources:	Incorporate into capital improvements plans / Bernalillo County, Pre-Disaster Mitigation Assistance funds administered by NMOEM, Hazard Mitigation Grant Program Technical Assistance funds administered by NMOEM
Timeline for Implementation:	Within three to five years of Plan adoption / Within 24 months of adoption of Plan
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Low**

Implement Residential Safe Room Rebate Program	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Tornados, High Winds
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Medium
Possible Funding Sources:	FEMA
Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Low**

Tornado Warning System	
Project Description/Comments:	Purchase and install a tornado warning system
	Bernalillo County, City of Albuquerque, Village of Los Ranchos de

Jurisdiction:	Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Tornados
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Low to Medium
Possible Funding Sources:	FEMA
Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Low**

Evaluate Options for Dam Failure Warning System	
Project Description/Comments:	Coordinate with other communities and dam operators to develop a gauge and communication system that would provide warning in event of a dam failure
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras , AMAFCA
Hazard(s) Addressed:	Dam Failure
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Medium
Possible Funding Sources:	USGS, FEMA
Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Low**

Explore Options for Mapping of Dam Failure Inundation Areas	
Project Description/Comments:	Map potential dam failure inundation area
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras, AMAFCA
Hazard(s) Addressed:	Dam Failure
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Medium
Possible Funding Sources:	FEMA Risk MAP
Timeline for Implementation:	Within three to five years of Plan adoption
Cost-Benefit Review	Benefits relative to costs would have to be explored in greater detail
Priority	**Low**

Designate/ Set up a Public Cooling Centers	
Project	Designate and set up cooling centers in well-known centrally located public

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Description/Comments:	facilities, that will serve as a shelter to vulnerable populations (particularly the elderly) during periods of extreme heat.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Extreme Heat
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Low to Medium (cost of generators)
Possible Funding Sources:	HUD, potentially FEMA
Timeline for Implementation:	Within two to three years from Plan adoption
Cost-Benefit Review	Due to potential health risks due to extreme heat, the benefits are anticipated to outweigh the costs
Priority	**Medium**

Conduct fan drive to prepare for periods of extreme heat	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Extreme Heat
Responsible Organization:	Local Emergency Managers
Estimated Costs:	Volunteer time and efforts
Possible Funding Sources:	Local donations
Timeline for Implementation:	Within three to five years from Plan adoption
Cost-Benefit Review	Due to potential health risks due to extreme heat and voluntary nature of this effort, the benefits are anticipated to outweigh the costs
Priority	**Low**

Map known landslide areas and debris flow run-out zones	
Project Description/Comments:	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 could enhance the accuracy of the USGS product and produce beneficial information for Bernalillo County and its juridictions.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Landslide
Responsible Organization:	Bernalillo County, CABQ, USGS, assistance from State of New Mexico

Estimated Costs:	Current staff and resources
Possible Funding Sources:	State and local budget, USGS, DOT, HMGP, PDM
Timeline for Implementation:	60 months
Cost-Benefit Review	Mapping may range from low to medium cost but provides essential information needed for other projects.
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Anchor slope mesh over areas prone to landslides that threaten infrastructure and critical facilities	
Project Description/Comments:	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.
Jurisdiction:	Bernalillo County
Hazard(s) Addressed:	Landslide
Responsible Organization:	Bernalillo County Office of Emergency Management/Emergency Manager and Bernalillo County Public Works Department
Estimated Costs:	Medium – estimated originally at $100,000
Possible Funding Sources:	General Fund
Timeline for Implementation:	Within one year of Plan adoption
Cost-Benefit Review	Protection of transportation routes and critical facilities will minimize damage and protect lives in the event of a landslide.
STAPLEE+C Review	No concerns raised
Priority	**Low**

Map known land subsidence areas.	
Project Description/Comments:	Data needs to be collected and compiled on past occurrence of the various types of land subsidence in Bernalillo County. Most land subsidence is expected to a sinkhole. Once all available information is collected and mapped, then risk, frequency and probability can be evaluated. This effort will help lead to identification of more specific mitigation measures.
Jurisdiction:	Bernalillo County, City of Albuquerque, Village of Los Ranchos de Albuquerque, Village of Tijeras
Hazard(s) Addressed:	Land Subsidence
Responsible Organization:	Bernalillo County, CABQ, assistance from State of New Mexico
Estimated Costs:	Current staff and resources
Possible Funding Sources:	Local budget, DOT, HMGP, PDM
Timeline for Implementation:	60 months

Cost-Benefit Review	Mapping will generally be a low cost but provides essential information needed for other projects.
STAPLEE+C Review	No concerns raised
Priority	**Medium**

Create monitoring system to track land subsidence due to groundwater depletion in the northeast quadrant of the City of Albuquerque	
Project Description/Comments:	The northeast quadrant of the City has experience subsidence due to groundwater pumping. Create a system to monitor groundwater levels and stop pumping when the water level drops low enough to increase the risk of land subsidence.
Jurisdiction:	City of Albuquerque
Hazard(s) Addressed:	Land Subsidence
Responsible Organization:	Albuquerque Bernalillo County Water Utility Authority
Estimated Costs:	Medium – Project cost originally estimated at $150,000
Possible Funding Sources:	City of Albuquerque general budget
Timeline for Implementation:	Within two to three years of Plan adoption
Cost-Benefit Review	The northeast quadrant is the largest geographical and most populous area of the city. The effects of not having a system to monitor groundwater pumping could cause millions of dollars of damage.
STAPLEE+C Review	No concerns raised
Priority	**Low**

6 Implementation Strategy

6.1 Capability Assessment

Bernalillo County and the municipalities have the following internal capabilities related to hazard mitigation which serve as a baseline of what they can accomplish with relation to hazard mitigation goals and strategies:

Table 6.1: Bernalillo County Capabilities

Type of Capability	Listing of Capabilities
Regulations	• Adoption of the 2009 IBC, IRC, and IEBC; and 2003 International Fire Code (IFC) by CABQ

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	• Adoption of 2003 IFC by Bernalillo County and the Los Ranchos Fire Department • Bernalillo County Planning and Development Services, County Planning Commission, County Development Review Authority, and Zoning Administrator. • City of Albuquerque Planning Department , Albuquerque Development Commission and Development Review Board • City of Albuquerque Subdivision Regulations • Tijeras Planning and Zoning Commission and Comprehensive Zoning • Los Ranchos Planning and Zoning Commission, Flood Damage Prevention Ordinance and Stormwater Management Regulations
Emergency Response	• Bernalillo County Office of Homeland Security and Emergency Management • City of Albuquerque Office of Emergency Management • Bernalillo County Sheriff's Department (largest sheriff department in the state) • 12 County Fire Districts including four in the North Valley, four in the South Valley, and four in the East Mountains. Response capacity includes a daily minimum on-duty staffing level of 57 firefighters, paramedics, lieutenants, captains and battalion commanders. Six tenders (water tankers) are available for firefighting in outlying areas with no fire hydrants. Eight brush trucks are available for difficult to reach areas. An airboat is available for fires in the bosque. • Bernalillo County Emergency response capacity includes 25 first responders and 6 fire rescue trucks • Tijeras Police and Volunteer Fire Departments • Los Ranchos Police and Fire Departments
Programs	• NFIP ordinance for all participating municipalities • Bernalillo County and City of Albuquerque CRS Program • AMAFCA • Middle Rio Grande Conservancy • 2012 ABCWUA Drought Management Strategy with Drought Advisories and Drought Emergencies Water Use Reductions • Ciudad Soil and Water Conservation District (encompasses most of Bernalillo County, including the City of Albuquerque and Villages of Los Ranchos and Tijeras, and part of southern Sandoval County). Includes the East Mountain Forest Health Program • Valencia Soil and Water Conservation District encompasses the parts of Bernalillo County not part of Ciudad (far western and southern parts of the County) • Mid-Region Councils of Government
Plans	• East Mountain CWPP • 2014 Bernalillo County Capital Improvement Plan

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	• 2013-2022 CABQ Decade Plan for Capital Improvements • Bernalillo County / City of Albuquerque Comprehensive Plan • Los Ranchos Master Plan 2020 • Tijeras Ordinance Comprehensive Zoning • 2010 Bernalillo County Emergency Operations Plan • 2010-2020 City of Albuquerque and Bernalillo County Facility Plan • 2002 Bernalillo County Wildland Urban Interface Area Inventory Assessment • Various Sector and Neighborhood Development Plans

Funding sources for hazard mitigation projects that the HMPT will consider for its identified mitigation actions are:

Table 6.2: Federal, State and Other Funding Sources

Name of Program	Primary Purpose
FEMA Public Assistance 406 Mitigation	For damaged public structures in a Presidential disaster declaration area that are otherwise eligible to receive Public Assistance funds, mitigation measures to reduce future risk can be considered. See http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit/hazard-mitigation-funding-under-section-406-0 for more information.
FEMA Hazard Mitigation Grant Program (HMGP)	Following a Presidential disaster declaration, this program funds mitigation projects and actions that are projected to reduce future losses in excess of the projects' costs. See http://www.fema.gov/hazard-mitigation-grant-program for more information.
FEMA Pre-Disaster Mitigation Program (PDM)	From an annual Congressional appropriation, this program funds mitigation projects and actions that are projected to reduce future losses in excess of the projects' costs. See http://www.fema.gov/pre-disaster-mitigation-grant-program for more information.
Natural Resource Conservation Service (NRCS) Emergency Watershed Protection Programs[23]	Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events. EWP is an

[23] See the following website for more information and examples of funded projects: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/?cid=nrcs143_008263

	emergency recovery program. All projects undertaken, with the exception of the purchase of floodplain easements, must have a project sponsor. 75% federal/25% non-federal cost-share
NRCS Watershed and Flood Prevention Operation Program	Assistance may be provided for authorized watershed projects to install conservation practices and project measures (works of improvement) throughout the watershed project area. The planned works of improvement are described in watershed project plans and are normally scheduled to be installed over multiple years.
USDA Rural Development Emergency Community Water Assistance Grants (ECWAG)	USDA can provide grants from $150,000 to $500,000 to assist a rural community that has experienced a significant decline in quantity or quality of drinking water due to an emergency, or in which such decline is considered imminent, to obtain or maintain adequate quantities of water that meets the standards set by the Safe Drinking Water Act. This emergency is considered an occurrence of an incident such as, drought, earthquake, flood, tornado, hurricane, disease outbreak or chemical spill, leakage or seepage. See http://www.rurdev.usda.gov/UWEP_HomePage.html for more information.
USACE Section 205 Authority	Provides authority to the Corps of Engineers to plan and construct small flood damage reduction projects (structural and nonstructural) that have not already been specifically authorized by Congress.
USACE Section 219 of the Water Resources Development Act of 1992 (WRDA92), Environmental Infrastructure, as amended	Provides assistance to non-federal interests for carrying out water-related environmental infrastructure and resource protection and development projects, including wastewater treatment and related facilities, water supply, storage, treatment, and distribution facilities. Such assistance may be in the form of technical, planning, and design assistance as well as construction assistance for defined projects and locations with specific amounts authorized for each location. A non-federal cost share of not less than 25% is required for all assistance under Section 219.
Bureau of Reclamation	Various funding may be available for activities like removal of exotic vegetation in the bosque and removal of jetty jacks
USFS Collaborative Forest Restoration Program (CFRP)	Assists public or private forest owners with an opportunity to reduce wildfire dangers that threaten the community as a whole. 80% Federally funded
USFS Forestland Enhancement Plan	This program is administered directly to private landowners who have at least 10 acres of forestland. It provides 75% federal funding for the reduction of fuel loading to improve forest health and reduce fire risk. A side benefit is the improvement of wildlife habitat and water quality.

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USFS Rural Community Assistance Economic Action Program (RCA-EAP)	The main purpose of the RCA-EAP is to use local forest products to produce value-added materials for resale or for the conversion of biomass materials (waste wood) to energy for heating of public buildings or other uses. It has a multi-objective component as a fuel reduction project in forests thereby mitigation wildfire potential. 80% Federally funded
HUD CDBG Program/Infrastructure Program	
HUD CDBG Tornado Shelters Act (TSA)	TSA allows local governments to use CDBG funds to create community tornado shelters ("safe rooms") in manufactured housing communities. No cost-share info available
US EPA Water Quality grants	
State Fire Assistance – Wildland/Urban Interface (SFA-WUI) Program	This grant program, funded at 50/50 cost-share by various federal agencies, is administered by the NM Forestry Division of the NM Energy, Minerals, and Natural Resources Department (EMNRD). SFA-WUI seeks to benefit local communities where the Wildland/Urban Interface is a concern through fuel reduction and creation of defensible space. Local governments are the grant recipients, and projects may be done on private land in conjunction with landowners.
State Water Trust Board	The Water Trust Board was created in the Act. Its purpose is to: 1) oversee and administer the Water Trust Fund and Water Project Fund; 2) review and recommend funding for qualifying water projects to the Legislature; and 3) pursue additional funding opportunities. See http://governor.state.nm.us/Water_Trust_Board.aspx for additional information.
New Mexico Community Foundation (NMCF)	NMCF is a statewide endowment-building and grant-making organization that serves and invests in New Mexico's people, communities and environment. With partners in every county, NMCF promotes philanthropy as a tool for building community assets, relationships and self-reliance. NMCF provides grants in several areas related to hazard mitigation and forest stewardship. See www.nmcf.org for more information.

Opportunities for increased capability:

- *UBC* – Building codes are important mitigation tools because they are tailored to fit specific hazards present in each region. Consequently, structures that are built to applicable codes are resistant to hazards, such as strong winds, floods, and wildfires, and can help mitigate the effects of these hazards. New Mexico has adopted the 1997 UBC code as a minimum standard for all communities and provides inspection services through the Construction

Industry Division of the New Mexico Department of Regulations and Licensing. Individual counties and municipalities are at liberty to adopt the most current UBC.

- *Floodplain Ordinance and Community Rating System (CRS)* – Bernalillo County and all participating jurisdictions are already participants in the NFIP. All jurisdictions can benefit from adopting higher standards in their floodplain ordinances to ensure additional protection for development in the floodplain or prohibit future development. Bernalillo County and CABQ should consider additional actions to continually improve their CRS ratings. Los Ranchos and Tijeras should consider joining the NFIP CRS to receive credit and potential flood insurance premium discounts for its policyholders for any adopted higher standards and other enhanced flood risk reduction activities.
- *Public Warning System* - Warning systems are needed to ensure timely and accurate information to minimize the effects of disasters in the county
- *Formal Mitigation Function* - For developing and implementing projects as well as maintaining the planning process
- *Firewise Communities/USA*: a project of the National Wildfire Coordinating Group's Wildland-Urban Interface Working Team. It provides information and guidance for communities in the wildland-urban interface area (www.firewise.org).

6.2 Prioritization

6.2.1 STAPLEE Criteria

FEMA developed a comprehensive set of criteria that allows communities to evaluate proposed actions in categories that reflect community values and sound principles for finding appropriate and cost-effective mitigation actions. The HMPT used these criteria, known by the acronym STAPLEE, to evaluate the potential impact of high priority proposed flood mitigation actions (which are the most actionable ones):

Table 6.3: STAPLEE Criteria

Evaluation Criteria	Considerations
Social	*Does the measure treat people fairly?* (i.e., Are different social and demographic groups, different generations, different creeds treated equally?)
Technical	*Will it work?* (i.e., Does it actually solve the problem and is it feasible?)
Administrative	*Does the County and/or its municipalities have the capacity to implement and manage the project?*
Political	*Does support exist from public and political stakeholders?*
Legal	*Does the County and/or its municipalities have the legal authority to implement and assume any reasonable liability?*

Economic	*Is it cost-effective? Is there a federal, state or non-profit source for funding? If federal, can the non-federal match bet met locally or through another source? Does it contribute to the local economy?*
Environmental	*Does it comply with environmental regulations? Will it preserve, protect, or enhance existing natural resources?*

The prioritization methodology involved comparing each proposed mitigation measure against the established criteria to determine if the measure would help the County and its municipalities meet the mitigation goals and objectives established for this Plan. Then the mitigation measures were compared against each other to determine a priority order.

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7 Plan Maintenance

This section discusses how the Bernalillo County Hazard Mitigation Plan will be implemented, evaluated and enhanced over time.

7.1 Implementing the Plan

Bernalillo County and participating jurisdictions will integrate this Plan into existing decision making processes or mechanisms. This includes integrating the requirements of the Plan into other planning documents; processes or mechanisms such as development plans, land use plans, continuity of operations plans, and capital improvement plans, when appropriate. The HMPT will be charged with monitoring, evaluating and implementing the Plan. It will also be responsible for ensuring that the goals and strategies of new and updated planning documents are consistent and do not conflict with the goals and actions of the Plan, and will not contribute to increased hazard risk for the planning area. Opportunities to integrate the requirements of this Plan into other planning mechanisms shall continue to be identified through future meetings of HMPT and through the five-year review process described herein.

7.2 Incorporation into Other Planning Mechanisms and Existing Programs

As part of the on-going planning process, the HMPT will continue to identify additional plans and programs that will augment or help support mitigation planning efforts. The HMPT will look to incorporate mitigation into additional existing planning mechanisms including updates to plans and ordinances identified in **Section 2.2** of this Plan.

Bernalillo County, the City of Albuquerque, AMAFCA, the Village of Tijeras, and the Village of Los Ranchos acknowledge that it is necessary to ensure that future growth in the county should avoid or control the use of all areas containing known potentially hazardous environments. Further, hazard mitigation will not stop upon completion of each of the specific actions listed in this Plan. Therefore, hazard mitigation will become a county-wide, ongoing and coordinated effort. The following areas of consideration will take place as part of this effort.

Evaluation of declared emergencies and activations of area emergency operations centers. In the event that an emergency declaration is made within the county or its participating jurisdictions, an evaluation of the events leading to this declaration will be made in order to identify possible mitigation actions that can be taken to reduce or eliminate this hazard in the future. In addition, the activation of an emergency operations center within the county will require this same type of evaluation in order to identify possible mitigation actions that can be taken.

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Incorporation into existing efforts. Successful efforts at eliminating or reducing the consequences of future hazard events cannot occur without controlling the growth of new development within known hazardous areas. For each investment considered by the County and its municipalities like construction or renovation of infrastructure and facilities, hazard mitigation should be considered. As part of implementing the resolutions of the Bernalillo County Mitigation Plan, all proposed new development should be evaluated against identified hazard-prone areas. Therefore, the building permit approval system should include a review of all newly-proposed development projects to keep them from being built in known hazard-prone areas such as floodplains. If a proposed project falls within such an area, the permit may be disapproved or additional construction requirements may be established to eliminate any dangers that could be caused by the existence of the hazard.

In addition, county and city planning staffs should ensure that all comprehensive 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 projects 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 the revision and updating of the Bernalillo County Hazard Mitigation Plan.

To address the concerns and desires of the general public, efforts will be made to obtain their input. Obtaining this input will be accomplished in the form of questionnaires and advertised public meetings. In addition, the comprehensive plan will be made available through public libraries and the internet. Contact numbers and addresses will be made available to the public so that input can be generated at any time. Questionnaires and public meetings will also be scheduled after the occurrence of a major disaster to provide an avenue for public input.

Additional Functions. In addition to incorporating the ideas of hazard mitigation into all planning efforts, other programs routinely take place in Bernalillo County and the participating jurisdictions to provide for the public's general safety. These programs are forms of mitigation. The road departments at each government level, including the state, work to maintain a safe transportation system through such projects as repaving and maintenance of road signs. Crews also maintain street sweeping capability, which removes dangerous debris from road surfaces and aids in keeping storm drains clean, which reduces the potential of flooding.

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Municipal, county, and state law enforcement of traffic regulations aids in maintaining safe transportation routes. Laws are in place concerning the illegal dumping of debris and restrictions on open burning. The New Mexico Department of Transportation further monitors and inspects commercial transports in an effort to ensure that hazardous material movement is conducted in compliance with mandated regulations.

Additionally, emergency operations plans are in place and exercised regularly to ensure that area response agencies coordinate their efforts during emergency situations. The emergency operations plans are reviewed annually and revised as necessary. Training for first responders is an ongoing project and further ensures that police, fire, and emergency medical personnel are kept up-to-date in their respective areas of expertise.

7.3 Monitoring, Evaluating, and Updating the Plan

It is critical that the Bernalillo County Mitigation Plan remains a living document, with the goal of continuing the process of eliminating or reducing potential threats and resulting damage due to existing hazards in the county and participating jurisdictions. The HMP reflects what Bernalillo County community will do to protect itself from its unique hazards and threats within its available resources. The general success of the HMP is dependent upon a well-established planning process and well-constructed maintenance process. The formal adoption of the HMP by the Bernalillo Board of County Commissioners, Councils of the City of Albuquerque and the Village of Tijeras, the AMAFCA Board of Directors, and the Board of Trustees of Los Ranchos is an imperative step to effectively executing the HMP and the continuing the planning process.

This HMP will be updated and maintained by Bernalillo County Homeland Security and Emergency Management with support from the HMPT in order to continually address hazards and risks. The HMPT will continue to **meet at least annually** to oversee and review updates and revisions to the HMP. The committee will hold an annual public forum for the continual development and assessment of the HMP. In addition, the HMP will be **re-evaluated every five years** and forwarded to the New Mexico State Department of Homeland Security and Emergency Management (DHSEM) and the Federal Emergency Management Agency (FEMA) for approval as required to remain eligible for Pre-Disaster Mitigation and Hazard Mitigation Grant Program funding.

The Plan will be revised based on local, state, and national guidelines. As laws, government regulations, political, public, and financial changes occur; the HMP should be adjusted if affected by these changes. Additionally, the HMP should be analyzed following applicable disasters to update and add mitigation actions. This will ensure the continued viability of the HMP.

The HMPT should be informed of and approve all changes. Updates requiring resolution will be forwarded to DHSEM upon approval. Changes to the HMP will be tracked. A system to track accomplishments and outstanding mitigation actions should be developed and maintained. Agencies, departments, and other partners who complete related mitigation actions are responsible for providing Bernalillo County Homeland Security and Emergency Management and the HMPT with a summary of actions undertaken. The annual HMPT review should allow for further evaluation and identification of completed projects.

The exercise of evaluating the HMP will occur annually as the HMPT will assess goals and objectives of the current HMP and appraise the mitigation project's effectiveness to expected conditions using the following criteria:

- Evaluate the resulting benefit of all completed action plans.
- Evaluate the progress of action plans still being implemented.
- Evaluate public input relating to completed projects, ongoing projects, or developing trends or concerns within the mitigation process.
- Determine if new hazard threats have been identified and devise action plans accordingly.
- Revise, if necessary, the schedule of pending mitigation action plans.

7.4 5 Year Plan Effectiveness Review and Update

The Plan will be thoroughly reviewed and updated every 5 years by the HMPT. This process will determine whether there have been any significant changes that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure to hazards, the increase or decrease in capability to address hazard risk, and changes to federal or state legislation are examples of factors that may affect the necessary content of the Plan.

The Plan review provides Bernalillo County and participating jurisdiction officials and the HMPT with an opportunity to evaluate those actions that have been successful, and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The Plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented as assigned. The Bernalillo County Emergency Manager will be responsible for reconvening the HMPT and conducting the 5 year plan review.

During the 5 year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the goals address current and expected conditions?

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- Has the nature or magnitude of risk to hazards changed?
- Are current human and capital resources appropriate for implementing the Plan?
- Are there planning and mitigation action implementation obstacles such as social, technical, administrative, political, legal, economic, environmental, or coordination issues?
- Have new issues or needs been identified which are not adequately addressed in the Plan?
- Has there been a change in information, data, or assumptions from those on which the Plan is based?
- Have the outcomes occurred as expected?
- Are there errors, inaccuracies, or omissions made in the identification of issues or needs in the Plan?
- Did the identified agencies, individuals, and/or other partners participate in the plan implementation process as assigned?

Following the 5 year plan review and update, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and plan amendment process outlined herein. Upon completion of the review and update/amendment process, the Plan will be submitted to the entire HMPT for review.

7.5 Continued Public Involvement

Input from the public is vital to an effective HMP. Bernalillo County and its participating jurisdictions will continue their transparent government and all-inclusive public involvement efforts established in the development of this HMP by continuing to include public input in the ongoing hazard mitigation planning processes. The County will continue to facilitate adequate public access to the HMP by posting it on the Bernalillo County Homeland Security and Emergency Management and the Albuquerque Office of Emergency Management websites. An annual public update will be prepared to inform residents and stakeholders on the progress of action items within the HMP. Where possible, a public meeting should be held in conjunction with this annual update to allow for a review process to assess existing goals and mitigation actions and to examine the action plan.

Residents are also welcome to submit comments (by letter or electronically) to the Bernalillo County Homeland Security and Emergency Management about the HMP at any time.

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APPENDIX A
Meeting Documentation

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APPENDIX B
Plan Review Tool

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