New Mexico State Hazard Mitigation Plan

September 2013

PLAN ADOPTION

As Governor's Authorized Representative, I hereby adopt 2013 edition of the New Mexico Hazard Mitigation Plan.

The State of New Mexico will comply with all applicable federal laws and statutes in compliance with 44 CFR 13.11(c), and will amend this plan whenever necessary to reflect changes in state or federal laws and statutes as required in 44 CFR 13.11(d).

Gregory A. Myers
Cabinet Secretary

Signature of Secretary__________________
Date________________

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The New Mexico Natural Hazard Mitigation Plan (the Plan) was developed as a cooperative effort of state agencies under the coordination of the New Mexico Department of Homeland Security and Emergency Management (NM DHSEM). It discusses the process used to identify, profile and assess natural hazards in New Mexico and the actions which should be taken to mitigate those hazards.

The Plan facilitates the delivery of mitigation grant funding to agencies, jurisdictions, tribes and organizations through FEMA's Unified Hazard Mitigation Program, which consists of several grant sources. The Plan addresses mitigation planning requirements for these grant sources.

The Plan will continue to be reviewed and enhances as new mitigation opportunities become available. Comments and suggestions are welcome and should be forwarded to the office of the State Hazard Mitigation Officer.

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Official Heading

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ACKNOWLEDGEMENTS

The New Mexico Department of Homeland Security and Emergency Management gratefully acknowledges the following offices, departments, and organizations, for their contributions, input and participation. Without their participation, completion of the New Mexico Natural Hazard Mitigation Plan would not have been possible.

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New Mexico Association of Counties
New Mexico State Forestry
New Mexico Radioactive Waste Consultation Task Force
Clovis Community College
College of Santa Fe
New Mexico State University
New Mexico Military Institute
New Mexico Emergency Management Association
New Mexico Floodplain Managers Association
Native American Section NMEMA
Natural Resources Conservation Service
University of New Mexico

SECTION 1 - INTRODUCTION

Across the United States, natural disasters have led to mounting levels of casualties, injury, property damage, and disruption of business and government services. The effects of disasters on families and individuals can be enormous and it is challenging for damaged businesses to contribute to the economy. The time, money and effort given to response and recovery efforts redirect public resources and attention away from other important programs and problems. The elected and appointed officials of the State of New Mexico know that mitigation actions in the form of projects and programs can become long-term, cost effective means for reducing the effects of natural hazards.

Purpose

The contents of this New Mexico Natural Hazard Mitigation Plan (the Plan) are intended to provide the framework for hazard mitigation not only during the recovery and reconstruction process, but on a year-round basis to identify current and proposed mitigation projects which will reduce the potential for future losses and decrease the costs to the taxpayers. The Plan will be used to increase awareness and initiate development of long-range, interagency, multi-hazard mitigation activities to be administered by the New Mexico Department of Homeland Security and Emergency Management (NMDHSEM) and the Hazard Mitigation Team (HMT) for the State of New Mexico.

The goal of mitigation 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. Attempts to comply with widespread mitigation policies, procedures and methods are evident; however, the Plan does not necessarily represent the views, policies and procedures of FEMA.

Scope

The Plan shall address those natural hazards that have resulted in claims for Federal assistance as well as other major natural hazards identified as presenting substantial risk to human life and private and public property. A joint decision was made by the HMT to keep the plan focused on natural hazards. This document is an instrument of mitigation primarily for natural disasters. It is not the intent of this document to address the prevention or mitigation of the possible impacts of terrorist activity, hazardous materials, transportation accidents or any other human-caused hazard. Separate efforts are in place for man-made hazards. The Plan utilizes a multi-agency planning process to identify hazards that can affect the state and to devise mitigation strategies to reduce or eliminate the effects of those hazards. The state plan provides guidance to local governments in preparing their own mitigation plans by prioritizing mitigation goals and objectives, proposing solutions to certain mitigation problems, and identifying possible funding sources for mitigation projects.

Authority

The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended by (PL) 106-390 (Pre-Disaster Mitigation Program, Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program - 44 CFR Part 78) addresses state mitigation planning, identifies new local mitigation planning requirements, authorizes Hazard Mitigation Grant Program (HMGP) funds for planning activities, and increases the amount of HMGP funds available to states that develop a comprehensive, enhanced mitigation plan. The Disaster Mitigation Act of 2000 (DMA 2000) emphasizes the importance of strong state and local planning processes and comprehensive program management at the state level with a link in the planning process between the state and local mitigation programs. The Federal Emergency Management Agency (FEMA) has promulgated rules for implementation in 44 CFR Parts 201 and 206.

Assurances

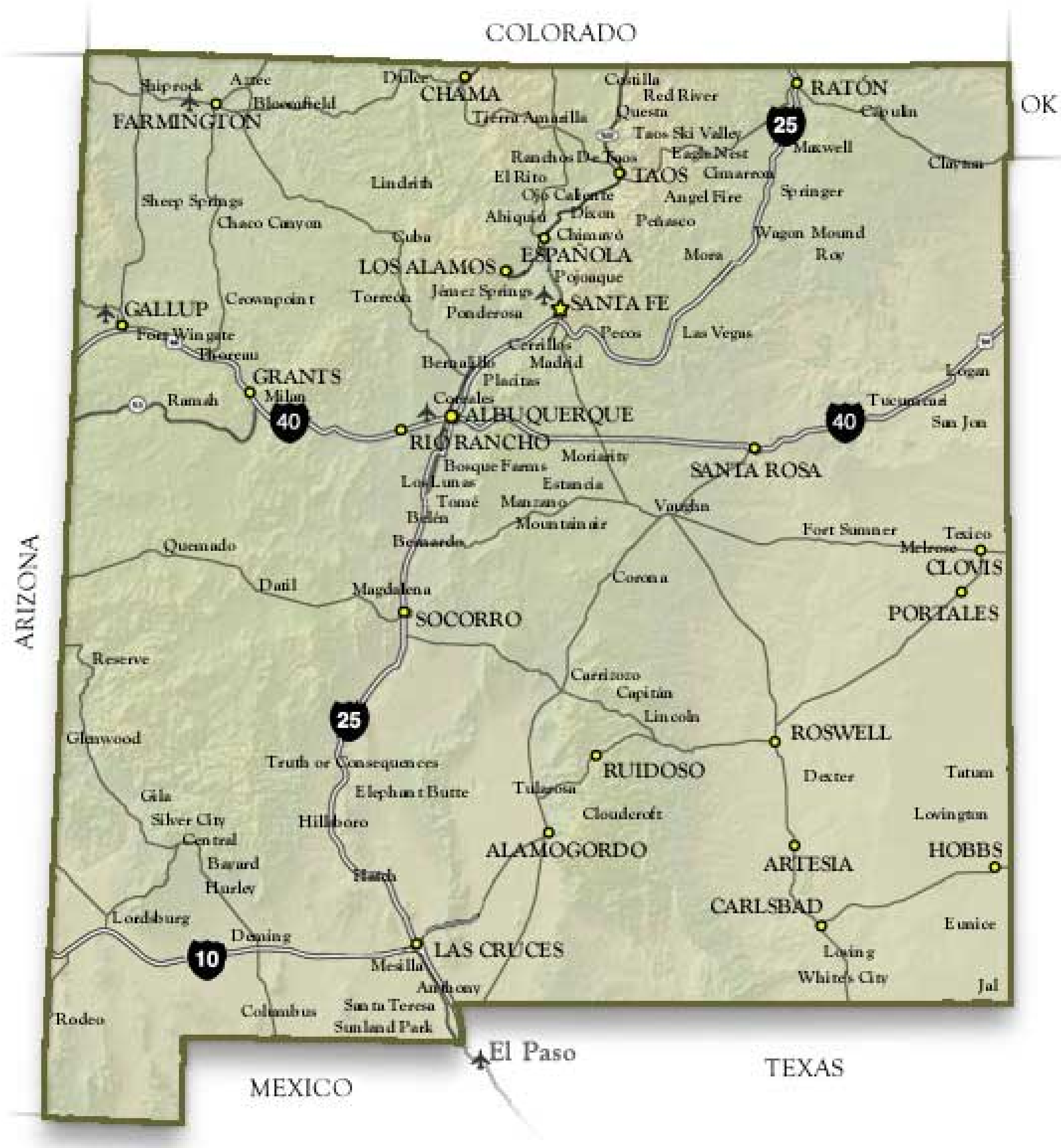
The State of New Mexico will comply with all applicable Federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c) and will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d). Funding for the 2013 Plan update came from internal sources and the 2013 version of this planning was spearheaded by the SHMO along with State, Federal and Local Subject Matter Experts.

Description of New Mexico

Location

New Mexico is located in the southwestern region of the United States. Contiguous states include Colorado, Arizona, and Utah at its northwestern corner to form the "four corners" region. Bordering New Mexico is Oklahoma to the northeast, Texas to the south and east, Mexico to the south, Arizona to the west, and Colorado to the north (see Figure 1.1). The state's total land area is approximately 121,598 square miles (5th largest in the nation). 121,365 square miles of New Mexico are land areas; water covers the remainder of the state.

Figure 1.1. Map of New Mexico



Geographic Features

Known for its varied topography, New Mexico includes desert terrain, broken mesas, wooded forests, and mountain peaks. The Rio Grande River runs through the middle of the state from north to south. The highest point in New Mexico is Wheeler Peak at 13,161 feet above sea level in the Sangre de Cristo Mountain range. Southern New Mexico is characteristic of broad, semi-arid plains, covered in cactus, yucca, creosote bush, sagebrush, and desert grasses, and the southwest opens to the Gila Wilderness. The mean elevation of the state of New Mexico is 5,700 feet above sea level.

Covering the eastern third of New Mexico is the *Great Plains*. The *Great Plains* extend from the high plateaus in the north to the vast Pecos River in the south. Rivers in the high plateau have cut deep canyons into the landscape. The *High Plains* or *Staked Plains (Llano Estacado)* run along the Texas border and are south of the Canadian River, along the eastern edge of New Mexico.

In the central part of New Mexico, the Rocky Mountains extend into New Mexico from Colorado to the north. The Rio Grande River cuts through the Rocky Mountains from north to south. East of the Rio Grande, is the Sangre de Cristo (Blood of Christ) Mountain range. To the west of the Rio Grande are the Nacimiento and Jemez Mountain ranges.

The Basin and Range Region covers about 1/3 of the state and lies to the south of the Rocky Mountain Region. This region extends south from around Santa F3 to Mexico and west to Arizona. This area is marked by rugged mountain ranges, such as the Guadalupe, Mogollon, Organ, Sacramento, and San Andres mountain ranges, separated by desert basins. The Rio Grande River flows north to south through the Basin and Range Region and exits New Mexico in the south to form the border between Texas and Mexico.[1]

Climate

Temperature – Mean annual temperatures range from 64° F in the extreme southeast to 40° F or lower in high mountains and valleys of the north. During the summer months, individual daytime temperatures quite often exceed 100° F at elevations below 5,000 feet; but the average monthly maximum temperatures during July, the warmest month, range from the low 90's at lower elevations to the upper 70's at high elevations. In January, the coldest month, average daytime temperatures range from the middle 50s in the southern and central valleys to the low 20's in the higher elevations of the north. Minimum temperatures below freezing are common in all sections of the State during the winter, but subzero temperatures are rare except in the mountains. The highest temperature recorded in New Mexico is 122°F on June 27, 1994 at the Waste Isolation Pilot Plant (WIPP) site. The lowest temperature recorded was -50 °F, on February 1, 1951 at Gavilan.

Precipitation – Average annual precipitation ranges from less than 10 inches over much of the southern desert and the Rio Grande and San Juan Valleys to more than 40 inches at higher elevations in the State. Summer rains fall almost entirely during brief, but frequently intense thunderstorms. July and August are the rainiest months over most of the State, with from 30 to 40 percent of the year's total moisture falling at that time. During the warmest 6 months of the year, May through October, total precipitation averages from 60 percent of the annual total in the Northwestern Plateau to 80 percent of the annual total in the eastern plains. Much of the winter precipitation falls as snow in the mountain areas, but it may occur as either rain or snow in the valleys. Average annual snowfall ranges from about 3 inches at the Southern Desert and Southeastern Plains stations to well over 100 inches at Northern Mountain stations. It may exceed 300 inches in the highest mountains of the north.

Sunshine –The average number of hours of annual sunshine ranges from near 3,700 in the southwest to 2,800 in the north-central portions.

Humidity –Relative humidity ranges from an average of near 65 percent about sunrise to near 30 percent in mid-afternoon; however, afternoon humidity in warmer months are often less than 20 percent and occasionally may go as low as 4 percent. The low relative humidity during periods of

[1] Source: http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm

extreme temperatures eases the effect of summer and winter temperatures. These low humidity levels contribute to decreased winter temperatures, since the atmosphere is unable to retain heat in the evenings.[2]

Economy

According to the 2010 Census, New Mexico's population reached 2.06 million people in 2010. That represents a growth rate of 13.2 percent between 2000 and 2010. During that time, New Mexico was the fifteenth fastest growing state in the country. New Mexico has a relatively low population density, with about 17 persons per square mile compared to an average of 87 persons for the United States. The Central, Southwestern, and Northern workforce investment regions, which each contain a Metropolitan Statistical Area (MSA), experienced a higher rate of growth than the Eastern region. Part of the population growth in New Mexico is due to in-migration of people from other states. Between 2009 and 2010, 73,600 people moved to New Mexico from another state, while 50,400 moved away.

New Mexico's unemployment rate fell to 6.5 percent in November 2011 (the most current month available) from a recent peak of 8.7 percent for both January and February 2011. The statewide unemployment rate began trending upward at the end of 2007. The national unemployment rate has hovered around 9.0 percent for most 2011, down from a 2010 annual average of 9.6 percent that marked the highest level in 27 years.

The total number of business establishments in the state increased 3.3%, from 42,782 in 2000 to 44,221 in 2010. Bernalillo County (Albuquerque) increased 1.7%; Santa Fe County (Santa Fe) increased 2.3% during the same period. Bernalillo County (Albuquerque) listed 15,943 businesses and Santa Fe listed 4,778 businesses in 2010.

Over the last 25 years, the number of farms in New Mexico increased while acreage in farming decreased by 3 million. The exception is the dairy industry, in which small farms have been replaced by large operations. According to the Southwest Dairy Farmers, the state ranks first in the nation in the number of cows per herd and is fifth among the 20 major milk-producing states. New Mexico leads the nation in the production of chili peppers and summer onions.

Tourism

New Mexico's diverse and scenic beauty is a major draw for visitors. The Rocky Mountains, the Chihuahua Desert, portions of the Great Plains, spectacular canyons and the Rio Grande all combine to make the state a popular tourist destination.

Of the many features that set New Mexico apart, one is the presence of numerous Native American and Spanish colonial ruins. The Aztec Ruins and Chaco Canyon in the northwest region and the Bandelier National Monument in the north central region are considered key national monuments. El Morro National Monument contains inscription rock that bears autographs, drawings and messages from Spanish explorers and westbound pioneers. Fort Selden Monument consists of remains of the 19th century adobe fort. Other attractions include the Gila Cliff Dwellings National Monument, Pecos National Historic Park, which contains ruins of a pueblo and Spanish colonial mission abandoned by

[2]Source: http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm

1838, Poshouinge Ruins, Salmon Ruins and Heritage Park, and the Three Rivers Petroglyph National Recreation Site.

The State is home to myriad museums, including the Palace of the Governors in Santa Fe, which is the oldest continually occupied public building in the country, the Museum of Fine Arts; the Museum of International Folk Art; the Museum of Indian Arts and Culture; and a large number of private art museums.

New Mexico also contains a large number of state monuments, including the Jemez State Monument in Jemez Springs, the Coronado State Monument in Bernalillo County, the Fort Sumner State Monument, the Lincoln State Monument, and the Fort Selden State Monument in Radium Springs.

Major Employers

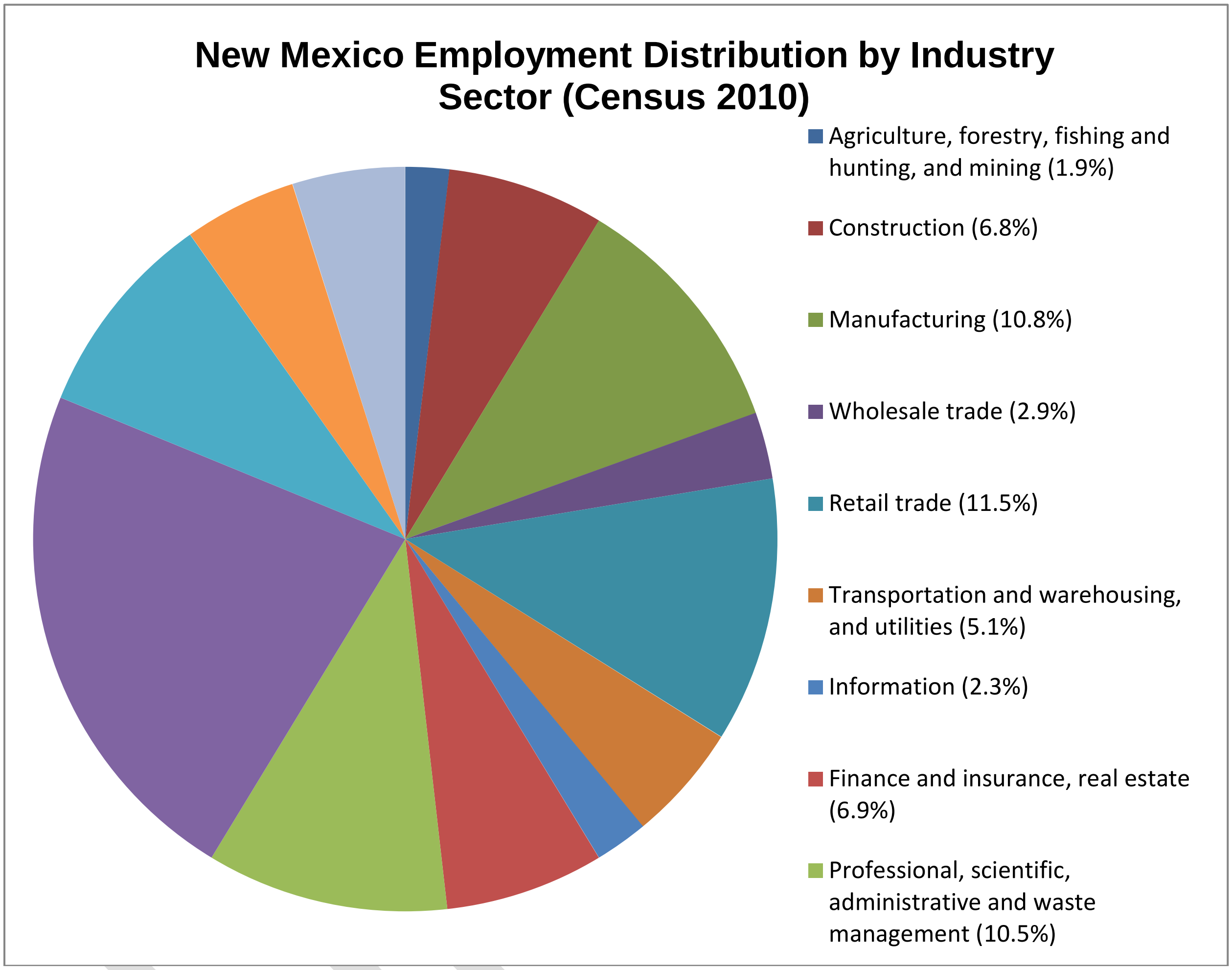
Employment in New Mexico varies from technical government research organizations and film production opportunities to the construction, sales and service industries, and retail stores. Aside from the federal government, the University of New Mexico (which cooperates with government research via the New Mexico Engineering and Research Institute) and Sandia National Laboratories in Albuquerque are two of the larger employers in the state. Other major employers in the Albuquerque area include the Albuquerque Public Schools, the City government, and Kirtland Air Force Base. Large manufacturing companies in the Albuquerque area include Intel, Sandia National Laboratories, and Lockheed Martin.

Between 2008 and 2009, labor force growth was slightly positive in the Southwestern area, up 0.1 percent, but negative in the three other areas: Northern, down 1.6 percent; Central, down 1.4 percent; and Eastern, down 0.3 percent. Between 2009 and 2010, all the WIA regions returned to positive labor force growth rates, although growth was minimal (between 0.8 and 2.9 percent). Based on the minimal growth between 2005 and 2010, it appears the labor force in the Northern area was impacted by the 2007–2009 recession more than other areas of the state.

In 2010, the majority of jobs in New Mexico were held in the educational services (22.5%), health care and social assistance sector. The retail sector followed, accounting for 11.5% of the state's workforce. The manufacturing sector and the professional, scientific, administrative and waste management sectors were comparable and accounted for 10.8% and 10.5% of the workforce, respectively.

Below, Figure 1.2 shows New Mexico employment distribution by industry sector based on Census 2010 data.

Figure 1.2 New Mexico Employment Distribution



In 2012, economic reports indicated that New Mexico was emerging from the worst recession in decades. The economic downturn rippled throughout the entire economy with devastating effects. The rate of over-the-year job growth, comparing 2010 with 2009, was a negative 0.6 percent, representing an over-the-year loss of 4,700 jobs.

In 2013, New Mexico's rate of over-the-year job growth, comparing April 2013 with April 2012, was 1.0 percent. This increase to an overall unemployment rate of 6.7 percent represents an increase in 7,900 jobs. April 2008 was the last time over-the-year employment growth in the State was at or above one-percent. These trends indicate that the economic recovery efforts in the state of New Mexico are gaining momentum towards sustained recovery. The largest employment gains were reported by the leisure and hospitality industries, which added 2,500 jobs between 2012 and 2013. The construction industry reported the best over-the-year numbers since 2006 after gaining 1,800 jobs.

Manufacturing

New Mexico manufacturing employment is expected to decrease by 11.5 percent from 2009 to 2019, shedding roughly 3,560 jobs. The largest job losses are expected to occur in the computer and electronic products manufacturing sectors due to advances in automation. Sector growth could change significantly if plans progress for the many manufacturers of renewable energy products who have committed to locating and expanding in New Mexico.

Construction

Employment in construction in New Mexico is expected to grow by about 5,800 jobs or 11.1 percent over the forecast period as construction employment rebounds from 51,700 in 2009 to 57,400 in 2019. The specialty trade contractor subsector is projected to grow by 2,540 jobs or 8.6 percent. Residential building construction employment is expected to recoup losses, increasing by about 1,700 jobs or 12.5 percent from 2009 to 2019. Heavy & civil engineering construction is projected to add 1,510 jobs or 17.8 percent, growing from 8,520 jobs in 2009 to 10,030 jobs in 2019.

Minerals

New Mexico remains a leading United States mineral producer with 2010 first-in-production rankings for potash, perlite and zeolite; fourth in copper; and thirteenth in coal, as reported by the U.S. Geological Survey (USGS) and the U.S. Energy Information Administration. The principal minerals, in descending order of 2010 production value, were coal, potash, and copper. According to USGS, New Mexico ranked twentieth in 2010 when ranking states by the production value of non-energy minerals, producing 1.6 percent of the production value of total U.S. non-energy minerals.

Coal claimed the top spot for both production value and payroll in 2010; also, the coal industry generated the greatest revenue for the state. Total 2010 revenues (state and federal) generated by mineral production in New Mexico declined 23 percent to $54.7 million from 2009's all-time high of $70.9 million.

Total mining sector employment increased while payroll amounts slightly decreased in 2010. The total number of direct and contract employees working in the mining industry in 2010 was 5,658, a nearly 10 percent increase from 2009. Industry payroll exceeded $271 million, down 5.5 percent from 2009. Direct employment increased six percent to 4,742 employees; contract employment increased 33 percent to 916 workers; and reclamation employment increased 59 percent to 627 workers (Figure 4). Coal was the largest employer in New Mexico's mining industry, followed by potash and copper.

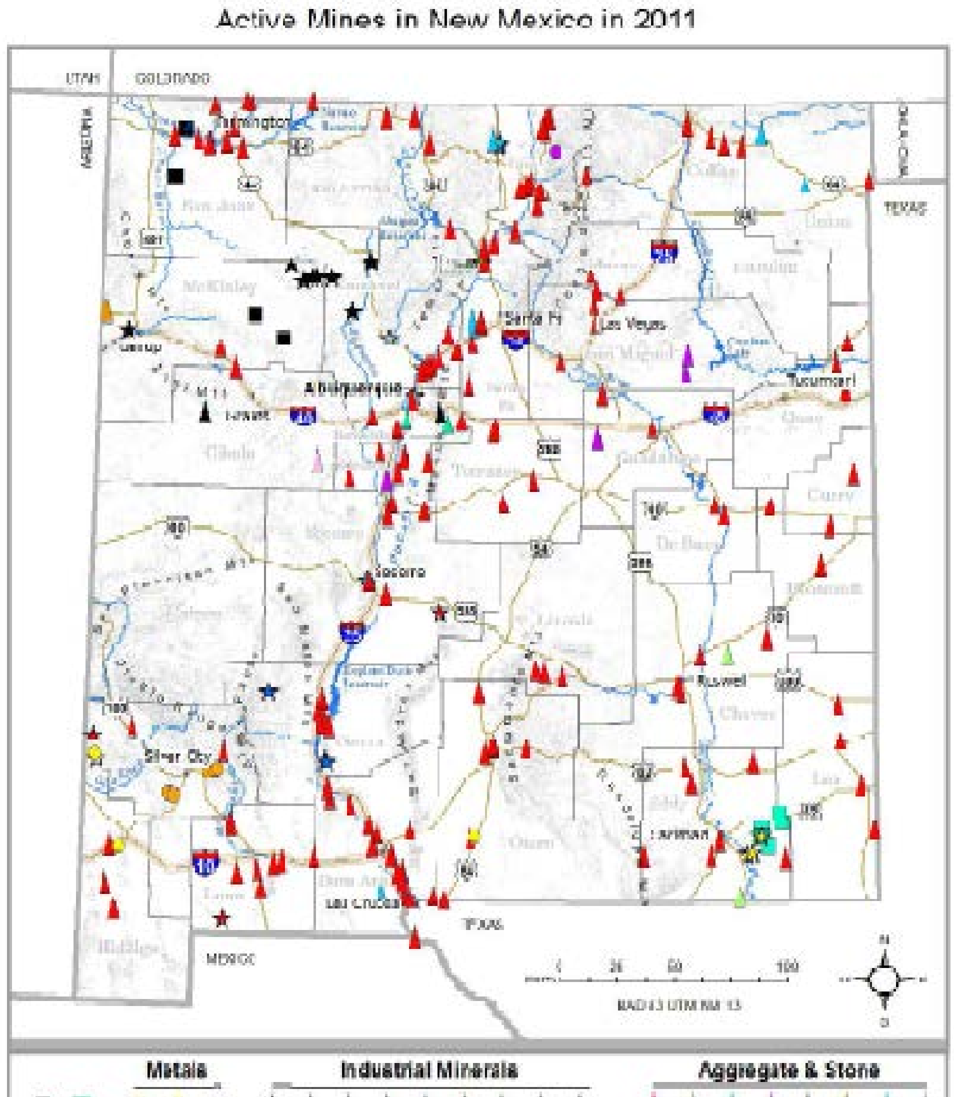
Employment in the New Mexico mining industry is expected to grow by about 1,730 jobs between 2009 and 2019. As the economy recovers from recession, much of the increase in projected activity is based on the growing demand for and rising worldwide price of natural resources. Support activities for mining will be the largest growing mining subsector, increasing from 11,130 in 2009 to 12,200 in 2019. Mining (except oil and gas) is projected to experience little growth, with employment levels at about 4,420 through 2019. The oil & gas extraction subsector is projected to increase 9.0 percent, adding about 380 jobs, between 2009 and 2019.

More than $2.2 billion worth of minerals were extracted from New Mexico mines in 2011, a 24% increase from 2010 levels. New Mexico remains a leading U.S. mineral producer with 2011 rankings of first in potash, perlite and zeolite; third in copper (up from fourth in 2010); and thirteenth in coal, as reported by the USGS and the U.S. Energy Information Administration.

There were 246 registered active mining operations in New Mexico in 2011 including four coal mines; eight potash mines; eleven metal mine, mill and SX/EW operations; twenty one industrial mineral mines; 15 industrial mineral mills; and 187 stone and aggregate operations (Figure 1.3).[3]

[3] Source: New Mexico Department of Workforce Solutions 2012 Annual State of the Workforce Report http://www.emnrd.state.nm.us/ADMIN/documents/EMNRD-2012-Annual-Report.pdf

Figure 1.3: Active Mines in New Mexico



Demographic Features

Population

The 2010 US Census reports an estimated total state population of 2,059,179 (US Census Bureau, 2010). This indicates an increase of 11.9% from the year 2000 to 2010. The population density of the state ranks 47th in the US with roughly 17 people per square mile. The US Census 2010 Demographic Profile for the State of New Mexico is as follows:

Table 1.4: Race and Ethnicity in New Mexico[4]

RACE AND ETHNICITY		
	July 1, 2010	Percent
Total	**2,059,179**	**100%**
Once Race	1,982,169	96.3%
White	1,407,876	68.4%
Black or African American	42,550	2.1%
American Indian & Alaska Native	193,222	9.4%
Asian	28,208	1.4%
Hawaiian & Pacific Islands	1,810	0.1%
Two or more races	77,101	3.7%
Hispanic Origin	953,403	46.3%
Not Hispanic Origin	1,105,776	53.7%

In 2012, The University of New Mexico's Bureau of Business and Economic Research released a set of population growth projections for the time period from 2010 to 2040. Table 1 shows New Mexico total population growth projections by county:

Table 1.5: New Mexico Projected Population Growth (2010 - 2040)[5]

County	2010	2015	2020	2025	2030	2035	2040
NEW MEXICO	2,065,826	2,208,450	2,351,724	2,487,227	2,613,332	2,727,1 18	2,827,692
Bernalillo	664,636	721,153	780,244	835,325	886,564	932,091	970,371
Catron	3,725	3,825	3,909	3,976	4,000	4,005	4,012
Chaves	65,783	68,538	71,632	74,867	77,949	80,724	83,263
Cibola	27,213	28,236	29,133	29,909	30,630	31,361	32,090
Colfax	13,752	13,710	13,631	13,506	13,296	12,998	12,642
Curry	48,941	51,001	52,900	54,778	56,707	58,611	60,395
De Baca	2,022	1,987	1,950	1,909	1,879	1,840	1,803
Dona Ana	210,536	226,855	243,164	258,887	273,513	286,818	299,088

[4]Source: U.S. Census Bureau 2010 Demographic Profile Data
[5] Source: New Mexico County Population Projections July 1, 2010 to July 1, 2040, Geospatial and Population Studies Group, University of New Mexico (November 2012)

Eddy	53,829	55,832	57,908	59,945	61,836	63,595	65,258
Grant	29,371	29,417	29,457	29,433	29,310	29,166	29,102
Guadalupe	4,687	4,742	4,765	4,779	4,776	4,773	4,760
Harding	695	693	684	670	647	625	607
Hidalgo	4,894	4,857	4,818	4,764	4,671	4,546	4,403
Lea	64,727	71,465	78,407	85,773	93,712	102,090	110,661
Lincoln	20,497	21,104	21,577	21,875	21,979	21,959	21,888
Los Alamos	18,026	18,058	18,063	18,016	17,880	17,603	17,210
Luna	25,095	26,478	28,024	29,694	31,465	33,399	35,595
McKinley	71,802	72,691	73,483	73,946	73,805	72,988	71,580
Mora	4,881	4,865	4,826	4,753	4,665	4,548	4,423
Otero	64,275	65,542	66,367	66,825	67,047	67,064	66,841
Quay	9,041	8,954	8,891	8,840	8,804	8,788	8,805
Rio Arriba	40,371	40,780	41,026	41,058	40,872	40,509	40,008
Roosevelt	20,040	21,657	23,178	24,522	25,721	26,836	27,912
Sandoval	132,434	154,048	176,276	198,950	221,644	243,897	265,607
San Juan	130,170	138,487	146,388	154,065	161,593	168,850	175,678
San Miguel	29,393	29,315	29,157	28,785	28,176	27,413	26,594
Santa Fe	144,532	154,756	164,006	171,905	178,124	182,410	184,832
Sierra	11,988	12,020	12,048	12,100	12,218	12,421	12,737
Socorro	17,866	17,998	18,008	17,879	17,621	17,274	16,857
Taos	32,937	35,012	36,769	38,183	39,221	39,850	40,062
Torrance	16,383	16,927	17,589	18,266	18,865	19,344	19,801
Union	4,549	4,803	5,066	5,318	5,553	5,773	5,977
Valencia	76,735	82,644	88,380	93,726	98,589	102,949	106,830

New Mexico experienced a 13% increase in population from 2000 - 2010. Out of all of the counties in the State, Sandoval County (located in the north western part of the State) had the largest positive percent change in population between 2000 and 2010 with a 46.3% increase in population. Hidalgo County, located in the south western corner of New Mexico, experienced the largest decrease in population. The population of Hidalgo County shrank by 17.5% between 2000 and 2010. The table below (Table 1.6) provides a comprehensive view of population change in New Mexico by County.

Table 1.6. Rank of Counties by Percent Change in Population: 2000 to 2010[6]

County	Population		Percent Change	
	2010	2000	Rank	Percent
Sandoval County	131,561	89,908	1	46.3
Doña Ana County	209,233	174,682	2	19.8

[6] Source: US Census Bureau 2010

Bernalillo County	662,564	556,678	3	19.0
Lea County	64,727	55,511	4	16.6
Valencia County	76,569	66,152	5	15.7
San Juan County	130,044	113,801	6	14.3
Santa Fe County	144,170	129,292	7	11.5
Roosevelt County	19,846	18,018	8	10.1
Taos County	32,937	29,979	9	9.9
Union County	4,549	4,174	10	9.0
Curry County	48,376	45,044	11	7.4
Chaves County	65,645	61,382	12	6.9
Cibola County	27,213	25,595	13	6.3
Lincoln County	20,497	19,411	14	5.6
Catron County	3,725	3,543	15	5.1
Eddy County	53,829	51,658	16	4.2
Otero County	63,797	62,298	17	2.4
Luna County	25,095	25,016	18	0.3
Guadalupe County	4,687	4,680	19	0.1
Socorro County	17,866	18,078	20	-1.2
Los Alamos County	17,950	18,343	21	-2.1
Rio Arriba County	40,246	41,190	22	-2.3
San Miguel County	29,393	30,126	23	-2.4
Colfax County	13,750	14,189	24	-3.1
Torrance County	16,383	16,911	25	-3.1
McKinley County	71,492	74,798	26	-4.4
Grant County	29,514	31,022	27	-4.8
Mora County	4,881	5,180	28	-5.8

Sierra County	11,988	13,270	29	-9.7
De Baca County	2,022	2,240	30	-9.7
Quay County	9,041	10,155	31	-11.0
Harding County	695	810	32	-14.2
Hidalgo County	4,894	5,932	33	-17.5
Total =	2,059,179	1,819,066		

There are 23 federally recognized Indian tribes and groups located in the State of New Mexico. According to Census 2010 data, these tribal groups make up 10.7% of New Mexico's total population. Table 1.7 shows the 2010 population estimates for the 23 tribal entities in New Mexico.

Table 1.7: Tribal Population in New Mexico (Census 2010)[7]

Tribal Population		
Tribe	**County**	**Pop.**
Acoma Pueblo	Cibola	3,011
Cochiti Pueblo	Sandoval	1,727
Isleta Pueblo	Bernalillo	3,400
Jemez Pueblo	Sandoval	1,815
Jicarilla Apache Reservation	Rio Arriba	3,254
Laguna Pueblo	Cibola	4,043
Mescalero Apache Reservation	Otero	3,613
Nambe Pueblo	Santa Fe	1,611
Navajo Nation (AZ-NM-UT)	San Juan	65,764
Picuris Pueblo	Taos	1,886
Pojoaque Pueblo	Santa Fe	3,316
San Felipe Pueblo	Sandoval	3,563
San Ildefonso Pueblo	Santa Fe	1,752
San Juan Pueblo (Ohkay Owingeh)	Rio Arriba	6,309
Sandia Pueblo	Sandoval	4,965
Santa Ana Pueblo	Sandoval	621
Santa Clara Pueblo	Rio Arriba	11,021
Santo Domingo Pueblo	Sandoval	3,255
Taos Pueblo	Taos	4,384

[7] Source: 2010 Census American Indian and Alaska Native Summary File: http://www.nmlegis.gov/lcs/handouts/New%20Mexico%20Census.pdf

Tesuque Pueblo	Santa Fe	841
Ute Mountain	San Juan	0
Zia Pueblo	Sandoval	737
Zuni Pueblo (NM portion)	McKinley	7,891

The table below shows a summary of the population size of each Preparedness Area in New Mexico (Figure 1.8).

Table 1.8: Populations by Preparedness Area

Preparedness Area	Counties	Total Population (2010)
Preparedness Area 1	Guadalupe, Quay, Curry, Chavez, Roosevelt, De Baca, Lincoln, Eddy, Lea	288,670
Preparedness Area 2	Colfax, Union, Harding, Mora, San Miguel	53,268
Preparedness Area 3	Rio Arriba, Taos, Los Alamos, Santa Fe	235,303
Preparedness Area 4	San Juan, McKinley, Cibola	228,749
Preparedness Area 5	Sandoval, Bernalillo, Torrance, Valencia, Socorro	904,943
Preparedness Area 6	Catron, Grant, Sierra, Otero, Doña Ana, Luna, Hidalgo	348,246

Housing

According to the Census Bureau, the total number of housing units in the state in 2010 totaled 901,388, with a home ownership rate of 69.6%. The statewide median value of owner-occupied housing units was $161,800 per unit (national average is $186,200 per unit). The median value is much higher in urban/suburban and resort areas in the state. The median value of a residential structure in Santa Fe County, for example, is approximately $300,000. The statewide average household size was 2.26 persons per household for 762,002 households. The national average is 2.60 persons per household.

Income

According to the US Census Bureau, in 2010, the median household income statewide was $44,631 per household, and per capita income was $23,537. The national average is $52,762 per household and $27,915 per capita. The percentage of persons below the poverty level was 19%, which is significantly higher than the national average of 14.3%.

Utilities and Infrastructure

Electricity

New Mexico has several large power generating facilities, upon which significant portions of the state are dependent. The Four Corners Power Plant and San Juan Power Plant northwest of Farmington in San Juan County are the two major power generation plants in the state. Both plants not only generate electricity for New Mexico, but also for Arizona, Utah, and Colorado. The Four Corners Power Plant is operated by the Arizona Public Service Company and provides electrical transmission to the Tucson Power Company, the Pacific Corporation in Utah, and the Western Area Power Administration in Colorado. The San Juan Power Plant is run by the Public Utility Company of New Mexico (PNM) and provides electrical transmission to many rural electric cooperatives, as well as customers in the Albuquerque Metro Area. Other major PNM generating plants are located in Albuquerque, Afton, and Las Vegas. The second largest wind-powered electricity generation plant in the United States is located near House, in Quay County.

Gas

There are several natural gas distributors serving the population of New Mexico. PNM is the major distributor, along with the El Paso Natural Gas Company, Transwestern Pipeline Company, and the Natural Gas Pipeline Company of America.

Two major gas pipelines cross the state, running roughly parallel southeast from Gallup toward Roswell and Carlsbad. There are several regional gas pipelines serving the valley areas, but not crossing over any mountain passes. Major gas pipeline compressor stations are located in Otero, Sierra, Lea, Curry, Rio Arriba, San Juan, Sandoval, McKinley, Bernalillo, and Valencia Counties. Within the state are many propane distributors, which are dependent upon truck and rail transportation.

Located west of the Albuquerque International Sunport are several bulk petroleum tank farms. These facilities are located near the Rio Grande and are primarily in agricultural and light industrial areas.

New Mexico has a significant oil production industry. There are two major refineries in the state, one east of Gallup and the largest one in Artesia.

Water Supply

Most jurisdictions have their own water companies, while extensive rural areas are dependent upon private wells or mutual domestic water users associations. Currently, the state's principal surface water supplies are at record lows due to drought conditions that have prevailed for many years. Drought conditions have impacted groundwater supplies as well, and the reduction of well water reserves is a serious concern for the state's water planners.

Transportation

Roadways

Three major interstate highways serve New Mexico: I-40, I-10, and I-25. I-40, running through Albuquerque, is the major east/west corridor through central New Mexico. I-10 serves the southern portion of the state from El Paso through Las Cruces to the Arizona border. I-25 is the major north-south corridor in the state, originating in Las Cruces, running northward through Albuquerque, and connecting to Colorado. I-40 and I-25 converge in Albuquerque to form the – Big I.

New Mexico has many important highway bridges crossing the Rio Grande and other major rivers. In urban areas such as Albuquerque and Las Cruces, there are other routing alternatives if a bridge should be rendered inoperable. In areas that are more rural river crossings are less frequent, and considerable detouring would be necessary if a bridge were to close.

Railroads

Since 1878, when the first transcontinental railway service began across New Mexico, railways have been an important component of the state‘s transportation and economic network. Two freight carriers and Amtrak serve the state. In addition, the state operates a narrow gauge tourist railroad, Cumbres and Toltec Scenic Railroad, between Chama, New Mexico, and Antonito, Colorado. The railways also serve as a mechanism of transporting hazardous materials, which are a major concern to populated areas along the rails, specifically the Albuquerque metro area.

The Burlington Northern Santa Fe (BNSF) Railroad hauls 90% of all freight originating in New Mexico and 80% of all cargo terminating in the state. The BNSF has two major routes that provide east-west and north-south service. The east-west route from the Texas border generally parallels U.S. Route 60 thru Vaughn to Belen. From Belen, the route parallels State Road 6 toward the intersection again with I-40. From this point

Rail Runner Express

The New Mexico Department of Transportation and the Mid-Region Council of Governments are responsible for developing the Rail Runner. While the NMDOT is the ultimate authority responsible for the Rail Runner, the Mid-Region Council of Governments is the lead agency for implementation of the new passenger rail service. The Rail Runner Express is a commuter rail system serving the metropolitan area of Albuquerque, New Mexico. The Rail Runner Express is administered by the New Mexico Department of Transportation (NMDOT) and a regional government planning association known as the Mid Region Council of Governments (MRCOG).

In addition to the NMDOT and the MRCOG, local governments (including counties, towns, and the Native American Tribes and Pueblos in the corridor) all play key roles in the planning and execution of the Rail Runner. This local involvement is an essential ingredient in the development of the project. Specifically, local jurisdictions have participated in the planning stages as well as the facilitation of public involvement and outreach. These communities will play important roles in the day-to-day operations of the Rail Runner.

The Rail Runner officially went into service on July 14, 2006. Using the existing Santa Fe Southern Railway track from Lamy to Santa Fe, which is filled with sharp curves, would have required the train to slow to 15 miles per hour (24 km/h) in some places, so new tracks were laid to produce travel times comparable to the automobile. The route uses previously existing track from Bernalillo to the base of La Bajada, a hill south of Santa Fe. It then runs on newly built track on new right-of-way from CP Madrid, for five miles and then in the I-25 median into Santa Fe, at CP Hondo, where it uses an improved Santa Fe Southern Railway track from I-25 to the terminal at the Santa Fe Railyard. The Rail Runner currently serves the following communities:

- Cities, Villages and Towns: City of Belen , Village of Los Lunas , City of Albuquerque, Town of Bernalillo and the City of Santa Fe

- Counties: Valencia County, Bernalillo County, Sandoval County and Santa Fe County

Rail Runner Emergency Management

Another important aspect of making the service operational was the preparation of a safety plan for the corridor and training activities that focused on emergency preparedness. The safety plan was prepared by the MRCOG and Herzog and submitted to the FRA for approval. This plan addresses FRA safety requirements related to the equipment, stations, rights of way and operating procedures. The FRA approved the plan in June of 2006.

Also, the NMDOT, MRCOG, BNSF, FRA, Amtrak, local and state law enforcement and emergency response personnel engaged in several training exercises to prepare for the service start up. On several different occasions local emergency responders were invited to class room and field trip style training designed to familiarize these folks with the commuter rail equipment, safety and access features and technical specifications. The Department of Homeland Security also performed a vulnerability assessment of the corridor and held a de-briefing with local and state law enforcement personnel. On June 17th, 2006 after two days of classroom training, a fullscale emergency drill was held with representatives from local and state emergency response personnel, the FRA, BNSF, Amtrak, Herzog staff and MRCOG and NMDOT staff. The purpose of the drill was to present a real world emergency situation and evaluate the response. Figure 50 below illustrates a portion of the drill which involved extricating an injured person through the second floor window of a Rail Runner car.

The MRCOG teamed with Operation Lifesaver to develop and distribute safety awareness materials for public events and other activities. Operation Lifesaver is a national program that promotes railroad safety and safety awareness. Much of the focus of this program is on children and young adults with a specific emphasis on the importance of exercising caution at railroad crossings. These safety awareness activities were coordinated with public involvement and open house activities discussed in the next section. This is now an ongoing part of the operations program. Along with this effort the MRCOG, Herzog and NMDOT evaluated signage at all crossings in the corridor and replaced worn striping and signage at several crossings. Several full-scale emergency response drills have been held since this initial exercise as well as additional classroom training sessions.

Figure 1.9: Emergency Response Training

Figure 1.10: Emergency Response Drill

Airports

New Mexico is home to 65 FAA-recognized airports. Of these, the Albuquerque International Sunport, the Las Cruces International Airport, and the Santa Fe Airport are the only ones with out-of-state commercial service. Nine of the state‘s airports have unpaved runways suitable only for light aircraft. Two of the state‘s airports, Holloman AFB and Cannon AFB, are not open for public use.

The Albuquerque International Sunport is the main arrival and departure point for New Mexico, with commuter flights available to Clovis, Hobbs, Farmington, Gallup, Roswell, Ruidoso, Santa Fee, and Silver City.

Kirtland AFB provides aircraft rescue and firefighting services for the Albuquerque Sunport and shares their runways. FAA facilities in Albuquerque include the Airport District Office, Air Traffic Control Tower, Automated Flight Service Station, Civil Aviation Security Office, Flight Standards District Office, and Rio Grande SMO (Airways Facilities). The Transportation Security Administration (TSA) occupies office space at the historic Old Terminal Building. The National Weather Service and U.S. Postal Service Express Mail Facility are also located at the airport. Adjacent to the airport is a major Southwest Airlines Reservations Center.

Corporate jet manufacturer Eclipse Aviation has expanded its operations to Double Eagle II Airport. This airport located on Albuquerque‘s west side, is used primarily for training, military, air ambulance service, charter and corporate flights.

State of New Mexico WIPP Program

The Waste Isolation Pilot Plant (WIPP), the nation's repository for defense-related transuranic wastes, received its first shipment on March 26, 1999. As other generator sites become certified, wastes generated from research, development and production of nuclear weapons at DOE sites across the country will be shipped to WIPP, southeast of Carlsbad, New Mexico. A campaign of approximately 38,000 shipments is expected to continue for over 35 years.

The State of New Mexico has been working since 1989, internally and with a coalition of western states through the Western Governors' Association, to develop a transportation system whose goal is the safe and uneventful transport of radioactive materials through western states. The WIPP Transportation Safety Program is a cooperative effort among the shipment-corridor states, tribes, local officials and the DOE. The program goes beyond what is required by law and has been proven through actual use in other radioactive waste shipping campaigns. There is not a shipment on the road that will have undergone as much scrutiny by transportation safety specialists as WIPP shipments. In a July 1989 report, the prestigious National Academy of Sciences WIPP Panel said, "The system proposed for transportation of Transuranic (TRU) waste to WIPP is safer than that employed for any other hazardous material in the United States today and will reduce risk to very low levels."

All contact-handled transuranic wastes destined for WIPP are transported in the Transuranic Packaging Transporter (TRUPACT-II), a reusable shipping package or "cask," certified by the Nuclear Regulatory Commission (NRC). No more than three TRUPACTs, each holding up to fourteen 55-gallon drums of waste, are secured directly to specially designed trailers and pulled by conventional diesel-powered tractors. The trucks are equipped with a satellite communication and tracking system called TRANSCOM. WIPP shipments cannot deviate from designated routes without explicit permission from the state.

Agriculture

In New Mexico all counties but Los Alamos, have agricultural production. Crops grown in the State include Hay, Alfalfa, Chile, Corn, Cotton, Pecans, Sorghum, Wheat, Onions, Peanuts and Pistachios. Livestock in New Mexico includes Milk Cows, Cattle (Beef), Sheep, goats and others. Many small vineyards and fruit orchards are scattered around the state.

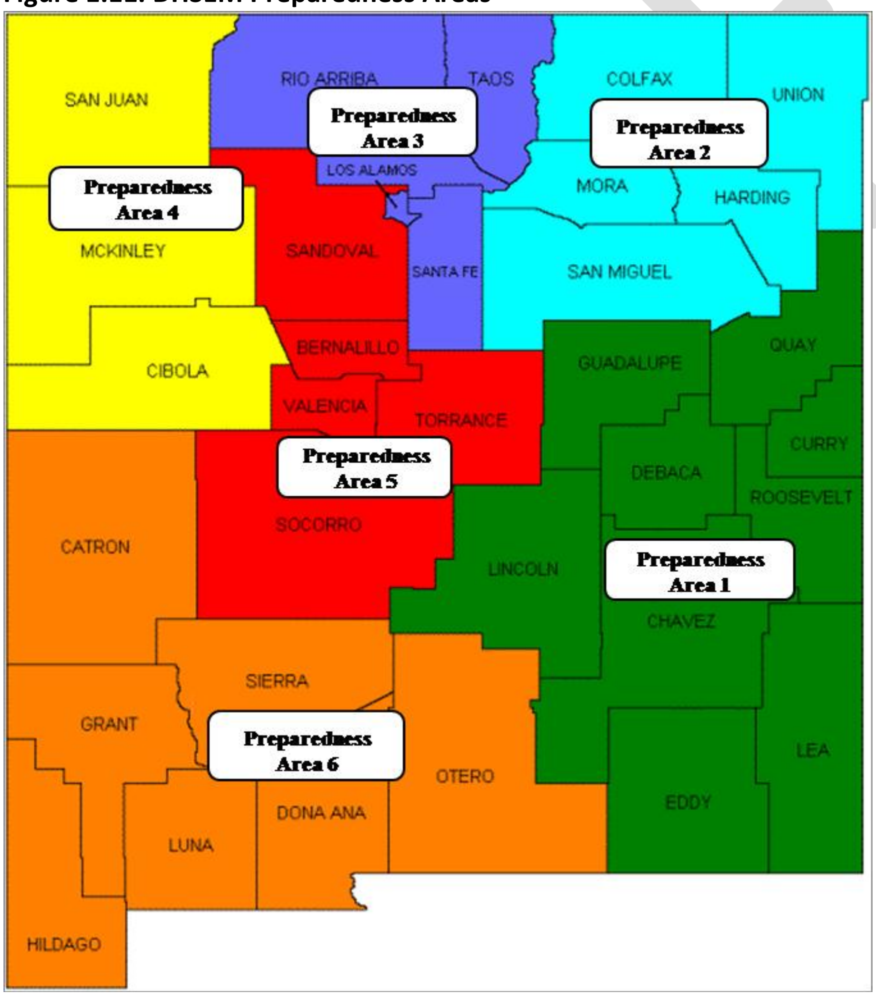
Plan Development Process

2013 Hazard Mitigation Plan Update

The 2013 New Mexico Natural Hazard Mitigation Plan Update is a collaborative effort resulting from the work of approximately 70 Planning Team Members and Subject Matter Experts over a period of 16 months. A list of the agencies/organizations represented, the contact individual and their associated subject areas is included in Appendix C. Primary contact was made by email and Hazard Mitigation Team Meetings. The SHMO attempted to communicate by telephone with Planning Team Members and Subject Matter Experts for follow-up as needed.

Throughout the process, each section of the 2010 version of the Plan was reviewed and edited. One major modification was that the 2013 Plan integrates text from previous up-dates so that each section reads more clearly. Another major modification is that the 2013 Plan is written to reflect hazard profiles and analysis at a Preparedness Area scale. DHSEM coordinates activities for counties and Tribes by Preparedness Area. The Figure 1.11 below shows the six Preparedness Areas and includes a chart which explains the tribal entities included in each Preparedness Area for DHSEM coordination.

Figure 1.11. DHSEM Preparedness Areas



There are a number of tribal entities located within four of the six DHSEM Preparedness Areas. Preparedness Area 3 includes the following tribes:

- Nambe Pueblo, Pojoaque Pueblo, San Ildefonso Pueblo, Tesuque Pueblo (Santa Fe County)
- Jicarilla Apache, Ohkay Owingeh Pueblo, Santa Clara Pueblo (Rio Arriba County)
- Picuris Pueblo, Taos Pueblo (Taos County)

Preparedness Area 4 includes the following tribes:

- Navajo, Ute Mountain (San Juan County)
- Navajo, Zuni Pueblo (McKinley County)
- Acoma Pueblo, Laguna Pueblo, Ramah Navajo, Tojajiilee Navajo (Cibola County)

Preparedness Area 5 includes the following tribes:

- Cochiti Pueblo, Jemez Pueblo, Sandia Pueblo, San Felipe Pueblo, Santa Ana Pueblo, Santo Domingo Pueblo, Zia Pueblo (Sandoval County)
- Isleta Pueblo (Bernalillo County)
- Alamo Navajo (Socorro County)

Preparedness Area 6 includes the following tribes:

- Mescalero Apache (Otero County)

Planning Team and Subject Matter Experts

In the spring of 2012, the SHMO compiled a list of the key agencies, organizations and entities that may have an interest in the State Natural Hazard Mitigation Plan. The list includes State agencies, federal agencies and professional organizations and can be viewed in Appendix C. At the first Planning Team Meeting, participants were asked to supply a list of agencies, organizations or other contacts that should be included in the process. The SHMO added names to the email distribution list as the process continued. If an individual was invited to participate who had not been involved since the kick-off meeting, the SHMO made individual contact to discuss the background and progress. An initial phone call was made. Follow-up was by email and the Kick-off Meeting PowerPoint presentation was provided. Numerous phone conversations were conducted to bring new participants up to speed with the Plan up-date process and progress to date.

Planning Team Members and Subject Matter Experts were invited to attend four meetings at the DHSEM Office in Santa Fe. All four meetings were conducted using a webinar format so that participants could follow the presentation visually and hear the discussion. The four meetings were held throughout the planning process. Dates, primary topics and homework are listed below. Meeting announcements, agendas, notes and participants lists are included in Appendix D.

- July 31, 2012: Primary topic was to introduce the regulatory requirements and the planning process. Homework was to provide feedback on the 2010 Plan goals and to come-up with a critical facilities definition for this 2013 Plan update.
- September 10, 2012: Primary topic was the Hazard Ranking. Homework was to provide feedback for the hazard profiles and risk assessment.
- January 29, 2013: Primary topic was to review the Hazard Ranking and to introduce the Capability Section. Homework was to provide feedback on the 2010 Plan Capability Section and Critical Facilities Section. The 2010 Plan Mitigation Action Section was distributed prior to the June Meeting and edits were requested.

- June 19, 2013: Primary topic was to edits and prioritize the Mitigation Actions.
- The Planning Team determined that a fifth meeting would only be warranted if consensus was needed regarding public comments. The fifth meeting would likely be conducted by conference call. *Paragraph to be finalized in September*

A description of the role of a Planning Team Member and of a Subject Matter Expert was discussed at the Kick-off Meeting. The Planning Team Members were to provide feedback on the planning process, over-all approach and draft Plan. In addition, Planning Team Members were expected to participate in the Planning Team Meetings. The Subject Matter Experts were to provide edits and feedback on specific hazards or topics and provide reference material/citations. Both the Planning Team Members and of a Subject Matter Experts were expected to assist with integrating the State Natural Hazard Mitigation Plan into their agency's, jurisdiction's or organization's planning documents. Based on feedback from the participants, there was one email list created that included both Planning Team Members and of a Subject Matter Experts. This way any up-dates, progress reports or requests for feedback would go to all involved.

In November 2012, as part of the FEMA-DR-4079 notification process, communities and tribes were invited to participate in the State Plan up-date. All County Emergency Managers were sent the Notification Letter with a copy to the County Manager and Floodplain Manager (if applicable). Incorporated jurisdictions within counties with FEMA approved Mitigations Plan also received Notification Letters. All tribal Governors and Presidents were sent the letter with a copy to the Emergency Manager and Floodplain Manager (if applicable).

Additional invitations to participate were extended at numerous Workshops, Conferences and Task Force Meetings. Below is a list of those events;

- Governor's Drought Task Force Meeting (September 2012 and January 2013)
- New Mexico Floodplain Manager's Association Meetings (March 2012 and April 2013)
- New Mexico Emergency Management Association Meetings (August 2012 and January 2013)
- Preparedness Area Quarterly Meetings
    - October 2013 (Preparedness Area 6)
    - January 2013 (Preparedness Areas 2, 3 and 4)
    - February 2013 (Preparedness Area 1)

    Note: Preparedness Area 5 communities tend to participate in the NEMA Meetings, as they are conducted in Albuquerque.

Process

The Planning Team Members and Subject Matter Experts addressed specific topics related to the 2013 State Natural Hazard Mitigation Plan. Between meetings, members provided information to the SHMO for incorporation. During meetings specific topics were discussed for consensus on the approach. For example, at the first meeting the concept of using Preparedness Areas for the hazard profiles and analysis was introduced. There was very little discussion from participants at the meeting on this topic. However, the participants were instructed to provide feedback on the concept. At the second meeting, the SHMO explained that there was no opposition to using the Preparedness Areas as the organizing concept and therefore that was how the process would proceed.

The SHMO coordinated and implemented the planning process. Throughout the process, the SHMO sent Plan sections, or parts of sections, to Planning Team Members and Subject Matter Experts. All participants were kept informed of the progress by email. Participants submitted revisions to the text. Revisions were integrated into the text. As a result, every section of the plan has been revised and updated. The SHMO subsequently incorporated changes and new information into the body of the plan.

If there were conflicting comments, the SHMO organized a sub-group of the key Subject Matter Experts to come to consensus. For example, Planning Team Members and Subject Matter Experts that are involved with State-wide critical facility inventory or management met to discuss a proposed draft definition of 'critical facilities' for the purpose of this Plan. After the meeting several drafts were circulated to the sub-group for finalization.

Two particularly important Planning Team and Subject Matter Expert activities were the ranking of hazards and the ranking of mitigation actions. The process followed for each of these activities is described in more detail in the respective sections of the Plan.

The general planning process followed is summarized below;

- State profile: Relevant data from the 2010 Census was integrated into the introduction of the Plan. This information was used for analysis of impacts in the vulnerability section of the Plan.

- Hazard Identification and Risk Assessment: The Planning Team and Subject Matter Experts identified natural hazards that potentially threaten all or portions of New Mexico. The group determined that Volcano hazard should be included in the 2013 up-date of the Plan. So, there are a total of 14 hazards now profiled in the Plan. Where possible, specific geographic areas subject to the impacts of the identified hazards were mapped. Subject Matter Experts provided hazard specific maps and data whenever possible. A description of previous occurrence was edited based on up-dated mapping and data.

  Probability of each hazard occurring in each Preparedness Area was evaluated and calculated. The impact of each hazard on public health, safety, property, the economy, and the environment was also evaluated and documented.

- Critical Facilities: The Subject Matter Experts agreed upon a definition for critical facilities for this specific Plan. The Planning Team and Subject Matter Experts then reviewed the 2010 list of Critical Facilities and made both edits and additions.

- Vulnerability by Preparedness Area: Overlays of the available hazard maps allowed for an analysis of the location of critical facilities at risk in each Preparedness Area. Vulnerability identified in local and tribal Mitigation Plans was also incorporated into the discussion for each Preparedness Area.

- Capability: The 2010 Capability Section of the Plan was reviewed and up-dated. Existing codes, plans, policies, programs and regulations were described for the up-date of this Section of the Plan. The list of reference documents was also up-dated.

- Mitigation Strategy: The Mitigation Strategy from 2010 was reviewed and edited. The concepts of the over-arching goals did not change. Based on the natural hazard vulnerabilities and the capability to manage the impacts, a series of mitigation actions were identified. The Planning Team and Subject Matter Experts revised and added mitigation actions based on the type of damage caused by past events plus the vulnerability and capability identified in Sections of the Plan.

- Monitor, Evaluate and Up-date: The final section of the Plan reviews the monitoring, evaluation and up-dating process that will be followed between Plan approval and the next Plan up-date. This section was drafted by the SHMO and reviewed by the Planning Team and Subject Matter Experts for feedback.

- Review, Adoption, Approval: The final draft of the plan was made available in Word format on an FTP site for Planning Team Members and Subject Matter Experts. Comments were integrated into the final. The final draft was also posted on a website for the public to review and comment. After all final draft comments were incorporated, the document was submitted to FEMA for approval. The Approval Pending Adoption Letter was received. The Governor's Authorized Representative (GAR) signed the plan and FEMA accepted the adopted plan.

Public Participation

Throughout the planning process, the general public was made aware of the State Natural Hazard Mitigation Plan Up-date process. As described above, DHSEM invited local communities, tribes and organizations to participate in the process. In addition, the State Plan Up-date process was described in presentations given at the following workshops;

- Volcanism in the Southwest (October 2012)
- Hidalgo County Commission (December 2012)
- Legislative Finance Committee Meeting (February 2013)
- National Earthquake Hazards Reduction Program Meeting (May 2013)
- Regional Interagency Steering Committee Meetings (July 2013 and February 2013)

The final draft of the 2013 State Natural Hazard Mitigation Plan was available for 30-days on a web site specifically designed for this effort. A Press Release went out to over 30 media outlets announcing the availability of the final draft for public review and comment. Feedback was incorporated into the final approved version of the Plan.

Contractor Assistance

DHSEM secured assistance from several contractors to complete the 2013 State Natural Hazard Mitigation Plan Up-date. B-Sting Ventures assisted with compiling data for the Hazard Identification and Risk Assessment portion of the Plan. The contract was funded with State General Funds.

The Earth Data Analysis Center (EDAC) also provided technical services through a State General Fund contract. EDAC generated damage estimation models for earthquake and flood in each Preparedness Area. FEMA's HAZUS software was utilized for the modeling (more detail is found in the earthquake and flood Risk Assessment sections of the Plan). EDAC provided summaries and analysis of the HAZUS results. EDAC also generated mapping for each Preparedness Area and State-wide for the topics listed below.

- Critical facilities listed in this Plan
- FEMA mapped floodplains
- Fire Management Assistance Grant burn perimeters
- Peak Ground Acceleration for the maximum probable magnitude earthquake
- Compilation map of all of the above

Michael Baker, Jr., Inc. provided technical assistance to DHSEM and was funded through a grant from the Hazard Mitigation Grant Program. Services provided by Michael Baker, Jr., Inc. included the following:

- Analysis and integration of the HAZUS data;
- Analysis and integration of local and tribal mitigation plans;
- Formatting and graphic lay-out;
- Integration of final draft comments by the Planning Team, Subject Matter Experts and the public; and
- Response to FEMA review comments on the final draft.

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SECTION 2 – HAZARD IDENTIFICATION / RISK ASSESSMENT

This section summarizes the results of the first fundamental task in the planning process wherein hazards that may affect the State of New Mexico (and Preparedness Areas) are identified, profiled, and their potential effects quantified. It describes previous occurrences, physical characteristics, the likelihood of future occurrence, and the potential severity of an occurrence. The steps in the process include:

- ✓ *Hazard Identification – Hazard identification* was compiled by investigating the various natural hazard occurrences within the state, as well as adjoining states, over the past several decades. The MPG also included hazard information from local mitigation plans. Because it is assumed that hazards that occurred in the state in the past may be experienced in the future, the hazard identification process includes a history and an examination of various hazards and their occurrences. Information of past hazards was obtained from historical documents and newspapers, state and county plans and reports, interviews with state agencies and local experts, and internet websites.
- ✓ *Hazard Profiles – Hazard profiles* determine the frequency or probability of future events, their severity, and factors that may exacerbate their severity. The Hazard Mitigation Team and hazard mitigation planners used national maps available online from sources such as the U.S. Geological Survey (USGS), ESRI (a GIS software development firm), and the University of New Mexico to further investigate the possible implications of a range of hazards. The data sets used to generate the assessment were sometimes out of date or lacked sufficient data. In those cases, hazard probabilities and severities identified in this document are discussed in broad terms, reflecting the lack of available detailed information. These data limitations are discussed in the appropriate sections.
- ✓ *Vulnerability Assessment* – The results of the hazard identification indicate that some of the hazards warrant a vulnerability assessment due to their frequency of occurrence or the fact that those hazards have caused major damage in the state. A vulnerability assessment was performed to determine the impact of frequently occurring hazards on the built environment and how they can affect the safety of the residents of New Mexico. The vulnerability assessment used the information generated in the hazard identification and hazard profile to identify locations where state could suffer the greatest injury or property damage in the event of a disaster. This assessment identified the effects of hazard events by estimating the relative exposure of people, buildings, and infrastructure to hazardous conditions.
- ✓ *Risk Assessment – Risk Assessments* in hazard events requires a full range of information and accurate data. Several site-specific characteristics—first-floor elevations for flooding, the number of stories, construction type, foundation type, and the age and condition of the structure for multiple hazards—determine a structure's ability to withstand hazards. In the State of New Mexico, much of this type of detailed information is not yet available. Projected loss estimates used in this document are based on 2010 U.S. Census data and Hazus analysis. The percentage of potential damage to structures varies depending upon the specific hazard. For example, drought will have no impact on residential structures, while wildfires typically destroy the entire structure.

The following Hazard Identification and Risk Assessment (HIRA) is the foundation upon the state mitigation strategies and actions are based. This section identifies the natural hazards that can occur within the state (preparedness areas) and provides a systematic analysis of risk and vulnerability to which the state's population and critical infrastructure are subject.

In the past, the Stafford Act only provided funding for disaster response and recovery and the Hazard Mitigation Grant Program (HMGP). DMA 2000 stresses the importance of hazard mitigation planning through the HMGP and establishes new requirements for HMGP and the Public Assistance Program. DMA 2000 is intended to facilitate cooperation between the state and local authorities. It encourages and rewards local HMP planning, and promotes sustainability as a strategy for disaster resistance. This enhanced planning network enables the state and its associated counties and tribal entities to project their mitigation needs and priorities, resulting in faster allocation of funding and more effective risk reduction projects.

Hazard Identification

The geographic area of the State of New Mexico is exposed to a number of natural hazards that have sufficient likelihoods of occurrence to warrant discussion. Information about potential hazards was obtained in a number of ways, including: reviewing past state and federal declarations of disasters; conducting internet searches; reviewing historic records; reviewing local mitigation plans and Emergency Operations Plans and archived newspaper articles; and interviewing hazard experts with the National Weather Service (NWS), US Army Corp of Engineer, state government, the University of New Mexico, and New Mexico Tech.

The State Hazard Mitigation Plan includes the following 14 hazards:

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

FEMA Disaster Declarations

Disaster declarations, for the state affected by a disaster, are declared by the President of the United States under the authority of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. FEMA then manages the entire process, including making federally-funded assistance available in declared areas; coordinating emergency rescue and response efforts; providing emergency resources; and providing other related activities/funding in the process of aiding citizens and local governments in a nationally-declared disaster.

As indicated above, the State of New Mexico is exposed to many hazards. New Mexico has experienced thousands of hazard events, resulting in millions of dollars in losses and casualties, and numerous major Federal disaster and emergency declarations. Table 2.1 identifies the major Federal disaster declarations in the state since 1950. The events listed in bold type have occurred since the 2010 State Hazard Mitigation Plan.

Table 2.1: State of New Mexico Major Disaster Declarations: 1954 - 2012[8]

Year	Date	Disaster Type	Disaster Number
2012	08/24/2012	Flooding	4079
2011	11/23/2011	Flooding	4047
2011	03/24/2011	Severe Winter Storms	1962
2010	09/13	Severe Storms and Flooding	1936
2008	14 Aug	Severe Storms & Flooding	1783
2007	S Apr	Severe Storms & Tornadoes	1690
2006	30 Aug	Severe Storms & Flooding	1659
2004	29 Apr	Severe Storms & Flooding	1514
2000	13 May	New Mexico Wildfire	1329
1999	29 Sep	Severe Storms & Flooding	1301
1998	29 Jan	Severe Winter Storms	1202
1993	7 Jun	Flooding, Severe Storm	992
1992	18 Jun	Flooding, Hail, Thunderstorms	945
1985	18 Jan	Severe Storms, Flooding	731
1984	6 Sep	Severe Storms, Flooding	722
1983	24 Oct	Severe Storms, Flooding	692
1979	23 Jun	Severe Storms, Snowmelt, Flooding	589

[8] Source: FEMA online at http://www.fema.gov/femaNews/disasterSearch.do

Year	Date	Disaster Type	Disaster Number
1979	29 Jan	Flooding	571
1973	11 May	Severe Storms, Snow Melt, Flooding	380
1972	20 Nov	Heavy Rains, Flooding	361
1972	20 Sep	Heavy Rains, Flooding	353
1972	1 Aug	Severe Storms, Flooding	346
1965	1 Jul	Severe Storms, Flooding	202
1955	15 Aug	Flood	38
1954	31 Oct	Flood	27

Table 2.2 identifies the major emergency declarations in the state since 1950.

Table 2.2: State of New Mexico Emergency Declarations: 1954 - 2012[9]

Year	Date	Disaster Type	Disaster Number
2005	7 Sep	Hurricane Katrina Evacuation	3229
2000	10 May	New Mexico Fire	3154
1998	2 Jul	Extreme Fire Hazard	3128
1997	2 Mar	Drought	3034

Based on the information in Tables 2.1 and 2.2 (above), floods, severe storms and wildfire hazards played a role in the majority of disasters and emergency declarations in the state. There have been three Federal disaster declarations in the state of New Mexico since the 2010 State Hazard Mitigation Plan. Two were the result of flooding and one was the result of severe winter weather.

Table 2.3 catalogues the Fire Management Assistance Declarations in the state since 1950. The events listed in bold type have occurred since the 2010 State Hazard Mitigation Plan.

[9] Source: FEMA online at http://www.fema.gov/femaNews/disasterSearch.do

Table 2.3: State of New Mexico Fire Management Assistance Declarations: 1954 - 2012[10]

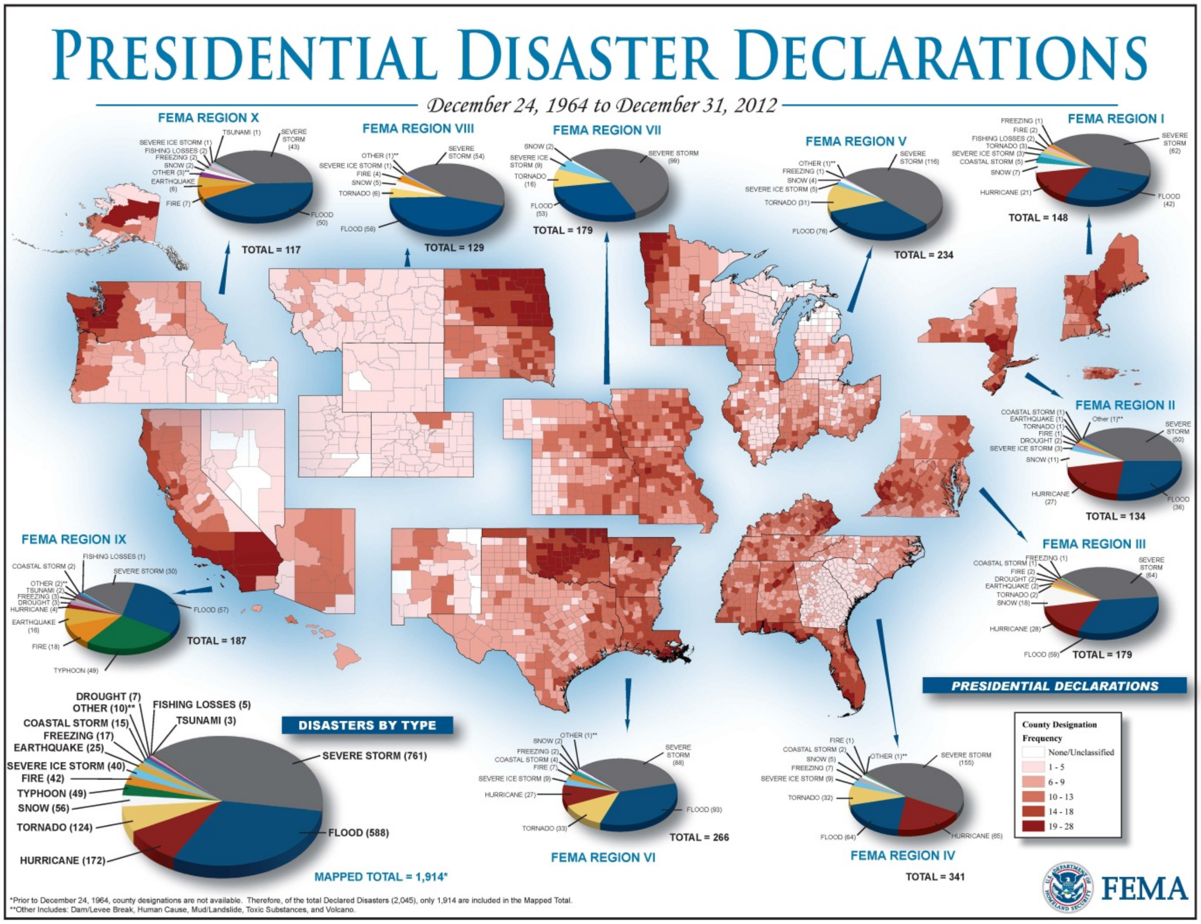
Year	Date	Disaster Type	Disaster Number
2012	06/20/2012	Romero Fire	2982
2012	06/18/2012	Blanco Fire	2981
2012	06/09/2012	Little Bear Fire	2979
2012	05/26/2012	Whitewater-Baldy Fire	2978
2011	06/30/2011	Donaldson Fire	2935
2011	06/29/2011	Little Lewis Fire	2933
2011	06/26/2011	Las Conchas Fire	2933
2011	06/12/2011	Track Fire	2918
2011	06/10/2011	Wallow Fire	2917
2011	04/17/2011	Tire Fire	2897
2011	04/03/2011	White Fire	2880
2011	03/08/2011	Quail Ridge Fire	2866
2010	06/02/2010	Rio Fire	2843
2010	05/24/2010	Cabazon Fire	2842
2009	05/07/2009	Buckwood Fire	2818
2008	06/25/2008	Big Springs Fire	2777
2008	04/21/2008	Trigo Fire	2762
2007	11/21/2007	Ojo Peak Fire	2741
2007	02/24/2007	Belen Fire	2682
2006	06/21/2006	Rivera Mesa Fire	2647
2006	06/16/2006	Malpais Fire	2644
2006	04/12/2006	Ojo Feliz Fire	2636
2006	03/01/2006	Casa Fire	2631
2006	01/02/2006	Southeast New Mexico Fire	2600
2004	06/18/2004	Bernardo Fire	2522
2004	05/25/2004	Peppin Fire	2518
2003	06/25/2003	Atrisco Fire (Formerly Bosque Fire)	2472

[10] Source: FEMA online at http://www.fema.gov/femaNews/disasterSearch.do

Year	Date	Disaster Type	Disaster Number
2003	05/10/2003	Walker Fire	2467
2002	08/26/2002	Lakes Fire Complex	2459
2002	06/13/2002	Roybal Fire Complex	2424
2002	06/06/2002	Ponil Fire	2416
2002	06/04/2002	Cerro Pelado Fire	2415
2002	06/04/2002	Turkey Fire	2414

New Mexico's disaster declaration profile differs slightly from the FEMA Region in which the state is located. In FEMA Region VI, the top four hazards in terms of the source of disaster declarations are floods, severe storms, hurricanes, and tornados (see Figure 2.4 below). Although it is located in Region VI, the state of New Mexico is rarely affected by hurricanes or tornados. Flooding and severe storms do, however, account for the majority of disaster declarations in the state. Additionally, compared to the other states in Region VI, far fewer Presidential Disaster Declarations have been made in New Mexico since 1964. Nationally, New Mexico ranks 40th out of the 50 states for the number of major disaster declarations.

Figure 2.4. National Map of Presidential Disaster Declarations



Local Plan Integration

The 2013 State Hazard Mitigation Plan update built and expanded upon the previous State Hazard Mitigation Plan's risk assessment. In addition to gleaning information from the previous State Hazard Mitigation Plan, Disaster Declaration data and subject matter experts, information about New Mexico's hazard risks was obtained by consulting local hazard mitigation plans.

The State Hazard Mitigation Plan update process is closely integrated with other mitigation programs and initiatives, including local jurisdiction and tribal planning efforts. The 2013 update includes an analysis and roll-up of risk assessment information (damage/loss information, hazard prioritization) from 14 local hazard mitigation plans (12 counties, 1 university, and 2 tribes). Based on the results of the roll-up, the relevant portions from local plans were incorporated in to the write up for each hazard and the vulnerability assessment. Table 2.5 (below) shows the three most significant hazards identified by the 14 local hazard mitigation plans that were reviewed as part of the local plan roll-up process.

Table 2.5. Local Hazard Mitigation Plan Roll-Up, Jurisdictions Ranking Hazards as Major (2012)

Hazard	Number Ranked as Major
Wildland/Urban Interface Fire	12
Thunderstorm (including Lightning and Hail)	10
Flood	8
Drought	5
High Wind	4
Winter Storm	2
Extreme Heat	0
Tornado	0
Expansive Soil	0
Land Subsidence	0
Landslide	0
Dam Failure	1
Earthquake	0
Volcano	0

Based on the results of the local plan Roll-Up, the four most significant hazards for the state of New Mexico are:

- Thunderstorms
- Floods
- Wildfires
- Drought

Hazard Profiles

Hazard profiles describe different hazard characteristics. In some cases, hazards affect specific geographic areas (i.e. Floods and Landslides). When this is the case, the hazard profile includes a map identifying areas of the state where the hazard could occur. For hazards that could occur anywhere, such as tornadoes and winter storms, the hazard profile identifies which portions of the state may be more vulnerable to the hazard.

The remainder of this section presents hazard profiles and risk assessment information for the fourteen hazards listed above. It includes a description of each hazard and historical reviews of hazard occurrences in the State of New Mexico. The order in which the hazards are presented does not reflect the relative levels of risk they pose to the state.

Dam Failure

Hazard Characteristics

Any malfunction or abnormality outside the design assumptions and parameters that adversely affects a dam's primary function is considered a dam failure. A catastrophic dam failure is characterized by a sudden, rapid, and uncontrolled release of impounded water. The sudden release of water may result in downstream flooding affecting life, property, and agriculture. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, or acts of terrorism can cause dam failures. The sudden release of the impounded water can occur during a flood that overtops or damages a dam, or it can occur on a clear day if the dam has not been properly constructed or maintained. Dam failures can occur anywhere there is a dam, but the threat from dam failures can increase as existing dams age. In New Mexico, floodplain maps do not include a dam breach inundation map, where applicable, because the probably of occurrence is not the same. Therefore, downstream residents can be unaware of the potential dangers.

The Office of the State Engineer (OSE) Dam Safety Bureau regulates the design, construction, reconstruction, modification, removal, abandonment, inspection, operation, and maintenance of dams 25 feet or greater in height with more than 15 acre-feet of storage or dams that store 50 acre-feet or more with at least 6 feet in height. Dams less than 25 feet in height and 50 acre-feet in storage are considered non-jurisdictional dams. While the Office of the State Engineer does not regulate non-jurisdictional dams, the Office of the State Engineer can exercise authority over a non-jurisdictional dam if it is considered unsafe and a threat to life or property. The jurisdictional size chart is shown in Figure 2.6. Federal dam owners are required to obtain a permit for a new dam. However, the Office of the State Engineer by law does not regulate the continued safety of federal dams.

Standard practice among federal and state dam safety offices is to classify a dam according to the potential impact a dam failure (breach) or mis-operation (unscheduled release) would have on downstream areas. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental and lifeline facilities. The Dam Hazard Potential Classification definitions are shown in Table 2.7.

Figure 2.6: Jurisdictional Dam Size

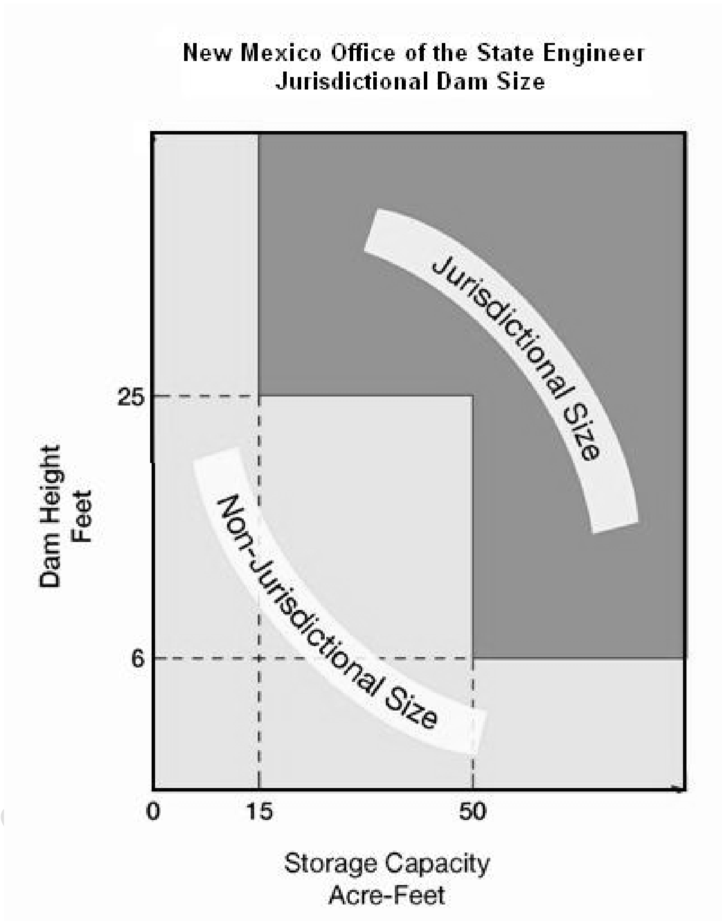


Figure 37 is provided by the New Mexico Office of the State Engineer, as of December 2012, and is used as a tool to exercise authority over non-jurisdictional dam to determine safety and threat to life.

Table 2.7: Dam Hazard Potential Classification

Category	Loss of Life	State Ranking
Low	None Expected	Low economic or environmental losses. Losses Principally Limited to Dam Owner's property
Significant	None Expected	Economic Loss, Environmental Damage and disruption of lifeline facilities. Predominantly located in rural areas
High	Expected	Based only on Loss of Life

Table 2.7 (above) is a hazard potential classification system that categorizes dams based on the probable loss of human life and the impacts on economic, environmental and lifeline facilities. This is a federal/State standard that is commonly used to classify dams.

Of the 594 dams in the state, 300 dams come under the jurisdiction of the Office of the State Engineer Dam Safety Bureau. Of the jurisdictional dams, 151 dams are classified as high hazard potential, 60 dams are classified as significant hazard potential, and 89 are of low hazard potential. Ownership of the jurisdictional dams is distributed as follows: 169 are owned by local government, 99 are privately owned, 18 are owned by public utilities, and 14 are owned by the state. There are 180 federally owned dams in NM.

In 2005, the Office of the State Engineer adopted new regulations for dams. The regulations were updated in 2010 to address changes in state law and to improve areas of the regulations. The regulations address the requirements for design and construction of new dams, modifications or alterations to existing dams and the continued safe operation and maintenance of existing dams. A new requirement for owners of dams classified as high or significant hazard potential is the preparation, maintenance and exercise of an Emergency Action Plan (EAP) and Operation and Maintenance Manual. The EAP identifies defensive action to prevent or minimize property damage, injury or loss of life due to an emergency at the dam.

According to the 2010 National Inventory of Dams and the Office of the State Engineer inventory, there are 77 dams with an Emergency Action Plan. This is a significant improvement from past years. Many of the EAPs are for high hazard potential dams where failure of mis-operation is expected to place lives at risk. The OSE requires EAPs for dams that are classified as high and significant hazard potential.

The development of missing EAPs is addressed in the Mitigation Strategies as an action item. Assistance for dam owners is needed to accomplish this goal. Each EAP has an inundation map based on modeling the dam failure under various operation conditions. An evacuation map is then prepared from the inundation map. There is no state map showing all inundation zones. The lack of adequate maps is also being addressed in Mitigation Strategies and is a focus of the U.S. Department of Homeland Security (DHS). In the fall of 2012, DHS introduced a software application, DSS-WISE Lite, to perform first-tier dam breach simulation and inundation mapping. The software was developed by the National Center for Computational Hydroscience and Engineering at the University of Mississippi. DSS-WISE Lite has been implemented in the Dams Sector Analysis Tool. This application may provide owners with a resource to prepare a basic level dam breach analysis and evaluate if a more detailed analysis is required.

Local mitigation plans will contain information on dams classified as high and significant hazard potential and inundation maps within their jurisdictions as the information becomes available. An example EAP is available on the Office of the State Engineer website to assist owners in preparing their EAP.[11] A list of dams with EAP is provided in Table 2.7.

[11] Source: http://www.ose.state.nm.us/doing-business/DamSafety/EAP-Model.pdf

Table 2.7: Dams with Emergency Action Plans as of December 2012

Preparedness Area	Location	Number of Dams	Hazard Type
Preparedness Area 1	Chaves County	2	High
	Eddy County	7	High
	De Baca County	1	High
	Eddy County	1	Significant
	Guadalupe County	2	High
Preparedness Area 2	Colfax County	4	High
	San Miguel County	2	High
Preparedness Area 3	Los Alamos County	1	High
	Rio Arriba County	12	High
	Rio Arriba County	1	Significant
	Santa Fe County	2	High
	Taos County	4	High
Preparedness Area 4	Cibola County	3	High
	Cibola County	1	Significant
	McKinley County	4	High
	McKinley County	1	Significant
	San Juan County	6	High
	San Juan County	2	Significant
Preparedness Area 5	Bernalillo County	1	High
	Sandoval County	4	High
	Sandoval County	5	Significant
	Sandoval County	1	Low
Preparedness Area 6	Dona Ana County	1	High
	Grant County	5	High
	Grant County	2	Significant
	Hidalgo County	1	Significant
	Otero County	1	High
	Sierra County	3	High

This chart represents the list of Emergency Action Plans for dams in each Preparedness Area. The information was provided by the Office of State Engineers

Previous Occurrences

There have been 41 Dam Incident Notifications in New Mexico since 1890, with 18 total failures. Of those, 13 dams are ranked as high hazard, one is low hazard and one no longer exists. Table 2.8 provides an overview of those notifications by Preparedness Area.

Table 2.8: Previous Occurrence - Dam Incidents 1890 - 2011

Preparedness Area	COUNTY	DAM NAME	DATE	TYPE OF INCIDENT	DAM FAILURE
Preparedness Area 3	Los Alamos	Los Alamos Canyon Dam	2011	Potential Overtopping	No
Preparedness Area 6	Dona Ana	Little Halla Wilson Dam	2007	Spillway Unsafe	No
Preparedness Area 3	Taos	Cabresto Dam	2005	Seepage	No
Preparedness Area 2	Cibola	San Mateo Lake Dam	2001	Crack & Seepage	No
Preparedness Area 6	Grant	Cobre Main Tailings Dam	1999	Uncontrolled Release	Yes
Preparedness Area 2	Colfax	Miami Lake Dam No. 2	1999	Crack	No
Preparedness Area 2	Colfax	Throttle Dam No. 2	1988	Overtopping	No
Preparedness Area 5	Bernalillo	Renaissance Detention Basin	1987	Piping	Yes
Preparedness Area 6	Dona Ana	Mclead Flood Control Dam	1987	Piping	Yes
Preparedness Area 2	Colfax	Ute Creek Dam	1982	Slope Failure	No
Preparedness Area 6	Dona Ana	Caballo Arroyo Dam No. 4	1981	Crack	No
Preparedness Area 6	Grant	Phelps Dodge Tailings Dam No. 3	1980S	Uncontrolled Release	Yes
Preparedness Area 6	Dona Ana	Little Halla Wilson Dam	1980S	Spillway Failed	No
Preparedness Area 2	San Miguel	Bradner Dam	1980S	Seepage	No
Preparedness Area 4	San Juan	Beeline Farmington Dam	1980S	Seepage	No
Preparedness Area 2	Colfax	Lake Maloya Dam	1979	Conduit Failed	No
Preparedness Area 1	Eddy	Hackberry Draw Site No. 3	1975	Sinkholes	No
Preparedness Area 4	Cibola	United Nuclear Homestake	1970S	Overtopping	Yes

Preparedness Area	COUNTY	DAM NAME	DATE	TYPE OF INCIDENT	DAM FAILURE
Preparedness Area 6	Luna	Merrell Dam	1967	Unknown	
Preparedness Area 2	Colfax	Cimarroncito Dam	1965	Overtopping	No
Preparedness Area 3	Taos	Cabresto Dam	1950s	Spillway Failed	No
Preparedness Area 2	Colfax	Lake Alice Dam	1942	Overtopping	No
Preparedness Area 2	Colfax	Lake Maloya Dam	1942	Overtopping	No
Preparedness Area 3	Rio Arriba	Crowley Irrigation System	1941	Overtopping	Yes
Preparedness Area 2	Colfax	Throttle Dam No. 2	1941	Overtopping	No
Preparedness Area 2	Colfax	Rito Del Plano Reservoir	1940	Failed	Yes
Preparedness Area 2	Colfax	Springer Dam No. 1	1937	Failed	Yes
Preparedness Area 4	McKinley	Ramah Dam	1937	Failed	Yes
Preparedness Area 4	McKinley	Black Rock Dam	1936	Seepage	Yes
Preparedness Area 3	Taos	Carson Dam	1935	Sinkhole	No
Preparedness Area 4	McKinley	Black Rock Dam	1932	Seepage	Yes
Preparedness Area 1	Lincoln	Bonito Dam	1930	Overtopping	Yes
Preparedness Area 2	Colfax	Ute Creek Dam	1913	Outlet Failure	No
Preparedness Area 4	McKinley	Ramah Dam	1910	Slope Failure	No
Preparedness Area 4	McKinley	Black Rock Dam	1909	Seepage	Yes
Preparedness Area 4	Cibola	Bluewater Dam	1909	Breach	Yes
Preparedness Area 3	Taos	Cabresto Dam	1907	Overtopping	Yes
Preparedness Area 2	Colfax	Springer Lake Dam	1928-29	Dam Failed	Yes
Preparedness Area 2	Colfax	McCrystal Dam	1994-95	Seepage	No
Preparedness Area 3	Taos	Cabresto Dam	1890	Overtopping	Yes

Preparedness Area	COUNTY	DAM NAME	DATE	TYPE OF INCIDENT	DAM FAILURE
Preparedness Area 5	Sandoval	Nacimiento Dam		Unknown	Yes

Since 2005, the OSE Dam Safety Bureau has been assessing whether dams are deficient under the new Dam Safety Regulations. In 2008 the US Army Corps of Engineers introduced a condition assessment field for the National Inventory of Dams. The OSE adopted the definitions by the USACE and will complete the condition assessment of jurisdictional dams by July 2014.

As of July 2012, the OSE Dam Safety Bureau has identified 115 deficient dams classified as high hazard potential, 40 deficient dams classified as significant hazard potential, and 62 dams classified as low hazard potential. Owners of these dams have been advised of the safety deficiency along with local emergency managers and the NM Department of Homeland Security and Emergency Management. Table 2.9 below provides the definitions for the condition assessment classification along with the OSE Spillway Risk Guidelines associated with each condition.

Table2.9: Dam Condition Classifications

Condition Assessment	2008 USACE Criteria	OSE Spillway Risk Guidelines
Satisfactory	No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions in accordance with State Engineer rules and regulations for dams or tolerable risk guidelines.	Spillway capacity ≥ 70% of the spillway design flood (SDF).
Fair	No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range [for the owner] to take further action.	Spillway capacity < 70% but ≥ 25% of the SDF.
Poor	A dam safety deficiency is recognized for loading conditions, which may realistically occur. Remedial action is necessary. A poor condition is also used when uncertainties exist as to critical analysis parameters that identify a potential dam safety deficiency. In such cases further investigations and studies are necessary.	Spillway capacity < 25% of the SDF.
Unsatisfactory	A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.	

The State Engineer has taken action against unsafe water storage dams that pose an immediate threat to life and property by ordering storage restrictions. Unfortunately, storage restrictions are not an option for flood control dams because the normal operating condition of the reservoir is empty. Safety deficient flood control dams still offer some flood protection but will likely fail and cause catastrophic consequences during extreme storm events. Where owners are unwilling or unable to upgrade their flood control dams a dilemma exists whether to order the dam breached resulting in flooding or allow the unsafe dam to remain knowing that an extreme storm will fail the dam.

Frequency

According to our Subject Matter Experts with the Office of State Engineer, Dam Safety, the last incident was reported in 2011**.** There have been no injuries reported as the result of dam safety problems.

Probability of Occurrence

To determine 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. This gives the percent chance of the event happening in any given year. Table2.10 identifies the probability that each Preparedness Area experiencing a Dam Failure event annually.

Table 2.10: Probability of Occurrence - Dam Failure

Probability of Occurrence	
Preparedness Area	**Dam Failure**
Preparedness Area 1	2%
Preparedness Area 2	12%
Preparedness Area 3	6%
Preparedness Area 4	7%
Preparedness Area 5	2%
Preparedness Area 6	6%

The Planning Team will continue to monitor the availability of levee data, and will base future probability estimates on updated, more robust data.

Risk Assessment

The rate of failure of a dam is difficult to predict, although sudden failure is certainly a possibility. Preventive measures such as proper maintenance, sound design, and proper construction can limit the probability of a dam failure. In an effort to profile the dam failure hazard for New Mexico and the Preparedness Areas, the Existing Emergency action plans are summarized below. These plans are out of date and do not conform to the template utilized by the Office of the State Engineer. However, they do have inundation zone descriptions if not the maps themselves.

Table 2.11 identifies impacts from Dam Failures in New Mexico for the purposes of EMAP compliance.

Table 2.11: Dam Failure Impacts

Subject	Potential Impacts
Health and Safety of the Public	A large dam failure may wipe out everything and everyone downstream for many miles. Drowning is likely
Health and Safety of Responders	Same as for the public
Continuity of Operations	A dam failure may shut down normal operations and can impact other critical infrastructure which may impact other operations
Delivery of Services	Service delivery may be impossible.

Subject	Potential Impacts
Property, Facilities, Infrastructure	Total loss of the entire built environment is possible depending on the size of the dam and the severity of the failure
Environment	Environmental effects from a dam failure would be similar to those of a flash flood: erosion, downed vegetation, loss of habitat.
Economic Condition	A dam failure may cause severe impacts as residences and businesses may be entirely destroyed. The survivors may not remain in the area to bolster the local economy
Public Confidence	Public confidence would likely be severely impacted. The public expects the government to regulate the safety of dams

Data Limitations

The 2008 Dam Condition Classifications address the lack of data and require a dam to be rated in poor condition when "uncertainties exist as to critical analysis parameters". The lack of inundation maps also impacts the ability to evaluate the consequences of dam failure which is used to define the risk related to dams. All high hazard dams should have an EAP in order to better prepare the dam operators and the downstream public in case there is a breech. Data from the EAPs will contribute to risk reduction.

What Can Be Mitigated?

Potential areas for mitigation activities include identifying tools for evaluating uncertainties in dam data, preparation of EAPs for all high hazard dams and rehabilitation of existing dams. These actions will contribute to dam failure risk reduction.

Drought

Hazard Characteristics

In New Mexico, Drought is a regular event. Experts predict that drought conditions are likely to continue for the foreseeable future. Drought increases the probability and severity of wildfire. Drought also increases the severity of flash flooding due to soils becoming hydrophobic, repelling or incapable of dissolving in water, resulting in increased runoff and erosion. Economically, prolonged drought can have devastating effects on agriculture and food supply.

The State of New Mexico has recorded periods of drought for the past few years. In every drought, agriculture is adversely impacted, especially in non-irrigated areas such as dry land farms and rangelands. Droughts impact individuals (farm owners, tenants, and farm laborers), the agricultural industry, other agriculture related sectors, and other industries such as tourism and recreation. There is increased danger of forest and wildland fires. Loss of forests and trees increases erosion, causing serious damage to aquatic life, irrigation, and power development by heavy silting of streams, reservoirs, and rivers.

Drought is nature's way of reminding us that we live in a desert. New Mexico is entering the ninth year of a drought, which magnifies the challenge of balancing our limited water supplies with growing demand. A drought is caused by a variety of factors. Scientists who study climate changes believe that conditions in the North Atlantic Ocean and the Eastern Pacific Ocean play a significant role in determining the amount of precipitation that New Mexico and the rest of the country receive. Studies show current conditions in those two oceans are similar to conditions that existed during the severe drought of the late 1940s and 1950s in New Mexico.

Drought is a condition of climatic dryness that reduces soil moisture, water or snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Drought conditions are usually not uniform over the entire state. Local and regional differences in weather, soil condition, geology, vegetation, and human influence need to be considered when assessing the impact of drought on any particular location.

The most commonly used drought definitions are based on meteorological, agricultural, hydrological, and socio-economic effects.

- **Meteorological** drought is defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.
- **Agricultural** drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought and can affect livestock and other dry-land agricultural operations.
- **Hydrological** drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow, snow pack, and as lake, reservoir, and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes, and reservoirs. Therefore, hydrological measurements tend to lag behind other drought indicators.

- **Socio-economic** drought occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

Although different types of drought may occur at the same time, they can also occur independently of one another. Drought differs from other natural hazards in three ways. First, the onset and end of a drought are difficult to determine due to the slow accumulation and lingering of effects of an event after its apparent end. Second, the lack of an exact and universally accepted definition adds to the confusion of its existence and severity. Third, in contrast with other natural hazards, the impact of drought is less obvious and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments.

Drought status is calculated using several indices that measure how much precipitation for a given period of time has deviated from historically established norms. The Palmer drought severity index (PDSI) is used by the U.S. Department of Agriculture (USDA) to determine allocations of grant funds for emergency drought assistance (Table 2.12). The Palmer index is based on the supply-and-demand concept of the water balance equation, taking into account more than the precipitation deficit at specific locations. The PDSI provides a measurement of moisture conditions that are "standardized" so that comparisons using the index can be made between locations and months.

Table 2.12 outlines the standardized measurements of moisture conditions for use in determining the severity of drought.

Table 2.12: Palmer Drought Severity Index[12]

Drought Severity	Return Period (years)	Description of Possible Impacts	Drought Monitoring Indices		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	D0	-1.0 to -1.9
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	D1	-2.0 to -2.9
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-1.3 to -1.5	D2	-3.0 to -3.9
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.	-1.6 to -1.9	D3	-4.0 to -4.9
Exceptional Drought	44+	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies.	less than -2	D4	-5.0 or less

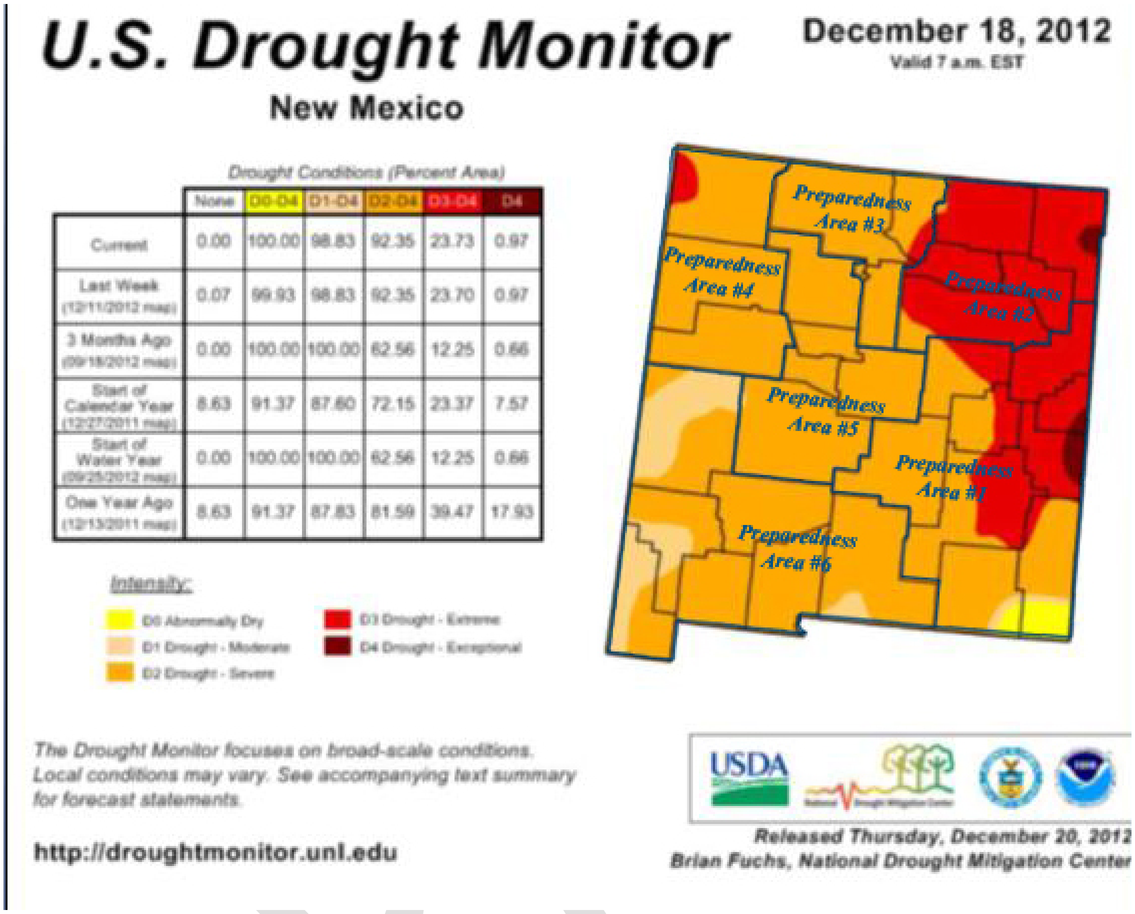
*NDMC - National Drought Mitigation Center

New Mexico precipitation for the first ten months of 2012 was 60 percent of average and ranked as the 6th driest start to any year on record. This makes 2012 the second consecutive year with a very dry start to the calendar year for New Mexico, as 2011 began as the 2nd driest January to October period. The past 24 months have been the second driest 24 month period on record ending in October for New Mexico, just behind the period that ended in October 1956.

Drought in the state of New Mexico ranges from abnormally dry to exceptionally dry, with a majority of the state hovering in a severe to extreme status (Figure 2.13). Given that drought is a slow-moving hazard without an event to mark its arrival, a one-time drought can be difficult to define. However, the consequences of a severe to extreme drought in the state pose significant challenges. Long-term solutions for coping with a limited water supply will require increased cooperation between urban users and agricultural use.

[12] Source: http://www.drought.noaa.gov/

Figure 2.13: US Drought Monitor - New Mexico as of December 18, 2012[13]

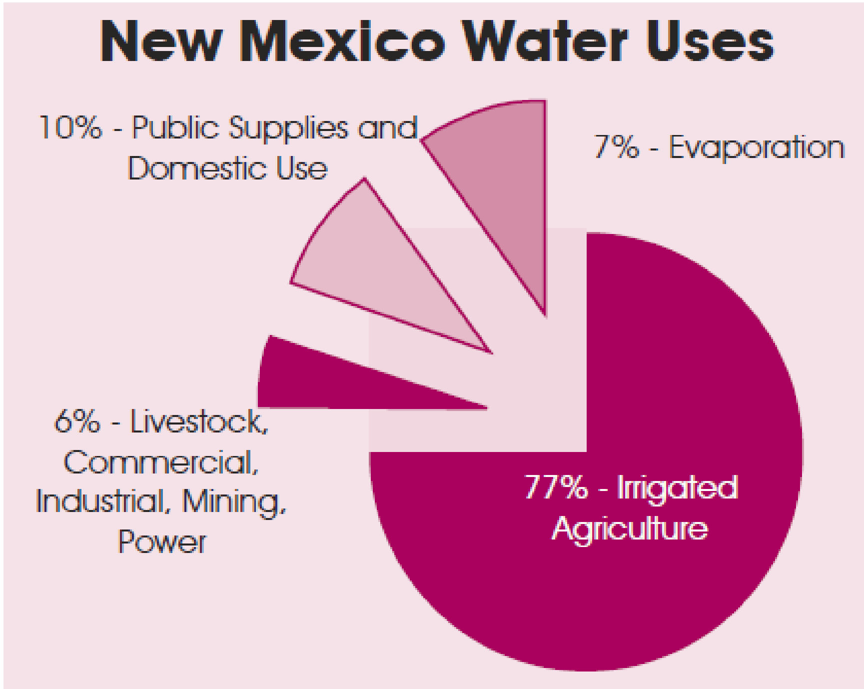


Water Use in New Mexico

Water in New Mexico is distributed among a variety of users, as the following pie chart indicates (Figure 2.14). According to the New Mexico Office of the State Engineer Interstate Stream Commission Annual Report 2009-2011, about 6 percent goes to livestock, commercial, industrial, mining, and power companies; about 10 percent goes to public supplies and domestic use; about 7 percent is lost to evaporation; and about 77 percent goes to irrigated agriculture.

[13] Source: New Mexico Drought Task Force http://www.nmdrought.state.nm.us/

Figure 2.14: New Mexico Water Uses[14]



Precipitation and Reservoir Storage

Yearly precipitation averages for 2012 were generally well below normal for the state, ranging from 70% of normal in the Animas/San Juan River Basin to 36% of normal in the Mimbres River Basin. In December 2012, streamflow conditions were generally at or below normal statewide. The January 1, 2013 forecast numbers from NRCS showed the majority of the State having a significantly lower than normal runoff season. Almost all forecasts expected less than 70% of normal runoff. Some forecasts were expecting less than 50% of normal runoff. As of December 2012, reservoir storage had dropped considerably state wide statewide and was 43% of normal. The demand for water stored in New Mexico reservoirs exceeded supply by a substantial margin. The only way to possibly meet user demands would be a much higher than normal spring runoff from snowpack. Early snow season indications show that even near normal runoff is unlikely. Water users and managers need to be prepared for very low runoff again this year.[15]

Previous Occurrences

According to the New Mexico Drought Plan, the state has experienced droughts since prehistoric times. Extended drought conditions in the region evidently led to the collapse of many early civilizations. Periods of drought since 1950 have been documented during 1950-1957, 1963-1964, 1976-1978, 1989, 1996, 1998-1999, 1999-2003, 2003-2006.

The most recent Drought Executive Order was signed by Governor Martinez on May 11, 2012 (Executive Order 2012-006). This order summarized the drought conditions at that time, and declared a state of emergency statewide due to the drought conditions. The Executive Order further directed the

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[14] Source: http://www.ose.state.nm.us/publications_index.html
[15] Source: New Mexico Basin Report, January 1, 2013, USDA, NRCS

continuation of the New Mexico Drought Task Force and for them to meet once a quarter. It also directed the following:

- Assess the continued severity of the drought and its effects on the various sectors of the state's resources and economy.
- Make recommendations to the Governor for intermediate actions and long-term strategies to mitigate drought conditions and impacts in the state.
- Appoint such working groups as may be necessary and appropriate to examine and recommend solutions regarding the drought conditions to the task force.
- Provide information and guidance to the Governor regarding drought conditions.

The Governor's Drought Task Force is led by the State Engineer's Office and has representation from the following state agencies:

- Agriculture Department
- Economic Development Department
- Energy Minerals and Natural Resources Department
- Environment Department
- Finance and Administration Department
- Finance Authority
- Governor's Office
- Indian Affairs Department
- Interstate Stream Commission
- Homeland Security and Emergency Management
- State Engineer's Office
- Interstate Stream Commission
- Tourism Department

All Preparedness Areas in New Mexico have experienced drought conditions over the last 9 years. The current online NCDC database is limited in past events and only contains data from January 2006 to present, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC currently does not have data on drought losses. Between 1995 and May 2007, there were three state declared disasters for effects related to drought, primarily for loss of domestic drinking water: May 1996, May 2000, and June 2002. The total cost for drought related events for this time period is $279,459. However, indirect costs are estimated to be between $50-100 Million.

Table 2.15 highlights significant past droughts by Preparedness Area.

Table 2.15: Significant Past Occurrences - Drought[16]

Date	Location	Significant Event
May 2010	Colfax and Harding County (Preparedness Area 3)	The US Department of Agriculture designated Colfax and Harding counties as natural disaster areas due to drought and high winds.
Summer 2008	Northern New Mexico (Preparedness Area 2 and 3)	In the summer of 2008, the agriculture community was in a panic as the state was dealing with the endangered silvery minnow. Farmers were faced with a low snowpack that feeds irrigation reservoirs in northern New Mexico and low rainfall with forecasted continuing dry conditions cut irrigation supplies dramatically. Compounding issues more, legal issues were being considered ordering farmers to share the river supply to save the silvery minnow. This impacts financial capabilities in the agricultural community and decreases agricultural supply.

Emergency Management Agency Declared Disasters from Drought

DHSEM reports one State Declared Disaster for drought between 2003 and 2013 which had State reimbursement funds available. This number is based on how many Executive Orders were signed by the Governor drought which resulted in local government or tribal reimbursement. According to DHSEM records, the total cost for the 2006 State declared drought event was $500,000 (Figure 2.16). Research into locations for each disaster would need to be completed prior to breaking-out the figures by Preparedness Area. There were no federal disaster declarations for drought from 2003 through 2012.

Figure 2.16. State Disaster Event Information 2003 through 2012

Event Type	State Executive Order	Dollar Loss*
Drought	06-012	$500,000.00
Total	**1**	**$500,000.00**

[16] Information is provided by the Drought Task Force Report at http://www.nmdrought.state.nm.us/

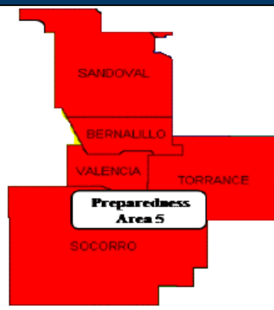
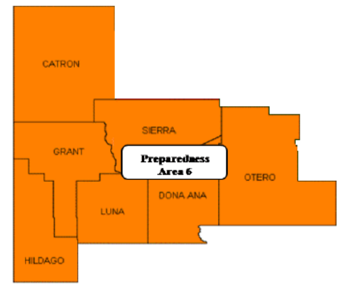
Current Drought Conditions

Each Preparedness Area has experience the effect of the drought. Table 2.17 provides an overview on each Preparedness Area and the condition that exists as of December 2012.

Table 2.17: Current Drought Conditions as of December 2012 for Preparedness Areas 1 - 6[17]

<table>
<tr><th colspan="2">Preparedness Area 1
Counties: Chaves, Curry, De Baca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt</th><th colspan="2">Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel</th></tr>
<tr><td>Abnormally Dry
Moderate
Severe
Extreme
Exceptional</td><td></td><td>Severe
Extreme</td><td></td></tr>
<tr><th colspan="2">Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache</th><th colspan="2">Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation</th></tr>
<tr><td>Moderate
Extreme
Severe</td><td></td><td>Moderate
Extreme
Severe</td><td></td></tr>
</table>

[17] Source: US Drought Monitor (December 25, 2012)

<table>
<tr><th colspan="2">Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia</th><th colspan="2">Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache</th></tr>
<tr><td>Moderate
Extreme</td><td>
</td><td>Moderate
Extreme</td><td>
</td></tr>
</table>

Frequency

Drought is a regular event in all areas of New Mexico that visits the state in recurring cycles. Experts predict that drought conditions are likely to continue for the foreseeable future. Periods of recent extreme meteorological drought, as defined by a Palmer drought index of -4.0 or lower, have been noted in the mid-1930's in the Northeastern Plains and Central Highlands, in 1947 in the Central Highlands, in the 1950's throughout the State, in 1963-64 in the Northern Mountains, in 1964 in the Southeastern Plains, and in 1967 in the Northern Mountains. Drought again started in 2000 and continued till 2004. The longest general drought since 1930 was in the 1950's. New Mexico, and all Preparedness Areas, have and continue to experience drought conditions.[18]

Probability of Occurrence

Drought conditions can create serious problems for many New Mexico communities, farms, ranches, and open spaces. Fire danger is high, water reservoirs run low, and in some cases, some towns have taken dramatic steps to reduce basic water consumption in their residents' homes and businesses. According to State Engineer's Office, 90 percent of New Mexico faced severe drought conditions at some point during the 2012, with the remaining areas facing moderate drought. The 2011 water year was also the second driest on record.[19] The probability for this hazard event is 100%

Risk Assessment

The entire State of New Mexico is currently experience some type of drought situation. Given that drought is a slow-moving hazard without an event to mark its arrival, a one-time drought can be difficult to define. However, the consequences of a moderate to severe drought in the state pose significant challenges. Long-term solutions for coping with a limited water supply will require increased cooperation between urban users and agricultural use. Critical facilities in rural parts of the state may need to increase or diversify their sources of water.

[18] Source: http://nmcc.nmsu.edu/en/climate-new-mexico/
[19] Source: http://www.nmdrought.state.nm.us/conditions.html

A prolonged drought also increases the probability of other hazards. Forests become more susceptible to wildfires and native vegetation dies, leaving exposed soils susceptible to erosion, flash flooding, and dust storms. The Hazard Mitigation Team has identified drought as a priority hazard for each Preparedness Area in the state.

Table 2.18 identifies potential impacts from a drought for the purposes of EMAP compliance.

Table 2.18. Potential Impacts from 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
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
CONTINUITY OF OPERATIONS	Impacts expected for operations that are dependent on water (Hydro power)
DELIVERY of SERVICES	Impacts expected for operations that are dependent on water
PROPERTY, FACILITIES, INFRASTRUCTURE	Potential impacts due to increase in dust and land subsidence
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

Data Limitations

It is difficult to determine when a drought hazard event starts. In most cases, the dry weather conditions that cause droughts will need to persist for a while before it becomes clear that drought conditions exist. There are also data limitations in determining the available quantity and quality of groundwater. The costs associated with the drought are difficult to quantify. Crop losses are straightforward, but losses from tourism dollars due to drought and uncertainty about availability of water are more difficult to define.

What Can Be Mitigated?

Continuous monitoring of the drought situation is ongoing through the Governor's Drought Task Force Monitoring Working Group. The Monitoring Group reports to the Governor's Drought Task Force on a monthly basis. The Drought Task Force will continue the vigilance of determining those best practices for mitigating the drought effects. A January 2013 status report of ongoing and recommended activities to mitigate drought is discussed in the Capabilities Section of this Plan.

Identifying the first phases of the drought and reacting with water conservation at the earliest time will help to mitigate drought later. Mitigation management for drought is a proactive process. The best practices include early assessment, public education, water conservation programs, and diversifying sources of water. However, most of the progress has been at the local and state level since there is no federal water conservation or drought policy.

The long-term future of water is a fundamental concern to all local governments in the state. Water use projections indicate that depletion of regional water resources will continue unless actions are taken to conserve and utilize water more efficiently with the ideal goal of balancing supply with demand.

Earthquakes

Hazard Characteristics

Earthquakes hazards principally arise from ground motions due to seismic waves (elastic waves traveling through the earth). Such ground motions can be generated by explosions, or by other phenomena that apply forces to the surface or interior of the earth. However, earthquakes are most commonly due to rapid slip along a zone of weakness (a fault). This process releases internal stress and converts a small portion (a few percent) of the associated strain energy into seismic waves that can propagate for great distances. Earthquakes occur most frequently near the boundaries between tectonic plates, which segment earth's crust and shallow mantle. However, damaging earthquakes can also occur within plate interiors in regions where strain accumulates, or where the frictional properties of faults are perturbed, due to volcanic, tectonic, or anthropogenic processes (e.g., fluid withdrawal or injection). Although earthquakes in the United States during the past few decades have caused less economic loss annually than other hazards, they have the potential to cause great and sudden losses. Within one to two minutes, an earthquake can devastate a city through ground shaking, surface-fault ruptures, and ground subsidence. Earthquakes furthermore often trigger other devastating hazards, such as landslides, fires, and damage to dams and levees.

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties typically result from falling objects and debris, or from forces that damage or demolish buildings and other structures. Disruption of communications, electrical power supplies, and gas, sewer, and water lines should be expected in a large earthquake. Earthquakes can trigger widespread fires, dam failures, landslides, or releases of hazardous material, compounding their hazards.

The vibration or shaking of the ground during an earthquake is described by the time history of its ground motion (when recorded, this record is called a seismogram). The severity of ground motion generally increases with the amount of energy released and decreases with distance from the earthquake hypocenter (the geographic location and depth of the earthquake source). Earthquakes generate elastic waves, both in earth’s interior (body waves), and along the earth’s surface (surface waves). P (primary) waves in the earth’s interior are physically similar in character to sound waves in air. P waves have a back-and-forth (longitudinal) motion along their direction of travel. They move through the shallow earth at speeds between approximately 1 to 4 km/s (roughly 2000 to 9000 miles/hour). P waves typically produce predominantly vertical forces on buildings. S (secondary) waves, also known as shear waves, have a transverse (side-to-side relative to their propagation direction) motion and travel more slowly (by about a factor of 0.6) than P waves. S waves can cause significantly more damage than P waves because their amplitudes are typically larger and their shear motion produces horizontal forces, which structures are typically much less able to sustain without damage. Surface waves generate both shear and vertical forces, and can be highly damaging in areas where development has occurred in low-seismic velocity basins (the extensive damage to Mexico City in 1985 is a type example of this).

Earthquakes are commonly described in terms of magnitude and intensity. Magnitude is a fixed property of the earthquake source estimated from seismograms, and is proportional to the logarithm of the total energy released (an increase of one in earthquake magnitude indicates an approximately 32-fold increase in energy). Intensity, in contrast, varies spatially and with local geology, and describes the strength of ground motion at specific locations. Thus, a large, distant earthquake can generate the same intensity at a given site than a much smaller, local earthquake.

There are several generally consistent magnitude scales in use by the scientific and hazard community, based on different observable characteristics of seismic waves. The oft-noted Richter Scale is the original magnitude scale, but it is technically applicable only to southern California and is scientifically obsolete. The three extensively quoted scales are the body wave magnitude, m_b the surface wave magnitude, M_s, and the moment magnitude, m_w. Body and surface wave magnitudes vary because they are based on the amplitudes of observed body and surface waves, respectively. These components of the seismic wavefield can vary in relative size for a given earthquake (for example, earthquakes with shallower hypocenters generally produce corresponding larger surface waves than those with deeper hypocenters). The moment magnitude is based on the fundamental forces produced by the earthquake fault motion, and is coming into increasing use as the de facto measure of earthquake size. All three magnitudes usually agree to within 0.5 of a magnitude unit, with larger departures only commonly occurring for very large earthquakes (magnitudes in excess of 7.5).

The commonly used Modified Mercalli Intensity (MMI) Scale is expressed in Roman numerals. It is based on the amount of shaking and specific kinds of damage to man-made objects or structures. This scale has twelve classes and ranges from I (not felt) to XII (total destruction). A quantitative method of expressing an earthquake's severity is to compare its acceleration history (commonly the peak acceleration) to the normal acceleration due to gravity (g=9.8 meters per second squared, or 980 cm/sec/sec). Peak ground acceleration (PGA) measures the rate of change of motion relative to the rate of acceleration due to gravity and is proportional to the forces exerted on a structure. For example, an acceleration of the ground surface of 244 cm/sec/sec equals a PGA of 25.0 percent. A higher PGA means a higher level of ground acceleration and a higher probability of structural damage. Ordinary structures typically begin to be damaged structurally at about 10% PGA. Table 2.19 illustrates the comparison for scales of magnitude and intensity.

Table 2.19: Different Magnitudes of Earthquakes[20]

PGA (% g)	Magnitude (Richter	Intensity (MMI)	Description
<0.17	1.0 – 3.0	I	I. Not felt except by a very few under especially favorably 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 motorcars 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 motorcars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

[20] Source: http://pubs.usgs.gov/fs/fs030-01/

PGA (% g)	Magnitude (Richter	Intensity (MMI)	Description
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. Damaged negligible in buildings of good design and construction; slight to moderate in well-build ordinary structures; considerable damage in poorly build or badly designed structures; chimneys broken.
34 – 124	6.0 – 6.9	VIII – 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 and 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	X or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed and 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 in the air.

Historic and Prehistoric Earthquakes in New Mexico

The Rio Grande rift is a major tectonic feature of western North America (Wilson et al., 2005), and is expressed on the surface of the earth as a series of elongate north-south trending basins that run from central Colorado, through the central parts of New Mexico, into northern Mexico where it blends with the greater Basin and Range Province. Because the rift guides the path of the Rio Grande in New Mexico, it is the most highly populous sector of the state. Much of New Mexico's historical seismicity has been concentrated in the Rio Grande Valley between Socorro and Albuquerque, with about half of the earthquakes of intensity VI or greater (MMI) that occurred in the state between 1868 and 1973 being centered in this region. Los Alamos lies near several major boundary faults of the Rio Grande rift in north-central New Mexico. The margin of the Rio Grande rift in the Los Alamos area is locally defined by the Rio Grande rift-related Pajarito fault system.

Historic earthquakes in the southwestern U.S. and northern Mexico region include a magnitude ~7.2 earthquake in northern Mexico in 1887 (which is perhaps a good analogue for a large Rio Grande rift earthquake in New Mexico), numerous magnitude 4 to 6 earthquakes in the Socorro areas throughout the 20th century (most notably two earthquakes near magnitude 6 in 1906), and magnitude 4 to 5+ events in Cerrillos and Dulce in 1918 and 1966, respectively. The net earthquake threat to the state is considered moderate in a national perspective. There have been at least eight earthquakes felt by the residents of Los Alamos since its creation during World War II. The largest of these registered a magnitude 4 that occurred in 1952 and a magnitude 3.3 in 1971; both earthquakes had reported MMIs of V in Los Alamos. More recently, Los Alamos experienced very small magnitude (<2) earthquakes (1991 and 1998) that produced unusually high MMIs (up to V). Recent paleoseismic studies on the Pajarito fault systems indicated that a large earthquake of approximately magnitude 7 occurred in recent prehistoric times. An October 17, 2011 magnitude 3.8 earthquake generated MMI levels of III-IV in the Espanola Basin/Pojaoque/Santa Fe region.

Thousands of recorded earthquakes have been recorded in New Mexico and analyzed in recent decades by New Mexico Tech and/or the U.S. Geological Survey. Figure 39 depicts the approximate epicenters for past earthquakes in New Mexico and surrounding areas between 1962 and 2012. The Socorro area has been the most active earthquake region of the state during at least the past 150 years. During the past 45 years, approximately 50% of the seismic energy generated by earthquakes in New Mexico has been released in a region centered near Socorro, encompassing only about 2% of the state's total land area. This relatively high rate of earthquake activity in the Socorro region is due to a slowly inflating (~2 mm/year) sill of molten rock (magma) that is roughly 1300 square miles in area and sits approximately 12 miles beneath the surface of the fault-bounded Rio Grande rift.

Some small earthquakes in New Mexico have also been triggered by human activity. Earthquake-like ground shaking is created by atomic bomb testing, including the explosion of the first atomic bomb at the Trinity Site in 1945 and subsequent underground explosions near Carlsbad in 1961 and east of Farmington in 1967. Many earthquakes in southeastern New Mexico may be related to oil and gas production and fluid reinjection. Earthquakes near Raton, NM and Trinidad, CO, show correlations with water injection associated with natural gas production, and a series of earthquakes recorded near the Heron and El Vado reservoirs in northern New Mexico may have been caused by the weight of the water in the reservoirs.

Figure 2.20 shows the identified fault lines located in the state of New Mexico.[21] Faults and associated folds are included that are believed to be the source of earthquakes with a magnitude greater than 6 during the Quaternary Period (the past 1,600,000 years).[22]

[21] Source: http://earthquake.usgs.gov/regional/qfaults/nm/
[22] Maps of each geologic structure: http://earthquake.usgs.gov/hazards/qfaults/

Figure 2.20: Preparedness Areas and Fault Lines in New Mexico

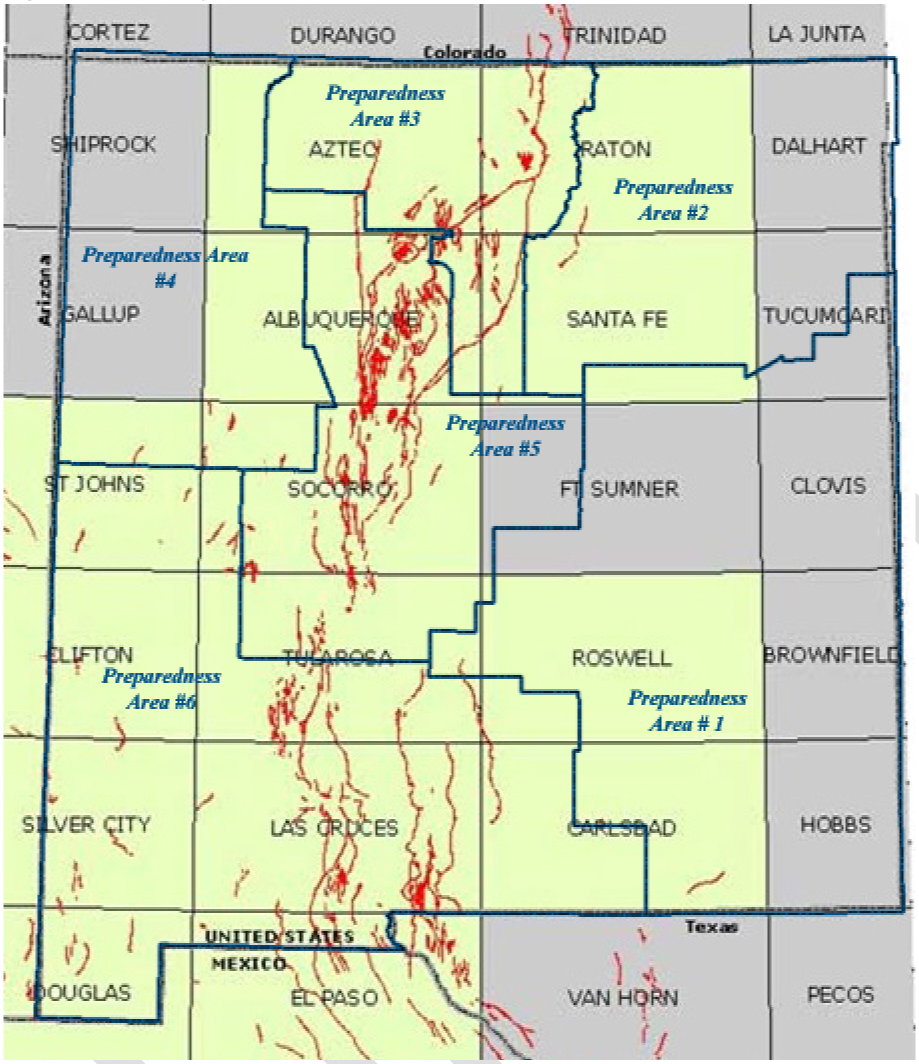
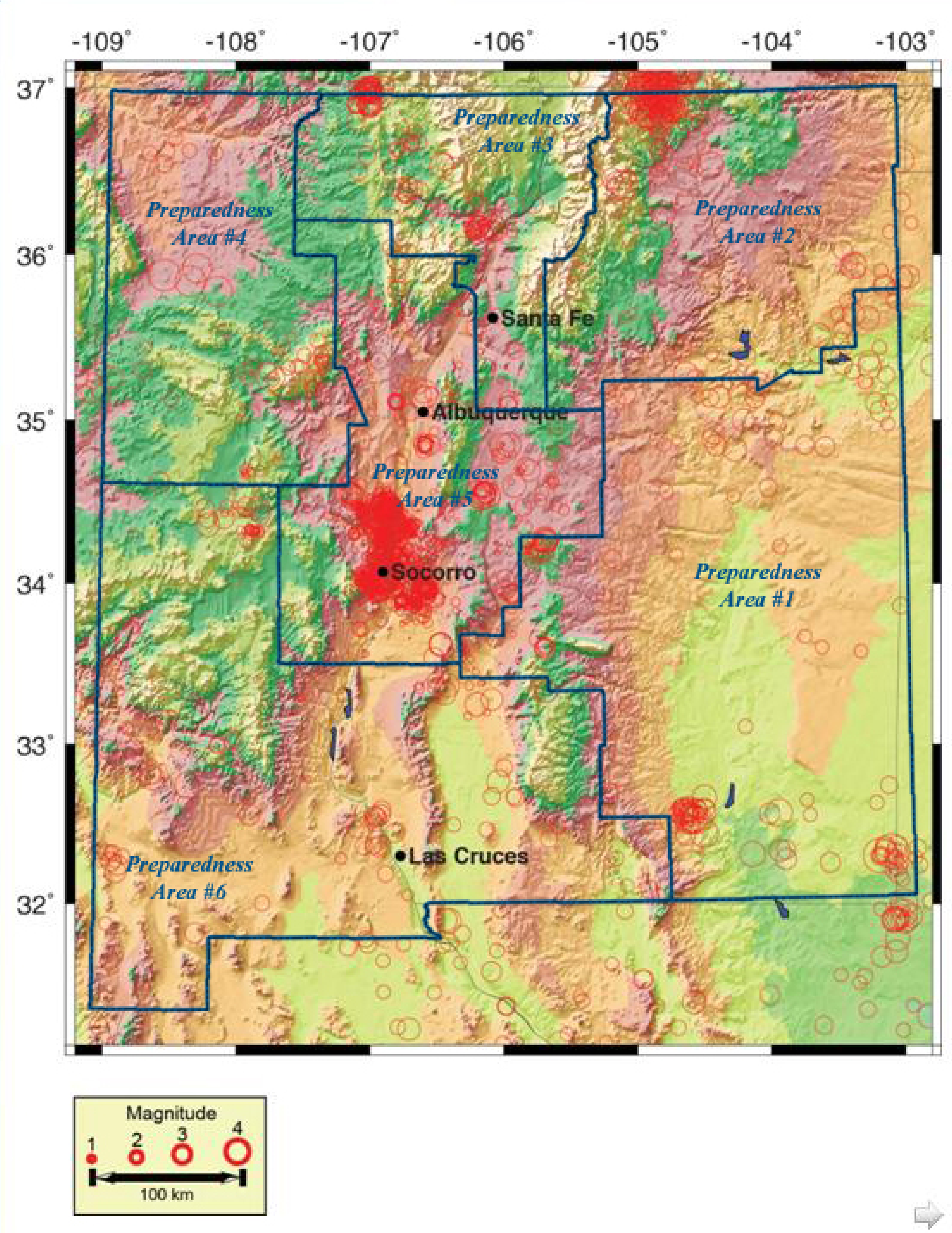


Figure2.21 illustrates the earthquake hazard areas in the state of New Mexico. There has been a clustering of earthquake activity around the cities of Socorro and Albuquerque (both located in Preparedness Area 5). Additionally, significant amounts of high-magnitude seismic activity has been recorder in the northeast area of the state in Preparedness Areas 2 and 3.

Figure 2.21: Earthquakes in New Mexico, 1962 - 2012[23]



[23] Aster, R., Bilek, S., Stankova, J., Morton, E., Earthquakes in the central Rio Grande rift and the Socorro magma body, *Proc. Volcanism in the American Southwest,* USGS Open File Report, Flagstaff, AZ, 2012.

The historic area of seismicity includes most of New Mexico's major population and transportation centers. The record of damaging earthquakes in the state does not support extreme earthquake mitigation measures, as are common in states like California or national like Japan. However, the lack of serious earthquake damage in the past should not be interpreted as evidence that such damage will not occur in the future.

Previous Occurrences

During October 1, 2010 – September 30, 2011, the New Mexico Bureau of Geology and Mineral Resources and Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology conducted a seismic and geophysical study focused on earthquakes located in or immediately adjacent to New Mexico, the majority of these events were distributed among three main regions: the northeast border of NM near Raton, NM (Preparedness Area 2); the Dagger Draw area in the Delaware Basin, Eddy County (Preparedness Area 1); and the Socorro Magma Body region (Preparedness Area 5). All of these regions are long-standing locations of prolonged seismicity. Events in the Raton area (Preparedness Area 2) are part of a continuing swarm that began in 2001, and that, to date, has culminated in a 5.3 earthquake near Trinidad, CO (North of Raton) on August 22nd of this year. The Dagger Draw area in the Delaware Basin in Eddy County (Preparedness Area 1) area has produced 13 Md > 3.0 (duration magnitude) earthquakes since 2002, and the Socorro Magma Body region has produced continuing activity since at least the mid-19th century, including earthquakes as large as an estimated magnitude 6 in 1906. The largest events in these regions are the following: Md 3.7 in Raton region south of the Colorado border (Preparedness Area 2); Md 2.3 near Dagger Draw (Preparedness Area 1); and Md 2.3 in the Socorro magma body region (Preparedness Area 5).

The City of Socorro (Preparedness Area 5) is the earthquake capital of New Mexico. A 5,000 km^2 (1,931 mi^2) area, less than 2% of New Mexico, surrounding the town has produced nearly 50% of the 30 natural earthquakes of magnitude 4.5 or greater in the state since 1869. Three of these shocks occurred during a very strong swarm from 2 July 1906 through early 1907 and were the strongest within the state from 1869 through 2012. Information on these shocks comes from newspaper accounts and notably from a published paper by the noted seismologist H. F. Reid. His paper on the 1906–1907 swarm in the first issue of the Bulletin of the Seismological Society of America and presents Rossi-Forel earthquake intensity observations out to distances of several hundred kilometers for the three strong earthquakes of the swarm.[24]

Earthquake swarms, defined as a series of earthquakes recurring for days in nearly the same location within minutes of each other, are very common in this region. Historical accounts of these swarms date back to the 1860s, and they have been recorded on local seismic instruments since the early 1960s. The majority of the earthquakes in these swarms are shallow (3-8 miles beneath the surface), and relatively small (M < 1.0). These small earthquakes are not damaging; however, based on historic seismicity and geologic evidence, there is a chance for a larger, possibly damaging event in the future (Wong, 2009). According to the US Geological Survey, there is an 18% chance of a large earthquake (M > 6.0) in the Socorro region in the next 100 years.

Twelve strong felt earthquakes with estimated magnitudes of 4.5 or greater occurred in the Socorro area (Preparedness Area 5) from 1869 through 1961. Unlike the instrumental data from 1962 through

[24] Source: Reid, H.G. Remarkable earthquakes in central New Mexico in 1906 and 1907, Bulletin of the Seismological Society of America, 1, 10-16, 1911.

2004, nearly all of these strong shocks appear to have had epicenters near Socorro rather than north of San Acacia (Preparedness Area 5). Also the statistics for earthquakes with magnitudes of 4.5 or greater from 1869 to the present indicated the Socorro-area seismic activity before the 1930s was significantly higher primarily because of prolonged earthquake swam that commenced in July 1906 a few months following the San Francisco earthquake in April of that year. Earthquakes were felt as early as July 2, 1906 and continued almost on a daily basis well into 1907. Three shocks in the swarm had magnitudes of 5.5 to 5.9, strong enough to significantly damage some adobe and masonry structures. The most unusual characteristic noted of the swarm was the exceptionally large number of felt earthquakes over a six-month period. It is suspected that weak shocks probably related to the swarm continuing into 1909.

The largest earthquakes of record in this region occurred during an ongoing earthquake swarm in 1906, and the magnitudes of the two largest events were approximately 5.8. For comparison, the largest felt and heard event from the most recent swarm in this region (August 2009) was M 2.6. This earthquake increased the property damage already sustained at Socorro from previous earthquakes. Four rebuilt chimneys were shaken off the Socorro County Courthouse, and two others were cracked severely. Plaster fell at the courthouse, and a cornice on the northwest corner of the two-story adobe Masonic Temple was thrown onto its first floor. Several bricks fell from the front gable on one house. Plaster was shaken from walls in Santa Fe, about 200 kilometers from the epicenter. Felt over most of New Mexico and in parts of Arizona and Texas.[25]

Table 2.22 lists the locations and dates of the 31 strongest earthquakes that have occurred in New Mexico since the turn of the century. The have been no earthquakes reported in the State larger than 4.5 since 2005.

Table 2.22: Strongest Earthquakes 4.5 and Greater in New Mexico (1869 - 2012)[26]

Date	Time			Approx Location		MMI	Moment Magnitude	Nearby City
	Hr	Min	Sec	Lat.	Long.			
1869	-	-	-	34.1	106.9	VII	5.2	Socorro
7-Sept-1893	-	-	-	34.7	106.6	VII	5.2	Belen
31-Oct-1895	12	-	-	34.1	106.9	VI	4.5	Socorro
1897	-	-	-	34.1	106.9	VI	4.5	Socorro
10-Sep-1904	-	-	-	34.1	106.9	VI	4.5	Socorro
2-Jul-1906	10	15	-	34.1	106.9	VI	4.5	Socorro
12-Jul-1906	12	15	-	34.1	106.9	VII to	5.5	Socorro
16-Jul-1906	19		-	34.1	106.9	VII	5.8	Socorro
15-Nov-1906	2	15	-	34.1	106.9	VII	5.8	Socorro
19-Dec-1906	12		-	34.1	106.9	VI	4.5	Socorro
28-May-1918	11	30	-	35.5	106.1	VII to	5.5	Cerrillos
5-Feb-1931	4	48	-	35	106.5	VI	4.5	Albuquerque
21-Feb-1935	1	25	-	34.5	106.8	VI	4.5	Bernardo
22-Dec-1935	1	56	-	34.7	106.8	VI	4.5	Belen
17-Sep-1938	17	20	-	33.3	108.5	VI	4.5	Glenwood

25 Source: http://earthquake.usgs.gov/regional/states/events/1906_11_15.php; Reid, 1911
26 Source: Sanford et al., Earthquake Catalogs for New Mexico and Bordering Areas: 1869-1998 http://earthquake.usgs.gov/earthquakes/eqarchives/epic

Date	Time			Approx Location		MMI	Moment Magnitude	Nearby City
	Hr	Min	Sec	Lat.	Long.			
20-Sep-1938	5	39	-	33.3	108.5	VI	4.5	Glenwood
29-Sep-1938	23	35	-	33.3	108.5	VI	4.5	Glenwood
2-Nov-1938	16	0	-	33.3	108.5	VI	4.5	Glenwood
20-Jan-1939	12	17	-	33.3	108.5	VI	4.5	Glenwood
4-Jun-1939	1	19	-	33.3	108.5	VI	4.5	Glenwood
6-Nov-1947	16	50	-	35	106.4	VI	4.5	Albuquerque
23-May-1949	7	22	-	34.6	105.2	VI	4.5	Vaughn
3-Aug-1955	6	39	42	37	107.3	VI	4.5	Dulce
23-Jul-1960	14	16	-	34.4	106.9	VI	4.5	Bernardo
3-Jul-1961	7	6	-	34.2	106.9	VI	4.5	Socorro
23-Jan-1966	1	56	39	37.02	107	VI	4.8	Dulce
5-Jan-1976	6	23	29	35.9	108.5	VI	4.7	Gallup
29-Nov-1989	6	54	39	34.5	106.9	VI	4.7	Bernardo
29-Jan-1990	13	16	11	34.5	106.9	VI	4.6	Bernardo
2-Jan-1992	11	45	35	32.3	103.2	VI	5	Eunice
10-Aug-2005	4	8	17	36.96	104.8	IV	5	Raton

Figure 2.23 below identifies the number of 4.5 or greater magnitude earthquakes for each Preparedness Area.

Preparedness Area	Number of 4.5+ magnitude earthquakes 1869 to present
1	2
2	1
3	3
4	1
5	18
6	6
Totals	31

Below, Table 2.24 outlines earthquakes where additional information was available regarding damage reports or unique conditions. Source information is from the NCDC and data provided by local authorities.

Table 2.24: Significant Past Occurrence - Earthquake 1918 – 2010

Date	Location	Significant Event
September 1, 2009	Socorro, NM (Socorro County) Preparedness Area 5	Earthquake Swarm Seismicity within the Socorro region has been very active in recent days. A felt earthquake of magnitude (ML) 2.3 occurred approximately 3 km NE of Socorro near Escondida. Small events continued to occur during this time with activity beginning near the Lemitar area on August 24, 2009. These events have been numerous and fairly shallow depth of 5.5-6 km. The largest event was ML=2.5 on August 29, 2009 at 18:31:01 MDT (August 30, 2009 at 01:31:01 UTC) and was felt by many residents of Lemitar and Socorro. We have preliminary locations on the largest 53 events (ML range of 0.5 to 2.5); however, over 400 smaller events have also occurred since August 19, 2009. The locations of 53 of the largest earthquakes are very similar, suggesting that this is an earthquake swarm. Earthquake swarms are usually caused in response to tectonic or hydrological pressure changes in the crust. Minor felt earthquakes in this region are not uncommon, and have been documented by Dr. Allan Sanford in the past (figure below, blue squares). However, this was a swarm with unusually frequent, large earthquakes (14 earthquakes with ML > 1.4). For a size comparison, felt reports were noted for 4 events with ML 1.9 and greater.
September 12, 2007	Reserve, NM (Catron, County) Preparedness Area 6	A minor felt earthquake (3.5 USGS) occurred on September 8, 2007 at 1:15:40 am MDT (07:15:40 UTC). The event was located approximately 6 miles (10 km) west-southwest of Reserve, the Catron County seat. The Sherriff's Department in Reserve logged felt reports as far away as Luna (20 miles N) and Apache Creek (15 miles east), as well as reports from the Catron County jail. The event was part of a small swarm that lasted several hours. This is an unusual location, historically, for a felt earthquake, although a swarm of felt earthquakes estimated to be as large as 4.5 occurred in the Glenwood Springs, NM region in 1938-1939.
January 23, 1966	Dulce, NM (Rio Arriba County) Preparedness Area 3	A magnitude 5.5 earthquake centered near Dulce (Rio Arriba County) affected about 39,000 square kilometers of northwestern New Mexico and southwestern Colorado. Nearly every building in Dulce was damaged to some degree; many buildings had exterior and interior damage and considerable chimney damage was noted. The principal property damage was sustained at the Bureau of Indian Affairs School and Dormitory Complex and at the Dulce Independent Schools. Rock falls and landslides occurred along Highway 17, about 15 to 25 km west of Dulce; in addition, some minor cracks appeared in the highway. Minor damage was also reported at Lumberton, New Mexico, and Edith, Colorado.

Date	Location	Significant Event
November 3, 1954	Albuquerque, NM (Bernalillo County) Preparedness Area 5	Plaster cracks, broken windows, and cracked fireplaces have been reported from past earthquakes. Minor structural damage occurred to a bank in Albuquerque from an intensity V earthquake. Barns have collapsed and rooftop air-conditioners shaken loose.
May 28, 1918	Village of Cerrillos (Santa Fe, County) Preparedness Area 3	An earthquake with strong local effects in Santa Fe County, where people in the village of Cerrillos were thrown off their feet and fallen plaster was reported (intensity VII - VIII).
November 15, 1906	Socorro, NM (Socorro County) Preparedness Area 5 Santa Fe, NM (Santa Fe, County) Preparedness Area 3	The largest historic earthquake in New Mexico: **(**Mercalli Intensity: VII): This earthquake, which was the culmination of a sustained earthquake swarm between 1904 through 1907, increased the property damage already sustained at Socorro from previous earthquakes. Four rebuilt chimneys were shaken off the Socorro County Courthouse, and two others were cracked severely. Plaster fell at the courthouse, and a cornice on the northwest corner of the two-story adobe Masonic Temple was thrown onto its first floor. Several bricks fell from the front gable on one house. Plaster was shaken from walls in Santa Fe about 200 kilometers from the epicenter. Felt over most of New Mexico and in parts of Arizona and Texas.[27]

Frequency

Based on state-wide date related to past seismic event, the frequency of magnitude 4.5 or larger earthquakes in the State of New Mexico has been determined as low to medium. Historically, based on available data related to previous earthquake events in New Mexico, every year there is a .22 chance of a 4.5+ earthquake occurring in New Mexico.

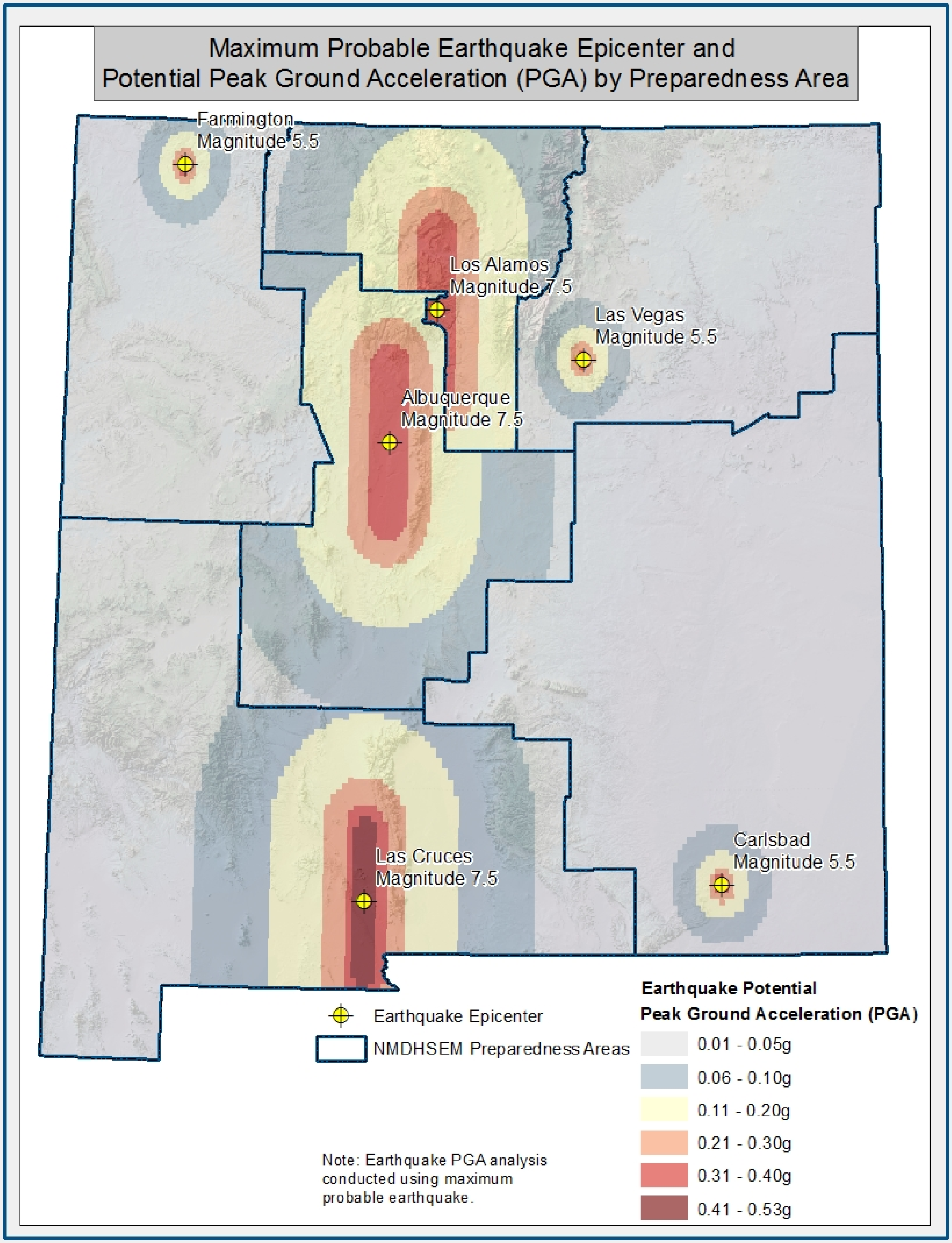
Probability of Occurrence

Significant earthquakes with epicenters in the State of New Mexico have not been detected in recent history, but the area has numerous faults with the potential for a large magnitude earthquake. The potential for such a disaster is low. The greatest threat is along the Rio Grande Rift and the Jemez Lineament that runs North-east to South-west near Los Alamos.

Figure 2.25 provides a visual representation of the maximum probable earthquake epicenter and potential peak ground acceleration (PGA) values across the state. At the end of this section six similar maps (Figures 2.25-2.32) are included that show earthquake epicenter and PGA probabilities at the individual Preparedness Area scale.

[27] Source: http://earthquake.usgs.gov/regional/states/events/1906_11_15.php; Reid, 1911

Figure 2.25. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration



Risk Assessment

Significant earthquakes with epicenters in the State of New Mexico have not been detected in recent history. However, the state contains numerous faults with potential for large magnitude earthquakes. The potential for such a disaster is low. The greatest threat is along the Rio Grande Rift and the Jemez Lineament that runs North-east to South-west near Los Alamos. According to Arup Maji (Professor Civil and Structural Engineering, University of New Mexico) the likely consequence to New Mexico is partial collapse of unreinforced masonry and old adobe buildings. Roads and bridges are unlikely to suffer damage that would render them unusable.

According to Rick Aster (Chair of the Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology), if a major basin and range earthquake similar to the 1887 Sonoran Earthquake were to occur in New Mexico, the state would suffer high levels of damage, with general losses ranging from 10s to 100s of millions of dollars depending on the location of the event. Furthermore, the area most subject to seismic activity, based on historic occurrence, is the Socorro-to-Albuquerque segment of the Rio Grande valley. This area is densely populated and rapidly developing. Present building codes require construction of certain occupancies (schools, hospitals, public buildings) to high earthquake resistance standards, although seismic mitigating construction is not required for residential buildings.

DHSEM was able to contract with the Earth Data Analysis Center of University of New Mexico to conduct HAZUS modeling in each of the six Preparedness Areas. HAZUS runs were done for each Preparedness Area based on the highest magnitude most probable earthquake. Based on input from Subject Matter Experts Dave Love (Principal Senior Environmental Geologist, New Mexico Institute of Mining and Technology) and Richard Aster, the following maximum probable magnitude earthquakes were modeled for each Preparedness Area.

Figure 2.26. HAZUS Model Maximum Probable Magnitude for each Preparedness Area

Preparedness Area	Location	Maximum Probable Magnitude
1	Carlsbad	5.5
2	Las Vegas	5.5
3	Los Alamos	7.5
4	Farmington	5.5
5	Albuquerque	7.5
6	Las Cruces	7.5

The following six maps depict the maximum probable earthquake epicenter and peak ground acceleration (PGA) calculations for each Preparedness Area. PGA quantifies what is experienced by a particle on the ground during the event of an earthquake. It is recorded by taking the largest increase in velocity recorded by a particular seismic station during an earthquake.

Figure 2.27. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration, Preparedness Area 1

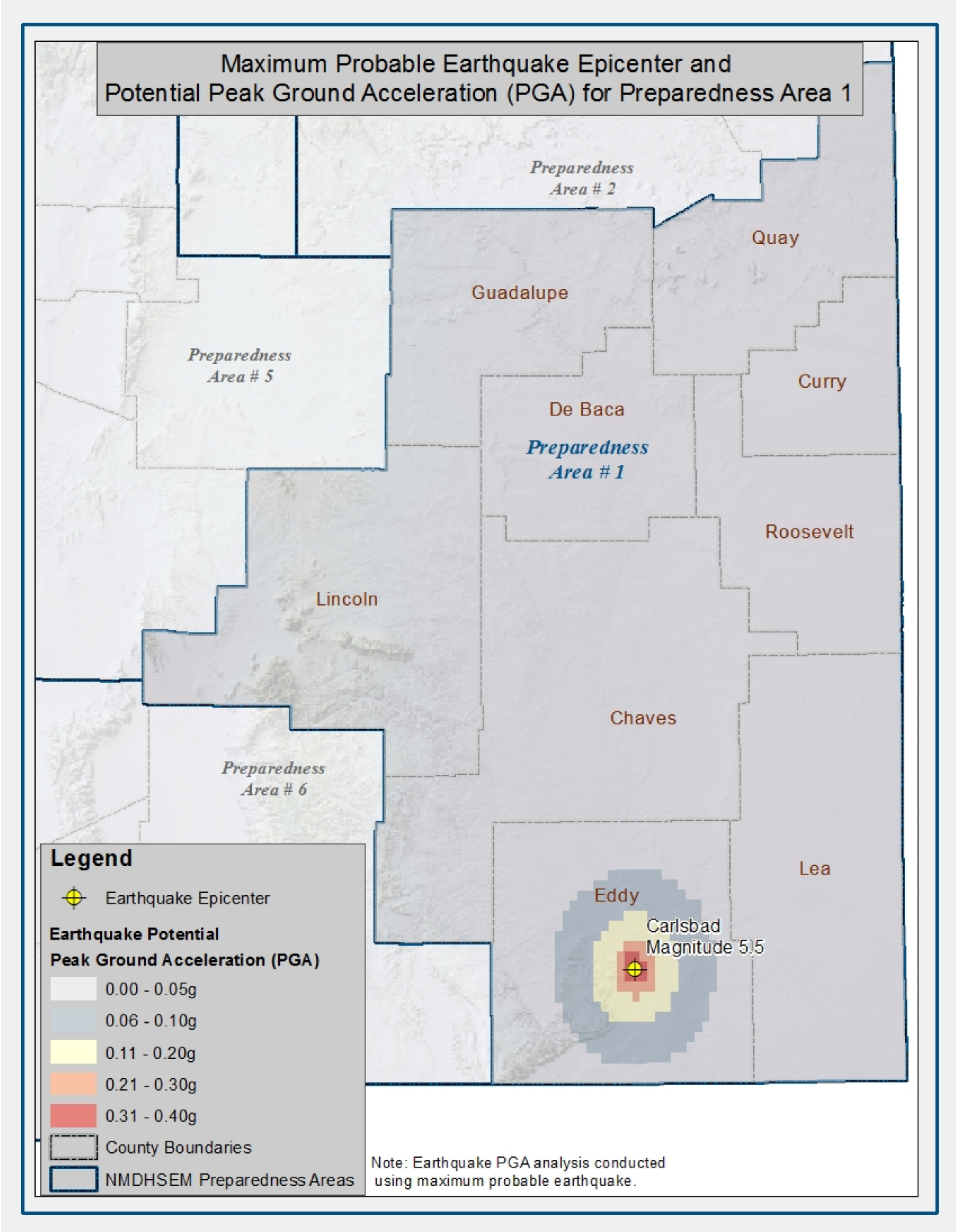


Figure 2.28. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration, Preparedness Area 2

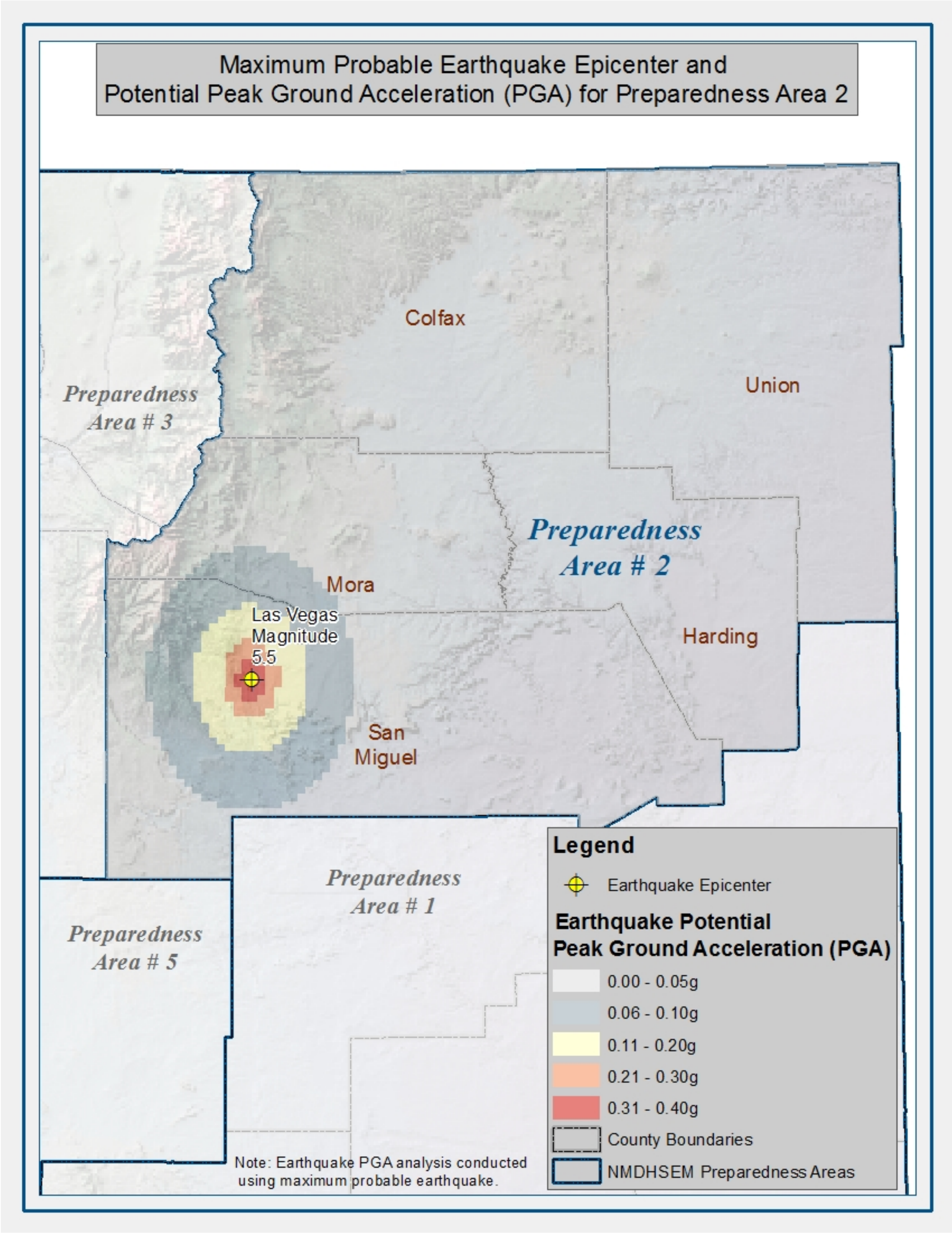


Figure 2.29. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration, Preparedness Area 3

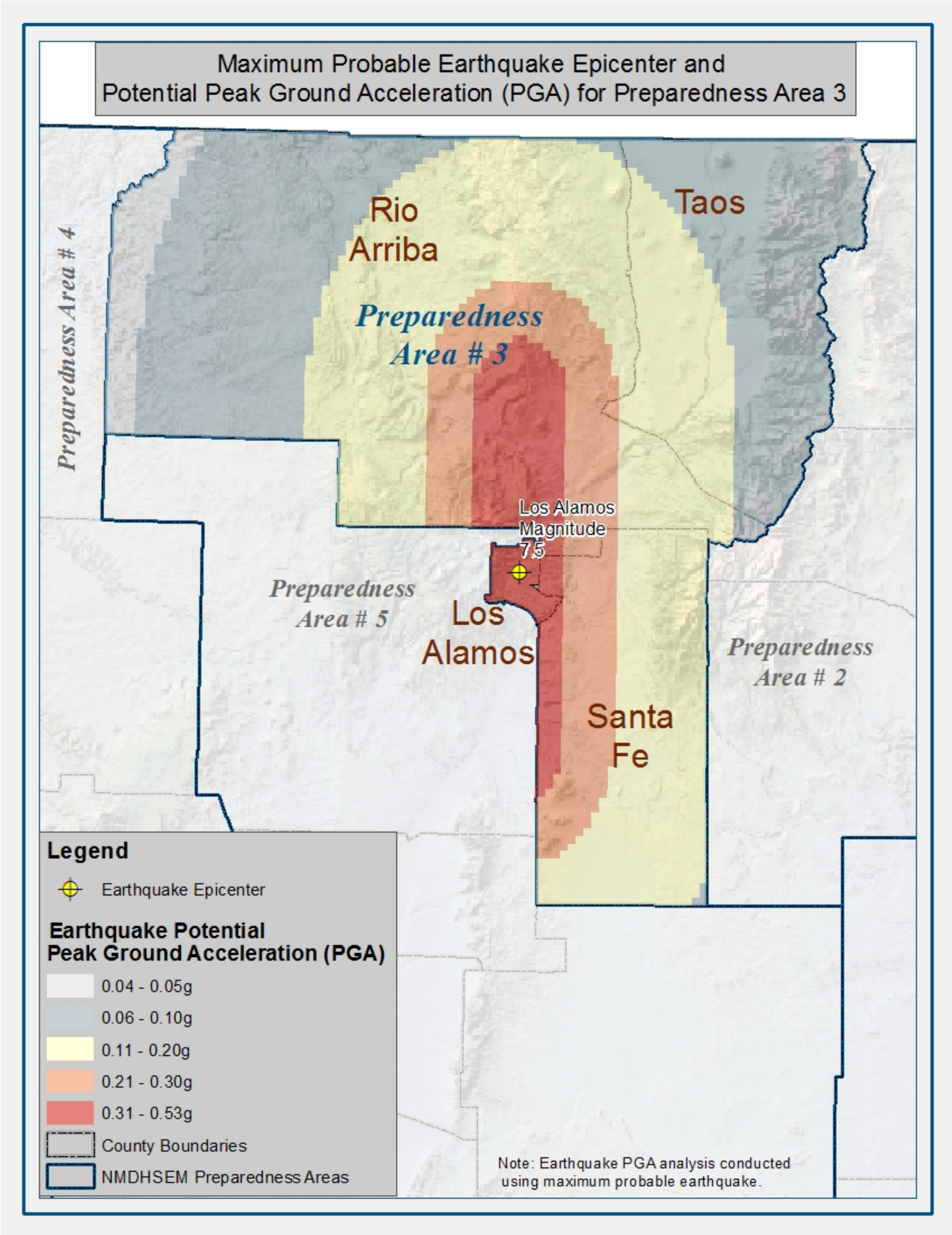


Figure 2.30. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration, Preparedness Area 4

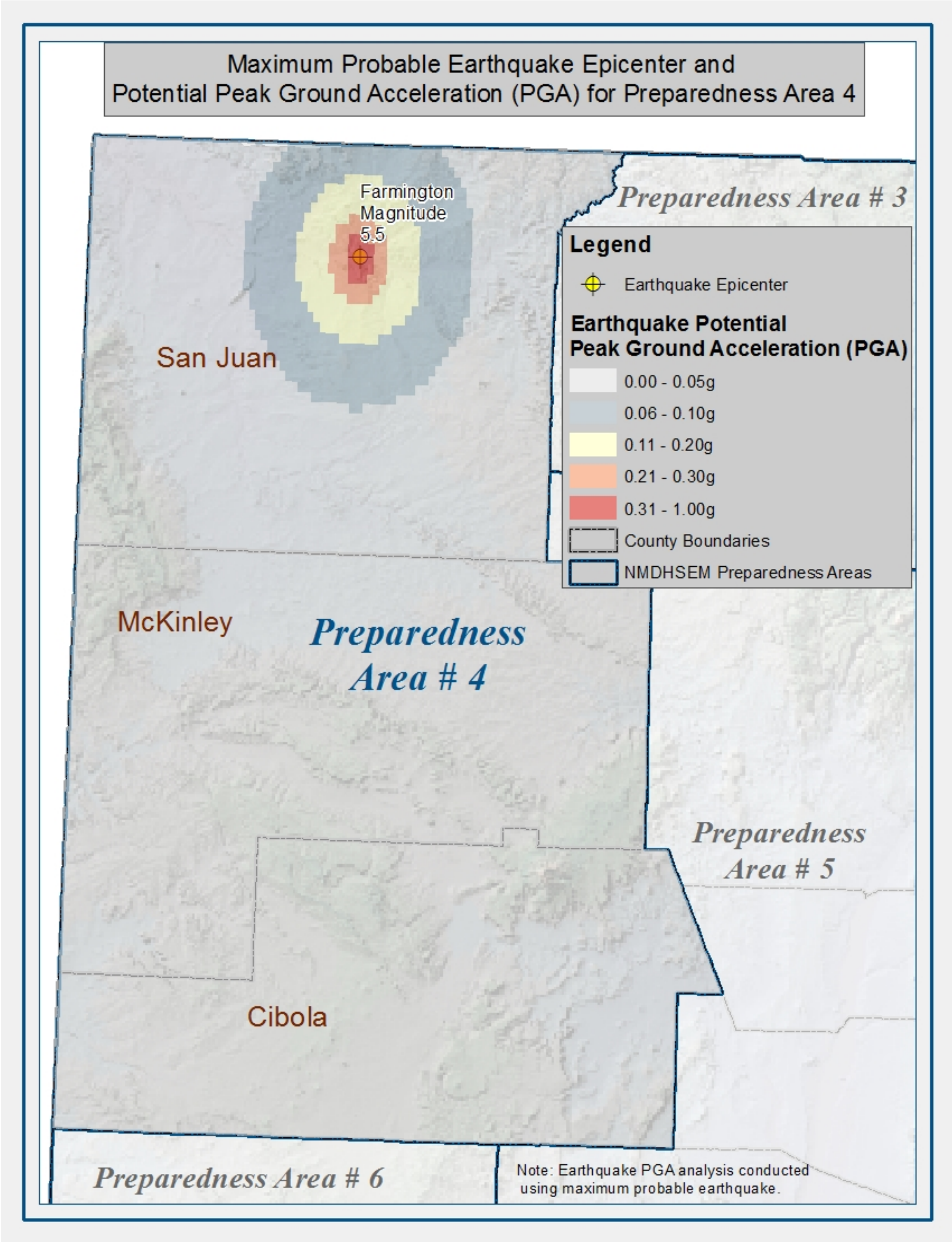


Figure 2.31. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration, Preparedness Area 5

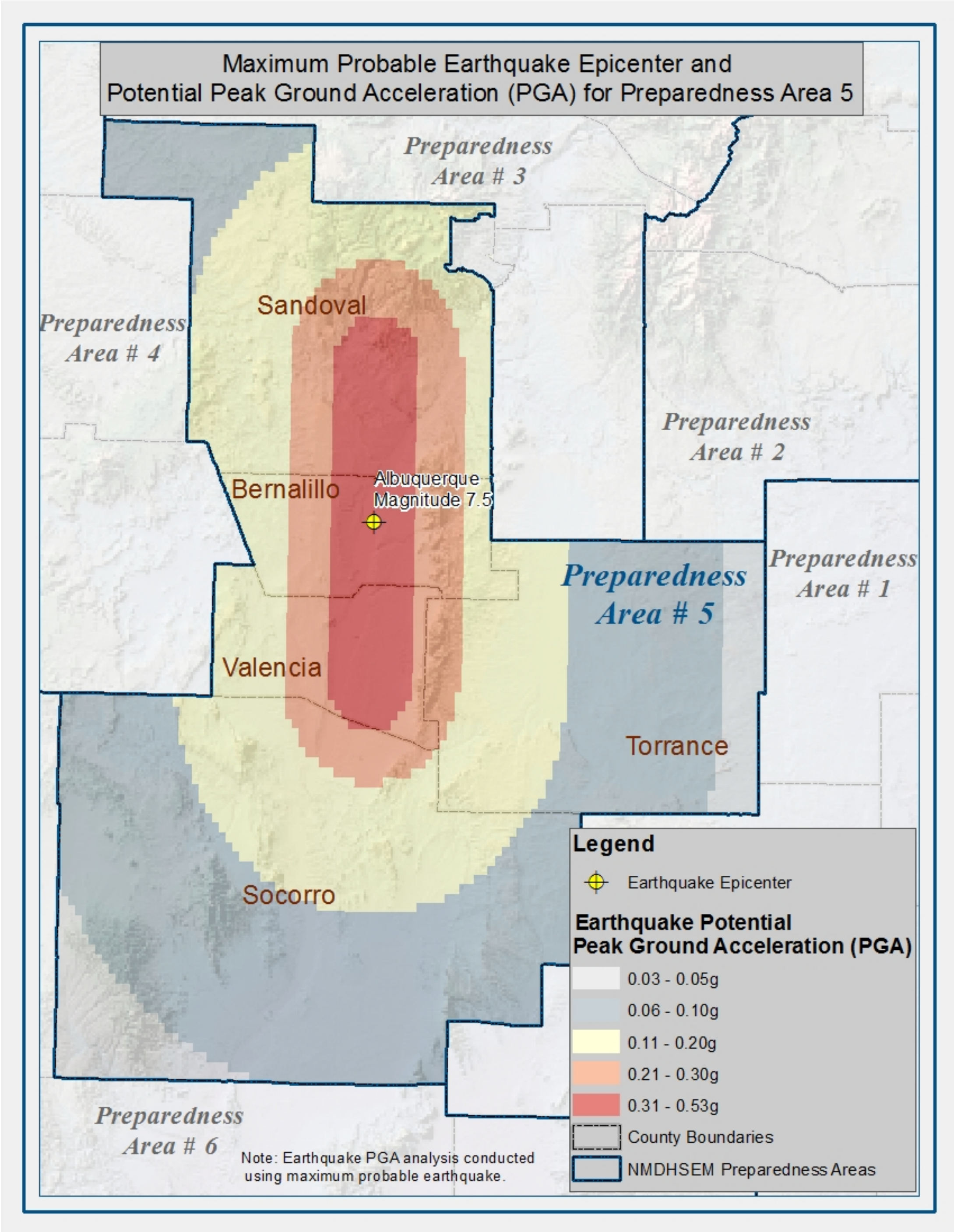


Figure 2.32. Maximum Probable Earthquake Epicenter and Potential Peak Ground Acceleration, Preparedness Area 6

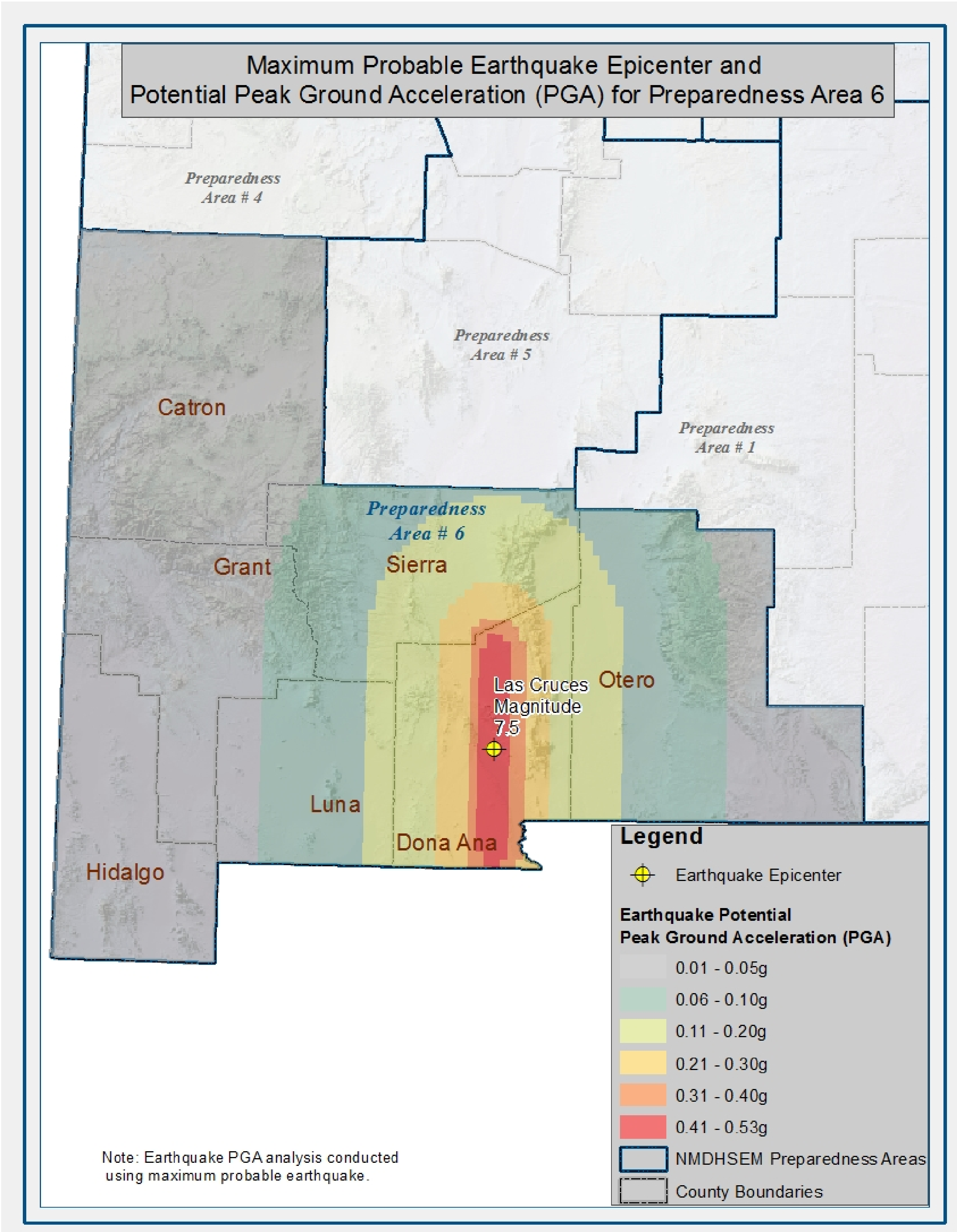


Table 2.33 identifies potential impacts from an earthquake for the purposes of EMAP compliance.

Table 2.33. Potential Impacts from Earthquakes

Subject	Potential Impacts
Health and Safety of the PUBLIC	The public may be injured or killed by falling materials. Broken glass can cause injuries.
Health and Safety of RESPONDERS	Responders face the same impacts as the public
CONTINUITY OF OPERATIONS	Those operations that are in or near the impact area may be shut down or even destroyed.
DELIVERY of SERVICES	Service delays are anticipated to operations within or near the damaged areas.
PROPERTY, FACILITIES, INFRASTRUCTURE	Earthquakes can cause widespread damages to buildings and infrastructure. Some buildings or bridges can be condemned. Water and gas lines as well as dams may rupture. Earthquake building codes have not been implemented consistently throughout the state, and this could be a serious problem.
ENVIRONMENT	The cascading effects such as landslides are the main environmental issue.
ECONOMIC CONDITION	A strong earthquake may cause severe damages within a community.
PUBLIC CONFIDENCE	No impacted by the event itself, but may be damaged if the response to an event is poor.

Data Limitations

Present seismic monitoring in New Mexico is conducted by New Mexico Tech and the U.S. Geological Survey National Earthquake Information Center in Golden, CO. Levels of instrumentation and staffing are presently sufficient to generally characterize events anywhere within the state to magnitude levels of approximately 3.0 (and significantly smaller in better-instrumented areas, such as the vicinity of the WIPP/Carlsbad area and the Socorro region. Unusual sequences of exceptional societal or scientific interest can be additionally studied with temporary deployments of portable seismographs through the IRIS PASSCAL Instrument Center at New Mexico Tech and/or using USGS national resources. Los Alamos National Laboratory also operates a regional seismographic network focused on the Pajarito fault zone and Valles Caldera region.

What Can Be Mitigated?

Damage from earthquakes can be mitigated for existing buildings by structural retrofits and by improved securing of vulnerable contents/furnishings/installations within structures. Structures erected before standard building codes, such as un-reinforced masonry buildings, are typically vulnerable to earthquake damage. Present building codes require construction of certain occupancies (schools, hospitals, public buildings) to high earthquake resistance standards, although seismic mitigating construction is not required for residential buildings. A prudent homeowner, business owner, or developer would be well advised to consider earthquake mitigation when designing subdivisions, apartment buildings, shopping centers, and individual residences in certain parts of the state. More detailed information on other structures in each Preparedness Area is required to identify those that are highly vulnerable. New buildings can be built stronger, according to the most recent seismic design specifications found in contemporary building codes, to minimize their vulnerability to earthquake damage.

Earthquake insurance in New Mexico has not generally been an option for residents. However, experts agree that there are cost benefits to seismic retrofits. One mitigation action is to research if earthquake insurance would be a benefit to New Mexico communities.

Extreme Heat

Hazard Characteristics

Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. In an average year, extreme heat kills 175 people.[28] Young children, the elderly, outdoor laborers, and sick people are the most likely to suffer the effects of extreme heat. The heat index measures the severity of hot weather by estimating the apparent temperature: how hot it feels. (Table 2.34). Skin resistance to heat and moisture transfer is directly related to skin temperature, therefore the ambient temperature can be quantified by examining the relation between relative humidity versus skin temperature. If the relative humidity is higher/lower than the base value, the apparent temperature is higher/lower than the ambient temperature.

Table 2.34 also outlines the heat disorders during extreme temperatures. 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.[29]

Table 2.34: Heat Index/Heat Disorders[30]

Heat Index/Heat Disorders		
Danger Category	**Heat Disorders**	**Apparent Temperature (^{0}F)**
I Caution	Fatigue possible with prolonged exposure and physical activity	80-90
II Extreme Caution	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and physical activity	90-105
III Danger	Sunstroke, heat cramps and heat exhaustion likely; heatstroke possible with prolonged exposure and physical activity	105-130
IV Extreme Danger	Heatstroke or sunstroke imminent	>130

Extreme heat, or heat wave, is defined by the NWS as a temperature of ten degrees or more above the average high temperature for the region, lasting for several weeks. This condition is definitely a public health concern. During extended periods of very high temperatures or high temperatures with high humidity, individuals can suffer a variety of ailments, including heatstroke, heat exhaustion, heat syncope, and heat cramps.

- **Heatstroke** is a life threatening condition that requires immediate medical attention. It exists when the body's core temperature rises above 105° F as a result of environmental temperatures. Patients may be delirious, in a stupor or comatose. The death-to-care ratio in reported cases in the U.S. averages about 15%.

[28] *FEMA Extreme Heat Backgrounder*
[29] Source: *Western Region Climate Center www.wrcc.dri.edu/narratives/NEWMEXICO.htm*
[30] Information provided by NOAA: http://www.nws.noaa.gov/os/heat/index.shtml#heatindex

- **Heat exhaustion** is much less severe than heatstroke. The body temperature may be normal or slightly elevated. A person suffering from heat exhaustion may complain of dizziness, weakness, or fatigue. The primary cause of heat exhaustion is fluid and electrolyte imbalance. The normalization of fluids will typically alleviate the situation.
- **Heat syncope** is typically associated with exercise by people who are not acclimated to physical activity. The symptoms include a sudden loss of consciousness. Consciousness returns promptly when the person lies down. The cause is primarily associated with circulatory instability because of heat. The condition typically causes little or no harm to the individual.
- **Heat cramps** are typically a problem for individuals who exercise outdoors but are unaccustomed to heat. Similar to heat exhaustion, it is thought to be a result of a mild imbalance of fluids and electrolytes.

The elderly, disabled, and debilitated are especially susceptible to heat stroke. Large and highly urbanized cities can create an island of heat that can raise the area's temperature by 3 to 5° F. Therefore, urban communities with substantial populations of elderly, disabled, and debilitated people could face a significant medical emergency during an extended period of excessive heat. The highest temperature recorded in New Mexico is 122°F on June 27, 1994 at the Waste Isolation Pilot Plant (WIPP) site in Eddy County (Preparedness Area 1).

New Mexico is partially an arid desert state, and summer temperatures often exceed the 100-degree mark under normal conditions. Nighttime temperatures are typically cool due to low humidity, and even though daytime temperatures may be high, people experience relief at night. Heat waves in which daily high temperatures exceed 110° F for many days in a row are rare. Such a heat wave in the higher altitudes would probably have a more damaging effect because people would not be expecting such hot conditions. However, anywhere in the state that experienced the humidity/temperature combination could suffer ill effects from the event. A heat wave would also have a drying effect on vegetation, facilitating the ignition of wildfires. If a heat wave were coupled with a power failure, the effect on the population would be much more severe due to a lack of air conditioning. In general, it is safe to say that there is no area of the state that is immune from the hazard of heat wave.

A unique aspect to extreme heat in New Mexico is the fact that UVB radiation also increases with increasing altitude, or distance above the surface of the earth. For every 1,000 feet of altitude, the UV radiation increases by about 4 percent. This means that approximately 20 percent more UV radiation reaches the earth's surface in Santa Fe, than in a city that is at similar latitude but at sea level. This can exacerbate heat effects at high altitude.

In 1979, meteorologist R.G. Steadman developed a heat index (Table 2.35) to illustrate the risks associated with extreme summer heat. NOAA's heat alert procedures are based mainly on Heat Index Values. The Heat Index, sometimes referred to as the "apparent temperature" is given in degrees Fahrenheit. The Heat Index is a measure of how hot it really feels when relative humidity is factored with the actual air temperature.

Table 2.35: Heat Index as of December 2012[31]

NOAA's National Weather Service

Heat Index

Temperature (°F)

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

According to the Office of the Medical Investigator, there are two recorded events of extreme heat causing death or injury within the state of New Mexico. Those deaths were due to negligence of parents leaving children in the car for a long period of time. Periods of excessive heat usually result in high electrical consumption for air conditioning, which can cause power outages and brownouts.

While PNM reports no wide spread power failures due to overuse, the large numbers of new homes and conversion to air conditioning from evaporative coolers, could put a strain on the electrical grid.

Previous Occurrences

The State of New Mexico experiences extreme heat events annually. Table 2.36 highlights past occurrences recorded by the Department of Homeland Security and Emergency Management. Referencing the NCDC online database there is only two occurrences entered for past events. Both events, August 6, 2012 and July 14, 2010 identified deaths.

31 Source: http://www.nws.noaa.gov/os/heat/index.shtml#heatindex

Table 2.36: Significant Past Occurrences - Extreme Heat (January 1, 2006 - December 1, 2012)[32]

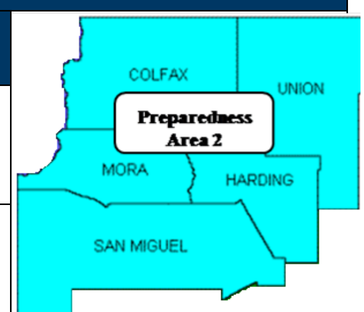
Date	Location	Significant Event
August 6, 2012	Albuquerque, NM Preparedness Area 5	A toddler died after being left inside a parked vehicle for over eight hours. Ambient air temperatures were in the lower to mid 90s. An Albuquerque toddler died Monday afternoon after being left inside a car for at least 8 hours. The boy was found Monday afternoon inside the car and was pronounced dead later at the hospital. High temperature recorded at the Albuquerque International Sunport was 93F.
July 14, 2010	Albuquerque, NM Preparedness Area 5	A 2-year-old died after being left in a hot car for almost four hours at Southwestern Indian Polytechnic Institute. By noon MST, the outside air temperature was 93 degrees which may have resulted in temperatures exceeding 135 degrees in the vehicle.
July 2003	State of New Mexico All Preparedness Areas	Hottest month ever recorded in New Mexico. There were 14 days of highs of 100° or more, and no cooling at night. A new all-time high low temperature of 78° is set. 21 days do not go below 70°. Average temperature of 84.6° for the entire month shatters 1980 record of 82.7°.
May 24, 2000	State of New Mexico All Preparedness Areas	New daily high temperature records were set across the state as temperatures soared into the high 90s and 100s all across the east and south. Record highs in the mid and upper 80s were also set in the higher elevation communities of both the south central, central and northern mountains.
June 1998	State of New Mexico All Preparedness Areas	Conditions had been unusually warm and dry throughout the month, but the heat intensified beginning on the 20th with daily high temperatures climbing well above 100 degrees, except in mountain communities at elevations above 7500 feet. Readings in the southeast section of the state peaked at 108 to 113 degrees as these locations exceeded 10 consecutive days with daily highs above 100 degrees. New records for duration of 100 plus degree-days were set from Carlsbad north to Clovis and Tucumcari. The heat broke records that had lasted 60 to 70 years. By the end of the month a number of locations in the east had observed 16 to 20 days with a daily high over 100 degrees.
June 27, 1994	Albuquerque, NM (Bernalillo County) Preparedness Area 5	Albuquerque area hits 107°, the highest temperature ever recorded in Albuquerque (the 104° on June 26 tied the previous record).

[32] Source: http://www.ncdc.noaa.gov

Date	Location	Significant Event
Summer (June through August) 1980	Albuquerque, NM (Bernalillo County) Preparedness Area 5	Record heat with 25 days of 100 or more in the Albuquerque metro area (prior record was 12 days). July average daytime high is 99.1°.

Table 2.37 outlines previously recorded extreme heat events within each Preparedness Area.

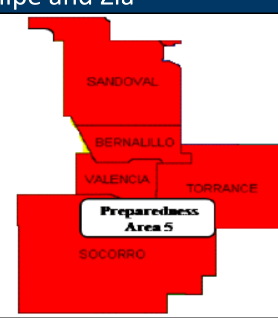
Table 2.37: Preparedness Areas 1 - 6 Extreme Heat History (January 1, 2006 - December 1, 2012)[33]

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	3	0	0	0	0	0	
Total	**3**	**0**	**0**	**0**	**0**	**0**	
Preparedness Area 2 **Counties:** Colfax, Harding, Mora, Union and San Miguel							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	3	0	0	0	0	0	
Total	**3**	**0**	**0**	**0**	**0**	**0**	

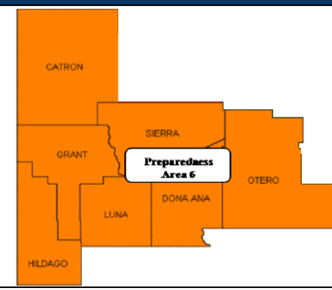
33 Source: http://www.ncdc.noaa.gov

Preparedness Area 3 **Counties:** Los Alamos, Rio Arriba, Santa Fe and Taos **Pueblos:** Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos **Tribal Nations:** Jicarilla Apache							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	3	0	0	0	0	0	
Total	**3**	**0**	**0**	**0**	**0**	**0**	

Preparedness Area 4 **Counties:** Cibola, McKinley and San Juan **Pueblos:** Acoma, Laguna, Zuni **Tribal Nations:** Navajo Nation							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	3	0	0	0	0	0	
Total	**3**	**0**	**0**	**0**	**0**	**0**	

Preparedness Area 5 **Counties:** Bernalillo, Sandoval, Socorro, Torrance and Valencia **Pueblos:** Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Extreme Heat	2	0	2	0	0	0	
Total	**2**	**0**	**2**	**0**	**0**	**0**	

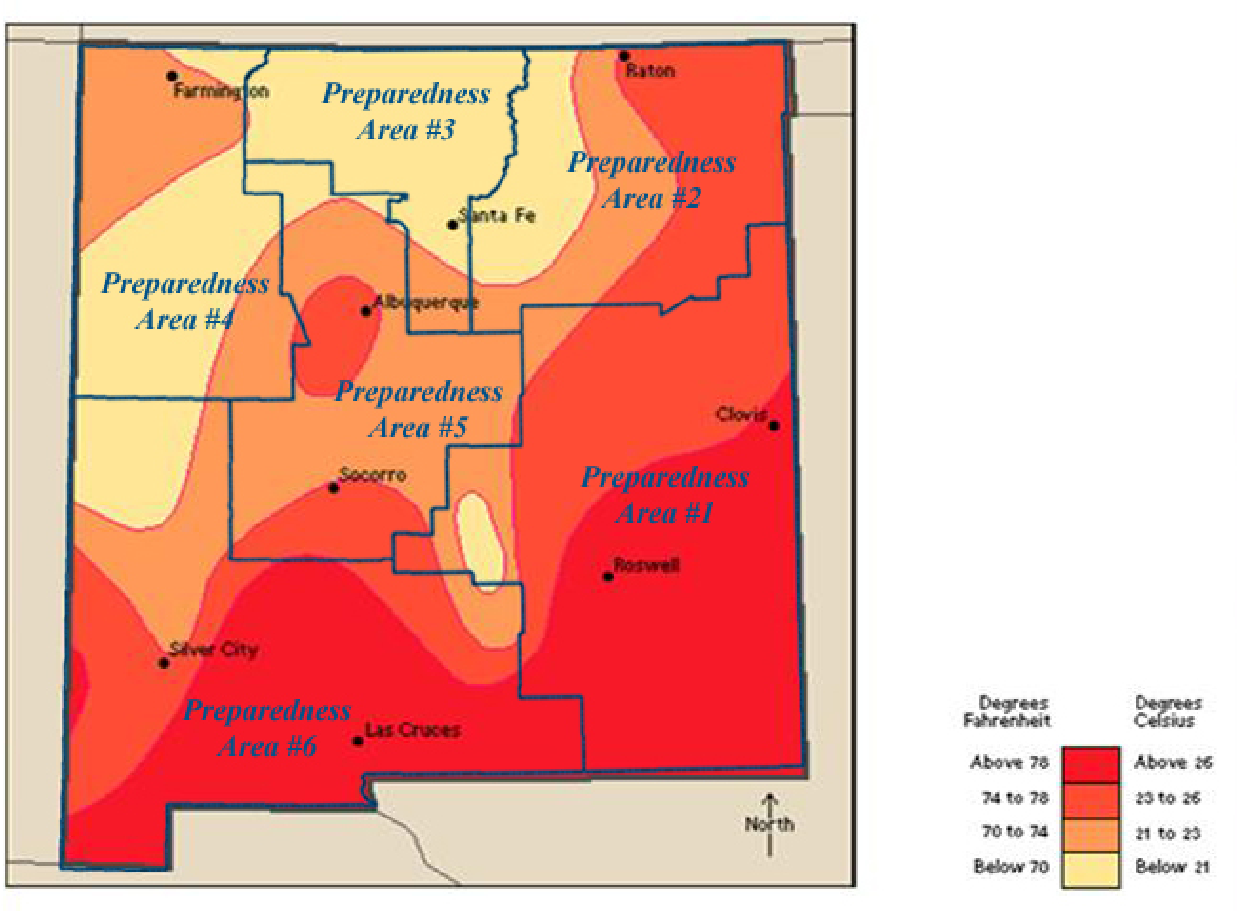
Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Extreme Heat	3	0	0	0	0	0
Total	**3**	**0**	**0**	**0**	**0**	**0**



Frequency

Patterns, frequency, and degree of severity of extreme heat events are difficult to predict. Referencing the map in Figure 2.38, the state can experience average summer temperatures from 70 to well over 78 degrees with temperatures in the summer reaching up to 100 degrees plus. In temperatures exceeding 90°F, young children, the elderly, outdoor laborers, and sick people are the most likely to suffer from sunstroke, heat cramps, heat exhaustion, and possibly heatstroke.

Figure 1: Average Temperature and Preparedness Area Map of New Mexico[34]



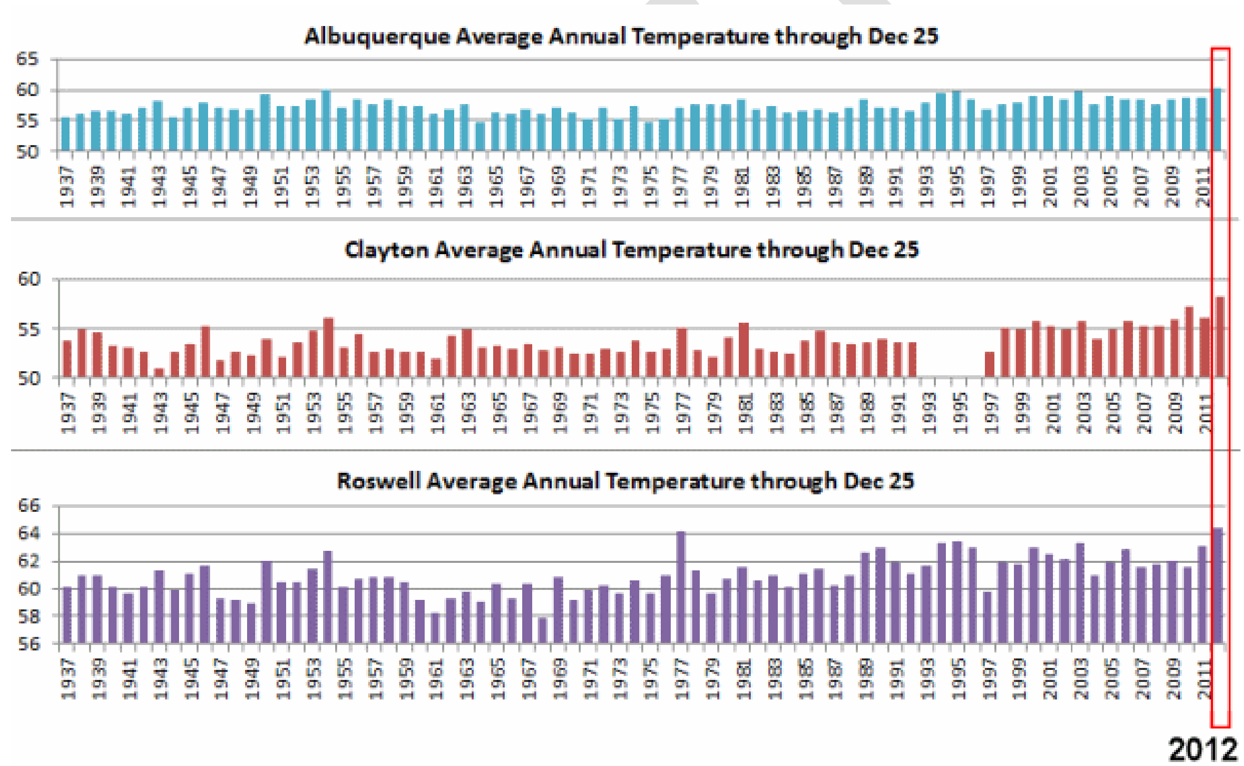
The National Weather Service Albuquerque reported above average monthly temperatures in New Mexico for 2012. 2012 will go down as the warmest year on record. Meteorologists stated that 2012 was yet another year that supported the upward trend in temperature. At each of their three climate stations, the average temperature through December 25, 2012 was the warmest on record, as shown in the Table 2.39 and Figure 2.40. Locations included Albuquerque (Preparedness Area 5), Clayton (Preparedness Area 2) and Roswell (Preparedness Area 1).

[34] Source: 2010 NM State Hazard Mitigation Plan

Table 2.39: Average Temperatures for December 2012[35]

Location	Long-term Average Temperature through 12/25	Average 2012 Temperature through 12/25
Albuquerque	57.4	60.4
Clayton	53.8	58.3
Roswell	61.0	64.4

Figure 2.40: Annual Temperatures for Albuquerque, Clayton, and Roswell 2012[36]



Probability of Occurrence

To determine the probability of each Preparedness Area experiencing future extreme heat occurrences, the probability or chance of occurrence was calculated based on historical data identified in Table 2.41. Table 2.41 identifies the probability of each Preparedness Area experiencing some type of extreme heat event annually. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year.

[35] Source: http://www.srh.weather.gov/abq/?n=clifeature_2012sigevents.
[36] Source: http://www.srh.weather.gov/abq/?n=clifeature_2012sigevents

It should be noted that general inconsistencies in local event reporting to the NCDC would make this probability seem low as extreme heat events are an annual occurrence.

Table 2.41: Probability of Occurrence - Extreme Heat

Probability of Occurrence	
Preparedness Area	**Extreme Heat**
Preparedness Area 1	.01%
Preparedness Area 2	1.2%
Preparedness Area 3	1.2%
Preparedness Area 4	3.6%
Preparedness Area 5	1.2%
Preparedness Area 6	6.0%

Risk Assessment

New Mexico experiences some form of extreme heat activity annually, based on seasonal meteorological patterns and local topographical conditions. All Preparedness Areas are susceptible to extreme heat conditions, although local topography, such as elevation and land contours, plays a significant part in how this extreme heat affects a particular area. The effects of extreme temperatures generally affect at risk sectors of the population: the elderly, the young, the sick/infirmed, those living below the poverty level and outdoor laborers. Table 2.42 outlines Impacts from extreme heat events for each Preparedness Area to consider when planning for these types of events.

Table 2.42: Extreme Heat Impacts

Subject	Impacts
Health and Safety of The Public	Injuries and death have resulted from extreme heat events. Individuals caught out doors can suffer dehydration and death from high temperatures; Increased wildfire risk
Health And Safety of Responders	Responders face the same impacts as the public.
Continuity of Operations	Airport closures and local/regional power failures
Delivery of Services	Airport closures and local/regional power failures
Property, Facilities, Infrastructure	None anticipated

Environment	Increased drought conditions (see Drought section for a list of associated environmental impacts)
Economic Condition	Increased utility costs due to the extreme temperatures are anticipated; Loss of tourism; Decreased agricultural yields
Public Confidence	No impact anticipated

Data Limitations

The Hazard Mitigation Team could not quantify vulnerability of individual structures to damage from extreme heat hazards. Subsequent versions of this Plan will need to incorporate and respond to these data deficiencies. The NCDC is limited in the amount of extreme heat incidents have occurred in New Mexico.

What Can Be Mitigated?

One important part of mitigating extreme heat hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to extreme heat by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending extreme heat events.

Expansive Soils

Hazard Characteristics

Expansive Soils, also called adobe or clay, is fine-grained clay that is generally found in areas that historically were a floodplain or lake area. Expansive soils swell when wet and shrink when dry. It contains fine-grained expandable clay that generally accumulates in low-energy areas such as floodplains or lakes. Expansive soil is subject to swelling and shrinkage, varying in proportion to the amount of moisture present in the soil. As water is absorbed into the soil (by rainfall or watering), expansion takes place. If dried out, the soil contracts, often leaving small fissures or cracks. Excessive drying and wetting of the soil will progressively deteriorate "slab on grade" foundations over the years.

Expansive soil is found in all states, although the highest concentrations are found in Texas, Colorado, Virginia, North Dakota, Oklahoma, and Montana. One of the most expansive soils, known locally as adobe[37], is found in New Mexico, Texas and Colorado. The expansion and contraction of soil beneath a structure tends to exert tremendous pressure and stress, causing severe structural damage. In some cases, entire sidewalks and streets have been lifted, resulting in severe cracking and distortion.

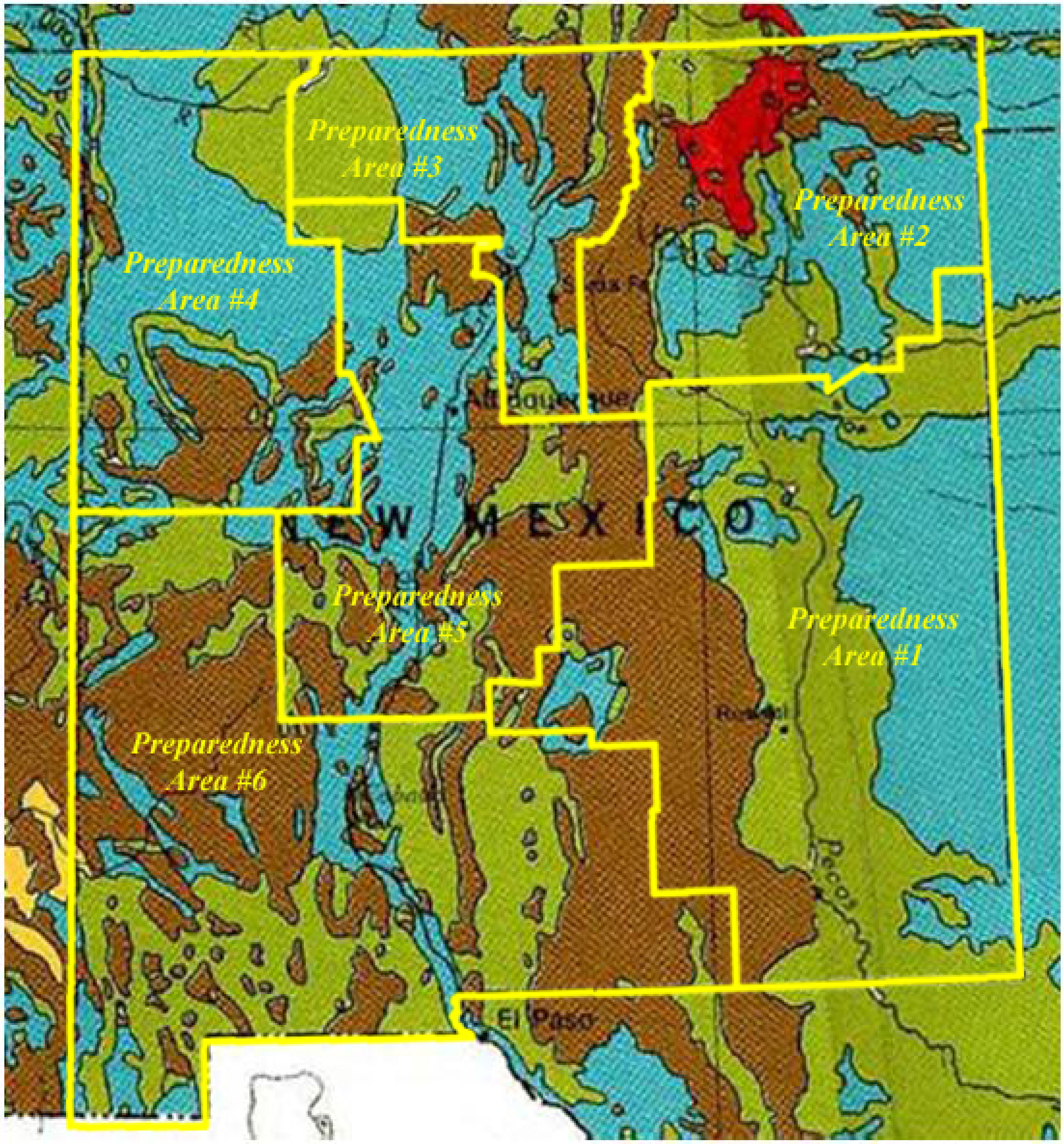
According to a 1987 document, entitled "Foundations in Expansive Soils" from the Office of the Chief of Engineers, U.S. Army, New Mexico has four physiographic provinces.[38] The northwest corner of the state is within the Colorado Plateau. The far north central portion of the state is within the southern Rocky Mountains. The central and southwestern portions of the state lie in the basin and range province, and the eastern third of the state is classified as the Great Plains.[39]

Figure 2.43 P[40] shows the areas of expansive soils in New Mexico. The red areas in the northeast portion of the state around Taos and Colfax Counties are areas that contain abundant clay with high swelling potential. The blue areas generally have less than 50% clay and also have high swelling potential. The orange area, of which there is only a very small portion on the Arizona border, indicates areas with abundant clay having slight to moderate swelling potential. The green areas generally have less than 50% clay with slight to moderate swelling potential and the brown areas have little or no swelling clay.

One Subject Matter Expert, Dr. Dave Love from New Mexico Tech, commented that it is surprising that only the Raton area is shown as having abundant clay that has high swelling potential. Although there is not current documentation available, areas in Santa Fe and Socorro are reported to have expandable soils, too.

[37] Not all adobe in New Mexico is expandable; adobe bricks have only a small proportion of clay.
[38] Source: http://www.usace.army.mil/publications/armytm/tm5-818-7/
[39] Source: http://geoinfo.nmt.edu/tour/provinces/home.html
[40] Source: Fidelity Inspection and Consulting Services at http://www.inspection1.com/types/soils/newmex.htm (December 2012)

Figure 2.43: New Mexico Expansive Soils and Preparedness Areas



(red)	Unit contains abundant clay having high swelling potential
(blue)	Part of unit (generally less than 50%) consists of clay having high swelling potential
(orange)	Unit contains abundant clay having slight to moderate swelling potential
(green)	Part of unit (generally less than 50%) consists of clay having slight to moderate swelling potential
(brown)	Unit contains little or no swelling clay
(yellow)	Data insufficient to indicate clay content of unit and/or swelling potential of clay (Shown in westernmost of state only)

Previous Occurrences

In conducting research for this hazard there were no previous occurrences identified at this time**.** While damages due to expansive soils are occurring in New Mexico, the fact that the onset takes a very long time, damages are cumulative rather than instantaneous. In the opinion of Dr. Dave Love, the damage is fairly frequent, but under-reported.

Frequency

Due to no previous occurrence data being available at this time, the Hazard Mitigation Team will not profile Expansive Soils any further. If future conditions or events warrant, upcoming editions of the plan will further elaborate on this hazard.

Risk Assessment

Expansive Soils can result in serious structural damage to roads, buildings, irrigation channels, utilities and pipelines. Due to the low frequency of this hazard, the Hazard Mitigation Team will not profile Expansive Soils any further. If future conditions or events warrant, upcoming editions of the plan will further elaborate on this hazard.

Table 2.44 provides impacts for consideration when reviewing expansive soil issues for the purposes of EMAP compliance.

Table 2.44: Impacts from Expansive Soil

Subject	Potential Impacts
Health and Safety of the Public	None anticipated
Health and Safety of Responders	None anticipated
Continuity of Operations	None anticipated
Delivery of Services	None anticipated

Property, Facilities, Infrastructure	The slow nature of this type of event causes the impacts to be almost imperceptible, however, costly damages to the built environment may occur (primarily highways and roads)
Environment	None anticipated
Economic Condition	High infrastructure and building repair costs.
Public Confidence	Very little impact anticipated.

Data Limitations

Until expansive soil occurrence and damage information becomes available, it cannot be integrated in to the Plan. It may be possible to combine expansive, corrosive and hydrocompactive soils into one heading called Hazardous Soils. Again, until data becomes available on any of these soil types, it cannot be integrated into the Plan. According to the Subject Matter Experts, there are no hazardous soils mapping or damage occurrence data being collected.

Expansive soils occurrence and damage data collection will be included as one of the mitigation actions in the Plan. Further analysis of existing data for corrosive and hydrocompactive soils will also be added as a mitigation action.

What Can Be Mitigated?

With regards to current day construction, mitigation of expansive soils is relatively simple in New Mexico. For small structures, the expansive clay can be excavated and removed. Then, compacted sandy soil is put beneath the foundations before construction starts. For larger structures with deeper foundations in thick expansive soils or rock, more extensive procedures are required.

It is possible that human activities in the area of expansive, hydrocompactive, and corrosive soils could be more closely regulated. Land management agencies along with local government permit review could be more proactive in requiring testing of soils before construction.

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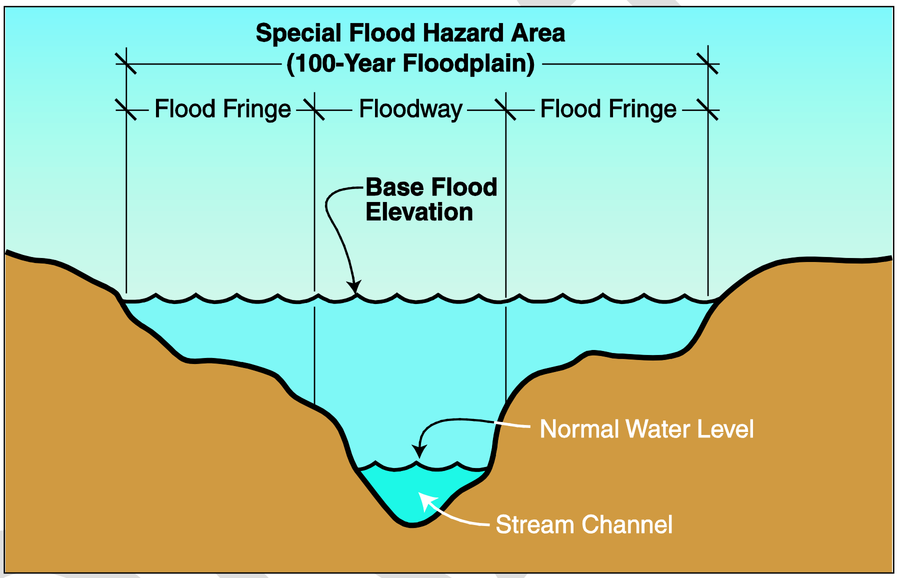
Flood/Flash Floods

Hazard Characteristics – Floods/Flash Flooding

Nationwide, hundreds of floods occur each year, making flooding one of the most common hazards in all 50 states and U.S. territories. Most injuries and deaths from flooding happen when people are swept away by flood currents, and most property damage results from inundation by sediment-filled water. The majority of flood events in the United States involve inundation of floodplains. Figure 2.45 shows inundation of floodplains during a large-scale weather system with prolonged rainfall from storms or snowmelt.

Figure 2.45: Flood Definition[41]



This type of flooding typically results from large-scale weather systems generating prolonged rainfall from locally intense storms or snowmelt. For the purposes of this report, this type of flooding is referred to as riverine flooding and is characterized by a gradual and predictable rise in a river or stream due to persistent precipitation. After the stream or river overflows its banks the surrounding area often remains under water for an extended period of time.

Riverine floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence, shown in Table 2.46, is expressed as the percentage chance that a flood of a specific extent will occur in any given year. Flash floods are usually the result of excessive precipitation or rapid snowmelt and can occur suddenly. Although the State of New Mexico experience riverine flooding, *flash flooding* is a more common and a more damaging type of flooding.

[41] Source: FEMA's "Understanding Your Risks – FEMA Publication 386-2, page 2-12.

Table 1: Flood Probability Terms[42]

Flood Recurrence Intervals	Chance of occurrence in any given year
10-year	10%
50-year	2%
100-year	1%
500-year	0.2%

Flash floods are aptly named: they occur suddenly after a brief but intense downpour; they move quickly and end abruptly. Although the duration of these events is usually brief, the damages can be quite severe. People are often surprised at how quickly a normally dry arroyo can become a raging torrent. Flash floods are the primary weather-related killer with around 140 deaths recorded in the United States each year. Flash floods are common and frequent in New Mexico, and as a result, New Mexico has the tenth highest flash flood fatality rate in the nation. Flash floods cannot be predicted. Alluvial fans and alluvial fan flood hazards exist in the state. Alluvial fan flood hazard characteristics include heavy sediment/debris loads and high velocity flows.

Flash flooding is the second greatest weather hazard in New Mexico. New Mexico ranks 10th in the nation in flash flood deaths per capita, using statistics based on storm data for 2006 - 2012. The flash flooding problem stems from a number of factors. During the summer (June through August period), thunderstorm frequency in certain parts of New Mexico is among the highest in the nation. Excessive moisture during the summer can lead to large volume runoffs enhanced by the terrain. Table 2.47 lists the major causes of riverine flooding vs. flash flooding.

Table 2: Flooding vs. Flash Floods - Cause[43]

Riverine Floods	Flash Floods
Low lying, relatively undisturbed topography	Hilly/mountainous areas
High season water tables	High velocity flows
Poor drainage	Short warning times
Excess paved surfaces	Steep slopes
Constrictions – filling	Narrow stream valleys
Obstructions – bridges	Parking lots and other impervious surfaces

[42] Source: USGS Water Science School: http://ga.water.usgs.gov/edu/100yearflood.html (December 2012)
[43] Source: http://www.weatherexplained.com/Vol-1/Floods-Flash-Floods.html

Riverine Floods	Flash Floods
Soil characteristics	Improper drainage

According to FEMA, "an alluvial fan is a sedimentary deposit located at a topographic break such as the base of a mountain front, escarpment, or valley side, that is composed of stream flow and/or debris flow/sediments and has the shape of a fan, either fully or partially extended."[44] "Over 15-25% of the arid West is covered by alluvial fans," reports FEMA.[45] New Mexico has more alluvial plains than alluvial fans due to the natural apex, according to Paul Dugie, NM Floodplain Managers Association. Though the intense rainstorms which produce fan floods occur randomly, they nevertheless can develop very rapidly at any time and can recur with frequency.[46] The California Alluvial Fan Task Force states, "When alluvial fan flooding occurs, it is flashy and unpredictable and variable in magnitude. This type of flooding does not necessarily occur as the result of large amounts of rain. Often, it is triggered by intense rainfall over short periods of time. The natural flooding process that drives alluvial fan sedimentation tends to produce thick deposits of sand and gravel, particularly near the apex of the fan, with relatively minor proportions of fine-grained particles." According to Dr. David Love, New Mexico Bureau of Geology and Mining Resources, in the State of New Mexico, there have been no confirmed studies specific to alluvial fan flooding risk.

According to multiple studies, alluvial fan flood risk can cause high velocity flow (as high as 15-30 feet per second) producing significant hydrodynamic forces, erosion/scour to depths of several feet, deposition of sediment and debris (to depths of several feet), deposition of sediment and debris (depths of 15 – 20 feet have been observed), debris flows/impact forces, mudflows, inundation, producing hydrostatic/buoyant forces (pressure against buildings caused by standing water), flash flooding with little, if any, warning times.

Alluvial fans are often an overlooked as hazards and there is a tendency to underestimate both the potential and severity of alluvial fan flood events. The infrequent rainfall, gently sloping terrain, and often long time spans between successive floods contribute to a sense of complacency regarding the existence of possible flood hazards.[47]

National Flood Insurance Program

In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods. The Federal Insurance and Mitigation Administration (FIMA) manages the National Flood Insurance Program (NFIP) and implements a variety of programs authorized by Congress to reduce losses that may result from natural disasters. FIMA is a component of the FEMA manages the NFIP, and oversees the floodplain management and mapping components of the Program.

[44] Source: FEMA, MT-2 Procedures Manual, May 2009, p.30
[45] FEMA, Alluvial Fans: Hazards and Management, 1989, p. 3
[46] FEMA, Alluvial Fans: Hazards and Management, 1989, p. 3
[47] FEMA, MT-2 Procedures Manual, May 2009

Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. The NFIP Community Rating System (CRS) was implemented in 1990 as a program to recognize and encourage community floodplain management activities that exceed minimum NFIP standards.

The Community Rating System (CRS) is a voluntary program for National Flood Insurance Program (NFIP) participating communities. The goals of the CRS are to reduce flood damages to insurable property, strengthen and support the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management. The CRS has been developed to provide incentives in the form of premium discounts for communities to go beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding.

The National Flood Insurance Reform Act of 1994 codified the CRS in the NFIP. Under the CRS, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance. Table 2.48 shows those communities in New Mexico, by Preparedness Area, that are eligible communities under CRS.

Table 38: New Mexico Eligible Communities in CRS as of October 1, 2012[48]

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
350045	Alamogordo,	10/1/91	10/1/91	9	5	5	C
350002	Albuquerque	10/1/93	10/1/08	9	5	5	C
350001	Bernalillo County	10/1/93	05/1/08	9	5	5	C
350010	Clovis	10/1/91	10/1/91	9	5	5	C
350012	Dona Ana County	10/1/03	10/1/08	8	10	5	C
350067	Farmington	10/1/91	10/1/91	9	5	5	C
350029	Hobbs	10/1/92	05/1/08	8	10	5	C
355332	Las Cruces	10/1/91	10/1/08	6	20	10	C
350054	Portales	10/1/95	10/1/95	9	5	5	C
350006	Roswell	10/1/92	10/1/92	9	5	5	C
350064	San Juan	05/1/08	10/1/12	8	10	5	C

[48] Source: FEMA CRS document http://www.fema.gov/national-flood-insurance-program/community-rating-system#3 (October 1, 2012)

	County						

Flood damage is reduced by nearly $1 billion a year through partnerships with NFIP and CRS communities, the insurance industry, and the lending industry. Buildings constructed in compliance with NFIP building standards also suffer approximately 80% less damage annually than those not built in compliance. Further, every $3 paid in flood insurance claims saves $1 in disaster assistance payments.

The NFIP is self-supporting for the average historical loss year, which means that operating expenses and flood insurance claims are not paid for by the taxpayer, but through premiums collected for flood insurance policies. The program has borrowing authority from the U.S. Treasury for times when losses are heavy; however, these loans are usually paid back with interest. To obtain secured financing to buy, build, or improve structures in Special Flood Hazard Areas (SFHAs), flood insurance must be purchased. Lending institutions that are federally regulated or federally insured must determine if the structure is located in a SFHA and must provide written notice requiring flood insurance. Flood insurance is available to any property owner located in a community participating in the NFIP. All areas are susceptible to flooding, although to varying degrees. In fact, 25% of all flood claims occur in low-to-moderate risk areas.

The most widely adopted design and regulatory standard for floods in the United States is the 1% annual chance flood and this is the standard formally adopted by FEMA. The 1% annual flood, also known as the base flood elevation, has a 1% chance of occurring in any particular year. It is also often referred to as the “100-year flood” since its probability of occurrence suggests it should only reoccur once every 100 years (although this is not the case in practice). Experiencing a 100-year flood does not mean a similar flood cannot happen for the next 99 years; rather it reflects the probability that over a long period of time, a flood of that magnitude should only occur in 1% of all years.

The state of New Mexico reported the following NFIP participation statics in December 2012:[49]

- NM State Number of NFIP Policies is 16,899
- NM State Coverage is $3,088,045,900
- NM State Claims (since 1978) is 1,057
- NM Total Paid (since 1978) is $11,145,831

According to the NM State Floodplain Coordinator, currently there are 25 counties, 35 cities, 18 villages, 11 towns and 1 tribal jurisdiction participating in the regular phase of the NFIP. Six Counties do not participate in the NFIP. They are De Baca (Preparedness Area 1), Guadalupe (Preparedness Area 1), Harding (Preparedness Area 2), Quay (Preparedness Area 1), Roosevelt (Preparedness Area 1), and Union (Preparedness Area 2).

[49] Source: http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13

Repetitive Loss Properties

As of December 8, 2011, 39 repetitive loss properties were identified in the state (Table 2.49) with 87 losses totaling $1.15 million in damages. Some of these properties have suffered damages as many as five times. Twenty-two of those properties were NFIP insured at the time of the loss.

Table 4: Repetitive Loss Properties (As of 12/8/11)

Community Name	Zip Code	Losses	Total Paid	County Name
ALAMOGORDO, CITY OF	883104105	2	53,570.41	OTERO COUNTY
ALAMOGORDO, CITY OF	883104107	2	59,057.57	OTERO COUNTY
ALAMOGORDO, CITY OF	883104107	2	57,991.20	OTERO COUNTY
ALAMOGORDO, CITY OF	883104107	2	48,035.09	OTERO COUNTY
ALAMOGORDO, CITY OF	883104107	2	76,273.94	OTERO COUNTY
ALAMOGORDO, CITY OF	883104179	2	15,417.25	OTERO COUNTY
ALAMOGORDO, CITY OF	883104138	2	23,448.64	OTERO COUNTY
ALAMOGORDO, CITY OF	883104138	2	45,965.89	OTERO COUNTY
ALAMOGORDO, CITY OF	883106104	2	11,344.47	OTERO COUNTY
ALBUQUERQUE, CITY OF	871051728	2	42,604.50	BERNALILLO COUNTY
ALBUQUERQUE, CITY OF	871122119	2	4,900.18	BERNALILLO COUNTY
CARLSBAD, CITY OF	882203332	2	38,218.28	EDDY COUNTY
CARLSBAD, CITY OF	882203332	2	35,781.76	EDDY COUNTY
CARLSBAD, CITY OF	882204256	2	12,971.87	EDDY COUNTY
CLOVIS, CITY OF	881017829	3	46,856.78	CURRY COUNTY
DEMING, CITY OF	88030	2	88,420.82	LUNA COUNTY
DONA ANA COUNTY	880817394	2	83,238.63	DONA ANA COUNTY
DONA ANA COUNTY	880058606	2	21,829.80	DONA ANA COUNTY
GALLUP, CITY OF	873015308	2	12,090.08	MCKINLEY COUNTY
GRANTS, CITY OF	870202740	2	44,538.28	CIBOLA COUNTY
HOBBS, CITY OF	882400000	3	43,896.57	LEA COUNTY
HOBBS, CITY OF	882404542	4	21,957.15	LEA COUNTY
HOBBS, CITY OF	882400000	4	25,323.38	LEA COUNTY
HOBBS, CITY OF	882404748	2	5,517.86	LEA COUNTY
HOBBS, CITY OF	882404749	2	9,023.07	LEA COUNTY
HOBBS, CITY OF	882404748	3	13,064.88	LEA COUNTY
HOBBS, CITY OF	882404733	2	14,224.26	LEA COUNTY
HOBBS, CITY OF	882404745	2	40,488.16	LEA COUNTY
HOBBS, CITY OF	882400000	2	13,128.48	LEA COUNTY
HOBBS, CITY OF	882404747	2	13,005.58	LEA COUNTY
LAS CRUCES, CITY OF	880052910	5	29,437.91	DONA ANA COUNTY
LEA COUNTY	882409671	2	30,843.88	LEA COUNTY
PORTALES, CITY OF	881307334	3	7,362.40	ROOSEVELT COUNTY
PORTALES, CITY OF	881306102	2	6,658.21	ROOSEVELT COUNTY
ROSWELL, CITY OF	882012047	2	8,255.34	CHAVES COUNTY
RUIDOSO, VILLAGE OF	883457509	2	22,154.83	LINCOLN COUNTY

SUNLAND PARK, CITY OF	88063	2	19,182.29	DONA ANA COUNTY
TAOS COUNTY	875560661	2	4,757.41	TAOS COUNTY
TOTAL:		**87**	**1,150,837.10**	

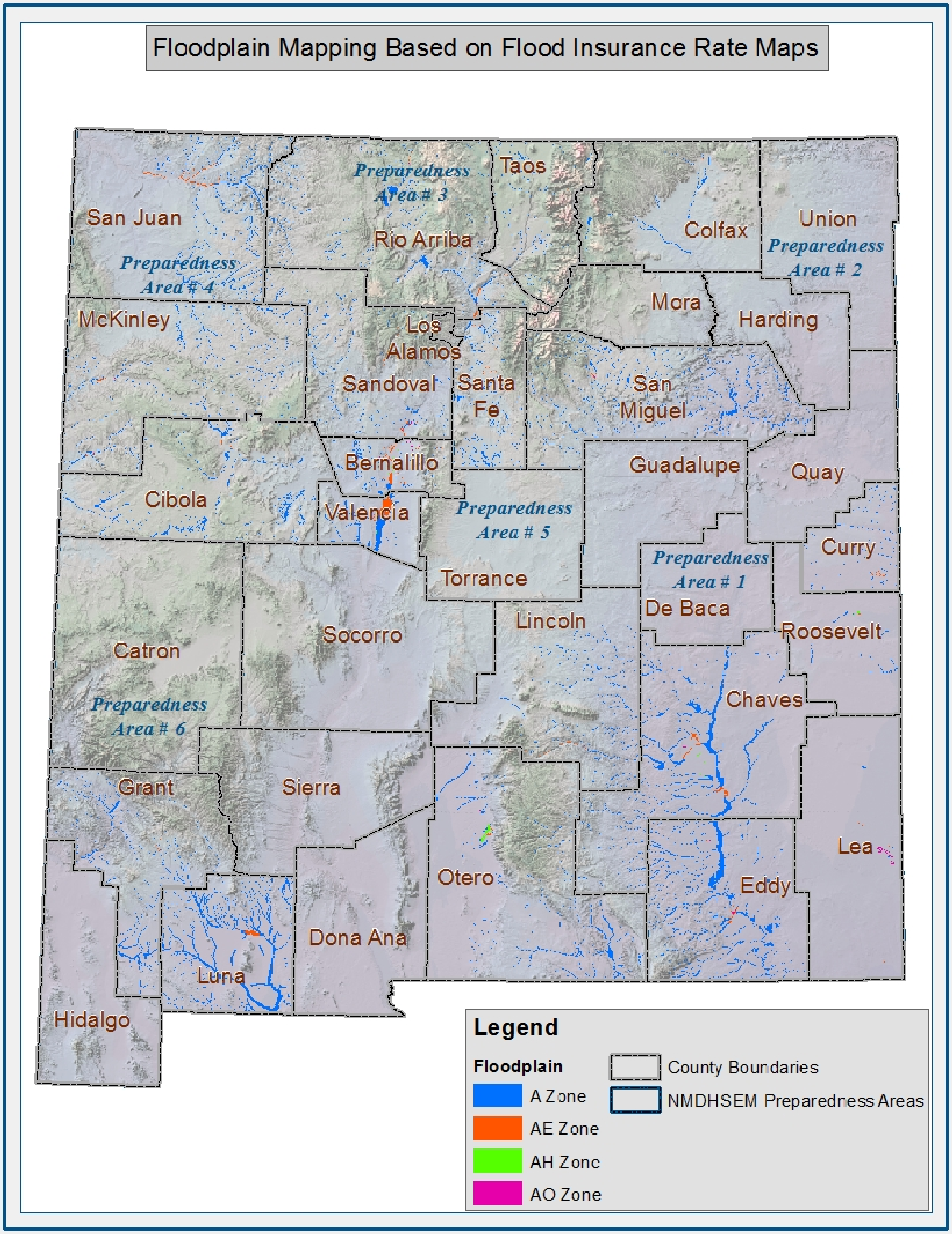
Floodplain Mapping

Most floodplain maps for the state of New Mexico are out dated and in need of revision. Only three of the counties (Curry, Doña Ana, and Otero) have digital Q-3 maps available. Digital Q3 Flood Data are developed by scanning the existing FIRM hardcopy, vectorizing a thematic overlay of flood risks. Vector Q3 Flood Data files contain only certain features from the existing FIRM hardcopy. Q3 vector data are contained in one single countywide file, including all incorporated and unincorporated areas of a county.

Digital Q3 Flood Data do not replace the existing FIRM hardcopy or, if one exists, DFIRM product. The product is designed to support planning activities, some Community Rating System activities, insurance marketing, and mortgage portfolio reviews. It does not provide base flood elevation information; thus, it has limited application for engineering analysis, particularly for site design or rating flood insurance policies for properties located within Special Flood Hazard Areas (SFHAs). The digital Q3 Flood Data product can be a valuable tool in screening property addresses within a Geographic Information System to determine flood risks. However, since the geographic processing performed to develop digital Q3 Flood Data may introduce differences with the FIRM hardcopy source, users must apply considerable care and judgment in the application of this product. For instance, digital Q3 Flood Data may be overlaid on highly detailed large-scale community base mapping data, but, if parcel level determinations are made, they must be prefaced with information about the accuracy of the data from which they are derived.

Local jurisdictions will report their lack of up-to-date floodplain maps in their mitigation strategies and will present maps of areas where flooding has been a problem. Below is a statewide floodplain map based on existing flood insurance rate maps (Figure 2.50). Figure 2.50 delineates Special Flood Hazard Areas (SFHA), or land areas that are subject to inundation by a flood. On this map, the SFHAs are shaded with different colors and divided into distinct flood hazard zones depicted on the map legend.

Figure 2.50. New Mexico State Floodplain Map

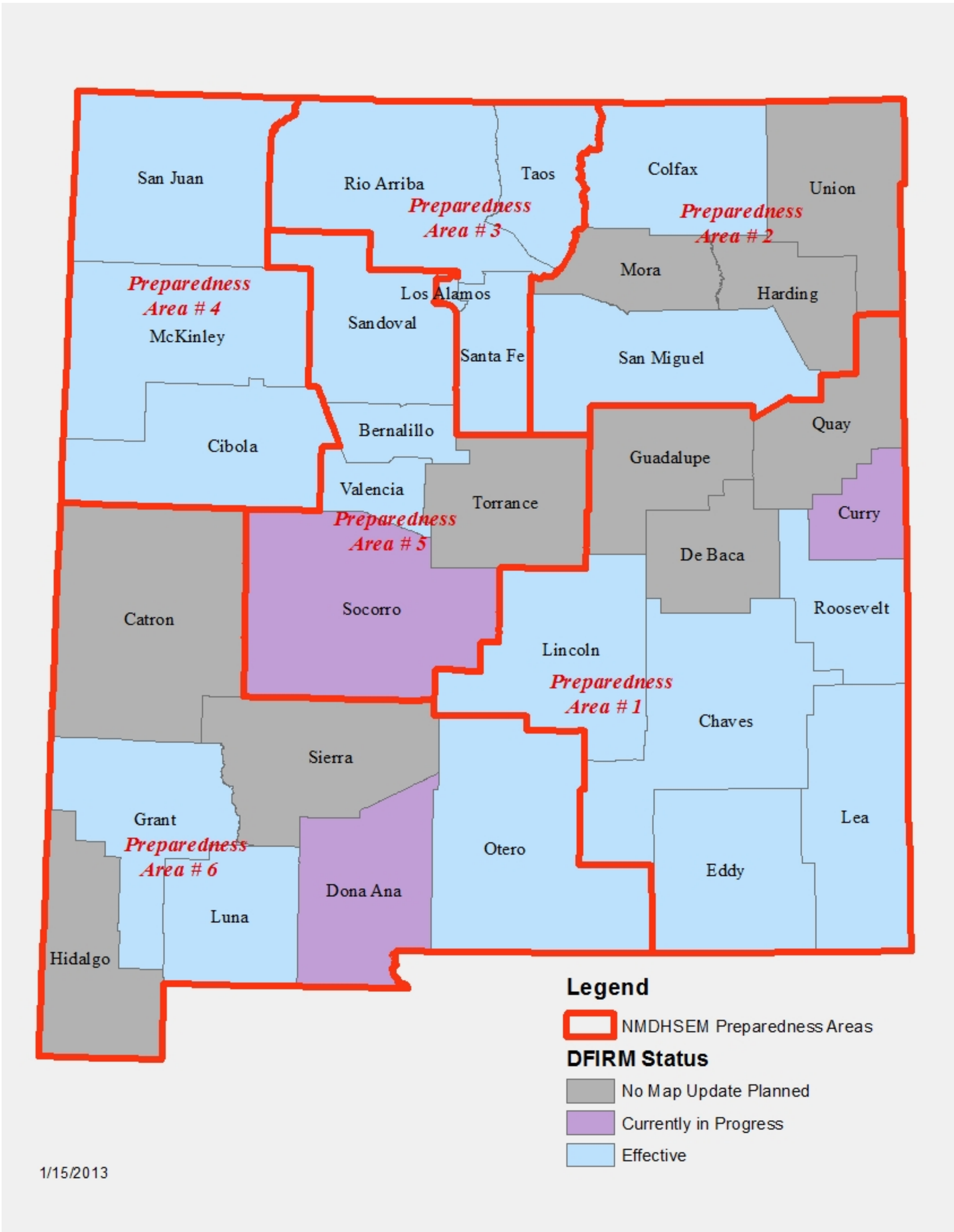


Floodplain maps like the one above are useful tools for identifying where flood-prone areas are and how frequently a floodplain will be inundated with water. This information contributes to the development of strategies that may decrease or eliminate the potential impacts from a flooding event.

Current Status of DFIRMs Maps

Most floodplain maps for the State of New Mexico are very old and in need of revision. Unfortunately, ten of the New Mexico countywide flood hazard maps will remain out outdated. In many cases, the older maps reflect outdated flood hazard information that limits their utility for insurance and floodplain management purposes. Additionally, most of the maps were prepared using road network information and manual cartographic techniques that are now outdated. This makes the maps difficult for State and local customers to use and expensive for FEMA and the State of New Mexico to maintain. However, as a result of the previous four years of mapping efforts New Mexico currently has three completed counties, nine preliminary studies completed and ten studies in process. No mapping activities are planned for ten counties, with one county's study on-hold as directed by the Regional Map Center. Figure 2.51 shows the status of each County DFIRM as of January 2013. Preparedness Area boundaries are also included on the map.

Figure 2.51: DFIRMs Status in New Mexico as of January 2013



Current FEMA designated flood zones identified for New Mexico are described below:[50]

- **Moderate to Low Risk Areas:** In communities that participate in the NFIP, flood insurance is available to all property owners and renters with moderate to low risk.
- ***Zones B, C, and X:*** Areas with less than a 1% chance of flooding each year; areas that have less than a 1% chance of sheet flow flooding with an average depth of less than 1 foot; areas that have less than a 1% chance of stream flooding where the contributing drainage area is less than 1 square mile; or areas protected from floods by levees. No base flood elevations or depths are shown within these zones.
- **High Risk Areas:** In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all A zones.
- ***Zone A:*** Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30 year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
- ***Zone AE and A1-A30:*** Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30 year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- ***Zone AH:*** Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- ***Zone AO:*** River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
- ***Zone AR:*** Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
- ***Zone A99:*** Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

Undetermined Risk Areas

- ***Zone D (present in Socorro County):*** Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

[50] Source: http://www.fema.gov/library/viewRecord.do?id=2324

Previous Occurrences

New Mexico has experienced numerous flood/flash flooding events in each Preparedness Area. The current online NCDC database is limited in past events and only contains data from January 2006 to December 1, 2012, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total of 310 flood/flash flood events with 7 deaths and $45.562 Million in property damage and $4.132 Million in crop damage.[51] This equates to a 27% probability of a flash flood somewhere in the state every year.

Table 2.52 highlights those significant past occurrences by Preparedness Area. Table 2.52 provides historical data for all Preparedness Areas in New Mexico.

Table 5. Significant Past Occurrences of Flood/Flash Flood by Preparedness Area

Date	Location	Significant Event
August 24, 2012	Lincoln County (Preparedness Area 1) Los Alamos and Santa Clara Pueblo (Preparedness Area 3) Sandoval County (Preparedness Area 5) Mescalero Apache (Preparedness Area 6)	FEMA-DR- 4079 was declared on August 24, 2012 for emergency work and repair/replacement of facilities damaged by the flooding in Lincoln County, Sandoval County and the Pueblo of Santa Clara The flooding occurred during the period of June 22 to July 12, 2012. Los Alamos County and Mescalero Apache were added to the declaration at a later date. Source; http://www.fema.gov/pdf/news/pda/4047.pdf Early monsoon rains provided an initial moisture surge impacting parts of the state June 20 through 22, 2012. Moisture spread into western New Mexico on June 21, giving the Albuquerque to Belen corridor (Preparedness Area 5) around one half to three quarters of an inch of rain. Additionally, heavy rain and flash flooding impacted the Little Bear and Whitewater Baldy burn scars on June 22 (Preparedness Area 6). A much more significant and sustained monsoon burst developed on July 2, 2012 and peaked July 5 and 6, 2012 before weakening July 11, 2012. Source; National Weather Service – Albuqeurque**,** 2012 Monsoon Season Summary

[51] Source: http://www.ncdc.noaa.gov/stormevents/

Date	Location	Significant Event
November 23, 2011	Pueblo of Santa Clara (Preparedness Area 3) Cibola County and Pueblo of Acoma (Preparedness Area 4) Sandoval County (Preparedness Area 5)	FEMA-DR- 4047 was declared for emergency work and repair/replacement of facilities damaged by the flooding in Cibola County, Sandoval County, the Pueblo of Acoma and the Pueblo of Santa Clara. The flooding occurred during the period of August 19-24, 2011. Source; http://www.fema.gov/pdf/news/pda/4047.pdf
August 12, 2012	Thoreau, NM Preparedness Area 4	A backdoor cold front pushed across the state from the northeast corner through the gaps of the central mountain chain and continued westward to the Arizona border. This front in combination with rich low level Gulf of Mexico moisture and mid-level monsoon moisture created a very unstable atmosphere. Precipitable water values were nearly 150% of normal across much of the state. Slow storm movement and repeated development of storms over the same general areas led to flash flooding in western New Mexico. Flooding was reported into Thoreau Baptist Church, Giant Gas Station, Thoreau Chapter House as well as multiple other businesses and 6 homes. Several bridges and roads were also washed over with debris, including state roads 118, 371 and 612 and county roads 61, 27, 51, and Castle Rock.
August 22, 2011	Cochiti Pueblo Preparedness Area 5	For the second day in a row, the southern portions of the Las Conchas burn scar was inundated with heavy rains as weak disturbances continued to round the western periphery of the upper high. Though storm coverage was less than on the 21st, slow storm motions resulted in significant impacts. Cochiti Canyon sustained the brunt of the flooding and damage as over 2 inches of rain fell on the headwaters. During the damage survey of the previous days flooding, abundant rain above Cochiti Canyon resulted in another, more devastating flood, to Dixon's Apple Orchard which was witness first hand by the NWS Albuquerque Warning Coordination Meteorologist. The force of the flow was estimated to be 3 times as that of the previous days flood. At least 10 feet high, the width of the flood waters was approximately 100 yards wide. 20 to 40 percent more of the apple orchard was destroyed. Also, the main storage building that sustained damage in the previous days flood was wiped completely off its foundation. The semi truck that moved 200 yards before, was washed downstream and ended up in the Cochiti Lake Reservoir in pieces. Property damage costs totaled

Date	Location	Significant Event
		$3M.
August 21, 2011	Frijoles, NM Preparedness Area 5	The first day of flash flooding over the Las Conchas burn scar was widespread as weak upper level disturbances rounded the west side of the upper high. Early in the afternoon, showers and thunderstorms developed over the central and northern portions of the burn scar. These storms generally produced 1 to 2 inches of rainfall. Later in the afternoon and early evening, even stronger and very slow moving storms developed across the southern portions of the burn scar. Radar estimated 3 to 4 inches of rain across a widespread area. Flash flooding was reported with each of these storms. The storms moved eastward over Santa Fe in the evening, and produced additional flooding. Major flash flooding ensued after an estimated 3 to 4 inches of rain fell across the southern portion of the Las Conchas burn scar. Flooding in Frijoles Creek caused damage in and around Bandelier National Monument. Two barrier walls around the Visitors Center were overtopped and the septic system lift station was inundated with water. Major flooding was also reported in Peralta Canyon around Kasha Katuwe (Tent Rocks) National Monument. Damage was reported to the access road as well as other local roads. ||Along and downstream of Cochiti Canyon sustained the most damage from flood waters. Flows were reported to be 8 to 10 feet high when they reached Dixon's Apple Orchard. The flood waters damaged the owners personal residence, inundated the

Date	Location	Significant Event
		main storage facility with 10 feet of mud and debris, moved a semi-truck approximately 200 yards and destroyed approximately 10 percent of the apple orchard. The water also wiped out a 50 yard long 4 foot by 4 foot rock retaining wall that was built in 1942. Property damage was reported to be $3.75M and crop damage was $1M.
August 21, 2011	Los Alamos, NM Preparedness Area 3	The first day of flash flooding over the Las Conchas burn scar was widespread as weak upper level disturbances rounded the west side of the upper high. Early in the afternoon, showers and thunderstorms developed over the central and northern portions of the burn scar. These storms generally produced 1 to 2 inches of rainfall. Later in the afternoon and early evening, even stronger and very slow moving storms developed across the southern portions of the burn scar. Radar estimated 3 to 4 inches of rain across a widespread area. Flash flooding was reported with each of these storms. The storms moved eastward over Santa Fe in the evening, and produced additional flooding. After 1 to 1.5 inches of rain fell on the northern portion of the Las Conchas burn scar, flash flooding was reported in Santa Clara Canyon. Four people that were working in the canyon had to be rescued by helicopter. Total reported property damage was $6M.
August 14, 2008	Navajo Nation Guadalupe and Lincoln Counties (Preparedness Area 1) Harding, Mora and San Miguel Counties (Preparedness Area 2) Rio Arriba and Taos Counties (Preparedness Area 3) Cibola and McKinley Counties (Preparedness Area 4) Sandoval, Socorro, Torrance and Valencia Counties	Severe storms and flooding between July 26 and Sept. 18, 2006 lead to disaster declaration FEMA 1659. In what was determined to be a 500-yr event, strong thunderstorms developed over the southern Sacramento Mountains and along the eastern heights of Alamogordo. One storm in particular dropped about an inch and a half of rain in 40 minutes over Marble Canyon, which drains into eastern Alamogordo. Roads along the eastern heights turned into raging torrents, which flowed westward into the center of town. The entire city of Hatch was flooded and mud flowed into numerous houses and apartments, when an arroyo overflowed. The entire apartment complex was condemned and 150+ families were evacuated. The Rio Grande River reached a stage of 9.3 feet, the highest in 50 years. The Navajo Nation (where two deaths occurred) and 19 counties were declared eligible for public assistance funds including: Cibola, Doña Ana, Grant, Guadalupe, Harding, Hidalgo, Lincoln, Luna, McKinley, Mora, Otero, Rio Arriba, Sandoval, San Miguel, Sierra, Socorro, Taos, Torrance and Valencia. Doña Ana and Otero counties were declared for Individual Assistance. Federal funding for this disaster exceeds $20 million (Source: New Mexico Storms and Flooding– FEMA-1783-DR."http://www.fema.gov/pdf/news/pda/1783.pdf. Federal

Date	Location	Significant Event
	(Preparedness Area 5) Dona Ana, Grant, Hildago, Luna, Otero and Sierra Counties	Emergency Management Agency, 14 Aug. 2008. Web. 13 May 2010. http://www.fema.gov/pdf/news/pda/1783.pdf)
May 23, 2007	Luna County Sierra County Doña Ana County (Preparedness Area 6) San Juan County (Preparedness Area 4) Rio Arriba County Las Alamos County (Preparedness Area 3) Sandoval County (Preparedness Area 5)	Federal disaster funds were authorized for this event (FEMA-1301) in September 1999 to help communities recover from the floods in Luna, Sierra, Doña Ana, San Juan, Rio Arriba, Los Alamos, Sandoval, and Mora Counties.
July 26 through September 18, 2006	Southern Sacramento Mountains, Alamogordo, Hatch, 19 Counties Preparedness Areas	Disaster declaration FEMA 1659. In what was determined to be a 500-yr event, strong thunderstorms developed over the southern Sacramento Mountains and along the eastern heights of Alamogordo. One storm in particular dropped about an inch and a half of rain in 40 minutes over Marble Canyon, which drains into eastern Alamogordo. Roads along the eastern heights turned into raging torrents, which flowed westward into the center of town. The entire city of Hatch was flooded and mud flowed into numerous houses and apartments, when an arroyo overflowed. The entire apartment complex was condemned and 150+ families were evacuated. The Rio Grande River reached a stage of 9.3 feet, the highest in 50 years. The Navajo Nation (where two deaths occurred) and 19 counties were declared eligible for public assistance funds including: Cibola, Doña Ana, Grant, Guadalupe, Harding, Hidalgo, Lincoln, Luna, McKinley, Mora, Otero, Rio Arriba, Sandoval, San Miguel, Sierra, Socorro, Taos, Torrance and Valencia. Doña Ana and Otero counties were declared for Individual Assistance. Federal funding exceeded $20 million (source: *http://www.fema.gov/pdf/news/pda/1783.pdf*)

Date	Location	Significant Event
April 2004	Bernalillo County Preparedness Area 5 Eddy County Preparedness Area 1 Mora County San Miguel County Preparedness Area 2	Heavy thunderstorms caused flash flooding in several areas of the state. This flooding lead to federal disaster (FEMA-1514) funds being authorized for four counties (Bernalillo, Eddy, Mora, and San Miguel). Damage costs for this event were approximately $5.8 million.
July 2, 2001	Los Alamos County Preparedness Area 3	A storm with heavy rain of 1 to 2 inches in an hour developed over Pueblo Canyon on the west edge of Los Alamos. Storm runoff from the burned forest was brief, but intense with water and mudflows estimated at 1,500 cubic feet per second, which overwhelmed the inlet structure west of North Road and then breached the street 60 feet above. A 150-yard section of road surface was destroyed and one of the city's main sewer lines was undercut and then broken. Debris filled the basements of at least five homes along Alabama Avenue. The total damage estimate for this event was $3.5 million.
May 23, 2001	Luna County Sierra County Doña Ana County Preparedness Area 6 San Juan County Preparedness Area 4 Rio Arriba County Las Alamos County Preparedness Area 3 Sandoval County (Preparedness Area 5)	Federal disaster funds were authorized for this event (FEMA-1301) in September 1999 to help communities recover from the floods in Luna, Sierra, Doña Ana, San Juan, Rio Arriba, Los Alamos, Sandoval, and Mora Counties.
July 29, 1999	Rio Rancho, NM Sandoval County Preparedness Area 5	A flash flood event from heavy rain of 2 inches in about 2 hours caused road and soil erosion in northern Rio Rancho. No injuries were reported, but residents in some of the newer or remote subdivisions on the far north edge of the city were stranded after numerous dirt roads and low water arroyo crossings were washed out. Some roads became gullies 4 feet deep and 14 feet wide. The area around the city landfill, along with Waste Water Treatment Plant #2, suffered heavily, with 2 miles of roads isolated by at least five deep cuts. Damage costs were estimated at $1 million.

Date	Location	Significant Event
June 16, 1999	Albuquerque, NM Bernalillo County Preparedness Area 5	Heavy rains up to 2 inches in a 45-minute period flooded streets and dry arroyos across northern Albuquerque. Over 100 new automobiles on a dealer lot were flooded by rapidly rising water. Poor or clogged drainage was partially to blame for these losses. The total losses were estimated at $1.2 million.
July 28, 1994	Las Cruces Doña Ana County (Preparedness Area 6	Heavy rains up to 3 inches produced flooding in several businesses, an apartment complex, and a church day care center. Property damage was estimated at $5 million.

Table 2.53 describes those significant events that have occurred in New Mexico with in specific Preparedness Areas. Information provided by NCDC and local Emergency Managers.

Figure 2.53. State Disaster Event History (2003 – 2012)

Event Type	State Executive Order	State and Local Dollar Loss
Flood	03-045	$43,427
Flood	03-046	$24,611
Flood	04-036	$429,172
Flood	04-038	$415,068
Flood	04-057	$70,323
Flood	04-064	$18,849
Flood	05-008	$1,352,561
Flood	05-057	$1,112,649
Flood	05-058	$352,262
Flood	06-033	$1,063,724
Flood	06-043	$347,180
Flood	06-045	$750,000
Flood	06-047	$750,000

Flood	06-054	$750,000
Flood	06-055	$750,000
Flood	07-001	$750,000
Flood	07-004	$750,000
Flood	07-017	$750,000
Flood	07-018	$750,000
Flood	07-019	$750,000
Flood	07-046	$225,671
Flood	08-042	$750,000
Flood	08-042a	$750,000
Flood	08-048	$266,666
Flood	08-049	$16,470
Flood	08-050	$66,666
Flood	08-051	$311,018
Flood	10-031	$266,666
Flood	10-034	$1,000,000
Flood	10-035	$533,333
Flood	10-036	$1,000,000
Flood	10-039	$333,333
Flood	10-040	$33,333
Severe Storm and Flood	10-042**	$333,333
Severe Storm and Flood	10-045	$1,000,000
Flood Threat	11-063**	$750,000
Flooding	11-075	$300,000
Flood Threat	12-007**	$250,000

Flooding	12-008**	$450,000
Flood Threat	12-018**	$750,000
Flood	13-001**	$10,500,000

Declared Disasters from Flood/Flash Flooding

DHSEM reports 40 State Declared Disasters for flooding between 2003 and 2013 (Figure 2.54). This number is based on how many Executive Orders were signed by the Governor for flooding or flood threat. According to DHSEM records, the total cost for State declared flood events from 2003 through 2012 was $31,866,315. The total does not reflect all costs for federal disasters 4047 and 4079 which are still being tallied. Data is not broken out by Preparedness Area. Research into locations for each disaster would need to be completed prior to breaking-out the figures by Preparedness Area.

Figure 2.54. New Mexico Flood Disaster Costs (2003 – 2012)

Event Type/Name	Event Number	Federal Share	State Share	Total Cost	State % of Total
Flood	1514	$4,351,152	$1,086,967	$5,801,536	18.74%
Flood	1659*	$33,861,482	$8,126,756	$45,148,643	18.00%
Severe Storms and Flooding	1783*	$12,598,624	$2,519,725	$16,798,165	15.00%
Flood	1936*	$7,007,898	$1,401,580	$9,343,864	15.00%
Flood	4047**	$27,217,485	$4,536,248	$36,289,980	12.50%
Flood	4079**	$43,805,282	$7,300,881	$58,407,042	12.50%
Total	**6**	**$85,036,641**	**$17,671,275**	**$113,382,188**	

**Event still open with total costs still being tallied.

Six of the 40 State flood disasters were also federally declared disasters. The total Public Assistance dollar losses from federal, State and local government entities and all tribal entities was $113,382,188. The State contributed between 12.5% and 18.74% of the total cost for the disasters. The percentage of State contribution varied with each disaster. Again, the total does not reflect all costs for federal disasters 4047 and 4079 which are still being tallied. Data is not broken out by Preparedness Area. Research into locations and costs for each County for these disasters would need to be completed prior to breaking-out the figures by Preparedness Area.

Another source of flood damage information is from the NCDC. Below is a tally of flood damage as reported by NCDC broken out by Preparedness Area (Figure 2.55). According to NCDC from 2006 through 2012 State-wide property damage from flood damage was $47,353,000 and crop damage was $7,549,500.

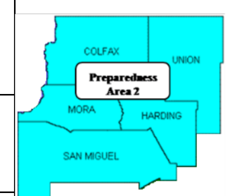
Figure 2.55. Preparedness Areas 1 - 6 Flood/Flash Flood History (January 1, 2006 - December 1, 2012)

Preparedness Area 1
Counties: Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	3	0	1	0	$25,004,000	$1,000
Flash Flooding	**55**	0	**0**	**0**	$7,811,000	$1,500
Total	**58**	**0**	**0**	**0**	$32,815,000	$2,500

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	0	0	0	0	0	0
Flash Flooding	14	0	0	0	$936,000	0
Total	**14**	**0**	**0**	**0**	$936,000	**0**



Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

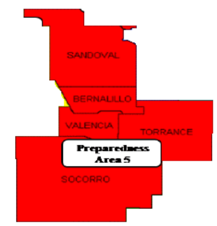
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	1	0	0	0	$5,000	0
Flash Flooding	24	0	0	0	$155,000	0
Total	**25**	**0**	**0**	**0**	**$160,000**	**0**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	0	0	0	0	0	0
Flash Flooding	35	0	0	0	$996,500	0
Total	**35**	**0**	**0**	**0**	**$996,500**	**0**

Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	0	0	0	0	0	0
Flash Flooding	39	0	2	0	$7,901,500	$3,003,000
Total	**39**	**0**	**2**	**0**	**$7,901,500**	**$3,003,000**



Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

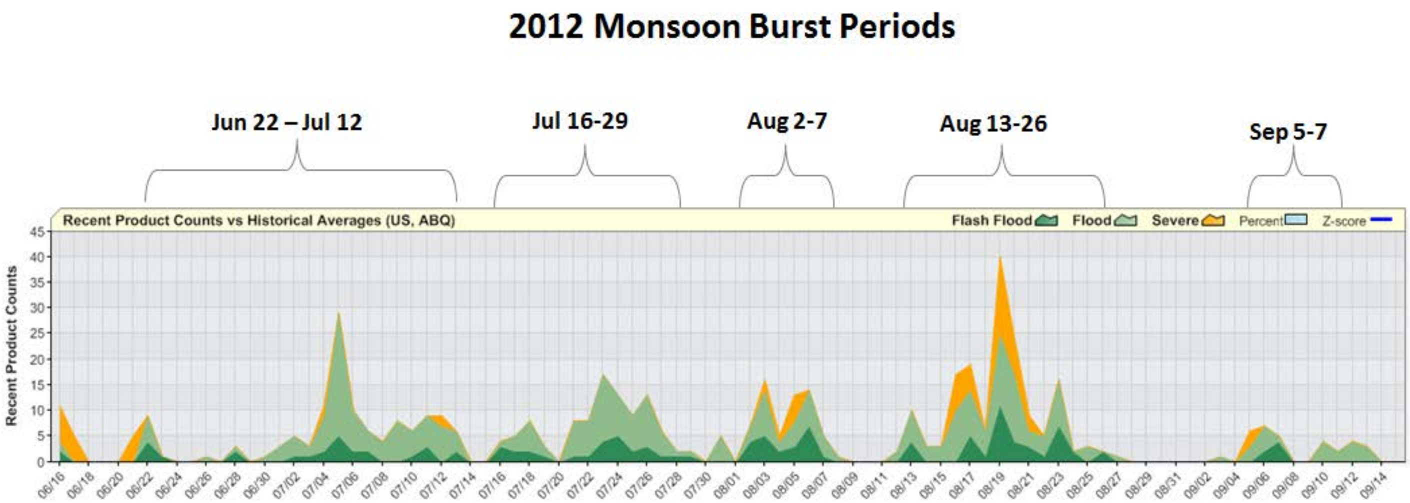
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Flood	7	0	0	0	$105,000	0
Flash Flooding	52	0	0	0	$1,776,350	$4,544,000
Total	**0**	**0**	**0**	**0**	**$1,776,350**	**$4,544,000**

Table 2.55 outlines significant past events that have occurred in New Mexico Preparedness Areas broken. Information is as of December 1, 2012 and provided by the NCDC at http://www.ncdc.noaa.gov

Frequency

Most of the flash floods in New Mexico are associated with the summer monsoon season. Approximately 60% of all flash floods in the state occur in July and August. The monsoon season generally dissipates in the northern part of the state (Preparedness Area 4) in early September. In mid to late summer, the pacific winds bring humid subtropical air into the state. Solar heating triggers afternoon thunderstorms that can be devastating. July and August 2012 brought intense flooding with burn scar areas producing up to 400% greater flows than the calculated 1% chance storm event. Figure 2.56 shows the monsoon burst periods that caused numeorus flood events. Information provided by the National Weather Service in Albuquerque**,** 2012 Monsoon Season Summary.

Figure 2.56: 2012 Monsoon Burst Periods



Because of too much rain, in too small an area, in too short a time, flash flooding may result. These flash floods generally travel down arroyos (normally dry streambed) and can involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage that includes the uprooting of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain. Dam failure and ice jams may also lead to flash flooding. Urban areas are increasingly subject to flash flooding due to the removal of vegetation, replacement of ground cover with impermeable surfaces, and construction of drainage systems. Local drainage floods may occur outside of recognized drainage channels or delineated floodplains due to a combination of locally heavy precipitation, a lack of infiltration, inadequate facilities for drainage and storm water conveyance, and increased surface runoff.

Winter flash flood events usually result from unseasonably high-level rain on top of a snow pack. Excessive runoff allows the combined release of the water in the snow pack along with the rain. These can be flash flood events lasting less than a day, or they can evolve into longer-term flooding events lasting from 1 day to a couple of weeks. Winter flooding occurs between November and February and usually affects the southwest portion of the state.

Most spring events occur between April and June. They vary between winter type events where the rain falls over the remaining winter snow pack in or near the mountains to events in the eastern plains, which are often associated with cold fronts, abundant moisture from the Gulf of Mexico, and upslope conditions. Although all of the eastern plains are subject to this type event, the greatest frequencies have been in the far southeast, in Eddy and Lea Counties (Preparedness Area 1).

Late summer floods can occur due to hurricane remnants and tropical storms that move over the state from both the Gulf of Mexico and the Pacific Ocean. By the time these remnants reach New Mexico, however, usually the only feature remaining is an abundance of moisture. Hurricane-force winds have long since dissipated. Flash floods frequently occur on alluvial fans with devastating results. The combination of rapidly rising floodwater, high velocities and heavy sediment/debris loads contributed to the damage in Alamogordo and Hatch (Preparedness Area 6) in 2006 (Figure 2.57).

Figure 2.57: Flooding in Preparedness Area 6 (Alamogordo and Hatch, NM) 2006

The series of photos show the devastation form floods in Preparedness Area 6 (Alamogordo and Hatch, NM). Photos provided by NMDHSEM.

Probability of Occurrence

Each Preparedness Area has several conditions that may contribute to flash floods and exacerbate the associated impacts:

- Steep Slopes: have moderate to steep sloping terrain that can contribute to flash flooding, since runoff reaches the receiving arroyos and rivers more rapidly over steeper terrain
- Obstructions: During floods, obstructions can block flood flow and trap debris, damming floodwaters and potentially causing increased flooding uphill from the obstructions
- Soils: Soils throughout much of the state are derived from underlying parent materials rich in carbonate as well as mixed clays. As a result, soils are typically fine grained, and have low infiltration rates and high runoff potential. Vegetative cover is either mixed shrubs or mixed

grasses. Sparse vegetative cover combines with high runoff soil potential to result in significant flooding hazards in ephemeral washes and adjacent areas

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed as the percentage chance that a flood of a specific magnitude will occur in any given year (Table 2.58).

To determine the probability of New Mexico experiencing flood/flash flood event, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of January 2006 to December 2012 (84 months). Probability was determined by dividing the number of events observed by the number of months and multiplying by 100. This gives the percent chance of the event happening in any given year. In applying this formula, Preparedness Areas probabilities to the following hazards are identified in Table 2.58.

Table 2.58: Probability of Occurrence - Flood/Flash Flood

Probability of Occurrence		
Preparedness Area	Flood	Flash Flooding
Preparedness Area 1	3.6%	66%
Preparedness Area 2	0%	17%
Preparedness Area 3	1.2%	29%
Preparedness Area 4	0%	42%
Preparedness Area 5	0%	46%
Preparedness Area 6	8.3%	62%

Risk Assessment

New Mexico and other areas across the Southwest U.S. are affected by the North American Monsoon System (NAMS) every summer, and the “Monsoon Season” is designated as the period lasting from June 15th through September 30th. With the onset of the Monsoon, New Mexico is typically impacted by a variety of weather hazards that can often put the population at risk for serious injury or death. Thunderstorm frequency increases during this period, while exceptionally hot days are common as well. These pages were prepared to help promote awareness of the life-threatening weather hazards that affect New Mexico during the Summer Monsoon. Impacts from Floods/Flash Flooding to New Mexico are identified in Table 2.59 for the purposes of EMAP compliance.

Table 2.59: Potential Impacts from Flood/Flash Flood Events

Subject	Potential Impacts
Health and Safety of the Public	Flooding in the state has been known to sweep people away and be drowned
Health and Safety of Responders	Same impact as the public
Continuity of Operations	While the flooding in New Mexico is generally short lives the long-term impacts such as in the Village of Hatch can shut down an entire community for weeks.
Delivery of Services	Delivery of services may be impossible for weeks.
Property, Facilities, Infrastructure	Facilities in the flooded areas will sustain damages, up to and including total loss. Utilities such as water and sewage may be completely unusable
Environment	Long term severe impacts are possible due to the severe contamination often found in flood waters. Fortunately for us, flash flooding passes quickly and doses not linger. However the strong forces of the water can cause massive amounts of erosion and can divert natural waterways.
Economic Condition	As we saw in 2006, communities can have severe economic losses in the form of damages, and business shutdowns.
Public Confidence	If a community is impacted by flooding, the public may very well be angry for allowing development to occur in hazardous areas, or for allowing adverse impacts downstream form development.

Below are six preparedness area scale floodplain maps based on existing flood insurance rate maps. Figures 2.60 – 2.65 delineate Special Flood Hazard Areas (SFHA), or land zones that are subject to inundation by a flood. Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. On this map, the SFHAs are shaded with different colors and divided into distinct flood hazard zones depicted on the map legend. Each zone reflects the severity or type of flooding in the area. The flowing flood zone maps have been included to allow for a finer level of analysis by depicting flood risks by Preparedness Area.

Figure 2.60. Preparedness Area 1 Floodplain Map

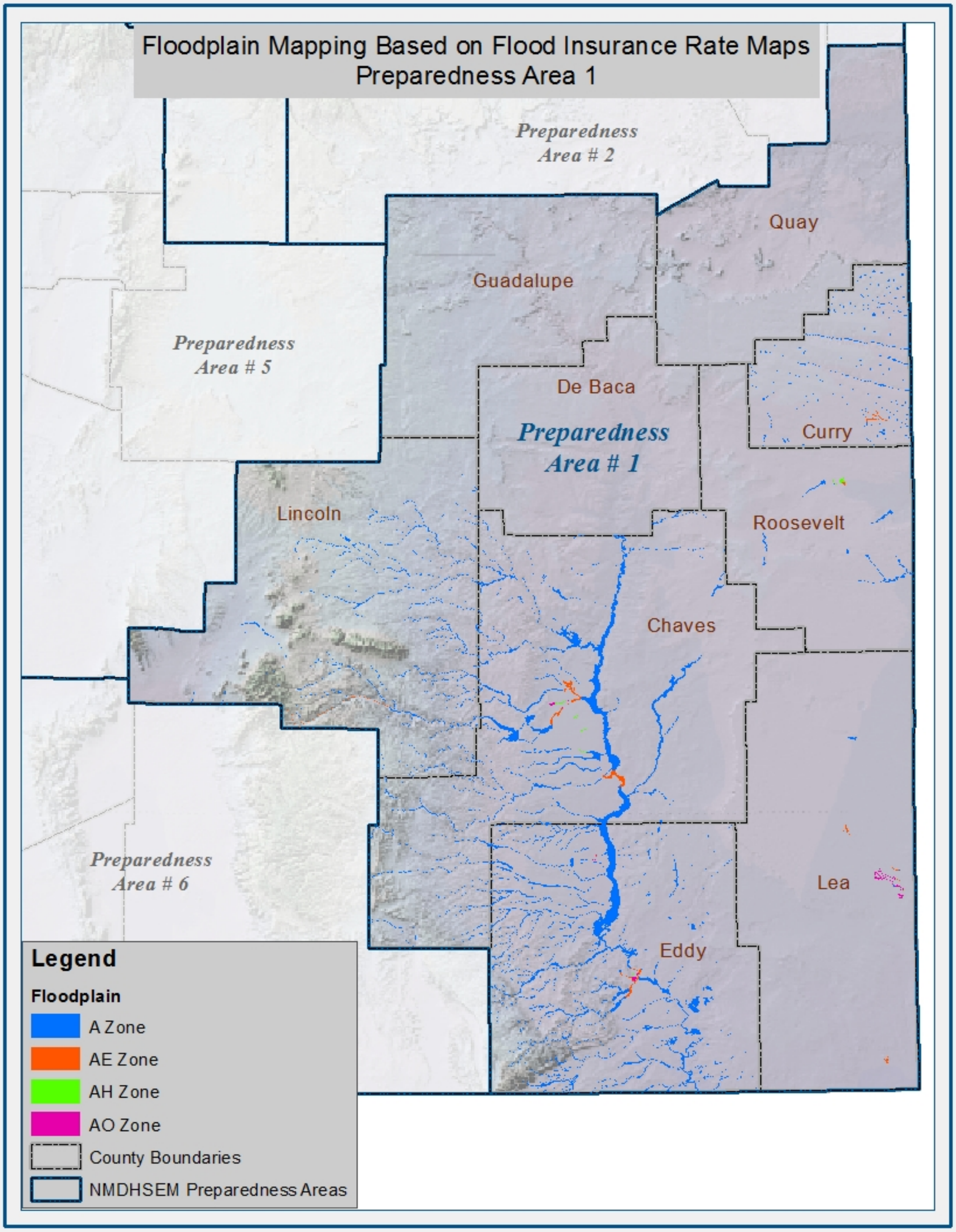


Figure 2.61. Preparedness Area 2 Floodplain Map

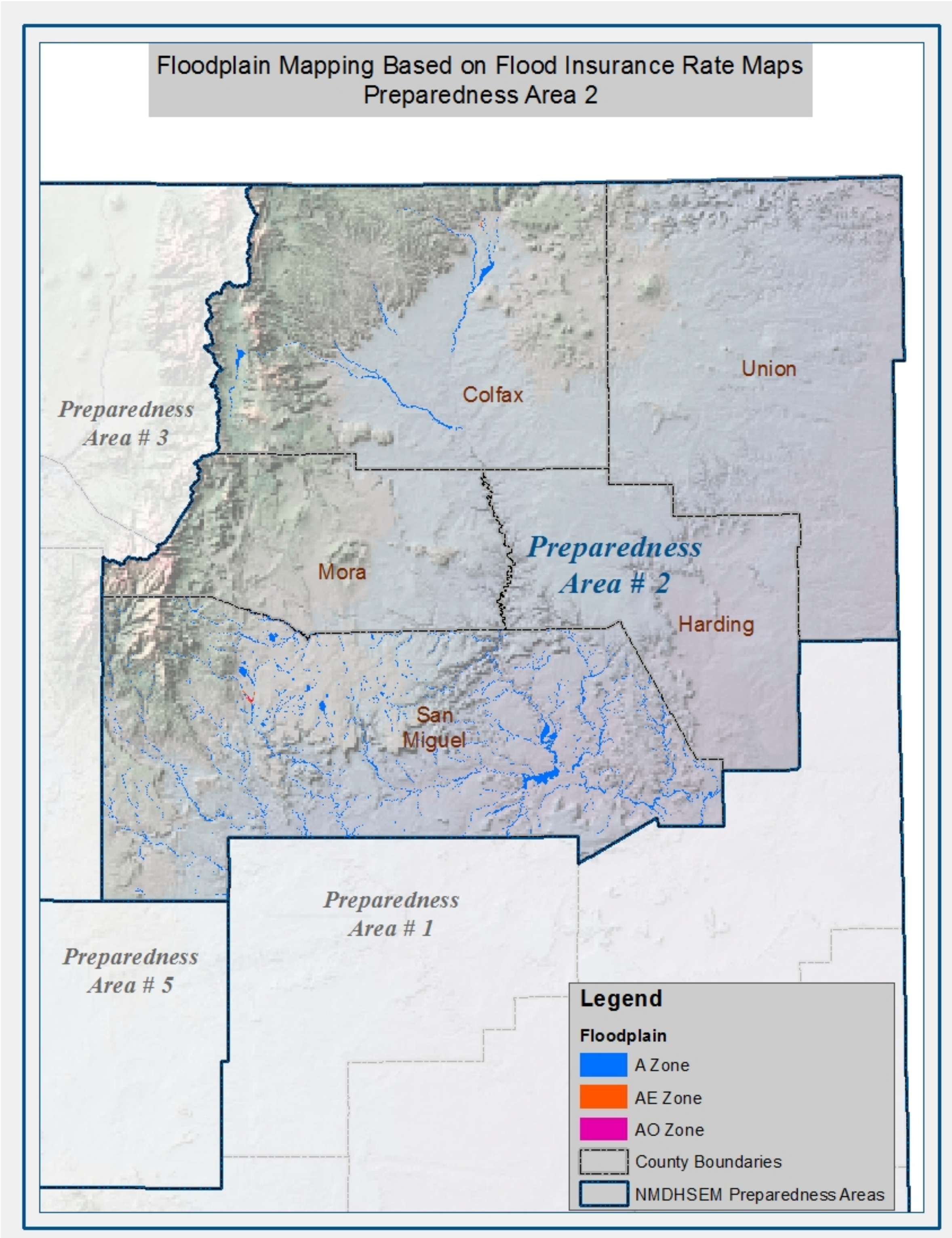


Figure 2.62. Preparedness Area 3 Floodplain Map

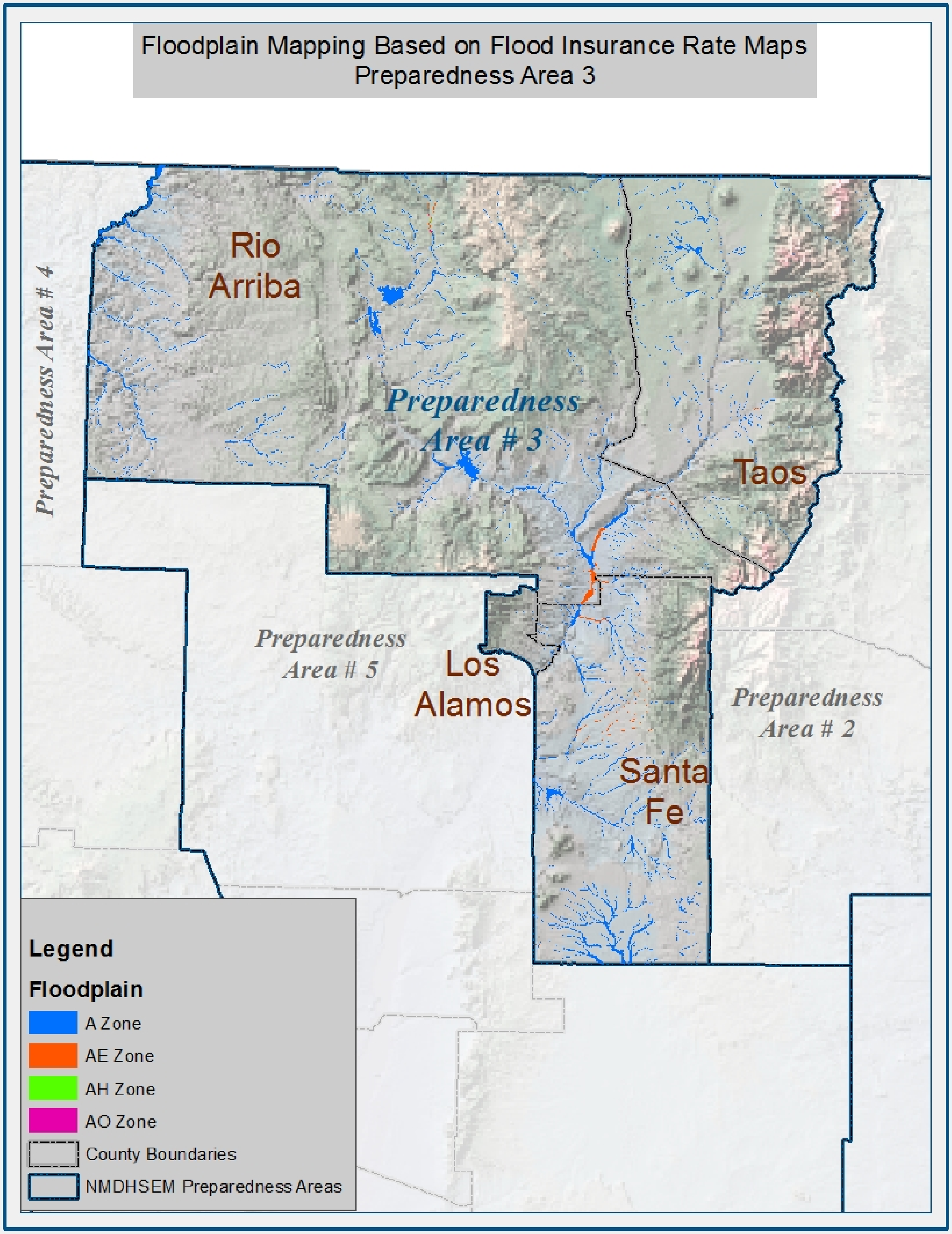


Figure 2.63. Preparedness Area 4 Floodplain Map

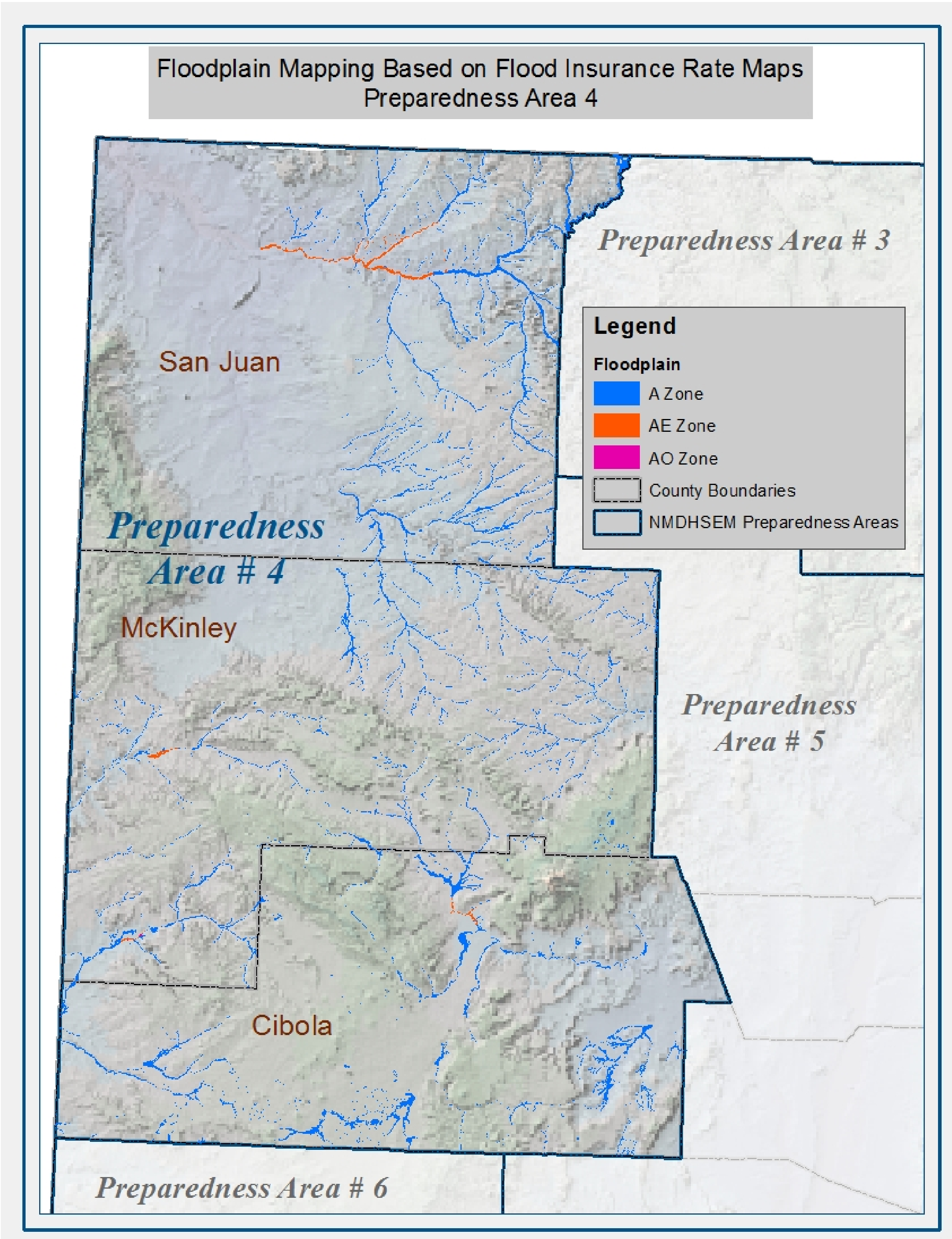


Figure 2.64. Preparedness Area 5 Floodplain Map

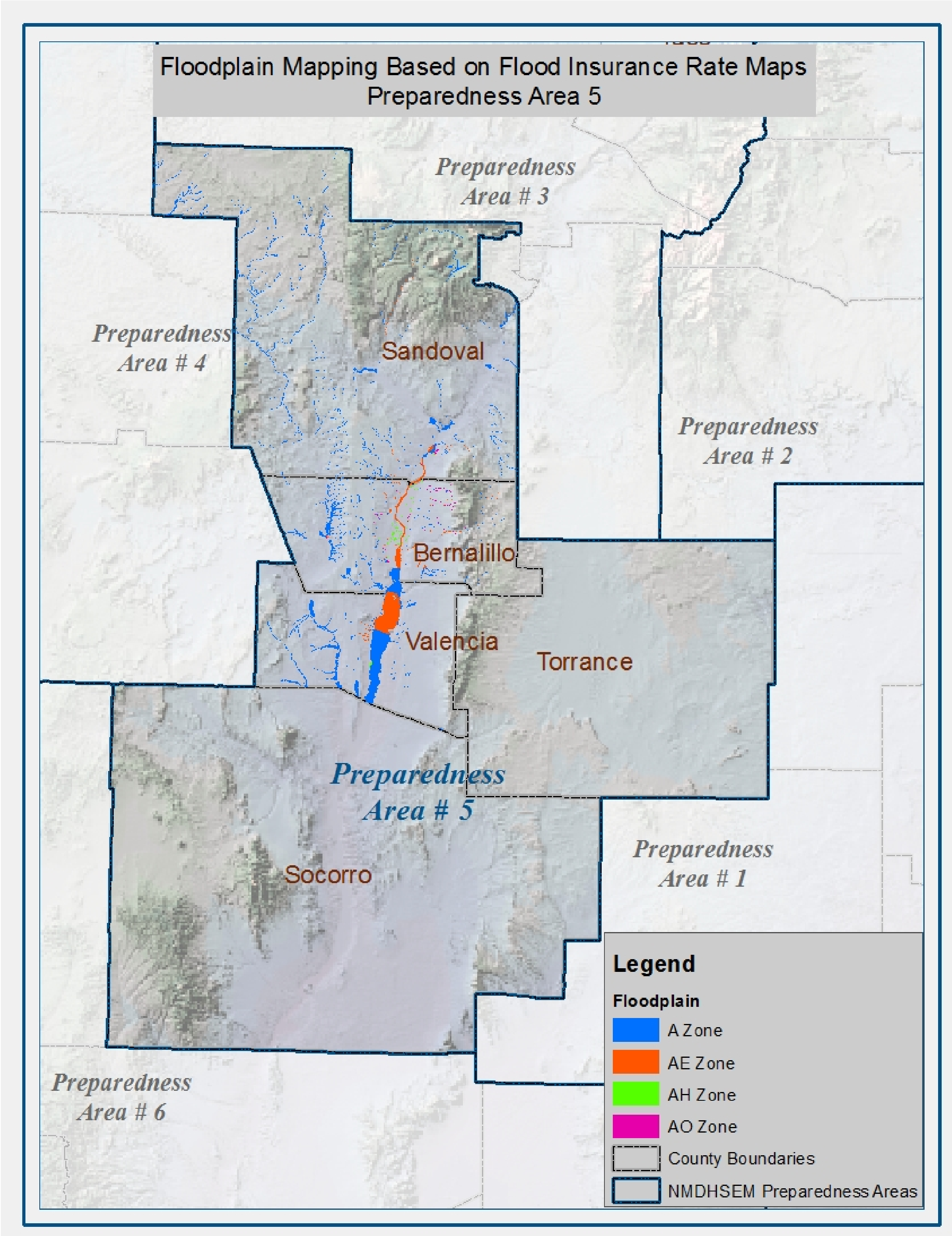
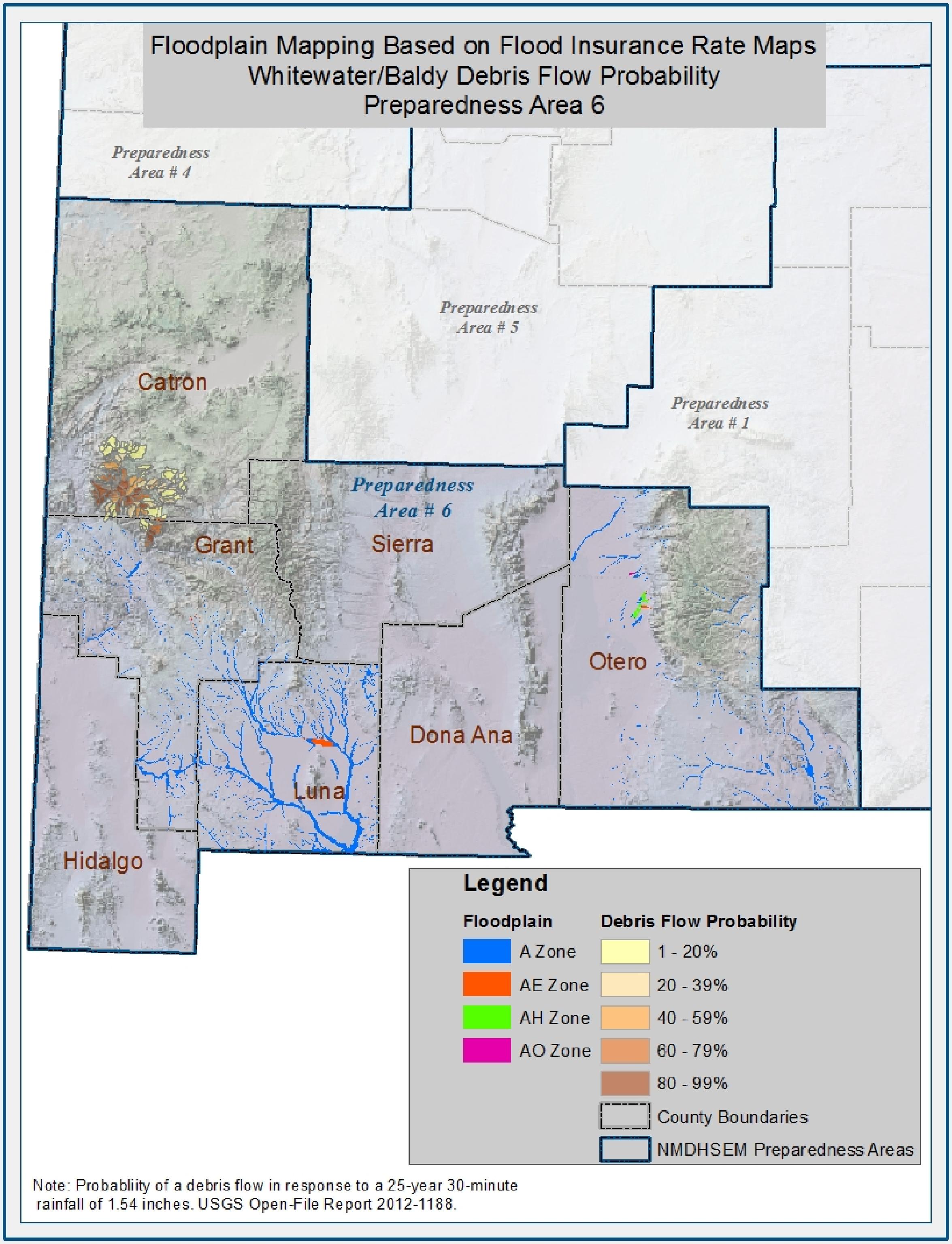


Figure 2.65. Preparedness Area 6 Floodplain Map



Flash floods have been and will continue to be a significant threat to the economic and social well-being in the State of New Mexico. Based on previous occurrences, Preparedness Areas 1 and 6 may be more prone to the effects of a flash flood occurring. Moving forward, Figures 2.60-2.65 are tools that each Preparedness Area can use to develop strategies that may decrease or eliminate the potential impacts from such an event.

Flooding and Debris Flow Post-fire

Freshly burned landscapes are at risk of damage from post-wildfire erosion hazards such as those caused by flash flooding and debris flows. Burn scar areas have a tremendous impact on flood and debris flow following short duration high intensity rainfall. These high volume low frequency floods result from typical monsoon summer rains and occur in and downstream of the burn scar areas. Dramatic changes in runoff, erosion, and deposition have been documented in watersheds affected by wildfire. These post-fire changes have led to loss of life, damage to property, and significant impacts on infrastructure.

Extreme soil damage occurs within watersheds that experience a wildfire. Soil damage usually occurs where burn intensities are severe to moderate. The loss of the organic components in the soil greatly decreases the ability of rain to infiltrate. Within these burned areas, large floods result from average monsoonal rainstorms. In combination with the damaged soil, the destruction of vegetation by wildfires and in particular the forest canopy has created high potential for floods. In general, coniferous trees intercept more rainfall than deciduous trees in full leaf. New Mexico forests are predominantly Coniferous and the risk for flooding is increased when these forest types and others are drastically reduced and destroyed by wildfires.

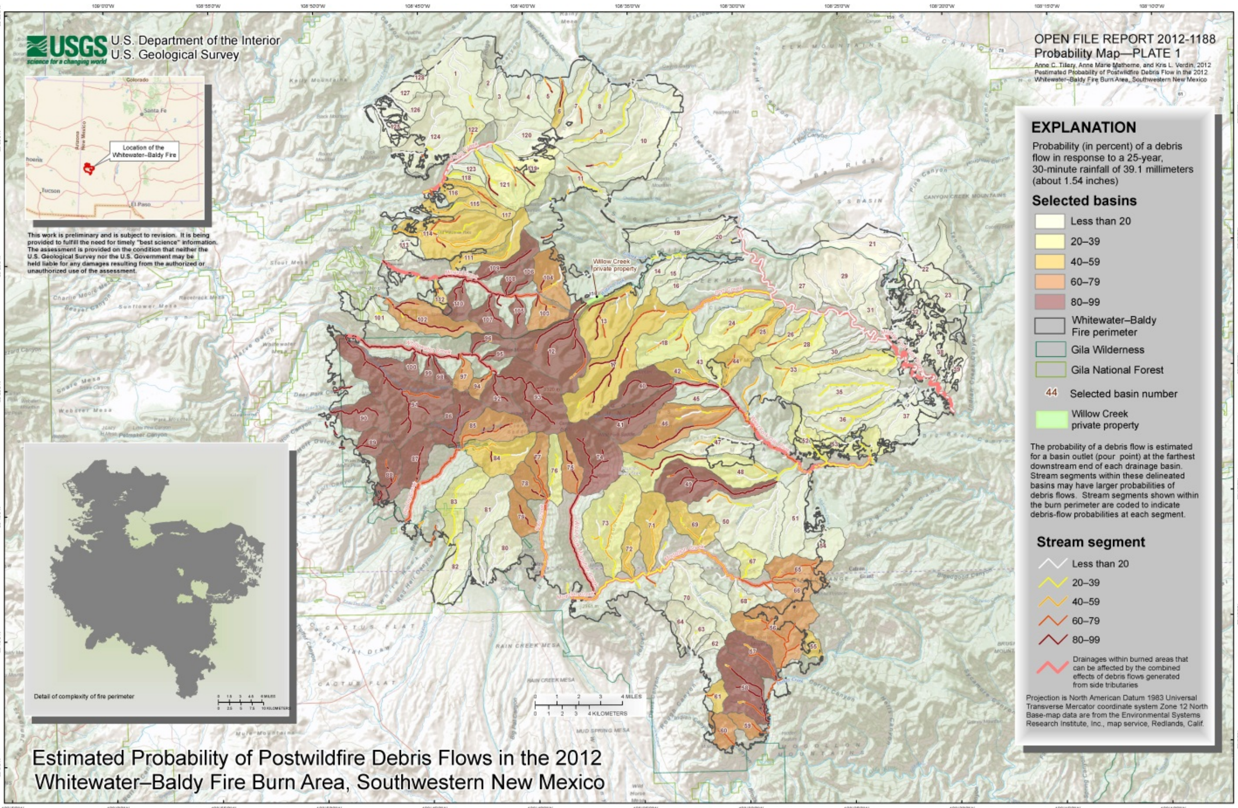
Increased long term risk of flooding will continue for years after a watershed has experienced a burn. Ongoing concerns are the increased potential for flooding and debris flow plus large amounts of sediment being transported from the burn scar areas. Additionally, debris flows could create temporary dams or sediment plugs along drainage courses that could fill and breach, sending flood waves downstream creating life safety issues. Life safety concerns are higher in those communities located downstream of burned watersheds.

Debris flows are destructive, fast-moving slurries of water and sediment that can originate from rainfall on recently burned, rugged areas and can have an enormous destructive power. The location, extent, and severity of wildfire and the subsequent rainfall intensity and duration cannot be known in advance; however, it is possible to determine likely locations and sizes of post-wildfire debris flows using available geospatial data and mathematical models. Debris flow hazards can also be assessed for areas that have not burned but are at high risk of wildfire.

The USGS has developed a model to estimate post-wildfire debris-flow probability and volume for watersheds originating in basins of concern, or areas most at risk for loss of life and property. Figure 2.66 shows an example of how debris flow hazard assessments conducted by the USGS for the area burned by the 2012 Whitewater-Baldy Complex Fire in Lincoln and Hidalgo Counties. The full USGS

Report includes three maps that show the probability of a flood, volume estimates and a combined map showing both factors.[52]

Figure 2.66. Post-wildfire debris flow analysis for the Whitewater-Baldy Complex Fire



The USGS, in cooperation with the U.S. Forest Service and NOAA, has conducted debris-flow analyses for the Las Conchas fire, the Track fire, and the Little Bear Fire.[53] Studies of these areas report high volume floods downstream of burn scar areas. The models showed that for a 28 millimeter rain in 30 minutes (equivalent to a 10-year recurrence interval), the debris flow probability increased by more than 80% for 67% of the basins burned by the Las Conchas Fire.

The models also showed that for a 38 millimeter rain in 30 minutes (equivalent to a 10-year recurrence interval), the debris flow probability increased by more than 80% for Railroad Canyon and Lake Maloya basins burned by the Track Fire (range of debris flow probability was from 2 to 97%). Lake Maloya is the main water supply for the City of Raton. Maps shown in the USGS Post-wildfire Debris Flow Assessment

[52] Map plates 2 and 3 can be found at the citations below:
Tillery, A.C., and Matherne, A.M., 2013, Postwildfire debris-flow hazard assessment of the area burned by the 2012 Little Bear Fire, south-central New Mexico: U.S. Geological Survey Open-File Report 2013–1108, 15 p., 3 pls. http://pubs.usgs.gov/of/2013/1108/

Tillery, A.C., Matherne, A.M., and Verdin K.L., 2012, Estimated probability of postwildfire debris flows in the 2012 Whitewater–Baldy Fire burn area, southwestern New Mexico: U.S. Geological Survey Open-File Report 2012–1188, 11 p., 3 pls: http://pubs.usgs.gov/of/2012/1188/

for the Area Burned by the Track Fire can be used for prioritization of erosion mitigation or protective measures.[54]

The Debris Flow Assessment Maps created for the area burned by the Las Conchas Fire can be used for prioritization of erosion mitigation or protective measures.[55] Basins with the highest probability of the highest debris flows include the upper Santa Clara Canyon (in the northern burn scar area) and Peralta, Colle, Bland, Cochiti, Capulin, Alamo and Frijoles Canyons (in the southern burn scar area). In the future, flood frequency predictions and debris flow hazard assessments could help land managers plan for and mitigate the effects of post-fire flooding and debris flows.

The main driver of post-fire watershed response is rainfall intensity. Short rain events can lead to significant flooding in wildfire damaged landscapes. To help communities decrease response time to potential flooding in burn scar areas, the USGS can install real-time rain gages in wildfire burn scars areas. Figure 2.67 is an example of a real time precipitation gage at Cochiti Mesa installed by a cooperative project of the USGS, US Forest Service and DHSEM. During the banner wildfire years of 2011 and 2012 in New Mexico, the USGS, in cooperation with the U.S. Forest Service, the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, the NM Department of Homeland Security, and the U.S. Park Service, installed real-time rain gages in the Las Conchas (6 gages), Whitewater Baldy (4 gages), and Little Bear (6 gages) burn scar areas. Figure 2 shows an example of a real-time rain gage installed by the USGS in the Los Conchas burn scar area on Cochiti Mesa. The data from the rain gages installed high in the watershed can accessed online at any time by citizens and managers and provide reliable information for use in reducing losses to life associated with post wildfire flooding.

[54] Source: *Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire debris flow hazard assessment for the area burned by the 2011 Track Fire, northeastern New Mexico and Southern Colorado: U.S. Geological Survey Open-File Report 2011-1257.* http://pubs.usgs.gov/of/2011/1257

[55] Source: *Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire preliminary debris flow hazard assessment for the area burned by the 2011 Las Conchas Fire in north-central New Mexico: U.S. Geological Survey Open-File Report 2011-1308.* http://pubs.usgs.gov/of/2011/1308

Figure 2.67. USGS real time precipitation gage at Cochiti Mesa (Las Conchas Fire).

The following figure (Figure 2.68) shows pre-burn and post-burn peak flows using a 25-year, 1-hour design storm for the area impacted by the Little Bear Fire (mostly in Lincoln County). The average change is a 158% increase in runoff. The highest increase was found in the Upper Big Bear Canyon with a 459% increase (from 573 to 3,202 CFS).

Figure 2.68. Little Bear Fire Data[56]

Watershed subHuc6	Acres	Peak CFS		
		Pre-Burn	Post-Burn	Increase
Eagle Lk_1	1086	851	1534	80%
Eagle Lk_2	586	565	960	70.0%
Kraut Creek	1027	1099	2871	161.0%
Little Creek	966	582	1744	200.0%
Philadelphia side drain	172	263	769	192.0%
SkiArea532drain	203	145	739	410.0%
Upper Big Bear Cyn	1050	573	3202	459.0%
FS_upper Eagle Crk Hm	2033	1794	4099	128.0%
Ski Area Outlet	1036	806	1515	88.0%
Upper Big Bear Cyn treated	1050	3202	2158	-32.6%
532midSkiDrain	117	36	93	160.0%
532NskiDrain	203	179	236	31.8%
Apache Bowl	278	60	123	105.0%
Moonshine Gulch	230	433	780	80.1%
Upper Reservoir Trib.	51	14	20	42.9%
average % change				**158%**

Data Limitations

In order to address the data deficiency, a team of subject matter experts (NM FPMA, local research scientists in geomorphology or geology) would study the probability, extent, vulnerability and impact of post-fire flooding and alluvial fan flood hazards.

What Can Be Mitigated?

For counties (Preparedness Areas) with extremely limited resources, mitigation actions have to be very specific and cost effective. As a result, mitigation actions should focus on property protection, localized corrective measures for drainage and erosion in developed areas, and ensuring that future development is sited out of the floodplain as identified by the study. One priority is to protect critical infrastructure such as utilities, access routes and water supply wellheads.

[56] Source: The Little Bear Fire Burn Area Emergency Response (BAER) Report (NOAA 14)

In order to address the data deficiency, a team of subject matter experts (NM FPMA, local research scientists in geomorphology or geology) would study the probability, extent, vulnerability and impact of post-fire flooding and alluvial fan flood hazards.

High Wind

Hazard Characteristics

Wind is defined as the motion of air relative to the earth's surface, and the hazard of high wind is commonly associated with severe thunderstorm winds (exceeding 58 mph) as well as tornadoes, hurricanes, tropical storms and nor'easters. High winds can also occur in the absence of other definable hazard conditions, events often referred to as simply "windstorms." High wind events might occur over large, widespread areas or in a very limited, localized area. They can occur suddenly without warning, at any time of the day or night.

Typically, high winds occur when large air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for severe thunderstorms, tornadoes and other windstorm events. These storms can occur singularly, in lines or in clusters. They can move through an area very quickly or linger for several hours.   While scales exist to measure the effects of wind, they can be conflicting or leave gaps in the information. For the purposes of this plan, we use the Beaufort Wind Scale (Table 2.69) because it is specifically adapted to wind effects on land.

Table 2.69: Beaufort Scale, December 2012[57]

Beaufort Wind Scale			
Beaufort Number	**Wind Speed mph**	**Description**	**Land Conditions**
0	0	Calm	Calm. Smoke rises vertically.
1	1-3	Light air	Wind motion visible in smoke.
2	4-7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	Moderate breeze	Dust and loose paper rises. Small branches begin to move.
5	19-24	Fresh breeze	Smaller trees sway.
6	25-31	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	Near gale	Whole trees in motion. Effort needed to walk against the wind.
8	39-46	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Strong gale	Light structure damage.
10	55-63	Storm	Trees uprooted. Considerable structural damage.
11	64-73	Violent storm	Widespread structural damage.
12	73-95	Hurricane	Considerable and widespread damage to structures.

[57] Source: http://www.spc.noaa.gov/faq/tornado/beaufort.html

All areas of the state can experience all 12 Beaufort categories. As used in this section, windstorms are both high velocity straight-line winds and violent wind gusts not associated with thunderstorms. Dust storms are strong windstorms that fill the air with thick dust, sometimes reducing visibility to resemble a dense fog. Other wind events include wet or dry microbursts that may produce damaging convective winds and dust devils even on a clear and otherwise calm day.

High wind events are experienced in every region of the United States. Figure 2.70 illustrates various wind zones throughout the country based on design wind speeds established by the American Society of Civil Engineers. It divides the country into four wind zones, geographically representing the frequency and magnitude of potential high wind events including severe thunderstorms, tornadoes and hurricanes. The figure shows that New Mexico is located Zone I, II and III wind speeds for shelters of up to 160 mph. Figure 2.70 shows where New Mexico Preparedness Areas relate to the wind speed map.

Figure 2.70: Wind Zones in the United States

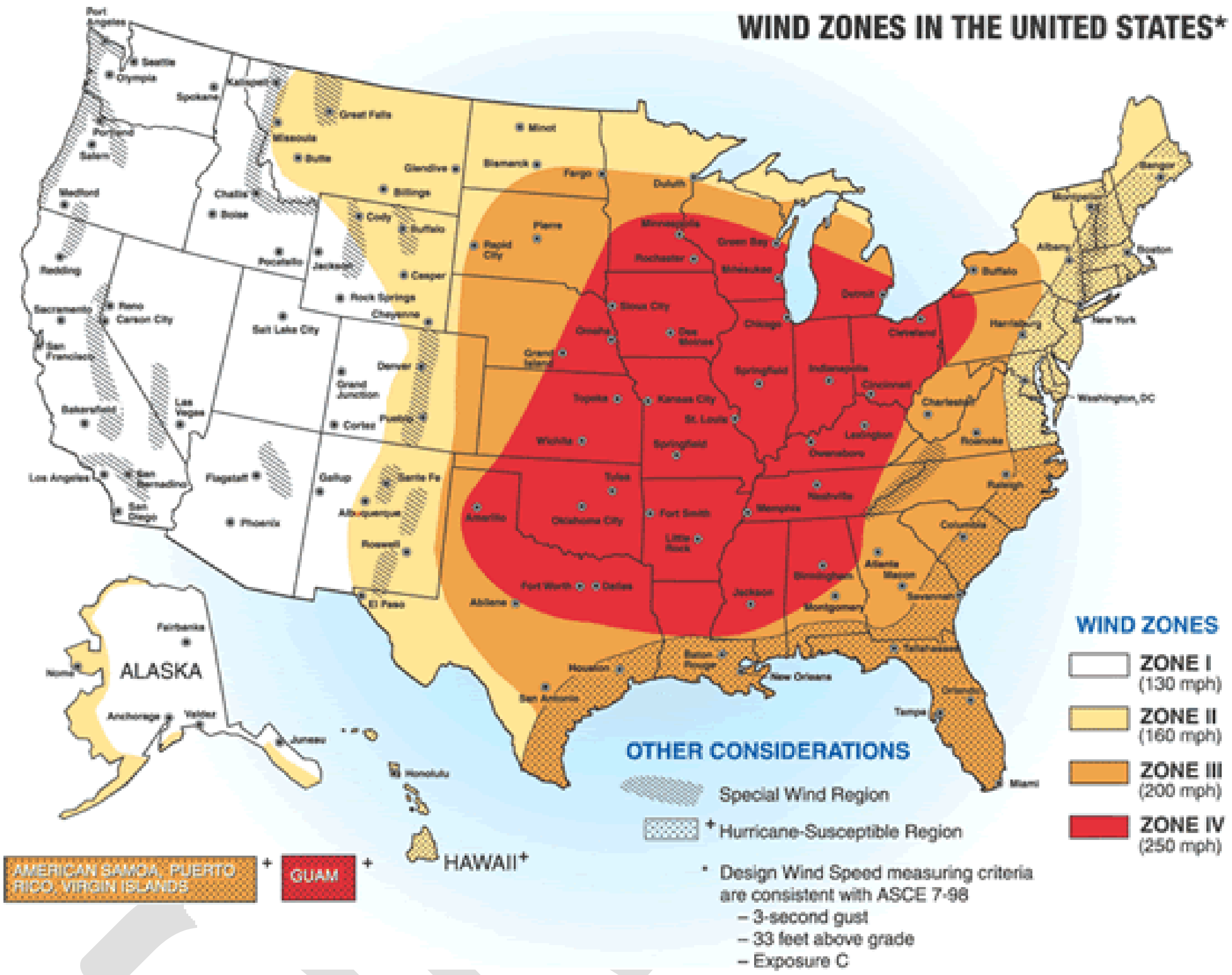


Figure 2.71 correlates New Mexico Preparedness Areas to the wind zones identified on the map.

Figure 2.71: Wind Speed Experienced by New Mexico Preparedness Areas[58]

Location	Wind Speed Zone
Preparedness Area 1	Zone II (Winds up to 160 mph)
Preparedness Area 2	Zone I and II (Winds from 130 up to 160 mph
Preparedness Area 3	Zone I and II (Winds from 130 up to 160 mph
Preparedness Area 4	Zone I (winds up to 130 mph)

[58] Source: http://www.fema.gov/safe-rooms/wind-zones-united-states

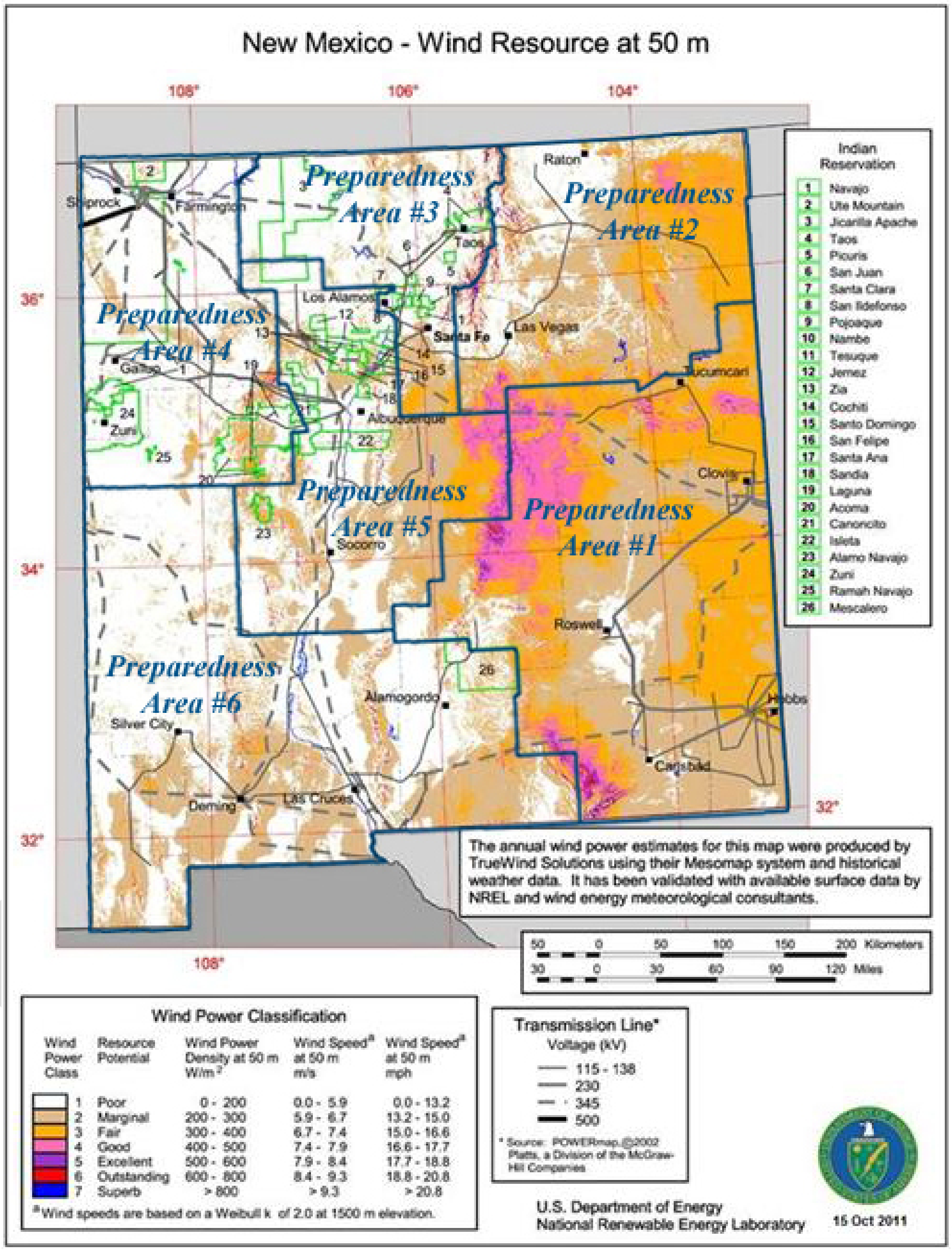
Location	Wind Speed Zone
Preparedness Area 5	Zone I and II (Winds from 130 up to 160 mph
Preparedness Area 6	Zone I and II (Winds from 130 up to 160 mph

Figure 2.71 correlates New Mexico Preparedness Areas to the wind zones identified on the Wind Zone Map Figure 2.72.

The entire State of New Mexico is subject to high wind conditions, but areas most vulnerable where the population is concentrated and buildings are of older design. Figure 2.72 shows average wind speeds in New Mexico as provided by the U.S. Department of Energy's (Energy Department's) Wind Program and the National Renewable Energy Laboratory.[59] This resource map shows estimates of wind power density at 50 m above the ground. This map indicates that New Mexico has wind resources consistent with community-scale production. The largest contiguous area of good-to-excellent resource is in central New Mexico between Albuquerque (Preparedness Area 1) and Clovis (Preparedness Area 1). Other notable areas of good-to-excellent resource are located near the Guadalupe Mountains in southern New Mexico, near Tucumcari (Preparedness Area 1), and in the northeastern part of the state (Preparedness Area 2 and 3) near the Colorado and Oklahoma borders.

[59] Source: U.S. Department of Energy http://www.windpoweringamerica.gov/maps_template.asp?stateab=nm

Figure 2.72: Average Wind Speeds in by NM Preparedness Area – October 15, 2011



Previous Occurrences

The current online NCDC database only contains data from January 1, 2006 to present, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total 836 high wind events with only two injuries and $14,090,300 in property damage and 3,500,000 in crop damage between January 1, 2006 and December 1, 2012. Table 2.73 describes significant events that have occurred in New Mexico within specific Preparedness Areas.[60]

Table 2.73: Significant Past Occurrence - High Wind

Date	Location	Significant Event
December 2009	Magdalena, NM (Socorro County) Preparedness Area 5	As reported by the Mountain Mail, after a weekend of wintry weather, high winds were a cause of concern for many county residents, especially those traveling on Highway 60, which had to be shut down near Magdalena for over an hour. The closure was the result of diesel fuel leaking from the tank of a wrecked semi tractor trailer. According to the Magdalena Marshal, two semis were blown off the road; one at mile marker 126, and the other at mile marker 119. The semi at 119 leaked 240 gallons of diesel fuel causing the highway had to be closed until the hazmat operation had been completed. The truck driver from Boise, Idaho, said he was on his way to Tucson when he experienced the estimated 100 mph gusts on Highway 60. Higher winds were recorded at other stations in the county. Magdalena Ridge Observatory sustained wind speeds at the 10,600 foot facility averaged about 100 mph over a seven hour period with gusts up to 128 mph.
April 2003	Silver City, NM (Grants County) Deming, NM Columbus, NM (Luna County) Preparedness Area 6	Strong winds blew dust from northern Mexico and caused a 10-car accident on US-180 near Deming in the southern part of the state. In Milan, two people were killed and five more injured when the blowing dust reduced visibility and caused a multiple car accident. State Police shut down several roads around Deming, including Interstate 10, U.S. 180 to Silver City, NM 11 from Deming to Columbus, NM 549 near Deming, NM 26 between Deming and Hatch, and NM 212 near Fort Sumner. High winds also blew a roof off a school and destroyed a church under construction. Over $200 thousand in damages were reported.
April 6, 2001	Artesia, NM Carlsbad, NM (Eddy County) Preparedness Area 1	A strong upper level storm system moving across the area produced strong gradient winds across southeast New Mexico during the afternoon of April 6. Wind gusts in excess of 70 mph at times resulted in a six-vehicle accident on Highway 2 north of the city of Artesia and a four-vehicle accident on Highway 285 north of the city of Artesia minutes later. The wind snapped large tree branches and electric power lines. The wind was responsible for disrupting cable television transmitters and for blowing a parking canopy support through the windshield of a pickup truck. In Carlsbad, winds as high as 67 mph blew down a 60-foot Arizona Cypress tree and caused major roof damage to a greenhouse.

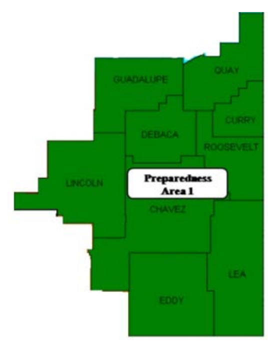
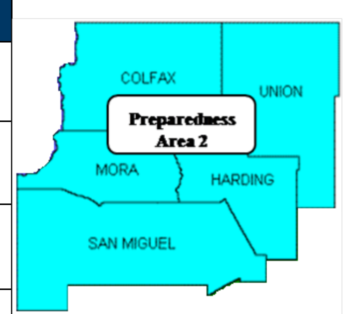
[60] Source: NCDC and local Emergency Managers

Date	Location	Significant Event
		Total damage was estimated to be in excess of $600 thousand.
May 24, 1999	Socorro Count Valencia County Preparedness Area 5	Over $1.2 million in damages were caused by a severe storm which began near Alamo in northwest Socorro County swept northeast across central Valencia County with high winds and large hail. Heavy wind damage from sustained winds estimated near 80 mph overturned and destroyed about 15 mobile homes and caused damage to about 150 other homes with many small outbuildings and sheds blown down in the area from Los Chavez to Tome Hill between Los Lunas and Belen. Large hail also knocked out numerous windows and broke windshields. Only two relatively minor injuries were reported in the hardest hit area. Residents had 40-60 minutes advanced warning and school officials successfully evacuated numerous portable classroom buildings without incident or injury to students before high winds struck.
May 1, 1999	Chaves County Preparedness Area 1	High winds were blamed in a fatal travel trailer-church bus accident in southwest Chaves County that claimed seven lives. State Police concluded that winds of 50-55 mph swept a truck pulling a travel trailer into the opposing lane and slicing into an on-coming bus filled with teenagers returning from a church retreat. One adult and six teenage girls died at the scene with other serious injuries reported.
April 9, 1999	White Sands, NM Preparedness Area 6	A major dust storm event occurred in the White Sands area when large clouds of milky white dust were observed overtopping the nearby Sacramento Mountains and blowing to the northeast. The dust storm started quickly and lasted for more than 8 hours, with visibilities reduced to as low as 1.5 miles and winds gusting to at least 38 knots (44 mph). NOAA wind data from White Sands National Monument indicated winds at approximately 10,000 feet above ground level in excess of 50 knots. Reduced visibility continued long after the active production of blowing dust ended.
March – April 1993	Albuquerque, NM Preparedness Area 5	Wind storms/Dust storms. Numerous days with high winds and blowing dust. Albuquerque Airport recorded a peak gust of 80 MPH in March, Sandia Peak a gust of 106 MPH.
December 1977	Albuquerque, NM (Bernalillo County) Preparedness Area 5	The central Rio Grande valley is occasionally subject to mountain wave-induced winds, which can become exceptionally strong. One such wave-induced windstorm occurred when surface winds with gusts between 50 and 70 mph were reported at the airport in Albuquerque. Wind reports from around the Albuquerque

Date	Location	Significant Event
		metro area included a peak wind of 71 mph at the airport, 97 mph at the base of the Sandia Tramway and gusts between 80 and 90 mph at Coronado Airport.
March 1977	Roswell and Clovis, NM Preparedness Area 1	Dust from White Sands was visible on the Geostationary Operational Environmental Satellite (GOES) imagery. It formed a plume more than 400 kilometers long, and blew eastward through Roswell, across eastern New Mexico to Clovis and then into the Texas Panhandle, where it eventually dissipated.

Table 2.74 provides a cumulative overview of significant high wind events that have occurred in all Preparedness Areas.

Table 2.74: Preparedness Areas 1 - 6 High Wind History (January 1, 2006 - December 1, 2012)[61]

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
High Wind	127	70 kts	0	0	$11,110,000	0	
Strong Wind	4	49 kts	0	0	$20,200	0	
Dust Storm	0	0	0	0	0	0	
Total	**131**	**49 – 70 Kts**	**0**	**0**	**$11,130,200**	**0**	
Preparedness Area 2 **Counties:** Colfax, Harding, Mora, Union and San Miguel							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
High Wind	7	61 kts	0	0	$1,133,000	0	
Strong Winds	2	33 kts	0	0	$40,000	0	
Dust Storm	0	0	0	0	0	0	
Total	**9**	**33 – 61 kts**	**0**	**0**	**$1,173,000**	**$4,731,000**	

[61] Source: NCDC http://www.ncdc.noaa.gov (December 2012)

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

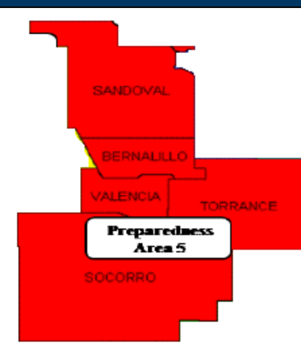
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	2	57 kts	0	0	$5,000	0
Strong Wind	5	48 kts	0	0	$34,000	$5,000
Dust Storm	0	0	0	0	0	0
Total	**7**	**48 – 57 kts**	**0**	**0**	**$39,000**	**$5,000**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

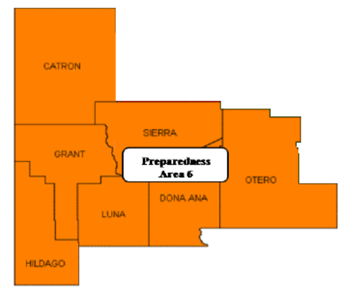
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	4	65 kts	0	0	$35,400	$1,000
Strong Wind	2	48 kts	0	0	$7,500	0
Dust Storm	0	0	0	0	0	0
Total	**6**	**48 – 65 kts**	**0**	**0**	**$42,900**	**$1,000**

Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
High Wind	25	86 kts	0	0	$5,185,000	$2,000
Strong Wind	3	40 kts	0	0	$11,000	0
Dust Storm	1	0	0	0	0	$5,000



Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Total	**29**	**40 – 86 kts**	**0**	**0**	**$5,196,000**	**$7,000**
Preparedness Area 6 **Counties:** Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra **Tribal Nation:** Mescalero Apache						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
High Wind	9	101	0	2	$6,063,000	0
Strong Wind	0	0	0	0	0	0
Dust Storm	1	0	0	0	0	0
Total	**10**	**101 kts**	**0**	**2**	**$6,063,000**	**0**



Frequency

The State of New Mexico experiences high wind events annually, based on seasonal meteorological patterns and local topographical conditions. The north/south east section of the state is susceptible to high wind events. One type of wind event is the gap wind or canyon wind. This occurs as the wind rushes over mountain passes, "gaps," in the ridgeline of a mountain chain. Wind speeds are generally strongest at narrow canyon openings. Another type of wind event is referred to as the spillover wind, which occurs when cold air to the east of the mountains has a sufficient depth (approximately 10,000 feet above sea level) to overtop the Sandia and Manzano Mountain ranges and spill over to the west, typically down slope toward the Albuquerque metropolitan area (Preparedness Area 5).

Wind speeds over the State are usually moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months and sometimes occur just in advance of thunderstorms. Frontal winds may exceed 30 mph for several hours and reach peak speeds of more than 50 mph. Spring is the windy season in New Mexico. Blowing dust and serious soil erosion of unprotected fields may be a problem during dry spells. Winds are generally stronger in the eastern plains than in other parts of the State. Winds generally predominate from the southeast in summer and from the west in winter, but local surface wind directions will vary greatly because of local topography and mountain and valley breezes.

Every Preparedness Area experiences some type of wind event as illustrated in Table 33. A study conducted by the National Weather Service – Albuquerque dated May 2010 conducted a study titled, "A Climatology of High Wind Warning Events for Northern and Central New Mexico: 1976-2005." The study conducted an assessment of climatological wind data across northern and central New Mexico in an effort that would benefit forecasters by providing supplemental knowledge of the synoptic regimes and frequency of high wind events.

The climatological record of high wind events was built for eight observational sites across New Mexico utilizing a 30 year period of record from 1976 to 2005. Locations included Albuquerque – Preparedness Area 1, Clayton – Preparedness Area 2, Farmington – Preparedness Area 4, Gallup – Preparedness Area 4, Los Vegas – Preparedness Area 2, Roswell – Preparedness Area 1, Santa Fe – Preparedness Area 3 and Tucumcari – Preparedness Area 1. NWS staff conducted hourly, monthly, seasonal, and yearly intervals and interim surface observations from these eight sites to determine the frequency of high wind events. The observations provided the NWS with information that with continued future work will hopefully include the construction of a database that will allow improved methods for inter-site comparisons of events on an individual and collective basis.[62]

As the past occurrences show, each Preparedness Area in New Mexico experience high wind events every year based on the climate, topography of the land and due to the annual spring and monsoon season weather patterns. Preparedness Area 1 shows the highest probability of experiencing a high wind event.

Probability of Occurrence

High winds are difficult to predict precisely in pattern, frequency, and degree of severity. The windiest time of the year is during the Spring months of April and May, with March and June often times not far behind. The graphs below depict mean monthly wind speeds at seven locations across the state - the Spring wind maximum is evident at all sites.

To determine the probability of New Mexico experiencing future high wind occurrences, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of January 1, 2006 – December 1, 2012 (84 months) and from local emergency management officials. Probability was determined by dividing the number of events observed by the number of months and multiplying by 100. This gives the percent chance of the event happening in any given year. Figure 2.75 provides the probability of occurrence in each Preparedness Area based on the probability formula.

Figure 2.75. Probability of Occurrence - High Winds

Probability of Occurrence			
Preparedness Area	**High Wind**	**Strong Wind**	**Dust Storm**
Preparedness Area 1	100%	4.8%	0%
Preparedness Area 2	8.3%	2.3%	0%
Preparedness Area 3	2.3%	6.0%	0%
Preparedness Area 4	4.8%	2.3%	0%
Preparedness Area 5	30%	3.6%	1.2%

[62] Source: http://www.srh.noaa.gov/media/abq/LocalStudies/hww_studyBTS2010.pdf

Probability of Occurrence			
Preparedness Area	High Wind	Strong Wind	Dust Storm
Preparedness Area 6	11%	0%	1.2%

Figure 2.75 provides the probability of each Preparedness Area experiencing some type of high wind event annually.

Risk Assessment

No areas of New Mexico are immune from damaging high winds. High wind is a fact of life for state residents, especially in the spring. Extremely high velocity wind over a prolonged period is rare. Such occurrences can result in downed power lines, roof damage, trees being blown down, and difficulty in controlling high profile vehicles on the highways. Microburst wind damage is more common, since it is often associated with powerful downdrafts originating from thunderstorms. These winds are of relatively short duration. Certain areas of the state are subject to hazardous dust storms when high winds blow over terrain that is relatively devoid of vegetation. The southwestern part of the state between Deming and the Arizona border is especially susceptible to this hazard, and highway closure is sometimes required. Localized dust storms can arise unexpectedly when high winds pick up dust and debris from construction sites.

These Large-scale dust storms occasionally occur in the White Sands region of New Mexico and in the region between Deming (Luna County – Preparedness Area 6) westward to the Arizona border. Major dust events can transport mineral aerosols (dust) for long distances, obscuring vision for motorists and causing breathing problems for people with respiratory difficulties.

Strong winds can damage buildings and uproot trees, but can also produce areas of blowing dust that can reduce visibilities making road travel hazardous. The NWS Albuquerque issues high wind warnings when winds are expected to have sustained speeds of 40 mph or greater and/or instantaneous gusts of 58 mph or higher. A study was recently completed to determine the frequency of high wind events across New Mexico, and to evaluate the synoptic regime associated with these events. This study showed that high wind events are also most common in the Spring.

High wind events often have a westerly component. During the Spring months two factors work in tandem to create strong winds. By March or April, the polar jet stream has started migrating northward but can still often influence the southwest U.S., such that wind speeds increase dramatically with height. Meanwhile, the sun angle is getting higher in the sky and creating greater heating near the surface of the earth. The heated surface air rises to a greater depth of the atmosphere during these spring months, often to a height between 7,500 and 10,000 feet above the surface. The rising air mixes with stronger winds aloft, resulting in stronger and turbulent winds mixing down to the surface. Strong surface pressure gradients can enhance surface winds. High wind events across New Mexico can also occur with strong surface fronts, especially those that race through the eastern plains.[63]

[63] Source: http://www.srh.noaa.gov/abq/?n=features_highwind

Table 2.76 identifies impacts related to high wind events for the purposes of EMAP compliance.

Table 2.76: Impact from a High Wind Event for Each Preparedness Area

Subject	Impacts
Health and Safety of the Public	The public can face severe injuries and even death because of high wind events.
Health And Safety of Responders	Responders face the same risks as the public.
Continuity of Operations	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Delivery of Services	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Property, Facilities, Infrastructure	High wind can cause anywhere from minor damage to total destruction of facilities and infrastructure depending on the size of the event. Extensive damages are anticipated.
Environment	Wind can cause widespread extensive damage to the environment in the form of damaged or downed trees and crops, and debris or contamination dispersal.
Economic Condition	A small community can be heavily damaged and by wind. The economic base (businesses) and individuals can lose everything, and recovery may require substantial investment.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

Data Limitations

Manufactured homes that are not adequately anchored are the most vulnerable structures for damage from high wind events. The information necessary to determine the location and condition of manufactured homes and aged or dilapidated structures was not available during the development of this mitigation plan. Consequently, the Hazard Mitigation Team could not quantify vulnerability of individual structures to damage from high winds. In addition, accurate methods to quantify potential future damages are not readily available. The amount of business lost due to high wind events has not been calculated due to the difficulty of attaining this information. The Hazard Mitigation Team could also not specify which critical facilities were vulnerable to high wind events. Subsequent versions of this Plan will need to incorporate and respond to these data deficiencies.

What Can Be Mitigated?

One important part of mitigating high wind hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to high wind events by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending wind events. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to wind events. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.

Landslide

Hazard Characteristics

Landslides are the downward and outward movement of loose material on slopes. Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on and over steepened slopes is the primary reason for a landslide, landslides are often prompted by the occurrence of other disasters such as seismic activity of heavy rain fall. Other contributing factors include the following:

- Erosion by rivers, glaciers, or ocean waves creating over-steepened slopes
- Rock and soil slopes weakened through saturation by snowmelt or heavy rains
- Earthquakes creating stresses that make weak slopes fail
- Volcanic eruptions producing loose ash deposits, heavy rain, and debris flows
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from manmade structures stressing weak slopes
- Floods or long duration precipitation events creating saturated, unstable soils that are more susceptible to failure

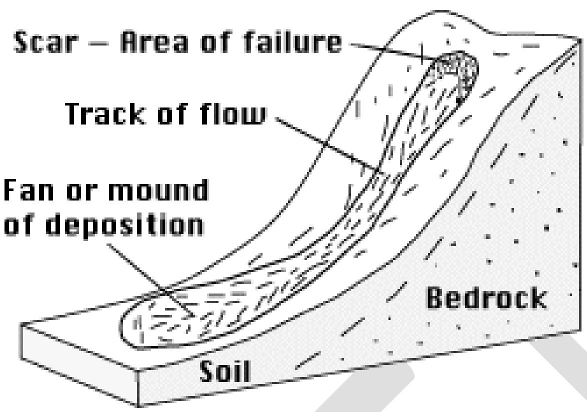
Slope material often becomes saturated with water and may develop a debris or mudflow. If the ground is saturated, the water weakens the soil and rock by reducing cohesion and friction between particles. Cohesion, which is the tendency of soil particles to "stick" to each other, and friction affect the strength of the material in the slope and contribute to a slope's ability to resist down slope movement. Saturation also increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope. Undercutting of a slope reduces the slope's resistance to the force of gravity by removing much-needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure. The resulting slurry of rock and mud can pick up trees, houses, and cars, and block bridges and tributaries, causing flooding along its path. Additionally, removal of vegetation can leave a slope much more susceptible to superficial landslides because of the loss of the stabilizing root systems.

Geologists identify active landslides and areas subject to slope instability so that they may be avoided or mitigated. Together, geologists and civil engineers develop and implement measures to improve the stability of slopes, repair existing landslides, and prevent damage from future landslides. Slope stability can be improved by removing material from the top of the slope, adding material or retaining structures to the base of the slope, and reducing the degree of saturation by improving drainage within the slope.

Landslide Types

Debris Flows – a mixture of rock fragments, soil, vegetation, water and, in some cases, entrained air that flows downhill as a fluid. Debris flows can range in consistency from that of freshly mixed concrete to running water. Debris flows can be further classified as mudflows and earth flows depending on the ratio of water to soil and rock debris. Lahars are a special form of debris flow caused by volcanic eruptions (Figure 2.77).

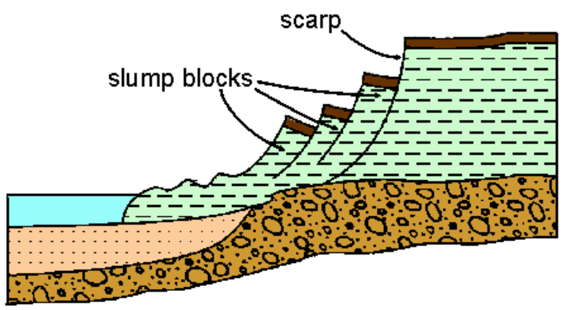
Figure 2.77: Landslide – Debris Flow



The Above Schematic of debris flow is courtesy of the USGS and shows the process of debris flow. Information is as of December 2012. Information found at http://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html.

Slump – a landslide consisting of a mass of material moving down slope as a unit, usually along a curved plane of failure. The removed mass of soil and rock leave an abrupt drop-off at the top of the landslide known as a scarp. Repeated slumping can often result in terracing, or series of scarps, as secondary failures occur within the landslide mass (Figure 2.78).

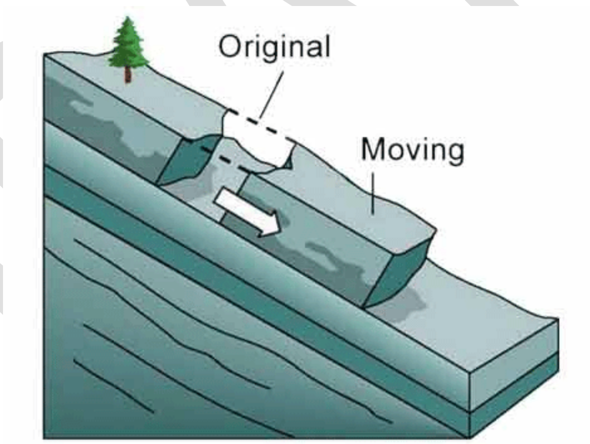
Figure 2.78: Landslide – Slump



The Above Schematic of Slump is courtesy of the USGS and shows how slump occurs. Information is as of December 2012. Information found at http://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html.

Rock Slide – the rapid movement of a large mass of rock along a plane of weakness, such as a bedding plane or joint. In general, rockslides occur on steep mountain faces, but have been known to occur on slopes as low as 15 degrees (Figure 2.79).

Figure 2.79: Landslide – Rock Slide

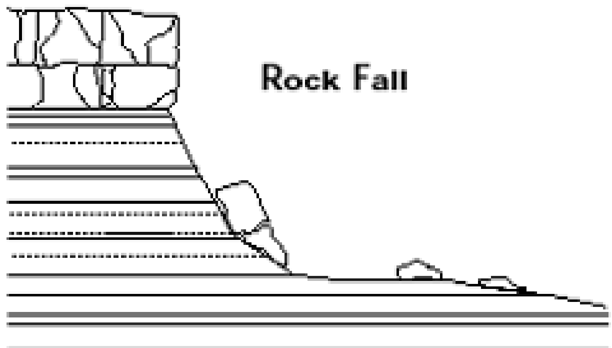


The Above Schematic of rock slide is courtesy of the USGS and shows how rock slides occur. Information is as of December 2012. Information found at http://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html.

Rock Fall – the freefall of rock from a cliff. Rock falls are often the result of physical weathering such as ice wedging. The rock typically accumulates at the base of the cliff in the form of talus (loose rock). Rock falls are often triggered by earthquakes (Figure 2.80).[64]

[64] Source: http://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html (December 2012)

Figure 2.80: Landslide – Rock Fall



Above: Schematic of rock fall. Image courtesy of USGS

The Above Schematic of rock fall is courtesy of the USGS and shows how rock falls occur.

Landslides can be classified by using the Alexander Scale (Table 2.81). The Alexander Scale provides descriptions of landslide damage and the different levels and type of damage.

Table 2.81: Alexander Scale for Landslide Damage[65]

Alexander Scale for Landslide Damage		
Level	**Damage**	**Description**
0	None.	Building is intact.
1	Negligible.	Hairline cracks in walls or structural members; no distortion of structure or detachment of external architectural details
2	Light.	Buildings continue to be habitable; repair not urgent. Settlement of foundations, distortion of structure, and inclination of walls are not sufficient to compromise overall stability.
3	Moderate.	Walls out of perpendicular by one or two degrees, or there has been substantial cracking in structural members, or the foundations have settled during differential subsidence of at least 15 cm; building requires evacuation and rapid attention to ensure its continued life.
4	Serious.	Walls out of perpendicular by several degrees; open cracks in walls; fracture of structural members; fragmentation of masonry; differential settlement of at least 25 cm compromising foundations; floors may be inclined by one or two degrees or ruined by heave. Internal partition walls will need to be replaced; door and window frames are too distorted to use; occupants must be evacuated and major repairs carried out.

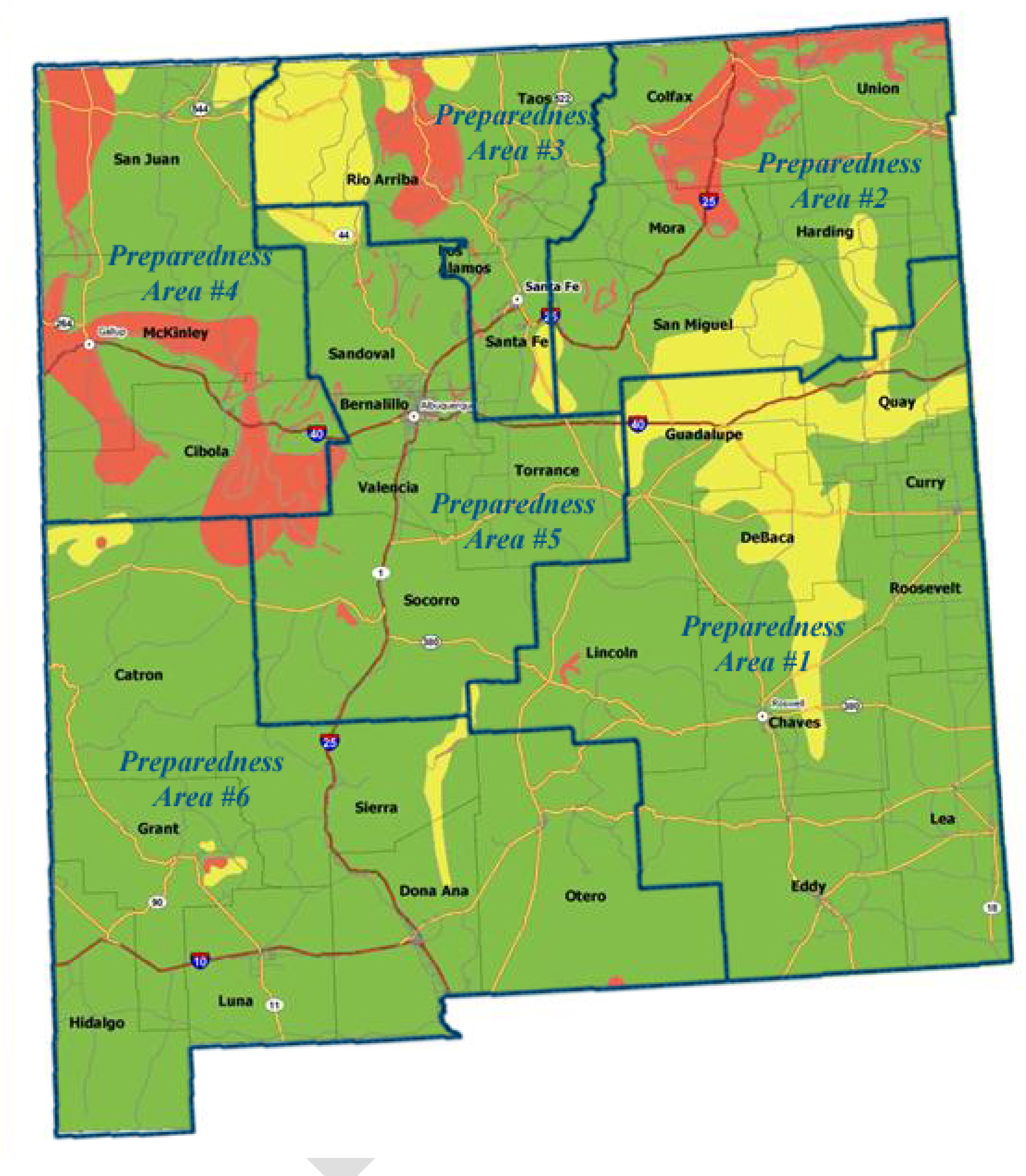
[65] Source: Risk Frontiers, Natural Hazards Research Center http://www.riskfrontiers.com/damage_scales13.htm (December 2012)

5	Very Serious.	Walls out of plumb by five or six degrees; structure grossly distorted; differential settlement has seriously cracked floors and walls or caused major rotation or slewing of the building [wooden buildings are detached completely from their foundations]. Partition walls and brick infill will have at least partly collapsed; roofs may have partially collapsed; outhouses, porches, and patios may have been damaged more seriously than the principal structure itself. Occupants will need to be re-housed on a long-term basis, and rehabilitation of the building will probably not be feasible.
6	Partial Collapse.	Requires immediate evacuation of the occupants and cordoning of the site to prevent accidents with falling masonry.
7	Total Collapse.	Requires clearance of the site.

Landslides occur in every state and U.S. territory. The Appalachian Mountains, the Rocky Mountains, the Pacific Coastal Ranges, and some parts of Alaska and Hawaii experience severe landslide problems. Any area composed of very weak or fractured materials resting on a steep slope may experience landslides. Although frequently associated with areas of high rainfall, landslides are a potential hazard in arid or semi-arid states like New Mexico. Landslides in New Mexico range from large, slow-moving, deep-seated masses, which can destroy structures by gradual movement, to shallow, fast-moving debris flows that threaten life and property. The USGS National Landslide Hazards Program has mapped the landslide risk for the entire conterminous U.S. Figure 2.82 provides a view of landslide susceptible areas in New Mexico along with the six Preparedness Area boundaries.[66] Most of New Mexico is mapped in the lowest risk zone where there is a low landslide incidence that involves less than 1.5% of the land area.

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

Figure 2.82: Landslide Susceptible Preparedness Areas in New Mexico



Low:	≤ 1.5% of land area
Moderate:	1.5% -15% of land area
High:	≥ 15% of land area.

The areas shown in yellow include the northern edge of Rio Arriba County (Preparedness Area 3), Sandoval (Preparedness Area 5) and San Juan County (Preparedness Area 4), and portions of Catron (Preparedness Area 6), Grant (Preparedness Area 6), Doña Ana (Preparedness Area 5), Sierra (Preparedness Area 6), Socorro (Preparedness Area 5), Lincoln (Preparedness Area 1), and large portions of Chaves (Preparedness Area 1), DeBaca (Preparedness area 1), Guadalupe (Preparedness Area 1), Quay (Preparedness Area 1), San Miguel (Preparedness Area 2) and Harding County (Preparedness Area 2), represent areas of moderate susceptibility and involve 1.5% to 15% of the land area. This can be based on steep slopes in the area, natural or artificial cutting, or high precipitation in the area. Although these areas have a moderate susceptibility to landslides, they also have a low occurrence. The red areas, Santa Rita open-pit copper mine in Grant County; an area around Magdalena Mountains in Socorro County; and portions of Union, Colfax, Mora, Rio Arriba, San Juan, McKinley, Cibola, Catron and Socorro Counties, an area in the Jicarilla Mountains in Lincoln County; and a couple small areas in Otero and Santa Fe Counties, indicate a high susceptibility and low incidence of past landslides that involves more than 15% of the land area.

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 Preparedness Area level. Data that has been captured is identified in Table 2.83 and briefly explains those significant events that have occurred. Information provided by local jurisdictions and DHSEM.

Table 2.83: Significant Past Occurrence - Landslide

Date	Location	Significant Event
January 15, 2013	Guadalupe Mesa (Sandoval County) Preparedness Area 5	Thousands of tons of rock (12,000-13,000 cubic yards) fell down the east face of Guadalupe Mesa leaving boulders displaced and a dust slope. A 30-foot thick and 150 foot high slab of rock broke loose. Some residents were awakened by the avalanche and there was a blanket of dust covering everything. No damage was reported in the article. Source: Jemez Thunder, Volume 19, No. 418, February 1, 2013

Date	Location	Significant Event
July 23, 2010	Magdalena Mountains (Socorro County) Preparedness Area 5	Heavy rain unleashed a mudslide in the Magdalena Mountains blocking a road and isolating researchers at a key New Mexico science facility. The landslide isolated the Langmuir Laboratory for Atmospheric Research located high on 10,700-foot South Baldy Peak. Five New Mexico Tech scientists and two technicians were working at the facility whose primary mission is to study thunderstorms. It wasn't long after the storm started that dirt and large boulders tumbled down the mountain sprawling over the only access road. Five members of the lab crew abandoned their vehicles and were picked up by a four-wheel-drive vehicle that took them to safety. The other two walked down part of the mountain to a four-wheel-drive vehicle that also took them to safety. No one was hurt in the landslide.
April 10, 2007	San Juan County Preparedness Area 4	The Farmers Mutual Ditch suffered a complete obstruction of the main canal due to a landslide for a length of approximately 300 yards in San Juan County. In this area, the canal runs along the north side of the San Juan River and below a cliff face. The Navajo Nation owns the land on the south side of the river, and their property line is defined as the middle of the river. (BLM owns the land on the north side.) Both up- or down-stream is a wetland and is the home of at least two Threatened or Endangered Species. This water system is quite large and services several communities with irrigation and drinking water. The complexity and severity of the event lead to a State Disaster Declaration The total cost of this landslide event is $263,408.
July 15, 2008	Gallup, NM Preparedness Area 4	A rockslide crushed 3 people in a homeless camp outside of Gallup, NM. One female and two male bodies were recovered after they were found trapped under a roughly 12-foot-wide boulder. Heavy rain had hampered recovery efforts. Gallup police Lt. Rick White says the rock slide might have happened during a rainstorm.
September 1998	Taos, NM (Taos County) Preparedness Area 3	A falling boulder (270,000 kg) struck a bus, killed five people, and injured 14, along HWY 68. The boulder left a 5x5x14 meter crater in the highway. The highway was closed for 19 hours and clean-up costs were approximately $75,000.

Date	Location	Significant Event
September 1991	De Baca County Preparedness Area 1	In De Baca County, a rockslide occurred that damaged a ranch road and buckled buried PVC pipes.
June 1977	Taos, NM (Taos County) Preparedness Area 3	A landslide event caused $50,000 in property damage.

Declared Disasters from Landslide

DHSEM reports one State Declared Disaster for landslide between 2003 and 2013 (Table 2.84). According to DHSEM records, the total cost for the2007 landslide disaster was $291,137. All associated damages were within San Juan County which (in Preparedness Area 4). There were no federal disaster declarations for landslide from 2003 through 2012.

Table 2.84. New Mexico Landslide Disaster Declarations (2003 – 2012)

Event Type	State Executive Order	Dollar Loss
Landslide	07-021	$291,137.00
Total	1	$291,137.00

Figure 2.85 shows two photos from the state landslide disaster at Farmers Mutual Ditch in San Juan County on April 10, 2007.[67]

[67] Photo is Courtesy of Bill Ewing, DHSE

Figure 2.85: Landslide Occurrence at Farmers Mutual Ditch in Preparedness Area 4

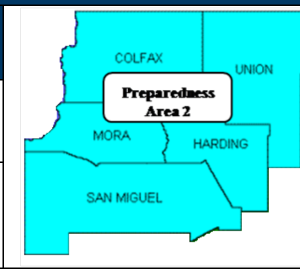
Another source of landslide damage information is from the NCDC. Below is a tally of landslide damage as reported by NCDC broken out by Preparedness Area. According to NCDC from 2006 through 2012 State-wide property damage from landslide damage was $388,408 and no crop damage was reported. Table 2.86 provides a cumulative overview of all landslide events that have occurred in all Preparedness Areas.

Table 2.86: Preparedness Areas 1 - 6 Landslide History (June 1997 - December 2012)[68]

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Landslide	1	0	0	0	0	0
Total	**1**	**0**	**0**	**0**	0	0

[68] Source: DHSEM and local jurisdictions.

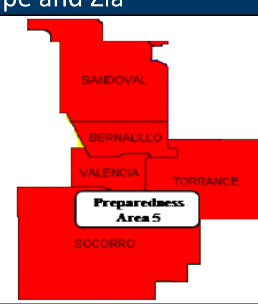
Preparedness Area 2 **Counties:** Colfax, Harding, Mora, Union and San Miguel						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Landslide	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**



Preparedness Area 3 **Counties:** Los Alamos, Rio Arriba, Santa Fe and Taos **Pueblos:** Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos **Tribal Nations:** Jicarilla Apache						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Landslide	2	0	0	0	$125,000	0
Total	**2**	**0**	**0**	**0**	**$125,000**	**0**

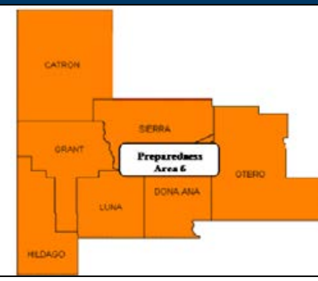
Preparedness Area 4 **Counties:** Cibola, McKinley and San Juan **Pueblos:** Acoma, Laguna, Zuni **Tribal Nations:** Navajo Nation						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Landslide	3	0	3	0	$263,408	0
Total	**3**	**0**	**3**	**0**	**$263,408**	**0**

Preparedness Area 5 **Counties:** Bernalillo, Sandoval, Socorro, Torrance and Valencia **Pueblos:** Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Landslide	1	0	0	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**



Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Landslide	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**



Frequency

The frequency of landslides in New Mexico is low based on previous occurrences. An issue for consideration is landslide events that do occur that are not reported and unpopulated land area where landslides go un-noticed

Probability of Occurrence

Landslides can result in serious structural damage to roads, buildings, irrigation channels, utilities and pipelines. To determine the probability of each Preparedness Area experiencing future landslide occurrences, 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. This gives the percent chance of the event happening in any given year. Table 2.87 provides the probability of each Preparedness Area experiencing a landslide event.

Table 2.87: Probability of Annual Occurrence of Landslide

Probability of Occurrence	
Preparedness Area	**Landslide**
Preparedness Area 1	3%
Preparedness Area 2	0%
Preparedness Area 3	7%
Preparedness Area 4	7%
Preparedness Area 5	3%
Preparedness Area 6	0%

One concern that is under review is landslides following a wildfire. In June 2011, the Track Fire burned 113 square kilometers in Colfax County, northeastern New Mexico, and Las Animas County, southeastern Colorado, including the upper watersheds of Chicorica and Raton Creeks. The burned landscape is now at risk of damage from post wildfire erosion, such as that caused by debris flows and flash floods.

A report by the USGS presents a preliminary hazard assessment of the debris-flow potential from basins burned by the Track Fire. A pair of empirical hazard-assessment models developed using data from recently burned basins throughout the intermountain western United States were used to estimate the probability of debris-flow occurrence and volume of debris flows at the outlets of selected drainage basins within the burned area. The models incorporate measures of burn severity, topography, soils, and storm rainfall to estimate the probability and volume of post-fire debris flows following the fire.

In response to a design storm of 38 millimeters of rain in 30 minutes (10-year recurrence-interval), the probability of debris flow estimated for basins burned by the Track fire ranged between 2 and 97 percent, with probabilities greater than 80 percent identified for the majority of the tributary basins to Raton Creek in Railroad Canyon; six basins that flow into Lake Maloya, including the Segerstrom Creek and Swachheim Creek basins; two tributary basins to Sugarite Canyon, and an unnamed basin on the eastern flank of the burned area. Estimated debris-flow volumes ranged from 30 cubic meters to greater than 100,000 cubic meters. The largest volumes (greater than 100,000 cubic meters) were estimated for Segerstrom Creek and Swachheim Creek basins, which drain into Lake Maloya. The Combined Relative Debris-Flow Hazard Ranking identifies the Segerstrom Creek and Swachheim Creek basins as having the highest probability of producing the largest debris flows.

This finding indicates the greatest post-fire debris-flow impacts may be expected to Lake Maloya. In addition, Interstate Highway 25, Raton Creek and the rail line in Railroad Canyon, County road A-27, and State Highway 526 in Sugarite Canyon may also be affected where they cross drainages downstream from recently burned basins. Although this assessment indicates that a rather large debris flow (approximately 42,000 cubic meters) may be generated from the basin above the City of Raton (basin 9) in response to the design storm, the probability of such an event is relatively low (approximately 10 percent). Additional assessment is necessary to determine if the estimated volume of material is sufficient to travel into the City of Raton. In addition, even small debris flows may affect structures at or downstream from basin outlets and increase the threat of flooding downstream by damaging or blocking flood mitigation structures. The maps presented here may be used to prioritize areas where erosion mitigation or other protective measures may be necessary within a 2- to 3-year window of vulnerability following the Track Fire.[69]

Risk Assessment

Landslides have occurred in New Mexico, specifically in Preparedness Areas 1, 3 and 4. Though data for landslides previous occurrences and minimal, based on previous occurrence, Taos County (Preparedness Area 3) would be considered of having a high risk to a landslide occurrence. Table 2.88 identifies potential impacts from a volcanic eruption for the purposes of EMAP compliance.

[69] Source: http://pubs.usgs.gov/of/2011/1257/

Table 2.88: Potential Landslide Impacts

Subject	Potential Impacts
Health and Safety of the Public	Anyone within the path of a land or rockslide at the time of occurrence, could be injured or killed
Health and Safety of Responders	Same as the public
Continuity of Operations	Any operation in the area of a slide may be unable to continue operations for a time perhaps even permanently depending on the damages.
Delivery of Services	Supply chains could be negatively affected if highways and roads are impacted. Otherwise minor impacts are anticipated.
Property, Facilities, Infrastructure	Buildings and almost all infrastructure would be severely damaged or destroyed in the event of a landslide occurring nearby.
Environment	Long-term severe impacts are very unlikely.
Economic Condition	The small impact area of landslides lead to minor economic impacts.
Public Confidence	Not likely to be impacted.

Data Limitations

USGS produced landslide maps approximately 20 years ago based on aerial photographs of steep regions throughout the State. There are archives paper copies at 1:100,000 and mylars of a compilation at 1:500,000 scale. It would be helpful to produce state-wide landslide maps in digital format based on the mapping done 20 years ago.
Also, the mapping the debris flow run-out zones would be helpful in understanding the potential impact of landslides.

Mapping of landslide areas and run-out zones will be listed as a potential project under the mitigation action section of this Plan.

What Can Be Mitigated?

There is no new information. This will be re-addressed further in the next plan update. One mitigation effort involves educating communities on the effects of landslides and determining which communities in the state have the biggest risk.

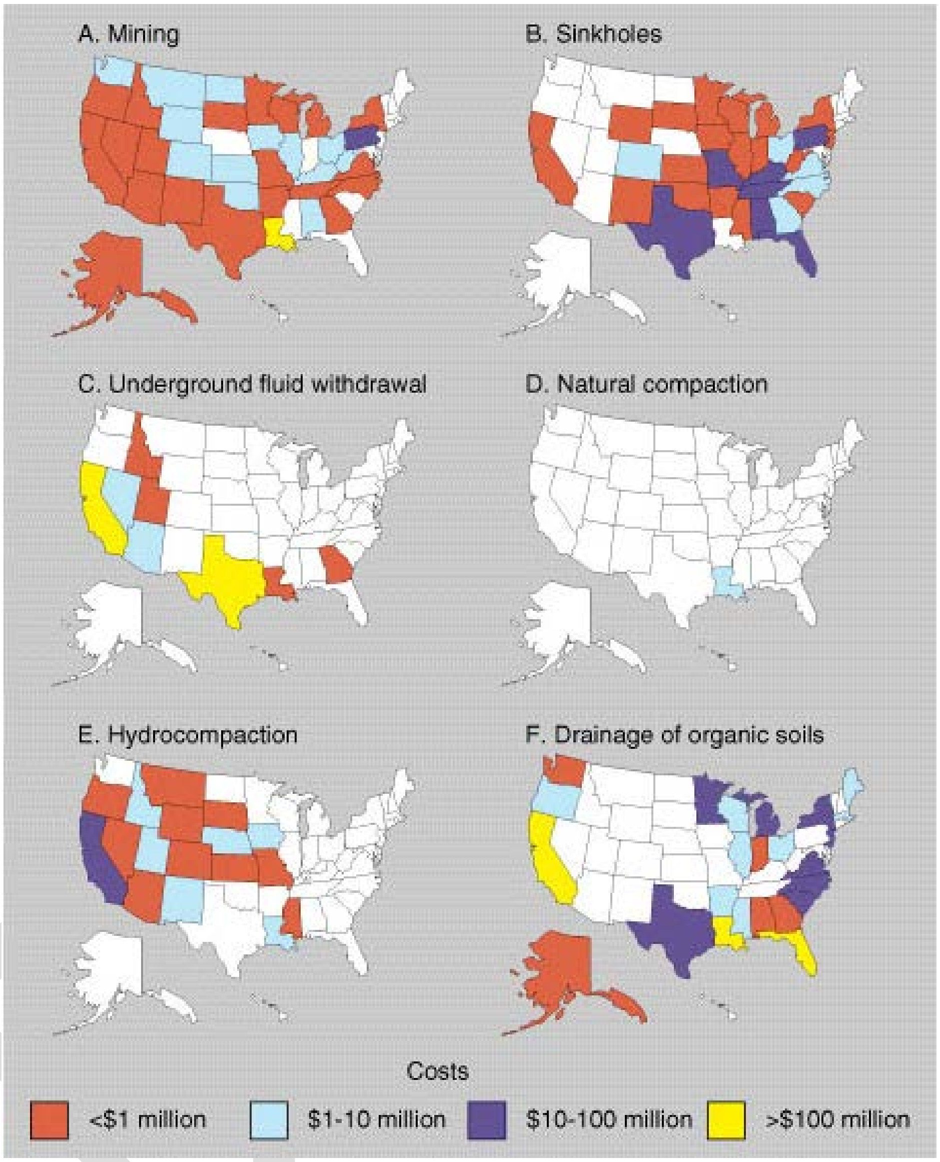
Land Subsidence

Hazard Characteristics

Land subsidence is the loss of surface elevation and affects nearly every U.S. state. Land subsidence has several causes, but most commonly occurs when large amounts of groundwater have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rock compacts. Subsidence may occur abruptly or over many years. It can occur uniformly over large areas or as localized sinkholes.

Common causes of land subsidence from human activity are pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydro compaction). Land subsidence from pumping of fluids is usually not observable because it occurs over a large area over a period of time. Figure 2.89 shows the geography of land subsidence across the United States along with the associated costs of subsidence related property damage.

Figure 29: Subsidence Problems in the U.S.[70]



When land subsidence is isolated in a small area, it appears as sinkholes. Land subsidence presents major problems in California, Arizona, Texas, and Florida, all of which have experienced hundreds of millions of dollars of damage over the years. In many areas of the southwest, earth fissures, which can be over 100 feet deep, are associated with land subsidence. They begin as narrow cracks and can erode to widths of over 15 feet. According to Subject Matter Expert, Dr. Dave Love from New Mexico Tech, fissures are evident in the Deming, New Mexico area (Preparedness Area 6).

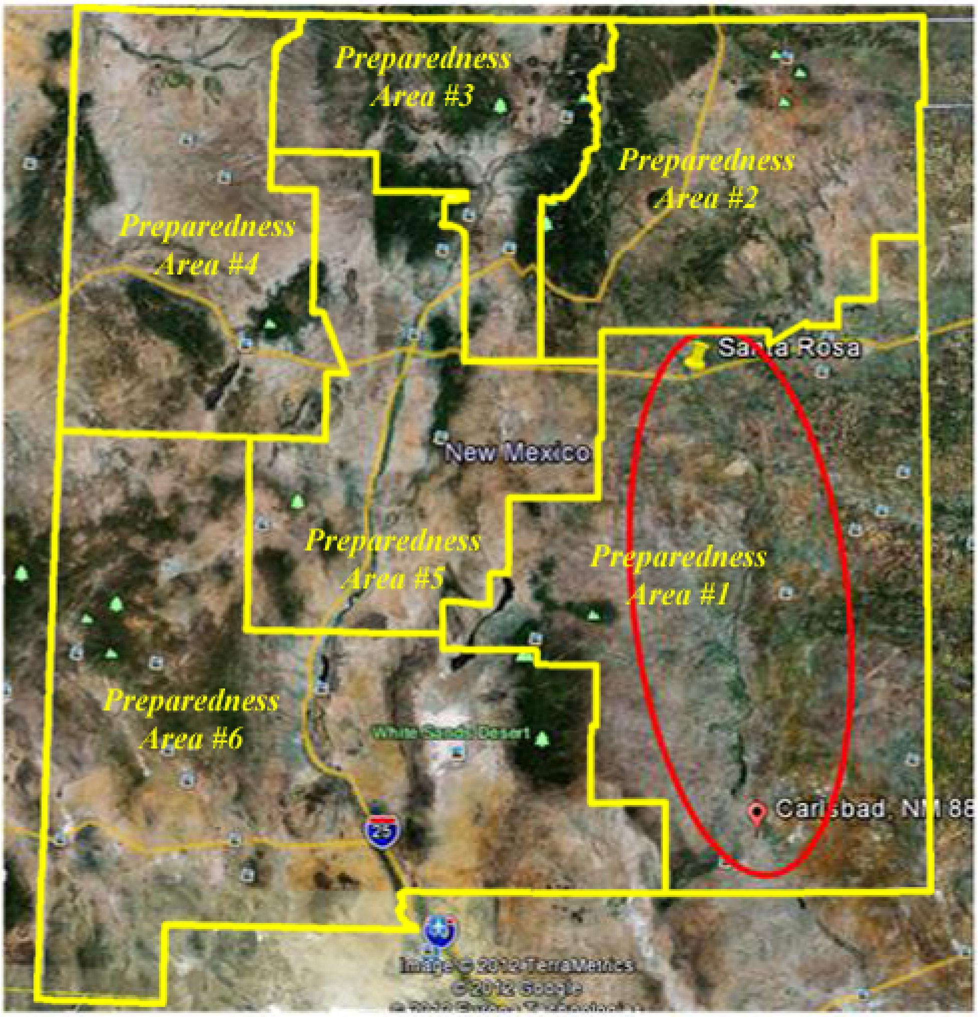
[70] Source: New Mexico 2010 State Hazard Mitigation Plan

In areas where communities pump the majority of the groundwater, such as New Mexico, Colorado, Arizona, Utah, Nevada, and California, major aquifers include compressible clay and silt that can compact when the groundwater is pumped. Increased groundwater demand from population growth may likely accelerate land subsidence in areas already subsiding. Land subsidence arising from the depletion of underground petroleum has not been reported from any of the regions of the state where the petroleum industry is active.

Sub Hazards of Land Subsidence

Sink Holes — Some areas of the state are subject to sinkhole formation, particularly the area between Santa Rosa in Guadalupe County (Preparedness Area 1) and Carlsbad in Eddy County (Preparedness Area 1). Numerous sinkholes are visible from highways in the region. Highway damages have been reported from this hazard, and the potential for sinkhole formation should not be overlooked in planning highways, pipelines, and electric transmission lines. Figure 2.90 provides a visual for the extent of the sinkhole formation between Santa Rosa, NM and Carlsbad, NM both in Preparedness Area 1.

Figure 30: Sinkhole Formation Area between Santa Rosa, NM and Carlsbad, NM as of December 2012



Sinkhole Formation Area Between Santa Rosa, NM and Carlsbad, NM

Collapsible Soils – Another type of subsidence, collapsible soils, are soils that compact and collapse after they get wet. The soil particles are originally loosely packed and barely touch each other before moisture soaks into the ground. As water is added to the soil in quantity and moves downward, the water wets the contacts between soil particles and allows them to slip past each other to become more tightly packed.

Collapsible soils develop on valley margins where soil particles move from the foothills toward the valleys. They commonly accumulate to tens of feet thick. As New Mexico's population has moved out of the well-watered and irrigated valleys with compact soils to develop the valley margins and foothills, the collapsible soils have made their presence known as the newcomers add water to the drier soils.[71]

[71] Source: http://geoinfo.nmt.edu/geoscience/hazards/collabsible.html

Previous Occurrences

Previous occurrences for land subsidence in New Mexico have been recorded, however, data on the extent of such events is extremely limited. NCDC does not provide any data on previous occurrences. One large event that has been in the news and huge concern in recent years is the collapse of two North Eddy County brine wells in 2008 sparked fears that a similar collapse might happen in Carlsbad (Preparedness Area 1). A giant manmade cavern beneath Carlsbad threatens to cave in, swallowing parts of the city that include several businesses, a trailer park and a stretch of a main U.S. highway.

Three decades of pumping freshwater into a salt layer about 400 feet below the surface, and then its extraction to help with oil well drilling, have already caused two sinkholes to open up last year. After the collapses, New Mexico State officials became concerned with the condition of the two brine wells near the South Y, the intersection of U.S. 285 and 62/180. Figure 2.91 shows a photo of the extent of this sinkhole in Carlsbad, NM (Preparedness Area 1)

The city of about 26,000 residents has declared an emergency and says government-installed sensors should give several hours of warning before any cave-in occurs to evacuate the population, but such a collapse could potentially damage the Carlsbad Irrigation Canal. The Irrigation Canal provides water to crops south of the brine well. If the canal goes, then these crops could not be irrigated, potentially causing $100 million in damage.

Figure 2.91: Sinkholes in Carlsbad, NM (Preparedness Area 1) as of December 2012[72]

There have been issues over the past three years related to mining but this data is not available. Further research will be required to gather information related to this hazard.

[72] Photos courtesy of the National Cave and Karst Research Institute
http://www.earthweek.com/2009/ew091113/ew091113a.html

Most of the land subsidence occurrences in the country have been due to sinkholes that are a subhazard of land subsidence. The most recent event in Carlsbad was directly related to the mining in the area and the US Environmental Protection Agency has taken the lead due to the high amount of brine (hazardous substance).

Land subsidence has been identified as a potential issue in one of the Los Lunas subdivisions. Residences, water lines, sewer lines and roads may be impacted. When additional information is available, it will be added to the Plan.

Frequency

Land Subsidence is not a matter of "frequency" it is ongoing and will continue as more water is pumped. Earth fissures at the ground surface will become more frequent and will damage infrastructure as well as individual structures, as in the situation in Carlsbad. Because data is not available on past occurrence, frequency can only be determined based on the few occurrences described here. Based on previous occurrence, it is reasonable to conclude that some form of land subsidence will occur in Preparedness Area 1.

Probability of Occurrence

Because historical data is not available, the probability of experiencing future land subsidence could not be calculated. Once data is compiled, probability can be determined by dividing the number of events observed by the number of years and multiplying by 100. This would give the percent chance of the event happening in any given year.

Risk Assessment

Sinkholes are secondary hazards related to land subsidence. The most recent New Mexico sinkhole event occurred in Carlsbad (Preparedness Area 1) and was directly related to the mining in the area and the US Environmental Protection Agency has taken the lead due to the high amount of brine (hazardous substance). Land Subsidence can result in serious structural damage to roads, buildings, irrigation channels, utilities and pipelines. Table 2.92 identifies impacts from Land Subsidence in New Mexico.

Table 2.92: Impacts of Land Subsidence

Subject	Impacts
Health And Safety of The Public	The sinkhole situation under Carlsbad is a concern. There is an anticipated a health and safety hazard to the public and to responders as well as property, facilities, and infrastructure.
Health And Safety of Responders	None likely
Continuity of Operations	None likely
Delivery of Services	None likely

Property, Facilities, Infrastructure	The slow nature of this type of event causes the impacts to be almost imperceptible, however damages to the built environment may occur, that can be very costly over time.
Environment	None anticipated
Economic Condition	The only anticipated impacts are repair costs but for both fissures and for collapsible soils, the results are catastrophic for whole subdivisions of home owners.
Public Confidence	Very little impact anticipated.

Data Limitations

Data needs to be collected and compiled on past occurrence of the various types of land subsidence. Once that information is collected and mapped, analysis of Preparedness Area risk can be evaluated.

What Can Be Mitigated?

This will be re-addressed further in the next plan update. One mitigation effort is educating communities about the effects of mining on land subsidence and the risks mining brings to the community.

Severe Winter Storms

Hazard Characteristics

Winter storms have significant snowfall, ice, and/or freezing rain, with the quantity of precipitation variable by elevation. According to the National Weather Service, heavy snowfall is four inches or more in a 12-hour period, or six or more inches in a 24-hour period in non-mountainous areas; and 12 inches or more in a 12-hour period or 18 inches or more in a 24- hour period in mountainous areas. Winter storms vary in size and strength and include heavy snowfalls, blizzards, freezing rain, sleet, ice storms, blowing and drifting snow conditions, and extreme cold.

A variety of weather phenomena and conditions can occur during winter storms. For clarification, the following are NWS approved definitions of winter storm elements:

- **Heavy snowfall** - the accumulation of 6 or more inches of snow in a 12-hour period or 8 or more inches in a 24-hour period
- **Blizzard** - the occurrence of sustained wind speeds in excess of 35 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow
- **Ice storm** - an occurrence where rain falls from warmer upper layers of the atmosphere to the colder ground, freezing upon contact with the ground and exposed objects near the ground
- **Freezing drizzle/freezing rain** - the effect of drizzle or rain freezing upon impact on objects that have a temperature of 32° F or below
- **Sleet** - solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. This ice does not cling to surfaces
- **Wind chill** - an apparent temperature that describes the combined effect of wind and low air temperatures on exposed skin

A blizzard is a winter storm with considerable falling and/or blowing snow combined with sustained winds or frequent gusts of 35 mph or greater that frequently reduces visibility to less than one-quarter mile. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death. Winter storm occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents, collapsed roofs from fallen trees and limbs, heavy ice and snow loads, and downed telephone poles and lines, electrical wires, and communication towers. Such storms can also cause exceptionally high rainfall that persists for days, resulting in heavy flooding.

A severe winter storm for New Mexico as defined by the National Weather Service:

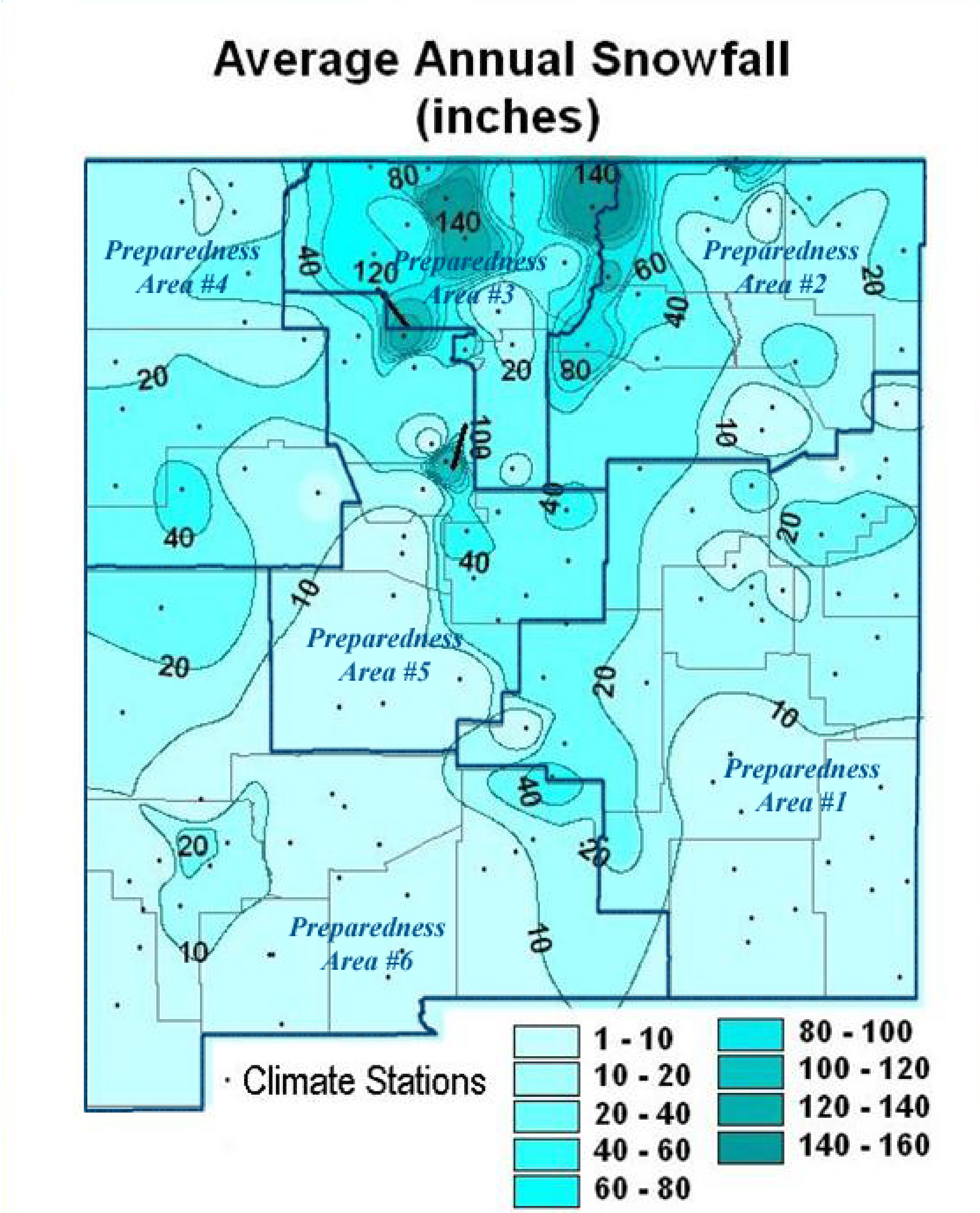
- 4 or more inches of snowfall below 7,500 ft or
- 6 or more inches of snowfall above 7,500 ft in a 12 hour period, or
- 6 or more inches of snowfall below 7,500 ft or
- 9 inches of snowfall above 7,500 ft in a 24-hour period

Most winter precipitation in New Mexico is associated with Pacific Ocean storms as they move across the state from west to east. As the storms move inland, moisture falls on the coastal and inland mountain ranges of California, Nevada, Arizona, and Utah. If conditions are right, the remaining moisture falls on the slopes of New Mexico's high mountain chains.

Much of the precipitation that falls as snow in the mountain areas may occur as either rain or snow in the valleys. The average annual snowfall ranges from about 3 inches in the southern desert and southeastern plains to over 100 inches in the northern mountains. It can, on rare occasions, exceed 300 inches in the highest mountains. January is usually the coldest month, with average daytime temperatures ranging from the middle 50s in the southern and central valleys to the middle 30s in the higher elevations. Minimum temperatures below freezing are common in all sections of the state during the winter[73]. The following two maps (Figures 2.93 - 2.94) depict statewide snowfall distributions by average inches and average numbers of days with snowfall over 1 inch.

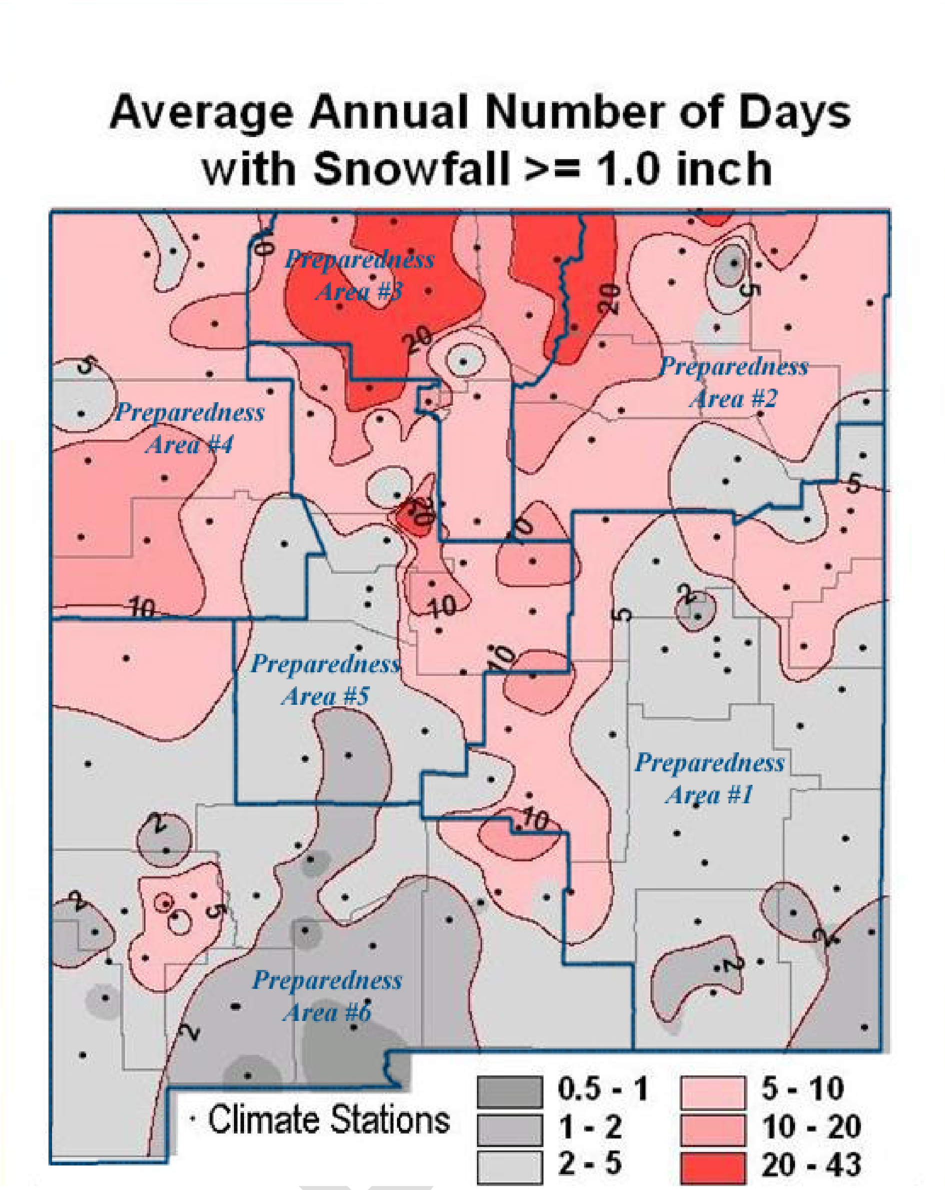
[73] Source: http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm

Figure 4: Statewide Snowfall Distributions by Preparedness Area as of January 2012[74]



[74] Source: http://www.srh.noaa.gov/abq/?n=prepwinterwxclimo

Figure 2.94: Statewide Average Annual Number of Days with Snowfall >= 1.0 Inch by Preparedness Area



Severe winter storms can vary in size and strength and include heavy snowstorms, blizzards, ice storms, freezing drizzle or rain, sleet, and blowing and drifting snow. Extremely cold temperatures accompanied by strong winds result in potentially lethal wind chills.

The Wind Chill is the temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from your body much more quickly, causing skin temperature to drop. The Wind Chill chart (Table 2.95) shows the difference between actual air temperature and perceived temperature, and amount of time until frostbite occurs

Table 2.95: Wind Chill Chart - December 2012[75]

		Temperature (?F)																	
		-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40
Wind (mph)	60	-98	-91	-84	-76	-69	-62	-55	-48	-40	-33	-26	-19	-11	-4	3	10	17	25
	55	-97	-89	-82	-75	-68	-61	-54	-46	-39	-32	-25	-18	-11	-3	4	11	18	25
	50	-95	-88	-81	-74	-67	-60	-52	-45	-38	-31	-24	-17	-10	-3	4	12	19	26
	45	-93	-86	-79	-72	-65	-58	-51	-44	-37	-30	-23	-16	-9	-2	5	12	19	26
	40	-91	-84	-78	-71	-64	-57	-50	-43	-36	-29	-22	-15	-8	-1	6	13	20	27
	35	-89	-82	-76	-69	-62	-55	-48	-41	-34	-27	-21	-14	-7	0	7	14	21	28
	30	-87	-80	-73	-67	-60	-53	-46	-39	-33	-26	-19	-12	-5	1	8	15	22	28
	25	-84	-78	-71	-64	-58	-51	-44	-37	-31	-24	-17	-11	-4	3	9	16	23	29
	20	-81	-74	-69	-61	-55	-48	-42	-35	-29	-22	-15	-9	-2	4	11	17	24	30
	15	-77	-71	-64	-58	-51	-45	-39	-32	-26	-19	-13	-7	0	6	13	19	25	32
	10	-72	-66	-59	-53	-47	-41	-35	-28	-22	-16	-10	-4	3	9	15	21	27	34
	5	-63	-57	-52	-46	-40	-34	-28	-22	-16	-11	-5	1	7	13	19	25	31	36

Extreme cold occurs when temperatures drop below normal and wind speeds increase, as this occurs, the body is cooled at a faster rate than normal, causing the skin temperature to drop, which can lead to frostbite (when body tissues freeze) and hypothermia (abnormally low body temperature, <95°F). Extreme cold is measured by the wind chill temperature index (Table 43). The index is based on heat loss from exposed skin and includes a frostbite indicator.

In New Mexico, January is the coldest month. Day-time temperatures range from the mid-50s in the southern and central valleys to the mid-30s in the north's higher elevations. Minimum temperatures below freezing are common throughout the state; however, subzero temperatures are rare, even in the mountains.[76]

Minimum temperatures below freezing are common in all sections of the state during the winter. Subzero temperatures are rare, except in the mountains. The lowest temperature ever officially recorded was -50° F at Gavilan on February 1, 1951. An unofficial low temperature of -57° F at Ciniza was reported by the press on January 13, 1963.[77]

The entire state of New Mexico experiences some form severe winter storm event. Based on the topography of the state, such as elevation and land contours, this all plays a significant part in winter weather affects a particular area. The effects of severe winter storm events vary according to the type of hazard. Winter storms often have the effect of disrupting transportation and commerce. Injury to people and property result from heavy loads of snow and ice causing collapse of roofs of buildings,

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75 Source: http://www.weather.com/outlook/recreation/ski/tools/windchill/
76 Source: Western Region Climate Center http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm
77 Source: http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm

falling trees and telephone poles, knocking down electrical lines, and creating slippery conditions for pedestrians and vehicles.

Previous Occurrences

The State of New Mexico experiences severe winter storm events annually. Referencing the NCDC, New Mexico experienced a total of 69 winter storm events between January 1, 2006 and December 1, 2012. For the same time period, NCDC reports 48 extreme temperature events with 1 death and $1.175 million in property damage, 3 deaths related to freezing fog and 1 death related to winter storm event. Reviewing severe winter storm events by Preparedness Area Table 44 briefly explains those significant winter storm events that have occurred in each throughout the State of New Mexico. The location of the event is identified by both the city/county and Preparedness Area. Source information is from the NCDC and data provided by local authorities. Table 2.96 provides a cumulative overview of all severe winter storm events that have occurred in all Preparedness Areas.

Table 2.96: Significant Past Occurrences - Severe Winter Storms

Date	Name/Location	Significant Event
December 25, 2011	Curry County Preparedness Area 1	A strong upper level low pressure system that slowly moved south over Arizona and then over southern New Mexico brought copious amounts of snow to the state. Some of the areas that were hit the hardest included the same areas that were blanketed by snow from the previous storm. However, this time, it was the southeast portion of the state, rather than the northeast portion of the state, that was hit hard. Another cold front moved down the plains and through the gaps of the central mountain chain on the 22nd, and snow quickly developed across the western two-thirds of the state. One to two feet of snow was common across the east slopes of the Sandia and Manzano Mountains as well as the west central and southwest mountains. As the low slowly moved east across southern portions of the state, snow was heaviest from the south central mountains eastward to the Texas state line. These areas saw between 6 and 12 inches of snow at lower elevations, while well over a foot of fresh snow was reported across the high terrain. A 4-year old girl died after her family's SUV lost traction on an icy Highway 209 north of Clovis and overturned. The girl's mother and sister suffered minor injuries.
December 24, 2011	Albuquerque, NM Preparedness Area 5	A major winter storm event moving through the Albuquerque Metro area caused the shutdown of I-25 / I-40 for over 18 hours stranding passengers.

Date	Name/Location	Significant Event
December 12, 2011	Central Highlands Clines Corner, NM Preparedness Area 5	After a very strong back door frontal passage on December 1st, which plowed through the eastern plains and westward through the gaps of the central mountain chain toward the Arizona border, much cooler temperatures were in place across the state. Then on the 2nd and 3rd, an upper level storm system swept across New Mexico. A nearly perfect setup for the state, significant snows were reported from south central New Mexico across far northeast New Mexico along a heavy band of snow. Lighter amounts of snow were reported elsewhere. Traffic was significantly impacted across the region. Two people were killed in separate rollover accidents on Interstate 40 near Clines Corners during the morning hours of the 2nd. The first crash occurred around 7 am near exit 218. The second occurred approximately 3 miles east a half an hour later, taking the life of a 70 year-old man. Both drivers lost control due to icy roadways.
January 4-5, 2009	Bloomfield & Farmington, NM (San Juan County) Preparedness Area 4	Up to 5 inches of snow fell in Bloomfield and Farmington. There was one death reported according to the NCDC.
December 15, 2008	Upper Rio Grande Valley Preparedness Area 5	A deep low pressure area centered over California continued to pump moisture into Mew Mexico on the 15th and 16th. A strong short wave trough ejected out of the low and helped bring widespread, heavy snow to much of the area near and north of Interstate 40. Eight to 12 inches of snow fell over much of the Upper Rio Grande Valley. Two deaths was reported from this storm event.
February 3, 2008	Chama, NM (Rio Arriba County) Preparedness Area 3	3 to 6 inches of snow fell across low elevations of the northwest mountains, while 1 – 2 feet fell in the high country, with an impressive 40 inches 2 miles north of Chama near the Colorado border. The roof collapsed at the lone grocery store in Chama (Lowes Chama Valley Supermarket). No fatalities or injuries reported; however $20K in damages were reported,
December 16, 2008	Upper Rio Grande Preparedness Area 3	8 – 10 inches of snow fell on "much of the Upper Rio Grande". Two fatalities were reported.

Date	Name/Location	Significant Event
December 25, 2006	Preparedness Area 2, 3 and 5	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. Estimated response costs are up to $5 million. The Governor made a request to FEMA for a Presidential Disaster Declaration.
January 1, 2001	McKinley County Cibola County Preparedness Area 4 San Miguel County Union County Mora County Preparedness Area 3 Torrance County Preparedness Area 5	A slow-moving winter storm howled into northern and central New Mexico with gusty winds and heavy snow, which closed state highways and many rural roads and contributed to two deaths from exposure. Tribal police found one body just north of Gallup and another near Bluewater. The storm produced 18 to 36 inches of heavy snow that engulfed snow removal and closed roads from the eastern Sangre de Cristo Mountains south over Las Vegas into the central highlands to Vaughn and Corona and westward over the Estancia Valley and the east slope communities of the Sandia and Manzano Mountains. Some residents remained trapped in their homes for 4-5 days before enough snow removal opened both the major and minor county roads. A state of emergency was declared in several counties including Mora, San Miguel and Torrance.
December 22-25, 1997	All Counties Preparedness Area 1 Union County Preparedness Area 3 Torrance County Preparedness Area 5	The state received a federal declaration (FEMA-1202) for a severe winter storm that affected Chaves, DeBaca, Eddy, Guadalupe, Lincoln, Mora, Quay, Torrance, and Union counties. Interstate 40 was closed for an extended period between Albuquerque and Santa Rosa. Approximately 400 tons of hay was airlifted to livestock, and over 10,000 sheep and cattle were lost. Total losses (property and crop) were valued at $6.5 million, and the cost for clearing and repairing roads and highways was estimated at $4 million.
January 1997	Albuquerque, NM Preparedness Area 5	Winter storms produced widespread heavy snow and icy roads across much of New Mexico. Icy roads were the direct cause of numerous auto mishaps as road conditions deteriorated very quickly. At least two fatal accidents were

Date	Name/Location	Significant Event
		directly related to the weather, with weather an indirect cause of a third fatal crash. A car spun while in snow south of Carrizozo and collided with a school bus killing a 27-year-old passenger. A passenger was also killed near Tucumcari when a van slid off the road in a snowstorm and overturned several times. A 30 year old woman and her 3 year old son were also killed when their automobile crashed into the rear a semi-truck stopped at the end of traffic tie-up about 15 miles west of Grants. In Rio Rancho, an elderly woman slipped and fell on ice in her driveway January 13; she could not get up and died of exposure before anyone found her. The interstate had been closed 3 miles away to clear other accidents. Roads were snow packed and icy. Snow totals in many areas averaged 7 inches with amounts of 10 to 19 inches reported on the Highlands between Edgewood and Santa Rosa and south to Carrizozo. Amounts of 14 inches were also recorded near Zuni and Pietown in west central sections of the state. Many rural roads remained snow clogged for several days and large sections of the interstate highways leading to Albuquerque in all directions were closed overnight until late on the 16th.
April 1997	DeBaca and Guadalupe Counties Preparedness Area 1 Torrance County Preparedness Area 5	The northern half of the state experienced blizzard conditions with widespread power outages. Utility damages were estimated at $1.5 million, and the three county area of DeBaca, Guadalupe, and Torrance Counties sustained over $1 million dollars in livestock losses, including an estimated 5,000 dead sheep.

Declared Disasters from Severe Winter Storm, Snow Storm and Freeze

DHSEM reports 10 State Declared Disasters for severe winter storms between 2003 and 2013. This number i based on how many Executive Orders were signed by the Governor for severe winter storm, snow storm an freeze. According to DHSEM records, the total cost for State declared flood events from 2003 - 2012 wa $6,052,869 (Table 2.97). The total does not reflect all costs for Executive Order 09-048 which is still bein tallied. Currently, the data has not been broken out by Preparedness Area. Research into locations for eac disaster needs to be completed prior to breaking-out the figures by Preparedness Area.

Table 2.97. State Disaster Event Information 2003 through 2012

Event Type	State Executive Order	Dollar Loss
Severe Winter Storm	04-031	$176,513
Snow Storm	05-012	$384,269
Snow Storm	05-016	$906,396
Snow Storm	06-070	$2,013,953
Snow Storm	08-005	$1,386,815
Snow Storm	09-001	$71,427
Snow/Wind Storm	09-048**	$54,040
Snow Storm	10-005	$209,456
Severe Cold	11-014	$750,000
Navajo Freeze	13-004	$100,000
Total	**10**	**$6,052,869**

One of the 10 State severe winter storm disasters was also a federally declared disaster (Figure 2.98). The total Public Assistance dollar losses from federal, State and local government entities and all tribal entities was $2,393,376. The State contributed 12.5% of the total cost for this disaster. Data is not broken out by Preparedness Area. Research into locations and costs for each County for this disaster would need to be completed prior to breaking-out the figures by Preparedness Area. However, for this one disaster damage was calculated from Preparedness Areas 1, 3, 5 and 6.

Figure 2.98. Federal Disaster Event Information 2003 through 2012

Event Type/Name	Event Number	Federal Share	State Share	Total Cost	State % of Total
Severe Winter Storm and Extreme Cold Temperatures	1962	$1,795,032	$299,172	$2,393,376	12.50%
Total	**1**	**$1,795,032**	**$299,172**	**$2,393,376**	

Another source of severe winter storm damage information is from the NCDC. Below is a tally of severe winter storm damage as reported by NCDC broken out by Preparedness Area (Table 2.99). According to NCDC from 2006 through 2012 State-wide property damage from severe winter storm damage was $26,209,000 and crop damage was $2,500.

Table 2.99: Preparedness Areas 1 - 6 Severe Winter Storm Events (January 1, 2006 - December 1, 2012)[78]

Preparedness Area 1 Counties: Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Extreme Cold/Wind Chill	1	0	0	0	0	0
Freezing Fog	3	0	1	0	$25,004,000	$1,500
Heavy Snow	35	0	0	0	0	0
Winter Storm	7	0	1	0	0	0
Total	**46**	**0**	**2**	**0**	**$25,004,000**	**$1,500**

Preparedness Area 2 Counties: Colfax, Harding, Mora, Union and San Miguel						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Extreme Cold/Wind Chill	1	0	0	0	0	0
Freezing Fog	0	0	0	0	0	0
Heavy Snow	3	0	0	0	0	0
Winter Storm	0	0	0	0	0	0
Total	**4**	**0**	**0**	**0**	**0**	**0**

[78] Source: http://www.ncdc.noaa.gov

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

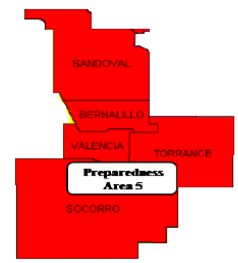
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	1	0	0	0	0	0
Freezing Fog	0	0	0	0	0	0
Heavy Snow	1	0	0	0	0	0
Winter Storm	0	0	0	0	0	0
Total	**2**	**0**	**0**	**0**	**0**	**0**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	3	0	3	0	0	0
Freezing Fog	0	0	0	0	0	0
Heavy Snow	1	0	1	0	0	0
Winter Storm	0	0	0	0	0	0
Total	**4**	**0**	**1**	**0**	**0**	**0**

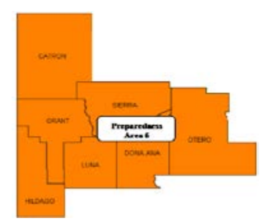
Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	1	0	0	0	0	0
Freezing Fog	0	0	2	0	0	0
Heavy Snow	9	0	3	0	$30,000	$1,000
Winter Storm	0	0	0	0	0	0
Total	**10**	**0**	**5**	**0**	**$30,000**	**$1,000**



Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Extreme Cold/Wind Chill	5	0	0	0	$1,175,000	0
Freezing Fog	0	0	0	0	0	0
Heavy Snow	0	0	0	0	0	0
Winter Storm	0	0	0	0	0	0
Total	**5**	**0**	**0**	**0**	**$1,175,000**	**0**



Preparedness Area 1 has suffered the highest levels of property damage. The impacts of 3 freezing fog events led to $25,004,000 worth of property damage and one fatality. Preparedness Area 6 was exposed to 5 extreme cold/wind chill events. Although no fatalities occurred, property damage soared to $1,175,000. Preparedness Area 5 reported 5 deaths related to severe winter storms. The deaths were attributed to heavy snow (9 heavy snow events were recorded) and freezing fog. Uneven distribution of the magnitude and types of impacts winter storms have on Preparedness Areas is closely related to the capacity of the people and communities who live there.

Frequency

No part of the state is immune from the severe winter storms, whether extreme cold, heavy snow, ice storm, or other cold weather condition. The mountainous areas of the state, which includes all Preparedness Areas, are more likely to receive snow and cold than the plains and desert, and residents of high altitude areas are more likely to be prepared for these conditions, even if they become extreme.

Probability of Occurrence

To determine the probability of New Mexico experiencing future high wind occurrences, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of January 1, 2006 – December 1, 2012. Probability was determined by dividing the number of events observed by the number of months and multiplying by 100. This gives the percent chance of the event happening in any given year. Table 46 provides the probability of occurrence in each Preparedness Area based on the probability formula.

Table 2.100: Probability of Occurrence - Severe Winter Storms

Probability of Occurrence				
Preparedness Area	Extreme Cold/Wind Chill	Freezing Fog	Heavy Snow	Winter Storm
Preparedness Area 1	.01%	3.6%	42%	8.3%
Preparedness Area 2	1.2%	0%	3.6%	0%
Preparedness Area 3	1.2%	0%	1.2%	0%
Preparedness Area 4	3.6%	0%	1.2%	0%
Preparedness Area 5	1.2%	0%	11%	0%
Preparedness Area 6	6.0%	0%	0%	0%

Risk Assessment

Severe winter storms are difficult to predict precisely in pattern, frequency, and degree of severity. The impact from severe winter storm events (heavy snowfall, blizzard, ice storm, freezing drizzle/freezing rain, sleet, wind chill, and extreme temperatures) has been moderate with impact to widespread area of crops and livestock depending on the time of year when it occurs. Highly vulnerable populations include those in mobile home parks, recreational vehicles, and aged or dilapidated housing, but no area is safe.

Severe winter weather is much more likely to have a serious impact on major population centers and transportation routes, most of which are not located in the high mountains. This actually occurred on December 24, 2011 during a serve snow storm when motorists traveling through Albuquerque, NM (Preparedness Area 5) interstate system were stranded for up to 18 hours. The plains and desert areas (Preparedness Areas 1 and parts of Preparedness Area 6) are more susceptible to high winds that contribute to the drifting of snow, and a snow storm that would hardly be noticed in the higher altitudes could present a serious hazard to people in the lower altitudes. If a severe winter storm were cause a power failure, as would be likely with an ice storm, the effect could be very serious anywhere in the state. Any accumulation of ice or snow on the roads is a hazardous situation and can lead to wide spread road and highway closures, that can strand motorists. Table 2.101 outlines Impacts from severe winter storm events for each Preparedness Area to consider when planning for these types of events.

Table 2.101: Severe Winter Storm Impacts

Subject	Impacts
Health and Safety of The Public	Injuries and death have resulted from winter storm events. Individuals caught out doors can suffer frostbite, hypothermia, and death from low temperatures.
Health And Safety of Responders	Responders face the same impacts as the public.
Continuity of Operations	Travel to key facilities and places of employment may be impossible, and those entities may not be able to function.
Delivery of Services	Facilities that are unable to be reached or if supply lines are blocked, widespread denial of services may result.
Property, Facilities, Infrastructure	Winter storms can cause ice to form on roads and bridges rendering them impassible, can accumulate on power lines and cause them to break, can cause water pipes to burst, and heavy snows can collapse roofs
Environment	Winter storms can cause damages to trees and plants as well as to crops and animals.
Economic Condition	The negative effects to the economic condition are generally from the damages the hazard causes to infrastructure and agriculture. Individuals and businesses can suffer unanticipated expenses.
Public Confidence	Winter storms are an expected event in the state, but a slow response such as road clearing or restoration of utilities can cause an erosion of the public's confidence in the government.

Data Limitations

The Hazard Mitigation Team could not quantify vulnerability of individual structures to damage from severe winter storm events. Accurate methods to quantify potential future damages are not readily available. The amount of business lost due to winter storms and road closures has not been calculated due to the difficulty of attaining this information. The Hazard Mitigation Team could also not specify which critical facilities were vulnerable to severe winter storms. Subsequent versions of this Plan will need to incorporate and respond to these data deficiencies.

What Can Be Mitigated?

One important part of mitigating severe winter storm hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to severe winter storm by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending storms. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to severe winter storm weather. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation. For supporting road closure mitigation, a state regulation was added to provide safety to the public. The regulation regarding road closure is as follows:

66-7-11. New Mexico State Police power to close certain highways in emergencies. Notwithstanding any rule, regulation or agreement of the state highway department, the New Mexico state police, in cases of emergency where the condition of a state highway presents a substantial danger to vehicular travel by reason of storm, fire, accident, spillage of hazardous materials or other unusual or dangerous conditions, may close such highway to vehicular travel until the New Mexico State Police determines otherwise. The state highway department shall be notified of the highway closure as soon as practicable.

This regulation is broad enough to allow for closure for any type of severe winter storm event, but it is also difficult to define what constitutes "dangerous conditions.

Thunderstorms (including Lightning and Hail)

Hazard Characteristics

Thunderstorms are produced when warm moist air is overrun by dry cool air. As the warm air rises, thunderheads form and cause strong winds, lightning, hail, and heavy rains. Atmospheric instability can be caused by surface heating or by upper tropospheric (>50,000 feet) divergence. Rising air parcels can also result from airflows over mountainous areas. Generally, the former "air mass" thunderstorms form on warm-season afternoons and are not severe. The latter "dynamically-driven" thunderstorms, which generally form in association with a cold front or other regional atmospheric disturbance, can become severe, thereby producing strong winds, frequent lightning, hail, downburst winds, heavy rain, and occasional tornadoes.

All areas of the state have thunderstorms. According to the National Weather Service (NWS), the thunderstorm season in New Mexico begins over the high plains in the eastern part of the state in mid- to late April, peaks in May and June, declines in July and August, and then drops sharply in September and October. In the western part of the state, thunderstorms are infrequent during April, May, and June, increase in early July and August, and then decrease rapidly in September. Over the central mountain chain, thunderstorms occur almost daily during July and August, especially over the northwest and north central mountains.

Thunderstorms tend to have different characteristics in different regions of the state. Across the eastern plains, thunderstorms tend to be more organized, long-lived, and occasionally severe, producing large hail, high winds, and tornadoes. Thunderstorms in the western part of the state tend to be less severe on average, occasionally producing life-threatening flash floods and small hail accumulations. Most of the storms in western New Mexico are associated with the southwest monsoons, which mainly produce flash floods.

Severe thunderstorms are reported each year in nearly all New Mexico counties. The NWS definition of a severe thunderstorm is 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. Typical thunderstorms can be 3 miles wide at the base, rise to 40,000-60,000 feet into the troposphere, and contain half a million tons of condensed water.

Thunderstorm frequency is measured in terms of incidence of thunderstorm days or days on which thunderstorms are observed. Any county (or Preparedness Area) may experience 10 or more thunderstorm days per year. According to the NWS Publication, *Storm Data*, in the past 30 years New Mexico has experienced over 50 reported events 75 mph or higher associated with thunderstorms, with a single occurrence of 115 mph winds. This means that in New Mexico winds similar to a Category 1 Hurricane (Saffir-Simpson Scale) are experienced on average about 1 day every 1.5 years.

The current online National Climatic Data Center (NCDC) database is limited in past events and only contains data from January 2006 to present, as entered by NOAA's National Weather Service. Referencing this online database, NCDC reports 331 Thunderstorm events since January 2006 causing 1 death, 4 injuries, $5.65 Million in property damage, and $5.032 Million in crop damages.[79] New Mexico

[79] Source: http://www.ncdc.noaa.gov/stormevents/

averages 25 thunderstorm events per year. Essentially New Mexico has a 100% probability of a thunderstorm, and .3% chance of a fatality from thunderstorms every year.

Lightning is defined 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. Nationwide, lightning is the cause of extensive damage to buildings and structures, death or injury to people and livestock, the cause of wildfires, and the disruption of electromagnetic transmissions. Lightning is extremely dangerous during dry lightning storms because people often remain outside, rather than taking shelter.

To the general public, lightning is often perceived as a minor hazard. However, lightning-caused damage, injuries, and deaths establish lightning as a significant hazard associated with any thunderstorm. Damage from lightning occurs four ways:

(1) Electrocution or severe shock of humans and animals;

(2) Vaporization of materials along the path of the lightning strike;

(3) Fire caused by the high temperatures (10,000-60,000°F); and

(4) A sudden power surge that can damage electrical or electronic equipment.

Large outdoor gatherings (sporting events, concerts, campgrounds, etc.) are particularly vulnerable to lightning strikes. New Mexico ranks sixth in the nation in lightning fatalities with 0.55 deaths per million people annually. We rank 22nd in lightning frequency overall.[80]

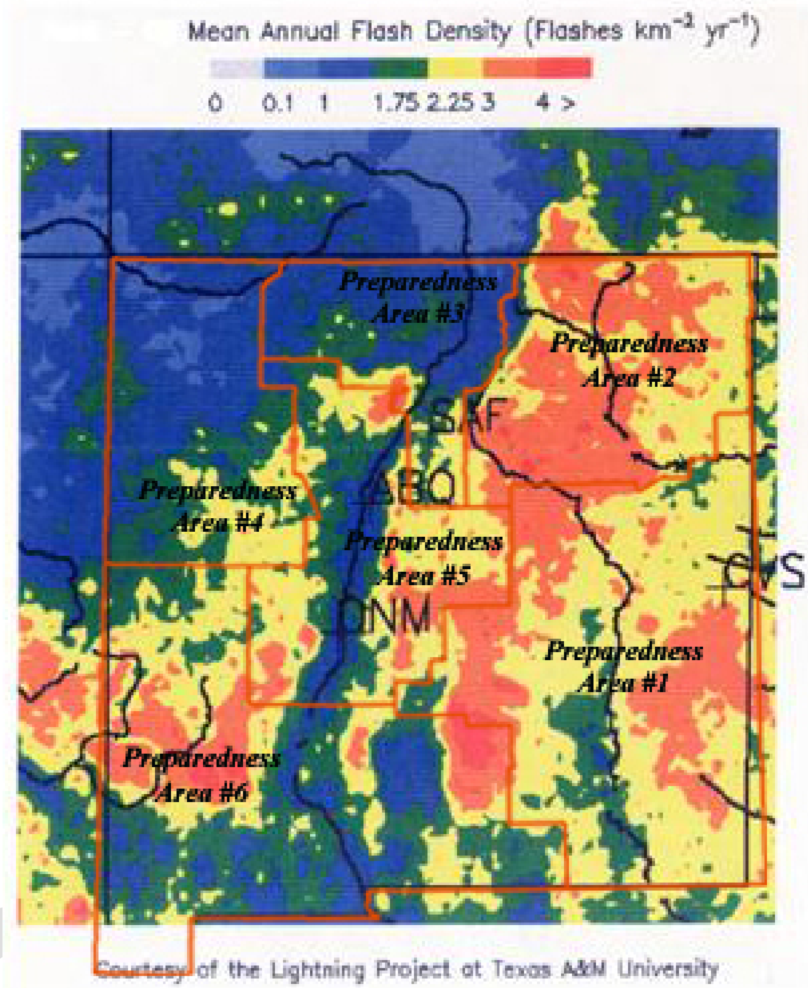
The current online NCDC database is limited in past events and only contains data from January 2006 to present, as entered by NOAA's National Weather Service (NWS). According to the database, NCDC reports 9 Lightning events since January 2006 causing 1 death, 7 injuries, and $93K in property damage.[81]

According to the National Weather Service, New Mexico suffered 90 lightning related fatalities between 1959 and 2011 (52 years). Overall New Mexico has a 100% probability of a lightning event every year and there is a 100% chance of a lightning fatality each year. According to NWS, New Mexico experienced 614,898 lightning flashes in 2011. Between 1997 and 2011 the average number of lightning flashes totaled 879,282 per year.[82]

Recent storms monitored by New Mexico Tech produced between 65 and 1062 lightning flashes per minute. Additionally, lightning strikes the ground or objects on average once in every five to 10 cloud flashes. Based on the NM Tech studies, New Mexico routinely has thunderstorms that have between 13 and 106 lightning strikes per minute. While the entire state is at risk for lightning events, some areas of the state have higher concentrations of them. Figure 2.102 shows areas of lightning density in the state. Based on the maps in Figure 2.102, higher concentrations of lightning strikes occur in Preparedness Areas 1, 2, 5 and 6.

[80] Source: http://www.lightningsafety.com/nlsi_lls/fatalities_us.html
[81] Source: http://www.ncdc.noaa.gov/stormevents/
[82] Source: http://www.lightningsafety.noaa.gov/stats/Table-Flashes_by_State_1997-2011.pdf

Figure 2.102. Lightning Density in New Mexico Preparedness Areas



The Lightning Activity Level is a scale from 1-6, which describes frequency and character of cloud-to-ground (cg) lightning (Table 2.103).

Table 2.103. Lightning Activity Level[83]

Cloud and Storm Development		Areal Coverage	Counts cg / 5 min	Counts cg / 15 min	Average cg / min
1	No thunderstorms	None	-	-	-
2	Cumulus clouds are common but only a few reach the towering stage. A single thunderstorm must be confirmed in the rating area. Light rain will occasionally reach ground. Lightning is very	<15%	1-5	1-8	<1

[83] Source: http://www.crh.noaa.gov/gid/?n=fwfintro

	infrequent.				
3	Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.	15% to 24%	6-10	9-15	1-2
4	Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.	25% to 50%	11-15	16-25	2-3
5	Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.	>50%	>15	>25	>3
6	Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)	>15%	-	-	-

Based on the Lightning Activity scale, all Preparedness Areas consistently experiences storms of LAL5 or higher, specifically during the monsoon seasons. The North American Monsoon System (NAMS) is a large scale shift in the atmospheric circulation that results in a summertime maximum of precipitation across portions of Mexico, Arizona and New Mexico. The monsoon season, broadly defined from mid-June to late September, is actually comprised of "bursts" and "breaks," or periods of rainy and dry weather. The average onset occurs around July 3 for the southwest corner of the state (Preparedness Area 6, around July 9 for the Middle Rio Grande valley (Preparedness Area 5), and around July 12 for the Four Corners region (Preparedness Area 4).

Hail is frozen water droplets formed inside a thunderstorm cloud. They are formed during the strong updrafts of warm air and downdrafts of cold air, when the water droplets are carried well above the freezing level to temperatures below 32 deg F, and then the frozen droplet begins to fall, carried by cold downdrafts, and may begin to thaw as it moves into warmer air toward the bottom of the thunderstorm. This movement up and down inside the cloud, through cold then warmer temperatures, causes the droplet to add layers of ice and can become quite large, sometimes round or oval shaped and sometimes irregularly shaped, before it finally falls to the ground as hail.

Hail usually occurs during severe thunderstorms, which also produce frequent lightning, flash flooding and strong winds, with the potential of tornadoes. The hail size ranges from smaller than a pea to as large as a softball, and can be very destructive to buildings, vehicles and crops. Even small hail can cause significant damage to young and tender plants. Hail usually lasts an average of 10 to 20 minutes but may last much longer in some storms. Hail causes $1 billion in damage to crops and property each year in the U.S. The costliest hailstorm in the United States was in Denver in July 1990 with damage of $625 million.

No part of the state is immune to hailstorms. Once the summer monsoon starts, thunderstorms often develop in the afternoons and evenings. Mountainous areas usually see more storms than the plains and desert, although mountain storms tend to be less severe and produce smaller hail. In the plains and over the desert, monsoon thunderstorms sometimes reach severe levels and can produce large hail. Table 19 shows hail sizes and possible damages from hail events.

According to the NWS, oversized and severe hailstorms occur most frequently in May, followed by June, July, and April. Most counties across the eastern half of the state will see large hail ranging from golf ball to softball at least 6 to 8 times during the spring and also during the summer thunderstorm season. Smaller hail is much more frequent and common in all counties across the east. Counties in the central and western areas will see damaging hail at least twice each year. Hail the size of baseballs or softballs has been reported near Albuquerque, Santa Fe and Las Cruces within the past 3 to 6 years. The Socorro hail storm in October 2004 caused nearly 40 million dollars in damage from baseball sized hail.[84]

The current online NCDC database is limited in past events and only contains data from January 2006 to present, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total of 917 hail events with $20.462 in property damage and $363.51 in crop damage.[85]

Table 2.104 combines the NOAA and TORRO hailstorm intensity scales as a way of describing the size of hail based on the intensity and diameter of the hail.[86]

Table 2.104: Combined NOAA/TORRO Hailstorm Intensity Scale

Combined NOAA/TORRO Hailstorm Intensity Scales					
	Intensity Category	**Typical Hail Diameter (mm)***	**Probable Kinetic Energy, J-m²**	**Description**	**Typical Damage Impacts**
H0	Hard Hail	5	0-20	Pea	No damage
H1	Potentially Damaging	5-**15**	>20	Mothball	Slight general damage to plants, crops
H2	Significant	10-**20**	>100	Marble, grape	Significant damage to fruit, crops, vegetation
H3	Severe	20-**30**	>300	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-**40**	>500	Pigeon's Egg > Squash ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-**50**	>800	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-**60**		Hen's egg	Bodywork of grounded aircraft dented, brick

84 Source: http://www.srh.noaa.gov/abq/?n=prephazards
85 Source: http://www.ncdc.noaa.gov/stormevents/
86 Source: Tornado and Strom Research Organization http://www.torro.org.uk/site/hscale.php

Combined NOAA/TORRO Hailstorm Intensity Scales					
	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, $J\text{-}m^2$	Description	Typical Damage Impacts
					walls pitted
H7	Destructive	50-**75**		Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
H8	Destructive	60-**90**		Large orange > Softball	(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-**100**		Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100		Melon	Extensive structural

Previous Occurrences

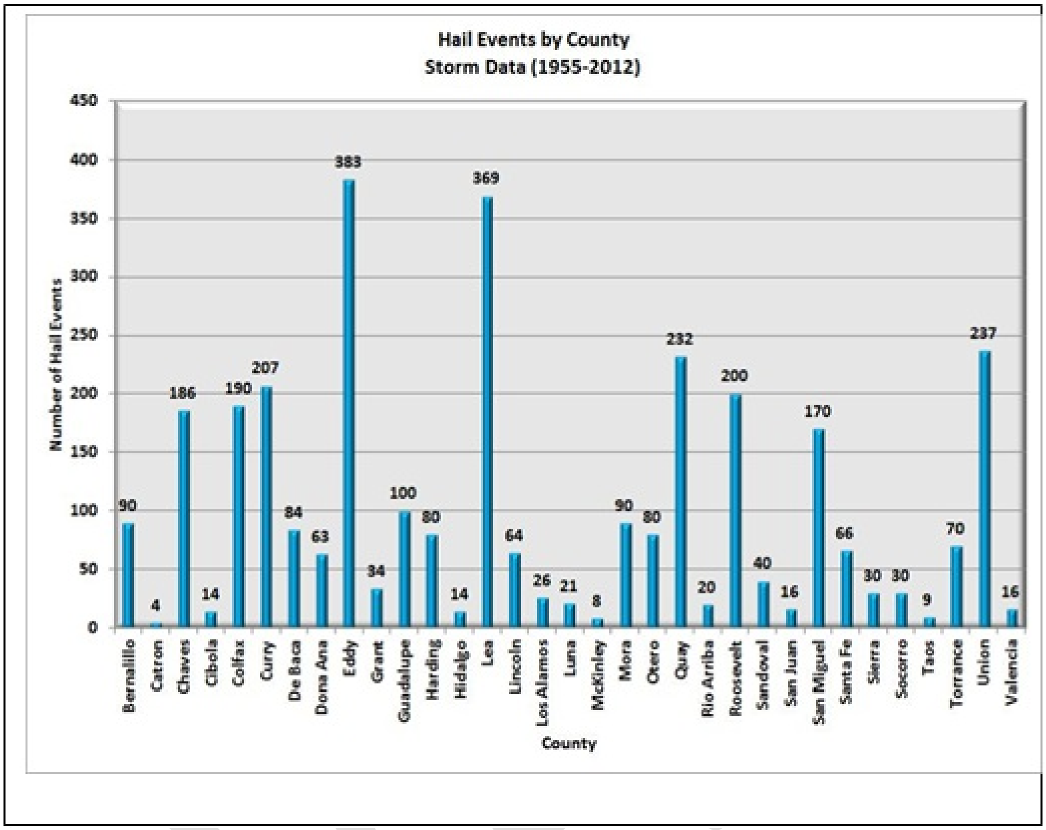
Thunderstorm activity in New Mexico is consistent due to seasonal meteorological patterns and local topographical conditions. The entire state is susceptible to a full range of weather conditions, including thunderstorms, lightning and hail. All areas of state are susceptible to thunderstorm conditions, although local topography, such as elevation and land contours, plays a significant part in how weather affects a particular area. For the purpose of this report, all areas of the state are considered equally vulnerable to all types of thunderstorm activity.

The impacts of thunderstorms vary according to the types of secondary hazards they produce. Thunderstorms can cause substantial rainfall leading to localized flash flooding. Additionally, thunderstorms can cause lightning strikes that have the potential to ignite wildfires and lead to injury and death. Hailstorms are another potential result of thunderstorms and they can sometimes damage agricultural crops and cause property damage.

The following four Figures illustrate the number of hail storms in the state of New Mexico by hail size, the number of hail storms by month of occurrence, and the number of recorded hail storms by county. This information offers insight into potential high risk counties and particularly risky times of the year for hail storms. Additionally, the data offers insight into the probability that the state will experience a high number of large hail-stone events.

Figure 2.105 shows the number of hail storms by County between 1955 and 2012.

Figure 2.105. Number of Hail Storms in New Mexico by County[87]



The summary table below (Figure 2.106) highlights the counties with the largest number of events and the Preparedness Area in which the high-risk counties are located.

Figure 2.106. Counties and Preparedness Areas Vulnerable to Hail

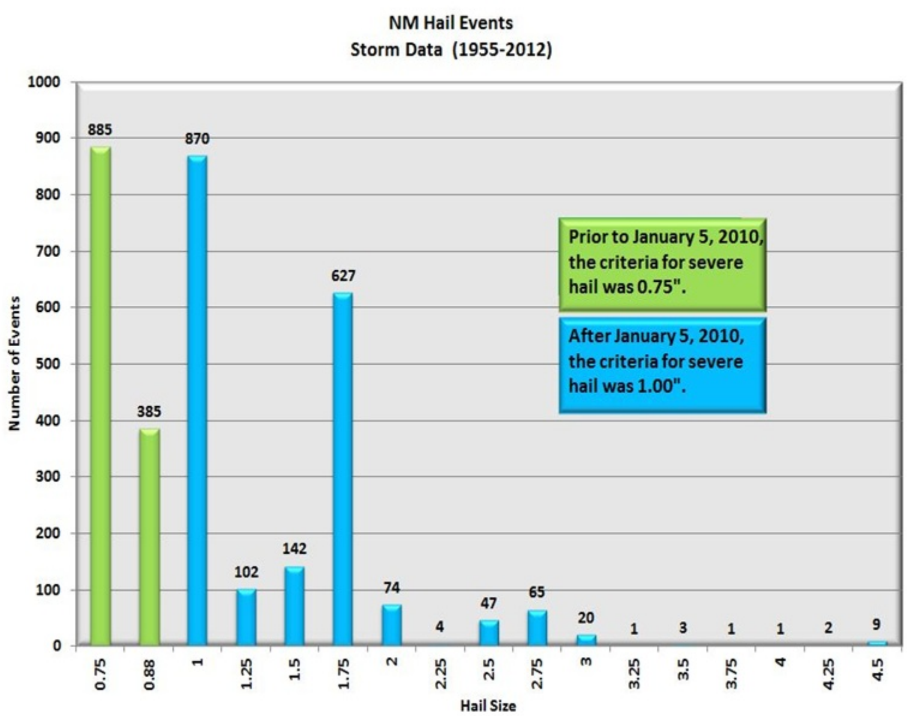
County	Number of Events	Preparedness Area
Eddy	383	1
Lea	369	1
Union	237	2
Quay	232	1
Curry	207	1
Roosevelt	200	1
Colfax	190	2
Chaves	186	1
San Miguel	170	2

[87] Source: http://www.srh.noaa.gov/abq/?n=svrwxclimo

Eddy and Lea County have the most hail storms with more than 350 over the reporting period. Chaves, Colfax, Curry, Quay, Roosevelt, San Miguel and Union Counties have had between 100 and 300 hail events during the reporting period. Three of these Counties are in Preparedness Area 1 and three are in Preparedness Area 2. The eastern boundary of the State has the highest number of hail events during the reporting period.[88]

Figure 2.107 shows the number of storm events in New Mexico related to hail size. Typical hail size in the state is between .75 and 1.75 centimeters.

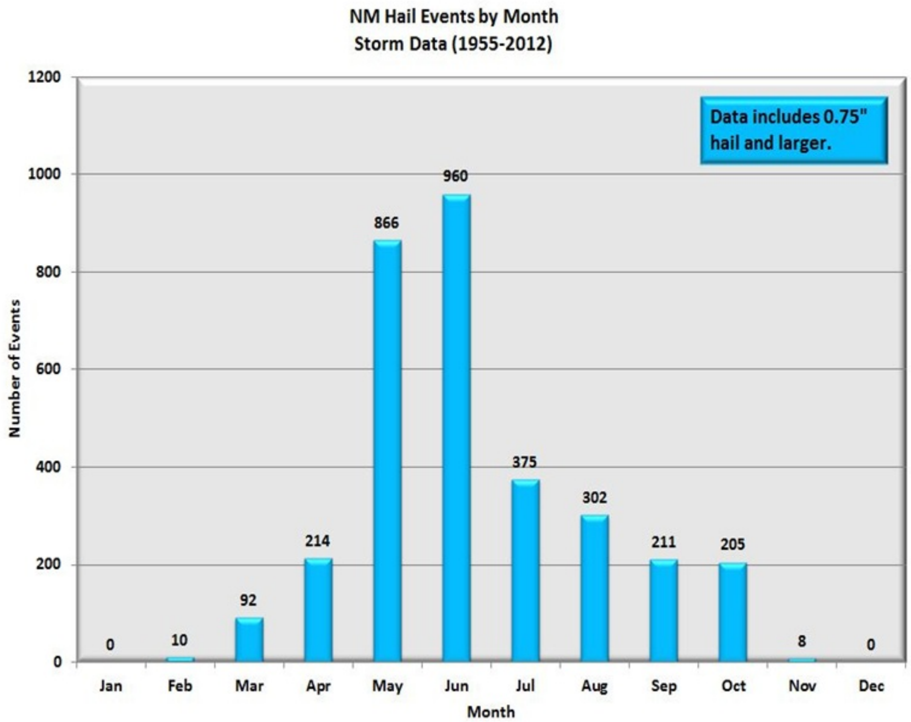
Figure 2.107. Number of Hail Storms in New Mexico Related to Hail Size[89]



[88] Source: http://www.srh.noaa.gov/abq/?n=svrwxclimo_hail
[89] Source: http://www.srh.noaa.gov/abq/?n=svrwxclimo

The final figure, Figure 2.108, illustrates the number of hail storm in New Mexico by their month of occurrence. From the data we see that hail events tend to occur between March and October with the majority of occurrences being in May and June.

Figure 2.108. Number of Hail Storms in New Mexico Related to Month of Occurrence[90]



90 Source: http://www.srh.noaa.gov/abq/?n=svrwxclimo

Table 2.109 briefly explains the most significant thunderstorm events (includes lightning and hail) that have occurred in the State of New Mexico from January 1, 2006 to December 1, 2012. The location of the events are identified by city or county and Preparedness Area. Source information is from the NCDC and data provided by local authorities.

Table 6. Significant Thunderstorm Past Occurrence (2006 – 2012)

Date	Location	Significant Event
June 16, 2012	Logan, NM Preparedness Area 1	Thunderstorms developed over the Sacramento Mountains early in the afternoon and produced localized flooding and severe hail. Another complex of thunderstorms that developed over northeastern New Mexico moved southeast and produced a large scale severe outflow boundary with winds of 60 to 70 mph. Several boats on Ute Lake were damaged due to strong winds. Over $500K in crop damage was reported. No report on the cost of damage to the boats.
October 2, 2010	Cedar Crest, NM Preparedness Area 5	A lone severe thunderstorm developed near San Felipe Pueblo and moved east-southeast along the east mountains. Hail up to 2 inches in diameter fell and devastated trees, roofs, windshields and windows across the area. Golf ball sized hail accumulated 2 inches deep on the ground. Over 200 houses sustained significant damage including roof and window damage. Multiple vehicles were also dented and damaged by the large hail. Over $6M in property damage was reported.
June 6, 2010	Clovis, NM Preparedness Area 1	A cold front stalled over the eastern plains, along with an approaching trough, brought moisture, lift and instability to far eastern New Mexico on the 12th. Numerous large hail was observed along with a few high wind reports. The hailstorm left much of the Clovis area battered by hail up to the size of golf balls. The majority of the damage occurred in the northeastern portion of the community. Over 1600 home and auto claims were submitted to insurance companies. Over $1.25M was reported in property damage and $25K in crop damage.

Date	Location	Significant Event
March 7, 2010	Carlsbad, NM Preparedness Area 1	An upper level low pressure system approaching from the west, combined with daytime heating and low level moisture, produced isolated thunderstorms across portions of southeast New Mexico. Significant hail damage was observed at car dealerships located north of Church Street in Carlsbad. Although there were specific reports of roof damage, an exact number of homes impacted could not be established and this portion of the property damage was roughly estimated. Over $7M in property damage was reported.
June 14, 2009	Jal, NM Preparedness Area 1	An upper level trough across the Great Basin resulted in southwest flow aloft across West Texas and Southeast New Mexico. The combination of disturbances moving northeast across the area, strong daytime heating and good low level moisture ahead of the dryline resulted in severe weather across the area. The main threat during this episode was large hail and strong damaging winds. The most extensive damage during this event was confined to the eastern portions Jal, NM with the most notable damage along State Highway 128 in the vicinity of the Lea County/Jal Airport. At this location, a small single engine plane was flipped over. Also, numerous aircraft hangar doors were blown in due to the high winds which resulted in extensive damage to several aircraft storage buildings. Along State Highway 128, 28 power poles stretched along the southern edge of the highway were blown over into the eastbound lane of traffic. Overall, a total of 60 power poles were damaged. Closer to the city, numerous residential structures received significant roof damage, mainly in the form of lost roof shingles. Several trees were also downed near the Jal Lake Recreational Area. Over $88K in property damage was reported.
October 11, 2008	Moriarty, NM Preparedness Area 1	A powerful early autumn storm system over the Great Basin spread strong winds and deep moisture across much of north and central New Mexico beginning early on October 11th. Strong to severe thunderstorms first developed over the southwest portion of the state and spread quickly north and east into the central valley and eastern plains by midafternoon. High winds also developed by the afternoon over the far western portions of the state. A steel building was destroyed and blown onto Interstate 40, six power poles were snapped, at least three water tanks

Date	Location	Significant Event
		were damaged beyond repair and a pumpkin shooter was damaged from sustained winds estimated at 55 to 70 mph with gusts of 90-100 mph. Corn stalks were also damaged in a large corn maze. Over $80K in property damage was reported.
August 14, 2008	Lincoln County Preparedness Area 1 Otero County Preparedness Area 6	Governor Bill Richardson requested a major disaster declaration due to severe weather from the remnants of Hurricane Dolly beginning on July 26, 2008 and continuing. The Governor requested a declaration for Individual Assistance and Hazard Mitigation for one county and Public Assistance for two counties. During the period of July 31 to August 3, 2008, joint Federal, State, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude, that effective response is beyond the capabilities of the State and the affected local governments, and that Federal assistance is necessary. On August 14, 2008, President Bush declared that a major disaster exists in the State of New Mexico. This declaration made Public Assistance requested by the Governor available to State and eligible local governments and certain private nonprofit organizations on a cost-sharing basis for emergency work and the repair or replacement of facilities damaged by the severe storms and flooding in Lincoln and Otero Counties. Direct Federal assistance also was authorized. This declaration also made Hazard Mitigation Grant Program assistance requested by the Governor available for hazard mitigation measures for Lincoln County. A copy of the summary of damage assessment information used in determining whether to declare a major disaster. The source for this information can be found at the following website: http://www.fema.gov/pdf/news/pda/1783.pdf

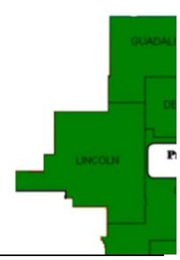
Date	Location	Significant Event
September 13, 2006	Las Cruces, NM (Doña Ana County) Luna County Preparedness Area 6	A heavy precipitation super-cell thunderstorm tracked from far eastern Luna County eastward along Interstate 10 through Las Cruces. This storm dropped golf ball sized hail, resulting in a 4-car collision on Interstate 10 in far eastern Luna County, and hundreds of damaged roofs and automobiles and destroyed skylights in Mesilla and south Las Cruces. The US Border Patrol Checkpoint was evacuated. This was the costliest hailstorm in the history of the NWS warning area, totaling more than $10 million in damage from large hail driven by strong winds. Finally, 2 inches of rain within 30 minutes caused flash flooding in Picacho Hills (far west Las Cruces) and forced the closure of I-10 in western Doña Ana County. Crop damage was estimated at $500 thousand.
August 17, 2006	Santa Fe, NM (Santa Fe County) Preparedness Area 3	Two men in their 20s were struck by lightning while standing on rebar rods at a Santa Fe construction site. One man recovered immediately, but the other had to be revived with CPR.

Table 2.110 outlines those significant thunderstorm events between 2006 and 2012 as identified in the NCDC.

Thunderstorm events characterized by high wind/hail events are common throughout New Mexico and occur hundreds of times each year. Analysis of the number of reported occurrences for the six Preparedness Areas from January 1, 2006 to December 1, 2012 by the NCDC shows a clear concentration of thunderstorm activity in Preparedness Areas 1, 2, 5 and 6. Conversely, concentrated areas of low thunderstorm occurrence were found in Preparedness Areas 3 and 4. Table 2.110 provides an overview of the total number of thunderstorms by each Preparedness Area.

Table 710. Preparedness Area 1 - 6 Thunderstorm History (January 1, 2006 - December 1, 2012)[91]

Preparedness Area 1 Counties: Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt						
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**
Hail	286	.75 – 4.00 in.	0	0	$8,801,750	$46,500
Heavy Rain	0	0	0	0	0	0
Lightening	1	0	0	0	$25,000	$1,000

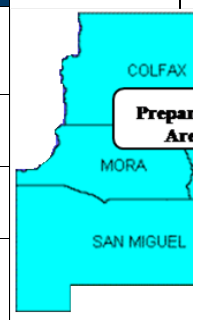


[91] Source: http://www.ncdc.noaa.gov

Thunderstorm Wind	141	87kts	0	0	$1,699,700	$1,100
Total	**428**		**0**	**0**	**$19,328,200 0**	**$48,600**

Preparedness Area 2
Counties: Colfax, Harding, Mora, Union and San Miguel

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	142	.75 – 2.75 in.	0	0	$2,500	$4,731,000
Heavy Rain	0	0	0	0	0	0
Lightening	0	0	0	0	0	0
Thunderstorm Wind	19	65kts	0	0	$35,000	0
Total	**161**		**0**	**0**	**$37,500**	**$4,731,000**

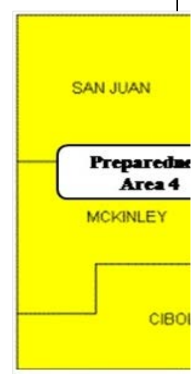


Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	27	.75 – 1.75 in.	0	0	$50,000	$10,000
Heavy Rain	0	0	0	0	0	0
Lightening	2	0	0	0	$25,000	0
Thunderstorm Wind	6	65kts	0	0	$31,000	0
Total	**35**		**0**	**0**	**$106,000**	**$10,000**

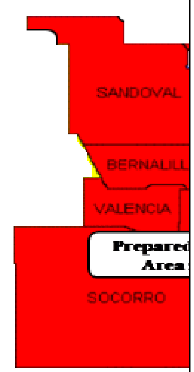
Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	10	.75 – 1.75 in.	0	0	0	0
Heavy Rain	2	0	1	0	$50,000	0
Lightening	1	0	0	1	0	0
Thunderstorm Wind	3	65kts	0	0	$20,000	0
Total	**16**		**1**	**1**	**$70,000**	**0**



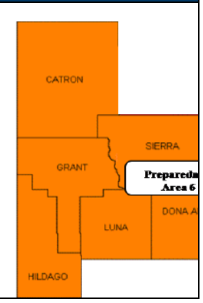
Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	49	.75 – 2.50 in.	0	0	$8,770,500	$20,000
Heavy Rain	1	0	0	0	$4,000	0
Lightening	2	0	1	6	$30,000	0
Thunderstorm Wind	22	87 kts	0	0	$1,627,000	0
Total	**74**		**1**	**6**	**$10,431,500**	**$20,000**



Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Hail	47	.75 – 2.50 in.	0	0	$2,516,005	$20,000
Heavy Rain	4	0	0	0	0	0
Lightening	1	0	1	0	$1,000	0



Thunderstorm Wind	1	75 kts	1	0	$1,000	0	
Total	**53**		**2**	**0**	**$2,518,005**	**$20,000**	

Frequency

The entire State of New Mexico can be equally affected by thunderstorm events, hail and lightning. The state has maintained a list of past thunderstorm occurrences highlighting their vulnerabilities as medium in damage from hail and lightning strikes. Over the past six years, Preparedness Area 1 recorded 286 hail events with over $8.8M in associated damages. Interesting to note, Preparedness Area 5 has recorded only 49 events with almost the same amount in damages. This can be contributed to this area being more dense population and infrastructure compared to the rural aspect of Preparedness Area 1. Hail events have in the state, specifically in Preparedness Area 1, have recorded hail as large as 4.0 inches in diameter or referring to Table 2.111, anywhere from H0 to H7.

Probability of Occurrence

All Preparedness Areas in New Mexico experience severe thunderstorms producing high winds, large hail, deadly lightning, and heavy rains at some time during the year. During the spring, from April through June, storms are at a peak mainly in the eastern areas of the state. Storms become more numerous statewide from July through August. Although the vulnerability is state wide those areas with a larger vulnerability to the effects include those areas where the population is concentrated and buildings are of older design.

To determine the probability of New Mexico experiencing thunderstorm occurrences, the probability or chance of occurrence was calculated based on historical data identified the NCDC database from a period of January 2006 to December 2012 (84 months). Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. In applying this formula, Preparedness Areas probabilities to the following hazards are identified in Table 2.111. Those Preparedness Areas with the least probability of a Thunderstorm event occurring is in Preparedness Areas 3 and 4.

Table 8. Probability of Occurrence (Thunderstorm Events)

Probability of Occurrence				
Preparedness Area	**Hail**	**Heavy Rain**	**Lightning**	**Thunderstorm Wind**
Preparedness Area 1	100%	0%	1.6%	100%
Preparedness Area 2	100%	0%	0%	32%
Preparedness Area 3	16%	0%	33%	7%
Preparedness Area 4	16%	33%	1.6%	.3%

Preparedness Area 5	81%	16%	33%	3.6%
Preparedness Area 6	78%	66%	1.6%	1.6%

Risk Assessment

Severe weather is difficult to predict precisely in pattern, frequency, and degree of severity. The impact from thunderstorm events (thunderstorms, hail, and lightning) has been moderate, with localized flooding occurring from severe thunderstorms and minor damages from lightning and moderate to heavy damage to specific locations from hail. Highly vulnerable populations include those in mobile home parks, recreational vehicles, and aged or dilapidated housing, but no area is safe. Table 2.112 identifies potential impacts from thunderstorms for the purposes of EMAP compliance.

Table 9. Potential Thunderstorm Impacts

Subject	Potential Impacts
Health and Safety of the Public	The component elements of a thunderstorm (lightning and hail) can and have impacted the public in the state. Lightning strikes have caused hospitalizations and fatalities. Individuals struck by hail have also sustained injury.
Health and Safety of Responders	Similar to the impacts to the public, any responders who are out of doors at the time of a lightning strike or hailstorm have and can receive serious injuries. Responders are at a higher risk due t the fact that they are often outside during major events assisting the public.
Continuity of Operations	Little to no impacts anticipated, except for facilities that may be damaged or have power failures during an event.
Delivery of Services	Little to no impacts anticipated, except for facilities that may be damaged or have power failures during an event.
Property, Facilities, Infrastructure	Property, facilities and infrastructure can be impacted by thunderstorm events. Lightning and the subsequent fires may destroy a facility or property. Heavy damage to roofs, windows and utilities components may be inflicted by hail.
Environment	Thunderstorms can cause crop or plant damages. Lightning caused fires may burn large areas.
Economic Condition	The overall economic condition is expected to be impacted only slightly.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

Data Limitations

Raw data is available dating back to 1955 for thunderstorm, lightning and hail storm occurrence in the State. Analysis and summary of the historical data could be accomplished for the next Mitigation Plan up-date.

What Can Be Mitigated?

One important part of mitigating thunderstorm hazards is forecasting and warning so that people can prepare. Each Preparedness Area can prepare for disruptions of utilities and transportation due to thunderstorm events by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending storms. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to severe weather. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.

Tornadoes

Hazard Characteristics

A tornado is an intense rotating column of air, extending from a thunderstorm cloud system. Average winds in a tornado, although never accurately measured, are thought to range between 100 and 200 mph, but some may have winds exceeding 300 mph. The following are NWS definitions of a tornado and associated terms:

- **Tornado** – A violently rotating column of air that is touching the ground
- **Funnel cloud** – A rapidly rotating column of air that does not touch the ground
- **Downburst** – A strong downdraft, initiated by a thunderstorm, which induces an outburst of straight-line winds on or near the ground. They may last anywhere from a few minutes in small-scale microbursts to periods of up to 20 minutes in larger, longer macro-bursts. Wind speeds in downbursts can reach 150 mph and therefore can result in damages similar to tornado damages.

Tornadoes are classified by the degree of damage they cause. The tornado classification, shown in Table 2.113, is called the Fujita Scale. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.

Table 2.113. Fujita Tornado Damage Scale[92]

Fujita Scale			
F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.
F1	Moderate tornado	73-112 mph	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.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

92 Information provided by NOAA at http://www.spc.noaa.gov/faq/tornado/f-scale.html

Fujita Scale			
F-Scale Number	**Intensity Phrase**	**Wind Speed**	**Type of Damage**
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

On February 1, 2007, the Fujita scale was decommissioned in favor of the more accurate Enhanced Fujita Scale, shown in Table 56, which replaces it. None of the tornadoes recorded on or before January 31, 2007 will be re-categorized. Therefore maintaining the Fujita scale will be necessary when referring to previous events.[93]

Table 2.114. Enhanced Fujita (EF) Scale[94]

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
EF0	65-85	**Light damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.

[93] Source: http://en.wikipedia.org/wiki/Fujita_scale
[94] Source: http://www.spc.noaa.gov/faq/tornado/ef-scale.html

EF4	166-200	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	**Incredible damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

The **Enhanced Fujita Scale**, or **EF Scale**, is the scale for rating the strength of tornadoes in the United States estimated via the damage they cause. Implemented in place of the Fujita scale, it was used starting February 1, 2007. The scale has the same basic design as the original Fujita scale, six categories from zero to five representing increasing degrees of damage. It was revised to reflect better examinations of tornado damage surveys, so as to align wind speeds more closely with associated storm damage. The new scale takes into account how most structures are designed, and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes.

Tornadoes cause an average of 70 fatalities and 1,500 injuries in the U.S. each year. The strongest tornadoes have rotating winds of more than 250 mph and can be one mile wide and stay on the ground over 50 miles. Tornadoes may appear nearly transparent until dust and debris are picked up or a cloud forms within the funnel. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. The average forward speed is 30 mph but may vary from nearly stationary to 70 mph.[95]

Damages from tornadoes result from extreme wind pressure and windborne debris. Because tornadoes are generally associated with severe storm systems, they are often accompanied by hail, torrential rain, and intense lightning. Depending on their intensity, tornadoes can uproot trees, bring down power lines, and destroy buildings. Flying debris is the main cause of serious injury and death. New Mexico lies along the southwestern edge of the nation's maximum frequency belt for tornadoes, often referred to as "tornado alley," which extends from the Great Plains through the central portion of the U.S. Broadly speaking, the eastern portions of New Mexico have a higher frequency of tornadoes; however, every county in the state has the potential to experience tornadoes (Figure 2.115). The publication "FEMA 320 Taking Shelter from the Storm", August 2008, presents a method where by residents can determine their tornado risk. Table 2.115 describes the risks associated to tornadoes for determining shelter requirements.

Table 2.115. Tornado Risk Table as of December 2012[96]

		Wind Zone			
		I	**II**	**III**	**IV**
does per3,7 00	**<1**	**Low Risk**	**Low Risk**	**Low Risk**	**Moderate Risk**
	1-5	**Low Risk**	**Moderate Risk**	**High Risk**	**High Risk**

[95] Source: http://www.noaawatch.gov/themes/severe.php
[96] Source: FEMA publication "FEMA 320 Taking Shelter from the Storm"

	6-10	Low Risk	Moderate Risk	High Risk	High Risk
	11-15	High Risk	High Risk	High Risk	High Risk
	>15	High Risk	High Risk	High Risk	High Risk
	Low Risk		Moderate Risk		High Risk
	High-wind Shelters are a matter of homeowner preference		Shelter should be considered for protection from high winds		Shelter is the preferred method of protection from high winds

Figure 2.116 illustrates tornado activity in the United States as provided by the NOAA Storm Prediction Center Statistics.

Figure 5. Tornado Activity by Square Miles as of December 2012

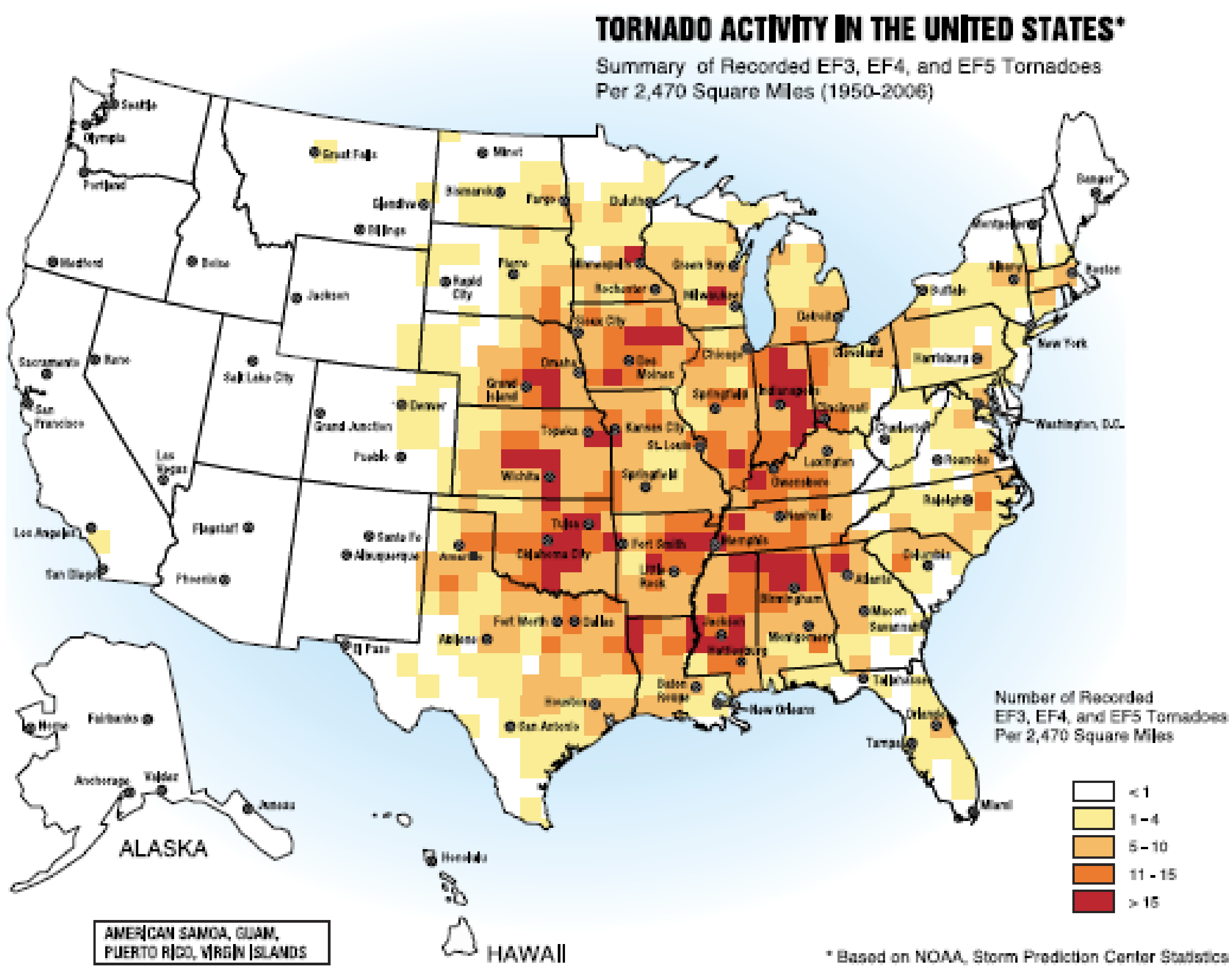


Figure I-2. The number of tornadoes recorded per 2,470 square miles

Previous Occurrences

Tornadoes have been verified in most New Mexico counties. The highest risk of tornadoes is in the east during April through July, but tornadoes are possible with any thunderstorm. New Mexico averages about 10 tornadoes in a year. For example, on October 21, 2010, a tornado tracked just north of Roswell. A significant tornado outbreak occurred on May 23, 2010 across eastern Union County.[97]

New Mexico experiences mostly weak, short-lived tornadoes. Strong tornadoes, while rare, are possible and occur about once every 10 years. Seventy-five (75) percent of severe storms with tornadoes occur in eastern New Mexico and are most likely to occur between April and July. However, the latest tornado fatalities in New Mexico occurred on March 23, 2007 when two people died, 1 near Clovis (and 33 were injured) and one in Quay County. Another fatality occurred west of Albuquerque in October 1974 and a rare winter tornado was reported southwest of Roswell in December 1997. This shows that tornadoes can be deadly at any time and nearly anywhere within the state, even at both low and high elevations.

The current online NCDC database is limited in past events and only contains data from January 2006 to present, as entered by NOAA's National Weather Service (NWS). Referencing this online database, NCDC reports a total 61 Tornado events, 2 deaths, 45 injured, $23.290 million in property damage and $255,000 thousand in crop damage between January 1, 2006 and December 1, 2012.

Table 2.117 briefly explains those significant tornado events that have occurred in the State of New Mexico. The location of the event is identified by both the city and county and Preparedness Area. Source information is from the NCDC and data provided by local authorities. Table 59 provides a cumulative overview of all tornado events that have occurred in all Preparedness Areas.

Table 2.117. Significant Past Occurrences - Tornado (January 1, 2006 - December 1, 2012)

Date	Location	Significant Event
October 21, 2010	Roswell, NM Preparedness Area 1	Tornado track just north of Roswell
May 23, 2010	Union County Preparedness Area 2	Swarm of Tornadoes tracked through Union County
October 11, 2009	Stanley, NM (Santa Fe County) Preparedness Area 3	2 miles east of Stanley a tornado touched down (Santa Fe County) causing $12K in damage it registered as a F0. There were no injuries or deaths.
July 13, 2009	Tres Piedras, NM (Taos County) Preparedness Area 3	2 miles south of Tres Piedras a tornado touched down (Taos County) causing $10K in damage; it registered as a F0. There were no injuries or deaths.

97 Source: http://www.srh.noaa.gov/abq/?n=climonhigh2010maysigevents

Date	Location	Significant Event
March 23, 2007	Clovis, Logan, Lovington, Arch, Rogers, Portales, and McDonald, NM Preparedness Area 1	"Widespread severe weather ignited over much of the eastern plains. Large hail was reported at several locations, stretching from southeast New Mexico to central Kansas. In addition, thirteen tornadoes where observed across the eastern plains of New Mexico." The two tornadoes that provided the most significant damage in eastern New Mexico were located at Logan and Clovis. The Logan tornado created damage that fit within the EF0 to EF1 range on the enhanced Fujita scale. Meanwhile, the damage in Clovis was rated to fit within the EF0 to EF2 range. "The Logan tornado created an intermittent three-mile damage track. The heaviest damage was noted on the south end of 4th Street, from Lake Drive north for approximately five blocks. RVs and trailers sustained the most significant damage in the Logan area. The Clovis tornado also created an intermittent three-mile damage track, with the most significant damage noted in the southern and northern sections of the city. Preliminary, estimated maximum winds for this particular tornado ranged from 120 to 125 mph. Mobile homes were destroyed, trees knocked down, power poles snapped, and roofs of substantial buildings and homes heavily damaged or blown off. Other verified tornadoes were reported 16 miles north/northwest of Lovington, ten miles north of McDonald, seven miles northwest of Tatum, 12 miles north of Tatum, three miles north of Crossroads, one mile south of Milnesand, two miles north of Arch, Rogers, ten miles northeast of Portales, 10 miles east/southeast of Lakewood, and 15 miles east of Lakewood." The damages (493 structures in Clovis and 97 in Logan) 2 fatalities and 35 injuries, led to a state declaration of disaster for Quay, Curry and Roosevelt counties. On April 2, 2007, the president declared disaster 1690, at that time damages were approximately $20 million. Figure 23 shows the Clovis tornado damage. (Source: http://www.srh.noaa.gov/abq/quickfeatures/March2007/Mar23SvrWxEvent.php)

Date	Location	Significant Event
June 4, 2003	Portales, NM Preparedness Area 1	Damage from brief tornado reported east side of Portales. A small thunderstorm that formed over south central San Miguel County at midafternoon moved eastward into northwest Quay County where it intensified. Near Tucumcari, the storm developed strong meso-cylcone radar signatures. A front continued east and northeast towards San Jon and Logan while the core of the storm headed southeast of Tucumcari. The storm then spread southward into western Curry County and continued through north central and southeast Roosevelt County with frequent reports of large hail and a number of brief tornado and funnel cloud sightings. Reported damages: $20,000.
May 28, 1997	Hobbs, NM Preparedness Area 1	Damage occurred just west of the Hobbs City. The damage included a 15x20 ft wooden roof taken off an old shed, parts of two other roofs damaged, an awning from a trailer destroyed, a trailer pushed 3-4 feet off its foundation, and two utility poles downed. The tornado was sighted, and a faint trail of it could be traced in the debris pattern upon inspection. Over $20 thousand in damages were reported.
May 6, 1997	Hobbs, NM Preparedness Area 1	Hobbs, A strong meso-cyclone on the leading edge of the severe thunderstorm moving to the southeast produced a tornado on the southeast flank of the storm. Tornadoes ranged from F0 on the southern end to F1 damage in the heart of the tornado path. Damage included travel trailers overturned, mobile homes pushed from foundation and roof sections missing, and a barn was leveled. Approximately $60 thousand in damages were reported.
July 25, 1996	Cimarron, NM (Colfax County) Preparedness Area 2	An F2 tornado destroyed 11 homes and 7 businesses in Cimarron. Another 43 structures were damaged. Among the building destroyed was the Post Office, which was sliced by the air-borne frame of a mobile home. Of the five injuries, two were serious, requiring hospitalization. All injuries occurred in mobile homes or portable buildings without permanent foundations. The tornado developed as convection moved over a horizontal shear axis created by southeast surface winds and northwest winds aloft above the foothills located just northwest of Cimarron. Reported damages approached $2 million. (Source: http://www4.ncdc.noaa.gov/cgi-

Date	Location	Significant Event
		win/wwcgi.dll?wwevent~storms)

Declared Disasters from Tornado

DHSEM reports one State Declared Disaster for tornado between 2003 and 2013. This number is based on how many Executive Orders were signed by the Governor. According to DHSEM records, the total cost for the 2007 State declared tornado was $848,660 (Figure 2.118). Research into damage amount per County has yet to be completed. However, all damage associated with this Executive Order was sustained within Preparedness Area 1. There were no federal disaster declarations for tornado from 2003 through 2012.

Figure 2.118. State Disaster Event Information 2003 through 2012

Event Type	State Executive Order	Dollar Loss*
Tornado	07-013	$848,660.00
Total	**1**	**$848,660.00**

Another source of tornado damage information is from the NCDC. Below is a tally of tornado damage as reported by NCDC broken out by Preparedness Area. According to NCDC from 2006 through 2012 State-wide property damage from tornado damage was $22,605,500 and no crop damage was reported. Figure 2.119 shows damage from the March 23, 2007 Tornado that ripped through homes and businesses in Clovis, NM (Preparedness Area 1).

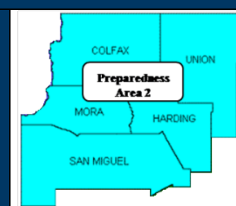
Figure 2.119. Clovis Tornado Damage[98]

[98] Photo courtesy of the Clovis News Journal

Below, Table 2.120 outlines significant past tornado events that have occurred in New Mexico by Preparedness Area.

Table 2.120. Preparedness Area 1 - 6 Tornado History

Preparedness Area 1 **Counties:** Chaves, Curry, DeBaca, Eddy, Guadalupe, Lea, Lincoln Quay and Roosevelt							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Tornado	13	EF0	0	0	$1,500	0	
March 23, 2007	1	EF0 to EF2	2	35	$20 million	0	
June 4, 2003	1		0	0	$20,000	0	

May 28, 1997	1		0	0	$20,000	0	
May 6, 1997	1	F0 to F1	0	0	$60,000	0	
Total	**17**		**0**	**0**	**$20,101,500**	**$0**	
Preparedness Area 2 **Counties:** Colfax, Harding, Mora, Union and San Miguel							
Hazard Type	**# of Events**	**Mag**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	
Tornado	19	EF2	0	0	$460,000	0	
July 25, 1996	1	F2	0	5	$2,000,000	0	
Total	**20**	**8**	**0**	**0**	**$2,460,000**	**0**	

Preparedness Area 3
Counties: Los Alamos, Rio Arriba, Santa Fe and Taos
Pueblos: Nambe, Ohkay Owingeh, Picuris, Pojoaque, San Ildelfonso, Santa Clara, Tesuque, and Taos
Tribal Nations: Jicarilla Apache

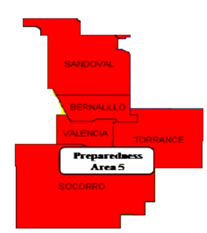
Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	6	EF0	0	0	$22,000	0
July 13, 2009	1	F0	0	0	$10,000	0
October 11, 2009	1	F0	0	0	$12,000	0
Total	**8**	**8**	**0**	**0**	**$44,000**	**0**

Preparedness Area 4
Counties: Cibola, McKinley and San Juan
Pueblos: Acoma, Laguna, Zuni
Tribal Nations: Navajo Nation

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**

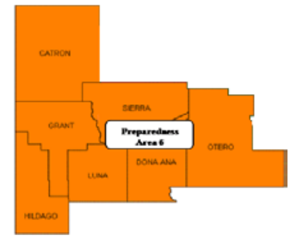
Preparedness Area 5
Counties: Bernalillo, Sandoval, Socorro, Torrance and Valencia
Pueblos: Cochiti, Isleta, Jemez, Sandia, Santa Ana, Santo Domingo, San Felipe and Zia

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	1	EF0	0	0	0	0
Total	**1**	**EF0**	**0**	**0**	**0**	**0**



Preparedness Area 6
Counties: Catron, Dona Ana, Grant, Hidalgo, Luna, Otero and Sierra
Tribal Nation: Mescalero Apache

Hazard Type	# of Events	Mag	Deaths	Injuries	Property Damage	Crop Damage
Tornado	2	EF0	0	0	0	0
Total	**2**	**EF0**	**0**	**0**	**0**	**0**



Frequency

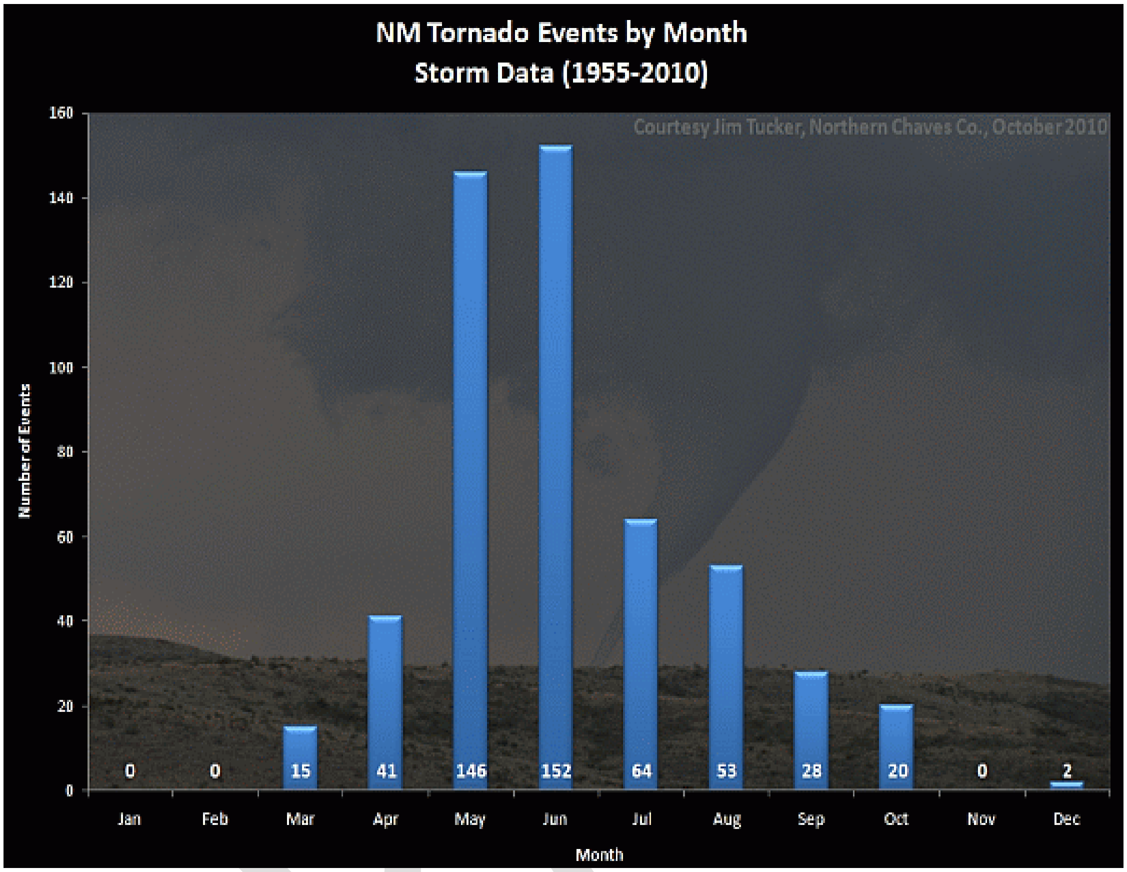
The State of New Mexico experiences some tornado activity annually, based on seasonal meteorological patterns and local topographical conditions. New Mexico's complex terrain favors the formation of numerous small landspouts, a weak and short-lived variation of the tornado similar to a dust devil. Landspouts may form without the presence of a strong thunderstorm.

The complex terrain in New Mexico, ranging from the eastern plains, to the high mountains across the northern and western regions, creates weather regimes that change quickly over relatively short distances. Highway travelers, especially truckers, hit by strong gusts of wind that can make driving hazardous. New Mexico experiences mostly weak, short-lived tornadoes. Strong tornadoes, while rare, are possible and occur about once every 10 years.

Figure 2.121 provides an overview of the number of tornado events by month in New Mexico. Based on the data collected by the National Weather Service – Albuquerque, tornado frequency is seen most in the May and June time frame. This is consistent with the NWS’s assessment in that:

- During the spring, from April through June, storms are at a peak mainly in the eastern areas of the state. Storms become more numerous statewide from July through August.
- Tornadoes have been verified in most New Mexico counties. The highest risk of tornadoes is in the east during April through July, but tornadoes are possible with any thunderstorm. New Mexico averages about 10 tornadoes in a year. For example, on October 21, 2010, a tornado tracked just north of Roswell (Preparedness Area 1). A significant tornado outbreak occurred on May 23, 2010 across eastern Union County (Preparedness Area 2).

Figure 2.121. NM Tornado Events by Month as of January 2011[99]



Probability of Occurrence

To determine the probability of each Preparedness Area experiencing future tornado occurrences, the probability or chance of occurrence was calculated based on historical data identified in the NCDC. Probability was determined by dividing the number of events observed by the number of years and multiplying by 100. This gives the percent chance of the event happening in any given year. Table 2.122 provides the probability of each Preparedness Area experiencing a tornado event in any given year.

Table 2.122. Probability of Occurrence - Tornado

Probability of Occurrence	
Preparedness Area	**Tornado**
Preparedness Area 1	100%
Preparedness Area 2	100%

[99] Source: http://www.srh.noaa.gov/abq/?n=climonhigh2010maysigevents.

Probability of Occurrence	
Preparedness Area	**Tornado**
Preparedness Area 3	86%
Preparedness Area 4	0%
Preparedness Area 5	14%
Preparedness Area 6	29%

Risk Assessment

Based on the assessment from data collected in Table 1.122 above, Preparedness Areas 1, 2 and 3 are risk to experiencing a tornado event in any given year is great then those in the Preparedness Areas 3, 4 and 5. For those Preparedness Areas with the greatest risk, assessments should be taken in consideration and determine what mitigation actions are appropriate for that location. Risks for consideration include manufactured homes that are not adequately anchored are the most vulnerable structures for damage from tornado events. Other risks for consideration include:

- **Environmental Risks**: Tornadoes pose several risks to the environment. The potential for property damage and disruption of vital, natural resources as a result of a tornado is often very high and increases in proportion to the strength of the storm. Tornadoes produce winds that are strong enough to destroy whole towns. These storms can damage water treatment facilities, block roadways, and destroy animal habitats.

- **Biological Risks**: Tornadoes also pose great risks to living things. The most powerful tornadoes are capable of killing hundreds of people. People are not only killed by the strong winds, flooding and debris, but also by fires, exposure to the elements and loss of electricity. Endangered animals and plants in national parks and forests are also killed during tornadoes.

Figure 2.123 identifies potential impacts from tornadoes for the purposes of EMAP compliance.

Figure 2.123. Impacts from Tornadoes

Subject	Potential Impacts
Health And Safety of The Public	Injuries and deaths have occurred in the state due to tornadoes. There is no reason to expect that the impacts will not continue.
Health and Safety of Responders	Responders face the same risks as the public.
Continuity of Operations	Little to no impacts anticipated, except for facilities that may be damaged or during an event.

Delivery of Services	Little to no impacts anticipated, except for facilities that may be damaged or during an event.
Property, Facilities, Infrastructure	A tornado can cause anywhere from minor damage to total destruction of facilities and infrastructure depending on the size of the event. Extensive damages are anticipated.
Economic Condition	A small community can be completely destroyed and by a tornado. The economic base (businesses) and individuals can lose everything, and recovery may require substantial investment.
Public Confidence	Not impacted by the event itself, but may be damaged if the response to an event is poor.

Data Limitations

The information necessary to determine the location and condition of manufactured homes and aged or dilapidated structures in areas where tornadoes have touched down was not available during the development of this mitigation plan. Consequently, the Hazard Mitigation Team could not quantify vulnerability of individual structures to damage from tornados. Maps and data of past tornado occurrence were not readily available. Numerous sources exist with conflicting information. Clarifying and source checking maps and data is an activity that can be under taken for future up-dates of the State Mitigation Plan.

In addition, accurate methods to quantify potential future damages are not readily available. The amount of business lost due to tornado events has not been calculated due to the difficulty of attaining this information. The Hazard Mitigation Team could also not specify which critical facilities were vulnerable to high wind events. Once the 2010 Census data is integrated into HAZUS, modeling can result in potential damage estimates.

Subsequent versions of this Plan will need to incorporate and respond to these data deficiencies.

What Can Be Mitigated?

One important part of mitigating tornado hazards is forecasting and warning so that people can prepare. Communities can prepare for disruptions of utilities and transportation due to high wind events by advising people to stay home or to use caution if they must go out, and by recommending that people stock up on food, water, batteries, and other supplies. The National Weather Service, combined with local television stations, have an effective strategy for notifying residents about impending tornado events. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to tornado events. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.

Volcanoes

Hazard Characteristics

A volcano is a vent through which molten rock escapes to the earth's surface. Unlike other mountains, which are pushed up from below, volcanoes are built by surface accumulation of their eruptive products (e.g., lava, pyroclastic flows and surges, and ashfall). When pressure from gases within a magma chamber becomes too great to be contained, an eruption occurs. Volcanic hazards include gases; lava flows, pyroclastic flows and surges; ashfall; volcanic mudflows (lahars), landslides; and earthquakes. Volcanoes produce a wide variety of hazards that can kill people and destroy property. Large explosive eruptions can endanger people and property hundreds of miles away and even affect global climate.

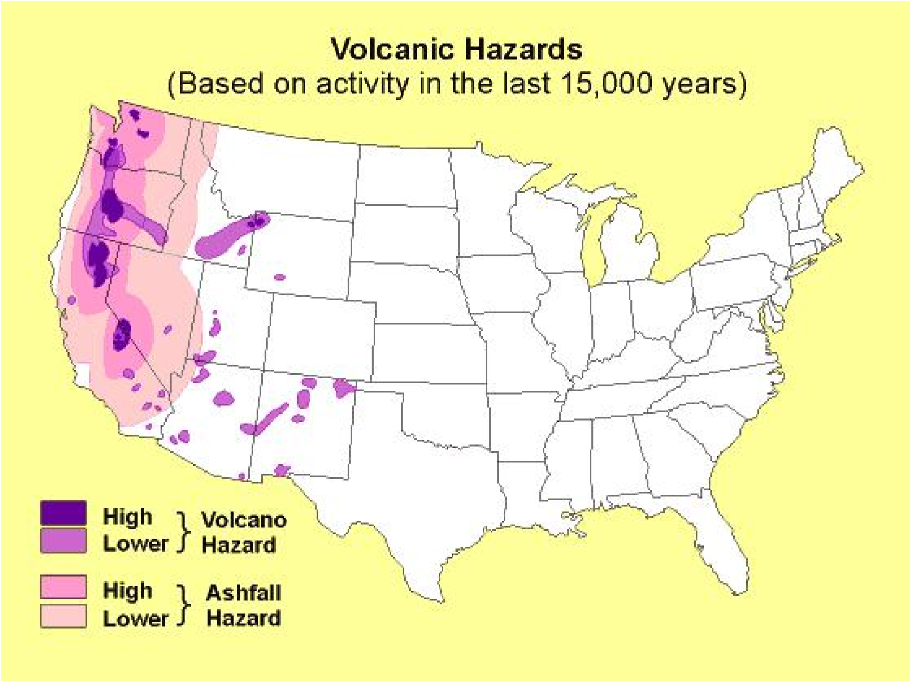
Eruptions can be relatively passive; producing lava flows that creep across the land at 2 to 10 mph. However, explosive eruptions can shoot columns of gases and rock fragments tens of miles into the atmosphere, producing devastating pyroclastic flows and surges, or depositing volcanic ash hundreds of miles downwind. The eruptive styles of volcanoes in New Mexico encompass the entire severity range from dangerously explosive to passive.

Lava flows are streams of molten rock that either pour from a vent quietly or through mildly explosive lava fountains. Lava flows destroy virtually everything in their path, but most move slowly enough that people can move out of the way. The speed at which lava moves across the ground depends on several factors, including the type of lava erupted, which influences the viscosity, the steepness of the ground, and the rate of lava production at the vent. Although lava flows are typically not dangerous to human life, because of their intense heat, they are a significant fire hazards.

The United States is third in the world, after Japan and Indonesia, for the number of active volcanoes. Since 1980, as many as five volcanoes have erupted each year in the United States. Eruptions are most likely to occur in Hawaii and Alaska. For the Cascade Range in Washington, Oregon, and California, volcanoes erupt on the average of once or twice each century.

Figure 2.124 illustrates the volcanic hazard areas in the United States based on events over the last 15,000 years. Areas in blue or purple show regions at greater or lesser risk of local volcanic activity, including lava flows, ashfalls, lahars (volcanic mudflows), and debris avalanches. Areas in pink show regions at risk of receiving 5 cm or more of ashfall from large or very large explosive eruptions, originating at the volcanic centers (shown in blue). These projected ashfall extents are based on observed ashfall distributions from an eruption ("large") of Mt. St. Helens that took place 3,400 years ago, and the eruption of Mt. Mazama ("very large") that formed Crater Lake, Oregon, 6,800 years ago.

Figure 2.124. Volcanic Hazard areas based on events over the last 15,000 years[100]



New Mexico has one of the greatest concentrations of young, well-exposed, and un-eroded volcanoes in North America. See Figure 2.124 below. These volcanoes reside in all Preparedness Areas (1, 2, 3, 4, 5 and 6) with a majority of volcanic concentration in Preparedness Areas 4 through 6 (Figure 1.125). Table 2.126 shows the principal types of volcanoes based on their locations by Preparedness Area in the state. The last volcanic episode in the state occurred approximately 3,000 years ago with the eruption of several cubic kilometers of basalt (McCartys lava flow of El Malpais, Figure 2.126). New Mexico has one of only three large mid-crustal active magma bodies (Socorro) in the continent; the others are Long Valley, California, and Yellowstone, Wyoming. The inflation of this magma body is responsible for elevated seismic hazards in the Socorro region (see Earthquakes section).

[100] Source: Mullineaux, D.R. 1976. Preliminary overview map of volcanic hazards in the 48 conterminous United State: U.S. Geological Survey Miscellaneous Field Studies Map MF-786.

Figure 2.125. Concentration of Volcanoes in New Mexico (2012)[101]

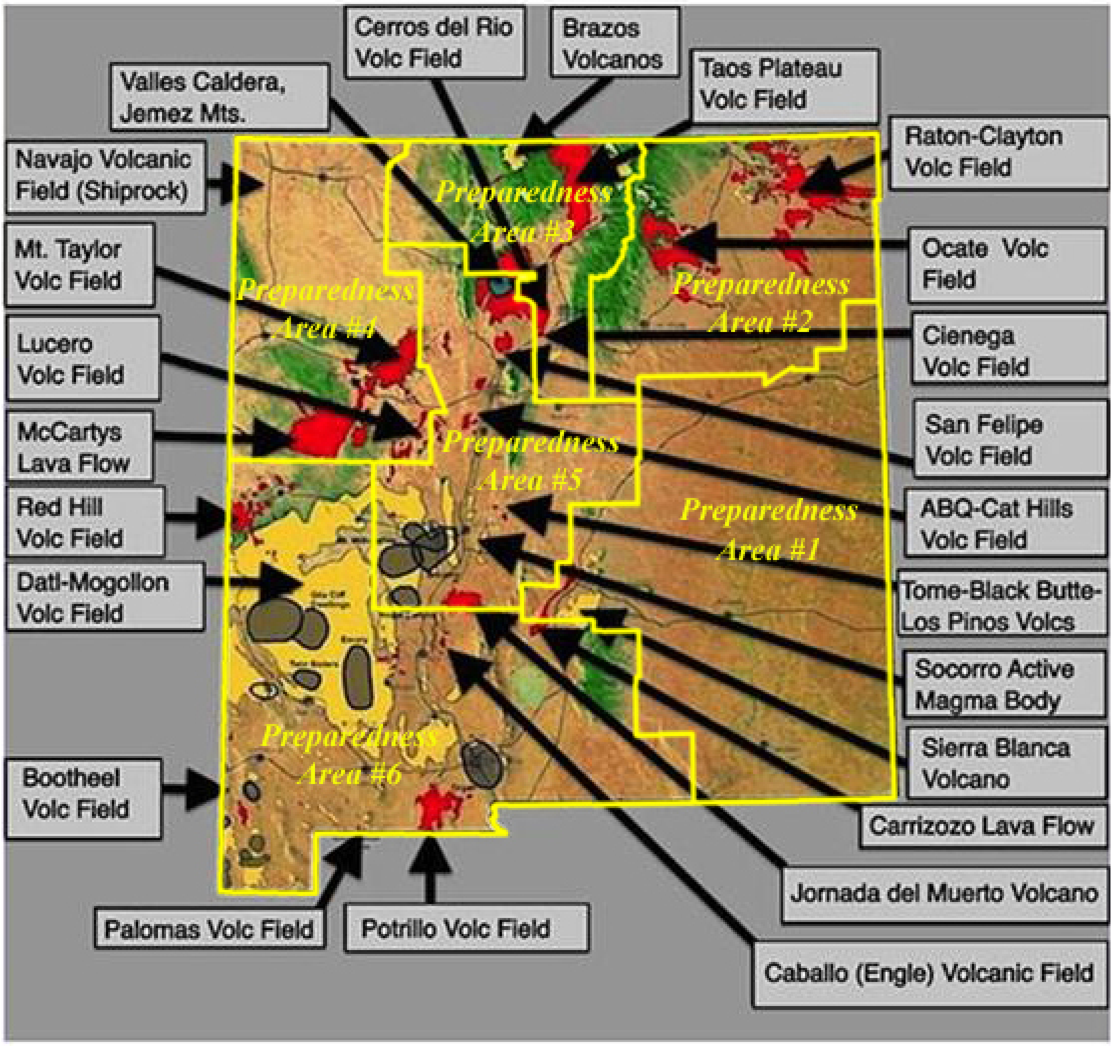


Table 2.126 provides description of volcano types in New Mexico. The data was provided by the New Mexico Museum of Natural History and Science.[102]

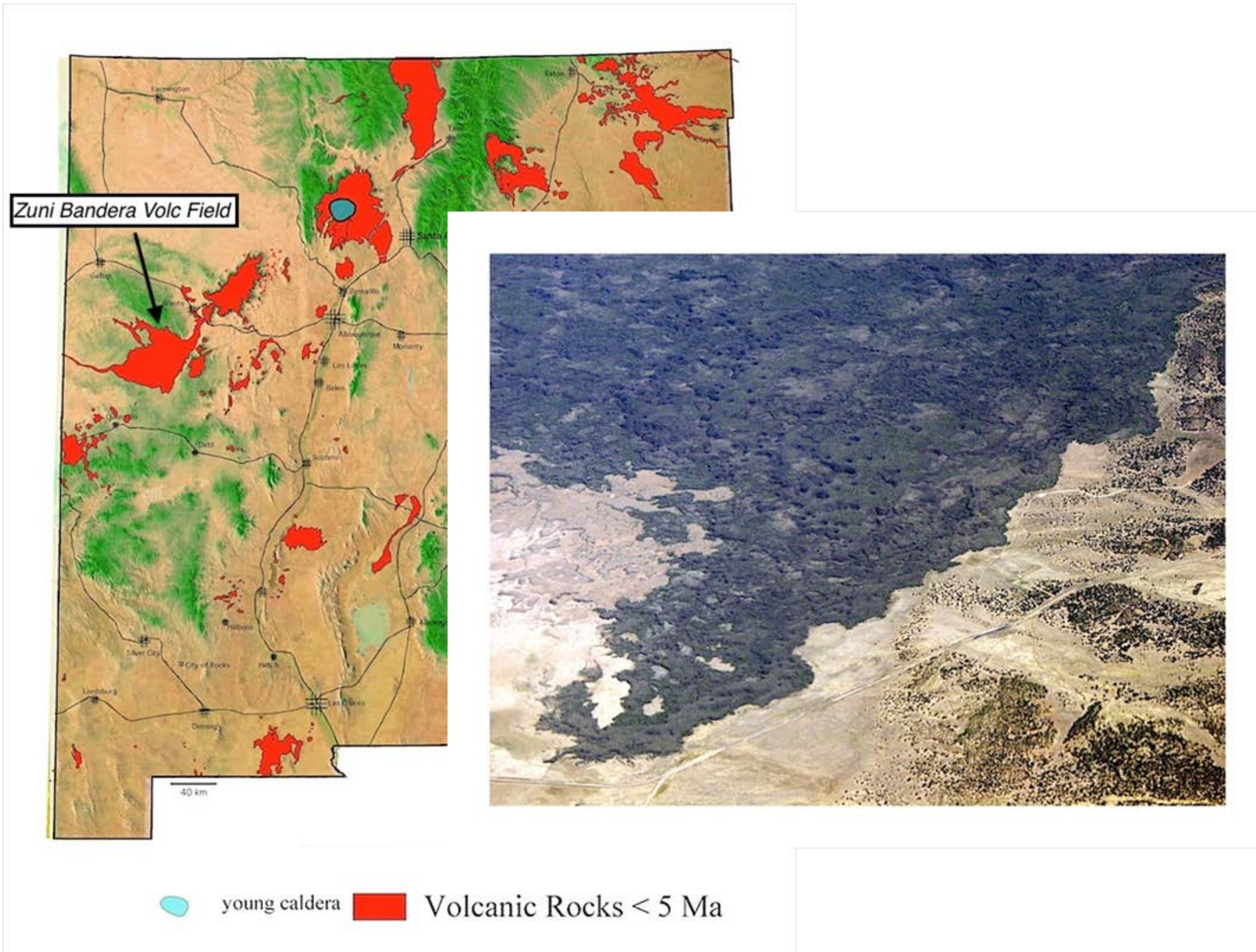
[101] Source: http://www.nmnaturalhistory.org/pap.html
[102] Source: http://nmnaturalhistory.org/volcanoes-of-nm.html

Table 2.126. Principal Types of Volcanoes in New Mexico

Large		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Ashflow calderas	Mid-Tertiary (Mogollon-Gila)	Preparedness Area 5
	Valles Caldera, Jemez Volcanic Field	Preparedness Area 5
	Bootheel Volcanic Field	Preparedness Area 6
	Navajo Volcanic Field (Chuska Narbona Pass)	Preparedness Area 4
Composite volcanoes	Agua Fria	Preparedness Area 3
	Mount Taylor Necks	Preparedness Area 4
	Navajo Volcanic Field: Ship Rock	Preparedness Area 4
	Sierra Blanca	Preparedness Area 6
Intermediate		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Scoria cone/silicic dome fields	Raton-Clayton: Capulin Volcano	Preparedness Area 2
	Taos Plateau Volcanic Field	Preparedness Area 3
	Mount Taylor field	Preparedness Area 4
	Bandera	Preparedness Area 4
	Red Hill Volcanic Fields	Preparedness Area 6
	Cerros del Rio Volcanic Field	Preparedness Area 3
	Potrillo Volcanic FIeld	Preparedness Area 6
	Cat Hills Volcanic Field	Preparedness Area 5
	Los Lunas	Preparedness Area 5
	Lucero Volcanic Field	Preparedness Area 5
	Ocate Volcanic Field	Preparedness Area 2

	Tusas-Brazos Volcanoes	Preparedness Area 3
Small		
Volcano Type	**Name of Volcano**	**Preparedness Area**
Small shield volcanoes	Cerro Verde	Preparedness Area 5
	Cienega Volcanic Filed	Preparedness Area 5
	San Felipe Volcano Field	Preparedness Area 5
	Jornada del Muerto Volcano	Preparedness Area 5
	Caballo (Engle) Volcanic Field	Preparedness Area 6
	Palomas Volcanic Field	Preparedness Area 6
	Navajo Volcanic Field	Preparedness Area 4
	Tome-Black Butte – Los Pinos Volcanoes	Preparedness Area 5
Large lava flows	McCartys Lava Flow	Preparedness Area 4
	Carrizozo Lava FLow	Preparedness Area 1
Active Magma Body	Socorro Active Magma Body	Preparedness Area 5

Figure 2.127. Location and extent of the lava flow from the McCartys Lava Flow, El Malpais[103]



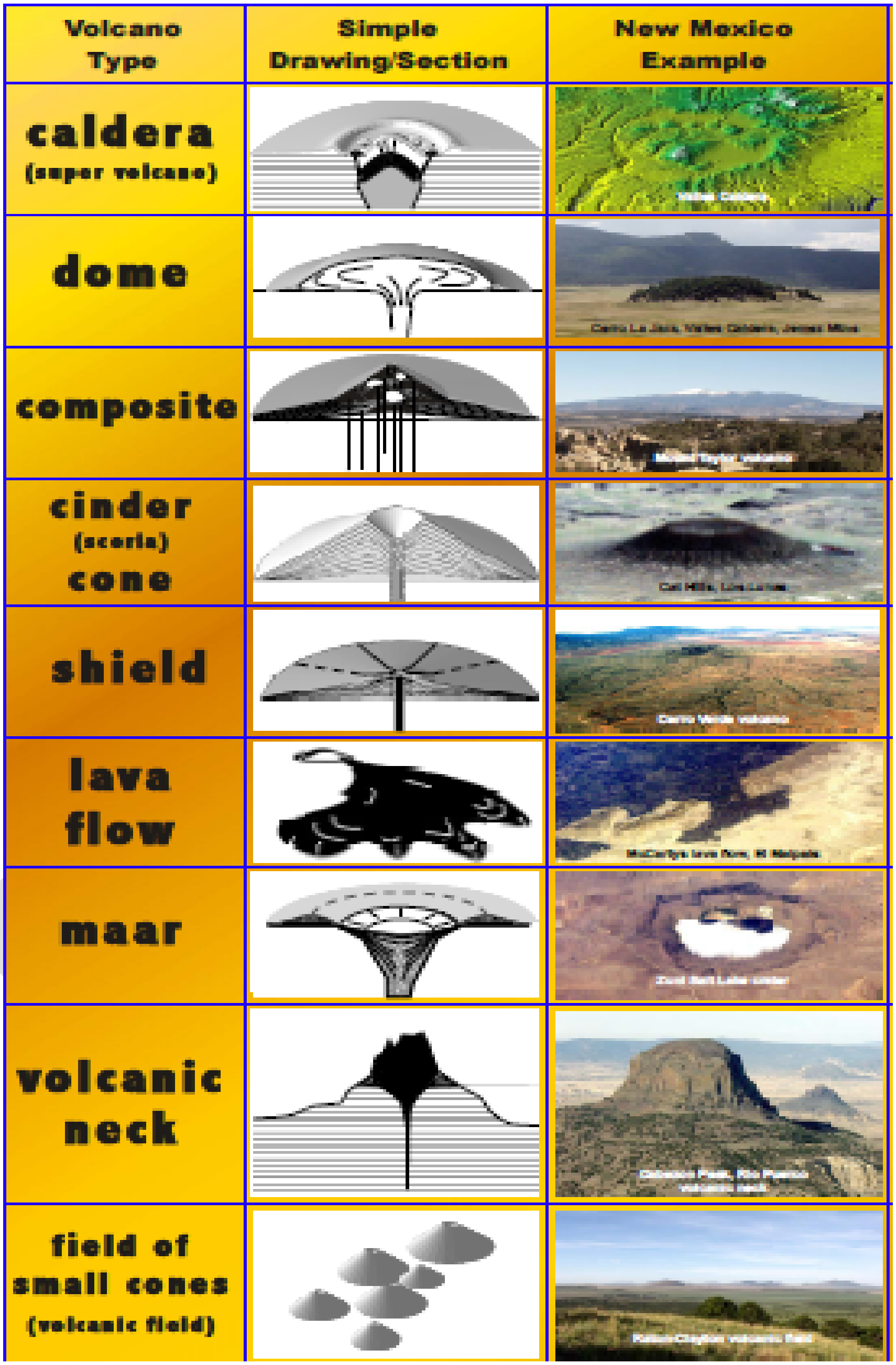
[103] Source: NM Museum of Natural History and Science http://www.nmnaturalhistory.org/pap.html
Photo Courtesy of DHSEM, December 2012.

Although there are currently no active volcanoes in New Mexico, examples of many types of volcanoes are present in the state. Table 2.128 below includes a description of the different types of volcanoes found in the State. Table 2.129 below shows a diagram and photograph of the different types of volcanoes found in the State.

Table 2.128. Description of Types of Volcanoes found in New Mexico

Volcano Type	Description
Calderas	The type example and one of the largest young calderas in the world (Valles Caldera) is in New Mexico.
Cinder Cones	There are several large concentrations of young cinder cones are in New Mexico.
Composite Volcano	A volcano consisting of a variety of eruption materials (ash, lava, mudflows, debris flows, and volcanoclastic deposits). Built from many eruptions over time. Also known as stratovolcano. Mount Taylor is an example.
Dome	A circular mound-shaped protrusion resulting from the slow extrusion of viscous lava from a volcano. The geochemistry of lava domes can vary from basalt to rhyolite although most preserved domes tend to have high silica content. Magdalena Peak, in Socorro County is an example.
Fissure Eruptions	Good young examples of a fissure eruption (Albuquerque Volcanoes) are found in New Mexico.
Lava Flows	Two of the largest young basaltic lava flows in the continental U.S. (Carrizozo and McCartys) are in New Mexico.
Maars - Steam Explosion Craters	A number of young volcanic steam explosion craters (referred to as "maars" by geologists) occur in New Mexico. Zuni Salt Lake Crater and Kilbourne Hole Crater are two maars in New Mexico often used as type examples in textbooks. The remains of maars literally fill White Rock Canyon and they pepper the surfaces of many of the other volcanic fields, like the Mount Taylor and Potrillo fields. A significant eruption occurred from Isleta Volcano near Albuquerque. They are more abundant, better preserved, and more diversely exposed than those in the type area (Eifel district of Germany).
Resurgent Calderas	The Datil-Mogollon region of New Mexico has a large concentration of mid-Tertiary resurgent calderas. These are more eroded than the Valles Caldera, but their exposure level is similar to the San Juan Mountains of Colorado, another collection of mid-Tertiary resurgent calderas.
Shield Volcano	A large volcano with broad summit areas and low-sloping sides (shield shape) because the extruded products are mainly low viscosity basaltic lava flows. Jornada del Muerto Volcano in Socorro County is a good example.
Volcanic Fields	Great diversity of young volcanic rock types and classic suites of volcanic rocks are present (for example, the Mount Taylor and the Raton-Clayton volcanic fields) occur in New Mexico.
Volcanic Necks	Well-exposed examples of young volcanic necks are found in New Mexico (Rio Puerco Valley).

Figure 2.129. Illustration of Types of Volcanoes found in New Mexico[104]



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104 Source: http://nmnaturalhistory.org/volcanoes-of-nm.html

One way to quantify the magnitude of a volcanic eruption is the Volcanic Explosivity Index (VEI), which is proportional to the logarithm of ejecta volume (See Table 2.130):

Table 2.130. Volcanic Explosivity Index - December 2012[105]

Volcanic Explosivity Index				
VEI	**Description**	**Plume**	**Ejecta volume**	**Frequency**
0	non-explosive	< 100 m	> 1000 m³	daily
1	Gentle	100-1000 m	> 10,000 m³	daily
2	explosive	1-5 km	> 1,000,000 m³	weekly
3	Severe	3-15 km	> 10,000,000 m³	yearly
4	cataclysmic	10-25 km	> 0.1 km³	≥ 10 yrs
5	paroxysmal	> 25 km	> 1 km³	≥ 50 yrs
6	colossal	> 25 km	> 10 km³	≥ 100 yrs
7	super-colossal	> 25 km	> 100 km³	≥ 1000 yrs
8	mega-colossal	> 25 km	> 1,000 km³	≥ 10,000 yrs

With respect to volcanic activity, New Mexico has one of the largest number, largest range of ages, largest diversity of types, largest range of preservation, and some of the best types of examples in North America. The question remains as to how likely it is that an eruption will actually occur in New Mexico in the near future, and what type of eruption this might be. There have been more than 700 volcanic eruptions in New Mexico in the last 5 million years.

Prior to an eruption, magma (molten rock) migrates into a magma chamber, or reservoir, beneath a volcano. As magma moves toward the surface, it (1) releases gases such as water, sulfur dioxide and carbon dioxide, (2) produces small earthquakes, and (3) causes subtle swelling of the flanks of the volcano. Scientists can watch for these warning signs by monitoring gases emitted by the volcano, determining the location, size and migration of small earthquakes under the volcano by using seismographs, and measuring changes on the slopes or inflation of the volcano using tiltmeters and geodetic methods especially permanent and temporarily deployed GPS receivers.[106]

Table 2.130 identifies potential impacts from a volcanic eruption for the purposes of EMAP compliance.

105 Source: http://volcanoes.usgs.gov/images/pglossary/vei.php

106 Source: http://geoinfo.nmt.edu/faq/volcanoes/home.html#when with modification by Richard Aster, Chair of the Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology

Table 2.130. Impacts from Volcanic Eruptions

Subject	Potential Impacts
Health and Safety of The Public	Severe injuries even death possible for individuals in or near the impact areas.
Health and Safety of Responders	Same impacts as the public
Continuity of Operations	In the event of a large event operations may be severely hampered; absenteeism expected to rise, severe impacts to facilities
Delivery of Services	With a large areas of damages or large numbers or absentees service delivery may be severely impacted
Property, Facilities, Infrastructure	Everything in the path of a volcanic eruption would be destroyed, this includes lava flows, explosions, cinder discharges etc.
Environment	Severe damages anticipated to large areas, depending on the type of eruption.
Economic Condition	If the community is severely impacted, the public may be forced to evacuate effectively shutting down the local economy for an extended period
Public Confidence	Volcanic eruption is potentially the most devastating natural event for the state. Similarly to other large scale catastrophic events (Katrina, Rita, Wilma) the public may lose all confidence in the government, if warnings are not issued in anticipation to the event, or if response is slow.

Probability of Occurrence

To date there are no estimates of future occurrence of volcanic eruptions in New Mexico in recent history. Volcanism in New Mexico is not "extinct," but is dormant**.** As stated previously, the last volcanic episode in the state occurred approximately 3,000 years ago. Based on past occurrence of volcanism in the state (Figure 2.131), it can be crudely estimated that there is roughly a 1% chance that some type of volcanic eruption could occur somewhere in New Mexico in the next 100 years, and a 10% chance that an eruption will occur in the next 1,000 years. Due to this extremely low probability of occurrence (.01% chance in ten years), this hazard will not be discussed in further detail. If circumstances warrant, future versions of the plan will elaborate.

Figure 2.131. New Mexico Volcanic Activity by Preparedness Area[107]

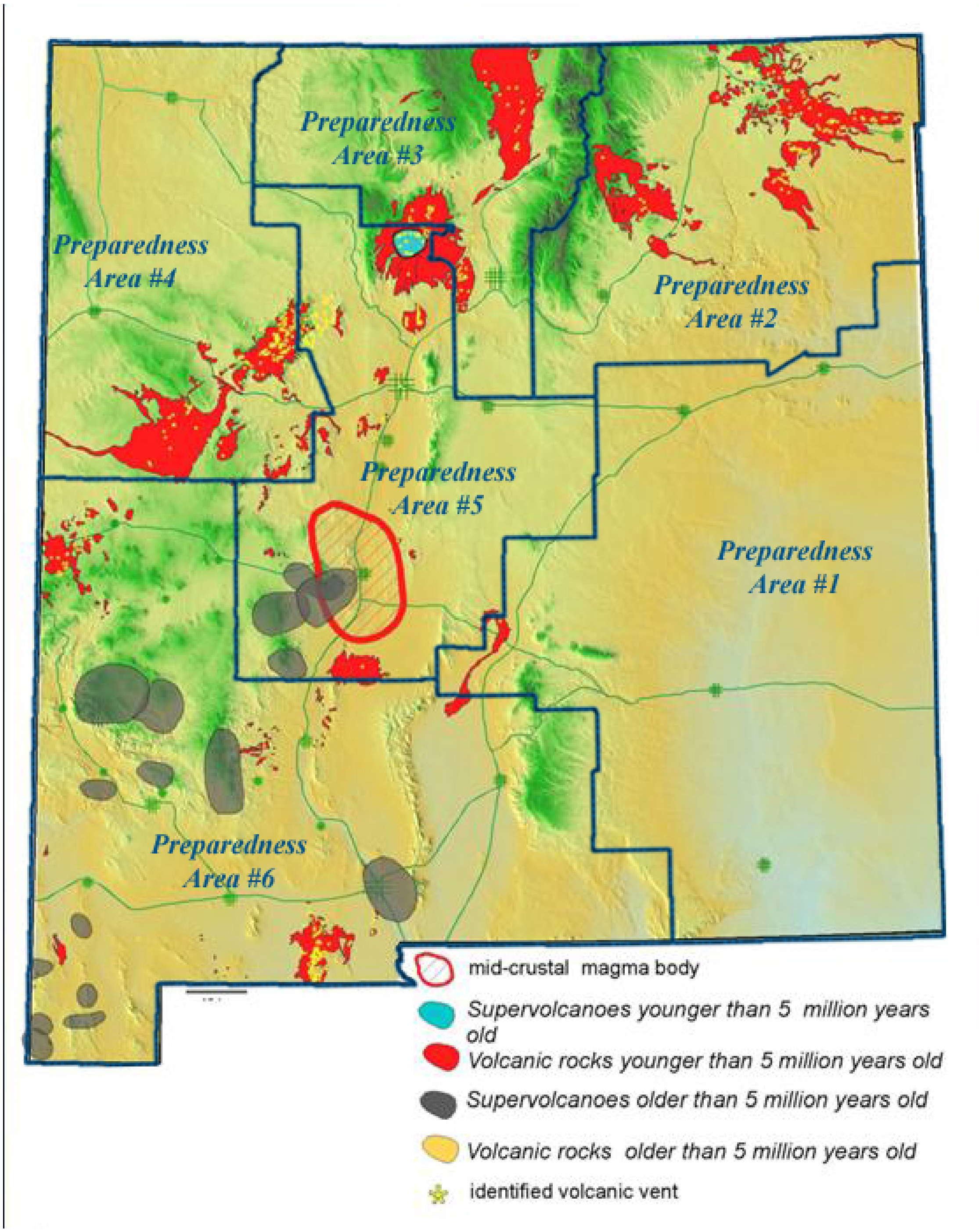


Table 2.132 identifies potential impacts from an earthquake for the purposes of EMAP compliance.

[107] Source: http://nmnaturalhistory.org/sci_volcanoes.html

Table 2.132. Potential Impacts from Volcanos

Subject	Potential Impacts
HEALTH and SAFETY of the PUBLIC	Breathing problems due to ash; Exacerbated heart and lung disease; Burn risk from lava, fire and/or pyroclastic flows
HEALTH and SAFETY of RESPONDERS	Same as the impacts affecting the public
CONTINUITY OF OPERATIONS	Damage to critical facilities including hospitals electricity-generation plants, pumping stations, storm sewers, telephone lines, radio and TV transmitters, and sewage treatment plants.
DELIVERY of SERVICES	Clogging of filters and industrial machines, short circuit and/or burial of electric transmission facilities and telephone lines due to ash, fire
PROPERTY, FACILITIES, INFRASTRUCTURE	Potential damage to roadways, airports, bridges and waterlines due to ash, fire and pyroclastic flows
ENVIRONMENT	Mudslides; Deforestation; Decrease in air and water quality; Increased erosion and runoff
ECONOMIC CONDITION	Ash clouds could disrupt air travel; Loss of agricultural lands, property and equipment
PUBLIC CONFIDENCE	May be affected if warning systems and/or response to an event is poor

Data Limitations

Due to the prolonged inactivity of the volcanic fields in New Mexico, it is believed that they are not likely to erupt in the foreseeable future. Field studies tend to focus on understanding the circumstances of previous events, rather than focusing on predicting future events. The current level of seismic monitoring in the state may provide some level of precursory warning of an impending eruption, but this cannot be assured at this time.

What Can Be Mitigated?

Mitigation options for volcano eruptions should address the lack of detailed, hazard-specific information at the State and local jurisdiction level. A possible mitigation action may be to assist in conducting mapping and delineation of areas vulnerable to volcano eruption in and around the state. Providing educating about the volcano alert system and the aviation color code warning systems is another possible mitigation action item.

Wildland/Wildland - Urban Interface Fire

Hazard Characteristics

A **wildfire** means a fire burning uncontrolled on lands covered wholly or in part by timber, brush, grass, grain or other inflammable vegetation. This is increasing the size of the wildland-urban interface (WUI), defined as the area where structures and other human development meet or intermingle with undeveloped wildland.

Topography, fuel, and weather are the three main factors that influence the behavior of a wildfire. Topography can direct the course of a fire. Depressions, such as canyons, funnel air and act as chimneys, intensifying the fire, causing a faster rate of spread. Saddles on ridge tops draw fires and steep slopes can double the rate of spread, due to the close proximity of fuel (vegetation). The rate of spread is generally stated in chains per hour, feet per minute, or meters per minute.

Fuel type, continuity of fuel, and the moisture content of the fuel all effect wildfire behavior. Continuity of fuel applies both horizontally across the landscape and vertically, from the ground surface up to tree crowns via the understory. Weather can have a profound influence on wildfires. Wind can direct the course of a fire and increase the rate of spread. High temperatures and low humidity can intensify fire, while low temperatures and high humidity can greatly limit the potential of a fire.

There are several types of wild fires. Prescribed fires are planned fires ignited by land managers to accomplish specific natural resource improvement objectives. Fires that occur from natural causes, such as lightning, that are then used to achieve management purposes under carefully controlled conditions with minimal suppression costs are known as wildland fire use (WFU). Wildfires are unwanted and unplanned fires that result from natural ignition, unauthorized human-caused fire, escaped WFU, or escaped prescribed fire. A wildland-urban interface (WUI) fire is a wildfire occurring in areas where structures and other human developments meet or intermingle with wildland vegetation-fuels. WUI fires are a specific concern because they directly pose risks to human lives, property, structures, and critical infrastructure more so than the other types of wildland fires.

A WUI fire involves areas where communities and wildland fuel intermix. Every fire season, catastrophic losses occur as a result of wildfire in WUI areas throughout the western United States. Homes are lost, businesses are destroyed, community infrastructure is damaged, and most tragically, lives are lost. Precautionary action taken before a wildfire strikes often makes the difference between saving and losing a structure. Creating a defensible space around homes, businesses, and other structures is an important component in wildfire hazard reduction. Providing an effective defensible space can be as basic as pruning trees, planting low-flammable vegetation, and cleaning up surface vegetation-fuels and other hazards near a home. These efforts are typically concentrated at a minimum of 30 feet from a building to increase the chance for structure survival and to create an area for firefighters to safely work.

WUI studies suggest that the intense radiant heat of a wildfire is unlikely to ignite a structure that is more than 30 feet away as long as there is no direct flame impingement. Studies of home survivability indicate that homes with noncombustible roofs and a minimum of 30 feet of defensible space have an 85-percent survival rate (Cohen and Saveland 1997). Conversely, homes with wood shake roofs and less than 30 feet of defensible space have a 15 percent survival rate. During a wildfire, structures will burn, wildlife will die or be injured due to burns or smoke inhalation, and death/injury to humans may occur. Wildfires may also create mudslides, landslides by removing the vegetative covering along slopes, and floods and flashfloods due to heat damaged soils that can resist water penetration.

Wildfires can occur at any time of day and during any month of the year, but the peak fire season in New Mexico is normally from March through June. The length of the fire season and the peak months vary appreciably from year to year. Land use, vegetation, amount of combustible materials present, and weather conditions such as wind, low humidity, and lack of precipitation are the chief factors in determining the number of fires and acreage burned. Generally, fires are more likely when vegetation is dry from a winter with little snow and/or a spring and summer with sparse rainfall.

Wildfires are capable of causing significant injury, death, and damage to property. The potential for property damage from fire increases each year as more recreational properties are developed on forested land and increased numbers of people use these areas. Fires can extensively affect the economy of an affected area, especially the logging, recreation, and tourism industries, upon which many counties depend. Major direct costs associated with wildfires are the salvage and removal of downed timber and debris and the restoration of the burned area. Additionally, agricultural production and food processing systems are highly vulnerable to the effects of wildfire.

The indirect effects of wildfires can also be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. If burned-out woodlands and grasslands are not replanted quickly, widespread soil erosion, mudflows and siltation of rivers could result, thereby enhancing flood potential, harming aquatic life and degrading water quality. Lands stripped of vegetation by wildfires are also subject to increased landslide hazards. Smoke from fires threatens air quality and can affect both human and livestock production and health.

Along the Rio Grande and other major rivers in the state occurs what is known as the "Bosque," which is a riparian forest ecosystem consisting largely of cottonwoods, willows, salt cedar, and other native and invasive species. When these areas are stressed by drought, as has happened in recent years, they become tinderboxes.

Land Ownership

Wildfires that occur in New Mexico affect lands of various ownership types including State, private, Tribal and/or federal lands. Diverse and complex landownership presents many different challenges when dealing with wildfires.

The majority of the land acreage in New Mexico is privately owned (44%). Approximately 34% of the land is federally owned. Responsibility for stewardship and management of the forests and woodlands in New Mexico falls primarily to federal agencies and about 43% of the State's acreage is managed by federal agencies. The primary federal agency that manages forest and woodland acreage in New Mexico is the United States Forest Service; they manage 7.6 million acres (46% of all forest and woodland acreage). Approximately 7% of forest and woodlands are under State ownership, while Native American tribes own 15%. The chart below (Table 2.133) shows land ownership in total acres, forest acres and woodland acres. Percent of total acres, forest acres and woodland acres is also presented.

Table 2.133. Land Ownership in New Mexico

Ownership	Area (acres)	% of NM	Forest (acres)	Woodland (acres)	% of NM Forest & Woodland
Federal					
Bureau of Land Management	13,481,000	17	97,800	2,161,100	10
Department of Defense	2,552,000	3	7,000	156,700	1
Bureau of Reclamation	54,500	<1	0	0	0
Fish and Wildlife Service	383,000	<1	1,500	42,600	0
National Park Service	379,000	<1	11,000	42,600	0
Forest Service	9,223,000	12	4,811,600	2,785,500	35
Other Federal	237,000	<1			0
Federal , Total	**26,309,500**	34	4,928,900	5,188,500	46
					0
State	**9,171,000**	12	150,500	1,326,700	7
Private	**34,157,000**	44	1,654,800	5,617,600	33
Tribal	**8,178,000**	10	802,700	2,284,600	14
Local	**3,000**	<1	0	0	0
TOTAL	**77,818,500**	**100**	7,536,900	14,417,400	100

The State Forestry Division does not own and manage land within New Mexico, but works with partners to promote healthy, sustainable forests in New Mexico through its various programs, encouraging sustainable economic growth while protecting and enhancing watershed health and community safety. The State Forestry Division provides technical and financial assistance to state, private, and tribal landowners and land managers.[108]

Wildfires happen on private, municipal, County, State and/or federal lands. Ownership is made up of private land owners, the State of New Mexico, Indian Reservations and the Federal Government which include the Forest Service, Bureau of Land Management (BLM), Fish and Wildlife Service, National Park Service, Bureau of Indian Affairs, Bureau of Reclamation and the Military. When wildfires happen they either happen on private, state and/or federal lands. These wildfires are capable of causing significant injury, death, and damage to property. The potential for property damage from fire, increases each year, as more recreational and residential properties are developed on both non-forested and forested land and because of the increase of people using these areas. With increased residential growth in or near federal and state lands, both on forested and non-forested land areas and in or near the bosque areas (Wildland Urban Interface), risk from catastrophic wildfire has increased dramatically. Private in holdings are being developed with multiple structures and limited access. This growth has also increased the traffic on roadways, resulting in safety concerns both for emergency response and urban interface fire evacuations.

[108] Source: New Mexico State Hazard Mitiagtion Plan (2010)

Natural vs. Human-caused Wildfire

The only natural cause of wildfire is lightning; however, human carelessness and arson account for the larger portion of all wildfires in the State. Table 2.134 below is based on State Forestry Division figures for fires on State and private land in 2011 and 2012. Please note that Tables 2.134 through 2.135 are based on State and private land only. Fires on federal land are reported separately.[109]

Table 2.134. Fires on State and private land in 2011 and 2012

	Human Caused Fires				Lighting Caused Fires			
	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Acres	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Total
2012	263	57%	20,403	80%	194	42%	5,073	20%
2011	706	63%	438,727	67%	411	37%	217,085	33%

Fires on federal land are tallied separately. Below is listing of human caused and lighting caused fires for 2011 and 2012 for the federal land management agencies in New Mexico. These figures are taken from the Southwest Coordination Center.

Table 2.135. Fires on Federal land (2011-2012)

Agency	Human Caused Fires				Lighting Caused Fires			
	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Acres	Number of Fires	% of Yearly Number	Acres Burned	% of Yearly Total
BIA 2011	203	80%	20,684	67 %	49	19%	9,896	32 %
BIA 2012	119	70%	243	33%	51	30%	494	67%
BLM 2011	100	50%	50,677	49 %	100	50%	53,655	51%
BLM 2012	45	41%	998	56%	64	63%	771	44%
USFW 2011	3	75%	9	9%	1	25%	92	91%
USFW 2012	1	50%	1	1%	1	50%	66	99%
NPS 2011	1	33%	29,078	100%	2	66%	1	Less than .01%
NPS 2012	0	-	0	-	8	100%	1,853	100%
USFS 2011	140	25%	265,924	88%	412	75%	35,872	12%
USFS 2012	135	36%	1,938	Less than .01%	242	63%	340,189	99%
Federal 2-year Totals	747		369,552		930		442,880	
State 2-year Totals	969		459,130		605		222,158	
Average per year	1,716	53%	828,682	55%	1,535	47%	665,038	45%

[109] Source: http://www.emnrd.state.nm.us/SFD/FireMgt/Historical.html

For general comparative purposes only, the State and private land fire data was collapsed with the federal fire data. A total of 3,251 fires burned on federal, State and private land in 2011 and 2012. Of that number, 1,716 (53%) were human-caused and 1,535 (47%) were lightning caused. A total of 1,493,720 acres burned on federal, State and private land in 2011 and 2012. Of that number, 828,682 acres (55%) were human-caused and 665,038 acres (45%) were lightning caused. From these figures, we can generalize that more fires and more acres are burned from human caused fires than lightning.

The pie charts below show the causes of fires on State and private land by acreage and in number of occurrences (Figures 2.136 and 2.137). Based on statistical information about fire cause and number, the trend has been that human caused fires cause more fires to occur and burn more acreage than natural caused fires. This trend provides mitigation opportunity for education and outreach to reduce the number and acreage of fires in the State.

Figure 2.136. New Mexico Number of Fires by Cause

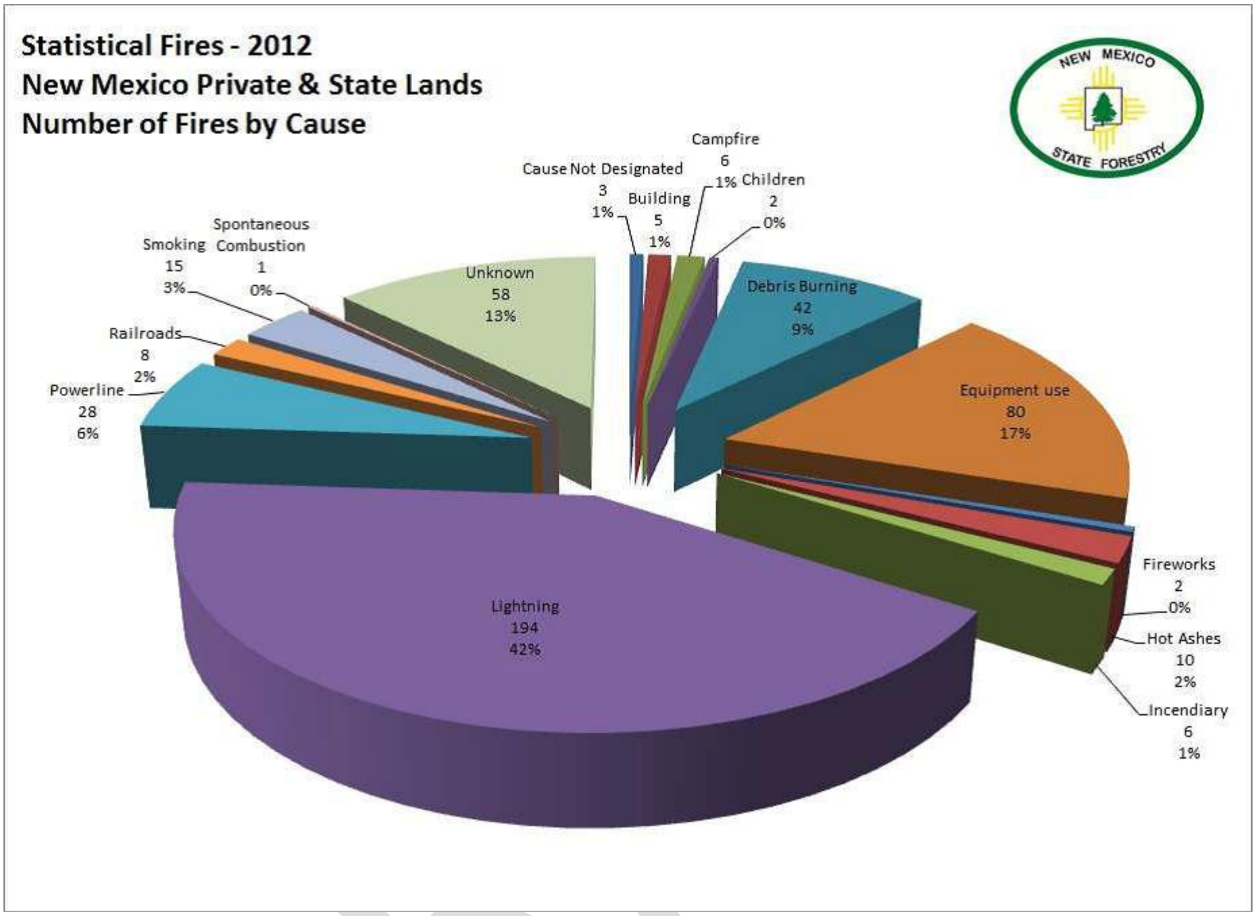
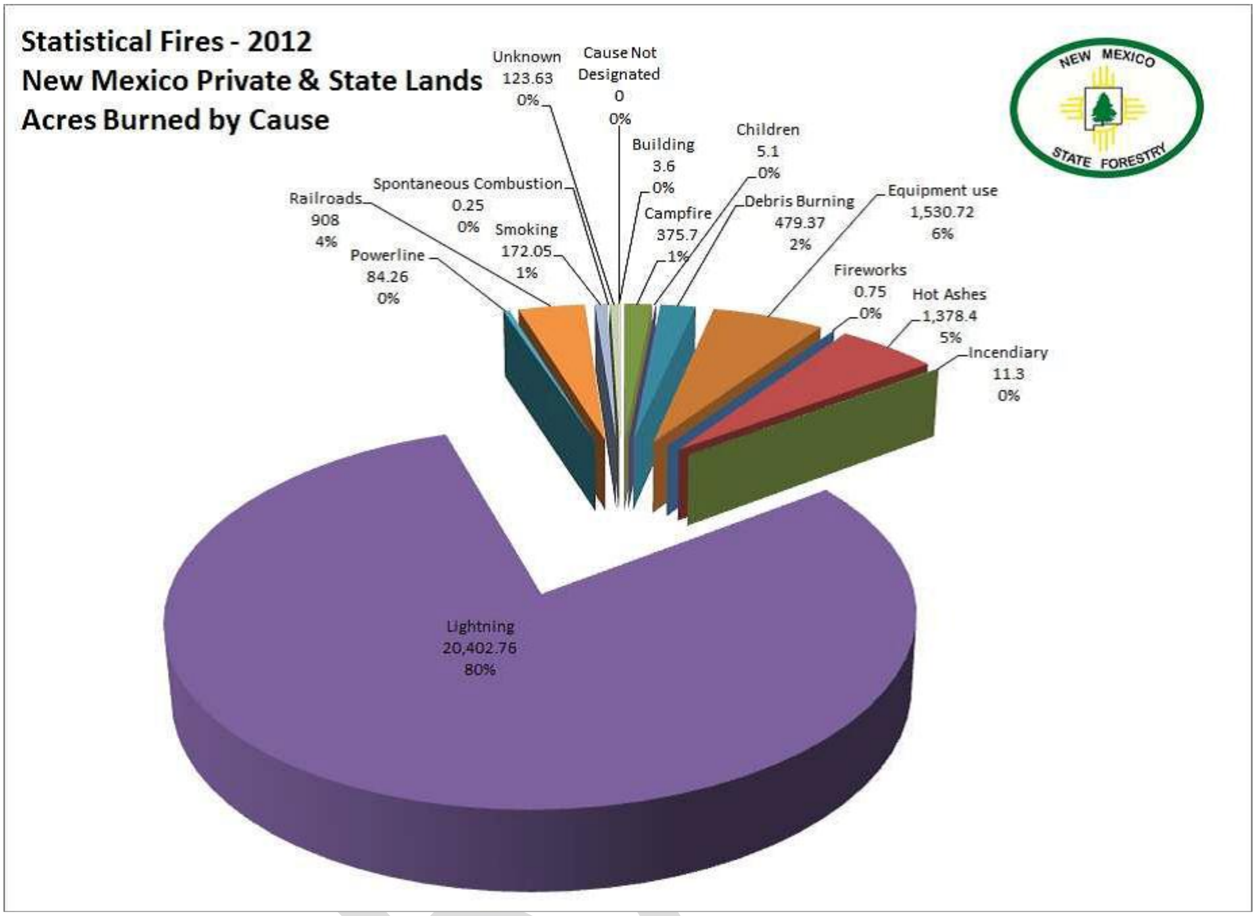


Figure 2.137. New Mexico Acres Burned by Cause



Firefighters use several methods to express fire potential. Some of the indicators are:

Relative Humidity (RH): the ratio of the amount of moisture in the air to the amount of moisture necessary to saturate the air at the same temperature and pressure. Relative humidity is expressed in percent. RH is measured directly by automated weather stations or manually by wet and dry bulb readings taken with a psychrometer and applying the National Weather Service, psychrometric tables applicable to the elevations where the reading were taken.

Fuel moisture: Fuel moistures are measured for live Herbaceous (annual and perennial), Woody (shrubs, branches and foliage) fuels, and Dry (dead) fuels. These are calculated values representing approximate moisture content of the fuel. Fuel moisture levels are measured in 1, 10, 100 and 100-hour increments.

The Lower Atmosphere Stability Index or Haines Index: is computed from the morning (12Zulu) soundings from Radiosonde Observation (RAOB) stations across North America. The index is composed of a stability term and a moisture term. The stability term is derived from the temperature difference at two atmosphere levels. The moisture term is derived from the dew point depression at a single atmosphere level. This index has been shown to correlate with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior. Haines Indexes range from 2 to 6 for indicating potential for large fire growth:

2 Very Low Potential (Moist Stable Lower Atmosphere)
3 Very Low Potential
4 Low Potential
5 Moderate Potential
6 High Potential (Dry Unstable Lower Atmosphere)

Keetch-Byram Drought Index (KBDI): used to measure the effects of seasonal drought on fire potential. The actual numeric value of the index is an estimate of the amount of precipitation (in 100ths of inches) needed to bring soil back to saturation (a value of 0 being saturated). The index deals with the top 8 inches of soil profile so the maximum KBDI value is 800 (8 inches), the amount of precipitation needed to bring the soil back to saturation. The index's relationship to fire is that as the index values increase, the vegetation is subjected to greater stress because of moisture deficiency. At higher values, living plants die and become fuel, and the duff/litter layer becomes more susceptible to fire.

KBDI = 0–200
Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. This is typical of spring dormant season following winter precipitation.

KBDI = 200–400
Typical of late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.

KBDI = 400–600
Typical of late summer, early fall. Lower litter and duff layers actively contribute to fire intensity and will burn actively.

KBDI = 600–800
Often associated with more severe drought with increased wildfire occurrence. Intense, deep burning fires with significant downwind spotting can be expected. Live fuels can also be expected to burn actively at these levels.

The Energy Release Component (ERC): the estimated potential available energy released per unit area in the flaming front of a fire. The day-to-day variations of the ERC are caused by changes in the moisture contents of the various fuel classes, including the 1,000-hour time lag class. The ERC is derived from predictions of the rate of heat release per unit area during flaming combustion and the duration of flaming.

The Ignition Component: a number that relates the probability that a fire will result if a firebrand is introduced into a fine fuel complex. The ignition component can range from zero, when conditions are cool and damp, to 100 on days when the weather is dry and windy. Theoretically, on a day when the ignition component registers a 60 approximately 60% of all firebrands that encounter wildland fuels will require suppression action.

The Spread Component: a numerical value derived from a mathematical model that integrates the effects of wind and slope with fuel bed and fuel particle properties to compute the forward rate of spread at the head of the fire. Output is in units of feet per minute. A Spread Component of 31 indicates a worst-case, forward rate of spread of approximately 31 feet per minute. The inputs required in to calculate the SC are wind speed, slope, fine fuel moisture (including the effects of green herbaceous plants), and the moisture content of the foliage and twigs of living, woody plants. Since the characteristics through which the fire is burning are so basic in determining the forward rate of spread of the fire front, a unique SC table is required for each fuel type.[110]

Another is the International Fire Code Institute susceptibility index (Table2.138), which combines slope and fuel levels:

Table 2.138. Wildfire Susceptibility Matrix

FEMA/IFCI Wildfire Susceptibility Matrix									
Fuel Class	**Critical Fire Weather Frequency**								
	<1 day per year			**2-7 days per year**			**8+ days per year**		
	Slope %			**Slope %**			**Slope %**		
	<40	**41-40**	**61+**	**<40**	**41-40**	**61+**	**<40**	**41-40**	**61+**
Light	M	M	M	M	M	M	M	M	H
Medium	M	M	H	H	H	H	E	E	E
Heavy	H	H	H	H	E	E	E	E	E
Note: M = Medium, H = High, E = Extreme.									
Source: International Fire Code Institute, January 2000									

All these indicators are taken into account when determining the fire danger for a specific area. These indicators can change daily, which is why the Fire Danger Rating System (Table 2.139) was created. It is a method of conveying in a simple way the relative danger level to the public.

Table 2.139. Fire Danger Rating System[111]

Fire Danger Rating System		
Rating	**basic description**	**detailed description**
CLASS 1: Low Danger (L) COLOR CODE: **Green**	fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: **Blue**	fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
CLASS 3: High Danger (H) COLOR CODE: **Yellow**	fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or

[110] Source: http://www.nps.gov/nifc/public/pub_und_understandingfire.cfm
[111] Source: http://www.wfas.net/content/view/34/51/

		in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) COLOR CODE: **Orange**	fires start very easily and spread at a very fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: **Red**	fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Wildland Fire Readiness Levels

The State Forestry Division's Fire Policy and Procedures established the Wildland Fire Readiness Levels as a method for dictating the overall preparedness levels for the Division. District Foresters and District Fire Management Officers shall assess the following criteria in determining readiness levels:

- Current and long-range forecasted weather;
- Current and forecasted fire behavior;
- Current and trend of five-day average energy release component (ERC);
- Comparison of current and trend of the seasonal ERC chart;
- Southwest Area preparedness levels; and
- Individual agency or district fire activity.

Because of the extreme geographical and topographical differences in the state, the Division's districts may be at different levels of fire readiness throughout the year. District Foresters and District Fire Management Officers shall determine fire readiness levels for their respective districts as determined by the following criteria and notify the State Fire Management Officer of the situation.

FIRE READINESS LEVEL 1:

- Most areas have low fire danger.
- Fire activity is light (occasional A, B, and C class fires) and all wildland fires are of short duration, usually lasting only one burning period.

- Moisture content in light fuels is high and heavy fuels are moist.
- State resources and interagency dispatch center cooperators are capable of handling fire incidents with minimum staffing levels.
- Initial attack forces are suppressing wildland fires.
- There is little or no commitment of state resources besides volunteer fire departments.
- ERC-5 day mean average is consistently below 30.

FIRE READINESS LEVEL 2:

- Fire danger is moderate.
- Class A, B, and C fires may occur and the potential exists for escapes to become larger but only have a potential duration of two burning periods.
- Heavy fuels are drying; frontal system winds increase the potential for rapid fire spread over a 36 to 48 hour period.
- State and volunteer fire department resources with limited assistance from the individual dispatch centers are capable of handling the situation.
- Fire department cooperators provide initial attack.
- High wind warnings and "Red Flag" alerts the National Weather Service issues are indicators that the districts may need additional resources.
- ERC-5-day mean average is consistently between 30 and 45.

FIRE READINESS LEVEL 3:

- Generally, all agencies are experiencing high fire danger.
- Numerous A, B, and C class fires, with a high potential for wildland fires to become Class D or larger in size, that may require additional resources.
- Light fuels are cured and heavy fuels are rapidly drying.
- Fires are escaping initial attack on a consistent basis and require extended attack support.
- The initial attack dispatch centers are requesting additional resources to increase initial attack capabilities.
- Federal cooperators provide critical initial attack and extended attack support during fire suppression.
- FEMA Fire Suppression Grants apply to urban/interface fires. The State Forester initiates FEMA Presidential Emergency Declaration requests.
- ERC-5 day mean average is consistently between 45 and 60.

FIRE READINESS LEVEL 4:

- Division and cooperating agencies are experiencing very high or greater fire danger.
- Numerous A, B, C, and D class fires that have the potential to exhaust dispatch area, state, Southwest Area, and national resources are common within the region.
- Division personnel implement and enforce fire restrictions.
- The Division may have Type 1 and Type 2 Incident Management Teams committed to incidents under this readiness level within the state.
- ERC-5 day mean average is consistently between 60 and 80.

FIRE READINESS LEVEL 5:

All criteria for Fire Readiness Level 4 plus the following additional criteria are met:

• Fire danger is extreme throughout the state and region;
• Several dispatch centers and agencies are experiencing major fires and national resources are exhausted;
• Air resources are in short supply;
• Fire restrictions require closures;
• EOC is activated;
• Area Command has been implemented;
• High potential for catastrophic fires exists;
• Extreme fire behavior, scarce resources, and extremely unsafe working conditions for fire fighters hinder efforts of Type 1 and 2 Incident Management Teams;
• A multi-agency Coordination (MAC) Group is allocating resources to high priority fires; and
• ERC-5 day average is consistently at or above 80.

Previous Occurrences

Table 2.140. Previous Occurrences – Wildland/WUI Fires

Date	Location	Significant Event
June 20, 2012	Corrales (Sandoval and Bernalillo County) Preparedness Area 5	The Romero Fire burned 360 acres. FMAG #2982.
June 18, 2012	Northwest Plateau Preparedness Area 4	The Blanco Wildfire burned out of control 10 miles east of Bloomfield consuming more than 350 acres. A wildfire along CR 1491 burned quickly out of control in the bosque along the San Juan River and consumed more than 350 acres, 5 homes, and 12 outbuildings. Property Damage was $1 Million. FMAG #2981.
June 9, 2012	Lincoln County Preparedness Area 1	The Little Bear Fire was the most destructive Fire in State history It burned 44,330 acres including 35 structures. FMAG #2979.
May 6, 2012	Southwest Mountains Preparedness Area 6	By the end of May, the Whitewater/Baldy Complex broke the record for the largest wildfire in New Mexico state history. It burned in Catron and Grant Counties. On May 6th, the Baldy Fire started and on May 16, the Whitewater fire was detected. Both of these fires were started by lightning. On May 24th, strong winds allowed the Whitewater and Baldy fires to join, then becoming the Whitewater/Baldy Complex. At this time 12 structures burned in the Willow Creek subdivision. On May 26th, another bout of stronger winds led to the evacuation of Mogollon. Spotting was reported up to three-quarters of a mile within mixed conifer and ponderosa pine on the northern side of the fire, while pinon pine and juniper were more common on the

Date	Location	Significant Event
		southeast flank. The fire led to numerous road closures including Forest Service Road 141, Forest Service Road 28 at the Forest Service Road 94 junction, State Road 159 at Whitewater and Forest Service Road 150 at the Forest Service Road 142 junction. By the time of containment in July, the fire had burned 297,845 acres, causing $26 million in damage including 20 structures. FMAG #2978.
March 25, 2012	Lower Chama River Valley Preparedness Area 3	Near record breaking temperatures fueled a human caused fire near Chimayo. The Chimayo Wildfire, near Highway 76 and County Road 87, was started when hot jumper cables were laid on dry vegetation. The fire, 10 acres in size, scorched Bureau of Land Management and privately owned land. In total, two homes and two outbuildings were burned. Total property damage was $300K.
June 30, 2011	Otero County Preparedness Area 6	Little Lewis Fire. FMAG #2934
June 29, 2011	Lincoln County Preparedness Area 1	Donaldson Fire. FMAG #2935.
June 26, 2011	Jemez Mountains Preparedness Area 3	The Las Conchas Wildfire began when a tree fell on a power line 12 miles southwest of Los Alamos on June 26th. The fire quickly spread eastward under windy and unstable conditions, covering more than 40,000 acres the first day. The fire was contained by the end of the month. In all, this fire burned 156,593 acres, making it the largest fire in New Mexico history. The Las Conchas wildfire damaged 80 homes, of which, 15 were primary residences. The other 65 homes were seasonal. Numerous outbuildings were also damaged or destroyed and 10 vehicles were completely destroyed. The fire prompted evacuations of Los Alamos National Labs, Bandelier National Monument, the city of Los Alamos, as well as numerous other campgrounds and homes within the burn area itself. The fire burned portions of the Santa Clara, Cochiti, San Ildefonso and Santa Domingo Indian Reservations as well as portions of Bandelier National Monument and the Valles Caldera National Preserve. This fire burned on both sides of Highway 4, and up to Highway 501, causing both highways to be closed for a time. Some of this area was previously burned by the Cerro Grande Fire in 2000. Fortunately, no member of the public or any emergency responders were seriously injured during the fire suppression efforts. Total

Date	Location	Significant Event
		property damage was $17 Million. FMAG #2933. State EO 2011-053.
June 26, 2011	Albuquerque Metro Area Preparedness Area 5	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 16, 2011	South Central Mountains Preparedness Area 5	The Swallow Wildfire quickly engulfed 9 homes amidst breezy, hot and very dry conditions. This human caused fire, named the Swallow Fire for starting on Swallow Drive, burned 10 acres of land in a wooded Ruidoso neighborhood. Nine homes were lost to the blaze. Total Property damage was $3.5 Million.
June 12, 2011	Raton Ridge / Johnson Mesa Preparedness Area 2	Breezy and dry conditions fueled the Track Wildfire for several days before crews could get a handle on the fire. The fire quickly gained recognition when Interstate 25 had to be closed and traffic had to be diverted for nearly 3.5 days. This grass and timber fueled fire, named the Track Fire, started just north of Raton and burned along and between Bartlett and Horse Mesas, and on either side of the Interstate 25 corridor. I-25 was closed for approximately 3.5 days. This fire was caused by engine exhaust particles, likely expelled by an TV on Burlington Northern Santa Fe Railway property. The ATV rider trespassed onto land owned by BNSF through access from nearby private property. Evacuations were needed along the north side of Raton, Pine Valley Estates, and within Sugarite Canyon State Park and Yankee Canyon. The Raton watershed sustained significant damage. In all, 27,792 acres burned, 19,962 of which was in New Mexico. In all, 8 residences and 11 outbuilding were destroyed. Property damage was $2.5 Million. FMAG #2918.
June 9, 2011	Catron County Preparedness Area 6	Wallow Fire. FMAG #2917.
April 17, 2011	Curry and Roosevelt Counties Preparedness Area 1	Tire Fire. FMAG #2897.

Date	Location	Significant Event
April 3, 2011	South Central Mountains Preparedness Area 1	As a storm system approached New Mexico on the 3rd, the mid level gradient and surface pressure gradient increased sharply, leading to high, damaging winds. These strong winds fueled a new wildfire near Ruidoso. A human-caused wildfire begun in Gavilan Canyon and quickly spread north and northeast as very strong winds fueled the fire. The White Wildfire crossed Highway 70 near Ruidoso Downs and continued to move toward Forest Service Road 120. Highway 70 between mile markers 265 and 271 was closed for a time. Much of the burned area consists of steep, rough and rocky terrain, which made it difficult to contain the fire. In all, 10,384 acres were scorched, 5 homes and 7 outbuildings were destroyed and another 2 homes and 2 outbuildings were damaged. Property damage was $1.5 Million. FMAG #2880.
March 8, 2011	Grant County Preparedness Area 6	Quail Ridge Fire. FMAG #2866.
June 23, 2010	San Juan Mountains Preparedness Area 3 Preparedness Area 5	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 23, 2008	Sandia/Manzano Mountains Preparedness Area 5	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.

Date	Location	Significant Event
April 30, 2008	Sandia/Manzano Mountains Preparedness Area 5	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
November 19, 2007	Sandia/Manzano Mountains Preparedness Area 5	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 were evacuated prior to Thanksgiving Day in the villages of Punta de Agua and Manzano. Cost was $500K
February 23, 2007	Belen (Valencia County) Preparedness Area 5	Fire threatened approximately 150 homes, three businesses in the City of Belen, several power lines and a sewer treatment plant. As a result, an estimated 400 individuals were evacuated and two shelters were opened to aid in the evacuations. The fire burned at least 500 acres, destroyed two homes and two people were injured. Federal assistance was approved for this event.
March 12, 2006	Lea County Preparedness Area 1	An emergency flare at a gas plant started a wildfire that grew to nearly 100,000 acres. Sustained wind speeds of 35 to 45 mph with gusts to 84 mph and very low relative humidity values contributed to the rapid growth and spread of this fire. New Mexico State Road 206 was closed by the New Mexico State Police between Tatum and McDonald due to the fire. News reports in later days indicated that the final acreage of the burn area was 92,390 acres. The fire was contained one day later after burning down the U.S. Post Office, two primary residences, four abandoned homes, three barns, and several pieces of fire equipment. Two dozen fire departments fought to put out the fire and one man suffered burns and was treated at a burn center in Lubbock, Texas. The property damage estimate exceeded $300 thousand.

Date	Location	Significant Event
January 1, 2006	Hobbs and Tatum (Lea County) Preparedness Area 1	A grass fire driven by wind burned 50,000 acres west of Hobbs. The western side of Hobbs had to be evacuated, including the community college, a casino, and several neighborhoods. Three firefighters sustained minor injuries, but no one was seriously injured. Four families were provided shelter by the Red Cross, and eleven homes were destroyed. Two businesses and 10 vehicles also were destroyed by the fire. In addition to the wildfire west of Hobbs, two fires burned near Tatum in northern Lea County. No structures were damaged in these fires; however, U.S. Highway 380 was closed from Roswell to the Texas state line during the day because of the fires. According to local authorities, one fire near Tatum was caused by fireworks and the other was sparked by a car crash. These fires combined to cause $700 thousand in property damage and $10 thousand in crop damage.
May 2004	Lincoln County Preparedness Area 1	Lightning is suspected to have started the Pippin Wildfire in the Capitan Mountains about 15 miles northeast of Lincoln which had consumed nearly 48,000 acres by the end of the month and destroyed about 15 historic cabins dating back to near 1920. The Lookout wildfire flared from an improperly extinguished campfire in the Gallinas Mountains just west of Corona. This 5500-acre wildfire claimed a ranch headquarters and mountain top communications facilities before it was contained. Total Damage $600 thousand.
June 2003	Albuquerque, NM (Bernalillo County) Preparedness Area 5	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.
June 1, 2002	Colfax County Preparedness Area 2	The Ponil Wildfire occurred northwest of Cimarron, in Colfax County near the Philmont Scout Ranch. This fire was caused by lightning and is the largest fire to occur in New Mexico to date. Valiant efforts by 1,342 personnel, 13 water dropping helicopters, 31 engines, 24 dozers, and 12 water tenders contained the fire by June 17, but not before it encompassed 92,000 acres (143 Sq. miles). About 28,000 (42 Sq. miles) of those were part of Philmont Scout Ranch.
March 2002	Lincoln County Preparedness Area 1	Winds of 45 to 55 mph whipped an accidental fire into a fast moving wildfire that consumed 12,000 acres and 20 homes before crews and air tanker assaults gained control in much lighter winds. Damages were approximately $5 million.
May 2000	Los Alamos County Preparedness Area 3	The Cerro Grande Wildfire, was the costliest fire in the state's history. The entire county of Los Alamos was evacuated when a prescribed burn, which was ignited May 4 on property of the Bandelier National Monument quickly, escaped its project area (Los Alamos Canyon) and entered the city's western perimeter. Although there was considerable warning, the city's 11,000

Date	Location	Significant Event
		residents had only a very short time to evacuate. Over 400 residences were destroyed, with many more damaged by smoke and prolonged power outages. The fire burned nearly 47,000 acres and hundreds of structures in Los Alamos and the adjacent Los Alamos National Laboratory (LANL), before it was completely contained in July 2000. The event resulted in a Federal Disaster Declaration, FEMA-1329.
May 1996	Taos County Preparedness Area 2	In Taos County, the Hondo Wildfire swept through the unincorporated community of Lama, south of Questa. This community was built in the forest and did not stand a chance against the fire that burned over 4000 acres in the first afternoon. Luckily, no one was injured, but the destruction was nearly total. Approximately 32 homes were destroyed, and the fire burned into the high country until it was finally extinguished by summer rains.

Declared Disasters from Wildfire

DHSEM reports seven State Declared Disasters for wildfire between 2003 and 2013. This number is based on how many Executive Orders were signed by the Governor for wildfire. According to DHSEM records, the total cost for State declared wildfire events between 2003 and 2012 was $2,681,694 (Figure 2.141). The total does not reflect all costs for Executive Orders from 2011 and 2012 which are still being tallied. Research into locations for each disaster would need to be completed prior to breaking-out the figures by Preparedness Area.

Table 2.141. State Disaster Event Information 2003 through 2012

Event Type	State Executive Order	Dollar Loss*
Fire Preparedness	06-009	$6,662.00
Wildfire	08-018	$375,032.00
Wildfire	11-047**	$200,000.00
Wildfire	11-053**	$750,000.00
Wildfire	11-061**	$100,000.00
Wildfire	12-014**	$500,000.00
Wildfire	12-015**	$750,000.00
Total	**7**	**$2,681,694.00**

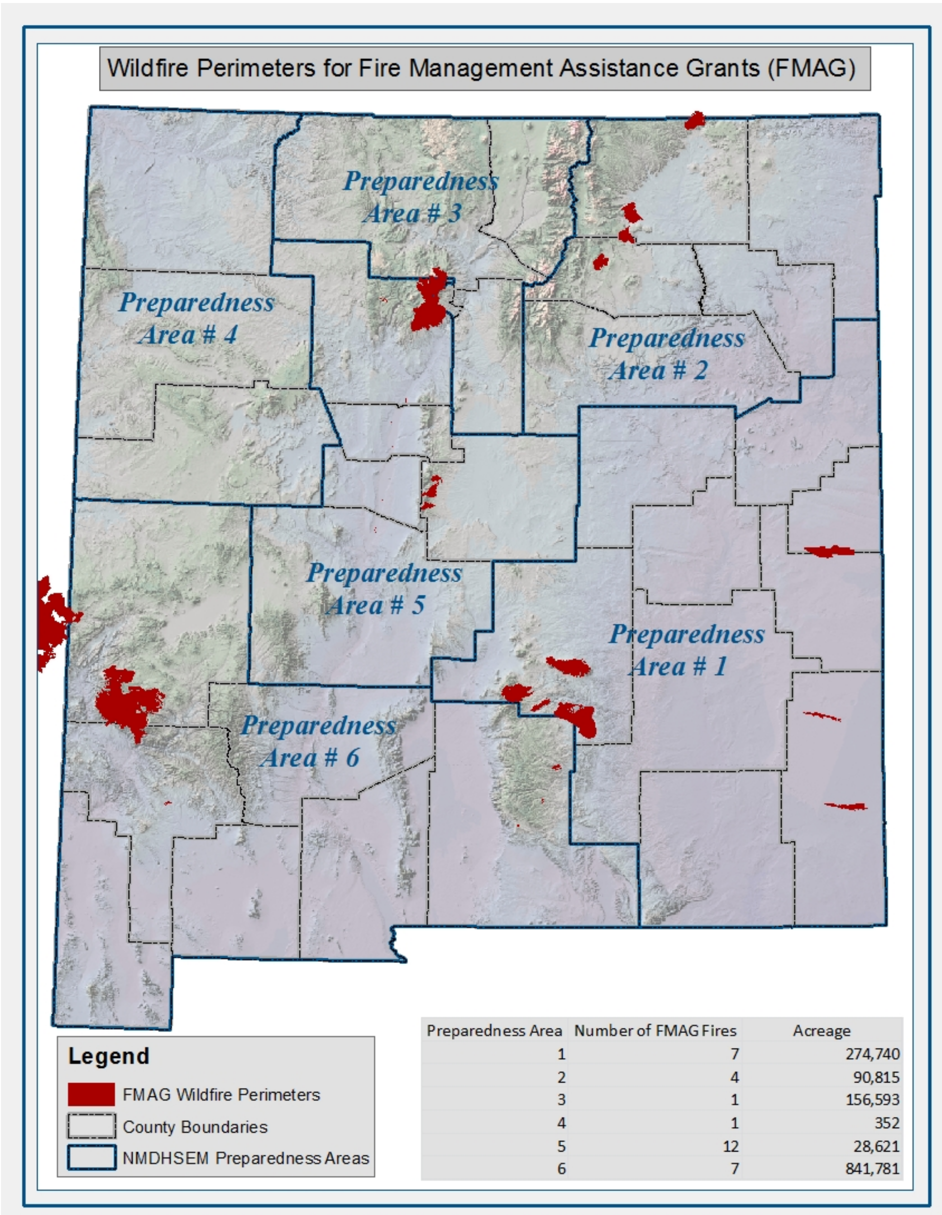
There were 29 Fire Management Assistance Grants at the federal level between 2003 and 2012 (Figure 2.142). The total Public Assistance dollar losses from federal, DHSEM and local government entities and all tribal entities was $28,356,974. DHSEM as the State emergency management agency contributed either 25% of the total cost or zero.

Table 2.142. Federal Disaster Event Information 2003 through 2012

Event Type/Name	Event Number	Federal Share	State (DHSEM) Share	Total Cost	State % of Total
Wildfire - Atrisco Fire	2472	$1,749,609	$583,203	$2,332,812	25%
Wildfire - Walker Fire	2467	$76,176	$25,392	$101,568	25%
Wildfire - Peppin Fire	2518	$283,186	$94,395	$377,581	25%
Wildfire - Bernardo Fire	2522	$238,140	$79,380	$317,520	25%
Wildfire - Casa Fire	2631	$262,647	$87,549	$350,196	25%
Wildfire - Southeast NM Fire	2600	$107,390	$35,797	$143,187	25%
Wildfire - Ojo Feliz Fire	2636	$2,406,369	$802,123	$3,208,492	25%
Wildfire - Malpais Fire	2644	$113,353	$37,784	$151,137	25%
Wildfire - Rivera Mesa Fire	2647	$2,718,248	$906,083	$3,624,331	25%
Wildfire - Belen Fire	2682	$89,839	$29,946	$119,785	25%
Wildfire - Ojo Peak Fire	2741	$17,400	$5,800	$23,200	25%
Wildfire - Trigo Fire	2762	$2,175,243	$725,081	$2,900,324	25%
Wildfire - Big Springs Fire	2777	$406,862	$135,621	$542,483	25%
Wildfire - Buckwood Fire	2818	$339,716		$452,955	0%
Wildfire - Cabezon Fire	2842	$55,680	$0	$74,239	0%
Wildfire - Rio Fire	2843	$55,983		$74,645	0%
Wildfire - Quail Ridge Fire	2866	$267,934	$89,311	$357,245	25%
Wildfire - White Fire	2880	$124,694	$41,565	$166,259	25%
Wildfire - Tire Fire	2897	$75,184	$25,061	$100,245	25%
Wildfire - Wallow Fire	2917	$515,274	$171,758	$687,033	25%
Wildfire - Track Fire	2918	$4,300,099	$1,433,366	$5,733,465	25%
Wildfire - Los Conchas Fire	2933	$1,640,181	$546,727	$2,186,909	25%
Wildfire - Little Lewis Fire	2934	$75,494	$25,165	$100,659	25%
Wildfire - Donaldson Fire	2935	$3,173,028	$1,057,676	$4,230,704	25%
Wildfire - Whitewater/Baldy Complex Fire	2978*	NA	NA	NA	NA
Wildfire - Little Bear	2979*	NA	NA	NA	NA
Wildfire - Blanco Fire	2981*	NA	NA	NA	NA
Wildfire - Romero Fire	2982*	NA	NA	NA	NA
Total	**29**	**$21,267,731**	**$6,938,784**	**$28,356,974**	

Figure 2.143 shows a map of statewide wildfire perimeters (including County boundaries) for Fire Management Assistance Grants (FMAGs) between 2003 and 2012.

Figure 2.143. State Wildfire Perimeters for Fire Management Assistance Grants (2003 - 2012)



Figures 2.145 through 2.150 on the following pages show maps of wildfire perimeters for FMAGs in each of the six state Preparedness Areas. The following chart (Figure 2.144) summarizes the number of FMAGs and acreage for each Preparedness Area. General conclusions drawn from this mapping are:

- The largest number of acres burned has been in Preparedness Area 6;
- The largest number of acres burned in one FMAG declaration was the Whitewater Baldy Complex in Preparedness Area 6 (297,801 acres);

- The second largest number of acres burned in one FMAG declaration was the Las Conchas in Preparedness Areas 3 and 5 (156,593 acres);
- The most individual FMAG declarations have been in Preparedness Area 5;
- The second highest number of FMAG declarations have been in Preparedness Areas 1 and 3;

Figure 2.144. Summary of FMAG and Acreage by Preparedness Area[112]

Preparedness Area	Number of FMAGs	Number of Acers per event	Notes
1	7	274,740	Majority of area in Lincoln County
2	4	90,815	All areas in Colfax and Mora Counties
3	1	156,593	Las Conchas Fire impacted area in Los Alamos, Rio Arriba and Santa Fe Counties (Preparedness Area 3) and Sandoval County (Preparedness Area 5)
4	1	352	All acreage in San Juan County
5	12	28,621	Majority of area in Torrance County. Las Conchas Fire impacted Sandoval County but was reported with Preparedness Area 3.
6	7	841,781	Majority of acreage in Catron County. (Acreage for Wallow Fire not included due to majority being outside the State.)
Total	32	1,392,902	

[112] Source: University of New Mexico Earth Data Analysis Center

Figure 2.145. FMAG Wildfire Perimeters for Preparedness Area 1 (2003 - 2012)

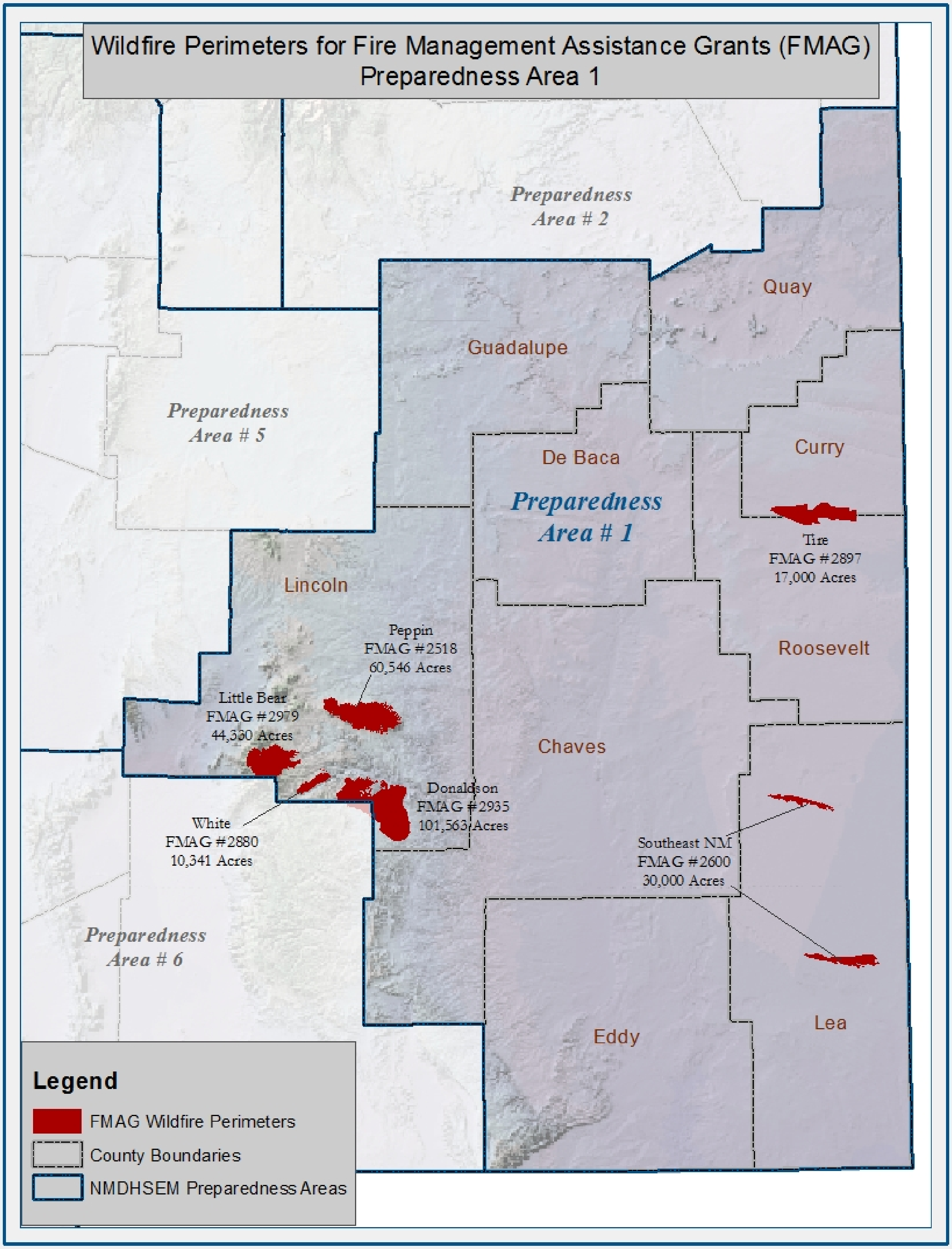


Figure 2.146. FMAG Wildfire Perimeters for Preparedness Area 2 (2003 - 2012)

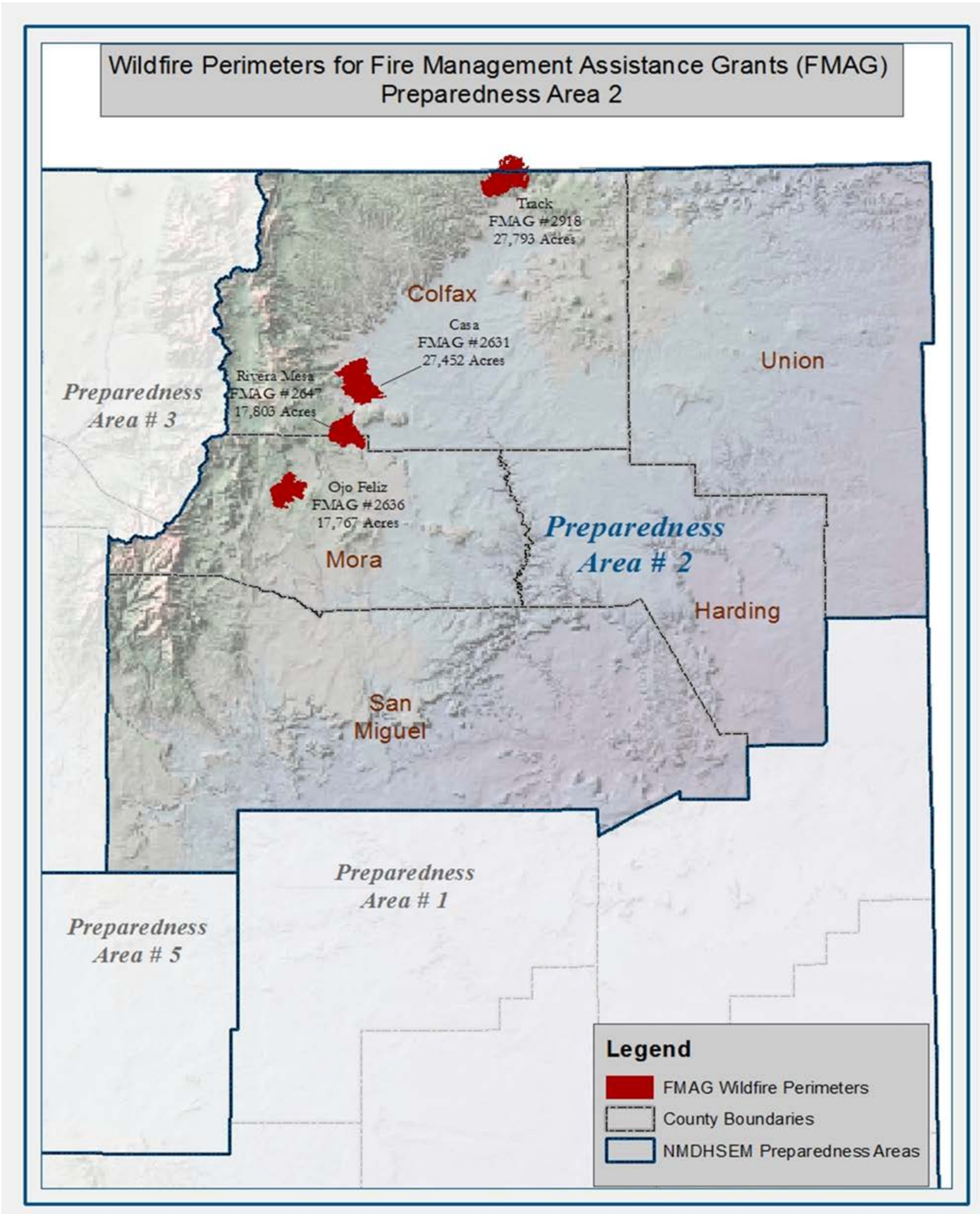


Figure 2.147. FMAG Wildfire Perimeters for Preparedness Area 3 (2003 - 2012)

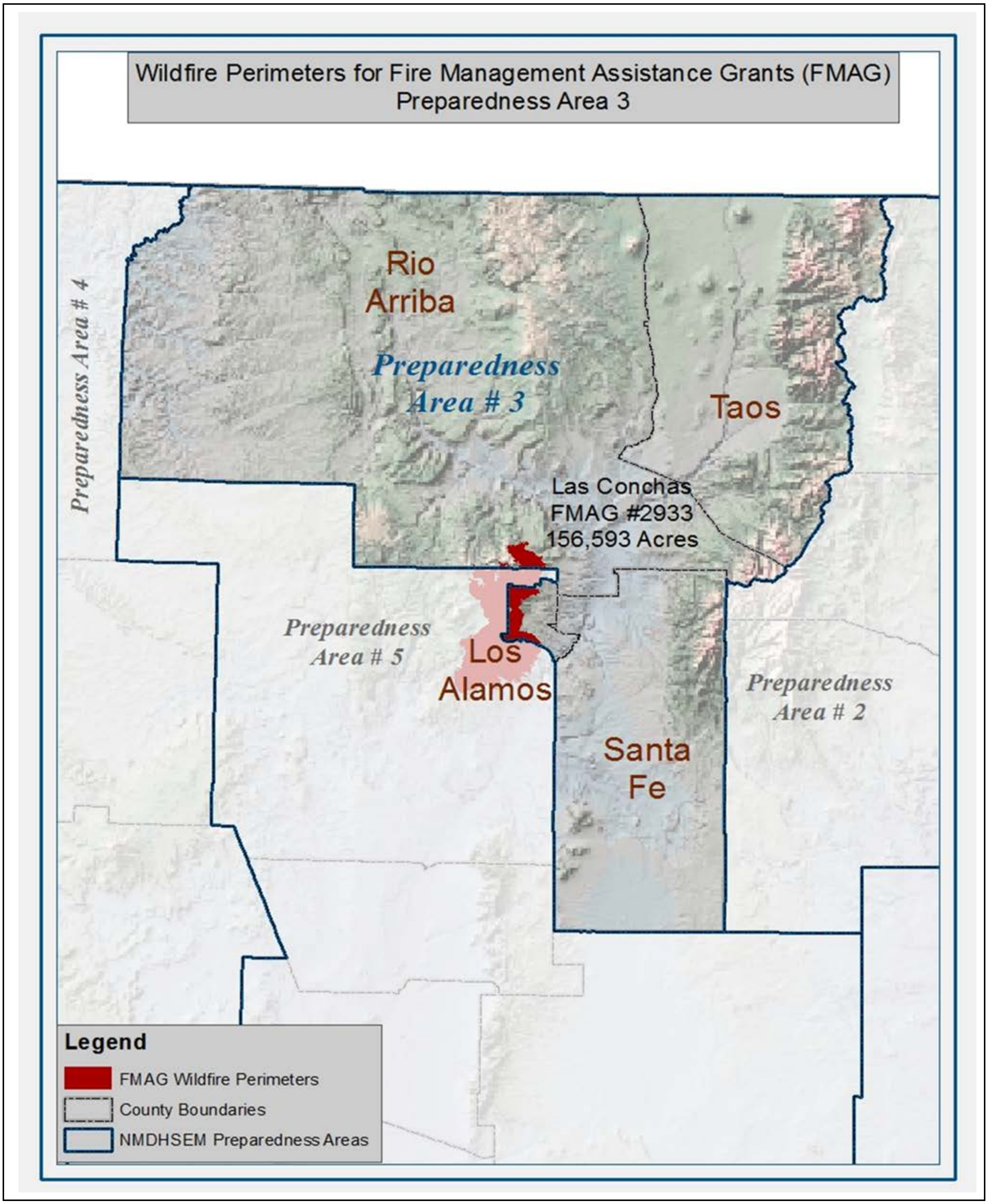


Figure 2.148. FMAG Wildfire Perimeters for Preparedness Area 4 (2003 - 2012)

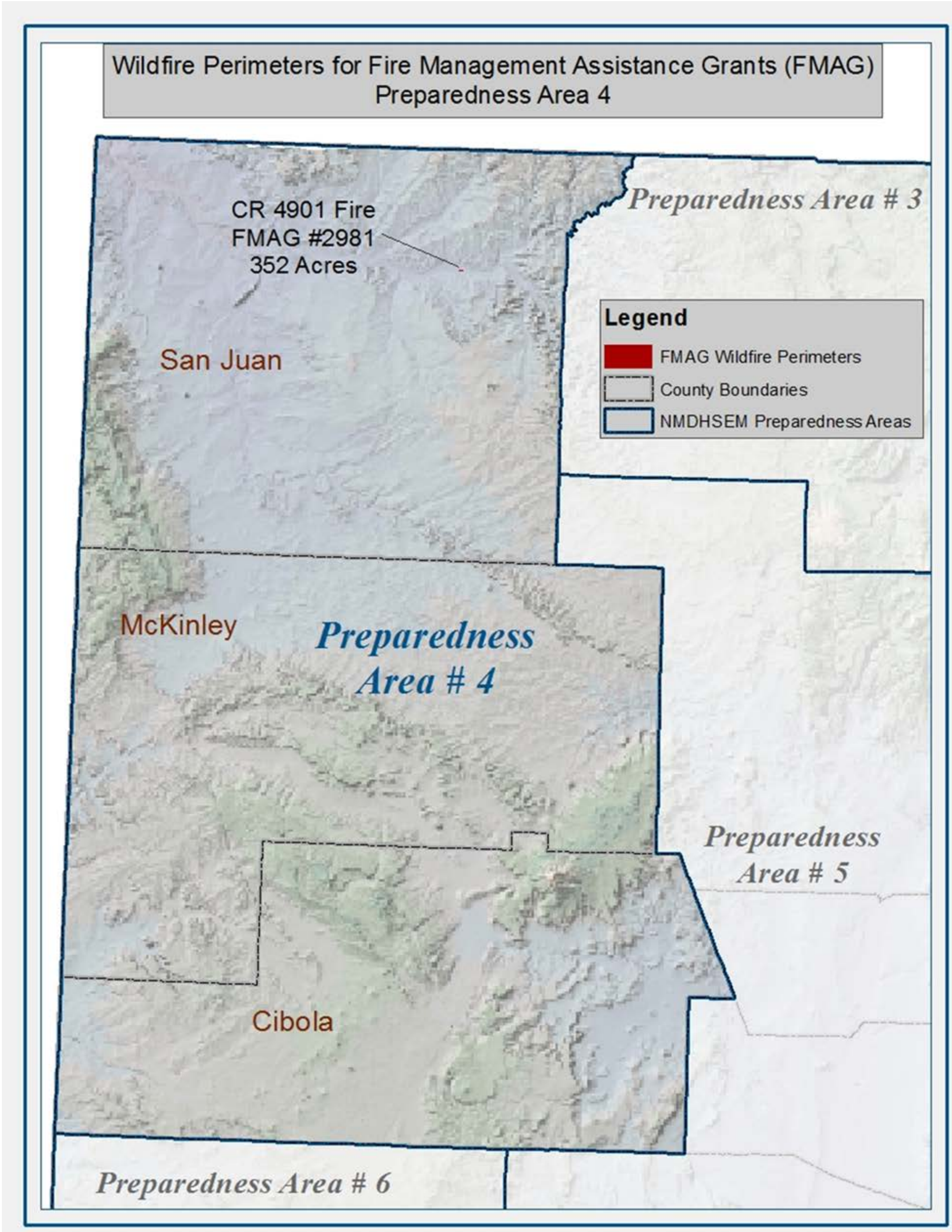


Figure 2.149. FMAG Wildfire Perimeters for Preparedness Area 5 (2003 - 2012)

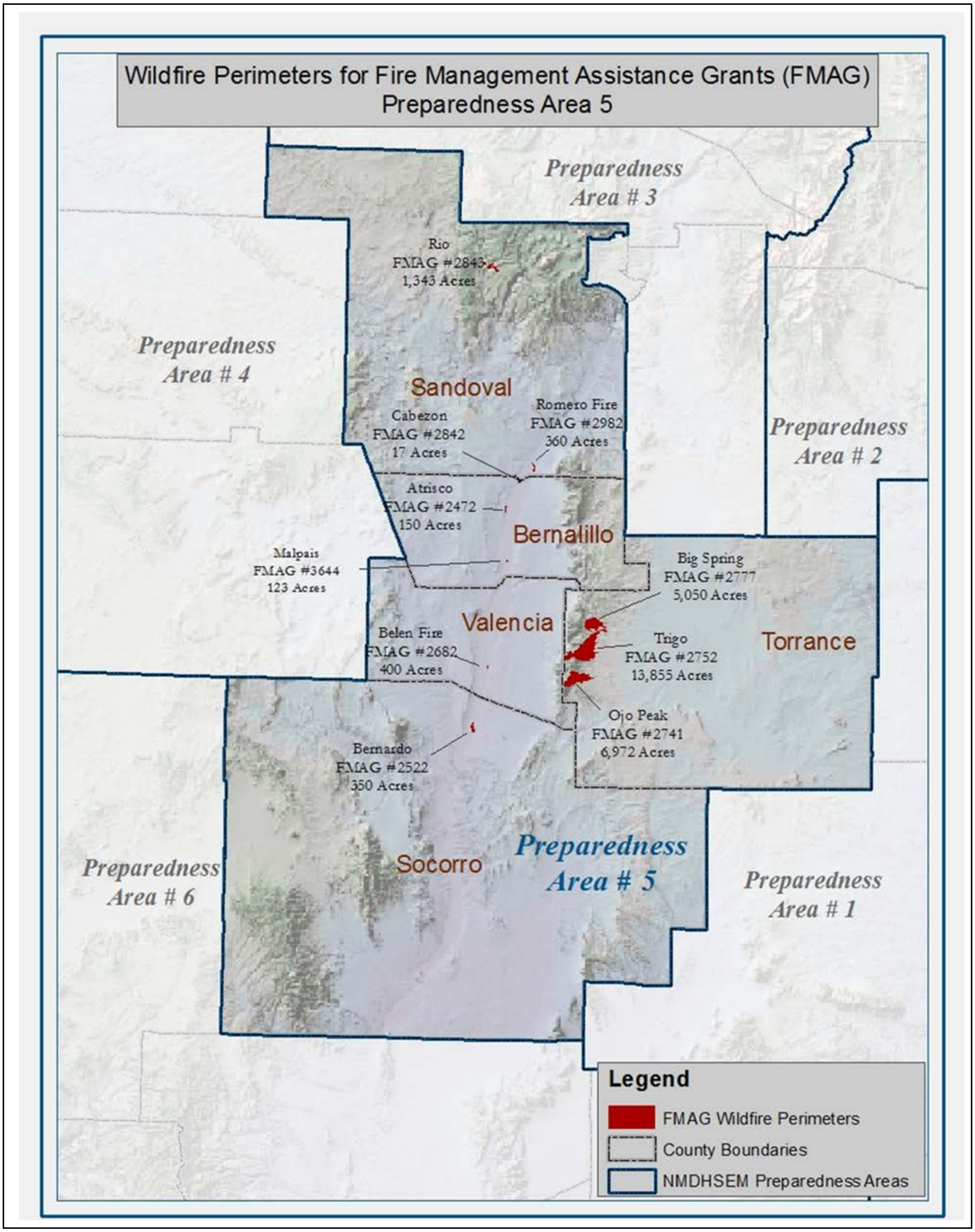
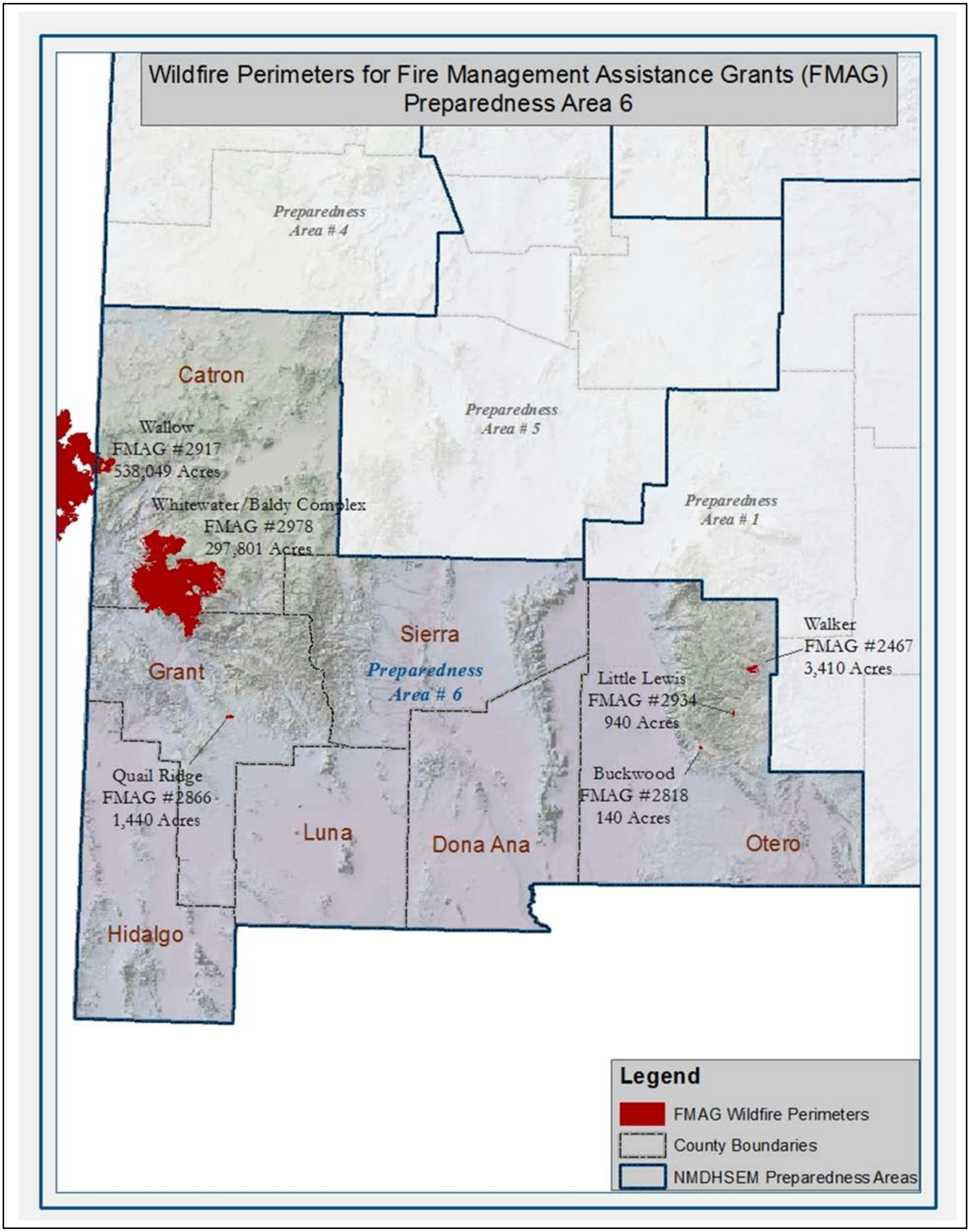


Figure 2.150. FMAG Wildfire Perimeters for Preparedness Area 6 (2003 - 2012)

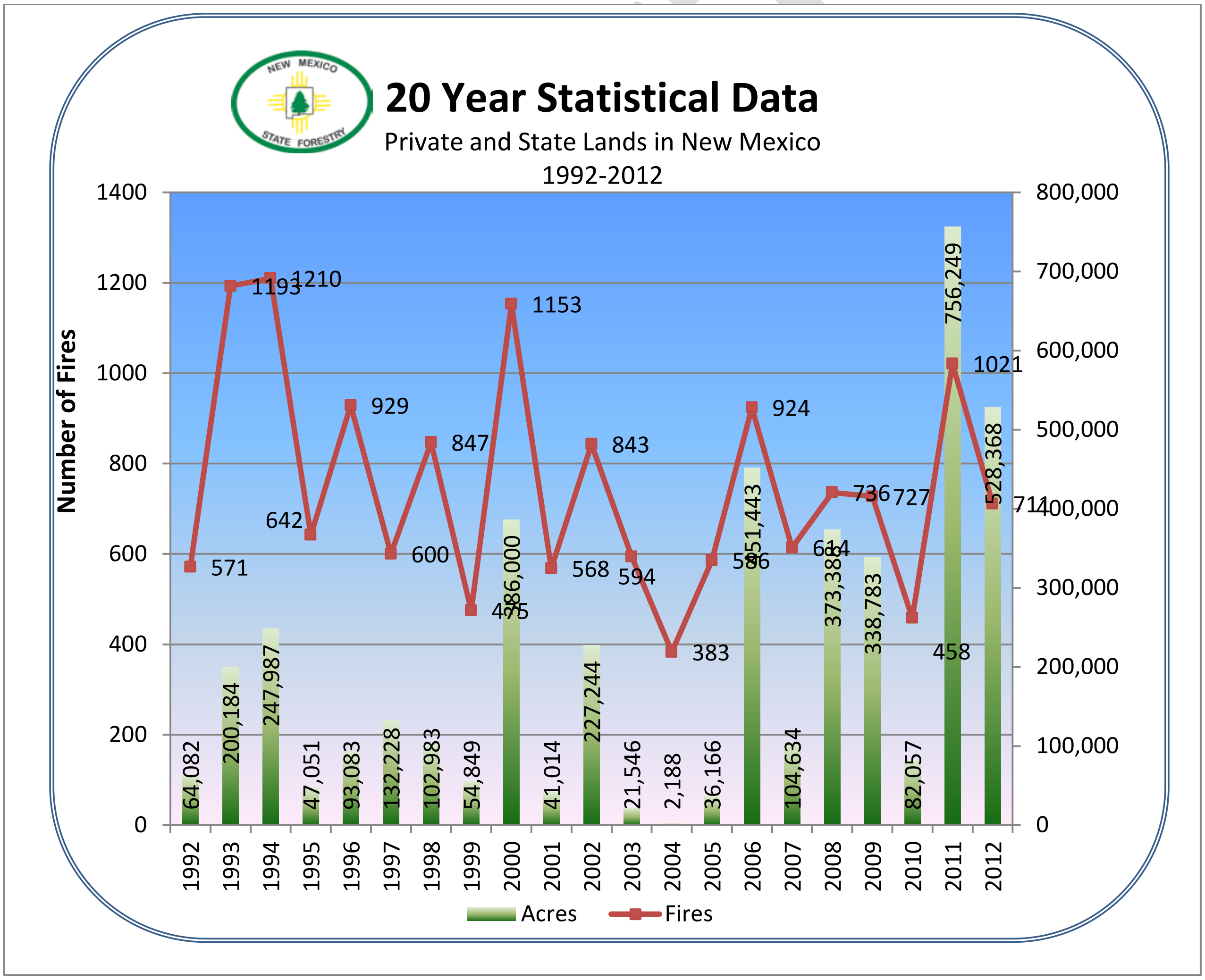


Frequency

Figure 2.151 and Table 2.152 identify 20-years of statistical data for the number of fires and acres burned State-wide. From 1992 to 2012, 15,785 fires have burned 4,291,527 acres State-wide. The average results in 752 wildland fires each year that burn 204,358 acres per year.

The data presented here reflects State Forestry Division data. The State Forestry Division keeps records on a State-wide and not County-wide basis. Therefore, wildfire data is not presented by Preparedness Area (as reported for other hazards in this Plan). It is unclear which specific acreage is included in the Southwest Coordination Center or the National Data Climatic Center figures. Therefore, only the State Forestry Division data is presented in the Mitigation Plan.

Figure 2.151. 20-Year New Mexico Fire History[113]



113 Source: ENMRD, NM State Forestry Division

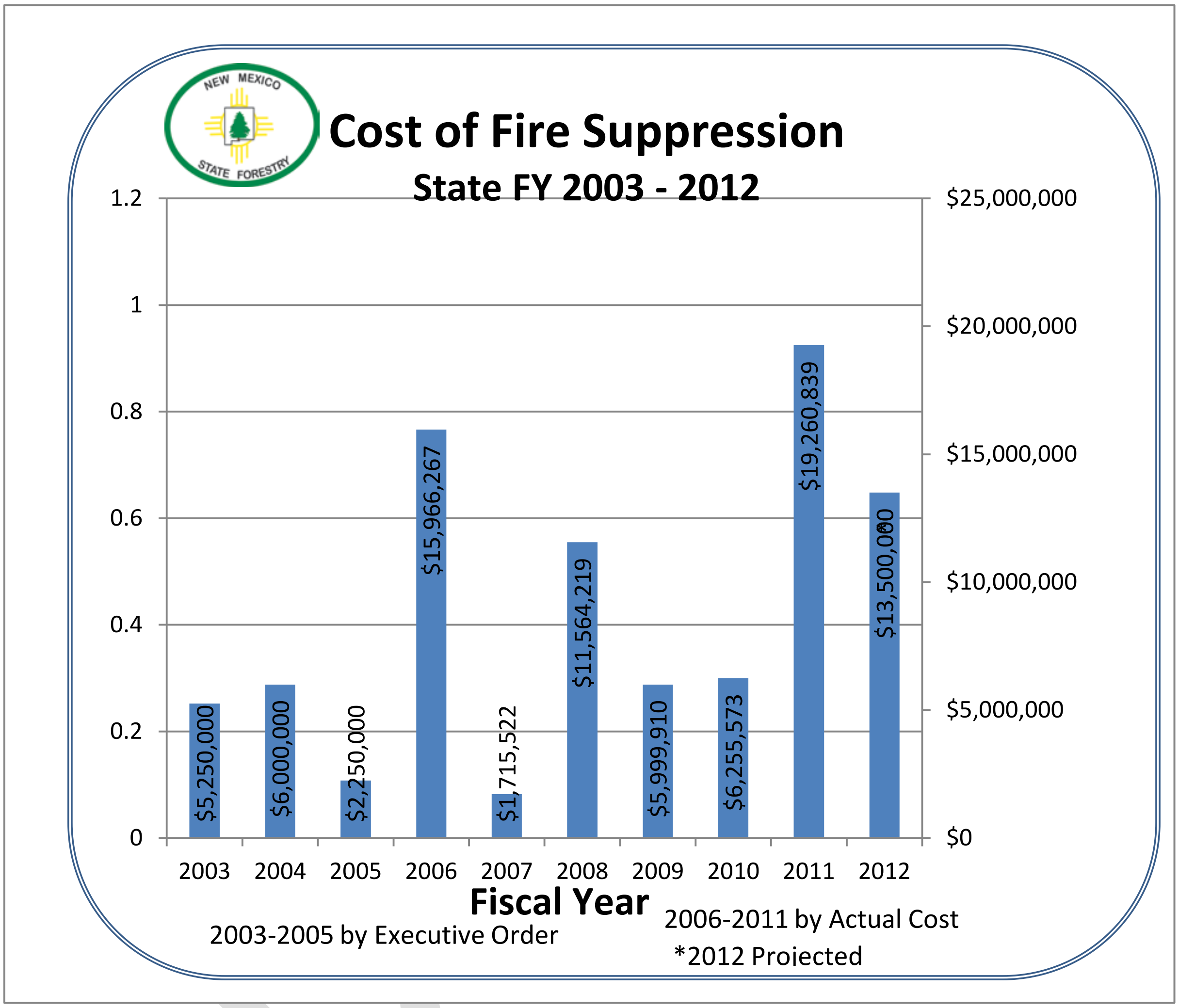
Table 2.152. Historical Fire Data (1992 – 2012)[114]

20 Year Historical Fire Data (1992-2012)		
Date	**Number of Fires**	**Number of Acres**
1992	571	64,082
1993	1,193	200,184
1994	1,210	247,987
1995	642	47,051
1996	929	93,083
1997	600	132,228
1998	847	102,983
1999	475	54,849
2000	1,153	386,000
2001	568	41,014
2002	843	227,244
2003	594	21,546
2004	383	2,188
2005	586	36,166
2006	924	451,443
2007	614	104,634
2008	736	373,388
2009	727	338,783
2010	458	82,057
2011	1,021	756,249
2012	711	528,368
Total	**15,785**	**4,291,527**
Average	**752**	**204,358**

114 Adapted from 20-year Statistical Data Chart from State Forestry Division

Figure 2.153 and Table 2.154 identify the cost of suppression for the past 10 years. From 2002 to 2012, $110,262,330 has been spent on suppression State-wide. The average annual cost for suppression is $10,024,850.

Figure 2.153. 10 Year Historical Cost of Fire Suppression[115]



115 Source: ENMRD, NM State Forestry Division

Table 2.154. Historical Fire Suppression Costs (2002-2012)

10 Year Historical Fire Suppression Cost	
Date	Cost
2002	$22,500,000.00
2003	$5,250,000.00
2004	$6,000,000.00
2005	$2,250,000.00
2006	$15,966,267.00
2007	$1,715,522.00
2008	$11,564,219.00
2009	$5,999,910.00
2010	$6,255,573.00
2011	$19,260,839.00
2012	$13,500,000.00
Total	**$110,262,330**
Average	**$10,023,848**

Adapted from Cost of Fire Suppression Chart from State Forestry Division

Additional information is available from New Mexico Forestry Division on the number of fires and acres burned on State and private land organized by County. See Figure 2.155 below for the 2012 data. Information is also available for the cause of fire organized by County. See Figure 2.156 below for the 2012 data. If this same data were available for several years, trends by County and Preparedness Area could be generalized.

Figure 2.155. Total Fires and Acres Burned by County for 2012

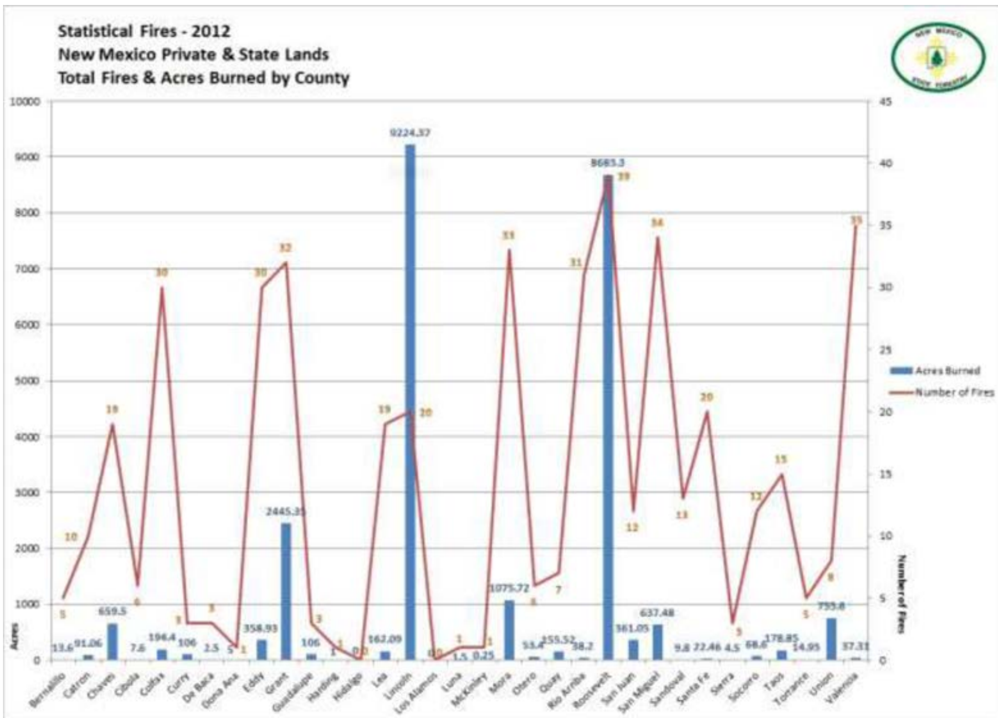


Figure 2.156. Total Fires and Acres Burned by County for 2012

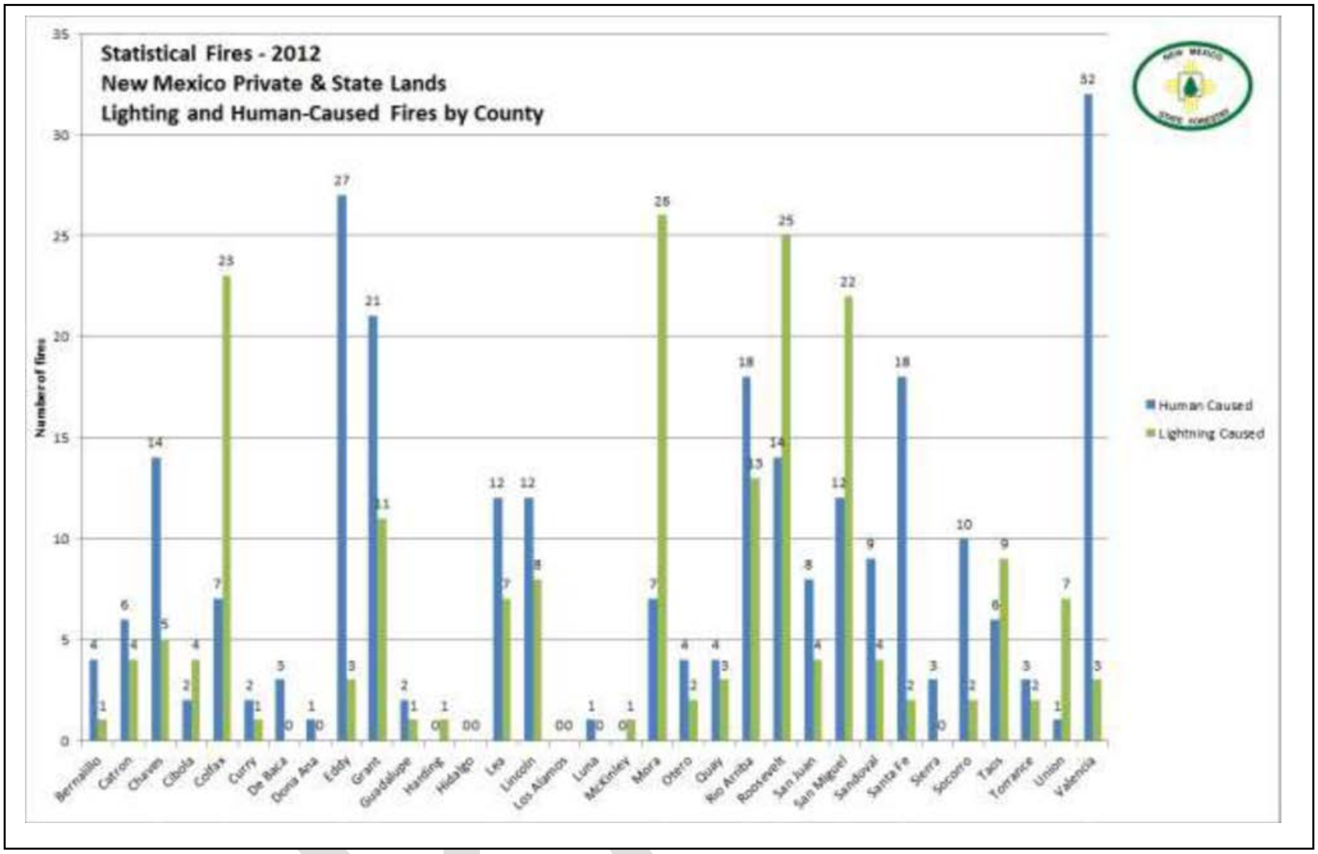


Figure 2.157. Track Fire, Raton (top and bottom), Little Lewis Fire, Cloudcroft (center)[116]

Probability of Occurrence

The threat of wildland/urban interface fires continues to be the number one natural hazard facing the state. Each Preparedness Area has experienced the effects of wildfire. The annual probability of a large fire event is 100%. There are hundreds of communities that are embedded in the forest, are surrounded by the forest, or have their major routes of egress surrounded by forest. This greatly increases the amount of people and infrastructure that are exposed to wildfire risks. With drought conditions persisting and more people locating their residences in the forest, it seems inevitable that all

[116] Source: Communities at Risk Assessment 2011, New Mexico Forestry Division.

Preparedness Areas will become more susceptible to fires occurring with increased consequences to the population, property, and natural resources.

Risk Assessment

Wildfires pose a significant threat to the citizens, structures, infrastructure, and natural resources within New Mexico. The US Forest Service estimates that approximately 942 thousand acres are in the New Mexican Wildland Urban Interface.

In 2012, the New Mexico Forestry Division updated the *Community at Risk Assessment Plan*, which ranks communities and tribal areas by how vulnerable they are to wildland-urban interface fires.[117]

The vulnerability criteria used to rank the communities include:

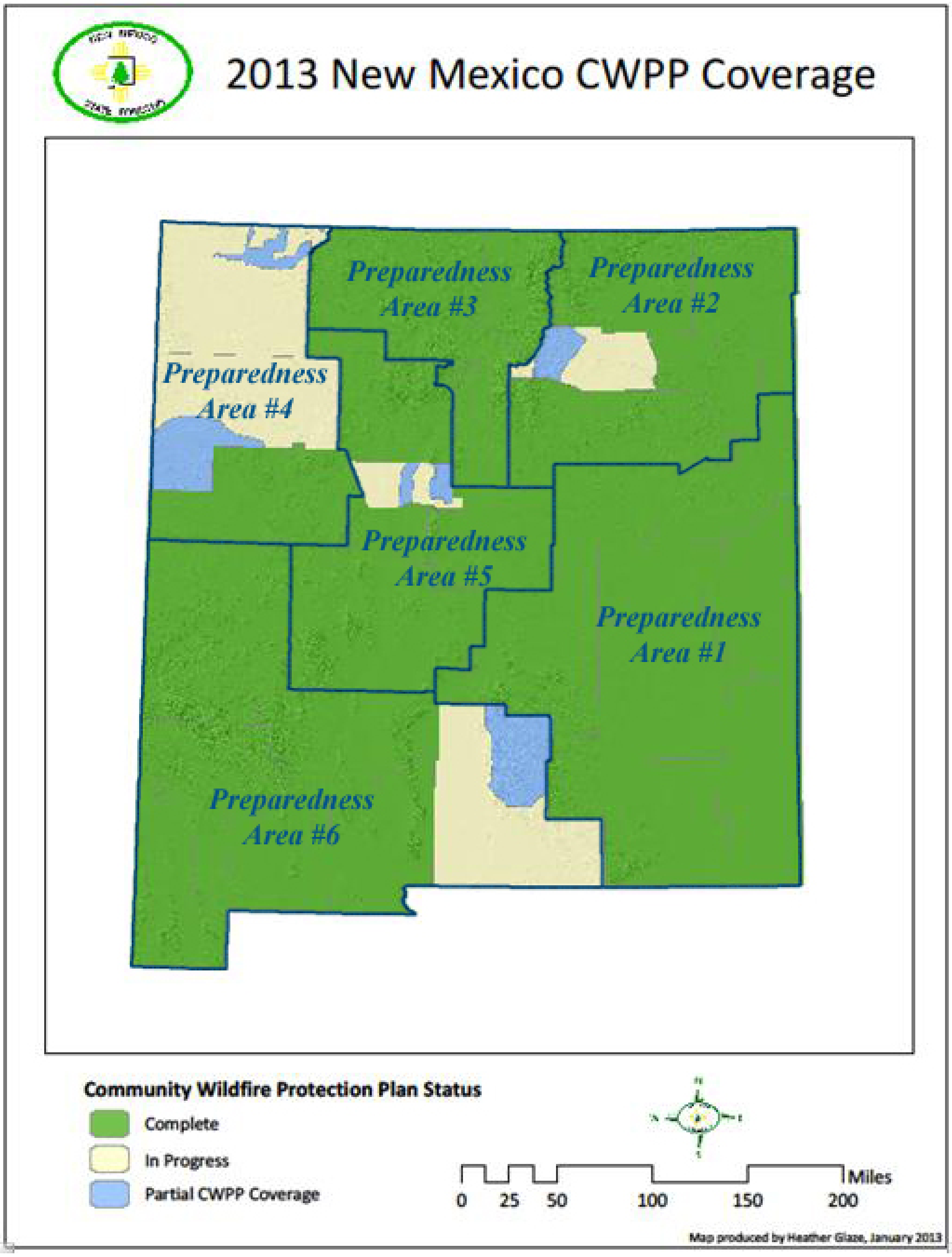
- Proximity of vegetation types to homes
- Availability of water
- Ease of evacuation
- Topography – ridge, valley, slope, and exposure
- Types of fuel (forest type)
- Number and size of previous fires
- Direction of prevailing and local winds in each community
- Ability of community/subdivision to protect homes

The number of Community Wildfire Protection Plans (CWPP) in New Mexico has increased since 2010. Currently, there are 58 CWPPs in the state. These 58 CWPPs identify 630 communities at risk from wildland fire. Of the 630 communities, 296 are listed as high risk, 224 are listed as moderate risk and 110 are listed as low risk from wildland fire. Figure 2.158 is a map showing the communities covered by a CWPP. A full listing of communities and their level of wildfire risk can be found in the *Community at Risk Assessment Plan*.

The New Mexico Fire Planning Task Force requires that CWPPs be updated within 5 years of adoption. A letter was sent to all CWPP participants to advise them of the updated requirements.

[117] The Plan can be found by visiting the following link: http://www.emnrd.state.nm.us/SFD/FireMgt/documents/2012_CAR_Planreduced.pdf

Figure 2.158. Community Wildfire Protection Plan Communities



Community Wildfire Protection Plan
Summary and Checklist[118]

Step One: Convene Decision Makers

• Form a core team made up of representatives from the appropriate local governments, local fire authority, and state agency responsible for forest management.

Step Two: Engage Interested Parties

• Contact and encourage active involvement in plan development from a broad range of interested organizations and stakeholders.
• Identify and engage local representatives of the USFS and BLM.
• Contact and involve other land management agencies as appropriate.

Step Three: Establish a Community Base Map

• Work with partners to establish a baseline map of the community that defines the community's WUI and displays inhabited areas at risk, forested areas that contain critical human infrastructure, and forest areas at risk for large-scale fire disturbance.

Step Four: Identify Problems to Be Addressed

• Work with partners to identify problems to be addressed, including fuel hazards; risk of wildfire occurrence; structural ignitability; local preparedness capability; and location of homes, businesses, essential infrastructure and other community values at risk.
• This "community risk assessment" can be simple or complex depending on the resources available to the community and partners.

Step Five: Establish Community Priorities and Recommendations

• Use the base map and community risk assessment to facilitate a collaborative community discussion that leads to the identification of local priorities for fuel treatment, reducing structural ignitability, and improving fire response capability.
• Clearly indicate whether priority projects are directly related to protection of communities and essential infrastructure or to reducing wildfire risks to other community values.

Step Six: Develop an Action Plan and Assessment Strategy

• Consider developing a detailed implementation strategy to accompany the CWPP, as well as a monitoring plan that will ensure its long-term success.

Step Seven: Complete the Community Wildfire Protection Plan

• Consider the CWPP complete for the year and date stamp the document.
• Communicate the results to the community and partners.
• Collect information to update the plan for revision the following year.

The Statewide Natural Resource Assessment & Strategy and Response Plans document produced by New Mexico State Forestry in June 2010 includes an analysis of wildfire risk. The map below shows the

[118] Adapted from "Preparing a Community Wildfire Protection Plan: A handbook for Wildland-Urban Interface Communities" by the New Mexico Fire Planning Task Force for use in New Mexico.

results of a GIS model. The document explains several data gaps that would need to be addressed in order to improve the wildfire risk map. The document also includes a more detailed wildfire risk analysis for each of the six State Forestry Districts.

In the next up-date of the State Mitigation Plan, additional GIS overlays will be available so that wildfire risk can be analyzed based on preparedness areas. Figure 2.158 displays the state wildfire risk model results by Preparedness Area.

Figure 2.158. Wildfire Risk Model Results[119]

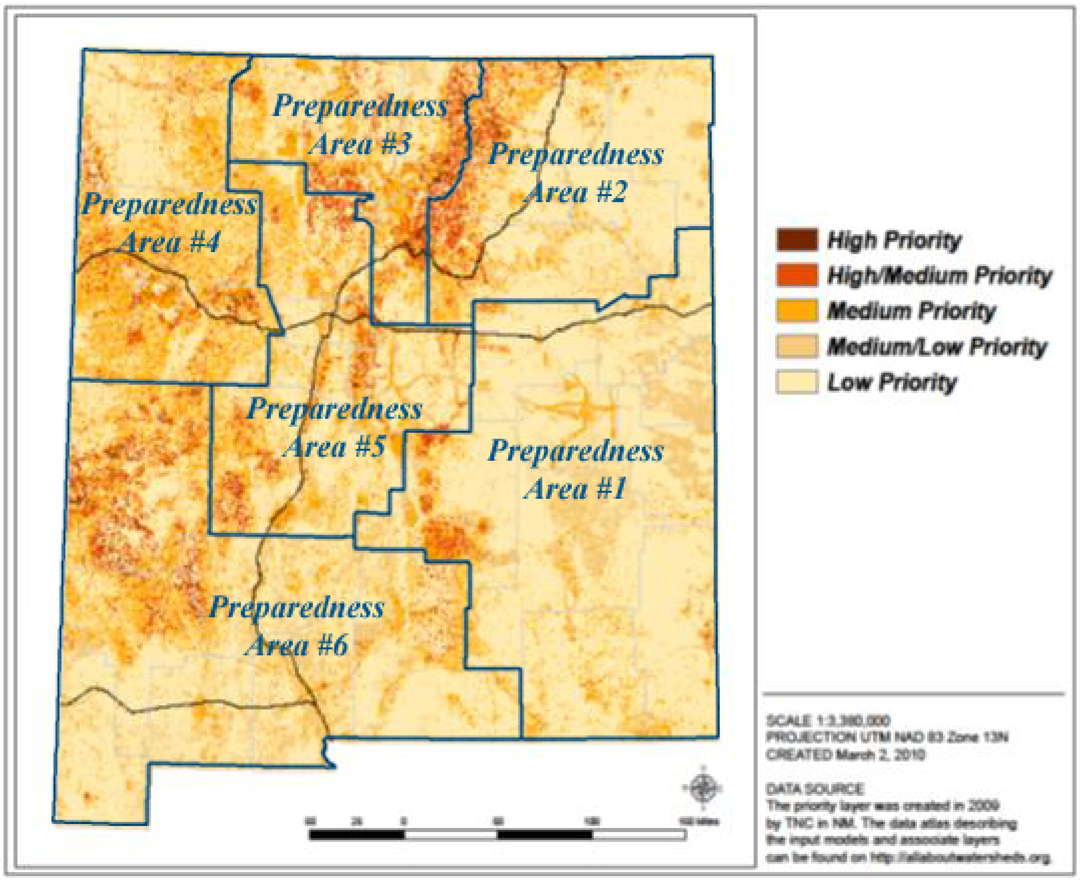


Table 2.159 identifies potential impacts from a wildland fire for the purposes of EMAP compliance.

[119] The US Forest Service developed a national-scale 2013 wildfire potential map. It is available for download at: http://www.firelab.org/fmi/data-products/229-wildland-fire-potential-wfp

Table 2.159. Potential Impacts from Wildland Fire

Subject	Potential Impacts
Health and Safety of the PUBLIC	The public is at risk to injuries from heat and smoke.
Health and Safety of RESPONDERS	Responders are at risk from heat exposure, burns, dehydration, smoke inhalation, etc.
CONTINUITY OF OPERATIONS	Those operations that are in or near the wildfire are may be shut down or even destroyed by the fire.
DELIVERY of SERVICES	Service delays are anticipated to operations within or near the fire areas.
PROPERTY, FACILITIES, INFRASTRUCTURE	Fire can cause damage or destruction of property and infrastructure. Infrastructure near the fire areas may be barricaded or restricted to use by responders
ENVIRONMENT	Fires can cause large areas to be denuded and plant life and subsequently animal life. These bare areas are susceptible to later erosion issues that can contaminate or fill waterways with contaminants or sediment. High temperature fires can cause the soils to be damaged, and plant recovery may be delayed.
ECONOMIC CONDITION	A wild fire can cause damages to residences and business in a community that can have lasting effects.
PUBLIC CONFIDENCE	Not impacted by the event itself, but may be damaged if the response to an event is poor.

Data Limitations

Because each agency and organization compiles data and maps using different reference points, it is difficult to collapse all of the information into one comprehensive map or listing. It would be very helpful to have all large fires and fires that threatened/damaged structures cataloged. It would also be helpful to have all damage estimates cataloged.

It would be helpful to have historical information on the number of fires and acres burned organized by County and information on the cause of fire organized by County. If data were available for several years, trends by County and Preparedness Area could be generalized. Ultimately, mitigation activities could be targeted at the highest risk communities.

It would also be helpful to have an analysis of burn scar areas and increased flood/debris flow maps. This type of analysis would enable wildfire and flood mitigation activities to target high risk areas.

What Can Be Mitigated?

Wildfires can be a significant threat to the citizens, structures, infrastructure, and natural resources within New Mexico. As a result, the Hazard Mitigation Team has identified the wildfire hazard as a priority in the Plan.

Mitigation options for wildland fire need to address not only the management of fuels, but also the potential for growing population in wildfire threat areas. The State Forestry Division has conducted a statewide assessment on forestry health and outlined mitigation efforts and priorities to reduce fuel loads and create more defensible space. More specific mitigation goals and actions are detailed in the Statewide Assessment, Strategy and Response Plans. A summary of the most relevant actions are included in the Mitigation Actions section of this Plan.

Based on statistical information about fire causation and occurrence, the trend has been that human caused fires cause more fires to occur and burn more acreage than natural caused fires. This trend offers a mitigation opportunity for education and outreach to reduce the number and acreage of fires in the State.

Conclusion

The hazard identification and risk assessment presented in this section was carried out using best available data and state-specific information. Based on guidance from FEMA's "How-to" document entitled *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA Publication 386-2), the assessment relies heavily on historical and anecdotal data, stakeholder input, and professional and experienced judgment regarding observed and/or anticipated hazard impacts. This hazard identification and risk assessment presents a reasonable range of hazards that have affected the state in the past. Additionally, it is likely that new hazards (or old hazards in new forms) will affect New Mexico in the future. To contribute the contextual relevance and accuracy of the plan the hazard identification and risk assessment carefully considers and incorporates the findings from other relevant plans, studies and technical reports.

SECTION 3 – CAPABILITIES AND RESOURCES

This capability and resource assessment section examines the ability of the state of New Mexico to implement and manage a comprehensive mitigation strategy, which includes a range of mitigation actions. The strengths, weaknesses and resources of partner agencies and jurisdictions are identified in this assessment as a means for developing an effective and appropriate hazard mitigation program. Additionally, the capabilities identified in this assessment have been evaluated collectively to develop recommendations that support the implementation of successful mitigation actions throughout the state.

This section identifies capabilities and resources related to: state-funded mitigation personnel; state policies and statutes related to mitigation activity; ongoing mitigation planning activity in the state; the Local Preparedness Program; Mitigation Grant Programs; and additional state and local capabilities related to the implementation of hazard mitigation activity in New Mexico. The assessment of capabilities and resources emphasizes accessible technical and financial resources available at the State and Federal levels.

State-Funded Mitigation Personnel

FEMA makes mitigation funding available through pre-disaster and post-disaster grant programs. There are no state-funded hazard mitigation grant programs. The state funds mitigation at DHSEM for salaries, benefits, and related support for the following:

- One State Hazard Mitigation Officer: 50% state, 50% federal grant
- One Floodplain Coordinator: 75% federal, 25% state FTE
- One Mitigation Specialist position: 100% Hazard Mitigation Grant Program Management Costs (This position has been approved, but not yet filled.). No State funding is required for this position.
- One half-time Grant Specialist: 50% of a full time staff person Hazard Mitigation Grant Program Management Costs (This position has been approved, but not yet filled.). No State funding is required for this position.

State Policies and Statutes Related to Mitigation Issues

Cornerstones of Emergency Management legislation in New Mexico are as follows:

1) 12-11-23 to -25, Emergency Powers Code, 2005, as amended: provides state funds to be expended for disaster relief for any disaster declared by the Governor that is beyond local control. Such funds may also be used as a match for federal disaster relief grants; and,

2) 12-10-2 to-5, NMSA 1978 as amended: The State Civil Emergency Preparedness Act. This Act establishes the basic structure of Emergency Management as a state agency and defines the role of local government in emergency preparedness.

Most policies that relate to mitigation are local initiatives and are not mandated by the state. The few state statues that relate to mitigation interests are detailed below.

72-5-32, NMSA as amended, give the Office of the State Engineer the responsibility to regulate dams and their appurtenances. The regulations governing dam design, construction and dam safety are included in Title 19, Chapter 25 Part 12 of the NMAC. These regulations require owners of dams that have the potential to cause loss of life and/or interruption of lifeline infrastructure to prepare and exercise an Emergency Action Plan (EAP). 19.25.12.18 of NMAC requires that the EAP be prepared through coordination with local emergency managers and that the plan be accepted by the responsible emergency managers prior to review by the State Engineer. These regulations require that the owner exercise the EAP and it is recommend that a functional exercise be carried out every five years with a tabletop exercise conducted two to three years before the functional exercise. Approximately 20% of dams in this category currently hold an approved EAP.

3-18-6, NMSA 1978 as amended: The state requires communities to designate special flood hazard areas and mudslide hazards: "A county or municipality shall designate flood plain areas having special flood or mudslide hazards in substantial conformity with areas identified as flood- or mudslide-prone by the federal insurance administration pursuant to the national flood insurance program." The DHSEM Floodplain Coordinator distributes information about NFIP and general floodplain issues and attempts to recruit non-participating communities into the NFIP program. NFIP communities have ordinances in place to comply with the various NFIP requirements, leading to mitigation of flood losses.

3-18-7, NMSA 1978 as amended describes additional county and municipal powers, flood and mudslide hazard areas, floodplain permits, land use control and jurisdiction agreements. The statute designates the New Mexico Department of Homeland Security and Emergency Management as the coordinating agency for Floodplain Management in the State of New Mexico. The Preparedness Bureau's State Floodplain Coordinator is responsible for the coordinating these activities. The State Floodplain Coordinator provides technical assistance to individual communities in order to promote floodplain management practices consistent with the intent of the National Flood Insurance Program. To this end, State officials work with NFIP communities to identify and resolve floodplain management issues before they result in an enforcement action by the Federal Emergency Management Agency.

3-17-7, 4-37-9.1, 72-14-3.2, 6-21-23, and 72-4A-7, NMSA 1978 as amended: All relate to the requirement for applicants for financial assistance from the New Mexico Finance Authority to submit water conservation plans with funding application, effective December 31, 2005. Water conservation plans help to mitigate drought.

74-6-2 and 74-6-4, NMSA 1978 as amended: Allows the use of up to 250 gallons per day of greywater for residential irrigation, subject to certain requirements. This reduces the consumer demand for potable water.

72-4A-2 through 72-4A-7, NMSA 1978 as amended: Allows Water Trust Board funds to be used for water conservation and water re-use activities. This serves to mitigate drought.

72-14-3.1, NMSA 1978 as amended: Directs the Interstate Stream Commission to prepare a comprehensive state water plan. This plan helps mitigate drought.

68-2-34, NMSA 1978 as amended: Creates the Fire Planning Task Force and outlines its duties. This serves to mitigate wildfire, especially in the Wildland/Urban Interface.

In addition, the state subscribes to and enforces the International Building Code, which requires that certain earthquake and wind-loading standards be met for specified categories of structures. Each county is responsible for monitoring its own development; the state does not have oversight on this. However, many counties rely on the State Construction Industries Division to permit structures.

Apart from those policies and statutes shown in Table 3.1, there are no other policies, laws or programs guiding mitigation in New Mexico. These policies were all in place prior to the 2004 mitigation plan; no changes have been made since that time.

Table 3.1. Evaluation of Policies and Statutes Related to Development

Policy/Statute	Effectiveness	Benefit
3-18-6	This statute is not particularly effective because there is no provision of a penalty for non-compliance.	This statute serves as evidence that the State Legislature believes floodplain regulation to be important; could ease the way into NFIP for communities that are contemplating NFIP.
3-18-7	This Statute provides effective floodplain management jurisdiction	This statute enhances NFIP compliance.
3-17-7 4-37-9.1 72-14-3.2 6-21-23 72-4A-7	This statute requires a water conservation plan as a co-requisite for receiving state funds from the NM Finance Authority and the water trust board for financial assistance in the construction of any water diversion, storage, conveyance, water treatment or wastewater treatment facility.	This statute serves to protect water users in time of drought and to clarify the need for drought contingency planning. The fact that the finance authority and water trust boards have issued tens of millions of dollars in loans shows that many jurisdictions are creating these plans.
74-6-2 to 74-6-4	The effectiveness of the legislation lies in the construction techniques of builders and the desire of homeowners to make retrofits. The statute does not require the installation of such systems. The fact that homeowners are not required to get state permits for installing such a system makes the process easier.	This statute serves to allow homeowners to use gray water for landscaping and gardening; therefore, it will conserve water through re-use in drought prone areas.
72-4A-2 to 72-4A-7	This statute allows funding to go to water conservation activities. Several projects around the state have been implemented that would not have been implemented had the funds not been available.	This statute serves to allow state funds from the water trust board to be used for water conservation and re-use activities, which had previously been prohibited. It will therefore promote water conservation in drought prone areas.
72-14-3.1	This statute is effective in planning for use of the state's limited water resource.	This statute requires a state plan to allocate the state's water resources and plan for future needs. It is beneficial to

		the entire state, which is facing drought conditions.
68-2-34	This statute is effective in bringing together representatives from a variety of state agencies that have a concern in the wildfire hazard.	This statute is beneficial in that the Fire Planning Task Force must identify areas of unusually high fire hazard and propose mitigation measures.
International Building Code	All new buildings in the state are required to meet or exceed the standards in the International Building Code or the International Residential building code. This code requires a certain level of protection be installed in new buildings, to protect against wind, snow loads, fires, earthquakes and other natural hazards.	This code represents a higher standard than was previously in effect, especially regarding earthquake and wind loading requirements for public buildings.

Mitigation Planning

Planning Grants: Having a FEMA approved Mitigation Plan is one of the eligibility requirements for a project to be funded under one of FEMA's mitigation grant programs. A list and map of approved mitigation plans in the State is shown in Figures 3.2 and 3.3.

For all presidential disasters declared after October 30, 2000:

- State mitigation plans must be developed that meet the regulations in CFR 44 Section 201.4
- local mitigation plans must be developed that meet the regulations in CFR 44 Section 201.6
- tribal mitigation plans must be developed that meet the regulations in CFR 44 Section 201.7

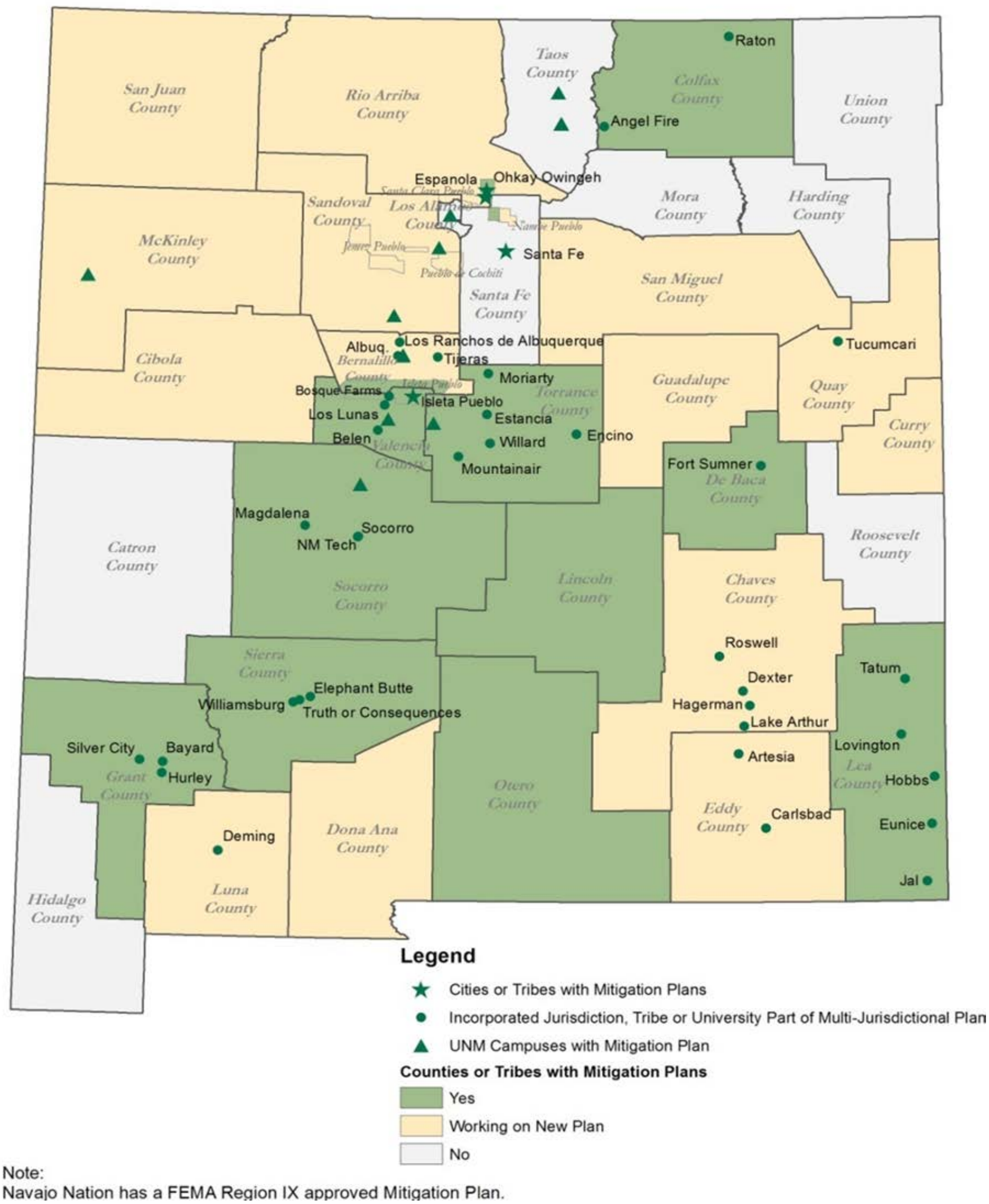
In general, mitigation plans include the following information:

- Public and private sector involvement in the planning process;
- Hazard Identification and Risk Assessment;
- A mitigation strategy that identifies mitigation goals, measures and priorities;
- A plan maintenance and review process; and
- Documentation that the governing body of the jurisdiction requesting approval of the plan has formally adopted the plan.

Figure 3.2. List of Approved Mitigation Plans as of December 31, 2013

Jurisdiction	County	Approval Date	Participating Jurisdictions
Colfax County	Colfax	3/10/2008	Colfax County, Angel Fire, Raton
De Baca County	De Baca	1/14/2008	De Baca County, Fort Sumner
Grant County	Grant	3/27/2008	Grant County, Silver City, Bayard, Hurley
Isleta Pueblo	Bernalillo	9/19/2012	Isleta Pueblo
Lea County	Lea County	6/6/2008	Lea County, Eunice, Hobbs, Jal, Lovington, Tatum
Lincoln County	Lincoln	10/22/2012	Lincoln County
Ohkay Owingeh	Rio Arriba	2/5/2008	Ohkay Owingeh
Otero County	Otero	11/21/2012	Otero County
Santa Fe, City of	Santa Fe	11/21/2008	Santa Fe (City of)
Sierra County	Sierra	6/15/2012	Elephant Butte, Sierra County, Truth or Consequences, Williamsburg
Socorro County with NM Tech	Socorro	9/29/2011	Village of Magdalena, New Mexico Tech, Socorro County, Socorro (City of)
Torrance County	Torrance	1/11/2008	Torrance County, Estancia, Encino, Moriarty, Mountainair, Willard
University of New Mexico	Bernalillo	12/20/2010	UNM Campuses
Valencia County	Valencia	5/15/2008	Valencia County, Belen, Los Lunas, Bosque Farms

Figure 3.3. Map of Approved Mitigation Plans as of December 31, 2013



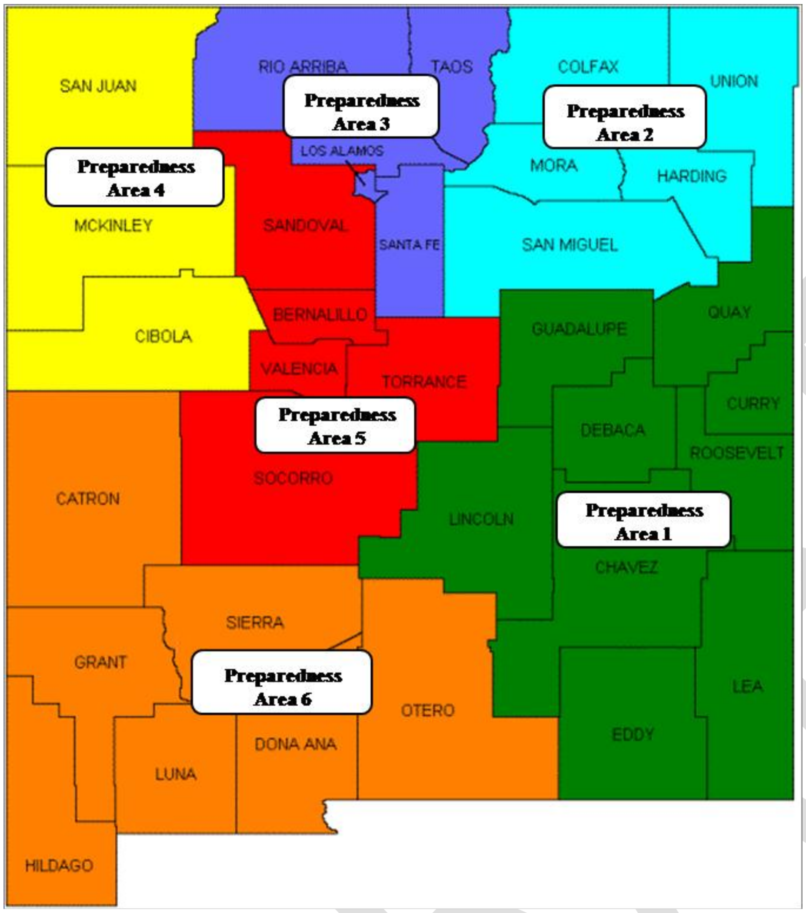
Local Preparedness Area Program

The purpose of the New Mexico Department of Homeland Security and Emergency Management's Local Preparedness Program is to provide technical assistance for Local Emergency Management Programs. This is achieved through a continuous cycle of planning, training, equipping, exercising, evaluating and taking action to correct and mitigate. Primarily, Local Preparedness Coordinators provide technical assistance for the following activities;

- Mitigation planning and project grant tracking and coordination liaison between the local communities, tribes and State Hazard Mitigation Officer;
- Dissemination of relevant mitigation planning and project reference material;
- Capability development based on emergency management shortfalls;
- National Incident Management System compliance for local jurisdictions;
- Planning, training and exercise grant applications, statements of work, and performance reporting;
- Exercise design, assessments and after action reports/improvement plans;
- Training and exercise needs assessments and coordination with DSHEM Training and Exercise Officers; and
- Development of emergency operations plans.

Each Local Preparedness Coordinator is assigned to one of the six DSHEM Preparedness Areas across the State (Figure 3.4). A listing of the tribal entities located in each Preparedness Area is provided in the Planning Process section of the Plan.

Figure 3.4. Map of New Mexico State Preparedness Areas



Mitigation Grant Programs

The state does not have any pre- or post-disaster mitigation grant programs or funding of its own. The State relies exclusively upon federal mitigation grant programs available through the Federal Emergency Management Agency to fund mitigation projects. There are no state or local funding sources for mitigation projects. Local jurisdictions may pursue outside funding sources at their discretion.[120]

The State of New Mexico Department of Homeland Security and Emergency Management acts as the grantee for five FEMA mitigation grant programs, evaluates and recommends projects to FEMA for funding, and passes federal grant funds through to sub-grantees (municipal government, county government, state government and tribal entities). The non-federal share is usually borne by the applicant for mitigation grants. Sub-applicants may meet their match by cash, in-kind services, or a combination of the two. Future funding of all federal grants depends upon continued funding by Congress. Apart from meeting the requirements of federal programs and technical assistance, DHSEM has limited mitigation capability.

[120] Additional resources for mitigation planning and funding are available on the FEMA website: http://www.fema.gov/hazard-mitigation-planning-resources#3

The following is a description of the three FEMA mitigation grant programs that New Mexico Communities have utilized.

- Hazard Mitigation Grant Program (risk reduction for all natural hazard types)
- Pre-disaster Mitigation Program (risk reduction for all natural hazard types)
- Flood Mitigation Assistance Program (flood risk reduction only).

There are two other FEMA flood mitigation grant programs that have not been utilized by New Mexico communities (Repetitive Loss and Severe Repetitive Loss). To date, there are no Severe Repetitive Loss structures in the State (more information on repetitive loss structures is found in the flood hazard identification section of this plan).

The New Mexico SHMP will provide information to all potential applicants across the state announcing the availability of HMGP, giving program details, explaining the application process, general program eligibility, key deadlines and references to the State's mitigation web page for more information.

Additionally, the SHMO will review submitted mitigation applications consulting with the State Coordinating Officer (SCO), state and federal agencies as needed. All project requirements must meet the minimum requirements of 44 CFR 206.434 (b) and 44 CFR 206.435 (b). The New Mexico SHMO will prioritize proposed projects based upon priorities established in the State Hazard Mitigation Plan, although other factors may be considered. Those factors include, but are not limited to:

- Is the project likely to limit loss and prevent harm to human life and property?
- Does the project constitute a long-term solution to a well-defined problem?
- Does the project demonstrate a favorable cost/benefit ratio?
- Is the applicant committed to maintenance of the project for the life of the project?
- Is the project environmentally sound?
- Is the project technically feasible?
- Is the project socially acceptable?
- Is the project politically acceptable?
- Is the project legal?
- Does the project reflect repetitive loss properties?

  Is the applicant a community with intense development pressure?

As of December 2012, the Hazard Mitigation Assistance Unified Guidance (March 2010) provides the most recent information on all five FEMA mitigation grant programs. It is anticipated that new guidance will be provided in 2013 which will likely combine the three flood mitigation grant programs.

Hazard Mitigation Grant Program

Section 404 of the Robert T. Stafford Disaster Relief Emergency Assistance Act created the Hazard Mitigation Grant Program (HMGP) in November 1988. The HMGP assists states and local communities in implementing long-term hazard mitigation measures following a major disaster declaration. The grant is a cost-share of 75% federal share and 25% non-federal share. On October 30, 2000, the Robert T. Stafford Disaster Relief and Emergency Assistance Act was amended by Public Law 106-390 and is referred to as the Disaster Mitigation Act of 2000 (DMA2K). The State administers the Hazard Mitigation Grant Program and is responsible for selecting projects for funding from the applications submitted by communities. The State then forwards selected applications to FEMA for an eligibility determination.

Objectives of the Hazard Mitigation Grant Program are;

- To prevent future losses of lives and property due to disasters;
- To implement state or local Hazard Mitigation plans;
- To enable mitigation measures to be implemented during immediate recovery from a disaster; and
- To provide funding for previously identified mitigation measures that benefit the disaster area.

How does the Hazard Mitigation Grant Program differ from mitigation funded under the Public Assistance Program?

The Hazard Mitigation Grant Program can fund mitigation measures to protect public or private property, so long as these measures fit within the overall mitigation strategy for the disaster area, and comply with program guidelines. The Hazard Mitigation Grant Program can be used to fund mitigation measures State-wide (not only in communities identified for federal assistance in the presidential disaster declaration to repair damaged public facilities). The Hazard Mitigation Grant Program can be used for any natural hazard risk reduction activity, not only the natural hazard that caused the presidential disaster declaration. Hazard Mitigation Grant Program funds can be used to prepare a local, State or tribal mitigation plan. A FEMA approved Mitigation Plan is one of the eligibility requirements for the Hazard Mitigation Grant Program.

HMGP derives its funding from a percentage of the eligible damages under a Stafford Act Disaster Declaration in which Public Assistance (PA) and/or Individual Assistance (IA) were authorized. The HMGP funding formula is an additional 15% of total disaster grants.

For public property damaged in the presidentially declared disaster, it is appropriate to consider funding mitigation measures under Public Assistance ("Section 406" of the Stafford Act) before applying for Hazard Mitigation Grant Program funding ("Section 404" of the Stafford Act). Public Assistance funds allow a sub-applicant to add mitigation measures to the design of a pre-existing damaged facility, if measures are cost-effective or are required by code. Mitigation funded under Public Assistance is only for public facilities damaged by the presidentially declared disaster. 406 Mitigation allows improvements or modifications to eligible PA projects, such as increasing culvert size. These mitigation actions must be cost-effective in reducing future disaster losses without creating a new footprint.

Applicant Eligibility: Applicant eligibility is the same for the Hazard Mitigation Grant Program as it is for the Public Assistance Program. New Mexico applicants eligible for the Hazard Mitigation Grant Program are:

- State and local governments;
- Certain private non-profit organizations or institutions; and
- Indian tribes or authorized tribal organizations

Grant Types: Two types of grants are available under the Hazard Mitigation Grant Program;

- Planning Grants are grants to States and communities to develop or upgrade their natural hazard mitigation plan. Hazard Mitigation Grant Program funds can be used to prepare a local, State or tribal mitigation plan.
-
- Project Grants are grants to States and communities to implement measures to reduce risk from natural disasters. Project grants can also be used for natural hazard risk reduction education and outreach.

Project grants: A project must, at a minimum, be:

- Cost Effective
- Comply with environmental and historic preservation regulations
- Technically feasible
- Within a jurisdiction or tribal entity boundary that has a FEMA approved mitigation plan.
- All applicants must be participating in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area (a Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) has been issued).
- The community must not be suspended or on probation from the NFIP

The Hazard Mitigation Grant Program can be used to fund any type of natural hazard mitigation activity including projects to protect either public or private property. Examples of projects include:

- Minor localized flood control projects;
- Wildfire hazardous fuel reduction and defensible space;
- Elevation or acquisition of structures from hazard-prone areas;
- Structural and non-structural retrofitting to protect structures from future damage;
- Safe room construction
- Code enforcement and
- 5% initiative projects that are not required to provide a positive benefit cost ratio (examples include outreach, education, warning sirens, generators, etc.)

In New Mexico, the Hazard Mitigation Grant Program assists State and local communities in implementing long-term hazard mitigation measures after a major disaster declaration. Taking action to mitigate the causes of damage immediately after a disaster occurs can significantly reduce future flood damages. Hazard Mitigation Grant Program mobilizes financial and technical assistance in the aftermath of disasters – exactly the time when citizens and local elected officials are most receptive to undertaking projects and initiatives that reduce the impacts of future disasters.

How the Hazard Mitigation Grant Program Works: The State serves as the grantee and program administrator for the Hazard Mitigation Grant Program. The State:

- Sets mitigation priorities
- Provides technical assistance to communities applying for the Hazard Mitigation Grant Program funds.
- Evaluates grant applications based on minimum eligibility criteria and State priorities
- Works with FEMA to approve planning and project grants
- Awards planning and project sub-grants to applicants
- Ensures that all community applicants are aware of their grant management responsibilities

Cost Share and Funding Limits: FEMA may contribute up to 75% of the total eligible costs. At least 25% of the total eligible costs must be provided by a non-federal source. In-kind and cash contributions can be used for the non-federal share.

A list of recent projects funded through Hazard Mitigation Grant Program is found in Figure 3.5 below.

Figure 3.5. History of Awards of Hazard Mitigation Grant Program Funds in New Mexico

Disaster	Year	Approx. $ available	Grantee or Sub-Grantee	Approximate Federal Share	Project Description
945	1992	$80,000	Hobbs	$80,000	Drainage Study
992	1993	$211,000	Silver City	$211,000	Road Drainage Improvements
1202	1998	$290,000	Lovington	$13,000	Warning System
			Hobbs	$278,000	Buy-outs
1301	1999	$240,000	Eddy County	$16,000	NOAA Radio and Lightning Protection
			Zuni Pueblo	$224,000	Flood Protection
1329	2000	$2,299,000	EMNRD	$50,000	Video
			Santa Fe	$40,000	Phone Alert System
			SSCAFCA	$20,000	Precipitation Monitors
			Angel Fire	$175,000	Fuel Reduction
			Ruidoso	$502,000	Fuel Reduction
			Las Vegas	$463,000	Fuel Reduction
			Rio Rancho	$473,000	Two Drainage Improvements
			Hobbs	$576,000	Drainage Improvements
1514	2004	$408,000	Taos County	$41,000	Mitigation Plan
1659	2006	$2,400,000	Pueblo of Isleta	$45,000	Mitigation Plan
1690	2007	$147,570		0	0
1783	2008	$2,120,980	Dona Ana County	$67,500	Mitigation Plan
			Santa Fe City	$34,140	Mitigation Plan
1936	2010	$1,376,350	Chaves County	$18,000	Mitigation Plan
			De Baca County	$22,500	Mitigation Plan
			Santa Clara Pueblo	$30,000	Mitigation Plan
			NM DHSEM	$68,819	Wildfire Public Service Radio Announcements
			Farmington	$55,301 Phase I	Porter Arroyo Detention Basin Phase II not yet awarded
1962	2011	$265,070	Cibola County	$15,000	Mitigation Plan
			Cibola County	Not yet awarded	Low Water Crossing
4047	2011	$4,077,400	Alamogordo	$28,367	Mitigation Plan
			Cochiti Pueblo	$28,880	Mitigation Plan
			Lea County	$22,500	Mitigation Plan
			Rio Arriba County	$33,750	Mitigation Plan
			Ruidoso	Not yet awarded	Mitigation Plan
			San Juan County	$33,750	Mitigation Plan
			NM DHSEM	$30,000	State Mitigation Plan
			Grants, City of	Not yet awarded	Bridge Re-design/installation
			Lincoln County	Not yet awarded	Wildfire Thinning
			Sierra County	Not yet awarded	Stream Gauges/Warning Signs
			SSCAFCA	Not yet awarded	Bank Stabilization
			SSCAFCA	Not yet awarded	Drainage Improvements

			SSCAFCA	Not yet awarded	Arroyo Safety Education/Outreach
4079	2012	$7,200,000	*Application*	*period closes*	*August 2013*

FEMA-DR-945 was a flood event in Lea County and Hobbs in 1992. The City of Hobbs used all of the available HMGP funding for a comprehensive city-wide drainage study (note; this would not be an eligible activity under the current HMGP).

FEMA-DR-992 was a flood event in 1993 along the Gila, San Francisco and Mimbres Rivers in southwestern New Mexico. The Town of Silver City used the HMGP funding for two structural drainage improvement projects.

Between FEMA-DR-992 and FEMA-DR-1202, the HMGP funding formula changed to 75% federal share and 25% non-federal share.

FEMA-DR-1202 was a record-breaking winter storm that affected much of eastern New Mexico in January of 1998. The resulting HMGP funding went to Lovington for purchase and installation of a tornado warning system and to Hobbs for the buy-out of certain properties subject to repetitive flood loss.

FEMA-DR-1301 in 1999 was a flood event that affected several counties, from Doña Ana in the south to San Juan in the northwest. That HMGP funding went to Eddy County for purchase and installation of a NOAA weather repeater in Artesia and for lightning protection for a new emergency communications tower, (the project was later withdrawn). Funding also went to Zuni Pueblo to provide structural flood protection for their Senior Citizen's Center, which is subject to repetitive flood loss.

FEMA-DR-1329 in 2000, known as the Cerro Grande Disaster, provided ample funding for numerous HMGP projects. These were: (1) the production of a wildfire mitigation video by the Forestry Division, EMNRD; (2) the purchase and installation of a telephone alert system by the City of Santa Fe; (3) the creation of a precipitation monitoring system for use in the area of Rio Rancho and Corrales by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA); (4) fuel reduction projects within the jurisdictions of Angel Fire, Ruidoso, and Las Vegas; and (5) structural drainage improvement project for Hobbs.

FEMA-DR-1514 in 2004, a flood event in Eddy, Bernalillo, Mora, and San Miguel Counties, generated approximately $408,000 in HMGP funds. Several Applications were made. A mitigation plan for Taos County was funded from this grant and was subsequently de-obligated at the request of the County.

FEMA-DR-1659 in 2006, a flood event covering 19 counties in the state generated over $2.4 million in HMGP funds. Pueblo of Isleta was awarded $45,000 for mitigation planning. The Pueblo of Isleta Mitigation Plan was approved in September 2012. As part of FEMA-1659, the Pueblo of Jemez was awarded $31,500. However, they chose to de-obligate in the spring of 2010.

FEMA-DR-1690 was declared for severe storms and flooding. There were no mitigation plans or projects funded by Hazard Mitigation Grant Program. However, $147,570 was available in funding.

FEMA-DR-1783 was declared for severe storms and flooding that resulted in $2,120,980 for the Hazard Mitigation Grant Program. Dona Ana County and the City of Santa Fe were awarded mitigation planning grants in the amount of $67,500 and $34,140 respectively. Both planning efforts are underway and plans are expected to receive approval in 2013. The Dona Ana County Mitigation Plan is a multi-jurisdictional effort that includes eight communities and entities.

FEMA-DR-1936 was declared for severe storms and flooding that resulted in $1,376,350 for the Hazard Mitigation Grant Program. Four mitigation plans were funded totaling $70,500 (Chaves County, De Baca County and Santa Clara Pueblo). Phase I of a flood mitigation detention pond project was funded for the City of Farmington. At the end of the Phase I tasks, if the project is confirmed to be eligible, FEMA will award Phase II funding. Also as part of FEMA-DR-1936-HMGP, DHSEM utilized approximately $68,800 for wildfire mitigation public service announcements on radio stations state-wide. The radio announcements will run for a three year period.

FEMA-DR-1962 was declared for severe winter storm and extreme cold that resulted in $265,070 for the Hazard Mitigation Grant Program. One mitigation plan was funded for Cibola County for $15,000. Cibola County submitted an application for a low water crossing. When all eligibility criteria are met, FEMA will award funding.

FEMA-DR-4047 was declared for flooding that resulted in $4,077,400 for the Hazard Mitigation Grant Program. Five local mitigation plans were funded totaling approximately $147,240 (Alamogordo, Cochiti Pueblo, Lea County, Rio Arriba County and San Juan County). DHSEM utilized $30,000 for assistance with this State Mitigation Plan up-date. Applications for six projects and one more plan were received prior to the application deadline of May 2013.

FEMA-DR-4079 was declared for flooding that has resulted in approximately $7,198,900 to date for the Hazard Mitigation Grant Program. The 12-month lock-in figure will be provided in the fall of 2013 and will determine the final amount of funding available for FEMA-DR-4079-HMGP. The application deadline line is currently August 21, 2013 although DHSEM will request a three-month extension.

Evaluation of Hazard Mitigation Grant Program (HMGP)

HMGP has been the most effective of the mitigation grant programs for mitigation projects for the State. The effectiveness of HMGP projects is not known until disaster events occur which challenge their design and function. Even then, if a mitigation project is successful, the disaster will probably have been averted, and it will not be possible to determine with certainty what would have happened had the project not been done.

The benefit of this grant program is that applicants will be able to carry out mitigation projects and up-date mitigation plans. However, the limitation of this grant program is that funding is only made available through a presidential disaster declaration and thus is not a reliable consistent funding source.

To date, tracking, follow-up and documentation of success have not been accomplished. Tracking function and effectiveness of mitigation projects funded through FEMA's mitigation programs will be one of the mitigation actions listed in this Plan.

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) Program was authorized by Section 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 USC, as amended by Section 102 of the Disaster Mitigation Act of 2000. Funding for the program has been provided through the National Pre-Disaster Mitigation Fund to assist States, local governments and tribal entities in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. The Pre-Disaster Mitigation Program is a nationally competitive funding source. At one point each State had a $500,000 set-aside, however, that figure has been modified over time based on the available funding.

As of December 2012, there have been proposed modifications to the Pre-Disaster Mitigation grant program. The amount of funding is allocated by congress each federal fiscal year. No funds had been awarded for federal fiscal year 2013. However, it is anticipated that funding will be allocated for federal fiscal year 2014 and that up-dated guidance will be released in the summer of 2013.

Applicant Eligibility: Applicant eligibility is the same for the Pre-Disaster Mitigation Program as it is for the Hazard Mitigation Grant Program. New Mexico applicants eligible for the Pre-Disaster Mitigation Program are:

- State and local governments;
- Certain private non-profit organizations or institutions; and
- Indian tribes or authorized tribal organizations

Grant Types: Two types of grants are available under the Pre-Disaster Mitigation Program;

- Planning Grants are grants to States and communities to develop or upgrade their natural hazard mitigation plans. Similar to the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program funds can be used to prepare a local, State or tribal mitigation plan.
- Project Grants are grants to States and communities to implement measures to reduce risk from natural disasters. Pre-Disaster Mitigation Program project grants can only be used for education and outreach associated with a specific natural hazard risk reduction project.

Project grants: A project must, at a minimum, be:

- Cost Effective
- Comply with environmental and historic preservation regulations
- Technically feasible
- Within a jurisdiction or tribal entity boundary that has a FEMA approved mitigation plan.
- All applicants must be participating in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area (a Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) has been issued).
- The community must not be suspended or on probation from the NFIP

The Pre-Disaster Mitigation Program can be used to fund any type of natural hazard mitigation activity including projects to protect either public or private property. Examples of projects include:

- Minor localized flood control projects;
- Wildfire hazardous fuel reduction and defensible space;
- Elevation or acquisition of structures from hazard-prone areas;
- Structural and non-structural retrofitting to protect structures from future damage; and

- Safe room construction.

How the Pre-Disaster Mitigation Program Works: The State serves as the grantee and program administrator for the Hazard Mitigation Grant Program. The State:

- Sets mitigation priorities
- Provides technical assistance to communities applying for the Hazard Mitigation Grant Program funds.
- Evaluates grant applications based on minimum eligibility criteria and State priorities
- Works with FEMA to approve planning and project grants
- Awards planning and project sub-grants to applicants
- Ensures that all community applicants are aware of their grant management responsibilities

Cost Share and Funding Limits: FEMA may contribute up to 75% of the total eligible costs. At least 25% of the total eligible costs must be provided by a non-federal source. In-kind and cash contributions can be used for the non-federal share.

A list of recent projects funded through the Pre-disaster Mitigation grant program is found in Figure 3.6 below.

Figure 3.6. History of Awards of Pre-disaster Mitigation Funds in New Mexico

Year	Sub-Grantee	Approximate Federal Share	Project Description
2002	State Emergency Management	$9,000	training
	State Emergency Management	$41,000	State Mitigation Plan
	17 communities		Mitigation Plans
	State Emergency Management	$2,662	Administrative costs
2003	Bernalillo County		Multi-jurisdictional Mitigation Plan
	3 communities		Mitigation Plans
	State Emergency Management		State Mitigation Plan
2004	Torrance County		Multi-jurisdictional Mitigation Plan
2007	New Mexico Tech	$65,105	Multi-jurisdictional Mitigation Plan for Socorro County
	Otero County	$30,000	Mitigation Plan
	University of New Mexico	$185,156	Mitigation Plan
	Sierra County	$20,000	Multi-jurisdictional Mitigation Plan
	Lincoln County	$29,000	Mitigation Plan
2008	Nambe Pueblo	$33,750	Mitigation Plan
2010	San Miguel County	$98,038	Mitigation Plan
2012	Valencia County	$36,000	Multi-jurisdictional Mitigation Plan
	McKinley County	$21,908	Multi-jurisdictional Mitigation Plan
	Bernalillo County	$43,095	Multi-jurisdictional Mitigation Plan
	Luna County	$35,625	Multi-jurisdictional Mitigation Plan
	Guadalupe County	$40,000	Multi-jurisdictional Mitigation Plan
	Curry County	$30,000	Multi-jurisdictional Mitigation Plan

In FY 2002, FEMA granted each state $50,000 to initiate the new mitigation planning process. That funding was 100% federal. The state used $9,000 to contract training for local mitigation planners, and $41,000 for assisting with the new State Hazard Mitigation Plan. The training effort was effective in training more than 20 local jurisdictions in the processes and practices used in local mitigation planning. This was a direct benefit to local jurisdictions, all of which are faced with the need to produce a DMA2K-compliant mitigation plan. The State also benefited by hiring a skilled contractor to present the training.

In FY 2002, FEMA allocated $293,031 to New Mexico in PDM Planning Grant funds. There was no funding for construction projects. Subsequently, the state divided this amount among the 17 jurisdictions that applied for it and withheld $2,662 for administrative costs related to the grant. The PDM grant was effective in assisting local jurisdictions in their planning effort, many of which hired contractors to assist them with the work. They would not have had the ability to carry out the planning effort without this funding. The effectiveness of dividing this funding among 17 jurisdictions can be debated. It is possible that the funding could have been more effective if a larger grant had been made to fewer jurisdictions. This is one of the difficulties in apportioning grant funding.

In FY 2003, FEMA allocated $248,375 to New Mexico for PDM Planning Grants. The state granted a significant portion of this funding to one jurisdiction, Albuquerque- Bernalillo County, which contains the bulk of the state population. The remainder was awarded to three other jurisdictions. The state retained a portion of the PDM funding to assist with writing the state's DMA2K-compliant mitigation plan.

Again, in FY 2004, FEMA allocated $131.5 million nationwide for PDM Grants to be used for either construction or planning projects. FEMA did not allocate any funding to individual states; all applications were evaluated competitively. DHSEM solicited applications statewide for this funding, and subsequently submitted four applications to FEMA, totaling just over $894,000. All of the projects submitted were in accord with mitigation priorities identified in the draft State Hazard Mitigation Plan. Only one PDM grant from New Mexico was funded, which was for mitigation planning in Torrance County. A side benefit was that FEMA used their new E-Grant application system for the first time for this grant, and both state and applicants learned this new method. In FY 2004, Torrance County's mitigation plan was funded with PDM money.

The FY 2005 application was for a drainage project for Carlsbad. This application was rejected. New Mexico's FY 2006 application was for funding for updating the state mitigation plan. This too, was denied.

In FY 2007, FEMA allocated a $500,000 set aside for each state. DHSEM solicited applications statewide for this funding, and subsequently submitted seven applications to FEMA, totaling just over $643,000. Five of our applications were for mitigation plans, and the other two were for drainage projects. Only the plan applications were selected as recipients for this grant. New Mexico Tech served as the sub-grantee for the Multi-jurisdictional Multi-hazard Socorro County Mitigation Plan. The Plan was approved September 2011. The Otero County Mitigation Plan is a single jurisdictional plan and was approved in November 2012. The University of New Mexico Mitigation Plan covers all campuses state-wide and was approved in December 2010. The Sierra County Mitigation Plan was a Multi-jurisdictional Plan and was approved in June 2012. The Lincoln County Mitigation Plan is a single jurisdictional plan and was approved in October 2012.

2008 Pre-disaster Mitigation funded one mitigation plan for Nambe Pueblo. This plan is still under development and is expected to be approved by August 2013.

2010 Legislative Pre-disaster Mitigation provided $400,000 to San Miguel County. The County has received a sub-grant in the amount of $98,038 to fund a Multi-jurisdictional Multi-Hazard Mitigation Plan. The Plan is under development.

2012 Pre-disaster Mitigation funded six multi-jurisdictional county mitigation plans. All six plans are under development.

Evaluation of Pre-Disaster Mitigation (PDM) Grant Program

Pre-disaster Mitigation funding has been used only for mitigation planning in the State. The effectiveness of the plans is evidenced by local communities and tribes up-dating their plans every five years. The up-dates summarize what actions have been taken, are under-way or are not yet implemented.

The benefit of this grant program is that applicants can get mitigation plans created or up-dated so that they can reduce the impact of future natural disasters. However, the limitation of this grant program is that funding has been competitive on a national scale. Our small communities and mostly rural state make it difficult to out-compete larger communities with higher population, higher structural/infrastructure damage and greater ability to cost share.

To date, tracking, follow-up and documentation of success have not been accomplished. Tracking function and effectiveness of mitigation projects funded through FEMA's mitigation programs will be one of the mitigation actions listed in this Plan.

Flood Mitigation Assistance

The Flood Mitigation Assistance program is made available to states on an annual basis. The Flood Mitigation Assistance program provides grants to communities for projects that reduce the risk of flood damage to structures that have National Flood Insurance Program coverage. This funding is available for flood mitigation planning and implementation of flood mitigation measures. A state administers the Flood Mitigation Assistance program and is responsible for selecting projects for funding from the applications submitted by communities. The State then forwards selected applications to FEMA for an eligibility determination. Flood Mitigation Assistance was created as part of the National Flood Insurance Reform ACT of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. Flood Mitigation Assistance is considered a pre-disaster mitigation grant program.

Applicant Eligibility: Any State agency, participating NFIP community or qualified local organization is eligible to participate in Flood Mitigation Assistance. Communities that are suspended or are on probation from the NFIP are ineligible. Although individuals cannot apply directly for Flood Mitigation Assistance funds, a local government may submit an application on their behalf.

Grant Types: Two types of grants are available under Flood Mitigation Assistance;

- Planning Grants are grants to States and communities to develop or upgrade flood mitigation plans and
- Project Grants are grants to States and communities to implement measures to reduce flood losses.

Planning: Planning is the foundation of Federal flood mitigation assistance. FEMA encourages communities to identify ways to reduce their risk of flood damage by preparing Flood Mitigation Plans. Approved plans make a community eligible to apply for Flood Mitigation Assistance project grants. Plans must assess flood risk and identify actions to reduce that risk.

Project grants: A project must, at a minimum, be:

- Cost Effective
- Cost beneficial to the National Flood Insurance Fund
- Technically feasible
- Physically located in a participating NFIP community or must reduce future flood damages in a NFIP community

A project must also conform with:

- The minimum standards of the NFIP Floodplain Management Regulations
- The applicant's Flood Mitigation Plan
- All applicable laws and regulations, such as Federal and State environmental standards or local building codes

Examples of Eligible Projects: Projects that reduce the risk of flood damage to structures insurable under the National Flood Insurance Program (NFIP) are eligible. Such activities include:

- Minor localized flood control projects;
- Elevation or acquisition of structures from flood-prone areas; and
- Dry flood proofing

Cost Share and Funding Limits: FEMA may contribute up to 75 percent of the total eligible costs. At least 25 percent of the total eligible costs must be provided by a nonfederal source. Of this 25 percent, no more than half can be provided as in-kind contributions from third parties.

How Flood Mitigation Assistance Works: The State serves as the grantee and program administrator for the Flood Mitigation Assistance. The State:

- Sets mitigation priorities.
- Provides technical assistance to communities applying for FMA funds.
- Evaluates grant applications based on minimum eligibility criteria and State priorities.
- Awards planning grants for flood mitigation only
- Works with FEMA to approve projects and award funds to communities.
- Ensures that all community applicants are aware of their grant management responsibilities

In FY 2003, DHSEM (called Office of Emergency Management at that time) awarded a Flood Mitigation Assistance grant to the Town of Estancia for a flood mitigation plan in the amount of $15,200. Estancia withdrew the project and refunded any advance payment in favor of working with Torrance County on the multi-jurisdictional and multi-hazard Mitigation Plan.

Evaluation of Flood Mitigation Assistance Grant Program

In New Mexico, we have not taken full advantage of this grant program. As described above, it is anticipated that new guidance will be provided in 2013 which will likely combine the three flood mitigation grant programs. Once the new guidance is available, DHSEM will develop a strategy to encourage grant applications.

Benefits of this program are that in the absence of a federal disaster declaration, communities and tribes could utilize funding for flood mitigation projects. However, it is difficult to have nationally competitive projects due to the low population and rural nature of development in the State.

Community Assistance Program - State Support Services Element

The Community Assistance Program State Support Services Element (CAP-SSSE) program derives its authority from the National Flood Insurance Act of 1968, as amended, the Flood Disaster Protection Act of 1973, and from 44 CFR Parts 59 and 60. This program provides funding to States to provide technical assistance to communities in the National Flood Insurance Program (NFIP) and to evaluate community performance in implementing NFIP floodplain management activities. This program provides partial funding for the State Floodplain Coordinator, a full-time position at DHSEM.

FEMA Regional Offices and the designated State agency (DHSEM for New Mexico) negotiate a CAP-SSSE Agreement (Agreement) that specifies activities and products to be completed by a State in return for CAP-SSSE funds. In addition, since Federal Fiscal Year (FY) 2005, each State is required to develop a Five-Year Floodplain Management Plan (Five-Year Plan) describing the activities to be completed using CAP-SSSE funding as well as how the required performance metrics will be met. Performance standards that address quality of service are to be developed and measured. There is a 25% non-federal match for all States receiving CAP-SSSE funds. The last date of the Five Year Floodplain Management Business Plan was September 30, 2010.

DHSEM through CAP-SSSE has partially funded the following New Mexico Floodplain Managers Association (NMFMA) projects:

- FloodSmart Calendars (1,500 copies)
- Printing Floodplain Manager Quick Guides (300 copies)
- NMFMA website redesign and maintenance
- Workshop and training per diem reimbursement

Evaluation of the Community Assistance Program State Support Services Element

The primary benefit of this grant is that it provides for a full-time State Floodplain Coordinator. The main challenge of this grant program is that the funding cycle does not allow for sufficient time to expend all of the available funds. If the award of the funds happened sooner in the cycle, DHSEM and NMFMA could take better advantage of this grant.

Community Rating System (CRS)

CRS is an adjunct program that NFIP-participating communities may elect to pursue in order to gain more favorable flood insurance rates. There is no federal or state share, so the local government must bear the entire cost of program elements, which they develop and enact according to FEMA standards. There are ten CRS communities in New Mexico, out of a total of 100 communities that are NFIP participants. Additional information on the CRS and a listing of participating New Mexico communities is found in the flood hazard profile section of this Plan.

Evaluation of the Community Rating System

The CRS is highly effective in reducing flood insurance premium rates for participating communities. However, smaller communities with limited staff, have difficulty implementing new flood risk reduction activities and maintaining the required documentation.

Cooperating Technical Partnership (CTP)

A Cooperating Technical Partner is a program to assist States and communities with floodplain mapping improvements. The program is funded by FEMA with 80% federal share and 20% non-federal share. In New Mexico, only one community, Doña Ana County, is participating as a Cooperating Technical Partner; they have modeled and produced new floodplain maps which are being considered for approval by FEMA. DHSEM is also a Cooperating Technical Partner, utilizing the expertise at the University of New Mexico's Earth Data Analysis Center (EDAC) to provide mapped resource information on flood risk. On June 5th, 2013, DHSEM and EDAC completed the New Mexico Risk MP Five Year Business Plan (2012 - 2016) for the Cooperating Technical Partner effort. This State CTP is 100% federally funded.

Evaluation of the Cooperating Technical Partnership

This program allows for State and local governments to integrate more site-specific data, reference information and historical data into the floodplain mapping effort. However, most of the State's local communities, tribes and educational institutions cannot provide a non-federal match for these efforts.

Emergency Management Performance Grant (EMPG)

The EMPG is a comprehensive funding mechanism whereby FEMA funds a variety of state emergency management functions. The funding formula is 50% federal and 50% non-federal. Many of the local and county emergency managers are funded through this program.

Only the aspects of EMPG that relate to mitigation are included in the following discussion. DHSEM has participated in EMPG since its inception (although the agency name has changed numerous times through that period). EMPG incorporates two mitigation programs that no longer exist as stand-alone programs: the National Earthquake Hazard Reduction Program (NEHRP) and the Mitigation Assistance Program.

In FY 2003, DHSEM (then called Office of Emergency Management) granted $10,000 to Doña Ana County to assist in converting their Flood Mitigation Plan to a Multi-hazard Mitigation Plan.

In FY 2004, DHSEM (then called Office of Emergency Management) hosted a Post- Earthquake Building Inspection course. This class presented both rapid and detailed evaluation procedures for inspecting and identifying the safety of affected buildings.

EMPG has funded an annual educational earthquake program for school teachers called "Rockin' 'Round New Mexico" held every summer since 1995. The Workshop provides hand-on mineral resources curriculum and an overview of geology, mining, mineralogy and environmental problems to New Mexico educators for kindergarten through 12th grade. New Mexico Tech provides the matching funds and implements the workshop. The Workshop is organized, facilitated and implemented by educators at New Mexico Tech. They invite other educators and researchers to present and be part of the program. The Workshop allows educators to teach educators. The teachers that implement the program are mostly college, university or PhD level educators. The teachers that take the Workshop as participants tend to be educators for kindergarten through 12th grade. The three-day Workshop is held in a different part of the State each summer so that teachers can be exposed to the diverse geologic resources and potential hazards throughout New Mexico. Lessons learned and teaching tools are brought back to the classroom in order to make earth science understandable and relatable in an age appropriate manner.

Other earthquake related grants were made to New Mexico Tech for scientific study of the “Taos Trench” and rapid visual assessment for eight counties along the Rio Grande Rift. According to Subject Matter Expert Dr. Claudia Wilson, “the State should complete basic vulnerability assessments in New Mexico leading to projects the State may need to do as protectorate”. This item is included in the Mitigation Action Section of the Plan.

Evaluation of Emergency Management Performance Grant for Mitigation

Benefits of this program are that in the absence of a federal disaster declaration, communities and tribes could utilize funding for any type of natural hazard mitigation project or education/outreach effort. However, there are many competing priorities for the EMPG funding, including preparedness training, materials and equipment. Another limitation of this grant is that the maximum federal share is 50% (compared to the typical 75% federal share for Hazard Mitigation Grant Program and the Pre-disaster Mitigation grant program).

National Dam Safety Program

The New Mexico Office of the State Engineer's Dam Safety Bureau has been the recipient of grant funding from the National Dam Safety Program of the Federal Emergency Management Agency for a number of years. These grants have been on the order of $70,000 per fiscal year. The NM Dam Safety Bureau has applied this grant funding to support training of dam safety engineers, education and outreach to dam owners and other tasks in New Mexico. Funding has been used to support the promotion of preparation of Emergency Action Planning for High and Significant Hazard dams.

State Fire Assistance – Wildland/Urban Interface (SFA-WUI) Program

This grant program, funded 50:50 by various federal agencies, is administered by the Forestry Division of the NM Energy, Minerals, and Natural Resources Department (EMNRD). State Fire Assistance – Wildland/Urban Interface Program 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. This is a very popular program, and there are always more requests than there are funds available.

Rural Fire Assistance (RFA) Program

The Rural Fire Assistance Program provides funds to smaller communities that would probably not be able to compete favorably for other funding. RFA funds the acquisition of firefighting equipment by rural fire departments, which are mostly volunteer. The funding is 90% federal and 10% applicant. This program is coordinated through EMNRD and funded by the US Department of the Interior.

Volunteer Fire Assistance (VFA) Program

The Volunteer Fire Assistance Program is similar to the RFA program, but it provides for the placement of "Wildland Coordinators" in rural counties that do not have a county fire marshal or countywide supervision of rural fire departments. This program increases the capability of rural volunteer fire department to meet wildland firefighting requirements and provides continuity in training, certification, and leadership. VFA is a program of the US Forest Service, administered by EMNRD.

Rural Community Assistance Economic Action Program (RCA-EAP)

The Rural Community Assistance Economic Action Program is administered directly by the USFS to local governments for developing ways to utilize 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 serves the interests of mitigation in that by reducing the fuel load in forests, the wildfire potential is mitigated. A more direct benefit is that it provides employment and boosts the local economy.

Forestland Enhancement Program (FLEP)

Forestland Enhancement Program is another program of the USFS 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.

Collaborative Forest Restoration Program (CFRP)

CFRP is another USFS program intended to assist public or private forest owners with an opportunity to reduce wildfire dangers that threaten the community as a whole.

Tornado Shelters Act (TSA)

The Tornado Shelters Act enables local governments to utilize Community Development Block Grant (CDBG) funds from Housing and Urban Development to create community tornado shelters ("safe rooms") in manufactured housing communities.

Small Business Administration (SBA) Mitigation Loan Program

The Small Business Administration provides low interest loans to small businesses for the mitigation of natural hazards. This is not a grant program, and DHSEM has no part in it except to make its availability known to potential applicants. Further inquiries must be made directly to SBA.

Table 3.7. Mitigation Programs available in New Mexico

Mitigation Related Funding Programs in New Mexico

Program	Funding Formula (Federal : Non-Federal)	Grantee	Sub-Grantees	Funding Source
HMGP	75:25	State (DHSEM)	Local Government and Tribes	FEMA
PDM	75:25	State (DHSEM)	Local Government and Tribes	FEMA
EMPG	50:50	State (DHSEM)	Local Government and Tribes	FEMA
FMA	75:25	State (DHSEM)	NFIP Communities	FEMA
CRS	0:100	NFIP Communities	n/a	Local Government
CTP	100% federal	State (DHSEM)	n/a	FEMA
Dam Safety	varies	State (OSE)	n/a	FEMA
SFA-WUI	50:50	State (EMNRD)	Local Government	Various Federal Agencies
RFA	90:10	State (EMNRD)	Fire Departments	US-Dept. of Interior
VFA	90:10	State (EMNRD)	Volunteer Fire Departments	US Forest Service
RCA EAP	80:20	Local Government	n/a	USFS
FLEP	75:25	Private Forest Owners	n/a	USFS
CFRP	80:20	Public and Private	n/a	USFS
TSA	n/a	Local Government	n/a	US-HUD
SBA	(Low Interest Loans)	Small Businesses	n/a	SBA

Other State Capabilities

Fire Prevention and Outreach Programs

There are numerous fire prevention outreach and education programs throughout the State. A partial list is below. Most of the programs are administered or coordinated by the State Forestry Division of the New Mexico Energy, Minerals and Natural Resources Department.

- Communities at Risk Report (www.nmforestry.com)
- Firewise Program (www.firewise.org)
- Ready Set Go! (http://wildlandfirersg.org/)
- Living with Fire (www.nmforestry.com)
- Smokey Bear (www.smokeybear.com)
- New Mexico Fire Information (www.nmfireinfo.com)
- Social Media such as Facebook and Twitter
- State Forestry Education and Outreach links can be found at http://www.emnrd.state.nm.us/SFD/FireMgt/FirePreventionandOutreachProgram.html

New Mexico Drought Task Force

New Mexico is very proactive with the New Mexico Drought Task Force. The Task Force is discussed under drought in the Hazard Identification and Risk Assessment Section of this Plan. The current Drought Plan for New Mexico is dated 2006 (click here to access the 2006 New Mexico Drought Plan) with a Recommendation Report dated 2008 (click here to access the 2008 State Water Plan) and a recent status report from January 2013. The impact sectors identified in the Drought Plan and subsequent up-dates/status reports are agriculture, wildlife, wildland fire, watersheds, drinking water, economics, tourism and recreation.

The status report from January 2013 includes approximately 20 pages of drought-specific actions that are under-way or are recommended for action. The following categories of activities most directly apply to the natural hazard mitigation focus of this Plan;

- wildfire prevention education/outreach
- wildfire pre-suppression
- wildfire fuel reduction treatment
- wildfire model ordinances and building codes
- improve forest and watershed health
- range, crop and livestock management

Mitigation activities related to these topics are included in the Mitigation Actions Section of this Plan.

State Water Plan

The New Mexico Office of the State Engineer and Interstate Stream Commission are required to undertake a review of the New Mexico State Water Plan every five years and to subsequently update the plan as needed. This document summarizes the review undertaken in 2008 and presents a proposed work program for conducting the update in 2009. It is the result of a collaborative exercise, which engaged staff from the Office of the State Engineer, Interstate Stream Commission, and other state agencies with water-related responsibilities, as well as public stakeholders in reviewing the 2003 New Mexico State Water Plan.[121]

The State Water Plan Act also requires that the plan be reviewed, updated, and amended in response to changing conditions. At a minimum, a review should take place every five years. The Interstate Stream Commission and the Office of the State Engineer, along with other state agencies, prepared a review document that was published in June 2008. Based on this review, the agencies will begin the update process, which will include public meetings around the state and other opportunities for public input. More information will be posted as it becomes available. As part of the review and update process, the Interstate Stream Commission contracted with University of New Mexico Bureau of Business and Economic Research to provide an updated population report with projections.

New Mexico Building Codes

The State of New Mexico Construction Industries and Manufactured Housing Division of the Regulations and Licensing Department oversees building code licensing in the State. The Division also oversees permitting for public agency structures and private sector structures for communities that do not have a building permitting program. The State has adopted the International Building Codes. However, the State has not adopted the National Fire Protection Association Codes (NFPA 5000).

The residential and commercial building codes include some natural hazard mitigation elements. For example, wind and snow load regional charts are utilized for compliance. There is not currently a regional chart or map that reflects earthquake hazard. This is one of the action items identified in the Mitigation Action Section of the Plan.[122]

Wildlife/Habitat

The Biota Information System of New Mexico (BISON-M) contains accounts for wildlife occurring in New Mexico and Arizona, including threatened, endangered and sensitive species.[123]

The New Mexico Game and Fish Habitat Handbook encourages the incorporation of conservation practices in the earliest possible stages of project development. It contains conservation measures, with respect to specific land use practices, targeted toward minimizing impacts of projects on wildlife and wildlife habitats. Below is a link to the online Handbook which provides useful information for project planning and mitigation related to wildlife and habitat protection.[124]

State Asset Database

Currently, the New Mexico Department of Information Technology has a project underway to create a geophysical catalogue of all state and federal assets and critical facilities. In the future, State and local hazard mitigation planning efforts will be able to leverage this information for improved risk and vulnerability assessment outcomes.

[121] Source; http://www.ose.state.nm.us/publications_state_water_plans.html
[122] For more information visit: http://www.rld.state.nm.us/construction/default.aspx
[123] For more information visit: http://www.bison-m.org/
[124] For more information visit: http://wildlife.state.nm.us/conservation/habitat_handbook/index.htm

Local Capabilities

Local and tribal mitigation plans are being prepared by many jurisdictions within the state concurrently with the preparation of this state mitigation plan. Some jurisdictions are not working on local mitigation plans at all. The state mitigation staff will continue to coach those that are in the preparation phase and to recruit other jurisdictions to enter the mitigation planning effort. The availability of funds will greatly influence the success of this effort. The goal of the state is for all jurisdictions either to have their own mitigation plan or to be a part of a multi-jurisdictional mitigation plan.

Several New Mexico jurisdictions have the capability and skill needed to plan and carry out mitigation projects. They have well developed emergency management and/or planning departments or organizations. They also have the professional capacity to apply for grants and have the financial capability to fund the non-federal share for mitigation projects.

Currently, there are still a number of New Mexico jurisdictions that have little to no financial capability to fund emergency managers, let alone implement mitigation actions, despite the serious need to enact mitigation projects. DHSEM is eager to assist any jurisdiction in developing mitigation projects to meet the needs of the local community and to attempt to find ways and means for funding those projects through various federal grant programs.

Private Mitigation Resources

Private individuals, organizations, and businesses are almost never able to apply for federal mitigation grants of any sort. The exception would be 406 mitigation under the Individual Assistance Program. DHSEM hopes that private sector interests would come forth to fund mitigation projects, especially those that would protect their own self-interests. Often, as with wildfire and floodplain measures, local, state, and possibly federal government agencies can offer free technical assistance to mitigate specific hazards.

Effectiveness of State and Local Plans

Many of the emergency management personnel in the state do not have extensive backgrounds in this field. Additionally most tribal, local and county emergency managers have additional jobs within their jurisdictions and are unable to dedicate 100% of their time to emergency management. DHSEM recognizes this and is attempting to provide as much technical assistance and training as possible. To date, few mitigation projects have been implemented in New Mexico. As such, most jurisdictions are unfamiliar with the policies and regulations that govern these programs.

Federal Program Summary

The following grant programs are federal in origin and directly or indirectly relate to mitigation (Table 3.8). Some of the programs are intended for specific hazards, while others can be applied to multiple natural hazards types. Contact information and/or reference websites is included. In addition, contact information for New Mexico based personnel is also included.

Table 3.8. Federal Mitigation Programs

Program / Activity	Type of Assistance	Agency & Contact
Basic & Applied Research/Development		
Center for Integration of Natural Disaster Information	Technical Assistance: Develops and evaluates technology for information integration and dissemination	Department of Interior (DOI) –US Geological Survey (USGS) The Center for Integration of Natural Hazards Research:
		Phone: (703) 648-6059
		Email: hazinfo@usga.gov
Hazard Reduction Program	Funding for research and related educational activities on hazards.	National Science Foundation (NSF), Directorate for Engineering, Division of Civil and Mechanical Systems, Hazard Reduction Program:
		Phone: (703) 306-1360
		Website: www.nsf.gov/sbe/drms/start.htm
Decision, Risk, and Management Science Program	Funding for research and related educational activities on risk, perception, communication, and management (primarily technological hazards).	NSF – Directorate for Social, Behavioral and Economic Science, Division of Social Behavioral and Economic Research, Decision, Risk, and Management Science Program (DRMS):
		Phone: (703) 306-1757
		Website: www.nsf.gov/sbe/drms/start.htm
Societal Dimensions of Engineering, Science, and Technology Program	Funding for research and related educational activities on topics such as ethics, values, and the assessment, communication, management and perception of risk.	NSF – Directorate for Social, Behavioral and Economic Science, Division of Social, Behavioral and Economic Research, Societal Dimensions of Engineering, Science and Technology Program:
		Phone: (703) 306-1743
National Earthquake Hazard Reduction Program (NEHRP) in Earth Sciences	Research into basic and applied earth and building sciences.	FEMA Region VI contact is Prince.Aryee@FEMA.DHS.gov
		NM DHSEM contact is Wendy.Blackwell@state.nm.us Website: www.nehrp.gov

Technical and Planning Assistance		
Mitigation Planning Assistance	Each FEMA Region has a Mitigation Directorate that provides technical assistance to States and tribal entities. Through the State, FEMA Region also provides technical assistance to local government agencies.	FEMA Region VI contact is Patricia.Schaffer@FEMA.DHS.gov NM DHSEM contact is Wendy.Blackwell@state.nm.us Website: www.FEMA.gov/mitigation-planning-assistance-resources
Planning Assistance to States and Tribes	Technical and planning assistance for the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Albuquerque contact is: Chief, Civil Projects Management Branch Deborah.A.Foley@usace.army.mil
Disaster Mitigation Planning and Technical Assistance	Technical and planning assistance grants for capacity building and mitigation project activities focusing on creating disaster resistant jobs and workplaces.	Department of Commerce (DOC), Economic Development Administration (EDA): (800) 345-1222 EDA's Disaster Recovery Coordinator: Phone: (202) 482-6225 Website: www.doc.gov/eda
Watershed Surveys and Planning	Surveys and planning studies for appraising water and related resources, and formulating alternative plans for conservation use and development. Grants and advisory/counseling services to assist w/ planning and implementation improvement.	US Department of Agriculture (USDA) – National Resources Conservation Service (NRCS) Watersheds and Wetlands Division Website: www.nrcs.usda.gov New Mexico NRCS contact for this program is Resource Conservationist Email: seth.fiedler@nm.usda.gov Phone: 505-761-4430

National Flood Insurance Program	Formula grants to States to assist communities to comply with NFIP floodplain management requirements (Community Assistance Program).	FEMA Region VI contact is Marya.Diaz@FEMA.DHS.gov NM DHSEM contact is Bill.Borthwick@state.nm.us Websites: www.fema.gov/national-flood-insurance-program www.floodsmart.gov www.fema.gov/protecting-our-communities/plan-ahead-dam-failure
Emergency Management Institute	Training in disaster mitigation, preparedness, planning.	NM DHSEM contact is Joyce.Purley@state.nm.us Website: www.training.FEMA.gov/EMI
National Dam Safety Program	Technical assistance, training, and grants to help improve State dam safety programs.	FEMA Region VI contact is Prince.Aryee@FEMA.DHS.gov NM OSE contact is Charles.Thompson@state.nm.us Websites: http://www.fema.gov/about-national-dam-safety-program www.fema.gov/protecting-our-communities/plan-ahead-dam-failure
National Earthquake Hazards Reduction Program	Training, planning and technical assistance under grants to States or local jurisdictions. Also, Technical and planning assistance for activities associated with earthquake hazards mitigation.	FEMA Region VI contact is Prince.Aryee@FEMA.DHS.gov USGS information as www.earthquake.usgs.gov DHSEM contact is Wendy.Blackwell@state.nm.us Website: www.nehrp.gov
Floodplain Management Services	Technical and planning assistance at the local, regional, or national level needed to support effective floodplain management.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Albuquerque District contact is: Floodplain Management Services Program Manager Email: Stephen.K.Scissons@usace.army.mil

Watershed Protection and Flood Prevention Program	Technical and financial assistance for installing works of improvement to protect, develop, and utilize land or water resources in small watersheds under 250,000 acres. Pre-disaster planning and hazard mitigation are eligible act ivies.	USDA-NRCS- Watersheds and Wetlands Division Website: www.nrcs.usda.gov New Mexico NRCS contact for this program is Resource Conservationist Email: seth.fiedler@nm.usda.gov
Environmental Quality Incentives Program (EQIP)	Technical, educational, and limited financial assistance to encourage environmental enhancement.	USDA-NRCS Website: www.nrcs.usda.gov New Mexico NRCS contact for this program is Resource Conservationist Email: michael.neubeiser@nm.usda.gov
Hazard ID & Mapping		
National Flood Insurance Program: Flood Mapping;	Flood insurance rate maps and flood plain management maps for all NFIP communities;	FEMA Region VI contact is Jim.Orwat@FEMA.DHS.gov NM DHSEM contact is Bill.Borthwick@state.nm.us Websites: https://msc.FEMA.gov www.floodsmart.gov
National Digital Orthophoto Program	Develops topographic quadrangles for use in mapping of flood and other hazards.	DOI-USGS- National Mapping Division: Phone: (573) 308-3802
Streamgaging and Flood Monitoring Network	Operation of a network of over 7,000 streamgaging stations that provide data on the flood characteristics of rivers.	DOE-USGS Chief, Office of Surface Water USGS: (703) 648-5303
Mapping Standards Support	Expertise in mapping and digital data standards to support the National Flood Insurance Program.	DOI-USGS- National Mapping Division: Phone: (573) 308-3802

Soil Survey	Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes.	USDA-NRCS – Deputy Chief for Soil Science and Resource Assessment: Phone: (202) 720-4630 New Mexico NRCS contact for this program is State Soil Scientist Email: richard.strait@nm.usda.gov
National Earthquake Hazards Reduction Program	Seismic mapping for U.S.	DOI-USGS-Earthquake Program Coordinator: Phone: (703) 648-6785
Project Support		
Aquatic Ecosystem Restoration	Direct support for carrying out aquatic ecosystem restoration projects that will improve the quality of the environment.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Albuquerque District contact is: Chief, Environmental Resources Section Email: Julie.A.Alcon@usace.army.mil
Beneficial Uses of Dredged Materials	Direct assistance for projects that protect, restore, and create aquatic and ecologically-related habitats, including wetlands, in connection with dredging an authorized Federal navigation project.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Albuquerque District contact is: Chief, Environmental Resources Section Email: Julie.A.Alcon@usace.army.mil
Wetlands Protection – Development Grants	Grants to support the development and enhancement of State and tribal wetlands protection programs.	US Environmental Protection Agency EPA Wetlands Hotline: (800) 832-7828 EPA Headquarters, Office of Water Chief, Wetlands Strategies and State Programs: Phone: (202) 260-6045
Clean Water Act Section 319 Grants	Grants to States to implement non-point source programs, including support for non-structural watershed resource restoration activities.	EPA Office of Water Phone: (202) 260-7088, 7100

Community Development Block Grant (CDBG) State Administered Program	Grants to States to develop viable communities (e.g., housing, a suitable living environment, expanded economic opportunities) in non-entitled areas, for low- and moderate-income persons.	US Department of Housing and Urban Development (HUD) State CDBG Program Manager State and Small Cities Division, Office of Block Grant Assistance, HUD Headquarters Phone: (202) 708-3587
Community Development Block Grant Entitlement Communities Program	Grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate-income persons.	HUD Community Planning and Development HUD field office. Entitlement Communities Division, Office of Block Grant Assistance, HUD Headquarters: (202) 708-1577, 3587
Emergency Watershed Protection Program	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 if damage is caused by an eligible disaster.	USDA – NRCS Phone: (202) 690-0848 New Mexico NRCS contact for this program is Resource Conservationist Email: seth.fiedler@nm.usda.gov
Rural Development Assistance -- Utilities	Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.	USDA-Rural Utilities Service (RUS) Program Support: (202) 720-1382 Northern Regional Division: (202) 720-1402 Electric Staff Division: (202) 720-1900 Power Supply Division: (202) 720-6436
Rural Development Assistance – Housing	Grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.	USDA-Rural Housing Service (RHS) Community Programs: (202) 720-1502 Single Family Housing: (202) 720-3773 Multi-Family Housing: (202) 720-5177

HOME Investments Partnerships Program	Grants to States, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.	HUD Community Planning and Development, Grant Programs, Office of Affordable Housing, HOME Investment Partnership Programs: (202) 708-2685 (202) 708 0614 extension 4594 1-800-998-9999
Disaster Recovery Initiative	Grants to fund gaps in available recovery assistance after disasters (including mitigation).	Community Planning and Development Divisions at HUD field offices HUD Community Planning and Development: (202) 708-2605
Non-Structural Alternatives to Structural Rehabilitation of Damaged Flood Control Works	Direct planning and construction grants for non-structural alternatives to the structural rehabilitation of flood control works damaged in floods or coastal storms. $9 million FY99	Department of Defense (DOD), US Army Corps of Engineers (USACE) Albuquerque USACE contact is: Floodplain Management Services Program Manager Email: Stephen.K.Scissons@usace.army.mil
Partners for Fish and Wildlife	Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.	Department of Interior (DOI) Fish and Wildlife Service (FWS) National Coordinator, Ecological Services: (703) 358-2201 A list of State and Regional contacts is available from the National Coordinator upon request.
Project Modifications for Improvement of the Environment	Provides for ecosystem restoration by modifying structures and/or operations or water resources projects constructed by the USACE, or restoring areas where a USACE project contributed to the degradation of an area.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Albuquerque District contact is: Chief, Environmental Resources Section Email: Julie.A.Alcon@usace.army.mil
Post-Disaster Economic Recovery Grants and Assistance	Grant funding to assist with the long-term economic recovery of communities, industries, and firms adversely impacted by disasters.	Department of Commerce (DOC) – Economic Development Administration (EDA) Disaster Recovery Coordinator Phone: (202) 482-6225

Public Housing Modernization Reserve for Disasters and Emergencies	Funding to public housing agencies for modernization needs resulting from natural disasters (including elevation, flood proofing, and retrofit).	HUD Director, Office of Capital Improvements: Phone: (202) 708-1640
Indian Housing Assistance (Housing Improvement Program)	Project grants and technical assistance to substantially eliminate sub-standard Indian housing.	Department of Interior (DOI)-Bureau of Indian Affairs (BIA) Division of Housing Assistance, Office of Tribal Services Phone: (202) 208-5427
Land Protection	Technical assistance for run-off retardation and soil erosion prevention to reduce hazards to life and property.	USDA-NRCS (202) 720-4527 New Mexico NRCS District Offices are the contact for this program. District Conservationists can be reached through 505-761-4400
North American Wetland Conservation Fund	Cost-share grants to stimulate public/private partnerships for the protection, restoration and management of wetland habitats.	DOI-FWS North American Waterfowl and Wetlands Office Phone: (703) 358-1784
Land Acquisition	Acquires or purchases easements on high-quality lands and waters for inclusion into the National Wildlife Refuge System.	DOI-FWS Division of Realty, National Coordinator Phone: (703) 358-1713
Federal Land Transfer / Federal Land to Parks Program	Identifies, assesses, and transfers available Federal real property for acquisition for State and local parks and recreation, such as open space.	DOI-NPS General Services Administration Offices Fort Worth, TX: (817) 334-2331 Boston, MA: (617) 835-5700 NPS National Office, Federal Lands to Parks Leader Phone: (202) 565-1184
Wetlands Reserve Program	Financial and technical assistance to protect and restore wetlands through easements and restoration agreements.	USDA-NRCS National Policy Coordinator, NRCS Watersheds and Wetlands Division Phone: (202) 720-3042 New Mexico NRCS District Offices are the contact for this program. District Conservationists can be reached through 505-761-4400

Transfers of Inventory Farm Properties to Federal and State Agencies for Conservation Purposes	Transfers title of certain inventory farm properties owned by FSA to Federal and State agencies for conservation purposes (including the restoration of wetlands and floodplain areas to reduce future flood potential)	US Department of Agriculture (USDA) – Farm Service Agency (FSA) Farm Loan Programs Phone: (202) 720-3467, 1632
Financing and Loan Guarantees		
Hazard Mitigation Grant Program, Pre-disaster Mitigation Grant Program, Flood Disaster Mitigation Assistance Program, Repetitive Loss Program	Federal grants administered by States with typically 75% federal share and 25% non-federal share. Tribal entities can apply directly to FEMA Region for funding.	FEMA Region VI contact is Patricia.Schaffer@FEMA.DHS.gov NM DHSEM contact is Wendy.Blackwell@state.nm.us Website: www.FEMA.gov/mitigation-planning-assistance-resources
Physical Disaster Loans and Economic Injury Disaster Loans	Disaster loans to non-farm, private sector owners of disaster damaged property for uninsured losses. Loans can be increased by up to 20 percent for mitigation purposes.	Small Business Administration (SBA) Associate Administrator for Disaster Assistance Phone: (202) 205-6734
Conservation Contracts	Debt reduction for delinquent and non-delinquent borrowers in exchange for conservation contracts placed on environmentally sensitive real property that secures FSA loans.	USDA-FSA Farm Loan Programs (202) 720-3467, 1632 Or local FSA Office
Clean Water State Revolving Funds	Loans at actual or below-market interest rates to help build, repair, relocate, or replace wastewater treatment plants.	EPA Office of Water, State Revolving Fund Branch Phone: (202) 260-7359 A list of Regional Offices is available upon request

Section 108 Loan Guarantee Program	Loan guarantees to public entities for community and economic development (including mitigation measures).	Community Planning and Development staff at HUD field office Section 108 Office in HUD Headquarters Phone: (202) 708-1871
Section 504 Loans for Housing	Repair loans, grants and technical assistance to very low-income senior homeowners living in rural areas to repair their homes and remove health and safety hazards.	US Department of Agriculture (USDA) – Rural Housing Service (RHS) RHS Headquarters Director, Single Family Housing Direct Loan Division Phone: (202) 720-1474
Section 502 Loan and Guaranteed Loan Program	Provides loans, loan guarantees, and technical assistance to very low and low-income applicants to purchase, build, or rehabilitate a home in a rural area.	USDA-RHS Contact the Local RHS Field Office Director, Single Family Housing Guaranteed Loan Division Phone: (202) 720-1452
Rural Development Assistance -- Utilities	Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.	USDA-Rural Utility Service (RUS) Contact Rural Development Field Offices RHS, Deputy Administrator, Community Programs Division Phone: (202) 720-1490
Farm Ownership Loans	Direct loans, guaranteed / insured loans, and technical assistance to farmers so that they may develop, construct, improve, or repair farm homes, farms, and service buildings, and to make other necessary improvements.	USDA-FSA Director, Farm Programs Loan Making Division, FSA Phone: (202) 720-1632

Other Agency Plans and Programs related to the State Hazard Mitigation Plan

The New Mexico Natural Hazard Mitigation Plan references information from a number of plans and programs that were previously developed by other state and federal agencies. The resources below have been included to provide guidance during future mitigation planning efforts. A comprehensive list of additional reference material is also located in Appendix F of the Plan. Future state and local mitigation planning efforts should strive to support, follow, and incorporate successful principles and practices outlined below as they relate to local mitigation priorities.

Wildfire

Ready, Set, Go! Your Personal Wildfire Action Guide for New Mexico, International Association of Fire Chiefs. Source: http://www.emnrd.state.nm.us/SFD/FireMgt/documents/RSGActionGuideNM.pdf

New Mexico Statewide Natural Resource Assessment & Strategy and Response Plans. Energy, Minerals and Natural Resources Department, Forestry Division, State Forestry Division, June 2010. Source: http://www.emnrd.state.nm.us/SFD/statewideassessment.html).

A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment, 10-Year Strategy Implementation Plan National Fire Plan. USFS December 2006. Source: http://www.fireplan.gov/reports/10-YearStrategyFinal_Dec2006.pdf

New Mexico Fire Plan, New Mexico Energy, Minerals and Natural Resources Department, Forestry Division, September 2003. Source: www.emnrd.state.nm.us/forestry

Water

New Mexico State Water Plan, Office of the State Engineer and the Interstate Stream Commission, December 2003, Source: http://www.ose.state.nm.us/water-info/NMWaterPlanning/2003StateWaterPlan.pdf

Progress Report: State of New Mexico Water Plan, Office of the State Engineer and the Interstate Stream Commission, June 2006, Source: http://www.ose.state.nm.us/PDF/Publications/StateWaterPlans/swp-2006-06-progress-report.pdf

Framework for a Comprehensive Statewide Municipal and Industrial Water Conservation Program. Office of the State Engineer. Nov. 2003. Source: www.ose.state.nm.us/water-info/conservation

Mining in New Mexico-The Environment, Water, Economics, and Sustainable Development: Decision-Makers Field Guide 2005, Edited by L. Greer Price, Douglas Bland, Virginia T. McLemore, and James M. Barker, New Mexico Bureau of Geology and Mineral Resources, 2005.

Water Resources of the Lower Pecos Region, New Mexico-Science, Policy, and a Look to the Future: Decision-Makers Field Guide 2003, Edited by Peggy S. Johnson, Levis A. Land, L. Greer Price, and Frank Titus, New Mexico Bureau of Geology and Mineral Resources, 2002.

Water, Watersheds, and Land Use in New Mexico: Impacts of Population Growth on Natural Resources-Santa Fe Region: Decision-Makers Field Guide 2001, Edited by Peggy S. Johnson, New Mexico Bureau of Geology and Mineral Resources, 2001.

Water Resources of the Middle Rio Grande-San Acacia to Elephant Butte: Decision-Makers Field Guide 2007, Edited by L Greer Price, Peggy S. Johnson, and Douglas Bland, New Mexico Bureau of Geology and Mineral Resources, May 2007

Floodplain

Handbook for New Mexico Floodplain Managers. NM Floodplain Managers Association. Sept. 2003. Source: www.nmfma.org/handbook.htm

No Adverse Impact: A Toolkit for Common Sense Floodplain Management. Association of State Floodplain Managers. 2003. Source: http://www.floods.org/NoAdverseImpact/NAI_Toolkit_2003.pdf

New Mexico Communities at Risk Assessment Plan, New Mexico Energy, Minerals and Natural Resources Department, Forestry Division, 2006, Source: http://www.emnrd.state.nm.us/fd/FireMgt/documents/2006_CAR.pdf

Strategic Plan for the New Mexico Floodplain Managers Association.
NM Floodplain Managers Association. April 2003. Source: www.nmfma.org

A History of Floods and Flood Problems in New Mexico, New Mexico Floodplain Managers Association, September 2003. Source: http:// www.nmfma.org/NM%20Flood%20History.pdf

Dams

Rules and Regulations Governing Dam Design, Construction and Dam Safety. December 21, 2010. Source: http://www.ose.state.nm.us/PDF/DamSafety/19-25-12-NMAC-2010.pdf

Watershed Health

New Mexico Emergency Watershed Protection Program Emergency Management Recovery Plan (NMERP), USDA Natural Resources Conservation Service, Albuquerque, NM. 2002, update pending 2013

New Mexico Forest and Watershed Health Plan. EMNRD Forestry Division. 2004.
Source: www.emnrd.state.nm.us/forestry

Drought

Report on Drought Conditions, New Mexico Drought Monitoring Work Group, Governor's Drought Task Force, January 2007. Sourcehttp://www.nmdrought.state.nm.us/MonitoringWorkGroup/2007-01-11-dmwg-rpt.pdf

New Mexico Drought Plan, New Mexico Drought Task Force, December 2006. Source: http://www.nmdrought.state.nm.us/2006-NM-Drought-Plan.pdf
2008 Update reference:
http://www.nmdrought.state.nm.us/MonitoringWorkGroup/RcommendationsReport-2008-08-01.pdf

Wind

Project Report, Wind Resource Maps of New Mexico. Prepared for State of New Mexico Energy, Minerals, and Natural Resource Division, Prepared by True Wind Solutions, LLC, May 30, 2003.

Multi-hazard

Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire debris flow hazard assessment for the area burned by the 2011 Track Fire, northeastern New Mexico and Southern Colorado: U.S. Geological Survey Open-File Report 2011-1257 http://pubs.usgs.gov/of/2011/1257/

Tillery, A.C., Darr, M.J., Cannon, S.H., and Michael, J.A., 2011, Postwildfire preliminary debris flow hazard assessment for the area burned by the 2011 Las Conchas Fire in north-central New Mexico: U.S. Geological Survey Open-File Report 2011-1308
http://pubs.usgs.gov/of/2011/1308/

Tillery, A.C., and Matherne, A.M., 2013, Postwildfire debris-flow hazard assessment of the area burned by the 2012 Little Bear Fire, south-central New Mexico: U.S. Geological Survey Open-File Report 2013–1108, 15 p., 3 pls.,
http://pubs.usgs.gov/of/2013/1108/

Tillery, A.C., Matherne, A.M., and Verdin K.L., 2012, Estimated probability of postwildfire debris flows in the 2012 Whitewater–Baldy Fire burn area, southwestern New Mexico: U.S. Geological Survey Open-File Report 2012–1188, 11 p., 3 pls.
http://pubs.usgs.gov/of/2012/1188/

Multi-Hazard Identification and Risk Assessment (MHIRA), Federal Emergency Management Agency, 1997. Source: http://www.fema.gov/plan/prevent/fhm/ft_mhira.shtm

Agency-Specific Plans

New Mexico 10-Year Comprehensive Strategy Implementation Plan. 2003.
EMNRD Forestry Division. Source: www.emnrd.state.nm.us/forestry

Strategic Plan, Office of the State Engineer and the Interstate Stream Commission, September 2006. Source: http://www.ose.state.nm.us/PDF/Publications/StrategicPlans/strategic_plan_2006.pdf

Other

New Mexico 2000: Census 2000 Profile. US Census Bureau, US Department of Commerce, Economics and Statistics Administration, August 2002. Source:
http://www.census.gov/prod/2002pubs/c2kprof00-nm.pdf

Planning For Extremes; A Report from Soil and Water Conservation Society Workshop, Soil and Water Conservation Society, 2007. Source:
http://www.swcs.org/documents/Planning_for_Extremes.pdf

SECTION 4 – NEW MEXICO VULNERABILITIES

The following section highlights the key social and physical vulnerability concerns in the state of New Mexico including a profile of vulnerable populations and the built environment. It also includes an inventory of critical facilities and estimates of potential losses from hazard events.

After providing an overview of vulnerability in the state, the chapter concludes with six Preparedness-Area-specific vulnerability assessments based on the hazard risk data previously identified in the hazard identification and risk assessment chapter. In addition, the Preparedness Area vulnerability assessments incorporate relevant information about local risk and hazard priorities identified in the hazard mitigation plans developed by local jurisdictions.

Social Vulnerability

New Mexico faces a range of impacts from hazard events, including flooding, wildfires, severe storms and drought. In a unique time of rapid population growth and development across the state, it has become increasingly clear that unsound development and planning strategies have contributed to significant increases in vulnerability to hazards as well as reductions in local and regional safety.

Studies have shown that social and economic variables such as race, age, income and employment can increase vulnerability and affect the ability of a community to prepare, respond and recover from hazards and their impacts. In particularly vulnerable systems even small perturbations may lead to collapse. Therefore, it is important for the State to fully understand the vulnerability of its population in order to develop successful vulnerability reduction strategies.

Social vulnerability measures population sensitivity to hazards as well as the ability of a population to respond and recover from hazard impacts. Because it is a complex, multidimensional concept, researchers and emergency management practitioners have come up with a number of ways of assessing local and regional social vulnerability to disasters. One of the most frequently used social vulnerability assessment methods is the Social Vulnerability Index (SOVI) that was developed for the purpose of distilling out the driving factors of social vulnerability.[125]

Various socioeconomic factors contribute to elevated levels of risk and vulnerability to hazards. Those characteristics that influence social vulnerability most often found in the disaster literature are listed in Table 4.1. These factors include personal wealth, age, gender, and race. Other characteristics identify special needs populations and those that lack the normal social safety nets necessary for disaster recovery and resilience (e.g. the physically or mentally challenged, the homeless, non-English speaking immigrants and seasonal tourists).

[125] In their 2003 paper, *Social vulnerability to environmental hazards*, Cutter et al. (2003) used county-level socioeconomic and demographic data to create an index of social vulnerability to environmental hazards. They called this the Social Vulnerability Index (SOVI).

Table 4.1. Social Vulnerability Characteristics[126]

Characteristic	Description	Increases (+) or Decreases Social Vulnerability (-)
Gender	Women can have a more challenging time during disaster recovery than men, often due to sector-specific employment, lower wages, and family care responsibilities.	Gender (+)
Age	Age extremes affect the ability of individuals to move out of harm's way. Additionally, parents lose time and money caring for children when daycare facilities are affected; the elderly may have mobility constraints.	Elderly (+) Children (+)
Renters	People that rent their homes do so because they are either transient or do not have the financial resources for home ownership. In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or too costly to afford.	Renters (+)
Family structure	Families with large numbers of dependents or single-parent households often have limited finances to outsource care. This demands that families juggle work responsibilities and care which affects the resilience to and recovery from hazards.	High birth rates (+) Large Families (+) Single-parent households (+)
Education	Education is closely linked to poverty status, with higher educational attainment resulting in greater lifetime earnings. Lower education levels also constrain the ability to understand warning information and access to recovery information.	Little education (+) Highly educated (-)
Population growth	Counties experiencing rapid	Rapid growth (+)

126 Cutter, S.L., Boruff, B.J., Shirley, W.L. (2003). Social Vulnerability to Environmental Hazards. Social Science Quarterly, V. 84: 2.

	population growth lack available quality housing; social services networks may not have had time to adjust to increased populations. New migrants may not speak the language or be familiar with how to obtain relief or recovery information, all of which increase vulnerability.	
Special needs populations	Infirm, institutionalized, transient and homeless people are disproportionately affected during disasters and are largely ignored during recovery.	Large special needs population (+)

Socio-economic status, gender, race and ethnicity are the most common characteristics that define the social vulnerability of populations. Age (children and the elderly), limited language status, and housing tenure (renter or owner) also play a significant role in the ability of populations to absorb impact, respond and recover in the event of a disaster.

Communities with high levels of social vulnerability often bear far greater impacts from disasters than others. Social vulnerability factors can contribute to elevated hazard vulnerability for a number of reasons, for example:

- Lack of individual and community wealth that can mean fewer available resources for recovery. For example, a poor family may not own a vehicle that would enable them to immediately evacuate the area. By identifying the number of families below the poverty level, Preparedness Areas can identify neighborhoods and communities that may be impacted more severely by disaster events due to a lack of resources and response capacity.

- Youth populations (18 years or under) and elderly populations (65 years or older) are more likely to need additional assistance during disasters and large concentrations of populations in either of these subgroups are an indicator of elevated community vulnerability to multi-hazards.

- People with limited language skills are more vulnerable in the event of a disaster. Their inability to understand evacuation warnings or preparedness bulletins influences their ability to comply with safety measures; the inability to communicate special needs to emergency responders or law enforcement influences their ability and willingness to receive adequate health care or emergency supplies; limited language ability also affects their ability to communicate their risks and vulnerabilities to planners and emergency managers who organize pre-disaster mitigation efforts. As a result, Preparedness Areas with populations made up of greater proportions of individuals with limited language skills have a higher social vulnerability to hazard impacts. Moreover, it will likely take those communities longer to recover from a hazard event.

Table 4.2 Vulnerable Subgroups in the State as a Percentage of State Population[127]

	Persons Below Poverty	Persons 18 Years and Younger	Persons 65 Years and Older	High school graduate or higher (persons age 25 +)	Homeownership Rate
New Mexico	19.0%	24.7%	14.1%	83.1%	69.6%
USA	14.3%	23.5%	13.7%	85.4%	66.1%

According to the 2012 US Census population estimates, approximately 24.7% of the total state population is under the age of 18 and 14.1% of the population is 65 years of age and older. This is slightly higher than that of the rest of the country. Additionally, New Mexico has a much higher poverty rate than the rest of the country with a poverty rate of 19%. Together, these statistics point to elevated social vulnerability to disasters among specific communities (and Preparedness Areas) across the state of New Mexico.

Vulnerability of the Built Environment

While social vulnerability depends on demographic factors such as age, education and poverty status, the vulnerability of the build environment is shaped by the composition of structures located in a community. This section quantifies the buildings exposed to potential hazards in the state of New Mexico. In addition to the following catalogue of critical facilities and the population information presented above, a quantitative analysis of the vulnerability of the built environment to earthquakes and flooding contributes to the larger vulnerability and risk assessment presented in this plan.

The information for this planning effort was derived from inventory data associated with FEMA's loss estimate software HAZUS-MH. HAZUS-MH classifies building stock types into seven categories: residential, commercial, industrial, agriculture, religious, government and education. HAZUS-MH analyzes data from the US Census for compilation of data (numb structures) and other sources of information, such as FEMA Guidance for determination of valuation, etc.

When it comes to assessing the vulnerability of the built environment, Hazus Level 1 analyses break building losses into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake. Detailed information about the vulnerability of the build environment in of the six Preparedness Areas is

127 Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits

presented in the following vulnerability assessment sections (Vulnerability Assessment – Preparedness Area 1-6).

Critical Facilities

Critical facilities deserve additional mitigation attention because of the higher potential life and property loss or environmental harm in the unlikely event that they suffer significant damage. Critical facilities protection is essential because these specific facilities can have a significant impact on the scope of damage caused by a natural disaster. Impact to critical facilities during a natural disaster will likely also affect response and recovery from a natural hazard event.

For the purpose of the State Natural Hazard Mitigation Plan 'critical facilities' means: State owned or managed assets which are vital to the health, safety and well-being of New Mexicans during time of natural disaster.

Critical facilities include State owned or managed:

- Essential facilities vital to the response effort (Emergency Service Facilities, such as police stations, fire stations, rescue squads, public works facilities, hospitals, evacuation shelters, etc.)
- Facilities that house populations requiring special consideration (nursing homes, prisons, juvenile detention centers, schools, secondary education facilities, child care centers, state hospitals and facilities, health clinics, and the Office of Medical Investigation, etc.)
- Locations where public health and safety functions are performed or coordinated (State Police District Offices, National Guard Facilities, Emergency Operations Centers, staging areas for emergency operations, Office of Medical Investigator, State Laboratory, housing for communications and computer systems, food/medical distribution centers, etc.)
- Communications networks (telephones, emergency medical radio communication system, emergency service radio systems, towers and repeater sites and base stations, television and radio stations, etc.).
- Water supply system/facilities, to include waste water treatment.
- Utilities (power plants, substations, power lines, etc.)
- Transportation networks (roads, bridges, airports, rail terminals, etc.)
- Facilities that can create secondary hazards, such as nuclear power plants and hazardous materials production or storage facilities

Local hazard mitigation plans will identify critical facilities, whether public or private, within their jurisdictions and propose mitigation strategies to protect them. Local mitigation plans do not address state owned facilities. Some critical facilities are owned by local, county, federal and/or tribal government. These properties are also beyond the scope of this State Plan.

Catalog of Critical Facilities

The New Mexico Department of Information Technology utilizes a Geographic Information System based data catalog called Community Anchor Site "CASA" as part of the State's Broadband Mapping Program. There are many layers of critical facilities data that are included in CASA. Examples of critical facilities layers are hospitals, Police Stations, Fire Stations, National Guard Emergency Readiness Centers, State government buildings, schools and libraries. CASA also includes infrastructure such as roads, airports and rail terminals.

CASA also includes some data associated with each of the specific structures or locations. For example, latitude and longitude is available for each structure. However, because CASA is not tied to the County Assessors' information, so there is limited valuation data available. There is an interactive website that can be utilized to research the locations of different types of critical facilities State-wide.[128]

The Earth Data Analysis Center at the University of New Mexico runs the Resource Geographic Information System (RGIS) Program. Through RGIS, users can share geospatial data State-wide. The information can be used to coordinate multiple-jurisdictions for emergency response, preparedness and mitigation, in addition to many other topics.

There is also a Homeland Security Infrastructure Program (HSIP) that includes mapped critical facilities and critical infrastructure. Access to HSIP is described as either 'freedom' and a 'gold', depending on the clearance level of the user. New Mexico Department of Homeland Security and Emergency Management accesses the data in HSIP through DH1View. All HSIP data available as 'freedom' access has already been collapsed into CASA.

There is some data that is available through individual State agencies which is not yet collapsed into CASA. For example, the Department of Transportation has mapped information on bridges and landslide locations. One mitigation action will be to collapse all publicly available mapped information into CASA so that local communities, tribes and State agencies can have access to all of the information.

Another mitigation action is to analyze HSIP Gold to determine what information may be appropriate to be made available publicly. For example, the locations of dams, flood control structures, wells and day care facilities are known, but not currently shared as public information. If the agency that has management responsibilities gives approval to include the locations in CASA, the information could be collapsed. Or, the data could be identified, as not being appropriate for the general public, but instead may be available to emergency managers and other necessary personnel only. Due to the sensitive nature of critical infrastructure, the data would be available only upon request.

Once the available data is identified, it will be important to determine which facilities are critical. For example, not all State government owned or managed facilities are critical. The structures that house the communications system or the archival information may be labeled as critical, while the office building may not be identified as critical. An office building that houses staff during business hours could be evacuated and continue operations in a different location. Another mitigation action would be to define what is 'critical' and identify which facilities and infrastructure are indeed critical. Then, mitigation actions can be targeted at the most critical facilities.

State-Owned or Managed Critical Facilities

Planning Team members and Subject Matter Experts were asked to review the list of State owned and managed critical facilities that were included in the 2010 State Natural Hazard Mitigation Plan. Participants were asked to submit edits, additions and deletions. Emphasis was placed on facilities that would be considered critical during a natural hazard event. The location of each facility was then compared to known hazard areas as identified in the Risk Assessment section of the Plan. The New Mexico General Services Department was consulted to up-date the value of each critical facility

[128] Source: http://nmbbmapping.org/mapping/

identified in the Plan. The potential damages to each location were estimated based on previous occurrence or damage estimation modeling.

The exclusion of a building from the list of critical facilities does not mean that it houses a minor function. It means that the Hazard Mitigation Team and Subject Matter Experts determined that the activities and functions of that facility were not vital to the immediate health and safety of the residents of New Mexico during a natural hazard event.

Government Offices

Facility: **State Capitol Complex**
Location: Santa Fe, Santa Fe County
Why Critical: State Government Headquarters
Replacement Value: $115,918,184
Contents Value: $10,231,694
Hazards/Potential Losses:

Earthquake PGA 14, 10-20% damage possible
Flood: Zone C, minimal hazard
Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40" snow, 24-32°F average winter temperature, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Harold Runnels Building**
Location: Santa Fe, Santa Fe County
Why Critical: NM Department of Health Headquarters, for Secretary of Health administration; infectious disease epidemiology and environmental health surveillance; public health services delivery.
Replacement Value: $27,947,678
Contents Value: $5,130
Hazards/Potential Losses

Earthquake PGA 14, 10-20% damage possible
Flood: Zone C, minimal hazard
Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med. Zone 11 (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential.
Winter Storm: 20-40" snow, 24-32◦F, no damage anticipated
Drought: No damages anticipated

Facility: **Wallace/Lamy Buildings**
Location: Santa Fe, Santa Fe County
Why Critical: Critical State Government Activities
Replacement Value: $ $27,161,687
Contents Value: $486,505
Hazards/Potential Losses:

- Earthquake: PGA 14, 10-20% damage possible
- Flood: Zone C, minimal Hazard
- Wildfire: none-low, fire resistant construction
- Landslide: none-low
- Dam Failure: none-low
- Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Med, Zone II (EF2-3) up to 50% damage
- Wind: none-low, average wind speed up to 13mph, Beaufort 0-3, high gust potential
- Winter Storm: 20-40" snow, 24-32°F, no damage anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **Villagra Building**
Location: Santa Fe, Santa Fe County
Why Critical: Attorney General Offices, Critical Government Operations
Replacement Value: $8,994,439
Contents Value: $8,710,665
Hazards/Potential Losses:

- Earthquake: PGA 14, 10-20% damage possible
- Flood: Zone C, minimal Hazard
- Wildfire: none-low, fire resistant construction
- Landslide: none-low
- Dam Failure: none-low
- Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Med, Zone II (EF2-3) up to 50% damage
- Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential
- Winter Storm: 20-40" snow, 24-32°F, no damage anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **Bataan Memorial Building**
Location: Santa Fe, Santa Fe County
Why Critical: Department of Finance and Administration, critical government function
Replacement Value: $23,527,668.00
Contents Value: $4,669,065
Hazards/Potential Losses:

- Earthquake: PGA 14, 10-20% damage possible
- Flood: Zone C, minimal Hazard

Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40” snow, 24-32°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Siler Building F**
Location: Santa Fe, Santa Fe County
Why Critical: Houses the Department of Health Emergency Operations Center and Emergency Medical Services.
Replacement Value: N/A
Contents Value: N/A
Hazards/Potential Losses:
Earthquake: PGA 14, 10-20% damage possible
Flood: Zone C, minimal Hazard
Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40” snow, 24-32°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Simms Building**
Location: Santa Fe, Santa Fe County
Why Critical: Houses main IT, communications, computer systems for state
Replacement Value: $9,367,820
Contents Value: 1,939,733
Hazards/Potential Losses:
Earthquake: PGA 14, 10-20% damage possible
Flood: Zone C, minimal Hazard
Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40” snow, 24-32°F, no damage anticipated

Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Department of Corrections

Facility: **Penitentiary of New Mexico (PNM)**
Location: Santa Fe, Santa Fe County
Why Critical: Houses over 900 inmates
Replacement Value: $109,594,619
Contents Value: $ 43,387,798
Hazards/Potential Losses:

Earthquake: PGA 16, 10-20% damages
Flood: Zone X, outside 500-year flood
Wildfire: Med risk, fire resistant construction, minimal damage anticipated
Landslide: no damages predicted
Dam Failure: none-low risk
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40" snow, 24-32°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Roswell Correctional Facility (RCF)**
Location: Roswell, Chaves County
Why Critical: Houses 230+ inmates
Replacement Value: $ 9,280,285
Contents Value: $ 1,795,517
Hazards/Potential Losses:

Earthquake: PGA 2, no damage anticipated
Flood: Zone C, minimal Hazard
Wildfire: none-low, fire resistant construction
Landslide: low risk area, no damages predicted
Dam Failure: Medium, dam failure could flood the city, not expected to affect RCF, but impacts are possible
Thunderstorm: 30-40 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: low, up to 10 mph average winds, Beaufort 0-3, no damage expected
Winter Storm: 1-10" snow per year, average winter temperatures above 40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Southern New Mexico Correctional Facility (SNMCF)**
Location: Las Cruces, Doña Ana County

Why Critical: houses over 800 inmates
Replacement Value: $52,913,307
Contents Value: $9,463,902
Hazards/Potential Losses:

- Earthquake: PGA 8, no damage expected
- Flood: Zone X, outside the 500-year event
- Wildfire: Low, fire resistant construction
- Landslide: low risk area, no damages predicted
- Dam Failure: none-low risk
- Thunderstorm: 30-40 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: straddles Zone I-II border, (up to EF3) up to 50% damage
- Wind: Average wind speed 10 mph, higher gusts possible, up to Beaufort 3, no damage expected
- Winter Storm: 1-10” snow per year, average winter temperatures above 40°F, no damages anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **Springer Detention Center (SDC)**
Location: Springer, Colfax County
Why Critical: Houses 220 inmates
Replacement Value: $23,986,927
Contents Value: $2,889,724
Hazards/Potential Losses:

- Earthquake: PGA 6, no damage anticipated
- Flood: Zone C, no BFEs, Minimal damages
- Wildfire: none-low risk, fire resistant construction
- Landslide: high-risk area, 50% damages possible
- Dam Failure: low risk, the city of Springer lies below Eagle Nest Dam along the Cimarron River, but SDC is not near the river
- Thunderstorm: 70+ thunderstorm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Wind Zone II (EF2-3) up to 50% damage possible
- Wind: average wind speeds 12-13 mph, Beaufort 3-4, no damage anticipated
- Winter Storm: as much as 60” of snow annually, average of 24-32°F, no damages anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **Central New Mexico Correctional Facility (CNMCF)**
Location: Los Lunas, Valencia County
Why Critical: Houses over 1,100 inmates
Replacement Value: $54,483,576
Contents Value: $8,845,712
Hazards/Potential Losses:

- Earthquake: PGA 19, as much as 30% damage possible
- Flood: Zone X, outside the 500-year flood
- Wildfire: Med risk, fire resistant construction no damage expected

Landslide: low risk area, no damages predicted
Dam Failure: low risk, the Rio Grande runs through the city but CNMCF is located some distance from the river
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: location is on the Zone I-II border, (up to EF3) up to 50% damage
Wind: average wind speeds in area up to 15 mph, Beaufort 4, gusts occur often in area, minimal damages anticipated
Winter Storm: approximately 10" of snow annually, average winter temperatures 32-40°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Grants Correctional Facility (GCF)**
Location: Grants, Cibola County
Why Critical: Houses 420+ inmates
Replacement Value: $17,435,548
Contents Value: $1,681,700
Hazards/Potential Losses:
Earthquake: PGA 10, 10-15% damage possible
Flood: Zone C, no BFEs, Minimal damages
Wildfire: Medium risk, fire resistant construction, no damages expected
Landslide: low risk area, no damages predicted
Dam Failure: none-low risk, no dams upstream of GCF
Thunderstorm: as many as 50 t-storm days annually, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: wind zone I, lowest tornado risk, no tornadoes reported in county
Wind: average annual wind sped up to 12 mph, Beaufort 0-3, gusts possible, no damages anticipated
Winter Storm: 10-20 inches of snow on average annually, average winter temperature 24-32°F
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Department of Public Safety (DPS)

Facility: **DPS Headquarters**
Location: Santa Fe, Santa Fe County
Why Critical: Statewide Headquarters for NM State Police, Disaster critical personnel
Replacement Value: $21,286,295
Contents Value: $4,000,042
Earthquake: PGA 14, 10-20% damage possible
Flood: Zone C, minimal Hazard
Wildfire: none-low, within city limits
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible

Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13 mph, Beaufort 4, high gust potential, minimal damages anticipated
Winter Storm: 20-40” snow, 24-32°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **DPS District 1**
Location: Santa Fe, Santa Fe County
Why Critical: (Same location as DPS HQ) Disaster critical personnel
Replacement Value: $495,586
Contents Value: $ 109,174
Earthquake: PGA 14, 10-20% damage possible
Flood: Zone C, minimal Hazard
Wildfire: none-low, within city limits
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13 mph, Beaufort 4, high gust potential, minimal damages anticipated
Winter Storm: 20-40” snow, 24-32°F, no damage anticipated, potential delays in service, personnel at risk
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **DPS District 2**
Location: Las Vegas, San Miguel County
Why Critical: Disaster critical personnel
Replacement Value: $859,153
Contents Value: $329,666
Hazards/Potential Losses:
Earthquake: PGA 12, up to 10% damage possible
Flood: Zone C, minimal hazard
Wildfire: Medium risk area, masonry building, no damage anticipated
Landslide: low risk area, no damages predicted
Dam Failure: none –low risk, no dams upstream of facility
Thunderstorm: 50-60 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Zone II (EF2-3), up to 50% damage
Wind: average wind speeds up to 13 mph, up to Beaufort 4, no damages anticipated,
Winter Storm: up to 60” average snow annually, 24-32°F average winter temperature, response delays
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **DPS District 3**
Location: Roswell, Chaves County
Why Critical: Disaster critical personnel
Replacement Value: $721,204
Contents Value: $134,603
Hazards/Potential Losses:

- Earthquake: PGA 2, No damages expected
- Flood: Flood Zone X, outside the 500-year flood
- Wildfire: Medium, non-combustible masonry
- Landslide: low risk area, no damages predicted
- Dam Failure: Failure of the Two Rivers Reservoir will affect Roswell; inundation is possible at this facility but not likely
- Thunderstorm: Thunderstorm: 30-40 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Wind Zone II (EF2-3), up to 50% damage
- Wind: low, up to 10 mph average winds, Beaufort 0-3, no damage expected
- Winter Storm: 1-10" snow per year, average winter temperatures above 40°F, no damages anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **DPS District 4**
Location: Las Vegas, San Miguel County
Why Critical: First Responders
Replacement Value: $963,092
Contents Value: $320,504
Hazards/Potential Losses:

- Earthquake: PGA 8, up to 10% damage possible
- Flood: Zone X, outside the 500-year flood boundary
- Wildfire: Medium risk area, joisted masonry building, no damage anticipated
- Landslide: low risk area, no damages predicted
- Dam Failure: none –low risk, no dams upstream of facility
- Thunderstorm: 50-60 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Zone II (EF2-3), up to 50% damage
- Wind: average wind speeds up to 11 mph, up to Beaufort 3, high gusts possible, no damages anticipated,
- Winter Storm: up to 60" average snow annually, 24-32°F average winter temperature, response delays
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **DPS District 5**
Location: Albuquerque, Bernalillo County
Why Critical: First Responders
Replacement Value: $2,056,772
Contents Value: $396,471

Hazards/Potential Losses:

- Earthquake: PGA 18, damages up to 30%
- Flood: Zone X, beyond the 500-year flood boundary
- Wildfire: none-low, within city area
- Landslide: low risk area, no damages predicted
- Dam Failure: Low to none, dam failure events would affect Albuquerque, but this facility lies beyond the inundation zones
- Thunderstorm: on average up to 40 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
- Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3
- Winter Storm: snow averages 10-20” winter temperatures average 32-40°F, no damages anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **DPS District 6**
Location: Gallup, McKinley
Why Critical: First responders, disaster critical personnel
Replacement Value: $2,037,289
Contents Value: $474,059
Hazards/Potential Losses:

- Earthquake: PGA 6, no damages projected
- Flood: Flood Zone C, minimal flood hazard
- Wildfire: medium risk, non-combustible materials, no damages anticipated
- Landslide: high-risk area, 50% damage possible
- Dam Failure: low to no risk, no dams upstream
- Thunderstorm: approximately 50 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible

- Tornado: Zone I lowest tornado risk, no tornadoes reported in county
- Wind: average wind speeds up to 13 mph, Beaufort 4, no damages
- Winter Storm: 10-20” of snow per year, average temperatures 24-32°F, no damages anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **DPS District 7**
Location: Española, Rio Arriba County
Why Critical: Critical First Responders
Replacement Value: $1,131,532
Contents Value: $136,560
Hazards/Potential Losses:

- Earthquake: PGA 18 up to 30% damages projected
- Flood: Zone X, no practical flood risk
- Wildfire: High Risk area, building is 100% masonry, non-combustible, minor damage possible
- Landslide: low risk area, no damages predicted

Dam Failure: Community is at risk from Abiquiu Reservoir, this facility lies beyond the inundation zones
Thunderstorm: 40-50 thunderstorm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Facility lies within Zone II (EF2-3), on edge of special wind zone
Wind: average wind speeds 11-12 mph, Beaufort 3, no damages expected
Winter Storm: 40-60" of snow annually, average winter temperatures 24-32°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **DPS Sub-District 7**
Location: Taos, Taos County
Why Critical: Critical First Responders
Replacement Value: $416,777
Contents Value: $102,489
Hazards/Potential Losses:
Earthquake: PGA 12, up to 15% damages probable
Flood: Zone X no appreciable flood hazard
Wildfire: High-risk area, Frame Construction, 100% damage possible
Landslide: low risk area, no damages predicted
Dam Failure: Low risk, no dams upstream
Thunderstorm: 50-60 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Wind Zone II (EF2-3), up to 60% damage possible
Wind: average wind speed 11 mph, Beaufort 4, higher gusts likely
Winter Storm: 20-40 inches normal, 60+ inches likely, Average winter temperatures below 24°F, losses possible
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **DPS District 9**
Location: Clovis, Curry County
Why Critical: First responders, critical personnel
Replacement Value: $436,452
Contents Value: $134,362
Hazards/Potential Losses:
Earthquake: PGA 2, no damages predicted
Flood: Zone X, no damages expected
Wildfire: no damages expected
Landslide: low risk area, no damages predicted
Dam Failure: no dams upstream
Thunderstorm: 40-50 thunderstorm days annually, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Wind Zone III (EF3+), >60% damages possible
Wind: average wind speeds over 15 mph, Beaufort 4+, higher gusts very likely,
Winter Storm: 10-20" snow average, average winter temps 32-40°F, Damages possible

Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Department of Homeland Security and Emergency Management (DHSEM)

Facility: **State Emergency Management Center**
Location: Santa Fe, Santa Fe County
Why Critical: State Emergency Operations Center, Critical Disaster Response
Replacement Value: $3,850,827
Contents Value: $1,243,393
Hazards/Potential Losses:
Earthquake: PGA 16, 10-20% damages
Flood: Zone X, outside 500-year flood
Wildfire: Med risk, fire resistant construction, minimal damage anticipated
Landslide: low risk area, no damages predicted
Dam Failure: none-low risk
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40” snow, 24-32°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Urban Search and Rescue Facility**
Location: Albuquerque, Bernalillo County
Latitude and Longitude: 35.084 degrees N, 106.651 degrees W
Why Critical: State Emergency Operations Center for continuity of operations, Critical Disaster Response
Replacement Value: $1,500,000
Contents Value: $ 6,000,000
Hazards/Potential Losses:
Earthquake: PGA 14, 10-20% damages
Flood: Zone X, outside 500-year flood
Wildfire: Med risk, fire resistant construction, minimal damage anticipated
Landslide: low risk area, no damages predicted
Dam Failure: Low risk, while dam failures will impact the city, the facility lies outside the inundation zones
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3
Winter Storm: snow averages 10-20” winter temperatures average 32-40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Department of Military Affairs

Facility: **Oñate Complex**
Location: Santa Fe, Santa Fe County
Why Critical: State National Guard Headquarters
Replacement Value: $56, 671,389
Contents Value: $1,008,072
Hazards/Potential Losses:

- Earthquake: PGA 16, 10-20% damages
- Flood: Zone X, outside 500-year flood
- Wildfire: Med risk, fire resistant construction, minimal damage anticipated
- Landslide: low risk area, no damages predicted
- Dam Failure: none-low risk
- Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Med, Zone II (EF2-3) up to 50% damage
- Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential
- Winter Storm: 20-40" snow, 24-32°F, no damage anticipated
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **Aircraft Maintenance Hanger**
Location: Santa Fe, Santa Fe County
Why Critical: Aviation Support for National Guard Disaster Response Activities
Replacement Value: $7,079,414
Contents Value: $740,555
Hazards/Potential Losses:

- Earthquake: PGA 16, 10-20% damages
- Flood: Zone X, outside 500-year flood
- Wildfire: Low risk, non-combustible construction, minimal damage anticipated
- Landslide: low risk area, no damages predicted
- Dam Failure: none-low risk
- Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
- Tornado: Med, Zone II (EF2-3) up to 50% damage
- Wind: none-low, average wind speed up to 13 mph, Beaufort 0-3, high gust potential
- Winter Storm: 20-40" snow, 24-32°F, no damage anticipated
- Drought: No Damages Anticipated
- Extreme Heat: Damages to runways possible, damages are gradual

Facility: **National Guard Bernalillo Armory**
Location: Albuquerque, Bernalillo County
Why Critical: Regional National Guard Operations
Replacement Value: $7,503,959
Contents Value: $656,888
Hazards/Potential Losses:

- Earthquake: PGA 18, up to 30% damage possible
- Flood: Flood Zone X, beyond 500-year flood plain

Wildfire: None –low, within city areas
Landslide: low risk area, no damages predicted
Dam Failure: Low risk, while dam failures will impact the city, the facility lies outside the inundation zones
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3
Winter Storm: snow averages 10-20" winter temperatures average 32-40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Roswell Armory**
Location: Roswell, Chaves County
Why Critical: Regional National Guard Operations
Replacement Value: $29,810,784
Contents Value: $4,663,159
Hazards/Potential Losses:

Earthquake: PGA 6, up to 10% damages projected
Flood: Flood Zone C. Minimal hazard, no damages anticipated
Wildfire: Low hazard, minimal damages projected
Landslide: low risk area, no damages predicted
Dam Failure: While dams on the Pecos and Hondo rives have dams, the facility is not within the inundation zones
Thunderstorm: 40-50 t-storm days per year, area of high lightning density, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: Average wind speeds around 11 mph, high gusts possible, none-light damages predicted
Winter Storm: less than 10" average snowfall annually, average winter temps between 32 and 40°F
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Colfax Armory**
Location: Springer, Colfax County
Why Critical: Regional National Guard Operations
Replacement Value: $4,351,924
Contents Value: $891,075
Hazards/Potential Losses:

Earthquake: PGA 6, no damages anticipated
Flood: Flood Zone C, minimal hazard
Wildfire: Low risk area, non-combustible materials, no damage projected
Landslide: high-risk area, 50% damages possible
Dam Failure: Medium hazard, Eagle Nest Dam could affect this area, 10% damage projected

Thunderstorm: 70+ thunderstorm days per year, high lightning density, the materials used in construction, and lightning shielding of equipment is in place, <20% damages anticipated
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: average wind speeds up to 15, mph, Beaufort 4, gust possible, light damages possible
Winter Storm: up to 40" annual snowfall, winter temperatures average as low as 24°F, damages possible but unlikely
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Belen Armory**
Location: Belen, Valencia County
Why Critical: Regional National Guard Operations
Replacement Value: $5,546,495
Contents Value: $396,568
Hazards/Potential Losses:
Earthquake: PGA 18, up to 30% damages anticipated
Flood: Flood Zone A, no BFEs, flooding possible, 25% damages likely
Wildfire: med fire risk area, 100% non-combustible materials, low damages expected
Landslide: low risk area, no damages predicted
Dam Failure: med risk, dam failures upstream will affect the community, facility lies within the inundation zone, ≥25% damages possible
Thunderstorm: 40-50 t-storm days per year, area of high lightning density, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds in area up to 15 mph, Beaufort 4, gusts occur often in area, minimal damages anticipated
Winter Storm: approximately 10" of snow annually, average winter temperatures 32-40°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Socorro Armory**
Location: Socorro, Socorro County
Why Critical: Regional National Guard Operations
Replacement Value: $2,081,668
Contents Value: $944,583
Hazards/Potential Losses:
Earthquake: PGA 20, possible damages of up to 30%
Flood: Flood Zone X, no damages projected
Wildfire: low risk area, no damages anticipated
Landslide: low risk area, no damages predicted
Dam Failure: Socorro lies along the Rio Grande River, and dam failures upstream will go through the town, the armory is approximately 3 miles from the river, minimal if any damages expected
Thunderstorm: 40-50 t-storm days per year, area of high lightning density, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10

Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds between 14 and 15 mph, Beaufort 4, gusts possible, low damages predicted
Winter Storm: average winter temperatures above 32 degrees, up to 10 inches annual snowfall, minimal damages predicted
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Sandoval Armory**
Location: Rio Rancho, Sandoval County
Why Critical: Regional National Guard Operations
Replacement Value: $11,326,041
Contents Value: $42,641,365
Hazards/Potential Losses:

Earthquake: PGA 16, Up to 10% damages
Flood: Zone X
Wildfire: Medium risk, grass fires, non-combustible materials, no damage probable
Landslide: low risk area, no damages predicted
Dam Failure: no dams up stream of facility
Thunderstorm: 40-50 t-storm days per year, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10
Tornado: wind zone I, lowest tornado risk, up to EF2, 40 % damages possible
Wind: average wind speeds 13 mph, Beaufort 4, gusts possible, no damages projected
Winter Storm: area receives 20-40 "per year of snow, winter temperatures up to 40°F
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Hospitals/Medical Facilities

Facility: **University of New Mexico Hospital**
Location: Albuquerque, Bernalillo NM
Why Critical: Only Level 1 Trauma Center in the State
Replacement Value: $103,710,520
Contents Value: $ 27,557,550
Hazards/Potential Losses:

Earthquake: PGA 18, damages up to 30%
Flood: Zone X, beyond the 500-year flood boundary
Wildfire: none-low, within city area
Landslide: low risk area, no damages predicted
Dam Failure: Low to none, dam failure events would affect Albuquerque, but this facility lies beyond the inundation zones
Thunderstorm: on average up to 40 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3

Winter Storm: snow averages 10-20” winter temperatures average 32-40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Tri-Service Building**
Location: Albuquerque, Bernalillo County
Why Critical: State Morgue, and location of primary scientific and veterinary laboratories in the state
Replacement Value: $ 11,515,095.00
Contents Value: $ 5,858,838
Earthquake: PGA 18, damages up to 30%
Flood: Zone X, beyond the 500-year flood boundary
Wildfire: none-low, within city area
Landslide: low risk area, no damages predicted
Dam Failure: Low to none, dam failure events would affect Albuquerque, but this facility lies beyond the inundation zones
Thunderstorm: on average up to 40 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3
Winter Storm: snow averages 10-20” winter temperatures average 32-40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **New Mexico Behavioral Health Institute**
Location: San Miguel County
Why Critical: Only State psychiatric and forensic hospital
Replacement Value:
Contents Value:
Hazards/Potential Losses:
Earthquake: PGA 8, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: 50+ t-storm days annually, high lightning density, up to 50% damages
Tornado: wind zone II, but any tornado could cause 100% loss
Wind: no damages anticipated
Winter Storm: 40+ inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **New Mexico Rehabilitation Center**
Location: Chavez County
Why Critical: Inpatient Physical Rehabilitation Facility
Replacement Value:

Contents Value:
Hazards/Potential Losses:

- Earthquake: PGA 6, up to 10% damages projected
- Flood: Flood Zone C. Minimal hazard, no damages anticipated
- Wildfire: Low hazard, minimal damages projected
- Landslide: low risk area, no damages predicted
- Dam Failure: While dams on the Pecos and Hondo rives have dams, the facility is not within the inundation zones
- Thunderstorm: 40-50 t-storm days per year, area of high lightning density, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10
- Tornado: Med, Zone II (EF2-3) up to 50% damage
- Wind: Average wind speeds around 11 mph, high gusts possible, none-light damages predicted
- Winter Storm: less than 10" average snowfall annually, average winter temps between 32 and 40°F
- Drought: No Damages Anticipated
- Extreme Heat: No Damages Anticipated

Facility: **New Mexico Veterans Center**
Location: Sierra County
Why Critical: Inpatient nursing facility for veterans
Replacement Value: $13,021,010
Contents Value: $ 1,193,940
Hazards/Potential Losses:

- Earthquake: PGA 8, 50% damage possible
- Flood: N/A
- Flood: N/A
- Wildfire: low risk area, less than 15% damages possible
- Landslide: low risk area, no damages predicted
- Dam Failure: N/A
- Thunderstorm: High-risk area, equipment could be 100% destroyed
- Tornado: wind zone II, but any tornado could cause 100% loss
- Wind: no damages anticipated
- Winter Storm: less than 10 inches of snow per year, no damages anticipated
- Drought: no damages projected
- Heat: no damages expected

Facility: **Fort Bayard Medical Center**
Location: Grant County
Why Critical: Inpatient Nursing Care Facility
Replacement Value:
Contents Value:
Hazards/Potential Losses:

- Earthquake: PGA 8, less than 10% damages projected
- Flood: N/A
- Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
- Landslide: low risk area, no damages predicted
- Dam Failure: N/A

Thunderstorm: High Risk, sensitive equipment could be damaged, up to 50% damages
Tornado: Low risk,
Wind: Medium risk, average wind speed low, but high gusts possible
Winter Storm: average snowfall between 20-40 "per year, minimal damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Miners Colfax Medical Center**
Location: Colfax County:
Why Critical: Hospital
Replacement Value: $10,449,286
Contents Value: $4,026,953
Hazards/Potential Losses:

Earthquake: PGA 6, no damage anticipated
Flood: Zone C, no BFEs, Minimal damages
Wildfire: none-low risk, fire resistant construction
Landslide: high-risk area, 50% damages possible
Dam Failure: low risk, the city of Springer lies below Eagle Nest Dam along the Cimarron River, but SDC is not near the river
Thunderstorm: 70+ thunderstorm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Wind Zone II (EF2-3) up to 50% damage possible
Wind: average wind speeds 12-13 mph, Beaufort 3-4, no damage anticipated
Winter Storm: as much as 60" of snow annually, average of 24-32°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Sequoyah Adolescent Treatment Center**
Location: Bernalillo County
Why Critical: Inpatient adolescent treatment
Replacement Value: $8,869,534
Contents Value: $1,090,232
Hazards/Potential Losses:

Earthquake: PGA 18, damages up to 30%
Flood: Zone X, beyond the 500-year flood boundary
Wildfire: none-low, within city area
Landslide: low risk area, no damages predicted
Dam Failure: Low to none, dam failure events would affect Albuquerque, but this facility lies beyond the inundation zones
Thunderstorm: on average up to 40 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3
Winter Storm: snow averages 10-20" winter temperatures average 32-40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Los Lunas Community Program**
Location: Valencia County
Why Critical: Program for Developmentally Disabled Children and Adults
Replacement Value:
Contents Value:
Hazards/Potential Losses:

Earthquake: PGA 18, up to 30% damages anticipated
Flood: Flood Zone A, no BFEs, flooding possible, 25% damages likely
Wildfire: med fire risk area, 100% non-combustible materials, low damages expected
Landslide: low risk area, no damages predicted
Dam Failure: med risk, dam failures upstream will affect the community, facility lies within the inundation zone, ≥25% damages possible
Thunderstorm: 40-50 t-storm days per year, area of high lightning density, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds in area up to 15 mph, Beaufort 4, gusts occur often in area, minimal damages anticipated
Winter Storm: approximately 10” of snow annually, average winter temperatures 32-40°F, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Radio/Communications Sites

Note: Not all critical radio and communication sites are included in this list. The Department of Homeland Security and Emergency Management along with the Department of Information Technology will analyze existing data to determine which radio and communication sites are critical according to the definition included in this Plan. Once those determinations are made, descriptions of each site will be compiled and included in the next State Plan update.

Facility: **Santa Fe Control (DOIT)**
Location: Santa Fe County New Mexico DPS or State Police Complex (for Radio Communications Bureau)
Why Critical: Critical communications Towers and Equipment
Replacement Value: $124,854
Contents Value: $384,667
Hazards/Potential Losses:

Earthquake: PGA 12, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: medium risk area, 50% damage possible
Dam Failure: N/A
Thunderstorm: High-risk area, equipment could be 100% destroyed
Tornado: wind zone II, but any tornado could cause 100% loss
Wind: no damages anticipated

Winter Storm: 40+ inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Sandia Peak**
Location: Bernalillo County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $28,023.00
Contents Value: $95,541
Hazards/Potential Losses:
Earthquake: PGA 16, any significant shaking could damage the facility, requiring extensive repairs
Flood: N/A
Wildfire: High-risk area, tower itself not at risk, but the equipment is at high risk, possible 50% damage.
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: High Risk, sensitive equipment could be damaged, up to 50% damages
Tornado: Low risk, top of mountain peak
Wind: Medium risk, average wind speed low, but high gusts possible
Winter Storm: As many as 100" of snow per year, minimal damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Davenport**
Location: Catron County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $22,284
Contents Value: $68,844
Hazards/Potential Losses:
Earthquake: PGA 8, less than 10% damages projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: High Risk, sensitive equipment could be damaged, up to 50% damages
Tornado: Low risk, top of mountain peak
Wind: Medium risk, average wind speed low, but high gusts possible
Winter Storm: average snowfall between 20-40 "per year, minimal damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **High Lonesome**
Location: Chaves County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $51,514
Contents Value: $294,855

Hazards/Potential Losses:

Earthquake: PGA 2, no damages projected
Flood: N/A
Wildfire: low risk area, minimal damages anticipated
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: High Risk, sensitive equipment could be damaged, up to 50% damages
Tornado: Medium Risk, Wind Zone II, EF2-3, 100% damage possible
Wind: low average wind speed, no damages anticipated
Winter Storm: average snowfall ≤10 ", no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **La Mosca**
Location: Cibola County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $60,764
Contents Value: $33,815
Hazards/Potential Losses:

Earthquake: PGA 10, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: high-risk area, 100% damage possible
Dam Failure: N/A
Thunderstorm: Up to 50 t-storm days per year, high lightning density area, and sensitive equipment could be damaged, up to 50% damages
Tornado: Wind Zone I, but a tornado could cause 100% damage
Wind: no damages anticipated
Winter Storm: up to 40" per year, no damages likely
Drought: no damages projected
Heat: no damages expected

Facility: **Touch-Me-Not**
Location: Colfax County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $8,486
Contents Value: $52,705
Hazards/Potential Losses:

Earthquake: PGA 10, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: high-risk area, 100% damage potential
Dam Failure: N/A
Thunderstorm: up to 70 t-storm days annually, high density lightning area, sensitive equipment could be damaged, up to 50% damages
Tornado: Wind zone II, 100% damage possible
Wind: average wind speeds nearing 15 mph, gust possible, minimal damages anticipated

Winter Storm: up to 140” snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Tucumcari**
Location: Quay County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $155,767
Contents Value: $42,488
Hazards/Potential Losses:
Earthquake: PGA 4, no damages anticipated
Flood: N/A
Wildfire: low risk
Landslide: medium risk area, 50% damage predicted
Dam Failure: N/A
Thunderstorm: up to 50 t-storm days annually, high lightning density area, sensitive equipment could be damaged, up to 50% damages
Tornado: Wind Zone III, EF3+, 1005 damage possible
Wind: average wind speeds up to 18 mph, no damages projected
Winter Storm: up to 20” annually, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Eureka Mesa**
Location: Rio Arriba County
Why Critical: Critical communications Towers and Equipment
Replacement Value:$21,906
Contents Value: $57,224
Hazards/Potential Losses:
Earthquake: PGA 10, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: medium risk area, 50% damage likely
Dam Failure: N/A
Thunderstorm: 50-60 t-storm days per year, sensitive equipment could be damaged, up to 50% damages
Tornado: straddles Zone I-II border, (up to EF3) up to 50% damage
Wind: no damages likely
Winter Storm: 100+ inches of snow per year, damages unlikely
Drought: no damages projected
Heat: no damages expected

Facility: **Archuleta**
Location: Rio Arriba County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $30,000
Contents Value: $50,000

Hazards/Potential Losses:

Earthquake: PGA 8, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: medium risk area, 50% damage possible
Dam Failure: N/A
Thunderstorm: 50+ thunderstorm days annually, sensitive equipment could be damaged, up to 50% damages
Tornado: Zone I, but any tornado could cause 100% damage
Wind: no damages anticipated
Winter Storm: high snow area 100+ inches, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **South Mesa**
Location: San Juan County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $22,908.00
Contents Value: $60,576
Hazards/Potential Losses:

Earthquake: PGA 6, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: low risk area, less than 15% damages possible
Landslide: low risk area, no damages predicted

Dam Failure: N/A
Thunderstorm: up to 50 thunderstorm days per year, sensitive equipment could be damaged, up to 50% damages
Tornado: Zone I, but any tornado could cause 100% damage
Wind: no damages anticipated
Winter Storm: up to 20 inches annually, no damages projected
Drought: no damages projected
Heat: no damages expected

Facility: **Gallinas**
Location: San Miguel County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $12,152
Contents Value: $16,246
Hazards/Potential Losses:

Earthquake: PGA 8, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: 50+ t-storm days annually, high lightning density, up to 50% damages
Tornado: wind zone II, but any tornado could cause 100% loss

Wind: no damages anticipated
Winter Storm: 40+ inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Tesuque Peak**
Location: Santa Fe County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $193,485
Contents Value: $6,165
Hazards/Potential Losses:
Earthquake: PGA 12, any significant shaking could cause damage, 50% projected
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages possible
Landslide: medium risk area, 50% damage possible
Dam Failure: N/A
Thunderstorm: High-risk area, equipment could be 100% destroyed
Tornado: wind zone II, but any tornado could cause 100% loss
Wind: no damages anticipated
Winter Storm: 40+ inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Galisteo**
Location: Santa Fe County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $162,538
Contents Value: $4,318,599
Hazards/Potential Losses:
Earthquake: PGA 14, >50% damage possible
Flood: N/A
Wildfire: Low risk
Landslide: medium risk area, 50% damage possible
Dam Failure: N/A
Thunderstorm: High-risk area, equipment could be 100% destroyed
Tornado: wind zone II, but any tornado could cause 100% loss
Wind: no damages anticipated
Winter Storm: 40+ inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Caballo**
Location: Sierra County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $23,834
Contents Value: $82,849
Hazards/Potential Losses:

Earthquake: PGA 8, 50% damage possible
Flood: N/A
Flood: N/A
Wildfire: low risk area, less than 15% damages possible
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: High-risk area, equipment could be 100% destroyed
Tornado: wind zone II, but any tornado could cause 100% loss
Wind: no damages anticipated
Winter Storm: less than 10 inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Socorro Peak**
Location: Socorro County
Why Critical: Critical communications Towers and Equipment
Replacement Value: $22,500
Contents Value: $50,000
Hazards/Potential Losses:
Earthquake: PGA 18, 10% loss possible
Flood: N/A
Wildfire: medium risk, 15-25% damages possible
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: High-risk area, equipment could be 100% destroyed
Tornado: wind zone I, but any tornado could cause 100% loss
Wind: no damages anticipated
Winter Storm: less than 10 inches of snow per year, no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Sierra Grande**
Location: Union County
Why Critical: Critical communications Towers and Equipment
Replacement Value: Unavailable
Contents Value: $20,368
Hazards/Potential Losses:
Earthquake: PGA 4 no damages likely
Flood: N/A
Wildfire: High wildfire risk area, equipment could be damaged, 50% damages predicted
Landslide: low risk area, no damages predicted
Dam Failure: N/A
Thunderstorm: High-risk area, equipment could be 100% destroyed
Tornado: wind zone II nearing zone III line, but any tornado could cause 100% loss
Wind: no damages anticipated
Winter Storm: less than 20 inches of snow per year, no damages anticipated
Drought: no damages projected

Heat: no damages expected

Department of Transportation Facilities

Facility: **Department of Transportation Headquarters**
Location: Santa Fe, Santa Fe County
Why Critical: Critical Emergency Operations
Replacement Value: $30,306,429
Contents Value: $7,017,272
Hazards/Potential Losses:

Earthquake PGA 14, 10-20% damage possible
Flood: Zone C, minimal hazard
Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40" snow, 24-32°F average winter temperature, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Dept. of Transportation District 1 Headquarters**
Location: Deming, Luna County
Why Critical: Critical Emergency Operations
Replacement Value: $5,737,660
Contents Value: $1,841,876
Hazards/Potential Losses:

Earthquake: PGA 8, no damages anticipated
Flood: Flood Zone X, Beyond the 500 year flood boundary
Wildfire: low risk, masonry construction
Landslide: low potential
Dam Failure: no risk, no dams upstream
Thunderstorm: low to medium lightning density, 20-30 thunderstorms per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: wind zone 1, EF0-2, up to 40% damages projected
Wind: average wind speed 13-14 mph, Beaufort 4, Gusts possible, no damages anticipated
Winter Storm: less than 10" annual snowfall, average winter temperatures above 40°F, and no damages anticipated
Drought: no damages projected
Heat: no damages expected

Facility: **Dept. of Transportation District 2 Headquarters**
Location: Roswell, Chaves County
Why Critical: Critical Emergency Operations

Replacement Value: $4,357,003
Contents Value: $1,966,822
Hazards/Potential Losses:
Earthquake: PGA 6, up to 10% damages projected
Flood: Flood Zone C. Minimal hazard, no damages anticipated
Wildfire: Low hazard, minimal damages projected
Landslide: low risk area, no damages predicted
Dam Failure: While dams on the Pecos and Hondo rives have dams, the facility is not within the inundation zones
Thunderstorm: 40-50 t-storm days per year, area of high lightning density, structures are non-combustible, low damage anticipated, up to LAL 5, Hail up to H10
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: Average wind speeds around 11 mph, high gusts possible, none-light damages predicted
Winter Storm: less than 10" average snowfall annually, average winter temps between 32 and 40°F
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Dept. of Transportation District 3 Headquarters**
Location: Albuquerque, Bernalillo County
Why Critical: Critical Emergency Operations
Replacement Value: $242,593
Contents Value: $101,723
Hazards/Potential Losses:
Earthquake: PGA 18, damages up to 30%
Flood: Zone X, beyond the 500-year flood boundary
Wildfire: none-low, within city area
Landslide: low risk area, no damages predicted
Dam Failure: Low to none, dam failure events would affect Albuquerque, but this facility lies beyond the inundation zones
Thunderstorm: on average up to 40 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: facility lies close to Zone I-II boundary, (up to EF3) up to 50% damage
Wind: average wind speeds <10 mph, gusty conditions exist, Beaufort 3
Winter Storm: snow averages 10-20" winter temperatures average 32-40°F, no damages anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Dept. of Transportation District 4 Headquarters**
Location: Las Vegas, San Miguel County
Why Critical: Critical Emergency Operations
Replacement Value: $5,176,674
Contents Value: $1,791,683
Hazards/Potential Losses:
Earthquake: PGA 12, up to 10% damage possible
Flood: Zone C, minimal hazard

Wildfire: Medium risk area, masonry building, no damage anticipated
Landslide: low risk area, no damages predicted
Dam Failure: none –low risk, no dams upstream of facility
Thunderstorm: 50-60 t-storm days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Zone II (EF2-3), up to 50% damage
Wind: average wind speeds up to 13 mph, up to Beaufort 4, no damages anticipated,
Winter Storm: up to 60" average snow annually, 24-32°F average winter temperature, response delays
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Dept. of Transportation District 5 Headquarters**
Location: Milan, Cibola County
Why Critical: Critical Emergency Operations
Replacement Value: $2,950,282
Contents Value: $906,881
Hazards/Potential Losses:
Earthquake PGA 14, 10-20% damage possible
Flood: Zone C, minimal hazard
Wildfire: none-low, fire resistant construction
Landslide: none-low
Dam Failure: none-low
Thunderstorm: 40-50 lightning days per year, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: Med, Zone II (EF2-3) up to 50% damage
Wind: none-low, average wind speed up to 13mph, Beaufort 0-3, high gust potential
Winter Storm: 20-40" snow, 24-32°F average winter temperature, no damage anticipated
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Facility: **Dept. of Transportation District 6 Headquarters**
Location: Las Vegas, San Miguel County
Why Critical: Critical Emergency Operations
Replacement Value: $117,591
Contents Value: $669,713
Hazards/Potential Losses:
Earthquake: PGA 10, 10-15% damage possible
Flood: Zone C, no BFEs, Minimal damages
Wildfire: Medium risk, fire resistant construction, no damages expected
Landslide: low risk area, no damages predicted
Dam Failure: none-low risk, no dams upstream of GCF
Thunderstorm: as many as 50 t-storm days annually, up to LAL 5, Hail up to H10, 15-20% damages possible
Tornado: wind zone I, lowest tornado risk, no tornadoes reported in county
Wind: average annual wind sped up to 12 mph, Beaufort 0-3, gusts possible, no damages anticipated

Winter Storm: 10-20 inches of snow on average annually, average winter temperature 24-32°F
Drought: No Damages Anticipated
Extreme Heat: No Damages Anticipated

Hazus breaks critical facilities into two groups: essential facilities and high potential loss facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

Table 4.3 provides a consolidated listing of identified critical facilities in the state by preparedness area as identified by the HAZUS-MH Level 1 analysis.

Table 4.3. Critical Facilities by Preparedness Area

Classification	Preparedness Area 1	Preparedness Area 2	Preparedness Area 3	Preparedness Area 4	Preparedness Area 5	Preparedness Area 6
Hospitals	10	4	4	9	19	8
Schools	193	64	151	159	348	162
Emergency Operations Centers	16	8	22	10	27	13
Police Stations	39	14	21	22	45	25
Fire Stations	61	35	38	22	41	65
Total	319	125	236	222	480	273

Visualizing the location of critical facilities through mapping can contribute to more robust understandings of both vulnerability and capability in the event of a disaster. The following seven Figures (Figures 4.4 – 4.10) present state and Preparedness Area maps of critical facilities.

Figure 4.4. Statewide Critical Facilities Map

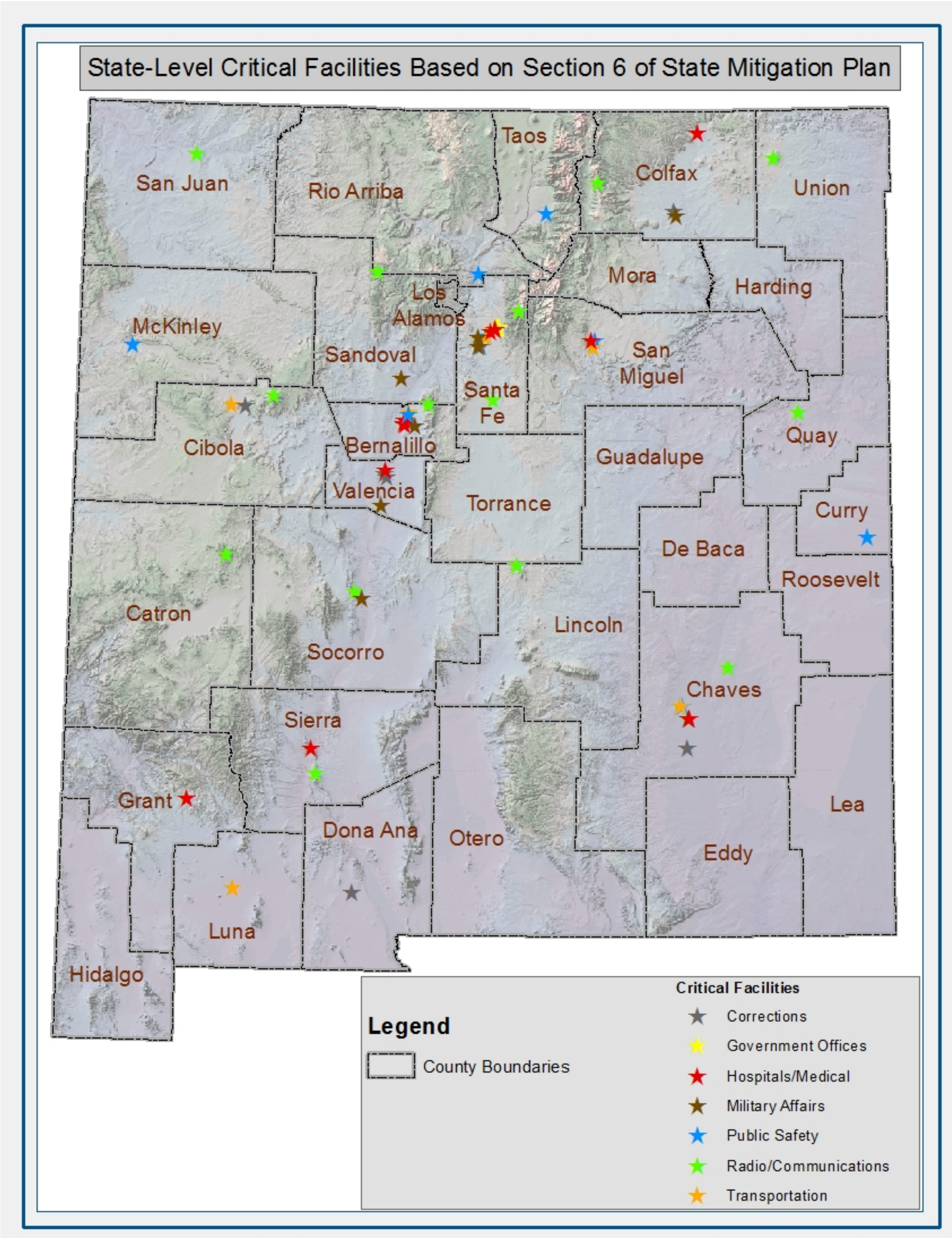
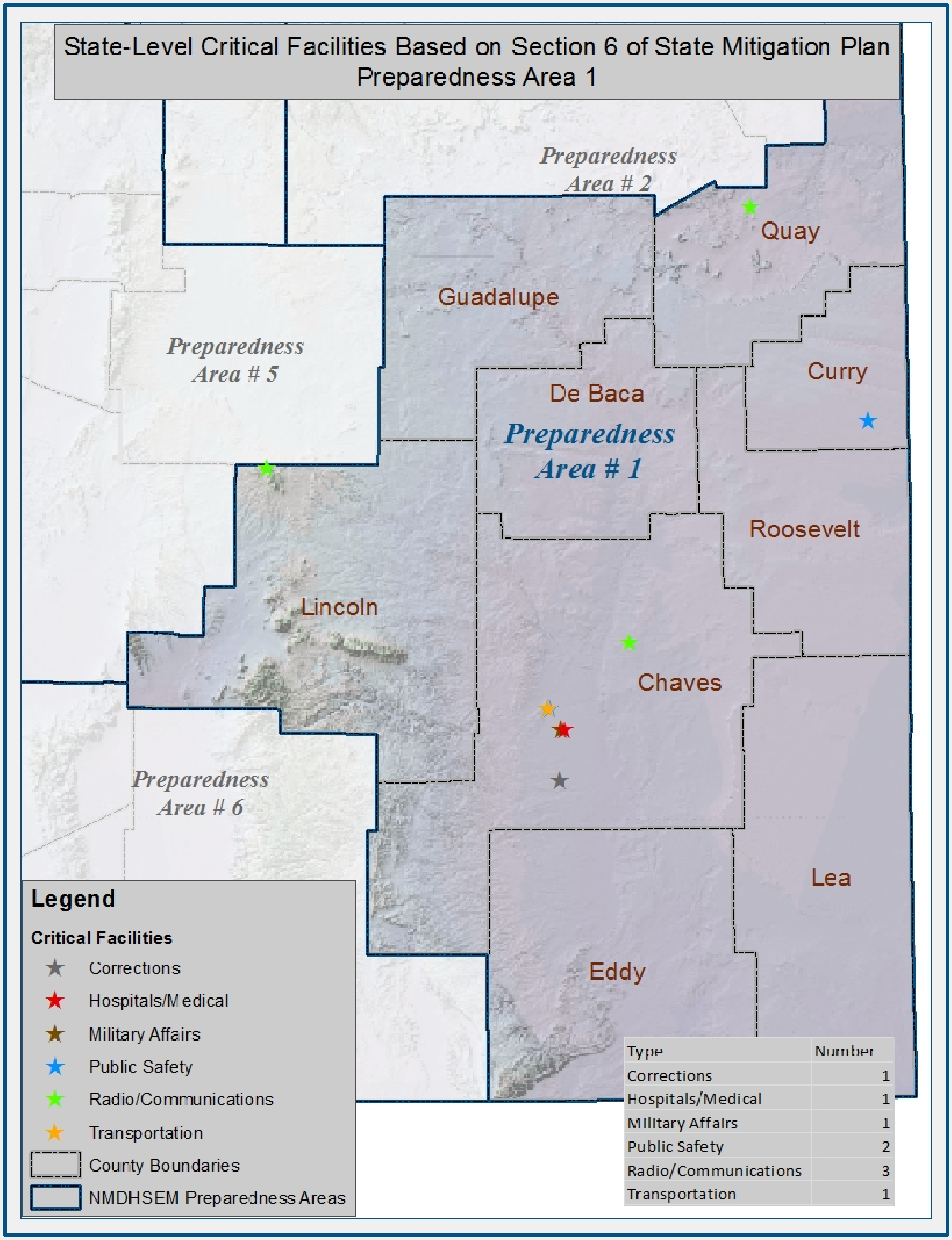


Figure 4.5: Critical Facilities Map of Preparedness Area 1



Type	Number
Corrections	1
Hospitals/Medical	1
Military Affairs	1
Public Safety	2
Radio/Communications	3
Transportation	1

Figure 4.6: Critical Facilities Map of Preparedness Area 2

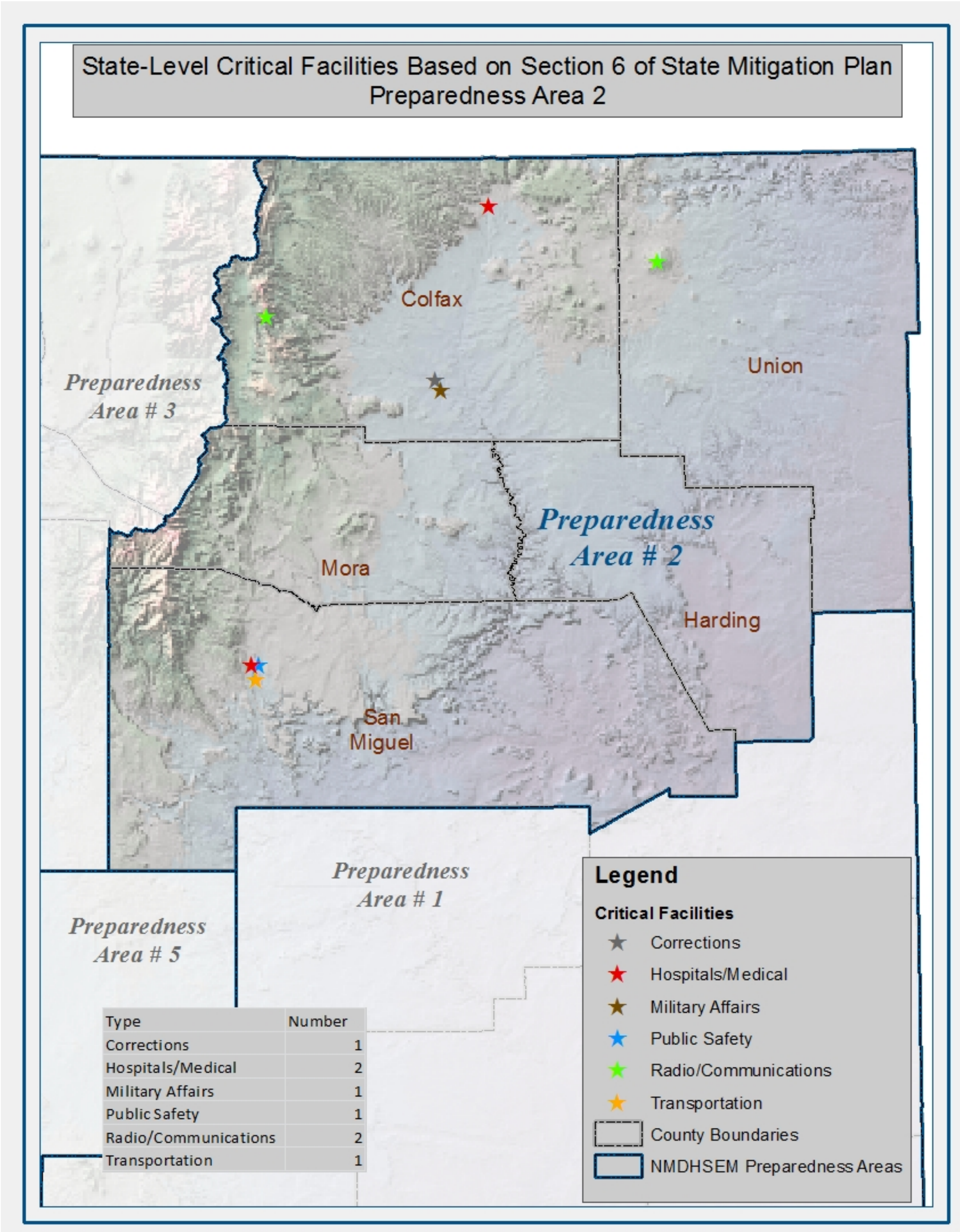


Figure 4.7: Critical Facilities Map of Preparedness Area 3

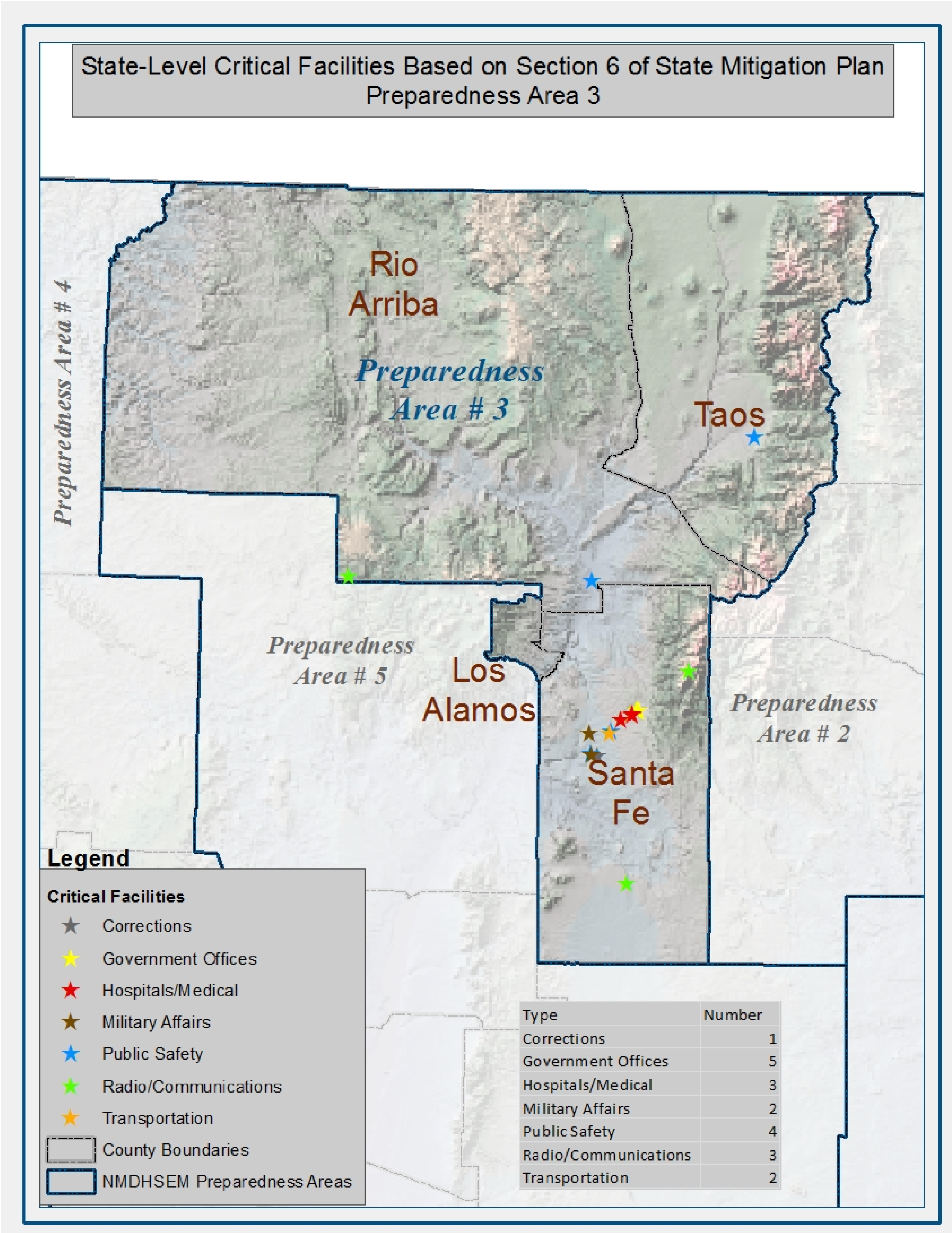


Figure 4.8: Critical Facilities Map of Preparedness Area 4

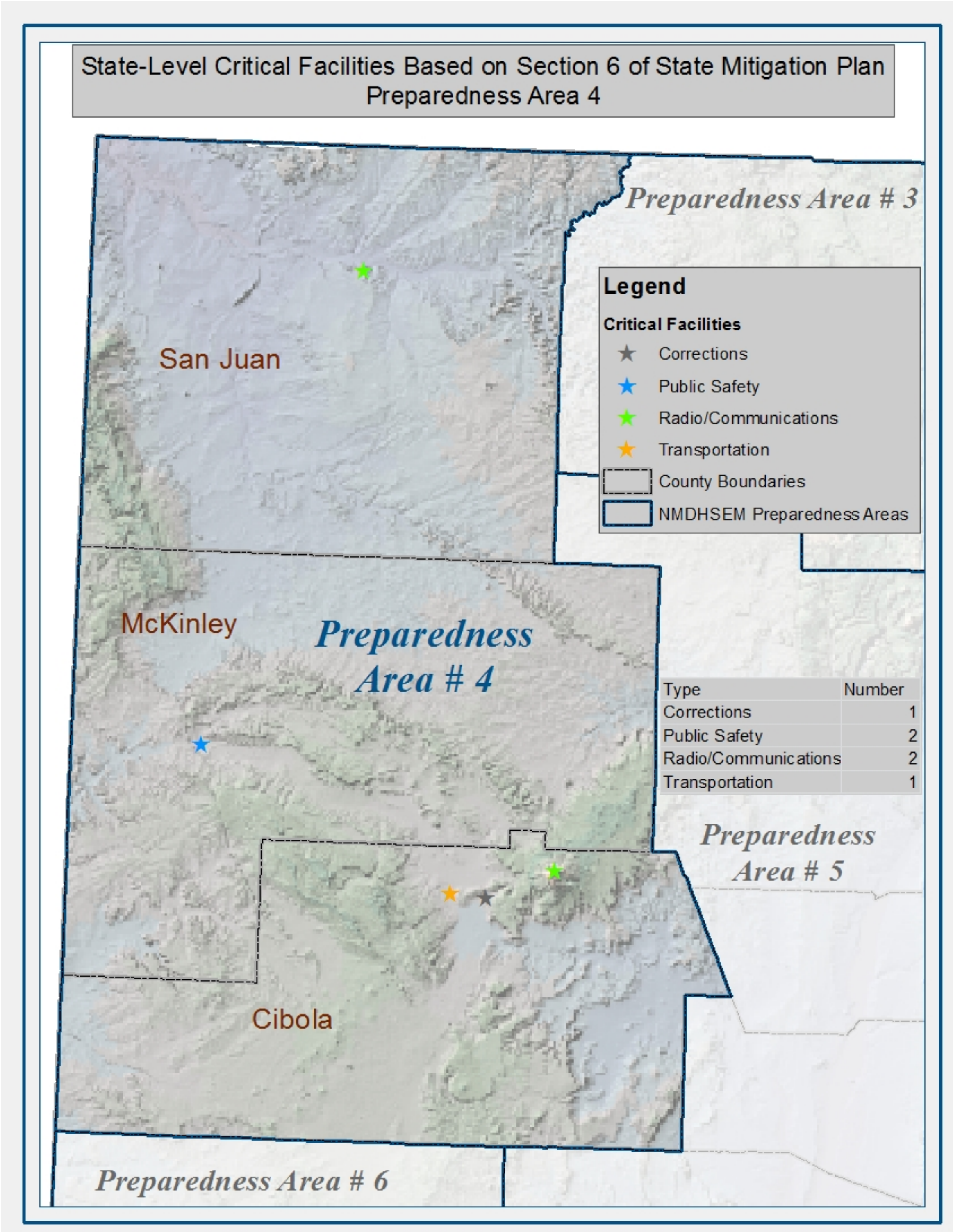
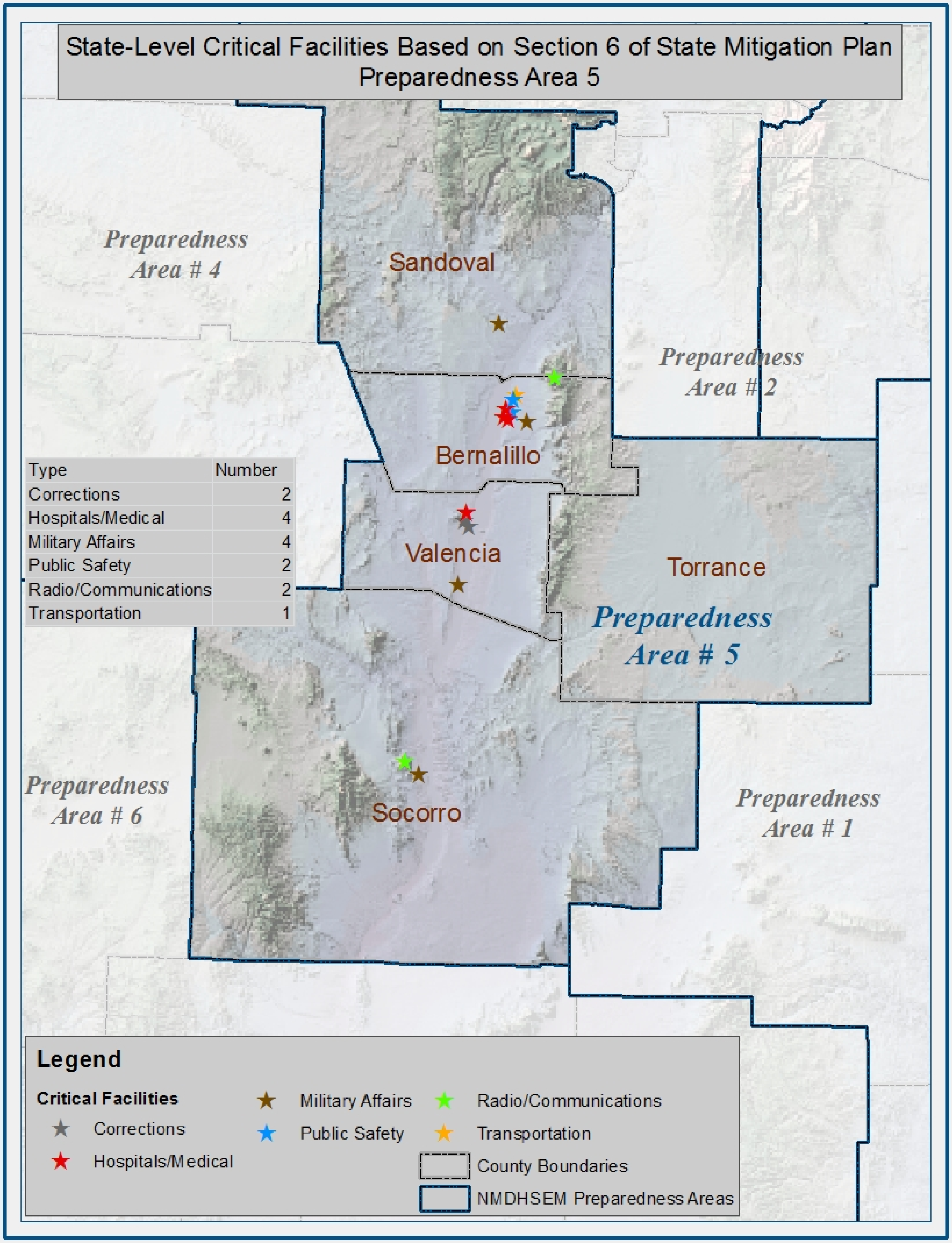
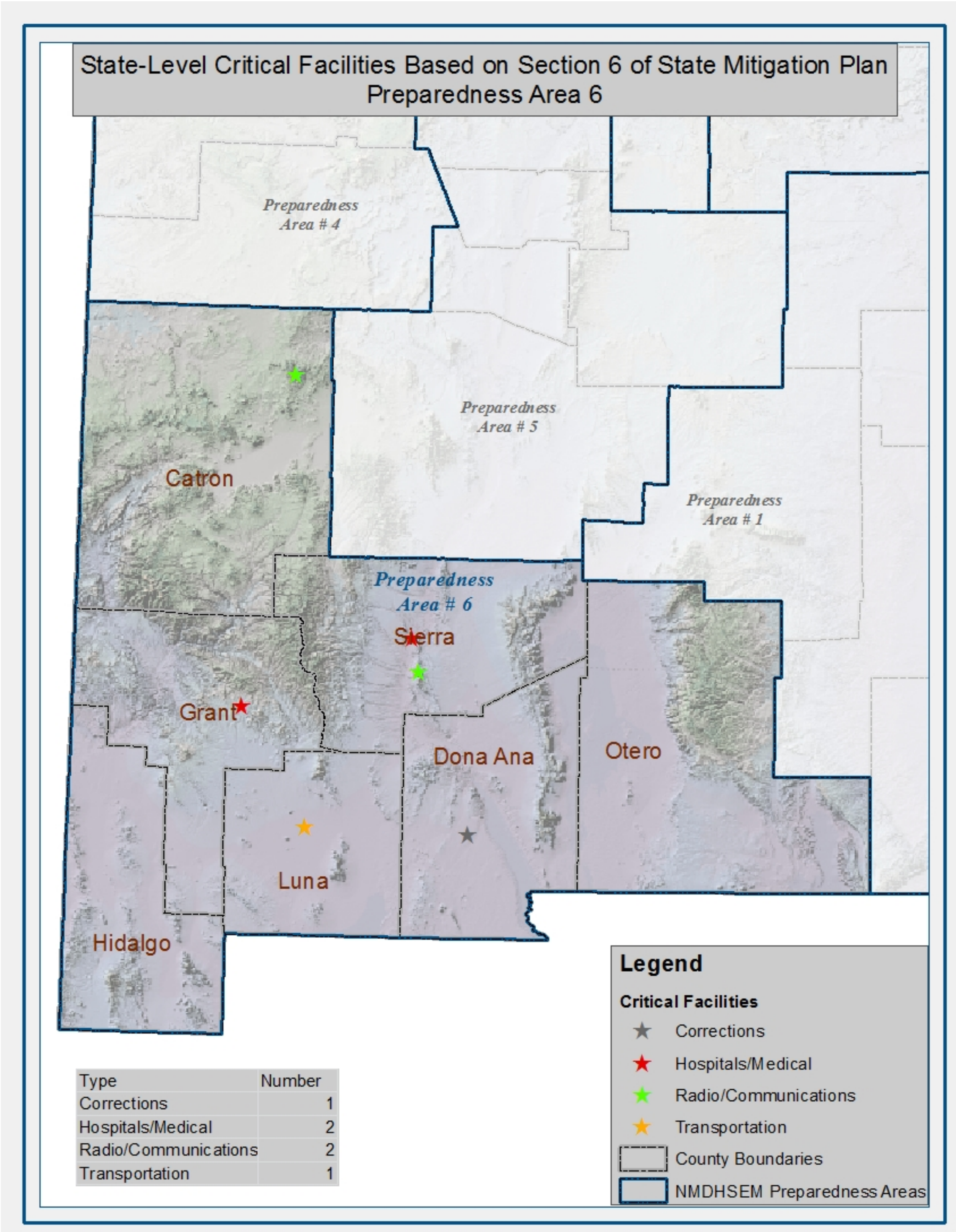


Figure 4.9: Critical Facilities Map of Preparedness Area 5



Type	Number
Corrections	2
Hospitals/Medical	4
Military Affairs	4
Public Safety	2
Radio/Communications	2
Transportation	1

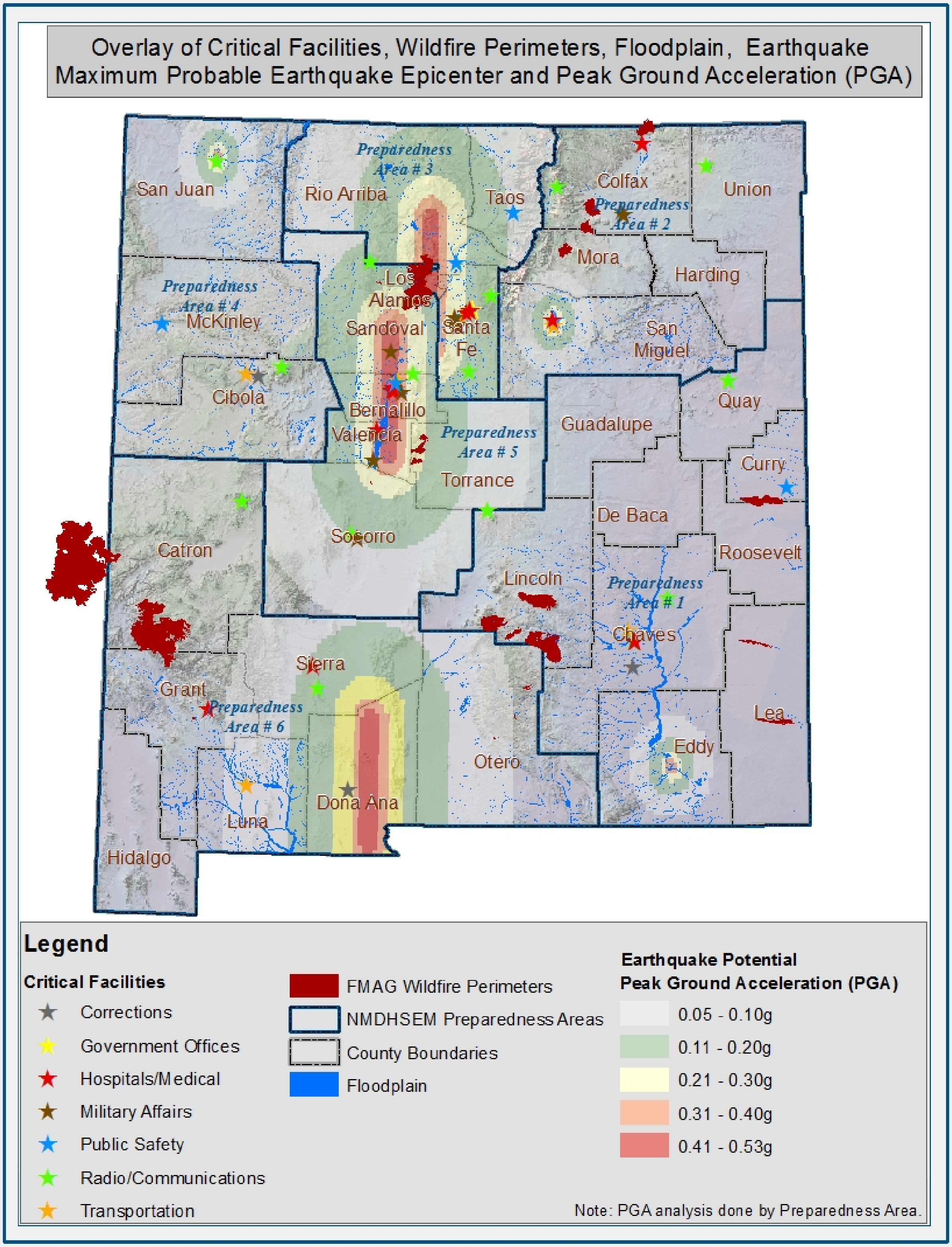
Figure 4.10: Critical Facilities Map of Preparedness Area 6



As mentioned previously, critical facilities are those facilities that are vital to government response and recovery activities immediately after a disaster. These facilities include but are not limited to police and fire stations, public works facilities, sewer and water facilities, health clinic, bridges and roads, and shelters. Important facilities may not be critical during or immediately after a disaster but are important to the resiliency and recovery of the county from a disaster.

Figure 4.11 maps critical facilities across the state of New Mexico with overlaid information about wildfire perimeters, floodplains, and potential earthquake epicenters and peak ground acceleration values. This state multi-hazard map provides a picture of the vulnerability of critical facilities to specific hazards. State critical facilities in the HMP maps include correctional facilities, hospitals, military bases, public safety infrastructure and service centers, radio/communications infrastructure and transportation infrastructure.

Figure 4.11 Statewide Critical Facilities Vulnerability Map



Later in this section, vulnerability profiles are provided for each of the six Preparedness Areas. Six maps showing the vulnerability of critical facilities in these regions are included in the profiles in order to provide more information about the vulnerability of critical facilities to flooding, earthquakes and wildfire events at the Preparedness Area scale.

Hazard Rating Process

There are three categories used by the Hazard Mitigation Team to rate the severity of the hazards included in this plan. The following three methodologies were used by the members of the Hazard Mitigation Team to identify and prioritize hazards across three categories: Probability/Frequency, Magnitude/Severity, and Risk.

1. Probability/Frequency (Table 4.12):
   - Based on the number of times that a disaster has occurred in a jurisdiction in the past 50 years
   - This information is used to determine and evaluate the likelihood for future disasters

Table 4.12. Probability/Frequency Table

Low	1	Occurs less than once every 10 years or more
Medium	2	Occurs less than once every 5 to 10 years
High	3	Occurs once every year or up to once every five years

Using the Probability/Frequency methodology displayed above, the Hazard Mitigation Team created the following hazard priority and ranking table (Figure 4.13):

Figure 4.13. Hazard Probability/Frequency Priority and Ranking Table

Hazards	Priority Order	Average Ranking
Thunderstorms	1	3.00
Wildfires/WUI	2	2.95
High Winds	3	2.89
Severe Winter Storms	4	2.88
Drought	5	2.78
Floods	6	2.74
Extreme Heat	7	2.71
Tornadoes	8	2.35
Expansive Soil	9	1.65
Land Subsidence	10	1.50
Landslide	11	1.33
Dam Failure	12	1.28
Earthquake	13	1.22
Volcanoes	14	1.06

2. Magnitude/Severity (Table 4.14):
   – Identify the worst conceivable impact to quality of life, property and response capability which could result from a hazard

Table 4.14. Magnitude/Severity Table

Low	1	• Negligible property damages (less than 5% of all buildings and infrastructure) • Negligible loss of quality of life • Local emergency response capability is sufficient to manage the hazard
Medium	2	• Moderate property damages (15% to 50% of all buildings and infrastructure) • Some loss of quality of life • Emergency response capability, economic and geographic effects of the hazard are of sufficient magnitude to involve one or more counties
High	3	• Property damages to greater than 50% of all buildings and infrastructure • Significant loss of quality of life • Emergency response capability, economic and geographic effects of the hazard are of sufficient magnitude to require federal assistance

Using the Magnitude/Severity methodology table displayed above, the Hazard Mitigation Team created the following hazard priority and ranking table (Figure 4.15):

Figure 4.15. Hazard Magnitude/Severity Priority and Ranking Table

Hazards	Priority Order	Average Ranking
Dam Failure	1	2.6
Wildfires/WUI	2	2.44
Floods	3	2.33
Earthquakes	4	2.12
Volcanoes	5	2.12
Tornadoes	6	2
Drought	7	1.82
Severe Winter Storms	8	1.71
Thunderstorms	9	1.67
High Winds	10	1.5
Extreme Heat	11	1.47
Land Subsidence	12	1.41
Landslide	13	1.35
Expansive Soil	14	1.25

3. Risk (Figure 4.16):
   - Based on duration of loss to critical facilities and services
   - The essential facilities are defined for this purpose as public safety (fire, police & local government) and utilities (electric, gas, telephone water & sewer)
   -

Figure 4.16. Risk Table

Low	1	Loss of critical facilities and services for up to one week
Medium	2	Loss of critical facilities and services from one week to three weeks
High	3	Loss of critical facilities and services for more than three weeks

Applying the Risk assessment methodology displayed in the Figure above (Figure 4.16), the Hazard Mitigation Team created the following hazard risk priority and ranking table (Figure 4.17):

Figure 4.17. Hazard Risk Priority and Ranking Table

Hazards	Priority Order	Average Ranking
Earthquake	1	2.35
Volcanoes	2	2.35
Dam Failure	3	2.28
Floods	4	2.22
Tornadoes	5	2.18
Wildfires/WUI	6	2.17
Severe Winter Storms	7	1.59
Thunderstorms	8	1.56
Landslides	9	1.47
Land Subsidence	10	1.47
Drought	11	1.47
High Winds	12	1.39
Extreme Heat	13	1.35
Expansive Soil	14	1.25

It was challenging for the Hazard Mitigation Team to aggregate the hazard priority metrics outlined above into a quantitative ranking system. Differing opinions about how to weigh the fourteen hazards against each other necessitated taking a case-by-case approach to hazard prioritization. Ultimately, the probability/frequency, magnitude/severity and risk rating results were used to inform the vulnerability assessment of each Preparedness Area and to prioritize mitigation actions for each hazard type.

Although the Hazard Mitigation Team acknowledged that each of these 14 hazards exist in the State of New Mexico, the Team chose to limit the scope of the plan to the most likely hazards (including those identified by local communities as priority hazards). It is the intent of the State of New Mexico Hazard Mitigation Team to re-evaluate these 14 hazards on an annual basis and to address additional identified hazards at that time to take into consideration any changes that may occur in priorities.

In the following six sections, detailed vulnerability profiles are provided for each of the six Preparedness Areas in the state of New Mexico. The vulnerability analyses used information collected from subject matter experts, from Hazus analysis, and from information and priorities underscored in local hazard mitigation plans developed by jurisdictions across the state. Where local jurisdiction plans identify communities with particularly high risk, the Plan includes these specific communities as mitigation priority areas.

Vulnerability Assessment – Preparedness Area 1

The following vulnerability analysis is based on information collected from Hazus analysis, content experts and local hazard mitigation plans developed by jurisdictions within Preparedness Area 1. Local jurisdictions within the Preparedness Area identified the following four hazards as medium to high priority planning concerns:

- Drought
- Floods/Flash Floods
- Severe Winter Storms
- Wildfire

Because they are identified in previous local planning efforts as priority hazards, the remainder of the Preparedness Area vulnerability assessment focuses on the hazards listed above. Although earthquakes were not identified as a primary hazard concern for the region, Hazus loss estimation data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

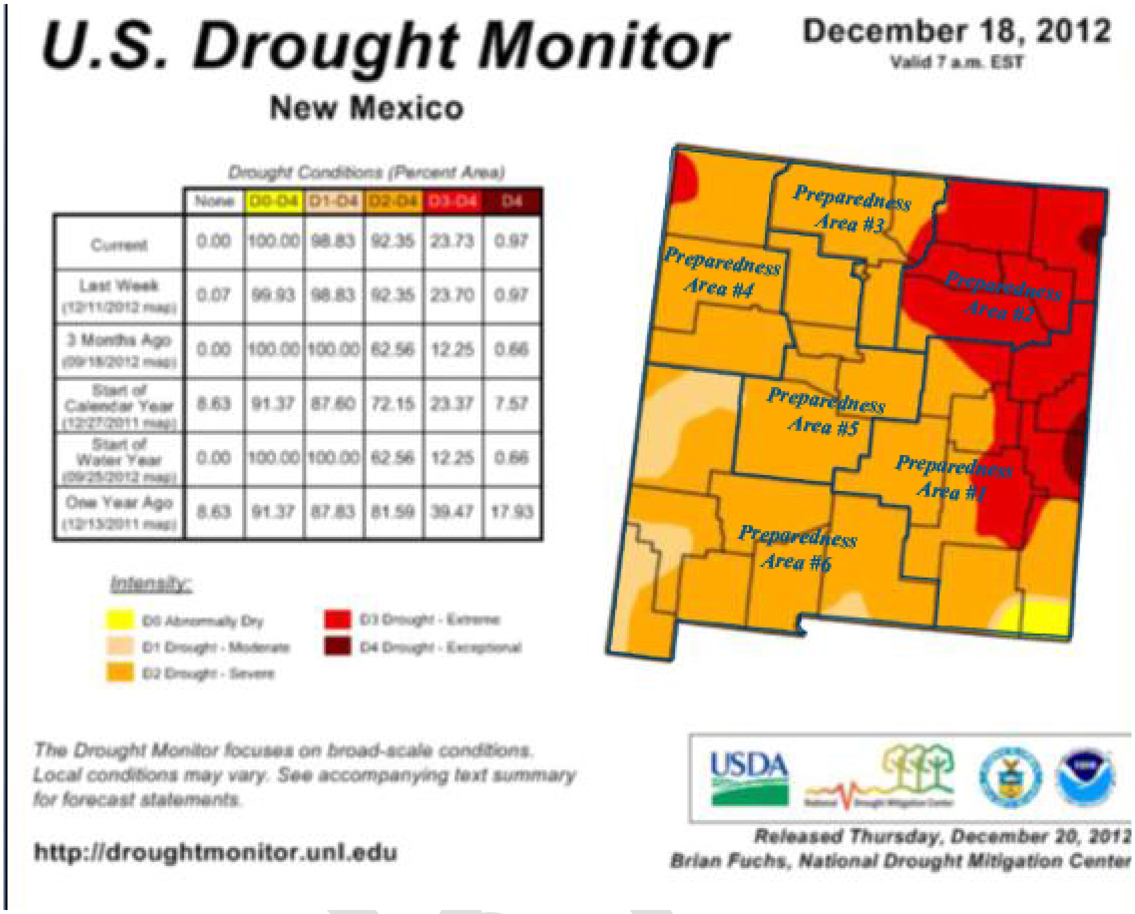
Preparedness Area Vulnerability

Preparedness Area 1 has a total population of 288,670 people and there are over 100 thousand households in the Area. Additionally, there are an estimated 144 thousand buildings in Preparedness Area 1. Approximately 94% of the buildings and 78% of the building value are associated with residential housing.

In terms of building construction types found in Preparedness Area 1, wood frame construction makes up 61% of the building inventory. The remaining percentage is distributed between the other general building types such as Reinforced Masonry, Manufactured Housing, and Concrete.

Drought was ranked below flooding in a number of local hazard mitigation plans in Preparedness Area 1. However, the monetary loss estimates for drought far exceed those for flooding. A large portion of the land mass of Preparedness Area 1 is experiencing extended extreme drought conditions (Figure 4.17). The region is also vulnerable to extreme heat conditions (Figure 4.18). Together, these conditions elevate regional wildfire vulnerability and create a perfect storm for future wildfire disasters. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event.

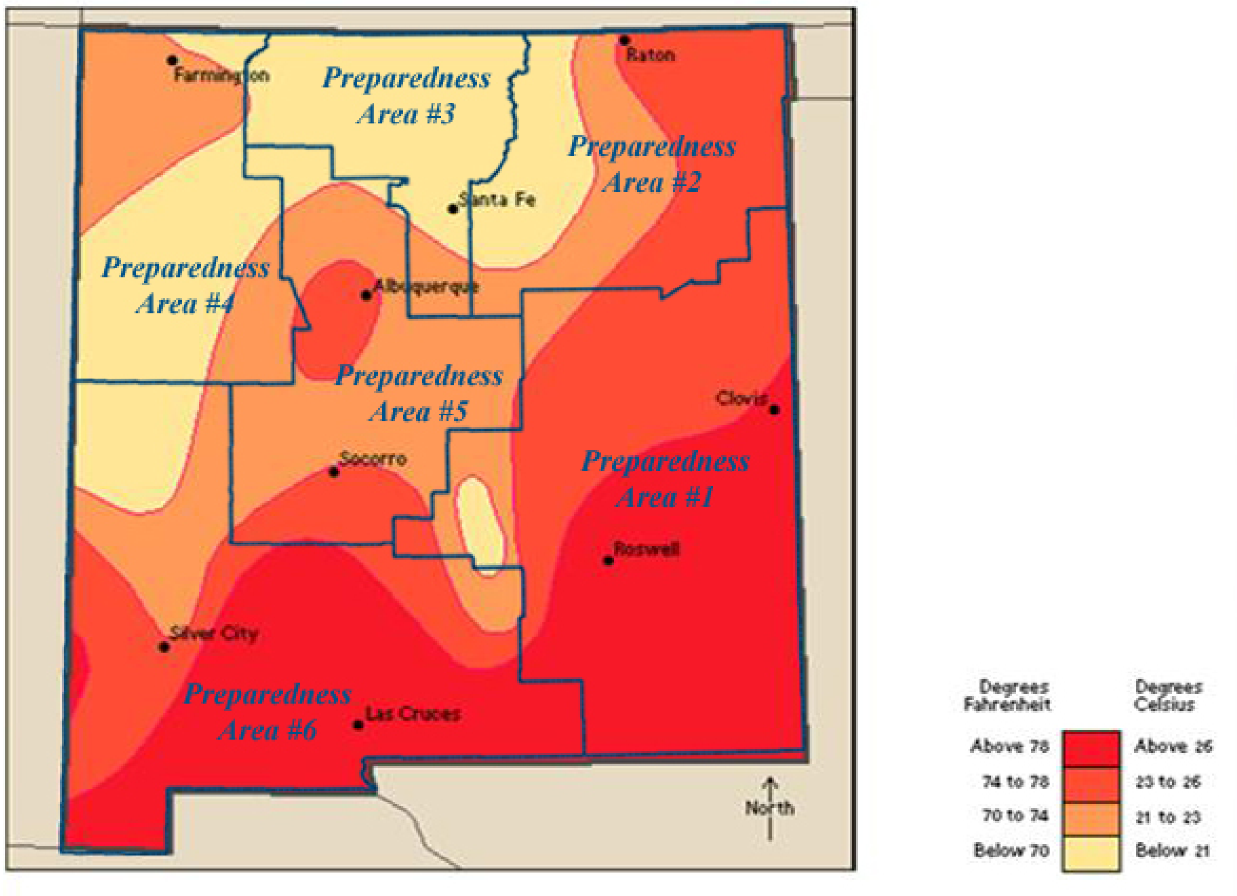
Figure 4.17. US Drought Monitor - New Mexico as of December 18, 2012[129]



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.83	92.35	23.73	0.97
Last Week (12/11/2012 map)	0.07	99.93	98.83	92.35	23.70	0.97
3 Months Ago (09/18/2012 map)	0.00	100.00	100.00	62.56	12.25	0.66
Start of Calendar Year (12/27/2011 map)	8.63	91.37	87.60	72.15	23.37	7.57
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	62.56	12.25	0.66
One Year Ago (12/13/2011 map)	8.63	91.37	87.83	81.59	39.47	17.93

[129] Source: New Mexico Drought Task Force at http://www.nmdrought.state.nm.us/

Figure 4.18. Average Temperature and Preparedness Area Map of New Mexico[130]



Reservoir levels throughout New Mexico are at their lowest levels since the mid-1970s and drought has a high risk, high vulnerability rating in Preparedness Area 1. A number of counties located in Preparedness Area 1 are home to generational ranching operations. In the last decade, an influx of entrepreneurs hassled to the diversification of agriculture and horticulture in this region of the state. These agricultural and ranching sectors are highly vulnerable to drought.

Preparedness Area 1 is highly vulnerable to wildfire due to multiple factors including rapid development near forested areas, prolonged drought conditions, and high fuel loads due to pine beetle kill. Based on the results of the local hazard mitigation plan roll-up, many jurisdictions within Preparedness Area 1 focused their mitigation efforts on education and outreach and well as on existing property protection and wildfire prevention strategies.

Under the right conditions, virtually every Preparedness Area in the state of New Mexico is vulnerable to flooding. Flash floods can occur with very little or no warning and the rains that produce them are often associated with secondary hazards including mudslides. The monsoon season in the State of New Mexico usually begins in June and can last through mid-September.

[130] Source: www.worldbook.com

The entire state of New Mexico is susceptible to severe winter storms. One of the primary concerns with winter storm events is that severe storms often knock out heat, power and communications services to homes and offices, sometimes for days at a time. For this reason, heavy snowfall and extreme cold have the potential to immobilize entire Preparedness Areas for extended periods of time.

Although the mountainous areas of the State are more likely to face heavy snow and extreme cold temperatures, residents living in the plains and desert are often unaccustomed to winter weather and are less likely to be prepared for a surprise winter event. Major population centers are most at risk to the impacts of severe winter weather and most of these communities are not located in the mountains. Highly vulnerable populations include people who live in mobile home parks, recreational vehicles, and aged or inadequately weatherized buildings. Moreover, the impacts associated with severe winter storms and freezes can affect wide areas of agricultural land and livestock habitat depending on the time of year when it occurs.

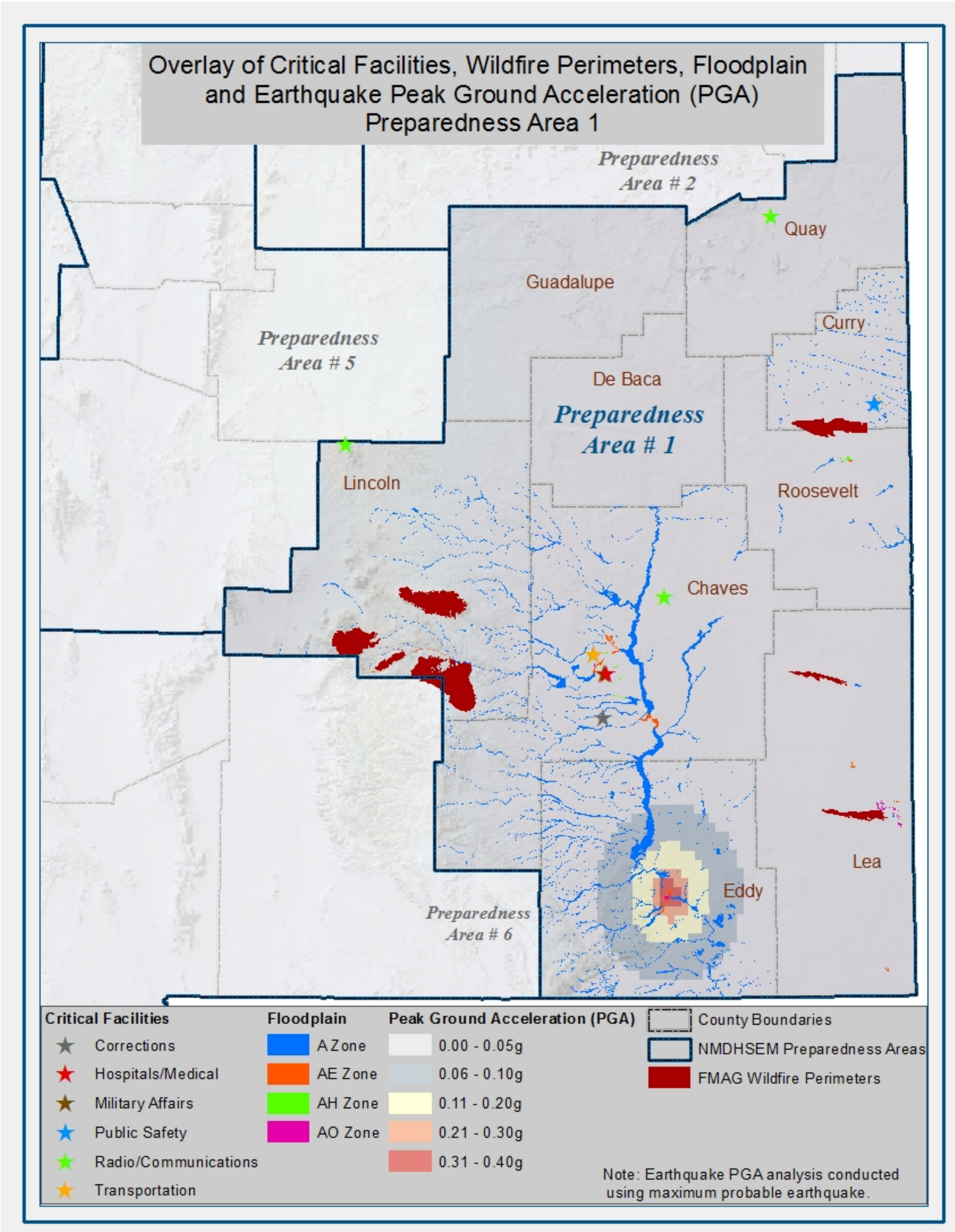
Critical Facilities

In terms of critical facilities, there are 10 hospitals within Preparedness Area 1 with a total bed capacity of 748. There are 193 schools, 61 fire stations, 39 police stations and 16 emergency operation facilities located in the region. With respect to high potential loss facilities, there are 48 dams in Preparedness Area 1. Of these, 18 of the dams are classified as 'high hazard'. The inventory also includes 58 hazardous material sites.

There are seven transportation systems within the Preparedness Area that include highways, railways, bus, and airports. There are six utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. This inventory includes over 4,030 kilometers of highways, 315 bridges and 166,549 kilometers of pipes.

The map below (Figure 4.19) provides spatial information about the vulnerability of critical facilities in Preparedness Area 1 based on Hazus-MH earthquake and flood analysis and previous wildfire risk data. There are a number of critical facilities located in Chavez, Curry, Lincoln and Quay Counties that are exposed to multiple hazards including wildfire, drought, flooding and severe storms.

Figure 4.19. Critical Facilities and Hazard Vulnerability in Preparedness Area 1



The map of Preparedness Area 1 shows a number of critical facilities (including hospitals, transportation infrastructure, correctional facilities and radio communications systems) clustered around the Zone A floodplain in Chavez County. Zone A floodplains are high risk areas, and are characterized as having a 1% annual chance of flooding. Additionally, there is a public safety facility in Curry County that is located near a wildfire perimeter area. As drought conditions persist across the state it is important that mitigation and preparedness planning activity are carried out for the most vulnerable critical facilities in the Preparedness Area.

Estimating Potential Loss

Loss estimates for each Preparedness Area were calculated using quantitative Hazus modeling and the results of the local plan roll-up. Many local jurisdictions included in the roll-up used Hazus Level 1 analysis to calculate potential losses for their jurisdictions. Additionally, Hazus flood and earthquake data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

Figure 4.20 (below) summarizes the expected structure damage within Preparedness Area 1 by building type. "Substantially Damaged" buildings are those that are damaged by 50% or more. In this data set, buildings have been categorized by the following building types:

- Concrete – A composite conglomerate of coarse granular and hard matrix materials used in commercial and residential construction.
- Manufactured Housing – Prefabricated homes built in factories elsewhere, shipped, and finally assembled on site. Majority have a wheeled chassis attached.
- Masonry –Any type of brick, concrete or other type of masonry that is used in construction of both commercial and residential buildings (refers to both reinforced and unreinforced masonry buildings)
- Steel – Supporting, framed material used in construction of both commercial and residential buildings.
- Wood – Supporting, framed material used in construction of both commercial and residential buildings.

Figure 4.20. Summary of Expected Damage by Building Type

	Preparedness Area 1	
Building Type	# Damaged	# Substantially Damaged
Concrete	0	0
Manufactured Housing	5	21
Masonry	73	0
Steel	0	0
Wood	260	3
Sub Total	338	24
Total	362	

In Preparedness Area 1, manufactured housing is highly vulnerable to substantial damages. Additionally, there are a large number of wood buildings in the Preparedness Area that are vulnerable to damage due to earthquakes.

Figure 4.21 (below) summarizes the building stock damages by occupancy sector in Preparedness Area 1. "Substantially Damaged" buildings are those that are damaged by 50% or more.

Figure 4.21. Building Stock Damage by Occupancy Sector

	Preparedness Area 1	
Occupancy Sector	# Damaged	# Substantially Damaged
Agriculture	0	0
Commercial	1	0
Education	0	0
Government	0	0
Industrial	0	0
Religion	0	0
Residential	339	24
Sub Total	340	24
Total	364	

In Preparedness Area 1, the residential sector is most vulnerable in terms of expected structural damages due to earthquakes.

Figure 4.22 provides an estimate of the expected number of damaged essential facilities in Preparedness Area 1 in the event of an earthquake. Moderate building damage describes large plaster or gypsum board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; and/or toppling of tall masonry chimneys. Complete damage describes structures that may have large permanent lateral displacement; may collapse, or be in imminent danger of collapse due to cripple wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; and/or large foundation cracks may occur.

The damage designations for the vulnerability assessment follow the methodology below:

• Moderate Damage > 50%: More than 50 percent of the building is of moderate damage
• Complete Damage > 50%: More than 50 percent of the building is completely damaged

• Functionality > 50% on day 1: This data describes the number of essential facilities working at greater than 50 percent functionality on day one (1) of the catastrophe.

Figure 4.22. Summary of Expected Damage to Essential Facilities

Classification	Preparedness Area 1
Hospitals	
Total	10
Moderate Damage > 50%	0
Complete Damage >50%	0
Functionality >50 % on day 1	9
Schools	
Total	193
Moderate Damage > 50%	0
Functionality >50 % on day 1	179
EOCs	
Total	16
Moderate Damage > 50%	0
Functionality >50 % on day 1	14
Police Stations	
Total	39
Moderate Damage > 50%	0
Functionality >50 % on day 1	36
Fire Stations	
Total	61
Moderate Damage > 50%	0
Functionality >50 % on day 1	59

The damage to essential facilities data indicates that most essential facilities can be expected to achieve greater than 50% functionality on day one of the catastrophe modeled by Hazus. Generally, damage estimates for essential facilities in Preparedness Area 1 are low.

Figure 4.23 summarizes of expected economic losses to potable water and electric power system performance in Preparedness Area 1. In the table below, the column on the right provides a daily count of residences without services provided. Potable water is water that is deemed safe for human consumption with low risk of having long term sustained health effects.

Figure 4.23. Summary of Expected Potable Water and Electric Power System Performance

# of Days Without Services	Preparedness Area 1
Potable H2O	
Day 1	0
Day 3	0
Day 7	0
Day 30	0
Day 90	0
Total # of Houses w/o water	0
Electrical	
Day 1	3,426
Day 3	1,848
Day 7	616
Day 30	99
Day 90	5
Total # of houses w/o Electric	5,994
Total Days Without Service	5,994

Based on the Hazus results, the loss of electrical power during an earthquake is a much greater concern for communities in Preparedness Area 1 than the loss of potable water. On the first day of the earthquake event, Preparedness Area 1 is expected to have a total of 3,426 homes without power. One week after the disaster this number is expected to drop to roughly 616 homes.

Hazus is able to estimate the number of people that will be injured and killed by the earthquake in a defined area (e.g. Preparedness Areas). The casualties are broken down into four severity levels that describe the extent of the injuries. The levels are described as follows:

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum; the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum; and 5:00 PM represents peak commute time. Figure 4.24 summarizes the injury/casualty estimates for Preparedness Area 1 based on the results of the Hazus modeling.

Figure 4.24. Summary of Injury/Casualty Estimates

	Preparedness Area 1			
2AM	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Commercial	0	0	0	0
Hotels	0	0	0	0
Industrial	0	0	0	0
Other-Residential	10	2	0	0
Single Family	30	5	0	1
Total	42	7	1	1
2PM				
Commercial	17	4	0	1
Commuting	0	0	0	0
Educational	5	1	0	0
Hotels	0	0	0	0
Industrial	1	0	0	0
Other-Residential	2	0	0	0
Single Family	7	1	0	0

Total	33	6	1	1
5PM				
Commercial	13	3	0	1
Commuting	0	1	1	0
Educational	0	0	0	0
Hotels	0	0	0	0
Industrial	1	0	0	0
Other-Residential	4	1	0	0
Single Family	12	2	0	0
Total	30	6	2	1
Over All Total	105	19	4	3

At or around 2am, there is maximum occupancy of people within their residences. Residential mortality is at its highest during this time of day. In contrast, at 2pm, there is maximum occupancy of people within commercial buildings or structures. Commercial mortality is highest during this time of day. At and around 5pm there is maximum occupancy of people on roadways (highways, bridges, railways) during rush hour. Commuting and transportation mortalities are highest during this time of day. These trends are reflected in the injury/casualty data provided for Preparedness Area 1. The majority of Level-1 injuries are expected to occur at 2am in single-family homes and at 2pm and 5pm in commercial areas. Casualty estimates are very low in Preparedness Area 1 as are Level-3 injuries.

The total replacement value (excluding contents) of the building stock located in Preparedness Area 1 is &17,053,000,000. Table 4.25 presents the potential losses from modeled earthquake hazards in Preparedness Area 1.

Table 4.25. Potential Losses from Hazards: Preparedness Area 1

Potential Losses: Preparedness Area 1				
	Residential	Non-Residential	Infrastructure: Transportation	Infrastructure: Utility Systems
Replacement Value (millions of dollars)	13,213	3, 832	24,423	1,366

Based on the results of the local hazard mitigation plan roll-up, wildfire loss estimates in Preparedness Area 1 are over $6 billion. The majority of potential wildfire loss estimates collected from local plans are calculated by using estimates of median structure values and number of structures located within at-risk areas. Despite the rough nature of the loss estimate methodology, elevated loss estimates are typically found in higher populated areas and the estimates provide a useful proxy for overall hazard vulnerability.

Future Development Trends

In many parts of the state, the potential for residential development along the wildland-urban interface is limited due to restrictive land use regulations. However, many of the most populated Preparedness Areas (including Preparedness Area 1) are experiencing an increase in residential growth in or near the forest boundary. This development trend significantly increases the risk of catastrophic structure losses from wildfires as well as increased exposure of humans, livestock and wildlife to wildfire related deaths.

Steady population growth in the region amid persistent drought conditions will further exacerbate the impacts of drought on communities within Preparedness Area 1. In the future, the need to acquire additional sources of water may pit some cities against other users for a diminishing supply of water.

Vulnerability Assessment – Preparedness Area 2

The following vulnerability analysis is based on information collected from Hazus analysis, content experts and local hazard mitigation plans developed by jurisdictions within Preparedness Area 2. Local jurisdictions within the Preparedness Area identified the following three hazards as medium to high priority planning concerns:

- Severe Winter Storms
- Wildfire
- Drought

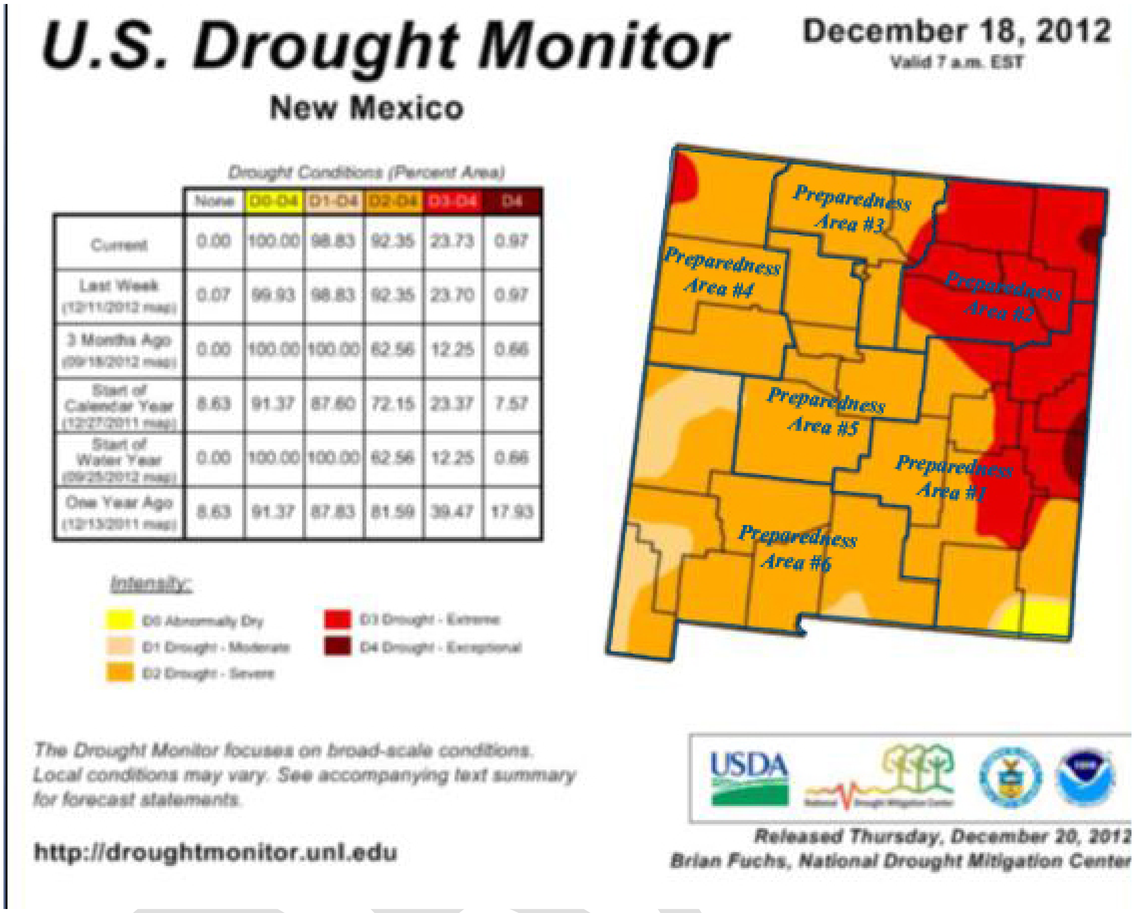
Because they are identified in previous local planning efforts as priority hazards, the remainder of the Preparedness Area vulnerability assessment focuses on the hazards listed above. Although earthquakes were not identified as a primary hazard concern for the region, Hazus loss estimation data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

Preparedness Area Vulnerability

There are over 21 thousand households in Preparedness Area 2, which has a total population of 53,268 people. Preparedness Area 2 includes Colfax, Union, Harding, Mora and San Miguel Counties. In terms of building construction types found in Preparedness Area 2, wood frame construction makes up 58% of the building inventory. The aggregate total replacement value of the building stock in Preparedness Area 2 is $3,530,000,000.

Preparedness Area 2 has been experiencing prolonged extreme and exceptional drought conditions and is one the Preparedness Areas most vulnerable to drought (Figure 4.26).

Figure 4.26. US Drought Monitor - New Mexico as of December 18, 2012[131]



Drought Conditions (Percent Area)

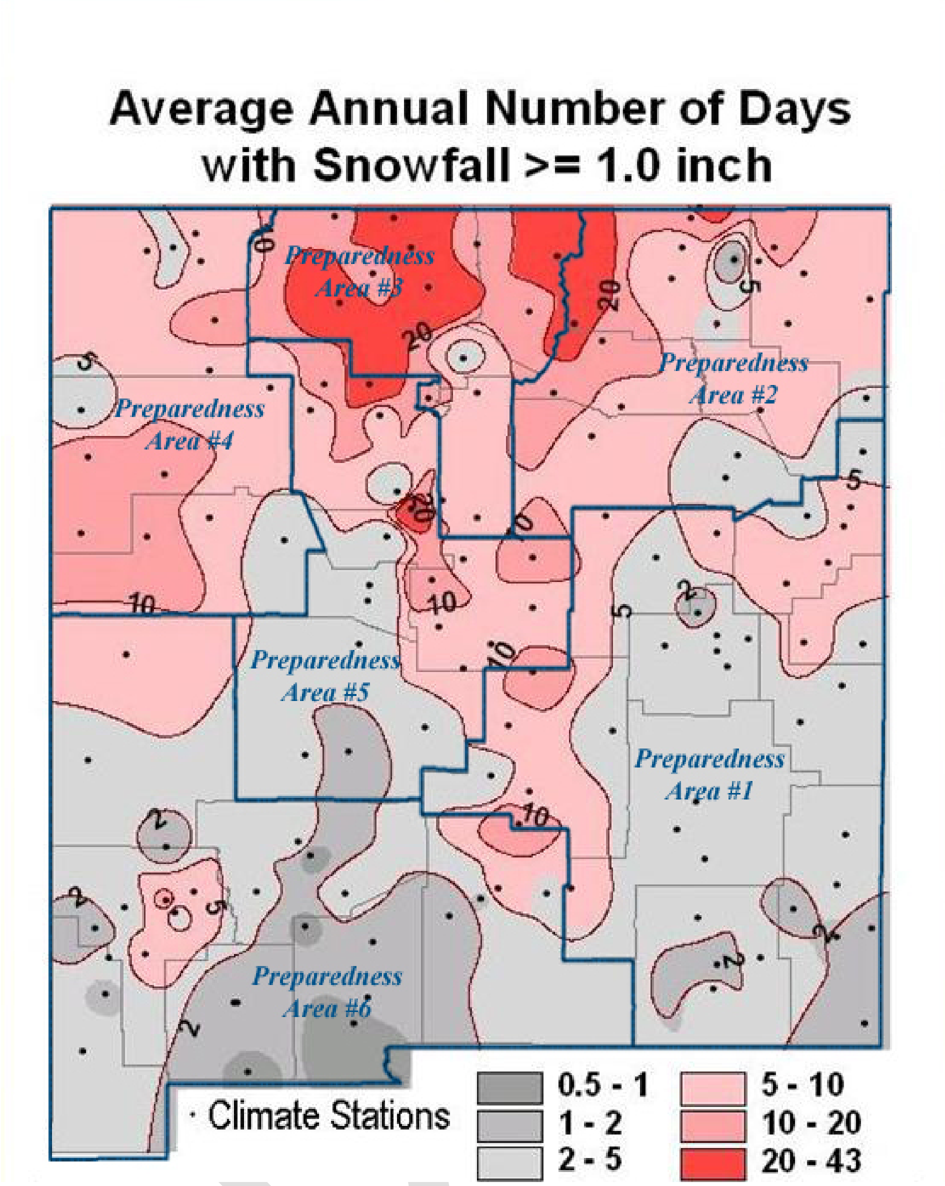
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.83	92.35	23.73	0.97
Last Week (12/11/2012 map)	0.07	99.93	98.83	92.35	23.70	0.97
3 Months Ago (09/18/2012 map)	0.00	100.00	100.00	62.56	12.25	0.66
Start of Calendar Year (12/27/2011 map)	8.63	91.37	87.60	72.15	23.37	7.57
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	62.56	12.25	0.66
One Year Ago (12/13/2011 map)	8.63	91.37	87.83	81.59	39.47	17.93

Vulnerability to wildfire and drought are closely related. As drought conditions persist (coupled with the extreme heat events the region is susceptible to) wildfire risk also increases. In populated areas that are already struggling with limited water resources, fighting fires becomes more difficult. As a result, the vulnerability of people and structures within the region increase significantly. Wood frame construction makes up 58% of the Preparedness Area's building inventory, elevating vulnerability even further as well as the risk of catastrophic losses of life and property.

In terms of severe winter storms, Preparedness Area 2 experiences a relatively high number of days of snowfall every year compared to the rest of the state (Figure 4.27).

131 Source: New Mexico Drought Task Force at http://www.nmdrought.state.nm.us/

Figure 4.27.



Although areas of the State that more frequently experience heavy snow and extreme cold temperatures are more likely to be prepared for such events, one of the primary concerns with winter storm events is that severe storms often knock out heat, power and communications services to homes and offices, sometimes for days at a time. Most major population centers (San Miguel County, for example) are not located in the mountains. As a result, they are most at risk to the impacts of uncharacteristically severe winter weather. The impacts associated with severe winter storms and freezes can affect wide areas of agricultural land and livestock habitat depending on the time of year when it occurs. Additionally, highly vulnerable populations include people who live in mobile home parks, recreational vehicles, and aged or inadequately weatherized buildings.

Critical Facilities

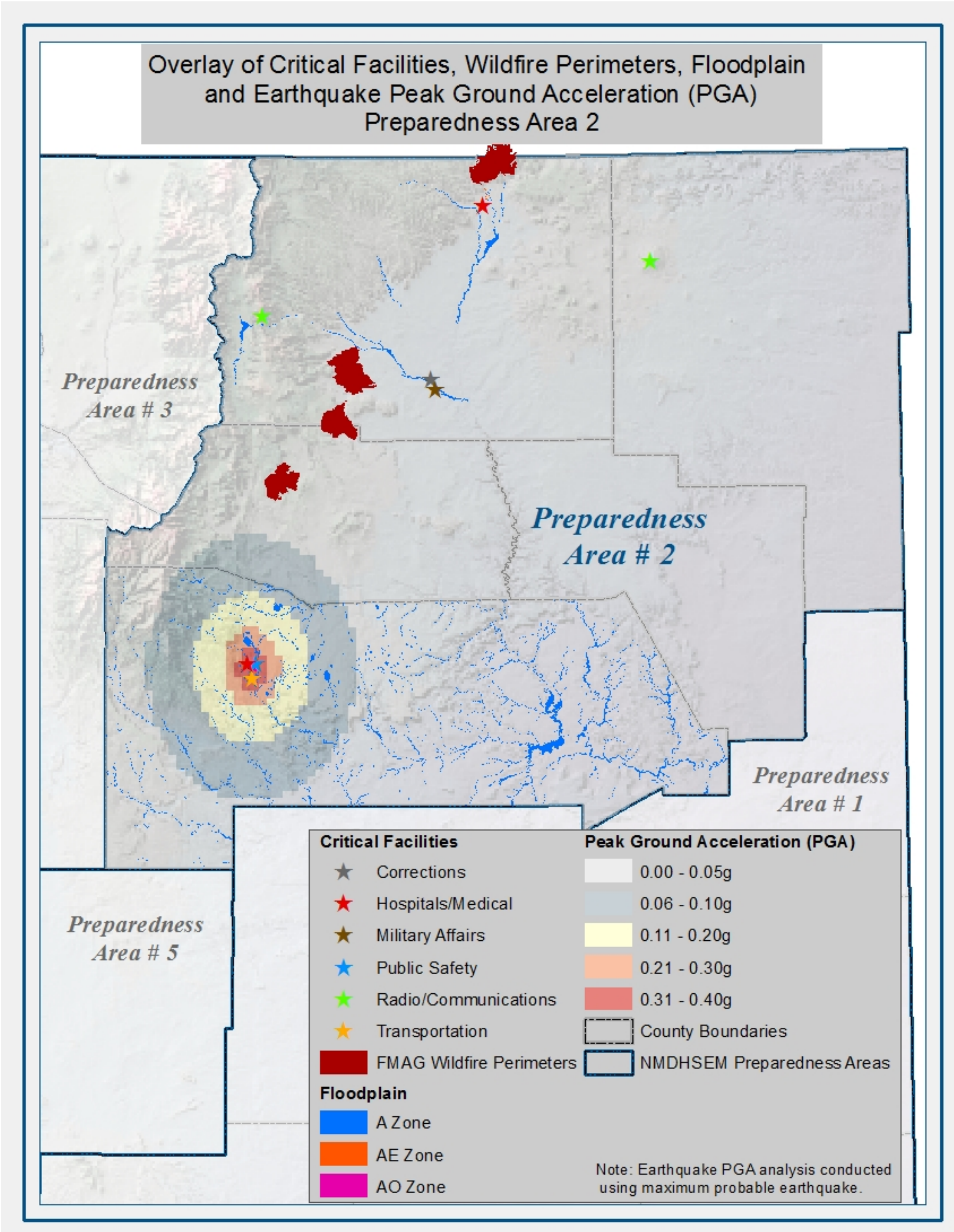
There are an estimated 35 thousand buildings in the region with a total building replacement value (excluding contents) of $3,530,000,000.

The critical facilities inventory for Preparedness Area 2 includes four hospitals with a total bed capacity of 563. There are 64 schools, 35 fire stations, 14 police stations and 8 emergency operation facilities located in the area. With respect to high potential loss facilities, there are 75 dams located in Preparedness Area 2. Of these, 16 of the dams are classified as 'high hazard'. The high potential loss inventory also includes 3 hazardous material sites.

There are seven critical transportation systems within Preparedness Area 2 that include highways, railways, bus, and airports. Additionally, there are six utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power, and communications. This inventory includes over 1,184 miles of highways, 304 bridges, and 46,960 miles of pipes.

The map below (Figure 4.28) provides spatial information about the vulnerability of critical facilities in Preparedness Area 2 based on Hazus-MH earthquake and flood analyses and previous wildfire risk data.

Figure 4.28. Critical Facilities and Hazard Vulnerability in Preparedness Area 2



The map of Preparedness Area 2 shows a number of critical facilities (including hospitals, transportation infrastructure and public safety facilities) clustered around a modeled earthquake epicenter. Additionally, in the north and northwestern parts of the Preparedness Area, a military affairs facility, a correctional facility, a hospital. and critical transportation infrastructure lie within a high risk, Zone A floodplain. During future Preparedness Area planning efforts, mitigation and risk reduction activities may be unrolled to give priority to the highlighted critical facilities because they are the most at risk critical facilities in the region.

Estimating Potential Loss

Figure 4.29 (below) summarizes the expected damage of buildings within Preparedness Area 2 by building type. "Substantially Damaged" buildings are those that are damaged by 50% or more. Please refer to the "Estimating Potential Loss" section included in "Vulnerability Assessment – Preparedness Area 1" for detailed descriptions and definitions of terms used in the following six figures.

Figure 4.29. Summary Building Damage by Building Type

	Preparedness Area 2	
Building Type	# Damaged	# Substantially Damaged
Concrete	0	0
Manufactured Housing	3	14
Masonry	33	0
Steel	0	0
Wood	117	0
Sub Total	153	14
Total	167	

In Preparedness Area 2, manufactured housing is highly vulnerable to substantial damages due to earthquakes. Additionally, there are a large number of wood and masonry-type buildings in the Preparedness Area that are vulnerable to earthquake damage.

Figure 4.30 (below) summarizes the building stock damages by occupancy sector in Preparedness Area 2.

Figure 4.30. Building Stock Damage by Occupancy Sector

	Preparedness Area 2	
Occupancy	# Damaged	# Substantially Damaged
Agriculture	0	0
Commercial	1	0
Education	0	0
Government	0	0
Industrial	1	0
Religion	0	0
Residential	153	14
Sub Total	155	14
Total	169	

In Preparedness Area 2, the residential sector is most vulnerable in terms of expected structural damages due to earthquakes.

Figure 4.31 provides an estimate of the expected number of damaged essential facilities in Preparedness Area 2. The damage designations follow the methodology below:

• Moderate Damage > 50%: More than 50 percent of the building is of moderate damage
• Complete Damage > 50%: More than 50 percent of the building is completely damaged
• Functionality > 50% on day 1: This data describes the number of essential facilities working at greater than 50 percent functionality on day one (1) of the catastrophe.

Figure 4.31. Summary of Expected Damage to Essential Facilities

Classification	Preparedness Area 2
Hospitals	
Total	4
Moderate Damage > 50%	0
Complete Damage >50%	0
Functionality >50 % on day 1	2
Schools	
Total	64
Moderate Damage > 50%	0
Functionality >50 % on day 1	47
EOCs	
Total	8
Moderate Damage > 50%	0
Functionality >50 % on day 1	7
Police Stations	
Total	14
Moderate Damage > 50%	0
Functionality >50 % on day 1	12
Fire Stations	
Total	35
Moderate Damage > 50%	0
Functionality >50 % on day 1	34

The data depicting expected damage to essential facilities indicates that most essential facilities are expected to achieve greater than 50% functionality on day one of the catastrophe. Generally, damage estimates in Preparedness Area 2 do not forecast long-term interruptions to essential facilities.

Figure 4.32 summarizes of expected economic losses to potable water and electric power system performance in Preparedness Area 2. In the table below, the column on the right provides a daily count of residences without services provided.

Figure 4.32. Summary of Expected Potable Water and Electric Power System Performance

# of Days Without Services	Preparedness Area 2
Potable H2O	
Day 1	0
Day 3	0
Day 7	0
Day 30	0
Day 90	0
Total # of Houses w/o water	0
Electrical	
Day 1	2,145
Day 3	1,157
Day 7	386
Day 30	62
Day 90	3
Total # of houses w/o Electric	3,753
Total Days Without Service	3,753

Based on the Hazus results, the loss of electrical power during an earthquake is a much greater concern for communities in Preparedness Area 2 than the loss of potable water. On the first day of the earthquake event, Preparedness Area is expected to have a total of 2,145 homes without power. One week after the disaster this number is expected to drop to approximately 386 homes.

Figure 4.33 summarizes the injury/casualty estimates for Preparedness Area 2 based on the results of Hazus modeling. The data provides time-specific estimations of approximate locations of individuals during an earthquake event.

Figure 4.33. Summary of Injury/Casualty Estimates

	Preparedness Area 2			
2AM	**L 1**	**L 2**	**L 3**	**L 4**
Commercial	0	0	0	0
Hotels	0	0	0	0
Industrial	0	0	0	0
Other-Residential	15	2	0	0
Single Family	15	3	0	0
Total	31	5	0	1
2PM				
Commercial	8	2	0	0
Commuting	0	0	0	0
Educational	4	1	0	0
Hotels	0	0	0	0

Industrial	0	0	0	0
Other-Residential	3	0	0	0
Single Family	3	1	0	0
Total	19	4	0	1
5PM				
Commercial	7	1	0	0
Commuting	0	0	0	0
Educational	1	0	0	0
Hotels	0	0	0	0
Industrial	0	0	0	0
Other-Residential	5	1	0	0
Single Family	6	1	0	0
Total	19	4	1	1
Over All Total	69	13	1	3

At or around 2am, there is maximum occupancy of people within their residences. Residential mortality is at its highest during this time of day. In contrast, at 2pm, there is maximum occupancy of people within commercial buildings or structures. As a result, commercial mortality is highest during this time of day. At and around 5pm there is maximum occupancy of people on roadways (highways, bridges, railways) during rush hour. Commuting and transportation mortalities are highest during this time of day. These trends are reflected in the injury/casualty data provided for Preparedness Area 2. The majority of Level-1 injuries are expected to occur at 2am in single-family homes and other residential buildings, and at 2pm and 5pm in commercial areas. Casualty estimates are very low in Preparedness Area 2 as are Level-3 injuries.

There are an estimated 35 thousand buildings in Preparedness Area 2 with a total building replacement value (excluding contents) of $3,530,000,000. Approximately 96% of the buildings and 83% of the building value are associated with residential housing. The replacement value of the transportation and utility lifeline systems is estimated to be over $11 million and $502 million, respectively. Table 4.34 presents a summary of the potential losses of residential and non-residential structures as well as infrastructure systems in Preparedness Area 2.

There are an estimated 35 thousand buildings in Preparedness Area 2 with a total building replacement value (excluding contents) of $3,530,000. Approximately 96% of the buildings and 83% of the building value are associated with residential housing. The replacement value of the transportation and utility lifeline systems is estimated to be over $11 million and $502 million, respectively. Table 4.34 presents the potential losses from modeled earthquake hazards in Preparedness Area 2.

Table 4.34. Potential Losses from Hazards: Preparedness Area 2

Potential Losses: Preparedness Area 2				
	Residential	Non-Residential	Infrastructure: Transportation	Infrastructure: Utility Systems
Replacement Value (millions of dollars)	2,917	607	11,708	502

Based on the results of the local hazard mitigation plan roll-up, potential loss estimates for wildfire hazards within Preparedness Area 2 were estimated at over $1 billion. Although the hazard was not identified as a high risk hazard, Preparedness Area 2 provided the largest estimate of potential losses from thunderstorms out of all of the Preparedness Areas with an overall lost estimate of $277,550,000.

Future Development Trends

A large amount of the building stock in Preparedness Area 2 is made up of more vacation homes than most other parts of the state. Therefore, larger than average numbers of unoccupied structures require management to mitigate and respond to severe storms. Colfax County, located in Preparedness Area 2, found that as many as 50% of their fire response calls during the past two years have been to fires caused by lightning strikes. This number is expected to remain high under current (and persistent) drought conditions.

Vulnerability Assessment – Preparedness Area 3

The following vulnerability analysis is based on information collected from Hazus analysis, content experts and local hazard mitigation plans developed by local jurisdictions within Preparedness Area 3. Local jurisdictions within the Preparedness Area identified the following three hazards as medium to high priority planning concerns:

- Floods/Flash Floods
- Wildfire
- Drought

Because they are identified in previous local planning efforts as priority hazards, the remainder of the Preparedness Area vulnerability assessment focuses on the hazards listed above. Although earthquakes were not identified as a primary hazard concern for the region, Hazus loss estimation data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

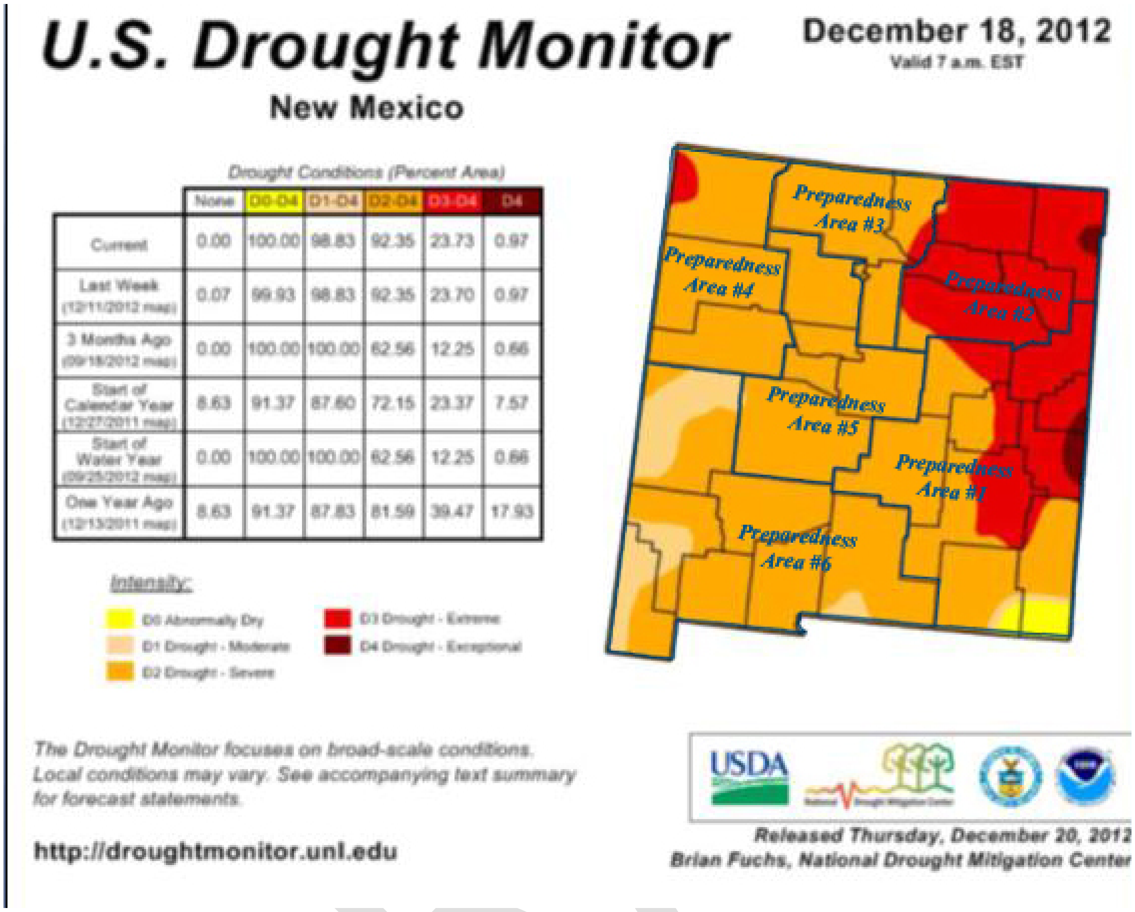
Preparedness Area Vulnerability

Preparedness Area 3 has a population of 235,303 and includes Rio Arriba, Taos, Los Alamos and Santa Fe Counties. There are over 87 thousand households in the Preparedness Area and an estimated 107 thousand buildings in the region. Approximately 94% of the buildings and 81% of the building value are associated with residential housing. In terms of building construction types found in the region, wood frame construction makes up 58% of the building inventory.

One third of the local plans from Preparedness Area 3 that were reviewed during the local hazard mitigation plan roll-up identified floods and flash floods as high-priority hazard concerns in their jurisdiction, making flooding a high level mitigation priority for the Preparedness Area as a whole. The monsoon season in the State of New Mexico usually begins in June and can last through mid-September. Populations within Preparedness Area 3 are most vulnerable to the impacts of flooding during these times.

Preparedness Area 3 is highly vulnerable to wildfire due to multiple factors including rapid development near forested areas, prolonged drought (Figure 4.35), and high fuel loads due to pine beetle kill. Currently, drought conditions in Preparedness Area 3 can be described as severe to extreme.

Figure 4.35. US Drought Monitor - New Mexico as of December 18, 2012[132]



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	98.83	92.35	23.73	0.97
Last Week (12/11/2012 map)	0.07	99.93	98.83	92.35	23.70	0.97
3 Months Ago (09/18/2012 map)	0.00	100.00	100.00	62.56	12.25	0.66
Start of Calendar Year (12/27/2011 map)	8.63	91.37	87.60	72.15	23.37	7.57
Start of Water Year (09/25/2012 map)	0.00	100.00	100.00	62.56	12.25	0.66
One Year Ago (12/13/2011 map)	8.63	91.37	87.83	81.59	39.47	17.93

Across Preparedness Area 3, significant numbers of people are exposed to wildfire risks, especially populations living or working in close proximity to forested areas, residents with asthma or other respiratory sensitivity, and very young and elderly residents.

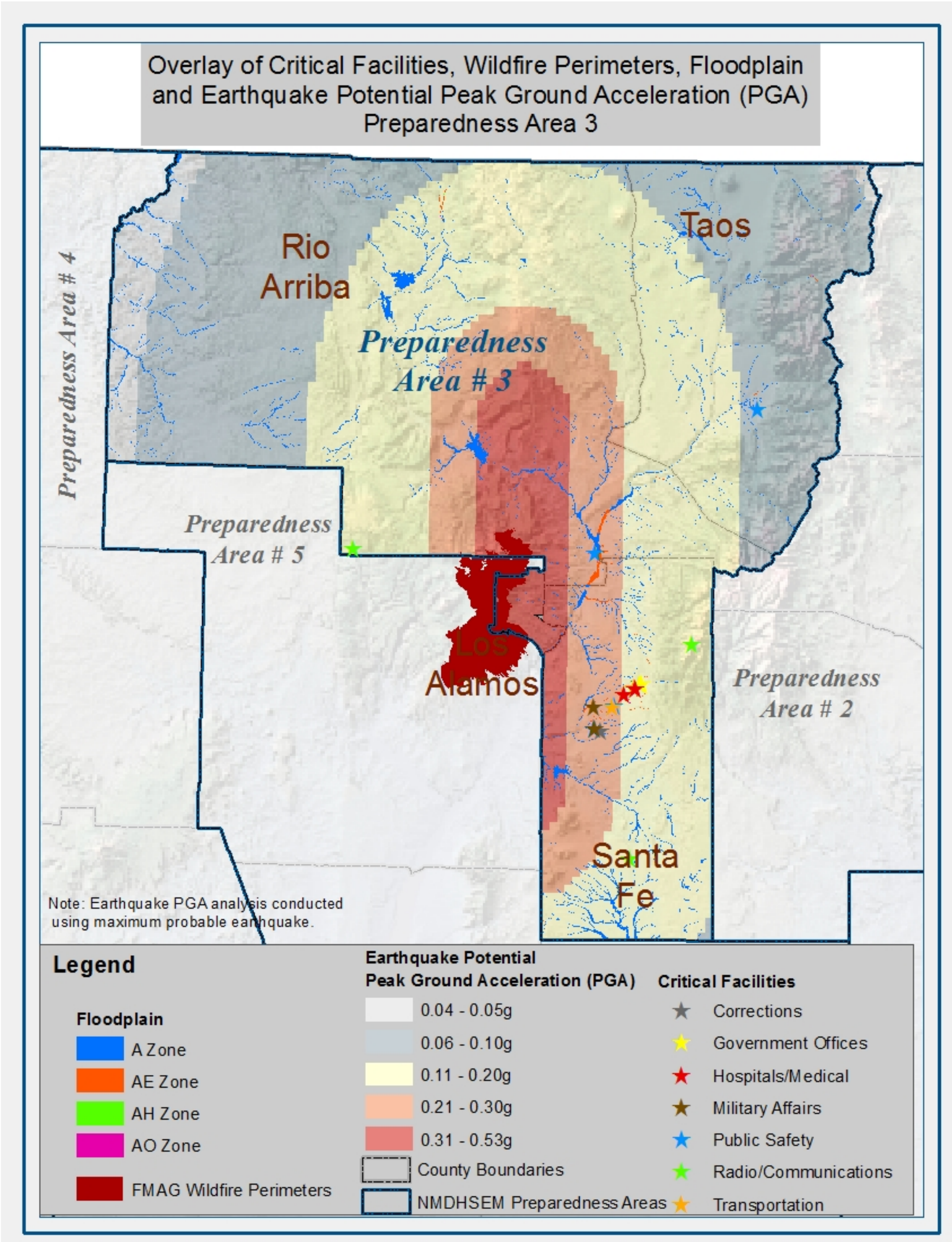
Critical Facilities

In terms of critical facilities, there are 4 hospitals in the region with a total bed capacity of 327 beds. There are 151 schools, 38 fire stations, 21 police stations and 22 emergency operation facilities located in Preparedness Area 3. With respect to high potential loss facilities there are 60 dams identifies within the region. Of there, 35 of the dams are classified as "high hazard." The inventory also includes 3 hazardous materials sites.

The map below (Figure 4.36) provides spatial information about the vulnerability of critical facilities in Preparedness Area 3 based on Hazus-MH earthquake and flood analysis and previous wildfire risk data.

132 Source: New Mexico Drought Task Force at http://www.nmdrought.state.nm.us/

Figure 4.36. Location of Critical Facilities in Preparedness Area 3



A large area of Preparedness Area 3 overlaps with a potentially dangerous earthquake shake zone. There are a number of critical facilities located in Santa Fe County that are vulnerable to the impacts of a future earthquake. These critical facilities are also located within Zone A and Zone AE floodplain areas (including 2 hospitals in Santa Fe County, and two public safety facilities in Rio Arriba and Taos). Future planning efforts in Preparedness Area 3 may focus on reducing the vulnerability of these facilities as a starting point for their broader mitigation strategies.

Estimating Potential Loss

Figure 4.37 (below) summarizes the expected damage of buildings within Preparedness Area 3 by building type. Please refer to the "Estimating Potential Loss" section included in "Vulnerability Assessment – Preparedness Area 1" for detailed descriptions and definitions of terms used in the following six figures.

Figure 4.37. Summary Building Damage by Building Type

	Preparedness Area 3	
Building Type	# Damaged	# Substantially Damaged
Concrete	1	0
Manufactured Housing	23	29
Masonry	39	0
Steel	1	0
Wood	332	1
Sub Total	396	30
Total	426	

In Preparedness Area 3, manufactured housing is highly vulnerable to substantial damages in the event of an earthquake. Additionally, there are a large number of wood and masonry buildings in the Preparedness Area that are vulnerable to damage.

Figure 4.38 (below) summarizes the building stock damages by occupancy sector in Preparedness Area 3.

Figure 4.38. Building Stock Damage by Occupancy Sector

	Preparedness Area 3	
Occupancy	# Damaged	# Substantially Damaged
Agriculture	0	0
Commercial	7	0
Education	0	0
Government	4	0
Industrial	0	0
Religion	0	0
Residential	429	30
Sub Total	440	30
Total	470	

In Preparedness Area 3, the residential sector is most vulnerable in terms of expected structural damages due to earthquakes. Additionally, a small number of commercial and government sector structures are expected to sustain some form of damage in the event of an earthquake.
Figure 4.39 provides an estimate of the expected number of damaged essential facilities in Preparedness Area 3. The damage designations follow the methodology below:

- Moderate Damage > 50%: More than 50 percent of the building is of moderate damage

• Complete Damage > 50%: More than 50 percent of the building is completely damaged
• Functionality > 50% on day 1: This data describes the number of essential facilities working at greater than 50 percent functionality on day one (1) of the catastrophe.

Figure 4.39. Summary of Expected Damage to Essential Facilities

Classification	Preparedness Area 3
Hospitals	
Total	4
Moderate Damage > 50%	1
Complete Damage >50%	1
Functionality >50 % on day 1	1
Schools	
Total	151
Moderate Damage > 50%	9
Functionality >50 % on day 1	138
EOCs	
Total	22
Moderate Damage > 50%	4
Functionality >50 % on day 1	18
Police Stations	
Total	21
Moderate Damage > 50%	2
Functionality >50 % on day 1	19
Fire Stations	
Total	38
Moderate Damage > 50%	6
Functionality >50 % on day 1	29

The expected damage to essential facilities data indicates that most essential facilities in Preparedness Area 3 will achieve greater than 50% functionality on day one of the catastrophe. A number of fire stations and schools are expected to sustain moderate levels of damage, but the functionality of the majority of these facilities remains over 50%. Generally, the probability of long-term functionality loss of critical facilities is low in Preparedness Area 3.

Figure 4.40 summarizes of expected economic losses to potable water and electric power system performance in Preparedness Area 3. In the table below, the column on the right provides a daily count of residences without services provided. Potable water is water that is deemed safe for human consumption with low risk of having long term sustained health effects.

Figure 4.40. Summary of Expected Potable Water and Electric Power System Performance

# of Days Without Services	Preparedness Area 3
Potable H2O	
Day 1	3,362
Day 3	60
Day 7	4
Day 30	0
Day 90	0
Total # of Houses w/o water	3,426
Electrical	
Day 1	5,691
Day 3	3,692
Day 7	1,622
Day 30	337
Day 90	7
Total # of houses w/o Electric	11,349
Total Days Without Service	14,775

Based on the Hazus results, both the loss of electrical power and potable water during an earthquake are cause for concern in Preparedness Area 3. On the first day of the earthquake event, Preparedness Area 3 is expected to have a total of 5,691 homes without power and 3,362 homes without potable water. One week after the disaster the power and water interruption numbers are expected to drop to approximately 1,622 and 4 homes, respectively.

Figure 4.41 summarizes the injury/casualty estimates for Preparedness Area 3 based on the results of the Hazus modeling. The data provides time-specific estimations of approximate locations of individuals during an earthquake event.

Figure 4.41. Summary of Injury/Casualty Estimates

	Preparedness Area 3			
2AM	**L 1**	**L 2**	**L 3**	**L 4**
Commercial	5	2	0	1
Hotels	9	3	0	1
Industrial	3	1	0	0
Other-Residential	229	48	4	7
Single Family	409	110	16	32
Total	656	163	21	40
2PM				
Commercial	325	99	17	34
Commuting	0	0	0	0
Educational	76	23	4	8
Hotels	2	0	0	0

Industrial	40	7	1	2
Other-Residential	66	8	1	1
Single Family	530	17	3	5
Total		155	26	50
5PM				
Commercial	262	79	14	26
Commuting	7	10	16	3
Educational	9	3	0	1
Hotels	3	1	0	0
Industrial	14	4	1	1
Other-Residential	83	17	1	2
Single Family	160	43	6	12
Total	538	157	39	47
Over All Total	1,724	475	86	137

At or around 2am, there is maximum occupancy of people within their residences. Residential mortality is at its highest during this time of day. In contrast, at 2pm, there is maximum occupancy of people within commercial buildings or structures. As a result, commercial mortality is highest during this time of day. At and around 5pm there is maximum occupancy of people on roadways (highways, bridges, railways) during rush hour. Commuting and transportation mortalities are highest during this time of day. In Preparedness Area 3, the majority of Level-4 injuries are expected to occur at 2am in single-family homes, at 2pm in commercial and educational areas and at 5pm in commercial and single-family areas. Casualty estimates are relatively high in this Preparedness Area.

There are an estimated 107 thousand buildings in the region with a total building replacement value (excluding contents) of $16,643,000,000. Approximately 94% of the buildings (and 81% of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems is estimated to be 9,571 and 845 (millions of dollars), respectively. Table 4.42 presents potential monetary loss estimates from Hazus earthquake models in Preparedness Area 3.

Table 4.42. Potential Losses from Hazards: Preparedness Area 3

Potential Losses: Preparedness Area 3				
	Residential	**Non-Residential**	**Infrastructure: Transportation**	**Infrastructure: Utility Systems)**
Replacement Value (millions of dollars)	**13, 420**	**3,219**	**9,571**	**845**

A number of local jurisdictions located with Preparedness Area 3 used HAZUS-MH Level 1 analyses to calculate potential losses from hazards. The County of Santa Fe alone (in Preparedness Area 3) estimates their potential wildfire losses at over $5 billion. Within the Ohkay Owingeh Pueblo, flash floods have been, and are expected to remain, a significant threat to the economic and social well-being of selected areas of the Pueblo. Exacerbating the effects of flooding on the Pueblo are steep slopes, unstable desert soils, and obstructions in the floodplain. Ohkay Owingeh Pueblo also estimates over $71 million in losses from prolonged drought conditions.

Future Development Trends

A number of counties in Preparedness Area 3 are experiencing large increases in population, especially in areas located in or near wildland-urban interface (i.e. Santa Fe County). In recent years wildland fires have been of major concern due to ongoing drought conditions. Additionally, increased development and population growth is leading to increased stress put on water resources. This leads to higher wildfire and drought vulnerability and risk across the region.

Flash floods have been and will continue to be a significant threat to the economic and social well-being of vulnerable areas in Preparedness Area 3. Many local jurisdictions use flood insurance as a strategy for curbing development in areas that are prone to flood hazards. Currently, there are a limited number of vacant lots within the Santa Fe County floodplain (the third most populous County in the state and the 7th fastest growing County in the State). However, new vulnerabilities may arise in the future as population continues to grow because lots platted prior to the adoption of the County's Comprehensive Plan may be developed within the floodplain if they are elevated or dry-flood proofed.

Vulnerability Assessment – Preparedness Area 4

The following vulnerability analysis is based on information collected from Hazus analysis, content experts and updated county-scale comprehensive plans developed by the three counties located within Preparedness Area 4: Cibola, McKinley and San Juan Counties. None of the counties located in Preparedness Area 4 had approved local hazard mitigation plans at the time of the update. Therefore, the hazard elements from the county comprehensive plans were used in the local jurisdiction plan roll-up. The counties within the Preparedness Area identified the following four hazards as medium to high priority planning concerns:

- Drought
- Floods/Flash Floods
- Wildfire

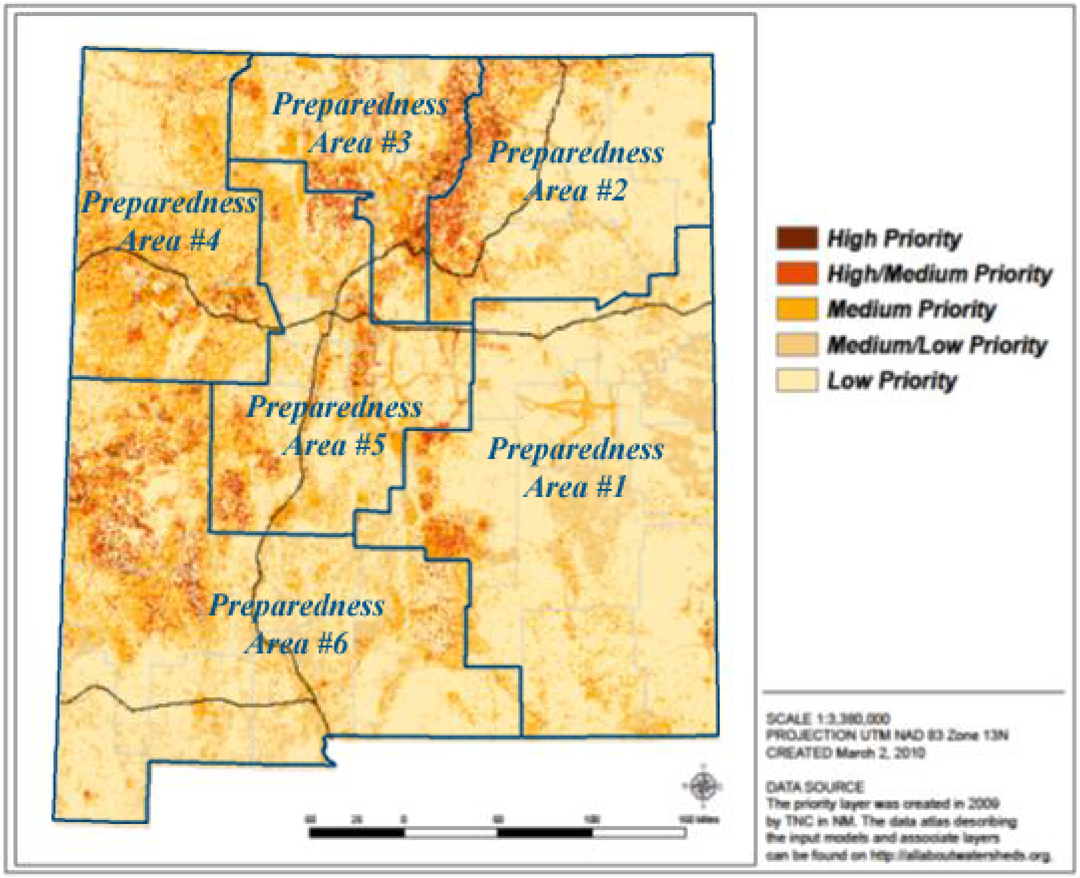
Because they are identified in previous local planning efforts as priority hazards, the remainder of the Preparedness Area vulnerability assessment focuses on the hazards listed above. Although earthquakes were not identified as a primary hazard concern for the region, Hazus loss estimation data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

Preparedness Area Vulnerability

Preparedness Area 4 has a population of 228,749 and includes San Juan, McKinley and Cibola Counties. There are over 67 thousand households in the region. There are an estimated 88 thousand buildings in Preparedness Area 4 and approximately 95% of the buildings (and 77% of the building value) are associated with residential housing. In terms of building construction types found in the region, wood frame construction makes up 53% of the building inventory. The remaining percentage is distributed between the other general building types such as Manufactured Housing, Reinforced Masonry, and Unreinforced Masonry.

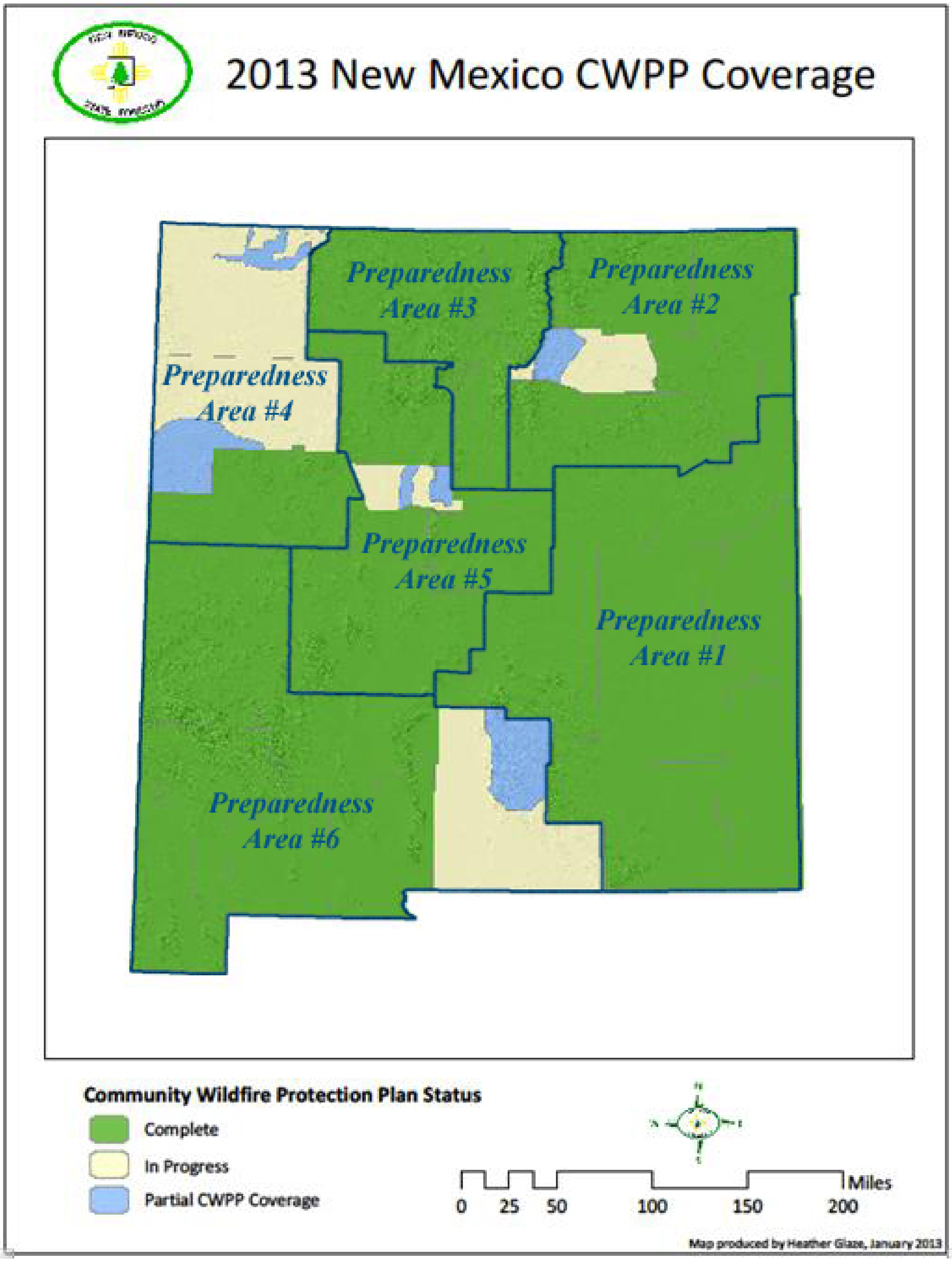
Preparedness Area 4 is in a medium – high priority fire risk zone (Figure 4.43). However, a large amount of the region is in progress towards completing their community wildfire protection plans (Figure 4.44). This planning activity is meant to decrease the vulnerability of communities and regions to wildfire.

Figure 4.43. Wildfire Risk Model[133]



[133] US Forest Service 2013 wildfire potential map: http://www.firelab.org/fmi/data-products/229-wildland-fire-potential-wfp

Figure 4.44. Community Wildfire Protection Plan Status



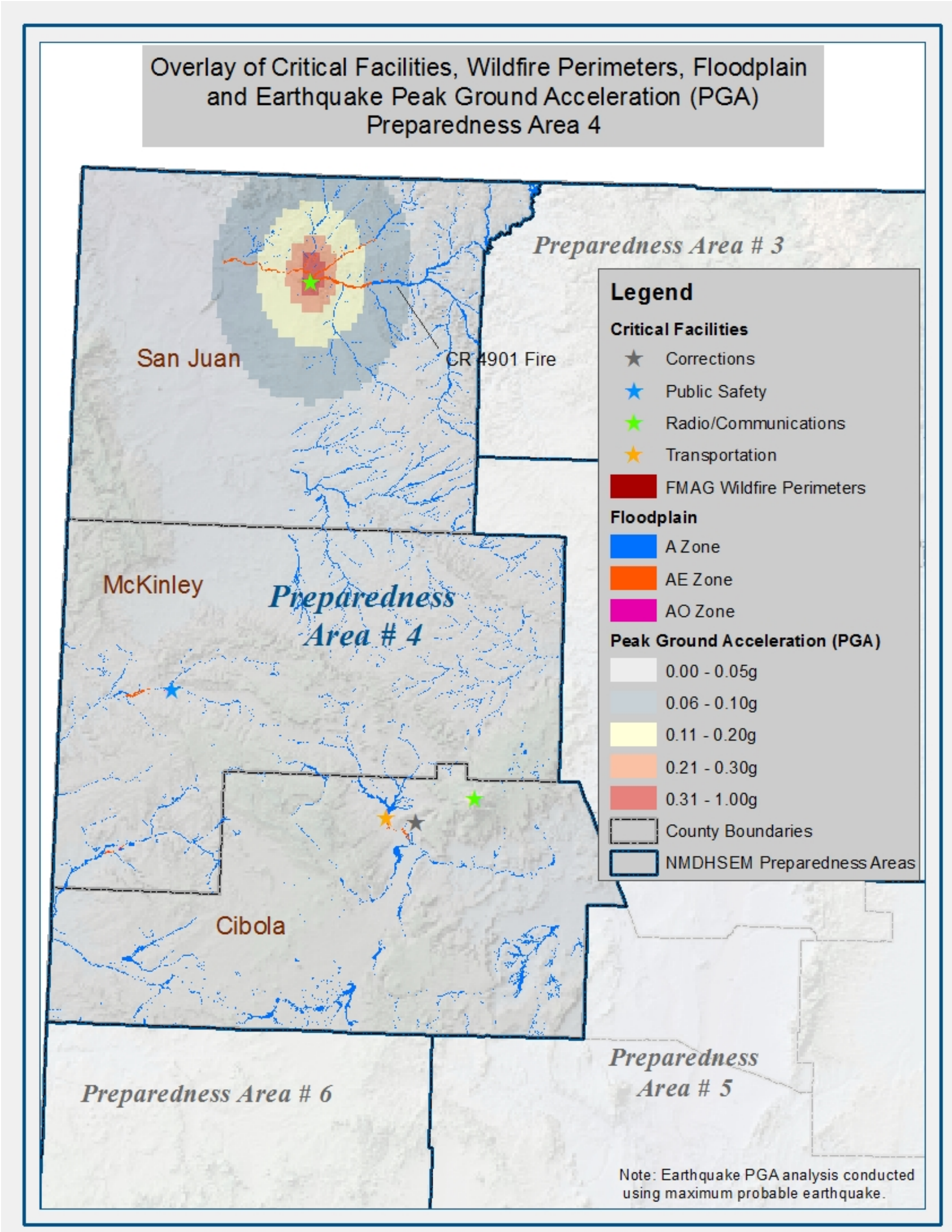
Critical Facilities

In terms of critical facilities, there are 9 hospitals located in Preparedness Area 4 with a total bud capacity of 581 beds. There are 159 schools, 22 fire stations, 22 police stations and 10 emergency operation facilities located in the region. With respect to high potential loss facilities, there are 56 dams identified within Preparedness Area 4. Of these, 21 of the dams are classified as "high hazard". The region also includes 99 hazardous material sites.

There are seven transportation systems within Preparedness Area 4. They include highways, railways, bus, and airports. There are six utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications.

The map below (Figure 4.45) provides spatial information about the vulnerability of critical facilities in Preparedness Area 4 based on Hazus-MH earthquake and flood analysis and previous wildfire risk data.

Figure 4.45. Critical Facilities Vulnerability Map: Preparedness Area 4



The map of Preparedness Area 4 shows one radio/communications facility located in an earthquake shake zone. Additional vulnerable facilities include transportation infrastructure, a correctional facility and a public safety facility, all located in Zone A floodplains in Cibola and McKinley Counties. There is also a radio/communications facility located in a high risk Zone AE floodplain in San Juan County.

Estimating Potential Loss

Figure 4.46 (below) summarizes the expected damage of buildings within Preparedness Area 4 by building type. Please refer to the "Estimating Potential Loss" section included in "Vulnerability

Assessment – Preparedness Area 1" for detailed descriptions and definitions of terms used in the following six figures.

Figure 4.46. Summary of Expected Damage by Building Type

	Preparedness Area 4	
Building Type	# Damaged	# Substantially Damaged
Concrete	4	0
Manufactured Housing	154	722
Masonry	320	237
Steel	2	0
Wood	1054	679
Sub Total	1534	1638
Total	3172	

In Preparedness Area 4, manufactured housing, masonry and wood structures are highly vulnerable to substantial damages in the event of an earthquake. Additionally, there are a small number of steel and concrete buildings in the Preparedness Area that are vulnerable to smaller levels of damage.

Figure 4.47 (below) summarizes the building stock damages by occupancy sector in Preparedness Area 4.

Figure 4.47. Building Stock Damage by Occupancy Sector

	Preparedness Area 4	
Occupancy	# Damaged	# Substantially Damaged
Agriculture	0	0
Commercial	9	0
Education	0	0
Government	2	0
Industrial	2	0
Religion	23	0
Residential	1525	1640
Sub Total	1561	1640
Total	3201	

Within Preparedness Area 4, residential structures are most vulnerable to sustaining substantial damage due to earthquakes. Additionally, religions and commercial buildings are also at risk of sustaining damage due to an earthquake.

Figure 4.48 provides an estimate of the expected number of damaged essential facilities in Preparedness Area 4. The damage designations follow the methodology below:

- Moderate Damage > 50%: More than 50 percent of the building is of moderate damage
- Complete Damage > 50% : More than 50 percent of the building is completely damaged
- Functionality > 50% on day 1: This data describes the number of essential facilities working at greater than 50 percent functionality on day one (1) of the catastrophe.

Figure 4.48. Summary of Expected Damage to Essential Facilities

Classification	Preparedness Area 4
Hospitals	
Total	9
Moderate Damage > 50%	0
Complete Damage >50%	0
Functionality >50 % on day 1	7
Schools	
Total	159
Moderate Damage > 50%	0
Functionality >50 % on day 1	147
EOCs	
Total	10
Moderate Damage > 50%	0
Functionality >50 % on day 1	10
Police Stations	
Total	22
Moderate Damage > 50%	0
Functionality >50 % on day 1	21
Fire Stations	
Total	22
Moderate Damage > 50%	0
Functionality >50 % on day 1	21

The expected damage to essential facilities data indicates that most essential facilities in Preparedness Area 4 will experience very little damage in the event of an earthquake. Functionality of all critical facilities is expected to persist. Generally, the probability of long-term functionality loss of critical facilities in Preparedness Area 4 is low.

Figure 4.49 summarizes of expected economic losses to potable water and electric power system performance in Preparedness Area 4. In the table below, the column on the right provides a daily count of residences without services provided.

Figure 4.49. Summary of Expected Potable Water and Electric Power System Performance

# of Days Without Services	Preparedness Area 4
Potable H2O	
Day 1	0
Day 3	0
Day 7	0
Day 30	0

Day 90	0
Total # of Houses w/o water	0
Electrical	
Day 1	1,622
Day 3	875
Day 7	292
Day 30	47
Day 90	3
Total # of houses w/o Electric	2,839
Total Days Without Service	2,839

Based on the Hazus results, the loss of electrical power during an earthquake is a much greater concern for communities in Preparedness Area 4 than the loss of potable water. On the first day of the earthquake event, Preparedness Area 4 is expected to have a total of 1,622 homes without power. One week after the disaster this number is expected to drop to approximately 292 homes.

Figure 4.50 summarizes the injury/casualty estimates for Preparedness Area 4 based on the results of the Hazus modeling. The data provides time-specific estimations of approximate locations of individuals during an earthquake event.

Figure 4.50. Summary of Injury/Casualty Estimates

	Preparedness Area 4			
2AM	**L 1**	**L 2**	**L 3**	**L 4**
Commercial	0	0	0	0
Hotels	1	0	0	0
Industrial	0	0	0	0
Other-Residential	19	2	0	0
Single Family	26	4	0	1
Total	46	7	0	1
2PM				
Commercial	27	5	1	1
Commuting	0	0	0	0
Educational	5	1	0	0
Hotels	0	0	0	0
Industrial	3	0	0	0
Other-Residential	4	0	0	0
Single Family	5	1	0	0
Total	43	8	1	2
5PM				
Commercial	19	4	0	1
Commuting	0	0	0	0
Educational	1	0	0	0
Hotels	0	0	0	0
Industrial	2	0	0	0
Other-Residential	7	1	0	0

Single Family	10	1	0	0
Total	38	7	1	1
Over All Total	127	22	2	4

At or around 2am, there is maximum occupancy of people within their residences. Residential mortality is at its highest during this time of day. In contrast, at 2pm, there is maximum occupancy of people within commercial buildings or structures. Commercial mortality is highest during this time of day. At and around 5pm there is maximum occupancy of people on roadways (highways, bridges, railways) during rush hour. Commuting and transportation mortalities are highest during this time of day. These trends are reflected in the injury/casualty data provided for Preparedness Area 4. The majority of Level-1 injuries are expected to occur at 2am in single-family homes, at 2pm commercial areas, and at 5pm in commercial areas and single-family homes. Estimated Level-4 injuries (death) are very low in Preparedness Area 4, as are Level-3 injuries.

There are an estimated 88 thousand buildings located in Preparedness Area 4 with a total building replacement value (excluding contents) of $9,943,000,000. Approximately 95% of the buildings (and 77% of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems are estimated to be $11,292,000,000 and $1,477,000,000, respectively. The total value of the lifeline inventory within the Preparedness Area is over $12,769,000. This inventory includes over 1,080 miles of highways, 319 bridges, and 60,098 miles of pipes.

Table 4.51 presents the potential losses from modeled earthquake hazards in Preparedness Area 4.

Table 4.51. Potential Losses from Hazards: Preparedness Area 4

Potential Losses: Preparedness Area 4				
	Residential	Non-Residential	Infrastructure: Transportation	Infrastructure: Utility Systems)
Replacement Value (millions of dollars)	7,666	2,275	11,292	1,477

Future Development Trends

Although Preparedness Area 4 is the fourth most populated Preparedness Area in the state of New Mexico, the general development trend shows increasing population growth over time. Between 2000 and 2010 the population of McKinley County decreased by 4.4% while Cibola and San Juan Counties grew by over 6% and 14%, respectively

Additionally, the poverty rates in Cibola county (25.9%) and McKinley County (30.7%) are much higher than that of the rest of the state (19%) suggesting that Preparedness Area 4 has a higher social vulnerability to multi-hazards than other Preparedness Areas. As population continues to increase and poverty rates remain high, Preparedness Area 4 is likely to face increased vulnerability to drought, flooding and wildfire. Additionally, these development trends may threaten the resilience of the region and make it more challenging for communities in Preparedness Area 4 to resist, respond and recover from disasters.

Vulnerability Assessment – Preparedness Area 5

The following vulnerability analysis is based on information collected from Hazus analysis, content expe

The following vulnerability analysis is based on information collected from Hazus analysis, content experts, and local hazard mitigation plans developed by jurisdictions within Preparedness Area 5. Local jurisdictions within the Preparedness Area identified the following four hazards as medium to high priority planning concerns:

- Floods/Flash Floods
- Severe Winter Storms
- Wildfire

Because they are identified in previous local planning efforts as priority hazards, the remainder of the Preparedness Area vulnerability assessment focuses on the hazards listed above. Although earthquakes were not identified as a primary hazard concern for the region, Hazus loss estimation data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

Preparedness Area Vulnerability

Preparedness Area 5 has a population of 904,943 and includes Sandoval, Bernalillo, Torrance, Valencia and Socorro Counties. There are over 287 thousand households in the region. There are an estimated 295 thousand buildings in Preparedness Area 5. Approximately 93% of the buildings and 80% of the building value are associated with residential housing. In terms of building construction types found in the region, wood frame construction makes up 63% of the building inventory. The remaining percentage is distributed between the other general building types, such as Reinforced Masonry, Manufactured Housing, and Unreinforced Masonry.

Local plans from Preparedness Area 5 identify floods and/or flash floods as the number one hazard concern in their jurisdiction. Flash floods have been and will continue to be a significant threat to the economic and social well-being of communities in the region. Preparedness Area 5 is the most populated Preparedness Area in the state and faces elevated levels of social and physical vulnerability to flooding. However, in some local jurisdictions (ie Socorro County) all political subdivisions participate in the National Flood Insurance Program (NFIP). Here, manufactured homes that will be residences within the county re required to be placed on a permanent foundation per zoning/land use regulations in each respective jurisdiction.

Although severe winter storm hazards (including high winds) were ranked below drought on a number of local hazard mitigation plans, the lost estimates for severe storms far exceeded most other hazards. This is largely due to the fact that a large percentage of the building stock within Preparedness Area 5 is made up of mobile and manufactured homes, effectively increasing the vulnerability of structures and their inhabitants to storm related hazard impacts.

Preparedness Area 5 is highly vulnerable to wildfire due to multiple factors including rapid development near forested areas, prolonged drought, and high fuel loads due to pine beetle kill. In terms of wildfire vulnerability and population growth, the potential for residential development along the wildland urban interface (WUI) in Preparedness Area 5 is limited in a number of local jurisdictions due to land use regulations. In these jurisdictions, land that is next to the WUI tends to be agricultural which restricts residential development. Variance procedures and amendments to the zoning map are necessary if land owners move to develop agricultural land into residential properties and sometimes these variances and amendments are difficult to obtain. The local plans created by jurisdictions within Preparedness Area 5 focus their mitigation efforts on education and outreach and well as on existing property protection and wildfire prevention strategies.

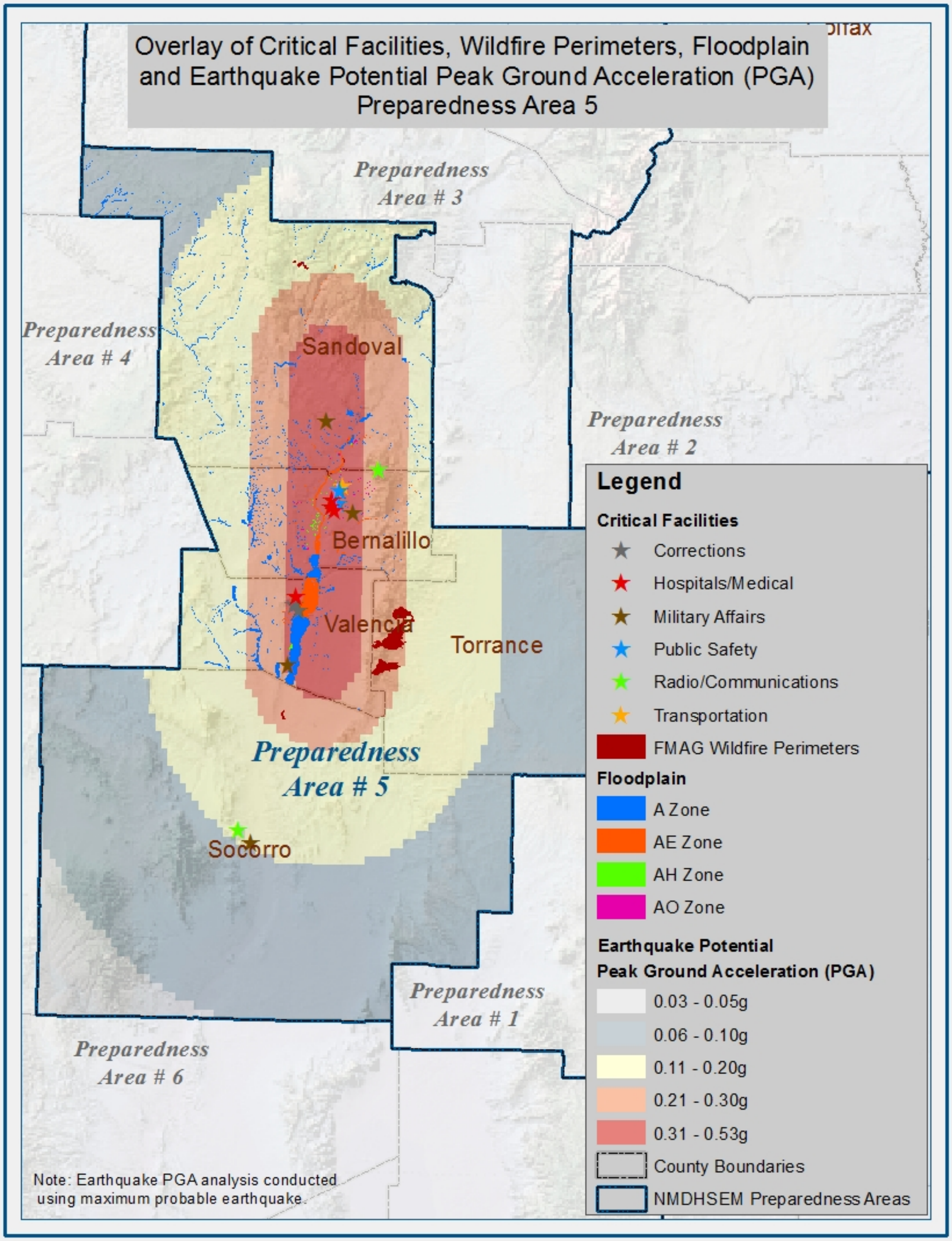
Critical Facilities

With respect to critical facilities, there are 19 hospitals located in Preparedness Area 5 with a total bed capacity of 1,985 beds. In addition, there are 384 schools, 41 fire stations, 45 police stations and 27 emergency operation facilities. In terms of high potential loss facilities, there are 55 dams identified within Preparedness Area 5 and 30 of those dams are classified as “high hazard” dams. The high potential loss inventory also includes 51 hazardous material sites.

There are seven transportation systems that include highways, railways, bus, and airports. There are six utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications.

The map below (Figure 4.52) provides spatial information about the vulnerability of critical facilities in Preparedness Area 5 based on Hazus-MH earthquake and flood analysis and previous wildfire risk data.

Figure 4.52. Critical Facilities Vulnerability Map: Preparedness Area 5



A large area of Preparedness Area 5 is covered by an earthquake shake zone. The vulnerability map shows a number of critical facilities clustered within the high PGA area as well as located within Zone A, AE and AH floodplain areas. Three hospitals within Bernadillo County and two public safety facilities are located in overlapping hazard areas, illustrating the elevated vulnerability of these critical facilities. Future planning efforts may focus on vulnerability reduction efforts in areas in Valencia, Bernadillo and Sandoval Counties where multi hazards overlap with critical facilities.

Estimating Potential Loss

Figure 4.53 (below) summarizes the expected damage of buildings within Preparedness Area 5 by building type. Please refer to the "Estimating Potential Loss" section included in "Vulnerability Assessment – Preparedness Area 1" for detailed descriptions and definitions of terms used in the following six figures.

Figure 4.53. Summary of Expected Damage by Building Type

	Preparedness Area 5	
Building Type	# Damaged	# Substantially Damaged
Concrete	5	0
Manufactured Housing	223	919
Masonry	615	2
Steel	2	0
Wood	1901	11
Sub Total	2746	932
Total	3678	

In Preparedness Area 5, manufactured housing structures are highly vulnerable to substantial damages in the event of an earthquake. Additionally, there are a large number of masonry and wood frame buildings in the Preparedness Area that are vulnerable to smaller levels of damage.

Figure 4.54 (below) summarizes the building stock damages by occupancy sector in Preparedness Area 5.

Figure 4.54. Building Stock Damage by Occupancy Sector

	Preparedness Area 5	
Occupancy	# Damaged	# Substantially Damaged
Agriculture	0	0
Commercial	10	0
Education	0	0
Government	1	0
Industrial	3	0
Religion	4	0
Residential	2736	932
Sub Total	2754	932
Total	3686	

In Preparedness Area 5, commercial, religious and industrial buildings are most vulnerable to damages in the event of an earthquake. That said, substantial levels of building damage are unlikely.

Figure 4.55 provides an estimate of the expected number of damaged essential facilities in Preparedness Area 5. The damage designations follow the methodology below:

- Moderate Damage > 50%: More than 50 percent of the building is of moderate damage
- Complete Damage > 50%: More than 50 percent of the building is completely damaged
- Functionality > 50% on day 1: This data describes the number of essential facilities working at greater than 50 percent functionality on day one (1) of the catastrophe.

Figure 4.55. Summary of Expected Damage to Essential Facilities

Classification	Preparedness Area 5
Hospitals	
Total	19
Moderate Damage > 50%	0
Complete Damage >50%	0
Functionality >50 % on day 1	0

Schools	
Total	348
Moderate Damage > 50%	0
Functionality >50 % on day 1	0
EOCs	
Total	27
Moderate Damage > 50%	0
Functionality >50 % on day 1	0
Police Stations	
Total	45
Moderate Damage > 50%	0
Functionality >50 % on day 1	0
Fire Stations	
Total	41
Moderate Damage > 50%	0
Functionality >50 % on day 1	0

The expected damage to essential facilities data indicates that most essential facilities in Preparedness Area 5 will be unable to return to full functionality for quite some time in the event of an earthquake.

Figure 4.56 summarizes of expected economic losses to potable water and electric power system performance in Preparedness Area 5. In the table below, the column on the right provides a daily count of residences without services provided.

Figure 4.56. Summary of Expected Potable Water and Electric Power System Performance

# of Days Without Services	Preparedness Area 5
Potable H2O	
Day 1	0
Day 3	0

Day 7	0
Day 30	0
Day 90	0
Total # of Houses w/o water	0
Electrical	
Day 1	0
Day 3	0
Day 7	0
Day 30	0
Day 90	0
Total # of houses w/o Electric	0
Total Days Without Service	0

Based on the Hazus results, Preparedness Area 5 is not expected to suffer a loss of electricity or potable water.

Figure 4.57 summarizes the injury/casualty estimates for Preparedness Area 5 based on the results of the Hazus modeling. The data provides time-specific estimations of approximate locations of individuals during an earthquake event.

Figure 4.57. Summary of Injury/Casualty Estimates

	Preparedness Area 5			
2AM	**L 1**	**L 2**	**L 3**	**L 4**
Commercial	0	0	0	0
Hotels	0	0	0	0
Industrial	0	0	0	0
Other-Residential	0	0	0	0
Single Family	0	0	0	0
Total	0	0	0	0

2PM				
Commercial	0	0	0	0
Commuting	0	0	0	0
Educational	0	0	0	0
Hotels	0	0	0	0
Industrial	0	0	0	0
Other-Residential	0	0	0	0
Single Family	0	0	0	0
Total	0	0	0	0
5PM				
Commercial	0	0	0	0
Commuting	0	0	0	0
Educational	0	0	0	0
Hotels	0	0	0	0
Industrial	0	0	0	0
Other-Residential	0	0	0	0
Single Family	0	0	0	0
Total	0	0	0	0
Over All Total	0	0	0	0

Based on the Hazus results, communities within Preparedness Area 5 are not expected to suffer any casualties or injuries in the event of an earthquake.

There are an estimated 295 thousand buildings located in Preparedness Area 5 with a total building replacement value (excluding contents) of 52,733 (millions of dollars). Approximately 93% of the buildings (and 80% of the building value) are associated with residential housing and 63% of the building stock is made up of wood frame construction.

The replacement value of the transportation and utility lifeline systems are estimated to be 17,360 and 738 (millions of dollars), respectively. This includes over 2,508 kilometers of highways, 561 bridges and 79,062 kilometers of pipe. Table 4.58 presents the potential losses from modeled earthquake hazards in Preparedness Area 5.

Table 4.58. Potential Losses from Hazards: Preparedness Area 5

Potential Losses: Preparedness Area 5				
	Residential	Non-Residential	Infrastructure: Transportation	Infrastructure: Utility Systems
Replacement Value (millions of dollars)	**42,091**	**10,638**	**17,360**	**738**

Based on the results of the local hazard mitigation plan roll-up, flood loss estimates in Preparedness Area 5 are over $250 million. Wildfire loss estimate for the region came in at over $30 million. The aggregated estimated losses from Severe Storms in Preparedness Area 5 were over $480 million. These loss estimates include estimated economic losses from interrupted services and job loss.

Future Development Trends

Not only does Preparedness Area 5 have the largest population of all of the Preparedness Areas in the state, it also contains Sandoval, Bernalillo and Valencia Counties, the 1st, 3rd and 5th fastest growing Counties in the state, respectively. Population growth is expected to increase across the region and, as a result, low density housing is booming. This growth trend, coupled with increasing development, exacerbates the risks associated with floods, wildfire, and severe weather.

In many parts of the state, the potential for residential development along the wildland-urban interface is limited due to restrictive land use regulations. However, Preparedness Area 5 is experiencing an increase in residential growth in or near the forest boundary. This development trend significantly increases the risk of catastrophic structure losses from wildfires as well as increased exposure of people to wildfire related deaths.

Preparedness Area 5 includes Torrance County, which had the fastest population growth rate in the state of New Mexico between 1990 and 2000. Considered a "commuter-shed" of the Albuquerque metro area, low density residential development is surging in the region. The increase in population and development along the urban/wildland boundary is one of the key reasons why counties like Torrance consider wildfire their most critically ranked hazard. This development trajectory is seen across the state and many local jurisdictions anticipate that wildfire will remain a hazard mitigation priority for quite some time.

Vulnerability Assessment – Preparedness Area 6

The following vulnerability analysis is based on information collected from Hazus analysis, content experts and local hazard mitigation plans developed by jurisdictions within Preparedness Area 6. Local jurisdictions within the Preparedness Area identified the following four hazards as medium to high priority planning concerns:

- High Winds
- Floods/Flash Floods
- Wildfire

Because they are identified in previous local planning efforts as priority hazards, the remainder of the Preparedness Area vulnerability assessment focuses on the hazards listed above. Although earthquakes were not identified as a primary hazard concern for the region, Hazus loss estimation data and parameters were used to evaluate the vulnerability of each Preparedness Area relative to the others.

Preparedness Area Vulnerability

Preparedness Area 6 has a population of 348,246 and includes Catron, Grant, Sierra, Otero, Doña Ana, Luna and Hidalgo Counties. There are over 113 thousand households in the region.

Severe wind storms are a typical occurrence in New Mexico, especially in the spring. Across the state, property damage and physical injury are the most frequently reported impacts of high wind events. Secondary hazards associated with high winds include downed power lines (additional wildfire hazard), structural instability and collapse, and injury dues to airborne dust and debris.

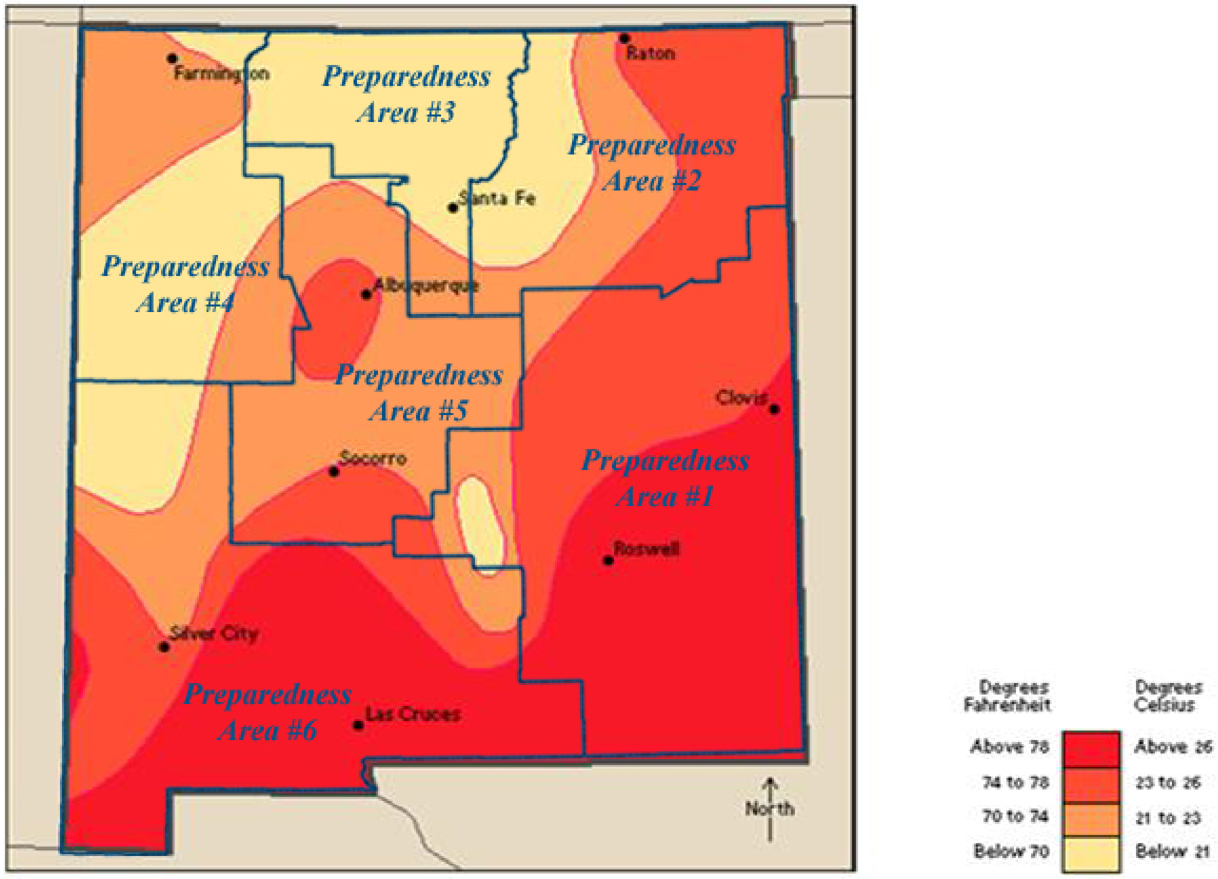
Although none of the local hazard mitigation plans reviewed for the state mitigation plan update identified high winds as a first priority hazard, a number of jurisdictions cited severe storms (including the associated high winds) as a serious concern. Based on the results of the local plan roll-up, the annual probabilities of high wind events were over 70% for any given local jurisdiction. In many cases, high winds was elevated to priority 2 or 3 hazards in local jurisdiction plans because of the high loss estimates generated for high wind scenarios.

A number of counties within Preparedness Area 6 are home to large numbers of mobile homes and commercial and public buildings. Structures of this type are highly vulnerable to high wind events. In many cases, however, these buildings have not been inventoried at the local scale.

Local plans from Preparedness Area 6 identify floods and/or flash floods as the number one hazard concern in their jurisdiction. This is one of the most populated Preparedness Areas in the state and therefore faces elevated levels of social and physical vulnerability to flooding.

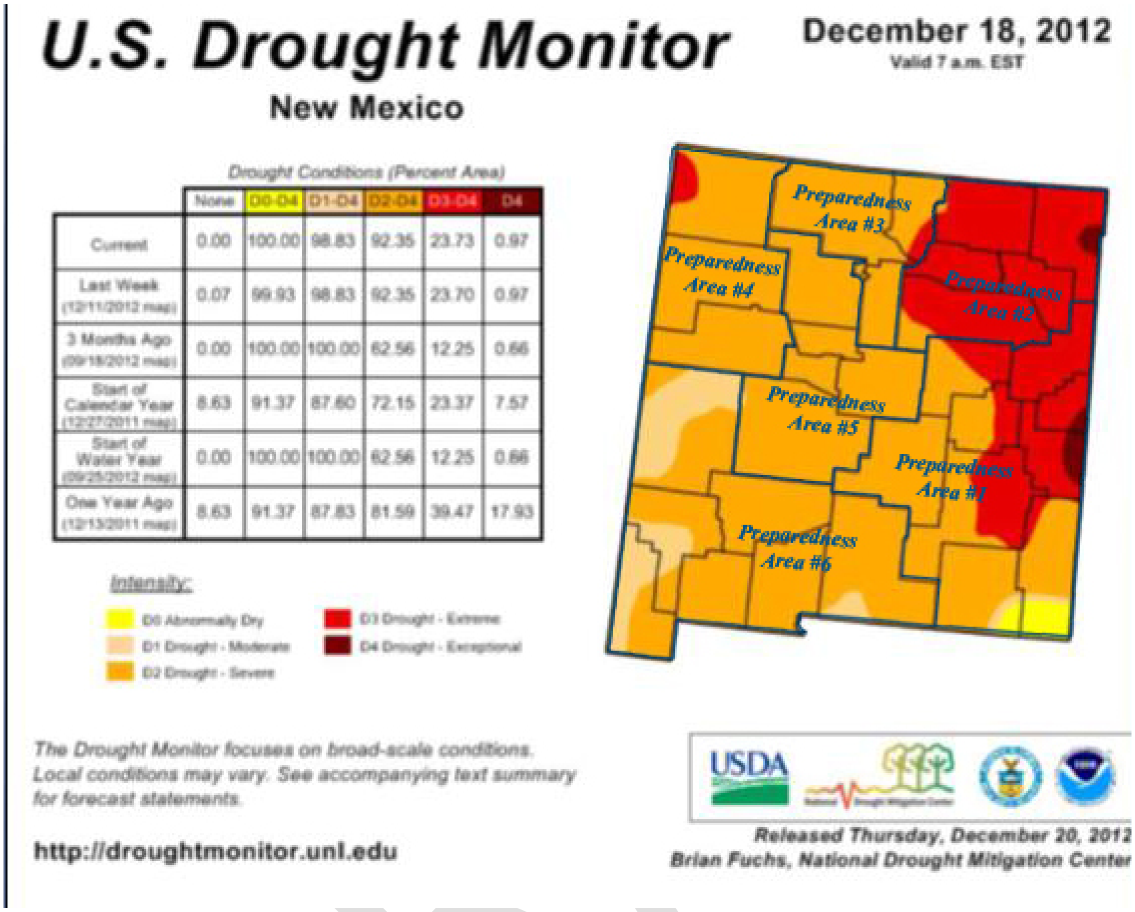
Preparedness Area 6 has a higher vulnerability to wildfire hazards due to prolonged high temperatures throughout the region (Figure 4.59). Additionally, a large portion of the land mass of Preparedness Area 6 is experiencing extended severe drought conditions (Figure 4.60). Together, these conditions elevate regional wildfire vulnerability and create a perfect storm for future wildfire disasters. Prolonged drought can also contribute to flash flooding events if the soil is unable to absorb moisture quickly after a rain event.

Figure 4.59. US Drought Monitor - New Mexico as of December 18, 2012[134]



134 Source: New Mexico Drought Task Force at http://www.nmdrought.state.nm.us/

Figure 4.60. New Mexico Drought Conditions (December, 2012)

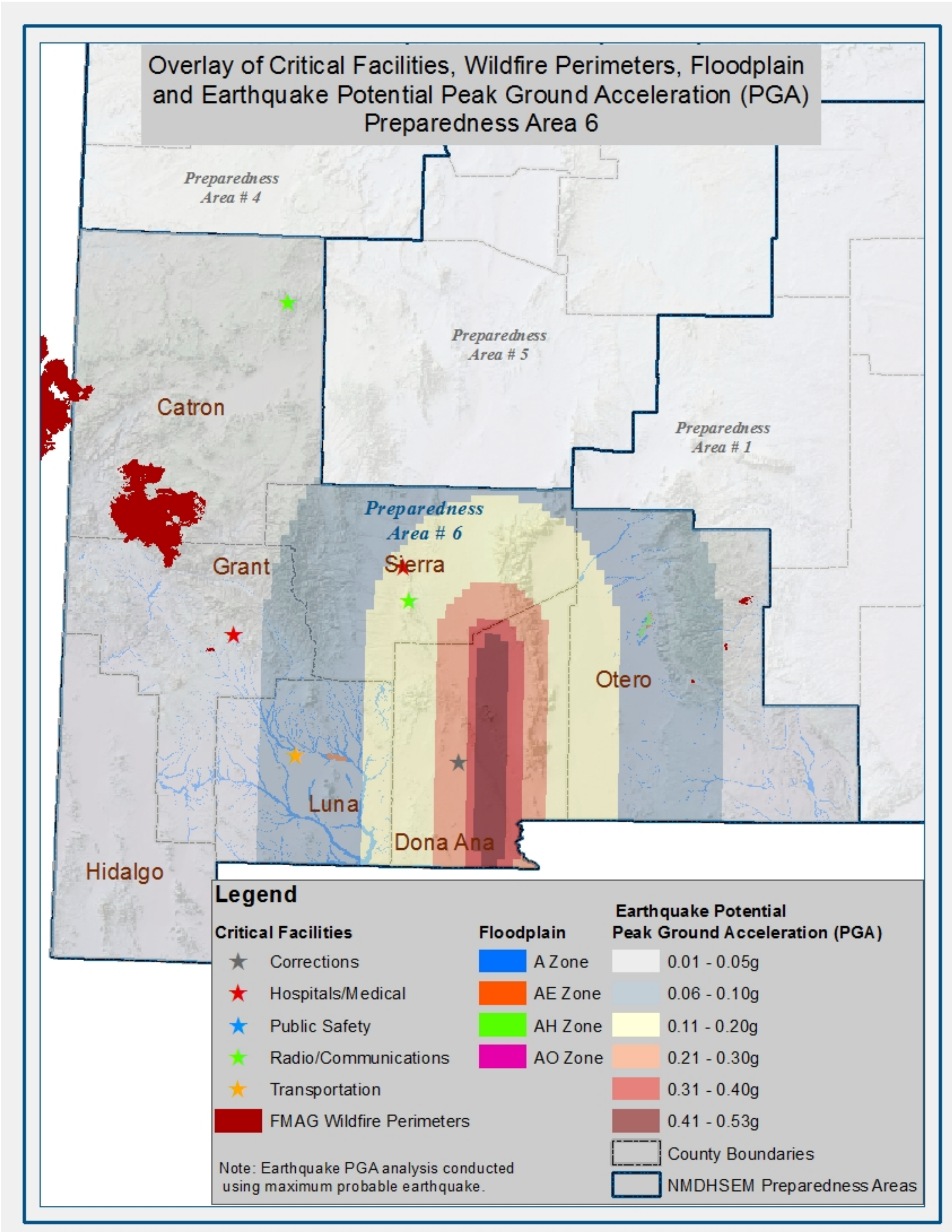


Critical Facilities

With respect to critical facilities, there are 8 hospitals in Preparedness Area 6 with a total bed capacity of 720 beds. There are 162 schools, 65 fire stations, 25 police stations and 13 emergency operation facilities in the Preparedness Area. In terms of high potential loss facilities, there are 107 dams identified within the region. Of these, 37 are classified as “high hazed” dams. The high potential loss inventory also includes 103 hazardous material sites.

The map below (Figure 4.61) provides spatial information about the vulnerability of critical facilities in Preparedness Area 6 based on Hazus-MH earthquake and flood analysis and previous wildfire risk data.

Figure 4.61. Critical Facilities Vulnerability Map: Preparedness Area 6



The map of Preparedness Area 6 shows one corrections facility, a hospital, a radio/communications structure and critical transportation infrastructure is also located in a high-risk earthquake shake zone. Additionally, the transportation facility also lays in a Zone A floodplain. Wildfire hazards have the potential to affect critical facilities located in the western part of the state, including a hospital in Grant County.

Estimating Potential Loss

Figure 4.62 (below) summarizes the expected damage of buildings within Preparedness Area 6 by building type. Please refer to the "Estimating Potential Loss" section included in "Vulnerability Assessment – Preparedness Area 1" for detailed descriptions and definitions of terms used in the following six figures.

Figure 4.62. Summary of Expected Damage by Building Type

	Preparedness Area 6	
Building Type	# Damaged	# Substantially Damaged
Concrete	17	0
Manufactured Housing	250	178
Masonry	329	0
Steel	5	0
Wood	940	1
Sub Total	1541	179
Total	1720	

In Preparedness Area 6, manufactured housing structures are vulnerable to substantial damages in the event of an earthquake. Additionally, there are a significant number of masonry and wood structures in the Preparedness Area that are vulnerable to smaller levels of damage.

Figure 4.63 (below) summarizes the building stock damages by occupancy sector in Preparedness Area 2.

Figure 4.63. Building Stock Damage by Occupancy Sector

	Preparedness Area 6	
Occupancy	# Damaged	# Substantially Damaged
Agriculture	3	0
Commercial	65	0
Education	2	0
Government	4	0
Industrial	7	0
Religion	7	0
Residential	1495	152
Sub Total	1583	152
Total	1735	

In Preparedness Area 6, the residential sector is most vulnerable to substantial damage due to an earthquake. The commercial sector is also vulnerable in lesser degrees of damage. The industrial and religion sectors are also vulnerable to structural damage

Figure 4.64 provides an estimate of the expected number of damaged essential facilities in Preparedness Area 6. The damage designations follow the methodology below:

- Moderate Damage > 50%: More than 50 percent of the building is of moderate damage
- Complete Damage > 50%: More than 50 percent of the building is completely damaged
- Functionality > 50% on day 1: This data describes the number of essential facilities working at greater than 50 percent functionality on day one (1) of the catastrophe.

Figure 4.64. Summary of Expected Damage to Essential Facilities

Classification	Preparedness Area 6
Hospitals	
Total	8
Moderate Damage > 50%	3
Complete Damage >50%	1
Functionality >50 % on day 1	5
Schools	
Total	162
Moderate Damage > 50%	42
Functionality >50 % on day 1	105
EOCs	
Total	13
Moderate Damage > 50%	1
Functionality >50 % on day 1	12
Police Stations	
Total	25
Moderate Damage > 50%	3
Functionality >50 % on day 1	22
Fire Stations	
Total	65
Moderate Damage > 50%	12
Functionality >50 % on day 1	48

The expected damage to essential facilities data indicates that although the majority of essential facilities in Preparedness Area 6 will return to over 50% functionality on day one of an earthquake event, a number of facilities will experience moderate damage of over 50%.

Figure 4.65 summarizes of expected economic losses to potable water and electric power system performance in Preparedness Area 6. In the table below, the column on the right provides a daily count of residences without services provided.

Figure 4.65. Summary of Expected Potable Water and Electric Power System Performance

# of Days Without Services	Preparedness Area 6
Potable H2O	
Day 1	9,851
Day 3	7,689
Day 7	3,754
Day 30	0
Day 90	0
Total # of Houses w/o water	21,294
Electrical	
Day 1	24,439
Day 3	16,442
Day 7	7,630
Day 30	1,663
Day 90	31
Total # of houses w/o Electric	50,205
Total Days Without Service	86,274

Based on the Hazus results, both the loss of electrical power and potable water during an earthquake are cause for concern in Preparedness Area 6. On the first day of the earthquake event, Preparedness Area 6 is expected to have a total of 24,439 homes without power and 9,851 homes without potable water. One week after the disaster the power and water interruption numbers are expected to drop to approximately 7,630 and 3,754 homes, respectively.

Figure 4.66 summarizes the injury/casualty estimates for Preparedness Area 6 based on the results of the Hazus modeling. The data provides time-specific estimations of approximate locations of individuals during an earthquake event.

Figure 4.66. Summary of Injury/Casualty Estimates

	Preparedness Area 6			
2AM	**L 1**	**L 2**	**L 3**	**L 4**
Commercial	18	6	1	2
Hotels	26	8	1	3
Industrial	15	5	1	2
Other-Residential	1,187	296	27	48
Single Family	1,395	402	61	118
Total	2,640	717	91	173
2PM				
Commercial	1,151	379	68	134
Commuting	2	2	4	1
Educational	497	163	29	57
Hotels	5	2	0	1

Industrial	108	36	6	13
Other-Residential	209	51	4	8
Single Family	265	75	12	21
Total	2,235	707	123	233
5PM				
Commercial	933	305	55	107
Commuting	38	45	82	16
Educational	105	35	6	12
Hotels	8	2	0	1
Industrial	67	22	4	8
Other-Residential	433	108	10	18
Single Family	547	155	24	44
Total	2,130	673	181	205
Over All Total	7,005	2,097	395	611

The majority of Level-4 injuries are expected to occur at 2am in single-family and other residential buildings, at 2pm in commercial and educational buildings, and at 5pm in commercial and single family buildings. Casualty estimates are much higher in Preparedness Area 6 than in the other five Preparedness Areas along with the Level 1-3 injury projections.

There are an estimated 147 thousand buildings located in Preparedness Area 6 with a total building replacement value (excluding contents) of $15,959,000,000. Approximately 95% of the buildings (and 79% of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems are estimated to be $20,882,000,000 and $1,088,000,000, respectively. Table 4.67 presents the potential losses from modeled earthquake hazards in Preparedness Area 6.

Table 4.67. Potential Losses from Hazards: Preparedness Area 6

	Potential Losses: Preparedness Area 6			
	Residential	**Non-Residential**	**Infrastructure: Transportation**	**Infrastructure: Utility Systems**
Replacement Value (millions of dollars)	12,621	3,331	20,882	1,088

Based on the results of the local hazard mitigation plan roll-up, flood loss estimates in Preparedness Area 6 are over $400 million. Regional loss estimate for high wind region came in at over $186 thousand. The aggregated estimated losses from wildfire in Preparedness Area 6 were over $238 million. These loss estimates do not include estimated economic losses from interrupted services, job loss and environmental damage.

Future Development Trends

The probability of a high wind event in any given year is 73%. The county consists of mobile homes commercial and public buildings that are vulnerable to high wind events. However, "these buildings have not been inventoried"

Flash floods have been and will continue to be a significant threat to the economic and social well-being of vulnerable areas in the county. Many local jurisdictions use flood insurance as a strategy for curbing development in areas that are prone to flood hazards. For example, in Sierra County (located in Preparedness Area 6), 80% of privately owned land is within areas of major drainage, and 50% of the inhabitants of the county live within the 50 year flood zone. Although there are no repetitive loss properties in the jurisdiction, there are 143 Flood Insurance Policies issued in County.

Vulnerability Assessment – Low Probability Hazards

During the 2013 Plan update process, the Hazard Mitigation Team identified a total of fourteen hazards that have sufficient likelihoods of occurrence to warrant discussion and planning. Out of these 14 hazards, local jurisdiction hazard mitigation plans identified five of these hazards as medium to high priority. These hazards are as follows: high winds, flood, wildfire, severe storms, and drought.

Despite the fact that the nine remaining hazards were not identified as high risk at the local level, it is important that the State consider these low probability (and sometimes high magnitude) hazards. The following section provides a statewide vulnerability assessment for each of the following nine hazards: Dam Failure, Earthquakes, Extreme Heat, Expansive Soils, Landslide, Land Subsidence, Thunderstorms, Tornadoes, and Volcanoes. At the present time, an in-depth vulnerability analysis has not been performed for each of these hazards at the local level or by Preparedness Area, due to current limitations in data availability. Improving upon this analysis will be a focus of the State in future Plan updates. Current development and population growth trends strongly suggest that statewide vulnerability to the following hazards will increase over time unless mitigation actions are identified, planned for and implemented.

Vulnerability Assessment – Dam Failure

The most significant vulnerability concern associated with dams in the state of New Mexico is dam washout due to overtopping during flash flood events. There have been 41 Dam Incident Notifications in New Mexico since 1890, with 18 total failures.

The probability of dam failure in is greatest in Preparedness Area 2, which has an overall 12% probability of failure. The Preparedness Area with the second greatest probability of failure is Preparedness Area 4, with a probability of failure of 7%. Despite these vulnerability profiles, dam failure was not listed as a top-three hazard priority by any of the local jurisdiction mitigation plans reviewed for the state update.

Vulnerability Assessment – Earthquakes

As mentioned above, seismic events are currently not identified by any local jurisdictions as a high priority hazard. This is quite common when it comes to planning for low probability, high impact events. The State recognizes the risk posed by earthquakes and has performed Hazus earthquake analyses for the 6 Preparedness Areas. Results of the Hazus analyses are included above in the specific Preparedness Area vulnerability sections and are also provided in Appendix D.

Much of the state and local infrastructure, many public buildings, and most private residences and businesses in New Mexico have not been designed with earthquake resistance in mind. As a result, an earthquake of even moderate scale in the right place could cause extensive damage.

The region located along the Rio Grande from southern Socorro County north into Rio Arriba County is where the most damaging seismic activity can be expected in the state. The Preparedness Areas most vulnerable to the impacts of earthquakes are Preparedness Areas 3, 5 and 6.

Vulnerability Assessment – Extreme Heat

New Mexico is partially an arid, desert state and under normal summertime conditions, temperatures often exceed 100 degrees. Extreme heat events, when temperatures are ten degrees or more above the average for several weeks, are an important public health concern for the state. During extended periods of very high temperatures or in situations of elevated humidity, individuals can suffer a variety of health effects, including heatstroke, heat exhaustion, heat syncope and heat cramps. Extreme heat events pose significant health risks for the following vulnerable populations: elderly, children, impoverished, the disabled, and outdoor workers. Special planning and emergency management considerations must be made for these particularly vulnerable groups of people.

Vulnerability Assessment – Expansive Soils

A large area of the New Mexico consists of expansive soils with high swelling potential. Although damages due to expansive soils have occurred in the past, because expansive soils are a slow onset hazard with cumulative rather than instantaneous damages, local and regional mitigation planning efforts have not focused planning efforts on hazards of this type. The slow nature of expansive soil hazards leads to nearly imperceptible, incremental impacts. However, damages to the built environment may occur that can be very costly over time.

Vulnerability Assessment – Landslide

Landslides are of a greater concern in areas of the state where development overlaps with high relief landscapes. Most of the landslide events in New Mexico have happened along roads in areas where roadways pass through erosive gorges. In New Mexico, those areas of most vulnerability to a landslide are Preparedness Area 2 (Colfax, Mora, and Union Counties), Preparedness Area 3 (Rio Arriba County), and Preparedness Area 4 (San Juan, McKinley and Cibola Counties).

Vulnerability Assessment – Land Subsidence

Land subsidence occurs when a large amount of groundwater (or petroleum) is withdrawn from fine-grained sediments and other porous rocks. These rocks and sediments collapse when water is removed, leading to a loss of surface elevation (abrupt losses of surface elevation are called sinkholes). Although land subsidence is a low frequency hazard, it poses significant threats to human life and infrastructure across the state.

In New Mexico, many communities get the majority of their water by pumping groundwater. Some of the major aquifers in the state include compressible clay and silt that are highly vulnerable to collapse. Increased groundwater demand from population growth is likely to accelerate land subsidence across the state.

Vulnerability Assessment – Thunderstorm

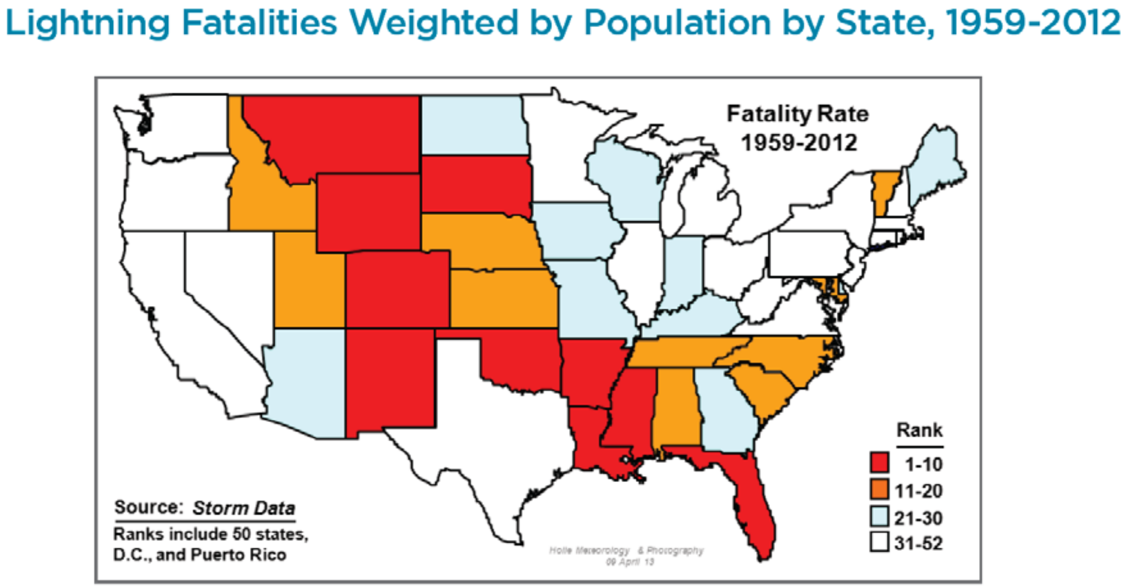
Thunderstorm events (including lighting and hail) are difficult to predict. Weather monitoring science and technology can provide us with forecasts and warnings. However, information about the frequency, duration, and severity of severe storms is not always precise. Despite their typically limited duration, thunderstorms can be extremely damaging to life, agriculture, and property, as they are often fast in their approach and accompanied by secondary hazards including flash flooding, lightning, hail, tornadoes, and high winds.

Although the local jurisdiction hazard mitigation plans reviewed during the 2013 Plan update process did not identify thunderstorms as a high priority hazard, a number of local plans reviewed during the roll-up emphasized the perennial nature of thunderstorms and the high probability of occurrence across the state. Additionally, local jurisdictions identified lightning as a great concern largely because of prolonged regional drought conditions and elevated wildfire risk. Colfax County, located in Preparedness Area 2, found that as many as 50% of their fire response calls during the past two years have been to fires caused by lightning strikes. This number is expected to remain high under current drought and environmental conditions.

In other parts of the state, Grant County in Preparedness Area 6, for example, lightning is also one of the most common causes of wild fires. The majority of Grant County's communication sites, and several other critical facilities, are located on top of forested mountains. This greatly increases the vulnerability of the community to the secondary impacts of thunderstorms. As true in most parts of the state, rapid development within Wild land Urban Interface areas in Grant County has exacerbated current vulnerability conditions. A severe fire in similar planning areas could lead the loss of communications capabilities, mass evacuations, loss of property, and loss of lives.

Per capita, New Mexico has the second highest incidence of lightning fatalities in the nation and outdoor workers, including highway workers and construction workers, are among the most vulnerable population group. Figure 4.68 shows a map of lightning fatalities by state between 1959 and 2012. The state rankings have been weighted by population size to present an accurate picture of relative vulnerability.

Figure 4.68. Lightning Fatalities by State (1959-2012)[135]



The general weather patterns of the last several decades are expected to continue in the state. Historical rates of injury and property damage are also expected to continue. An increasing dependence on electronic equipment may lead to an increase in the amount and extent of property damage resulting from lightning strikes. Additionally, increased development across the state has the potential to increase vulnerability and potential losses to lightning and hail damage.

Vulnerability Assessment – Tornado

Tornado hazards are extremely variable with respect to how and where the strike. Moreover, reporting on tornado events is inconsistent due to low population densities in some areas of the state. The severity of a tornado event can vary greatly depending on the severity of the storm and on the location of the funnel cloud. In general, highly vulnerable populations include residents of mobile home parks, low income individuals who do not have access to transportation or shelter, and limited language speakers who are unable to understand pre-event warnings and preparedness information.

Vulnerability Assessment – Volcano

New Mexico is characterized by an enormously diverse record of volcanic activity, perhaps more than any other state in the U.S. Many of the most distinctive landscapes of the state were formed by volcanoes and volcanic rocks: Ship Rock is the eroded remnant of a volcano (in Preparedness Area 4), as is Cabezon Peak (located in Preparedness Area 5); Mount Taylor in Cibola County (Preparedness Area 4) and Capulin Mountain in Union County (Preparedness Area 2) are volcanoes; and the list goes on.

[135] Lightning fatality data were collected by NOAA. Source: http://www.lightningsafety.noaa.gov/stats/59-12_State_Ltg._Fatality_Map-rates.pdf

Residents across New Mexico are living in a state with a very small yet very real change of volcanic activity occurring in the next century. Due to this extremely low probability of occurrence of a volcanic event in the state (.01% chance in ten years), the State Hazard Mitigation Plan will not address volcanos in further detail unless data emerges to suggest that a volcanic eruption is more likely than previously indicated.

Conclusion – New Mexico Vulnerabilities

The goal of the previous vulnerability assessments was to determine the impact of hazards on the built environment and the safety of New Mexico residents in the event of a disaster. The assessment identified the effects of hazard events by estimating the relative exposure of people, buildings, and infrastructure to hazardous conditions. Ultimately, the results of the hazards-specific vulnerability assessments provide a logical framework for the identification and prioritization of appropriate mitigation actions.

Based on the analysis, the following conclusions can be drawn about hazard vulnerability in the state of New Mexico:

- Preparedness Area 4 has the highest social vulnerability in the state.
- Preparedness Area 5 has the highest vulnerability in terms of Residential and Non-residential building stock.
- Preparedness Area 1 has the highest vulnerability in terms of transportation infrastructure.
- Preparedness Area 4 has the highest vulnerability in terms of utility infrastructure.

The following Figures (4.69 – 4.73) provide summaries of Expected Building Damage by Building Type, Expected Building Damage by Occupancy Sector, Expected Damage to Essential Facilities, Expected Potable Water and Electric Power System Performance, and Injury/Casualty Estimates. The Hazus data presented in the tables below are aggregated by Preparedness Area for the sake of comparison between planning areas.

Figure 4.69. Summary of Expected Damage by Building Type (Preparedness Areas 1-6)

	PA1		PA2		PA3		PA4		PA5		PA6	
Building Type	# dam	# Sub. Dam	# dam	# Sub. Dam	# dam	# Sub. Dam	# dam	# Sub. Dam	# dam	# Sub. Dam	# dam	# Sub. Dam
Concrete	0	0	0	0	1	0	4	0	5	0	17	0
Manufactured Housing	5	21	3	14	23	29	154	722	223	919	250	178
Masonry	73	0	33	0	39	0	320	237	615	2	329	0
Steel	0	0	0	0	1	0	2	0	2	0	5	0
Wood	260	3	117	0	332	1	1054	679	1901	11	940	1
Sub Total	338	24	153	14	396	30	1534	1638	2746	932	1541	179

Total	362	167	426	3172	3678	1720

Figure 4.70. Summary of Expected Building Damage by Occupancy Sector (Preparedness Areas 1-6)

	PA1		PA2		PA3		PA4		PA5		PA6	
Occupancy	# dam	#sub. dam	# dam	#sub. dam	# dam	#sub. dam	# dam	#sub. dam	# dam	#sub. dam	# dam	#sub. dam
Agriculture	0	0	0	0	0	0	0	0	0	0	3	0
Commercial	1	0	1	0	7	0	9	0	10	0	65	0
Education	0	0	0	0	0	0	0	0	0	0	2	0
Government	0	0	0	0	4	0	2	0	1	0	4	0
Industrial	0	0	1	0	0	0	2	0	3	0	7	0
Religion	0	0	0	0	0	0	23	0	4	0	7	0
Residential	339	24	153	14	429	30	1525	1640	2736	932	1495	152
Sub Total	340	24	155	14	440	30	1561	1640	2754	932	1583	152
Total	364		169		470		3201		3686		1735	

Figure 4.71. Summary of Expected Damage to Essential Facilities (Preparedness Areas 1-6)

Classification	PA1	PA2	PA3	PA4	PA5	PA6
Hospitals						
Total	10	4	4	9	19	8
Moderate Damage > 50%	0	0	1	0	0	3
Complete Damage >50%	0	0	1	0	0	1
Functionality >50 %on day 1	9	2	1	7	0	5
Schools	-	-	-	-	-	-
Total	193	64	151	159	348	162
Moderate Damage > 50%	0	0	9	0	0	42
Functionality >50 %on day 1	179	47	138	147	0	105
EOCs						
Total	16	8	22	10	27	13
Moderate Damage > 50%	0	0	4	0	0	1
Functionality >50 %on day 1	14	7	18	10	0	12

Police Stations						
Total	39	14	21	22	45	25
Moderate Damage > 50%	0	0	2	0	0	3
Functionality >50 %on day 1	36	12	19	21	0	22
Fire Stations						
Total	61	35	38	22	41	65
Moderate Damage > 50%	0	0	6	0	0	12
Functionality >50 %on day 1	59	34	29	21	0	48

Figure 4.72. Summary of Expected Potable Water and Electric Power System Performance (Preparedness Areas 1-6)

# of Days Without Services	PA 1	PA 2	PA 3	PA 4	PA 5	PA 6
Potable H2O						
Day 1	0	0	3,362	0	0	9,851
Day 3	0	0	60	0	0	7,689
Day 7	0	0	4	0	0	3,754
Day 30	0	0	0	0	0	0
Day 90	0	0	0	0	0	0
Total # of Houses w/o water	0	0	3,426	0	0	21,294
Electrical						
Day 1	3,426	2,145	5,691	1,622	0	24,439
Day 3	1,848	1,157	3,692	875	0	16,442
Day 7	616	386	1,622	292	0	7,630
Day 30	99	62	337	47	0	1,663
Day 90	5	3	7	3	0	31
Total # of houses w/o Electric	5,994	3,753	11,349	2,839	0	50,205
Total Days Without Service	5,994	3,753	14,775	2,839	0	86,274

Figure 4.73. Summary of Injury/Casualty Estimates (Preparedness Areas 1-6)

	PA 1				PA 2				PA 3				PA 4				PA 5				PA 6			
2AM	L 1	L 2	L 3	L 4	L 1	L 2	L 3	L 4	L 1	L 2	L 3	L 4	L 1	L 2	L 3	L 4	L 1	L 2	L 3	L 4	L 1	L 2	L 3	L 4

Commercial	0	0	0	0	0	0	0	0	5	2	0	1	0	0	0	0	0	0	0	0	18	6	1	2
Hotels	0	0	0	0	0	0	0	0	9	3	0	1	1	0	0	0	0	0	0	0	26	8	1	3
Industrial	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	15	5	1	2
Other-Residential	10	2	0	0	15	2	0	0	229	48	4	7	19	2	0	0	0	0	0	0	1,187	296	27	48
Single Family	30	5	0	1	15	3	0	0	409	110	16	32	26	4	0	1	0	0	0	0	1,395	402	61	118
Total	42	7	1	1	31	5	0	1	656	163	21	40	46	7	0	1	0	0	0	0	2,640	717	91	173
2PM																								
Commercial	17	4	0	1	8	2	0	0	325	99	17	34	27	5	1	1	0	0	0	0	1,151	379	68	134
Commuting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	4	1
Educational	5	1	0	0	4	1	0	0	76	23	4	8	5	1	0	0	0	0	0	0	497	163	29	57
Hotels	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	5	2	0	1
Industrial	1	0	0	0	0	0	0	0	40	7	1	2	3	0	0	0	0	0	0	0	108	36	6	13
Other-Residential	2	0	0	0	3	0	0	0	66	8	1	1	4	0	0	0	0	0	0	0	209	51	4	8
Single Family	7	1	0	0	3	1	0	0	530	17	3	5	5	1	0	0	0	0	0	0	265	75	12	21
Total	33	6	1	1	19	4	0	1		155	26	50	43	8	1	2	0	0	0	0	2,235	707	123	233
5PM																								
Commercial	13	3	0	1	7	1	0	0	262	79	14	26	19	4	0	1	0	0	0	0	933	305	55	107
Commuting	0	1	1	0	0	0	0	0	7	10	16	3	0	0	0	0	0	0	0	0	38	45	82	16
Educational	0	0	0	0	1	0	0	0	9	3	0	1	1	0	0	0	0	0	0	0	105	35	6	12
Hotels	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	8	2	0	1
Industrial	1	0	0	0	0	0	0	0	14	4	1	1	2	0	0	0	0	0	0	0	67	22	4	8
Other-Residential	4	1	0	0	5	1	0	0	83	17	1	2	7	1	0	0	0	0	0	0	433	108	10	18
Single Family	12	2	0	0	6	1	0	0	160	43	6	12	10	1	0	0	0	0	0	0	547	155	24	44
Total	30	6	2	1	19	4	1	1	538	157	39	47	38	7	1	1	0	0	0	0	2,130	673	181	205
Over All Total	105	19	4	3	69	13	1	3	1,724	475	86	137	127	22	2	4	0	0	0	0	7,005	2,097	395	611

The information presented in the *New Mexico Vulnerabilities* section of the Plan indicates that New Mexico's communities, environment and infrastructure are highly vulnerable to a number of high probability, high risk hazards. Furthermore, the vulnerability profile of the state strongly suggests that if the status quo persists, future hazard events have the potential to significantly affect people and property in negative ways. These findings confirm the need for continued focus on hazards across all Preparedness Areas, particularly related to drought, flood/flash floods, high winds, severe winter storms, and wildfires. In the future, local mitigation planning groups are encouraged to review lessons learned from this Plan and other state jurisdictions in their continuing development of their local mitigation plans.

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SECTION 5 – MITIGATION STRATEGY, GOALS AND ACTIONS

Overview of the Mitigation Strategy Concept

The ultimate mission of all hazard mitigation is to reduce injury and property damage from the impact of natural hazards. State, tribal and local governments can make progress toward this goal through an intense and coordinated planning effort and by the use of prudent fiscal management to achieve the objectives set forth in mitigation plans.

The Hazard Identification and Risk Analysis Section of this Plan focuses on the hazards that are most likely to impact the state of New Mexico. The hazards in alphabetical order are dam failure, drought, earthquake, extreme heat, expansive soils, flood/flash flood, high wind, landslide, land subsidence, severe winter storm, thunderstorm (including lightning and hail), tornado, volcanoes and wildfire.

Strategies reflect what the State government agencies would like to mitigate. For the purposes of this Plan, the Planning Team does not consider the lack of funding as a limiting factor in the identification of mitigation strategies. Instead, solid mitigation actions are included in the Plan with the hopes that funding will become available at some point in time. Other factors, such as special considerations due to the National Environmental Policy Act (NEPA) and the National Historic Properties Act (NHPA), impose limitations on the spending of federal funds, making some actions highly challenging to implement. For the purposes of this Plan, the Planning Team does not consider environmental and historic compliance as a limiting factor in the identification of mitigation strategies. When the time comes to decide on pursuing a specific project, these influences must be considered in addition to other requirements of the relevant funding source.

The Hazard Mitigation Team and Subject Matter Experts reviewed the mitigation goals, objectives, and action items from the 2010 Plan. Edits and up-dates were integrated into the 2013 Plan based on the feedback provided. One additional goal was added and the order of the goals was modified.

Mitigation Goals

The goal of mitigation is to save lives and to 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.

Goals for the natural hazard mitigation in New Mexico are:

1. Reduce the number of injuries due to natural hazards;
2. Reduce the number of fatalities from natural hazards;
3. Reduce the amount of property damage, both public and private, from natural hazards;
4. Reduce the number of necessary evacuations;
5. Shorten recovery time for both community function and the natural environment after natural hazard events;
6. Improve communication, collaboration and integration among State, tribal and local emergency management agencies and
7. Increase awareness and understanding of risks and opportunities for mitigation among the citizens and elected officials of New Mexico.

Setting Priorities

The Hazard Mitigation Team and Subject Matter Experts worked together to prioritize a myriad of mitigation actions. The methodology used to determine mitigation action priorities was based upon the Team's understanding of the STAPLE+E framework.

STAPLE+E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental and the framework provides a systematic approach to weighing the pros and cons of potential mitigation actions. FEMA recommends using the STAPLE+E framework because it comprehensively addresses the major factors important to weighing the costs and benefits of implementing one action over another.

Figure 5.1 below summarizes each of the seven STAPLE+E characteristics by highlighting the considerations taken when weighing one mitigation action against another. Additional textual explanations for each characteristic are provided below.

Figure 5.1. STAPLE+E Evaluation Summary

Evaluation Category	Consideration
Social	• Effects on a specific segment of the population • Disrupt communities • Impact on community values • Impact on cultural resources
Technical	• Realistic • Long-term solution • Secondary impacts
Administrative	• Capability (staffing levels and training) • Funding availability • Maintenance oversight
Political	• Political support • Public support • Local champion or proponent
Legal	• Legal authority • Liability • Action potentially subject to legal challenge
Economic	• Cost to implement and maintain mitigation action • Burden to local economy • Contribution to economic goals • Outside funding available
Environmental	• Affects land/water resources • Affects endangered species • Consistent with applicable environmental laws • Consistent with community's environmental goals

Social

The public must support the overall implementation strategy and specific mitigation action. Each proposed mitigation action was evaluated in terms of social impact and community acceptance by taking the following themes into consideration:

- The action does not adversely affect one segment of the population;
- The action will not disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people;
- The action is compatible with present and future community values; and
- The action will not adversely affect cultural values or resources.

Technical

Only those actions for which there are reasonable solutions, given the technological requirements of the project, have been considered in this Plan. No assumptions were made that new technologies will emerge to solve challenging problems. Each proposed mitigation action was evaluated in terms of technical feasibility by taking the following themes into consideration:

- The action can realistically be accomplished;
- The action is a long-term solution; and
- The action reduces/eliminates secondary impacts.

Administrative

This evaluation criteria examines the anticipated staffing, funding, and maintenance requirements for the mitigation action to determine if administrative capabilities necessary to implement the action are available to the state. Each proposed mitigation action was evaluated in terms of administrative capability by taking the following themes into consideration:

- Existing capability is available or can readily be obtained (staff, technical experts, reference information);
- Funding is available or can readily be obtained; and
- Resources for oversight and maintenance are available or can readily be obtained.

Political

Very often, the support of political stakeholders and decision-makers is critical to the timely implementation a mitigation action. Therefore, each proposed mitigation action was evaluated in terms of its political feasibility by taking the following themes into consideration:

- There is political support to implement and maintain the action;
- There is a department, agency or individual willing to help see the action to completion; and
- There is a department, agency or individual willing to take responsibility for long-term maintenance.

Legal

Each level of government operates under a specific source of delegated authority. Therefore, without the appropriate legal authority, many mitigation actions cannot be lawfully implemented. Each proposed mitigation action was evaluated in terms of its legal implications and parameters by taking the following themes into consideration:

- The state, tribe, or community has the legal authority to implement the proposed action;
- There are no potential legal consequences such as liability;
- It is unlikely that the action will be challenged by stakeholders who may be negatively affected.

Economic

No quantitative Benefit Cost Analysis was completed for the proposed mitigation actions. Such an analysis would require detailed information only available at the time that the project completed a scoping phase. The Hazard Mitigation Team agreed that considering the economics of a proposed mitigation action should be based on the general understanding that the cost to implement and maintain the project would at least equal future damages avoided. Furthermore, economic considerations must include the present economic base and projected growth. Each proposed mitigation action was evaluated in terms of its economic impacts by taking the following themes into consideration:

- The cost appears to at least equal the future damages avoided;
- A long-term financial burden will not be placed on the tax base or local economy to implement this action;
- The action contributes to other community economic goals, such as capital; improvements or economic development; and
- Outside sources of funding are available.

Environmental

The careful consideration of environmental impacts is important to mitigation planning because of a strong public desire for sustainable and environmentally healthy communities. There are many statutory considerations, such as the National Environmental Policy Act (NEPA), to keep in mind when using federal funds. Numerous mitigation actions may well have beneficial impacts on the environment. For instance, sediment/erosion control actions or arroyo/wetland restoration projects help restore the natural function of the floodplain. Such mitigation actions benefit the environment while creating sustainable communities that are more resilient to disasters. Each proposed mitigation action was evaluated in terms of its environmental impacts and secondary benefit by taking the following themes into consideration:

- The action will not have a negative effect on natural resources such as arroyos, wetlands, forests, etc.;
- The action will have beneficial impacts on natural resources such as improving floodplain natural functions;
- The action will have beneficial impact on cultural resources such as preserving historic properties or structures;
- The action will not have a negative effect on any endangered or threatened species;
- The action complies with local, state, and federal environmental laws or regulations; and
- The action is consistent with environmental goals.

Overall STAPLE+E scores are calculated for each mitigation action on a scale of low/poor (1 point), to medium/good (2 points) to high/excellent (3 points) priority based on an overall ranking of each of the seven characteristics. The scores are then averaged (based on the total number of voting project team members) and the actions are prioritized based on their average scores.

Although the Hazard Mitigation Team and Subject Matter Experts Staple did not use a STAPLE+E checklist to determine mitigation planning priorities, the group applied the framework and methodology during their discussions and used STAPLE+E to inform their ranking activity. The “Adapted STAPLE+E Averages” recorded under each mitigation action item (below) are based on the priority-setting activity conducted by the Hazard Mitigation Team during the course of the Plan update.

Mitigation Action Items

The process for developing mitigation actions for the New Mexico Hazard Mitigation Plan consisted of a thorough review and evaluation of the actions in the 2010 plan. The Planning Team and Subject Matter Experts provided progress updates for each mitigation action and also suggested additional mitigation actions.

Below is a brief description of 41 mitigation actions. The actions are listed under each natural hazard type. The natural hazard types are in alphabetical order for ease of reference. Mitigation actions that address multiple hazard types are described in the first category and reference is made under each individual hazard type. At the end of the list of mitigation actions is a summary chart which shows all actions in priority order based on the ranking process described above. Under each action there is a comment on "2013 Update" if relevant information is available.

All mitigation actions listed here are actions that the Planning Team and Subject Matter Experts believe will most significantly and effectively reduce the impacts of natural hazards on New Mexico communities. The actions included in this "wish list" are meant to be implemented as staffing and funding become available. There is no implied or actual commitment to the implementation of these suggested actions.

I. MULTI-HAZARD

1. **Develop comprehensive public education/outreach strategies for natural hazard mitigation.** *(#2, 2010 Plan)*

The campaign as envisioned includes a series of public service announcements, pamphlets, trainings, and demonstration activities on the hazards New Mexicans face. Special populations will be identified for targeted messages (mobile homes, low income, homebound, apartment dwellers). The effort would focus on one hazard each month and would involve collaborating with local subject matter experts. Additional special topics would also be covered, such as evacuation and sheltering in place. Additionally, a program such as "Map Your Neighborhood" as created by Washington State OEM, could be rolled out as part of this effort.

Hazards: Dam Failure, Drought, Earthquakes, Extreme Heat, Expansive Soils, Flood/Flash Floods, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorms, Tornados, Volcanoes, Wildfire

How Contributes to Strategy: This program educates the public on the range of possible mitigation, prevention and preparedness actions that could be initiated within the State. It will show simple do-it-yourself initiatives through large scale federally funded projects. It will introduce topics and concepts that are familiar to emergency managers, but that are relatively new to the general population.

Suggested Responsible Party: NMEMA, NMFMA, NM TECH, EDAC, DHSEM, State Forestry, NM Environment Department, Department of Agriculture, Office of the State Engineer, Department of Energy Minerals and Natural Resources, local hardware and home improvement stores, local media outlets, websites, etc.

Estimated Expenses: Employee time, materials, estimated costs for first year $100,000

Funding Sources: FEMA grants, NMEMA, NMFMA, NM TECH, EDAC, DHSEM, State Forestry, NM Environment Department, Department of Agriculture, Office of the State Engineer, Department of

Energy Minerals and Natural Resources, private contributions, local emergency management personnel time, legislative allotments
Timeframe: Immediate and ongoing
Adapted STAPLE+E Average: 2.69
Ranking: 5

2013 UPDATE:

Hazard Mitigation Grant Program funds have recently been used for two outreach efforts as described below. In addition, DHSEM has Notices of Interest from local government for flood and wildfire mitigation outreach efforts.
1) DHSEM - Radio Public Service Announcements on camp fire safety and taking personal responsibility for wildfire mitigation will be aired state-wide through the Public Education Partnership of the New Mexico Broadcasters Association. The ad will be aired an estimated 10,000 times each year for three years. The ads were produces in both English and Spanish.
2) Department of Agriculture – An eight-page full color wildfire mitigation newspaper insert was produced to educate property owners and managers about actions that can be taken to reduce wildfire risk. Approximately 300,000 inserts were produced with 178,000 being distributed through 25 local newspapers. The remaining copies will be distributed through State agency workshops/offices and at community events.

DHSEM also has four Notices of Interest for additional outreach and education. The projects address the following topics; Ready! Set! Go! (wildfire) water conservation (drought), arroyo safety (flood), stream gauges/warning signs (flood).

2. **Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.** *(#28, 2010 Plan)*

This action focuses on creating the statewide repository and providing access to local and tribal entities. GIS capabilities vary between local jurisdictions and tribes. Local jurisdictions and tribal entities do not always have the capability for in-house GIS personnel and resources. EDAC is working to compile all of the public GIS information into one location (as described above). Some hazard types below include a separate action item to create a hazard map (earthquake hazard, land slide, land subsidence, soil hazard). There is not a single State-wide map that shows the risk for these hazard types.
Hazards: Dam Failure, Drought, Earthquakes, Extreme Heat, Expansive Soils, Flood/Flash Floods, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorms, Tornados, Volcanoes, Wildfire
How Contributes to Strategy: Although funding for GIS personnel and resources varies with each entity, the State should make all publicly available data accessible for mitigation planning and recovery.
Suggested Responsible Party: DoIT, EDAC
Estimated Expenses: Computer equipment, software, GIS technicians/contractors
Funding Sources: FEMA, USACE, State budget
Timeframe: Ongoing
Adapted STAPLE+E Average: 2.44
Ranking: 9

2013 UPDATE:

With the new State legislation authorizing this type of activity, there will be a more specific task list and time line available for the next State Plan up-date.

3. **<u>Establish and enhance GIS capability within DHSEM.</u>** *(#3, 2010 Plan)*

GIS capability allows DHSEM to identify specific hazard areas, critical facilities/key resources and to analyze the overlap of numerous hazard impacts. This information would provide data to prioritize mitigation and recovery efforts.

Hazards: Dam Failure, Drought, Earthquake, Flood, Heat (Extreme), Landslide, Land Subsidence, Soil (Expansive), Thunderstorms, Tornadoes, Volcano, Wildfire, Wind (High), and Winter Storms (Severe)

How Contributes to Strategy: By providing comprehensive multi-hazard data, DHSEM can pass-on site-specific information to local emergency managers to assist in prioritization of both long-term mitigation actions and recovery efforts.

Suggested Responsible Party: NMEMA, NMFMA, NMT, EDAC, DHSEM

Estimated Expenses: contract services, employee time, software, materials

Funding Sources: DHSEM Budget, FEMA grants

Timeframe: Ongoing

Adapted STAPLE+E Average: 2.38

Ranking: 11

<u>2013 UPDATE:</u>

NM DHSEM has executed a contract with UNM's Earth Data Analysis Center to provide GIS mapping and analysis services. EDAC has performed an initial assessment of the current DHSEM data set library and has developed a secure interactive web site. EDAC will continue to monitor and maintain the web site. Examples of work produced thus far which will aid in focusing mitigation efforts are; production of wildfire burn scar maps superimposed on watershed boundaries in order to identify high risk debris flow locations; geographic mapping of federal disaster declarations; National Flood Insurance Program participation; and Mitigation Plan status. It is anticipated that funding will continue through FEMA grants and State Executive Orders on a fiscal year basis.

Future actions will include making available the Community Anchor Site Assessment (CASA) database so that local communities, tribes and State agencies can have access to the information. The Resource Geographic Information System and Clearinghouse (RGIS) at the Earth Data Analysis Center has been legislatively designated as the State Digital Geospatial Data Clearinghouse and as such would allow for distribution of the CASA database. In addition there is public website which is an interactive crowdsourcing web-mapping site that will allow for updates to the CASA database[136]. An example of additional data sources is the information on bridges and landslide locations that the Department of Transportation collects for its internal use. If this information were mapped in a State-wide GIS data base, all emergency managers and mitigation planners would be able to consider this information in analyzing risk.

4. **<u>Map State facilities and assets in relation to identified hazard areas of the state.</u>** *(#4, 2010 Plan)*

[136] CASA Crowdsourcing Application: http://nmbbmapping.org/bbcrowd/

Including State owned and managed facilities in a GIS database will aid with the process of identifying critical facilities and assets that are within State-agency control. Having this critical facility information in a database that can be spatially queried allows for greater understanding of asset value and the impact that natural disasters would have on them. This would allow the re-examination of mitigation priorities.

Hazards: Dam Failure, Drought, Earthquakes, Extreme Heat, Expansive Soils, Flood/Flash Floods, High Wind, Landslide, Land Subsidence, Severe Winter Storms, Thunderstorms, Tornados, Volcanoes, Wildfire

How Contributes to Strategy: By integrating State owned or managed facilities into the comprehensive multi-hazard data, DHSEM can provide site-specific information to other State agencies to assist in prioritization of both long-term mitigation actions and recovery efforts.

Suggested Responsible Party: DHSEM, GSD, DoIT, State Forestry, National Guard, local emergency management agencies, UNM EDAC, NMT, SIPI

Estimated Expenses: Contract services, employee time, software, materials

Funding Sources: DHSEM Budget, FEMA grants (PDM, HMGP), UNM, NMT

Timeframe: Ongoing

Adapted STAPLE+E Average: 2.25

Ranking: 16

2013 UPDATE:

As described above, in action item #3, DHSEM recently executed a contract with UNM's Earth Data Analysis Center to provide GIS mapping and analysis services. The EOC can now integrate the critical facilities mapping provided from the Intelligence Bureau with the comprehensive multi-hazard information from EDAC in order to prioritize mitigation activities for critical assets and key resources. DHSEM can now more effectively track, preposition, and deploy response resources and plan for long-term mitigation State-wide.

Specific sub-tasks under this action could include:

- Once the available data is identified, determine which facilities are critical. For example, not all State government owned or managed facilities are critical. The structures that house the communications system or the archival information may be labeled as critical, while the office building may not be identified as critical. An office building that houses staff during business hours could be evacuated and continue operations in a different location.
- For those facilities identified as critical, provide all data as explained in the Critical Facilities Section of this Plan. In particular, detail must be provided for critical radio and communication towers.

5. **Update HAZUS and train emergency management personnel in its use.** *(#1, 2010 Plan)*

At present the group tasked with maintaining the New Mexico HAZUS data (Earth Data Analysis Center at UNM), is not responsible for data acquisition or data entry. EDAC relies on the default HAZUS data which currently is data from the 2000 US Census.

Hazards: Earthquake, Flood, High Wind

How Contributes to Strategy: HAZUS is a tool that can forecast potential damages from hazard events. It can help local emergency managers to fully understand the vulnerability within the state, counties and individual jurisdictions. This action includes creating a training workshop to explain why HAZUS is important, how it can be useful, and how to update and use the program.

Suggested Responsible Party: DHSEM, EDAC, NMT, SIPI (Southwest Indian Polytechnic Institute)

Estimated Expenses: Employee time, training materials for workshop; software and hardware costs

Funding Sources: EMPG grant, FEMA grants, local emergency management, UNM EDAC, NMT, SIPI

Timeframe: 60+ months
Adapted STAPLE+E Average 2013: 2
Ranking: 27

2013 UPDATE:
This Plan includes new HAZUS information for earthquake and flood damage estimates (as described in the Hazard Identification and Risk Assessment Section). When the HAZUS software integrates 2010 census data, the runs will need to be repeated.

6. **Implement actions to improve forest and watershed health.**

This is a new mitigation action for the 2013 State Plan. It was identified in the Drought Task Force Impact Assessment Committee Status Report from January 2013. Implement actions as identified in the New Mexico Forest and Watershed Health Plan in addition to the New Mexico Statewide Natural Resources Assessment and Strategy and Response Plans.
Hazard: Drought, Flood, Wildfire
How Contributes to Strategy: Drought can affect forest health by increasing susceptibility to insects and disease. Large stands of insect mortality that have occurred across the state greatly increase the risk of negative impacts on New Mexico's watersheds including higher fire danger.
Suggested Responsible Party: State Forestry, OSE, Environment Department, Energy Minerals and Natural Resources
Estimated Expenses: More detail is needed for specific action items
Funding Sources: Agency budgets, US EPA grants
Timeframe: Continuous
Adapted STAPLE+E Average: 2.71
Ranking: 3

II. DAM FAILURE

7. ***Hire a Dam Safety Engineer.*** *(#9, 2010 Plan)*

At present, the Office of the State Engineer (OSE) has oversight over non-federally owned dams in New Mexico. However, there is no one specifically assigned to assist these dam owners with their Emergency Action Plans (EAPs). An additional Dam Safety Engineer could focus on the large number of existing dams that do not hold an EAP. Potential areas for mitigation activities include resources to evaluate uncertainties with dam data, preparation of EAPs for all high hazard dams and rehabilitation of existing dams. These actions will contribute to dam failure risk reduction through emergency planning and possibly through increased warning for affected communities.
Hazard: Dam Failure
How Contributes to Strategy: The Dam Safety Engineer will be responsible for assisting the local dam owners create or update their EAPs. The Dam Safety Engineer will create or coordinate creation of inundation zone maps with input from dam owners and operators.
Suggested Responsible Party: DHSEM, OSE
Estimated Expenses: Salary and benefits for this position could be shared between DHSEM and the OSE
Funding Sources: EMPG, existing or future OSE budget
Timeframe: When funding is available
Adapted STAPLE+E Score 2013: 2.24
Ranking: 18

2013 UPDATE:

Due to extraordinary circumstances in the national economy, the State of New Mexico will not be hiring a Dam Safety Engineer anytime soon. It is possible that the New Mexico Silver Jackets could enable more participation and better communication. The OSE has an unfunded engineer position and it will analyze the budgetary obstacles for filling this position.

8. **Rehabilitate or remove unsafe dams starting with those classified as High Hazard.** *(#11 2010 Plan)*

The OSE identified nearly 100 dams across the state as needing repair or rehabilitation to correct safety concerns. There are numerous dam owners that do not have the financial capability to make the necessary repairs.

Hazard: Dam Failure

How Contributes to Strategy: Poorly maintained dams pose significant risks to the communities and infrastructure below them. Rehabilitation or removal of these dams will reduce or eliminate the potential for catastrophic failure and will preserve life and property.

Suggested Responsible Party: OSE, Silver Jackets and NM OSEDam Safety Bureau

Estimated Expenses: Funding for engineering analysis and design, construction of rehabilitation projects, and demolition when appropriate.

Funding Sources: EMPG, special legislative funding, owner cost share

Timeframe: 60 months+

Adapted STAPLE+E Score 2013: 2.35

Ranking: 12

2013 UPDATE:

Cabresto Dam in Taos County was rehabilitated in 2012-2013 with statewide funds. Springer Dams 1 and 2 in Colfax County received funding for reconstruction in the 2013 New Mexico Legislative session. Design activities are ongoing for a few High Hazard dams that have deficiencies.

9. **Create Emergency Action Plans for High and Significant Hazard class dams.** *(#10, 2010 Plan)*

Assistance for dam owners is needed to accomplish this goal. The OSE has created an Emergency Action Plan (EAP) template for dams within New Mexico. Each EAP has an inundation map based on modeling for the potential dam failure under various operation conditions. An evacuation map is then prepared from the inundation map. The EAP also provides steps for the owner to follow in a potential emergency that help to recognize the situation and to provide the best response to avert a dam failure if possible. Many owners report that the costs associated with preparation of the inundation maps are prohibitive.

Hazard: Dam Failure

How Contributes to Strategy: The new EAPs will specifically lay out the emergency procedures, notification lists, and inundation zones of each dam. The future Dam Safety Engineer could be responsible for assisting in the preparation of these EAPS and can work with owners to maintain them.

Suggested Responsible Party: DHSEM, OSE, Dam Safety Engineer

Estimated Expenses: Engineering analysis and mapping and staff time

Funding Sources: EMPG existing or future budgets

Timeframe: 60 months

Adapted STAPLE+E Score 2013: 2.41

Ranking: 10

2013 UPDATE:
A number of new EAPs have been created and put in place since 2010. The OSE is looking at new methods that may be able to streamline the inundation mapping process.

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

III. DROUGHT

10. **Mandate xeriscaping with drought resistant species at State facilities.** *(#15, 2010 Plan)*
Xeriscaping refers to landscaping in ways that requires little to no supplemental irrigation. The end result is a reduction in water use at State owned facilities. Once implementation occurs, the State facilities could serve as field examples of xeriscaping methods and techniques.
Hazard: Drought
How Contributes to Strategy: The use of xeriscaping requires less water to maintain therefore more water is available for other uses (such as human consumption, agriculture, livestock, ecological enhancement, etc.). Xeriscaping can enhance habitat for native bees, butterflies, and other fauna.
Suggested Responsible Party: New Mexico State Legislature
Estimated Expenses: Installation of plants and hardscape
Funding Sources: Existing budgets
Timeframe: 60 months
Adapted STAPLE+E Average: 1.88
Ranking: 35

2013 UPDATE
There has been no work towards accomplishing this action.

11. **Require grey water systems at State owned facilities.** *(#16, 2010 Plan)*

This action requires installation of grey water systems for new State construction and retrofits of existing structures. Reusing water to irrigate landscaping would conserve potable water for uses such as human consumption, agriculture and livestock.

Hazard: Drought

How Contributes to Strategy: The use of greywater requires less fresh water to maintain landscaping making more water available for other uses and other people. This action would also lessen strain on failing septic tanks and treatment plants. This action could also result in enhanced groundwater recharge, improved forest health and improved watershed health.

Suggested Responsible Party: New Mexico State Legislature

Estimated Expenses: Up to $50,000 depending on the facility

Funding Sources: Unknown at this time

Timeframe: 60 months

Adapted STAPLE+E Average: 1.88

Ranking: 32

2013 UPDATE

There has been no work towards accomplishing this action.

12. **Establish a Rebate Program.** *(#17, 2010 Plan)*

Establish new rebate programs where they do not exist, for homeowners who convert to low flow toilets or purchase EnergyStar certified clothes and dish washers.

Hazard: Drought

How Contributes to Strategy: These fixtures and appliances use less energy and less water than conventional fixtures/appliances. The reduction of the amount of water used would allow water to be directed toward other uses. This action could also result in enhanced groundwater recharge, improved forest health and improved watershed health.

Suggested Responsible Party: DHSEM, OSE, local emergency managers, water conservation and watershed health interest groups

Estimated Expenses: $50,000-$1,000,000

Funding Sources: US EPA grants

Timeframe: 36 months

Adapted STAPLE+E Average: 1.63

Ranking: 41

2013 UPDATE

There has been no work towards accomplishing this action. Additional research needs to be conducted to 1) clarify how the State's anti-donation clause would affect implementation and 2) identify successful rebate programs that have been implemented in the State and elsewhere.

13. Incorporate drought mitigation activities into range management plans.

This is a new mitigation action for the 2013 State Plan. It was identified in the Drought Task Force Impact Assessment Committee Status Report from January 2013. NMDA provides technical assistance in the form of consultation in developing range management plans. Cooperation between State, federal and industry organizations must be part of developing and monitoring mitigation strategy implementation.

Hazard: Drought

How Contributes to Strategy: Including drought mitigation activities in range management plans will provide appropriate techniques that can be implemented at a site-specific scale to reduce the impact of drought.
Suggested Responsible Party: NMDA, industry organizations, ranch owners and managers
Estimated Expenses: More detail is needed for specific action items
Funding Sources: State budget
Timeframe: Continuous
Adapted STAPLE+E Average: 2.35
Ranking: 13

14. **Develop new useable water sources.** *(#27, 2010 Plan)*
Additional water sources are a constant concern in New Mexico. Advances in technology have allowed continued extraction of water from sources previously thought to have been unusable. Identifying the location of new sources and determining the impact of new techniques is an ongoing process.
Hazard: Drought
How Contributes to Strategy: un-clear
Suggested Responsible Party: local water providers
Estimated Expenses: water extraction and purification equipment
Funding Sources: State budget
Timeframe: Continuous
Adapted STAPLE+E Average: 2.35
Ranking: 14

2013 Up-date
It is recommended that this action be removed from the State Plan. It does not reduce the impact of drought. Instead, it provides for immediate relief from low water supply. It is a response and not a mitigation activity.

15. **Public Water Supply and Drought Vulnerability Assessments**
Better understanding of the vulnerability of public water supply will assist emergency, utility and land use managers to mitigate the impacts of reduced resource availability. Municipal water supply assessments are currently being conducted by NMED. Additional assessments could be done at a County, watershed (regional) and/or State-wide basis. The assessments would identify specific vulnerabilities and also recommend mitigation measures such as water supply monitoring, water conservation measures, utilization of multiple points of diversion, identification of additional sources of water, and/or developing Standard Operating Procedures specific to drinking water supply.
Hazard: Drought
How Contributes to Strategy: As part of the assessment mitigation actions would be identified. A strategy for implementation of the mitigation actions would be the next step in making the community more resilient to drought. As an example, a mitigation action recommended in an assessment may be "install and utilize monitoring equipment to track the water supply level". When the community implements this measure and determines that the water supply is too low, they could switch to alternative water source or implement water conservation measures. The end result is a reduction of the impact of drought on the community.
Suggested Responsible Party: NMED, OSE, DHSEM

Estimated Expenses: More detail needed for specific action items
Funding Sources: State budget
Timeframe: 36 months
Adapted STAPLE+E Average: 2.53
Ranking: 7

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Implement actions to improve forest and watershed health.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: Drought, Flood, Wildfire

IV. EARTHQUAKE

16. **Develop the New Mexico Seismic Risk Map to effectively predict the probability of seismic damage State-wide.** *(part of #4, 2010 Plan)*

Although there are numerous studies and mapping projects that have been conducted State-wide, there is not one compilation map that clearly identifies earthquake risk.
Hazard: Earthquake
How Contributes to Strategy: Combining existing risk maps into one assessment map would provide a visual snapshot of statewide risk. A series of maps may need to be produced in order to reflect the actual risk at an appropriate scale.
Suggested Responsible Party: DHSEM, NM Tech, DoIT
Estimated Expenses: Cost for engineering studies, GIS mapping and production
Funding Sources: State budget, DoIT, NM Tech, FEMA Earthquake Hazards Reduction State Assistance Program, EMPG
Timeframe: 60 months
Adapted STAPLE+E Average: 2.18
Ranking: 22

2013 UPDATE:

This mitigation action has been broken-out into a specific action item and modified based on more detail as provided by the NM Tech.

17. ***Complete basic vulnerability assessments for State owned critical facilities in New Mexico.*** *(revised from #18, 2010 Plan)*

Most state owned facilities have not been engineered to withstand Earthquakes. Complete a seismic assessment of all critical facilities State-wide with the Belen to Taos corridor as a priority due to the seismic risk. A systematic study of these facilities would establish a susceptible structure prioritization. The loss of any of these facilities could lead to loss of life, injury, structural damage and delayed response time. The result of the seismic assessment would be a comprehensive attribute table (or database) linked directly to geospatial references. Mapping would visually communicate seismic risk to the public.

Hazard: Earthquake

How Contributes to Strategy: Understanding which structures are at risk and prioritizing critical facilities for earthquake retrofit would provide an ordered listing for an implementation schedule.

Suggested Responsible Party: DHSEM, OSE, GSD, NM Tech

Estimated Expenses: Cost for engineering study at the identified critical facilities

Timeframe: 60 months

Funding Sources: State budget, EMPG

Adapted STAPLE+E Average: 2.29

Ranking: 15

2013 UPDATE:

This mitigation action has been modified with more detail as provided by the NM Tech professor involved in the Rapid Visual Assessment projects. DHSEM has provided a grant to NM Tech to begin a Rapid Visual Assessment of critical facilities in the eight Counties along the Rio Grande Rift. However, students were only able to access the outside of the structures and therefore not able to input all of the relevant data that needed to be included in the assessment. Reports are available for many structures and the summary reports will be available in the near future.

18. **Develop region-specific earthquake building codes and zone map that reflect actual risk.**

This is a new mitigation action for the 2013 State Plan. It was identified during Planning Team and Subject Matter Expert discussions. There are wind and snow load region-specific building codes for New Mexico, but no similar system exists for earthquake. The range of earthquake risk varies greatly State-wide and building codes should reflect the actual risk.

Hazard: Earthquake

How Contributes to Strategy: New buildings can be built stronger, according to the most recent seismic design specifications that are regionally specific. This will lessen vulnerability to earthquake damage.

Suggested Responsible Party: CID, GSD, DOT, DCA, local jurisdictions and tribal entities that implement building codes

Estimated Expenses: Uncertain at this time

Funding Sources: Existing budgets, FEMA Hazard Mitigation Grant Program, EMPG

Timeframe: 60 months

Adapted STAPLE+E Average: 1.65

Ranking: 40

19. **Retrofit the most hazard-prone critical and public facilities.** *(#26, 2010 Plan)*

The result would be critical facilities that are retrofit to withstand earthquake risk that is regionally specific. Retrofitting these facilities will assure their operation during an earthquake event. It will allow for continuity of operations during and after an earthquake and will lead to fewer injuries.

Hazard: Earthquake

How Contributes to Strategy: The previous mitigation action relates to both new and existing buildings. If existing buildings were retrofit to the region-specific earthquake building code, damage would be lessened and there would be less injury.

Suggested Responsible Party: Local jurisdictions, GSD, DOT, DCA

Estimated Expenses: Design, engineering, construction material purchase and installation

Timeframe: 60 months

Funding Sources: State legislature, FEMA Mitigation grant programs, EMPG

Adapted STAPLE+E Average: 1.88

Ranking: 33

20. **Participate in the Western States Shake-Out.**

This is a new mitigation action for the 2013 Plan. Shake-Out is the largest ever earthquake drill. It is implemented internationally with 2013 being the first coordinated Western States Shake-Out. By participating in the exercise, individuals will be better prepared to survive and recover quickly from an actual earthquake event.

Hazard: Earthquake

How Contributes to strategy: This is an education and outreach strategy that engages citizens, jurisdictions, organizations and agencies. It is an active participatory method that will lead to reduced structural damage and less injury during an actual earthquake event.

Suggested Responsible Party: local jurisdictions, State agencies, schools

Estimated Expenses: Public Service Announcements, free registration on-line, DHSEM lead agency

Timeframe: Annual October event to be implemented in 2014

Funding Sources: DHSEM staff

Adapted STAPLE+E Average: 1.69

Ranking: 39

Multi-Hazard Actions:

Develop comprehensive public education/outreach strategies for natural hazard mitigation.

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and enhance GIS capability within DHSEM.

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

<u>Update HAZUS and train emergency management personnel in its use.</u>
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

V. <u>EXTREME HEAT</u>

Multi-Hazard Actions:
<u>Develop comprehensive public education/outreach strategies for natural hazard mitigation.</u>
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

<u>Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.</u>
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

<u>Establish and enhance GIS capability within DHSEM.</u>
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

<u>Update HAZUS and train emergency management personnel in its use.</u>
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

VI. <u>EXPANSIVE SOILS</u>

21. <u>Map location of the various types of hazardous soils.</u>

This is a new mitigation action for the 2013 Plan and was suggested by the Planning Team and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Expansive soil occurrence and damage data collection is needed. Research of existing soil data for corrosive and hydrocompactive soils should also be included. Once all available information is collected and mapped, analysis of Preparedness Area risk, frequency and probability can be evaluated. Then, more specific mitigation measures can be identified.
Note; Based on the results of research and data collection, it may be effective to have all hazard soils discussed as one subject in future up-dates of the Plan.
Hazard: Expansive Soil
How Contributes to Strategy: Mapping hazardous soils would provide emergency managers, land managers, land developers and building code officials with information to better understand the potential impact of hazardous soils. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.
Suggested Responsible Party: DoIT, DHSEM, DOT, NM Tech
Estimated Expenses: Current staff and resources
Funding Sources: State budget, DOT, HMGP, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 1.93
Ranking: 31

Multi-Hazard Actions:

Develop comprehensive public education/outreach strategies for natural hazard mitigation.

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and enhance GIS capability within DHSEM.

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.

Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state

NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

VII. FLOOD

22. **Acquire or relocate repetitive loss properties.** *(#7, 2010 Plan)*

At present FEMA shows 39 repetitive loss properties in the state, 22 of which were NFIP insured at the time of losses. Determining property ownership and creating a strategy for encouraging acquisition or relocation are tasks that could assist with implementing this action item.

Hazard: Flood

How Contributes to Strategy: The acquisition or relocation of these properties will reduce the dames to the structures as well as the costs to repair them.

Suggested Responsible Party: DHSEM, State Floodplain Coordinator, Local Floodplain managers, local jurisdictions, property owners

Estimated Expenses: Cost of structure acquisition or cost of retrofits and relocation

Funding Sources: HMGP, FMA, SRL, PDM, local/homeowner matching funds.

Timeframe: Unknown as based on voluntary participation of property owners

Adapted STAPLE+E Average: 2.06

Ranking: 24

2013 UPDATE:

The number of repetitive loss structures increased from 36 to 39 since the last up-date of this Plan. No repetitive loss structures have been purchased or relocated through State or FEMA funded efforts. However, local government or private efforts may result in removal of these structures but is not reported to DHSEM. The strategy was changed to take-out a specific number per year (the 2010 Plan stated two per year) and instead allow local government to encourage private property acquisition and relocation.

23. To add or improve flood control structures at known flood impact points. *(#24, 2010 Plan)*

Depending on the nature of the flooding, ponding (detention, retention or sediment), arroyo/river crossing (low water, culvert, bridge), energy dissipation, bank stabilization, erosion control elements or other structural mitigation measure may be appropriate to lessen the impact of flooding.

Hazard: Flood

How Contributes to Strategy: Existing infrastructure has not been up-graded to include additional flow rates due to modification of watershed condition (added infrastructure that impacts flow direction/amount, increased impervious surface, increased erosion/sedimentation, denuded vegetation, burn scar, etc.). Up-dating drainage and other infrastructure to respond to current watershed condition will decrease flood impacts on structures and the landscape in addition to reducing injury or death.

Suggested Responsible Party: DOT, land management agencies, local jurisdictions

Estimated Expenses: Staff time, construction costs

Funding Sources: DOT, HMGP, PDM,

Timeframe: 60 months

Adapted STAPLE+E Average: 2.24

Ranking: 19

2013 UPDATE:

Numerous State agencies (DOT, State Forestry, Energy Minerals and Natural Resources), local jurisdiction and tribal entities implement flood mitigation projects every year. However, each project is not reported to DHSEM for tracking purposes. DHSEM has provided a Hazard Mitigation Grant Program sub-grant to one local jurisdiction to implement the first phase of a detention/sediment pond to reduce flood impacts downstream. After the first phase is complete and all eligibility is assured, the second phase will be funded to construct the pond. DHSEM also has eight Notices of Interest for additional structural flood mitigation projects.

24. Study the probability, extent, vulnerability and impact of post-fire flooding.

This is a new mitigation action for the 2013 Plan. USACE and USGS have generated flood frequency predictions and debris flow hazard assessments for areas impacted by recent wildfires. These studies have helped emergency and land managers plan for and mitigate some of the effects of post-fire flooding and debris flows. Public education and outreach should be part of the dissemination of the resulting maps and reports.

Hazard: Flood

How Contributes to Strategy: Understanding site-specific impacts of post-fire flooding and debris flows have helped emergency and land managers plan for and mitigate some of the effects of post-fire flooding and debris flows. In addition, maps and reports have scientific data to share with public and private land owners so that they can make decisions that will reduce future impact of flooding.

Suggested Responsible Party: USACE, USGS, DHSEM, land management agencies, local jurisdictions, tribal entities

Estimated Expenses: staff time, production of reports and maps

Funding Sources: USACE, USGS, State legislature, land management agencies

Timeframe: Ongoing

Adapted STAPLE+E Average: 2.71

Ranking: 4

25. **Study the probability, extent, vulnerability and impact of alluvial fans.**

This is a new mitigation action for the 2013 Plan although it was discussed in the Hazard Identification and Risk Assessment Section of the 2010 Plan. The study could include: 1) identification and mapping of alluvial fan flood hazards, 2) definition of active and inactive areas of erosion and deposition, and 3) definition and characterization of the base flood within defined areas.

Hazard: Flood

How Contributes to Strategy: Understanding the patterns of alluvial flooding will allow emergency managers, floodplain managers and land management agencies to identify and implement effective mitigation measures to reduce the impacts of future damage.

Suggested Responsible Party: USACE, USGS, DHSEM, NMFMA, land management agencies, local jurisdictions, tribal entities

Estimated Expenses: Staff time, production of reports and maps

Timeframe: Ongoing

Funding Sources: USACE, USGS, State legislature, land management agencies

Adapted STAPLE+E Average: 1.94

Ranking: 30

26. **Increase the number of communities participating in the Community Rating System.** *(#6, 2010 Plan)*

The Community Rating System (CRS) is a component of the National Flood Insurance Program. CRS reduces flood insurance rates in exchange for a community conducting certain flood hazard reduction activities that are beyond the minimum national standard for floodplain management.

Hazard: Flood

How Contributes to Strategy: The benefits of a community completing CRS actions is two- fold. It not only reduces insurance rates, thereby enticing additional homeowners to get flood insurance so that they can pay for flood damage repairs, but it also strengthens a community's reliance. Examples of CRS activities include floodplain mapping available on a public web site or a local floodplain ordinance that requires No Adverse Impact approach to development that impacts floodplains.

Suggested Responsible Party: DHSEM, State Floodplain Coordinator, local floodplain managers, local jurisdictions

Estimated Expenses: Staff time, legal review, community outreach, raising political support

Funding Sources: Existing budgets, US EPA watershed and water quality grant programs

Timeframe: 60 months

Adapted STAPLE+E Average: 2.13

Ranking: 23

2013 UPDATE:

There are currently 11 CRS communities in the State (listed under the Flood Hazard Identification and Risk Assessment section of this Plan). The 2010 State Plan identifies that there were 10 participating communities.

27. **Provide technical assistance for the development or modification of codes and ordinances.** *(#23, 2010 Plan)*

Local jurisdictions (especially those that have recently joined the NFIP or that have new floodplain administrators) may have difficulty in the creation of jurisdiction specific language that addresses floodplain management. If the communities are interested in implementing higher standards than

the minimum federal requirement, the model codes may not be easily understandable. The State Floodplain Coordinator and NMFMA could provide training or workshops on this topic.
Hazard: Flood
How Contributes to Strategy: In order to have an effective program, local jurisdictions must have appropriately written ordinances. In order to implement an effective floodplain management program at the local level, the floodplain management ordinance must integrate with other existing local codes and standards in addition to accomplish the specific local community goals.
Suggested Responsible Party: DHSEM State Floodplain Coordinator, NMFMA
Estimated Expenses: Staff time
Funding Sources: CAPSEEE
Timeframe: Ongoing
Adapted STAPLE+E Average: 2
Ranking: 28

2013 UPDATE:
The State Floodplain Coordinator provides model ordinance examples to local communities and tribal entities upon request.

28. **Provide Floodplain Management Classes every two years.** *(#8, 2010 Plan)*
This action would be to bring the following two courses to New Mexico every two years; 1) E-273 Managing Floodplain Development through the National Flood Insurance Program and 2) E-278 National Flood Insurance Program/Community Rating System
Hazard: Flood
How Contributes to Strategy: Having trained floodplain administrators will allow each community to have better oversight and management of their development to assure it is compliant with NFIP guidance and regulation. This will reduce property losses and injuries in the long run.
Suggested Responsible Party: DHSEM**,** NMFMA
Estimated Expenses: Instructor time, training manuals, attendees time, travel expenses
Funding Sources: Existing budgets
Timeframe: Two year cycle
Adapted STAPLE+E Average: 1.88
Ranking: 34

2013 Up-date
The New Mexico Floodplain Managers Association has arranged for and hosted the four-day Managing Floodplain Development through the National Flood Insurance Program (E-273) course four times in the past few years. The course is taught by FEMA and has been given in August 2009 (Alamogordo), July 2010 (Los Lunas), June 2011 (Española) and June 2012 (Las Cruces).

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.

Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Update HAZUS and train emergency management personnel in its use.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

Implement actions to improve forest and watershed health.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: Drought, Flood, Wildfire

IIX. HIGH WIND
Multi-Hazard Actions;
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Update HAZUS and train emergency management personnel in its use.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #5.
Hazards: Earthquake, Flood and High Wind

IX. LANDSLIDE

29. **Map known landslide areas and debris flow run-out zones.**
This is a new mitigation action for the 2013 Plan and was suggested by the Planning Team and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. USGS produced landslide maps approximately 20 years ago based on aerial

photographs of steep regions throughout the State. There are archive paper copies at 1:100,000 and mylars of a compilation at 1:500,000 scale. It would be helpful to produce state-wide landslide maps in digital format based on the mapping done 20 years ago. The Department of Transportation also has landslide information that is used for design and maintenance priorities. This information should also be included in a State-wide digital map to enhance the accuracy of the product.

Hazard: Landslide

How Contributes to Strategy: Mapping the debris flow run-out zones would provide emergency managers, road designers, traffic engineers and public works entities to better understand the potential impact of landslides. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.

Suggested Responsible Party: DoIT, DHSEM, DOT, NM Tech

Estimated Expenses: Current staff and resources

Funding Sources: State budget, DOT, HMGP, PDM

Timeframe: 60 months

Adapted STAPLE+E Average: 2.06

Ranking: 25

30. **Install rock nets or other protective measures along roads.** *(#29, 2010 Plan)*

Most of the landslide events in the state have been along roadways.

Hazard: Landslide

How Contributes to Strategy: Installation of rock nets protects vehicles and passengers, as well as reduces cleanup costs.

Suggested Responsible Party: DOT

Estimated Expenses: Cost for study along roadways.

Funding Sources: State budget, HMGP, PDM

Timeframe: 60 months

Adapted STAPLE+E Average: 2.24

Ranking: 20

2013 Up-date

No activities were reported to DHSEM for inclusion. However, State, local and tribal implementation may have occurred over the three-year period.

31. **Adopt zoning which restricts development in landslide prone areas.** *(#19, 2010 Plan)*

Many areas in the state have no zoning restrictions at all, much less any specifically addressing landslide. Investigate if the New Mexico Building Code addresses this specific hazard. Research model ordinances that address this specific hazard. Adopt State-wide standard and encourage local communities and tribal entities to adopt codes that address their specific hazard.

Hazard: Landslide

How Contributes to Strategy: Restricting development in landslide prone areas reduces the risk of damage to structures and infrastructure while reducing the potential for injury or death.

Suggested Responsible Party: CID, DOT, DHSEM, NM Tech

Estimated Expenses: staff time, legal review, community outreach, raising political support

Funding Sources: State budget

Timeframe: 60 months

Adapted STAPLE+E Average: 2.06

Ranking: 26

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

X. LAND SUBSIDENCE

32. Map known land subsidence areas.

This is a new mitigation action for the 2013 Plan and was suggested by the Planning Team and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Data needs to be collected and compiled on past occurrence of the various types of land subsidence. For example, most of the land subsidence occurrences in the country have been due to sinkholes that are a sub-hazard of land subsidence. Once all available information is collected and mapped, analysis of Preparedness Area risk, frequency and probability can be evaluated. Then, more specific mitigation measures can be identified.

Hazard: Land Subsidence
How Contributes to Strategy: Mapping land subsidence area would provide emergency managers, land managers, land developers and building code officials with information to better understand the potential impact of land subsidence. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.
Suggested Responsible Party: DoIT, DHSEM, DOT, NM Tech
Estimated Expenses: Current staff and resources
Funding Sources: State budget, DOT, HMGP, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 2
Ranking: 29

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation. *NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.*
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

XI. SEVERE WINTER STORM

33. Install Snow Fences. (#21, 2010 Plan)

Blowing snow can pile up and create hazardous driving conditions.
Hazard: Severe Winter Storm
How Contributes to Strategy: Installing snow fences reduces the pile-up of snow along roadways, and will reduce dangerous driving conditions.
Suggested Responsible Party: NMDOT
Estimated Expenses: Purchase and installation of equipment
Timeframe: 30 months
Funding Sources: WIPP budgets, highway maintenance budgets
Adapted STAPLE+E Average: 1.8
Ranking: 36

2013 UPDATE
No up-date on the progress of this action is available at this time.

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

XII. THUNDERSTORMS (INCLUDING LIGHTNING)

34. Require use of hail resistant materials in new state funded construction. *(#20, 2010 Plan)*

Hail causes damages to roofing, windows and siding materials
Hazard: Thunderstorm
How Contributes to Strategy: This action would require that any new state facility erected contain hail/impact resistant materials. Consistently enforcing building codes provides the greatest benefit for new construction to mitigate damages due to severe weather. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation. Hail resistant materials can increase the cost by as much as 35-40%, but reduced insurance premiums can offset this.
Suggested Responsible Party: GSD, OSE, Legislature
Estimated Expenses: Dependent on the specific structure
Funding Sources: State Budget
Timeframe: 60 months
Adapted STAPLE+E Average: 1.75
Ranking: 38

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

XIII. TORNADO

35. Encourage the use and installation of Storm Shelters in tornado prone areas. *(#5, 2010 Plan)*

There are very few storm shelters in some areas of the State that are particularly vulnerable to tornado impacts. Certain communities are especially vulnerable. Identification of local vulnerability in local and tribal mitigation plans will help to identify those communities that would benefit from a storm shelter program. Enforcing existing building codes provides the greatest benefit for new construction to mitigate damages due to tornado events.
Hazards: Tornado

How Contributes to Strategy: Storm shelters have been shown to greatly reduce the impact from tornadoes. Individuals must be trained on how to prepare for and utilize the shelters prior to required need for use.
Suggested Responsible Party: State agencies, local jurisdictions, tribal entities
Estimated Expenses: Dependent on the construction, size and specifications of each shelter location
Funding Sources: HMGP, HUD, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 2.19
Ranking: 21

2013 UPDATE:
This action was modified in 2013 to reflect encouraging the installation of storm shelters through the use of government funded grant programs (not a State mandated regulation as described in the 2010 version of the Plan). The action was also modified to reflect participation on a voluntary basis.

36. **Create additional shelters using public buildings and retrofit existing public shelters with safe rooms.** *(#25, 2010 Plan)*

Few public shelters are rated to serve as safe rooms. Moreover, additional shelter locations are needed on the eastern side of the state to protect building occupants.
Hazard: tornadoes
How Contributes to Strategy: Retrofitting of public buildings to include storm shelters is an effective way to protect community members. For existing structures and critical facilities, follow-up inspections and retrofits provide effective mitigation.
Suggested Responsible Party: local jurisdictions, GSD, State agencies
Estimated Expenses: Cost dependent on the construction, size and specifications of each shelter location
Funding Sources: Existing budgets, HMGP, PDM
Timeframe: 60 months
Adapted STAPLE+E Average: 2.25
Ranking: 27

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.

Hazards: All

XIV. VOLCANO

37. Conduct mapping and delineation of areas vulnerable to volcano eruption in and around the state.

This is a new mitigation action for the 2013 Plan and was suggested by the Planning Team and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Data needs to be collected and compiled on past occurrence of different types of volcanic activity. It may be beneficial to include volcanic activity outside the state that has the potential to impact New Mexico (ash clouds for example). Once all available information is collected and mapped, analysis of Preparedness Area risk, frequency and probability can be evaluated. Then, more specific mitigation measures can be identified.
Hazard: Volcano
How Contributes to Strategy: Mapping the various volcanic activity types would provide emergency managers, land managers, transportation industry and building code officials with information to better understand the potential impact of this hazard. When mapping is complete, decisions can be made about mitigation methods that would be effective to reduce damage and injury.
Suggested Responsible Party: DoIT, DHSEM, DOT, NM Tech, USGS
Estimated Expenses: Unknown at this time
Funding Sources: Unknown at this time
Timeframe: 60 months
Adapted STAPLE+E Average: 1.59
Ranking: 42

38. Provide education about the volcano alert system and the aviation color code warning system.

This is a new mitigation action for the 2013 Plan and was suggested by the Planning Team and Subject Matter Experts during the data review for the Hazard Identification and Risk Assessment Section of the Plan. Because this is a hazard that is not experienced often, many citizens don't understand the severity of the potential impact of volcanic activity.
Hazard: Volcano
How Contributes to Strategy: Educating citizens, emergency managers and first responders about the volcano alert system could likely reduce damage and potential injury in the future.
Suggested Responsible Party: DoIT, DHSEM, NM Tech, USGS
Estimated Expenses: Unknown at this time
Funding Sources: Unknown at this time
Timeframe: 60 months
Adapted STAPLE+E Average: 1.76
Ranking: 37

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.
Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

XV. WILDFIRE

39. Increase the Number of Firewise Communities *(#12, 2010 Plan)*

This program emphasizes community responsibility for maintaining a safe community. Mitigation options for wildland fire need to address not only the management of fuels, but also the potential for growing population in wildfire threat areas. The State Forestry Division has conducted a statewide assessment on forestry health and outlined mitigation efforts and priorities to reduce fuel loads and create more defensible space. More specific mitigation goals and actions are detailed in the Statewide Assessment, Strategy and Response Plans.
Hazard: Wildfire
How Contributes to Strategy: Firewise is a program designed to involve homeowners, local leaders, developers and others in the effort to protect people property and natural resources from wildfires, by building and maintaining communities that are compatible to local environments. The goal is to increase the number of Firewise communities from 9 to 18 in five years.
Suggested Responsible Party: NM Forestry, local fire departments, local emergency managers
Estimated Expenses: Volunteer and community efforts
Funding Sources: Unknown at this time
Timeframe: 60 months
Adapted STAPLE+E Average: 2.76
Ranking: 1

2013 Up-date
Uncertain at this time.

40. Implement defensible space around state owned facilities. *(#21, 2010 Plan)*

Defensible space around the structure will lessen the risk of structure damage.
Hazard: Wildfire
How Contributes to Strategy: Establishing defensible perimeter around state owned facilities will reduce the likelihood of these resources to being destroyed by wildfire.
Suggested Responsible Party: DHSEM, NM Forestry
Estimated Expenses: Brush/tree removal and maintenance of perimeter
Timeframe: 60 months
Funding Sources: Existing budgets, SFA-WUI
Adapted STAPLE+E Average: 2.65

Ranking: 6

2013 UPDATE
This action was modified in 2013 to reflect voluntary participation (not legislative mandate).

41. **Increase participation in Community Wildfire Protection Plans (CWPP).** *(#13, 2010 Plan)*
CWPP are community or county plans that address wildfire risk and mitigation for specific communities in New Mexico. The plan must have collaboration between land management agencies and the community and it must prioritize fuel reduction areas and address the treatment of structural ignitability within the plan boundaries. Communities to target for participation are those with the highest risk.
Hazard: Wildfire
How Contributes to Strategy: Suggested Responsible Party: NM Forestry, local jurisdictions
Estimated Expenses: Creation of plan
Timeframe: 60 months
Funding Sources: existing budgets, RFA, SFA-WUI, NM Assoc. of Counties Grants
Adapted STAPLE+E Average: 2.5
Ranking:8

2013 UPDATE
The number of Community Wildfire Protection Plans (CWPP) remains the same as in 2010; there are 57 CWPPs in New Mexico. These 57 CWPPs identify 600 communities at risk from wildland fire.

42. **Reduce combustible fuels around critical facilities in WUI areas.** *(#22, 2010 Plan)*
This action reduces the susceptibility to wildfires at critical facilities such as power stations, power lines, transformer sites, major transportation routes and critical watersheds. Critical facilities must be protected from wildfire on a priority basis. Transportation routes are critical for emergency traffic, residential ingress and egress. Some watershed areas can be vulnerable to other hazards (such increased sediment or pollutants) after wildfires.
Hazard: Wildfire
How Contributes to Strategy: By reducing fuel around critical facilities, wildfire risk is reduced. Therefore, less damage to structures or infrastructure will result. In addition, there will be less potential for injury and the possibility of loss of life.
Suggested Responsible Party: Local jurisdictions, utilities providers, DOT, State Forestry, facility owners
Estimated Expenses: Equipment and manpower
Funding Sources: Existing budgets, PDM, HMGP, RFA, SFA-WUI, RCA EAP,
Timeframe: 60 months
Adapted STAPLE+E Average: 2.76
Ranking: 2

2013 UPDATE
Description of the action item was modified in regard to the description of critical facilities. No up-date on the progress of this action is available at this time.

Multi-Hazard Actions:
Develop comprehensive public education/outreach strategies for natural hazard mitigation.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #1.

Hazards: All

Create a centralized repository of hazard mapping that can be accessed by local jurisdictions, tribal entities and State agencies.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: All

Establish and enhance GIS capability within DHSEM.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #3.
Hazards: All

Map State facilities and assets in relation to identified hazard areas of the state
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #4.
Hazards: All

Implement actions to improve forest and watershed health.
NOTE: Full mitigation action description can be found under Multi-Hazard category, action #2.
Hazards: Drought, Flood, Wildfire

Result of Ranking

The prioritization of mitigation actions in this Plan should not be construed as absolute. It is not necessary for the first priority to be met before subsequent priorities are addressed. Governmental agencies and institutions often make determinations about what project to implement based on available resources such as funding and staffing. Often grant funding is available for a specific project type; potential grant recipients must use what is available to them, even if the action item is not listed as the top priority. The priorities identified in this Plan are to be viewed as guidelines for State agencies, not as requirements. Tribal governments, local governments and institutions must make their own prioritization for mitigation actions based on appropriateness for each individual community or entity.

Figure 5.2. Mitigation Action Rank by Hazard Type

Draft #	Hazard	Adapted STAPLE+E Average	Prioritization Rank
	Multi-Hazard		
1	Public education/outreach	2.69	5
2	Centralized hazard mapping	2.44	9
3	Establish/enhance GIS in DHSEM	2.38	11
4	Map State facilities	2.25	16
5	Up-date/train HAZUS (damage estimator software)	2	27
6	Improve forest/watershed health	2.71	3
	Dam Failure		
7	Hire Dam Safety Engineer	2.24	18
8	Acquire/remove unsafe dams	2.35	12
9	Create EAPs for private dams	2.41	10
	Drought		
10	Mandate xeriscaping for State facilities	1.88	35
11	Require Grey Water systems for State Facilities	1.88	32
12	Establish Rebate Program	1.63	41
13	Drought mitigation in range plans	2.35	13
14	New water sources	2.35	14
15	Water Supply/ Drought Vulnerability Assessment	2.53	7
	Earthquake		
16	Map seismic risk State-wide	2.18	22
17	Vulnerability assessment for State critical facilities	2.29	15
18	Develop regional earthquake codes	1.65	40
19	Retrofit public facilities	1.88	33
20	Participate in Shake-out	1.69	39
	Expansive Soil		
21	Map hazardous soils	1.93	31
	Flood		
22	Acquire/relocate repetitive loss structures	2.06	24
23	Add/improve flood control structures	2.24	19
24	Study impact of post-fire flooding/debris flow	2.71	4
25	Study impact of alluvial fans	1.94	30
26	Increase number of CRS communities	2.13	23
27	Technical assistance for ordinance development	2	28
28	One week-long floodplain management class in State per year	1.88	34
	Landslide		
29	Map landslide and debris flow	2.06	25
30	Install rock nets or similar	2.24	20
31	Adopt Zoning	2.06	26
	Land Subsidence		

32	Map land subsidence	2	29
	Severe Winter Storms		
33	Install Snow Fences	1.8	36
	Thunderstorm		
34	Hail resistant material in State facilities	1.75	38
	Tornado		
35	Storm Shelters	2.19	21
36	Public Sheltering	2.25	17
	Volcano		
37	Mapping of volcanic hazards	1.59	42
38	Education on warning system and alert codes	1.76	37
	Wildfires		
39	Increase number of Firewise communities	2.76	1
40	Defensible space around State facilities	2.65	6
41	Increase number of CWPPs	2.5	8
42	Reduce combustible fuel around critical facilities	2.76	2

Figure 5.3. Mitigation Action Ranking in Priority Order

Prioritization Rank	Hazard	Adapted STAPLE+E Average	Draft #
1	Increase number of Firewise communities	2.76	39
2	Reduce combustible fuel around critical facilities	2.76	42
3	Improve forest/watershed health	2.71	6
4	Study impact of post-fire flooding/debris flow	2.71	24
5	Public education/outreach	2.69	1
6	Defensible space around State facilities	2.65	40
7	Water Supply/ Drought Vulnerability Assessment	2.53	15
8	Increase number of CWPPs	2.5	41
9	Centralized hazard mapping	2.44	2
10	Create EAPs for private dams	2.41	9
11	Establish/enhance GIS in DHSEM	2.38	3
12	Acquire/remove unsafe dams	2.35	8
13	Drought mitigation in range plans	2.35	13
14	New water sources	2.35	14
15	Vulnerability assessment for State critical facilities	2.29	17

16	Map State facilities	2.25	4
17	Public Sheltering	2.25	36
18	Hire Dam Safety Engineer	2.24	7
19	Add/improve flood control structures	2.24	23
20	Install rock nets or similar	2.24	30
21	Storm Shelters	2.19	35
22	Map seismic risk State-wide	2.18	16
23	Increase number of CRS communities	2.13	26
24	Acquire/relocate repetitive loss structures	2.06	22
25	Map landslide and debris flow	2.06	29
26	Adopt Zoning	2.06	31
27	Up-date/train HAZUS (damage estimator software)	2	5
28	Technical assistance for ordinance development	2	27
29	Map land subsidence	2	32
30	Study impact of alluvial fans	1.94	25
31	Map hazardous soils	1.93	21
35	Mandate xeriscaping for State facilities	1.88	10
32	Require Grey Water systems for State Facilities	1.88	11
33	Retrofit public facilities	1.88	19
34	One week-long floodplain management class in State per year	1.88	28
36	Install Snow Fences	1.8	33
37	Education on warning system and alert codes	1.76	38
38	Hail resistant material in State facilities	1.75	34
39	Participate in Shake-out	1.69	20
40	Develop regional earthquake codes	1.65	18
41	Establish Rebate Program	1.63	12
42	Mapping of volcanic hazards	1.59	37

SECTION 6 – IMPLEMENTATION STRATEGY

Once the 2013 New Mexico Natural Hazard Mitigation Plan is approved by FEMA, it will be available on the DHSEM webpage for reference. An email notification will be sent to all Planning Team Members, Subject Matter Experts, State Agencies, Tribal entities and organizations with an interest in natural hazard mitigation. Neighboring State SHMOs and national organizations with an interest in natural hazard mitigation will also receive a notification.

Effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. Agencies and organizations involved with the preparation of the 2013 Plan will implement mitigation actions as resources become available. In many instances mitigation actions were identified that are already in the planning or implementation stages.

Monitoring, evaluating, and up-dating the State Natural Hazard Mitigation Plan are critical to maintaining its relevance. The Planning Team and Subject Matter Experts will continue to be asked for input into the Plan throughout the five year up-date cycle.

Monitoring and Evaluation

In September each year, an annual survey will be utilized to encourage Planning Team and Subject Matter Expert feedback. It is anticipated that the survey will be sent September 1 with comments due back by September 30. Questions and information to be collected on the annual survey will include;

- Describe any public outreach activities regarding the State Natural Hazard Mitigation Plan.
- If additional maps or hazard data is available, what information is relevant to the State Plan?
- If a natural disaster has occurred in this reporting period, provide data on the event and its impacts.
- Do any new critical facilities need to be added to the list?
- If there has been change in development patterns, provide information about how it may influence the effects of hazards or create additional risks.
- Are there different financial, technical or human resources now available for mitigation planning and project implementation?
- Describe any progress on mitigation action implementation.
- Should new mitigation actions be added? If so, describe the activity.

The SHMO will facilitate a meeting of the Planning Team and Subject Matter Experts in early November. The primary purpose of the meeting will be to evaluate the progress on implementation of mitigation actions. In January of each year the SHMO will distribute a brief listing of the up-dates suggested for the Plan. The listing will be sent to all Planning Team and Subject Matter Experts. In addition, it will be posted on the DHSEM website along with the FEMA approved version of the Plan.

Additionally, the SHMO will monitor and evaluate the progress of HMP projects via quarterly financial and performance reporting, site visits, and telephone, email and postal correspondence throughout the course of a project. For construction projects, the SHMO, or other designated person, will visit the project side at the request of sub-grantees to provide direct advice and to resolve challenges. The SHMO may visit a project site to perform an interim inspection at any time.

Plan Update

In year four of the five-year cycle, the SHMO will initiate the update process. If appropriate, a planning grant will be pursued. The Planning Team and Subject Matter Experts will be invited to a Kick-off Meeting 18 months prior to the expiration of the Plan (approximately March 2016). Updates to each section of the Plan will occur during that time. The spring of 2018 is when the public will be asked to comment. The draft Plan will be submitted to FEMA for review in the summer of 2018. The chart below (Figure 5.4) summarizes the activities to take place during the next five years.

Figure 5.4. Plan Update Timeline

Approximate Timeline	Action	Responsible Party
2014		
September	Distribute Annual Survey	SHMO
October	Fill out and return Annual Survey	Planning Team and SMEs
November	Planning Team and SME Evaluation Meeting	SHMO to facilitate
2015		
January	Update report generated	SHMO
September	Distribute Annual Survey	SHMO
October	Fill out and return Annual Survey	Planning Team and SMEs
November	Planning Team and SME Evaluation Meeting	SHMO to facilitate
2016		
January	Update report generated	SHMO
September	Distribute Annual Survey	SHMO
October	Fill out and return Annual Survey	Planning Team and SMEs
October	Apply for grant funding for up-date	SHMO
November	Planning Team and SME Evaluation Meeting	SHMO to facilitate
2017		
January	Update report generated	SHMO
January	Begin procurement for up-date services	SHMO
April	Services secured	SHMO
April	Kick-off Meeting for 2018 Up-date	SHMO to facilitate
2018		
April	Public comment period	SHMO
June	Submittal to FEMA for review	SHMO
September	Plan update approved	SHMO

It is anticipated that the Kick-off Meeting for the 2018 update will occur in the spring of 2018. Specific items that will be reviewed and modified for the 2018 update will be based on based on Planning Team and Subject Matter input. At a minimum, the update will address the following;

- Should the same planning process be followed as in the 2013 update?
- Does the Planning Team and Subject Matter Expert list reflect the full range of interests State-wide?
- Are the State-wide mitigation goals still appropriate?

- Has the pattern or type of natural disasters changed sufficiently that the Plan should have a different focus?
- What policies or regulations have been modified at the State or federal level that may impact the Plan update?

As the 2013 update was proceeding, it became obvious that certain topics could not be covered in enough depth due to the lack of availability of data and resources. If resources are available, it is anticipated that the following topics will be addressed in the 2018 update;

- Forest and watershed health influence on hazard risk and resource vulnerability;
- Impacts of natural hazards on agriculture (food source, distribution, safety) and related potential natural hazard mitigation activities;
- Impacts of natural hazards that occur across State boundaries that impact New Mexico communities and wildlife populations;
- Improve HAZUS modeling, if resources as available;
    - Re-run earthquake model with 2010 census data;
    - Re-run flood model with 2010 census data and with a level of detail to result in more detailed damage assessment information;
    - Run high wind model

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Appendix A - Acronyms

Acronym	Term
ASCE	American Society of Civil Engineers
BCA	Benefit/Cost Analysis
BD/DR	Business Continuity/Disaster Recovery
BFE	Base Floodplain Elevation
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BNSF	Burlington Northern Santa Fe (Railroad)
BWS	Beaufort Wind Scale
CBR	Cost/Benefit Review
CDBG	Community Development Block Grant
CFM	Certified Floodplain Manager
CFOI	Census of Fatal Occupational Injuries
cg	Cloud-to-Ground (lightning)
CMMS	Computerized Maintenance Management System
COE	College of Economics
CRS	Community Rating System (for NFIP)
CWPP	Community Wildfire Protection Plan
DFIRM	Digital Flood Insurance Rate Map
DMA	Disaster Mitigation Act
DMA 2000	Disaster Mitigation Act of 2000
DMA2K	Disaster Mitigation Act of 2000
DOC	Department of Commerce
DOD	Department of Defense
DOI	Department of the Interior
DRMS	NSF Directorate for Social, Behavioral and Economic Science, Division of Social Behavioral and Economic Research, Decision, Risk, and Management

	Science Program
EAP	Emergency Action Plan
EDA	Economic Development Administration
EF	Enhanced Fujita Scale
EM	Emergency Manager
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ERC	Energy Release Component
ERP	Enterprise Resource Planning
ESRI	Economic and Social Research Institute
FEMA	Federal Emergency Management Agency
FDRS	Fire Danger Rating System
FHBM	Flood Hazard Boundary Map
FIMA	Federal Insurance and Mitigation Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Studies
FMA	Flood Mitigation Assistance
FRCC	Fire Regime Condition Class
FWS	Fish and Wildlife Service
FY	Fiscal Year
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GSD	General Services Department
HAZUS-MH	Hazards U.S. Multi-Hazard
HIRA	Hazard Identification and Risk Assessment
HMGP	Hazard Mitigation Grant Program
HMO	Hazard Mitigation Officer
HMP	Hazard Mitigation Plan
HUD	Housing and Urban Development
IA	Individual Assistance

IBC	International Building Code
IFR	Interim Final Rule
KBDI	Keetch-Byram Drought Index
LAL	Lightning Activity Level
LOMR	Letters of Map Revision
LTER	Long Term Ecological Research
MHIRAM	Multi-Hazard Identification and Risk Assessment
MMI	Modified Mercalli Intensity
MPG	Mitigation Planning Group
MPH	Miles Per Hour
NCDC	National Climatic Data Center
NCHS	National Centers for Health Statistics
NDFD	National Digital Forecast Database
NEHRP	National Earthquake Hazard Reduction Program
NEPA	National Environmental Policy Act
NFHL	National Flood Hazard Layer
NFIP	National Flood Insurance Program
NHPA	National Historic Properties Act
NIBS	National Institute of Building Sciences
NIMS	National Incident Management System
NMDHSEM	New Mexico Department of Homeland Security and Emergency Management
NMDOT	New Mexico Department of Transportation
NMSM	New Mexico School of Mines
NMTEP	New Mexico Tech Emergency Planner
NNMCC	Northern New Mexico Community College
NPS	National Park Service
NRCS	National Resources Conservation Service
NSF	National Science Foundation
NWR	National Wildlife Refuge
NWS	National Weather Service
OCP	Office of Capital Projects

OEM	Office of Emergency Management
PA	Public Assistance
PCD	Planning and Campus Development
PCPI	Per Capita Personal Income
PDA	Preliminary Damage Assessment
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
PGA	Peak Ground Acceleration
PI	Principle Investigator
PNM	Public Utility Company of New Mexico
POC	Point of Contact
RAOB	RAwinsonde OBservation
RGIS	Resource Geographic Information System
RH	Relative Humidity
RHS	Rural Housing Service
ROTC	Reserve Officers Training Corp
RUS	Rural Utilities Service
SBA	Small Business Administration
SC	Spread Component
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SRS	Safety and Risk Services
SSA	Socorro Seismic Anomaly
STAPLE+E	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
TERA	Terminal Effects Research and Analysis
TPI	Total Personal Income
USACE	US Army Corp of Engineers
USDA	US Department of Agriculture
USGS	United States Geological Survey
VEI	Volcanic Explosivity Index

WFAS	Wildland Fire Assessment System
WIPP	Waste Isolation Pilot Plant
WUI	Wildland-Urban Interface

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Appendix B – Definitions and Terms

Asset: Any manmade or natural feature that has value, including people; buildings; infrastructure such as bridges, roads, and sewer and water systems; lifelines such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, dunes, wetlands, and landmarks.

Building: A structure that is walled, roofed, principally above ground, and permanently affixed to a site. The term also applies to a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Capability Assessment: An assessment that provides an inventory and analysis of a community or state's current capacity to address the threats associated with hazards. The capability assessment attempts to identify and evaluate existing policies, regulations, programs, and practices that positively or negatively affect the community or state's vulnerability to hazards or specific threats.

Comprehensive Plan: A document, also known as a "general plan," which covers the entire geographic area of a community and expressing community goals and objectives. The plan lays out the vision, policies, and strategies for the future of the community, including all of the physical elements that will determine the community's future development. This plan can discuss the community's desired physical development, desired rate and quantity of growth, community character, transportation services, location of growth, and siting of public facilities and transportation. In most states, the comprehensive plan has no authority in and of itself, but serves as a guide for community decision-making. Not all governmental jurisdictions maintain a plan of this type.

Comprehensive Range of Mitigation Actions: As required by the mitigation strategy, at least two distinct mitigation actions per hazard that are inclusive in nature and which relate to accomplishing the goals and objectives of the plan.

Cost-Benefit Review: An evaluation of the favorable returns that result vs. the monetary expenditures required to complete proposed mitigation actions. When prioritizing actions in a mitigation strategy, a special emphasis shall be made on this economic evaluation. *Note: The Cost-Benefit Review should not be confused with FEMA's Benefit-Cost Analysis software. Though this software can provide you with a method for this evaluation, it is not a required step for completing this prioritization.*

Critical facility: Facilities vital to the health, safety, and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.

Disaster Mitigation Act of 2000 (DMA 2000): DMA 2000 (PL 106-390) is legislation designed to improve the planning process signed into law on October 30, 2000 to amend the Stafford Act. This legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.

Duration: How long a hazard event lasts.

Essential Facility: Elements important to ensure a full recovery of a community or state following a hazard event. These would include: government functions, major employers, banks, schools, and certain commercial establishments, such as grocery stores, hardware stores, and gas stations.

Evapotranspiration: means the total loss of water from a crop into the air. Water evaporates from any moist surface into the air unless the air is saturated. Water surfaces in contact with air, such as lakes, plant leaves, and moist soils, all evaporate water.

Extent of a Hazard: The magnitude or severity of a hazard. Not to be confused with the location or site of a hazard. The extent and damage predicted by a hazard can be established by comparing previous or predicted hazard events to established technical measures, such as the Fujita Scale for tornados. For example, a community might predict that the typical tornado that would affect them is an F2 storm, with speeds of 150 mph. The Fujita Scale predicts impacts that include "considerable damage, roofs torn off houses, mobile homes demolished, boxcars pushed over" etc. This demonstrates the extent, which is the typical magnitude and impact expected on the community.

Frequency: A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, or extent typically occurs. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average and has a 1% chance (its probability) of happening in any given year. The reliability of frequency information varies depending on the kind of hazard being considered.

Goals: General guidelines that explain what you want to achieve. They are usually broad policy-type statements, long term in nature, and represent global visions.

Governing Body: The governing body of a Tribe, County, Parish or City having legislative and administrative powers, such as passing ordinances and appropriating funds, e.g. city council, county commissioners, quorum court, policy jury, tribal council, etc.

Hazard: A source of potential danger or adverse conditions. A natural event is a hazard when it has the potential to harm people or property. Per the Section 322 of the Disaster Mitigation Act of 2000, only natural hazards are required to be assessed for mitigation planning.

Hazard Event: A specific occurrence of a particular type of hazard.

Hazard Identification: The process of identifying all the types of hazards that threaten or affect a specific planning area.

Hazard Mitigation: Sustained actions taken to reduce or eliminate long-term risk from hazards and their effects.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 404 of the Stafford Act, HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

Hazard Profile: It is a description of the physical characteristics of each hazard identified and a presentation of its various descriptors, including location, extent (magnitude), previous occurrences, and the probability of future events. In most cases, a community can most easily use these descriptors when they are displayed on maps.

Impact: The damage that is expected or predicted by a hazard occurring is a specific area.

Infrastructure: Public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technologies (e.g., telephone lines and Internet access); vital services (e.g., public water supplies and sewer treatment facilities); transportation system components (e.g., airways, airports, and heliports); highways, (e.g., bridges, tunnels, roadbeds, overpasses, railways, rail yards, and depots); and waterways (e.g., canals, locks, seaports, ferries, harbors, dry-docks, piers, and regional dams).

Intensity: A measure of the effects of a hazard event at a particular place.

Interim Final Rule on Local Mitigation Planning (IFR): The governing regulations found in 44 CFR 201.6 which provide the criteria for completing a local hazard mitigation plan. Originally published in the Federal Register on February 26, 2002.

Inventory: The assets identified in a study region, which include buildings and infrastructure.

Location of a Hazard: The area affected by a hazard or hazard event. Some hazards are general to the whole of a planning area (thunderstorms, earthquakes) while others are very specific to known areas (flooding, landslides).

Loss Estimation: Estimation of potential losses by assigning hazard-related costs and losses to inventory data such as data for populations, building stocks, transportation and utility lines, regulated facilities, and more). Loss estimation is essential to decision-making at all levels of government and provides a basis for developing mitigation plans and policies. Loss estimation also supports planning for emergency preparedness, response, and recovery.

Magnitude: A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures to be specific to the hazard.

Mitigate: To cause something to become less harsh or hostile, to make less severe or painful.

Mitigation Actions: Activities or projects that help achieve the goals and objectives of a mitigation plan.

Mitigation Plan: Authorized by Section 322 of the Stafford Act, it is a document that presents a systematic evaluation of the nature and extent of an area's vulnerability to the effects of natural hazards and a description of actions to minimize future vulnerability to hazards. Note: Local Hazard Mitigation Plans must be written to meet 44 CFR Part 201.6 (Interim Final Rule on Local Mitigation Planning) and approved by FEMA for continued eligibility for FEMA mitigation grant programs.

Multi-jurisdictional Mitigation Plan: A mitigation plan that represents the participation of more than one governmental entity in its risk assessment, mitigation strategy, plan maintenance, and adoption. This is opposed to a single-jurisdictional mitigation plan which represents only one governmental entity.

Objectives: Measurable strategies or implementation steps to attain a goal. They are shorter in range and more specific than goals.

Ordinance: A term for a law or regulation adopted by a local government.

Plan Maintenance: An ongoing planning function designed to maintain the reliability and accuracy of an approved mitigation plan. This process will include a method and schedule for monitoring, evaluating and updating of the plan following its approval.

Planning: The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.

Planning Team: A group composed of government, private sector, and individuals with a variety of skills and areas of expertise, usually appointed by a city or town manager, or chief elected official. The group finds solutions to community mitigation needs and seeks community acceptance of those solutions.

Preparedness: Actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Probability: The numeric or statistical likelihood that a hazard event will occur. Theoretically, the probability of the occurrence of an event is between 0% (indicating that the event will never occurs) and 100% (indicating that the event always occurs).

Public Education and Outreach: Any campaign to make the public more aware of hazard mitigation and mitigation programs, including hazard information centers, mailings, public meetings, etc.

Recovery: The actions taken by an individual or community after a catastrophic event to restore order and lifelines in a community.

Reoccurrence Interval: The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any given year.

Resolutions: Expressions of a governing body's opinion, will, or intention that can be executive or administrative in nature. Most planning documents must undergo a council resolution, which must be supported in an official vote by a majority of representatives to be adopted.

Response: The actions taken during and immediately after an event to address immediate life and safety needs and to minimize further damage to properties.

Risk: The estimated impact that a hazard event would have on people, services, facilities, and structures in a community, or the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of damage being sustained above a particular threshold as a result of a specific type of hazard event. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard event. In mathematical terms, Risk=Hazard x Vulnerability.

Risk Assessment: A methodology used to assess potential exposures and estimated losses associated with likely hazard events. A risk assessment process includes four steps: identifying hazards, profiling hazard events, inventorying assets, and estimating losses.

Severity: See magnitude

Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL100-107) was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974 (PL 93-288). The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs. It was most recently amended with the enactment of the Disaster Mitigation Act of 2000 (PL 106-390).

STAPLEE: A systematic evaluation and prioritization method used to assess whether existing and potential alternative mitigation actions fulfill the plan's objectives and if they are appropriate for the planning area. The method evaluates the **S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**conomic, and **E**nvironmental (STAPLEE) opportunities and constraints of implementing a particular mitigation action within the jurisdiction.

State Hazard Mitigation Officer (SHMO): The state government representative who is the primary point of contact with FEMA, other state and federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities. This position usually resides in the State Emergency Management Agency.

Strategy: A collection of actions developed to achieve the goals and objectives. In a mitigation plan, the actions are aimed at reducing or eliminating the risk that a hazard presents to a community.

Vulnerability: How exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, its contents, and the economic value of its functions. Vulnerability of an asset may differ from one hazard to another. As well, indirect effects can often be much more widespread and damaging than direct effects of a hazard.

Vulnerability Assessment: An assessment of the extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address the impacts of hazard events on both existing and future conditions.

Appendix C – 2013 Hazard Mitigation Team Members and Participants

Name	Department/ Organization	Planning Team Member
Xavier Anderson	National Forestry Services	
Fermin Aragon	NM Regulation & Licensing Dept., Construction Industries & Manufactured Housing	
Rick Aster	NM Institute of Mining & Technology, Geophysical Research Center	
Jayne Aubele	Museum of Natural History	
Shirley Baros	UNM, Earth Data Analysis Center	X
James Berazi	Inter-State Stream Commission	
Wendy Blackwell	US Dept. of Homeland Security & Emergency Mgmt., State Hazard Mitigation Officer	X
Doug Bland	NM Institute of Mining & Technology, Bureau of Geology	
Patrick Block	NM Dept. of Game & Fish	
Angela Bordegaray	Inter-State Stream Commission, State Water Planner	X
Bill Borthwick	US Dept. of Homeland Security & Emergency Mgmt., State Floodplain Coordinator	X
Daniela Bowman	US Dept. of Homeland Security & Emergency Mgmt., HAZMAT Coordinator	X
Doug Boykin	NM Energy, Minerals & Natural Resources Dept., Forestry Division	
Cheryl Buckel	US Army Corps of Engineers	
Richard Clark	US Dept. of Homeland Security & Emergency Mgmt., Intel & Security Bureau Chief	X
Gar Clarke	NM Dept. of Information Technology	
Larry Crumpler	Museum of Natural History	
Jeffery Daniels	US Army Corp of Engineers	
Dave DuBois	NM State University, State Climatologist	
Duane Duffy	NM Indian Affairs Department	X
Lorenzo Espinoza	US Dept. of Homeland Security & Emergency Mgmt., Preparedness Area Coordinator	X
Jennifer Faler	US Dept. of Interior, Bureau of Reclamation	
Seth Fiedler	US Dept. Of Agriculture, Natural Resources Conservation Center	X
Evonne Gantz	Dept. of Homeland Security & Emergency Mgmt., Response Unit Manager	X
Joe Garcia	NM Dept. of Transportation	X
Kevin Gardner	NM Dept. of Game & Fish	
Katie Goetz	NM State University, Dept. of Agriculture	X
Mark Gunn	US Geological Survey, NM Water Science Center	
Michael Gustin	NM Dept. of Game & Fish	
Kelly Hamilton	NM State University, Dept. of Agriculture	X
Dale Hoff	FEMA, Region VI National Flood Insurance Program	X
Carmella Jasso	GSD, Risk Management Division Procurement Manager, Insurance Liaison	
Kerry Jones	National Weather Service	
Todd Kelley	US Geological Survey, NM Water Science Center	

Michael Kessler	NM Environment Dept., Operations & Infrastructure Division	
RJ Kirkpatrick	NM Dept. of Game & Fish	
Taura Livingston	Red Cross	X
John Longworth	Office of the State Engineer, Water Use Bureau Chief	X
Dave Love	NM Institute of Mining & Technology, Bureau of Geology	
Arup Maji	UNM, Civil Engineering	
Andrea Martinez	US Forest Service, Gila National Forest	
John Martinez	NM State Records Center & Archive	
Tamara Massong	US Army Corps of Engineers	X
Donald Mathiasen	US Dept. of Homeland Security & Emergency Mgmt., Preparedness Area Coordinator	X
Courtney McBride	US Dept. of Homeland Security & Emergency Mgmt., Preparedness Area Coordinator	X
Jeff Murray	US Dept. of Homeland Security, Office of Infrastructure Protection NM	
Jeff Pappas	NM Dept. of Cultural Affairs, Historic Preservation Division	
Shawn Penman	UNM, Earth Data Analysis Center	X
Dennis Pepe	Dept. of Homeland Security & Emergency Mgmt., Critical Infrastructure	
John Pierson	US Forest Service	
Grant Pinkerton	NM Floodplain Managers Association	X
Ed Polasko	National Weather Service	
Garret Ross	US Dept. of Interior, Bureau of Reclamation	
Cliff Sanchez	Natural Resources Conservation Service, Water Resources	
Mary Schumacher	Dept. of Health	
Stephen Sissons	US Army Corps of Engineers	x
Donald Scott	US Dept. Homeland Sec & Emergency Mgmt., Response & Recovery Bureau Chief	X
Wayne Sleep	Natural Resources Conservation Service, Snow Survey Technician	
Daniel Stark, LTC	US Army	X
Roger Tannen	NM Emergency Management Association (Bernalillo Co. Emergency Manage)	X
Charles Thompson	Office of State Engineer, Dam Safety	
Anne Tillery	US Geological Survey, NM Water Science Center	
Geno Trujillo	NM Department of Public Safety	X
Eddie Tudor	NM Energy, Minerals & Natural Resources Dept, Forestry Division	
Susan Walker	Dept. of Homeland Security & Emergency Mgmt., Preparedness Bureau Chief	X
Mike Waring, Captain	NM Department of Public Safety	X
Valli Wasp	US Dept. of Homeland Security & Emergency Mgmt., Preparedness Unit Manager	x
Linda Weiss	US Geological Survey, NM Water Science Center	
Brian Williams	US Dept. of Homeland Security & Emergency Mgmt., Recovery Unit Manager	x

Appendix D – Hazard Mitigation Team Meeting Notes

New Mexico Natural Hazard Mitigation Plan Up-date
Planning Team Meeting #1
10am to noon July 31, 2012
DHSEM Classroom, Santa Fe

Welcome

NM DHSEM State Mitigation Officer, Wendy Blackwell, opened the kick off meeting. A quick overview of the meeting agenda was provided.

Introductions

Everyone in attendance provided a brief introduction of the agency or organization that they represent and their involvement with natural hazard mitigation. At the end of this document are copies of the sign-in sheets and a list of conference call participants.

Planning Team Discussion

Wendy Blackwell provided a briefing to the group based on a PowerPoint presentation (see attachment to these notes).

I. What is natural hazard mitigation? Actions that we take now to reduce injury, loss of life and structural damage from future disasters.

II. Planning, project design and implementation were discussed.
   - The current Natural Hazard Mitigation Plan (Plan) identifies natural hazards that affect the state. Through the up-date process, the Planning Team will revisit the current text to ensure that the Plan represents the current priorities and reflects natural disasters that have occurred since the last State Natural Hazard Mitigation Plan Up-date in 2010.
   - Planning and prioritization is important for mitigation activities. The State Natural Hazard Mitigation Plan will include a general summary of the current approved Mitigation Plans for the local jurisdictions and tribal entities.
   - Examples of opportunities for mitigation actions were explained to the group to serve as examples.

- The following resources and references were presented to the group. The references will be sent to all on the distribution list.
  - NM Natural Hazard Mitigation Plan, 2010.
  - FEMA Crosswalk of the current NM Natural Hazard Mitigation Plan, 2010.
  - Planning Guidance under the Disaster Mitigation Act of 2000 (FEMA's "Blue Book'), 2010. This document provides the guidance that will be followed for the State Natural Hazard Mitigation Plan Up-date.
  - Hazard Mitigation Assistance Guidance, 2010. This document explains eligibility for FEMA's five hazard mitigation grant programs.
  - Local Mitigation Plan Review Guidance, 2011.
  - Tribal Mitigation Plan Guidance, 2010.
  - Coordination, integration and efficiency were discussed. An explanation was provided on the benefits of keeping the State Natural Hazard Mitigation Plan current and how it relates to funding opportunities in a pre-hazard and post-hazard situation.
  - Regulations identify the basic requirements for the State Natural Hazard Mitigation Plan (CFR 201.4). The following information must be included in the Plan;

o Describe State-wide hazard identification and risk assessment.

- o Develop State-wide mitigation strategy.
- o Describe how the State provides funding and technical assistance to local jurisdictions and tribal entities.
- o Describe State coordination with local and tribal mitigation planning.
- o Integrate the State Natural Hazards Mitigation Plan into other plans and actions at the State-wide, local and tribal level.
- o Establish a maintenance schedule for the State Natural Hazard Mitigation Plan.
  - The current State Natural Hazard Mitigation Plan expires on September 27, 2013 and is available on the DHSEM website; http://www.nmdhsem.org/uploads/files/Preparedness/Mitigation/FINAL_NM_Plan_Sept2010.pdf
  - The Table of Contents from the current State Natural Hazard Mitigation Plan was reviewed. The up-date may not reflect the same format, as the Planning Team will integrate new ideas and information.
  - o CHAPTER 1 - New Mexico Description
  - o CHAPTER 2 - Planning Process

Question; Gar Clarke, NM Department of Information and Technology, asked if the preparedness areas are grouped by county lines.
Answer; Wendy Blackwell described that DHSEM groups counties and tribal entities into one of six Preparedness Areas. The current Preparedness Area Map will be sent to the participants as follow-up to this meeting.
Lorenzo Espinoza, DHSEM Preparedness Area 6 Coordinator with DHSEM, provided a brief overview the Preparedness Area Program.

- o CHAPTER 3 - Program Integration

As we build the State Natural Hazards Mitigation Plan, the Planning Team will add other related plans and data.

- o CHAPTER 4 - Hazard Identification and Risk Analysis

Suggestion; Bill Borthwick, State Floodplain Coordinator with DHSEM, suggested that an appendix listing New Mexico levees should be included in the Plan.
Suggestion; Bill Borthwick cautioned incorporation of information from the Emergency Action Plans to make sure the information is the most recent and accurate.
Question; Cheryl Buckel, US Army Corps of Engineers Albuquerque District, asked about the inclusion of sensitive information such as dam inundation maps.
Answer; Wendy Blackwell explained that a summary can be included in the text of the State Natural Hazards Mitigation Plan and the maps can be referenced. The Planning Team can decide to have an Appendix that includes sensitive information which would only be accessible to the necessary personnel.

- o CHAPTER 5 - Vulnerability by Jurisdiction
- o CHAPTER 6 - Critical Facilities

Question; Cheryl Buckel asked for the definition of critical facilities.
Answer; Wendy Blackwell explained that there is a standard definition in the FEMA guidance. However, the Planning Team can modify the definition for the State Natural Hazards Mitigation Plan Up-date so that it works for our State-wide approach. Standard FEMA definition is included as an attachment to these notes.
Suggestion; Gar Clarke stated NM Department of Information and Technology has a data base with listing of critical facilities (CASA – Community Anchor Site Assessment). This will serve as an excellent source for up-dating the critical facilities section of the State Natural Hazard Mitigation Plan.

- o CHAPTER 7 - Pre-Disaster Mitigation Capability
- o CHAPTER 8 - Evaluation of 2007 Mitigation Items
- o CHAPTER 9 - Mitigation Strategy: Goal, Objectives and Action Items

Question; Gar asked if there is there a prioritization process.

Answer; Brian Fields, consultant to the State, explained the STAPLE+E process that will be used for prioritization. STAPLE+E stands for **S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**conomic and **E**nvironmental.
Suggestion; Bill Borthwick suggested that if the State is considering adopting new building codes, the mitigation plan recommendations should be considered.
Question; Gar Clarke asked how funding works in regard to project prioritization?
Answer; Wendy Blackwell provided an overview of how mitigation projects are funded and explained that it is of benefit to identify a wide range of potential mitigation actions, even if the funding can't be realized in the near future. Brian Fields explained that mitigation actions need to be tied to a specific natural hazard identified in the mitigation plan.

- CHAPTER 10 - Coordination of Local Mitigation Planning
- CHAPTER 11 - Plan Maintenance
- Reference section to be added.

Suggestion; Gar Clarke suggested that related plans and documents from other agencies should be incorporated in the reference list.

- Local and tribal mitigation plans were briefly described.
    - These local and tribal Natural Hazard Mitigation Plans must be updated every 5 years.
    - There is a new Local Plan Review Tool that was introduced in October 2011 which will be used to review all local mitigation plans starting October 2012.
    - The Tribal Mitigation Planning Guidance is dated 2010 and describes how all tribal plans will be reviewed.

Question; Gar Clarke asked about the difference between the local plan and tribal plan.
Answer; Wendy Blackwell provided a brief overview of the differences and referred the group to Appendix A in the Tribal Planning Guidance document where the differences are stated in a chart format.
Question; Gar Clarke asked how the mitigation process is integrated across the state.
Answer; Brian Fields explained that the local and tribal mitigation plans are very important, especially for reference in the State Natural Hazard Mitigation Plan. The integration of the priorities from the local and tribal mitigation plans provides both data and prioritization for the State-wide Plan.

Update Process

The proposed schedule for the State Natural Hazard Mitigation Plan Up-date was described. The goal is to have the hazard identification and risk assessment complete by the end of 2012 and the final draft of the Plan submitted to FEMA Region VI in the spring of 2013. We expect to have five Planning Team Meetings throughout the process. A sixth meeting may be scheduled if needed to review and incorporate feedback received from FEMA.

a. Planning Team roles and responsibilities were discussed as follows;
    i. Attend planning team meetings.
    ii. Provide feedback on over-all approach and process.
    iii. Provide edits on over-all document including formatting.
b. Subject Matter Experts (SME) roles and responsibilities were discussed as follows;
    i. Provide edits and feedback on specific hazards or topics.
    ii. Provide reference materials or websites.
c. Tasks that both Planning Team and Subject Matter Experts will be asked to complete are;
    i. Participate throughout planning process.
    ii. Have input into Preparedness Area approach.
    iii. Assist with integration into other State-wide plans and local plans.
    iv. Identify additional Planning Team Members and Subject Matter Experts.

Input from participants over the next year

- It was explained that DHSEM requests assistance from the participants to help up-date the data and contribute to the prioritization process for the State Natural Hazards Mitigation Plan.
- Input from the Planning Team and Subject Matter Experts should include;
- o Goals; review, comment and ranking
- o Hazard Identification; review, comment and ranking
- o Risk Analysis; review, comment and ranking
- o Capability; review and comment
- o Mitigation Actions; review, comment and ranking
- o Integration into other State-wide Plans; review and comment
- The request was made to review documents that are sent out by DHSEM to ensure that information is complete and correct. DHSEM will draft the text and then request that the Planning Team and Subject Matter Experts review and edit.

Wrap-up

- What additional agencies or organization should be invited to participate? A list of invited agencies and organizations is attached to these notes. The group was asked to provide feedback on any additional participants or Subject Matter Experts.
- Should there be changes to the current text for the State Natural Hazard Mitigation Plan goals? A hand-out was provided with an excerpt from the current Plan text. It was requested that the Planning Team review and provide feedback on the concepts.

Tasks to Follow-up from this meeting

- Wendy will provide meeting notes, reference materials, a corrected PowerPoint, a list of agencies/organizations invited to participate and the guidance definition of 'critical facility'.
- Participants should;
  - Determine appropriate role (as Planning Team member or Subject Matter Expert).
  - Provide names of additional agencies and organizations that should be invited to participate.
  - Provide feedback on current draft of State Natural Hazard Mitigation Plan goals.
  - Provide feedback on suggested dates and times for the next meeting (sometime the week of September 10th).

Attachments to these notes *(sent by email to all on the distribution list)*

- PowerPoint (7-31-12 corrected version)
  - Preparedness Area Map
  - Critical Facilities definition
  - List of agencies/organizations invited to participate
  - 2010 Plan Goals Excerpt

Reference Information *(included in a separate email message to all on the distribution list)*

- NM Natural Hazard Mitigation Plan, 2010; http://www.nmdhsem.org/uploads/files/Preparedness/Mitigation/FINAL_NM_Plan_Sept2010.pdf
    - FEMA Crosswalk of the current NM Natural Hazard Mitigation Plan, 2010
    - Planning Guidance under the Disaster Mitigation Act of 2000 (FEMA's "Blue Book'), 2010
    - Hazard Mitigation Assistance Guidance, 2010
    - Local Mitigation Plan Review Guidance, 2011
    - Tribal Mitigation Plan Guidance, 2010

Participants

Participants are shown in the two sign-in sheets below. The following list shows the attendees via webinar/conference call.

- Courtney McBride, DHSEM Preparedness Area 1
- Richard Aster, NM Tech Earthquake and Volcano seismic analyst
- Dave Dubois, NMSU Climatologist
- Grant Pinkerton, NM Floodplain Management Association
- Lt Col Steve Garcia, New Mexico State Guard
- Paul Dugie, NM Floodplain Management Association
- Damen Vigil, American Red Cross

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #1

10am to noon July 31, 2012, DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
STEPHEN SCISSONS	USACE	505.342.3328	Stephen.K.Scissons@usace.army.mil
MARK GUNN	USGS	505-830-7903	mgunn@usgs.gov
Linda Weiss	USGS	505 830 7901	lsweiss@usgs.gov
Mike Waring	NM STATE Police	505 476-9613	Mike.Waring@state.nm.us.
JOHN LONGWORTH	NMOSE	505-827-6121	JOHN.LONGWORTH@STATE.NM.US
Evonne Gantz	DHSEM	476-9684	evonne.gantz@state.nm.us
LORENZO ESPINOZA	DHSEM	505 699-9323	lorenzo.Espinoza@state.nm.us
BRIAN WILLIAMS	DHSEM RECOVERY	505 476-9601	brian.williams@state.nm.us
Bill Borthwick	DHSEM Preparedness Mitigation	(505) 476 9617	william.borthwick@state.nm.us
Shawn Penman	EDAC	505 277-3622 x 227	spenman@edac.unm.edu

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #1

10am to noon July 31, 2012, DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
Jon Hall	DHSEM	505 231 7365	jonathan.hall@state.nm.us
GENO TRUJILLO	NMSP	505 476-9613	geno.trujillo@state.nm.us
GAR CARRAS	DoIT	" 827-1663	—
Darshana Kamdar	DOIT	476-3886	Darshana.Kamdar@state.nm.us
BRIAN FIELDS	B-Sting Ventures LLC ABQ	703-863-8857	bwfabg@gmail.com
Cheryl Buckel	US Army Corps Engineers		Cheryl.S.Buckel@us.army.mil
Kerry Jones	NWS - Albuquerque		Kerry.Jones@noaa.gov

New Mexico Natural Hazard Mitigation Plan Up-date
Planning Team Meeting #2
1:30 to 3:00 September 10, 2012
DHSEM Classroom, Santa Fe

Welcome

NM DHSEM State Mitigation Officer, Wendy Blackwell, provided quick overview of the meeting agenda.

Introductions

Everyone in attendance provided a brief introduction of the agency or organization that they represent. At the end of this document are copies of the sign-in sheets and a list of conference call participants. Wendy and Brian Fields (DHSEM consultant) provided a briefing to the group based on a PowerPoint presentation (see attachment to these notes).

Follow-up from July 31, 2012 Meeting

- **Corrections to July 31, 2012 Notes**: The group was asked for any comments or changes to the minutes from last meeting. There were no comments from those in attendance.

- **Preparedness Area Approach**: The Preparedness Area approach to the State Mitigation Plan Up-date was described, as it was at the first Hazard Mitigation Team Meeting. The group was asked if there were any additional comments or concerns with this approach. There were no comments from those in attendance.
- **Goals Input**: The goals for the 2013 State Mitigation Plan Up-date including changes recommended by the MPT were presented. The group was asked if there were any additional comments or changes. There were no comments from those in attendance. The Goals draft is attached to these notes.
- **Agency List**: An up-dated list of participating agencies and organizations was presented. The group was asked if there were any comments, changes or if any additional entities should be included in the Hazard Mitigation Team. The Agency List is attached to these notes.
    - o *Suggestion*; Bill Borthwick, State Floodplain Coordinator with DHSEM, stated that the Earth Data Analysis Center should be listed under UNM in the educational institutions section.
    - o *Suggestion*; Elaine Pacheco, Dam Safety Bureau Chief with Office of State Engineer, requested that Dam Safety Bureau be added to list of participants from the Office of State Engineer.
    - o *Suggestion*; It was suggested that the National Park Service and the Bureau of Land Management be included in the State Mitigation Plan Up-date.
    - o *Response*; These suggestions will be incorporated on the next up-ate of the list.
    - **Critical facilities definition**: The definition for 'critical facilities' was described. The definition which will be used for the State Mitigation Plan up-date is up to the Hazard Mitigation Team to determine. The group does not have to use the FEMA definition but instead could craft a definition that is specific for the New Mexico Mitigation Plan. Dennis Pepe, Critical Infrastructure Coordinator with DHSEM, agreed to be the lead contact to coordinate a final draft definition for the Hazard Mitigation Team to consider at the next meeting.
    - o *Comment;* Dennis Pepe provided suggested wording for the critical facilities definition.
    - o *Question*; Cliff Sanchez, NRCS, asked what was meant by the term "special population"?
    - o *Answer*; Dennis Pepe provided described a special population based on the National Flood Insurance Program Community Rating System. People in hospitals, day care and child-care facilities are examples of special populations because they would require special care in the event of a disaster.

Planning Team and Subject Matter Expert Chart

The purpose of the Planning Team and Subject Matter Expert Chart was explained. The Chart shows all Planning Team Members and all Subject Matter Experts in alphabetical order. The Chart also identifies which topics are relevant for each Subject Matter Expert. The group was asked if there were any comments or changes. There were no comments from those in attendance. The Chart is attached to these notes.

Hazard Identification Text Discussion

- It was described that emails were sent out to the Subject Matter Experts prior to the meeting. The emails included attachments with text for the specific hazard(s) relevant for review. Suggested directions for providing feedback were also included in the email.
- It was described that for each hazard type the requirement is that locations, previous occurrences and probability of future hazard events must be discussed in the hazard profile text. Hard copy of the hazard profile for flooding was used in the meeting as an example for review.
- The color coding used in the hazard profile text was described as follows.
- o yellow highlight = need more information, if available
- o blue highlight = new information added since the 2010 up-date

- red highlight = do more research
- Subject Matter Experts were asked to conduct a review of the relevant hazard profiles to provide
  - additional descriptive data,
  - up-dated charts, graphs or web sites and
  - additional data on past occurrences.
- Suggested directions for providing feedback were presented so there would be a standardized approach. It was described that conceptual comments are okay, but that specific text edits would result in the most accurate final text. Suggested standardization is as follows;
- highlight changes in green,
- use strike-through for deletion,
- use underline for addition, and
- label the file name with the date and reviewer's initials.
- All feedback should be provided by September 30, 2012 to Brian Fields (bwfabq@gmail.com and 505-990-0401). The next draft of the text will be sent to the Subject Matter Experts by end of October for final review.
  - *Question*; Elaine Pacheco asked if utilizing track change mode in Word would be acceptable.
  - *Answer*; The preference is to not use track change mode as it makes a large committee process very cumbersome. However, since the goal is to get input, the Subject Matter Expert should respond with comments in a way that is easy for them.

Hazard Analysis/Prioritization Chart

- The group was asked to fill-out the Hazard Analysis and Prioritization Chart. Each individual was to review the 14 hazards identified in the 2010 State Hazard Mitigation Plan and rank them based on probability/frequency, magnitude/severity and risk. The Chart is attached to these notes.
- Instructions included an explanation of how to fill-in the chart rankings. Approximately 20 minutes was provided during the meeting for those present to fill-in the Chart. Ranking is as follows;
  - red = highest ranking = 3 points
  - yellow = medium ranking = 2 points
  - green = lowest ranking = 1 point
- *Question*; Arup Maji, UNM Civil Engineering, asked if ranking should be based on what could possibly happen or on past experience?

Answer; Ranking should be based on the possibility of future occurrence. The participant's past experience will likely help with assessing the potential for future occurrence.

- For those that were not at the meeting in person, September 30, 2012 was given as the deadline to return the Hazard Analysis/Prioritization Chart. Once all are received, the data will be compiled to determine if the analysis has changed since the 2010 State Mitigation Plan Up-date.

Risk Assessment

- A brief overview of the risk assessment section of the State Mitigation Plan Up-date was presented. The risk assessment text will be distributed by October 31, 2012 along with the corrected hazard profile text. Edits and comments will be due by November 15, 2012.
- Instructions for edits and comments will be the same format as that being used for the hazard profiles.

Follow-up tasks from this meeting

- DHSEM will provide meeting notes and attachments/hand-outs to all on the distribution list.
- DHSEM will contact additional agencies and organizations to invite them to participate in the State Mitigation Plan Up-date.
- By September 30th participants should submit;
    - corrections to the Goals draft, Agency List and Planning Team/Subject Matter Expert Chart
    - hazard identification text edits and comments
    - Hazard Analysis/Ranking chart

Attachments to these notes *(sent by email to all on the distribution list)*

- PowerPoint (9-10-12)
    - Goals Draft for 2013 State Mitigation Plan
    - Agency List
    - Planning Team and Subject Matter Expert Chart
    - Hazard Analysis/Prioritization Chart

Participants

Participants are shown on the sign-in sheets below. The following list shows the attendees via webinar/conference call.

- Dave Dubois, NMSU Climatologist
- Lorenzo Espinoza, DHSEM Preparedness Area 6 Coordinator
- John Longworth, Office of the State Engineer, Water Use Bureau Chief
- Shawn Penman, UNM Earth Data Analysis Center
- Ed Polasko, National Weather Service Albuquerque
- Garrett Ross, Bureau of Reclamation
- Cliff Sanchez, Natural Resources Conservation Service, Water Resources

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #2

1:30 to 3:30pm September 10, 2012, DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
ARUP MAJI	UNIV. NEW MEXICO	505 2771757	amaji@unm.edu
DENNIS PEPE	NMDHSEM	505-231-4649	dennis.pepe@ STATE.NM.US
JEFF MURRAY	U.S. DHS	505-554-0957	jeffrey.t.murray@dhs.gov
BRIAN WILLIAMS	NM DHSEM RECOVERY	476 9601	brian.williams@ state.nm.us
Bill BORTHWICK	NMDHSEM	(505) 4769610	william.BORTHWICK@ STATE.NM.US
ROGER TANNEN	NM Emergency Management Association	505-468-1303	RJTANNEN@BERNCO.gov

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #2

1:30 to 3:30pm September 10, 2012, DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
Evonne Gantz	DHSEM	476-9684	evonne.gantz@state.nm.US
Mike Waring	NMSP	476-9613	mike.waring@STATE.NM.US
Richard Clark	DHSEM	476-0630	Richarda-Clark@STATE.NM.US
CHARLES THOMPSON	OSE DAM SAFETY	827-6137	charles.thompson@state.nm.us
Elaine Pacheco	OSE Dam Safety	827-6111	elaine.pacheco@state.nm.us

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #2

1:30 to 3:30pm September 10, 2012, DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
Valli Wasr	DHSEM	660-8368 476-9689	Valli.Wasr@state.nm.us

New Mexico Natural Hazard Mitigation Plan Up-date
Planning Team Meeting #3
10:00am to noon, January 29, 2013
DHSEM Classroom, Santa Fe

Welcome

NM DHSEM State Mitigation Officer, Wendy Blackwell, provided quick overview of the meeting agenda.

Introductions

Everyone in attendance provided a brief introduction of the agency or organization that they represent. At the end of this document are copies of the sign-in sheets and a list of conference call participants. Wendy provided a briefing to the group based on a PowerPoint presentation (see attachment to these notes).

Follow-up from September 10, 2012 Meeting

The group was asked for any comments or changes to the minutes from the last meeting (held September 10, 2012). There were no comments from those in attendance.

Modification to the schedule includes the following;

- Finalize Risk Assessment and Vulnerability in April, after damage assessment and mapping completed.

- Next Planning Team Meeting in March on Asset Inventory and Capability review plus introduction to Mitigation actions. This may be pushed back to April based on the damage assessment and mapping submittal date.
- Planning team Meeting in May to prioritize Mitigation Actions.
- Draft submittals to FEMA in April (Hazard Identification and Risk Assessment), June (Vulnerability, Capability and Mitigation Actions) and July (full final draft).

Hazard Analysis/Ranking Comparison to current Mitigation Plan

Hazard Ranking shown on the PowerPoint slide (and distributed as a hand-out) was based on the Hazard Analysis/Prioritization forms submittals to date. The rankings may change based on additional submittals. The ranking was based on the average tally of all votes. Hazards listed in order of priority are; Thunderstorm, Wildland/Urban Interface Fires, Floods, High Wind, Drought, Winter Storm, Extreme Heat, Tornado, Land Subsidence, Expansive Soil, Landslide, Earthquake, Dam Failure and Volcanoes.

Local jurisdiction and tribal hazard rankings will be tallied and reported in the State Mitigation Plan. After seeing the results of the local and tribal rankings, the Planning Team will consider if it should be collapsed into the State-wide rankings or if a general discussion is more appropriate.

Inventory Assets

The inventory of assets will be compiled in February and March by DHSEM. This includes State-wide vulnerability data, loss estimation and mapping. It also includes review of local and tribal Natural Hazard Mitigation Plans for incorporation of relevant data.

Subject Matter Experts will work with DHSEM to finalize the description of ‘critical facilities’ for the purposes of this State Natural Hazard Mitigation Plan Up-date. The latest draft of the description was handed-out at the meeting. It is also attached to these notes.

- *Comment;* Gar Clarke, DoIT, suggested that there be standard guidelines for local mitigation plans so that the mapped information could be collapsed into a State-wide inventory.
- *Response;* Wendy explained that DHSEM uses only the federal requirements and it is current policy to not add additional State requirements for the local mitigation plans. However, this could be suggested in the State’s future guidance to local communities and tribes.

- *Comment;* Gar Clarke, DoIT, suggested putting all inventory of asset data into an Excel spreadsheet to include contact information. Crowd sourcing could be used to maintain accurate data.
- *Response;* Wendy explained that developing this format and crowd sourcing process could be included as a mitigation action.

- *Comment;* Seth Fiedler, NRCS Albuquerque, suggested that specific location data should be integrated.
- *Comment;* Cliff Sanchez, NRCS Albuquerque, suggested that the USDA State Soil Scientist may have relevant information.
- *Response;* Wendy will follow-up with Seth and Cliff, then contact the State Soil Scientist.

Capability

Planning Team and Subject Matter experts were asked to review the existing Capability text and identify additional mitigation capabilities such as projects, programs, technical assistance, funding and education/outreach

DHSEM will review local and tribal Natural Hazard Mitigation Plans for incorporation of relevant capability data.

- *Comment;* Brian Williams, DHSEM, explained that the Department of Finance has a catalog of assistance for local governments that provides a summary of funding opportunities.
- *Response;* Wendy will follow-up with Department of Finance to get the most recent version.

- *Comment;* Gar Clarke, DoIT, suggested putting all capability data into an Excel spreadsheet to include contact information. Crowd sourcing could be used to maintain accurate data.
- *Response;* Wendy explained that developing this format and crowd sourcing process could be included as a mitigation action.

Follow-up tasks from this meeting

- DHSEM will provide meeting notes and attachments/hand-outs to all on the distribution list.
- DHSEM will contact additional agencies and organizations to invite them to participate in the State Mitigation Plan Up-date.
- By February 28th participants should;
  - Review Capability Section of the current State Natural Hazard Mitigation Plan
  - Identify additional mitigation capabilities such as projects, programs, technical assistance, funding, education and outreach.

Attachments to these notes *(sent by email to all on the distribution list)*

- Sign-in Sheets
- PowerPoint (1-29-13)
- Revised Critical Facilities Description (1-29-13)
- Capability Section of the current State Natural Hazard Mitigation Plan

Participants

Participants are shown on the sign-in sheets attached. The following list shows the attendees via webinar/conference call.

- Rick Aster, New Mexico Tech Department of Earth and Environmental Science
- Grant Pinkerton, New Mexico Floodplain Managers Association
- Ed Polasko, National Weather Service Albuquerque
- Roger Tannen, New Mexico Emergency Management Association

New Mexico Natural Hazard Mitigation Plan Up-date

Planning Team Meeting #4

10am to noon June 19, 2013

DHSEM Classroom, Santa Fe

Welcome

NMDHSEM State Hazard Mitigation Officer, Wendy Blackwell, provided a quick overview of the meeting agenda.

Introductions

Everyone in attendance provided a brief introduction of the agency or organization that they represent. At the end of this document are copies of the sign-in sheets and a list of conference call participants. Wendy provided a briefing to the group based on a PowerPoint presentation (see attachments to these notes).

Follow-up from January 29, 2013 Meeting

Modifications to the schedule include the following:

- In June
    - Mitigation Action Ranking Tally from Planning Team Meeting #4
    - up-dates for the Plan text will be complete
- In July
    - final draft submittal to FEMA
    - final draft in Word format on FTP site for Planning Team review
    - final draft in pdf format on public web site for State-wide review
- In August DHSEM will integrate FEMA required revisions
- In September the final adoption and approval will occur

EDAC generated mapping

Under contract, Earth Data Analysis Center (EDAC) at the University of New Mexico compiled the following maps for each of the six Preparedness Areas. A State-wide map for each topic was also compiled. The mapping and analysis will be included in the Hazard Identification and Risk Assessment section of the Plan.

- Maximum probable earthquake by Preparedness Area
- Floodplain by Preparedness Area
- Fire Management Assistance Grant perimeters by Preparedness Area
- Critical Facilities by Preparedness Area
- Compilation map by Preparedness Area

Comment: Mike Gustin, New Mexico Game and Fish, asked if it was appropriate to include the impacts of an earthquake with an epicenter in Colorado that impacted area in New Mexico.
Response: The effects of the earthquake should be included in the plan if impacts were experienced in New Mexico. Wendy will follow-up with Mike to get more information.

EDAC generated HAZUS models (2000 census data)

Under contract, EDAC also provided damage estimation information using FEMA's HAZUS software. For earthquake the maximum probable magnitude earthquake was used for modeling and all results have been submitted to DHSEM for analysis. For flooding a Quick Look model was used. This data will be delivered in the next week.

Additional contractor assistance

There is a separate contract was just signed to provide the following assistance;

- Integration of local and tribal plans
- Integration of 2010 census data
- Document formatting and figure numbering

Mitigation Action Section

- Wendy explained that the current draft version of the Mitigation Action Section of the Plan (included as a hand-out) was prepared based on the text in the 2010 Plan plus up-dates provided by the Planning Team. She also explained the STAPLE+E process and how it correlates with the mitigation actions. The PowerPoint includes a detailed description of each of the STAPLE+E characteristics.
- There was consensus among all participating in the meeting that one summary ranking for each mitigation action would be supplied by each person assigning a ranking. So instead of one ranking for each of the six STAPLE+E characteristics, each participant would consider all six characteristics and determine one summary ranking for each action.
- There was consensus among all participants that any text edits would be made as we went through each action for ranking.

Mitigation Action Ranking

- The entire group took a few minutes to read the first action. No edits were suggested. All ranked the first action using;
  - 1 = low priority or poor mitigation action when considering STAPLE+E factors
  - 2 = medium priority or good mitigation action when considering STAPLE+E factors
  - 3= high priority or excellent mitigation action when considering STAPLE+E factors
- The group worked through each of the multi-hazard mitigation actions, asked questions or discussed the topic. Some participants filled-out the entire Ranking Form in the meeting. Others agreed to finish the Ranking Form and submit it by June 25th.

Comment: Kelly Hamilton, Department of Agriculture, wanted to be sure that there was some information included in the Plan that reflected the importance of safe and reliable food storage and transportation.
Response: Wendy will work with Kelly to be sure that the general concept is integrated into the Plan with more detail to be added in the next up-date.

Comment: Linda Weiss, Unites States Geological Survey, was concerned that since she is representing a federal agency, she didn't feel comfortable ranking the actions for a State-level Plan.
Response: Wendy asked for Linda to rank as many actions as is comfortable, possibly only ranking those that relate to the specific agency.
Note; Several federal agency representatives shared this concern and did not submit a Ranking Form. DHSEM will be sure to include a disclaimer about how the ranking (both for the hazards and the actions)

were done by individuals that presented their own opinion based on their knowledge and expertise. Their ranking did not represent the formal opinion of their agency or organization.

Comment: John Longworth, Office of the State Engineer, wasn't certain how to rank the action that related to DHSEM securing GIS expertise. He suggested that since other State agencies have their own or shared GIS services, DHSEM could coordinate with other agencies to get the information they need.
Response: Wendy explained that he should rank the action based on how his agency would view the action based on the STAPLE+E characteristics. She agreed that it made sense that the action would receive a low score from agencies that did not think DHSEM needed greater GIS resources for mitigation planning.

Comment: Chuck Thompson, Dam Safety Bureau Chief with the Office of the State Engineer, suggested adding the word "rehabilitate" to mitigation action #7. All on the call were informed of that change.
Response: This change will be included in the follow up notes.
Note; The up-dated Ranking Form attached to these notes includes the change to the wording.

Comment: John Longworth, suggested adding an action that addressed the need for public water supply and drought vulnerability assessments.
Response: Wendy will work with John to draft the action wording. All participants should add this as action #14a and rank it.
Note; The up-dated Ranking Form attached to these notes includes this additional action.

Group Discussion: Action #12 on improving watershed health is a cross-over between many different hazards. Right now it is listed under drought. It should be listed under multi-hazard because watershed health has an impact on wildfire and flood, in addition to drought. Wendy will work with John to be sure that the general concept is integrated into the Plan with more detail to be added in the next up-date.
Note; This change will be made to the Ranking Form once the tally has been completed.

Wrap-up

- The group agreed that there is no need for another in-person meeting unless there are feedback comments that require discussion. However, a follow-up conference call may be scheduled if the feedback warrants discussion and decision by the Planning Team.
- The group agreed that they prefer to wait to receive the final version of the entire Plan and not receive sections as ready.
    - Wendy outlined the following schedule;
    - June 25th Mitigation Action Ranking Forms due
    - July 15th final draft submittal to FEMA
    - July 15th final draft in Word format on FTP site for Planning Team and Subject Matter Expert review
    - July 15th final draft in pdf format on public web site for State-wide review
    - July 31st comments due from Planning Team and Subject Matter Experts
        - August 15th comments from the public due
        - First week of September, if needed, Planning Team and Subject Matter Expert coordination call on processing comments

Attachments to these notes *(sent by email to all on the distribution list)*

- Sign-in Sheets
- PowerPoint
- Ranking Sheet (*up-dated with comments from the June 19th meeting*)
- Mitigation Action draft dated 6-17-13 for reference in ranking actions (*Note; The text will be modified to reflect the Planning Team edits as described in these notes. In particular, the text will be modified to reflect the decision to rank each action with one overall number and not rank all six STAPLE+E characteristics individually*).

Participants

Participants are shown on the sign-in sheets attached. The following list shows the attendees via webinar/conference call.

People that have called in

- Dave Love, New Mexico Tech, Bureau of Geology
- Linda Weiss, USGS
- Kelly Hamilton, New Mexico Department of Agriculture
- Grant Pinkerton, New Mexico Floodplain Managers Association
- Garrett Ross, US Bureau of Reclamation
- Angela Shackle, Office of the State Engineer

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #3

10am to noon Tuesday, January 29th, 2013; DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
Seth Fiedler	USDA NRCS	505.761.4416	seth.fiedler@nm.usda.gov
Gar Clarke	NM DoIT	505.827-1663	george.clarke@state.nm.us
Clifford Sánchez	USDA NRCS	505-761-4404	clifford.sanchez@nm.usda.gov
Bill Borthwick	DHSEM	505 476 9617	william.borthwick@state.nm.us
Joe Garcia	NMDOT	490-2698	joe.s.garcia@state.nm.us
Brian Williams	NM DHSEM Recovery	476.9601	brian.williams@state.nm.us
Dennis Pepe	DHSEM	231-4649	dennis.pepe@state.nm.us
Rick Padilla	NMDOT	490-1168	rick.padilla@state.nm.us
Yvonne Crawford	NM DHSEM	4769630	yvonne.crawford@state.nm.us
Stephen Scissons	USACE	342.3328	stephen.k.scissons@usace.army.mil

SIGN-IN SHEET

New Mexico Natural Hazard Mitigation Plan Up-date, Planning Team Meeting #3

10am to noon Tuesday, January 29th, 2013; DHSEM Classroom, Santa Fe

Name	Agency/Organization	Phone	Email
Don Gallegos	USACE	342-3268	donald.j.gallegos@usace.army.mil
Evonne Gantz	NMDHSEM	476-9684	evonne.gantz@state.nm.us
CHARLES THOMPSON	OSE DAM SAFETY	827-6137	charles.thompson@state.nm.us
Fermin Aragon	CID/RID	505-476-4672	fermin.aragon@state.nm.us

Appendix E – HAZUS-MH Earthquake Assessment

Hazus-MH: Earthquake Event Report

Region Name: PA1-Carlsbad

Earthquake Scenario: Carlsbad A1

Print Date: June 05, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 9 county(ies) from the following state(s):

New Mexico

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 31,610.68 square miles and contains 62 census tracts. There are over 100 thousand households in the region which has a total population of 268,099 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 144 thousand buildings in the region with a total building replacement value (excluding contents) of 17,053 (millions of dollars). Approximately 94.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 24,423 and 1,366 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 144 thousand buildings in the region which have an aggregate total replacement value of 17,053 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 61% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 748 beds. There are 193 schools, 61 fire stations, 39 police stations and 16 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 48 dams identified within the region. Of these, 18 of the dams are classified as ‘high hazard’. The inventory also includes 58 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 25,789.00 (millions of dollars). This inventory includes over 4,030 kilometers of highways, 315 bridges, 166,549 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	315	327.70
	Segments	360	21,573.80
	Tunnels	0	0.00
		Subtotal	**21,901.50**
Railways	Bridges	5	0.60
	Facilities	0	0.00
	Segments	436	1,235.80
	Tunnels	0	0.00
		Subtotal	**1,236.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	8	8.40
		Subtotal	**8.40**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	13	138.50
	Runways	30	1,138.90
		Subtotal	**1,277.40**
		Total	**24,423.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1,665.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1,665.50**
Waste Water	Distribution Lines	NA	999.30
	Facilities	6	383.60
	Pipelines	0	0.00
		Subtotal	**1,382.90**
Natural Gas	Distribution Lines	NA	666.20
	Facilities	327	342.20
	Pipelines	0	0.00
		Subtotal	**1,008.40**
Oil Systems	Facilities	5	0.50
	Pipelines	0	0.00
		Subtotal	**0.50**
Electrical Power	Facilities	6	633.60
		Subtotal	**633.60**
Communication	Facilities	64	6.10
		Subtotal	**6.10**
		Total	**4,697.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Carlsbad A1
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-104.23
Latitude of Epicenter	32.42
Earthquake Magnitude	5.50
Depth (Km)	2.00
Rupture Length (Km)	3.31
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 3,269 buildings will be at least moderately damaged. This is over 2.00 % of the buildings in the region. There are an estimated 72 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	476	0.35	6	0.18	5	0.19	2	0.25	0	0.30
Commercial	4,714	3.50	109	2.96	110	4.42	46	6.42	6	8.20
Education	161	0.12	4	0.11	4	0.15	2	0.21	0	0.25
Government	211	0.16	4	0.10	4	0.15	1	0.20	0	0.23
Industrial	1,000	0.74	20	0.53	19	0.76	8	1.11	1	1.33
Other Residential	42,526	31.62	949	25.78	748	30.08	206	28.98	22	31.21
Religion	434	0.32	13	0.34	11	0.45	4	0.59	0	0.66
Single Family	84,982	63.18	2,578	70.01	1,587	63.81	442	62.24	42	57.82
Total	**134,504**		**3,683**		**2,488**		**710**		**72**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	82,919	61.65	2635	71.56	1,232	49.53	187	26.33	18	24.81
Concrete	3,160	2.35	65	1.76	67	2.68	23	3.27	3	3.48
Precast	1,674	1.24	28	0.76	43	1.73	26	3.61	3	4.35
RM	23,411	17.41	415	11.26	594	23.87	297	41.81	20	28.12
URM	2,966	2.21	83	2.26	81	3.26	37	5.22	13	18.33
MH	20,373	15.15	457	12.41	471	18.94	140	19.76	15	20.92
Total	**134,504**		**3,683**		**2,488**		**710**		**72**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 748 hospital beds available for use. On the day of the earthquake, the model estimates that only 693 hospital beds (93.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 96.00% of the beds will be back in service. By 30 days, 99.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	0	0	9
Schools	193	0	0	179
EOCs	16	0	0	14
PoliceStations	39	0	0	36
FireStations	61	0	0	59

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	360	0	0	360	360
	Bridges	315	0	0	315	315
	Tunnels	0	0	0	0	0
Railways	Segments	436	0	0	436	436
	Bridges	5	0	0	5	5
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	8	0	0	8	8
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	13	0	0	13	13
	Runways	30	0	0	30	30

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	6	0	0	5	6
Natural Gas	327	0	0	326	327
Oil Systems	5	0	0	5	5
Electrical Power	6	2	0	4	6
Communication	64	5	0	64	64

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	83,275	41	10
Waste Water	49,965	21	5
Natural Gas	33,310	7	2
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	100,024	0	0	0	0	0
Electric Power		3,426	1,848	616	99	5

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.08 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 32.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 3,040 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 90 households to be displaced due to the earthquake. Of these, 67 people (out of a total population of 268,099) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	10	2	0	0
	Single Family	30	5	0	1
	Total	**42**	**7**	**1**	**1**
2 PM	Commercial	17	4	0	1
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	7	1	0	0
	Total	**33**	**6**	**1**	**1**
5 PM	Commercial	13	3	0	1
	Commuting	0	1	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	4	1	0	0
	Single Family	12	2	0	0
	Total	**30**	**6**	**2**	**1**

Economic Loss

The total economic loss estimated for the earthquake is 228.56 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 161.00 (millions of dollars); 20 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 73 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	1.02	3.59	0.05	0.27	4.92
	Capital-Related	0.00	0.43	2.99	0.03	0.08	3.53
	Rental	2.93	1.57	2.17	0.01	0.14	6.83
	Relocation	11.04	1.68	3.33	0.12	1.15	17.32
	Subtotal	**13.97**	**4.70**	**12.08**	**0.21**	**1.64**	**32.60**
Capital Stock Losses							
	Structural	14.14	2.42	3.65	0.29	1.24	21.72
	Non_Structural	49.24	11.02	10.17	1.02	3.24	74.68
	Content	19.28	3.15	6.25	0.68	2.18	31.54
	Inventory	0.00	0.00	0.23	0.14	0.09	0.45
	Subtotal	**82.66**	**16.59**	**20.29**	**2.12**	**6.74**	**128.40**
	Total	**96.63**	**21.29**	**32.37**	**2.33**	**8.38**	**161.00**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	21,573.82	$0.00	0.00
	Bridges	327.66	$1.08	0.33
	Tunnels	0.00	$0.00	0.00
	Subtotal	**21901.50**	**1.10**	
Railways	Segments	1,235.80	$0.00	0.00
	Bridges	0.55	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**1236.40**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	8.37	$0.73	8.67
	Subtotal	**8.40**	**0.70**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	138.46	$1.92	1.39
	Runways	1,138.92	$0.00	0.00
	Subtotal	**1277.40**	**1.90**	
	Total	**24423.60**	**3.70**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1,665.50	$0.19	0.01
	Subtotal	**1,665.49**	**$0.19**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	383.60	$9.33	2.43
	Distribution Lines	999.30	$0.09	0.01
	Subtotal	**1,382.91**	**$9.42**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	342.20	$2.91	0.85
	Distribution Lines	666.20	$0.03	0.00
	Subtotal	**1,008.37**	**$2.94**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.00	0.02
	Subtotal	**0.48**	**$0.00**	
Electrical Power	Facilities	633.60	$51.18	8.08
	Subtotal	**633.60**	**$51.18**	
Communication	Facilities	6.10	$0.10	1.65
	Subtotal	**6.14**	**$0.10**	
	Total	**4,696.99**	**$63.83**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Chaves,NM

Curry,NM

De Baca,NM

Eddy,NM

Guadalupe,NM

Lea,NM

Lincoln,NM

Quay,NM

Roosevelt,NM

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Mexico					
	Chaves	61,382	2,853	919	3,772
	Curry	45,044	2,025	592	2,617
	De Baca	2,240	123	34	157
	Eddy	51,658	2,478	675	3,153
	Guadalupe	4,680	206	59	266
	Lea	55,511	2,409	828	3,237
	Lincoln	19,411	1,800	323	2,123
	Quay	10,155	502	160	663
	Roosevelt	18,018	817	242	1,060
Total State		**268,099**	**13,213**	**3,832**	**17,048**
Total Region		**268,099**	**13,213**	**3,832**	**17,048**

Hazus-MH: Earthquake Event Report

Region Name: PA2-Las Vegas

Earthquake Scenario: LasVegas-PA2

Print Date: June 05, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 5 county(ies) from the following state(s):

New Mexico

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16,386.79 square miles and contains 13 census tracts. There are over 21 thousand households in the region which has a total population of 54,479 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 35 thousand buildings in the region with a total building replacement value (excluding contents) of 3,530 (millions of dollars). Approximately 96.00 % of the buildings (and 83.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 11,708 and 502 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 35 thousand buildings in the region which have an aggregate total replacement value of 3,530 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 58% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 4 hospitals in the region with a total bed capacity of 563 beds. There are 64 schools, 35 fire stations, 14 police stations and 8 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 75 dams identified within the region. Of these, 16 of the dams are classified as 'high hazard'. The inventory also includes 3 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 12,210.00 (millions of dollars). This inventory includes over 1,906 kilometers of highways, 304 bridges, 75,576 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	304	246.20
	Segments	172	10,732.40
	Tunnels	0	0.00
		Subtotal	**10,978.60**
Railways	Bridges	4	0.30
	Facilities	2	5.30
	Segments	167	414.60
	Tunnels	0	0.00
		Subtotal	**420.20**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.00
		Subtotal	**1.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	4	42.60
	Runways	7	265.70
		Subtotal	**308.40**
		Total	**11,708.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	755.80
	Facilities	1	32.00
	Pipelines	0	0.00
		Subtotal	**787.70**
Waste Water	Distribution Lines	NA	453.50
	Facilities	4	255.70
	Pipelines	0	0.00
		Subtotal	**709.20**
Natural Gas	Distribution Lines	NA	302.30
	Facilities	2	2.10
	Pipelines	0	0.00
		Subtotal	**304.40**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	2	211.20
		Subtotal	**211.20**
Communication	Facilities	12	1.20
		Subtotal	**1.20**
		Total	**2,013.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	LasVegas-PA2
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.23
Latitude of Epicenter	35.59
Earthquake Magnitude	5.50
Depth (Km)	2.00
Rupture Length (Km)	3.31
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 2,235 buildings will be at least moderately damaged. This is over 6.00 % of the buildings in the region. There are an estimated 56 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	55	0.18	2	0.09	1	0.09	1	0.11	0	0.12
Commercial	640	2.13	66	3.08	67	4.05	27	5.29	4	6.28
Education	35	0.12	2	0.09	2	0.11	1	0.14	0	0.15
Government	70	0.23	4	0.18	4	0.23	1	0.28	0	0.28
Industrial	141	0.47	8	0.40	8	0.48	3	0.62	0	0.69
Other Residential	11,794	39.25	802	37.69	802	48.31	267	51.42	32	55.99
Religion	64	0.21	5	0.22	4	0.26	2	0.31	0	0.31
Single Family	17,251	57.41	1,239	58.26	771	46.47	217	41.84	21	36.18
Total	**30,048**		**2,127**		**1,660**		**519**		**57**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	17,938	59.70	1321	62.09	626	37.74	96	18.41	9	16.07
Concrete	686	2.28	38	1.80	41	2.50	14	2.78	2	2.72
Precast	244	0.81	13	0.62	22	1.32	13	2.56	2	2.87
RM	4,741	15.78	205	9.64	297	17.87	150	28.92	10	18.14
URM	596	1.98	42	1.97	42	2.51	19	3.72	7	12.20
MH	5,844	19.45	508	23.87	632	38.07	226	43.61	27	48.00
Total	**30,048**		**2,127**		**1,660**		**519**		**57**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 563 hospital beds available for use. On the day of the earthquake, the model estimates that only 350 hospital beds (62.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 79.00% of the beds will be back in service. By 30 days, 96.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	4	0	0	2
Schools	64	0	0	47
EOCs	8	0	0	7
PoliceStations	14	0	0	12
FireStations	35	0	0	34

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	172	0	0	172	172
	Bridges	304	4	0	304	304
	Tunnels	0	0	0	0	0
Railways	Segments	167	0	0	167	167
	Bridges	4	0	0	4	4
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	4	4
	Runways	7	0	0	7	7

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	1	0	0	1	1
Waste Water	4	1	0	3	4
Natural Gas	2	0	0	2	2
Oil Systems	0	0	0	0	0
Electrical Power	2	1	0	1	2
Communication	12	4	0	12	12

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	37,788	20	5
Waste Water	22,673	10	3
Natural Gas	15,115	4	1
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	21,076	0	0	0	0	0
Electric Power		2,145	1,157	386	62	3

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.05 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 35.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 1,800 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 63 households to be displaced due to the earthquake. Of these, 60 people (out of a total population of 54,479) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	15	2	0	0
	Single Family	15	3	0	0
	Total	**31**	**5**	**0**	**1**
2 PM	Commercial	8	2	0	0
	Commuting	0	0	0	0
	Educational	4	1	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	3	0	0	0
	Single Family	3	1	0	0
	Total	**19**	**4**	**0**	**1**
5 PM	Commercial	7	1	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	5	1	0	0
	Single Family	6	1	0	0
	Total	**19**	**4**	**1**	**1**

Economic Loss

The total economic loss estimated for the earthquake is 136.86 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 89.34 (millions of dollars); 22 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 73 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.48	2.25	0.02	0.24	2.98
	Capital-Related	0.00	0.21	1.83	0.01	0.03	2.07
	Rental	1.38	1.50	1.30	0.00	0.11	4.28
	Relocation	5.18	2.21	2.02	0.03	0.59	10.04
	Subtotal	**6.56**	**4.39**	**7.39**	**0.06**	**0.97**	**19.36**
Capital Stock Losses							
	Structural	6.13	3.07	2.11	0.08	0.45	11.84
	Non_Structural	21.31	12.22	6.01	0.31	1.50	41.35
	Content	8.35	3.31	3.78	0.18	0.97	16.58
	Inventory	0.00	0.00	0.15	0.04	0.00	0.19
	Subtotal	**35.79**	**18.60**	**12.05**	**0.61**	**2.92**	**69.97**
	Total	**42.35**	**22.99**	**19.44**	**0.67**	**3.88**	**89.34**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	10,732.39	$0.00	0.00
	Bridges	246.21	$1.99	0.81
	Tunnels	0.00	$0.00	0.00
	Subtotal	**10978.60**	**2.00**	
Railways	Segments	414.59	$0.00	0.00
	Bridges	0.28	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	5.33	$0.91	17.11
	Subtotal	**420.20**	**0.90**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1.05	$0.36	34.22
	Subtotal	**1.00**	**0.40**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	42.60	$1.50	3.52
	Runways	265.75	$0.00	0.00
	Subtotal	**308.40**	**1.50**	
	Total	**11708.20**	**4.80**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	32.00	$0.00	0.00
	Distribution Lines	755.80	$0.09	0.01
	Subtotal	**787.74**	**$0.09**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	255.70	$16.92	6.62
	Distribution Lines	453.50	$0.05	0.01
	Subtotal	**709.21**	**$16.97**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	2.10	$0.00	0.00
	Distribution Lines	302.30	$0.02	0.01
	Subtotal	**304.40**	**$0.02**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	211.20	$25.59	12.12
	Subtotal	**211.20**	**$25.59**	
Communication	Facilities	1.20	$0.10	8.52
	Subtotal	**1.15**	**$0.10**	
	Total	**2,013.70**	**$42.76**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Colfax,NM

Harding,NM

Mora,NM

San Miguel,NM

Union,NM

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Mexico					
	Colfax	14,189	1,039	233	1,273
	Harding	810	46	10	57
	Mora	5,180	243	31	274
	San Miguel	30,126	1,376	272	1,649
	Union	4,174	213	61	275
Total State		**54,479**	**2,917**	**607**	**3,528**
Total Region		**54,479**	**2,917**	**607**	**3,528**

Hazus-MH: Earthquake Event Report

Region Name: PA3-LosAlamos

Earthquake Scenario: 7.5 Los Alamos

Print Date: June 05, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 4 county(ies) from the following state(s):

New Mexico

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 10,115.92 square miles and contains 61 census tracts. There are over 87 thousand households in the region which has a total population of 218,804 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 107 thousand buildings in the region with a total building replacement value (excluding contents) of 16,643 (millions of dollars). Approximately 94.00 % of the buildings (and 81.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 9,571 and 845 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 107 thousand buildings in the region which have an aggregate total replacement value of 16,643 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 58% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 4 hospitals in the region with a total bed capacity of 327 beds. There are 151 schools, 38 fire stations, 21 police stations and 22 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 60 dams identified within the region. Of these, 35 of the dams are classified as 'high hazard'. The inventory also includes 3 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 10,416.00 (millions of dollars). This inventory includes over 1,713 kilometers of highways, 247 bridges, 62,436 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	247	213.40
	Segments	214	8,884.90
	Tunnels	0	0.00
		Subtotal	**9,098.30**
Railways	Bridges	0	0.00
	Facilities	2	5.30
	Segments	69	143.10
	Tunnels	0	0.00
		Subtotal	**148.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	6	6.30
		Subtotal	**6.30**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	5	53.30
	Runways	7	265.70
		Subtotal	**319.00**
		Total	**9,572.00**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	624.40
	Facilities	7	223.80
	Pipelines	0	0.00
		Subtotal	**848.10**
Waste Water	Distribution Lines	NA	374.60
	Facilities	7	447.60
	Pipelines	0	0.00
		Subtotal	**822.20**
Natural Gas	Distribution Lines	NA	249.70
	Facilities	64	67.00
	Pipelines	0	0.00
		Subtotal	**316.70**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	105.60
		Subtotal	**105.60**
Communication	Facilities	16	1.50
		Subtotal	**1.50**
		Total	**2,094.20**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	7.5 Los Alamos
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.31
Latitude of Epicenter	35.89
Earthquake Magnitude	7.50
Depth (Km)	2.00
Rupture Length (Km)	100.00
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 19,999 buildings will be at least moderately damaged. This is over 19.00 % of the buildings in the region. There are an estimated 2,598 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	127	0.18	24	0.17	18	0.15	8	0.14	4	0.15
Commercial	2,283	3.23	556	3.85	497	4.24	236	4.18	152	5.87
Education	124	0.18	24	0.17	22	0.18	10	0.18	5	0.19
Government	132	0.19	32	0.22	30	0.25	13	0.24	7	0.27
Industrial	561	0.79	141	0.98	133	1.13	65	1.14	35	1.34
Other Residential	17,377	24.56	4,880	33.82	5,409	46.06	2,795	49.42	1,079	41.51
Religion	181	0.26	37	0.26	34	0.29	18	0.32	15	0.57
Single Family	49,962	70.62	8,733	60.53	5,602	47.70	2,510	44.37	1,302	50.10
Total	**70,748**		**14,428**		**11,745**		**5,656**		**2,599**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	46,438	65.64	8484	58.80	4,208	35.83	1,396	24.69	523	20.12
Concrete	1,183	1.67	314	2.18	311	2.65	141	2.49	87	3.37
Precast	681	0.96	142	0.98	197	1.68	120	2.13	66	2.55
RM	12,401	17.53	1657	11.48	2,086	17.76	1,340	23.69	847	32.60
URM	1,416	2.00	335	2.32	253	2.16	122	2.16	117	4.49
MH	8,630	12.20	3497	24.23	4,689	39.92	2,536	44.84	958	36.88
Total	**70,748**		**14,428**		**11,745**		**5,656**		**2,599**	

*Note:
- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 327 hospital beds available for use. On the day of the earthquake, the model estimates that only 112 hospital beds (34.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 54.00% of the beds will be back in service. By 30 days, 75.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	4	1	1	1
Schools	151	9	0	138
EOCs	22	4	0	18
PoliceStations	21	2	0	19
FireStations	38	6	0	29

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	214	0	0	214	214
	Bridges	247	8	0	239	245
	Tunnels	0	0	0	0	0
Railways	Segments	69	0	0	69	69
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	6	1	0	6	6
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	5	1	0	5	5
	Runways	7	0	0	7	7

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	7	1	0	3	7
Waste Water	7	0	0	5	7
Natural Gas	64	0	0	64	64
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	16	2	0	15	16

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	31,218	1604	401
Waste Water	18,731	806	201
Natural Gas	12,487	276	69
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	87,698	3,362	60	4	0	0
Electric Power		5,691	3,692	1,622	337	7

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.71 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 36.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 28,440 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 2,284 households to be displaced due to the earthquake. Of these, 1,233 people (out of a total population of 218,804) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	5	2	0	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	9	3	0	1
	Industrial	3	1	0	0
	Other-Residential	229	48	4	7
	Single Family	409	110	16	32
	Total	**656**	**163**	**21**	**40**
2 PM	Commercial	325	99	17	34
	Commuting	0	0	0	0
	Educational	76	23	4	8
	Hotels	2	0	0	0
	Industrial	22	7	1	2
	Other-Residential	40	8	1	1
	Single Family	66	17	3	5
	Total	**530**	**155**	**26**	**50**
5 PM	Commercial	262	79	14	26
	Commuting	7	10	16	3
	Educational	9	3	0	1
	Hotels	3	1	0	0
	Industrial	14	4	1	1
	Other-Residential	83	17	1	2
	Single Family	160	43	6	12
	Total	**538**	**157**	**39**	**47**

Economic Loss

The total economic loss estimated for the earthquake is 1,605.69 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 1,518.08 (millions of dollars); 19 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 75 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	6.91	31.94	0.68	3.44	42.96
	Capital-Related	0.00	2.96	28.24	0.40	0.72	32.31
	Rental	25.19	16.42	16.63	0.23	1.92	60.40
	Relocation	89.11	24.65	25.62	1.32	12.26	152.95
	Subtotal	**114.30**	**50.94**	**102.42**	**2.62**	**18.34**	**288.62**
Capital Stock Losses							
	Structural	169.55	33.22	31.67	4.13	9.55	248.13
	Non_Structural	516.80	118.76	94.20	13.70	29.09	772.54
	Content	119.78	21.90	42.54	8.37	13.45	206.04
	Inventory	0.00	0.00	1.00	1.67	0.08	2.75
	Subtotal	**806.13**	**173.88**	**169.41**	**27.86**	**52.17**	**1,229.46**
	Total	**920.43**	**224.82**	**271.83**	**30.49**	**70.51**	**1,518.08**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	8,884.92	$0.00	0.00
	Bridges	213.38	$8.22	3.85
	Tunnels	0.00	$0.00	0.00
	Subtotal	**9098.30**	**8.20**	
Railways	Segments	143.08	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	5.33	$0.62	11.68
	Subtotal	**148.40**	**0.60**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	6.28	$1.06	16.95
	Subtotal	**6.30**	**1.10**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	53.26	$7.95	14.93
	Runways	265.75	$0.00	0.00
	Subtotal	**319.00**	**8.00**	
	Total	**9572.00**	**17.90**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	223.80	$29.20	13.05
	Distribution Lines	624.40	$7.22	1.16
	Subtotal	**848.14**	**$36.42**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	447.60	$18.41	4.11
	Distribution Lines	374.60	$3.63	0.97
	Subtotal	**822.17**	**$22.03**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	67.00	$0.36	0.54
	Distribution Lines	249.70	$1.24	0.50
	Subtotal	**316.71**	**$1.61**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	105.60	$9.56	9.05
	Subtotal	**105.60**	**$9.56**	
Communication	Facilities	1.50	$0.13	8.37
	Subtotal	**1.54**	**$0.13**	
	Total	**2,094.16**	**$69.75**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Los Alamos,NM

Rio Arriba,NM

Santa Fe,NM

Taos,NM

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Mexico					
	Los Alamos	18,343	1,661	256	1,918
	Rio Arriba	41,190	1,683	308	1,991
	Santa Fe	129,292	8,296	2,240	10,537
	Taos	29,979	1,780	415	2,196
Total State		**218,804**	**13,420**	**3,219**	**16,642**
Total Region		**218,804**	**13,420**	**3,219**	**16,642**

Hazus-MH: Earthquake Event Report

Region Name: PA4-Farmington

Earthquake Scenario: Contour PA4

Print Date: June 05, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 3 county(ies) from the following state(s):

New Mexico

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 15,529.87 square miles and contains 52 census tracts. There are over 67 thousand households in the region which has a total population of 214,194 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 88 thousand buildings in the region with a total building replacement value (excluding contents) of 9,943 (millions of dollars). Approximately 95.00 % of the buildings (and 77.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 11,292 and 1,477 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 88 thousand buildings in the region which have an aggregate total replacement value of 9,943 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 53% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 9 hospitals in the region with a total bed capacity of 581 beds. There are 159 schools, 22 fire stations, 22 police stations and 10 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 56 dams identified within the region. Of these, 21 of the dams are classified as ‘high hazard’. The inventory also includes 99 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 12,769.00 (millions of dollars). This inventory includes over 1,739 kilometers of highways, 319 bridges, 96,718 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	319	313.70
	Segments	210	10,238.80
	Tunnels	0	0.00
		Subtotal	**10,552.50**
Railways	Bridges	2	0.50
	Facilities	1	2.70
	Segments	163	377.80
	Tunnels	0	0.00
		Subtotal	**381.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	2	2.10
		Subtotal	**2.10**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	5	53.30
	Runways	8	303.70
		Subtotal	**357.00**
		Total	**11,292.50**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	967.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**967.20**
Waste Water	Distribution Lines	NA	580.30
	Facilities	10	639.40
	Pipelines	0	0.00
		Subtotal	**1,219.70**
Natural Gas	Distribution Lines	NA	386.90
	Facilities	192	200.90
	Pipelines	0	0.00
		Subtotal	**587.80**
Oil Systems	Facilities	5	0.50
	Pipelines	0	0.00
		Subtotal	**0.50**
Electrical Power	Facilities	6	633.60
		Subtotal	**633.60**
Communication	Facilities	34	3.30
		Subtotal	**3.30**
		Total	**3,412.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Contour PA4
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-108.22
Latitude of Epicenter	36.72
Earthquake Magnitude	5.50
Depth (Km)	2.00
Rupture Length (Km)	3.31
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 3,567 buildings will be at least moderately damaged. This is over 4.00 % of the buildings in the region. There are an estimated 61 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	75	0.10	7	0.15	4	0.16	1	0.20	0	0.22
Commercial	1,987	2.52	210	4.53	181	6.40	66	9.87	7	12.04
Education	99	0.12	6	0.13	5	0.18	2	0.27	0	0.30
Government	111	0.14	5	0.10	4	0.14	1	0.19	0	0.22
Industrial	456	0.58	48	1.02	41	1.44	15	2.29	2	2.49
Other Residential	30,496	38.69	1,921	41.37	1,307	46.10	268	39.93	25	41.56
Religion	176	0.22	15	0.33	12	0.43	4	0.62	0	0.71
Single Family	45,421	57.63	2,432	52.37	1,280	45.15	313	46.63	26	42.47
Total	**78,820**		**4,643**		**2,835**		**672**		**61**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	42,102	53.42	2569	55.34	1,020	35.98	136	20.31	12	19.98
Concrete	1,347	1.71	97	2.09	85	3.01	25	3.77	2	3.97
Precast	677	0.86	57	1.22	75	2.66	39	5.81	4	6.35
RM	12,127	15.39	447	9.63	535	18.89	227	33.85	13	20.85
URM	1,425	1.81	103	2.21	84	2.98	33	4.96	10	17.07
MH	21,143	26.82	1370	29.51	1,034	36.49	210	31.28	19	31.78
Total	**78,820**		**4,643**		**2,835**		**672**		**61**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 581 hospital beds available for use. On the day of the earthquake, the model estimates that only 479 hospital beds (82.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 90.00% of the beds will be back in service. By 30 days, 98.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	9	0	0	7
Schools	159	0	0	147
EOCs	10	0	0	10
PoliceStations	22	0	0	21
FireStations	22	0	0	21

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	210	0	0	210	210
	Bridges	319	0	0	319	319
	Tunnels	0	0	0	0	0
Railways	Segments	163	0	0	163	163
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	2	0	0	2	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	5	0	0	5	5
	Runways	8	0	0	8	8

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	10	1	0	8	10
Natural Gas	192	0	0	192	192
Oil Systems	5	0	0	5	5
Electrical Power	6	1	0	5	6
Communication	34	9	0	34	34

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	48,359	28	7
Waste Water	29,015	14	4
Natural Gas	19,344	5	1
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	67,514	0	0	0	0	0
Electric Power		1,622	875	292	47	3

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.09 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 33.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 3,440 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 113 households to be displaced due to the earthquake. Of these, 82 people (out of a total population of 214,194) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	0	0	0	0
	Other-Residential	19	2	0	0
	Single Family	26	4	0	1
	Total	**46**	**7**	**0**	**1**
2 PM	Commercial	27	5	1	1
	Commuting	0	0	0	0
	Educational	5	1	0	0
	Hotels	0	0	0	0
	Industrial	3	0	0	0
	Other-Residential	4	0	0	0
	Single Family	5	1	0	0
	Total	**43**	**8**	**1**	**2**
5 PM	Commercial	19	4	0	1
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	7	1	0	0
	Single Family	10	1	0	0
	Total	**38**	**7**	**1**	**1**

Economic Loss

The total economic loss estimated for the earthquake is 261.68 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 201.75 (millions of dollars); 23 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 56 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.90	7.88	0.16	0.46	9.40
	Capital-Related	0.00	0.39	5.64	0.17	0.11	6.30
	Rental	2.33	2.17	3.99	0.10	0.17	8.75
	Relocation	8.78	2.92	7.05	0.60	1.63	20.98
	Subtotal	**11.10**	**6.39**	**24.56**	**1.02**	**2.37**	**45.43**
Capital Stock Losses							
	Structural	12.22	3.61	7.17	1.49	1.36	25.85
	Non_Structural	42.45	15.84	20.65	5.20	4.41	88.54
	Content	16.36	4.30	13.45	3.94	2.84	40.88
	Inventory	0.00	0.00	0.44	0.59	0.02	1.05
	Subtotal	**71.03**	**23.74**	**41.71**	**11.21**	**8.62**	**156.32**
	Total	**82.13**	**30.13**	**66.27**	**12.23**	**10.99**	**201.75**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	10,238.79	$0.00	0.00
	Bridges	313.67	$0.38	0.12
	Tunnels	0.00	$0.00	0.00
	Subtotal	**10552.50**	**0.40**	
Railways	Segments	377.79	$0.00	0.00
	Bridges	0.55	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	2.66	$0.00	0.00
	Subtotal	**381.00**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	2.09	$0.36	17.11
	Subtotal	**2.10**	**0.40**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	53.26	$3.65	6.85
	Runways	303.71	$0.00	0.00
	Subtotal	**357.00**	**3.60**	
	Total	**11292.50**	**4.40**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	967.20	$0.13	0.01
	Subtotal	**967.18**	**$0.13**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	639.40	$29.80	4.66
	Distribution Lines	580.30	$0.06	0.01
	Subtotal	**1,219.67**	**$29.86**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	200.90	$1.09	0.54
	Distribution Lines	386.90	$0.02	0.01
	Subtotal	**587.78**	**$1.12**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.50	$0.00	0.83
	Subtotal	**0.48**	**$0.00**	
Electrical Power	Facilities	633.60	$24.23	3.82
	Subtotal	**633.60**	**$24.23**	
Communication	Facilities	3.30	$0.21	6.42
	Subtotal	**3.26**	**$0.21**	
	Total	**3,411.98**	**$55.55**	

Table 14. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Cibola,NM

McKinley,NM

San Juan,NM

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Mexico					
	Cibola	25,595	981	222	1,204
	McKinley	74,798	2,398	565	2,963
	San Juan	113,801	4,287	1,488	5,775
Total State		**214,194**	**7,666**	**2,275**	**9,942**
Total Region		**214,194**	**7,666**	**2,275**	**9,942**

Hazus-MH: Earthquake Event Report

Region Name: PA5-Albuquerque

Earthquake Scenario: Albuquerque-PA5

Print Date: March 28, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 5 county(ies) from the following state(s):

New Mexico

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 15,943.87 square miles and contains 202 census tracts. There are over 287 thousand households in the region which has a total population of 747,727 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 295 thousand buildings in the region with a total building replacement value (excluding contents) of 52,733 (millions of dollars). Approximately 93.00 % of the buildings (and 80.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 17,360 and 738 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 295 thousand buildings in the region which have an aggregate total replacement value of 52,733 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 63% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 19 hospitals in the region with a total bed capacity of 1,985 beds. There are 348 schools, 41 fire stations, 45 police stations and 27 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 55 dams identified within the region. Of these, 30 of the dams are classified as 'high hazard'. The inventory also includes 51 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 18,098.00 (millions of dollars). This inventory includes over 2,508 kilometers of highways, 561 bridges, 79,062 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	561	835.50
	Segments	682	15,484.30
	Tunnels	2	0.30
		Subtotal	**16,320.10**
Railways	Bridges	3	0.20
	Facilities	5	13.30
	Segments	211	631.90
	Tunnels	0	0.00
		Subtotal	**645.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	10	10.50
		Subtotal	**10.50**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	4	42.60
	Runways	9	341.70
		Subtotal	**384.30**
		Total	**17,360.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	790.60
	Facilities	2	63.90
	Pipelines	0	0.00
		Subtotal	**854.60**
Waste Water	Distribution Lines	NA	474.40
	Facilities	7	447.60
	Pipelines	0	0.00
		Subtotal	**921.90**
Natural Gas	Distribution Lines	NA	316.30
	Facilities	10	10.50
	Pipelines	0	0.00
		Subtotal	**326.70**
Oil Systems	Facilities	1	0.10
	Pipelines	0	0.00
		Subtotal	**0.10**
Electrical Power	Facilities	2	211.20
		Subtotal	**211.20**
Communication	Facilities	58	5.60
		Subtotal	**5.60**
		Total	**2,320.10**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Albuquerque-PA5
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.62
Latitude of Epicenter	35.12
Earthquake Magnitude	7.50
Depth (Km)	2.00
Rupture Length (Km)	100.00
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Total										

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Total										

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 1,985 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	19	0	0	0
Schools	348	0	0	0
EOCs	27	0	0	0
PoliceStations	45	0	0	0
FireStations	41	0	0	0

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	682	0	0	0	0
	Bridges	561	0	0	0	0
	Tunnels	2	0	0	0	0
Railways	Segments	211	0	0	0	0
	Bridges	3	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	5	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	10	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	0	0
	Runways	9	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	2	0	0	0	0
Waste Water	7	0	0	0	0
Natural Gas	10	0	0	0	0
Oil Systems	1	0	0	0	0
Electrical Power	2	0	0	0	0
Communication	58	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	39,531	0	0
Waste Water	23,719	0	0
Natural Gas	15,813	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	287,727	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 747,727) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
	Total				

Economic Loss

The total economic loss estimated for the earthquake is 0.00 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.00
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Capital Stock Losses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Non_Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	15,484.33	$0.00	0.00
	Bridges	835.49	$0.00	0.00
	Tunnels	0.27	$0.00	0.00
	Subtotal	**16320.10**	**0.00**	
Railways	Segments	631.91	$0.00	0.00
	Bridges	0.20	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	13.32	$0.00	0.00
	Subtotal	**645.40**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	10.46	$0.00	0.00
	Subtotal	**10.50**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	42.60	$0.00	0.00
	Runways	341.68	$0.00	0.00
	Subtotal	**384.30**	**0.00**	
	Total	**17360.30**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	63.90	$0.00	0.00
	Distribution Lines	790.60	$0.00	0.00
	Subtotal	**854.56**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	447.60	$0.00	0.00
	Distribution Lines	474.40	$0.00	0.00
	Subtotal	**921.93**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	10.50	$0.00	0.00
	Distribution Lines	316.30	$0.00	0.00
	Subtotal	**326.71**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.10	$0.00	0.00
	Subtotal	**0.10**	**$0.00**	
Electrical Power	Facilities	211.20	$0.00	0.00
	Subtotal	**211.20**	**$0.00**	
Communication	Facilities	5.60	$0.00	0.00
	Subtotal	**5.57**	**$0.00**	
	Total	**2,320.07**	**$0.00**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Bernalillo,NM

Sandoval,NM

Socorro,NM

Torrance,NM

Valencia,NM

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Mexico					
	Bernalillo	556,678	33,246	9,081	42,328
	Sandoval	89,908	5,127	762	5,889
	Socorro	18,078	683	168	851
	Torrance	16,911	540	140	680
	Valencia	66,152	2,495	487	2,983
Total State		**747,727**	**42,091**	**10,638**	**52,731**
Total Region		**747,727**	**42,091**	**10,638**	**52,731**

Hazus-MH: Earthquake Event Report

Region Name: PA6-LasCruces

Earthquake Scenario: LasCruces-PA6

Print Date: June 05, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 7 county(ies) from the following state(s):

New Mexico

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 31,995.13 square miles and contains 66 census tracts. There are over 113 thousand households in the region which has a total population of 315,743 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 147 thousand buildings in the region with a total building replacement value (excluding contents) of 15,959 (millions of dollars). Approximately 95.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 20,882 and 1,088 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 147 thousand buildings in the region which have an aggregate total replacement value of 15,959 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 52% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 8 hospitals in the region with a total bed capacity of 720 beds. There are 162 schools, 65 fire stations, 25 police stations and 13 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 107 dams identified within the region. Of these, 37 of the dams are classified as 'high hazard'. The inventory also includes 103 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 21,970.00 (millions of dollars). This inventory includes over 3,220 kilometers of highways, 343 bridges, 113,410 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	343	325.40
	Segments	368	18,745.00
	Tunnels	1	1.80
		Subtotal	**19,072.20**
Railways	Bridges	6	1.10
	Facilities	2	5.30
	Segments	273	944.40
	Tunnels	0	0.00
		Subtotal	**950.80**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	4	4.20
		Subtotal	**4.20**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	9	95.90
	Runways	20	759.30
		Subtotal	**855.10**
		Total	**20,882.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	1,134.10
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1,134.10**
Waste Water	Distribution Lines	NA	680.50
	Facilities	7	447.60
	Pipelines	0	0.00
		Subtotal	**1,128.00**
Natural Gas	Distribution Lines	NA	453.60
	Facilities	4	4.20
	Pipelines	0	0.00
		Subtotal	**457.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	6	633.60
		Subtotal	**633.60**
Communication	Facilities	36	3.50
		Subtotal	**3.50**
		Total	**3,357.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	LasCruces-PA6
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.79
Latitude of Epicenter	32.32
Earthquake Magnitude	7.50
Depth (Km)	2.00
Rupture Length (Km)	100.00
Rupture Orientation (degrees)	0.00
Attenuation Function	West US, Extensional 2008 - Strike Slip

Building Damage

Building Damage

Hazus estimates that about 44,092 buildings will be at least moderately damaged. This is over 30.00 % of the buildings in the region. There are an estimated 12,479 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	203	0.23	30	0.22	37	0.21	28	0.20	27	0.22
Commercial	2,252	2.57	261	1.94	484	2.74	545	3.91	765	6.13
Education	95	0.11	12	0.09	18	0.10	18	0.13	23	0.18
Government	146	0.17	14	0.10	19	0.11	17	0.12	22	0.18
Industrial	497	0.57	66	0.49	119	0.67	126	0.90	166	1.33
Other Residential	36,588	41.77	5,392	40.20	7,208	40.76	6,450	46.30	6,486	51.98
Religion	226	0.26	24	0.18	35	0.20	35	0.25	46	0.37
Single Family	47,589	54.33	7,614	56.77	9,764	55.21	6,711	48.18	4,944	39.62
Total	**87,595**		**13,412**		**17,684**		**13,929**		**12,480**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	49,496	56.51	8414	62.74	9,935	56.18	5,482	39.35	2,495	20.00
Concrete	1,781	2.03	167	1.24	252	1.43	310	2.23	489	3.92
Precast	792	0.90	69	0.51	136	0.77	182	1.31	336	2.70
RM	12,338	14.08	975	7.27	2,059	11.64	2,662	19.11	3,257	26.10
URM	1,550	1.77	219	1.64	272	1.54	268	1.92	455	3.65
MH	21,638	24.70	3568	26.60	5,029	28.44	5,025	36.08	5,447	43.65
Total	**87,595**		**13,412**		**17,684**		**13,929**		**12,480**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 720 hospital beds available for use. On the day of the earthquake, the model estimates that only 409 hospital beds (57.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 65.00% of the beds will be back in service. By 30 days, 75.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	8	3	1	5
Schools	162	42	0	105
EOCs	13	1	0	12
PoliceStations	25	3	0	22
FireStations	65	12	0	48

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	368	0	0	368	368
	Bridges	343	32	10	311	319
	Tunnels	1	0	0	1	1
Railways	Segments	273	0	0	273	273
	Bridges	6	0	0	6	6
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	4	2	0	4	4
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	9	0	0	9	9
	Runways	20	0	0	20	20

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	7	1	0	6	7
Natural Gas	4	1	0	3	4
Oil Systems	0	0	0	0	0
Electrical Power	6	1	0	4	6
Communication	36	9	0	33	36

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	56,705	1917	479
Waste Water	34,023	963	241
Natural Gas	22,682	330	82
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	113,932	9,851	7,689	3,754	0	0
Electric Power		24,439	16,442	7,630	1,663	31

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1.91 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 37.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 76,440 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 9,569 households to be displaced due to the earthquake. Of these, 8,535 people (out of a total population of 315,743) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	18	6	1	2
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	26	8	1	3
	Industrial	15	5	1	2
	Other-Residential	1,187	296	27	48
	Single Family	1,395	402	61	118
	Total	**2,640**	**717**	**91**	**173**
2 PM	Commercial	1,151	379	68	134
	Commuting	2	2	4	1
	Educational	497	163	29	57
	Hotels	5	2	0	1
	Industrial	108	36	6	13
	Other-Residential	209	51	4	8
	Single Family	265	75	12	21
	Total	**2,235**	**707**	**123**	**233**
5 PM	Commercial	933	305	55	107
	Commuting	38	45	82	16
	Educational	105	35	6	12
	Hotels	8	2	0	1
	Industrial	67	22	4	8
	Other-Residential	433	108	10	18
	Single Family	547	155	24	44
	Total	**2,130**	**673**	**181**	**205**

Economic Loss

The total economic loss estimated for the earthquake is 3,581.29 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 3,468.56 (millions of dollars); 21 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 69 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	18.24	89.48	2.27	6.48	116.47
	Capital-Related	0.00	7.76	78.47	1.31	1.59	89.13
	Rental	54.01	53.86	46.14	0.57	3.21	157.79
	Relocation	187.67	72.15	69.90	2.99	23.06	355.76
	Subtotal	**241.68**	**152.01**	**283.98**	**7.14**	**34.34**	**719.15**
Capital Stock Losses							
	Structural	276.99	119.48	98.22	11.47	22.43	528.59
	Non_Structural	858.43	452.77	306.79	42.96	70.79	1,731.74
	Content	189.80	91.40	137.98	25.44	32.75	477.37
	Inventory	0.00	0.00	4.77	6.35	0.60	11.72
	Subtotal	**1,325.23**	**663.64**	**547.76**	**86.21**	**126.57**	**2,749.42**
	Total	**1,566.91**	**815.65**	**831.74**	**93.35**	**160.91**	**3,468.56**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	18,745.03	$0.00	0.00
	Bridges	325.39	$19.64	6.04
	Tunnels	1.76	$0.00	0.01
	Subtotal	**19072.20**	**19.60**	
Railways	Segments	944.43	$0.00	0.00
	Bridges	1.05	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	5.33	$0.08	1.57
	Subtotal	**950.80**	**0.10**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	4.19	$1.00	23.97
	Subtotal	**4.20**	**1.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	95.86	$9.54	9.95
	Runways	759.28	$0.00	0.00
	Subtotal	**855.10**	**9.50**	
	Total	**20882.30**	**30.30**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1,134.10	$8.63	0.76
	Subtotal	**1,134.10**	**$8.63**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	447.60	$28.99	6.48
	Distribution Lines	680.50	$4.33	0.64
	Subtotal	**1,128.01**	**$33.32**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	4.20	$0.28	6.73
	Distribution Lines	453.60	$1.48	0.33
	Subtotal	**457.83**	**$1.77**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	633.60	$38.45	6.07
	Subtotal	**633.60**	**$38.45**	
Communication	Facilities	3.50	$0.30	8.68
	Subtotal	**3.46**	**$0.30**	
	Total	**3,357.00**	**$82.46**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

Catron,NM

Dona Ana,NM

Grant,NM

Hidalgo,NM

Luna,NM

Otero,NM

Sierra,NM

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Mexico					
	Catron	3,543	184	41	225
	Dona Ana	174,682	6,558	1,799	8,358
	Grant	31,002	1,330	397	1,728
	Hidalgo	5,932	234	72	307
	Luna	25,016	811	252	1,064
	Otero	62,298	2,830	553	3,383
	Sierra	13,270	674	217	891
Total State		**315,743**	**12,621**	**3,331**	**15,956**
Total Region		**315,743**	**12,621**	**3,331**	**15,956**

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Appendix F – Additional Resources

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