

98. Shade-Lohmann Bridge

	
Carries	4 lanes (2 each WB/EB) of I-474
Crosses	Illinois River
Locale	Bartonville, IL and Creve Coeur, IL
Total length	WB: 3,424.9 ft (1,043.9 m) EB: 3,420.9 ft (1,042.7 m)
Width	39.0 ft (11.9 m)
Beginning date of construction	1973
Completion date	1975
Opening date	1975
Coordinates	 40°38'05.86"N 89°37'20.89"W

The **Shade-Lohmann Bridge** carries Interstate 474 over the Illinois River near the Peoria Lock and Dam located at River Mile 158.0 in Tazewell County, in the U.S. state of Illinois. It connects U.S. Route 24 between Bartonville and Peoria, Illinois to Illinois Route 29 between Creve Coeur and North Pekin, Illinois.

Built in 1973, the bridge was named after Pekin's former Mayor and Illinois Legislator, Norman Shade, and Martin B. Lohmann who served in the Illinois Legislature continuously from 1923-1953.

99. Cedar Street Bridge

	
Carries	4 lanes of ILL 8/ILL 29/ILL 116
Crosses	Illinois River
Locale	Peoria, Illinois and East Peoria, Illinois
Design	Truss arch bridge
Total length	3,750 ft (1,143 m)
Width	40 ft (15 m)
Load limit	53.1 metric tons
Clearance below	61.7 feet (18.8 m)
Opening date	1932
Coordinates	 40°40'38.42"N 89°36'00.84"W

The **Cedar Street Bridge** carries Illinois Route 8, Illinois Route 29, and Illinois Route 116 over the Illinois River. It is about a mile and a half southwest from downtown. The bridge is a simple steel arch bridge that towers approximately 70 to 80 feet above the surface of the river, and is the shortest span of the five.

The name of the bridge comes from the original name of its street on the Peoria side of the river; the street itself is now called MacArthur Highway, while the bridge is still referred to as Cedar Street.

100. Bob Michel Bridge



Carries	4 lanes of ILL 40, sidewalk
Crosses	Illinois River
Locale	Peoria, Illinois and East Peoria, Illinois
Design	Steel girder
Total length	2,365 ft (720.9 m)
Width	62.0 ft (18.9 m)
Clearance below	65.9 ft (20.1 m)
Opening date	1993
Coordinates	 40°41'04"N 89°35'31"W

The **Bob Michel Bridge** carries Illinois Route 40 over the Illinois River just 0.75 miles (1.21 km) up-river from the Cedar Street Bridge. Illinois 40 terminates at an interchange with Interstate 74 just east of the bridge. The bridge serves as a direct surface route from a major commercial center in East Peoria to the Civic Center in downtown Peoria. The Bob Michel bridge replaced the antiquated Franklin Street Draw Bridge. The bridge is located at mile 162.3 of the Illinois River.

The Bob Michel Bridge is named after former Congressman Robert H. Michel who served as a Congressman from 1956 to 1995.

101. Murray Baker Bridge

	
Carries	4 lanes of I-74
Crosses	Illinois River
Locale	Peoria, Illinois and East Peoria, Illinois
Design	Cantilever bridge
Total length	Original: 3,216 feet (980.2 m) Current: 3,036 feet (925.3 m)
Vertical clearance	14.4 ft (4.4 m) ^[1]
Clearance below	48.9 ft (14.9 m) ^[1]
Opening date	1958
Coordinates	 40°41′16″N 89°35′00″W

The **Murray Baker Bridge** is a landmark cantilever bridge that carries Interstate 74 over the Illinois River from downtown Peoria to East Peoria in central Illinois. According to the Illinois Department of Transportation, the Murray Baker Bridge was built in 1958, and had an original length of 3,216 feet (980.2 m).

The bridge carries Interstate 74 over the Illinois River at the end of Peoria Lake. The bridge itself is a single cantilever bridge, with two lanes in each direction. Because it has no shoulders, the Baker Bridge is not up to modern Interstate standards.

102. McClugage Bridge

	
Carries	5 lanes (3 WB, 2 EB) of US 24/150
Crosses	Illinois River
Locale	Peoria, Illinois
Design	Dual Cantilever bridges
Total length	4,745.1 ft (1446.3 m)
Width	WB: 39.0 ft (11.9 m) EB: 28.9 ft (8.8 m)
Clearance below	14.9 m
Opening date	WB: 1982 EB: 1948, reconstructed 2000
Coordinates	 40°43'11.08"N 89°32'40.27"W

The **McClugage Bridge** carries U.S. Route 24 and U.S. Route 150 over Upper Peoria Lake in Illinois, United States.

The route is actually two steel cantilever bridges, side by side, with three lanes on the westbound bridge and two on the eastbound bridge.

There was an effort to change the name of the bridge to "Ironworkers Memorial Bridge" after an accident in 2000 killed three iron workers when scaffolding on the bridge collapsed 60 feet into the river. However, instead of the name change, the iron workers were memorialized by a monument near the bridge that was dedicated in April 2001.

103. Lacon Bridge



Carries	IL-17
Crosses	Illinois River
Locale	Sparland and Lacon, Illinois
Design	Steel truss
Longest Span Length	378 ft
Total length	1,573 ft
Width	26 ft 2 lanes
Clearance below	60 ft
Opening date	1939
Coordinates	 41°01'32.43"N 89°25'00.28"W

The Lacon Bridge is a large steel through truss bridge carries Illinois State Highway 17 across the Illinois River south of the Peru-La Salle area and north of the Peoria area.

This style truss bridge is called a continuous truss as opposed to a simple truss. The Lacon Bridge has 4 piers, one on each end, and two mid-channel. The continuous truss bridge is one rigid structure that spans more than 2 piers. The continuous truss can be built with longer main channel spans than simple truss bridges, so they are used in cases where a wide navigation channel preferred. There are many continuous truss bridges over the major rivers, but they have the disadvantage that they are costly to maintain.

104. Henry Bridge



Carries	IL-18
Crosses	Illinois River
Locale	Henry, Illinois
Design	Steel Truss Through Deck
Largest span	364 ft
Total length	1,719 ft
Width	23 ft 2 lanes
Clearance below	60 ft
Opening date	August 15, 1935
Coordinates	 41°06'29.89"N 89°21'07.68"W

The **Henry Bridge** was dedicated on August 15, 1935. It is a steel bridge that consists of six Pennsylvania style through truss spans. Five of the spans are the same size, while the main river span is slightly larger.

The new Henry Bridge was in service until 1988. The deck had deteriorated to the point where it was no longer safe. The deck system, under deck braces, and a number of rivets were replaced. The structure was then sandblasted and painted. The bridge emerged in like-new condition, and it serves traffic to this day with only routine inspections and maintenance.

105. Gudmund Sonny Jessen Bridge

	
Carries	I-180, IL-26
Crosses	Illinois River
Locale	Hennepin, Illinois
Design	Steel girder
Total length	3,084 ft
Width	59 ft 4 lanes
Clearance below	60 ft
Opening date	1969
Coordinates	 41°15'39.13"N 89°20'50.79"W

Prior to the **Gudmund Sonny Jessen Bridge**, which is formerly known as I-180 Bridge, IL-26 crossed the Illinois River at Hennepin. It was crossed on a huge metal monster bridge that featured a 3-span through truss connected back to back with a 2-span through truss. The designation for highway IL-26 was moved to share the I-180 bridge in 1990. The old bridge continued to deteriorate until it became a hazard. The state of Illinois attempted to sell the old bridge, but no takers had the wherewithal to refurbish the structure to make it safe. As a result, the old bridge was removed in 2000.

Interstate highway I-180 is one of the least traveled Interstate highways in the US. I-180 serves the small city of Hennepin, Illinois.

106. Spring Valley Bridge



Carries	IL-89
Crosses	Illinois River
Locale	Spring Valley, Illinois
Design	Steel truss
Longest Span Length	364 ft
Total length	1,776 ft
Width	23 ft 2 lanes
Clearance below	63 ft
Opening date	1934
Coordinates	 41°18'43.62"N 89°11'59.82"W

The bridge at **Spring Valley** is almost a duplicate of the Henry Bridge, with the exception that the Spring Valley bridge has only 5 spans, whereas the Henry bridge has 6 spans. Like the Henry Bridge, the main channel span is slightly larger than the other bridge spans. This bridge was also built at the time that the 9-foot navigation project was being constructed.

The Spring Valley bridge was rebuilt in 1989 and 1990. The contractor used an innovative overhead crane system.

107. Peru Bridge



Carries	IL-251 Highway
Crosses	Illinois River
Locale	Peru, Illinois
Design	Steel truss
Longest span	477 ft
Total length	2,292 ft
Width	30 ft, 2 lanes
Clearance below	65 ft
Opening date	1958
Coordinates	 41°19'25.80"N 89°07'12.48"W

The **Peru Bridge** (or IL-251 Bridge) was built between the two cities of Peru and La Salle in 1958. The original river crossing in the Peru and La Salle area was the Shippingsport Bridge, just up river from this structure. A wagon bridge was built prior to 1900. It was replaced with a multi-span steel truss bridge with a lift span in 1929.

The original name of this bypass took the name US-51, so the Shippingsport Bridge alignment was called Business-51. The new US-51 bypass crossed the Illinois Waterway with a large steel truss structure about a mile west of the Shippingsport Bridge.

Then the US-51 bypass was turned back to the state of Illinois, which gave it the name IL-251.

Major work was completed on the bridge in 1992. The deck was removed and replaced, bearings were repaired, and the pins that held key beams together were replaced.

108. Abraham Lincoln Memorial Bridge



Carries	Four lanes of U.S. 51/I-39
Crosses	Illinois River, IL 351, Illinois and Michigan Canal ,Iowa Interstate Railroad, and Buzzi Unicem industrial rail lead (the former Illinois Central Railroad mainline).
Locale	La Salle, Illinois and Oglesby, Illinois
Design	Tied arch
Longest span	619.9 feet (189 m)
Total length	2,170.8 metres (7,122.0 ft)
Width	4 traffic lanes, 82 ft (25 m)
Vertical clearance	19.3 feet (5.88 m)
Opening date	1987
Coordinates	 41°19'29"N 089°04'37"W

The **Abraham Lincoln Memorial Bridge** in Illinois is a four-lane bidirectional road bridge that spans the Illinois River, Illinois Route 351, Illinois and Michigan Canal, and numerous local roads, lakes, and railroads. It carries Interstate 39, a major north-south Interstate through central Illinois, and its U.S. Route counterpart, U.S. Route 51.

The bridge connects the cities of La Salle and Oglesby, and (like the Mississippi River) maintains an elevation of about 60 feet (18 m) above the Illinois River Valley for its 2 mile (3 km) length. The main span is 619 ft (189 m) long, with approaches in excess of a mile and a half (2½ km). It is the longest arch bridge in Illinois.^[1]

The bridge was built in 1987 when Interstate 39 was first extended south to what is now Illinois Route 251.

109. Utica Bridge



Carries	IL-178
Crosses	Illinois River
Locale	Utica, Illinois
Design	Steel truss
Longest Span Length	378 ft
Total length	1,158 ft
Width	30 ft 2 lanes
Clearance below	63 ft
Opening date	1962
Coordinates	 41°19'37.67"N 89°00'38.31"W

The main truss structure of the **Utica Bridge** is 812 feet long, with a center span of 378 feet, which is flanked by two side spans of 217 feet each. This 1962 vintage bridge replaced an earlier swing bridge. The higher and wider truss bridge is much safer for river navigation than a narrow swing span. The bridge is a bit narrow.

While this bridge looks like a continuous style truss, it is actually a cantilever style truss. On each side of the bridge, the first span and 1/4 of the center span balance each other out. That is, if you removed the middle half of the main span, the two end sections would remain standing and be structurally sound. The middle half of the center span is then suspended by the outside sections. The outside sections count on being balanced properly to resist the force that wants them to tip towards the middle of the river and drop the center span into the water. This works as long as there is more weight on the outside of the main span than between the main span piers. The cantilever effect results in the center span having a flat top, where as a continuous truss would have the U-shape or catenary shape like an upside down arch.

110. Ottawa Bridge



Carries	IL 23 IL 71 Railroad
Crosses	Illinois river
Locale	Ottawa, Illinois
Design	Steel truss w/ lift span
Width	1 track
Clearance below	21 ft
Opening date	1868
Coordinates	 41°19'22.85"N 88°42'36.61"W

The **Ottawa Bridge** is a railroad bridge carrying IL 23 IL 71. It is a steel truss span with lift span. The new lift span would likely have been installed, along with raising the rest of the bridge to match the height of new lift span.

It was built in 1868. The first bridge built at this location was part of the Chicago, Burlington, & Quincy Railroad mainline heading from Chicago to the Mississippi River. The key rival was the Santa Fe, which had a Chicago to Mississippi River mainline that crossed the Illinois River at Chillicothe. The CB&Q became the Burlington Northern Railway.

111. Seneca Bridge



Carries	IL-170
Crosses	Illinois River
Locale	Seneca, Illinois
Design	Steel truss
Longest Span Length	364 ft
Total length	1,510 ft
Width	23 ft 2 lanes
Clearance below	48 ft
Opening date	1932, (Reconstructed 1986)
Coordinates	 41°17'56.80"N 88°36'33.01"W

The **Seneca Bridge** is on the endangered list. A new bridge is under construction as of 2008, and this old 4 span through truss bridge will be removed in a few years. It is a shame to lose yet another truss style bridge. It is unfortunate that they are so expensive to maintain and cost-prohibitive to expand the narrow lanes. The only thing that can be said is to get out and see this old bridge before it is removed in 2010.

The village of Seneca was incorporated in 1865, and the first bridge across the Illinois River was built in 1866. That bridge collapsed, so an iron bridge was built in 1877. That bridge was replaced in 1932 by the current highway bridge.

The new bridge will be a 2 lane structure very much like the IL-351 bridge at Shippingsport. It will feature high strength steel girders with a concrete deck. The deck will be 40 feet wide, enough room for two 12-foot lanes, shoulders, and a walkway on one side. The walkway will be separated from the bridge by a concrete barrier. The main span is expected to be 350 to 375 feet.

112. Morris Bridge



Carries	IL-47
Crosses	Illinois River
Locale	Morris, Illinois
Design	Steel Girder Concrete Deck
Longest Span Length	410 ft
Total length	1,730 ft
Width	61 ft 4 lanes
Opening date	November 2002
Coordinates	 41°01'32.43"N 89°25'00.28"W

The **Morris Bridge** is very new, having been completed in late 2002. The old bridge was a graceful metal monster built from 5 sections of Pennsylvania style through truss spans. The old bridge, built in 1934 and rehabilitated in 1978, was 1,456 feet long, had a 363 foot main span supporting a 350 foot wide navigation channel. It stood 50 feet from the water to low steel. The key figure that lead to its eventual doom was its 22 foot deck width. That was too narrow for modern highway lanes, and two lanes was too few to support a growing region.

To meet the needs of the 21st century, a modern steel girder bridge supporting 4 traffic lanes and a 10 foot wide regional trail was built. To meet the needs of river navigation, the bridge was built with a 410-foot main span soaring high over the water. Side spans of 300 feet and 360 feet flank the main span. The new bridge is purely functional with no decorative elements. The piers are large and blocky, designed to withstand the pressures of ice and barge strikes.

There is good access under the north end of the bridge. The I&M Canal runs under the far north end of the bridge, along with the tow path trail. There is also a boat launch and city park between the canal and the Illinois River.

113. Pendleton Bridge



Carries	US 165
Crosses	Arkansas River
Locale	Arkansas Post, Arkansas
Design	Steel girder
Coordinates	 33°58'49"N 91°23'05"W

The **Pendleton Bridge** is a steel girder bridge located in Arkansas Post, nearly 8 miles (13 km) southeast of Gillett, Arkansas. The bridge crosses the Arkansas River at the 22.6 mile and carries Highway 165.

114. Lawrence Blackwell Bridge



Carries	US 79 AR 63
Crosses	Arkansas River
Locale	Pine Bluff, Jefferson County, Arkansas
Design	Concrete girder
Coordinates	 34°14'56"N 91°54'13"W

The **Lawrence Blackwell Bridge** is concrete girder bridge crossing the Arkansas River in Pine Bluff, Jefferson County, Arkansas. The bridge carries US 79 and AR 63.

115. Rob Roy Bridge



Crosses	Arkansas River on the Union Pacific Railroad northeast of Pine Bluff
Locale	Pine Bluff, Jefferson County, Arkansas
Design	Vertical lift Warren through truss
Coordinates	 34°15'58" N 91°54'52" W

The **Rob Roy Bridge** is a historic railroad bridge. It is a truss bridge over the Arkansas River on the Union Pacific Railroad northeast of Pine Bluff. It was designed with vertical lift Warren through truss and its vertical lift span was renewed. The bridge is open to railroad traffic.

116. 79-B Bridge

	
Carries	US 79 Bybass
Crosses	Arkansas River
Locale	Pine Bluff, Arkansas
Design	Concrete girder
Largest span	51.8 ft
Total length	91.8 ft
Width	49.8 ft
Opening date	1929; rehabilitated 1973
Coordinates	 34°17'23"N 91°59'49"W

The **79-B Bridge** is an arch bridge on US 79B in Pine Bluff, Arkansas. It crosses the Arkansas River. It was built in 1923 and rehabilitated in 1973. Its longest span is 51.8 ft length. The total length is 91.8 ft. The deck with is 49.8 ft. It is open to traffic. The average daily traffic (as of 2005)of the bridge is 5,300.

117. Pipeline Bridge

Carries	Pipeline
Crosses	Arkansas River
Locale	Redfield, Arkansas
Design	Suspension bridge
Coordinates	 34°28'47\"/>

The **Pipeline Bridge** is a suspension bridge carrying pipeline. The bridge crosses the Arkansas River.

118. I-440 Bridge



Carries	Interstate 440
Crosses	Arkansas River
Locale	Little Rock, Arkansas
Design	Steel girder
Coordinates	 34°43'26"N 92°10'40"W

The **I-440 Bridge** is located in Little Rock, Arkansas. The bridge crosses the Arkansas River. It carries the Interstate 440 (abbreviated I-440) which connects the Gates Island to the Jones Island. Interstate 440 (abbreviated I-440) in Arkansas is a 10-mile-(16-km)-long partial loop connecting Interstate 40 with Interstate 30 and Interstate 530 near Little Rock. The bridge has two bounds; east and west bounds.

119. Rock Island Bridge



Crosses	Arkansas River
Locale	Little Rock, Pulaski County, Arkansas
Design	Railroad bridge with vertical-lift
Total length	1,614 ft
Opening date	1899
Coordinates	 34°44'55" N 92°15'29" W

The **Rock Island Bridge** is a closed railroad over the Arkansas River in Little Rock, Pulaski County, Arkansas. It was built in 1899 by the Choctaw and Memphis Railroad and on December 10, 1899, first regularly scheduled train service crossed the bridge from Memphis to Oklahoma City. The lift span of the bridge was added in 1972. It was designed as two 14-panel Pennsylvania through truss spans and one 12-panel, polygonal Warren through truss vertical lift span. The bridge is awaiting for rehabilitation to reopen for pedestrian traffic.

120. I-30 Bridge



Carries	Interstate 30
Crosses	Arkansas River
Locale	Little Rock, Arkansas
Design	Steel girder
Coordinates	 34°45′01″N 92°15′46″W

The **I-30 Bridge** is a continuous steel girder bridge in Little Rock, Arkansas. The bridge is over the Arkansas River. It is on the Interstate 30 which links the downtowns of Little Rock to North Little Rock, Arkansas.

121. Junction Bridge

	
Carries	Connect the Little Rock and Fort Smith rail line with the Little Rock, Mississippi River and Texas railway
Crosses	Arkansas River
Locale	Little Rock
Design	Steel truss (railroad)
Longest span	360 ft
Total length	1800 ft
Clearance below	38 ft
Opening date	1884
Coordinates	 34°45'03"N 92°15'59"W

The Junction Bridge was constructed in 1884 as the primary railroad bridge connecting the northern and southern railway lines. In 1985, the then-owners of the bridge, Union Pacific closed the bridge to rail traffic and in 1999 ceded the bridge to the City of Little Rock. Through an inter-local agreement the bridge was leased for 99 years to the Pulaski County Bridges Facilities Board for the purpose of developing the pedestrian/bicycle bridge. After the planning for the conversion of the bridge into a pedestrian and bicycle venue for public use, construction was begun in 2007.

The bridge is believed to be the only “lift span” bridge that has been converted to a pedestrian/bicycle bridge in the United States. The “lift span” is locked into place in a raised position to allow for uninterrupted barge traffic on the river. Visitors to the bridge may transverse the entire length of the structure by riding elevators up to and down from the 360 foot (length) lift span. The overall length of the bridge is 1,800 feet. To accommodate passing river traffic, lift span is now raised 38 feet above the fixed bridge span.

122. Main Street Bridge



Carries	Main Street in North Little Rock
Crosses	Arkansas River
Locale	Little Rock, Pulaski County, Arkansas
Design	Open-spandrel arch
Opening date	Rebuilt 1973
Coordinates	 34°45'04"N 92°16'08"W

The **Main Street Bridge** is a seven-span open-spandrel arch bridge over the Arkansas River on Main Street at Little Rock in North Little Rock, Pulaski County, Arkansas. In 1973 it replaced by a modern bridge.

123. Broadway Bridge



Carries	US 67
Crosses	Arkansas River
Locale	Little Rock, Pulaski County, Arkansas
Design	Steel through arch
Max. span length	419.8 ft
Total length	2,786.3 ft
Width	40 ft
Vertical clearance	24.3 ft
Opening date	March 1923, rebuilt 1974
Coordinates	 34°45'09"N 92°16'27"W

The **Brodway Bridge** is an arch bridge over the Arkansas River on US 70 (Broadway Street) at Little Rock in North Little Rock, Pulaski County, Arkansas. It is open to traffic. It was completed on March 1923 as a five-span open-spandrel arch bridge. Two spans of the bridge were replaced with a single steel through arch span in 1974. The length of largest span is 419.8 ft, total length is 2,786.3 ft, and deck width is 40.0 ft. Vertical clearance of the bridge above deck is 24.3 ft. The average daily traffic (*as of 2004*) is 24,900.

124. Union Pacific Rail Bridge



Carries	Union Pacific Railroad
Crosses	Arkansas River
Locale	Little Rock, Pulaski County, Arkansas
Design	Steel truss
Opening date	Dec. 21, 1873; destroyed April 3, 1927; rebuilt 1929
Coordinates	 34°45'16"N 92°16'55"W

The **Union Pacific Rail Bridge** is a railroad bridge over the Arkansas River in Little Rock on the Union Pacific Railroad. The bridge has vertical-lift. The steel truss Union Pacific Rail Bridge is located in Little Rock, Arkansas. The bridge is originally completed Dec. 21, 1873; destroyed by flooding on April 3, 1927 and rebuilt 1929. It is open to two tracks of railroad traffic.

125. Big Dam Bridge



Carries	Pedestrians and bicycles
Crosses	Arkansas River
Locale	Little Rock, Arkansas North Little Rock, Arkansas
Total length	4,226 feet (1,288 m)
Width	14 feet (4 m)
Opening date	September 30, 2006
Coordinates	 34°47'37"N 92°21'31"W

The Pulaski County Pedestrian and Bicycle Bridge, better known as the **Big Dam Bridge**, is the newest bridge to span the Arkansas River at Little Rock, Arkansas, over the Murray Lock and Dam, and is open only to pedestrian and bicycle traffic.

The bridge is the longest pedestrian-only bridge built for that purpose in North America. The longest in the United States is the Chain of Rocks Bridge on the north edge of St. Louis, Missouri at 5,350 feet (1,630 m), but it was originally a highway bridge. At 4,226 feet (1288 m.) in length, the **Big Dam Bridge** rises to 65 feet (20 m) over the surface of the Arkansas River and 30 feet (9.1 m) over the dam. The span over the river is 3463 feet (1055 m.), with the ramps on either side of the river accounting for the rest of the length.

126. I-430 Bridge



Carries	Interstate 430
Crosses	Arkansas River
Locale	Little Rock, Arkansas
Design	Steel girder
Coordinates	 34°48'02"N 92°22'28"W

The **I-430 Bridge** is a steel girder bridge carrying Interstate 430 (abbreviated I-430). The bridge crosses the Arkansas River in Little Rock, Arkansas.

127. Highway 9 Bridge



Carries	AR 9 AR 113
Crosses	Arkansas River
Locale	Morrilton, Arkansas
Design	Steel girder
Coordinates	 35°07'34"N 92°43'58"W

The **Highway 9 Bridge** is the unique highway bridges crossing the Arkansas River in Morrilton, Arkansas. It carries the Highway 9 in Morrilton.

Appendix 5 – Direct Damage and Economic Losses

The results discussed in this appendix are presented in a more detailed manner than those in Volume I of this report. The earthquake impact assessment for the Central US was comprised of a single scenario, though individual analyses were completed for each state due to the large amount of inventory in the eight-state region. Results are presented by state with a regional overview at the conclusion of state-level discussions. Only direct damage to infrastructure, casualties, and direct economic losses based on HAZUS analysis are presented in this appendix. Social vulnerability, social impacts and other response quantities are detailed in Appendix 6. Direct damage to buildings is presented by occupancy type and building type. Damage to essential facilities, transportation lifelines, utility lifelines, and other critical infrastructure is also discussed. Additionally, total debris generation from infrastructure damage is detailed. Though casualties are not a form of direct infrastructure damage they are determined based on infrastructure damage and thus presented herein. Lastly, direct economic losses due to infrastructure damage are discussed. Earthquake impact assessment results are presented by state and include estimates of damage and loss for ‘impacted counties’ which were identified for regional planning workshops in the four FEMA regions in the Central US. Finally, results are totaled for the eight-state region and presented at the conclusion of this appendix.

All earthquake impact assessment results presented in this report are based on a sequential rupture of all three New Madrid Seismic Zone (NMSZ) fault segments, each with magnitude $M_w 7.7$. Liquefaction susceptibility for the entire region is also included in the analysis. For more information on the hazard please refer to Appendix 1. All inventory included in the HAZUS analysis is detailed in Appendix 2. The fragility relationships used to determine damage are discussed in Appendix 3. Please consult these appendices for more information on how the scenario was constructed. Only results from HAZUS earthquake impact analyses are presented in this appendix. For information on network models, flood risk modeling, and uncertainty characterization completed with other software and models please refer to additional appendices.

Lists of ‘Impacted Counties’ were compiled by state based on a cumulative review of direct damage and functional capabilities of infrastructure, social impacts and direct economic losses. The counties selected in each state are estimated to incur the most severe damage, loss of operational capability, social impacts and direct economic losses, as estimated by the models used to generate the New Madrid Seismic Zone Scenario. Please note that damage, operational capabilities losses, social impacts, and direct economic losses were not confined to these counties, but rather most severe in these areas. All counties in the eight-state region are likely impacted by a New Madrid event, though the impacts will be less severe outside the areas identified as ‘Impacted Counties.’ There are no ‘Impacted Counties’ in the State of Alabama since the impacts in that state are not severe enough to meet the criteria established to define ‘Impacted Counties’.

Alabama Earthquake Impact Assessment Results

The State of Alabama incurs some of the least severe impacts of all states in the eight-state region. No ‘impacted counties’ are selected in this state due to lesser levels of infrastructure damage and economic loss. A set of ‘socially impacted counties’ is outlined in Appendix 6, and is based on social impacts exclusively. These ‘socially impacted counties’ are not discussed specifically in this appendix.

General Building Stock

There are approximately 1.76 million buildings in the State of Alabama, with approximately 1.73 million residences. Approximately 80% of those residences are single family homes, while the remaining are multiple family dwellings. Over 1.3 million buildings are wood frame structures, while another 88,000 are unreinforced masonry (URM) structures. Manufactured housing comprises nearly 20% of all buildings with 315,000 structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

The earthquake impact assessment of Alabama indicates that 15,400 buildings are damaged, of which 3,800 are completely damaged. Complete damage does not necessarily mean collapse, though complete damage does indicate that the buildings are uninhabitable. In many cases, collapse may occur as the result of an aftershock. A substantial portion of damage, roughly 75%, occurs in ‘other residential’ (multiple family) structures. Only 20% of at least moderate damage is attributed to single family homes, as shown in Table 1. Estimates show a large portion of damage occurs in Mobile County which is along the Gulf Coast and very far from the fault rupture. This seemingly disproportionate distribution is due to the high density of infrastructure in the Mobile metropolitan area. The percentage of buildings damaged in Mobile County is similar to the remainder of the state, though this percentage equates to a larger number of damaged buildings in these highly populated and developed areas.

Table 1: Building Damage by Occupancy Type for Alabama¹

General Building Damage by Occupancy Type for Alabama			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	1,342,900	3,200	3,000
Other Residential	368,400	11,400	700
Commercial	29,100	500	60
Industrial	8,100	200	20
Other	9,800	100	40
Total	1,758,300	15,400	3,820

¹ Building damage estimates are rounded in an effort to avoid provide highly specific numbers that are often thought to reflect high levels of certainty, when actual impacts are likely to vary from the exact model outputs.

Wood and manufactured housing incur the largest proportion of damage based on structure type. Table 2 details damage by structure type and shows that over 11,000 damaged buildings are manufactured housing. While only 3,000 wood structures are damaged in Alabama nearly all of those are completely damaged buildings. This is due to settlement and spreading from liquefaction. Ground deformations of only several inches can render these structures uninhabitable even though ground shaking is minor. Table 2 illustrates the distribution of building damage throughout the state.

Table 2: Building Damage by Building Type for Alabama²

General Building Damage by Building Type For Alabama			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	1,315,900	3,000	2,960
Steel	23,000	700	50
Concrete	5,500	200	< 20
Precast	1,800	< 100	< 20
Reinforced Masonry	8,600	< 100	20
Unreinforced Masonry	88,100	400	200
Manufactured Housing	315,500	11,100	570
Total	1,758,400	15,400	3,820

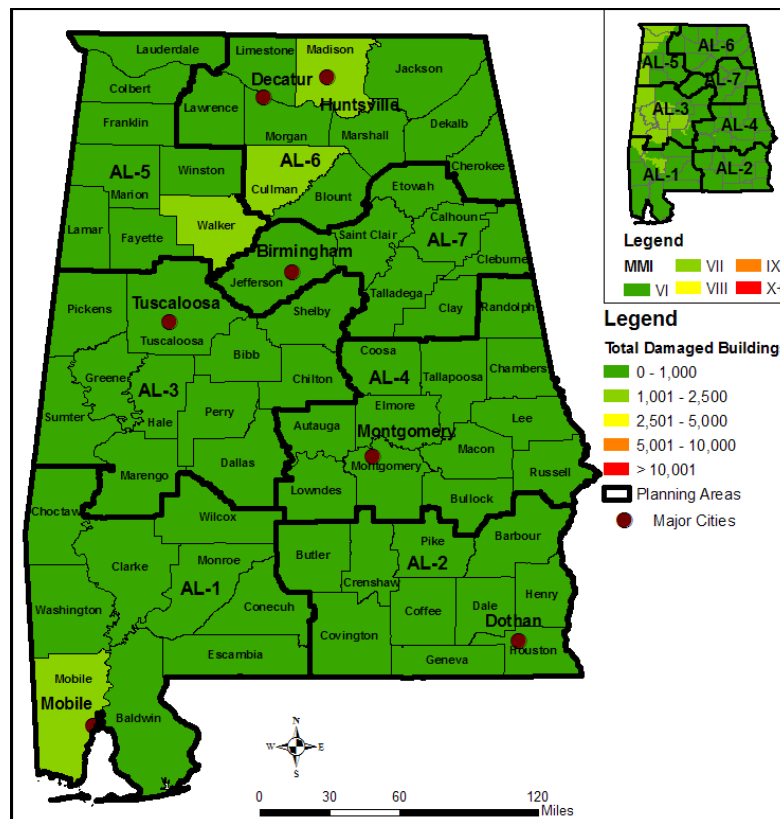


Figure 1: General Building Damage in Alabama (No. of Buildings Damaged)

² Please reference footnote 1.

Essential Facilities

The State of Alabama experiences minor shaking, leaving many of the hospitals intact and able to care for current patients and those injured as a result of the earthquake. It is unlikely that hospitals will experience significant structural damage, though minor structural damage may occur. This may include superficial cracking of concrete beams and columns. Non-structural damage to interior walls, facades, and false ceilings may be more common. In some cases, this type of damage may impact the operation of hospitals. Additionally, losses of power and water services may limit the operation of some facilities. Roughly 90% of the 23,000 hospital beds in the state inventory are operational the day after the event, though this estimate accounts for structural damage only. Structural damage to Alabama hospitals is also shown in Figure 2.

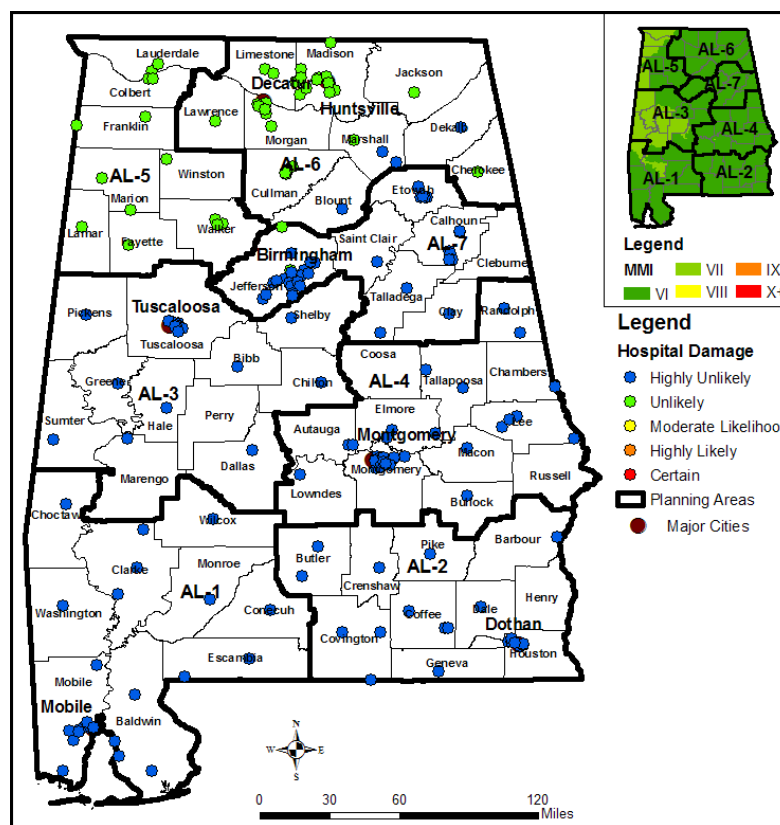


Figure 2: Hospital Damage for Alabama

Fire and police services are operational throughout the majority of the state. There is little structural damage, though non-structural damage may inhibit the response of fire and police personnel in some cases. Similar types of damage, or lack thereof, occur in schools as well. Table 3 shows the lack of moderate or severe damage to essential facilities throughout the state. Most structures are usable and may be used for shelters, staging areas or command centers serving aid workers or evacuees from more heavily impacted neighboring states.

Table 3: Essential Facilities Damage for Alabama³

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	1,903	0	0
Fire Stations	1,388	0	0
Police Stations	496	0	0
Hospitals	210	0	0
EOCs	124	0	0

Transportation Lifelines

All major transportation modes are included in the HAZUS earthquake impact assessment analysis: roads, railways, water, and air transport. Damage to bridges in Alabama is minor and likely does not impede the flow of traffic. Of the 17,500 bridges in Alabama none experience moderate or more severe damage. No major river crossings are identified in Alabama and thus no damage determinations provided for these unique structures.

Ground shaking is not intense enough to cause significant structural damage. Less severe structural damage, such as minor cracking of abutments and decking and very small displacements of piers and abutments which do not cause unseating of the deck, may occur in some cases. Such displacements are most likely in areas where liquefaction occurs. Damage to approach spans is not considered here, though these spans may incur damage as the result of ground settlement or spreading from liquefaction beneath the bridge. Damage to highways and interstates due to ground deformation from liquefaction may also occur, rendering some roads unusable due to cracking and displacements of road segments.

Table 4: Transportation Lifeline Damage for Alabama⁴

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	17,491	0	0
Railway Bridges	118	0	0
Railway Facilities	115	0	0
Bus Facilities	24	0	0
Port Facilities	327	0	0
Airport Facilities	469	0	0

Railway facilities, railway bridges, airports, and port facilities experience damage similar to highway bridges. Minor structural damage may occur, though it is unlikely that significant structural damage occurs as shown in Table 4. Non-structural damage to

³ For tables in this section the following method is used to determine the number of facilities in a damage category. HAZUS assigns each facility a probability of reaching a specific damage level (at least moderate, complete, etc.). In order to provide quantities of facilities at various damage levels, all those facilities that experience a damage probability of 50% or greater for a given damage level are counted as 'damaged.' Therefore, the facilities that are not 50% likely to incur damage at a specific damage level are deemed 'undamaged.'

⁴ Please reference footnote 3.

contents, equipment, and interior walls or ceilings may occur and in some cases may affect facility operations. Facilities in Alabama are largely functional, however.

Utility Lifelines

As with essential facilities and transportation infrastructure, damage to utility infrastructure is minor and impacts far less than in other NMSZ states. Utility facilities may incur minor structural damage and some damage to equipment, though most facilities will remain operational immediately after the event. Table 5 illustrates the lack of significant structural damage to utility facilities in Alabama. Damage to utility pipelines is shown Table 6, and details the number of repairs required for water, natural gas, and oil pipelines throughout the state. Interstate pipelines include natural gas and oil only and carry large quantities of product between states and to areas outside the eight NMSZ states. Damage to these pipelines and continued down-time or lack of commodities flow will impact commerce far from the rupture zone.

Table 5: Utility Facilities Damage for Alabama⁵

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	30	0	0
Waste Water Facilities	9,315	0	0
Natural Gas Facilities	458	0	0
Oil Facilities	425	0	0
Electric Facilities	1,629	0	0
Communication Facilities	15,895	0	0

Table 6: Utility Pipeline Damage for Alabama

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	124,800	460	292	752
Waste Water Local	74,900	364	231	595
Natural Gas Local	49,900	389	247	636
Natural Gas Interstate	5,300	5	11	16
Oil Interstate	1,800	2	5	7

Table 7: Service Outages at Day 1 for Alabama

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	1,737,000	230,000	0

Service outages for Alabama are displayed in Table 7 and electric outages illustrated in Figure 3. Roughly 14% of all households in Alabama are without power immediately after the event. Damage estimations are based on expected damage to local substations which help distribute power to neighborhoods and homes. No potable water outages are expected immediately after the event. Pipeline damage is used to estimate water outages and though there are several hundred repairs

⁵ Please reference footnote 3.

required, damage is not substantial enough to generate outages. Though HAZUS calculates service restoration estimates they are extremely optimistic and likely do not reflect realistic availability of personnel or parts. As a result restoration timelines are not reported. Based on conversations with those in the energy and emergency response sectors, however, it is assumed that most Day 1 outages persist until three days post-event, and many until seven or more days post-event. This applies to all service outage estimates included in this study.

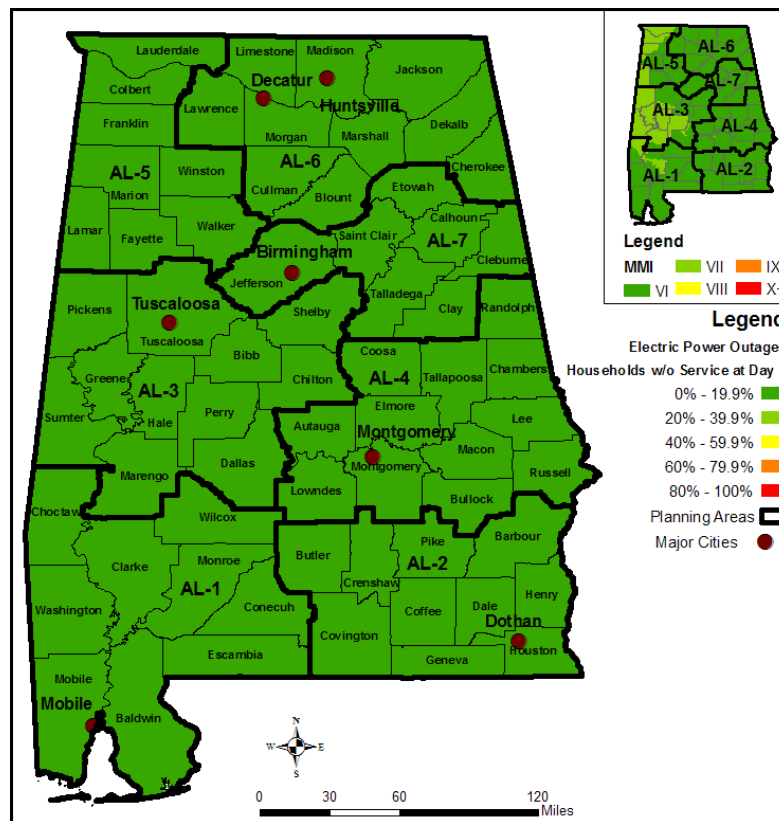


Figure 3: Electric Power Outages at Day 1 for Alabama

Other Critical Infrastructure

Three types of ‘other critical infrastructure’ are considered in this study: dams, levees, and hazardous materials facilities. Thresholds values are used to estimate damage and are discussed in Appendix 4. There are over 2,200 dams and nearly 3,700 hazardous materials facilities in Alabama, none of which are damaged by the NMSZ scenario event. The low levels of ground shaking in Alabama are not strong enough to cause substantial damage and generate the release of water or hazardous materials.

Table 8: Other Critical Facilities Damage for Alabama

Facility Type	Total Facilities	Damaged
Dams	2,233	0
Levees	5	0
Hazardous Materials	3,656	0

Induced Damage, Casualties, and Economic Losses

Damage to infrastructure generates nearly 600,000 tons of debris. The largest amount of debris is generated in Mobile County, roughly 180,000 tons. The combination of dense infrastructure and minor damage leads to large amounts of debris, though still relatively small in comparison to the total volume of infrastructure. Additionally, Baldwin, Madison, Tuscaloosa, Lauderdale, Morgan, and Dallas Counties show above average debris generation. Between 20,000 and 35,000 tons are generated in each county. Over 22,000 truckloads⁶ are required to removal all debris, as shown in Table 9.

Table 9: Debris Generation for Alabama

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	256,000	303,000	559,000	22,360

Table 10: Casualties at 2:00AM for Alabama

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	726	179	16	28	949

Casualties are the only social impact considered in this appendix since they are solely based on infrastructure damage and calculated within the HAZUS program. Casualty severity levels are defined by the program and include minor injuries, major injuries, and fatalities. Descriptions of the four HAZUS casualty levels are provided below:

- Severity Level 1: Injuries will require rudimentary medical attention but hospitalization is not needed, though injuries should be rechecked frequently
- 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 as a result of the earthquake

As shown in Table 10 most casualties are minor injuries. Over 700 minor injuries are expected and roughly 200 people require hospitalization for their injuries (levels 2 and 3). Approximately 30 fatalities are expected for the 2:00AM scenario event. Though casualties are determined at three times throughout the day, 2:00AM, 2:00PM, and 5:00PM, the early morning scenario event typically generates the most substantial casualty estimates. Since the scenario event is designed to be nationally catastrophic the same time of day is used for all casualty estimates across the eight states. Furthermore, Figure 4 illustrates the distribution of total casualties throughout Alabama. The largest number of casualties occurs in Mobile County, which is due to the density of

⁶ All truck for debris removal are assumed to be 25-ton trucks for state results and regional summary results.

infrastructure and minor structural damage. Most of these injuries are minor and do not require hospitalization.

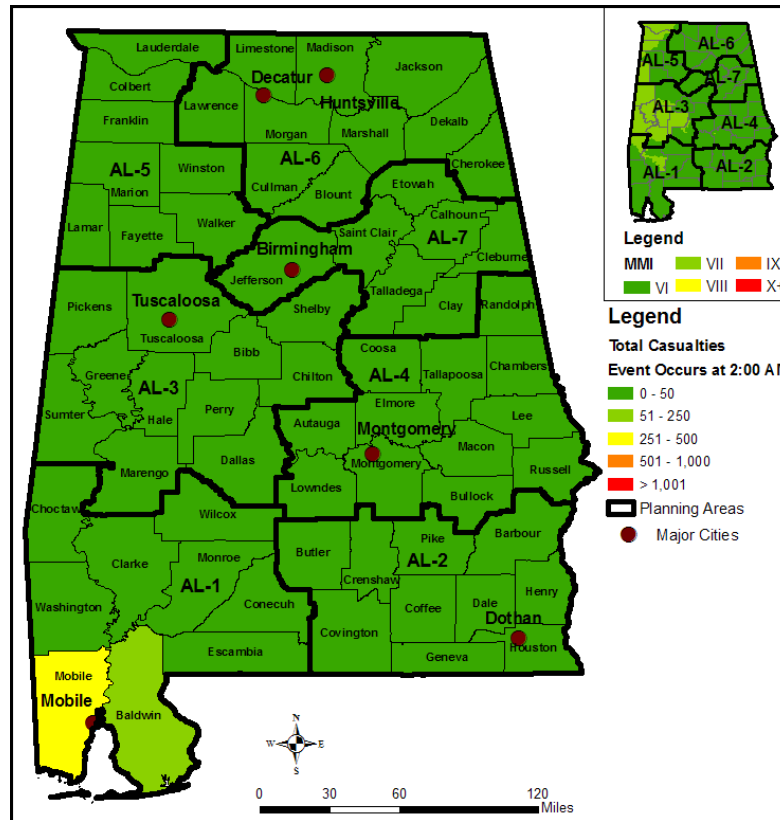


Figure 4: Total Casualties for 2:00AM Event in Alabama

Total assets in Alabama include more than \$290 billion in building value, approximately \$125 billion in transportation infrastructure value, nearly \$700 billion in utility infrastructure value. This equates to \$1.1 trillion in total infrastructure value throughout the state. Direct economic losses in Alabama total nearly \$14 billion for the NMSZ scenario event. A large portion of that total loss, nearly 85%, is attributed to utility network losses. Building and transportation network losses contribute significantly less to the state total. All losses shown in Table 11 are the direct result of damage to infrastructure and do not include indirect economic losses such as loss of market share or business interruption, among other indirect losses. Though \$14 billion is a substantial amount the relative loss is small in comparison to most of the other NMSZ states.

Table 11: Direct Economic Loss for Alabama (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$1,758	\$274	\$11,626	\$13,658

Arkansas Earthquake Impact Assessment Results

The earthquake impact analysis of Arkansas was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 19 counties were selected as ‘impacted counties’ in Arkansas and are listed below:

- Arkansas
- Clay
- Craighead
- Crittenden
- Cross
- Greene
- Independence
- Jackson
- Lawrence
- Lee
- Mississippi
- Monroe
- Phillips
- Poinsett
- Prairie
- Randolph
- Saint Francis
- White
- Woodruff

General Building Stock

There are approximately 1.3 million buildings in the State of Arkansas, with approximately 1.2 million residences. Nearly 70% of those residences are single family homes, while the remaining are multiple family dwellings. Over 900,000 buildings are wood frame structures, while another 180,000 are unreinforced masonry (URM) structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Table 12: Building Damage by Occupancy Type for Arkansas⁷

General Building Damage by Occupancy Type for Arkansas			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	833,500	69,700	35,800
Other Residential	408,500	75,000	27,400
Commercial	53,200	11,000	4,700
Industrial	14,600	2,800	1,100
Other	15,600	3,700	1,700
Total	1,325,400	162,200	70,700

Over 162,000 buildings are damaged in Arkansas, with nearly 71,000 of those being completely damaged. A large portion of damage occurs in residential buildings, both single family homes and multi-family dwellings (other residential). ‘Other’ buildings include educational, agricultural, governmental, and religious structures. These types of buildings are far less common and thus fewer are damaged, as shown in Table 12. Over

⁷ Please reference footnote 1.

128,000 buildings are damaged in the impacted counties, and the remaining 34,000 are damaged throughout the rest of the state. Craighead and Mississippi Counties incur nearly 29,000 and 20,000 damaged buildings, respectively. Furthermore Poinsett, Greene, and Crittenden Counties experience between 10,000 and 12,000 damaged buildings each.

Table 13: Building Damage by Building Type for Arkansas⁸

General Building Damage by Building Type For Arkansas			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	902,100	68,800	35,000
Steel	25,300	7,300	2,700
Concrete	6,600	1,500	700
Precast	6,700	1,600	700
Reinforced Masonry	5,200	1,100	500
Unreinforced Masonry	181,900	29,100	15,500
Manufactured Housing	197,600	52,800	15,600
Total	1,325,400	162,200	70,700

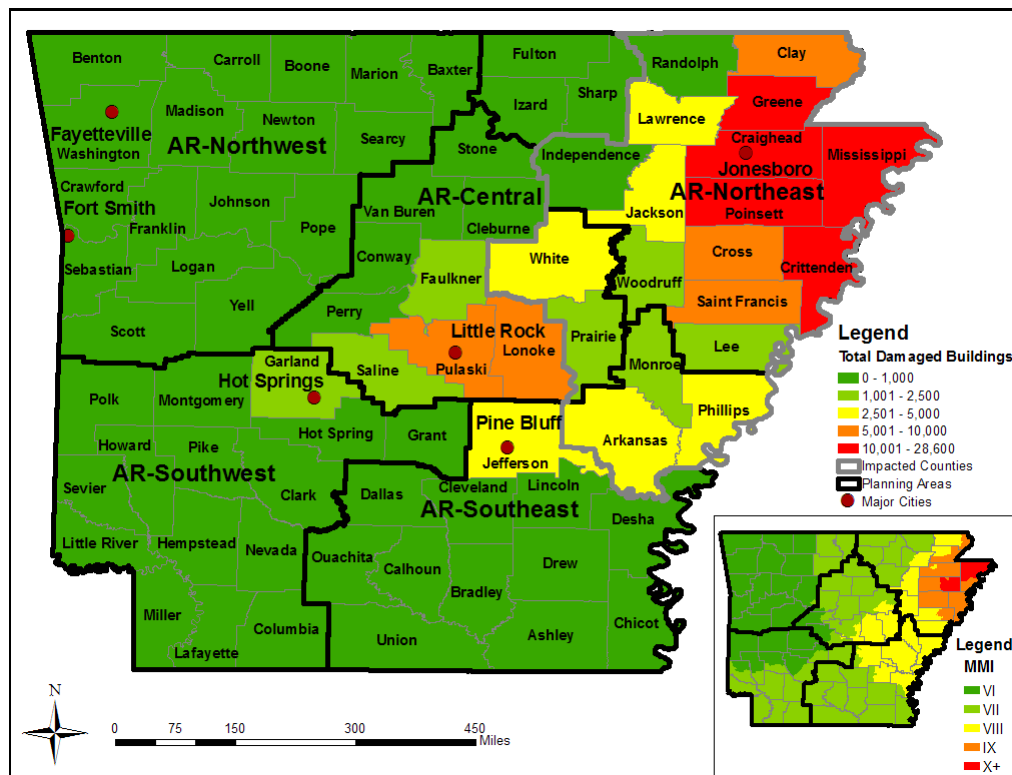


Figure 5: General Building Damage in Arkansas (No. of Buildings Damaged)

Wood structures, manufactured housing and unreinforced masonry (URM) structures comprise a large portion of the state inventory and thus a large portion of damaged structures. Approximately 50% of all complete damage occurs in wood frame structures, with 40% of moderate and more severe damage occurring in this structure type as well. Manufactured housing also incurs nearly 53,000 cases of damage, though only 30% of

⁸ Please reference footnote 1.

those are completely damaged. Additionally, over half of all URM damage cases are completely damaged buildings. Table 13 shows the distribution of building damage by structure type. The total number of buildings damaged is illustrated, by county, in Figure 5.

Essential Facilities

Hundreds of essential facilities are damaged in Arkansas, many of them completely damaged. Over 25 hospitals are located in the 19 impacted counties comprising 1,700 total beds. Only 120 beds are available after the earthquake as a result of damage to these facilities. Numerous counties in northeast Arkansas are without most medical services, either due to damage or complete lack of facilities, including: Lee, Monroe, Poinsett, Prairie, Woodruff, Clay, Greene, Lawrence, Craighead, Mississippi, Crittenden, St. Francis, Jackson, Arkansas, Phillips, and Jefferson. Damaged hospitals are shown in Figure 6. Neighboring counties will need to provide medical support in terms of caring for earthquake victims and patients evacuated from damaged facilities.

Emergency services are also compromised after the scenario earthquake as a result of damage to fire and police stations. Table 14 shows that over 175 fire stations and 100 police stations are damage in Arkansas; nearly half of those facilities are damaged completely. Clay, Craighead, Crittenden, Cross, Greene, Jackson, Lee, Mississippi, Monroe, Phillips, Poinsett, Prairie, St. Francis, and Woodruff Counties are without most of the 160 fire stations located in that portion of the state. Additionally, there are approximately 130 police stations in the 19 impacted counties. Police stations in most of these counties incur substantial structural damage and many are unusable. Furthermore, it is relevant to note that services may be further compromised by a lack of law enforcement and fire personnel as these local responders stay home to assist their families.

Emergency operation centers (EOCs), which include EOCs and 9-1-1 call centers, are damaged in northeast Arkansas and unable to assist residents. A total of 25 are damaged, most of which are in the impacted counties. Without operation facilities in the most heavily impacted areas large coordination centers will likely be located outside the northeastern portion of Arkansas.

Table 14: Essential Facilities Damage for Arkansas⁹

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	1,328	219	56
Fire Stations	1,330	179	65
Police Stations	515	107	48
Hospitals	125	24	18
EOCs	113	25	8

⁹ Please reference footnote 3.

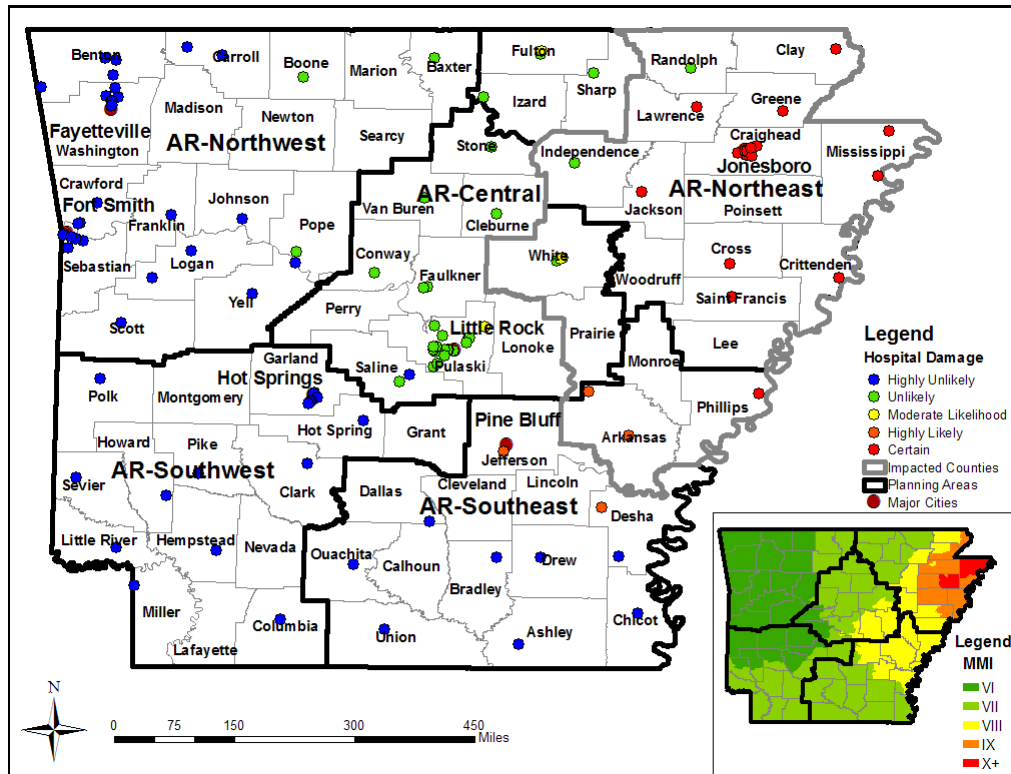


Figure 6: Hospital Damage for Arkansas

Transportation Lifelines

Transportation lifelines incur substantial damage creating difficulties for those trying to evacuate and response workers attempting to access the most heavily impacted areas. Nearly 1,100 highway bridges are damaged, of which nearly 350 are completely damaged. All damaged bridges are located in the impacted counties. Craighead, Crittenden, Mississippi, and Poinsett Counties incur the largest numbers of damaged bridges. Furthermore, several major river bridges are damaged effectively separating major sections of Arkansas from neighboring states. The Harahan, Frisco, and Memphis/Arkansas bridges are damaged and impassible after the event. Major river crossing damage is illustrated in Figure 7 as well.

Table 15: Transportation Lifeline Damage for Arkansas¹⁰

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	14,060	1,083	336
Railway Bridges	68	11	0
Railway Facilities	69	14	0
Bus Facilities	18	1	0
Port Facilities	103	17	0
Airport Facilities	335	37	0

¹⁰ Please reference footnote 3.

Damage to airports, ports, and railway infrastructure is also significant in northeast Arkansas. Nearly 40 airports and 15 railway facilities are damaged in the state, as shown in Table 15. All damaged facilities are located in the impacted counties, with most damage occurring in Clay, Craighead, Crittenden, Cross, Greene, Mississippi, and Poinsett Counties. Landing aircraft in these counties may not be possible after the earthquake. Railway facilities and bridges in Crittenden, Mississippi, Cross, and Poinsett Counties are heavily damaged and likely inhibit rail traffic after the earthquake. Most ports along the Mississippi River in northeast Arkansas are damaged as well.

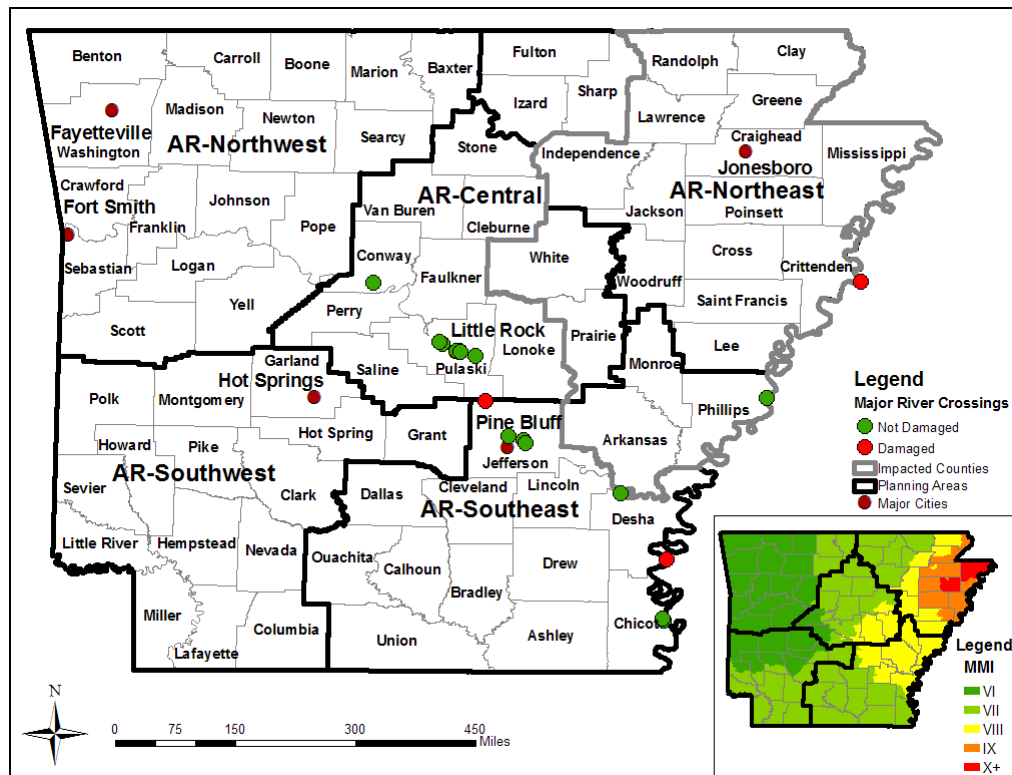


Figure 7: Major River Crossing Damage for Arkansas

Utility Lifelines

Utility networks are severely compromised in northeast Arkansas as a result of the NMSZ scenario event, very similar to other types of infrastructure. A large portion of waste water, electric power, and communication facilities are damaged, though not completely. Nearly 350 waste water facilities in Clay, Crittenden, Craighead, Cross, Greene, Independence, Jackson, Lawrence, Lee, Mississippi, Phillips, Poinsett, Randolph, St. Francis, White, and Woodruff Counties are damaged and not operating at full capacity. Nearly all of the aforementioned counties incur substantial damage to electric power, communication and other utility facilities. Table 16 details the number of damaged facilities in Arkansas.

Table 16: Utility Facilities Damage for Arkansas¹¹

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	69	6	0
Waste Water Facilities	2,107	349	0
Natural Gas Facilities	422	47	0
Oil Facilities	96	14	0
Electric Facilities	800	147	0
Communication Facilities	4,626	633	0

Table 17: Utility Pipeline Damage for Arkansas

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	118,700	19,532	27,649	47,181
Waste Water Local	71,200	15,448	21,868	37,316
Natural Gas Local	47,500	16,513	23,376	39,889
Natural Gas Interstate	9,700	340	1,092	1,432
Oil Interstate	2,200	62	214	276

Table 18: Service Outages at Day 1 for Arkansas

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	1,043,000	330,000	193,000

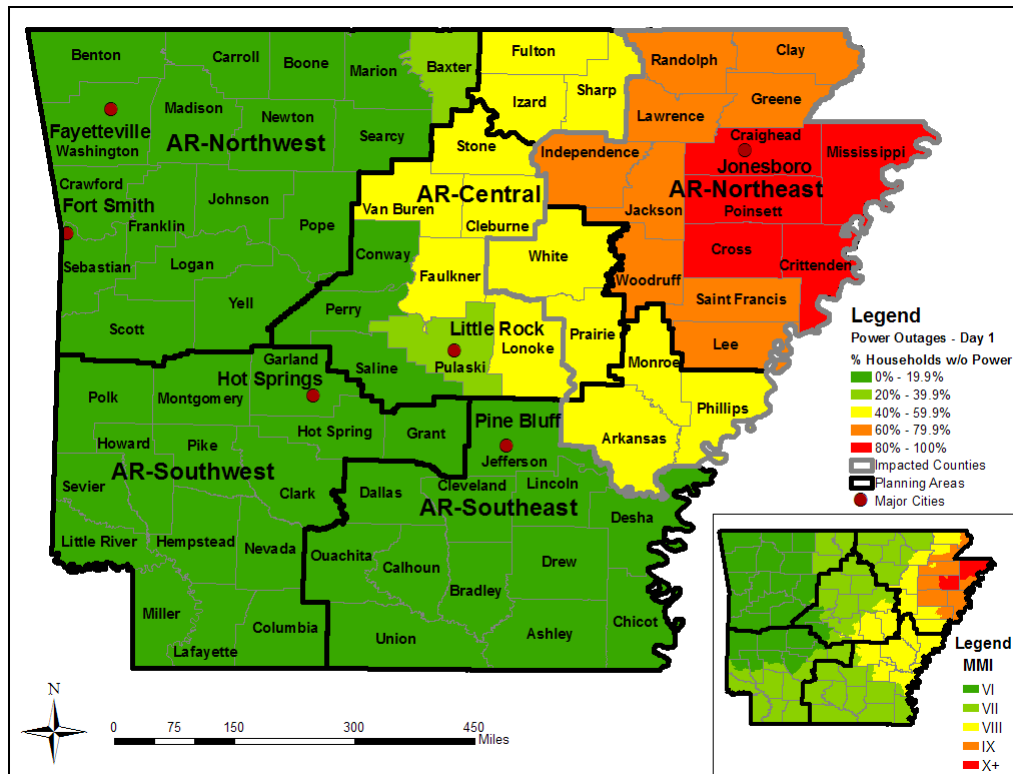


Figure 8: Electric Power Outages at Day 1 for Arkansas

¹¹ Please reference footnote 3.

Intense shaking and substantial ground deformation in northeast Arkansas generate tens of thousands of breaks and leaks in both local and interstate pipelines. Local water lines are heavily damaged with over 47,000 repairs required for potable water pipes and 37,000 repairs to waste water pipes. Table 17 also details the breaks and leaks to natural gas lines. Nearly 40,000 total breaks and leaks occur in local distribution lines and another 1,400 occur in interstate major transmission lines. When interstate natural gas damage is combined with interstate oil pipeline damage, nearly 300 breaks and leaks, it is evident that there will be severe interruptions to gas and oil distribution throughout the Midwest and east coast.

Damage to utility facilities and pipelines leads to substantial service losses throughout northeast Arkansas and the remainder of the state. Table 18 details electric power and potable water service loss in terms of households. Nearly 200,000 households, most in northeast Arkansas, are without water. Electric power is out for 330,000 households throughout the state. The distribution of electric power outages is illustrated in Figure 8 with percentages of all households in a given county without service. Craighead, Poinsett, Cross, Crittenden, and Mississippi Counties experience the greatest percentage of service losses. A total of 14 counties in northeast Arkansas show 60% or more of all households are without power.

Other Critical Infrastructure

There are over 3,000 other critical facilities in Arkansas and over 100 are damaged by the scenario earthquake. Table 19 shows that nearly 60 dams are damaged, all of which are located in Poinsett County. The 20 damaged levees are located in Craighead, Greene, Mississippi, and Poinsett Counties. Very intense ground shaking is required to damage hazardous materials facilities and such levels of shaking occur in small portions of northeast Arkansas. All damaged hazardous materials facilities are located in Mississippi County.

Table 19: Other Critical Facilities Damage for Arkansas

Facility Type	Total Facilities	Damaged
Dams	1,228	55
Levees	124	20
Hazardous Materials	1,834	69

Induced Damage, Casualties, and Economic Losses

Damage to Arkansas infrastructure is among the most severe and widespread of any state in the NMSZ and as a result debris generation, casualties and economic loss are substantial. Roughly 9.4 million tons of debris are generated from earthquake damage and require 375,000 truckloads¹² to remove. This will be a major challenge considering many roads are impassible in counties where debris is dense. Nearly two million tons of

¹² Please reference footnote 6.

debris are created in Craighead County, with another 1.5 million tons in Mississippi County and one million tons in Crittenden County. Poinsett, Pulaski, and Greene Counties also have debris estimates between 650,000 and 750,000 tons.

Extensive infrastructure damage also leads to substantial casualties, which is shown in Table 21. Over 11,000 people experience minor injuries and nearly 3,500 people require hospitalization for major or life-threatening injuries. Impact assessments also estimate nearly 650 fatalities for a 2:00AM event. A total of 15,300 casualties are expected in Arkansas, one of the most severely impacted of the eight states. Figure 9 illustrates the distribution of total casualties. Over 90% of all casualties occur in the impacted counties. Furthermore, Crittenden, Craighead, and Mississippi Counties each incur between 2,000 and 3,000 total casualties. It is clear that counties with the highest casualty estimates correspond to counties with widespread infrastructure damage.

Table 20: Debris Generation for Arkansas

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	4,096,000	5,295,000	9,391,000	375,640

Table 21: Casualties at 2:00AM for Arkansas

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	11,245	3,075	344	641	15,305

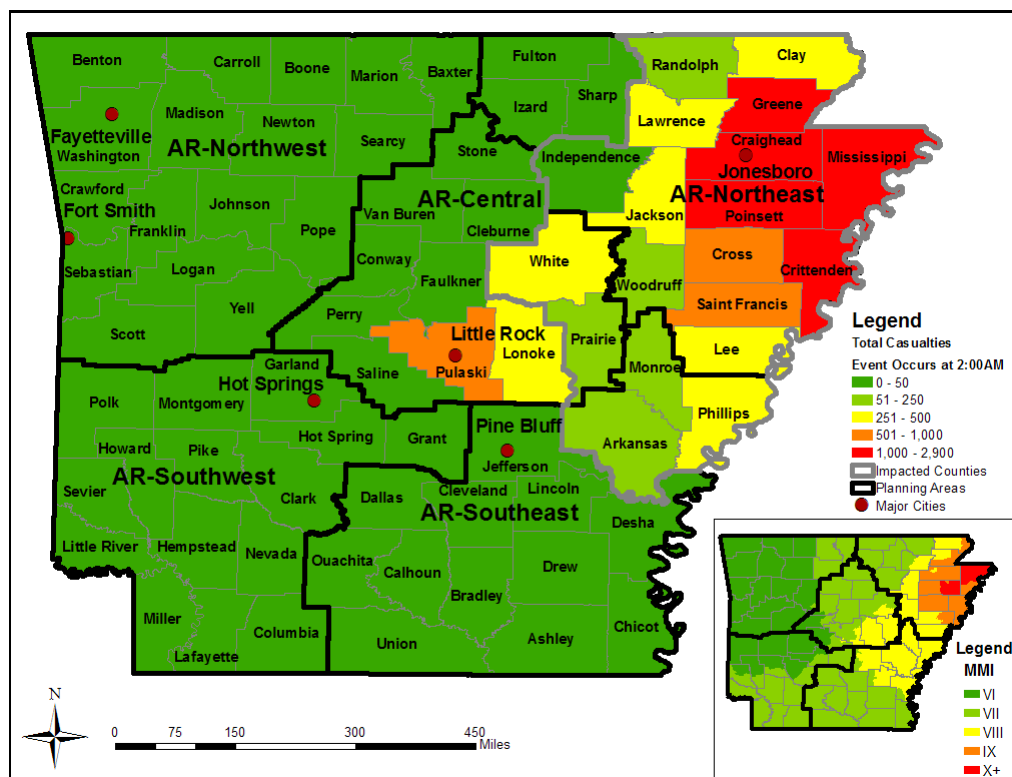


Figure 9: Total Casualties for 2:00AM Event in Arkansas

Total assets in Arkansas include more than \$180 billion in building value, nearly \$75 billion in transportation infrastructure value, and approximately \$210 billion in utility infrastructure value. This equates to more than \$465 billion in total infrastructure value throughout the state. Direct economic losses indicate the value of infrastructure lost during an earthquake event and losses in Arkansas are among the highest in the eight-state study region. Table 22 illustrates losses by infrastructure group which shows that buildings and utility lifelines experience nearly identical economic losses, about \$18 billion. Transportation lifelines constitute a smaller portion of state economic loss at nearly \$2.5 billion. At nearly \$40 billion in total losses Arkansas requires substantial assistance to rebuild after the disaster.

Table 22: Direct Economic Loss for Arkansas (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$18,167	\$2,347	\$18,515	\$39,029

Illinois Earthquake Impact Assessment Results

The earthquake impact analysis of Illinois was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 27 counties were selected as ‘impacted counties’ in Illinois and are listed below:

- Alexander
- Bond
- Clinton
- Fayette
- Franklin
- Gallatin
- Hamilton
- Hardin
- Jackson
- Jefferson
- Johnson
- Lawrence
- Madison
- Marion
- Massac
- Monroe
- Perry
- Pope
- Pulaski
- Randolph
- Saint Clair
- Saline
- Union
- Washington
- Wayne
- White
- Williamson

General Building Stock

There are approximately 3.7 million buildings in the State of Illinois, of which approximately 3.5 million are residences. Over 85% of those residences are single family homes, while the remainder are multiple family dwellings. Additionally, over 2.6 million buildings are wood frame structures and another 780,000 are (URM) structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Table 23: Building Damage by Occupancy Type for Illinois¹³

General Building Damage by Occupancy Type for Illinois			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	3,079,900	26,700	16,600
Other Residential	455,900	15,900	4,100
Commercial	78,300	1,200	400
Industrial	22,500	300	100
Other	19,200	400	100
Total	3,655,800	44,500	21,300

Nearly 45,000 buildings are damaged statewide, though the majority of this damage occurs in southern Illinois. Roughly 21,000 of those buildings, or more than 45%, are completely damaged buildings. As shown in Table 23 large portions of at least moderate

¹³ Please reference footnote 1.

and complete damage occur in single family homes. Additionally, ‘other residential’ structures incur nearly 16,000 cases of damage. Wood structures incur the most cases of damage with over half of all complete damage occurring in this building type. According to Table 24 URM and manufactured housing also incur significant damage.

Table 24: Building Damage by Building Type for Illinois¹⁴

General Building Damage by Building Type For Illinois			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	2,626,400	17,700	12,600
Steel	38,100	1,000	200
Concrete	41,800	900	300
Precast	11,300	200	< 50
Reinforced Masonry	8,300	100	< 50
Unreinforced Masonry	783,300	10,100	5,000
Manufactured Housing	146,600	14,500	3,200
Total	3,655,800	44,500	21,300

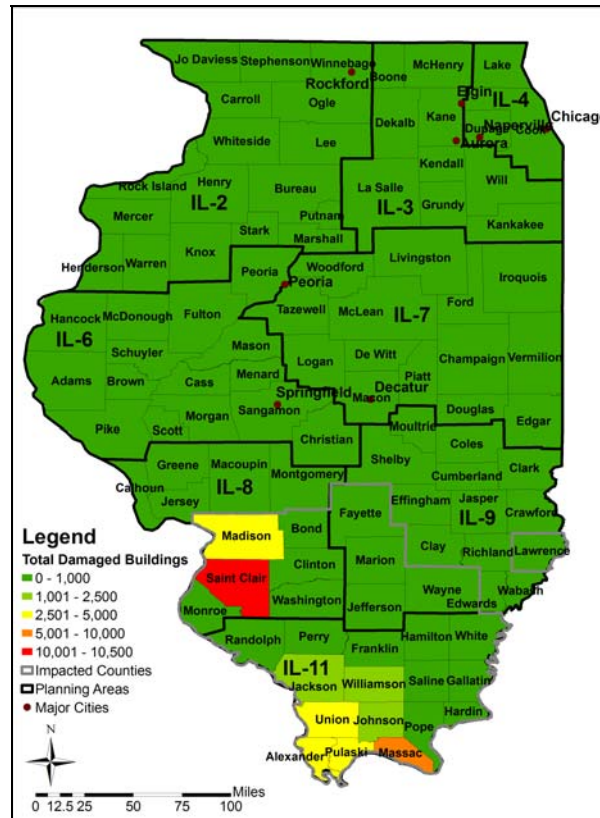


Figure 10: General Building Damage in Illinois (No. of Buildings Damaged)

Additionally, Figure 10 illustrates the number of damaged buildings throughout the State of Illinois. St. Clair and Madison Counties incur the greatest number of damaged buildings largely due to the high density of buildings in these more urban areas. The

¹⁴ Please reference footnote 1.

percentage of buildings damaged in these counties is less than in the southernmost counties where more 80% of all buildings are damaged, such as Alexander, Massac, and Pulaski.

Essential Facilities

The southernmost portion of Illinois experiences intense shaking, leaving most of the hospitals in that area unable to care for current patients and those injured during the earthquake. One hospital is completely damaged and roughly 15 hospitals are moderately or more severely damaged, all in southern Illinois as is shown in Table 25. A total of six hospitals are located in Alexander, Johnson, Massac, Pope, Pulaski, Union, and Williamson Counties, which provide a total of nearly 950 beds. The day after the earthquake, roughly 225 beds are available, while the remaining 725 beds are unusable due to damage from the earthquake. This means that the nearly 130,000 people that reside in these seven counties will have limited healthcare services immediately after the event. Most of the current patients and those injured during the event will require care outside this heavily impacted area. Neighboring counties such as Franklin, Hamilton, Perry, and Washington Counties have numerous functional hospitals and may be able to care for those evacuated from the most heavily impacted counties. Additionally, Hardin, Jackson, Randolph, and Saline Counties may require some level of assistance with patient care from adjacent counties. Roughly 560 of the 930 total beds are operational the day after the earthquake. It is likely that some of the injured in Hardin, Jackson, Randolph, and Saline Counties must be evacuated for treatment. Figure 11 also illustrates the likelihood of damage to hospitals throughout the state.

Table 25: Essential Facilities Damage for Illinois¹⁵

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	5,795	114	47
Fire Stations	1,822	60	17
Police Stations	1,082	34	14
Hospitals	413	7	1
EOCs	221	8	3

Police and fire response capabilities are severely reduced in the southernmost counties as well. Alexander, Johnson, Massac, Pope, Pulaski, Saline, and Union Counties have more than 50 fire stations, most of which are operating at a severely limited capacity immediately after the earthquake. The roughly 30 fire stations in Gallatin, Jackson, and Williamson Counties are estimated to function at reduced capacities but are better able to respond than the more southern counties. It is likely, however, that all the aforementioned counties will require some level of external support. The capabilities of local law enforcement are also severely reduced in southern Illinois. There are nearly 60 police stations in the ten counties listed previously. The southernmost counties are likely to have no usable stations, while Gallatin, Jackson, Saline, and Williamson Counties may be able

¹⁵ Please reference footnote 3.

to provide minimal services. Counties in the southernmost portion of Illinois require substantial external support immediately after the event.

The schools in southern Illinois are severely damaged and unable to operate. Of the nearly 250 schools in Alexander, Johnson, Massac, Pope, Pulaski, Saline, Union, Gallatin, Jackson, and Williamson Counties, roughly half are completely unusable or are operating at reduced capacity. Most schools in these counties can not be used as temporary shelters, thus requiring the evacuation of most people seeking public shelter.

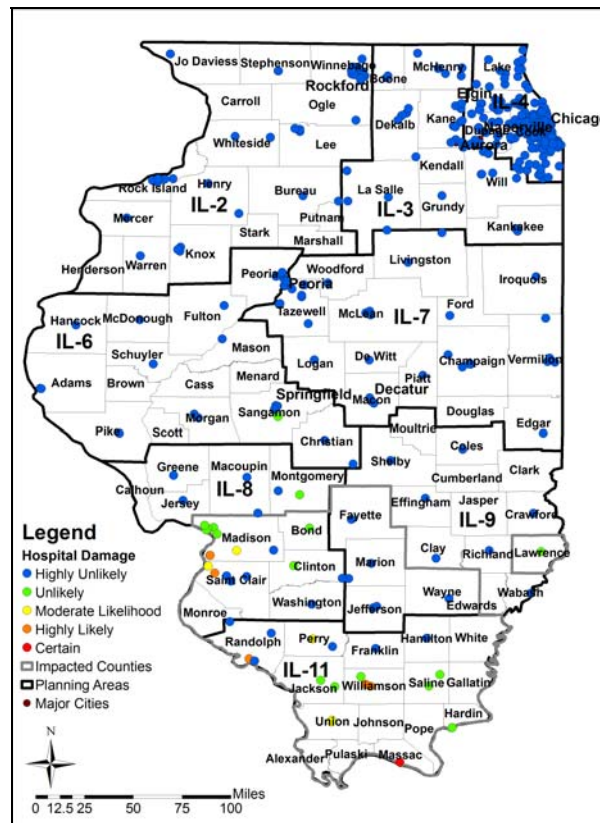


Figure 11: Hospital Damage for Illinois

Transportation Lifelines

Transportation in southern Illinois is heavily impacted by ground shaking and ground deformation. The airports in Alexander, Johnson, Massac, Pulaski, and Union Counties experience severe damage, leaving these counties without many functioning facilities. There are nearly 20 airports in these five counties, most of which are not operational the day after the event, as shown in Table 26.

There are approximately 30,000 bridges in the State of Illinois with over 13,000 in southern Illinois. Over 150 bridges are damaged in southern Illinois, and almost 70 bridges are completely damaged. As a result, many of these bridges are impassible after the earthquake. Nearly all damaged bridges are located in Alexander, Massac, and

Pulaski Counties. Most bridges along Interstate 57 in Alexander and Pulaski Counties are heavily damaged and likely impassible. Also, the Interstate 24 bridge in Massac County is damaged and not functioning immediately after the event.

Approximately 70 major river crossings are included in the Illinois bridge analysis. These bridges cross the Illinois, Mississippi, and Ohio Rivers. Roughly 10 major bridges are damaged in southern Illinois, limiting traffic between Illinois and the neighboring states of Kentucky and Missouri. Figure 12 illustrates damage to major river crossings within Illinois as well as bridges to neighboring states. Most bridges are located in Alexander and Massac Counties, though a major bridge in Jackson County is damaged as well. Among the damaged bridges are the Mississippi and Ohio River bridges in Cairo, Illinois, the I-57 bridge at Cairo, Illinois, and the I-24 bridge at Metropolis, Illinois.

Table 26: Transportation Lifeline Damage for Illinois¹⁶

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	29,967	157	66
Railway Bridges	1,030	11	0
Railway Facilities	304	7	0
Bus Facilities	120	2	0
Port Facilities	517	20	0
Airport Facilities	935	20	0

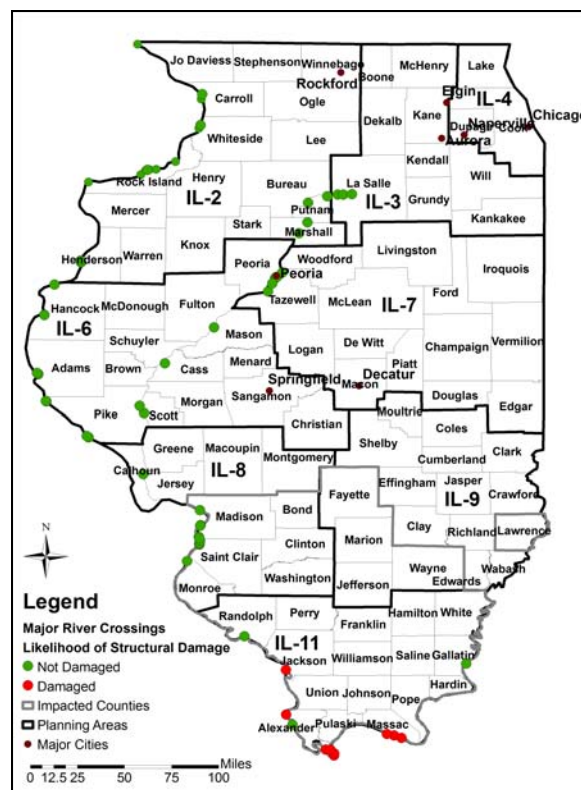


Figure 12: Major River Crossing Damage for Illinois

¹⁶ Please reference footnote 3.

Railway bridges and facilities are also damaged in Alexander, Hardin, Massac, Pulaski, and Williamson Counties. Most rail bridges in Alexander and Massac Counties are not operational the day after the event. Bridges in Hardin, Williamson, Gallatin, and Jackson Counties are damaged and likely function at severely reduced capacities. Additionally, most ports in southern Illinois, are damaged and not functioning, including all 15 ports in Alexander, Pulaski, and Massac Counties.

Utility Lifelines

Thousands of utility facilities are damaged in Illinois with most damage occurring in southern Illinois. Tens of thousands of oil facilities, particularly oil wells, are located in southern Illinois, and over 750 are damaged by the scenario earthquake. Table 27 details utility facility damage for the state and shows that communication facilities are also damaged significantly. Over 1,700 facilities are damaged compromising the integrity of communication systems in southern Illinois, effectively limiting communication for the immediate response effort. Furthermore, over 600 waste water facilities incur moderate or more severe damage.

Facilities are not the only utility infrastructure damaged by the scenario event. Utility pipelines are heavily damaged, especially in southern Illinois where ground shaking is most intense and ground deformation most severe. Local distribution pipelines for waste water and potable water require 17,500 repairs while local natural gas lines require 8,200 repairs, as shown in Table 28. Interstate pipelines for natural gas and oil require nearly 1,500 repairs, without which service to the east coast and northern states will be severely impacted

Table 27: Utility Facilities Damage for Illinois¹⁷

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	242	14	0
Waste Water Facilities	9,807	616	5
Natural Gas Facilities	3,778	150	3
Oil Facilities	41,105	755	0
Electric Facilities	2,231	75	0
Communication Facilities	36,436	1,715	30

Table 28: Utility Pipeline Damage for Illinois

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	164,800	4,396	5,372	9,768
Waste Water Local	98,900	3,480	4,252	7,732
Natural Gas Local	74,200	3,651	4,516	8,167
Natural Gas Interstate	15,000	371	955	1,326
Oil Interstate	8,400	37	111	148

¹⁷ Please reference footnote 3.

Hundreds of thousands of households are without critical utility services immediately after the event as a result of infrastructure damage. Nearly 100,000 households are without potable water service in southern Illinois immediately after the event. Over 90% of households in the following counties are without water immediately after the event: Alexander, Pulaski, Massac, and Jackson. Substantial outages are also reported in Perry, St. Clair, and Fayette Counties. Table 29 also shows that approximately 235,000 households are without power. Figure 13 details the distribution of power outages in Illinois. Union, Johnson, Alexander, Pulaski, and Massac Counties experience the greatest percentages of power loss with over 80% of households without power immediately after the event. Numerous other counties in southern Illinois show significant power losses and are likely to be without service for several days or weeks.

Table 29: Service Outages at Day 1 for Illinois

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	4,592,000	235,000	95,000

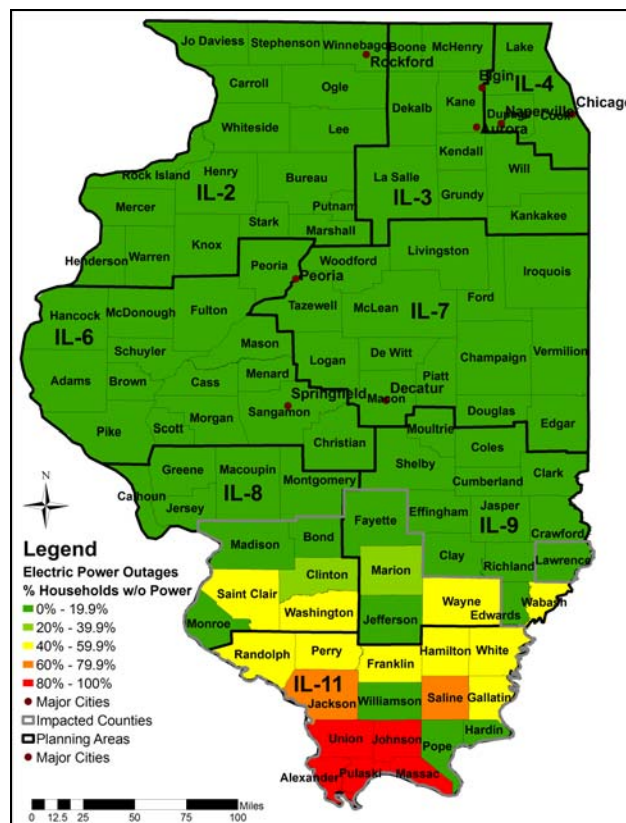


Figure 13: Electric Power Outages at Day 1 for Illinois

Other Critical Infrastructure

Damage to critical infrastructure is most common in the southernmost counties of Illinois. All damaged dams are located in Johnson, Massac, Union, Pope, and Pulaski Counties. Additionally, damage to levees occurs in Union, Pope, Alexander, Massac, and Pulaski

Counties. Hazardous materials facilities require substantially more intense ground shaking than dams and levees for damage to occur. These levels of ground shaking occur only in the southernmost parts of Illinois. Nearly 40 hazardous materials facilities are damaged in Alexander, Massac, and Pulaski Counties. Table 30 details the state inventory and damage to other critical infrastructure.

Table 30: Other Critical Facilities Damage for Illinois

Facility Type	Total Facilities	Damaged
Dams	1,562	31
Levees	576	34
Hazardous Materials	17,130	36

Induced Damage, Casualties, and Economic Losses

Extensive damage to buildings and other infrastructure create significant amounts of debris, especially in southern Illinois. Nearly 2.8 million tons of total debris are generated in Illinois. St. Clair County produces the most debris of any single county, roughly 850,000 tons. Massac and Madison Counties produce roughly 300,000 tons of total debris each. Three additional counties generate more than 100,000 tons each: Alexander, Jackson and Pulaski Counties. These six counties alone generate a total of two million tons of debris, or more than 70% of all debris in the state. As Table 31 illustrates, over 110,000 truckloads¹⁸ are required to remove all the debris created by the earthquake event.

Falling debris and damaged infrastructure lead to nearly 6,300 total casualties throughout the state. Casualties are detailed, by type, in Table 32. The largest number of casualties, 2,500 total casualties, occurs in St. Clair County. Many of these casualties are injuries. Most fatalities occur in more southern counties. Massac, Madison, Pulaski, and Alexander Counties also incur large numbers of casualties of 500 or 600. Figure 14 illustrates the distribution of casualties in Illinois.

Table 31: Debris Generation for Illinois

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	1,308,000	1,454,000	2,762,000	110,480

Table 32: Casualties at 2:00AM for Illinois

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	4,597	1,270	146	271	6,284

Total assets in Illinois include more than \$1 trillion in building value, nearly \$170 billion in transportation infrastructure value, and approximately \$1 trillion in utility infrastructure value. This equates to more than \$2.2 trillion in total infrastructure value throughout the state. The presence of an extensive utility inventory in southern Illinois

¹⁸ Please reference footnote 6.

contributes significantly to the direct economic losses in the state. As Table 33 shows, utility lifelines losses account for just under 80% of all economic losses. Building losses comprise a little less than 20%, while the remaining 3% are attributed to transportation losses. Total economic losses of more than \$44 billion are among the largest in the eight-state study region.

Table 33: Direct Economic Loss for Illinois (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$8,105	\$1,303	\$34,764	\$44,172

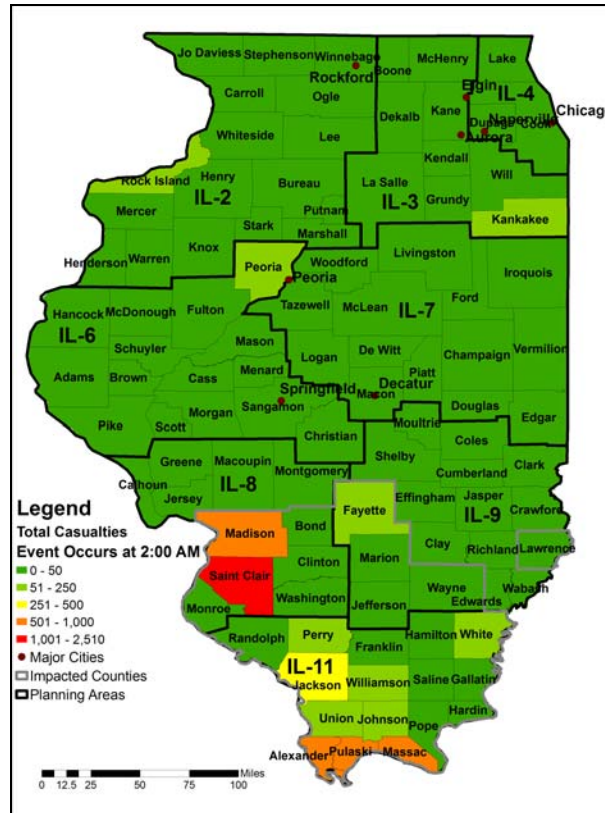


Figure 14: Total Casualties for 2:00AM Event in Illinois

Indiana Earthquake Impact Assessment Results

The earthquake impact analysis of Indiana was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 14 counties were selected as ‘impacted counties’ in Indiana and are listed below:

- Crawford
- Dubois
- Gibson
- Harrison
- Knox
- Lawrence
- Martin
- Orange
- Perry
- Pike
- Posey
- Spencer
- Vanderburgh
- Warrick

General Building Stock

There are approximately 2.2 million buildings in the State of Indiana, of which approximately 2.1 million are residences. Over 90% of those residences are single family homes with the remainder being multiple family dwellings. Additionally, 1.6 million buildings are wood frame structures and another 420,000 are URM structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Over 14,000 buildings are damaged statewide, with approximately half of this damage occurring in the impacted counties. Roughly 6,800 buildings, or nearly 50% of all damaged buildings, experience complete damage. Single family homes experience a substantial portion of building damage, over 80% of all complete damage and nearly 50% of all moderate and more severe damage. Table 34 also shows that other residential structures incur roughly 45% of all moderate and more severe damage and 15% of all complete damage.

Table 34: Building Damage by Occupancy Type for Indiana¹⁹

General Building Damage by Occupancy Type for Indiana			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	1,883,300	6,800	5,600
Other Residential	251,700	6,400	1,000
Commercial	41,200	600	100
Industrial	13,600	200	< 50
Other	12,200	200	100
Total	2,202,000	14,200	6,800

¹⁹ Please reference footnote 1.

Table 35: Building Damage by Building Type for Indiana²⁰

General Building Damage by Building Type For Indiana			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	1,587,800	4,800	4,700
Steel	21,800	600	100
Concrete	6,200	100	< 50
Precast	6,300	100	< 50
Reinforced Masonry	3,200	< 50	< 50
Unreinforced Masonry	416,500	2,600	1,300
Manufactured Housing	160,200	6,000	600
Total	2,202,000	14,200	6,800



Figure 15: General Building Damage in Indiana (No. of Buildings Damaged)

Table 35 details building damage by building type. Wood frame construction comprises nearly 70% of all complete building damage and nearly 35% of all moderate or more severe building damage. Vanderburgh, Gibson, Marion, and Posey Counties incur the greatest numbers of damaged buildings of all counties in Indiana. Marion County shows a higher number of damaged buildings than the surrounding counties, though the 1,400 damaged buildings in this county are a very small portion of the total inventory of 290,000 buildings. Figure 15 illustrates the total number of buildings damage in each county in Indiana.

²⁰ Please reference footnote 1.

Essential Facilities

The southwestern portion of Indiana experiences the most intense shaking of any area in the state. As a result, all essential facilities incurring significant damage are located there. Posey County experiences the most substantial damage rendering over 110 of the 130 total hospital beds unusable. Additionally hospitals in Dubois, Gibson, Harrison, Orange, Perry, Pike, Spencer, and Vanderburgh Counties are operating at severely reduced capacities as the result of damage to their facilities. These counties provide roughly 5,400 beds, though only 3,400 are likely usable immediately after the event. With nearly 40% fewer beds than the typical 5,400, these southwestern Indiana counties must evacuate current patients as well as those seriously injured during or after the earthquake. A depiction of hospital damage in Indiana is provided in Figure 16.

Table 36: Essential Facilities Damage for Indiana²¹

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	2,874	6	0
Fire Stations	1,247	4	0
Police Stations	537	2	0
Hospitals	1,285	5	0
EOCs	113	1	0

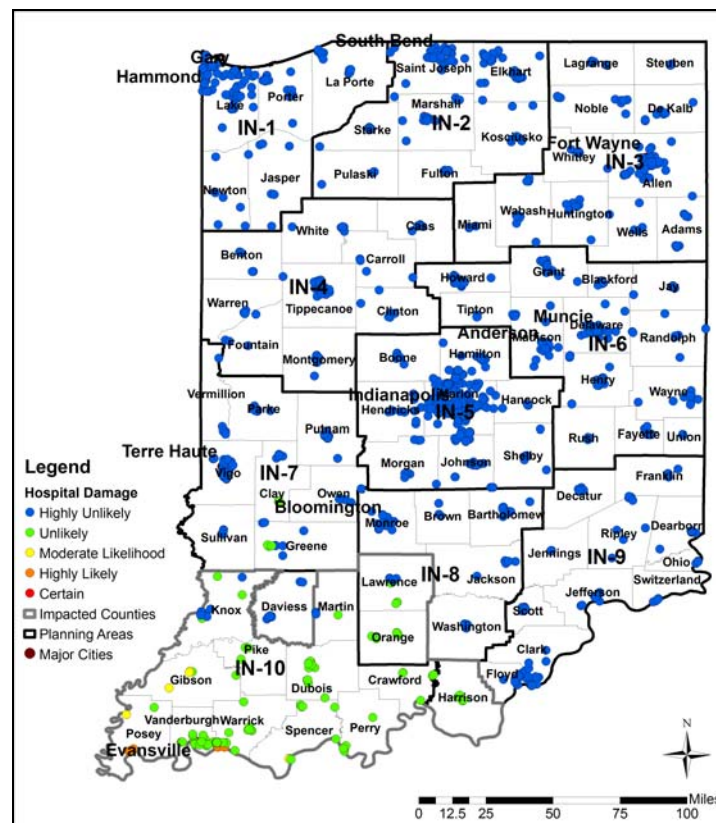


Figure 16: Hospital Damage for Indiana

²¹ Please reference footnote 3.

Police and fire response capabilities are severely reduced in the southwestern counties much the same as hospital capabilities. Posey County is likely to lose a majority of its law enforcement and fire services as a result of earthquake induced damage. The remaining 13 impacted counties contain more than 60 police stations and nearly 160 fire stations, many of which sustain some form of damage reducing the services these stations can provide. It is likely that all the impacted counties will require some level of external support.

Numerous schools in southwestern Indiana are damaged and in many cases unable to remain open. Posey, Vanderburgh, Gibson, Pike, Warrick, Dubois, Spencer, Perry, Crawford, Harrison, Orange, and Lawrence Counties are the most severely impacted counties in terms of the operational capabilities of schools. Many schools in these counties can not be used as temporary shelter, requiring the relocation of those seeking public shelter. Damage to schools and all other essential facilities are displayed in Table 36.

Transportation Lifelines

Air, highway, water, and rail transportation alternatives are all impacted by the New Madrid earthquake, though the lower levels of ground shaking in Indiana do not cause severe damage. Most airports throughout the state are operational immediately after the event. There are a total of 75 airports in the impacted counties, and most do not sustain damage that would inhibit or suspend their operation. Minor damage to airports in the southwestern part of Indiana, such as Posey, Vanderburgh, or Gibson Counties incur minor damage to non-structural components such as interior walls and ceilings, but nothing that compromises the structural integrity of the buildings. Table 37 details damage for airports and other transportation facilities in Indiana.

There are more than 20,000 bridges in the State of Indiana with nearly 3,000 in the impacted counties. Very few bridges in Indiana incur damage that inhibits or prevents their usage immediately after the event. Minor damage to bridge piers or abutments is likely, such as cracking of concrete. Also, small displacements due to the settlement or lateral shifting of the ground may occur. These displacements do not cause significant damage to bridges, such as unseating of deck spans. Cracking of concrete and small displacements occur in southwestern Indiana and appear less frequently in central and northern Indiana.

Seven major river crossings are included in the Indiana bridge analysis. All of these bridges cross the Ohio River separating Indiana from Kentucky. These bridges provide access to Indiana in Vanderburgh, Spencer, Perry, and Harrison Counties. Two of these bridges across the Ohio River carry major roads: US Route 41 in Vanderburgh County and US Route 231 in Spencer County. All of these major river crossings are expected to remain operational immediately after the earthquake, though minor cracking of concrete or settlement may occur. Figure 17 displays the locations of all major river crossings in or bordering Indiana.

Table 37: Transportation Lifeline Damage for Indiana²²

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	20,387	0	0
Railway Bridges	92	0	0
Railway Facilities	149	0	0
Bus Facilities	46	0	0
Port Facilities	100	0	0
Airport Facilities	675	0	0

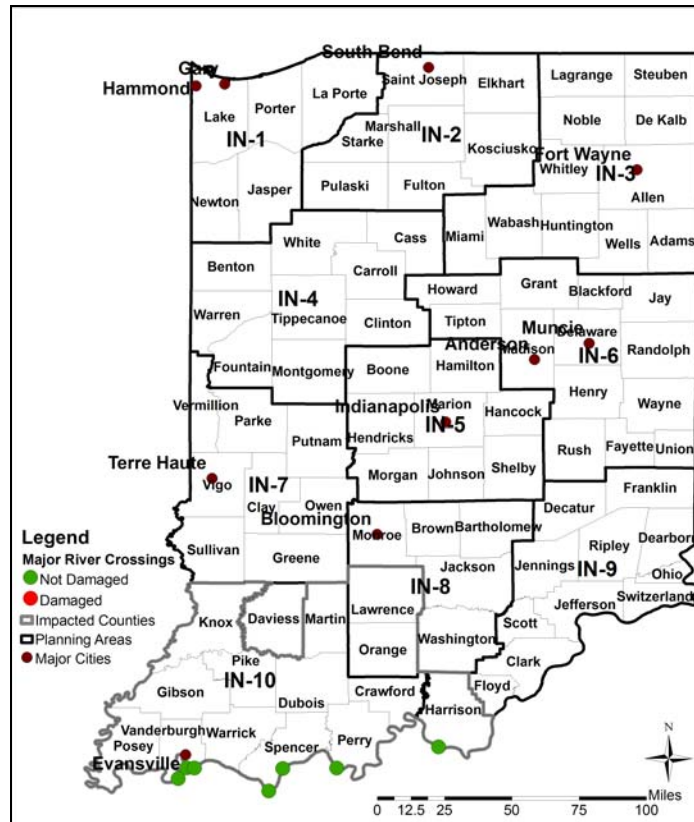


Figure 17: Major River Crossing Damage for Indiana

Railway bridges and facilities are largely undamaged throughout the state. As with airports, minor structural damage to railway facilities does not compromise the use of these structures. Non-structural damage to walls and ceilings, as well as equipment at railway facilities, is possible, particularly in the southwestern portion of the state. Railway bridges are expected to incur damage similar to highway bridges and in similar portions of the state. Numerous ports in Indiana are located along the southern border, on the Ohio River. These ports remain operational immediately after the earthquake, though minor damage is likely. Minor damage includes cracking of supporting piers on waterfront structures and misalignment of handling equipment.

²² Please reference footnote 3.

Utility Lifelines

Ground shaking throughout Indiana is not sufficient to cause significant structural damage to utility facilities, as is evident in Table 38. As with transportation infrastructure minor damage is possible and non-structural damage may reduce the capacity of some utility facilities. A large portion of pipeline damage occurs in southern Indiana where local pipeline networks are likely off-line for an extended period of time. Also natural gas and oil major transmission line damage is shown in Table 39. These are the large pipelines that carry product between states. Though the repairs required in Indiana are significant the number of repairs is still substantially less than in other NMSZ states.

Table 38: Utility Facilities Damage for Indiana²³

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	203	0	0
Waste Water Facilities	4,531	0	0
Natural Gas Facilities	3,556	0	0
Oil Facilities	5,771	0	0
Electric Facilities	975	0	0
Communication Facilities	22,806	0	0

Table 39: Utility Pipeline Damage for Indiana

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	111,400	727	1,080	1,807
Waste Water Local	66,800	575	854	1,429
Natural Gas Local	44,600	615	913	1,528
Natural Gas Interstate	10,200	9	24	33
Oil Interstate	4,600	28	102	130

Damage to the electric grid leaves over 220,000 households without power immediately after the event. Figure 18 shows the percentage of households in each Indiana county that are without power immediately after the event. Marion and Vanderburgh Counties show the greatest number of households without power at roughly 50,000 and 32,000 households, respectively. Additionally, Clark, Delaware, Hamilton, Hendricks, Madison, Monroe, Tippecanoe, Vigo, and Warrick Counties each report between 5,000 and 10,000 households without power at Day 1. Though not specifically shown here, it is likely that many of the critical facilities in southern Indiana are also without electric power. This includes hospitals, schools, telecommunication infrastructure, emergency command centers and other facilities that are critical to response efforts. Damage to the potable water system leaves nearly 15,000 households without water at Day 1. Table 40 shows the outages expected as a result of the NMSZ scenario event. Over 75% of all outages estimated in Indiana occur in Gibson County. Over 85% of households in Gibson County are expected to be without water immediately after the event.

²³ Please reference footnote 3.

Table 40: Service Outages at Day 1 for Indiana

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	2,336,000	222,000	15,000

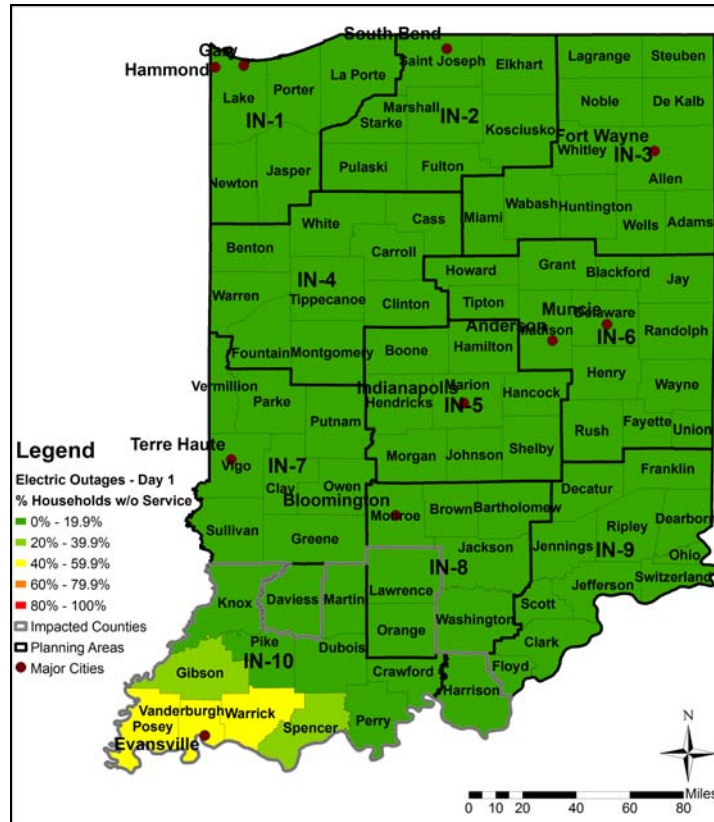


Figure 18: Electric Power Outages at Day 1 for Indiana

Other Critical Infrastructure

Damage to dams, levees, and hazardous materials facilities is unlikely in Indiana. Ground shaking is not intense enough to cause significant structural damage and thus no release of water or hazardous material is expected. Table 41 shows that none of the several thousands critical facilities incur damage, though minor cracking or damage may occur.

Table 41: Other Critical Facilities Damage for Indiana

Facility Type	Total Facilities	Damaged
Dams	1,187	0
Levees	101	0
Hazardous Materials	5,112	0

Induced Damage, Casualties, and Economic Losses

Over one million tons of debris is generated by the NMSZ scenario earthquake. Table 42 shows roughly 560,000 tons are brick, wood and other debris while steel and concrete comprise 490,000 tons of debris. Nearly 50% of all debris is generated in three counties: Gibson, Marion, and Vanderburgh Counties. Marion County alone, where Indianapolis is located, generates nearly 230,000 tons of debris. Though the shaking beneath Marion County, and Indianapolis, is relatively low, small amounts of debris generated by minor damage are amplified due to the density of housing and infrastructure. Nearly 42,000 truckloads²⁴ are required to remove all the debris generated from the event.

Table 42: Debris Generation for Indiana

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	488,000	561,000	1,049,000	41,960

Table 43: Casualties at 2:00AM for Indiana

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	1,458	395	43	80	1,976

Nearly 2,000 casualties are expected in Indiana, with approximately 80 total fatalities. Nearly 40% all casualties occur in the 14 impacted counties. Four counties, not all in southern Indiana, experience a large portion of casualties: Gibson, Vanderburgh, Marion and Tippecanoe Counties. Nearly all casualties in Tippecanoe and Marion Counties are minor injuries that do not require hospitalization while the other two counties have greater numbers of serious injuries as well as minor injuries. These four counties account for nearly 60% of all fatalities. All casualties, separated by type, are shown in Table 43, and displayed in Figure 19.

Total assets in Indiana include nearly \$500 billion in building value, nearly \$115 billion in transportation infrastructure value, and approximately \$430 billion in utility infrastructure value. This equates to more than \$1 trillion in total infrastructure value throughout the state. Total direct economic losses are roughly \$12 billion for the entire state. Utility losses are a large portion of all state economic losses accounting for nearly 70% of all economic losses. Building losses comprise nearly 30% of all losses and the remaining losses are attributed to transportation lifelines. Losses in Indiana are far less than many states included in the NMSZ study region.

Table 44: Direct Economic Loss for Indiana (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$3,472	\$464	\$8,355	\$12,291

²⁴ Please reference footnote 6.

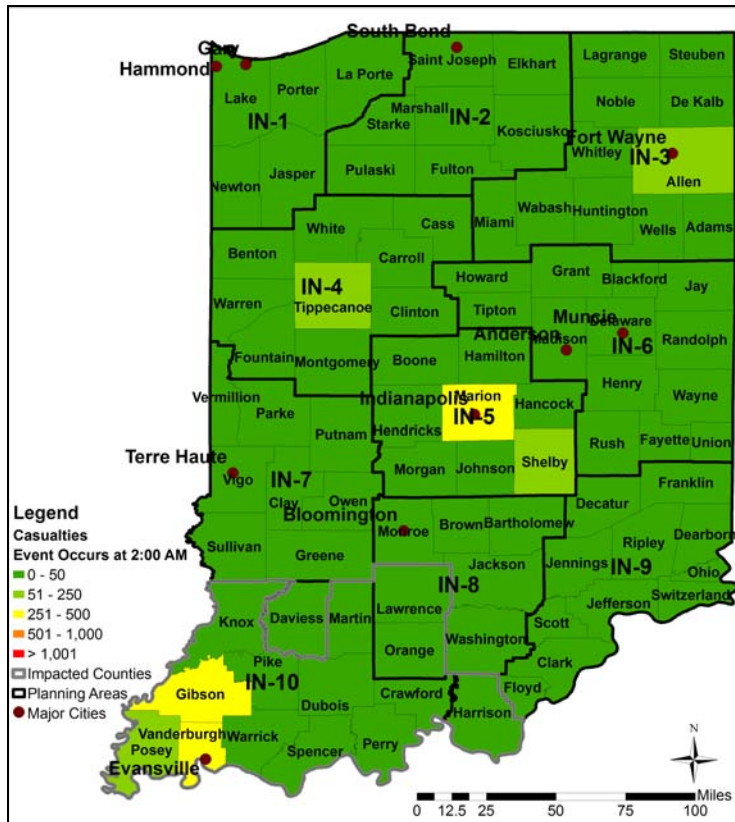


Figure 19: Total Casualties for 2:00AM Event in Indiana

Kentucky Earthquake Impact Assessment Results

The earthquake impact analysis of Kentucky was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 19 counties were selected as ‘impacted counties’ in Kentucky and are listed below:

- Ballard
- Caldwell
- Calloway
- Carlisle
- Crittenden
- Daviess
- Fulton
- Graves
- Henderson
- Hickman
- Hopkins
- Livingston
- Lyon
- McCracken
- Marshall
- Muhlenberg
- Trigg
- Union
- Webster

General Building Stock

There are approximately 1.54 million buildings in the State of Kentucky, with approximately 1.52 million residences. Roughly 80% of those residences are single family homes, while the remaining are multiple family dwellings. Over 1.1 million buildings are wood frame structures, while another 170,000 are URM structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Over 68,000 buildings are damaged statewide, though the majority of this damage occurs in the impacted counties. Roughly 24,500 buildings, or approximately 35% of all damaged buildings, are completely damaged. Residential structures account for a large portion of damage to buildings, as is shown in Table 45. Single family homes account for more than 60% of all damaged buildings with over 42,000 damaged homes, and multiple family dwelling comprising another 30% of building damage by building use group with nearly 23,000 damaged structures. Single family homes incur a larger proportion of complete damage. Roughly 65% of all complete damage occurs to this occupancy type. Multiple family dwellings account for approximately 30% of all complete damage.

Wood frame construction comprises roughly 50% of all complete building damage and also more than 50% of all moderate or more severe building damage. URM structures also comprise a substantial portion of damage, which is evident in Table 46. This structure type accounts for approximately 20% of all complete damage and nearly 15% of all moderate and more severe damage.

Table 45: Building Damage by Occupancy Type for Kentucky²⁵

General Building Damage by Occupancy Type for Kentucky			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	1,194,800	42,100	16,100
Other Residential	305,100	22,800	7,100
Commercial	28,100	2,200	900
Industrial	7,900	700	200
Other	8,000	600	200
Total	1,543,900	68,400	24,500

Table 46: Building Damage by Building Type for Kentucky²⁶

General Building Damage by Building Type For Kentucky			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	1,106,000	36,100	12,700
Steel	14,100	1,700	500
Concrete	3,900	300	100
Precast	4,000	300	100
Reinforced Masonry	2,000	100	< 50
Unreinforced Masonry	170,100	9,400	5,000
Manufactured Housing	243,800	20,500	6,100
Total	1,543,900	68,400	24,500

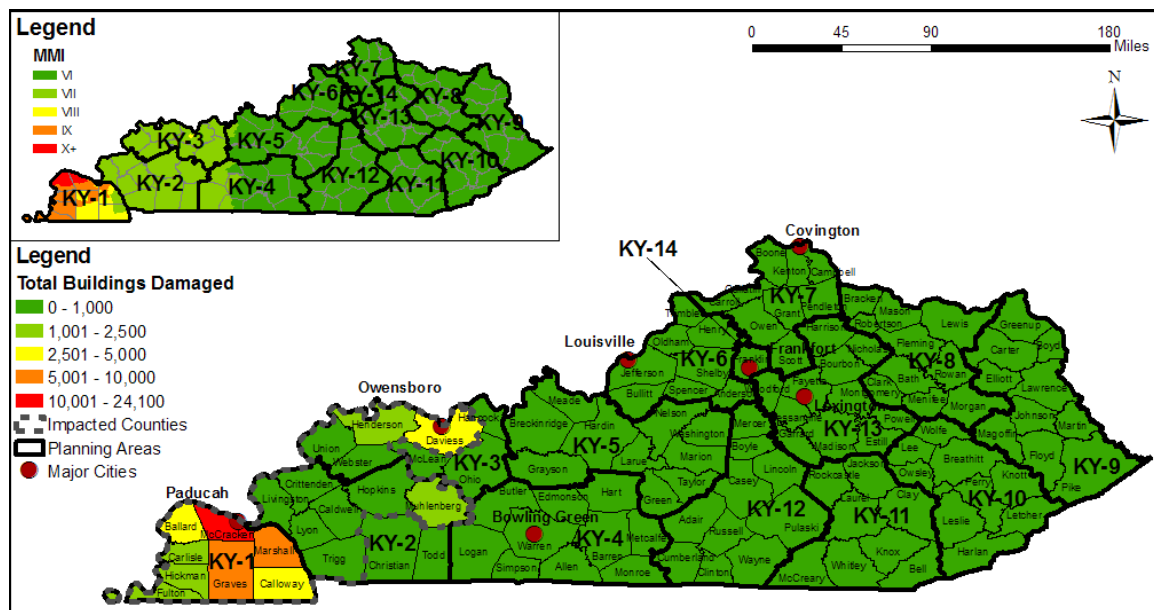


Figure 20: General Building Damage in Kentucky (No. of Buildings Damaged)

Additionally, Figure 20 illustrates the number of damaged buildings in Kentucky. The largest number of damaged buildings occurs in McCracken County where 24,100 structures are damaged. Graves and Marshall Counties also incur substantial building

²⁵ Please reference footnote 1.

²⁶ Please reference footnote 1.

damage at 9,000 and 5,100 buildings, respectively. Conversely, over 90% of all buildings in Ballard and Hickman Counties are expected to be damaged. Additionally, 80% - 90% of buildings in McCracken and Carlisle Counties are damaged as well.

Essential Facilities

The western portion of Kentucky experiences intense shaking, leaving most of the hospitals in that area unable to care for current patients and those injured as a result of the earthquake. A total of roughly 25 hospitals are located in the 19 impacted counties, together providing approximately 2,600 beds. The day after the earthquake, roughly 650 beds are available, while the remaining 1,950 beds are unusable due to damage from the earthquake. Damaged hospitals are defined by structural damage only, and numerous counties in western Kentucky incur severe structural damage, including: Calloway, Daviess, Fulton, Graves, Marshall, and McCracken Counties. Additionally, several of the impacted counties do not have hospitals or urgent care facilities. Ballard, Carlisle, Hickman, Lyon, and Webster Counties lack emergency care facilities, requiring the evacuation of those injured by the earthquake. This means that healthcare services are limited immediately after the event for the nearly 500,000 people that reside in the impacted counties. Table 47 details the number of hospitals, and other essential facilities, damaged throughout the state. Most of the current patients and those injured during the event will require care outside this heavily impacted area. Neighboring counties such as Livingston, Crittenden, Caldwell, and Trigg Counties have numerous functional hospitals and may be able to provide the necessary medical care for those being evacuated from the most heavily impacted counties. Hospital damage is also illustrated in Figure 21.

Table 47: Essential Facilities Damage for Kentucky²⁷

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	1,871	99	40
Fire Stations	1,066	71	25
Police Stations	407	22	10
Hospitals	189	9	3
EOCs	146	10	5

Police and fire response capabilities are severely reduced in western Kentucky as well. A total of 71 fire stations and 22 police stations are damaged in Kentucky. Table 47 also shows that numerous fire and police stations incur complete damage. Most impacted counties experience substantial fire station damage. Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, and McCracken Counties are without most of the 60 fire stations located in those counties. Those fire stations that are not completely damaged throughout the impacted counties are operating at severely reduced capacity immediately after the earthquake due to structural damage. It is likely that all of the aforementioned counties will require extensive external support because such a large number are without adequate fire services.

²⁷ Please reference footnote 3.

The capabilities of local law enforcement are also severely reduced in western Kentucky. There are approximately 55 police stations in the 19 impacted counties. Police stations in Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Livingston, Marshall, and McCracken Counties incur substantial structural damage, and many are unusable. These counties in western Kentucky require substantial external support immediately after the event. Surrounding counties may likely experience minimal damage to police stations and could provide service for their respective jurisdictions as well as some external support to severely impacted counties.

The schools in western Kentucky are severely damaged and unable to operate since all of the nearly 100 damaged schools are located in the western portion of the state. Of the approximately 230 schools in the 19 impacted counties, all damaged schools are completely unusable or are operating at reduced capacity. Most schools in Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Livingston, Marshall, and McCracken Counties can not be used as temporary shelters, thus requiring the evacuation of most people seeking public shelter.

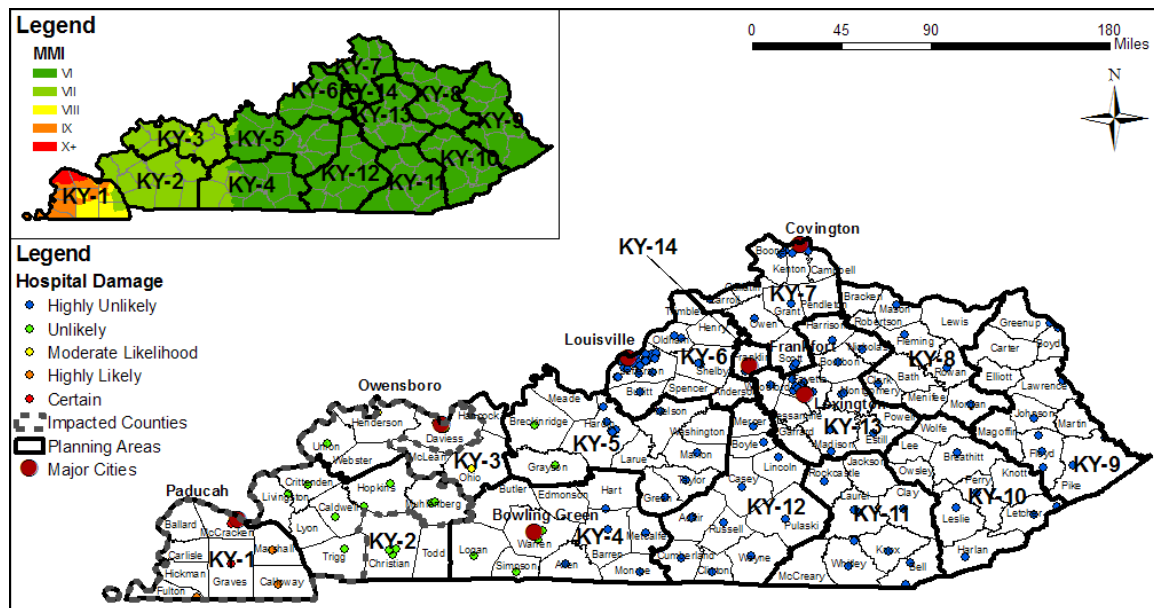


Figure 21: Hospital Damage for Kentucky

Transportation Lifelines

Damage to transportation infrastructure is extensive, particularly in western Kentucky. Table 48 details transportation infrastructure damage for the entire state. A total of 13 airports in Kentucky are damaged. The airports in Carlisle, Fulton, Graves, Hickman, and McCracken Counties experience severe damage, leaving these counties with few operational facilities. There are nearly 10 airports in these five counties, most of which are not operational the day after the event. Additionally, some airports in Calloway, Livingston, and Marshall Counties are damaged, severely limiting access to the western portion of Kentucky via air transport.

There are approximately 15,400 bridges in the State of Kentucky and roughly 3,200 bridges in the 19 impacted counties. More than 250 bridges are damaged in Kentucky and all are in western Kentucky. Of the 262 damaged bridges, nearly 65 bridges are completely damaged. As a result, many of these bridges are expected to be impassible the day after the earthquake. Many damaged bridges are located in Ballard and McCracken Counties. Numerous bridges along US-51, US-60, and US-45 are heavily damaged and likely impassible the day after the earthquake. Damage to highways and interstates due to ground deformation from liquefaction is also common and further impedes the ability to evacuate residents and provide aid workers access to western Kentucky.

Table 48: Transportation Lifeline Damage for Kentucky²⁸

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	15,418	262	64
Railway Bridges	166	3	0
Railway Facilities	125	17	0
Bus Facilities	26	1	0
Port Facilities	301	61	0
Airport Facilities	222	13	0

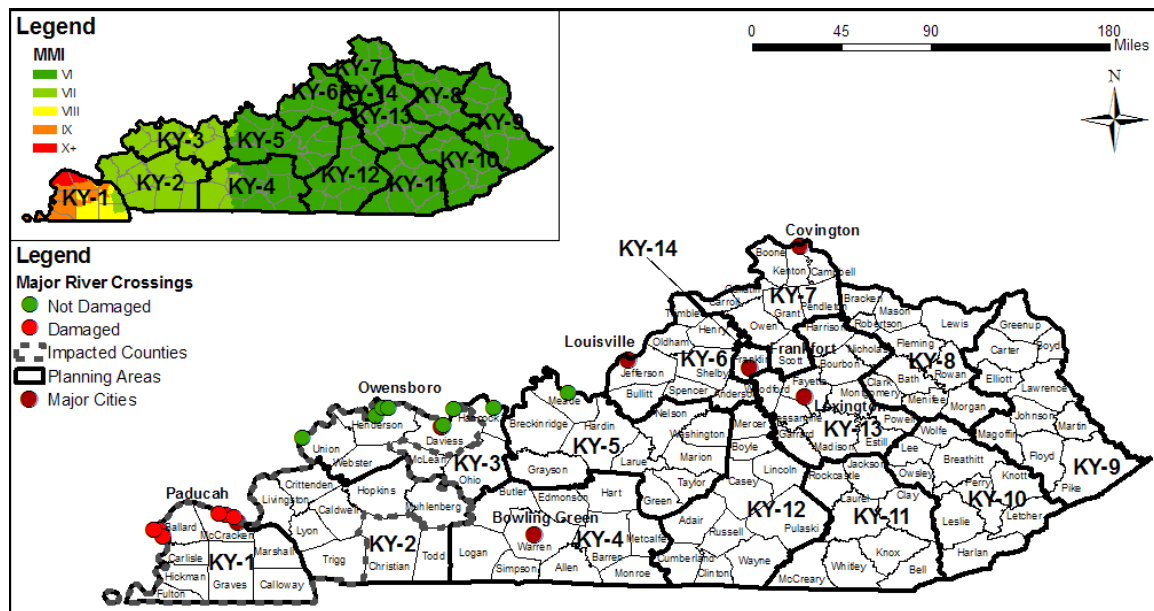


Figure 22: Major River Crossing Damage for Kentucky

Approximately 15 major river crossings are included in the Kentucky bridge analysis. All bridges cross the Mississippi and Ohio Rivers. Those bridges damaged during the event severely limit traffic between Kentucky and Arkansas, Tennessee, and Missouri. It is estimated that several bridges from Cairo, IL to Kentucky are damaged as well as the I-24 Bridge from Metropolis, Illinois, and the Irvin S. Cobb Bridge at Paducah, Kentucky, are substantially damaged and unusable after the event. With these bridges down,

²⁸ Please reference footnote 3.

transferring commodities and aid into the heavily impacted area of western Kentucky from the north and west via the highway/interstate systems will be virtually impossible.

Railway bridges and facilities are also damaged in Ballard, McCracken, Fulton, Graves, and Livingston Counties. Most rail bridges in Ballard and McCracken Counties are not operational the day after the event. Railway facilities in western Kentucky are heavily damaged, making continued operation in the days after the event highly unlikely. Similarly, most ports along the Mississippi and Ohio Rivers in western Kentucky are significantly damaged and unable to operate at full capacity. This includes port facilities in Ballard, Carlisle, Fulton, Hickman, Livingston, and McCracken Counties.

Utility Lifelines

Utility facilities in Kentucky are heavily damaged and many are inoperable, particularly in western Kentucky. Approximately 200 electric power facilities are damaged, with most damage occurring in Ballard, Caldwell, Calloway, Carlisle, Crittenden, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken, and Trigg Counties. Natural gas and oil production is also greatly reduced and most operations are shut down completely due to significant structural damage.

Table 49 shows that nearly 80 natural gas facilities and 175 oil facilities in the impacted counties are damaged. Most damaged natural gas facilities are located in Ballard, Caldwell, Calloway, Carlisle, Crittenden, Fulton, Graves, Hickman, Hopkins, Livingston, Lyon, Marshall, Trigg, Union, and Webster Counties. Most damaged oil facilities are located in Caldwell, Crittenden, Hickman, Hopkins, McCracken, Trigg, Union, and Webster Counties.

Communication capabilities are severely reduced in the most heavily impacted portions of Kentucky. Communication facilities include television and radio stations, AM and FM transmitters/towers, central offices, and internet service providers, among others. Nearly 1,400 communication facilities are damaged with most damage occurring in Ballard, Caldwell, Calloway, Carlisle, Crittenden, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken, Trigg, and Union Counties.

Table 49: Utility Facilities Damage for Kentucky²⁹

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	179	17	0
Waste Water Facilities	9,447	650	5
Natural Gas Facilities	22,146	77	0
Oil Facilities	34,492	175	0
Electric Facilities	1,976	202	2
Communication Facilities	17,099	1,373	24

²⁹ Please reference footnote 3.

Local distribution pipelines experience significant damage due to ground shaking and ground deformation. A large portion of repairs are required in western Tennessee where the affects of the earthquake are most intense. Local potable and waste water pipelines experience over 20,000 breaks and leaks which will take several weeks or months to fully repair. Additionally, natural gas service is severely reduced for local customers and neighboring states as both local and interstate pipelines are heavily damaged as is shown in Table 50. Interstate oil pipelines are damaged as well and inhibit the flow of oil to the upper Midwest and east coast.

Table 50: Utility Pipeline Damage for Kentucky

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	120,800	5,834	5,572	11,406
Waste Water Local	61,600	4,614	4,408	9,022
Natural Gas Local	41,100	4,932	4,712	9,644
Natural Gas Interstate	7,400	72	214	286
Oil Interstate	1,200	37	105	142

Table 51: Service Outages at Day 1 for Kentucky

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	1,591,000	329,000	76,000

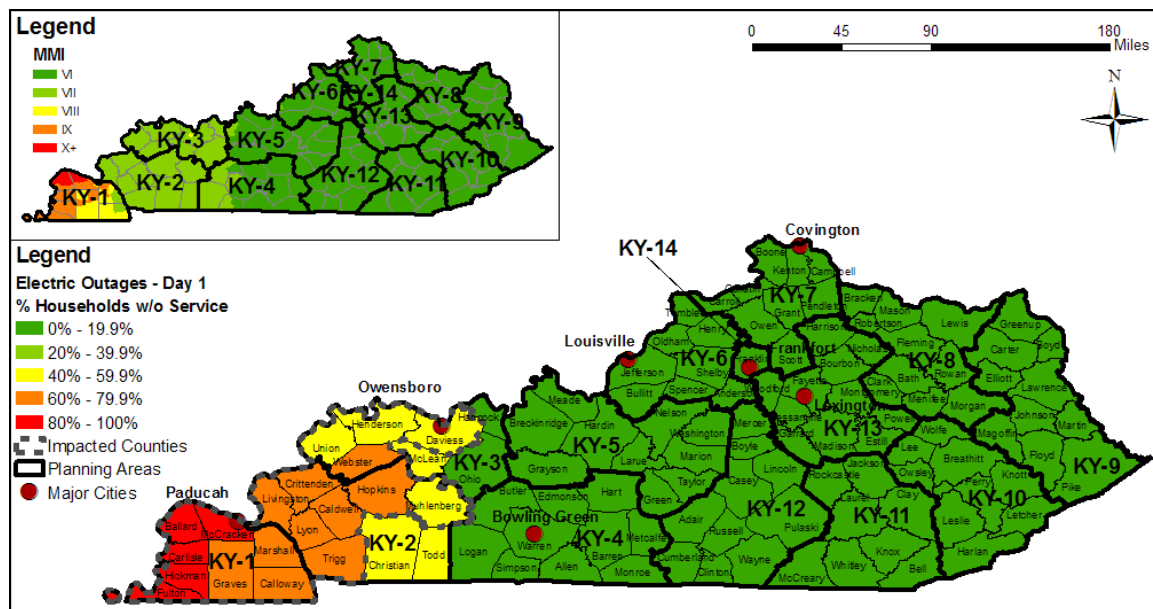


Figure 23: Electric Power Outages at Day 1 for Kentucky

Damage to electric grid components leaves hundreds of thousands of households without power immediately after the earthquake. Nearly 330,000 households are without power at Day 1 (see Table 51). Nearly 125,000 households are without power in the impacted counties, which equates to more than 60% of all households in the impacted counties. Although only 13% of all Kentucky households are located in the impacted counties, this portion of the state accounts for nearly 40% of all Kentucky households without power at Day 1. Though not explicitly shown here, it is likely that many of the critical facilities in

western Kentucky are also without electrical power. Figure 23 illustrates the percentage of households without power in Kentucky.

Potable water network damage leaves more than 76,000 households without water at Day 1 (see Table 51). Over 90% of all households in Ballard, Carlisle, Fulton, Graves, Hickman, and McCracken Counties are without water immediately after the event. Furthermore, 75% of all households in Marshall County and 50% of all households in Calloway Counties are without water.

Other Critical Infrastructure

Critical infrastructure in western Kentucky is heavily damaged and secondary impacts are possible as a result. Table 52 details state damage totals for various types of critical infrastructure. Over 50 dams are damaged and all are located in Carlisle, Ballard, Hickman, McCracken, and Graves Counties. Fulton and McCracken County are expected to incur levee damage, while most hazardous materials facilities damage is confined to Ballard and McCracken Counties. Many of these counties are at risk of flooding from dam and levee failure or hazardous materials release.

Table 52: Other Critical Facilities Damage for Kentucky

Facility Type	Total Facilities	Damaged
Dams	1,196	53
Levees	90	10
Hazardous Materials	2,865	43

Induced Damage, Casualties, and Economic Losses

Damage to tens of thousands of buildings and thousands of other transportation and utility facilities generates substantial amounts of debris. Table 53 lists state debris totals by debris type as well as the number of truckloads required to remove all debris. Over 4.8 million tons of debris is generated throughout the state with nearly 2.8 million tons attributed to brick, wood, and other materials. The remaining two million tons is attributed to steel and concrete. McCracken County generates more debris than any other county in the state, with nearly 2.1 million tons of total debris. Nearly 550,000 tons of debris are generated in Graves County and roughly 350,000 tons are generated in each of Marshall and Daviess Counties. Though Daviess County is not located in the rupture zone the high density of infrastructure leads to larger amounts of debris in that particular county. A total of 193,000 truckloads³⁰ are required to remove all debris.

Table 53: Debris Generation for Kentucky

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	2,058,000	2,760,000	4,818,000	192,720

³⁰ Please reference footnote 6.

Table 54: Casualties at 2:00AM for Kentucky

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	5,042	1,358	153	287	6,840

The scenario event causes nearly 7,000 total casualties in the State of Kentucky. As Table 54 shows, over 5,000 casualties are minor injuries and roughly 1,500 are injuries which require medical attention or immediate hospitalization. Of the nearly 300 fatalities roughly 250 occur in planning area KY-1 in western Kentucky. Figure 24 illustrates the number of total casualties, by county, experienced throughout the state. The largest number of total casualties, approximately 2,750, occurs in McCracken County. Graves, Ballard, Daviess, and Marshall Counties each incur roughly 500 casualties as a result of building and infrastructure damage.

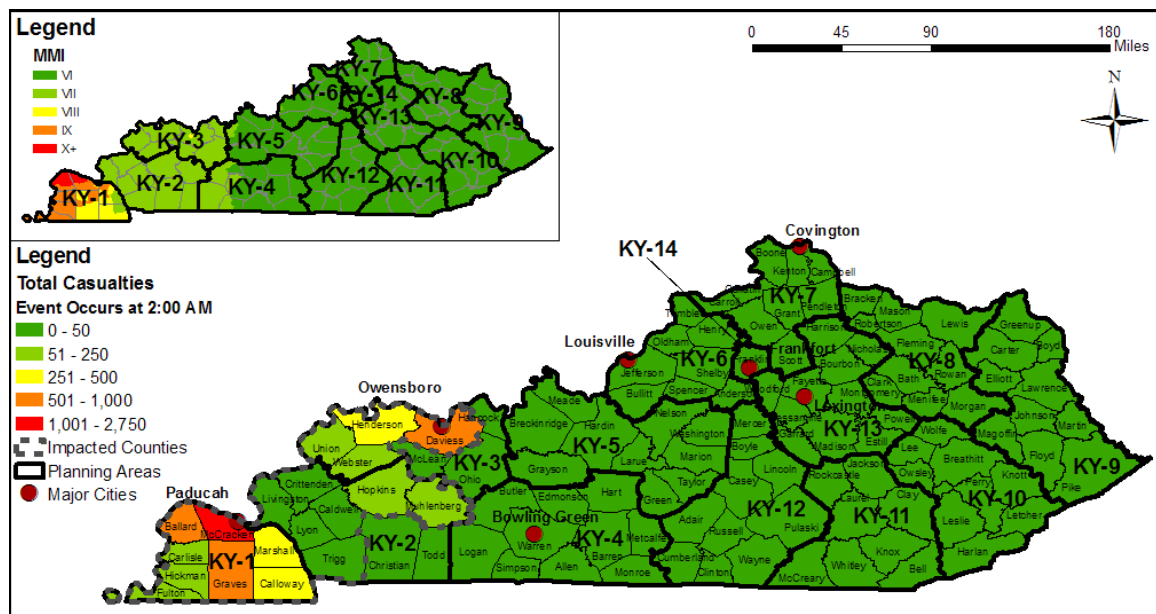


Figure 24: Total Casualties for 2:00AM Event in Kentucky

Total assets in Kentucky include nearly \$290 billion in building value, approximately \$135 billion in transportation infrastructure value, and nearly \$875 billion in utility infrastructure value. This equates to approximately \$1.3 trillion in total infrastructure value throughout the state. Total direct economic losses are nearly \$53 billion for Kentucky, which is among the greatest economic loss estimates of all states in the study region. Utility network loss is a large portion of all economic losses, accounting for more than 75% of all direct losses. Building losses of over \$11 billion comprise a smaller portion, roughly 20%, of all state losses. Table 55 details economic losses by type for Kentucky.

Table 55: Direct Economic Loss for Kentucky (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$11,369	\$1,131	\$40,261	\$52,761

Mississippi Earthquake Impact Assessment Results

The earthquake impact analysis of Mississippi was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 19 counties were selected as ‘impacted counties’ in Mississippi and are listed below:

- Alcorn
- Benton
- Bolivar
- Coahoma
- Desoto
- Lafayette
- Marshall
- Panola
- Pontotoc
- Prentiss
- Quitman
- Sunflower
- Tallahatchie
- Tate
- Tippah
- Tishomingo
- Tunica
- Union
- Yalobusha

General Building Stock

There are approximately 1.06 million buildings in the State of Mississippi, with approximately 1.03 million residences. Roughly 75% of those residences are single family homes, while the remaining are multiple family dwellings. Nearly 800,000 buildings are wood frame structures, while another 65,000 URM structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Table 56: Building Damage by Occupancy Type for Mississippi³¹

General Building Damage by Occupancy Type for Mississippi			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	814,000	22,700	17,400
Other Residential	222,000	31,500	4,200
Commercial	17,400	1,900	500
Industrial	4,600	700	100
Other	6,000	600	100
Total	1,064,000	57,400	22,300

Over 57,400 buildings are damaged statewide, though the majority of this damage occurs in the impacted counties. Roughly 22,300 of those buildings, or nearly 40% of all damaged buildings, are completely damaged as is evident in Table 56. Single family homes account for nearly 40% of all damaged buildings, with multiple family dwelling comprising another 45% of building damage by building use group. Single family homes

³¹ Please reference footnote 1.

incur a larger proportion of complete damage. More than 75% of all complete damage occurs to this occupancy type. Multiple family dwellings account for approximately 20% of all complete damage.

Table 57: Building Damage by Building Type for Mississippi³²

General Building Damage by Building Type For Mississippi			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	794,700	19,900	16,800
Steel	8,600	1,500	200
Concrete	2,600	300	100
Precast	2,600	400	100
Reinforced Masonry	1,200	100	< 50
Unreinforced Masonry	64,500	5,000	1,500
Manufactured Housing	189,800	30,200	3,600
Total	1,064,000	57,400	22,300

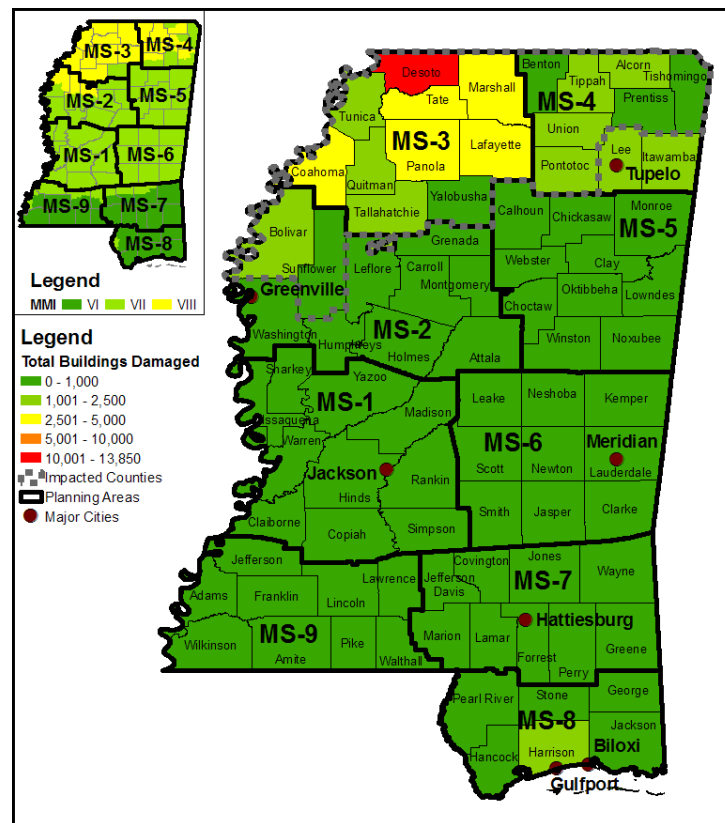


Figure 25: General Building Damage in Mississippi (No. of Buildings Damaged)

Building damage by building type is detailed in Table 57. Wood frame construction comprises roughly 75% of all complete building damage and also roughly 35% of all moderate or more severe building damage. URM structures comprise a smaller portion of damage. This structure type accounts for approximately 7% of all complete damage and

³² Please reference footnote 1.

nearly 10% of all moderate and more severe damage. Manufactured housing accounts for more than 50% of moderate and more severe damage, though only 15% of complete damage. Moreover, building damage totals are illustrated in Figure 25 by county.

Essential Facilities

The northern portion of Mississippi experiences moderate shaking, leaving many of the hospitals in that area unable to care for current patients and those injured as a result of the earthquake. Nearly 25 hospitals are damaged in the State of Mississippi and many of those facilities are located in the impacted counties. A total of roughly 25 hospitals are located the 19 impacted counties, together providing approximately 2,200 beds. The day after the earthquake, roughly 200 beds are available, while the remaining 2,000 beds are unusable due to damage from the earthquake. Damaged hospitals are defined by structural damage only, and numerous counties in northern Mississippi incur severe structural damage, including: Benton, Bolivar, Coahoma, Desoto, Lafayette, Marshall, Panola, Pontotoc, Prentiss, Quitman, Tallahatchie, Tate, Tippah, Union, and Yalobusha Counties. Additionally, not all impacted counties have hospitals or urgent care facilities. Tunica County lacks emergency care facilities requiring the evacuation of those injured by the earthquake. This means that healthcare services are limited immediately after the event for the nearly 555,000 people that reside in the impacted counties. Most of the current patients and those injured during the event will require care outside this heavily impacted areas where there are very few undamaged hospitals. Neighboring counties such as Washington, Leflore, Grenada, Calhoun, Chickasaw, and Monroe Counties have numerous functional hospitals, and may be able to care for those being evacuated from the most heavily impacted counties. The likelihood of hospital damage in Mississippi is illustrated in Figure 26. Damage totals for hospitals in Mississippi, as well as other essential facilities, are described in Table 58.

Table 58: Essential Facilities Damage for Mississippi³³

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	1,297	140	0
Fire Stations	984	104	0
Police Stations	365	42	0
Hospitals	163	23	2
EOCs	121	15	2

Police and fire response capabilities are severely reduced in northern Mississippi as well. Most impacted counties experience substantial fire station damage. Over 100 fire stations and 40 police stations are damaged in Mississippi. In particular, Alcorn, Benton, Desoto, Lafayette, Marshall, Panola, Quitman, Tate, and Tunica Counties are without most of the nearly 100 fire stations located in those counties. Those fire stations that are not completely damaged throughout the impacted counties are operating at severely reduced capacity immediately after the earthquake as the result of structural damage. This is the case in Coahoma, Prentiss, Tippah, and Tishomingo Counties where some, though not all,

³³ Please reference footnote 3.

fire stations are damaged. It is likely that all of the aforementioned counties will require extensive external support because since a large number are without adequate fire services.

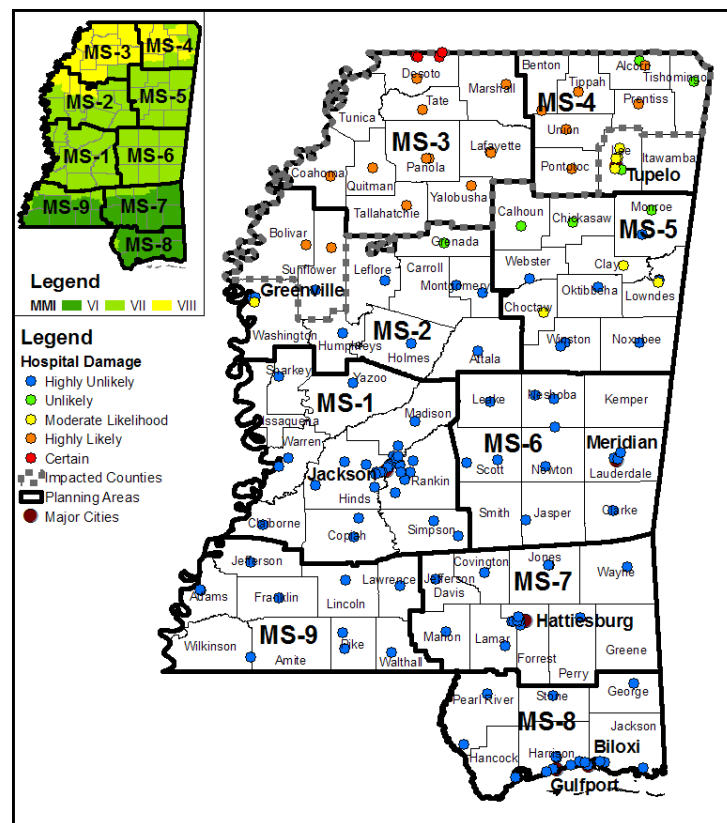


Figure 26: Hospital Damage for Mississippi

The capabilities of local law enforcement are also severely reduced in northern Mississippi. There are approximately 100 police stations in the 19 impacted counties. Police stations Alcorn, Benton, Coahoma, Desoto, Lafayette, Marshall, Panola, Quitman, Tate, Tippah, and Tunica Counties incur substantial structural damage and many are unusable. These counties in northern Mississippi require substantial external support immediately after the event. Surrounding counties may incur minimal damaged to police stations and could provide service for their respective jurisdictions as well as some external support to severely impacted counties.

The schools in northern Mississippi are severely damaged and unable to operate. Of the approximately 270 schools in the 19 impacted counties, roughly 140 are completely unusable or are operating at reduced capacity. Most schools in Alcorn, Benton, Desoto, Lafayette, Marshall, Panola, Quitman, Tate, Tippah, and Tunica Counties can not be used as temporary shelters, thus requiring the evacuation of most people seeking public shelter.

Transportation Lifelines

Numerous modes of transportation are impacted by the New Madrid earthquake, particularly in northern Mississippi. Though no airports incur significant structural damage, numerous airports in northern Mississippi incur minor structural damage. This is especially true in planning areas MS-3 and MS-4. This level of damage may limit access to some airports in northern Mississippi. Damage estimations for Mississippi transportation infrastructure are shown in Table 59.

There are approximately 18,300 bridges in the State of Mississippi and roughly 3,300 bridges in the 19 impacted counties. Fewer than 10 bridges incur substantial structural damage, and all are located in planning area MS-3. These bridges are expected to be impassible the day after the earthquake. Lesser levels of damage will impact a far greater number of bridges in northern Mississippi and may also affect the amount of traffic these bridges can carry in the first several days after the event. Damage to highways and interstates due to ground deformation from liquefaction is also common and further impedes the ability to evacuate residents and provide aid workers access to northern Mississippi.

Approximately 10 major river crossings are included in the Mississippi bridge analysis. All bridges cross the Mississippi River. Those bridges damaged during the event, severely limit traffic between Mississippi and Arkansas. It is estimated that the Charles W. Dean Bridge from Arkansas City, Arkansas, is damaged and unusable after the event. Transferring commodities and providing aid to the heavily impacted area of northern Mississippi via the highway/interstate systems is hindered by the severe damage to this major bridge in Bolivar County. Figure 27 illustrates the locations and damage levels for numerous major river crossings within and neighboring Mississippi.

Table 59: Transportation Lifeline Damage for Mississippi³⁴

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	18,293	6	0
Railway Bridges	63	0	0
Railway Facilities	76	0	0
Bus Facilities	41	0	0
Port Facilities	222	0	0
Airport Facilities	257	0	0

Railway bridges and facilities do not incur substantial structural damage as a result of the New Madrid Seismic Zone event. Lesser forms of structural damage, however, are common and will likely affect the operational capabilities of these types of facilities. Railway bridges and facilities in planning area MS-3 are likely to experience some structural damage, though substantial structural damage is unlikely. Similarly, most ports along the Mississippi River in northern Mississippi are likely to experience minor

³⁴ Please reference footnote 3.

structural damage and some damage to equipment. In some cases damage may reduce the operational capabilities of the facility.

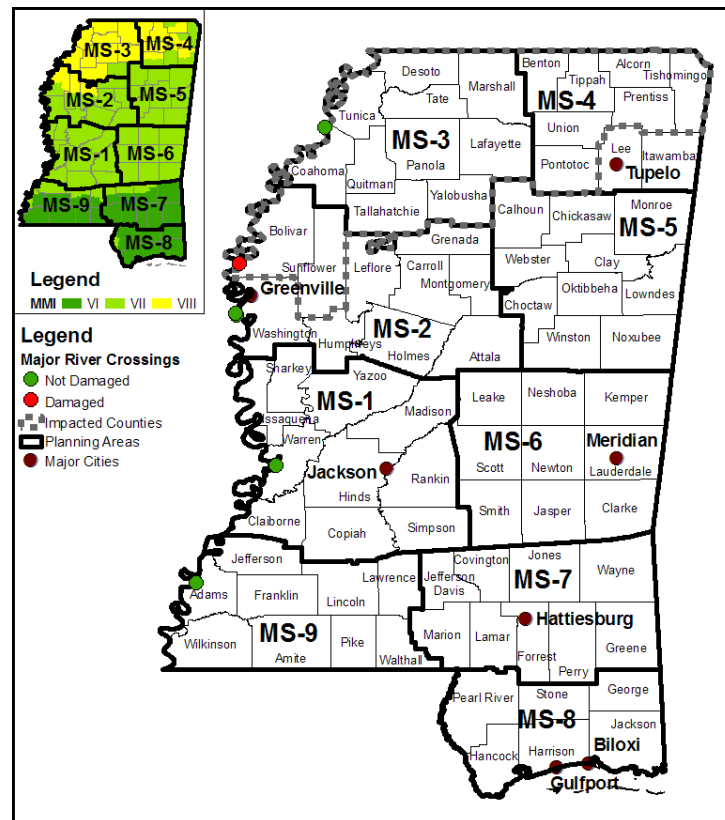


Figure 27: Major River Crossing Damage for Mississippi

Utility Lifelines

Numerous utility facilities are damaged in Mississippi, particularly northern Mississippi. Table 60 details the number of damaged facilities by type for the entire state. Communication capabilities are severely reduced in the most heavily impacted portions of Mississippi. Communication facilities include television and radio stations, AM and FM transmitters/towers, central offices, and internet service providers, among others. Nearly 500 communication facilities are damaged with most damage occurring in Desoto, Marshall, Tate, and Tunica Counties. There are also approximately 35 electric power facilities are damaged, with most damage occurring in Desoto, Tate, and Tunica Counties. Moreover, nearly 150 waste water facilities are damaged with most damage occurring in Desoto, Marshall, Tate, and Tunica Counties.

Natural gas and oil production is also greatly reduced, particularly in northern Mississippi, where most operations are shut down completely due to significant structural damage. Nearly 20 natural gas facilities and five oil facilities in the impacted counties are damaged. Most damaged natural gas facilities are located in Desoto, Marshall, Tate, and Tunica Counties. A large portion of natural gas operations in planning area MS-3 are

down immediately after the event due to structural damage. Damaged oil facilities are located in Desoto and Marshall Counties.

Table 60: Utility Facilities Damage for Mississippi³⁵

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	17	0	0
Waste Water Facilities	3,406	145	0
Natural Gas Facilities	3,442	19	0
Oil Facilities	7,405	4	0
Electric Facilities	853	36	0
Communication Facilities	9,915	467	0

Table 61: Utility Pipeline Damage for Mississippi

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	106,200	4,281	6,454	10,735
Waste Water Local	63,700	3,386	5,104	8,490
Natural Gas Local	42,500	3,620	5,456	9,076
Natural Gas Interstate	10,200	169	586	755
Oil Interstate	3,500	21	68	89

A substantial number of pipeline repairs are required throughout Mississippi. All water pipelines require nearly 20,000 repairs leaving customers without service for an extended period of time. Specific types of pipeline damage are detailed in Table 61. Natural gas pipelines for local customers are heavily damaged and interstate natural gas lines require nearly 800 repairs. The damage to this extensive network of major pipelines in Mississippi, both oil and natural gas, severely limit the commodities flowing to other parts of the country.

Damage to electric grid components leaves hundreds of thousands of households without power immediately after the earthquake. Over 230,000 households are without power at Day 1. Nearly 105,000 households are without power in the impacted counties, which equates to more than 50% of all households in that portion of the state. Furthermore, 69,000 households are without power in planning area MS-3, which equates to roughly 60% of all households in that planning area. Additionally, 48,500 households are without power in planning area MS-4, which is roughly 50% of all households in the planning area. Although less than 20% of all Mississippi households are located in the impacted counties, this portion of the state accounts for nearly 25% of all households without power at Day 1. Figure 28 illustrates the percentage of households without power in each county in Mississippi. Damage to the potable water system leaves approximately 80,000 households without water at Day 1. All outages occur in the impacted counties, leaving 40% of all households without water at Day 1. Numerous counties in planning area MS-3 experience substantial outages. Approximately 72,000 households are without water at Day 1 in planning area MS-3. This equates to nearly 65% of all households in the planning area. Outage estimates are shown in Table 62.

³⁵ Please reference footnote 3.

Table 62: Service Outages at Day 1 for Mississippi

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	1,046,000	233,000	80,000

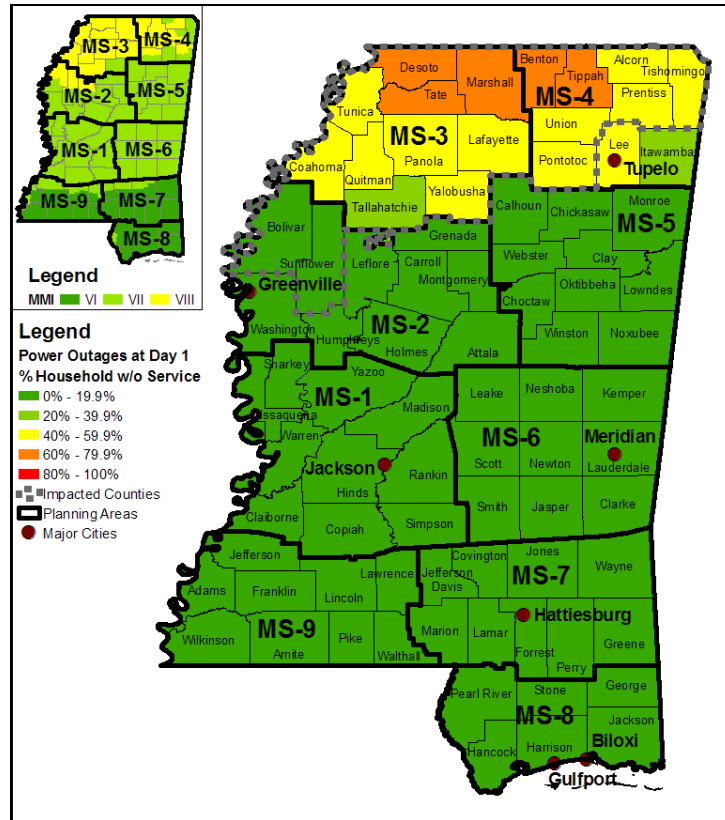


Figure 28: Electric Power Outages at Day 1 for Mississippi

Other Critical Infrastructure

Though numerous transportation and utility infrastructure are damaged, dams, levees, and hazardous materials facilities are largely undamaged. Table 63 shows that no facilities are damaged, mainly due to their location. The facilities do not experience significant ground shaking and thus are largely undamaged. Minor cracking of dams and levees may occur though it is unlikely that flooding will follow. Furthermore, it is unlikely that hazardous materials are released in Mississippi.

Table 63: Other Critical Facilities Damage for Mississippi

Facility Type	Total Facilities	Damaged
Dams	3,544	0
Levees	50	0
Hazardous Materials	2,042	0

Induced Damage, Casualties, and Economic Losses

Damage to infrastructure generates substantial amounts of debris, especially in northern Mississippi. Specific types of debris are broken down in Table 64, including categories for brick, wood, and other debris, as well as steel and concrete debris. A total of 3.4 million tons of debris is generated by the New Madrid scenario earthquake. Approximately 80% of all debris is generated in the 19 impacted counties. Desoto County produces the most debris by far, with roughly 1,256,000 tons of total debris. Coahoma, Tate, and Panola Counties produce 265,000, 184,000, and 161,000 tons of total debris, respectively. Additionally, Tunica and Harrison Counties produce roughly 125,000 tons each. These six counties generate a total of 2.1 million tons of debris, or nearly 65% of all debris in the state. In addition, more than 135,000 truckloads³⁶ are required to remove the debris.

Table 64: Debris Generation for Mississippi

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	1,489,000	1,919,000	3,408,000	136,320

Table 65: Casualties at 2:00AM for Mississippi

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	4,588	1,181	104	183	6,056

Casualty estimates for Mississippi are provided in Table 65. Nearly 6,100 total casualties occur, with nearly 200 total fatalities. More than 75% of all casualties occur in the impacted counties. Numerous counties in northwestern Mississippi, in particular those in planning areas MS-3 and MS-2 incur substantial casualties. A substantial portion of fatalities, more than 75%, also occur in the impacted counties as well. Desoto County incurs the greatest number of total casualties, approximately 2,100. Coahoma and Tate Counties incur substantial casualties, with roughly 680 and 400 total casualties, respectively. Additionally, Tunica, Panola, and Harrison Counties incur approximately 300 total casualties each. Figure 29 illustrates the distribution of total casualties throughout Mississippi.

Table 66: Direct Economic Loss for Mississippi (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$7,305	\$660	\$8,759	\$16,724

Total assets in Mississippi include nearly \$160 billion in building value, approximately \$72 billion in transportation infrastructure value, and more than \$290 billion in utility infrastructure value. This equates to nearly \$525 billion in total infrastructure value throughout the state. Total direct economic losses are nearly \$17 billion for Mississippi, as is shown in Table 66. More than 50% of all direct economic losses are attributed to the

³⁶ Please reference footnote 6.

nearly \$9 billion in utility losses. Building losses contribute 45% of all economic losses while transportation losses comprise a far lesser percentage of all losses.

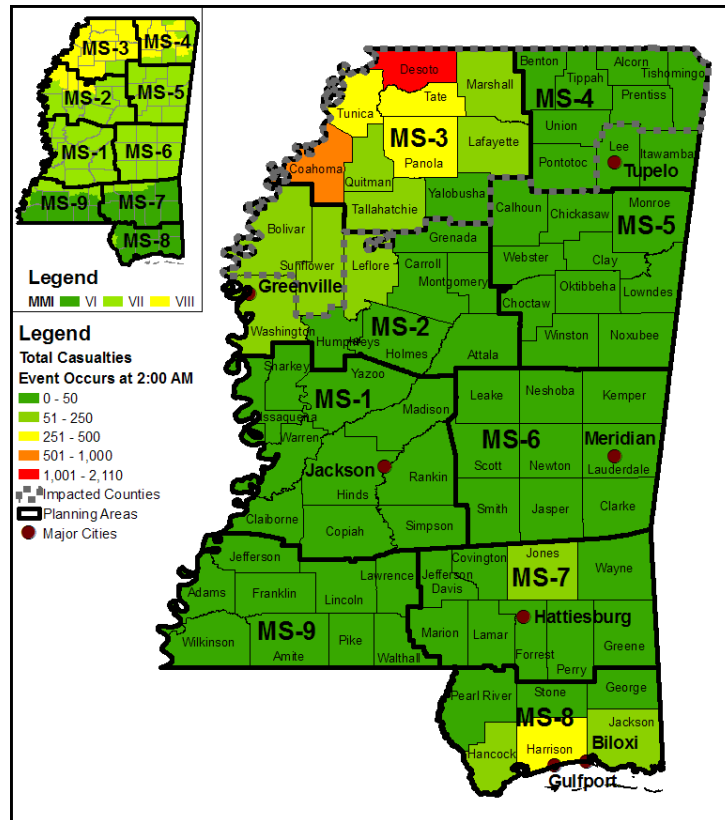


Figure 29: Total Casualties for 2:00AM Event in Mississippi

Missouri Earthquake Impact Assessment Results

The earthquake impact analysis of Missouri was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 22 counties and the City of St. Louis were selected as ‘impacted counties’ in Missouri and are listed below:

- Bollinger
- Butler
- Cape Girardeau
- Carter
- Dunklin
- Iron
- Jefferson
- Madison
- Mississippi
- New Madrid
- Oregon
- Pemiscot
- Perry
- Reynolds
- Ripley
- St. Charles
- St. Francois
- St. Louis
- Ste. Genevieve
- Scott
- Stoddard
- Wayne
- City of St. Louis

Please note that the City of St. Louis is not a county, but rather a separate jurisdiction. It is included in the list of impacted counties, thus creating a list of 23 impacted areas, all of which are referred to as impacted counties in this report.

General Building Stock

There are approximately 2.1 million buildings in the State of Missouri, with approximately 2.0 million residences. Over 85% of those residences are single family homes, while the remainder are multiple family dwellings. Over 1.4 million buildings are wood frame structures, while another 460,000 are URM structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Table 67: Building Damage by Occupancy Type for Missouri³⁷

General Building Damage by Occupancy Type for Missouri			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	1,753,400	61,700	31,800
Other Residential	292,600	21,900	10,400
Commercial	35,300	2,000	1,000
Industrial	9,600	600	300
Other	10,900	600	300
Total	2,101,800	86,800	43,800

³⁷ Please reference footnote 1.

Table 68: Building Damage by Building Type for Missouri³⁸

General Building Damage by Building Type For Missouri			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	1,418,000	40,200	20,300
Steel	17,500	1,200	500
Concrete	5,200	300	200
Precast	5,200	300	200
Reinforced Masonry	2,900	200	100
Unreinforced Masonry	460,200	26,800	14,300
Manufactured Housing	192,800	17,800	8,200
Total	2,101,800	86,800	43,800

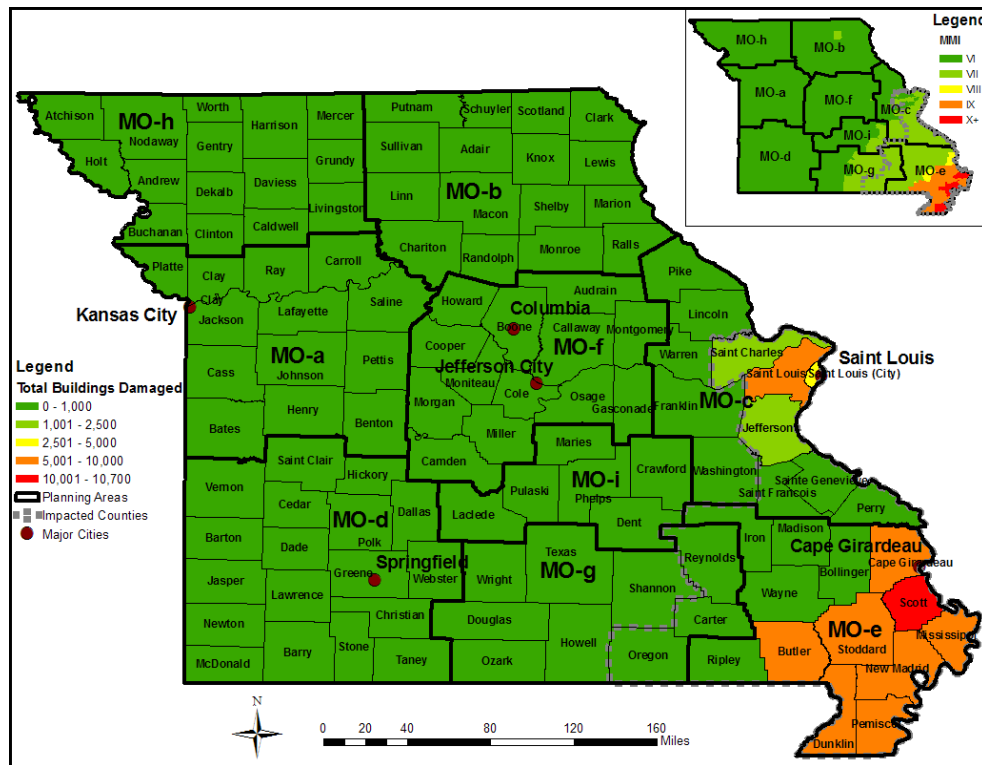


Figure 30: General Building Damage in Missouri (No. of Buildings Damaged)

Nearly 87,000 buildings are damaged statewide, though the majority of this damage occurs in the impacted counties. Table 67 details building damage by building use, or occupancy type. Roughly 44,000 of those buildings, or approximately 50% of all damaged buildings, are completely damaged. Single family homes account for a large portion of damage to buildings. More than 70% of all complete damage and approximately 70% of all moderate and more severe damage is incurred by this occupancy type. Other residential structures comprise a significant portion of building damage. Approximately 25% of all damage occurs with this occupancy type.

³⁸ Please reference footnote 1.

Wood frame construction comprises more than 45% of all complete building damage and also more than 45% of all moderate or more severe building damage. URM structures also comprise a substantial portion of damage, as shown in Table 68. This structure type accounts for more than 30% of all complete damage and approximately 30% of all moderate and more severe damage. Manufactured housing incurs nearly 18,000 cases of moderate or more severe damage and 8,200 cases of complete damage. All other structure types incur far less damage.

Total building damage is also depicted in Figure 30. The largest number of damaged buildings occurs in Scott County where nearly 10,700 buildings are damaged. Nearly 10,000 buildings are damaged in Dunklin County, 8,200 in Stoddard County, and approximately 7,000 in both Cape Girardeau and Pemiscot Counties. The largest building damage percentages occur in Mississippi, Pemiscot, and New Madrid Counties where 93%, 86%, and 83% are damaged, respectively.

Essential Facilities

The southeastern portion of Missouri experiences intense shaking, leaving most of the hospitals in that area unable to care for current patients and those injured as a result of the earthquake. Essential facilities damage for the entire state of Missouri is detailed in Table 69. A total of eight hospitals are located in Cape Girardeau, Dunklin, Pemiscot, Scott, and Stoddard Counties, together providing approximately 1,100 beds. Seven of these hospitals are damaged by the scenario event. The day after the earthquake, roughly 80 beds are available, while the remaining 1,030 beds are unusable due to damage from the earthquake. Additionally, New Madrid and Mississippi Counties do not have hospitals or urgent care facilities. This means that healthcare services are limited immediately after the event for the 225,000 people that reside in the southeastern portion of the state. Most of the current patients and those injured during the event will require care outside this heavily impacted area. Neighboring counties such as Butler, Ripley, or Madison Counties have numerous functional hospitals and may be able to care for those being evacuated from the most heavily impacted counties. Several additional counties in southeast Missouri do not have emergency medical care facilities, such as Bollinger, Wayne, and Iron Counties. Those injured in these counties will also require medical attention outside the heavily impacted area, further burdening the surrounding counties in Missouri planning areas MO-g, MO-i, and MO-c. The likelihood of damage to Missouri hospitals is illustrated in Figure 31.

Police and fire response capabilities are severely reduced in southeast Missouri as well. A total of nearly 70 fire stations and over 50 police stations are damaged by the New Madrid scenario earthquake. Dunklin, Pemiscot, New Madrid, Mississippi, Scott, and Stoddard Counties have more than 50 fire stations, most of which are operating at a severely limited capacity immediately after the earthquake due to structural damage. Some of the nearly 15 fire stations in Butler and Cape Girardeau Counties experience structural damage and operate at reduced capacities but are better able to respond than the more southern counties. It is likely, however, that all of the aforementioned counties will

require some level of external support. The capabilities of local law enforcement are also severely reduced in southeast Missouri.

There are more than 50 police stations in the eight counties listed previously. Police stations in all of these counties incur substantial structural damage and many are unusable. These counties in southeast Missouri require substantial external support immediately after the event. Surrounding counties such as Bollinger, Butler, Perry, Wayne, Madison, and Ripley Counties have several minimally damaged police stations and are likely to provide service for their respective jurisdictions.

Table 69: Essential Facilities Damage for Missouri³⁹

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	2,871	136	90
Fire Stations	1,399	69	45
Police Stations	654	53	40
Hospitals	208	7	1
EOCs	84	13	11

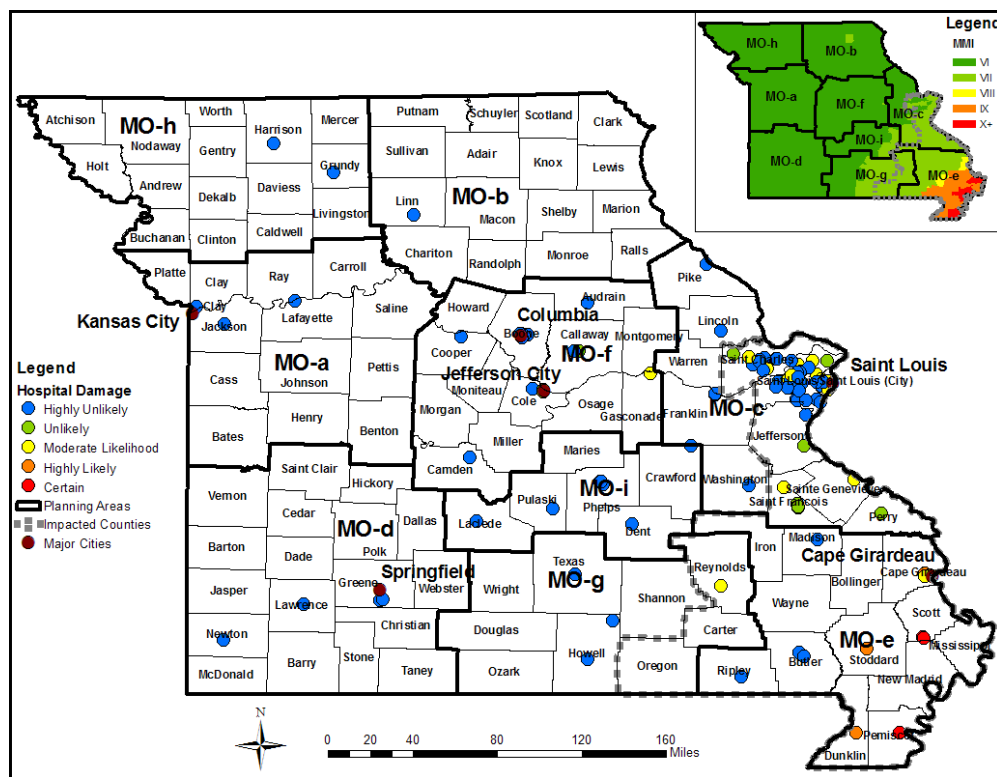


Figure 31: Hospital Damage for Missouri

The schools in southeast Missouri are severely damaged and unable to operate, particularly in planning area MO-e. Many of the nearly 140 damaged schools are located in this planning area. Of the nearly 200 schools in Butler, Cape Girardeau, Dunklin, Mississippi, New Madrid, Pemiscot, Ste. Genevieve, Scott, and Stoddard Counties, most

³⁹ Please reference footnote 3.

are completely unusable or are operating at reduced capacity. Most schools in these counties can not be used as temporary shelters, thus requiring the evacuation of most people seeking public shelter.

Transportation Lifelines

Air, highway, water, and rail transportation alternatives are all impacted by the scenario earthquake, particularly in southeast Missouri. Table 70 details damage to various transportation infrastructure types in Missouri. The airports in Dunklin, Pemiscot, New Madrid, Butler, Mississippi, Scott, and Stoddard Counties experience severe damage, leaving these counties without many operational facilities. There are nearly 30 airports in these seven counties, most of which are not operational the day after the event. Additionally, some airports in Cape Girardeau County are damaged, severely limiting access to the boot-heel of Missouri via air transport.

There are approximately 27,000 bridges in the State of Missouri with nearly 11,000 in eastern Missouri⁴⁰. Over 1,000 bridges are damaged in eastern Missouri, and almost 500 bridges are completely damaged. As a result, many of these bridges are impassible the day after the earthquake. Nearly all damaged bridges are located in Dunklin, Pemiscot, New Madrid, Mississippi, Scott, and Stoddard Counties. Most bridges along Interstate 55 in Dunklin, Pemiscot, and New Madrid Counties are heavily damaged and likely impassible the day after the earthquake. Additionally, numerous bridges along I-57, US-412, and US-60 in southeast Missouri are damaged and unable to carry typical traffic volumes. Damage to highways and interstates due to ground deformation from liquefaction is also common and further impedes the ability to evacuate residents and provide aid workers access to southeast Missouri.

Table 70: Transportation Lifeline Damage for Missouri⁴¹

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	27,258	1,004	545
Railway Bridges	200	2	0
Railway Facilities	139	23	0
Bus Facilities	72	5	0
Port Facilities	232	52	0
Airport Facilities	562	28	0

Approximately 30 major river crossings are included in the Missouri bridge analysis. These bridges cross the Missouri and Mississippi Rivers. Several major bridges are damaged in southern Missouri, severely limiting traffic between Missouri and Illinois, Kentucky, and Tennessee. It is estimated that the Caruthersville Bridge in Caruthersville, Missouri, is substantially damaged and unusable after the event. The I-57 Bridge between Cairo, Illinois, and Mississippi County, Missouri, and the Bill Emerson Memorial Bridge

⁴⁰ In this report 'eastern Missouri' includes planning areas: MO-c, MO-e, MO-f, MO-g, and MO-i. These planning areas are comprised of 52 counties and the City of St. Louis.

⁴¹ Please reference footnote 3.

in Cape Girardeau, Missouri, are also heavily damaged. These three major bridges provide access to Missouri from the eastern side of the Mississippi River. With these bridges down, transferring commodities and aid into the heavily impacted area of southeast Missouri from the east via the highway/interstate systems will be virtually impossible. Figure 32 illustrates expected damage to major river crossings in or bordering Missouri.

Railway bridges and facilities are also damaged in New Madrid, Pemiscot, Mississippi, Scott, and Cape Girardeau Counties. Most rail bridges in New Madrid County are not operational the day after the event. Railway facilities in southeast Missouri are heavily damaged, making continued operation in the days after the event highly unlikely. Similarly, most ports along the Mississippi River in southern Missouri are significantly damaged and unable to operate at full capacity. This includes port facilities in Pemiscot, New Madrid, Mississippi, Scott, and Cape Girardeau Counties.

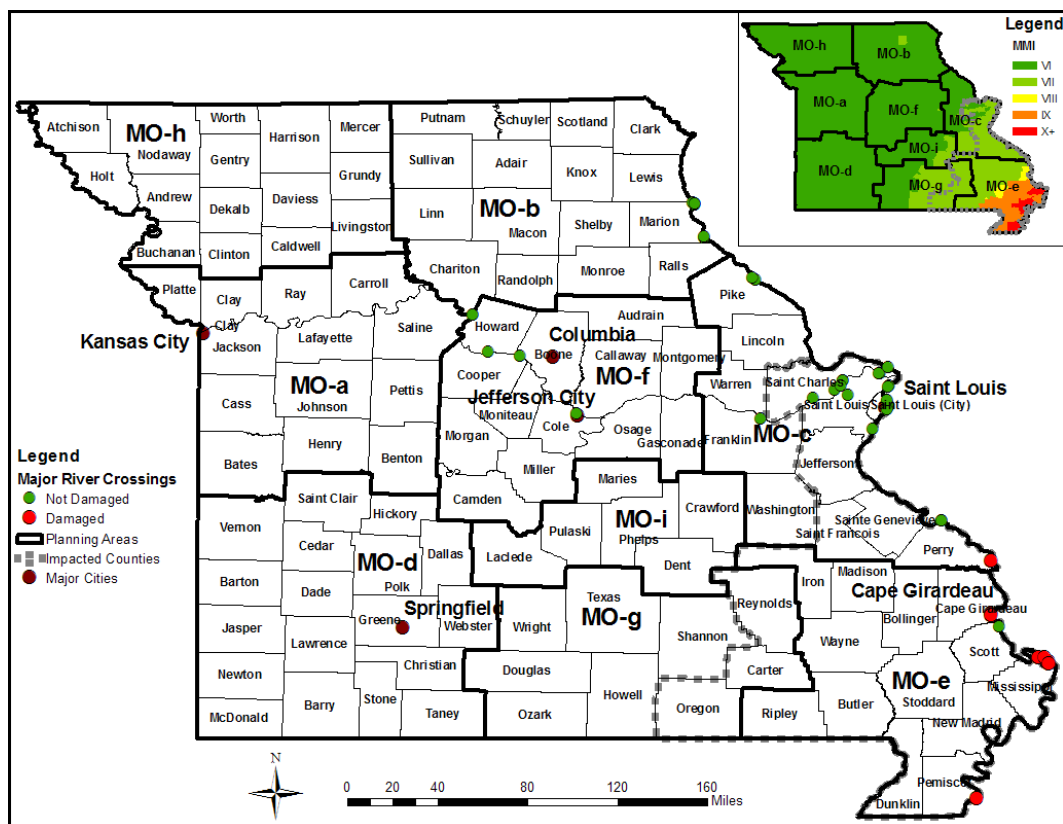


Figure 32: Major River Crossing Damage for Missouri

Utility Lifelines

Much like other infrastructure in Missouri, utility lifelines incur substantial damage. Table 71 details the number of utility facilities damage in Missouri. Over 100 electric power facilities are damaged, with most damage occurring in Butler, Cape Girardeau, Dunklin, Mississippi, New Madrid, Pemiscot, Scott, and Stoddard Counties.

Communication capabilities are severely reduced in the most heavily impacted portions of Missouri as well. More than 1,500 communication facilities are damaged with most damage occurring in Butler, Dunklin, Pemiscot, Stoddard, New Madrid, Mississippi, Scott, and Cape Girardeau Counties.

Natural gas and oil production is also greatly reduced, particularly in southeast Missouri, where most operations are shut down completely due to significant structural damage. Over 60 natural gas facilities and several oil facilities in that portion of the state are damaged. Most damaged natural gas facilities are located in Dunklin, Pemiscot, Butler, Stoddard, New Madrid, Mississippi, Scott, Bollinger, Cape Girardeau, and Perry Counties. Nearly all of these counties are located in planning area MO-e. The majority of natural gas operations in this planning area are down immediately after the event due to structural damage. Most damaged oil facilities are located in New Madrid, Scott, Stoddard, and Cape Girardeau Counties.

Table 71: Utility Facilities Damage for Missouri⁴²

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	357	28	0
Waste Water Facilities	7,816	519	0
Natural Gas Facilities	354	64	0
Oil Facilities	167	7	0
Electric Facilities	1,855	117	0
Communication Facilities	21,789	1,536	0

Table 72: Utility Pipeline Damage for Missouri

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	165,900	14,964	21,624	36,588
Waste Water Local	99,500	11,842	17,098	28,940
Natural Gas Local	66,400	12,653	18,275	30,928
Natural Gas Interstate	4,100	217	727	944
Oil Interstate	6,400	52	176	228

Pipeline damage for Missouri is depicted in Table 72 by pipe type. The extensive network of local service lines incurs tens of thousands of leaks and breaks. Potable water pipelines alone require nearly 36,600 repairs; another 29,000 repairs are required for waste water lines, and also 31,000 repairs to local natural gas lines. Additionally, damage to major natural gas and oil transmission lines are shown. Breaks and leaks in these interstate lines limit the commodities flowing to NMSZ states as well as many other Midwest and east coast states.

Damage to the electric grid leaves tens of thousands of households without power immediately after the earthquake. Table 73 details the number of households without utility service immediately after the event. Over 310,000 households are without power at Day 1 as the result of damage to electric power facilities. Over 290,000 households are

⁴² Please reference footnote 3.

without power in eastern Missouri. Although only slightly more than 50% of all Missouri households are located in eastern Missouri, this portion of the state accounts for over 90% of all households without power at Day 1. Planning area MO-e comprises approximately 125,000 households, of which nearly 100,000 households are without power immediately after the event. This is 80% of the households in planning area MO-e. Similarly, there are roughly 830,000 households in planning area MO-c, and 150,000 households are without power the day after the event. Though this is a small portion of households in planning area MO-c (less than 15%), this is still a substantial number of power outages immediately after the event. Though not explicitly shown here, it is likely that many of the critical facilities in eastern Missouri are also without electric power. Figure 33 illustrates the percentage of households without service in each Missouri county.

Damage to pipelines also inhibits the operational capabilities of utilities. The potable water system is damage leaving nearly 125,000 households without water at Day 1. Numerous counties in planning areas MO-e and MO-g experience substantial outages. There are approximately 120,000 households in these two planning areas, and 105,000 are without potable water immediately after the event.

Table 73: Service Outages at Day 1 for Missouri

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	2,195,000	310,000	124,000

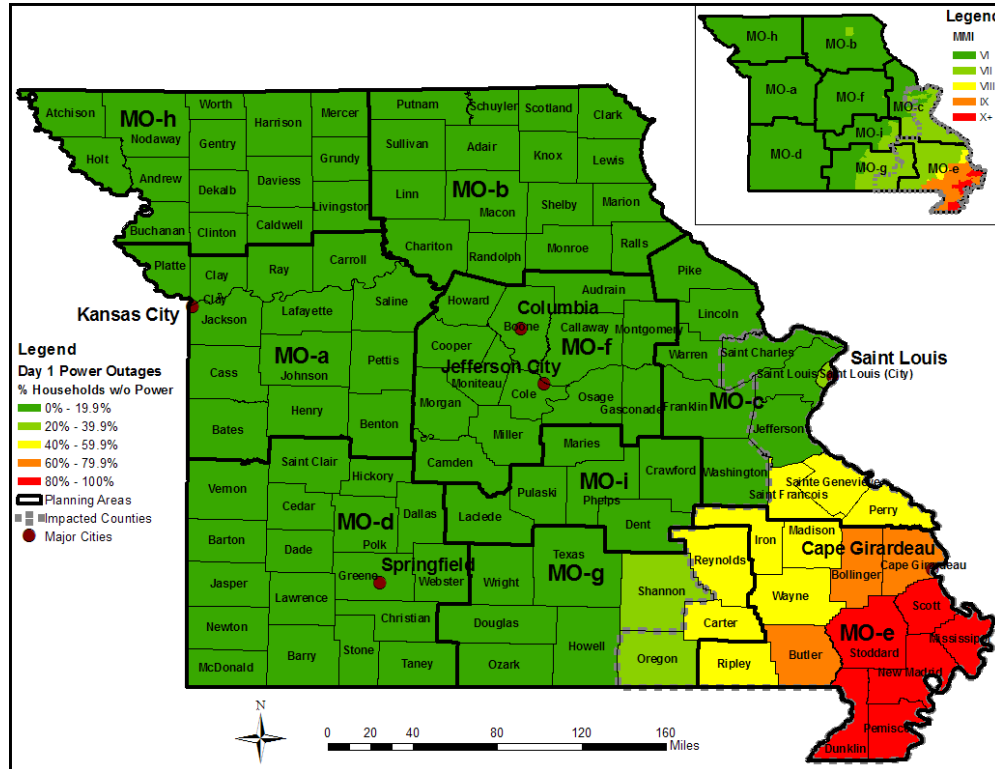


Figure 33: Electric Power Outages at Day 1 for Missouri

Other Critical Infrastructure

Severe shaking and ground deformation lead to numerous damaged facilities in southeast Missouri. Table 74 details damage to dams, levees, and hazardous materials facilities. Several dams in Pemiscot County along with a few dams in Mississippi County are likely to incur substantial damage. This includes cracking of the dam structure and measurable deformation of the ground beneath the dam. It is also possible for the earth dams in these counties to experience very intense shaking, resulting in some release of water in the reservoirs behind dams. Levees are likely to incur damage at slightly lower levels of ground shaking than dams. As a result, most levees in Butler, Dunklin, Pemiscot, New Madrid, Mississippi, Scott, and Cape Girardeau Counties will incur large cracks along the length and width of the levee, as well as some displacement of the soil beneath the levee. If cracking is severe enough, some release of water is possible as long as there is standing water behind the levee.

Some hazardous materials facilities in Pemiscot, New Madrid, and Mississippi Counties likely incur some damage to tank supports, though this level of damage is not likely to cause leakage. Intense shaking of more than 1.1g may cause some of the stored materials to leak, while shaking between 0.8g and 0.9g will damage a tank without creating serious leaks. This would be most common in southeast Missouri, where shaking is most intense.

Table 74: Other Critical Facilities Damage for Missouri

Facility Type	Total Facilities	Damaged
Dams	5,408	55
Levees	369	25
Hazardous Materials	3,040	32

Induced Damage, Casualties, and Economic Losses

Damage to infrastructure generates substantial amounts of debris, especially in southeast Missouri. Specific types of debris are broken down in Table 75, including categories for brick, wood, and other debris, as well as steel and concrete debris. A total of 6.5 million tons of debris is generated by the New Madrid scenario earthquake. Over 95% of all debris is generated in planning areas MO-c, -e, -f, -g, and -i, while 70% of all debris is generated in planning area MO-e alone. Scott and Dunklin Counties produce the most debris of all Missouri counties, roughly 935,000 and 835,000 tons, respectively. New Madrid, Stoddard, Pemiscot Counties, and the City of St. Louis produce roughly 500,000 tons of total debris each. Four additional counties generate more than 350,000 tons each: Butler, Cape Girardeau, St. Louis, and Mississippi Counties. These nine counties and the City of St. Louis generate a total of 5.5 million tons of debris, or approximately 85% of all debris in the state. Nearly 260,000 truckloads⁴³ are required to remove the debris.

A total of 14,100 casualties occur in Missouri, which includes nearly 700 total fatalities. Casualty estimates are provided in Table 76 and detailed by severity level.

⁴³ Please reference footnote 6.

Approximately 90% of all casualties occur in the impacted counties. Numerous counties in planning area MO-e incur substantial casualties. Most fatalities also occur in planning area MO-e. Nearly 1,900 total casualties occur in both Dunklin and Scott Counties, while New Madrid and Pemiscot Counties are each estimated to incur 1,300 total casualties. Additionally, Jefferson and St. Louis Counties, along with the City of St. Louis, incur large numbers of casualties. The dense infrastructure in this portion of the state, coupled with a moderate level of ground shaking and highly liquefiable soils, leads to numerous injuries and fatalities. Jackson County also experiences a significant number of casualties, though most of those are minor injuries. Figure 34 illustrates the distribution of total casualties throughout the State of Missouri.

Table 75: Debris Generation for Missouri

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	2,943,000	3,507,000	6,450,000	258,000

Table 76: Casualties at 2:00AM for Missouri

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	10,179	2,898	361	687	14,125

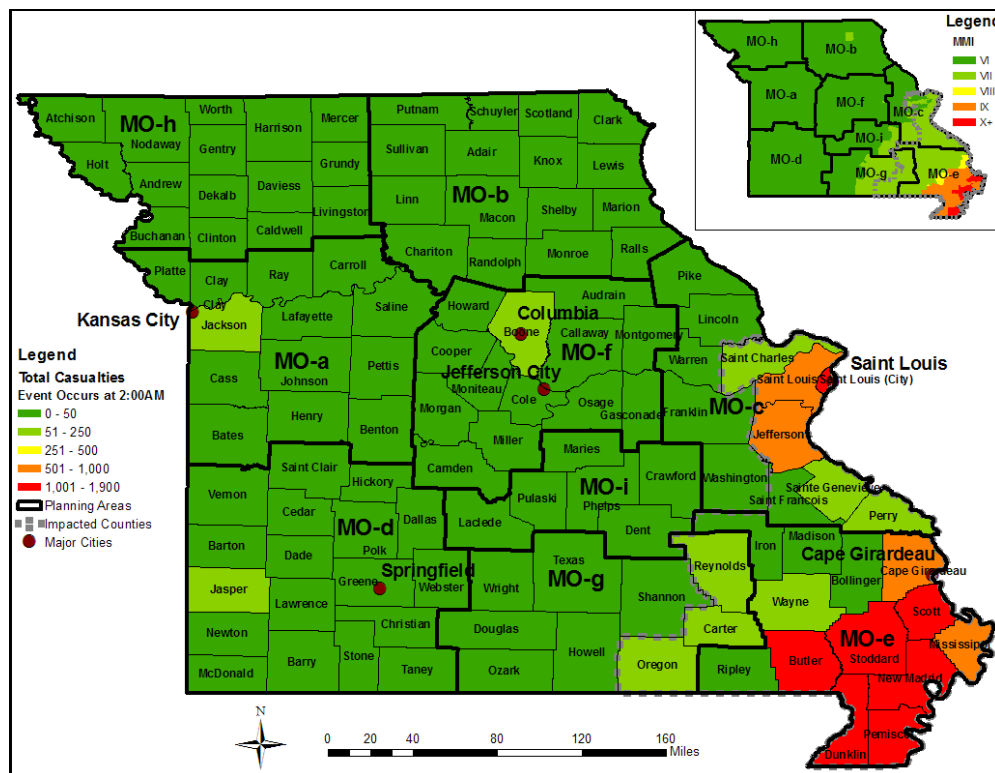


Figure 34: Total Casualties for 2:00AM Event in Missouri

Total assets in Missouri include more than \$400 billion in building value, nearly \$125 billion in transportation infrastructure value, and approximately \$770 billion in utility infrastructure value. This equates to more than \$1.3 trillion in total infrastructure value

throughout the state. Total direct economic losses are nearly \$50 billion for Missouri, as is shown in Table 77. Utility losses comprise a large portion of all economic losses, accounting for nearly 70% of all direct losses. Building losses are estimated at nearly \$14 billion and more than 25% of all economic losses in Missouri. Transportation losses are substantially less than the previous two infrastructure groups.

Table 77: Direct Economic Loss for Missouri (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$13,512	\$1,789	\$33,700	\$49,001

Tennessee Earthquake Impact Assessment Results

The earthquake impact analysis of Tennessee was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 20 counties were selected as ‘impacted counties’ in Tennessee and are listed below:

- | | | |
|------------|--------------|-----------|
| • Benton | • Hardeman | • Madison |
| • Carroll | • Hardin | • McNairy |
| • Chester | • Haywood | • Obion |
| • Crockett | • Henderson | • Shelby |
| • Dyer | • Henry | • Tipton |
| • Fayette | • Lake | • Weakley |
| • Gibson | • Lauderdale | |

General Building Stock

There are approximately 2.1 million buildings in the State of Tennessee, with approximately 2.0 million residences. More than 80% of those residences are single family homes, while the remaining are multiple family dwellings. Over 1.6 million buildings are wood frame structures, while an additional 210,000 are URM structures. Steel, precast, and cast-in-place concrete buildings comprise a much smaller portion of the state building inventory.

Nearly 265,000 buildings are damaged statewide, though the majority of this damage occurs in the impacted counties. Roughly 107,000 of those buildings, or approximately 40% of all damaged buildings, are completely damaged. Residential structures account for a large portion of damage to buildings as is shown in Table 78. Single family homes account for nearly 75% of all damaged buildings, with multiple family dwelling comprising another 20% of building damage by building use group. Single family homes also incur a larger proportion of complete damage. Roughly 80% of all complete damage occurs to this occupancy type. Multiple family dwellings account for approximately 15% of all complete damage.

Building damage is also determined based on structure type and is displayed in Table 79. Wood frame construction comprises roughly 70% of all complete building damage and also more than 60% of all moderate or more severe building damage. URM structures also comprise a substantial portion of damage. This structure type accounts for approximately 15% of all complete damage and nearly 20% of all moderate and more severe damage. The 42,300 damaged manufactured homes comprise more than 15% of

all moderate or more severe damage and roughly 10% of all complete damage. The distribution of total building damage is illustrated in Figure 35.

Table 78: Building Damage by Occupancy Type for Tennessee⁴⁴

General Building Damage by Occupancy Type for Tennessee			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	1,715,800	193,300	84,700
Other Residential	348,400	55,200	16,700
Commercial	40,500	10,100	3,500
Industrial	10,800	2,800	1,000
Other	11,100	2,800	1,000
Total	2,126,600	264,200	106,900

Table 79: Building Damage by Building Type for Tennessee⁴⁵

General Building Damage by Building Type For Tennessee			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	1,619,800	163,600	75,400
Steel	19,500	5,700	2,100
Concrete	5,500	1,400	500
Precast	5,600	1,600	600
Reinforced Masonry	2,800	700	200
Unreinforced Masonry	209,000	48,900	16,600
Manufactured Housing	264,400	42,300	11,500
Total	2,126,600	264,200	106,900

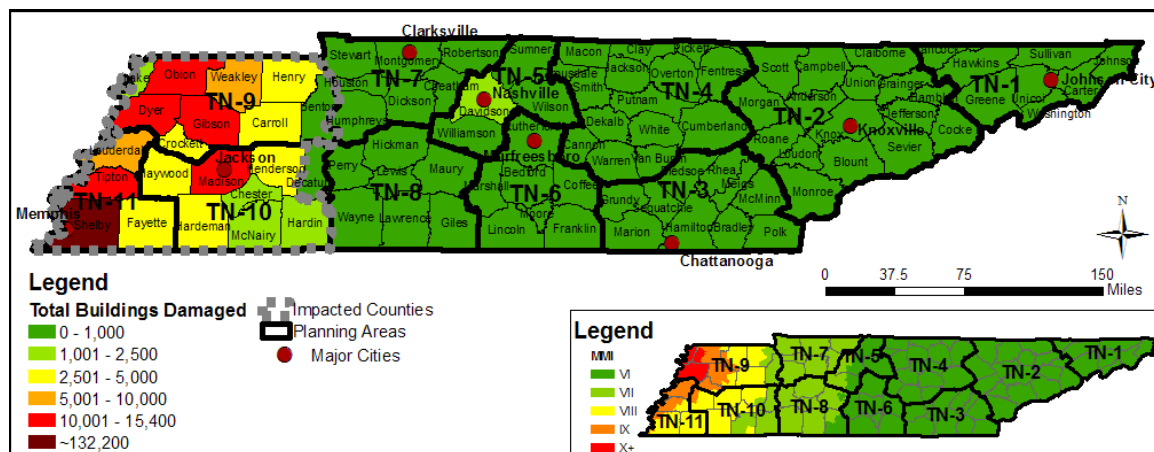


Figure 35: General Building Damage in Tennessee (No. of Buildings Damaged)

Essential Facilities

The western portion of Tennessee experiences intense shaking and ground deformation damaging numerous essential facilities. Table 80 details the number of facilities damaged

⁴⁴ Please reference footnote 1.

⁴⁵ Please reference footnote 1.

in the State of Tennessee. Most of the hospitals in the impacted counties are unable to care for current patients and those injured during the earthquake. A total of nearly 60 hospitals are located the 20 impacted counties, with a combined capacity of approximately 8,400 beds. The day after the earthquake, roughly 400 beds are available, while the remaining 8,000 beds are unusable due to damage from the earthquake. Damaged hospitals are defined by structural damage only, and numerous counties in western Tennessee incur severe structural damage, including: Carroll, Dyer, Fayette, Gibson, Hardeman, Haywood, Henderson, Henry, Lauderdale, Madison, McNairy, Obion, Shelby, Tipton, and Weakley Counties. Additionally, several of the impacted counties do not have hospitals or urgent care facilities. Chester, Crocket, and Lake Counties lack emergency care facilities requiring the evacuation of those injured by the earthquake. This indicates that healthcare services are limited immediately after the event for the nearly 1.5 million people that reside in the western portion of the state, specifically planning areas TN-9, TN-10, and TN-11. Most of the current patients and those injured during the event will require care outside this heavily impacted area. Neighboring counties such as Stewart, Benton, Decatur, Hardin, Houston, Humphreys, Perry and Wayne Counties have numerous functional hospitals and may be able to provide the necessary medical care for those being evacuated from the most heavily impacted counties. A map of hospital damage in the State of Tennessee is provided in Figure 36.

Table 80: Essential Facilities Damage for Tennessee⁴⁶

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	2,352	608	44
Fire Stations	1,110	242	25
Police Stations	424	119	24
Hospitals	232	54	7
EOCs	171	44	15

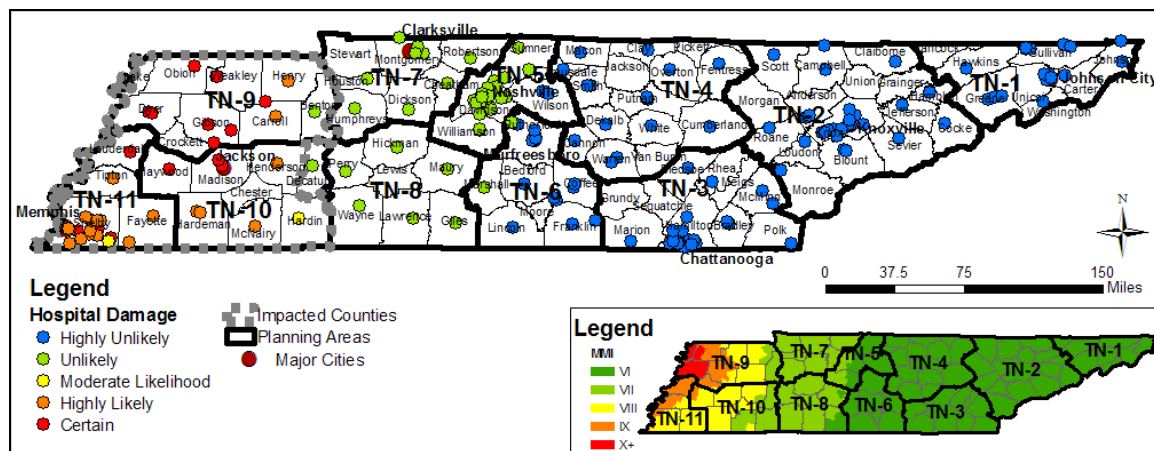


Figure 36: Hospital Damage for Tennessee

Police and fire response capabilities are severely reduced in western Tennessee as well. Most impacted counties experience substantial fire station damage. Carroll, Chester, Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Henderson, Lake, Lauderdale,

⁴⁶ Please reference footnote 3.

Madison, Obion, Shelby, Tipton, and Weakley Counties are without most of the 225 fire stations located in those counties. Fire stations that are not completely damaged in the impacted counties are operating at severely reduced capacity immediately after the earthquake due to structural damage. It is likely that all of the aforementioned counties will require extensive external support because such a large number of counties are without adequate fire services.

The capabilities of local law enforcement are also severely reduced in western Tennessee. There are approximately 130 police stations in the 20 impacted counties. Police stations in most of these counties incur substantial structural damage and many are unusable. These counties in western Tennessee require substantial external support immediately after the event. Surrounding counties such as Stewart, Benton, Decatur, Hardin, Houston, Humphreys, Perry, and Wayne Counties incur minimal damage to police stations. Facilities in these counties could provide external support to severely impacted counties, in addition to providing service for their respective jurisdictions.

The schools in western Tennessee are severely damaged and unable to operate, particularly in planning areas TN-9, TN-10, and TN-11. Of the nearly 650 schools in the 20 impacted counties, most are completely unusable or are operating at reduced capacity. Most schools in these counties can not be used as temporary shelters, thus requiring the evacuation of most people seeking public shelter.

Transportation Lifelines

Air, highway, water, and rail transportation alternatives are all impacted by the New Madrid scenario earthquake. Damage estimations for the entire state are provided in Table 81, though the majority of damaged facilities are located in western Tennessee. The airports in Dyer, Gibson, Haywood, Lake, Lauderdale, Obion, Shelby, Tipton, and Weakley Counties experience severe damage, leaving these counties with few operational facilities. There are more than 40 airports in these nine counties, most of which are not operational the day after the event. Additionally, some airports in Carroll and Madison Counties are damaged, severely limiting access to the western portion of Tennessee via air transport.

Table 81: Transportation Lifeline Damage for Tennessee⁴⁷

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	22,897	1,035	244
Railway Bridges	151	2	0
Railway Facilities	141	58	0
Bus Facilities	58	7	0
Port Facilities	202	82	0
Airport Facilities	318	45	0

⁴⁷ Please reference footnote 3.

There are approximately 23,000 bridges in the State of Tennessee and roughly 6,700 bridges in the 20 impacted counties. More than 1,000 bridges are damaged in western Tennessee, and almost 250 bridges are completely damaged, as is shown in Table 81. As a result, many of these bridges are expected to be impassible the day after the earthquake. Nearly all damaged bridges are located in Crockett, Dyer, Fayette, Gibson, Haywood, Lake, Lauderdale, Obion, Shelby, Tipton, and Weakley Counties. Numerous bridges along I-55, I-40, US-51, US-412, and US-45W are heavily damaged and likely impassible the day after the earthquake. Damage to highways and interstates due to ground deformation from liquefaction is also common and further impedes the ability to evacuate residents and provide access to western Tennessee for aid workers.

Four major river crossings are included in the Tennessee bridge analysis. All four bridges cross the Mississippi River and are damaged during the event, severely limiting traffic between Tennessee and Arkansas or Missouri. Figure 37 illustrates the locations of damaged major river bridges in and bordering Tennessee. With these bridges down, transferring commodities and aid into the heavily impacted area of western Tennessee from the west via the highway/interstate systems will be virtually impossible.

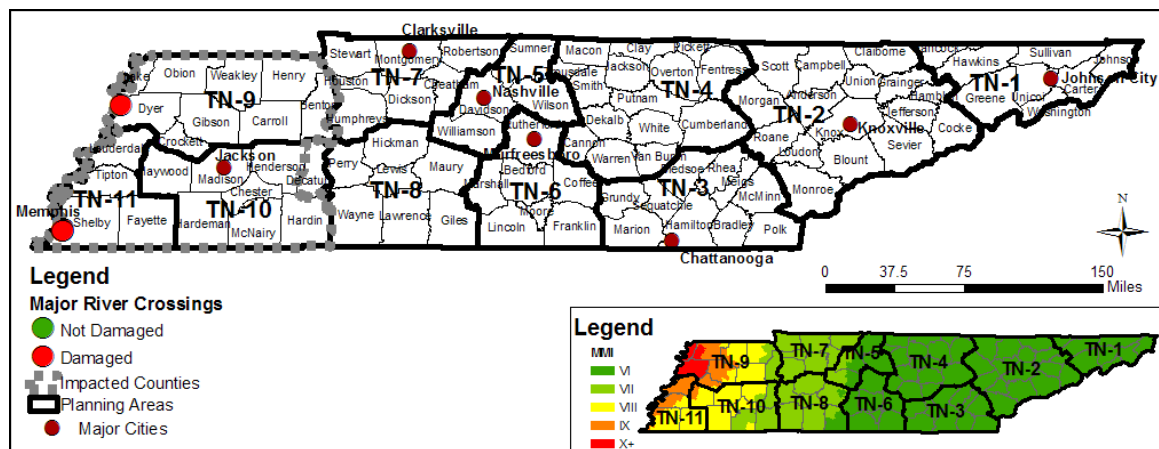


Figure 37: Major River Crossing Damage for Tennessee

Railway bridges and facilities are also damaged in Obion, Dyer, Lake, Lauderdale, Shelby, and Tipton Counties. Most rail bridges in Obion County are not operational the day after the event. Railway facilities in western Tennessee are heavily damaged, making continued operation in the days after the event highly unlikely. Similarly, most ports along the Mississippi River in western Tennessee are significantly damaged and unable to operate at full capacity. This includes port facilities in Dyer, Lake, Lauderdale, Shelby, and Tipton Counties.

Utility Lifelines

There is substantial damage to utility lifelines in Tennessee, especially western Tennessee. Estimations of damaged facilities for the state are detailed in Table 82. Over 110 electric power facilities are damaged, with most damage occurring in Benton, Dyer, Gibson,

Hardeman, Haywood, Henderson, Henry, Lake, Madison, McNairy, Obion, Shelby, Tipton, and Weakley Counties. Communication capabilities are also severely reduced in the most heavily impacted portions of the state. Over 4,000 communication facilities are damaged with most damage occurring in Benton, Carroll, Chester, Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Henry, Henderson, Lake, Lauderdale, Madison, McNairy, Obion, Shelby, Tipton, and Weakley Counties. Over 450 waste water facilities are damaged in Benton, Carroll, Chester, Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Henderson, Henry, Lake, Lauderdale, Madison, McNairy, Obion, Shelby, Tipton, and Weakley Counties.

Natural gas and oil production is also greatly reduced, particularly in western Tennessee, where most operations are shut down completely due to significant structural damage. Nearly 70 natural gas facilities and numerous oil facilities in that portion of the state are damaged. Most damaged natural gas facilities are located in Crockett, Dyer, Gibson, Haywood, Henry, Lauderdale, Madison, McNairy, Obion, Shelby, Tipton, and Weakley Counties. Most damaged oil facilities are located in Carroll, Fayette, Haywood, Henry, Lauderdale, Madison, McNairy, Obion, and Shelby Counties.

Table 82: Utility Facilities Damage for Tennessee⁴⁸

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	98	11	1
Waste Water Facilities	2,001	453	7
Natural Gas Facilities	183	61	0
Oil Facilities	160	43	0
Electric Facilities	574	96	2
Communication Facilities	17,156	4,024	61

Table 83: Utility Pipeline Damage for Tennessee

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	117,400	15,258	24,051	39,309
Waste Water Local	70,500	12,067	19,022	31,089
Natural Gas Local	47,000	12,900	20,334	33,234
Natural Gas Interstate	4,600	351	1,232	1,583
Oil Interstate	1,000	71	234	305

Extensive pipeline damage limits service in the most heavily impacted areas as well as states far from the rupture zone. Local distribution water and natural gas lines experience tens of thousands of breaks and leaks, most in western Tennessee. Table 83 shows that local potable water pipelines require over 39,000 repairs and waste water lines require another 31,000 repairs. Interstate natural gas and oil lines require a combined 1,900 repairs. The longer these major pipelines remain damaged the more time hundreds of thousands are without much-needed commodities in areas hundreds of miles from the rupture zone.

⁴⁸ Please reference footnote 3.

Damage to electric grid components leaves hundreds of thousands of households without power immediately after the earthquake. Nearly 710,000 households are without power at Day 1. Over 440,000 households are without power in the impacted counties, which equates to more than 75% of all households in the impacted counties. Furthermore, 308,000 households are without power in planning area TN-11, which includes the City of Memphis. Also, over 77,000 households are without power in planning area TN-9, and nearly 58,000 households without power in planning area TN-10. Although only 25% of all Tennessee households are located in the impacted counties, this portion of the state accounts for more than 60% of all households without power at Day 1. Planning area TN-11 comprises approximately 377,000 households, where more than 80% of all households are without power immediately after the event. Additionally, planning area TN-9 contains approximately 100,000 households, where more than 75 % of all households are without power the day after the event. Additionally, more than 60% of the 94,000 households in planning area TN-10 are without power immediately after the event. Though not explicitly shown here, it is likely that many of the critical facilities in western Tennessee are also without electric power. This includes critical facilities such as hospitals, schools, telecommunication infrastructure, emergency command centers, and other facilities that are integral to response efforts. Service outages are detailed in Table 84 while Figure 38 illustrates the extent of power loss throughout Tennessee.

Table 84: Service Outages at Day 1 for Tennessee

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	2,233,000	709,000	507,000

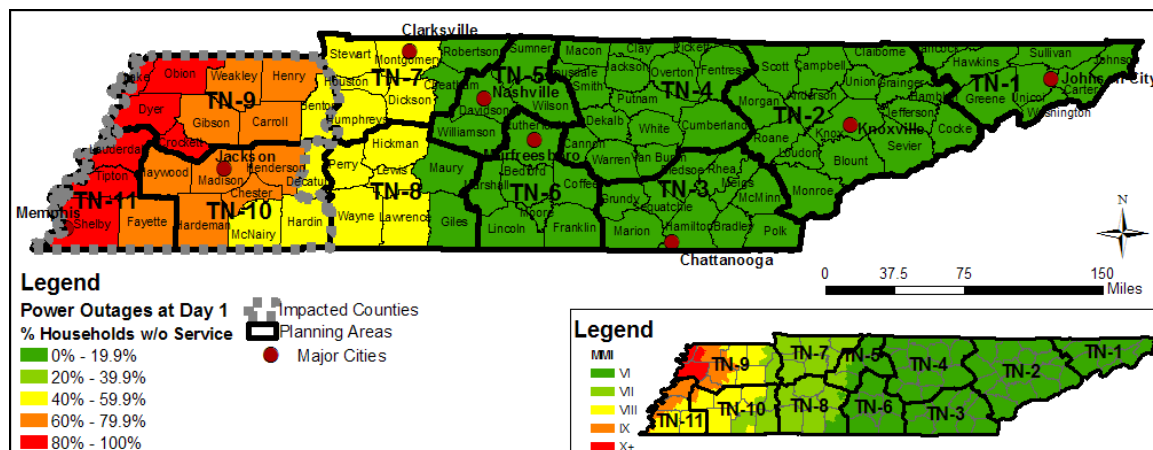


Figure 38: Electric Power Outages at Day 1 for Tennessee

Damage to pipelines also inhibits the operational capabilities of utilities. The potable water system leaves more than 507,000 households without water at Day 1, which is more than 20% of all households in the State of Tennessee. All water outages are estimated to occur in the impacted counties. Approximately 372,000 households are without water at Day 1 in planning area TN-11. This equates to 99% of all households in the planning area. Furthermore, more than 75% of all households in planning area TN-9 are without water, and 60% of all households in planning area TN-10 are without water immediately after the event.

Other Critical Infrastructure

Damage to special critical infrastructure is detailed in Table 85. Most levees in Dyer, Lake, and Shelby Counties will experience large cracks along the length and width of the levee, along with some displacement of the soil beneath the levee. If cracking is severe enough, some release of water is possible as long as there is standing water behind the levee. There is a larger inventory of dams in western Tennessee thus the larger number of damaged facilities. The majority of dam damage occurs in Dyer and Obion Counties though a small number of dams in Gibson and Lake Counties are damaged as well. Some hazardous materials facilities in Dyer, Lake, Lauderdale, Gibson, Obion, and Tipton Counties likely incur some damage to tank supports, though this level of damage does not likely lead to leakage.

Table 85: Other Critical Facilities Damage for Tennessee

Facility Type	Total Facilities	Damaged
Dams	1,215	133
Levees	11	7
Hazardous Materials	4,080	73

Induced Damage, Casualties, and Economic Losses

Damage to infrastructure generates substantial amounts of debris, especially in western Tennessee. Specific types of debris are broken down in Table 86, including categories for brick, wood, and other debris, as well as steel and concrete debris. A total of 21.6 million tons of debris is generated by the scenario earthquake. Over 95% of all debris is generated in the 20 impacted counties. Approximately 70% of all debris is generated in the four counties comprising planning area TN-11. Shelby, Dyer, and Gibson Counties produce the most debris, roughly 13,012,000 tons, 1,454,000 tons, and 1,082,000 tons, respectively. Madison, Obion, and Tipton Counties produce between roughly 775,000 and 975,000 tons of total debris each. Additionally, Lauderdale and Weakley Counties produce more than 500,000 tons each while Haywood County generates over 325,000 tons of debris. These nine generate a total of 20 million tons of debris, or approximately 90% of all debris in the state. Furthermore, nearly 865,000 truckloads⁴⁹ are required to remove all debris generated by the scenario event.

A total of 34,200 casualties occur in Tennessee as a result of the scenario event. Over 1,300 of those total casualties are fatalities, most of which occur in western Tennessee. Table 87 delineates the casualty estimates by severity level. More than 95% of all casualties occur in the impacted counties. Nearly all fatalities occur in the impacted counties. Shelby County experiences the greatest number of total casualties, nearly 21,500. Dyer, Tipton, and Gibson Counties incur substantial casualties as well, with 2,100, 1,500 and 1,500, respectively. Additionally, Obion, Lauderdale, and Madison Counties incur 1,000 to 1,250 total casualties. Furthermore, Figure 39 illustrates the distribution of total casualties throughout the state.

⁴⁹ Please reference footnote 6.

Table 86: Debris Generation for Tennessee

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	9,305,000	12,314,000	21,619,000	864,760

Table 87: Casualties at 2:00AM for Tennessee

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	25,431	6,765	715	1,319	34,230

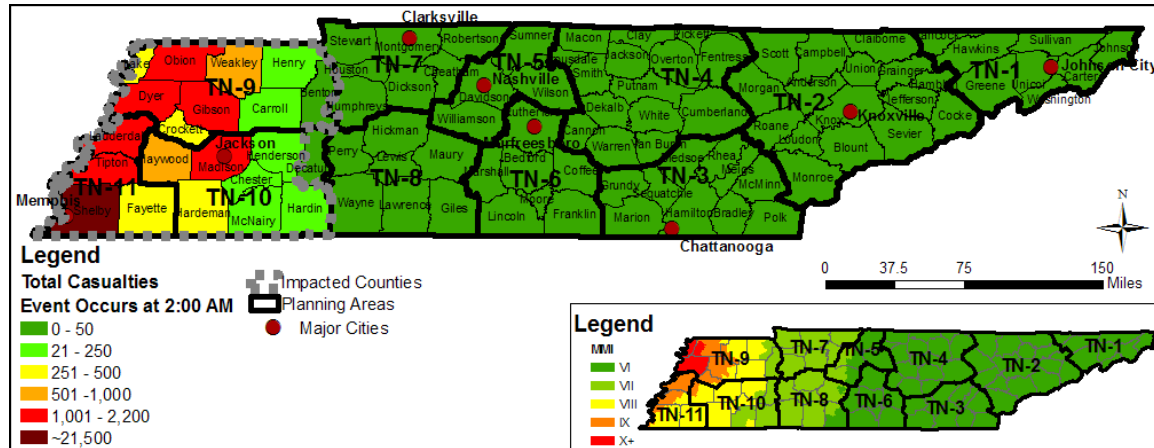


Figure 39: Total Casualties for 2:00AM Event in Tennessee

Total assets in Tennessee include nearly \$400 billion in building value, approximately \$95 billion in transportation infrastructure value, and nearly \$185 billion in utility infrastructure value. This equates to more than \$675 billion in total infrastructure value throughout the state. Total direct economic losses in Tennessee are nearly \$70. Table 88 details the economic losses of each major infrastructure group. Building loss is a large portion of all economic losses, accounting for more than 70% of all direct losses. The \$16 billion in utility losses is less than %25 of all economic loss in the State of Tennessee. Overall, however, economic losses in Tennessee are greater than any other state included in the NMSZ earthquake impact assessment.

Table 88: Direct Economic Loss for Tennessee (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$49,392	\$2,898	\$16,121	\$68,411

Central US Eight-State Region Earthquake Impact Assessment Results

The entirety of the eight-state region included in the NMSZ earthquake impact assessment is affected by the scenario earthquake. As previously mentioned in each state section there were numerous counties selected by researchers due to the severity of impacts in specific counties. The most catastrophic damage to infrastructure, loss of facility functionality, social impacts and direct economic losses occur in these 140 impacted counties. Though these counties were listed previously they are provided below as a reminder of the most critically impacted portions of the eight-state study region. Additionally, a map of these impacted counties is provided in Figure 40. There are no impacted counties in Alabama, though a set of ‘socially impacted’ counties is outlined in another appendix.

Arkansas

- | | | |
|----------------|---------------|-----------------|
| • Arkansas | • Jackson | • Prairie |
| • Clay | • Lawrence | • Randolph |
| • Craighead | • Lee | • Saint Francis |
| • Crittenden | • Mississippi | • White |
| • Cross | • Monroe | • Woodruff |
| • Greene | • Phillips | |
| • Independence | • Poinsett | |

Illinois

- | | | |
|-------------|-------------|---------------|
| • Alexander | • Jefferson | • Pulaski |
| • Bond | • Johnson | • Randolph |
| • Clinton | • Lawrence | • Saint Clair |
| • Fayette | • Madison | • Saline |
| • Franklin | • Marion | • Union |
| • Gallatin | • Massac | • Washington |
| • Hamilton | • Monroe | • Wayne |
| • Hardin | • Perry | • White |
| • Jackson | • Pope | • Williamson |

Indiana

- | | | |
|------------|------------|---------------|
| • Crawford | • Lawrence | • Posey |
| • Dubois | • Martin | • Spencer |
| • Gibson | • Orange | • Vanderburgh |
| • Harrison | • Perry | • Warrick |
| • Knox | • Pike | |

Kentucky

- | | | |
|--------------|--------------|--------------|
| • Ballard | • Graves | • Marshall |
| • Caldwell | • Henderson | • Muhlenberg |
| • Calloway | • Hickman | • Trigg |
| • Carlisle | • Hopkins | • Union |
| • Crittenden | • Livingston | • Webster |
| • Daviess | • Lyon | |
| • Fulton | • McCracken | |

Mississippi

- Alcorn
- Benton
- Bolivar
- Coahoma
- Desoto
- Lafayette
- Marshall
- Panola
- Pontotoc
- Prentiss
- Quitman
- Sunflower
- Tallahatchie
- Tate
- Tippah
- Tishomingo
- Tunica
- Union
- Yalobusha

Missouri

- Bollinger
- Butler
- Cape Girardeau
- Carter
- Dunklin
- Iron
- Jefferson
- Madison
- Mississippi
- New Madrid
- Oregon
- Pemiscot
- Perry
- Reynolds
- Ripley
- St. Charles
- St. Francois
- St. Louis
- Ste. Genevieve
- Scott
- Stoddard
- Wayne
- City of St. Louis

Tennessee

- Benton
- Carroll
- Chester
- Crockett
- Dyer
- Fayette
- Gibson
- Hardeman
- Hardin
- Haywood
- Henderson
- Henry
- Lake
- Lauderdale
- Madison
- McNairy
- Obion
- Shelby
- Tipton
- Weakley

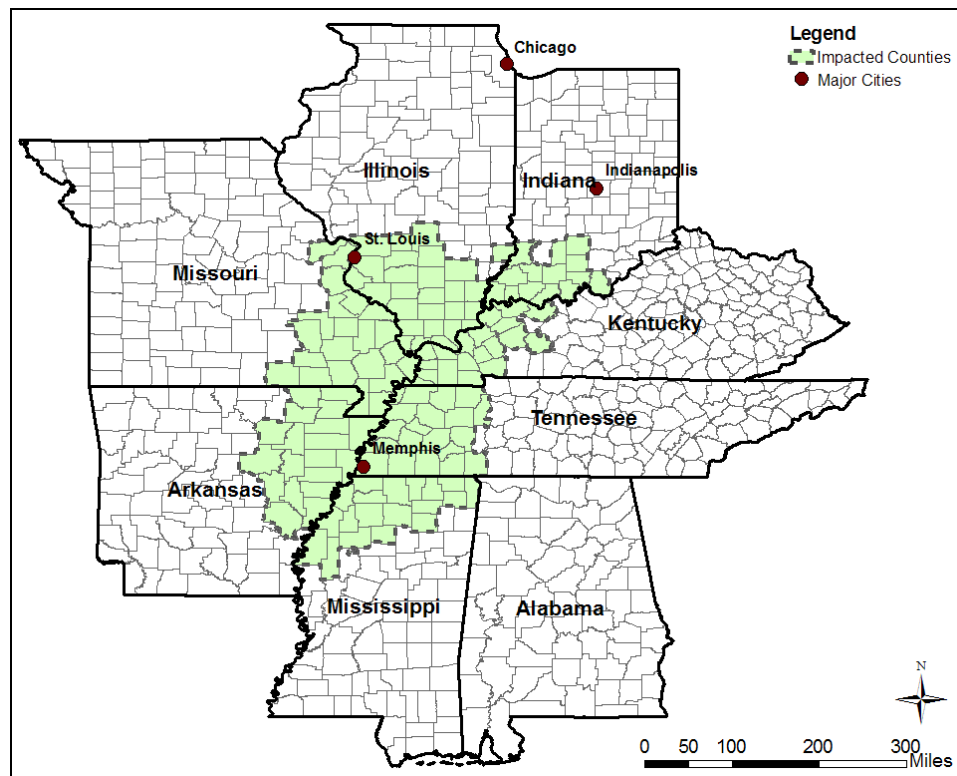


Figure 40: Impacted Counties in Eight-State Study Region

General Building Stock

There are nearly 16 million buildings in the eight-state study region. Table 90 shows that over 713,000 buildings are damaged throughout the eight states and over 300,000 are completely damaged. A large number of buildings are damaged in Tennessee accounting for over 35% of all moderate or more severe building damage as well as complete damage. Only 13% of all regional buildings are located in Tennessee indicating that a large percentage, as well as a large total number of buildings, is damaged in Tennessee. Additionally, nearly 25% of all building damage occurs in Arkansas, both moderate and complete, though only 8% of the regional building inventory is located there. Furthermore, roughly 15% of all complete damage occurs in Missouri, and roughly 12% of all moderate or more severe damage. Though substantial building damage occurs in Illinois, Kentucky, and Mississippi, the percentages of regional building damage are far less than three aforementioned states.

Total building damage for the entire region is also illustrated in Figure 41. Shelby County, Tennessee incurs far more damage than any other county in the study region, roughly 21,500 buildings. This is largely due to the high density of buildings in Memphis, Tennessee, and the high levels of ground shaking and substantial ground deformations.

Table 89: Building Damage by State for Eight-State Study Region

State	Total Buildings	Buildings Damaged	URM Damage	Wood Damage
Alabama	1,758,300	15,400	400	3,000
Arkansas	1,325,400	162,200	29,100	68,800
Illinois	3,655,800	44,500	10,100	17,700
Indiana	2,202,000	14,200	2,600	4,800
Kentucky	1,543,900	68,400	9,400	36,100
Mississippi	1,064,000	57,400	5,000	19,900
Missouri	2,101,800	86,800	26,800	40,200
Tennessee	2,126,600	264,200	48,900	163,600
Total	15,777,800	713,100	132,300	354,100

Table 90: Building Damage by Occupancy Type for the Eight-State Study Region⁵⁰

General Building Damage by Occupancy Type for Eight States			
General Occupancy Type	Total Buildings	At Least Moderate Damage	Complete Damage
Single Family	12,617,800	426,300	210,900
Other Residential	2,652,600	240,100	71,700
Commercial	323,200	29,600	11,000
Industrial	91,700	8,400	2,900
Other	92,700	8,800	3,700
Total	15,778,000	713,200	300,200

⁵⁰ Please reference footnote 1.

Table 91: Building Damage by Building Type for the Eight-State Study Region⁵¹

General Building Damage by Building Type For Eight States			
General Building Type	Total Buildings	At Least Moderate Damage	Complete Damage
Wood	11,370,700	354,000	180,500
Steel	167,800	19,600	6,500
Concrete	77,300	5,000	2,000
Precast	43,500	4,600	1,700
Reinforced Masonry	34,200	2,400	1,000
Unreinforced Masonry	2,373,800	132,300	59,200
Manufactured Housing	1,710,700	195,300	49,300
Total	15,778,000	713,200	300,200

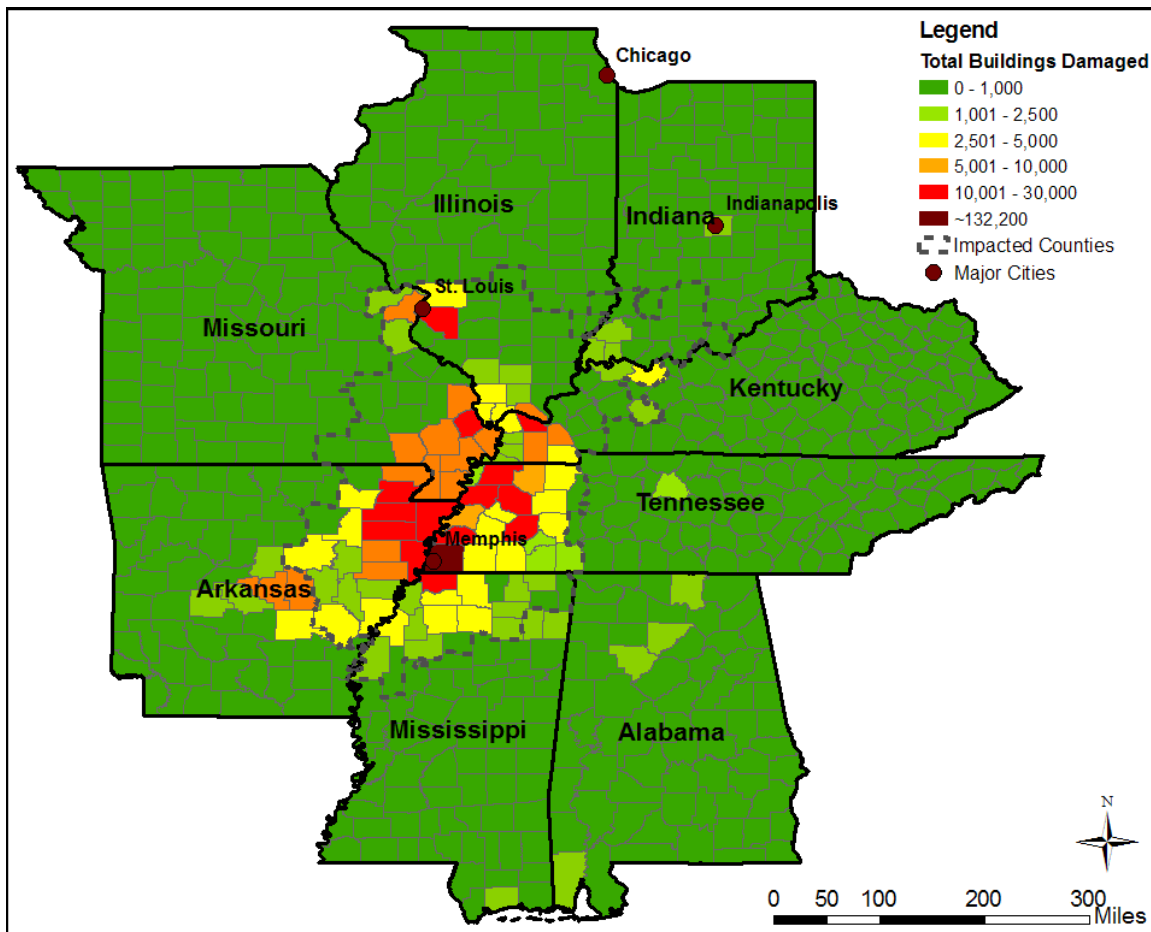


Figure 41: General Building Damage in Eight-State Study Region (No. of Buildings Damaged)

Residential buildings comprise a significant portion of all building damage in the eight-state study region. Approximately 60% of all at least moderate damage is experienced by single family homes, and another 35% is attributed to other residential structures. Nearly 670,000 damaged structures are residential buildings which is over 90% of all building

⁵¹ Please reference footnote 1.

damage. Table 90 details the number of damaged structures by building use group throughout the eight-state study region. Furthermore,

Table 91 displays building damage by structure type for the entire study region. Roughly 60% of all complete damage is attributed to wood structures. URM and manufactured housing constitute lesser portions of regional building damage, 20% and 15%, respectively. Wood structures comprise only 50% of all at least moderate damage, while manufactured housing comprises over 25%. Nearly 20% of all at least moderate damage is attributed to URM structures.

Essential Facilities

Most emergency services are severely compromised after the scenario earthquake event. Nearly 130 hospitals are damaged by the scenario event, with over 40% of those facilities located in western Tennessee. Arkansas and Mississippi each also account for nearly 20% of damaged hospitals. As a result of such extensive damage medical services in the 140 impacted counties are extremely limited and most patients will need to be evacuated to more stable areas for long-term care. The likelihood of damage to regional hospitals is illustrated in Figure 42 where the most severely damaged hospitals are shown in red and orange. It is likely these facilities are not functional after the scenario earthquake.

Table 92: Essential Facilities Damage for Eight-State Study Region⁵²

Essential Facility	Total Facilities	At Least Moderate Damage	Complete Damage
Schools	20,291	1,322	277
Fire Stations	10,346	729	177
Police Stations	4,480	379	136
Hospitals	2,825	129	32
EOCs	1,093	116	44

Fire and law enforcement services are also reduced in the eight-state study region. As is evident in Table 92, over 375 police stations and 725 fire stations are damaged in the Central US. Most of these damaged facilities are located in the impacted counties. Over 100 police stations are damaged in both Tennessee and Arkansas, leaving large portions of those states without law enforcement services immediately after the event. Mississippi, Missouri, and Illinois also experience large numbers of damaged facilities. Nearly one-third of all damaged fire stations are located in western Tennessee, leaving residents and businesses in that portion of the study region extremely vulnerable to fire damage since services are so severely reduced. Large numbers of fire stations are also damaged in Missouri, Mississippi, Kentucky, and Illinois.

Many schools in the impacted counties are damaged leaving children without schools to attend after the event and no shelter locations for displaced residents. Over 1,300 schools are damaged in the eight-state study region. Nearly half of all damaged schools are located in western Tennessee, mainly due to the large school inventory in Memphis,

⁵² Please reference footnote 3.

Tennessee. Over 200 schools are damaged in northeastern Arkansas and roughly 100 schools are damaged in Illinois, Kentucky, Mississippi, and Missouri. Nearly 300 of the 1,300 damaged schools are completely damaged. Most completely damaged schools are located very near the fault rupture in Arkansas, Illinois, Kentucky, Missouri, and Tennessee.

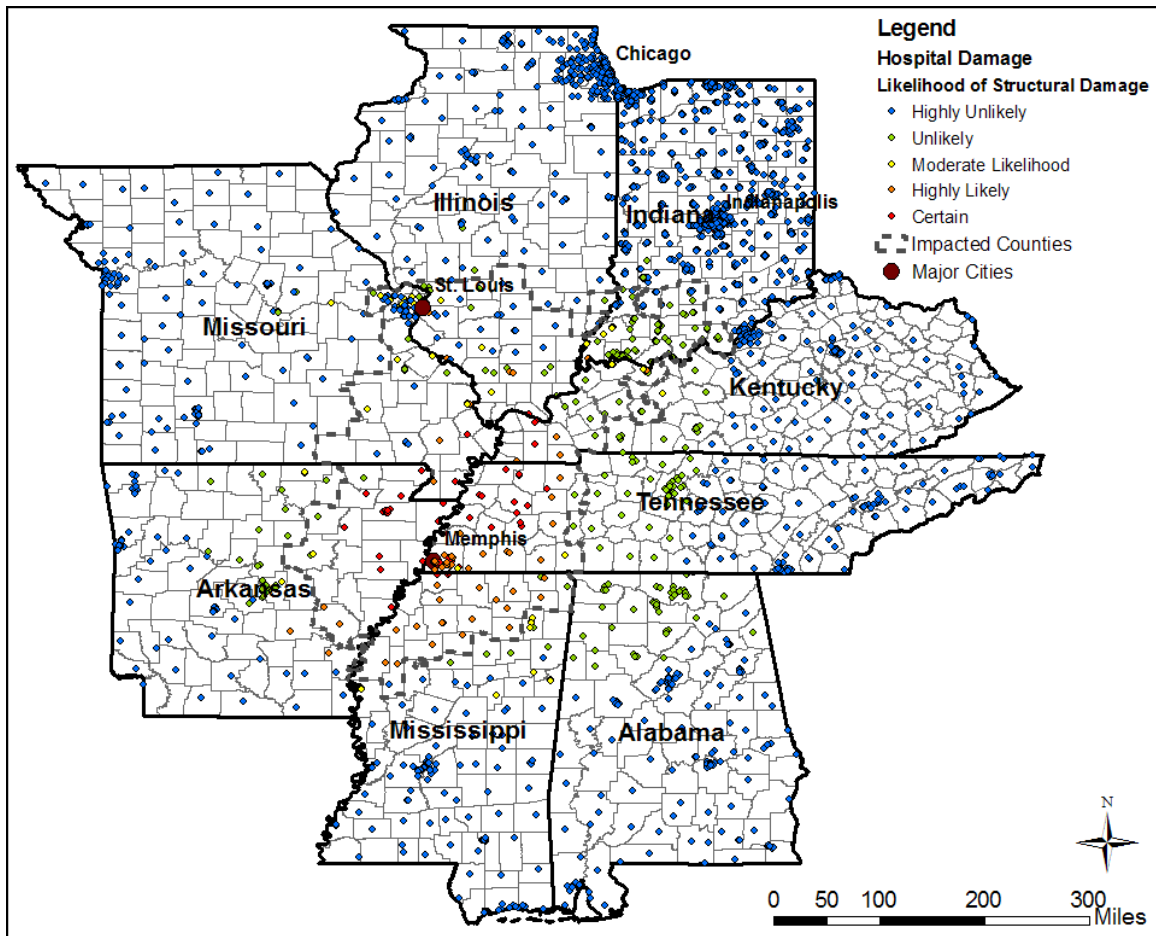


Figure 42: Hospital Damage for Eight-State Study Region

Transportation Lifelines

Damage to transportation lifelines limits the extent and methods of travel available to residents and response workers. Highway bridges are significantly damaged near the fault rupture. Arkansas, Missouri, and Tennessee, each experience over 1,000 damaged bridges. Road travel will be extremely difficult since many bridges are impassible. Furthermore, nearly 150 airports are damaged thus limiting air travel to and from the impacted counties. Roughly one-third of all damaged airports are located in western Tennessee, with nearly 40 in Arkansas and nearly 30 in Missouri. Landing large planes with response personnel and aid supplies will be extremely difficult since most major airports in the heavily impacted areas are unusable. Table 93 also details damage to port and railway facilities. Major ports along the Mississippi River and other major rivers in

the Central US are not operational immediately after the event thus inhibiting the flow of commodities and any potential evacuation efforts over water.

Table 93: Transportation Lifeline Damage for Eight-State Study Region⁵³

Transportation Lifelines	Total Facilities	At Least Moderate Damage	Complete Damage
Highway Bridges	165,771	3,547	1,255
Railway Bridges	1,888	29	0
Railway Facilities	1,118	119	0
Bus Facilities	405	16	0
Port Facilities	2,004	232	0
Airport Facilities	3,773	143	0

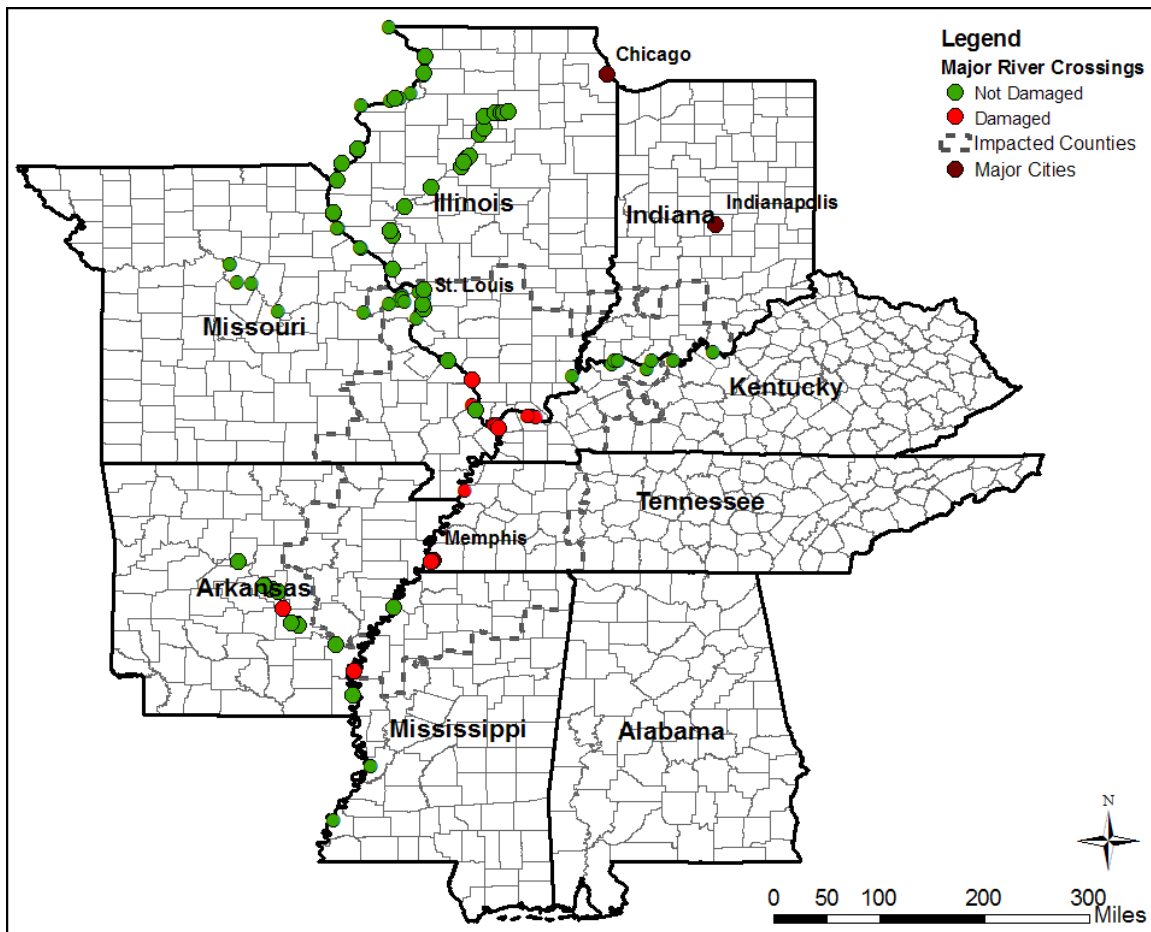


Figure 43: Major River Crossing Damage for Eight-State Study Region

Major river crossings in the Central US are those that cross the Illinois, Mississippi, Missouri, Ohio, and Arkansas Rivers. These bridges are unique structures and carry high volumes of traffic as well as major pipelines and communication lines. It is estimated that roughly 15 major bridges are damaged and impassible. Figure 43 illustrates the locations of damaged major river crossings in the Central US. Numerous damaged bridges lie

⁵³ Please reference footnote 3.

along the Mississippi River, effectively separating the eight-state study region into two separate sections along the length of the river. It is unlikely that response workers, evacuees and supplies can be moved from east of the Mississippi to the west side, or vice versa, for several hundred miles near the rupture zone.

Utility Lifelines

Utility lifelines are heavily damaged and service for regional residents and response workers limited as a result. Nearly 10,000 communication facilities are damaged throughout the eight-state region as is shown in Table 94. Most damage is confined to the impacted counties, making it incredibly difficult for response workers to communicate and coordinate evacuation efforts, set up temporary shelters, advise the public and media, and facilitate interagency cooperation. Approximately 40% of all communication facilities damage occurs in western Tennessee, while Missouri and Illinois also experience substantial communications damage. Damage to other utility facilities is detailed in Table 94 and shows that over 2,700 waste water facilities are damaged and nearly 1,000 oil production or distribution facilities are also damaged. Without functioning facilities portions of the eight-state study region are without much-needed utility services.

Table 94: Utility Facilities Damage for Eight-State Study Region⁵⁴

Utility Facilities	Total Facilities	At Least Moderate Damage	Complete Damage
Potable Water Facilities	1,195	76	1
Waste Water Facilities	48,430	2,732	17
Natural Gas Facilities	34,339	418	3
Oil Facilities	89,621	998	0
Electric Facilities	10,893	673	4
Communication Facilities	145,722	9,748	115

Table 95: Utility Pipeline Damage for Eight-State Study Region

Pipeline System	Total Miles	Leaks	Breaks	Total Repairs
Potable Water Local	1,030,000	65,452	92,094	157,546
Waste Water Local	607,100	51,776	72,837	124,613
Natural Gas Local	413,200	55,273	77,829	133,102
Natural Gas Interstate	66,500	1,534	4,841	6,375
Oil Interstate	29,100	310	1,015	1,325

Both local and interstate pipelines are damaged extensively in the eight-state study region. Local potable water pipelines alone require nearly 158,000 repairs. When combined with the nearly 125,000 repairs to local waste water lines, and 133,000 repairs to local natural gas lines, it is expected that all repairs will take several months. In addition, the interstate pipelines that deliver natural gas and oil to the Central US and east coast must be repaired and the flow of necessary commodities restored. There are limited service teams and supplies and thus the 425,000 total repairs required in the eight states will take a very

⁵⁴ Please reference footnote 3.

long time and some areas will be without water, gas, or oil service for an extended period of time.

Damage to facilities and pipelines leads to millions of service losses in the eight states. As Table 96 shows, 2.6 million households are without power and 1.1 million households without water immediately after the earthquake. As with pipeline damage, the limited number of service crews and spare parts limits the rate of repairs and the speed with which power and water will return. It is expected that most households without power immediately after the event will be without power for several days to a week, or more in severely damaged areas. Residents in the impacted counties may be without power for a month, or several months, depending upon the extent of damage to power plants, distribution facilities and power lines. Electric power service losses for the entire eight-state region are illustrated in Figure 44.

Table 96: Service Outages at Day 1 for Eight-State Study Region

	Total Households	Electric Power	Potable Water
Service Outages at Day 1 (Households)	16,773,000	2,598,000	1,090,000

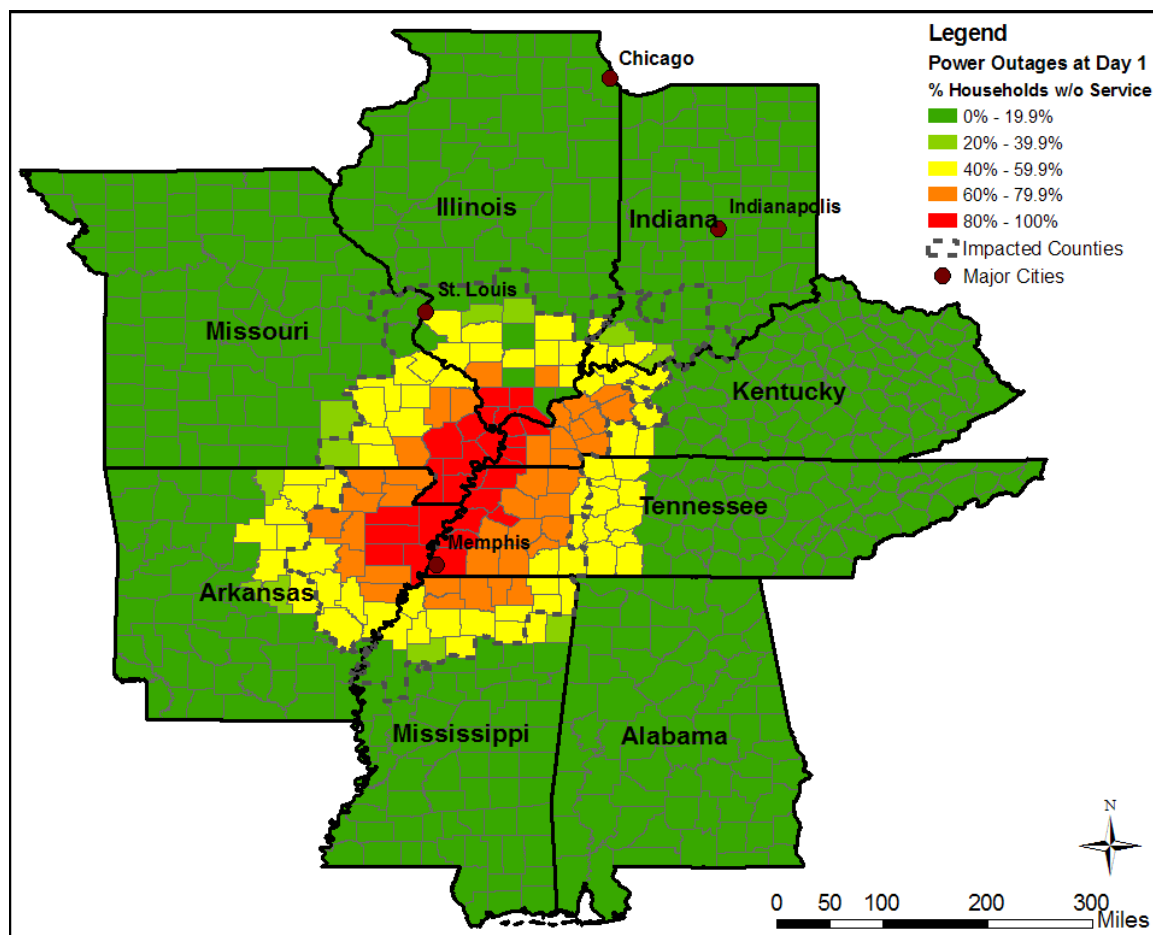


Figure 44: Electric Power Outages at Day 1 for Eight-State Study Region

Other Critical Infrastructure

Damage to dams, levees, and hazardous materials facilities are critical components of the NMSZ impact assessment because of potentially disastrous secondary impacts resulting from infrastructure failure. Over 325 dams are damaged in the Central US, with most damage occurring near the fault rupture where shaking is most intense. Some dams may release water and flood neighboring land and infrastructure. Table 97 also details levee damage and hazardous materials facilities damage. Flooding from the failure of nearly 100 levees is also possible, especially in western Kentucky and Tennessee, eastern Missouri and Arkansas, and southern Illinois. Additionally, over 250 hazardous materials facilities are damaged, though damage is confined to only a few counties with intense shaking. Some release of hazardous materials is possible in certain areas.

Table 97: Other Critical Facilities Damage for Eight-State Study Region

Facility Type	Total Facilities	Damaged
Dams	17,573	327
Levees	1,326	96
Hazardous Materials	39,759	253

Induced Damage, Casualties, and Economic Losses

Approximately 50 million tons of debris are generated by the NMSZ scenario event. As Table 98 shows, roughly 22 millions tons are steel and concrete debris, while the remaining 28 million tons are attributed to wood, brick, and other building materials. Over 40% of all debris occurs in Arkansas, roughly 30% is generated in Tennessee, and just over 20% in Kentucky. Most of this debris is located in the impacted counties within each state. Initial debris removal is required to obtain access to critically impacted areas and assist victims. A second stage of debris removal is required during the recovery phase as homes are repaired or rebuilt and businesses reopened.

The NMSZ scenario event causes nearly 86,000 casualties in the eight-state study region. Table 99 details the number of expected casualties by severity level. Over 63,000 casualties are minor (Level 1) injuries. Approximately 1,900 casualties are injuries that require hospitalization (Levels 2 & 3), and 3,500 are fatalities (Level 4). Over 35% of all fatalities and total casualties occur in western Tennessee, largely due to the amount of damage in Memphis. Arkansas and Missouri each incur roughly 20% of all fatalities and total casualties. Other states account for far lesser percentages of casualties. Figure 45 illustrates the distribution of total casualties in the eight-state study region. It is evident that Shelby County, Tennessee, incurs the largest number of any single county in the eight states.

Table 98: Debris Generation for Eight-State Study Region

	Steel, Concrete (Tons)	Wood, Brick, Other (Tons)	Total Debris (Tons)	Removal Truckloads (25-ton truck)
Debris Generation	21,943,000	28,113,000	50,056,000	2,002,240

Table 99: Casualties at 2:00AM for Eight-State Study Region

	Level 1	Level 2	Level 3	Level 4	Total
Casualties at 2:00AM	63,266	17,121	1,882	3,496	85,765

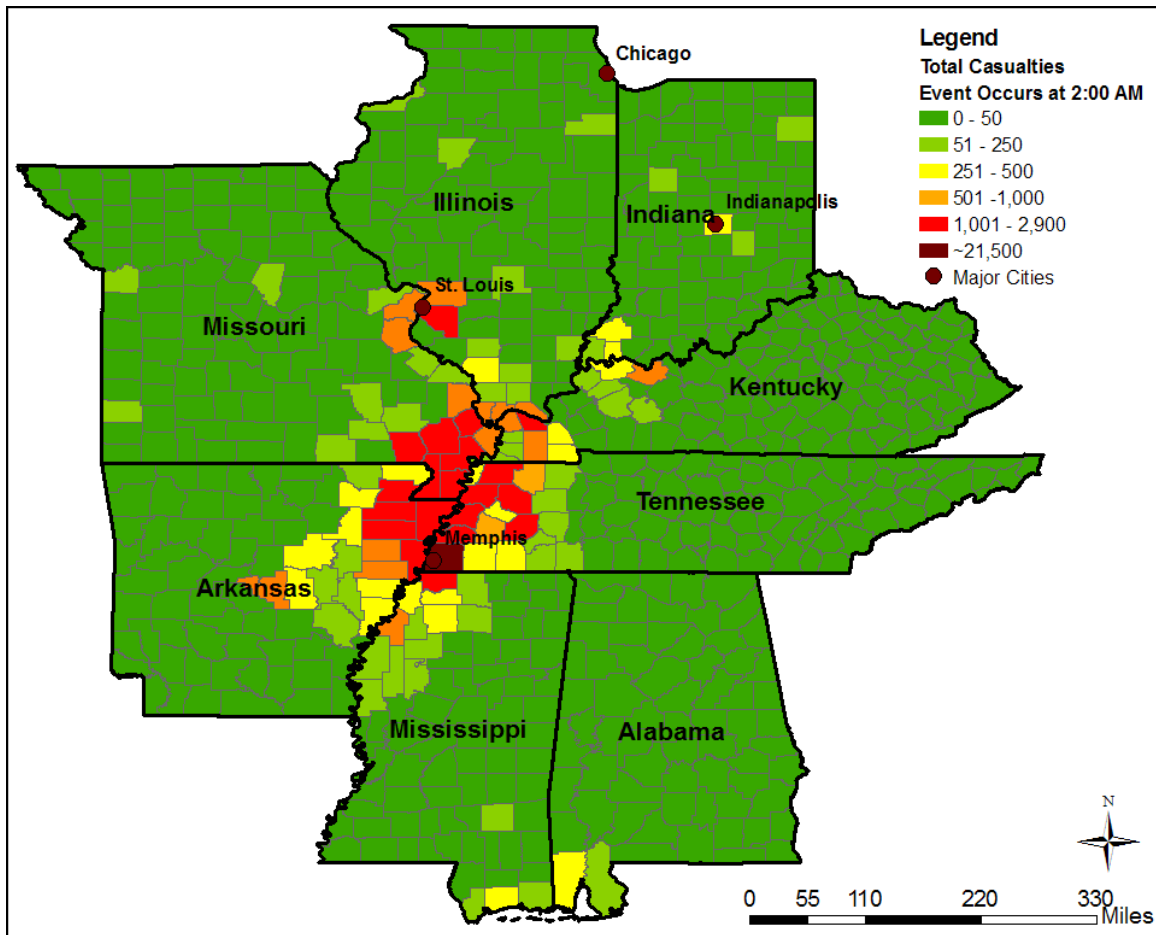


Figure 45: Total Casualties for 2:00AM Event in Eight-State Study Region

The eight-state study region includes \$8.6 trillion in building, transportation lifeline, and utility lifeline assets. Over 25% of all study region assets are located in Illinois though only 15% of all economic losses occur there. Conversely, only 8% of regional asset value is located in Tennessee but nearly 25% of all economic losses occur there. Kentucky and Missouri each incur roughly 17% of all regional direct economic losses. Arkansas comprises only 5% of all regional economic assets, though 13% of all economic losses occur there.

Table 100: Direct Economic Loss for Eight-State Study Region (\$ millions)

	Buildings	Transportation	Utilities	Total
Direct Economic Loss	\$113,080	\$10,866	\$172,101	\$296,047

Overall, the NMSZ scenario event generated approximately \$300 billion in direct economic losses. Table 100 describes economic losses by infrastructure type. Nearly 60% of all economic losses are attributed to utility lifelines and nearly 40% are attributed to buildings. Less than 4% of all economic losses are attributed to transportation lifelines.

Appendix 6 – Social Impacts and Response Requirements

The results discussed in this appendix are presented in a more detailed manner than those in Volume I of this report. This appendix provides the results of the social impacts and response requirements for each of the eight states in the New Madrid Seismic Zone (NMSZ). The earthquake impact assessment for the Central US was comprised of a single scenario, though individual analyses were completed for each state due to the large amount of inventory in the eight-state region. The social impacts and response requirements presented in this section are based upon the direct damages presented in Appendix 5. This section also shows the results of a social vulnerability analysis. Certain portions of the impacted population are more vulnerable based on their characteristics, such as, income level, command of the English language, age and disabilities. These populations may have different needs and/or require different levels of response activities based on their characteristics. Therefore, it is important to identify those areas where high vulnerability overlaps with high impact. For a detailed discussion concerning the calculation of social vulnerability as well all other methodology related to social impacts and response requirements please refer to the “Model Overview and Component Characteristics” chapter in Volume I. The results in this section are presented by state and include estimates of social impacts and response requirements for the ‘impacted counties’ which were identified for regional planning workshops in the four FEMA regions in the Central US. Regional totals are shown in the “Overview of Results from Impact Assessment” chapter in Volume I.

Lists of ‘impacted counties’ were compiled by state based on a cumulative review of direct damage and functional capabilities of infrastructure, social impacts and direct economic losses. The counties selected in each state are estimated to incur the most severe damage, loss of operational capability, social impacts and direct economic losses, as estimated by the models used to generate the NMSZ Scenario. Please note that damage, operational capabilities losses, social impacts, and direct economic losses were not confined to these counties, but rather most severe in these areas. All counties in the eight-state region are likely impacted by a New Madrid event, though the impacts will be less severe outside the areas identified as ‘impacted counties.’ There are no ‘impacted counties’ in the State of Alabama since the impacts in that state are not severe enough to meet the criteria established to define ‘impacted counties’.

Social impacts and resulting response demands are presented as credible point estimates in order to enhance readability and utility. However, as described in Volume I of this report, these estimates are subject to a high degree of uncertainty and should not be treated as predictions.

Alabama: Social Impact and Response Requirements Analysis Results

The State of Alabama incurs the smallest impacts of all states in the eight-state region. No ‘impacted counties’ are selected in this state due to lesser levels of infrastructure damage and economic loss. However, a set of ‘socially impacted counties’ was determined, based on social impacts exclusively.

‘Socially Impacted Counties’

Figure 1 displays a map of the 21 counties determined to be ‘Socially Impacted’ in the State of Alabama. Table 1 provides the corresponding population.

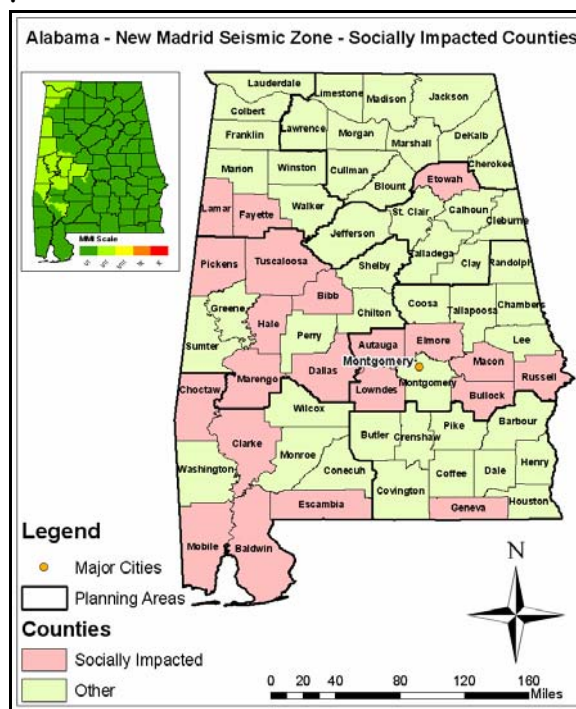


Figure 1: ‘Socially Impacted Counties’ in the State of Alabama

Socially Impacted Counties (SIC)	Population
Autauga	43,671
Baldwin	140,415
Bibb	20,826
Bullock	11,714
Choctaw	15,922
Clarke	27,867
Dallas	46,365
Elmore	65,874
Escambia	38,440
Etowah	103,459
Fayette	18,495
Geneva	25,764
Hale	17,185
Lamar	15,904
Lowndes	13,473
Macon	24,105
Marengo	22,539
Mobile	399,843
Pickens	20,949
Russell	49,756
Tuscaloosa	164,875
Total in SIC	1,287,441
Total in Alabama	4,447,100

Table 1: Population in the ‘Socially Impacted Counties’ in the State of Alabama

Social Vulnerability

Figure 2 provides the results of a vulnerability analysis for the State of Alabama based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 1, which shows the socially impacted counties, it is evident that the impacted area has a moderate-to-high concentration of its population living in poverty. Furthermore, Figure 3 illustrates the results of a vulnerability analysis for the State of Alabama based on age. By comparing the large map, which shows the age distribution by

county, with the map in Figure 1, it can be seen that the impacted area has a moderate-to-high concentration of its population younger than 5 or older than 65 years of age.

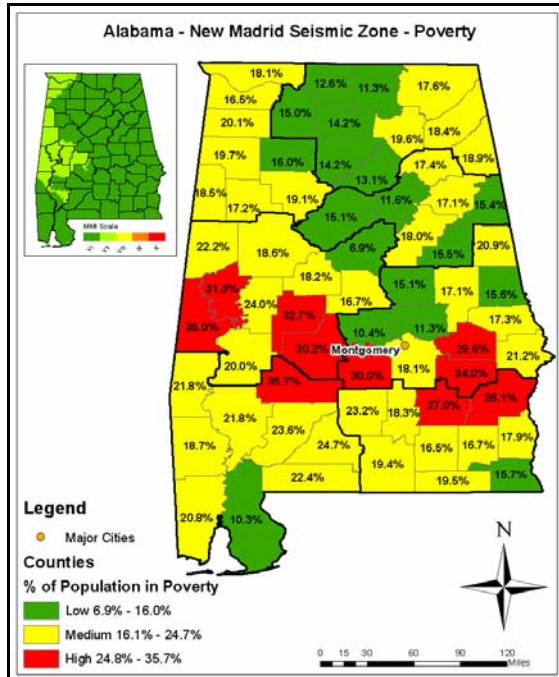


Figure 2: Vulnerability based on Poverty

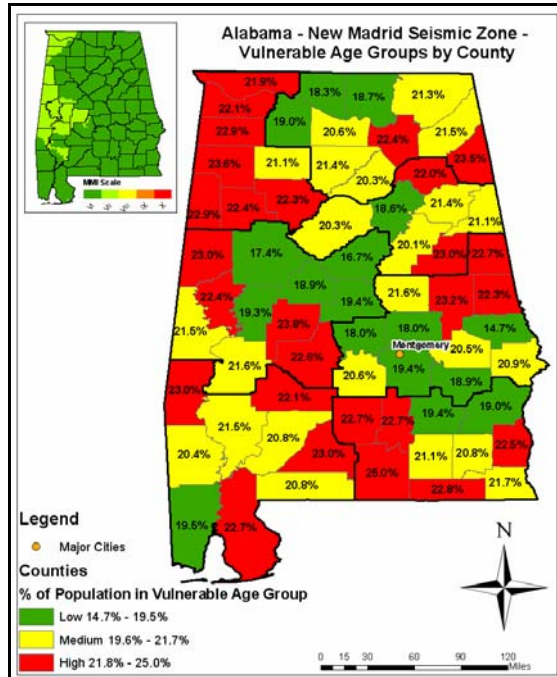


Figure 3: Vulnerability based on Age

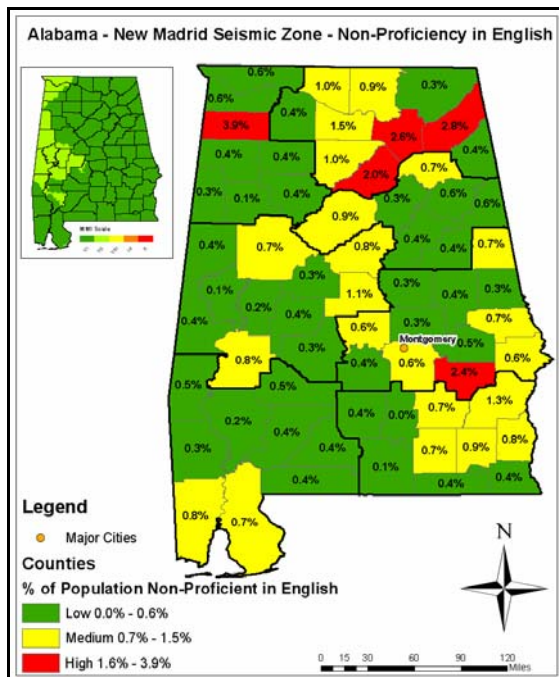


Figure 4: Vulnerability based on English Proficiency

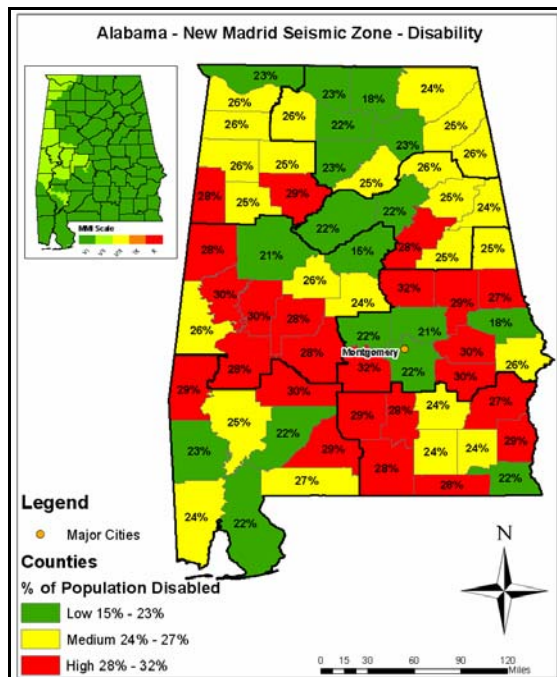


Figure 5: Vulnerability based on Disabilities

Figure 4 provides the results of a vulnerability analysis for the State of Alabama based on English proficiency. Comparing the large map, which shows the English proficiency

levels by county, with the map in Figure 1, shows that the majority of the population in the impacted area is proficient in English. For those counties which have a lower level of English proficiency, the most prevalent language is Spanish. Additionally, Figure 5 illustrates the results of a vulnerability analysis for the State of Alabama based on people with disabilities. Comparing the large map, which shows the people with disabilities by county, with the map in Figure 1 reveals that within the socially impacted area there is a high concentration of people with disabilities.

Based on the vulnerability analysis shown above, planning and response activities in the State of Alabama must consider that a large portion of the impacted population is lower-income families, some have various disabilities and are below the age of five or over the age of 65. There is also a fair portion of the population that is not proficient in English and speaks Spanish as their primary language.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

Table 2: Distribution of “At Risk” and Shelter-Seeking Population in the State of Alabama

Socially Impacted Counties (SIC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Autauga	43,671	207	60	6,069	1,727
Baldwin	140,415	551	122	19,518	4,288
Bibb	20,826	154	59	2,896	1,089
Bullock	11,714	73	21	1,628	464
Choctaw	15,922	83	33	2,212	858
Clarke	27,867	100	32	3,873	1,199
Dallas	46,365	460	179	6,445	2,508
Elmore	65,874	275	75	9,155	2,463
Escambia	38,440	183	54	5,342	1,608
Etowah	103,459	368	107	14,380	4,142
Fayette	18,495	205	62	2,572	765
Geneva	25,764	113	37	3,580	1,139
Hale	17,185	75	24	2,390	796
Lamar	15,904	116	34	2,211	669
Lowndes	13,473	214	77	1,872	681
Macon	24,105	81	32	3,350	1,368
Marengo	22,539	147	46	3,134	962
Mobile	399,843	4,598	1,475	55,578	17,828
Pickens	20,949	127	47	2,912	1,078
Russell	49,756	355	134	6,916	2,588
Tuscaloosa	164,875	440	151	22,918	7,874
Total in SIC	1,287,441	8,925	2,861	178,951	56,094
Total in Alabama	4,447,100	9,645	3,081	601,561	173,412

The estimates reflect that by day 3 the size of the “At Risk” population in Alabama is expected to be over 600,000 people, with more than 170,000 people expected to seek shelter. Table 2 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Location and Size of Other Relevant Populations

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 3 provides an overview of the additional population in the socially impacted counties, a total of over 60,000 people. While it is unlikely that this entire number will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Table 3: Distribution of Other Relevant Populations in the State of Alabama

Socially Impacted Counties (SIC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Autauga	79	81	100	241	501
Baldwin	620	610	877	14,991	17,098
Bibb	215	106	918	17	1,256
Bullock	-	114	1,397	8	1,519
Choctaw	-	100	33	21	154
Clarke	39	168	59	229	495
Dallas	352	157	30	558	1,097
Elmore	8	577	4,756	715	6,056
Escambia	1,184	240	1,556	217	3,197
Etowah	642	799	551	862	2,854
Fayette	125	162	53	15	355
Geneva	50	184	40	21	295
Hale	-	158	132	6	296
Lamar	7	146	46	5	204
Lowndes	17	-	30	-	47
Macon	1,813	387	38	101	2,339
Marengo	22	151	67	230	470
Mobile	4,245	1,900	1,418	5,854	13,417
Pickens	9	198	137	27	371
Russell	78	314	295	277	964
Tuscaloosa	6,244	1,172	661	2,179	10,256
Total SIC	15,749	7,724	13,194	26,574	62,740

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s (meals ready to eat) required for the first 72 hours post-event, are shown in Tables 4, 5, and 6, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 4: Water Required to Support the “At Risk” Population in the State of Alabama

Socially Impacted Counties (SIC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Autauga	180	180	18,207	18,567	-	-	1	1
Baldwin	366	366	58,554	59,286	-	-	3	3
Bibb	177	177	8,688	9,042	-	-	-	<1
Bullock	63	63	4,884	5,010	-	-	-	<1
Choctaw	99	99	6,636	6,834	-	-	-	<1
Clarke	96	96	11,619	11,811	-	-	1	<1
Dallas	537	537	19,335	20,409	-	-	1	1
Elmore	225	225	27,465	27,915	-	-	2	2
Escambia	162	162	16,026	16,350	-	-	1	<1
Etowah	321	321	43,140	43,782	-	-	2	2
Fayette	186	186	7,716	8,088	-	-	-	<1
Geneva	111	111	10,740	10,962	-	-	1	<1
Hale	72	72	7,170	7,314	-	-	-	<1
Lamar	102	102	6,633	6,837	-	-	-	<1
Lowndes	231	231	5,616	6,078	-	-	-	<1
Macon	96	96	10,050	10,242	-	-	1	<1
Marengo	138	138	9,402	9,678	-	-	1	<1
Mobile	4,425	4,425	166,734	175,584	-	-	9	10
Pickens	141	141	8,736	9,018	-	-	-	<1
Russell	402	402	20,748	21,552	-	-	1	1
Tuscaloosa	453	453	68,754	69,660	-	-	4	4
Total in SIC	8,583	8,583	536,853	554,019	1	1	30	31
Total in Alabama	9,243	9,243	1,804,683	1,823,169	1	1	100	102

Table 5: MREs Required to Support the “At Risk” Population in the State of Alabama

Socially Impacted Counties (SIC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Autauga	120	120	12,138	12,378	-	-	1	<1
Baldwin	244	244	39,036	39,524	-	-	2	2
Bibb	118	118	5,792	6,028	-	-	-	<1
Bullock	42	42	3,256	3,340	-	-	-	<1
Choctaw	66	66	4,424	4,556	-	-	-	<1
Clarke	64	64	7,746	7,874	-	-	-	<1
Dallas	358	358	12,890	13,606	-	-	1	<1
Elmore	150	150	18,310	18,610	-	-	1	<1
Escambia	108	108	10,684	10,900	-	-	-	<1
Etowah	214	214	28,760	29,188	-	-	1	1
Fayette	124	124	5,144	5,392	-	-	-	<1
Geneva	74	74	7,160	7,308	-	-	-	<1
Hale	48	48	4,780	4,876	-	-	-	<1
Lamar	68	68	4,422	4,558	-	-	-	<1
Lowndes	154	154	3,744	4,052	-	-	-	<1
Macon	64	64	6,700	6,828	-	-	-	<1
Marengo	92	92	6,268	6,452	-	-	-	<1
Mobile	2,950	2,950	111,156	117,056	-	-	5	5
Pickens	94	94	5,824	6,012	-	-	-	<1
Russell	268	268	13,832	14,368	-	-	1	<1
Tuscaloosa	302	302	45,836	46,440	-	-	2	2
Total in SIC	5,722	5,722	357,902	369,346	<1	<1	16	17
Total in Alabama	6,162	6,162	1,203,122	1,215,446	<1	<1	55	56

Table 6: Ice Required to Support the “At Risk” Population in the State of Alabama

Socially Impacted Counties (SIC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Autauga	480	480	48,552	49,512	-	-	1	1
Baldwin	976	976	156,144	158,096	-	-	4	4
Bibb	472	472	23,168	24,112	-	-	1	<1
Bullock	168	168	13,024	13,360	-	-	-	<1
Choctaw	264	264	17,696	18,224	-	-	-	<1
Clarke	256	256	30,984	31,496	-	-	1	<1
Dallas	1,432	1,432	51,560	54,424	-	-	1	1
Elmore	600	600	73,240	74,440	-	-	2	2
Escambia	432	432	42,736	43,600	-	-	1	1
Etowah	856	856	115,040	116,752	-	-	3	3
Fayette	496	496	20,576	21,568	-	-	1	<1
Geneva	296	296	28,640	29,232	-	-	1	<1
Hale	192	192	19,120	19,504	-	-	-	<1
Lamar	272	272	17,688	18,232	-	-	-	<1
Lowndes	616	616	14,976	16,208	-	-	-	<1
Macon	256	256	26,800	27,312	-	-	1	<1
Marengo	368	368	25,072	25,808	-	-	1	<1
Mobile	11,800	11,800	444,624	468,224	-	-	11	12
Pickens	376	376	23,296	24,048	-	-	1	<1
Russell	1,072	1,072	55,328	57,472	-	-	1	1
Tuscaloosa	1,208	1,208	183,344	185,760	-	-	5	5
Total in SIC	22,888	22,888	1,431,608	1,477,384	-	1	36	37
Total in Alabama	24,648	24,648	4,812,488	4,861,784	1	1	120	122

Search and Rescue teams and personnel required

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 7 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 8 provides the number and type of US&R Task Force teams required along with the number of personnel

Table 7: Distribution of Building Collapse Types for the ‘Socially Impacted Counties’ in Alabama

County	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Autauga	-	-	1	5
Baldwin	1	-	5	16
Bibb	-	-	1	3
Bullock	-	-	-	2
Choctaw	-	-	-	2
Clarke	-	-	1	2
Covington	-	-	-	2
Dale	-	-	-	2
Dallas	1	-	3	10
Elmore	-	-	2	6
Escambia	-	-	1	5
Etowah	-	-	3	9
Fayette	-	-	1	5
Geneva	-	-	1	3
Hale	-	-	-	2
Houston	-	-	1	3
Lamar	-	-	1	3
Lowndes	-	-	1	5
Macon	-	-	1	2
Marengo	-	-	1	4
Mobile	5	3	30	95
Montgomery	-	-	2	6
Pickens	-	-	1	3
Russell	-	-	2	7
Tuscaloosa	-	-	3	9
Washington	-	-	-	1
Total	7	3	62	212

Table 8: Number and Type of S&R Teams for the State of Alabama

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Alabama	2	140	1	32	3	66	5	30

Shelter Capacity and Requirements

Table 9 provides a summary of the shelter demand and capacity for Alabama. Although Alabama suffers little direct damage from the earthquake, there is still a large demand for shelter given the widespread water and power outages. Figure 6 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 6 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however, shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Table 10 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

Table 9: Shelter Demand and Capacity for the State of Alabama

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
3,081	173,412	772	69,000	104,412	44,220	49,842

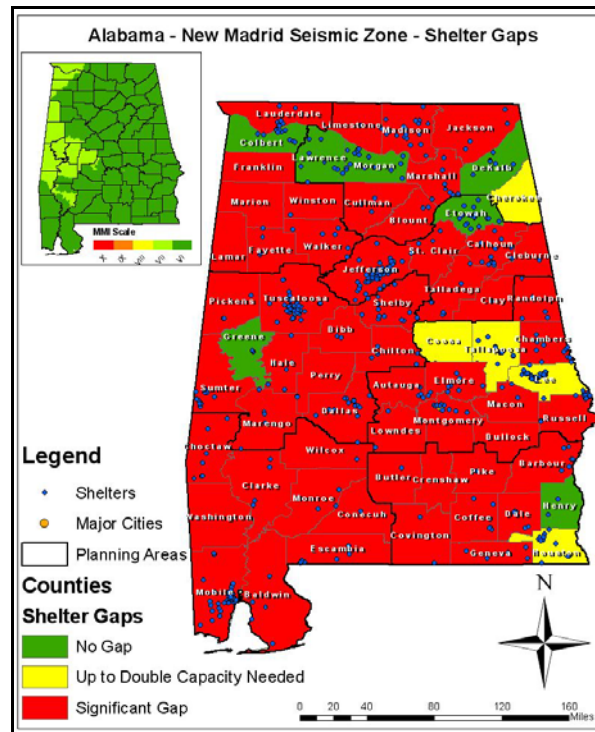


Figure 6: Shelter Gaps in the State of Alabama

Table 10: Shelter Resource Needs for the State of Alabama

Socially Impacted Counties (SIC)	Blankets	Cots	Sinks	Port-a-Pottys/ Toilets	Trash Cans
Autauga	3,454	1,727	22	43	35
Baldwin	8,576	4,288	54	107	86
Bibb	2,178	1,089	14	27	22
Bullock	928	464	6	12	9
Choctaw	1,716	858	11	21	17
Clarke	2,398	1,199	15	30	24
Dallas	5,016	2,508	31	63	50
Elmore	4,926	2,463	31	62	49
Escambia	3,216	1,608	20	40	32
Etowah	8,284	4,142	52	104	83
Fayette	1,530	765	10	19	15
Geneva	2,278	1,139	14	28	23
Hale	1,592	796	10	20	16
Lamar	1,338	669	8	17	13
Lowndes	1,362	681	9	17	14
Macon	2,736	1,368	17	34	27
Marengo	1,924	962	12	24	19
Mobile	35,656	17,828	223	446	357
Pickens	2,156	1,078	13	27	22
Russell	5,176	2,588	32	65	52
Tuscaloosa	15,748	7,874	98	197	157
Total in SIC	112,188	56,094	702	1,403	1,122
Total in Alabama	346,824	173,412	2,170	4,333	3,467

Medical Response Requirements

Table 11: Injuries and Hospital Status

Socially Impacted Counties (SIC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total	Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Autauga				-	None (0%)	2	50	None (14%)	None (0%)
Baldwin	38	11	1	50	None (0%)	5	449	None (14%)	None (0%)
Bibb	11	3	-	14	None (0%)	1	35	None (14%)	None (0%)
Bullock	4	1	-	5	None (0%)	1	30	None (14%)	None (0%)
Choctaw	5	1	-	7	None (0%)	1	-	None (14%)	None (0%)
Clarke	7	2	-	8	None (0%)	3	134	None (14%)	None (0%)
Dallas	30	8	1	40	None (0%)	1	214	None (14%)	None (0%)
Elmore	17	5	-	22	None (0%)	3	138	None (14%)	None (0%)
Escambia	10	3	-	13	None (0%)	2	141	None (14%)	None (0%)
Etowah	24	6	1	31	None (0%)	5	735	None (14%)	None (0%)
Fayette	15	4	-	18	None (0%)	1	183	None (14%)	None (0%)
Geneva	7	2	-	9	None (0%)	1	169	None (14%)	None (0%)
Hale	5	1	-	6	None (0%)	1	32	None (14%)	None (0%)
Lamar	9	2	-	11	None (0%)	1	-	None (14%)	None (0%)
Lowndes	13	4	-	17	None (0%)	1	-	None (14%)	None (0%)
Macon	5	1	-	7	None (0%)	1	213	None (14%)	None (0%)
Marengo	10	3	-	12	None (0%)	1	99	None (14%)	None (0%)
Mobile	305	84	8	396	None (0%)	13	2,312	None (14%)	None (0%)
Pickens	10	2	-	13	None (0%)	1	56	None (14%)	None (0%)
Russell	25	7	1	32	None (0%)	1	73	None (14%)	None (0%)
Tuscaloosa	34	8	1	43	None (0%)	12	2,409	None (14%)	None (0%)
Total in SIC	596	161	15	772		58	7,472		
Total in Alabama	726	179	16	921		210	23,107		

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals

will most likely be non-operational and will have to be evacuated. This will also require that injured people who call for hospital treatment will need to be cared for outside the county of residence. For the State of Alabama all hospitals are expected to remain operational, as is shown in Table 11.

Table 12: Cases of Chronic Illnesses in the Shelter-seeking Population of Alabama

Socially Impacted Counties (SIC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Autauga	76	119	150	285	16	143	300
Baldwin	189	296	373	708	39	356	746
Bibb	48	75	95	180	10	90	189
Bullock	20	32	40	77	4	39	81
Choctaw	38	59	75	142	8	71	149
Clarke	53	83	104	198	11	100	209
Dallas	110	173	218	414	23	208	436
Elmore	108	170	214	406	22	204	429
Escambia	71	111	140	265	14	133	280
Etowah	182	286	360	683	37	344	721
Fayette	34	53	67	126	7	63	133
Geneva	50	79	99	188	10	95	198
Hale	35	55	69	131	7	66	139
Lamar	29	46	58	110	6	56	116
Lowndes	30	47	59	112	6	57	118
Macon	60	94	119	226	12	114	238
Marengo	42	66	84	159	9	80	167
Mobile	784	1,230	1,551	2,942	160	1,480	3,102
Pickens	47	74	94	178	10	89	188
Russell	114	179	225	427	23	215	450
Tuscaloosa	346	543	685	1,299	71	654	1,370
Total in SIC	2,468	3,870	4,880	9,256	505	4,656	9,760
Total in Alabama	7,630	11,965	15,087	28,613	1,561	14,393	30,174

Table 12 shows the number of cases of chronic illnesses in the shelter-seeking population for Alabama. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Mortuary Services

Approximately 28 people die in Alabama as a result of the initial event. It is to be expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 13 shows the number of initial fatalities by ‘socially impacted’ county. This will require mortuary services such as victim identification and the establishment of temporary morgue facilities.

Table 13: Fatalities in Alabama

Socially Impacted Counties (SIC)	Fatalities
Autauga	-
Baldwin	2
Bibb	1
Bullock	-
Choctaw	-
Clarke	-
Dallas	1
Elmore	1
Escambia	-
Etowah	1
Fayette	1
Geneva	-
Hale	-
Lamar	-
Lowndes	-
Macon	-
Marengo	-
Mobile	14
Pickens	-
Russell	1
Tuscaloosa	1
Total in SIC	22
Total in Alabama	28

Security Needs

There are over 42,000 prisoners within Alabama. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 7 and Table 14 provide the distribution and type of prisoners within the state of Alabama.

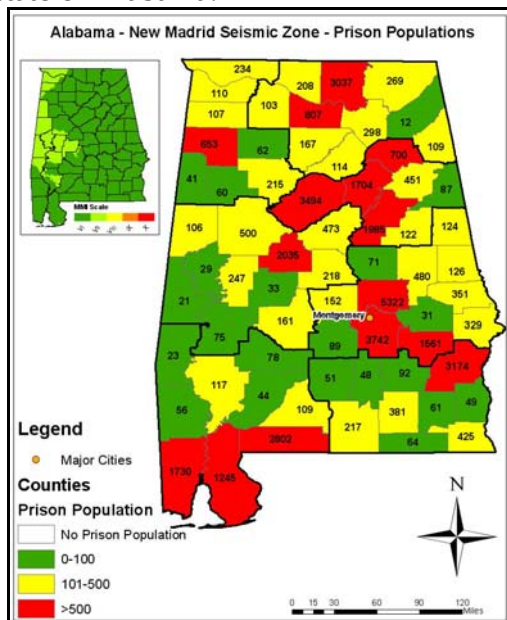


Figure 7: Distribution of Prisoners within the State of Alabama

Socially Impacted Counties (SIC)	Local Jails	State Prisons	Federal Prisons	Total
Autauga	152	-	-	152
Baldwin	739	506	-	1,245
Bibb	78	1,957	-	2,035
Bullock	47	1,514	-	1,561
Choctaw	23	-	-	23
Clarke	117	-	-	117
Dallas	161	-	-	161
Elmore	243	5,079	-	5,322
Escambia	143	2,659	-	2,802
Etowah	700	-	-	700
Fayette	60	-	-	60
Geneva	64	-	-	64
Hale	47	200	-	247
Lamar	41	-	-	41
Lowndes	89	-	-	89
Macon	31	-	-	31
Marengo	75	-	-	75
Mobile	1,538	192	-	1,730
Pickens	106	-	-	106
Russell	329	-	-	329
Tuscaloosa	500	-	-	500
Total SIC	5,283	12,107	-	17,390
Total Alabama	15,047	25,090	2,054	42,191

Table 14: Types of Prisoners in the State of Alabama

Arkansas: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Arkansas was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 19 counties were selected as ‘impacted counties’ in Arkansas.

‘Impacted Counties’

Figure 8 displays a map of the counties determined to be ‘impacted counties’ in the State of Arkansas. Table 15 provides the corresponding population for those counties.

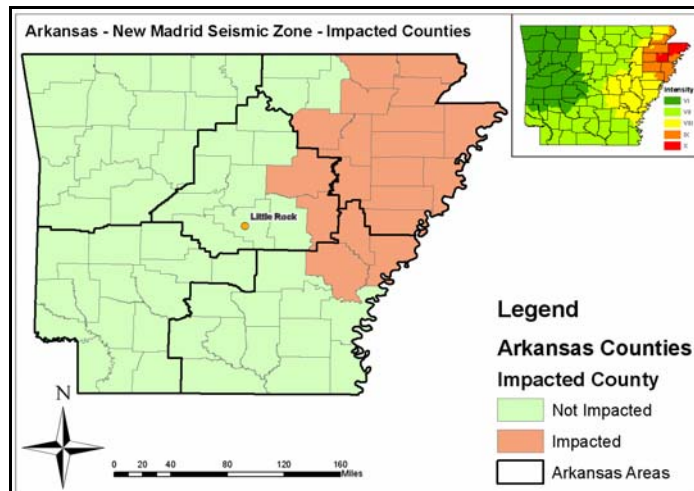


Figure 8: ‘Impacted Counties’ in the State of Arkansas

Impacted Counties (IC)	Population
Arkansas	20,749
Clay	17,609
Craighead	82,148
Crittenden	50,866
Cross	19,526
Greene	37,331
Independence	34,233
Jackson	18,418
Lawrence	17,774
Lee	12,580
Mississippi	51,979
Monroe	10,254
Phillips	26,445
Poinsett	25,614
Prairie	9,539
Randolph	18,195
Saint Francis	29,329
White	67,165
Woodruff	8,741
Total in IC	558,495
Total in Arkansas	2,673,400

Table 15: Population in the ‘Impacted Counties’ in the State of Arkansas

Social Vulnerability

Figure 9 provides the results of a vulnerability analysis for the State of Arkansas based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 8, it can be seen that the impacted area has a moderate-to-high concentration of its population living in poverty.

Figure 10 illustrates the results of a vulnerability analysis for the State of Arkansas based on age. Comparing the large map, which shows the age distribution by county, with the map in Figure 8 shows that the impacted area has a mixed concentration of its population younger than 5 or older than 65 years of age.

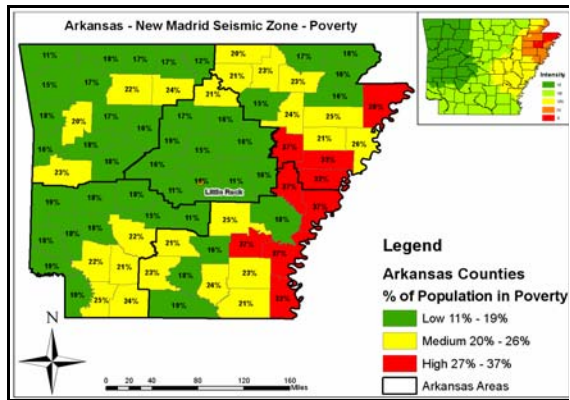


Figure 9: Vulnerability based on Poverty

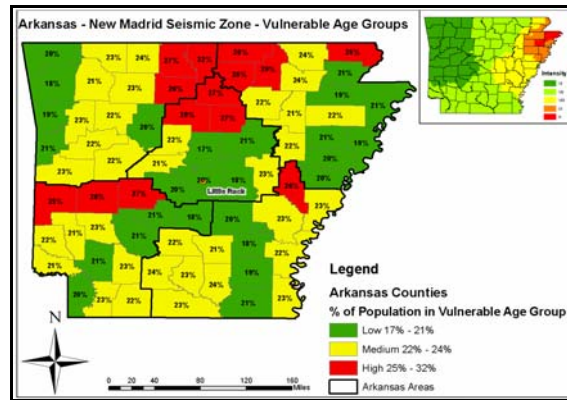


Figure 10: Vulnerability based on Age

Figure 11 provides the results of a vulnerability analysis for the State of Arkansas based on English proficiency. By comparing the large map, which shows the English proficiency levels by county, with the map in Figure 8 it is evident that the majority of the population in the impacted area is proficient in English. Additionally, Figure 12 illustrates the results of a vulnerability analysis for the State of Arkansas based on people with disabilities. Comparing the large map, which shows the people with disabilities per county, with the map in Figure 8 reveals that within the impacted area there is a fairly high concentration of people with disabilities.

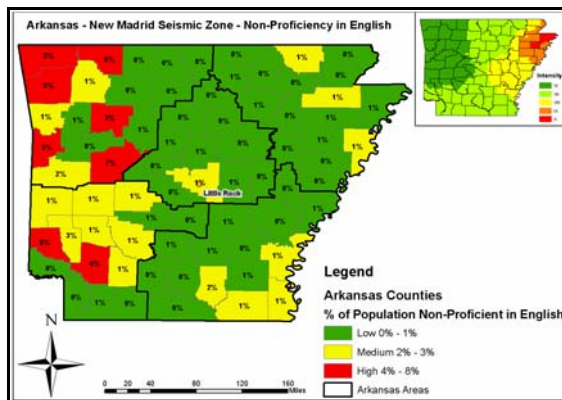


Figure 11: Vulnerability based on English Proficiency

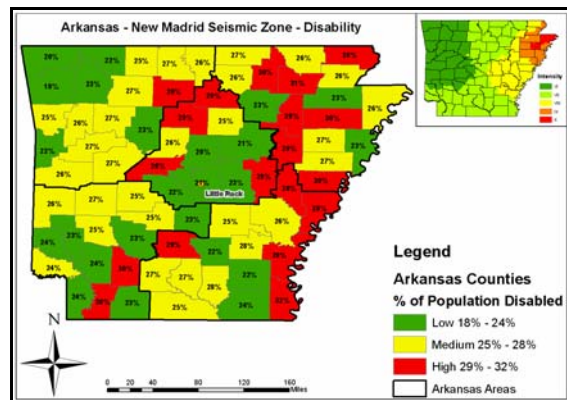


Figure 12: Vulnerability based on Disabilities

Based on the vulnerability analysis shown above, planning and response activities in the State of Arkansas must consider that a large portion of the impacted population will be from lower-income families and have various disabilities.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power

for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

The estimates reflect that by day 3 the size of the “At Risk” population in Arkansas is expected at nearly 940,000 people, with more than 285,000 people expected to seek shelter. Table 16 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Table 16: Distribution of “At Risk” and Shelter-Seeking Population in the State of Arkansas

Impacted Counties (IC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Arkansas	20,749	2,483	746	14,206	4,274
Clay	17,609	3,454	1,075	17,383	5,411
Craighead	82,148	22,451	6,282	81,871	22,904
Crittenden	50,866	16,457	5,202	50,792	16,058
Cross	19,526	4,652	1,458	19,373	6,076
Greene	37,331	9,288	2,561	36,951	10,187
Independence	34,233	-	-	20,613	5,564
Jackson	18,418	3,577	1,152	17,253	5,551
Lawrence	17,774	2,413	733	14,696	4,464
Lee	12,580	2,455	927	12,342	4,657
Mississippi	51,979	19,748	6,318	51,941	16,618
Monroe	10,254	1,254	445	7,237	2,568
Phillips	26,445	3,442	1,239	18,294	6,590
Poinsett	25,614	8,908	2,741	25,568	7,864
Prairie	9,539	1,149	348	6,413	1,947
Randolph	18,195	942	291	12,330	3,809
Saint Francis	29,329	5,484	2,000	28,716	10,467
White	67,165	3,253	916	34,285	9,666
Woodruff	8,741	1,812	636	8,375	2,943
Total in IC	558,495	113,222	35,070	478,639	147,618
Total in Arkansas	2,673,400	124,730	38,827	937,518	285,865

Location and Size of Other Relevant Populations

In estimating the “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 17 provides an overview of the additional population in the impacted counties, a total of over 25,000 people. While it is unlikely that this entire number will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Table 17: Distribution of Other Relevant Populations in the State of Arkansas

Impacted Counties (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Arkansas	48	242	73	389	752
Clay	7	144	28	167	346
Craighead	1,896	655	229	994	3,774
Crittenden	79	298	251	1762	2,390
Cross	66	175	59	155	455
Greene	147	348	93	267	855
Independence	470	306	161	392	1,329
Jackson	44	251	1369	156	1,820
Lawrence	261	253	37	164	715
Lee	20	77	1651	42	1,790
Mississippi	81	323	437	1081	1,922
Monroe	-	109	26	363	498
Phillips	80	165	69	308	622
Poinsett	-	252	143	145	540
Prairie	-	124	16	52	192
Randolph	11	234	66	189	500
St. Francis	83	179	2426	474	3,162
White	2,746	615	152	573	4,086
Woodruff	17	113	12	71	213
Total in IC	6,056	4,863	7,298	7,744	25,961

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for the first 72 hours post-event, are shown in Tables 18, 19, and 20, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 18: Water Required to Support the “At Risk” Population in the State of Arkansas

Impacted Counties (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Arkansas	2,238	2,238	42,618	47,094	-	-	2	3
Clay	3,225	3,225	52,149	58,599	-	-	3	3
Craighead	18,846	18,846	245,613	283,305	1	1	14	16
Crittenden	15,606	15,606	152,376	183,588	1	1	8	10
Cross	4,374	4,374	58,119	66,867	-	-	3	4
Greene	7,683	7,683	110,853	126,219	-	-	6	7
Independence	-	-	61,839	61,839	-	-	3	3
Jackson	3,456	3,456	51,759	58,671	-	-	3	3
Lawrence	2,199	2,199	44,088	48,486	-	-	2	3
Lee	2,781	2,781	37,026	42,588	-	-	2	2
Mississippi	18,954	18,954	155,823	193,731	1	1	9	11
Monroe	1,335	1,335	21,711	24,381	-	-	1	1
Phillips	3,717	3,717	54,882	62,316	-	-	3	3
Poinsett	8,223	8,223	76,704	93,150	-	-	4	5
Prairie	1,044	1,044	19,239	21,327	-	-	1	1
Randolph	873	873	36,990	38,736	-	-	2	2
Saint Francis	6,000	6,000	86,148	98,148	-	-	5	5
White	2,748	2,748	102,855	108,351	-	-	6	6
Woodruff	1,908	1,908	25,125	28,941	-	-	1	2
Total for IC	105,210	105,210	1,435,917	1,646,337	6	6	80	92
Total for Arkansas	116,481	116,481	2,812,554	3,045,516	6	6	156	169

Table 19: MREs Required to Support the “At Risk” Population in the State of Arkansas

Impacted Counties (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Arkansas	1,492	1,492	28,412	31,396	-	-	1	1
Clay	2,150	2,150	34,766	39,066	-	-	2	2
Craighead	12,564	12,564	163,742	188,870	1	1	8	9
Crittenden	10,404	10,404	101,584	122,392	-	-	5	6
Cross	2,916	2,916	38,746	44,578	-	-	2	2
Greene	5,122	5,122	73,902	84,146	-	-	3	4
Independence	-	-	41,226	41,226	-	-	2	2
Jackson	2,304	2,304	34,506	39,114	-	-	2	2
Lawrence	1,466	1,466	29,392	32,324	-	-	1	1
Lee	1,854	1,854	24,684	28,392	-	-	1	1
Mississippi	12,636	12,636	103,882	129,154	1	1	5	6
Monroe	890	890	14,474	16,254	-	-	1	<1
Phillips	2,478	2,478	36,588	41,544	-	-	2	2
Poinsett	5,482	5,482	51,136	62,100	-	-	2	3
Prairie	696	696	12,826	14,218	-	-	1	<1
Randolph	582	582	24,660	25,824	-	-	1	1
Saint Francis	4,000	4,000	57,432	65,432	-	-	3	3
White	1,832	1,832	68,570	72,234	-	-	3	3
Woodruff	1,272	1,272	16,750	19,294	-	-	1	<1
Total for IC	70,140	70,140	957,278	1,097,558	3	3	63	68
Total for Arkansas	77,654	77,654	1,875,036	2,030,344	4	4	86	93

Table 20: Ice Required to Support the “At Risk” Population in the State of Arkansas

Impacted Counties (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Arkansas	5,968	5,968	113,648	125,584	-	-	3	3
Clay	8,600	8,600	139,064	156,264	-	-	3	4
Craighead	50,256	50,256	654,968	755,480	1	1	16	19
Crittenden	41,616	41,616	406,336	489,568	1	1	10	12
Cross	11,664	11,664	154,984	178,312	-	-	4	4
Greene	20,488	20,488	295,608	336,584	1	1	7	8
Independence	-	-	164,904	164,904	-	-	4	4
Jackson	9,216	9,216	138,024	156,456	-	-	3	4
Lawrence	5,864	5,864	117,568	129,296	-	-	3	3
Lee	7,416	7,416	98,736	113,568	-	-	2	3
Mississippi	50,544	50,544	415,528	516,616	1	1	10	13
Monroe	3,560	3,560	57,896	65,016	-	-	1	2
Phillips	9,912	9,912	146,352	166,176	-	-	4	4
Poinsett	21,928	21,928	204,544	248,400	1	1	5	6
Prairie	2,784	2,784	51,304	56,872	-	-	1	1
Randolph	2,328	2,328	98,640	103,296	-	-	2	3
Saint Francis	16,000	16,000	229,728	261,728	-	-	6	7
White	7,328	7,328	274,280	288,936	-	-	7	7
Woodruff	5,088	5,088	67,000	77,176	-	-	2	2
Total for IC	280,560	280,560	3,829,112	4,390,232	6	6	137	148
Total for Arkansas	310,616	310,616	7,500,144	8,121,376	8	8	188	203

Search and Rescue Teams and Personnel Required

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 21 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 22 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 21: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Arkansas

Impacted County (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Arkansas	7	4	60	72
Clay	16	11	157	121
Craighead	103	62	943	459
Crittenden	53	34	603	338
Cross	21	13	187	135
Greene	32	20	319	229
Independence	-	-	-	-
Jackson	12	8	105	97
Lawrence	12	8	84	76
Lee	5	3	43	56
Mississippi	76	53	1,042	470
Monroe	5	3	35	46
Phillips	8	5	71	84
Poinsett	44	27	451	220
Prairie	2	2	36	43
Randolph	1	1	24	30
Saint Francis	19	12	122	133
White	5	4	70	88
Woodruff	4	3	52	59
Total in IC	425	273	4,404	2,756
Total in Arkansas	454	289	4,643	3,040

Table 22: Number and Type of S&R Teams for the State of Arkansas

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Arkansas	114	7,980	37	1,184	212	4,664	70	420

Shelter Capacity and Requirements

Table 23 provides a summary of the shelter demand and capacity for Arkansas. Figure 13 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 13 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however, shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Additionally, Table 24 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

Table 23: Shelter Demand and Capacity for the State of Arkansas

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
38,827	285,865	465	19,059	266,806	72,602	81,833

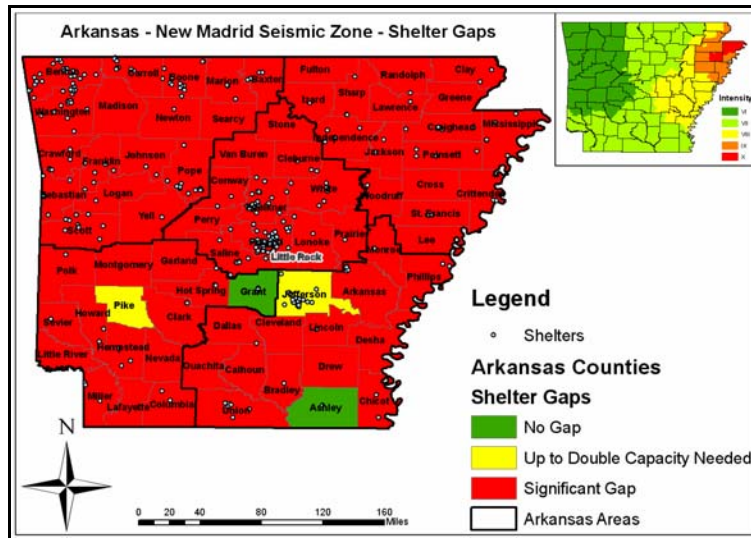


Figure 13: Shelter Gaps in the State of Arkansas

Table 24: Shelter Resource Needs for the State of Arkansas

Impacted Counties (IC)	Blankets	Cots	Sinks	Port-a-Pottys/ Toilets	Trash Cans
Arkansas	8,548	4,274	53	107	85
Clay	10,822	5,411	68	135	108
Craighead	45,808	22,904	286	573	458
Crittenden	32,116	16,058	201	401	321
Cross	12,152	6,076	76	152	122
Greene	20,374	10,187	127	255	204
Independence	11,128	5,564	70	139	111
Jackson	11,102	5,551	69	139	111
Lawrence	8,928	4,464	56	112	89
Lee	9,314	4,657	58	116	93
Mississippi	33,236	16,618	208	415	332
Monroe	5,136	2,568	32	64	51
Phillips	13,180	6,590	82	165	132
Poinsett	15,728	7,864	98	197	157
Prairie	3,894	1,947	24	49	39
Randolph	7,618	3,809	48	95	76
Saint Francis	20,934	10,467	131	262	209
White	19,332	9,666	121	242	193
Woodruff	5,886	2,943	37	74	59
Total in IC	295,236	147,618	1,845	3,692	2,950
Total in Arkansas	571,730	285,865	3,574	7,151	5,713

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Arkansas, there is a large number of injured people that require medical treatment. This is complicated by the large number of hospitals that sustain physical damages as well as widespread power and water outages, as is shown in Table 25. Most of the hospitals in the state must be evacuated and most injured patients will need to be cared for outside of the state.

Table 25: Injuries and Hospital Status for Arkansas

Injuries (2 AM)					Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Impacted Counties (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total					
Arkansas				-	Complete (100%)	2	74	Reduced (42%)	Complete (68%)
Clay	308	82	9	399	Complete (100%)	1	25	Complete (78%)	Complete (99%)
Craighead	2,111	585	70	2,767	Complete (100%)	10	594	Complete (84%)	Complete (100%)
Crittenden	1,461	412	48	1,921	Complete (100%)	1	152	Complete (85%)	Complete (100%)
Cross	459	126	14	599	Complete (100%)	1	15	Complete (83%)	Complete (99%)
Greene	802	216	23	1,041	Complete (100%)	1	129	Complete (79%)	Complete (99%)
Independence	5	-	-	5	None (0%)	1	185	Complete (60%)	None (0%)
Jackson	296	79	8	383	Complete (100%)	1	133	Complete (66%)	Complete (94%)
Lawrence	199	54	6	259	Complete (100%)	1	25	Complete (66%)	Complete (94%)
Lee	203	55	6	263	No Data			Complete (66%)	Complete (98%)
Mississippi	1,925	554	68	2,547	Complete (100%)	2	193	Complete (92%)	Complete (100%)
Monroe	104	27	3	133	No Data			Reduced (52%)	Complete (71%)
Phillips	263	70	7	339	Complete (100%)	1	155	Reduced (48%)	Complete (69%)
Poinsett	851	241	29	1,120	No Data			Complete (88%)	Complete (100%)
Prairie	85	22	2	110	No Data			Reduced (45%)	Complete (67%)
Randolph	66	18	2	85	None (0%)	1	50	Complete (65%)	Complete (68%)
Saint Francis	497	133	14	644	Complete (100%)	1	118	Complete (67%)	Complete (98%)
White	224	59	5	288	None (0%)	3	438	Reduced (49%)	Reduced (51%)
Woodruff	138	37	4	178	None (0%)			Reduced (37%)	None (2%)
Total in IC	10,178	2,820	321	13,318		27	2,286		
Total in Arkansas	11,245	3,075	344	14,664		125	11,592		

Table 26: Cases of Chronic Illnesses in the Shelter-seeking Population of Arkansas

Impacted Counties (IC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Arkansas	197	197	350	645	51	436	791
Clay	249	249	444	817	65	552	1,001
Craighead	1,054	1,054	1,878	3,459	275	2,336	4,237
Crittenden	739	739	1,317	2,425	193	1,638	2,971
Cross	279	279	498	917	73	620	1,124
Greene	469	469	835	1,538	122	1,039	1,885
Independence	256	256	456	840	67	568	1,029
Jackson	255	255	455	838	67	566	1,027
Lawrence	205	205	366	674	54	455	826
Lee	214	214	382	703	56	475	862
Mississippi	764	764	1,363	2,509	199	1,695	3,074
Monroe	118	118	211	388	31	262	475
Phillips	303	303	540	995	79	672	1,219
Poinsett	362	362	645	1,187	94	802	1,455
Prairie	90	90	160	294	23	199	360
Randolph	175	175	312	575	46	389	705
Saint Francis	481	481	858	1,581	126	1,068	1,936
White	445	445	793	1,460	116	986	1,788
Woodruff	135	135	241	444	35	300	544
Total in IC	6,790	6,790	12,105	22,290	1,771	15,057	27,309
Total in Arkansas	13,150	13,150	23,441	43,166	3,430	29,158	52,885

Table 26 shows the number of cases of chronic illnesses in the shelter-seeking population for Arkansas. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Mortuary Services

Approximately 641 people die in Arkansas as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 27 shows the number of initial fatalities by 'impacted county'. Mortuary services will be required, such

as victim identification and the establishment of temporary morgue facilities. The number of fatalities will quickly overwhelm local resources even enhanced by DMORTs.

Table 27: Fatalities in Arkansas

Impacted Counties (IC)	Fatalities
Arkansas	9
Clay	16
Craighead	133
Crittenden	90
Cross	26
Greene	43
Independence	-
Jackson	15
Lawrence	11
Lee	10
Mississippi	129
Monroe	5
Phillips	12
Poinsett	54
Prairie	4
Randolph	3
Saint Francis	25
White	10
Woodruff	6
Total in IC	599
Total in Arkansas	641

Security Needs

There are almost 23,000 prisoners within Arkansas. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 24 and Table 28 provide the distribution and type of prisoners within the State of Arkansas.

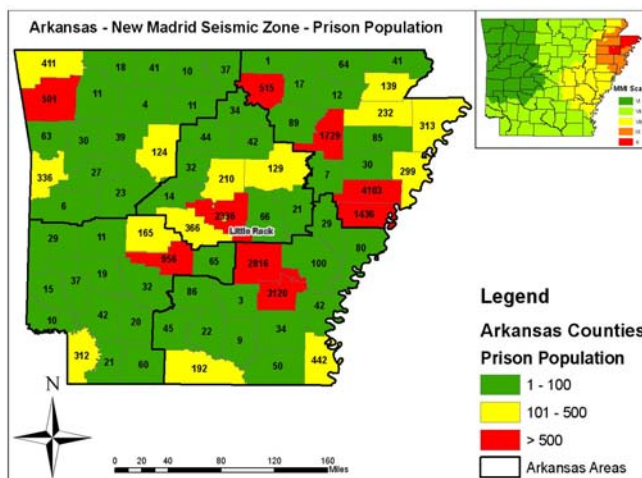


Figure 24: Distribution of Prisoners within the State of Arkansas

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Arkansas	100	-	-	100
Clay	41	-	-	41
Craighead	232	-	-	232
Crittenden	299	-	-	299
Cross	30	-	-	30
Greene	139	-	-	139
Independence	89	-	-	89
Jackson	29	1,700	-	1,729
Lawrence	12	-	-	12
Lee	4	1,432	-	1,436
Mississippi	192	121	-	313
Monroe	29	-	-	29
Phillips	80	-	-	80
Poinsett	85	-	-	85
Prairie	21	-	-	21
Randolph	64	-	-	64
Saint Francis	94	-	4,009	4,103
White	129	-	-	129
Woodruff	7	-	-	7
Total IC	1,676	3,253	4,009	8,938
Total Arkansas	6,230	12,723	4,009	22,962

Table 28: Types of Prisoners in the State of Arkansas

Illinois: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Illinois was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 27 counties were selected as ‘impacted counties’ in Illinois.

‘Impacted Counties’

Figure 15 displays a map of the ‘impacted counties’ in the State of Illinois. Table 29 provides the corresponding population.

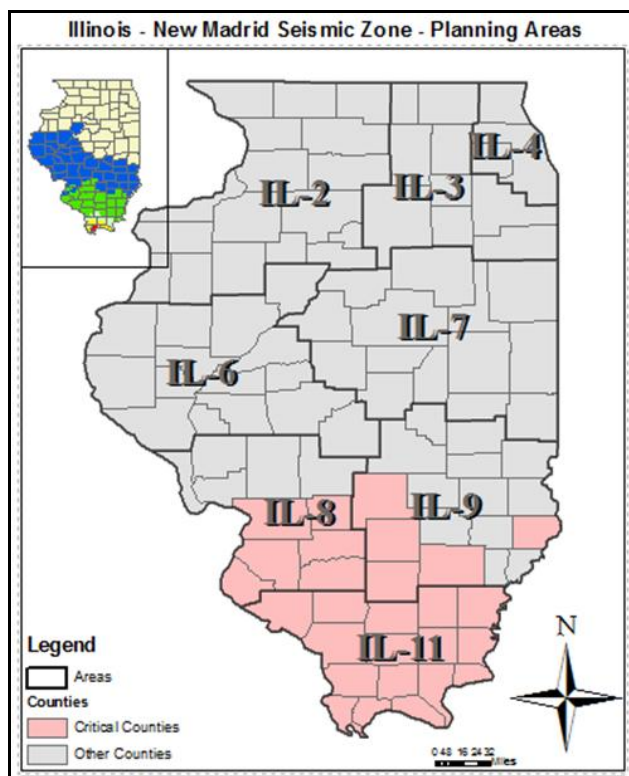


Figure 15: ‘Impacted Counties’ in the State of Illinois

Impacted Counties (IC)	Population
Alexander	9,590
Bond	17,633
Clinton	35,535
Fayette	21,802
Franklin	39,018
Gallatin	6,445
Hamilton	8,621
Hardin	4,800
Jackson	59,612
Jefferson	40,045
Johnson	12,878
Lawrence	15,452
Madison	258,941
Marion	41,691
Massac	15,161
Monroe	27,619
Perry	23,094
Pope	4,413
Pulaski	7,348
Randolph	33,893
Saint Clair	256,082
Saline	26,733
Union	18,293
Washington	15,148
Wayne	17,151
White	15,371
Williamson	61,296
Total IC	1,093,665
Total Illinois	12,419,293

Table 29: Population in the ‘Impacted Counties’ in the State of Illinois

Social Vulnerability

Figure 16 provides the results of a vulnerability analysis for the State of Illinois based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 15 it is shown that the impacted area has a moderate-to-high concentration of its population living in poverty. Also, Figure 17 illustrates the results of a vulnerability analysis for the State of Illinois based on age. Comparing the large map, which shows the

age distribution by county, with the map in Figure 15 shows that the impacted area has a high concentration of its population younger than 5 or older than 65 years of age.

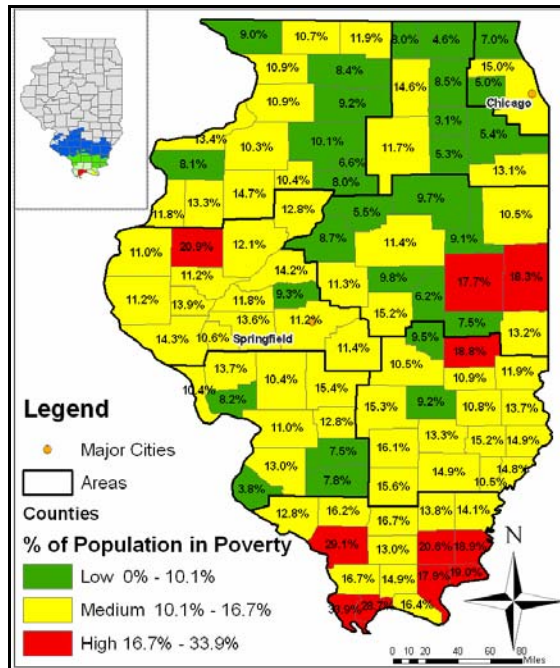


Figure 16: Vulnerability based on Poverty

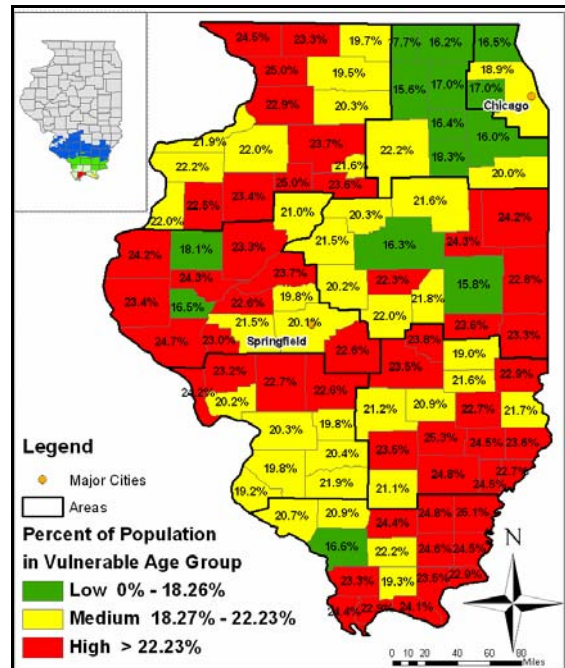


Figure 17: Vulnerability based on Age

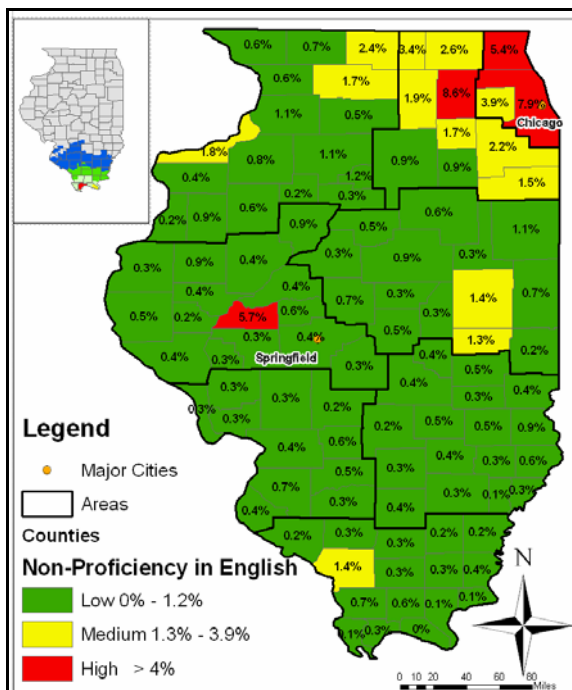


Figure 18: Vulnerability based on English Proficiency

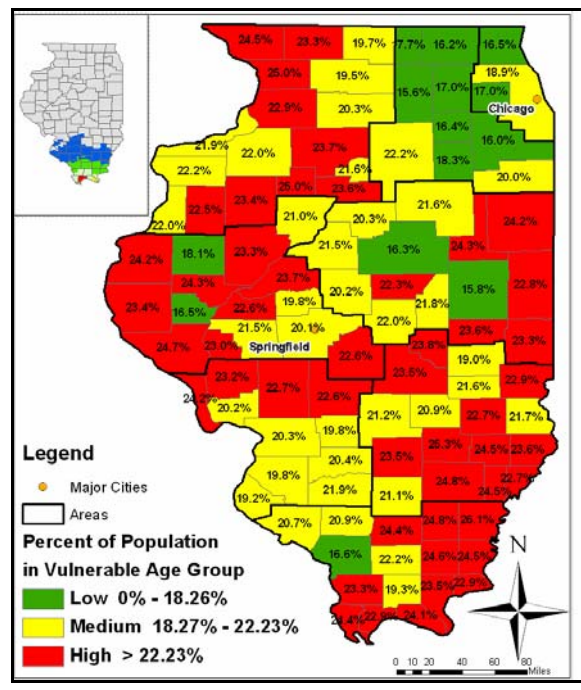


Figure 19: Vulnerability based on Disabilities

Figure 18 provides the results of a vulnerability analysis for the State of Illinois based on English proficiency. By comparing the large map, which shows the English proficiency

levels by county, with the map in Figure 15 it is evident that the majority of the population in the impacted area is proficient in English. Furthermore, Figure 19 illustrates the results of a vulnerability analysis for the State of Illinois based on people with disabilities. Comparing the large map, which shows the people with disabilities per county, with the map in Figure 15 reveals that within the impacted area there is a fairly high concentration of people with disabilities.

Based on the vulnerability analysis shown above, planning and response activities in the State of Illinois must consider that a large portion of the impacted population will be from lower-income families, will have various disabilities, and be under the age of five and greater than age 65.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

Table 30: Distribution of “At Risk” and Shelter-Seeking Population in the State of Illinois

Impacted Counties (IC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Alexander	9,590	3,710	1,229	9,575	3,176
Bond	17,633	-	-	-	-
Clinton	35,535	28	6	7,668	1,652
Fayette	21,802	581	147	6,913	1,750
Franklin	39,018	83	24	17,402	4,808
Gallatin	6,445	147	45	3,509	1,078
Hamilton	8,621	-	-	3,845	1,038
Hardin	4,800	-	-	-	-
Jackson	59,612	2,358	704	55,171	16,445
Jefferson	40,045	-	-	-	-
Johnson	12,878	385	92	10,966	2,592
Lawrence	15,452	51	15	2,148	585
Madison	258,941	6,030	1,410	35,992	8,417
Marion	41,691	-	-	8,354	2,255
Massac	15,161	4,695	1,327	15,023	4,242
Monroe	27,619	-	-	3,838	1,038
Perry	23,094	864	206	14,005	3,357
Pope	4,413	25	7	25	7
Pulaski	7,348	4,412	1,466	7,340	2,438
Randolph	33,893	8	3	15,471	3,677
Saint Clair	256,082	22,804	7,729	133,659	45,307
Saline	26,733	384	112	17,350	5,056
Union	18,293	256	70	14,958	4,150
Washington	15,148	-	-	6,755	1,824
Wayne	17,151	-	-	7,650	2,065
White	15,371	816	216	6,909	1,828
Williamson	61,296	467	131	467	131
Total IC	1,093,665	48,104	14,939	404,993	118,916
Total Illinois	12,419,293	50,285	15,588	650,247	185,139

The estimates reflect that by day 3 the size of the “At Risk” population in Illinois is expected to be over 650,000 people, with more than 185,000 people expected to seek

shelter. Table 30 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Location and Size of Other Relevant Populations

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 31 provides an overview of the additional population in the impacted counties, a total of over 53,000 people. While it is unlikely that this entire population will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Table 31: Distribution of Other Relevant Populations in the State of Illinois

Impacted Counties (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Alexander	46	81	468	42	637
Bond	633	157	1,624	93	2,507
Clinton	86	380	1,892	287	2,645
Fayette	57	161	1,468	160	1,934
Franklin	85	422	58	206	771
Gallatin	19	52	-	24	95
Hamilton	41	163	-	39	244
Hardin	14	57	153	47	271
Jackson	5,243	357	608	411	6,619
Jefferson	121	338	2,025	562	3,132
Johnson	35	49	2,640	116	2,840
Lawrence	105	473	10	59	647
Madison	3,025	2,234	354	2,226	8,005
Marion	64	606	278	203	1,172
Massac	28	266	40	471	805
Monroe	20	364	-	76	460
Perry	36	180	2,227	170	2,613
Pope	232	55	-	37	324
Pulaski	56	51	184	26	317
Randolph	119	496	3,203	180	4,295
Saint Clair	1,361	2,473	995	2,751	7,620
Saline	6	558	571	114	1,297
Union	595	300	20	62	977
Washington	40	181	41	110	372
Wayne	38	139	30	66	273
White	28	244	95	134	561
Williamson	103	732	712	701	2,248
Total IC	12,236	11,569	19,696	9,373	53,681

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for

the first 72 hours post-event, are shown in Tables 32, 33, and 34, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 32: Water Required to Support the “At Risk” Population in the State of Illinois

Impacted Counties (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Alexander	3,687	3,687	28,725	36,099	-	-	2	2
Bond	-	-	-	-	-	-	-	-
Clinton	18	18	23,004	23,040	-	-	1	1
Fayette	441	441	20,739	21,621	-	-	1	1
Franklin	72	72	52,206	52,350	-	-	3	3
Gallatin	135	135	10,527	10,797	-	-	<1	<1
Hamilton	-	-	11,535	11,535	-	-	<1	<1
Hardin	-	-	-	-	-	-	-	-
Jackson	2,112	2,112	165,513	169,737	-	-	9	9
Jefferson	-	-	-	-	-	-	-	-
Johnson	276	276	32,898	33,450	-	-	2	2
Lawrence	45	45	6,444	6,534	-	-	-	<1
Madison	4,230	4,230	107,976	116,436	-	-	6	6
Marion	-	-	25,062	25,062	-	-	1	1
Massac	3,981	3,981	45,069	53,031	-	-	3	3
Monroe	-	-	11,514	11,514	-	-	<1	<1
Perry	618	618	42,015	43,251	-	-	2	2
Pope	21	21	75	117	-	-	-	-
Pulaski	4,398	4,398	22,020	30,816	-	-	1	2
Randolph	9	9	46,413	46,431	-	-	3	3
Saint Clair	23,187	23,187	400,977	447,351	1	1	22	25
Saline	336	336	52,050	52,722	-	-	3	3
Union	210	210	44,874	45,294	-	-	3	3
Washington	-	-	20,265	20,265	-	-	1	1
Wayne	-	-	22,950	22,950	-	-	1	1
White	648	648	20,727	22,023	-	-	1	1
Williamson	393	393	1,401	2,187	-	-	-	<1
Total IC	44,817	44,817	1,214,979	1,304,613	1	1	65	68
Total Illinois	46,764	46,764	1,950,741	2,044,269	3	3	108	114

Table 33: MREs Required to Support the “At Risk” Population in the State of Illinois

Impacted Counties (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Alexander	2,458	2,458	19,150	24,066	-	-	1	1
Bond	-	-	-	-	-	-	-	-
Clinton	12	12	15,336	15,360	-	-	<1	<1
Fayette	294	294	13,826	14,414	-	-	1	<1
Franklin	48	48	34,804	34,900	-	-	2	2
Gallatin	90	90	7,018	7,198	-	-	-	<1
Hamilton	-	-	7,690	7,690	-	-	-	<1
Hardin	-	-	-	-	-	-	-	-
Jackson	1,408	1,408	110,342	113,158	-	-	5	5
Jefferson	-	-	-	-	-	-	-	-
Johnson	184	184	21,932	22,300	-	-	1	1
Lawrence	30	30	4,296	4,356	-	-	-	<1
Madison	2,820	2,820	71,984	77,624	-	-	3	4
Marion	-	-	16,708	16,708	-	-	<1	<1
Massac	2,654	2,654	30,046	35,354	-	-	1	2
Monroe	-	-	7,676	7,676	-	-	-	<1
Perry	412	412	28,010	28,834	-	-	1	1
Pope	14	14	50	78	-	-	-	-
Pulaski	2,932	2,932	14,680	20,544	-	-	<1	<1
Randolph	6	6	30,942	30,954	-	-	1	1
Saint Clair	15,458	15,458	267,318	298,234	1	1	12	14
Saline	224	224	34,700	35,148	-	-	2	2
Union	140	140	29,916	30,196	-	-	1	1
Washington	-	-	13,510	13,510	-	-	<1	<1
Wayne	-	-	15,300	15,300	-	-	1	<1
White	432	432	13,818	14,682	-	-	<1	<1
Williamson	262	262	934	1,458	-	-	-	<1
Total IC	29,878	29,878	809,986	869,742	1	1	33	34
Total Illinois	31,176	31,176	1,300,494	1,362,846	1	1	60	63

Table 34: Ice Required to Support the “At Risk” Population in the State of Illinois

Impacted Counties (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Alexander	9,832	9,832	76,600	96,264	-	-	2	2
Bond	-	-	-	-	-	-	-	-
Clinton	48	48	61,344	61,440	-	-	2	2
Fayette	1,176	1,176	55,304	57,656	-	-	1	1
Franklin	192	192	139,216	139,600	-	-	3	3
Gallatin	360	360	28,072	28,792	-	-	<1	<1
Hamilton	-	-	30,760	30,760	-	-	<1	<1
Hardin	-	-	-	-	-	-	-	-
Jackson	5,632	5,632	441,368	452,632	-	-	11	11
Jefferson	-	-	-	-	-	-	-	-
Johnson	736	736	87,728	89,200	-	-	2	2
Lawrence	120	120	17,184	17,424	-	-	-	<1
Madison	11,280	11,280	287,936	310,496	-	-	7	8
Marion	-	-	66,832	66,832	-	-	2	2
Massac	10,616	10,616	120,184	141,416	-	-	3	4
Monroe	-	-	30,704	30,704	-	-	<1	<1
Perry	1,648	1,648	112,040	115,336	-	-	3	3
Pope	56	56	200	312	-	-	-	<1
Pulaski	11,728	11,728	58,720	82,176	-	-	1	2
Randolph	24	24	123,768	123,816	-	-	3	3
Saint Clair	61,832	61,832	1,069,272	1,192,936	2	2	27	30
Saline	896	896	138,800	140,592	-	-	3	4
Union	560	560	119,664	120,784	-	-	3	3
Washington	-	-	54,040	54,040	-	-	1	1
Wayne	-	-	61,200	61,200	-	-	2	2
White	1,728	1,728	55,272	58,728	-	-	1	1
Williamson	1,048	1,048	3,736	5,832	-	-	-	<1
Total IC	119,512	119,512	3,239,944	3,478,968	2	2	78	81
Total Illinois	124,704	124,704	5,201,976	5,451,384	3	3	130	136

Search and Rescue Teams and Personnel Required

Table 35: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Illinois

Impacted County (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Alexander	-	-	2	-
Bond	-	-	-	-
Clinton	7	2	139	100
Fayette	-	-	-	-
Franklin	24	6	511	387
Gallatin	-	-	-	-
Hamilton	<1	-	12	13
Hardin	-	-	-	-
Jackson	-	-	2	<1
Jefferson	-	-	-	-
Johnson	-	-	-	-
Lawrence	9	2	173	68
Madison	-	-	2	2
Marion	-	-	9	3
Massac	-	-	-	-
Monroe	-	-	-	-
Perry	2	<1	53	47
Pope	<1	-	14	5
Pulaski	11	3	209	90
Randolph	<1	-	18	17
Saint Clair	-	-	2	-
Saline	8	2	153	95
Union	-	-	<1	-
Washington	<1	-	10	8
Wayne	<1	-	18	4
White	1	-	23	16
Williamson	<1	-	15	7
Total in IC	67	17	1,364	863
Total in Illinois	74	19	1,486	950

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 35 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 36 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 36: Number and Type of S&R Teams for the State of Illinois

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Illinois	19	1330	3	96	68	1496	22	132

Shelter Capacity and Requirements

Table 37 provides a summary of the shelter demand and capacity for Illinois. Figure 20 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 20 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Additionally, Table 38 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

Table 37: Shelter Demand and Capacity for the State of Illinois

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
15,588	185,139	1,680	122,302	62,837	48,010	54,113

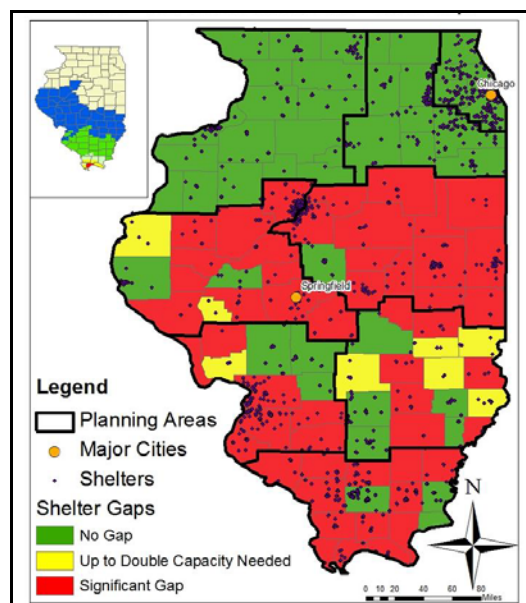


Figure 20: Shelter Gaps in the State of Illinois

Table 38: Shelter Resource Needs for the State of Illinois

Impacted Counties (IC)	Blankets	Cots	Sinks	Toilets	Trash Cans
Alexander	6,352	3,176	40	79	64
Bond	-	-	-	-	-
Clinton	3,304	1,652	21	41	33
Fayette	3,500	1,750	22	44	35
Franklin	9,616	4,808	60	120	96
Gallatin	2,156	1,078	13	27	22
Hamilton	2,076	1,038	13	26	21
Hardin	-	-	-	-	-
Jackson	32,890	16,445	206	411	329
Jefferson	-	-	-	-	-
Johnson	5,184	2,592	32	65	52
Lawrence	1,170	585	7	15	12
Madison	16,834	8,417	105	210	168
Marion	4,510	2,255	28	56	45
Massac	8,484	4,242	53	106	85
Monroe	2,076	1,038	13	26	21
Perry	6,714	3,357	42	84	67
Pope	14	7	-	-	-
Pulaski	4,876	2,438	30	61	49
Randolph	7,354	3,677	46	92	74
Saint Clair	90,614	45,307	566	1,133	906
Saline	10,112	5,056	63	126	101
Union	8,300	4,150	52	104	83
Washington	3,648	1,824	23	46	36
Wayne	4,130	2,065	26	52	41
White	3,656	1,828	23	46	37
Williamson	262	131	2	3	3
Total IC	237,832	118,916	1,486	2,973	2,380
Total Illinois	370,278	185,139	2,313	4,630	3,704

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Illinois, there is a large number of injured people that will require medical treatment. This is complicated by the large number of hospitals that sustain physical damages and the widespread power and water outages, as can be seen in Table 39. Many of the hospitals within the state will need to be evacuated and many of those injured will need to be cared for outside of their county of residence.

Table 40 shows the number of cases of chronic illnesses in the shelter-seeking population for Illinois. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Table 39: Injuries and Hospital Status for Illinois

Injuries (2 AM)					Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Impacted Counties (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total					
Alexander				-	No Data			Complete (85%)	Complete (100%)
Bond	5	1	-	6	None (0%)	1	189	None (0%)	None (0%)
Clinton	1	-	-	1	None (0%)	2	197	Reduced (22%)	None (0%)
Fayette	55	11	1	67	None (0%)	1	48	None (14%)	Reduced (32%)
Franklin	470	133	17	620	None (0%)	1	158	Reduced (45%)	None (0%)
Gallatin	-	-	-	-	No Data			Reduced (54%)	None (0%)
Hamilton	1	-	-	1	None (0%)	1	101	Reduced (45%)	None (0%)
Hardin	59	16	2	77	None (0%)	1	48	None (0%)	None (0%)
Jackson	11	2	-	13	None (0%)	2	209	Complete (65%)	Complete (93%)
Jefferson	9	1	-	11	None (0%)	2	207	None (0%)	None (0%)
Johnson	398	113	13	524	No Data			Complete (85%)	None (12%)
Lawrence	7	1	-	8	None (0%)	1	58	None (14%)	None (0%)
Madison	12	2	-	14	None (18%)	11	1294	None (14%)	None (1%)
Marion	33	9	1	43	None (0%)	2	322	Reduced (20%)	None (0%)
Massac	23	5	1	29	Complete (100%)	1	57	Complete (93%)	Complete (99%)
Monroe	29	7	1	37	No Data			None (14%)	None (0%)
Perry	1	-	-	1	None (0%)	2	125	Reduced (45%)	Complete (61%)
Pope	42	11	1	55	No Data			None (0%)	None (0%)
Pulaski	1	-	-	1	No Data			Complete (31%)	Complete (100%)
Randolph	4	-	-	4	Reduced (25%)	4	542	Reduced (46%)	None (0%)
Saint Clair	2	-	-	2	Reduced (20%)	5	1153	Reduced (46%)	Reduced (52%)
Saline	66	13	1	81	None (0%)	2	131	Complete (65%)	None (0%)
Union	1	-	-	1	None (0%)	2	508	Complete (82%)	None (0%)
Washington	2	-	-	2	None (0%)	1	61	Reduced (45%)	None (0%)
Wayne	60	17	2	80	None (0%)	1	185	Reduced (45%)	None (0%)
White	193	53	6	252	No Data			Reduced (45%)	None (0%)
Williamson	59	12	1	72	Complete (67%)	3	363	None (0%)	None (0%)
Total in IC	1,911	515	61	2,487		46	5,956		
Total in Illinois	4,597	1,270	145	6,011		413	52,153		

Table 40: Cases of Chronic Illnesses in the Shelter-Seeking Population of Illinois

Impacted Counties (IC)	Cancers	Diabetes	Heart Disease	Hypertension	Stroke	Mental Disorders	Pulmonary Conditions
Alexander	111	137	213	394	29	286	530
Bond	-	-	-	-	-	-	-
Clinton	58	71	111	205	15	149	276
Fayette	61	75	117	217	16	158	292
Franklin	168	207	322	596	43	433	803
Gallatin	38	46	72	134	10	97	180
Hamilton	36	45	70	129	9	93	173
Hardin	-	-	-	-	-	-	-
Jackson	576	707	1,102	2,039	148	1,480	2,746
Jefferson	-	-	-	-	-	-	-
Johnson	91	111	174	321	23	233	433
Lawrence	20	25	39	73	5	53	98
Madison	295	362	564	1,044	76	758	1,406
Marion	79	97	151	280	20	203	377
Massac	148	182	284	526	38	382	708
Monroe	36	45	70	129	9	93	173
Perry	117	144	225	416	30	302	561
Pope	0	0	0	1	0	1	1
Pulaski	85	105	163	302	22	219	407
Randolph	129	158	246	456	33	331	614
Saint Clair	1,586	1,948	3,036	5,618	408	4,078	7,566
Saline	177	217	339	627	46	455	844
Union	145	178	278	515	37	374	693
Washington	64	78	122	226	16	164	305
Wayne	72	89	138	256	19	186	345
White	64	79	122	227	16	165	305
Williamson	5	6	9	16	1	12	22
Total IC	4,162	5,113	7,967	14,746	1,070	10,702	19,859
Total Illinois	6,480	7,961	12,404	22,957	1,666	16,663	30,918

Mortuary Services

Approximately 271 people die in Illinois as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 41 shows the number of initial fatalities by ‘impacted county’. Mortuary services will be required, such as victim identification and the establishment of temporary morgue facilities. The number of

fatalities will quickly overwhelm local resources and will need to be enhanced by (DMORTs).

Table 41: Fatalities in Illinois

Impacted Counties (IC)	Fatalities
Alexander	484
Bond	6
Clinton	1
Fayette	67
Franklin	620
Gallatin	-
Hamilton	1
Hardin	77
Jackson	13
Jefferson	11
Johnson	524
Lawrence	8
Madison	14
Marion	43
Massac	29
Monroe	37
Perry	1
Pope	55
Pulaski	1
Randolph	4
Saint Clair	2
Saline	81
Union	1
Washington	2
Wayne	80
White	252
Williamson	72
Total in IC	115
Total in Illinois	271

Security Needs

There are almost 70,000 prisoners within Illinois. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 21 and Table 42 provide the distribution and type of prisoners within the State of Illinois.

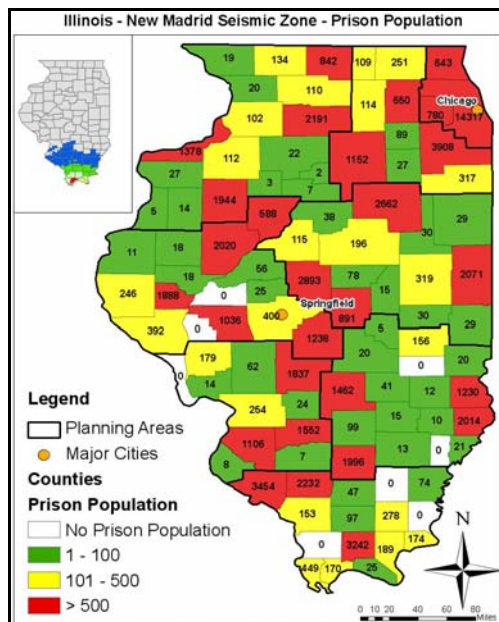


Figure 21: Distribution of Prisoners within the State of Illinois

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Alexander	-	449	-	449
Bond	24	-	-	24
Clinton	27	1,525	-	1,552
Fayette	31	1,431	-	1,462
Franklin	47	-	-	47
Gallatin	-	-	-	-
Hamilton	-	-	-	-
Hardin	2	172	-	174
Jackson	93	60	-	153
Jefferson	152	1,844	-	1,996
Johnson	-	3,242	-	3,242
Lawrence	18	1,996	-	2,014
Madison	254	-	-	254
Marion	99	-	-	99
Massac	25	-	-	25
Monroe	8	-	-	8
Perry	44	2,188	-	2,232
Pope	-	189	-	189
Pulaski	170	-	-	170
Randolph	13	3,441	-	3,454
Saline	104	174	-	278
St. Clair	436	670	-	1,106
Union	-	-	-	-
Washington	7	-	-	7
Wayne	13	-	-	13
White	74	-	-	74
Williamson	97	-	-	97
Total IC	1,738	17,381	-	19,119
Total Illinois	23,027	45,536	799	69,362

Table 42: Types of Prisoners in the State of Illinois

Indiana: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Indiana was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 14 counties were selected as ‘impacted counties’ in Indiana.

‘Impacted Counties’

Figure 22 displays a map of the ‘impacted counties’ in the State of Indiana. Table 43 provides the corresponding population.

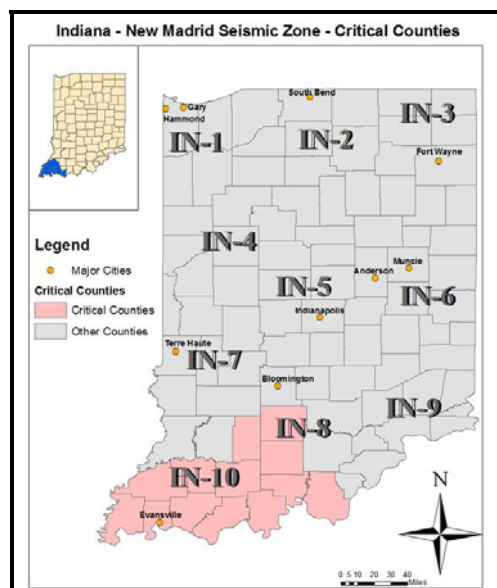


Figure 22: ‘Impacted Counties’ in the State of Indiana

Impacted Counties (IC)	Population
Crawford	10,743
Dubois	39,674
Gibson	32,500
Harrison	34,325
Knox	39,256
Lawrence	45,922
Martin	10,369
Orange	19,306
Perry	18,899
Pike	12,837
Posey	27,061
Spencer	20,391
Vanderburgh	171,922
Warrick	52,383
Total IC	535,588
Total Indiana	6,080,485

Table 43: Population in the ‘Impacted Counties’ in the State of Indiana

Social Vulnerability

Figure 23 provides the results of a vulnerability analysis for the State of Indiana based on poverty. Comparing the large map, which shows the poverty levels by county, with the map in Figure 21 illustrates that the impacted area has a moderate-low concentration of its population living in poverty. Additionally, Figure 24 illustrates the results of a vulnerability analysis for the State of Indiana based on age. By comparing the large map, which shows the age distribution by county, with the map in Figure 21 it is shown that the impacted area has a high concentration of its population younger than 5 or older than 65 years of age.

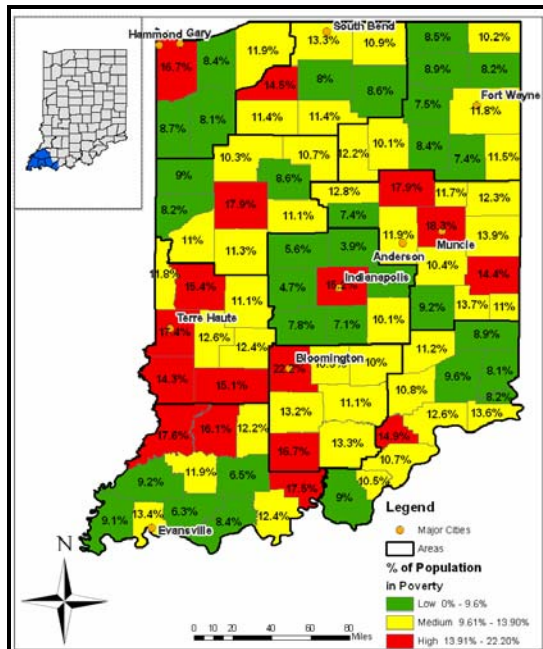


Figure 23: Vulnerability based on Poverty

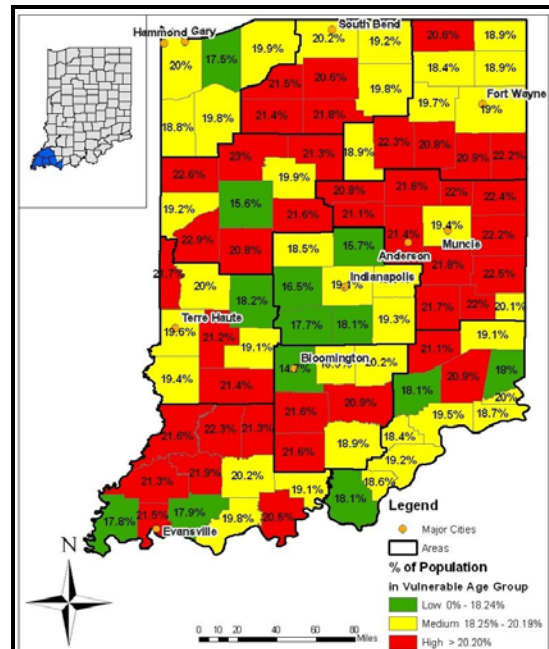


Figure 24: Vulnerability based on Age

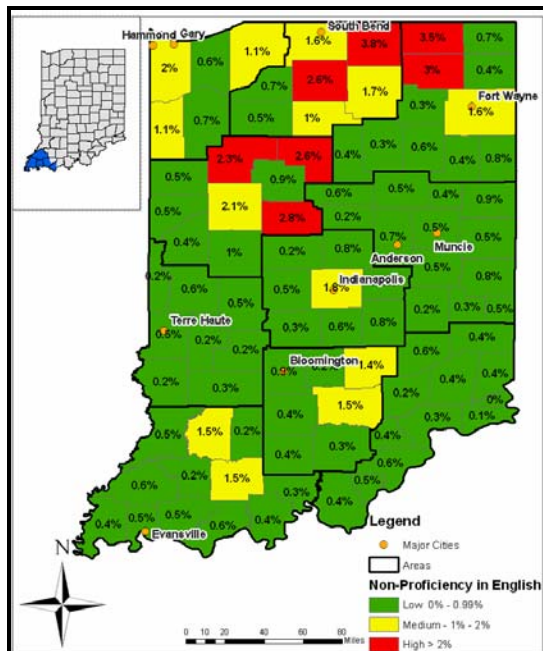


Figure 25: Vulnerability based on English Proficiency

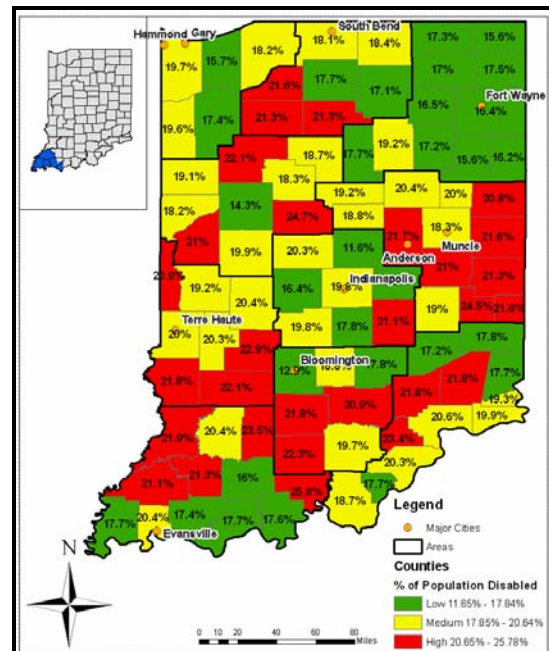


Figure 26: Vulnerability based on Disabilities

Figure 25 provides the results of a vulnerability analysis for the State of Indiana based on English proficiency. By comparing the large map, which shows the English proficiency levels by county, with the map in Figure 21 it is evident that the majority of the population in the impacted area is proficient in English. Furthermore, Figure 26 illustrates the results of a vulnerability analysis for the State of Indiana based on people with disabilities. Comparing the large map, which shows the people with disabilities per

county, with the map in Figure 21 reveals that within the impacted area there is a mixed concentration of people with disabilities.

Based on the vulnerability analysis shown above, planning and response activities in the State of Indiana must consider that a large portion of the impacted will be under the age of five and greater than age 65. Also, some of the impacted counties have a high concentration of people with various disabilities.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

The estimates reflect that by day 3 the size of the “At Risk” population in Indiana is expected to be almost 580,000 people, with more than 153,000 people expected to seek shelter. Table 44 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Table 44: Distribution of “At Risk” and Shelter-Seeking Population in the State of Indiana

Impacted Counties (IC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Crawford	10,743	-	-	1,493	403
Dubois	39,674	-	-	5,515	1,489
Gibson	32,500	-	-	28,106	7,589
Harrison	34,325	-	-	4,770	1,289
Knox	39,256	182	68	5,457	2,072
Lawrence	45,922	129	32	6,382	1,635
Martin	10,369	-	-	1,440	389
Orange	19,306	-	-	2,683	725
Perry	18,899	-	-	2,628	710
Pike	12,837	-	-	1,785	481
Posey	27,061	753	175	12,068	2,821
Spencer	20,391	-	-	4,922	1,328
Vanderburgh	171,922	3,065	896	76,678	22,442
Warrick	52,383	-	-	22,308	6,023
Total IC	535,588	4,129	1,171	176,235	49,396
Total Indiana	6,080,485	9,932	2,701	579,627	153,570

Location and Size of Other Relevant Populations

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more

temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 45 provides an overview of the additional population in the impacted counties, a total of over 19,000 people. While it is unlikely that this entire number will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Table 45: Distribution of Other Relevant Populations in the State of Indiana

Impacted Counties (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Crawford	11	76	14	no data	101
Dubois	242	476	61	no data	779
Gibson	243	295	136	no data	683
Harrison	54	193	113	no data	360
Knox	1,838	497	160	no data	2,496
Lawrence	58	517	142	no data	717
Martin	4	56	48	no data	108
Orange	8	227	79	no data	314
Perry	40	142	929	no data	1,111
Pike	16	121	35	no data	172
Posey	12	203	57	no data	272
Spencer	163	144	56	no data	363
Vanderburgh	4,274	1,900	616	3,790	10,889
Warrick	47	532	104	no data	683
Total IC	7,010	5,379	2,550	3,790	19,048

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for the first 72 hours post-event, are shown in Tables 46, 47, and 48, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 46: Water Required to Support the “At Risk” Population in the State of Indiana

Impacted Counties (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Crawford	-	-	4,479	4,479	-	-	-	<1
Dubois	-	-	16,545	16,545	-	-	-	<1
Gibson	-	-	84,318	84,318	-	-	-	5
Harrison	-	-	14,310	14,310	-	-	-	<1
Knox	204	204	16,371	16,779	-	-	-	<1
Lawrence	96	96	19,146	19,338	-	-	1	1
Martin	-	-	4,320	4,320	-	-	-	<1
Orange	-	-	8,049	8,049	-	-	-	<1
Perry	-	-	7,884	7,884	-	-	-	<1
Pike	-	-	5,355	5,355	-	-	-	<1
Posey	525	525	22,386	23,436	-	-	1	1
Spencer	-	-	14,766	14,766	-	-	-	<1
Vanderburgh	2,688	2,688	230,034	235,410	-	-	13	13
Warrick	-	-	66,924	66,924	-	-	4	4
Total IC	3,513	3,513	514,887	521,913	-	-	27	27
Total Indiana	8,103	8,103	1,738,881	1,755,087	<1	<1	97	98

Table 47: MREs Required to Support the “At Risk” Population in the State of Indiana

Impacted Counties (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Crawford	-	-	2,986	2,986	-	-	-	<1
Dubois	-	-	11,030	11,030	-	-	-	<1
Gibson	-	-	56,212	56,212	-	-	3	3
Harrison	-	-	9,540	9,540	-	-	-	<1
Knox	136	136	10,914	11,186	-	-	-	<1
Lawrence	64	64	12,764	12,892	-	-	-	<1
Martin	-	-	2,880	2,880	-	-	-	<1
Orange	-	-	5,366	5,366	-	-	-	<1
Perry	-	-	5,256	5,256	-	-	-	<1
Pike	-	-	3,570	3,570	-	-	-	<1
Posey	350	350	14,924	15,624	-	-	-	<1
Spencer	-	-	9,844	9,844	-	-	-	<1
Vanderburgh	1,792	1,792	153,356	156,940	-	-	7	7
Warrick	-	-	44,616	44,616	-	-	2	2
Total IC	2,342	2,342	343,258	347,942	-	-	12	12
Total Indiana	5,402	5,402	1,159,254	1,170,058	<1	<1	53	54

Table 48: Ice Required to Support the “At Risk” Population in the State of Indiana

Impacted Counties (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Crawford	-	-	11,944	11,944	-	-	-	<1
Dubois	-	-	44,120	44,120	-	-	1	1
Gibson	-	-	224,848	224,848	-	-	6	6
Harrison	-	-	38,160	38,160	-	-	-	<1
Knox	544	544	43,656	44,744	-	-	1	1
Lawrence	256	256	51,056	51,568	-	-	1	1
Martin	-	-	11,520	11,520	-	-	-	<1
Orange	-	-	21,464	21,464	-	-	-	<1
Perry	-	-	21,024	21,024	-	-	-	<1
Pike	-	-	14,280	14,280	-	-	-	<1
Posey	1,400	1,400	59,696	62,496	-	-	1	2
Spencer	-	-	39,376	39,376	-	-	-	<1
Vanderburgh	7,168	7,168	613,424	627,760	-	-	15	16
Warrick	-	-	178,464	178,464	-	-	4	4
Total IC	9,368	9,368	1,373,032	1,391,768	-	-	30	30
Total Indiana	21,608	21,608	4,637,016	4,680,232	<1	<1	116	117

Search and Rescue Teams and Personnel Required

Table 49: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Indiana

Impacted County (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Crawford	-	-	-	-
Dubois	-	-	-	-
Gibson	<1	-	56	59
Harrison	-	-	-	-
Knox	-	-	4	3
Lawrence	-	-	3	3
Martin	-	-	-	-
Orange	-	-	-	-
Perry	-	-	-	-
Pike	-	-	-	-
Posey	<1	-	18	15
Spencer	-	-	9	8
Vanderburgh	<1	<1	61	49
Warrick	-	-	-	-
Total in IC	3	2	151	138
Total in Indiana	3	2	151	138

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 49 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the

four different US&R Task Force Types. Table 50 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 50: Number and Type of S&R Teams for the State of Indiana

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Indiana	4	280	1	32	18	396	8	48

Shelter Capacity and Requirements

Table 51 provides a summary of the shelter demand and capacity for Indiana. Figure 27 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 27 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Table 52 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

Table 51: Shelter Demand and Capacity for the State of Indiana

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
2,701	154,646	1,228	174,974	(20,328)	39,762	44,817

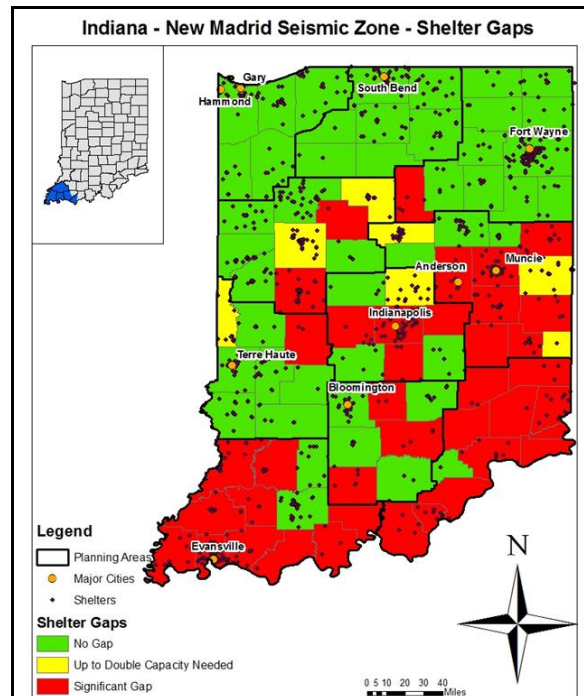


Figure 27: Shelter Gaps in the State of Indiana

Table 52: Shelter Resource Needs for the State of Indiana

Impacted Counties (IC)	Blankets	Cots	Sinks	Toilets	Trash Cans
Crawford	806	403	5	10	8
Dubois	2,978	1,489	19	37	30
Gibson	15,178	7,589	95	190	152
Harrison	2,578	1,289	16	32	26
Knox	4,144	2,072	26	52	41
Lawrence	3,270	1,635	20	41	33
Martin	778	389	5	10	8
Orange	1,450	725	9	18	15
Perry	1,420	710	9	18	14
Pike	962	481	6	12	10
Posey	3,490	1,745	22	44	35
Spencer	2,656	1,328	17	33	27
Vanderburgh	44,884	22,442	281	561	449
Warrick	12,046	6,023	75	151	120
Total IC	96,640	48,320	605	1,209	968
Total Indiana	307,140	153,570	1,920	3,840	3,073

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Indiana, there is a large number of injured people that require medical treatment. This is complicated by the large number of hospitals that sustain physical damages and the widespread power and water outages, as detailed in Table 53. With the exception of Posey County, few of the hospitals within the state will need to be evacuated and most of those who are injured will be able to be cared for within their county of residence.

Table 53: Injuries and Hospital Status for Indiana

Impacted Counties (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total	Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Crawford				-	None (0%)	5	0	None (14%)	None (0%)
Dubois	5	-	-	5	None (0%)	14	1072	None (14%)	None (0%)
Gibson	197	54	5	257	None (0%)	6	490	Reduced (37%)	Complete (86%)
Harrison	5	-	-	5	None (0%)	6	338	None (14%)	None (0%)
Knox	20	5	1	25	None (0%)	12	957	None (14%)	None (0%)
Lawrence	14	3	-	17	None (0%)	14	1063	None (14%)	None (0%)
Martin	2	-	-	2	None (0%)	4	62	None (14%)	None (0%)
Orange	3	-	-	3	None (0%)	5	294	None (14%)	None (0%)
Perry	3	-	-	3	None (0%)	6	255	None (14%)	None (0%)
Pike	2	-	-	2	None (0%)	5	184	None (14%)	None (0%)
Posey	66	17	2	85	Complete (60%)	5	130	Reduced (45%)	Reduced (28%)
Spencer	32	8	1	41	None (0%)	7	179	Reduced (24%)	None (0%)
Vanderburgh	234	63	7	303	None (0%)	20	1344	Reduced (45%)	None (1%)
Warrick	7	1	-	8	None (8%)	24	932	Reduced (43%)	None (0%)
Total in IC	591	153	16	760		133	7,300		
Total in Indiana	1,457	395	43	1,896		1,285	92,092		

Table 54 shows the number of cases of chronic illnesses in the shelter-seeking population for Indiana. While the majority of these illnesses are often able to be treated on a day-to-

day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Table 54: Cases of Chronic Illnesses in the Shelter-seeking Population of Indiana

Impacted Counties (IC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Crawford	14	19	29	56	4	41	74
Dubois	51	68	106	207	15	150	272
Gibson	258	349	539	1,055	76	766	1,389
Harrison	44	59	92	179	13	130	236
Knox	70	95	147	288	21	209	379
Lawrence	56	75	116	227	16	165	299
Martin	13	18	28	54	4	39	71
Orange	25	33	51	101	7	73	133
Perry	24	33	50	99	7	72	130
Pike	16	22	34	67	5	49	88
Posey	96	130	200	392	28	285	516
Spencer	45	61	94	185	13	134	243
Vanderburgh	763	1,032	1,593	3,119	224	2,267	4,107
Warrick	205	277	428	837	60	608	1,102
Total IC	1,679	2,272	3,507	6,866	494	4,989	9,039
Total Indiana	5,258	7,114	10,980	21,496	1,546	15,619	28,300

Mortuary Services

Approximately 80 people die in Indiana as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 55 shows the number of initial fatalities by ‘impacted county’. Mortuary services will be required, such as victim identification and the establishment of temporary morgue facilities. The number of fatalities will quickly overwhelm local resources and will need to be enhanced by DMORTs.

Table 55: Fatalities in Indiana

Impacted Counties (IC)	Fatalities
Crawford	0
Dubois	0
Gibson	10
Harrison	0
Knox	1
Lawrence	0
Martin	0
Orange	0
Perry	0
Pike	0
Posey	3
Spencer	2
Vanderburgh	12
Warrick	0
Total in IC	29
Total in Indian	80

Security Needs

There are over 49,000 prisoners within Indiana. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce

resources. Figure 28 and Table 56 provide the distribution and type of prisoners within the state of Indiana.

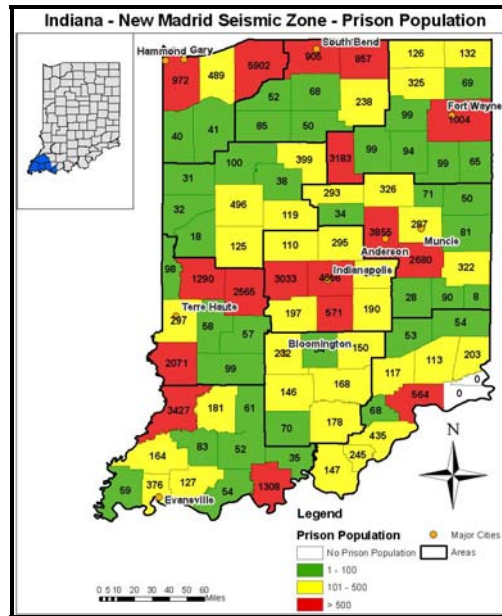


Figure 28: Distribution of Prisoners within the State of Indiana

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Crawford	35	-	-	35
Dubois	52	-	-	52
Gibson	164	-	-	164
Harrison	147	-	-	147
Knox	77	-	3,350	3,427
Lawrence	146	-	-	146
Martin	61	-	-	61
Orange	70	-	-	70
Perry	43	1,265	-	1,308
Pike	83	-	-	83
Posey	59	-	-	59
Spencer	54	-	-	54
Vanderburgh	376	-	-	376
Warrick	127	-	-	127
Total IC	1,494	1,265	3,350	6,109
Total Indiana	19,141	26,850	3,350	49,341

Table 56: Types of Prisoners in the State of Indiana

Kentucky: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Kentucky was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 19 counties were selected as ‘impacted counties’ in Kentucky.

‘Impacted Counties’

Figure 29 displays a map of the ‘impacted counties’ in the State of Kentucky. Table 57 provides the corresponding population.

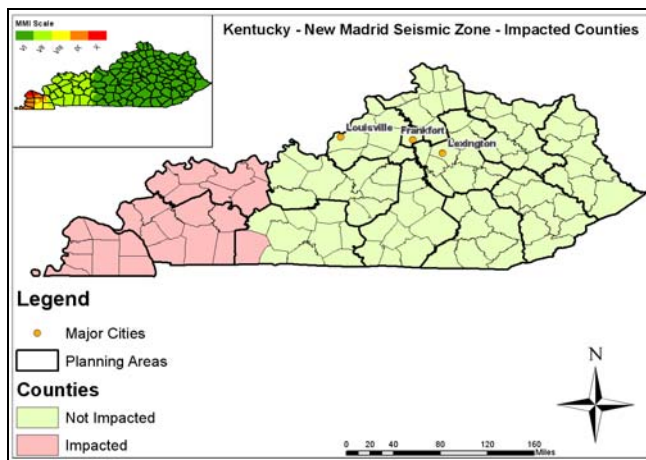


Figure 29: ‘Impacted Counties’ in the State of Kentucky

Impacted Counties (IC)	Population
Ballard	8,286
Caldwell	13,060
Calloway	34,177
Carlisle	5,351
Crittenden	9,384
Daviess	91,545
Fulton	7,752
Graves	37,028
Henderson	44,829
Hickman	5,262
Hopkins	46,519
Livingston	9,804
Lyon	8,080
Marshall	30,125
McCracken	65,514
Muhlenberg	31,839
Trigg	12,597
Union	15,637
Webster	14,120
Total in IC	490,909
Total in Kentucky	4,041,769

Table 57: Population in the ‘Impacted Counties’ in Kentucky

Social Vulnerability

Figure 30 provides the results of a vulnerability analysis for the State of Kentucky based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 29, it is shown that the impacted area has a moderate concentration of its population living in poverty. Additionally, Figure 31 illustrates the results of a vulnerability analysis for the State of Kentucky based on age. Comparing the large map, which shows the age distribution by county, with the map in Figure 29 reveals that the impacted area has a high concentration of its population younger than 5 or older than 65 years of age.

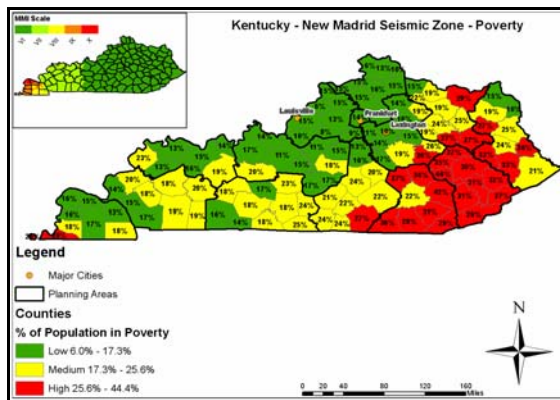


Figure 30: Vulnerability based on Poverty

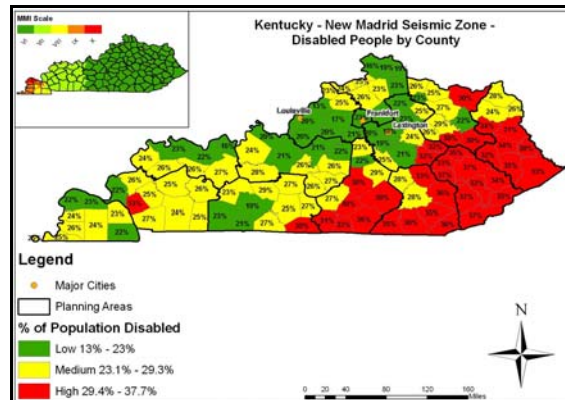


Figure 31: Vulnerability based on Age

Figure 32 provides the results of a vulnerability analysis for the State of Kentucky based on English proficiency. Comparing the large map, which shows the English proficiency levels by county, with the map in Figure 29 illustrates that a moderate level of the population in the impacted area is not proficient in English. The most prevalent primary language for this section of the population is Spanish. Furthermore, Figure 33 illustrates the results of a vulnerability analysis for the State of Kentucky based on people with disabilities. By comparing the large map, which shows the people with disabilities per county, with the map in Figure 29, it is evident seen that within the impacted area there is a moderate concentration of people with disabilities.

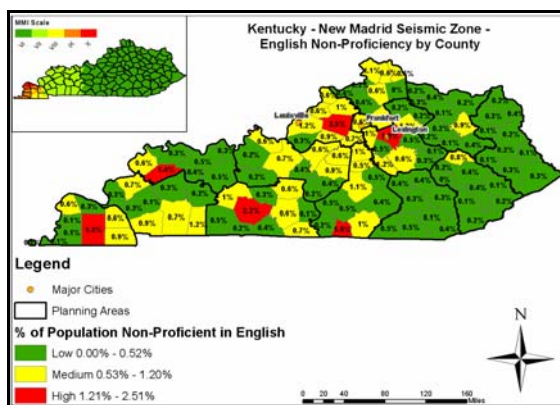


Figure 32: Vulnerability based on English Proficiency

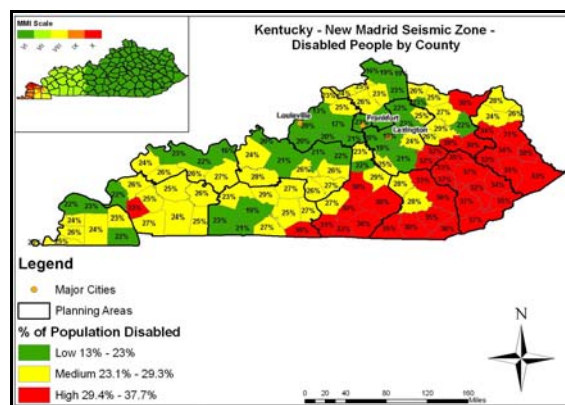


Figure 33: Vulnerability based on Disabilities

Based on the vulnerability analysis shown above, planning and response activities in the State of Kentucky must consider vulnerabilities based on income level, age, English proficiency and disabilities.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power

for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

The estimates reflect that by day 3 the size of the “At Risk” population in Kentucky is expected to be over 850,000 people, with 234,000 people expected to seek shelter. Table 58 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Table 58: Distribution of “At Risk” and Shelter-Seeking Population in the State of Kentucky

Impacted Counties (IC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Ballard	8,286	4,291	1,172	8,264	2,258
Caldwell	13,060	185	53	8,527	2,395
Calloway	34,177	3,077	890	22,318	6,462
Carlisle	5,351	1,025	291	5,252	1,495
Crittenden	9,384	147	42	6,090	1,740
Daviess	91,545	5,424	1,359	40,830	10,236
Fulton	7,752	1,339	431	7,149	2,306
Graves	37,028	6,105	1,744	36,115	10,317
Henderson	44,829	3,372	919	20,084	5,468
Hickman	5,262	1,061	315	5,151	1,534
Hopkins	46,519	1,295	341	30,190	7,925
Livingston	9,804	169	47	6,813	1,852
Lyon	8,080	-	-	5,244	1,416
Marshall	30,125	3,291	859	22,589	5,895
McCracken	65,514	19,848	5,556	64,999	18,193
Muhlenberg	31,839	1,610	497	14,200	4,391
Trigg	12,597	-	-	8,177	2,208
Union	15,637	671	170	6,975	1,758
Webster	14,120	693	193	9,163	2,537
Total in IC	490,909	53,603	14,879	328,130	90,386
Total in Kentucky	4,041,769	53,860	14,952	850,615	233,909

Location and Size of Other Relevant Populations

Table 59: Distribution of Other Relevant Populations in the State of Kentucky

Impacted Counties (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Ballard	13	90	57	3	163
Caldwell	-	194	36	4	234
Calloway	2,438	407	151	33	3,029
Carlisle	-	59	-	-	59
Crittenden	-	115	16	3	134
Daviess	1,258	882	357	133	2,630
Fulton	8	61	189	4	262
Graves	168	407	190	16	781
Henderson	145	359	316	31	851
Hickman	-	121	30	-	151
Hopkins	113	562	130	37	842
Livingston	13	109	15	11	148
Lyon	-	172	1,371	18	1,561
McCracken	138	705	481	169	1,493
Marshall	35	362	175	41	613
Muhlenberg	264	345	924	17	1,550
Trigg	-	97	14	11	122
Union	1,192	90	107	3	1,392
Webster	7	167	83	2	259
Total in IC	5,792	5,304	4,642	536	16,274

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 59 provides an overview of the additional population in the impacted counties, a total of over 16,000 people. While it is unlikely that this entire number will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for the first 72 hours post-event, are shown in Tables 60, 61, and 62, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 60: Water Required to Support the “At Risk” Population in the State of Kentucky

Impacted Counties (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Ballard	3,516	3,516	24,792	31,824	-	-	1	2
Caldwell	159	159	25,581	25,899	-	-	1	1
Calloway	2,670	2,670	66,954	72,294	-	-	4	4
Carlisle	873	873	15,756	17,502	-	-	1	<1
Crittenden	126	126	18,270	18,522	-	-	1	1
Daviess	4,077	4,077	122,490	130,644	-	-	7	7
Fulton	1,293	1,293	21,447	24,033	-	-	1	1
Graves	5,232	5,232	108,345	118,809	-	-	6	7
Henderson	2,757	2,757	60,252	65,766	-	-	3	4
Hickman	945	945	15,453	17,343	-	-	1	<1
Hopkins	1,023	1,023	90,570	92,616	-	-	5	5
Livingston	141	141	20,439	20,721	-	-	1	1
Lyon	-	-	15,732	15,732	-	-	1	<1
Marshall	2,577	2,577	67,767	72,921	-	-	4	4
McCracken	16,668	16,668	194,997	228,333	1	1	11	13
Muhlenberg	1,491	1,491	42,600	45,582	-	-	2	3
Trigg	-	-	24,531	24,531	-	-	1	1
Union	510	510	20,925	21,945	-	-	1	1
Webster	579	579	27,489	28,647	-	-	2	2
Total for IC	44,637	44,637	984,390	1,073,664	2	2	55	92
Total for Kentucky	44,856	44,856	2,551,845	2,641,557	3	3	142	147

Table 61: MREs Required to Support the “At Risk” Population in the State of Kentucky

Impacted Counties (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Ballard	2,344	2,344	16,528	21,216	-	-	1	<1
Caldwell	106	106	17,054	17,266	-	-	1	<1
Calloway	1,780	1,780	44,636	48,196	-	-	2	2
Carlisle	582	582	10,504	11,668	-	-	-	<1
Crittenden	84	84	12,180	12,348	-	-	1	<1
Daviess	2,718	2,718	81,660	87,096	-	-	4	4
Fulton	862	862	14,298	16,022	-	-	1	<1
Graves	3,488	3,488	72,230	79,206	-	-	3	4
Henderson	1,838	1,838	40,168	43,844	-	-	2	2
Hickman	630	630	10,302	11,562	-	-	-	<1
Hopkins	682	682	60,380	61,744	-	-	3	3
Livingston	94	94	13,626	13,814	-	-	1	<1
Lyon	-	-	10,488	10,488	-	-	-	<1
Marshall	1,718	1,718	45,178	48,614	-	-	2	2
McCracken	11,112	11,112	129,998	152,222	1	1	6	7
Muhlenberg	994	994	28,400	30,388	-	-	1	1
Trigg	-	-	16,354	16,354	-	-	1	<1
Union	340	340	13,950	14,630	-	-	1	<1
Webster	386	386	18,326	19,098	-	-	1	<1
Total for IC	29,758	29,758	656,260	715,776	1	1	30	33
Total for Kentucky	29,904	29,904	1,701,230	1,761,038	1	1	78	81

Table 62: Ice Required to Support the “At Risk” Population in the State of Kentucky

Impacted Counties (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Ballard	9,376	9,376	66,112	84,864	-	-	2	2
Caldwell	424	424	68,216	69,064	-	-	2	2
Calloway	7,120	7,120	178,544	192,784	-	-	4	5
Carlisle	2,328	2,328	42,016	46,672	-	-	1	1
Crittenden	336	336	48,720	49,392	-	-	1	1
Daviess	10,872	10,872	326,640	348,384	-	-	8	9
Fulton	3,448	3,448	57,192	64,088	-	-	1	2
Graves	13,952	13,952	288,920	316,824	-	-	7	8
Henderson	7,352	7,352	160,672	175,376	-	-	4	4
Hickman	2,520	2,520	41,208	46,248	-	-	1	1
Hopkins	2,728	2,728	241,520	246,976	-	-	6	6
Livingston	376	376	54,504	55,256	-	-	1	1
Lyon	-	-	41,952	41,952	-	-	1	1
Marshall	6,872	6,872	180,712	194,456	-	-	5	5
McCracken	44,448	44,448	519,992	608,888	1	1	13	15
Muhlenberg	3,976	3,976	113,600	121,552	-	-	3	3
Trigg	-	-	65,416	65,416	-	-	2	2
Union	1,360	1,360	55,800	58,520	-	-	1	1
Webster	1,544	1,544	73,304	76,392	-	-	2	2
Total for IC	119,032	119,032	2,625,040	2,863,104	-	3	66	72
Total for Kentucky	119,616	119,616	6,804,920	7,044,152	3	3	170	176

Search and Rescue Teams and Personnel Required

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 63 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 64 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 63: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Kentucky

Impacted County (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Ballard	5	3	107	111
Caldwell	-	-	3	5
Calloway	2	2	49	62
Carlisle	2	1	52	32
Crittenden	-	-	2	4
Daviess	5	3	77	97
Fulton	4	2	79	18
Graves	9	5	163	137
Henderson	2	1	42	60
Hickman	2	1	47	30
Hopkins	1	-	18	27
Livingston	-	-	3	5
Lyon	-	-	-	-
Marshall	5	3	108	88
McCracken	46	26	703	378
Muhlenberg	1	-	20	36
Trigg	-	-	-	-
Union	-	-	9	14
Webster	-	-	9	16
Total in IC	84	47	1,491	1,120
Total in Kentucky	84	47	1,491	1,120

Table 64: Number and Type of S&R Teams for the State of Kentucky

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Kentucky	21	1,470	6	192	68	1,496	26	156

Shelter Capacity and Requirements

Table 65 provides a summary of the shelter demand and capacity for Kentucky. Figure 34 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 34 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Table 66 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

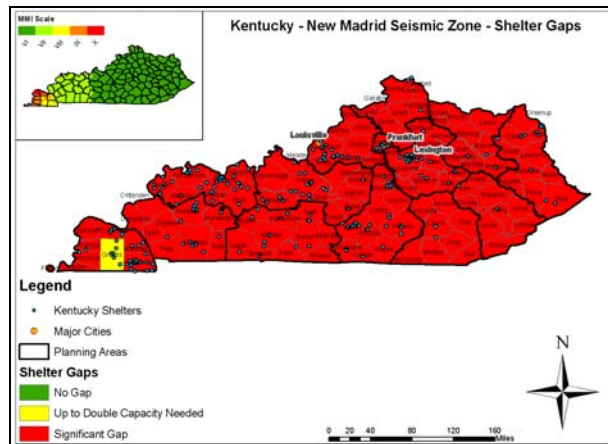


Figure 34: Shelter Gaps in the State of Kentucky

Table 65: Shelter Demand and Capacity for the State of Kentucky

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
14,952	233,909	378	7,969	225,940	59,888	67,502

Table 66: Shelter Resource Needs for the State of Kentucky

Impacted Counties (IC)	Blankets	Cots	Sinks	Port-a-Pottys/ Toilets	Trash Cans
Ballard	4,516	2,258	28	56	45
Caldwell	4,790	2,395	30	60	48
Calloway	12,924	6,462	81	162	129
Carlisle	2,990	1,495	19	37	30
Crittenden	3,480	1,740	22	44	35
Daviess	20,472	10,236	128	256	205
Fulton	4,612	2,306	29	58	46
Graves	20,634	10,317	129	258	206
Henderson	10,936	5,468	68	137	109
Hickman	3,068	1,534	19	38	31
Hopkins	15,850	7,925	99	198	159
Livingston	3,704	1,852	23	46	37
Lyon	2,832	1,416	18	35	28
Marshall	11,790	5,895	74	147	118
McCracken	36,386	18,193	227	455	364
Muhlenberg	8,782	4,391	55	110	88
Trigg	4,416	2,208	28	55	44
Union	3,516	1,758	22	44	35
Webster	5,074	2,537	32	63	51
Total for IC	180,772	90,386	1,131	2,259	1,808
Total for Kentucky	467,818	233,909	2,926	5,851	4,682

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Kentucky, there is a large number of injured people that will require medical treatment. This is complicated by the number of hospitals that sustain physical damages and the widespread power outages, as can be seen in Table 67. These power outages are likely to cause hospital evacuations to other states as well as requiring many of those who are injured to be treated outside of Kentucky.

Table 68 shows the number of cases of chronic illnesses in the shelter-seeking population for Kentucky. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Table 67: Injuries and Hospital Status for Kentucky

Injuries (2 AM)					Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Impacted Counties (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total					
Ballard				-	No Data			Complete (96%)	Complete (100%)
Caldwell	14	3	-	17	None (0%)	2	15	Complete (65%)	None (0%)
Calloway	257	66	7	330	Complete (100%)	1	378	Complete (65%)	Reduced (53%)
Carlisle	130	35	4	169	No Data	1	48	Complete (92%)	Complete (98%)
Crittenden	11	3	-	14	None (0%)	5	469	Complete (65%)	None (0%)
Daviess	376	103	11	490	Complete (60%)	1	70	Reduced (45%)	None (7%)
Fulton	154	44	6	204	Complete (100%)	1	106	Complete (86%)	Complete (92%)
Graves	582	153	17	752	Complete (100%)	3	205	Complete (65%)	Complete (98%)
Henderson	230	63	6	300	None (0%)	3	401	Reduced (45%)	None (4%)
Hickman	132	36	4	172	No Data	1	26	Complete (89%)	Complete (98%)
Hopkins	93	25	2	120	None (0%)			Complete (65%)	None (2%)
Livingston	16	4	-	20	None (0%)			Complete (69%)	None (1%)
Lyon	1	-	-	1	No Data			Complete (65%)	None (0%)
Marshall	358	96	11	464	Complete (100%)	1	84	Complete (69%)	Complete (75%)
McCracken	1,995	557	68	2,620	Complete (100%)	2	563	Complete (92%)	Complete (99%)
Muhlenberg	116	31	3	149	None (0%)	2	135	Reduced (45%)	None (16%)
Trigg	2	-	-	2	None (0%)	1	25	Complete (65%)	None (0%)
Union	42	11	1	55	None (0%)	1	54	Reduced (45%)	None (9%)
Webster	48	13	1	62	No Data			Complete (65%)	None (17%)
Total in IC	4,937	1,347	153	6,437		25	2,579		
Total in Kentucky	5,042	1,358	153	6,553		189	20,755		

Table 68: Cases of Chronic Illnesses in the Shelter-Seeking Population of Kentucky

Impacted Counties (IC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Ballard	95	120	178	332	20	208	560
Caldwell	101	127	189	352	22	220	594
Calloway	271	342	510	950	58	595	1,603
Carlisle	63	79	118	220	13	138	371
Crittenden	73	92	137	256	16	160	432
Daviess	430	543	809	1,505	92	942	2,539
Fulton	97	122	182	339	21	212	572
Graves	433	547	815	1,517	93	949	2,559
Henderson	230	290	432	804	49	503	1,356
Hickman	64	81	121	225	14	141	380
Hopkins	333	420	626	1,165	71	729	1,965
Livingston	78	98	146	272	17	170	459
Lyon	59	75	112	208	13	130	351
Marshall	248	312	466	867	53	542	1,462
McCracken	764	964	1,437	2,674	164	1,674	4,512
Muhlenberg	184	233	347	645	40	404	1,089
Trigg	93	117	174	325	20	203	548
Union	74	93	139	258	16	162	436
Webster	107	134	200	373	23	233	629
Total in IC	3,796	4,790	7,140	13,287	813	8,316	22,416
Total in Kentucky	9,824	12,397	18,479	34,385	2,105	21,520	58,009

Mortuary Services

Approximately 287 people die in Kentucky as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 69 shows the number of initial fatalities by ‘impacted county’. Mortuary services will be required, such as victim identification and the establishment of temporary morgue facilities. The number of fatalities will quickly overwhelm local resources and will need to be enhanced by DMORTs.

Table 69: Fatalities in Kentucky

Impacted Counties (IC)	Fatalities
Ballard	20
Caldwell	1
Calloway	13
Carlisle	8
Crittenden	-
Daviess	19
Fulton	12
Graves	31
Henderson	12
Hickman	8
Hopkins	4
Livingston	1
Lyon	-
Marshall	20
McCracken	129
Muhlenberg	5
Trigg	-
Union	2
Webster	2
Total in IC	285
Total in Kentucky	287

Security Needs

There are over 45,000 prisoners within Kentucky. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 35 and Table 70 provide the distribution and type of prisoners within the state of Kentucky.

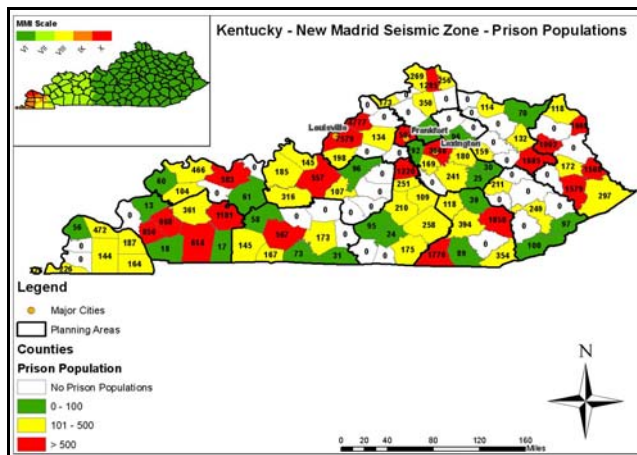


Figure 35: Distribution of Prisoners within the State of Kentucky

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Ballard	56	-	-	56
Caldwell	-	668	-	668
Calloway	164	-	-	164
Carlisle	-	-	-	-
Christian	614	-	-	614
Crittenden	13	-	-	13
Daviess	583	-	-	583
Fulton	226	-	-	226
Graves	144	-	-	144
Hancock	-	-	-	-
Henderson	466	-	-	466
Hickman	-	-	-	-
Hopkins	361	-	-	361
Livingston	-	-	-	-
Logan	145	-	-	145
Lyon	-	856	-	856
McCracken	472	-	-	472
McLean	-	-	-	-
Marshall	187	-	-	187
Muhlenberg	220	961	-	1,181
Ohio	61	-	-	61
Todd	17	-	-	17
Trigg	18	-	-	18
Union	60	-	-	60
Webster	104	-	-	104
Total IC	3,911	2,485	-	6,396
Total Kentucky	22,563	14,352	8,218	45,133

Table 70: Types of Prisoners in the State of Kentucky

Mississippi: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Mississippi was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 19 counties were selected as ‘impacted counties’ in Mississippi.

‘Impacted Counties’

Figure 36 displays a map of the counties determined to be ‘impacted counties’ in the State of Mississippi. Table 71 provides the corresponding population data.

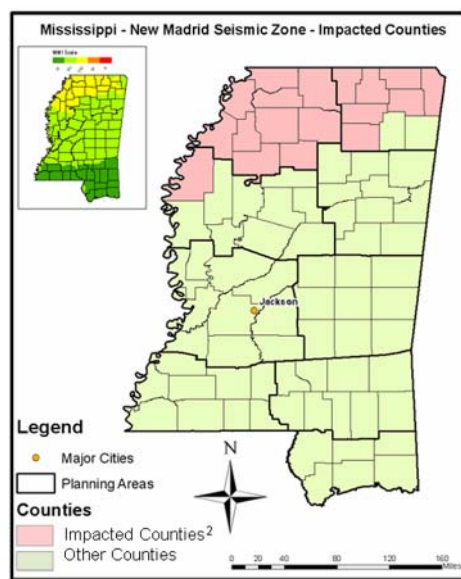


Figure 36: ‘Impacted Counties’ in the State of Mississippi

Impacted Counties (IC)	Population
Alcorn	34,558
Benton	8,026
Bolivar	40,633
Coahoma	30,622
Desoto	107,199
Lafayette	38,744
Marshall	34,993
Panola	34,274
Pontotoc	26,726
Prentiss	25,556
Quitman	10,117
Sunflower	34,369
Tallahatchie	14,903
Tate	25,370
Tippah	20,826
Tishomingo	19,163
Tunica	9,227
Union	25,362
Yalobusha	13,051
Total in IC	553,719
Total in Mississippi	2,844,658

Table 71: Population in the ‘Impacted Counties’ in the State of Mississippi

Social Vulnerability

Figure 37 provides the results of a vulnerability analysis for the State of Mississippi based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 36, it is evident that, with the exception of Fulton County, the impacted area has a moderate-to-high concentration of its population living in poverty.

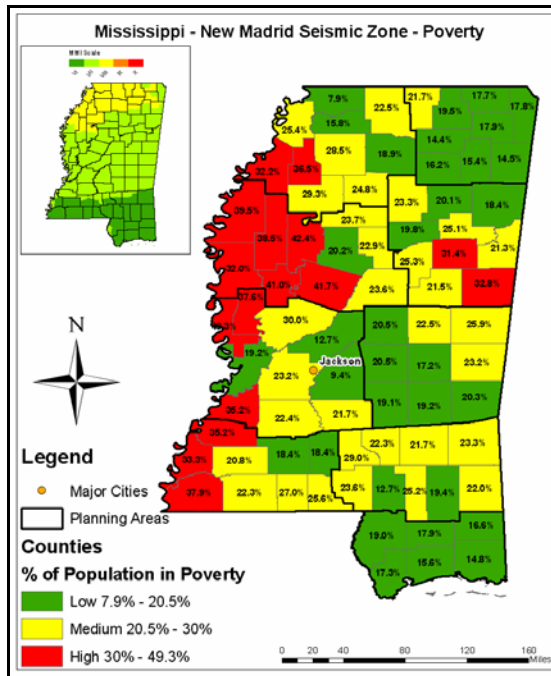


Figure 37: Vulnerability based on Poverty

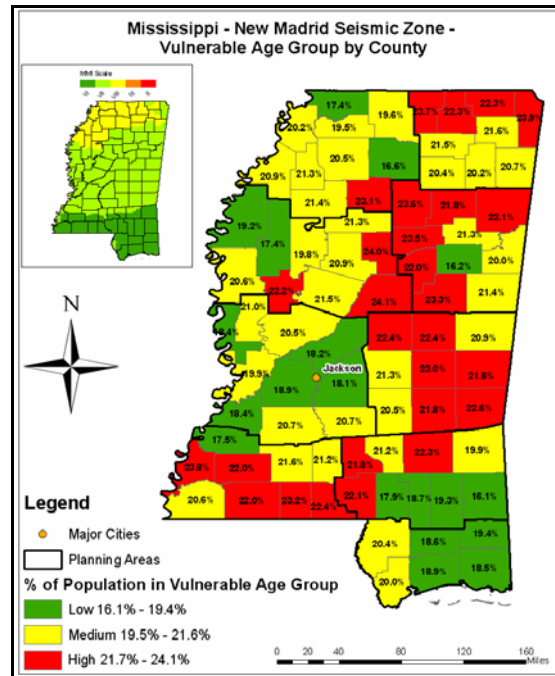


Figure 38: Vulnerability based on Age

Figure 38 illustrates the results of a vulnerability analysis for the State of Mississippi based on age. Comparing the large map, which shows the age distribution by county, with the map in Figure 36 reveals that the impacted area has a moderate concentration of its population younger than 5 or older than 65 years of age.

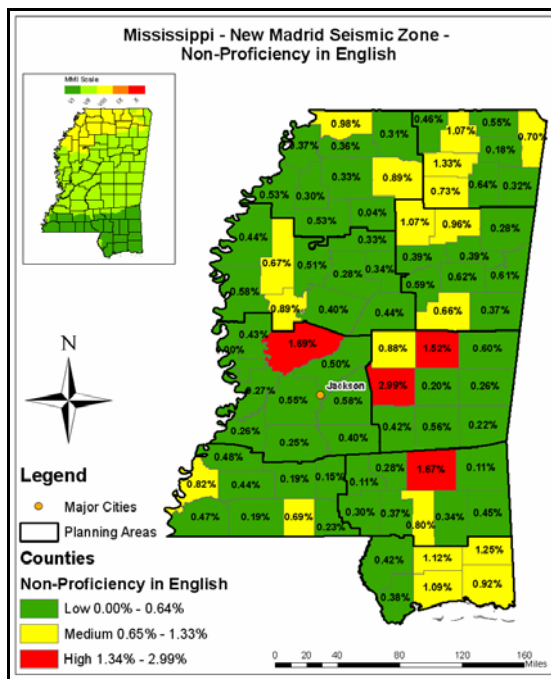


Figure 39: Vulnerability based on English Proficiency

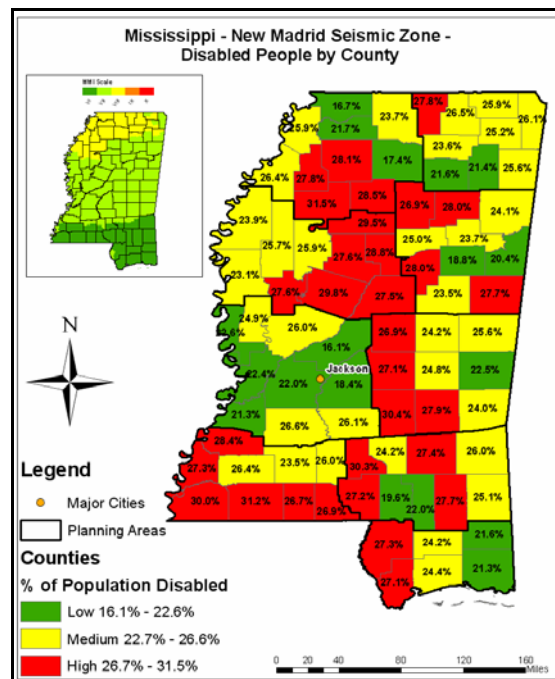


Figure 40: Vulnerability based on Disabilities

Figure 39 provides the results of a vulnerability analysis for the State of Mississippi based on English proficiency. Comparing the large map, which shows the English proficiency levels by county, with the map in Figure 36 illustrates that the majority of the population in the impacted area is proficient in English. Figure 40 details the results of a vulnerability analysis for the State of Mississippi based on people with disabilities. By comparing the large map, which shows the people with disabilities per county, with the map in Figure 36, it is evident that within the impacted area there is a fairly high concentration of people with disabilities.

Based on the vulnerability analysis shown above, planning and response activities in the State of Mississippi need to take into consideration vulnerabilities based on disabilities and to a lesser extent, vulnerabilities based on poverty and age.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

The estimates reflect that by day 3 the size of the “At Risk” population in Mississippi is expected to be over 705,000 people, with 205,000 people expected to seek shelter. Table 72 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Table 72: Distribution of “At Risk” and Shelter-Seeking Population in the State of Mississippi

Impacted Counties (IC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Alcorn	34,558	58	17	20,734	6,399
Benton	8,026	5	3	5,216	1,948
Bolivar	40,633	1,982	796	23,172	9,306
Coahoma	30,622	7,466	2,762	29,368	10,864
Desoto	107,199	23,138	5,322	104,977	24,147
Lafayette	38,744	127	46	17,435	6,329
Marshall	34,993	538	158	22,746	6,724
Panola	34,274	2,914	1,000	15,537	5,332
Pontotoc	26,726	3	-	12,028	3,248
Prentiss	25,556	5	-	11,499	2,209
Quitman	10,117	2,469	948	9,669	3,718
Sunflower	34,369	742	267	4,779	1,715
Tallahatchie	14,903	1,906	714	10,817	4,052
Tate	25,370	4,160	1,175	22,968	6,493
Tippah	20,826	15	5	13,536	4,392
Tishomingo	19,163	-	-	8,624	2,329
Tunica	9,227	2,308	850	8,975	3,305
Union	25,362	5	3	11,414	3,081
Yalobusha	13,051	-	-	5,873	1,585
Total in IC	553,719	47,841	14,066	359,367	107,176
Total in Mississippi	2,844,658	61,997	18,345	705,032	205,507

Location and Size of Other Relevant Populations

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 73 provides an overview of the additional population in the impacted counties, a total of over 37,000 people. While it is unlikely that this entire population will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Table 73: Distribution of Other Relevant Populations in the State of Mississippi

Impacted Counties (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Alcorn	65	256	166	521	1,008
Benton	-	100	16	-	116
Bolivar	1,537	164	491	494	2,686
Coahoma	303	197	274	1,519	2,293
Desoto	62	225	229	3,241	3,757
Lafayette	4,371	326	125	789	5,611
Marshall	556	101	1,042	335	2,034
Panola	284	184	109	822	1,399
Pontotoc	49	172	22	132	375
Prentiss	664	133	56	389	1,242
Quitman	-	59	70	-	129
Sunflower	440	204	4,692	254	5,590
Tallahatchie	2	67	34	-	103
Tate	972	139	42	231	1,384
Tippah	132	177	71	196	576
Tishomingo	-	252	23	775	1,050
Tunica	5	53	52	7,135	7,245
Union	82	120	40	271	513
Yalobusha	10	65	24	34	133
Total in IC	9,534	2,994	7,578	17,138	37,244

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for the first 72 hours post-event, are shown in Tables 74, 75, and 76, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 74: Water Required to Support the “At Risk” Population in the State of Mississippi

Impacted Counties (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Alcorn	51	51	62,202	62,304	-	-	3	3
Benton	9	9	15,648	15,666	-	-	1	<1
Bolivar	2,388	2,388	69,516	74,292	-	-	4	4
Coahoma	8,286	8,286	88,104	104,676	-	-	5	6
Desoto	15,966	15,966	314,931	346,863	1	1	18	19
Lafayette	138	138	52,305	52,581	-	-	3	3
Marshall	474	474	68,238	69,186	-	-	4	4
Panola	3,000	3,000	46,611	52,611	-	-	3	3
Pontotoc	-	-	36,084	36,084	-	-	2	2
Prentiss	-	-	34,497	34,497	-	-	2	2
Quitman	2,844	2,844	29,007	34,695	-	-	2	2
Sunflower	801	801	14,337	15,939	-	-	1	<1
Tallahatchie	2,142	2,142	32,451	36,735	-	-	2	2
Tate	3,525	3,525	68,904	75,954	-	-	4	4
Tippah	15	15	40,608	40,638	-	-	2	2
Tishomingo	-	-	25,872	25,872	-	-	1	1
Tunica	2,550	2,550	26,925	32,025	-	-	2	2
Union	9	9	34,242	34,260	-	-	2	2
Yalobusha	-	-	17,619	17,619	-	-	1	<1
Total in IC	42,198	42,198	1,078,101	1,162,497	2	2	60	65
Total in Mississippi	55,035	55,035	2,115,096	2,225,166	3	3	118	124

Table 75: MREs Required to Support the “At Risk” Population in the State of Mississippi

Impacted Counties (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Alcorn	34	34	41,468	41,536	-	-	2	2
Benton	6	6	10,432	10,444	-	-	-	<1
Bolivar	1,592	1,592	46,344	49,528	-	-	2	2
Coahoma	5,524	5,524	58,736	69,784	-	-	3	3
Desoto	10,644	10,644	209,954	231,242	-	-	10	11
Lafayette	92	92	34,870	35,054	-	-	2	2
Marshall	316	316	45,492	46,124	-	-	2	2
Panola	2,000	2,000	31,074	35,074	-	-	1	2
Pontotoc	-	-	24,056	24,056	-	-	1	1
Prentiss	-	-	22,998	22,998	-	-	1	1
Quitman	1,896	1,896	19,338	23,130	-	-	1	1
Sunflower	534	534	9,558	10,626	-	-	-	<1
Tallahatchie	1,428	1,428	21,634	24,490	-	-	1	1
Tate	2,350	2,350	45,936	50,636	-	-	2	2
Tippah	10	10	27,072	27,092	-	-	1	1
Tishomingo	-	-	17,248	17,248	-	-	1	<1
Tunica	1,700	1,700	17,950	21,350	-	-	1	<1
Union	6	6	22,828	22,840	-	-	1	1
Yalobusha	-	-	11,746	11,746	-	-	1	<1
Total in IC	28,132	28,132	718,734	774,998	1	1	33	36
Total in Mississippi	36,690	36,690	1,410,064	1,483,444	2	2	65	68

Table 76: Ice Required to Support the “At Risk” Population in the State of Mississippi

Impacted Counties (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Alcorn	136	136	165,872	166,144	-	-	4	4
Benton	24	24	41,728	41,776	-	-	1	1
Bolivar	6,368	6,368	185,376	198,112	-	-	5	5
Coahoma	22,096	22,096	234,944	279,136	1	1	6	7
Desoto	42,576	42,576	839,816	924,968	1	1	21	23
Lafayette	368	368	139,480	140,216	-	-	3	4
Marshall	1,264	1,264	181,968	184,496	-	-	5	5
Panola	8,000	8,000	124,296	140,296	-	-	3	4
Pontotoc	-	-	96,224	96,224	-	-	2	2
Prentiss	-	-	91,992	91,992	-	-	2	2
Quitman	7,584	7,584	77,352	92,520	-	-	2	2
Sunflower	2,136	2,136	38,232	42,504	-	-	1	1
Tallahatchie	5,712	5,712	86,536	97,960	-	-	2	2
Tate	9,400	9,400	183,744	202,544	-	-	5	5
Tippah	40	40	108,288	108,368	-	-	3	3
Tishomingo	-	-	68,992	68,992	-	-	2	2
Tunica	6,800	6,800	71,800	85,400	-	-	2	2
Union	24	24	91,312	91,360	-	-	2	2
Yalobusha	-	-	46,984	46,984	-	-	1	1
Total in IC	112,528	112,528	2,874,936	3,099,992	-	3	72	77
Total in Mississippi	146,760	146,760	5,640,256	5,933,776	4	4	141	148

Search and Rescue Teams and Personnel Required

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 77 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 78 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 77: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Mississippi

Impacted County (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Bolivar	1	1	12	38
Alcorn	-	-	1	2
Benton	-	-	-	1
Coahoma	4	2	51	137
Desoto	18	9	185	439
Lafayette	-	-	1	3
Marshall	-	-	4	14
Panola	2	1	18	63
Pontotoc	-	-	-	2
Prentiss	-	-	-	1
Quitman	1	1	16	53
Sunflower	-	-	4	12
Tallahatchie	1	-	11	41
Tate	2	1	28	84
Tippah	-	-	-	2
Tishomingo	-	-	-	-
Tunica	3	1	15	47
Union	-	-	-	2
Yalobusha	-	-	-	-
Total in IC	32	16	346	941
Total in MS	63	31	680	1,844

Table 78: Number and Type of S&R Teams for the State of Mississippi

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Mississippi	10	700	2	64	21	462	28	168

Shelter Capacity and Requirements

Table 79 provides a summary of the shelter demand and capacity for Mississippi. Figure 41 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 41 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Table 80 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

Table 79: Shelter Demand and Capacity for the State of Mississippi

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
18,345	205,507	436	32,863	172,644	49,415	55,698

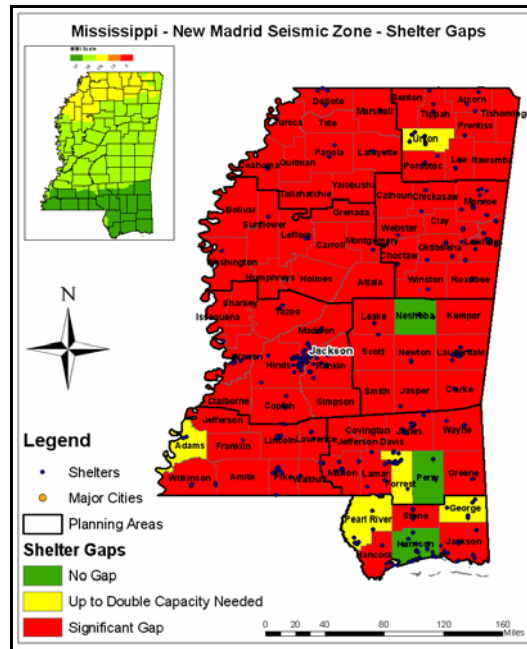


Figure 41: Shelter Gaps in the State of Mississippi

Table 80: Shelter Resource Needs for the State of Mississippi

Impacted Counties (IC)	Blankets	Cots	Sinks	Port-a-Pottys/ Toilets	Trash Cans
Alcorn	12,798	6,399	80	160	128
Benton	3,896	1,948	24	49	39
Bolivar	18,612	9,306	116	233	186
Coahoma	21,728	10,864	136	272	217
Desoto	48,294	24,147	302	604	483
Lafayette	12,658	6,329	79	158	127
Marshall	13,448	6,724	84	168	134
Panola	10,664	5,332	67	133	107
Pontotoc	6,496	3,248	41	81	65
Prentiss	4,418	2,209	28	55	44
Quitman	7,436	3,718	46	93	74
Sunflower	3,430	1,715	21	43	34
Tallahatchie	8,104	4,052	51	101	81
Tate	12,986	6,493	81	162	130
Tippah	8,784	4,392	55	110	88
Tishomingo	4,658	2,329	29	58	47
Tunica	6,610	3,305	41	83	66
Union	6,162	3,081	39	77	62
Yalobusha	3,170	1,585	20	40	32
Total in IC	214,352	107,176	1,340	2,680	2,144
Total in Mississippi	411,014	205,507	2,567	5,144	4,109

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Mississippi, there is a large number of injured people that will require medical treatment.

This is complicated by the fact that the majority of hospitals sustain physical damages and the widespread power outages, as can be seen in Table 81. Most of the hospital will be forced to evacuate their patients to other states. The majority of those who are injured will also need to be treated outside of Mississippi.

Table 81: Injuries and Hospital Status for Mississippi

Injuries (2 AM)					Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Impacted Counties (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total					
Alcorn				-	Reduced (50%)	2	165	Reduced (60%)	None (0%)
Benton	9	1	-	10	Complete (100%)	1	-	Complete (65%)	None (0%)
Bolivar	152	39	3	195	Complete (100%)	1	155	None (14%)	Reduced (57%)
Coahoma	508	138	12	659	Complete (100%)	1	195	Reduced (47%)	Complete (96%)
Desoto	1,593	416	36	2,046	Complete (100%)	5	246	Complete (79%)	Complete (98%)
Lafayette	46	7	1	54	Complete (100%)	2	204	Reduced (45%)	None (0%)
Marshall	72	13	1	86	Complete (100%)	1	40	Complete (65%)	None (1%)
Panola	229	57	5	291	Complete (100%)	2	182	Reduced (45%)	Reduced (45%)
Pontotoc	17	2	-	19	Complete (100%)	1	102	Reduced (45%)	None (0%)
Prentiss	11	1	-	12	Complete (100%)	1	114	Reduced (45%)	None (0%)
Quitman	166	44	4	213	Complete (100%)	1	36	Reduced (46%)	Complete (96%)
Sunflower	59	15	1	76	Reduced (50%)	2	160	None (14%)	None (%)
Tallahatchie	131	34	3	167	Complete (100%)	1	77	Reduced (40%)	Complete (73%)
Tate	296	78	7	381	Complete (100%)	1	76	Complete (65%)	Complete (91%)
Tippah	16	2	-	18	Complete (100%)	1	110	Complete (65%)	None (0%)
Tishomingo	2	-	-	2	None (0%)	1	48	Reduced (45%)	None (0%)
Tunica	230	62	6	298	No Data			Reduced (55%)	Complete (97%)
Union	15	2	-	17	Complete (100%)	1	200	Reduced (45%)	None (0%)
Yalobusha	3	-	-	3	Complete (100%)	1	85	Reduced (45%)	None (0%)
Total in IC	3,577	917	80	4,574		163	18,288		
Total in MS	4,588	1,181	104	5,872		163	18,288		

Table 82: Cases of Chronic Illnesses in the Shelter-Seeking Population of Mississippi

Impacted Counties (IC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Alcorn	282	442	557	1,056	58	531	1,113
Benton	86	134	169	321	18	162	339
Bolivar	409	642	810	1,535	84	772	1,619
Coahoma	478	750	945	1,793	98	902	1,890
Desoto	1,062	1,666	2,101	3,984	217	2,004	4,202
Lafayette	278	437	551	1,044	57	525	1,101
Marshall	296	464	585	1,109	61	558	1,170
Panola	235	368	464	880	48	443	928
Pontotoc	143	224	283	536	29	270	565
Prentiss	97	152	192	364	20	183	384
Quitman	164	257	323	613	33	309	647
Sunflower	75	118	149	283	15	142	298
Tallahatchie	178	280	353	669	36	336	705
Tate	286	448	565	1,071	58	539	1,130
Tippah	193	303	382	725	40	365	764
Tishomingo	102	161	203	384	21	193	405
Tunica	145	228	288	545	30	274	575
Union	136	213	268	508	28	256	536
Yalobusha	70	109	138	262	14	132	276
Total in IC	4,716	7,395	9,324	17,684	965	8,896	18,649
Total in Mississippi	9,042	14,180	17,879	33,909	1,850	17,057	35,758

Table 82 shows the number of cases of chronic illnesses in the shelter-seeking population for Mississippi. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Mortuary Services

Approximately 183 people die in Mississippi as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 83 shows the number of initial fatalities by ‘impacted county’. Mortuary services will be required, such as victim identification and the establishment of temporary morgue facilities. The number of fatalities will quickly overwhelm local resources and will need to be enhanced by DMORTs.

Table 83: Fatalities in Mississippi

Impacted Counties (IC)	Fatalities
Alcorn	-
Benton	-
Bolivar	6
Coahoma	22
Desoto	64
Lafayette	1
Marshall	2
Panola	8
Pontotoc	-
Prentiss	-
Quitman	6
Sunflower	3
Tallahatchie	5
Tate	12
Tippah	-
Tishomingo	-
Tunica	12
Union	-
Yalobusha	-
Total in IC	140
Total in MS	183

Security Needs

There are over 26,000 prisoners within Mississippi. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 42 and Table 84 provide the distribution and type of prisoners within the state of Mississippi.

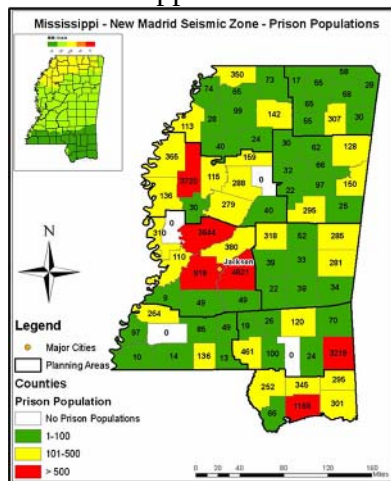


Figure 42: Distribution of Prisoners within the State of Mississippi

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Alcorn	58	-	-	58
Benton	17	-	-	17
Bolivar	365	-	-	365
Coahoma	113	-	-	113
DeSoto	350	-	-	350
Lafayette	142	-	-	142
Marshall	73	-	-	73
Panola	99	-	-	99
Pontotoc	55	-	-	55
Prentiss	68	-	-	68
Quitman	28	-	-	28
Tallahatchie	40	-	-	40
Tate	65	-	-	65
Tippah	55	-	-	55
Tishomingo	28	-	-	28
Tunica	74	-	-	74
Union	65	-	-	65
Yalobusha	24	-	-	24
Total IC	1,719	-	-	1,719
Total Mississippi	11,280	11,396	3,580	26,256

Table 84: Types of Prisoners in the State of Mississippi

Missouri: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Missouri was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 22 counties and the City of St. Louis were selected as ‘impacted counties’ in Missouri.

‘Impacted Counties’

Figure 43 displays a map of the counties determined to be ‘impacted counties’ in the State of Missouri. Table 85 provides the corresponding population data.

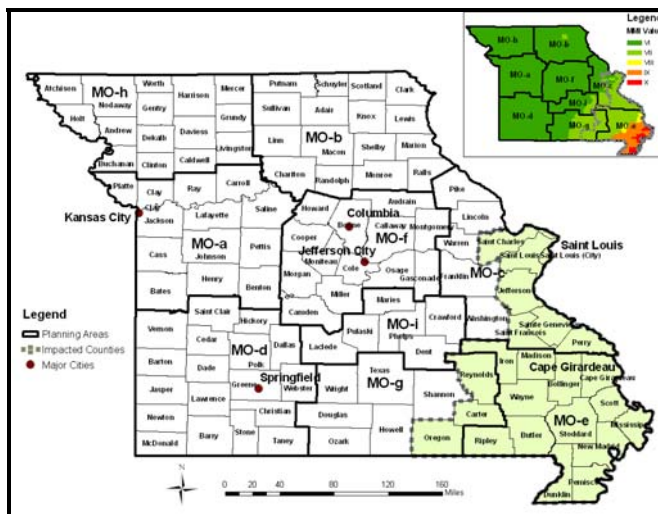


Figure 43: ‘Impacted Counties’ in the State of Missouri

Impacted Counties (incl. St. Louis City) (IC)	Population
Bollinger	12,029
Butler	40,867
Cape Girardeau	68,693
Carter	5,941
Dunklin	33,155
Iron	10,697
Jefferson	198,099
Madison	11,800
Mississippi	13,427
New Madrid	19,760
Oregon	10,344
Pemiscot	20,047
Perry	18,132
Reynolds	6,689
Ripley	13,509
Saint Charles	283,883
Saint Francois	55,641
Saint Louis	1,016,315
Saint Louis City	348,189
Sainte Genevieve	17,842
Scott	40,422
Stoddard	29,705
Wayne	13,259
Total in IC	2,288,445
Total in Missouri	5,595,211

Table 85: Population in the ‘Impacted Counties’ in Missouri

Social Vulnerability

Figure 44 provides the results of a vulnerability analysis for the State of Missouri based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 43, it is evident that portions of the impacted area have a high concentration of its population living in poverty. Additionally, Figure 45 illustrates the results of a vulnerability analysis for the State of Missouri based on age. Comparing the large map, which shows the age distribution by county, with the map in Figure 43 shows

that the impacted area has a moderate concentration of its population younger than 5 or older than 65 years of age.

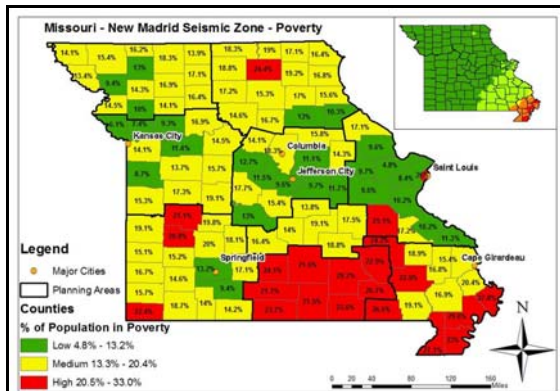


Figure 44: Vulnerability based on Poverty

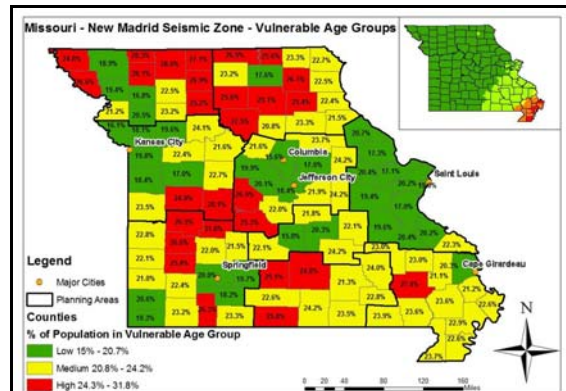


Figure 45: Vulnerability based on Age

Figure 46 provides the results of a vulnerability analysis for the State of Missouri based on English proficiency. By comparing the large map, which shows the English proficiency levels by county, with the map in Figure 43, it is shown that the majority of the population in the impacted area is proficient in English. Furthermore, Figure 47 illustrates the results of a vulnerability analysis for the State of Missouri based on people with disabilities. Comparing the large map, which shows the people with disabilities per county, with the map in Figure 43 reveals that within the impacted area there is a high concentration of people with disabilities.

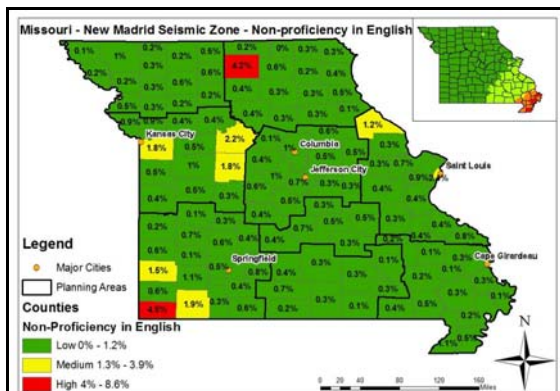


Figure 46: Vulnerability based on English Proficiency

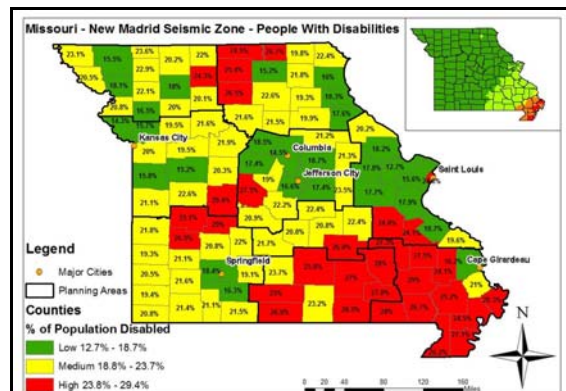


Figure 47: Vulnerability based on Disabilities

Based on the vulnerability analysis shown above, planning and response activities in the State of Missouri must consider vulnerabilities based on income-level, and disabilities, and to a lesser extent age.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as

displaced households (due to structural damage) and those without water and/or power for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

The estimates reflect that by day 3 the size of the “At Risk” population in Missouri is expected to be over 842,000 people, with 238,000 people expected to seek shelter. Table 86 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Table 86: Distribution of “At Risk” and Shelter-Seeking Population in the State of Missouri

Impacted Counties (incl. St. Louis) (IC)		Day 1		Day 3	
County	Total Population	# at risk	# shelter	# at risk	# shelter
Bollinger	12,029	-	-	7,807	2,108
Butler	40,867	8,328	2,537	40,581	12,367
Cape Girardeau	68,693	6,121	1,589	52,665	13,672
Carter	5,941	652	187	4,844	1,397
Dunklin	33,155	12,660	4,087	33,118	10,687
Iron	10,697	-	-	4,883	1,318
Jefferson	198,099	5,148	1,180	27,418	6,284
Madison	11,800	-	-	5,263	1,420
Mississippi	13,427	6,099	2,055	13,417	4,522
New Madrid	19,760	8,547	2,720	19,742	6,281
Oregon	10,344	621	204	6,471	2,116
Pemiscot	20,047	8,703	3,022	20,032	6,957
Perry	18,132	573	152	15,369	4,108
Reynolds	6,689	1,625	509	6,392	2,001
Ripley	13,509	-	-	6,939	1,873
Saint Charles	283,883	1,684	338	39,459	7,897
Saint Francois	55,641	3	-	24,817	9,275
Saint Louis	1,016,315	5,430	1,197	141,267	31,117
Saint Louis City	348,189	8,402	3,139	128,569	48,049
Sainte Genevieve	17,842	1,333	312	7,957	1,856
Scott	40,422	11,943	3,513	40,300	11,858
Stoddard	29,705	6,399	1,859	29,395	8,539
Wayne	13,259	874	251	8,133	2,336
Total in IC		95,145	28,851	684,838	198,038
Total in Missouri		103,665	30,074	842,002	237,991

Location and Size of Other Relevant Populations

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 87 provides an overview of the additional population in the impacted counties, a total of nearly 96,000 people. While it is unlikely that this entire number will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Table 87: Distribution of Other Relevant Populations in the State of Missouri

Impacted Counties (incl. St. Louis City) (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Bollinger	89	64	11	41	205
Butler	230	521	163	658	1,572
Cape Girardeau	2,228	1,078	100	1499	4,905
Carter	40	45	0	73	158
Dunklin	83	537	92	250	962
Iron	91	266	24	58	439
Jefferson	606	1,259	163	2039	4,067
Madison	17	89	124	70	300
Mississippi	-	173	97	96	366
New Madrid	1	313	36	230	580
Oregon	10	98	2	76	186
Pemiscot	40	205	33	130	408
Perry	72	273	34	213	592
Reynolds	113	38	5	47	203
Ripley	20	127	12	71	230
Saint Charles	2,428	983	377	5765	9,553
Saint Francois	268	877	2718	844	4,707
Saint Louis	7,206	8,735	3278	23495	42,714
Saint Louis City	5,959	2,943	1335	10642	20,879
Sainte Genevieve	46	221	87	140	494
Scott	133	386	43	446	1,008
Stoddard	464	304	45	268	1,081
Wayne	15	124	3	80	222
Total in IC	20,159	19,659	8,782	47,231	95,831

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for the first 72 hours post-event, are shown in Tables 88, 89, and 90, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 88: Water Required to Support the “At Risk” Population in the State of Missouri

Impacted Counties (incl. St. Louis City) (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Bollinger	-	-	23,421	23,421	-	-	1	1
Butler	7,611	7,611	121,743	136,965	-	-	7	8
Cape Girardeau	4,767	4,767	157,995	167,529	-	-	9	9
Carter	561	561	14,532	15,654	-	-	1	<1
Dunklin	12,261	12,261	99,354	123,876	1	1	6	7
Iron	-	-	14,649	14,649	-	-	1	<1
Jefferson	3,540	3,540	82,254	89,334	-	-	5	5
Madison	-	-	15,789	15,789	-	-	1	<1
Mississippi	6,165	6,165	40,251	52,581	-	-	2	3
New Madrid	8,160	8,160	59,226	75,546	-	-	3	4
Oregon	612	612	19,413	20,637	-	-	1	1
Pemiscot	9,066	9,066	60,096	78,228	1	1	3	4
Perry	456	456	46,107	47,019	-	-	3	3
Reynolds	1,527	1,527	19,176	22,230	-	-	1	1
Ripley	-	-	20,817	20,817	-	-	1	1
Saint Charles	1,014	1,014	118,377	120,405	-	-	7	7
Saint Francois	-	-	74,451	74,451	-	-	4	4
Saint Louis	3,591	3,591	423,801	430,983	-	-	24	24
Saint Louis City	9,417	9,417	385,707	404,541	1	1	21	22
Sainte Genevieve	936	936	23,871	25,743	-	-	1	1
Scott	10,539	10,539	120,900	141,978	1	1	7	8
Stoddard	5,577	5,577	88,185	99,339	-	-	5	6
Wayne	753	753	24,399	25,905	-	-	1	1
Total for IC	86,553	86,553	2,054,514	2,227,620	2	2	114	119
Total for Missouri	90,222	90,222	2,526,006	2,706,450	5	5	141	150

Table 89: MREs Required to Support the “At Risk” Population in the State of Missouri

Impacted Counties (incl. St. Louis City) (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Bollinger	-	-	15,614	15,614	-	-	1	<1
Butler	5,074	5,074	81,162	91,310	-	-	4	4
Cape Girardeau	3,178	3,178	105,330	111,686	-	-	5	5
Carter	374	374	9,688	10,436	-	-	-	<1
Dunklin	8,174	8,174	66,236	82,584	-	-	3	4
Iron	-	-	9,766	9,766	-	-	-	<1
Jefferson	2,360	2,360	54,836	59,556	-	-	3	3
Madison	-	-	10,526	10,526	-	-	-	<1
Mississippi	4,110	4,110	26,834	35,054	-	-	1	2
New Madrid	5,440	5,440	39,484	50,364	-	-	2	2
Oregon	408	408	12,942	13,758	-	-	1	<1
Pemiscot	6,044	6,044	40,064	52,152	-	-	2	2
Perry	304	304	30,738	31,346	-	-	1	1
Reynolds	1,018	1,018	12,784	14,820	-	-	1	<1
Ripley	-	-	13,878	13,878	-	-	1	<1
Saint Charles	676	676	78,918	80,270	-	-	4	4
Saint Francois	-	-	49,634	49,634	-	-	2	2
Saint Louis	2,394	2,394	282,534	287,322	-	-	13	13
Saint Louis City	6,278	6,278	257,138	269,694	-	-	12	12
Sainte Genevieve	624	624	15,914	17,162	-	-	1	<1
Scott	7,026	7,026	80,600	94,652	-	-	4	4
Stoddard	3,718	3,718	58,790	66,226	-	-	3	3
Wayne	502	502	16,266	17,270	-	-	1	<1
Total for IC	57,702	57,702	1,369,676	1,485,080	3	3	63	68
Total for Missouri	60,148	60,148	1,684,004	1,804,300	3	3	77	83

Table 90: Ice Required to Support the “At Risk” Population in the State of Missouri

Impacted Counties (incl. St. Louis City) (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Bollinger	-	-	62,456	62,456	-	-	2	2
Butler	20,296	20,296	324,648	365,240	1	1	8	9
Cape Girardeau	12,712	12,712	421,320	446,744	-	-	11	11
Carter	1,496	1,496	38,752	41,744	-	-	1	1
Dunklin	32,696	32,696	264,944	330,336	1	1	7	8
Iron	-	-	39,064	39,064	-	-	1	<1
Jefferson	9,440	9,440	219,344	238,224	-	-	5	6
Madison	-	-	42,104	42,104	-	-	1	1
Mississippi	16,440	16,440	107,336	140,216	-	-	3	4
New Madrid	21,760	21,760	157,936	201,456	1	1	4	5
Oregon	1,632	1,632	51,768	55,032	-	-	1	1
Pemiscot	24,176	24,176	160,256	208,608	1	1	4	5
Perry	1,216	1,216	122,952	125,384	-	-	3	3
Reynolds	4,072	4,072	51,136	59,280	-	-	1	1
Ripley	-	-	55,512	55,512	-	-	1	1
Saint Charles	2,704	2,704	315,672	321,080	-	-	8	8
Saint Francois	-	-	198,536	198,536	-	-	5	5
Saint Louis	9,576	9,576	1,130,136	1,149,288	-	-	28	29
Saint Louis City	25,112	25,112	1,028,552	1,078,776	1	1	26	27
Sainte Genevieve	2,496	2,496	63,656	68,648	-	-	2	2
Scott	28,104	28,104	322,400	378,608	1	1	8	9
Stoddard	14,872	14,872	235,160	264,904	-	-	6	7
Wayne	2,008	2,008	65,064	69,080	-	-	2	2
Total for IC	230,808	230,808	5,478,704	5,940,320	6	6	137	148
Total for Missouri	240,592	240,592	6,736,016	7,217,200	6	6	168	180

Search and Rescue Teams and Personnel Required

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 91 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 92 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 91: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Missouri

Impacted County (incl. St. Louis City) (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Bollinger	-	-	-	-
Butler	6	3	278	171
Cape Girardeau	4	3	146	71
Carter	-	-	20	16
Dunklin	14	9	695	214
Iron	-	-	-	-
Jefferson	1	-	113	88
Madison	-	-	-	-
Mississippi	6	3	358	88
New Madrid	8	5	463	148
Oregon	-	-	17	15
Pemiscot	9	5	495	137
Perry	-	-	14	11
Reynolds	-	-	52	43
Ripley	-	-	-	-
Saint Charles	-	-	37	24
Saint Francois	-	-	-	-
Saint Louis	1	1	137	86
Saint Louis City	3	4	168	102
Sainte Genevieve	1	1	32	22
Scott	16	8	627	193
Stoddard	9	5	404	104
Wayne	-	-	23	29
Total in IC	78	47	4,079	1,562
Total in Missouri	78	47	4,079	1,562

Table 92: Number and Type of S&R Teams for the State of Missouri

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Missouri	20	1,400	6	192	195	4,290	39	234

Shelter Capacity and Requirements

Table 93 provides a summary of the shelter demand and capacity for Missouri. Figure 48 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 48 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Table 94 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

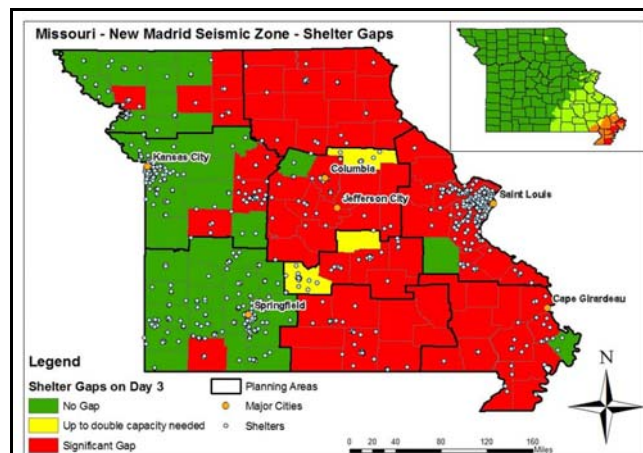


Figure 48: Shelter Gaps in the State of Missouri

Table 93: Shelter Demand and Capacity for the State of Missouri

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
30,074	237,991	907,303	669,312	60,688	68,403

Table 94: Shelter Resource Needs for the State of Missouri

Impacted Counties (incl. St. Louis City) (IC)	Blankets	Cots	Sinks	Port-a-Pottys Toilets	Trash Cans
Bollinger	4,216	2,108	26	53	42
Butler	24,734	12,367	155	309	247
Cape Girardeau	27,344	13,672	171	342	273
Carter	2,794	1,397	17	35	28
Dunklin	21,374	10,687	134	267	214
Iron	2,636	1,318	16	33	26
Jefferson	12,568	6,284	79	157	126
Madison	2,840	1,420	18	36	28
Mississippi	9,044	4,522	57	113	90
New Madrid	12,562	6,281	79	157	126
Oregon	4,232	2,116	26	53	42
Pemiscot	13,914	6,957	87	174	139
Perry	8,216	4,108	51	103	82
Reynolds	4,002	2,001	25	50	40
Ripley	3,746	1,873	23	47	37
Saint Charles	15,794	7,897	99	197	158
Saint Francois	18,550	9,275	116	232	186
Saint Louis	62,234	31,117	389	778	622
Saint Louis City	96,098	48,049	601	1,201	961
Sainte Genevieve	3,712	1,856	23	46	37
Scott	23,716	11,858	148	296	237
Stoddard	17,078	8,539	107	213	171
Wayne	4,672	2,336	29	58	47
Total in IC	396,076	198,038	2,476	4,950	3,959
Total in Missouri	475,982	237,991	2,972	5,946	4,755

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Missouri, there is an extremely large number of injured people that require medical treatment. This is complicated by the fact that while most of the hospitals do not sustain physical damages there are widespread power and water outages, as shown in Table 95. Therefore, many of the hospital will be forced to evacuate their patients. The majority of those who are injured will most likely need to be treated outside of Missouri.

Table 96 shows the number of cases of chronic illnesses in the shelter-seeking population for Missouri. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Table 95: Injuries and Hospital Status for Missouri

Injuries (2 AM)					Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Impacted Counties (incl. St. Louis City) (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total					
Bollinger				-	No Data	No data	No data	Complete (65%)	None (0%)
Butler	747	210	24	981	None (0%)	3	483	Complete (66%)	Complete (99%)
Cape Girardeau	520	135	16	670	Complete (67%)	3	545	Complete (77%)	Reduced (57%)
Carter	50	14	2	66	No Data			Reduced (45%)	Complete (82%)
Dunklin	1,326	388	51	1,765	Complete (100%)	1	118	Complete (86%)	Complete (100%)
Iron	2	-	-	2	No Data			Reduced (46%)	None (0%)
Jefferson	395	111	12	519	None (0%)	2	236	None (0%)	None (14%)
Madison	1	-	-	1	None (0%)	1	159	Reduced (45%)	None (0%)
Mississippi	652	193	26	870	No Data	No data	No data	Complete (91%)	Complete (100%)
New Madrid	934	276	36	1,246	No Data	No data	No data	Complete (90%)	Complete (100%)
Oregon	47	13	1	61	No Data	No data	No data	Reduced (34%)	Complete (63%)
Pemiscot	943	280	37	1,260	Complete (100%)	1	209	Complete (94%)	Complete (100%)
Perry	46	12	1	59	None (0%)	1	64	Reduced (56%)	Complete (85%)
Reynolds	126	36	4	166	None (0%)	1	159	Reduced (45%)	Complete (96%)
Ripley	3	-	-	3	None (0%)	1	30	Reduced (51%)	None (0%)
Saint Charles	137	36	4	177	None (0%)	11	743	None (14%)	None (0%)
Saint Francois	8	1	-	9	None (0%)	4	464	Reduced (45%)	None (0%)
Saint Louis	536	139	15	691	None (0%)	30	5,542	None (14%)	None (%)
Saint Louis City	738	207	24	969	None (0%)	14	2,634	Reduced (37%)	None (2%)
Sainte Genevieve	99	28	3	130	Complete (100%)	1	47	Reduced (45%)	None (1%)
Scott	1,339	390	51	1,781	Complete (100%)	2	188	Complete (88%)	Complete (100%)
Stoddard	756	215	28	1,000	No Data	1	50	Complete (87%)	Complete (99%)
Wayne	64	17	2	82	None (0%)	No data	No data	Reduced (50%)	Complete (61%)
Total in IC	9,473	2,703	338	12,513		77	11,671		
Total in Missouri	10,177	2,897	360	13,434		208	27,343		

Table 96: Cases of Chronic Illnesses in the Shelter-Seeking Population of Missouri

Impacted Counties (incl. St. Louis City) (IC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Bollinger	70	84	173	299	21	219	382
Butler	408	495	1,014	1,756	124	1,286	2,238
Cape Girardeau	451	547	1,121	1,941	137	1,422	2,475
Carter	46	56	115	198	14	145	253
Dunklin	353	427	876	1,518	107	1,111	1,934
Iron	43	53	108	187	13	137	239
Jefferson	207	251	515	892	63	654	1,137
Madison	47	57	116	202	14	148	257
Mississippi	149	181	371	642	45	470	818
New Madrid	207	251	515	892	63	653	1,137
Oregon	70	85	174	300	21	220	383
Pemiscot	230	278	570	988	70	724	1,259
Perry	136	164	337	583	41	427	744
Reynolds	66	80	164	284	20	208	362
Ripley	62	75	154	266	19	195	339
Saint Charles	261	316	648	1,121	79	821	1,429
Saint Francois	306	371	761	1,317	93	965	1,679
Saint Louis	1,027	1,245	2,552	4,419	311	3,236	5,632
Saint Louis City	1,586	1,922	3,940	6,823	480	4,997	8,697
Sainte Genevieve	61	74	152	264	19	193	336
Scott	391	474	972	1,684	119	1,233	2,146
Stoddard	282	342	700	1,213	85	888	1,546
Wayne	77	93	192	332	23	243	423
Total in IC	6,535	7,922	16,239	28,121	1,980	20,596	35,845
Total in Missouri	7,892	9,566	19,611	33,960	2,392	24,872	43,287

Mortuary Services

Approximately 686 people in Missouri die as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 97 shows the number of initial fatalities by ‘impacted county’. Mortuary services will be required, such as victim identification and the establishment of temporary morgue facilities. The number of fatalities will quickly overwhelm local resources even enhanced by DMORTs.

Table 97: Fatalities in Missouri

Impacted Counties (incl. St. Louis City) (IC)	Fatalities
Bollinger	-
Butler	45
Cape Girardeau	29
Carter	3
Dunklin	98
Iron	-
Jefferson	23
Madison	-
Mississippi	50
New Madrid	69
Oregon	2
Pemiscot	72
Perry	2
Reynolds	7
Ripley	-
Saint Charles	8
Saint Francois	-
Saint Louis	29
Saint Louis City	45
Sainte Genevieve	6
Scott	98
Stoddard	55
Wayne	3
Total in IC	645
Total in Missouri	686

Security Needs

There are over 43,600 prisoners within Missouri. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 49 and Table 98 provide the distribution and type of prisoners within the State of Missouri.

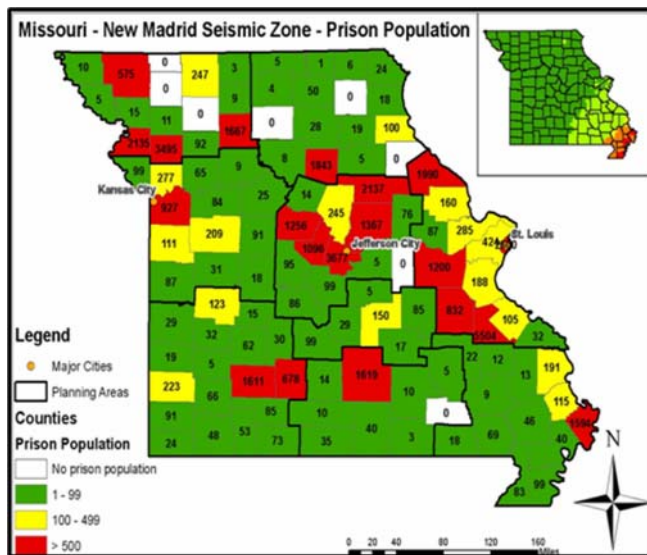


Figure 49: Distribution of Prisoners within the State of Missouri

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Bollinger	13	-	-	13
Butler	69	-	-	69
Cape Girardeau	191	-	-	191
Carter	-	-	-	-
Dunklin	83	-	-	83
Iron	22	-	-	22
Jefferson	188	-	-	188
Madison	424	-	-	424
Mississippi	94	1,500	-	1,594
New Madrid	40	-	-	40
Oregon	2,600	-	-	2,600
Pemiscot	99	-	-	99
Perry	32	-	-	32
Reynolds	5	-	-	5
Ripley	18	-	-	18
St. Charles	285	-	-	285
Ste. Genevieve	105	-	-	105
St. Francois	134	5,370	-	5,504
St. Louis City	2,600	-	-	2,600
St. Louis County	424	-	-	424
Scott	115	-	-	115
Stoddard	46	-	-	46
Wayne	9	-	-	9
Total IC	7,596	6,870	-	14,466
Total MO	10,799	31,750	1,118	43,667

Table 98: Types of Prisoners in the State of Missouri

Tennessee: Social Impact and Response Requirements Analysis Results

The earthquake impact analysis of Tennessee was used to develop a list of ‘impacted counties’. This list, as well as lists of impact counties for other NMSZ states, was compiled based on a cumulative review of direct damage and functionality of infrastructure, social impacts, and direct economic losses. Impacts are most severe in the impacted counties, though it is important to remember that all counties in each state are impacted at some level by the NMSZ scenario event. A total of 20 counties were selected as ‘impacted counties’ in Tennessee.

‘Impacted Counties’

Figure 50 displays a map of the counties determined to be ‘impacted counties’ in the State of Tennessee. Table 99 provides the corresponding population data.

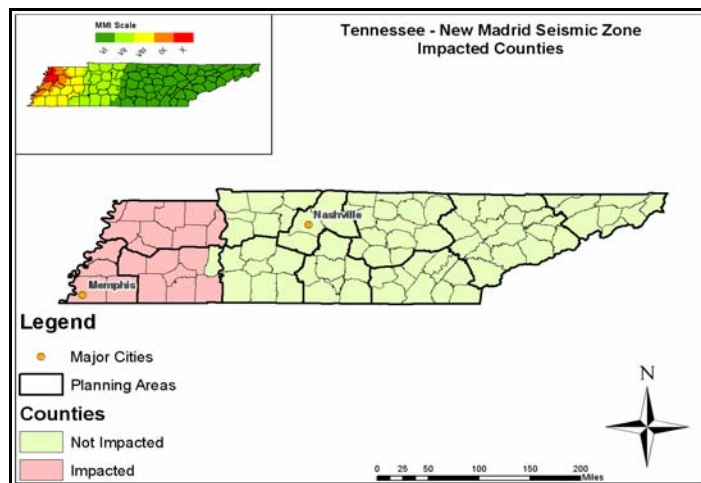


Figure 50: ‘Impacted Counties’ in the State of Tennessee

Impacted Counties (IC)	Population
Benton	16,537
Carroll	29,475
Chester	15,540
Crockett	14,532
Dyer	37,279
Fayette	28,806
Gibson	48,152
Hardeman	28,105
Hardin	25,578
Haywood	19,797
Henderson	25,522
Henry	31,115
Lake	7,954
Lauderdale	27,101
Madison	91,837
McNairy	24,653
Obion	32,450
Shelby	897,472
Tipton	51,271
Weakley	34,895
Total in IC	1,488,071
Total in Tennessee	5,689,283

Table 99: Population in the ‘Impacted Counties’ in the State of Tennessee

Social Vulnerability

Figure 51 provides the results of a vulnerability analysis for the State of Tennessee based on poverty. By comparing the large map, which shows the poverty levels by county, with the map in Figure 50, it is evident that the impacted area has a moderate-to-high concentration of its population living in poverty. Additionally, Figure 52 illustrates the results of a vulnerability analysis for the State of Tennessee based on age. Comparing the large map, which shows the age distribution by county, with the map in Figure 50 reveals that the impacted area has a moderate-to-high concentration of its population younger than 5 or older than 65 years of age.

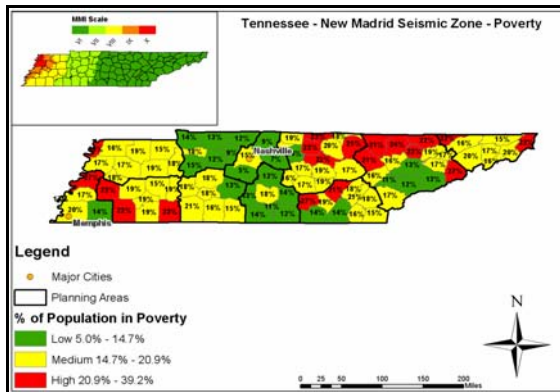


Figure 51: Vulnerability based on Poverty

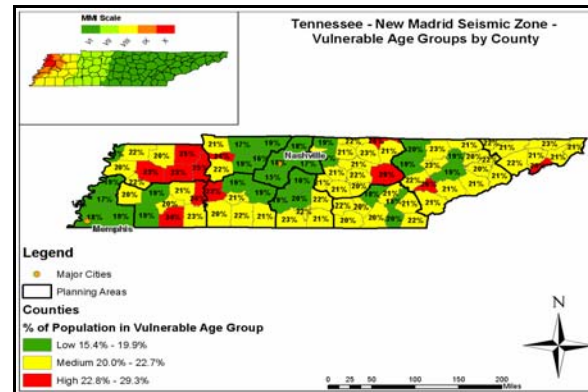


Figure 52: Vulnerability based on Age

Figure 53 provides the results of a vulnerability analysis for the State of Tennessee based on English proficiency. By comparing the large map, which shows the English proficiency levels by county, with the map in Figure 50, it is shown that the majority of the population in the impacted area is proficient in English. Furthermore, Figure 54 illustrates the results of a vulnerability analysis for the State of Tennessee based on people with disabilities. Comparing the large map, which shows the people with disabilities per county, with the map in Figure 50 illustrates that within the impacted area there is a fairly high concentration of people with disabilities.

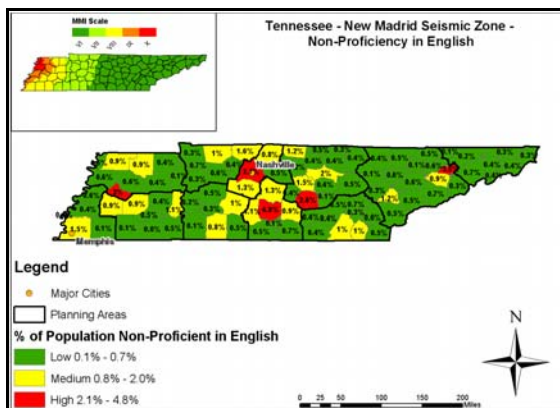


Figure 53: Vulnerability based on English Proficiency

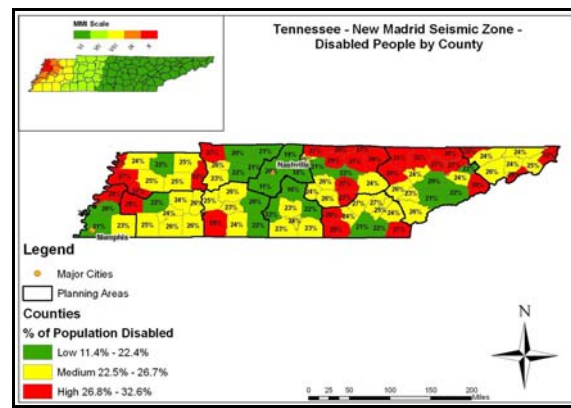


Figure 54: Vulnerability based on Disabilities

Based on the vulnerability analysis shown above, planning and response activities in the State of Tennessee must consider vulnerabilities based primarily on disabilities, but also must consider vulnerabilities as a result of poverty and age.

Mass Care Needs

Mass care and emergency requirements comprise the commodities (water, ice, food) and shelter requirements of the “At Risk” population. The “At Risk” population is defined as displaced households (due to structural damage) and those without water and/or power for 72 hours. Shelter-seeking population is a subset of the ‘At Risk’ population based on demographic and socio-economic characteristics such as ethnicity and income level.

Location and Size of “At Risk” and Displaced Population

The estimates reflect that by day 3 the size of the “At Risk” population in Tennessee is expected to be over 2,070,000 people, with 562,000 people expected to seek shelter. Table 100 shows the distribution of the “At Risk” and shelter-seeking populations by county.

Table 100: Distribution of “At Risk” and Shelter-Seeking Population in the State of Tennessee

Impacted Counties (IC)		Day 1		Day 3	
County	Population	# at risk	# shelter	# at risk	# shelter
Benton	16,537	253	70	7,376	2,041
Carroll	29,475	983	280	19,130	5,465
Chester	15,540	1,430	456	10,085	3,207
Crockett	14,532	3,667	1,097	14,480	4,330
Dyer	37,279	19,520	5,383	37,241	10,268
Fayette	28,806	4,461	1,219	26,684	7,299
Gibson	48,152	12,732	3,671	48,006	13,840
Hardeman	28,105	3,129	950	22,569	6,844
Hardin	25,578	1,717	446	11,408	2,964
Haywood	19,797	4,683	1,543	19,650	6,475
Henderson	25,522	768	220	16,565	4,770
Henry	31,115	1,491	437	20,193	5,918
Lake	7,954	2,518	891	7,947	2,812
Lauderdale	27,101	8,068	2,515	27,044	8,430
Madison	91,837	8,765	2,439	79,094	22,001
McNairy	24,653	1,275	371	14,668	4,269
Obion	32,450	10,265	2,870	32,376	9,052
Shelby	897,472	209,726	60,479	888,650	256,261
Tipton	51,271	12,811	3,316	51,095	13,221
Weakley	34,895	8,293	2,435	34,600	10,154
Total in IC	1,488,071	316,555	91,088	1,388,861	399,621
Total in Tennessee	5,689,283	316,681	91,103	2,072,942	562,468

Location and Size of Other Relevant Populations

Table 101: Distribution of Other Relevant Populations in the State of Tennessee

Impacted Counties (IC)	Dorms	Nursing Homes	Institutions	Visitors	Total
Benton	55	164	54	202	475
Carroll	400	446	73	158	1,077
Chester	960	136	25	82	1,203
Crockett	1	241	56	68	366
Dyer	124	331	154	254	863
Fayette	7	155	230	68	460
Gibson	44	912	112	314	1,382
Hardeman	103	203	3,438	205	3,949
Hardin	65	360	39	283	747
Haywood	-	158	66	125	349
Henderson	81	174	97	183	535
Henry	84	326	114	452	976
Lake	-	165	2,113	88	2,366
Lauderdale	10	216	2,462	141	2,829
McNairy	170	272	86	92	620
Madison	2,024	891	387	1,497	4,799
Obion	165	294	63	407	929
Shelby	6,905	4,187	7,567	30,278	48,937
Tipton	25	268	596	239	1,128
Weakley	1,935	423	141	152	2,651
Total in IC	13,158	10,322	17,873	35,288	76,641

In estimating the numbers for “At Risk” and shelter-seeking population, the base data used is primarily permanent residences. Therefore, the numbers estimated do not take into account other relevant populations that use facilities and services of a more temporary nature, such as visitors and individuals who reside in dormitories, nursing homes, and institutions. Table 101 provides an overview of the additional population in the impacted counties, a total of over 76,600 people. While it is unlikely that this entire population will be “At Risk” or seek shelter after the earthquake, requirements planning should make plausible assumptions regarding how these populations are provided with the basic care they may need.

Response Requirements Models

Response requirement models estimate resources necessary to respond to a given a disaster scenario.

Commodities Required

The estimates calculated for commodities required include the immediate needs of the “At Risk” population. The amount and truckloads of water, ice, and MRE’s required for the first 72 hours post-event, are shown in **Error! Reference source not found.**, 103, and 104, respectively. It is assumed that each truck has a 25-ton capacity. The water estimate only includes the required amount for drinking water, though up to four times the amount of drinking water may be required for washing and other uses.

Table 102: Water Required to Support the “At Risk” Population in the State of Tennessee

Impacted Counties (IC)	Drinking Water							
	Liters				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Benton	210	210	22,128	22,548	-	-	1	1
Carroll	840	840	57,390	59,070	-	-	3	3
Chester	1,368	1,368	30,255	32,991	-	-	2	2
Crockett	3,291	3,291	43,440	50,022	-	-	2	3
Dyer	16,149	16,149	111,723	144,021	1	1	6	8
Fayette	3,657	3,657	80,052	87,366	-	-	4	5
Gibson	11,013	11,013	144,018	166,044	1	1	8	9
Hardeman	2,850	2,850	67,707	73,407	-	-	4	4
Hardin	1,338	1,338	34,224	36,900	-	-	2	2
Haywood	4,629	4,629	58,950	68,208	-	-	3	4
Henderson	660	660	49,695	51,015	-	-	3	3
Henry	1,311	1,311	60,579	63,201	-	-	3	4
Lake	2,673	2,673	23,841	29,187	-	-	1	2
Lauderdale	7,545	7,545	81,132	96,222	-	-	5	5
Madison	7,317	7,317	237,282	251,916	-	-	13	14
McNairy	1,113	1,113	44,004	46,230	-	-	2	3
Obion	8,610	8,610	97,128	114,348	-	-	5	6
Shelby	181,437	181,437	2,665,950	3,028,824	10	10	148	168
Tipton	9,948	9,948	153,285	173,181	1	1	9	10
Weakley	7,305	7,305	103,800	118,410	-	-	6	7
Total for IC	273,264	273,264	4,166,583	4,713,111	15	15	232	262
Total for Tennessee	273,309	273,309	6,218,826	6,765,444	15	15	346	376

Table 103: MREs Required to Support the “At Risk” Population in the State of Tennessee

Impacted Counties (IC)	MREs							
	Packages				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Benton	140	140	14,752	15,032	-	-	1	<1
Carroll	560	560	38,260	39,380	-	-	2	2
Chester	912	912	20,170	21,994	-	-	1	1
Crockett	2,194	2,194	28,960	33,348	-	-	1	2
Dyer	10,766	10,766	74,482	96,014	1	1	3	4
Fayette	2,438	2,438	53,368	58,244	-	-	2	3
Gibson	7,342	7,342	96,012	110,696	-	-	4	5
Hardeman	1,900	1,900	45,138	48,938	-	-	2	2
Hardin	892	892	22,816	24,600	-	-	1	1
Haywood	3,086	3,086	39,300	45,472	-	-	2	2
Henderson	440	440	33,130	34,010	-	-	2	2
Henry	874	874	40,386	42,134	-	-	2	2
Lake	1,782	1,782	15,894	19,458	-	-	1	<1
Lauderdale	5,030	5,030	54,088	64,148	-	-	2	3
Madison	4,878	4,878	158,188	167,944	-	-	7	8
McNairy	742	742	29,336	30,820	-	-	1	1
Obion	5,740	5,740	64,752	76,232	-	-	3	4
Shelby	120,958	120,958	1,777,300	2,019,216	6	6	82	93
Tipton	6,632	6,632	102,190	115,454	-	-	5	5
Weakley	4,870	4,870	69,200	78,940	-	-	3	4
Total for IC	182,176	182,176	2,777,722	3,142,074	8	8	128	145
Total for Tennessee	182,206	182,206	4,145,884	4,510,296	8	8	191	207

Table 104: Ice Required to Support the “At Risk” Population in the State of Tennessee

Impacted Counties (IC)	Ice							
	Pounds				Truckloads			
	Day 1	Day 2	Day 3	Total (Days 1-3)	Day 1	Day 2	Day 3	Total (Days 1-3)
Benton	560	560	59,008	60,128	-	-	1	2
Carroll	2,240	2,240	153,040	157,520	-	-	4	4
Chester	3,648	3,648	80,680	87,976	-	-	2	2
Crockett	8,776	8,776	115,840	133,392	-	-	3	3
Dyer	43,064	43,064	297,928	384,056	1	1	7	10
Fayette	9,752	9,752	213,472	232,976	-	-	5	6
Gibson	29,368	29,368	384,048	442,784	1	1	10	11
Hardeman	7,600	7,600	180,552	195,752	-	-	5	5
Hardin	3,568	3,568	91,264	98,400	-	-	2	2
Haywood	12,344	12,344	157,200	181,888	-	-	4	5
Henderson	1,760	1,760	132,520	136,040	-	-	3	3
Henry	3,496	3,496	161,544	168,536	-	-	4	4
Lake	7,128	7,128	63,576	77,832	-	-	2	2
Lauderdale	20,120	20,120	216,352	256,592	1	1	5	6
Madison	19,512	19,512	632,752	671,776	-	-	16	17
McNairy	2,968	2,968	117,344	123,280	-	-	3	3
Obion	22,960	22,960	259,008	304,928	1	1	6	8
Shelby	483,832	483,832	7,109,200	8,076,864	12	12	178	202
Tipton	26,528	26,528	408,760	461,816	1	1	10	12
Weakley	19,480	19,480	276,800	315,760	-	-	7	8
Total for IC	728,704	728,704	11,110,888	12,568,296	-	18	278	314
Total for Tennessee	728,824	728,824	16,583,536	18,041,184	18	18	415	451

Search and Rescue Teams and Personnel Required

Search and Rescue (S&R) requirements are calculated based on a methodology developed by D. Bausch. Table 105 summarizes the number of collapsed buildings for the four different categories which are based on construction material and correspond to the four different US&R Task Force Types. Table 106 provides the number and type of US&R Task Force teams required along with the number of personnel.

Table 105: Distribution of Building Collapse Types for the ‘Impacted Counties’ in Tennessee

Impacted County (IC)	Type I Collapsed Buildings	Type II Collapsed Buildings	Type III Collapsed Buildings	Type IV Collapsed Buildings
Benton	-	-	3	7
Carroll	2	1	27	30
Chester	1	1	17	27
Crockett	4	2	87	82
Dyer	30	17	448	376
Fayette	4	2	55	96
Gibson	23	12	290	264
Hardeman	2	1	33	60
Hardin	1	1	26	50
Haywood	6	4	82	87
Henderson	2	1	14	22
Henry	1	1	18	38
Lake	3	3	71	33
Lauderdale	11	7	186	157
Madison	16	9	146	128
McNairy	1	-	16	32
Obion	16	9	257	237
Shelby	212	118	2,815	3,054
Tipton	12	6	239	266
Weakley	8	6	133	169
Total in IC	355	201	4,963	5,215
Total in TN	355	201	4,963	5,215

Table 106: Number and Type of S&R Teams for the State of Tennessee

	Type I		Type II		Type III		Type IV	
	Teams	Personnel	Teams	Personnel	Teams	Personnel	Teams	Personnel
Total for Tennessee	89	6,213	25	804	226	4,972	119	714

Shelter Capacity and Requirements

Table 107 provides a summary of the shelter demand and capacity for Tennessee. Figure 55 provides a spatial gap analysis of shelter availability and expected shelter needs within the state. The data concerning available shelters comes from the NSS database. The green color in Figure 55 represents areas where there is no shelter gap, meaning there is sufficient shelter capacity in these locations. The yellow color represents areas where there is a shelter gap, however shelter demand is less than double the available shelter capacity. The red color represents areas with significant shelter gaps, where shelter demand is more than double the available shelter capacity. Table 108 provides the quantities of some of the shelter resources required (blankets, cots, sinks, toilets, and trash cans).

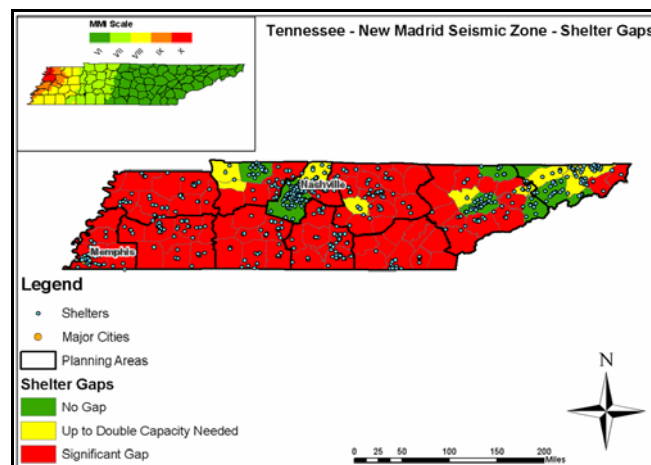


Figure 55: Shelter Gaps in the State of Tennessee

Table 107: Shelter Demand and Capacity for the State of Tennessee

Shelter Demand (Day 1)	Shelter Demand (Day 3)	Number of Shelters	Shelter Capacity	Absolute Capacity Gap (Day 3)	Dog Shelter Demand (Day 3)	Cat Shelter Demand (Day 3)
91,103	562,468	915	104,317	458,151	143,429	125,590

Table 108: Shelter Resource Needs for the State of Tennessee

Impacted Counties (IC)	Blankets	Cots	Sinks	Port-a-Pottys/Toilets	Trash Cans
Benton	4,082	2,041	26	51	41
Carroll	10,930	5,465	68	137	109
Chester	6,414	3,207	40	80	64
Crockett	8,660	4,330	54	108	87
Dyer	20,536	10,268	128	257	205
Fayette	14,598	7,299	91	182	146
Gibson	27,680	13,840	173	346	277
Hardeman	13,688	6,844	86	171	137
Hardin	5,928	2,964	37	74	59
Haywood	12,950	6,475	81	162	130
Henderson	9,540	4,770	60	119	95
Henry	11,836	5,918	74	148	118
Lake	5,624	2,812	35	70	56
Lauderdale	16,860	8,430	105	211	169
Madison	44,002	22,001	275	550	440
McNairy	8,538	4,269	53	107	85
Obion	18,104	9,052	113	226	181
Shelby	512,522	256,261	3,203	6,407	5,125
Tipton	26,442	13,221	165	331	264
Weakley	20,308	10,154	127	254	203
Total for IC	799,242	399,621	4,994	9,991	7,991
Total for Tennessee	1,124,936	562,468	7,030	14,064	11,244

Medical Response Requirements

The injuries estimated by the model are only for those that occur at the time of the event. The number and type of injuries are displayed by county, along with the hospital damage for that county and the status of power and water services. Although a county may sustain little to no physical damage to the hospitals, without power and/or water those hospitals will most likely be non-operational and will have to be evacuated. This will also require that people who require hospital treatment will need to be cared for outside the county. In Tennessee, there is an extremely large number of injured people that will require medical treatment. This is complicated by the fact that almost all hospitals sustain physical damages and there are widespread power and water outages, as can be seen in Table 109. Therefore, almost all of the hospital will be forced to evacuate their patients. Injured people will also need to be evacuated and treated outside of Tennessee.

Table 110 shows the number of cases of chronic illnesses in the shelter-seeking population for Tennessee. While the majority of these illnesses are often able to be treated on a day-to-day basis by the patients themselves, this will most likely not be the case in the days following the earthquake. Without the proper medical equipment and/or medication required to treat their illnesses, the ability for these people to care for themselves will be severely limited.

Table 109: Injuries and Hospital Status for Tennessee

Injuries (2 AM)					Hospital Damage	# Facilities	# Beds	Power Outages	Water Outages
Impacted Counties (IC)	Medical Aid Needed	Hospital Care Needed	Life Threatening	Total					
Benton				-	None (0%)	1	93	Reduced (45%)	None (0%)
Carroll	149	33	3	185	Complete (100%)	2	135	Complete (65%)	None (13%)
Chester	127	33	4	164	No Data			Complete (65%)	Reduced (32%)
Crockett	337	90	10	437	No Data			Complete (88%)	Complete (100%)
Dyer	1,559	430	47	2,036	Complete (100%)	2	225	Complete (96%)	Complete (100%)
Fayette	349	90	8	447	Complete (100%)	2	50	Complete (65%)	Complete (93%)
Gibson	1,103	295	32	1,430	Complete (100%)	3	235	Complete (75%)	Complete (100%)
Hardeman	235	60	6	302	Complete (100%)	2	308	Complete (69%)	Complete (80%)
Hardin	118	32	3	152	None (0%)	1	131	Reduced (45%)	Reduced (43%)
Haywood	379	101	10	490	Complete (100%)	1	62	Complete (66%)	Complete (99%)
Henderson	94	20	2	116	Complete (100%)	1	52	Complete (65%)	None (6%)
Henry	129	30	3	162	Complete (100%)			Complete (65%)	Complete (61%)
Lake	303	90	12	405	No Data	1	317	Complete (100%)	Complete (100%)
Lauderdale	789	218	25	1,032	Complete (100%)	1	70	Complete (89%)	Complete (100%)
Madison	783	196	21	1,000	Complete (100%)	5	876	Complete (65%)	Complete (86%)
McNairy	95	24	2	121	Complete (100%)	1	86	Reduced (59%)	Reduced (42%)
Obion	925	250	27	1,202	Complete (100%)	1	173	Complete (96%)	Complete (100%)
Shelby	15,933	4,271	449	20,653	Complete (97%)	30	5,323	Complete (82%)	Complete (99%)
Tipton	1,130	299	30	1,459	Complete (100%)	1	110	Complete (86%)	Complete (100%)
Weakley	702	187	20	909	Complete (100%)	2	140	Complete (65%)	Complete (99%)
Total in IC	25,256	6,753	715	32,724		57	8,386		
Total in Tennessee	25,431	6,765	715	32,911		111	29,985		

Table 110: Cases of Chronic Illnesses in the Shelter-Seeking Population of Tennessee

Impacted Counties (IC)	Cancers	Diabetes	Heart Disease	Hyper-tension	Stroke	Mental Disorders	Pulmonary Conditions
Benton	90	120	159	306	20	218	408
Carroll	240	322	426	820	55	585	1,093
Chester	141	189	250	481	32	343	641
Crockett	191	255	338	650	43	463	866
Dyer	452	606	801	1,540	103	1,099	2,054
Fayette	321	431	569	1,095	73	781	1,460
Gibson	609	817	1,080	2,076	138	1,481	2,768
Hardeman	301	404	534	1,027	68	732	1,369
Hardin	130	175	231	445	30	317	593
Haywood	285	382	505	971	65	693	1,295
Henderson	210	281	372	716	48	510	954
Henry	260	349	462	888	59	633	1,184
Lake	124	166	219	422	28	301	562
Lauderdale	371	497	658	1,265	84	902	1,686
Madison	968	1,298	1,716	3,300	220	2,354	4,400
McNairy	188	252	333	640	43	457	854
Obion	398	534	706	1,358	91	969	1,810
Shelby	11,275	15,119	19,988	38,439	2,563	27,420	51,252
Tipton	582	780	1,031	1,983	132	1,415	2,644
Weakley	447	599	792	1,523	102	1,086	2,031
Total in IC	17,583	23,578	31,170	59,943	3,996	42,759	79,924
Total in Tennessee	24,749	33,186	43,873	84,370	5,625	60,184	112,494

Mortuary Services

Approximately 1,320 people in Tennessee die as a result of the initial event. It is expected that this number will increase as a result of injuries to first responders as well as complicating factors in treating life-threatening injuries post event. Table 111 shows the number of initial fatalities by ‘impacted county’. Mortuary services will be required, such as victim identification and the establishment of temporary morgue facilities. The number of fatalities will quickly overwhelm local resources even enhanced by DMORTs.

Table 111: Fatalities in Tennessee

Impacted Counties (IC)	Fatalities
Benton	1
Carroll	6
Chester	7
Crockett	18
Dyer	88
Fayette	15
Gibson	59
Hardeman	11
Hardin	5
Haywood	19
Henderson	3
Henry	4
Lake	23
Lauderdale	47
Madison	40
McNairy	4
Obion	50
Shelby	827
Tipton	55
Weakley	37
Total in IC	1,318
Total in Tennessee	1,319

Security Needs

There are over 45,000 prisoners within Tennessee. Prison populations are illustrated as a potential indicator of security needs as well as a competitor in the allocation of scarce resources. Figure 56 and Table 112 provide the distribution and type of prisoners within the State of Tennessee.

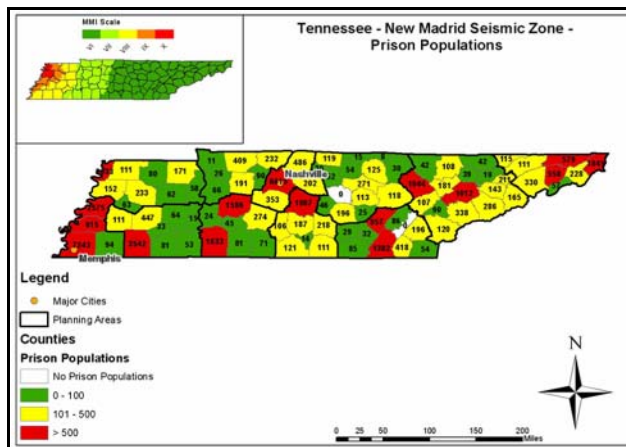


Figure 56: Distribution of Prisoners within the State of Tennessee

Impacted Counties (IC)	Local Jails	State Prisons	Federal Prisons	Total
Benton	58	-	-	58
Carroll	62	-	-	62
Chester	33	-	-	33
Crockett	63	-	-	63
Dyer	152	-	-	152
Fayette	94	-	-	94
Gibson	233	-	-	233
Hardeman	94	3,448	-	3,542
Hardin	53	-	-	53
Haywood	111	-	-	111
Henderson	64	-	-	64
Henry	171	-	-	171
Lake	46	2,287	-	2,333
Lauderdale	119	2,456	-	2,575
McNairy	81	-	-	81
Madison	447	-	-	447
Obion	111	-	-	111
Shelby	5,273	407	1,563	7,243
Tipton	615	-	-	615
Weakley	80	-	-	80
Total IC	7,960	8,598	1,563	18,121
Total Tennessee	24,415	19,182	1,563	45,160

Table 112: Types of Prisoners in the State of Tennessee

Appendix 7 – Maps for Direct Damage and Economic Loss

This appendix includes direct and induced damage as well as casualties, economic loss and scenario hazard maps of the New Madrid Seismic Zone (NMSZ) sequential fault rupture scenario employed in the analysis discussed in this report. All impact and hazard maps are presented at the state level as well as for the entire eight-state study region. All state maps include a state overview of impact for the parameter displayed. At the state-level a damage surface representation is used for most impacts. In addition, a portion of the state is highlighted in a second map which focuses on the most heavily impacted portion of each state. The impacted counties in each state are shown with either aggregated damage at the county-level or individual infrastructure items as necessary. Maps of the most impacted areas highlight the likelihood of structural damage to critical infrastructure, among other impact parameters, and the classifications included relate to damage probabilities in the HAZUS model. Only the ‘at least moderate’ damage state is illustrated in the maps provided in this appendix, thus the correlations apply to damage probabilities of the ‘at least moderate’ damage state. The correlation between map classifications and HAZUS damage probabilities is shown below:

Table 1: Damage State Correlations for Critical Infrastructure

Damage State Correlations	
Damage State of Probability	→ Relative Likelihood of Damage
0% - 5%	Highly Unlikely
5% - 15%	Unlikely
15% - 50%	Average Likelihood
50% - 90%	Highly Likely
90% - 100%	Certain

It has been noted elsewhere in this report that the State of Alabama includes a list of *socially* impacted counties since impacts in that particular state do not meet the direct damage criteria required to classify counties as ‘impacted’ as is the case with all other states. All maps for the State of Alabama highlight the ‘*socially* impacted counties’ instead of ‘impacted counties’. In addition, maps of the entire eight-state region are provided for numerous impact and hazard parameters. Only those maps denoted with (*) are provided for the entire eight-state region.

All states include the following maps, unless otherwise noted:

- Essential Facilities
 - Hospital Damage *
 - Fire Station Damage *
 - Police Station Damage *
 - Emergency Operation Center Damage
 - School Damage *

- Transportation Lifelines
 - Airport Damage *
 - Highway Bridge Damage *
 - Major River Crossing (MRC) Damage¹ *
 - Railway Bridge Damage *
 - Railway Facility Damage
 - Railway Tunnel Damage
 - Bus Facility Damage
 - Port Facility Damage
- Utility Lifelines
 - Communication Facility Damage *
 - Electric Power Facility Damage with Electric Power Outages at Day 1 **²
 - Natural Gas Facility Damage with Interstate Natural Gas Pipeline Inventory *
 - Oil Facility Damage with Interstate Oil Pipeline Inventory *
 - Waste Water Facility Damage with Local Distribution Pipeline Damage *³
 - Potable Water Facility Damage with Local Distribution Pipeline Damage *⁴
 - Potable Water Outages at Day 1 *
- Other Critical Infrastructure
 - Dam Damage *
 - Levee Damage *
 - Hazardous Materials Facility Damage *
- Other Impact Parameters and Miscellaneous Maps
 - Total Casualties at 2:00AM *
 - Total Building Damage *
 - Building Asset Value Loss Ratio
 - Total Debris Generated *
 - Peak Ground Acceleration (PGA) *
 - Modified Mercalli Intensity (MMI) *
 - Liquefaction Susceptibility *

It is also noted that all maps in this appendix are based on HAZUS analysis and do not include data or impact assessment results from any other modeling methods, software, or procedures discussed elsewhere in this report such as network models, uncertainty characterization, or social impacts.

¹ There are no major river crossings in the State of Alabama and thus no map is included for this impact parameter.

² Facility damage and service outages are provided on individual maps.

³ Local distribution pipelines are not included.

⁴ Local distribution pipelines are not included.

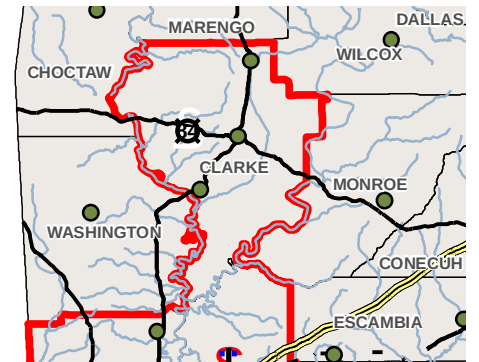
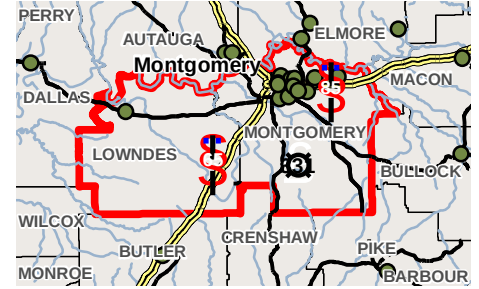
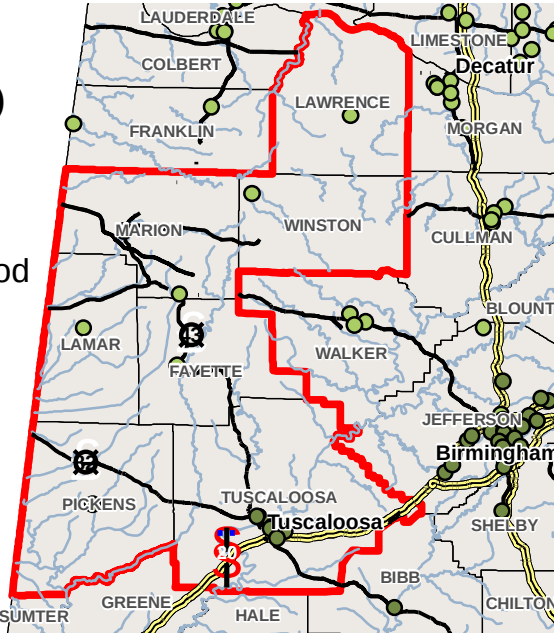
Alabama Hospitals Damage

New Madrid Seismic Zone: M7.7 Event

Hospitals Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



Legend

Socially Impacted Counties

Hospitals Damage (Surface)

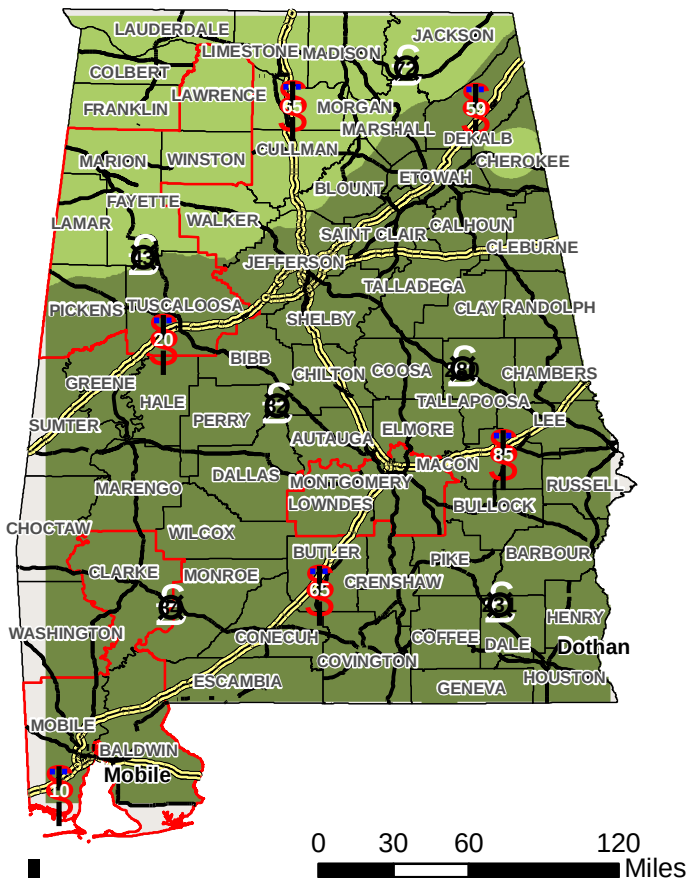
- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain
- No Inventory

Major Cities by Population

- " 52,000- 80,000
- " 80,001 - 196,000
- " 196,001 - 265,000

Roads

- US Routes
- Interstates



0 30 60 120 Miles



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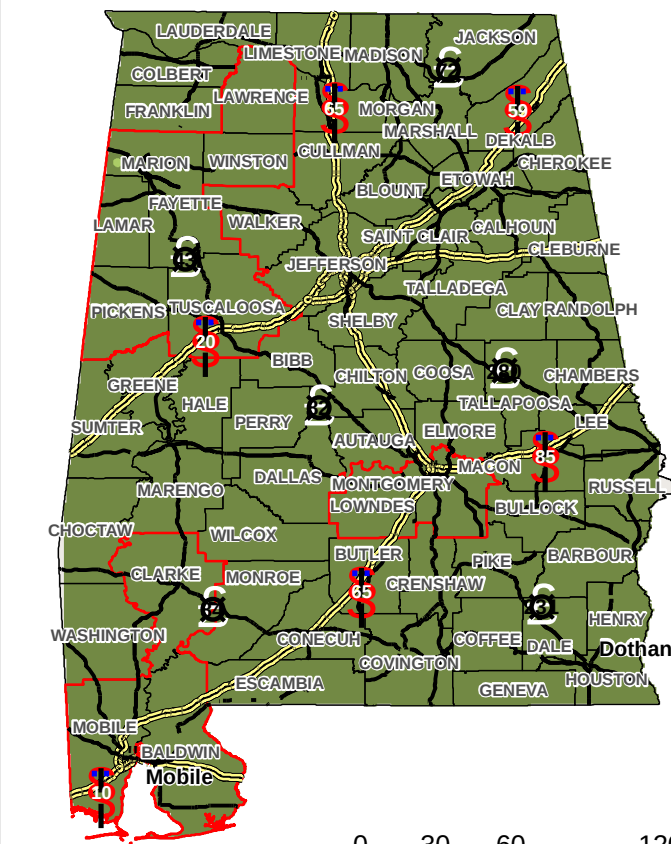
Alabama Fire Station Damage

New Madrid Seismic Zone: M7.7 Event

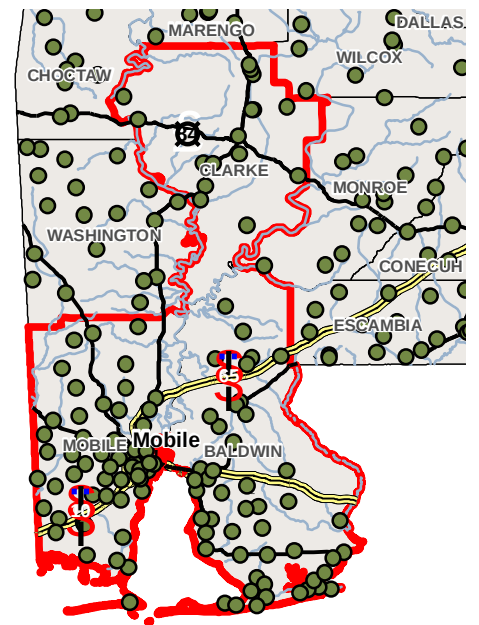
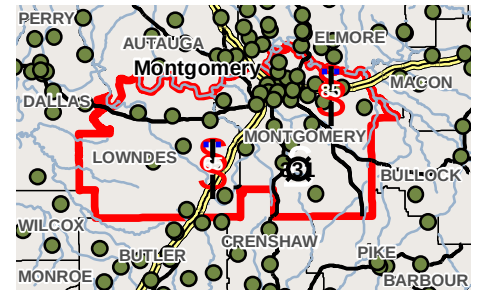
Fire Station Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



0 30 60 120 Miles



Legend

Socially Impacted Counties

Fire Station Damage (Surface)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain
- No Inventory

Major Cities by Population

- " 52,000- 80,000
- " 80,001 - 196,000
- " 196,001 - 265,000

Roads

- US Routes
- Interstates



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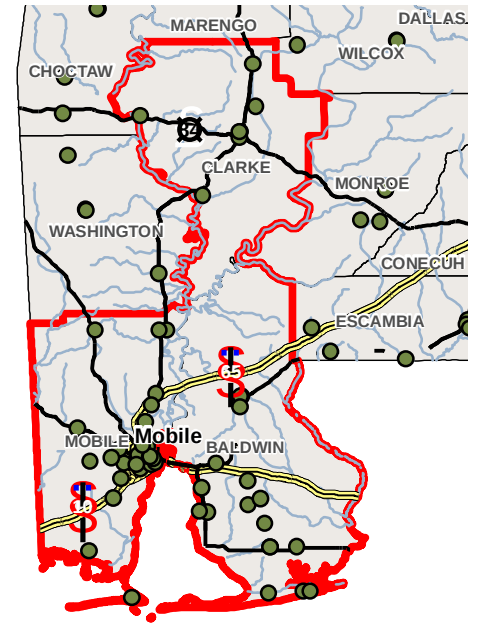
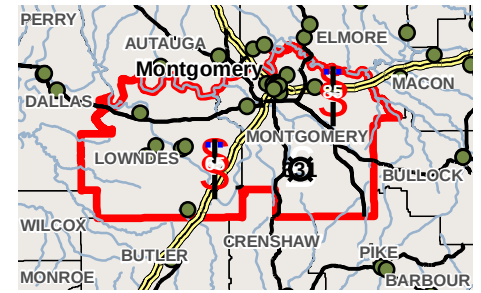
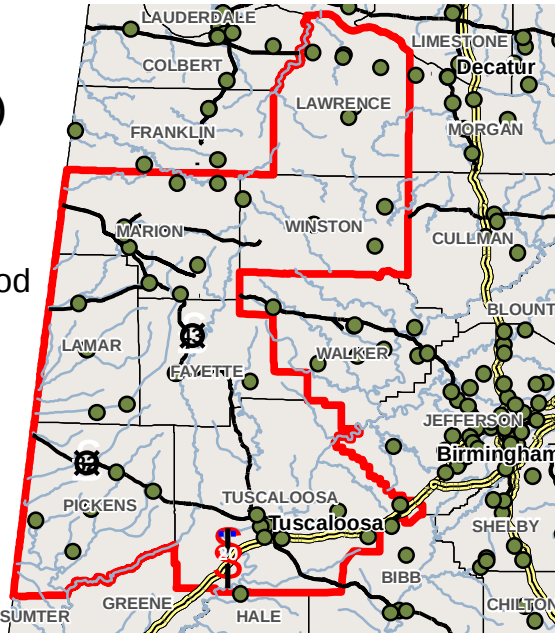
Alabama Police Station Damage

New Madrid Seismic Zone: M7.7 Event

Police Station Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



Legend

Socially Impacted Counties

Police Station Damage (Surface)

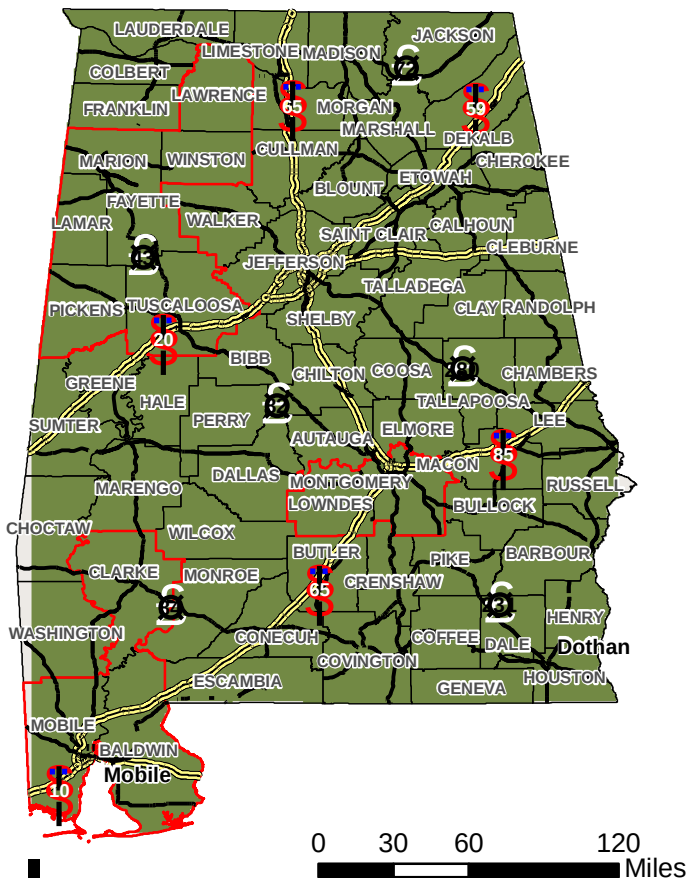
- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain
- No Inventory

Major Cities by Population

- " 52,000- 80,000
- " 80,001 - 196,000
- " 196,001 - 265,000

Roads

- US Routes
- Interstates



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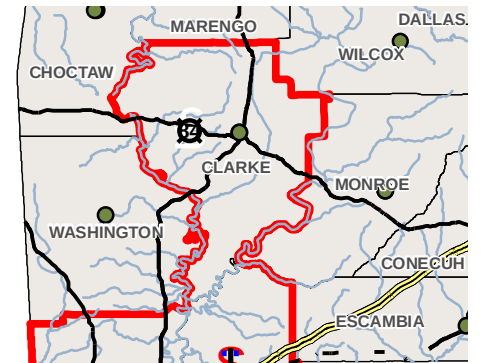
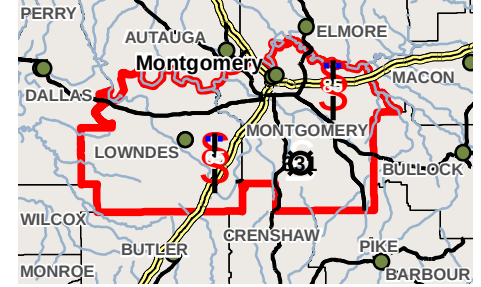
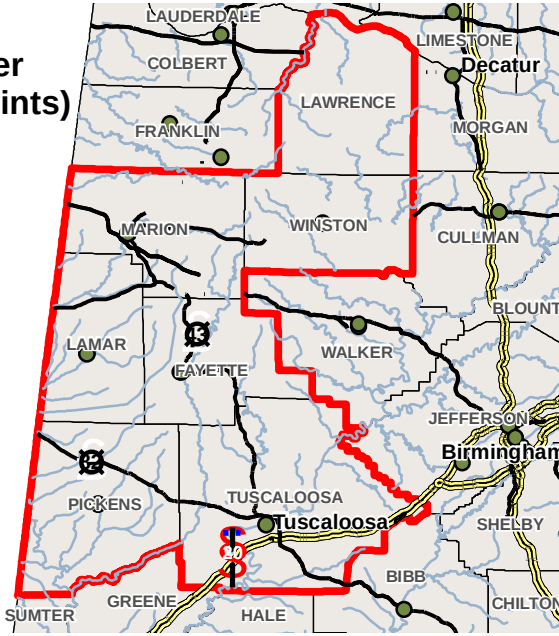
Alabama Emergency Operation Center Damage

New Madrid Seismic Zone: M7.7 Event

Emergency Operation Center Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



Legend

Socially Impacted Counties

Emergency Operation Center Damage (Surface)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain
- No Inventory

Major Cities by Population

" 52,000- 80,000

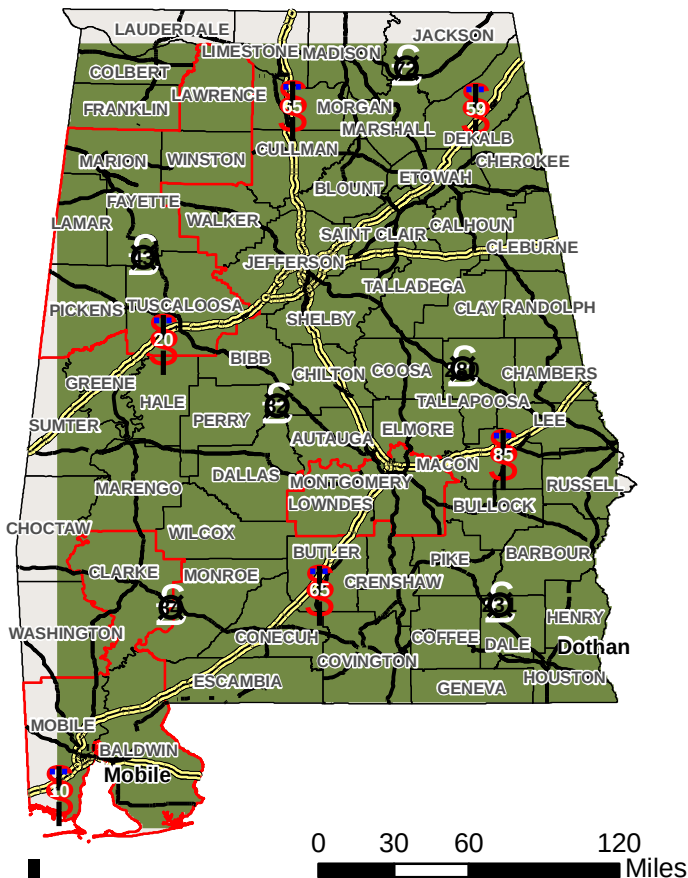
" 80,001 - 196,000

" 196,001 - 265,000

Roads

— US Routes

— Interstates



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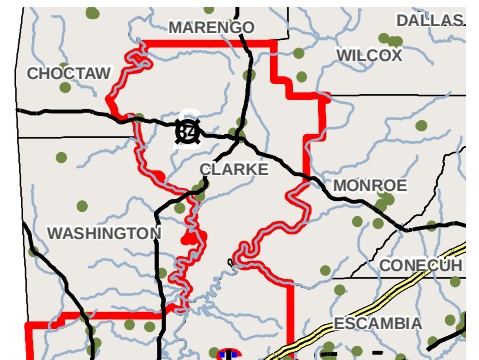
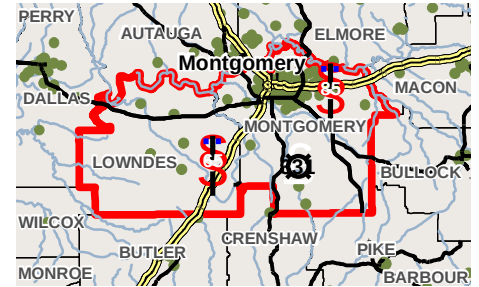
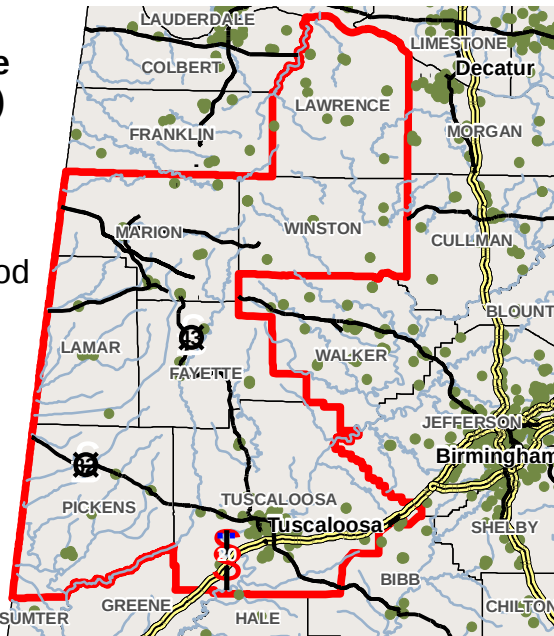


Alabama School Facility Damage New Madrid Seismic Zone: M7.7 Event

School Facility Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



Legend

Socially Impacted Counties

School Facility Damage (Surface)

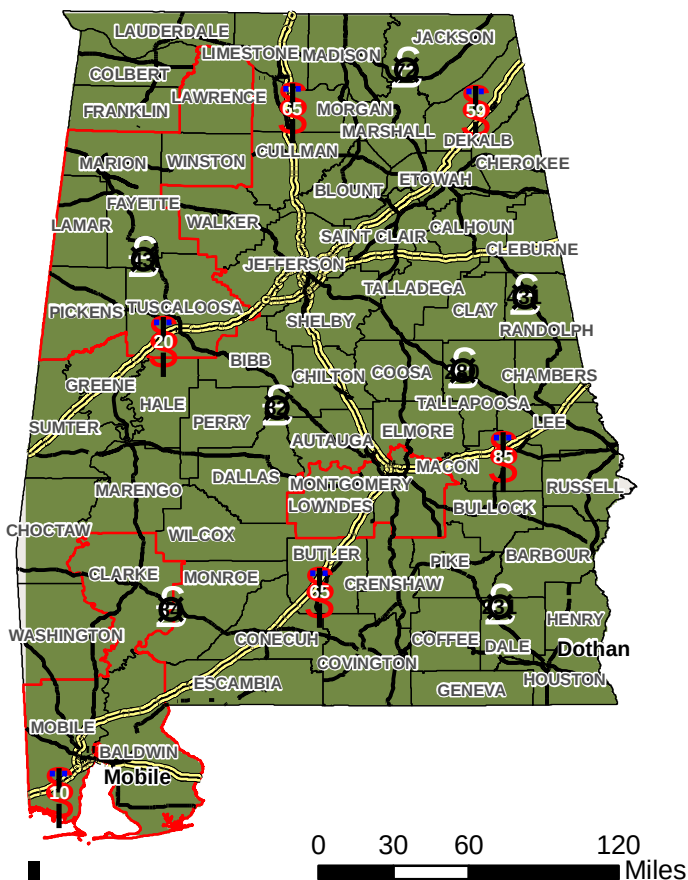
- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain
- No Inventory

Major Cities by Population

- " 52,000- 80,000
- " 80,001 - 196,000
- " 196,001 - 265,000

Roads

- US Routes
- Interstates



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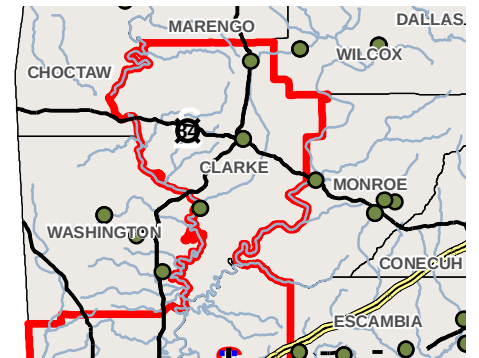
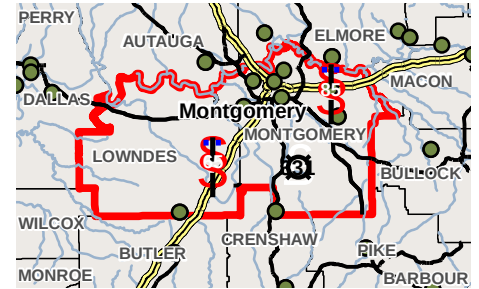
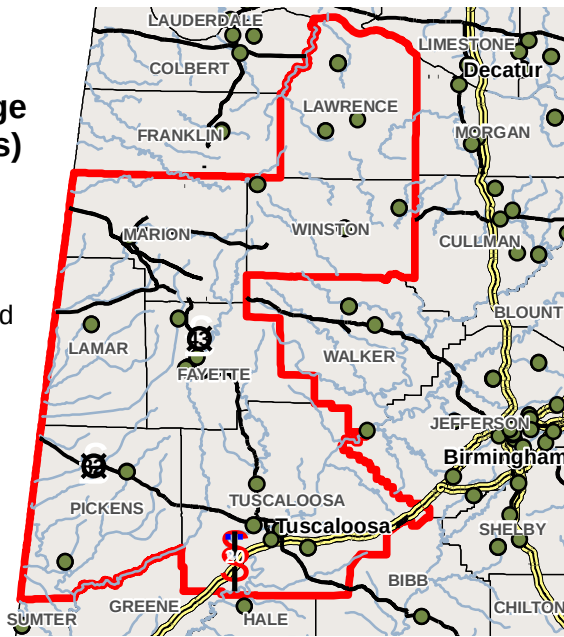
Alabama Airport Facility Damage

New Madrid Seismic Zone: M7.7 Event

Airport Facility Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



Legend

Socially Impacted Counties

Airport Facility Damage (Surface)

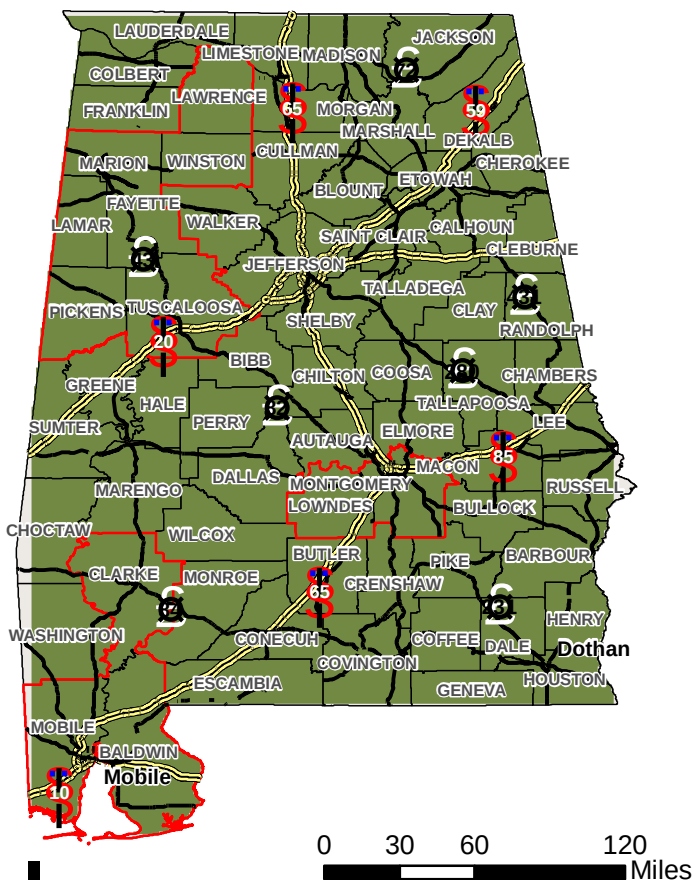
- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

Major Cities by Population

- " 52,000- 80,000
- " 80,001 - 196,000
- " 196,001 - 265,000

Roads

- US Routes
- Interstates



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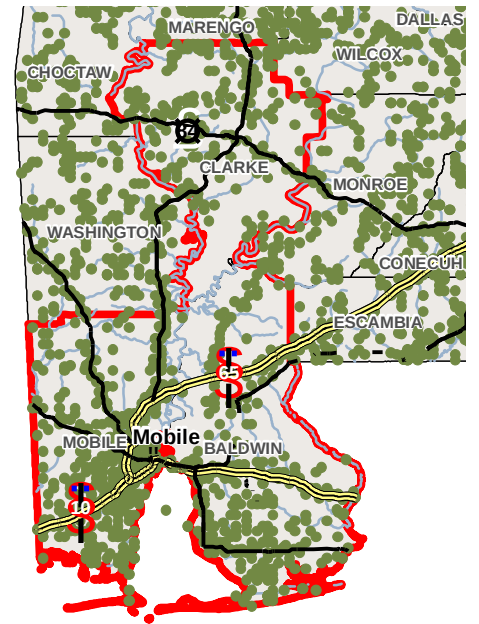
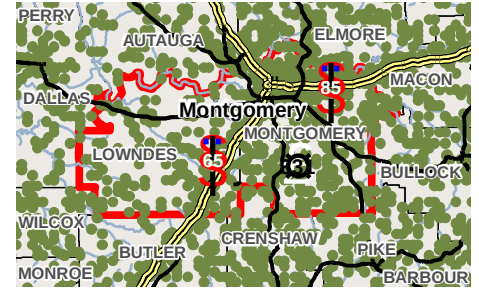
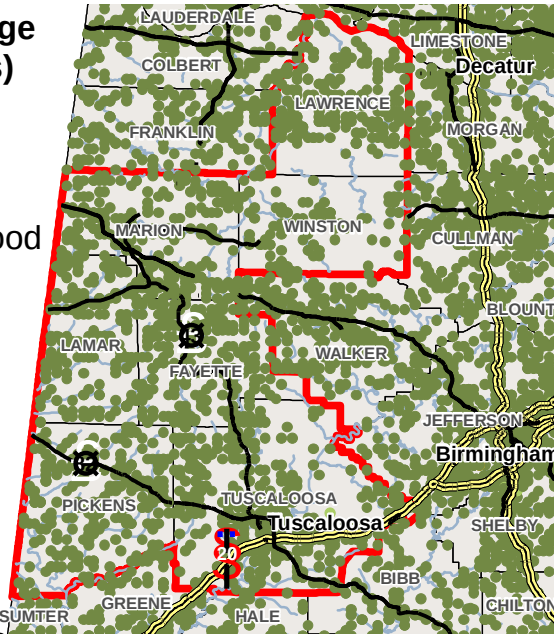


Alabama Highway Bridge Damage New Madrid Seismic Zone: M7.7 Event

Highway Bridge Damage of Critical Area (Points)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

0 20 40 80 Miles



Legend

Socially Impacted Counties

Highway Bridge Damage (Surface)

- Highly Unlikely
- Unlikely
- Moderate Likelihood
- Likely
- Certain

Major Cities by Population

- | | | |
|---|-------------------|--|
| " | 52,000- 80,000 | Roads |
| " | 80,001 - 196,000 | US Routes |
| " | 196,001 - 265,000 | Interstates |

0 30 60 120 Miles

