SECTION 5
HAZARD PROFILES

This section includes detailed hazard profiles for each of the hazards identified in the previous section (*Hazard Identification*) as significant enough for further evaluation in the MEMA District 6 Regional Hazard Mitigation Plan. It contains the following subsections:

44 CFR Requirement
44 CFR Part 201.6(c)(2)(i): The risk assessment shall include a description of the type, location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events

5.1 OVERVIEW

This section includes detailed hazard profiles for each of the hazards identified in the previous section (*Hazard Identification*) as significant enough for further evaluation in the MEMA District 6 Region hazard risk assessment by creating a hazard profile. Each hazard profile includes a general description of the hazard including its location, extent (or severity), historical occurrences, probability of future occurrences. Each profile also includes specific items noted by members of the MEMA District 6 Regional Hazard Mitigation Council (RHMC) as it relates to unique historical or anecdotal hazard information for the counties in the MEMA District 6 Region or a participating municipality within them.

The following hazards were identified:

- **Flood-related Hazards**
  - Flood
  - Erosion
  - Dam and Levee Failure

- Winter Storm and Freeze
- **Fire-related Hazards**
  - Drought / Heat Wave
  - Wildfire
- **Geologic Hazards**
  - Earthquake
  - Landslide
  - Land Subsidence
- **Wind-related Hazards**
  - Hurricane and Tropical Storm
  - Thunderstorm (including wind, hail, and lightning)
  - Tornado
- **Other Hazards**
  - Hazardous Materials Incident
  - Pandemic

5.2 STUDY AREA

The MEMA District 6 Region includes 9 counties and 30 incorporated jurisdictions. **Table 5.1** provides a summary table of the participating jurisdictions within each county. In addition, **Figure 5.1** provides a base map, for reference, of the MEMA District 6 Region.

Table 5.1: PARTICIPATING JURISDICTIONS IN THE MEMA DISTRICT 6 REGIONAL HAZARD MITIGATION PLAN

Clarke County	
Enterprise	Shubuta
Pachuta	Stonewall
Quitman	
Jasper County	
Bay Springs	Louin
Heidelberg	Montrose
Kemper County	
De Kalb	Scooba
Lauderdale County	
Marion	Meridian
Leake County	
Carthage	Walnut Grove
Lena	

Neshoba County	
Philadelphia	
Newton County	
Chunky	Newton
Decatur	Union
Scott County	
Forest	Morton
Lake	Sebastopol
Smith County	
Mize	Sylvarena
Polkville	Taylorsville
Raleigh	

Figure 5.1: MEMA DISTRICT 6 BASE MAP

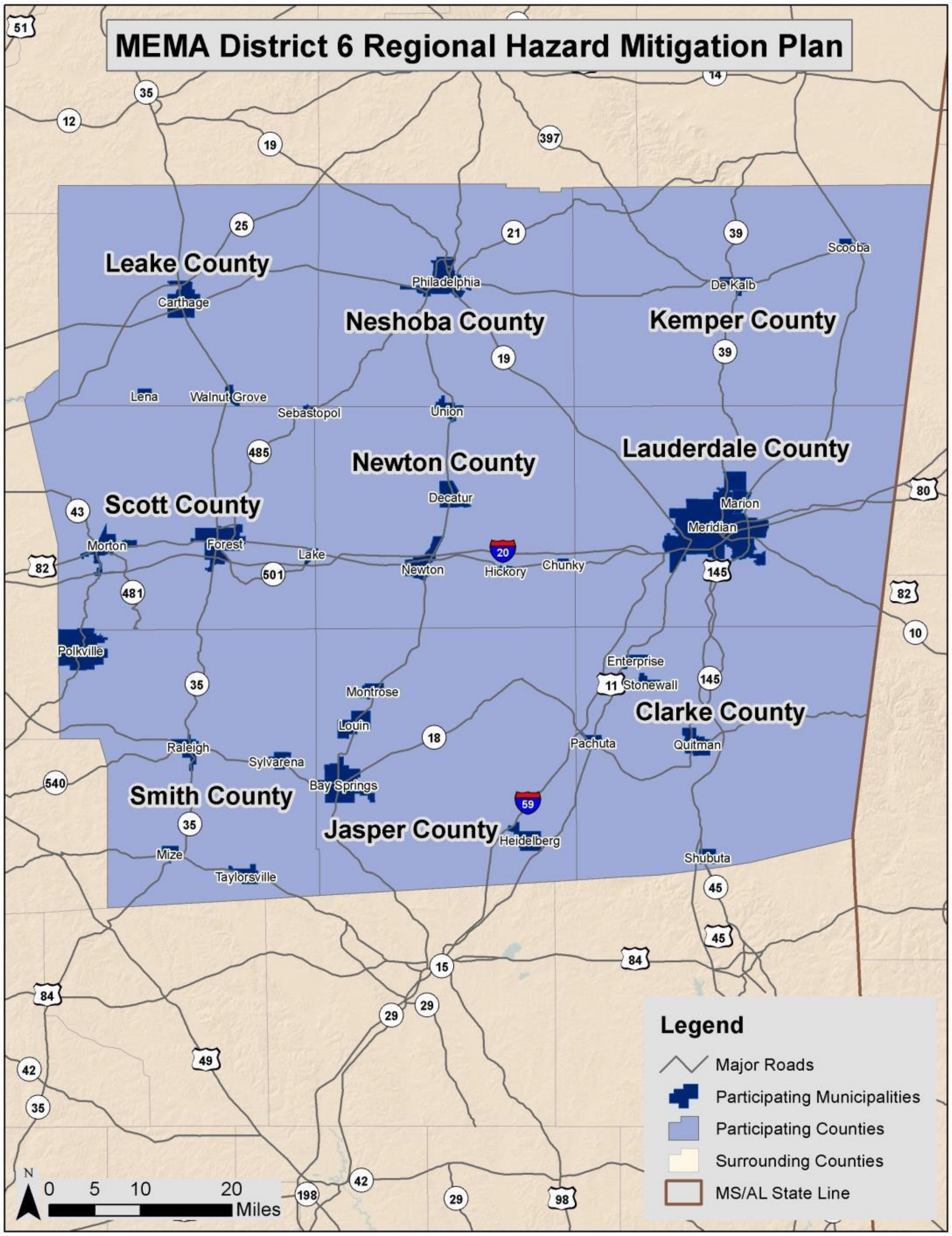


Table 5.2 lists each significant hazard for the MEMA District 6 Region and identifies whether or not it has been determined to be a specific hazard of concern for the municipal jurisdictions and the unincorporated areas of the counties. This is the based on the best available data and information from the MEMA District 6 Regional Hazard Mitigation Council. (● = hazard of concern)

Table 5.2: SUMMARY OF IDENTIFIED HAZARD EVENTS IN THE MEMA DISTRICT 6 REGION

Jurisdiction	Flood-related				Fire-related		Geologic			Wind-related			Other	
	Flood	Erosion	Dam / Levee	Winter Storm /	Drought / Heat Wave	Wildfire	Earthquake	Landslide	Land	Hurricane	Thunderstorm	Tornado	HAZMAT	Pandemic
Clarke County														
Enterprise	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Quitman	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Pachuta	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Shubuta	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Stonewall	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Jasper County														
Bay Springs	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Heidelberg	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Louin	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Montrose	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Kemper County														
De Kalb	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Scooba	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lauderdale County														
Marion	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Meridian	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Leake County														
Carthage	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lena	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Walnut Grove	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Neshoba County														
Philadelphia	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Newton County														
Chunky	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Decatur	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Hickory	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Newton (city)	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Union	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Scott County														
Forest	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Morton	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lake	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sebastopol	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Jurisdiction	Flood-related				Fire-related		Geologic			Wind-related			Other	
	Flood	Erosion	Dam / Levee	Winter Storm /	Drought / Heat Wave	Wildfire	Earthquake	Landslide	Land	Hurricane	Thunderstorm	Tornado	HAZMAT	Pandemic
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Smith County														
Mize	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Polkville	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Raleigh	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sylvarena	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Taylorsville	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Unincorporated Area	•	•	•	•	•	•	•	•	•	•	•	•	•	•

FLOOD-RELATED HAZARDS

5.3 FLOOD

5.3.1 Background

Flooding is the most frequent and costly natural hazard in the United States and is a hazard that has caused more than 10,000 deaths since 1900. Nearly 90 percent of presidential disaster declarations result from natural events where flooding was a major component.

Floods generally result from excessive precipitation and can be classified under two categories: general floods, precipitation over a given river basin for a long period of time along with storm-induced wave action, and flash floods, the product of heavy localized precipitation in a short time period over a given location. The severity of a flooding event is typically determined by a combination of several major factors, including stream and river basin topography and physiography, precipitation and weather patterns, recent soil moisture conditions, and the degree of vegetative clearing and impervious surface.

General floods are usually long-term events that may last for several days. The primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, and other large coastal storms. Urban flooding occurs where manmade development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.

Flash flooding is another type of flooding that can be associated with urban flooding. It is common in urbanized areas where much of the ground is covered by impervious surfaces. Most flash flooding occurs along mountain streams and is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms. However, flash-flooding events may also occur from a dam or levee failure within minutes or hours of heavy amounts of rainfall, or from a sudden release of water held by retention basin or other stormwater control facility.

The periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as floodplain) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 100-year flood and the 100-year floodplain by the 1,000-year flood. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in a given year, which is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1- percent annual chance of occurring in any given year, and the 500-year flood has a 0.2-percent annual chance of occurring in any given year.

5.3.2 Location and Spatial Extent

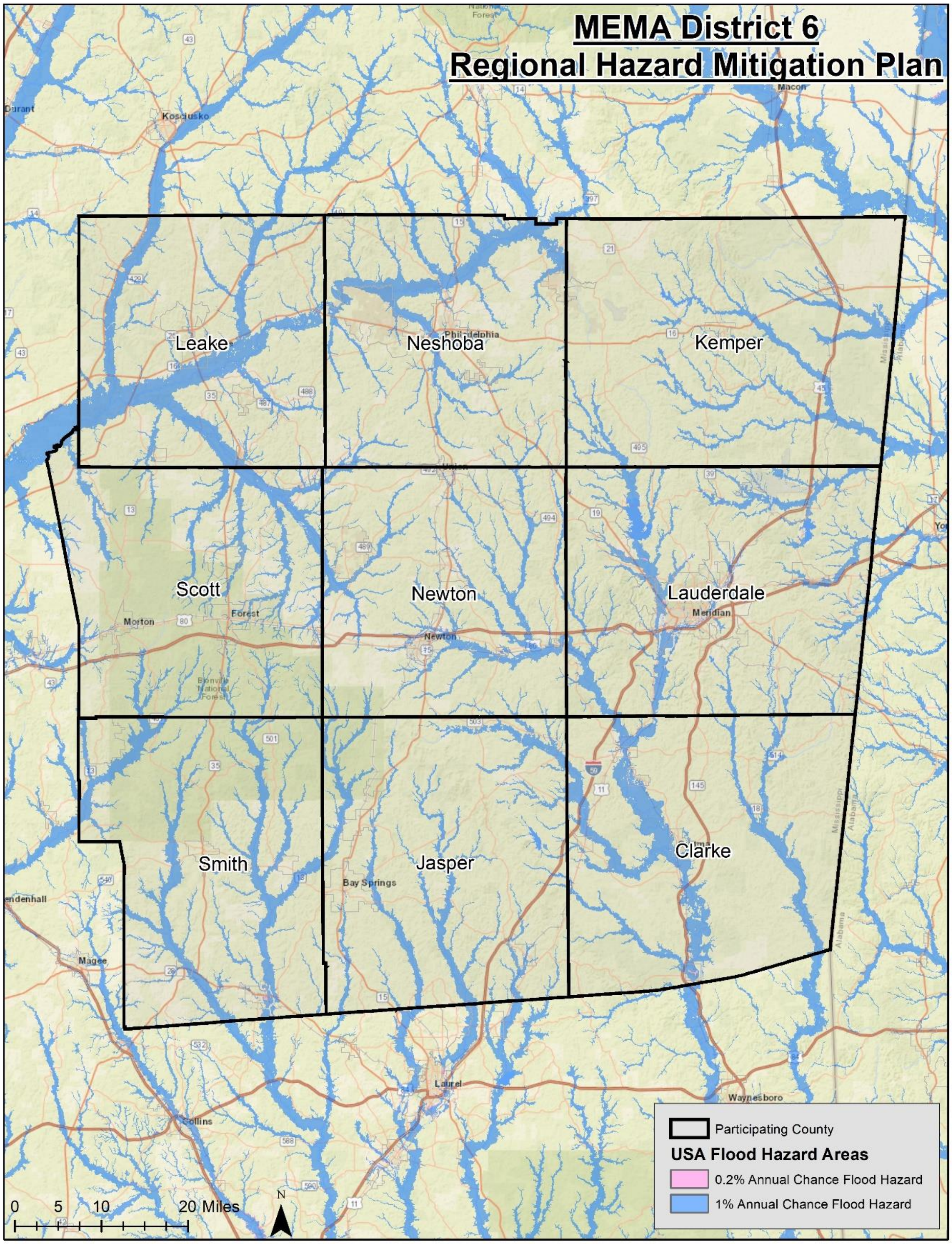
There are areas in the MEMA District 6 Region that are susceptible to flood events. Special flood hazard areas in the Region were mapped using Geographic Information System (GIS) and FEMA Digital Flood Insurance Rate Maps (DFIRM). This includes Zone A (1-percent annual chance floodplain), Zone AE (1-percent annual chance floodplain with elevations), and Zone X500 (0.2-percent annual chance floodplain). According to GIS analysis, of the 5,842 square miles that make up the MEMA District 6 Region, there are approximately 917.2 square miles of land in zones A and AE (1-percent annual chance floodplain/100-year floodplain) and 3.2 square miles of land in zone X500 (0.2-percent annual chance floodplain/500-year floodplain). The county totals are presented below in **Table 5.3**.

Table 5.3: SUMMARY OF FLOODPLAIN AREAS IN THE MEMA DISTRICT 6 REGION

Location (DFIRM date)	100-year area (square miles)	500-year area (square miles)
Clarke County (2011)	113.2	0.3
Jasper County (2011)	96.9	0.0
Kemper County (2007)	69.6	0.1
Lauderdale County (2013)	114.3	1.8
Leake County (2011)	125.5	0.0
Neshoba County (2010)	99.8	0.2
Newton County (2011)	95.3	0.3
Scott County (2010)	92.6	0.0
Smith County (2021)	110.0	0.5
MEMA DISTRICT 6 REGION TOTAL	**917.2**	**3.2**

These flood zone values account for approximately 15.8 percent of the total land area in the MEMA District 6 Region. It is important to note that while FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood-related losses often do occur outside of delineated special flood hazard areas. **Figure 5.2** illustrates the location and extent of currently mapped special flood hazard areas for the Region based on best available FEMA Digital Flood Insurance Rate Map (DFIRM) data.

Figure 5.2: SPECIAL FLOOD HAZARD AREAS IN MEMA DISTRICT 6 REGION[1]



Source: Federal Emergency Management Agency

[1] Additional, more detailed county-level and jurisdiction-level maps can be found in the annexes.

Flood extent can be measured by the amount of land and property in the floodplain as well as flood height and velocity. The amount of land in the floodplain accounts for 15.8 percent of the total land area in the MEMA District 6 Region.

Flood depth and velocity are recorded via United States Geological Survey stream gages throughout the region. While a gage does not exist for each participating jurisdiction, there is one at or near many areas. The greatest peak discharge recorded for the region was near Lena in Leake County in 1979. Water reached a discharge of 122,000 cubic feet per second and the stream gage height was recorded at 32.2 feet. Additional peak discharge readings and gage heights are in the table below.

County	Location/Jurisdiction	Date	Peak Discharge (cfs)	Gage Height (ft)
Clarke County	Chickasawhay River at Enterprise	02/23/1961	61,700	37.94
	Chickasawhay River near Quitman	April 1900	66,000	50.91
	Souinlovie Creek near Pachuta	April 1900	27,000	59.00
	Chickasawhay River at Shubuta	April 1900	90,000	47.90
Jasper County	Tallahala Creek at Waldrup	02/06/2004	18,900	23.17
Kemper County	Hamilton Branch near DeKalb	04/13/1974	662	7.58
	Flat Scooba Creek Tributary near Scooba	04/12/1979	427	8.87
Lauderdale County	Okatibbee Creek near Meridian	02/22/1961	27,000	26.14
Leake County	Pearl River near Carthage	04/14/1979	102,000	28.74
	Pearl River near Lena	04/17/1979	122,000	32.20
	Tuscolameta Creek at Walnut Grove	04/08/2003	45,800	32.08
	Town Creek near Verona	03/21/1955	70,000	29.40
Neshoba County	Pearl River at Burnside (unincorporated area)	04/13/1979	76,600	23.60
Newton County	Potterchitto Creek at Newton	04/07/2003	8,520	18.64
Scott County	Strong River near Morton	12/24/1974	5,600	22.00
Smith County	Oakohay Creek at Mize	04/13/1974	28,900	17.26
	Leaf River near Raleigh	04/13/1974	17,000	28.17
	Leaf River near Taylorsville	04/14/1974	37,600	57.44

5.3.3 Historical Occurrences

Floods were at least partially responsible for 18 disaster declarations in the MEMA District 6 Region between 1973 and 2021.[2] Information from the National Centers for Environmental Information was used to ascertain additional historical flood events. The National Centers for Environmental Information reported a total of 345 events throughout the MEMA District 6 Region since 1997. A summary of these

[2] Not all of the participating counties were declared disaster areas for these storms.

events is presented in **Table 5.4**. These events accounted for $165.2 million in property damage and 1 fatality throughout the region. Specific information on flood events for each county, including date, type of flooding, and deaths and injuries, can be found in the county-specific annexes. Annualized, flooding accounts for roughly $6.9 million dollars in losses to the MEMA District 6 Region.

Table 5.4: SUMMARY OF FLOOD OCCURRENCES IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	34	0/0	$4,668,000
Jasper County	33	0/0	$4,007,000
Kemper County	14	0/0	$1,590,000
Lauderdale County	73	0/0	$55,579,000
Leake County	28	0/0	$10,980,000
Neshoba County	39	0/0	$2,160,000
Newton County	43	0/0	$32,296,000
Scott County	48	1/0	$53,310,000
Smith County	33	0/0	$627,000
MEMA DISTRICT 6 REGIONAL TOTAL	345	1/0	$165,217,000

Source: National Centers for Environmental Information – retrieved April 2021

5.3.4 Historical Summary of Insured Flood Losses

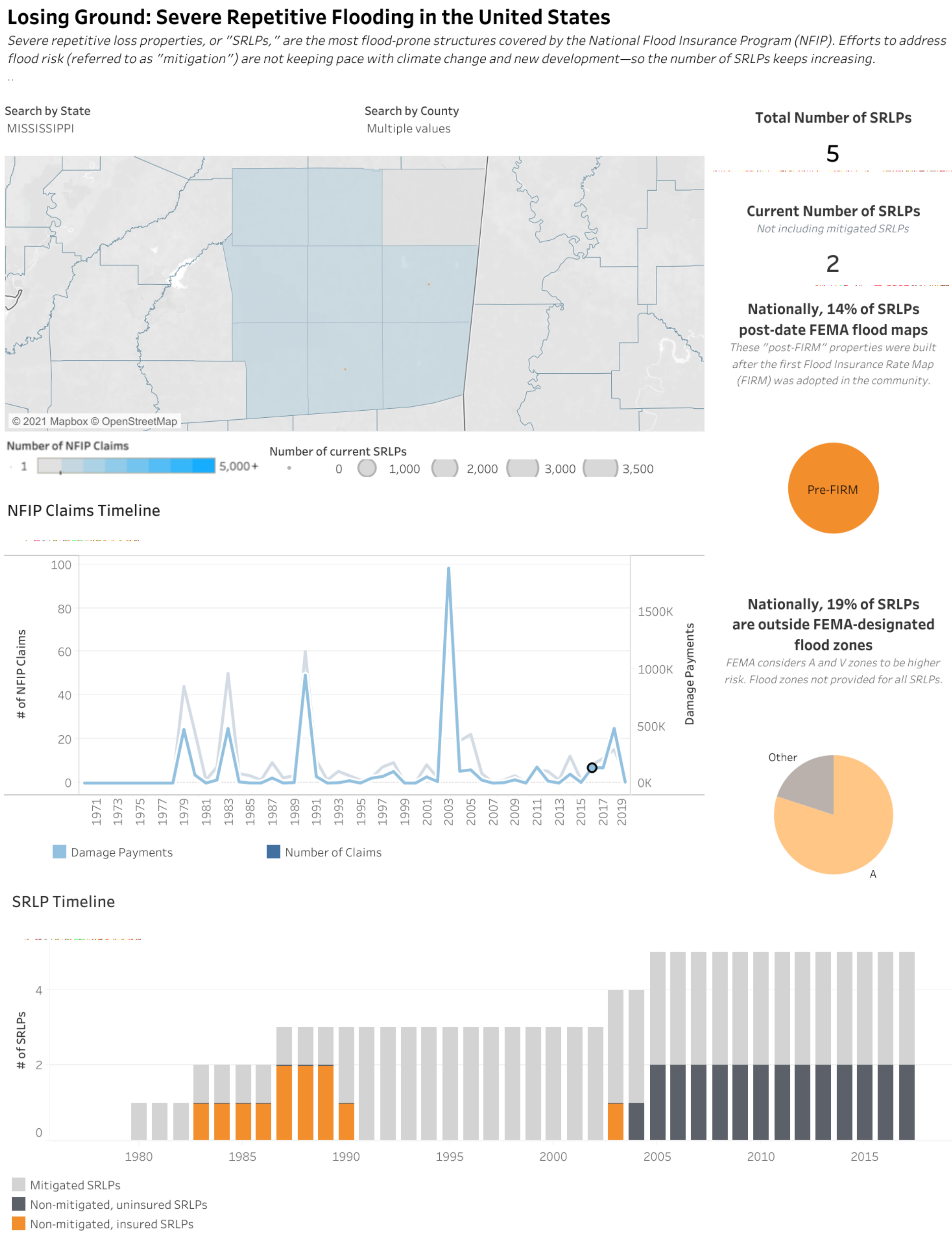
According to FEMA flood insurance policy records as of September 2019, there have been 464 flood losses reported in the MEMA District 6 Region through the National Flood Insurance Program (NFIP) since 1978, totaling over $5.53 million in claims payments. A summary of these figures for each MEMA District 6 county is provided in **Table 5.5**. It should be emphasized that these numbers include only those losses to structures that were insured through the NFIP policies, and for losses in which claims were sought and received. It is likely that many additional instances of flood loss in the MEMA District 6 Region were either uninsured, denied claims payment, or not reported.

Table 5.5: SUMMARY OF INSURED FLOOD LOSSES IN MEMA DISTRICT 6 REGION

Location	Flood Losses	Claims Payments
Clarke County	78	$1,218,834
Jasper County	13	$112,372
Kemper County*	0	$0
Lauderdale County	263	$3,201,731
Leake County	48	$388,303
Neshoba County	8	$48,062
Newton County	12	$125,229
Scott County	31	$364,905
Smith County	11	$74,475
MEMA DISTRICT 6 REGION TOTAL	464	$5,533,911

*These communities do not participate in the National Flood Insurance Program. Therefore, no values are reported.
Source: Federal Emergency Management Agency, National Flood Insurance Program, NFIP Data as of September 30, 2019 received from the Natural Resources Defense Council. NRDC received this data from FEMA via FOIA.

Figure 5.3: Overview of Severe Repetitive Loss Properties in the MEMA District 6 Region



Source: https://www.nrdc.org/resources/losing-ground-flood-visualization-tool

5.3.5 Repetitive Loss Properties

FEMA defines a repetitive loss property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Currently there are over 140,000 repetitive loss properties nationwide.

FEMA also has a higher designated rating known as Severe Repetitive Loss (SRL) which is any NFIP-insured single -family or multi-family residential building that has incurred flood-related damage for which four or more separate claims have been made, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or for which at least two separate claims payments (building payments only) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the building.

According to the Mississippi Emergency Management Agency, there are 40 non-mitigated repetitive loss properties located in the MEMA District 6 Region, which accounted for 101 losses and almost $2.2 million in claims payments under the NFIP. The average claim amount for these properties is $21,494. Of the 40 properties, 29 are single family and 11 are non-residential. Without mitigation, these properties will likely continue to experience flood losses. **Table 5.6** presents a summary of these figures for the MEMA District 6 Region. Detailed information on repetitive loss properties and NFIP claims and policies can be found in the county-specific annexes.

Table 5.6: SUMMARY OF REPETITIVE LOSS PROPERTIES IN THE MEMA DISTRICT 6 REGION

Location	Number of Properties	Number of Losses	Total Payments
Clarke County	**4**	**9**	**$232,608**
Enterprise	2	5	$221,482
Pachuta	0	0	$0
Quitman	0	0	$0
Shubuta	0	0	$0
Stonewall	0	0	$0
Unincorporated Area	2	4	$11,125
Jasper County	**1**	**3**	**$58,475**
Bay Springs	0	0	$0
Heidelberg	1	3	$58,475
Louin*	--	--	--
Montrose*	--	--	--
Unincorporated Area	0	0	$0
Kemper County	**0**	**0**	**$0**
De Kalb	0	0	$0
Scooba	0	0	$0
Unincorporated Area	0	0	$0
Lauderdale County	**27**	**73**	**$1,732,349**
Marion	0	0	$0

Meridian	10	34	$782,844
Unincorporated Area	17	39	$949,504
Leake County	**4**	**8**	**$56,800**
Carthage	3	6	$46,028
Lena*	--	--	--
Walnut Grove	0	0	$0
Unincorporated Area	1	2	$10,772
Neshoba County	**0**	**0**	**$0**
Philadelphia	0	0	$0
Unincorporated Area	0	0	$0
Newton County	**1**	**2**	**$24,850**
Chunky	0	0	$0
Decatur*	--	--	--
Hickory*	--	--	--
Newton (city)	1	2	$24,850
Union	0	0	$0
Unincorporated Area	0	0	$0
Scott County	**3**	**6**	**$65,840**
Forest	2	4	$62,767
Lake	0	0	$0
Morton	1	2	$3,072
Sebastopol	0	0	$0
Unincorporated Area	0	0	$0
Smith County	**0**	**0**	**$0**
Mize	0	0	$0
Polkville*	--	--	--
Raleigh	0	0	$0
Sylvarena*	--	--	--
Taylorsville	0	0	$0
Unincorporated Area	0	0	$0
MEMA DISTRICT 6 REGIONAL TOTAL	**40**	**101**	**$2,170,921**

* These communities do not participate in the National Flood Insurance Program. Therefore, no values are reported.
Source: Federal Emergency Management Agency, National Flood Insurance Program. Updated information for Repetitive Loss Properties was not available and it current as of 2015.

5.3.6 Probability of Future Occurrences

Flood events will remain a threat in the MEMA District 6 Region, and the probability of future occurrences will remain likely (between 10 and 100 percent annual probability). The probability of future flood events based on magnitude and according to best available data is illustrated in the figures above**,** which indicates those areas susceptible to the 1-percent annual chance flood (100-year floodplain) and the 0.2-percent annual chance flood (500-year floodplain).

It can be inferred from the floodplain location maps, previous occurrences, and repetitive loss properties that risk varies throughout the region. For example, the northwestern corner of the region has more floodplain and thus a higher risk of flood than the northeastern corner of the region. Flood is not the greatest hazard of concern but will continue to occur and cause damage. Therefore, mitigation actions may be warranted, particularly for repetitive loss properties.

5.4 EROSION

5.4.1 Background

Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year.

There are two types of soil erosion: wind erosion and water erosion. Wind erosion can cause significant soil loss. Winds blowing across sparsely vegetated or disturbed land can pick up soil particles and carry them through the air, thus displacing them. Water erosion, the hazard of topic here, can occur over land or in streams and channels. Water erosion that takes place over land may result from raindrops, shallow sheets of water flowing off the land, or shallow surface flow, which becomes concentrated in low spots. Stream channel erosion may occur as the volume and velocity of water flow increases enough to cause movement of the streambed and bank soils. Major storms, such hurricanes in coastal areas, may cause significant erosion by combining high winds with heavy surf and storm surge to significantly impact the shoreline.

An area's potential for erosion is determined by four factors: soil characteristics, vegetative cover, topography climate or rainfall, and topography. Soils composed of a large percentage of silt and fine sand are most susceptible to erosion. As the clay and organic content of these soils increases, the potential for erosion decreases. Well-drained and well-graded gravels and gravel-sand mixtures are the least likely to erode. Coarse gravel soils are highly permeable and have a good capacity for absorption, which can prevent or delay the amount of surface runoff. Vegetative cover can be very helpful in controlling erosion by shielding the soil surface from falling rain, absorbing water from the soil, and slowing the velocity of runoff. Runoff is also affected by the topography of the area including size, shape, and slope. The greater the slope length and gradient, the more potential an area has for erosion. Climate can affect the amount of runoff, especially the frequency, intensity, and duration of rainfall and storms. When rainstorms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature and rainfall amounts define the period of highest erosion risk of the year.

During the past 20 years, the importance of erosion control has gained the increased attention of the public. Implementation of erosion control measures consistent with sound agricultural and construction operations is needed to minimize the adverse effects associated with harmful chemicals run-off due to wind or water events. The increase in government regulatory programs and public concern has resulted in a wide range of erosion control products, techniques, and analytical methodologies in the United States. The preferred method of erosion control in recent years has been the restoration of vegetation.

5.4.2 Location and Spatial Extent

Erosion in the MEMA District 6 Region is typically caused by flash flooding events. Unlike coastal areas, areas of concern for erosion in the MEMA District 6 Region are primarily rivers and streams. Generally, vegetation also helps to prevent erosion in the area, and it is not an extreme threat to any of the participating counties and jurisdictions.

At this time, there is no data available on localized areas of erosion so it is not possible to depict extent on a map. No areas of concern were reported by the hazard mitigation council.

5.4.3 Historical Occurrences

Several sources were vetted to identify areas of erosion in the MEMA District 6 Region. This includes searching local newspapers, interviewing local officials, and reviewing previous hazard mitigation plans. No historical erosion occurrences were found in these sources.

5.4.4 Probability of Future Occurrences

Erosion remains a natural, dynamic, and continuous process for the MEMA District 6 Region, and it will continue to occur. The annual probability level assigned for erosion is possible (between 1 and 10 percent annually). However, given the lack of historical events, location, and threat to life or property, no further analysis will be done in Section 6: *Vulnerability Assessment*.

5.5 DAM AND LEVEE FAILURE

5.5.1 Background

Worldwide interest in dam and levee safety has risen significantly in recent years. Aging infrastructure, new hydrologic information, and population growth in floodplain areas downstream from dams and near levees have resulted in an increased emphasis on safety, operation, and maintenance.

There are approximately 91,000 dams in the United States today, the majority of which are privately owned. Other owners include state and local authorities, public utilities, and federal agencies. The benefits of dams are numerous: they provide water for drinking, navigation, and agricultural irrigation. Dams also provide hydroelectric power, create lakes for fishing and recreation, and save lives by preventing or reducing floods.

Though dams have many benefits, they also can pose a risk to communities if not designed, operated, and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and extensive property damage if development exists downstream. If a levee breaks, scores of properties may become submerged in floodwaters and residents may become trapped by rapidly rising water. The failure of dams and levees has the potential to place large numbers of people and great amounts of property in harm’s way

5.5.2 Location and Spatial Extent

The Mississippi Department of Environmental Quality provides information on dams including a hazard potential classification. There are three hazard classifications—high, significant, and low—that correspond to qualitative descriptions. **Table 5.7** explains these classifications.

Table 5.7: MISSISSIPPI DAM HAZARD CLASSIFICATIONS

Hazard Classification	Description
Low	Dam failure may cause damage to farm buildings (excluding residences), agricultural land, or county or minor roads.
Significant	Dam failure may cause significant damage to main roads, minor railroads, or cause interruption of use or service of relatively important public utilities.
High	Dam failure may cause loss of life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads. Dams constructed in existing or proposed residential, commercial or industrial areas will be classified as high hazard dams, unless the applicant presents clear and convincing evidence to the contrary.

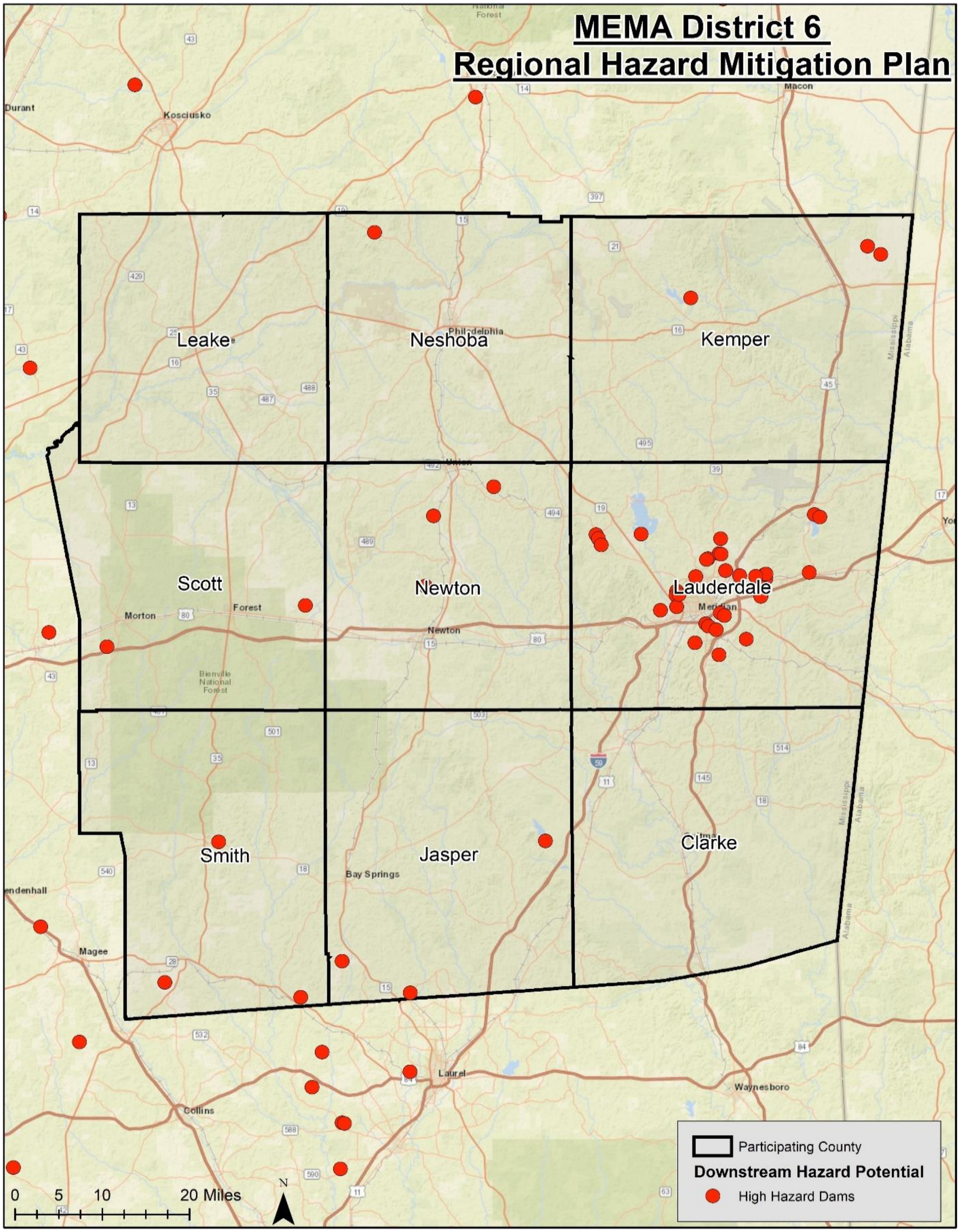
Source: U.S. Army Corps of Engineers – National Inventory of Dams

According to the U.S. Army Corps of Engineers' National Inventory of Dams, there are 48 high hazard dams in the MEMA District 6 Region. **Figure 5.4** shows the location of each of these high hazard dams and **Table 5.8** lists them by name.

[5] The list of high hazard dams obtained from the Mississippi Department of Environmental Quality was reviewed and amended

by local officials to the best of their knowledge.

Figure 5.4: MEMA DISTRICT 6 HIGH HAZARD DAM LOCATIONS



Source: U.S. Army Corps of Engineers – National Inventory of Dams

Table 5.8: MEMA DISTRICT 6 REGION HIGH HAZARD DAMS

Dam Name	Hazard Potential
Clarke County	
NONE	*N/A*
Jasper County	
HERITAGE LAKE DAM	High
LAKE EDDINS DAM	High
BIG CREEK WATERSHED STRUCTURE	High
Kemper County	
SHAMMACK CREEK WATERSHED STRUCTURE 2 DAM	High
SHAMMACK CREEK WATERSHED STRUCTURE 3 DAM	High
KEMPER COUNTY LAKE DAM	High
Lauderdale County	
OKATIBBEE DAM	High
DALEWOOD SHORES LAKE DAM	High
BRIARWOOD COUNTRY CLUB LAKE DAM	High
MEMORIAL PARK CEMETERY POND DAM	High
C W DOWNER POND DAM	High
N D BROOKSHIRE POND	High
LAKE TOM BAILEY	High
BOUNDS LAKE DAM	High
LAKEWOOD LAKE DAM	High
EAST MISSISSIPPI STATE HOSPITAL LAKE DAM	High
BONITA LAKE DAM NUMBER 1	High
LAKEMONT LAKE DAM	High
MIRROR LAKE DAM	High
FAULKNER LAKE DAM	High
LONG CREEK RESERVOIR DAM	High
CRESCENT LAKE DAM	High
LAKE DRUID DAM	High
SOWASHEE CREEK WS STR 11 DAM	High
SOWASHEE CREEK WS STR 8 DAM	High
BONITA NUMBER 2 DAM	High
SOWASHEE CREEK WS STR NO 2 DAM	High
LAKE MAILANDE	High
MAGNOLIA LAKE ESTATES DAM	High
SCHAMBERVILLE NUMBER 1 DAM	High
SCHAMBERVILLE NUMBER 2 DAM	High
RAINBOW LAKES # 1 DAM	High
RAINBOW LAKES # 4 DAM	High
RAINBOW LAKES # 5 DAM	High
MS05625 LAKE DAM	High
FAIR OAKS LAKE DAM	High
MS05765 LAKE DAM	High
MS05766 LAKE DAM	High
MS05901 LAKE DAM	High
Leake County	
NONE	*N/A*
Neshoba County	
WISH YOU ENOUGH DAM	High
Newton County	
CHUNKY RIVER WS STR 47 DAM	High

TURKEY CREEK WATER PARK DAM	High
CHUNKY RIVER WS NUMBER 8 DAM	High

Dam Name	Hazard Potential
Scott County	
HINES LAKE DAM	High
ROOSEVELT STATE PARK LAKE DAM	High
Smith County	
PRENTISS WALKER LAKE	High
UPPER LEAF RIVER STRUCTURE 9 DAM	High
BIG CREEK WATERSHED STRUCTURE	High

Source: National Inventory of Dams – U.S. Army Corps of Engineers

5.5.3 Historical Occurrences

According to the Mississippi State Hazard Mitigation Plan, there have been eleven dam failures reported in the MEMA District 6 Region, seven in Lauderdale County, two in Smith County, one in Scott County, and one in Leake County. Although no damage was reported with these events, several breach scenarios in the region could be catastrophic.

Table 5.9 below provides a brief description of the eight reported dam failures.

Table 5.9: MEMA DISTRICT 6 REGION DAM FAILURES (1982-2020)

Date	County	Structure Name	Cause of
May 1983	Leake	State Highway 35	Overtopped
March 1984	Lauderdale	Dalewood Shores	Minor Breach
May 1995	Lauderdale	Vise Lake Dam	Sand boils – problem with longevity of dam
January 2002	Lauderdale	John Kasper Lake	Excessive seepage leading to dam breach
March 2002	Lauderdale	Lake Tom Bailey	Deterioration for primary concrete spillway
August 2002	Lauderdale	State Hospital Lake	Poor overall condition
April 2003	Lauderdale	Lake Evelyn	Piping
May 2003	Lauderdale	Wild Duck Lake	Piping
April 2014	Scott	Whiteway Farms Dam	Severe seepage through dam that will eventually lead to failure
March 2016	Smith	Vowell Lake Dam	Piping
May 2017	Smith	Vowell Lake Dam	Slide occurs in the center of the crest and downstream slope

Source: Mississippi Department of Environmental Quality

5.5.4 Probability of Future Occurrence

Given the current dam inventory and historic data, a dam breach is possible (between 1 and 10 percent annual probability) in the future. However, as has been demonstrated in the past, regular monitoring is necessary to prevent these events. No further analysis will be completed in Section 6: *Vulnerability Assessment* as more sophisticated dam breach plans (typically completed by the U.S. Army Corp of Engineers) have been completed for dams of concern in the region.

5.6 WINTER STORM AND FREEZE

5.6.1 Background

A winter storm can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Events may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Some winter storms might be large enough to affect several states, while others might affect only localized areas. Occasionally, heavy snow might also cause significant property damages, such as roof collapses on older buildings.

All winter storm events have the potential to present dangerous conditions to the affected area. Larger snowfalls pose a greater risk, reducing visibility due to blowing snow and making driving conditions treacherous. A heavy snow event is defined by the National Weather Service as an accumulation of 4 of more inches in 12 hours or less. A blizzard is the most severe form of winter storm. It combines low temperatures, heavy snow, and winds of 35 miles per hour or more, which reduces visibility to a quarter mile or less for at least 3 hours. Winter storms are often accompanied by sleet, freezing rain, or an ice storm. Such freeze events are particularly hazardous as they create treacherous surfaces.

Ice storms are defined as storms with significant amounts of freezing rain and are a result of cold air damming (CAD). CAD is a shallow, surface-based layer of relatively cold, stably-stratified air entrenched against the eastern slopes of the Appalachian Mountains. With warmer air above, falling precipitation in the form of snow melts, then becomes either super-cooled (liquid below the melting point of water) or re-freezes. In the former case, super-cooled droplets can freeze on impact (freezing rain), while in the latter case, the re-frozen water particles are ice pellets (or sleet). Sleet is defined as partially frozen raindrops or refrozen snowflakes that form into small ice pellets before reaching the ground. They typically bounce when they hit the ground and do not stick to the surface. However, it does accumulate like snow, posing similar problems and has the potential to accumulate into a layer of ice on surfaces. Freezing rain, conversely, usually sticks to the ground, creating a sheet of ice on the roadways and other surfaces. All of the winter storm elements – snow, low temperatures, sleet, ice, etcetera – have the potential to cause significant hazard to a community. Even small accumulations can down power lines and tree limbs and create hazardous driving conditions. Furthermore, communication and power may be disrupted for days.

5.6.2 Location and Spatial Extent

Nearly the entire continental United States is susceptible to winter storm and freeze events. Some ice and winter storms may be large enough to affect several states, while others might affect limited, localized areas. The degree of exposure typically depends on the normal expected severity of local winter weather. The MEMA District 6 Region is not accustomed to severe winter weather conditions and rarely receives severe winter weather, even during the winter months. Events tend to be mild in nature; however, even relatively small accumulations of snow, ice, or other wintery precipitation can lead to losses and damage due to the fact that these events are not commonplace. Given the atmospheric nature of the hazard, the entire region has uniform exposure to a winter storm.

The extent of winter storms can be measured by the amount of snowfall received (in inches). Official long term snow records are not kept for any areas in the MEMA District 6 Region. However, the greatest snowfall reported in Meridian (north of the region) was 14.0 inches in 1963. In February 2021, the region experienced winter weather with heavy snow up to three inches. Transportation was greatly impacted.

5.6.3 Historical Occurrences

Winter weather has resulted in two disaster declarations in the MEMA District 6 Region, one in 1999, and most recently in 2021. According to the National Centers for Environmental Information, there have been a total of 121 recorded winter storm events in the MEMA District 6 Region since 1996 (**Table 5.10**). These events resulted in more than $13.5 million in damages. Detailed information on the recorded winter storm events can be found in the county-specific annexes.

Table 5.10: SUMMARY OF WINTER STORM EVENTS IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	10	0/0	$885,000
Jasper County	12	0/0	$1,305,000
Kemper County	14	0/0	$1,000,000
Lauderdale County	17	3/0	$3,006,000
Leake County	14	0/0	$1,700.000
Neshoba County	12	0/0	$1,600,000
Newton County	16	0/0	$1,490,000
Scott County	14	0/0	$1,170.000
Smith County	12	0/0	$1,400,000
MEMA DISTRICT 6 REGION TOTAL	**121**	**3/0**	**$13,556,000**

Source: National Centers for Environmental Information - retrieved April 2021

There have been several severe winter weather events in the MEMA District 6 Region. The text below describes two of the major events and associated impacts on the region. Similar impacts can be expected with severe winter weather.

December 1998

Central Mississippi was hit by a crippling ice storm. Up to 2 inches of ice accumulated on power lines and much of the region experienced long power outages, nearly seven days in some cases. The ice caused numerous power outages and brought down many trees and power lines. Christmas travel was severely hampered for several days with motorists stranded at airports, bus stations, and truck stops. Travel did not return to normal until after Christmas in some locations.

January 2008 Winter Storm

This storm produced heavy snow across the region, with an average of three to four inches of snow. Some heavier amounts, between four to five inches, also fell in isolated areas. At the height of the snow, temperatures fell to near freezing, and accumulations occurred on roadways resulting in a number of traffic accidents. Additionally, some power outages occurred in the heaviest snow band due to the weight of wet snow on limbs and lines.

December 2017 Heavy Snow

An early season winter storm brought heavy snow to much of Mississippi between the evening of the 7th and into the afternoon of the 8th. The greatest amounts fell mainly south and east of the Natchez Trace corridor. Amounts of up to 7 to 8 inches were measured in the Pine Belt. Heavier snow accumulations resulted in downed limbs and trees, power outages, and traffic accidents across the state.

February 17, 2021 Ice Storm

As an arctic air mass continued to build southward across the South on February 17th, another wave of precipitation overspread this cold air mass across much of Mississippi. The main impacts across central and southern portions of the state were from freezing rain and resulting heavy icing, but some significant accumulations of sleet and snow also occurred in areas mainly north and west of the Natchez Trace. Freezing rain continued through the evening hours, ending from west to east by the early morning of February 18th. Ice accumulated quickly in many locations and downed numerous trees, large limbs, and power lines across the affected areas. Several trees and limbs fell onto power lines, resulting in more widespread power outages as well. Some trees fell onto homes or cars, and significant amounts of ice, sleet, and snow collapsed a few gas station awnings and roofs where accumulations were greatest. In the hardest hit areas, extensive damage to trees and power lines took several months and cost several hundred thousands of dollars to clean up.

Winter storms throughout the planning area have several negative externalities including hypothermia, cost of snow and debris cleanup, business and government service interruption, traffic accidents, and power outages. Furthermore, citizens may resort to using inappropriate heating devices that could lead to fire or an accumulation of toxic fumes.

5.6.4 Probability of Future Occurrences

Winter storm events will continue to occur in the MEMA District 6 Region. Based on historical information, the probability is likely (between 10 and 100 percent annual probability).

FIRE-RELATED HAZARDS

5.7 DROUGHT / HEAT WAVE

5.7.1 Background

DROUGHT

Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. High temperatures, high winds, and low humidity can exacerbate drought conditions. In addition, human actions and demands for water resources can hasten drought-related impacts. Droughts may also lead to more severe wildfires.

Droughts are typically classified into one of four types: 1) meteorological, 2) hydrologic, 3) agricultural, or 4) socioeconomic. **Table 5.11** presents definitions for these types of droughts.

Table 5.11: DROUGHT CLASSIFICATION DEFINITIONS

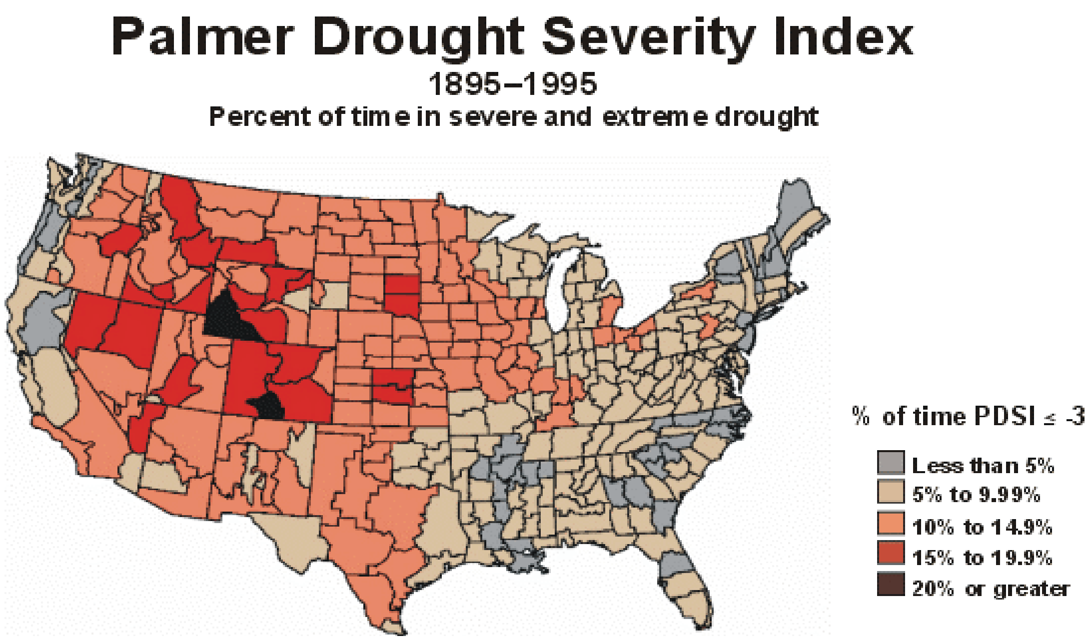
Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
Agricultural Drought	Soil moisture deficiencies relative to water demands of plant life, usually crops.
Socioeconomic Drought	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.

Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

Droughts are slow-onset hazards, but, over time, can have very damaging affects to crops, municipal water supplies, recreational uses, and wildlife. If drought conditions extend over a number of years, the direct and indirect economic impact can be significant.

The Palmer Drought Severity Index (PDSI) is based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). Evident in **Figure 5.5**, the Palmer Drought Severity Index Summary Map for the United Stated, drought affects most areas of the United States, but is less severe in the Eastern and Southeastern United States.

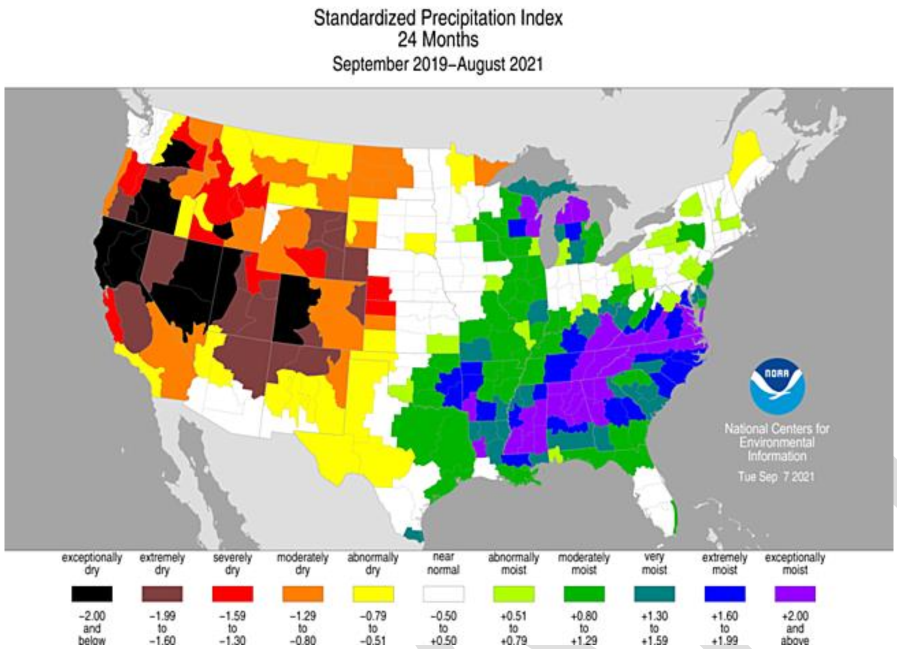
Figure 5.5: PALMER DROUGHT SEVERITY INDEX SUMMARY MAP FOR THE UNITED STATES



Source: National Drought Mitigation Center

The Standardized Precipitation Index (SPI) measures moisture supply. The SPI maps here show the spatial extent of anomalously wet and dry areas at time scales for the last 24 months.

Figure 5.6: Standardized Precipitation Index [3]



[3] National Centers for Environmental Information

The U.S. Drought Monitor also records information on historical drought occurrence. The U.S. Drought Monitor categorizes drought on a D0-D4 scale as **Table 5.12** presents definitions for these classifications.

Table 5.12:U.S. DROUGHT MONITOR

D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies

Source: United States Drought Monitor, http://droughtmonitor.unl.edu/classify.htm

HEAT WAVE

Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and that last for an extended period of time. A heat wave may occur when temperatures hover 10 degrees or more above the average high temperature for the region and last for a prolonged number of days or several weeks. Humid conditions may also add to the discomfort of high temperatures.

While extreme heat does not typically affect buildings, the impact to the population can have grave effects. Health risks from extreme heat include heat cramps, heat fainting, heat exhaustion and heat stroke. According to the National Weather Service (which compiles data from the National Centers for Environmental Information), heat is the leading weather-related killer in the United States. During the ten-year period between 2000 and 2009 heat events killed 162 people - more people than lightning, tornado, flood, cold, winter storm, wind and hurricane hazards. However, most deaths are attributed to prolonged heat waves in large cities that rarely experience hot weather. The elderly and the ill are most at-risk, along with those who exercise outdoors in hot, humid weather.

The National Weather Service devised the Heat Index as a mechanism to better inform the public of heat dangers. The Heat Index Chart, shown in **Figure 5.7**, uses air temperature and humidity to determine the heat index or apparent temperature. **Table 5.13** shows the dangers associated with different heat index temperatures. Some populations, such as the elderly and young, are more susceptible to heat danger than other segments of the population.

Figure 5.7: HEAT INDEX CHART

Air Temp (in F)	Relative Humidity (in percent)																				
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
140	125																				
135	120	128																			
130	117	122	131																		
125	111	116	123	131	141																
120	107	111	116	123	130	139	148														
115	103	107	111	115	120	127	135	143	151												
110	99	102	105	108	112	117	123	130	137	143	150										
105	95	97	100	102	105	109	113	118	123	129	135	142	149								
100	91	93	95	97	99	101	104	107	110	115	120	126	132	138	144						
95	87	88	90	91	93	94	96	98	101	104	107	110	114	119	124	130	136				
90	83	84	85	86	87	88	90	91	93	95	96	98	100	102	106	109	113	117	122		
85	78	79	80	81	82	83	84	85	86	87	88	89	90	91	93	95	97	99	102	105	108
80	73	74	75	76	77	77	78	79	79	80	81	81	82	83	85	86	86	87	88	89	91
75	69	69	70	71	72	72	73	73	74	74	75	75	76	76	77	77	78	78	79	79	80
70	64	64	65	65	66	66	67	67	68	68	69	69	70	70	70	70	71	71	71	71	72

Source: National Oceanic and Atmospheric Administration

Table 5.13: HEAT DISORDERS ASSOCIATED WITH HEAT INDEX TEMPERATURE

Heat Index Temperature (Fahrenheit)	Description of Risks
80°- 90°	Fatigue possible with prolonged exposure and/or physical activity
90°- 105°	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105°- 130°	Sunstroke, heat cramps, and heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity
130° or higher	Heatstroke or sunstroke is highly likely with continued exposure

Source: National Weather Service, National Oceanic and Atmospheric Administration

5.7.2 Location and Spatial Extent

DROUGHT

Drought typically covers a large area and cannot be confined to any geographic or political boundaries. Furthermore, it is assumed that the MEMA District 6 Region would be uniformly exposed to drought, making the spatial extent potentially widespread. It is also notable that drought conditions typically do not cause significant damage to the built environment but may exacerbate wildfire conditions.

HEAT WAVE

Heat waves typically impact a large area and cannot be confined to any geographic or political boundaries.

5.7.3 Historical Occurrences

DROUGHT

Data from the U.S. Drought Monitor and National Centers for Environmental Information (NCEI) were used to ascertain historical drought events in the MEMA District 6 Region. The U.S. Drought Monitor reports data at the county level on a weekly basis throughout the county. It classifies drought conditions on a scale of D0 to D4, as described in **Table 5.13** above.

According to the U.S. Drought Monitor, all of the counties in the MEMA District 6 Region had drought levels (including abnormally dry) in at least 19 of the last 21 years (2000-2021). According to NCEI, there have been 12 drought occurrences in the MEMA District 6 Region (**Table 5.14**). The most severe drought classification reported for each year, according to U.S. Drought Monitor classifications, is listed in the county-specific annexes. It should be noted that the U.S. Drought Monitor also estimates what percentage of the county is in each classification of drought severity. For example, the most severe classification reported may be exceptional, but a majority of the county may actually be in a less severe condition.

Table 5.14: SUMMARY OF DROUGHT OCCURRENCES IN THE MEMA DISTRICT 6 REGION

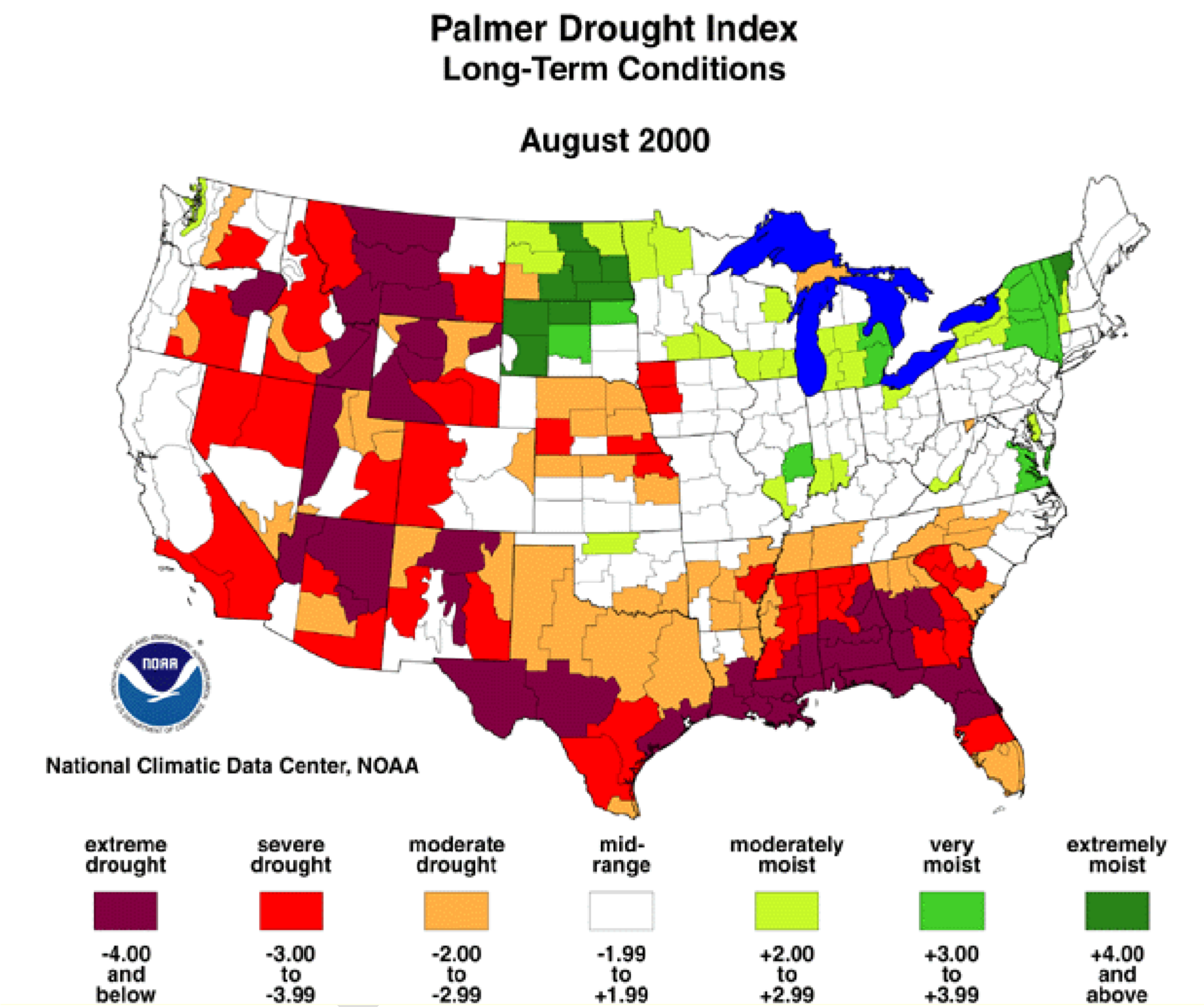
Location	Number of Drought Occurrences
Clarke County	11
Jasper County	10
Kemper County	11
Lauderdale County	11
Leake County	12
Neshoba County	12
Newton County	12
Scott County	12
Smith County	12

Source: National Centers for Environmental Information - retrieved April 2021

Some additional anecdotal information was provided from the National Centers for Environmental Information on droughts in the MEMA District 6 Region.

Summer 2000 Drought – As shown in **Figure 5.7** below, drought conditions were pronounced throughout much of the south and western areas of the nation.

Figure 5.8: PALMER DROUGHT INDEX FOR AUGUST 2000



Summer 2006 – During a four-and-a-half-month period, from June to the middle of October, abnormally dry conditions prevailed across most of Jackson, MS County Warning Area (CWA). The drought had a significant impact on the agricultural industry. Non-irrigated crops were destroyed and all other sustainable crops produced a below normal yield. Catfish ponds were drawn down to severe levels and required water to be pumped back into the fish ponds. The cattle industry suffered due to low watering ponds and lack of sufficient grasslands for grazing and hay production. Water supply problems were encountered by those cities who obtained water from local rivers for drinking purposes due to the low river flows. Fire threat was significant causing the issuance of burn bans across the CWA.

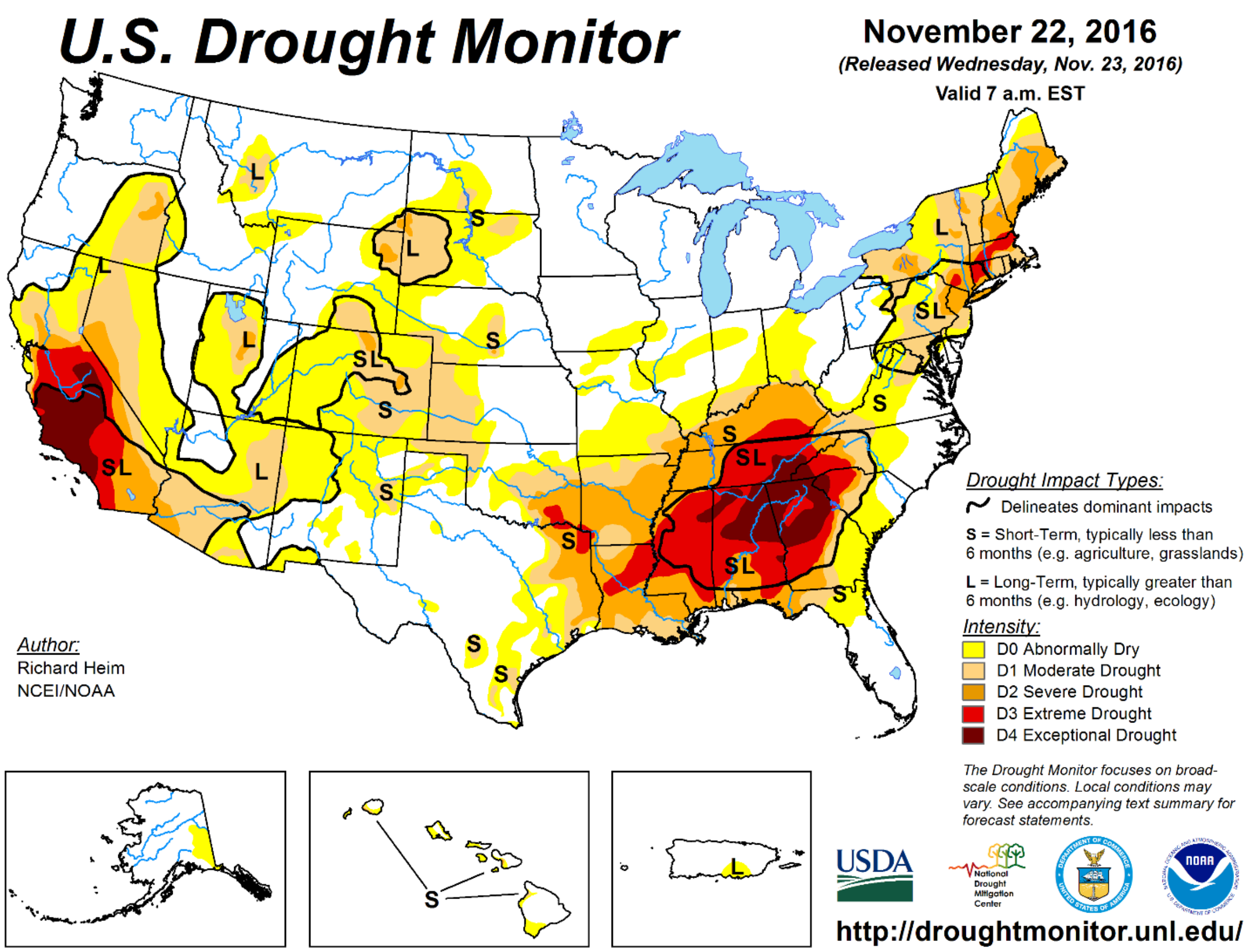
Summer 2007 – By the middle of April, drought conditions were being experienced across a large portion of Eastern and some of Central Mississippi. During the month of May, the drought worsened and expanded. In June, the drought peaked across the region. Although drought conditions continued throughout July and August, conditions were less severe than earlier in the summer. As a result of these conditions, area farmers and crop yields were affected.

October 2010 – Very dry conditions continued across central Mississippi during most of October. Crops were put under stress under the warm and dry conditions. The likely impact was less crop yields for harvest time.

November 2016

Dry conditions continued into November, which created continued stress on crops. Some locations were even classified as being in extreme drought. This drought classification expanded and covered much of the state by the end of the month shown in the figure below.

Figure 5.9: U.S. Drought Monitor November 22, 2016

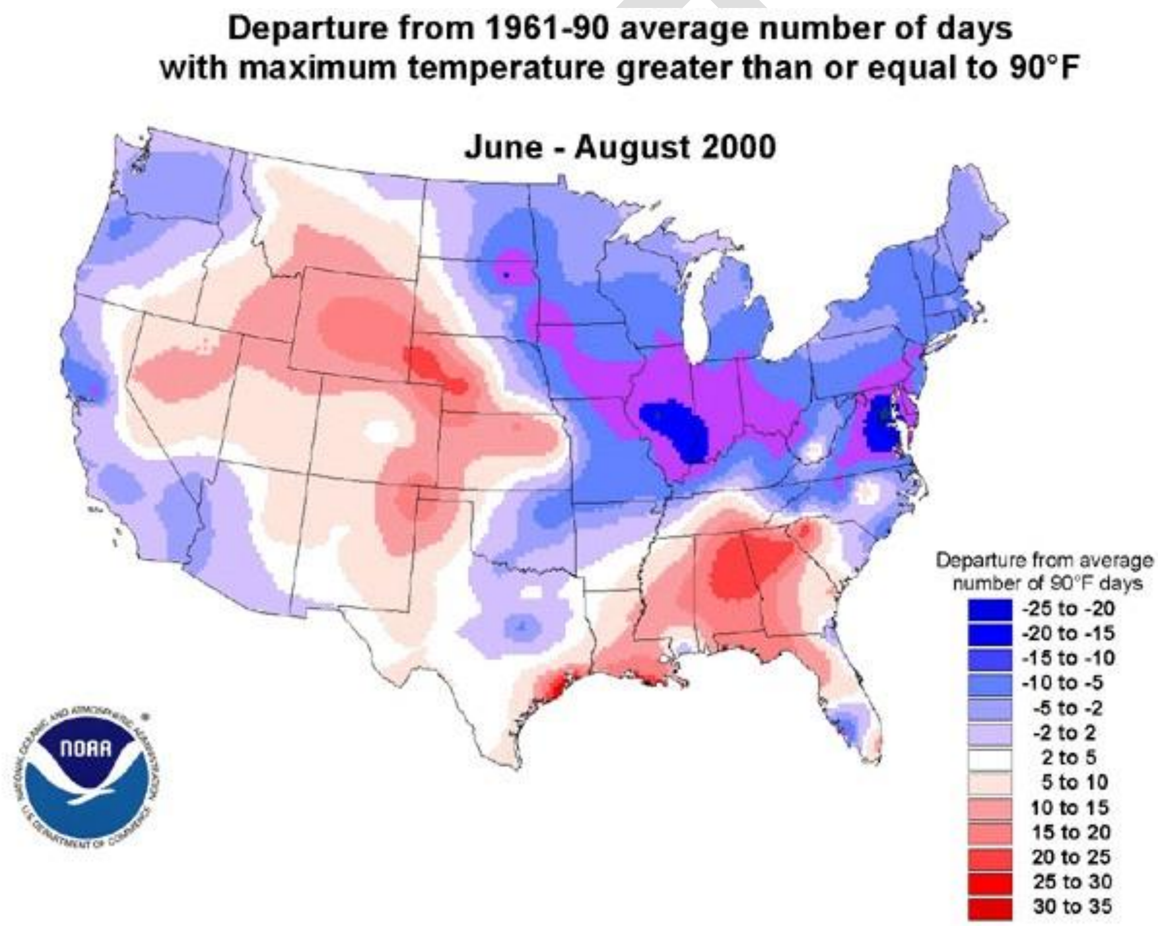


HEAT WAVE

The National Centers for Environmental Information was used to determine historical heat wave occurrences in the region.

Summer of 2000 Heat Wave – Hot temperatures persisted from July to September across the South and Plains. Known as the Summer of 2000 Heat Wave, high temperatures commonly peaked over 100 degrees. As shown in figure below, there were several days over 90 degree than the typical average. This was the fourth warmest July-August on record.

Figure 5.10: DEPARTURE FROM AVERAGE NUMBER OF 90 DEGREE DAYS



Source: http://www.NCEI.noaa.gov/sotc/drought/2000/16#Heat

July 2005 – A five-day heat wave occurred across the region. Heat index values reached near 110 degrees each day. Each day had high temperatures ranging from 95 to 99 degrees. This was the warmest stretch of weather the area experienced since July 2001.

August 2005 –A heat wave covering the south began in mid-August and lasted about 10 days. High temperatures were consistently over 95 degrees and surpassed 100 degrees or more on some days. It was the first time since August 2000 that 100-degree temperatures reached the area.

July 2006 – A short heat wave impacted most of the area temperatures in the 90s to around 100 for five straight days.

August 2007 – A heat wave gripped most of the area with the warmest temperatures since 2000. It lasted from August 5th to the 16th.

August 2010 – The combination of high humidity and above normal temperatures produced heat index readings ranged between 105 and 109 degrees during the afternoon hours in the middle part of August.

5.7.4 Probability of Future Occurrences

DROUGHT

According to the Palmer Drought Severity Index (**Figure 5.5**), MEMA District 6 has a relatively low risk for drought hazard (5 to 9.99%). However, local areas may experience much more severe and/or frequent drought events than what is represented on the Palmer Drought Severity Index map.

Based on historical occurrence information, it is assumed that all of the MEMA District 6 Region has a probability level of likely (between 10 and 100 percent annual probability) for future drought events. However, the extent (or magnitude) of drought and the amount of geographic area covered by drought, varies with each year. Historic information indicates that there is a much lower probability for extreme, long-lasting drought conditions.

HEAT WAVE

Based on historical occurrence information, it is assumed that all of the MEMA District 6 Region has a probability level of likely (between 10 and 100 percent annual probability) for future heat wave events.

5.8 WILDFIRE

5.8.1 Background

A wildfire is any outdoor fire (i.e., grassland, forest, brush land) that is not under control, supervised, or prescribed.[4] Wildfires are part of the natural management of forest ecosystems, but may also be caused

[4] Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.

by human factors.

Nationally, over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning. In Mississippi, a majority of fires are caused by debris burning.

There are three classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildfires are usually signaled by dense smoke that fills the area for miles around.

Wildfire probability depends on local weather conditions, outdoor activities such as camping, debris burning, and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural hazards (such as tornadoes, hurricanes, etc.) increase the probability of wildfires by producing fuel in both urban and rural settings.

Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses, and industries are located within high wildfire hazard areas. Furthermore, the increasing demand for outdoor recreation places more people in wildlands during holidays, weekends, and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for wildfire events that can sweep through the brush and timber and destroy property within minutes.

Wildfires can result in severe economic losses as well. Businesses that depend on timber, such as paper mills and lumber companies, experience losses that are often passed along to consumers through higher prices and sometimes jobs are lost. The high cost of responding to and recovering from wildfires can deplete state resources and increase insurance rates. The economic impact of wildfires can also be felt in the tourism industry if roads and tourist attractions are closed due to health and safety concerns.

State and local governments can impose fire safety regulations on home sites and developments to help curb wildfire. Land treatment measures such as fire access roads, water storage, helipads, safety zones, buffers, firebreaks, fuel breaks, and fuel management can be designed as part of an overall fire defense system to aid in fire control. Fuel management, prescribed burning, and cooperative land management planning can also be encouraged to reduce fire hazards.

5.8.2 Location and Spatial Extent

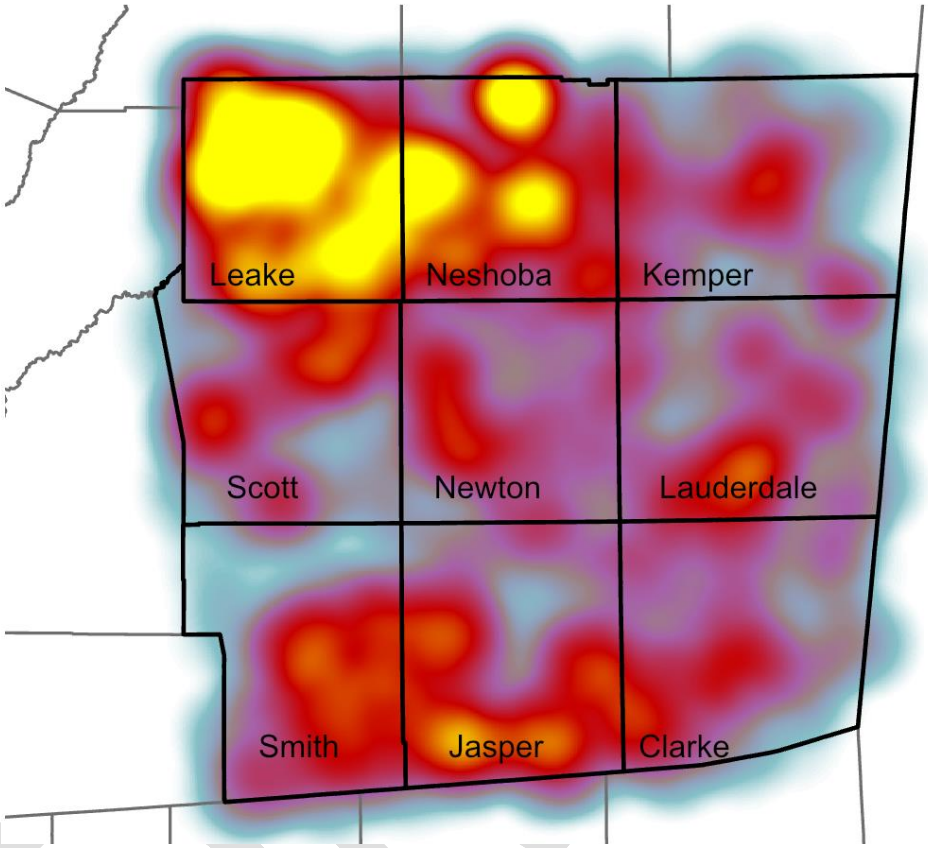
The entire region is at risk to a wildfire occurrence. However, several factors such as drought conditions or high levels of fuel on the forest floor, may make a wildfire more likely. Furthermore, areas in the urban-wildland interface are particularly susceptible to fire hazard as populations abut formerly undeveloped areas. The Wildfire Ignition Density data shown in the figure below give an indication of historic location.

5.8.3 Historical Occurrences

Figure below

shows the Wildfire Ignition Density in the MEMA District 6 Region based on data from the Southern Wildfire Risk Assessment. This data is based on historical fire ignitions and the likelihood of a wildfire igniting in an area. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. This is measured in the number of fires per year per 1,000 acres.

Figure 5.11: WILDFIRE IGNITION DENSITY IN THE MEMA DISTRICT 6 REGION
January 2015 – June 2021



Source: Mississippi Forestry Commission

Based on data from the Mississippi Forestry Commission from 2005 to 2014, the MEMA District 6 Region experienced an average of 294 wildfires annually which burned a combined 3,522 acres, on average per year. The data indicates that most of these fires are small, averaging about 12 acres per fire. Recent data provided by the Mississippi Forestry Commission for the time period 2015 – 2021 shows an overall reduction in the number of fires with an average of 160 fires occurring annually and 11.5 acres burned per fire. The year 2017 saw a total average of acres burned well under the average with only 74 fires and 451 total acres having been reportedly burned in the MEMA District 6 Region. **Table 5.15** provides a summary table for wildfire occurrences in the MEMA District 6 Region. The number of reported wildfire occurrences in the participating counties between the years 2015 and 2021 is listed in the county-specific annexes to this plan. Jurisdiction specific information is not available due to Mississippi Forestry Commission providing only county level data.

Table 5.15: SUMMARY TABLE OF ANNUAL WILDFIRE OCCURRENCES (2015 -2021)

	Clarke County	Jasper County	Kemper County	Lauderdale County	Leake County
Average Number of Fires per year	15	18	13	14.8	34.4
Average Number of Acres Burned per year	194	144.4	305.2	134.2	422.1
Average Number of Acres Burned per fire	12.9	8.0	23.4	9.0	12.27

Source: Mississippi Forestry Commission (January 2015 – June 2021)

TABLE 5.15 (CONT.): SUMMARY TABLE OF ANNUAL WILDFIRE OCCURRENCES (2015 -2021)

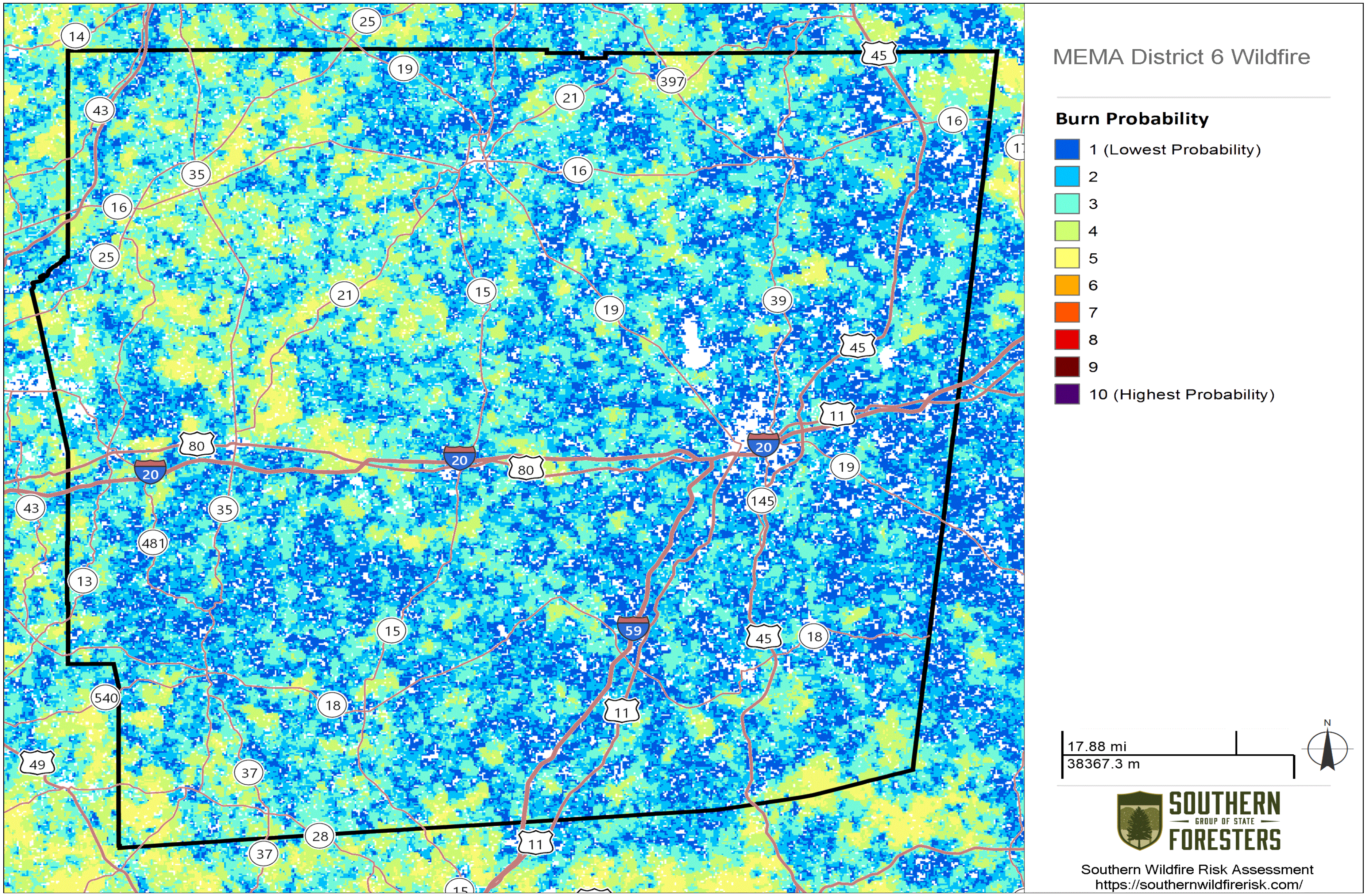
	Neshoba County	Newton County	Scott County	Smith County	MEMA D6 Region Total
Average Number of Fires per year	23.2	12.1	13.4	15.8	160.5
Average Number of Acres Burned per year	132.7	71.1	189.1	198.8	1,859.8
Average Number of Acres Burned per fire	5.7	5.8	14.1	12.5	11.5

Source: Mississippi Forestry Commission (January 2015 – June 2021)

5.8.4 Probability of Future Occurrences

Wildfire events will be an ongoing occurrence in the MEMA District 6 Region. Figure below shows that there is some probability a wildfire will occur throughout the region. However, the likelihood of wildfires increases during drought cycles and abnormally dry conditions. Fires are likely to stay small in size but could increase due to local climate and ground conditions. Dry, windy conditions with an accumulation of forest floor fuel (potentially due to ice storms or lack of fire) could create conditions for a large fire that spreads quickly. It should also be noted that some areas do vary somewhat in risk. For example, highly developed areas are less susceptible unless they are located near the urban-wildland boundary. The risk will also vary due to assets. Areas in the urban-wildland interface will have much more property at risk, resulting in increased vulnerability and need to mitigate compared to rural, mainly forested areas. The probability assigned to the MEMA District 6 Region for future wildfire events is highly likely (100 percent annual probability).

Figure 5.12: BURN PROBABILITY IN THE MEMA DISTRICT 6 REGION



Source: Southern Wildfire Risk Assessment

GEOLOGIC HAZARDS

5.9 EARTHQUAKE

5.9.1 Background

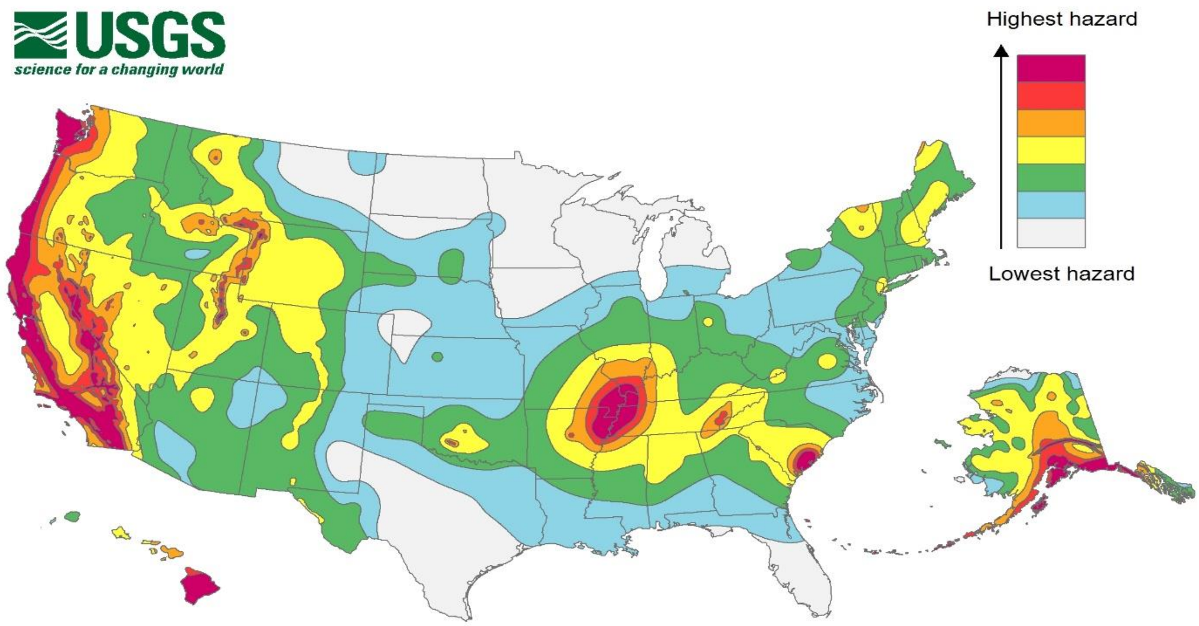
An earthquake is movement or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site, and regional geology. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (mountain regions and along hillsides), and liquefaction, in which ground soil loses the ability to resist shear and flows much like quick sand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

Most earthquakes are caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along borders of the Earth's 10 tectonic plates. The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

The greatest earthquake threat in the United States is along tectonic plate boundaries and seismic fault lines located in the central and western states; however, the Eastern United State does face moderate risk to less frequent, less intense earthquake events. Figure below shows relative seismic risk for the United States.

Figure 5.13: UNITED STATES EARTHQUAKE HAZARD MAP



Source: United States Geological Survey

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (**Table 5.16**). Each unit increase in magnitude on the Richter Scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, ranging from "I" corresponding to imperceptible (instrumental) events to "XII" for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in **Table 5.17**.

Table 5.16: RICHTER SCALE

RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
< 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
5.4 - 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Source: Federal Emergency Management Agency

Table 5.17: MODIFIED MERCALLI INTENSITY SCALE FOR EARTHQUAKES

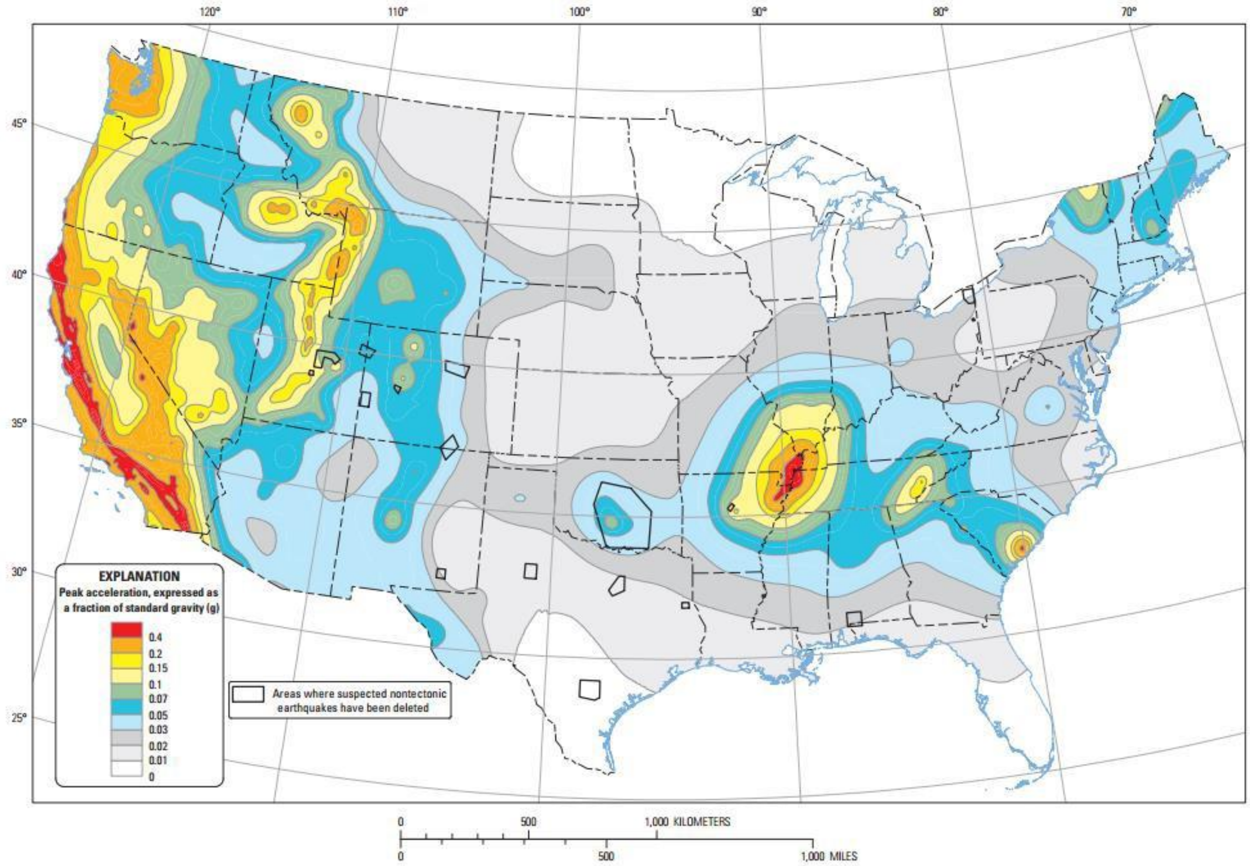
SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
I	INSTRUMENTAL	Detected only on seismographs.	
II	FEEBLE	Some people feel it.	< 4.2
III	SLIGHT	Felt by people resting; like a truck rumbling by.	
IV	MODERATE	Felt by people walking.	
V	SLIGHTLY STRONG	Sleepers awake; church bells ring.	< 4.8
VI	STRONG	Trees sway; suspended objects swing, objects fall off shelves.	< 5.4
VII	VERY STRONG	Mild alarm; walls crack; plaster falls.	< 6.1
VIII	DESTRUCTIVE	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged.	
IX	RUINOUS	Some houses collapse; ground cracks; pipes break open.	< 6.9
X	DISASTROUS	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread.	< 7.3
XI	VERY DISASTROUS	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards.	< 8.1
XII	CATASTROPHIC	Total destruction; trees fall; ground rises and falls in waves.	> 8.1

Source: Federal Emergency Management Agency

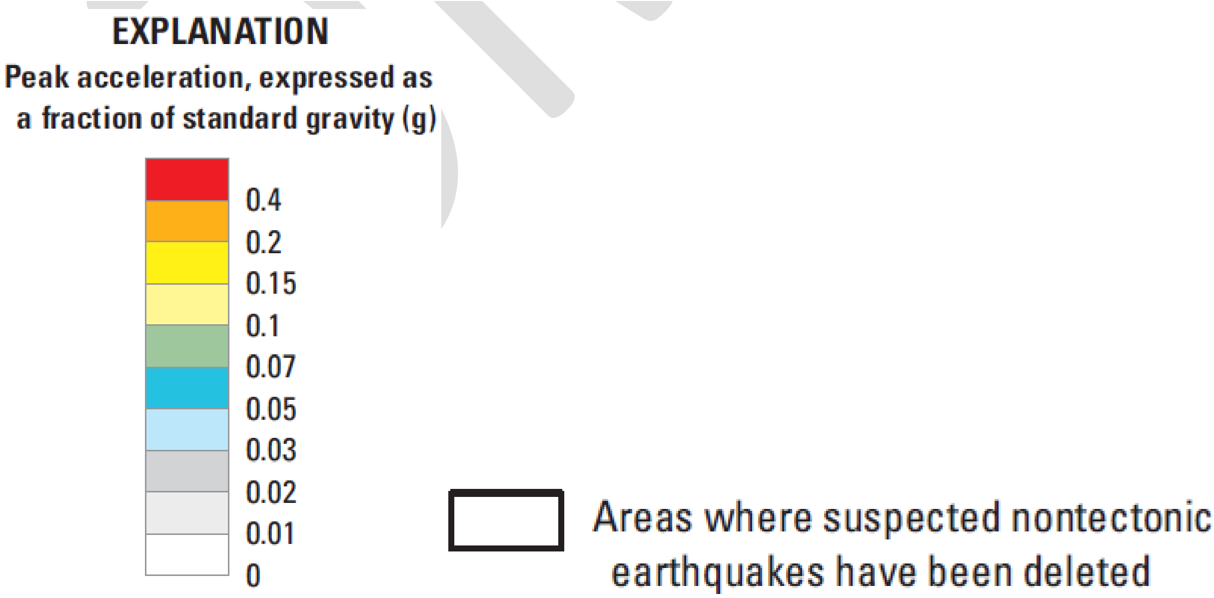
5.9.2 Location and Spatial Extent

Figure below shows the intensity level associated with the MEMA District 6 Region, based on the national USGS map of peak acceleration with 10 percent probability of exceedance in 50 years. It is the probability that ground motion will reach a certain level during an earthquake. The data show peak horizontal ground acceleration (the fastest measured change in speed, for a particle at ground level that is moving horizontally due to an earthquake) with a 10 percent probability of exceedance in 50 years. The map was compiled by the U.S. Geological Survey (USGS) Geologic Hazards Team, which conducts global investigations of earthquake, geomagnetic, and landslide hazards. According to this map, all of the MEMA District 6 Region lies within an approximate zone of level “2” to “5” ground acceleration. This indicates that the region as a whole exists within an area of moderate seismic risk.

Figure 5.14: PEAK ACCELERATION WITH 10 PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS

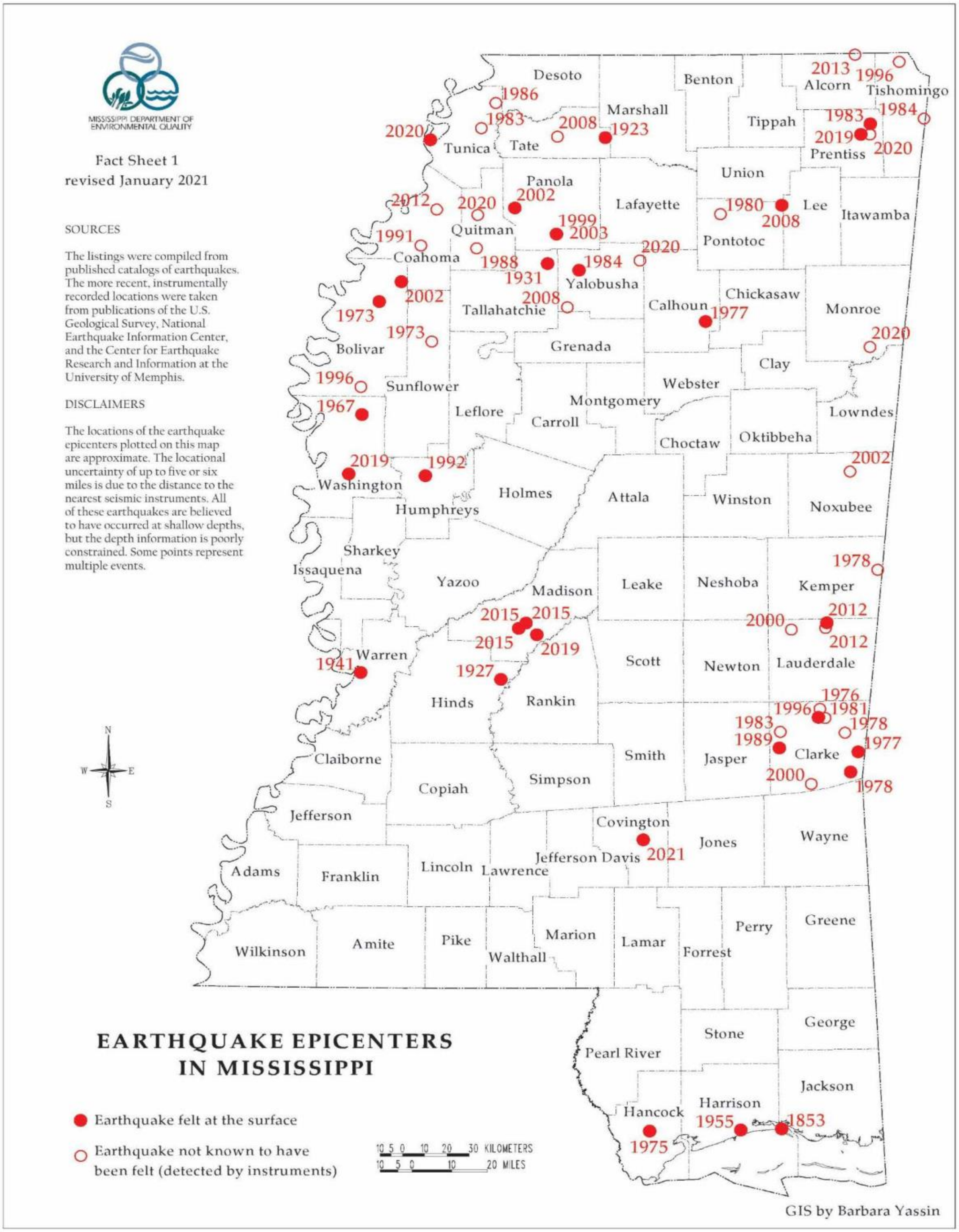


Ten-percent probability of exceedance in 50 years map of peak ground acceleration



Source: United States Geological Survey, 2014

Figure 5.15: Earthquake Epicenters in the State of Mississippi



Source: Mississippi Department of Environmental Quality

5.9.3 Historical Occurrences

At least eight earthquakes are known to have affected the MEMA District 6 Region since 1886. The strongest of these measured a V on the Modified Mercalli Intensity (MMI) scale. **Table 5.18** provides a summary of earthquake events reported by the National Geophysical Data Center between 1638 and 1985. A detailed occurrence of each event including the date, distance from the epicenter, magnitude, and Modified Mercalli Intensity (if known) can be found in the county-specific annexes. [5]

No earthquakes have occurred in the planning area since the last plan update. This was also confirmed during planning meetings with participants.

Table 5.18: SUMMARY OF SEISMIC ACTIVITY IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Greatest MMI Reported	Richter Scale Equivalent
Clarke County	**1**	**II**	**< 4.2**
Enterprise	1	II	< 4.2
Pachuta	0	--	--
Quitman	0	--	--
Shubuta	0	--	--
Stonewall	0	--	--
Unincorporated Area	0	--	--
Jasper County	**1**	**III**	**< 4.8**
Bay Springs	0	--	--
Heidelberg	0	--	--
Louin	0	--	--
Montrose	0	--	--
Unincorporated Area	1	III	< 4.8
Kemper County	**1**	**III**	**< 4.8**
De Kalb	0	--	--
Scooba	0	--	--
Unincorporated Area	1	III	< 4.8
Lauderdale County	**4**	**IV**	**< 4.8**
Marion	0	--	--
Meridian	3	IV	< 4.8
Unincorporated Area	1	IV	< 4.8
Leake County	**1**	**V**	**< 4.8**
Carthage	1	V	< 4.8
Lena	0	--	--
Walnut Grove	0	--	--
Unincorporated Area	0	--	--
Neshoba County	**0**	**--**	**--**
Philadelphia	0	--	--
Unincorporated Area	0	--	--
Newton County	**0**	**--**	**--**

[5] Due to reporting mechanisms, not all earthquake events were recorded during this time. Furthermore, some are missing data, such as the epicenter location, due to a lack of widely used technology. In these instances, a value of "unknown" is reported.

Chunky	0	--	--
Decatur	0	--	--
Hickory	0	--	--

Location	Number of Occurrences	Greatest MMI Reported	Richter Scale Equivalent
Newton (city)	0	--	--
Union	0	--	--
Unincorporated Area	0	--	--
Scott County	**0**	**--**	**--**
Forest	0	--	--
Lake	0	--	--
Morton	0	--	--
Sebastopol	0	--	--
Unincorporated Area	0	--	--
Smith County	**0**	**--**	**--**
Mize	0	--	--
Polkville	0	--	--
Raleigh	0	--	--
Sylvarena	0	--	--
Taylorsville	0	--	--
Unincorporated Area	0	--	--
MEMA DISTRICT 6 REGIONAL TOTAL	**8**	**V**	**< 4.8**

Source: National Geophysical Data Center

In addition to those earthquakes specifically affecting the MEMA District 6 Region, a list of earthquakes that have affected Mississippi is presented below in **Table 5.19.**

Table 5.19: EARTHQUAKES WHICH HAVE AFFECTED MISSISSIPPI

Date	Origin	Richter Scale (Magnitude)	MMI (Intensity)	MMI in Mississippi	MEMA District 6 Counties Affected
1811-1812	New Madrid Seismic Zone	7.8-8.1	XI	Not available	Affected counties as far as the Gulf Coast
3/29/1972	New Madrid Seismic Zone	Not available	IV	I, II, III, IV	--
4/29/2003	8 miles ENE of Ft. Payne, AL	4.6	V	I, II, III, IV	Lauderdale
11/7/2004	25 miles SW of Tuscaloosa, AL	4.0	V	I, II, III, IV	Lauderdale, Leake, Newton, and Scott
2/10/2005	22 miles WSW of Blytheville, AR	4.1	V	I, II, III	--
5/1/2005	15 miles WSW of Blytheville, AR	4.1	IV	I, II, III	--
6/2/2005	10 miles NNW of Dyersburg, TN	4.0	III	I	--
9/10/2006	253 miles SSW of Apalachicola, FL	6.0	VI	I, II, III, IV	Lauderdale and Scott

Source: State of Mississippi Standard Mitigation Plan (2018Update)

5.9.4 Probability of Future Occurrences

The probability of significant, damaging earthquake events affecting the MEMA District 6 Region is unlikely. However, it is possible that future earthquakes resulting in light to moderate perceived shaking and damages ranging from none to very light will affect the region. The annual probability level for the region is estimated to be between 1 and 10 percent (possible).

5.10 LANDSLIDE

5.10.1 Background

A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation, which is driven by gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, volcanic eruptions, and changes in groundwater levels.

There are several types of landslides: rock falls, rock topple, slides, and flows. Rock falls are rapid movements of bedrock, which result in bouncing or rolling. A topple is a section or block of rock that rotates or tilts before falling to the slope below. Slides are movements of soil or rock along a distinct surface of rupture, which separates the slide material from the more stable underlying material. Mudflows, sometimes referred to as mudslides, mudflows, lahars or debris avalanches, are fast-moving rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as heavy rainfall or rapid snowmelt, changing the soil into a flowing river of mud or "slurry." Slurry can flow rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. As the flows reach flatter ground, the mudflow spreads over a broad area where it can accumulate in thick deposits.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly.

Among the most destructive types of debris flows are those that accompany volcanic eruptions. A spectacular example in the United States was a massive debris flow resulting from the 1980 eruptions of Mount St. Helens, Washington. Areas near the bases of many volcanoes in the Cascade Mountain Range of California, Oregon, and Washington are at risk from the same types of flows during future volcanic eruptions.

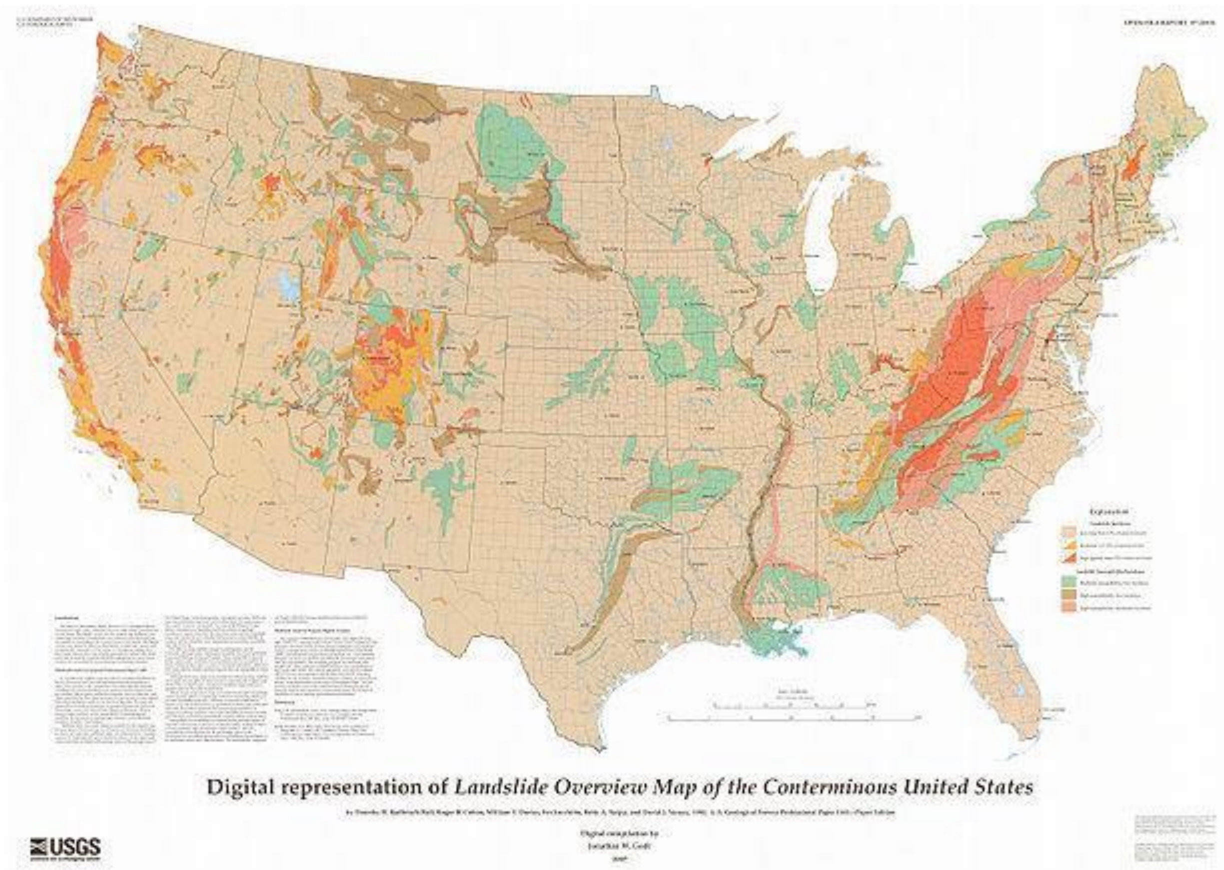
Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, and developed hillsides where leach-field septic systems are used. Areas that are typically considered safe from landslides include areas that have not moved in the past, relatively flat-lying areas away from sudden changes in slope, and areas at the top or along ridges set back from the tops of slopes.

According to the United States Geological Survey, each year landslides cause $5.1 billion (2009 dollars) in damage and between 25 and 50 deaths in the United States.[6] **Figure 5.14** delineates areas where large numbers of landslides have occurred and areas that are susceptible to landsliding in the conterminous United States.[7]

[6] United States Geological Survey (USGS). United States Department of the Interior. "Landslide Hazards – A National Threat." 2005.

[7] This map layer is provided in the U.S. Geological Survey Professional Paper 1183, Landslide Overview Map of the Conterminous United States, available online at: http://landslides.usgs.gov/html_files/landslides/nationalmap/national.html.

Figure 5.16: LANDSLIDE OVERVIEW MAP OF THE CONTERMINOUS UNITED STATES[8]



Landslide Incidence		Landslide Susceptibility/Incidence	
	Low Incidence (less than 1.5% of area involved)		Moderate susceptibility/low incidence
	Moderate Incidence (1.5%-15% of area involved)		High susceptibility/low incidence
	High Incidence (greater than 15% of area involved		High susceptibility/moderate incidence

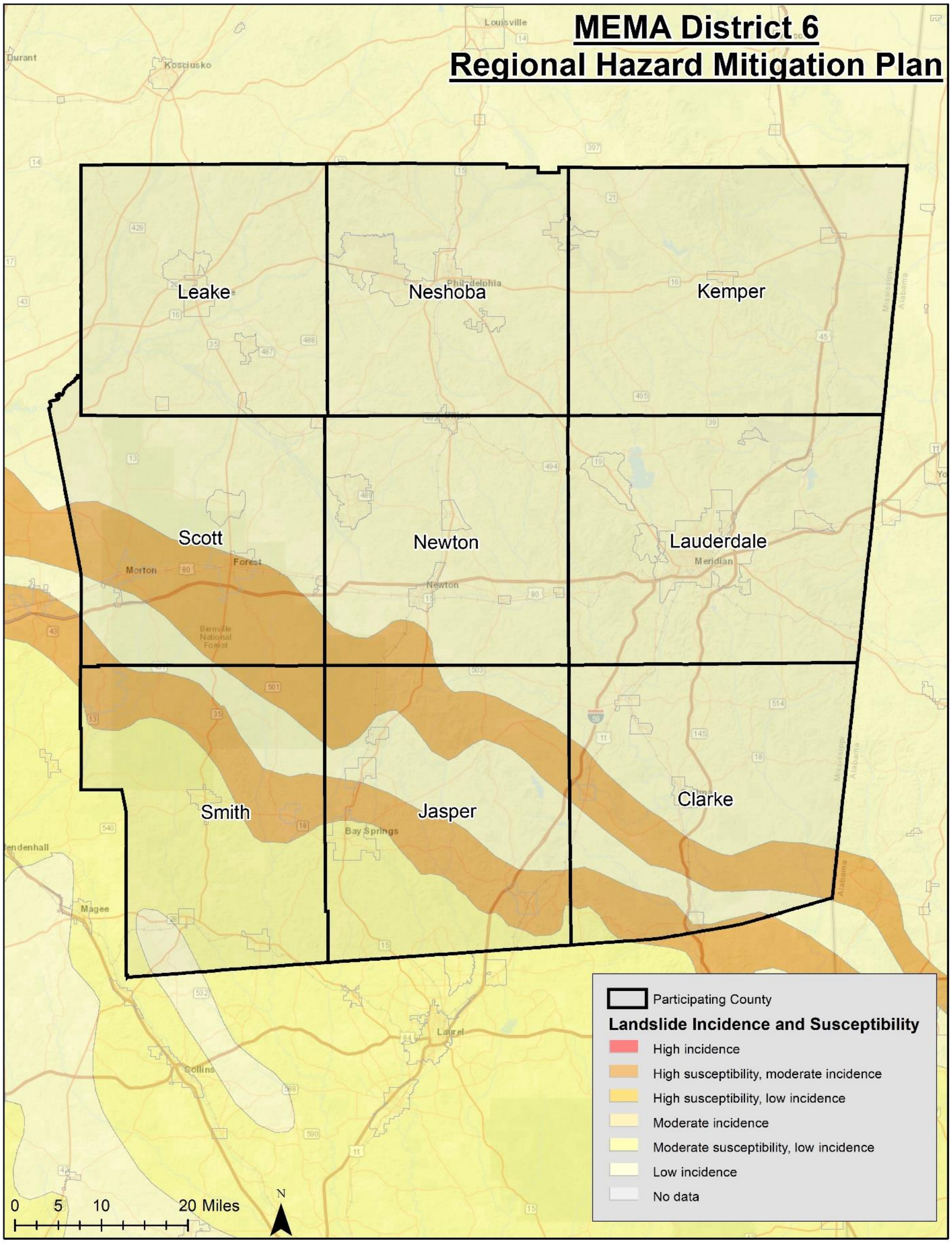
Source: United States Geological Survey

[8] Susceptibility not indicated where same or lower than incidence. Susceptibility to landsliding was defined as the probable degree of response of [the areal] rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated.

5.10.2 Location and Spatial Extent

Landslides occur along steep slopes when the pull of gravity can no longer be resisted (often due to heavy rain). Human development can also exacerbate risk by building on previously undevelopable steep slopes. Landslides are possible throughout the MEMA District 6 Region, though the risk is relatively low. According to figure below, the majority of the region falls under a low incidence area. This indicates that less than 1.5 percent of the area is involved in landsliding. There are also some areas in the southwestern portion of the region that are moderate incidence areas. This indicates that between 1.5 and 10 percent of the area is involved in landsliding.

Figure 5.17: LANDSLIDE SUSCEPTIBILITY MAP OF THE MEMA DISTRICT 6 REGION



Source: United States Geological Survey

5.10.3 Historical Occurrences

There is no extensive history of landslides in the MEMA District 6 Region. Landslide events typically occur in isolated areas, but no major landside events were reported.

5.10.4 Probability of Future Occurrences

Based on historical information and the USGS susceptibility index, the probability of future landslide events is unlikely (less than 1 percent annual probability). The USGS data indicates that most areas in the MEMA District 6 Region have a low incidence rate and low susceptibly to landsliding activity. There are also some areas in the southwestern corner of the region with moderate susceptibility to landsliding as well as additional areas with moderate incidence and high susceptibility. Local conditions may become more favorable for landslides due to heavy rain, for example. This would increase the likelihood of occurrence. It should also be noted that some areas in the MEMA District 6 Region have greater risk than others given factors such as steepness on slope and modification of slopes.

5.11 LAND SUBSIDENCE

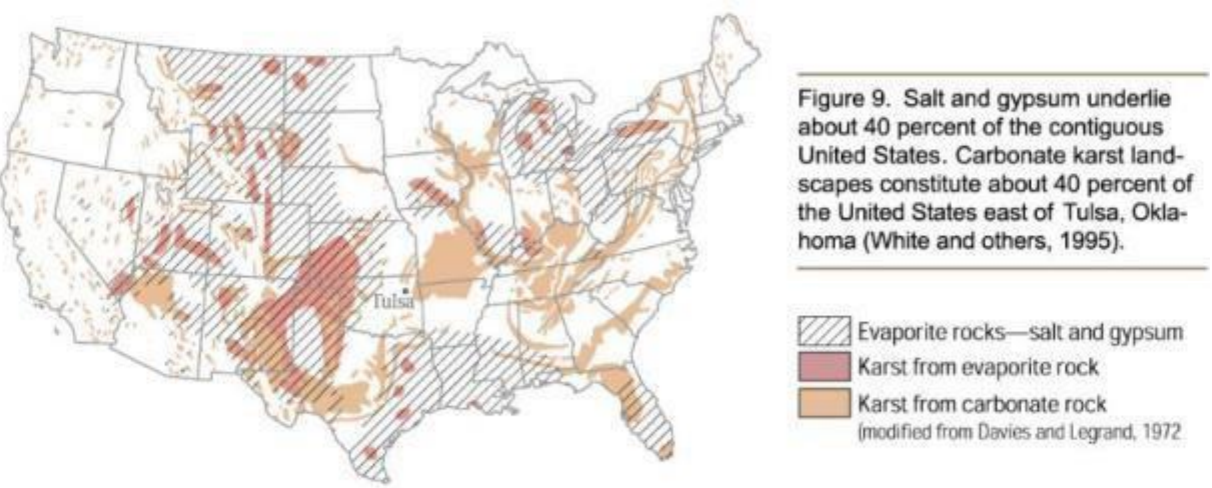
5.11.1 Background

Land subsidence is the gradual settling or sudden sinking of the Earth's surface due to the subsurface movement of earth materials. This can occur over a large area or a small spot, creating a sinkhole. Causes of land subsidence include groundwater pumpage, aquifer system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost.

The geological composition of an area impacts the potential for subsidence. Karst and evaporative rock contribute to land subsidence. Karst is distinctive topography in which the landscape is largely shaped by the dissolving action of water on carbonate bedrock (usually limestone, dolomite, or marble). As groundwater flows, voids are created from dissolving subsurface foundations. Karst topography includes land subsidence in the form of sink holes, which is brought on by sinking soils resulting from caves or cavities below the surface. Evaporative rock (salt and gypsum) are soluble in water and large cavity formations can occur. Sink holes or cavity collapses occur when these underground voids are created naturally, or artificially, and then collapse due to natural or human induced forces.

Figure below shows the location of rock types associated with subsidence in the United States.

Figure 5.18: MAP OF ROCK TYPES ASSOCIATED WITH SUBSIDENCE IN THE UNITED STATES



Source: United States Geological Survey

According to the U.S. Geological Survey (USGS), subsidence affects an estimated 17,000 square miles in 45 states. Salt and gypsum underlie about 35 to 40 percent of the United States, though in many areas they are buried at great depths.

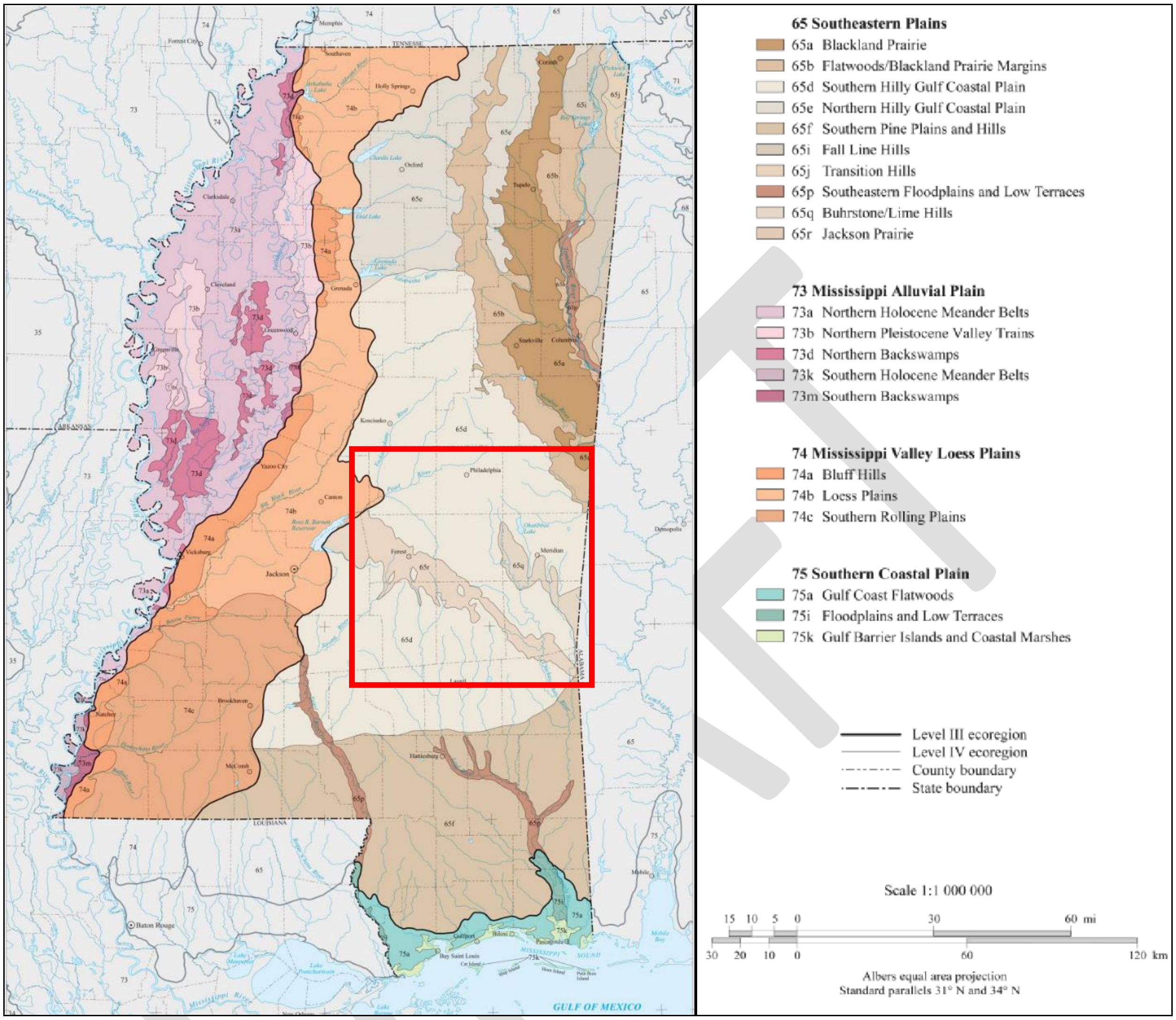
Underground mining of coal, salt, limestone, and gypsum contribute to subsidence. Most mining is accomplished by direct human action utilizing heavy machinery to remove the material; however, with salt there are cases where pressurized water is used to wash-out the deposit (solution mining). All of these mines create voids under the Earth's surface. Several key factors determining the potential for these voids to collapse include depth, mining technique used, types of rock and or soils, and development on the ground surface.

Subsidence causes regional drainage patterns to change. This can impact flooding, back up storm drains, and damage infrastructure. Subsidence can also negatively impact riverine flooding by altering the topography and rupture land surface.

5.11.2 Location and Spatial Extent

Much of the MEMA D6 region is located in an area where the soil is substantially clay, causing a shrink and swell effect depending on the current conditions. Indeed, much of the area underlain by the calcareous Yazoo clay which, when combined with sand and marl, is highly susceptible to expansion when wet and shrinking when dry. These areas are denoted below.

Figure 5.19: MAP OF MISSISSIPPI SOILS



Source: http://www.eoearth.org/view/article/152119/

5.11.3 Historical Occurrences

Although there is no significant historical record of land subsidence in the MEMA District 6 Region, anecdotal evidence of isolated incidents has been reported. Many local county officials have noted the impacts from these swings and changes in soil as roads and other infrastructure have experienced large cracks and breaks, causing stops in daily operations and significant costs to local, state, and federal budgets. Often the cost to repair this infrastructure can be in the range of millions of dollars depending on the degree of damage and necessity for quick repairs.

5.11.4 Probability of Future Occurrences

The probability of future land subsidence events in the region is unlikely (less than 1 percent annual probability). The potential for land subsidence may be impacted by local conditions such as heavy rain or extremely dry periods.

WIND-RELATED HAZARDS

5.12 HURRICANE AND TROPICAL STORM

5.12.1 Background

Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in the Atlantic basin is about six.

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Scale (**Table 5.20**), which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

Table 5.20: SAFFIR-SIMPSON SCALE

Category	Maximum Sustained Wind Speed (MPH)
1	74–95
2	96–110
3	111–129
4	130–156
5	157 +

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure and storm surge potential, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as "major" hurricanes and, while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. **Table 5.21** describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge, and inland flooding associated with heavy rainfall that usually accompanies these storms.

Table 5.21: HURRICANE DAMAGE CLASSIFICATIONS

Storm Category	Damage Level	Description of Damages	Photo Example
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.	
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.	
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland.	
4	EXTREME	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.	
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.	

Source: National Hurricane Center; Federal Emergency Management Agency

5.12.2 Location and Spatial Extent

Hurricanes and tropical storms threaten the entire Atlantic and Gulf seaboard of the United States. While coastal areas are most directly exposed to the brunt of landfalling storms, their impact is often felt hundreds of miles inland and they can affect the MEMA District 6 Region. All areas in the MEMA District 6 Region are equally susceptible to hurricane and tropical storms.

5.12.3 Historical Occurrences

According to the National Hurricane Center's historical storm track records, 57 hurricane or tropical storm/depression tracks have passed within 75 miles of the MEMA District 6 Region since 1855.[15] This includes: 1 Category 3 hurricane, 2 Category 2 hurricanes, 5 Category 1 hurricanes, 33 tropical storms, and 16 tropical depressions.

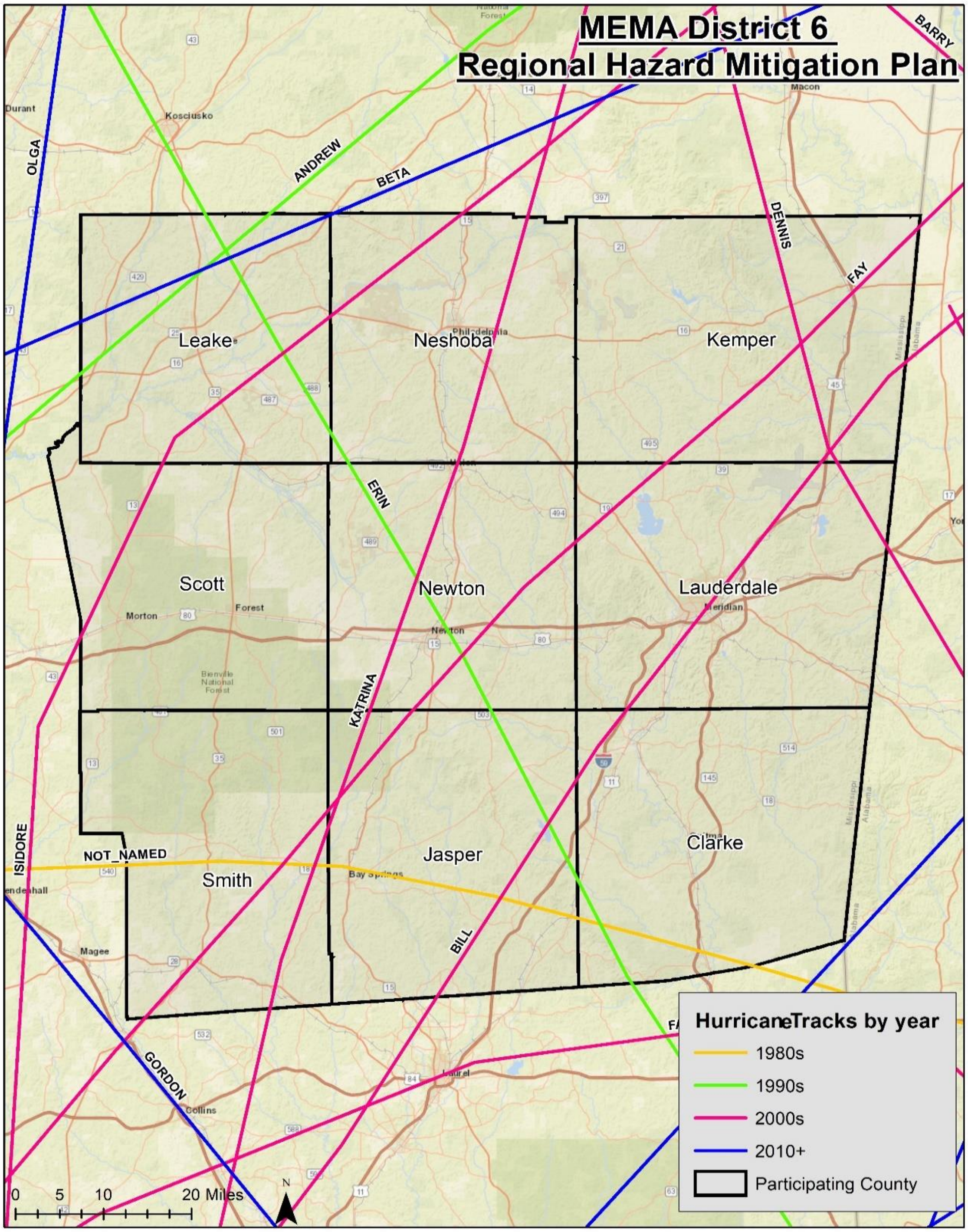
Of the recorded storm events, 35 hurricane or tropical storm/depression events traversed directly through the region as shown in the figure below. Notable storms include Hurricane Frederic (1979) and Hurricane Katrina (2005). The following table provides for each event the date of occurrence, name (if

[15] These storm track statistics include tropical depressions, tropical storms, and hurricanes. Lesser events may still cause

significant local impact in terms of rainfall and high winds.

applicable), maximum wind speed (as recorded within 75 miles of the MEMA District 6 Region) and category of the storm based on the Saffir-Simpson Scale.

Figure 5.20: HISTORICAL HURRICANE STORM TRACKS WITHIN 75 MILES OF THE MEMA DISTRICT 6 REGION



Source: National Oceanic and Atmospheric Administration, National Hurricane Center

Table 5.22: HISTORICAL STORM TRACKS WITHIN 75 MILES OF THE MEMA 6 DISTRICT REGION (1850–2020)

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
9/16/1855	UNNAMED	70	Category 1
9/15/1860	UNNAMED	70	Category 1
7/12/1872	UNNAMED	40	Tropical Storm
9/2/1879	UNNAMED	60	Tropical Storm
10/7/1879	UNNAMED	40	Tropical Storm
10/16/1879	UNNAMED	40	Tropical Storm
9/1/1880	UNNAMED	50	Tropical Storm
8/3/1881	UNNAMED	40	Tropical Storm
6/14/1887	UNNAMED	30	Tropical Depression
8/28/1890	UNNAMED	35	Tropical Storm
9/12/1892	UNNAMED	40	Tropical Storm
9/8/1893	UNNAMED	55	Tropical Storm
8/17/1895	UNNAMED	35	Tropical Storm
8/3/1898	UNNAMED	35	Tropical Storm
8/16/1901	UNNAMED	45	Tropical Storm
10/10/1905	UNNAMED	35	Tropical Storm
9/27/1906	UNNAMED	95	Category 2
9/22/1907	UNNAMED	35	Tropical Storm
6/13/1912	UNNAMED	50	Tropical Storm
7/17/1912	UNNAMED	25	Tropical Depression
9/14/1912	UNNAMED	50	Tropical Storm
9/30/1915	UNNAMED	60	Tropical Storm
7/6/1916	UNNAMED	80	Category 1
7/5/1919	UNNAMED	30	Tropical Depression
10/18/1923	UNNAMED	50	Tropical Storm
7/30/1926	UNNAMED	25	Tropical Depression
9/1/1932	UNNAMED	60	Tropical Storm
10/16/1932	UNNAMED	45	Tropical Storm
8/1/1936	UNNAMED	40	Tropical Storm
9/1/1937	UNNAMED	30	Tropical Depression
6/16/1939	UNNAMED	35	Tropical Storm
8/14/1939	UNNAMED	35	Tropical Storm
9/26/1939	UNNAMED	40	Tropical Storm
9/25/1940	UNNAMED	20	Tropical Depression
9/4/1948	UNNAMED	50	Tropical Storm
9/5/1949	UNNAMED	40	Tropical Storm
8/31/1950	BAKER	65	Category 1
6/1/1959	ARLENE	25	Tropical Depression
9/16/1960	ETHEL	35	Tropical Storm
9/26/1960	FLORENCE	15	Tropical Depression

Date of Occurrence	Storm Name	Maximum Wind Speed (knots)	Storm Category
8/18/1969	CAMILLE	100	Category 3
9/16/1971	EDITH	60	Tropical Storm
7/19/1977	UNNAMED	25	Tropical Depression
9/6/1977	BABE	30	Tropical Depression
7/11/1979	BOB	40	Tropical Storm
9/13/1979	FREDERIC	95	Category 2
8/12/1987	UNNAMED	25	Tropical Depression
8/27/1992	ANDREW	30	Tropical Depression
8/4/1995	ERIN	45	Tropical Storm
8/6/2001	BARRY	20	Tropical Depression
9/26/2002	ISIDORE	55	Tropical Storm
7/1/2003	BILL	45	Tropical Storm
7/11/2005	DENNIS	45	Tropical Storm
8/29/2005	KATRINA	80	Category 1
9/14/2007	HUMBERTO	20	Tropical Depression
8/24/2008	FAY	30	Tropical Depression
8/17/2009	CLAUDETTE	25	Tropical Depression
10/28/2020	Zeta	33	Tropical Depression

*It should be noted that the track of several major hurricanes that impacted the region fell outside of the 75-mile buffer. These storms were included in the table due to their significant impact. (Georges, 1988; Ivan, 2004; Issac, 2012)

Source: National Hurricane Center - retrieved April 2021

Federal records indicate that seven disaster declarations were made in 1969 (Hurricane Camille), 1979 (Hurricane Frederic), 1998 (Hurricane Georges), 2004 (Hurricane Ivan), 2005 (Hurricane Dennis and Hurricane Katrina), and 2012 (Hurricane Isaac).[16] Hurricane and tropical storm events can cause substantial damage in the area due to high winds and flooding.

Flooding and high winds from hurricanes and tropical storms can cause damage throughout the region. Anecdotes are available from NCEI for the major storms that have impacted the area as found below:

Tropical Storm Isidore – September 26, 2002

The heavy rainfall associated with Tropical Storm Isidore resulted in significant river and flash flooding across much of Mississippi. Twenty-four-hour rainfall totals between 5 and 10 inches were common over much of Mississippi, especially in the southern part of the state, where 24-hour amounts exceeded 9 inches near Hattiesburg. Gradient wind gusts between 35 and 45 miles per hour combined with the saturated ground to lead to numerous downed trees and powerlines over the state. Most of the damage was seen along and east of the Natchez Trace, near the path of the storm's diffuse center. One indirect fatality was reported just east of the Kalem community in Scott County. Here, a falling tree struck a truck driven by a 31-year-old male. Damage from Isidore was an estimated $500,000.

Tropical Storm Bill – June 30 and July 1, 2003

Heavy rainfall with Tropical Storm Bill resulted in several reports of flash flooding. Forty-eight-hour rainfall totals ranged between 3 and 7 inches, mainly across SE portions of Mississippi. Gradient wind gusts between 30 and 40 mph combined with saturated soils to down numerous trees very close to center's track. Damage from Bill was an estimated $100,000.

Hurricane Ivan – September 16, 2004
Thousands of trees were blown down across Eastern Mississippi during Hurricane Ivan as well as hundreds of power lines. The strong wind itself did not cause much structural damage, however the fallen trees did. These downed trees accounted for several hundred homes, mobile homes and businesses to be damaged or destroyed. Most locations across Eastern Mississippi reported sustained winds between 30 and 40 mph with Tropical Storm force gusts between 48 and 54 mph. The strongest reported winds occurred in Newton, Lauderdale and Oktibbeha Counties.

Overall, rainfall totals were held in check as Ivan steadily moved north. The heaviest rains were confined to far Eastern Mississippi where 3 to 4 inches fell over a 15-hour period. Due to the duration of the rain no flooding was reported. Across Eastern Mississippi, Hurricane Ivan was responsible for one fatality. This fatality occurred in Brooksville (Noxubee County) when a tree fell on a man. Damage from Ivan was estimated at $200 million.

Tropical Storm Arlene – June 11, 2005
The western periphery of Tropical Storm Arlene affected far Eastern Mississippi during the evening and brought gusty winds and locally heavy rains to that portion of the state. Peak wind gusts were reported up to 40 mph and the combination of wet soils allowed for a few hundred trees to get blown down or uprooted. Several of the downed trees took down power lines and a small few landed on homes causing damage. Additionally, the counties across Eastern Mississippi received 3 to 5 inches of rain as Arlene lifted north.

Hurricane Dennis – July 10, 2005
Hurricane Dennis moved north-northwest across Southwest Alabama and then into East-Central Mississippi and finally across Northeast Mississippi. Wind gusts over tropical storm force were common across areas east of a line from Starkville to Newton to Hattiesburg. These winds caused several hundred trees to uproot or snap and took down numerous power lines. Additionally, a total of 21 homes or businesses sustained minor to major damage from fallen trees or gusty winds.

Heavy rainfall was not a major issue as Dennis steadily moved across the region. Rainfall totals between 2 and 5 inches fell across Eastern Mississippi over a 12-hour period. One indirect fatality occurred in Jasper County from an automobile accident due to wet roads.

Hurricane Katrina – August 29, 2005
Hurricane Katrina will likely go down as the worst and costliest natural disaster in United States history. The amount of destruction, the cost of damaged property/agriculture and the large loss of life across the affected region has been overwhelming. Catastrophic damage was widespread across a large portion of the Gulf Coast region. The devastation was not only confined to the coastal region, widespread and significant damage occurred well inland up to the Hattiesburg area and northward past Interstate 20.

Hurricane force winds were common across Central Mississippi. The region received sustained winds of 60-80 mph with gusts ranging from 80-120 mph. Wind damage to structures was widespread, with roofs blown off or partially peeled. Hundreds of signs were shredded or blown down. Many businesses sustained structural damage as windows were broken, roofs were blown off, and walls were collapsed. Millions of trees were uprooted and snapped. Power poles and lines were snapped and taken down from wind and trees. It was thousands of downed trees which caused the most significant structural damage as these trees fell onto homes and businesses. Power outages lasted from a few days to as long as four weeks. Agriculture and timber industries were severely impacted. Row crops, including cotton, rice, corn, and soybeans, took a hard hit. Other impacted industries were the catfish industry, dairy and cattle industry, and nursery businesses.

5.12.4 Probability of Future Occurrences

Given the inland location of the region, it is more likely to be affected by remnants of hurricane and tropical storm systems (as opposed to a major hurricane) which may result in flooding or high winds. The probability of being impacted is less than coastal areas, but still remains a real threat to the MEMA District 6 Region due to induced events like flooding. Based on historical evidence, the probability level of future occurrence is likely (between 10 and 100 percent annual probability). Given the regional nature of the hazard, all areas in the region are equally exposed to this hazard. However, when the region is impacted, the damage could be catastrophic, threatening lives and property throughout the planning area.

5.13 THUNDERSTORM (WIND, HAIL, LIGHTNING)

5.13.1 Background

THUNDERSTORM / HIGH WIND

Thunderstorms can produce a variety of accompanying hazards including wind (discussed here), hail, and lightning. Although thunderstorms generally affect a small area, they are very dangerous may cause substantial property damage.

Three conditions need to occur for a thunderstorm to form. First, it needs moisture to form clouds and rain. Second, it needs unstable air, such as warm air that can rise rapidly (this often referred to as the “engine” of the storm). Third, thunderstorms need lift, which comes in the form of cold or warm fronts, sea breezes, mountains, or the sun’s heat. When these conditions occur simultaneously, air masses of varying temperatures meet, and a thunderstorm is formed. These storm events can occur singularly, in lines, or in clusters. Furthermore, they can move through an area very quickly or linger for several hours.

According to the National Weather Service, more than 100,000 thunderstorms occur each year, though only about 10 percent of these storms are classified as “severe.” A severe thunderstorm occurs when the storm produces at least one of these three elements: 1) hail of three-quarters of an inch, 2) a tornado, or 3) winds of at least 58 miles per hour.

Downbursts are also possible with thunderstorm events. Such events are an excessive burst of wind in excess of 125 miles per hour. They are often confused with tornadoes. Downbursts are caused by down drafts from the base of a convective thunderstorm cloud. It occurs when rain-cooled air within the cloud becomes heavier than its surroundings. Thus, air rushes towards the ground in a destructive yet isolated manner. There are two types of downbursts. Downbursts less than 2.5 miles wide, duration less than 5 minutes, and winds up to 168 miles per hour are called “microbursts.” Larger events greater than 2.5 miles at the surface and longer than 5 minutes with winds up to 130 miles per hour are referred to as “macrobursts.”

HAILSTORM

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until they develop to a sufficient weight and fall as precipitation. Hail typically takes the form of spheres or irregularly-shaped masses greater than 0.75 inches in diameter. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size. **Table 5.23** shows the TORRO Hailstorm Intensity Scale which is a way of measuring hail severity.

Table 5.23: TORRO HAILSTORM INTENSITY SCALE

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	mm to inch conversion (inches)	Typical Damage Impacts
H0	Hard Hail	5	0-20	0 - 0.2	No damage
H1	Potentially Damaging	5-**15**	>20	0.2 - 0.6	Slight general damage to plants, crops
H2	Significant	10-**20**	>100	0.4 - 0.8	Significant damage to fruit, crops, vegetation
H3	Severe	20-**30**	>300	0.8 - 1.2	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-**40**	>500	1.0 - 1.6	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-**50**	>800	1.2 - 2.0	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-**60**		1.6 - 2.4	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-**75**		2.0 - 3.0	Severe roof damage, risk of serious injuries
H8	Destructive	60-**90**		1.6 - 3.5	(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-**100**		3.0 - 3.9	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100			Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: http://www.torro.org.uk/site/hscale.php

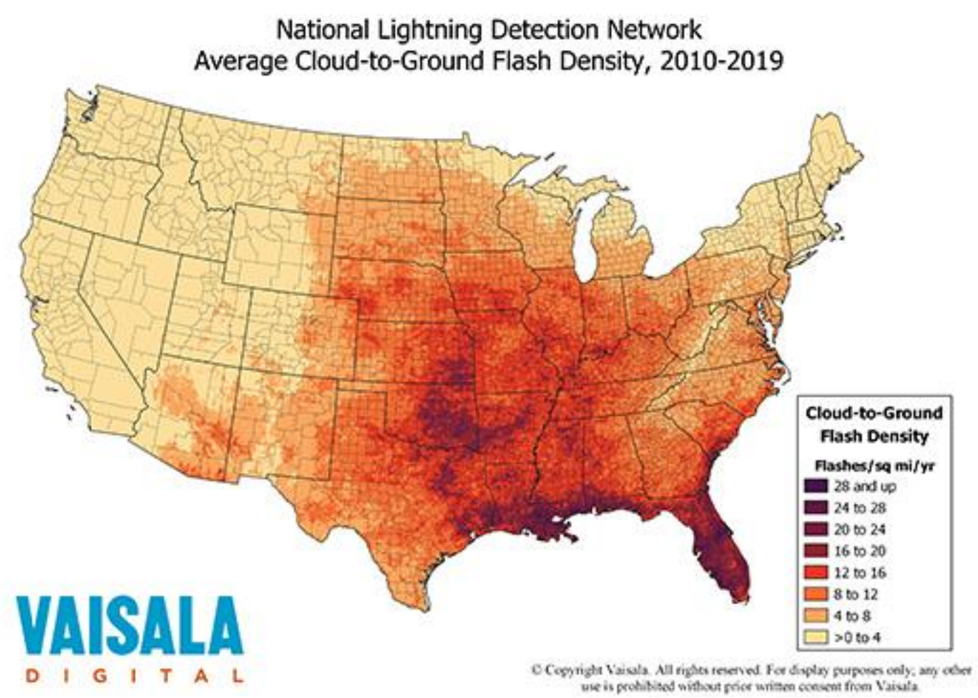
LIGHTNING

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a “bolt” when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes the thunder which often accompanies lightning strikes. While most often affiliated with severe thunderstorms, lightning may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

Lightning strikes occur in very small, localized areas. For example, they may strike a building, electrical transformer, or even a person. According to FEMA, lightning injures an average of 300 people and kills 80 people each year in the United States. Direct lightning strikes also have the ability to cause significant damage to buildings, critical facilities, and infrastructure largely by igniting a fire. Lightning is also responsible for igniting wildfires that can result in widespread damages to property.

Figure below shows the Vaisala’s U.S. National Lightning Detection Network which indicates the average flash density per foot per square kilometer per year.

Figure 5.21: LIGHTNING FLASH DENSITY IN THE UNITED STATES



Source: Vaisala United States National Lightning Detection Network

5.13.2 Location and Spatial Extent

THUNDERSTORM / HIGH WIND

A thunderstorm event is an atmospheric hazard, and thus has no geographic boundaries. It is typically a widespread event that can occur in all regions of the United States. However, thunderstorms are most common in the central and southern states because atmospheric conditions in those regions are favorable for generating these powerful storms. It is assumed that the MEMA District 6 Region has uniform exposure to an event and the spatial extent of an impact could be large.

The following Beaufort scale is an empirical measure for the intensity of the wind associated with windstorms.

Table 5:24A: Beaufort Wind Scale

Beaufort Scale					
NUMBER	**WIND SPEED (MPH)**	**DESCRIPTION**	**WAVE HEIGHT (FT)**	**SEA CONDITIONS**	**LAND CONDITIONS**
0	<1	Calm	0	Flat.	Calm. Smoke rises vertically.
1	1-3	Light air	0.33	Ripples without crests.	Wind motion visible in smoke.
2	3-7	Light breeze	0.66	Small wavelets.	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	2	Large wavelets.	Leaves and smaller twigs in constant motion.
4	13-17	Moderate breeze	3.3	Small waves.	Dust and loose paper rise. Small branches begin to move.
5	18-24	Fresh breeze	6.6	Moderate (1.2 m) longer waves. Some foam and spray.	Small trees sway.
6	25-30	Strong breeze	9.9	Large waves with foam crests and some spray.	Large branches in motion. Whistling heard in overhead wires. Umbrella use difficult.
7	31-38	High wind, Moderate Gale, Near Gale	13.1	Sea heaps up and foam begins to streak.	Whole trees in motion. Effort needed to walk against the wind.

Beaufort Scale					
NUMBER	WIND SPEED (MPH)	DESCRIPTION	WAVE HEIGHT (FT)	SEA CONDITIONS	LAND CONDITIONS
8	39-46	Fresh Gale	18	Moderately high waves with breaking crests forming spindrift. Streaks of foam.	Twigs broken from trees. Cars veer on road.
9	47-54	Strong Gale	23	High waves (6-7 m) with dense foam. Wave crests start to roll over. Considerable spray.	Larger branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	55-63	Whole Gale/Storm	29.5	Very high waves. The sea surface is white and there is considerable tumbling.	Trees uprooted. Considerable structural damage.
11	64-72	Violent storm	37.7	Exceptionally high waves.	Widespread vegetation and structural damage.
12	≥73	Hurricane-force	≥46	Huge waves. Sea is completely white with foam and spray. Air is filled with driving spray, reduced visibility.	Massive and widespread damage to structures.

Source: www.spc.noaa.gov

Although wind damage associated with thunderstorms is normally minor, the extent to which MEMA District 6 could be affected by high winds is not insignificant. As an example of the intensity of winds that MEMA District 6 may experience, a thunderstorm on record in Lauderdale County indicated damage associated with 68 kts, which equates to 78 mile per hour straight line winds and a Number 12 on the Beaufort Scale. In this scenario, building damage would be significant, power lines downed, trees uprooted, and loss of life possible. This same category of thunderstorm wind could also happen elsewhere in the planning area. Historically, windstorms in the region fall within the 50-60kts, which equates to 57-69 miles per hour and a Number 10-11 on the Beaufort Scale.

HAILSTORM

Hailstorms frequently accompany thunderstorms, so their locations and spatial extents coincide. It is assumed that the MEMA District 6 Region is uniformly exposed to severe thunderstorms; therefore, all areas of the region are equally exposed to hail which may be produced by such storms.

LIGHTNING

Lightning occurs randomly, therefore it is impossible to predict where and with what frequency it will strike. It is assumed that all of the MEMA District 6 Region is uniformly exposed to lightning.

5.13.3 Historical Occurrences

THUNDERSTORM / HIGH WIND

Severe storms were at least partially responsible for 21 disaster declarations in the MEMA District 6 Region in between 1971 and 2021. According to NCEI, there have been 2,292 reported thunderstorm and high wind events since 1955 in the MEMA District 6 Region. These events caused over $57.9 million in damages. There were also reports of 6 fatalities and 34 injuries. **Table 5.24B** summarizes this information. Detailed thunderstorm and high wind event reports including date, magnitude, and associated damages for each event are presented in the county-specific annexes.

Table 5.24B: SUMMARY OF THUNDERSTORM / HIGH WIND OCCURRENCES IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	215	0/0	$3,820,000
Jasper County	222	0/1	$3,424,000
Kemper County	140	0/7	$1,862,000
Lauderdale County	309	1/4	$6,181,000
Lauderdale County	357	1/4	$6,130,000
Leake County	208	2/6	$8,727,000
Neshoba County	223	1/8	$5,081,000
Newton County	208	1/2	$5,010,000
Scott County	189	0/2	$12,100,000
Smith County	221	0/0	$5,604,000
MEMA DISTRICT 6 REGIONAL TOTAL	2,292	6/34	$57,939,000

Source: National Centers for Environmental Information - retrieved April 2021

HAILSTORM

According to the National Centers for Environmental Information, 891 recorded hailstorm events have affected the MEMA District 6 Region since 1960. **Table 5.25** is a summary of the hail events in the MEMA District 6 Region. Detailed information about each event that occurred in the region is provided in the county- specific annexes. In all, hail occurrences resulted in over $12.98 million in property damages, with significantly higher damages reported in Kemper County and Smith County. Hail ranged in diameter from 0.75 inches to 4.5 inches. It should be noted that hail is notorious for causing substantial damage to cars, roofs, and other areas of the built environment that may not be reported to the National Centers for Environmental Information. Furthermore, high losses in Kemper County and Smith County indicate that neighboring counties may also be subject to additional, unreported losses. Therefore, it is likely that damages are greater than the reported value. Additionally, a single storm event may have affected multiple counties. On an annualized basis, hail accounts for roughly $212,000 in losses to the MEMA District 6 Region.

Table 5.25: SUMMARY OF HAIL OCCURRENCES IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	**82**	**0/0**	**$372,000**
Jasper County	**99**	**0/0**	**$548,000**
Kemper County	**78**	**0/0**	**$1,215,000**
Lauderdale County	**151**	**0/0**	**$534,000**
Leake County	**77**	**0/0**	**$433,500**
Neshoba County	**111**	**0/0**	**$1,685,000**
Newton County	**116**	**0/0**	**$475,000**
Scott County	**87**	**0/0**	**$5,509,000**
Smith County	**90**	**0/0**	**$2,209,000**
MEMA DISTRICT 6 REGIONAL TOTAL	**891**	**0/0**	**$12,980,500**

Source: National Centers for Environmental Information - retrieved April 2021

LIGHTNING

According to the National Centers for Environmental Information, there have been a total of 25 recorded lightning events in the MEMA District 6 Region since 1998. These events resulted in over $2.1 million in damages, as listed in summary **Table 5.26**. Furthermore, lightning has caused one fatality and three injuries in the MEMA District 6 Region. Detailed information on historical lightning events can be found in the county-specific annexes.

It is certain that more than 25 events have impacted the region. Many of the reported events are those that cause damage, and it should be expected that damages are likely much higher for this hazard than what is reported.

Table 5.26: SUMMARY OF LIGHTNING OCCURRENCES IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	7	1/1	$237,000
Jasper County	2	0/0	$25,000
Kemper County	1	0/0	$250,000
Lauderdale County	1	0/2	$0
Leake County	3	0/0	$113,000
Neshoba County	6	0/3	$103,000
Newton County	1	0/0	$150,000
Scott County	2	0/0	$155,000
Smith County	2	0/0	$1,103,000
MEMA DISTRICT 6 REGIONAL TOTAL	25	1/6	$2,136,000

Source: National Centers for Environmental Information - retrieved April 2021

5.13.4 Probability of Future Occurrences

THUNDERSTORM / HIGH WIND

Given the high number of previous events, it is certain that thunderstorm events, including straight-line wind events, will occur in the future. This results in a probability level of highly likely (100 percent annual probability) for the entire planning area.

HAILSTORM

Based on historical occurrence information, it is assumed that the probability of future hail occurrences is highly likely (100 percent annual probability). Since hail is an atmospheric hazard, it is assumed that the entire MEMA District 6 Region has equal exposure to this hazard. It can be expected that future hail events will continue to cause minor damage to property and vehicles throughout the region.

LIGHTNING

Although there was not a high number of historical lightning events reported throughout the MEMA District 6 Region via NCEI data, it is a regular occurrence accompanied by thunderstorms. In fact, lightning events will assuredly happen on an annual basis, though all events will not cause damage. According to Vaisala's U.S. National Lightning Detection Network (NLDN), the MEMA District 6 Region is located in an area of the country that experienced an average of 4 to 6 cloud-to-ground lightning flashes per square kilometer per year between 2015 and 2019.[9] Therefore, the probability of future events is highly likely (100 percent annual probability). It can be expected that future lightning events will continue to threaten life and cause minor property damages throughout the region.

[9] Vaisala's Annual Lightning Report – 2020. Retrieved on 9.8.2021 from: https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf

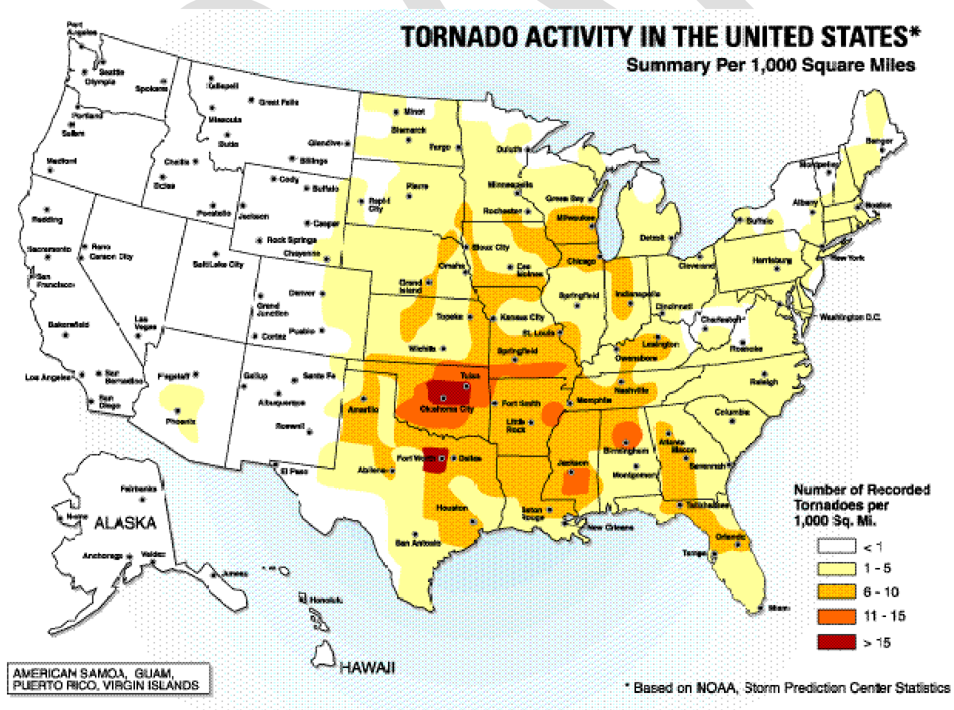
5.14 TORNADO

5.14.1 Background

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes and other tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally range from 40 miles per hour to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries.[24] According to the NOAA Storm Prediction Center (SPC), the highest concentration of tornadoes in the United States has been in Oklahoma, Texas, Kansas, and Florida respectively. Although the Great Plains region of the Central United States does favor the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"), Florida experiences the greatest number of tornadoes per square mile of all U.S. states (SPC, 2002). **Figure 5.20** shows tornado activity in the United States based on the number of recorded tornadoes per 1,000 square miles.

Figure 5.22: TORNADO ACTIVITY IN THE UNITED STATES



Source: Federal Emergency Management Agency

[24] NOAA, 2009.

Tornadoes are more likely to occur during the months of March through May and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings (particularly mobile homes). Tornadic magnitude is reported according to the Fujita and Enhanced Fujita Scales. Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (**Table 5.27**). Tornado magnitudes that were determined in 2005 and later were determined using the Enhanced Fujita Scale (**Table 5.28**).

Table 5.27: THE FUJITA SCALE (EFFECTIVE PRIOR TO 2005)

F-SCALE NUMBER	INTENSITY	WINDSPEED	TYPE OF DAMAGE DONE
F0	GALE TORNADO	40–72 MPH	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	MODERATE TORNADO	73–112 MPH	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	SIGNIFICANT TORNADO	113–157 MPH	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	SEVERE TORNADO	158–206 MPH	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	DEVASTATING TORNADO	207–260 MPH	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	INCREDIBLE TORNADO	261–318 MPH	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6	INCONCEIVABLE TORNADO	319–379 MPH	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Source: National Weather Service

Table 5.28:THE ENHANCED FUJITA SCALE (EFFECTIVE 2005 AND LATER)

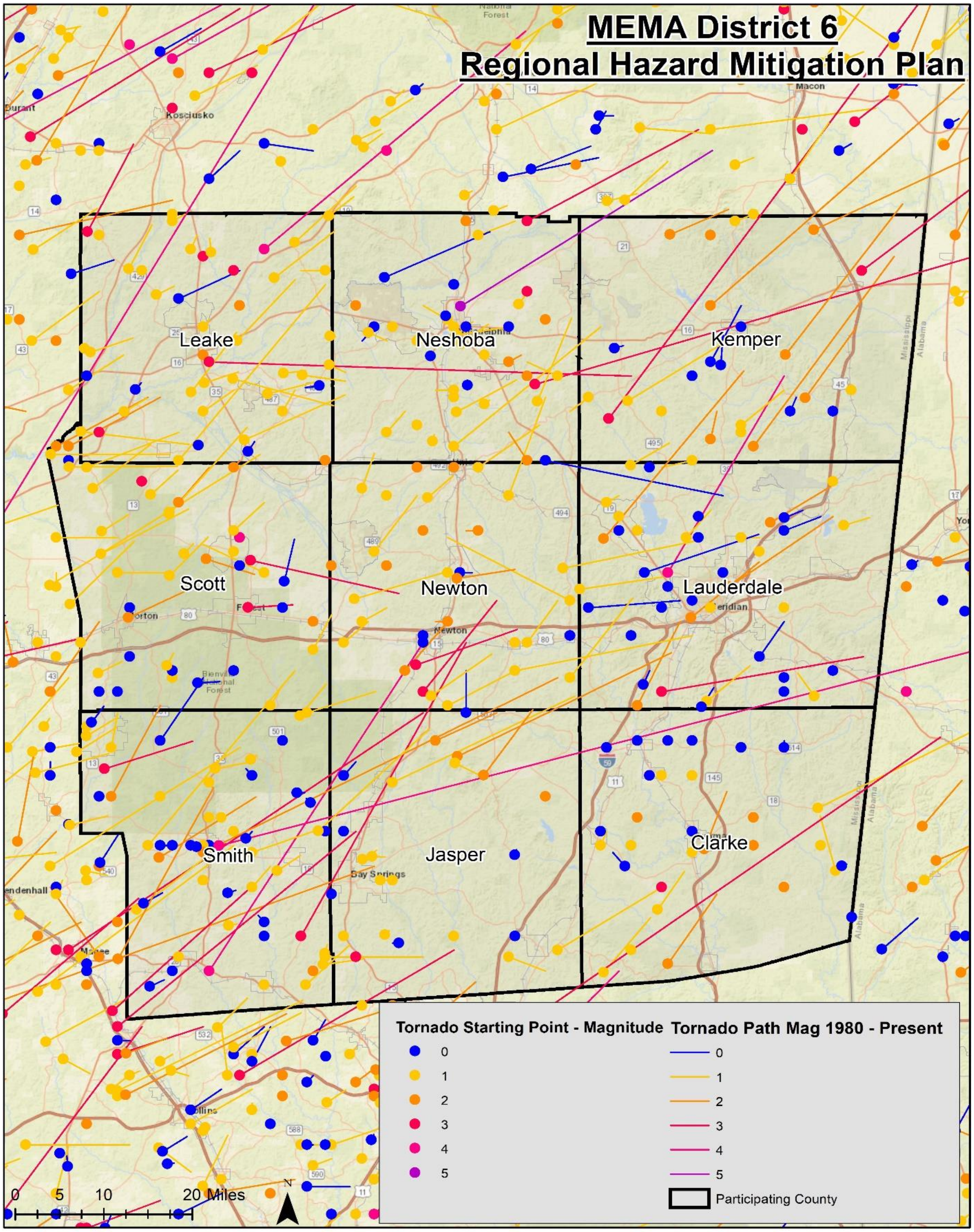
EF-SCALE NUMBER	INTENSITY PHRASE	3 SECOND GUST (MPH)	TYPE OF DAMAGE DONE
EF0	GALE	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	SIGNIFICANT	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	SEVERE	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	DEVASTATING	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	INCREDIBLE	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Source: National Weather Service

5.14.2 Location and Spatial Extent

Tornadoes occur throughout the state of Mississippi, and thus the MEMA District 6 Region. Tornadoes typically impact a relatively small area, but damage may be extensive. Event locations are completely random and it is not possible to predict specific areas that are more susceptible to tornado strikes over time. Therefore, it is assumed that the MEMA District 6 Region is uniformly exposed to this hazard. With that in mind, figure below shows tornado track data for many of the major tornado events that have impacted the region. While no definitive pattern emerges from this data, some areas that have been impacted in the past may be potentially more susceptible in the future.

Figure 5.23: HISTORICAL TORNADO TRACKS IN THE MEMA DISTRICT 6 REGION



Source: National Weather Service Storm Prediction Center

5.14.3 Historical Occurrences

Tornadoes were at least partially responsible for 18 disaster declarations in the MEMA District 6 Region between 1971 and 2021. According to the National Centers for Environmental Information, there have been a total of 471 recorded tornado events in the MEMA District 6 Region since 1950 (**Table 5.29**), resulting in more than $366.250 million in property damages. In addition, 35 fatalities and 464 injuries were reported. The magnitude of these tornadoes ranges from F0 to F5 in intensity. Detailed information on historical tornado events can be found in the county-specific annexes. Annualized, tornadic events account for $5.15 million dollars in losses to the MEMA District 6 Region each year.

Table 5.29: SUMMARY OF TORNADO OCCURRENCES IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	39	4/26	$28,520,000
Jasper County	45	2/21	$50,252,000
Kemper County	34	5/36	$43,075,000
Lauderdale County	51	3/100	$19,497,000
Leake County	67	4/66	$65,986,000
Neshoba County	59	3/69	$76,934,000
Newton County	45	1/42	$19,870,000
Scott County	53	2/20	$10,048,000
Smith County	78	11/84	$52,068,000
MEMA DISTRICT 6 REGIONAL TOTAL	471	35/464	$366,250,000

Source: National Centers for Environmental Information - retrieved April 2021

There have been several significant tornado events in the MEMA District 6 Region. The text below describes one of the major events and associated impacts on the region.

From April 25 to 28, 2011, the largest tornado outbreak ever recorded affected the Southern, Midwestern, and Northeastern U.S., leaving catastrophic destruction in its wake, especially across the states of Alabama and Mississippi. On April 27, 10 tornadoes were reported in the MEMA District 6 region that ranged in magnitude from EF0 to EF5. These tornadoes resulted in 10 fatalities, 20 injuries, and $5,102,934 in property damages across the region.

5.14.4 Probability of Future Occurrences

According to historical information, tornado events pose a significant threat to the MEMA District 6 Region. The probability of future tornado occurrences affecting MEMA District 6 Region is likely (between 10 and 100 percent annual probability).

OTHER HAZARDS

5.15 HAZARDOUS MATERIALS INCIDENTS

5.15.1 Background

Hazardous materials can be found in many forms and quantities that can potentially cause death; serious injury; long-lasting health effects; and damage to buildings, homes, and other property in varying degrees. Such materials are routinely used and stored in many homes and businesses and are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This subsection on the hazardous material hazard is intended to provide a general overview of the hazard, and the threshold for identifying fixed and mobile sources of hazardous materials is limited to general information on rail, highway, and fixed HAZMAT sites determined to be of greatest significance as appropriate for the purposes of this plan.

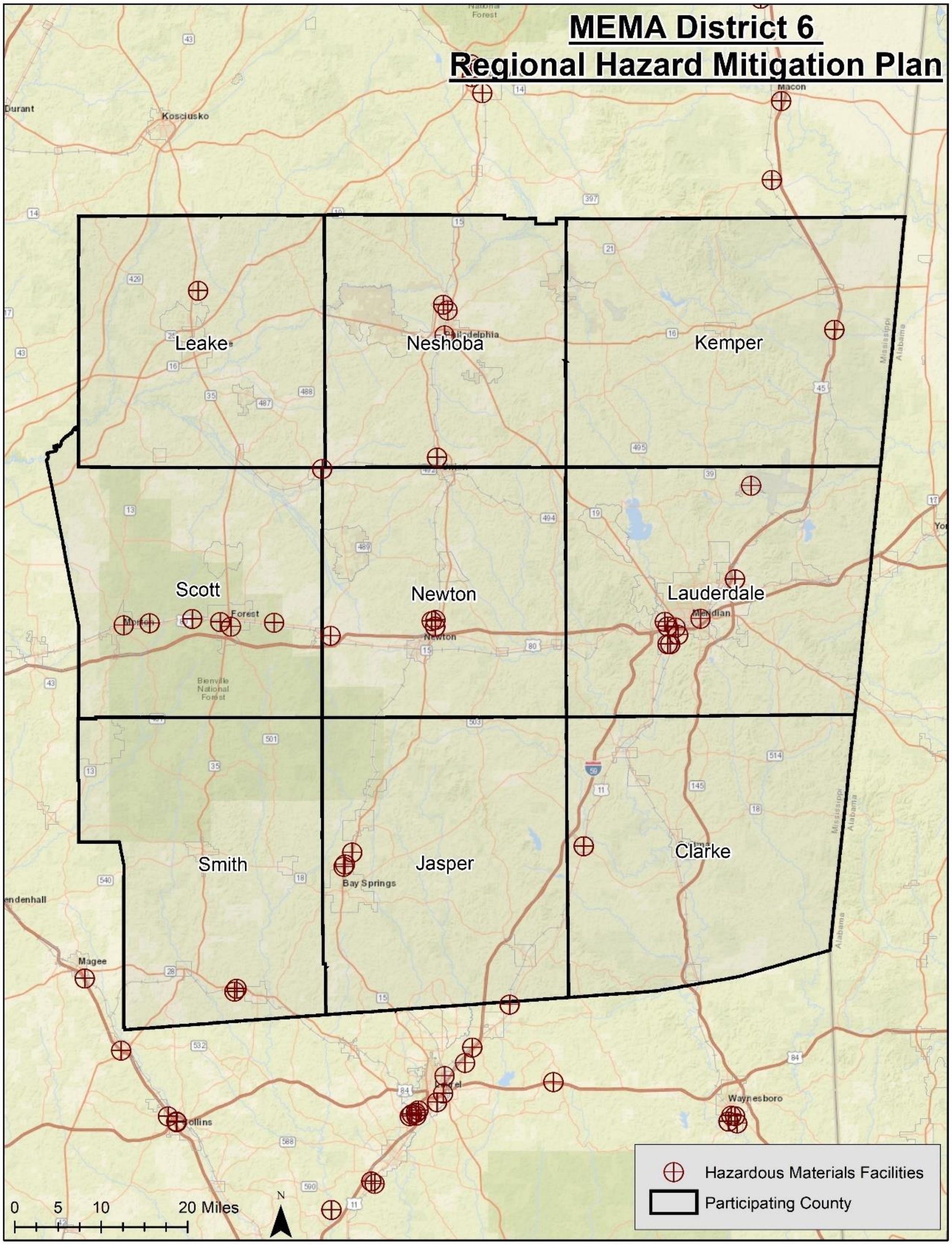
Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation's highways, and on the water. Approximately 6,774 HAZMAT events occur each year, 5,517 of which are highway incidents, 991 are railroad incidents, and 266 are due to other causes. In essence, HAZMAT incidents consist of solid, liquid, and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and possibly wildlife as well.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and
(4) the normal application of fertilizer.

5.15.2 Location and Spatial Extent

As a result of the 1986 Emergency Planning and Community Right to Know Act (EPCRA), the Environmental Protection Agency provides public information on hazardous materials. One facet of this program is to collection information from industrial facilities on the releases and transfers of certain toxic agents. This information is then reported in the Toxic Release Inventory (TRI). TRI sites indicate where such activity is occurring. The MEMA District 6 Region has 32 TRI sites. These sites are shown below.

Figure 5.24: TOXIC RELEASE INVENTORY (TRI) SITES IN THE MEMA DISTRICT 6 REGION



Source: Environmental Protection Agency

In additional to "fixed" hazardous materials locations, hazardous materials may also impact the region via roadways and rail. Many roads in the region are subject to hazardous materials transport and all roads that permit hazardous material transport are considered potentially at risk to an incident.

5.15.3 Historical Occurrences

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) lists historical occurrences throughout the nation. A "serious incident" is a hazardous materials incident that involves:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 galls or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

However, prior to 2002, a hazardous materials "serious incident" was defined as follows:

- a fatality or major injury due to a hazardous material,
- closure of a major transportation artery or facility or evacuation of six or more person due to the presence of hazardous material, or
- a vehicle accident or derailment resulting in the release of a hazardous material.

There has been a total of 310 recorded HAZMAT incidents in the MEMA District 6 Region since 1971. These events resulted in almost $4.9 million in remediation costs and property damage as well as 8 injuries. **Table 5.30** summarizes the HAZMAT incidents reported in the MEMA District 6 Region. Detailed information on these events is presented in the county-specific annexes.

Table 5.30: SUMMARY OF HAZMAT INCIDENTS IN THE MEMA DISTRICT 6 REGION

Location	Number of Occurrences	Deaths / Injuries	Property Damage
Clarke County	4	0/0	$331,225
Jasper County	10	0/0	$344,778
Kemper County	0	0/0	$0
Lauderdale County	269	0/7	$2,022,646
Leake County	1	0/0	$0
Neshoba County	3	0/0	$0
Newton County	9	0/1	$374,544
Scott County	9	0/0	$1,569,600
Smith County	5	0/0	$250,783
MEMA DISTRICT 6 REGIONAL TOTAL	310	0/8	$4,893,576

Source: United States Department of Transportation Pipeline and Hazardous Materials Safety Administration - retrieved April 2021

5.15.4 Probability of Future Occurrence

Given the location of more than thirty toxic release inventory sites in the MEMA District 6 Region and prior roadway and railway incidents, it is likely (between 10 and 100 percent annual probability) that a hazardous material incident may occur in the region. County and town officials are mindful of this possibility and take precautions to prevent such an event from occurring. Furthermore, there are detailed plans in place to respond to an occurrence.

5.16 Pandemic

5.16.1 Background

A pandemic is defined as an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people. A pandemic result when a virus mutates from an animal to a strain that can be passed to humans. Humans have no immunity to these new strains, making them especially deadly. The strain may ultimately mutate to a form where it can be passed from human-to-human. Given the lack of immunity, the virus spreads quickly and can have devastating effects on the population. When the virus spreads globally, it is deemed a pandemic.

The World Health Organization (WHO) constantly monitors influenza cases throughout the world and has implemented a six-phase system:

- **Phase 1**: No new influenza virus has been found in people or animals.
- **Phase 2**: an animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans, and is therefore considered a potential pandemic threat.
- **Phase 3**: an animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for example, when there is close contact between an infected person and an unprotected caregiver. However, limited transmission under such restricted circumstances does not indicate that the virus has gained the level of transmissibility among humans necessary to cause a pandemic.
- **Phase 4**: Is characterized by verified human-to-human transmission of an animal or human-animal influenza reassortant virus able to cause "community-level outbreaks". The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk of a pandemic. Any country that suspects or has verified such an event should urgently consult with WHO so that the situation can be jointly assessed and a decision made by the affected country if implementation of a rapid pandemic containment operation is warranted. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.
- **Phase 5**: is characterized by human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
- **Phase 6**: the pandemic phase, is characterized by community level outbreaks in at least one other

country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way
- **Post-Peak Period**: Levels of pandemic influenza in most countries have dropped below peak levels.
- **Possible New Wave**: Level of pandemic influenza activity in most counties rising again.
- **Post-Pandemic Period**: Levels of influenza activity have returned to levels seen for seasonal influenza.

Pandemics are also known to occur in waves. For example, initial wave of infected persons may be those first to contract the virus. These people may subsequently pass it to health officials or family members. For this reason, the duration of pandemic outbreaks tends to last weeks or even months.

5.16.2 Location & Spatial Extent

Pandemics are global in nature. However, they may start anywhere. The MEMA District 6 Region chose to analyze this hazard given the current and on-going COVID-19 Public Health Emergency.

All populations should be considered at risk to pandemic. Buildings and infrastructure while not directly impacted by the virus/pathogen could be indirectly impacted if people are not able to operate and maintain them due to illness. Many buildings could potentially be shutdown, at least temporarily, as a result. Employers may initiate work from home procedures for non-essential workers in order to help stop infection. Commerce activities, and thus the economy, may suffer greatly during this time.

5.16.3 Historical Occurrences

Several pandemics have been reported throughout history. A short history of the flu/Spanish Flu was collected from The Historical Text Archive and is described below. [38]

The first known pandemic dates back to 430 B.C. with the Plague of Athens. It reportedly killed a quarter of the population over four years due to typhoid fever. In 165-180 A.D., the Antonine Plague killed nearly 5 million people. Next, the Plague of Justinian (the first bubonic plague pandemic) occurred from 541 to 566. It killed 10,000 people a day at its peak and resulted in a 50 percent drop in Europe's population.

Since the 1500s, influenza pandemics have occurred about three times every century or roughly every 10-50 years. The Black Death devastated European populations in the 14th century. Nearly a third of the population (20-30 million) was killed over six years. From 1817 to present, seven Cholera Pandemics have impacted to the world and killed millions. Perhaps most severe, was the Third Cholera Pandemic (1852-1959) which started in China. Isolated cases can still be found in the Western U.S. today. There were three major pandemics in the 20th century (1918-1919, 1957-1958, and 1968-1969). The most infamous pandemic flu of the 20th century, however, was that of 1918-1919. Since the 1960s, there has been two pandemics, the 2009 H1N1 influenza and SARS-CoV-2 (COVID-19). The pandemics of the 20th and 21st centuries that impacted the United States are detailed below.

***1918 Spanish Flu*:** This was the most devastating flu of the 20th century. This pandemic spread across the world in three waves between 1918 and 1919. It typically impacted areas for around twelve weeks and then would largely disappear. However, it would frequently reemerge several months later. Worldwide, approximately 50 million persons died and over a quarter of the population was infected. Nearly 675,000 people died in the United States. The illness came on suddenly and could cause death within a few hours. The virus impacted those aged 15 to 35 especially hard. The movement of troops during World War I is thought to have facilitated the spread of the virus.

In Mississippi, state officials noted that "epidemics have been reported from a number of places in the State," on October 4th, 1918. By the 18th, twenty-six localities reported 1,934 cases (the real number of cases was likely much higher). West Point, Mississippi was hit especially hard and quarantine was established. Throughout the state, African Americans were impacted at a greater rate than white populations. This is thought to be partly caused from a shortage of caretakers. It is estimated that over 6,000 people died in Mississippi, though that number may be much higher as death records were not widely recorded.

***1957 Asian Flu*:** It is estimated that the Asian Flu caused 2 million deaths worldwide. Approximately 70,000 deaths were in the U.S. However, the proportion of people impacted was substantially higher than that of the Spanish Flu. This flu was characterized as having much milder effects than the Spanish Flu and greater survivability. Similar to other pandemics, this pandemic has two waves. Elderly and infant populations were more likely to succumb to death. This flu is thought to have originated from a genetic mutation of a bird virus.

***1968 Hong Kong Flu*:** The Hong Kong Flu is thought to have caused one million deaths worldwide. It was milder than both the Asian and Spanish influenza viruses. It was similar to the Asian Flu, which may have provided some immunity to the virus. It had the most severe impact on elderly populations.

2009 H1N1 Influenza: This flu was derived from human, swine, and avian virus strains. It was initially reported in Mexico in April 2009. On April 26, the U.S. government declared H1N1 a public health emergency. A vaccine was developed and over 80 million were vaccinated which helped minimize the impacts. The virus had mild impacts on most of the population but did cause death (usually from viral pneumonia) in high-risk populations such as pregnant women, obese persons, indigenous people, and those with chronic respiratory, cardiac, neurological, or immunity conditions. Worldwide, it is estimated that 43 million to 89 million people contracted H1N1 between April 2009 and April 2010, and between 8,870 and 18,300 H1N1 cases resulted in death.

2020 SARS-CoV-2 (COVID-19): Coronavirus Disease 2019 (COVID-19) was declared as pandemic by the World Health Organization on March 11th, 2020 mainly due to the speed and scale of the transmission of the disease. Before that, it started as an epidemic in mainland China with the focus being firstly reported in the city of Wuhan, Hubei province in February 26th. The etiologic agent of COVID-19 was isolated and identified as a novel coronavirus, initially designated as 2019-nCoV. Later, the virus genome was sequenced and because it was genetically related to the coronavirus outbreak responsible for the SARS outbreak of 2003, the virus was named as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) by the International Committee for Taxonomy of Viruses.

As of May 2021, the COVID-19 pandemic has resulted in over 156 million confirmed cases and over 3.6 million deaths globally, with 32.6 million confirmed cases and 579,000 deaths in the United States alone. It has also sparked fears of an impending economic crisis and recession. Social distancing, self-isolation and travel restrictions have led to a reduced workforce across all economic sectors and caused many jobs to be lost. Schools closed down, and the need for commodities and manufactured products had decreased. In contrast, the need for medical supplies had significantly increased. The food sector also faced increased demand due to panic-buying and stockpiling of food products. No industry or sector was left untouched by COVID-19.

- **Agriculture** - A global crash in demand from hotels and restaurants saw prices of agricultural commodities drop by 20%

- **Petroleum & Oil** - During a meeting at the Organization of the Petroleum Exporting Countries (OPEC) in Vienna on March 6th, 2020 a refusal by Russia to slash oil production triggered Saudi Arabia to retaliate with extraordinary discounts to buyers and a threat to pump more crude. Saudi, regarded as the de facto leader of OPEC, increased its provision of oil by 25% compared to February – taking production volume to an unprecedented level. This caused the steepest one-day price crash seen in nearly 30 years
- **Education** - COVID-19 has affected all levels of the education system, from pre-school to post-secondary education. Different countries introduced various policies, ranging from complete closure in Germany, Italy, and the United States to targeted closure in the United Kingdom for all but the children of workers in key industries.
- **Finance Industry** - COVID-19 has affected communities, businesses and organizations globally, inadvertently affecting the financial markets and the global economy. Uncoordinated governmental responses and lockdowns have led to a disruption in the supply chain. In China, lockdown restrictions significantly reduced the production of goods from factories, while quarantine and self-isolation policies decreased consumption, demand and utilization of products and services

5.16.4 Probability of Future Occurrences

Based on historical occurrence information, it is assumed that all of the MEMA District 6 Region has a probability level of unlikely (less than 1 percent annual probability) for future pandemic events. The massive increase in globalization and connectivity has meant that a virus can spread from one side of the world to another in mere hours. In 2020, people around the world were as used to hopping on an international flight as they were catching a bus or a train. Air travel makes it possible for someone to travel halfway across the globe in less time than it takes for many diseases to incubate, making it extremely difficult to prevent their spread. In 1990, 1 billion people travelled by air, a number that has since increased to more than 4.2 billion in 2018. While pandemics are still relatively rare, the ease of international travel, coupled with climate change, and urbanization increases the probability of more frequent pandemics.

The Mississippi State Department of Health maintains a state pandemic plan which can be found here: http://www.msdh.state.ms.us/msdhsite/index.cfm/44,1136,122,154,pdf/SNSPlan.pdf It should also be noted that several counties in the region maintain Pandemic Incident Response Plans.

5.17 CONCLUSIONS ON HAZARD RISK

The hazard profiles presented in this section were developed using best available data and result in what may be considered principally a qualitative assessment as recommended by FEMA in its “How-to” guidance document titled *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA Publication 386-2). It relies heavily on historical and anecdotal data, stakeholder input, and professional and experienced judgment regarding observed and/or anticipated hazard impacts. It also carefully considers the findings in other relevant plans, studies, and technical reports.

5.17.1 Hazard Extent

Table 5.31 describes the extent of each natural hazard identified for the MEMA District 6 Region. The extent of a hazard is defined as its severity or magnitude, as it relates to the planning area.

Table 5.31: EXTENT OF MEMA DISTRICT 6 REGION HAZARDS

Flood-related Hazards

Flood

Flood extent can be measured by the amount of land and property in the floodplain as well as flood height and velocity. The amount of land in the floodplain accounts for 15.8 percent of the total land area in the MEMA District 6 Region.

Flood depth and velocity are recorded via United States Geological Survey stream gages throughout the region. While a gage does not exist for each participating jurisdiction, there is one at or near many areas. The greatest peak discharge recorded for the region was near Lena in Leake County in 1979. Water reached a discharge of 122,000 cubic feet per second and the stream gage height was recorded at 32.2 feet. Additional peak discharge readings and gage heights are in the table below.

Location/ Jurisdiction	Date	Peak Discharge (cfs)	Gage Height (ft)
Clarke County			
Chickasawhay River at Enterprise	2/23/1961	61,700	37.94
Chickasawhay River near Quitman	April 1900	66,000	50.91
Souinlovie Creek near Pachuta	April 1900	27,000	59.00
Chickasawhay River at Shubuta	April 1900	90,000	47.90
Jasper County			
Tallahala Creek at Waldrup (unincorporated area)	2/6/2004	18,900	23.17

Kemper County			
Hamilton Branch near De Kalb	4/13/1974	662	7.58
Flat Scooba Creek Tributary near Scooba	4/12/1979	427	8.87
Lauderdale County			
Okatibbee Creek near Meridian	2/22/1961	27,000	26.14
Leake County			
Pearl River near Carthage	4/14/1979	102,000	28.74
Pearl River near Lena	4/17/1979	122,000	32.20
Tuscolameta Creek at Walnut Grove	4/8/2003	45,800	32.08
Neshoba County			
Pearl River at Burnside (unincorporated area)	4/13/1979	76,600	23.60
Newton County			
Potterchitto Creek at Newton	4/7/2003	8,520	18.64
Scott County			
Strong River near Morton	12/24/1974	5,600	22.00
Smith County			
Oakohay Creek at Mize	4/13/1974	28,900	17.26
Leaf River near Raleigh	4/13/1974	17,000	28.17
Leaf River near Taylorsville	4/14/1974	37,600	57.44

Erosion	The extent of erosion can be defined by the measurable rate of erosion that occurs. There are no erosion rate records located in the MEMA District 6 Region.
Dam Failure	Dam Failure extent is defined using the Mississippi Division of Environmental Quality criteria (Table 5.7). Forty-eight dams are classified as high-hazard in the MEMA District 6 Region. • Clarke County: 0 high hazard dams • Jasper County: 3 high hazard dams • Kemper County: 3 high hazard dams • Lauderdale County: 33 high hazard dams • Leake County: 0 high hazard dams • Neshoba County: 1 high hazard dam • Newton County: 3 high hazard dams • Scott County: 2 high hazard dams • Smith County: 3 high hazard dams

Winter Storm and Freeze	The extent of winter storms can be measured by the amount of snowfall received (in inches). Official long term snow records are only kept for one location in the MEMA District 6 Region. The greatest snowfall reported in Meridian (Lauderdale County) was 14.0 inches in 1963.
Fire-related Hazards	
Drought / Heat Wave	Drought extent is defined by the U.S. Drought Monitor Classifications which include Abnormally Dry, Moderate Drought, Severe Drought, Extreme Drought, and Exceptional Drought. According to the U.S. Drought Monitor Classifications, the most severe drought condition is Exceptional. All of the participating counties have received this ranking at least once over the fifteen-year reporting period. The extent of extreme heat can be measured by the record high temperature recorded. Official long term temperature records are only kept for one location in the MEMA District 6 Region. The highest recorded temperature in Meridian (Lauderdale County) was 107°F in 1980.
Wildfire	Wildfire data was provided by the Mississippi Forestry Commission and is reported annually by county from 2011-2020. The greatest number of fires in one year occurred in Jasper County and the greatest number of acres burned in year occurred in Smith County. Analyzing the data by county indicates the following wildfire hazard extent for each county. ***Clarke County*** • The greatest number of fires to occur in any year was 75 in 2006. • The great number of acres to burn in a single year occurred in 2006 when 1,057 acres were burned. ***Jasper County*** • The greatest number of fires to occur in any year was 106 in 2007. • The great number of acres to burn in a single year occurred in 2006 when 1,144 acres were burned. ***Kemper County*** • The greatest number of fires to occur in any year was 43 in 2007. • The great number of acres to burn in a single year occurred in 2007 when 533 acres were burned. ***Lauderdale County*** • The greatest number of fires to occur in any year was 53 in 2007. • The great number of acres to burn in a single year occurred in 2007 when 887 acres were burned. ***Leake County*** • The greatest number of fires to occur in any year was 102 in 2007. • The great number of acres to burn in a single year occurred in 2007 when 1,994 acres were burned. ***Neshoba County*** • The greatest number of fires to occur in any year was 47 in 2005. • The great number of acres to burn in a single year occurred in 2014

	when 356 acres were burned. ***Newton County*** • The greatest number of fires to occur in any year was 57 in 2007. • The great number of acres to burn in a single year occurred in 2006 when 509 acres were burned. ***Scott County*** • The greatest number of fires to occur in any year was 37 in 2007. • The great number of acres to burn in a single year occurred in 2006 when 503 acres were burned. ***Smith County*** • The greatest number of fires to occur in any year was 50 in 2006 and 2007. • The great number of acres to burn in a single year occurred in 2008 when 4,405 acres were burned.
Geologic Hazards	
Earthquake	Earthquake extent can be measured by the Richter Scale (Table 5.16), the Modified Mercalli Intensity (MMI) scale (Table 5.17), and the distance of the epicenter from the MEMA District 6 Region. According to data provided by the National Geophysical Data Center, the greatest earthquake to impact the region was reported in Leake County with an MMI of V (slightly strong) and a correlating Richter Scale measurement of approximately 4.9. • Clarke County: MMI of II; unknown magnitude; 829.0 km to epicenter • Jasper County: MMI of III; unknown magnitude; 240.0 km to epicenter • Kemper County: MMI of III; unknown magnitude; 229.0 km to epicenter • Lauderdale County: MMI of IV; unknown magnitude; 218.0 km to epicenter • Leake County: MMI of V; 4.9 magnitude; 461.0 km to epicenter • Neshoba County: None Reported • Newton County: None Reported • Scott County: None Reported • Smith County: None Reported
Landslide	As noted above in the landslide profile, there is no extensive history of landslides in the MEMA District 6 Region and landslide events typically occur in isolated areas. This provides a challenge when trying to determine an accurate extent for the landslide hazard. However, when using the USGS landslide susceptibility index, extent can be measured with incidence, which is low throughout most of the MEMA District 6 Region, except for some areas of moderate incidence in the southwestern portion. There is also low susceptibility throughout the majority of the region, except for some areas in the southwestern portion which have moderate and high susceptibility.
Land Subsidence	The extent of land subsidence can be defined by the measurable rate of subsidence that occurs. There are no subsidence rate records located in the MEMA District 6 Region nor is there any significant historical record of events.
Wind-related Hazards	
Hurricane and Tropical Storm	Hurricane extent is defined by the Saffir-Simpson Scale which classifies hurricanes into Category 1 through Category 5 (Table 5.20). The greatest classification of hurricane to traverse directly through the MEMA District 6 Region was Hurricane

	Frederic, which was a Category 2 hurricane when it passed through the region. • Clarke County: Hurricane Frederic, Category 2 (95 knots) • Jasper County: Hurricane Katrina, Category 1 (80 knots) • Kemper County: Hurricane Frederic, Category 1 (65 knots) • Lauderdale County: Hurricane Frederic, Category 1 (65 knots) • Leake County: Unnamed 1879 Storm, Tropical Storm (50 knots) • Neshoba County: Hurricane Katrina, Category 1 (80 knots) • Newton County: Hurricane Katrina, Category 1 (80 knots) • Scott County: Unnamed 1915 Storm, Tropical Storm (60 knots) • Smith County: Hurricane Katrina, Category 1 (80 knots)
Thunderstorm / Hail / Lightning	Thunderstorm extent is defined by the number of thunder events and wind speeds reported. According to a 65-year history from the National Centers for Environmental Information the strongest recorded wind event in the MEMA District 6 Region was reported on February 12, 2008 at 90 knots (approximately 104 mph). It should be noted that future events may exceed these historical occurrences. • Clarke County: 72 knots • Jasper County: 75 knots • Kemper County: 87 knots • Lauderdale County: 87 knots • Leake County: 80 knots • Neshoba County: 80 knots • Newton County: 83 knots • Scott County: 87 knots • Smith County: 90 knots Hail extent can be defined by the size of the hail stone. The largest hail stone reported in the MEMA District 6 Region was 4.5 inches (reported on April 15, 2011). It should be noted that future events may exceed this. • Clarke County: 4.25 inches • Jasper County: 2.5 inches • Kemper County: 4.5 inches • Lauderdale County: 2.75 inches • Leake County: 2.75 inches • Neshoba County: 2.75 inches • Newton County: 1.75 inches • Scott County: 2.0 inches • Smith County: 2.75 inches According to the Vaisala's flash density map (Figure 5.17), the MEMA District 6 Region is located in an area that experiences 6 to 8 lightning flashes per square kilometer per year. It should be noted that future lightning occurrences may exceed these figures.

Tornado	Tornado hazard extent is measured by tornado occurrences in the US provided by FEMA (Figure 5.18) as well as the Fujita/Enhanced Fujita Scale (Tables 5.27 and 5.28). The greatest magnitude reported was an F5 (reported on March 3, 1966). • Clarke County: F4 • Jasper County: F4 • Kemper County: F4 • Lauderdale County: F4 • Leake County: F5 • Neshoba County: F3 • Newton County: F4 • Scott County: F4 • Smith County: F4
Other Hazards	
Hazardous Materials Incident	According to USDOT PHMSA, the largest hazardous materials incident reported in the region was 16,000 LGA released on the railway on July 4, 1977. It should be noted that larger events are possible. • Clarke County: 2,730 LGA • Jasper County: 2,113 LGA • Kemper County: 3,287 LGA • Lauderdale County: 13,000 LGA • Leake County: 0.13368 GCF • Neshoba County: 1,937 LGA • Newton County: 16,000 LGA • Scott County: 6,133 LGA • Smith County: 4,000 LGA
Pandemic	Due to historical reporting limitations, the data from only COVID-19 has been included below. The following data is current as of 08/10/2021 and represents the deaths reported: • Clarke County: 80 • Jasper County: 48 • Kemper County: 30 • Lauderdale County: 246 • Leake County: 77 • Neshoba County: 182 • Newton County: 65 • Scott County: 77 • Smith County: 37

5.17.2 Priority Risk Index

In order to draw some meaningful planning conclusions on hazard risk for the MEMA District 6 Region, the results of the hazard profiling process were used to generate region-wide hazard classifications according to a “Priority Risk Index” (PRI). The purpose of the PRI is to categorize and prioritize all potential hazards for the MEMA District 6 Region as high, moderate, or low risk. Combined with the asset inventory and quantitative vulnerability assessment provided in the next section, the summary hazard classifications generated through the use of the PRI allows for the prioritization of those high hazard risks for mitigation planning purposes and, more specifically, the identification of hazard mitigation opportunities for the MEMA District 6 Region to consider as part of their proposed mitigation strategy.

The prioritization and categorization of identified hazards for the MEMA District 6 Region is based principally on the PRI, a tool used to measure the degree of risk for identified hazards in a particular planning area. The PRI is used to assist the MEMA District 6 Regional Hazard Mitigation Council in gaining consensus on the determination of those hazards that pose the most significant threat to the MEMA District 6 counties based on a variety of factors. The PRI is not scientifically based, but is rather meant to be utilized as an objective planning tool for classifying and prioritizing hazard risks in the MEMA District 6 Region based on standardized criteria.

The application of the PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a value (1 to 4) and an agreed upon weighting factor, as summarized in **Table 5.32**. To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

PRI VALUE = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

According to the weighting scheme and point system applied, the highest possible value for any hazard is 4.0. When the scheme is applied for the MEMA District 6 Region, the highest PRI value is 3.1 (thunderstorm wind / high wind). Prior to being finalized, PRI values for each identified hazard were reviewed and accepted by the members of the MEMA District 6 Regional Hazard Mitigation Council.

Table 5.32: PRIORITY RISK INDEX FOR THE MEMA DISTRICT 6 REGION

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self explanatory	1	10%
	12 to 24 hours	Self explanatory	2	
	6 to 12 hours	Self explanatory	3	
	Less than 6 hours	Self explanatory	4	
Duration	Less than 6 hours	Self explanatory	1	10%
	Less than 24 hours	Self explanatory	2	
	Less than one week	Self explanatory	3	
	More than one week	Self explanatory	4	

5.17.3 Priority Risk Index Results

Table 5.33 summarizes the degree of risk assigned to each category for all initially identified hazards based on the application of the PRI. Assigned risk levels were based on the detailed hazard profiles developed for this section, as well as input from the Regional Hazard Mitigation Council. The results were then used in calculating PRI values and making final determinations for the risk assessment.

Table 5.33: SUMMARY OF PRI RESULTS FOR THE MEMA DISTRICT 6 REGION

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Flood-related Hazards						
Flood	Likely	Critical	Moderate	6 to 12 hours	Less than 24 hours	**2.9**
Erosion	Possible	Minor	Small	More than 24 hours	More than 1 week	**1.8**
Dam Failure	Possible	Critical	Small	Less than 6 hours	Less than 6 hours	**2.4**
Winter Storm and Freeze	Likely	Limited	Moderate	More than 24 hours	Less than 24 hours	**2.4**
Fire-related Hazards						
Drought / Heat Wave	Likely	Minor	Large	More than 24 hours	More than 1 week	**2.5**
Wildfire	Highly Likely	Minor	Small	Less than 6 hours	Less than 1 week	**2.6**
Geologic Hazards						
Earthquake	Possible	Minor	Moderate	Less than 6 hours	Less than 6 hours	**2.0**
Landslide	Unlikely	Minor	Small	Less than 6 hours	Less than 6 hours	**1.5**
Land Subsidence	Unlikely	Minor	Small	Less than 6 hours	Less than 6 hours	**1.5**
Wind-related Hazards						
Hurricane and Tropical Storm	Likely	Critical	Large	More than 24 hours	Less than 24 hours	**2.9**
Thunderstorm Wind / High Wind	Highly Likely	Critical	Moderate	6 to 12 hours	Less than 6 hours	**3.1**
Hailstorm	Highly Likely	Limited	Moderate	6 to 12 hours	Less than 6 hours	**2.8**
Lightning	Highly Likely	Limited	Negligible	6 to 12 hours	Less than 6 hours	**2.4**
Tornado	Likely	Catastrophic	Small	Less than 6 hours	Less than 6 hours	**3.0**
Other Hazards						
Hazardous Materials Incident	Likely	Limited	Small	Less than 6 hours	Less than 24 hours	**2.5**
Pandemic	Unlikely	Catastrophic	Large	More than 24 hours	More than 24	**2.8**

5.18 FINAL DETERMINATIONS

The conclusions drawn from the hazard profiling process for the MEMA District 6 Region, including the PRI results and input from the Regional Hazard Mitigation Council, resulted in the classification of risk for each identified hazard according to three categories: High Risk, Moderate Risk, and Low Risk (Table 5.34). For purposes of these classifications, risk is expressed in relative terms according to the estimated impact that a hazard will have on human life and property throughout all of the MEMA District 6 Region. A more quantitative analysis to estimate potential dollar losses for each hazard has been performed separately and is described in Section 6: Vulnerability Assessment. It should be noted that although some hazards are classified below as posing low risk, their occurrence of varying or unprecedented magnitudes is still possible in some cases and their assigned classification will continue to be evaluated during future plan updates.

Table 5.34: CONCLUSIONS ON HAZARD RISK FOR THE MEMA DISTRICT 6 REGION

HIGH RISK	Thunderstorm Wind / High Wind Tornado Flood Hurricane and Tropical Storm Hailstorm Pandemic
MODERATE RISK	Wildfire Drought / Heat Wave Hazardous Materials Incident Dam and Levee Failure Winter Storm and Freeze Lightning
LOW RISK	Earthquake Erosion Landslide Land Subsidence