

# RIPLLEY COUNTY HAZARD MITIGATION PLAN

Ripley County, Missouri  
2020-2021 Plan Update



**Prepared By:**

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**FEMA Approval Date:**

October 18, 2021

# CONTRIBUTORS

## Ripley County Hazard Mitigation Planning Committee

### Jurisdictional Representatives

Name	Title	Department	Jurisdiction/Agency/Organizat
Jesse Roy	Presiding Commissioner	County Commission	Ripley County
Gary Emmons	Eastern District Commissioner	County Commission	Ripley County
Andy Towell	Western District Commissioner	County Commission	Ripley County
Dennis Cox	Mayor	City Administration	City of Doniphan
Dale Day	Mayor	City Administration	City of Naylor
Brad Hagood	Superintendent	District Administration	Doniphan R-I School District
Terry Arnold	Superintendent	District Administration	Naylor R-II School District
Cody Young	Superintendent	District Administration	Ripley County R-III School
Sheila Featherston	School Counselor	District Administration	Ripley County R-III School
Carly Carter	Superintendent	District Administration	Ripley County R-III School

### Stakeholder Representatives

Name	Title	Agency/Organization
Lance Pigg	Emergency Management Director	City of Doniphan
Laura Oldham	Director	Ripley County Transit
Jesse Roy	Flood Plain Manager	Ripley County
Crystal Jones	Mitigation Planner	Ozark Foothills Regional Planning Commission
Keith Harris	Volunteer	Ponder-Gatewood Road District
Karen White	Director	Missouri Highlands Healthcare
Julie O'Neal	CFO	Missouri Highlands Healthcare
Jan Morrow	Director	Ripley County Health Center
Tammy Cosgrove	Public Health Officer	Ripley County Health Center

The table above lists stakeholders that participated in the plan update in some way. Stakeholders invited to participate in the planning process, but who did not participate are listed within Step 3 of the planning process description in Chapter 1 and Appendix C.

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## EXECUTIVE SUMMARY

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The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. Ripley County, its two participating jurisdictions, and three participating school districts developed this multi-jurisdictional local hazard mitigation plan update to reduce future losses from hazard events to the county, its communities, and school/special districts. The current plan is an update of a plan that was approved on September 23<sup>rd</sup>, 2016. The plan and the update were prepared pursuant to the requirements of the *Disaster Mitigation Act of 2000* to result in eligibility for the Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Grant Programs.

The *Ripley County Multi-Hazard Mitigation Plan* is a multi-jurisdictional plan covering the following jurisdictions that participated in the planning process:

- Unincorporated Ripley County
- City of Doniphan
- City of Naylor
- Doniphan R-I School District
- Naylor R-II School District
- Ripley County R-III School District

The Ripley County R-IV School District was invited to participate in the planning process but did not meet all of the established requirements for official participation. When the future five-year update is developed for this plan, this school district again will be invited again to participate.

Ripley County and the entities listed above developed a Multi-Jurisdictional Hazard Mitigation Plan that was approved by FEMA on September 23<sup>rd</sup>, 2016 (hereafter referred to as the *2016 Ripley County Hazard Mitigation Plan*). This current planning effort serves to update that previously approved plan.

The plan update process followed a methodology in accordance with FEMA guidance, which began with the formation of a Mitigation Planning Committee (MPC) comprised of representatives from Ripley County and its participating jurisdictions. The MPC updated the risk assessment that identified and profiled hazards that pose a risk to Ripley County and analyzed jurisdictional vulnerability to those hazards. The MPC also examined the capabilities in place to mitigate the hazard damages, with emphasis on changes that have occurred since the previously approved plan was adopted (2016). The MPC determined that the planning area is vulnerable to several hazards that are identified, profiled, and analyzed in this plan. Riverine and flash flooding, winter storms, severe thunderstorms/hail/lightning/high winds, and tornadoes are among the hazards that historically have had a significant impact within the county.

Based upon the risk assessment, the MPC updated goals for reducing risk from hazards. The goals are listed below:

1. Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters;
2. Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters;
3. Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters; and,
4. Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.

To advance the identified goals, the MPC developed recommended mitigation actions, as summarized in the table on the following pages. The MPC developed an implementation plan for each action, which identifies priority level, background information, ideas for implementation, responsible agency, timeline, cost estimate, potential funding sources, and more. These additional details are provided in Chapter 4.

**Table I. Mitigation Action Matrix**

<b>*Jurisdiction/ Goal #/ Action #</b>	<b>Action</b>	<b>Hazards Addressed</b>	<b>Address Current Development</b>	<b>Address Future Development</b>	<b>Continued Compliance with NFIP</b>
Ripley County 1.1	Extreme Heat Education	Extreme Heat			
Ripley County 1.2	Tornado Safety Drills	Tornado			
Ripley County 3.1	Fire Prevention Education	Fires	x	x	
Ripley County 1.3	Fire Alert Systems	Fires			
Ripley County 2.1	Making Mitigation Plan Available				
Ripley County 1.4	Warning Siren Mapping	Tornado	x		
Ripley County 2.3	Ditch Cleanout & Construction	Flooding (Flash and River)	x		
Ripley County 2.4	Tree Trimming	Winter Weather/Snow/Ince/Severe Cold	x		
Ripley County 2.5	Bridge Reinforcement	Earthquakes	x		
Ripley County 3.2	Flood Buyouts	Flooding (Flash and River)	x	x	
Ripley County 2.6	Alternate Transportation Routes	Flooding (Flash and River)			
Ripley County 3.3	Burn Bans	Fires	x	x	
Ripley County 2.7	Generator Acquisition & Installation	Thunderstorm/High Winds/Lightning/Hail			
Ripley County 2.8	Upgrade Water Systems	Drought	x	x	
Ripley County 2.9	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail	x		
Ripley County 3.4	Sinkhole Mapping	Land Subsidence/Sinkholes	x	x	
Ripley County 4.1	Continuity in Planning				
Ripley County 4.2	National Flood Insurance Program Participation	Flooding (Flash and River)			x
Doniphan 2.1	Ditch Cleanout & Construction	Flooding (Flash and River)	x		
Doniphan 2.3	Bridge Reinforcement	Earthquakes	x		
Doniphan 3.1	Floodplain Policy Updates	Flooding (Flash and River)			x
Doniphan 3.2	Flood Acquisition & Demolition	Flooding (Flash and River)	x	x	

Doniphan 4.1	Alternate Transportation Routes	Flooding (Flash and River)			
Doniphan 2.5	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail	x		
Doniphan 4.2	National Flood Insurance Program Participation	Flooding (Flash and River)			x
Doniphan 4.3	Continuity in Planning				
Naylor 2.1	Ditch Cleanout & Construction	Flooding (Flash and River)	x		
Naylor 4.1	National Flood Insurance Program Participation	Flooding (Flash and River)			x
Doniphan R-I 1.1	Earthquake Awareness	Earthquakes			
Doniphan R-I 1.2	Tornado Safety Drills	Tornado			
Doniphan R-I 4.1	Alternate Transportation Routes	Flooding (Flash and River)			
Doniphan R-I 3.1	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail	x		
Doniphan R-I 4.2	Continuity in Planning				
Naylor R-II 1.1	Tornado Safe Room	Tornado		x	
Naylor R-II 1.2	Earthquake Awareness	Earthquakes			
Naylor R-II 1.3	Tornado Safety Drills	Tornado			
Naylor R-II 4.1	Alternate Transportation Routes	Flooding (Flash and River)			
Naylor R-II 3.1	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail	x		
Naylor R-II 4.2	Continuity in Planning				
Ripley County R-III 1.1	Earthquake Awareness	Earthquakes			
Ripley County R-III 1.2	Tornado Safety Drills	Tornado			
Ripley County R-III 4.1	Alternate Transportation Routes	Flooding (Flash and River)			
Ripley County R-III 3.1	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail	x		
Ripley County R-III 4.2	Continuity in Planning				

\*GOALS

*Goal 1: Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.*

*Goal 2: Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.*

*Goal: 3: Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.*

*Goal 4: Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.*



## PREREQUISITES

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**44 CFR requirement 201.6(c)(5): The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.**

This plan has been reviewed by and adopted with resolutions or other documentation of adoption by all participating jurisdictions and schools/special districts. The documentation of each adoption is included in Appendix E, and a model resolution is included on the following page.

The jurisdictions listed in the Executive Summary participated in the development of this plan and have adopted the multi-jurisdictional plan.

**Model Resolution**

(LOCAL GOVERNING BODY/SCHOOL DISTRICT), Missouri RESOLUTION NO. \_\_\_\_\_

A RESOLUTION OF THE (LOCAL GOVERNING BODY /SCHOOL DISTRICT) ADOPTING THE (PLAN NAME)

WHEREAS the (local governing body/school district) recognizes the threat that natural hazards pose to people and property within the (local governing body/school district); and

WHEREAS the (local governing body/school district ) has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the (plan name), hereafter referred to as the Plan, in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the (local governing body/school district) from the impacts of future hazards and disasters; and

WHEREAS the (local governing body) recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the (local governing body/school district) will endeavor to integrate the Plan into the comprehensive planning process; and

WHEREAS adoption by the (local governing body/school district) demonstrates their commitment to hazard mitigation and achieving the goals outlined in the Plan.

NOW THEREFORE, BE IT RESOLVED BY THE (LOCAL GOVERNMENT/SCHOOL DISTRICT), in the State of Missouri, THAT:

In accordance with (local rule for adopting resolutions), the (local governing body/school district) adopts the final FEMA-approved Plan.

ADOPTED by a vote of \_\_\_\_\_ in favor and \_\_ against, and \_\_ abstaining, this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

By (Sig): \_\_\_\_\_  
Print name: \_\_\_\_\_

ATTEST:  
By (Sig.): \_\_\_\_\_  
Print name: \_\_\_\_\_

APPROVED AS TO FORM:  
By (Sig.): \_\_\_\_\_  
Print name: \_\_\_\_\_

# 1 INTRODUCTION AND PLANNING PROCESS

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## 1.1 PURPOSE

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Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of natural disasters. For hazard mitigation to be effective, mitigation actions must be taken prior to disaster, thereby reducing negative impacts to people and property. The purpose of this plan is for the jurisdictions and special districts of Ripley County to proactively identify their extent of exposure to natural hazards as well as attainable goals and specific actions designed to minimize harm to people and property following a disaster. Furthermore, the exercise of mitigation planning results in a document—such as the current document—which outlines strategies for the implementation of prioritized mitigation actions.

*The Robert T. Stafford Disaster Relief and Emergency Act* (Public Law 93-288), which was later amended by *The Disaster Mitigation Act of 2000* (Public Law 106-390), and implementation regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002 (44 CFR §201.6) and finalized on October 31, 2007 establish the requirements for local hazard mitigation plans. (Hereafter, the amended law and implementing regulations will be referred to collectively as the Disaster Mitigation Act or DMA). The DMA sets forth the requirement for jurisdictions and special districts to adopt a hazard mitigation plan to be eligible to receive federal hazard mitigation grant funding. On October 1, 2002, FEMA published a change to the Interim Final Rule at 67 FR 61512, extending the effective date for state and local hazard mitigation plan adoption requirements to November 1, 2004. Since this date, participation within and adoption of a FEMA-approved hazard mitigation plan has been required for state, municipalities, and special districts to receive non-emergency Stafford Act assistance including hazard mitigation grant funding.

Following tornado and flooding disasters declared during the spring of 2002 (DR-1412), the Missouri State Emergency Management Agency (SEMA) received flood acquisition and demolition proposals from twenty-three communities throughout the state. Fortunately, SEMA assisted some of the communities with federal mitigation grant funding provided by the Federal Emergency Management Agency (FEMA). While communities like these remain eligible for federal disaster public assistance and individual assistance, they are no longer eligible for mitigation assistance unless they have participated within the development of and adopted a FEMA-approved hazard mitigation plan. For nearly 1,000 municipalities and 114 counties in Missouri, mitigation plans are required. All Missouri jurisdictions that participate in the development of the hazard mitigation plan and adopt the completed plan are eligible to receive federal mitigation grant funding. Any jurisdictions that do not participate in the development or adoption of the plan are ineligible for such mitigation funding.

To assist jurisdictions and special districts in creating or updating their hazard mitigation plan, FEMA has created guidance documents. These documents, specifically FEMA's *Local Mitigation Planning Handbook, March 2013* and FEMA's *Local Mitigation Plan Review Guide, October 1, 2011*, were consulted by Ripley County and its participating jurisdictions during the update of its *2021 Ripley County Hazard Mitigation Plan*.

The Community Rating System (CRS) is a voluntary program for which communities participating within

the National Flood Insurance Program (NFIP) are eligible. The CRS provides a range of flood insurance premium reductions (0% to 45%) for certain properties located within participating communities. In this way, the program encourages communities to implement floodplain management practices beyond those required by the NFIP. Buildings located within certain flood zones of a CRS-participating community are eligible for flood insurance premium discounts depending upon the community CRS-assigned “class.” The community’s class may range from “10” to “0” with a class of “0” providing the most flood mitigation benefit. The table below shows the CRS classes and associated insurance premium discounts. A description of the types of properties eligible for flood insurance premium discounts can be found within Table 1 of the FEMA CRS community listing document located at [https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS\\_List\\_of\\_Communities\\_10\\_01\\_2016.pdf](https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS_List_of_Communities_10_01_2016.pdf). Unfortunately, as of the update of this plan, neither Ripley County, nor its two municipalities participated within the CRS.

**Table 1.1 CRS Classes and Insurance Premium Discounts**

<b>CLASS</b>	<b>DISCOUNT</b>	<b>CLASS</b>	<b>DISCOUNT</b>
1	45%	6	20%
2	40%	7	15%
3	35%	8	10%
4	30%	9	5%
5	25%	10	0%

Source: Community Rating System, FEMA, [https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS\\_List\\_of\\_Communities\\_10\\_01\\_2016.pdf](https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS_List_of_Communities_10_01_2016.pdf)

## 1.2 BACKGROUND AND SCOPE

This plan is an update to the Ripley County Hazard Mitigation Plan that was approved in September 2016. The plans are required to be updated every five years to remain valid and ensure the plan is addressing current trends and needs of the participating jurisdictions.

The *2016 Ripley County Hazard Mitigation* and this update were both prepared by the Ozark Foothills Regional Planning Commission (OFRPC). The OFRPC, a member of the Missouri Association of Councils of Government MACOG) was created in 1967. The commission serves the five-county region of Butler, Carter, Reynolds, Ripley and Wayne Counties, as well as all municipalities within those five counties.

Information in this plan should be used as a guide for the coordination of mitigation activities and decisions regarding local land use planning in the future. The actions included in this plan are not final solutions, but rather short-term efforts that will ultimately have long-term strategic impacts when implemented.

In the *2016 Ripley County Hazard Mitigation Plan* the following jurisdictions participated within and adopted the plan:

- Ripley County
- City of Doniphan
- Doniphan R-I School District
- Naylor R-II School District
- Ripley County R-III School District
- Ripley County R-IV School District

Those entities with representatives participating in the current plan update included the following:

- Ripley County
- City of Doniphan
- City of Naylor
- Doniphan R-I School District
- Naylor R-II School District
- Ripley County R-III School District

Both the City of Doniphan and the City of Naylor are fully located within Ripley County. Two of the school districts—the Doniphan R-I and the Naylor R-II School Districts—have a small portion of their service area located within neighboring Butler County to the east. Neither district has assets located within Butler County. The two districts participated within the current plan update because they are headquartered within Ripley County and hold all of their assets within the county.

### 1.3 PLAN ORGANIZATION

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This plan updated is organized into five chapters and an assembly of appendices. Following is a list of the chapters and their respective title:

- Chapter 1: Introduction and Planning Process
- Chapter 2: Planning Area Profile and Capabilities
- Chapter 3: Risk Assessment
- Chapter 4: Mitigation Strategy
- Chapter 5: Plan Implementation and Maintenance
- Appendices (A-E)

There were no document format changes made from the previously approved (2016) plan.

**Table 1.2 Changes Made in Plan Update**

Plan Section	Summary of Updates
<b>Chapter 1 - Introduction and Planning Process</b>	Updated members of the Mitigation Planning Committee (MPC) and the participating jurisdictions that formally adopted the updated plan.
<b>Chapter 2 - Planning Area Profile and Capabilities</b>	Completed a vulnerability analysis for each jurisdiction.
<b>Chapter 3 - Risk Assessment</b>	Rearranged hazard order per state preference.

<b>Chapter 4 - Mitigation Strategy</b>	The numbering system for the mitigation actions was reconstructed.
<b>Chapter 5 - Plan Implementation and Maintenance</b>	Updated MPC meetings for evaluating and updating the plan to the first Tuesday in January and July of each year beginning January 2022.

## 1.4 PLANNING PROCESS

**44 CFR Requirement 201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.**

The county's regional planning commission—the Ozark Foothills Regional Planning Commission (RPC)—was contracted by Ripley County to facilitate update of the county's 2016 hazard mitigation plan. In this role the RPC conducted the following actions:

- assisted in establishing a Mitigation Planning Committee (MPC) as defined by the Disaster Mitigation Act;
- determined if the MPC established for the previously approved (2016) plan was a standing committee that met in the interim and documented changes in the MPC membership and procedures since adoption of the previous plan;
- assessed adherence to the plan maintenance process set forth in the previously approved plan;
- ensured the updated plan meets the DMA requirements as established by federal regulations and follows the most current planning guidance of the Federal Emergency Management Agency (FEMA);
- facilitated the entire plan development process;
- identified data that MPC participants could provide and conducted research to augment that data;
- assisted in soliciting public input;
- produced the draft and final plan update in a FEMA-approvable document; and,
- coordinated the Missouri State Emergency Management Agency (SEMA) and (FEMA) plan reviews.

Adherence to the plan maintenance process established in 2016 did not occur due to a lack of funding for a process facilitator.

All of the participating jurisdictions listed within the table actively and directly participated within the plan update process. The governing bodies of all participating jurisdictions formally adopted the updated planning document<sup>1(c)</sup>. **Table 1.3** lists the MPC members and the entities they represent, along with their titles<sup>1(a) and 2(a)</sup>.

**Table 1.3. Jurisdictional Representatives of the Ripley County Mitigation Planning Committee**

Name	Title	Jurisdiction/Agency /Organization
Jesse Roy	Presiding Commissioner/Floodplain Administrator	Ripley County
Dennis Cox	Mayor	City of Doniphan
Dale Day	Mayor	City of Naylor
Brad Hagood	Superintendent	Doniphan R-I School District
Terry Arnold	Superintendent	Naylor R-II School District
Cody Young	Superintendent	Ripley County R-III School District

**Table 1.4** below lists all members of the MPC and notes each member’s expertise in the six mitigation categories (Prevention, Property Protection, Natural Resource Protection, Emergency Services, Structural Flood Control Projects and Public Information) <sup>1(b)</sup>.

**Table 1.4. MPC Capability with Six Mitigation Categories** <sup>1(b)</sup>

Community Department/Office	Prevention	Structure and Infrastructure Projects		Natural Systems Protection	Education and Awareness Programs	Emergency Services
		Property Protection	Structural Flood Control Projects			
County Commissioner	✓	✓		✓	✓	
County Floodplain Administrator		✓	✓			
City Council		✓	✓	✓	✓	
City Council		✓	✓	✓	✓	
Management	✓	✓			✓	
Management	✓	✓			✓	
Management	✓	✓			✓	
Transportation						✓
Health Information	✓				✓	✓
Healthcare	✓				✓	✓
Road and Bridge		✓				
Emergency Management	✓			✓	✓	✓

### 1.4.1 Multi-Jurisdictional Participation

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

The Ozark Foothills Regional Planning Commission (OFRPC), on behalf of Ripley County, invited all cities, school districts, special districts, transportation, healthcare, and private nonprofit entities in the planning area to participate in this update of the Ripley County Multi-

Jurisdictional Hazard Mitigation Plan. DMA 2000 requires that jurisdictions represented by a multi-jurisdictional plan participate in the planning process and formally adopt the plan. Each participating jurisdiction was required to meet plan participation requirements as defined by the MPC at the beginning of the planning process. Minimum participation requirements were defined as follows:

- ✓ Designation of a representative from each participating jurisdiction to serve on the MPC;
- ✓ Participation in all planning meetings, including virtual attendance, by either direct participation or authorized representative;
- ✓ Provision of information sufficient to support plan development by completion and return of Data Collection Questionnaires and validating/correcting critical facility inventories;
- ✓ Provision of progress reports on mitigation actions from the previously approved plan and identification of additional mitigation actions for the plan;
- ✓ Elimination from further consideration those actions from the previously approved plan that were not implemented because they were impractical, inappropriate, not cost-effective, or otherwise infeasible;
- ✓ Review and comment on plan drafts;
- ✓ Active solicitation of input from the public, local officials, and other interested parties about the planning process and provision of opportunity for public comment;
- ✓ Provision of documentation to showing time donated to the planning effort; and,
- ✓ Formal adoption of the updated mitigation plan prior to submittal to SEMA and FEMA for final approval.

Written invitations were mailed to all persons attending the Initial Coordination Meeting as well as to those agencies and stakeholders identified during the Initial Coordination Meeting. Reminders of the Project Kick-Off Meeting and the importance of the planning effort were emailed to invitees prior to the date of the meeting. Reminder text notifications were also sent to the MPC members. All meeting documentation—invitation letters, meeting minutes, and sign-in sheets—can be located within Appendix C.

The Project Kick-Off Meeting was held on August 13, 2020 at the Ripley County Caring Communities Building. Written invitations were mailed to all persons attending the Initial Coordination Meeting as well as to those agencies and stakeholders identified during the Initial Coordination Meeting. A copy of the invitation letter and meeting sign-in sheets are included within Appendix C of this document. During the Project Kick-Off Meeting, those in attendance offered suggestions of additional stakeholders who were invited to participate within the planning process. The focus of the meeting was establishment of participation requirements, identification of hazards, as well as introduction of the Data Collection Questionnaire and the critical facilities inventory. Reminders of the Project Kick-Off Meeting and the importance of the planning effort were emailed to invitees prior to the date of the meeting. Reminder text notifications were also sent to the MPC members.

The second planning meeting was held on January 19, 2021. Two separate written invitations were mailed to prospective attendees—one for MPC members and one for potential stakeholders identified at the Project Kick-Off Meeting. Copies of the invitation letters and sign-in sheets can be found within Appendix C of this document. A virtual attendance meeting option was offered. Finalization of project goals, review of public comment, identification of jurisdictional capabilities and jurisdictional risk assessments were the focus of the meeting. Meeting minutes can also be located within Appendix C.

The final planning meeting was held on April 13, 2021 at the Ripley County Caring Communities



Building in Doniphan, MO. The topic of the meeting was update and identification of jurisdiction-specific mitigation actions. All members of the MPC and previously identified stakeholders were invited to the meeting via written letter followed by email reminders. A virtual attendance meeting option was offered. All meeting documentation—invitation letters, meeting minutes, and sign-in sheets—can be located within Appendix C.

The Ripley County R-IV School District was the sole jurisdiction which did not meet the plan update participation requirements as established by the MPC. While an MPC representative was named by the district and the representative attended the first two planning meetings, no one representing the jurisdiction attended the final planning meeting. Furthermore, the Data Collection Questionnaire was not completed and mitigation actions for the district were neither updated, nor identified. All jurisdictions were notified in writing and via email of all meetings. Numerous written attempts were made to collect the district's Data Collection Questionnaire.

Members of the MPC actively participated within the planning process. These planning partners possess the expertise to develop the plan, and their organizations have the authority to implement the developed mitigation strategy. Per the FEMA guide *Local Mitigation Planning Handbook March 2013 ("Handbook")*, active leadership from elected officials with an interest in improving safety and disaster resiliency ensures the planning process has visibility and encourages stakeholder participation.

The following jurisdictions met all of the participation requirements:

- ✓ Ripley County;
- ✓ City of Doniphan;
- ✓ City of Naylor;
- ✓ Doniphan R-I School District;
- ✓ Naylor R-II School District; and,
- ✓ Ripley County R-III School District.

Public input was solicited via word-of-mouth, during six regional public meetings, as well as through a survey distributed via social media and in-person. Due to the rural nature of the jurisdictions, their lack of resources, and the conduct of the planning effort in the midst of a global pandemic, public participation in the planning process, though solicited, was hampered. None of the participating jurisdictions have the resources needed to fund a full-time public information/marketing officer. Furthermore, broadband and internet connectivity within the planning area is either significantly limited or nonexistent, consequently, limiting the reach of the public survey.

**Table 1.5** below shows participation of each jurisdiction at the planning meetings, the provision of responses to the Data Collection Questionnaire including the active critical facility validation, and the update/development of mitigation actions. As stated above, meeting sign-in sheets are located in Appendix C.

**Table 1.5. Jurisdictional Participation in Planning Process**

Jurisdiction	Kick-off Meeting	Meeting #2	Meeting #3	Data Collection Questionnaire Response	Update/Develop Mitigation Actions
Ripley County	✓	✓	✓	✓	✓
City of Doniphan	✓	✓	✓	✓	✓
City of Naylor	✓	✓	✓	✓	✓
Doniphan R-I School District	✓	✓	✓	✓	✓
Naylor R-II School District	✓	✓	✓	✓	✓
Ripley County R-III School District	✓	✓	✓	✓	✓
Ripley County R-IV School District	✓	✓			

### 1.4.2 The Planning Steps

Data for this plan was created through a series of public meetings held within Ripley County. The planning process for the *2021 Ripley County Hazard Mitigation Plan* began during the summer of 2020, with presentations to elected officials, community members, and other interested parties. These individuals were invited to attend planning meetings, with a special effort to invite participants representing various business and service interests throughout Ripley County communities. Participants were asked to identify critical infrastructure, ranking the likelihood of disaster occurrence, perform a risk assessment based on these factors, and determine/update appropriate mitigation strategies for each individual disaster. This data was recorded and assimilated into the current plan update by staff of the Ozark Foothills Regional Planning Commission.

Background and statistical data for this plan were collected from a variety of sources, including Data Collection Questionnaires, the United States Census Bureau, the United States Geological Survey, the United States Army Corps of Engineers, the Missouri Department of Natural Resources, the Missouri Department of Conservation, the Center for Agricultural, Resources and Environmental Systems at the University of Missouri-Columbia, and the National Climatic Data Center. The *Missouri State Hazard Mitigation Plan* was last updated in 2018 and provided information regarding tornado, earthquake, and flood hazards affecting Ripley County.

The most recent flood insurance study for Ripley County was completed in 2019 with production of a new DFIRM. Flood hazard data from the 2006 HAZUS-MH loss run for Ripley County was incorporated into the plan providing updated information on vulnerable structures, shelter requirements, and loss estimates. Other sources of information including Comprehensive Plans, Zoning Ordinances, Building Codes, and local Storm Water Regulations were reviewed for applicability to the plan.

Development of the current plan update followed the 10-step planning process adapted from FEMA’s Community Rating System (CRS) and Flood Mitigation Assistance programs. This 10-step process allows the plan to meet funding eligibility requirements of the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program, as well as qualify for points under Activity 510 for Mitigation Plans, within the Community Rating System. The following table shows how the CRS process aligns with the Nine Task Process outlined in the 2013 *Local Mitigation Planning Handbook*.

**Table 1.6. Ripley County Mitigation Plan Update Process**

Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
Step 1. Organize	Task 1: Determine the Planning Area and Resources
	Task 2: Build the Planning Team 44 CFR 201.6(c)(1)
Step 2. Involve the public	Task 3: Create an Outreach Strategy 44 CFR 201.6(b)(1)
Step 3. Coordinate	Task 4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)
Step 4. Assess the hazard	Task 5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)
Step 5. Assess the problem	
Step 6. Set goals	Task 6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)
Step 7. Review possible activities	
Step 8. Draft an action plan	
Step 9. Adopt the plan	Task 8: Review and Adopt the Plan
Step 10. Implement, evaluate, revise	Task 7: Keep the Plan Current
	Task 9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)

***Step 1: Organize the Planning Team  
(Handbook Tasks 1, 2, and 4)***

The chief officers of Ripley County, the City of Doniphan, the City of Naylor, and the four public school districts were invited via written letter and follow-up phone calls and email messages to the Initial Coordination Meeting held on June 16, 2020 at the Ripley County Commission Chambers on June 16, 2020 at the Ripley County Commission Chambers. Those in attendance are listed upon the attendance roster found in Appendix C of this document. During the Initial Coordination Meeting, additional potential MPC members and key stakeholders were identified by the attendees. In addition, the plan’s purpose was outlined, a tentative plan update schedule was set, and the general process methodology was discussed.

The Project Kick-Off Meeting was held on August 13, 2020 at the Ripley County Caring Communities Building. Written invitations were mailed to all persons attending the Initial Coordination Meeting as well as to those agencies and stakeholders identified during the Initial Coordination Meeting. A copy of the invitation letter and meeting sign-in sheets are included within Appendix C of this document. During the Project Kick-Off Meeting, those in attendance offered suggestions of additional stakeholders who were invited to participate within the planning process. The focus of the meeting was establishment of participation requirements, identification of hazards, as well as introduction/distribution of the Data Collection Questionnaires and discussion of the critical facilities inventory. Reminders of the Project Kick-Off Meeting and the importance of the planning effort were emailed to invitees prior to the date

of the meeting. Reminder text notifications were also sent to the MPC members.

Throughout the planning process, MPC members communicated via socially-distanced face to-face meetings, virtual meetings, phone interviews, and email correspondence.

**Table 1.7. Schedule of MPC Meetings**

Meeting	Topic	Date
Initial Coordination Meeting	Overview of hazard mitigation provided, plan purpose/requirement/process outline explained, jurisdictions named a representative to the MPC, future meeting location was selected, public input solicitation was discussed, additional MPC members and stakeholders were identified	6/16/2020
Kick-off Meeting	Hazards were reviewed and identified, previous disaster declarations were discussed, data collection questionnaires were distributed, public feedback methodologies and other data sources were identified.	8/13/2020
Planning Meeting #2	2016 plan goals reviewed, updated 2021 plan goals established, jurisdictional capabilities determined, risk assessment reviewed and refined	1/19/2021
Planning Meeting #3	2011 county plan actions reviewed, updated goals established utilizing STAPLEE, plan for maintenance of plan established	4/13/2021

**Step 2: Plan for Public Involvement** *2(a), (b), (c) and (d)*  
**(Handbook Task 3)**

**44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.**

The Kick off meeting was held on August 13, 2020 at the Ripley County Caring Communities building in Doniphan, Missouri. Attendees finalized the seemingly most effective way to solicit and collect public input amid a global pandemic. A survey prepared by the process facilitator was provided to the group and all agreed to share the survey with their respective contacts. An online version of the survey was created using SurveyMonkey. The link to this online survey was shared electronically through emails, on Facebook sites, and on local websites. A copy of the survey and the results are included in Appendix D. Seventeen responses were received—six via paper and eleven online responses. Two comments were received from survey and were as follows:

- “upgraded storm warning systems - sirens - automated devices, updated radar”

- *“most concern is those without jobs and too much time to be idle and get in trouble. Need to be motivated to work ethics and serving their community. If they would work and feel good about themselves, it could change their lives”*

The first suggested action was taken into consideration by the MPC and included within the updated plan as a mitigation action.

The hazards ranked by respondents as most likely to occur are listed as follows from most likely to occur to least likely to occur:

1. Thunderstorm/Lightning/High Winds/Hail
2. Flood
3. Extreme Heat
4. Winter Weather/Snow/Ice/Extreme Cold
5. Tornado
6. Drought
7. Earthquake
8. Wildfire
9. Sinkholes
10. Levee Failure
11. Dam Failure

The hazards ranked by respondents as most likely to result in damage (i.e. potential magnitude) are listed as follows from most likely to occur to least likely to occur:

1. Flooding
2. Earthquake
3. Tornado
4. Winter Weather/Snow/Ice/Extreme Cold
5. Thunderstorm/Lightning/High Winds/Hail
6. Drought
7. Wildfire
8. Extreme Heat
9. Levee Failure
10. Dam Failure/Sinkholes (tie)

Throughout the planning process, public input was solicited in a variety of ways. A public survey was designed and disseminated via the internet using survey monkey. The electronic survey was advertised via direct email contact and s regional facebook page. The survey was also printed in hard copy and distributed during the December meeting of the county’s regional planning commission. Analysis of the survey results indicates that the public’s perception of natural hazards—with regard to both frequency and magnitude aligned strongly with the perceptions of MPC members.

The planning process and update status was discussed at six public meetings held during December 2019, March 2020, June 2020, August 2020, December 2020, and March 2021. The agendas of each meeting were advertised publicly. During each meeting discussion, public input was requested and a point of contact provided.

There were no reports of damages made by the public during the planning process. All applicable public input was incorporated into the plan either directly through the creation of

specific mitigation actions, or by quotation of the comment within this section.

The final public comment opportunity—prior to plan approval—was held during the month of August 2021. The completed plan draft was posted on a regional website located at [www.ofrpc.org](http://www.ofrpc.org) and advertised via social media and word-of-mouth. During the month of July 2021, Ripley County and its two incorporated cities, included information regarding the public comment period upon their official commission/council meeting agendas. Comments from the public were encouraged and could be made either by telephone, email, or in written form to the Ripley County Commission. A hard copy was located at the Ripley County Clerk’s office for review by those members of the public lacking access computer/internet access. The deadline for the receipt of public comment was August 31, 2021.

All documentation of public input solicitations is included within Appendix D.

***Step 3: Coordinate with Other Departments and Agencies and Incorporate Existing Information<sup>3(b)</sup>***  
***(Handbook Task 3)***

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

During the planning process, stakeholders were provided the opportunity to be involved<sup>3(b)</sup>. Stakeholders identified by the MPC represented the following types of entities:

- Neighboring communities
- Local and regional agencies involved in hazard mitigation activities
- Agencies with the authority to regulate development
- Businesses
- Transportation
- Healthcare
- Academia
- State Departments
- Other private and non-profit interests

The persons listed within the table below were stakeholders identified by the MPC as having goals and/or interests which may interface with hazard mitigation in the planning area. All were invited via written letter to participate within the plan update process and were directly asked to comment on the plan draft. A copy of the invitation and plan draft review request letters can be found within Appendix C and Appendix D of this document. Stakeholders that actively participated within the plan update process are included in the table in the “Contributors” Section of the Executive Summary.

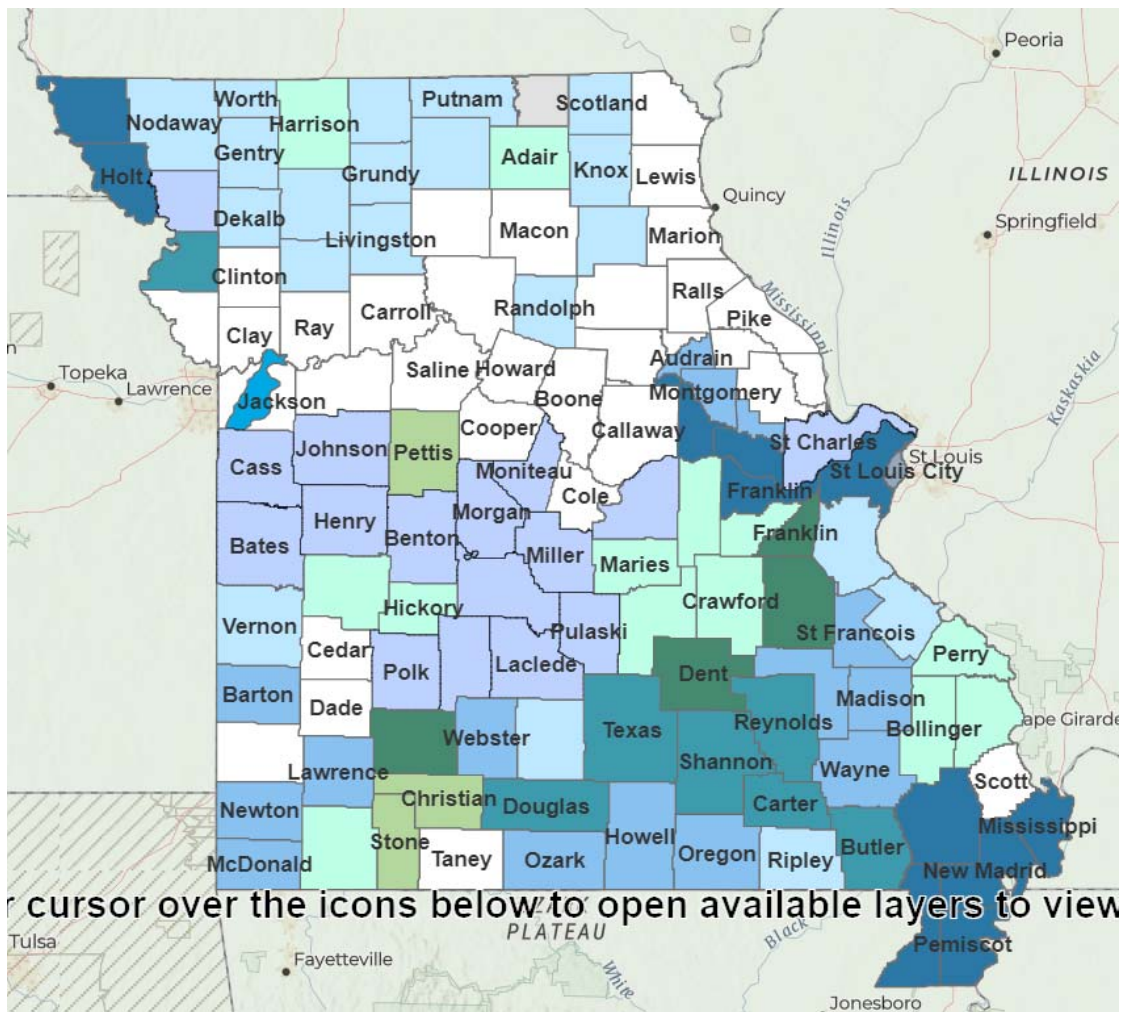
**Table 1.8 Planning Process Stakeholders**

<b>Name</b>	<b>Title</b>	<b>Organization</b>
Randy Sams	Plant Manager	Vitronic Promotional Group
	Owner	Missouri Forge
	Plant Manager	Missouri Forge
Sandy Johnson	Board Secretary	PWSD #2
Karen White	Director	Missouri Highlands Healthcare
	President of the Board	PWSD #1
Leonard Gladden	Administrator	School of Hope
Lance Pigg	Emergency Management Director/Assistant Fire Chief	Ripley County/City of Doniphan
	Director	Women's Crisis Shelter
Greg Tharp	President	Naylor Drainage District
Chuck Carr	Pastor	West Point Christian Academy
David Wyman	Area Engineer	Missouri Department of Transportation, Southeast District
Mona Settles	Administrator	Doniphan Nutrition Center
Hazel Slusher	Administrator	Naylor Nutrition Center
	Manager	MERS Goodwill
Laura Oldham	Manger	Ripley County Transit
Jan Morrow	Director	Ripley County Health Center
Fred Aldrich	President/President	Purman Fire Department/Purman Road District
Ron Dickson	President	Pine-Bardley Road District
Keith Harris	President	Ponder-Gatewood Road District
Bryce Wilson	President	Jordan Road District
Gary Woolard	President	Doniphan Special Road District
Vince Lampe	Presiding Commissioner	Butler County, Missouri
Ron Keeney	Presiding Commissioner	Carter County, Missouri
Patrick Ledgerwood	Presiding Commissioner	Oregon County, Missouri
Mike Patterson	County Judge	Clay County, Arkansas
	Director	Air Evac Life Team – O'Fallon, MO
	Administrator	Ripley County Ambulance District
	Administrator	Walnut Street Assisted Living
	Administrator	Current River Nursing Center
	Property Manager/Owner	Summit Terrace Apartments
Dianna Bland		U.S. Forest Service
Brian Byrd	Fire Chief	Doniphan Fire Department
	Ripley County Agent	USDA, Soil Conservation Service
Logan McGhee	County Director	USDA Farm Service Agency
	Fire Chief	Current River Volunteer Fire Dept.
	Administrator	Naylor-Neelyville Ambulance District
	Director	Survival Flight – Batesville, AR
	Director	Air Evac Life Team – Poplar Bluff, MO

### Coordination with FEMA Risk MAP Project<sup>3(a)</sup>

FEMA has established the Risk Mapping, Assessment and Planning (Risk MAP) program to identify flood risk and promote informed planning and development practices that reduce the risk of property damage due to flooding. There are no RiskMAP projects currently underway in Ripley County. **Figure 1.1 below** shows locations of RiskMAP projects throughout Missouri. Ripley County is located in the southeastern corner of the state along the Arkansas state line. Those counties indicated by the light aqua color (as Ripley County) should be interpreted as “RiskMAP Complete Effective.” The three Missouri counties surrounding Ripley County are classified as “Field Survey” regarding RiskMAP project status. The DFIRM released November 1, 2019 was used as the best available data to inform the flood risk assessment (Section 3 of this document) for the planning area.

**Figure 1.1. RiskMAP Study Status Map**



### Integration of Other Data, Reports, Studies, and Plans<sup>3(a)</sup>



Contact was made with the U.S. Geological Survey to obtain data needed for the flood risk assessment—specifically the surface area of water located within the county. USGS was unfamiliar with the measure and unable to provide the data. Data was collected from a variety of sources (e.g. FEMA, the U.S. Census Bureau, etc.) for which no representatives attended planning meetings.

The 2018 State of Missouri Hazard Mitigation Plan was consulted numerous times for a variety of technical data—specifically when completing the risk assessment portion of the plan update. Specific sources of technical data included, Ripley County’s 2019 Flood Insurance Rate Map (FIRM), the Missouri Department of Natural Resources, the Missouri Department of Conservation, the National Inventory of Dams (NID), SILVIS Lab—Department of Forest Ecology and Management within the University of Wisconsin, National Centers for Environmental Information of the National Oceanic and Atmospheric Administration, and the USDA Risk Management Agency’s Crop Insurance Statistics.

Relevant information from the above-listed sources was reviewed by the planner as appropriate and included within the updated planning document. Data was either manually entered by the planner, or “copied and pasted” from the online data source to the document. Sources for each data insertion were cited where appropriate.

#### ***Step 4: Assess the Hazard: Identify and Profile Hazards (Handbook Task 5)***

During the Kickoff meeting held on August 13, 2020, at the Ripley County Caring Communities Building information was presented to the MPC that identified and profiled the natural hazards to be potentially included within the plan update. As a part of this discussion previous disaster declarations were discussed with local input provided by members of details related to those declarations. The hazards included in the 2018 State Plan were also presented to the MPC, along with the hazards identified in the 2016 *Ripley County Hazard Mitigation Plan*.

Data Collection Questionnaires were distributed to the jurisdictional representatives during the Project Kick-Off Meeting. The purpose and importance of the questionnaires were discussed, as well as the intention of inserting the collected information to conduct a jurisdiction-specific risk assessment.

During the second planning meeting, data provided within the Data Collection Questionnaires was reviewed and identified for incorporation within the plan update. It was further determined that each participating jurisdiction was required to incorporate the final updated hazard mitigation plan into future plans. In addition to the questionnaires, the MPC discussed other sources from which data could be pulled for use in the plan update. These additional data sources included internet searches, GIS analysis, local newspaper articles, local “historians”, and local officials from the jurisdictions. The risk assessment found within Section 3 of this plan update is provides additional detail on conclusions drawn from the Data.

#### ***Step 5: Assess the Problem: Identify Assets and Estimate Losses (Handbook Task 5)***

In an effort to identify local assets a variety of sources were used. The 2018 State Plan was

reviewed along with US Census Data, GIS data, HAZUS data, and the completed Data Collection Questionnaires distributed to all jurisdictions. Once assets were identified, losses were estimated utilizing information in the 2018 State Plan, as well as other available data such as dam inundation maps and prior loss history for events.

Section 2 of this plan provides area profiles and information regarding each jurisdiction's capabilities. This section includes information on the participating jurisdictions' regulatory, personnel, fiscal, and technical capabilities. The information was collected through a review of local ordinances, staff members, and annual budgets. Completed Data Collection Questionnaires were also consulted to complete the jurisdiction-specific capability analysis.

Section 3 of this plan includes a discussion of jurisdiction-specific vulnerabilities relative to each hazard identified in the plan. The data used for the vulnerability estimates were taken from the 2018 State Plan as it was the best and most recent data source available.

### ***Step 6: Set Goals (Handbook Task 6)***

Talk about the MPC review of the goals from the previously approved plan, No changes were made to the plan goals or priorities. The MPC reviewed the goals of the previous (2016) plan during the Project Kick-Off Meeting and finalized the goals for the current plan update during the second planning meeting held on January 19, 2021. Minutes of the meetings are included within Appendix C of this document. The identified goals are listed within Chapter 4.

The goals for the updated were established as follows:

- Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters;
- Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters;
- Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters; and,
- Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.

The record-breaking riverine flood event of 2017 along the Current River emphasized the importance of goal #2—implementing mitigation actions that will ensure the continuity of essential and government services following a disaster. During the flood event, the City of Doniphan lost its city hall and jail facility. With this loss the county also lost its jail facility. In neighboring Carter County, the county courthouse and jail facility were also destroyed. Loss of the uninsured facilities resulted in extensive direct losses to the communities and significantly hampered recovery efforts. Goal #4 was also exemplified by the flood event as the loss of communication lines resulted in confusion and unrest.

### ***Step 7: Review Possible Mitigation Actions and Activities (Handbook Task 6)***

The third planning meeting occurred on April 13, 2021, at the Ripley County Caring Communities Building in Doniphan, Missouri. At this meeting MPC members reviewed the mitigation strategies from the 2016 county plan and proposed new and updated strategies. Each

jurisdiction—particularly those who did not participate within the 2016 planning process—was required to identify at least one mitigation action. Members were asked to consider actions that substantially addressed long-term risks identified within the risk assessment in Section 3 of the updated plan.

During the final planning meeting, each jurisdiction representative reported upon progress made by their jurisdiction upon the previously proposed mitigation actions. MPC members analyzed each action, the progress (of lack thereof) made with regard to each action since 2016, and either, continued, deleted or modified the action for the 2021 plan update. It was determined by representatives of the City of Doniphan that residential flood risk had been significantly mitigated since the prior plan update (2016). Consequently, the city's mitigation action relative to flood acquisition and demolition projects now focuses on upon commercial properties. No mitigation actions were identified during a RiskMAP project.

The FEMA publication *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* (January 2013) that was used as a reference in the development of action projects. Participants were encouraged to focus on long-term mitigation solutions and that consideration was given to the potential cost of each project in relation to the anticipated future cost savings. The MPC used a modified STAPLEE method to prioritize the mitigation actions included within Section 4 of this plan update. The STAPLEE worksheet used for the analysis is included within this section.

### ***Step 8: Draft an Action Plan*** ***(Handbook Task 6)***

The action worksheets, including the plan for implementation, submitted by each jurisdiction for the updated Mitigation Strategy are included in Chapter 4.

### ***Step 9: Adopt the Plan*** ***(Handbook Task 8)***

The Ripley County Hazard Mitigation Plan was adopted by the Ripley County Commission on August 25, 2021. Adoption by the City of Doniphan and the City of Naylor is also expected during August 2021—prior to FEMA's final approval of this plan. The Doniphan R-I, Naylor R-II, and Ripley County R-III School Districts will adopt the plan at their respective school board meetings during the month of September 2021. The plan will be approved by FEMA prior to adoption by the school districts due to scheduling of their respective board members. Once these adoption resolutions are executed, documentation will be submitted verifying the adoptions.

### ***Step 10: Implement, Evaluate, and Revise the Plan*** ***(Handbook Tasks 7 & 9)***

At the third and final planning meeting on April 13, 2021, the MPC developed and agree upon an overall strategy for plan implementation and plan maintenance. Section 5 provides additional information on plan maintenance and monitoring as determined by the MPC for five years following plan approval.

# 2 PLANNING AREA PROFILE AND CAPABILITIES

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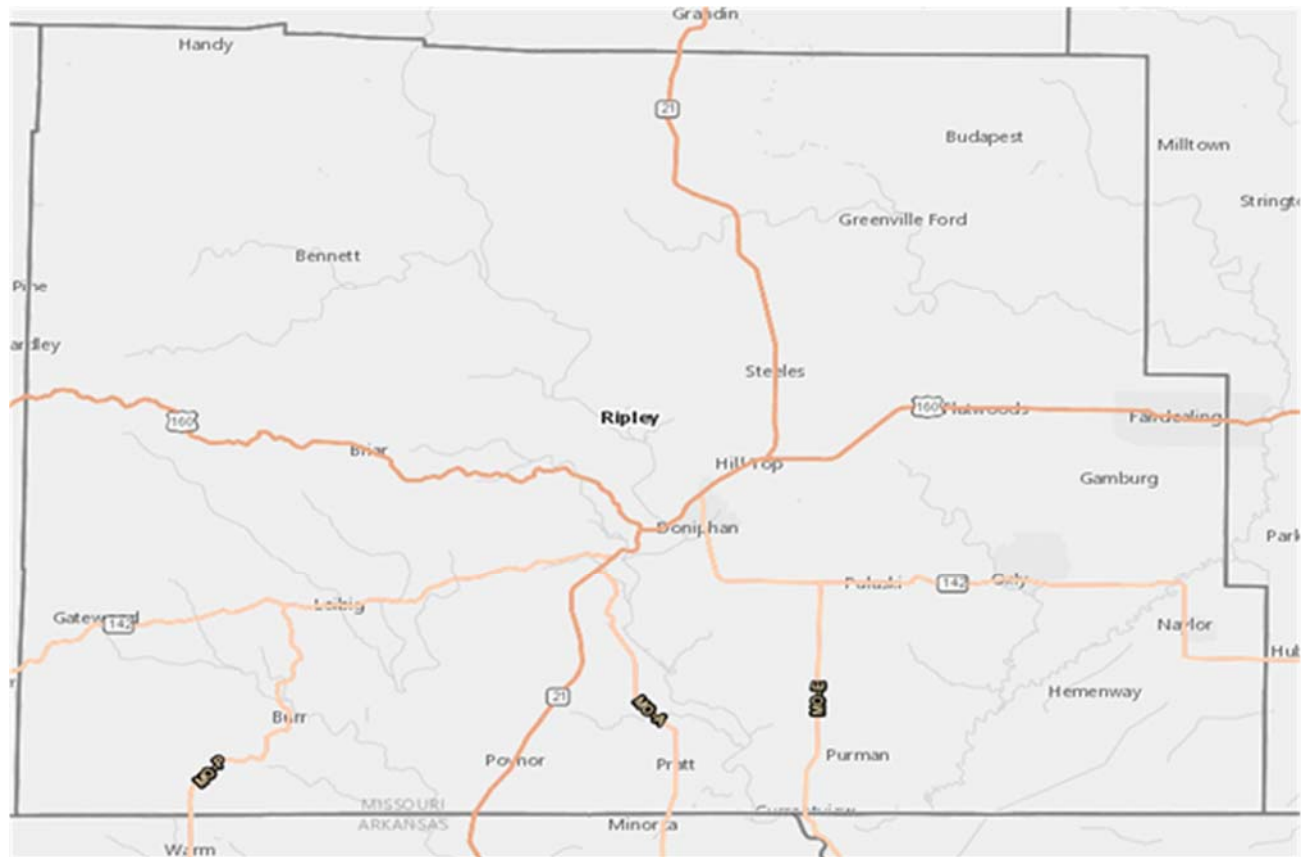
<b>2</b>	<b>PLANNING AREA PROFILE AND CAPABILITIES.....</b>	<b>2.1</b>
2.1	<i>Ripley County Planning Area Profile .....</i>	<i>2.1</i>
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## 2.1 RIPLEY COUNTY PLANNING AREA PROFILE

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**Figure 2.1. Map of Ripley County**





The population of Ripley County in 2019, as estimated by the U.S. Census Bureau, was 13,288, a decline of 221 persons or 1.6% from the 2000 US Census full count of 13,509. In reviewing this census data, Ripley County falls behind both the State of Missouri and the country as a whole regarding population growth. From 2000 through 2019. The State of Missouri's population grew by 542,217 persons, or 9.7%, while growth for the United States was 46,817,617 persons, or 16.6%. While the number of people in state and country grew, Ripley County's population declined.

Ripley County is also a county with a very-low median household income (MHI), as compared to the State of Missouri and the United States. The 2015-2019 Ripley County MHI estimate reported by the American Community Survey (ACS) was \$34,971, a 54% increase from the 2000 Census county MHI of \$22,761. The ACS also reports that the MHI in Missouri grew by 46% during the same time period, from \$37,934 to \$55,461, while the United States' MHI grew 49%. Even though the MHI grew at a higher percentage rate than either the state or national MHI, Ripley County residents exist on 63% of the income of their fellow Missourians and 56% of their fellow Americans. As can be seen, Ripley County residents experience extreme poverty with few opportunities for financial gain.

Housing values reflect even more wealth disparities between the planning area and rest of the state and nation. Per the 2000 Decennial Census, Ripley County's median housing value was \$49,100, but increased to \$83,800 per the 2015-2019 ACS. For the same time periods, the State of Missouri and the United States reported \$89,900/\$157,200 and \$119,600/\$217,500, respectively. The increases in median housing value from 2000 to 2015-2019 amounted to 71% for Ripley County, 75% for Missouri, and 45% for the United States.

## 2.1.1 Geography, Geology and Topography

Ripley County consists of 632 square miles or 404,480 acres. According to the U.S. Census of

- Agriculture, Ripley County has approximately 22,066 acres of harvested land, 205,022 acres of deciduous upland mixed oak forest, 92,686 acres of non-native, cool season grasslands, and 38,265 acres of mixed evergreen-deciduous shortleaf pine-oak forest. A portion of the Mark Twain National Forest is in the northwest corner of the county. Following is a list of all streams in the planning area:
  - Bay Creek (Eleven Point River tributary)
  - Beaverdam Creek (Little Black River tributary)
  - Bills Creek (Current River tributary)
  - Buffalo Creek (Current River tributary)
  - Buzzard Run (Missouri)
  - Caldwell Creek (Logan Creek tributary)
  - Capps Creek (Current River tributary)
  - Cedar Creek (Current River tributary)
  - Cogshell Branch
  - Colvin Creek (Current River tributary)
  - Colvin Creek (Eleven Point River tributary)
  - Compton Creek (Missouri)
  - Cope Branch
  - Current River (Ozarks)
  - Cypress Creek (Logan Creek tributary)
  - Dry Branch (Cypress Creek tributary)
  - Dudley Creek
  - Flat Creek (Little Black River tributary)
  - Fourche River
  - Harris Creek (Missouri)
  - Hurricane Creek (Current River tributary)
  - Hurricane Creek (Tenmile Creek tributary)
  - Isaacs Creek (Missouri)
  - Klenn Creek
  - Merrell Branch
  - Mulberry Creek (Current River tributary)
  - Pigeon Creek (South Fork Buffalo Creek tributary)
  - Simpson Creek (Missouri)
  - Terrible Creek

The Current River is the only stream monitored by the U.S. Geological Service. Per USGS records, a mean of 2,500 (during October) to 5,500 (during May) cubic feet of water per second flow through the gauge. In the five years preceding the update of this plan the maximum flow reading at the Current River-Doniphan gauge reached nearly 200,000 cubic feet per second during May 2017.

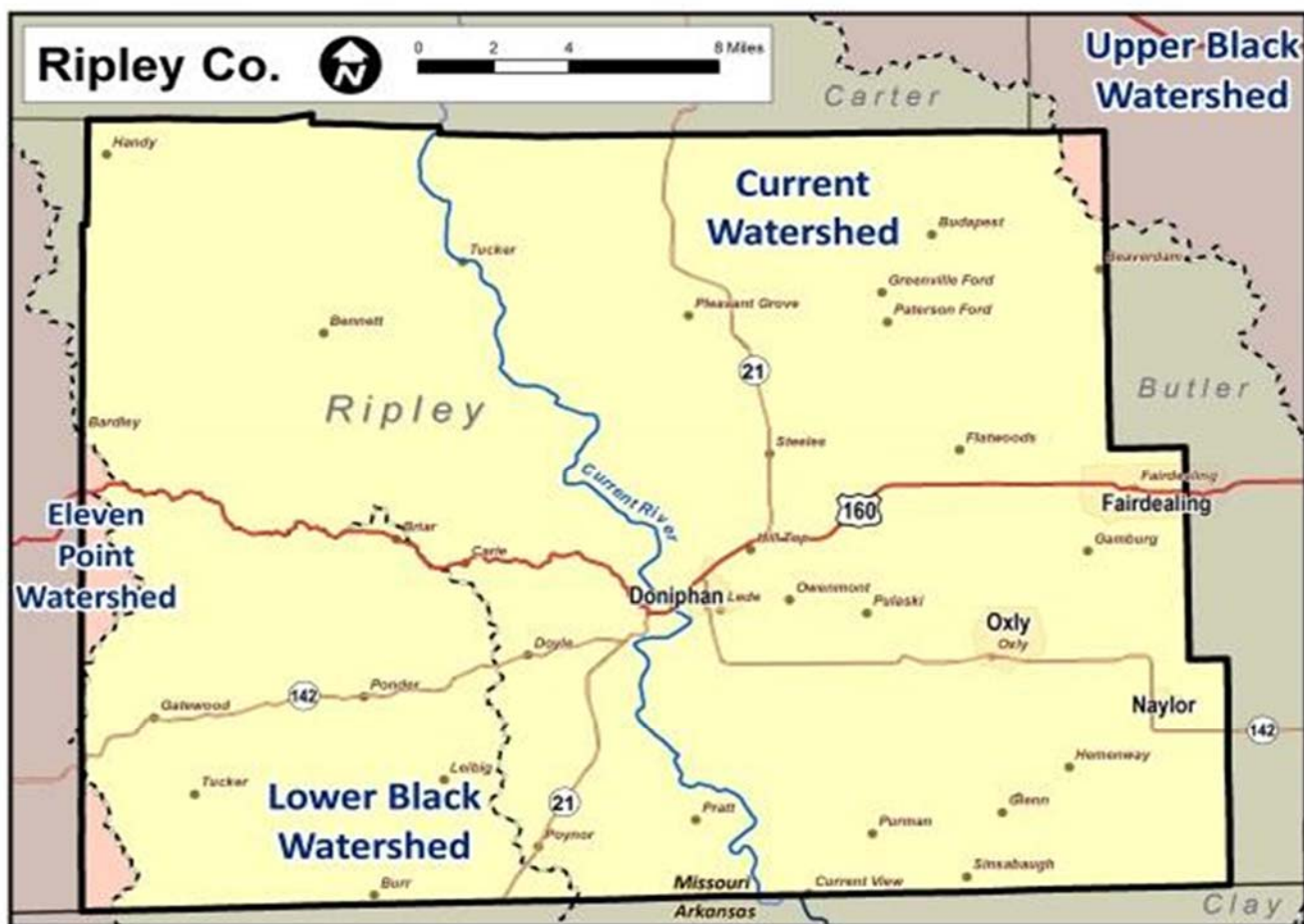
As a rural county with no planning or zoning, single family residences and mobile homes are sprawled throughout the county, usually tucked away in the dense forested areas and accessible by county-maintained gravel roads. There are only two incorporated cities within the county limits. The City of Doniphan is the largest incorporated city in Ripley County with a population of 1,997 as reported in the 2010 US Census. Doniphan also serves as the county seat. The other

incorporated city in Ripley County is the City of Naylor with a reported population of 632 persons according to the 2010 Census. There are other, smaller, unincorporated communities within the county that include Fairdealing, Oxly, Purman, Poyner, and Gatewood among others.

The majority of Ripley County has a topography classification of highly dissected plateaus, while the southeastern corner is flat lowlands. Ripley County also has two geology classifications; the majority of which is Ordovician-Age Bedrock and the southeastern corner is Tertiary and Quaternary Age material.

The County has two main rivers running through it; the Current River and the Little Black River, as well as several creeks and drainage ditches throughout the county. According to the United States Environmental Protection Agency, there are four (4) watersheds that cross Ripley County, the Upper Black River, Current River, Lower Black River, and Eleven Point River. A map of the watersheds is shown below in **Figure 2.2**.

**Figure 2.2. Ripley County, Missouri Watershed Map**



Source: Missouri Department of Natural Resources

### 2.1.2 Climate

According to the National Weather Service (NWS) the county’s average annual precipitation is 49.65 inches, higher than the United States average of 37 inches. It is reported that of these 49.65 inches of precipitation, 10 inches snowfall. The average U.S. city gets 25 inches of snow per year. The number of days with any measurable precipitation is 97 annually.

On average, there are 216 sunny days per year in Ripley County. The month with the highest average temperature is July with an average of 92 degrees. The month with the lowest average temperature is January with an average low of 34 degrees. The High Plains Regional Climate Center provides monthly climate averages based on data collected from 1981-2010. According to this data, the maximum average monthly temperature in Ripley County occurs in July at 90.3 degrees with the minimum average monthly temperature occurring in January at 23.0 degrees. The month that averages the highest precipitation is May with 5.12 inches and the month with the lowest precipitation average is June with 2.97 inches.

### 2.1.3 Population/Demographics

The following table (**Table 2.1**) provides the populations for each city and the unincorporated portion of the county for 2000, 2010, and 2015-2019 (5-year estimate) along with the percentage change in population. The unincorporated area population was determined by subtracting the populations of the incorporated areas from the overall county population. All incorporated communities are located fully within the county boundaries.

**Table 2.1 Ripley County Population 2000-2010 by Jurisdiction**

Jurisdiction	2000 Population	2010 Population	2019 ACS 5-Year Population Estimate	# Change (2010-2019)	% Change (2010-2019)
Ripley County (total population)	13,509	14,100	13,288	-812	-5.7%
Ripley County (unincorporated)	10,967	11,471	10,425	-1,046	-9.1%
City of Doniphan	1,932	1,997	2,062	+65	+3.3%
City of Naylor	610	632	801	+169	+26.7%

Source: U.S. Bureau of the Census, Decennial Census, 2000 & 2010; 5-Year American Community Survey, 2019

In reviewing population data provided by the US Census Bureau, vulnerable populations—those under age 5 and over age 65—can be identified. Per the 2015-2019 ACS 5-Year Estimates, there are 849 children under the age of five years residing in Ripley County. This number represents 6.3% of the total population of the county, a rate that is higher than the percentage of children under 5 in the State of Missouri (6.0%), and in the United States (5.9%). Also, there are, in the planning area, and estimated 2,792 persons over 65 years of age. This figure equals 20.6% of the total county population—higher than the percentage of seniors in the state and nation, which equal 17.2% and 16.5%, respectively.

Per the American Community Survey 2015-2019 5-Year Estimates, there are 5,059 households in Ripley County, with an average household size of 2.67 persons. Per the same source, the average household size for Missouri is similar: 2.46 persons per household, while the average household size for the United States is slightly higher: 2.62 persons per household.



The median age of residents of Ripley County is 42.1, compared to Missouri as 37.9, and the United States being reported as 37.2 years of age. The largest percentage differences in population between Ripley County and residents elsewhere is that 22.6% of all Ripley County residents are over the age of 62, a much higher rate for persons over 62 than either the State of Missouri (17.2%) or the United States (16.2%).

The University of South Carolina developed an index to evaluate and rank the ability to respond to, cope with, recover from, and adapt to disasters. The index synthesizes 29 socioeconomic variables which research literature suggests contribute to reduction in a community’s ability to prepare for, respond to, and recover from hazards. A low number means that the county is more resilient to hazard events, and a high number means that the county is less resilient. SoVI ® data sources include primarily those from the United States Census Bureau.

The SoVI ranking for Ripley County is reported as high based on 2010-2014 data. This ranking places Ripley County in the top 33% of vulnerable counties throughout the country. When compared with both the state and nation, the county’s vulnerability to hazards ranks “medium-high” on the five-point low/medium-low/medium/medium-high/high scale. As can be seen from this score, Ripley County is a vulnerable county as it relates to preparing, responding and recovering from hazards.

In the table below (**Table 2.2**), further demographic data is provided to present a better picture of the local population in comparison the State of Missouri and the United States as a whole. As can be seen from this data, the residents are poorer and less educated than residents across the state and the nation.

**Table 2.2** provides additional demographic and economic indicators from the U.S. Census Bureau for the planning area and compares them to the state and nation as a whole.

**Table 2.2 Unemployment, Poverty, Education, and Language Percentage Demographics, Ripley County, Missouri**

Jurisdiction	Total in Labor Force	Percent of Population Unemployed	Percent of Families Below the Poverty Level	Percentage of Population (High School graduate)	Percentage of Population (Bachelor’s degree or higher)	Percentage of population with spoken language other than English
Ripley County	10,752	5.8	25.4	79.9	10.2	1.5
City of Doniphan	1,762	14.6	35.5	81.3	12.4	2.5
City of Naylor	604	11.8	32.5	85.1	6.3	4.3
State of Missouri	4,881,733	4.6	13.7	89.9	29.2	6.3
United States	259,662,880	5.3	13.4	88.0	32.1	21.6

Source: U.S. Census, 2019 American Community Survey, 5-Year Estimates.

## 2.1.4 History

Ripley County is in the south-central part of Missouri. The City of Doniphan is the county seat, located near the center of Ripley County on the east bank of the Current River. Ripley County is located in the Ozark Foothills region of Missouri near the Arkansas border. The county is bordered by Butler County to the east, Carter County to the north and Oregon County to the west. To the south are the Arkansas counties of Randolph and Clay. The City of Doniphan lies approximately 30

miles west of Poplar Bluff, Missouri, 10 miles north of the Arkansas border, 180 miles east of Springfield, Missouri, and 180 miles south of St. Louis, Missouri.

The territory that now comprises Ripley County was one of the chief hunting grounds of Native Americans. Covered with a dense forest, it provided habitat for various games. The first permanent settler was Lemuel Kittrell, who settled near the Current River about 1819. About that time, the Natchitoches Trail/Old Military Road was marked out from Potosi to Little Rock, and along this road the first settlements were made.

Ripley County was organized by a legislative act in January 5, 1833 and named in honor of General Eleazar W. Ripley who fought in the War of 1812. It was created out of a part of Wayne County, and greatly decreased the size of the "State of Wayne". This vast tract embraced nearly one-fifth of the present State of Missouri. Ripley County was reduced to its present limits by the formation of Carter County in 1859.

Van Buren, the original county seat, had but one store in 1837 and a log building where the court met. Later another courthouse was built at Doniphan, which became the county seat. It was burned during the Civil War, when all but a few houses of the town of Doniphan were destroyed. There was scarcely a farmhouse or building in the county that was not pillaged as a result of the bushwhacking during the Civil War. Like other sections of the State, when peace was declared, the county was quick to recover from its strife. (Source: *History and Families: Ripley County, Missouri*)

Ripley County's population over that past 100 years has seen a steady number of persons; however, in 1960 the county lost 2.2 percent of its population reducing the overall population to below 10,000. This decline in population continued through the 1970s until 1980 when it grew by 2.4 percent.

## 2.1.5 Occupations

**Table 2.3** shows occupation statistics for the incorporated cities within the planning area and the county, as a whole.

**Table 2.3 Occupation Statistics, Ripley County, Missouri**

Place	Management, Business, Science, and Arts Occupations	Service Occupations	Sales and Office Occupations	Natural Resources, Construction, and Maintenance Occupations	Production, Transportation, and Material Moving Occupations
Ripley County	1,360	1072	977	589	1,212
City of Doniphan	167	140	72	58	216
City of Naylor	41	69	45	27	116

Source: U.S. Census, 2019 American Community Survey, 5-Year Estimates.

## 2.1.6 Agriculture

According to the 2017 County Summary Highlights of the United States Department of Agriculture, National Agricultural Statistics Service, 143,212 acres of the 404,480 total acres that make up Ripley County are utilized as farm land. There are reportedly 438 farms in the county with an average size of 327 acres. The eastern section of the county is flat, fertile farmland that is used in the production of a variety of crops. The most popular are corn, wheat, soybeans, and rice, with

soybeans being the most popular harvested crop with 2012 harvests valued at \$4,295,000.

The most recent data available from the USDA’s Census of Agriculture were 2012 figures. This data reported that there were 2,635 acres of corn grown in the county. The Census also reveals that there were 709 acres of wheat grown in the county, and 8,583 acres of soybeans, 4,440 acres of rice, and 13,835 acres of land used for all hay and all haylage, grass silage, and greenchop.

As you travel west through the county, the landscape becomes more rolling hills and hay and livestock farming becomes more prevalent. USDA reports that approximately 92,700 acres in the county is used for livestock farm land. The livestock raised in Ripley County is primarily cattle with smaller numbers of hogs, sheep, and chickens. The Census of Agriculture reports that there were 273 farms with cattle and calves with inventory that totaled 18,641 head. This figure includes beef cattle which was the majority at 246 farms, and milk cows on seven of the farms. It is also reported that there are five hog farms, three sheep and/or lamb farms, and 42 chicken farms in the county.

The average farm sales in the planning area is 314 acres. This compares to an average farm size of 285 acres in Missouri, 460 acres in Butler County to the east, 376 acres in Carter County to the north, and 338 acres in Oregon County to the west. The total net farm income for all farms in Ripley County was \$3,106,000, with an average of \$7,075 per farm. Total gross sales of all agricultural products in the county in 2012 was \$19,133,000, as the average farm produced \$43,583 in marketable crops, livestock, etc. During 2017, 76 farms in the planning area employed 195 workers--amounting to 3.7% of the county’s total workforce.

### 2.1.7 FEMA Hazard Mitigation Assistance (HMA) Grants in Planning Area

According to the Federal Emergency Management Agency, there have been five Hazard Mitigation Grant awards made to jurisdictions within the boundaries of Ripley County. Two of these grant awards were for school districts to construct tornado safe rooms and three of the projects were removing residential structures from the floodplain through a flood buyout programs conducted by the City of Doniphan. The total dollar amount of these four projects has been \$3,542,137. The table below provides information for each of the projects.

**Table 2.4 FEMA HMA Grants in County from 1993-2020**

Disaster Declaration	Project Type	Sub-Grantee	Date Approved	Project Total (\$)
DR-1676	Acquisition/Demolition	City of Doniphan	7/16/2013	585,573
DR-1980	Safe Room Construction	Ripley County R-IV	6/5/2014	704,223
DR-1980	Acquisition/Demolition	City of Doniphan	8/7/2013	24,185
DR-1980	Safe Room Construction	Doniphan R-I School District	9/15/2014	1,890,136
DR-4317	Acquisition/Demolition	City of Doniphan	7/23/2018	338,020
<b>Total</b>				<b>3,542,137</b>

Source: Federal Emergency Management Agency, March 15, 2021

## 2.1.8 FEMA Public Assistance (PA) Grants in Planning Area

**Table 2.5 FEMA PA Grants in Ripley County from 2002-2020**

Disaster Declaration	Project Type	Project Size	Applicant	Project Total (\$)
1412	Roads & Bridges	Small	Ripley County	23494.19
1749	Roads & Bridges	Large	Ripley County	89710.78
1749	Roads & Bridges	Large	Ripley County	40292.7
1749	Roads & Bridges	Small	Ripley County	28833.16
1749	Roads & Bridges	Small	Ripley County	26118.05
1822	Debris Removal	Large	Ripley County	211293.8
1822	Debris Removal	Large	Ripley County	206597.6
1822	Protective Measures	Small	Ripley County	20290.93
1980	Protective Measures	Small	Ripley County	26893.51
1980	Roads & Bridges	Large	Ripley County	108318
1980	Roads & Bridges	Small	Ripley County	30989.08
1980	Roads & Bridges	Small	Ripley County	51491.5
1980	Roads & Bridges	Small	Ripley County	13420.42
1980	Roads & Bridges	Small	Ripley County	32082.9
1980	Roads & Bridges	Small	Ripley County	32554.99
1980	Roads & Bridges	Small	Ripley County	42791.49
1980	Roads & Bridges	Small	Ripley County	12260.83
1980	Roads & Bridges	Small	Ripley County	23808.2
1980	Roads & Bridges	Small	Ripley County	42890.91
1980	Roads & Bridges	Small	Ripley County	32439.89
1980	Roads & Bridges	Small	Ripley County	49834.78
1980	Roads & Bridges	Small	Ripley County	8181.42
1980	Protective Measures	Small	Ripley County	4587.25
1980	Roads & Bridges	Small	Ripley County	45413.26
1980	Roads & Bridges	Small	Ripley County	41356.19
1980	Roads & Bridges	Small	Ripley County	32187.53
1980	Roads & Bridges	Small	Ripley County	34261.55
1980	Roads & Bridges	Small	Ripley County	48003.05
1980	Roads & Bridges	Small	Ripley County	22429.21
1980	Roads & Bridges	Small	Ripley County	42200.35
1980	Roads & Bridges	Small	Ripley County	15061.7
3232	Protective Measures	Small	Ripley County	3382.38
4317	Public Buildings	Small	Ripley County	27705.02
4317	Protective Measures	Small	Ripley County	7070.63
4317	Roads & Bridges	Large	Ripley County	33815.43
4317	Protective Measures	Small	Ripley County	32743.2
4317	Roads & Bridges	Large	Ripley County	189650.9
4317	Roads & Bridges	Small	Ripley County	95690.1

4317	Roads & Bridges	Large	Ripley County	283891.1
4317	Roads & Bridges	Large	Ripley County	88969.69
4552	Roads & Bridges	Small	Ripley County	50960.81
			<b>Subtotal</b>	<b>2,253,968</b>
1749	Recreational or Other	Small	City of Doniphan	6680.38
1749	Protective Measures	Small	City of Doniphan	3320.6
1749	Public Buildings	Small	City of Doniphan	8917.23
1749	Recreational or Other	Small	City of Doniphan	27909.78
1822	Debris Removal	Small	City of Doniphan	10356
1822	Debris Removal	Small	City of Doniphan	17882.64
1822	Protective Measures	Small	City of Doniphan	1994
1822	Protective Measures	Small	City of Doniphan	10144.17
1980	Recreational or Other	Small	City of Doniphan	13129.08
1980	Debris Removal	Small	City of Doniphan	6627
1980	Protective Measures	Small	City of Doniphan	7454.08
1980	Public Buildings	Small	City of Doniphan	4285.6
1980	Roads & Bridges	Small	City of Doniphan	35034.04
1980	Protective Measures	Small	City of Doniphan	9372.5
4317	Protective Measures	Small	City of Doniphan	6622.44
4317	Debris Removal	Small	City of Doniphan	4060.38
4317	Debris Removal	Small	City of Doniphan	26758.73
4317	Protective Measures	Small	City of Doniphan	65149.97
4317	Public Utilities	Small	City of Doniphan	108696.3
4317	Recreational or Other	Small	City of Doniphan	26568.96
4317	Public Buildings	Large	City of Doniphan	54209.44
			<b>Subtotal</b>	<b>455,173.30</b>
1749	Roads & Bridges	Small	City of Naylor	7364.67
1749	Public Buildings	Small	City of Naylor	1000
1822	Protective Measures	Small	City of Naylor	8286.76
1822	Debris Removal	Small	City of Naylor	16696.22
			<b>Subtotal</b>	<b>33,347.65</b>
<b>Grand Total</b>				<b>2,742,488.95</b>

Source: Federal Emergency Management Agency, As of April 8, 2021

## 2.2 JURISDICTIONAL PROFILES AND MITIGATION CAPABILITIES<sup>3, 7, AND 8</sup>

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The following section will provide capacity profiles for each participating jurisdiction. It will also include a discussion of previous mitigation initiatives and ongoing mitigation capabilities in the county. Summary tables will list specific capabilities of each jurisdiction regarding their ability to implement mitigation actions. The unincorporated county is profiled first, followed by the incorporated communities and public school districts.

### 2.2.1 Unincorporated Ripley County

Ripley County is a third-class county administered by a three-member County Commission. One commissioner from each of the two County Districts join a Presiding Commissioner elected at-large for terms of four years. County property taxes are collected to support the road, school, and library infrastructure of the county. A sales tax is levied for county general revenue purposes. The county commission has general supervision of the county public roads and maintains the courthouse and other county owned buildings. The commission also oversees the budgets for independently elected county officers such as the county clerk, sheriff, prosecuting attorney, coroner, public administrator, assessor, collector, treasurer, and surveyor.

The Ripley County Commission meets weekly in the county courthouse located in the county seat of Doniphan on Wednesday mornings from 9:00am-12:00pm and at other times in special session as needed. The county clerk is also present for these meetings and serves as the chief financial officer of the commission.

The following is a list of county officials as of January 1, 2021:

- Presiding County Commissioner
- Associate Commissioner East District
- Associate Commissioner West District
- County Clerk
- Recorder
- Assessor
- Collector
- Treasurer
- Prosecuting Attorney
- Public Administrator
- Circuit Clerk
- Sheriff
- Coroner
- Emergency Management Director

#### **Mitigation Initiatives/Capabilities<sup>3, 7, and 8</sup>**

Ripley County is a small, poor, rural county that lacks many staffed positions typical of a Missouri county. The county's highway department has a supervisor that manages the maintenance of the county roads and reports directly to the commissioners. The county shares its emergency management director with the City of Doniphan.

Due to the size of Ripley County, its small staff and lack of resources, comprehensive planning is conducted on a regional basis as opposed to county level. The county works with the Ozark Foothills Regional Planning Commission to develop a regional Comprehensive Economic Development Strategy every five years and conducts transportation planning on an annual basis. Transportation-related planning documents produced in part by the county include the Ozark Foothills Regional Transportation Plan and the regional Public Transit – Human Services Transportation Plan. The county participates within a regional local emergency planning district (LEPD), the Ozark Foothills LEPD which includes Butler, Ripley, and Wayne Counties. Consequently, the planning area is included within the regional LEPD’s Local Emergency Operations Plan.

Ripley County utilizes its elected prosecuting attorney for legal direction and services. Its Highway Department supervisor is responsible for overseeing the county’s transportation infrastructure, which consists primarily of gravel-surfaced roadways. The county funds a sheriff’s department, which is responsible for maintaining order and enforcing law within the county. Ripley County’s fire protection is provided by volunteer fire departments including the K-Highway Volunteer Fire Department, the Pine-Bardley Volunteer Fire Department, the Purman Volunteer Fire Department, and the Oxly Fire Volunteer Fire Department. The county’s emergency management director also functions as the county floodplain manager. Ripley County has neither a planning and zoning department/committee, nor land use designations within the balance of the county.

The below table (**Table 2.6**) includes data collected from Ripley County officials for the unincorporated portion of the county via the prescribed Data Collection Questionnaire.

**Table 2.6 Unincorporated Ripley County Mitigation Capabilities**

Capabilities	Status Including Date of Document or Policy
<b>Planning Capabilities</b>	
Comprehensive Plan	Yes, 2018
Builder’s Plan	No
Capital Improvement Plan	No
City Emergency Operations Plan	N/A
County Emergency Operations Plan	Yes
Local Recovery Plan	N/A
County Recovery Plan	No
City Mitigation Plan	N/A
County Mitigation Plan	Yes, 9/2016
Debris Management Plan	No
Economic Development Plan	No
Transportation Plan	Yes, 2019
Land-use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	No
School Mitigation Plan	No
Critical Facilities Plan (Mitigation/Response/Recovery)	No
<b>Policies/Ordinance</b>	
Zoning Ordinance	No
Building Code	No
Floodplain Ordinance	Yes, 9/9/1998
Subdivision Ordinance	No

Tree Trimming Ordinance	No
Nuisance Ordinance	No
Stormwater Ordinance	No
Drainage Ordinance	No
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Seismic Construction Ordinance	No
<b>Program</b>	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
Hazard Awareness Program	No
National Flood Insurance Program (NFIP)	Yes
NFIP Community Rating System (CRS) program	No
National Weather Service (NWS) Storm Ready	No
Firewise Community Certification	No
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	N/A



<b>Capabilities</b>	<b>Status Including Date of Document or Policy</b>
Economic Development Program	No
Land Use Program	No
Public Education/Awareness	No
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for Streams (Local/County/Regional)	No
Mutual Aid Agreements	No
<b>Studies/Reports/Maps</b>	
Hazard Analysis/Risk Assessment (Local)	N/A
Hazard Analysis/Risk Assessment (County)	Yes, 3/1/2021
Flood Insurance Maps	Yes, 11/1/2019
FEMA Flood Insurance Study (Detailed)	Yes, 11/1/2019
Evacuation Route Map	No
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	No
<b>Staff/Department</b>	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	No
Emergency Management Director	Yes
NFIP Floodplain Administrator	Yes
Emergency Response Team	No
Hazardous Materials Expert	No
Local Emergency Planning Committee	Yes, Ozark Foothills Local Emergency Planning District
County Emergency Management Commission	No
Sanitation Department	No
Transportation Department	Yes
Economic Development Department	No
Housing Department	No
Historic Preservation	No
<b>Non-Governmental Organizations (NGOs)</b>	
American Red Cross	Yes
Salvation Army	No
Veterans Groups	Yes
Local Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	Yes
Community Organizations (Lions, Kiwanis, etc.)	No

Capabilities	Status Including Date of Document or Policy
<b>Local Funding Availability</b>	
Apply for Community Development Block	Yes
Fund projects through Capital	No
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric services	No
Impact fees for new development	No
Ability to incur debt through general obligation bonds	No
Ability to incur debt through special tax bonds	No
Ability to incur debt through private activities	No
Withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, December 2020

## 2.2.2 City of Doniphan

The City of Doniphan is located in the central portion of Ripley County and serves as the county seat. The city is overseen by a city council whose four aldermen are elected by ward. Mayor Dennis Cox leads all meetings of the council and executes legal documents on behalf of the city. A city clerk and assistant to the clerk assist the council in the management of the city budget and operations.

The City of Doniphan contracts with a local attorney for legal direction and services. Its public works director is responsible for overseeing the city's municipal water and wastewater systems, as well as its parks. The city also funds a public safety department, which is responsible for maintaining order and enforcing local ordinances, as well as a fire department. The emergency management director also functions as the floodplain manager. The city's planning and zoning committee meets regularly to ensure the city's established zones and land use designations are maintained.

Some commercial development—the establishment of a fast food restaurant—has occurred since the last plan update in 2016. No industrial development has occurred since the last plan update. Little development is expected within the community in the foreseeable future as little developable land exists within city limits. A twenty-unit single family housing complex is planned for development along the northside of the city limits. Expansion and installation of infrastructure to service the residential development is planned by the city. No development is expected within the 100-year floodplain.

The two largest employers located within the City of Doniphan include the Doniphan R-I School System and Vitronic (a division of Ebsco Corporation). The county hospital—formerly a large employer located within the city limits—closed during early 2019.

The city fire department provides fire safety education for local schools. Residents of the City of Doniphan have access to a community tornado safe room, which was constructed per FEMA standards. The safe room is located upon the Doniphan R-I Elementary School campus at 603 Summit Street. The city has—since the last plan update—received a substantial amount of property (mostly scattered lots) through residential and commercial flood buyout projects. During 2017, the city lost its city hall and jail to a record-breaking riverine flood. Within the past year, the city located to a new permanent city hall location. The city no longer operates a jail. Ripley County is in the process of constructing a county jail facility funded mostly by Community Development Block Grant funding.

The City of Doniphan participates with in the Ozark Foothills Local Emergency Planning District (LEPD). Consequently, the city is included within the district's Local Emergency Operations Plan. The city operates, maintains and regularly tests a warning siren system used to warn the public of fire, severe storms and tornadoes. Two outdoor warning sirens comprise the public warning siren system. While the county is now addressed for 911 service (a development since the 2016 plan update), there is not yet a 911 emergency operations system established and operational within the county. The City of Doniphan utilizes no other warning system such as Cable Override, Reverse 911, etc.

English is the predominant language in Doniphan with 98% of residents identifying it as their

primary language.

In the past twelve years, the City of Doniphan has purchased and demolished approximately forty residential and one large commercial structure—all located within or near the 100-year floodplain. Few occupied residential structures remain at risk of flooding within city limits. The former Doniphan City Hall and Jail was repurposed as the city fire department following the historic flood event of 2017, during which five feet of water inundated the facility.

In 2016, the City of Doniphan identified the following mitigation initiatives:

- Adopt and/or enforce floodplain ordinances;
- Clean out ditches, and construct new ditches or drainage systems;
- Trim trees around overhead utility lines;
- Prioritize work on bridges and roadways that are vulnerable to earthquakes;
- Relocation residents from floodways;
- Establish alternate routes during an emergency;
- Allow fire departments and forest service to identify safe burn periods and issues bans;
- Seek funding to improve water and sewage throughout the county;
- Explore needed lightning protection at critical facilities and communication equipment;
- Integrate hazard mitigation plan into other community plans, such as the comprehensive plan so all documents work together; and,
- Explore CRS county wide and receive a community rating.

**Table 2.7**, which follows, include capability data for the city based upon the Data Collection Questionnaire completed by city officials. [3](#), [7](#), and [8](#).

**Table 2.7 City of Doniphan Mitigation Capabilities**

Capability	Status Including Date of Document or Policy
<b>Planning Capabilities</b>	
Comprehensive Plan	Yes, 9-26-2016
Builder's Plan	No
Capital Improvement Plan	Yes, 2016
Local Emergency Plan	Yes, 2019
County Emergency Plan	N/A
Local Recovery Plan	Yes, 2016
County Recovery Plan	N/A
Local Mitigation Plan	No
County Mitigation Plan	N/A
Local Mitigation Plan (PDM)	No
County Mitigation Plan (PDM)	N/A
Economic Development Plan	No
Transportation Plan	Yes, <i>Ozark Foothills Regional Transportation Plan, 2019</i>
Land-Use Plan	Yes, 2019
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	No
School Mitigation Plan	No
Critical Facilities Plan (Mitigation/Response/Recovery)	No
<b>Policies/Ordinance</b>	
Zoning Ordinance	Yes, 1976
Building Code	Yes, IBC 2018

<b>Capability</b>	<b>Status Including Date of Document or Policy</b>
Floodplain Ordinance	Yes, 2001
Subdivision Ordinance	Yes, 10/1994
Tree Trimming Ordinance	None
Nuisance Ordinance	Yes, 5/1998
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	No
<b>Capability</b>	
Site Plan Review Requirements	No
Historic Preservation Ordinance	Yes, 2013
Landscape Ordinance	No
Iowa Wetlands and Riparian Areas Conservation Plan	No
Debris Management Plan	No
<b>Program</b>	
Zoning/Land Use Restrictions	Yes
Codes Building Site/Design	Yes
National Flood Insurance Program (NFIP) Participant	Yes
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	Yes
National Weather Service (NWS) Storm Ready	No
Building Code Effectiveness Grading (BCEGs)	Yes, Rating=9
ISO Fire Rating	6
Economic Development Program	Yes, Regional Planning Commission
Land Use Program	No
Public Education/Awareness	Yes, fire safety annually
Property Acquisition	Yes
Planning/Zoning Boards	Yes
Stream Maintenance Program	Yes
Tree Trimming Program	Yes
Engineering Studies for Streams (Local/County/Regional)	No
Mutual Aid Agreements	Yes, all rural fire depts and sheriff
<b>Studies/Reports/Maps</b>	
Hazard Analysis/Risk Assessment (Local)	Yes
Hazard Analysis/Risk Assessment (County)	N/A
Flood Insurance Maps	Yes
FEMA Flood Insurance Study (Detailed)	Yes
Evacuation Route Map	No
Critical Facilities Inventory	Yes
Vulnerable Population Inventory	Yes, Ripley County Health Department
Land Use Map	No
<b>Staff/Department</b>	
Building Code Official	Yes, Full-time
Building Inspector	Yes, Full-time
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes, Full-time
Emergency Management Coordinator	Yes
NFIP Floodplain Administrator	Yes
Emergency Response Team	Yes
Hazardous Materials Expert	No
Local Emergency Planning Committee	Yes, 3-County LEPC
County Emergency Management Commission	N/A
Sanitation Department	Yes, Full-time
Transportation Department	Yes, Full-time
Economic Development Department	No
Housing Department	No

Capability	Status Including Date of Document or Policy
Historic Preservation	Yes, Part-time
<b>Non-Governmental Organizations (NGOs)</b>	
American Red Cross	No
Salvation Army	No
Veterans Groups	Yes, VFW
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	Yes
Community Organizations (Lions, Kiwanis, etc.)	No
<b>Local Funding Availability</b>	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	Yes
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Ability to incur debt through general obligation bonds	Yes
Ability to incur debt through special tax bonds	Yes
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, December 2020

### 2.2.3 City of Naylor

The City of Naylor is located in the southeastern portion of Ripley County. The city is overseen by a city council with four aldermen. Mayor Dale Day leads all meetings of the council and executes legal documents on behalf of the city. A city clerk assists the council in the management of the city budget and operations.

The City of Naylor contracts with a local attorney for legal direction and services. Its public works director is responsible for overseeing the city's municipal water and wastewater systems, as well as its parks. Due to limited resources, the city has no public safety department and depends upon the county sheriff's department to maintain order and enforce local ordinances. The city is protected by a volunteer fire department. The City of Naylor has no emergency management director or planning and zoning committee. The mayor functions as the floodplain manager.

No commercial or industrial development has occurred within the City of Naylor since the last plan update in 2016. Little development is expected within the community in the foreseeable future. No development is expected within the 100-year floodplain. The city's largest employer is the Naylor R-II School District. The city is home to a nutrition center which serves persons over age 62 and a small medical clinic operated on a part-time basis by Missouri Highlands Healthcare.

The City of Naylor participates with in the Ozark Foothills Local Emergency Planning District (LEPD). Consequently, the city is included within the district's Local Emergency Operations Plan. The city operates, maintains and regularly tests a warning siren system used to warn the public of fire, severe storms and tornadoes. Two outdoor warning sirens comprise the public warning siren system. While the county is now addressed for 911 service, there is not yet a 911 emergency operations system established and operational within the county. The City of Naylor utilizes no other warning system such as Cable Override, Reverse 911, etc.

English is the predominant language in Naylor with 97% of residents identifying it as their primary language. In 2016, the City of Naylor did not participate within the hazard mitigation planning process.

**Table 2.8**, which follows, include capability data for the city based upon the Data Collection Questionnaire completed by city officials. [3](#), [7](#), and [8](#).

**Table 2.8 City of Naylor Mitigation Capabilities**

Capability	Status Including Date of Document or Policy
<b>Planning Capabilities</b>	
Comprehensive Plan	No
Builder's Plan	No
Capital Improvement Plan	No
Local Emergency Plan	Ripley County
County Emergency Plan	N/A
Local Recovery Plan	No
County Recovery Plan	N/A
Local Mitigation Plan	No
County Mitigation Plan	No
Local Mitigation Plan (PDM)	No
County Mitigation Plan (PDM)	N/A
Economic Development Plan	<i>Ozark Foothills Comprehensive Economic Development Strategy, 2018 &amp; Naylor Economic Development Plan, April 2015 (Ordinance #15-02)</i>
Transportation Plan	<i>Yes, Ozark Foothills Regional Transportation Plan, 2019</i>
Land-Use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	No
School Mitigation Plan	No
Critical Facilities Plan (Mitigation/Response/Recovery)	No
<b>Policies/Ordinance</b>	
Zoning Ordinance	No
Building Code	Yes, State Version
Floodplain Ordinance	Yes, June 2019 (Ordinance #19-02)
Subdivision Ordinance	No
Tree Trimming Ordinance	No
Nuisance Ordinance	No
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	No
<b>Capability</b>	
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Wetlands and Riparian Areas Conservation Plan	No
Debris Management Plan	No
<b>Program</b>	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	Yes
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	No

Capability	Status Including Date of Document or Policy
National Weather Service (NWS) Storm Ready	No
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	Yes, 10
Economic Development Program	No
Land Use Program	No
Public Education/Awareness	Yes
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for Streams (Local/County/Regional)	No
Mutual Aid Agreements	No
<b>Studies/Reports/Maps</b>	
Hazard Analysis/Risk Assessment (Local)	Yes, 2021
Hazard Analysis/Risk Assessment (County)	N/A
Flood Insurance Maps	Yes, 2019
FEMA Flood Insurance Study (Detailed)	Yes, 2019
Evacuation Route Map	No
Critical Facilities Inventory	Yes, 2021
Vulnerable Population Inventory	Yes, 2021
Land Use Map	No
<b>Staff/Department</b>	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes, Full-Time
Emergency Management Coordinator	No
NFIP Floodplain Administrator	Yes, Part-Time (Mayor)
Emergency Response Team	No
Hazardous Materials Expert	No
Local Emergency Planning Committee	No
County Emergency Management Commission	N/A
Sanitation Department	No
Transportation Department	No
Economic Development Department	No
Housing Department	No
Historic Preservation	No
<b>Non-Governmental Organizations (NGOs)</b>	
American Red Cross	No
Salvation Army	No
Veterans Groups	No
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	No
Community Organizations (Lions, Kiwanis, etc.)	No
<b>Local Funding Availability</b>	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	Yes
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Ability to incur debt through general obligation bonds	No
Ability to incur debt through special tax bonds	No



<b>Capability</b>	<b>Status Including Date of Document or Policy</b>
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, January 2021

## 2.2.4 Summary of Jurisdictional Capabilities<sup>3, 7, and 8</sup>

**Table 2.9 Mitigation Capabilities Summary Table**

CAPABILITIES	Unincorporated Ripley County	City of Doniphan	City of Naylor
<b>Planning Capabilities</b>			
Comprehensive Plan	Yes, 2018	Yes, 9-26-2016	No
Builder's Plan	No	No	No
Capital Improvement Plan	No	Yes, 2016	No
Local Emergency Plan	No	Yes, 2019	Yes
County Emergency Plan	Yes	N/A	N/A
Local Recovery Plan	N/A	Yes, 2016	No
County Recovery Plan	No	N/A	N/A
Local Mitigation Plan	N/A	No	No
County Mitigation Plan	Yes	Yes	No
Local Mitigation Plan (PDM)	N/A	No	No
County Mitigation Plan (PDM)	No	N/A	N/A
Debris Management Plan	No	No	No
Economic Development Plan	No	No	No
Transportation Plan	Yes, 2019	Yes, 2019	Yes, 2019
Land-use Plan	No	Yes	No
Flood Mitigation Assistance (FMA) Plan	No	No	No
Watershed Plan	No	No	No
Firewise or other fire mitigation plan	No	No	No
School Mitigation Plan	No	No	No
Critical Facilities Plan (Mitigation/Response/Recovery)	No	No	No
<b>Policies/Ordinance</b>			
Zoning Ordinance	No	Yes, 1976	No
Building Code	No	Yes, IBC 2018	Yes, State Version
Floodplain Ordinance	Yes, 9/9/1998	Yes, 2001	Yes, June 2019 (Ordinance #19-02)
Subdivision Ordinance	No	Yes, 10/1994	No
Tree Trimming Ordinance	No	No	No
Nuisance Ordinance	No	Yes, 5/1998	No
Storm Water Ordinance	No	No	No
Drainage Ordinance	No	No	No

CAPABILITIES	Unincorporated Ripley County	City of Doniphan	City of Naylor
Site Plan Review Requirements	No	Yes	No
Historic Preservation Ordinance	No	Yes, 2013	No
Landscape Ordinance	No	No	No
Seismic Construction Ordinance	No	No	No
<b>Program</b>			
Zoning/Land Use Restrictions	No	Yes	No
Codes Building Site/Design	No	Yes	No
National Flood Insurance Program (NFIP) Participant	Yes	Yes	Yes
NFIP Community Rating System (CRS) Participating Community	No	No	No
Hazard Awareness Program	No	Yes	No
National Weather Service (NWS) Storm Ready	No	No	No
Building Code Effectiveness Grading (BCEGs)	No	Yes, Rating=9	No
ISO Fire Rating	N/A	6	8
Economic Development Program	No	Yes, Regional Planning Commission	No
Land Use Program	No	No	No
Public Education/Awareness	No	Yes, fire safety annually	Yes
Property Acquisition	No	Yes	No
Planning/Zoning Boards	No	Yes	No
Stream Maintenance Program	No	Yes	No
Tree Trimming Program	No	Yes	No
Engineering Studies for Streams (Local/County/Regional)	No	No	No
Mutual Aid Agreements	No	Yes, all rural fire depts and sheriff	No
<b>Studies/Reports/Maps</b>			
Hazard Analysis/Risk Assessment (Local)	N/A	Yes	Yes, 2021
Hazard Analysis/Risk Assessment (County)	Yes, 3/1/2021	N/A	N/A
Flood Insurance Maps	Yes, 11/1/2019	Yes	Yes, 2019
FEMA Flood Insurance Study (Detailed)	Yes, 11/1/2019	Yes	Yes, 2019
Evacuation Route Map	No	No	No

CAPABILITIES	Unincorporated Ripley County	City of Doniphan	City of Naylor
Critical Facilities Inventory	No	Yes	Yes, 2021
Vulnerable Population Inventory	No	Yes, Ripley County Health Dept.	Yes, 2021
Land Use Map	No	No	No
<b>Staff/Department</b>			
Building Code Official	No	Yes, Full-time	No
Building Inspector	No	Yes, Full-time	No
Mapping Specialist (GIS)	No	No	No
Engineer	No	No	No
Development Planner	No	No	Yes, Part-Time
Public Works Official	No	Yes, Full-time	Yes, Full-Time
Emergency Management Coordinator	Yes	Yes	No
NFIP Floodplain Administrator	Yes	Yes	Yes, (Mayor)
Emergency Response Team	No	Yes	No
Hazardous Materials Expert	No	No	No
Local Emergency Planning Committee	Yes, Ozark Foothills Local Emergency Planning District	Yes, 3-County LEPD	No
County Emergency Management Commission	No	N/A	N/A
Sanitation Department	No	Yes, Full-time	No
Transportation Department	Yes	Yes, Full-time	No
Economic Development Department	No	No	No
Housing Department	No	No	No
Historic Preservation	No	Yes, Part-time	No
<b>Non-Governmental Organizations (NGOs)</b>			
American Red Cross	Yes	No	No
Salvation Army	No	No	No
Veterans Groups	Yes	Yes, VFW	No
Environmental Organization	No	No	No
Homeowner Associations	No	No	No
Neighborhood Associations	No	No	No
Chamber of Commerce	Yes	Yes	No
Community Organizations (Lions, Kiwanis, etc.)	No	No	No
<b>Financial Resources</b>			
Apply for Community Development Block Grants	Yes	Yes	Yes

<b>CAPABILITIES</b>	<b>Unincorporated Ripley County</b>	<b>City of Doniphan</b>	<b>City of Naylor</b>
Fund projects through Capital Improvements funding	No	Yes	Yes
Authority to levy taxes for specific purposes	Yes	Yes	Yes
Fees for water, sewer, gas, or electric services	No	Yes	Yes
Impact fees for new development	No	No	No
Incur debt through general obligation bonds	No	Yes	No
Incur debt through special tax bonds	No	Yes	No
Incur debt through private activities	No	No	No
Withhold spending in hazard prone areas	No	No	No

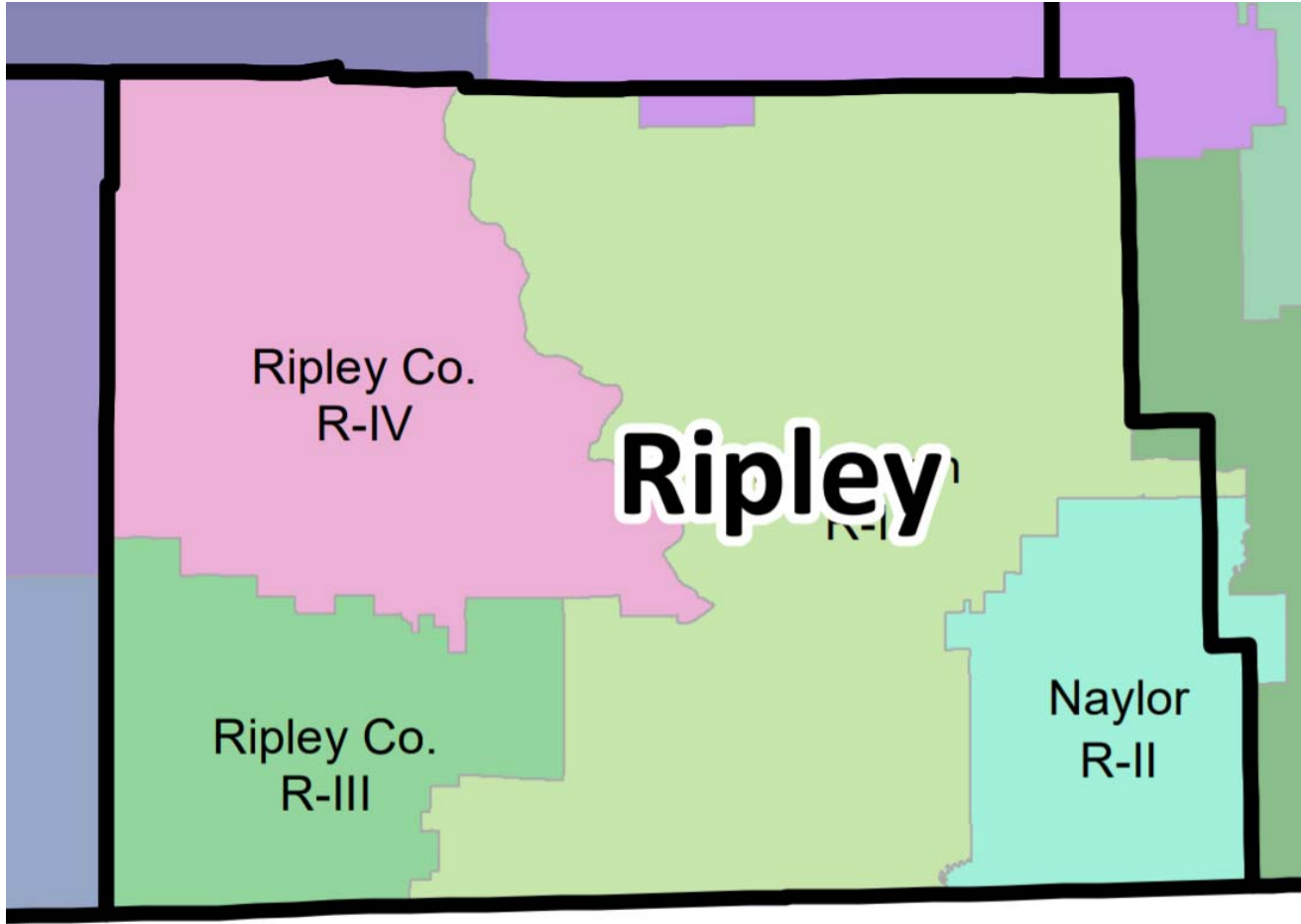
Source: Data Collection Questionnaire, December 2020

### 2.2.5 Special District

No special districts participated within the planning process.

### 2.2.6 Public School District Profiles and Mitigation Capabilities

There are four public school districts headquartered within and serving Ripley County, Missouri. Three of the districts participated fully in the planning process. Ripley County R-IV School District started, but did not complete, the planning process. The light green area in the graphic below represents the Doniphan R-I School District.



The Doniphan R-I School District is the largest in the planning area and is headquartered in the county seat of Doniphan. The location and enrollment for each school district is as follows:

- Doniphan R-I, City of Doniphan serving 1,645 youth from northern, southern, and central Ripley County;
- Naylor R-II School District, City of Doniphan serving 408 youth from southeastern Ripley County;
- Ripley County R-III School District, located in the unincorporated portion of the county and serving 98 youth from the southwestern corner of the county; and,

- Ripley County R-IV School District, located in the unincorporated portion of the county and serving 120 youth from the northwestern portion of the county.

The data above was obtained from the *Missouri School Directory* provided by the Missouri Department of Elementary and Secondary Education. All enrollment data is for the 2019-2020 school year. Enrollment data for both the Doniphan R-I School District and the Naylor R-II School District is slightly limited due to small portions of the district boundary being located outside of Ripley County. It should be noted that these “out-of-county” areas are sparsely populated and likely do not significantly impact enrollment numbers in either district.

The tables below provide building inventories and enrollment data, as well as mitigation capabilities for each of the participating districts.

**Table 2.10 School District - Buildings and Enrollment Data, December 2020**

District Name	Building Name	Building Enrollment
Doniphan R-I School District	Current River Career Center	0
Doniphan R-I School District	Doniphan Elementary School	447
Doniphan R-I School District	Doniphan Intermediate School	369
Doniphan R-I School District	Doniphan Middle School	358
Doniphan R-I School District	Doniphan High School	471
Doniphan R-I School District	Math & Science Building	N/A
Doniphan R-I School District	Bus Garage	N/A
Doniphan R-I School District	Band Building	N/A
Doniphan R-I School District	Elementary Gym	N/A
Doniphan R-I School District	Current River Career Center	N/A
Doniphan R-I School District	Building Trades Shop	N/A
Doniphan R-I School District	Central Office	N/A
Doniphan R-I School District	Greenhouse	N/A
Doniphan R-I School District	Federal Programs Building	N/A
Doniphan R-I School District	Technology Department	N/A
Doniphan R-I School District	Special Education House	N/A
Doniphan R-I School District	Doniphan Intermediate (FEMA Building)	N/A
Naylor R-II School District	Naylor Elementary School	229
Naylor R-II School District	Naylor High School	179
Naylor R-II School District	Administration Building	N/A
Naylor R-II School District	Tech Building	N/A

# 3 RISK ASSESSMENT

<b>3</b>	<b>RISK ASSESSMENT</b>	<b>3.1</b>
3.1	<i>HAZARD IDENTIFICATION</i>	3.4
3.1.1	Review of Existing Mitigation Plans	3.4
3.1.2	Review Disaster Declaration History	3.4
3.1.3	Research Additional Sources	3.5
3.1.4	Hazards Identified	3.7
3.1.5	Multi-Jurisdictional Risk Assessment	3.9
3.2	<i>ASSETS AT RISK</i>	3.9
3.2.1	Total Exposure of Population and Structures	3.9
	Unincorporated County and Incorporated Cities	3.9
3.2.2	Critical and Essential Facilities and Infrastructure	3.11
3.2.3	Other Assets	3.17
3.3	<i>LAND USE AND DEVELOPMENT</i>	3.20
3.3.1	Development Since Previous Plan Update <sup>5(e)</sup>	3.20
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3.4	<i>HAZARD PROFILES, VULNERABILITY, AND PROBLEM STATEMENTS</i>	3.23
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	Vulnerability Assessments	3.24
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3.4.1	Flooding (Riverine and Flash)	3.25
	Hazard Profile	3.25
	Vulnerability <sup>5(b); 5(d)</sup>	3.38
	Problem Statement	3.40
3.4.2	Levee Failure <sup>4(b)(1)a; 4(b)(2,3)</sup>	3.41
	Hazard Profile	3.41
	Vulnerability	3.45
	Problem Statement	3.47
3.4.3	Dam Failure <sup>4(b)(1)b; 4(b)(2,3)</sup>	3.48
	Hazard Profile	3.48
	Vulnerability	3.55
	Problem Statement	3.56
3.4.4	Earthquakes	3.57
	Hazard Profile	3.57
	Vulnerability	3.62
	Problem Statement	3.66
3.4.5	Land Subsidence/Sinkholes <sup>4(b)(1)c; 4(b)(2,3)</sup>	3.67
	Hazard Profile	3.67
	Vulnerability	3.70
	Problem Statement	3.71
3.4.6	Drought	3.72
	Hazard Profile	3.72
	Vulnerability	3.76
	Problem Statement	3.78
3.4.7	Extreme Temperatures	3.78



Hazard Profile .....	3.78
Vulnerability.....	3.82
Problem Statement.....	3.84
<b>3.4.8</b> Severe Thunderstorms Including High Winds, Hail, and Lightning .....	3.84
Hazard Profile .....	3.84
Vulnerability.....	3.92
Problem Statement.....	3.94
<b>3.4.9</b> Severe Winter Weather .....	3.94
Hazard Profile .....	3.94
Vulnerability.....	3.97
Problem Statement.....	3.99
<b>3.4.10</b> Tornado.....	3.99
Hazard Profile .....	3.99
Vulnerability.....	3.103
Problem Statement.....	106
<b>3.4.11</b> Wildfire .....	107
Hazard Profile .....	3.107
Vulnerability.....	3.109
Problem Statement.....	3.110

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

Following is a community-wide risk assessment for Ripley County, Missouri. The data used to compile this assessment can be found throughout the body of this document, primarily within the profile of each hazard and capabilities of each jurisdiction. The natural hazards discussed throughout this document were examined using available data relevant and necessary for determining the types of hazards, frequency and strength of those hazards, areas vulnerable to those hazards, potential impacts, and probability that each hazard will occur.

The purpose and goal of the risk assessment is to estimate the potential loss in the planning area, including loss of life, personal injury, property damage, and economic loss, from a natural hazard event. To begin the process, all relevant natural hazards must be identified and profiled as described above. The risk assessment process allows communities and school/special districts in the planning area to better understand their potential exposure risks to the identified hazards. When executed properly, it provides a framework for developing and prioritizing mitigation actions which will reduce risk from future hazard events.

This chapter is divided into four main sections:

- **Section 3.1 Hazard Identification** identifies the hazards that threaten the planning area and provides a factual basis for elimination of hazards from further consideration;
- **Section 3.2 Assets at Risk** provides the planning area's total physical exposure to natural hazards, considering critical facilities and other community assets at risk;
- **Section 3.3 Land Use and Development** discusses development that has occurred since the last plan update and any increased or decreased risk that resulted. This section also discusses areas of planned future development and any implications on risk/vulnerability;
- **Section 3.4 Hazard Profiles and Vulnerability Analysis** provides more detailed information about the hazards impacting the planning area. For each hazard, there are three sections:
  - 1) Hazard Profile provides a general description and discusses the threat to the planning area, the geographic location at risk, potential Strength/Magnitude/Extent, previous occurrences of hazard events, probability of future occurrence, risk summary by jurisdiction, impact of future development on the risk;
  - 2) Vulnerability Assessment further defines and quantifies populations, buildings, critical facilities, and other community/school or special district assets at risk to natural hazards; and,
  - 3) Problem Statement briefly summarizes the problem and develops possible solutions.

## 3.1 HAZARD IDENTIFICATION

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**Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...of all natural hazards that can affect the jurisdiction.**

The Ripley County Hazard Mitigation Planning Committee has determined that this updated plan, as with past county plans, will address only natural hazards. Natural Hazard has been defined by I. Burton, R. Kates, and G. White in *The Environment as Hazard*, as “those elements of the physical environment, harmful to man and caused by forces extraneous to him.” Consistent with this definition, war, chemical contamination, and other manmade phenomena are excluded from classification as natural hazards.

Natural hazards can be classified as hazard events or disasters. Hazardous events may occur in populated areas, but do not cause significant property damage, injury, or loss of life. It is not until significant property damage and loss of life result from the occurrence of a natural hazard that the phenomena can be classified as a natural disaster.

### 3.1.1 Review of Existing Mitigation Plans

The planning committee reviewed the hazards identified within the 2016 Ripley County Hazard Mitigation Plan and the current state plan—both identify eleven natural hazards: dam failure, drought, earthquake, extreme heat, flooding, land subsidence/sinkholes, levee failure, severe winter weather, thunderstorm/hail/high winds, tornado, and wildfires. The planning committee reviewed these hazards and examined known historical hazards that have impacted jurisdictions in Ripley County. The committee determined inclusion of all of those listed above as necessary for a thorough risk assessment. Since 2016, there development within Ripley County has been minimal and, therefore, did not affect the hazards to be included within the current update.

All of the above listed phenomena have either occurred within Ripley County, or could occur within the county due to its geography and other environmental factors. Some of the above hazards are more likely to occur in the planning area, while some are less likely. Within the following pages, each hazard, its history of occurrence in Ripley County and its probability of occurring in the future will be described.

Due to the location and geography of Ripley County, the occurrence of certain natural hazards, which may also occur in other parts of the world, is virtually impossible. The following list contains natural hazards, which have been determined by the planning committee to be insignificant threats within Ripley County, Missouri: hurricane and other tropical storms, tsunami, volcano, as well as arid and semi-arid-related phenomena. Hurricanes, tropical storms, and tsunamis do not occur in or near Ripley County due to its central location within North America. Furthermore, the geologic and soil structure found within Ripley County is not conducive to volcanic activity. Because of this, there are no hurricanes, tropical storms, tsunamis, or volcanoes within the county.

The planning committee discussed including man-made hazards within the *Ripley County Hazard Mitigation Plan*. However, because only natural hazards are required for inclusion by FEMA regulations, the committee focused their initiative on naturally-occurring events.

### 3.1.2 Review Disaster Declaration History

State and/or federal disaster declarations may be granted when the severity and magnitude of a hazard event surpasses the ability of the local government to respond and recover. Disaster

assistance is supplemental and sequential. When the local government’s response capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster results in damages beyond the local and state’s capacities to respond, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

Federally declared emergencies differ from disaster declarations in that they are more limited in scope. “Emergencies” do not include the provision of long-term federal recovery programs, while “disasters” do include such provisions. Determinations for declaration type are based on the scale and type of damages, as well as the institutions/industrial sectors affected.

The table below lists the hazard events have resulted in federal disaster declarations within Ripley County since 1965.

**Table 3.1. FEMA Disaster Declarations that included Ripley County, Missouri, 1965-Present**

Disaster Number	Description	Declaration Date	Incident Period	Individual Assistance (IA) Public Assistance (PA)
DR-4552-MO	Severe Storms, Tornadoes, Straight-line Winds & Flooding	7/9/2020	5/3/2020-5/4/2020	PA
DR-4490-MO	Missouri Covid-19 Pandemic	5/26/2020	1/20/2020-present	IA & PA
DR-4317-MO	Severe Storms, Tornadoes, Straight-line Winds, And Flooding	6/2/2020	4/28/2017-5/11/2017	IA & PA
DR-1980-MO	Severe Storms, Tornadoes, And Flooding	5/9/2011	4/19/2011-6/6/2011	IA & PA
DR-1847-MO	Severe Storms, Tornadoes, And Flooding	6/19/2009	5/8/2009-5/16-2009	IA & PA
DR-1822-MO	Severe Winter Storm	2/17/2009	1/26/2009-1/28/2009	PA
DR-1809-MO	Severe Storms, Flooding, And A Tornado	11/13/2008	9/11/2008-9/24/2008	PA
DR-1749-MO	Severe Storms And Flooding	3/19/2008	3/17/2008-5/9/2008	IA & PA
DR-1412-MO	Severe Storms And Tornadoes	5/6/2002	4/24/2002-6/10/2002	IA & PA

Source: Federal Emergency Management Agency, <https://www.fema.gov/data-visualization-summary-disaster-declarations-and-grants>

### 3.1.3 Research Additional Sources

The following additional sources of data were consulted to determine the locations and past impacts of hazards in the planning area:

- Missouri Hazard Mitigation Plans (2010, 2013, and 2018)
- Previously approved *Ripley County Hazard Mitigation Plan* (2016)
- Federal Emergency Management Agency (FEMA)
- Missouri Department of Natural Resources
- National Drought Mitigation Center Drought Reporter
- US Department of Agriculture’s (USDA) Risk Management Agency Crop Insurance Statistics
- National Agricultural Statistics Service (Agriculture production/losses)
- Data Collection Questionnaires completed by each jurisdiction

- Environmental Protection Agency
- Flood Insurance Administration
- Hazards US (Hazardus)
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI)
- County Emergency Management
- County Flood Insurance Rate Map, FEMA
- Flood Insurance Study, FEMA
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- United States Geological Survey (USGS)
- Various articles and publications available on the internet (citations provided when applicable)

It should be noted that the primary centralized source of data for many weather-related hazards is the National Oceanic and Atmospheric Administration's (NOAA), National Centers for Environmental Information (NCEI). Although it is usually the best and most current source, there are limitations to the data. The NCEI documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. Some information appearing in the NCEI may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, local law enforcement and/or other government agencies, private companies, individuals, etc. Because of this the NWS is unable to guarantee the accuracy or validity of the data.

The NCEI damage amounts are estimates received from a variety of sources. The NWS uses all data available at the time of the publication to arrive at the estimated damages. Property and crop damage figures should be considered as a broad estimate. Damages reported are in dollar values as they existed at the time of the storm event, and do not represent current dollar values.

As of the compilation of this plan update, the NCEI database contained data from January 1950 to September 2020. Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. The following timelines outline the different time spans for each period of unique data collection and processing.

1. Tornado: From 1950 through 1954, only tornado events were recorded.
2. Tornado, Thunderstorm Wind and Hail: From 1955 through 1992, tornado, thunderstorm wind and hail events were keyed from paper publications into digital data. From 1993 to 1995, tornado, thunderstorm wind and hail events have been extracted from the Unformatted Text Files.
3. All Event Types: From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605 found at <https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf>

It should be noted that injuries and deaths caused by a storm event are reported within the NCEI database on an area-wide basis. When reviewing a table resulting from an NCEI database search by county, any death or injury listed as a result of that county search may not have occurred in the county for which the search was conducted.

### 3.1.4 Hazards Identified

The hazards determined by the planning committee to potentially and significantly impact the planning area are as follows:

- Dam failure
- Drought
- Earthquake
- Extreme temperatures
- Flooding
- Land subsidence/sinkholes
- Levee failure
- Severe winter weather
- Thunderstorm/lightning/hail/high wind
- Tornado
- Wildfire

It should be noted that not all of the above-listed hazards impact every jurisdiction within Ripley County. The table below provides a summary of the jurisdictions impacted by each hazard. An “x” in the table below indicates the jurisdiction is impacted by the applicable hazard. A “-” indicates the hazard is not applicable to that jurisdiction. There are no variations in the assessed hazard risk from one jurisdiction to another for hazards that are area-wide in risk, such as drought, earthquakes, thunderstorm, etc.

**Table 3.2. Hazards Identified for Each Jurisdiction**

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Temperatures	Flooding (River and Flash)	Land Subsidence/Sinkholes	Levee Failure	Severe Winter Weather	Thunderstorm/Lightning/Hail/High Wind	Tornado	Wildfire
Ripley County	x	x	x	x	x	x	x	x	x	x	x
City of Doniphan	-	x	x	x	x	x	-	x	x	x	x
City of Naylor	-	x	x	x	x	x	-	x	x	x	x

Doniphan R-I	-	-	X	X	X	-	-	X	X	X	-
Naylor R-II	-	-	X	X	X	-	-	X	X	X	-
Ripley County R-III	-	-	X	X	X	-	-	X	X	X	X

### 3.1.5 Multi-Jurisdictional Risk Assessment

Following is a multi-jurisdictional risk assessment for Ripley County, Missouri and all jurisdictions within its boundaries. Within this section, a profile will be presented for each relevant hazard identified by the planning committee. Each hazard profile will assess the risk of that particular hazard to the planning area on an area-wide basis. The risk for some hazards (e.g. flooding) varies from jurisdiction to jurisdiction. Discussions of such variations are included within each hazard profile. The data sources used to compile this assessment are consistently referenced throughout the body of Section 3. This plan is an update of the *Ripley County Natural Hazard Mitigation Plan* approved by FEMA in 2016. The data and information included reflect changes and updates since that time.

Ripley County is adequately uniform in terms of climate; temperatures and precipitation are relatively consistent throughout the county. Some variations of the topography within the county exist—wooded hills within the northwest portions of the county and flat, low-lying farmland to the southeast near the City of Naylor. Ripley County’s population is spread throughout two incorporated communities: Doniphan and Naylor, and the unincorporated areas of the county.

The types of buildings and infrastructure are consistent from town to town. Residential structures are mainly wooden, brick and mortar with a noticeable quantity of mobile homes or modular homes. There are no urbanized areas within Ripley County. While farmland and related agricultural assets are concentrated within the southeastern portion of the county, development within the City of Naylor and the unincorporated portion of the county is limited. Some residential development is occurring within the City of Doniphan along the northern city limit boundary. However, this development is not anticipated to impact Doniphan’s future vulnerability. The differences among the participating jurisdictions, though slight, will be discussed in greater detail within the hazard-specific vulnerability sections of each hazard profile.

## 3.2 ASSETS AT RISK

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This section assesses the planning area population, structures, critical facilities and infrastructure, as well as other important assets that may be at risk to damage from hazards. There have been limited changes to the planning areas since the approval of the 2016 *Ripley County Hazard Mitigation Plan*. The U.S. Census Bureau estimated a population of 13,567 persons in Ripley County for 2019—a decrease of 533 persons or 3.8% from the final 2010 population of 14,100. This population decrease was county-wide and included the county’s two incorporated communities—further evidence of the lack of development and unlikelihood of future development within Ripley County, Missouri.

While a recently updated DFIRM for the county was available for the flood risk assessment, parcel data was not available in digital format. Furthermore, building values were not available by individual parcel within the county. Consequently, analysis could not be done to show parcels and associated values in the planning area as located within the regulatory floodplain. Because a digital FIRM was available for the county, it and the asset inventories provided by each jurisdiction were analyzed to best describe all assets at risk of flood in the planning area.

### 3.2.1 Total Exposure of Population and Structures

#### Unincorporated County and Incorporated Cities



In the following three tables, population data is based on 2019 Census Bureau data estimates. Building counts and building exposure values are based on parcel data developed by the State of Missouri Geographic Information Systems (GIS) database. This data, organized by county, is available on Google Drive through the following link:

<https://drive.google.com/drive/folders/0Bzg99s866kWocFB5Y3hCRIRuWWM> .

Contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The multipliers were derived from FEMA’s loss and risk assessment software (HAZUS) and are defined below within the source citing for **Table 3.3**. Land values have been purposely excluded from consideration because land remains following disasters, and subsequent market devaluations are frequently short-term and difficult to quantify. Another reason for excluding land values is that state and federal disaster assistance programs generally do not address loss of land (other than crop insurance).

It should be noted that the total valuation of buildings is based on county assessors’ data which may not be current. In addition, government-owned properties are usually taxed differently or not at all—further hindering the dependability of county-provided data. Note, however, that public school district assets and special districts assets are included within the total exposure tables.

**Table 3.3** shows the total population, building count, estimated value of buildings, estimated value of building contents and estimated total exposure for the unincorporated portion of Ripley County and each of its two incorporated cities. There are no multi-county communities within Ripley County. **Table 3.4** which follows provides the building value exposures for the county and each city delineated by usage type. And, finally, **Table 3.5** provides the building count total for the county and each city delineated by building usage types (residential, commercial, industrial, and agricultural).

**Table 3.3. Maximum Population and Building Exposure by Jurisdiction**

Jurisdiction	2019 Annual Population Estimate	Building Count	Building Exposure (\$)	Contents Exposure (\$)	Total Exposure (\$)
City of Doniphan	2,062	958	\$134,346	\$76,759	\$211,105
City of Naylor	801	313	\$36,488	\$23,045	\$59,533
Unincorporated Ripley County	10,704	8,858	\$538,259	\$299,663	\$837,922
<b>Totals</b>	13,567	10,129	\$709,093	\$399,467	\$1,108,560

Source: U.S. Bureau of the Census, Annual population estimates/ 5-Year American Community Survey 2019; Building Count and Building Exposure, Missouri GIS Database from SEMA Mitigation Management; Contents Exposure derived by applying multiplier to Building Exposure based on Hazus MH 2.1 standard contents multipliers per usage type as follows: Residential (50%), Commercial (100%), Industrial (150%), Agricultural (100%). For purposes of these calculations, government, school, and utility structure were calculated at the commercial contents rate.

**Table 3.4. Building Values/Exposure by Usage Type**

Jurisdiction	Residential	Commercial	Industrial	Agricultural	Government & Education	Total
City of Doniphan	\$78,292	\$32,957	\$2,599	\$5	\$20,492	\$134,346
City of Naylor	\$27,138	\$1,953	\$4,679	\$21	\$2,697	\$36,488

Unincorporated Ripley County	\$488,297	\$20,263	\$21,315	\$5,105	\$3,279	\$538,259
<b>Totals</b>	<b>\$593,727</b>	<b>\$55,173</b>	<b>\$28,594</b>	<b>\$5,131</b>	<b>\$26,468</b>	<b>\$709,093</b>

Source: Missouri GIS Database, SEMA Mitigation Management Section

**Table 3.5. Building Counts by Usage Type**

Jurisdiction	Residential Counts	Commercial Counts	Industrial Counts	Agricultural Counts	Government & Education	Total
City of Doniphan	802	135	5	4	12	958
City of Naylor	278	8	9	15	3	313
Unincorporated Ripley County	5,002	83	41	3,719	13	8,858
<b>Totals</b>	<b>6,082</b>	<b>226</b>	<b>55</b>	<b>3,738</b>	<b>28</b>	<b>10,129</b>

Source: Missouri GIS Database, SEMA Mitigation Management Section; Public School Districts and Special Districts

Even though schools and special districts' total assets are included in the tables above, additional discussion is needed, based on the data that is available from the districts' completion of the Data Collection Questionnaire and state-maintained websites. The number of enrolled students at the participating public schools is provided in **Table 3.6** below. Additional information includes the number of buildings, building values (building exposure) and contents value (contents exposure). These numbers represent the total enrollment and building count for the entire public school district regardless of the county(ies) through which their service area extends.

**Table 3.6. Population and Building Exposure by Jurisdiction-Public School Districts**

Public School District	Enrollment	Building Count	Building Exposure (\$)	Contents Exposure (\$)	Total Exposure (\$)
Doniphan R-I	1,645	5	\$27,530,374	\$3,038,153	\$30,568,527
Naylor R-II	408	2	\$12,229,897	\$2,937,103	\$15,167,000
Ripley County R-III	98	1	\$2,706,420	\$701,499	\$3,407,919

Source: <http://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx>, 2019 Building Enrollment PK-12, Data Collection Questionnaires

### 3.2.2 Critical and Essential Facilities and Infrastructure

This section will include information from the jurisdiction-specific Data Collection Questionnaires and other sources concerning the vulnerability of participating jurisdictions' critical, essential, high potential loss, and transportation/lifeline facilities to identified hazards. Definitions of each of these types of facilities are provided below.

- Critical Facility: Those facilities essential in providing utility or direction either during the response to an emergency or during the recovery operation.
- Essential Facility: Those facilities that if damaged, would have devastating impacts on disaster response and/or recovery.

- High Potential Loss Facilities: Those facilities that would have a high loss or impact on the community.
- Transportation and Lifeline Facilities: Those facilities and infrastructure critical to transportation, communications, and necessary utilities.

**Table 3.7** includes a summary of the inventory of critical and essential facilities and infrastructure in the planning area. The list was compiled from the Data Collection Questionnaires as well as the following sources:

- 2018 Missouri State Hazard Mitigation Plan and Hazard Mitigation Viewer  
<http://bit.ly/MoHazardMitigationPlanViewer2018>
- Hazus contains an inventory of critical facilities that can be exported for each jurisdiction.

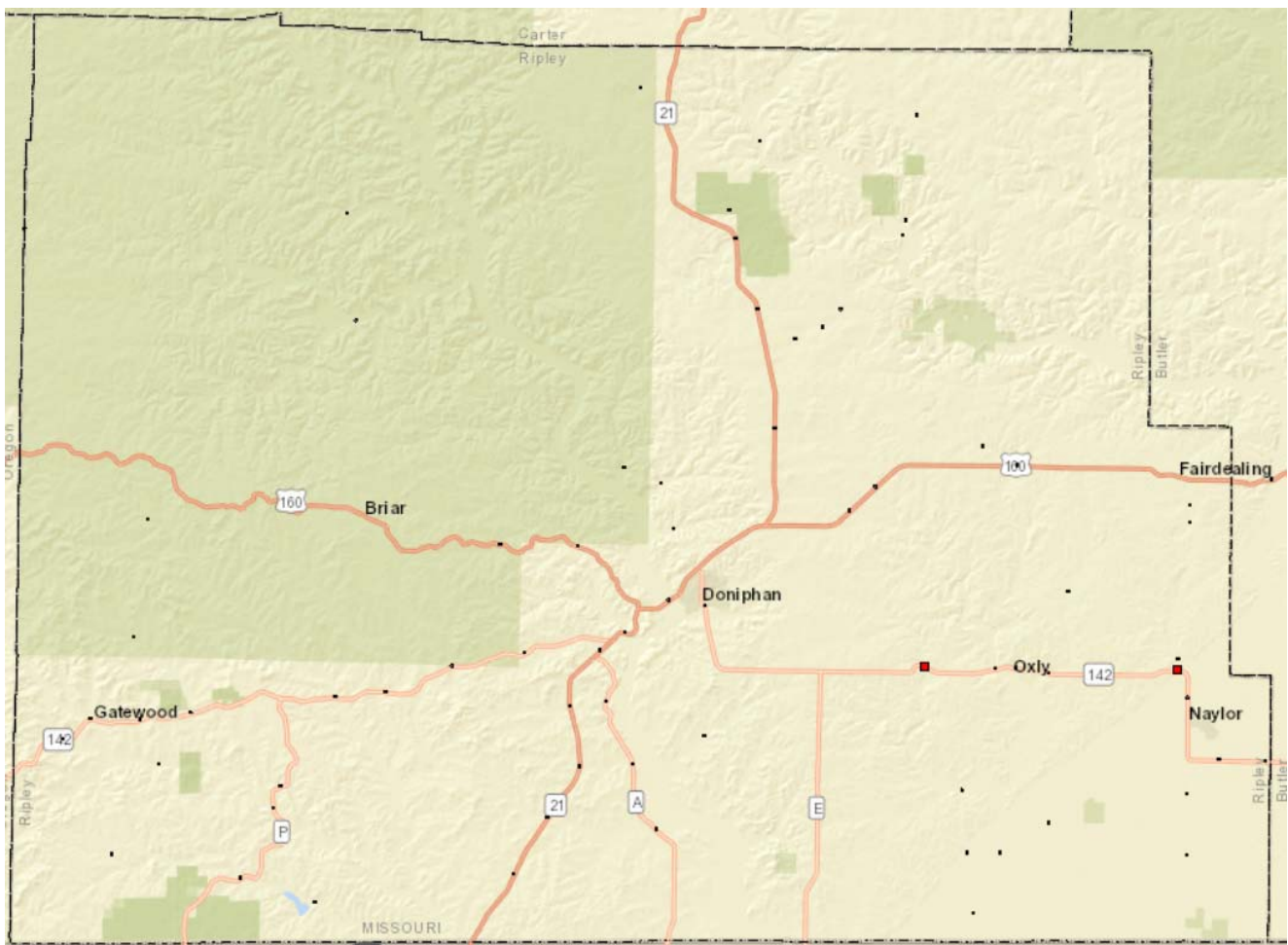
**Table 3.7. Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction**

Jurisdiction	Airport Facility	Bus Facility	Childcare Facility	Communications Tower	Electric Power Facility	Emergency Operations	Fire Service	Government	Housing	Shelters	Highway Bridge	Hospital/Health Care	Military	Natural Gas Facility	Nursing Homes	Police Station	Potable Water Facility	Rail	Sanitary Pump Stations	School Facilities	Stormwater Pump Stations	Tier II Chemical Facility	Wastewater Facility	TOTAL
City of Doniphan	1	0	5	2	0	0	1	2	2	1	3	2	1	1	3	1	1	0	3	3	0	4	2	38
City of Naylor	0	0	0	1	0	0	1	1	1	0	0	1	0	1	0	0	1	0	1	1	0	0	1	10
Ripley County	0	1	2	3	1	0	7	2	0	0	5	0	0	1	0	1	2	0	0	4	0	1	0	30
Doniphan R-I School District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	17
Naylor R-II School District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	9
Ripley County R-III School	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	6
<b>Totals</b>	1	1	8	6	1	0	9	5	3	1	8	3	1	3	3	2	4	0	4	14	0	5	3	85

Source: Missouri 2018 State Hazard Mitigation Plan and Hazard Mitigation Viewer; Data Collection Questionnaires

Bridge scour is the term used to describe the removal of rocks, sediment, or other foundation element from around a bridge piers, supports, or abutments by swiftly moving water. The term “scour critical” refers to one of the database elements in the National Bridge Inventory. This element is quantified using a “scour index”, which is a number indicating the vulnerability of a bridge to scour during a flood. Bridges with a scour index of 0 or 1 are at or near failure due to scour. Bridges with a scour rating of 2 or 3 also fall within the category of “scour critical” as their foundations are vulnerable to scour resulting in instability. Ripley County has two state-owned “scour critical” bridges per the inventory—none of which are located within neither the City of Doniphan, nor the City of Naylor. Both bridges have been assigned a scour rating of 3 by the Missouri Department of Transportation. Below Figure 3.1) is a map of indicating showing all state-owned bridges in the county (indicated by a black dot), as well as the county’s two state owned “scour-critical” bridges (indicated by a red square).

**Figure 3.1. Ripley County State-Owned Bridges**

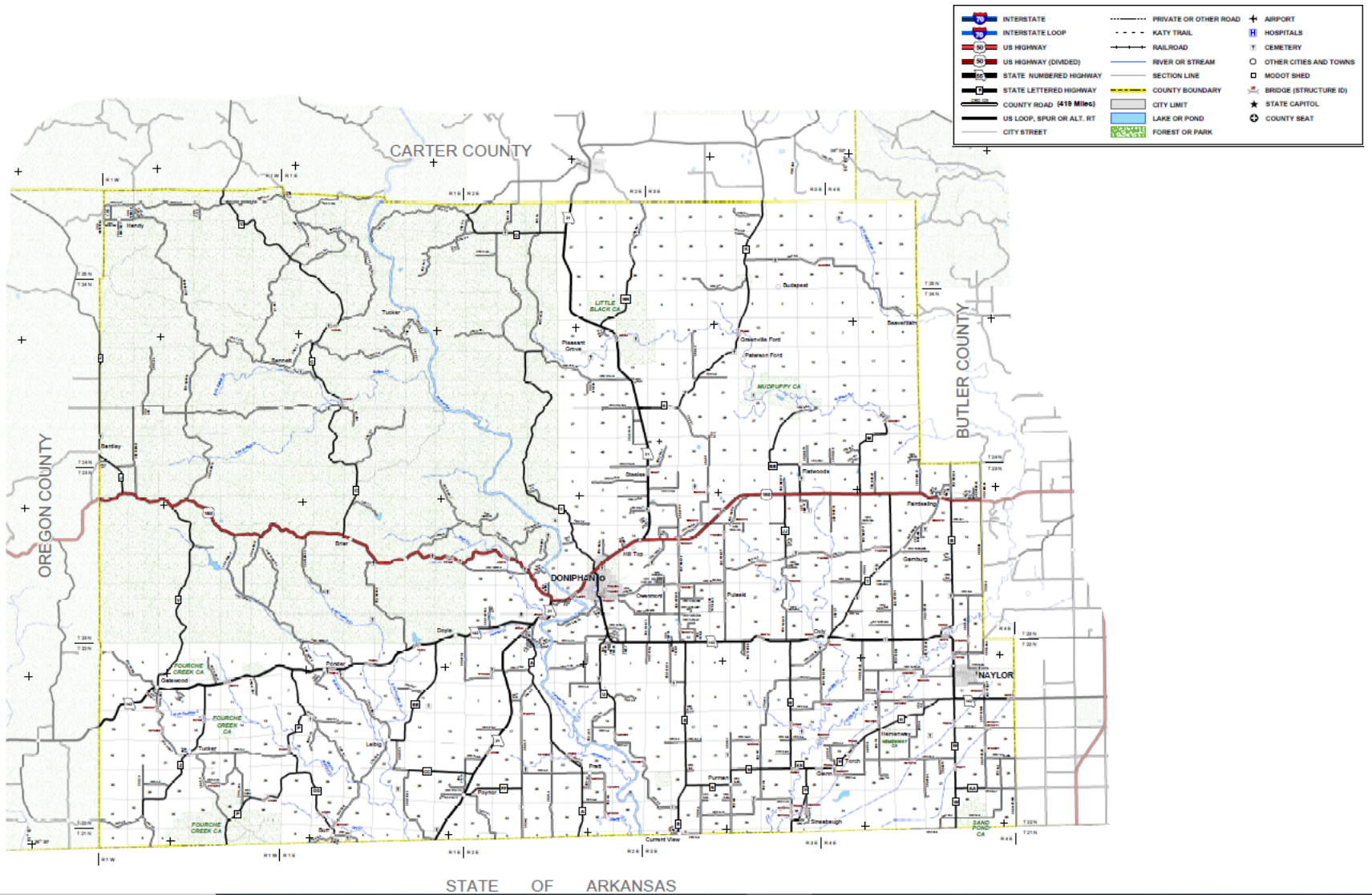


Source: Missouri Hazard Mitigation Viewer, 2018 Update

Per the Federal Highways Administration database found at <http://www.fhwa.dot.gov/bridge/nbi/no10/county.cfm>, there are 116 state-owned bridges within Ripley County comprising 23,063 square feet. Of this total, 36 bridges are considered in good condition, 73 in fair condition and seven spanning 688 square feet are in poor condition as rated by the Missouri Department of Transportation. The county highway map on the next page show the location and identification number of each bridge in Ripley County.



Figure 3.2. Ripley County Bridges



Source: Missouri Department of Transportation, County Maps

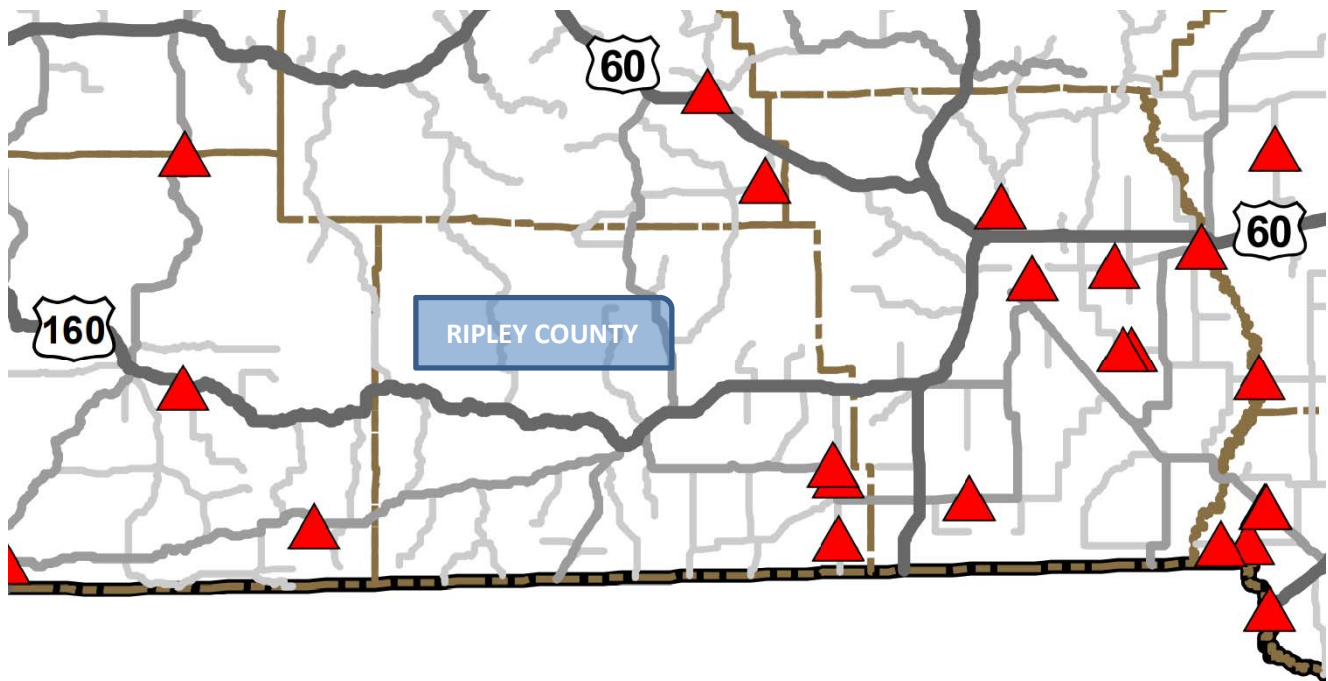
The map below—provided by the Missouri Department of Transportation—indicates that three bridges in Ripley County are considered structurally deficient as determined by the Missouri Department of Transportation. The bridges are described by the department at [Poor Bridges Public 2 \(1\).pdf](#) as follows:

Bridge# L0378, 157 feet long by 19 feet wide along Missouri Highway 142 East over the Little Black River;

Bridge# P0677, 102 feet long by 22 feet wide along Missouri Highway W over Ditch #3; and,

Bridge# T0758, 34 feet long by 21 feet wide along Missouri Highway 142 East over Ditch #2.

**Figure 3.3. Ripley County Structurally Deficient Bridges**



Source: Missouri Department of Transportation, [Statewide Poor Bridges 2020 with insets 0\(1\).pdf](#)

### 3.2.3 Other Assets

Assessing the vulnerability of Ripley County to disaster also requires data on the natural, historic, cultural, and economic assets of the area. This information is important for multiple reasons, some of which follow:

- the resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy;
- knowledge of these resources in advance allows for consideration immediately following a hazard event, which is when the potential for damage is higher;
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources;
- the presence of natural resources can reduce the impacts of future natural hazards, such as wetlands and riparian habitats which help absorb floodwaters; and,
- losses to economic assets (e.g., major employers or primary economic sectors) could have



severe impacts on a community's ability to recover from disaster.

**Table 3.8** below lists Federally Threatened, Endangered, Proposed and Candidate Species in Ripley County.

**Table 3.8. Threatened and Endangered Species in Ripley County**

Common Name	Type	Scientific Name	Status
Gray Bat	Mammal	Myotis grisescens	Endangered
Indiana Bat	Mammal	Myotis sodalist	Endangered
Northern Long-Eared Bat	Mammal	Myotis septentrionalis	Threatened
Ozark Hellbender	Amphibian	Cryptobranchus alleganiensis bishopi	Endangered
Curtis Pearlymussel	Clam	Epioblasma Florentina curtisii	Endangered
Pink Mucket	Clam	Lampsilis abrupta	Endangered
Hine's Emerald Dragonfly	Insect	Somatochlora hineana	Endangered
Pondberry	Flowering Plant	Lindera melissifolia	Endangered

Source: U.S. Fish and Wildlife Service, <https://ecos.fws.gov/ipac/location/SWOZ7HRAMBC2HBVVNFOXXJYKSQ/resources>

**Natural Resources:** The Missouri Department of Conservation (MDC) provides a database of lands the MDC owns, leases, or manages for public use. **Table 3.9** lists the names and locations of parks and conservation areas within Ripley County.

**Table 3.9. Parks in Ripley County**

Park / Conservation Area	Location	Jurisdiction
Doniphan Tower Site	County Road 21 N-7	Ripley County
Fourche Creek Conservation Area	State Route P and County Road P-3	Ripley County
Greenville Ford Access	State Route K at the Little Black River	Ripley County
Hemenway Conservation Area	State Highway H and County Road H-4	Ripley County
Little Black Conservation Area	State Route NN and 21	Ripley County
Mudpuppy Conservation Area	End of State Route BB	Ripley County
Sand Pond Conservation Area	Ripley County W-3	Ripley County
T.L. Wright Memorial Access	West Jefferson Street	City of Doniphan
Deer Leep Recreation Area	State Route Y	Ripley County
Riverfront Park	Corner of River Drive & Jefferson Street	City of Doniphan
Heritage Park	Corner of Grand Avenue & Washington Street	City of Doniphan
Mabry Park	Highway 160 @ The Current River Bridge	City of Doniphan
Pioneer Heritage Homestead	Corner of Franklin & Charles Streets	City of Doniphan
Naylor Park	Highway 142	City of Naylor
Naylor Community Park	Front Street	City of Naylor

Source: <http://mdc7.mdc.mo.gov/applications/moatlas/AreaList.aspx?txtUserID=guest&txtAreaNm=s>

**Historic Resources:** The National Register of Historic Places is the official list of registered cultural resources determined worthy of preservation through an established process. The register was authorized under the National Historic Preservation Act of 1966 as part of a national program. The purpose of the program is to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. The National Register is administered by the National Park Service under the Secretary of the U.S. Department of the Interior. Properties listed in the National Register include districts, sites, buildings, structures and objects that are significant

in American history, architecture, archeology, engineering, and culture.

According to Andrew Rumbach—a professor of planning at the University of Colorado Denver, “Many historic resources were built before modern flood regulations and modern building codes, so they’re located in areas that are prone to these kind of disasters.” In some communities, historic structure may be integral to the area’s local economy via the tourism industry. In others, such structures may provide a sense of identity and heritage to a community’s residents. Two programs—the National Park Service’s Certified Local Government Program and the National Main Street Program can assist local governments in identifying ways to mitigate damage to historic resources. No jurisdiction within the planning area participates in either program.

The National Main Street Program helps member communities outline a clear deliberate path to revitalize and strengthen their downtown or commercial districts. The program is implemented by the National Mainstreet Center—a subsidiary of the National Trust for Historic Preservation. Through the program, communities develop a revitalization plan based upon market data and organized around economic vitality, design, promotion, and organization. There are no Main Street communities within the planning area.

The Certified Local Government Program is a partnership between national, state, and local governments developed to help communities save the irreplaceable historic character of places. Local communities must become certified as a CLG through a process overseen by the National Park Service, communities make a local commitment to historic preservation. Communities that have these programs typically have infrastructure designed to protect historic sites. There are no Certified Local Governments within Ripley County.

Below is a listing of properties within Ripley County that are on the National Register of Historic Places (**Table 3.10**).

**Table 3.10. Ripley County Properties on the National Register of Historic Places**

Property	Address	City	Date Listed
Missouri SP Barrett, Randolph Columbus House	209 Plum Street	Doniphan	2/1/1977
Missouri SP Ripley County Courthouse	Courthouse Circle	Doniphan	11/7/1976
Missouri SP Sylvan School	County Road H-4, 2 miles SW of Hwy, 142 & Hwy. W	Ripley County	10/10/2002
Missouri SP Ripley County Jail, Sheriff's Office and Sheriff's Residence	Courthouse Circle	Doniphan	4/5/1991
Acel Price Site	Address Restricted	--	4/3/1978
B-9 Structure Archeological Site	Address Restricted	--	10/7/1975
Indian Ford (Cherokee Trail of Tears)	Address Restricted	--	6/21/2007
Little Black River Archeological District	Address Restricted	--	4/21/1975
Mule Camp Site	Address Restricted	--	11/11/1975

Source: Missouri Department of Natural Resources – Missouri National Register Listings by County  
<http://dnr.mo.gov/shpo/mnrlist.htm>

**Economic Resources:** Below is a table listing the major non-government employers in Ripley County (Table 3.11).

**Table 3.11. Major Non-Government Employers in Ripley County**

Employer Name	Main Locations	Product or Service	# Employees
Vitronic	Doniphan	Promotional Products	300
Current River Nursing Center	Doniphan	Long-Term Nursing Facility	110
Missouri Highlands Healthcare	Doniphan	Healthcare	62
Missouri Forge	Ripley County	Industrial Manufacturing	60
Harp's Grocery	Doniphan	Retail Food Sales	50

Source: Data Collection Questionnaires; Ripley County Chamber of Commerce

**Agriculture:** Agriculture plays an important role in Ripley County's economy. Per the 2012 Census of Agriculture found at [https://www.nass.usda.gov/Publications/AqCensus/2012/Online\\_Resources/County\\_Profiles/Missouri/cp29181.pdf](https://www.nass.usda.gov/Publications/AqCensus/2012/Online_Resources/County_Profiles/Missouri/cp29181.pdf), 137,829 acres comprise 439 farms within Ripley County. The average farm size was sizeable at 314 acres. Land use among farms in the county is roughly equally divided between cropland (32.7%), pasture (31.0%), and woodlands (32.5%). Fourteen of the county's 439 farms reported an annual sales value above \$250,000 indicating that the overwhelming majority of farming operations in the county are small operations. For example, nearly 74% of all Ripley County farms have an annual sales value of less than \$19,999.

Crop sales accounted for 56% of agricultural sales in the county at \$10,669,000. The remaining 44% of farm income totaled \$8,464,000 and resulted from the sale of livestock. Grains, oil seeds, dry beans and dry peas—valued at \$9,308,000—accounted for 87% of all crop sales with hay being the majority of the remainder. Cattle—at 18,641 head—accounted for 92.3% of all livestock raised upon farms within Ripley County, with hogs, poultry, goats, and horses comprising the remaining 7.7%. The table below provides a summary of the farm acreage by crop type. Only 87 farms in the county employ workers with an average of 2.8 workers per farm. Nearly 64% of all farm workers were reported as unpaid.

**Table 3.12. Acres of Farmland in Ripley County by Crop Type**

Type of Crop	Number of Acres	Percentage of Total Cropland
Forage-Land for Hay	13,835	45.8%
Soybeans	8,583	28.4%
Rice	4,440	14.7%
Corn	2,635	8.7%
Wheat	709	2.4%
Total	30,202	100.0%

Source: 2012 Census of Agriculture found at [https://www.nass.usda.gov/Publications/AqCensus/2012/Online\\_Resources/County\\_Profiles/Missouri/cp29181.pdf](https://www.nass.usda.gov/Publications/AqCensus/2012/Online_Resources/County_Profiles/Missouri/cp29181.pdf)

### 3.3 LAND USE AND DEVELOPMENT

#### 3.3.1 Development Since Previous Plan Update<sup>5(e)</sup>

From 2010 to 2019, change and development in Ripley County has been minimal despite an indication of large population growth as estimated by the U.S. Census Bureau within the City of Naylor. From 2010 to 2019, only fifteen residential building permits were issued by the City of

Doniphan, with none issued by the City of Naylor. Because little development has occurred, little to no change is anticipated with regard to the county’s risk associated with natural hazards as compared to the last plan update in 2016. The City of Doniphan’s building permit data is compiled by the U.S. Census Bureau, and can be found at <https://www2.census.gov/econ/bps/Place/Midwest%20Region/>.

**Table 3.13** provides estimates of population growth or decline for both cities in Ripley County, as well as the county as a whole. It should be noted that the data included below within the second column are five-year estimates of population determined by the U.S. Census Bureau and do not represent a count obtained by decennial census.

**Table 3.13. County Population Growth, 2010-2019**

Jurisdiction	Total Population 2010	Total Estimated Population 2019	2010-2019 # Change	2010-2019 % Change
Ripley County	14,100	13,567	-533	- 3.8%
City of Doniphan	1,997	2,062	+169	+3.3%
City of Naylor	632	801	+65	+26.7%

Source: U.S. Bureau of the Census, Decennial Census, Annual Population Estimates, American Community Survey 5-year Estimates; Population statistics are for entire incorporated areas as reported by the Census Bureau

Population changes generally precede or occur simultaneously with increases or decreases in the number of housing units. **Table 3.14** below provides the change in numbers of housing units in the Ripley County from 2010 to 2019.

**Table 3.14. Change in Housing Units, 2010-2019**

Jurisdiction	Housing Units 2010	Housing Units 2019	2010-2019 # Change	2000-2019 % Change
Ripley County	6,597	6,638	+41	+.6%
City of Doniphan	966	998	+32	+3.3%
City of Naylor	290	319	+29	+10%

Source: U.S. Bureau of the Census, Decennial Census, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the U.S. Census Bureau

Population growth within the county as a whole between 2010 and 2019 was estimated to be fairly stagnant by the Census Bureau, with more pronounced increases in population estimated in the planning area’s two cities. The paragraphs below outline the growth which the U.S. Census Bureau estimates to have occurred within the county’s two population centers during the last decade.

**City of Doniphan**

Between 2010 and 2019, the United States Census Bureau reports only an anticipated slight increase in Doniphan’s population (3.3%). This estimated increase directly corresponds with an estimated increase in the number of new housing units in the city. Upon a simple drive-through inspection of Doniphan, one will witness some new residential construction and new commercial development—primarily retail food establishments. Despite experiencing a 500-year flood in 2017—in which it lost all city offices—and losing its only hospital in 2018, the city has survived.

**City of Naylor**

Between 2010 and 2019, the United States Census Bureau reports an anticipated decrease in overall county population, but an increase in the number of housing units—particularly within the City of

Naylor. This estimated increase corresponds with an estimated 26.7% increase in the number of Naylor residents. Upon a simple drive-through inspection of Naylor, this population boom is challenging to fathom. The community appears economically depressed with an increasing number of vacant structures and no new construction. As of the writing of this proposal, the community's nutrition center was planning a new facility construction.

### **3.3.2 Future Land Use and Development<sup>5(e)</sup>**

Neither Ripley County, nor the City of Naylor have comprehensive plans. Land use maps are also not available for any jurisdiction within the county. None of the school districts in Ripley County, MO have growth plans.

Growth in the county is not anticipated, and, consequently, is not anticipated to impact hazard risk in the planning area. Per the Missouri Census Data Center's Missouri County Fact Sheet for Ripley County, the county's largest population group consists of persons between the ages of 65 and 84. This age group comprises 18.4% of the total population. It is reasonable to assume that as the members of this group age, population decline will occur within the county.

The remaining discussion in this section provides future growth and development information, where available, relative to each participating jurisdiction.

#### **City of Doniphan's Future Development**

Per the data provided above, the City of Doniphan experienced minimal growth from 2010 through 2019—169 individuals. The city recently acquired and renovated a vacant bank building as its new city hall as its former city hall was destroyed by floodwaters in 2017. The City of Doniphan currently has no other plans for significant development, yet is the only town in Ripley County with land use and zoning regulations. The City updated its comprehensive plan during September 2016 and continues the process of reviewing and updating zoning and land use regulations. The city's planning and zoning board meets regularly and is charged with reviewing ordinances and making recommendations to the city council for changes and updates. The construction of a single family housing development along the north side of the city's limits is anticipated before the next plan update (2026). The development is estimated to include twenty single-family swelling units.

#### **City of Naylor's Future Development**

The City of Naylor has no land use or zoning regulations. Naylor is a small, farming community with a population of 632 persons. There has been no new development in Naylor in several years, and despite extraordinarily unusual estimates by the American Community Survey, no future growth or development is anticipated by local officials.

#### **School District's Future Development**

No extensive future development to the facilities of any of the public schools in Ripley County is planned. Currently none of the districts are pursuing bond issues or planning for large development projects outside of small projects or the routine maintenance of existing facilities. Both the Doniphan R-I School District and the Ripley County R-IV School Districts are currently servicing bond issues used to construct tornado safe rooms. The Doniphan School District plans to replace one or more roofs upon its campus, it does not currently have the funding to construct new facilities.

While the Naylor R-II School District does not have an official future development plan, they are planning to build a fifty foot by eighty foot storage building during the summer of 2021, as well as a thirty-two foot by eighty foot structure to house the softball and baseball batting cages. The district has initiated discussions regarding the possibility of applying for HMGP funding for the construction of a tornado safe room. Should this occur, the district may then explore the possibility of constructing a new high school facility adjacent to the safe room structure.

## Special District's Future Development

The special districts that are found in Ripley County are two public water districts, Ripley County Public Water Supply District (PWSD) #1 and #2. These special districts serve defined areas, PWSD #1 serves to the south and west of the City of Doniphan and PWSD #2 serves to the east of the City of Doniphan. Despite being invited, neither districts participated in the development of this plan update. Consequently, no information regarding the anticipated development of special districts was available. Water storage towers and wells are adequate to handle current service demands.

## 3.4 HAZARD PROFILES, VULNERABILITY, AND PROBLEM STATEMENTS

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Each of the natural hazards identified by Ripley County as pertinent to its jurisdictions will be analyzed individually in the below hazard profiles. The profiles will consist of a general hazard description, location, strength/magnitude/extent, previous events, future probability, a discussion of risk variations between jurisdictions, and how anticipated development could impact risk. At the end of each hazard profile will be a vulnerability assessment, followed by a summary problem statement.

### Hazard Profiles

**Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the...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.**

Each hazard identified in Section 3.1.4 will be profiled individually in this section in alphabetical order. The level of information presented in the hazard profiles will vary by hazard based on available data. With each update of this plan, new information will be incorporated when available to provide better evaluation and prioritization of the hazards that affect the planning area. Detailed profiles for each of the identified hazards include information categorized as follows:

- **Hazard Description:** This section consists of a general description of the hazard and the types of impacts it may have on a jurisdiction within the planning area.
- **Geographic Location:** This section describes the geographic areas in the planning area that are affected by the hazard. When appropriate, maps are used to indicate the specific locations within the planning area that are vulnerable to the subject hazard. For some hazards, the entire planning area will be stated as “at risk.”
- **Strength/Magnitude/Extent:** This section includes information about the strength, magnitude, and extent of past hazard events. For some hazards, this is accomplished with description of a value on an established scientific scale or measurement system, such as an EF2 tornado on the Enhanced Fujita Scale. This section will also include information on the typical or expected strength/magnitude/extent of the hazard in the planning area. Strength, magnitude, and extent can also include the speed of onset and the duration of hazard events. Describing the strength/magnitude/extent of a hazard differs from describing its potential impacts on a community. Strength/magnitude/extent defines the characteristics of the hazard regardless of the people and/or property it affects.
- **Previous Occurrences:** This section includes available information on historic hazard events and their impacts. Historic event records are then used to calculate probability of future

occurrence.

- **Probability of Future Occurrence:** The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability can be determined by dividing the number of recorded events by the number of years of available data and multiplying by 100. This results in the percent chance of the event happening in any given year. For events occurring more than once annually, the probability is reported as 100% in any given year. For hazards such as drought that may have gradual onset and extended duration, probability is based on the number of months in drought in a given time-period and expressed as the probability for any given month to be in drought.

- **Changing Future Conditions Considerations:**

In addition to the probability of future occurrence, changing future conditions will also be considered, including the effects of long-term changes in weather patterns and climate on the identified hazards. An informative tool provided by the National Oceanic and Atmospheric Administration (NOAA) and found at <https://toolkit.climate.gov/tools/climate-explorer> was used in considering the effect changing future conditions may have on a particular hazard's future occurrence.

### **Vulnerability Assessments**

**Requirement §201.6(c)(2)(ii) :[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.**

**Requirement §201.6(c)(2)(ii)(A) :The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.**

**Requirement §201.6(c)(2)(ii)(B) :[The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.**

**Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.**

**Requirement §201.6(c)(2)(ii): (As of October 1, 2008) [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged in floods.**

Following the hazard profile for each hazard will be the vulnerability assessment. The vulnerability assessment defines and quantifies populations, buildings, critical facilities, and other community assets at risk to damages from natural hazards. Data used in assessing a community's vulnerability will be pulled from the *Missouri State Hazard Mitigation Plan, 2018 Update* and extracted using the Missouri Hazard Mitigation Viewer found at <http://bit.ly/MoHazardMitigationPlanViewer2018>. The vulnerability assessments in the Ripley County plan update were also based on:

- Written descriptions of assets and risks provided by participating jurisdictions;
- Existing plans and reports;
- Personal interviews with planning committee members and other stakeholders; and,

- Other sources as cited.

Within the Vulnerability Assessment for each hazard, the following sub-headings will be addressed:

- **Vulnerability Overview:**

An overall summary of each jurisdiction’s vulnerability to the identified hazards will be presented within the vulnerability overview. The summary will identify structures, systems, populations or other community assets as defined by the community that are susceptible to damage and/or loss as a result of the hazard.

- **Potential Losses to Existing Development:**

This section will describe—for each participating jurisdiction—the potential impacts of the hazard. Impact, in terms of hazard mitigation, is described as the consequences of the effects of the hazard on a particular jurisdiction and its assets (buildings, critical facilities, etc.). Assets are determined by the community and include people, structures, facilities, systems, capabilities, and/or activities that have value to the community. Impact may be described by referencing the effects of historical disasters or by estimating potential future losses.

- **Previous and Future Development:**

This section will include information on how changes in development, over time, have impacted the community’s vulnerability to this hazard. A description of how developmental changes occurring since the previous plan update have increased or decreased a community’s vulnerability will be described. Anticipated future development in the county and how that development may impact hazard risk in the planning area will also be discussed.

- **Hazard Summary by Jurisdiction:**

For hazard risks that vary by jurisdiction, this section will provide an overview of that variation and the factual basis for that variation. A vulnerability analysis will be summarized and assigned to each jurisdiction using one of the following terms:

- 1) Low
- 2) Low-medium
- 3) Medium
- 4) Medium-high
- 5) High

## **Problem Statements**

Each hazard analysis will conclude with a brief summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems. Jurisdiction specific information in those cases where the risk varies across the planning area will be provided. The purpose of this summary will be to synthesize the “problems” revealed through the risk assessment and develop mitigation actions that are aimed at “solving” the identified problems.

### **3.4.1 Flooding (Riverine and Flash)**

#### **Hazard Profile**

##### ***Hazard Description*<sup>4(a)(2)</sup>**



A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt or ice melt. The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100- year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin, which is defined as all the land drained by a river and its branches.

Flooding caused by dam and levee failure is discussed in Section 3.4.3. and Section 3.4.2., respectively. It will not be addressed in this section.

A flash flood occurs when water levels rise at an extremely fast rate as a result of intense rainfall over a brief period, sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil, or impermeable surfaces. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by the National Flood Insurance Program (NFIP) and can also happen in areas not associated with floodplains.

Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation.

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development frequently fails incorporate the installation of adequate drainage infrastructure to properly carry and disburse the water flow.

Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area. Flash flooding is a dangerous form of flooding which can reach full peak in only a few minutes. Rapid onset allows little or no time for protective measures. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding can result in higher loss of life, both human and animal, than slower developing river and stream flooding.

In certain areas, aging storm sewer systems are not designed to carry the capacity needed to handle ever-increasing stormwater runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. This combined with rainfall trends and rainfall extremes all demonstrate the high probability, yet generally unpredictable nature of flash flooding in the planning area.

Although flash floods are somewhat unpredictable, there are factors that can point to the likelihood of flash floods occurring. Weather surveillance radar is being used to improve monitoring capabilities of intense rainfall. This, along with knowledge of the watershed characteristics, modeling techniques, monitoring, and advanced warning systems has increased the warning time for flash floods.

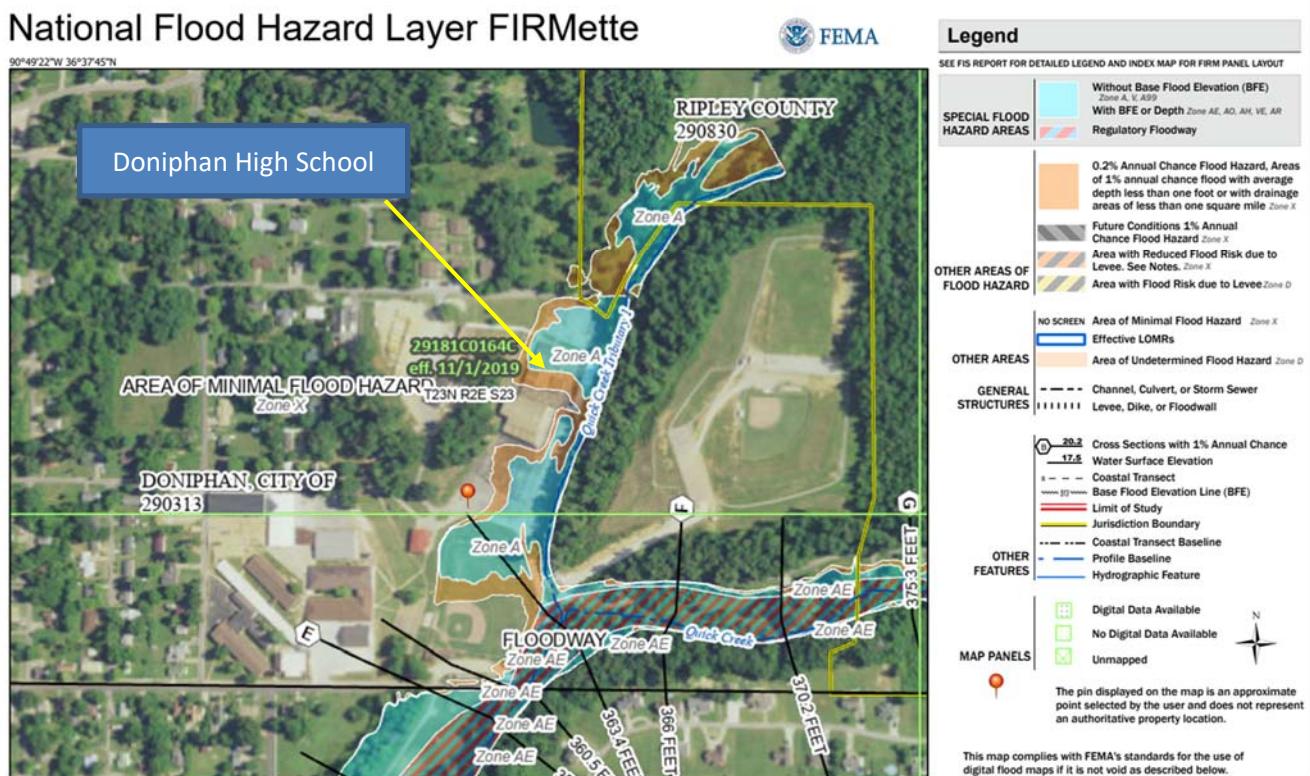
### **Geographic Location**<sup>4(a)(1)</sup>

A Flood Risk Report for the Lower Black Watershed was funded by FEMA and produced by FTN Associates, Ltd. for the Arkansas Natural Resources Commission during September 2015. The report provides data to help local officials, planners, and other interested parties to better understand and plan for their flood risk. This particular report describes Ripley County as the northernmost

county of seven counties impacted by the Lower Black River Watershed. Despite the report's estimate that 18% of county residents reside within the watershed across 631.7 square miles, the report concluded that \$0 in potential losses across all Lower Black River flood event scenarios could be expected. As a result, the report authors offered no mitigation actions for Ripley County. The report can be found at [https://map1.msc.fema.gov/data/FRP/FRR\\_11010009\\_20150915.pdf?LOC=101b6ef0ea443ee1e6ee4b1ddac4af91](https://map1.msc.fema.gov/data/FRP/FRR_11010009_20150915.pdf?LOC=101b6ef0ea443ee1e6ee4b1ddac4af91).

Riverine flooding is most likely to occur in Special Flood Hazard Areas (SFHAs). Floodplain maps for Ripley County were updated and finalized by FEMA on November 1, 2019. Maps showing the SFHA for all participating jurisdictions have been included within Appendix A to this document. A floodplain map showing the Doniphan R-I School campus has been inserted below for emphasis as the district has significant assets located within a SFHA. <sup>4(a)(1)</sup>

**Figure 3.4. Doniphan R-I School District – Floodplain Map**



**Table 3.15** shows the number of flood events occurring in Ripley County for a twenty-year period.

**Table 3.15. Ripley County NCEI Flood Events by Location, 2000-2020**

Location	# of Events
-Unincorporated Ripley County (unspecified) - 7 flood events	38
-Unincorporated Ripley County (Doniphan) - 18 flood events	
-Unincorporated Ripley County (Naylor) – 5 flood events	
-Unincorporated Ripley County (Bennett) – 4 flood events	
-Unincorporated Ripley County (Briar) - 1 flood event	
-Unincorporated Ripley County (Oxly) - 1 flood event	
-Unincorporated Ripley County (Ponder) - 1 flood event	

-Unincorporated Ripley County (Torch) - 1 flood event	
City of Doniphan	
-City of Doniphan (unspecified)- 18 flood events	18
City of Naylor	
-City of Naylor (unspecified) - 5 flood events	5

Source: National Centers for Environmental Information, March 16, 2021

Flash flooding occurs in SFHAs and those locations in the planning area that are low-lying. It also occurs in areas without adequate drainage to carry away the stormwater during intense rainfall events. **Table 3.16**, below, shows with the number of flash flood events by location recorded within NCEI for a 20-year period.

**Table 3.16. Ripley County NCEI Flash Flood Events by Location, 2000-2020**

Location	# of Events
Unincorporated Ripley County	
-Unincorporated Ripley County (unspecified) - 7 flash flood events	
-Unincorporated Ripley County (Doniphan) - 14 flash flood events	
-Unincorporated Ripley County (Briar) - 2 flash flood events	
-Unincorporated Ripley County (Oxly) - 1 flash flood event	
-Unincorporated Ripley County (Naylor) - 3 flash flood events	
-Unincorporated Ripley County (Glenn) - 2 flash flood events	
-Unincorporated Ripley County (Fairdealing) – 1 flash flood event	
-Unincorporated Ripley County (Bennett) - 1 flash flood event	
City of Doniphan	
-City of Doniphan (unspecified) - 14 flash flood events	14
City of Naylor	
-City of Naylor (unspecified) – 3 flash flood events	3

Source: National Centers for Environmental Information, March 16, 2021

### **Strength/Magnitude/Extent**

Missouri has a long and active history of flooding over the past century, according to the 2018 State Hazard Mitigation Plan. Flooding along Missouri’s rivers generally results in slow-moving disasters. River crest levels are forecast several days in advance, allowing communities downstream sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, floods often result in human suffering and losses to public and private property. By contrast, flash flood events in recent years have caused a higher number of deaths and major property damage in many areas of Missouri.

According to the U.S. Geological Survey, two critical factors affect flooding due to rainfall: rainfall duration and rainfall intensity – the rate at which it rains. These factors contribute to a flood’s height, water velocity and magnitude.

### **National Flood Insurance Program (NFIP) Participation<sup>5(c)</sup>**

**Table 3.17** provides details regarding National Flood Insurance Program (NFIP) participation for the communities in Ripley County. **Table 3.18** shows the number of flood insurance policies in force in each community, the amount of insurance provided, the number of closed losses, and total payments for each jurisdiction, where applicable.

**Table 3.17. NFIP Participation in Ripley County**

Community ID #	Community Name	NFIP Participant (Y/N Sanctioned)	Current Effective Map Date	Regular-Emergency Program Entry Date
290830	Ripley County	Not Sanctioned	11-1-2019	9-29-1986
290313	City of Doniphan	Not Sanctioned	11-1-2019	9-15-1989
290314	City of Naylor	Not Sanctioned	11-1-2019	8-19-1987

Source: NFIP Community Status Book, March 16, 2021; <https://www.fema.gov/cis/MO.html>

**Table 3.18. NFIP Policy and Claim Statistics as of Date**

Community Name	Policies in Force	Insurance in Force	Closed Losses	Total Payments
Ripley County	43	\$9,373,500	146	\$8,612,729.07
City of Doniphan	5	\$626,000	77	\$2,665,985.66
City of Naylor	0	\$0	1	\$3,386.44

Source: PIVOT, March 17, 2021, \*Closed Losses are those flood insurance claims that resulted in payment. Loss statistics are calculated from program start through the date noted.

The jurisdiction with the most flood insurance payments is clearly the unincorporated portion of the county. To date, payments made to policies holders within the unincorporated portion of Ripley County totaled \$8,612,729.07—76.3% of the total claims amounts paid within the county as a whole. No communities within the planning area are sanctioned by the NFIP.

### Repetitive Loss/Severe Repetitive Loss Properties<sup>5(c)</sup>

Repetitive Loss Properties are those properties with at least two flood insurance payments of \$1,000 or more in any 10-year period. According to the Flood Insurance Administration, jurisdictions included within Ripley County have a combined total of 40 repetitive loss properties, with 11 of those 40 located within the City of Doniphan and the remaining 29 within the balance of Ripley County. Per the 2018 Missouri State Hazard Mitigation Plan, \$5,438,723 had been paid via 120 flood insurance claims made on repetitive loss properties located within the county. **Table 3.19** provides a summary of the repetitive loss properties located in Ripley County.

**Table 3.19. Ripley County Repetitive Loss Properties**

Jurisdiction	# of Properties	Type of Property	# Mitigated	Building Payments	Content Payments	Total Payments	Average Payment	# of Losses
City of Doniphan	11	Unknown	0	Unknown	Unknown	\$1,600,918.19	\$37,230.66	43
Ripley County	29	Unknown	0	Unknown	Unknown	\$3,837,804.94	\$49,841.62	77

Source: Missouri State Hazard Mitigation Plan, 2018,

A Severe Repetitive Loss (SRL) property is defined it as a single-family property (consisting of one-to-four residences) that is covered by the NFIP and has incurred flood-related damage for which four or more separate claims payments have been issued under flood insurance coverage with the amount of each claim payment exceeding \$5,000 and with cumulative amounts of such claims payments exceeding \$20,000; or, for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Per the 2018 Missouri State Hazard Mitigation Plan, three Severe Repetitive Loss properties are located in Ripley County. Due to Federal restrictions on data sharing, the State of Missouri was unable to provide neither full Repetitive Loss data, nor current Severe Repetitive Loss data. “Property Type” was not available for Repetitive Loss properties. The Severe Repetitive Loss data cited here was obtained from the 2018 Missouri State Hazard Mitigation Plan and did not specify the property type, property mitigation status, or payment type.

### Previous Occurrences<sup>4(a)(3)</sup>

**Table 3.20 and Table 3.21** below show the number of events of both flash flooding and riverine flooding which have occurred in Ripley County in the past twenty years.

During the twenty-year period beginning November 1, 2001, thirty flash flood events in Ripley County occurred. One of the events resulted in an injury, while five events resulted in property damages totaling \$409,000. No deaths or crop damages have resulted from flash flooding in Ripley County in the past twenty years.

In the same time period, thirty-eight riverine flood events have occurred in Ripley County. While none of the events resulted in injuries, deaths, or crop damage, nine events resulted in significant property damages totaling \$6,623,000. The largest most impactful event occurred in 2017 and caused \$4,700,000 of the cited twenty-year total property damage amount.

**Table 3.20. NCEI Ripley County Flash Flood Events Summary, 2001 to 2021**

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2001	0	0	0	0	0
2002	6	0	1	0	0
2003	2	0	0	0	0
2004	3	0	0	\$34,000	0
2006	3	0	0	\$125,000	0

2007	3	0	0	0	0
2008	2	0	0	0	0
2009	2	0	0	\$150,000	0
2011	1	0	0	\$50,000	0
2014	1	0	0	0	0
2016	1	0	0	0	0
2017	1	0	0	0	0
2019	2	0	0	\$50,000	0
2020	3	0	0	\$0	0

Source: NCEI, data accessed March 23, 2021

The FEMA Data Visualization Tool found at <https://www.fema.gov/data-visualization-floods-data-visualization> reports that Ripley County has experienced sixty-eight flood events since the inception of the NCEI data collection program. The specific timeframe is not cited. According to the source, Ripley County has experienced eleven disaster declarations resulting from severe storms and flood events since 1953. Unfortunately, previous Public Assistance data is not provided by the tool at the county level. A review of previous Public Assistance grants would be helpful in identifying specific locations within the planning area most in need of mitigation.

**Table 3.21. NCEI Ripley County Riverine Flood Events Summary, 2001 to 2021**

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2001	1	0	0	\$80,000	0
2002	4	0	0	\$240,000	0
2003	1	0	0	0	0
2006	2	0	0	0	0
2007	1	0	0	0	0
2008	5	0	0	\$800,000	0
2009	4	0	0	\$40,000	0
2011	4	0	0	\$550,000	0
2013	2	0	0	\$3,000	0
2014	1	0	0	\$10,000	0
2015	2	0	0	\$200,000	0
2016	5	0	0	0	0
2017	2	0	0	\$4,700,000	0
2018	1	0	0	0	0
2019	1	0	0	0	0
2020	2	0	0	0	0

Source: NCEI, data accessed March 23, 2021

The NCEI provides narrative description for each flood event. Flash flood event details regarding the planning area are provided below by event date.

- 1-31-2001: In Ripley County, flooding affected County Road (CR) 24 and Highway 142 East. A low water bridge was impassable due to high water. The flooding was caused by a large area of moderate to heavy rain associated with a slow-moving cold front and falling upon already moist ground.
- 3-25-2001: A large area of slow-moving showers and thunderstorms persisted producing up to an inch of rain per hour. Rainfall totals were around three inches. Within the planning area, Mo Highway 142 at Naylor was completely flooded and a couple of rural roads were under water.
- 4-14-2002: An estimated two to three inches of rainfall fell over several hours. Water covered Mo Highway 21 north of Doniphan and Mo Route 142 near Naylor. The Little Black River was reported out of its banks north of Doniphan.
- 7-15-2002: Flooding occurred in and near the Gatewood and Briar areas. One foot of water

was over Highway 160 just west of State Highway C. On Highway 142 West, a motorist was trapped between two flooded creeks. The flash flooding was caused by a nearly stationary complex of thunderstorms that produce an estimated three to five inches of rain over a few hours.

- 12-31-2002: Around three inches of rain in three days caused flooding of roads, creeks, and low-lying areas. Within the planning area, Mo Routes H and W were closed. MO Highway 142 east of Naylor was impassable.
- 8-3-2003: A complex of severe thunderstorms moved slowly westward across Ripley County. The storms produced rainfall and hail. In Ripley County, flooding of K Highway was reported about 7 miles north of Doniphan.
- 9-2-2003: Heavy rain, estimated from one to two inches in a few hours, fell over saturated ground. In Ripley County, high water swept a car off of a low-water bridge near Oxly and left the driver stranded. Several low water bridges and gravel roads were flooded in the county.
- 4-24-2004: Localized flash flooding of road and creeks occurred as a series of thunderstorms crossed parts of Southeast Missouri producing heavy rain over saturated ground. In Ripley County, creeks overflowed across low water bridges. From April 21-24 rainfall measured 4.98 inches at Doniphan
- 5-14-2004: Persistent heavy rains across Ripley county filled creek banks and isolated a couple of homes. A cooperative observer in Doniphan measured 2.96 inches.
- 7-3-2004: Numerous streets were closed in Doniphan. Radar estimated about 2.5 inches of rain fell during three hours.
- 3-9-2006: Flooding occurred on many roads north of Doniphan. Low water crossing on Highways NN and K were impassable.
- 7-11-2006: Thunderstorms with periods of heavy rainfall over several days saturated the ground. Gages measured 7.5-8 inches of rain over a forty-eight-hour period. Flooding occurred in low-lying areas in and around Doniphan, affecting some streets and the high school. A vehicle was abandoned due to high water and a dumpster carried into a ditch. Some creeks escaped their banks.
- 9-23-2006: Rainfall over three days totaled nearly nine inches. Flash flooding forced more than twenty Naylor residents from their homes as a senior citizen complex and nearby homes were inundated with one foot of water. Many homes, a nutrition center, library, and the city hall were flooded in Naylor. Four single family dwellings, twenty-four multi-family housing units, and eight businesses sustained minor damage. One business received major damage. MO Highway 142 was closed at Naylor. A few roads were impassable and one water rescue was conducted. Street flooding was reported throughout Doniphan and low-lying areas of the county.
- 1-13-2007: A slow-moving upper level trough approached the region by the 12<sup>th</sup> and did not pass until the 16<sup>th</sup>. Several secondary roads were flooded, mainly throughout the eastern portion of the county. Creeks were out of their banks and spreading across secondary roads in Southeast Ripley County near Naylor.
- 1-14-2007: Water was over several streets in Doniphan.
- 5-3-2007: Six to twelve inches of water was across B Highway outside of Naylor. Street flooding occurred in Naylor. No evacuations were conducted.
- 4-3-2008: Large clusters of thunderstorms produced very heavy rain and large hail. Rainfall amounts averaged from two to four inches during twenty-four hours. Several secondary roads

and one highway were closed for a short period of time due to high water. Route H was closed from MO Highway 142 to the Arkansas State Line. Due to flooding of roads near the Little Black River near Naylor, Naylor R-II Schools were closed.

- 5-2-2008: A complex of thunderstorms during the morning produced heavy rain and locally gusty winds. Street flooding occurred in Doniphan. Some creeks in the planning area were out of their banks.
- 5-8-2009: Excessive rainfall totaled five inches in twenty-four hours. Then people were evacuated from their homes in Doniphan near Quick Creek. The county courthouse sustained major water damage. Major flooding occurred at the Doniphan R-I High School, where every classroom was flooded with eighteen inches of water and the asphalt parking lots buckled. Homes near the high school were flooded. Leaks cause minor water damage at the elementary and middle schools. A grocery market was flooded. Flash flooding of Quick Creek in Doniphan caused significant damage—one vehicle was totally submerged, and flood water came several feet up the sides of a house and garage. All secondary roads were covered with water and fifty percent of the primary roads were covered. A woman and child were rescued from their vehicle which was submerged in waist deep water.
- 12-24-2009: Widespread rainfall amounts from two to four inches occurred. Harris Creek overflowed its banks onto MO Highway 142 at Oxy. Water was over Highway A several miles southwest of Doniphan.
- 4-25-2011: The City of Naylor was isolated by flooding of roads through the night. Some homes were evacuated by boat throughout the county. Water entered a few homes and businesses.
- 4-28-2011: Isolated severe storms occurred within the planning area resulting in heavy rainfall and local flash flooding. A few state highways were closed due to flooding. Highway 142 was closed at Cypress Creek west of Oxy. State Routes H and W were closed near MO Highway 142.
- 8-13-2016: Thunderstorms over several days resulted in locally significant flash flooding. There were isolated reports of twelve to seventeen inches in the Ozark Foothills Region including Doniphan. Low water crossings were flooded west of Briar.
- 4-30-2017: Significant flooding developed following two thunderstorms, bringing three-day rainfall totals up to a foot in isolated locations. Some county roads were impassable. Water was over U.S. Highway 160 East at the Butler County line and in Fairdealing. Water was over State Highway JJ.
- 6-26-2019: Loosely organized clusters of thunderstorms produced isolated damaging winds, flash flooding, and large hail. Swiftly moving water was observed on streets in Doniphan. The high school and elementary school were both damaged by flooding.
- 7-10-2019: The slow movement of the storms through tropical humidity resulted in torrential rainfall. Numerous roads were flooded across the county.
- 1-11-2020: Rainfall totals ranged from two to five inches, which resulted in isolated flash flooding. Several roads were closed across the county, including portions of Route H and Route 142 in the southeast portion of the planning area and Routes NN and K in the northeast portion of the county.
- 5-4-2020: Flash flooding of low water crossings occurred due to repeated thunderstorm activity over the Ozark Foothills Region. Flooding of many low water crossings in northern Ripley County rendered them impassable.
- 7-22-2020: Thunderstorms moved southeast across Southeast Missouri ahead of a cold



front. Rainfall measured 2.11 inches in one hour at Doniphan. Precipitable water values ranged from 1.5 to 1.9 inches, which resulted in locally heavy downpours and isolated flash flooding. Several city streets around Doniphan were flooded.

Details pertaining to riverine flood events occurring in Ripley County within the past twenty years are provided below and arranged by event date.

- 12-16-200: Numerous roads were flooded in most counties of Southeast Missouri. CR 18 was washed out in Ripley County.
- 1-23-2002: Thunderstorms moved across Ripley County. Personnel at the airport in Doniphan measured 3.2 inches of rain in only two hours, and 4.2 inches in four hours. Major flooding occurred in Riley County, where about two dozen roads were washed out at least eight inches deep. Highway 160 was flooded near Fairdealing and Flatwoods. Highway 21 south of Doniphan was also flooded.
- 5-8-2002: Significant flooding occurred along the Current River in Ripley County. At Doniphan, the river crested at 20.6 feet. A gas station, car wash, and oil change station within an eight mile of the river were flooded. Jefferson Street, along which the police station and courthouse are located, became impassable due to flooding.
- 5-14-2002: Minor flooding occurred along the Current River at Doniphan. The river crested at 13.7 feet at Doniphan where flood stage is thirteen feet.
- 5-18-2002: The Current river flooded at Doniphan. The river crested at 17.4 feet, several feet above the flood stage of 13.0 feet.
- 11-20-2003: Minor flooding of the Current River occurred at Doniphan. The river crested at 13.39 feet at the Doniphan gage, where the flood stage is 13.0 feet.
- 9-23-2006: Following heavy rain, B Highway into Naylor, as well as, H Highway and W Highways in southern Ripley County remained closed throughout the day.
- 12-3-2006: Heavy rainfall resulted in flooding along the Current River. The Current River crested at 13.15 feet at Doniphan, just above the 13.0-foot flood stage.
- 5-3-2007: Route H was closed by flooding from Route 142 to the Arkansas State Line. Eight families were isolated. Four of the families relocated temporarily, while four other remained stranded.
- 3-18-2008: Torrential rainfall amounts from six to twelve inches occurred over a two-day period, causing a historic flood event. A cooperative observer in Doniphan measured 8.3 inches of rain on March 17<sup>th</sup> and 18<sup>th</sup>. Major flooding was responsible for numerous reports of people stranded in homes. Firefighters and deputy sheriffs worked for more than twenty-four hours conducting evacuations and rescues via boat. Between fifteen and twenty persons were rescued. The Doniphan Police Department received more than 1,600 calls about the flooding within twenty-four hours. Several churches were opened to provide shelter. Several propane tanks floating in the water were tied up. Numerous roads were closed, including U.S. Highway 160. Some families were stranded for multiple days due to roads flooded by Bills Creek, Simpson Creek, ad Isaacs Creek. A water rescue was conducted when a pick-up truck stalled in floodwaters on MO Highway 142 near Naylor. Two boys in a small boat took the motorist to dry land but were nearly overpowered by the current. Damage to county gravel road was extensive. One gravel road was washed out to a depth of five feet. One bridge on a county road was extensively damaged. Countywide, at least fifteen homes were damaged and two were destroyed. Eleven businesses were damaged.
- 3-19-2008: Torrential rainfall between nine and thirteen inches fell in a forty-eight-hour period, causing record flooding of rivers. Major flooding of the Current River occurred. At the

Doniphan gage, the river crested at 24.11 feet—the fifth highest in more than 100 years. Flood stage there is thirteen feet, and major flooding begins at twenty-two feet. More than fifteen businesses in Doniphan were closed, and the city hall and police stations were inaccessible due to high water. Several homes were damaged in town. Three people were stuck on the roof of their mobile home in Doniphan. Rescue efforts were hampered by a bridge which was too low to the water for the boats to pass. People were evacuated by boat from houses in the downtown area

- 3-31-2008: Rainfall amounts were generally from one to two inches, most of which fell within two hours. Several roads were closed by flooding. Standing water was reported over roads in numerous places. Some creeks escaped their banks.
- 4-10-2008: Widespread heavy rain and thunderstorms over saturated ground produced flooding. Rainfall was mostly in the two to four-inch range. A few streets were closed in Doniphan.
- 4-11-2008: Due to heavy thunderstorms, moderate flooding of the Current River occurred. At the Doniphan gage, the river crested at 18.17 feet. Flood stage at Doniphan is 130 feet. Low-lying fields and bottom lands were under water.
- 10-30-2009: Prolonged rain caused widespread flooding of roads and creeks. Schools released students early due to flooding of roads. State Highway NN was closed at the Little Black River bridge. MO Highway 142 was closed at Gatewood. Portions of Routes H and K were closed.
- 10-31-2009: Moderate flooding occurred along the Current River. At the Doniphan river gage, the river crested at 18.92 feet. Flood stage there is 13.0 feet. There was considerable flooding of parking lots and streets adjacent to the river. In Doniphan, two vans parked near the river were flooded up to the windshield. Riverside Park in Doniphan was flooded. Water began to flood homes.
- 11-1-2009: Moderate flooding continued along the Current River. There was considerable flooding of parking lots and streets adjacent to the river. A park was flooded.
- 12-24-2009: Widespread rainfall amounts from two to four inches occurred resulting in closure of Routes NN, H, and K.
- 4-24-2011: Widespread and excessive rainfall from thirteen to eighteen inches caused most creeks and small rivers to flood for an extended period of time. Numerous roads were flooded and closed, including major state highways. Many road washouts were reported across Southeast Missouri. Some schools canceled or delayed classes due to the large number of inaccessible homes
- 4-24-2011: Around twenty-one inches of rain fell across much of Southeast Missouri in a ten-day period starting April 22<sup>nd</sup>. Major flooding occurred on the Current River. At the Doniphan river gage, the river crested at 23.76 feet—the fifth highest reading on record. About fifteen homes were evacuated by boat. Swift water rescue teams were called into the region from Sikeston and Cape Girardeau to assist. One of the team rescued a couple stranded in their vehicle. Several businesses were flooded including two resorts on the river. Much of downtown Doniphan was flooded. Red Cross shelter were opened. The entrance into Doniphan on MO Highway 142 was closed due to flooding.
- 5-1-2011: Following excessive rain, additional rounds of thunderstorms produced average rainfall amounts of four to six inches. Some major flooding resulted. Numerous roads were flooded and closed, including major highways. Some homes were sandbagged or evacuated, and there were reports of people trapped in their homes due to flooded access roads. Water rescues were conducted due to motorists driving into flooded areas. Some schools canceled

or delayed classes due to the large number of inaccessible homes.

- 5-2-2011: The wettest meteorological spring (March through May) occurred with minor flooding along the Current River. At the Doniphan river gage, the river crested at 17.82 feet. Some low-lying fields and woodlands near the river were flooded.
- 6-3-2013: Heavy rain fell during the first two days of June. Minor flooding occurred on the Current River at Doniphan. Low-lying fields, woodlands, and river access roads were flooded.
- 12-21-2013: Storm total rainfall amounts ranged mostly from four to nine inches resulting in the closure of sections of MO Highways 142, H, K, NN, and W.
- 4-28-2014: Widespread thunderstorms and moderate rain caused flooding that closed MO Highway 142 between Oxly and Doniphan. A water rescue was conducted late in the day due to a vehicle in the water.
- 3-13-2015: Widespread moderate to heavy rain produced rain totals between two and four inches. Route K was closed at Beaver Dam Creek, and Route H was closed near the Little Black River.
- 12-28-2015: Rainfall totals from late on the 25<sup>th</sup> through the 29<sup>th</sup> ranged from five to seven inches. Major flooding occurred along the Current River. At the Doniphan river gage, the river crested at 22.82 feet. Flood stage there is 13.0 feet. Jefferson Street, along which the police station and courthouse are located became impassable due to flooding. About a dozen homes were evacuated. Several businesses were flooded, including a couple of resorts on the river. Parts of downtown Doniphan were flooded. The entrance into Doniphan on Highway 142 was flooded.
- 5-24-2016: A slow-moving cluster of thunderstorms produced very heavy rain and isolated flooding of roads. There was minor flooding of Highway V near Gatewood due to a nearby creek, and water was reported along MO Highway 142 near Highway V. There was minor flooding on MO Highway 142 near Naylor.
- 7-9-2016: Ditches and small streams were overflowing.
- 8-14-2016: There were isolated reports of twelve to seventeen inches in the Ozark Foothills Region including Doniphan resulting in the flooding of numerous roads around the county, including NN Highway on the Carter County line.
- 8-15-2016: There was considerable flooding of low-lying areas due to several thunderstorms over the previous few days. A lane of Route H near Naylor was closed due to flooding. A lane of MO Route 21 near Doniphan was closed due to flooding. A seventy-two-hour rainfall total of 10.84 inches was reported at the U.S. Forest Service weather observation site near Doniphan.
- 9-15-2016: Street flooding occurred in Doniphan as a result of thunderstorms. An automated rain gage measured 2.25 inches of rain in less than one hour.
- 4-30-2017: Significant flooding developed after two more thunderstorm complexes dumped heavy rain, bringing three-day rainfall totals up to a foot in isolated locations. A large complex of thunderstorms moved southeast across Southeast Missouri. This deluge of heavy rain brought flash flooding to the Ozark Foothills Region. During the overnight hours through the early morning of the 30<sup>th</sup>, an even larger complex of thunderstorms dumped very heavy widespread rain. A record-breaking flood began on the Current River on the 30<sup>th</sup>. The river rose rapidly above flood stage, climbing about 20 feet in 24 hours. The river exceeded its highest level on record around midday on the 30<sup>th</sup>. The old record was established in 1904. The river continued rising further above the record during the night of the 30<sup>th</sup>. Roads and bridges were closed, and many buildings were flooded in Doniphan. The river continued rising

at the end of April.

- 5-1-2017: Record or near-record flooding occurred after a succession of thunderstorm complexes dumped heavy rain in late April, bringing three-day rainfall totals up to a foot in isolated locations. On the 30th, a larger complex of thunderstorms dumped widespread very heavy rain. These storms accelerated rises in area rivers, which were already above flood stage in some cases. The Current River rose more than six feet above the record flood level, set in 1904. Catastrophic flood damage occurred in Doniphan and surrounding riverbank areas. At the Doniphan river gage, the river crested at 33.13 feet with the previous record of 26.80 feet set in March of 1904. The Highway 160 bridge over the Current River was closed. Much of the city of Doniphan was flooded, including about 40 businesses. Of those forty businesses, 35 received major damage and two were destroyed. The others had minor damage. Approximately fifteen homes were destroyed, another thirty-seven homes received major damage, and nine received minor damage. The Ripley County and Doniphan city government offices were flooded. Phone service was disrupted. Some of the flooded buildings were total losses. At least a dozen water rescues were conducted by boat. Some of the rescues involved vehicles in high water and others involved residents of flooded cabins. The Missouri State Highway Patrol conducted twelve water rescues at a location off Highway H at CR 12. Public property damage alone was estimated at two million dollars.
- 2-26-2018: Heavy rainfall caused minor flooding on the Current River. Some low-lying woods and field near the river were inundated.
- 5-2-2019: Lower parts of the Current River rose above flood stage due to several rounds of slow-moving showers and thunderstorms. The river flooding was minor, consisting of inundated low-lying woods and fields.
- 1-13-2020: An unseasonably strong storm system impacted the region January 10-11 and included heavy rainfall. Rainfall totals ranged from two to five inches. Minor flooding occurred on the Current River. Some low-lying woods and fields were under water.
- 3-21-2020: A line of thunderstorms produced heavy rainfall. Minor flooding occurred on the Current River. Low-lying woods and bottomland field were inundated.

### ***Probability of Future Occurrence***

Probability can be calculated by analyzing the numbers of events occurring in a set number of years and dividing the number of events by the number of years. Regarding the probability of a flash flood event occurring in Ripley County in any given year, thirty-one events is divided by twenty years resulting in an average of 1.55 events being likely to occur each year. Using the same formula, 1.8 riverine floods can be expected to occur somewhere in the planning area in any given year.

### ***Changing Future Conditions Considerations<sup>4(c)</sup>***

According to the 2018 Missouri State Hazard Mitigation Plan, “over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. Rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the worst flood of the year has increased by more than 20 percent.” If this increased precipitation intensity continues, the frequency of flooding within the planning area is likely to increase. Such changes in climate patterns can lead to the development of compounding events that interact to create extreme conditions. Flooding caused by high groundwater levels typically recedes more slowly than riverine flooding, slowing the response and recovery process. Per the state plan, “Communities already prone to flooding should be prepared for a potential increase in facility closures and/or damages, as well as an increase in public demand for flood response and assistance.”

## **Vulnerability**<sup>5(b); 5(d)</sup>

### ***Vulnerability Overview***

Flooding presents a danger to life and property, often resulting in injuries, and in some cases, fatalities. Floodwaters themselves can interact with hazardous materials. Hazardous materials stored in large containers could break loose or puncture as a result of flood activity. Examples are bulk propane tanks. When this happens, evacuation of citizens is necessary.

Public health concerns may result from flooding, requiring disease and injury surveillance. Community sanitation to evaluate flood-affected food supplies may also be necessary. Private water and sewage sanitation could be impacted, and vector control (for mosquitoes and other entomology concerns) may be necessary.

When roads and bridges are inundated by water, damage can occur as the water scours around bridge abutments and gravel roads. Floodwaters can also cause erosion undermining road beds. In some instances, steep slopes that are saturated with water may cause mud or rock slides onto roadways. These damages can cause costly repairs for state, county, and city road and bridge maintenance departments. When sewer back-up occurs, this can result in costly clean-up for home and business owners and present health hazards.

As mentioned within Section 3.2.2, Ripley County has two state-owned scour critical bridges none of which are located within either the City of Doniphan, or the City of Naylor.

### ***Potential Losses to Existing Development***

As reported within the University of Missouri GIS Department's MSDIS Structure Inventory & All Hazard Risk Dataset, there are 10,129 structures located in Ripley County. The City of Doniphan is home to 958 of the structures and the City of Naylor 313, with the remainder (8,858) in the unincorporated portion of the county. The total structure value in the planning area is estimated at \$709,092,000, with contents valued at \$399,467,000. The majority of structures in each jurisdiction are residential, valued, in total, at \$593,727,000.

Of the structures located within Ripley County, 796 are in the Special Flood Hazard Area (SFHA), or 100-year floodplain. Most of the flood-prone structures (83.5%) are located in the unincorporated portion of the planning area. Eleven percent (87 structures) are located in the City of Doniphan and the remaining 5.5% (44 structures) are in Naylor. Doniphan is home to twenty-three commercial and thirty-two residential flood-prone structures. Naylor is home to zero commercial and seventeen residential flood-prone structures. Most of the flood-prone structures in the balance of the county are used for either residential or agricultural purposes.

Per the 2018 Missouri State Hazard Mitigation Plan (State Vulnerability Overview and State Estimates of Potential Losses), HAZUS software was utilized to generate the flood hazard boundary and associated depth of flooding. Draft floodplain data for Ripley County became available in January 2018 and the MSDIS structure exposure count was consequently updated. Per the plan, total building exposure to flood in the planning area is \$1,131,335,000, with potential structural damage amounting to \$29,116,000. For jurisdictional level vulnerability, see the section below entitled "Hazard Summary by Jurisdiction."

Per the Missouri State Hazard Mitigation Plan, 2018, there exist twelve repetitive loss structures within the county and zero severe repetitive loss structures. Between 1978 and 2018, there have been 660 flood insurance policies in the county with 412 claims. The amount claims paid within the forty-year period equals \$3,290,913.

The Doniphan Fire Department is located within an area that flooding during the record-breaking 2017 riverine flood event. Per the National Weather Service, the Current River flood waters peaked

at 33.13 feet. During that event water flood the structure 4.5 feet.

### ***Impact of Previous and Future Development***<sup>4(c); 5(f)</sup>

Development of any kind can impact flash and riverine flooding within and around the development area. The installation of impervious (concrete, asphalt, etc.) increases stormwater runoff. Impervious surfaces do not allow water to be absorbed by the soil resulting in rainfall collections and flash flooding. At the time of this plan update, there was no development in low-lying areas near rivers and streams known to the MPC. While there are inadequate drainage systems within the City of Doniphan and the City of Naylor, no development within the affected areas of the two cities is anticipated. No additional installation of large-scale development involving impervious surfaces is planned for the two cities.

In the past decade, the City of Doniphan has conducted three residential and one commercial and three residential flood buyout projects. These projects have significantly decreased the city's vulnerability to flooding. Neither Ripley County, nor the City of Naylor have engaged in such activities. No other changes in development within flood-prone areas have impacted vulnerability within the planning area.

### ***Hazard Summary by Jurisdiction***

Vulnerability varies greatly across the county. To the eastern side of the county, particularly the far southeastern corner, there is potential for flooding from the Little Black River. This area includes the City of Naylor and the very rural areas surrounding Naylor. Much of this is farmland and there are not large concentrations of people or structures.

The center of the county, around Doniphan is very vulnerable to flooding. Doniphan is located along the banks of the Current River and much of the flooding in Doniphan and the surrounding unincorporated areas results from the water levels of the Current River. The floodplain maps included above and within Appendix A provide a pictorial reference of the areas most vulnerable to flooding. The City of Doniphan and areas along the Current River within the balance of the county are most susceptible to flooding. Table 3.15 presents information showing past flooding as most common the in the areas within and around the City of Doniphan.

**Ripley County** – Of the thirty flash flood events occurring within the past twenty years, twenty of the events occurred within the unincorporated portions of the county. Of the thirty-eight riverine flood events that have occurred within Ripley County in the past twenty years, thirty-six have directly impacted the unincorporated portion of the county.

**City of Doniphan** – Ten flash flood events occurred within the City of Doniphan from 2001 to 2020. Twenty riverine flood events have occurred within city limits in the same time period. The building now holding the city's fire department, though not located within the 100-year floodplain, did flood 4.5 feet during the flood of 2017. It is likely to flood again.

**City of Naylor** – Four flash flood events were identified as directly occurring within the City of Naylor between 2001 and 2020. No riverine flood events occurred within the city in the past two decades.

**Doniphan R-I School District** – Facilities owned by the Doniphan R-I School District have been directly impacted and damaged by flash flooding at least twice within the past twenty years. During one 2009 incident all classrooms within the high school campus were flooded with 18" of water. Such flash flooding occurs along the Quick Creek. The district's high school facility is partially located within the 100-year floodplain. Riverine flooding rarely directly impacts the school district.

**Naylor R-II School District** – While the Naylor R-II School District has been forced to close multiple times due to blocked transportation routes resulting from both flash and riverine flooding, school facilities have not been damaged due to flash or riverine flooding. The district has no assets located in the 100-year floodplain.

**Ripley County R-III School District** – School facilities have not been damaged due to flash or riverine flooding within the past twenty years. Some students may not be able to access the school building during flash flood events. The district has no assets located in the 100-year floodplain.

## **Problem Statement**

Ripley County is crisscrossed by numerous streams and rivers and is often susceptible to both flash flooding and riverine flooding. Both types of flooding have resulted in damage to businesses and residences in the county and within the City of Doniphan and the City of Naylor. Flooding is one of the most common hazards to occur and cause damage within the planning area. Following the 2008, 2011, and 2017 flood events, the City of Doniphan implemented multiple residential and commercial flood buyout projects—effectively addressing mitigation actions proposed in previous hazard mitigation plans. Few structures in the floodplain remain for purchase and demolition. The owners of those that do remain (some being repetitive loss properties) have denied participation in such projects.

Furthermore, following the historic 2017 flood event, the City of Doniphan lost its city hall and jail, which also served as the county’s jail. The city recently acquired an abandoned bank building and established a new city hall. The county is currently in the process of building a county jail. Both facilities are located outside of the floodplain. Despite these mitigation actions, flooding remains one of the most frequently occurring and most damaging natural hazards within the city. The Doniphan R-I School District’s high school campus is prone to flash flooding from the Quick Creek. The facility has been repetitively damaged by floodwaters. Injuries resulting from the creek’s quickly rising water have also occurred.

Possible solutions which may help to alleviate injury and damages resulting from flash and riverine flooding in the planning area may include the following:

- Ditch cleanout and new ditch construction within the unincorporated portions of the county, the City of Doniphan, and the City of Naylor;
- Purchase flood-prone residential properties within the balance of the county;
- Purchase flood-prone commercial properties within the City of Doniphan;
- Establish alternate transportation routes for use during flood events;
- Stormwater collection system improvements within the City of Doniphan; and,
- Drainage improvements and bank stabilization along the Quick Creek within the City of Doniphan.

## 3.4.2 Levee Failure<sup>4(b)(1)a; 4(b)(2,3)</sup>

### Hazard Profile

#### *Hazard Description*

Levees are earth embankments constructed along rivers and coastlines to protect adjacent lands from flooding. Floodwalls are concrete structures, often components of levee systems, designed for urban areas where there is insufficient room for earthen levees. When levees and floodwalls and their appurtenant structures are stressed beyond their capabilities to withstand floods, levee failure can result in injuries and loss of life, as well as damages to property, the environment, and the economy.

Levees can be small agricultural levees that protect farmland from high-frequency flooding. Levees can also be designed to protect people and property in larger urban areas from less frequent flooding events such as the 100-year and 500-year flood levels. For purposes of this discussion, levee failure will refer to both overtopping and breach as defined in FEMA's Publication "So You Live Behind a Levee" (<http://mrcc.isws.illinois.edu/1913Flood/awareness/materials/SoYouLiveBehindLevee.pdf>).

Following are the FEMA publication descriptions of different types of levee failure.

#### **Overtopping: When a Flood Is Too Big**

Overtopping occurs when floodwaters exceed the height of a levee and flow over its crown. As the water passes over the top, it may erode the levee, worsening the flooding and potentially causing an opening, or breach, in the levee.

#### **Breaching: When a Levee Gives Way**

A levee breach occurs when part of a levee gives way, creating an opening through which floodwaters may pass. A breach may occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water. The resulting torrent can quickly inundate a large area behind the failed levee with little or no warning.

Earthen levees can be damaged in several ways. For instance, strong river currents and waves can erode the surface. Debris and ice carried by floodwaters—and even large objects such as boats or barges—can collide with and gouge the levee. Trees growing on a levee can blow over, leaving a hole where the root wad and soil used to be. Burrowing animals can create holes that enable water to pass through a levee. If severe enough, any of these situations can lead to a zone of weakness that could cause a levee breach. In seismically active areas, earthquakes and ground shaking can cause a loss of soil strength, weakening a levee and possibly resulting in failure. Seismic activity can also cause levees to slide or slump, both of which can lead to failure.

#### **Geographic Location**

Missouri is a state with many levees. Currently, there is no single comprehensive inventory of levee systems in the state. Levees have been constructed across the state by public entities and private entities with varying levels of protection, inspection oversight, and maintenance. The lack of a comprehensive levee inventory is not unique to Missouri.

There are two concurrent nation-wide levee inventory development efforts, one led by the United State Army Corps of Engineers (USACE) and one led by Federal Emergency Management Agency (FEMA). The National Levee Database (NLD), developed by USACE, captures all USACE related levee projects, regardless of design levels of protection. The Midterm Levee Inventory (MLI), developed by FEMA, captures all levee data (USACE and non-USACE) but primarily focuses on levees that provide 1% annual-chance flood protection on FEMA Flood Insurance Rate Maps (FIRMs).



Typically, agricultural levees and other non-regulated levees are not inventoried or inspected. Levees that are not designed to provide protection from the 1-percent annual chance flood would likely overtop or fail during a 1-percent annual chance flood scenario. Consequently, associated losses would be taken into account in the loss estimates provided within the Flood Hazard Section, which precedes this section. Levees located within the planning area are primarily agricultural in function—the breach of which would not cause widespread damages. Typically, these types of levees are viewed by locals as ditch banks.

Per the National Levee Database (NLD), there are no levees within the City of Doniphan or the City of Naylor. Twelve levees are located within Ripley County—eleven of which are located within the southeastern corner. The remaining levee is located within the Mudpuppy Conservation Area located in the eastern central portion of the county and maintained by the Missouri Department of Conservation. None of the twelve levees are listed upon the county’s DFIRM and none are maintained, screened, or monitored by the U.S. Army Corps of Engineers (USACE). Table 3.22 below lists the levees identified as located within the balance of the county.

**Table 3.22. Levees in Ripley County, Missouri**

<b>NAME</b>	<b># POPULATION PROTECTED</b>	<b># STRUCTURES PROTECTED</b>	<b>PROPERTY VALUE PROTECTED (\$)</b>	<b>LENGTH (MILES)</b>
Cypress Ditch Levee	4	2	394,000	9.56
Cypress Ditch Levee 2	2	15	4,960,000	9.53
Ditch #2 – Naylor 1	0	0	0	3.74
Ditch #2 – Naylor 2	3	1	270,000	3.36
Ditch #2 – Naylor 3	0	0	0	3.11
Ditch #2 – Naylor 4	3	1	167,000	3.25
Ditch #3 Levee	3	1	394,000	4.34
Ditch #3 Levee B	0	0	0	3.24
Ditch #3 Levee C	0	0	0	2.17
Ditch #3 Levee D	0	0	0	4.19
Ditch #3 Levee E	0	0	0	2.2
Little Black River Levee	0	0	0	.68
<b>TOTAL</b>	<b>15</b>	<b>20</b>	<b>6,185,000</b>	<b>49.37</b>

Source: National Levee Inventory, USACE, January 2021

The map below (Figure 3.5) shows the levees identified by the USACE as existing within the planning area. There exists little to no development behind the county’s levees. There are no schools or special district assets located in the areas protected by the county’s levees.

**Figure 3.5. County Levees Shown within National Levee Database**



Source: National Levee Database, USACE, January 2021

***Strength/Magnitude/Extent***

Levee failure is typically an additional or secondary impact of another disaster such as flooding or earthquake. The main difference between levee failure and losses associated with riverine flooding is magnitude. Levee failure often occurs during a flood event, causing destruction in addition to what would have been caused by flooding alone. In addition, there would be an increased potential for loss of life due to the speed of onset and greater depth, extent, and velocity of flooding due to a levee breach.

As previously mentioned, agricultural levees and levees that are not designed to provide flood protection from at least the 1-percent annual chance flood do exist in the planning area. However, none of these levees are shown on the Preliminary DFIRM, nor are they enrolled in the USACE Levee Safety Program. As a result, an inventory of these types of levees is not available for analysis. Additionally, since these types of levees do not provide protection from the 1-percent annual chance flood, losses associated with overtopping or failure are captured in the Flood Section

of this plan.

### ***Previous Occurrences***

There have been no previous levee breaches or incidents in the planning area.

### ***Probability of Future Occurrence***

The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability is determined by dividing the number of recorded events by the number of years during which the events occurred. The result represents the probability of a levee failure occurring in any given year. There are no records of previous levee breaches in Ripley County. Because the probability of future occurrence is based upon past events, no probability can be calculated.

### ***Changing Future Conditions Considerations***

Per the Missouri State Hazard Mitigation Plan, 2018, “the impact of changing future conditions on levee failure will most likely be related to changes in precipitation and flood likelihood.” Climate change projections suggest that precipitation may increase and occur in more extreme events, which will likely increase risk of flooding, thereby placing additional stress on levees. This increased pressure directly increases the likelihood of levee failure. With the exception of one structure (Little Black River Levee), levees in the planning area are maintained by local drainage districts and private property owners with limited or lacking resources. As the structures age, regular levee maintenance becomes paramount to preserving the function of the structure. The lack of regular maintenance (including seepage monitoring and the removal of trees, roots, animals, and other vegetation that can weaken a levee) most common with privately maintained levees, further increases the risk of future structural failure.

## **Vulnerability**

### ***Vulnerability Overview***

The USACE regularly inspects levees within its Levee Safety Program to monitor their overall condition, identify deficiencies, verify that maintenance is taking place, determine eligibility for federal rehabilitation assistance (in accordance with P.L. 84-99), and provide information about the levees on which the public relies. Inspection information also contributes to effective risk assessments and supports levee accreditation decisions for the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA).

The USACE now conducts two types of levee inspections. Routine Inspection is a visual inspection to verify and rate levee system operation and maintenance. It is typically conducted each year for all levees in the USACE Levee Safety Program. Periodic Inspection is a comprehensive inspection led by a professional engineer and conducted by a USACE multidisciplinary team that includes the levee sponsor. The USACE typically conducts this inspection every five years on the federally authorized levees in the USACE Levee Safety Program.

Both Routine and Periodic Inspections result in a rating for operation and maintenance. Each levee segment receives an overall segment inspection rating of Acceptable, Minimally Acceptable, or Unacceptable. **Figure 3.6.6** below defines the three ratings.

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**Figure 3.6. Definitions of the Three Levee System Ratings**

<b>Levee System Inspection Ratings</b>	
<b>Acceptable</b>	All inspection items are rated as Acceptable.
<b>Minimally Acceptable</b>	One or more levee segment inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.
<b>Unacceptable</b>	One or more levee segment inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

None of the levees listed within the National Levee Database as located within Ripley County are screened by the USACE. There are few "Risk Characteristics" cited by USACE for the levees located within the planning area. A summary of these risk characteristics is provided within Table 3.22. In total, fifteen people and twenty structures valued at \$6,185,000 are protected by the county's 49.37 miles of levee. Cypress Ditch Levee 2 protects fifteen of those structures valued at \$4,960,000. Upon careful inspection of aerial imagery, the MPC was unable to locate any structures or real property protected by the structure.

### ***Potential Losses to Existing Development***

Per Figures 3.68 and 3.69 located in the *Missouri State Hazard Mitigation Plan, 2018*, no persons or buildings within the planning area are exposed by potential failure of any levee listed within the USACE National Levee Inventory and providing protection against a 100-year or greater flood.

None of the levees located in Ripley County are listed upon the county's DFIRM. For levees included

in the new National Levee Database, there are “Risk Characteristics” available for many levees. These characteristics provide number of people at risk, number of structures at risk and the property value at risk. Per the database, fifteen people and twenty structures are protected by the county’s levee system.

### ***Impact of Previous and Future Development***

There is no known development planned in areas protected by levees within the planning area.

### ***Hazard Summary by Jurisdiction***

There are no specific critical facilities or critical systems situated in levee protected areas within Ripley County. There are no school or special district assets located in levee protected areas. List each jurisdiction, including any participating school/special districts in a separate heading and discuss each jurisdiction’s overall vulnerability separately.

**Ripley County** – There are twelve levees in the unincorporated portion of Ripley County. Eleven are located near Naylor in the southeastern corner of the county. One is located at the Mudpuppy Conservation Area in the central eastern portion of the county. No critical facilities or systems are protected by the levees, which are primarily agricultural in nature. The threat to loss of life injury, and property damage resulting from levee failure in Ripley County is minimal.

**City of Doniphan** – There are no levees in or near the City of Doniphan. Levee failure does not impact the city.

**City of Naylor** – While there are levees located near the City of Naylor—specifically the Cypress Ditch Levee and the Cypress Ditch Levee 2--levee failure does not directly impact the city.

**Doniphan R-I School District** – Only one levee is located within the district’s service area. This levee is contained within a conservation area maintained by the Missouri Department of Conservation. Consequently, levee failure does not impact the district.

**Naylor R-II School District** – Eleven of the county’s twelve levees are located within the service area of the district. Failure at one or more of these structures, could result in temporary inundation of transportation infrastructure forcing school buses to identify alternate transportation routes. Despite this fact, however, levee failure does not significantly impact the district.

**Ripley County R-III School District** – There are no levees in or near the district service area. Levee failure does not impact the district.

## **Problem Statement**

While Ripley County has some levees, they are primarily agricultural in function and located within the eastern/southeastern portion of the county. Because of the sparse population within this portion of the planning area, the county does not rank among the top five counties in the state as most impacted for building loss from levee failure. There are no regulated levees located in the county. While transportation routes could be hampered, the State of Missouri reports that exposure of buildings and people regarding levee failure in Ripley County is zero.

### 3.4.3 Dam Failure<sup>4(b)(1)b; 4(b)(2,3)</sup>

#### Hazard Profile

##### *Hazard Description*

A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property. Dam failure can be caused by any of the following:

1. Overtopping: Inadequate spillway design, debris blockage of spillways or settlement of the dam crest.
2. Piping: Internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam.
3. Erosion: Inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection.
4. Structural Failure: Caused by an earthquake, slope instability or faulty construction.

Both the Missouri Department of Natural Resources (MoDNR) and the U.S. Army Corps of Engineers maintain inventories of dams. The *National Inventory of Dams (NID)*, is maintained by the U.S. Army Corps of Engineers (USACE). The MoDNR database contains information for dams located within the State of Missouri.

In Missouri, dams less than 25 feet are generally not inventoried and are unregulated by the Missouri Department of Natural Resources. Dams taller than 25 feet but less than 35 feet are inventoried by the department with some dam data (e.g. height, etc.) provided to the *National Inventory of Dams*. Dams within this size category, however, remain unregulated in the State of Missouri. And, finally, dams 35 feet or more in height are regulated by the department. Construction and operation of such dams require a permit.

Table 3.23, below, outlines the classification system—defined by inundations areas—Missouri uses to describe dams. There are no Class I dams located in Ripley County. There are eight dams in the planning area defined as Class II. These eight dams must be inspected every three years and are the same eight dams in the county classified by the USACE as “High Hazard” dams.

Table 3.24. outlines the classification system used by the U.S. Army Corps of Engineers within its *National Inventory of Dams*, which defines dams by size and potential loss of life assuming failure.

**Table 3.23. MoDNR Dam Hazard Classification Definitions**

Hazard Class	Definition
Class I	The area downstream from the dam that would be affected by inundation contains ten (10) or more permanent dwellings or any public building. Inspection of these dams must occur every two years.
Class II	The area downstream from the dam that would be affected by inundation contains one to nine permanent dwellings, or one or more campgrounds with permanent water, sewer, and electrical services or one or more industrial buildings. Inspection of these dams must occur every three years.

Class III	The area downstream from the dam that would be affected by inundation does not contain any of the structures identified for Class I or Class II dams. Inspection of these dams must occur once every five years
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Source: Missouri Department of Natural Resources, [http://dnr.mo.gov/env/wrc/docs/rules\\_reg\\_94.pdf](http://dnr.mo.gov/env/wrc/docs/rules_reg_94.pdf)

**Table 3.24. NID Dam Hazard Classification Definitions**

Hazard Class	Definition
Low Hazard	Loss of one human life is likely if the dam fails.
Significant Hazard	Possible loss of human life and likely significant property or environmental destruction.
High Hazard	Equals or exceeds 25 feet in height and which exceeds 15 acre-feet in storage, or equals or exceeds 50 acre-feet of storage and exceeds 6 feet in height.

Source: *National Inventory of Dams*, US Army Corps of Engineers

### Geographic Location

#### Dams Located Within the Planning Area

There are twenty-six dams located within Ripley County. Eight of these dams are considered high hazard dams by the U.S. Army Corps of Engineers while three are considered significant hazard dams. Fifteen dams in the planning area are classified as low hazard dams and are not profiled within this section. No dams in Ripley County are owned or operated by the U.S. Army Corps of Engineers.

**Table 3.25** below lists the names, locations, and other pertinent information for all high hazard dams in the planning area. The term “acre-foot” is defined as the amount of water needed to inundate one acre of land at a depth of one foot. “Distance to Nearest City” was estimated as straight-line or aerial distance, rather than stream distance. An “Emergency Action Plan” is a formal document which outlines preplanned actions to be followed by the dam owner to mitigate damages and loss of life resulting from dam failure.

**Table 3.25. High Hazard Dams in the Ripley County Planning Area**

Dam Name	Emergency Action Plan (EAP/AP)	Dam Height (Ft)	Normal Storage (Acre-Ft)	Last Inspection Date	River	Nearest Downstream City	Distance To Nearest City (Miles)	Dam Owner
Fourche Creek Watershed #7	Not Required	68	4,775	3/7/2017	East Fork Fourche Creek	None	N/A	Ripley County Soil & Water Conservation District
Lower Little Black G-2 Dam	No	55	7,441	8/31/2017	Harris Creek	Success, AR	15 miles	Little Black Watershed Subdistrict
Upper Little Black A-2 Dam	Not Required	60	5,400	3/7/2017	Beaver Dam Creek	Success, AR	30 miles	Upper Little Black Watershed Subdistrict

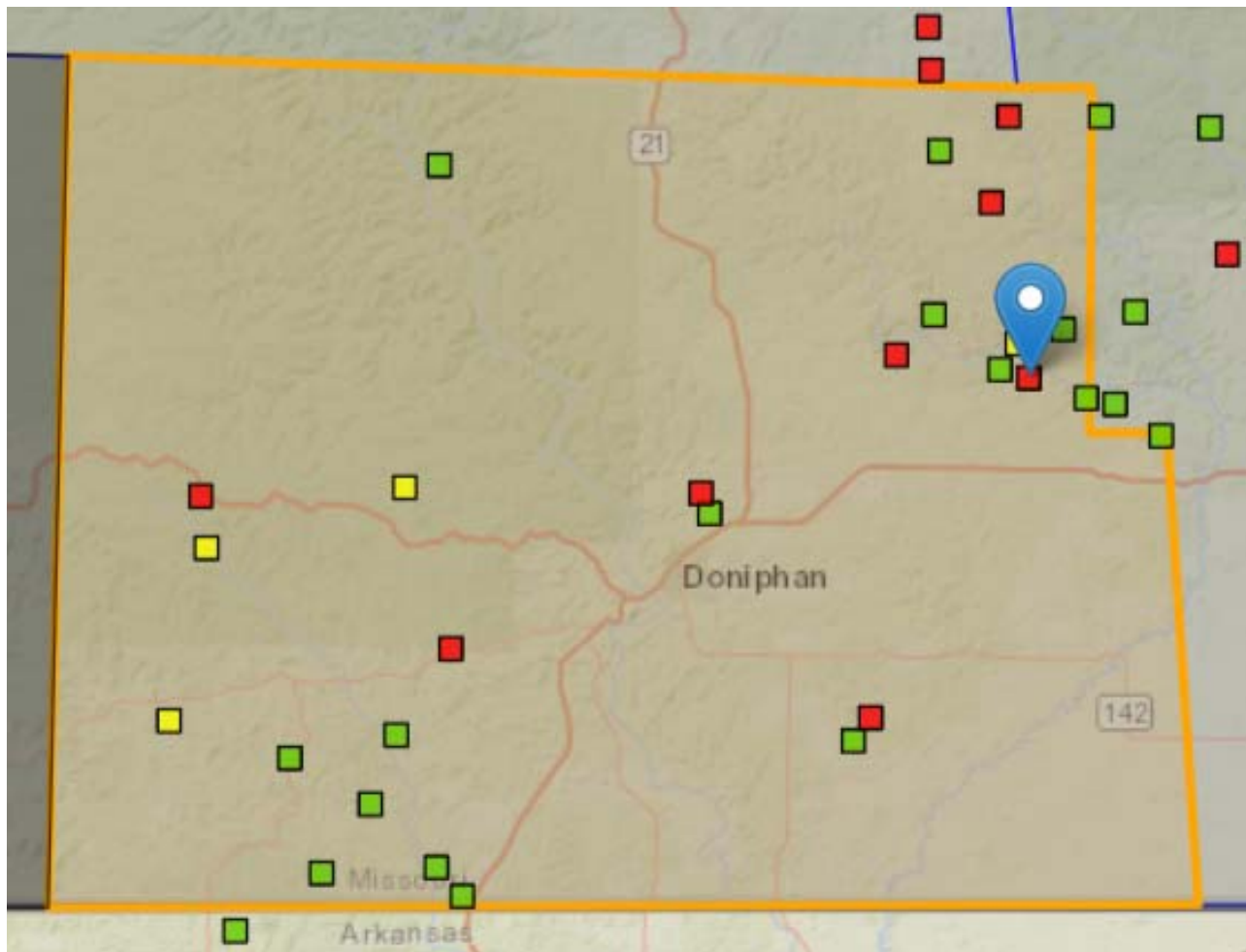


Upper Little Black A-7 Dam	Yes	54	5,793	2/11/2016	Little Black River	Success, AR	35 miles	Upper Little Black Watershed Subdistrict
Upper Little Black D-2 Dam	Yes	73	4,683	11/16/2016	Little Black River	Success, AR	25 miles	Upper Little Black Watershed
Kirby Dam	Not Required	30	48	Unknown	Tributary Bills Creek	Doniphan, MO	5 miles via Current River	Lee Kirby
Fourche Creek Dam 1	No	65	4,800	7/18/2018	Fourche Creek	None	N/A	USDA, Forest Service
Upper Little Black D-8 Dam	Yes	38	444	11/15/2016	Little Black River Tributary	Success, AR	25 miles	Dr. Michael Spezia

Sources: Missouri Department of Natural Resources, <https://dnr.mo.gov/geology/wrc/dam-safety/damsinmissouri.htm> and *National Inventory of Dams*, [http://nid.usace.army.mil/cm\\_apex/f?p=838:12](http://nid.usace.army.mil/cm_apex/f?p=838:12).

**Figure 3.77** below provide the locations of NID high hazard dams located in the planning area indicated by a red square. Dam locations labeled with a green square represent significant hazard dams, while those with a yellow square are considered low hazard.

**Figure 3.7. High Hazard Dam Locations in Ripley County**



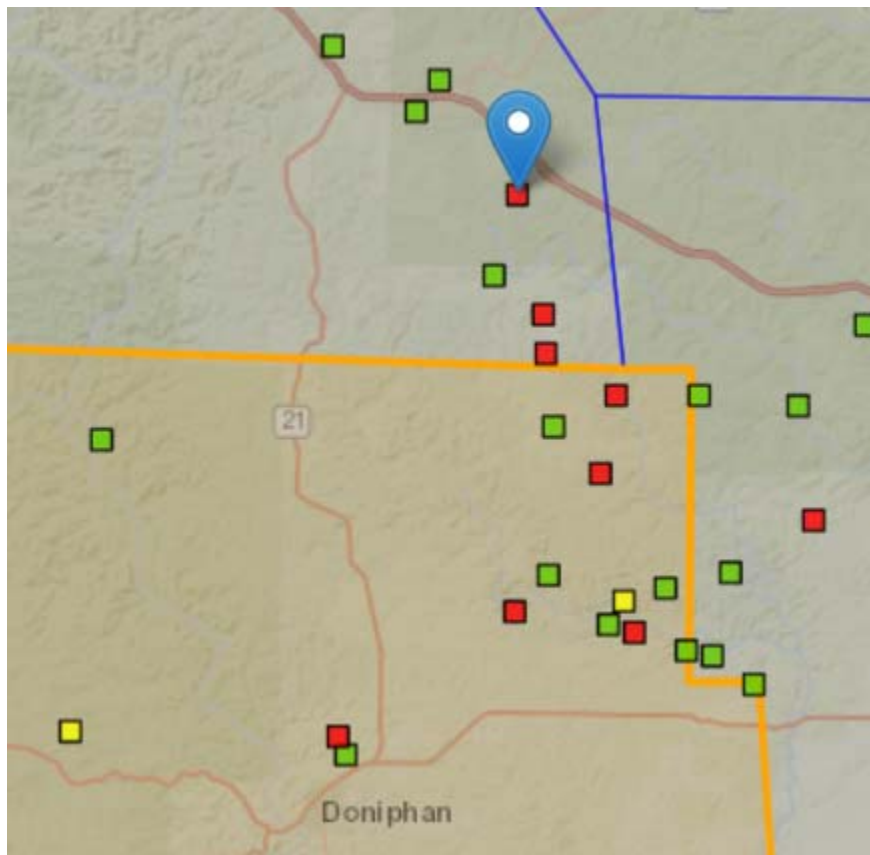
Source: *National Inventory of Dams*, U.S. Army Corps of Engineers

Fortunately, there are no dams in the county that would impact incorporated areas, or concentrations of populations in the event of a dam breach or failure. The inundation areas consist primarily of wooded areas and farmland. The vulnerability assessment on the pages following will discuss in greater detail, the assets—or lack thereof—that may be impacted by a dam failure. Furthermore, no communities, school districts, or special districts would be impacted by a breach at any one of Ripley County’s dams.

#### Upstream Dams Outside the Planning Area

There are three high hazard dams located north of and proximate to the planning area in Carter County. Failure of any of these three dams could negatively impact Ripley County. The three dams are the Lake Hogan Dam holding a maximum of 167 acre-feet of water, the Ed Baker #1 Lake Dam holding a maximum of 957 acre-feet of water, and the Ed Baker #2 Lake Dam holding a maximum of 2,162 acre-feet of water. All three are privately-owned. The Lake Hogan Dam is not regulated; both Ed Baker Lake Dams are regulated by the Missouri Department of Natural Resources (MDNR). **Figure 3.88** shows the high hazard dams located upstream of the planning area. The inundation areas of these high hazard dams do not include assets of any participating jurisdiction and consist primarily of remote wooded areas.

**Figure 3.8. High Hazard Upstream Dams Outside of Ripley County, Missouri**



Source: Missouri Department of Natural Resources,

### ***Strength/Magnitude/Extent***

The probable severity of a future dam failure event in Ripley County depends primarily upon two variables—the location and size of the dam in question. As stated above, there are eight high hazard dams located in Ripley County—all of varying sizes. Should any one of these structures fail, resulting damages could range from negligible to limited depending upon both the dam’s location and its size. For example, many dams along Fourche Creek are larger impoundments, located near major transportation routes. Should one of these structures fail, damages to transportation infrastructure could occur. Even though, the Ripley County Lake Dam holds a considerable amount of water, it is located in a rather isolated area, and, therefore, poses little threat to life or property.

Of the dams located in Ripley County, the Missouri Department of Natural Resources shows ten as holding more than 500 acre-feet of water, while twelve are shown to hold between 100 and 500 acre-feet. The remaining four, for which data is available, hold less than 100 acre-feet of water. Based solely upon this data, severity classifications of negligible and limited can be assigned to future dam failure incidents within the planning area.

The severity/magnitude of dam failure would be similar in some cases to the impacts associated with flood events (see the flood hazard vulnerability analysis and discussion). Yet, catastrophic failure of a high hazard dam could result in severe destruction due to the potential speed of onset and greater depth, extent, and velocity of the flood waters. For this reason, dam failures could flood areas beyond

mapped flood boundaries. Based on the USACE dam hazard class definitions, failure of a dam classified as “high hazard” could result in loss of life, serious damage to residential, industrial or commercial areas, public utilities, public buildings, or major transportation facilities.

Inundation maps showing the geographic location at risk are available for the following six dams in Ripley County:

- Fourche Creek Watershed #7
- Upper Little Black A-7 Dam
- Upper Little Black D-8 Dam
- Upper Little Black D-2 Dam
- Upper Little Black A-2 Dam
- Lower Little Black G-2 Dam

These maps are included in Appendix B of this plan.

While an official inundation map was not available for the three high hazard dams upstream from Ripley County, some inundation data was provided by the MDNR. The Emergency Action Plans (EAP) for the Ed Baker #1 and #2 Lake Dams identify two structures—both located in Carter County—as within the inundation zone for these two dams. Both dams drain into the Upper Little Black A-7 Dam approximately 3.8 miles away in northeastern Ripley County. Per the EAP, the Upper Little Black A-7 Dam has a storage capacity of 5,793 acre-feet—more than both of the Ed Baker Dams combined (957 acre feet + 2,162 acre-feet). It should be noted that seven structures and one transportation route (County Road K-5) are located within the inundation area of the Upper Little Black A-7 Dam.

The following table shows the number of structures and transportation routes to be affected by a failure at each dam per the inundation maps. No critical facilities or jurisdictional assets lie within the identified inundation zones.

**Table 3.26. Inundation Data for Dams Impacting Ripley County**

<b>NAME OF DAM</b>	<b>INUNDATION AREA DESCRIPTION</b>	<b># AFFECTED STRUCTURES IDENTIFIED</b>	<b>TRANSPORTATION ROUTES AFFECTED</b>
Fourche Creek Watershed #7	wooded areas and pasture land extending into Arkansas	1	Highway 142 (immediate) County Road 142W-1 (within 75 minutes) County Road EE-2 (within 90 minutes)
Upper Little Black A-7 Dam	wooded areas and pasture land extending into Butler County	7	County Road K-5 (within 65 minutes)
Upper Little Black D-8 Dam	wooded areas and pasture land extending into Butler County	3	County Road M-3 (15 minutes)
Upper Little Black D-2 Dam	wooded areas and pasture land extending into Butler County	0	County Road BB-2 (50 minutes) County Road M-3 (150 minutes)

Upper Little Black A-2 Dam	wooded areas and pasture land extending into Butler County	8	None
Lower Little Black G-2 Dam	wooded areas and pasture land extending into Butler County	2	County Road N-2 (35 minutes) State Highway N (50 Minutes) County Road H-7 (90 minutes)
Ed Baker #1 Lake Dam	wooded areas and pasture land extending from Carter County into Ripley County	0	None
Ed Baker #2 Lake Dam	wooded areas extending from Carter County into Ripley County	0	None

While an official inundation map was not available for the three high hazard dams upstream from Ripley County, some inundation data was provided by the MDNR. The Emergency Action Plans (EAP) for the Ed Baker #1 and #2 Lake Dams identify two structures—both located in Carter County—as within the inundation zone for these two dams. Both dams drain into the Upper Little Black A-7 Dam approximately 3.8 miles away in northeastern Ripley County. Per the EAP, the Upper Little Black A-7 Dam has a storage capacity of 5,793 acre-feet—more than both of the Ed Baker Dams combined (957 acre feet + 2,162 acre-feet).

Recent inspection reports from the MDNR for all high hazard dams regulated by the State were requested of the Missouri Department of Natural Resources. Ms. Cara Blevins of the Dam and Reservoir Safety Program within the department indicated that the reports could not be released due to privacy and safety reasons.

It should be noted that the Fourche Creek Dam 1, while classified by the USACE as a “high hazard” dam, is not regulated by the MDNR. This is likely due to the fact of its federal ownership (USDA, Forest Service). This dam holds a maximum of 4,800 acre-feet of water—the fourth largest in the planning area.

### ***Previous Occurrences***

According to the Missouri Department of Natural Resources, the 2018 Missouri State Hazard Mitigation Plan and interviews with local officials, there have been no reported dam failures in Ripley County.

### ***Probability of Future Occurrence***

Regular inspection and maintenance of high hazard dams is necessary to prevent structure failure, consequential loss of life and property damage. Regular inspections can identify structural deficiencies before failure occurs. Regular maintenance helps preserve the integrity and functionality of the structure, thereby lessening the probability of dam failure. Inspection records exist for all high hazard dams in Ripley County. There are no USACE-inspected dams in the planning area. There are thirteen state-inspected high hazard dams located in the planning area.

According to all available data sources there have been no recorded dam failures in Ripley County; therefore, a probability calculation based on historical events is not possible. Inspection of all high hazards dams in the planning area must occur every three years.

### ***Changing Future Conditions Considerations***

Climate change projections suggest that precipitation may increase and occur in more extreme events, which will likely increase risk of flooding, thereby placing additional stress on dams. This increased pressure directly increases the likelihood of a dam failure. Two dams in the planning area are maintained by private property owners who may lack resources to conduct regular dam maintenance. Regular dam maintenance becomes paramount to preserving the function of the structure. The lack of regular maintenance most common with privately maintained dams, further increases the risk of future structural failure.

## **Vulnerability**

### ***Vulnerability Overview***

As reported above, there are eight high hazard dams as defined by the USACE. Three dams are classified by the USACE as significant hazard dams meaning loss of human life is possible and significant property or environmental destruction is likely.

Of the eight high hazard dams, all are classified by the MDNR as Class 2 dams meaning the area downstream from the dam contains one to nine permanent dwellings, or one or more campgrounds with permanent water, sewer, and electrical services or one or more industrial buildings. There are no Class 1 dams in the planning area. Of the three significant hazard dams, all are classified by MDNR as Class 3 dams meaning the area downstream from the dam does not contain any of the structures identified for Class I or Class II dams.

For NID-identified high hazard dams, the county's dam failure vulnerability analysis was conducted by visually identifying assets (structures and transportation routes) located in dam breach inundation areas using aerial imagery. Twenty-one structures (located within and outside of Ripley County), two state highways, and eight county roads were identified using this method. No incorporated places or critical facilities were identified within the zones. There are no publicly-owned or school district-owned assets located within the inundation zones of any dams in Ripley County.

Dams fail on an individual basis; when one dam fails not all dams fail. Vulnerability to dam failure is limited to those persons and structures residing/working or located within the inundation zone of a failed dam. Therefore, the vulnerability of the county to dam failure is minimal.

### ***Potential Losses to Existing Development: (including types and numbers, of buildings, critical facilities, etc.)***

The 2018 Missouri State Hazard Mitigation Plan provides estimates of the number and value of structures, as well as population numbers vulnerable to the failure of state-regulated dams. It should be noted that this data is only available for those dams with available inundation area maps. The Missouri Department of Natural Resources (MDNR) has produced inundation maps for six high hazard dams located in the county. Within these inundation areas are twenty-three structures (fifteen agricultural and eight residential), valued at approximately \$1,128,290. The estimated total population that is vulnerable to a dam failure is 21 persons. This data accounts for exposure at all dams; however, dam failures are generally isolated events and do not typically occur in conjunction with failure at additional dam sites. This must be considered for an accurate vulnerability analysis.

### ***Impact of Previous and Future Development***

Ripley County is very rural in nature and sparsely populated. There is little to no development anticipated within the inundation areas of any of the dams located in the county. Only the Cities of Doniphan and Naylor issue building permits. Neither of the two cities is located within a dam inundation area. The county does not issue building permits.

### ***Hazard Summary by Jurisdiction***

**Ripley County** – The only jurisdiction vulnerable to the failure of a high hazard or Class I dam is the unincorporated portion of the county. Wooded area, pasture ground, up to two state highways, and up to eight county roads could be submerged or damaged. As many as eight residential structures, fifteen agricultural structures, and twenty-one people could be negatively impacted by failure of all high hazard dams in the county.

**City of Doniphan** – Not vulnerable to damage caused by a dam failure.

**City of Naylor** – Not vulnerable to damage caused by a dam failure.

**Doniphan R-I School District** – Not vulnerable to damage caused by a dam failure.

**Naylor R-II School District** – Not vulnerable to damage caused by a dam failure.

**Ripley County R-III School District** – Not vulnerable to damage caused by a dam failure.

**Ripley County R-IV School District** – Not vulnerable to damage caused by a dam failure.

### **Problem Statement**

There are eight dams in Ripley County that considered "high hazard" dams by the U.S. Army Corps of Engineers (USACE). Seven of the eight are regulated by the State of Missouri via its Department of Natural Resources (MDNR). The majority of these dams are located within the Little Black River Watershed on the eastern side of the county and the Fourche Creek Watershed in the western portion of the county. The areas at risk are limited to the inundation zones of these dams. The rural nature and sparse population of Ripley County--particularly within the inundation zones--significantly reduces the potential negative impact—in terms of loss of life and property damage—of a dam failure in the county.

## 3.4.4 Earthquakes

### **Hazard Profile**

#### ***Hazard Description***

An earthquake is a sudden motion or trembling that is caused by a release of energy accumulated within or along the edge of the earth's tectonic plates. Earthquakes occur primarily along fault zones and tears in the earth's crust. Along these faults and tears in the crust, stresses can build until one side of the fault slips, generating compressive and shear energy that produces the shaking and damage to the built environment. Heaviest damage generally occurs nearest the earthquake epicenter, which is that point on the earth's surface directly above the point of fault movement. The composition of geologic materials between these points is a major factor in transmitting the energy to buildings and other structures on the earth's surface.

As explained by the Federal Emergency Management Agency, major earthquakes and their accompanying foreshocks and aftershocks can be measured in two different ways. In 1935, the Richter Scale was developed by Charles F. Richter to measure the amount of energy released by an earthquake. The Modified Mercalli Intensity Scale was also developed as a tool to measure the severity of a quake using damage observations. The Mercalli Scale uses Roman numerals I to XII to rate an earthquake's intensity. A description of various Richter Scale and Modified Mercalli Scale intensities is offered below in Figure 3.9.



**Figure 3.9. Projected Earthquake Intensities**

## MODIFIED MERCALLI INTENSITY SCALE

- I People do not feel any Earth movement.
- II A few people might notice movement.
- III Many people indoors feel movement. Hanging objects swing.
- IV Most people indoors feel movement. Dishes, windows, and doors rattle. Walls and frames of structures creak. Liquids in open vessels are slightly disturbed. Parked cars rock.
- V Almost everyone feels movement. Most people are awakened. Doors swing open or closed. Dishes are broken. Pictures on the wall move. Windows crack in some cases. Small objects move or are turned over. Liquids might spill out of open containers.
- VI Everyone feels movement. Poorly built buildings are damaged slightly. Considerable quantities of dishes and glassware, and some windows are broken. People have trouble walking. Pictures fall off walls. Objects fall from shelves. Plaster in walls might crack. Some furniture is overturned. Small bells in churches, chapels and schools ring.
- VII People have difficulty standing. Considerable damage in poorly built or badly designed buildings, adobe houses, old walls, spires and others. Damage is slight to moderate in well-built buildings. Numerous windows are broken. Weak chimneys break at roof lines. Cornices from towers and high buildings fall. Loose bricks fall from buildings. Heavy furniture is overturned and damaged. Some sand and gravel stream banks cave in.
- VIII Drivers have trouble steering. Poorly built structures suffer severe damage. Ordinary substantial buildings partially collapse. Damage slight in structures especially built to withstand earthquakes. Tree branches break. Houses not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Temporary or permanent changes in springs and wells. Sand and mud is ejected in small amounts.
- IX Most buildings suffer damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks conspicuously. Reservoirs suffer severe damage.
- X Well-built wooden structures are severely damaged and some destroyed. Most masonry and frame structures are destroyed, including their foundations. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. Railroad tracks are bent slightly. Cracks are opened in cement pavements and asphalt road surfaces.
- XI Few if any masonry structures remain standing. Large, well-built bridges are destroyed. Wood frame structures are severely damaged, especially near epicenters. Buried pipelines are rendered completely useless. Railroad tracks are badly bent. Water mixed with sand, and mud is ejected in large amounts.
- XII Damage is total, and nearly all works of construction are damaged greatly or destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move. Lakes are dammed, waterfalls formed and rivers are deflected.

Intensity is a numerical index describing the effects of an earthquake on the surface of the Earth, on man, and on structures built by man. The intensities shown in these maps are the highest likely under the most adverse geologic conditions. There will actually be a range in intensities within any small area such as a town or county, with the highest intensity generally occurring at only a few sites. Earthquakes of all three magnitudes represented in these maps occurred during the 1811 - 1812 "New Madrid earthquakes." The isoseismal patterns shown here, however, were simulated based on actual patterns of somewhat smaller but damaging earthquakes that occurred in the New Madrid seismic zone in 1843 and 1895.

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The most severe earthquakes occurred in the New Madrid Seismic Zone (NMSZ) from December 16, 1811 through March 12, 1812, with the most severe occurring on December 16, 1811 and February 7, 1812. These quakes rank seventh and ninth respectively among the largest earthquakes recorded in the United States

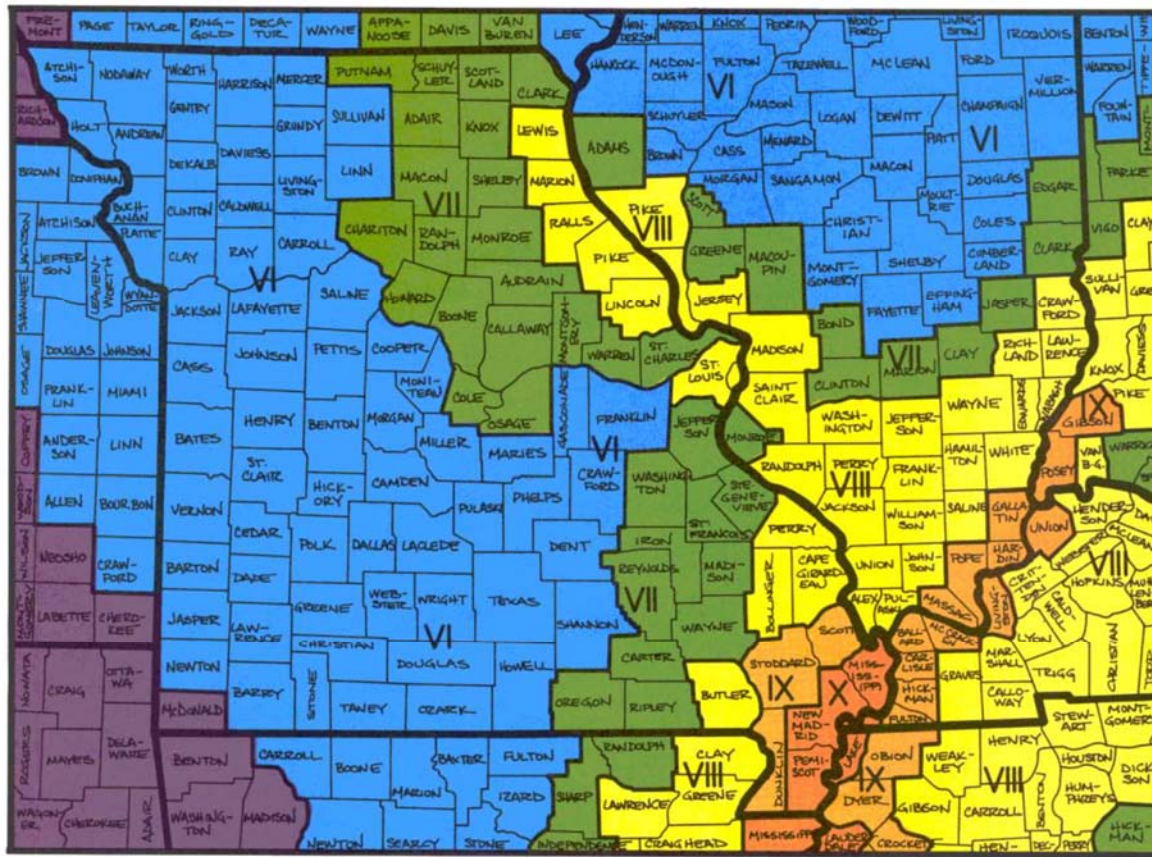
### **Geographic Location**

The New Madrid Seismic Zone (NMSZ) is made up of several thrust faults that stretch from Marked Tree, Arkansas to Cairo, Illinois. Although Ripley County is on the western edge of the NMSZ, the effects of a large quake will impact the entire county indiscriminately. Data indicates that earthquake intensity will not vary considerably across the planning area.

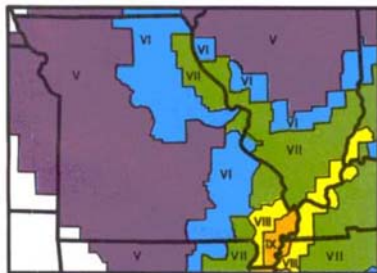
Of the entire state, Southeast Missouri, including Ripley County, is most susceptible to earthquakes because it overlies the NMSZ. The county is at risk of strong ground movements and has a high potential for soil liquefaction due to the presence of loose, sandy consolidated sediments and a high water table within the southeastern portion of the county. The immediate vicinity of the Ozark Foothills is also at risk from the earthquakes in the New Madrid Seismic Zone because, like in the bootheel, subsurface conditions of the Mississippi and Missouri River valleys tend to amplify earthquakes.

**Figure 3.10** shows the highest projected Modified Mercalli intensities by county from a potential magnitude 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid Seismic Zone. The secondary maps in **Figure 3.10** show the same regional intensities for a 6.7 and an 8.6 earthquake, respectively.

**Figure 3.10. Impact Zones for Earthquake Along the New Madrid Fault**

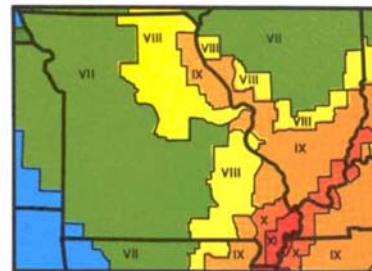


This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude - 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude - 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude - 8.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



Source: [https://sema.dps.mo.gov/docs/EQ\\_Map.pdf](https://sema.dps.mo.gov/docs/EQ_Map.pdf)

**Strength/Magnitude/Extent**

As mentioned above, the extent or severity of earthquakes is generally measured in two ways: 1) the Richter Magnitude Scale is a measure of earthquake magnitude; and 2) the Modified Mercalli Intensity Scale is a measure of earthquake severity. The two scales are defined as follows.

*Richter Magnitude Scale*

The Richter Magnitude Scale was developed in 1935 as a device to compare the size of earthquakes. The magnitude of an earthquake is measured using a logarithm of the maximum extent of waves recorded by seismographs. Adjustments are made to reflect the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, comparing a 5.3 and a 6.3 earthquake shows that the 6.3 quake is ten times bigger in magnitude. Each whole number increase in magnitude represents a tenfold increase in measured amplitude because of the logarithm. Each whole number step in the magnitude scale represents a release of approximately thirty-one times more energy.

### *Modified Mercalli Intensity Scale*

The intensity of an earthquake is measured by the effect of the earthquake on the earth's surface. The intensity scale is based on the responses to the quake, such as people awakening, movement of furniture, damage to chimneys, etc. The intensity scale currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 and is composed of 12 increasing levels of intensity. They range from imperceptible shaking to catastrophic destruction, and each of the twelve levels is denoted by a Roman numeral. The scale does not have a mathematical basis, but rather, is based on observed effects. Its use gives the laymen a more meaningful idea of the severity.

### **Previous Occurrences**

#### Damages

The largest earthquakes ever felt in the United States occurred along the New Madrid fault line during the winter of 1811-1812. During the course of three months, three earthquakes registering above 8.0 on the Richter Scale were felt by nearly the entire eastern half of the United States. According to the United States Geological Survey, church bells in Washington, D.C., rang as a result of the tremendous shaking. In fact, the New Madrid quakes were two to three times stronger than the 1964 Alaska earthquake and ten times more powerful than the 1906 San Francisco quake.

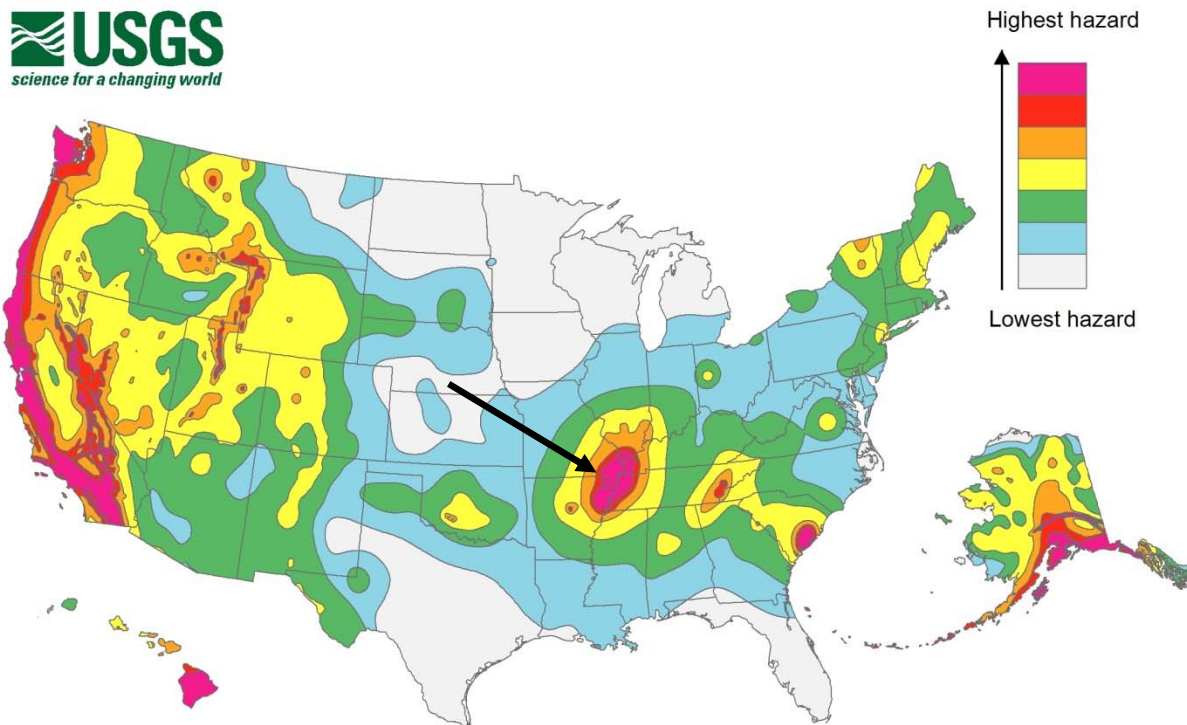
Per the Missouri Department of Natural Resources, 236 earthquakes measuring between magnitude 2.0 and magnitude 3.9 occurred in Southeast Missouri between 2000 and 2009. According to [www.homefacts.com](http://www.homefacts.com), there have been eight earthquakes ranging from magnitude 2.4 to 3.4 within the planning area in the past twenty years. The largest earthquake within thirty miles of the planning area, registered 3.9 and occurred in 2000. The U.S. Geological Survey estimates that there is a 4.65% chance of a major earthquake centered within 50 km of Ripley County in the next fifty years. Per [homefacts.com](http://homefacts.com), the risk of an earthquake in the planning area is low. These earthquakes have resulted in minimal damage and no injuries.

### **Probability of Future Occurrence**

The probability of future occurrence of an earthquake (of any magnitude) with an epicenter in Ripley County is one per two and one-half years. Per historical events, Southeast Missouri will experience twenty-four earthquakes (of magnitude 2.0 to 3.9) within any one-year period.

Earthquake hazard can be measured by describing peak ground accelerations having a 2 percent probability of being exceeded in 50 years, for a firm rock site. **011**, below, illustrates seismicity in the United States defined by recent (2018) USGS models based on seismicity and fault-slip rates. The models account for earthquake frequency and events of various magnitudes. The black arrow indicating a spot within the red zone shows the location of Ripley County.

Figure 3.11. United States Seismic Hazard Map



Source: United States Geological Survey at [https://earthquake.usgs.gov/hazards/hazmaps/conterminous/2014/images/HazardMap2014\\_lg.jpg](https://earthquake.usgs.gov/hazards/hazmaps/conterminous/2014/images/HazardMap2014_lg.jpg)

### ***Changing Future Conditions Considerations***

Per the *Missouri State Hazard Mitigation Plan, 2018*, “scientists are beginning to believe there may be a connection between changing climate conditions and earthquakes. Changing ice caps and sea-level redistribute weight over fault lines, which could potentially have an influence on earthquake occurrences. However, currently no studies quantify the relationship to a high level of detail, so recent earthquakes should not be linked with climate change. While not conclusive, early research suggests that more intense earthquakes and tsunamis may eventually be added to the adverse consequences that are caused by changing future conditions.” This could eventually change the probability of earthquake occurrence for the planning area.

### **Vulnerability**

#### ***Vulnerability Overview***

Per the *Missouri State Hazard Mitigation Plan, 2018*, the most significant direct earthquake hazard is ground shaking. Ground shaking affects structures near the earthquake epicenter but also those at further away—particularly where thick clay-rich soils can amplify ground motions. Certain types of buildings are more vulnerable to ground shaking than others. Unreinforced masonry structures, tall structures without adequate lateral resistance, and aged poorly maintained structures are specifically susceptible to large earthquakes.

Damage from a large earthquake in the New Madrid Seismic Zone (NMSZ) will vary depending on magnitude, land characteristics, and the degree of urbanization. Southeast Missouri is primarily rural with scattered small to medium-sized towns. Damage to the land could be extensive and significantly affect the area's farming industry. Shaking would be most severe to development built on thick, clay-rich soils. Roads and railroads in Southeast Missouri and Saint Louis could be severely damaged by earthquake triggered slope failures, rockfalls, and liquefaction.

The State of Missouri collects residential insurance data by zip code. As a state, Missouri has the third largest market for earthquake insurance coverage in the country. However, due to a reduced number of insurers and increasing premium costs, only 14% of residences located within the New Madrid Seismic Zone are covered by earthquake insurance according to the Missouri Department of Insurance. Deductibles of up to twenty percent of the home value are not uncommon. Since 2000, residential earthquake insurance has become less available and less affordable—leaving this segment of the state's population (including Ripley County) more vulnerable to earthquakes.

### ***Potential Losses to Existing Development***

FEMA's loss estimation software, HAZUS 3.2 (October 2016) was used to analyze vulnerability and estimate losses due to earthquakes. All HAZUS analyses were run using an enhanced Level 2 inventory database comprised of updated demographic and aggregated data using the 2010 US Census. The information and data for this vulnerability overview and potential loss were gathered from the *2018 Missouri State Hazard Mitigation Plan*. The updated annualized loss scenario presented here shows the economic losses to buildings annualized over eight earthquake return periods (100, 200, 500, 750, 1,500, 2,000 and 2,500 years).

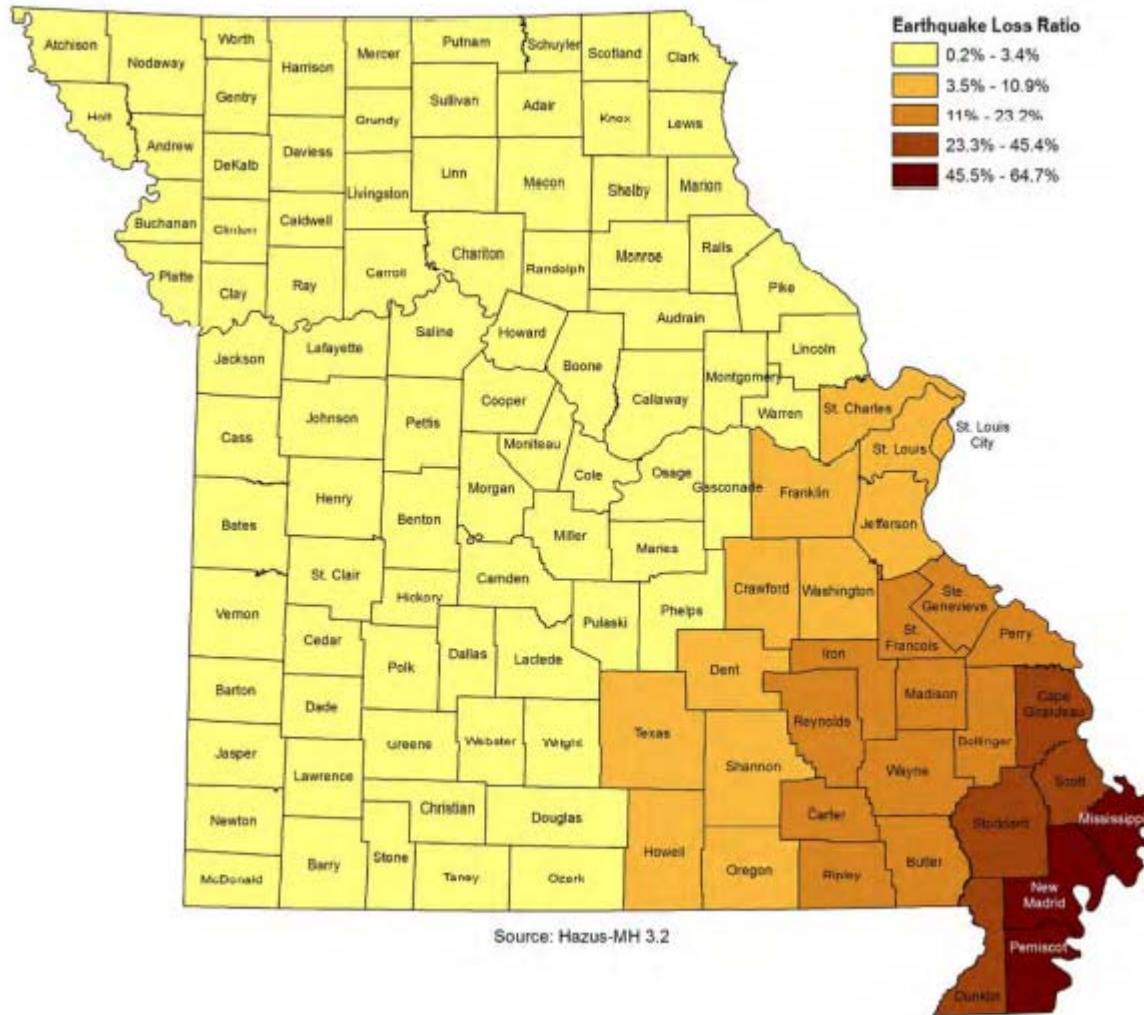
HAZUS defines annualized loss as the expected value of loss in any one year. The software develops annualized loss estimates by aggregating the losses and their exceedance probabilities from the eight return periods. Annualized loss is the maximum potential annual dollar loss resulting from various return periods averaged on a 'per year' basis.

As found within Table 3.60 of the *2018 Missouri State Hazard Mitigation Plan*, annualized loss scenarios conducted using HAZUS show that Ripley County is among the top ten counties when ranked by the highest annualized loss ratio. The loss-ratio represents the ratio of the average annualized losses divided by the entire building inventory in the county as calculated by HAZUS. The loss ratio is an indication of the economic impacts an earthquake could have, and how difficult it could be for a particular community to recover from the event. With an estimated \$430,000 (or \$30.50 per person) in total structural value losses the county's loss ratio is \$380 per \$1 million in building value.

A second scenario based on an event with a 2% probability of exceedance in 50 years was also examined by the state to model a "worst case scenario". HAZUS was again used to estimate direct economic losses due to earthquake assuming a 2% probability of exceedance in fifty years scenario. Per Table 3.63 of the *Missouri State Hazard Mitigation Plan, 2018*, in such a scenario, Ripley County will experience \$54,859,000 in structural damages, \$179,711,000 in non-structural damages, and \$65,791,000 lost in contents. When combined with inventory losses, rental income loss, lost wages, relocation and capital costs, the estimated loss total equals \$363,888,000, thereby placing Ripley County 20<sup>th</sup> of 114 counties for total losses in the given scenario. With a loss ratio percentage of 20.73% (greater than 10%), the county is considered at risk for earthquake by FEMA.

The map below displays the loss ratio percentage for each county in the state. Ripley County falls within the middle range at 20.73%.

**Figure 3.12 Earthquake Loss Estimation with a 2% Probability of Exceedance in 50 Years Scenario – Loss Ratio**



Source: 2018 Missouri State Hazard Mitigation Plan, HAZUS 3.2

The HAZUS building inventory counts are based on the 2010 census data adjusted to 2014 numbers using the Dun & Bradstreet Business Population Report. Inventory values reflect 2014 valuations, based on RSMeans (a supplier of construction cost information) replacement costs. Population counts are 2010 estimates from the U.S. Census Bureau. Buildings occupied by the school districts in the county have all been constructed since 1939, most were built in the 1960’s or more recently.

***Impact of Previous and Future Development***

Future development is not expected to increase the risk other than contributing to the overall exposure of what could become damaged as a result of an earthquake within the planning area.

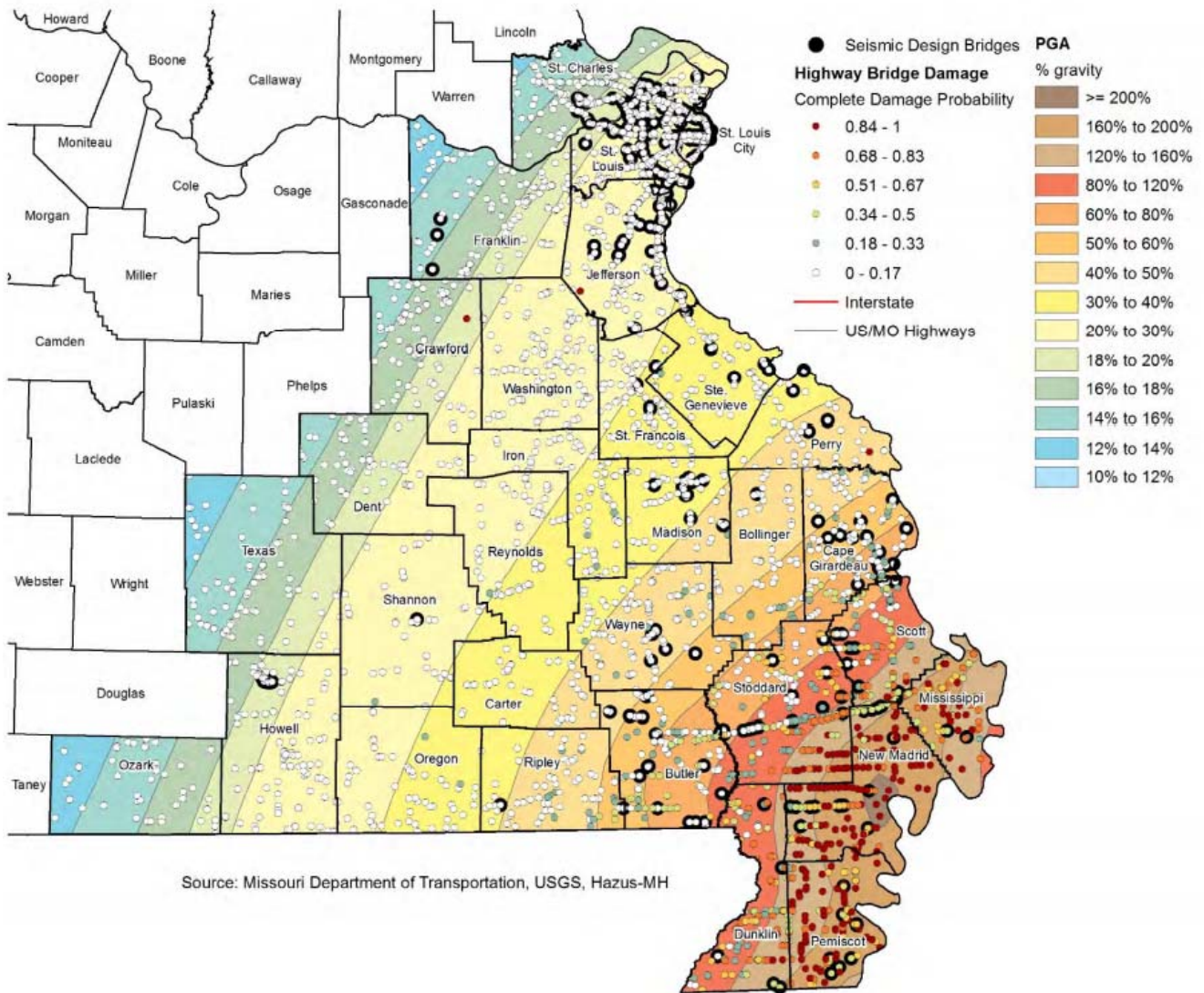
***Hazard Summary by Jurisdiction***

Earthquake intensity is not likely to vary greatly throughout the planning area; consequently, risk of damage and injury from an earthquake is likely to be the same throughout the county. Damages could be more significant within the City of Doniphan as it is home to more multi-story aged

buildings than the remainder of the county. The majority of these structures—including the county courthouse constructed in 1889—are located within the city’s downtown area. Aged residences—those built before 1939—are distributed equally among the community. Most structures throughout the remainder of the county have been constructed since 1939.

Per Appendix C of the Missouri State Hazard Mitigation Plan, 2018, there are seventy bridges in the planning area. HAZUS estimates that the majority of bridges in the county will be either slightly damaged or not damaged. Per the map below (Figure 3.13), there are two bridges in the unincorporated portion of the county that have been constructed with incorporated seismic design.

**Figure 3.13 Map of Bridge Damage Probability**



According to MERC and the U.S. Geological Survey, there are five Tier II facilities and one EPA-tracked hazardous materials facility located in Ripley County—all with the potential for moderate to heavy damage due to an earthquake.

There are no fire departments, hospitals, or educational facilities in the county with a greater than 0.50 complete damage probability.



**Ripley County** – Risk of damage to assets and injury from an earthquake is likely to be significant.

**City of Doniphan** – Damages could be more significant within the City of Doniphan as it is home to more multi-story aged buildings than the remainder of the county

**City of Naylor** – Risk of damage to assets and injury from an earthquake is likely to be significant.

**Doniphan R-I School District** – risk of damage and injury from an earthquake is likely to be significant.

**Naylor R-II School District** – Risk of damage to assets and injury from an earthquake is likely to be significant.

**Ripley County R-III School District** – Risk of damage to assets and injury from an earthquake is likely to be significant.

### **Problem Statement**

Ripley County is very near the New Madrid Seismic Zone, near enough that substantial damage would result in Ripley County should a severe earthquake occur. Per the State of Missouri, Ripley County has a total annualized expected earthquake loss of \$430,000. When this value is divided by the county's entire building inventory value, a "loss ratio" is generated. Per its loss ratio, Ripley County ranks tenth highest out of 114 counties in the state.

The City of Doniphan is the jurisdiction with the highest potential for damage as its downtown area is home to many historic structures. The county courthouse—built in 1889—is especially vulnerable and houses all county offices. Of greatest concern is potential loss of life. To mitigate loss of life due to a severe earthquake event within the planning area and ensure the continuity of essential service provision, the following mitigation actions are suggested:

- Continue participation in earthquake awareness events;
- Conduct public education and outreach measures to promote the purchase of earthquake insurance;
- Establish and/or enforce building ordinances within city limits which address seismic reinforcement; and,
- Develop a contingency plan to ensure the continuity of county government operations should the county's courthouse incur debilitating damage resulting from a seismic event.

### 3.4.5 Land Subsidence/Sinkholes<sup>4(b)(1)c; 4(b)(2,3)</sup>

#### **Hazard Profile**

##### ***Hazard Description***

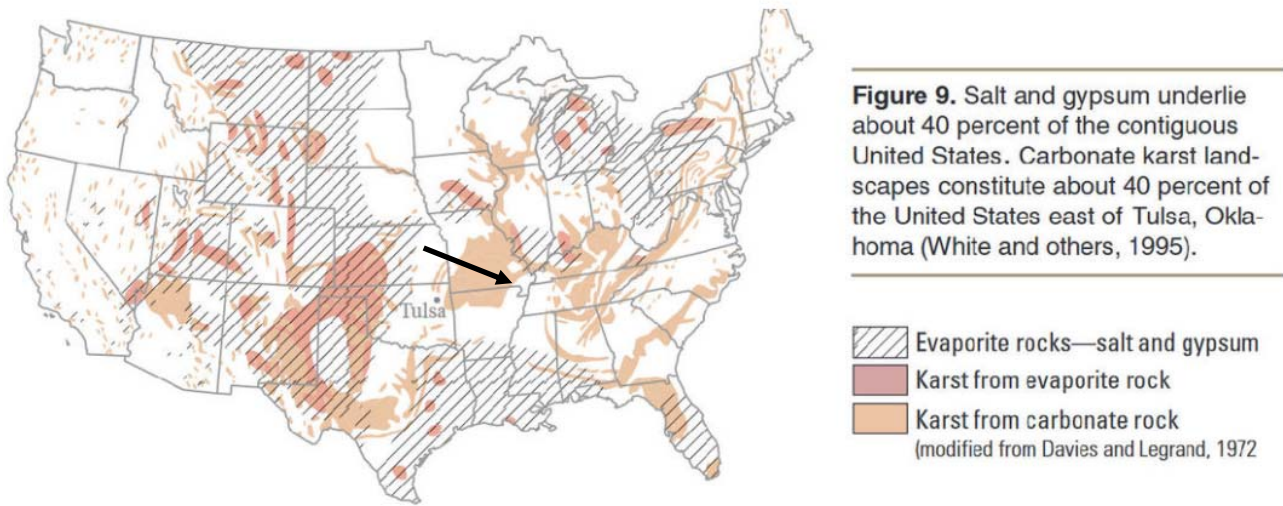
Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that naturally can be dissolved by ground water circulating through them. As the rock dissolves, spaces and caverns develop underground. The sudden collapse of the land surface above them can be dramatic and range in size from broad, regional lowering of the land surface to localized collapse. However, the primary causes of most subsidence are human activities: underground mining of coal, groundwater or petroleum withdrawal, and drainage of organic soils. In addition, sinkholes can develop as a result of subsurface void spaces created over time due to the erosion of subsurface limestone (karst).

As a general rule, land subsidence occurs slowly and continuously over time. On occasion, it can occur abruptly, as in the sudden formation of sinkholes. Sinkhole formation can be aggravated by flooding. In Missouri, sinkhole problems are usually a result of surface materials above openings into bedrock caves eroding and collapsing into the cave opening. These collapses are called “cover collapses” and geologic information can be applied to predict the general regions where collapse will occur. Sinkholes range in size from several square yards to hundreds of acres and may be quite shallow or hundreds of feet deep.

According to the U.S. Geological Survey (USGS), the most damage from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. Fifty-nine percent of Missouri is underlain by thick, carbonate rock rendering the state vulnerable to sinkholes. Sinkholes occur in Missouri on a fairly frequent basis with most occurring naturally in the state’s karst regions (areas with soluble bedrock). They are a common geologic hazard in southern Missouri, but also occur in the central and northeastern parts of the State.

Missouri sinkholes have varied from a few feet to hundreds of acres and from less than one to more than 100 feet deep. The largest known sinkhole in Missouri encompasses about 700 acres in western Boone County. Some sinkholes hold water and form natural ponds. The figure below shows a map of the United States classified by type of bedrock. Areas with karst from carbonate rock (as in the northeastern corner of the planning area, evaporite rock and karst from evaporite rock are shown. Those areas with karst topography are at greater risk of sinkholes. The planning area is indicated by the black arrow.

**Figure 3.14 Topography Across the United States**



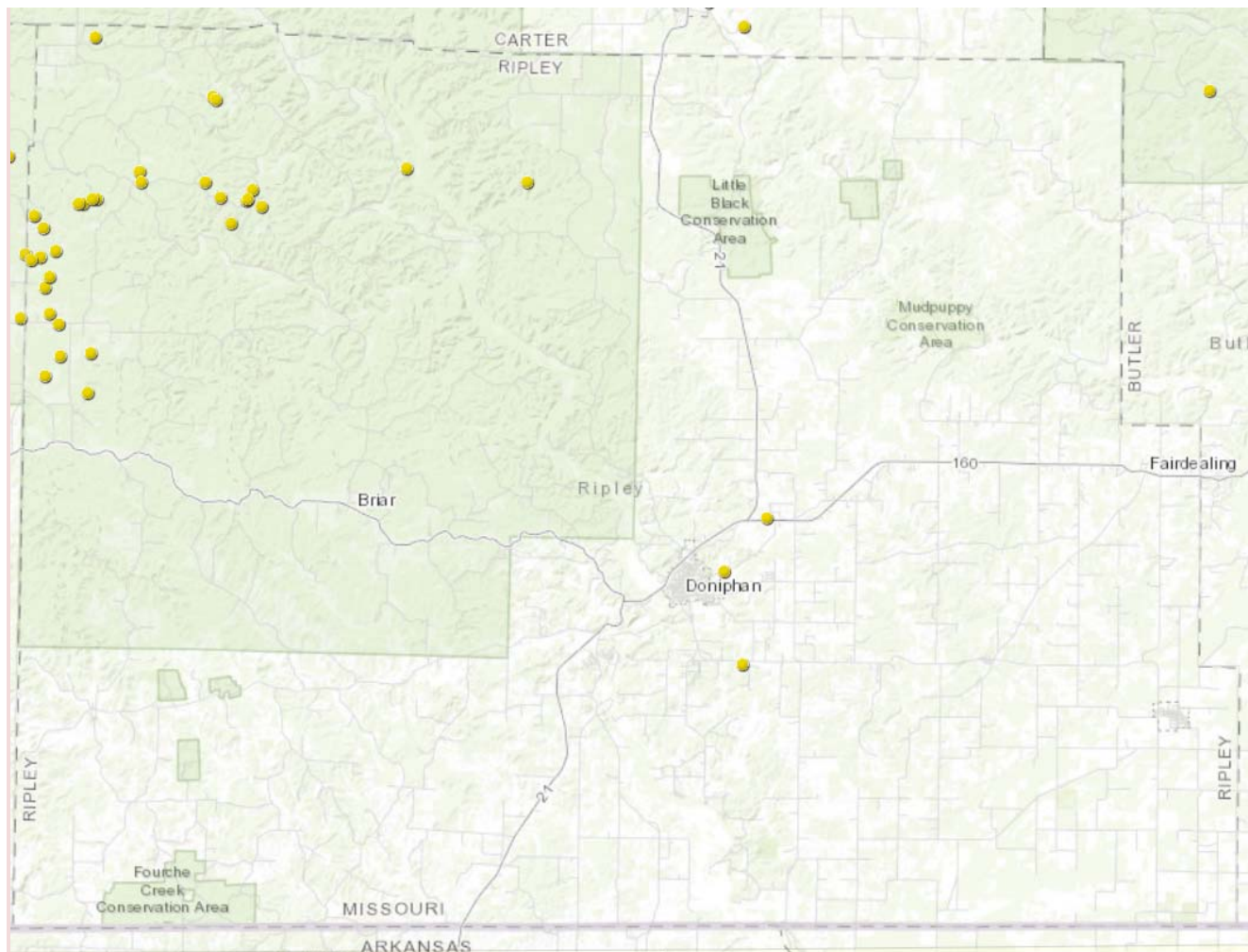
Source: Land Subsidence in the United States, USGS Fact Sheet 165-00

With the exception of two industrial mineral mines (sand and gravel quarries), there are no other active mining activities in the county.

**Geographic Location**

According to the *2018 Missouri State Hazard Mitigation Plan* there are 33 documented sinkholes in Ripley County. As can be seen from the following maps, the majority of these sinkholes are located in the northwest corner of the county, in parts of the Mark Twain National Forest. This area is also home to old mines, 72 of which are located in the county, and the area where all caves in Ripley County are located. Figure 3.15 below provides a map of the locations in Ripley County.

**Figure 3.15 Ripley County Sinkhole Map**



Source: Missouri Department of Natural Resources, GeoSTRAT Tool

### ***Strength/Magnitude/Extent***

Sinkholes vary in size and location, and these variances will determine the impact of the hazard. A sinkhole could result in the loss of a personal vehicle, a building collapse, or damage to infrastructure such as roads, water, or sewer lines. Groundwater contamination is also possible from a sinkhole. Because of the relationship of sinkholes to groundwater, pollutants captured or dumped in sinkholes could affect a community’s groundwater system. Sinkhole collapse could be triggered by large earthquakes. Sinkholes located in floodplains can absorb floodwaters but make detailed flood hazard studies difficult to model.

The *Missouri State Hazard Mitigation Plan, 2018* included fourteen documented sinkhole “notable events” since 2004. The plan stated that sinkholes are common to Missouri and the probability is high that they will occur in the future. To date, sinkholes in Ripley County have historically not had major impacts on development nor have they caused serious damage. Thus, the severity of future events is likely to be low.

### ***Previous Occurrences***

As noted in the *Missouri State Hazard Mitigation Plan, 2018*, sinkholes are a regular occurrence in Missouri, but rarely are the events of any significance. There have been no damage reports resulting from sinkholes in Ripley County and few from around the State of Missouri. In the *Missouri State Hazard Mitigation Plan, 2018* beginning on page 3.225 fourteen recent events are described from around the state. In August 2006, a sinkhole collapse in the City of Nixa in Christian County severely destroyed a residence and vehicle and threatened adjacent homes and city utilities. While no one was injured in this event, ten years later one man did incur fatal injuries due to falling in a sinkhole while hunting in south central Missouri.

### ***Probability of Future Occurrence***

The probability of future occurrences of sinkholes in the planning area is high. Damages from this hazard event, however, is low due to the location of sinkholes in the county. The map above depicts the general location of sinkholes that are known in the county. Other sinkholes may be found later that are not currently identified. Because there is no centralized database for sinkhole occurrences in the state, there are no records of previous event dates in the planning area. As a result, probabilities of future occurrence in the planning area cannot be calculated.

### ***Changing Future Conditions Considerations***

Per the Missouri State Hazard Mitigation Plan, 2018, “direct effects from changing climate conditions such as an increase in droughts could contribute to an increase in sinkholes. These changes raise the likelihood of extreme weather, meaning the torrential rain and flooding conditions which often lead to the exposure of sinkholes are likely to become increasingly common. Certain events such as a heavy precipitation following a period of drought can trigger a sinkhole due to low levels of groundwater combined with a heavy influx of rain.”

## **Vulnerability**

### ***Vulnerability Overview***

Sinkholes are a common feature in Missouri, however in Ripley County there are only 35 documented sinkholes. The northeastern area of the county is the most vulnerable area due to the karst topography of that part of the county. This area is mainly covered in Mark Twain National Forest and will not be developed in the foreseeable future. The vulnerability to Ripley County is low due to these factors.

### ***Potential Losses to Existing Development***

All known sinkholes are in remote and very rural areas of the county, there have been no reported sinkholes near populations or developments. Therefore, the potential loss to existing development is very low and not expected. There have been no historical losses upon which to base future loss estimates.

### ***Impact of Previous and Future Development***

All known sinkholes are in remote and very rural areas that are at risk of sinkhole formation are in extremely rural areas that are not anticipated for any type of future development. Many of the areas of sinkholes and areas at risk for sinkholes are in the Mark Twain National Forest, which is restricted from future development as a national forest. Therefore, there is not expected to be any impacts on future development from sinkholes. There are no abandoned coal mines in the planning area. No participating jurisdictions limit construction over abandoned mine or near sinkholes.

### ***Hazard Summary by Jurisdiction***

Susceptibility to sinkholes does vary throughout the planning area, with the unincorporated portion of the county being more susceptible. There are no critical facilities located near any known sinkholes.

**Ripley County** – Due to its topography, the northeastern corner of the planning area is at higher risk for sinkholes. This area is mostly undeveloped and is in large part encompassed by the Mark Twain National Forest.

**City of Doniphan** – There are two sinkholes that are noted to be just to the east of Doniphan; however, these are isolated and not close to developed areas.

**City of Naylor** – There are no known sinkholes in or near the City of Naylor.

**Doniphan R-I School District** – There are no known districts assets located upon or near known sinkholes.

**Naylor R-II School District** – There are no known districts assets located upon or near known sinkholes.

**Ripley County R-III School District** – There are no known districts assets located upon or near known sinkholes.

### **Problem Statement**

The only area of Ripley County at a high risk for sinkholes is the northeastern corner of the county. This area is home to a large portion of the Mark Twain National Forest and primarily undeveloped. There are no critical facilities or school district assets located or housed in the vicinity of any sinkholes. Because of this, the risk for damages due to sinkholes is limited and unlikely within the planning area. More accurate mapping of existing sinkholes could help mitigate against damages to future development if the county/city officials and private property owners are more aware of specific sinkhole locations.

## 3.4.6 Drought

### Hazard Profile

#### ***Hazard Description***

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. A drought period can last for months, years, or even decades. According to the *Missouri State Hazard Mitigation Plan, 2018*, there are four types of drought conditions relevant to the state. Those conditions follow:

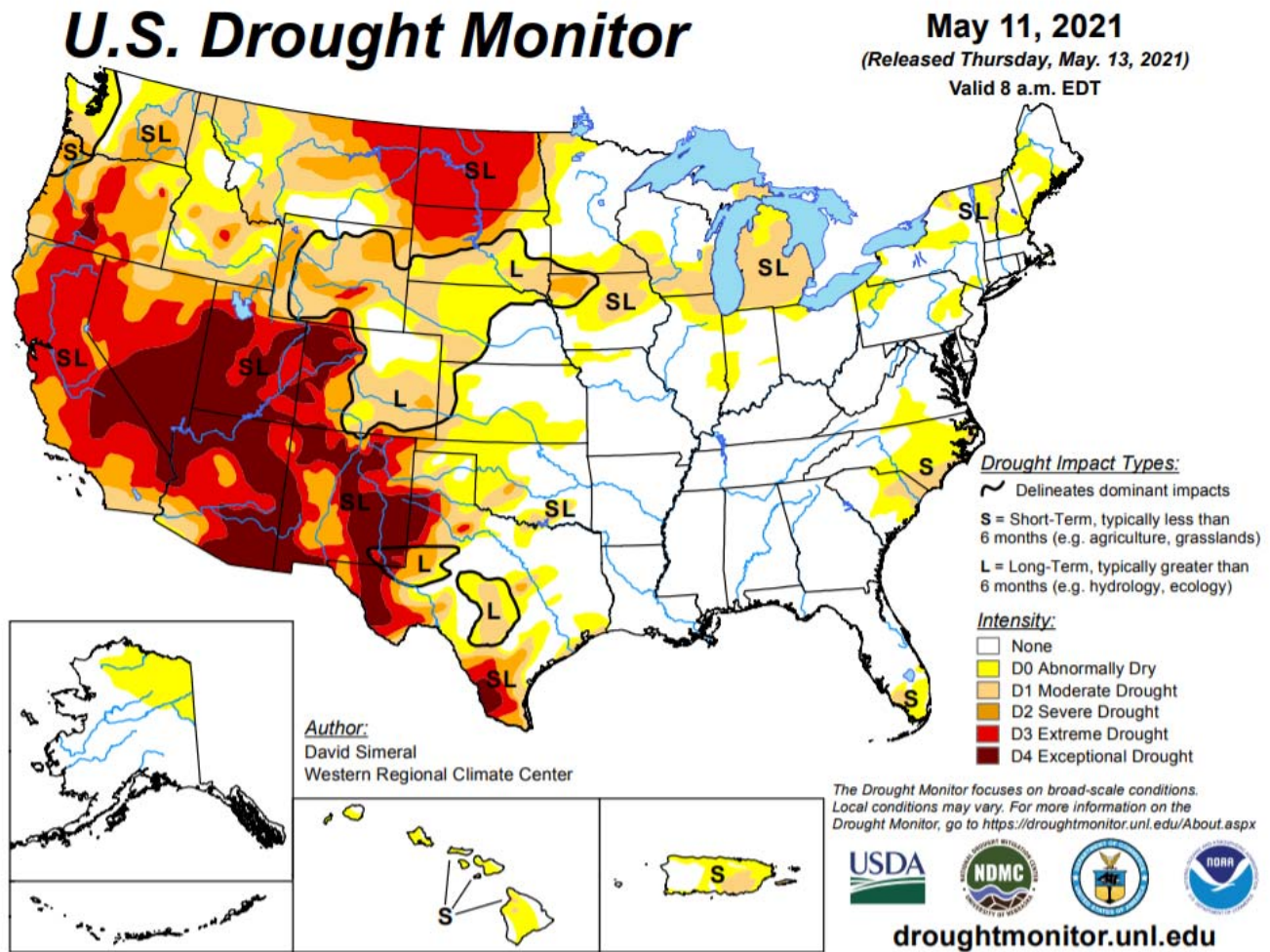
- Meteorological drought is defined in terms of the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.
- Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts also are out of phase with impacts in other economic sectors.
- Agricultural drought focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, etc. Plant demand for water depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- Socioeconomic drought refers to when physical water shortage begins to affect people.

#### ***Geographic Location***

While drought most directly impacts the agricultural sector, the entire planning area is at risk to drought. Per the *2012 Census of Agriculture*, 137,829 acres of the county’s 404,480 acres—or 34%—are used for agriculture purposes. In Ripley County, farming is concentrated in the southeastern portion of the county around the City of Naylor. No conversion of farmland to development is currently occurring in the planning area. The portion of the county land area used for agriculture purposes is not expected to vary significantly in the future.

**Figure 3.16** below, is a map from the U.S. Drought Monitor and is provided as an example of the area that could be experiencing drought at any one point in time. The black arrow indicates the location of the planning area on the map.

Figure 3.16 U.S. Drought Monitor Map of Missouri on May 11, 2021



Source: U.S. Drought Monitor, <https://droughtmonitor.unl.edu/Maps/MapArchive.aspx>

### Strength/Magnitude/Extent

The Palmer Drought Indices measure dryness based on recent precipitation and temperature. The indices are based on a “supply-and-demand model” of soil moisture. Calculation of supply is relatively straightforward, using temperature and the amount of moisture in the soil. However, demand is more complicated as it depends on a variety of factors, such as evapotranspiration and recharge rates. These rates are harder to calculate. Palmer tried to overcome these difficulties by developing an algorithm that approximated these rates and based the algorithm on the most readily available data — precipitation and temperature.

The Palmer Index has proven most effective in identifying long-term drought of more than several months. However, the Palmer Index has been less effective in determining conditions over a matter of weeks. It uses a “0” as normal, and drought is shown in terms of negative numbers; for example, negative 2 is moderate drought, negative 3 is severe drought, and negative 4 is extreme drought. Palmer’s algorithm also is used to describe wet spells, using corresponding positive numbers.

Palmer also developed a formula for standardizing drought calculations for each individual location based on the variability of precipitation and temperature at that location. The Palmer index can therefore be applied to any site for which sufficient precipitation and temperature data is available.



The National Drought Monitor Center at the University of Nebraska at Lincoln summarized the potential severity of drought as follows. Drought can create economic impacts on agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn place both human and wildlife populations at higher levels of risk. Finally, while drought is rarely a direct cause of death, the associated heat, dust and stress can all contribute to increased mortality.

### ***Previous Occurrences***

08/01/02-09/19/02 Moderate drought conditions developed over southeast Missouri during early August as a result of dryness that began in June. Farmers anticipated substantial crop losses at harvest time.

09/22/04-09/30/04 This was the driest September on record for southeast Missouri, at Poplar Bluff, only 0.01 inch of rain was recorded. Lawns and fields turned brown, by the end of September, moderate drought conditions were assessed over southeast Missouri.

06/05/05-08/19/05 Drought conditions progressively worsened during June, the drought status went from moderate to severe during the month. Hay growth and production was halted, prompting concern about a hay shortage. Other crops such as soybeans and corn were slowed or stunted by the dry weather. Levels of smaller rivers such as the Current River, fell far below normal. Fire danger was high during this time as well. During July drought conditions worsened to the extreme category over most of southeast Missouri. Fortunately, timely rainfall from the remnants of a hurricane eased the drought conditions and offset some potential devastating agricultural impacts.

08/21/07-09/30/07 This was the driest August on record in Poplar Bluff, and no measurable rainfall was recorded during the month in Doniphan. All of the pasture land across southeast Missouri was rated as poor or very poor, 53% of the soybean crop was rated poor or very poor, and 20% of the corn crop was poor or very poor. Due to high fire danger, burn bans were issued. Corn crops were harvested much earlier than normal due to increasing heat and drought. All non-irrigated soybeans were damaged.

07/02/10-01/31/11 Moderate drought conditions developed over much of southeast Missouri after a very dry June. Poplar Bluff received only about one-half inch of rain during June. Corn yields were expected to be cut in half where irrigation was not used. Livestock producers in Ripley and Carter Counties were feeding hay due to pastures that were burned up by not having meaningful rain for six weeks. Livestock water was also becoming a concern for some producers. By the end of September, 32% of the cotton crop in Missouri was rated poor to very poor. Eighty-seven percent of pasture land was rated as poor or very poor. Unirrigated corn yields were expected to be a total failure in some areas. Drought conditions continued in to October and by month's end 92% of the topsoil was rated short or very short on moisture. Drought conditions worsened during the first half of November, then improved with heavy rainfall on 11/24 and 11/25. During this drought event, extreme drought conditions extended as far north as Doniphan to Dexter to Charleston. The extreme drought conditions lingered into December along the Arkansas border from Doniphan to New Madrid. For calendar year 2010, most locations ended the year with a precipitation deficit of 10-13 inches. These conditions extended in January of 2011.

05/18/12-01/12/13 One of the warmest and driest Mays on record worsened the rare spring drought over southeast Missouri. By the end of May the drought was severe in the extreme southeast Missouri counties. Drought conditions extended and worsened in June with burn bans being issues for the Mark Twain National Forest and other areas across southeast Missouri. Stream flows were

running below normal as well. By the end of July, all of southeast Missouri was upgraded to extreme to exceptional drought. Ponds across the region were dry or quickly drying. Fourth of July fireworks shows were cancelled in many towns across the region and banned by local users in some towns. The drought reached its most extreme stage by early August. Significant improvement in drought conditions occurred during the month of September from heavy rains from the remnants of Hurricane Isaac. Though improved, drought conditions continued into October with precipitation levels reported as below normal. There was no appreciable change in long-term drought conditions in November or December. Rainfall remained below normal but was slightly offset by low evaporation rates from colder winter weather. The drought officially ended in January of 2013.

12/5/2017 – 12/31/2017 Severe drought conditions expanded eastward across the Ozark Foothills Region of Southeast Missouri. A lack of precipitation causes soil moisture to decrease rapidly through October and November. Pasture land conditions began to deteriorate. There were reports of early hay feeding of farm animals due to the lack of quality pasture. Stock ponds were beginning to run low in some areas. The dry conditions contributed to a high potential for wildfires. Bans on outdoor burning were imposed in some areas, including Ripley County. A lack of precipitation, combined with above normal temperatures, contributed to the rapid onset of drought conditions. During the fall, seasonal rainfall totals were about fifty percent of the normal amounts.

1/1/2018 – 1/31/2018 Severe drought conditions persisted across the Ozark Foothills Region of Southeast Missouri through the first month of the new year. A lack of precipitation caused soil moisture to remain low. Stock ponds continued to run low in some areas. The dry conditions contributed to an above normal potential for wildfires.

The USDA's Risk Management Agency publishes data concerning insured crop loss payments as a result of drought during a period of years. The data is available at the county level. Per this data, there have been fourteen crop claims resulting from five drought events in Ripley County between and including 2010 and 2020. The year with the greatest losses due to drought was 2012 with total losses amounting to \$81,829 in soybeans. The total value of all losses during the eleven-year period equaled \$9,550,097. Of this total, \$177,955 (or 1.2%) of the crop losses were due to drought and consisted of lost soybeans and grain sorghum.

The secretary of the U.S. Department of Agriculture (USDA) designates drought declarations. Declarations involving the planning area occurred in 2012, 2013, and 2018. During both of the 2012 and 2018 events, Ripley County was a primary impacted county. In the 2013 event, it was a contiguous to a primary drought county.

### ***Probability of Future Occurrence***

The eight incidents reported above span a twenty-year time period, or 240 months. During this 240-month timeframe, Ripley County experienced drought conditions for 25 months. Dividing the number of months in drought by the total number of months within the given time period results in a probability calculation. Using drought statistics provided by the National Centers for Environmental Information for the planning area, there is a 10.4% probability of drought in Ripley County in any given year. The timing of a drought is not predictable, but long-range outlooks and predicted impacts of climate change could indicate an increased chance of drought conditions.

### ***Changing Future Conditions Considerations***

Severe drought is a significant risk to areas dependent upon agriculture. Future increases in evaporation rates due to higher temperatures may increase the intensity of naturally-occurring droughts. Although springtime in Missouri is likely to be wetter, summer droughts are likely to be more severe. Higher evaporation and lower summer rainfall are likely to reduce river flows. The number of heavy rainfall events is predicted to increase, yet researchers currently expect little change in total rainfall amounts, indicating that the periods between heavy rainfalls will be marked by an

increasing number of dry days. Higher temperatures and increased evapotranspiration increase the likelihood of drought. This could lead to agricultural drought and suppressed crop yields.

## **Vulnerability**

### ***Vulnerability Overview***

According to the High Plains Regional Climate Center, average monthly precipitation in the planning area ranges from a low of 3.17 in August to a high of 4.97 in November.

County level data from the *Missouri State Hazard Mitigation Plan, 2018* was used as the best and most recent data available to determine the county's vulnerability to drought. As stated in the plan on page, Southeast Missouri (including Ripley County) "has very little drought susceptibility. It is a region underlain by sands and gravel (alluvial deposits). Surface and groundwater resources are generally adequate for domestic, municipal, and agricultural needs."

To determine vulnerability, the State of Missouri conducted a statistical analysis of data from several sources: USDA Risk Management Agency's insured crop losses as a result of drought (2007-2016), USDA crop exposure by county, the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina, storm events data (1950 to December 31, 2016) and probability of severe drought based on historic Palmer Drought Severity Index. The USDA crop exposure by county is from the 2012 Agricultural Census and assumes that the larger the exposure, the greater potential for loss and impact on the local economy.

From the statistical data collected, four factors were considered in determining overall vulnerability to drought as follows: social vulnerability, crop exposure ratio, annualized crop claims paid, and likelihood of occurrence. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

- 1) Low
- 2) Low-medium
- 3) Medium
- 4) Medium-high
- 5) High.

Using this system, Ripley County and all of its jurisdictions were assigned a drought vulnerability classification of low-medium. Per the data cited above, the county has a 6.42% chance of experiencing a severe drought in any given year.

### ***Potential Losses to Existing Development***

The National Drought Monitor Center at the University of Nebraska at Lincoln summarized the potential impacts of drought as follows: Drought can create economic impacts on agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn place both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Finally, while drought is rarely a direct cause of death, the associated heat, dust and stress can all contribute to increased mortality.

Losses due to drought in the county have been limited. Using insurance claims data over an eleven-year period from USDA's Risk Management Agency, crop losses were totaled at \$177,995, or \$16,181 per year. Therefore, it is reasonable to assume similar losses will continue into the future.

### ***Impact of Previous and Future Development***

Little future development is anticipated within Ripley County. Any future development will not result in increased impacts from droughts. All of the public water supply districts have ample capacity to meet all foreseen future development. No significant increase is anticipated in the number of acres farmed.

### ***Changing Future Conditions Considerations***

A new analysis, performed for the Natural Resources Defense Council, examined the effects of climate change on water supply and demand in the contiguous United States. The study found that more than 1,100 counties will face higher risks of water shortages by mid-century as a result of climate change. Two of the principal reasons for the projected water constraints are shifts in precipitation and potential evapotranspiration (PET). Climate models project decreases in precipitation in many regions of the U.S., including areas that may already be described as experiencing water shortages of some degree.

### ***Hazard Summary by Jurisdiction***

There is little variation among jurisdictions with regard to drought. For example, some communities could be more at risk because the public water supply is a single source well. There are three publicly-owned and operated water supply districts in Ripley County: the City of Doniphan, Ripley County Public Water Supply District (PWSD) #1, and Ripley County Public Water Supply District #2. The City of Naylor and the Naylor R-II School District receive their water from PWSD #2. Residents living outside of these service areas rely on private wells for their water supply. The Doniphan R-I School District receives its water from the City of Doniphan. A private well supplies the Ripley County R-III School District with water.

The City of Doniphan utilizes a ground well for water supply with a backup well available as needed. Ripley County PWSD #1 has six wells that supply water for its customers. Ripley County PWSD #2 has four wells with the newest having been drilled in 2015.

There is no farmland within the city limits of Doniphan and Naylor, therefore drought impacts may be experienced as lawn or garden losses as opposed to large-scale crop or livestock losses. In addition, building foundations within all jurisdictions could be weakened due to shrinking and expanding

**Ripley County** – The unincorporated portion of the county is at higher risk of negative impacts from drought when compared to the remainder of the planning area due to its agricultural lands. Drought vulnerability for the county, however, remains low.

**City of Doniphan** – The City of Doniphan has low vulnerability to the negative impacts of drought.

**City of Naylor** – The City of Doniphan has low vulnerability to the negative impacts of drought.

**Doniphan R-I School District** – The Doniphan R-I School District has low vulnerability to the negative impacts of drought.

**Naylor R-II School District** – The Naylor R-II School District has low vulnerability to the negative

impacts of drought.

**Ripley County R-III School District** – The Ripley County R-III School District has low vulnerability to the negative impacts of drought.

## **Problem Statement**

Drought is a hazard that impacts large geographic regions of the country. The sector that is most impacted in Ripley County is agriculture—which spans the unincorporated areas of the county. Drought causes damages to crops and can negatively impact the yield of crops depending on the timing of the drought. Fortunately, water supplies within the county are abundant, thereby limiting the negative impacts of this hazard upon the county. No mitigation actions related solely to drought were identified by the MPC.

### **3.4.7 Extreme Temperatures**

#### **Hazard Profile**

##### ***Hazard Description***

Extreme temperature events, both hot and cold, can impact human health and mortality, natural ecosystems, agriculture and other economic sectors. According to information provided by FEMA, extreme heat is defined as temperatures that hover ten degrees or more above the average high temperature for the region and last for several weeks. Ambient air temperature is one component of heat conditions, with relative humidity being the other. The relationship of these factors creates what is known as the apparent temperature. The Heat Index chart shown in **07** uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Extreme cold often accompanies severe winter storms and can lead to hypothermia and frostbite in people without adequate clothing protection. Cold can cause fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. Extreme cold also increases the likelihood for ice jams on flat rivers or streams. When combined with high winds from winter storms, extreme cold becomes extreme wind chill, which is hazardous to health and safety.

The National Institute on Aging estimates that more than 2.5 million Americans are elderly and especially vulnerable to hypothermia, with the isolated elders being most at risk. About 10 percent of people over the age of 65 have some kind of bodily temperature-regulating defect, and 3-4 percent of all hospital patients over 65 are hypothermic.

Also at risk are those without shelter, those who are stranded, or who live in a home that is poorly insulated or without heat. Other impacts of extreme cold include asphyxiation (unconsciousness or death from a lack of oxygen) from toxic fumes from emergency heaters; household fires, which can be caused by fireplaces and emergency heaters; and frozen/burst pipes.

##### ***Geographic Location***

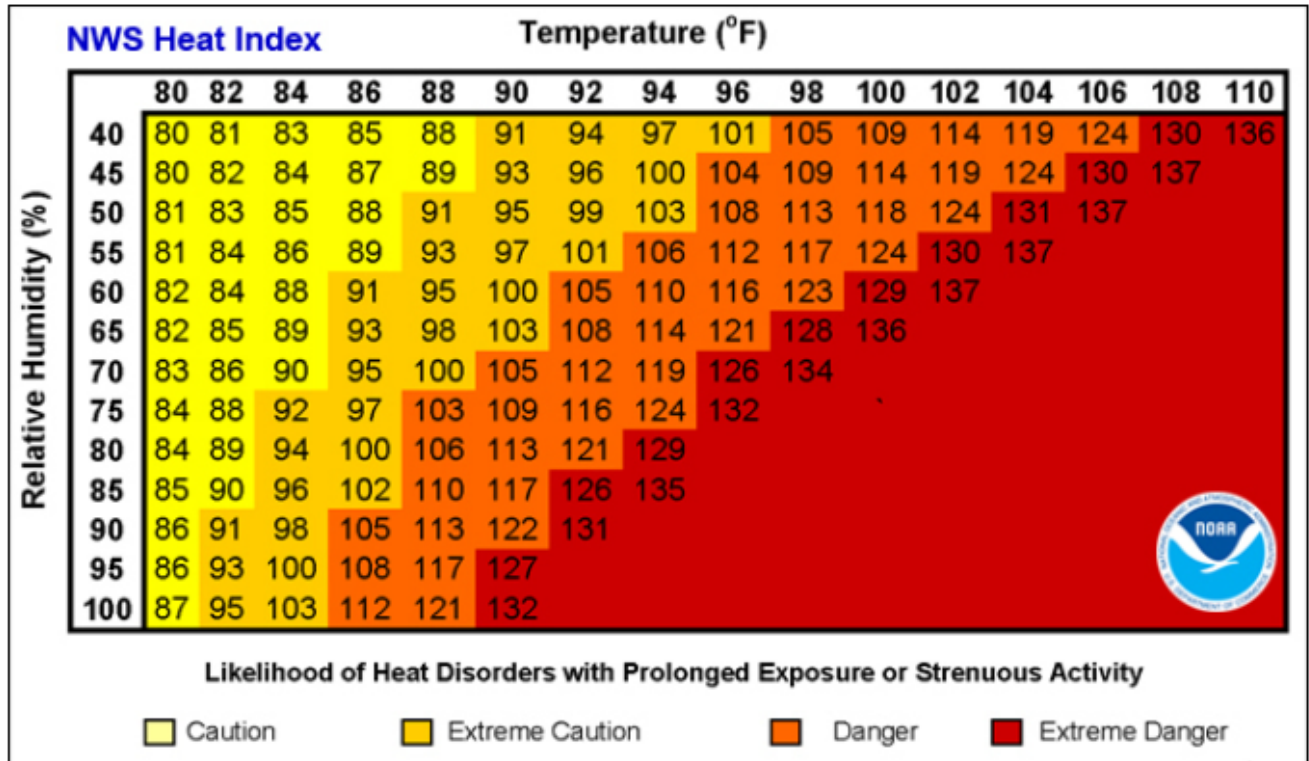
Extreme heat is an area-wide hazard event. The risk of extreme heat does not vary across the planning area.

##### ***Strength/Magnitude/Extent***

The National Weather Service (NWS) has an alert system in place (advisories or warnings) when the

Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when for two or more consecutive days: (1) when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°F); and the night time minimum Heat Index is 80°F or above. A heat advisory is issued when temperatures reach 105 degrees and a warning is issued at 115 degrees.

**Figure 3.17 Heat Index (HI) Chart**

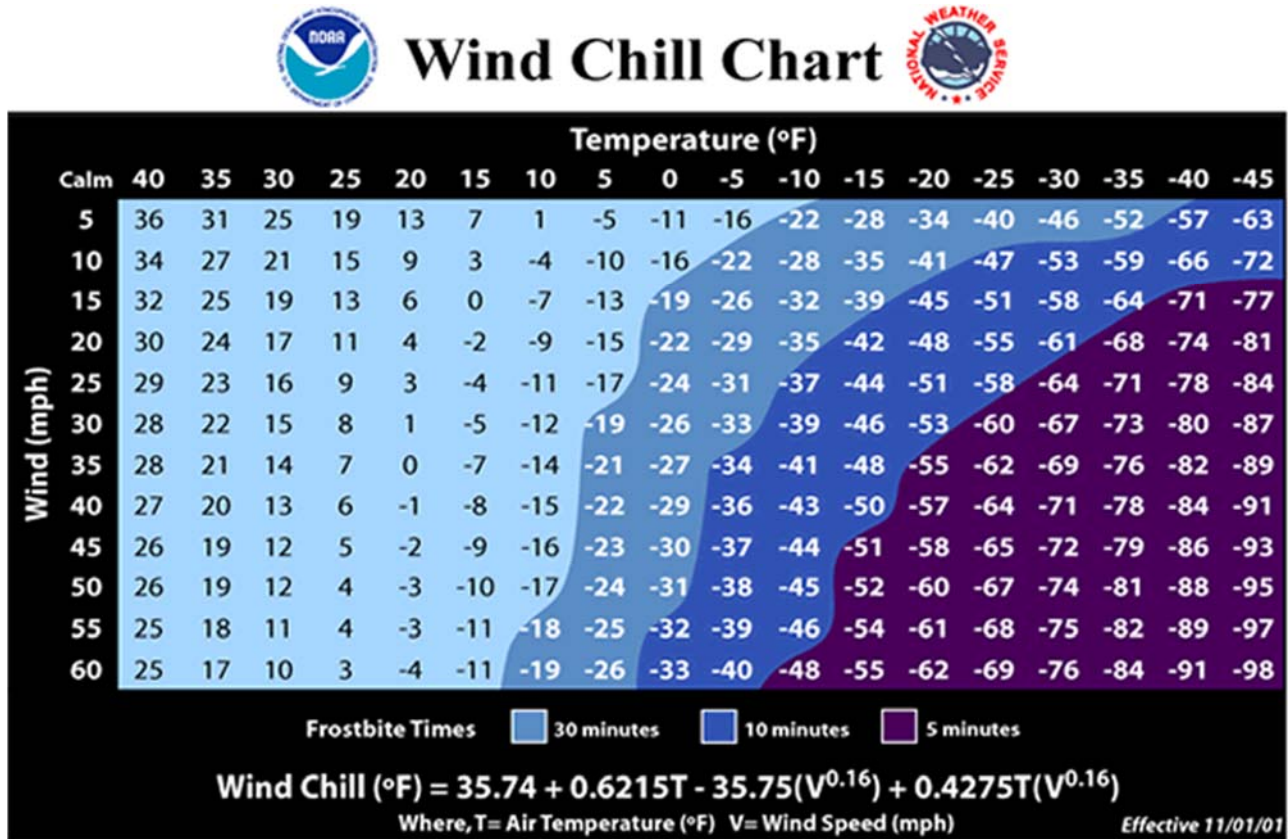


Source: National Weather Service (NWS); <https://www.weather.gov/safety/heat-index>

Note: Exposure to direct sun can increase Heat Index values by as much as 15°F. The shaded zone above 105°F corresponds to a HI that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

The NWS Wind Chill Temperature (WCT) index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. The figure below presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 3.18 Wind Chill Chart



Source: <https://www.weather.gov/safety/cold-wind-chill-chart>

**Previous Occurrences**

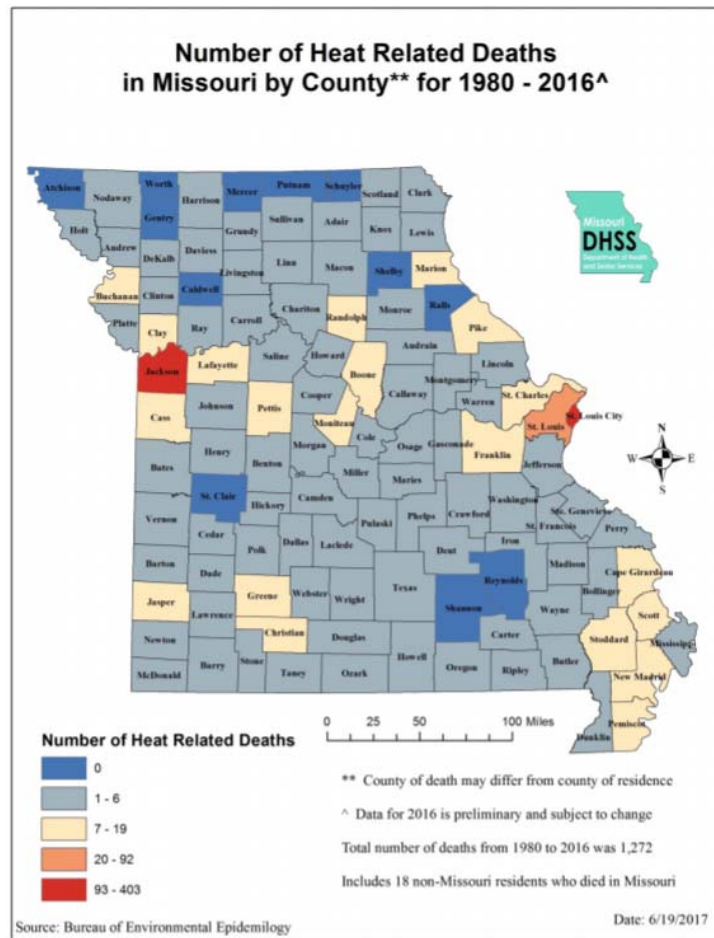
Per the *Missouri State Hazard Mitigation Plan, 2018*, there were thirty-three extreme cold events occurring within the planning area between 1996 and 2016. No deaths or injuries resulted from the events. While property damage was associated with those events involving ice storms, there were no property damages reported as resulting directly from extreme cold. There was \$30,000 in crop losses due to extreme cold reported during the time period.

The following map (09), shows Ripley County as a light blue area, which represents 1-6 heat-related deaths having occurred between 1980 and 2016.

Extreme heat can cause stress to crops and animals. Extreme heat can also strain electricity delivery infrastructure overloaded during peak use of air conditioning during extreme heat events. Another type of infrastructure damage from extreme heat is road damage. When asphalt is exposed to prolonged extreme heat, it can cause buckling of asphalt-paved roads, driveways, and parking lots.

From 1988-2011, there were 3,496 fatalities in the U.S. attributed to summer heat. This translates to an annual national average of 146 deaths. Per the NCEI data, sixty-three instances of extreme heat and one consequential death were recorded in the planning area between 1997 and 2019. The National Weather Service states that among natural hazards, no other natural disaster—not lightning, hurricanes, tornadoes, floods, or earthquakes—causes more deaths.

**Figure 3.19 Heat Related Deaths in Missouri 2000 - 2016**



Source: <https://health.mo.gov/living/healthcondiseases/hyperthermia/pdf/stat-report.pdf>

**Probability of Future Occurrence**

Per NCEI data from the past twenty-two years, an average of 2.9 extreme heat events per year are likely to occur within the planning area. While it is the best source of data currently available, it should be noted that extreme heat events could be underreported in the NCEI.

Using the data above, it can be determined that 1.57 extreme cold events are likely to occur each year within Ripley County in the future.

**Changing Future Conditions Considerations**

Per the *Missouri State Hazard Mitigation Plan, 2018*, “under a higher emissions pathway, historically unprecedented warming is projected by the end of the century. Even under a pathway of lower greenhouse gas emissions, average annual temperatures are projected to most likely exceed historical record levels by the middle of the 21st century. For example, in southern Missouri, the annual maximum number of consecutive days with temperatures exceeding 95 degrees F is projected to increase by up to 20 days! Temperature increases will cause future heat waves to be more intense, a concern for this region which already experiences hot and humid conditions.” At the same time, extreme cold events are expected to decrease in likelihood. “The impacts of extreme heat events are experienced most acutely by the elderly and other



vulnerable populations. Higher demand for electricity as people try to keep cool amplifies stress on power systems and may lead to an increase in the number of power outages. Atmospheric concentrations of ozone occur at higher air temperatures, resulting in poorer air quality, while harmful algal blooms flourish in warmer water temperatures, resulting in poorer water quality.”

**Vulnerability**

***Vulnerability Overview***

Extreme heat and extreme cold events are common occurrences in the planning area. Within the Missouri State Hazard Mitigation Plan, 2018, the method used to determine vulnerability to extreme temperatures across Missouri was statistical analysis of data from several sources: National Centers for Environmental Information (NCEI) storm events data (1996 to December 31, 2016), total population and percentage of population over 65 data from the U.S. Census (2015 ACS), and the calculated Social Vulnerability Index for Missouri counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina.

From the statistical data collected, four factors were considered in determining overall vulnerability to extreme temperatures as follows: total population, percentage of population over 65, likelihood of 3.264 3 Risk Assessment occurrence, and social vulnerability. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

- 1) Low
- 2) Low-medium
- 3) Medium
- 4) Medium-high
- 5) High

Using the process described above, Ripley County was assigned a total vulnerability rating of “12” for both extreme heat and extreme cold. This is due in large part to the high percentage of persons over age 65 residing in the county. A vulnerability rating of “12” equates to a medium-high vulnerability description.

Those at greatest risk for heat-related illness include infants and children up to five years of age, people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to extreme temperatures is a major concern.

**Table 3.2727** lists typical symptoms and health impacts due to exposure to extreme heat.

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**Table 3.27. Typical Health Impacts of Extreme Heat**

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

Source: National Weather Service Heat Index Program, [www.weather.gov/os/heat/index.shtml](http://www.weather.gov/os/heat/index.shtml)

***Potential Losses to Existing Development***

According to USDA Risk Management Agency, losses to insurable crops during the eleven-year time period from 2010 to 2020 were \$391,898, resulting in an average annual loss of \$35,627.

Deaths due to extreme temperatures within the planning area are very rare. Historical information indicates that one death every twenty years is likely to occur as a result of extreme heat. It should be noted that, with climate, change, the frequency of death due to extreme heat within the planning area could increase slightly.

**Impact of Previous and Future Development**

No jurisdictions within the planning area are currently experiencing significant growth or development. No large scale conversion of non-agricultural land to farmland is anticipated.

**Hazard Summary by Jurisdiction**

Those at greatest risk for heat-related illness and deaths include children up to five years of age, people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. To determine jurisdictions within the planning area with populations more vulnerable to extreme heat, demographic data was obtained from the 2010 census on population percentages in each jurisdiction comprised of those under age 5 and over age 65. Data was not available for overweight individuals and those on medications vulnerable to extreme heat. **Table 3.2828** below summarizes vulnerable populations in the participating jurisdictions. Note that school and special districts are not included in the table because students and those working for the special districts are not customarily in these age groups.

**Table 3.28. Ripley County Population Under Age 5 and Over Age 65, 2015 American Community Survey**

Jurisdiction*	Population Under 5 yrs	Population 65 yrs and over
Ripley County	849	2,792
City of Doniphan	64	493
City of Naylor	62	132

Source: U.S. Census Bureau, (\*) includes entire population of each city or county

Although it was not always the case, all three participating school districts furnish air-conditioning within student classrooms. Too, all three districts have policies which mandate school closure during high heat events.

**Ripley County** – Per the 2019 American Community Survey Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations comprise 26.9% of the total population in the county.

**City of Doniphan** – Per the 2019 American Community Survey Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations comprise 27.0% of the total population in the county.

**City of Naylor** – Per the 2019 American Community Survey Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations comprise 24.2% of the total population in the county.

**Doniphan R-I School District** – Because district operations are limited primarily to the fall, winter, and spring seasons, the risk of damage or injury due to extreme heat is low. Damaged infrastructure (i.e. frozen pipes) due to extreme cold should be mitigated.

**Naylor R-II School District** – Because district operations are limited primarily to the fall, winter,

and spring seasons, the risk of damage or injury due to extreme heat is low. Damaged infrastructure (i.e. frozen pipes) due to extreme cold should be mitigated.

**Ripley County R-III School District** – Because district operations are limited primarily to the fall, winter, and spring seasons, the risk of damage or injury due to extreme heat is low. Damaged infrastructure (i.e. frozen pipes) due to extreme cold should be mitigated.

### **Problem Statement**

The risks resulting from extreme heat include heat-related illness and death and damage to crops in the planning area. Ripley County has a growing population of residents over 65 years, who are at a greater risk for extreme-temperature related illnesses, injuries, and death. All jurisdictions within the county have populations at risk of illness and death resulting from extreme heat. To address the problem of extreme heat, potential mitigation actions may include:

- organizing cooling centers;
- delaying school year start dates until after the Labor Day holiday;
- allocating additional funding to repair and maintain roads damaged by buckling and potholes;
- reducing nutrient runoff that contributes to algal blooms;
- Improving energy efficiency in public buildings;
- Create a database of vulnerable populations in cooperation with home health care; and,
- Provide heat related illness educational information to the general public.

## **3.4.8 Severe Thunderstorms Including High Winds, Hail, and Lightning**

### **Hazard Profile**

#### ***Hazard Description***

##### ***Thunderstorms***

A thunderstorm is defined as a storm that contains lightning and thunder which is caused by unstable atmospheric conditions. When cold upper air sinks and warm moist air rises, storm clouds or ‘thunderheads’ develop resulting in thunderstorms. This can occur singularly, as well as in clusters or lines. The National Weather Service defines a thunderstorm as “severe” if it includes hail that is one inch or more, or wind gusts that are at 58 miles per hour or higher. At any given moment across the world, there are about 1,800 thunderstorms occurring. Severe thunderstorms most often occur in Missouri in the spring and summer, during the afternoon and evenings, but can occur at any time. Other hazards associated with thunderstorms are heavy rains resulting in flooding (discussed separately in **Section 3.4.1**) and tornadoes (discussed separately in **Section 3.4.10**).

##### ***High Winds***

A severe thunderstorm can produce winds causing as much damage as a weak tornado. The damaging winds of thunderstorms include downbursts, microbursts, and straight-line winds. Downbursts are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground. Microbursts are minimized downbursts covering an area of less than 2.5 miles across. They include a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Microbursts may or may not include precipitation and can produce winds at speeds of more than 150 miles per hour. Damaging straight-line winds are high

winds across a wide area that can reach speeds of 140 miles per hour.

### ***Lightning***

All thunderstorms produce lightning which can strike outside of the area where it is raining and has been known to strike more than ten miles away from the rainfall area. Lightning is a huge discharge of electricity that shoots through the air causing vibrations and creating the sound of thunder.

### ***Hail***

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when thunderstorm updrafts carry raindrops upward into extremely cold atmosphere causing them to freeze. The raindrops form into small frozen droplets. They continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow before it hits the earth.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a  $\frac{1}{4}$ " diameter or pea sized hail requires updrafts of 24 miles per hour, while a  $2\frac{3}{4}$ " diameter or baseball sized hail requires an updraft of 81 miles per hour. According to the NOAA, the largest hailstone in diameter recorded in the United States was found in Vivian, South Dakota on July 23, 2010. It was eight inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea-sized hail can do damage.

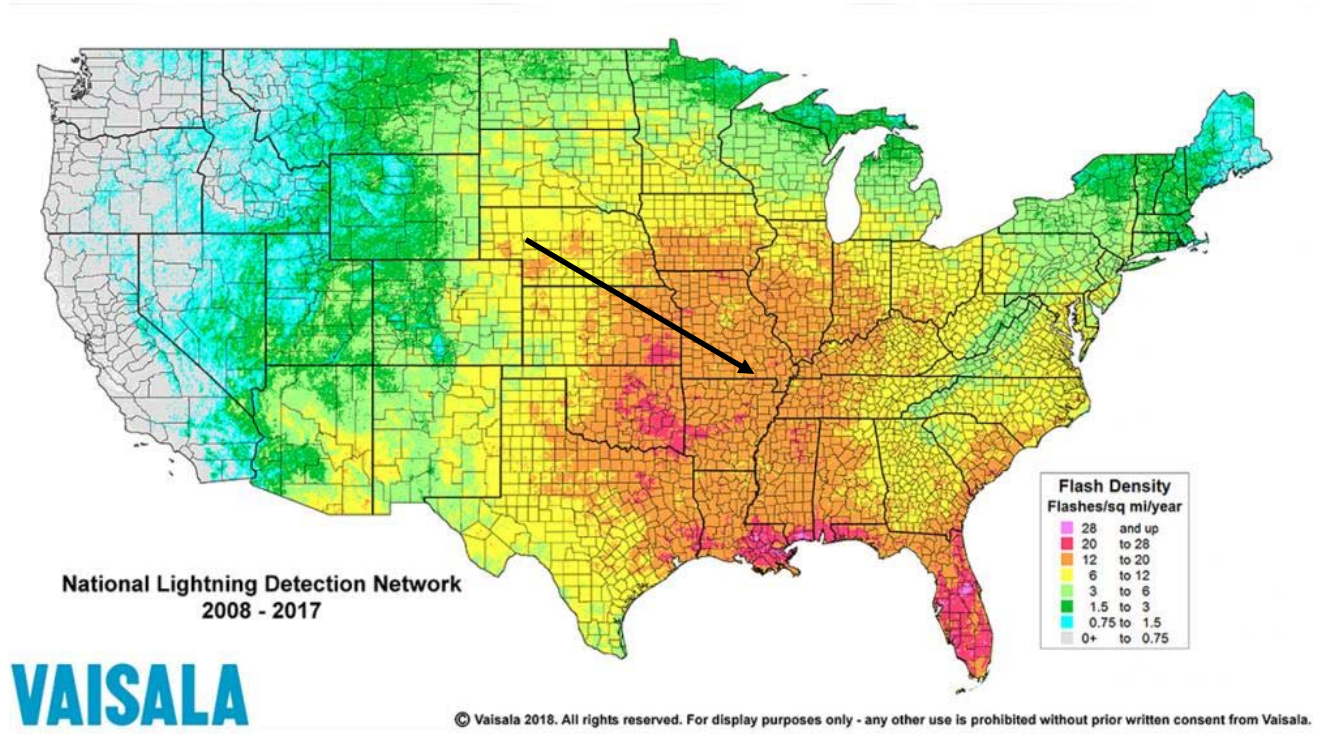
### ***Geographic Location***

Thunderstorms/high winds/hail/lightning events are an area-wide hazard that can happen anywhere in the county. Although these events occur similarly throughout the planning area, they are more frequently reported in more populated areas. In addition, damages are more likely to occur in more heavily populated areas.

**020** below shows lightning frequency in the state. The planning area is indicated by the black arrow.

Figure 3.20

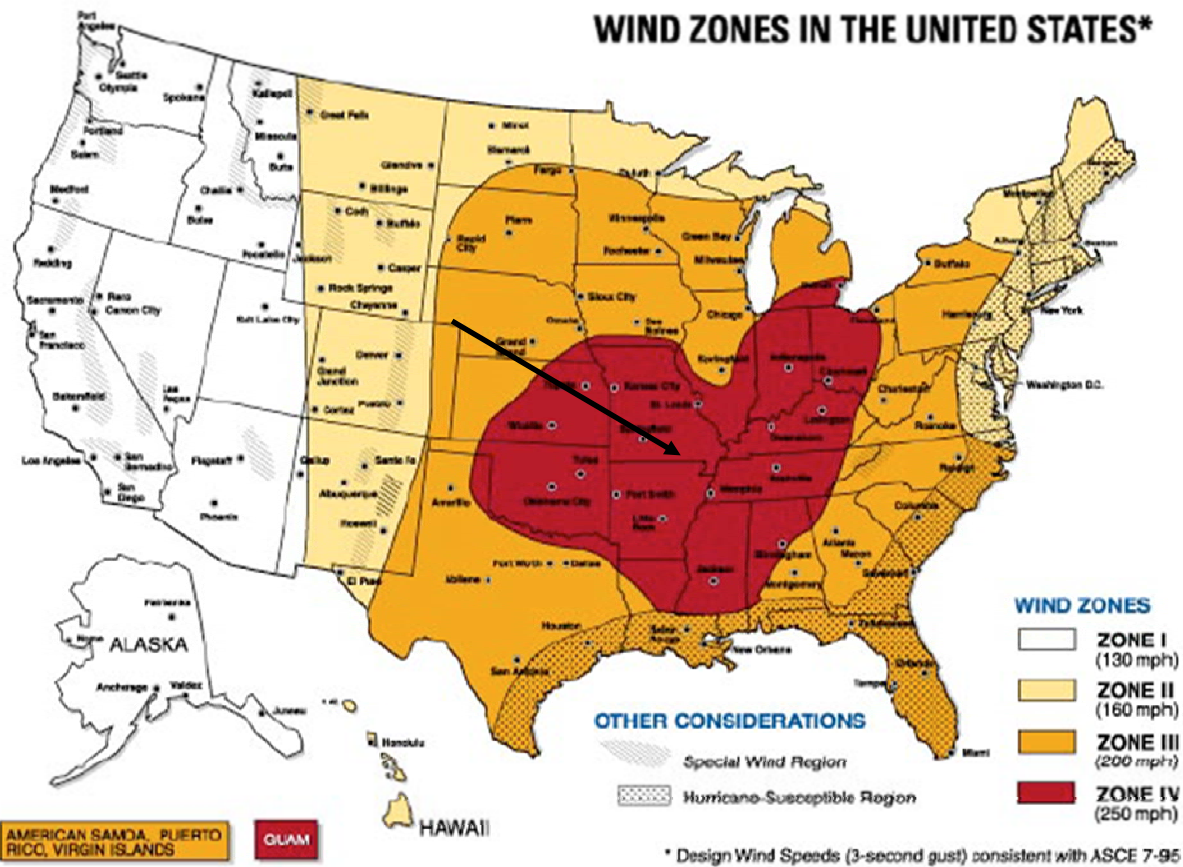
Location and Frequency of Lightning in Missouri



Source: National Weather Service,  
<http://www.vaisala.com/en/products/thunderstormandlightningdetectionsystems/Pages/NLDN.aspx>.

021 shows wind zones in the United States. The planning area is indicated by the black arrow.

**Figure 3.21 Wind Zones in the United States**



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition, [https://www.fema.gov/pdf/library/ism2\\_s1.pdf](https://www.fema.gov/pdf/library/ism2_s1.pdf)

**Strength/Magnitude/Extent**

Based on information provided by the Tornado and Storm Research Organization (TORRO), **Table 3.29** below describes typical damage impacts of the various sizes of hail.

**Table 3.29. Tornado and Storm Research Organization Hailstorm Intensity Scale**

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
Hard Hail	5-9	0.2-0.4	Pea	No damage
Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	31-40	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	76-90	3.0-3.5	Large orange	Severe damage to aircraft bodywork

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
			> Soft ball	
Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University  
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity. <http://www.torro.org.uk/site/hscale.php>

Straight-line winds are defined as any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). It is these winds, which can exceed 100 miles per hour, which represent the most common type of severe weather. They are responsible for most wind damage related to thunderstorms. Since thunderstorms do not have narrow tracks like tornadoes, the associated wind damage can be extensive and affect entire (and multiple) counties. Objects like trees, barns, outbuildings, high-profile vehicles, and power lines/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase.

The onset of thunderstorms with lightning, high wind, and hail is generally rapid. Duration is less than six hours and warning time is generally six to twelve hours. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start structural and wildland fires, as well as damage electrical systems and equipment.

### ***Previous Occurrences***

The narrative below discusses the frequency of thunderstorms, high winds, lightning, and hail within the planning area, as well as the resulting damages and injuries. There were no lightning events reported between 1950 and 2020. It should be noted that, limitations to the use of NCEI reported lightning events include the fact that only lightning events resulting in fatality, injury and/or property and crop damage are in the NCEI.

### ***Thunderstorms***

Within the ten-year period from 2011 to 2020, thirty-two thunderstorm events were reported as occurring within the planning area—fourteen in the City of Doniphan, two in the City of Naylor and sixteen within the balance of the county. In total, the events resulting in \$957,000 in property damage and \$0 in crop damage. Two of the events—occurring in 2013 and 2020 in the balance of the county—resulted in the majority of the damage (\$350,000 and \$250,000, respectively). There were no deaths or injuries reported as resulting from any of the events.

### ***High Winds***

There were seven high wind events recorded between 1997 and 2021. Fortunately, no deaths or injuries were reported as resulting directly from the events. Only two events resulted in damages to property and/or crops.

On September 14, 2008, frequent wind gusts resulting from Hurricane Ike and measuring between 60 and 75 mph caused widespread damage in parts of southeast Missouri. A very large number of trees were uprooted, and large limbs were broken. Some trees fell on homes, businesses, and public buildings. Downed trees and limbs landed on many vehicles. Numerous streets and highways were blocked. More than half the streets in some cities were blocked by downed trees and power lines. Roof and siding damage was reported on numerous structures. Some windows were broken out of homes and businesses. Some structures within the planning area lost power. Schools were canceled for two to three days due to power outages in some areas. Large signs were blown down across the

region. A wind gust to 75 mph was measured at Doniphan in Ripley County by the emergency management director. Lots of pecans and walnuts were blown off trees. Corn and cotton crops were flattened in some places. Preliminary estimates of lost corn yield ranged from twenty to thirty bushels per acre and totaled \$3,000,000. A few minor fires were sparked by damaged electrical lines. Damage to property totaled \$5,000,000 across the area of impact.

In December 2012, a high wind event resulted in \$2,000 in property damage somewhere within the area of impact. A wind gust of fifty-eight miles per hour was measured within the City of Doniphan. No crop damage resulted from the event.

**Lightning**

No lightning events were reported within the planning area between 1950 and 2020. As stated above, only lightning events resulting in fatality, injury and/or property and crop damage are recorded by the NCEI. Therefore, it can be reasonably assumed that little to no property or crop damage within the planning area occurred as a result of lightning.

**Hail**

Per the NCEI, there were thirty hail events occurring within the county between 2011 and 2020. April, May, and June were the most common months during which hail fell within the planning area. Hailstones ranged in size from .75 of one inch to 1.75 inches. Of all the events, neither injuries/deaths, nor damage to property/crops was reported. Thirteen of the events were reported as occurring in Doniphan with three in Naylor. The remaining fifteen events occurred within the balance of the county.

Agriculture is prevalent in the southeastern portion of the planning area. Damage to crops as a result of high winds and hail has been recorded within the planning area. The tables below (**Table 3.300 through Table 3.333**) summarize past crop damages as indicated by crop insurance claims. The tables illustrate the magnitude of the impact on the planning area’s agricultural economy. There were no crop damages due to thunderstorms or lightning. The primary crop impacted was rice, which was exclusively damaged by extreme wind. On occasion, grain sorghum and soybeans were negatively impacted by hot winds. In an eleven-year period, a total of \$373,675 was paid in crop losses as a result of hot/high winds.

**Table 3.30. Crop Insurance Claims Paid in Ripley County due to Thunderstorms, 2010-2020**

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
<b>Total</b>			\$0

Source: USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

**Table 3.31. Crop Insurance Claims Paid in Ripley County from High Winds, 2010-2020**

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
2010	Rice	Hot Wind	\$111,766
2011	None	N/A	\$0



2012	Grain Sorghum/Soybeans	Hot Wind/Excess Wind	\$86,018
2013	Grain Sorghum	Hot Wind	\$7,842
2014	Soybeans	Hot Wind	\$16,250
2015	Rice	Wind/Extreme Wind	\$6,886
2016	Rice	Wind/Extreme Wind	\$30,031
2017	Rice	Wind/Extreme Wind	\$14,195
2018	None	N/A	\$0
2019	Rice	Wind/Extreme Wind	\$7,947
2020	Rice	Wind/Extreme Wind	\$29,716
<b>Total</b>			\$373,675

Source: USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

**Table 3.32. Crop Insurance Claims Paid in Ripley County from Lightning, 2010-2020**

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
<b>Total</b>			\$0

USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

**Table 3.33. Crop Insurance Claims Paid in Ripley County from Hail, 2010-2020**

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid
2011	Wheat	Hail	\$15,208
<b>Total</b>			\$15,208

USDA Risk Management Agency, Insurance Claims, <https://www.rma.usda.gov/data/cause>

### ***Probability of Future Occurrence***

#### ***Thunderstorm***

With regard to thunderstorms, the probability of future occurrence in the entire planning area is 3.2 events per year. This can be further analyzed by jurisdiction as event location is provided within the NCEI data.

#### ***High Wind***

In reviewing the twenty-four-year history presented above, the probability of a high wind event with winds greater than 50 knots is .3 in any given year. In other words, one high wind event could reasonably be anticipated every 3.4 years.

#### ***Lightning***

Although lightning will occur somewhere within the planning area every year, historical data indicate that resulting damage is not likely.

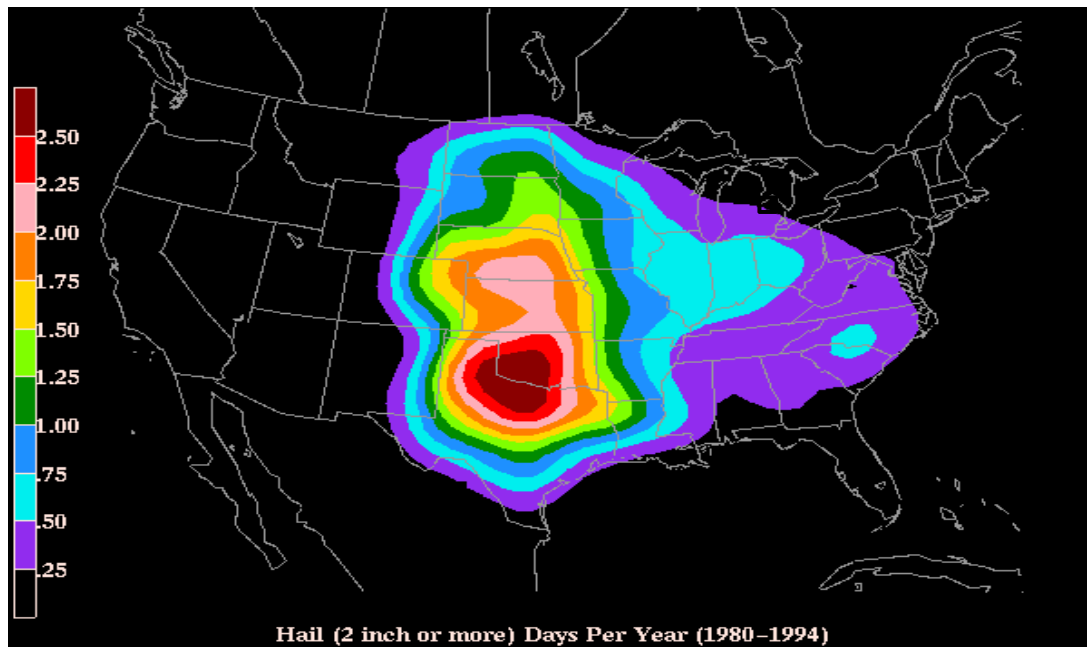
#### ***Hail***

As reported earlier, there were thirty hail events reported for the ten-year period between 2011 and

2020, resulting in an estimated probability of three events per year. Of the thirty events, nineteen involved hailstones one inch in diameter or larger. It can also be concluded from this data that nearly two (2) events of 1" diameter hail can be expected annually somewhere within the planning area. This can be further analyzed by jurisdiction as event location is provided within the NCEI data.

The map in **02** below is based on hailstorm data from 1980-1994. It shows the probability of hailstorm occurrence (2" diameter or larger) based on number of days per year. Ripley County is located within the light aqua blue zone, which indicates a probability of .5 to .75 days per year during which hail 2 inches or larger in diameter is expected to occur.

**Figure 3.22 Annual Hailstorm Probability (2" diameter or larger), 1980-1994**



Source: NSSL, [http://www.nssl.noaa.gov/users/brooks/public\\_html/bighail.gif](http://www.nssl.noaa.gov/users/brooks/public_html/bighail.gif) Note:

### **Changing Future Conditions Considerations**

Per the *Missouri State Hazard Mitigation Plan, 2018*, "NASA's Earth Observatory provides an analysis on how climate change could, theoretically, increase potential storm energy by warming the surface and putting more moisture in the air through evaporation. The presence of warm, moist air near the surface is a key ingredient for summer storms that meteorologists have termed "convective available potential energy," or CAPE. With an increase in CAPE, there is greater potential for cumulus clouds to form. The study also counters this theory with the theory that warming in the Arctic could lead to less wind shear in the mid-latitude areas prone to summer storms, making the storms less likely.

Predicted increases in temperature could help create atmospheric conditions that are fertile breeding grounds for severe thunderstorms and tornadoes in Missouri. Possible impacts include an increased risk to life and property in both the public and private sectors. Public utilities and manufactured housing developments will be especially prone to damages. Jurisdictions already affected should be prepared for more of these events and prioritize mitigation actions such as construction of safe rooms for vulnerable populations, retrofitting and/or hardening existing structures, improving warning systems and public education, and reinforcing utilities and additional critical infrastructure."

## **Vulnerability**

### ***Vulnerability Overview***

Severe thunderstorm losses are usually attributed to the associated hazards of hail, downburst winds, lightning and heavy rains. Losses due to hail and high wind are typically insured losses that are localized and do not result in presidential disaster declarations. However, in some cases, impacts are severe and widespread and assistance outside state capabilities is necessary. Hail and wind also can have devastating impacts on crops. Severe thunderstorms/heavy rains that lead to flooding are discussed in the flooding hazard profile. Though it is not recorded as having occurred in the planning area, hailstorms can result in damage to property, crops, and the environment, and can injure and kill livestock. In the United States, hail causes more than \$1 billion in damage to property and crops each year. Even relatively small hail can quickly destroy plants. Vehicles, roofs of buildings and homes, and landscaping are also commonly damaged by hail. Hail has been known to cause injury to humans, occasionally fatal injury.

In general, assets in the county vulnerable to thunderstorms with lightning, high winds, and hail include people, crops, vehicles, and built structures. Although this hazard results in high annual losses, private property insurance and crop insurance usually cover the majority of losses. Considering insurance coverage as a recovery capability, the overall impact on jurisdictions is reduced.

Most lightning damages occur to electronic equipment located inside buildings. But structural damage can also occur when a lightning strike causes a building fire. In addition, lightning strikes can cause damages to crops, if fields or forested lands are set on fire. Communications equipment and warning transmitters and receivers can also be knocked out by lightning strikes.

The method used to determine vulnerability to severe thunderstorms across Missouri was statistical analysis of data from several sources: National Centers for Environmental Information (NCEI) storm events data (1996 to December 31, 2016), HAZUS Building Exposure Value data, housing density and mobile home data from the U.S. Census (2015 ACS), and the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina.

From the statistical data collected, six factors were considered in determining overall vulnerability to lightning as follows: housing density, building exposure, percentage of mobile homes, social vulnerability, likelihood of occurrence, and average annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms which were used to classify Missouri's 114 counties by vulnerability:

- 6) Low
- 7) Low-medium
- 8) Medium
- 9) Medium-high
- 10) High

Based on the analysis, Ripley County's vulnerability to thunderstorm was classified as "medium."

### ***Potential Losses to Existing Development***

Per HAZUS, total building exposure in the county is \$1,131,335,000. Estimates of total annualized property losses due to high wind and hail were \$327,286 and \$714, respectively. There were no losses estimated as a result of lightning events.

### ***Previous and Future Development***

No significant additional development is anticipated within any of the jurisdictions. As a result, the exposure of more households and businesses vulnerable to damages from severe thunderstorms/ high winds/lightning/hail is not expected.

### ***Hazard Summary by Jurisdiction***

Although thunderstorms/high winds/lightning/hail events are area-wide, there are demographics indicating higher losses in one jurisdiction as compared to another. The primary factor for differences in the higher losses in one jurisdiction than another is population density. The population density for Ripley County is twenty-two persons per square mile. As the size of Doniphan is on 1.378 square miles and the population according to the 2010 Census is 1,997, the density is 1,447 persons per square mile. The City of Naylor also has a higher population density of 1,124 persons per square mile. The damages resulting from a thunderstorm have the potential to be greater in these two more concentrated towns than in the sparsely populated unincorporated areas of the county.

Unfortunately, information about jurisdictions with high percentages of housing built before 1939, is not calculated by the American Community Survey for the small rural cities of Doniphan and Naylor. No participating school districts reported previous losses involving school assets due to the hazard.

**Ripley County** – The unincorporated portion of Ripley County is likely to experience 1.6 thunderstorm events per year, 1.5 hail events per year, and endure winds greater than 50 knots once every 3.4 years, damages are not anticipated to be as significant as would be expected within the Cities of Doniphan and Naylor. This is due solely to the population density of the county as compared to the two cities.

**City of Doniphan** – The City of Doniphan is likely to experience 1.6 thunderstorm events per year, 1.5 hail events per year, and endure winds greater than 50 knots once every 3.4 years. Due to the city's significantly increased population density when compared to the county, its vulnerability to damage from thunderstorms, high wind, and hail is considerably higher. Given the City of Doniphan's high population density and greatest likelihood of occurrence for all associated events, this jurisdiction is most vulnerable of all of the participating jurisdictions to damage from thunderstorm, high winds, and hail.

**City of Naylor** – Per the data reported by the NCEI, the City of Naylor is likely to experience a thunderstorm once every five years, a hail event once every 40 months, and endure winds greater than 50 knots once every 3.4 years. Due to the city's significantly increased population density when compared to the county, its vulnerability to damage from thunderstorms, high wind, and hail is considerably higher.

**Doniphan R-I School District** – While thunderstorms, high winds, and hail can occur anywhere within the school district's service area, damages to district assets can be projected to be similar to those of other properties located within the City of Doniphan.

**Naylor R-II School District** – While thunderstorms, high winds, and hail can occur anywhere within the school district's service area, damages to district assets can be projected to be similar to those of other properties located within the City of Naylor.

**Ripley County R-III School District** – While thunderstorms, high winds, and hail can occur anywhere within the school district's service area, damages to district assets can be projected to be similar to those of other properties located within the balance of the county.

## **Problem Statement**

Thunderstorms and the associated risks of high winds, lightning, and hail can result in property and crop damage and have the potential to cause injuries and death to residents. These storms are common occurrences in Ripley County; however, due in large part to the sparse population density of the county, the damages resulting from these events is relatively limited. The probability of a high wind event with winds greater than 50 knots is more than 100% in the county in any given year, with an average of two events per year. Electrical outages frequently occur as a result. There also exists a 100% chance that a 1" diameter hail event will occur in the county in any given year, with an average of two events per year. Lightning accompanies both types of events. Potential mitigation actions for the planning are may include the following:

- seek funding for emergency generator installation at critical facilities;
- ensure critical facilities—particularly those outfitted with communications equipment—are protected from lightning strikes.

### **3.4.9 Severe Winter Weather**

#### **Hazard Profile**

##### ***Hazard Description***

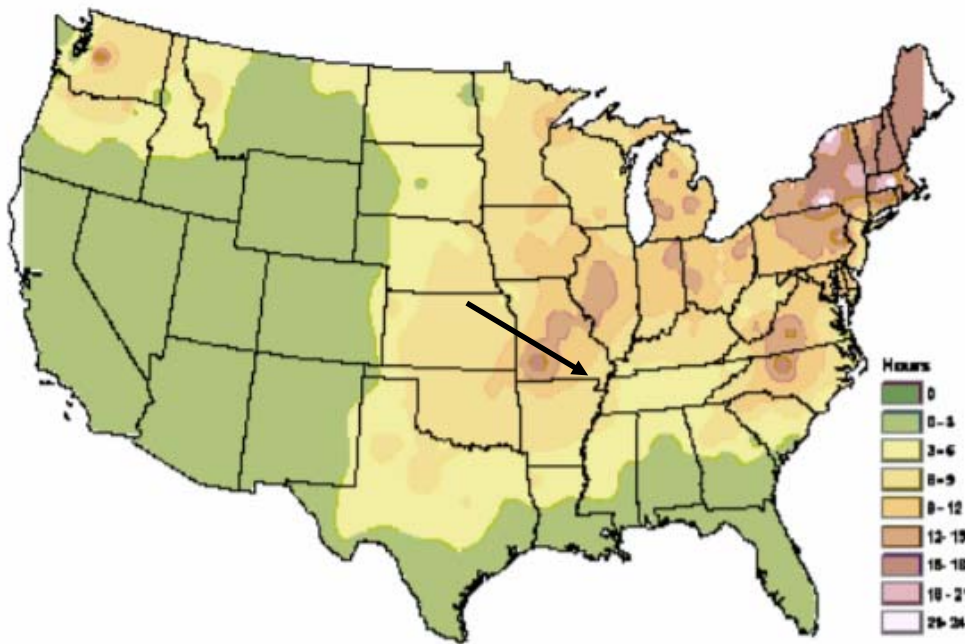
A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The National Weather Service describes different types of winter storm events as follows.

- **Blizzard**—Winds of 35 miles per hour or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
- **Blowing Snow**—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow Squalls**—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- **Snow Showers**—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- **Freezing Rain**—Measurable rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Most freezing-rain events are short lived and occur near sunrise between the months of December and March.
- **Sleet**—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

##### ***Geographic Location***

The entire county is vulnerable to heavy snow, ice, extreme cold temperatures and freezing rain. The map in **023** below shows the average number of hours of freezing rain experienced within the country annually. The planning area is indicated by the black arrow. Per this source, the county should anticipate eight to nine hours of freezing rain per year.

**Figure 3.23 NWS Statewide Average Number of Hours per Year with Freezing Rain**



Source: American Meteorological Society. "Freezing Rain Events in the United States." <http://ams.confex.com/ams/pdfpapers/71872.pdf>

### ***Strength/Magnitude/Extent***

Severe winter storms include heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area.

For severe weather conditions, the National Weather Service issues some or all of the following products as conditions warrant across the State of Missouri. NWS local offices in Missouri may collaborate with local partners to determine when an alert should be issued for a local area.

- Winter Weather Advisory — Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. Often the greatest hazard is to motorists.
- Winter Storm Watch — Severe winter conditions, such as heavy snow and/or ice are possible within the next day or two.
- Winter Storm Warning — Severe winter conditions have begun or are about to begin.
- Blizzard Warning — Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.
- Ice Storm Warning — Dangerous accumulations of ice are expected with generally over one quarter inch of ice on exposed surfaces. Travel is impacted, and widespread downed trees and power lines often result.
- Wind Chill Advisory -- Combination of low temperatures and strong winds will result in wind chill readings of -20 degrees F or lower.
- Wind Chill Warning -- Wind chill temperatures of -35 degrees F or lower are expected. This is

a life-threatening situation.

### **Previous Occurrences**

Per the NCEI Storm Events Database, Ripley County and its participating jurisdictions experienced forty-three winter weather events in the ten-year timeframe spanning 2012-2021. Table 3.3434 below lists NCEI reported events and damages within the planning area for the past ten years.

**Table 3.34. NCEI Ripley County Winter Weather Events Summary, 2012-2021**

DATE	TYPE OF EVENT	# DEATHS	# INJURIES	PROPERTY DAMAGE (\$)	CROP DAMAGE (\$)
2/13/2012	Winter Weather	0	0	0	0
12/25/2012	Winter Storm	0	0	0	0
12/28/2012	Winter Weather	0	0	0	0
2/21/2013	Ice Storm	0	0	100,000	0
3/21/2013	Winter Storm	0	0	0	0
12/5/2013	Winter Storm	0	0	0	0
1/6/2014	Cold/Wind Chill	0	0	0	0
2/2/2014	Winter Storm	0	0	0	0
2/4/2014	Winter Storm	0	0	0	0
2/10/2014	Winter Weather	0	0	0	0
3/2/2014	Winter Storm	0	0	0	0
11/16/2014	Winter Weather	0	0	0	0
1/11/2015	Winter Weather	0	0	0	0
2/15/2015	Winter Storm	0	0	0	0
2/17/2015	Winter Weather	0	0	0	0
2/19/2015	Cold/Wind Chill	0	0	0	0
2/20/2015	Winter Storm	0	0	0	0
2/28/2015	Winter Weather	0	0	0	0
3/1/2015	Winter Weather	0	0	0	0
3/4/2015	Winter Storm	0	0	0	0
1/19/2016	Winter Weather	0	0	0	0
2/14/2016	Winter Weather	0	0	0	0
1/5/2017	Winter Weather	0	0	0	0
1/13/2017	Winter Weather	0	0	0	0
1/1/2018	Cold/Wind Chill	0	0	0	0
1/12/2018	Winter Weather	0	0	0	0
1/15/2018	Heavy Snow	0	0	0	0
1/16/2018	Cold/Wind Chill	0	0	0	0
2/6/2018	Winter Weather	0	0	0	0
2/11/2018	Winter Weather	0	0	0	0
4/7/2018	Winter Weather	0	0	0	0
11/14/2018	Winter Weather	0	0	0	0
12/8/2018	Winter Weather	0	0	0	0
1/11/2019	Winter Weather	0	0	0	0
1/19/2019	Heavy Snow	0	0	0	0
2/15/2019	Winter Weather	0	0	0	0
11/11/2019	Winter Weather	0	0	0	0
1/27/2021	Winter Weather	0	0	0	0
2/10/2021	Winter Weather	0	0	0	0
2/14/2021	Cold/Wind Chill	0	0	0	0
2/14/2021	Winter Storm	0	0	0	0
2/16/2021	Cold/Wind Chill	0	0	0	0
2/17/2021	Winter Weather	0	0	0	0
Total		0	0	100,000	0

Source: NCEI, data accessed, March 2021

Fortunately, there were no Presidential Disaster Declarations resulting from winter storms within the planning area during the timeframe evaluated.

While winter storms, cold, frost and freeze can damage crop production, this is not always the case within Ripley County. Per USDA’s Risk Management Agency, only one loss occurred within the planning area as a result of cold conditions and snow from 2010-2020. The event occurred during May 2014 and resulted in the loss of \$1,054 in wheat.

**Table 3.35. Crop Insurance Claims Paid in Ripley County as a Result of Winter Weather**

Crop Year	Crop Name	Cause of Loss Description	Insurance Paid (\$)
2014	Wheat	Cold Winter	1,053.50
<b>Total</b>			1,053.50

Source: USDA Risk Management Agency, <https://www.rma.usda.gov/data/cause>

**Probability of Future Occurrence**

The probability of a future occurrence of severe winter weather within the planning area in any given year is 100%. According to the ten years of incident data reported above, each year Ripley County experiences an average of 4.3 winter weather events ranging from extreme cold temperatures to snow and ice.

**Changing Future Conditions Considerations**

Per the *Missouri State Hazard Mitigation Plan, 2018*, “a shorter overall winter season and fewer days of extreme cold may have both positive and negative indirect impacts. Warmer winter temperatures may result in changing distributions of native plant and animal species and/or an increase in pests and non-native species. Warmer winter temperatures will result in a reduction of lake ice cover. Reduced lake ice cover impacts aquatic ecosystems by raising water temperatures. Water temperature is linked to dissolved oxygen levels and many other environmental parameters that affect fish, plant, and other animal populations. A lack of ice cover also leaves lakes exposed to wind and evaporation during a time of year when they are normally protected. As both temperature and precipitation increase during the winter months, freezing rain will be more likely. Additional wintertime precipitation in any form will contribute to saturation and increase the risk and/or severity of spring flooding. A greater proportion of wintertime precipitation may fall as rain rather than snow.”

**Vulnerability**

**Vulnerability Overview**

Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough that precipitation falls as freezing rain rather than snow.

Buildings with overhanging tree limbs are more vulnerable to damage during winter storms when limbs fall. Businesses experience loss of income as a result of closure during power outages. In general heavy winter storms increase wear and tear on roadways though the cost of such damages is difficult to determine. Businesses can experience loss of income as a result of closure during winter storms.



Overhead power lines and infrastructure are also vulnerable to damages from winter storms. In particular ice accumulation during winter storm events damage to power lines due to the ice weight on the lines and equipment. Damages also occur to lines and equipment from falling trees and tree limbs weighted down by ice. Potential losses could include cost of repair or replacement of damaged facilities, and lost economic opportunities for businesses.

Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard. Standard values for loss of service for utilities reported in FEMA's 2009 BCA Reference Guide, the economic impact as a result of loss of power is \$126 per person per day of lost service.

In reviewing the *Missouri State Hazard Mitigation Plan, 2018*, Ripley County's vulnerability for winter storms can be estimated. The method used to determine this vulnerability in the state plan included the statistical analysis of data from several sources: the NCEI storm events database from 1993-December 2012, FEMA's Public Assistance funds from DR-1672, DR-1736, DR-1748, DR-1822, and DR-1961, Crop Insurance Claims data from the USDA Risk Management Agency (1998-2012), total building exposure from HAZUS, US Census Data, and the USDA Census of Agriculture. For presidential disaster declared events, the Public Assistance (PA) amounts paid by FEMA were used in lieu of NCEI data. NCEI damages represent early estimates and the FEMA PA funds represent actual amounts.

From the statistical data collected, seven factors were considered in determining overall winter storm vulnerability: housing density, likelihood of occurrence, building exposure, crop exposure, average annual property loss ratio, average annual crop insurance claims, and social vulnerability. To complete the vulnerability analysis utilizing the factors above, a rating value of 1-5 was assigned to the data obtained for each factor. These rating values correspond to the following descriptive terms:

1. Low
2. Medium-low
3. Medium
4. Medium-high
5. High

The rating values of all factors were then considered in determining overall vulnerability rating. As was determined through this vulnerability analysis, Ripley County has a medium-high vulnerability to future winter weather events.

### ***Potential Losses to Existing Development***

In reviewing the loss data as presented by the NCEI for 2012-2021 there were forty-three events that resulted in \$100,000 in property damage. Future losses, based on this historic data, could be estimated at \$10,000 annually. It should be noted that many property loss incidents are indirectly related to winter weather events and occur as a result of utility failure or loss of power.

### ***Previous and Future Development***

There is little future development projected for Ripley County, therefore the potential impact of winter weather is not expected to increase due to development

### ***Hazard Summary by Jurisdiction***

Some jurisdictions may suffer heavier damages during winter weather events due to demographic factors. For example, as with thunderstorms, high wind, hail, and lightning, more densely populated areas are more vulnerable to damages from winter weather. Per the completed, Data Collection Questionnaires, no damage was caused to school district assets as a result of winter weather.

Due to the rural nature of the area, there are few buildings with a high occupancy. Mobile homes, for the most part, are scattered singly throughout the balance of the county and sometimes grouped together in sets of two or three.

**Ripley County** – The unincorporated portion of Ripley County is likely to experience 4.3 winter weather events per year. Damages are not anticipated to be as significant as would be expected within the Cities of Doniphan and Naylor. This is due solely to the population density of the county—twenty-two persons per square mile—as compared to the two cities.

**City of Doniphan** – While the City of Doniphan is also likely to experience 4.3 winter weather events per year, its vulnerability to damage from these types of events is considerably higher than that of the county. This is because of the city’s population density is significantly higher than that of the county—1,447 persons per square mile compared to twenty-two persons per square mile.

**City of Naylor** – While the City of Naylor is also likely to experience 4.3 winter weather events per year, its vulnerability to damage from these types of events is considerably higher than that of the county. This is because of the city’s population density is significantly higher than that of the county—1,124 persons per square mile compared to twenty-two persons per square mile.

**Doniphan R-I School District** – Severe winter weather can occur anywhere within the school district’s service area, however, damages to district assets can be projected to be similar to those of other properties located within the City of Doniphan.

**Naylor R-II School District** – Severe winter weather can occur anywhere within the school district’s service area, however, damages to district assets can be projected to be similar to those of other properties located within the City of Naylor.

**Ripley County R-III School District** – While severe winter weather can occur anywhere within the school district’s service area, damages to district assets can be projected to be similar to those of other properties located within the unincorporated portion of the county.

## **Problem Statement**

Winter weather comes with a myriad of impacts that including health concerns related to extreme cold temperatures, personal injury from falling and motor vehicle accidents caused by icy surfaces, and power outages caused by ice accumulating on overhead powerlines. All jurisdictions within the planning area are at risk of severe winter weather. One potential mitigation action could be the provision of emergency power generators at critical facilities. Such facilities include water and wastewater treatment plants, nursing homes, schools, and police and fire stations.

### **3.4.10 Tornado**

#### **Hazard Profile**

##### ***Hazard Description***

Essentially, tornadoes are a vortex storm with two components of winds. The first is the rotational

winds that can measure up to 500 miles per hour, and the second is an uplifting current of great strength. The dynamic strength of both these currents can cause vacuums that can overpressure structures from the inside.

Although tornadoes have been documented in all 50 states, most of them occur in the central United States. The unique geography of the central United States allows for the development of thunderstorms that spawn tornadoes. The jet stream, which is a high-velocity stream of air, determines which area of the central United States will be prone to tornado development. The jet stream normally separates the cold air of the north from the warm air of the south. During the winter, the jet stream flows west to east from Texas to the Carolina coast. As the sun “moves” north, so does the jet stream, which at summer solstice flows from Canada across Lake Superior to Maine. During its move northward in the spring and its recession south during the fall, the jet stream crosses Missouri, causing the large thunderstorms that breed tornadoes.

Tornadoes spawn from the largest thunderstorms. The associated cumulonimbus clouds can reach heights of up to 55,000 feet above ground level and are commonly formed when Gulf air is warmed by solar heating. The moist, warm air is overridden by the dry cool air provided by the jet stream. This cold air presses down on the warm air, preventing it from rising, but only temporarily. Soon, the warm air forces its way through the cool air and the cool air moves downward past the rising warm air. This air movement, along with the deflection of the earth’s surface, can cause the air masses to start rotating. This rotational movement around the location of the breakthrough forms a vortex, or funnel. If the newly created funnel stays in the sky, it is referred to as a funnel cloud. However, if it touches the ground, the funnel officially becomes a tornado.

A typical tornado can be described as a funnel-shaped cloud that is “anchored” to a cloud, usually a cumulonimbus that is also in contact with the earth’s surface. This contact on average lasts 30 minutes and covers an average distance of 15 miles. The width of the tornado (and its path of destruction) is usually about 300 yards. However, tornadoes can stay on the ground for upward of 300 miles and can be up to a mile wide. The National Weather Service, in reviewing tornadoes occurring in Missouri between 1950 and 1996, calculated the mean path length at 2.27 miles and the mean path area at 0.14 square mile.

The average forward speed of a tornado is 30 miles per hour but may vary from nearly stationary to 70 miles per hour. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Tornadoes are most likely to occur in the afternoon and evening but have been known to occur at all hours of the day and night.

### ***Geographic Location***

Due to the spontaneous and erratic nature of tornadoes, they can occur, with as little as a few minutes of warning, anywhere in the planning area.

### ***Strength/Magnitude/Extent***

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour and damage paths can be more than one mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also can generate a tremendous amount of flying debris or “missiles,” which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, the less spectacular damage is much more common.

Tornado magnitude is classified according to the EF Scale (or the Enhanced Fujita Scale, based on the original Fujita Scale developed by Dr. Theodore Fujita, a renowned severe storm researcher). The EF-

Scale (see **Table 3.3636**) attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F Scale was implemented in the U.S. on February 1, 2007.

**Table 3.36. Enhanced F Scale for Tornado Damage**

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F #	Fastest ¼-mile (mph)	3 Second Gust (mph)	EF #	3 Second Gust (mph)	EF #	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Source: The National Weather Service, [www.spc.noaa.gov/faq/tornado/ef-scale.html](http://www.spc.noaa.gov/faq/tornado/ef-scale.html)

The wind speeds for the EF scale and damage descriptions are based on information from the NOAA Storm Prediction Center as listed in **Table 3.3737**. The damage descriptions are summaries. For the actual EF scale, it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator. Information on the Enhanced Fujita Scale's damage indicators and degrees of damage is located online at [www.spc.noaa.gov/efscale/ef-scale.html](http://www.spc.noaa.gov/efscale/ef-scale.html).

**Table 3.37. Enhanced Fujita Scale with Potential Damage**

Enhanced Fujita Scale			
Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center, <http://www.spc.noaa.gov/efscale/ef-scale.html>

Enhanced weather forecasting has provided the ability to predict severe weather likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes. Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

## Previous Occurrences

**Table 3.3838** includes NCEI reported tornado events and damages since 1993 in the planning area. Prior to this year, only really destructive tornadoes were recorded.

There are limitations to the use of NCEI tornado data that must be noted. For example, one tornado may contain multiple segments as it moves geographically. A tornado that crosses a county line or state line is considered a separate segment for the purposes of reporting to the NCEI. Also, a tornado that lifts off the ground for less than five minutes or 2.5 miles is considered a separate segment. If the tornado lifts off the ground for greater than five minutes or 2.5 miles, it is considered a separate tornado. Tornadoes reported in Storm Data and the Storm Events Database are in segments.

While there are twenty-four tornado events recorded by the NCEI as occurring in Ripley County since 1950, from May 1, 1993 to March 2021 there were a total of thirteen reported tornadoes. The resulting damage included \$1,115,000 of property damage, one injury and one death. The tornado that resulted in a death occurred on November 27, 2005, with a beginning time of 10:30 pm. According to the incident report in NCEI, the victim was asleep in a second story bedroom when the tornado struck and was later found 75 yards from the residence. Two other individuals on the first floor escaped the home with no injuries.

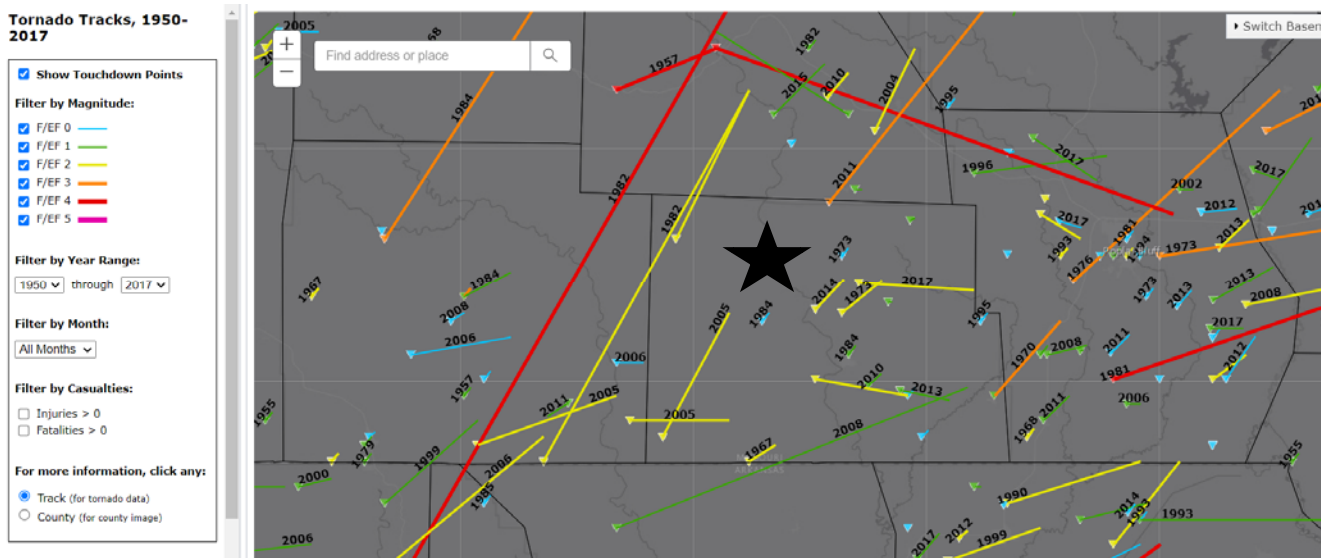
**Table 3.38. Recorded Tornadoes in Ripley County, 1993 – Present**

DATE	BEGINNING LOCATION	ENDING LOCATION	TORNADO LENGTH	TORNADO WIDTH	RATING	DEATHS (#)	INJURIES (#)	PROPERTY DAMAGE (\$)
6/7/1995	Fairdealing	Not Recorded	0.5	250	F0	0	0	0
4/19/1996	DONIPHAN	DONIPHAN	10	100	F2	0	0	100,000
4/5/1999	NAYLOR	NAYLOR	1	250	F1	0	0	30,000
11/5/2005	GATEWOOD	GATEWOOD	7.4	250	F2	0	0	75,000
11/27/2005	GATEWOOD	BRIAR	12	250	F2	1	0	250,000
2/5/2008	BURR	NAYLOR	19.96	200	EF1	0	0	80,000
3/10/2010	OWENMONT	OWENMONT	1.47	180	EF1	0	1	200,000
5/25/2011	TORCH	TORCH	0.74	50	EF0	0	0	0
12/9/2012	FLATWOODS	FLATWOODS	0.4	150	EF1	0	0	100,000
1/29/2013	FLATWOODS	FLATWOODS	0.27	100	EF1	0	0	100,000
10/31/2013	OXLY	OXLY	4.16	150	EF1	0	0	100,000
4/3/2014	HILL TOP	HILL TOP	3.48	220	EF2	0	0	50,000
3/9/2017	HILL TOP	FAIRDEALING	9.64	600	EF2	0	0	30,000
TOTAL								1,115,000

Source: National Centers for Environmental Information, <http://www.NCEI.noaa.gov/stormevents/>, March 2021

**024** below shows historic tornado paths in the planning area, which is indicated by a black star. Adjacent counties are shown to demonstrate the random and unpredictable nature of tornado events. As shown in the map, there have been no EF 4 or EF 5 tornado events recorded as occurring within Ripley County.

**Figure 3.24 Ripley County Map of Historic Tornado Events Categorized by Strength**



Source: Midwestern Regional Climate Center, <https://mrcc.illinois.edu/gismaps/cntytor.htm#>

A review of data reported by the USDA Risk Management Agency and regarding insurance payments made in the county for crop damages was conducted for a ten-year period. No crop damages were noted as having been due to tornadoes.

### ***Probability of Future Occurrence***

Based on historical tornado events occurring between 1993 and 2021, there is a 45% chance that a tornado (of any magnitude) could strike somewhere in the county in any given year. This percentage was calculated by dividing the number of events (thirteen) by the number of years within the specified timeframe (twenty-nine). More simply stated, there has been an average of one tornado somewhere within the planning area every twenty-seven months.

### ***Changing Future Conditions Considerations***

According to the *Missouri State Hazard Mitigation Plan, 2018*, “scientists do not know how the frequency and severity of tornadoes will change. Research published in 2015 suggests that changes in heat and moisture content in the atmosphere, brought on by a warming world, could be playing a role in making tornado outbreaks more common and severe in the U.S. The research concluded that the number of days with large outbreaks have been increasing since the 1950s and that densely concentrated tornado outbreaks are on the rise. It is notable that the research shows that the area of tornado activity is not expanding, but rather the areas already subject to tornado activity are seeing the more densely packed tornadoes. Because Missouri experiences on average around 39.6 tornadoes a year, such research is closely followed by meteorologists in the state.”

## **Vulnerability**

### ***Vulnerability Overview***

Ripley County is located in a region of the U.S. with high frequency of dangerous and destructive tornadoes referred to as “Tornado Alley”. **025** illustrates areas where dangerous tornadoes historically have occurred.

**Figure 3.25 Tornado Alley in the U.S.**



Source: <http://www.tomadochaser.net/tornalley.html>

The State of Missouri determine vulnerability to tornadoes across Missouri using a statistical analysis of data from several sources: HAZUS building exposure value data, population density and mobile home data from the U.S. Census (2015 ACS), the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina, and storm events data (1950 to December 31, 2016) from the National Centers for Environmental Information (NCEI). The statistical model used for this analysis was probabilistic based purely on tornado frequency and historic losses. It is based on past experience and forecasts the expected results for the immediate or extended future.

From the statistical data collected, six factors were considered in determining overall vulnerability to tornadoes as follows: building exposure, population density, social vulnerability, percentage of mobile homes (25% for the planning area), likelihood of occurrence, and annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

- 1) Low
- 2) Low-medium
- 3) Medium
- 4) Medium-high
- 5) High

Once the ranges were determined and applied to all factors considered in the analysis, the ratings were combed to determine an overall vulnerability rating for tornadoes. Ripley County's overall vulnerability to tornado events was determined, based on he analysis described above, to be medium-high. It should be noted that, per historical records, there has been neither an EF 4, nor EF 5 tornado within the planning area.

### ***Potential Losses to Existing Development***

Per tornado history data provided from the NCEI from May 1, 1993 through March 1, 2021, there were thirteen tornado events in Ripley County, resulting in property damages amounting to \$1,115,000. This equates to \$85,769 of property damage per event. With a probability of one event every twenty-seven months, it can be assumed that a tornado will occur somewhere in the county

every twenty-seven months and result in property damages of valued at \$85,769. Total building and contents exposure for the planning is available via MSDIS for each jurisdiction within the planning area and is as follows:

- City of Doniphan: \$135,304,000
- City of Naylor: \$36,801,000
- Unincorporated Ripley County: \$547,117,000

### ***Previous and Future Development***

Little future development is anticipated in to occur in Ripley County or its two incorporated municipalities, therefore, the vulnerability to tornadoes and the resulting damages are not expected to increase.

### ***Hazard Summary by Jurisdiction***

A tornado can occur anywhere in the planning area, although, some jurisdictions may suffer heavier damages due to the age or type of their housing stock, or high concentration of people and property—particularly mobile homes. As with thunderstorm, high winds, hail and lightning, higher population density increases the vulnerability of a jurisdiction to tornado events.

The Cities of Naylor and Doniphan have a higher concentration of people and housing than the rural areas in Ripley County, therefore the risk for damages and injuries and deaths due to tornado are higher in these jurisdictions. The age and type of housing stock is consistent throughout the planning area. There are no large concentrations of mobile homes in any one particular area.

The Doniphan R-I School districts recently completed construction of tornado safe room on its middle school campus. The safe room reduces the risk of death and injury for those seeking shelter during a tornado. Per the Data Collection Questionnaires, there has been no damage school district assets resulting from tornado occurrences.

**Ripley County** – The unincorporated portion of Ripley County is likely to experience a tornado once every twenty-seven months, damages are not anticipated to be as significant as would be expected within the Cities of Doniphan and Naylor. This is due solely to the population density of the county—twenty-two persons per square mile—as compared to the two cities.

**City of Doniphan** – While the City of Doniphan is also likely to experience a tornado every twenty-seven months, its vulnerability to damage from these types of events in considerably higher than that of the county. This is because of the city’s population density is significantly higher than that of the county—1,447 persons per square mile compared to twenty-two persons per square mile.

**City of Naylor** – While the City of Naylor is also likely to experience a tornado once every twenty-seven months, its vulnerability to damage from these types of events in considerably higher than that of the county. This is because of the city’s population density is significantly higher than that of the county—1,124 persons per square mile compared to twenty-two persons per square mile

**Doniphan R-I School District** – Tornadoes can occur anywhere within the school district’s service area, however, damages to district assets can be projected to be similar to those of other properties located within the City of Doniphan.

**Naylor R-II School District** – Tornadoes can occur anywhere within the school district’s service area, however, damages to district assets can be projected to be similar to those of other properties located within the City of Naylor.



**Ripley County R-III School District** – While tornadoes can occur anywhere within the school district’s service area, damages to district assets can be projected to be similar to those of other properties located within the unincorporated portion of the county.

### **Problem Statement**

Tornadoes are destructive and can impact any area of the county with very short notice. Tornadoes are capable of causing injury, loss of life, damage to property and to crops. Based on historical event data for Ripley County, it can be assumed that a tornado will occur somewhere in the county once every two years and result in an average property damage amount of \$90,416. One potential mitigation action is to seek funding to map the coverage area of the county’s tornado warning sirens and upgrade those sirens as needed. Another would be to consider the construction of a tornado safe room at the county’s second largest school district—the Naylor R-II School District.

## 3.4.11 Wildfire

### **Hazard Profile**

#### ***Hazard Description***

The fire incident types for wildfires include:

- 1) natural vegetation fire;
- 2) outside rubbish fire;
- 3) special outside fire; and,
- 4) cultivated vegetation/crop fire.

The Forestry Division of the Missouri Department of Conservation (MDC) is responsible for protecting privately owned and state-owned forests and grasslands from wildfires. To accomplish this task, eight forestry regions have been established in Missouri for fire suppression. The Forestry Division works closely with volunteer fire departments and federal partners to assist with fire suppression activities. Currently, more than 900 rural fire departments in Missouri have mutual aid agreements with the Forestry Division to obtain assistance in wildfire protection if needed.

Most of Missouri fires occur during the spring season between February and May. The length and severity of wildland fires depend largely on weather conditions. Spring in Missouri is usually characterized by low humidity and high winds. These conditions result in higher fire danger. In addition, due to the recent lack of moisture throughout many areas of the state, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper firefighting efforts, as decreasing water supplies may not prove adequate for firefighting. It is common for rural residents burn their garden spots, brush piles, and other areas in the spring. Some landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, spring months are the most dangerous for wildfires. The second most critical period of the year is fall. Depending on the weather conditions, a sizeable number of fires may occur between mid-October and late November.

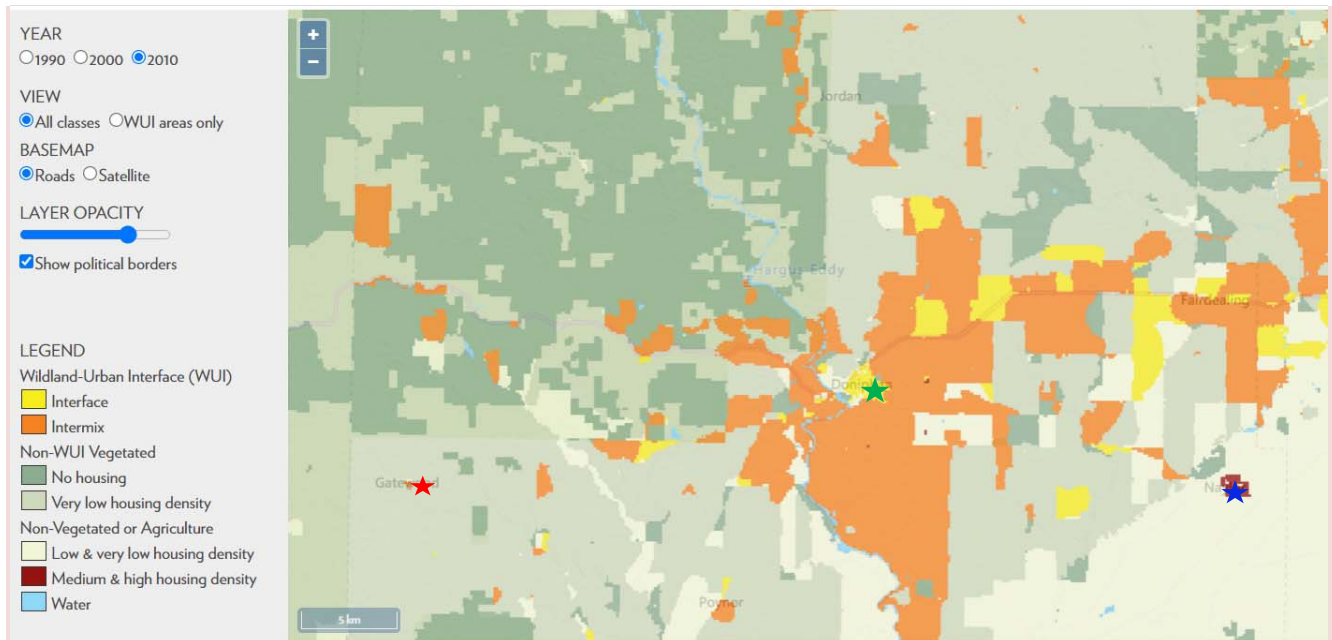
#### ***Geographic Location***

Wildland–urban interface (WUI) areas are those areas located within the zone of transition between unoccupied land and human development. Within the WUI, there are two specific areas identified:

- 1) Interface; and,
- 2) Intermix.

The interface areas are those areas that abut wildland vegetation and the intermix areas are those areas that intermingle with wildland areas. The City of Naylor is surrounded by cleared farmland and does not include WUI areas. The City of Doniphan and the unincorporated area of the county do have some WUI areas (primarily intermix) as national forest and wooded areas are common. The map below shows the WUI areas within the county. Some interface areas are located along U.S. Highway 160 between the City of Doniphan and the Ripley County/Butler County line. The stars on the below map indicate the locations of the three participating school districts. Doniphan R-I School District is indicated by the green star, Naylor R-II School District is indicated by the blue star, and Ripley County R-III School District is indicated by the red star. The Doniphan R-I School District is located within an WUI-interface area. The Ripley County R-III School District is located within an WUI-intermix area.

**Figure 3.26 Ripley County Map of Wildland Urban Interface/Intermix Areas, 2020**



Source: University of Wisconsin Slivis Lab, <http://silvis.forest.wisc.edu/maps/wui/2010/download>

### ***Strength/Magnitude/Extent***

Wildfires damage the environment, killing some plants and occasionally animals. Firefighters have been injured or killed, and structures can be damaged or destroyed. The loss of plants can heighten the risk of soil erosion and landslides. Although Missouri wildfires are not the size and intensity of those in the Western United States, they could impact recreation and tourism in and near the fires.

Wildland fires in Missouri have been mostly a result of human activity rather than lightning or some other natural event. Wildfires in Missouri are usually surface fires, burning the dead leaves on the ground or dried grasses. They do sometimes “torch” or “crown” out in certain dense evergreen stands like eastern red cedar and shortleaf pine. However, Missouri does not have the extensive stands of evergreens found in the western US that fuel the large fire storms seen on television news stories.

While very unusual, crown fires can and do occur in Missouri native hardwood forests during prolonged periods of drought combined with extreme heat, low relative humidity, and high wind. Tornadoes, high winds, wet snow and ice storms in recent years have placed a large amount of woody material on the forest floor that causes wildfires to burn hotter and longer. These conditions also make it more difficult for fire fighters suppress fires safely.

Often wildfires in Missouri go unnoticed by the general public because the sensational fire behavior that captures the attention of television viewers is rare in the state. Yet, from the standpoint of destroying homes and other property, Missouri wildfires can be quite destructive. No information regarding the severity of damages from sizeable structural fires and wildland fires within the planning area was available at the time of this plan update.

### ***Previous Occurrences***

Data regarding wildland fires was pulled from the Missouri Department of Conservation (MDC) Wildfire Data Search at: <http://mdc7.mdc.mo.gov/applications/FireReporting/Report.aspx>. Reports were made by paid and volunteer fire department serving the county. According to the source, 404

wildfires were reported to have occurred within the planning area between February 2011 and March 2021. Acres burned ranged from one-tenth of an acres to 316 acres. Of the fires, 166, or 41%, burned less than 1.5 acres. Another twenty-seven, or 6.7%, burned more than fifty acres. Of all the causes, “Debris” was listed as the fire’s source in 49% of cases, with children, smoking, arson, equipment, lightning, miscellaneous, and unknown listed as other possible causes. Interestingly, lightning was cited as causing three of the wildfires within the eleven-year time period.

Per the NCEI database, which records only large events, there have been four wildfires in the county, resulting in no injuries or deaths and \$18,000 in property damage. Per the NCEI, 1,244 acres of pastureland and national forest were consumed by the blazes—an average of 311 acres per event. The dates of the events were March 2006, March 2010, February 2011 & April 2011. Both of the later events are reflected within the data reported by MDC.

No school districts reported information regarding fire events within their data collection questionnaires.

### ***Probability of Future Occurrence***

Per the thorough MDC data provided above, the planning area regularly experiences wildfires. Based on this data, a wildfire is likely to occur somewhere within the planning area nearly thirty-seven times each year. Per the *Missouri State Hazard Mitigation Plan, 2018*, the county’s likelihood to wildfire is thirty-two times per year. This calculation was based on data regarding events occurring between 2004 and 2016. Review of the MDC data cited above indicates that wildfires regularly occur in all months of the year and are not primarily limited to periods of dry weather (July & August).

### ***Changing Future Conditions Considerations***

Per the *Missouri State Hazard Mitigation Plan, 2018*, “higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Missouri, although the composition of trees in the forests may change. More droughts would reduce forest productivity, and changing future conditions are also likely to increase the damage from insects and diseases. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors.

Forests cover about one-third of the state, dominated by oak and hickory trees. As the climate changes, the abundance of pines in Missouri’s forests is likely to increase, while the population of hickory trees is likely to decrease. Higher temperatures will also reduce the number of days prescribed burning can be performed. Reduction of prescribed burning will allow for growth of understory vegetation – providing fuel for destructive wildfires. Drought is also anticipated to increase in frequency and intensity during summer months under projected future scenarios. Drought can lead to dead or dying vegetation and landscaping material close to structures which creates fodder for wildfires within both the urban and rural settings.”

## **Vulnerability**

### ***Vulnerability Overview***

Per the *Missouri State Hazard Mitigation Plan, 2018*, the average amount of land burned in one year as a result of wildfires in Ripley County was 377 acres. This average was based on wildfires occurring in the county between 2004 and 2016. The total acreage burned during this thirteen-year time period was 4,900 acres.

Per the MDC data, the total acreage burned in all 404 Ripley County wildfire events between 2011 and 2021 was 5,855—an event average of 14.5 acres burned per wildfire event.

## ***Potential Losses to Existing Development***

To estimate potential damage to existing development, WUI areas should be closely examined. Per the *Missouri State Hazard Mitigation Plan, 2018*, there are 62,592 acres of interface and intermix in the planning area. Per MSDIS data, there are 4,904 structures located in such areas with a total value of \$657,277,520. Using these figures, the state valued one acre of land located in the WUI in Ripley County at \$10,501 ( $\$657,277,520/62,592$  acres). This average value per Ripley County WUI acre was then multiplied by the average number of county acres burned per year (377 acres) to arrive at an “average annualized land burned potential loss.” This potential loss amount when finalized for Ripley County totaled \$3,958,894.

Certain data limitations should be noted. For example, National Fire Incident Reporting System (NFIRS) data from 2004 to 2008 was used to determine vulnerability; however, only 61% of fire departments in Missouri reported to the NFIRS during that time period. This limitation could account for the lower loss values as reported within the state plan when compared to the losses reported by MDC.

## ***Impact of Previous and Future Development***

No development is anticipated in areas of special hazard, such as WUI areas.

## ***Hazard Summary by Jurisdiction***

Absent demographic factors or other variations in housing construction, risk of structural fire probably does not vary greatly across the planning area. Communities with more WUI areas (interface and intermix) are at greater risk of wildland fires. A WUI map of Ripley County is included in Figure 3.26. Headquarters locations—where the majority of assets are located—are noted for each participating school district.

**Ripley County** – The unincorporated portion of the county is at risk of damage, potential injury/death due to wildland fires.

**City of Doniphan** – Residents of the City of Doniphan—due to its proximity to woodland areas—are at risk of property damage and potential injury/death due to wildland fires.

**City of Naylor** – Wildfire vulnerability is nonexistent to limited within the City of Naylor due to the lack of interface/intermix areas near the city.

**Doniphan R-I School District** – Due to its proximity to wooded areas, assets owned by the Doniphan R-I School District are vulnerable to wildfire—particularly the high school campus.

**Naylor R-II School District** – Wildfire vulnerability is nonexistent to limited for the Naylor R-II School District due to the lack of interface/intermix areas near the city in which the district is headquartered.

**Ripley County R-III School District** – Due to its proximity to wooded areas and location within a WUI intermix area, assets owned by the Ripley County R-III School District are vulnerable to wildfire.

## **Problem Statement**

Given the rural nature of Ripley County and its 97,437 acres included in the Mark Twain National Forest, wildland fires are inevitable. The greatest risk to property damages occur in the

wildland/urban interface (WUI) areas where residential areas intersect with wildland areas, which—within Ripley County—are often heavily wooded. Based upon historical data, residences, outbuildings, and pasture land have been damaged and destroyed by wildland fires in the planning area. In reviewing the risk of wildland fires and the historical data related to wildland fires, the City of Doniphan and unincorporated portions of the county—particularly south of Doniphan along the Current River and east of Doniphan along U.S. Highway 160 are at greatest risk of wildland fires. Mitigation actions could be developed to help reduce the impacts of wildland fires within the planning area.

- Seek funding to develop a fire safety awareness program addressing the causes, risk factors, and potential damage resulting from wildfires; and,
- Continue the coordination of “burn bans” with cooperation from the county commissioners, county emergency management director, local fire departments, the National Forest Service and the Missouri Department of Conservation.

## CRS Activity Points

Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
Step 4. Assess the hazard	Task 5: Conduct a Risk Assessment
Step 5. Assess the problem	44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)

Chapter 2 *Planning Area Profile and Capabilities* assists the community and mitigation planner in identifying the background information necessary to review possible mitigation actions and draft the action plan. CRS items of note include:

### 4. Assess the hazard. (max: 35)

(a) 15 points – for including an assessment of the flood hazard in the plan, with points scored as follows:

(1) 5 points, for a map of the flood hazard areas. Area maps are acceptable for multijurisdictional plans.

Section 3.4.1 Flooding, subsection “Geographic Location” includes instructions to include maps showing the SFHA’s for all participating jurisdictions, as applicable.

(2) 5 points, for a description of the known flood hazards, including source of water, depth of flooding, velocities, and warning time.

Section 3.4.1 Flooding, subsection “Hazard Description” addresses the known flood hazard. A sample table of flooding, velocities, and warning time is provided below.

Depth (threat to life)	In stagnant backwater areas (zero velocity), depths in excess of about 1m (3.3ft) are sufficient to float young children, and depths above 1.4m (4.6ft) are sufficient to float teenage children and many adults.
Velocity (threat to life)	In shallow areas, velocities in excess of 1.8m/s (5.9 ft/s) pose a threat to the stability of many individuals.
Depth and Velocity (threat to life)	The hazards of depth and velocity are closely linked as they combine to effect instability through an upward buoyant force and a lateral force. A product of less than or equal to 0.4m <sup>2</sup> /s (43 ft <sup>2</sup> /s) defines a low hazard provided the depth does not exceed 0.8m (2.6ft) and the velocity does not exceed 1.7m/s (5.6 ft/s).
Vehicular access (emergency access)	Most automobiles will be halted by flood depths above 0.3-0.5m (1.0-1.7ft). A maximum flood velocity of 3m/s (9.8 ft/s) would be permissible, providing that flood depths are less than 0.3m (1.0ft). A depth of 0.9-1.2m (2.9-3.9 ft) is the maximum depth for rapid access of large emergency vehicles.
Structural Integrity (structures above ground)	A depth of 0.8m (2.6ft) is the safe upper limit for the above ground/super structure of conventional brick veneer, and certain types of concrete block buildings. The structural integrity of elevated structures is more a function of flood velocities (e.g. Erosion of foundations, footings or fill) than depth. The maximum velocity to maintain structural stability depends on soil type, vegetation cover, and slope but ranges between 0.8-1.5m/s (2.6-4.9 ft/s)
Fill (stability)	In general, fill may become susceptible to erosion/instability at depths of 1.8-2.4m (5.9-7.9ft).

Source: Technical Guide - River and Stream Systems: Flooding Hazard Limit, Ontario Ministry of Natural Resources, 2002

(3) 5 points, for a discussion of past floods.

Section 3.4.1 Flooding, subsection “Previous Occurrences” addresses past flood events.

(b) 10 points – for including an assessment of less-frequent flood hazards in the plan. For this credit, the community must:

(1) Identify the hazard, including:

a. Preparing an inventory of levees that would result in a flood of developed areas if they failed or were overtopped during a flood, and/or

The preparation of Section 3.4.2 Levee Failure will include an inventory of levees.

b. Preparing an inventory of dams that would result in a flood of developed areas if they failed, and/or.

The preparation of Section 3.4.3 Dam Failure will include an inventory of dams.

c. Identifying any of the flood-related special hazards listed in Section 401 of the CRS Coordinator’s Manual that may affect the community, and/or

This includes uncertain flow paths, closed basin lakes, ice jams, land subsidence, mudflow hazards, coastal erosion, and tsunamis. The preparation of Section 3.4.5 Land Subsidence/Sinkholes will include an identify the land subsidence hazard.

d. Identifying the coastal A Zone, i.e., the area where wave heights during the 100-year flood are between 1.5 and 3 feet.

(2) Map the area(s) affected.

(3) Summarize the hazard(s) in lay terms.

As previously noted, Sections 3.4.2, 3.4.3, and 3.4.5 will address Levee Failure, Dam Failure and Land Subsidence, respectively. Each section should summarize the natural hazard an include a map of the areas affected.

(c) 5 points - If the assessment identifies areas likely to be flooded and flood problems that are likely to get worse in the future as a result of (1) changes in floodplain development and demographics, (2) development in the watershed, and (3) climate change or sea level rise. The credit is prorated if the assessment does not include all three types of changes.

Section 3.4.1 Flooding includes subsections addressing “Impact of Previous and Future Development” and “Changing Future Conditions Considerations”. These subsections should address specific areas of the community, not general terms. The subsection addressing future development will need to address development in the watershed, which may extend beyond the community’s jurisdictional boundaries, in order to receive full credit.

(d) 5 points - if the plan includes a description of the magnitude or severity, history, and probability of future events for other natural hazards, such as earthquakes, wildfires, or tornadoes. The plan should include all natural hazards that affect the community. At a minimum, it should include hazards identified by the state’s hazard mitigation plan.

Sections 3.4.3 – 3.4.11 address the natural hazards other than flooding.

## 5. Assess the problem. (max: 52)



- (a) 2 points - If the plan includes an overall summary of the jurisdiction's vulnerability to each hazard identified in the hazard assessment (Step 4) and the impact on the community.

Sections 3.4.1-3.4.11 all include the subsection "Vulnerability" with the "Hazard Summary by Jurisdiction" to address this requirement.

- (b) 25 points - if the plan includes a description of the impact that the hazards identified in the hazard assessment, with points scored as follows:

(1) 5 points, for life safety and the need for warning and evacuating residents and visitors.

(2) 5 points, for public health, including health hazards to individuals from flood waters and mold.

(3) 5 points, for critical facilities and infrastructure.

(4) 5 points, for the community's economy and major employers.

(5) 5 points, for the number and types of affected buildings (e.g., residential, commercial, industrial, with or without basements, etc.).

Section 3.4.1 Flooding, subsection "Vulnerability" includes instructions to address these impacts to the planning area.

- (c) 5 points - if the assessment includes a review of historical damage to buildings, including all repetitive loss properties and all properties that have received flood insurance claims payments, and/or an estimate of the potential damage and dollar losses to vulnerable structures, including damage from mold and other flood-related hazards. Vulnerable structures must include all buildings within the community's defined repetitive loss area(s).

Section 3.4.1 Flooding, subsections "National Flood Insurance Program (NFIP) Participation" and "Repetitive Loss/Severe Repetitive Loss Properties" address historical damages to buildings.

- (d) 5 points - if the assessment describes areas within the floodplain that provide natural functions, such as wetlands, riparian areas, sensitive areas, and habitat for rare or endangered species.

Section 3.4.2 Other Assets identifies the natural assets of the planning area. Section 3.4.1 Flooding, subsection "Vulnerability" should incorporate any of the identified natural assets that are impacted by the flood hazard.

- (e) 7 points - if the assessment includes a description of development, redevelopment, and population trends and a discussion of what the future brings for development and redevelopment in the community, the watershed, and natural resource areas.

Section 3.3.2 Future Land Use and Development addresses future growth, land use, and development in the planning area.

- (f) 8 points, if the assessment includes a description of the impact of the future flooding conditions described in Step 4(c) on people, property, and natural floodplain functions.

Section 3.4.1 Flooding includes subsections addressing "Impact of Previous and Future Development" which should address people, property, and natural floodplain functions.

# 4 MITIGATION STRATEGY

4 MITIGATION STRATEGY.....4.1

4.1 Goals<sup>6(a)</sup>..... 4.1

4.2 Identification and Analysis of Mitigation Actions..... 4.2

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**44 CFR Requirement §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction’s blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.**

This section presents the mitigation strategy updated by the Mitigation Planning Committee (MPC) based on the hazard risk assessment conducted in 2021. The mitigation strategy was developed through a collaborative group process. The process included review of general goal statements updated in 2021 to guide the jurisdictions in lessening disaster impacts as well as specific mitigation actions to directly reduce vulnerability to hazards and losses. The following definitions are taken from FEMA’s *Local Hazard Mitigation Review Guide (October 1, 2012)*.

- **Mitigation Goals** are general guidelines that explain what you want to achieve. Goals are long-term policy statements and global visions that support the mitigation strategy. The goals address the risk of hazards identified in the plan.
- **Mitigation Actions** are specific actions, projects, activities, or processes taken to reduce or eliminate long-term risk to people and property from hazards and their impacts. Implementing mitigation actions helps achieve the plan’s mission and goals.

## 4.1 Goals<sup>6(a)</sup>

**44 CFR Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.**

This planning effort is an update to Ripley County’s existing hazard mitigation plan approved by FEMA on 9/23/2016. The goals from the *2016 Ripley County Hazard Mitigation Plan* were reviewed to see if they were still valid, feasible, practical, and applicable to the defined hazard impacts. The MPC conducted a discussion session during their second meeting to review and update the plan goals. To ensure that the goals developed for this update were comprehensive and supported State goals, the 2018 State Hazard Mitigation Plan goals were reviewed. The MPC also reviewed the goals from current local plans.

The MPC reviewed the goals from the prior plan update following the discussion of risk during the second planning meeting. After a breakout discussion, which included a review of state plan goals, the MPC determined to leave the goal unamended. The same four goals identified within the 2016 plan update were carried forward to this 2021 plan update. The four goals are as follows:

- 1) Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters;
- 2) Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters;
- 3) Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters; and,
- 4) Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.

## 4.2 Identification and Analysis of Mitigation Actions

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**44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.**

The second MPC meeting, the results of the risk assessment update were provided to the MPC members for review and the key issues were identified for specific hazards. Changes in risk since adoption of the previously approved plan were discussed. Actions from the previous plan included completed actions, on-going actions, and actions upon which progress had not been made. The MPC discussed SEMA's identified funding priorities and the types of mitigation actions generally recognized by FEMA.

The MPC included problem statements in the plan update at the end of each hazard profile. The problem statements summarize the risk to the planning area presented by each hazard and include possible methods to reduce that risk. Use of the problem statements allowed the MPC to recognize new and innovative strategies to mitigate risks in the planning area.

During the second planning meeting, the MPC discussed and acknowledged the difference between mitigation actions and response actions. The difference was well understood by each jurisdiction's representative prior to development of jurisdiction-specific mitigation actions. Actions that reduce risk to existing buildings and infrastructure and/or limit risk to future development and redevelopment were considered. Care was taken to identify specific and measurable actions, which were achievable, relevant, and time-bound.

The focus of the third planning meeting was update of the mitigation strategy. For a comprehensive range of mitigation actions to consider<sup>7(a)</sup>, the MPC reviewed the following information during the meeting:

- A list of actions proposed in the previous mitigation plan, the current State Plan, and approved plans in nearby counties,
- Key issues from the risk assessments, including the problem statements concluding each hazard profile and vulnerability analysis,
- State priorities established for HMA grants, and
- Public input during meetings, responses to data collection questionnaires, and other efforts to involve the public in the plan development process.

During the third planning meeting, individual jurisdictions, including the school the districts, developed final mitigation strategy for submission to the MPC. They were encouraged to review the details of the risk assessment vulnerability analysis specific to their jurisdiction. They were also provided a link to the FEMA's publication, *Mitigation Ideas: A Resource for Reducing Risk to*

*Natural Hazards (January 2013)*. This document was developed by FEMA as a resource for identification of a range of potential mitigation actions for reducing risk to natural hazards and disasters.

The MPC reviewed the actions from the previously approved plan for progress made since the plan had been adopted, using action worksheets located at the end of this Section. Actions worksheets from the 2016 plan update were distributed in person to each jurisdiction's MPC representative at the close of the second planning meeting. For those MPC members attending virtually, the action worksheets were emailed to the jurisdiction's MPC representative. Each jurisdiction was instructed to provide information regarding the "Action Status" with one of the following status choices:

- Completed, with a description of the progress;
- Ongoing, with a description of the progress made to date; or
- Not Yet Started, with a discussion of the reasons for lack of progress.

Additionally, the future inclusion of each mitigation action in the plan update was identified as either keep, delete, or modify. Based on the status updates, there were two completed actions, thirty-five continuing actions (either ongoing or modified), and five deleted actions.

Table 4.1, below, provides a summary of the action statuses for each jurisdiction:

**Table 4.1. Action Status Summary**

<b>Jurisdiction</b>	<b>Completed Actions</b>	<b>Continuing Actions (ongoing or modify)</b>	<b>Deleted Actions</b>
<b>Ripley County</b>	Upgrade Water Systems	Extreme Heat Education Tornado Safety Drills Fire Prevention Education Fire Alert Systems Making Mitigation Plan Available Warning Siren Mapping Ditch Cleanout & Construction Tree Trimming Bridge Reinforcement Flood Buyouts Alternate Transportation Routes Burn Bans Generator Acquisition & Installation Lightning Protection Sinkhole Mapping Continuity in Planning National Flood Insurance Program Participation	Vulnerable Persons Database Hazard Training
<b>City of Doniphan</b>	Tree Trimming Burn Bans	Ditch Cleanout & Construction Floodplain Policy Updates Flood Acquisition & Demolition Alternate Transportation Routes Lightning Protection National Flood Insurance Program Participation Continuity in Planning Bridge Reinforcement	Upgrade Water Systems
<b>City of Naylor</b>	<i>Did not Participate in 2016 Plan Update</i>	<i>Did not Participate in 2016 Plan Update</i>	<i>Did not Participate in 2016 Plan Update</i>

<b>Doniphan R-I School District</b>		Earthquake Awareness Tornado Safety Drills Alternate Transportation Routes Lightning Protection Continuity in Planning	
<b>Naylor R-II School District</b>		Earthquake Awareness Tornado Safety Drills Alternate Transportation Routes Lightning Protection Continuity in Planning	
<b>Ripley County R-III School District</b>	<i>Did not Participate in 2016 Plan Update</i>	<i>Did not Participate in 2016 Plan Update</i>	<i>Did not Participate in 2016 Plan Update</i>
<b>Ripley County R-IV School District</b>	<i>Did not Participate in 2021 Plan Update</i>	<i>Did not Participate in 2021 Plan Update</i>	<i>Did not Participate in 2021 Plan Update</i>

Table 4.2 provides a summary of the completed and deleted actions from the previous plan.

**Table 4.2. Summary of Completed and Deleted Actions from the Previous Plan**

<b>Completed Actions</b>	<b>Completion Details (date, amount, funding source)</b>
Ripley County - Upgrade Water Systems	New well installed for Ripley County PWSD #2.
Doniphan - Burn Bans	Policy established and implemented as needed.
Doniphan - Tree Trimming	Trees have been trimmed. Have also installed generators at all critical government facilities and have acquired a portable generator to operate the wastewater lagoons in the event of electrical outage.
<b>Deleted Actions</b>	<b>Reason for Deletion</b>
Ripley County - Hazard Training	No political support at this time.
Ripley County – Vulnerable Persons Database	No funding available at this time.
Doniphan - Upgrade Water Systems	No political support/funding available.

Source: 2016 Ripley County Hazard Mitigation Plan (Action Worksheets); Data Collection Questionnaires

All incomplete mitigation actions identified within the 2016 Ripley County Hazard Mitigation Plan (with the exception of three) have been carried forward within the current plan update. Jurisdictional members of the MPC determined the deletion of three prior mitigation actions necessary. Those actions included “Hazard Training” and “Vulnerable Persons Database” for Ripley County and “Upgrade Water Systems” for the City of Doniphan. All three actions are no longer relevant to the particular jurisdiction. The lack of funding and implementation resources is the primary barrier for all incomplete mitigation actions. In some circumstances, a lack of political support exists because

Barriers to implementation consisted primarily of a lack of resources (both financial and human), as well as administration changes. Lack of funding with which to compensate a facilitator of the plan maintenance process also contributed to the incompleteness of previously identified mitigation actions.

The goals and actions of this updated plan were developed through review by and discussions held among the members of the mitigation planning committee (MPC). MPC members were encouraged to view proposed actions within the broad priorities of hazard mitigation. All actions were found to be cost effective, environmentally sound, and technically feasible.

Certain operating principles can improve fiscal and operational efficiency, help maintain focus on the overall goal of community improvement and well-being, and help ensure implementation of the actions. The MPC committed to implementing each mitigation action according to the following principals:

1. Incorporate mitigation actions into existing and future plans, regulations, programs, and projects.
2. Promote and encourage collaboration between disparate agencies and departments to create synergy resulting in benefits that would not be possible through a single agency.
3. Employ sustainable principles and techniques in the implementation of each action to attain maximum benefits.
4. Create and implement a prioritization process that includes monetary, environmental and sociological considerations.

### 4.3 Implementation of Mitigation Actions

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**44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include an action strategy describing how the actions identified in paragraph (c)(2)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefits review of the proposed projects and their associated costs.**

The prioritization process and methodology did not change from that used during the 2016 plan update. Actions were prioritized independently for each participating jurisdiction. For example, if two communities each had an action to acquire flood-prone properties, the actions were evaluated independently based on each jurisdiction's capabilities.

FEMA's STAPLEE methodology was used to assess the costs and benefits, overall feasibility of mitigation actions, and other issues impacting project<sup>7(a)</sup>. During the prioritization process, the STAPLEE worksheets were used to assign scores. The worksheets posed questions based on the STAPLEE elements as well as the potential mitigation effectiveness of each action. Scores were based on the responses to the questions as follows:

Definitely YES = 3 points  
Maybe YES = 2 points  
Probably NO = 1 points  
Definitely NO = 0 points

The following questions were asked for each proposed action.

S: Is the action socially acceptable?

T: Is the action technically feasible and potentially successful?

A: Does the jurisdiction have the administrative capability to successfully implement this action?

P: Is the action politically acceptable?

L: Does the jurisdiction have the legal authority to implement the action?

E: Is the action economically beneficial?

E: Will the project have an environmental impact that is either beneficial or neutral? (score "3" if

positive and “2” if neutral)

Will the implemented action result in lives saved?

Will the implanted action result in a reduction of disaster damage?

The final scores are listed below in the analysis of each action. The worksheets are attached to this plan as Appendix E. The STAPLEE final score for each action, absent other considerations, such as a localized need for a project, determined the priority. Low priority action items were those that had a total score of between 0 and 24. Moderate priority actions were those scoring between 25 and 29. High priority actions scored 30 or above. A blank STAPLEE worksheet is shown in Figure 4.1



**Figure 4.1. Blank STAPLEE Worksheet**

<b>STAPLEE Worksheet</b>		
<b>Name of Jurisdiction:</b>		
<b>Action or Project</b>		
<b>Action/Project Number:</b>	Insert a unique action number for this action for future tracking purposes. This can be a combination of the jurisdiction name, followed by the goal number and action number (i.e. Joplin1.1)	
<b>Name of Action or Project:</b>		
<b>Mitigation Category:</b>	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services	
<b>STAPLEE Criteria</b>		<b>Score</b>
<b>Evaluation Rating</b>		
Definitely YES = 3      Maybe YES = 2 Probably NO = 1      Definitely NO = 0		
<b>S:</b> Is it <b>Socially</b> Acceptable		
<b>T:</b> Is it <b>Technically</b> feasible and potentially successful?		
<b>A:</b> Does the jurisdiction have the <b>Administrative</b> capacity to execute this action?		
<b>P:</b> Is it <b>Politically</b> acceptable?		
<b>L:</b> Is there <b>Legal</b> authority to implement?		
<b>E:</b> Is it <b>Economically</b> beneficial?		
<b>E:</b> Will the project have either a neutral or positive impact on the natural <b>Environment</b> ?		
Will historic structures be saved or protected?		
Could it be implemented quickly?		
<b>STAPLEE SCORE</b>		
<b>Mitigation Effectiveness Criteria</b>	<b>Evaluation Rating</b>	<b>Score</b>
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	
<b>MITIGATION EFFECTIVENESS SCORE</b>		
<b>TOTAL SCORE (STAPLEE + Mitigation Effectiveness)</b>		
<input type="checkbox"/> <b>High Priority</b> (30+ points)	<input type="checkbox"/> <b>Medium Priority</b> (25 - 29 points)	<input type="checkbox"/> <b>Low Priority</b> (<25 points)

Completed by  
(Name, Title, Phone Number) \_\_\_\_\_

Each participating jurisdiction identified mitigation actions addressing those hazards with the highest probability of occurrence in their community/service area and dollar value of historic damage. Additional mitigation actions were developed specific to each jurisdiction and based on the community's/service area's risk and vulnerabilities. Jurisdictional MPC members were encouraged to meet with others in their community to identify the actions to be submitted for the updated mitigation strategy.

Throughout the planning process, emphasis was placed upon the importance of a benefit-cost analysis in determining project priority. The *Disaster Mitigation Act* requires benefit-cost review as the primary method by which mitigation projects should be prioritized. The MPC decided to pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in the *Missouri State Hazard Mitigation Plan*. The benefit/cost review at the planning stage consisted primarily of a qualitative analysis. For each action, the plan sets forth a narrative describing the types of benefits that could be realized from action implementation as well as the responsible parties and planning mechanism to be used during implementation. The cost was estimated as closely as possible with further refinement to be supplied as project development occurs.

The table below (**Table 4.3**) lists the mitigation actions identified via the current planning process. The worksheets that follow are action specific, arranged by jurisdiction, and provide a succinct, yet comprehensive, description of each action.

**Table 4.3. 2021 Ripley County Hazard Mitigation Plan Mitigation Actions**

<b>*Jurisdiction/ Goal #/ Action #</b>	<b>Action</b>	<b>Hazards Addressed</b>
Ripley County 1.1	Extreme Heat Education	Extreme Heat
Ripley County 1.2	Tornado Safety Drills	Tornado
Ripley County 1.3	Fire Alert Systems	Fires
Ripley County 1.4	Warning Siren Mapping	Tornado
Ripley County 2.1	Making Mitigation Plan Available	
Ripley County 2.2	Ditch Cleanout & Construction	Flooding (Flash and River)
Ripley County 2.3	Tree Trimming	Winter Weather/Snow/Ince/Severe Cold
Ripley County 2.4	Bridge Reinforcement	Earthquakes
Ripley County 2.5	Alternate Transportation Routes	Flooding (Flash and River)
Ripley County 2.6	Generator Acquisition & Installation	Thunderstorm/High Winds/Lightning/Hail
Ripley County 2.7	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail
Ripley County 3.1	Fire Prevention Education	Fires
Ripley County 3.2	Flood Buyouts	Flooding (Flash and River)
Ripley County 3.3	Burn Bans	Fires
Ripley County 3.4	Sinkhole Mapping	Land Subsidence/Sinkholes
Ripley County 4.1	Continuity in Planning	
Ripley County 4.2	National Flood Insurance Program Participation	Flooding (Flash and River)

Doniphan 2.1	Ditch Cleanout & Construction	Flooding (Flash and River)
Doniphan 2.2	Bridge Reinforcement	Earthquakes
Doniphan 2.3	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail
Doniphan 3.1	Floodplain Policy Updates	Flooding (Flash and River)
Doniphan 3.2	Flood Acquisition & Demolition	Flooding (Flash and River)
Doniphan 4.1	Alternate Transportation Routes	Flooding (Flash and River)
Doniphan 4.2	National Flood Insurance Program Participation	Flooding (Flash and River)
Doniphan 4.3	Continuity in Planning	
Naylor 2.1	Ditch Cleanout & Construction	Flooding (Flash and River)
Naylor 4.1	National Flood Insurance Program Participation	Flooding (Flash and River)
Doniphan R-I 1.1	Earthquake Awareness	Earthquakes
Doniphan R-I 1.2	Tornado Safety Drills	Tornado
Doniphan R-I 3.1	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail
Doniphan R-I 4.1	Alternate Transportation Routes	Flooding (Flash and River)
Doniphan R-I 4.2	Continuity in Planning	
Naylor R-II 1.1	Tornado Safe Room	Tornado
Naylor R-II 1.2	Earthquake Awareness	Earthquakes
Naylor R-II 1.3	Tornado Safety Drills	Tornado
Naylor R-II 3.1	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail
Naylor R-II 4.1	Alternate Transportation Routes	Flooding (Flash and River)
Naylor R-II 4.2	Continuity in Planning	
Ripley County R-III 1.1	Earthquake Awareness	Earthquakes
Ripley County R-III 1.2	Tornado Safety Drills	Tornado
Ripley County R-III 3.1	Lightning Protection	Thunderstorm/High Winds/Lightning/Hail
Ripley County R-III 4.1	Alternate Transportation Routes	Flooding (Flash and River)
Ripley County R-III 4.2	Continuity in Planning	

Action – Ripley County 1.1: Extreme Heat Education

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Lack of education regarding heat related illness.
<b>Hazard(s) Addressed:</b>	Extreme Heat
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 1.1
<b>Name of Action or Project:</b>	Education of Extreme Heat
<b>Action or Project Description:</b>	Provide educational resources to residents on the dangers of heat stroke and how to avoid heat related illness.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in the incidence of illness and death due to heat.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Ripley County Health Department
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds.
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual Budget process
<b>Progress Report</b>	
<b>Action Status</b>	Continue, Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 1.2: Tornado Safety Drills

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Injury & death due to tornado
<b>Hazard(s) Addressed:</b>	Tornado
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 1.2
<b>Name of Action or Project:</b>	Tornado Safety Drills
<b>Action or Project Description:</b>	Implement drills at the county courthouse and encourage drills within nursing homes and child care facilities.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in the number of injuries and deaths due to tornados.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Ripley County Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 33 (High Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	None
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 1.3: Fire Alert Systems

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Injury and death due to fire.
<b>Hazard(s) Addressed:</b>	Fire
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 1.3
<b>Name of Action or Project:</b>	Fire Alert Systems
<b>Action or Project Description:</b>	Implement fire drills into schools. Provide education for residents. Install smoke detectors throughout the county.
<b>Applicable Goal Statement:</b>	Provide fire safety education and install smoke detectors throughout the county.
<b>Estimated Cost:</b>	\$50,000 - \$100,000
<b>Benefits:</b>	Reduction in the number of injuries and deaths due to fires.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Volunteer Fire Departments
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	3-51 years
<b>Potential Fund Sources:</b>	Grant Funding
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Fire department personnel conduct public education activities regularly.
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 1.4: Warning Siren Mapping

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Lack of mapped warning siren locations.
<b>Hazard(s) Addressed:</b>	Tornado
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 1.4
<b>Name of Action or Project:</b>	Warning Siren Mapping
<b>Action or Project Description:</b>	Create an updated map of warning sirens located throughout the unincorporated portion of the county.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Identification of areas with inadequate warning systems.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 28 (Medium Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	County Emergency Management Director
<b>Progress Report</b>	
<b>Action Status</b>	Continue, Not Started
<b>Report of Progress</b>	None
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 2.1: Making Mitigation Plan Available

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Public knowledge of mitigation actions.
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.1
<b>Name of Action or Project:</b>	Making Mitigation Plan Available
<b>Action or Project Description:</b>	Make the hazard mitigation plan easily available to the public by providing a copy to the city, chamber of commerce, schools, the county health department, and the region's facebook page.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Improve public awareness and education regarding hazard mitigation planning and its benefits.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Commission & County Clerk
<b>Action/Project Priority:</b>	STAPLEE Score: 31 (High Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	n/a
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	County Commission Meetings & COVID-19 Response Meetings
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	The <i>2016 Ripley County Hazard Mitigation Plan</i> was made available to the public via a regional website maintained by the regional planning commission ( <a href="http://www.ofrpc.org">www.ofrpc.org</a> ).
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner



Action – Ripley County 2.2 Ditch Cleanout and Construction

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Flooding
<b>Hazard(s) Addressed:</b>	Flooding (Flash and River)
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.2
<b>Name of Action or Project:</b>	Ditch Cleanout and Construction
<b>Action or Project Description:</b>	Clean out ditches and construct new ditches or drainage systems along vulnerable county-maintained roadways.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Maintenance of transportation routes during and following a disaster event.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Road & Bridge Department
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium Priority)
<b>Timeline for Completion:</b>	3 -5 years
<b>Potential Fund Sources:</b>	USDA, HMGP, & Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process & regional planning commission membership services
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Ditch clean-out is an ongoing operation.
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 2.3: Tree Trimming

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Prevent transportation obstructions and interruptions of electrical service due to falling limbs/trees.
<b>Hazard(s) Addressed:</b>	Winter Weather/Snow/Ince/Severe Cold
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.3
<b>Name of Action or Project:</b>	Tree Trimming
<b>Action or Project Description:</b>	Cut trees, limbs, and heavy brush around and overhead power lines and electrical infrastructure.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Maintenance of electrical service during and following a disaster event.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Ozark Border Electrical Cooperative
<b>Action/Project Priority:</b>	STAPLEE Score: 23 (Low Priority)
<b>Timeline for Completion:</b>	More than 5 years
<b>Potential Fund Sources:</b>	HMGP, Cooperative Funds, and Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual Cooperative Work Program & Budget Process
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Tree trimming is an ongoing operation conducted by the local electrical cooperative on an as-needed and available funding basis.
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 2.4: Bridge Reinforcement

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Bridge failure during an earthquake
<b>Hazard(s) Addressed:</b>	Earthquake
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.4
<b>Name of Action or Project:</b>	Bridge Reinforcement
<b>Action or Project Description:</b>	Reinforce/reconstruct bridges susceptible to damage from earthquakes.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$100,000 to \$500,000
<b>Benefits:</b>	Maintenance of transportation routes during and following a disaster event.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Road & Bridge Department
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Off-System Bridge Replacement & Rehabilitation Fund (BRO) Funds & Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	BRO Annual Planning Process
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	A county-owned bridge along County Road U-5 was replaced with new construction.
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 2.5: Alternate Transportation Routes

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Transportation obstructions
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.5
<b>Name of Action or Project:</b>	Alternate Transportation Routes
<b>Action or Project Description:</b>	Establish alternate transportation routes for use during emergency events or following a hazard event.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Continued access to emergency services and continuity of transportation.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Road & Bridge Department
<b>Action/Project Priority:</b>	STAPLEE Score: 24 (Low Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	None
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 2.6: Generator Acquisition & Installation

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Power Outages
<b>Hazard(s) Addressed:</b>	Thunderstorm/High Winds/Lightning/Hail & Severe Winter Weather
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.6
<b>Name of Action or Project:</b>	Generator Acquisition & Installation
<b>Action or Project Description:</b>	Seek funding for, acquire and install emergency power generators (solar preferred) within critical facilities.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$100,000 to \$500,000
<b>Benefits:</b>	Decrease loss of basic service provision during power outages.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	CDBG funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process & regional planning commission membership services
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 2.7: Lightning Protection

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Damage from lightning strikes
<b>Hazard(s) Addressed:</b>	Thunderstorm/High Winds/Lightning/Hail
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 2.7
<b>Name of Action or Project:</b>	Lightning Protection
<b>Action or Project Description:</b>	Explore needed lightning protection at critical facilities and upon communication equipment.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Continuity of basic public service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Emergency Management Director
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds, Hazard Mitigation Grants
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 3.1: Fire Prevention Education

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Property damage due to fire.
<b>Hazard(s) Addressed:</b>	Fire
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 3.1
<b>Name of Action or Project:</b>	Fire Prevention Education
<b>Action or Project Description:</b>	Provide safe burning education for residents.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in the incidence of wildfires and damage due to wildfires.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Volunteer Fire Departments
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	None
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Fire department personnel conduct public education activities regularly.
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 3.2: Flood Buyouts

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Participate in Flood buyout programs
<b>Hazard(s) Addressed:</b>	Property protection
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 3.2
<b>Name of Action or Project:</b>	Flood Buyouts
<b>Action or Project Description:</b>	Relocate residents from floodways and demolish abandoned residential structures.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	\$500,000 to \$1,000,000
<b>Benefits:</b>	Elimination of property damage due to riverine flooding.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 28 (Medium Priority)
<b>Timeline for Completion:</b>	3 – 5 years
<b>Potential Fund Sources:</b>	HMGP, CDBG, & Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process & regional planning commission membership services
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner



Action – Ripley County 3.3: Burns Bans

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Wildfires
<b>Hazard(s) Addressed:</b>	Fire
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 3.3
<b>Name of Action or Project:</b>	Burn Bans
<b>Action or Project Description:</b>	Call upon fire departments and the USDA, Forest Service to identify unsafe burn periods and issue bans.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Acreage maintained and structures preserved.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	None
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Burn bans are considered annually during the dry season (June-September) and issued when deemed necessary.
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 3.4: Sinkhole Mapping

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Unawareness of sinkholes
<b>Hazard(s) Addressed:</b>	Land Subsidence/Sinkholes
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 3.4
<b>Name of Action or Project:</b>	Sinkhole Mapping
<b>Action or Project Description:</b>	Create a county-wide map of active and potential sinkholes.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Enhanced knowledge of sinkholes
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Emergency Management Director
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	None
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 4.1: Continuity in Planning

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Mitigation education
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 4.1
<b>Name of Action or Project:</b>	Continuity in Planning
<b>Action or Project Description:</b>	Integrate identified mitigation actions into other planning mechanisms.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Comprehensive and consistent planning.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Regional Planning Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 24 (Low Priority)
<b>Timeline for Completion:</b>	Ongoing
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	All local planning processes
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Ripley County 4.2 National Flood Insurance Program Participation

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Property damage due to flooding & lack of flood insurance
<b>Hazard(s) Addressed:</b>	Flooding (Flash and River)
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County 4.2
<b>Name of Action or Project:</b>	National Flood Insurance Program Participation
<b>Action or Project Description:</b>	Regulate new construction in the Special Flood Hazard Areas and explore CRS county wide. Receive a CRS community rating.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Reduced flood insurance premium costs and reduction in property damage due to flooding
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	County Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 33 (High Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Floodplain Ordinance
<b>Progress Report</b>	
<b>Action Status</b>	Continued
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Jesse Roy, Presiding Commissioner

Action – Doniphan 2.1 Ditch Cleanout and Construction

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Flooding of roadways
<b>Hazard(s) Addressed:</b>	Flooding, Dam Failure
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 2.1
<b>Name of Action or Project:</b>	Ditch Cleanout and Construction
<b>Action or Project Description:</b>	Clean out ditches and construct new ditches or drainage systems along vulnerable city streets.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Maintenance of transportation routes during and following a disaster event.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Street Department
<b>Action/Project Priority:</b>	STAPLEE Score: 28 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	USDA, HMGP, & Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process & regional planning commission membership services
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Applied for and received approval of 4 grants to replace a box culvert on Quick Creek and stabilize the creek banks.
<b>Completed by:</b>	Dennis Cox, Mayor

Action – Doniphan 2.2: Bridge Reinforcement

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Bridge failure during an earthquake
<b>Hazard(s) Addressed:</b>	Earthquake
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 2.2
<b>Name of Action or Project:</b>	Bridge Reinforcement
<b>Action or Project Description:</b>	Reinforce/reconstruct bridges susceptible to damage from earthquakes.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$50,000 to \$100,000
<b>Benefits:</b>	Maintenance of transportation routes during and following a disaster event.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Street Department
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium Priority)
<b>Timeline for Completion:</b>	Continue Not Started
<b>Potential Fund Sources:</b>	Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual Budget Process
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Dennis Cox, Mayor

Action – Doniphan 2.3: Lightning Protection

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Damage from lightning strikes
<b>Hazard(s) Addressed:</b>	Thunderstorm/High Winds/Lightning/Hailstorm
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 2.3
<b>Name of Action or Project:</b>	Lightning Protection
<b>Action or Project Description:</b>	Install surge protection or redundancy systems at critical facilities and upon communications equipment.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Continuity of basic public service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Emergency Management Director
<b>Action/Project Priority:</b>	STAPLEE Score: 24 (Low Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds, Hazard Mitigation Grants
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Lance Pigg, Emergency Management Director

Action - Doniphan 3.1: Adopt and/or enforce floodplain ordinances.

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Inadequate floodplain policy
<b>Hazard(s) Addressed:</b>	Flooding
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 3.1
<b>Name of Action or Project:</b>	Floodplain Policy Updates
<b>Action or Project Description:</b>	Examine city ordinances regarding construction in floodplains.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	n/a
<b>Benefits:</b>	Prevent future structure damage. Reduce flood insurance rates.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Council
<b>Action/Project Priority:</b>	STAPLEE Score: 27 (Medium Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	No funds needed
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	City ordinances and Planning and Zoning Board
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Ordinances were amended, raised freeboard
<b>Completed by:</b>	Dennis Cox, Mayor



Action – Doniphan 3.2: Flood Acquisition & Demolition

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Structures located in the floodplain
<b>Hazard(s) Addressed:</b>	Flooding (Flash and River)
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 3.2
<b>Name of Action or Project:</b>	Flood Acquisition & Demolition
<b>Action or Project Description:</b>	Purchase properties located within the floodplain and demolish the abandoned structures.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	Over \$1,000,000
<b>Benefits:</b>	Prevents property damage due to flooding and reduces flood insurance claims.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Council
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium)
<b>Timeline for Completion:</b>	3 -5 years
<b>Potential Fund Sources:</b>	HMGP, CDBG, & Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process & regional planning commission membership services
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Have completed several residential and one commercial buyout with demolition of the acquired structures. Primarily commercial structures remain for acquisition and demolition.
<b>Completed by:</b>	Dennis Cox, Mayor

Action – Doniphan 4.1: Alternate Transportation Routes

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Obstructed transportation
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 4.1
<b>Name of Action or Project:</b>	Alternate Transportation Routes
<b>Action or Project Description:</b>	Establish alternate transportation routes during an emergency.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Maintenance of service delivery and access to emergency medical services.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Street Department
<b>Action/Project Priority:</b>	STAPLEE Score: 22 (Low Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds & MODOT
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	N/A
<b>Progress Report</b>	
<b>Action Status</b>	Continue, Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Lance Pigg, Emergency Management Director

Action – Doniphan 4.2 National Flood Insurance Program Participation

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Public Awareness
<b>Hazard(s) Addressed:</b>	Flooding (Flash and River)
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 4.2
<b>Name of Action or Project:</b>	National Flood Insurance Program Participation
<b>Action or Project Description:</b>	Regulate new construction in the Special Flood Hazard Areas and explore CRS county wide. Receive a community rating.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Reduced flood insurance premium costs and reduction in property damage due to flooding
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Council
<b>Action/Project Priority:</b>	STAPLEE Score: 27 (Medium Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Floodplain Ordinance
<b>Progress Report</b>	
<b>Action Status</b>	Continued
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Dennis Cox, Mayor

Action – Doniphan 4.3: Continuity in Planning

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Doniphan
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Mitigation Education
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan 4.3
<b>Name of Action or Project:</b>	Continuity in Planning
<b>Action or Project Description:</b>	Integrate identified mitigation actions into other planning mechanisms.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Comprehensive and consistent planning.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Regional Planning Commission
<b>Action/Project Priority:</b>	STAPLEE Score: 24 (Low Priority)
<b>Timeline for Completion:</b>	Ongoing
<b>Potential Fund Sources:</b>	Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	All local planning processes
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Dennis Cox, Mayor

Action – Naylor 2.1: Ditch Cleanout & Construction

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Naylor
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Flooding of roadways.
<b>Hazard(s) Addressed:</b>	Flooding (Flash and River)
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor 2.1
<b>Name of Action or Project:</b>	Ditch Cleanout & Construction
<b>Action or Project Description:</b>	Clean out ditches and construct new ditches or drainage systems along vulnerable city streets.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Maintenance of transportation routes during and following a disaster event.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	City Street Department
<b>Action/Project Priority:</b>	STAPLEE Score: 33 (High Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	USDA, HMGP, & Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual budget process & regional planning commission membership services
<b>Progress Report</b>	
<b>Action Status</b>	New
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Dale Day, Mayor

Action - Naylor 4.1: National Flood Insurance Program Participation

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	City of Naylor
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Public Awareness
<b>Hazard(s) Addressed:</b>	Flooding (Flash and River)
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor 4.1
<b>Name of Action or Project:</b>	National Flood Insurance Program Participation
<b>Action or Project Description:</b>	Regulate new construction in the Special Flood Hazard Area and explore CRS county wide. Receive a community rating.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Reduced flood insurance premium costs and reduction in property damage due to flooding
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	Board of Aldermen
<b>Action/Project Priority:</b>	STAPLEE Score: 40 (High Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Floodplain Ordinance
<b>Progress Report</b>	
<b>Action Status</b>	Continue
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Dale Day, Mayor

Action - Doniphan R-I 1.1: Earthquake Awareness

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Doniphan R-I School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Earthquake awareness.
<b>Hazard(s) Addressed:</b>	Earthquakes
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan R-I 1.1
<b>Name of Action or Project:</b>	Earthquake Awareness
<b>Action or Project Description:</b>	Provide educational resources to students & residents on earthquake procedure and how to stay safe.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in accidents & deaths due to earthquakes.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds.
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Earthquake drills, Educational materials
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Earthquake drills ongoing, educational materials yet to be distributed.
<b>Completed by:</b>	Brad Hagood, Superintendent

Action – Doniphan R-I 1.2: Tornado Safety Drills

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Doniphan R-I School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Injury & death due to tornado
<b>Hazard(s) Addressed:</b>	Tornado
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan R-I 1.2
<b>Name of Action or Project:</b>	Tornado Safety Drills
<b>Action or Project Description:</b>	Implement drills at each school for the protection of students and faculty.
<b>Applicable Goal Statement:</b>	Improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in accidents & deaths due to tornados.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School District Administration.
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds.
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Tornado drills
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Tornado drills held regularly within schools.
<b>Completed by:</b>	Brad Hagood, Superintendent



Action – Doniphan R-I 3.1: Lightning Protection

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Doniphan R-I School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Damage from lightning strikes
<b>Hazard(s) Addressed:</b>	Thunderstorm/High Winds/Lightning/Hail
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan R-I 3.1
<b>Name of Action or Project:</b>	Lightning Protection
<b>Action or Project Description:</b>	Install an electrical generator within the district's tornado safe room.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Maintenance of routine schedule and continuity of service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 31 (High Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Local funds, Hazard Mitigation Grants
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual school district budget
<b>Progress Report</b>	
<b>Action Status</b>	Continue, Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Brad Hagood, Superintendent

Action – Doniphan R-I 4.1: Alternate Transportation Routes

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Doniphan R-I School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Alternate Routes
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan R-I 4.1
<b>Name of Action or Project:</b>	Alternate Transportation Routes
<b>Action or Project Description:</b>	Establish alternate transportation routes during an emergency.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Maintenance of routine schedule and continuity of service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 22 (Low Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds & MODOT
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	N/A
<b>Progress Report</b>	
<b>Action Status</b>	Continue, Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Brad Hagood, Superintendent

Action – Doniphan R-I 4.2: Continuity in Planning

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Doniphan R-I School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Mitigation Education
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Doniphan R-I 4.2
<b>Name of Action or Project:</b>	Continuity in Planning
<b>Action or Project Description:</b>	Integrate identified mitigation actions into other planning mechanisms.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Comprehensive and consistent planning.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration and contracted planners.
<b>Action/Project Priority:</b>	STAPLEE Score: 29 (Medium Priority)
<b>Timeline for Completion:</b>	Ongoing
<b>Potential Fund Sources:</b>	Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	All local planning processes
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Brad Hagood, Superintendent

Action – Naylor R-II 1.1: Tornado Safe Room

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Naylor R-II School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Tornado safety
<b>Hazard(s) Addressed:</b>	Tornado
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor R-II 1.1
<b>Name of Action or Project:</b>	Tornado Safe Room
<b>Action or Project Description:</b>	Building a FEMA-compliant community tornado safe room on the school campus.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Over \$1,000,000
<b>Benefits:</b>	Reduction in injuries and deaths due to tornados.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 30 (High Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Hazard Mitigation Grant Program & School District Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual school district budgeting process
<b>Progress Report</b>	
<b>Action Status</b>	New
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Terry Arnold, School Superintendent

Action – Naylor R-II 1.2: Earthquake Awareness

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Naylor R-II
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Earthquake awareness.
<b>Hazard(s) Addressed:</b>	Earthquakes
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor R-II 1.2
<b>Name of Action or Project:</b>	Earthquake Awareness
<b>Action or Project Description:</b>	Provide educational resources to students & residents on earthquake procedure and how to stay safe.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in accidents & deaths due to earthquakes.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 25 (Medium Priority)
<b>Timeline for Completion:</b>	1-3 years
<b>Potential Fund Sources:</b>	Local funds.
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Earthquake drills, Educational materials
<b>Progress Report</b>	
<b>Action Status</b>	Continue In-Progress
<b>Report of Progress</b>	Earthquake drills ongoing, educational materials yet to be distributed.
<b>Completed by:</b>	Terry Arnold, Superintendent

Action – Naylor R-II 1.3: Tornado Safety Drills

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Naylor R-II School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Injury & death due to tornado
<b>Hazard(s) Addressed:</b>	Tornado
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor R-II 1.3
<b>Name of Action or Project:</b>	Tornado Safety Drills
<b>Action or Project Description:</b>	Implement drills at each school for the protection of students and faculty.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in accidents, and deaths due to tornados.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 25 (Medium Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds.
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Tornado drills
<b>Progress Report</b>	
<b>Action Status</b>	N/A
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	N/A

Action – Naylor R-II 3.1: Lightning Protection

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Naylor R-II School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Damage from lightning strikes
<b>Hazard(s) Addressed:</b>	Thunderstorm/High Winds/Lightning/Hail
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor R-II 3.1
<b>Name of Action or Project:</b>	Lightning Protection
<b>Action or Project Description:</b>	Install needed lightning protection at critical facilities and upon communication equipment.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Maintenance of routine schedule and continuity of service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Local funds, Hazard Mitigation Grants
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual school district budget
<b>Progress Report</b>	
<b>Action Status</b>	Continue Not Started
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Terry Arnold, Superintendent

Action – Naylor R-II 4.1: Alternate Transportation Routes

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Naylor R-II School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Obstructed transportation
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor R-II 4.1
<b>Name of Action or Project:</b>	Alternate Transportation Routes
<b>Action or Project Description:</b>	Establish alternate transportation routes during an emergency.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Maintenance of routine schedule and continuity of service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 22 (Low Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds & MODOT
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	
<b>Progress Report</b>	
<b>Action Status</b>	New
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Terry Arnold, Superintendent



Action –Naylor R-II 4.2: Continuity in Planning

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Naylor R-II School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Mitigation education
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Naylor R-II 4.2
<b>Name of Action or Project:</b>	Continuity in Planning
<b>Action or Project Description:</b>	Integrate identified mitigation actions into other planning mechanisms.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Comprehensive and consistent planning.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration and contracted planners.
<b>Action/Project Priority:</b>	STAPLEE Score: 23 (Low Priority)
<b>Timeline for Completion:</b>	Ongoing
<b>Potential Fund Sources:</b>	Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	All local planning processes
<b>Progress Report</b>	
<b>Action Status</b>	Continue – In Progress
<b>Report of Progress</b>	Mitigation actions were incorporated into other planning mechanisms
<b>Completed by:</b>	Terry Arnold, Superintendent

Action – Ripley County R-III 1.1: Earthquake Awareness

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County R-III School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Earthquake awareness.
<b>Hazard(s) Addressed:</b>	Earthquakes
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County R-III 1.3
<b>Name of Action or Project:</b>	Earthquake Awareness
<b>Action or Project Description:</b>	Provide educational resources to students & residents on earthquake procedure and how to stay safe.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in accidents & deaths due to earthquakes.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 27 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Earthquake drills, Educational materials
<b>Progress Report</b>	
<b>Action Status</b>	N/A
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	N/A

Action – Ripley County R-III 1.2: Tornado Safety Drills

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County R-III School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Injury & death due to tornado
<b>Hazard(s) Addressed:</b>	Tornado
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County R-III 1.2
<b>Name of Action or Project:</b>	Tornado Safety Drills
<b>Action or Project Description:</b>	Implement drills at each school for the protection of students and faculty.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of human life, health, & safety from adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Reduction in accidents and deaths due to tornados.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 35 (High Priority)
<b>Timeline for Completion:</b>	1 year
<b>Potential Fund Sources:</b>	Local funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Tornado drills
<b>Progress Report</b>	
<b>Action Status</b>	N/A
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Cody Young, Superintendent

Action – Ripley County R-III 3.1: Lightning Protection

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County R-III School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Damage from lightning strikes
<b>Hazard(s) Addressed:</b>	Thunderstorm/High Winds/Lightning/Hail
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County R-III 3.1
<b>Name of Action or Project:</b>	Lightning Protection
<b>Action or Project Description:</b>	Install needed lightning protection at critical facilities and upon communication equipment.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
<b>Estimated Cost:</b>	\$10,000 to \$50,000
<b>Benefits:</b>	Maintenance of routine schedule and continuity of service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 36 (High Priority)
<b>Timeline for Completion:</b>	3-5 years
<b>Potential Fund Sources:</b>	Local funds, Hazard Mitigation Grants
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	Annual school district budget
<b>Progress Report</b>	
<b>Action Status</b>	New
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Cody Young, Superintendent

Action – Ripley County R-III 4.1: Alternate Transportation Routes

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Obstructed transportation
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County R-III 4.1
<b>Name of Action or Project:</b>	Alternate Transportation Routes
<b>Action or Project Description:</b>	Establish alternate transportation routes during an emergency.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Less than \$10,000
<b>Benefits:</b>	Maintenance of routine schedule and continuity of service.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration
<b>Action/Project Priority:</b>	STAPLEE Score: 26 (Medium Priority)
<b>Timeline for Completion:</b>	2-3 years
<b>Potential Fund Sources:</b>	Local funds & MODOT
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	N/A
<b>Progress Report</b>	
<b>Action Status</b>	New
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Cody Young, Superintendent

Action – Ripley County R-III 4.2: Continuity in Planning

<b>Action Worksheet</b>	
<b>Name of Jurisdiction:</b>	Ripley County R-III School District
<b>Risk / Vulnerability</b>	
<b>Problem being Mitigated:</b>	Mitigation education
<b>Hazard(s) Addressed:</b>	All
<b>Action or Project</b>	
<b>Action/Project Number:</b>	Ripley County R-III 4.2
<b>Name of Action or Project:</b>	Continuity in Planning
<b>Action or Project Description:</b>	Integrate identified mitigation actions into other planning mechanisms.
<b>Applicable Goal Statement:</b>	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
<b>Estimated Cost:</b>	Little or no cost
<b>Benefits:</b>	Comprehensive and consistent planning.
<b>Plan for Implementation</b>	
<b>Responsible Organization/Department:</b>	School district administration and contracted planners.
<b>Action/Project Priority:</b>	STAPLEE Score: 20 (Low Priority)
<b>Timeline for Completion:</b>	Ongoing
<b>Potential Fund Sources:</b>	Local Funds
<b>Local Planning Mechanisms to be Used in Implementation, if any:</b>	All local planning processes
<b>Progress Report</b>	
<b>Action Status</b>	New
<b>Report of Progress</b>	N/A
<b>Completed by:</b>	Cody Young, Superintendent



**Table 4.3. Mitigation Action Matrix**

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
<b>Prevention Public Education</b>								
Ripley County 1.1	Provide educational resources to residents on the dangers of heat stroke and how to avoid heat related illness.	Ripley County	Medium	#1	Extreme Heat			
Ripley County 1.2	Implement drills at the county courthouse and encourage drills within nursing homes and child care facilities.	Ripley County	High	#2	Tornado	✓		
Ripley County 1.3	Provide fire safety education and install smoke detectors throughout the county.	Ripley County	Medium	#1	Fires			
Ripley County 3.1	Provide safe burning education for residents.	Ripley County	Medium	#3	Fires	✓		
Ripley County 3.4	Create a county-wide map of active and potential sinkholes.	Ripley County	Medium	#3	Land Subsidence/Sinkholes	✓		
Ripley County 4.2	Explore CRS countywide and receive a community rating	Ripley County	High	#4	Flooding (Flash and River)	✓	✓	✓
Doniphan 3.1	Examine city ordinances regarding construction in floodplains.	Doniphan	Medium	#3	Flooding (Flash and River)		✓	✓
Doniphan 4.2	Explore CRS countywide and receive a community rating	Doniphan	Medium	#4	Flooding (Flash and River)	✓	✓	✓
Naylor 4.1	Explore CRS countywide and receive a community rating	Naylor	High	#4	Flooding (Flash and River)	✓	✓	✓
Doniphan R-I 1.2	Implement tornado safety drills at each school for the protection of students and faculty.	Doniphan R-I	Medium	#1	Tornado			
Naylor R-II 1.3	Implement tornado safety drills at each school for the protection of students and faculty.	Naylor R-II	Medium	#1	Tornado			
Ripley County R-III 1.1	Provide educational resources to students & residents on earthquake procedure and how to stay safe.	Ripley County R-III	Medium	#1	Earthquake			
Ripley County R-III 1.2	Implement tornado safety drills at each school for the protection of students and faculty.	Ripley County R-III	High	#1	Tornado			
<b>Structure and Infrastructure Projects</b>								
Ripley County 2.4	Reinforce/reconstruct bridges susceptible to damage from earthquakes.	Ripley County	Medium	#2	Earthquakes	✓		
Ripley County 2.6	Seek funding for, acquire and install emergency power generators (solar preferred) within critical facilities.	Ripley County	Medium	#2	All	✓		



#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Ripley County 2.7	Explore needed lightning protection at critical facilities and upon communication equipment.	Ripley County	Medium	#2	Thunderstorm/ High Winds/Lightning/Hail	✓	✓	
Ripley County 3.2	Relocate residents from floodways and demolish abandoned residential structures.	Ripley County	Medium	#3	Flooding (Flash and River)	✓		
Doniphan 2.2	Reinforce/reconstruct bridges susceptible to damage from earthquakes.	Doniphan	Medium	#2	Earthquake	✓		
Doniphan 2.3	Install surge protection or redundancy systems at critical facilities and upon communications equipment.	Doniphan	Low	#2	Thunderstorm/ High Winds/Lightning/Hail	✓	✓	
Doniphan 3.2	Purchase properties located within the floodplain and demolish the abandoned structures.	Doniphan	Medium	#3	Flooding (Flash and River)	✓		
Doniphan R-I 3.1	Install an electrical generator within the district's tornado safe room.	Doniphan R-I	High	#3	Thunderstorm/ High Winds/Lightning/Hail	✓	✓	
Naylor R-II 1.1	Building a FEMA-compliant community tornado safe room on the school campus.	Naylor R-II	High	#1	Tornado		✓	
Naylor R-II 3.1	Install needed lightning protection at critical facilities and upon communication equipment.	Naylor R-II	Medium	#3	Thunderstorm/ High Winds/Lightning/Hail	✓	✓	
Ripley County R-III 3.1	Install needed lightning protection at critical facilities and upon communication equipment.	Ripley County R-III	High	#3	Thunderstorm/ High Winds/Lightning/Hail	✓	✓	
<b>Natural Systems Protection</b>								
Ripley County 2.2	Clean out ditches and construct new ditches or drainage systems along vulnerable county-maintained roadways.	Ripley County	Medium	#2	Flooding (Flash and River)	✓	✓	
Ripley County 2.3	Cut trees, limbs, and heavy brush around and overhead power lines and electrical infrastructure.	Ripley County	Low	#2	Winter Weather/Snow/Ince/Severe Cold	✓		
Ripley County 3.3	Call upon fire departments and the USDA, Forest Service to identify unsafe burn periods and issue bans.	Ripley County	Medium	#3	Fires	✓	✓	
Doniphan 2.1	Clean out ditches and construct new ditches or drainage systems along vulnerable city streets.	Doniphan	Medium	#2	Flooding (Flash and River)	✓	✓	

#	Action	Jurisdiction	Priority	Goals Addressed	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
Naylor 2.1	Clean out ditches and construct new ditches or drainage systems along vulnerable city streets.	Naylor	High	#3	Flooding (Flash and River)	✓	✓	
<b>Emergency Services</b>								
Ripley County 1.4	Create an updated map of warning sirens in throughout the unincorporated portion of the county.	Ripley County	Medium	#1	Tornado			
Ripley County 2.5	Establish alternate transportation routes for use during emergency events or following a hazard event.	Ripley County	Low	#2	All			
Doniphan 4.1	Establish alternate transportation routes during an emergency.	Doniphan	Low	#2	All			
Doniphan R-I 4.1	Establish alternate transportation routes during an emergency.	Doniphan R-I	Low	#2	All			
Naylor R-II 4.1	Establish alternate transportation routes during an emergency.	Naylor R-II	Low	#2	All			
Ripley County R-III 4.1	Establish alternate transportation routes during an emergency.	Ripley County R-III	Low	#2	All			
<b>Education and Outreach</b>								
Ripley County R-III 4.2	Integrate identified mitigation actions into other planning mechanisms.	Ripley County R-III	Low	#3	All		✓	
Ripley County 2.1	Make the hazard mitigation plan easily available to the public by providing a copy to the city, chamber of commerce, schools, the county health department, and the region's facebook page.	Ripley County	High	#2	All		✓	
Ripley County 4.1	Integrate identified mitigation actions into other planning mechanisms.	Ripley County	Low	#4	All		✓	
Doniphan 4.3	Integrate identified mitigation actions into other planning mechanisms.	Doniphan	Low	#4	All		✓	
Doniphan R-I 1.1	Provide educational resources to students & residents on earthquake procedure and how to stay safe.	Doniphan R-I	Medium	#1	Earthquake			
Doniphan R-I 4.2	Integrate identified mitigation actions into other planning mechanisms.	Doniphan R-I	Medium	#4	All		✓	
Naylor R-II 1.2	Provide educational resources to students & residents on earthquake procedure and how to stay safe.	Naylor R-II	Medium	#1	Earthquake			
Naylor R-II 4.2	Integrate identified mitigation actions into other planning mechanisms.	Naylor R-II	Low	#4	All		✓	
Ripley County R-III 4.2	Integrate identified mitigation actions into other planning mechanisms.	Ripley County R-III	Low	#4	All		✓	



# 5 PLAN MAINTENANCE PROCESS

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<b>5 PLAN MAINTENANCE PROCESS .....</b>	<b>5.1</b>
<b>5.1 Monitoring, Evaluating, and Updating the Plan<sup>10(a)</sup> .....</b>	<b>5.1</b>
5.1.1 Responsibility for Plan Maintenance .....	5.1
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This chapter provides an overview of the overall strategy for plan maintenance and outlines the method and schedule for monitoring, updating and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

## 5.1 Monitoring, Evaluating, and Updating the Plan<sup>10(a)</sup>

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**44 CFR Requirement 201.6(c)(4): The plan maintenance process shall include a section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.**

### 5.1.1 Responsibility for Plan Maintenance

The Mitigation Planning Committee (MPC) will be a standing committee, with oversight by the Ripley County Commission, the Doniphan City Council, the Naylor City council, and the elected boards of all three participating school districts. The MPC will be responsible for plan monitoring, evaluation and maintenance. Maintenance will involve agreement of the participating jurisdictions, including school, to conduct the following activities and take the following actions:

- Meet annually<sup>10(b)</sup>, and after a disaster event, to monitor and evaluate the implementation of the plan;
- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high priority, low- or no-cost recommended actions;
- Maintain vigilant monitoring of multi-objective, cost-share, and other funding opportunities to help the community implement the plan’s recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Report on plan progress and recommended changes to the Ripley County Commission and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The MPC is an advisory body and can only make recommendations to county, city, town, or district elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities<sup>10(a)</sup>. Other duties include reviewing and promoting mitigation proposals, fielding stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information in areas accessible to the public.

### **5.1.2 Plan Maintenance Schedule**

The MPC agrees to meet annually<sup>10(b)</sup> and after a state or federally declared hazard event as appropriate to monitor progress and update the mitigation strategy. The Ripley County Emergency Management Director will be responsible for initiating the plan reviews and will invite members of the MPC to the meeting.

In coordination with all participating jurisdictions, the Emergency Management Director will be responsible for initiating a five-year written update of the plan to be submitted to the Missouri State Emergency Management Agency (SEMA) and FEMA Region VII per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

### **5.1.3 Plan Maintenance Process**

Progress on the proposed actions will be monitored by evaluating changes in vulnerabilities identified in the plan. The MPC, during the annual<sup>10(b)</sup> meeting, should review changes in vulnerability identified as follows:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions,
- Increased vulnerability due to hazard events, and/or
- Increased vulnerability as a result of new development (and/or annexation).

Future 5-year updates to this plan will include the following activities:

- Consideration of changes in vulnerability due to action implementation,
- Documentation of success stories where mitigation efforts have proven effective,
- Documentation of unsuccessful mitigation actions and why the actions were not effective,
- Documentation of previously overlooked hazard events that may have occurred since the previous plan approval,
- Incorporation of new data or studies with information on hazard risks,
- Incorporation of new capabilities or changes in capabilities,
- Incorporation of growth data and changes to inventories, and
- Incorporation of ideas for new actions and changes in action prioritization.

In order to best evaluate any changes in vulnerability as a result of plan implementation, the participating jurisdictions will adopt the following process:

- Each proposed action in the plan identified an individual, office, or agency responsible for action implementation. This entity will track and report on an annual<sup>10(b)</sup> basis to the jurisdictional MPC member on action status. The entity will provide input on whether the action as implemented meets the defined objectives and is likely to be successful in

reducing risk.

- If the action does not meet identified objectives, the jurisdictional MPC member will determine necessary remedial action, making any required modifications to the plan.

Changes will be made to the plan to remedy actions that have failed or are not considered feasible. Feasibility will be determined after a review of action consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring of this plan. Updating of the plan will be accomplished by written changes and submissions, as the MPC deems appropriate and necessary. Changes will be approved by the Ripley County Commission and the governing boards of the other participating jurisdictions.

## 5.2 Incorporation into Existing Planning Mechanisms

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**44 CFR Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.**

Where possible, plan participants, including all three participating school districts, will use existing plans and/or programs to implement hazard mitigation actions. Those existing plans and programs were described in Section 2 of this plan. Based on the capability assessments of the participating jurisdictions, communities in Ripley County will continue to plan and implement programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through the following plans:

- Capital improvement plans of participating jurisdictions;
- Ordinances of participating jurisdictions;
- Ripley County Emergency Operations Plan;
- Annual budgets;
- Other community plans that incorporate the county, such as its Regional Transportation Plan and the Comprehensive Economic Development Strategy;
- School District budgets; and
- Other plans and policies outlined in the capability assessment sections for each jurisdiction in Chapter 2 of this plan.

The MPC (or designated responsible entity) members involved in updating these existing planning mechanisms will be responsible for integrating the findings and actions of the mitigation plan, as appropriate. The MPC (or designated responsible entity) is also responsible for monitoring this integration and incorporation of the appropriate information into the five-year update of the multi-jurisdictional hazard mitigation plan.

Additionally, after the annual<sup>10(b)</sup> review of the Hazard Mitigation Plan, the Ripley County Emergency Management Director will provide the updated Mitigation Strategy with the current status of each mitigation action to the County Commission as well as all Mayors, City Clerks, and School District Superintendents<sup>10(a)</sup>. The Emergency Manager Director will request that the mitigation strategy be incorporated, where appropriate, within other planning mechanisms.

**Table 5.1** below lists the planning mechanisms by jurisdiction into which the Hazard Mitigation Plan will be integrated.

**Table 5.1. Planning Mechanisms Identified for Integration of Hazard Mitigation Plan**

Jurisdiction	Planning Mechanisms	Integration Process for Previous Plan	Integration Process for Current Plan
Ripley County	Comprehensive Economic Development Strategy (CEDS)	County representative(s) attended CEDS planning meetings and recommended goals and strategies related to hazard mitigation for inclusion within the regional planning document as appropriate.	County representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.
City of Doniphan	Comprehensive Economic Development Strategy (CEDS)	City representative(s) attended CEDS planning meetings and recommended goals and strategies related to hazard mitigation for inclusion within the regional planning document as appropriate.	City representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.
City of Naylor	Comprehensive Economic Development Strategy (CEDS)	Not Applicable – Did not participate in previous hazard mitigation planning process.	City representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.
Doniphan R-I School District	Annual Budget Process	Implemented annual planning and budget process meetings and recommended goals and strategies related to hazard mitigation for inclusion within the annual budget of expenditures as applicable.	School district administrators will execute goals and strategies identified within this hazard mitigation plan via its annual budget process.
Naylor R-II School District	Annual Budget Process	Implemented annual planning and budget process meetings and recommended goals and	School district administrators will execute goals and strategies identified

		strategies related to hazard mitigation for inclusion within the annual budget of expenditures as applicable.	within this hazard mitigation plan via its annual budget process.
Ripley County R-III School District	Annual Budget Process	Not Applicable – Did not participate in previous hazard mitigation planning process.	School district administrators will execute goals and strategies identified within this hazard mitigation plan via its annual budget process.
Ripley County	Regional Transportation Plan (RTP)	County representatives (as members of the regional transportation advisory committee) attended regular planning meetings (four per year) and identified transportation maintenance and new construction projects. When possible and appropriate, project recommendations incorporated hazard mitigation actions. The regional planning document was updated every two years with the previous year’s recommendations.	County officials and Highway Department employees will attend all RTP planning meetings to identify new actions and/or ongoing actions relating to transportation infrastructure for inclusion within the annual RTP update.
City of Doniphan	Regional Transportation Plan (RTP)	County representatives (as members of the regional transportation advisory committee) attended regular planning meetings (four per year) and identified transportation maintenance and new construction projects. When possible and appropriate, project recommendations incorporated hazard mitigation actions. The	City officials will attend all RTP planning meetings and identify new actions and/or ongoing actions relating to transportation infrastructure to be included within the annual RTP update.



		regional planning document was updated every two years with the previous year's recommendations.	
City of Naylor	Regional Transportation Plan (RTP)	Not Applicable – Did not participate within prior hazard mitigation planning process.	City officials will attend all RTP planning meetings and identify new actions and/or ongoing actions relating to transportation infrastructure to be included within the annual RTP update.

### 5.3 Continued Public Involvement

**44 CFR Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.**

The hazard mitigation plan update process provides an opportunity to publicize success stories resulting from the plan's implementation and seek additional public comment. Information about the annual<sup>10(b)</sup> reviews will be posted in the local newspaper, as well as, on a regional website following each annual<sup>10(b)</sup> review of the mitigation plan<sup>10(a)</sup> and will solicit comments from the public based on the annual review. When the MPC reconvenes for the five-year update, it will coordinate with all stakeholders participating in the planning process. Included in this group will be those who joined the MPC after the initial effort, to update and revise the plan. Public notice will be posted and public participation will be actively solicited, at a minimum, through available website postings and press releases to local media outlets, primarily newspapers.